MITSUBISHI DATA BOOK 1984

GENERAL PURPOSE ICs

MITSUBISHI ELECTRIC

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ELECTRIC

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OPERATIONAL AMPLIFIER, PRE AMPLIFIER

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended (Features)
Single op amp	741	M51802P/M5F741P	●M51802L [Single in line package]
Dual op amp	4557, 4558, 4559	M5218P/M5R4558P	●M5218L [Compatible with 4557, 4558, 4559 single in line package]
	358/2904	M5223P/M5N358P	●M5223L [Single in line package]
			●M5216P/L [High current output equivalent to 4556]
	324/2902	M5224P/M5N324P	
J.FET Input op amp	072, 082	M5221P/M5T082P	●M5221L [Single in line package]
Dual low noise pre-amp			△M5219L/P [V_{CC}±25V, S/N=77dB]
			△M5220L/P [V_{CC}±25V, S/N=83dB]

Note : △ Mitsubishi original, ● Functional equivalent

VOLTAGE COMPARATOR

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended (Features)
Single comparator			△M51201L [Low input current high output drive, including refference with hysteresis, V_{CC}1.7~6.5V]
			△M51202L [Low input current high output drive, V_{CC}1.7~6.5V]
			△M51203L [Low input current high output drive, V_{CC}3~28V including refference with hysteresis]
			△M51204L [Low input current high output drive, V_{CC}2.5~28V]
			△M51205L [Low input current stabilized power supply terminal including refference with hysteresis]
			△M51206L [Low input current stabilized power supply terminal]
Dual comparator			△M51200P [Low input current]
			△M51207L [Low input current high output drive, V_{CC}2.5~28V]
Quad comparator	339		M51209P/M5N339P [high output drive low input current, V_{CC}2.5~28V]

Note : △ Mitsubishi original, ● Functional equivalent

TIMER

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended [Features]
Single timer	555	M51841P/M5E555P	●M51848P/M5E555AP [High speed guaranty reset terminal TTL compatible]
			●M51848L [High speed guaranty reset terminal TTL compatible single in line package]
			△M51843P [Large supply voltage application]
Dual timer	556		●M51847P/M5E556AP [High speed guaranty reset terminal TTL compatible]
Counter timer			△M51849L [Long time capability~50hours]
			△M58479P [Low power dissipation superior noise immunity, extremely broad time-delay range (50ms~480h)]
			△M58482P [Low power dissipation superior noise immunity, extremely broad time-delay range (50ms~480h)]

Note : △ Mitsubishi original, ● Functional equivalent

MOTOR DRIVER

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended [Features]
Motor control Position control			△M51660L [Radio control servo]
F-G Servo			△M51970L [Single in line]
PLL Servo			△M51728L [High stability single in line]
3-Phase brushless			△M51712P [Linear driver]
			△M51724P [Pre-driver]
Bi-directional driver			△M54540AL [$I_{O(max)}/I_O$ ±0.6A/±0.1A]
			△M54541L [$I_{O(max)}/I_O$ ±0.8A/±0.2A]
			△M54542L [$I_{O(max)}/I_O$ ±1.2A/±0.3A]
			△M54543L [$I_{O(max)}/I_O$ ±1.2A/±0.3A Motor braking function]
			△M54544L [$I_{O(max)}/I_O$ ±1.2A/±0.3A Motor braking function]
			△M54545L [$I_{O(max)}/I_O$ ±1.2A/±0.2A Motor braking function]
			△M54546L [$I_{O(max)}/I_O$ ±0.7A/±0.15A Motor braking function]
			△M54547P [$I_{O(max)}/I_O$ ±0.6A/±0.15A Built in error amp, motor braking function]
			△M54548L [$I_{O(max)}/I_O$ ±1.2A/±0.3A Motor braking function op amp and decoder]
			△M54549L [$I_{O(max)}/I_O$ ±1.2A/±0.3A Motor braking function dual bi-directional, thermal shutdown]
			△M54543AL [$I_{O(max)}/I_O$ ±1.2A/±0.3A Motor braking function thermal shutdown]
			△M54544AL [$I_{O(max)}/I_O$ ±1.2A/±0.3A Motor braking function thermal shutdown]
			△M51714P [$I_{O(max)}/I_O$ ±1.2A/±0.4A Motor braking function dual bi-directional]
F-V Servo			△M51723P/FP [Low quiescent supply current]

Note : △ Mitsubishi original, ● Functional equivalent

ANALOG SWITCH

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended (Features)
Analog SW			△M51320P [Video SW, 2 inputs 3ch]
Bipolar SW			△M51326P [Video SW, 2 inputs 3ch]
			△M51321P [Video SW, 3 inputs 3ch]
			△M51327P [Video SW, 3 inputs 3ch]
			△M51551P/FP [Audio SW, 2 inputs 2ch]
CMOS SW	4016B	M4016BP	
	4066B	M4066BP	
	4051B	M4051BP	
	4052B	M4052BP	
	4053B	M4053BP	

Note : △ Mitsubishi original, ● Functional equivalent

VOLTAGE REGULATOR

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended (Features)
Variable single			△M5231L [High voltage $V_I = \pm 8 \sim \pm 70V$ Low noise $V_{NO} = 12\mu Vrms$ typ.]
Variable dual			△M5230L [High voltage $V_I = \pm 8 \sim \pm 35V$ Low noise $V_{NO} = 12\mu Vrms$ typ.]

Note : △ Mitsubishi original, ● Functional equivalent

DISPLAY DRIVER

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended (Features)
5-Step bar indicator			△M51903L [Linear mode operation]
6-Step bar indicator			△M51906P [Including AC-DC converter log scale]
			△M51911L [Including AC-DC converter low current log scale]
			△M51912L [Including AC-DC converter low current linear scale]
8-Step bar indicator			△M51907P [Including AC-DC converter low current log scale]
			△M51909P [Including AC-DC converter low current linear scale]
9-Point level indicator			△M51910P [2 inputs indicator]
12-Point level indicator			△M51901P [23-Mode indicator]
2-Dig BCD to 7-Seg			△M54847AP [Direct drive for LED or FL display]
8-Dig 7-Seg, FL driver			△M54940P [Direct drive for 35V FL display]

Note : △ Mitsubishi original, ● Functional equivalent

TRANSISTOR ARRAY

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended 〔Features〕
4-Unit Tr array			△M54512L 〔50mA Single in line package〕
	2064		△54532P 〔1.5A darlington, with clamp diode〕
			△M54567P 〔1.5A darlington with clamp diode input "L" active〕
			△M54568L 〔30mA PNP single in line package〕
5-Unit Tr array			△M54516P 〔500mA darlington〕
			△M54521P 〔500mA darlington〕
			△M54529P/AP 〔320mA with strobe〕
6-Unit Tr array			△M54527P 〔150mA with clamp diode〕
			△M54533P 〔320mA with clamp diode and strobe〕
			△M54534P 〔320mA with clamp diode and strobe〕
			△M54578P 〔700mA with clamp diode and strobe〕
			△M54539P 〔700mA with clamp diode〕
			△M54571P 〔350mA printer driver〕
7-Unit Tr array			△M54514AP 〔50mA NPN driver〕
			△M54515P 〔16mA NPN driver〕
			△M54517P 〔400mA darlington〕
			△M54519P 〔400mA darlington〕
	2003	●M54523P	
	2001	●M54524P	
	2002	●M54525P	
	2004	●M54526P	
			△M54528P 〔150mA darlington with clamp〕
			△M54530P 〔400mA darlington with clamp〕
			△M54531P 〔400mA darlington with clamp〕
			△M54535P 〔150mA with clamp and strobe〕
			△M54536P 〔150mA with clamp and strobe〕
			△M54537P 〔320mA non-darlington driver〕
			△M54538P 〔350mA and motor driver〕
			△M54560P 〔150mA source darlington〕
			△M54561P 〔300mA source darlington〕
			△M54566P 〔400mA darlington input "L" active〕

Note : △ Mitsubishi original, ● Functional equivalent

TRANSISTOR ARRAY

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended (Features)
7-Unit Tr array			△M54576P/FP [30mA input "L" active]
			△M54577P/FP [30mA non-darlington driver]
			△M54580P [100mA source darlington for FL]
8-Unit Tr array			△M54513P [50mA NPN driver]
			△M54522P [400mA darlington with clamp diode]
	2982	●M54562P	
	2981	●M54563P	
			△M54564P [500mA source darlington for FL]
			△M54565P [50mA input "L" active]
			△M54569P [30mA PNP array]

Note : △ Mitsubishi original, ● Functional equivalent

OTHERS

Function	Generic No.	Mitsubishi Pin For Pin Replacement	Mitsubishi Recommended (Features)
D/A converter			△M50601P [6b CMOS D/A converter for electronic volume control]
			△M50602P [5b CMOS D/A converter for electronic volume control]
A/D converter			●M52670P/FP [4b bipolar A/D converter for high speed use sampling rate 10M sample/sec]
PLL		M51361P/M5E565P	
Dual differential amp	3054	M5109P	
Zero volt trigger ckt Flame detector			△M5172L [Line operation IC built—in differential amp]
			△M5174P [Fail—safe design for flame detector built—in relay driver]
			△M51743P [Sequential control for flame detector built—in five comparators and two regulators]
Electronic attenuator			△M51523L [Including balance control dual channel]
			△M51133P [Including balance control dual channel]
Double diode			△MC911 [Common anode]
			△MC921 [Common cathode]
			△MC931 [Series type]
Flasher control			△M51961L [Including break detecting circuit]
Voltage detection alarm system			△M5232L [Battery reduced voltage checker (LED turn ON and OFF)]

Note : △ Mitsubishi original, ● Functional equivalent

OPERATIONAL AMPLIFIER, PRE AMPLIFIER

Function	Mitsubishi Type No.	Fairchild	National	Motorola	T. I.
Single op amp	M51802P/M5F741P	μA741TC	LM741CN	MC1741CP1	μA741CP
	●M51802L				
Dual op amp	M5218P/M5R4558P	μA4558TC		MC4558CP1	TL4558P RC4558P
	●M5218L				
	M5223P/M5N358P	LM358 LM2904	LM358N	LM358N	LM358P
	●M5223L				
	●M5216P				
	●M5216L				
J. FET Input op amp	M5221P/M5T082P				TL072 TL082
	●M5221L				
Quad op amp dual low noise	M5224P/M5N324P	μA324 μA2902	LM324		LM324 LM2902
	△M5219L/P				
Pre-amp	△M5220L/P				

Note : △ Mitsubishi original device, ● Functional equivalent

VOLTAGE COMPARATOR

Function	Mitsubishi Type No.	Fairchild	National	Motorola	T. I.
Single comparator	△M51201L				
	△M51202L				
	△M51203L				
	△M51204L				
	△M51205L				
	△M51206L				
Dual comparator	△M51200P				
	△M51207L				
Quad comparator	●M51209P/M5N339P	μA339	LM339		LM139

Note : △ Mitsubishi original device, ● Functional equivalent

TIMER

Function	Mitsubishi Type No.	Fairchild	National	Motorola	T. I.
Single timer	M51841P/M5E555P	μA555TC	LM555C	MC1455P1	NE555P
	●M51848P/M5E555AP				
	●M51848L/M5E555AL				
	△M51843P				
Dual timer	●M51847P/M5E556AP	μA556PC	LM556C		
Counter timer	△M51849L				
	△M58479P				
	△M58482P				

Note : △ Mitsubishi original device, ● Functional equivalent

MOTOR DRIVER

Function	Mitsubishi Type No.	Fairchild	National	Motorola	T. I.
Position control	△M51660L				
F-G Servo	△M51970L				
PLL servo	△M51728L				
3-Phase brushless	△M51712P				
	△M51724P				
Bi-Directional driver	△M54540AL				
	△M54541L				
	△M54542L				
	△M54543L				
	△M54544L				
	△M54545L				
	△M54546L				
	△M54547P				
	△M54548L				
Dual Bi-Directional Driver	△M54549L				
	△M51714P				
Bi-Directional driver with thermal shutdown function	△M54543AL				
	△M54544AL				
F-V Servo	△M51723P/FP				

Note : △ Mitsubishi original device, ● Functional equivalent

ANALOG SWITCH

Function	Mitsubishi Type No.	Fairchild	National	Motorola	T. I.
Bipolar SW	△M51320P				
	△M51326P				
	△M51321P				
	△M51327P				
	△M51551P/FP				
CMOS SW	M4016BP	F4016BPC		MC14016BCP	TP4016BN
	M4066BP	F4066BPC	CD4066BCN	MC14066BCP	TP4066BN
	M4051BP	F4051BPC	CD4051BCN	MC14051BCP	TP4051BN
	M4052BP	F4052BPC	CD4052BCN	MC14052BCP	TP4052BN
	M4053BP	F4053BFC	CD4053BCN	MC14053BCP	TP4053BN

Note : △ Mitsubishi original device, ● Functional equivalent

VOLTAGE REGULATOR

Function	Mitsubishi Type No.	Fairchild	National	Motorola	T. I.
Variable single	△M5231L				
Variable dual	△M5230L				

Note : △ Mitsubishi original device, ● Functional equivalent

DISPLAY DRIVER

Function	Mitsubishi Type No.	Fairchild	National	Motorola	T. I.
12-point level indicator	△M51901P				
5-step bar indicator	△M51903L				
6-step bar indicator	△M51906P				
8-step bar indicator	△M51907P				
	△M51909P				
9-point 2 inputs indicator	△M51910P				
6-step bar indicator	△M51911L				
	△M51912L				
2-Dig, BCD to 7-Seg	△M54847AP				
8-Dig, 7-Seg, FL Driver	△M54940P				

Note : △ Mitsubishi original device, ● Functional equivalent

TRANSISTOR ARRAY

Function	Mitsubishi Type No.	Sprague	National	Motorola	T. I.
4-Unit Tr array	△M54512L				
	M54532P	(ULN2064A) Noted: Pin connection			
	△M54567P				
	△M54568L				
5-Unit Tr array	△M54516P				
	△M54521P				
	△M54529P/AP				
6-Unit Tr array	△M54527P				
	△M54533P				
	△M54534P				
	△M54578P				
	△M54539P				
	△M54571P				
7-Unit Tr array	△M54514AP				
	△M54515P				
	△M54517P				
	△M54519P				
	●M54523P	ULN2003A		MC1413PW	ULN2003A
	●M54524P	ULN2001A		MC1411PW	ULN2001A
	●M54525P	ULN2002A		MC1412PW	ULN2002A
	●M54526P	ULN2004A		MC1416PW	ULN2004A
	△M54528P				
	△M54530P				
	△M54531P				
	△M54535P				
	△M54536P				
	△M54537P				
	△M54538P				
	△M54560P				
	△M54561P				
	△M54566P				

Note : △ Mitsubishi original device, ● Functional equivalent

TRANSISTOR ARRAY

Function	Mitsubishi Type No.	Sprague	National	Motorola	T. I.
7-Unit Tr array	△M54576P/FP				
	△M54577P/FP				
	△M54580P				
8-Unit Tr Array	●M54562P	UDN-2982A			
	●M54563P	UDN-2981A			
	△M54564P				
	△M54565P				
	△M54569P				
	△M54513P				
	△M54522P				

Note : △ Mitsubishi original device, ● Functional equivalent

OTHERS

Function	Mitsubishi Type No.	Fairchild	National	Motorola	T. I.
D/A Converter	△M50601P				
	△M50602P				
A/D Converter	●M52670P/FP				Hitachi HA19203
PLL	●M51361P/M5E565P		LM565CN	NE565N	Signetics NE565
Dual differential amp	M5109P			CA3054	RCA CA3054
Zero volt trigger CRt	△M5172L				
Flame detector	△M5174P				
	△M51743P				
Electronic attenuator	△M51523L				
	△M51133P				
Double diode	△MC911				
	△MC921				
	△MC931				
Flasher control	△M51961L				
Voltage detection alarm system	△M5232L				

Note : △ Mitsubishi original device, ● Functional equivalent

ORDERING INFORMATION

FOR MITSUBISHI ORIGINAL PRODUCTS

Example: **M 5 1 86 A P**

M : Indicates the product is a Mitsubishi Electric integrated circuit.

5 : Industrial/consumer
(Operating ambient temperature range is −20 to 75℃ , standard)

9 : High-reliability type

0 : CMOS

1~2 : Linear circuit

3 : TTL

10~19 : Linear circuit

32~33 : TTL (equivalent to the TI SN74 family)

41~47 : TTL, others

48~49 : I^2L

84 : COMS

85 : p-channel silicon gate MOS

86 : p-channel aluminum gate MOS

87 : n-channel silicon gate MOS

88 : p-channel aluminum gate EDMOS

89 : COMS

S0~S2 : Shottky TTL
(equivalent to the TI SN74S family)

This group consists of a two-digit serial number to indicate the type of circuit within the series.

Consists of a single letter which indicates the difference of outer appearance or some part of the device specifications as listed below.

(1) For linear circuits, this is one letter of the alphabet, chosen in alphabetical order but not including I or O, which is used to flag devices for which parts of the specifications differ.

(2) For devices with identical specifications having only pin bending direction differences, an R is assigned to this group.

(3) When this group designation is not required, the next group is shifted to the left to follow the group (4) immediately.

K : Low melting point glass sealed ceramic-type package

L : Plastic molded SIL (single in-line) package

P : Plastic molded DIL (dual in-line) package

S : Cermet packge

FOR SECOND SOURCE PRODUCTS

Example: **M 5 K 4116 S - 2**

M : Mitsubishi integrated prefix

Temperature range
5 : Standard industrial/commercial (0 to 70/75℃ or −20 to 85℃)
9 : High reliability

Series designation of original source using 1 or 2 alphabetical characters.
A : Advanced Micro Devices
C : Motorola's MC series
E : Signetics
F : Fairchild
G : General Instrument's series
K : Mostek's MK series
L : Intel's series
N : National Semiconductor
R : Raytheon
T : Texas Instrument's
W : Western Digital's series

Circuit function identification code of the original source type name.

Package style
K : Glass-sealed ceramic
P : Molded plastic
S : Metal-sealed ceramic

Electrical characteristic identification code using 1 or 2 digits.

PACKAGE CODE

Package style may be specified by using the following simplified alphanumeric code.

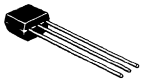
Example: **24 P 4**

Number of pins

Package structure
K : Glass-sealed ceramic
P : Molded plastic
S : Metal-sealed ceramic

Package outline
1 : DIL without fin
2 : Flat without fin
4 : DIL without fin (improved)
4B : Shrink DIL without fin
10 : DIL without fin and with quartz lid

EXTERNAL PACKAGES



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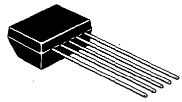

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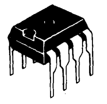

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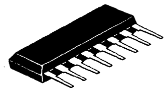

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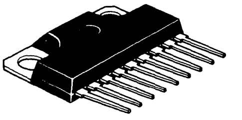

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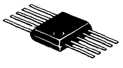

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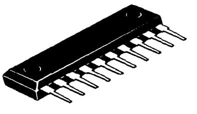

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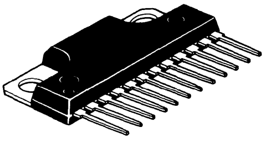

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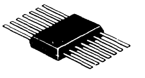

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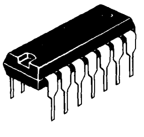

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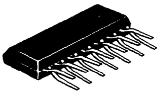
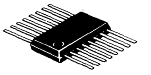
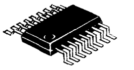


14P5-A



16P2



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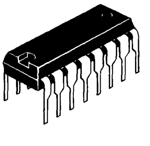
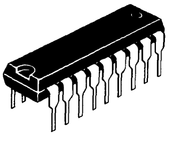


16P4



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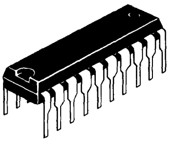

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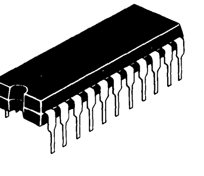
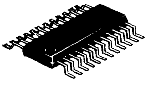
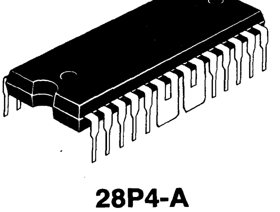


22P4

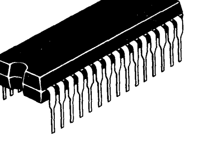
24P2



24P2-C



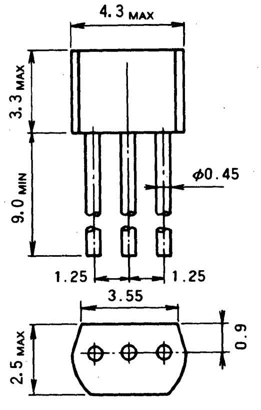
28P4-A



30P4-B

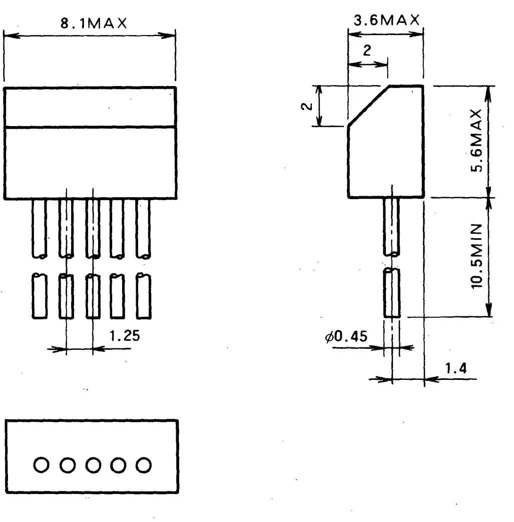
TYPE 3P5 3-PIN MOLDED PLASTIC SIL

Dimension in mm



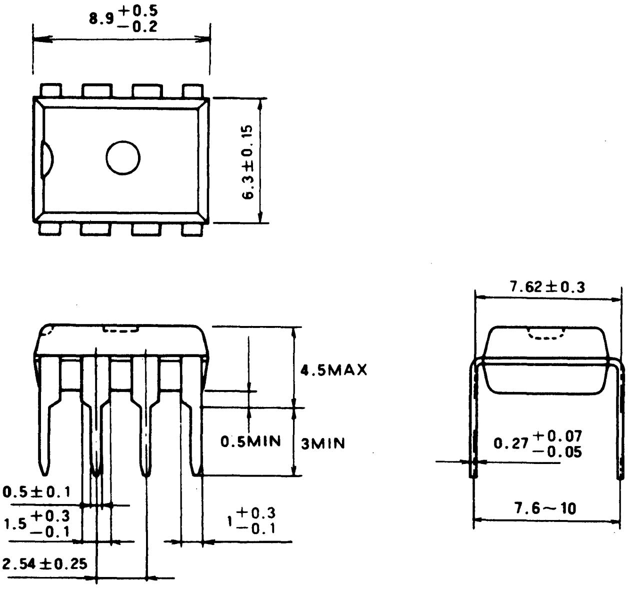
TYPE 5P5 5-PIN MOLDED PLASTIC SIL

Dimension in mm



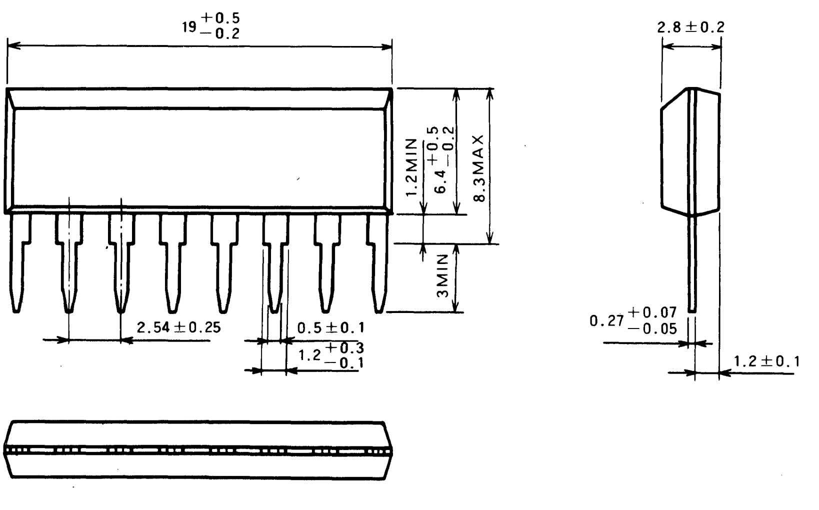
TYPE 8P4 8-PIN MOLDED PLASTIC SIL

Dimension in mm



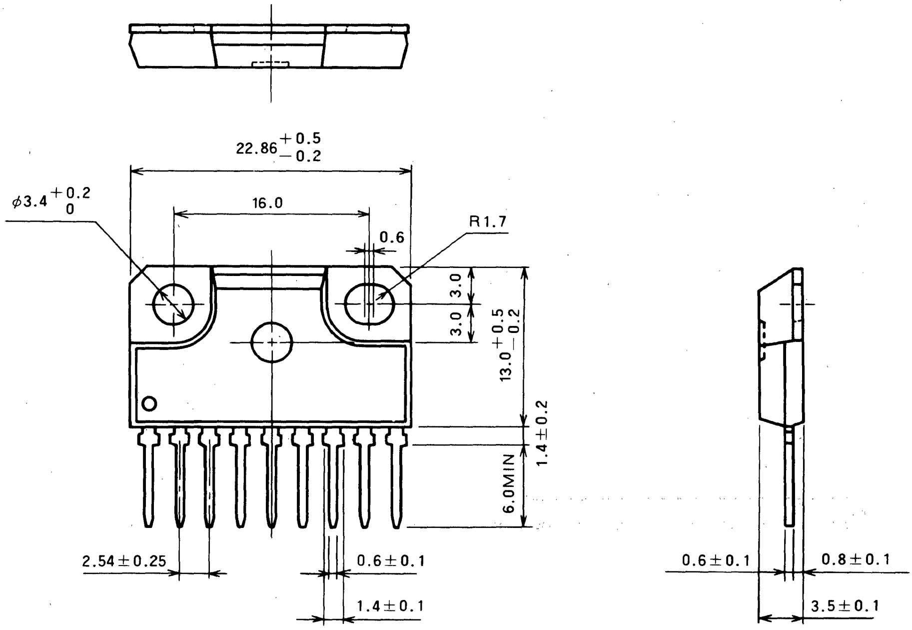
TYPE 8P5 8-PIN MOLDED PLASTIC DIL

Dimension in mm



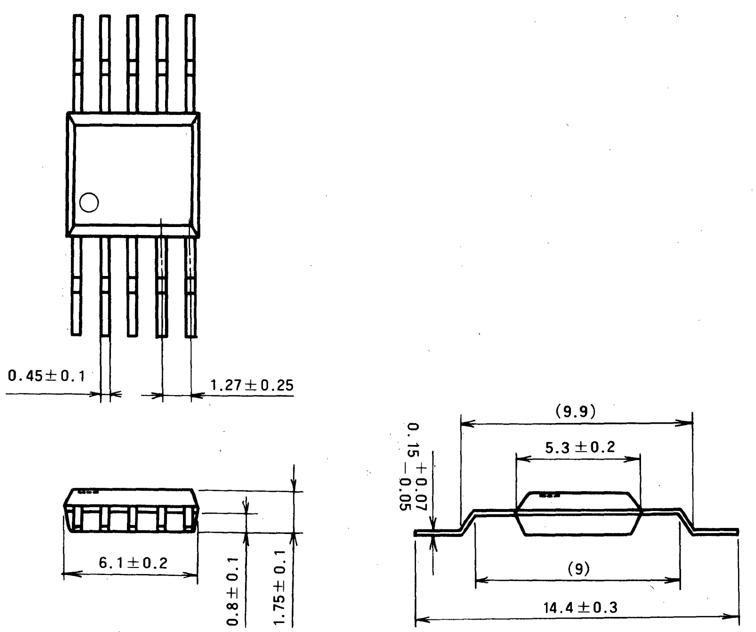
TYPE 9P9 9-PIN MOLDED PLASTIC SIL

Dimension in mm



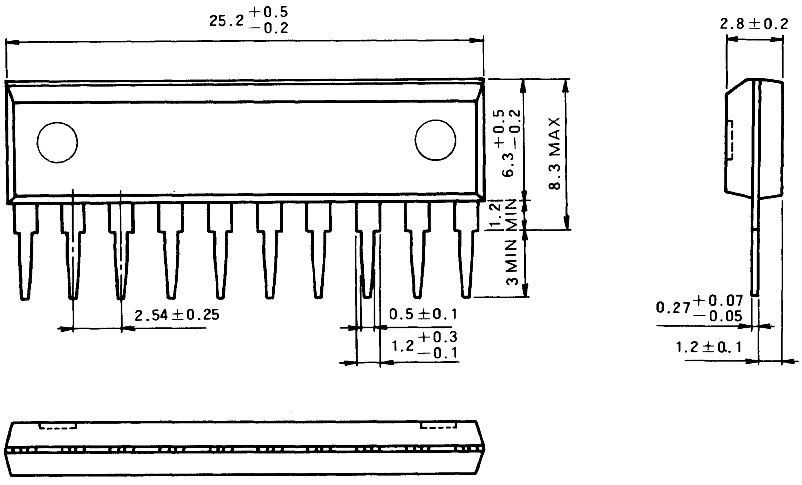
TYPE 10P2-A 10-PIN MOLDED PLASTIC FLAT

Dimension in mm



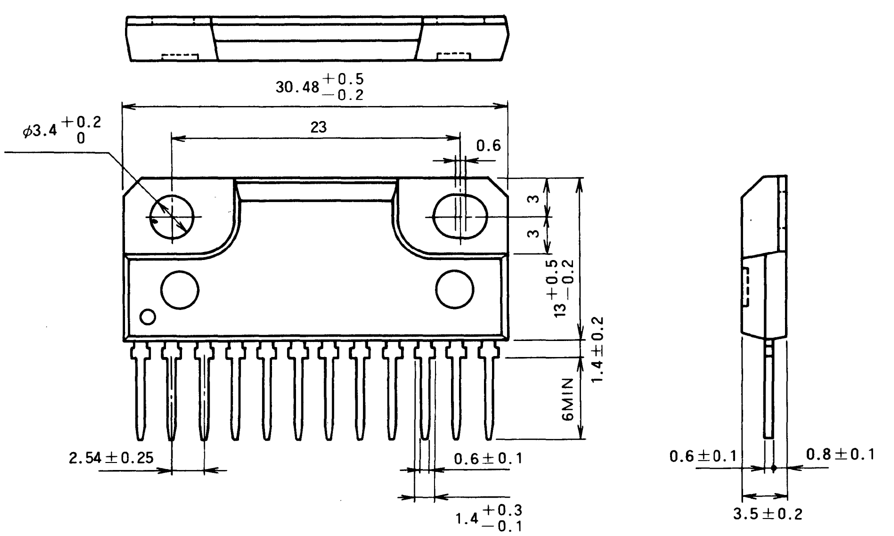
TYPE 10P5 10-PIN MOLDED PLASTIC SIL

Dimension in mm



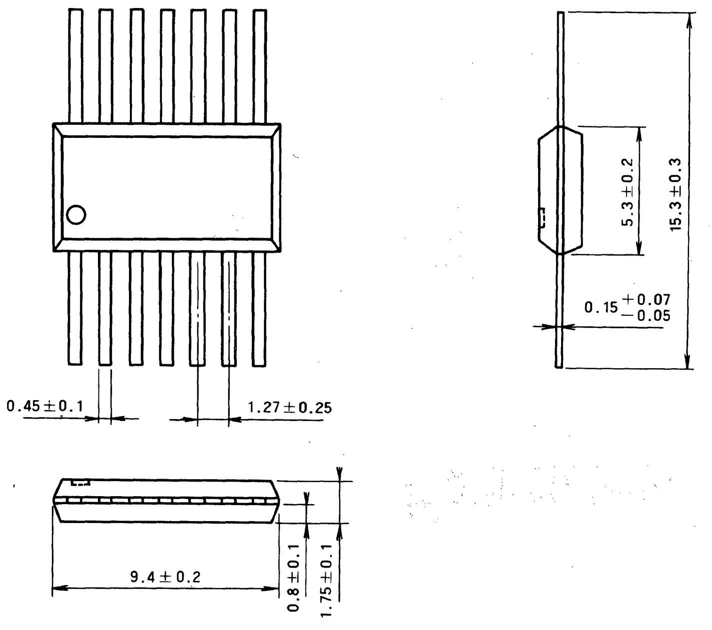
TYPE 12P9 12-PIN MOLDED PLASTIC SIL

Dimension in mm



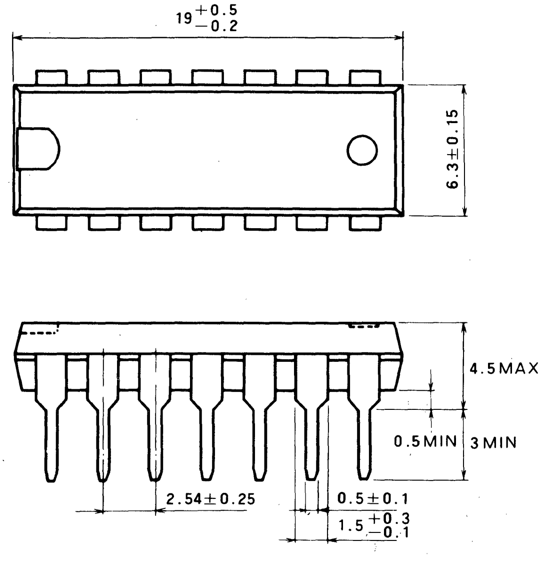
TYPE 14P2 14-PIN MOLDED PLASTIC FLAT

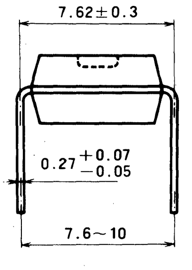
Dimension in mm



TYPE 14P4 14-PIN MOLDED PLASTIC DIL

Dimension in mm





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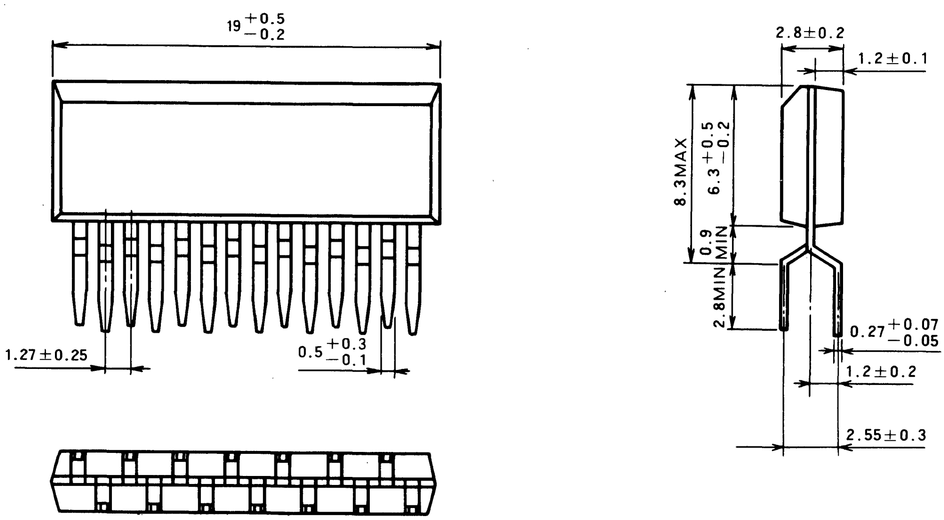
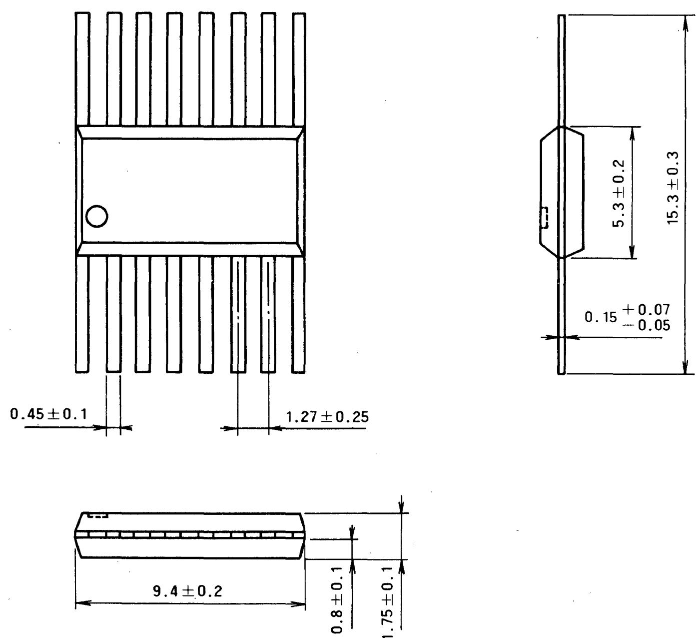
TYPE 14P5A 14-PIN MOLDED PLASTIC ZIL

Dimension in mm



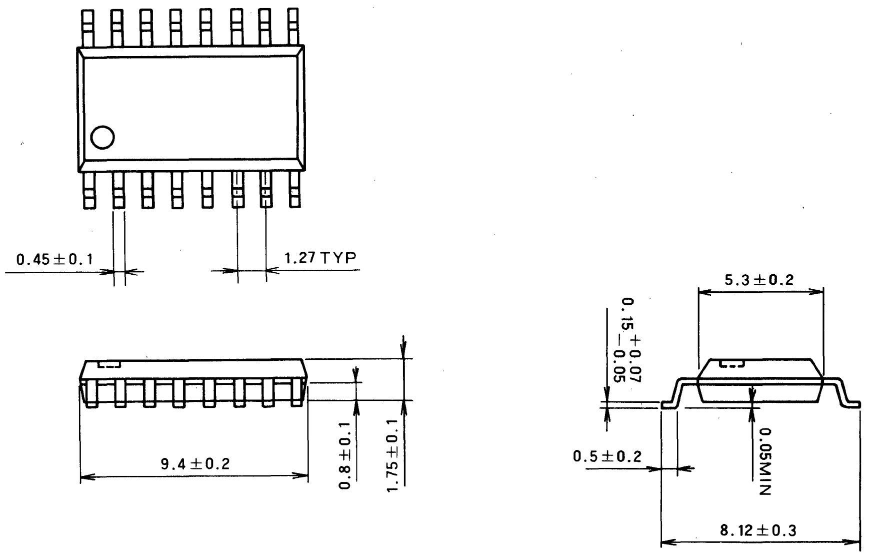
TYPE 16P2 16-PIN MOLDED PLASTIC FLAT

Dimension in mm



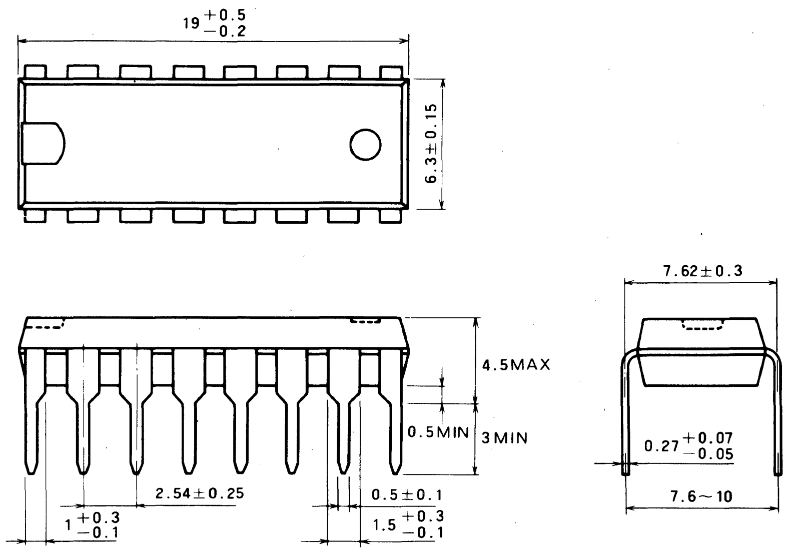
TYPE 16P2-C 16-PIN MOLDED PLASTIC FLAT

Dimension in mm



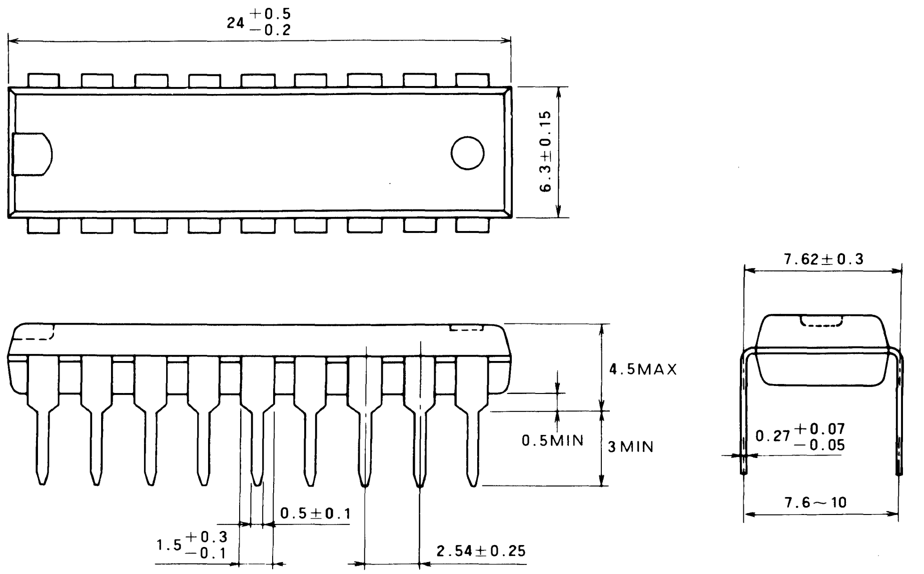
TYPE 16P4 16-PIN MOLDED PLASTIC DIL

Dimension in mm



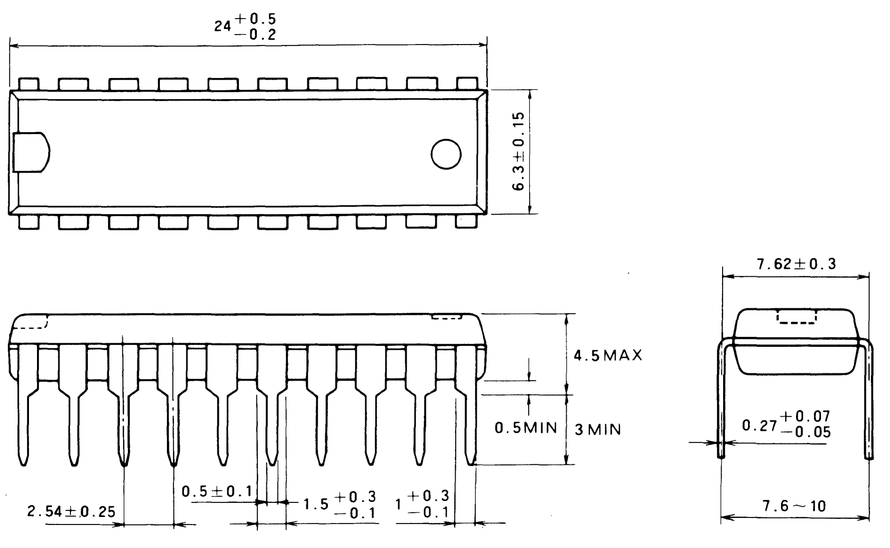
TYPE 18P4 18-PIN MOLDED PLASTIC DIL

Dimension in mm



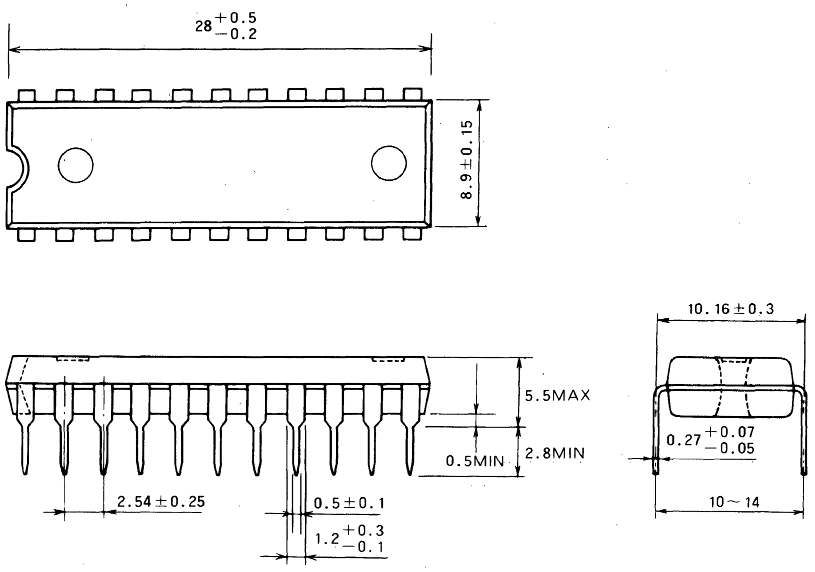
TYPE 20P4 20-PIN MOLDED PLASTIC DIL

Dimension in mm



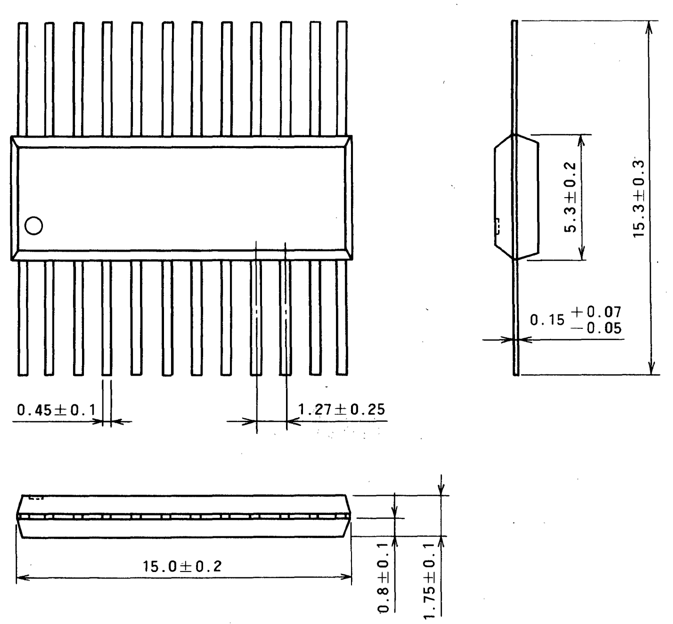
TYPE 22P4 22-PIN MOLDED PLASTIC DIL

Dimension in mm



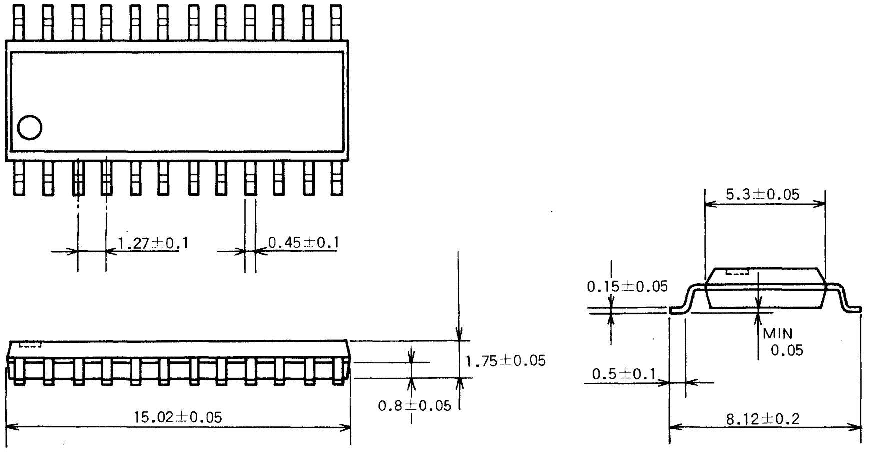
TYPE 24P2 24-PIN MOLDED PLASTIC FLAT

Dimension in mm



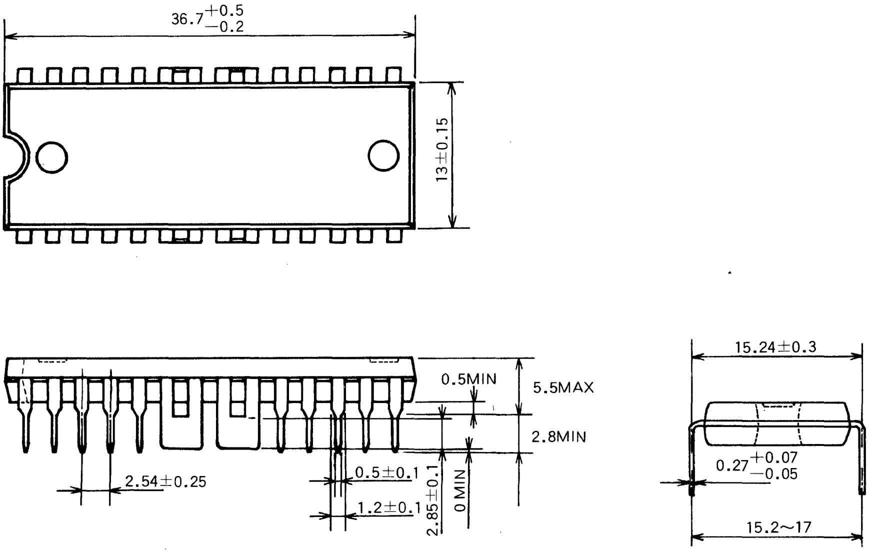
TYPE 24P2-C 24-PIN MOLDED PLASTIC FLAT

Dimension in mm



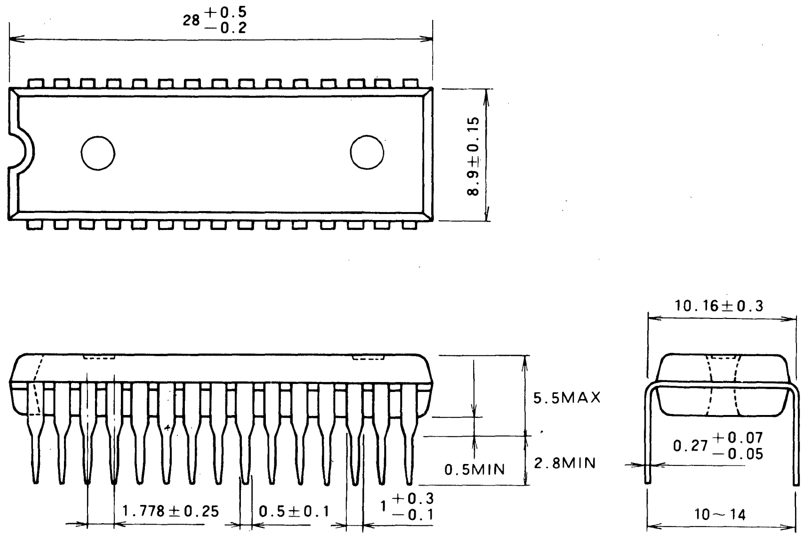
TYPE 28P4-A 28-PIN MOLDED PLASTIC DIL (WITH FIN)

Dimension in mm



TYPE 30P4B 30-PIN MOLDED PLASTIC DIL(SHRINK)

Dimension in mm



QUALITY ASSURANCE AND RELIABILITY TESTING

1. INTRODUCTION

Recent years have seen rapid advancements in semiconductor integrated circuits in the areas of level of integration, speed, and other performance factors. Increasingly complex systems requiring higher reliability and the need to simplify assembly processes has resulted in a rapidly increasing demand for semiconductor integrated circuits. Accompanying this increased demand is the very serious problem of supplying customers with devices that operate with uniform quality. Mitsubishi Electric has developed the system of quality assurance described below as well as a system for controlling reliability, enabling the supply of highly reliable devices to customers. This system and the results of reliability testing will be described below in addition to an overview of the problems that face us in the future for the support of high semiconductor reliability.

2. QUALITY ASSURANCE SYSTEM

This system consists of a combination of design reliability and product quality and is summarized in Fig. 1, along with the procedures for evaluation of reliability.

2.1 Design Quality Assurance

This part of the quality assurance system is implemented by the following two methods.

(1) Investigations are performed of required device characteristics and quality by means of breadboarding with standardly available components.

(2) CAD technology is used to design the device according to established design standards.

2.2 Product Quality Assurance

Product quality assurance is implemented with the following controls and inspections.

(1) Environmental control

(2) Periodic inspection and preventative maintenance on equipment and measurement instruments used in design.

(3) Purchasing control

(4) Manufacturing process control

(5) Intermediate inspections: Wafer process and assembly

(6) Final inspections: Inspections of the finished product for outward appearance, dimensions, structure, and electrical characteristics to determine the device's pass or fail status.

(7) Quality assurance inspections: These inspections are performed from the standpoint of the end user to provide an overall verification of quality to judge whether the device will be placed in stock. The following groups of categories are used in this type of inspection:

Group A: Tests of outward appearance, markings and electrical characteristics.

Group B: Tests of environmental mechanical life.

Group C: Reliability tests of samples made from lots that have passed the Group A and Group B tests. Testing is performed to determine life and includes environmental and mechanical testing and is performed every several months.

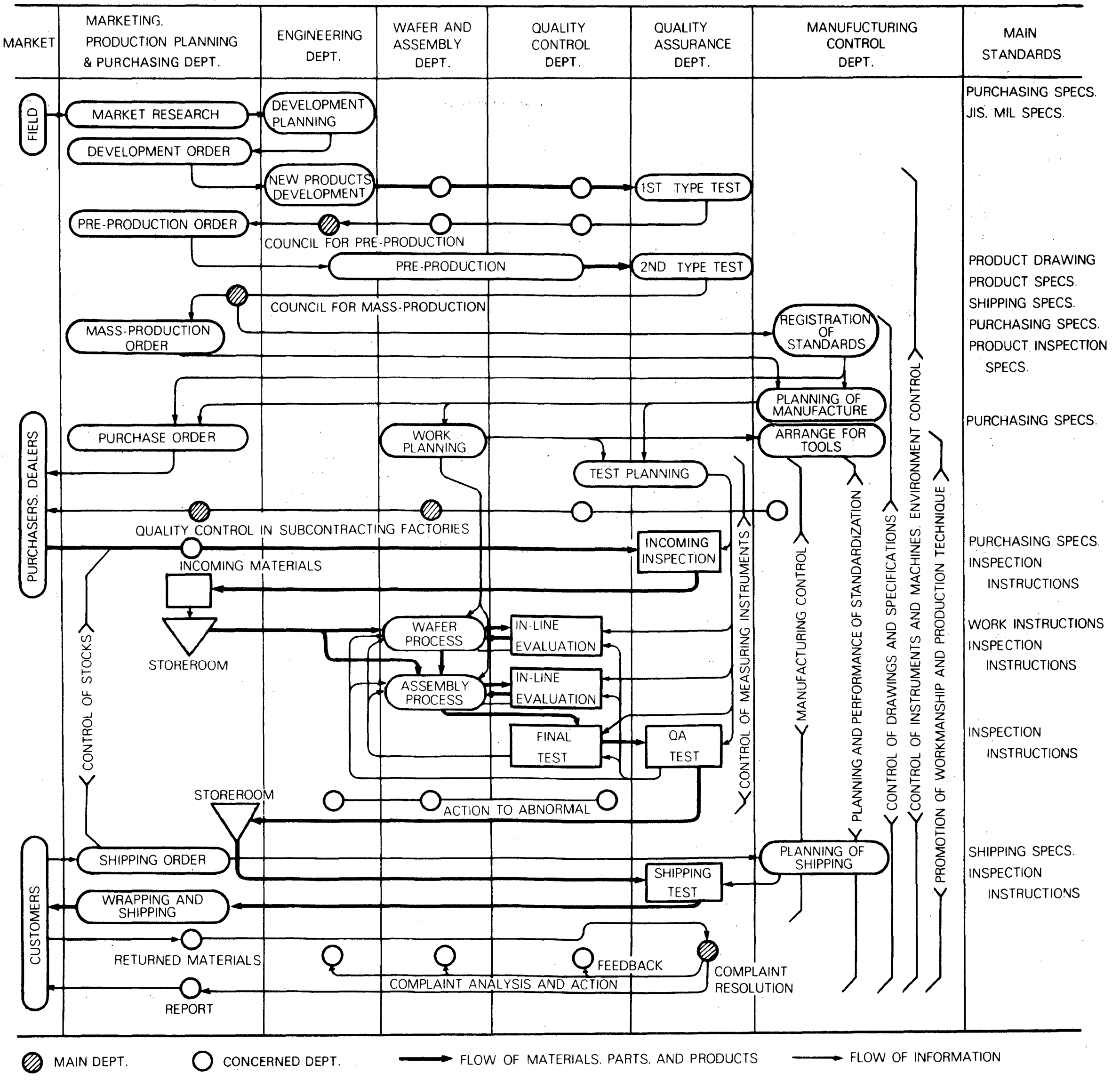
Table 1 Integrated Circuit Reliability Testing Categories and Conditions (examples)

Group	Test category	Test conditions
1	Continuous operation	Maximum operating temperature for 1000h
	High-temperature storage	Maximum storage temperature for 1000h
	Resistance to humidity (storage)	85°C, 85%RH, 500Hrs
2	Resistance to soldering heat	260°C, 10Sec
	Thermal shock	0~100°C, 15 cycles, 10min/cycle
	Temperature cycling	Minimum – Maximum storage temperature, 10 cycles 1h/cycle
3	Solderability	230°C, 5s, using rosin flux
	Lead strength	Bending: 250g, 90°, 2 times (Flat: 125g, 90°, 2 times)
	Vibration	20G in X,Y, and Z directions, 100~2000Hz, 4min/cycle, cycles in each direction
	Shock	75cm, 3 times, on a wooden board, Y_1 direction
	Constant acceleration	20000G, Y_1 direction, 1min

Table 2 Integrated Circuit Failure Analysis Procedures

Step	Description
(1) External inspection	• Inspection of the condition of the leads, plating, soldering and bonding • Package material, sealing, and marking inspection • Inspection of other specified external features • Inspections using stereo and metallurgical microscopes, X-ray fluoroscopy, and fine leakage or gross leakage inspections are performed as required.
(2) Electrical inspection	• Determination of shorts, opens, and deteriorization in parameters by measurement of electrical parameters. • Observation of characteristics by means of oscilloscope and curves tracers, including physical characteristics observed indirectly by means of electrical characteristics. • If required, perform stress testing such as environmental and life testing.
(3) Internal inspection	• Open the package lid and optically inspect the device internally. • Observation of the surface of the silicon chip • When applicable, measurement of electrical characteristics using a probe. • If required, the application of SEM, XMA, or IR microscanning
(4) Chip analysis	• Metallurgical inspection and analysis to supplement the internal inspection analysis • Cross-sectioning of the chip • Analysis of flaws in the oxide layer • Analysis of flaws in the diffusion layer

Fig. 1 Quality assurance system



2.3 Reliability Evaluation Testing Used from the Development Prototype Phase through the Mass Production Phase

To verify the quality as described in sections 2.1 and 2.2 above, reliability evaluation is performed at three different stages of a product's life, development prototype, preproduction, and mass production.

In the development prototype stage, after a product has passed primary tests it advances to the preproduction stage at which some quantity of product is produced, after which secondary testing is performed to verify that the quality and reliability observed in the prototype has been maintained. In the mass production stage, a verification of quality and reliability is again performed, using the above described quality assurance testing procedures.

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3. RELIABILITY CONTROL

3.1 Reliability Testing

Reliability certification is controlled on a worldwide basis by the IEC and locally in Japan by the Reliability Center of Japan (RCJ), operating in accordance with JIS standards to certify quality.

At Mitsubishi Electric, reliability testing is performed in accordance with such standards as MIL-STD-883 and EIAJ-IC-121 and is summarized in Table 1.

3.2 Failure Analysis

To improve the reliability of integrated circuits, the causes of failures encountered in reliability and accelerated testing are sought to provide feedback information for the improvement of process technology and the manufacturing function. Such failure analysis procedures are summarized in Table2.

4. EXAMPLES OF RELIABILITY TEST AND FAILURE ANALYSIS RESULTS

4.1 Reliability Test Results

Mitsubishi General Purpose Linear ICs are used in many application from consumer to industrial field and have been used with high reliability in these applications . The Table 3 shows an example of the results of the life testing of General Purpose Linear ICs.

4.2 Example of Failure Analysis Results

Accelerated testing under conditions more severe than those encountered in normal operation is used to observe failures caused by moisture, wire bonding failures, and those caused when surge voltages cause damage or failures of vapor-deposited aluminum conductors. Typical results are shown below.

(1) Failures Caused by Moisture

An example of the results of steam pressure testing performed to evaluate moisture resistance of a plastic molded package is shown in Fig. 2. The vapor-deposited aluminum conductor was dissolved by moisture which penetrated the package.

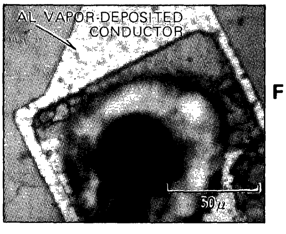


Fig. 2 Example of corrosion of an aluminum vapor-deposited conductor (analyzed using a metallurgical microscope)

TABLE 3. EXAMPLES OF GENERAL PURPOSE IC ENDURANCE TEST RESULTS

Application	Type No.	Package	Test category and conditions		Number of samples	Component hours	Number of failures	Type of failure
Timer	M51848P	8-pin	Steady-state operation life	75℃	70	158,000	0	
		Plastic molded DIL	High-temperature storage	125℃	22	22,000	0	
	M51848L	8-pin	Steady-state operation life	75℃	70	158,000	0	
		Plastic molded SIL	High-temperature storage	125℃	22	22,000	0	
Comparator	M51204L	5-pin	Steady-state operation life	75℃	66	132,000	0	
		Plastic molded SIL	High-temperature storage	125℃	50	50,000	0	
	M51209P	14-pin	Steady-state operation life	75℃	22	22,000	0	
		Plastic molded SIL	High-temperature storage	125℃	22	22,000	0	
Operational Amplifiers	M51802P	8-pin	Steady-state operation life	75℃	48	48,000	0	
		Plastic molded DIL	High-temperature storage	125℃	50	50,000	0	
	M51802L	8-pin	Steady-state operation life	75℃	48	48,000	0	
		Plastic molded SIL	High-temperature storage	125℃	50	50,000	0	
LED Level Indicator	M51903L	8-pin	Steady-state operation life	75℃	22	22,000	0	
		Plastic molded SIL	High-temperature storage	125℃	22	22,000	0	
	M51906P	14-pin	Steady-state operation life	75℃	22	22,000	0	
		Plastic molded DIL	High-temperature storage	125℃	22	22,000	0	
Motor Driver	M51970L	8-pin	Steady-state operation life	75℃	22	22,000	0	
		Plastic molded SIL	High-temperature storage	125℃	22	22,000	0	
	M54543L	9-pin	Steady-state operation life	75℃	22	44,000	0	
		Plastic molded with fin SIL	High-temperature storage	125℃	22	44,000	0	
Transistor Array	M54519P	16-pin	Intermittent operation life	25℃	40	40,000	0	
		Plastic molded DIL	High-temperature reverse bias	150℃	38	38,000	0	
	M54523P	16-pin	Steady-state operation life	75℃	22	44,000	0	
		Plastic molded DIL	High-temperature storage	125℃	22	44,000	0	

(2) Wire Bonding Failures

Fig. 3 shows an example of a failure occuring during the operational temperature cycling testing for evaluating the reliability of the wire bonding of the ICs inner leads. The cause of this failure is thought to be the opening of an internal lead bond due to the difference in thermal expansion coefficients of metal and resin, resulting in stress being applied to the inner lead.

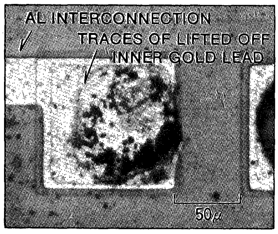


Fig. 3 Lift off of inner gold lead (analyzed using a metallurgical microscope)

Fig. 4 Surge destruction example (analyzed using a metallurgical microscope)

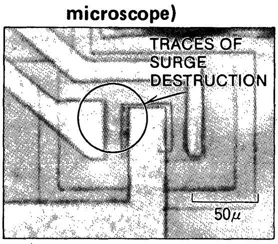


Fig. 5 Enlarged view of Fig. 4 aluminum bridge (analyzed using XAM-A1Kα)

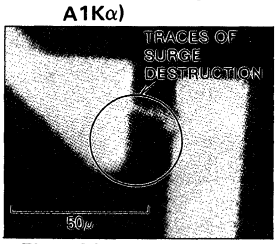


Fig. 6 Hot spot at the bonding head (analyzed using an infrared microscanner)

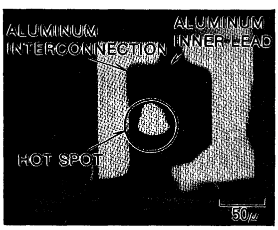
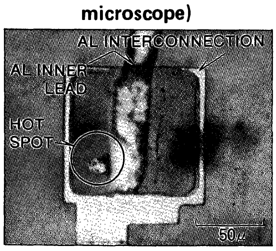


Fig. 7 The junction of Fig. 6 after removal of aluminum (analyzed using a metallurgical microscope)



(3) Failures Due to Surge Voltages

Many integrated circuits fail in the field due to the application of surge voltages. Surge voltage margin tests have been performed to reproduce this type of failure to allow analysis of this type of destruction and development of suitable protection.

Examples of failures occuring during such tests are shown in Fig. 4~7. In Fig. 4 and 5, the presence of a bridge was verified by means of an X-ray microscanner, while the hot spot shown in Fig. 6 and 7 was verified using an infrared microscanner.

(4) Failures of Aluminum Vapor-Deposited Interconnections

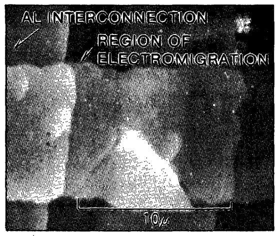


Fig. 8 Electromigration of an aluminum interconnection (analyzed using an SEM)

Fig. 8 shows an open circuit vapor-deposited aluminum interconnection, in a high current density region, caused by the operating life test. This test is performed as a step stress test to investigate IC deteriorization and failure caused by temperature and voltage stresses. This phenomenon is due to aluminum electromigration, which is observed when high-current loads are applied to a vapor-deposited aluminum interconnection.

5. SUMMARY

We have discussed the concepts of the Mitsubishi Electric quality assurance system and reliability control methods. The demands for high reliability integrated circuits will be increasing in the future. To anticipate and meet these new, more severe demands, as a manufacturer of integrated circuits, Mitsubishi Electric is making efforts in the following areas:

(1) Cooperation with device users in establishing quality levels, including those for reliability.
(2) The establishment of thorough reliability testing centered on evaluation of wafer and assembly and the feedback of information gained in such testing to create design standards and product standards.
(3) Facilitation of the achievement of reliability by means of improvements in failure analysis and accelerated life testing methods.
(4) Establishment of a system of collecting data on failures in the field and the use of this data in improving reliability.

To improve IC reliability even further, Mitsubishi Electric is continuing to make efforts with the cooperation of its users in system design, setting of quality levels, performing of incoming inspections, controlling the assembly and adjustment phase of IC equipment production and in the collection of field data essential to the improvement of device reliability.

DATA SHEET

M4016BP

QUADRUPLE BILATERAL SWITCH

DESCRIPTION
The M4016BP is a semiconductor integrated circuit consisting of four independent bilateral analog switches.

FEATURES
- Typical ON resistance of 250Ω (at V_{DD} = 15V)
- High off-state resistance 10^9Ω or greater (typical)
- Small variations in ON resistance between switches in the same package: 10Ω (typical, at V_{DD} = 15V)
- Wide operating voltage range: V_{DD} = 3 ~ 18V
- Wide operating temperature range: T_a = −40 ~ +85°C

APPLICATIONS
General purpose, for use in industrial and consumer digital equipment.

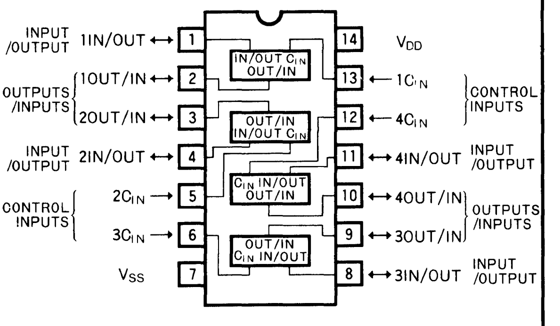
FUNCTIONAL DESCRIPTION
The control input (C_{IN}) can be used to change the input-to-output impedance (IN/OUT − OUT/IN) of the switches.

When (C_{IN}) is made high, the input-to-output switch impedance is low and when set to low, this impedance is high.

FUNCTION TABLE

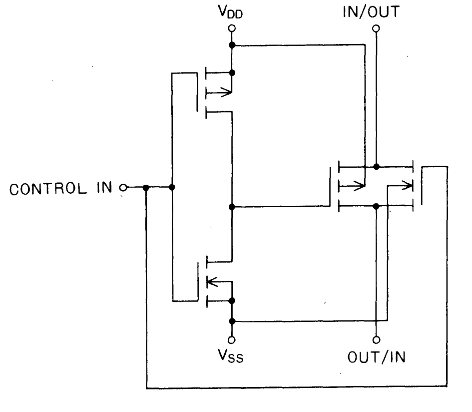
Input C_{IN}	INPUT/OUTPUT and OUTPUT/INPUT resistance (V_{DD} = 10V, 15V)
H	2 ~ 20 × 10^2 Ω
L	> 10^9 Ω typical

PIN CONFIGURATION (TOP VIEW)

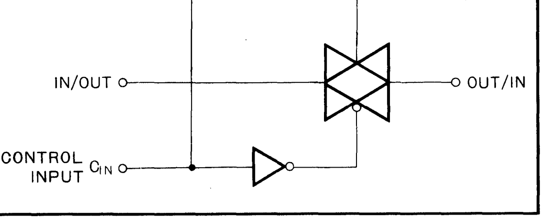


Outline 14P4

CIRCUIT SCHEMATIC (EACH SWITCH)



LOGIC DIAGRAM (EACH SWITCH)



ABSOLUTE MAXIMUM RATINGS (Ta = −40 ~ +85°C, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{DD}	Supply voltage		V_{SS}−0.5~V_{SS}+20	V
V_I	Input voltage		V_{SS}−0.5~V_{DD}+0.5	V
I_I	Input current	Control inputs	±10	mA
I_O	Output current		±10	mA
T_{opr}	Operating temperature range		−40~+85	℃
T_{stg}	Storage temperature range		−65~+150	℃

RECOMMENDED OPERATING CONDITIONS (Ta = −40 ~ +85°C, V_{SS} = 0V, unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min	Typ	Max	
V_{DD}	Supply voltage	3		18	V
V_I	Input voltage	0		V_{DD}	V

ELECTRICAL CHARACTERISTICS (V_{SS} = 0V)

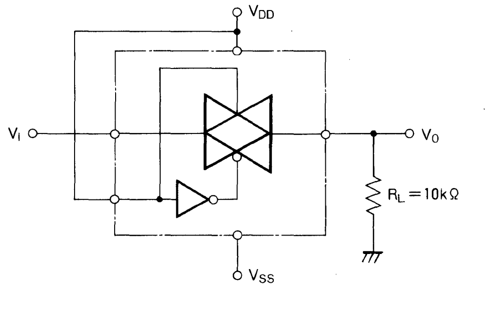
Symbol	Parameter	Test conditions			Limits							Unit
					−40℃		25℃			85℃		
			V_{SS}(V)	V_{DD}(V)	Min	Max	Min	Typ	Max	Min	Max	
V_{IH}	High-level input voltage (C_{IN})	Input-to-output current = 10μA	0	5	3.5		3.5			3.5		V
			0	10	7.0		7.0			7.0		
			0	15	11.0		11.0			11.0		
V_{IL}	Low-level input voltage (C_{IN})	Input-to-output current = 10μA	0	5		1.0			1.0		1.0	
			0	10		1.0			1.0		1.0	
			0	15		1.0			1.0		1.0	
R_{ON}	ON resistance	V_I = 5 V	0	5				600				Ω
		V_I = 2.5V	0	5				6000				
		V_I = 0.25V	0	5				600				
		V_I = 10V	0	10		600			700		900	
		V_I = 5 V	0	10		1300			1500		2000	
		V_I = 0.25V	0	10		600			700		900	
		V_I = 15 V	0	15		430			500		650	
		V_I = 7.5V	0	15		800			950		1200	
		V_I = 0.25V	0	15		430			500		650	
		V_I = 5 V	−5	5		600			700		900	
		V_I = ±0.25V	−5	5		1300			1500		2000	
		V_I = − 5 V	−5	5		600			700		900	
		V_I = 7.5V	−7.5	7.5		430			500		650	
		V_I = ±0.25V	−7.5	7.5		800			950		1200	
	Test circuit 1	V_I = −7.5V	−7.5	7.5		430			500		650	
ΔR_{ON}	ON resistance variations between switches of the same package		−5	5				15				
			−7.5	7.5				10				
I_{OFF}	Input-to-output off-state leakage current	$V_{I/O}$=10V, $V_{O/I}$= 0 V	0	10					125			nA
		$V_{I/O}$= 0 V, $V_{O/I}$=10V	0	10					−125			
		$V_{I/O}$=18V, $V_{O/I}$= 0 V	0	18		250			250		1000	
		$V_{I/O}$= 0 V, $V_{O/I}$=18V	0	18		− 250			−250		−1000	
I_{DD}	Quiescent supply current	V_I (C_{IN}) = V_{DD}, V_{SS}	0	5		1			1		7.5	μA
			0	10		2			2		15	
			0	15		4			4		30	
I_{IH}	High-level input current (C_{IN})	V_{IH} = 18V	0	18		0.3			0.3		1.0	μA
I_{IL}	Low-level input current (C_{IN})	V_{IL} = 0 V	0	18		−0.3			−0.3		−1.0	

SWITCHING CHARACTERISTICS (Ta = 25°C)

Symbol	Parameter	Test conditions		V_{SS}(V)	V_{DD}(V)	Limits Min	Limits Typ	Limits Max	Unit
f max(I/O)	Maximum transfer frequency	R_L = 2 kΩ	C_L = 15pF Test circuit 2	−5	5		18		MHz
		R_L = 10kΩ		−5	5		15		
		R_L = 100kΩ		−5	5		12		
f max(C_{IN})	Maximum control frequency	R_L = 300 Ω C_L = 15pF	Test circuit 3	0	5		4		
				0	10		10		
				0	15		12		
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (IN/OUT—OUT/IN)	R_L = 10kΩ C_L = 50pF	Test circuit 4	0	5			100	ns
				0	10			40	
				0	15			30	
t_{PHL}				0	5			100	
				0	10			40	
				0	15			30	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (CONTROL IN—OUT/IN)	R_L = 10kΩ C_L = 50pF	Test circuit 5	0	5			140	
				0	10			60	
				0	15			50	
t_{PHL}				0	5			140	
				0	10			60	
				0	15			50	
	Sinewave distortion	R_L = 10kΩ f_I = 1 kHz	Test circuit 2	−5	5		0.3		%
	Feedthrough (switch off)	R_L = 1 kΩ	Test circuit 6	−5	5		600		kHz
	Crosstalk (CONTROL IN—OUT/IN)	R_I = 1 kΩ R_L = 10kΩ C_L = 15pF	Test circuit 7	0	5		80		mV
				0	10		150		
				0	15		210		
C_I	Input capacitance	Control input					5		pF
		Switch Input/output					4		

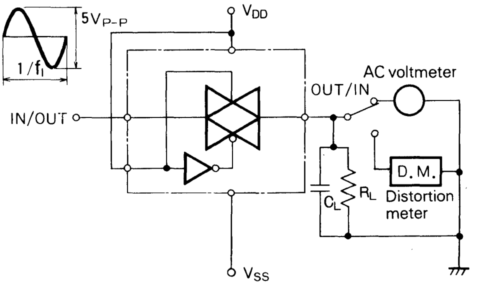
TEST CIRCUITS

1 ON resistance (R_{ON})



$$R_{ON} = 10 \times \frac{(V_I - V_O)}{V_O} \quad [k\Omega]$$

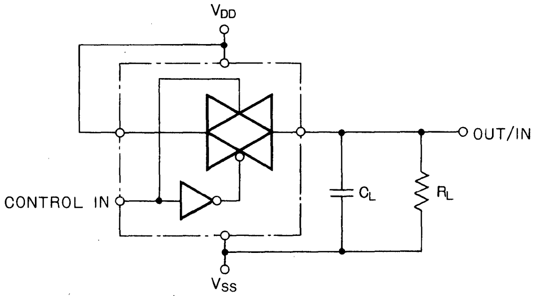
2 Maximum transfer frequency (fmax(I/O))
Sinewave distortion



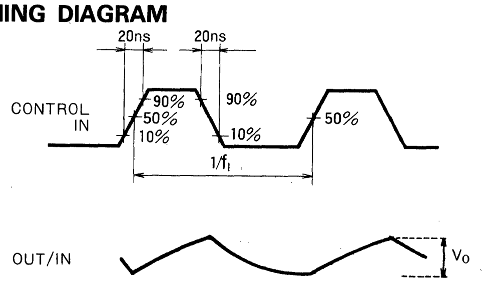
fmax(I/O) is taken as that frequency f_I at which, using a sinewave input of ±2.5Vp-p, 20 $\log_{10}$ (V_O/V_I) = −3dB.

3

Maximum control frequency (fmax(C_{IN}))



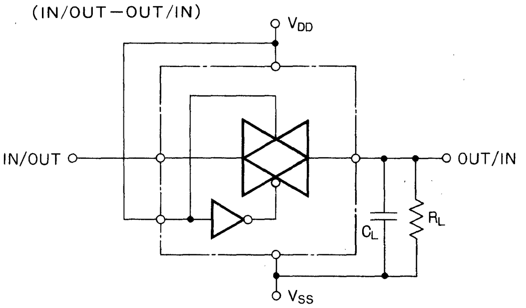
TIMING DIAGRAM



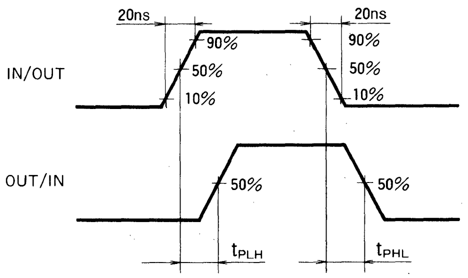
fmax(C_{IN}) is taken as that frequency f_I at which the output amplitude V_O is ½ that at 1kHz.

4

Low-level to high-level and high-level to low-level output propagation time
(IN/OUT—OUT/IN)

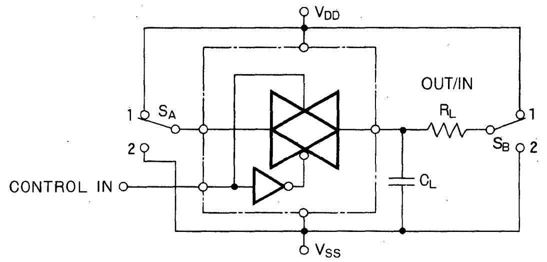


TIMING DIAGRAM



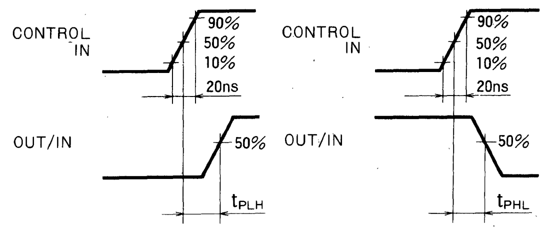
5

Low-level to high-level and high-level to low-level output propagation time
(CONTROL IN—OUT/IN)



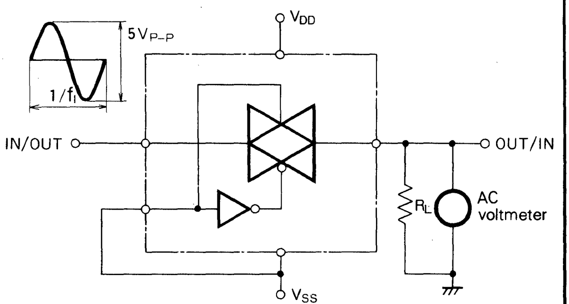
$S_A=1$, $S_B=2$ $S_A=2$, $S_B=1$

TIMING DIAGRAM



6

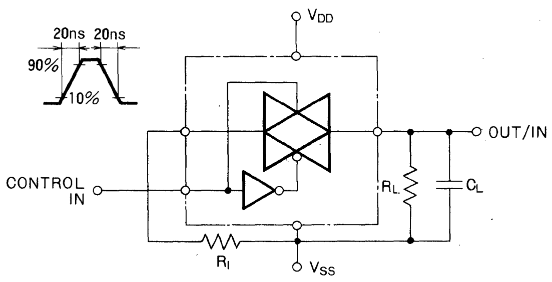
Feedthrough



The feedthrough is taken as that frequency f_I at which, using a sinewave input of ±2.5Vp-p, 20 $\log_{10}$ (V_O/V_I) = −50dB.

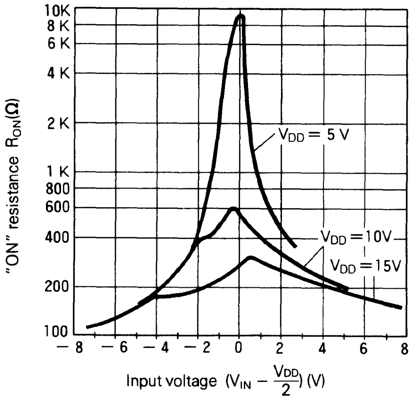
7

Crosstalk



Analog switch "ON" resistance characteristics

M4016BP



8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

DESCRIPTION

The M4051BP is a semiconductor integrated circuit consisting of a multiplexer/demultiplexer which uses a 3-bit digital input to perform selection of eight analog switches.

FEATURES

- Low ON resistance: 50Ω (typical, at V_{DD} = 15V)
- High off-state resistance:
  10^9Ω or greater (typical)
- Small variations in ON resistance between switches in the same package:
  10Ω (typical, at V_{DD} = 7.5V and V_{SS} = −7.5V)
- Linearized transfer characteristics:
  0.07% distortion (typical)
- Signals with amplitude greater than the logic level amplitude of the control inputs may be switched.
- Provided with an inhibit input

APPLICATIONS

General purpose, for use in industrial and consumer digital equipment.

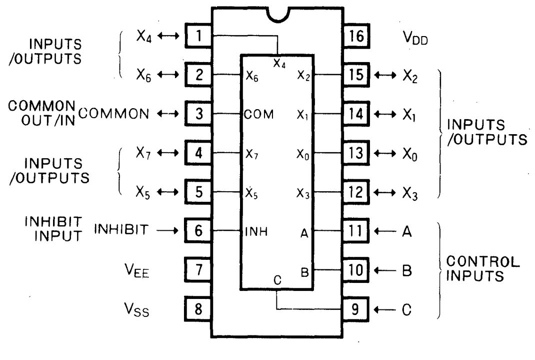
FUNCTIONAL DESCRIPTION

When a 3-bit binary input signal is applied to the control inputs (A, B, and C), the channel number corresponding to the binary value input (X_0 through X_7) is set at low impedance with respect to the (COMMON). All other channels remain at high impedance with respect to (COMMON).

In this operation, if the (INHIBIT) input is held high, all channels (X_0 through X_7) will be put in the high-impedance state, regardless of the state of the other inputs.

It is possible to switch an analog signal of amplitude $V_{DD} - V_{EE}$ if this is greater than the logic level span $V_{DD} - V_{SS}$ for inputs (A, B, and C).

PIN CONFIGURATION (TOP VIEW)



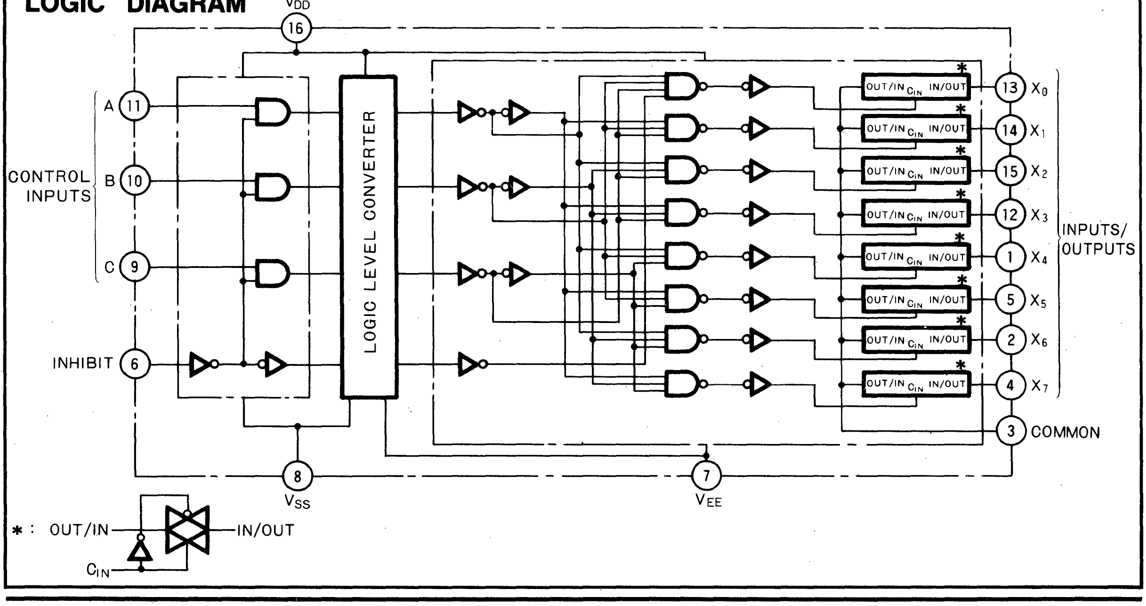
Outline 16P4

FUNCTION TABLE (Note 1)

Inhibit input	Control inputs			Channel INPUT/OUTPUT to COMMON switch selection							
INHIBIT	C	B	A	X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7
L	L	L	L	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
L	L	L	H	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
L	L	H	L	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
L	L	H	H	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
L	H	L	L	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
L	H	L	H	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
L	H	H	L	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
L	H	H	H	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
H	X	X	X	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Note 1. X : Irrelevant
ON : Low impedance between X_n and COMMON (n = 0 ~ 7)
OFF : High impedance between X_n and COMMON (n = 0 ~ 7)

LOGIC DIAGRAM



8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

ABSOLUTE MAXIMUM RATINGS (Ta = −40 ~ +85°C, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
$V_{DD}-V_{SS}$	Supply voltage		−0.5 ~ 20	V
$V_{DD}-V_{EE}$			−0.5 ~ 20	V
V_I	Input voltage	Control and inhibit inputs	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
		Channel and common inputs	$V_{EE}-0.5 \sim V_{DD}+0.5$	V
$V_{I/O}$	Input-to-output voltage		±0.5	V
I_I	Input current	Control and inhibit inputs	±10	mA
I_O	Output current	Switch-off	±10	mA
V_O	Output voltage	Channel and common outputs	$V_{EE}-0.5 \sim V_{DD}+0.5$	V
T_{opr}	Operating temperature range		−40 ~ +85	℃
T_{stg}	Storage temperature range		−65 ~ +150	℃

RECOMMENDED OPERATING CONDITION (Ta = −40 ~ +85°C, V_{SS} = 0V, unless otherwise noted)

Symbol	Parameter		Limits Min	Typ	Max	Unit
$V_{DD}-V_{SS}$	Supply voltage		3		18	V
$V_{DD}-V_{EE}$			3		18	V
V_I	Input voltage	Control and inhibit inputs	V_{SS}		V_{DD}	V
		Channel and common inputs	V_{EE}		V_{DD}	V
V_O	Output voltage		V_{EE}		V_{DD}	V

ELECTRICAL CHARACTERISTICS (V_{SS} = 0V)

Symbol	Parameter	Test conditions	V_{EE}(V)	V_{DD}(V)	−40℃ Min	−40℃ Max	25℃ Min	25℃ Typ	25℃ Max	85℃ Min	85℃ Max	Unit
V_{IH}	High-level input voltage (A, B, C, INHIBIT)	Input-to-output current = 10μA	0	5	3.5		3.5			3.5		V
			0	10	7.0		7.0			7.0		
			0	15	11.0		11.0			11.0		
V_{IL}	Low-level input voltage (A, B, C, INHIBIT)	Input-to-output current = 10μA	0	5		1.5			1.5		1.5	
			0	10		3.0			3.0		3.0	
			0	15		4.0			4.0		4.0	
R_{ON}	ON resistance	V_I = 5V	0	5		500			600		800	Ω
		V_I = 2.5V	0	5		850			950		1300	
		V_I = 0.25V	0	5		500			600		800	
		V_I = 10V	0	10		210			250		300	
		V_I = 5V	0	10		210			250		300	
		V_I = 0.25V	0	10		210			250		300	
		V_I = 15V	0	15		140			160		200	
		V_I = 7.5V	0	15		140			160		200	
		V_I = 0.25V	0	15		140			160		200	
		V_I = 5V	−5	5		210			250		300	
		V_I = ±0.25V	−5	5		210			250		300	
		V_I = −5V	−5	5		210			250		300	
		V_I = 7.5V	−7.5	7.5		140			160		200	
		V_I = ±0.25V	−7.5	7.5		140			160		200	
	Test circuit 1	V_I = −7.5V	−7.5	7.5		140			160		200	
ΔR_{ON}	ON resistance variations between switches of the same package		−2.5	2.5				30				
			−5	5				15				
			−7.5	7.5				10				
I_{OFF}	Input-to-output off-state leakage current ($X_0 \sim X_7$ — COMMON)	$V_{I/O}$ = 10V, $V_{O/I}$ = 0V	0	10					125			nA
		$V_{I/O}$ = 0V, $V_{O/I}$ = 10V	0	10					−125			
		$V_{I/O}$ = 18V, $V_{O/I}$ = 0V	0	18		250			250		1000	
		$V_{I/O}$ = 0V, $V_{O/I}$ = 18V	0	18		−250			−250		−1000	
I_{DD}	Quiescent supply current	$V_I = V_{DD}$, V_{SS}	0	5		20			20		150	μA
			0	10		40			40		300	
			0	15		80			80		600	
I_{IH}	High-level input current (A ~ C, INH)	V_{IH} = 18V	0	18		0.3			0.3		1.0	μA
I_{IL}	Low-level input current (A ~ C, INH)	V_{IL} = 0V	0	18		−0.3			−0.3		−1.0	

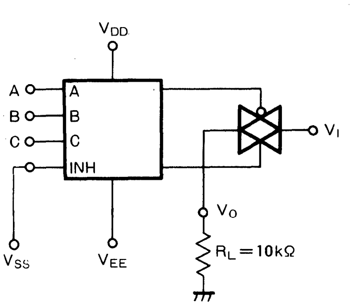
8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SWITCHING CHARACTERISTICS (Ta = 25°C, V_{SS} = 0V)

Symbol	Parameter	Test conditions	V_{EE} (V)	V_{DD} (V)	Limits Min	Typ	Max	Unit
$f_{max(I/O)}$	Maximum transfer frequency	R_L = 10kΩ, C_L = 15pF Test circuit 2	−5	5		25		MHz
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (A, B, C—X_0 ~ X_7, COMMON)	R_L = 10kΩ, C_L = 50pF Test circuit 3	0	5			1000	ns
			0	10			500	
			0	15			400	
			−5	5			700	
			−7.5	7.5			500	
t_{PHL}			0	5			1000	
			0	10			500	
			0	15			400	
			−5	5			700	
			−7.5	7.5			500	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (INHIBIT—X_0 ~ X_7, COMMON)	R_L = 10kΩ, C_L = 50pF Test circuit 4	0	5			1400	
			0	10			700	
			0	15			500	
			−5	5			900	
			−7.5	7.5			500	
t_{PHL}			0	5			1400	
			0	10			700	
			0	15			500	
			−5	5			900	
			−7.5	7.5			500	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (X_0 ~ X_7/COMMON —COMMON/X_0 ~ X_7)	R_L = 10kΩ, C_L = 50pF Test circuit 5	0	5			45	
			0	10			30	
			0	15			20	
t_{PHL}			0	5			45	
			0	10			30	
			0	15			20	
	Sinewave distortion	R_L = 10kΩ, f_I = 1 kHz Test circuit 2	−5	5		0.1		%
	Feedthrough (switch off)	R_L = 1 kΩ Test circuit 6	−5	5		500		kHz
	Crosstalk (A, B, C, INHIBIT—X_0 ~ X_7, COMMON)	R_I = 1 kΩ, R_L = 10kΩ, C_L = 15pF Test circuit 7	0	5		200		mV
			0	10		300		
			0	15		400		
C_I	Input capacitance	Control and inhibit inputs					7.5	pF
		Switch input/output				10		

TEST CIRCUITS (V_{SS} = 0V, The capacitance C_L includes stray wiring capacitances and the probe input capacitance.)

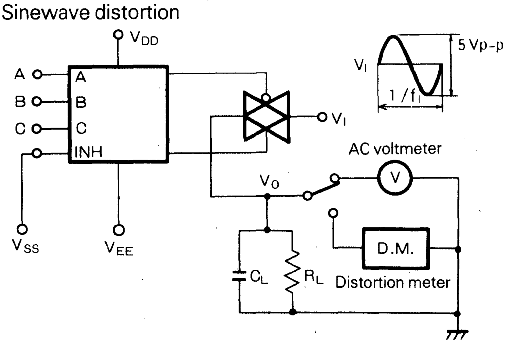
1 ON resistance (R_{ON})



$$R_{ON} = 10 \times \frac{(V_I - V_O)}{V_O} \; [k\Omega]$$

Refer to the function table for conditions of control inputs A, B, and C.

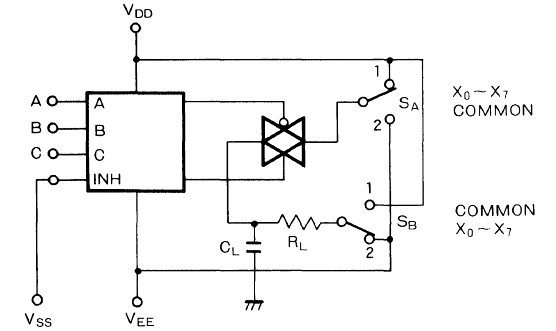
2 Maximum transfer frequency (fmax(I/O))
Sinewave distortion



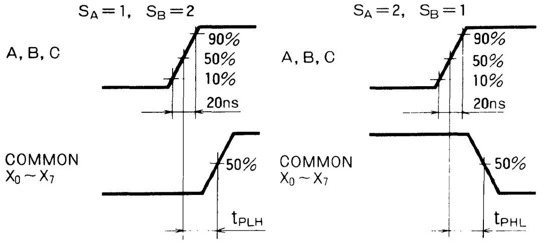
fmax (I/O) is taken as that frequency f_I at which, using a sinewave input of ±2.5Vp-p, $20 \log_{10} (V_O/V_I) = -3$dB. Refer to the function table for conditions of control inputs A, B, and C.

3 Low-level to high-level and high-level to low-level output propagation time

($A, B, C - X_0 \sim X_7$, COMMON)



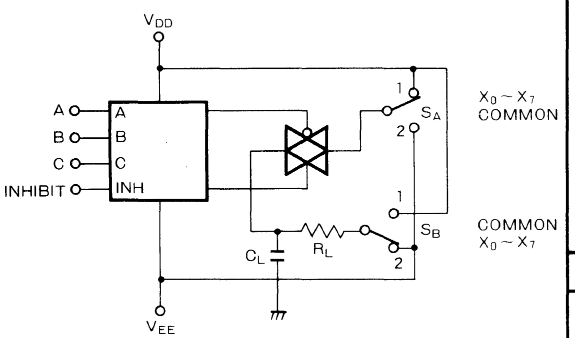
TIMING DIAGRAM



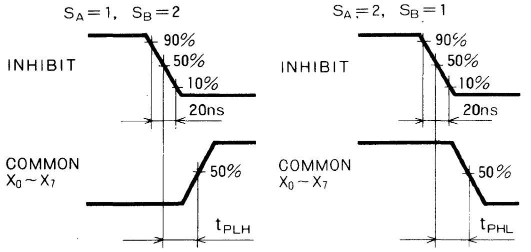
Refer to the function table for conditions of control inputs A, B, and C.

4 Low-level to high-level and high-level to low-level output propagation time

(INHIBIT—$X_0 \sim X_7$, COMMON)



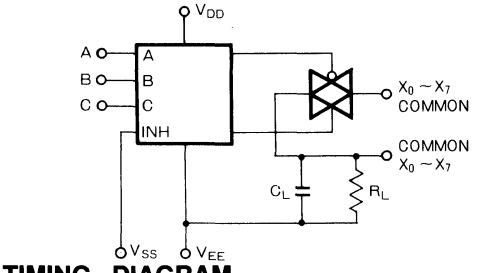
TIMING DIAGRAM



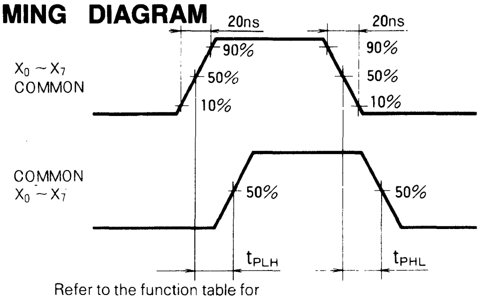
Refer to the function table for conditions of control inputs A, B, and C.

5 Low-level to high-level and high-level to low-level output propagation time

($X_0 \sim X_7$/COMMON—COMMON/$X_0 \sim X_7$)

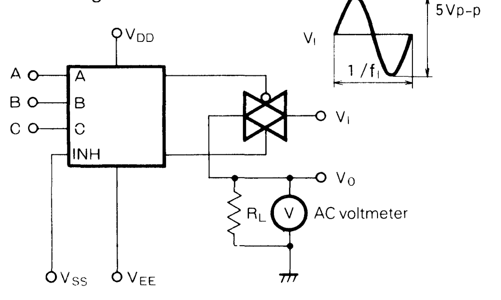


TIMING DIAGRAM



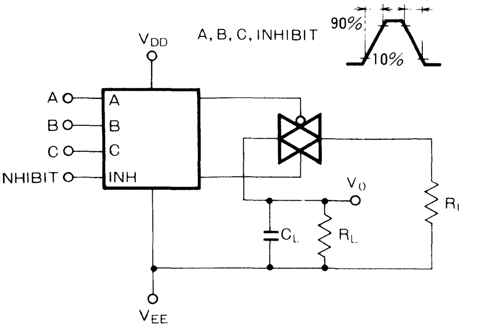
Refer to the function table for conditions of control inputs A, B, and C.

6 Feedthrough



The feedthrough is taken as that frequency f_I at which, using a sinewave input of ±2.5Vp-p, $20 \log_{10}(V_O/V_I) = -50dB$. Refer to the function table for conditions of control inputs A, B, and C.

7 Crosstalk

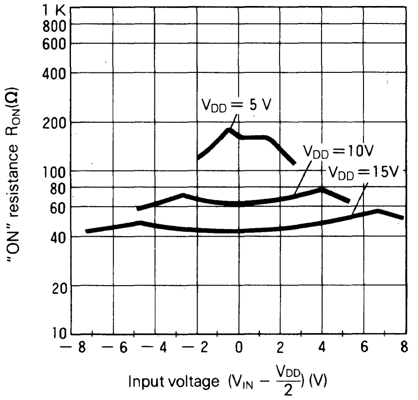


Refer to the function table for conditions of control inputs A, B, and C.

TYPICAL PERFORMANCE CHARACTERISTICS

Analog switch "ON" resistance characteristics

M4051BP



M4052BP

DUAL 4-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

DESCRIPTION

The M4052BP is a semiconductor integrated circuit consisting of two multiplexer/demultiplexers which use 2-bit digital inputs to perform selection of four analog switches.

FEATURES

- Low ON resistance: 50Ω (typical, at V_{DD} = 15V)
- High off-state resistance: 10^9Ω or greater (typical)
- Small variations in ON resistance between switches in the same package: 10Ω (typical, at V_{DD} = 7.5V and V_{SS} = −7.5V)
- Linearized transfer characteristics: 0.07% distortion (typical)
- Signals with amplitude greater than the logic level amplitude of the control inputs may be switched.
- Provided with an inhibit input

APPLICATIONS

General purpose, for use in industrial and consumer digital equipment.

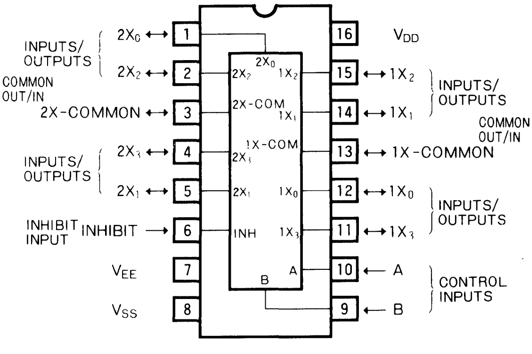
FUNCTIONAL DESCRIPTION

When a 2-bit binary input signal is applied to the control inputs (A and B), the channel number corresponding to the binary value input (X_0 through X_3) is set at low impedance with respect to the corresponding (X-COMMON). All other channels remain at high impedance.

In this operation, if the (INHIBIT) input is held high, all channels (X_0 through X_3) will be put in the high-impedance state, regardless of the state of the other inputs.

It is possible to switch an analog signal of amplitude $V_{DD} - V_{EE}$ if this is greater than the logic level span $V_{DD} - V_{SS}$ for inputs (A and B).

PIN CONFIGURATION (TOP VIEW)



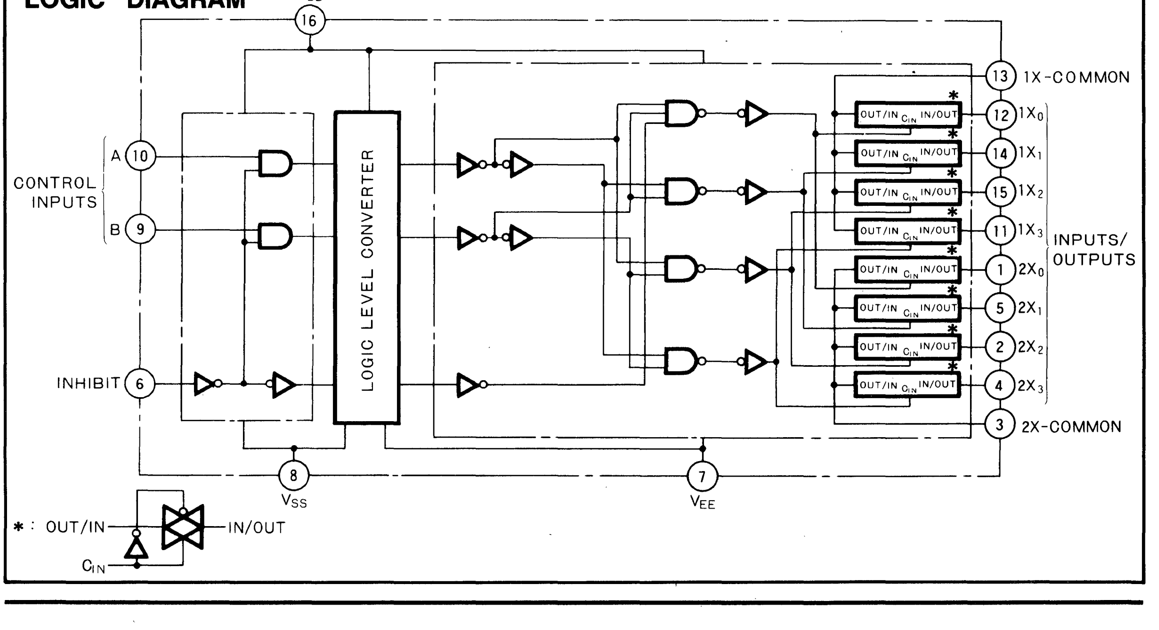
Outline 16P4

FUNCTION TABLE (Note 1)

Inhibit input	Control inputs		Channel INPUT/OUTPUT to COMMON switch selection			
INHIBIT	B	A	X_0	X_1	X_2	X_3
L	L	L	ON	OFF	OFF	OFF
L	L	H	OFF	ON	OFF	OFF
L	H	L	OFF	OFF	ON	OFF
L	H	H	OFF	OFF	OFF	ON
H	X	X	OFF	OFF	OFF	OFF

Note 1. X : Irrelevant
ON : Low impedance between Xn and X-COMMON (n = 0 ~ 3)
OFF : High impedance between Xn and X-COMMON (n = 0 ~ 3)

LOGIC DIAGRAM



DUAL 4-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

ABSOLUTE MAXIMUM RATINGS (Ta = −40 ~ +85°C, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
$V_{DD}-V_{SS}$	Supply voltage		−0.5 ~ 20	V
$V_{DD}-V_{EE}$			−0.5 ~ 20	V
V_I	Input voltage	Control and inhibit inputs	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
		Channel and common inputs	$V_{EE}-0.5 \sim V_{DD}+0.5$	V
$V_{I/O}$	Input-to-output voltage		±0.5	V
I_I	Input current	Control and inhibit inputs	±10	mA
I_O	Output current	Switch-off	±10	mA
V_O	Output voltage	Channel and common outputs	$V_{EE}-0.5 \sim V_{DD}+0.5$	V
T_{opr}	Operating temperature range		−40 ~ +85	℃
T_{stg}	Storage temperature range		−65 ~ +150	℃

RECOMMENDED OPERATING CONDITIONS (Ta = −40 ~ +85°C, V_{SS} = 0V, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
$V_{DD}-V_{SS}$	Supply voltage		3		18	V
$V_{DD}-V_{EE}$			3		18	V
V_I	Input voltage	Control and inhibit inputs	V_{SS}		V_{DD}	V
		Channel and common inputs	V_{EE}		V_{DD}	V
V_O	Output voltage		V_{EE}		V_{DD}	V

ELECTRICAL CHARACTERISTICS (V_{SS} = 0V)

Symbol	Parameter	Test conditions			Limits							Unit
					−40℃		25℃			85℃		
			V_{EE}(V)	V_{DD}(V)	Min	Max	Min	Typ	Max	Min	Max	
V_{IH}	High-level input voltage (A, B, INHIBIT)	Input-to-output current = 10μA	0	5	3.5		3.5			3.5		V
			0	10	7.0		7.0			7.0		
			0	15	11.0		11.0			11.0		
V_{IL}	Low-level input voltage (A, B, INHIBIT)	Input-to-output current = 10μA	0	5		1.5			1.5		1.5	
			0	10		3.0			3.0		3.0	
			0	15		4.0			4.0		4.0	
R_{ON}	ON resistance	V_I = 5 V	0	5		500			600		800	Ω
		V_I = 2.5V	0	5		850			950		1300	
		V_I = 0.25V	0	5		500			600		800	
		V_I = 10V	0	10		210			250		300	
		V_I = 5 V	0	10		210			250		300	
		V_I = 0.25V	0	10		210			250		300	
		V_I = 15V	0	15		140			160		200	
		V_I = 7.5V	0	15		140			160		200	
		V_I = 0.25V	0	15		140			160		200	
		V_I = 5 V	−5	5		210			250		300	
		V_I = ±0.25V	−5	5		210			250		300	
		V_I = − 5 V	−5	5		210			250		300	
		V_I = 7.5V	−7.5	7.5		140			160		200	
		V_I = ±0.25V	−7.5	7.5		140			160		200	
	Test circuit 1	V_I = −7.5V	−7.5	7.5		140			160		200	
ΔR_{ON}	ON resistance variations between switches of the same package		−2.5	2.5				30				
			−5	5				15				
			−7.5	7.5				10				
I_{OFF}	Input-to-output off-state leakage current ($X_0 \sim X_3$—X-COMMON)	$V_{I/O}$ = 10V, $V_{O/I}$ = 0 V	0	10					125			nA
		$V_{I/O}$ = 0 V, $V_{O/I}$ = 10V	0	10					−125			
		$V_{I/O}$ = 18V, $V_{O/I}$ = 0 V	0	18		250			250		1000	
		$V_{I/O}$ = 0 V, $V_{O/I}$ = 18V	0	18		−250			−250		−1000	
I_{DD}	Quiescent supply current	V_I = V_{DD}, V_{SS}	0	5		20			20		150	μA
			0	10		40			40		300	
			0	15		80			80		600	
I_{IH}	High-level input current(A, B, INH)	V_{IH} = 18V	0	18		0.3			0.3		1.0	μA
I_{IL}	Low-level input current(A, B, INH)	V_{IL} = 0 V	0	18		−0.3			−0.3		−1.0	

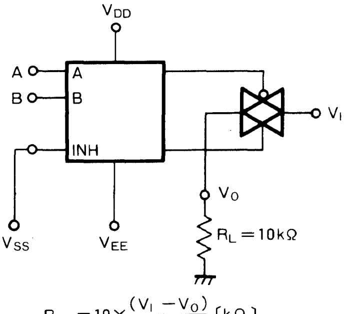
DUAL 4-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SWITCHING CHARACTERISTICS (Ta = 25°C, V_{SS} = 0V)

Symbol	Parameter	Test conditions	V_{EE} (V)	V_{DD} (V)	Limits Min	Limits Typ	Limits Max	Unit
fmax(I/O)	Maximum transfer frequency	R_L = 10kΩ, C_L = 15pF Test circuit 2	−5	5		25		MHz
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (A, B—X_0~X_3, X-COMMON)	R_L = 10kΩ, C_L = 50pF Test circuit 3	0	5			1000	ns
			0	10			500	
			0	15			400	
			−5	5			700	
			−7.5	7.5			500	
t_{PHL}			0	5			1000	
			0	10			500	
			0	15			400	
			−5	5			700	
			−7.5	7.5			500	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (INHIBIT—X_0~X_3, X-COMMON)	R_L = 10kΩ, C_L = 50pF Test circuit 4	0	5			1400	
			0	10			700	
			0	15			500	
			−5	5			900	
			−7.5	7.5			500	
t_{PHL}			0	5			1400	
			0	10			700	
			0	15			500	
			−5	5			900	
			−7.5	7.5			500	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (X_0~X_3/X-COMMON —X-COMMON/X_0~X_3)	R_L = 10kΩ, C_L = 50pF Test circuit 5	0	5			45	
			0	10			30	
			0	15			20	
t_{PHL}			0	5			45	
			0	10			30	
			0	15			20	
	Sinewave distortion	R_L = 10kΩ, f_I = 1 kHz Test circuit 2	−5	5		0.1		%
	Feedthrough (switch off)	R_L = 1 kΩ Test circuit 6	−5	5		500		kHz
	Crosstalk (A, B, INHIBIT—X_0~X_3, X-COMMON)	R_I = 1 kΩ, R_L = 10kΩ, C_L = 15pF Test circuit 7	0	5		200		mV
			0	10		300		
			0	15		400		
C_I	Input capacitance	Control and inhibit inputs					7.5	pF
		Switch input/output				10		

TEST CIRCUITS (V_{SS} = 0V, The capacitance C_L includes stray wiring capacitances and the probe input capacitance.)

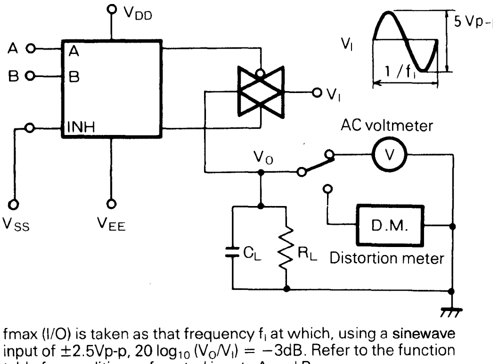
1 ON resistance (R_{ON})



$$R_{ON} = 10 \times \frac{(V_I - V_O)}{V_O} \; [k\Omega]$$

Refer to the function table for conditions of control inputs A and B.

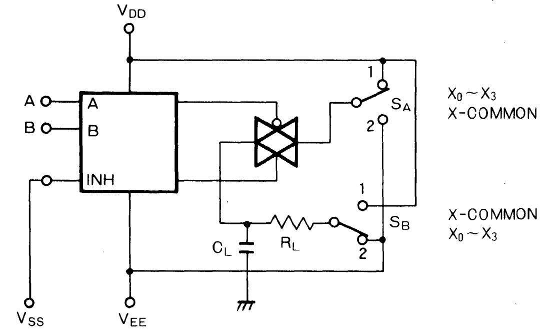
2 Maximum transfer frequency (fmax(I/O))
Sinewave distortion



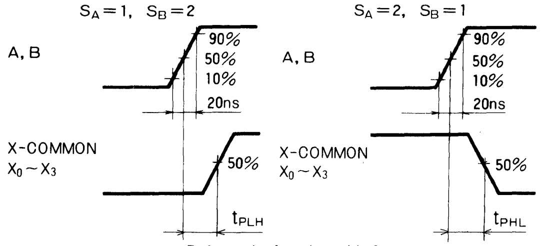
fmax (I/O) is taken as that frequency f_I at which, using a sinewave input of ±2.5Vp-p, $20 \log_{10} (V_O/V_I) = -3$dB. Refer to the function table for conditions of control inputs A and B.

DUAL 4-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

3 Low-level to high-level and high-level to low-level output propagation time
(A, B—$X_0 \sim X_3$, X-COMMON)

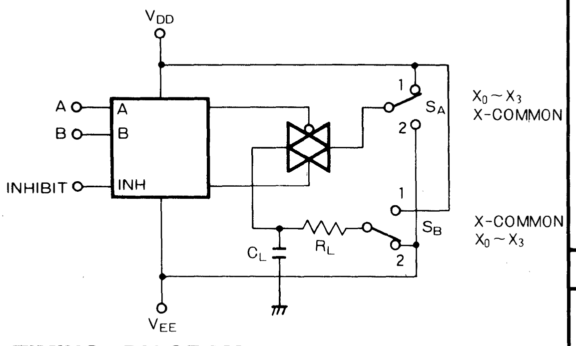


TIMING DIAGRAM

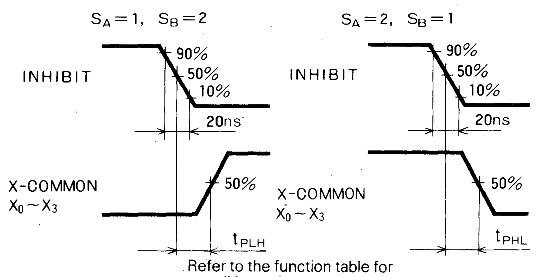


Refer to the function table for conditions of control inputs A and B.

4 Low-level to high-level and high-level to low-level output propagation time
(INHIBIT—$X_0 \sim X_3$, X-COMMON)

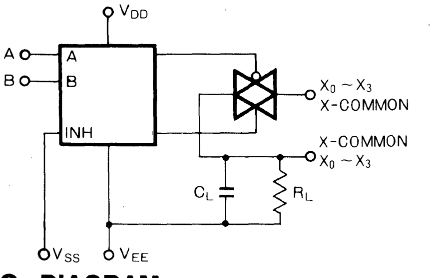


TIMING DIAGRAM

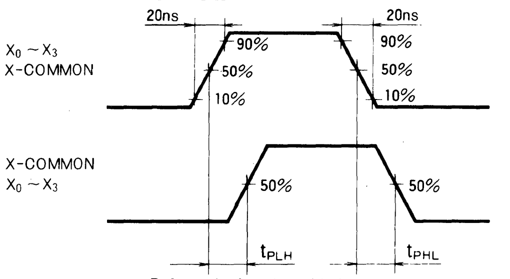


Refer to the function table for conditions of control inputs A and B.

5 Low-level to high-level and high-level to low-level output propagation time
($X_0 \sim X_3$/X-COMMON—X-COMMON/$X_0 \sim X_3$)

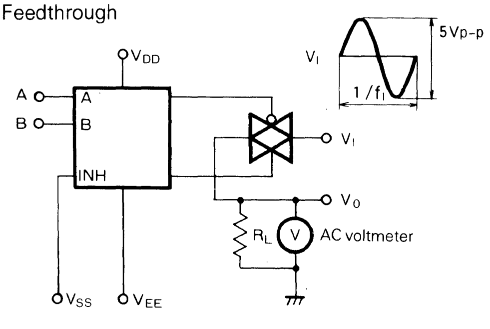


TIMING DIAGRAM



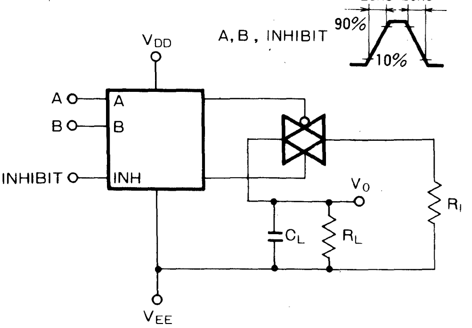
Refer to the function table for conditions of control inputs A and B.

6 Feedthrough



The feedthrough is taken as that frequency f_I at which, using a sinewave input of ± 2.5Vp-p, 20 $\log_{10}(V_O/V_I) = -50$dB. Refer to the function table for conditions of control inputs A and B.

7 Crosstalk



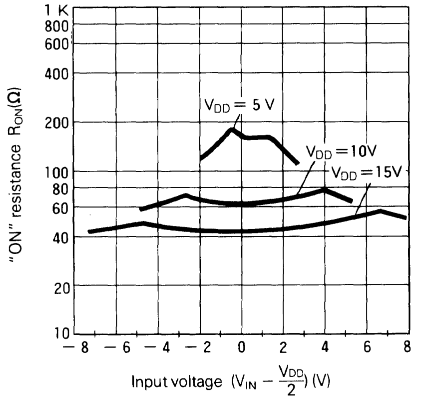
Refer to the function table for conditions of control inputs A and B.

MITSUBISHI ELECTRIC

TYPICAL PERFORMANCE CHARACTERISTICS

Analog switch "ON" resistance characteristics

M4052BP



TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

DESCRIPTION

The M4053BP is a semiconductor integrated circuit consisting of three multiplexer/demultiplexers which use 1-bit digital inputs to perform selection of two analog switches.

FEATURES

- Low ON resistance: 50Ω (typical, at V_{DD} = 15V)
- High off-state resistance:
  10^9Ω or greater (typical)
- Small variations in ON resistance between switches in the same package:
  10Ω (typical, at V_{DD} = 7.5V and V_{SS} = −7.5V)
- Linearized transfer characteristics:
  0.07% distortion (typical)
- Signals with amplitude greater than the logic level amplitude of the control inputs may be switched.
- Provided with an inhibit input

APPLICATIONS

General purpose, for use in industrial and consumer digital equipment.

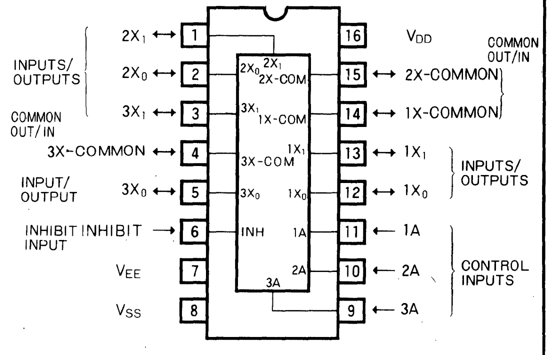
FUNCTIONAL DESCRIPTION

When a 1-bit binary input signal is applied to the control inputs (A), the channel numbers corresponding to the binary value input (X_0, X_1) are set to low impedance with respect to the corresponding (X-COMMON). All other channels remain at high impedance.

In this operation, if the (INHIBIT) input is held high, all channels (X_0, X_1) will be put in the high-impedance state, regardless of the state of the other inputs.

It is possible to switch an analog signal of amplitude $V_{DD} - V_{EE}$ if this is greater than the logic level span $V_{DD} - V_{SS}$ for input (A).

PIN CONFIGURATION (TOP VIEW)



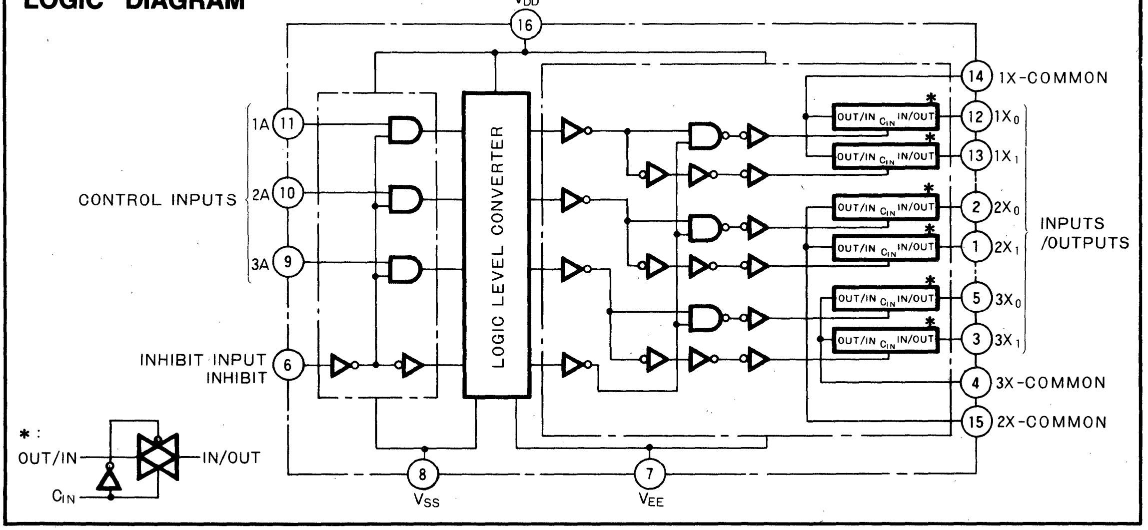
Outline 16P4

FUNCTION TABLE (Note 1)

Inhibit input	Control input	Channel INPUT/OUTPUT to COMMON switch selection	
INHIBIT	A	X_0	X_1
L	L	ON	OFF
L	H	OFF	ON
H	X	OFF	OFF

Note 1. X : Irrelevant
ON : Low impedance between Xn and X-COMMON (n = 0 ~ 1)
OFF : High impedance between Xn and X-COMMON (n = 0 ~ 1)

LOGIC DIAGRAM



MITSUBISHI ELECTRIC

TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

ABSOLUTE MAXIMUM RATINGS (Ta = −40 ~ +85°C, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
$V_{DD}-V_{SS}$	Supply voltage		$-0.5\sim20$	V
$V_{DD}-V_{EE}$			$-0.5\sim20$	V
V_I	Input voltage	Control and inhibit inputs	$V_{SS}-0.5\sim V_{DD}+0.5$	V
		Channel and common inputs	$V_{EE}-0.5\sim V_{DD}+0.5$	V
$V_{I/O}$	Input-to-output voltage		±0.5	V
I_I	Input current	Control and inhibit inputs	±10	mA
I_O	Output current	Switch-off	±10	mA
V_O	Output voltage	Channel and common outputs	$V_{EE}-0.5\sim V_{DD}+0.5$	V
T_{opr}	Operating temperature range		$-40\sim+85$	℃
T_{stg}	Storage temperature range		$-65\sim+150$	℃

RECOMMENDED OPERATING CONDITIONS (Ta = −40 ~ +85°C, V_{SS} = 0V, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
$V_{DD}-V_{SS}$	Supply voltage		3		18	V
$V_{DD}-V_{EE}$			3		18	V
V_I	Input voltage	Control and inhibit inputs	V_{SS}		V_{DD}	V
		Channel and common inputs	V_{EE}		V_{DD}	V
V_O	Output voltage		V_{EE}		V_{DD}	V

ELECTRICAL CHARACTERISTICS (V_{SS} = 0V)

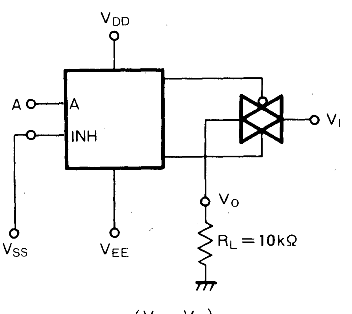
Symbol	Parameter	Test conditions	V_{EE}(V)	V_{DD}(V)	−40℃ Min	−40℃ Max	25℃ Min	25℃ Typ	25℃ Max	85℃ Min	85℃ Max	Unit
V_{IH}	High-level input voltage (A, INHIBIT)	Input-to-output current = 10μA	0	5	3.5		3.5			3.5		V
			0	10	7.0		7.0			7.0		
			0	15	11.0		11.0			11.0		
V_{IL}	Low-level input voltage (A, INHIBIT)	Input-to-output current = 10μA	0	5		1.5			1.5		1.5	
			0	10		3.0			3.0		3.0	
			0	15		4.0			4.0		4.0	
R_{ON}	ON resistance	V_I = 5 V	0	5		500			600		800	Ω
		V_I = 2.5V	0	5		850			950		1300	
		V_I = 0.25V	0	5		500			600		800	
		V_I = 10V	0	10		210			250		300	
		V_I = 5 V	0	10		210			250		300	
		V_I = 0.25V	0	10		210			250		300	
		V_I = 15V	0	15		140			160		200	
		V_I = 7.5V	0	15		140			160		200	
		V_I = 0.25V	0	15		140			160		200	
		V_I = 5 V	−5	5		210			250		300	
		V_I = ±0.25V	−5	5		210			250		300	
		V_I = − 5 V	−5	5		210			250		300	
		V_I = 7.5V	−7.5	7.5		140			160		200	
		V_I = ±0.25V	−7.5	7.5		140			160		200	
	Test circuit 1	V_I = −7.5V	−7.5	7.5		140			160		200	
ΔR_{ON}	ON resistance variations between switches of the same package		−2.5	2.5				30				
			−5	5				15				
			−7.5	7.5				10				
I_{OFF}	Input-to-output off-state leakage current (X_0, X_1—X-COMMON)	$V_{I/O}$=10V, $V_{O/I}$ = 0 V	0	10					125			nA
		$V_{I/O}$= 0 V, $V_{O/I}$ =10V	0	10					−125			
		$V_{I/O}$=18V, $V_{O/I}$ = 0 V	0	18		250			250		1000	
		$V_{I/O}$= 0 V, $V_{O/I}$ =18V	0	18		−250			−250		−1000	
I_{DD}	Quiescent supply current	V_I = V_{DD}, V_{SS}	0	5		20			20		150	μA
			0	10		40			40		300	
			0	15		80			80		600	
I_{IH}	High-level input current(A, INH)	V_{IH}=18V	0	18		0.3			0.3		1.0	μA
I_{IL}	Low-level input current(A, INH)	V_{IL} = 0 V	0	18		−0.3			−0.3		−1.0	

SWITCHING CHARACTERISTICS (Ta = 25°C, V_{SS} = 0V)

Symbol	Parameter	Test conditions			Limits			Unit
			V_{EE}(V)	V_{DD}(V)	Min	Typ	Max	
fmax(I/O)	Maximum transfer frequency	R_L = 10kΩ, C_L = 15pF Test circuit 2	−5	5		25		MHz
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (A—X_0, X_1, X-COMMON)	R_L = 10kΩ, C_L = 50pF Test circuit 3	0	5			1000	ns
			0	10			500	
			0	15			400	
			−5	5			700	
			−7.5	7.5			500	
t_{PHL}			0	5			1000	
			0	10			500	
			0	15			400	
			−5	5			700	
			−7.5	7.5			500	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (INHIBIT—X_0, X_1, X-COMMON)	R_L = 10kΩ, C_L = 50pF Test circuit 4	0	5			1400	
			0	10			700	
			0	15			500	
			−5	5			900	
			−7.5	7.5			500	
t_{PHL}			0	5			1400	
			0	10			700	
			0	15			500	
			−5	5			900	
			−7.5	7.5			500	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (X_0, X_1/X-COMMON —X-COMMON/X_0, X_1)	R_L = 10kΩ, C_L = 50pF Test circuit 5	0	5			45	
			0	10			30	
			0	15			20	
t_{PHL}			0	5			45	
			0	10			30	
			0	15			20	
	Sinewave distortion	R_L = 10kΩ, f_I = 1 kHz Test circuit 2	−5	5		0.1		%
	Feedthrough (switch off)	R_L = 1 kΩ Test circuit 6	−5	5		500		kHz
	Crosstalk (A, INHIBIT—X_0, X_1, X-COMMON)	R_I = 1 kΩ, R_L = 10kΩ, C_L = 15pF Test circuit 7	0	5		200		mV
			0	10		300		
			0	15		400		
C_I	Input capacitance	Control and inhibit inputs					7.5	pF
		Switch input/output				10		

TEST CIRCUITS (V_{SS} = 0V, The capacitance C_L includes stray wiring capacitances and the probe input capacitance.)

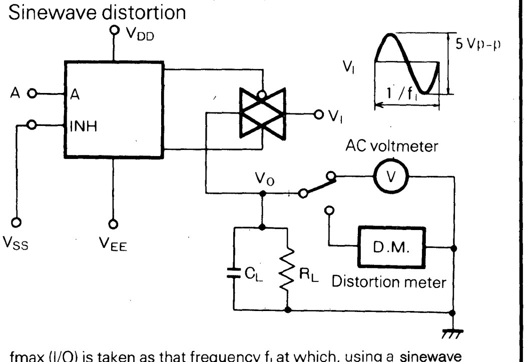
1 ON resistance (R_{ON})



$$R_{ON} = 10 \times \frac{(V_I - V_O)}{V_O} \ [k\Omega]$$

Refer to the function table for conditions of control input A.

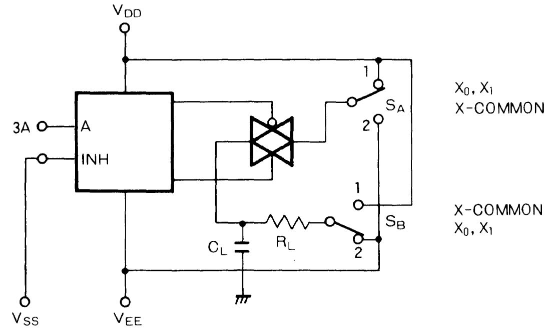
2 Maximum transfer frequency (fmax(I/O))
Sinewave distortion



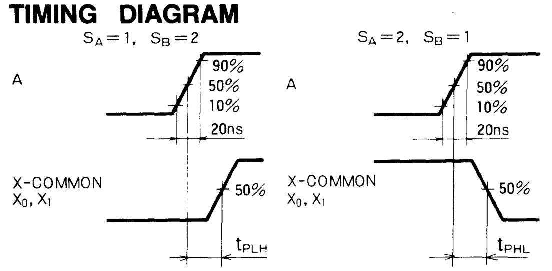
fmax (I/O) is taken as that frequency f_I at which, using a sinewave input of ±2.5Vp-p, 20 $\log_{10}$ (V_O/V_I) = −3dB. Refer to the function table for conditions of control input A.

TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

3 Low-level to high-level and high-level to low-level output propagation time
($A—X_0, X_1$, X-COMMON)

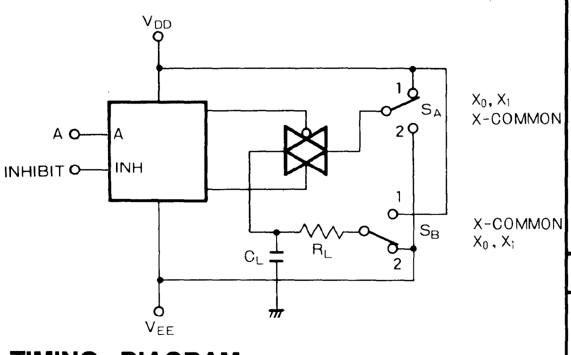


TIMING DIAGRAM

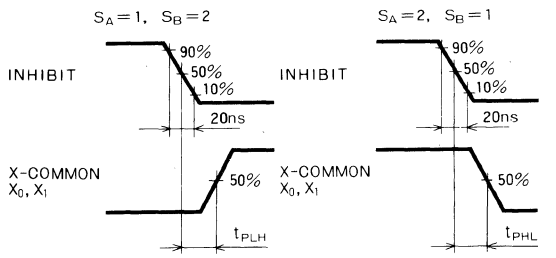


Refer to the function table for conditions of control input A.

4 Low-level to high-level and high-level to low-level output propagation time
(INHIBIT—X_0, X_1, X-COMMON)

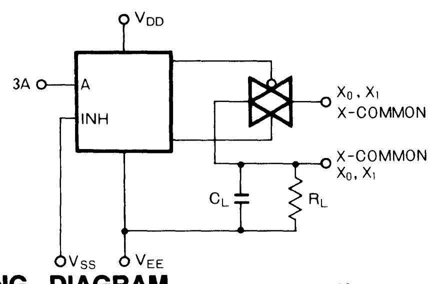


TIMING DIAGRAM

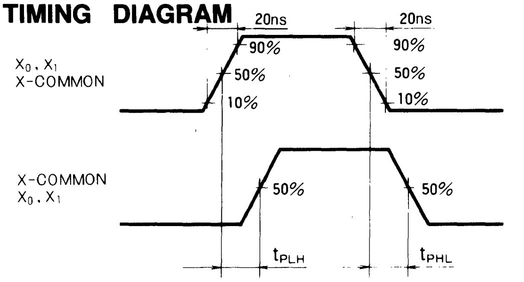


Refer to the function table for conditions of control input A.

5 Low-level to high-level and high-level to low-level output propagation time
(X_0, X_1/X-COMMON—X-COMMON/X_0, X_1)

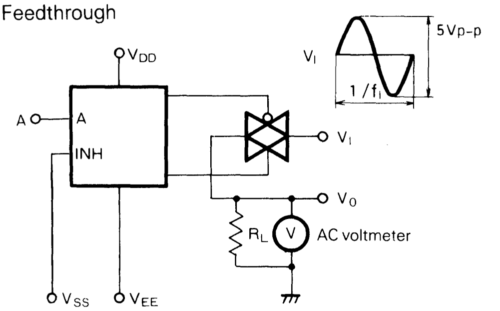


TIMING DIAGRAM



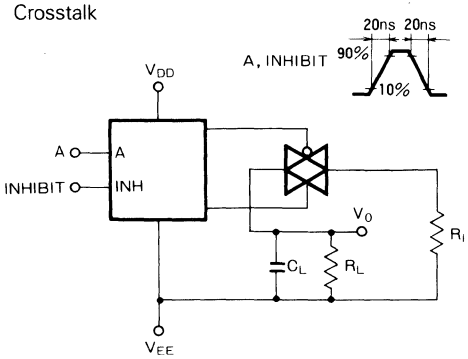
Refer to the function table for conditins of control input A.

6 Feedthrough



The feedthrough is taken as that frequency f_i at which, using a sinewave input of ±2.5Vp-p, 20 $\log_{10}$ (Vo/Vi) = −50dB. Refer to the function table for conditions of control input A.

7 Crosstalk

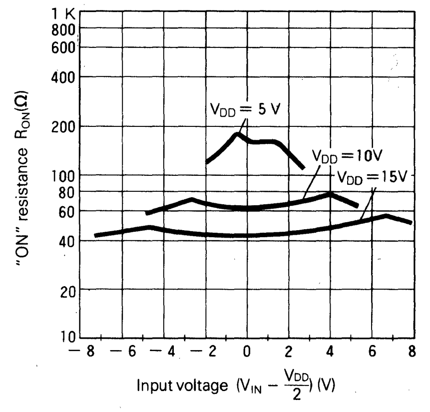


Refer to the function table for conditions of control input A.

TYPICAL PERFORMANCE CHARACTERISTICS

Analog switch "ON" resistance characteristics

M4053BP



MITSUBISHI ELECTRIC

M4066BP

QUADRUPLE BILATERAL SWITCH

DESCRIPTION

The M4066BP is a semiconductor integrated circuit consisting of four independent bilateral analog switches.

FEATURES

- Low ON resistance: 50Ω (typical, at V_{DD} = 15V)
- High off-state resistance: 10^9Ω or greater (typical)
- Small variations in ON resistance between switches in the same package: 10Ω (typical, at V_{DD} = 15V)
- Wide operating voltage range: V_{DD} = 3 ~ 18V
- Wide operating temperature range: T_a = −40 ~ +85°C

APPLICATIONS

General purpose, for use in industrial and consumer digital equipment.

FUNCTIONAL DESCRIPTION

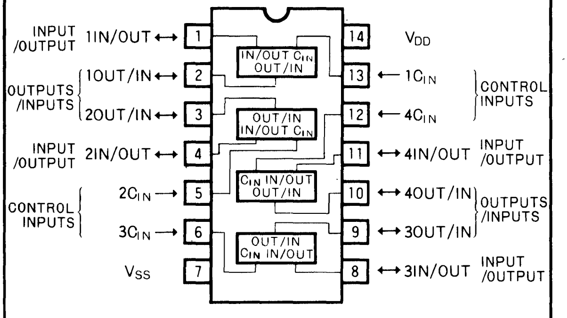
The control input (C_{IN}) can be used to change the input-to-output impedance (IN/OUT – OUT/IN) of the switches.

When (C_{IN}) is made high, the input-to-output switch impedance is low and when set to low, this impedance is high. While this device is compatible with the M4016BP, the lower ON resistance and better transfer characteristics allow a larger input voltage range.

FUNCTION TABLE

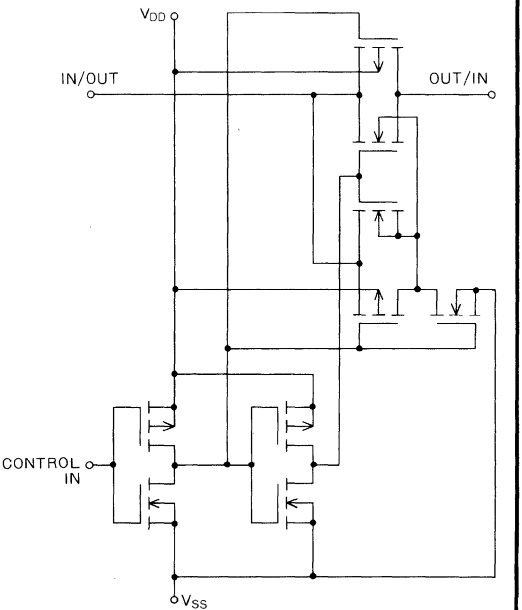
Input C_{IN}	INPUT/OUTPUT and OUTPUT/INPUT resistance (V_{DD} = 10V, 15V)
H	0.5~ 3 ×10^2 Ω
L	> 10^9 Ω typical

PIN CONFIGURATION (TOP VIEW)

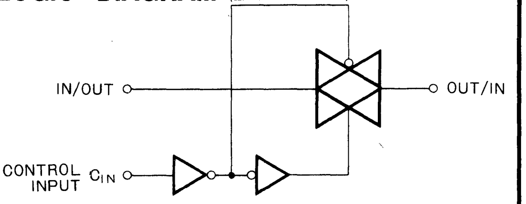


Outline 14P4

CIRCUIT SCHEMATIC (EACH SWITCH)



LOGIC DIAGRAM (EACH SWITCH)



ABSOLUTE MAXIMUM RATINGS (Ta = −40 ~ +85°C, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{DD}	Supply voltage		$V_{SS}-0.5 \sim V_{SS}+20$	V
V_I	Input voltage		$V_{SS}-0.5 \sim V_{DD}+0.5$	V
$V_{I/O}$	Input-to-output voltage		±0.5	V
I_I	Input current	Control inputs	±10	mA
I_O	Output current	Switch-off	±10	mA
T_{opr}	Operating temperature range		−40 ~ +85	℃
T_{stg}	Storage temperature range		−65 ~ +150	℃

RECOMMENDED OPERATING CONDITIONS (Ta = −40 ~ +85°C, V_{SS} = 0V, unless otherwise noted)

Symbol	Parameter	Limits Min	Limits Typ	Limits Max	Unit
V_{DD}	Supply voltage	3		18	V
V_I	Input voltage	0		V_{DD}	V

ELECTRICAL CHARACTERISTICS

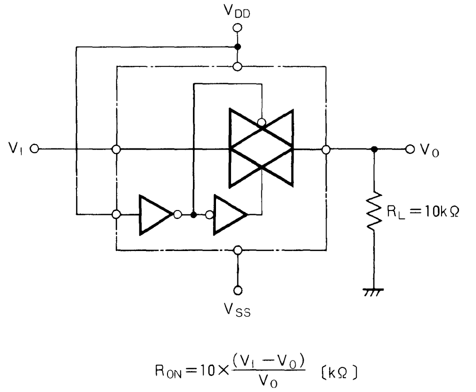
Symbol	Parameter	Test conditions	V_{SS}(V)	V_{DD}(V)	−40℃ Min	−40℃ Max	25℃ Min	25℃ Typ	25℃ Max	85℃ Min	85℃ Max	Unit
V_{IH}	High-level input voltage (C_{IN})	Input-to-output current = 10μA	0	5	3.5		3.5			3.5		V
			0	10	7.0		7.0			7.0		
			0	15	11.0		11.0			11.0		
V_{IL}	Low-level input voltage (C_{IN})	Input-to-output current = 10μA	0	5		1.5			1.5		1.5	
			0	10		2.0			2.0		2.0	
			0	15		2.5			2.5		2.5	
R_{ON}	ON resistance	V_I = 5 V	0	5		500			600		800	Ω
		V_I = 2.5V	0	5		850			950		1300	
		V_I = 0.25V	0	5		500			600		800	
		V_I = 10V	0	10		210			250		300	
		V_I = 5 V	0	10		210			250		300	
		V_I = 0.25V	0	10		210			250		300	
		V_I = 15V	0	15		140			160		200	
		V_I = 7.5V	0	15		140			160		200	
		V_I = 0.25V	0	15		140			160		200	
		V_I = 5 V	−5	5		210			250		300	
		V_I = ±0.25V	−5	5		210			250		300	
		V_I = − 5 V	−5	5		210			250		300	
		V_I = 7.5V	−7.5	7.5		140			160		200	
		V_I = ±0.25V	−7.5	7.5		140			160		200	
	Test circuit 1	V_I = −7.5V	−7.5	7.5		140			160		200	
ΔR_{ON}	ON resistanse variations between switches of the same package		−2.5	2.5				30				
			−5	5				15				
			−7.5	7.5				10				
I_{OFF}	Input-to-output off-state leakage current	$V_{I/O}$=10V, $V_{O/I}$=0 V	0	10					125			nA
		$V_{I/O}$=0 V, $V_{O/I}$=10V	0	10					−125			
		$V_{I/O}$=18V, $V_{O/I}$=0 V	0	18		250			250		1000	
		$V_{I/O}$=0 V, $V_{O/I}$=18V	0	18		−250			−250		−1000	
I_{DD}	Quiescent supply current	$V_{I(CIN)}$ = V_{DD}, V_{SS}	0	5		1			1		7.5	μA
			0	10		2			2		15	
			0	15		4			4		30	
I_{IH}	High-level input current (C_{IN})	V_{IH} = 18V	0	18		0.3			0.3		1.0	μA
I_{IL}	Low-level input current (C_{IN})	V_{IL} = 0 V	0	18		−0.3			−0.3		−1.0	

SWITCHING CHARACTERISTICS (T_a=25℃)

Symbol	Parameter	Test conditions		V_{SS}(V)	V_{DD}(V)	Limits Min	Limits Typ	Limits Max	Unit
$f_{max(I/O)}$	Maximum transfer frequency	R_L = 10kΩ, C_L = 15pF	Test circuit 2	−5	5		25		MHz
$f_{max(C_{IN})}$	Maximum control frequency	R_L = 300Ω, C_L = 15pF	Test circuit 3	0	5		6		MHz
				0	10		18		
				0	15		22		
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (IN/OUT−OUT/IN)	R_L = 10kΩ, C_L = 50pF	Test circuit 4	0	5			45	ns
				0	10			30	
				0	15			20	
t_{PHL}				0	5			45	
				0	10			30	
				0	15			20	
t_{PLH}	Low-level to high-level and high-level to low-level output propagation time (CONTROL IN—OUT/IN)	R_L = 10kΩ, C_L = 50pF	Test circuit 5	0	5			200	ns
				0	10			70	
				0	15			60	
t_{PHL}				0	5			200	
				0	10			70	
				0	15			60	
	Sinewave distortion	R_L = 10kΩ, f_I = 1 kHz	Test circuit 2	−5	5		0.07		%
	Feedthrough (switch off)	R_L = 1 kΩ	Test circuit 6	−5	5		500		kHz
	Crosstalk (CONTROL IN—OUT/IN)	R_I = 1 kΩ, R_L = 10kΩ, C_L = 15pF	Test circuit 7	0	5		200		mV
				0	10		300		
				0	15		400		
C_I	Input capacitance	Control input						7.5	pF
		Switch Input/output					10		

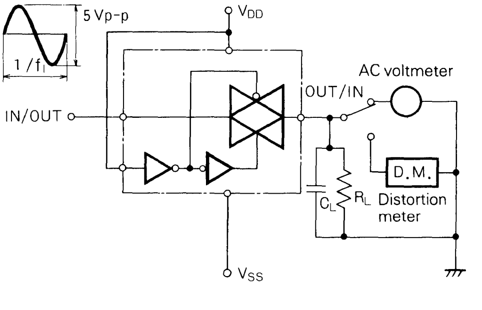
TEST CIRCUITS

1 ON resistance (R_{ON})



$$R_{ON} = 10 \times \frac{(V_I - V_O)}{V_O} \quad [k\Omega]$$

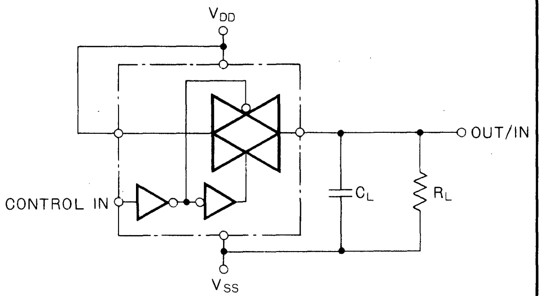
2 Maximum transfer frequency (fmax (I/O))
Sinewave distortion



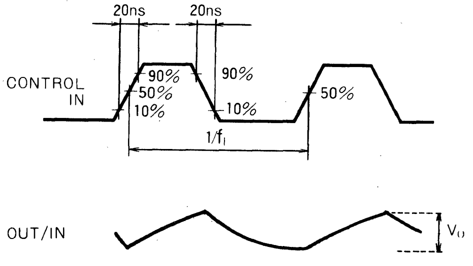
fmax (I/O) is taken as that frequency f_I at which, using a sinewave input of ±2.5Vp-p, 20 $\log_{10}$ (V_O/V_I) = −3dB.

3

Maximum control frequency (fmax (C_{IN}))



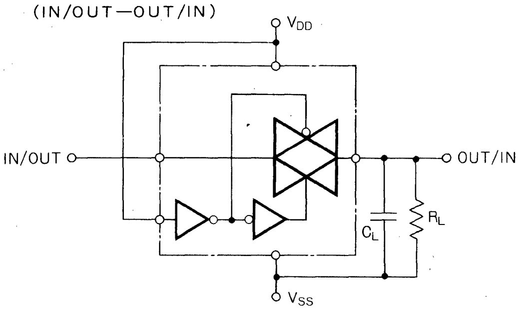
TIMING DIAGRAM



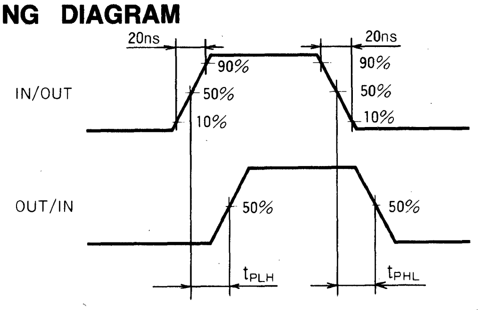
fmax (C_{IN}) is taken as that frequency f_I at which the output amplitude V_O is 1/2 that at lkHz.

4

Low-level to high-level and high-level to low-level output propagation time (IN/OUT—OUT/IN)

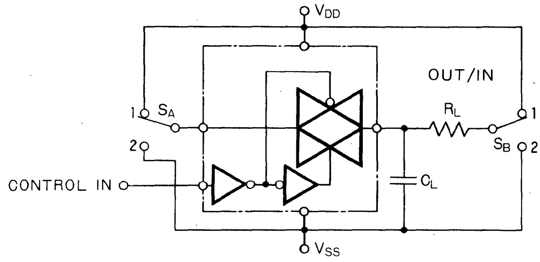


TIMING DIAGRAM



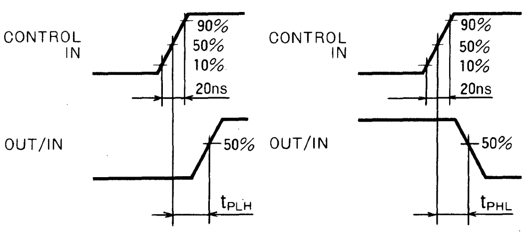
5

Low-level to high-level and high-level to low-level output propagation time (CONTROL IN—OUT/IN)



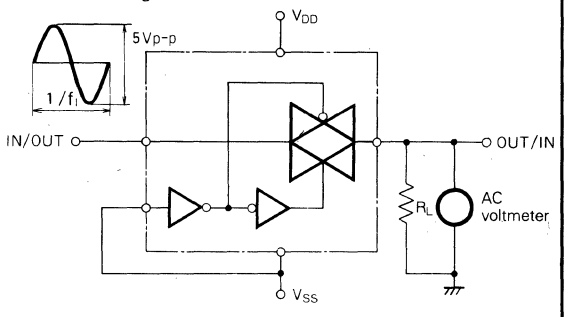
$S_A = 1$, $S_B = 2$ $S_A = 2$, $S_B = 1$

TIMING DIAGRAM



6

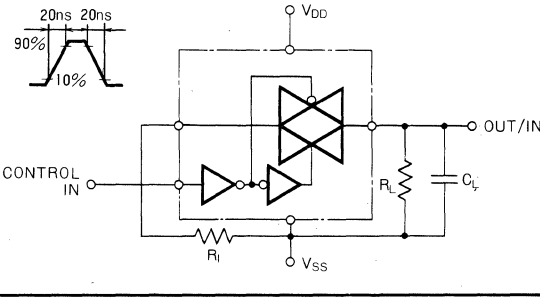
Feedthrough



The feedthrough is taken as that frequency f_I at which, using a sinewave input of ±2.5Vp-p, $20 \log_{10} (V_O/V_I) = -50$dB.

7

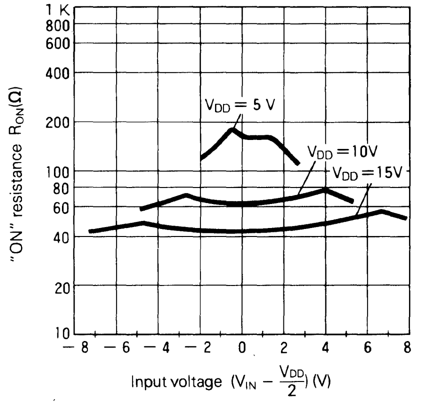
Crosstalk



TYPICAL PERFORMANCE CHARACTERISTICS

Analog switch "ON" resistance characteristics

M4066BP



M5109P

DUAL DIFFERENTIAL AMPLIFIER

DESCRIPTION

The M5109P is a semiconductor integrated circuit consisting of two differential amplifiers, fabricated by making use of complementary symmetry.

Since the two differential amplifiers are part of the same structure and have closely matched characteristics, this device is convenient for use in applications requiring such matched characteristics. A bias diode has been built into the device as a convenience.

The high reliability of this device makes it useful in applications such as audio equipment, communications equipment and control equipment.

FEATURES

- Two differential amplifiers with closely matched characteristics.
- Small input offset voltage ························ 5mV (max.)
- Small input offset current ························ 2μA (max.)
- Built-in bias diode

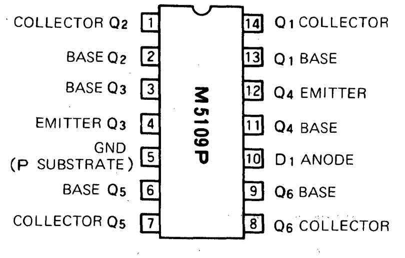
APPLICATION

RF/IF amplifiers, frequency mixers, voltage comparators, balanced dual differential amplifiers, and detectors.

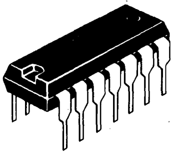
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ······································ 2 ~ 15V
Rated supply voltage ·· 12V

PIN CONFIGURATION (TOP VIEW)

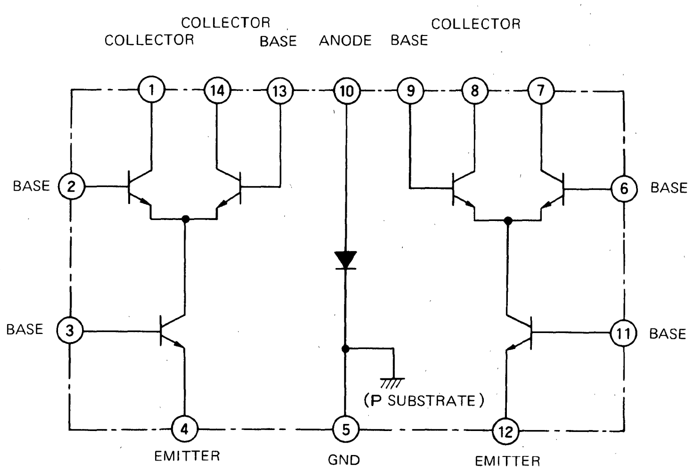


Outline 14P4



14-pin molded plastic DIL

EQUIVALENT CIRCUIT



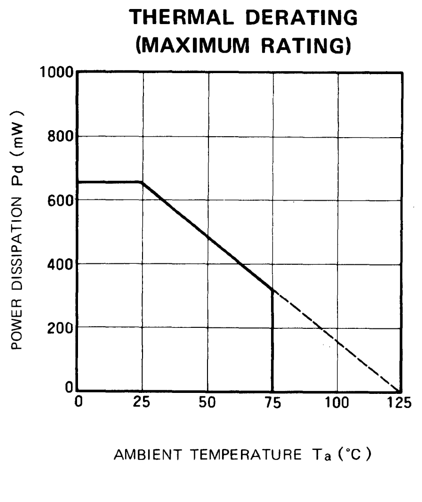
ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Collector-emitter voltage		15	V
V_{CBO}	Collector-base voltage		20	V
V_{EBO}	Emitter-base voltage		5	V
I_C	Collector current		50	mA
Pd	Power dissipation		650	mW
K_θ	Derating	Ta≧25°C	6.5	mW/°C
T_{opr}	Operating temperature		−20～+75	°C
T_{stg}	Storage temperature		−40～+125	°C

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

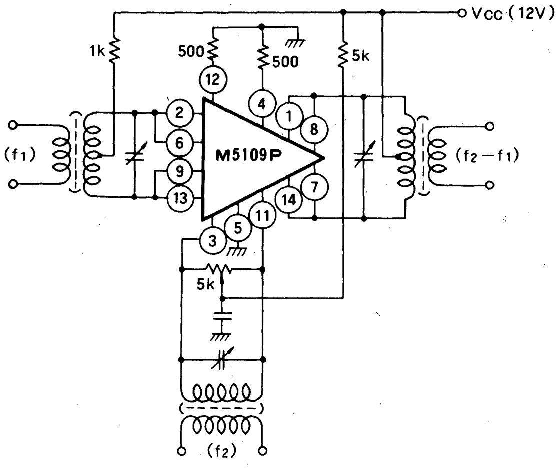
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{IO}	Input offset voltage	V_{CE}=3V, I_E=2mA			5	mV
I_{IO}	Input offset current	V_{CE}=3V, I_E=2mA			2	μA
I_{IB}	Input bias current	V_{CE}=3V, I_E=2mA			24	μA
$\frac{I_{C(Q1)}}{I_{C(Q2)}}$ or $\frac{I_{C(Q5)}}{I_{C(Q6)}}$	Differential stage current ratio	V_{CE}=3V, I_E=2mA		1.0		—
I_{CBO}	Collector cutoff current	V_{CB}=18V, I_E=0			1	μA

TYPICAL CHARACTERISTICS (Ta =25°C , unless otherwise noted)

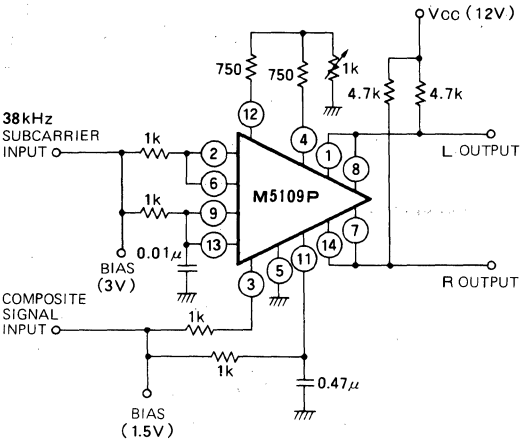


APPLICATION EXAMPLES

(1) Frequency mixer



(2) FM Stereo demodulator



Units Resistance: Ω
Capacitance: F

M5172L

THERMO CONTROLLER

DESCRIPTION

Monolithic integrated circuit M5172L is designed for the use of the thermo controller applied for the Zero Crossing circuit. It is intended for use in A-C power supply control circuits operating directly with the A-C line. It is consisted of the trigger pulse circuit occurring at the zero crossing point of the input A-C voltage, rectifying circuit, differential comparator, and negative input voltage threshold detector.

FEATURES

- Designed for applications in 50Hz and 60Hz AC power control system.
- Operates directly from a AC line or from a DC supply
- Provides zero crossing thyristor triggering circuit for minimum RFI
- Negative input threshold voltage detector involved for the use of the safety protection.

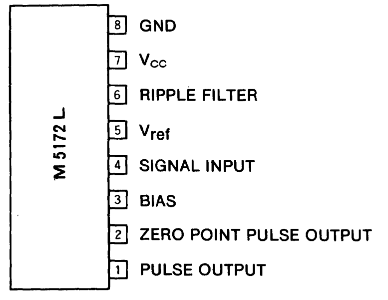
APPLICATIONS

- Zero-voltage triggering circuit of SCR, BCR
- Electric blanket

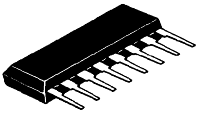
RECOMMENDED OPERATING CONDITIONS

Supply AC voltage range .... 90~110Vrms
Rated AC voltage range....................................... 100Vrms
(Resistor (10kΩ, $\geqq$2W) must be connected between Pin7 and AC power supply.)

PIN CONFIGURATION (TOP VIEW)

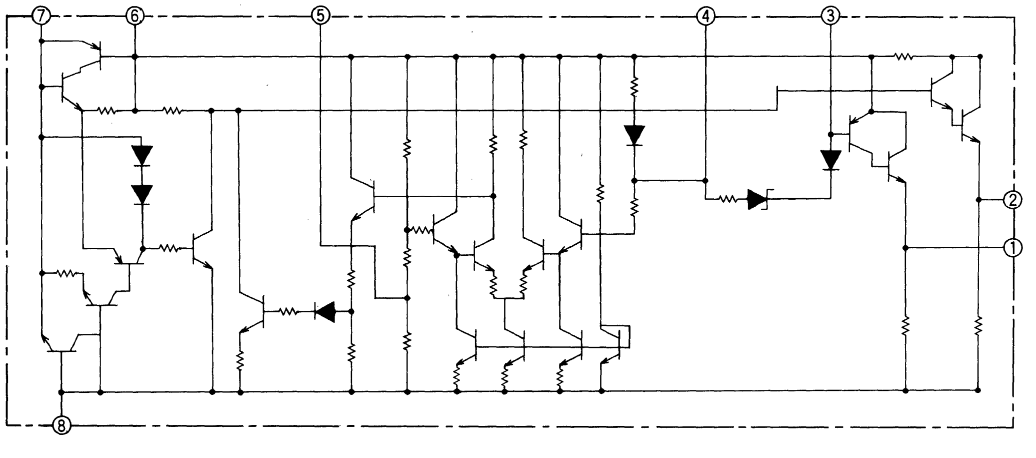


Outline 8P5

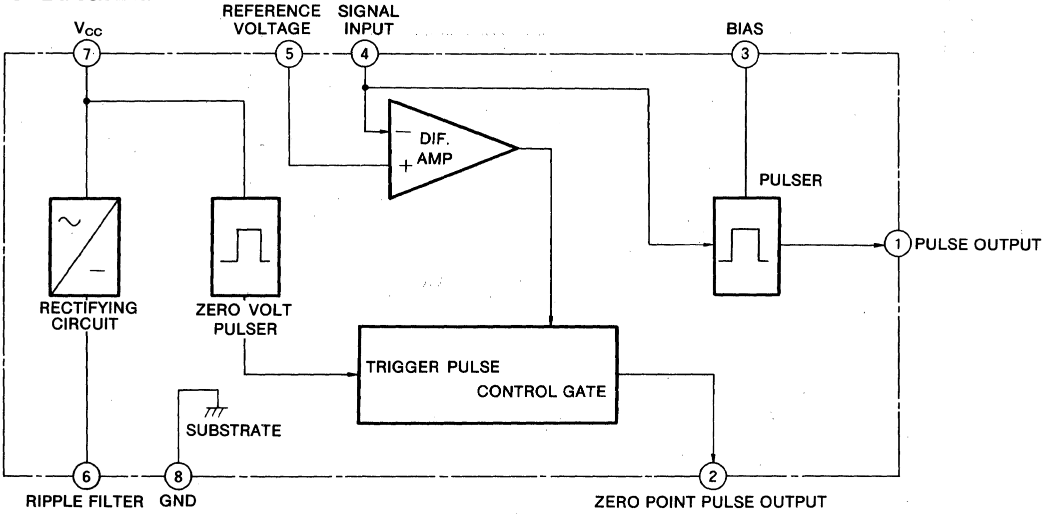


8-pin molded plastic SIL

CIRCUIT SCHEMATIC



BLOCK DIAGRAM



* CAPACITOR MUST BE CONNECTED BETWEEN PIN 6 AND GND.

ABSOLUTE MAXIMUM RATINGS (T_a=+25℃, unless otherwise noted)

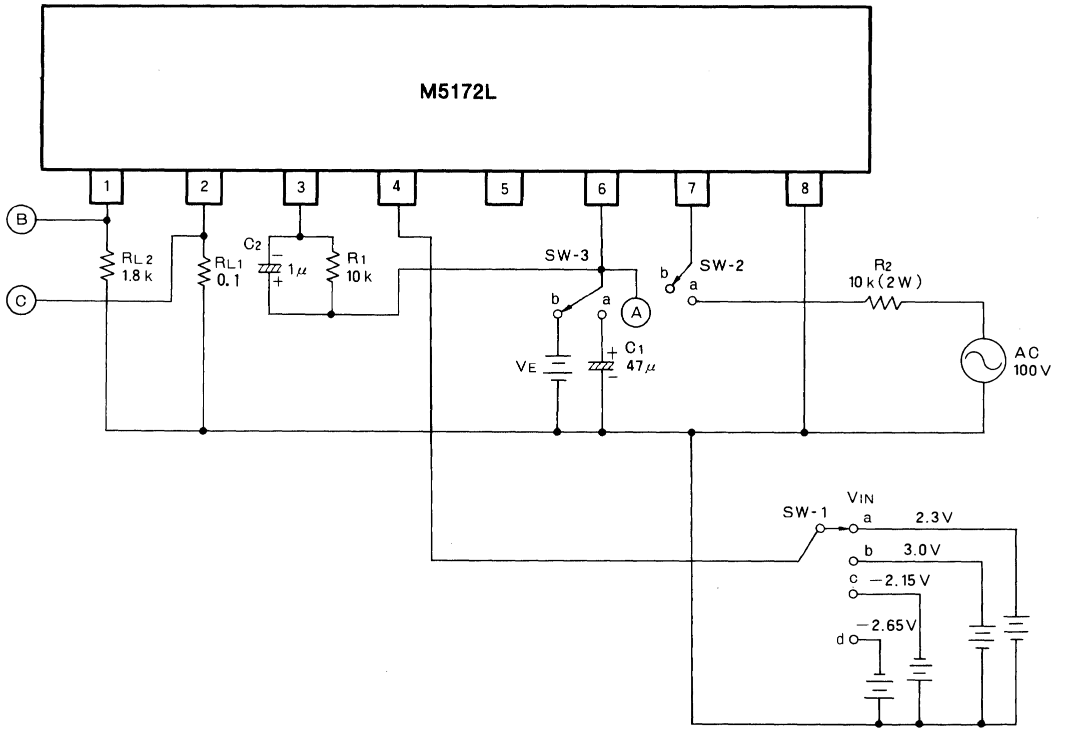
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage(voltage between Pin 7 and Pin 5)		10	V
$I_{⑦}$	Pin7 circuit current		10	mA
P_d	Power dissipation		360	mW
K_θ	Power derating rate	$T_a \geqq 25$℃	3.6	mW/℃
T_{opg}	Operating ambient temperature		−20～+60	℃
T_{stg}	Storage temperature		−20～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=+25℃)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{DC}	DC voltage between Pin6 and Pin8	R_1=10kΩ *1, C_1=47μF	5.85	—	6.9	V
V_{thp}	Positive threshold voltage at Pin4	V_E=5.9V	2.3	2.7	3.0	V
V_{thN}	Negative threshold voltage at Pin4	V_E=5.9V	−2.65	−2.4	−2.15	V
V_{P-P}	Peak trigger output pulse at Pin2	R_{L1}=100Ω, V_E=5.9V	0.65	—	—	V_{P-P}
V_H	High level at pin1	R_{L2}=1.8k, V_E=5.9V	0.59	—	—	V_{P-P}
V_L	Low level at pin1	R_{L2}=1.8k, V_E=5.9V			0.1	V_{P-P}

*1 Measuring condition : connect R=10kΩ (≧ 2 W) between terminal 7 and A-C power supply (100V r. m. s.)

MEASURING CIRCUIT



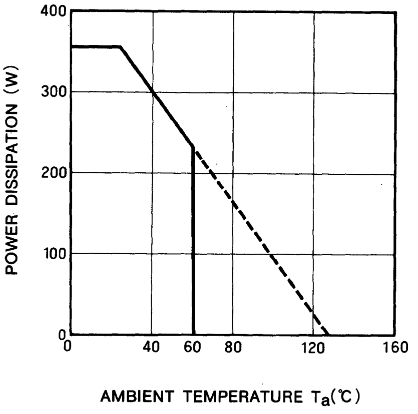
Units Resistance : kΩ
Capacitance : μF

MEASURING CONDITION

Parameter	SW-1	SW-2	SW-3	Measuring point
V_{DC}	a	a	a	A
V_{TH-P}	a/b	b	b	C
V_{TH-N}	c/d	b	b	B
$V_{OH(T)}$	a	b	b	C
$V_{OH(S)}$	d	b	b	B

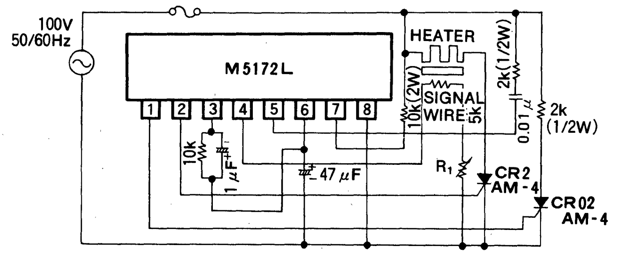
TYPICAL CHARACTERISTICS

THERMAL DERATING
(MAXIMUM RATING)



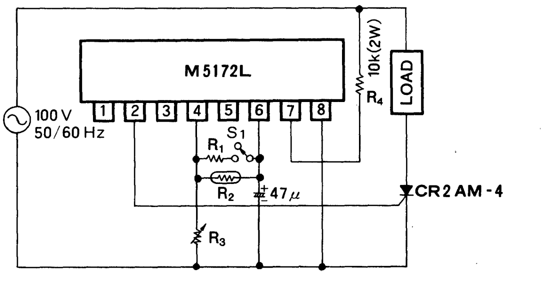
APPLICATION EXAMPLE

(1) THERMO CONTROLLER FOR ELECTRIC BLANKET (ZERO VOLT SWITCH OF SCR)



Units Resistance : Ω
Capacitance : F

(2) THERMO CONTROLLER USING THERMISTER
(ZERO VOLT SWITCH OF SCR)



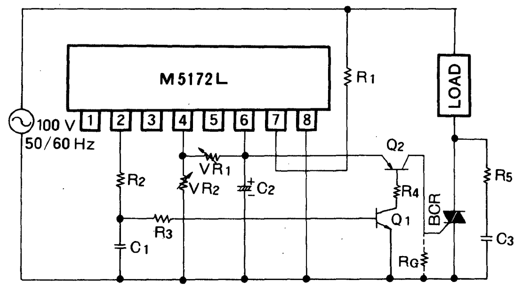
Units Resistance : Ω
Capacitance : F

R_2 : NTC THERMISTER

R_1 : RESISTOR FOR COMPENSATION FOR THERMISTER LINEARITY

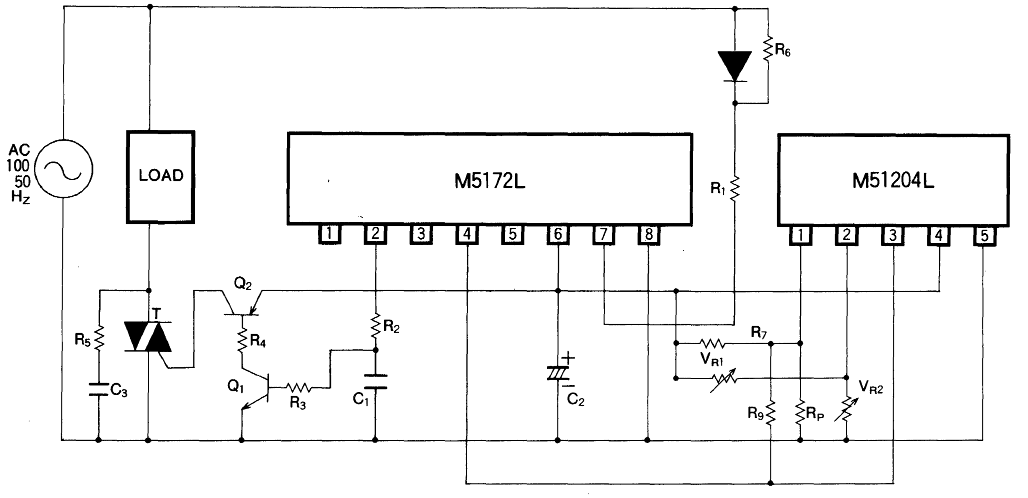
R_4 : 10kΩ

(3) ZERO VOLT SWITCH OF BCR



R_1 : 10kΩ (2W)	R_2 : 1kΩ (1/4W)	R_3 : 10kΩ (1/4W)
R_4 : 1kΩ (1/4W)	R_5 : 100Ω (1/2W)	C_1 : 0.068μF (50WV)
C_2 : 220μF (25WV)	C_3 : 0.1μF (400WV)	Q_1 : 2SC712-D
Q_2 : 2SA696-D	BCR : BCR3AM~BCR25A	

(4) ZERO VOLT SWITCH OF BCR HAVING HYSTERESIS CHARACTERISTICS



R_1=6kΩ(2W) R_2=1kΩ(¼W) R_3=10kΩ(¼W) R_4=1kΩ(¼W)
R_5=100Ω(½W) R_6=30kΩ(½W) R_7, R_8=R FOR REFERENCE VOLTAGE
R_9=R FOR HYSTERESIS
V_{R1}=TEMPERATURE SENSOR
C_1=0.068μF(50WV) C_2=220μF(250WV) C_3=0.1μF(400WV)
Q_1=2SC713-D Q_2=2SA696-D T : BCR 3AM~25AI

M5174P

FLAME DETECTOR

DESCRIPTION

Monolithic integrated circuit M5174P is designed for the use of the flame detection circuit.

It is composed of current amplifiers, a thyristor circuit, a couple of the relay drivers and a internal voltage regulator.

The current limiting circuit of the driver and internal two sets of shunt circuits parallely connected with relay protect the relay against the danger in an abnormal state of no signal flame. A differential amplifier configuration and a temperature-independent reference voltage source minimize the variation of the operating threshold level of the flame current detector.

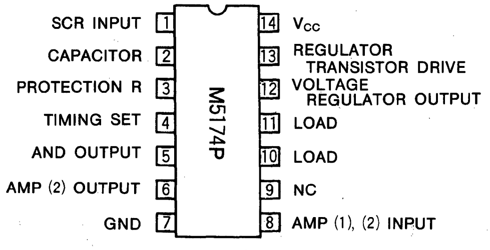
FEATURES

- Fail-safe system (The operating mode of two degrees of redundancy.)
- Available input flame current .... 50μA(max.)
- Minimum tollelance for operating threshold input current .... ±20%(T_a=−20∼+60℃)

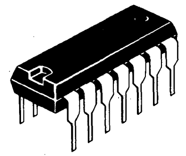
APPLICATION

Flame detection circuit for a gaseous appliance

PIN CONFIGURATION (TOP VIEW)

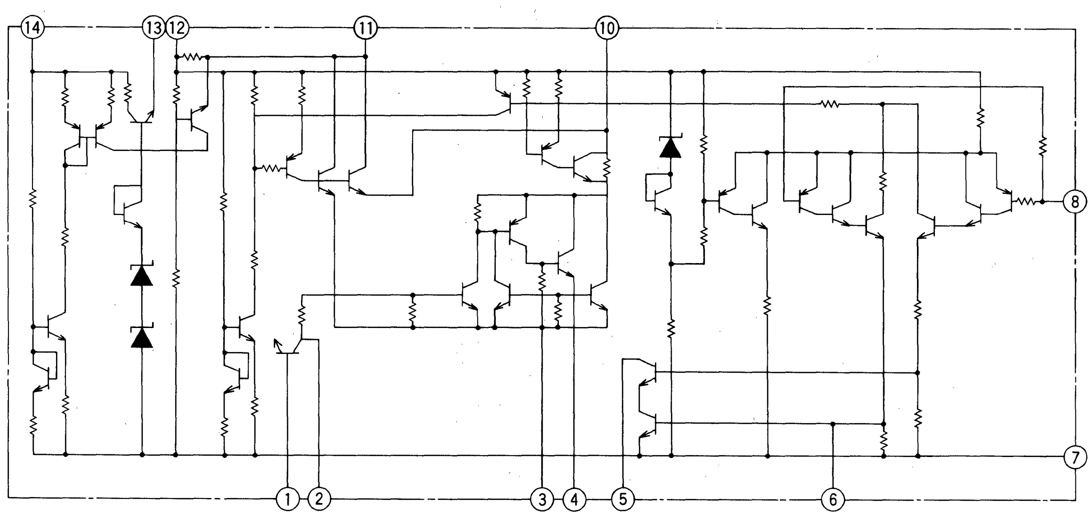


Outline 14P4

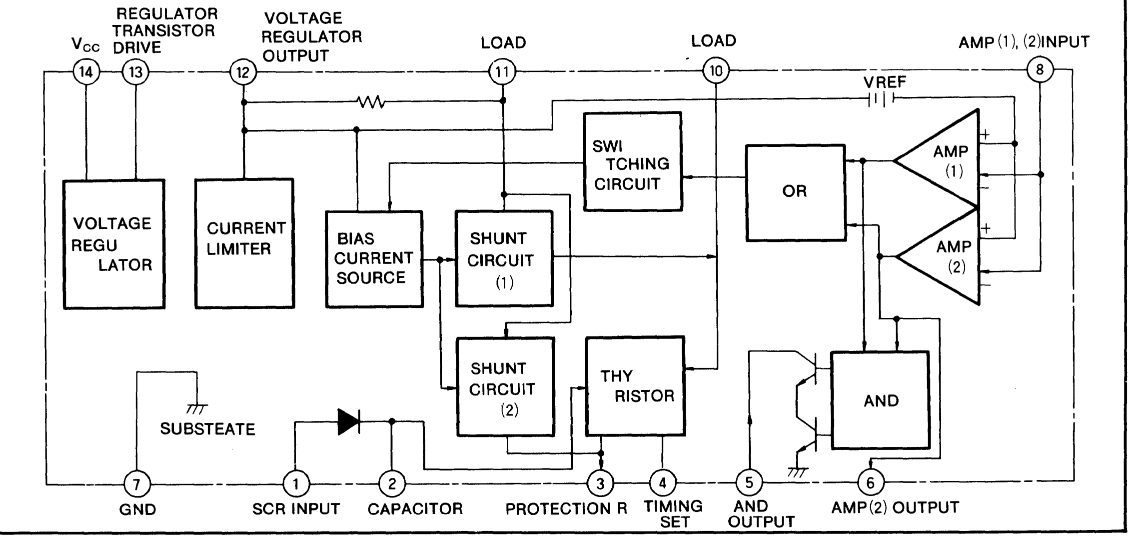


14-pin molded plastic DIL

SCHEMATIC DIAGRAM



BLOCK DIAGRAM



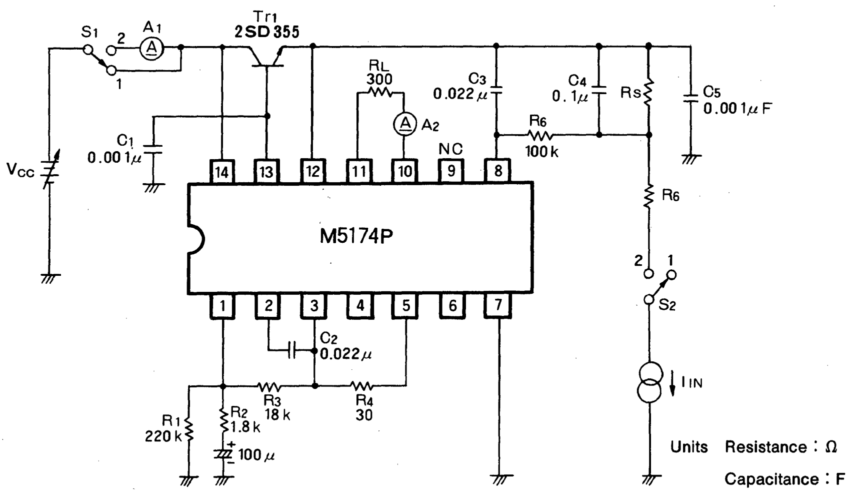
ABSOLUTE MAXIMUM RATINGS (T_a=+25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage	I_8=0μA	20	V
I_{CC}	Circuit current		40	mA
I_{IN}	Maximum input current		50	μA
Pd	Power dissipation		650	mW
K_θ	Power derating rate	T_a≧25℃	−6.5	mW/℃
T_{opg}	Operating ambient temperature		−20～+60	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC1}	Supply voltage	I_8=0μA	12	15	20	V
V_{CC2}		I_8=1μA, I_{CC}=36mA	12	15	17	V
I_{CC1}	Quiescent circuit current	V_{CC}=15V	7	10	14	mA
I_{CC2}	Circuit current	I_L=20mA, V_{CC}=17V		30	36	mA
I_L	Drive current	R_L=300Ω, V_{CC}=17V	15			mA
V_{O1}	Stabilizer output voltage	I_8=0μA, V_{CC}=12V	9.5	10.3	11.5	V
V_{O2}		I_8=1μA, V_{CC}=12V	9.2	10	11.5	V
I_{IN}	Threshold input current	R_L=300, V_{CC}=17V, R_S=4.7MΩ	0.58	0.60	0.72	μA
$I_{IN'}$	Maximum input current	V_{CC}=17V	50			μA
I_{LS2}	Drive current at Pin 5-GND shorted	I_8=0μA V_{CC}=15V			5	mA
I_{LS2}	Drive current at Pin 5-GND shorted and Pin 5-Pin 10 shorted	I_8=1μA, V_{CC}=15V			8	mA

TEST CIRCUIT

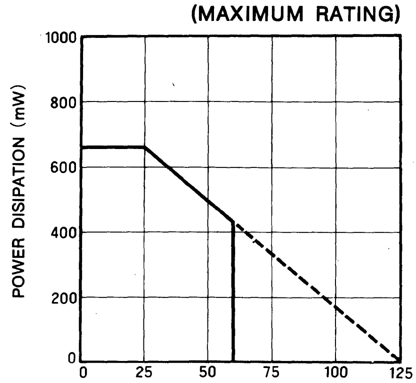


TEST CIRCUIT

Parameter	S_1	S_2	Measuring Point	Note
I_{CC1}	2	1	A_1 *1	V_{CC}=15V
I_{CC2}	2	2	A_1	V_{CC}=17V, I_L=20mA, I_{IN}=1μA
I_L	1	2	A_2 *2	V_{CC}=17V, R_5=300Ω, I_{IN}=1μA
V_{O1}	1	1	pin 12	V_{CC}=12V
V_{O2}	1	2	pin 12	V_{CC}=12V, I_{IN}=1μA
I_{IN}	1	2	A_2	V_{CC}=17V, I_{IN}=0.58~0.78μA
$I_{IN(max)}$	1	2	A_2	V_{CC}=17V, I_{IN}=50μA
I_{LS1} *3	1	1	A_2	V_{CC}=15V
I_{LS2} *4	1	1	A_2	V_{CC}=15V

* 1 ···Supply current from V_{CC} (pin 14)
* 2 ···Supply current to pin 10 from pin 11.
* 3 ···Short circuit condition between pin 5 and pin 7.
* 4 ···Short circuit condition between pin 5 and pin 7, and between pin 10 and pin 5.

THERMAL DELATING (MAXIMUM RATING)



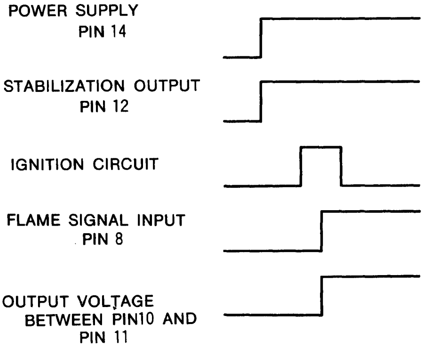
AMBIENT TERMPERATURE T_a (℃)

ABSOLUTE MAXIMUM VOLTAGE RATINGS

(Voltage values are reffered to the ground (pin 7).)

Pin	Limit +	Limit −	Conditions
1	50V	80V	1: Connect to GND through 1.8kΩ. 100μF.
2	60V	20V	2: Connect to pin 3 through 0.022μF.
3	30V	20V	3: Connect to pin 1 through 18KΩ.
4	70V	40V	4: Open
5	40V	15V	5: Connect to pin 3 through 30Ω.
6	10V	15V	6: Open
7	GND		7: GND
8	70V	80V	8: Connect to pin 12 through 0.022μF.
9	N. C.		9: N. C.
10	20V	20V	10: Connect to GND through 0.022μF.
11	20V	20V	11: Connect to pin 10 through 300Ω.
12	20V	10V	12: Connect to pin 8 through 0.022μF.
13	30V	20V	13: Connect to GND through 0.001μF.
14	50V	20V	14: Open

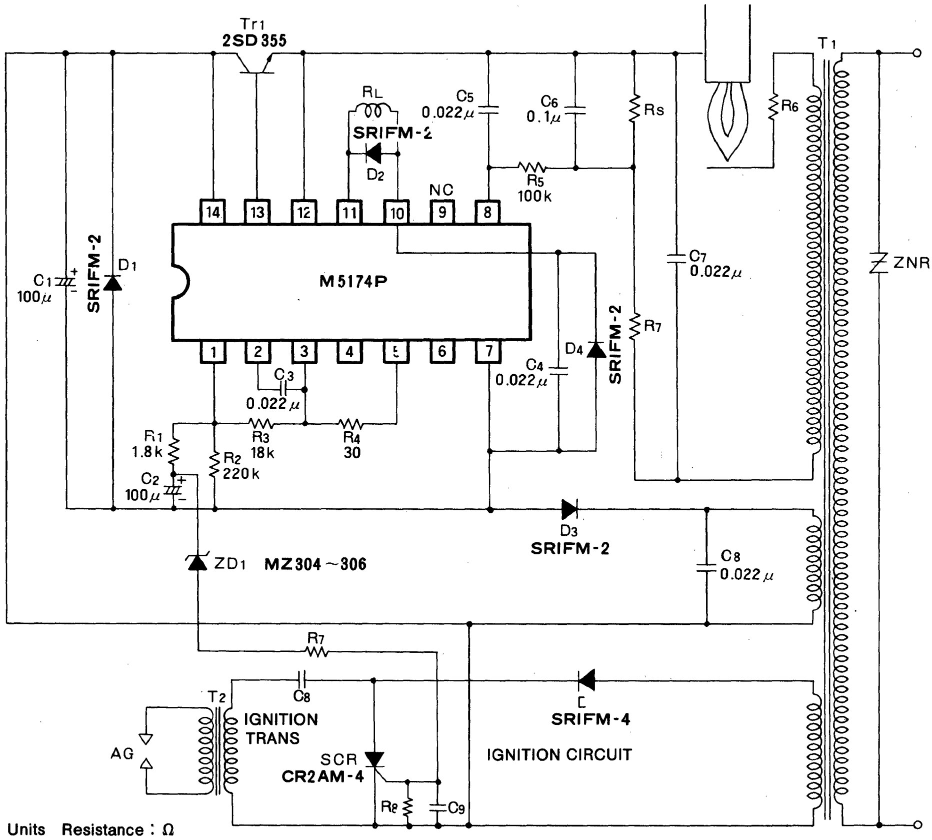
TIME SEQUENTIAL DIAGRAM



Fail-safe system in the M5174P is considered as follows.
Flame signal detector is composed of the two independent amplifiers operating by the additional logic.

APPLICATION EXAMPLE

(1) FLAME DETECTOR USING FLAME CURRENT (1)

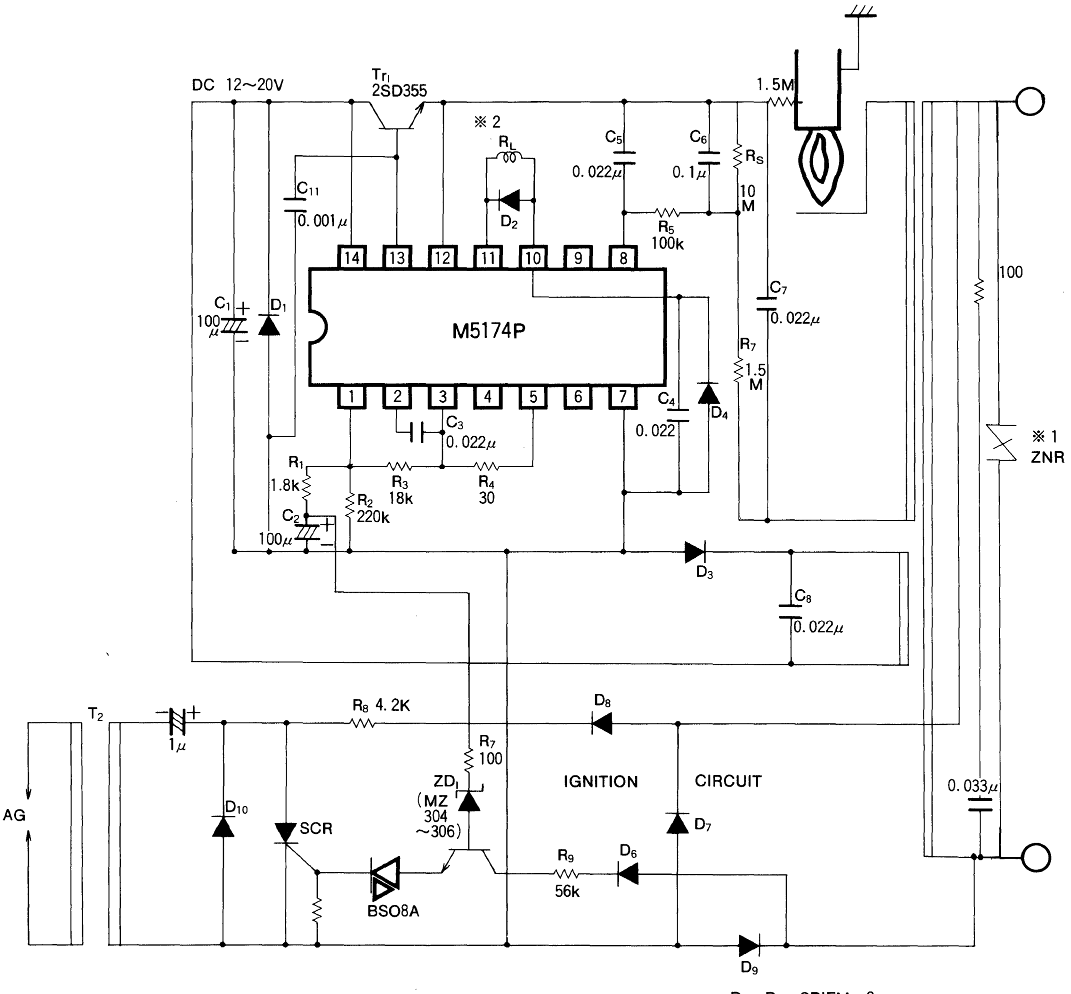


Units Resistance : Ω

Capacitance : F

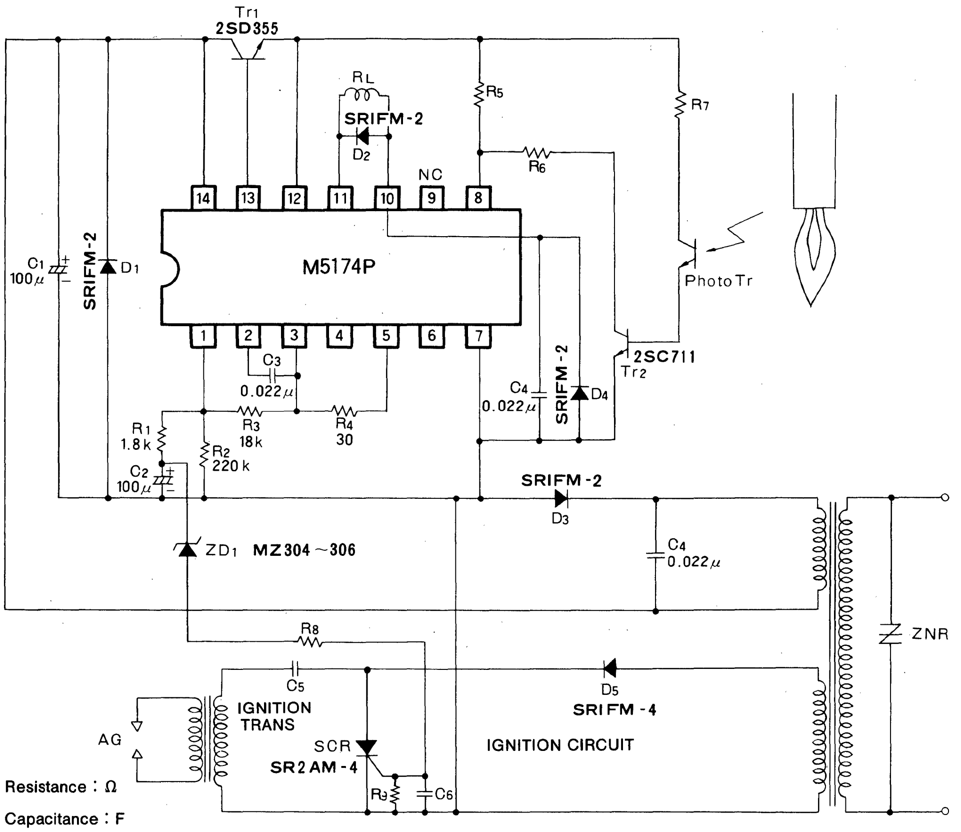
MITSUBISHI ELECTRIC

(2) FLAME DETECTOR USING FLAME CURRENT (2)



D1~D4 SRIFM−2
D6~D10 SRIFM−4
※1 ZNR (Z10L-221)
※2 RL (RELAY 300Ω, 20mA, 6V)

(3) FLAME DETECTOR USING A PHOTO TRANSISTOR



Units Resistance : Ω

Capacitance : F

M5216

DUAL LARGE-CURRENT OPERATIONAL AMPLIFIERS (DUAL POWER SUPPLY TYPE)

DESCRIPTION

The M5216 is a semiconductor integrated circuit designed as a high-output and high-speed operational amplifier for use in high-performance headphone amplifiers and mixer amplifiers found in cassette decks.

The device comes in an 8-pin SIL or DIL package and it contains two circuits for yielding a high internally phase-compensated gain, a high current capacity and a high slew rate. It can be widely used as a general-purpose dual amplifier in electronic equipment. In addition, it can be used in a single power supply format and employed in conditions where the supply voltage is low. These are features which make this device ideal for headphone amplifiers in portable products.

FEATURES

- Large current capacity ························· $I_{LP} = \pm 100$mA
- High power output ························· $P_O = 40$mW(typ.)
  $P_O = 27$mW(typ.)
- High slew rate, high f_T· SR = 3.5V/us, f_T = 10MHz(typ.)
- Low noise(R_S = 1kΩ)FLAT ·········· V_{NI} = 1.7uVrms(typ.)
- Low supply voltage drive possible ········ V_{CC} = 4V(±2V)
- High allowable power ··· Pd = 800mW(SIL), 625mW(DIL)

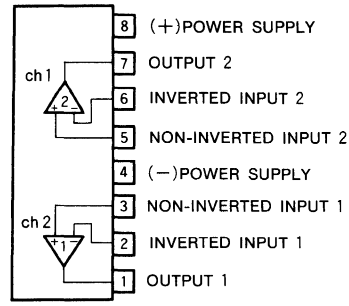
APPLICATION

High-performance headphone amplifiers in VTRs, tape decks and stereo cassette tape recorders with built-in radios; mixer amplifiers, public address equipment, electronic musical instruments; also as a high-current, high-speed, general-purpose operating amplifier in other electronic products and equipment.

RECOMMENDED OPERATING CONDITIONS

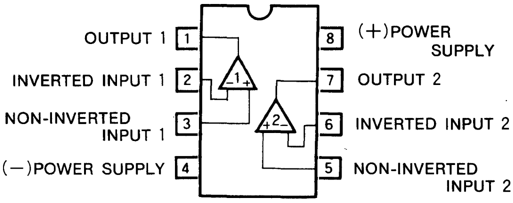
Supply voltage range ········ ±2V~±16V(dual power supply)
+4V~+32V(single power supply)
Rated supply voltage ·· ±15V

PIN CONFIGURATION (TOP VIEW)

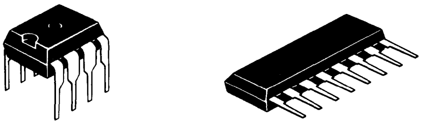


M5216L
Outline 8P5

PIN CONFIGURATION (TOP VIEW)

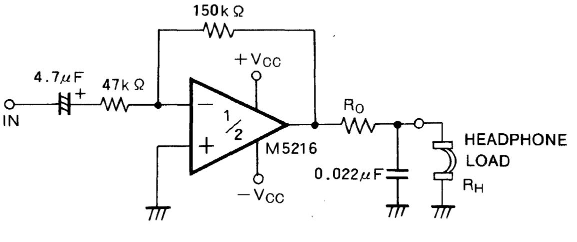


M5216P
Outline 8P4



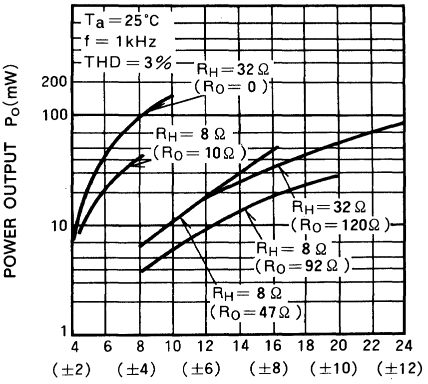
8-pin molded plastic DIL 8-pin molded plastic SIL

APPLICATION EXAMPLE IN HEADPHONE AMPLIFIER



Note : For a single power supply system, the level of the (+) input pin should be shifted to $V_{CC}/2$ potential and the output should be AC-coupled through a capacitor.

HEADPHONE AMPLIFIER CIRCUIT P_O VS V_{CC}



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

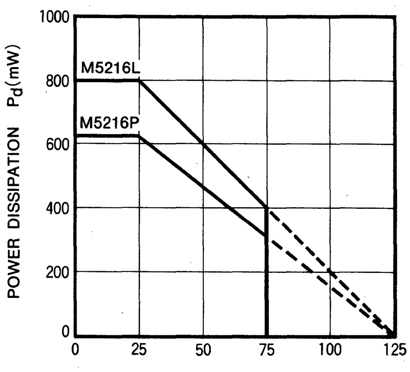
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		±18	V
I_{LP}	Load current		±100	mA
V_{id}	Differential input voltage		±30	V
V_{ic}	Common input voltage		±15	V
P_d	Power dissipation		800(M5216L)	mW
			625(M5216P)	
K_θ	Thermal derating	T_a≧25℃	8(M5216L)	mW/℃
			6.25(M5216P)	
T_{opr}	Ambient temperature		−20～+75	℃
T_{stg}	Storage temperature		−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=±15V)

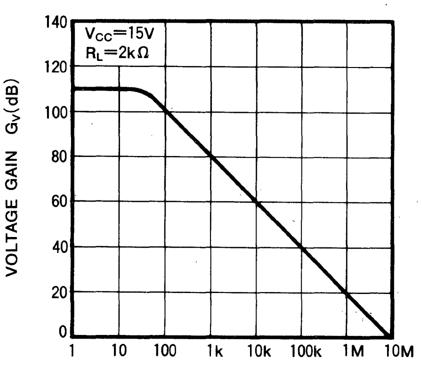
Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
I_{CC}	Circuit current	V_{IN}=0	—	7.5	12.0	mA
V_{IO}	Input offset voltage	R_S≦10kΩ	—	0.5	6.0	mV
I_{IO}	Input offset current		—	5	200	nA
I_{IB}	Input bias current		—	—	500	nA
R_{in}	Input resistance		0.3	5	—	MΩ
G_{VO}	Open loop voltage gain	R_L≧2kΩ, V_O=±10V	86	110	—	dB
V_{OM}	Maximum output voltage	R_L≧2kΩ	±12	±13.5	—	V
		R_L≧150Ω	±10.5	±11	—	V
V_{CM}	Common input voltage width		±12	±14	—	V
CMRR	Common mode rejection ratio	R_S≦10kΩ	70	90	—	dB
SVRR	Supply voltage rejection ratio	R_S≦10kΩ	—	30	150	μV/V
P_d	Power dissipation		—	225	360	mW
SR	Slew rate	G_V=0dB, R_L=2kΩ	—	3.0	—	V/μs
f_T	Gain bandwidth product		—	10	—	MHz
V_{IN}	Input referred noise voltage	R_S=1kΩ, BW : 10Hz～30Hz	—	1.8	—	μVrms

TYPICAL CHARACTERISTICS

THERMAL DERATING
(MAXIMUM RATING)



VOLTAGE GAIN VS
FREQUENCY RESPONSE



M5218/M5R4558P

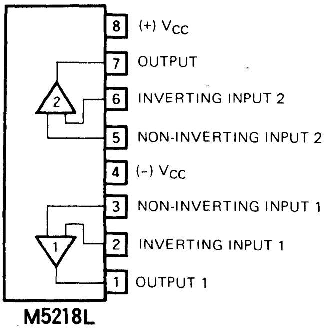
DUAL LOW-NOISE OPERATIONAL AMPLIFIERS (DUAL POWER SUPPLY TYPE)

DESCRIPTION

The M5218/M5R4558P is a monolithic integrated circuit designed for a lownoise preamplifier in audio equipment and a general-purpose operational amplifier in other electronic equipment. Two lownoise operational amplifier circuits displaying internal phasecompensated high gain and low distortion are contained in a 8-pin (SIL, DIL) package for application over a wide range as a general-purpose dual amplifier in general electronic equipment.

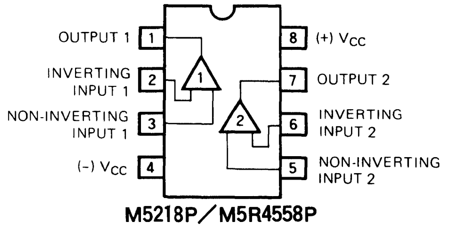
The device has virtually the same characteristics as the 4557, 4558, 4559 and 741 operational amplifiers. The unit can also be used as a single power supply type and employed with low supply voltages, making it ideal as a general-purpose amplifier in portable equipment. It is also suitable as a headphone amplifier because of its high load current.

PIN CONFIGURATION (TOP VIEW)

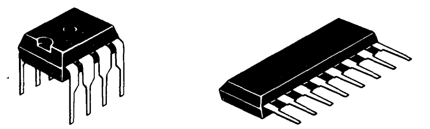


M5218L
Outline 8P5

PIN CONFIGURATION (TOP VIEW)



M5218P/M5R4558P
Outline 8P4



8-pin plastic DIL package 8-pin plastic SIL package

FEATURES

- High gain, low distortion
  .... G_{VO} = 110dB, THD = 0.0015% (typ.)
- High slew rate, high f_T .... SR = 2.2V/μs, f_T = 7MHz (typ.)
- Low noise (R_g = 1kΩ) FLAT .... V_{NI} = 2μVrms (typ.)
  RIAA .... V_{NI} = 1μVrms (typ.)
- Operation with low supply voltage .... $\geqq$4V (±2V)
- High load current, high power dissipation
  .... I_{LP} = ±50mA, P_d = 800mW (SIL)
  625mW (DIL)

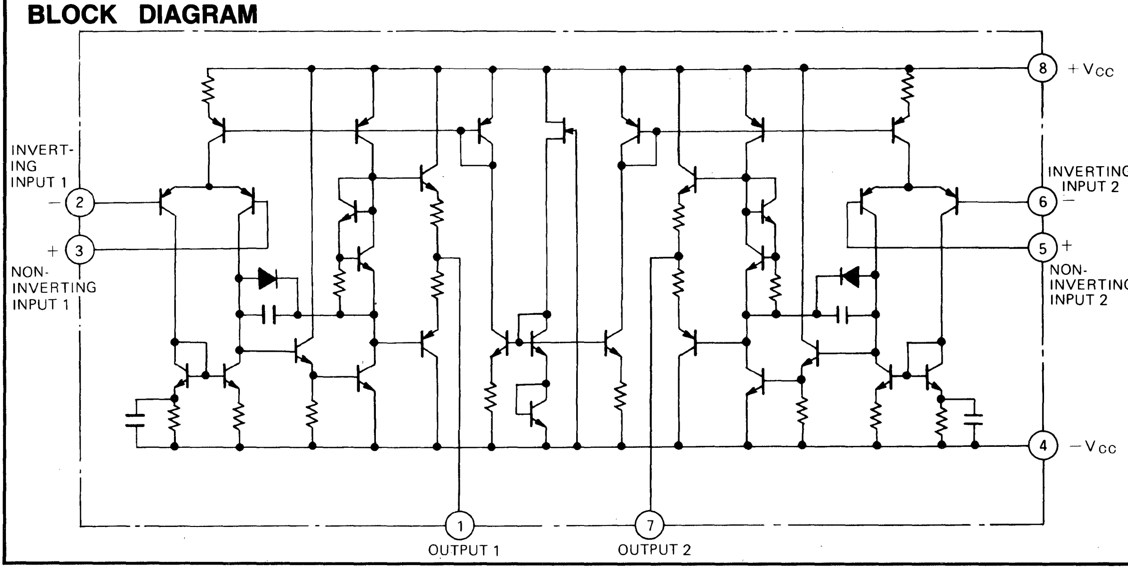
APPLICATION

General-purpose amplifier in stereo equipment, tape decks and radio stereo cassette recorders; active filters, servo amplifiers, operational circuits in other general electronic equipment.

RECOMMENDED OPERATING CONDITIONS

Supply voltage range .... ±2~±16V
Rated supply voltage .... ±15V

BLOCK DIAGRAM



DUAL LOW-NOISE OPERATIONAL AMPLIFIERS (DUAL POWER SUPPLY TYPE)

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

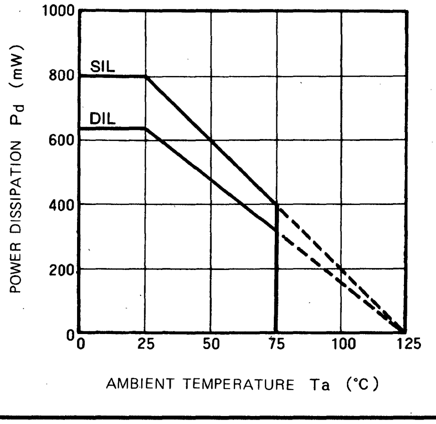
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		±18	V
I_{LP}	Load current		±50	mA
V_{id}	Differential input voltage		±30	V
V_{ic}	Common input voltage		±15	V
P_d	Power dissipation		800(SIL)	mW
			625(DIL)	
K_θ	Thermal derating	T_a≧25℃	8(SIL)	mW/℃
			6.25(DIL)	
T_{opr}	Operation temperature		−20～+75	℃
T_{stg}	Storage temperature		−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=±15V)

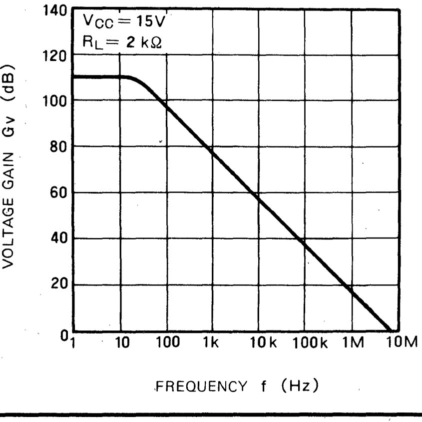
Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
I_{CC}	Circuit current	Vin=0		3.0	6.0	mA
V_{IO}	Input offset voltage	R_S≦10kΩ		0.5	6.0	mV
I_{IO}	Input offset current			5	200	nA
I_{IB}	Input bias current				500	nA
R_{in}	Input resistance		0.3	5		MΩ
G_{VO}	Open loop voltage gain	R_L≧2kΩ, V_O=±10V	86	110		dB
V_{OM}	Maximum output voltage	R_L≧10kΩ	±12	±14		V
		R_L≧2kΩ	±10	±13		V
V_{CM}	Common input voltage range		±12	±14		V
CMRR	Common mode rejection ratio	R_S≦10kΩ	70	90		dB
SVRR	Supply voltage rejection ratio	R_S≦10kΩ		30	150	μV/V
Pd	Power dissipation			90	180	mW
SR	Slew rate	G_V=0dB, R_L=2kΩ		2.2		V/μs
f_T	Gain bandwidth product			7		MHz
V_{NI}	Input-referred noise voltage	R_S=1kΩ, BW : 10Hz～30kHz		2.0		μVrms

TYPICAL CHARACTERISTICS

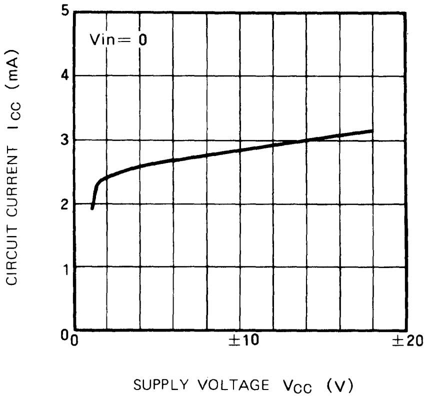
THERMAL DERATING (MAXIMUM RATING)



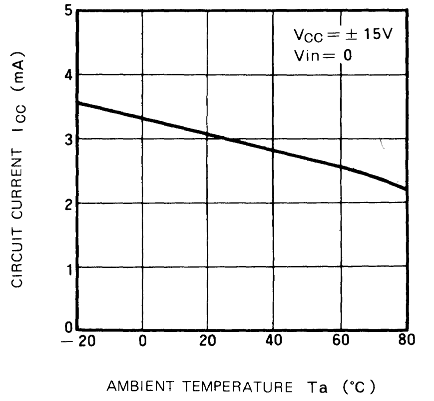
VOLTAGE GAIN VS FREQUENCY RESPONSE



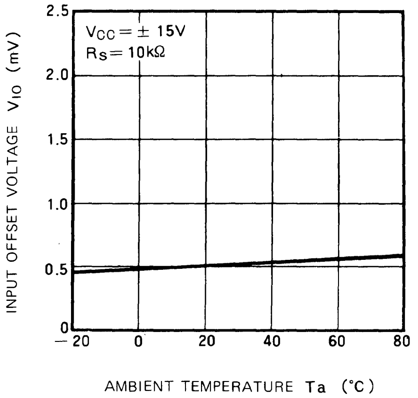
CIRCUIT CURRENT VS SUPPLY VOLTAGE



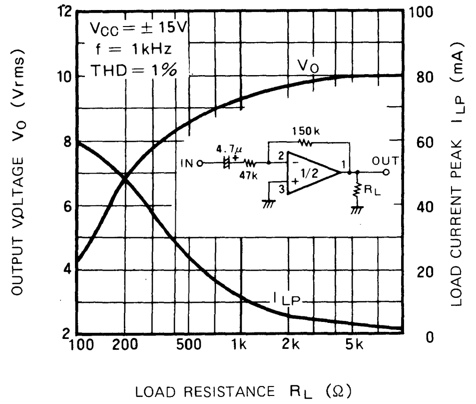
CIRCUIT CURRENT VS AMBIENT TEMPERATURE



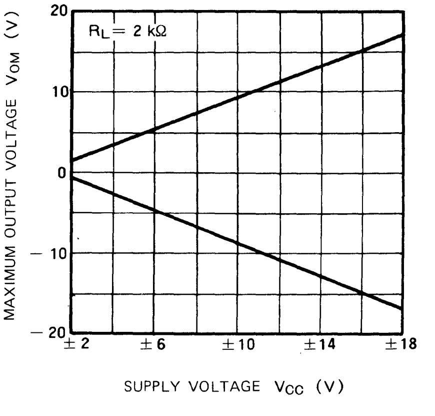
INPUT OFFSET VOLTAGE VS AMBIENT TEMPERATURE



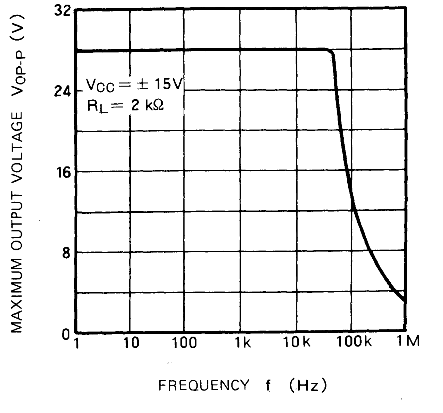
OUTPUT VOLTAGE/LOAD CURRENT PEAK VS LOAD RESISTANCE



MAXIMUM OUTPUT VOLTAGE VS SUPPLY VOLTAGE



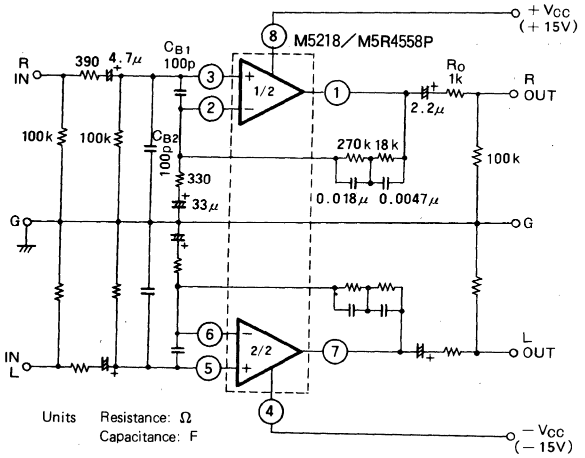
MAXIMUM OUTPUT VOLTAGE VS FREQUENCY RESPONSE



DUAL LOW-NOISE OPERATIONAL AMPLIFIERS (DUAL POWER SUPPLY TYPE)

APPLICATION EXAMPLES

(1) Stereo equalizer amplifier circuit



Left channel circuit constants are identical to those of right channel

C_{B1}, C_{B2} : Capacitors for buzz prevention, use if required.

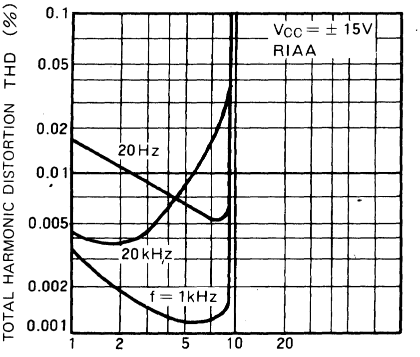
R_O: Resistor used to prevent parasitic oscillation for capacitive loads and current limiting with shorted and other abnormal load conditions.

TYPICAL CHARACTERISTICS

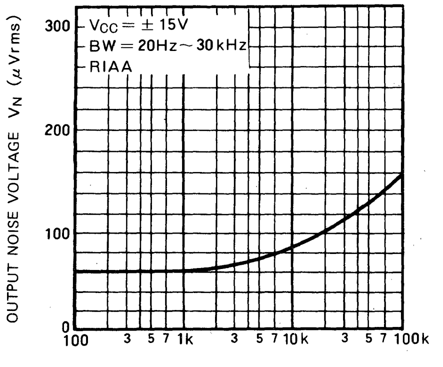
($V_{CC}=\pm 15V$, RIAA)

- $G_V=35.6dB$ ($f=1kHz$)
- $V_{NI}=1\mu Vrms$ ($R_S=1k\Omega$, $BW=20Hz \sim 30kHz$)
- Signal-to-noise = 72.5dB (IHF-A network, shorted input, 2.5mVrms input sensitivity)
- $THD=0.0015\%$ ($f=1kHz$, $V_O=3Vrms$)

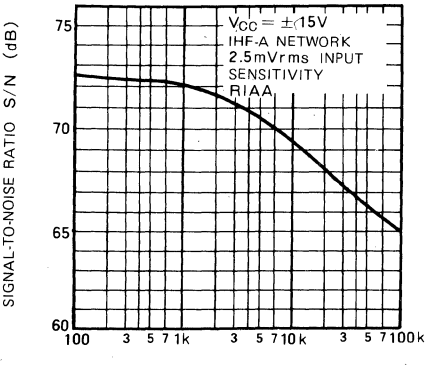
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE



OUTPUT NOISE VOLTAGE VS SIGNAL SOURCE RESISTANCE

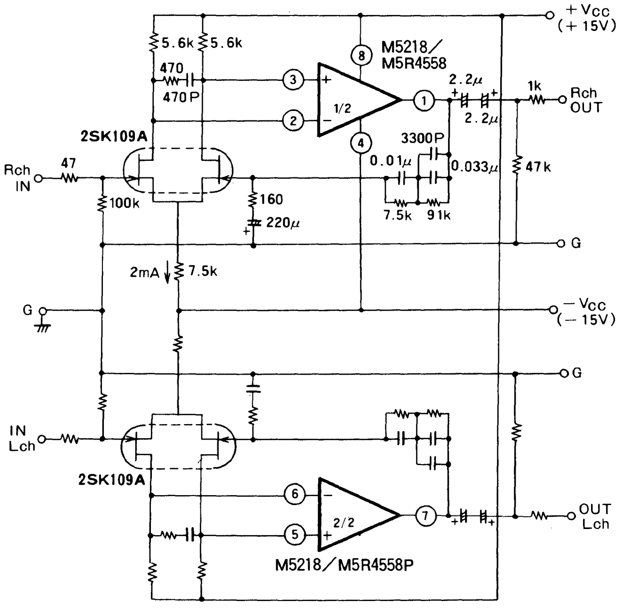


SIGNAL-TO-NOISE RATIO VS SIGNAL SOURCE RESISTANCE



DUAL LOW-NOISE OPERATIONAL AMPLIFIERS (DUAL POWER SUPPLY TYPE)

(2) High S/N stereo DC ICL equalizer



Left channel circuit constants are identical to those of right channel.

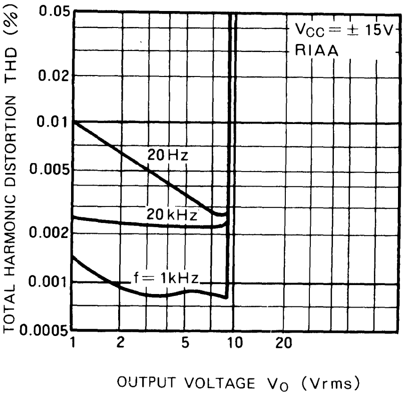
Units Resistance: Ω
Capacitance: F

TYPICAL CHARACTERISTICS

($V_{CC} = \pm 15V$, RIAA)

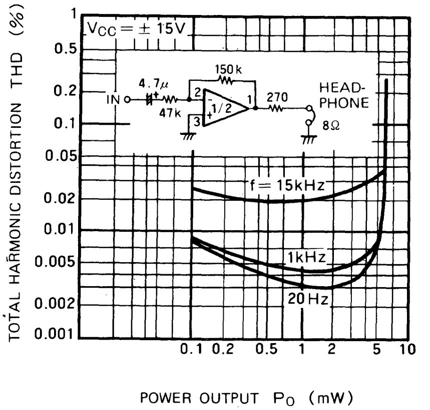
- Signal-to-noise = 85 dB (IHF-A network, shorted input, 2.5mVrms input sensitivity)
- $V_{NI} = 0.77\mu Vrms$ ($R_S = 5.1k\Omega$, BW = 5 Hz ~ 100kHz)
- $G_V = 35.6dB$ (f = 1kHz)

TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE



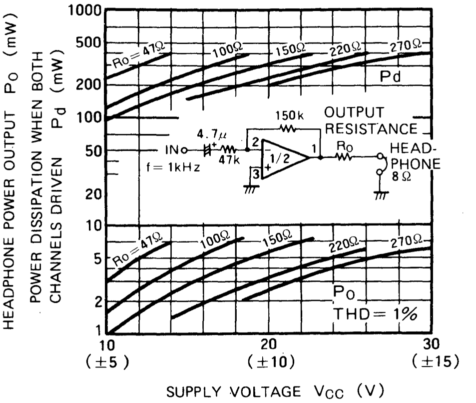
(3) Headphone amplifier

TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE



(Output resistance Ro is made the parameter)

POWER OUTPUT/POWER DISSIPATION VS SUPPLY VOLTAGE



M5219

DUAL LOW-NOISE VOLTAGE AMPLIFIERS (DUAL POWER SUPPLY TYPE)

DESCRIPTION

The M5219L and M5219P are dual power supply type of semiconductor integrated circuit designed for preamplifiers in stereo equipment and tape decks. Two low-noise, high-voltage preamplifier circuits displaying internal phase-compensated high gain and low distortion are contained in a 8-pin (SIL/DIL) package, making the device ideal for use as an equalizer amplifier or tone control amplifier in stereo equipment and tape decks.

The device can also be used as a single power supply type and employed with low supply voltages, making it suitable as a general-purpose amplifier in stereo radio-cassette tape recorders and other portable equipment.

FEATURES

- Low noise (Rg = 2.2kΩ, RIAA) ········· V_{NI} = 0.9μVrms (typ.)
  S/N = 77dB (typ.) (shorted input, IHF-A network RIAA, PHONO = 2.5mVrms)
- High voltage ·· V_{CC} = ±25V (50V)
- High maximum allowable PHONO input voltage
  ······················ V_i=230mVrms(typ.)(V_{CC}=±22.5V, f=1kHz)
- High gain, low distortion G_{VO} = 110dB, THD = 0.001% (typ.)
- High slew rate ···································· SR = 6.5V/μs (typ.)
- High load current, high power dissipation
  ······································· I_{LP} = ±50mA, P_d = 800mW (SIL) 625mW (DIL)

APPLICATION

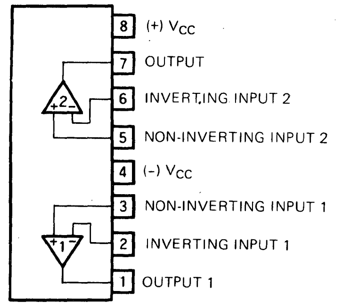
General-purpose amplifier in stereo equipment, tape decks, stereo radio-cassette tape recorders and other general electronic equipment.

RECOMMENDED OPERATING CONDITIONS

Supply voltage range ·· ±2 ~ ±22.5V

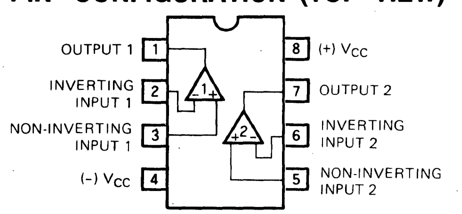
Rated supply voltage ·· ±22.5V

PIN CONFIGURATION (TOP VIEW)

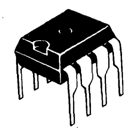


M5219L
Outline 8P5

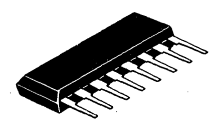
PIN CONFIGURATION (TOP VIEW)



M5219P
Outline 8P4

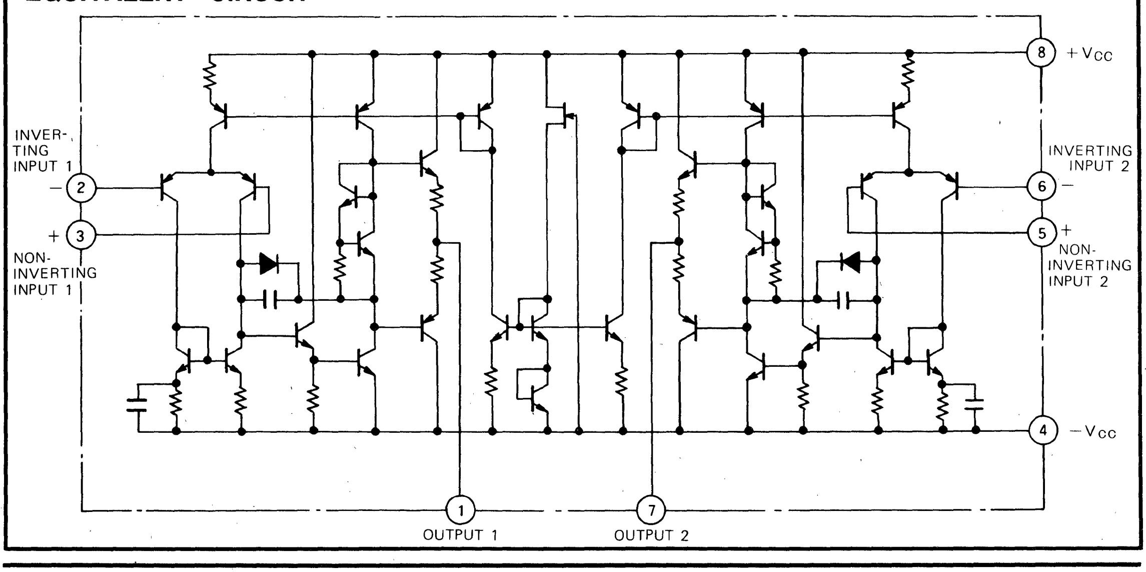


8-pin plastic DIL package



8-pin plastic SIL package

EQUIVALENT CIRCUIT



MITSUBISHI ELECTRIC

DUAL LOW-NOISE VOLTAGE AMPLIFIERS (DUAL POWER SUPPLY TYPE)

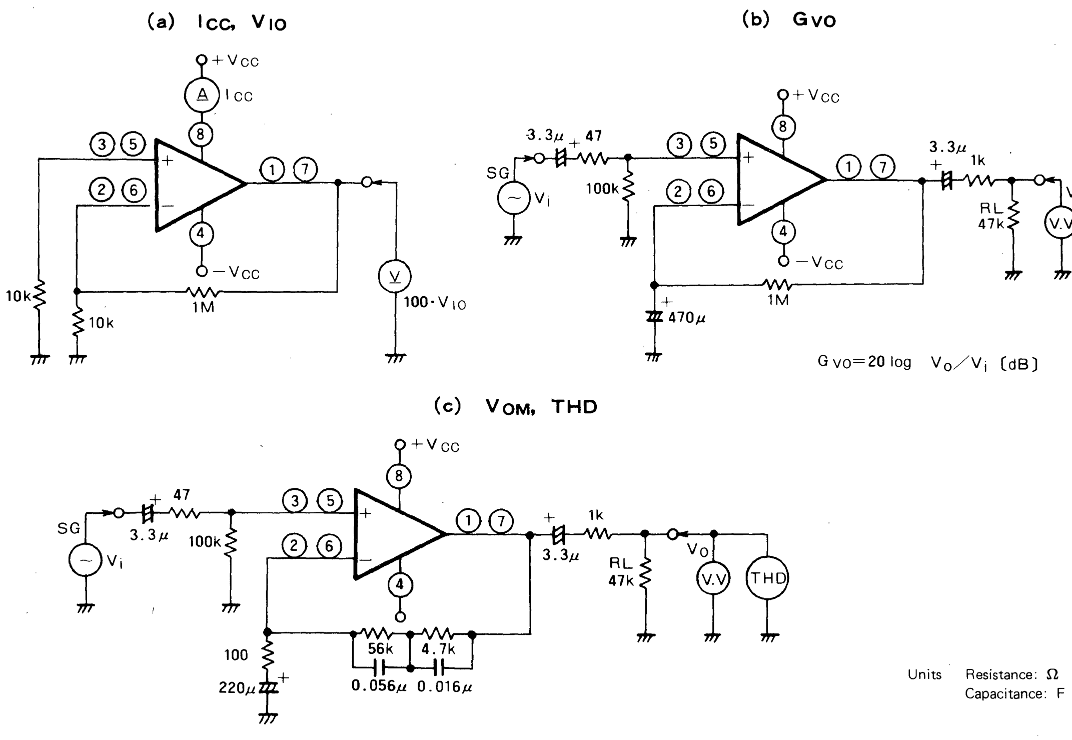
ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		±25 (50)	V
I_{LP}	Load current		±50	mA
Vid	Differential input voltage		±30	V
Vic	Common input voltage		±22.5V	V
Pd	Power dissipation		800 (SIL) 625 (DIL)	mW
K_θ	Thermal derating	Ta ≧ 25°C	8 (SIL) 6.25 (DIL)	mW/°C
Topr	Operating temperature		−20 ～ +75	°C
Tstg	Storage temperature		−55 ～ +125	°C

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=±22.5V)

Symbol	Parameter	Test conditions	Limits Min	Typ	Max	Unit
I_{CC}	Circuit current	Vin = 0		3.5	7.0	mA
V_{IO}	Input offset voltage	R_S ≦ 10kΩ		0.5	6.0	mV
I_{IB}	Input bias current			0.3		μA
G_{VO}	Open loop voltage gain	f = 100Hz, R_L = 47kΩ, C_{NF} = 470μF	90	110		dB
V_{OM}	Maximum output voltage	f = 1kHz, THD = 0.1%, R_L = 47kΩ, RIAA	12.5	14.0		μVrms
THD	Total harmonic distortion	f = 1kHz, V_O = 5Vrms, R_L = 47kΩ, RIAA		0.001	0.03	%
V_{NI}	Input-referred noise voltage	Rg = 2.2kΩ, BW = 10Hz ～ 30kHz, RIAA		0.9	1.8	μVrms
S/N	Signal-to-noise ratio	Shorted input (Rg = 47Ω), IHF-A network, PHONO = 2.5mVrms, RIAA		77		dB

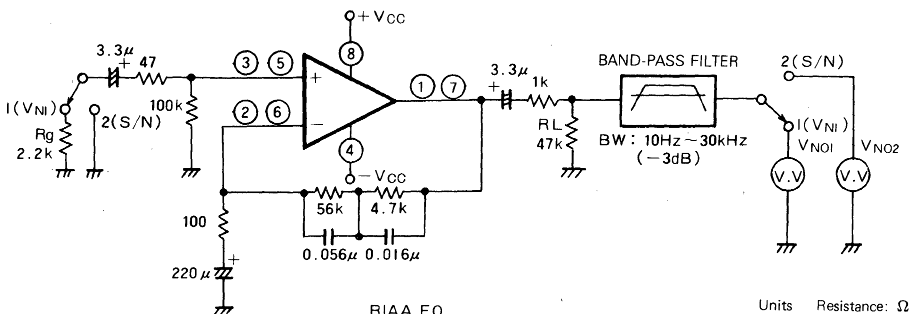
TEST CIRCUITS



Units Resistance: Ω
Capacitance: F

DUAL LOW-NOISE VOLTAGE AMPLIFIERS (DUAL POWER SUPPLY TYPE)

(d) V_{NI}, S/N



RIAA EQ
G_V = 35.6dB = 60 TIMES (@ f = 1kHz)

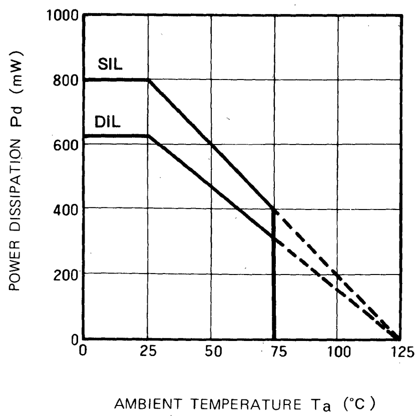
Units Resistance: Ω
Capacitance: F

1. $V_{NI} = V_{NO1}/60$ (μVrms)
2. S/N = 20 log [2.5mVrms/(V_{NO2}/60)] (dB)

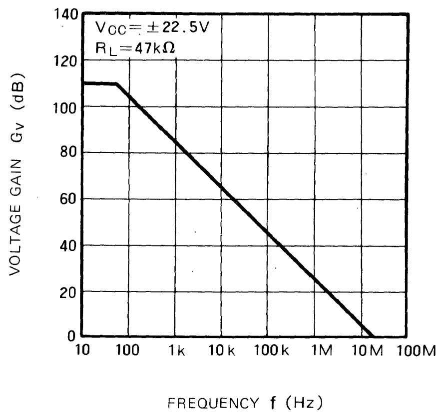
* An AC voltmeter VV with a built-in IHF-A network filter should be used for measuring the S/N ratio.

TYPICAL CHARACTERISTICS

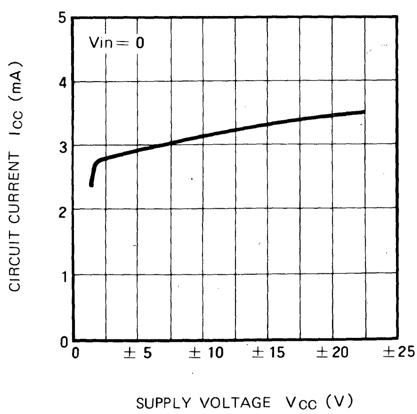
THERMAL DERATING (MAXIMUM RATING)



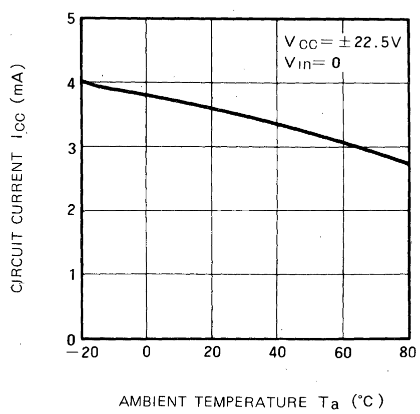
VOLTAGE GAIN VS FREQUENCY



CIRCUIT CURRENT VS SUPPLY VOLTAGE

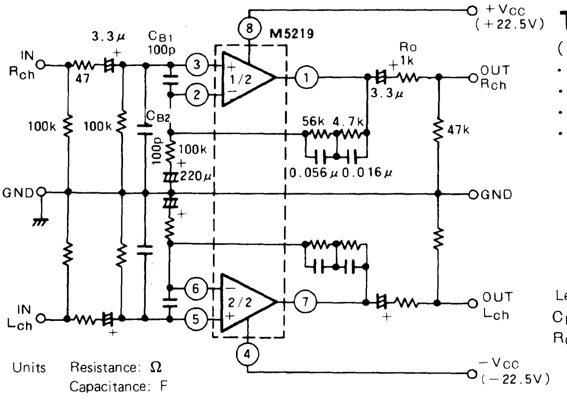


CIRCUIT CURRENT VS AMBIENT TEMPERATURE



APPLICATION EXAMPLES

(1) Stereo equalizer amplifier circuit



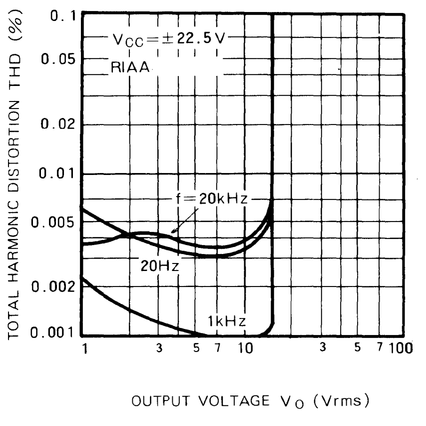
TYPICAL CHARACTERISTICS

(V_{CC} = ±22.5V, RIAA)

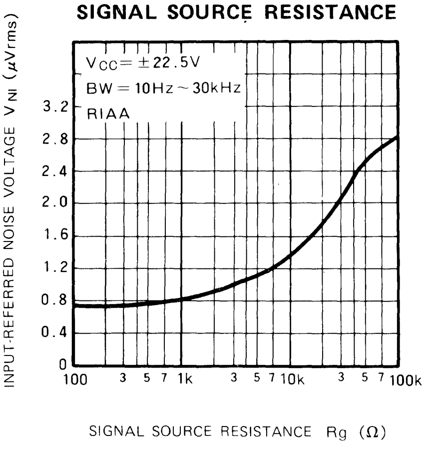
- G_V = 35.6dB (f = 1kHz)
- V_{NI} = 0.9μVrms (R_g = 2.2kΩ, BW = 10Hz ~ 30kHz)
- S/N = 77dB (IHF-A network, shorted input, 2.5mVrms input sensitivity)
- THD = 0.001% (f = 1kHz, V_O = 5 Vrms)

Left channel circuit constants are identical to those of right channel.
C_{B1}, C_{B2} : Capacitors for buzz prevention; use if required.
R_O : Resistor used to prevent parasitic oscillation for capacitive loads and current limiting with shorted and other abnormal load conditions.

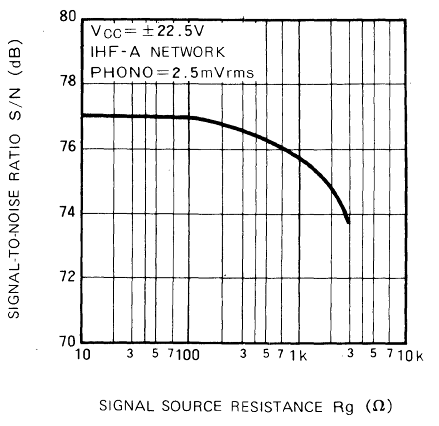
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE



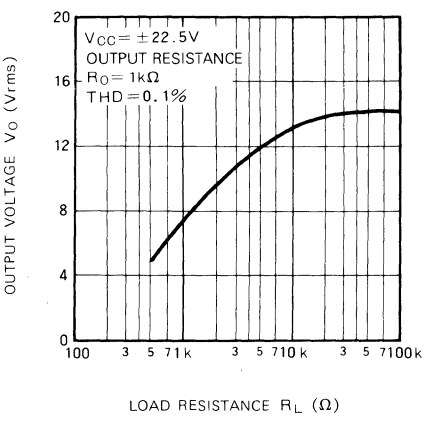
OUTPUT NOISE VOLTAGE VS SIGNAL SOURCE RESISTANCE

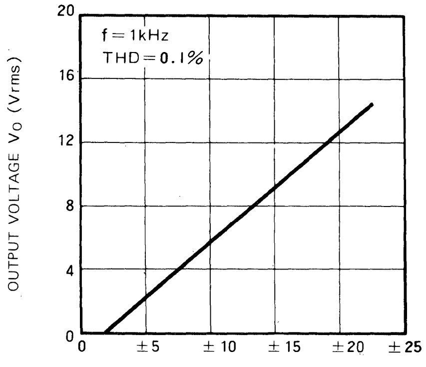


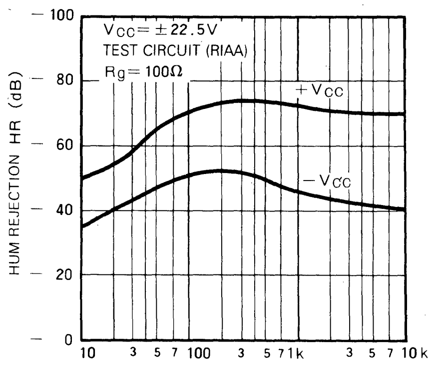
SIGNAL-TO-NOISE RATIO VS SIGNAL SOURCE RESISTANCE



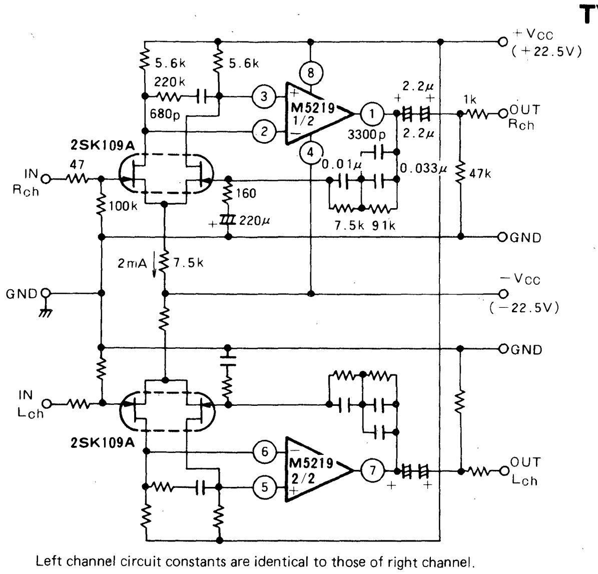
OUTPUT VOLTAGE VS LOAD RESISTANCE







(2) High S/N stereo DC ICL equalizer amplifier circuit

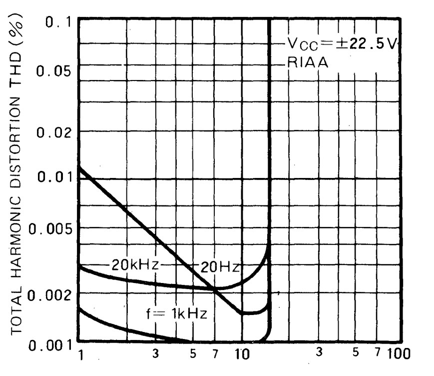


Left channel circuit constants are identical to those of right channel.

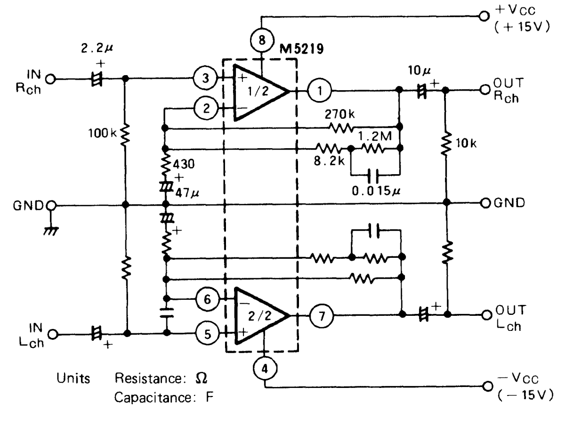
Units Resistance: Ω
Capacitance: F

TYPICAL CHARACTERISTICS (V_{CC}=±22.5V, RIAA)

- S/N=85dB (IHF-A network, shorted input, 2.5mVrms input sensitivity)
- V_{NI}=0.77μVrms(Rg=5.1kΩ, BW=5Hz~100kHz)
- Gv=35.6dB(f=1kHz)



(3) Tape deck equalizer amplifier circuit

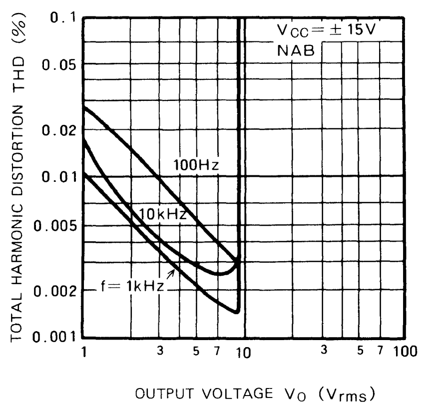


Left channel circuit constants are identical to those of right channel.

TYPICAL CHARACTERISTICS (V_{CC} = ± 15V, NAB)

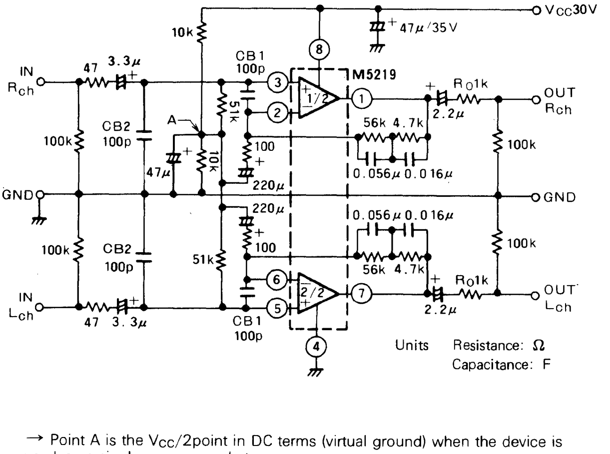
- G_V = 29.9dB (f = 1kHz)
- V_{NI} = 1.4μVrms (R_g = 2.2kΩ, BW = 20Hz ~ 15kHz) (−117dBv)

TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE



(4) Typical single power supply application

PHONO EQUALIZER AMPLIFIER (RIAA)



→ Point A is the Vcc/2point in DC terms (virtual ground) when the device is used as a single power supply type.

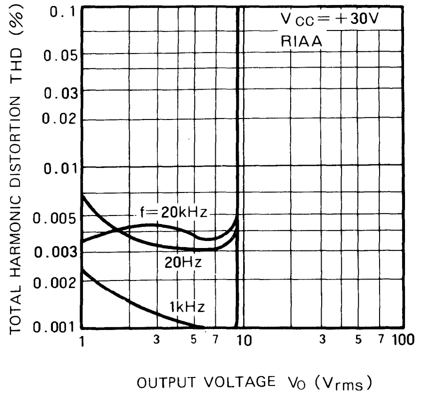
C_{B1}, C_{B2} : Capacitors for buzz prevention; use if required.

R_O : Resistor used to prevent parasitic oscillation for capacitive loads and current limiting with shorted and other abnormal load conditions.

TYPICAL CHARACTERISTICS (V_{CC} = +30V RIAA)

- G_V = 35.6dB (f = 1kHz)
- V_{NI} = 0.9μVrms (R_g = 2.2kΩ, BW = 10Hz ~ 30kHz)
- S/N = 77dB (IHF-A network, shorted input, 2.5mVrms input sensitivity)

TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE



M5220

DUAL LOW-NOISE VOLTAGE AMPLIFIERS (DUAL POWER SUPPLY TYPE)

DESCRIPTION

The M5220 is a dual power supply type of semiconductor integrated circuit designed for preamplifiers in stereo equipment and tape decks. Two low-noise, high-voltage preamplifier circuits displaying internal phase-compensated high grain and low distortion are contained in a 8-pin (SIL/DIL) package, making the device ideal for use as an equalizer amplifier or tone control amplifier in stereo equipment and tape decks. The device can also be used as a single power supply type and employed with low supply voltages, making it suitable as a general-purpose amplifier in stereo radio-cassette tape recorders and other portable equipment.

FEATURES

- Low noise (R_g = 2.2k, R1AA) ·········· V_{NI} = 0.75μVrms (typ.)
  S/N = 83dB (typ.) (shorted input, IHF-A network RIAA, PHONO = 2.5mVrms)
- High voltage ······································ V_{CC} = ±25V (50V)
- High maximum allowable PHONO input voltage
  ··················· V_i = 235mVrms (typ.) (V_{CC} = ±22.5V, f = 1kHz)
- High gain, low distortion G_{VO} = 113dB, THD = 0.001% (typ.)
- High slew rate ··················· SR = 6.5V/μs (typ.)
- High load current, high power dissipation
  ·· I_{LP} = ±50mA, P_d = 800mW (SIL) 625mW (DIL)

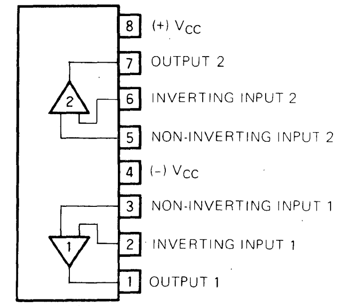
APPLICATION

General-purpose amplifier in stereo equipment, tape decks, stereo radio-cassette tape recorders and other general electric equipment.

RECOMMENDED OPERATING CONDITIONS

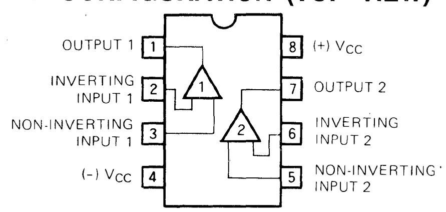
Supply voltage range ·· ±2 ~ ±22.5V
Rated supply voltage ·· ±22.5V

PIN CONFIGURATION (TOP VIEW)

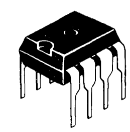


M5220L
Outline 8P5

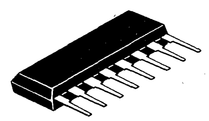
PIN CONFIGURATION (TOP VIEW)



M5220P
Outline 8P4

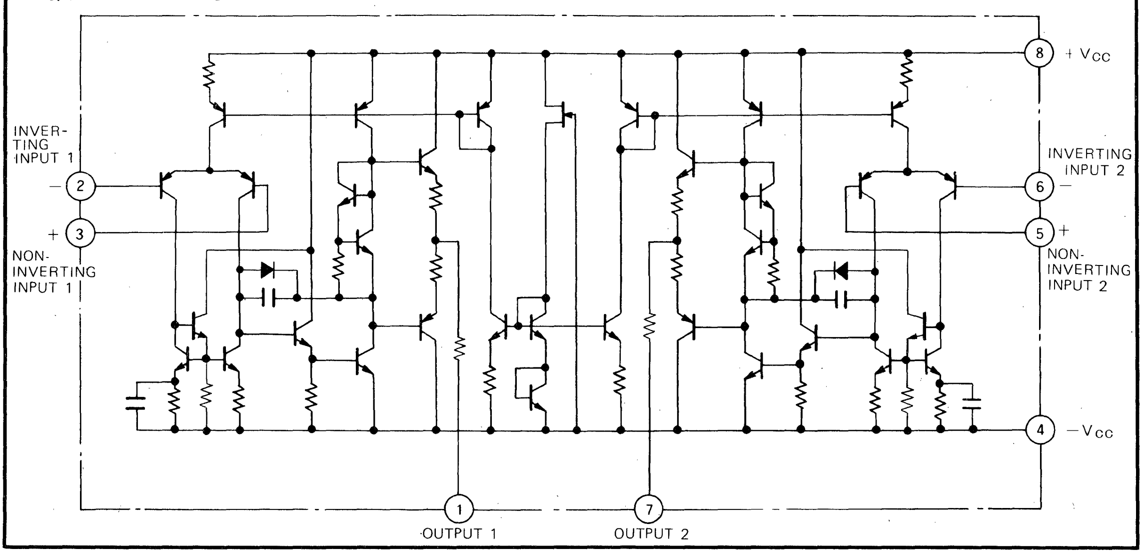


8-pin plastic DIL package



8-pin plastic SIL package

EQUIVALENT CIRCUIT



DUAL LOW-NOISE VOLTAGE AMPLIFIERS (DUAL POWER SUPPLY TYPE)

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

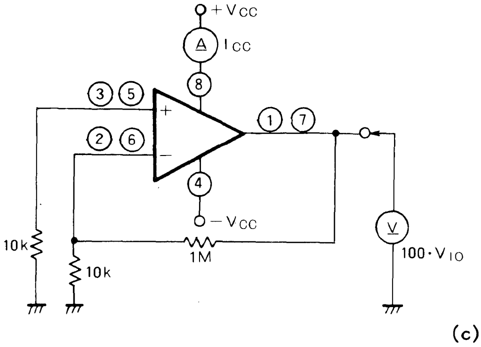
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		±25(50)	V
I_{LP}	Load current		±50	mA
V_{id}	Differential input voltage		±30	V
V_{ic}	Common input voltage		±22.5V	V
P_d	Power dissipation		800(SIL)	mW
			625(DIL)	
K_θ	Thermal derating	T_a≧25℃	8 (SIL)	mW/℃
			6.25(DIL)	
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=±22.5V)

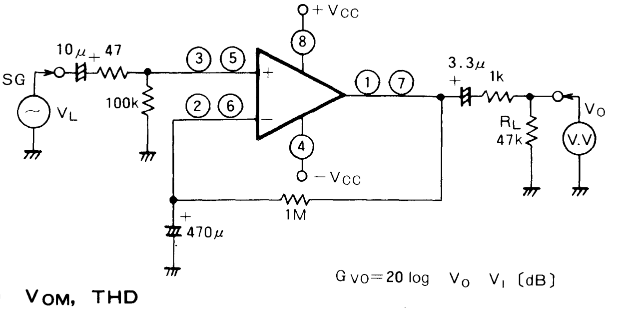
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	Vin = 0		3.5	7.0	mA
V_{IO}	Input offset voltage	R_S≦10kΩ		0.5	6.0	mV
I_{IB}	Input bias current			0.3		μA
G_{VO}	Open loop voltage gain	f=100Hz, R_L=47kΩ, C_{NF}=470μF	90	110		dB
V_{OM}	Maximum output voltage	f=1kHz, THD=0.1%, R_L=47kΩ, RIAA	12.5	14.0		Vrms
THD	Total harmonic distortion	f=1kHz, V_O=5Vrms, R_L=47kΩ, RIAA		0.001	0.03	%
V_{NI}	Input-referred noise voltage	Rg=2.2kΩ, BW=10Hz～30kHz, RIAA		0.9	1.8	μVrms
S/N	Signal-to-noise ratio	Shorted input (Rg=47Ω), IHF-A network, PHONO=2.5mVrms, RIAA		77		dB

TEST CIRCUITS

(a) I_{CC}, V_{IO}

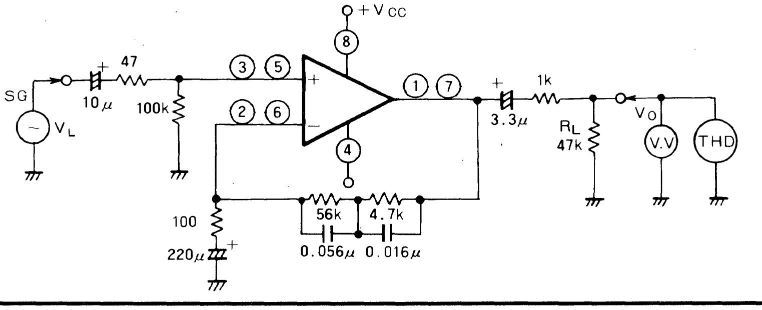


(b) G_{VO}



G_{VO}=20 log V_O V_I [dB]

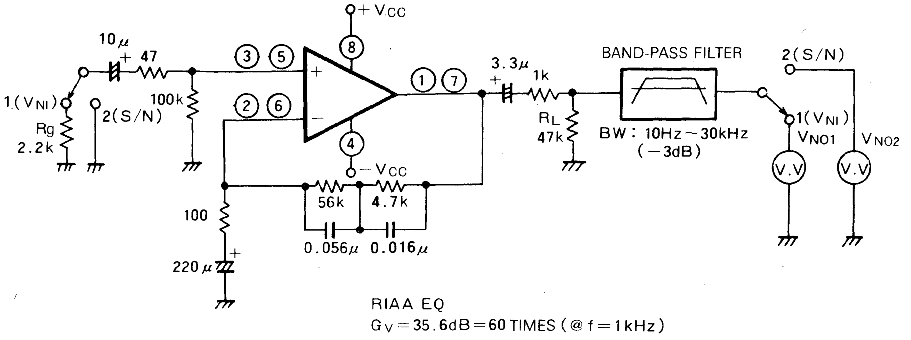
(c) V_{OM}, THD



Units Resistance: Ω
Capacitance: F

DUAL LOW-NOISE VOLTAGE AMPLIFIERS (DUAL POWER SUPPLY TYPE)

(d) V_{NI}, S/N



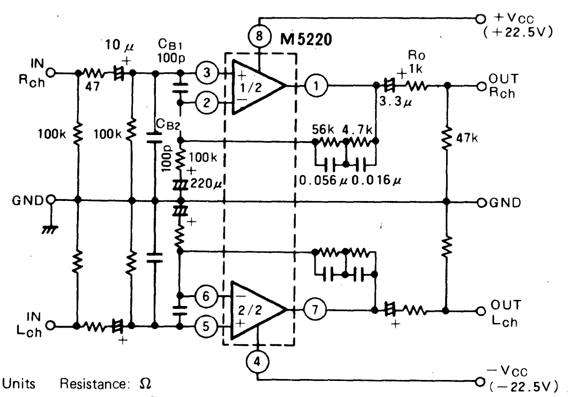
Units Resistance: Ω
Capacitance: F

1. $V_{NI}=V_{NO1}/60$ (μVrms)
2. $S/N=20\log[2.5\text{mVrms}/(V_{NO2}/60)]$ (dB)

* An AC voltmeter VV with a built-in IHF-A network filter should be used for measuring the S/N ratio.

APPLICATION EXAMPLES

(1) Stereo equalizer amplifier circuit



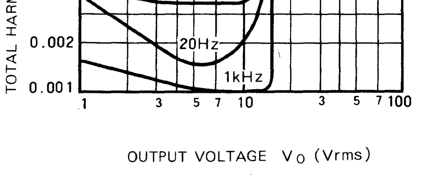
Units Resistance: Ω
Capacitance: F

Left channel circuit constants are identical to those of right channel.
C_{B1}, C_{B2}: Capacitors for buzz prevention; use if required.
R_O: Resistor used to prevent parasitic oscillation for capacitive loads and current limiting with shorted and other abnormal load conditions.

TYPICAL CHARACTERISTICS ($V_{CC}=\pm22.5$V, RIAA)

- $G_V=35.6$dB(f=1kHz)
- $V_{NI}=45\mu$Vrms($R_g=2.2$kΩ, BW=10Hz~30kHz)
- S/N=83dB (IHF-A network, shorted input, 2.5mVrms input sensitivity)
- THD=0.001%(f=1kHz, V_O=5 Vrms)

TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE



MITSUBISHI ELECTRIC

M5221/M5T082P

DUAL J-FET INPUT OPERATIONAL AMPLIFIERS

DESCRIPTION

The M5221/M5T082P are a semiconductor integrated circuit designed as a high-performance dual operational amplifier which adopts J-FETs in the input stage.

The device comes in an 8-pin SIL or DIL package and it contains two circuits for yielding a high input impedance, high slew rate, low bias current and other excellent characteristics. It can be widely used as a general-purpose operational amplifier in stereo equipment, tape decks, digital audio disc players and other similar products as well as in VTRs, video disc players and video-related players.

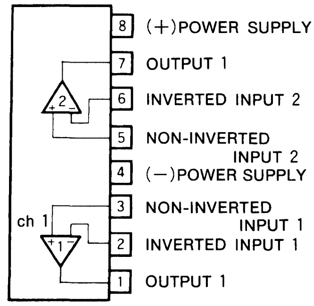
FEATURES

- High input impedance due to J-FET input .... Ri = 1000Mohms(typ.)
- High slew rate .... SR = 13V/μs(typ.)
- High gain and low distortion .... GV_O = 100dB, THD = 0.002%(typ.)
- High load current and allowable power .... I_{LP} = ±50mA, P_d = 800mW(SIL), 625mW(DIL)

APPLICATION

General-purpose operational amplifiers in stereo equipment, tape decks, digital audio disc players, VTRs and video disc players.

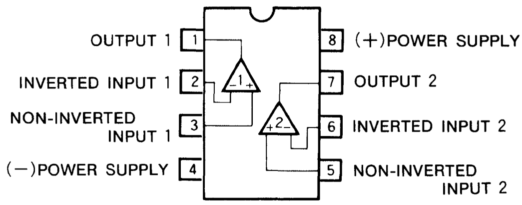
PIN CONFIGURATION (TOP VIEW)



M5221L

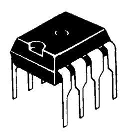
Outline 8P5

PIN CONFIGURATION (TOP VIEW)

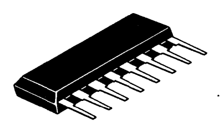


M5221P/M5T082P

Outline 8P4

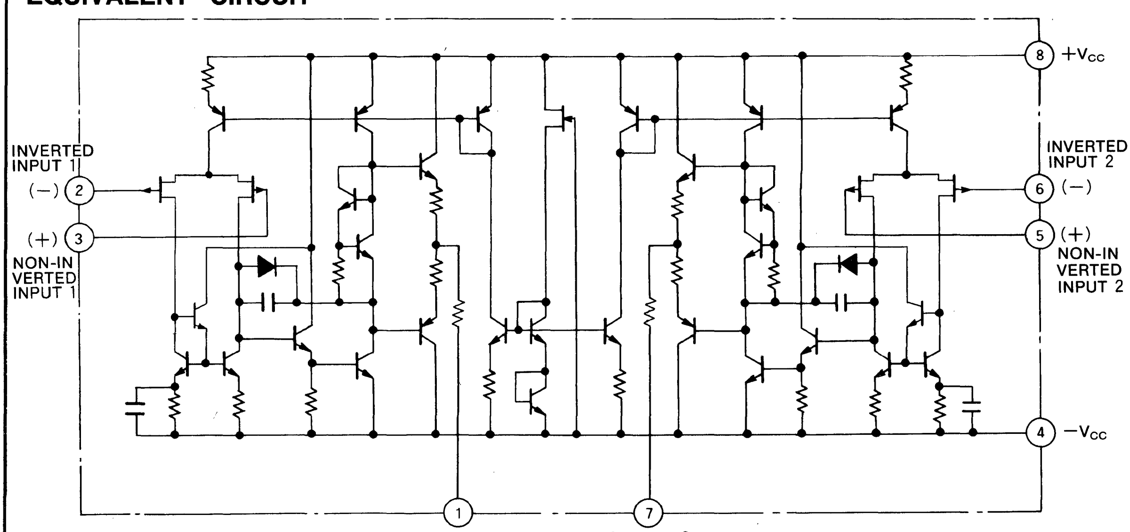


8-pin molded plastic DIL



8-pin molded plastic SIL

EQUIVALENT CIRCUIT



DUAL J-FET INPUT OPERATIONAL AMPLIFIERS

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

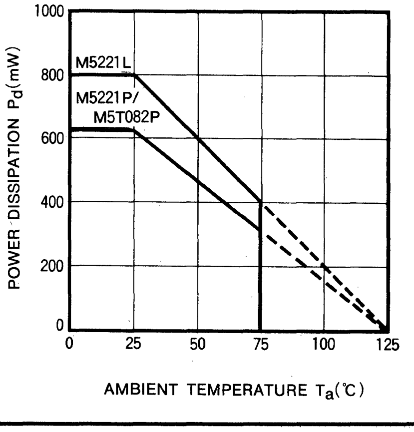
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		±18	V
I_{LP}	Load current		±50	mA
V_{id}	Differential input voltage		±30	V
V_{ic}	Common input voltage		±15	V
P_d	Power dissipation		800(SIL)	mW
			625(DIL)	
K_θ	Thermal derating	T_a≧25℃	8(SIL)	mW/℃
			6.25(DIL)	
T_{opr}	Ambient temperature		−20～+75	℃
T_{stg}	Storage temperature		−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=±15V)

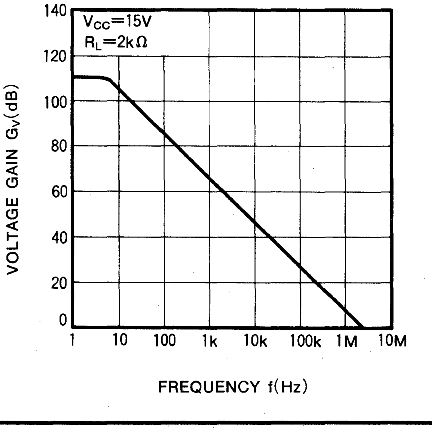
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	V_{IN}=0	—	3.0	6.0	mA
V_{IO}	Input offset voltage	R_S≦10kΩ	—	5.0	15.0	mV
I_{IO}	Input offset current		—	5	200	pA
I_{IB}	Input bias current		—	30	400	pA
R_{in}	Input resistance		—	106	—	MΩ
G_{VO}	Open loop voltage gain	R_L≧2kΩ, V_O=±10V	86	106	—	dB
V_{OM}	Maximum output voltage	R_L≧10kΩ	±12	±14	—	V
		R_L≦2kΩ	±10	±13	—	V
V_{CM}	Common input voltage width		±12	±14	—	V
CMRR	Common mode rejection ratio	R_S≦10kΩ	70	76	—	dB
SVRR	Supply voltage rejection ratio	R_S≦10kΩ	—	30	150	μV/V
P_d	Power dissipation		—	90	180	mW
SR	Slew rate	G_V=0dB, R_L=2kΩ	—	13	—	V/μs
f_T	Gain bandwidth product		—	3	—	MHz

TYPICAL CHARACTERISTICS

THERMAL DERATING
(MAXIMUM RATING)



VOLTAGE GAIN VS
FREQUENCY RESPONSE



M5223/M5N358P

DUAL SINGLE POWER SUPPLY OPERATIONAL AMPLIFIERS

DESCRIPTION

The M5223/M5N358P are a semiconductor integrated circuit designed as a dual operational amplifier which permits single power supply operation.

The device comes in a compact 8-pin SIL or DIL package and it contains two circuits for yielding a high internal phase compensation and high performance. For both input and output operation is possible from the GND level and this makes it possible for the device to be used widely as a general-purpose operational amplifier in the motor control circuits of such equipment as cassette decks, turntables, VTRs and digital audio disc players as well as in automotive electronic products and communications equipment. It can also be employed as a simple comparator.

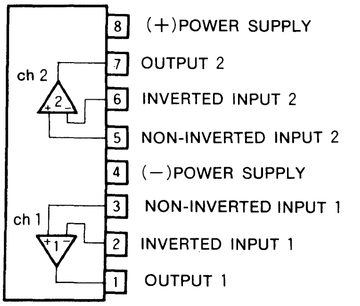
FEATURES

- Wide common input voltage range and operation permitted with GND level input ························ $V_I = 0.3\sim36V$
- Output voltage level can be reduced to near the GND level
- Wide operating supply voltage range and single power supply operation possible············ $V_{CC} = 3V\sim36V$(max.)
- High voltage gain··························· $G_{VO} = 100dB$(typ.)
- High allowable power dissipation
 ································ $P_d = 800mW$(SIL), $625mW$ (DIL)

APPLICATION

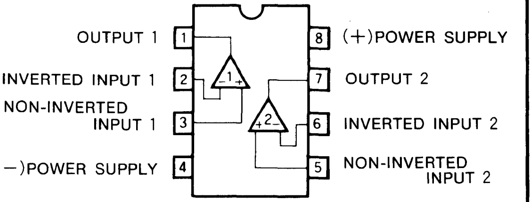
General-purpose amplifier in control circuits of cassette decks, turntables, VTRs, video disc players and audio disc players; general-purpose amplifier in automotive electronic products, communications equipment and copying machines. General-purpose amplifier in radio-controlled and electronic toys, and electronic games.

PIN CONFIGURATION (TOP VIEW)

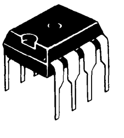


M5223L
Outline 8P5

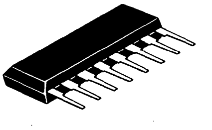
PIN CONFIGURATION (TOP VIEW)



M5223P/M5N358P
Outline 8P4

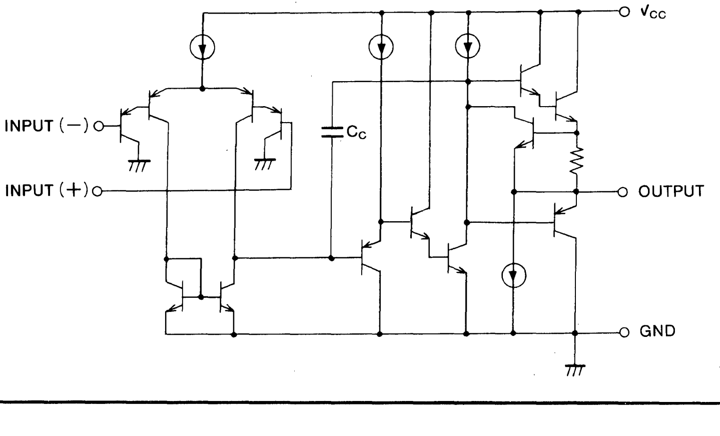


8-pin molded plastic DIL



8-pin molded plastic SIL

EQUIVALENT CIRCUIT



Two circuits are featured in the circuit on the left.

DUAL SINGLE POWER SUPPLY OPERATIONAL AMPLIFIERS

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

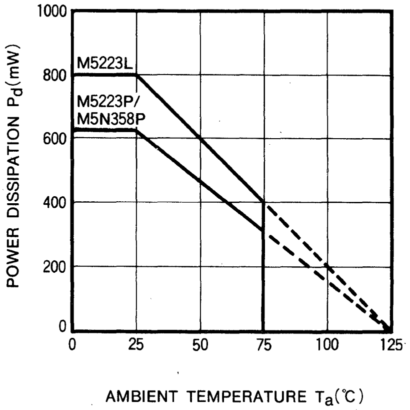
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		36(±18)	V
I_{LP}	Load current		50	mA
V_{id}	Differential input voltage		36	V
V_I	Input voltage		−0.3〜+36	V
P_d	Power dissipation		800(SIL)	mW
			625(DIL)	
K_θ	Thermal derating	T_a≧25℃	8(SIL)	mW/℃
			6.25(DIL)	
T_{opr}	Ambient temperature		−20〜+75	℃
T_{stg}	Storage temperature		−55〜+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=±15V)

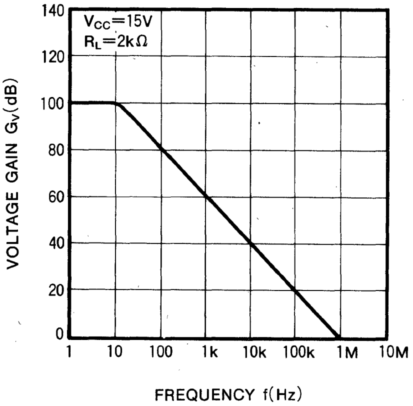
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	V_{IN}=0	—	0.7	1.2	mA
V_{IO}	Input offset voltage	R_S≦50kΩ	—	2	7	mV
I_{IO}	Input offset current		—	5	50	nA
I_{IB}	Input bias current		—	30	250	nA
C_{SR}	Channel separation	f=1kHz	—	120	—	dB
G_{VO}	Open loop voltage gain	R_L≧2kΩ	90	100	—	dB
V_{OH}	Maximum output voltage	R_L≧2kΩ	12.0	13.5	—	V
V_{OL}		R_L≦2kΩ	—	0.9	1.8	V
V_{CM}	Common input voltage width		−0.3	—	13.5	V
CMRR	Common mode rejection ratio	R_S≦50kΩ	—	85	—	dB
SVRR	Supply voltage rejection ratio	R_S≦50kΩ	—	100	—	dB
P_d	Power dissipation		—	10.5	18	mW
SR	Slew rate	G_V=0dB, R_L=2kΩ	—	0.6	—	V/μs
I_{source}	Output source current		20	40	—	mA
I_{sink}	Output sink current		10	20	—	mA

TYPICAL CHARACTERISTICS

THERMAL DERATING (MAXIMUM RATING)



VOLTAGE GAIN VS FREQUENCY RESPONSE



M5224P/M5N324P

QUAD SINGLE POWER SUPPLY OPERATIONAL AMPLIFIER

DESCRIPTION

The M5224P/M5N324P are a semiconductor integrated circuit designed as a quad operational amplifier which permits single power supply operation.

The device comes in a standard 14-pin DIL package and it contains four circuits for yielding a high internal phase compensation and high performance. For both input and output operation is possible from the GND level and this makes it possible for the device to be used widely as a general-purpose operational amplifer in the motor control circuits of such equipment as cassette decks, turntables, VTRs and digital audio disc players as well as in automotive electronic products and communications equipment. It can also be employed as a simple comparator.

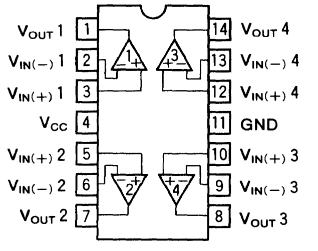
FEATURES

- Wide common input voltage range and operation permitted with GND level input ····················· $V_I = -0.3 \sim +36V$
- Output voltage level can be reduced to near the GND level
- Wide operating supply voltage range and single power supply operation possible ········ $V_{CC} = 3V \sim 36V (V_{CC}$ max)
- High voltage gain ····························· $G_{VO} = 100dB$(typ.)
- High allowable power dissipation ················ $P_d = 700mW$

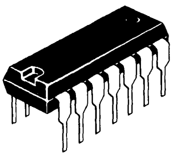
APPLICATIONS

General-purpose amplifier in control circuits of cassette decks, turntables, VTRs, video disc players and audio disc players; general-purpose amplifier in automotive electronic products, communications equipment and copying machines. General-purpose amplifier in radio-controlled and electronic toys, and electronic games.

PIN CONFIGURATION (TOP VIEW)

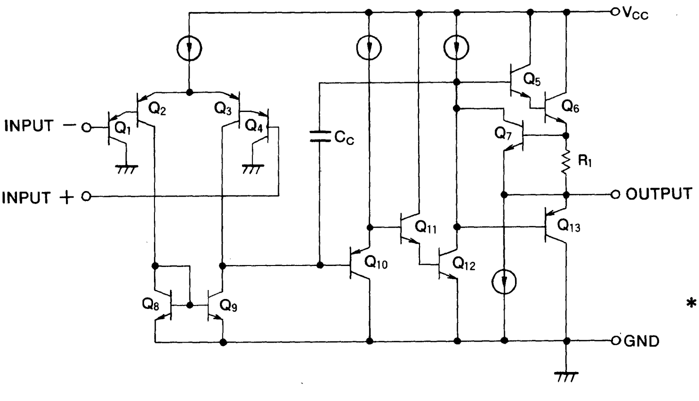


Outline 14P4



14-pin molded plastic DIL

EQUIVALENT CIRCUIT



* Four circuits are featured in the circuit on the left.

QUAD SINGLE POWER SUPPLY OPERATIONAL AMPLIFIER

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

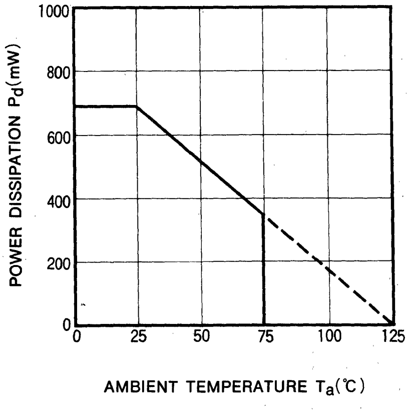
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		36 (±18)	V
I_{LP}	Load current		±50	mA
V_{IO}	Differential input voltage		±36	V
V_I	Input voltage		−0.3～+36	V
P_d	Power dissipation		700	mW
K_θ	Thermal derating	T_a≧25℃	7.0	mW/℃
T_{opr}	Ambient temperature		−20～+75	℃
T_{stg}	Storage temperature		−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=+15V)

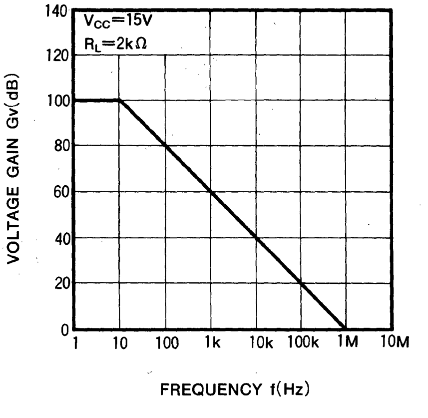
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	Vin=0	—	1.2	2.5	mA
V_{IO}	Input offset voltage	V_S≦10kΩ	—	2	7	mV
I_{IO}	Input offset current		—	5	50	nA
I_{IB}	Input bias current		—	30	250	nA
C_{SR}	Channel separation	f=1kHZ	—	120	—	dB
G_{VO}	Open loop voltage gain	R_L≧2kΩ	90	100	—	dB
V_{OH}	Maximum output voltage	R_L≧2kΩ	12.0	13.5	—	V
V_{OL}	Maximum output voltage	R_L≧2kΩ	—	0.9	1.8	V
V_{CM}	Common input voltage width		−0.3	—	+13.5	V
CMRR	Common mode rejection ratio	R_S≦10kΩ	—	85	—	dB
SVRR	Supply voltage rejection ratio	R_S≦10kΩ	—	100	—	dB
P_d	Power dissipation		—	18	37.5	mW
SR	Slew rate	G_V=0₀B, R_L=2kΩ	—	0.6	—	V/μs
Isource	Output source current		20	40	—	mA
Isink	Output sink current		10	20	—	mA

TYPICAL CHARACTERISTICS

THERMAL DERATING CURVE (MAXIMUM RATING)



VOLTAGE GAIN VS FREQUENCY RESPONSE



MITSUBISHI ELECTRIC

M5230L

VARIABLE OUTPUT VOLTAGE REGULATOR (DUAL TRACKING TYPE)

DESCRIPTION

The M5230L is a semiconductor integrated circuit consisting of a power supply for use as a dual tracking power supply.
It is housed in an 8-pin SIL package. The output voltage can be adjusted over the wide range from ±3~±30V by adjusting the value of the voltage setting external resistors. By adjusting the resistance of the external balance setting resistors the positive/negative output voltage ratio can also be set freely. Again by attaching power transistors high current gains can be achieved, making the device suitable for use in the power supplies of a wide variety of equipment.

FEATURES

- High input voltage ································· (V_I=±35V)
- Wide range of output voltages ············ (V_O=±3~±30V)
- Low output noise voltage·············· (V_{NO}=12μVrms typ.)
- Built-in current limiting and thermal shutdown circuits
- The output voltage risetime constant of the coefficients can be adjusted by the value of the external capacitor.
- Capability of operation control by the external control signal (8)

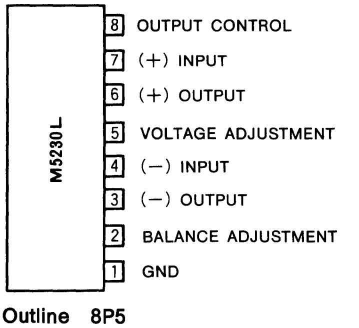
APPLICATIONS

- Dual voltage power supplies for stereo preamplifiers and power amplifiers.
- For the power supplies of other equipment, including operational amplifiers.

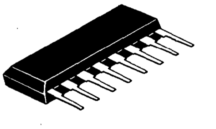
RECOMMENDED OPERATING CONDITIONS

Supply voltage range······································ ±8~±35
Rated supply voltage·· ±20V

PIN CONFIGURATION (TOP VIEW)

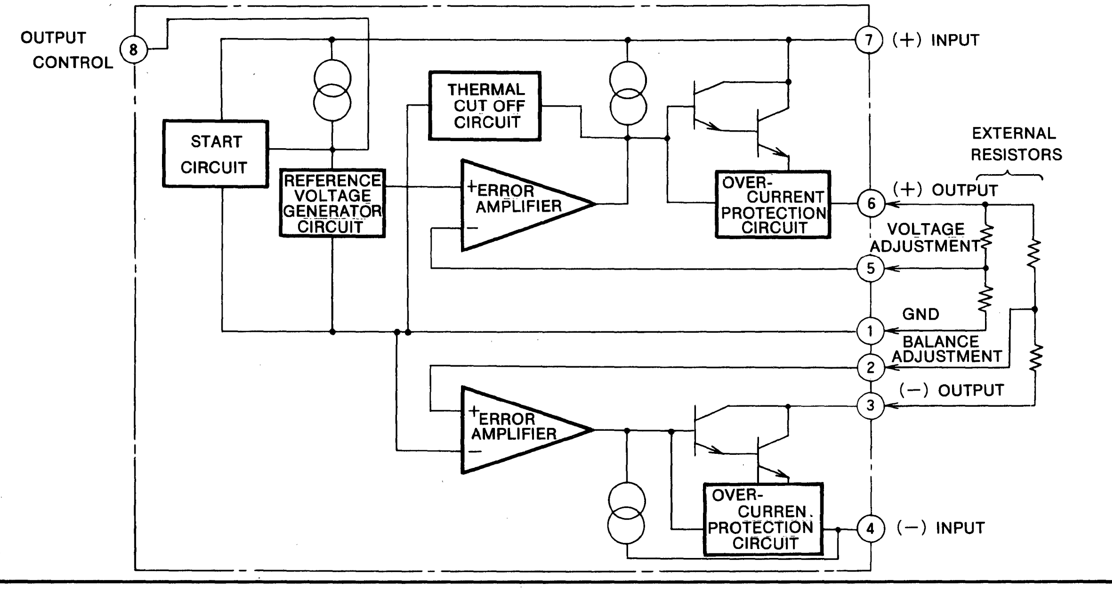


Outline 8P5



8-pin molded plastic SIL

BLOCK DIAGRAM



VARIABLE OUTPUT VOLTAGE REGULATOR (DUAL TRACKING TYPE)

ABSOLUTE MAXIMUM RATINGS (T_a=25℃)

Symbol	Parameter	Limit	Unit
V_I	Input voltage	±35	V
I_L	Load current	±30	mA
V_I-V_O	Input-output voltage difference	±32	V
P_d	Power dissipation	800	mW
T_{opr}	Operating temperature	−20～+75	℃
T_{stg}	Storage temperature	−55～+125	℃

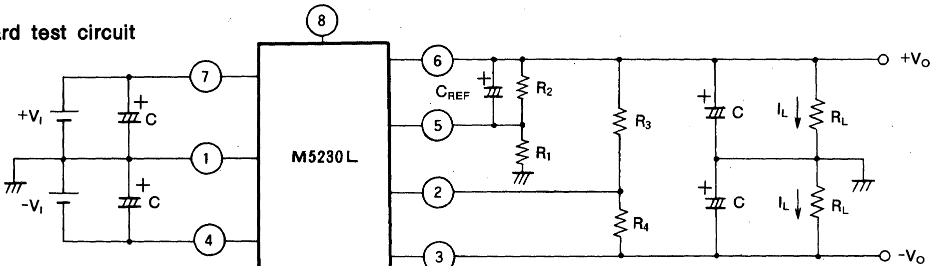
ELECTRICAL CHARACTERISTICS

(measurement circuit (a) is used with, T_a=25℃, V_I=±20V, V_O=±15V, I_L=10mA, C=10μF, C_{REF}=1μF, R_I=3.3kΩ, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_I	Input voltage		±8		±35	V
V_O	Output voltage	R_2=1.5～55kΩ	±3		±30	V
V_{REF}	Reference voltage	(between pin⑤ and pin①)	(1.66)	1.8	(1.95)	V
V_I-V_O	Minimum input-output voltage differential			2.5	3	V
$\Delta V_O\pm$	Dual voltage tracking				1	%
$R_{eg\text{-}in}$	Input regulation	V_I=±18～±30V		0.02	0.1	%/V
$R_{eg\text{-}L}$	Load regulation	I_L=0～20mA		0.02	0.1	%
I_B	Bias current	I_L=0(disregarding the current in resistors R_1, R_2, R_3, R_4)		1.3	3.0	mA
TC_{VO}	Temperature coefficient of output voltage	T_a=0～75℃, V_O=±3～±30V		0.01		%/℃
RR	Ripple rejection	f=120Hz(measured with circuit(b))		68		dB
V_{NO}	Output noise voltage	f=20Hz～100kHz(between the output terminal and ground)		12		μVrms
$V_{O(OFF)}$	Output cut-off voltage	V_I=10V			±0.1	V

TEST CIRCUITS

(a) Standard test circuit



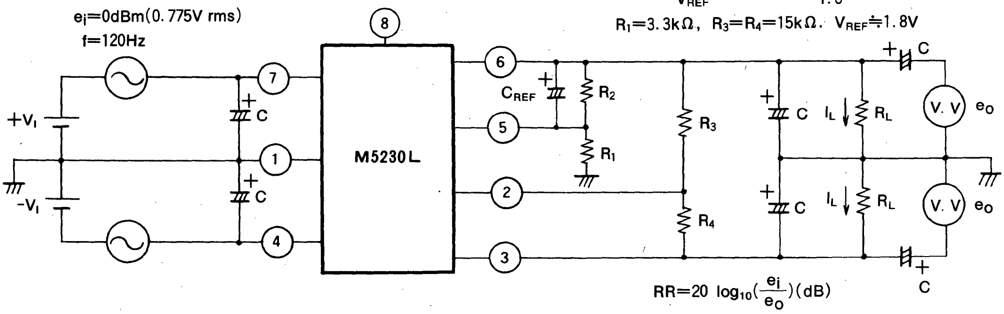
$+V_O=V_{REF}(1+\frac{R_2}{R_1})\fallingdotseq 1.8\times(1+\frac{R_2}{3.3})(V)$

$-V_O=+V_O\cdot\frac{R_4}{R_3}$ (V)

$R_2=R_1(\frac{V_O}{V_{REF}}-1)\fallingdotseq 3.3\times(\frac{+V_O}{1.8}-1)(K\Omega)$

R_1=3.3kΩ, R_3=R_4=15kΩ. $V_{REF}\fallingdotseq$1.8V

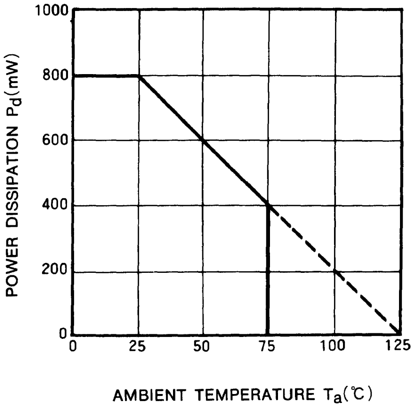
(b) Ripple rejection test circuit



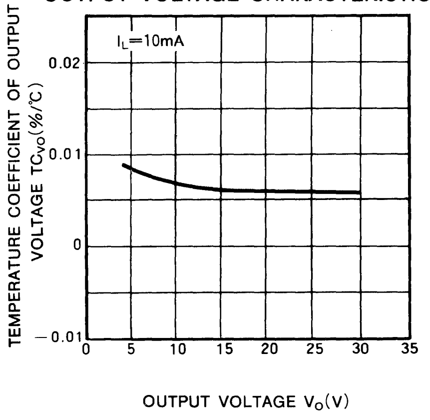
$RR=20\ \log_{10}(\frac{e_i}{e_O})$(dB)

TYPICAL CHARACTERISTICS

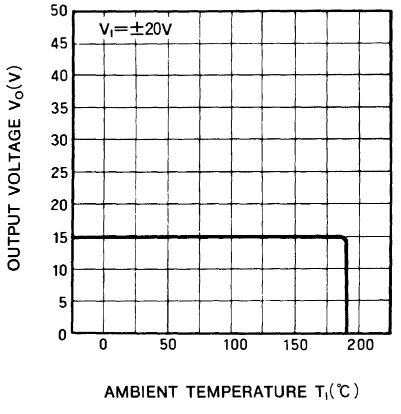
THERMAL DERATING (MAXIMUM RATING)



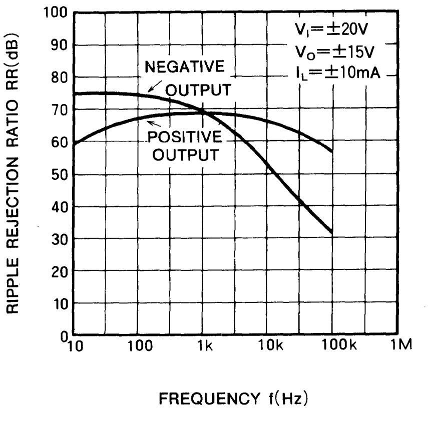
TEMPERATURE COEFFICIENT OF OUTPUT VOLTAGE VS OUTPUT VOLTAGE CHARACTERISTICS



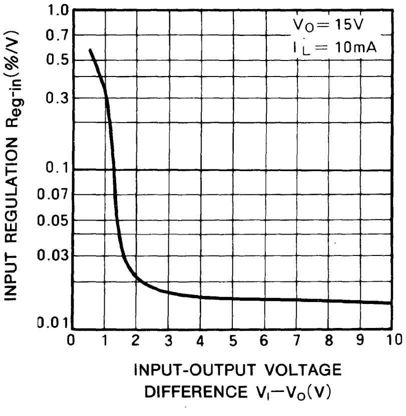
THERMAL CUTOFF



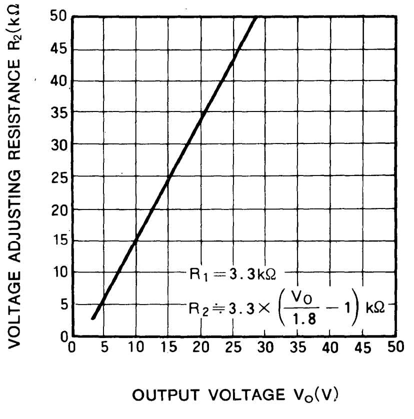
RIPPLE REJECTION



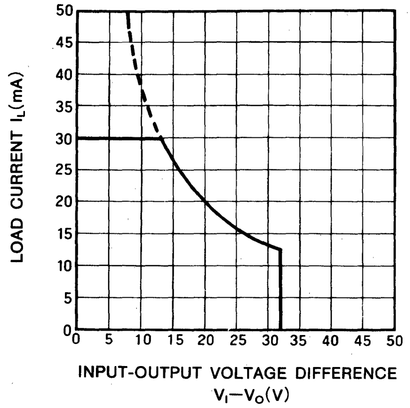
INPUT REGULATION VS INPUT-OUTPUT VOLTAGE DIFFERENCE



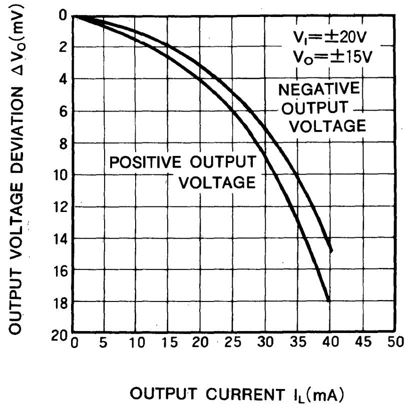
VOLTAGE ADJUSTING RESISTANCE VS OUTPUT VOLTAGE



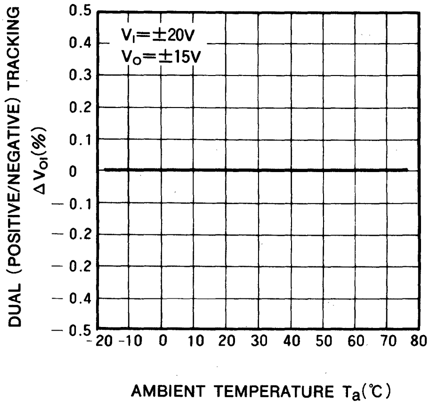
LOAD CURRENT VS INPUT-OUTPUT VOLTAGE DIFFERENCE



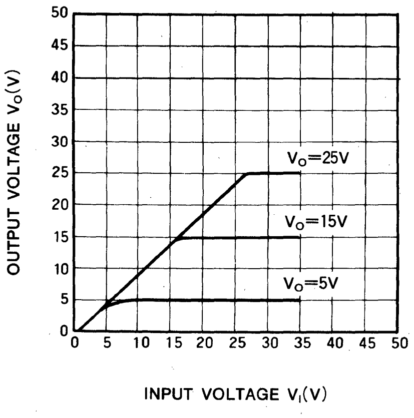
OUTPUT VOLTAGE REGULATION



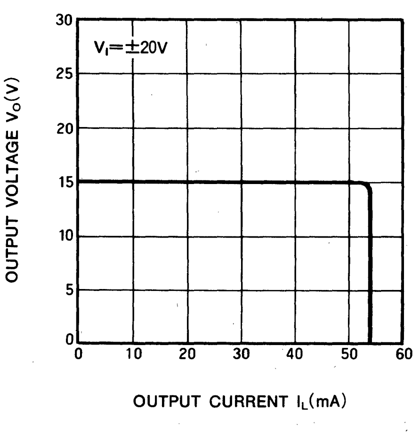
DUAL-TRACKING TEMPERATURE CHARACTERISTICS



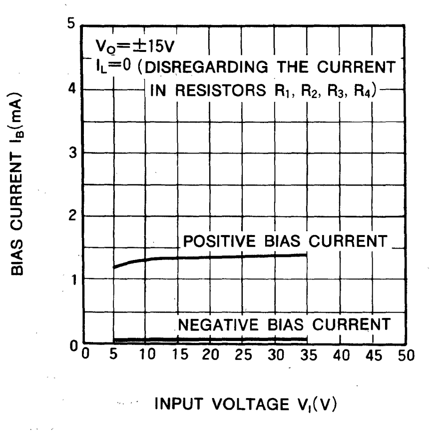
OUTPUT VOLTAGE CHARACTERISTICS



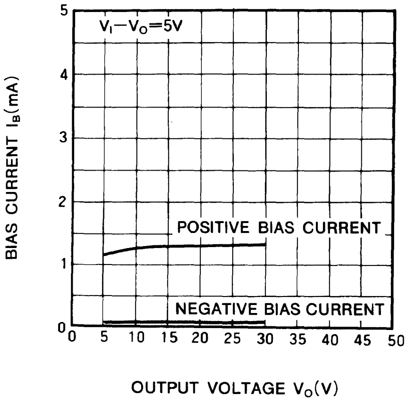
LOAD CHARACTERISTICS



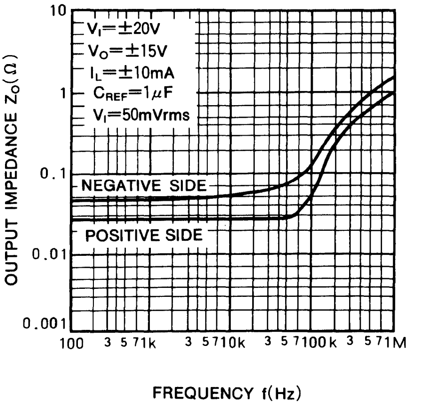
BIAS CURRENT VS INPUT VOLTAGE



BIAS CURRENT
VS OUTPUT VOLTAGE

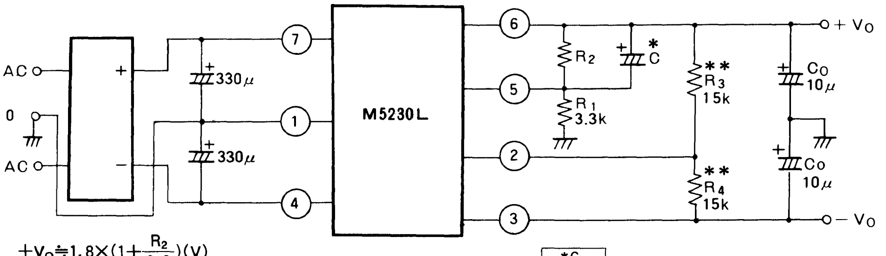


OUTPUT IMPEDANCE
VS FREQUENCY



APPLICATION EXAMPLES

(1) Typical application circuit



$+V_O \doteqdot 1.8\times(1+\frac{R_2}{3.3})$(V)

$R_2 \doteqdot 3.3\times(\frac{V_O}{1.8}-1)$(kΩ) $-V_O=(+V_O)\cdot\frac{R_4}{R_3}$(V)

Note : When the input power supply lines become long, a 0.1μF capacitor should be connected between input power supply pins ⑦ and ④ and ground.

*C

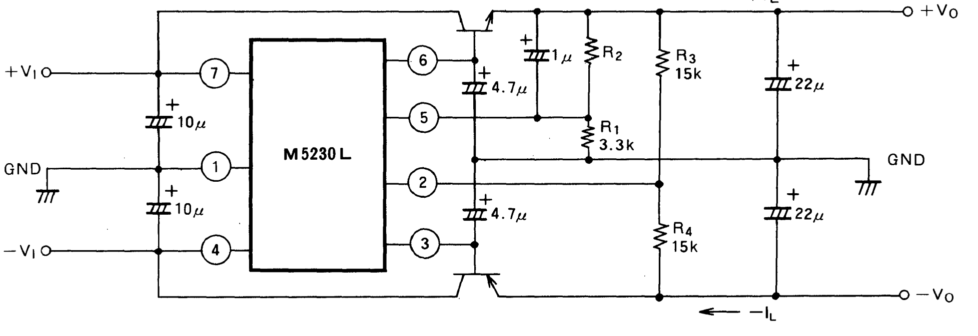
The connection of this capacitor gives the following characteristics.

1) The rise time constant of the output voltage can be adjusted (slowed) (See Fig.1)
2) The ripple rejection ratio is improved.
3) Noise output voltage is reduced.

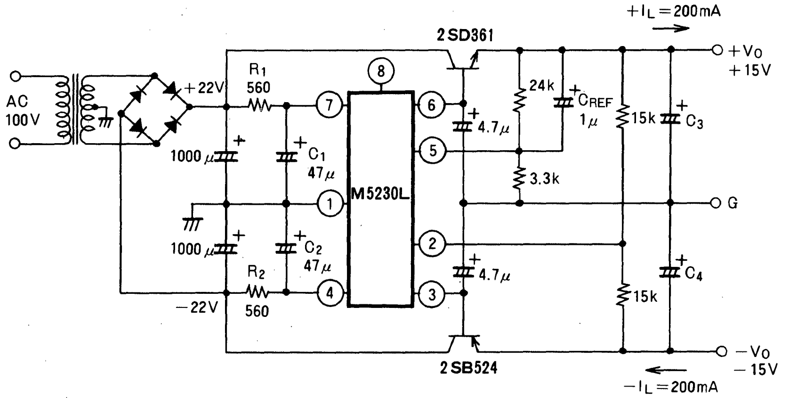
**R3. R4

By changing the ratio of these two resistances the positive/negative voltage ratio can also be set freely. (See Fig.2)

(2) Typical application circuit with power transistors connected

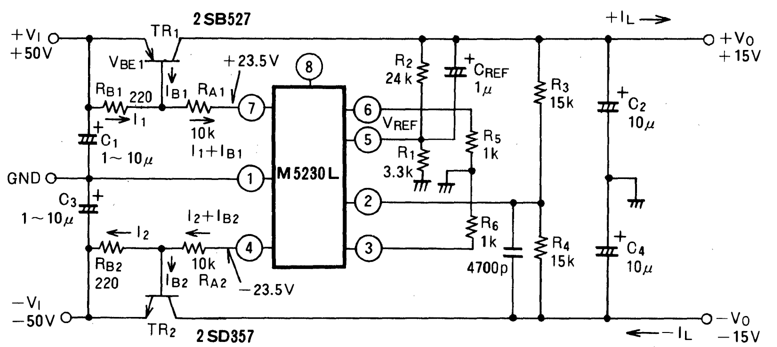


(3) High ripple rejection circuit (80dB)



- Ripple rejection is gained by the input resistance R1, (R2), and condensor C1, (C2).
- C_{REF} can reduce noise to the 1/10 of that of 3—Terminal regulator IC, and also can improve the ripple rejection. In addition, by increasing the capacitance of the C_{REF}, the constant at set-up of the output voltage V_O can be adjusted. (Soft set-up enable).

(4) High input voltage (V_I=±50V)

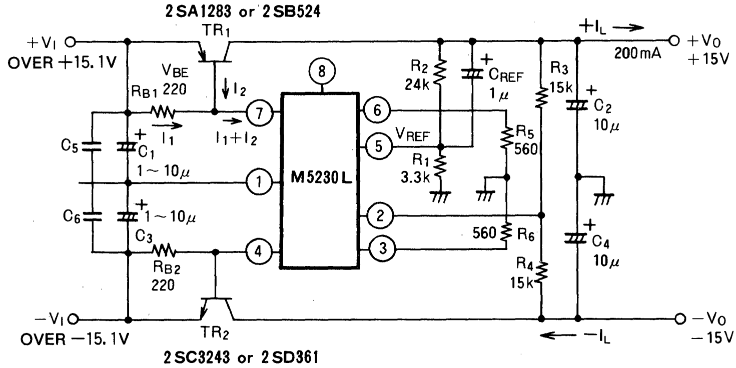


- By the resistance R_{A1}, (R_{A2}), the voltage that will be supplied to pins ⑦, ④ can be lower.
- Resistances R_5 and R_6 are for load current limit. Keep the I/O voltage (V_{IO}) difference between ⑦—⑥ more than 3V.

$$V_I - V_{BE1} - (I_I + I_{BI} - I_B)R_5 > 3V$$

$$I_I = V_{BE}/R_{BI}, \quad I_{BI} = I_L/h_{FE}$$

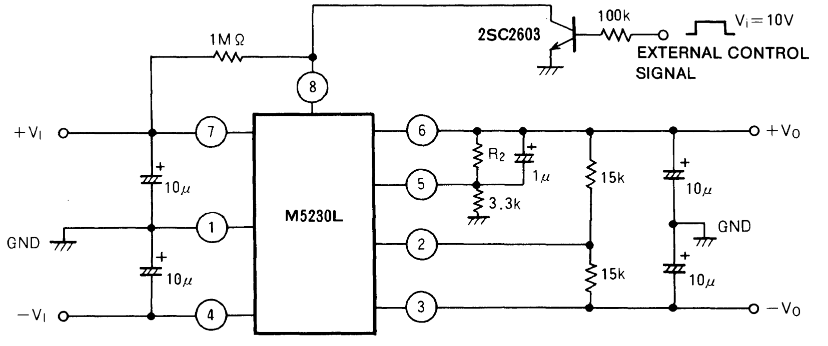
(5) Low dropout regulator circuit (V_{I-O}=0.1V)

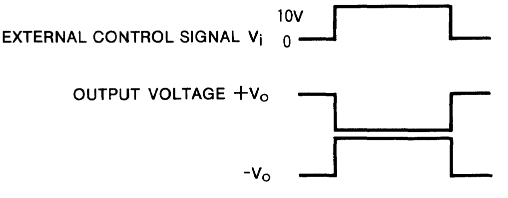


- Stable operations are expected even if the input-output voltage differences are quite low as 0.1V.
- The heat sink of power TR can become small in size owing to the low dissipation.

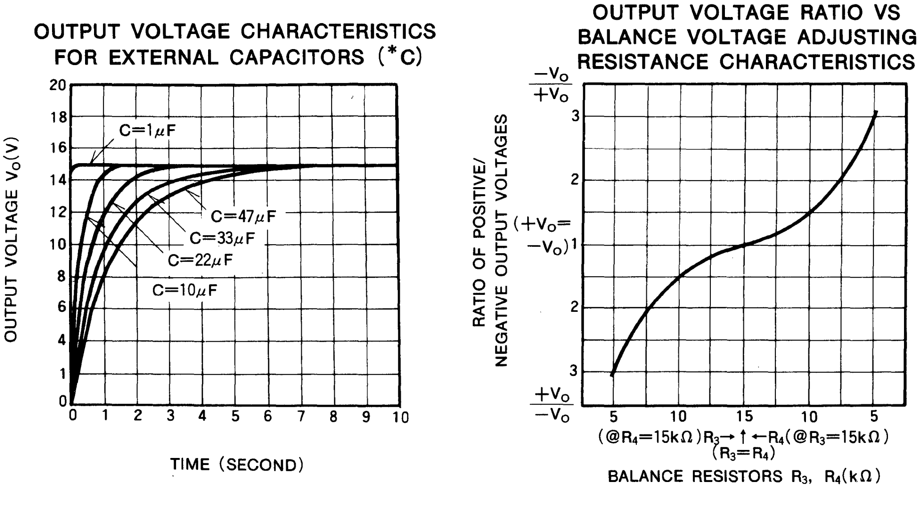
(Note) The load current can be over 1A by connecting the external power TR.

(6) ON · OFF control of output voltage circuit





EXAMPLES OF THE CHARACTERISTICS ACHIEVED



M5231L

VARIABLE OUTPUT VOLTAGE REGULATOR

DESCRIPTION

The M5231L is a semiconductor integrated circuit which is designed for variable output voltage regulator and is housed in a small 5-pin SIL package.

The input range 8 ~ 70V, and the output voltage range 3 ~ 50V can be optionally adjusted by the external resistors. In addition, by attaching power transistors, high current gains can be achieved, making the device suitable for use in the power supplies of a wide variety of equipment.

FEATURES

- High input voltage (V_I=70V)
- Wide range of output voltages (V_O=3V~50V)
- Low output noise voltage (V_{NO}=6μVrms typ.)
- Built-in current limiting and thermal shutdown circuits
- Capability of adjusting the output voltage rise time constant of the coefficients by the value of the external capacitor
- Capability of the operating control by the external signal

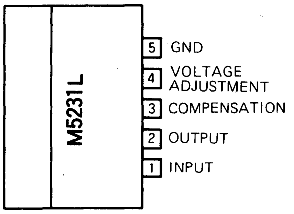
APPLICATIONS

- Audio, VTR
- General use

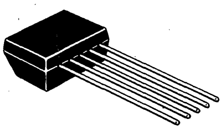
RECOMMENDED OPERATING CONDITIONS

Supply voltage range .... 8~70V
Rated supply voltage 40V

PIN CONFIGURATION (TOP VIEW)

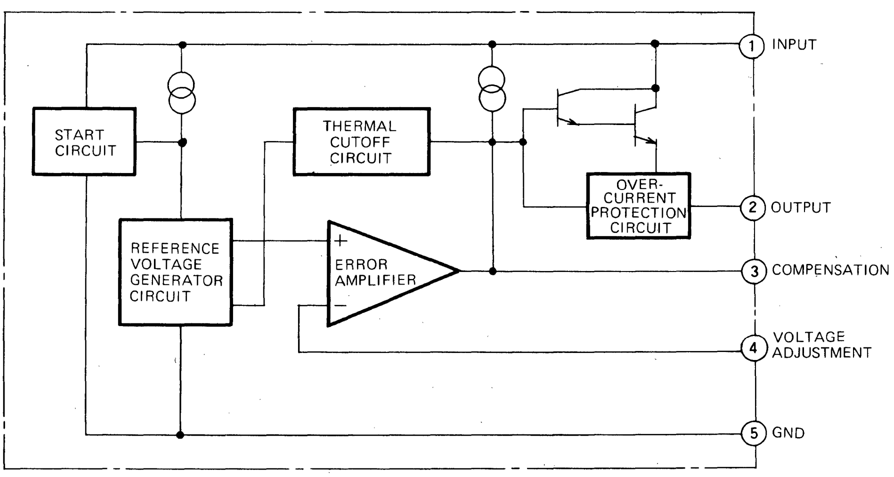


Outline 5P5



5 pin plastic SIL

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

VARIABLE OUTPUT VOLTAGE REGULATOR

ABSOLUTE MAXIMUM RATINGS (T_a=25℃)

Symbol	Parameter	Limits	Unit
V_I	Input voltage	70	V
I_L	Load current	30	mA
V_I-V_O	Input-output voltage difference	67	V
Pd	Power dissipation	300	mW
Topr	Operating temperature	−20～+75	°C
Tstg	Storage temperature	−55～+125	°C

ELECTRICAL CHARACTERISTICS

(measurement circuit (a) is used, with, T_a = 25℃, V_I = 40V, V_O = 35V, I_L = 10mA, C = 10 μF, C_{REF} = 1 μF, R_1 = 3.3kΩ, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_I	Input voltage		8		70	V
V_O	Output voltage	R_2≈1.5～88kΩ	3		50	V
V_{REF}	Reference voltage	(between Pin ④ and Pin ⑤)	(1.62)	1.8	(1.98)	V
V_I-V_O	Minimum input-output voltage differential			2.0		V
Reg-in	Input regulation	V_I=38～60V		0.04	0.1	%/V
Reg-L	Load regulation	I_L=0～20mA		0.03	0.1	%
I_B	Bias current	I_L=0 (disregarding the current in resistors R_1, R_2)		1.2	3.0	mA
TC_{VO}	Temperature coefficient of output voltage	Ta=0～75°C, V_O=3～50V		0.01		%/°C
RR	Ripple rejection	f=120Hz (measured with circuit (b))		62		dB
V_{NO}	Output noise voltage	f=20Hz～100kHz (between the output terminal and ground)		6		μVrms

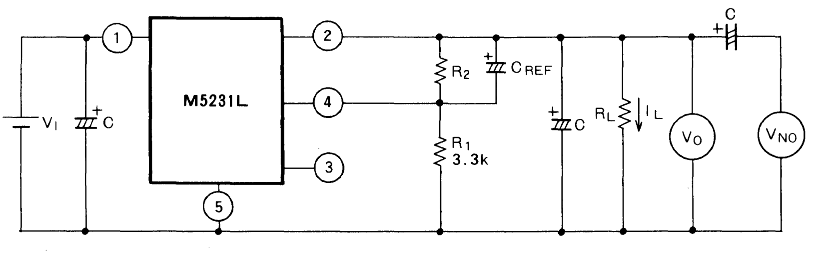
TEST CIRCUITS

(a) Standard test circuit

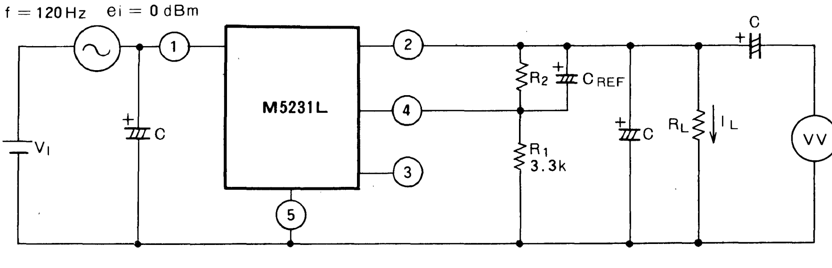
$$V_O = V_{REF}\left(1+\frac{R_2}{R_1}\right) \fallingdotseq 1.8\times\left(1+\frac{R_2}{3.3}\right) \quad (V)$$

$$R_2 = R_1\left(\frac{V_O}{V_{REF}}-1\right) \fallingdotseq 3.3\times\left(\frac{V_O}{1.8}-1\right) \quad (k\Omega)$$

R_1 = 3.3kΩ, V_{REF} ≒ 1.8V



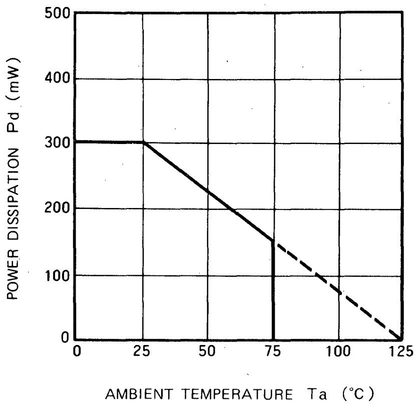
(b) Ripple rejection test circuit



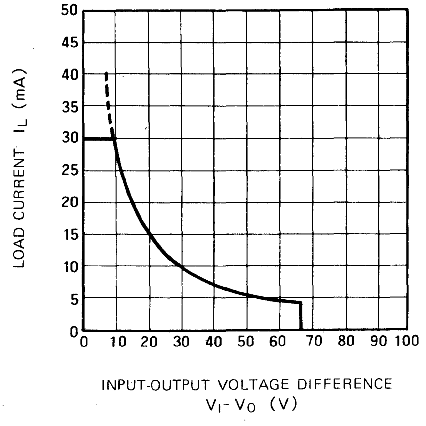
$$RR = 20\log\left(\frac{e_i}{e_o}\right) \quad (dB)$$

TYPICAL CHARACTERISTICS

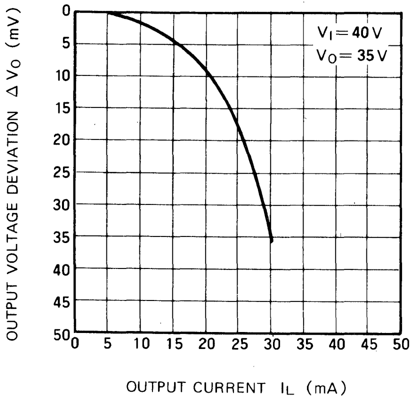
THERMAL DERATING



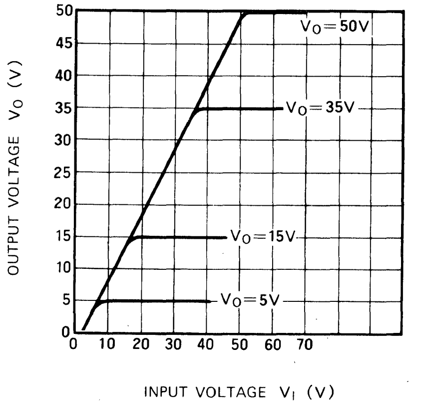
LOAD CURRENT VS INPUT-OUTPUT VOLTAGE DIFFERENCE



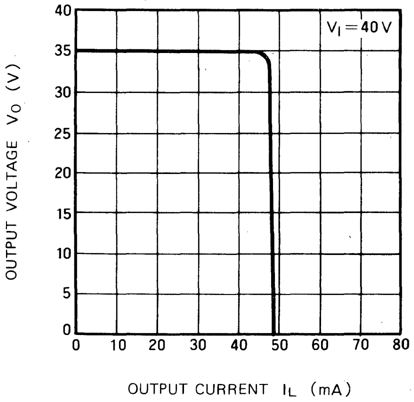
OUTPUT VOLTAGE REGULATION



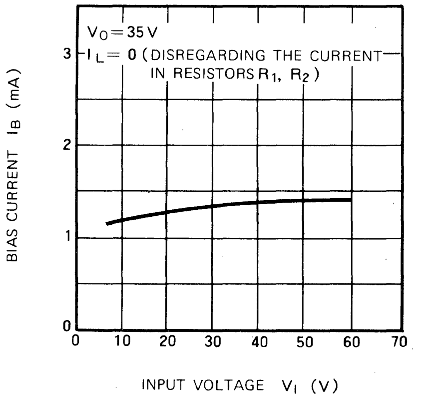
OUTPUT VOLTAGE CHARACTERISTICS



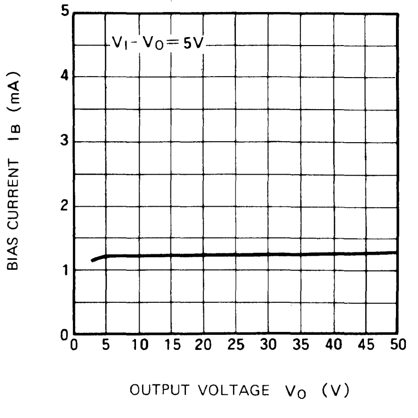
LOAD CHARACTERISTICS



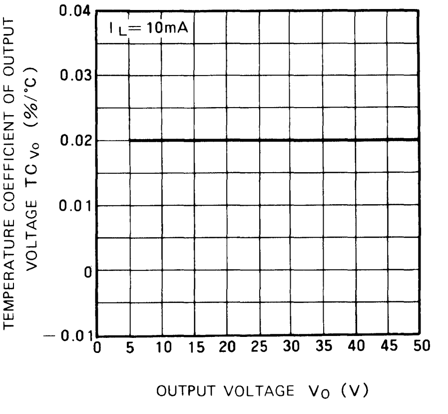
BIAS CURRENT VS INPUT VOLTAGE



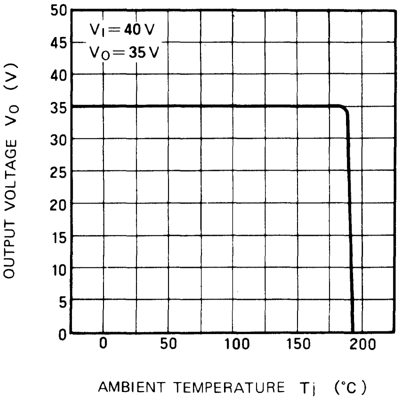
BIAS CURRENT VS OUTPUT VOLTAGE



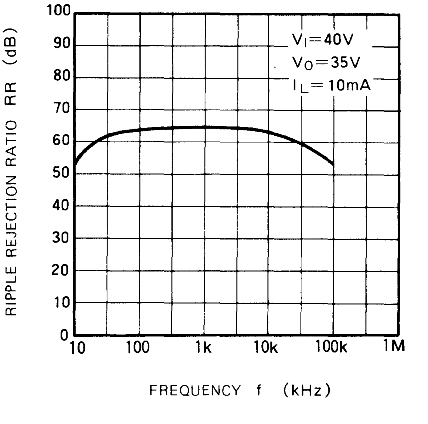
TEMPERATURE COEFFICIENT OF OUTPUT VOLTAGE VS OUTPUT VOLTAGE CHARACTERISTICS



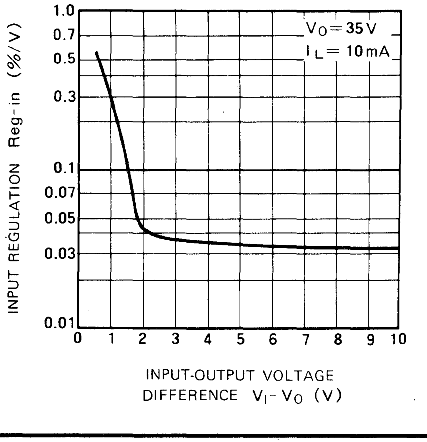
THERMAL CUTOFF



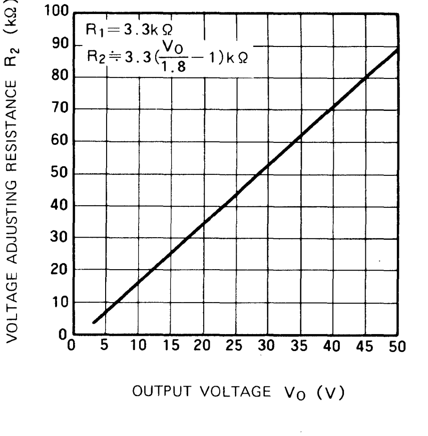
RIPPLE REJECTION



INPUT REGULATION VS INPUT-OUTPUT VOLTAGE DIFFERENCE

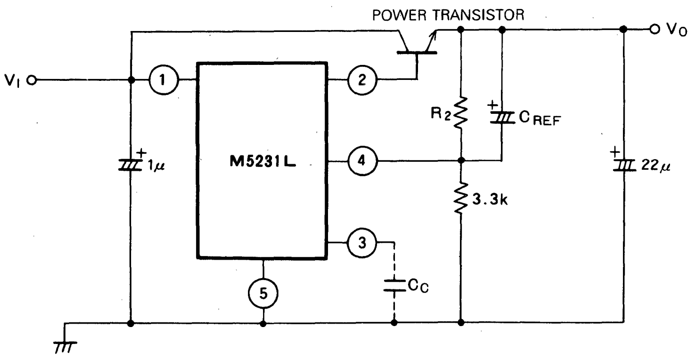


VOLTAGE ADJUSTING RESISTANCE VS OUTPUT VOLTAGE



APPLICATION EXAMPLES

1. Current boost circuit with NPN external power TR



C_{REF}

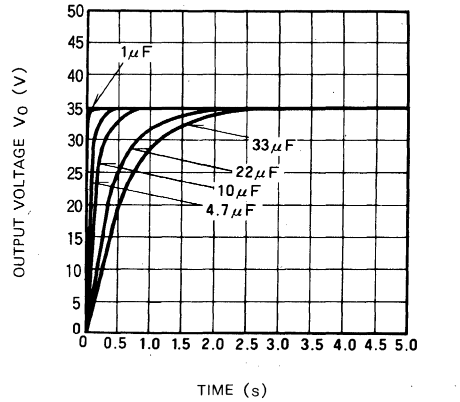
The connection of this capacitor gives the following characteristics.

1) The rise time constant of the output voltage can be adjusted (slowed).
2) The ripple rejection ratio is improved.
3) Output noise voltage is reduced down to 1/10 of three terminals regulator IC.

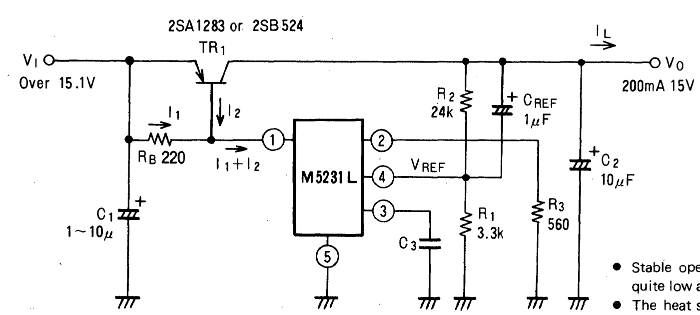
C_C

Capability of the compensation by connecting the capacitor.

OUTPUT VOLTAGE CHARACTERISTICS FOR EXTERNAL CAPACITORS (C_{REF})



2. Low dropout regulator circuits (V_{IO}=0.1V) Ripple rejection 65dB



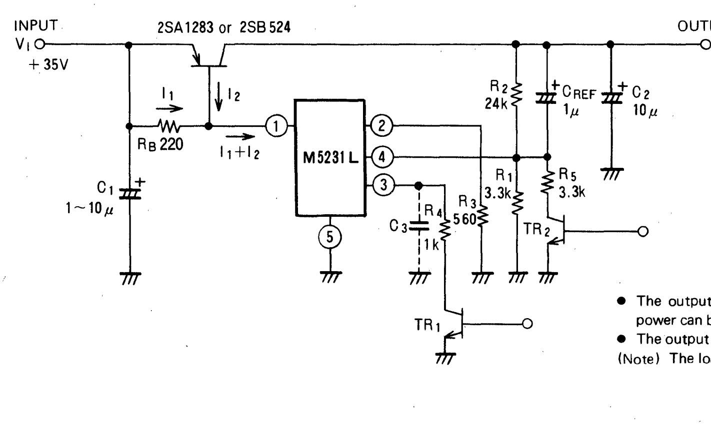
$$I_2=\frac{I_L}{h_{FE}} \fallingdotseq 2\,\text{mA} \qquad (h_{FE}\,100)$$

$$I_1=\frac{V_{BE}}{R_B} \fallingdotseq 3\,\text{mA}$$

- Stable operations are expected even if the input-output voltage differences are quite low as 0.1V.
- The heat sink of power TR can become small in size owing to the low dissipation.
- The R_3 is a load current limit resistor and the input-output voltage differencial between ① and ② pins must be over 3V.

$$V_I-V_{BE}-(I_1+I_2-I_B)R_3>3V$$

3. Output voltage ON/OFF controller, Step UP/DOWN controller



+28V when TR_2 is ON
+15V when TR_2 is OFF

- The output voltage V_O is 0V when the TR_1 of ③ pin is ON. Therefore, the power can be on/off depending on each case.
- The output voltage V_O is changeable by switching the TR_2.

(Note) The load current can be over 1A by connecting the external power TR.

M5232L

VOLTAGE DETECTION FOR ALARM SYSTEM (LED TURN ON AND OFF)

DESCRIPTION

The M5232L is a semiconductor circuit designed for voltage detection for alarm system(LED turn ON and OFF).

Housed in its compact 8-pin SIL package featuring excellent operation are the comparator, reference voltage source, vibrator circuit for LED turn ON and OFF and voltage regulate circuit. When the input voltage at pin(7) is higher than the internal reference voltage, the LED is made to light and when it is lower, it is made to turn ON and OFF. Also provided is an output pin(pin (6)) which does not result in turn ON and OFF, and this makes it possible to drive a relay or micro buzzer while the LED is turn ON and OFF. Signals from the battery reduced voltage checker or from the optical or thermal sensor are detected at the comparator's input(pin (7)) and so the semiconductor can be applied widely in the indicator and protection circuits of electronic equipment.

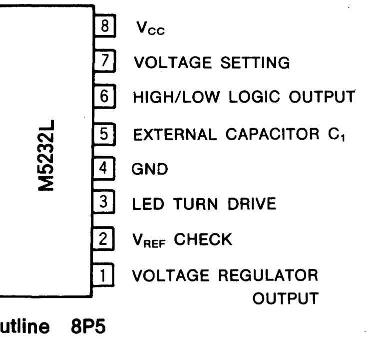
FEATURES

- LED turn ON and OFF start supply voltage can be set to any value using external resistors R_1 and R_2(battery reduced voltage checker)
- LED turn ON and OFF frequency can be set to any value using external capacitor C_1
- Built-in logic output pin(pin (6)) which causes a high-to-low level transition as soon as turn ON and OFF starts
- Hysteresis operation also possible for turn ON and OFF start voltage using pin(6)
- LED lights when input voltage of pin (7) comparator is higher than internal reference voltage, and this can be used as a pilot lamp to indicate the power ON mode.

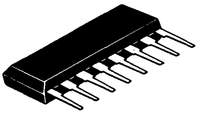
APPLICATION

Radio cassette recorder, portable VTR, checker for battery reduced voltage for such equipment as camera, alarm circuit for electronical equipment, protect circuit.

PIN CONFIGURATION (TOP VIEW)



Outline 8P5

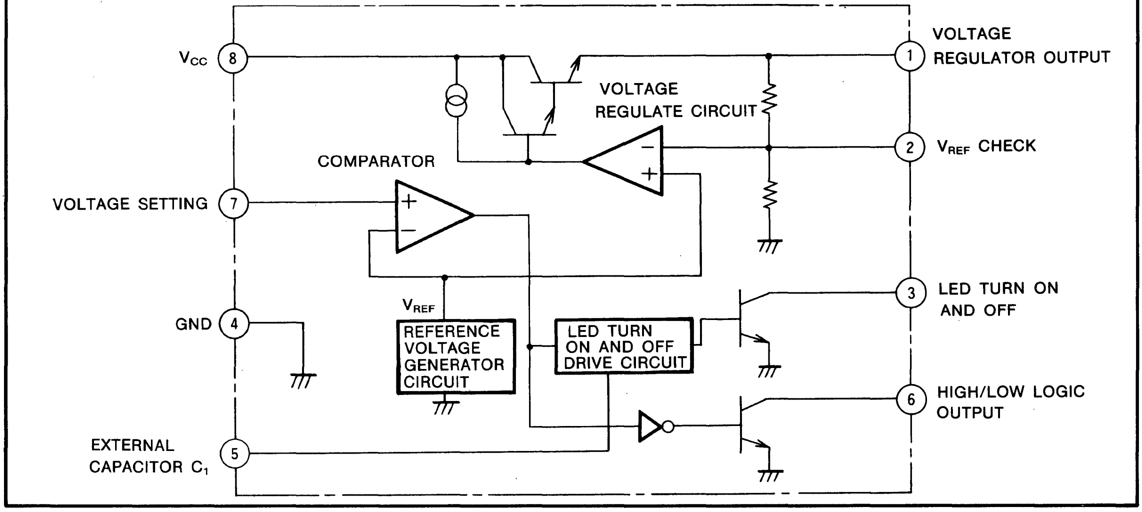


8-pin molded plastic SIL

RECOMMENDED OPERATING CONDITION

Supply voltage range ································· V_{CC}=5~18V

BLOCK DIAGRAM



VOLTAGE DETECTION FOR ALARM SYSTEM (LED TURN ON AND OFF)

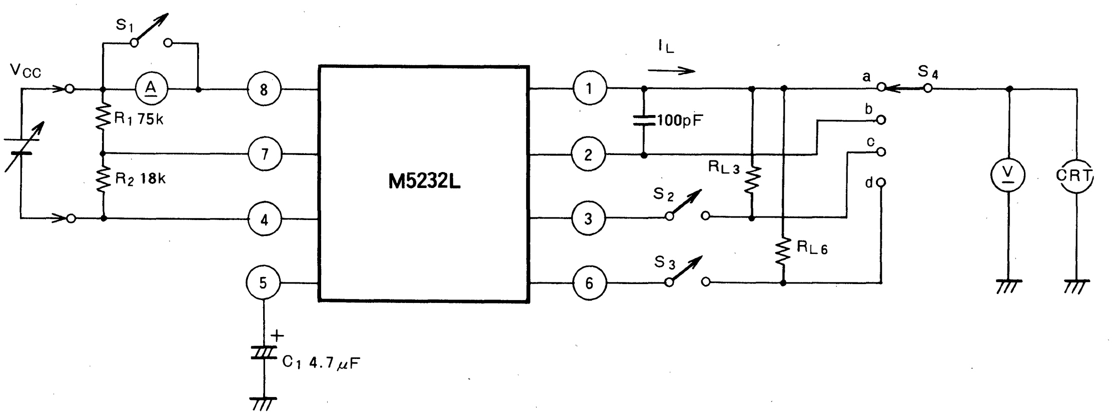
ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		20	V
P_d	Power dissipation		800	mW
I_{LP}	Load current		50	mA
K_θ	Thermal derating	$T_a \geqq 25$℃	8	mW/℃
T_{opr}	Ambient temperature		−20～+75	℃
T_{stg}	Storage temperature		−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃)

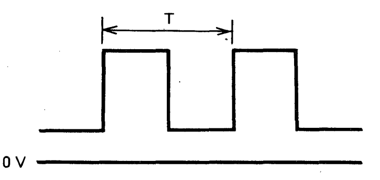
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	V_{CC}=9V, I_L=0		2.0	3.0	mA
V_2	Reference voltage	V_{CC}=9V, R_{L3}=400Ω	1.22	1.31	1.40	V
V_1	Output voltage	V_{CC}=9V, R_{L3}=400Ω	3.6	4.0	4.4	V
V_3	Saturation voltage	V_{CC}=9V, R_{L3}=400Ω		0.2	0.5	V
V_6	Saturation voltage	V_{CC}=6V, R_{L6}=400Ω		0.2	0.5	V
f	Oscillation frequency	V_{CC}=6V, C_1=4.7μF, R_{L3}=400Ω		1.8		Hz

TEST CIRCUIT



Parameter	V_{CC}	S_1	S_2	S_3	S_4
I_{CC}	9V	OFF	OFF	OFF	—
V_2	9V	ON	ON	OFF	b
V_1	9V	ON	ON	OFF	a
V_3	9V	ON	ON	OFF	c
V_6	6V	ON	OFF	ON	d
f	6V	ON	ON	OFF	c

MEASUREMENT OF f ON CRT
3-PIN WAVEFORM f=1/T(Hz)



(Duty ratio is approx. 50%.)

VOLTAGE DETECTION FOR ALARM SYSTEM (LED TURN ON AND OFF)

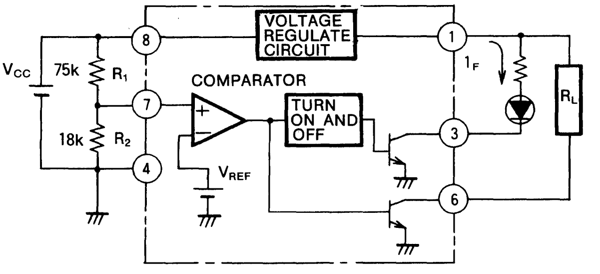
1. BASIC PRINCIPLE OF M5232L OPERATION

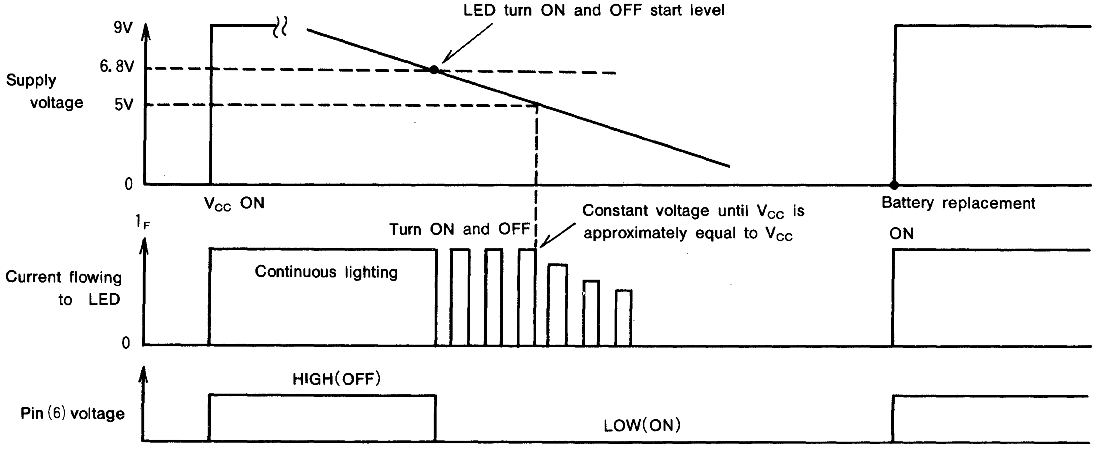
- When the supply voltage V_{CC} is normal, the LED lights and functions as a pilot lamp. In this case, pin (3) drives the LED with the open collector output.
- When V_{CC} falls and becomes V_{CC1} and when the pin (7) potential is :

$$V_7 = \frac{R}{R_1 + R_2} \cdot V_{CC1} < V_{REF}$$

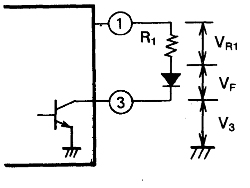
then the comparator is inverted, the turn ON and OFF circuit is turned on and the LED turn ON and OFF. (V_{REF}, produced by the internal reference voltage source, is 1.31V typ.)
- The circuit shown on the right indicates the turn ON and OFF circuit when the voltage is 6.8V, 25% less than V_{CC} =9V(1.5V×6).
- Pin (6) is an open collector output which causes a high-to-low level transition simultaneously with the pin (3) turn ON and OFF operation. A micro buzzer, relay or other load can be connected across this pin and pin (1) or V_{CC} (pin (8)) for a wide range of applications.

BATTERY REDUCED VOLTAGE CHECKER (SIMPLIFIED VIEW)





2. LED DRIVE CURRENT I_F



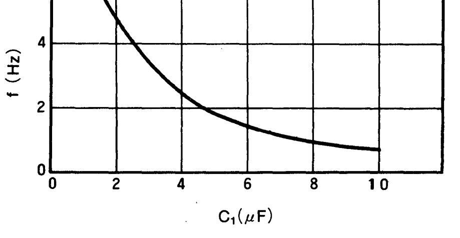
- If it is assumed that the pin (1) output voltage is 4V, the LED forward voltage is V_F and V_3 is 0.2V, then

$$I_F = \frac{4V - 0.2V - V_F}{R_1}$$

I_F is approximately equal to 4.6mA with V_F=2V and R_1= 390 ohms(typical application circuit)

3. TURN ON AND OFF OSCILLATION FREQUENCY

The turn ON and OFF oscillation frequency can be varied by changing the external capacitor C_1.

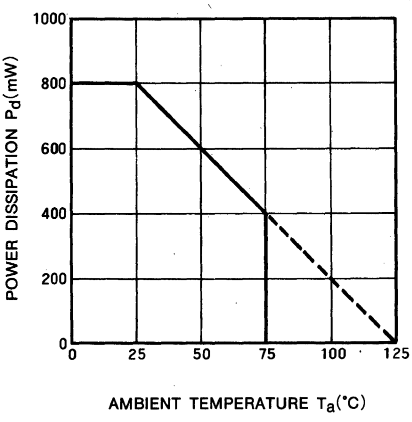


* If the C_1 capacitance is reduced to a low level, oscillation is still possible up to a frequency of about 10kHz.

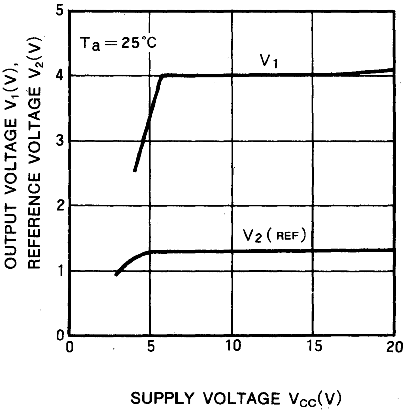
VOLTAGE DETECTION FOR ALARM SYSTEM (LED TURN ON AND OFF)

TYPICAL CHARACTERISTICS

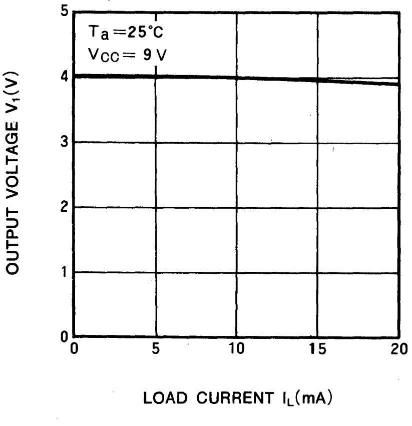
POWER DISSIPATION VS AMBIENT TEMPERATURE



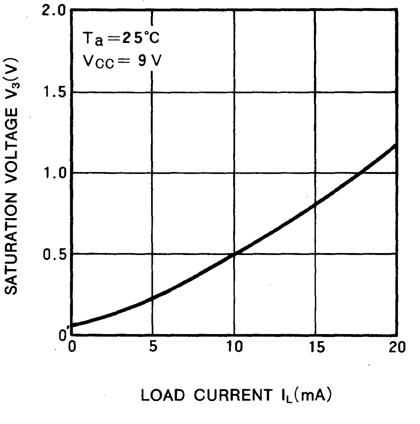
OUTPUT VOLTAGE, REFERENCE VOLTAGE VS SUPPLY VOLTAGE



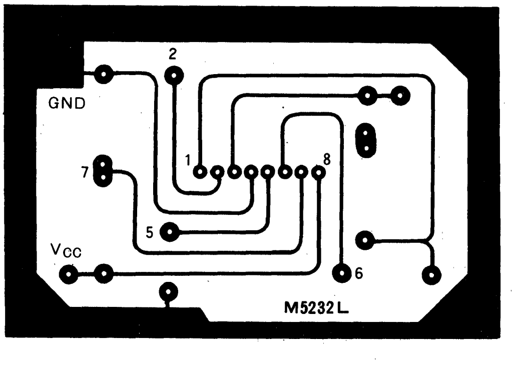
OUTPUT VOLTAGE VS LOAD CURRENT



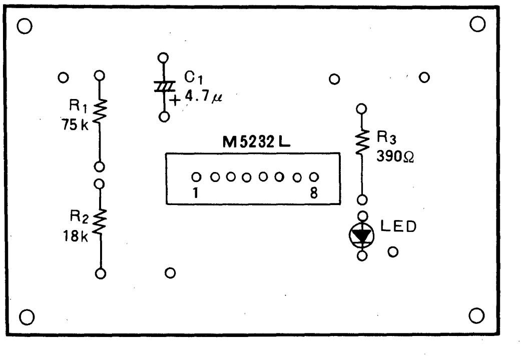
SATURATION VOLTAGE VS LOAD CURRENT



PCB FOR CIRCUIT TESTING (TYPICAL APPLICATION EXAMPLE)



PCB DIAGRAM (COPPER FOIL SIDE) (PARTS INSERTION SIDE)

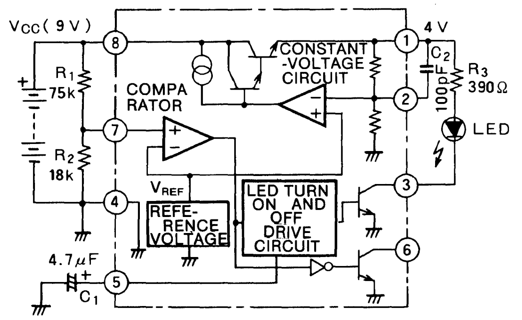


MITSUBISHI ELECTRIC

VOLTAGE DETECTION FOR ALARM SYSTEM (LED TURN ON AND OFF)

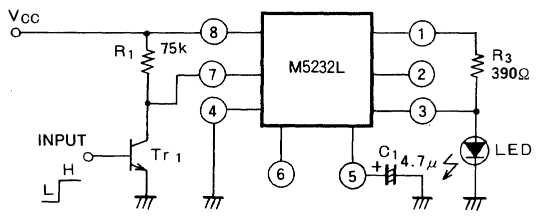
APPLICATION CIRCUIT

1. BATTERY REDUCED VOLTAGE CHECKER



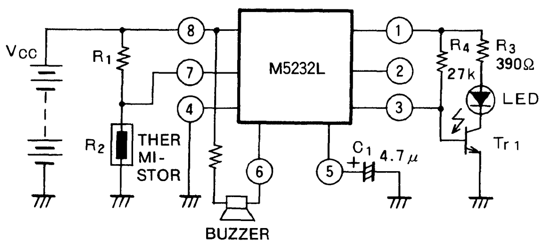
This is a battery reduced voltage checker which is set so that the LED starts turn ON and OFF when the voltage drops by 25%(V_{CC}=6.8V)of the supply voltage(V_{CC}=9V, 1.5V×6).
C_1=4.7μF→f≒1.8Hz
C_2 with its 100pF capacitance prevents oscillation. It should be inserted when the input/output leads are long or when parasitic oscillation is generated by the load.

2. TROUBLE DETECTION INDICATOR CIRCUIT



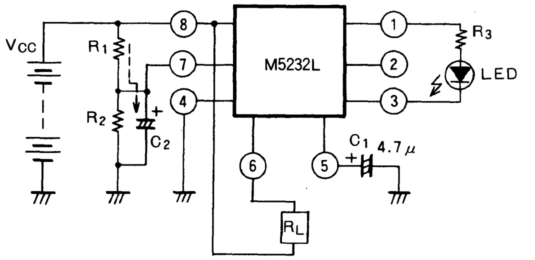
When the base of transistor T_{r1} is set low(normal), the pin(7) comparator input voltage is set high, pin (3) is set low and the LED is turned off.
When the base of transistor T_{r1} is conversely set high(this signifies trouble), the pin(7) comparator input voltage is set low, the internal vibrator circuit is turned on, pin (3) is set high and low repeatedly and the LED turn ON and OFF. It is also possible to drive a relay or indicator using an electronic buzzer.(In place of transistor T_{r1}, an ordinary switch may be used.)

3. ABNORMAL TEMPERATURE INDICATOR CIRCUIT



In nomal circumstances the LED is set off and the current dissipation is kept down. In abnormal circumstances, the LED turn ON and OFF. It is also possible to drive a relay or indicator using a buzzer at pin(6).

4. TIMER, MUTING INDICATOR CIRCUITS



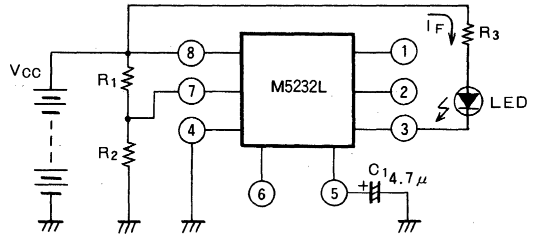
By connecting C_2 in parallel with R_2, V_{CC} is turned on, the charging current indicated by the dotted line in the figure is made to flow, and until the pin(7) voltage reaches :

$$V_{CC}\cdot\frac{R_2}{R_1+R_2}$$

the LED turn ON and OFF; when it is charged up, it lights. These operations can be applied to timer and muting circuits.

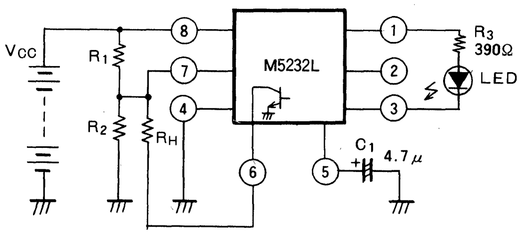
VOLTAGE DETECTION FOR ALARM SYSTEM (LED TURN ON AND OFF)

5. LOW-VOLTAGE(5V OR LESS) BATTERY CHECKER



The output is not stabilized at $V_{CC} < 5V$ since the output voltage at pin (1) of M5232L is not regulated at 4V.
When an LED is connected directly from V_{CC} as shown in the figure on the left, it is possible to configure a battery checker of less than V_{CC} 5V. In this case, however, the I_F of the LED will fluctuate in accordance with the changes in V_{CC}.

6. LED TURN ON AND OFF START VOLTAGE HYSTERESIS OPERATION



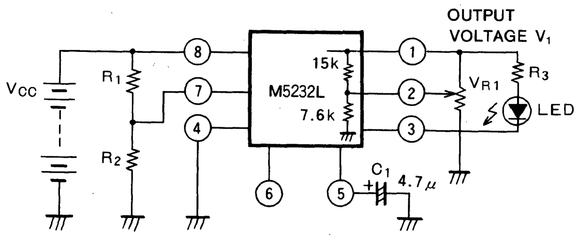
By connecting R_H across pins (6) and (7), as shown in the figure on the left, the turn ON and OFF start voltage is set at :

$$V_{2(REF)} \cdot \frac{R_1 + R_2}{R_2}$$

After the turn ON and OFF starts, pin (6)(open collector) goes on, and so it is possible to apply hysteresis and the voltage below :

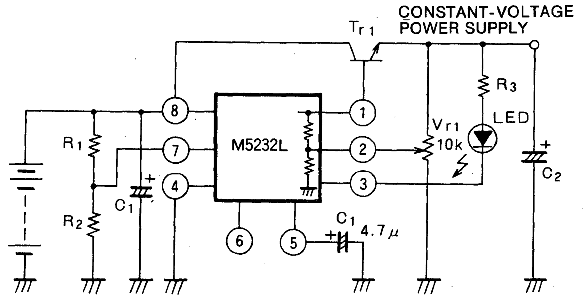
$$V_{2(REF)} \cdot \frac{R_1 + R_2 // R_H}{R_2 // R_H}$$

7. OUTPUT VOLTAGE V_1 MODIFICATION



The M5232L has its output voltage V_1 set by the built-in resistor, as shown in the figure, but this can be changed by connecting a semi-fixed resistor across GND and pins (1) and (2).

8. INCREASED CURRENT CAPACITY IN VOLTAGE REGULATOR CIRCUIT REGULATED POWER SUPPLY



The current capacity of the built-in constant-voltage regulated power supply is approximately 20mA. However, by externally mounting transistor T_{r1}, as shown in the figure on the left, it is possible to yield a constant-voltage regulated power supply with a high current capacity of 1A or more. The output voltage of the power supply can also be varied with variable resistor V_{r1}.

Note : Oscillation may be generated when the input or output leads are long.
In cases like this, input or output capacitors C_1, C_2(1-10uF) should be inserted near the IC.

M50601P

ELECTRONIC VOLUME CONTROL CMOS 6-BIT D/A CONVERTER

DESCRIPTION

The M50601P is a controller IC that controls digitally the control voltage of an electronic volume control. Fabricated using an aluminum gate CMOS technology, this IC has a built-in 6-bit D/A converter circuit based on the PWM system and it can control analogue quantities in 64 steps.

FEATURES

- Low power dissipation
- Built-in ceramic oscillator circuit with a high frequency stability
- Control of analogue quantities in 64 steps
- Self-contained memory function
- Self-contained preset function

APPLICATION

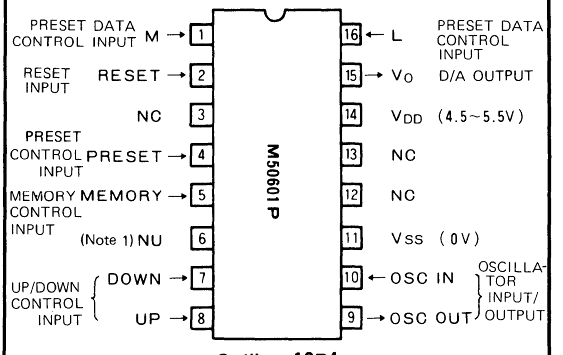
Electronic volume control systems

FUNCTION

The M50601P is a CMOS IC containing a 6-bit up/down counter, an oscillator circuit, a frequency divider and a D/A converter, and it is designed to control digitally the control voltage of an electronic volume control.

Functions include manual up/down and auto up/down functions of the 6-bit up/down counter, a memory function for memorizing the contents of the counter and a preset function for presetting the contents of the 6-bit up/down counter to the contents of the memory or "0" or "32".

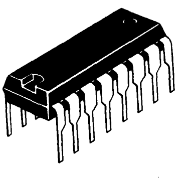
PIN CONFIGURATION (TOP VIEW)



Outline 16P4

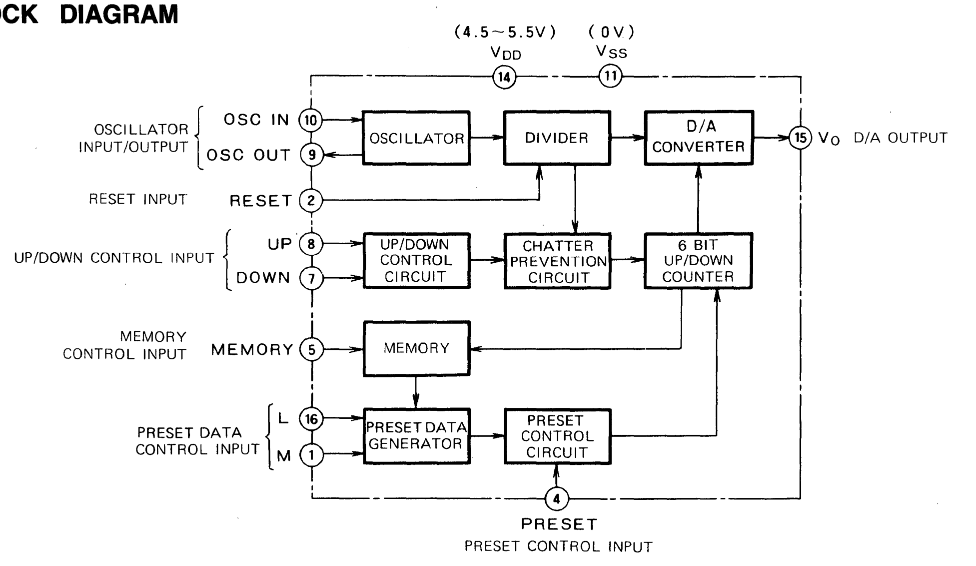
NC: NO CONNECTION

Note 1: Pin 6 should be left disconnected and not used for any reason.



16-pin molded plastic DIL

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Oscillator Circuit

This IC contains an oscillator circuit. The reference signal is obtained by mounting a ceramic vibrator and two capacitors at the OSC IN and OSC OUT pins. A typical circuit is shown in Fig. 1.

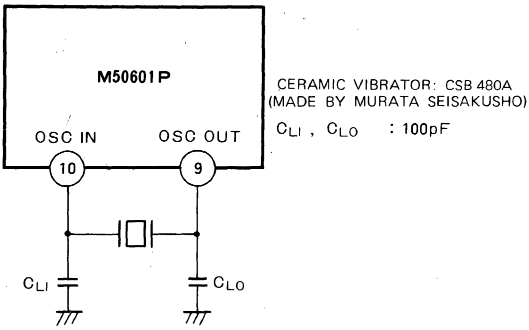


Fig. 1 Typical oscillator circuit (using ceramic vibrator)

Up/Down Function

Every time a high-level signal is applied to the UP pin, the contents of the 6-bit up/down counter increase by one step. When "63" has been reached, no further increase is possible.

When a high-level signal is kept applied to the UP pin for more than 0.41 ~ 0.52 sec, the contents of the 6-bit up/down counter increase at a rate of approximately 9.77 steps/sec. Until "63" has been reached.

Every time a high-level signal is applied to the DOWN pin, the contents of the 6-bit up/down counter decrease by one step. When "0" has been reached, no further decrease is possible.

When a high-level signal is kept applied to the DOWN pin for more than 0.41 ~ 0.52 sec, the contents of the 6-bit up/down counter decrease at a rate of approximately 9.77 steps/sec. Until "0" has been reached.

When high-level signals are applied to both the UP and DOWN pins, the contents of the 6-bit up/down counter do not change.

A chatter-prevention circuit is added to inhibit reading when high-level signals of less than 25 ~ 50ms are applied to the UP and DOWN pins.

Memory Function

When a pulse signal such as that shown in Fig. 2 is applied to the MEMORY pin, the contents of the 6-bit up/down counter are stored in the memory.

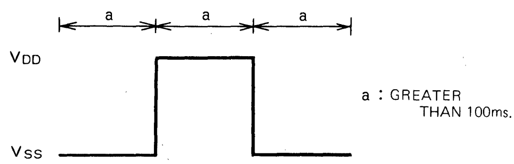


Fig. 2 MEMORY pin input waveform

Preset Function

When a pulse signal such as that shown in Fig. 3 is applied to the L pin with the PRESET pin and M pin both low, the contents of the 6-bit up/down counter are preset to "0". When a pulse signal such as that shown in Fig. 3 is applied to the M pin with the PRESET pin and L pin both low, the contents of the 6-bit up/down counter are preset to "32". When a pulse signal such as that shown in Fig. 3 is applied to the PRESET pin with the M and L pins both low, the contents of the 6-pin up/down counter are preset by the memory contents.

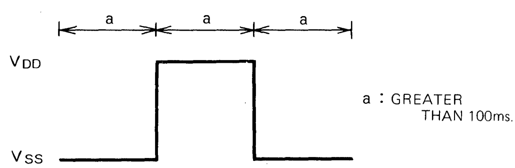


Fig. 3 L pin/M pin/PRESET pin input waveform

Reset Function

This is a function used for testing. When a high-level signal is applied to the RESET pin, the frequency divider (480kHz ~ 4.88Hz) is reset.

D/A Output

This IC contains a 6-bit D/A converter which can control analogue quantities in 64 steps.

A pulse width modulated signal having a minimum pulse width of 12.5μs is output with a repeat frequency of 1.25kHz.

When the mode is set to auto up or auto down through the UP pin or DOWN pin operation, the analogue quantity can be increased or decreased at a rate of approximately 9.77 steps/sec. Consequently, the time required to set the analogue quantity from the minimum to maximum value, or vice versa, is approximately 6.45 sec.

Note: It is necessary to do the initial reset to the UP/DOWN counter and the memory after power on.

ELECTRONIC VOLUME CONTROL CMOS 6-BIT D/A CONVERTER

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Limits	Unit
V_{DD}	Supply voltage	with respect to V_{SS}	$-0.3 \sim 7$	V
V_I	Input voltage		$V_{SS} \leqq V_I \leqq V_{DD}$	—
V_O	Output voltage		$V_{SS} \leqq V_O \leqq V_{DD}$	—
Pd	Maximum power dissipation	Ta = 25°C	300	mW
Topr	Operating free-air temperature range		$-30 \sim 70$	°C
Tstg	Storage temperature range		$-40 \sim 125$	°C

RECOMMENDED OPERATIONAL CONDITIONS

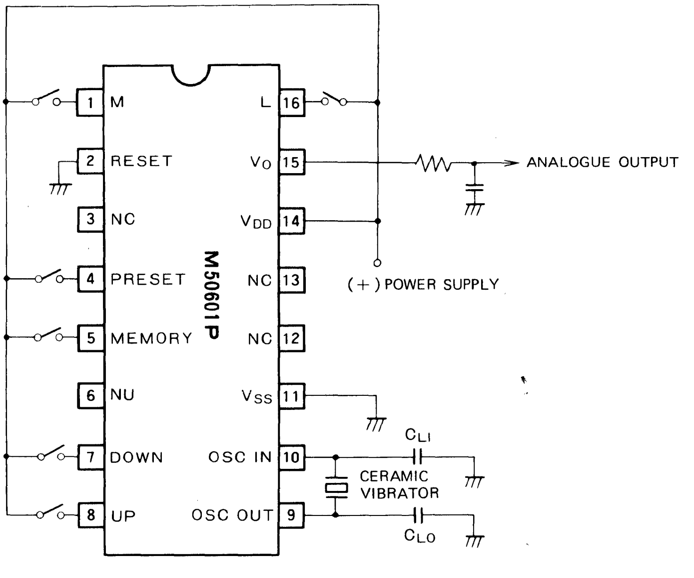
Symbol	Parameter	Limits			Unit
		Min	Typ	Max	
V_{DD}	Supply voltage	4.5	5	5.5	V
f_{OSC}	Oscillation frequency		480		kHz
V_{IH}	High-level input voltage (Note 2)	$0.7 \times V_{DD}$	V_{DD}	V_{DD}	—
V_{IL}	Low-level input voltage (Note 2)	0	0	$0.3 \times V_{DD}$	—

Note 2. These conditions apply to M, RESET, PRESET, MEMORY, DOWN, UP and L pins.

ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_{DD} = 5V, V_{SS} = 0V, C_{LI} = C_{LO} = 100pF, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{DD}	Operational supply voltage	Ta = −30 ~ 70°C, f_{OSC} = 480kHz	4.5	5	5.5	V
I_{DD}	Supply current	f_{OSC} = 480kHz		0.3	2	mA
R_I	Pull-down resistances (Note 2)	V_I = 5V		100		kΩ
I_{OH}	High-level output current	V_O = 0V	2			mA
I_{OL}	Low-level output current	V_O = 5V	2			mA

APPLICATION EXAMPLE



ELECTRONIC VOLUME CONTROL CMOS 5-BIT D/A CONVERTER

DESCRIPTION

The M50602P is a controller IC that controls digitally the control voltage of an electronic volume control. Fabricated using aluminum gate CMOS technology, this IC has a built-in 5-bit D/A converter circuit based on the PWM system and it can control analogue quantities in 32 steps.

FEATURES

- Low power dissipation
- Built-in ceramic oscillator circuit with a high frequency stability
- Control of analogue quantities in 32 steps
- Self-contained offset function
- Self-contained preset function

APPLICATION

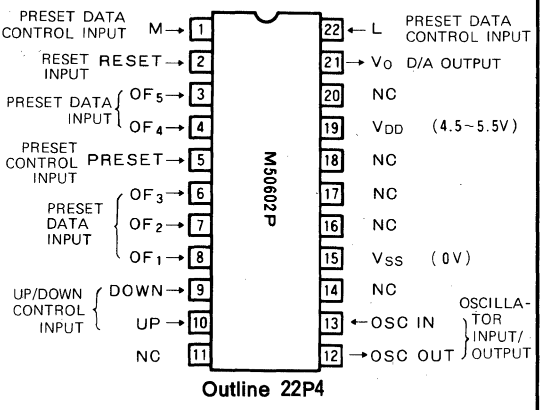
Electronic volume control systems

FUNCTION

The M50602P is CMOS IC containing a 5-bit up/down counter, an oscillator circuit, a frequency divider and a D/A converter, and it is designed to control digitally the control voltage of an electronic volume control.

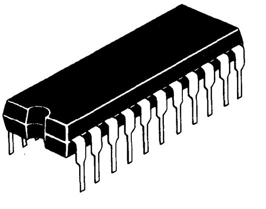
Functions include manual up/down and auto up/down functions of the 5-bit up/down counter and a preset function for presetting the contents of the counter to "0," "16" or to any value using the 5-bit offset inputs.

PIN CONFIGURATION (TOP VIEW)



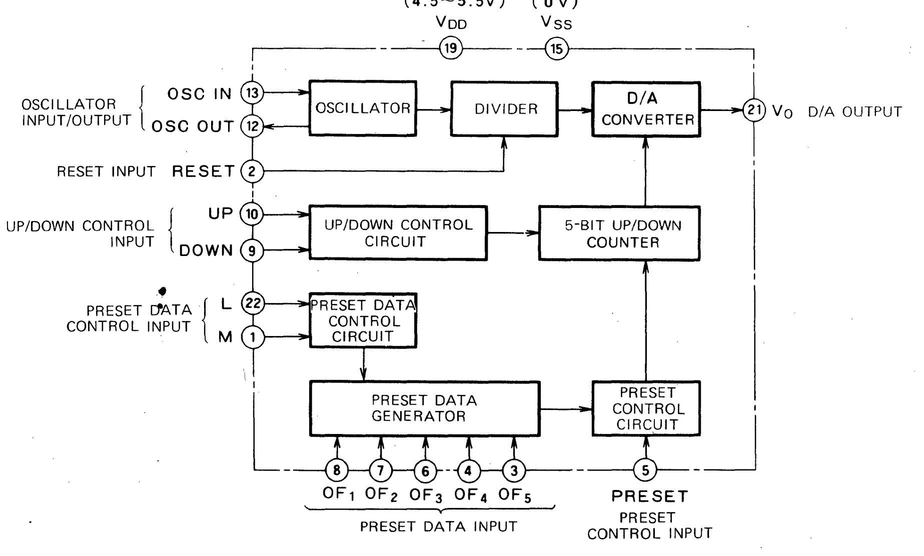
Outline 22P4

NC: NO CONNECTION



22-pin molded plastic DIL

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

FUNCTIONAL DESCRIPTION

Oscillator Circuit

This IC contains an oscillator circuit. The reference signal is obtained by mounting a ceramic vibrator and two capacitors at the OSC IN and OSC OUT pins. A typical circuit is shown in Fig. 1.

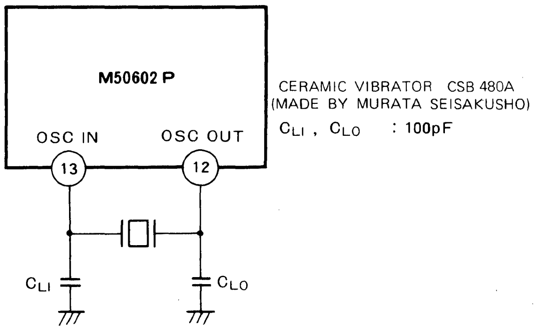


Fig. 1 Typical oscillator circuit (using ceramic vibrator)

Up/Down Function

Every time a high-level signal is applied to the UP pin, the contents of the 5-bit up/down counter increase by one step. When "31" has been reached, no further increase is possible. The high-level must be 100μs at the minimum.

When a high-level signal is kept applied to the UP pin for more than 0.41 ~ 0.52 sec, the contents of the 5-bit up/down counter increase at a rate of approximately 9.77 steps/sec. Until "31" has been reached.

Every time a high-level signal is applied to the DOWN pin, the contents of the 5-bit up/down counter decrease by one step. When "0" has been reached, no further decrease is possible. The high-level must be 100μs at the minimum. When a high-level signal is kept applied to the DOWN pin for more than 0.41 ~ 0.52 sec, the contents of the 5-bit up/down counter decrease at a rate of approximately 9.77 steps/sec. Until "0" has been reached.

When high-level signals are applied to both the UP and DOWN pins, the contents of the 5-bit up/down counter do not change.

Preset Function

When a pulse signal such as that shown in Fig. 2 is applied to the L pin with the PRESET pin and M pin both low, the contents of the 5-bit up/down counter are preset to "0". When a pulse signal such as that shown in Fig. 2 is applied to the M pin with the PRESET pin and L pin both low, the contents of the 5-bit up/down counter are preset to "16". When a pulse signal such as that shown in Fig. 2 is applied to the PRESET pin with the M and L pins both low, the contents of the 5-bit up/down counter are preset by the contents of the offset input pins (OF_1, OF_2, OF_3, OF_4, OF_5). Consequently, the contents of the counter can be preset to any value by combining the five offset input pins. Table 1 shows the relationship between the contents of the offset input pins and the contents of the 5-bit up/down counter.

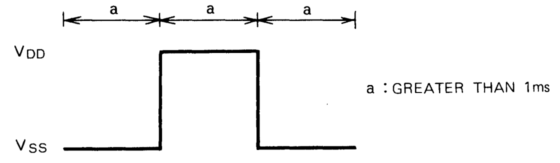


Fig. 2 L pin/M pin/PRESET pin input waveform

Table 1 Relationship between Offset Input and 5-bit UP/down Counter Contents

Offset input					5-bit up/down counter contents	Remarks
OF_1	OF_2	OF_3	OF_4	OF_5		
0	0	0	0	0	0	Lowest level
1	0	0	0	0	1	
0	1	0	0	0	2	
1	1	0	0	0	3	
0	0	1	0	0	4	
1	0	1	0	0	5	
0	1	1	0	0	6	
1	1	1	0	0	7	
0	0	0	1	0	8	
1	0	0	1	0	9	
0	1	0	1	0	10	
1	1	0	1	0	11	
0	0	1	1	0	12	
1	0	1	1	0	13	
0	1	1	1	0	14	
1	1	1	1	0	15	
0	0	0	0	1	16	Intermediate level
1	0	0	0	1	17	
0	1	0	0	1	18	
1	1	0	0	1	19	
0	0	1	0	1	20	
1	0	1	0	1	21	
0	1	1	0	1	22	
1	1	1	0	1	23	
0	0	0	1	1	24	
1	0	0	1	1	25	
0	1	0	1	1	26	
1	1	0	1	1	27	
0	0	1	1	1	28	
1	0	1	1	1	29	
0	1	1	1	1	30	
1	1	1	1	1	31	Highest level

Reset Function

This is a function used for testing. When a high-level signal is applied to the RESET pin, the frequency divider (480kHz ~4.88Hz) is reset.

D/A Output

This IC contains a 5-bit D/A converter which can control analogue quantities in 32 steps.

A pulse width modulated signal having a minimum pulse width of 12.5μs is output with a repeat frequency of 2.5kHz.

When the mode is set to auto up or auto down through the UP pin or DOWN pin operation, the analogue quantity can be increased or decreased at a rate of approximately 9.77 steps/sec. Consequently, the time required to set the analogue quantity from the minimum to maximum value, or vice versa, is approximately 3.18 sec.

Note: It is necessary to do the initial reset to the UP/DOWN counter and the memory after power on.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Limits	Unit
V_{DD}	Supply voltage	with respect to V_{SS}	−0.3~7	V
V_I	Input voltage		$V_{SS} \leqq V_I \leqq V_{DD}$	—
V_O	Output voltage		$V_{SS} \leqq V_I \leqq V_{DD}$	—
Pd	Maximum power dissipation	Ta=25°C	300	mV
Topr	Operating free-air temperature range		−30~70	°C
Tstg	Storage temperature range		−40~125	°C

RECOMMENDED OPERATING CONDITIONS

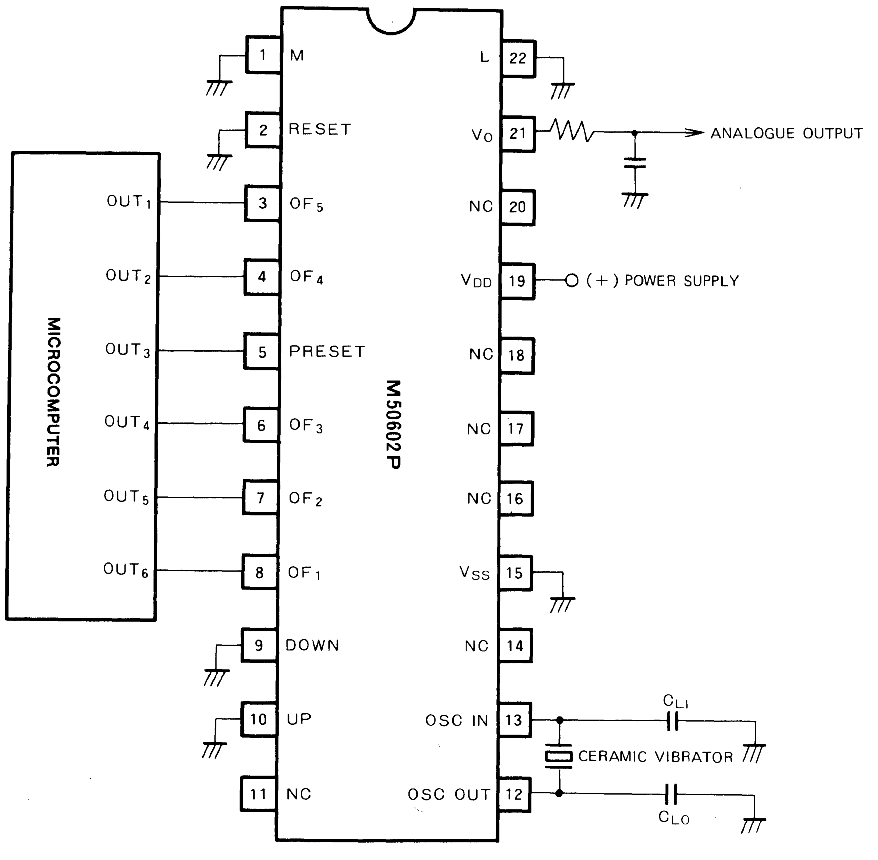
Symbol	Parameter	Limits Min	Typ	Max	Unit
V_{DD}	Supply voltage	4.5	5	5.5	V
f_{OSC}	Oscillation frequency		480		kHz
V_{IH}	High-level input voltage (Note 1)	$0.7 \times V_{DD}$	V_{DD}	V_{DD}	—
V_{IL}	Low-level input voltage (Note 1)	0	0	$0.3 \times V_{DD}$	—

Note 1. These conditions apply to M, RESET, OF_5, OF_4, PRESET, OF_3, OF_2, OF_1, DOWN, UP and L pins.

ELECTRICAL CHARACTERISTICS (Ta=25°C, V_{DD}=5V, V_{SS}=0V, $C_{LI}=C_{LO}$=100pF, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Typ	Max	Unit
V_{DD}	Operational supply voltage	Ta=−30~70°C, f_{OSC}=480kHz	4.5	5	5.5	V
I_{DD}	Supply current	f_{OSC}=480kHz		0.3	2	mA
R_I	Pull-down resistances (Note 1)	V_I=5V		100		kΩ
I_{OH}	High-level output current	V_O=0V	2			mA
I_{OL}	Low-level output current	V_O=5V	2			mA

APPLICATION EXAMPLE



STEREO ELECTRIC VOLUME/BALANCE CONTROL

DESCRIPTION

The M51133P is a semiconductor integrated circuit consisting of dual electronic volume, balance circuit for use in Hi-Fi audio, and by DC voltage control system, it is very easy to design the PCB board layout.

FEATURES

- Low distortion ········· 0.006%(typ.)
- Low noise ········· 5μVrms(typ.)(JIS-A)
- High attenuation ········· 100dB(typ.)(JIS-A)

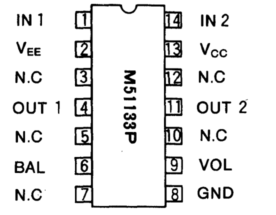
APPLICATION

Hi-Fi stereo equipment

RECOMMENDED OPERATING CONDITIONS

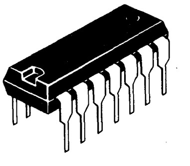
Rated supply voltage ········· ±15V
Supply voltage range ········· ±12V~±16V

PIN CONFIGURATION (TOP VIEW)



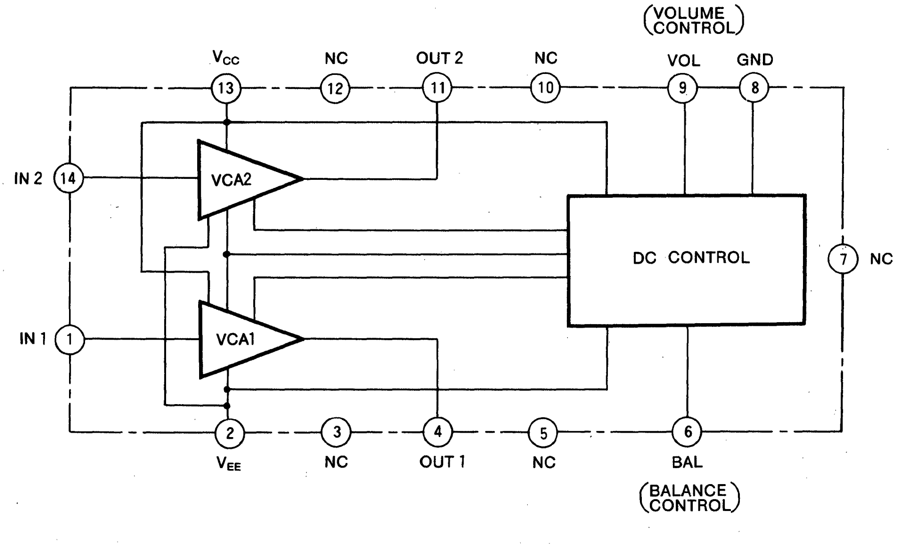
Outline 14P4

NC : NO CONNECTION



14-pin molded plastic DIL

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

STEREO ELECTRIC VOLUME/BALANCE CONTROL

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage	Quiescent	±16	V
Pd	Power dissipation	T_a≦25℃	1.2	W
K_θ	Thermal derating	T_a≧25℃	12	mW/℃
T_{opr}	Operating temperature		−20~+65	℃
T_{stg}	Storage temperature		−40~+125	℃

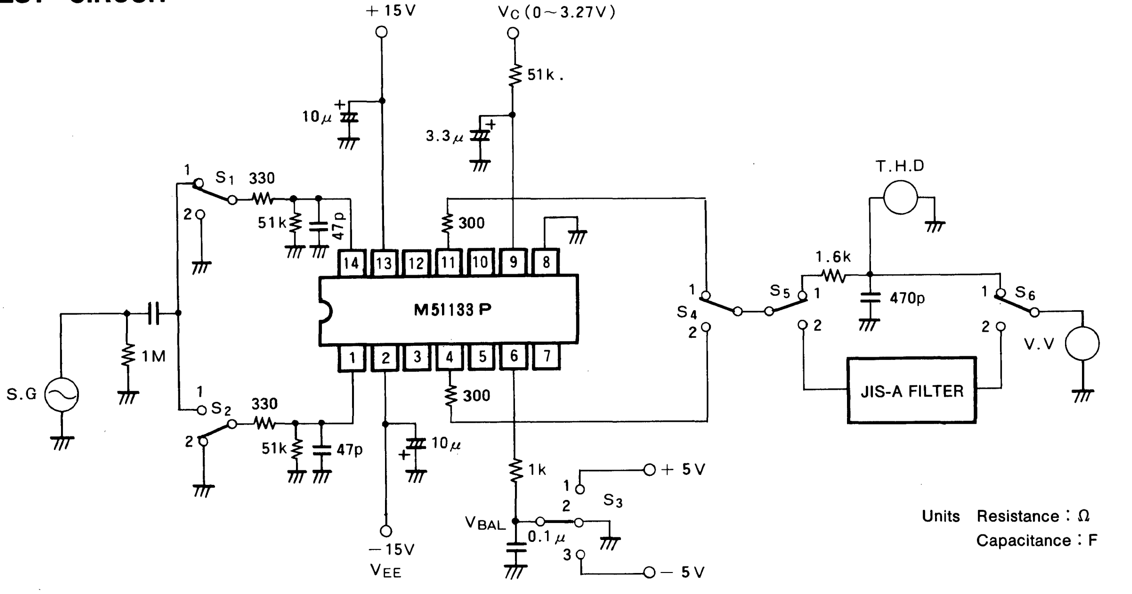
ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=15.0V, V_{EE}=−15.0V, f=1kHz)

Symbol	Parameter	Test conditions	Conditions	Measuring equipments	Limits Min	Limits Typ	Limits Max	Unit
I_{CC}	Circuit current	V_i=0	A	DCA1		17.2	24	mA
I_{EE}		V_i=0	A	DCA2		16.2	24	mA
ATT_0	Attenuation	V_i=1Vrms, V_C=3.27V	B	V.V	−1	0	1	dB
ATT_{-20dB}		V_i=1Vrms, V_C=1.66V	B	V.V	−26	−21	−17	dB
$ATT_{-\infty}$		V_i=1Vrms, V_C=0V, f=10kHz	B	V.V		55	110	μVrms
THD	Total harmonic distortion	V_i=1Vrms, V_C=3.27V	B	T.H.D		0.006	0.02	%
N_O	Output noise voltage	V_i=0, V_C=3.27V, JIS-A filter	C	V.V		15	30	μVrms
$N_{O(r)}$		V_i=1Vrms, V_C=0V, JIS-A filter	C	V.V		5	10	μVrms

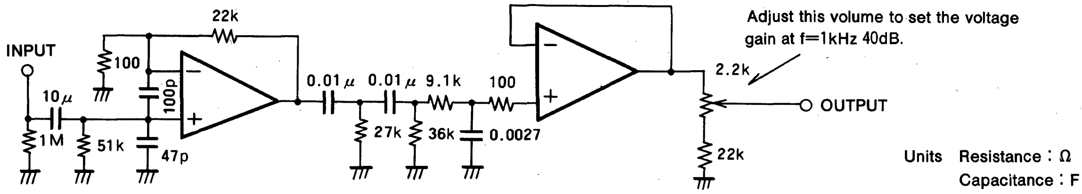
SWITCH CONDITIONS

	S_1	S_2	S_3	S_4	S_5	S_6
A	2	2	2	1	1	1
B	1	1	2	½	1	1
C	2	2	2	½	2	2

TEST CIRCUIT

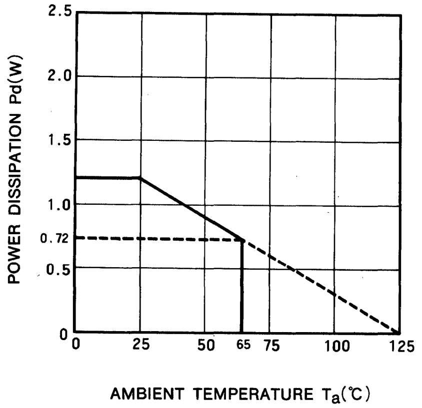


Note : Low-ripple-noise Power Supply recommended for V_{CC} and V_{EE}.(under 2μVrms)
The circuit on next page can be substituted for JIS-A (FILTER). (Note; Gain 40dB)

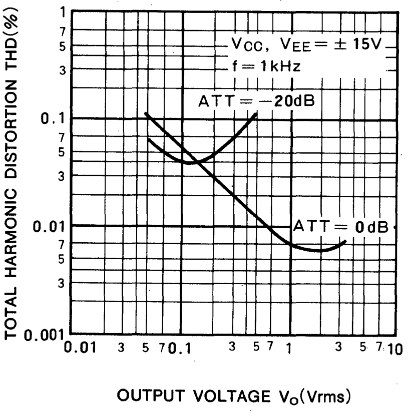


TYPICAL CHARACTERISTIC

THERMAL DERATING
(MAXIMUM RATING)



TOTAL HARMONIC DISTORTION
VS OUTPUT VOLTAGE



TEST METHODS

1. Circuit current(I_{CC}, I_{EE})
   Set SG output voltage (Vi) 0Vrms, and I_{CC} and I_{EE} are measured by DCA 1 and DCA 2 with switch condition A.
2. Attenuation

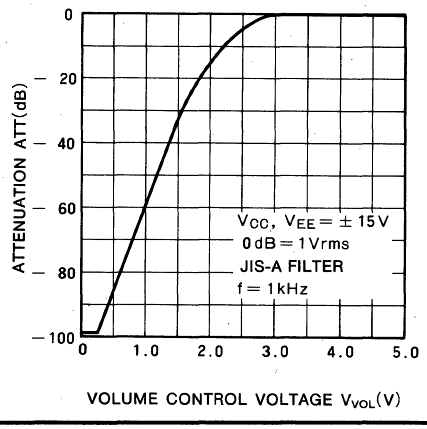
ATT_0 Set SG output voltage (Vi) 1Vrms, the frequency 1kHz, the control voltage V_C 3.27V, and read off output voltage V_O on vacuum-tube voltmeter. ATT_0 is determined by formula (1)

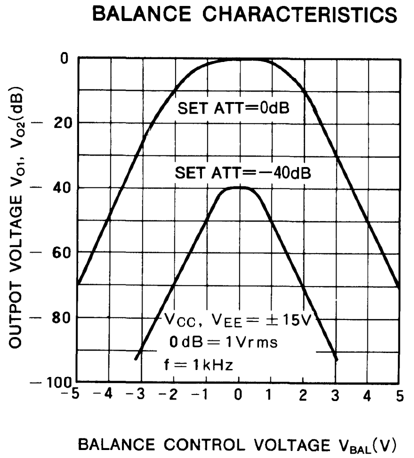
ATT_{-20} Set SG output voltage (Vi) 1Vrms, the frequency 1kHz, the control voltage V_C 1.66V, and read off output voltage V_O on vacuum-tube voltmeter. ATT_{-20} is determined by formula (2)

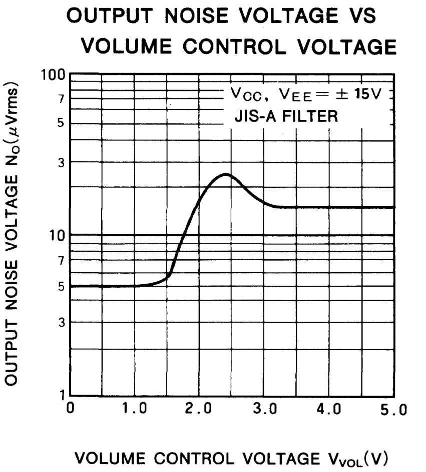
$ATT_{-\infty}$ Set SG output voltage (Vi) 3.5Vrms, the frequency 1kHz, the control voltage V_C 0V, and read off output voltage V_O on vacuum-tube voltmeter. AT this V_O is $ATT_{-\infty}$.

3. Total harmonic distortion (THD)
   Set SG output voltage (Vi) 1Vrms, the frequency 1kHz, the control voltage V_C 3.27V, and measure output total harmonic distortion with distortion meter.
4. Output noise voltage (No, $No_{(r)}$)
   Set the control voltage V_C 3.27V, and measure output voltage on vacuum-tube voltmeter with switch condition C.
   This value is "No".
   Set Vi 1Vrms, the control voltage V_C 0V, and measure output voltage on vacuum-tube voltmeter with switch condition C.
   This value is "$No_{(r)}$"

ATTENUATION VS VOLUME
CONTROL VOLTAGE

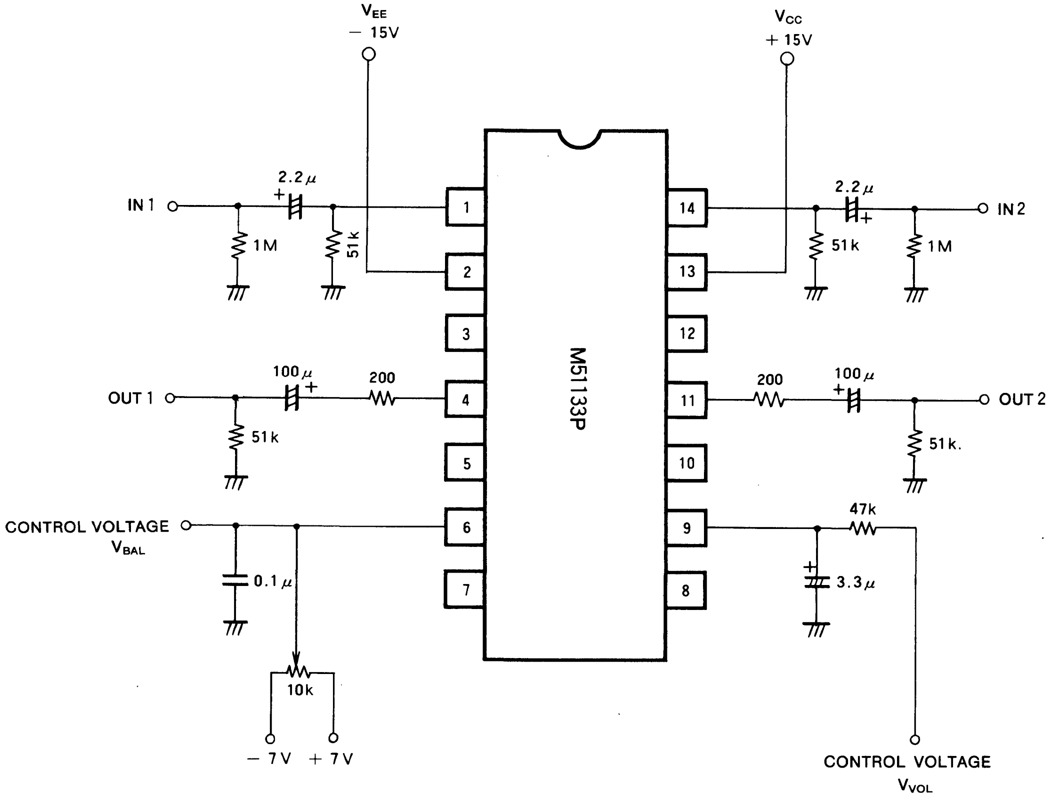






APPLICATION CIRCUIT

ELECTRONIC VOLUME FOR HI-FI STEREO EQUIPMENTS



Units Resistance : Ω
Capacitance : F

M51200P

DUAL COMPARATOR

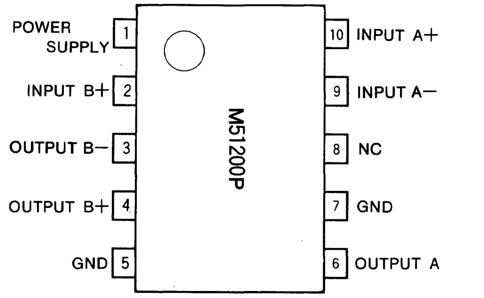
DESCRIPTION
The M51200P is a monolithic integrated circuit encapsulated in a 10-leads flat plastic package, intended for use as a dual (two independent) comparator. One of the comparators has dual input and single output, the other has single input and dual output. Both of them operate in the range of 1.4 to 6V.

FEATURES
- Low input current ···················· 3 nA (typ.), 10nA (max.)
- High output current capability ···················· 40mA (max.)
- Wide supply voltage range ···························· 1.4~6 V
- Including surge absorbing zener diodes.

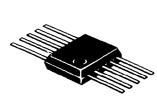
APPLICATIONS
- Electric shutter
- Comparator
- Level detector
- CR Timer
- Time delay circuit

RECOMMENDED OPERATING CONDITIONS
Supply voltage range ·· 1.4~6.0V
Rated supply voltage ·· 3V±10%

PIN CONFIGURATION (TOP VIEW)

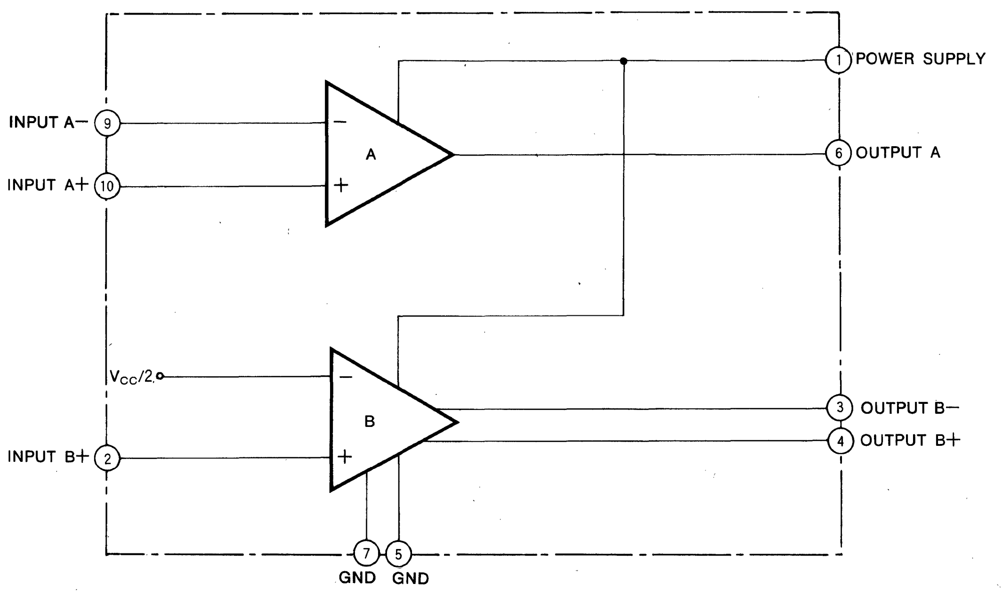


Outline 10P2 NC : NO CONNECTION



10-pin molded plastic FLAT

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

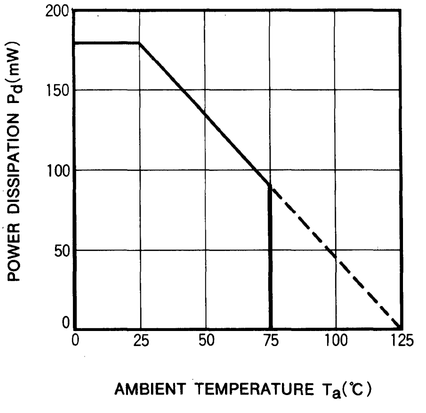
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		6	V
V_{IN}	Input voltage		V_{CC}	V
$I_⑥$	Output drive current	Output saturated	40	mA
$I_③$			2	mA
$I_④$			25	mA
$V_⑥$	Output drive voltage		18	V
$V_③$			10	V
$V_④$			18	V
P_d	Power dissipation		180	mW
T_{opr}	Operating temperature range		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=3.0V, unless otherwise noted)

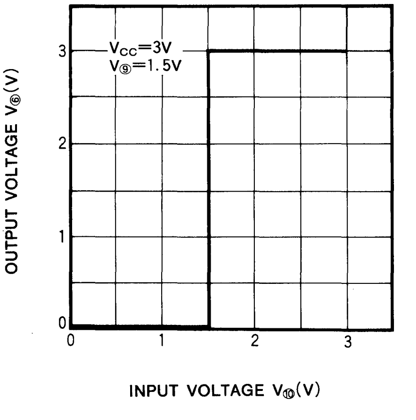
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		1.4		6.0	V
I_{CC}	Circuit current	V_{CC}=3V		1.8	2.8	mA
		V_{CC}=6V		3.4	4.9	
$I_{IN⑩}$	Input current	V_{CC}=3V		3	10	nA
$I_{IN⑨}$				3	10	nA
$I_{IN②}$				8	100	nA
V_{REF}	Reference voltage for #B		1.35	1.5	1.65	V
$V_{S⑥}$	Output saturation voltage	$I_⑥$=20mA		0.18	0.3	V
$V_{S③}$		$I_③$=10μA		38	60	mV
$V_{S④}$		$I_④$=25mA		0.2	0.5	V
$V_{Z⑥}$	Output zener voltage	$I_⑥$=5mA	18	21	26	V
$V_{Z④}$		$I_④$=5mA	18	21	26	V
V_{IN}	Input voltage range	V_{CC}=3V	0.8		V_{CC}−0.2	V
t_{PLH}	Output "L→H" propagation delay time	V_{CC}=3V		20		μs
t_{PHL}	Output "H→L" propagation delay time			20		μs

TYPICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

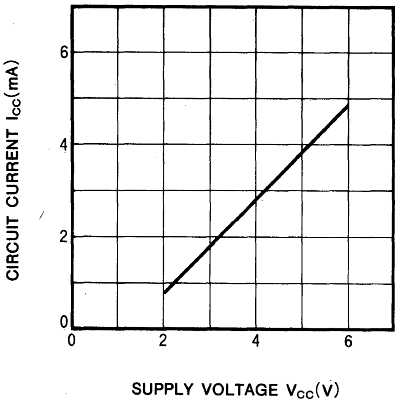
THERMAL DERATING (MAXIMUM RATING)



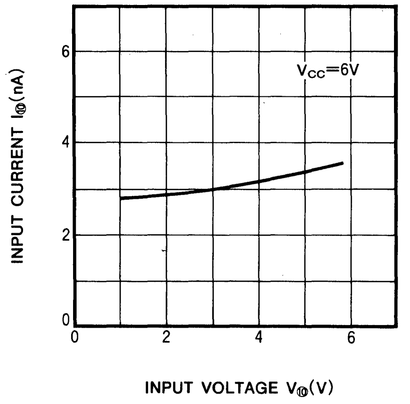
OUTPUT VOLTAGE VS INPUT VOLTAGE (COMPARATOR A)



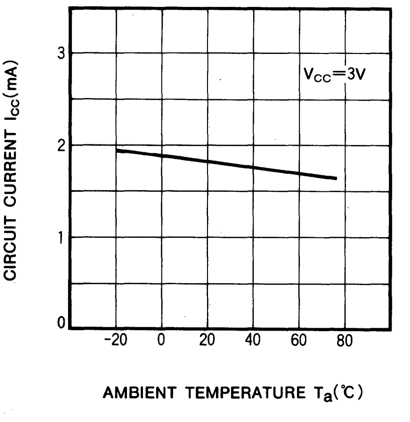
CIRCUIT CURRENT VS SUPPLY VOLTAGE



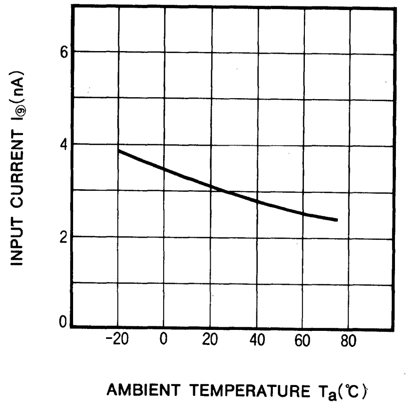
INPUT CURRENT VS INPUT VOLTAGE V⑩



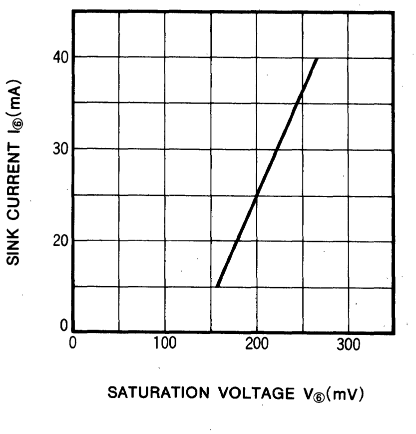
CIRCUIT CURRENT VS AMBIENT TEMPERATURE



INPUT CURRENT VS AMBIENT TEMPERATURE

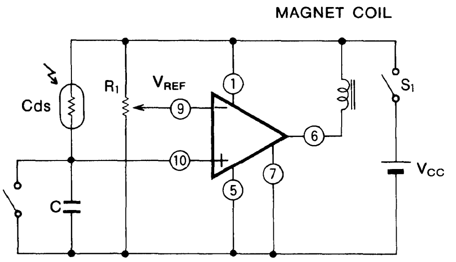


SINK CURRENT VS SATURATION VOLTAGE



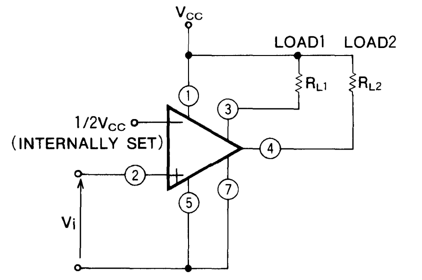
APPLICATION EXAMPLES

(1) Electric shutter



$$t = CR_{cds}\,\ell n\,\frac{V_{CC}}{V_{CC}-V_{REF}}$$

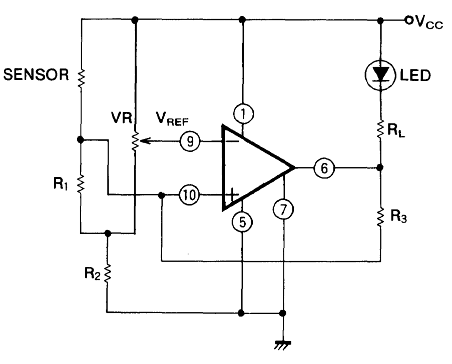
(2) Voltage comparator



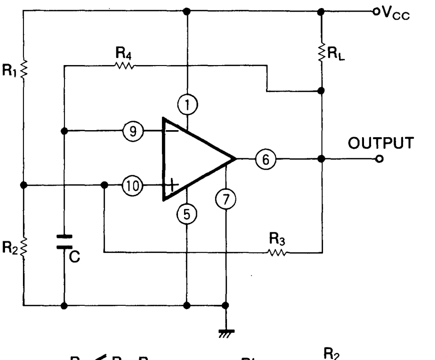
$V_i < \frac{1}{2}V_{CC}$: $V_{(4)}$=Low, $V_{(3)}$=High

$V_i > \frac{1}{2}V_{CC}$: $V_{(4)}$=High, $V_{(3)}$=Low

(3) Detector



(4) Oscillator



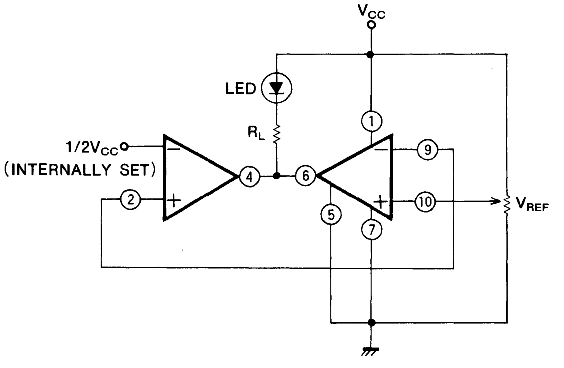
$R_L < R_3, R_4$

$$f = \frac{1}{CR_4\,\ell n\,\frac{R\ell}{Rh}\cdot\frac{1-R\ell}{1-Rh}}\ \text{[Hz]}$$

$$Rh = \frac{R_2}{R_2+\frac{R_1R_3}{R_1+R_3}}$$

$$R\ell = \frac{\frac{R_2R_3}{R_2+R_3}}{R_1+\frac{R_2R_3}{R_2+R_3}}$$

(5) Window comparator



PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51200P may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51200P is connected wrong position each other.

2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.

M51201L

VOLTAGE COMPARATOR

DESCRIPTION

The M51201L is a semiconductor integrated circuit consisting of precision voltage comparator. It is designed specifically to operate from a single power supply of low voltage. One of the input stages has a characteristic of low bias current and the other has built-in reference voltage with hysteresis. Output stage is capable of sinking high current. So, it is intended for a wide range of applications, ex. CR Timer, relays or lamps driver. M51201L's package is a mini SIL package, therefore can use very easily.

FEATURES

- Low input current ··8nA(typ.)
- 60mA output current capability can drive a relay or a lamp
- Built-in protection zener diodes for reverse E.M.F. at the output terminal
- Wide supply voltage range ··························· 1.7~6.5V
- Including both reference voltage circuit and hysteresis for switching
- High output break down voltage···················· 18V(max.)

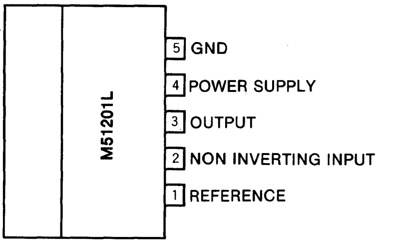
APPLICATIONS

- Electric shutter
- Comparator
- Level detector
- CR Timer
- Time delay circuit

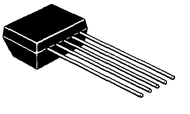
RECOMMENDED OPERATING CONDITIONS

Supply voltage range·· 1.7~6.5V
Rated supply voltage··· 3V±10%

PIN CONFIGURATION (TOP VIEW)

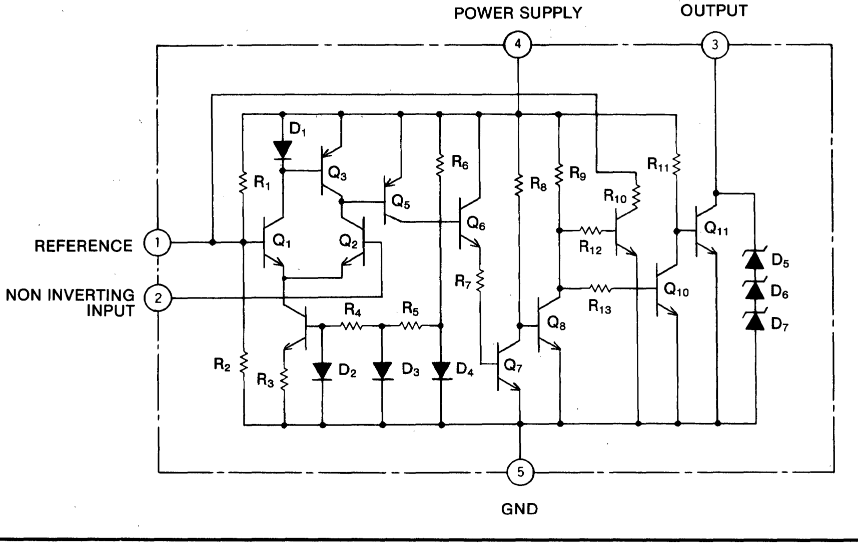


Outline 5P5



5-pin molded plastic SIL

EQUIVALENT CIRCUIT



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

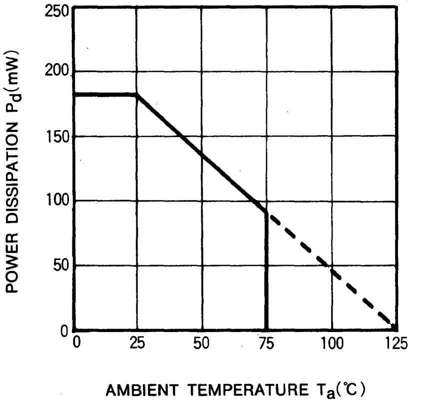
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		6.5	V
I_{OL}	Output drive current	Output saturated	60	mA
V_{IN}	Input voltage		V_{CC}	V
P_d	Power dissipation		180	mW
K_θ	Thermal derating	$T_a \geq 25$℃	1.8	mW/℃
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃)

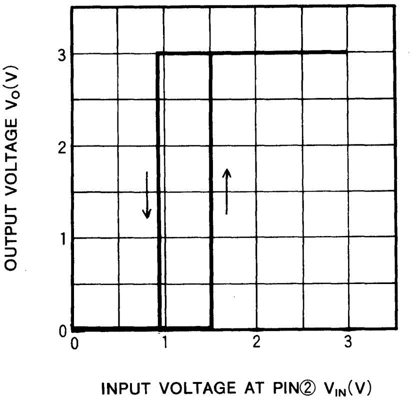
Symbol	Parameter	Test conditions		Limits			Unit
		V_{CC}(V)		Min	Typ	Max	
V_{CC}	Supply voltage range			1.7		6.5	V
I_{CC}	Circuit current	2.65			2.0	3.5	mA
		6.0			5.0	8.8	
I_{IN}	Input current	2.65			8	100	nA
V_{REF}	Reference voltage	6.0		2.55	3.0	3.45	V
V_{OL}	Output saturation voltage	6.0	I_{OL}=60mA		0.2	0.6	V
V_Z	Output zener voltage		I_Z=5mA	18	22	26	V
t_{PLH}	Output "L-H" propagation delay time	6.0			0.2		μs
t_{PHL}	Output "H-L" propagation delay time	6.0			50		μs
V_{IN}	Input voltage range			0.8		V_{CC}−0.2	V

TYPICAL CHARACTERISTICS (T_a=25℃, V_{CC}=3V, unless otherwise noted)

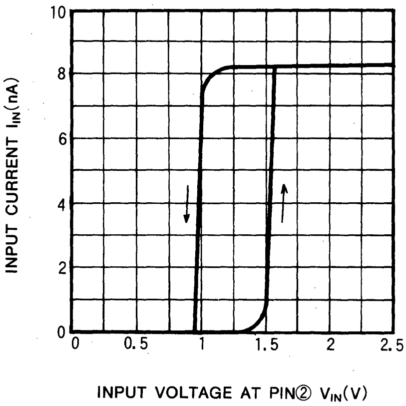
THERMAL DERATING
(MAXIMUM RATING)



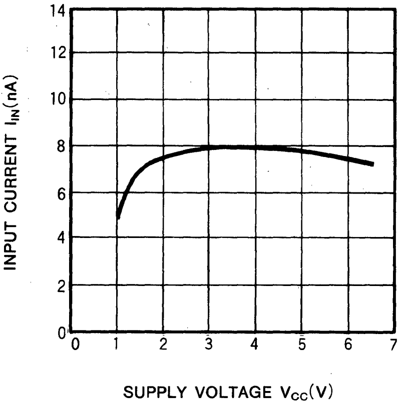
OUTPUT VOLTAGE VS
INPUT VOLTAGE AT PIN②



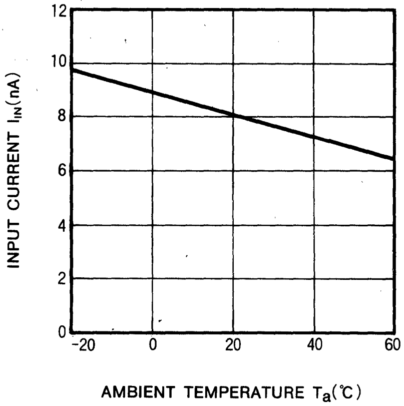
INPUT CURRENT VS INPUT VOLTAGE AT PIN②



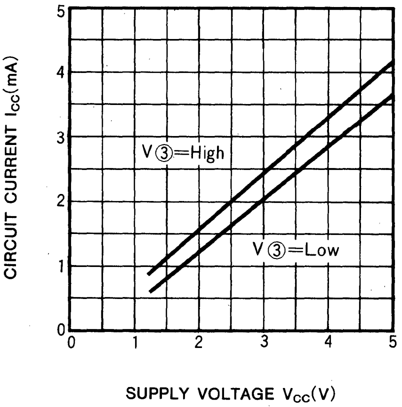
INPUT CURRENT VS SUPPLY VOLTAGE



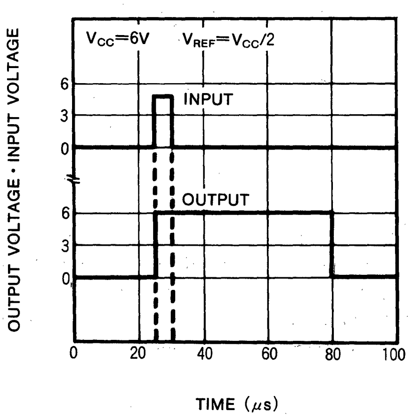
INPUT CURRENT VS AMBIENT TEMPERATURE



CIRCUIT CURRENT VS SUPPLY VOLTAGE

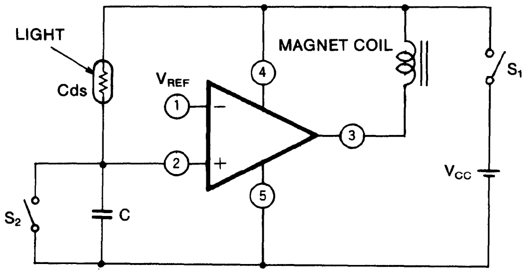


PULSE RESPONSE CHARACTERISTICS



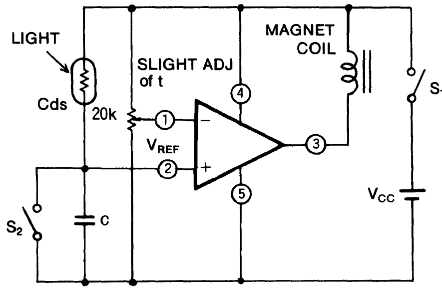
APPLICATION EXAMPLES

Electric shutter (1)



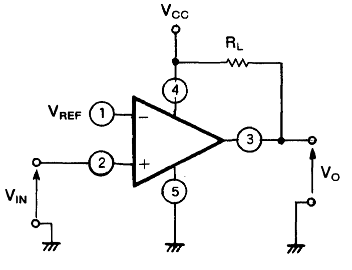
t≈0.7CRcds [s]

Electric shutter (2)

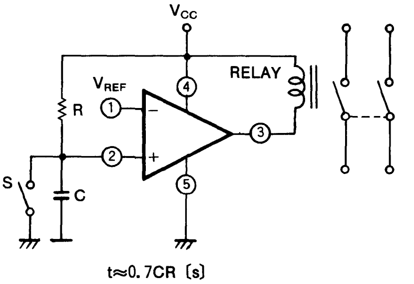


$t \approx 0.7CRcds \cdot \ln\frac{V_{CC}}{V_{CC}-V_{REF}}$

Voltage comparator



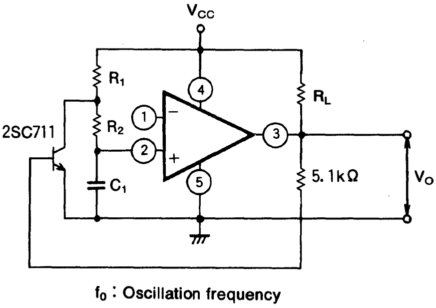
CR Timer



t≈0.7CR [s]

$0.1\text{ms} \leqq t \leqq 180\text{s} < V_{REF} \approx V_{CC}/2$

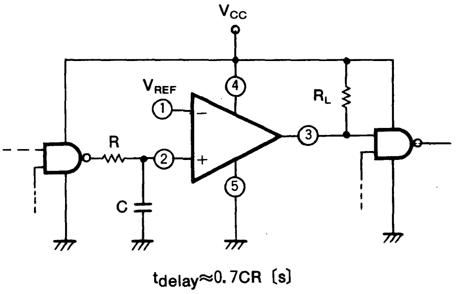
Oscillator



f_0 : Oscillation frequency

$$f_0=\frac{1}{C_1(0.337R_1+0.847R_2)} \text{ [Hz]}$$

Time delay circuit



$t_{delay} \approx 0.7CR$ [s]

PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51201L may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51201L is connected wrong position each other.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.
3. Reference voltage (V_{REF}) is adjustable for connecting external resistor, but adjustable voltage range is 0.8 to V_{CC}−0.2(V).

M51202L

VOLTAGE COMPARATOR

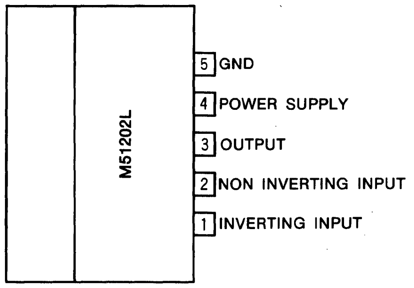
DESCRIPTION
The M51202L is a semiconductor integrated circuit consisting of precision voltage comparator. It is designed specifically to operate from a single power supply of low voltage. Input stage has a characteristic of low bias current and output stage is capable of sinking high current. So, it is intended for a wide range of application, ex. CR Timer, relays or lamps driver. M51202L's package is a mini SIL package, therefore can use very easily.

FEATURES
- Low input current ···································· 8nA(typ.)
- 60mA output current capability can drive a relay or a lamp.
- Built-in protection zener diodes for reverse E.M.F. at the output terminal.
- Wide supply voltage range ························ 1.7 ~ 6.5V
- High output break down voltage .... 18V(max.)

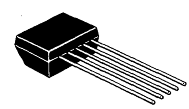
APPLICATIONS
- Electric shutter
- Comparator
- Level detector
- CR Timer
- Time delay circuit

RECOMMENDED OPERATING CONDITIONS
Supply voltage range ···································· 1.7~6.5V
Rated supply voltage ···································· 3V±10%

PIN CONFIGURATION (TOP VIEW)

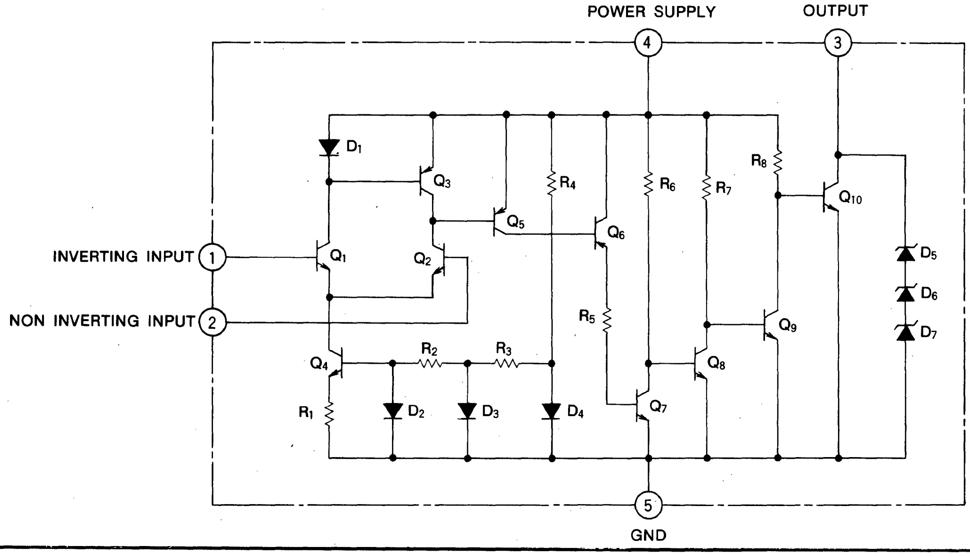


Outline 5P5



5-pin molded plastic SIL

EQUIVALENT CIRCUIT



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

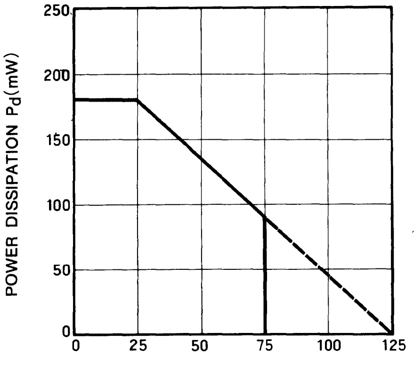
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		6.5	V
I_{OL}	Output drive current	output saturated	60	mA
V_{IN}	Input voltage		V_{CC}	V
P_d	Power dissipation		180	mW
K_θ	Thermal derating	$T_a \geqq 25$℃	1.8	mW/℃
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃)

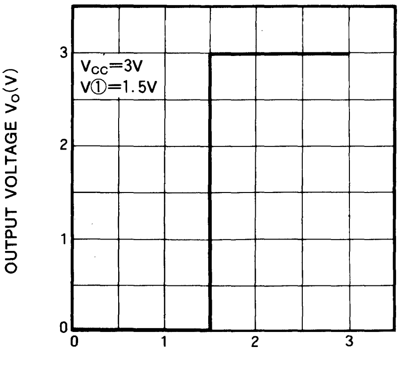
Symbol	Parameter	Test conditions		Limits			Unit
		V_{CC}(V)		Min	Typ	Max	
V_{CC}	Supply voltage range			1.7		6.5	V
I_{CC}	Circuit current	2.65			1.7	3.2	mA
		6.0			4.4	8.2	
I_{IN}	Input current	2.65			8	100	nA
V_{IO}	Input offset voltage	2.65			2	50	mV
V_{OL}	Output saturation voltage	6.0	I_{OL}=60mA		0.2	0.6	V
V_Z	Output zener voltage		I_Z=5mA	18	22	26	V
t_{PLH}	Output "L-H" propagation delay time	6.0	$V_{REF}=V_{CC}/2$		0.2		μs
t_{PHL}	Output "H-L" propagation delay time	6.0	$V_{REF}=V_{CC}/2$		50		μs
V_{IN}	Input voltage			0.8		$V_{CC}-0.2$	V

TYPICAL CHARACTERISTICS (T_a=25℃, V_{CC}=3V, unless otherwise noted)

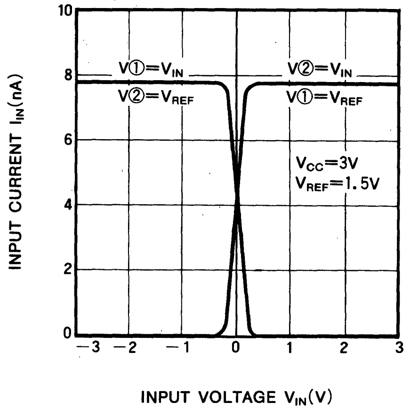
THERMAL DERATING (MAXIMUM RATING)



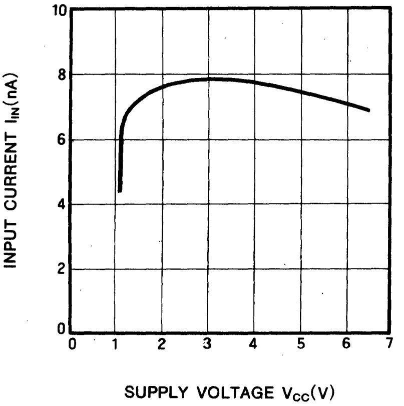
OUTPUT VOLTAGE VS INPUT VOLTAGE AT PIN②



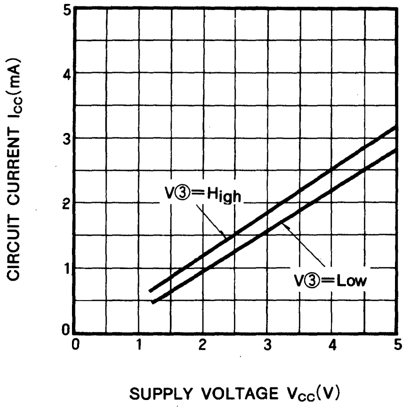
INPUT CURRENT VS INPUT VOLTAGE



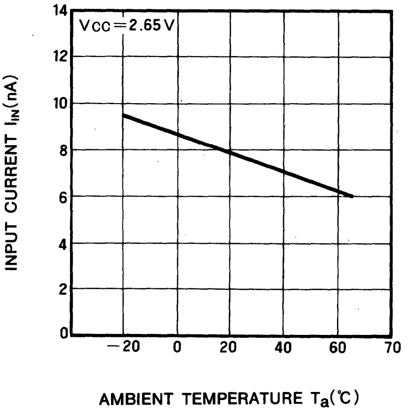
INPUT CURRENT VS SUPPLY VOLTAGE



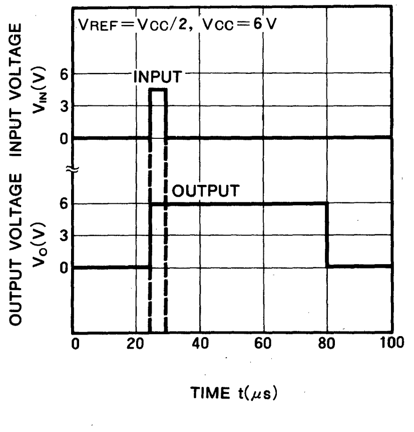
CIRCUIT CURRENT VS SUPPLY VOLTAGE



INPUT CURRENT VS AMBIENT TEMPERATURE

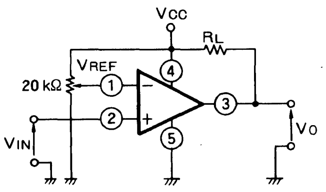


PULSE RESPONSE CHARACTERISTICS



APPLICATION EXAMPLES

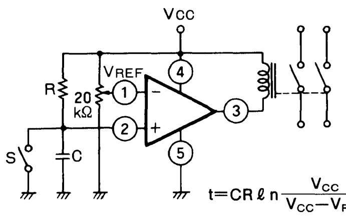
Voltage comparator



if $V_{REF} > V_{IN}$ V_O=Low

if $V_{REF} < V_{IN}$ V_O=High

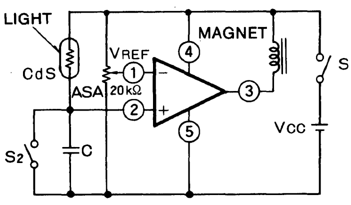
CR Timer



$t = CR\,\ell n \frac{V_{CC}}{V_{CC} - V_{REF}}$ [s]

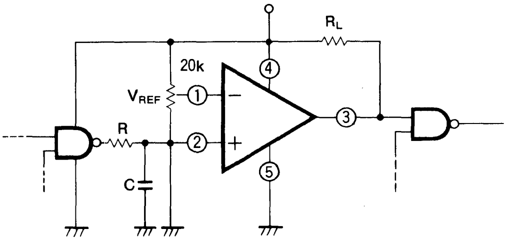
0.1ms≦ t≦180s

Electric shutter



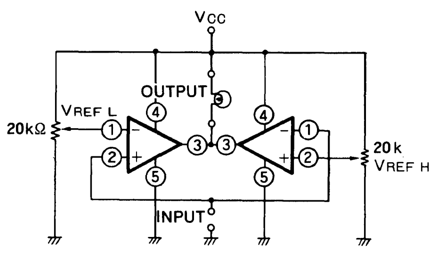
$t = CRcds\,\ell n \frac{V_{CC}}{V_{CC} - V_{REF}}$ [s]

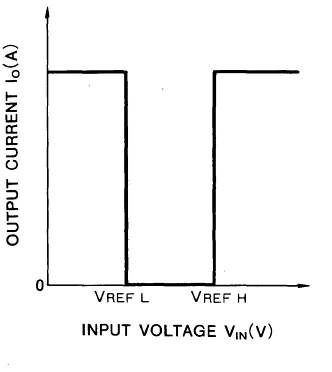
Time delay circuit



$ts = CR\,\ell n \frac{V_{CC}}{V_{CC} - V_{REF}}$ [s]

Window comparator (alarm circuit)





PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51202L may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51202L is connected wrong position each other.
2. Output is “open collector” and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.

M51203L

VOLTAGE COMPARATOR

DESCRIPTION

The M51203L is a semiconductor integrated circuit consisting of precision voltage comparator. It is designed specifically to operate from a single power supply of wide range.

One of the input stages has a characteristic of low bias current and the other has built-in reference voltage with hysteresis. Output stage is capable of sinking high current. So, it is intended for a wide range of applications, ex. CR Timer, relays or lamps driver. M51203L's package is a mini SIL package, therefore can use very easily.

FEATURES

- Low input current ·· 20nA(typ.)
- Wide supply voltage range ······························ 3.0~28V
- Low circuit current ······································ 2.5mA(max.)
- 60mA output current capability can drive a relay or a lamp
- High output break down voltage ····················· 30V(max.)
- Including both reference voltage circuit and hysteresis for switching

APPLICATIONS

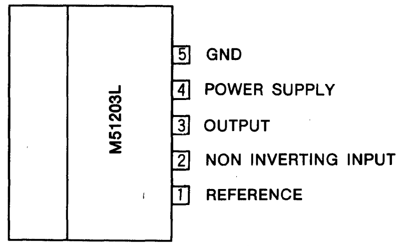
- Electric shutter
- Comparator
- Level detector
- CR Timer
- Time delay circuit

RECOMMENDED OPERATING CONDITIONS

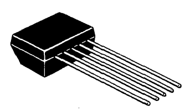
Supply voltage range ·· 3 ~28V

Rated supply voltage ·· 12V±10%

PIN CONFIGURATION (TOP VIEW)

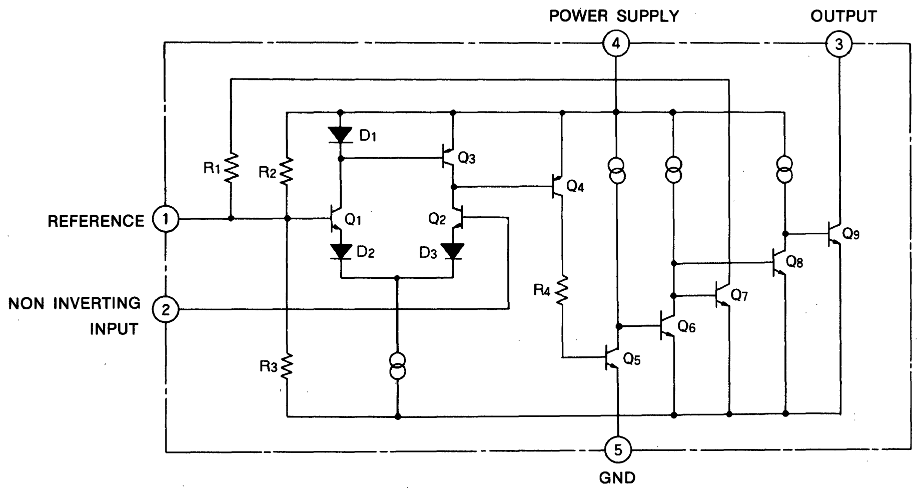


Outline 5P5



5-pin molded plastic SIL

EQUIVALENT CIRCUIT



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

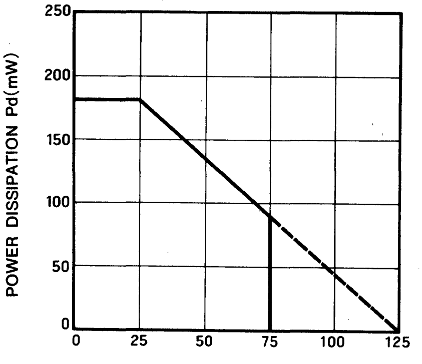
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		28	V
V_{IN}	Input voltage		V_{CC}	V
I_{OL}	Output drive current	Output saturated	60	mA
V_{OH}	Output drive voltage		30	V
Pd	Power dissipation		180	mW
K_θ	Thermal derating	$T_a \geqq 25$℃	1.8	mW/℃
Topr	Operating temperature		−20～+75	℃
Tstg	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃)

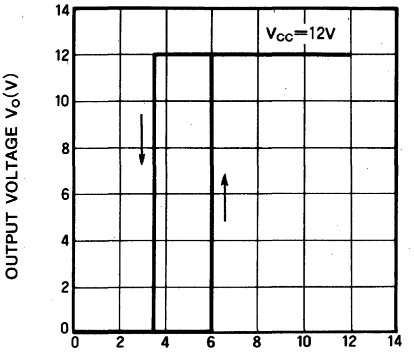
Symbol	Parameter	Test conditions		Limits			Unit
		V_{CC}(V)		Min	Typ	Max	
V_{CC}	Supply voltage range			3.0		28	V
I_{CC}	Circuit current	6.0			1.9	2.5	mA
		12.0			2.0		
		24.0			2.1		
V_{IN}	Input voltage range			1.4		V_{CC}−0.2	V
I_{IN}	Input current	6.0			20	75	nA
		12.0					
		24.0					
V_{IO}	Input offset voltage	6.0			2.0	20	mV
		12.0					
		24.0					
ΔV_{hys}	Hysteresis for switching	6.0		1.0	1.2	1.4	V
		12.0		1.9	2.4	2.9	
		24.0		3.8	4.8	5.8	
V_{OL}	Output saturation voltage	6.0	I_{OL}=60mA		0.3	0.6	V
		12.0					
		24.0					
t_{PLH}	Output "L-H" propagation delay time	12.0			1		μs
t_{PHL}	Output "H-L" propagation delay time				10		
V_{REF}	Reference voltage at Pin②			$0.85X\frac{V_{CC}}{2}$	$\frac{V_{CC}}{2}$	$11.5X\frac{V_{CC}}{2}$	V

TYPICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

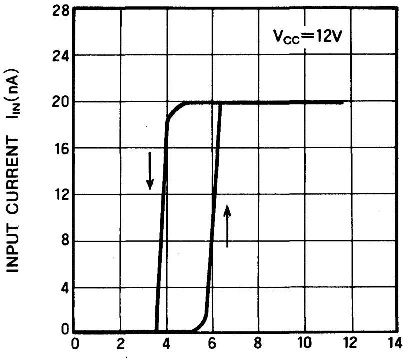
THERMAL DERATING (MAXIMUM RATING)



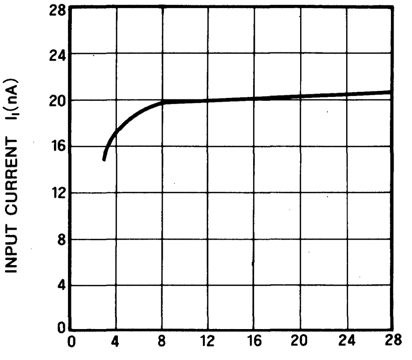
OUTPUT VOLTAGE VS INPUT VOLTAGE AT PIN②



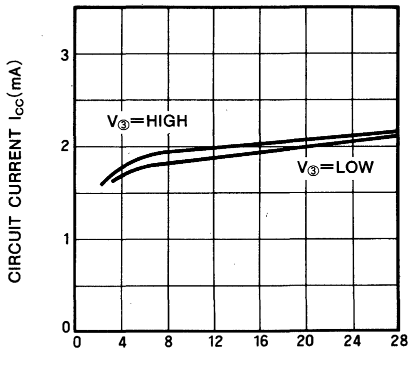
INPUT CURRENT VS INPUT VOLTAGE AT PIN②



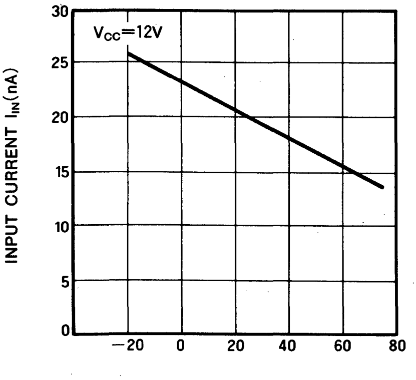
INPUT CURRENT VS SUPPLY VOLTAGE



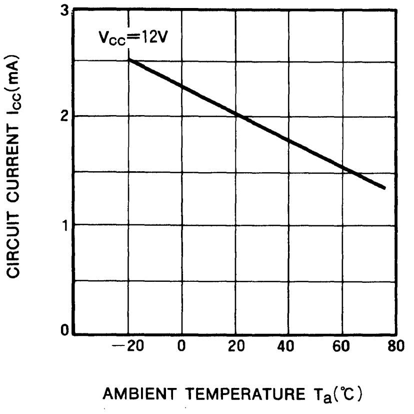
CIRCUIT CURRENT VS SUPPLY VOLTAGE



INPUT CURRENT VS AMBIENT TEMPERATURE

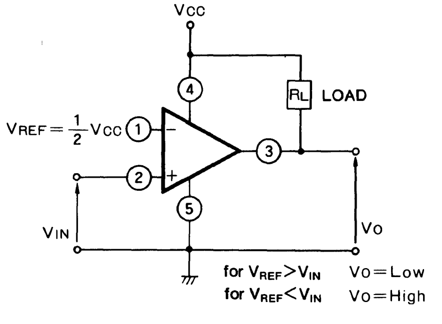


CIRCUIT CURRENT VS
AMBIENT TEMPERATURE

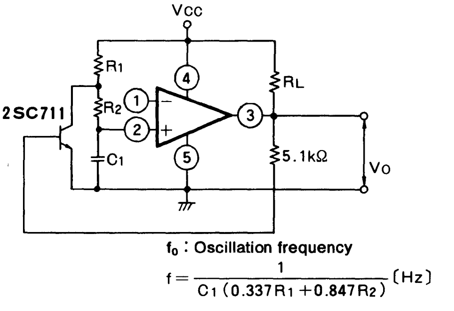


APPLICATION EXAMPLES

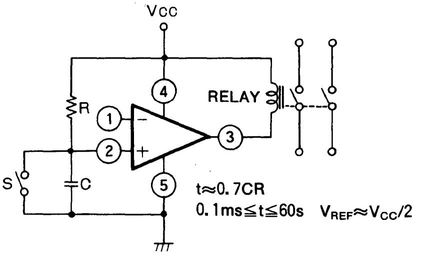
Voltage comparator



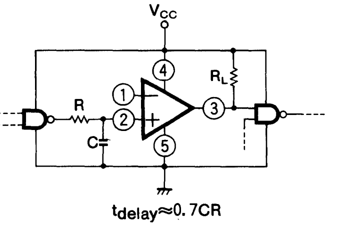
Oscillator



CR Timer



Time delay circuit



PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51203L may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51203L is connected wrong position each other.

2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.

M51204L

VOLTAGE COMPARATOR

DESCRIPTION

The M51204L is a semiconductor integrated circuit consisting of precision voltage comparator. It is designed specifically to operate from a single power supply of wide range. Input stage has a characteristic of low bias current and output stage is capable of sinking high current. So, it is intended for a wide range of applications, ex. CR Timer, relays and lamps driver. M51204L's package is a mini SIL package, therefore can use very easily.

FEATURES

- Low input current ······ 20nA (typ.)
- Wide supply voltage range ······ 3.0~28V
- Low circuit current ······ 2.5mA(max.)
- 60mA output current capability can drive a relay or a lamp.
- High output break down voltage ······ 30V(max.)

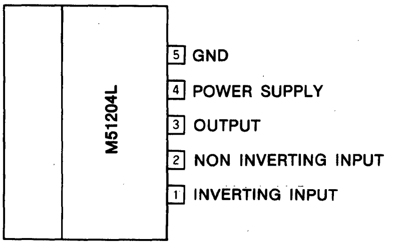
APPLICATIONS

- Electric shutter
- Comparator
- Level detector
- CR Timer
- Time delay circuit

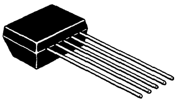
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ······ 2.5~28V
Rated supply voltage ······ 12V±10%

PIN CONFIGURATION (TOP VIEW)

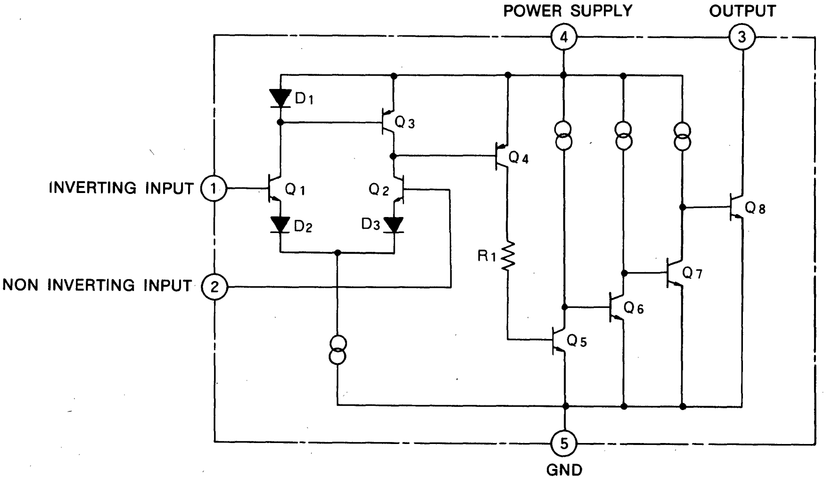


Outline 5P5



5-pin molded plastic SIL

EQUIVALENT CIRCUIT



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

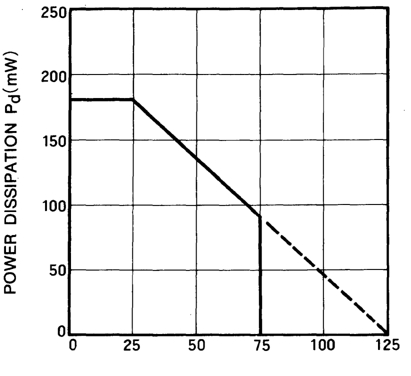
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		28	V
V_{IN}	Input voltage		V_{CC}	V
I_{OL}	Output drive current	Output saturated	60	mA
V_{OH}	Output drive voltage		30	V
P_d	Power dissipation		180	mW
K_θ	Thermal derating	$T_a \geqq 25$℃	1.8	mW/℃
T_{opr}	Operating temperature		−20∼+75	℃
T_{stg}	Storage temperature		−40∼+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃)

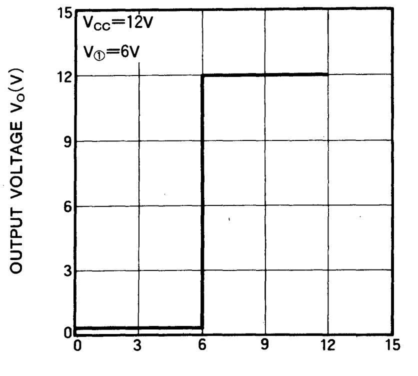
Symbol	Parameter	V_{CC}(V)	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage range			2.5		28	V
I_{CC}	Circuit current	6.0 / 12.0 / 24.0			1.8	2.5	mA
V_{IN}	Input voltage range	12.0		1.4		V_{CC}−0.2	V
I_{IN}	Input current	6.0 / 12.0 / 24.0			20	75	nA
V_{IO}	Input offset voltage	6.0 / 12.0 / 24.0			2	20	mV
V_{OL}	Output saturation voltage	6.0 / 12.0 / 24.0	I_{OL}=60mA		0.3	0.6	V
t_{PLH}	Output "L-H" propagation delay time	12.0			1		μs
t_{PHL}	Output "H-L" propagation delay time	12.0			10		μs

TYPICAL CHARACTERISTIC (T_a=25℃, unless otherwise noted)

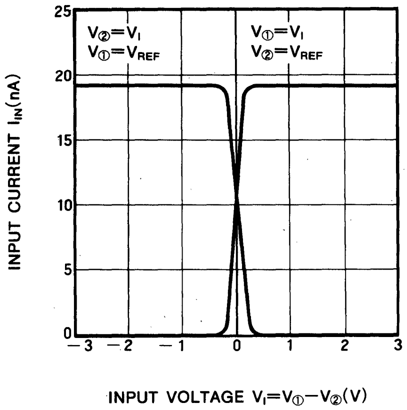
THERMAL DERATING (MAXIMUM RATING)



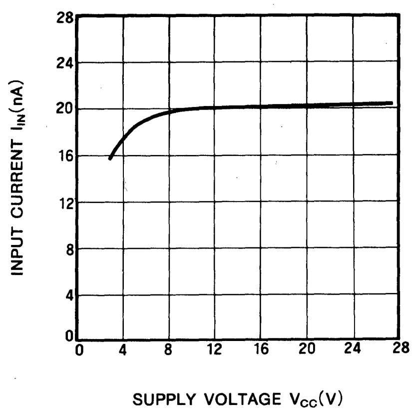
OUTPUT VOLTAGE VS INPUT VOLTAGE AT PIN ②



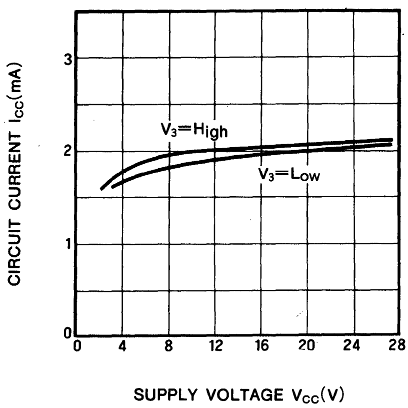
INPUT CURRENT VS INPUT VOLTAGE



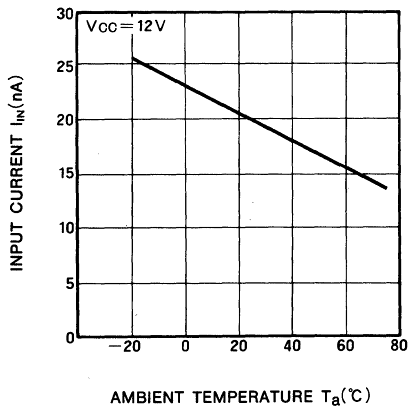
INPUT CURRENT VS SUPPLY VOLTAGE



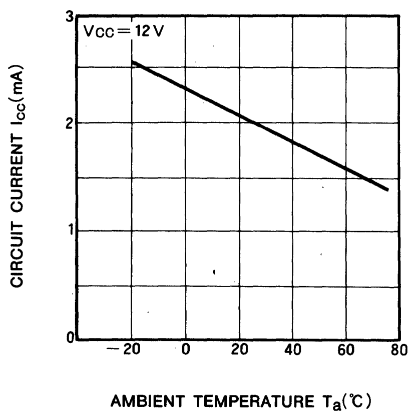
CIRCUIT CURRENT VS SUPPLY VOLTAGE



INPUT CURRENT VS AMBIENT TEMPERATURE

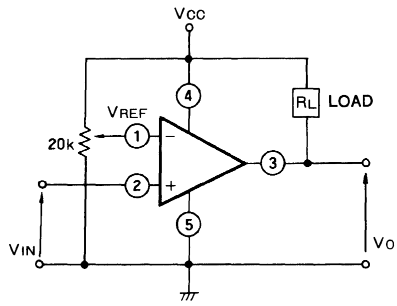


CIRCUIT CURRENT VS AMBIENT TEMPERATURE

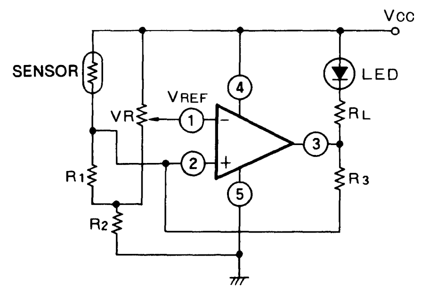


APPLICATION EXAMPLES

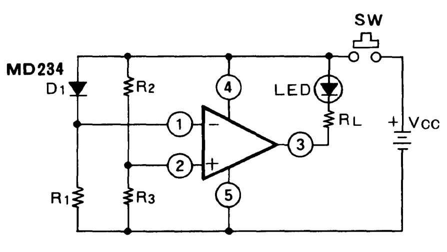
Voltage comparator



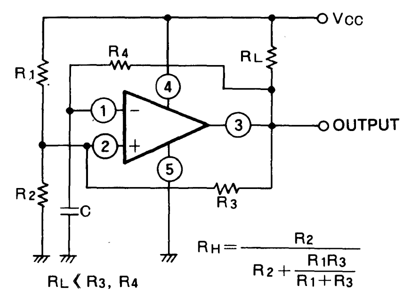
Detector



Battery checker



Oscillator

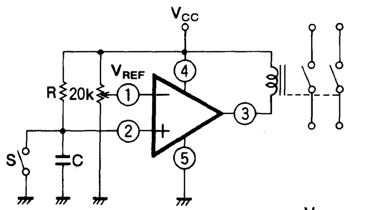


$R_L \ll R_3, R_4$

$$R_H = \frac{R_2}{R_2 + \frac{R_1R_3}{R_1+R_3}}$$

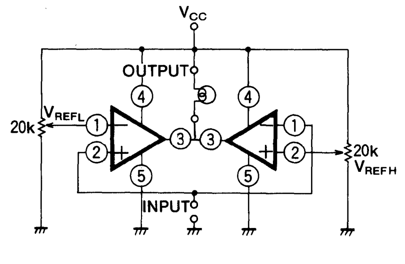
$$f = \frac{1}{CR_4 \ell n \frac{R_L}{R_H} \cdot \frac{1-R_L}{1-R_H}} \text{ [Hz]} \qquad R_L = \frac{\frac{R_2R_3}{R_2+R_3}}{R_1 + \frac{R_2R_3}{R_2+R_3}}$$

CR Timer



$$t = CR\,\ell n \frac{V_{CC}}{V_{CC} - V_{REF}}$$

Window comparator



PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51204L may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51204L is connected wrong position each other.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.

M51205L

VOLTAGE COMPARATOR

DESCRIPTION

The M51205L is a semiconductor integrated circuit consisting of precision voltage comparator. It is designed specifically to operate from a high voltage because of built-in zener diode for stabilization. One of the input stages has a characteristic of low bias current and the other has built-in reference voltage with hysteresis. Output stage is capable of sinking high current. So, it is intended for a wide range of applications, ex. CR Timer, relays or lamps driver. M51205L's package is a mini SIL package, therefore can use very easily.

FEATURES

- Low input current ······································ 20nA(typ.)
- Built-in zener diode for stabilization of power supply voltage.
- 60mA output current capability can drive a relay or a lamp
- High output break down voltage ··················· 30V(max.)
- Including both reference voltage circuit and hysteresis for switching

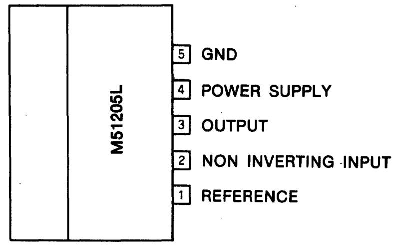
APPLICATIONS

- Electric shutter
- Comparator
- Level detector
- CR Timer
- Time delay circuit

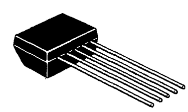
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ·· Over 2.5V
Rated supply voltage ················ 12V (with dropper resistor)

PIN CONFIGURATION (TOP VIEW)

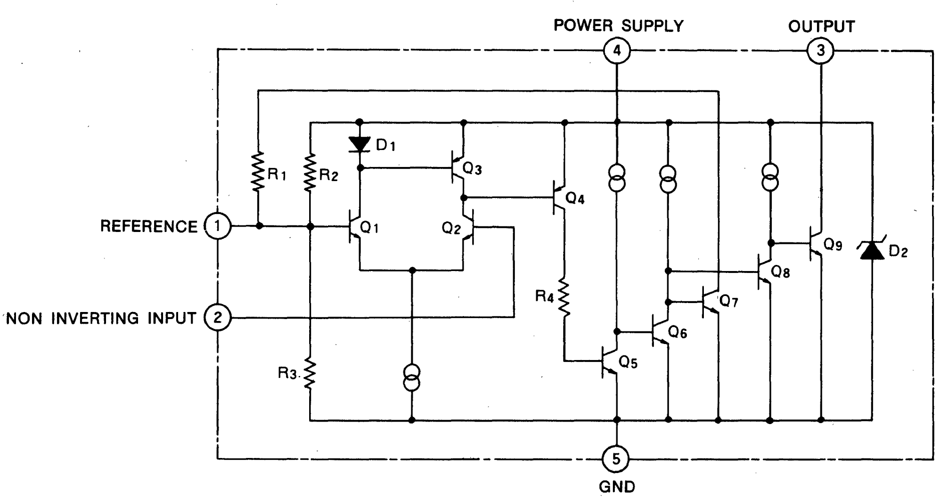


Outline 5P5



5-pin molded plastic SIL

EQUIVALENT CIRCUIT



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (Ta=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
I_{CC}	Circuit current		20	mA
V_{IN}	Input voltage		V④※	V
I_{OL}	Output drive current	Output saturated	60	mA
V_{OH}	Output drive voltage		30	V
P_d	Power dissipation		180	mW
K_θ	Thermal derating	$T_a \geqq 25$℃	1.8	mW/℃
T_{opr}	Operating temperature		−20〜+75	℃
T_{stg}	Storage temperature		−40〜+125	℃

※ : Voltage at Pin④

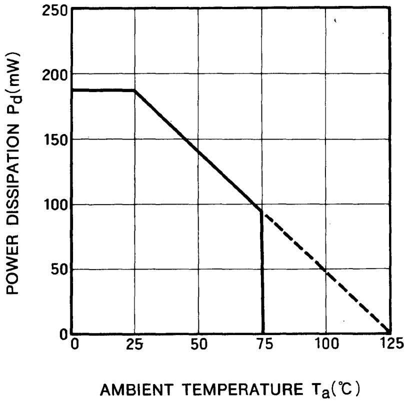
ELECTRICAL CHARACTERISTICS (Ta=25℃, Rd : dropper resistor)

Symbol	Parameter	Test conditions		Limits			Unit
		V_{CC}(V)		Min	Typ	Max	
V④	Zener voltage	12.0	R_d=1kΩ	5.0	5.6	7.0	V
V_{IN}	Input voltage range	12.0	Rd=1kΩ	0.8		V④−0.2	V
I_{IN}	Input current	12.0	R_d=1kΩ		20	75	nA
V_{REF}	Reference voltage	5.00	R_d=0Ω, V_{IN}=0V	2.25	2.50	2.75	V
ΔV_{hys}	Hysteresis for switching	5.00	R_d=0Ω, V_{IN}=3V	0.80	1	1.20	V
V_{OL}	Output saturation voltage	12.0	R_d=1kΩ, R_L=200Ω		0.3	0.6	V
t_{PLH}	Output "L-H" propagation delay time	12.0	R_d=1kΩ		1		μs
t_{PHL}	Output "H-L" propagation delay time				10		μs
I_{CC}※	Circuit current ($V_{CC} \leqq$ V④)	5.00	R_d=0Ω		1.9	2.4	mA

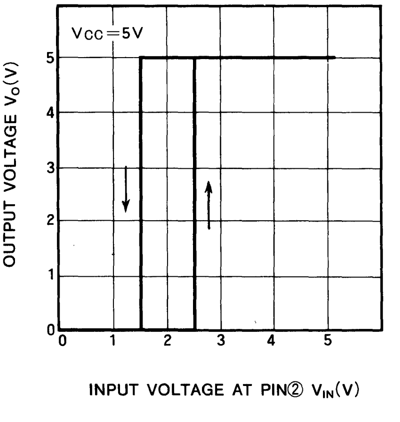
※ : Excluding zener current of zener diode connected to Pin④

TYPICAL CHARACTERISTICS (Ta=25℃, unless otherwise noted)

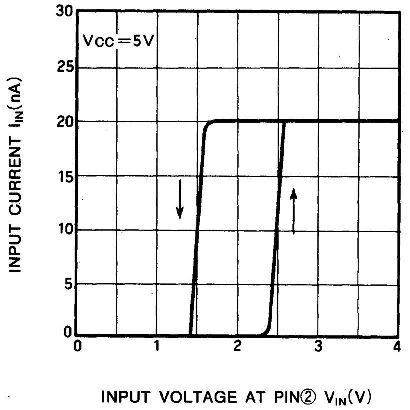
THERMAL DERATING (MAXIMUM RATING)



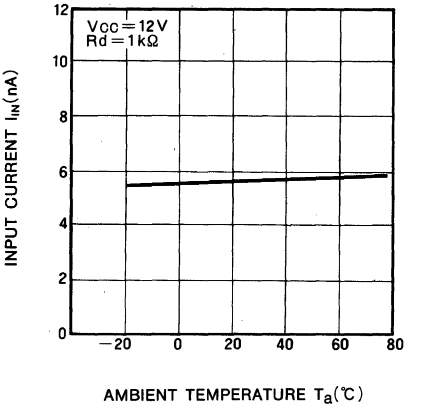
OUTPUT VOLTAGE VS INPUT VOLTAGE AT PIN②



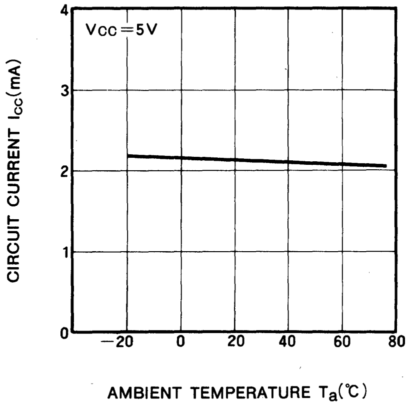
INPUT CURRENT VS INPUT VOLTAGE AT PIN②



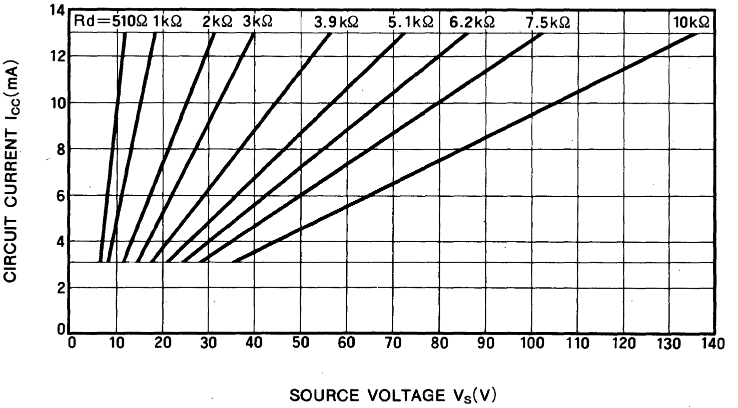
INPUT CURRENT VS AMBIENT TEMPERATURE



CIRCUIT CURRENT VS AMBIENT TEMPERATURE

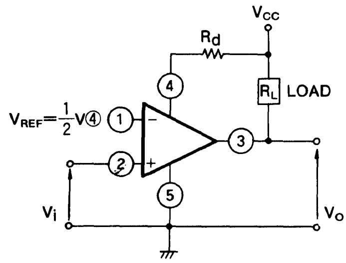


DROPPER RESISTOR(Rd) SELECTION GRAPH

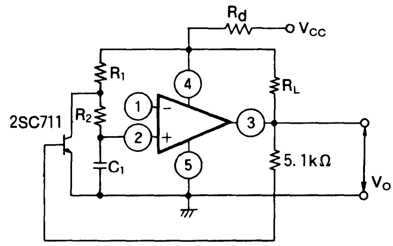


APPLICATION EXAMPLES

Voltage comparator



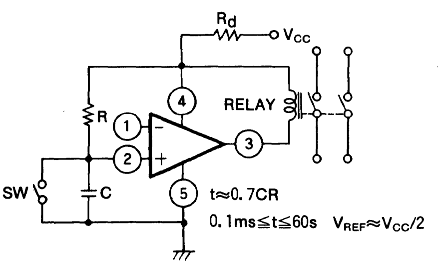
Oscillator



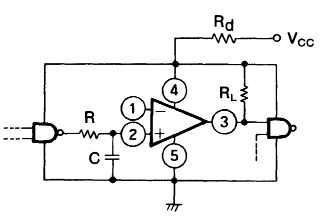
f_0 : Oscillation frequency

$$f=\frac{1}{C_1(0.337R_1+0.847R_2)}\ \text{[Hz]}$$

CR Timer



Time delay circuit



$t_{delay}\approx 0.7CR$

PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51205L may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51205L is connected wrong position each other.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.
3. Care should be taken not to apply over 5(V) directly to the terminals between Pin④ and Pin⑤. Connect a dropper resistor(Rd) in series to Pin④, in case of applying over 5(V) between Pin④ and Pin⑤.

M51206L

VOLTAGE COMPARATOR

DESCRIPTION

The M51206L is a semiconductor integrated circuit consisting of precision voltage comparator.

It is designed specifically to operate from a high voltage because of built-in zener diode for stabilization. Input stage has a characteristic of low bias current and output stage is capable of sinking high current. So, it is intended for a wide range of applications, ex. CR Timer, relays or lamps driver. M51206L's package is a mini SIL package, therefore can use very easily.

FEATURES

- Low input current ······································ 20nA (typ.)
- Built-in zener diode for stabilization of power supply voltage.
- 60mA output current capability can drive a relay or a lamp.
- High output break down voltage····················· 30V(max.)

APPLICATIONS

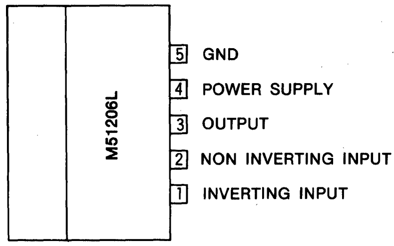
- Electric shutter
- Comparator
- Level detector
- CR Timer
- Time delay circuit

RECOMMENDED OPERATING CONDITIONS

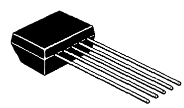
Supply voltage range··· over 3V

Rated supply voltage················ 12V (with dropper resistor)

PIN CONFIGURATION (TOP VIEW)

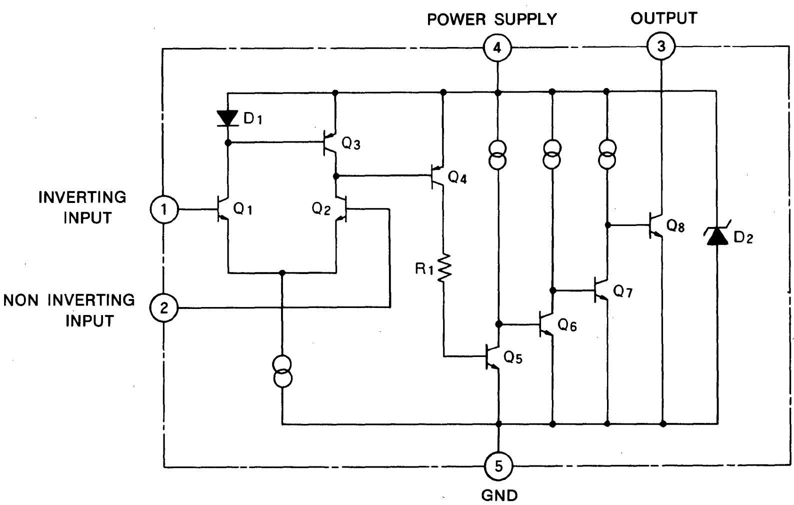


Outline 5P5



5-pin molded plastic SIL

EQUIVALENT CIRCUIT



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
I_{CC}	Circuit current		20	mA
V_{IN}	Input voltage		V④※	V
I_{OL}	Output drive current	Output saturated	60	mA
V_{OH}	Output drive voltage		30	V
P_d	Power dissipation		180	mW
K_θ	Thermal derating	$T_a \geq 25$℃	1.8	mW/℃
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

※Voltage at Pin④

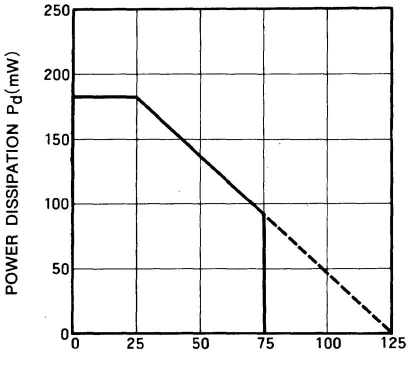
ELECTRICAL CHARACTERISTICS (T_a=25℃)

Symbol	Parameter	Test conditions		Limits			Unit
		V_{CC}(V)		Min	Typ	Max	
$V_④$	Zener voltage	12.0	R_d=1kΩ	5.0	5.6	7.0	V
V_{IN}	Input voltage range	12.0	R_d=1kΩ	0.8		$V_④$−0.2	V
I_{IN}	Input current	12.0	R_d=1kΩ		20	75	nA
I_{CC}※	Circuit current $V_{CC} \leq V_④$	5.0	R_d=0Ω		1.8	2.4	mA
V_{IO}	Input offset voltage	12.0	R_d=1kΩ		2	20	mV
V_{OL}	Output saturation voltage	12.0	R_d=1kΩ, R_L=200Ω		0.3	0.6	V
t_{PLH}	Output "L-H" propagation delay time	12.0	R_d=1kΩ		1		μS
t_{PHL}	Output "H-L" propagation delay time				10		

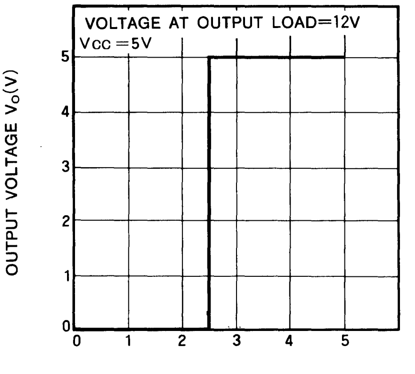
※Excluding zener current of zener diode connected to Pin④

TYPICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

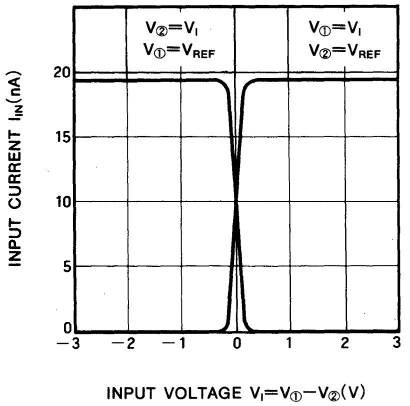
THERMAL DERATING (MAXIMUM RATING)



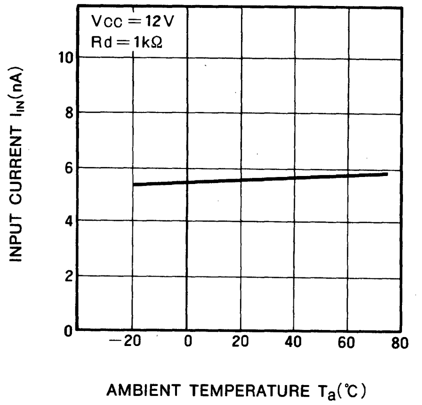
OUTPUT VOLTAGE VS INPUT VOLTAGE AT PIN ②



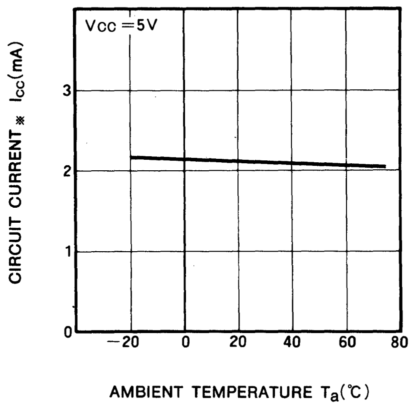
INPUT CURRENT VS INPUT VOLTAGE



INPUT CURRENT VS AMBIENT TEMPERATURE

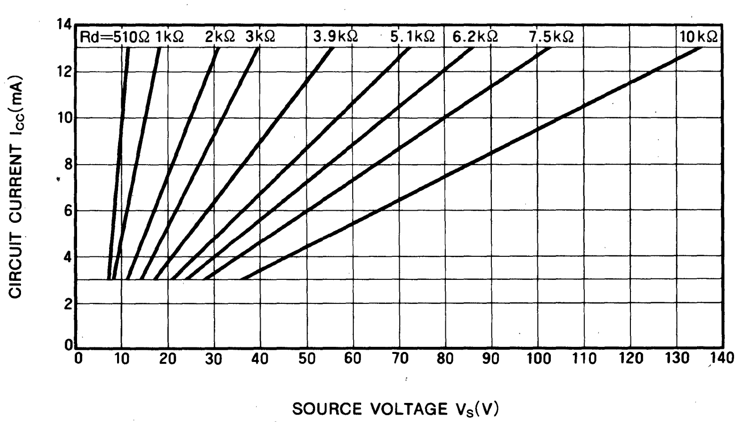


CIRCUIT CURRENT VS AMBIENT TEMPERATURE



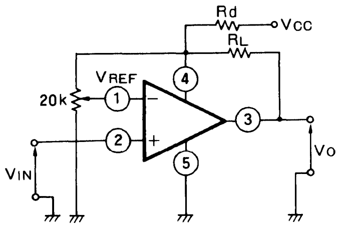
※Excluding zener current of zener diode connected to Pin④

DROPPER RESISTOR (Rd) SELECTION GRAPH

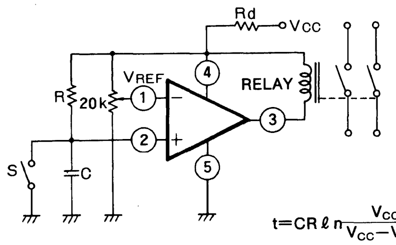


APPLICATION EXAMPLES

Voltage comparator



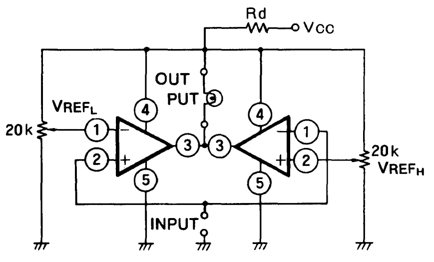
CR Timer



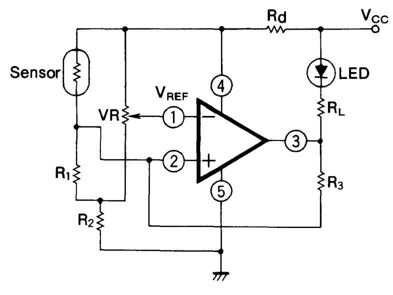
$t = CR\ln\frac{V_{CC}}{V_{CC}-V_{REF}}$

$0.1ms \leqq t \leqq 60s$

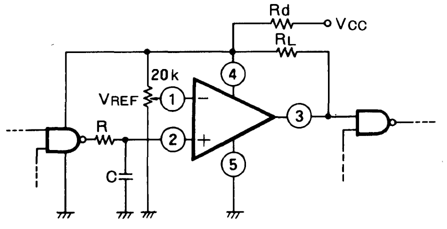
Window comparator



Detector

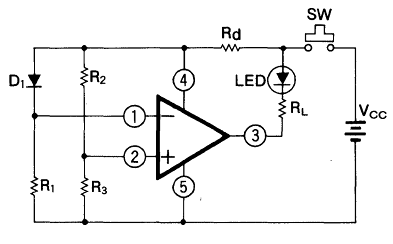


Time delay circuit



$t_{delay} = CR\ln\frac{V_{CC}}{V_{CC}-V_{REF}}$

Battery checker



PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51206L may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51206L is connected wrong position each other.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.
3. Care should be taken not to apply over 5(V) directly to the terminals between Pin④ and Pin⑤.Connect a dropper resistor(Rd) in series to Pin④, in case of applying over 5(V) between Pin④ and Pin⑤.

DUAL COMPARATOR

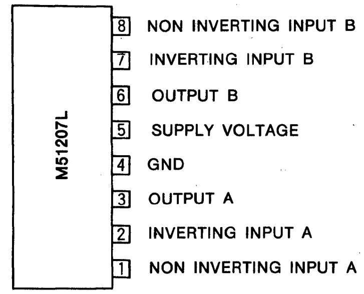
DESCRIPTION
The M51207L is dual (two independent) comparator and operates over wide voltage range at single supply voltage. Especially the M51207L has superiority as to characteristics of input current (input resistance) and fits to wide ranged applications, for example CR Timer, oscillator and etc..

FEATURES
- Low input current (high input resistance) ······· 20nA(typ.)
- Wide supply voltage range ···························· 2.5～28V
- Low dissipation current ····························· 3.8mA(typ.)
- Enable to drive a relay or a lamp directly ····· 60mA(max.)
- Including voltage surge absorbing zener diodes
- High output breakdown voltage ···················· 30V(max.)
- Low output voltage ···································· 0.2V(typ.)
- Low input offset voltage ······························ 2mV(typ.)

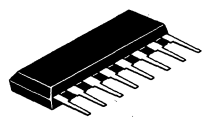
APPLICATIONS
- Voltage comparator, sequential timer, pulse generator
- A/D converter, time delay circuit, etc.

RECOMMENDED OPERATING CONDITIONS
Supply voltage range ·· 2.5～28V
Rated supply voltage range ·· 12V

PIN CONFIGURATION (TOP VIEW)

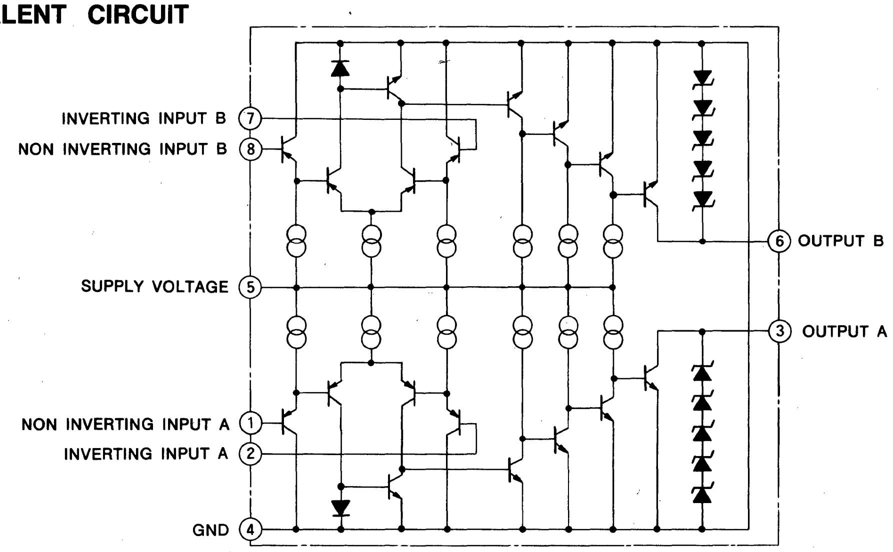


Outline 8P5



8-pin molded plastic SIL

EQUIVALENT CIRCUIT



DUAL COMPARATOR

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

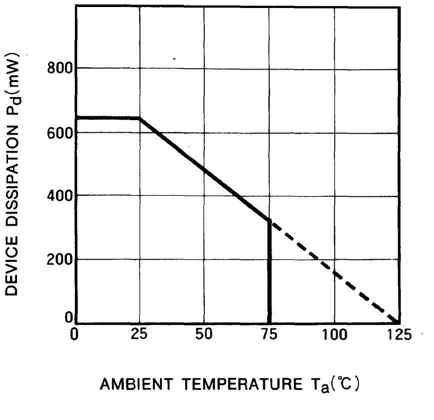
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		28	V
V_{id}	Differential input voltage		V_{CC}	V
V_{icm}	Common mode input voltage range		$-0.3 \sim V_{CC}$	V
I_{sink}	Output sink current	Output saturated	60	mA
V_{OH}	"H" Output voltage		30	V
P_d	Power dissipation		650	mW
T_{opr}	Operating temperature		$-20 \sim +75$	℃
T_{stg}	Storage temperature		$-40 \sim +125$	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=2.5~28V, unless otherwise noted)

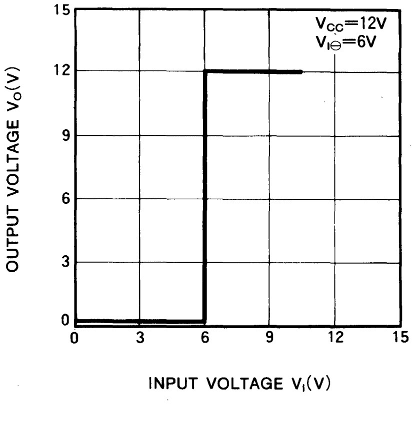
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		2.5		28	V
I_{CC}	Circuit current			3.8	5.3	mA
$V_{I\ominus}$	Inverting input voltage range		0		$V_{CC}-1.5$	V
$V_{I\oplus}$	Non inverting input voltage range		0		$V_{CC}-1.5$	V
V_{IO}	Input offset voltage			2	7	mV
$I_{I\ominus}$	Inverting input current			20	100	nA
$I_{I\oplus}$	Non inverting input current			20	100	nA
I_{IO}	Input offset current			5	50	nA
V_{OL}	"L" output voltage	I_{OL}=60mA		0.2	0.4	V
I_{sink}	Output sink current				60	mA
I_{LO}	Output leakage current				0.1	μA
t_{PLH}	Output "L→H" propagation delay time			2		μS
t_{PHL}	Output "H→L" propagation delay time			1		μS

TYPICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

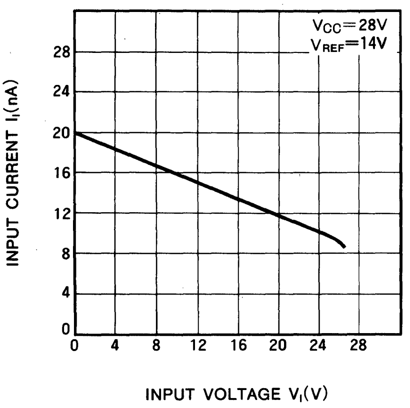
THERMAL DERATING
(MAXIMUM RATING)



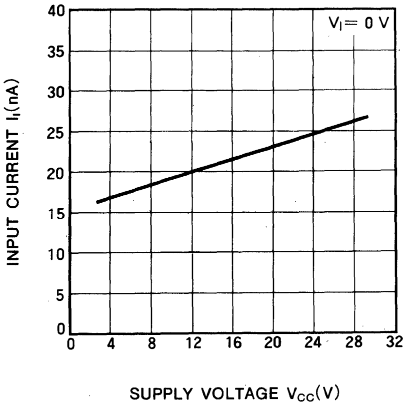
OUTPUT VOLTAGE VS
INPUT VOLTAGE



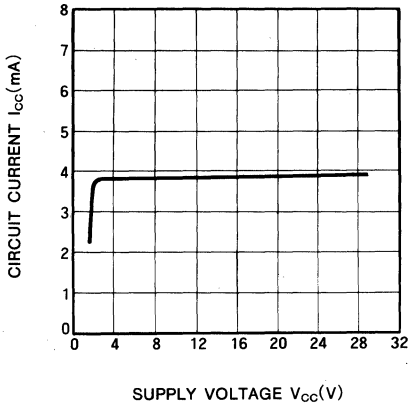
INPUT CURRENT VS
INPUT VOLTAGE



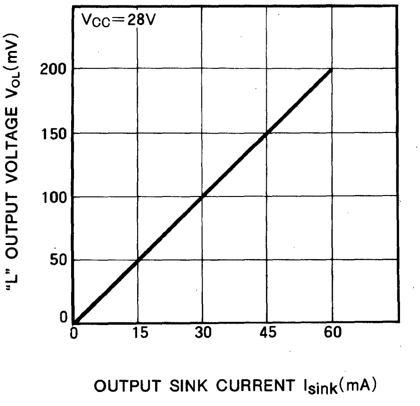
INPUT CURRENT VS
SUPPLY VOLTAGE



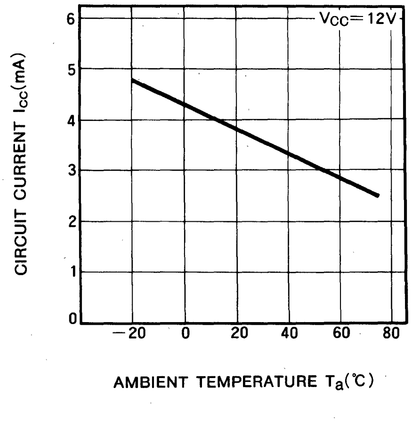
CIRCUIT CURRENT VS
SUPPLY VOLTAGE



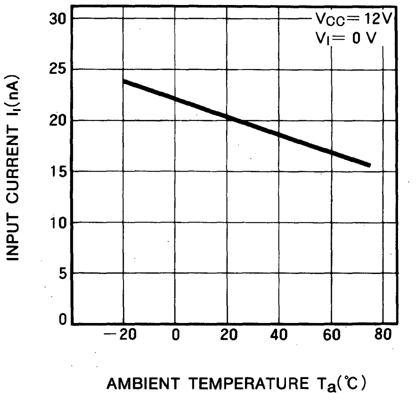
"L" OUTPUT VOLTAGE
VS OUTPUT SINK CURRENT



CIRCUIT CURRENT
VS AMBIENT TEMPERATURE



INPUT CURRENT
VS AMBIENT TEMPERATURE

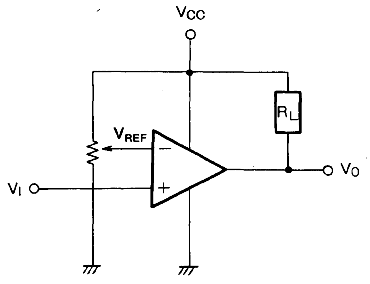


PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51207L may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51207L is connected wrong position each other.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.

APPLICATIONS

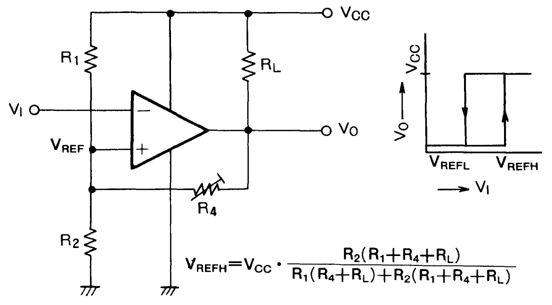
(1) Voltage comparator



If $V_{REF} > V_i$, V_O=Low

If $V_{REF} < V_i$, V_O=High

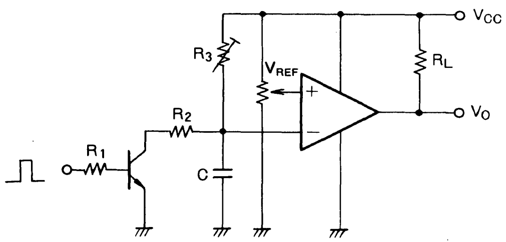
(2) Schmit trigger circuit



$$V_{REFH}=V_{CC}\cdot\frac{R_2(R_1+R_4+R_L)}{R_1(R_4+R_L)+R_2(R_1+R_4+R_L)}$$

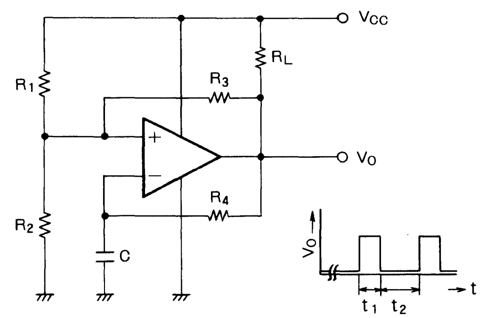
$$V_{REFL}=V_{CC}\cdot\frac{R_2R_4}{R_2R_4+R_1(R_2+R_4)}$$

(3) Monostable multi vibrator



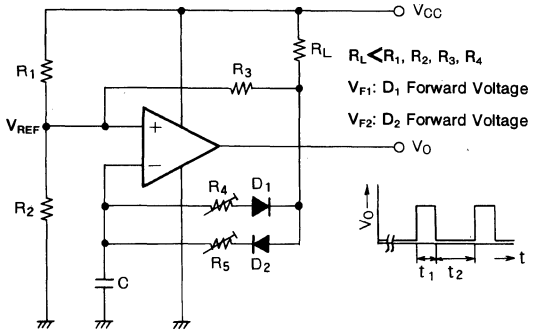
$$t=CR_3\cdot \ell n\frac{V_{CC}}{V_{CC}-V_{REF}}\text{(sec)}$$

(4) Astable multi vibrator



$$t_1=CR_4\cdot \ell n\frac{R_2+R_3}{R_3}\quad t_2=CR_4\cdot \ell n\frac{R_1+R_3}{R_3}(R_L<R_1, R_2, R_3, R_4)$$

(5) Pulse generator



$R_L<R_1$, R_2, R_3, R_4

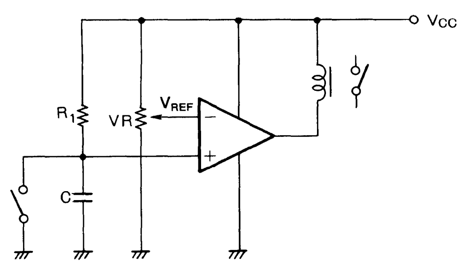
V_{F1}: D_1 Forward Voltage

V_{F2}: D_2 Forward Voltage

$$V_{REFH}=\frac{V_{CC}\cdot R_2(R_1+R_3)}{R_1R_2+R_2R_3+R_3R_1}\qquad t_1=CR_5\cdot \ell n\frac{V_{CC}-V_{REFL}-V_{F2}}{V_{CC}-V_{REFH}}$$

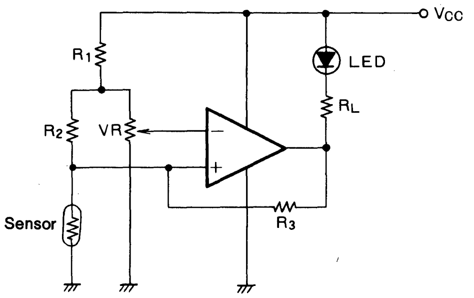
$$V_{REFH}=\frac{V_{CC}\cdot R_2R_3}{R_1R_2+R_2R_3+R_3R_1}\qquad t_2=CR_4\cdot \ell n\frac{V_{REFH}-V_{F1}}{V_{REFL}}$$

(6) CR Timer

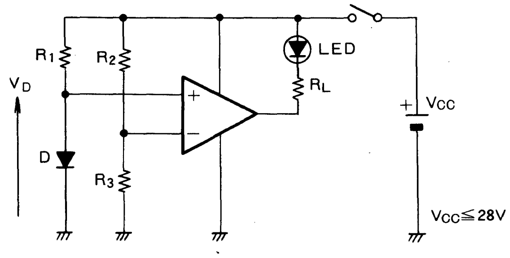


$$t=CR_1\cdot \ell n\frac{V_{CC}}{V_{CC}-V_{REF}}$$

(7) Sensor detector



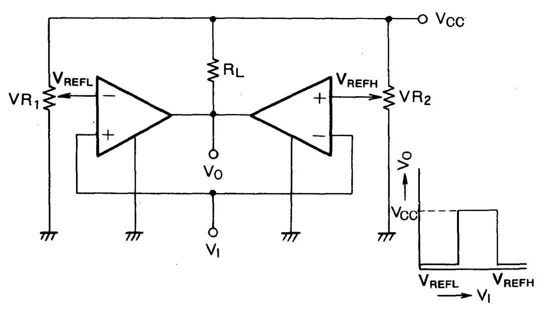
(8) Battery check circuit



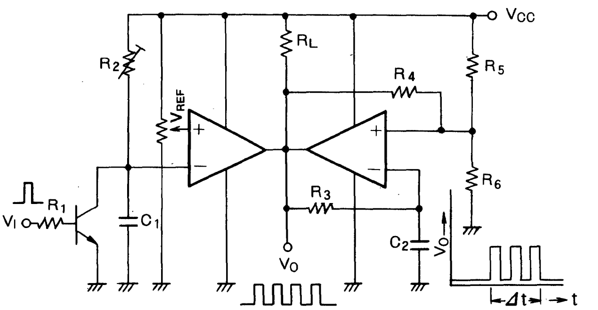
$$V_D < V_{CC} \cdot \frac{R_3}{R_2+R_3} : \text{LED} \rightarrow \text{ON}$$

$$V_D > V_{CC} \cdot \frac{R_3}{R_2+R_3} : \text{LED} \rightarrow \text{OFF}$$

(9) Window comparator



(10) Pulse train generator

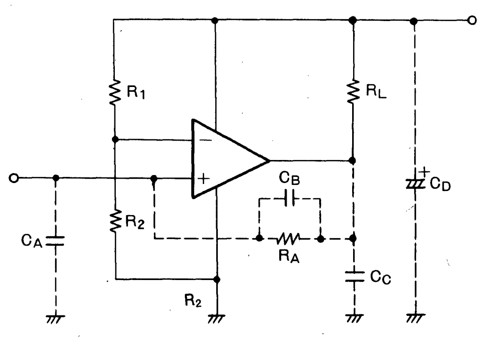


$$\Delta t = C_1 R_2 \cdot \ell n \frac{V_{CC}}{V_{CC}-V_{REF}}$$

(11) Countermeasure against oscillation

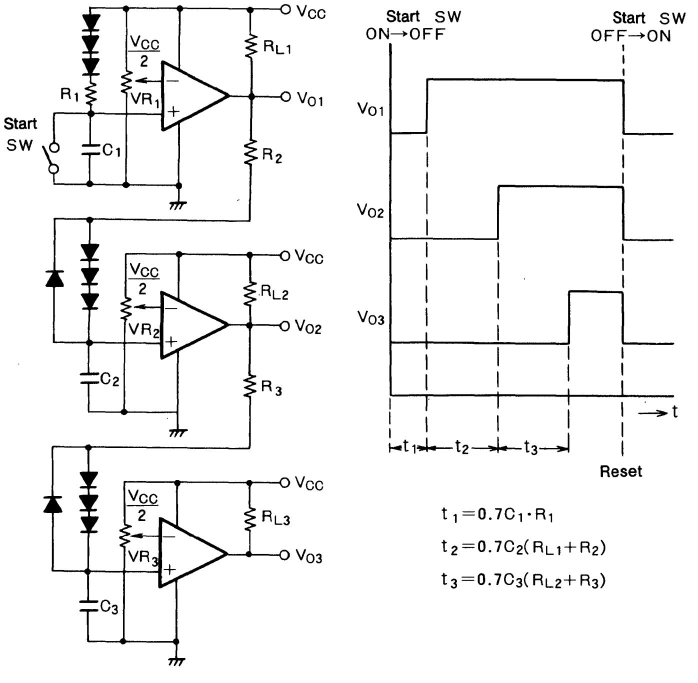
(NOTE) Taking steps against oscillation
The M51207L has possibility of oscillation according to input condition. If the M51207L should oscillate, following countermeasures are applicable.

* : In case of connecting input signal with chattering connect a capacitor of small value, C_A.
* : In case of oscillating on the condition of ordinary input, employ positive feedback inserting R_A (resistor of large value), C_S(no polar) or connect C_C.
* : In case that supply voltage is not stabilized, connect C_D (electrolytic capacitor of large value) to absorb the supply voltage change.



MITSUBISHI ELECTRIC

(12) Sequential timer

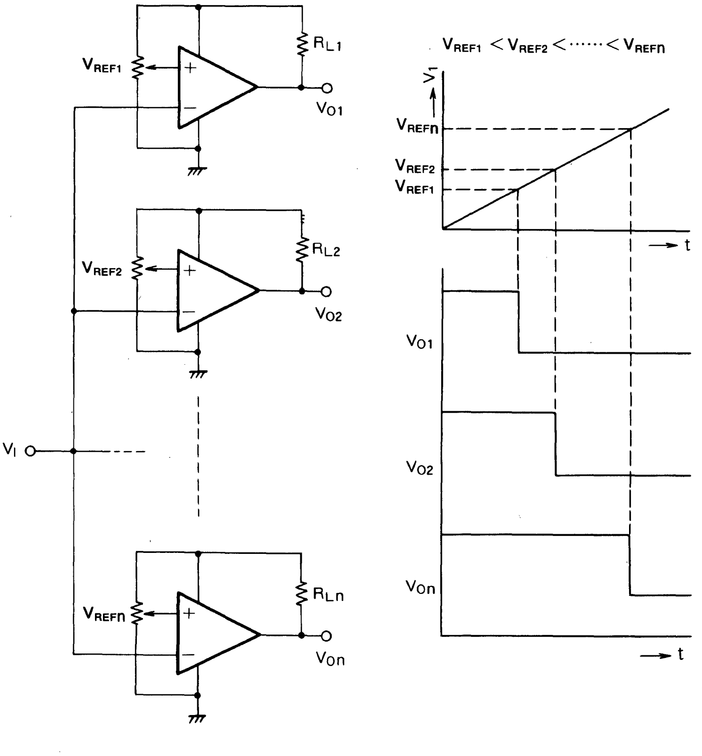


$t_1 = 0.7C_1 \cdot R_1$

$t_2 = 0.7C_2(R_{L1} + R_2)$

$t_3 = 0.7C_3(R_{L2} + R_3)$

(13) Analog/Digital converter



M51209P/M5N339P

QUAD COMPARATOR

DESCRIPTION

The M51209P/M5N339P is quad (four independent) comparator and operates over wide voltage range at single supply voltage. Especially the M51209P/M5N339P has superiority as to characteristics of input current (input resistance) and fits to wide ranged applications, for example CR Timer, oscillator and etc.

FEATURES

- Low input current (high input resistance) ······ 20nA (typ.)
- Wide supply voltage range ······························ 2.5~28V
- Low dissipation current ·································· 6.8mA (typ.)
- Enable to drive a relay or a lamp directly ···· 60mA (max.)
- Including voltage surge absorbing zener diodes
- High output breakdown voltage ······················ 30V (max.)
- Low output voltage ·· 0.2V (typ.)
- Low input offset voltage ································ 2mV (typ.)

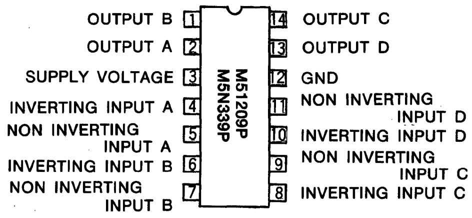
APPLICATIONS

- Voltage comparator, sequential timer, pulse generator
- A/D converter, time delay circuit, etc.

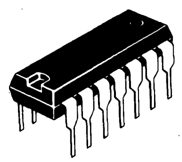
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ··· 2.5~28V
Rated supply voltage range ·· 12V

PIN CONFIGURATION (TOP VIEW)

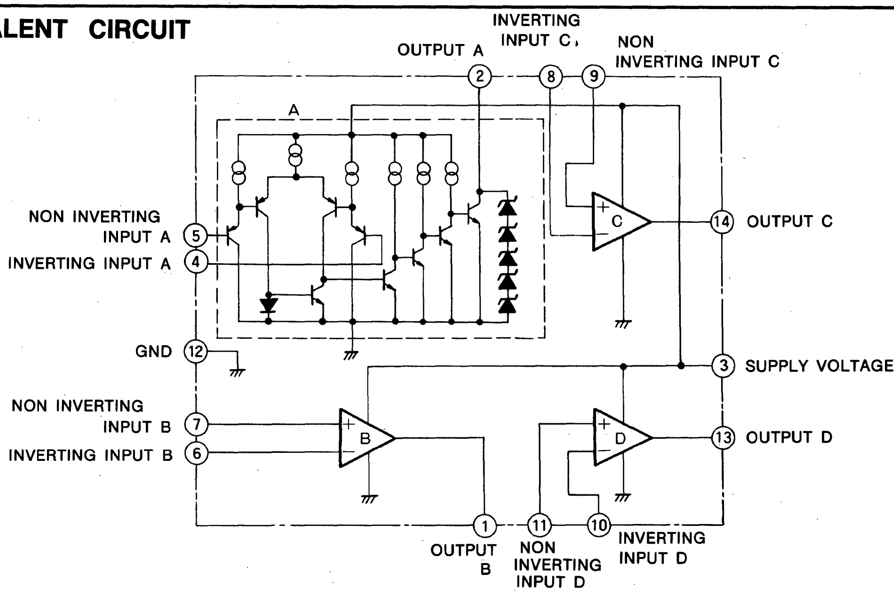


Outline 14P4



14-pin molded plastic DIL

EQUIVALENT CIRCUIT



QUAD COMPARATOR

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

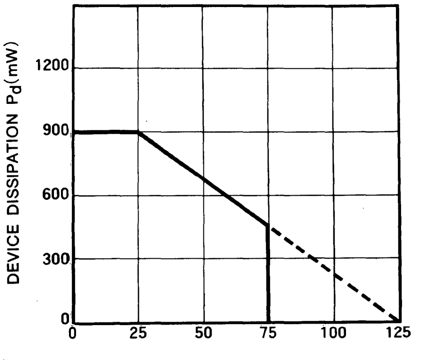
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		28	V
V_{id}	Differential input voltage		V_{CC}	V
V_{icm}	Common mode input voltage range		$-0.3 \sim V_{CC}$	V
I_{sink}	Output sink current	Output saturated	60	mA
V_{OH}	"H" output voltage		30	V
P_d	Power dissipation		900	mW
T_{opr}	Operating temperature		$-20 \sim +75$	℃
T_{stg}	Storage temperature		$-40 \sim +125$	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=2.5 to 28V, unless otherwise noted)

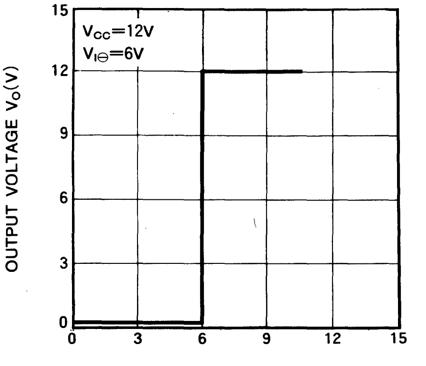
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		2.5		28	V
I_{CC}	Circuit current			6.8	9.5	mA
$V_{I\ominus}$	Inverting input voltage range		0		$V_{CC}-1.5$	V
$V_{I\oplus}$	Non inverting input voltage range		0		$V_{CC}-1.5$	V
V_{IO}	Input offset voltage			2	7	mV
$I_{I\ominus}$	Inverting input current			20	100	nA
$I_{I\oplus}$	Non inverting input current			20	100	nA
I_{IO}	Input offset current			5	50	nA
V_{OL}	"L" output voltage	I_{OL}=60mA		0.2	0.4	V
I_{sink}	Output sink current				60	mA
I_{LO}	Output leakage current				0.1	μA
t_{PLH}	Output "L→H" propagation delay time			2		μS
t_{PHL}	Output "H→L" propagation delay time			1		μS

TYPICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

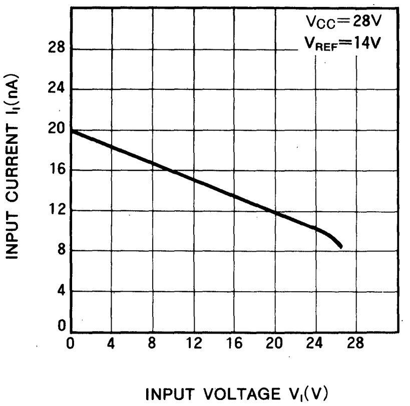
THERMAL DERATING (MAXIMUM RATING)



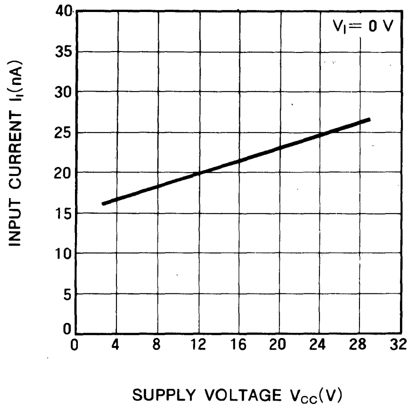
OUTPUT VOLTAGE VS INPUT VOLTAGE



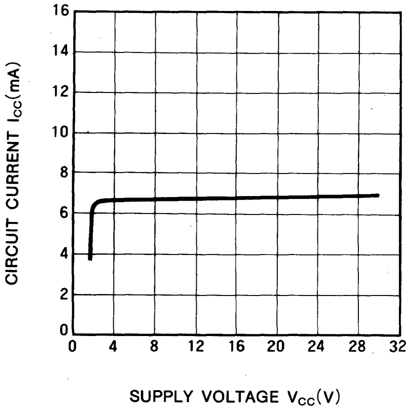
INPUT CURRENT VS INPUT VOLTAGE



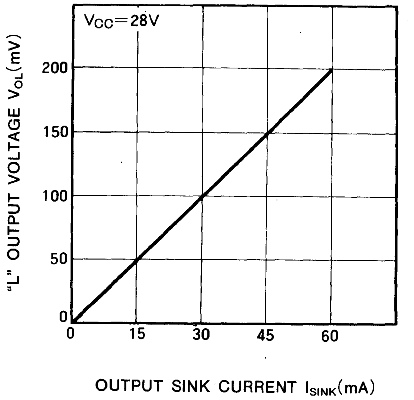
INPUT CURRENT VS SUPPLY VOLTAGE



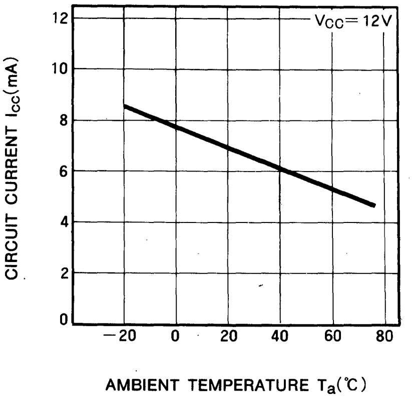
CIRCUIT CURRENT VS SUPPLY VOLTAGE



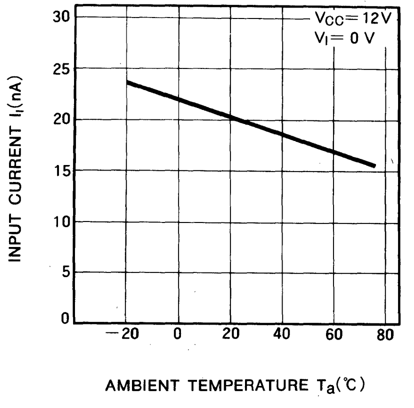
"L" OUTPUT VOLTAGE VS OUTPUT SINK CURRENT



CIRCUIT CURRENT VS AMBIENT TEMPERATURE



INPUT CURRENT VS AMBIENT TEMPERATURE

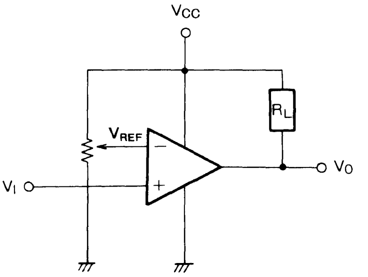


PRECAUTIONS FOR USE

1. Paying much attention is necessary for fear that the M51209P may flow large current and reach to destroy because of the structure when the terminals of V_{CC} and GND of the M51209P is connected wrong position each other.
2. Output is "open collector" and a loading resistor is not included. Connect a loading resistor to stabilize operation, in case of driving a next stage.

APPLICATION

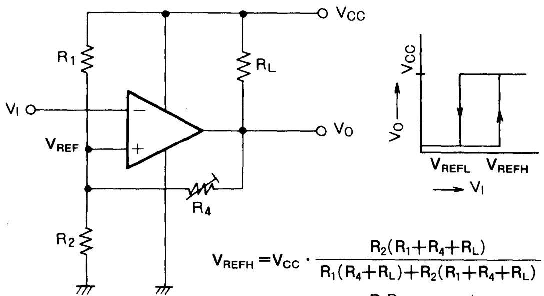
(1) Voltage comparator



If $V_{REF} > V_I$, V_O=Low

If $V_{REF} < V_I$, V_O=High

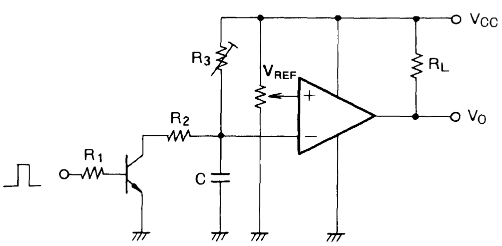
(2) Schmit trigger circuit



$$V_{REFH} = V_{CC} \cdot \frac{R_2(R_1+R_4+R_L)}{R_1(R_4+R_L)+R_2(R_1+R_4+R_L)}$$

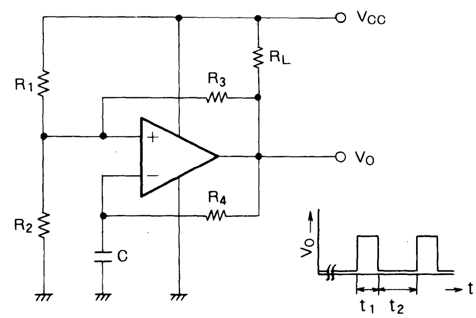
$$V_{REFL} = V_{CC} \cdot \frac{R_2R_4}{R_2R_4+R_1(R_2+R_4)}$$

(3) Monostable multi vibrator



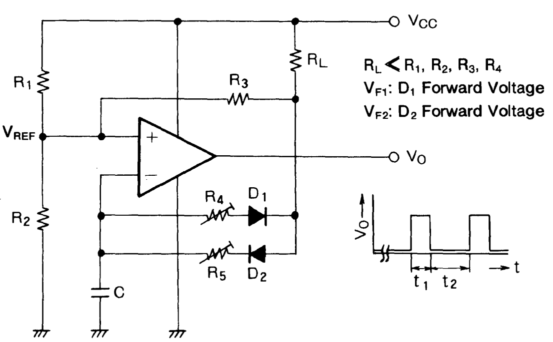
$$t = CR_3 \cdot \ell n \frac{V_{CC}}{V_{CC} - V_{REF}} \text{(sec)}$$

(4) Astable multi vibrator



$$t_1 = CR_4 \cdot \ell n \frac{R_2+R_3}{R_3} \quad t_2 = CR_4 \cdot \ell n \frac{R_1+R_3}{R_3} (R_L < R_1, R_2, R_3, R_4,)$$

(5) Pulse generator



$R_L < R_1, R_2, R_3, R_4$

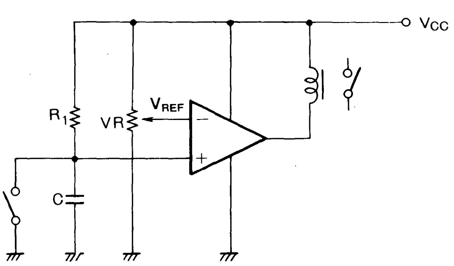
V_{F1}: D_1 Forward Voltage

V_{F2}: D_2 Forward Voltage

$$V_{REFH} = \frac{V_{CC} \cdot R_2(R_1+R_3)}{R_1R_2+R_2R_3+R_3R_1} \quad t_1 = CR_5 \cdot \ell n \frac{V_{CC}-V_{REFL}-V_{F2}}{V_{CC}-V_{REFH}}$$

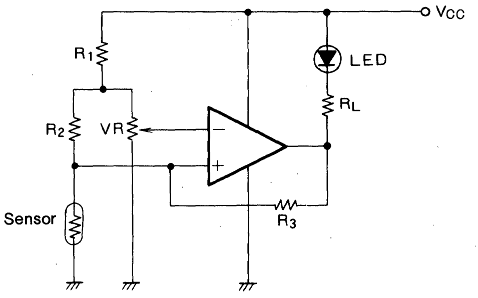
$$V_{REFL} = \frac{V_{CC} \cdot R_2R_3}{R_1R_2+R_2R_3+R_3R_1} \quad t_2 = CR_4 \cdot \ell n \frac{V_{REFH}-V_{F1}}{V_{REFL}}$$

(6) CR Timer

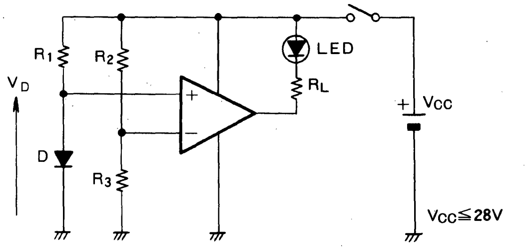


$$t = CR_1 \cdot \ell n \frac{V_{CC}}{V_{CC} - V_{REF}}$$

(7) Sensor detector



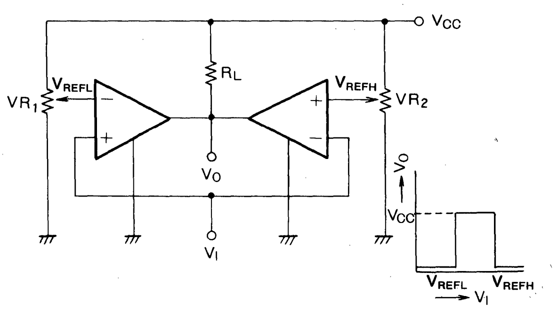
(8) Battery check circuit



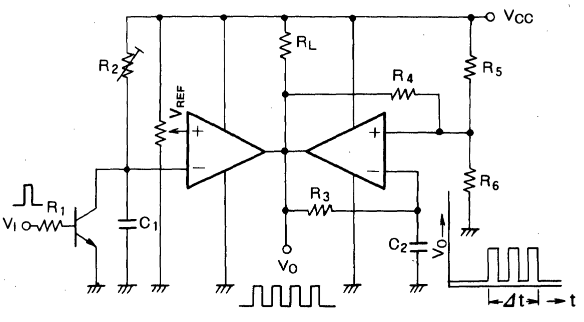
$V_D < V_{CC} \cdot \frac{R_3}{R_2+R_3}$: LED→ON

$V_D > V_{CC} \cdot \frac{R_3}{R_2+R_3}$: LED→OFF

(9) Window comparator



(10) Pulse train generator

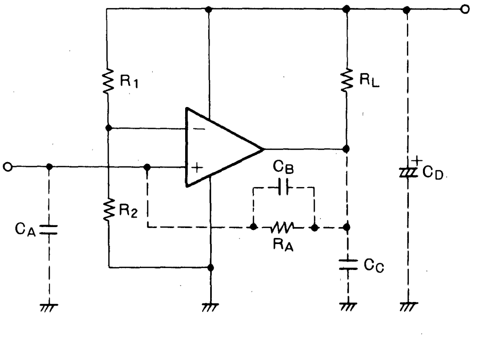


$\Delta t = C_1 C_2 \cdot \ell n \frac{V_{CC}}{V_{CC} - V_{REF}}$

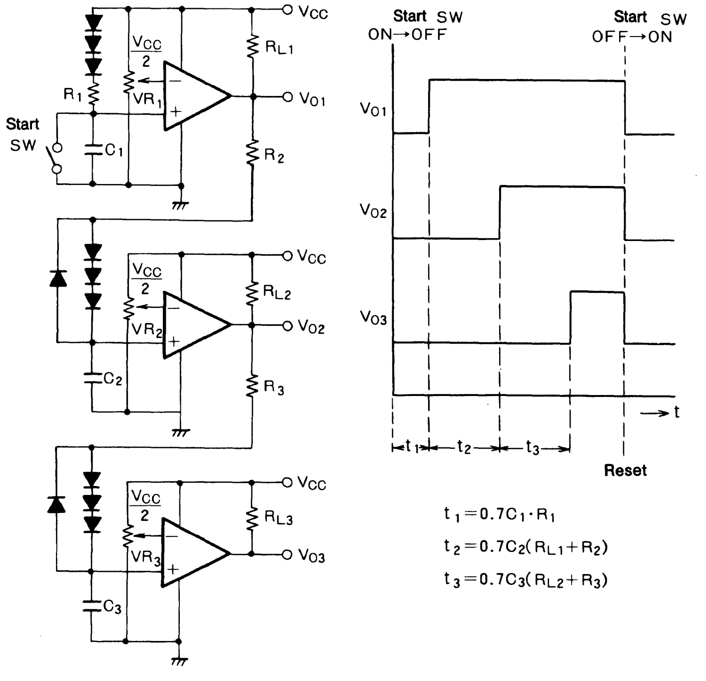
(11) Countermeasure against oscillation

(NOTE) Taking steps against oscillation
The M51209P has possibility of oscillation according to input condition. If the M51209P should oscillate, following countermeasures are applicable.

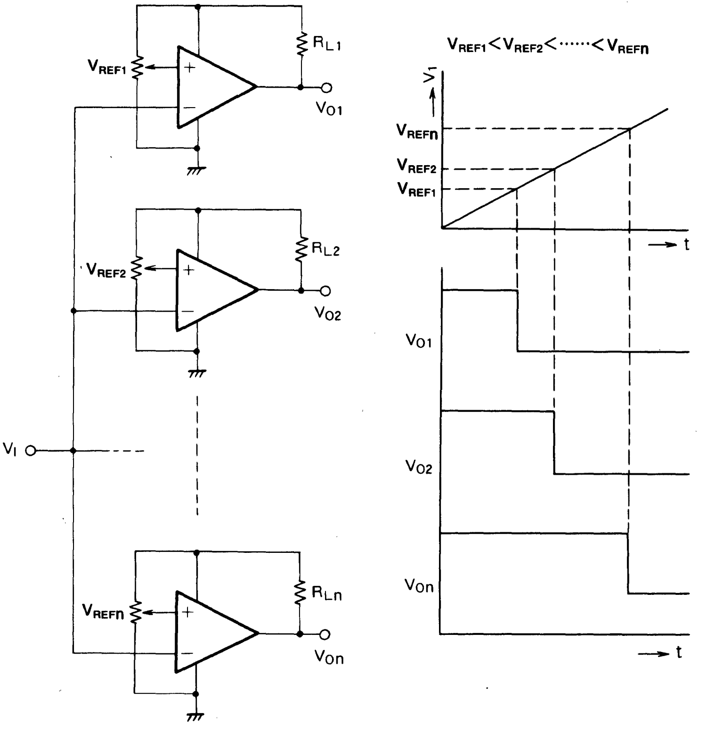
* : In case of connecting input signal with chattering connect a capacitor of small value, C_A.
* : In case of oscillating on the condition of ordinary input, employ positive feed back inserting R_A (resistor of large value), C_S(no polar) or connect C_C.
* : In case that supply voltage is not stabilized, connect C_D (electrolytic capacitor of large value) to absorb the supply voltage change.



(12) Sequential timer



(13) Analog/Digital converter



DESCRIPTION

The M51320P, a monolithic analog switch, is designed for electronic switch for a video system. It contains one video frequency switch circuit and two audio frequency switch circuits. The video frequency switch and the one of the audio frequency switch circuit have two inputs for connecting with TV and Video Tape Recorder. The other audio frequency switch circuit has three inputs. In addition, the video frequency switch circuit has a gain stage about 6dB.

FEATURES

- Video and stereo sound switches in one package
- Wide frequency range ······························ DC to 10 MHz
- High separation ···················· Crosstalk 55dB (typ.) (@5MHz)
  60dB (typ.) (@1MHz)
- High input impedance
- Low output impedance by emitter follower output.

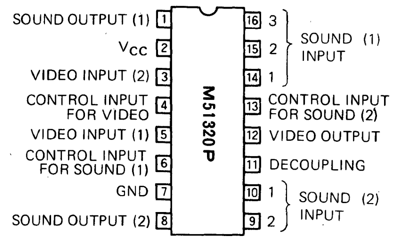
APPLICATION

Video equipment

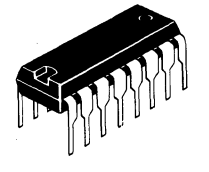
RECOMMENDED OPERATING CONDITIONS

Rated supply voltage range ·································· 5~14V

PIN CONFIGURATION (TOP VIEW)

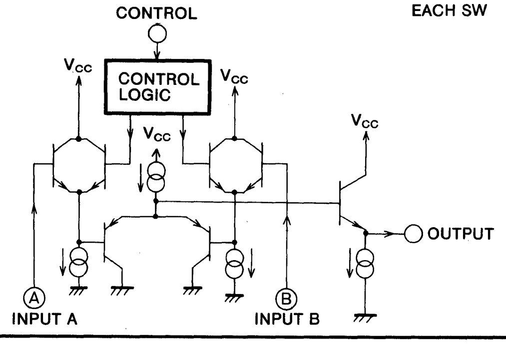


Outline 16P4

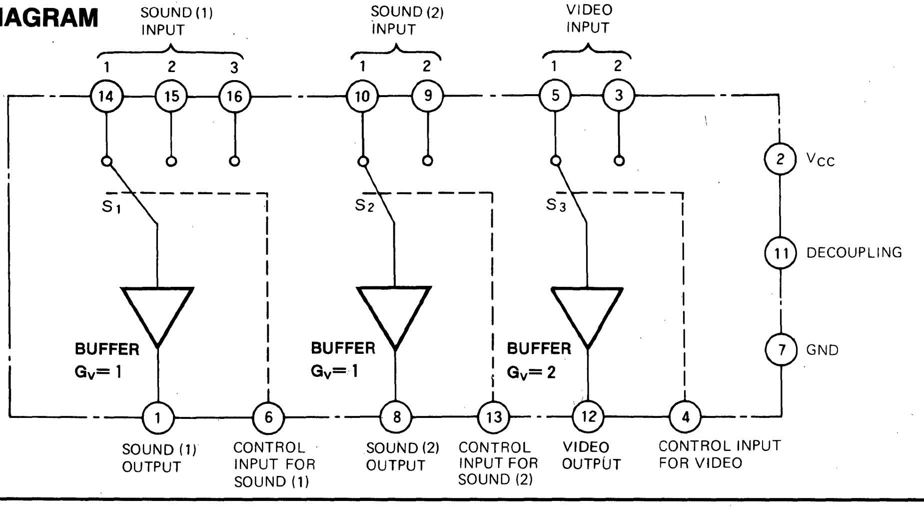


16 pin molded plastic DIL

EQUIVALENT CIRCUIT



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		14	V
V_I	Input DC voltage		6	V
V_C	Control voltage		V_{CC}	V
Pd	Power dissipation		1.25	W
Topr	Operating ambient temperature		−20～+75	℃
Tstg	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Typ	Max	Unit
I_{CC}	Circuit current			40	48	mA
V_{IDC}	Input bias voltage		3.8	4.2	4.6	V
V_{ODC}	Output bias voltage	video	5.0	5.6	6.2	V
		sound	3.0	3.6	4.2	V
ΔV_{ODC}	Output offset voltage			15	100	mV
V_{CH}	Threshold voltage	pin ⑥	7.0	8.0	9.0	V
V_{CL}		pin ⑥	3.0	4.0	5.0	V
V_{IC}		pin ④, ⑬	1.7	2.1	2.5	V
G_V	Voltage gain	video, f=1MHz	5.7	6.7	7.7	dB
		sound, f=1kHz	−0.5	−0.1		dB
R_i	Input resistance	sound, f=1kHz		22		kΩ
		video, f=5MHz		11		kΩ
C_i	Input capacitance	video, f=5MHz		4		pF
THD	Total harmonic distortion	sound, f=1kHz, V_O=1Vrms		0.02	0.2	%
		sound, f=100Hz, V_O=1Vrms		0.03	0.2	%
V_N	Output noise voltage	video, Rg=75Ω, BW=10MHz		0.5	1.0	mVrms
		sound, Rg=600Ω, BW=15kHz		3	50	μVrms
CT	Crosstalk	sound, f=1kHz	65	80		dB
		video, f=5MHz	45	55		dB

SWITCH MODE

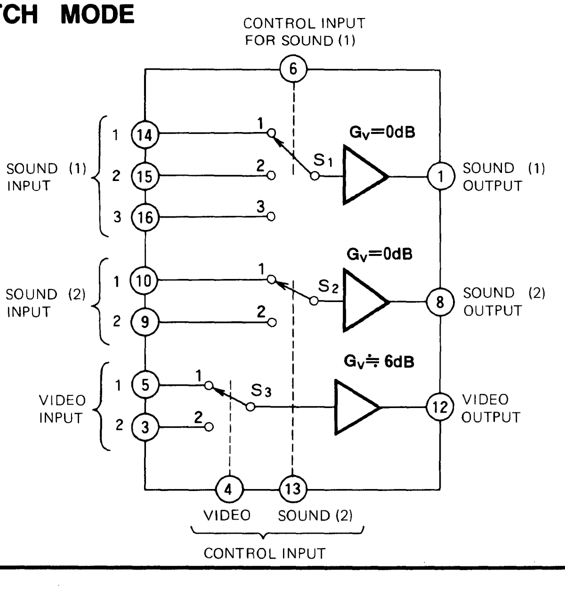


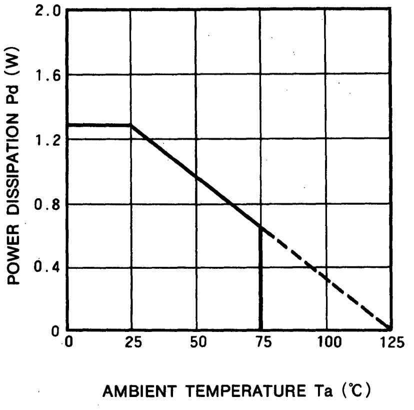
Table 1 Switch Mode versus Control Input

Control Input	S_1	S_2	S_3
V_{CC}	1	1	1
Open	2	*	*
GND	3	2	2

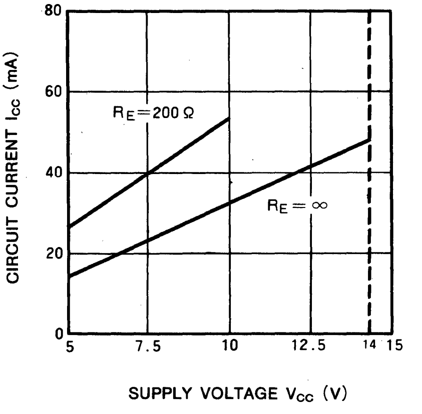
*V_{CC} or GND

TYPICAL CHARACTERISTICS

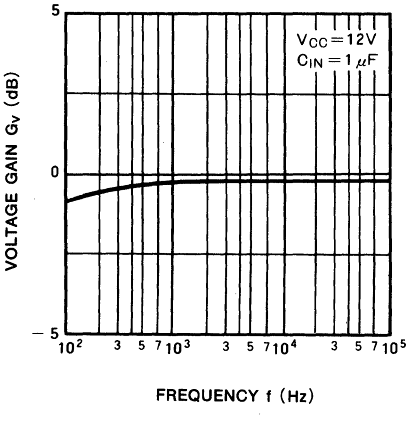
THERMAL DERATING (MAXIMUM RATING)



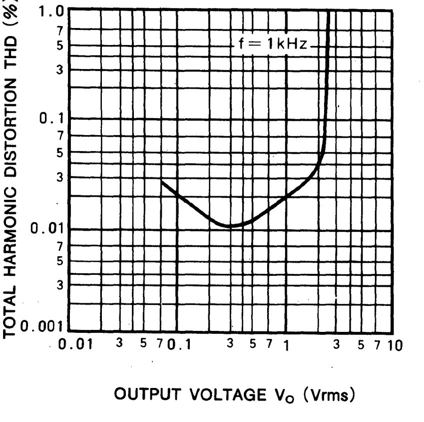
SUPPLY VOLTAGE VS CIRCUIT CURRENT



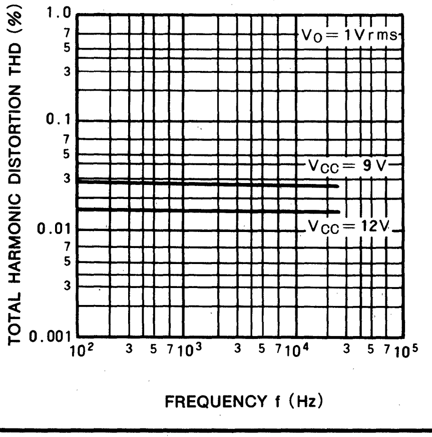
VOLTAGE GAIN VS FREQUENCY (SOUND)



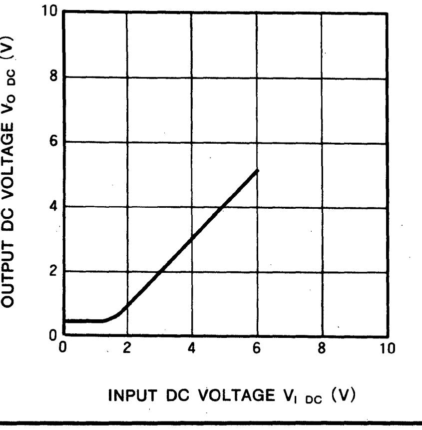
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (SOUND)



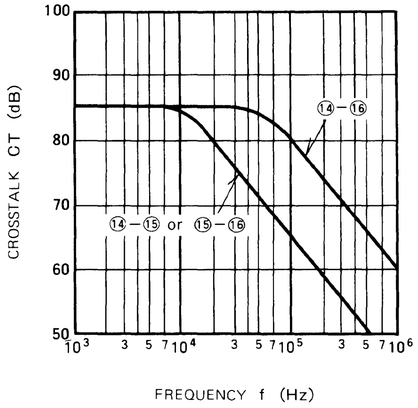
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (SOUND)



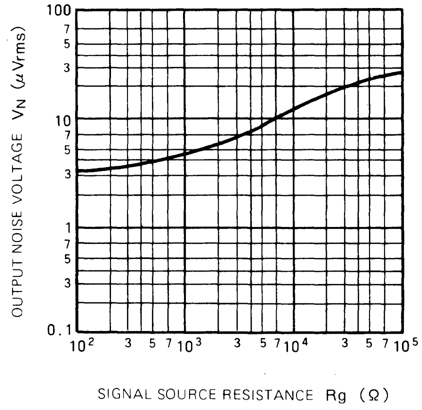
INPUT DC VOLTAGE VS OUTPUT DC VOLTAGE (SOUND)



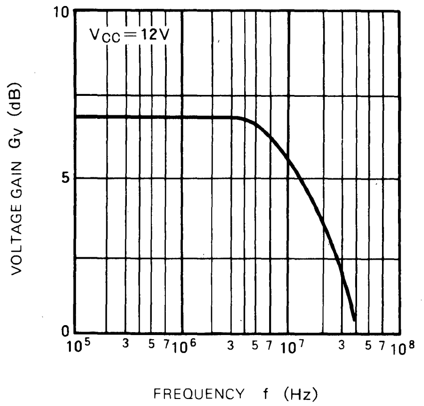
CROSSTALK VS FREQUENCY (SOUND)



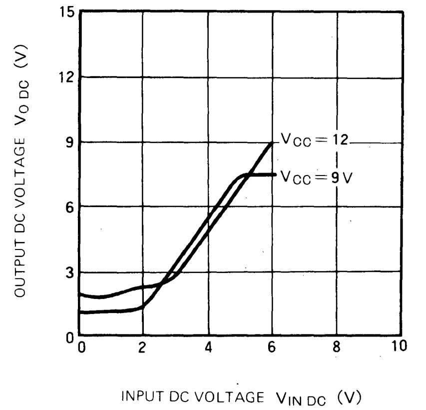
OUTPUT NOISE VOLTAGE VS SIGNAL SOURCE RESISTANCE (SOUND)



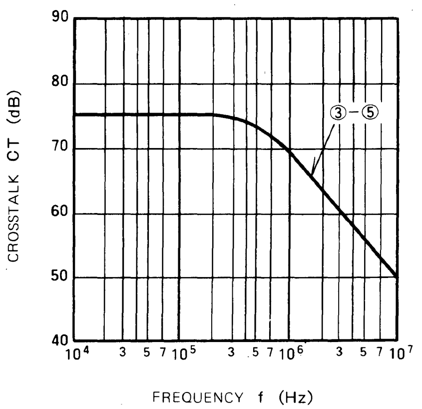
VOLTAGE GAIN VS FREQUENCY (VIDEO)



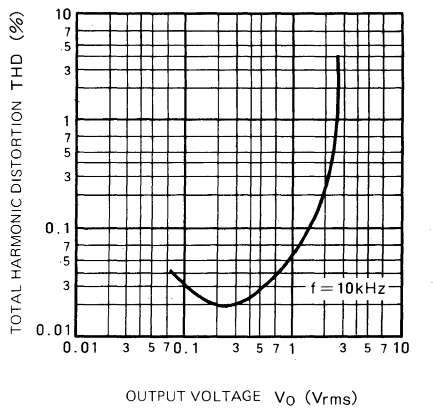
INPUT DC VOLTAGE VS OUTPUT DC VOLTAGE (VIDEO)



CROSSTALK VS FREQUENCY (VIDEO)

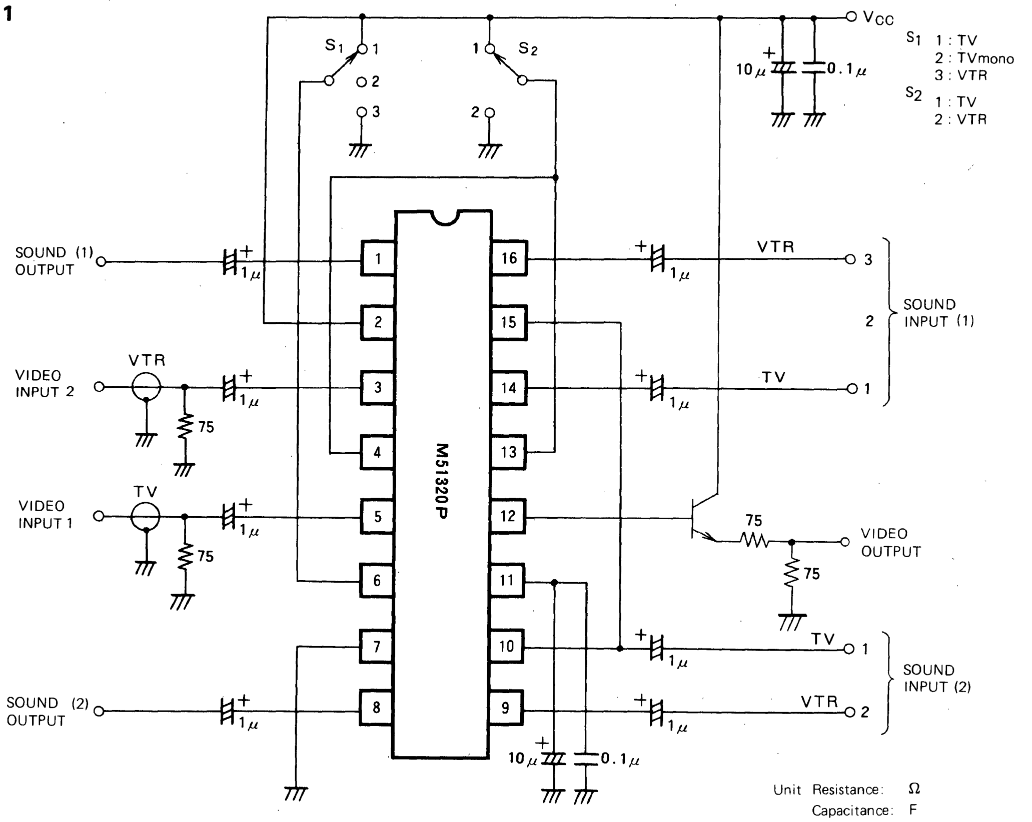


TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (VIDEO)



APPLICATION EXAMPLE

Fig. 1

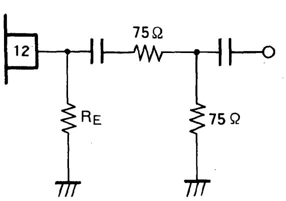


(Note) It is usually to use the external transistor to the video output shown in Fig. 1. When the supply voltage is below 9 volts, it is able to use the circuit shown in Fig. 2. In this circuit, the power dissipation is given by the following formula;

$$Pd = V_{CC} \cdot I_{CC} + \frac{V_O}{R_E} (V_{CC} - V_O)$$

V_O is the DC output voltage of the video switch. The minimum load resistance R_E must be chosen more than 200 ohms not to exceed the maximum rating of power dissipation.

Fig. 2



$R_E \geqq 200\Omega$

MITSUBISHI ELECTRIC

M51321P

ANALOG SWITCH

DESCRIPTION

The M51321P, a monolithic analog switch, is designed for an electronic switch for a video system. It contains one video frequency switch circuit and two audio frequency switch circuits.

The each circuit has three inputs for connecting with TV, Video Tape Recorder and Video Disc signals.

In addition, the video frequency switch circuit has a gain stage about 6dB.

FEATURES

- Video and stereo sound switches in one package
- Wide frequency range ···································· DC to 10MHz
- High separation ··················· Crosstalk 55dB (typ.) (@ 5 MHz)
  60dB (typ.) (@ 1 MHz)
- High input impedance
- Low output impedance by emitter follower output

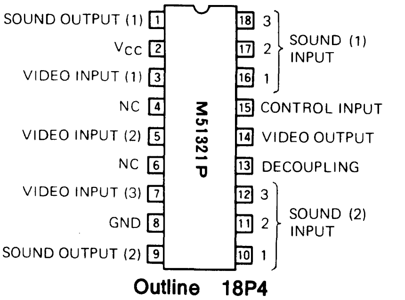
APPLICATION

Video equipment

RECOMMENDED OPERATING CONDITIONS

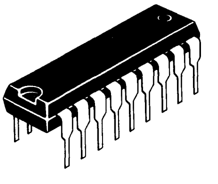
Rated supply voltage range··5~14V

PIN CONFIGURATION (TOP VIEW)



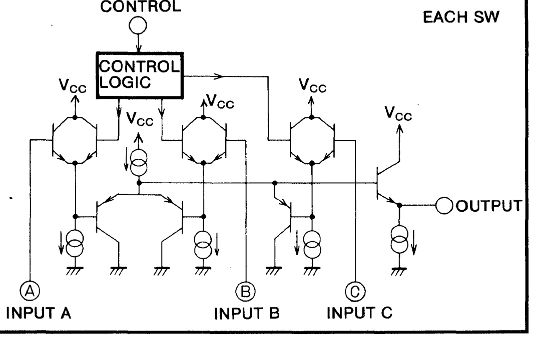
Outline 18P4

NC: NO CONNECTION

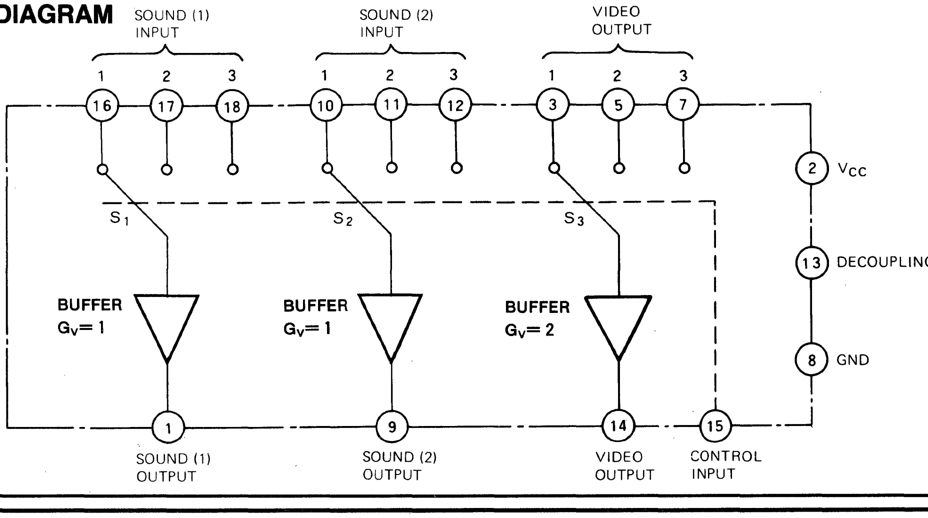


18 pin molded plastic DIL

EQUIVALENT CIRCUIT



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		14	V
V_I	Input DC voltage		6	V
V_C	Control voltage		V_{CC}	V
Pd	Power dissipation		1.25	W
Topr	Operating ambient temperature		−20～+75	℃
Tstg	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current			39	48	mA
V_{IDC}	Input bias voltage		3.8	4.2	4.6	V
V_{ODC}	Output bias voltage	video	5.0	5.6	6.2	V
		sound	3.0	3.6	4.2	V
ΔV_{ODC}	Output offset voltage			15	100	mV
V_{CH}	Threshold voltage		7.0	8.0	9.0	V
V_{CL}			3.0	4.0	5.0	V
G_V	Voltage gain	video , f= 1 MHz	5.7	6.7	7.7	dB
		sound , f= 1 kHz	−0.5	−0.1		dB
R_i	Input resistance	sound , f= 1 kHz		22		kΩ
		video , f= 5 MHz		11		kΩ
C_i	Input capacitance	video , f= 5 MHz		4		pF
THD	Total harmonic distortion	sound , f= 1 kHz , V_O= 1 Vrms		0.02	0.2	%
		sound , f=100Hz V_O= 1 Vrms		0.03	0.2	%
V_N	Output noise voltage	video , Rg=750Ω , BW=10MHz		0.5	1.0	mVrms
		sound , Rg=600Ω , BW=15kHz		3	50	μVrms
CT	Crosstalk	sound , f= 1 kHz	65	80		dB
		video , f= 5 MHz	45	55		dB

SWITCH MODE

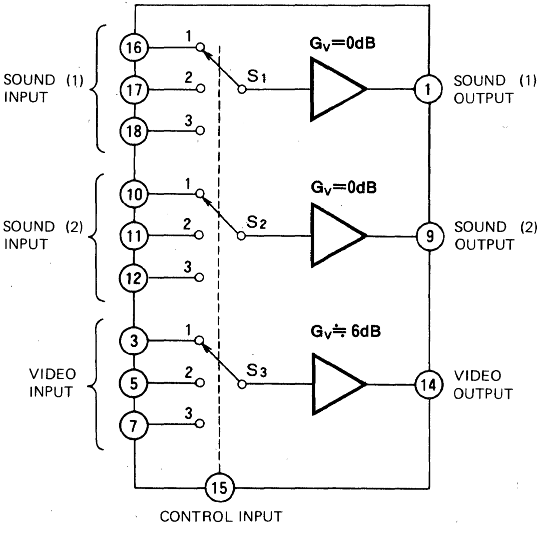
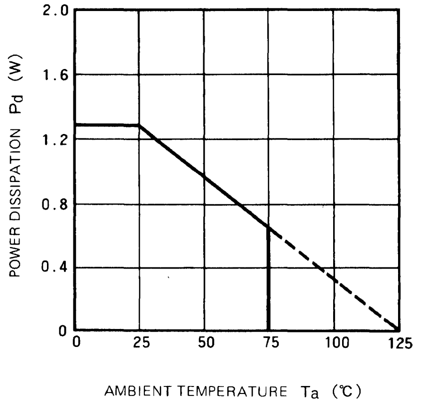


Table 1 Switch Mode versus Control Input

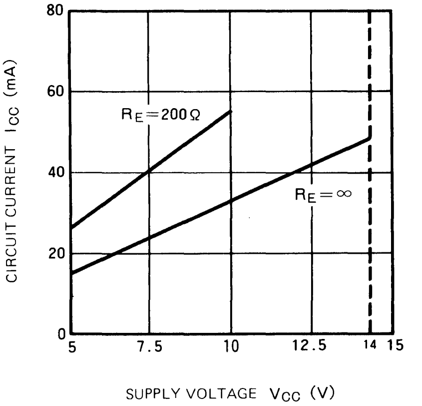
Control Input	S_1	S_2	S_3
V_{CC}	1	1	1
Open	2	2	2
GND	3	3	3

TYPICAL CHARACTERISTICS

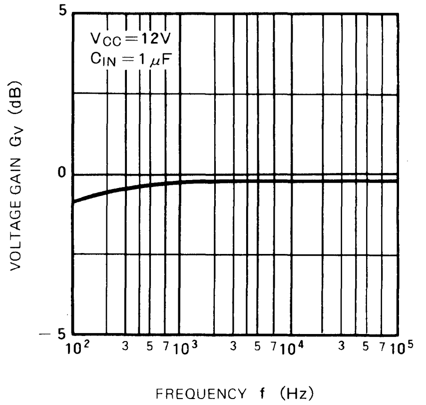
THERMAL DERATING (MAXIMUM RATING)



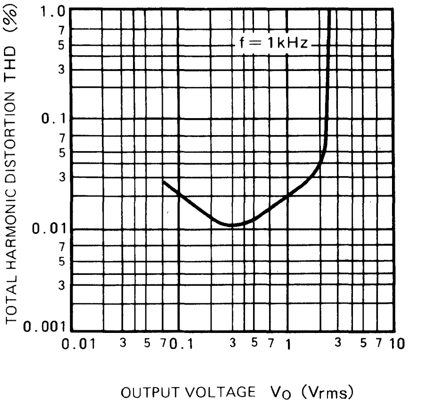
SUPPLY VOLTAGE VS CIRCUIT CURRENT



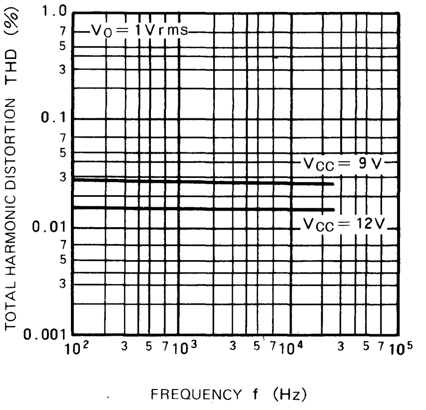
VOLTAGE GAIN VS FREQUENCY (SOUND)



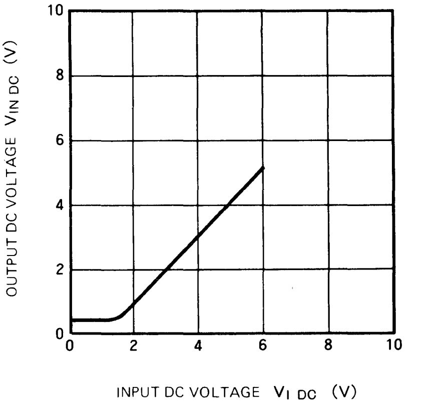
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (SOUND)



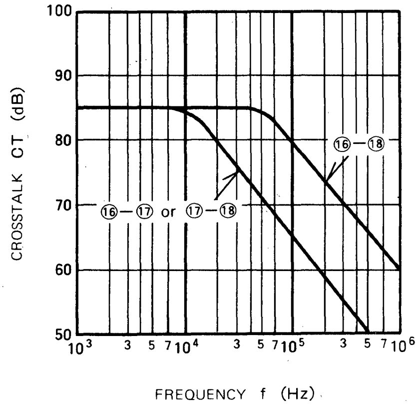
TOTAL HARMONIC DISTORTION VS FREQUENCY (SOUND)



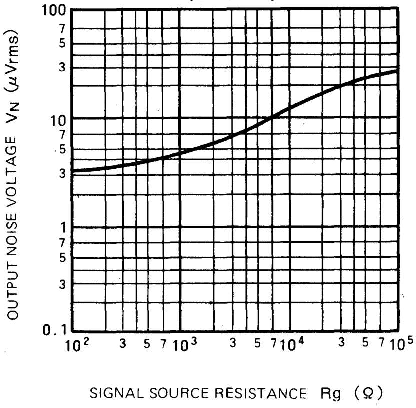
INPUT DC VOLTAGE VS OUTPUT DC VOLTAGE (SOUND)



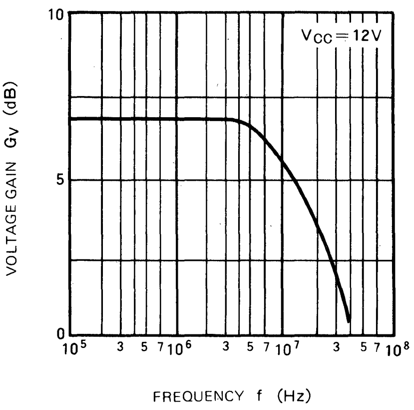
CROSSTALK VS FREQUENCY (SOUND)



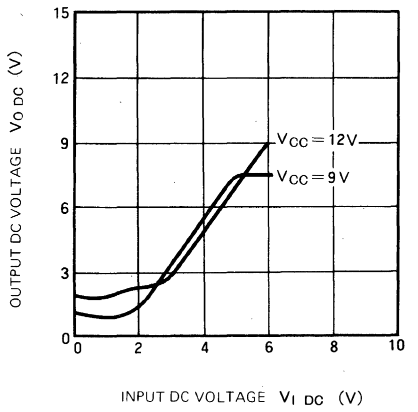
OUTPUT NOISE VOLTAGE VS SIGNAL SOURCE RESISTANCE (SOUND)



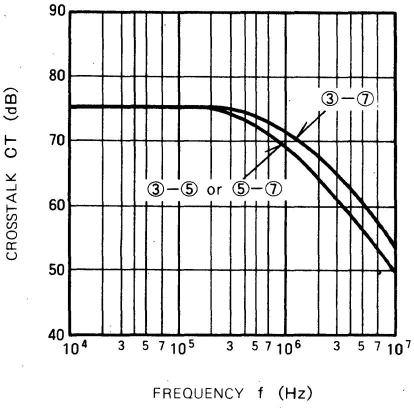
VOLTAGE GAIN VS FREQUENCY (VIDEO)



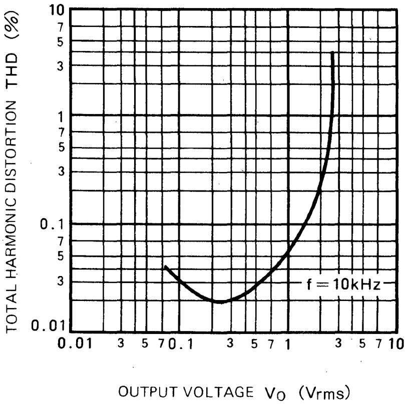
INPUT DC VOLTAGE VS OUTPUT DC VOLTAGE (VIDEO)



CROSSTALK VS FREQUENCY (VIDEO)

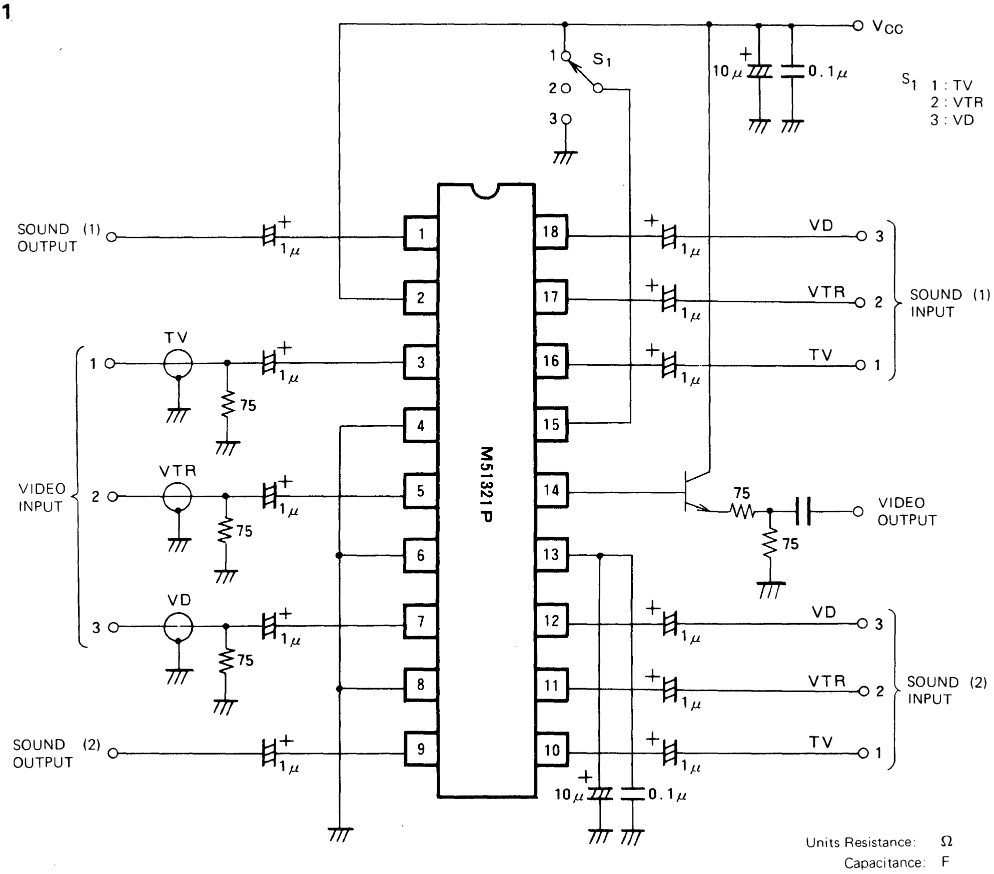


TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (VIDEO)



APPLICATION EXAMPLE

Fig. 1

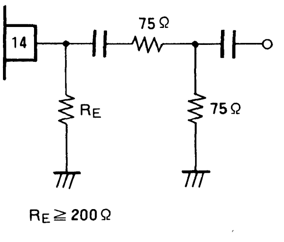


(Note) It is usually to use the external transistor to the video output shown in Fig. 1. When the supply voltage is below 9 volts, it is able to use the circuit shown in Fig. 2. In this circuit, the power dissipation is given by the following formula;

$$P_d = V_{CC} \cdot I_{CC} + \frac{V_O}{R_E} \ (V_{CC} - V_O)$$

V_O is the DC output voltage of the video switch. The minimum load resistance R_E must be chosen more than 200 ohms not to exceed the maximum rating of power dissipation.

Fig. 2



M51326P

ANALOG SWITCH

DESCRIPTION

The M51326P, a monolithic analog switch, is designed for electronic switch for a video system. It contains one video frequency switch circuit and two audio frequency switch circuits. The video frequency switch and the one of the audio frequency switch circuits. The video frequency switch and the one of the audio frequency switch circuit have two inputs for connecting with TV and Video Tape Recorder. The other audio frequency switch circuit has three inputs.

FEATURES

- Video and stereo sound switches in one package
- Wide frequency range ······························ DC to 10MHz
- High separation ·················· Crosstalk 55dB (typ.) (@ 5 MHz)
  60dB (typ.) (@ 1 MHz)
- High input impedance
- Low output impedance by emitter follower output

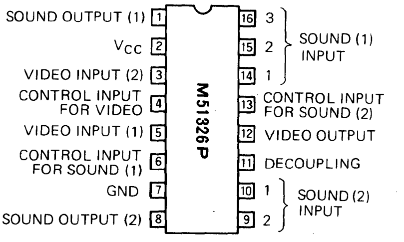
APPLICATION

Video equipment

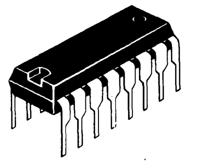
RECOMMENDED OPERATING CONDITIONS

Rated supply voltage range ······························ 5~14 V

PIN CONFIGURATION (TOP VIEW)

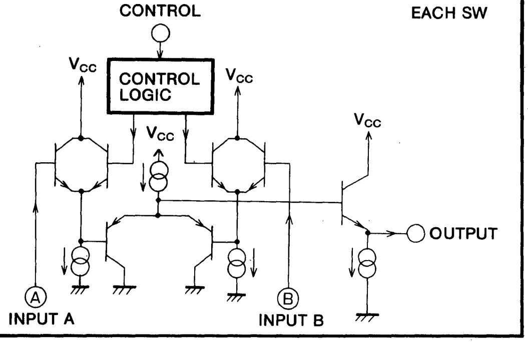


Outline 16P4

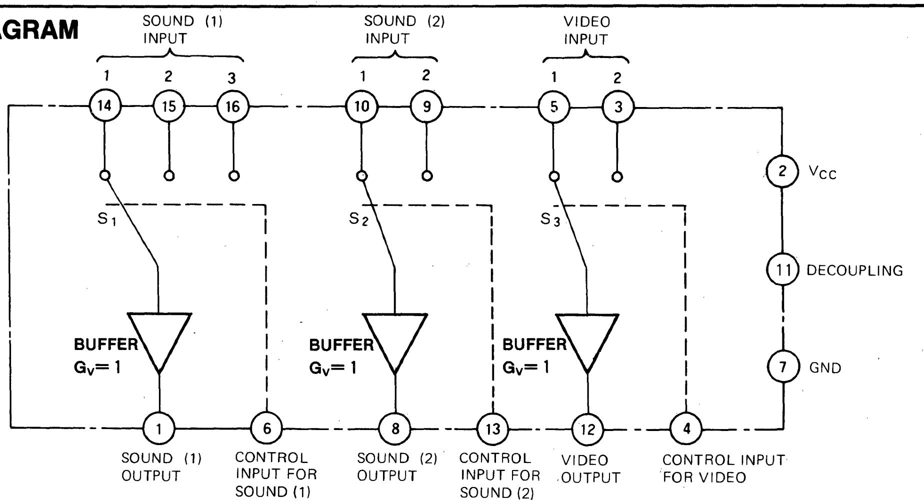


16 pin molded plastic DIL

EQUIVALENT CIRCUIT



BLOCK DIAGRAM



ANALOG SWITCH

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		14	V
V_I	Input DC voltage		6	V
V_C	Control voltage		V_{CC}	V
Pd	Power dissipation		1.25	W
Topr	Operating ambient temperature		−20～+75	℃
Tstg	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current			28	36	mA
V_{IDC}	Input bias voltage		3.8	4.2	4.6	V
V_{ODC}	Output bias voltage		3.0	3.6	4.2	V
ΔV_{ODC}	Output offset voltage			15	100	mV
V_{CL}	Threshold voltage	pin ⑥	7.0	8.0	9.0	V
V_{CH}		pin ⑥	3.0	4.0	5.0	V
V_{IC}		pin ④, ⑬	1.7	2.1	2.5	V
G_V	Voltage gain	f= 1 kHz	−0.5	−0.1		dB
R_i	Input resistance	sound, f= 1 kHz		22		kΩ
		video, f= 5 MHz		11		kΩ
C_i	Input capacitance	video, f= 5 MHz		4		pF
THD	Total harmonic distortion	sound, f= 1 kHz, V_O= 1 Vrms		0.02	0.2	%
		sound, f=100Hz, V_O= 1 Vrms		0.03	0.2	%
V_N	Output noise voltage	video, Rg=75Ω, BW=10kHz		0.5	1.0	mVrms
		sound, Rg=600Ω, BW=15kHz		3	50	μVrms
CT	Crosstalk	sound, f= 1 kHz	65	80		dB
		video, f= 5 MHz	45	55		dB

SWITCH MODE

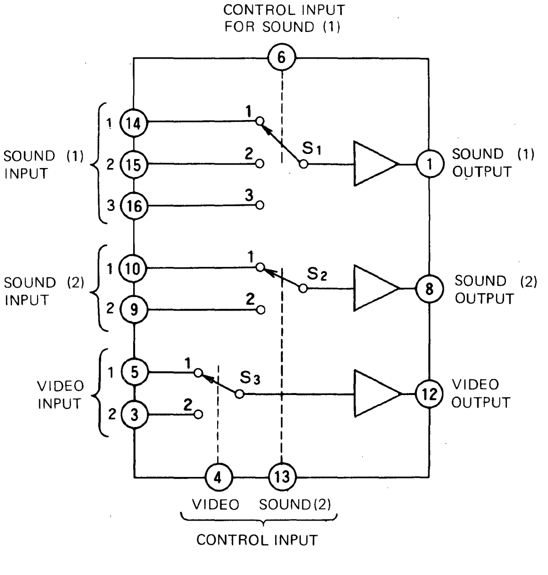


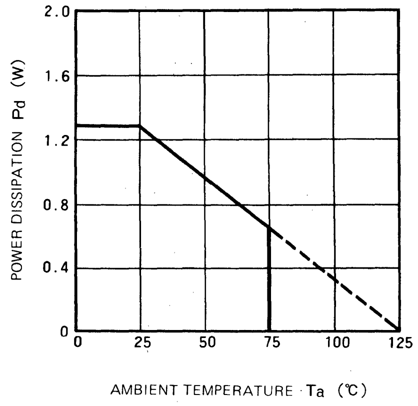
Table 1 Switch Mode versus Control Input

Control Input	S_1	S_2	S_3
V_{CC}	1	1	1
Open	2	*	*
GND	3	2	2

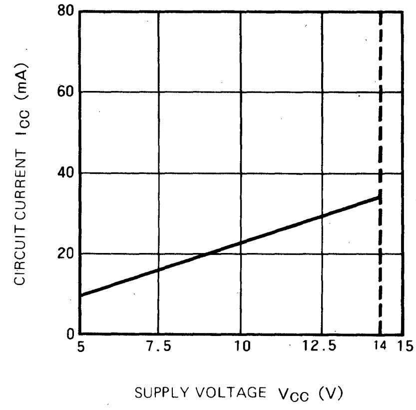
* V_{CC} or GND

TYPICAL CHARACTERISTICS

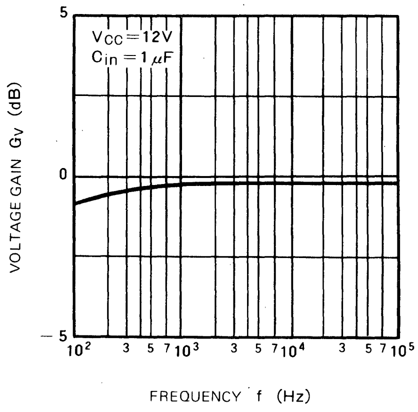
THERMAL DERATING (MAXIMUM RATING)



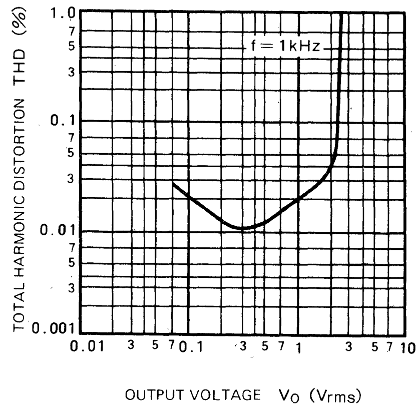
SUPPLY VOLTAGE VS CIRCUIT CURRENT



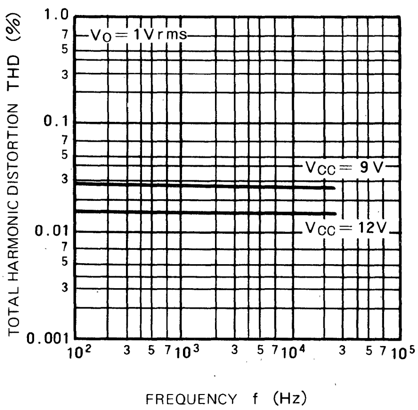
VOLTAGE GAIN VS FREQUENCY (SOUND)



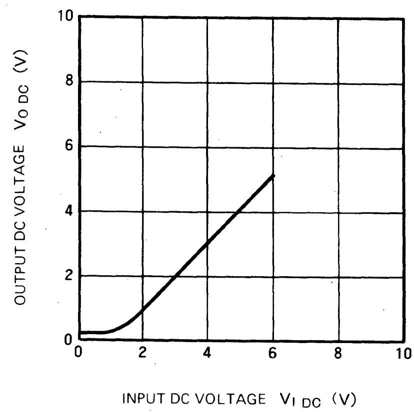
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (SOUND)



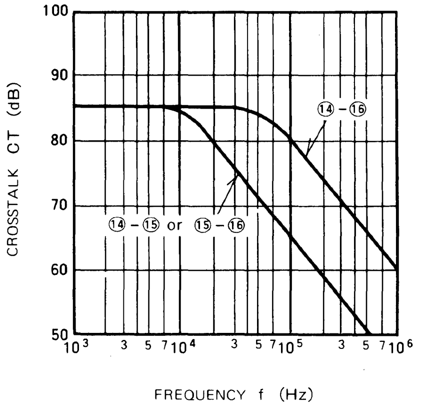
TOTAL HARMONIC DISTORTION VS FREQUENCY (SOUND)



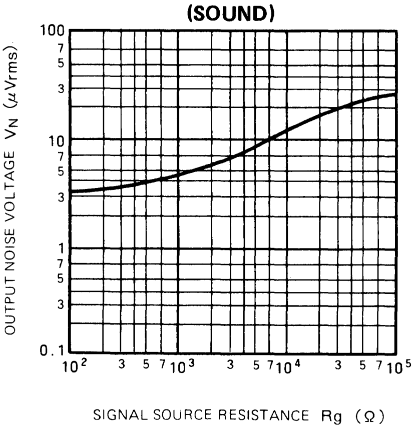
INPUT DC VOLTAGE VS OUTPUT DC VOLTAGE (SOUND)



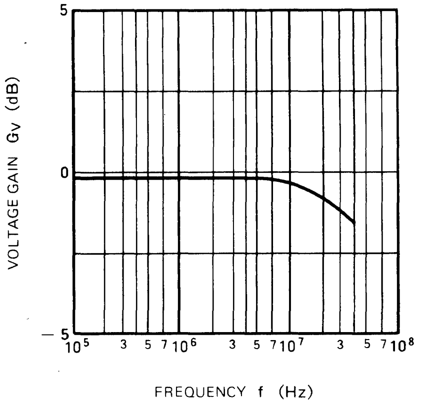
CROSSTALK VS FREQUENCY (SOUND)



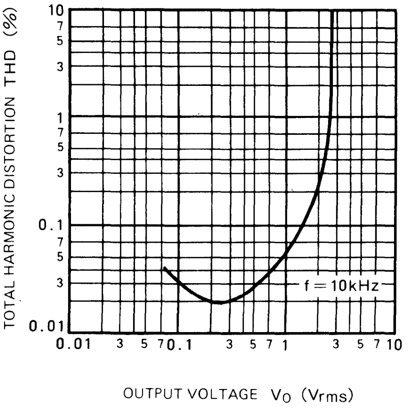
OUTPUT NOISE VOLTAGE VS SIGNAL SOURCE RESISTANCE (SOUND)



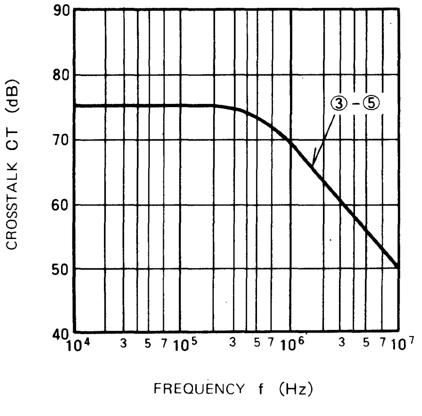
VOLTAGE GAIN VS FREQUENCY (VIDEO)



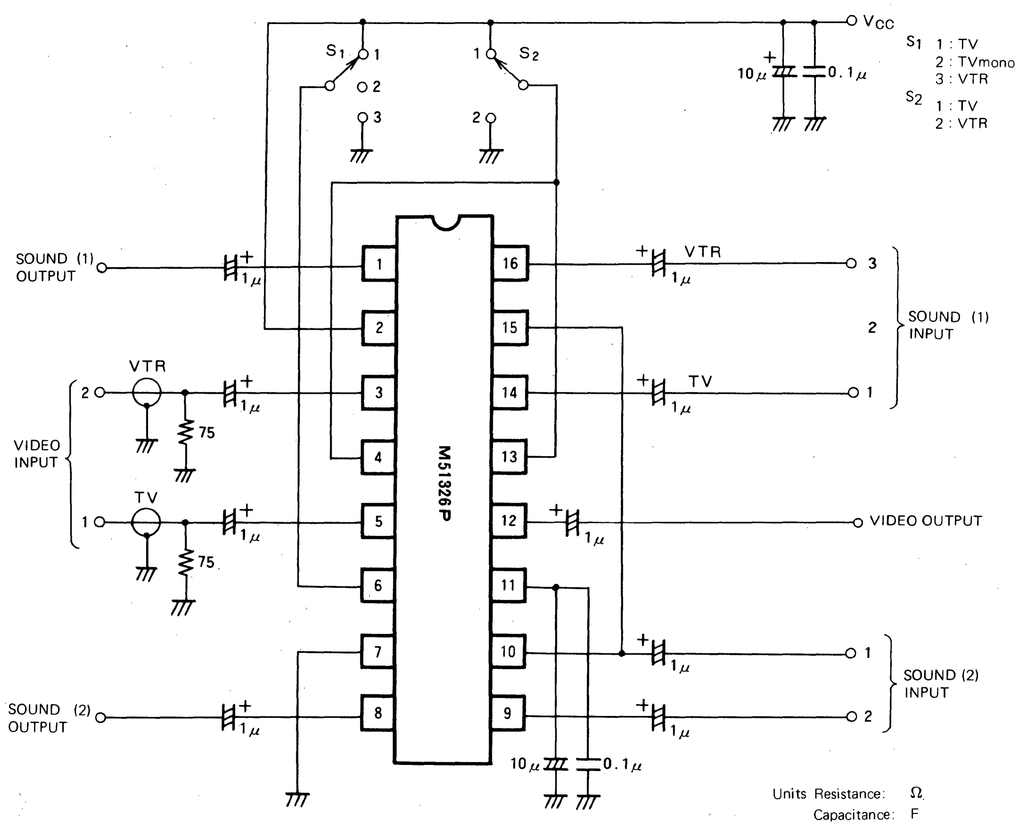
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (VIDEO)



CROSSTALK VS FREQUENCY (VIDEO)



APPLICATION EXAMPLE



MITSUBISHI ELECTRIC

M51327P

ANALOG SWITCH

DESCRIPTION

The M51327P, a monolithic analog switch, is designed for an electronic switch for a video system. It contains one video frequency switch circuit and two audio frequency switch circuits.

The each circuit has three inputs for connecting with TV, Video Tape Recorder and Video Disc signals.

FEATURES

- Video and stereo sound switches in one package
- Wide frequency range ······························· DC to 10MHz
- High separation ·················· Crosstalk 55dB(typ.) (@5MHz) 60dB(typ.) (@1MHz)
- High input impedance
- Low output impedance by emitter follower output

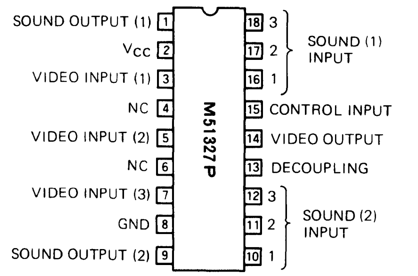
APPLICATION

Video equipment

RECOMMENDED OPERATING CONDITIONS

Rated supply voltage range ······································ 5~14V

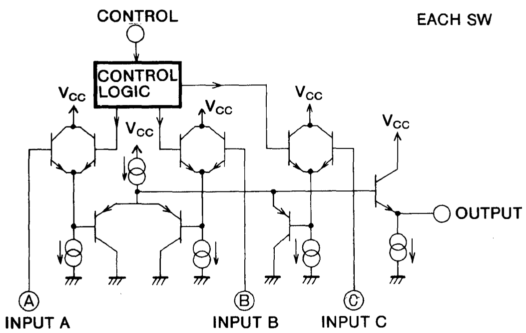
PIN CONFIGURATION (TOP VIEW)

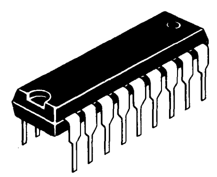


Outline 18P4

NC: NO CONNECTION

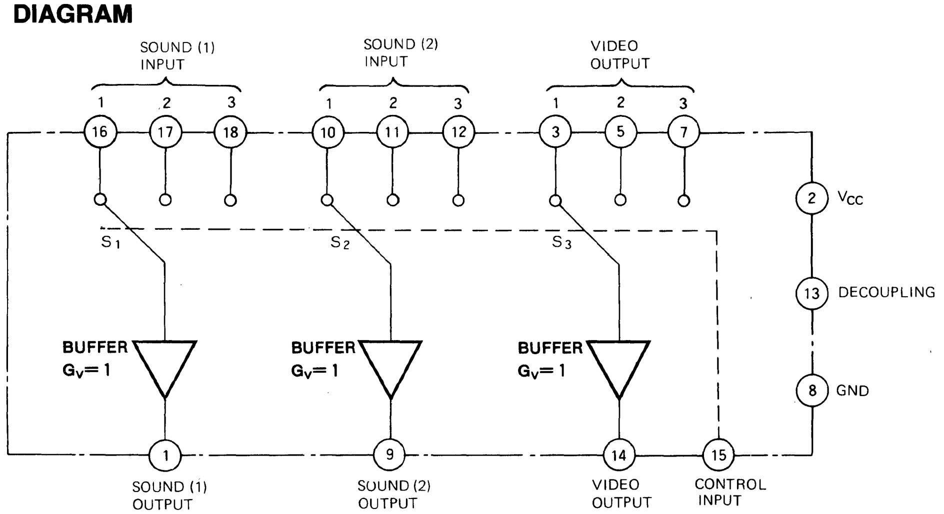
EQUIVALENT CIRCUIT





18 pin molded plastic DIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		14	V
V_I	Input DC voltage		6	V
V_C	Control voltage		V_{CC}	V
Pd	Power dissipation		1.25	W
Topr	Operating ambient temperature		−20～+75	℃
Tstg	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current			28	36	mA
V_{IDC}	Input bias voltage		3.8	2.5	4.6	V
V_{ODC}	Output bias voltage		3.0	3.6	4.2	V
ΔV_{ODC}	Output offset voltage			15	100	mV
V_{CH}	Threshold voltage		7.0	8.0	9.0	V
V_{CL}			3.0	4.0	5.0	V
G_V	Voltage gain	sound, f=1kHz	−0.5	−0.1		dB
R_I	Input resistance	sound, f=1kHz		22		kΩ
		video, f=5MHz		11		kΩ
C_I	Input resistance	video, f=5MHz		4		pF
THD	Total harmonic distortion	sound, f=1kHz, V_O=1Vrms		0.02	0.2	%
		sound, f=100Hz, V_O=1Vrms		0.03	0.2	%
V_N	Output noise voltage	video, R_g=75Ω, BW=10MHz		0.5	1.0	mVrms
		sound, Rg=600Ω, BW=15kHz		3	50	μVrms
CT	Crosstalk	sound, f=1kHz	65	80		dB
		video, f=5MHz	45	55		dB

SWITCH MODE

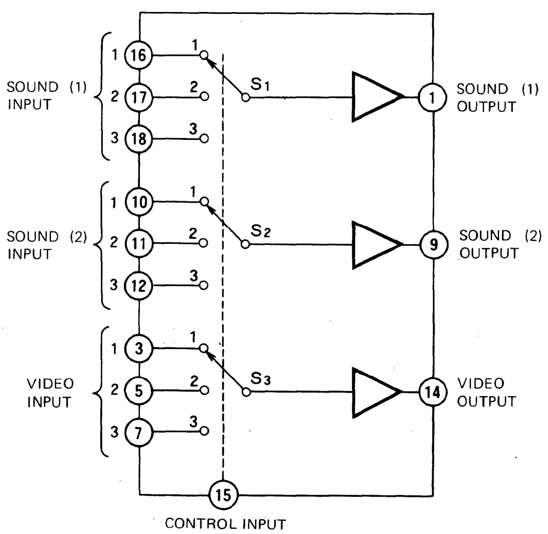
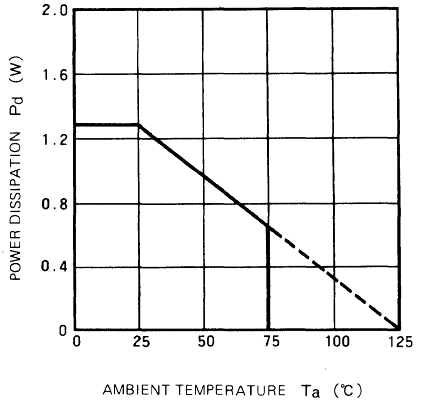


Table 1 Switch Mode versus Control Input

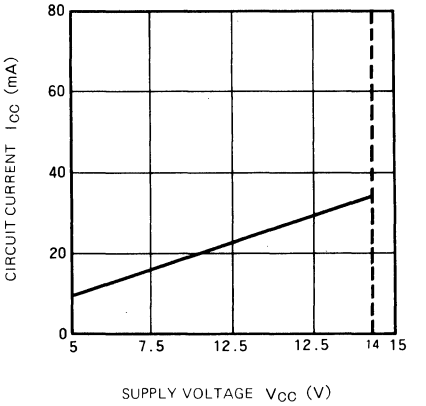
Control Input	S_1	S_2	S_3
V_{CC}	1	1	1
Open	2	2	2
GND	3	3	3

TYPICAL CHARACTERISTICS

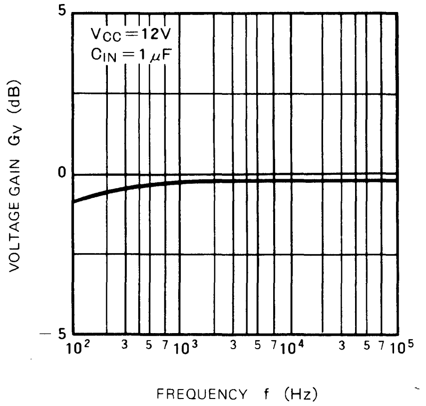
THERMAL DERATING (MAXIMUM RATING)



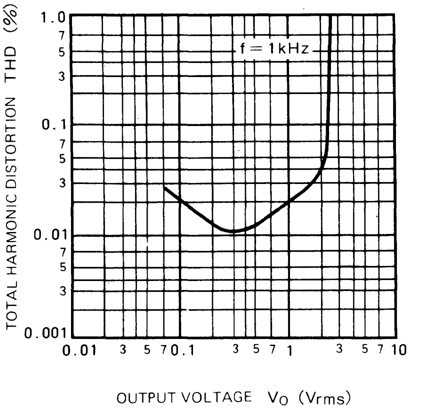
SUPPLY VOLTAGE VS CIRCUIT CURRENT



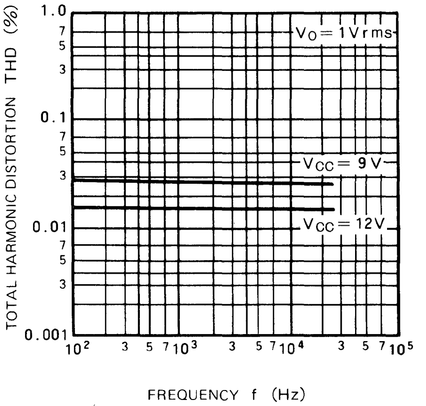
VOLTAGE GAIN VS FREQUENCY (SOUND)



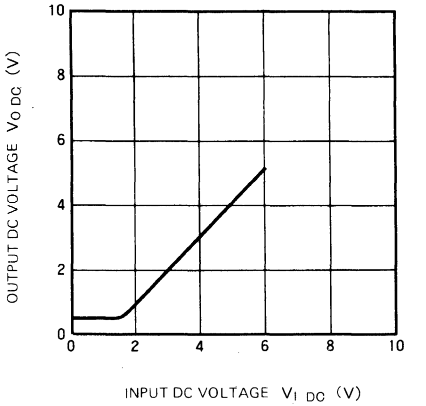
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (SOUND)



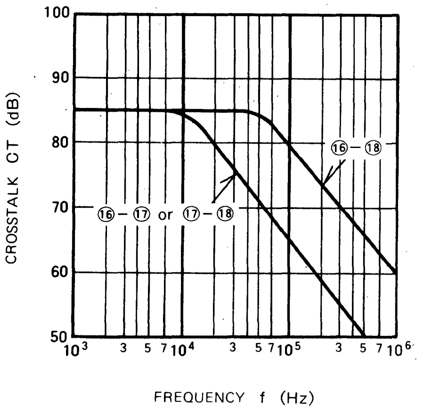
TOTAL HARMONIC DISTORTION VS FREQUENCY (SOUND)



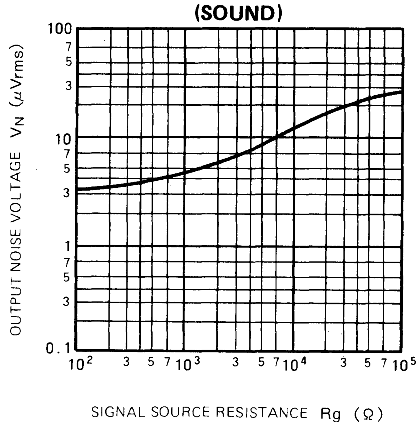
INPUT DC VOLTAGE VS OUTPUT DC VOLTAGE (SOUND)



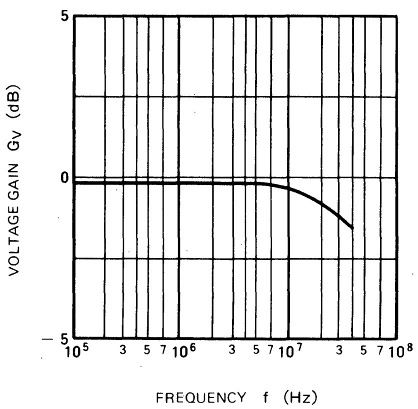
CROSSTALK VS FREQUENCY (SOUND)



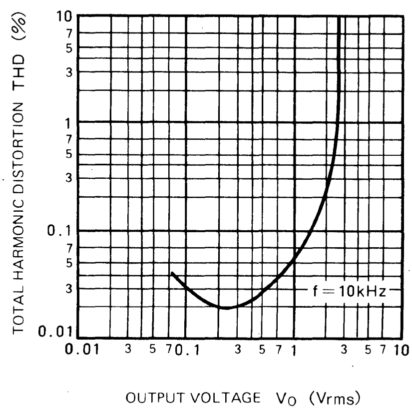
OUTPUT NOISE VOLTAGE VS SIGNAL SOURCE RESISTANCE (SOUND)



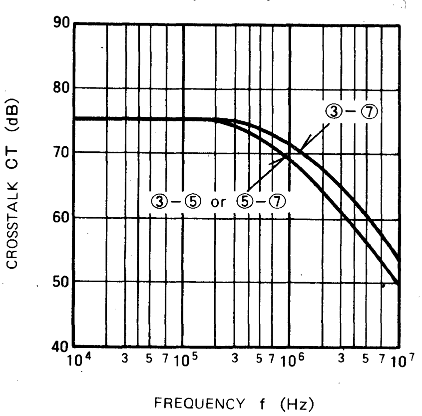
VOLTAGE GAIN VS FREQUENCY (VIDEO)



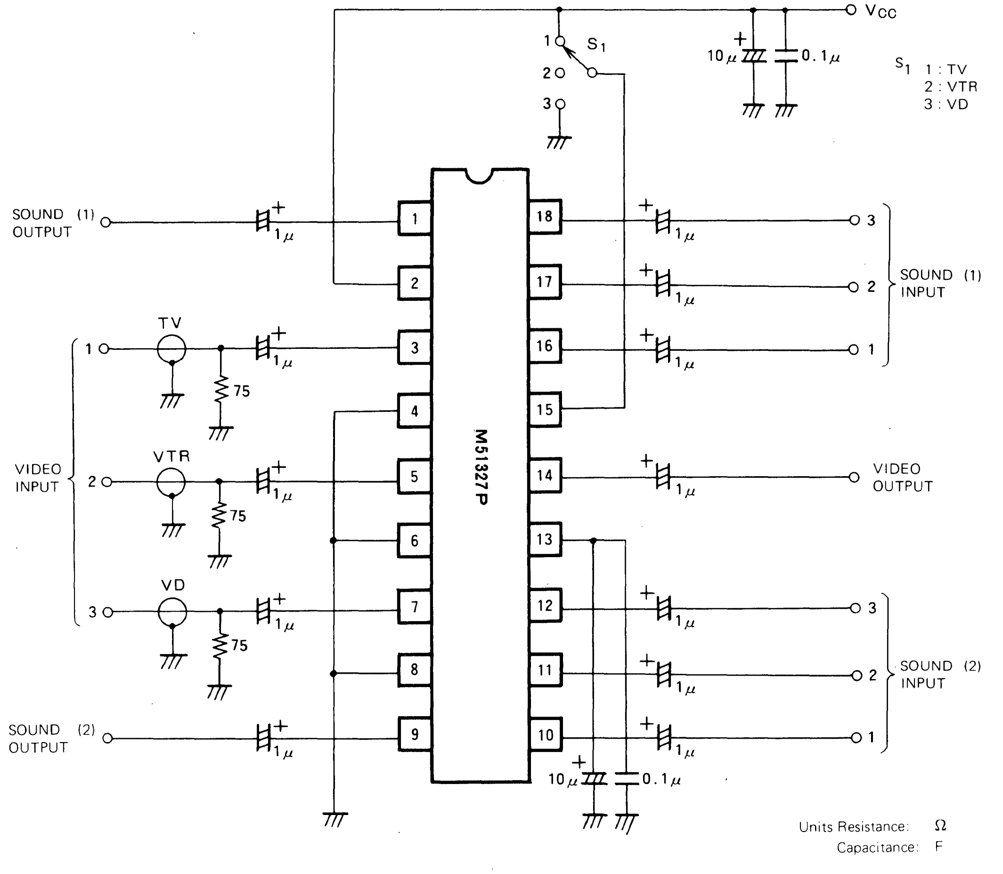
TOTAL HARMONIC DISTORTION VS OUTPUT VOLTAGE (VIDEO)



CROSSTALK VS FREQUENCY (VIDEO)



APPLICATION EXAMPLE



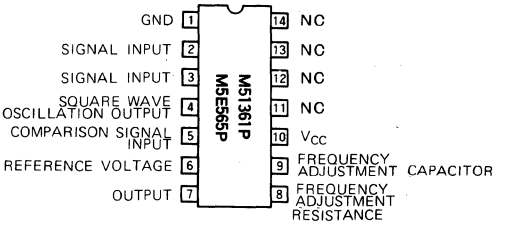
M51361P/M5E565P

DESCRIPTION

The M51361P/M5E565P is semiconductor integrated circuit consisting of a phase locked loop (PLL) IC which includes a phase comparator, a voltage controlled oscillator and a DC amplifier.

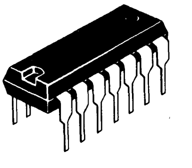
The center frequency is determined by the oscillation frequency of the voltage controlled oscillator; the oscillation frequency can easily adjusted with a resistor and a capacitor, making this IC suitable for use in frequency modulators and tracking filters, etc.

PIN CONFIGURATION (TOP VIEW)



Outline 14P4

NC: NO CONNECTION



14-pin molded plastic DIL

FEATURES

- Variations in the supply voltage have little effect on the oscillation frequency ·········· 200Hz/V typ (f_O = 30kHz)
- The total harmonic distortion of demodulated output is low ·· 0.35%
- Both square and triangular wave forms can be obtained as oscillator output
- Both lock range and capture range are externally controllable
- Wide oscillation frequency range ·············· 0.5~500kHz
- The loop can be opened and a frequency divider inserted from outside

APPLICATION

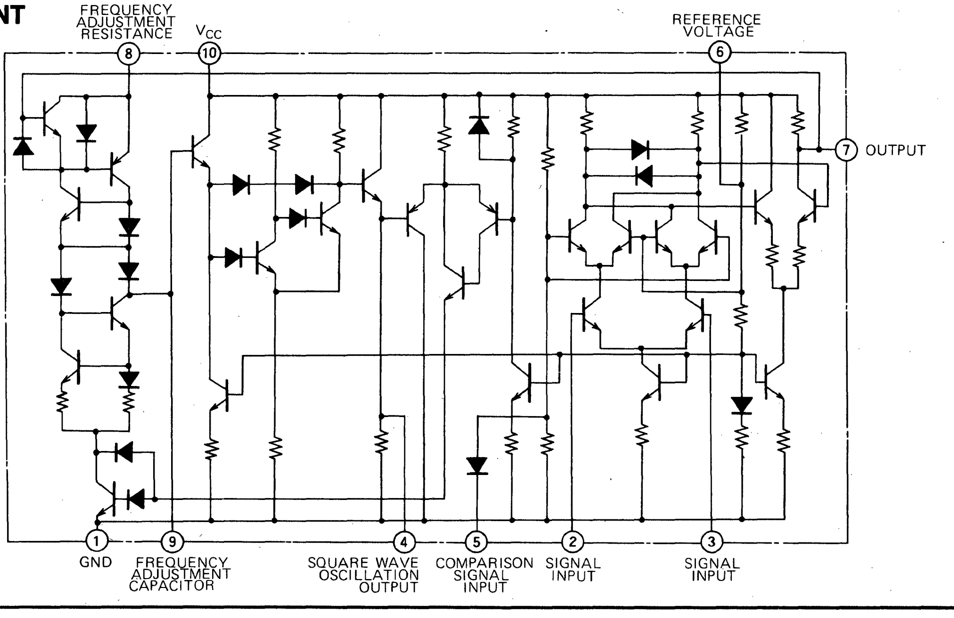
Frequency modulators, frequency discriminators, tracking filters, frequency multipliers, FSK (Frequency shift keying) modulators.

RECOMMENDED OPERATING CONDITIONS

Supply voltage range ······································ 12~15.6V

Rated supply voltage ·· 14V

EQUIVALENT CIRCUIT



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

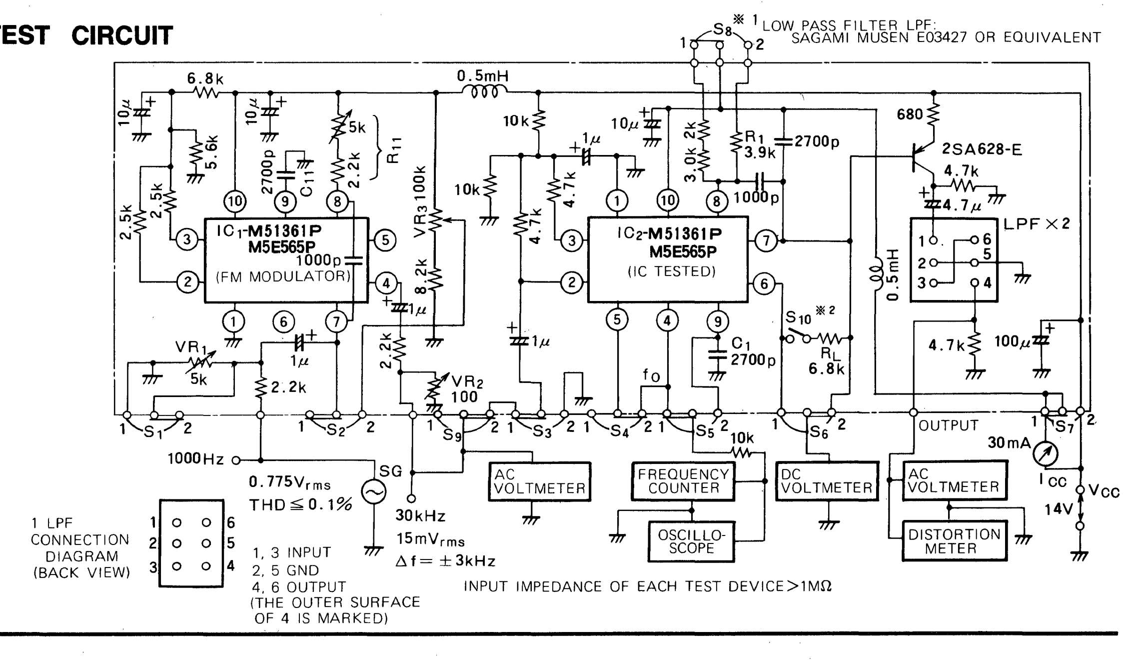
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		16	V
Vin	Input voltage		1	V_{P-P}
I_{CC}	Circuit current		30	mA
Pd	Power dissipation		600	mW
K_θ	Thermal derating	Ta≧25°C	6	mW/°C
Topr	Operating temperature		0～+75	°C
Tstg	Storage temperature		−40～+125	°C

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol		Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
I_{CCO}		Quiescent circuit current	No signal		11	17	mA
$V_⑦$		Pin 7 voltage	No signal		12.5	13.5	V
$V_{⑥-⑦}$		Offset voltage	Potential difference between pins 6 and 7		150	360	mV
Vo(af)	Demodulation circuit	Output voltage	Oscillation frequency 30kHz, Input frequency 30kHz, Input voltage 15mVrms, Modulation frequency 1kHz, Frequency deviation ±3kHz	200	300		mVrms
THD	Demodulation circuit	Total harmonic distortion			0.35	0.75	%
S/N	Demodulation circuit	Signal to noise ratio			※1 56		dB
V_{SQ}	Voltage controlled oscillator	Square wave output voltage			7.0		V_{P-P}
	Voltage controlled oscillator	Duty cycle	Oscillation frequency 30kHz	40	50	60	%
V_{TRI}	Voltage controlled oscillator	Triangular wave output voltage			2.4		V_{P-P}
fo(max)	Voltage controlled oscillator	Maximum free-running frequency	Frequency setting capacitor 100pF		※2 500		kHz
	Voltage controlled oscillator	Oscillation frequency drift vs V_{CC}	Oscillation frequency 30kHz		200		Hz/V
	Voltage controlled oscillator	Oscillation frequency drift vs temperature	Oscillation frequency 30kHz		850		ppm/°C
f_L	Voltage controlled oscillator	Lock range	Oscillation frequency 30kHz		25		kHz

※1: Unmodulated
※2: Free-running frequency adjustment resistor R_1 = 2k ~ 20kΩ (4kΩ standard)

TEST CIRCUIT



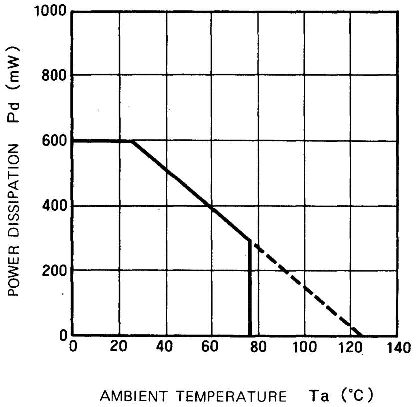
TEST METHODS

Parameter	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	Method
Oscillation frequency adjustment			2	2	1		2	1		Adjust f_O to 30±0.5kHz with R_1 to prepare for testing (testing with the frequency counter)
Quiescent circuit current			2	2			1	1		Ammeter
Demodulated output voltage	2	1	1	2			2	1	2	$V_{O(af)}$ (AC Voltmeter)
Total harmonic distortion	2	1	1	2			2	1	2	Distortion meter
Signal to noise ratio	1	1	1	2			2	1	2	Ratio to $V_{O(af)}$ (AC Voltmeter)
Pin⑦DC voltage			2	2		2	2	1		(DC Voltmeter)
Lock range	1	2	1	2		1	2	1	2	Measure the limits of the pin④output frequency which is synchronized with input frequency by variing VR_3.

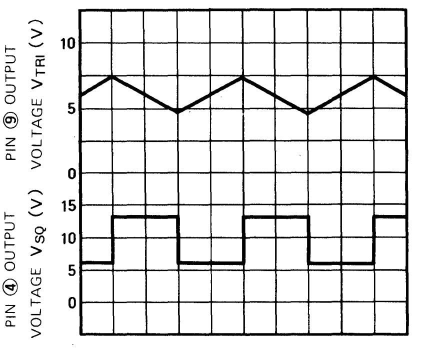
2: Connect pins ⑥ and ⑦ through a 6.8kΩ resistance only when measuring the lock range. (S_{10} ON)

TYPICAL CHARACTERISTICS (Ta=25°C, V_{CC}=12V, unless otherwise noted)

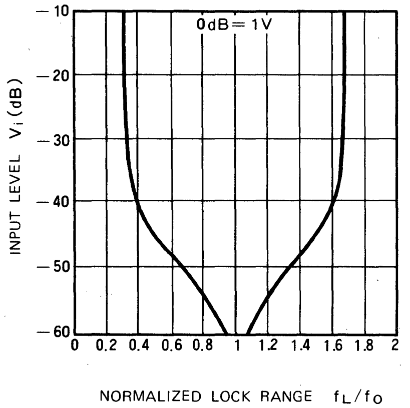
THERMAL DERATING (MAXIMUM RATING)



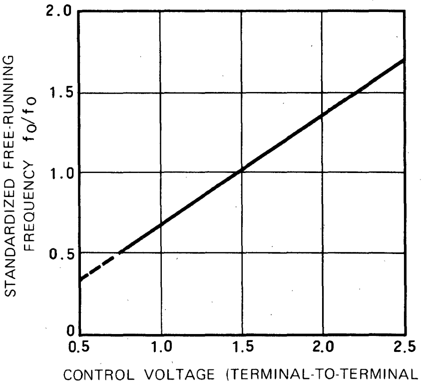
VOLTAGE CONTROLLED OSCILLATOR OUTPUT WAVE FORM



LOCK RANGE VS INPUT LEVEL

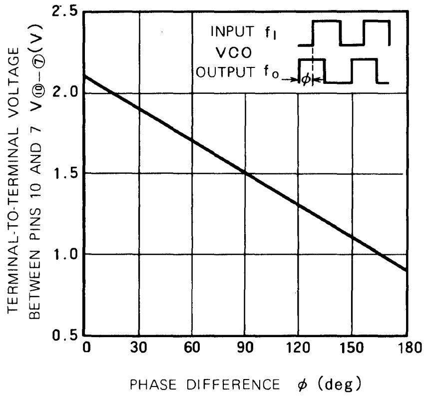


FREE-RUNNING FREQUENCY VS CONTROL VOLTAGE (VCO CONVERSION GAIN)

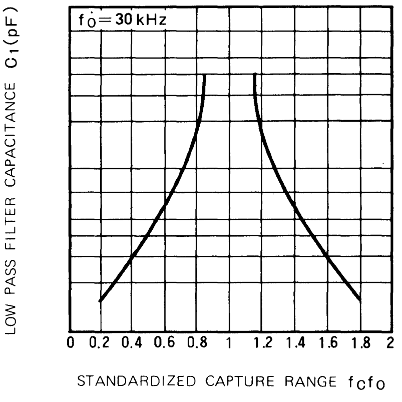


MITSUBISHI ELECTRIC

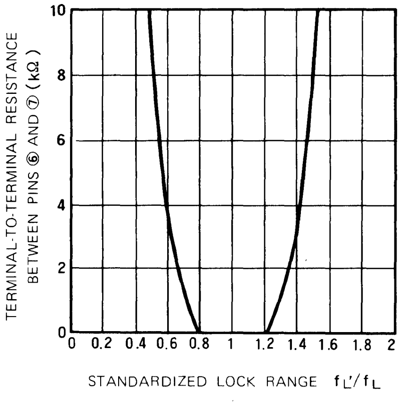
TERMINAL-TO-TERMINAL VOLTAGE BETWEEN PINS ⑩ AND ⑦ VS INPUT/OUTPUT PHASE DIFFERENCE



CAPTURE RANGE VS LOW PASS FILTER CAPACITANCE



LOCK RANGE VS TERMINAL-TO-TERMINAL RESISTANCE BETWEEN PINS ⑥ AND ⑦



EXPLANATION OF TERMINOLOGY AND THE BASIC COMPUTATIONAL DESIGN EXPRESSIONS

1. Terminology

Terms commonly employed in describing phase locked loop systems are explained below.

Free-running frequency f_O

This is the frequency produced by the voltage controlled oscillator (VCO) when no input signal is applied.

Lock state

When the loop can sequentially follow changes in the input signal phase or frequency it is said to be in the lock state.

Capture range

If the loop enters the lock state when a signal is input to it, then the frequency of the signal is within the capture range. Frequencies outside of the capture range cannot cause the loop to enter the lock state.

Lock range

A frequency is said to be within the lock range if the lock state is maintained after it is captured by a signal even though the frequency of the signal is changed. The loop will lose the lock state if the signal shifts to a frequency outside this range. In general, the lock range is wider than the capture range.

2. Computational expression

The computational expressions which are the basis for operation of the M51361P/M5E565P are as follows.

Free-running frequency f_O

$$f_O \fallingdotseq \frac{1}{4R_1C_1} \quad \text{(Hz)} \quad \cdots\cdots\cdots \quad (1)$$

where R_1 is the resistance between pins ⑧ and ⑩ in ohms and C_1 is the capacitance between pin ⑨ and GND in Farads.

Lock range

$$f_L = \pm \frac{8fo}{V_{CC}} \quad \text{(Hz)} \dots\dots\dots\dots \quad (2)$$

Capture range

$$fc \doteqdot \frac{1}{2\pi}\sqrt{\frac{2\pi f_L}{\tau}} \quad \text{(Hz)} \dots\dots\dots\dots \quad (3)$$

where $\tau = 3.6 \times 10^3) \times C_2$ and C_2 (F) is the capacitance between pins ⑦ and ⑩ in farads.

Lock range control

The lock range is determined by the supply voltage (V_{CC}) and the free-running frequency (f_O); this range can be reduced, however, by connecting pins ⑥ and ⑦ through a resistance. In such cases the lock range becomes

$$f_{L'} \doteqdot f_L \frac{(R_{⑥-⑦} + 1.6)}{(R_{⑥-⑦} + 5.2)} \quad \text{(Hz)} \dots\dots\dots \quad (4)$$

where $R_{6\sim7}$ is, the resistance between pins ⑥ and ⑦ in kΩ and f_L is the lock range when pins ⑥ and ⑦ are not connected in Hz.

This method can be used to reduce the lock range about 30% from that when pins ⑥ and ⑦ are not connected.

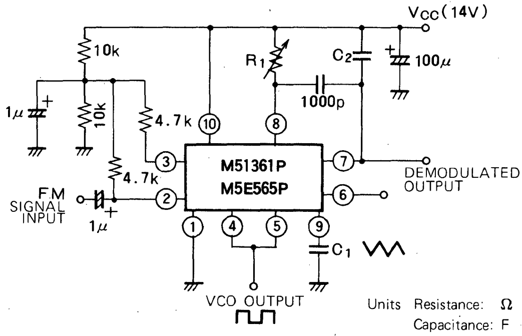
APPLICATION EXAMPLE

FM Demodulation

FM signals can be demodulated with good linearity using the M51361P. When the loop is in the lock state, the amount of variation in the average direct current voltage level of the signal output by the phase comparator is proportional to variation in the frequency of the input signal. With the M51361P/M5E565P variations in the input frequency over a wide range (about ±60%) are followed with a linearity which is within about 0.5%.

A basic example of application of this IC as an FM demodulator is shown in the diagram at right. The VCO free-running frequency is $(f_O) = 1/4C_1R_1$ so that it is the same (at pin ④) as the center frequency of the input signal when the circuit is idle. A value for R_1 of about 4kΩ is appropriate, but any value from 2～20kΩ may be used. Sometimes it is desirable to insert a 300～1000pF capacitor between pins ⑦ and ⑧ to prevent parasitic oscillation. Capacitor C_2 between pin ⑦ and V_{CC} constitutes a low pass filter which, together with the internal output resistance (about 3.6kΩ), determines the cut-off frequency for the demodulated output.

FM demodulation circuit



Units Resistance: Ω
Capacitance: F

M51523L

DUAL CHANNEL ELECTRONIC ATT

DESCRIPTION

The M51523L is a semiconductor integrated circuit consisting of dual electronic attenuator and a balancer. It is housed in a compact 14-pin ZIL package and is designed for use in car audio equipment, radio cassette tape recorder, TV set etc. Its attenuation and balance can be controlled by DC volume control voltage and DC balance control voltage respectively. And the included reference voltage supply is available for DC volume control voltage or DC balance control voltage.

FEATURES

- High attenuation ·· 92dB(typ.)
  ($f=1kHz$, $V_I=150mV$ IHF-A Network)
- Low distortion ······································· 0.015%(typ.)
  ($f=1kHz$, $V_I=150mV$ Volume max.)
- Low noise ··········3.6μVrms(Volume min IHF-A Network)
- Including stabilized power supply, operation not affected by supply voltage variation.
- Operation almost not affected by variation of temperature.

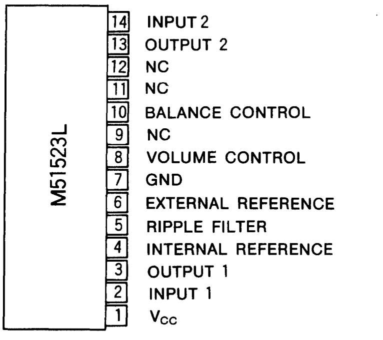
APPLICATION

Car audio, radio cassette tape recorder, TV set

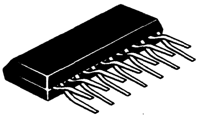
RECOMMENDED OPERATING CONDITIONS

Supply voltage ··· 8 ~ 16V
Rated supply voltage ··· 12V

PIN CONFIGURATION (TOP VIEW)

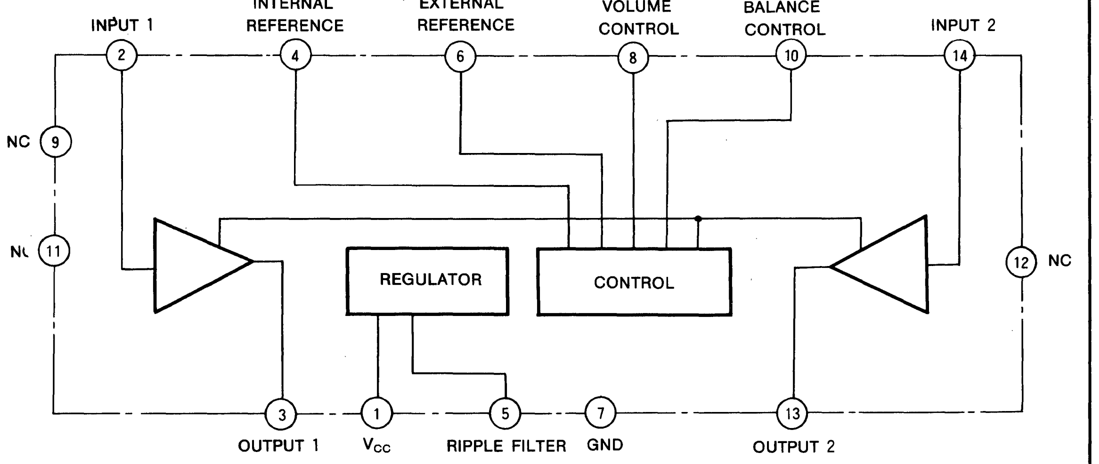


Outline 14P5A NC : NO CONNECTION



14-pin molded plastic ZIL

BLOCK DIAGRAM



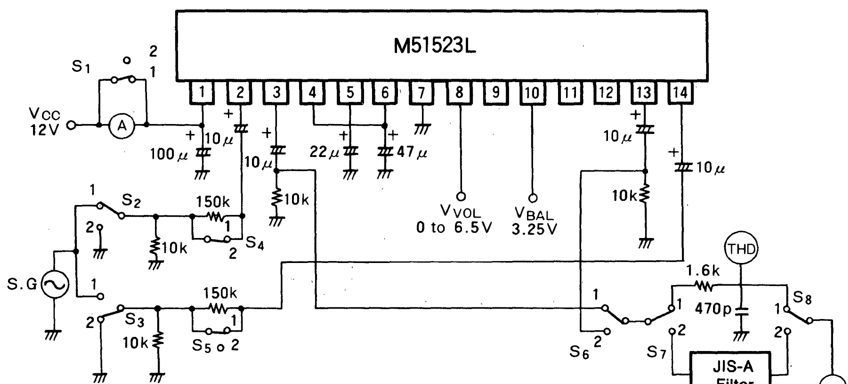
ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage	Quiescent	18	V
I_{CC}	Circuit current		30	mA
P_d	Power dissipation		550	mW
K_θ	Thermal derating	$T_a \geq 25$℃	5.5	mW/℃
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CCO}	Quiescent circuit current	no signal V_{OL} Min	7	12	20	mA
ATT	Attenuation	IHF-A V_{OL} Min V_i=150mVrms	83	92		
C.B	Channel balance		−3	0	3	dB
THD	Total harmonic distortion	V_{OL} Max V_i=150mVrms 1kHz		0.015	0.1	%
R_i	Input resistance		50	150		kΩ
V_i(max)	Maximum input voltage	THD=1% at 1kHz	1.0	1.5		Vrms
N_O	Output noise voltage	V_i=0 IHF-A Network		3.6	10	μVrms
$N_{O(r)}$	Remaining output noise voltage	V_i=150mVrms IHF-A Network		3.6	10	μVrms

TEST CIRCUIT

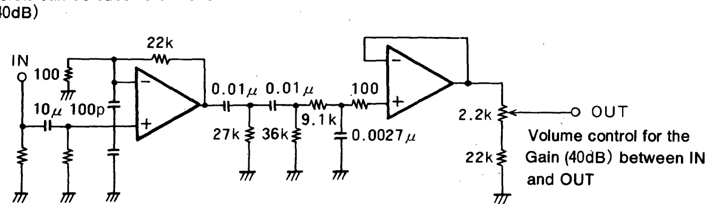


Note : 1. S.G; equivalent to HP-339A
THD; equivalent to HP-339A
V.V; equivalent to Kikusui Model 1635

Units: Resistance : Ω, Capacitance : F

Note : 2. Low-ripple-noise power supply recommended (under 2μV)

The circuit below can be substituted for JIS-A Network.
(Note; gain 40dB)

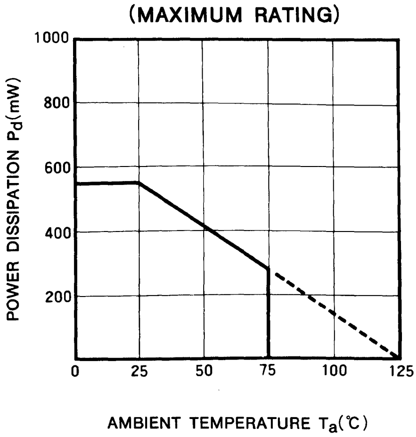


TEST METHODS (T_a=25℃, V_{CC}=12V, f=1kHz, unless otherwise noted)

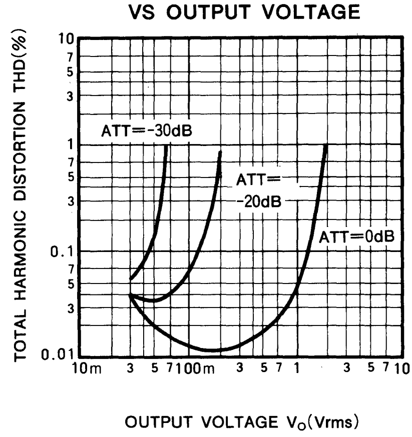
Parameter	Switch connection								Methods
	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	
I_{CCO}	2	2	2	1	1	—	1	1	Read value on ammeter
ATT	1	1 1	1 1	1	1	1 2	1	1	V_{VOL};0 to 6.5V ATT=20 log(V_i/V_O)dB
ΔG_V	1	1 1	1 1	1	1	1 2	1	1	Channel balance at volume max
THD	1	1	1	1	1	1 2	1	1	V_O=1Vrms, volume max take reading from distortion meter
R_i	1	1	1	1→2 1	1 1→2	1 2	1	1	V_{01} is output for S_4 of 1, V_{02} is output for S_4 of 2 R_i=150/(V_{01}/V_{02}−1)kΩ
V_i(max)	1	1	1	1	1	1 2	1	1	Input voltage level at which THD of output voltage exceeds 1% at volume max
N_O	1	2	2	1	1	1 2	1	1	Volume min, R_g=10kΩ
$N_{O(r)}$	1	1	1	1	1	1 2	2	2	IHF-A Network

ELECTRICAL CHARACTERISTICS CURVE

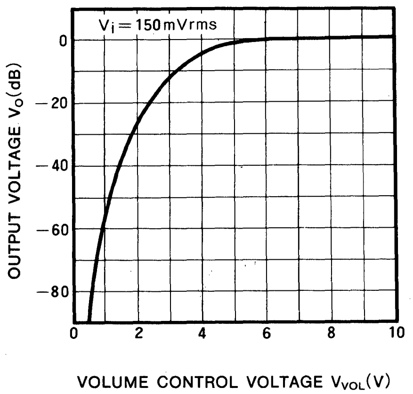
THERMAL DERATING
(MAXIMUM RATING)



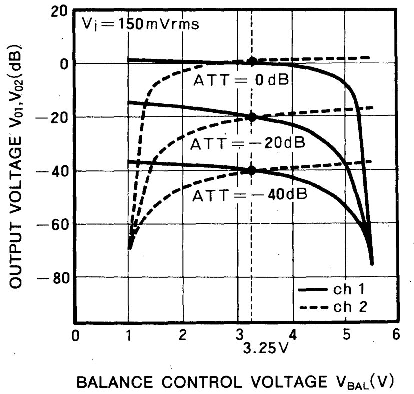
TOTAL HARMONIC DISTORTION
VS OUTPUT VOLTAGE



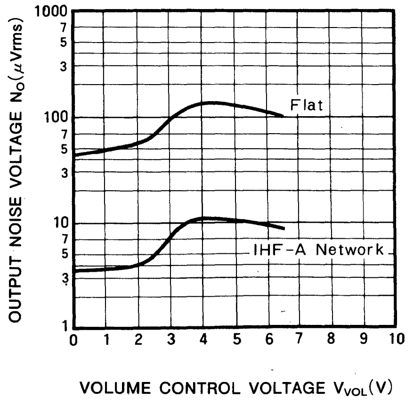
OUTPUT VOLTAGE VS VOLUME CONTROL VOLTAGE



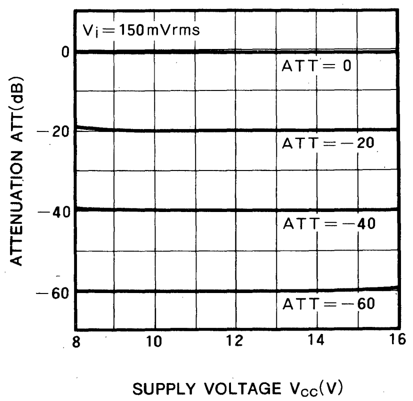
OUTPUT VOLTAGE VS BALANCE CONTROL VOLTAGE



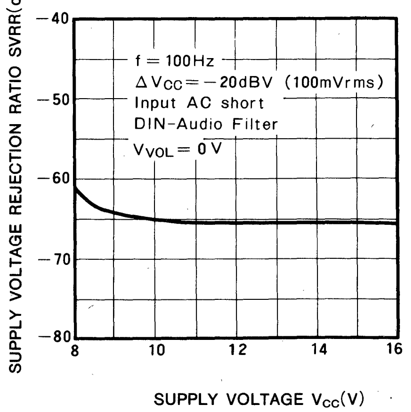
OUTPUT NOISE VOLTAGE VS VOLUME CONTROL VOLTAGE



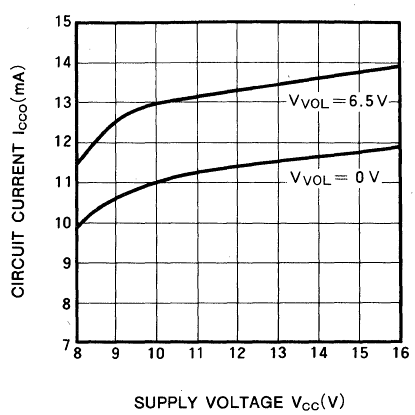
ATTENUATION VS SUPPLY VOLTAGE



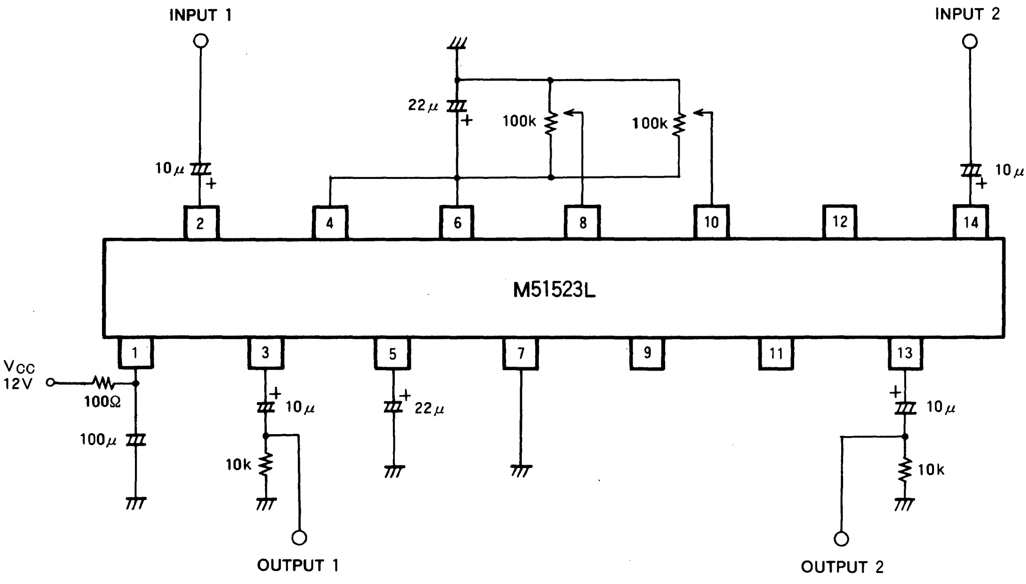
SUPPLY VOLTAGE REJECTION RATIO VS SUPPLY VOLTAGE



CIRCUIT CURRENT VS SUPPLY VOLTAGE



APPLICATION EXAMPLE



Units Resistance : Ω
Capacitance : F

M51551

DUAL 2-MODE ELECTRONIC SWITCH

DESCRIPTION
The M51551P/M51551FP is an integrated circuit consisting of dual channels two-mode electronic switch. It can select the both channel input signal at the same time by means of forcing DC voltage at control terminal. And it consists of LED driver for displaying the selected input mode. M51551P is housed in 14-pin plastic molded DIL package. M51551FP is housed in 14-pin plastic molded FLAT package.

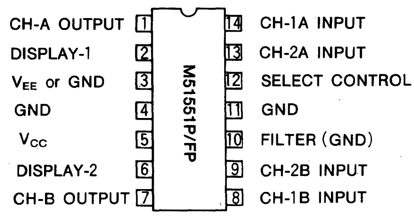
FEATURES
- Dual channel two-mode electronic switch
- Mode changeable by means of forcing DC voltage
- Built-in output circuit for mode display
- Low distortion transmission characteristics because of bipolar process ····························· 0.006%(typ.)
- Single power supply and dual power supply are available for power supply
- Positive logic control

APPLICATION
Signal switch, stereo radio cassette recorder, radio receiver

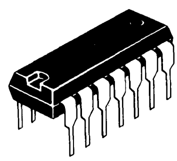
RECOMMENDED OPERATING CONDITIONS
(T_a=25℃)

Dual power supply
Operating supply voltage ························ ±6~±10V
Rated supply voltage ····································· ±8V
Single power supply
Operating supply voltage ····························· 6~20V
Rated supply voltage ·· 15V

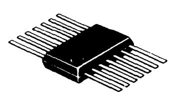
PIN CONFIGURATION (TOP VIEW)



Outline 14P4 M51551P
Outline 14P2 M51551FP

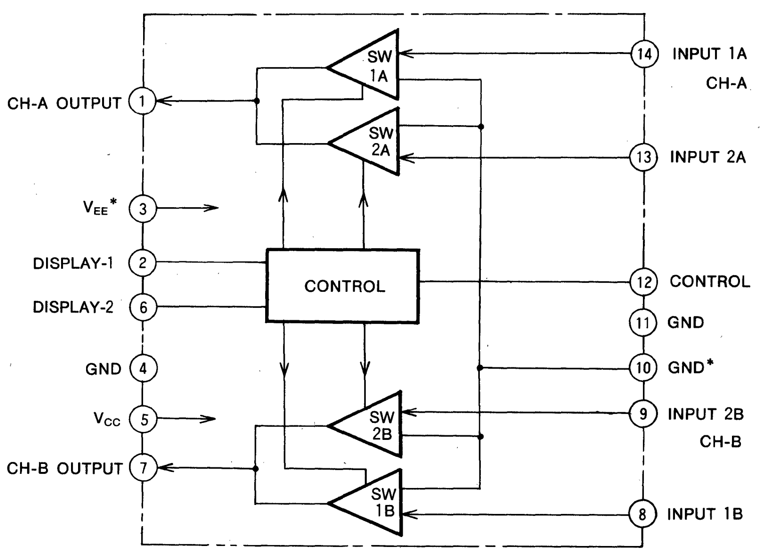


14-pin molded plastic DIL



14-pin molded plastic FLAT

BLOCK DIAGRAM



* : Terminal meaning

	Dual power supply	Single power supply
pin③	V_{EE}	GND
pin⑩	GND	Filter

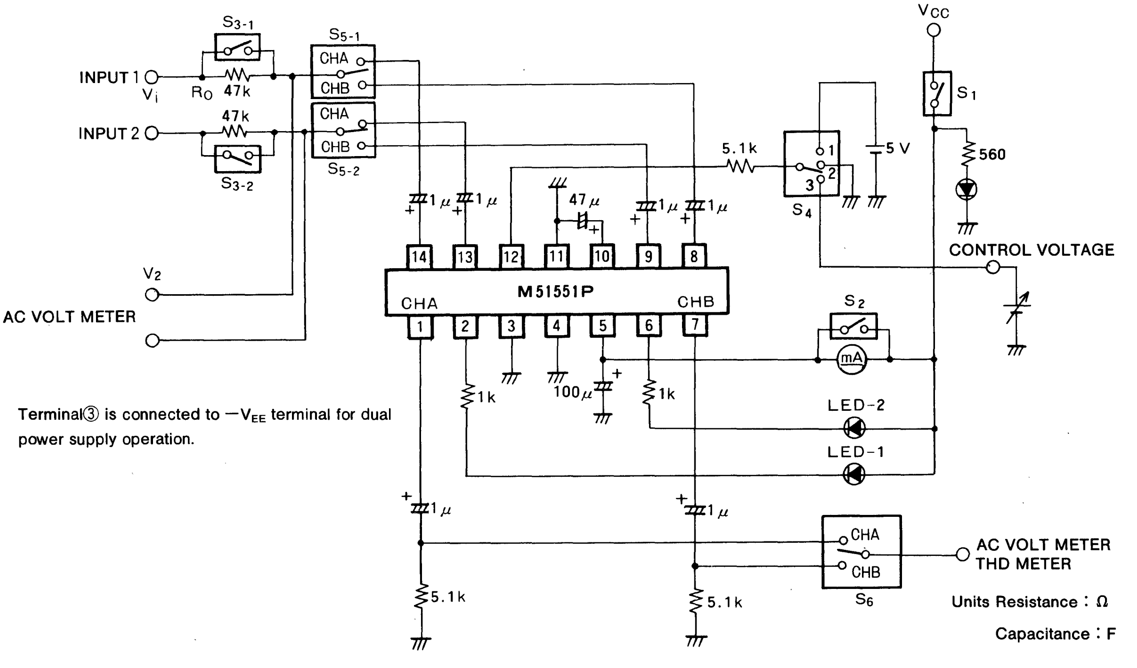
ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage	At zero signal (between pin⑤ to ③)	24	V
I_{CC}	Circuit current	Not including pin②, ⑥ current	30	mA
I_{CC}②, ⑥	Display current	Pin②, ⑥	40	mA
P_d	Power dissipation		620	mW
K_θ	Thermal derating above 25℃	T_a≧25℃	6.2	mW/℃
T_{opr}	Operating temperature		−20〜+75	℃
T_{stg}	Storage temperature		−40〜+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=15V, V_i=1.5Vrms, f=1kHz, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	Not including pin②, ⑥ current		12	16	mA
V_{CNTL1}	Input 1select control voltage	Control voltage when input 1 is selected.	2.0			V
V_{CNTL-2}	Input 2select control voltage	Control voltage when input 2 is selected.			0.7	V
R_i	Input resistance	V_i=1.5V_{rms}, f=1kHz, R_o=47kΩ	30	47		kΩ
G_V	Voltage gain	V_i=1.5V_{rms}, f=1kHz	−1	0	1	dB
$V_{O(max)}$	Maximum output voltage.	Output level as output THD=1%	4.0	4.5		Vrms
THD	Total harmonic distortion	V_O=1.0V_{rms}		0.006	0.017	%
N_O	Noise output	Zero-signal, input pin short to GND		5.5	10	μV_{rms}
C.T.	Cross talk	Leakage ratio of input 1 to input 2	52	58		dB
C.L.	Channel leakage	Leakage ratio of channel A to channel B	77	83		dB
C.B.	Channel balance	Voltage gain ratio of channel A to channel B	−0.5	0	0.5	dB

TEST CIRCUIT (for single power supply)



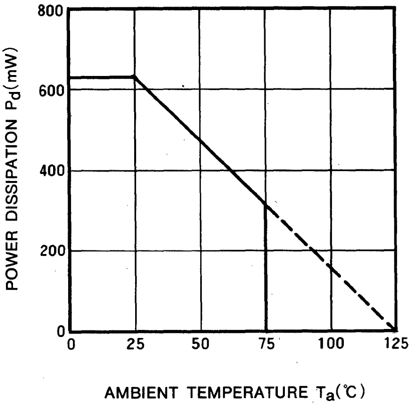
Terminal③ is connected to $-V_{EE}$ terminal for dual power supply operation.

Units Resistance : Ω
Capacitance : F

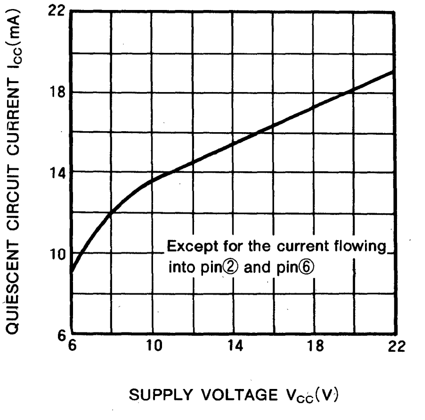
Symbol	Switch							Method
	S_1	S_2	S_3	S_4	S_{5-1}	S_{5-2}	S_6	
I_{CC}	ON	OFF	ON	½				Zero signal, measure circuit current
V_{CNTL1}	ON	ON	ON	3				Measure Pin⑫ DC supply voltage as input signal 1 is output
V_{CNTL2}	ON	ON	ON	3				Measure Pin⑫ DC supply voltage as input signal 2 is output
R_i	ON	ON	OFF	½	CHA / CHB	CHA / CHB		$R_i=\frac{V_2 \times R_0}{V_1-V_2}$, $V_1=1.5V_{rms}$, $R_0=47k\Omega$ Measure input level at V_2 point
G_V	ON	ON	ON	½	CHA / CHB	CHA / CHB	CHA / CHB	$G_V=20\log\frac{V_0}{V_1}$ (dB), $V_1=1.5V_{rms}$ V_0=output level
$V_{O(max)}$	ON	ON	ON	½	CHA / CHB	CHA / CHB	CHA / CHB	Measure output level as output THD is 1.0%
THD	ON	ON	ON	½	CHA / CHB	CHA / CHB	CHA / CHB	Measure output THD as output level is $1.0V_{rms}$
N_O	ON	ON	ON	½			CHA / CHB	Input pin short to GND. Measure the output noise level, BPF 20Hz~20kHz
C.T.	ON	ON	ON	1⇄2	CHA / CHB		CHA / CHB	C.T. $=20\log\left(\frac{V_O(S_4\to1)}{V_O(S_4\to2)}\right)$ (dB)
C.L.	ON	ON	ON	1	CHA	CHA	CHA ⇅ CHB	C.L. $=20\log\left(\frac{V_O(CHA)}{V_O(CHB)}\right)$ (dB)
C.B.	ON	ON	ON	1	CHA / CHB	CHA / CHB	CHA / CHB	C.B. $=20\log\left(\frac{V_O(CHA)}{V_O(CHB)}\right)$ (dB)

TYPICAL CHARACTERISTIC ($T_a=25°C$, $V_{CC}=15V$, unless otherwise noted)

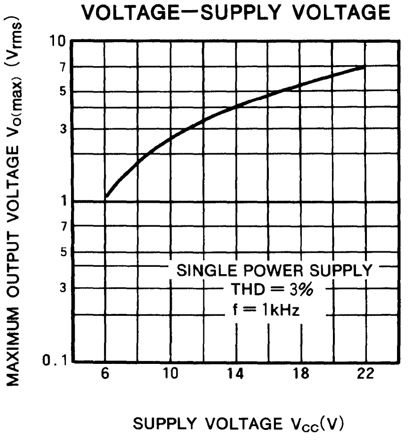
THERMAL DERATING (MAXIMUM RATING)



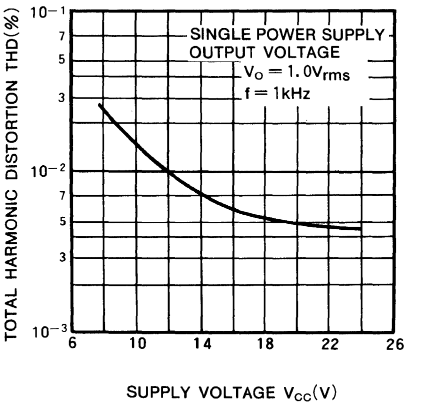
QUIESCENT CIRCUIT CURRENT—SUPPLY VOLTAGE



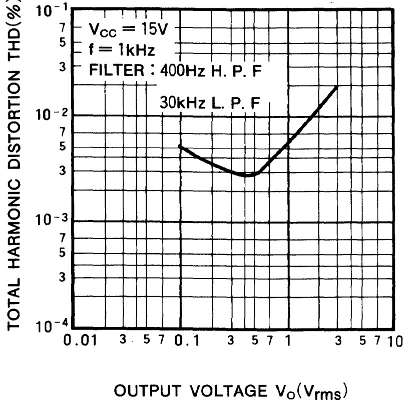
MAXIMUM OUTPUT VOLTAGE—SUPPLY VOLTAGE



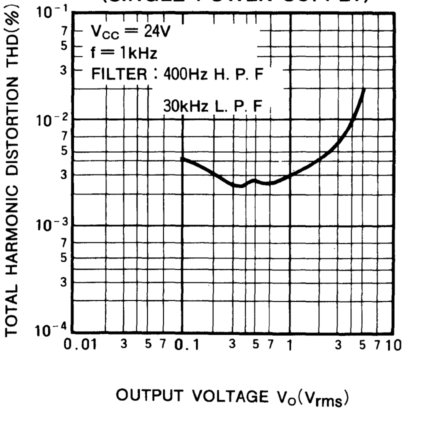
TOTAL HARMONIC DISTORTION SUPPLY VOLTAGE



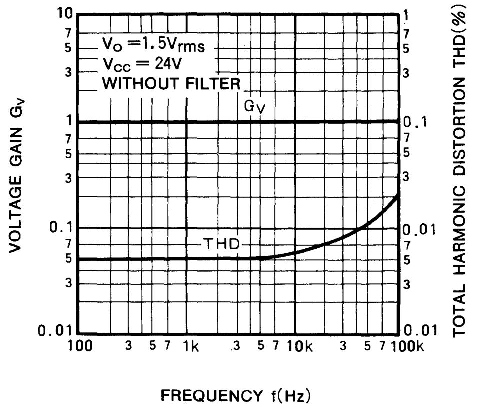
TRANCE CONDUCTANCE CHARACTERISTICS (V_{CC}=15V) (SINGLE POWER SUPPLY)



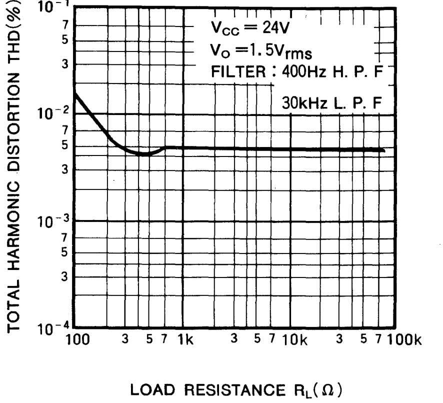
TRANCE CONDUCTANCE CHARACTERISTICS (V_{CC}=24V) (SINGLE POWER SUPPLY)



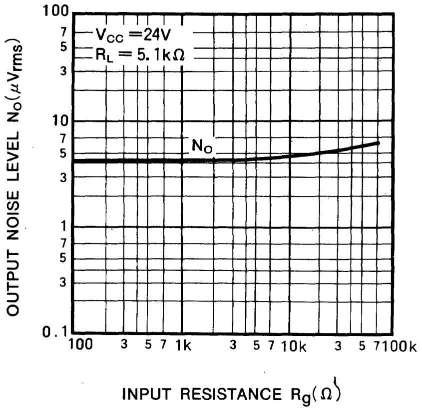
FREQUENCY RESPONCE (SINGLE POWER SUPPLY)



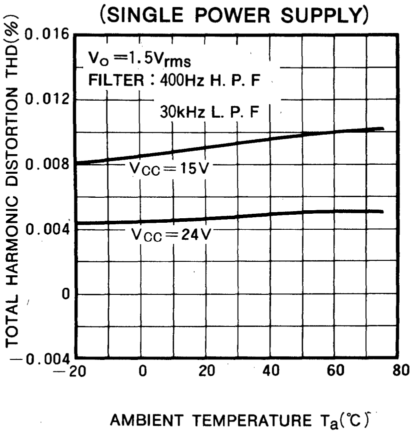
TOTAL HARMONIC DISTORTION—LOAD RESISTANCE (SINGLE POWER SUPPLY)



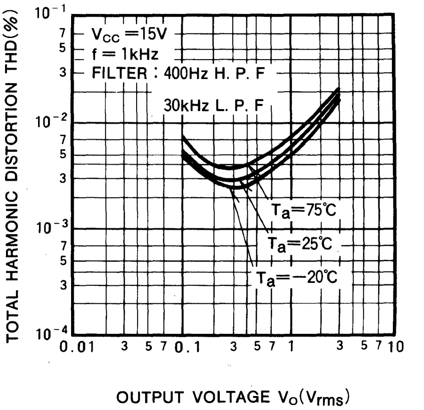
INPUT RESISTANCE—OUTPUT NOISE LEVEL (SINGLE POWER SUPPLY)



TOTAL HARMONIC DISTORTION—AMBIENT TEMPERATURE (SINGLE POWER SUPPLY)

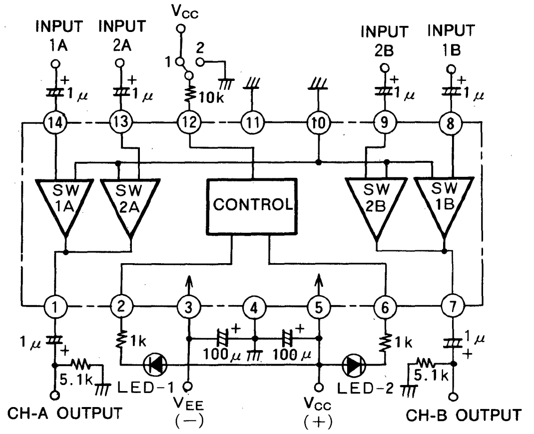


TRANCE CONDUCTANCE—AMBIENT TEMPERATURE (SINGLE POWER SUPPLY)

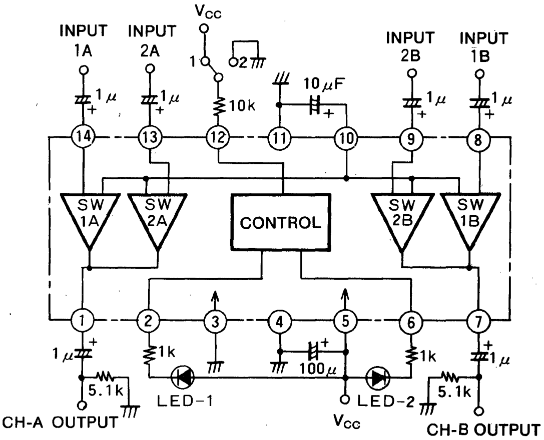


APPLICATION CIRCUIT

DUAL POWER SUPPLY OPERATION



SINGLE POWER SUPPLY OPERATION



M51660L

SERVO MOTOR CONTROL

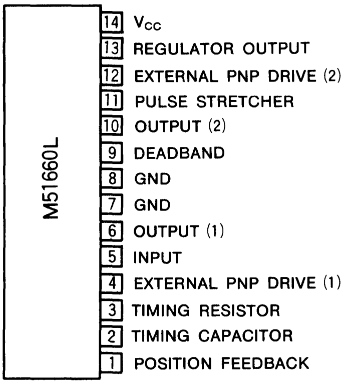
DESCRIPTION
The M51660L is a servo control amprifier and pulse width demodulatar with internal motor drive transistors in compact ZIL (zig-zag in line) package. It is designed for remote control applications in digital proportional systems.

FEATURES
- Low standby power drain ···························· 3.5mA(typ.)
- Wide supply voltage range
- Easily adjustable deadband
- Output cutoff circuit for continuous "H" input

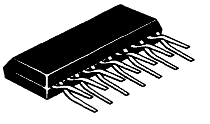
APPLICATION
Proportional system for radio control servo motor control

RECOMMENDED OPERATING CONDITIONS
Supply voltage range ··· 3.5~7V
Rated supply voltage ·· 4.8V

PIN CONFIGURATION (TOP VIEW)

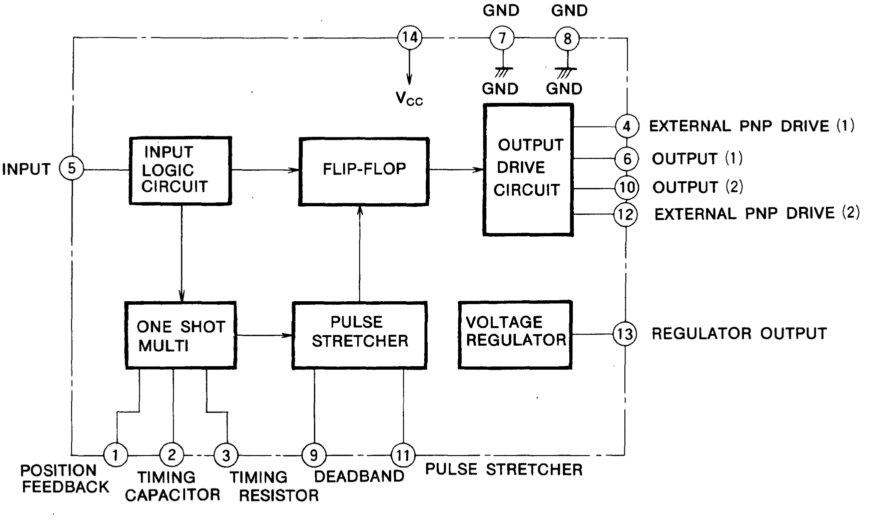


Outline 14P5A



14-pin molded plastic ZIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

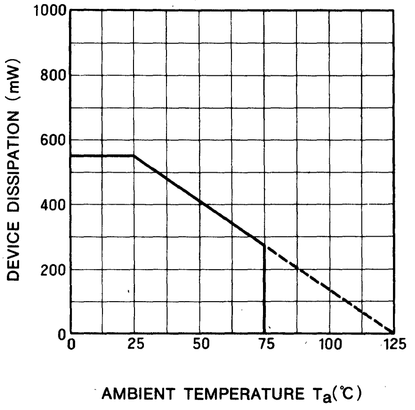
Symbol	Parameter	Conditions	Limit	Unit
V_{CC}	Supply voltage		7.5	V
P_d	Maximum dissipation		550	mW
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=4.8V, unless otherwise noted)

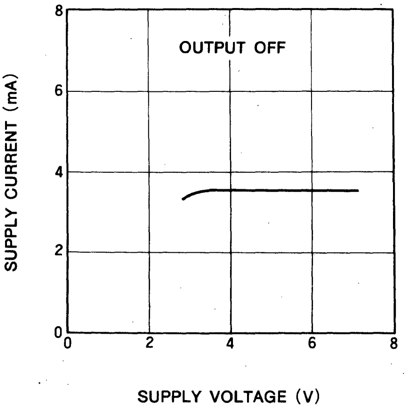
Symbol	Parameter	Test conditions	Limit			Unit
			Min	Typ	Max	
I_{CC}	Supply current	Output off		3.5	5	mA
		Output on		20		
V_{OL}	Output voltage "L"	$I_{O\ SINK}$=100mA		0.1	0.2	V
		$I_{O\ SINK}$=400mA		0.4	0.7	
V_{OH}	Output voltage "H"	$I_{O\ SOURCE}$=100mA	3.4	3.8		V
I_{PNP}	External PNP drive current		30			mA
V_{Reg}	Regulate voltage		2.3	2.45	2.6	V
I_{Reg}	Voltage regulator output current				3.0	mA
T_{OB}	Minimum deadband width	R_{OS}=510Ω O_S=0.1μF			1.5	μS

TYPICAL CHARACTERISTICS

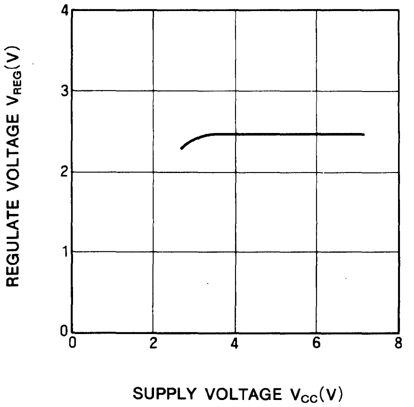
AMBIENT TEMPERATURE VS MAXIMUM DISSIPATION



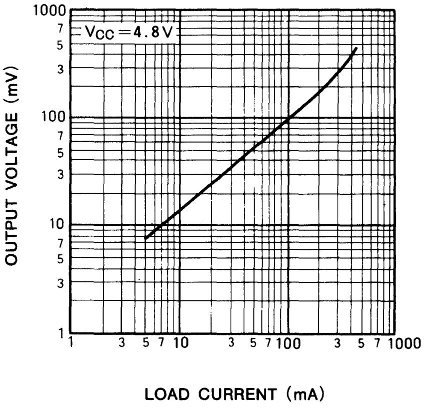
SUPPLY CURRENT VS SUPPLY VOLTAGE



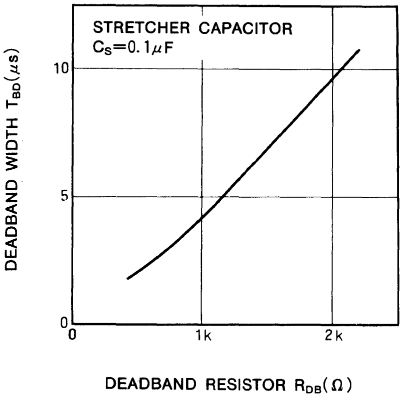
REGULATE VOLTAGE VS SUPPLY VOLTAGE



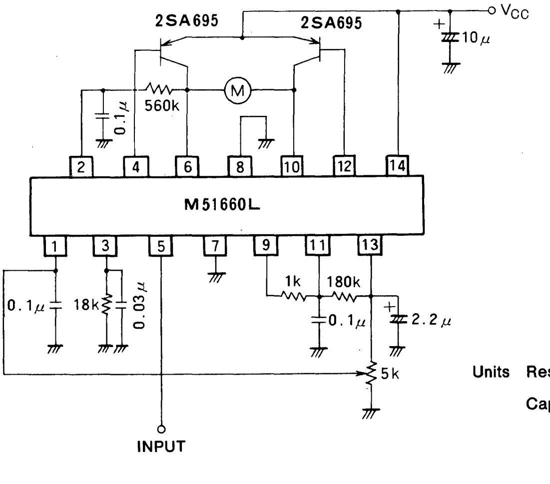
OUTPUT VOLTAGE VS LOAD CURRENT



DEADBAND WIDTH VS DEADBAND RESISTOR



APPLICATION



Units Resistance : Ω
Capacitance : F

3-PHASE BRUSHLESS MOTOR DRIVER

DESCRIPTION

The M51712P is designed for use in 3-phase Brushless Motor in combination with the servo IC.

The M51712P is encapsulated in DIL with the fin 20-pin package, integrating Hall drivers, output drivers, Hall compensator and control amplifier and other functions.

The M51712P provides the linear amplified outputs (shown later) so that it can reduce the mechanical noise which occurs in pulse driving motors.

FEATURES

- Low torque ripple
- Reducing the mechanical noise
- High speed response
- Minimized external components

APPLICATION

VTR, floppy disk driver, etc

RECOMMENDED OPERATING CONDITIONS

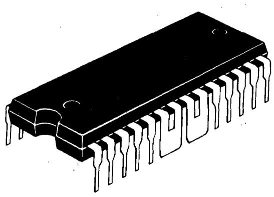
Supply voltage range .... 6～12V
Rated supply voltage 12V

PIN CONFIGURATION (TOP VIEW)

V_{CC}	1	20	OUT 1
HALL DRIVE (+)	2	19	OUT 2
HALL DRIVE (−)	3	18	OUT 3
Vref	4	17	HALL OUTPUT 1 (+)
F/R SWITCH	5	16	HALL OUTPUT 1 (−)
GND	FIN	FIN	GND
GND	FIN	FIN	GND
LEVEL SHIFT	6	15	HALL OUTPUT 2 (+)
CONTROL INPUT	7	14	HALL OUTPUT 2 (−)
ERROR AMP OUTPUT	8	13	HALL OUTPUT 3 (+)
ERROR AMP INPUT	9	12	HALL OUTPUT 3 (−)
COMPENSATION (1)	10	11	COMPENSATION (2)

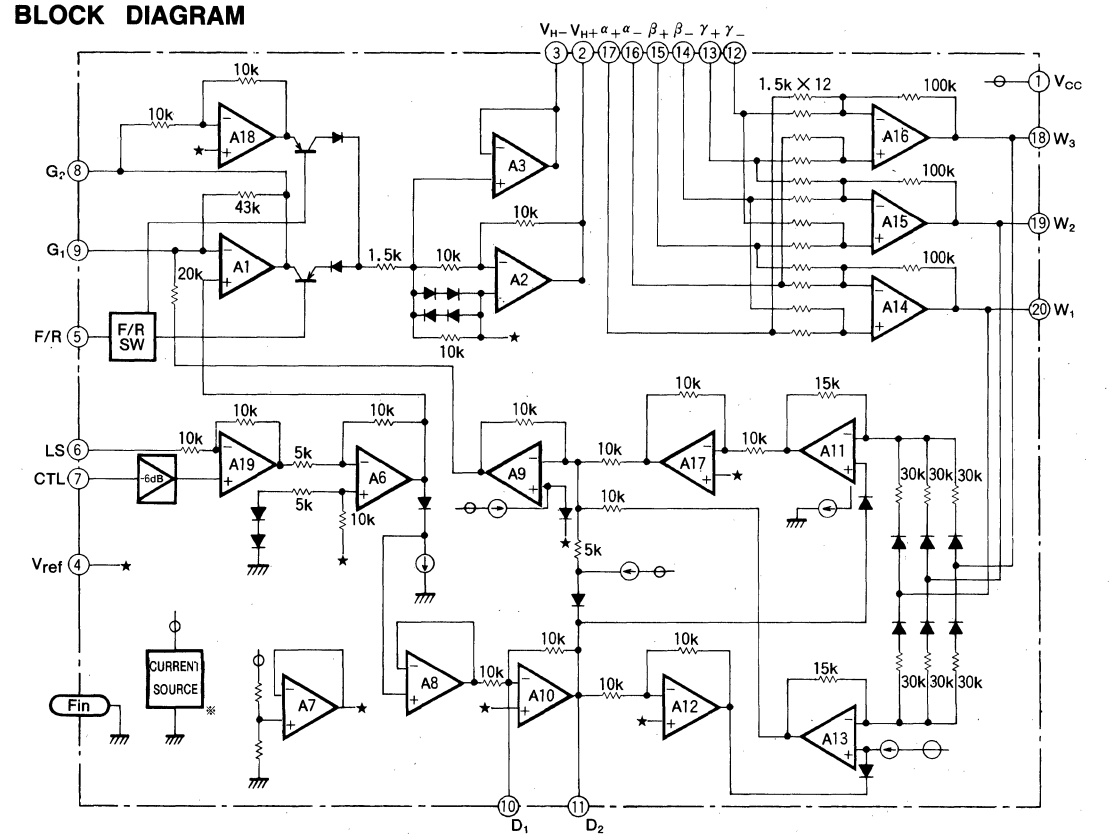
M51712P

Outline 28P4-A



28-pin molded plastic DIL with fins

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

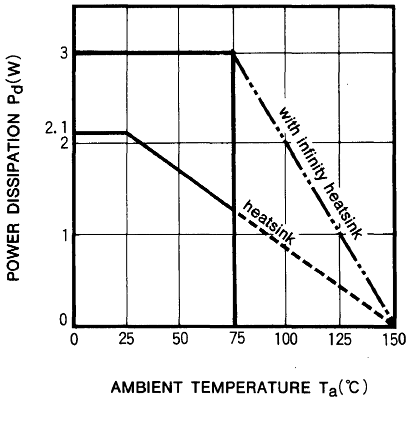
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		26	V
$I_{O(MAX)}$	Maximum output current		1.2	A
P_d	Power dissipation		2.1	W
T_j	Junction temperature		150	C
V_{CTL}	Control voltage		0～V_{CC-1}	V
V_{LS}	Level shift voltage		0～7	V
I_h	Hall drive current		20	mA
T_{opr}	Operating temperature range		−20～+75	℃
T_{stg}	Storage temperature range		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

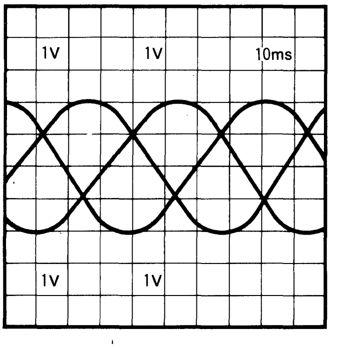
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Quiescent supply current		9	15	24	mA
V_{ref}	Reference voltage		5.6	6	6.4	V
G_{CTL}	Control amp voltage gain			2		V/V
G_{hd}	Hall drive amp voltage gain			1.4		V/V
G_{oa}	Output amp voltage gain			40		dB
V_{sat} (U)	Source saturation voltage	I_O=0.8A		1.2		V
V_{sat} (D)	Sink saturation voltage	I_O=0.8A		1.2		V

TYPICAL CHARACTERISTICS

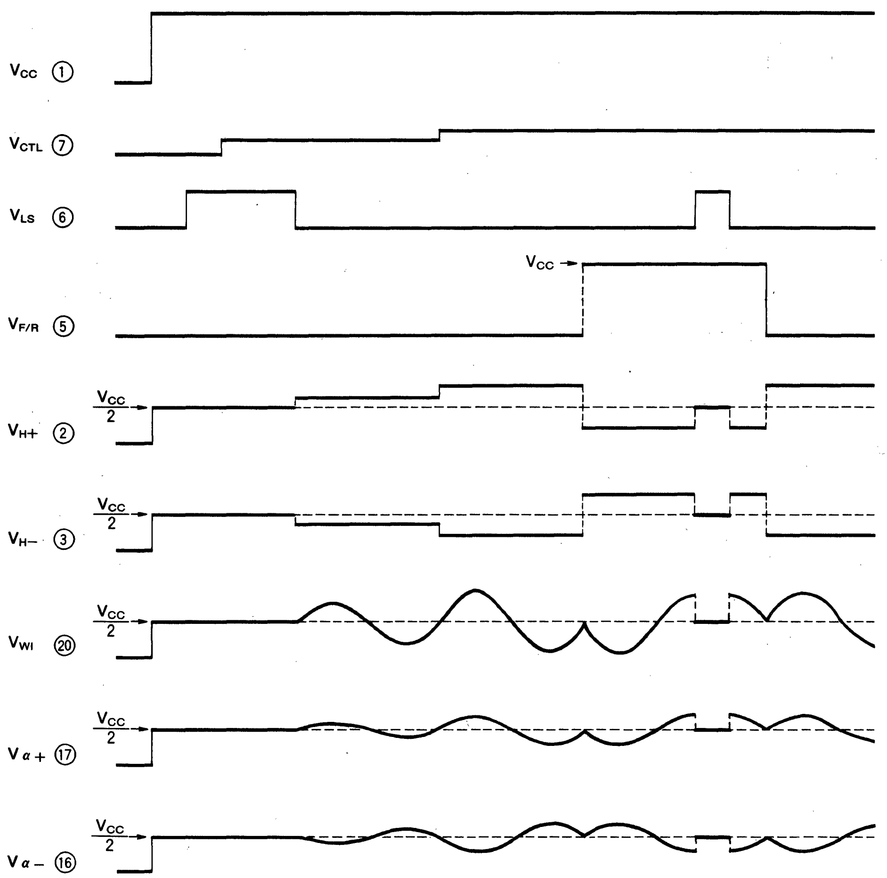
THERMAL DERATING
(MAXIMUM RATING)



3-phase output waveforms

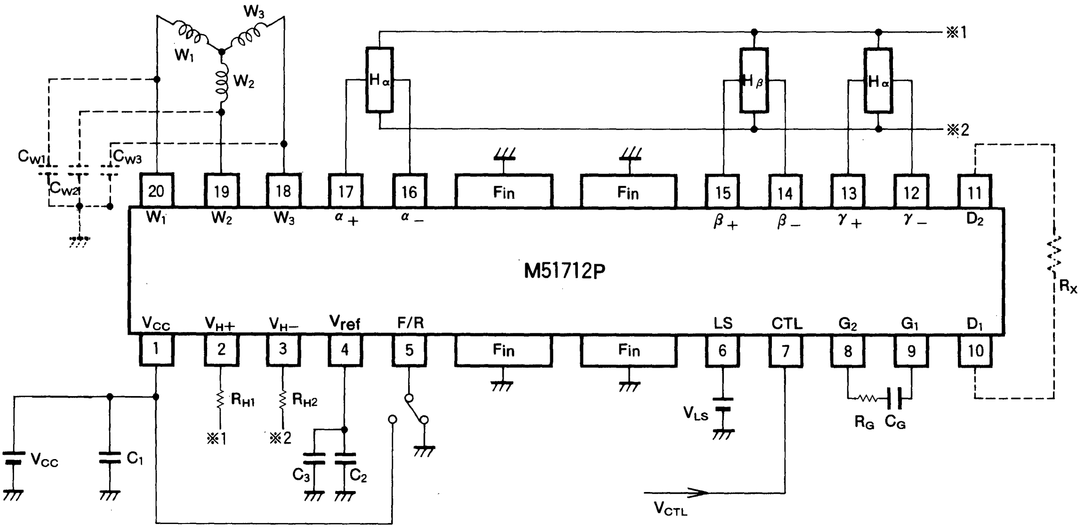


SIGNAL LEVEL & TIMING RELATIONSHIPS



Note 1. V_{W1}, V_{W2}, V_{W3}; Motor driver outputs
2. $O_{W2}= O_{W1}\pm 2/3\pi$, $O_{W3}=O_{W1}\pm 4/3\pi$
3. $V\alpha\pm$, $V\beta\pm$, $V\gamma\pm$; Hall elements outputs
4. V_{H+}, V_{H-}; Hall drive
5. N1<N2

APPLICATION EXAMPLE



V_{CC}	Supply voltage	12V
V_{1S}	Level shift voltage	0V(GND)
R_{H1}, R_{H2}	Short protection and gain tune	0V(GND)
R_G, C_G	Phase compensation	1.2kΩ, 0.01μF
C_1~C_3	Supply and reference voltage by-pass	33, 10, 0.01μF
C_{W1}~C_{W3}	For stability	10μF (∗3)
R_X	Compensating circuit gain adjust	normally open
V_{CTL}	Control voltage from servo system	

M51714P

DUAL BI-DIRECTIONAL DRIVER

DESCRIPTION

The M51714P is designed for use in various motor equipments, such as audio, video and OA devices.

The M51714P is able to drive two motors forward or backward in bridge configurations. The circuit is mounted in a 16-pin DIL package which helps to minimize the space for a motor control unit and is easy to assemble one.

FEATURES

- 0. 4A output current capability per driver
- 1. 2A peak output current per driver
- Many choice of operating mode
- 2-Enable facility
- Theshold voltage is set at 2. 0V (typ.)(Inputs & Enables).

APPLICATION

VTR, tape recorders and typewriters

RECOMMENDED OPERATING CONDITIONS

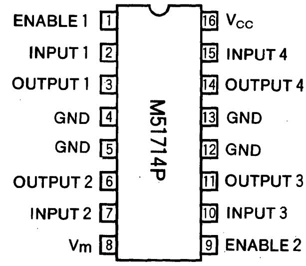
Supply voltage range ································ V_M V_{CC} ~ 24V
V_{CC} 4V ~ V_M
Rated supply voltage ································ V_M 12V
V_{CC} 5V

TRUTH TABLE

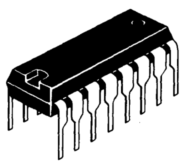
Input	Enable*1	Output
Hi	Lo	Hi
Lo	Lo	Lo
Hi	Hi	OFF*2
Lo	Hi	OFF*2

*1) Relative to the considered devision, as below.
Enable 1 ($\overline{EN}$ 1) ·········· Output 1 and Output 2
Enable 2 ($\overline{EN}$ 2) ·········· Output 3 and Output 4
*2) High Impedance

PIN CONFIGURATION (TOP VIEW)

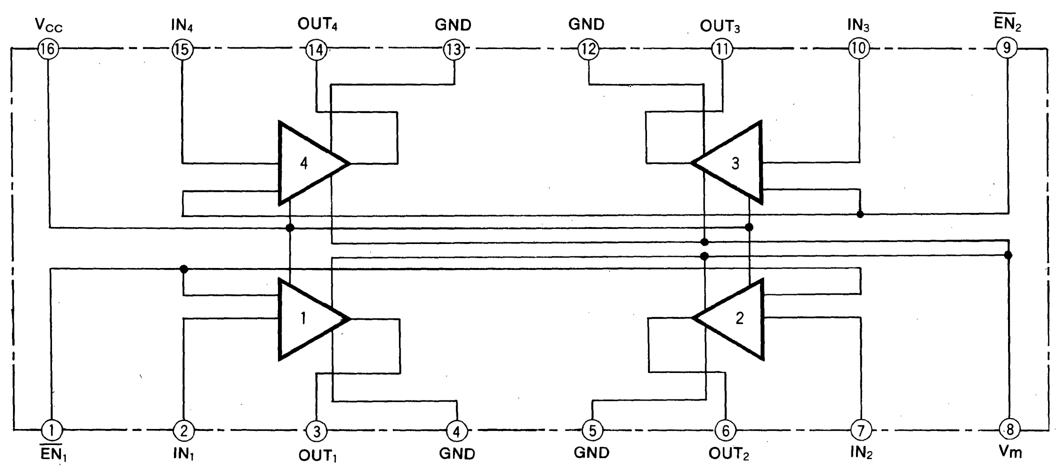


Outline 16P4



16-pin molded plastic DIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

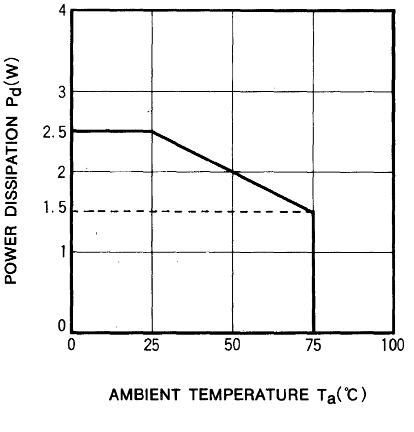
Symbol	Parameter	Conditions	Limits	Unit
V_m	Output power supply voltage		V_{CC}~26	V
V_{CC}	Supply voltage		V_m	V
V_i	Input voltage		−0.3~+7	V
V_e	Enable input voltage		−0.3~+7	V
$I_{O(MAX)}$	Maximum output current		1.2	A
I_O	Rated output current		0.4	A
P_d	Power dissipation		2.5	W
T_j	Junction temperature		150	℃
T_{opr}	Operating temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−40~+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

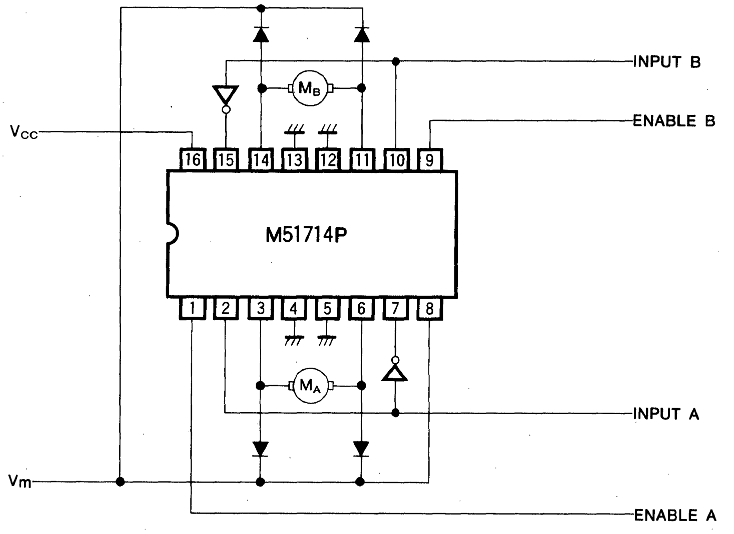
Symbol	parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Quiescent supply current			10	20	mA
I_m	Quiescent output supply current			25	50	mA
$V_{th}(i)$	Input threshold voltage		1.6	2.2	2.7	V
$V_{th}(e)$	Enable input threshold voltage		1.6	2.2	2.7	V
$I_{in}(i)$	Input current			3.5	20	vA
$I_{in}(e)$	Enable input current			0.5	10	vA
$V_{sat}(U)$	Source saturation voltage	I_O=0.2A		1.0	1.6	V
		I_O=0.4A		1.3	1.9	V
$V_{sat}(D)$	Sink saturation voltage	I_O=0.2A		0.9	1.5	V
		I_O=0.4A		1.0	1.6	V

TYPICAL CHARACTERISTICS

THERMAL DERATING (MAXIMUM RATING)



APPLICATION EXAMPLE



FREQUENCY-VOLTAGE (F-V) CONVERTER

DESCRIPTION

The M51723P/FP is designed for use in frequency-voltage (F-V) converting.

The device provides FG amplifier, sample and hold circuits, error amplifier and sawteeth wave generating circuits.

The M51723P/FP constitutes frequency-servo motor control system with brushless motor pre-driver, M51724P or other driver ICs.

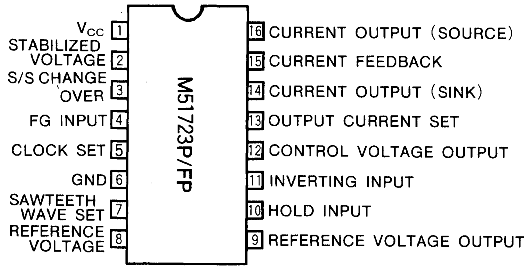
FEATURES

- Low quiescent supply current
- Suitable for both current output (current source or current sink) and voltage output
- Start/stop changeover terminal

APPLICATION

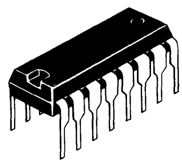
VTR, floppy disk drive, etc.

PIN CONFIGURATION (TOP VIEW)

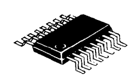


Outline 16P4 M51723P

Outline 16P2-C M51723FP

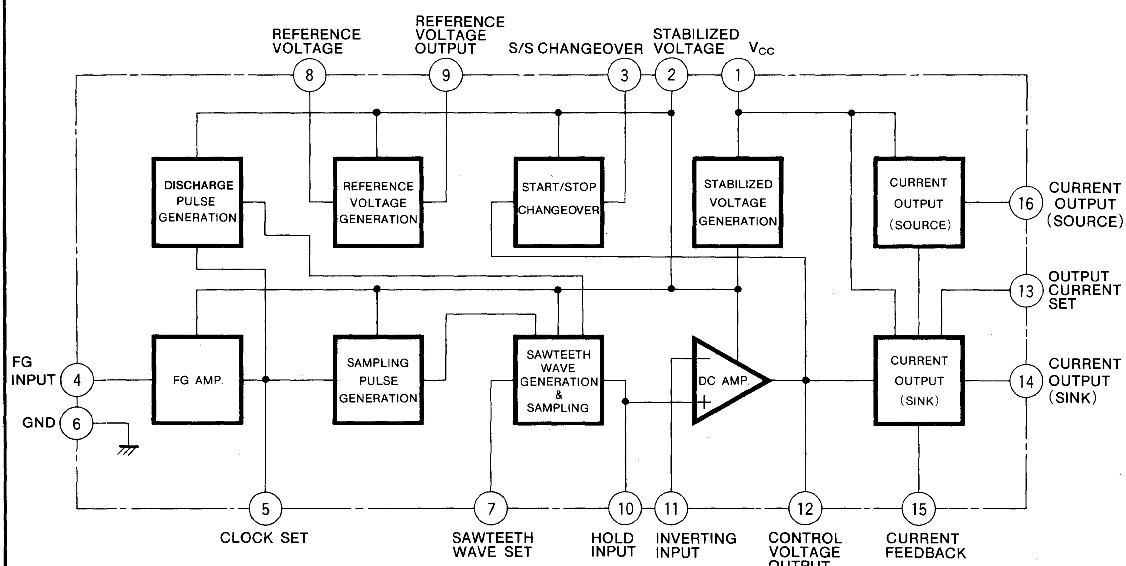


16-pin molded plastic DIL



16-pin molded plastic FLAT

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		20	V
$I_{OSO(MAX)}$	Maximum output current (source)		6	mA
$I_{OSi(MAX)}$	Maximum output current (sink)		6	mA
P_d	Power dissipation		770(440)	mW
T_{opr}	Operating temperature range		−20～+75	℃
T_{stg}	Storage temperature range		−40～+125	℃

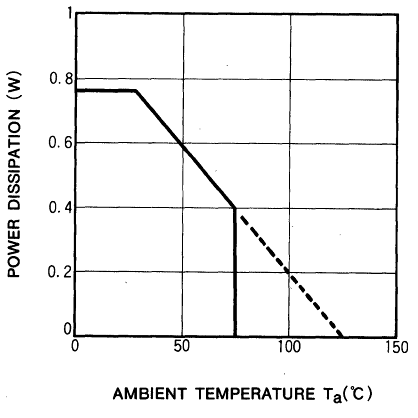
( ) : M51723FP

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

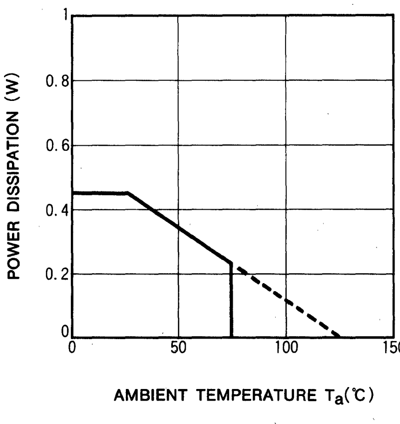
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Quiescent supply current		2	3	5	mA
V_{stb}	Stabilized voltage		5.3	5.8	6.3	V
V_{REF}	Reference voltage		2.5	2.9	3.2	V
$V_{offset(FG)}$	FG amp input offset				10	mV
$V_{TH(S/S)}$	S/S changeover threshold voltage			2.6		V

THERMAL DERATING (MAXIMUM RATING)

M51723P

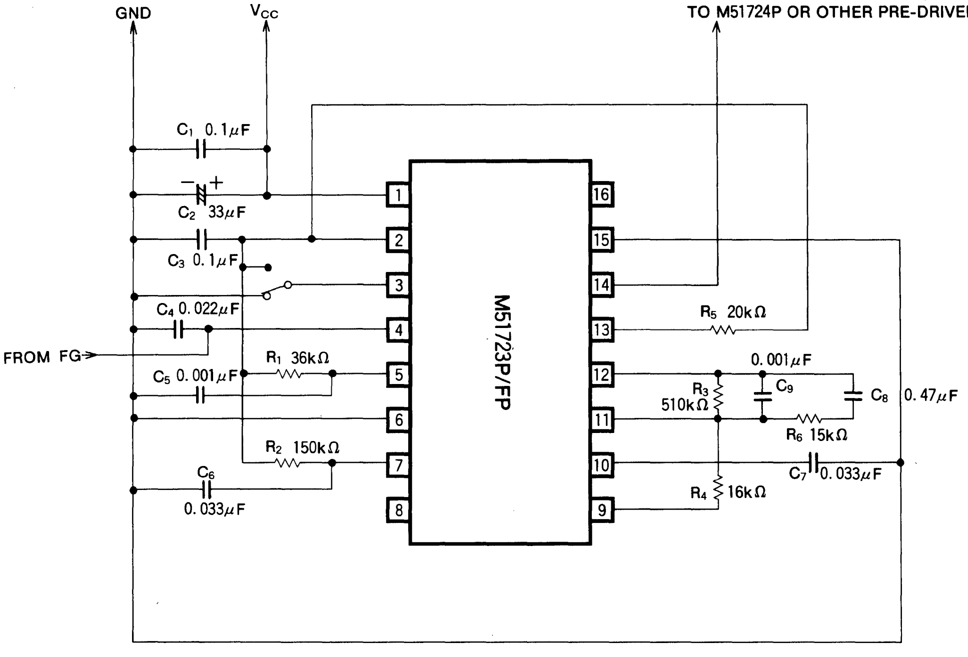


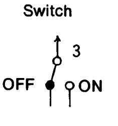
M51723FP



MITSUBISHI ELECTRIC

APPLICATION EXAMPLE





ON : Operation start

OFF : Operation stop

Note : The specifications of this device are subject to change without notice.

M51724P

3-PHASE BRUSHLESS MOTOR PRE-DRIVER

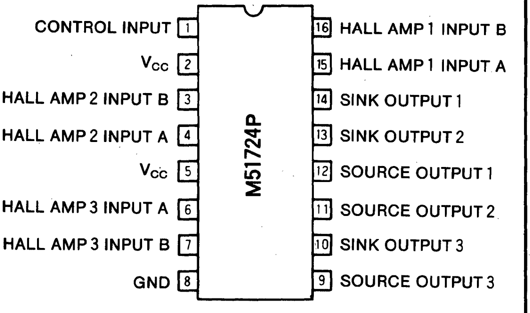
DESCRIPTION
The M51724P is designed for use in 3-phase Brushless Motor in combination with the servo IC and suitable power transistors.

The M51724P provides the hall amp, logic section and current source.

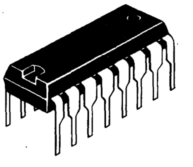
FEATURES
- Suitable for various kind of motor system by selecting the external power transistors
- Good balance in output current between each phases

APPLICATION
VTR, Tape deck and floppy disc drive

PIN CONFIGURATION (TOP VIEW)

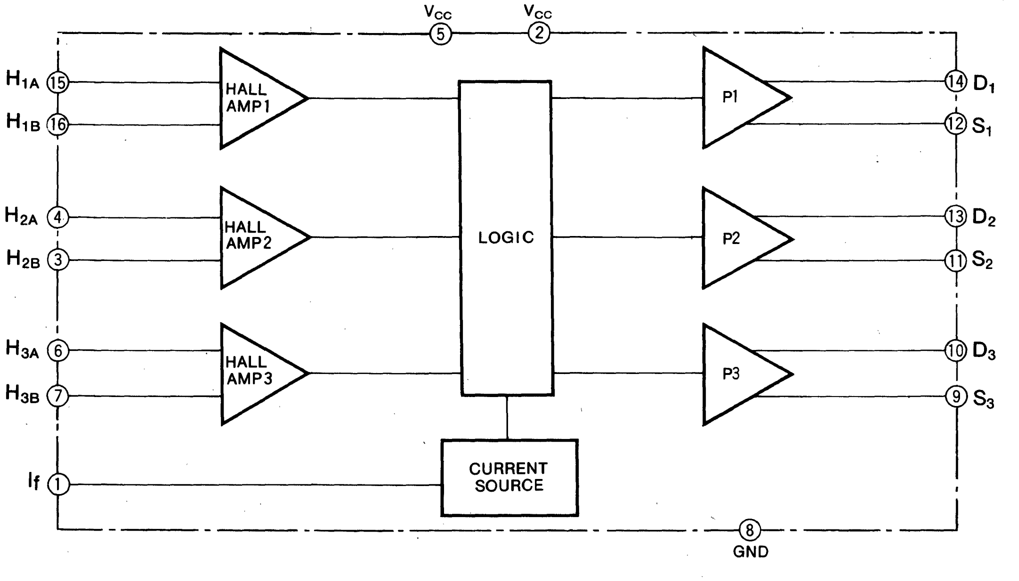


Outline 16P4



16-pin molded plastic DIL

BLOCK DIAGRAM



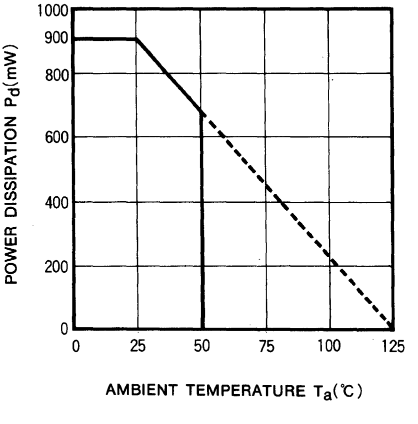
ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		20	V
I_f	Control current		1	mA
V_D	Sink output breakdown voltage		24	V
V_S	Source output breakdown voltage		6.5	V
V_H	Hall amp input voltage		6.5	V
P_d	Power dissipation		900	mW
T_{opr}	Operating temperature range		−10～+50	℃
T_{stg}	Storage temperature range		−40～+125	℃

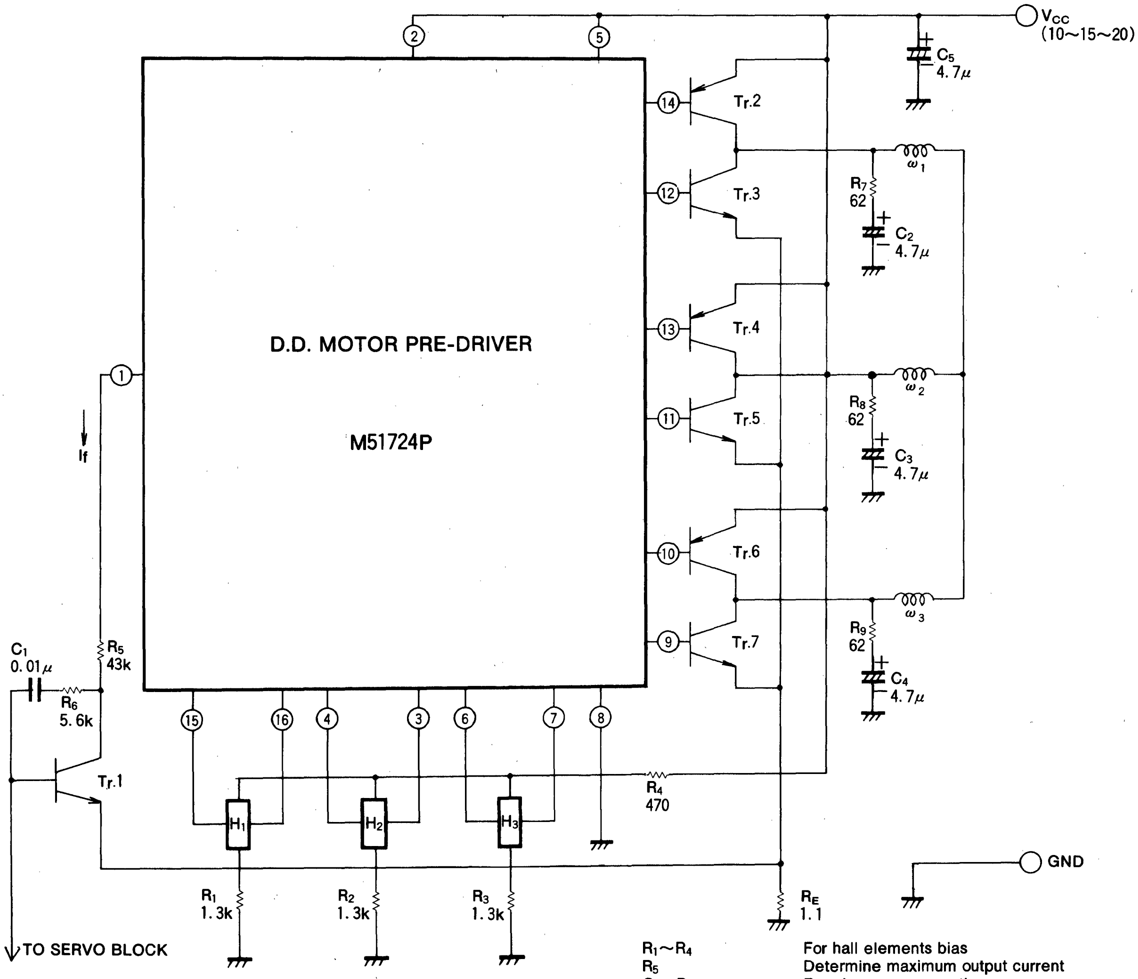
ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=15V, unless otherwise noted)

Symbol	Parameter	Test condition	Limits			Unit
			Min	Typ	Max	
I_{CC}	Quiescent supply current		5	12	27	mA
V_{OFFSET}	Hall amp input offset voltage			5	20	mV
K_D	Sink output current gain		10	15	20	A/A
K_S	Source output current gain		11	16	21	A/A
I_{Dmax}	Sink output maximum current		5.5	7		mA
I_{smax}	Source output maximum current		5	7		mA
M_D	Current balances between sink outputs		0.75	1	1.33	A/A
M_S	Current balances between source outputs		0.75	1	1.33	A/A
I_{IN}	Hall amp input current			1.5	6	μA
I_l	Output leak current				200	nA

THERMAL DERATING
(MAXIMUM RATING)



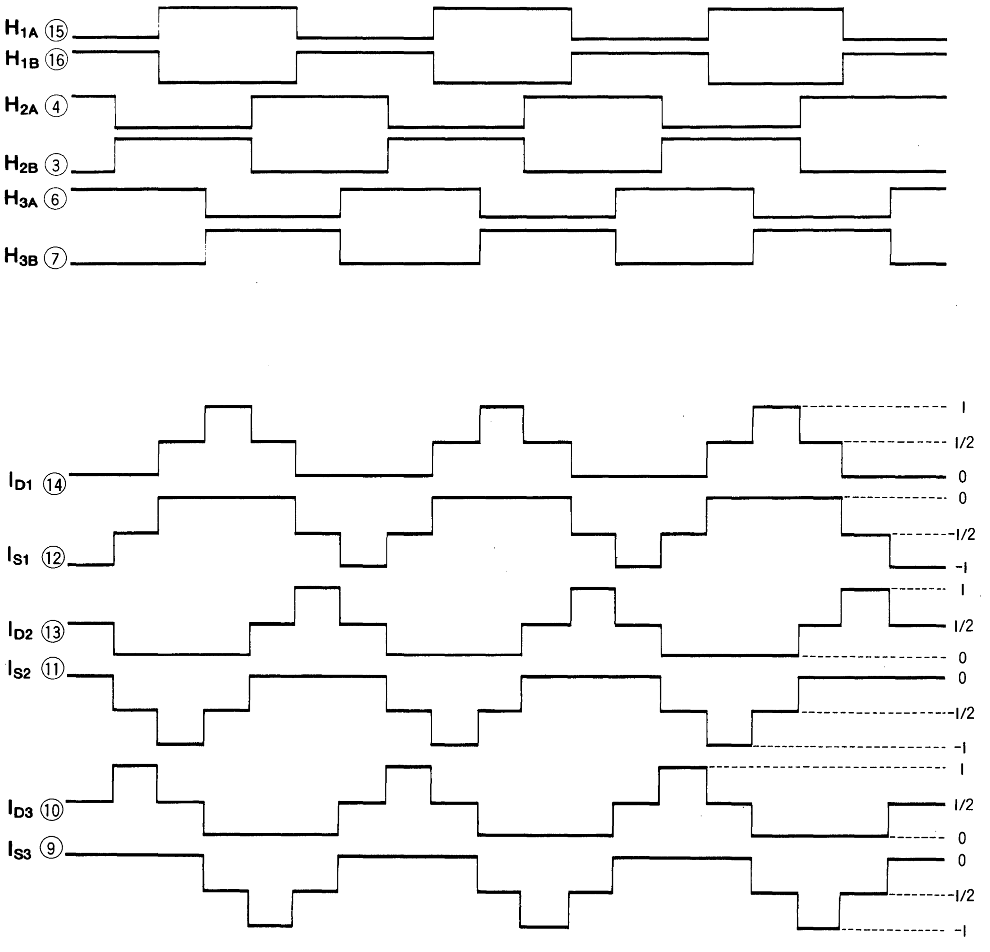
APPLICATION EXAMPLE



$R_1 \sim R_4$	For hall elements bias
R_5	Determine maximum output current
$C_1 \cdot R_6$	For phase compensation
$R_7 \sim R_9 \cdot C_2 \sim C_4$	For stability and mechanical noise reduction
R_E	For detecting output current
C_5	For power supply by-pass
$T_{r2} \sim T_{r7}$	Power transistors
T_{r1}	Control transistor

Note : Specifications subject to change without notice.

SIGNAL LEVEL & TIMING RELATIONSHIPS



PLL SPEED CONTROL FOR DC MOTOR

DESCRIPTION

The M51728L is monolithic IC designed for the use of the speed control circuit for DC micro motor. It controls constantly the speed of the DC micro motor, using the signal of the Frequency Generator and the precision speed control can be obtained because of the P. L. L. circuit. It consists of the internal oscillator, phase comparator, input signal comparator, output buffer amplifier, and internal voltage stabilizer.

FEATURES

- High stability vs supply voltage ············· 0.01%(9~18V)
- High stability vs temperature ······ ±0.01%(−20~+75℃)
- High stability vs load ·· 0
- Wide supply voltage range················9~18V(RD=910Ω)

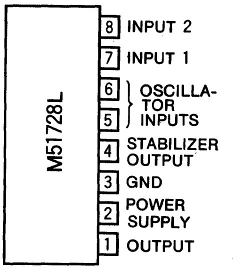
APPLICATIONS

- Motor driven equipment
- Record player
- Tape recorder
- Car stereo

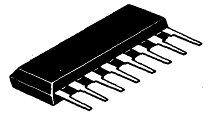
RECOMMENDED OPERATING CONDITIONS

V_S=13V (RD=910Ω)

PIN CONFIGURATION (TOP VIEW)

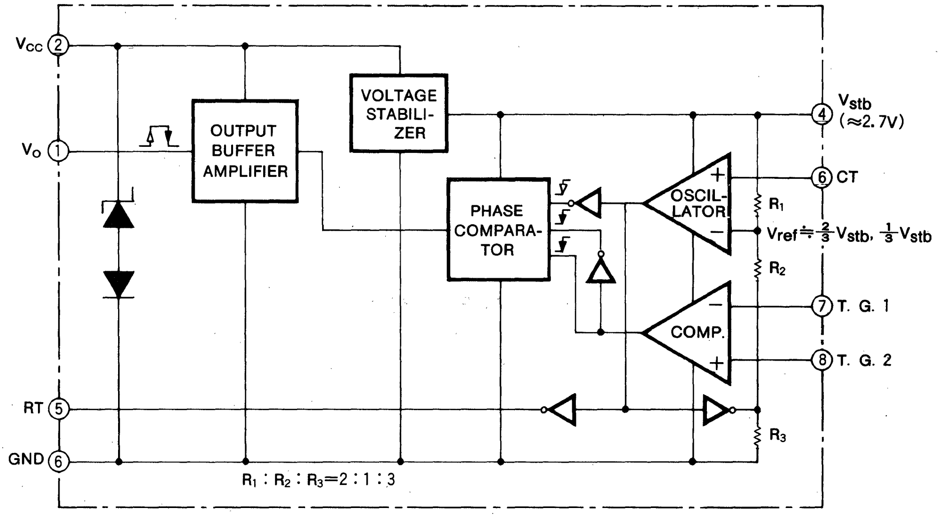


Outline 8P5



8-pin molded plastic SIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=+25℃, unless otherwise noted)

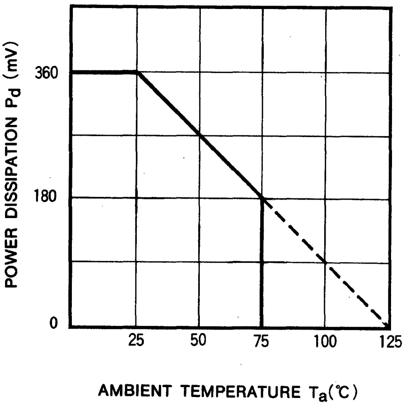
Symbol	Parameter	Conditions	Limits	Unit
I_{CC}	Supply current		20	mA
$V_{In⑦-⑧}$	Supply voltage between 7-8pin		5.7	V_{P-P}
$V_{④}$	4 Pin supply voltage		3.7	V
$V_{⑤}$	5 Pin supply voltage		7	V
$I_{⑤}$	5 Pin supply voltage		2	mA
$V_{⑥}$	6 Pin supply voltage		3.7	V
$V_{⑦}$	7 Pin supply voltage		3.9	V
$V_{⑧}$	8 Pin supply voltage		3.9	V
$V_{①}$	1 Pin supply voltage		7	V
I_{OH}	1 Pin supply voltage		2	mA
I_{OL}	1 Pin sink current		2	mA
P_d	Power dissipation		0.36	W
K_θ	Power derating rate (T_a>+25℃)		−3.6	mW/℃
T_{OPr}	Operating ambient temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=+25℃)

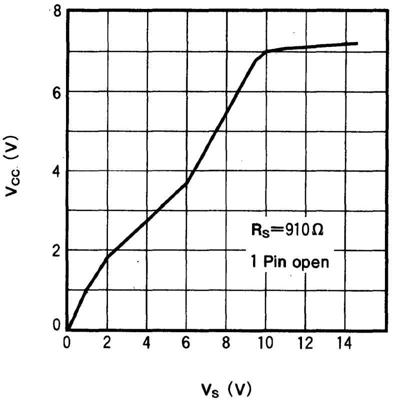
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	4 Pin voltage	V_S=13V, R_S=910Ω	6.2	6.9	7.6	V
I_{CC}	Circuit current		2.3	3.5	5.2	mA
V_{OH}	1 Pin output high voltage	V_S=13V, R_S=910Ω	4.3	5.5	—	V
V_{OL}	1 Pin Output low voltage	V_S=13V, R_S=910Ω	—	35	300	mV
V_{stb}	Regulate output voltage		2.4	2.7	3.0	V
$V_{⑤L}$	5 Pin low voltage		—	35	150	mV
$V_{⑥ON}$	6 Pin on voltage		1.90	2.00	2.10	V
$V_{⑥off}$	6 Pin off voltage		0.90	1.00	1.10	V
f_{OSC}	Oscillator frequency	C_T=0.0100μF, RT_1=RT_2=47kΩ	995	1025	1055	Hz
$V_{⑦}$	7 Pin voltage		1.0	1.3	1.5	V
$V_{⑧}$	8 Pin voltage		1.0	1.3	1.5	V
$I_{⑦-⑧}$	Current between ⑦-⑧pin		1.9	2.5	3.6	mA
$I_{⑥in}$	6 Pin input current		—	200	600	nA

TYPICAL CHARACTERISTICS

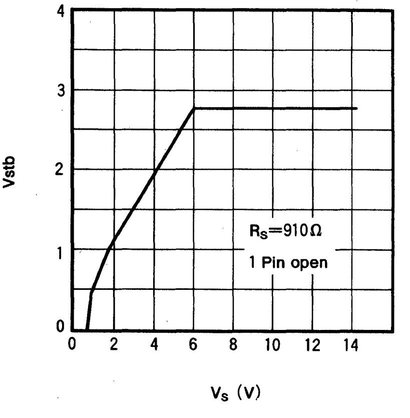
THERMAL DERATING
(MAXIMUM RATING)



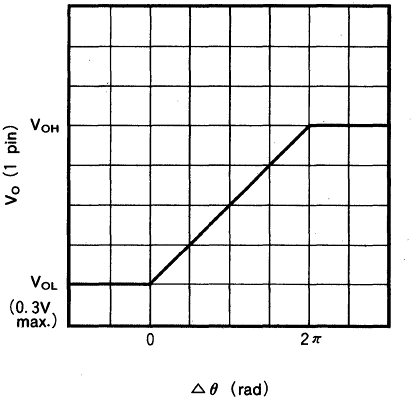
A. Vs—Vcc



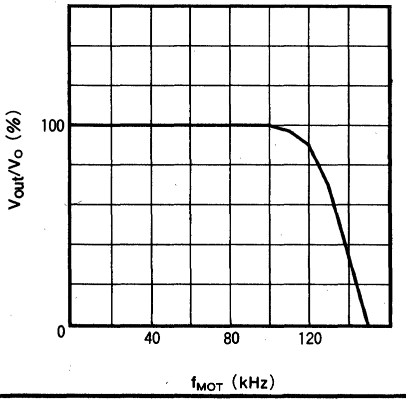
B. Vs—Vstb



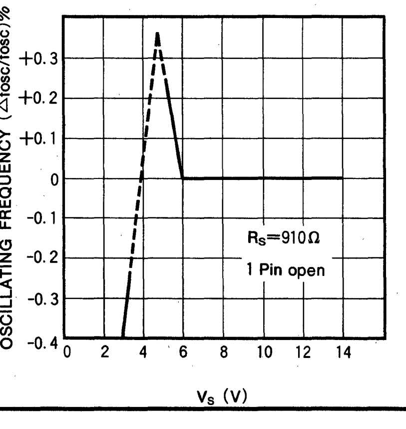
OUTPUT CHARACTERISTICS
OF PHASE COMPARATOR



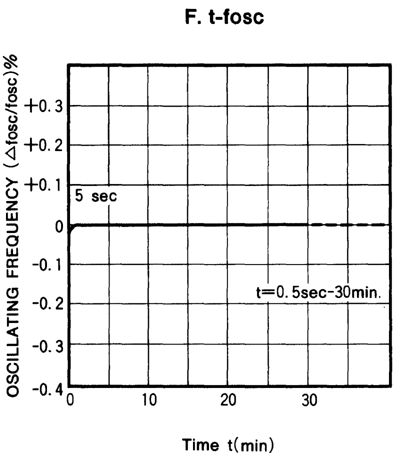
OUTPUT CHARACTERISTICS OF
THE INPUT SIGNAL AMPLIFIER

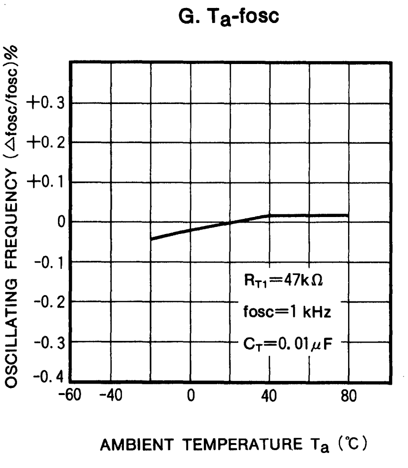


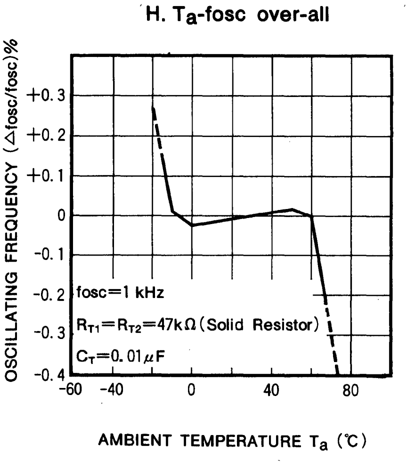
E. Vs-fosc



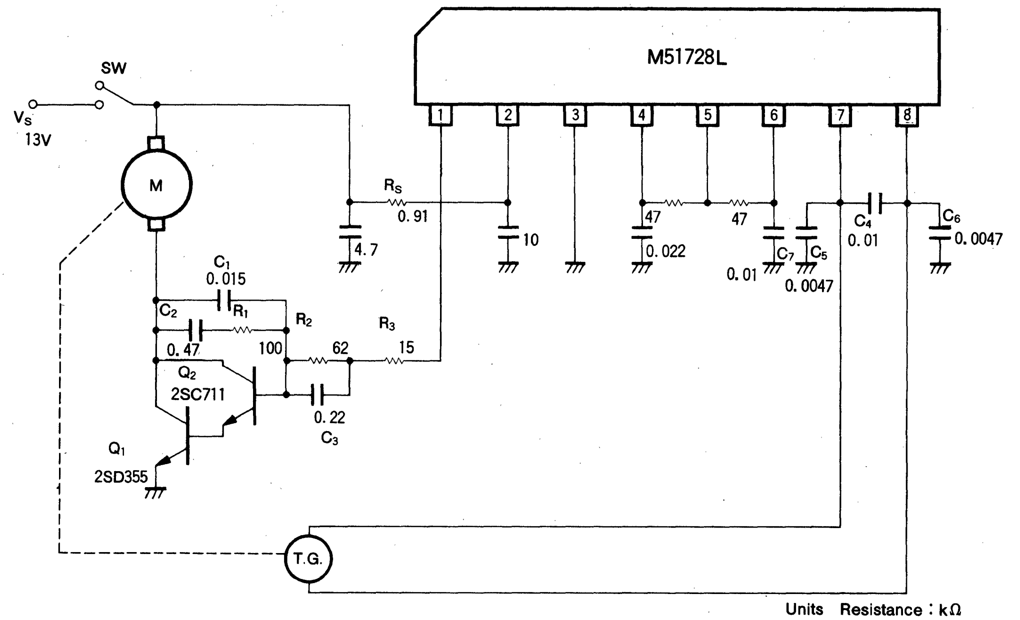
MITSUBISHI ELECTRIC


F. t-fosc
OSCILLATING FREQUENCY (△fosc/fosc)%
+0.3
+0.2
+0.1
0
-0.1
-0.2
-0.3
-0.4
5 sec
t=0.5sec-30min.
0
10
20
30
Time t(min)


G. Ta-fosc
OSCILLATING FREQUENCY (△fosc/fosc)%
+0.3
+0.2
+0.1
0
-0.1
-0.2
-0.3
-0.4
RT1=47kΩ
fosc=1 kHz
CT=0.01μF
-60
-40
0
40
80
AMBIENT TEMPERATURE Ta (℃)


H. Ta-fosc over-all
OSCILLATING FREQUENCY (△fosc/fosc)%
+0.3
+0.2
+0.1
0
-0.1
-0.2
-0.3
-0.4
fosc=1 kHz
RT1=RT2=47kΩ (Solid Resistor)
CT=0.01μF
-60
-40
0
40
80
AMBIENT TEMPERATURE Ta (℃)

APPLICATION EXAMPLE



Units Resistance : kΩ
Capacitance : μF

M51743P

SEQUENCE CONTROLLER FOR FLAME DETECTOR

DESCRIPTION

The M51743P is a monolithic integrated circuit designed for sequential control especially for the burner system.

This IC is consisted of five comparators and two voltage regulators. The three comparators of five comparators internally involved are mainly used for comparing sensor monitor signal with the built-in reference voltage, and the other two comparators are used for timer and for detecting the main signal, for instance, flame signal. And the latter two comparators have a capability of directly driving of relay load. This IC is suitable for designing the safety system needed "Fail-Safe", because the main comparators are consisted of "redundancy 2 " system.

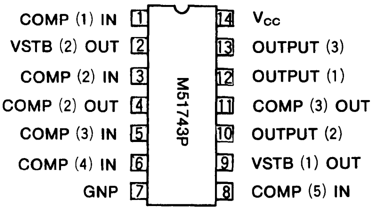
FEATURES

- Built-in five comparators
- Built-in two voltage regulators ······························(Output typical voltage 5.5V, 6.2V)
- It is capable of directly driving of relay load ······························ (Output driving current 60mA max.)
- Hysteresis characteristics internally involved ··(comparator 1, 4, 5)
- Memory function is involved in comparator 2.
- Safety design of "redundancy 2 " is introduced for the main comparators (5) which is driving output load.
- Very few external components needed because of the reference voltage internally involved.
- Wide range of supply voltage ······················ 8.5V~20V

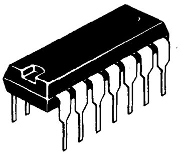
APPLICATIONS

- Sequence controller for oil or gasous appliance
- Flame detector
- Relay driver

PIN CONFIGURATION (TOP VIEW)



Outline 14P4

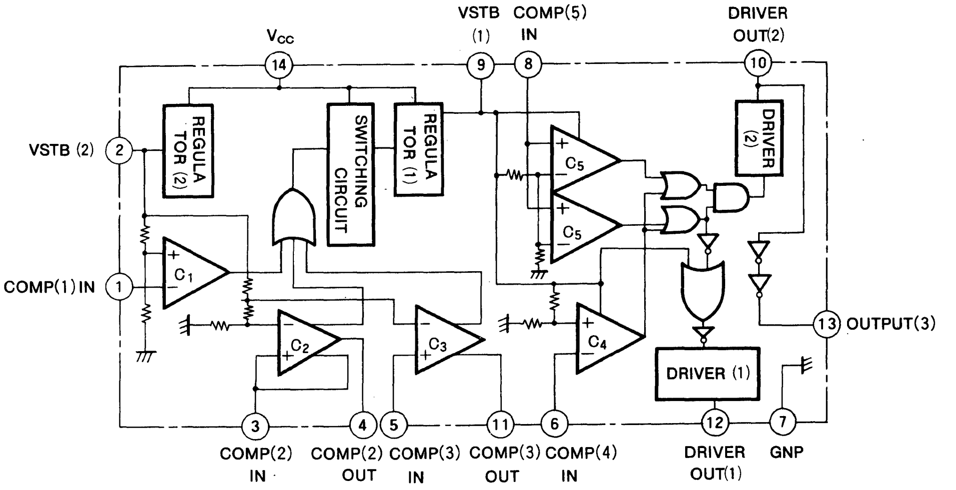


14-pin molded plastic DIL

RECOMMENDED OPERATING CONDITIONS

Supply voltage range ··· 8.5~20V
Rated supply voltage ······································· 12V±20%

BLOCK DIAGRAM



※ Pin 4, 10, 11, 12 : open-collector output
Pin 13 : emitter-follower output

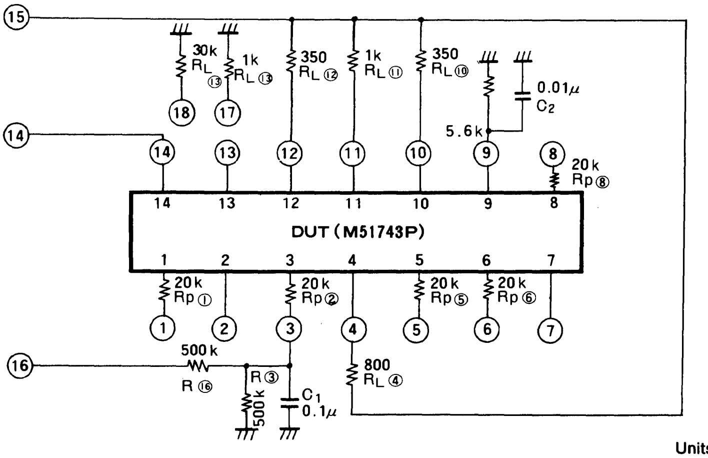
ABSOLUTE MAXIMUM RATINGS (T_a=+25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		20	V
I_{CC}	Circuit current		22	mA
$I_{L④}$	Pin ④ maximum current	peak value	70	mA
$I_{L⑩}$	Pin ⑩ maximum current		60	mA
$I_{L⑫}$	Pin ⑫ maximum current		60	mA
Pd_F	Power dissipation		900	mW
K_θ	Thermal derating		9	mW/℃
Topr	Operating temperature		−20～+ 65	℃
Tstg	storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=+25℃, V_{CC}=15V, unless otherwise noted)

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
$V_{O(1)}$	$V_{stb(1)}$ output voltage	Pin ⑩ , Pin⑫ on-state	5.0	5.5	6.3	V
$V_{O(2)}$	$V_{stb(2)}$ output voltage		5.0	6.1	6.9	V
$I_{CC(1)}$	Circuit current (1)	$V_⑥$=1.2V , $V_⑧$=3V	6	14	20	mA
$I_{CC(2)}$	Circuit current (2)	$V_⑥$=4.5V	2	10	17	mA
$V_{ON(1)}$	Comparator (1) threshold voltage 1-(1)		3.8	4.4	5.3	V
$V_{OFF(1)}$	Comparator (1) threshold voltage 1-(2)		3.0	3.5	4.6	V
$I_{IN(1)}$	Comparator (1) input current	$V_①$=5.1V		0.15	0.6	μA
$V_{ON(2)}$	Comparator ② threshold voltage 2		1.5	2.0	2.8	V
$V_③$	Comparator ② pin ③ clamp voltage	$R_③$=500kΩ	4.9	5.75	6.3	V
$V_{sat(4)}$	Comparator ② pin ④ saturation voltage	$R_{L④}$=800Ω	0.9	1.12	1.5	V
$V_{ON(3)}$	Comparator ③ threshold voltage 3		2.5	3.3	4.1	V
$I_{IN(3)}$	Comparator ③ input current (3)	$V_⑤$= 4 V		0.15	0.5	μA
$V_{sat⑪}$	Comparator pin ⑪ saturation voltage	$R_{L⑪}$= 1 kΩ , $V_⑤$=4.1V	1.3	1.83	3.0	V
$V_{REF\,I(4)}$	Comparator ④ threshold voltage (1)		3.3	3.84	4.5	V
$V_{REF\,II(4)}$	Comparator ④ threshold voltage (2)		2.9	3.55	3.9	V
$I_{IN(4)}$	Comparator ④ input current (4)	$V_{(6)}$=2.5V		50	250	nA
$V_{ON(5)}$	Comparator ⑤ threshold voltage 5-(1)		2.0	2.3	2.7	V
$V_{OFF(5)}$	Comparator ⑤ threshold voltage 5-(2)		1.6	2.0	2.3	V
$I_{IN(5)}$	Comparator ⑤ input current (5)	$V_⑧$=2.5V	—	0.1	0.35	μA
$V_{sut⑩}$	Pin 10 saturation voltage	$R_{L⑩}$=350Ω , V_{CC}=10V	—	0.3	0.9	V
$V_{sut⑫}$	Pin 12 saturation voltage	$R_{L⑫}$=350Ω , V_{CC}=10V	—	0.3	0.9	V
$V_{OH⑬}$	Pin 13 output voltage	$R_{L⑬}$= 1 kΩ	7.5	—	—	V

TEST CIRCUIT



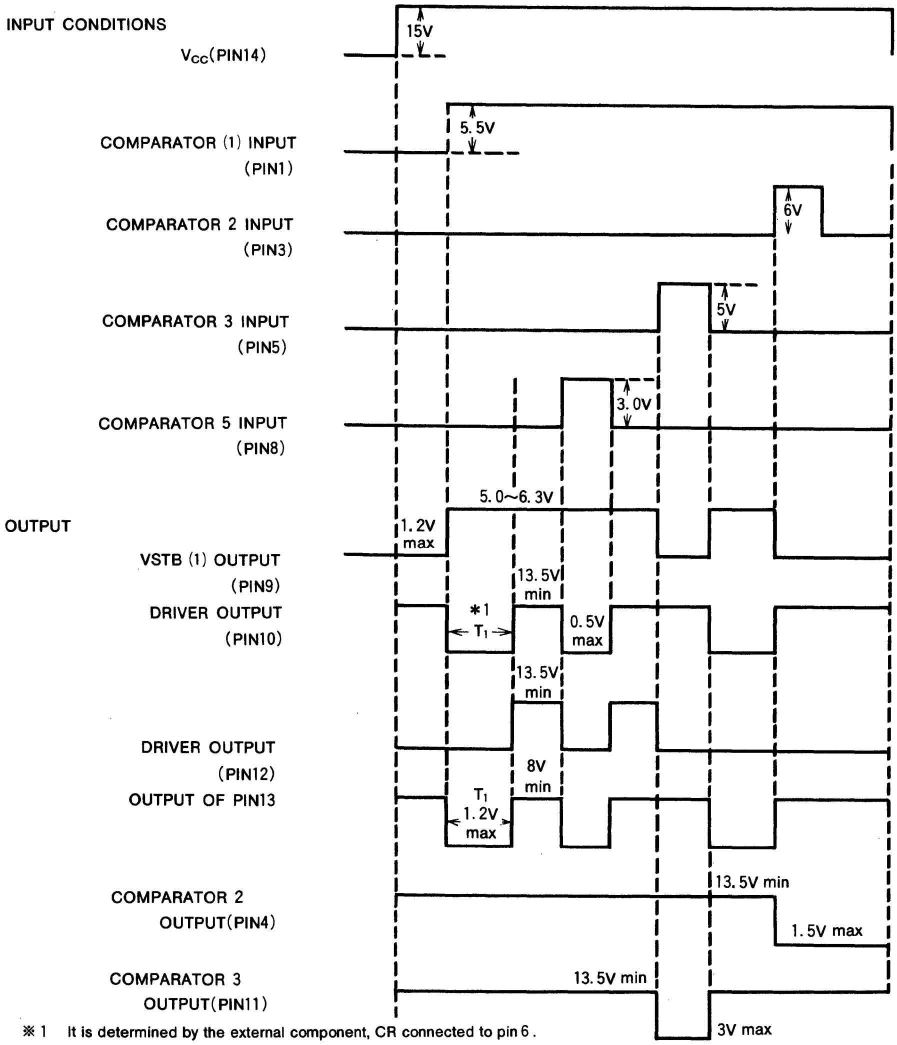
Units Resistance : Ω
Capacitance : F

TEST CONDITIONS

Symbol	Pin number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	MEAS-URING POINT
$V_{O(1)}$	*1 ②	①	GND		GND	1.2V	GND	GND	*2 Ⓜ				⑰	15V	15V		⑬		⑨
$V_{O(2)}$	5.2	Ⓜ				1.2V							⑰	15V			⑬		②
$I_{CC(I)}$						1.2V		3 V					⑱	Ⓜ 15V				⑬	⑭
$I_{CC(II)}$						4.5V							⑱	Ⓜ 15V				⑬	⑭
$V_{ON(1)}$	1.3V 3.8V					1.2V			Ⓜ				⑰	15V			⑬		⑨
$V_{OFF(1)}$	4.6V 3.0V								Ⓜ										⑨
$I_{IN(1)}$	Ⓜ 5.1V		GND																①
$V_{ON(2)}$	②	①				1.2V			Ⓜ										⑨
$V_{③}$			Ⓜ					GND											③
$V_{sat④}$				Ⓜ	GND	1.2V		GND											④
$V_{ON(3)}$			GND		4.1V 2.5V				Ⓜ										⑨
$I_{IN(3)}$					Ⓜ 4 V														③
$V_{sat⑪}$					4 V	1.2V					Ⓜ								⑪
$V_{REF\,I(4)}$					GND	4.1V 3.3V				Ⓜ									⑩
$V_{REF\,II(4)}$						3.9V 2.9V				Ⓜ				15V					⑩
$V_{sat⑫(1)}$						4.5V		2.6V				Ⓜ	⑰	10V					⑫
$V_{OH⑬}$								2.6V					⑰ Ⓜ	15V					⑬
$I_{IN(4)}$						Ⓜ 2.5V							⑰						④
$V_{ON(5)}$						4.5V		2.7V 2.0V				Ⓜ							⑫
$V_{OFF(5)}$								2.3V 1.6V				Ⓜ							⑫
$I_{IN(5)}$								2.5V						15V					⑤
$V_{sat⑩(1)}$	②	①	GND		GND	4.5V	GND	2.6V		Ⓜ			⑰	10V	15V		⑬		⑩

* : 1. The number expressed in the ○ symbol means the pin number.
* : 2. The symbol of Ⓜ means measuring point.

TIME CHART OF M51743P IN STANDARD APPLICATION



※1 It is determined by the external component, CR connected to pin 6.

TRUTH TABLE OF M51743P

A) Example of operation of comparator 1, 2, 3

	Pin No.	State *1			
Input	Pin ①	0	1	1	1
	Pin ③	0	0	1	0
	Pin ⑤	0	0	0	1
Output	Pin ⑨	0	1	0	0
	Pin ⑩	1 *3	0 *4	1	1
	Pin ⑫	0 *3	0 *4	0	0
	Pin ⑬	1 *2	0 *4	1	1
	Pin ④	1 *3	1	0	1
	Pin ⑪	1 *3	1	1	0

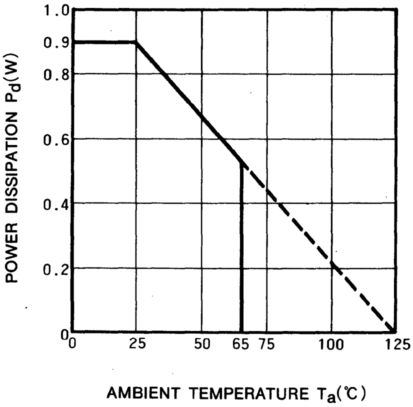
B) Example of operation of comparator 4, 5

	Pin No.	State							
Input	Pin ⑨	1	1	1	1	0	0	0	0
	Pin ⑥	0	1	0	1	0	1	—	—
	Pin ⑧	0	0	1	1	—	—	0	1
Output	Pin ⑩	0	1	0	0	1	1	1	1
	Pin ⑫	0	1	0	0	0	0	0	0
	Pin ⑬	0	1	0	0	1	1	1	1

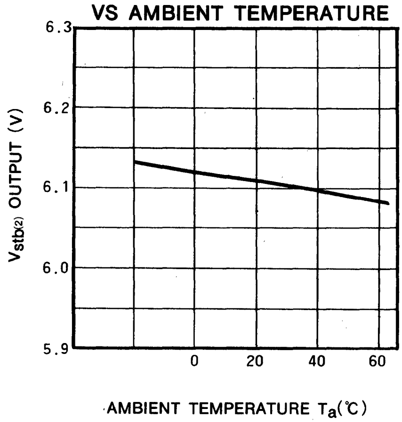
* : 1. "1", "0" express the "H" level and "L" level of the voltage of each terminal.
* : 2. Pin 13 is consisted of emitter follower output, so "1" expresses "ON" and "0" expresses "OFF" state.
* : 3. Pin 10, Pin 12, Pin 4, Pin 11 are consisted of open-collector output, so "0" expresses "ON" and "1" expresses "OFF" state.
* : 4. Output state of these pins depends on the conditions of the operation of comparator 4 and 5. Ref.B.

TYPICAL CHARACTERISTICS

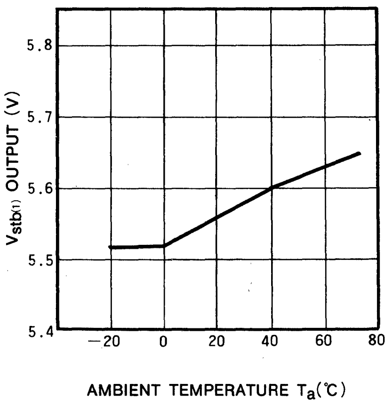
DERATING CURVE
(MAXIMUM RATING)



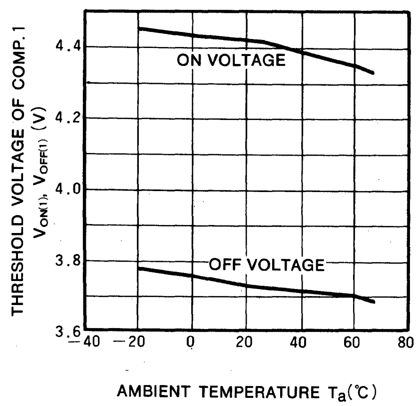
OUTPUT VOLTAGE OF
VOLTAGE REGULATOR (2)
VS AMBIENT TEMPERATURE



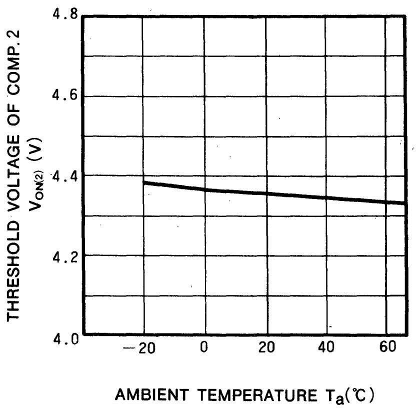
OUTPUT VOLTAGE OF REGULATOR (1)
VS AMBIENT TEMPERATURE



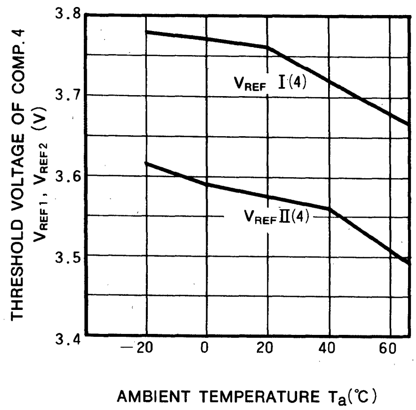
THRESHOLD VOLTAGE OF COMPARATOR 1
VS AMBIENT TEMPERATURE



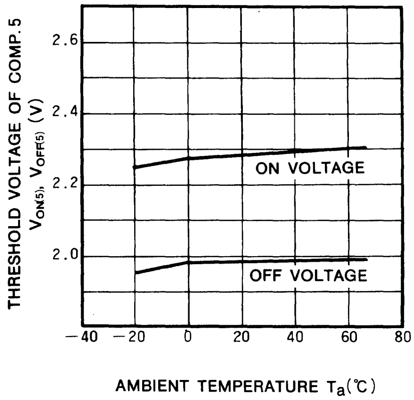
THRESHOLD VOLTAGE OF COMPARATOR 2
VS AMBIENT TEMPERATURE



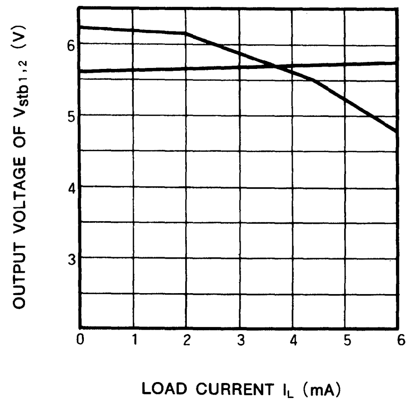
THRESHOLD VOLTAGE OF COMPARATOR 4
VS AMBIENT TEMPERATURE



THRESHOLD VOLTAGE OF COMPARATOR 5 VS AMBIENT TEMPERATURE

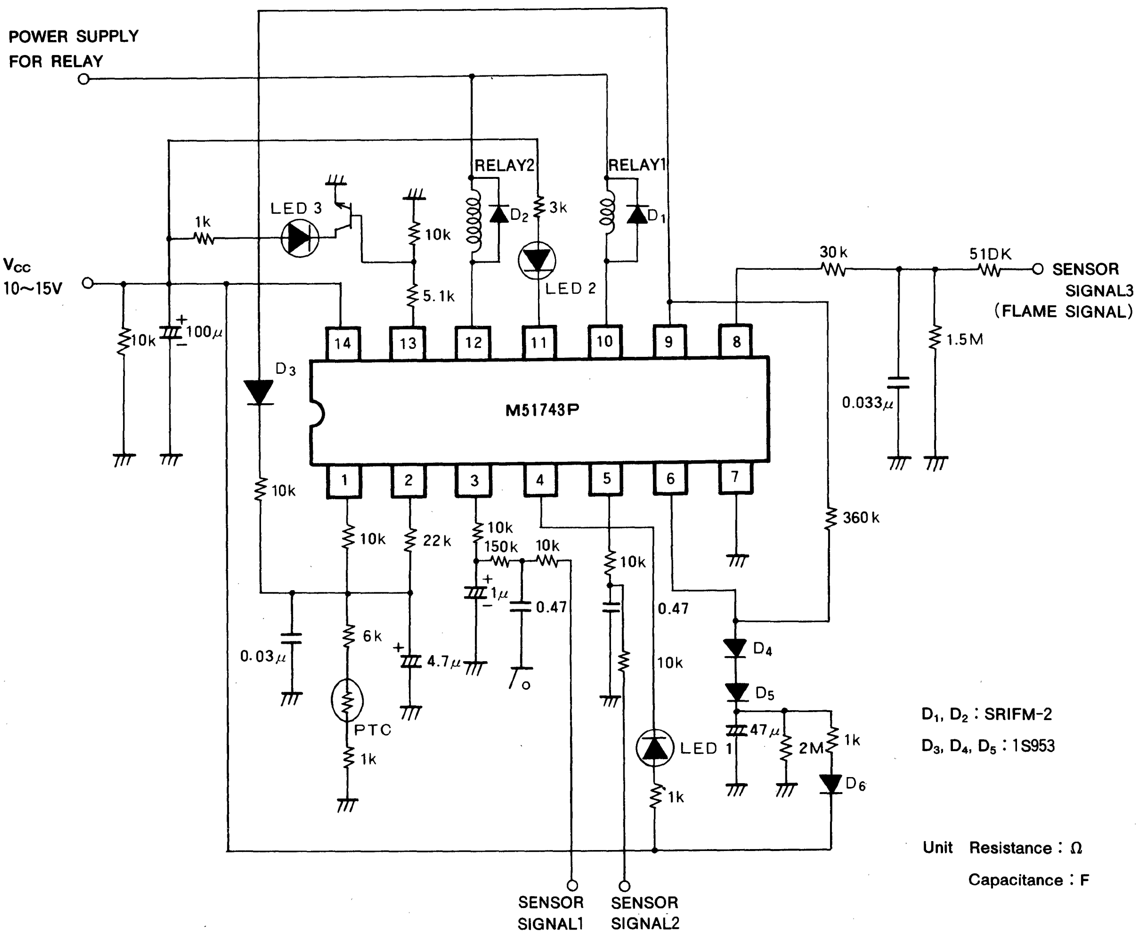


OUTPUT VOLTAGE OF REGULATION VS LOAD CURRENT



APPLICATION EXAMPLE

(IN THE CASE OF TIMER OPERATION OF COMPARATOR(4))



D_1, D_2 : SRIFM-2
D_3, D_4, D_5 : 1S953

Unit Resistance : Ω
Capacitance : F

M51802/M5F741P

OPERATIONAL AMPLIFIER

DESCRIPTION

The M51802L/M51802P is a semiconductor integrated circuit consisting of a differential amplifier and output circuit.
It is designed for a wide range of analog applications.

The high gain and wide range of operating voltage provides excellent performance in summing amplifer, integrator, and general feedback applications.

FEATURES

- No frequency compensation required
- Short-circuit protection
- No latch up
- Offset voltage null capability
- Large common mode and differential voltage ranges
- Low power dissipation

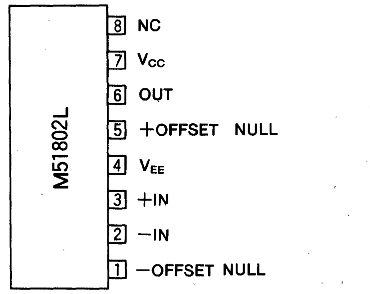
APPLICATION

General feedback applications

RECOMMENDED OPERATING CONDITIONS

Supply voltage range················$V_{CC}(+V)$, $V_{EE}(-V)$ 4~18V
Rated supply voltage················$V_{CC}(+V)$, $V_{EE}(-V)$ 15V

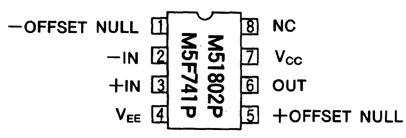
PIN CONFIGURATION (TOP VIEW)



Outline 8P5

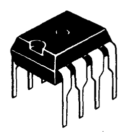
NC : NO CONNECTION

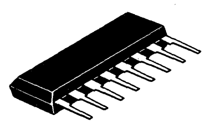
PIN CONFIGURATION (TOP VIEW)



Outline 8P4

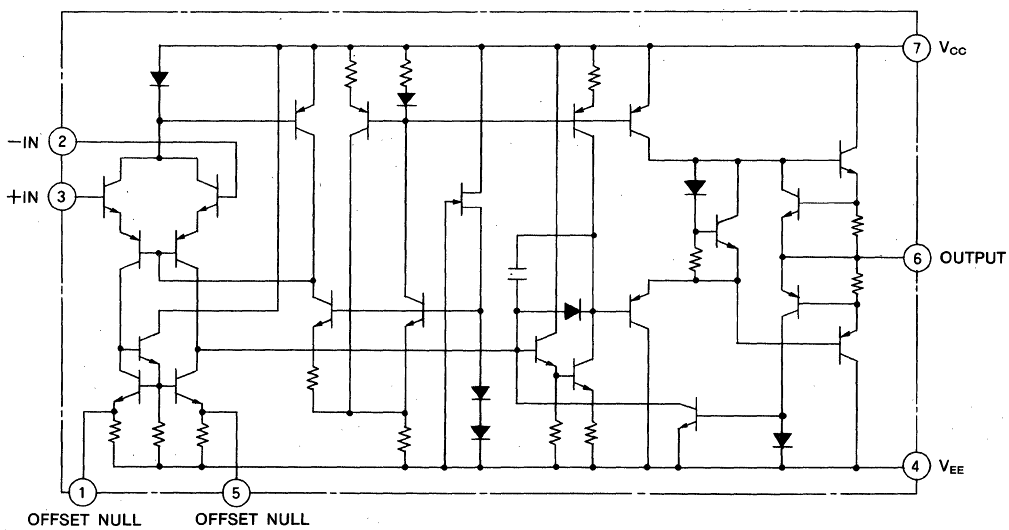
NC : NO CONNECTION





8-pin molded plastic DIL 8-pin molded plastic SIL

EQUIVALENT CIRCUIT



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		18	V
V_{EE}			−18	V
V_{id}	Differential input voltage		±30	V
V_{ic}	Common mode input voltage	(Note 1)	±15	V
P_d	Power dissipation		360(SIL)	mW
			625(DIL)	
K_θ	Thermal derating	T_a≧25℃	3.6(SIL)	mW/℃
			6.25(DIL)	
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

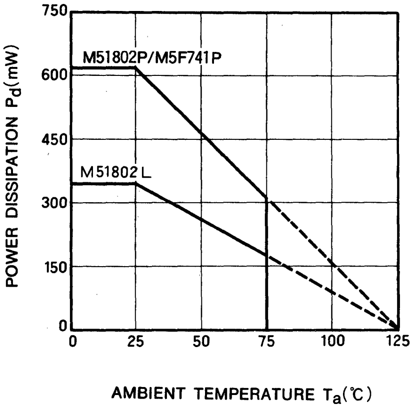
Note : 1. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=+15V, V_{EE}=−15V)

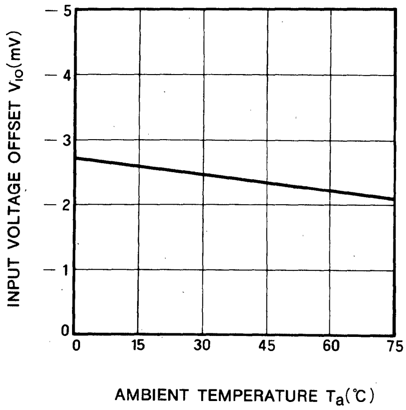
Symbol	Parameter		Test conditions	Limits			Unit
				Min	Typ	Max	
V_{IO}	Input offset voltage		R_g≦10kΩ		1.0	5.0	mV
I_{IB}	Input bias current				150	500	nA
I_{IO}	Input offset current				30	200	nA
R_{in}	Input resistance		Input frequency f=1kHz		1.0		MΩ
G_V	Voltage gain		R_L≧2kΩ, V_O=±10V	86	100		dB
V_{OPP}	Output voltage swing		R_g≧10kΩ	±12	±14		V
			R_g≧2kΩ	±10	±13		V
V_{ic}	Input voltage range			±12	±13		V
CMRR	Common mode rejection ratio		R_g≦10kΩ	70	90		dB
SVRR	Supply voltage rejection ratio		R_g≦10kΩ		80	150	μV/V
P_d	Power dissipation		R_L=∞		50	85	mW
t_r	Transient response	Rise time	V_{in}=20mV, R_L=2kΩ, C_L≦100pF		0.3		μs
K_{OV}		Over shoot			5.0		%
SR	Slew rate		R_L=2kΩ		0.5		V/μs

TYPICAL CHARACTERISTICS

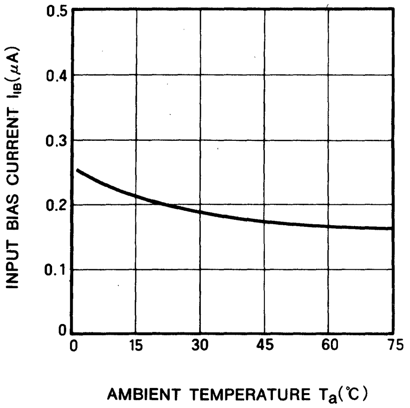
THERMAL DERATING
(MAXIMUM RATING)



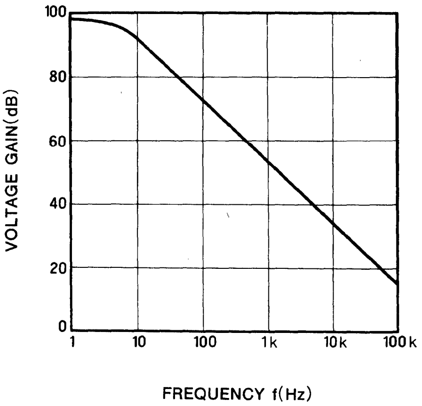
INPUT VOLTAGE OFFSET
VS AMBIENT TEMPERATURE



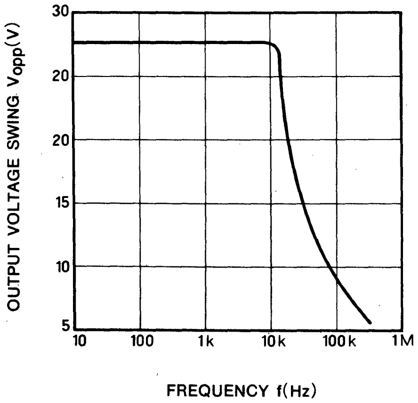
INPUT BIAS CURRENT VS
AMBIENT TEMPERATURE



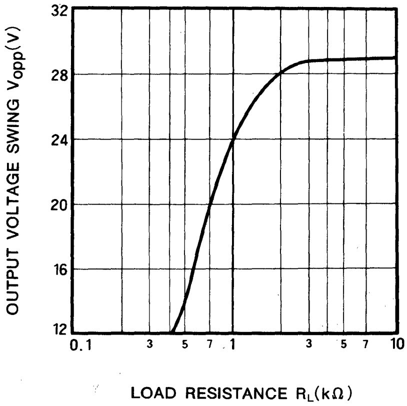
VOLTAGE GAIN VS
FREQUENCY



OUTPUT VOLTAGE SWING
VS FREQUENCY

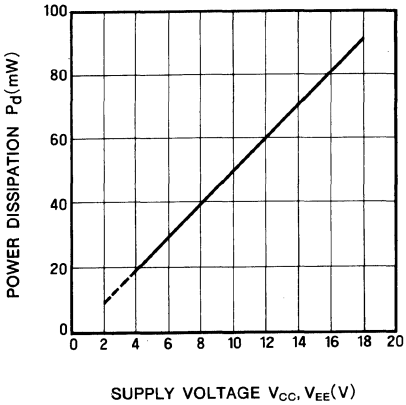


OUTPUT VOLTAGE SWING
VS LOAD RESISTANCE

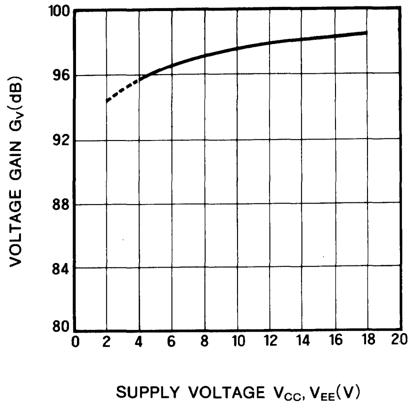


MITSUBISHI
ELECTRIC

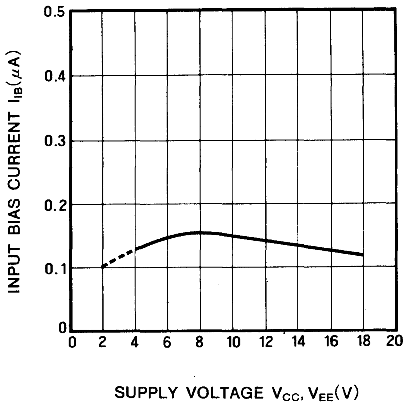
POWER DISSIPATION VS SUPPLY VOLTAGE



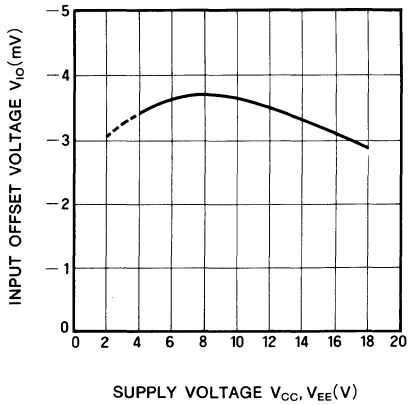
VOLTAGE GAIN VS SUPPLY VOLTAGE



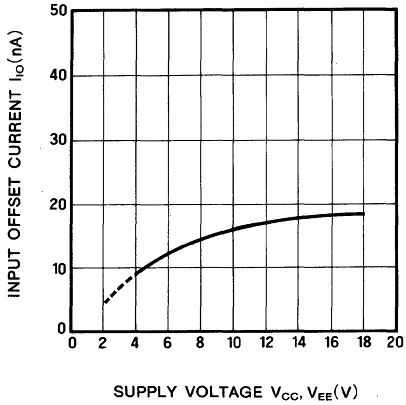
INPUT BIAS CURRENT VS SUPPLY VOLTAGE



INPUT OFFSET VOLTAGE VS SUPPLY VOLTAGE

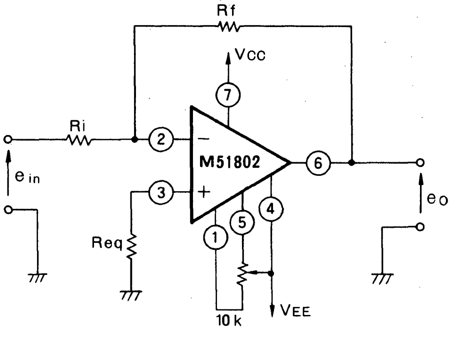


INPUT OFFSET CURRENT VS SUPPLY VOLTAGE



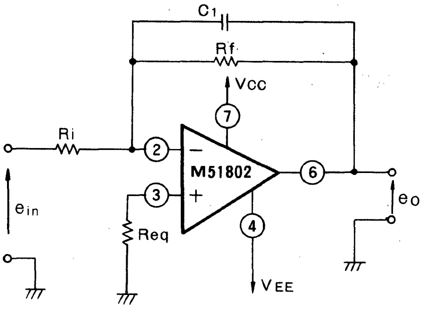
APPLICATION EXAMPLES

(1) INVERSE POLARITY AMP



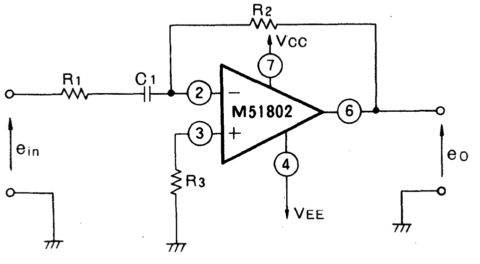
$$R_{eq}=\frac{R_f \cdot R_i}{R_f+R_i} \qquad A_{vo}=\frac{R_f}{R_i}$$

(2) INTEGRATOR



$$R_{eq}=\frac{R_f \cdot R_i}{R_f+R_i} \qquad e_o=\frac{1}{R_iC_i}\int e_{in}dt$$

(3) DIFFERENTIATOR



$$e_o=R_2C_i\frac{de_{in}}{dt}$$

MITSUBISHI ELECTRIC

M51841P/M5E555P

SINGLE TIMER

DESCRIPTION

The M51841P／M5E555P monolithic timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. Additional terminals are provided for triggering or resetting, if desired. In the time delay mode, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, both the free running frequency and the duty cycle are accurately controlled by two external resistors and capacitor.

The circuit will trigger and reset on falling waveforms, and the output structure can source or sink up to 200mA or drive TTL circuits.

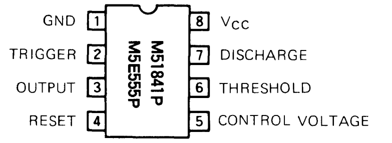
FEATURES

- Timing from microseconds through minutes
- Operates in both astable and monostable modes
- Adjustable duty cycle
- High current output can source or sink 200mA
- Output can drive TTL
- Temperature stability of 0.005% per °C
- Normally on and normally off output
- Interchangeable with the signetics NE555 in pin configuration and characteristics

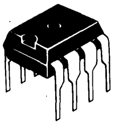
APPLICATIONS

- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Missing pulse detector

PIN CONFIGURATION (TOP VIEW)



Outline 8P4

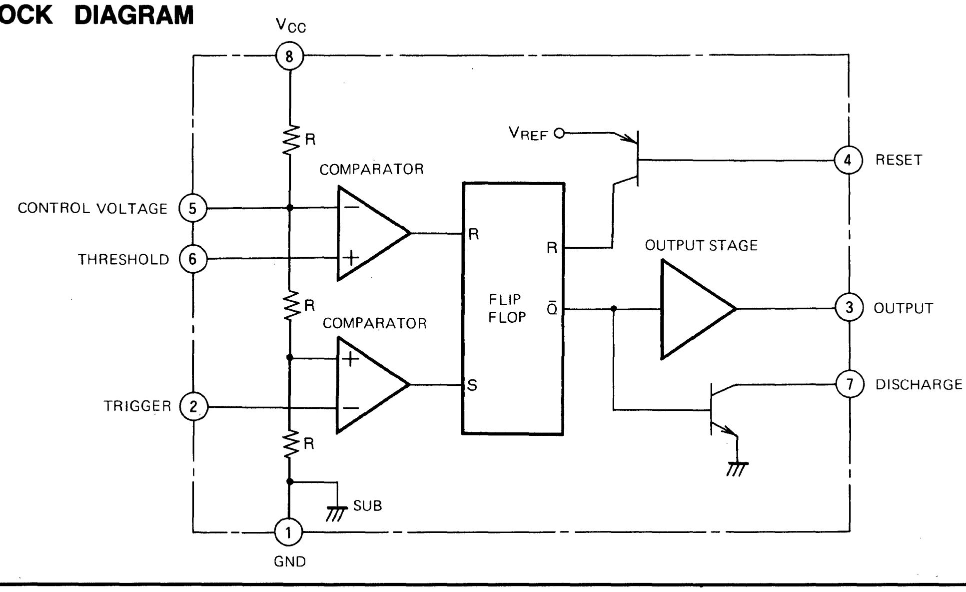


8-pin plastic DIL package

RECOMMENDED OPERATING CONDITIONS

Supply voltage .... 4.5 ~ 16V
Rated supply voltage 6V, 12V

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

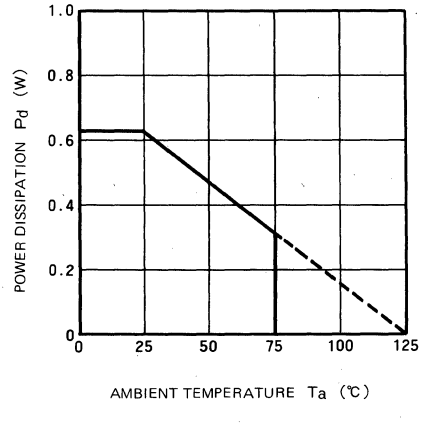
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		18	V
I_O	Output current		200	mA
P_d	Power dissipation		625	mW
T_{opr}	Operating ambient temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

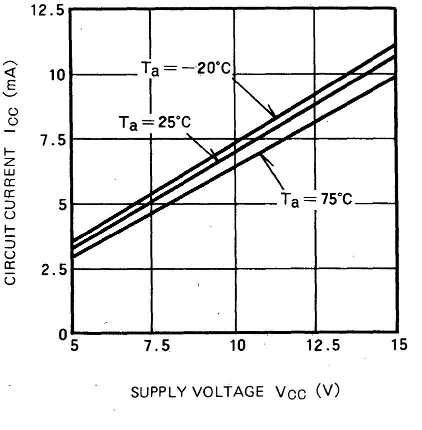
Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		4.5		16	V
I_{CC}	Circuit current	V_{CC}=5V, No load		3	6	mA
		V_{CC}=15V, No load		10	15	mA
V_{CNT}	Control voltage	V_{CC}=5V	2.6	3.3	4	V
		V_{CC}=15V	9	10	11	V
V_{TH}	Threshold voltage			$\frac{2}{3}V_{CC}$		V
I_{TH}	Threshold current			0.1	0.25	μA
V_T	Trigger voltage			$\frac{1}{3}V_{CC}$		V
I_T	Trigger current			0.5	1.0	μA
V_R	Reset voltage			0.7	1.0	V
I_R	Reset current			0.1		mA
V_{OL}	Low output voltage	V_{CC}=5V, I_{sink}=5mA		0.25	0.35	V
		V_{CC}=15V, I_{sink}=10mA		0.1	0.25	V
		V_{CC}=15V, I_{sink}=50mA		0.4	0.75	V
		V_{CC}=15V, I_{sink}=100mA		2.0	2.5	V
V_{OH}	High output voltage	V_{CC}=5V, I_{source}=100mA	2.75	3.3		V
		V_{CC}=15V, I_{source}=100mA	12.75	13.3		V

TYPICAL CHARACTERISTICS

THERMAL DERATING (MAXIMUM RATING)



SUPPLY VOLTAGE VS CIRCUIT CURRENT



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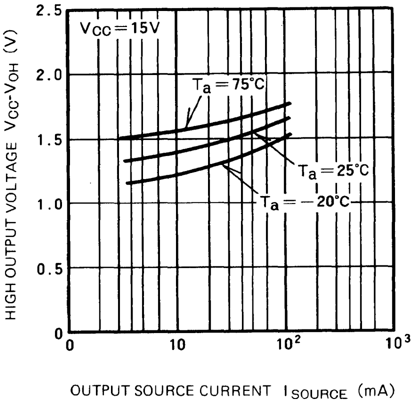
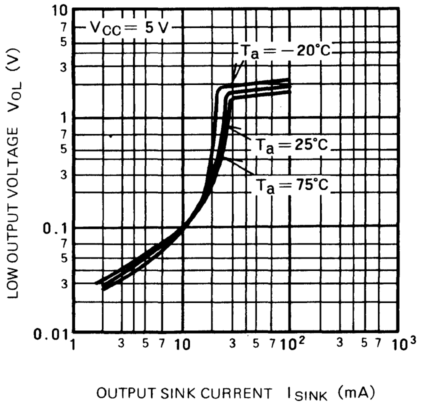
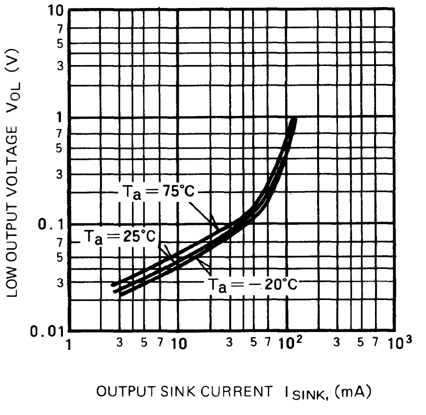
HIGH OUTPUT VOLTAGE VS OUTPUT SOURCE CURRENT



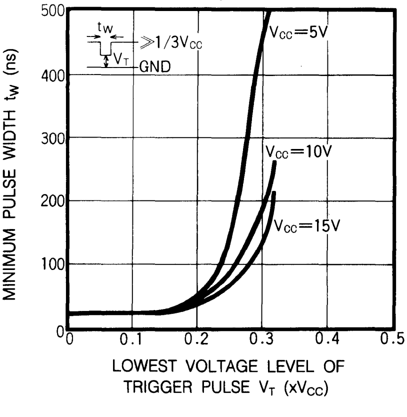
LOW OUTPUT VOLTAGE VS OUTPUT SINK CURRENT



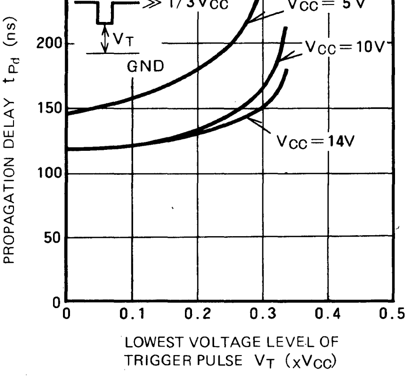
LOW OUTPUT VOLTAGE VS OUTPUT SINK CURRENT



MINIMUM PULSE WIDTH VS LOWEST VOLTAGE LEVEL OF TRIGGER PULSE



PROPAGATION DELAY VS LOWEST VOLTAGE LEVEL OF TRIGGER PULSE



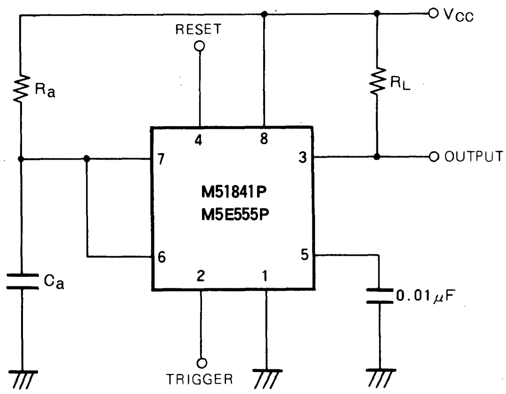
APPLICATIONS

Monostable operation

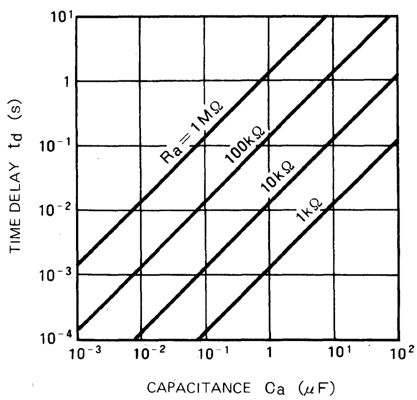
In this mode operation, timer function an one-shot. The external capacitor is initially held discharged by a transistor internal to the timer. Applying a negative trigger pulse to Pin ② sets the flip-flop, driving the output high and releasing the short-circuit across the external capacitor. The voltage across the capacitor increases with the time constant $\tau = R_a \cdot C_a$ to 2/3 V_{CC}, where the comparator resets the flip-flop and discharges the external capacitor. The output is now in the low state. The circuit triggering takes place when the negative going trigger pulse reaches 1/3 V_{CC} and the circuit stays in the output high state until the set time elapses. The time the output remains in the high state is 1.1 $R_a \cdot C_a$ and can be determined by the graph. A negative pulse applied to Pin ④ during the timing cycle over again beginning on the positive going edge of the reset pulse. If reset function is not used, Pin ④ should be connected to V_{CC} to avoid false resetting. The delay time is given by:

$t_d = 1.1\ R_a \cdot C_a$

Monostable multivibrator



TIME DELAY VS Ra, Ca



Astable operation

With the circuit connected as shown and it will trigger itself and free run as a multivibrator. The external capacitor charges through R_a and R_b and discharges through R_b only.

Through the duty cycle is set by the ratio of these two resistors, and the capacitor charges and discharges between 1/3 V_{CC} and 2/3 V_{CC}.

Charge and discharge times, and therefore frequency, are independent of supply voltage. The free running frequency versus R_a, R_b and C_a is shown in the graph. The charge time (output high) is given by:

$t_1 = 0.693\ (R_a + R_b) \cdot C_a$

and discharge time (output low) by:

$t_2 = 0.693\ R_b \cdot C_a$

Through the free running frequency is given by:

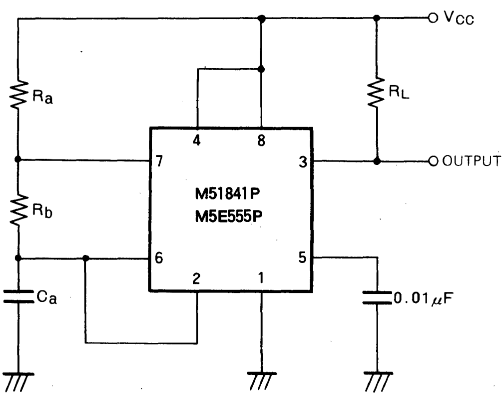
$f = 1/(t_1 + t_2)$

$= 1.44/\left\{(R_a + 2R_b) \cdot C_a\right\}$

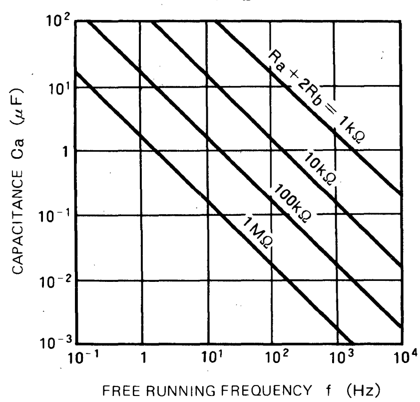
and the duty cycle by:

$D = R_b/(R_a + 2R_b)$

Astable multivibrator



FREE RUNNING FREQUENCY VS Ra, Rb and Ca



M51843P

SINGLE TIMER

DESCRIPTION

The M51843P monolithic timing circuit is a highly stable controller capable of producing accurate time delay or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor.

The circuit may be triggered and reset on falling waveforms, and two output terminals are provided. The collector output can sink up to 200mA and the emitter output can source above 1 mA to drive the external transistor or thyristor. In addition, the circuit consists of shutdown control circuit of power supply turn-on, and discharge control circuit of power supply turn-off.

FEATURES

- Operates in both astable and monostable modes
- Collector output current ··························· 200mA(max.)
- Emitter output current ······························ 1 mA (typ.)
- Output can drive TTL or DTL

APPLICATION

Pulse generation, time delay generation, pulse width modulation, sequential timing

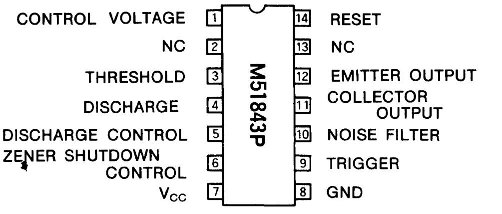
RECOMMENDED OPERATING CONDITIONS

(excluding pin ⑥)

Supply voltage range ······································ 4.5~16V

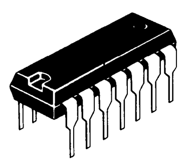
Rated supply voltage ································· 5 V, 12V, 15V

PIN CONFIGURATION (TOP VIEW)



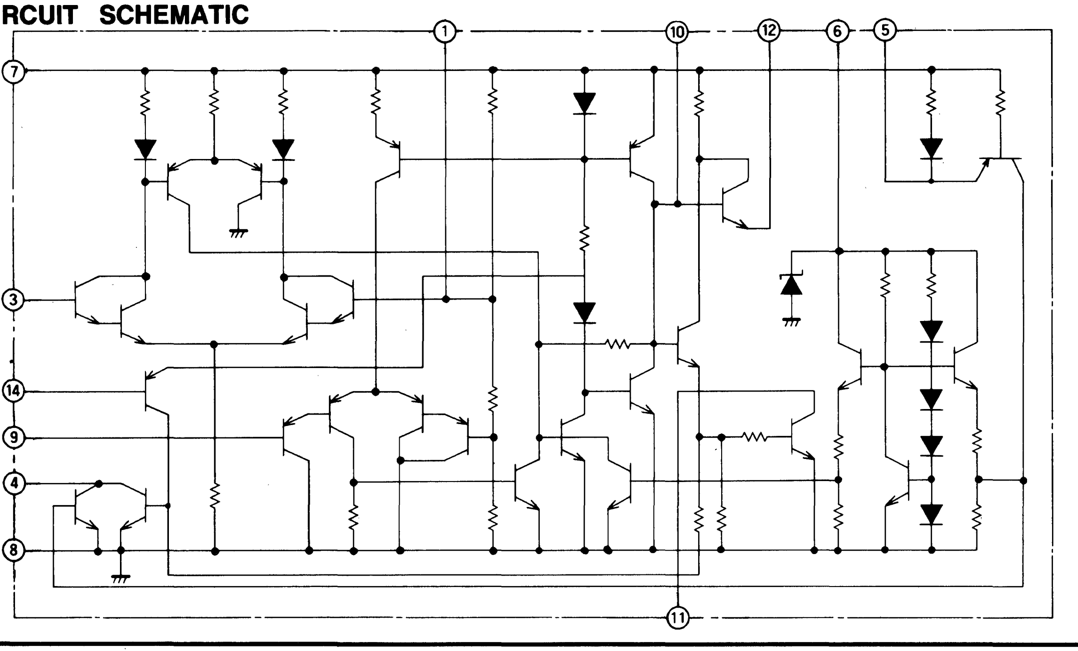
Outline 14P4

NC : NO CONNECTION

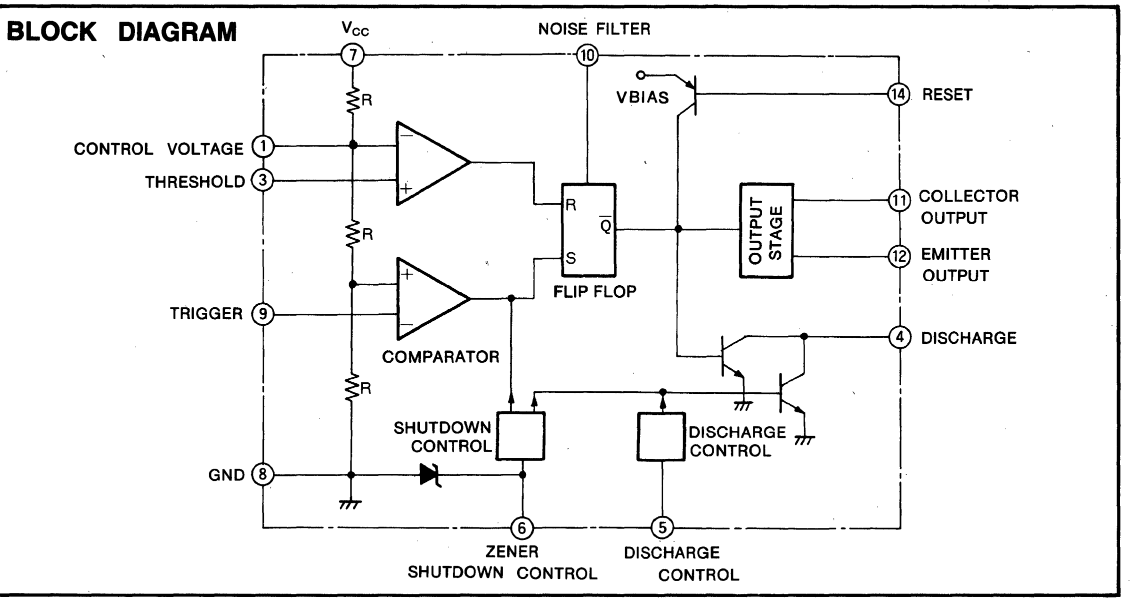


14-pin molded plastic DIL

CIRCUIT SCHEMATIC



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limit	Unit
V_{CC}	Supply voltage (pin ⑦)		18	V
Iz	Zener Current (pin ⑥)		10	mA
I_{OC}	Collector output current	ⓐsaturation	200	mA
$BV_{⑪}$	Break down voltage (pin ⑪)		27	V
Pd	Power dissipation		650	mW
K_θ	Derating	$T_a \geqq 25$℃	6.5	mW/℃
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

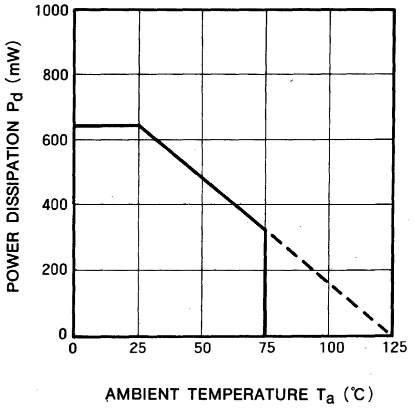
ELECTRICAL CHARACTERISTICS (T_a=25℃)

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage	Excluding pin ⑥ $R_L=\infty$	4.5		16	V
I_{CC}	Circuit current			4	10	mA
				13	22	
V_{CRT}	Control voltage level		2.6	3.33	4.0	V
			9	10	11	
V_{TH}	Threshold voltage			$2/3V_{CC}$		V
I_{TH}	Threshold current			0.1	0.25	μA
V_T	Trigger voltage			$1/3V_{CC}$		V
I_T	Trigger current			0.5	1.0	μA
V_R	Reset voltage			0.7	1.0	V
I_R	Reset current			0.1		mA
V_Z	Zener voltage	I_Z= 2 mA	6.5	7.5	8.5	V
V_{SC}	Voltage range of shutdown control at pin⑥			2.4	4.0	V
V_{DCC}	Voltage range of discharge control at pin⑤			$0.7+V_{CC}$	$1.0+V_{CC}$	V
V_{OC}	Saturation voltage at pin⑪	I_{OC}=30mA		0.15	0.3	V
		I_{OC}=10mA		0.05	0.1	
		I_{OC}=100mA		0.3	1.0	
I_{OE}	Output current at pin⑫		1	2		mA
	Timing accuracy			0.5		%
	Temperature coefficient			50		ppm/℃
	Supply voltage rejection ratio			0.01		%/V

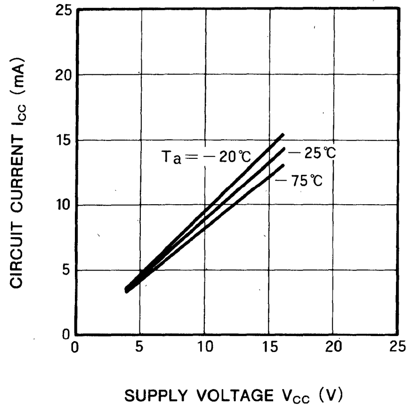
Note : Pin⑪ and Pin⑫ should not be used at the same time.

TYPICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

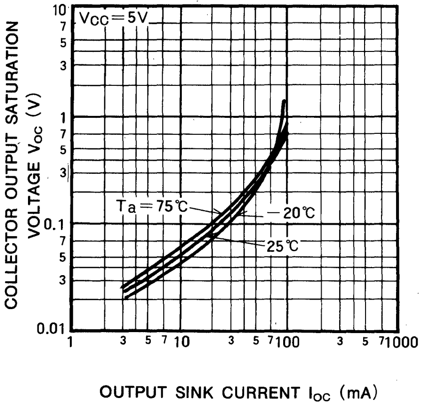
THERMAL DERATING (MAXIMUM RATING)



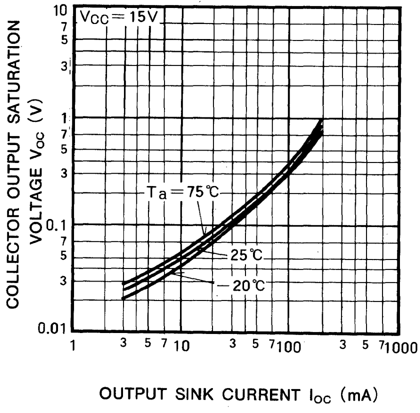
CIRCUIT CURRENT VS SUPPLY VOLTAGE



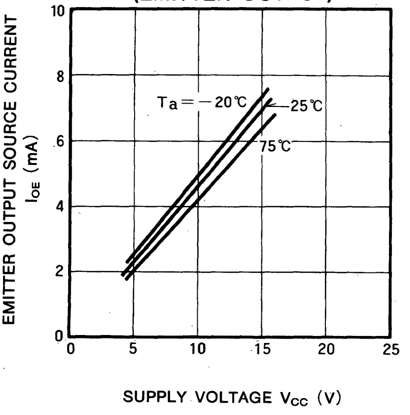
SATURATION VOLTAGE VS SINK CURRENT (COLLECTOR OUTPUT)



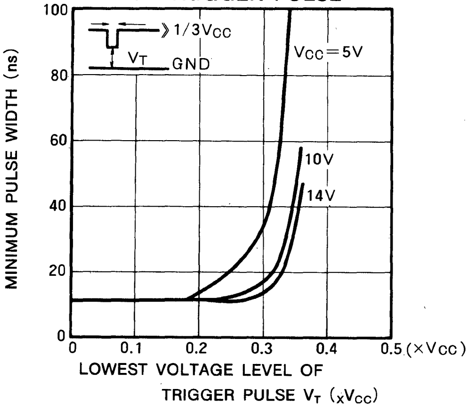
SATURATION VOLTAGE VS SINK CURRENT (COLLECTOR OUTPUT)



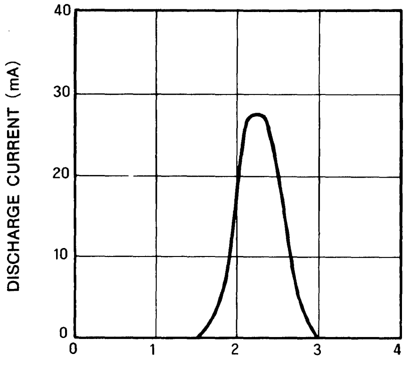
SOURCE CURRENT VS SUPPLY VOLTAGE (EMITTER OUTPUT)

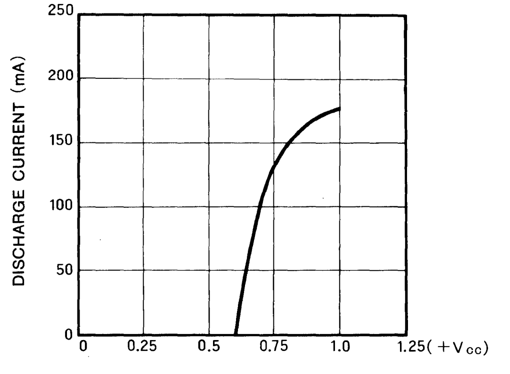


MINIMUM PULSE WIDTH VS LOWEST VOLTAGE LEVEL OF TRIGGER PULSE



MITSUBISHI ELECTRIC





NOTES

1. Using Pin 5

The circuit is connected as shown in Fig.a. In steady state, the capacitor C_D, connected with pin 5, is charged through the resistor R_{22} and the diode D_9, and the transistor Q_{25} is cut off.

When the supply voltage turns off and the voltage of pin 5 is above V_{BE} compared with that of pin 7, the transistor Q_{25} turns on and the timing capacitor C_A is discharged by the charge of the capacitor C_D.

It is effective to shorten the repetitive interval before timing generation.

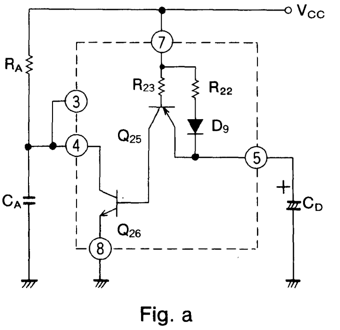


Fig. a

2. Using Pin 6

The circuit is connected as shown in Fig.b (pin 6 and 7 connected). Applying V_{CC} to pin 6 through R_D. The voltage is regulated about 8 volts by a zener diode inside the timer.

Therefore, it can operate stably, even if it is fed by the high voltage supply or by the noisy supply.

In addition, the another application of using pin 6 is to set the flip-flop and discharge the timing capacitor C_A. These circuit consist of the transistors Q_{21}~Q_{24}, the diodes D_5~D_8 and the resistors R_{16}~R_{21}.

When the voltage of pin 6 is from $2V_{BE}$ to about 4 volts, the transistorsQ_{22} and Q_{24} turn on, the transistor Q_{21} set flip-flop and the transistor Q_{26} discharge the timing capacitor C_A. Therefore it can be use the trigger circuit and discharge the initial charge of the timing capacitor C_A.

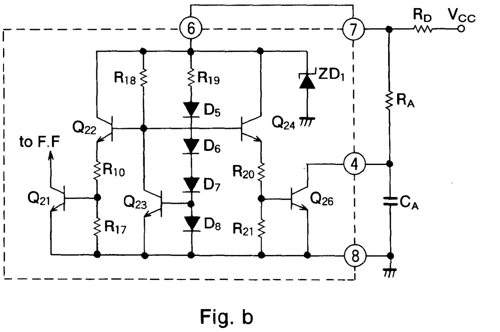


Fig. b

3. Using Pin10 (Normally open)

The capacitor, connected with pin10, is less than 1000pF if it is used for the noise filter.

APPLICATIONS

Monostable operation

In this mode of operation, the timer functions as a one-shot. The external capacitor is initially held discharged by a transistor internal to the timer. Applying a negative trigger pulse to Pin 9 sets the flip-flop, driving the output high and releasing the short-circuit across the external capacitor.

The voltage across the capacitor increases with time constant $\tau = R_AC_A$ to $2/3V_{CC}$, where the comparator resets the flip-flop and discharges the external capacitor. The output is now in the low state.

Circuit triggering takes place when the negative-going trigger pulse reaches $1/3V_{CC}$ and the circuit stays in the output high state until the set time elapses. The time the output remains in the high state is $1.1R_AC_A$ and can be determined by the graph. A negative pulse applied to pin 14 (reset) during the timing cycle over again beginning on the positive-going edge of the reset pulse. If reset function is not used, Pin 14 should be connected to V_{CC} to avoid false resetting.

The delay time is given by :

$$td=1.1R_AC_A$$

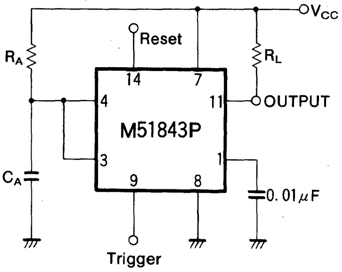


Fig. c

TIME DELAY VS R_A, C_A

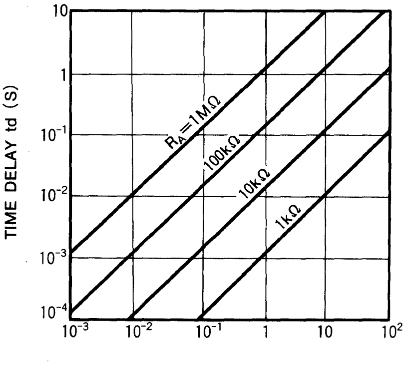


Fig. d

ASTABLE OPERATION

With the circuit connected as shown and it will trigger itself and free run as a multivibrator. The external capacitor charges thru R_A and R_B and discharges thru R_B only. Thus the duty cycle is set by the ratio of these two resistors, and the capacitor charges and discharges between $1/3V_{CC}$ and $2/3V_{CC}$.

Charge and discharge times, and therefore frequency, are independent of supply voltage. The free running frequency versus R_A, R_B, and C_A is shown in the graph.

The charge time (output high) is given by :

$$t_1=0.693\ (R_A+R_B)\ C_A$$

and the discharge time (output low) by :

$$t_2=0.693R_BC_A$$

Thus the free running frequency is given by :

$$f=\frac{1}{t_1+t_2}=\frac{1.44}{(R_A+2R_B)C_A}$$

and the duty cycle by :

$$D=\frac{R_B}{R_A+2R_B}$$

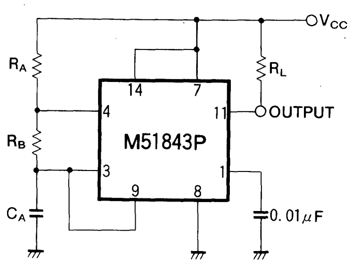


Fig. e

FREE RUNNING FREQUENCY VS R_A, R_B AND C_A

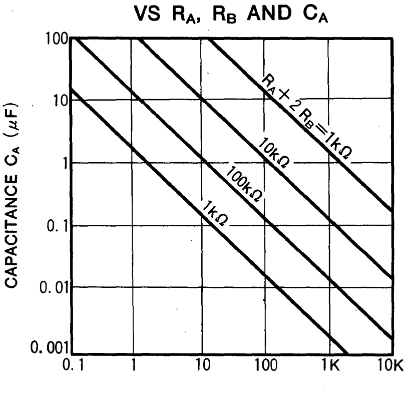
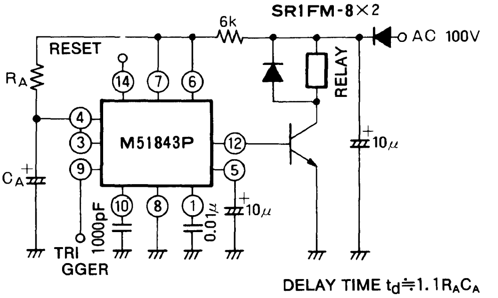


Fig. f

APPLICATION

APPLICATION AT HIGH SUPPLY VOLTAGE

(1) DELAY TIMER



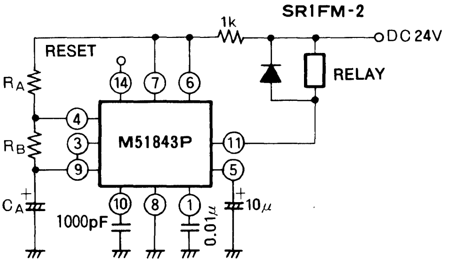
DELAY TIME $t_d \fallingdotseq 1.1 R_A C_A$

UNIT

R : Ω

C : F

(2) ASTABLE OPERATION



FREE RUNNING FREQUENCY
$f \fallingdotseq 1.44/(R_A+2R_B)C_A$

DUTY CYCLE
$D=R_B/(R_A+2R_B)$

M51847P/M5E556AP

DUAL TIMER

DESCRIPTION

The M51847P / M5E556AP monolithic timing circuits are highly stable controllers capable of producing accurate time delays, or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, both the free running frequency and the duty cycle are accurately controlled by two external resistors and capacitor. In this operation, the maximum frequency is 100kHz. The circuit will trigger and reset on falling waveforms. The reset voltage is about 1.4V and is compatible with TTL level. The output structure can source or sink up to 100mA or drive TTL circuits.

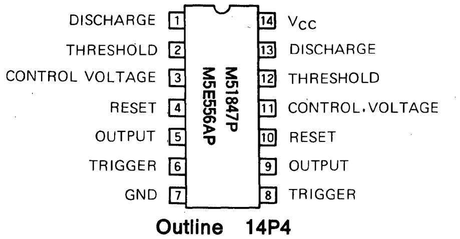
FEATURES

- Timing from microseconds through minutes
- Operates in both astable and monostable modes
- Adjustable duty cycle
- High current output can source or sink 100mA
- Maximum frequency is 100kHz (guarantee)
- Reset voltage is about 1.4V for TTL level
- Built in power on reset
- Interchangeable with the signetics NE556 in pin configuration and characteristics

APPLICATIONS

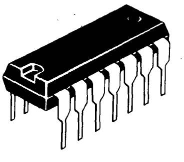
- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Missing pulse detector

PIN CONFIGURATION (TOP VIEW)



Outline 14P4

NC: NO CONNECTION

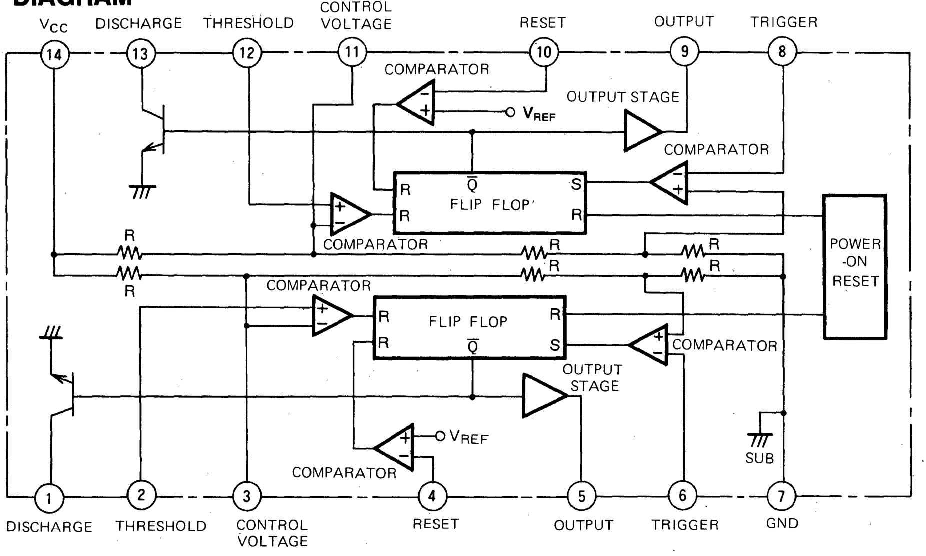


14-pin plastic DIL package

RECOMMENDED OPERATING CONDITIONS

Supply voltage .... 4 ~ 17V
Rated supply voltage 6V, 12V

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

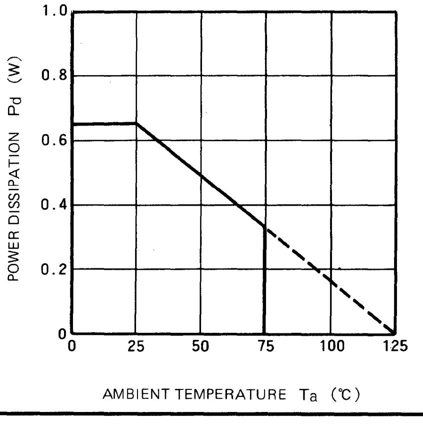
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		18	V
I_O	Output current		100	mA
P_d	Power dissipation		650	mW
Topr	Operating ambient temperature		−20 ~ +75	°C
Tstg	Storage temperature		−40 ~ +125	°C

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

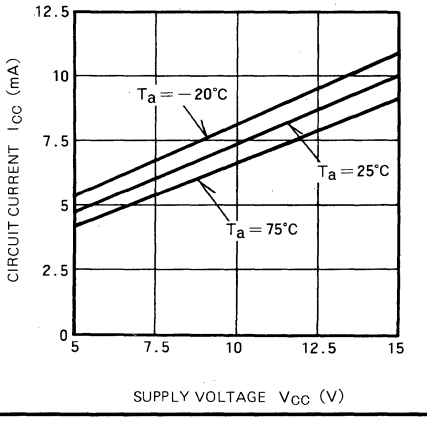
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4		17	V
I_{CC}	Circuit current	V_{CC}=5V, No load		5	9	mA
		V_{CC}=15V, No load		10	19	mA
V_{CNT}	Control voltage	V_{CC}=5V	2.6	3.3	4	V
		V_{CC}=15V	9	10	11	V
V_{TH}	Threshold voltage			⅔V_{CC}		V
I_{TH}	Threshold current			0.03	0.2	μA
V_T	Trigger voltage			⅓V_{CC}		V
I_T	Trigger current			0.05	0.4	μA
V_R	Reset voltage		1.0	1.4	2.0	V
I_R	Reset current			0.05	0.2	μA
V_{OL}	Low output voltage	V_{CC}=5V, I_{sink}=5mA		0.05	0.2	V
		V_{CC}=15V, I_{sink}=10mA		0.05	0.2	V
		V_{CC}=15V, I_{sink}=50mA		0.2	0.5	V
		V_{CC}=15V, I_{sink}=100mA		1.0	2.0	V
V_{OH}	High output voltage	V_{CC}=5V, I_{source}=100mA	2.8	3.3		V
		V_{CC}=15V, I_{source}=100mA	12.8	13.3		V
fmax	Maximum frequency	Ra=Rb=2kΩ, Ca=200pF	100			kHz

TYPICAL CHARACTERISTICS

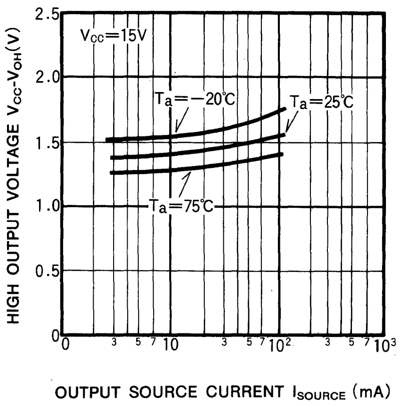
THERMAL DERATING (MAXIMUM RATING)



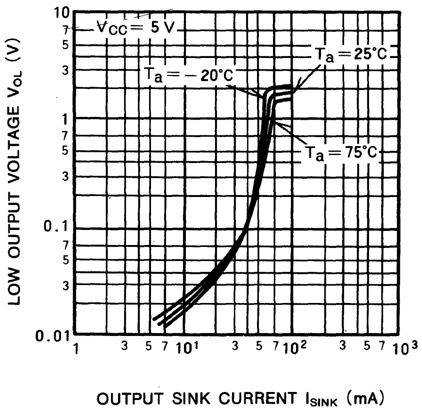
SUPPLY VOLTAGE VS CIRCUIT CURRENT



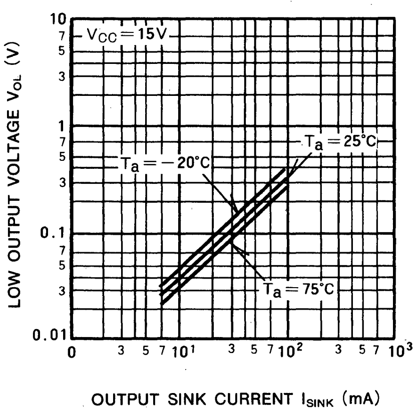
HIGH OUTPUT VOLTAGE VS OUTPUT SOURCE CURRENT



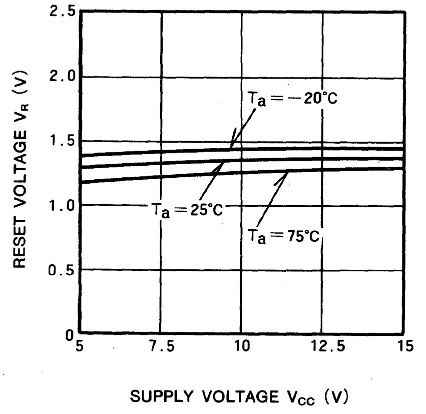
LOW OUTPUT VOLTAGE VS OUTPUT SINK CURRENT



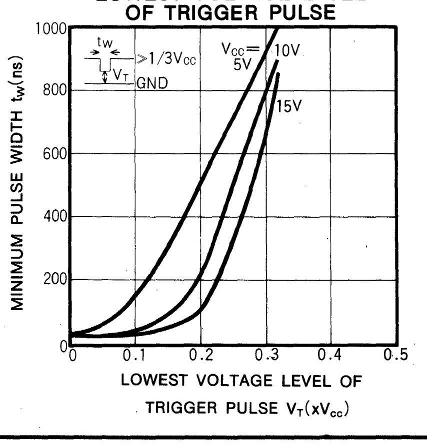
LOW OUTPUT VOLTAGE VS OUTPUT SINK CURRENT



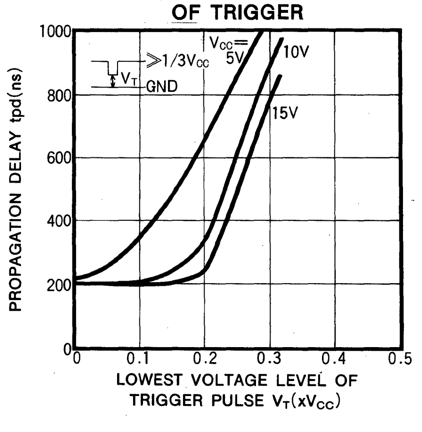
SUPPLY VOLTAGE VS RESET VOLTAGE



MINIMUM PULSE WIDTH VS LOWEST VOLTAGE LEVEL OF TRIGGER PULSE



PROPAGATION DELAY VS LOWEST VOLTAGE OF TRIGGER



APPLICATIONS

Monostable operation

In this mode operation, timer functions an one-shot. The external capacitor is initially held discharged by a transistor internal to the timer.

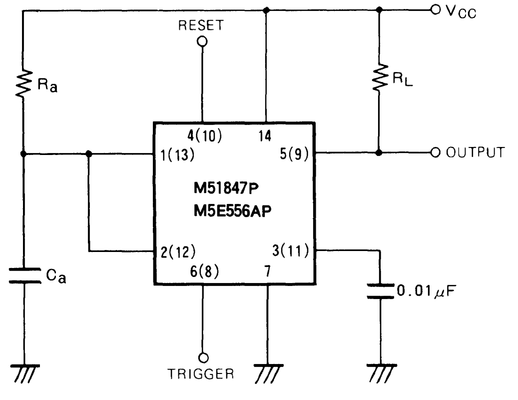
Applying a negative trigger pulse to Pin ⑥ (Pin ⑧) sets the flip-flop, driving the output high and releasing the short-circuit across the external capacitor. The voltage across the capacitor increases with the time constant $\tau = R_a \cdot C_a$ to 2/3 V_{CC}, where the comparator resets the flip-flop and discharges the external capacitor.

The output is now in the low state. The circuit triggering takes place when the negative going trigger pulse reaches 1/3 V_{CC} and circuit stays in the output high state until the set time elapses. The time the output remains in the high state is 1.1 Ra·Ca and can be determined by the graph.

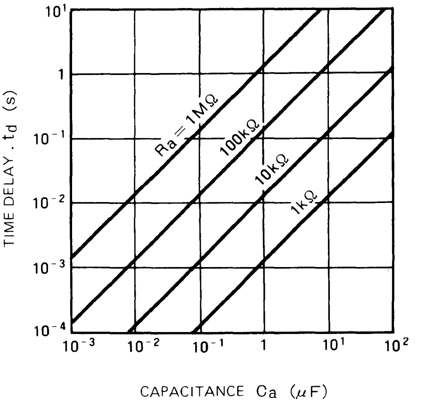
A negative pulse applied to Pin ④ (Pin ⑩) during the timing cycle over again beginning on the positive going edge of the reset pulse. If reset function is not used, Pin ④ (Pin ⑩) should be connected to V_{CC} to avoid false resetting. The delay time is given by:

$t_d = 1.1\ Ra \cdot Ca$

Monostable multivibrator



TIME DELAY VS R_a, C_a



Astable operation

With the circuit connected as shown and it will trigger itself and free run as a multivibrator. The external capacitor charges through R_a and R_b and discharges through Rb only.

Through the duty cycle is set by the ratio of these two resistors, and the capacitor charges and discharges between 1/3 V_{CC} and 2/3 V_{CC}.

Charge and discharge times, and therefore frequency, are independent of supply voltage. The free running frequency versus R_a, R_b and C_a is shown in the graph. The charge time (output high) is given by:

$t_1 = 0.693\ (R_a + R_b) \cdot C_a$

and discharge time (output low) by:

$t_2 = 0.693\ R_b \cdot C_a$

Through the free running frequency is given by:

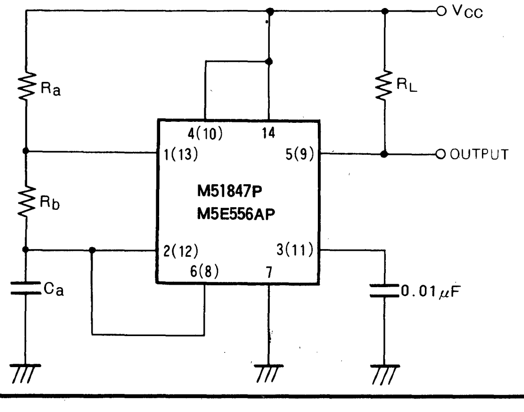
$f = 1/(t_1 + t_2)$

$= 1.44/\{(R_a + 2R_b) \cdot C_a\}$

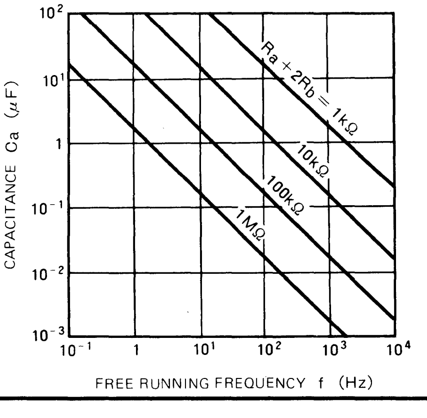
and the duty cycle by:

$D = R_b/(R_a + 2R_b)$

Astable multivibrator



FREE RUNNING FREQUENCY VS R_a, R_b and C_a



M51848/M5E555A

SINGLE TIMER

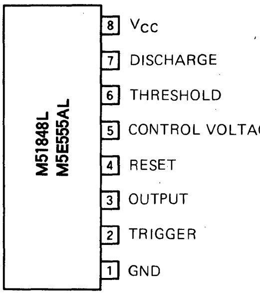
DESCRIPTION
The M51848/M5E555A monolithic timing circuits are highly stable controllers capable of producing accurate time delays, or oscillation. Additional terminals are provided for triggering or resetting. In the time delay mode, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, both the free running frequency and the duty cycle are accurately controlled by two external resistors and capacitor. In this operation, the maximum frequency is 100kHz. The circuit will trigger and reset on falling waveforms. The reset voltage is about 1.4V and is compatible with TTL level. The output structure can source or sink up to 200mA or drive TTL circuits.

FEATURES
- Timing from microseconds through minutes
- Operates in both astable and monostable modes
- Adjustable duty cycle
- High current output can source or sink 200mA
- Maximum frequency is 100kHz
- Reset voltage is about 1.4V for TTL level
- Built in power on reset
- Interchangeble with the signetics NE555 in pin configuration and characteristics

APPLICATIONS
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Missing pulse detector
- Precision timing
- Pulse generation

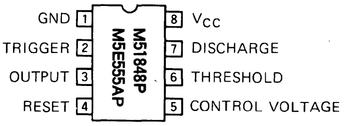
RECOMMENDED OPERATING CONDITIONS
Supply voltage ························ 4~17V
Rated supply voltage ························ 6V, 12V

PIN CONFIGURATION (TOP VIEW)

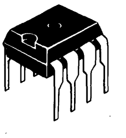


Outline 8P5

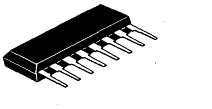
PIN CONFIGURATION (TOP VIEW)



Outline 8P4

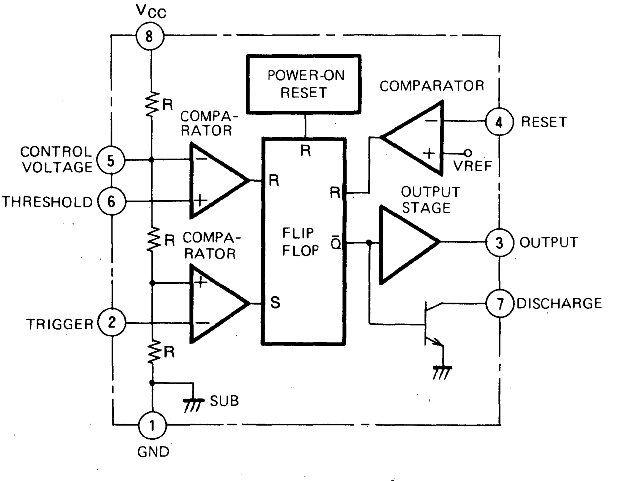


8-pin plastic DIL package



8-pin plastic SIL package

BLOCK DIAGRAM



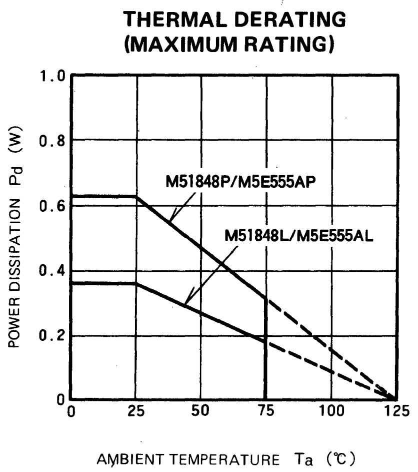
ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless noted)

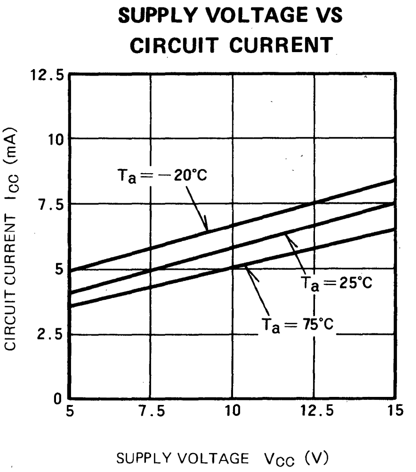
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		18	V
I_O	Output current		200	mA
P_d	Power dissipation		360(SIL)	mW
			625(DIL)	mW
T_{opr}	Operating ambient temperature		−20∼+75	℃
T_{stg}	Storage temperature		−40∼+125	℃

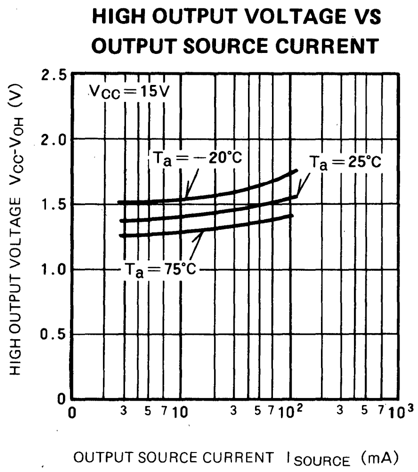
ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

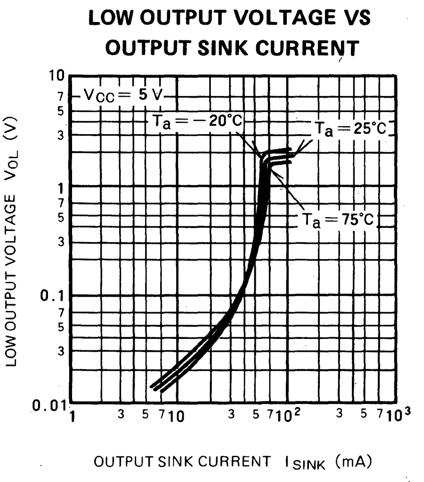
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4		17	V
I_{CC}	Circuit current	V_{CC}=5V, No load		3	5.5	mA
		V_{CC}=15V, No load		7	10	mA
V_{CNT}	Control voltage	V_{CC}=5V	2.6	3.3	4	V
		V_{CC}=15V	9	10	11	V
V_{TH}	Threshold voltage			$2/3V_{CC}$		V
I_{TH}	Threshold current			0.05	0.3	μA
V_T	Trigger voltage			$1/3V_{CC}$		V
I_T	Trigger current			0.1	0.5	μA
V_R	Reset voltage		1.0	1.4	2.0	V
I_R	Reset current			0.05	0.2	μA
V_{OL}	Low output voltage	V_{CC}=5V, I_{sink}=5mA		0.05	0.2	V
		V_{CC}=15V, I_{sink}=10mA		0.05	0.2	V
		V_{CC}=15V, I_{sink}=50mA		0.2	0.5	V
		V_{CC}=15V, I_{sink}=100mA		0.5	2.0	V
V_{OH}	High output voltage	V_{CC}=5V, I_{source}=100mA	2.8	3.3		V
		V_{CC}=15V, I_{source}=100mA	12.8	13.3		V
fmax	Maximum frequency	Ra=Rb=2kΩ, Ca=200pF	100			kHz

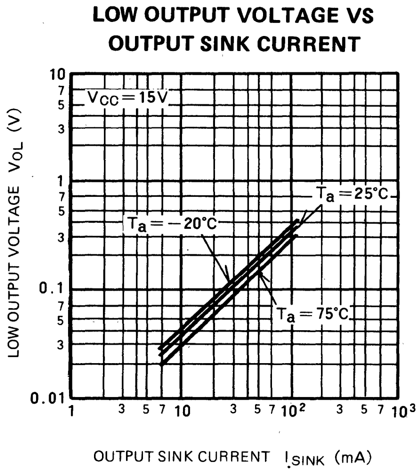
TYPICAL CHARACTERISTICS

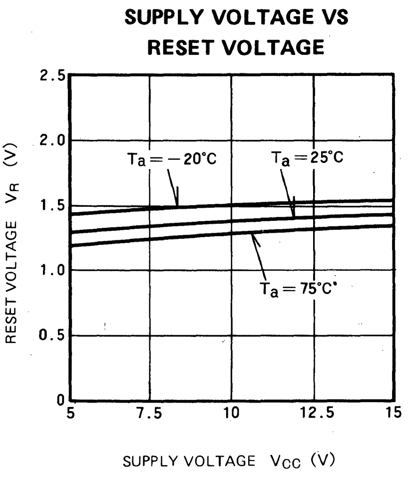




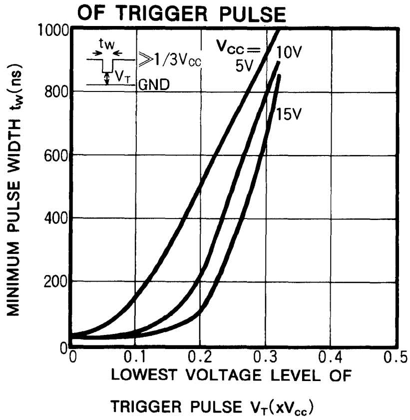




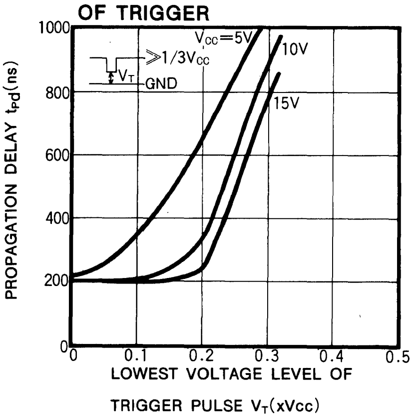




MINIMUM PULSE WIDTH VS LOWEST VOLTAGE LEVEL OF TRIGGER PULSE



PROPAGATION DELAY VS LOWEST VOLTAGE LEVEL OF TRIGGER



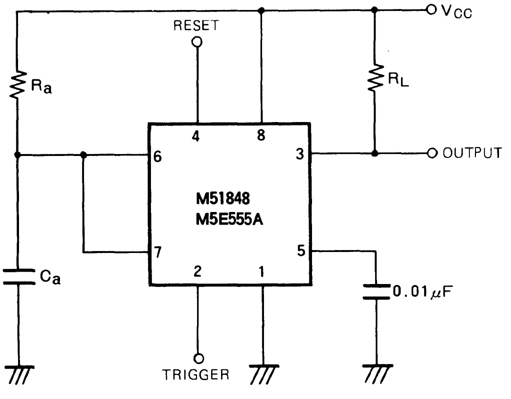
APPLICATIONS

Monostable operation

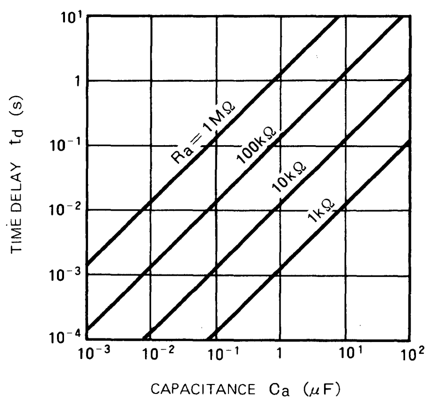
In this mode operation, timer functions an one-shot. The external capacitor is initially held discharged by a transistor internal to the timer. Applying a negative trigger pulse to Pin ② sets the flip-flop, driving the output high and releasing the short-circuit across the external capacitor. The voltage across the capacitor increases with the time constant $\tau = R_a \cdot C_a$ to 2/3 V_{CC}, where the comparator resets the flip-flop and discharges the external capacitor. The output is now in the low state. The circuit triggering takes place when the negative going trigger pulse reaches 1/3 V_{CC} and the circuit stays in the output high state until the set time elapses. The time the output remains in the high state is 1.1 $R_a \cdot C_a$ and can be determined by the graph. A negative pulse applied to Pin ④ during the timing cycle over again beginning on the positive going edge of the reset pulse. If reset function is not used, Pin ④ should be connected to V_{CC} to avoid false resetting.. The delay time is given by:

$t_d = 1.1\ R_a \cdot C_a$

Monostable multivibrator



TIME DELAY VS R_a, C_a



Astable operation

With the circuit connected as shown and it will trigger itself and free run as a multivibrator. The external capacitor charges through R_a and R_b and discharges through R_b only.

Through the duty cycle is set by the ratio of these two resistors, and the capacitor charges and discharges between 1/3 V_{CC} and 2/3 V_{CC}.

Charge and discharge times, and therefore frequency, are independent of supply voltage. The free running frequency versus R_a, R_b and C_a is shown in the graph. The charge time (output high) is given by:

$t_1 = 0.693\ (R_a + R_b) \cdot C_a$

and discharge time (output low) by:

$t_2 = 0.693\ R_b \cdot C_a$

Through the free running frequency is given by:

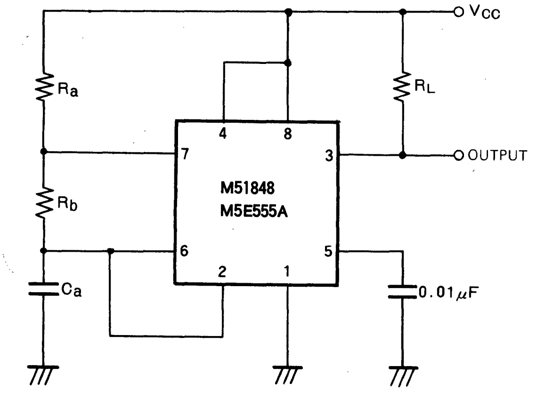
$f = 1/(t_1 + t_2)$

$= 1.44/\{(R_a + 2R_b) \cdot C_a\}$

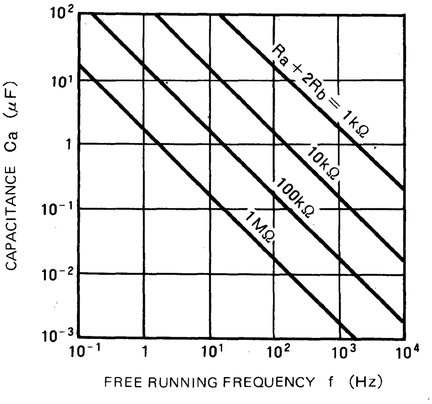
and the duty cycle by:

$D = R_b/(R_a + 2R_b)$

Astable multivibrator



FREE RUNNING FREQUENCY VS Ra, Rb and Ca



M51849L

COUNTER TIMER

DESCRIPTION

The M51849L monolithic timing circuit is a highly stable controller capable of producig accurate long time delays, or oscillation up to 50hr. It consists of CR oscillator and 11 stage divider by I^2 L. Additional terminals are provided for reset or stop oscillation, if desired.

The time base period t_0 of oscillator is determined by external three resistors and one capacitor. For astable operaiton, the output period is 2048 t_0. It should be connected the resistor from pin ② to pin ⑧ at monostable operation. In this mode, the output period is 1024 t_0.

FEATURES

- Timing from1 sec through 50 hr
- Operates in both astable and monostable mode.
- High current output can sink 30mA
- Output can drive TTL
- Built in power on reset

APPLICATIONS

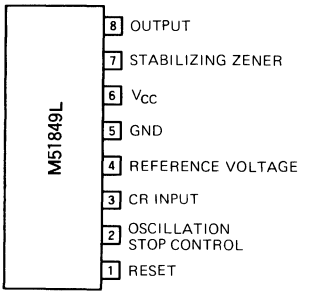
- Long delay generation
- Precision timing
- Ultra-low-frequency oscillator

RECOMMENDED OPERATING CONDITIONS

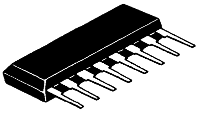
Supply voltage ········ 5V ~ Vz (Vz = pin ⑦ Zener voltage)

Rated supply voltage ······································ 6V ± 10%

PIN CONFIGURATION (TOP VIEW)

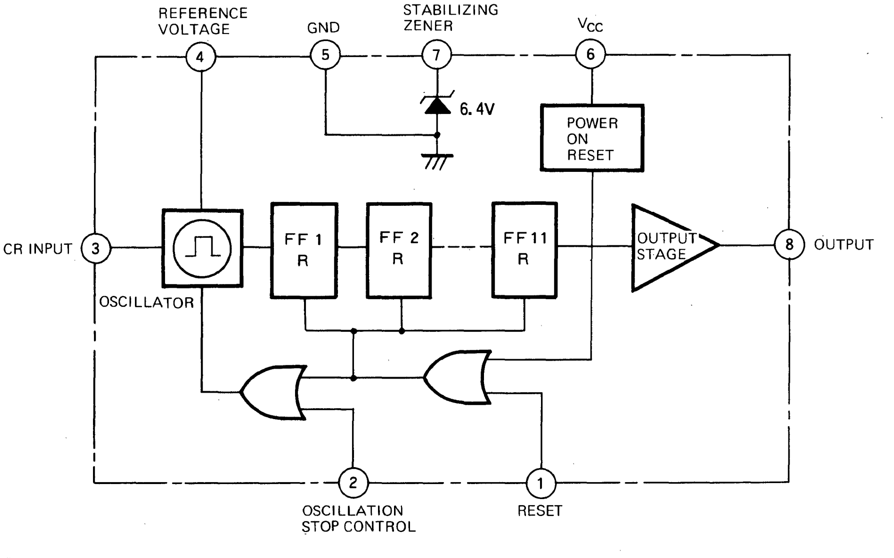


Outline 8P5



8-pin plastic SIL package

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

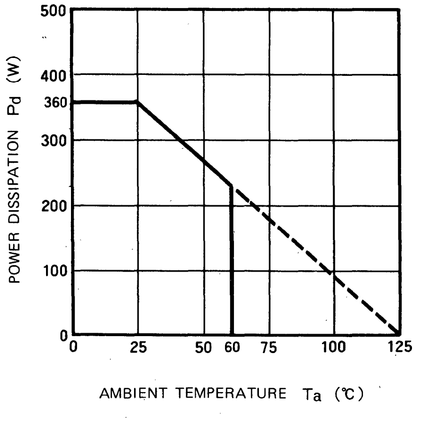
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		7.0	V
I_Z	Zener current		20	mA
I_O	Output sink current		30	mA
Pd	Power dissipation		360	mW
K_θ	Thermal derating	Ta≧25°C	3.6	mW/°C
Topg	Operating ambient temperature		0～+60	°C
Tstg	Storage temperature		−40～+125	°C

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=±6V, unless otherwise noted)

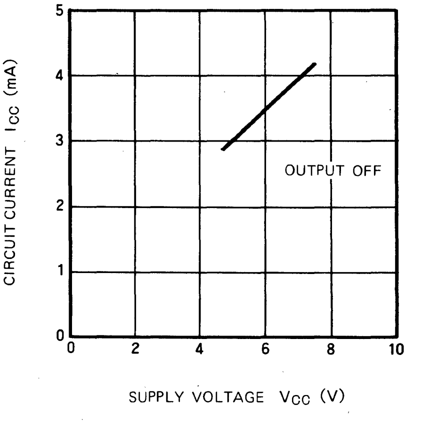
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
I_{CC}	Circuit current	V_{CC}=6.0V		3.5	6.0	mA
V_Z	Zener voltage	I_Z=1mA	6.0	6.4	6.8	V
V_R	Reset voltage			1.5	1.8	V
I_R	Reset current			0.1		mA
V_{OS}	Oscillation stop voltage			1.6	1.9	V
I_{OS}	Oscillation stop input current			0.1		mA
V_{OH}	High output voltage	I_{SOURCE}=10mA	4.0	4.5		V
V_{OL}	Low output voltage	I_{SINK}=10mA		0.2	0.6	V
R_T	Timing resistor		2		2000	kΩ
C_T	Tw capacitor		0.1			μF

TYPICAL CHARACTERISTICS (Ta = 25°C, unless otherwise noted)

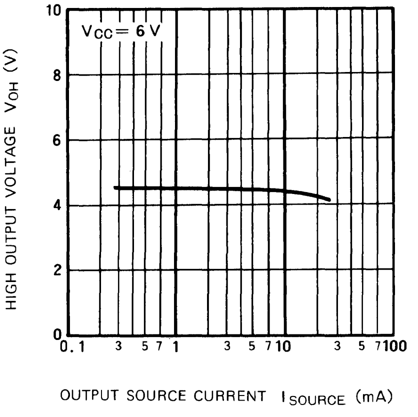
THERMAL DERATING (MAXIMUM RATING)



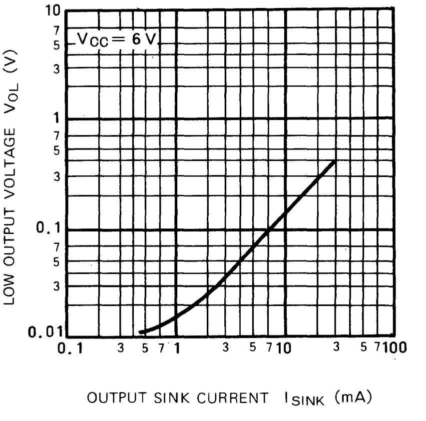
CIRCUIT CURRENT VS SUPPLY VOLTAGE



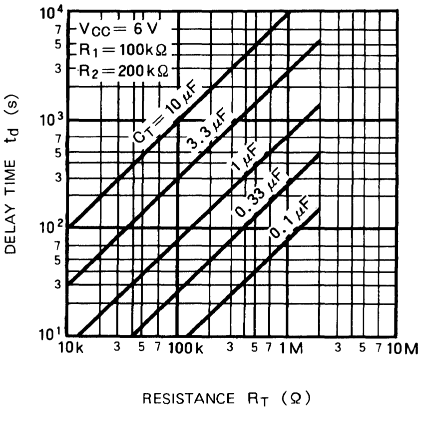
HIGH OUTPUT VOLTAGE VS OUTPUT SOURCE CURRENT



LOW OUTPUT VOLTAGE VS OUTPUT SINK CURRENT

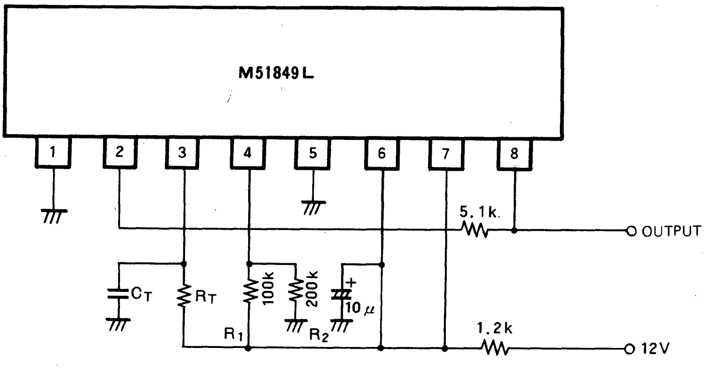


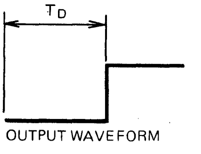
RESISTANCE VS DELAY TIME



APPLICATIONS

Monostable operation



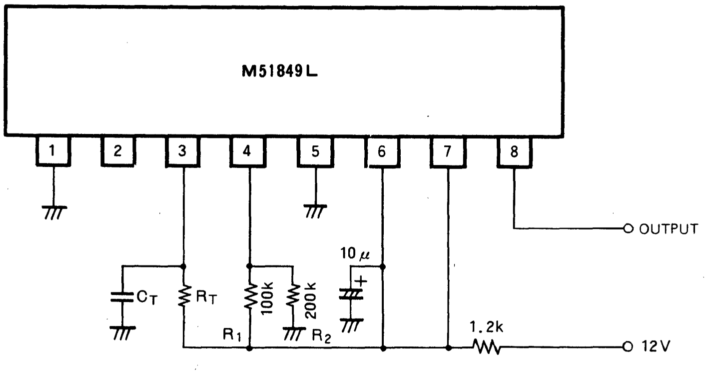


Units Resistance: Ω
Capacitance: F

In this mode operation, timer functions an one-shot. The delay time is given by:

$$T_D \approx C_T \cdot R_T \cdot \ln\left(0.8 \times \frac{R_1 + R_2}{R_1}\right) \quad \text{(sec)}$$

Astable operation



With the circuit connected as shown and it will trigger itself free run as a multivibrator.

M51901P

12-POINT/23-MODE LED DRIVER

DESCRIPTION

The M51901P is a semiconductor integrated circuit consisting of a driver circuit capable of driving 12 LEDs in 23 modes.

When a DC voltage is applied to the input pin the LED driving outputs are activated either 1 or 2 at a time to provide 23 LED drive modes in accordance with the applied voltage level. In addition, a blanking function is available when the reference voltage is made a low level.

The M51901P consists of 12 differential amplifiers and the associated ladder circuit as well as a blanking circuit.

FEATURES

- 12 LEDs may be driven in accordance with the level of a DC voltage applied to the input, using a built-in A-D conversion capability.
- 23 operating modes are provided
- Built-in blanking function
- The reference voltage level may be freely selected

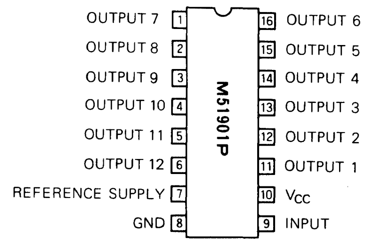
APPLICATION

23-mode drivers for 12 LEDs, simplified A-D converters

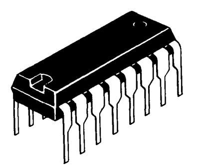
RECOMMENDED OPERATING CONDITIONS

Supply voltage range	10.2~16.5V
Rated supply voltage	13.2V
Reference voltage range	5.0~7.5V
Input voltage range	0~9.2V

PIN CONFIGURATION (TOP VIEW)

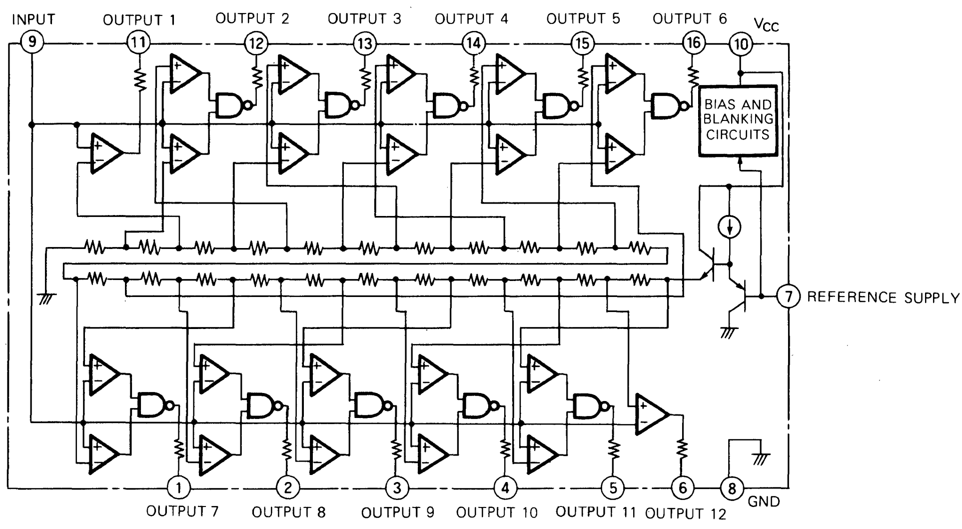


Outline 16P4



16-pin molded plastic DIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Ta=25℃, unless otherwise noted)

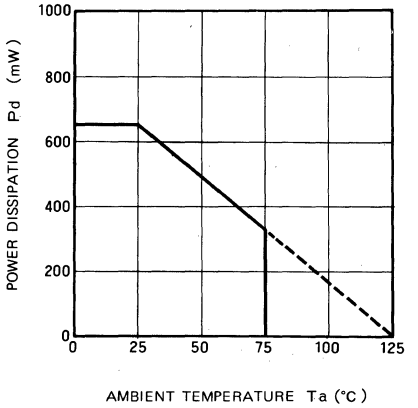
Symbol	Parameter	Conditions	Limits	Unit
Vcc	Supply voltage		18	V
Io	Output current		30	mA
Pd	Power dissipation		650	mW
Kθ	Derating	Ta≧25°C	6.5	mW/°C
Topg	Operating temperature		−20～+75	°C
Tstg	Storage temperature		−40～+125	°C

ELECTRICAL CHARACTERISTICS (Ta=25℃, V_{CC}=±13.2V, V_{REF}=7.20V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
I_{CC}	Circuit current	V_{IN}=0V, outputs open		2	5	mA
I_I	Input current	V_{IN}=9.2V			100	μA
V_O	Output voltage (pins ①～⑫)	R_L=620 Ω	4.2	5.5	6.8	V
V_{BL}	Blanking voltage	V_{IN}=9.2V, I_O=100μA			0.8	V
I⑦	Pin ⑦ output current	V_{IN}=0V			15	μA
V②	Output 2 on-state central input voltage	I_O≧1mA		1.99		V
V③	Output 3 on-state central input voltage	I_O≧1mA		2.51		V
V④	Output 4 on-state central input voltage	I_O≧1mA		3.03		V
V⑤	Output 5 on-state central input voltage	I_O≧1mA		3.55		V
V⑥	Output 6 on-state central input voltage	I_O≧1mA		4.07		V
V⑦	Output 7 on-state central input voltage	I_O≧1mA		4.59		V
V⑧	Output 8 on-state central input voltage	I_O≧1mA		5.11		V
V⑨	Output 9 on-state central input voltage	I_O≧1mA		5.63		V
V⑩	Output 10 on-state central input voltage	I_O≧1mA		6.15		V
V⑪	Output 11 on-state central input voltage	I_O≧1mA		6.67		V

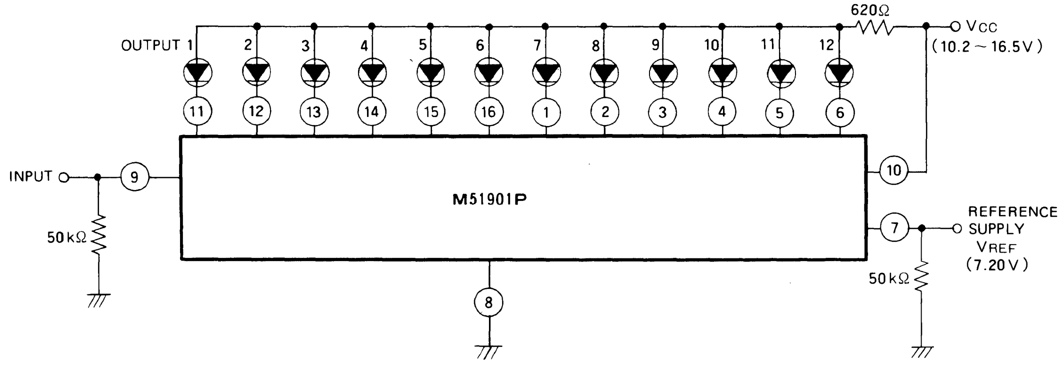
TYPICAL CHARACTERISTICS (Ta=25°C, unless otherwise noted)

THERMAL DERATING (MAXIMUM RATING)

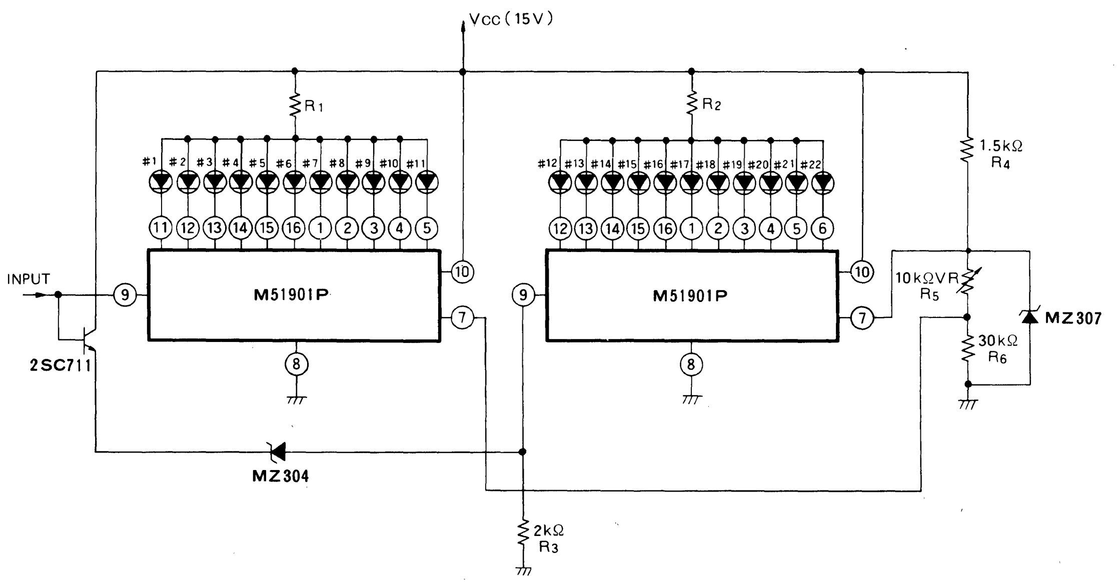


APPLICATION EXAMPLES

(1) 23-MODE DRIVER FOR 12 LEDS



(2) 22-LED DRIVER (USING CASCADE CONNECTION)



Note R_5 is chosen such that the lower drive level limit for LED #12 is just 0.24V higher than higher drive level limit for LED #10.

M51903L

LED LINEAR LEVEL INDICATOR

DESCRIPTION

The M51903L is a semiconductor integrated circuit consisting of a circuit designed for use in level meters. It is capable of driving 5 LEDs to create a bar-type display. In accordance with the input level, the uppermost LED brightness varies to form a linear indicator, making this device ideal for use in signal meters and VU meters. A low-voltage reference power supply is built in, so that the only external components required are 'LEDs, resistors and capacitors.

FEATURES

- Bar-type display of input level using 5 LEDs
- The uppermost LED brightness varies linearly with respect to the input level resulting in a high-resolution display with no radiation.
- By changing the external resistance values, the LED brightness can be adjusted ·················· I_O=15mA(max.)
- Operates over a wide range of supply voltages ·· V_{CC}=4~18V
- Built-in reference supply
- High input impedance ·················· I_{IN}=100nA (typ.)

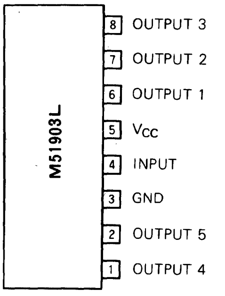
APPLICATION

Signal meters, VU meters, tuning meters, and other general display applications

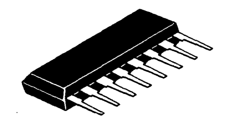
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ·· 4~18V
Rated supply voltage ·· 10V

PIN CONFIGURATION (TOP VIEW)

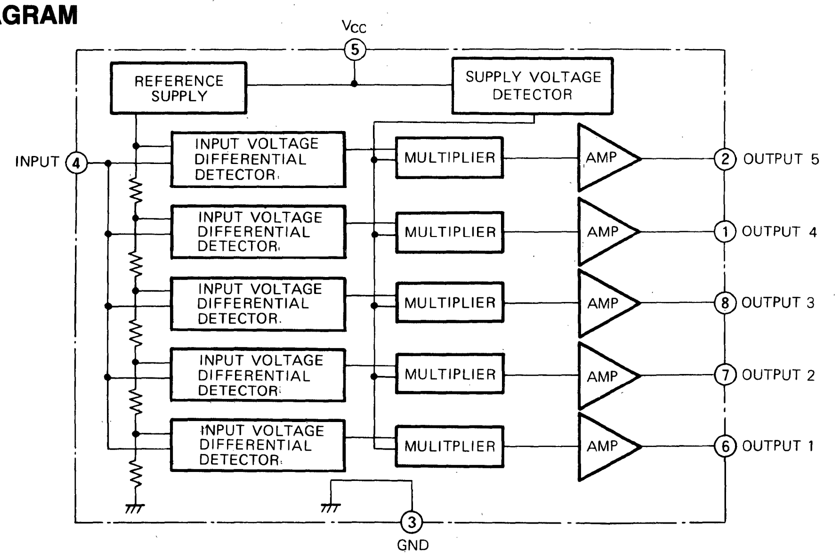


Outline 8P5



8-pin molded plastic SIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		18	V
V_{IN}	Input voltage		6	V
BV_O	Output breakdown voltage		18	V
I_O	Output current		15 (per pin)	mA
P_{dF}	Power dissipation	With the M51903L soldered to a printed circuit board (copper-clad area 4.5 x 5.5cm, thickness 35μ, board thickness 2.0mm)	550	mW
$K_{\theta F}$	Derating	$T_a \geqq 25$℃	5.5	mW/℃
Topg	Operating temperature		−20～+75	℃
Tstg	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=±10V, unless otherwise noted)

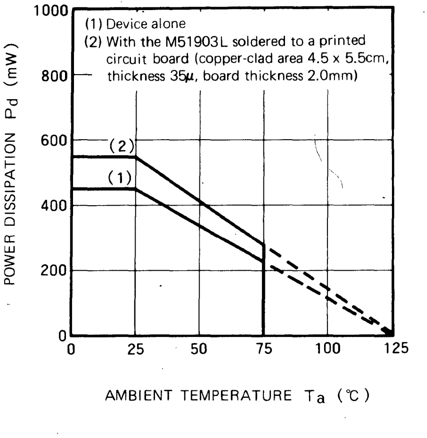
Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage range		4	10	18	V
V_{INF}	Fullscale input voltage			1320		mV
Vstep	Step voltage			210		mV
I_{IN}	Input current	V_{IN}=0V (Note 1)		0.1	1.0	μA
I_{CC}	Circuit current	V_{IN}=0V		5	8	mA
$V_{IT⑥}$	Output 1 LED drive voltage	R_L=1.5kΩ, I_L=100μA, Using red GaAlAs LEDs	170	230	300	mV
$V_{IT⑦}$	Output 2 LED drive voltage		380	450	530	mV
$V_{IT⑧}$	Output 3 LED drive voltage		580	660	730	mV
$V_{IT①}$	Output 4 LED drive voltage		780	860	940	mV
$V_{IT②}$	Output 5 LED drive voltage		980	1070	1180	mV

Note 1. Current flowing from pin ④ is taken as positive current.

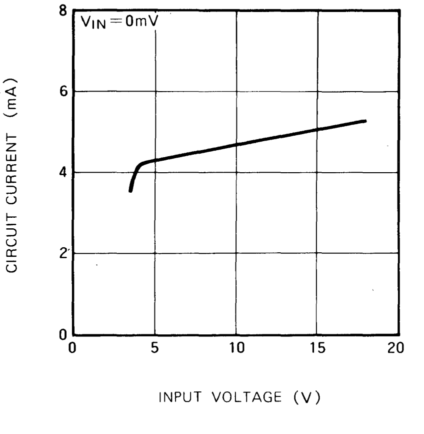
TYPICAL CHARACTERISTICS (T_a=25℃, V_{CC}=10V unless otherwise noted)

(For the following typical characteristics, R_L in the application example (1) is 1.5kΩ and red GaAlAs LEDs are used for measurements)

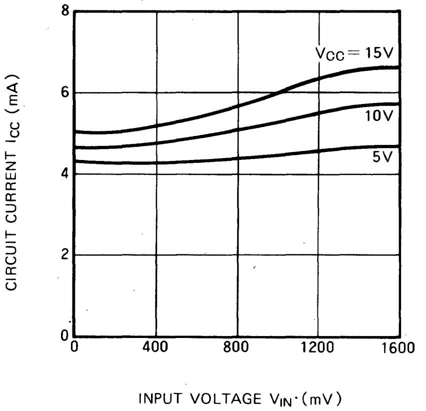
THERMAL DERATING (MAXIMUM RATING)



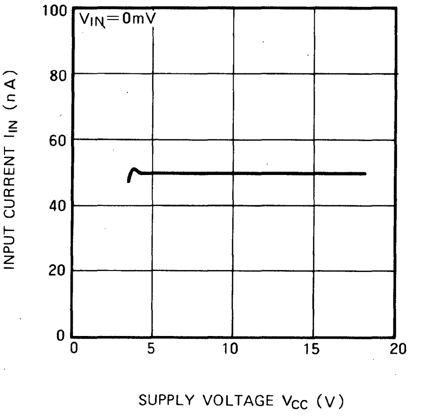
CIRCUIT CURRENT VS SUPPLY VOLTAGE



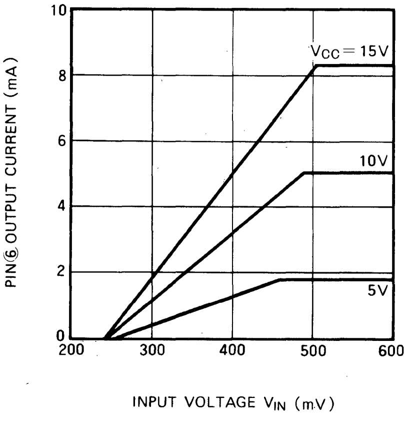
CIRCUIT CURRENT VS INPUT VOLTAGE



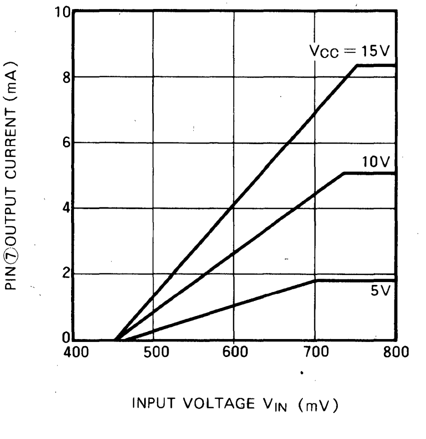
INPUT CURRENT VS SUPPLY VOLTAGE



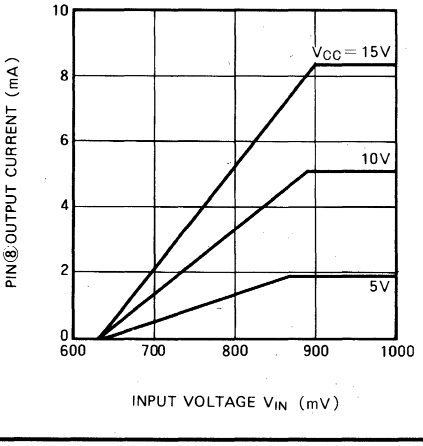
PIN⑥OUTPUT CURRENT VS INPUT VOLTAGE



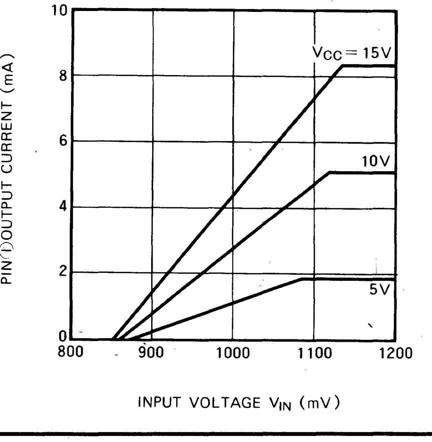
PIN⑦OUTPUT CURRENT VS INPUT VOLTAGE



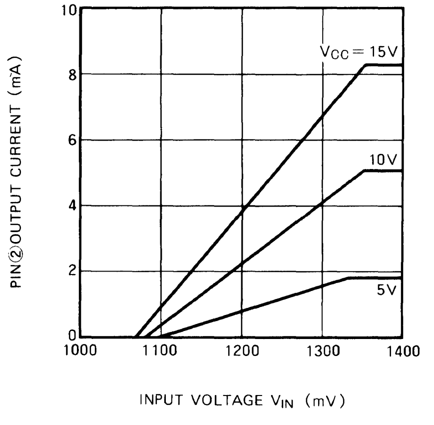
PIN⑧OUTPUT CURRENT VS INPUT VOLTAGE



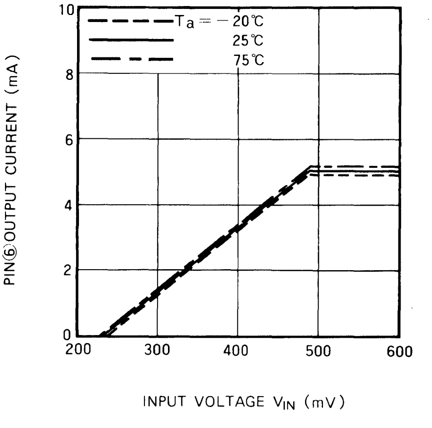
PIN①OUTPUT CURRENT VS INPUT VOLTAGE



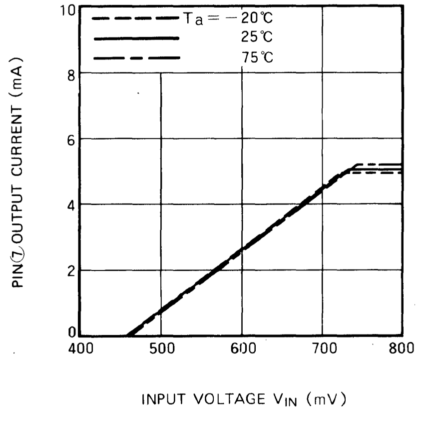
PIN ② OUTPUT CURRENT VS INPUT VOLTAGE



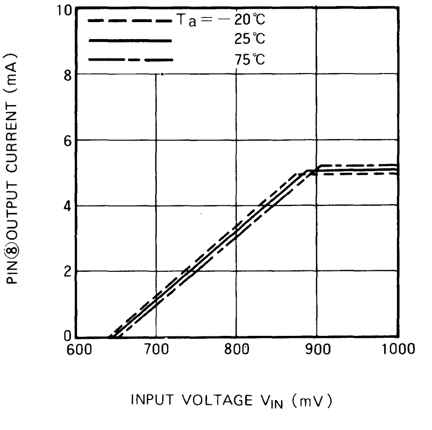
PIN ⑥ OUTPUT CURRENT VS INPUT VOLTAGE TEMPERATURE CHARACTERISTICS



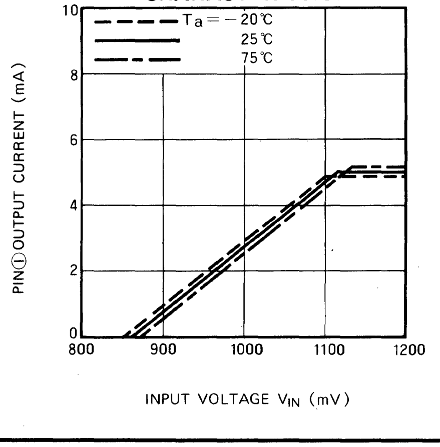
PIN ⑦ OUTPUT CURRENT VS INPUT VOLTAGE TEMPERATURE CHARACTERISTICS



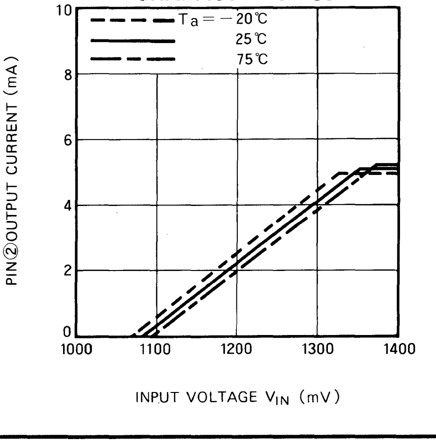
PIN ⑧ OUTPUT CURRENT VS INPUT VOLTAGE TEMPERATURE CHARACTERISTICS



PIN ① OUTPUT CURRENT VS INPUT VOLTAGE TEMPERATURE CHARACTERISTICS

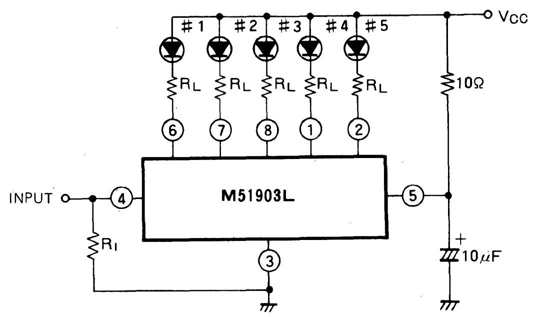


PIN ② OUTPUT CURRENT VS INPUT VOLTAGE TEMPERATURE CHARACTERISTICS



APPLICATION EXAMPLES

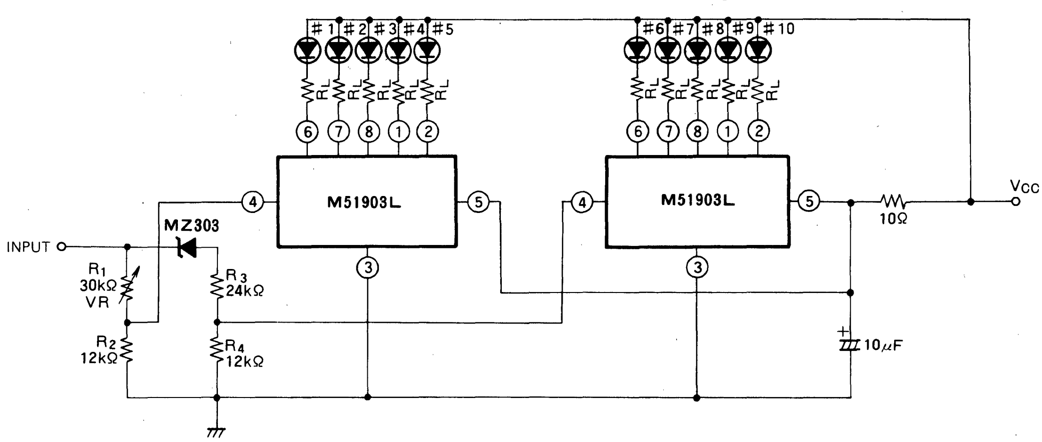
(1) M51903L used alone



Note 1. The value of R_L is chosen to suit the LED devices to be used. The maximum LED current ≒ (V_{CC}-LED forward voltage drop−1.0)/R_L ≦ 15mA

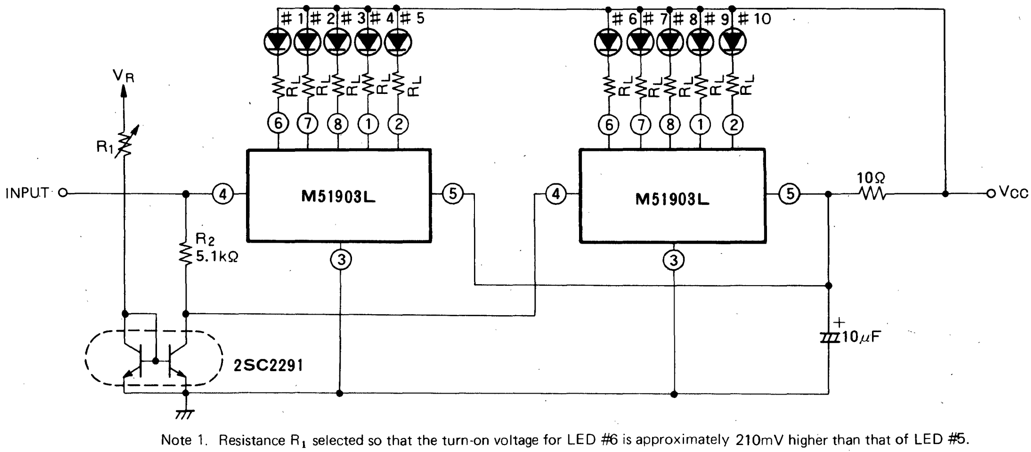
(2) M51903L used in cascade connection

(i) Circuit for a maximum input voltage of 7V



Note 1. Resistance R_1 is selected so that the turn-on voltage for LED #6 is approximately 630mV higher than that of LED # 5.

(3) Circuit for a maximum input voltage of 2.3V



Note 1. Resistance R_1 selected so that the turn-on voltage for LED #6 is approximately 210mV higher than that of LED #5.

M51906P

6-STEP BAR TYPE LED LEVEL INDICATOR

DESCRIPTION

The M51906P is a semiconductor integrated circuit consisting of a circuit designed for LED level meters. It is capable of bar type display for 6 LEDs according to a input level.
AC or DC signal can be used because of built-in superior half-wave rectification OP Amp.

FEATURES

- Built-in superior half-wave rectification OP Amp.
  Cut off frequency ······························ 500kHz(typ.)
  Input offset voltage ·································· 2mV(typ.)
- Output can sink high current ······················ 30mA(typ.)
- Range of supply voltage is wide ······················ 4V~15V
- In no signal condition, circuit current is small.
  ·· 0. 9mA(typ.)
- Small power dissipation and capable of low voltage operating because of open collector outputs.
- Amp gain can be variabled by resistor.
- Be easily shifted on level of LED by LOWER REF INPUT terminal.

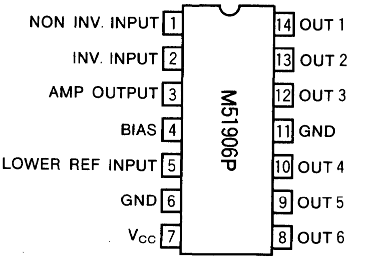
APPLICATION

Signal meters, VU meters, tuning meters, and other general display applications.

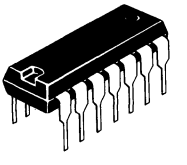
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ·· 4 ~15V
Rated supply voltage ······································ 9 V±10%

PIN CONFIGURATION (TOP VIEW)

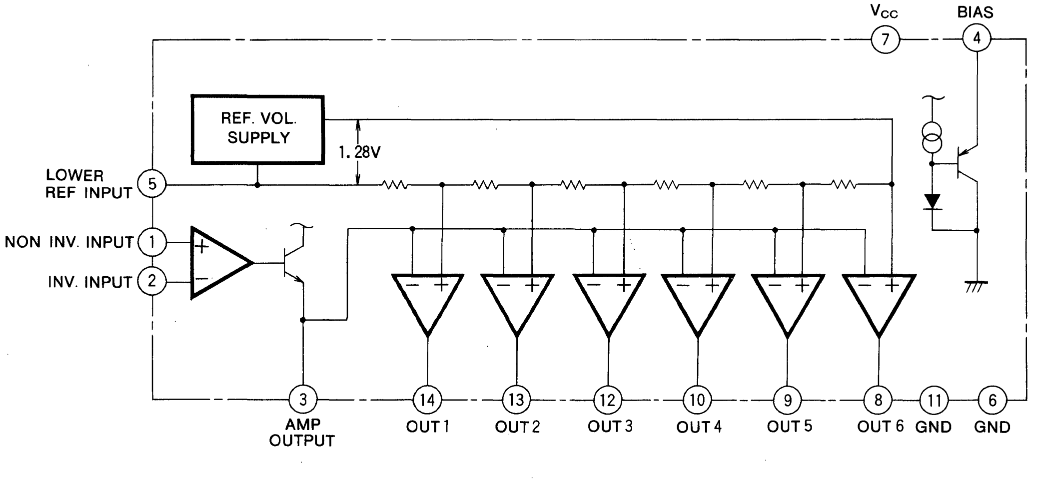


Outline 14P4



14-pin molded plastic DIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

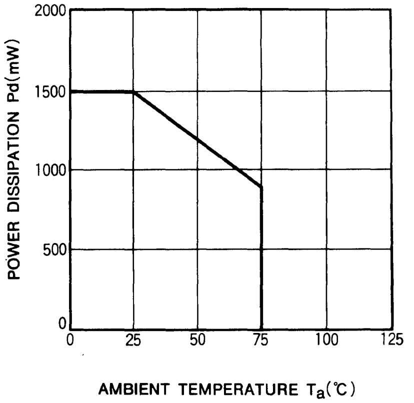
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		16	V
BV_O	Output voltage		16	V
I_O	Output sink current		30	mA
V_{IN}	Input voltage	Input terminal to GND	$-3 \sim V_{CC}-0.8$	V
$\lvert V_{①}-V_{②}\rvert$	Difference input voltage	Between pin① and pin②	5	V
$V_{⑤}$	Pin⑤ voltage	Pin⑤ to GND	4	V
$I_{④}$	Pin④ sink current		1.5	mA
$I_{③}$	Pin③ issued current	Static value	−1	mA
$V_{③}$	Pin③ voltage	Pin③ to GND	6	V
P_d	Power dissipation		1500	mW
K_θ	Thermal derating	$T_a \geqq 25$℃	12	mW/℃
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V)

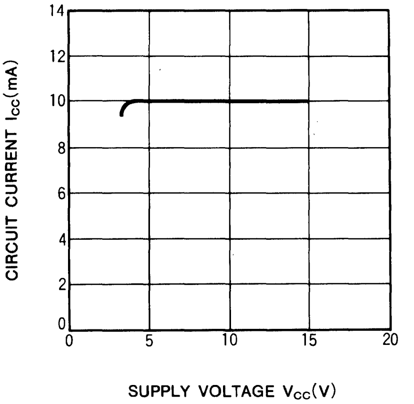
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		4.0		15.0	V
I_{CC1}	Circuit current	All outs are off.		0.9	2	mA
I_{CC2}	Circuit current	All outs are on.		10	20	mA
V_{IO}	Input amp offset voltage	$V_{①}$=2V		2	10	mV
I_{IB}	Input amp bias current	$V_{①}$=2V		50	250	nA
V_{REF}	Reference voltage		1.15	1.35	1.55	V
$I_{⑤}$	Pin⑤ issued current	$V_{⑤}$=0V	−600	−400	−260	μA
V_{SAT}	Output saturation voltage	I_O=30mA		0.3	1	V
V_{th1}	OUT 1 threshold voltage	Amp gain=1 Threshold voltage is between Pin ③ and Pin⑤.	91	114	144	mV
			−20	−18	−16	dB
V_{th2}	OUT 2 threshold voltage		181	228	287	mV
			−14	−12	−10	dB
V_{th3}	OUT 3 threshold voltage		341	405	481	mV
			−8.5	−7	−5.5	dB
V_{th4}	OUT 4 threshold voltage		572	641	720	mV
			−4	−3	−2	dB
V_{th5}	OUT 5 threshold voltage		807	906	1017	mV
			−1	0	+1	dB
V_{th6}	OUT 6 threshold voltage		1141	1280	1436	mV
			+2	+3	+4	dB
I_{OL}	Output leakage current	$V_{OUT}=V_{CC}$			1	μA

TYPICAL CHARACTERISTICS (T_a=25℃, V_{CC}= 9V, unless otherwise noted)

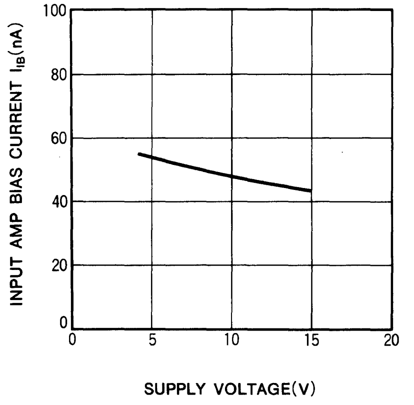
THERMAL DERATING (MAXIMUM RATING)



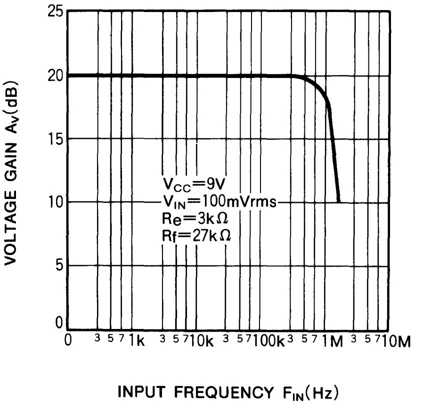
CIRCUIT CURRENT VS SUPPLY VOLTAGE



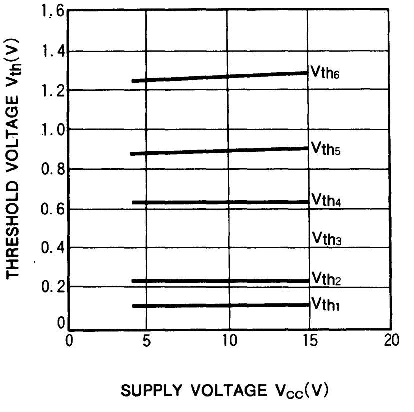
INPUT AMP BIAS CURRENT VS SUPPLY VOLTAGE



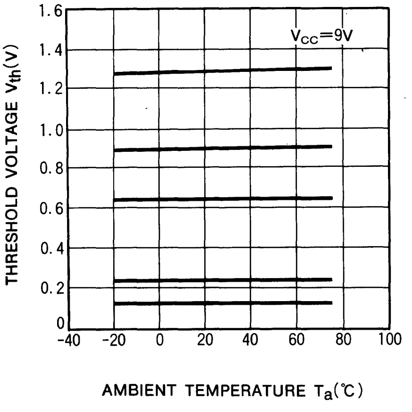
VOLTAGE GAIN VS INPUT FREQUENCY



THRESHOLD VOLTAGE VS SUPPLY VOLTAGE

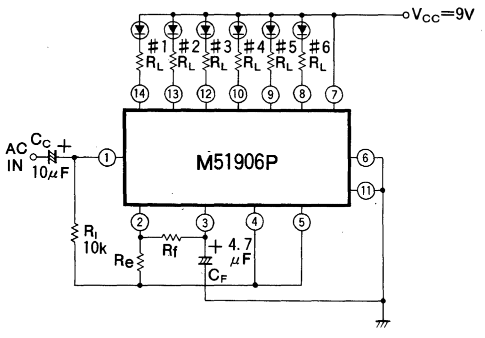


THRESHOLD VOLTAGE VS AMBIENT TEMPERATURE

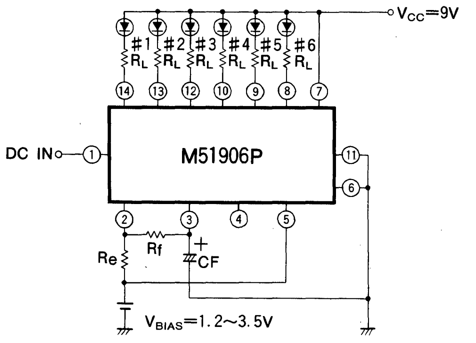


APPLICATION EXAMPLES

(1) AC input application circuit



(2) DC input application circuit



Note : 1. Output current$\sim\frac{V_{CC}-V_{FLED}}{R_L}$
2. Amp gain$\sim\frac{R_e+R_f}{R_e}$ $(R_e+R_f\sim30k\Omega)$
3. Recovery time : $C_F\times(R_e+R_f)$
4. Attack time : $C_F\times430\Omega$
5. A thermal coefficient of Pin ④ voltage is about −4mV/℃
6. Open output terminal if wish to use fewer than 6 pieces of LED.

1. In DC, INPUT condition, Be Pin ④ open and connect reference voltage (area of 1.2~3.5V) to Pin ⑤.

M51907P
M51909P

8-STEP BAR TYPE LED LEVEL INDICATOR

DESCRIPTION

The M51907P/M51909P is a semiconductor integrated circuit consisting of a circuit designed for LED level meters. It is capable of bar type display for 8 LEDs according to a input level. AC or DC signal can be inputted because of built-in superior half-wave rectification OP Amp. Output is a cascade connection of a pair of LEDs, so current for display is half. Display level of the M51907P is logarithmical scale, +5, +2, 0, −2, −5, −8, −13, −18 dB.

The M51909P is a companion products to the M51907P, display level is linear scale, 156mV step.

FEATURES

- Built-in superior half-wave rectification OP Amp.
  Cut off frequency ································ 500kHz (typ.)
  Input offset voltage ······························ 2 mV (typ.)
- The LED brightness can be adjusted by resistor.
  ·· 2～25mA
- Range of supply voltage is wide ························ 4～15V
- Output is a cascade connection of a pair of LEDs, so current for display is half.
- Amp gain can be varied by resistor.
- Be easily sifted on display level of LED by LOWER REF INPUT terminal.
- It is capable of cascade connection (if use more than 8 LEDs because of built-in REF OUT terminal (V_{REF} = 1.25V) correspond to full scale.

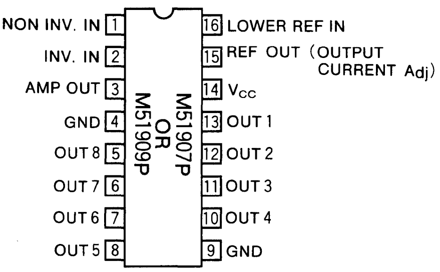
APPLICATION

Signal meters, VU meters, tuning meters, and other general display applications.

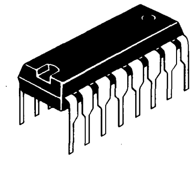
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ·· 4～15V
Rated supply voltage ··· 9 V±10%

PIN CONFIGURATION (TOP VIEW)

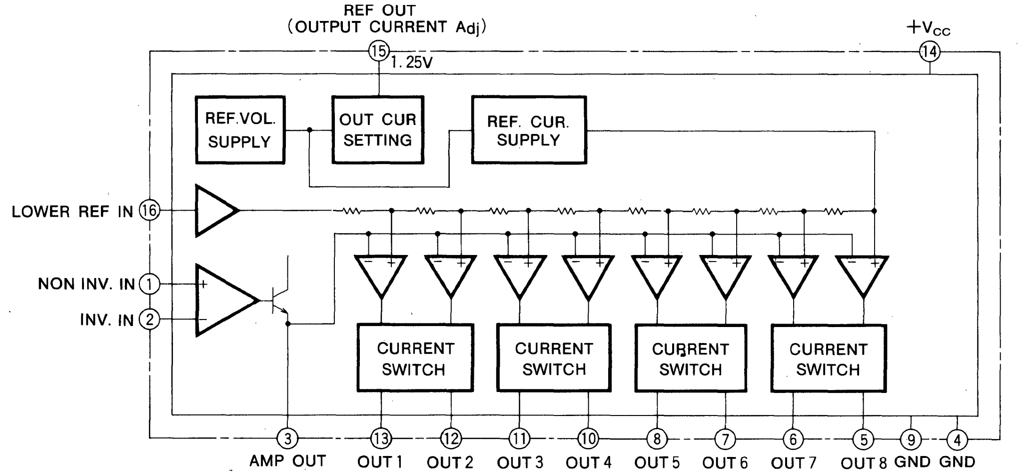


Outline 16P4



16-pin molded plastic DIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		16	V
BV_O	Output voltage		16*	V
I_O	Output sink current		25*	mA
V_{IN}	Input voltage		$-3 \sim V_{CC}$	V
$\lvert V_{①}-V_{②} \rvert$	Difference input voltage		5	V
$V_{⑮}$	Pin⑮ voltage		V_{CC}	V
$I_{⑮}$	Pin⑮ issued current		500	μA
$I_{③}$	Pin③ issued current	Static value	1	mA
P_{dF}	Power dissipation		1600	mW
$K_{\theta F}$	Thermal derating	$T_a \geq 25$℃	12.8	mW/℃
T_{opr}	Operating temperature		$-20 \sim +75$*	℃
T_{stg}	Storage temperature		$-40 \sim +125$	℃

*Relations of BV_O, I_O, T_{opr} should satisfy the condition of power dissipation and derating.

M51907P
ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V)

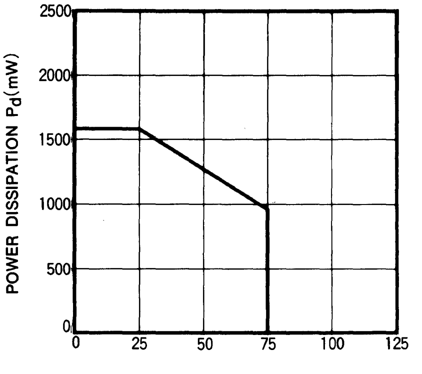
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		4		15	V
I_{CC1}	Circuit current	All outs are off. R_{ad}=2.8kΩ		5	8	mA
I_{CC2}	Circuit current	All outs are on. R_{ad}=2.8kΩ		7.0	11.2	mA
V_{IO}	Input amp offset voltage	$V_{①}$=1V		2	10	mV
I_{IB}	Input amp bias current	$V_{①}$=0V	−300	−50		nA
V_{IN}	Input voltage range		0		$V_{CC}-2$	V
V_{REF}	Reference voltage	R_{ad}=6.4kΩ	1.125	1.250	1.375	V
$V_{⑮}$	Pin⑮ setting voltage range		−0.2		$V_{CC}-3.5$	V
$I_{⑮}$	Pin⑮ issued current		−2000	−50		nA
V_{th1}	OUT 1 threshold voltage	Amp gain=1 Threshold voltage is between Pin① and Pin⑮.	70	89	111	mV
			−20	−18	−16	dB
V_{th2}	OUT 2 threshold voltage		125	157	198	mV
			−15	−13	−11	dB
V_{th3}	OUT 3 threshold voltage		235	280	333	mV
			−9.5	−8	−6.5	dB
V_{th4}	OUT 4 threshold voltage		352	395	443	mV
			−6	−5	−4	dB
V_{th5}	OUT 5 threshold voltage		498	558	627	mV
			−3	−2	−1	dB
V_{th6}	OUT 6 threshold voltage		627	703	789	mV
			−1	0	+1	dB
V_{th7}	OUT 7 threshold voltage		789	885	993	mV
			1	2	3	dB
V_{th8}	OUT 8 threshold voltage		1114	1250	1403	mV
			4	5	6	dB
I_{OL}	Output leakage current				1	μA
I_O	Output sink current	R_{ad}=6.4kΩ	9.6	12	14.4	mA
$I_{O'}$	Output sink current	R_{ad}=2.8kΩ	20	25	30	mA
V_{SAT}	Output saturation voltage	R_{ad}=2.8kΩ, I_O=12.5mA			500	mV

M51909P
ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V)

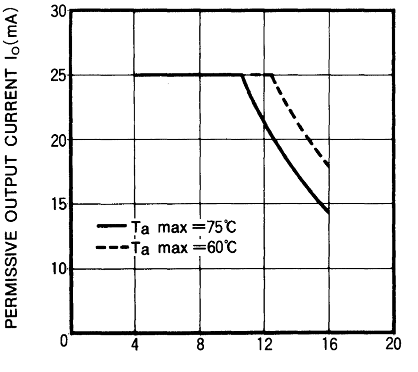
Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage range		4		15	V
I_{CC1}	Circuit current	All outs is off, R_{ad}=2.8kΩ		5	8	mA
I_{CC2}	Circuit current	All outs is on, R_{ad}=2.8kΩ		7	11.2	mA
V_{IO}	Input amp offset voltage	$V_{①}$=1V		2	10	mV
I_{IB}	Input amp bias current	$V_{①}$=0V	−300	−50		nA
V_{IN}	Input voltage range		0		V_{CC}−2	V
V_{REF}	Reference voltage	R_{ad}=6.4kΩ	1.125	1.250	1.375	V
$V_{⑮}$	Pin⑮ setting voltage range		−0.2		V_{CC}−3.5	V
$I_{⑮}$	Pin⑮ issued current		−2000	−50		nA
V_{th1}	OUT 1 threshold voltage	Amp gain=1. Threshold voltage is between pin① and pin⑮.	136	156	177	mV
V_{th2}	OUT 2 threshold voltage		276	313	349	mV
V_{th3}	OUT 3 threshold voltage		417	469	521	mV
V_{th4}	OUT 4 threshold voltage		558	625	693	mV
V_{th5}	OUT 5 threshold voltage		698	781	864	mV
V_{th6}	OUT 6 threshold voltage		839	938	1036	mV
V_{th7}	OUT 7 threshold voltage		979	1094	1208	mV
V_{th8}	OUT 8 threshold voltage		1120	1250	1380	mV
I_{OL}	Output leakage current				1	μA
I_O	Output sink current	R_{ad}=6.4kΩ	9.6	12	14.4	mA
I_O'	Output sink current	R_{ad}=2.8kΩ	20	25	30	mA
V_{SAT}	Output saturation voltage	R_{ad}=2.8kΩ, I_O=12.5mA			500	mV

TYPICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V, unless otherwise noted)

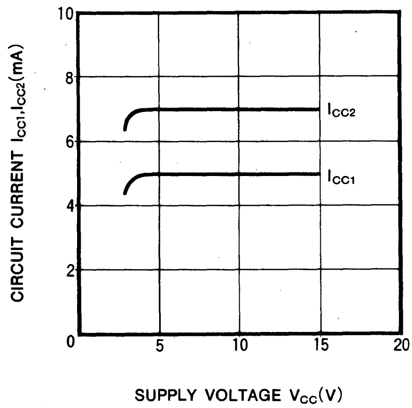
THERMAL DERATING (MAXIMUM RATING)



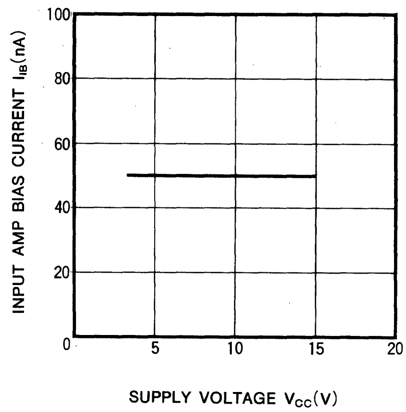
PERMISSIVE OUTPUT CURRENT VS SUPPLY VOLTAGE



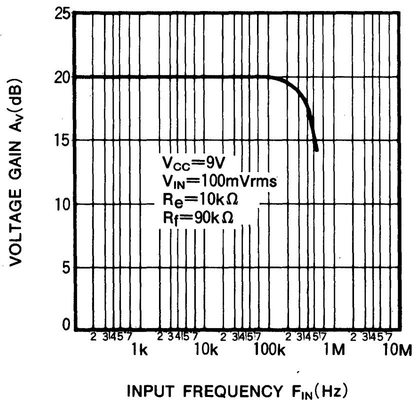
CIRCUIT CURRENT VS SUPPLY VOLTAGE



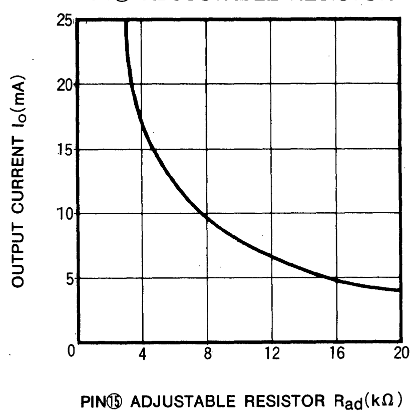
INPUT AMP BIAS CURRENT VS SUPPLY VOLTAGE



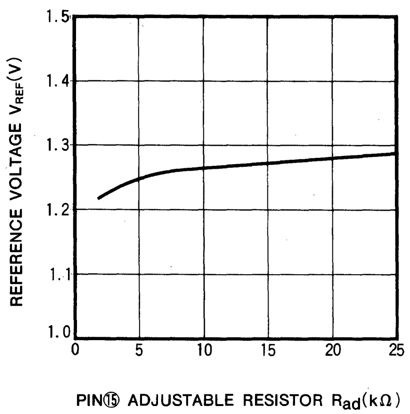
VOLTAGE GAIN VS INPUT FREQUENCY



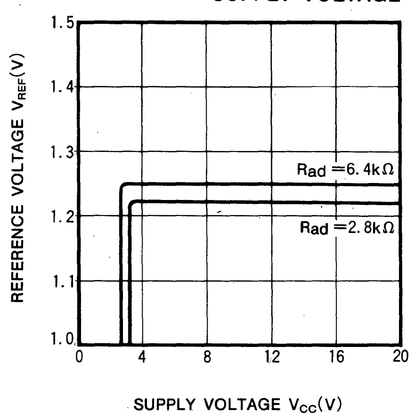
OUTPUT CURRENT VS PIN⑮ ADJUSTABLE RESISTOR



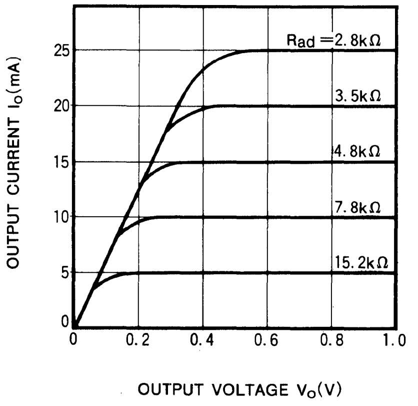
REFERENCE VOLTAGE VS PIN⑮ ADJUSTABLE RESISTOR



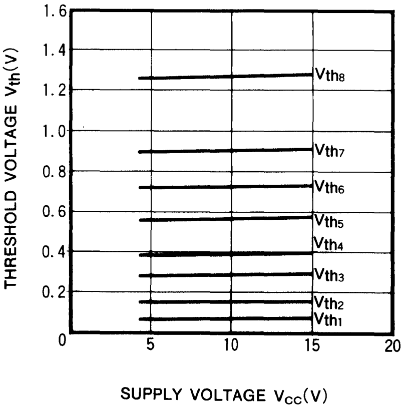
REFERENCE VOLTAGE VS SUPPLY VOLTAGE



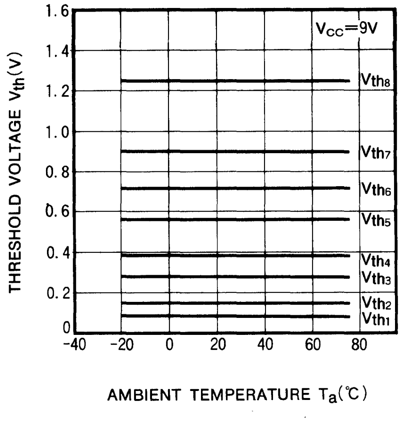
OUTPUT CURRENT VS OUTPUT VOLTAGE



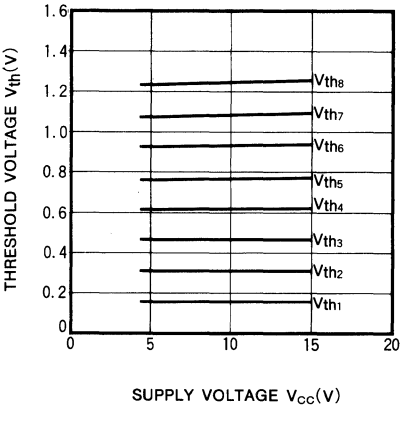
THRESHOLD VOLTAGE VS SUPPLY VOLTAGE (M51907P)



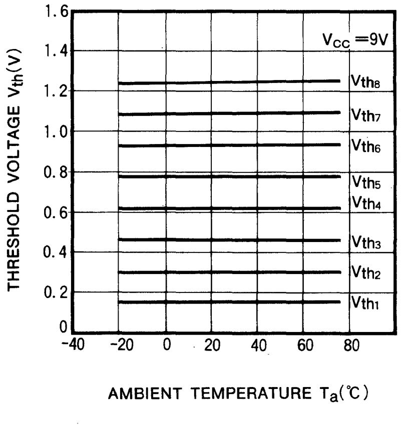
THRESHOLD VOLTAGE VS AMBIENT TEMPERATURE (M51907P)



THRESHOLD VOLTAGE VS SUPPLY VOLTAGE (M51909P)

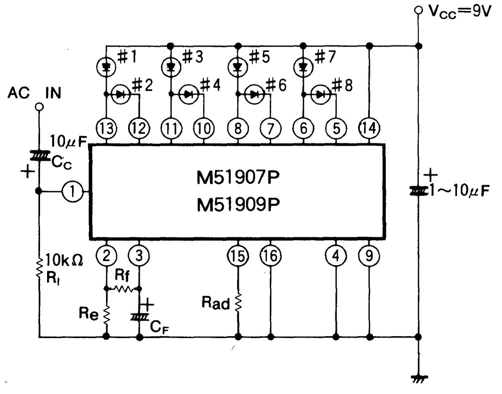


THRESHOLD VOLTAGE VS AMBIENT TEMPERATURE (M51909P)

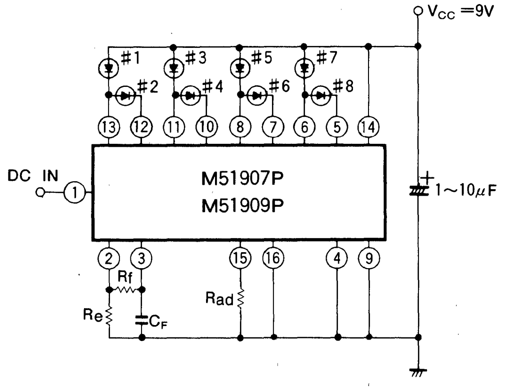


APPLICATION EXAMPLES

(1) AC input application circuit



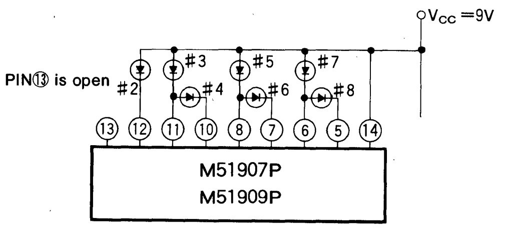
(2) DC Input application circuit



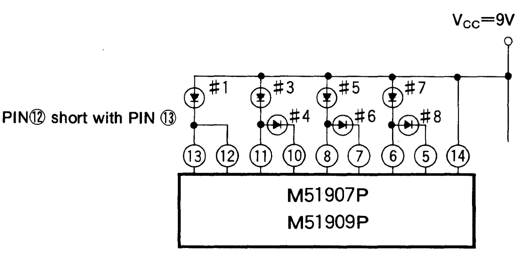
Note : 1. Output current is decided by Rad
2. Amp gain $\sim \frac{R_e + R_f}{R_e}$ ($R_e + R_f \sim 30k\Omega$)
3. Recovery time : $C_F \times (R_e + R_f)$
4. Attack time: $C_F \times 430\Omega$

(3) In case of use fewer than 8 pieces of LED

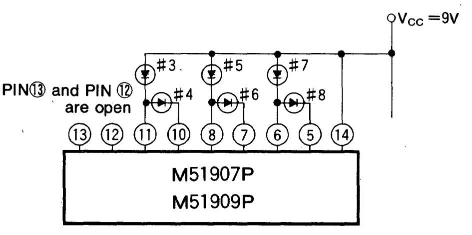
1. In case of no use of #1 LED



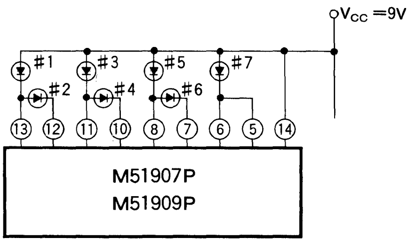
2. In case of no use of #2 LED



3. In case of no use of #1 and #2 LEDs

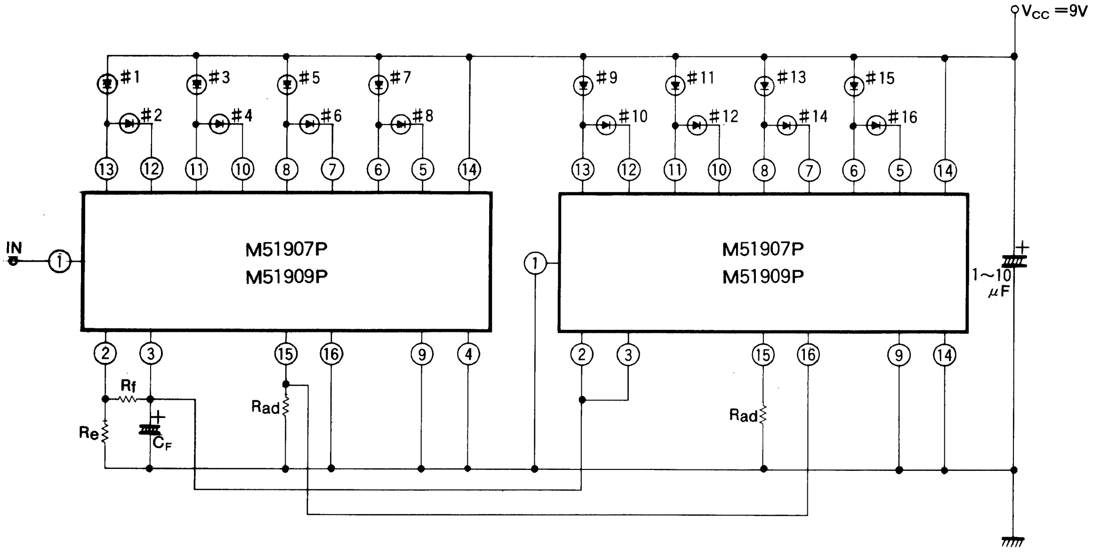


4. In case of no use of same of #3～#8 LEDs

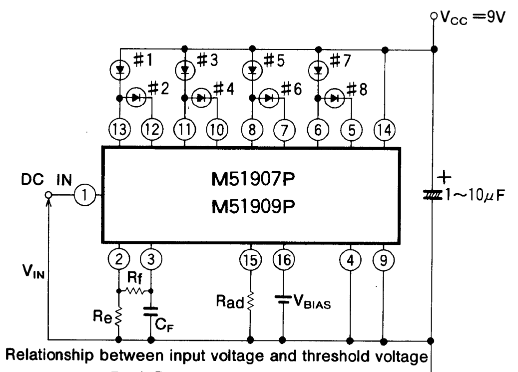


Connect similar to 1～3 according that a number of LED is odd or even. For example, in case of no use of #8 LED, connect similar to the case of no use of #2 LED.

(4) Cascade connection with 2 ICs application circuit

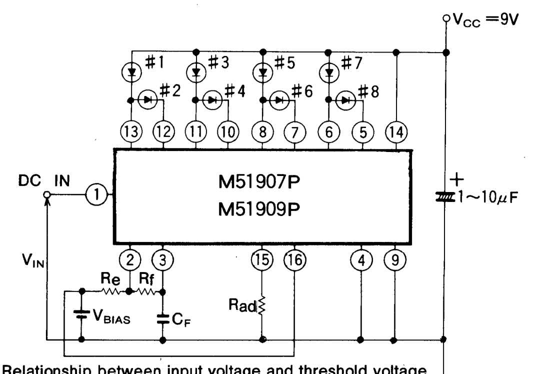


(5) In case that start point for display is not zero



Relationship between input voltage and threshold voltage

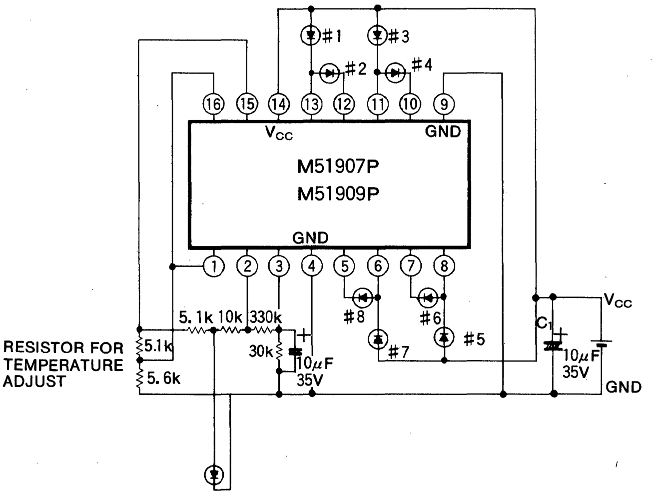
$$V_{thn}=V_{IN}\times\frac{R_e+R_f}{R_e}-V_{BIAS}$$



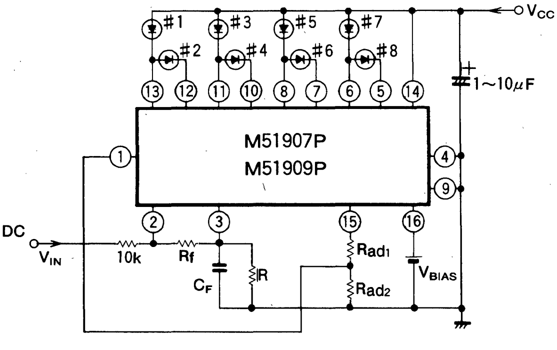
Relationship between input voltage and threshold voltage

$$V_{thn}=(V_{IN}-V_{BIAS})\times\frac{R_e+R_f}{R_e}$$

(6) Thermo indicator with diode sensor



(7) In case that LEDs turn off
by turns according to increase of input voltage.

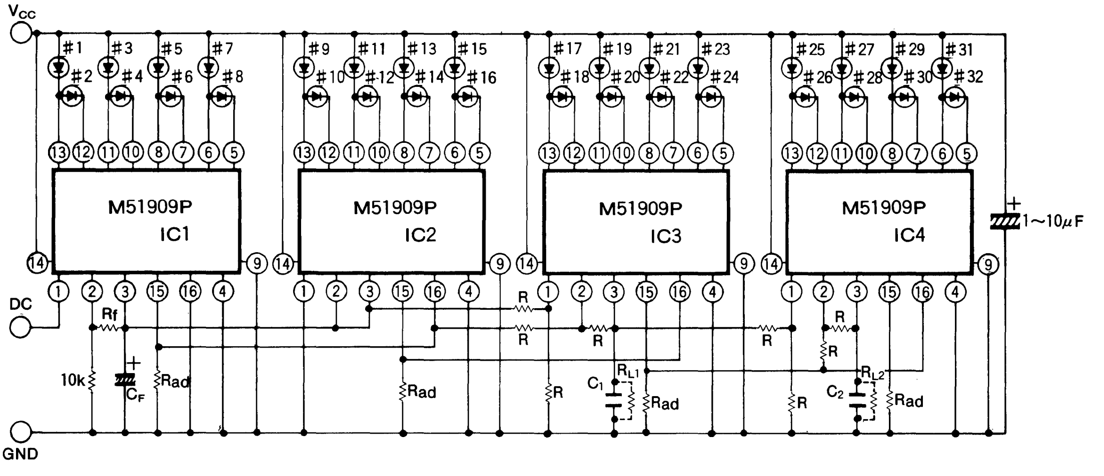


Note : 1. Relationship between input voltage

$$V_{thn}=\frac{1.25\times R_{ad2}}{R_{ad1}+R_{ad2}}\times(1+\frac{R_f}{10k})-V_{IN}\times\frac{R_f}{10k}-V_{BIAS}$$

2. The LED brightness is decided by $(R_{ad1}+R_{ad2})$.

(8) 32 step bar type LED level indicator



Note : 1. Use R over 100kΩ
2. This circuit is suitable for the case V_{CC} over a 6V.
3. Recovery time $C_F \times (R_F + 10k)$
4. C_1, C_2 is a capacity for avoid oscillation.
5. Relationship between R_{L1}, R_{L2} (is resistor for discharge) and recovery time
$C_F\ (R_F+10k) > C_1R_{L1} > C_2R_{L2}\ (C_1, C_2 > 0.1\mu F)$

M51910P

9-POINT/2-INPUT LED LEVEL INDICATOR

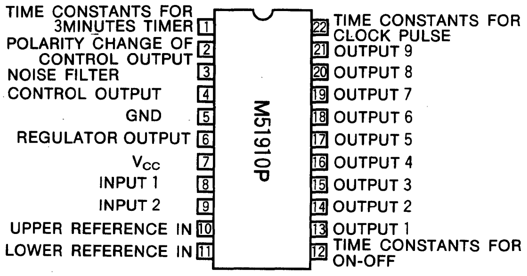
DESCRIPTION

The M51910P is a dot display type LED indicator. 2input levels can be indicated at the same time with the different modes, static mode and on-off mode. The built-in comparator compares that 2 input levels, and that output can drive the current within 50mA.

FEATURES

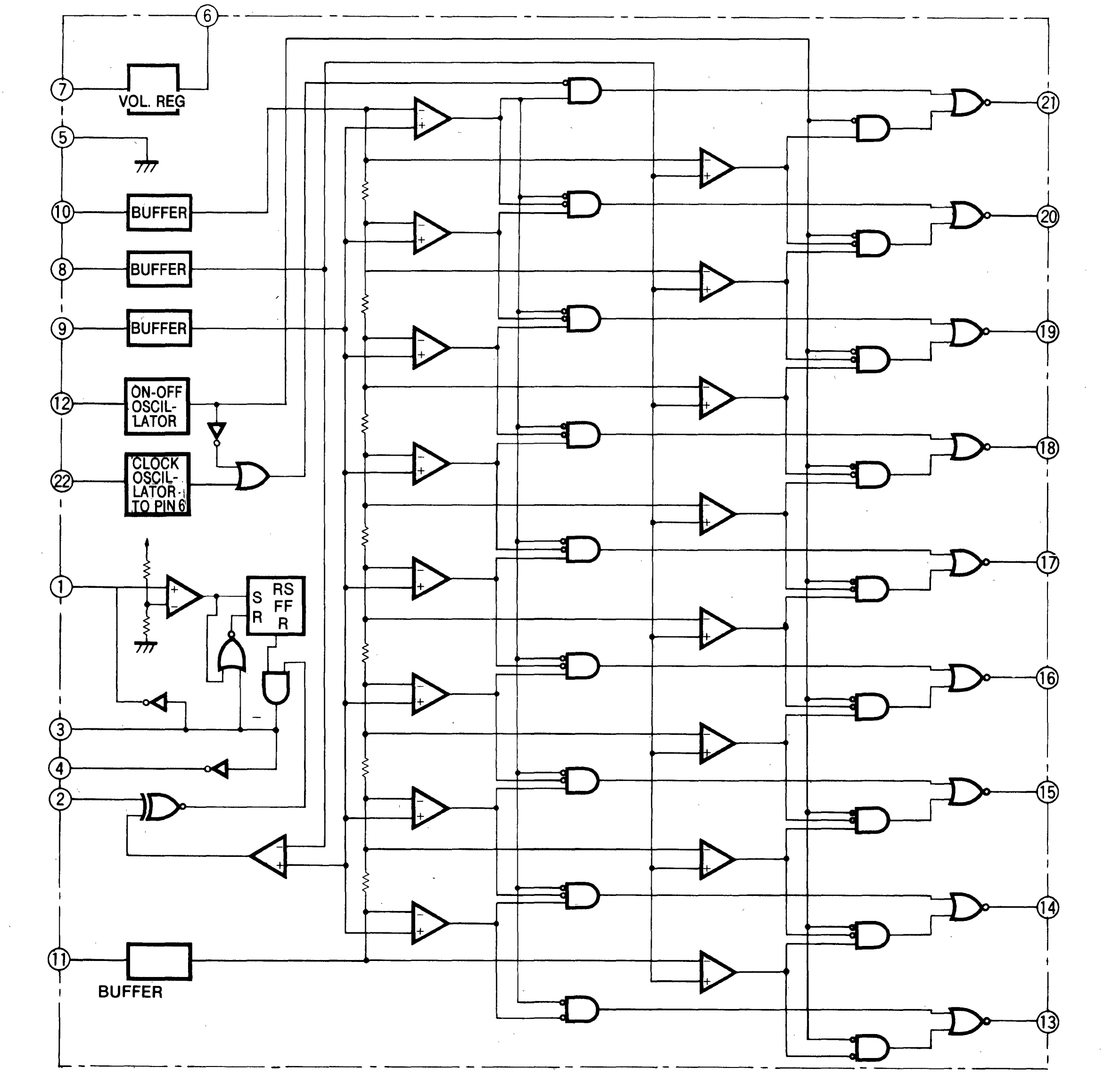
- 2 input level indicator
- Threshold voltage is selectable by the external reference voltage ············ reference voltage range 0.5~3.5V
- Built-in voltage regulator ········· V_S=4.8V, Iomax=10mA
- Built-in timer that operates even when power is off for a moment ······················ Setting range is within 5 minutes.

PIN CONFIGURAION (TOP VIEW)



Outline 22P4

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		18	V
I_{odis}	Display output current		30*	mA
BV_{odis}	Display output voltage		18	V
$I_{④}$	Pin④ current	Sink current	50	mA
$BV_{④}$	Pin④ voltage		30	V
$I_{⑥}$	Pin⑥ current	Issued current	−10	mA
P_d	Power dissipation		1400	mW
K_{θ}	Thermal derating	T_a≧25℃	1.4	mW/℃
T_{opr}	Operating temperature		−20~+75	℃
T_{stg}	Storage temperature		−40~+125	℃

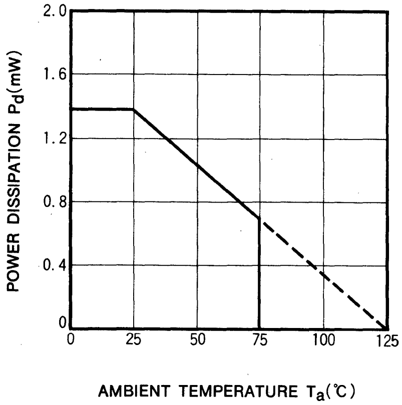
* : The average current rating is 20mA when the clock frequency is over 30Hz. (Peak current=40mA)

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=12V, unless otherwise noted)

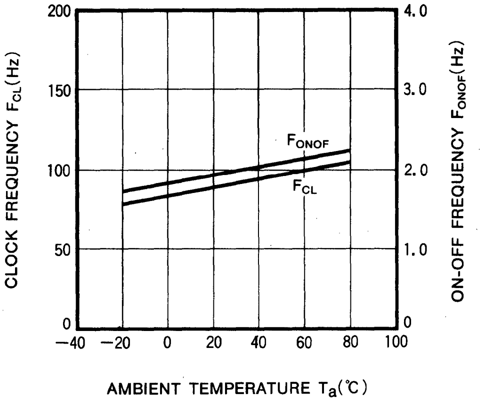
Symbol	Parameter		Test conditions	Limits Min	Typ	Max	Unit
I_{CC}	Circuit current				10	20	mA
V_S	Regulated voltage		Pin⑥ voltage	4.4	4.8	5.4	V
$I_{⑧in}$	Pin⑧ input current			−10	−1.7		μA
$I_{⑨in}$	Pin⑨ input current			−10	−1.7		
$I_{⑩in}$	Pin⑩ input current			−10	−1.7		
$I_{⑪in}$	Pin⑪ input current			−15	−2.7		
$V_{⑧on2}$	Threshold voltage for pin⑧	Output 2	Input level when the output change from off to on according to rising input level	2.180	2.22	2.250	V
$V_{⑧on3}$		Output 3		2.265	2.30	2.335	
$V_{⑧on4}$		Output 4		2.345	2.38	2.415	
$V_{⑧on5}$		Output 5		2.425	2.46	2.495	
$V_{⑧on6}$		Output 6		2.505	2.54	2.574	
$V_{⑧on7}$		Output 7		2.585	2.62	2.655	
$V_{⑧on8}$		Output 8		2.670	2.70	2.740	
$V_{⑧on9}$		Output 9		2.750	2.79	2.820	
$V_{⑨on2}$	Threshold voltage for pin⑨	Output 2		2.180	2.22	2.250	V
$V_{⑨on3}$		Output 3		2.265	2.30	2.335	
$V_{⑨on4}$		Output 4		2.345	2.38	2.415	
$V_{⑨on5}$		Output 5		2.425	2.46	2.495	
$V_{⑨on6}$		Output 6		2.505	2.54	2.575	
$V_{⑨on7}$		Output 7		2.585	2.62	2.655	
$V_{⑨on8}$		Output 8		2.670	2.70	2.740	
$V_{⑨on9}$		Output 9		2.750	2.79	2.820	
$V_{⑧HY}$	Hysterisis of pin⑧ level for display		Input difference between off-on level and on-off level	3	5	7	mV
$V_{⑨HY}$	Hysterisis of pin⑨ level for display						
$\Delta V_{⑧}$	Threshold voltage difference for pin⑧ between neighboring outputs			70	82	95	mV
$\Delta V_{⑨}$	Threshold voltage difference for pin⑨ between neighboring outputs						
$\Delta V_{⑧⑨}$	Threshold voltage difference for same output between pin⑧ and pin⑨			−12	0	12	mV
F_{CL}	Frequency of clock oscillator		Half of frequency at pin㉒		90		Hz
F_{ONOF}	Frequency of on-off oscillator		Half of frequency at pin⑫		2		Hz
V_{CTH}	Built-in comparator threshold voltage		$V_{⑧}$=2.500V, threshold voltage for pin⑨	2.490	2.505	2.530	V
ΔV_{CT}	Built-in comparator hysterisis			5	15	25	mV
T_t	Operating time of timer				200		Sec

TYPICAL CHARACTERISTICS

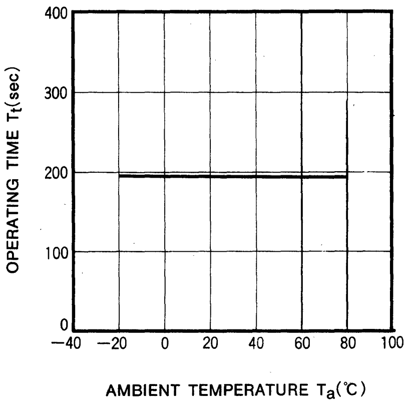
THERMAL DERATING
(MAXIMUM RATING)



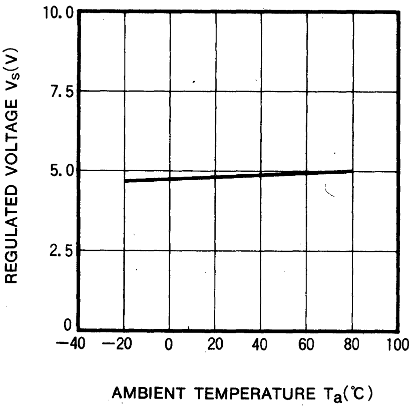
ON-OFF, CLOCK FREQUENCY
VS AMBIENT TEMPERATURE



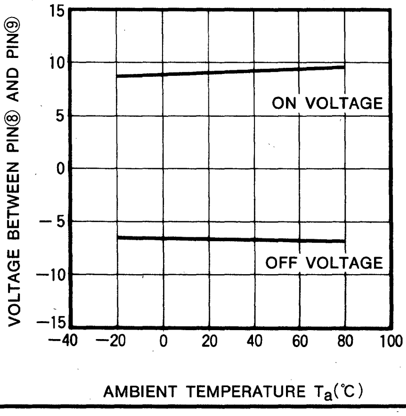
OPERATING TIME OF TIMER
VS AMBIENT TEMPERATURE



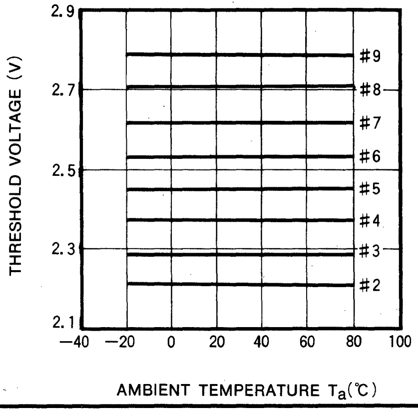
REGULATED VOLTAGE
VS AMBIENT TEMPERATURE



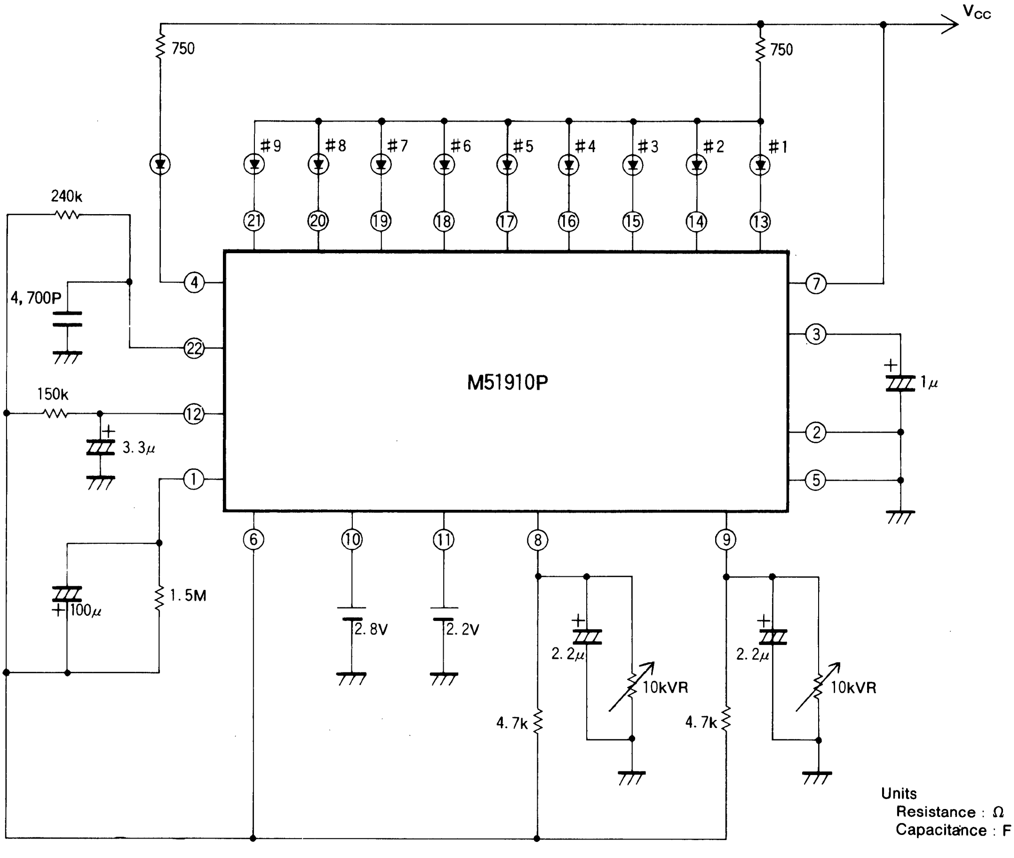
BUILT-IN COMPARATOR
ON, OFF VOLTAGE VS
AMBIENT TEMPERATURE



THRESHOLD VOLTAGE
FOR DISPLAY VS
AMBIENT TEMPERATURE



TEST CIRCUIT AND TYPICAL APPLICATION



Units
Resistance : Ω
Capacitance : F

M51911L
M51912L

6-STEP BAR TYPE LED LEVEL INDICATOR

DESCRIPTION

The M51911L/M51912L is a semiconductor integrated circuit consisting of a circuit designed for LED level meters.
It is capable of bar type display for 6 LEDs according to a input level. AC or DC signal can be inputed because of built-in superior half-wave rectification OP Amp. Output is a cascade connection of a pair of LEDs, so current for display is half. Display level of the M51911L is logarithmical scale, +3, 0, −3, −7, −12, −18dB.

The M51912L is a companion products to the M51911L, display level is linear scale, 208mV step.

FEATURES

- Built-in superior half-wave rectification OP Amp.
  Cut off frequency ······ 500kHz(typ.)
  Input offset voltage ······ 2mV(typ.)
- Output current is decided by internal circuit, so has few external parts. ······ I_O=13mA(typ.)
- Built-in reference voltage for threshold level
  It has little dependence on supply voltage and temperature ······ V_{REF}=1.25V(typ.)
- Range of supply voltage in wide ······ 4∼15V
- Amp gain is decided by internal circuit ······ 17dB(typ.)

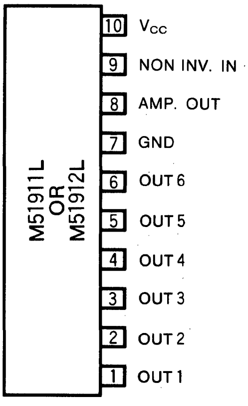
APPLICATION

Signal meters, VU meters, tuning meters, and other general display applications.

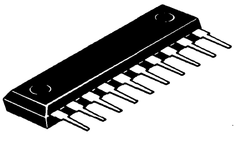
RECOMMENDED OPERATING CONDITIONS

Supply voltage range ······ 4∼15V
Rated supply voltage ······ 9V±10%

PIN CONFIGURATION (TOP VIEW)

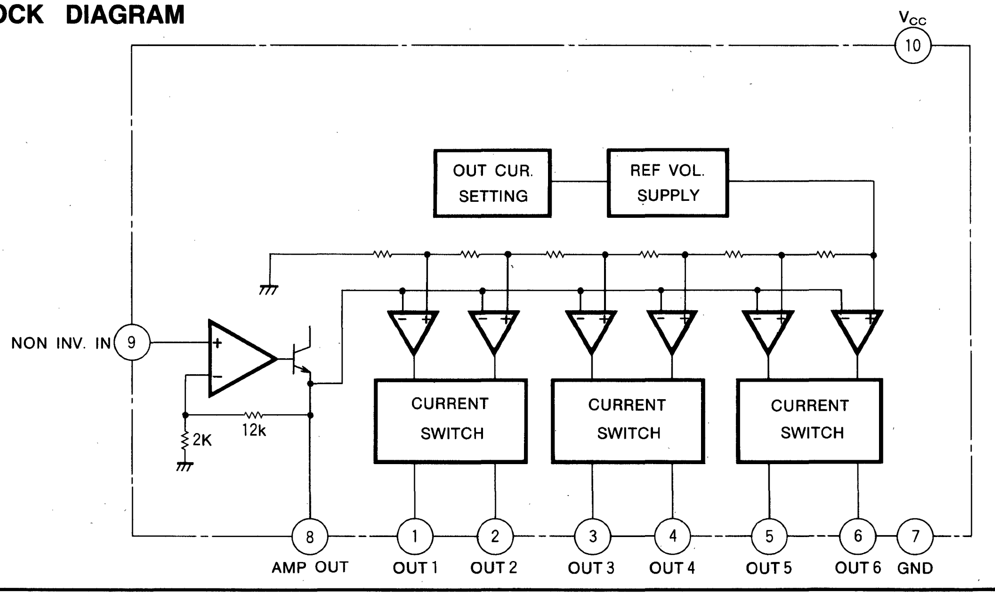


Outline 10P5



10-pin molded plastic SIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		16	V
BV_O	Output voltage		16	V
V_{IN}	Input voltage	Pin⑨−GND	−2~V_{CC}	V
$I_⑧$	Pin⑧ issued current		−1	mA
$V_⑧$	Pin⑧ voltage	Pin⑧−GND	6	V
P_d	Power dissipation		1100	mW
K_θ	Thermal derating	T_a≧25℃	8.8	mW/℃
T_{opr}	Operating temperature		−20~+75	℃
T_{stg}	Storage temperature		−40~+125	℃

M51911L
ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		4.0		16.0	V
I_{CC1}	Circuit current	All outs are off, $V_⑨$=0V		3.5	5.6	mA
I_{CC2}	Circuit current	All outs are on, $V_⑨$=200mV		4.0	6.4	mA
I_{IB}	Input amp bias current	$V_⑨$=0V	−500	−150		nA
A_V	Input amp gain			17		dB
V_{th1}	OUT 1 threshold voltage	Amp gain=17dB Threshold voltage is $V_⑨$−GND	6.3	11.2	16.8	mV_{rms}
			−23	−18	−14.5	dB
V_{th2}	OUT 2 threshold voltage		16.8	22.5	28.3	mV_{rms}
			−14.5	−12	−10	dB
V_{th3}	OUT 3 threshold voltage		33.7	40	47.6	mV_{rms}
			−8.5	−7	−5.5	dB
V_{th4}	OUT 4 threshold voltage		56.6	63.5	71.3	mV_{rms}
			−4	−3	−2	dB
V_{th5}	OUT 5 threshold voltage		79.9	89.7	100.6	mV_{rms}
			−1	0	+1	dB
V_{th6}	OUT 6 threshold voltage		112.9	126.6	142.2	mV_{rms}
			+2	+3	+4	dB
I_O	Output sink current		8.5	13	18	mA
I_{OL}	Output leakage current	Output voltage=V_{CC}			1	μA
$R_⑧$	Pin⑧ internal resistor	$V_⑧$=0.3V	9	14	19	kΩ

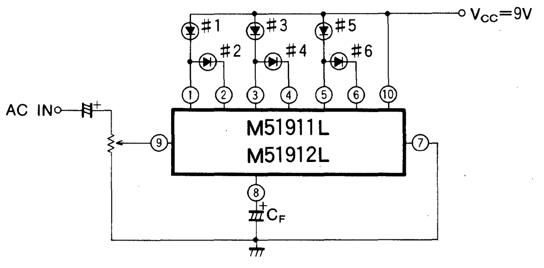
M51912L
ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		4		16	V
I_{CC1}	Circuit current	All outs are off, $V_⑨$=0V		3.5	5.6	mA
I_{CC2}	Circuit current	All outs are on, $V_⑨$=200mV		4	6.4	mA
I_{IB}	Input amp bias current	$V_⑨$=0V	−500	−150		nA
A_V	Input amp gain			17		dB
V_{th1}	OUT 1 threshold voltage	Amp gain=17dB Threshold voltage is $V_⑨$−GND	22	29	36	mV
V_{th2}	OUT 2 threshold voltage		49	59	69	mV
V_{th3}	OUT 3 threshold voltage		75	89	103*	mV
V_{th4}	OUT 4 threshold voltage		102*	119	136*	mV
V_{th5}	OUT 5 threshold voltage		128*	149	170*	mV
V_{th6}	OUT 6 threshold voltage		153*	179	205	mV
I_O	Output sink current		8.5	13	18	mA
I_{OL}	Output leakage current	Output voltage=V_{CC}			1	μA
$R_⑧$	Pin⑧ internal resistor	$V_⑧$=0.3V	9	14	19	kΩ

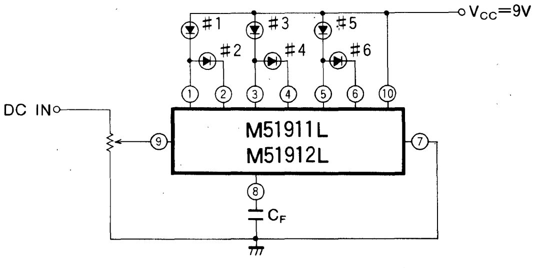
(NOTES : * No overlap in a IC)

APPLICATION EXAMPLES

(1) AC input application circuit



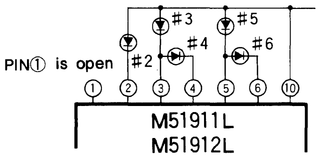
(2) DC input application circuit



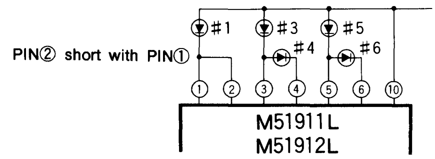
Note : 1. Output current is decided by internal circuit : 13mA(typ.)
2. Amp gain is decided by internal resistor : 17dB(typ.)
3. Recovery time : CF×14kΩ(typ.)
4. Attack time : CF×430Ω(typ.)

(3) In case of use fewer than 6 pieces of LED

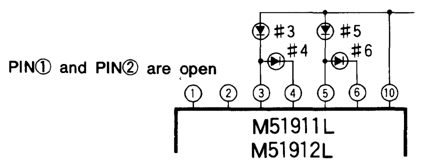
1. In case of no use of #1 LED



2. In case of no use of #2 LED

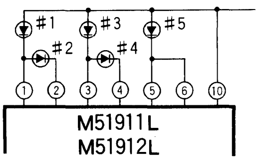


3. In case of no use of #1 and #2 LEDs



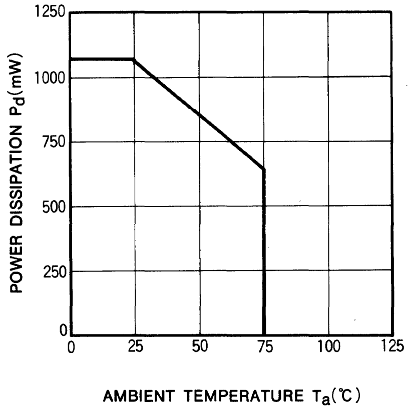
4. In case of no use of some of #3~#6 LEDs

Connect similar to 1 ~ 3 according that the number of LED is odd or even. For example in case of no use of #6 LED connect similar to the case of no use of #2 LED.

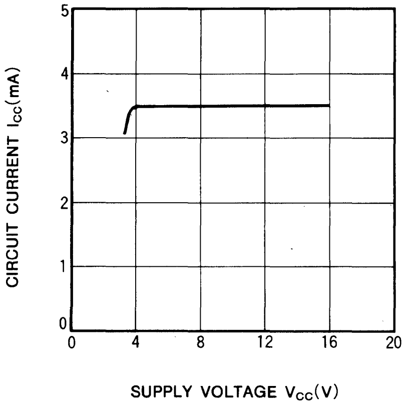


TYPICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V, unless otherwise noted)

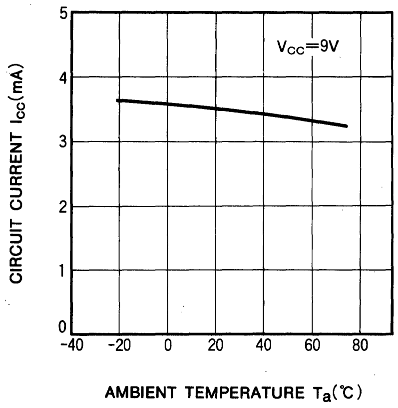
THERMAL DERATING (MAXIMUM RATING)



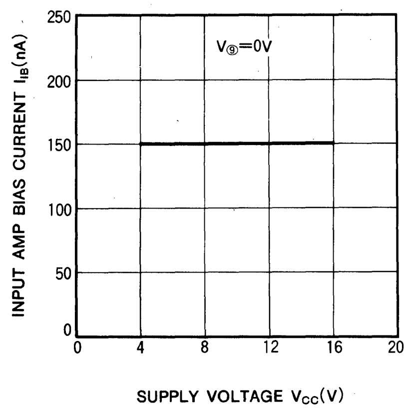
CIRCUIT CURRENT VS SUPPLY VOLTAGE



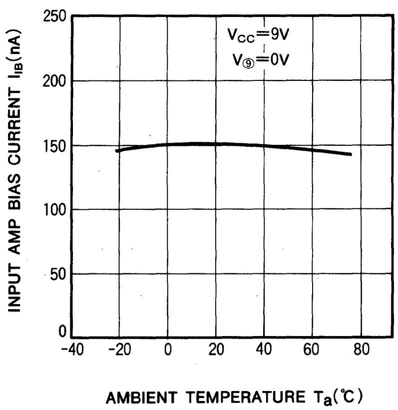
CIRCUIT CURRENT VS AMBIENT TEMPERATURE



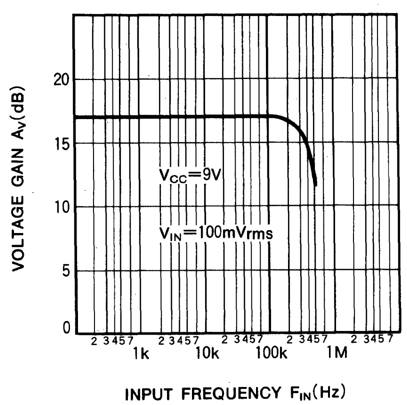
INPUT AMP BIAS CURRENT VS SUPPLY VOLTAGE



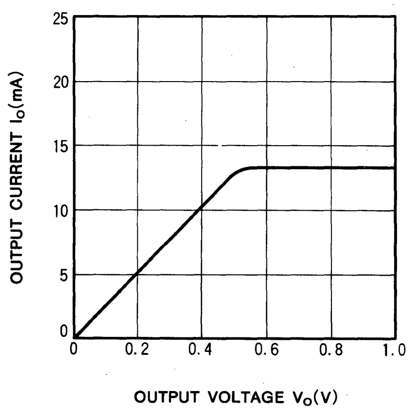
INPUT AMP BIAS CURRENT VS AMBIENT TEMPERATURE



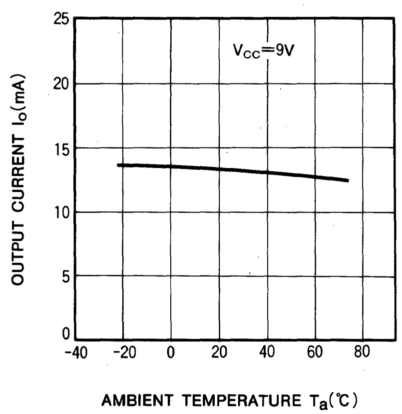
VOLTAGE GAIN VS INPUT FREQUENCY



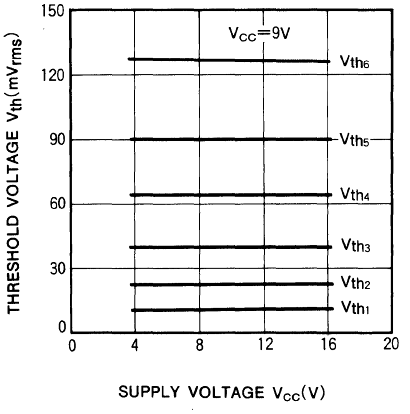
OUTPUT CURRENT VS OUTPUT VOLTAGE



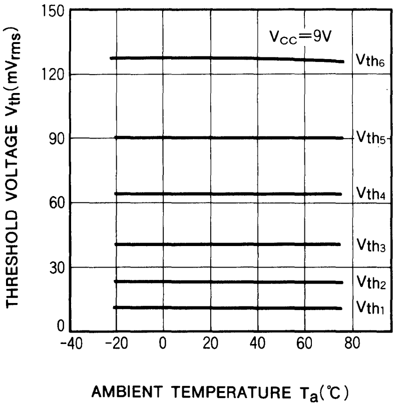
OUTPUT CURRENT VS AMBIENT TEMPERATURE



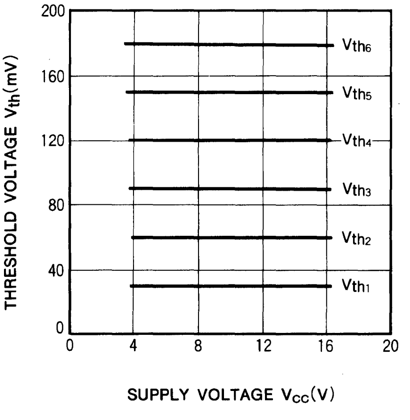
THRESHOLD VOLTAGE VS SUPPLY VOLTAGE (M51911L)



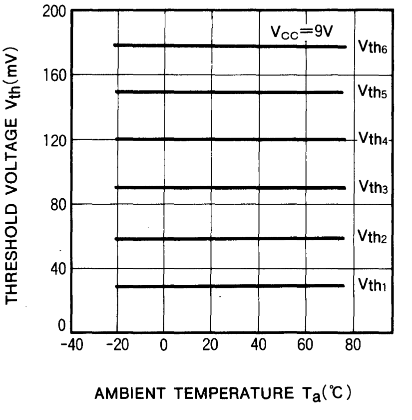
THRESHOLD VOLTAGE VS AMBIENT TEMPERATURE (M51911L)



THRESHOLD VOLTAGE VS SUPPLY VOLTAGE (M51912L)



THRESHOLD VOLTAGE VS AMBIENT TEMPERATURE (M51912L)



M51961L

FLASHER CONTROL CIRCUIT

DESCRIPTION

The M51961L is a semiconductor integrated circuit for flasher, and especially is suited for the automobile flasher. It is designed so that its flashing frequency is set to 85cpm in case of turn signal or hazard, then it is 192cpm in case of break.

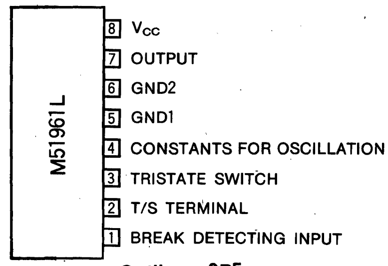
The break detecting is made use of the break detecting resistance connecting between the power supply and the lamp.

The threshold voltage for break is about 90mV when supply voltage is 12.8V, and it is designed so as to compensate for the characteristics of the lamp of supply voltage and temperature.

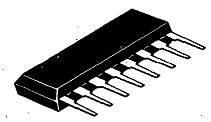
FEATURES

- The lamp is on immediately after turn signal switch is turned on. .... 25ms (max.)
- Threshold voltage for break detecting compensates for the characteristics of the lamp.
- Deviation of flashing frequency according to supply voltage and temperature is small......................... 1 %(typ.) (V_{CC}=7∼17V and T_a=−20∼+60℃)
- Flashing frequency is not influenced by the ripple of power supply because of the built-in stabilized power supply.
- The built in zenor diode at the output terminal for absorbing reverse E.M.F of the relay.

PIN CONFIGURATION (TOP VIEW)



Outline 8P5



8-pin molded plastic SIL

APPLICATION

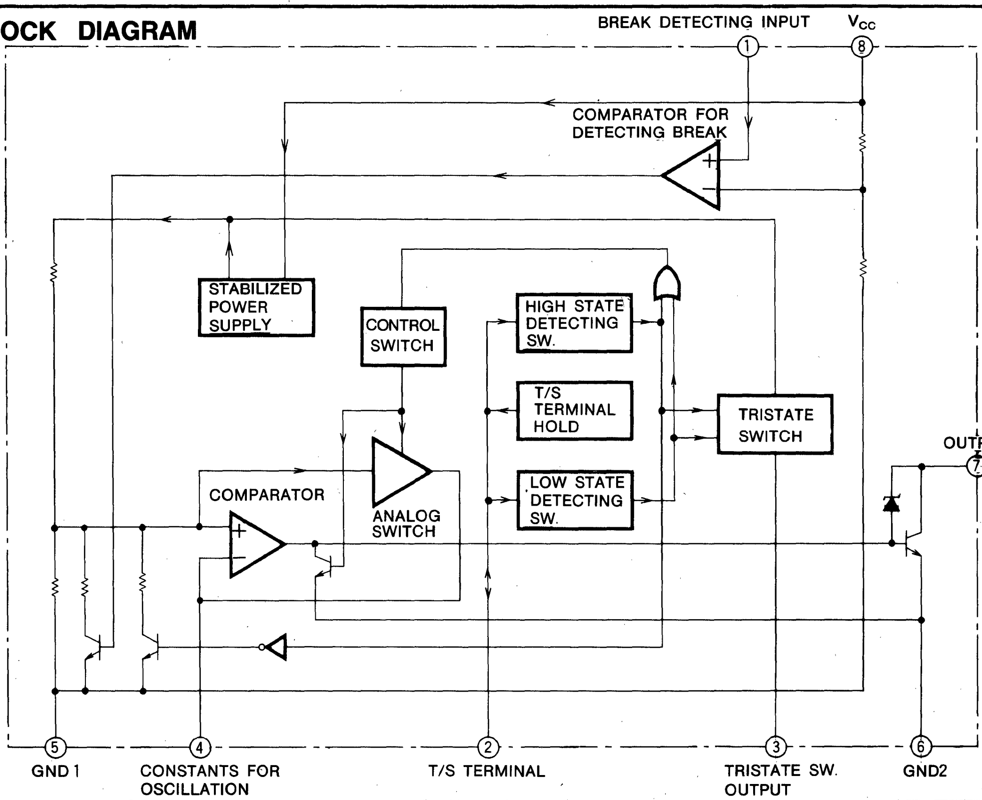
Automobile flasher, break detecting of lamp.

RECOMMENDED OPERATING CONDITIONS

Supply voltage range.. 9∼16V

Rated supply voltage.. 12.8V

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Limits	Unit
V_{CC1}	Supply voltage		18	V
V_{CC2}	Peak supply voltage	t≦1min	24.5	V
BV_{O}	Output breakdown voltage		24.5	V
I_{O}	Output current		150	mA
$V_{②}$	Voltage at ②pin		V_{CC}−36V∼V_{CC}	V
$V_{①}$	Voltage at ①pin		O∼V_{CC}	V
P_{d}	Power dissipation		900	mW
K_{θ}	Derating	T_{a}≧25℃	7.2	mW/℃
T_{opr}	Operating temperature		−40∼+85	℃
T_{stg}	Storage temperature		−50∼+125	℃

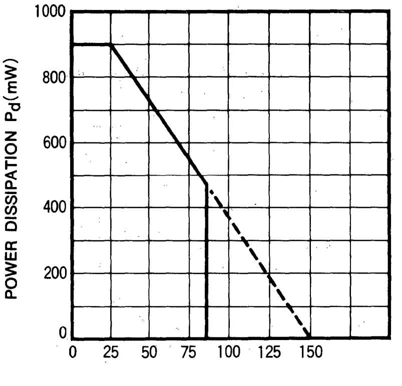
ELECTRICAL CHARACTERISTICS (R_{t}=55kΩ, C_{t}=10μF, T_{a}=25℃, V_{CC}=12.8V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range		7	12.8	17	V
T_{S}	Time from T/S on to lamp on			5	25	mS
N_{1}	Flashing frequency 1	In case of T/S or hazard	81	85	89	cpm
N_{2}	Flashing frequency 2	In case of break	178	192	207	cpm
D_{1}	Duty of lamp on 1	In case of T/S or hazard	41	45	49	%
D_{2}	Duty of lamp on 2	In case of break	33	37	41	%
$V_{①TH}$	Threshold voltage for break detecting		84	91.3	98.5	mV
I_{CC1}	Circuit current 1	In case of output off		3.4	5.3	mA
I_{CC2}	Circuit current 2	In case of output on		8.9	15	mA
$V_{②}$	②pin voltage	②pin open	6.0	7.4	9.0	V
$V_{②THH}$	High threshold voltage of ②pin		$V_{②}$+1	9.2*1	11.3*1	V
$V_{②THL}$	Low threshold voltage of ②pin		3.5*2	5.6*2	$V_{②}$−1	V
$I_{②IN1}$	Input current to ②pin	Voltage at ②pin is V_{CC}.	0.6	0.96	1.6	mA
$I_{②IN2}$	Input current from ②pin	Voltage at ② pin is GND.	−2.2	−1.36	−0.9	mA
$I_{①IN}$	Input current to ①pin	Voltage at ①pin is V_{CC}.		1.6	20	μA
V_{OS}	Output saturation voltage	R_{L}=120Ω		180	500	mV
I_{OL}	Output leak current				100	nA
V_{OZ}	Zenor voltage at output		26	30	36	V

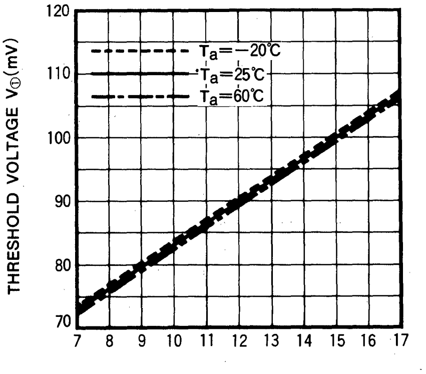
*1 Higher than $V_{②}$+1V
*2 Lower than $V_{②}$−1V

TYPICAL CHARACTERISTICS (T_a=25℃, V_{CC}=12.8V, unless otherwise noted)

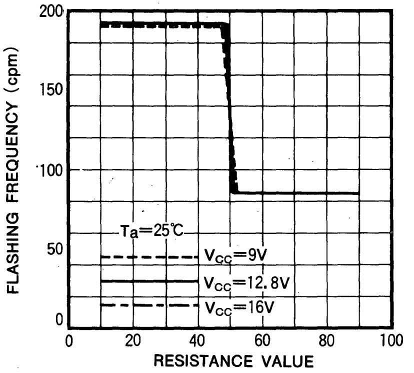
THERMAL DERATING (MAXIMUM RATING)



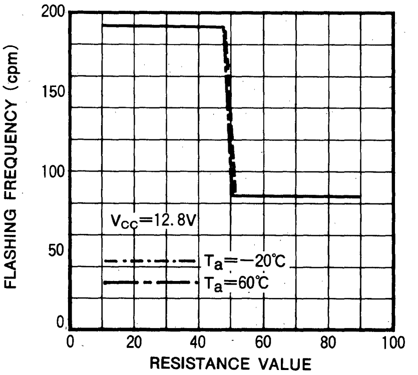
THRESHOLD VOLTAGE CHARACTERISTICS FOR BREAK DETECTING



FLASHING FREQUENCY CHARACTERISTICS ①



FLASHING FREQUENCY CHARACTERISTICS ②

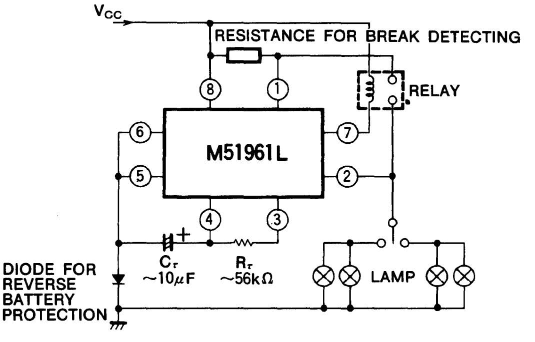


Note : 1. Flashing frequency characteristics was measured by changing the resistance value for break detecting instead of the lamp resistance used lamp; one 23W lamp

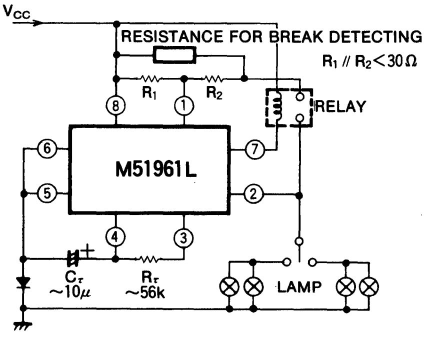
Note : 2. In the flashing frequency characteristics ② we didn't take the change of R_I C_I by temperature into cnsideration.

APPLICATION EXAMPLES

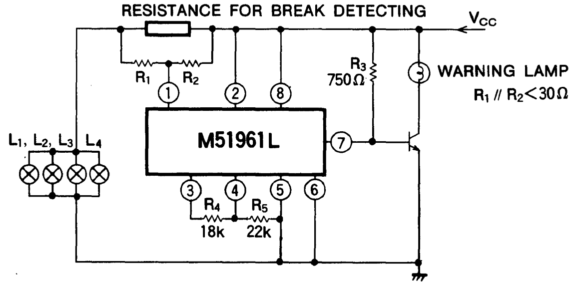
(1) Typical example



(2) Example in case of adjusting the threshold voltage for break detecting



(3) Example for break warning



The warning lamp is on when one or more lamps of the four break.

M51970L

SPEED CONTROL FOR DC MICRO MOTOR

DESCRIPTION

The M51970L is a monolithic IC designed for use of speed control for DC micro motor. It controls constantly speed of DC micro motor, connecting the signal of frequency-generation detector to the IC. It consists of an input signal amplifier, a monostable multivibrator, an integrator, an output current amplifier with current limiter, an overshoot protector and an internal voltage regulator.

FEATURES

- Wide supply voltage range······ 2.5~18V (−20~+75℃)
- High stability vs supply voltage············±0.01%/V (typ.)
- High stability vs temperature············ ±10ppm/℃ (typ.)
- High stability vs load ····························· ±0.1%(typ.)
- Provides DC output drive for minimum RFI.
- Includes overshoot protection circuit for quick start response of motor with less overshoot.

APPLICATIONS

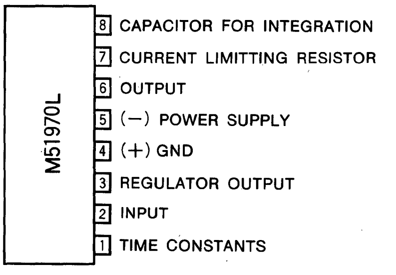
- 8m/m movie camera
- Floppy disk driver
- Record player
- Tape recorder
- Car stereo
- Motor driven equipment

RECOMMENDED OPERATING CONDITIONS

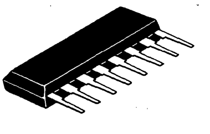
Supply voltage range·· 2.5~17V

Rated supply voltage··· 9V

PIN CONFIGURATION (TOP VIEW)

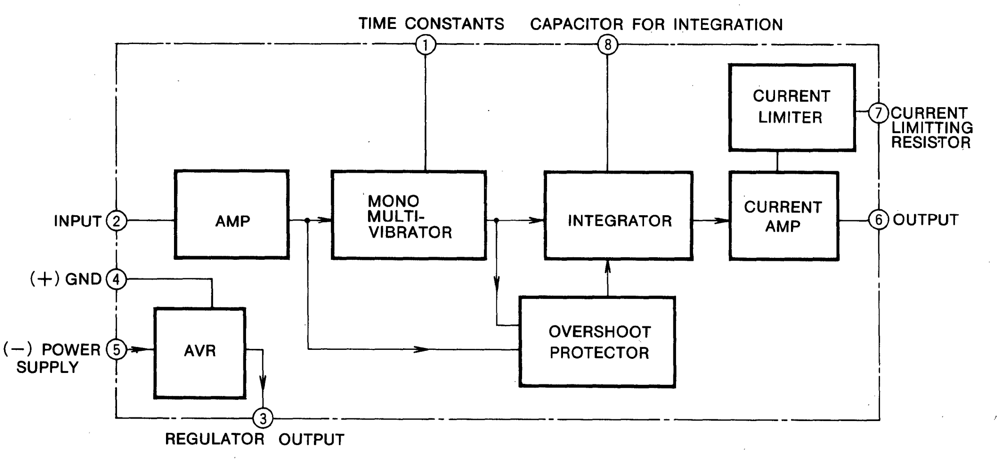


Outline 8P5



8-pin molded plastic SIL

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

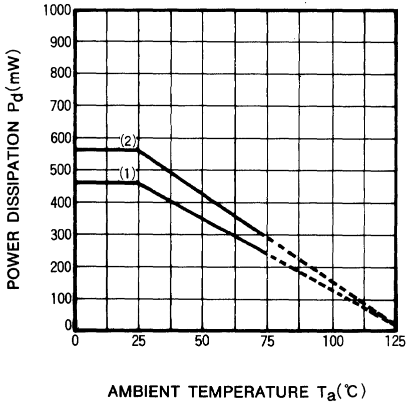
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		18	V
$I_⑥$	Sink current into ⑥		40	mA
$I_③$	Issued current from ③		−3	mA
P_d	Power dissipation	Mounted on the P-C board (Cu foil area 4.5×5.5cm, t=35μ, thickness of the P-C board 2mm)	550	mW
K_θ	Derating		5.5	mW/℃
T_{opr}	Operating temperature		−20～+75	℃
T_{stg}	Storage temperature		−40～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=9V, unles otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage range	T_a=−20～+75℃	2.5		18	V
I_{CC}	Circuit current	Except output current	3	4.5	8	mA
V_S	Regulated output voltage	Between ④ and ③	1.8	2.0	2.2	V
$V_{TH②}$	Input threshold voltage		−50	0	50	mV
$R_{IN②}$	Input impedance		4.2	7.9	12	kΩ
$I_{SC⑥}$	Limitted output current	R_{SC}=27Ω	20	27	35	mA
T_τ	Pulse width of mono. -multi.	R_τ=75k, C_τ=4700pF	375	395	415	μs
R_{eg}-V_{CC}	Motor speed stability for V_{CC}	V_{CC}=4～15V		±0.1		%
R_{eg-L}	Motor speed stability for load			±0.1		%
TC_N	Motor speed stability for temperature	T_a=−20～+75℃		±10		ppm/℃

TYPICAL CHARACTERISTICS

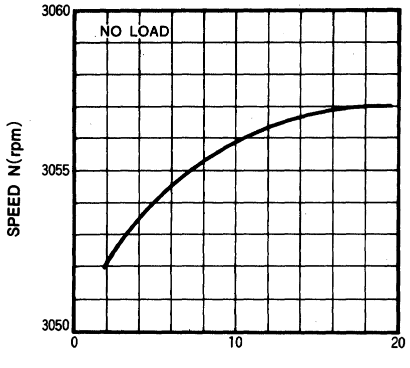
THERMAL DERATING (MAXIMUM RATING)



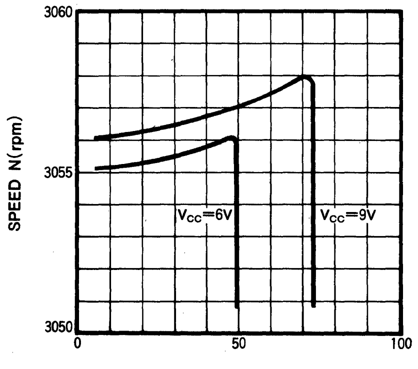
(1) IC only
(2) With printed circuit board of 2mm thick cover with Cu area of 4.5cmW×5.5cmL×35μt

Following datas come from the "APPLICATION CIRCUIT" applying the following components.
R_1=100kΩ, R_2=30kΩ, C_{F1}=1μF, C_{F2}=4.7μF, R_F=4.7kΩ, R_τ=75kΩ, C_τ=22,000pF, R_{SC}=56Ω, No. of tachogeneratorpoles=10. Components R, C, were located outside of the temperature test chamber in case of measuring "Speed VS ambient temperature".

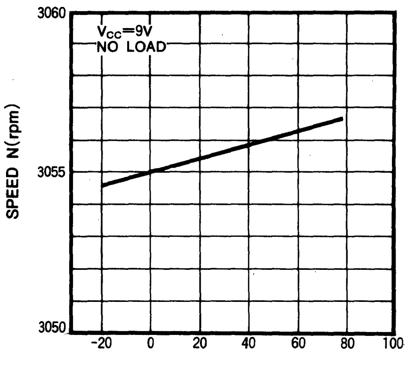
SPEED VS SUPPLY VOLTAGE



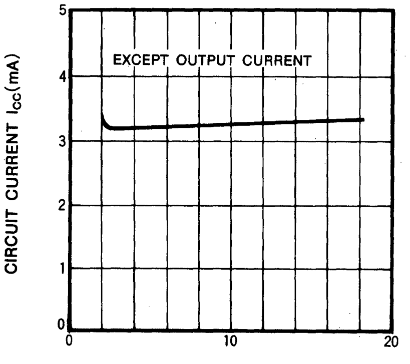
SPEED VS MOTOR TORQUE



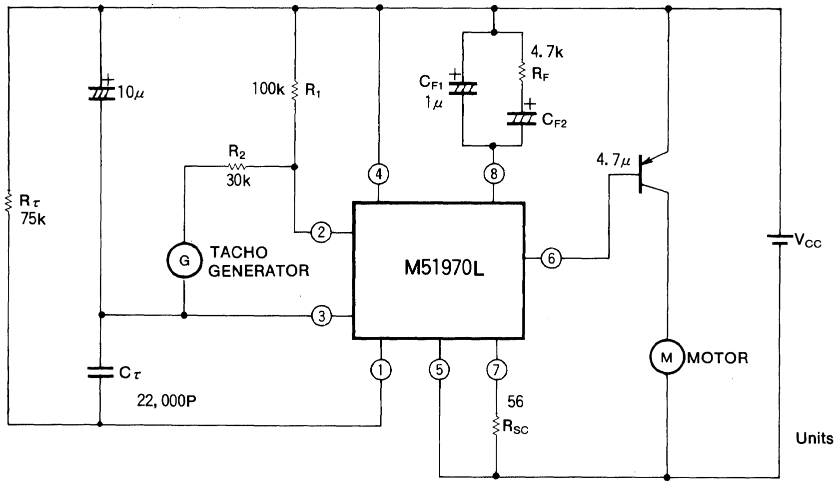
SPEED VS AMBIENT TEMPERATURE



CIRCUIT CURRENT VS POWER SUPPLY

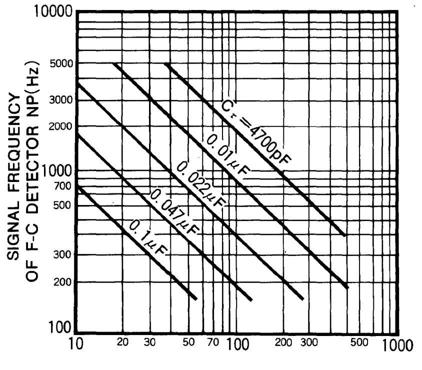


MEASUREMENT CIRCUIT AND TYPICAL APPLICATION CIRCUIT



Units Resistance : Ω
Capacitance : F

● HOW TO DETERMINE Rτ. Cτ



Rτ. Cτ. determine the speed of motor

$$NP \doteqdot \frac{1}{1.17 R_\tau C_\tau}$$

where N; the speed of motor
P; number of pole pair of F-G detector.
The desiarable range of Rτ is usually 10k to 500kΩ.

APPLICATION HINTS

(1) HOW TO DECIDE THE CONSTANTS OF FILTER AT ⑧ PIN

The dynamic characteristics of a motor is determined by the relationships between the constants which a motor originally has, (such as, mechanical constant or inertia and tacho generator frequency) and circuit constants (C_{F1}, C_{F2}, RF in the typical application circuit)

The following relationships will be recommendable to choose circuit constants when a cycle of tacho generator is $T_G(=1/f_G)$, and the mechanical time constant of a motor is τ_M.

1. C_{F1} should be a smaller value in order to improve the circuit response. (But if the value is too small, peak to peak value of ramp shaped driving wave increases and becomes pulsive driven).

$$F_G \times C_{F1} = 50 \sim 150\text{Hz} \cdot \mu\text{F}$$

2. The relationship between the time period of a tacho generator, and the motor constant should be following, because the control is more unstable if speed information is less,

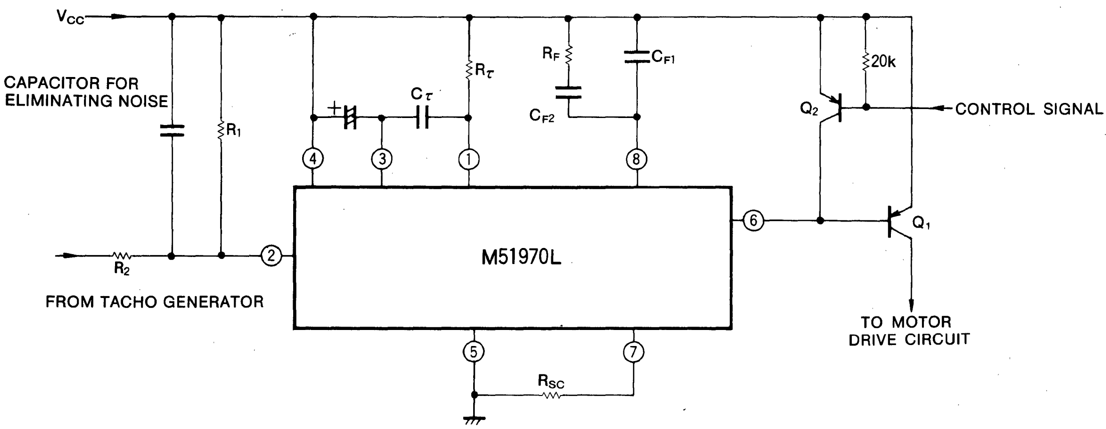
$$T_G/\tau_M << 1 \quad (T_G < \tfrac{1}{6}\tau_M \text{ at least})$$

3. Relationship between R_F, C_{F2} and τ_M

$$\tau_M \sim R_F \times C_{F2}$$

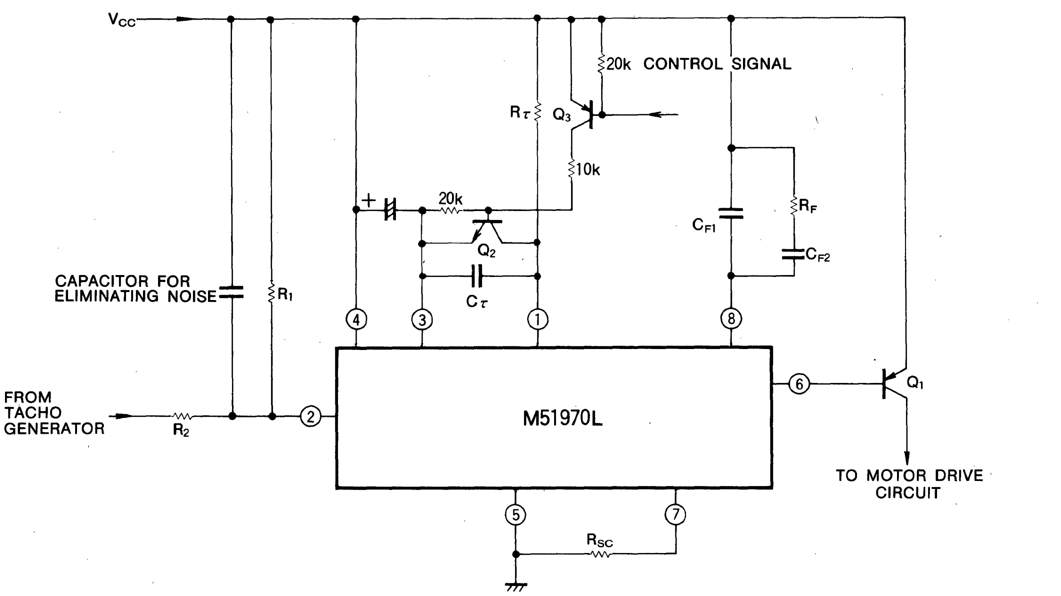
(2) HOW TO GET A MOTOR ON OR OFF BY THE CONTROL SIGNAL.

Example 1



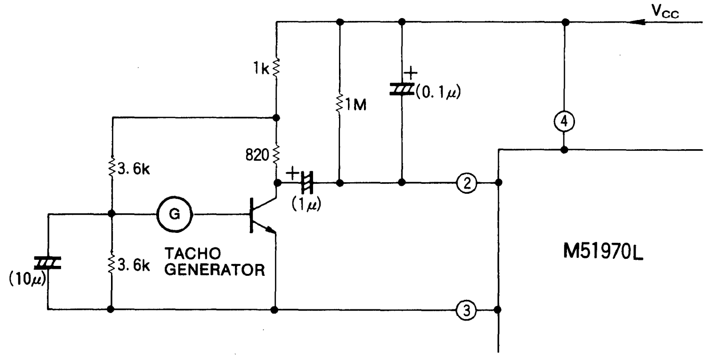
The motor is off when Q_2 is on.
Choose the constants as the current driving ability of $Q_2 \geqq V_{BE}/R_{SC} \sim 0.7V/R_{SC}$

Example 2



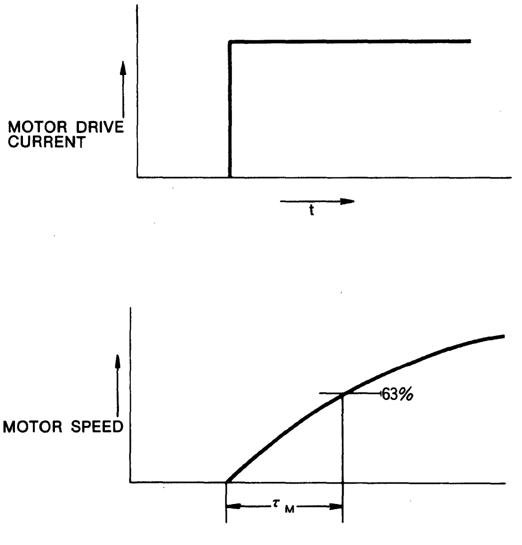
The motor is off when Q_2 and Q_3 are on.
Use example 2 in case overshoot is large in example 1.

(3) HOW TO AMPLIFY THE SIGNAL FROM TACHO GENERATOR WHEN IT IS SMALL.



The above constants of capacitors are example in case F_G=500Hz.

(4) HOW TO GET THE APPROXIMATE VALUE OF THE MECHANICAL CONSTANT OF A MOTOR, τ_M.
First, drive the stationary motor by the step current. Then measure the time until the motor speed reachs 63% of the final value as following.



M52670

4BIT A/D CONVERTER

DESCRIPTION

The M52670P and M52670FP are monolithic integrated circuits designed for 4bit analog to digital (A/D) converter, especially for the use of high speed signal converting system. It is capable of high speed signal convertion because of its paralel comparating circuits system. This device is consisted of high speed comparators (16 elements), gray-code converter, ECL-to-TTL converter, latching circuits, gray-to-binary code converter, and under-flow output switching circuits.

FEATURES

- Capable of high speed sampling rate .... (max.) 10M sample/sec
- High resolution in analog to digital convertion ....(max.) ILSB
- T.T.L compatible output (open collectored output)
- Easy to expand to 5bit A/D converter by parallel combination of these two ICs.
- Built-in high speed comparator composed of ECL type circuit.

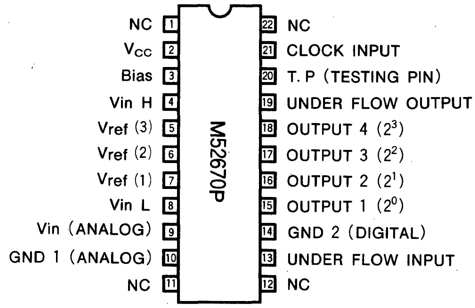
APPLICATIONS

- High speed data converting system
- Interface circuits for video equipments

RECOMMENDED OPERATING CONDITIONS

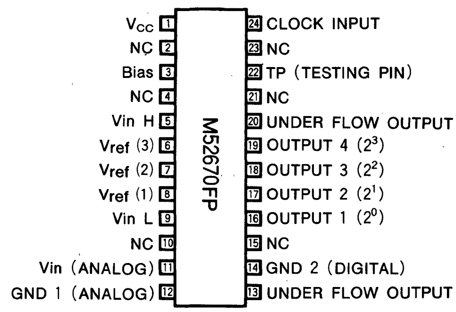
Supply voltage range .... 4.5V~7V
Rated supply voltage .... 5V±10%

PIN CONFIGURATION (TOP VIEW)

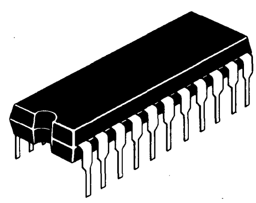


Outline 22P4 NC : NO CONNECTION

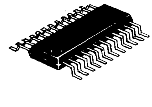
PIN CONFIGURATION (TOP VIEW)



Outline 24P2-C NC : NO CONNECTION



22-pin molded plastic DIL

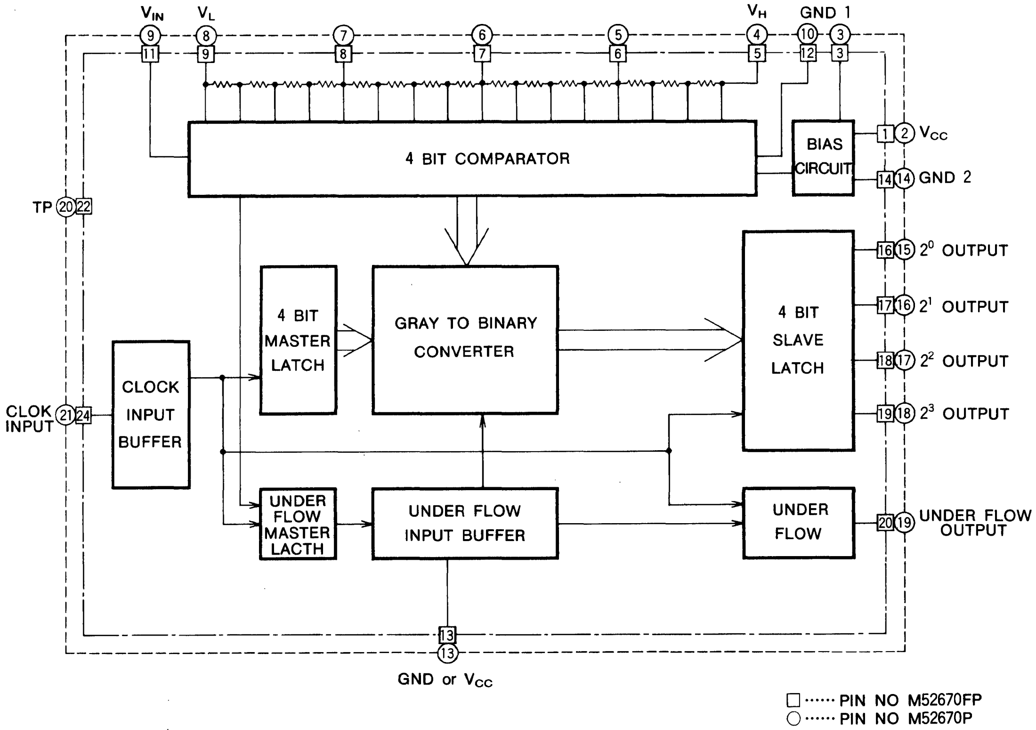


24-pin molded plastic FLAT

MITSUBISHI ELECTRIC

4BIT A/D CONVERTER

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		7	V
V_{IN}	Input voltage	Pin13, 24-GND····M52670FP Pin13, 21-GND····M52670P	7	V
BV_O	Output voltage		15	V
P_d	Power dissipation		(M52670FP) 550 (M52670P) 800	mW
T_{opr}	Operating temparature		−10～+75	℃
T_{stg}	Storage temparature		−40～+125	℃

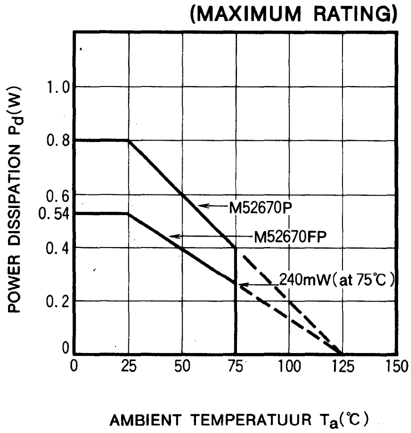
ELECTRIC CHARACTERISTICS (T_a=25℃, V_{CC}=5V, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4.5	5.0	6.5	V
I_{CC}	Circuit current	V_{CC}=5.0V, Clock 10MHz		33	48	mA
f_{SC}	Maximum sampling freguency	V_{CC}=5.0V, Duty 50%	10			MHz
V_{IN} ⑧[9]	Pin⑧[9] input voltage		1.1			V
V_{IN} ④[5]	Pin④[5] input voltage				V_{CC}−0.7	V
ΔV ⑧[9] - ④[5]	Pin⑧[9]-④[5] input voltage		1.0			V
V_{th} ⑬[13]	Pin⑬[13] threshold voltage		0.6	0.9	2.0	V
V_{th} ㉑[24]	Pin㉑[24] threshold voltage		0.6	0.9	2.0	V
I_{IN} ⑬[13]	Pin⑬[13] input current	V_{CC}=5.25V, V_{IN}⑬[13]=2.7V			20	μA
I_{IN} ㉑[24]	Pin㉑[24] input current	V_{CC}=5.25V, V_{IN}㉑[13]=2.7V			20	μA
V_{OL} ⑮[16] - ⑲[20]	Pin⑮[16]-⑲[20] output voltage	V_{CC}=4.75V, I_{OL}=8.0mA			0.5	V

○……PIN NO M52670P
□……PIN NO M52670FP

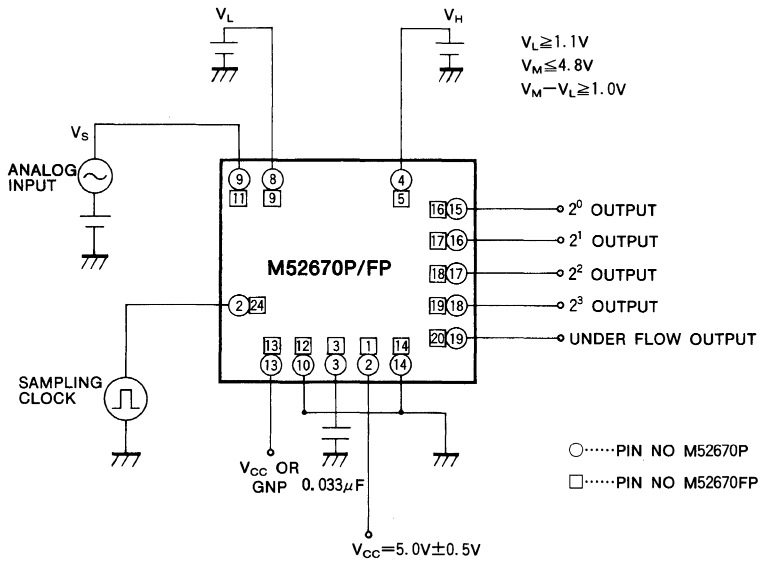
TYPICAL CHARACTERISTICS

THERMAL DERATING
(MAXIMUM RATING)



APPLICATION EXAMPLES

(1) 4bits A/D converter



A) OUTPUT LEVEL VS INPUT LEVEL

(in the case of 13 Pin GND)

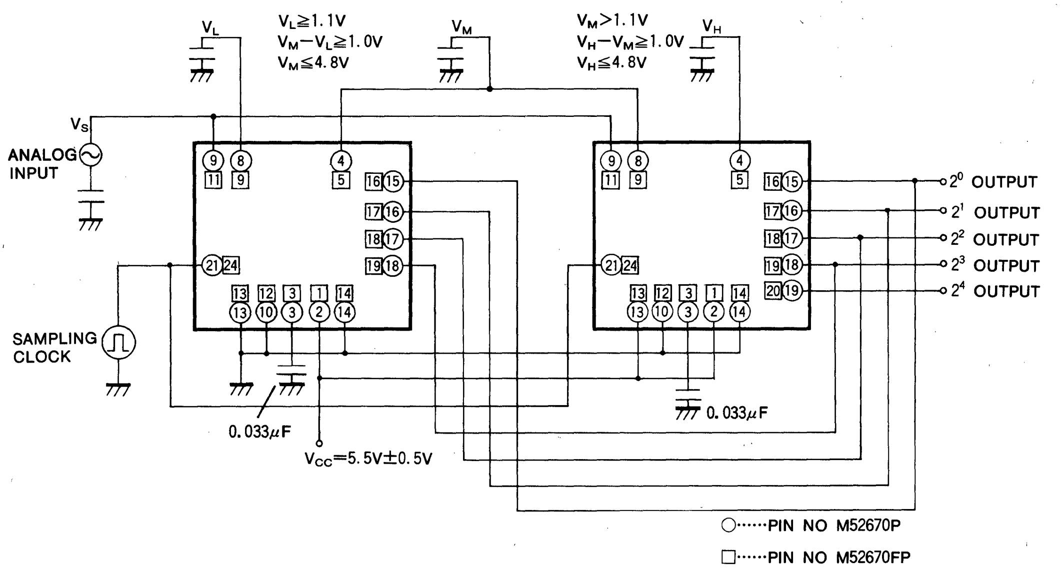
Output		Low								V_S			→					High
M52670FP	M52670P	V_0 V_1 V_2 V_3 V_4 V_5 V_6 V_7 V_8 V_9 V_{10} V_{11} V_{12} V_{13} V_{14} V_{15}																
16 Pin	15 Pin	L	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
17 Pin	16 Pin	L	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H
18 Pin	17 Pin	L	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H
19 Pin	18 Pin	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
20 Pin	19 Pin	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

B) OUTPUT LEVEL VS INPUT LEVEL

(in the case of 13 Pin V_{CC})

Output		Low								V_S			→					High
M52670FP	M52670P	V_0 V_1 V_2 V_3 V_4 V_5 V_6 V_7 V_8 V_9 V_{10} V_{11} V_{12} V_{13} V_{14} V_{15}																
16 Pin	15 Pin	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
17 Pin	16 Pin	H	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H
18 Pin	17 Pin	H	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H
19 Pin	18 Pin	H	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
20 Pin	19 Pin	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

(2) Example of 5bits A/D converter using two M52670P/FP



A OUTPUT LEVEL VS INPUT LEVEL

Output	V_S																																
	V_L																V_M																
	V_0	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}	V_{12}	V_{13}	V_{14}	V_{15}	V_0	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}	V_{12}	V_{13}	V_{14}	V_{15}	
2^0	L	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
2^1	L	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H
2^2	L	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H
2^3	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
2^4	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

M54512L

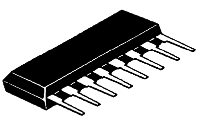
4-UNIT 50mA TRANSISTOR ARRAY

DESCRIPTION
The M54512L, 4-channel sink driver, consists of four NPN transistors, and designed for use in medium-current switching applications.

FEATURES
- Output breakdown voltage to 20V
- 50mA output sink current capability
- Wide operating temperature range ($T_a = -20 \sim +75$℃)

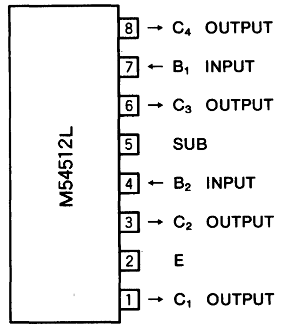
APPLICATION
LED or incandescent display driver

FUNCTION
The M54512L is comprised of four NPN transistors with a 10kΩ series input resistor, connected to form dual 2-parallel output drivers. All emitters of transistors are connected together to pin 2. The substrate is connected to pin 5 and pin 5 must be tied to the most negative point in the external circuit. The drivers are capable of sinking 50mA and will withstand 20V in the OFF state.



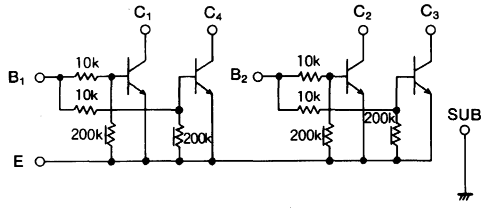
8-pin molded plastic SIL

PIN CONFIGURATION (TOP VIEW)



Outline 8P5

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
V_{EBO}	Emitter-base sustaining voltage		4	V
I_C	Collector current	Transistor ON	50	mA
V_I	Input voltage		20	V
P_d	Power dissipation	T_a =75℃	500	mW
T_{opr}	Operating ambient temperature range		−10～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

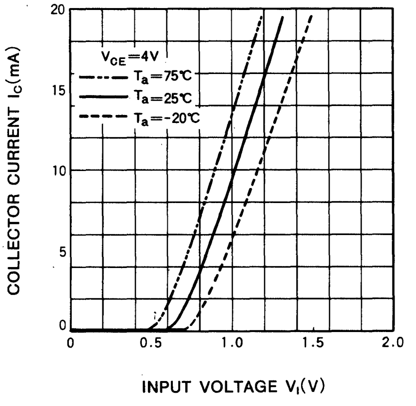
Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_C	Output voltage		0		18	V
I_C	Collector current per channel		0		20	mA
V_{IH}	"H" Input voltage	I_C =30mA	2			V
V_{IL}	"L" Input voltage				0. 2	V

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

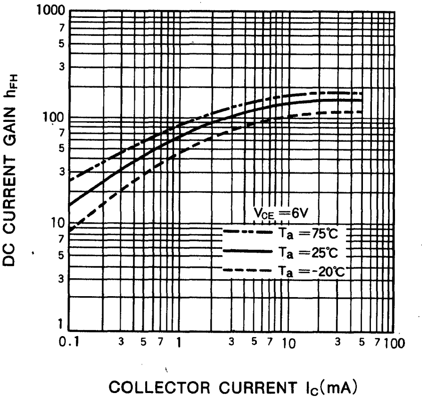
Symbol	Parameter	Test conditions		Limits Min	Typ	Max	Unit
$I_{O(leak)}$	Output leakage current	V_{CE} =20V				20	μA
$V_{CE(sat)}$	Output saturation voltage	I_B = 2 mA	I_C =10mA			0.1	V
			I_C =20mA			0.2	V
BV_{EBO}	Emitter-base sustaining voltage	I_{EBO} =150 μA		4			V
V_I	Input voltage	I_B = 2 mA			11		V
h_{FE}	DC forward current gain	V_{CE} = 6 V, I_C =20mA, T_a=25℃		60			

TYPICAL CHARACTERISTICS

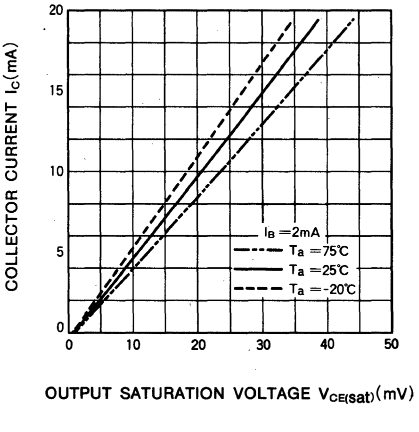
OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



OUTPUT CHARACTERISTICS



M54513P

8-UNIT 50mA TRANSISTOR ARRAY

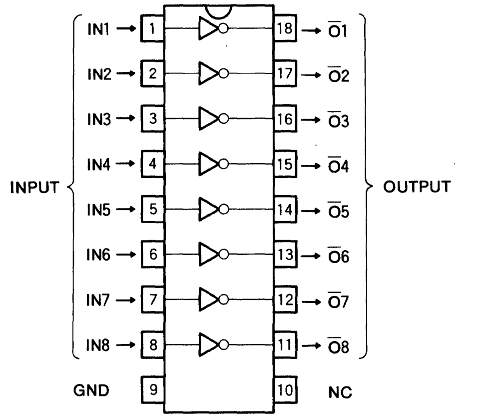
DESCRIPTION
The M54513P, 8-channel sink drivers, consists of 8 NPN transistors with 2 kΩ series input resistors.

FEATURES
- High output sustaining voltage of 40V
- 50mA output sink current capability
- Wide operating temperature range (T_a = −20∼+75℃)

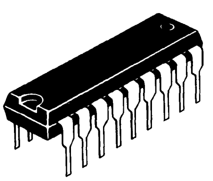
APPLICATION
LED or incandescent display digit driver

FUNCTION
The M54513P is comprised of eight NPN drivers. Each input has a voltage divider by 2kΩ and 13.6kΩ resistors. All emitters and the substrate are connected together to pin 9. The open collector outputs are capable of sinking 50mA and will withstand 40V in the OFF state.

PIN CONFIGURATION (TOP VIEW)

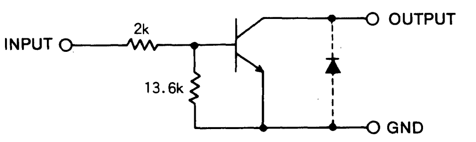


Outline 18P4 NC : NO CONNECTION



18-pin molded plastic DIL

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a = −20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	40	V
I_C	Collector current	Transistor ON	50	mA
V_I	Input voltage		10	V
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a = −20∼+75℃, unless otherwise noted)

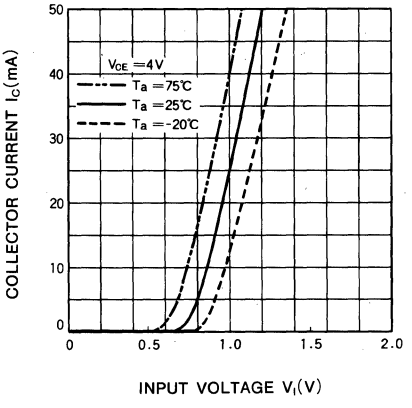
Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage		0		40	V
I_C	Collector current per channel		0		20	mA
V_{IH}	"H" Input voltage	I_C =20 mA	2			V
V_{IL}	"L" Input voltage				0.2	V

ELECTRICAL CHARACTERISTICS (T_a = −20∼+75℃, unless otherwise noted)

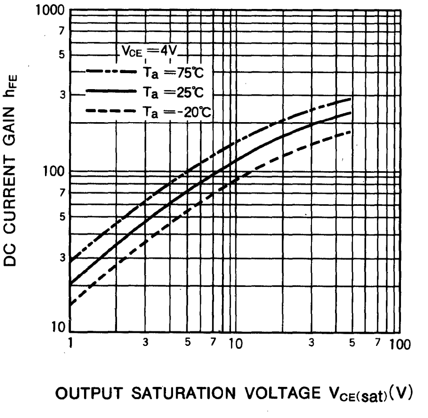
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	V_O = 40V			50	μA
$V_{CE(sat)}$	Output saturation voltage	V_I = 2V, I_C = 12mA			100	mV
		V_I = 2.5V, I_C = 30mA			170	mV
I_I	Input current	V_I = 2.5V			1.7	mA
h_{FE}	DC forward current gain	V_{CE} = 4 V, I_C = 30mA, T_a = 25℃	80			

TYPICAL CHARACTERISTICS

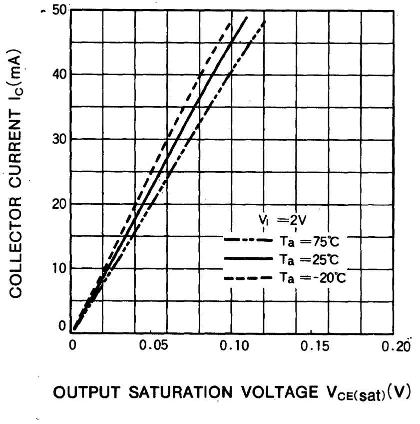
OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



OUTPUT CHARACTERISTICS



M54514AP

7-UNIT 50mA TRANSISTOR ARRAY

DESCRIPTION

The M54514AP, 7-channel sink drivers, consists of 7 NPN transistors with 2.8kΩ series input resistors.

FEATURES

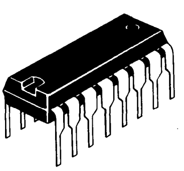
- Output breakdown voltage to 20V
- 50mA output sink current capability
- Low output saturation voltage
- Wide operating temperature range (T_a = −20∼+75℃)

APPLICATION

LED or incandescent display digit driver

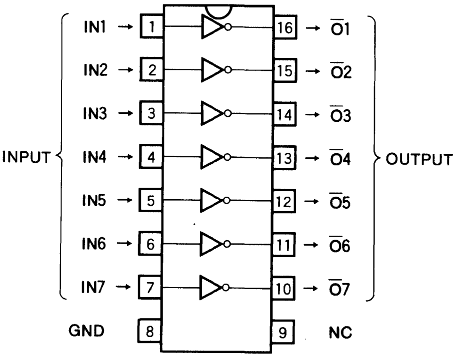
FUNCTION

The M54514AP is comprised of seven NPN drivers. Each input has a voltage divider by 2.8kΩ and 10kΩ resistors. All emitters and the substrate are connected together to pin 8. The open collector outputs are capable of sinking 50mA and will withstand 20V in the OFF state.



16-pin molded plastic DIL

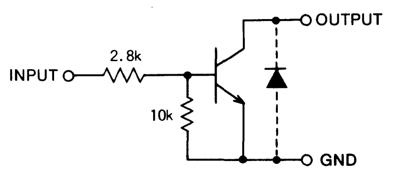
PIN CONFIGURATION (TOP VIEW)



Outline 16P4

NC : NO CONNECTION

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a = −20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	50	mA
V_I	Input voltage		10	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a = −20∼+75℃, unless otherwise noted)

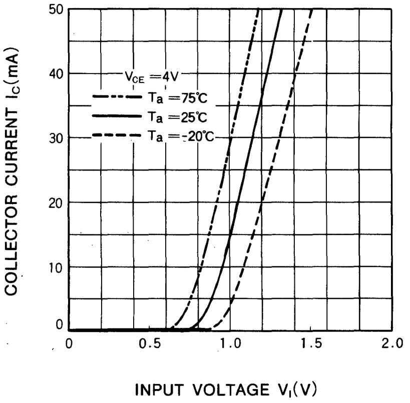
Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_O	Output voltage		0		20	V
I_C	Collector current		0		20	mA
V_{IH}	"H" Input voltage	I_C=50mA	2.4			V
V_{IL}	"L" Input voltage				0.2	V

ELECTRICAL CHARACTERISTICS (T_a = −20∼+75℃, unless otherwise noted)

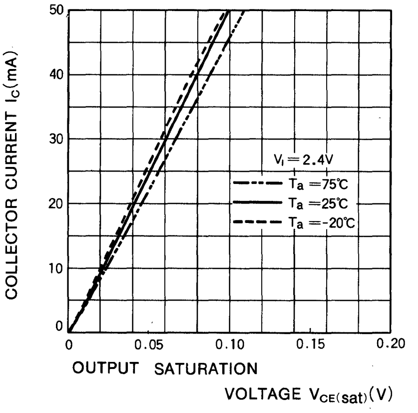
Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	V_O=20V				20	μA
$V_{CE(sat)}$	Output saturation voltage	V_I=2.4V	I_C=20mA			0.17	V
			I_C=40mA			0.23	V
I_I	Input current	V_I=2.4V				1.1	mA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=40mA, T_a=25℃		80			

TYPICAL CHARACTERISTICS

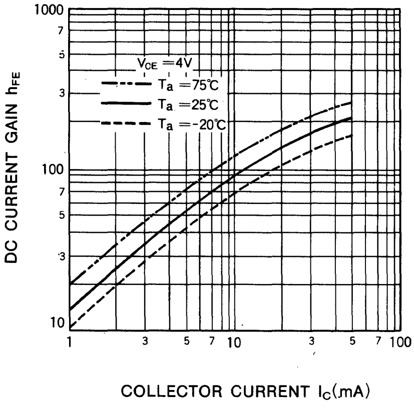
OUTPUT CURRENT CHARACTERISTICS



OUTPUT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54515P

7-UNIT 16mA TRANSISTOR ARRAY

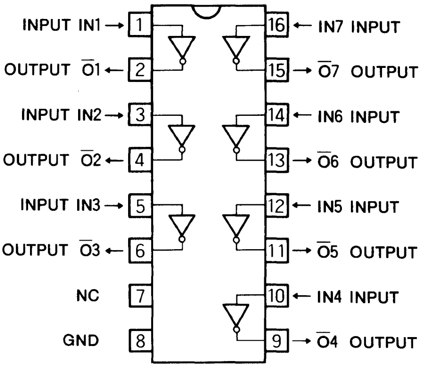
DESCRIPTION
The M54515P, transistor array, consists of seven NPN transistors and is connected in a common-emitter configuration.

FEATURES
- Output breakdown voltage to 17V
- 16mA output sink current capability
- Wide operating temperature range (T_a = −20∼+75℃)

APPLICATION
LED or incandescent display driver

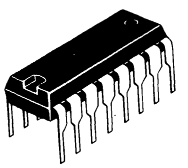
FUNCTION
The M54515P is comprised of seven NPN transistors. All emitters and the substrate are connected together to pin 8. The outputs are capable of sinking 16mA and will withstand 17V in the OFF state.

PIN CONFIGURATION (TOP VIEW)



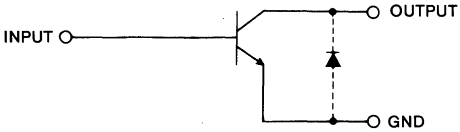
Outline 16P4

NC : NO CONNECTION



16-pin molded plastic DIL

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a = −20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	17	V
V_I	Input voltage		1.2	V
I_C	Collector current	Transistor ON	16	mA
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a = −20∼+75℃, unless otherwise noted)

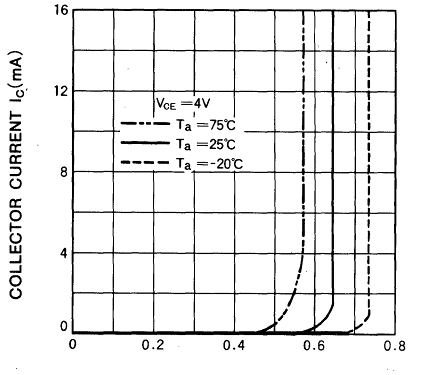
Symbol	Parameter	Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage			17	V
I_C	Collector current per channel			16	mA

ELECTRICAL CHARACTERISTICS (T_a = −20∼+75℃, unless otherwise noted)

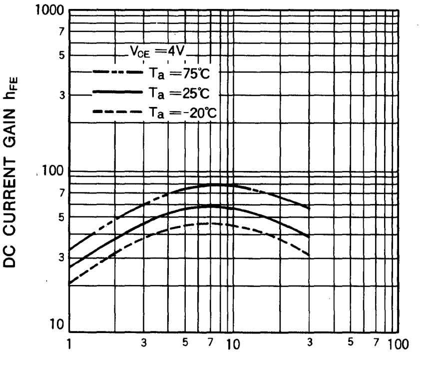
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$V_{(BR)CEO}$	Output sustaining voltage	I_{OH}=100μA	17			V
$V_{CE(sat)}$	Output saturation voltage	I_{OL}=16mA, I_B=0.5mA			0.5	V
$V_{BE(sat)}$	Base-emitter saturation voltage	I_{OL}=16mA, I_B=0.5mA			1.2	V
h_{FE}	DC forward current gain	V_{CE}=5V, I_C=16mA, T_a=25℃	32			
$I_{O(leak)}$	Output leakage current	V_O=17V, V_I=0.2V			700	μA

TYPICAL CHARACTERISTICS

OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



MITSUBISHI ELECTRIC

M54516P

5-UNIT 500mA DARLINGTON TRANSISTOR ARRAY

DESCRIPTION

The M54516P, 5-channel sink driver, consists of 10 NPN transistors connected to form five high current gain driver pairs.

FEATURES

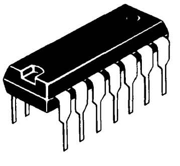
- Output sustaining voltage to 25 V
- High output sink current to 500mA
- PMOS Compatible input
- Wide operating temperature range (Ta = −20∼+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics.

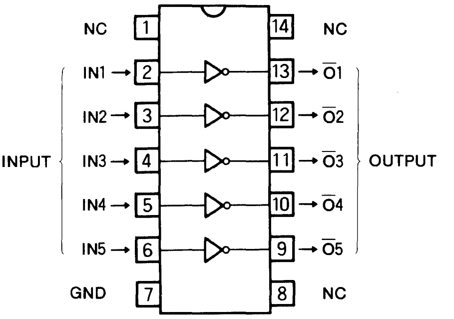
FUNCTION

The M54516P is comprised of five NPN darlington driver pairs with 20kΩ series input resistors. All emitter and the substrate are connected together to pin 7. The output are capable of sinking 500mA and will withstand 25V in the OFF state.



14-pin molded plastic DIL

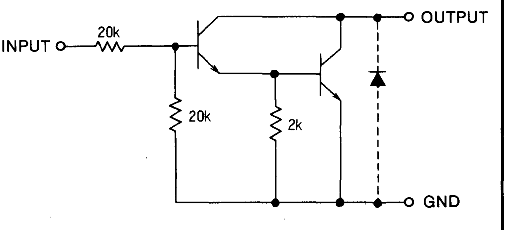
PIN CONFIGURATION (TOP VIEW)



Outline 14P4

NC : NO CONNECTION

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (Ta=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	25	V
I_C	Collector current	Transistor ON	500	mA
V_I	Input voltage		25	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				25	V
I_C	Collector current per channel	Percent duty cycle less than 10%			400	mA
		Percent duty cycle less than 55%			200	mA
V_{IH}	"H" Input voltage	I_C=400mA	8			V
		I_C=200mA	5			
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			0.5	V

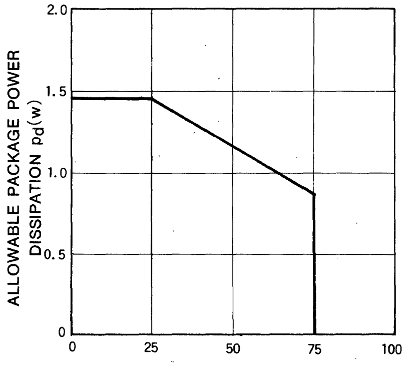
ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA	25			V
$V_{CE(sat)}$	Output saturation voltage	V_I=8V, I_C=400mA			2.2	V
		V_I=5V, I_C=200mA			1.4	V
I_I	Input current	V_I=17V		0.8	1.8	mA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=400mA, T_a=25℃	1000			

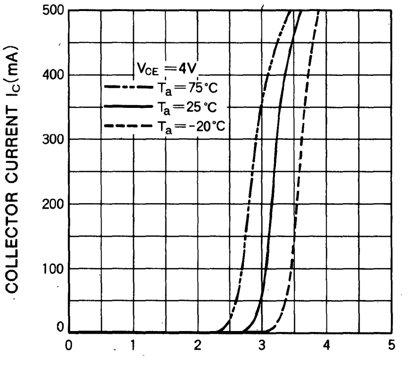
* : A typical value is at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

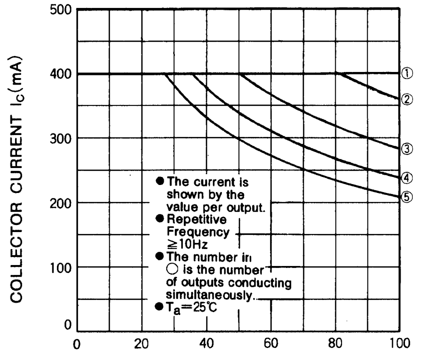


OUTPUT CURRENT CHARACTERISTICS

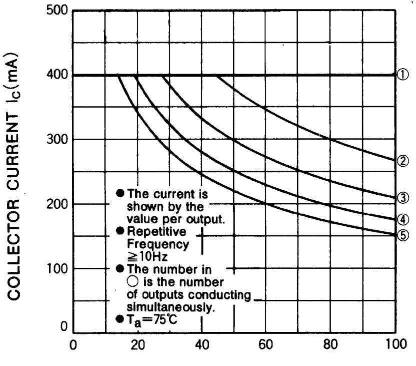


5-UNIT 500mA DARLINGTON TRANSISTOR ARRAY

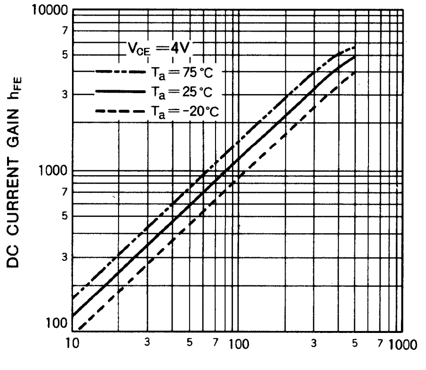
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54517P

7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY

DESCRIPTION

The M54517P, 7-channel sink driver, consists of 14 NPN transistors connected to form seven high current gain driver pairs.

FEATURES

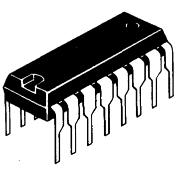
- Output sustaining voltage to 25V
- High output sink current to 400mA
- PMOS Compatible input
- Wide operating temperature range (T_a =−20~+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

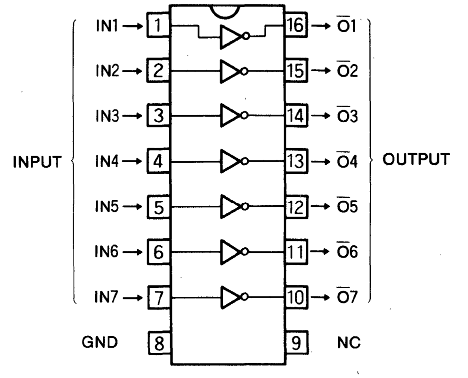
FUNCTION

The M54517P is comprised of seven NPN darlington driver pairs with 20kΩ series input resistors. All emitters and the substrate are connected to pin 8. The output are capable of sinking 400mA and will withstand 25V in the OFF state.



16-pin molded plastic DIL

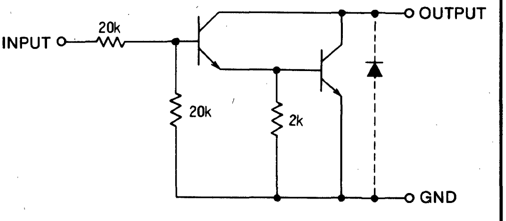
PIN CONFIGURATION (TOP VIEW)



Outline 16P4

NC : NO CONNECTION

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	25	V
I_C	Collector current	Transistor ON	400	mA
V_I	Input voltage		25	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Typ	Max	Unit
V_O	Output voltage				25	V
I_C	Collector current per channel	Percent duty cycle less than 8%			400	mA
		Percent duty cycle less than 40%			200	mA
V_{IH}	"H" Input voltage	I_C=400mA	8			V
		I_C=100mA	5			
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			0.5	V

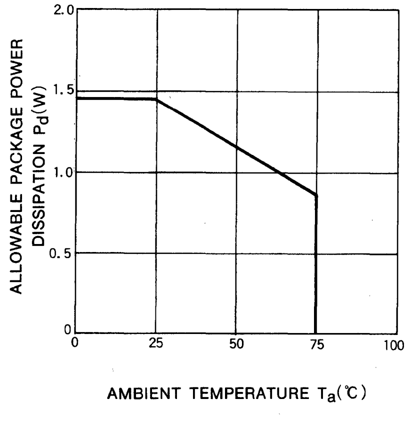
ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Typ*	Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA	25			V
$V_{CE(sat)}$	Output saturation voltage	V_I=8V, I_C=400mA			2.2	V
		V_I=5V, I_C=200mA			1.4	V
I_I	Input current	V_I=17V		0.8	1.8	mA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=400mA, T_a=25℃	1000			

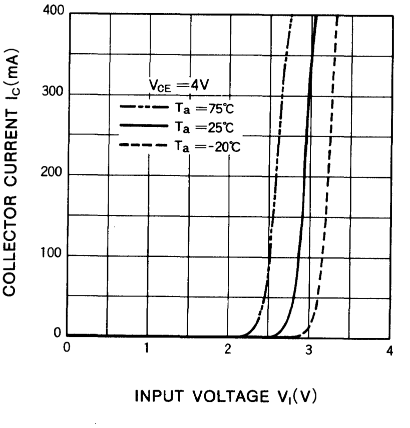
* : A typical value is at T_a=25℃.

TYPICAL CHARACTERISTICS

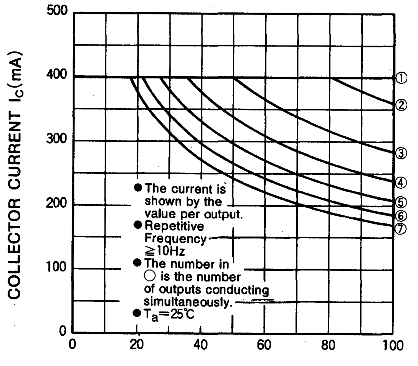
ALLOWABLE AVERAGE POWER DISSIPATION



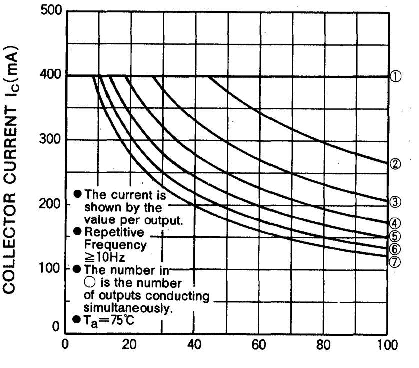
OUTPUT CURRENT CHARACTERISTICS



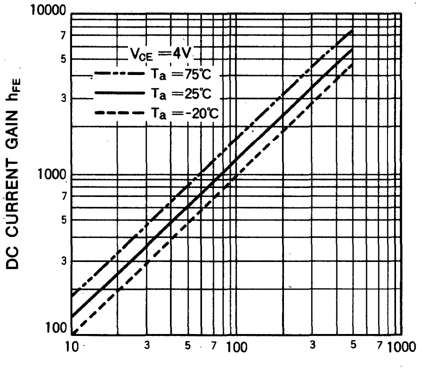
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



MITSUBISHI ELECTRIC

M54519P

7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY

DESCRIPTION

The M54519P, 7-channel sink driver, consists of 14 NPN transistors connected to form seven high current gain driver pairs.

FEATURES

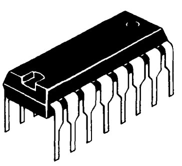
- High output sustaining voltage to 40V
- High output sink current to 400mA
- PMOS Compatible input
- Wide operating temperature range (T_a=−20~+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

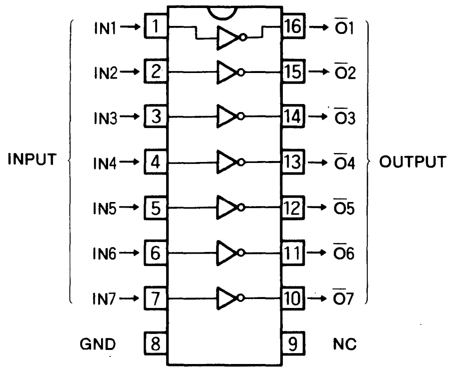
FUNCTION

The M54519P is comprised of seven NPN darlington driver pairs with 20kΩ series input resistors.
All emitters and the substrate are connected together to pin 8. The output are capable of sinking 400mA and will withstand 40V in the OFF state.



16-pin molded plastic DIL

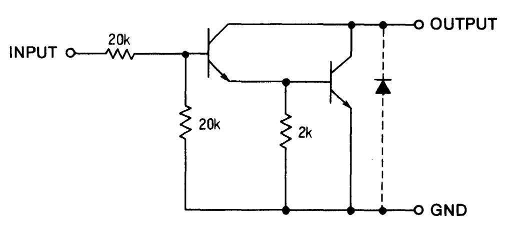
PIN CONFIGURATION (TOP VIEW)



Outline 16P4

NC : NO CONNECTION

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	40	V
I_C	Collector current	Transistor ON	400	mA
V_I	Input voltage		40	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				40	V
I_C	Collector current per channel	Percent duty cycle less than 8%			400	mA
		Percent duty cycle less than 30%			200	mA
V_{IH}	"H" Input voltage	I_C=400mA	8			V
		I_C=100mA	5			
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			0.5	V

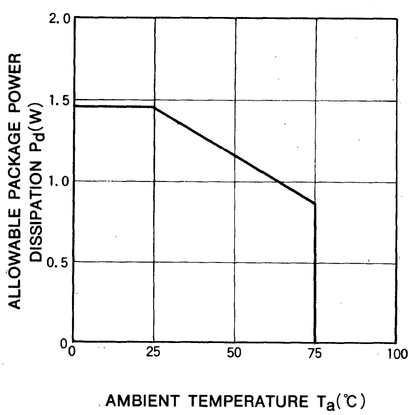
ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ*	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA	40			V
$V_{CE(sat)}$	Output saturation voltage	V_I=8V, I_C=400mA			2.4	V
		V_I=5V, I_C=200mA			1.6	V
I_I	Input current	V_I=17V		0.8	1.8	mA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=400mA, T_a=25℃	1000			

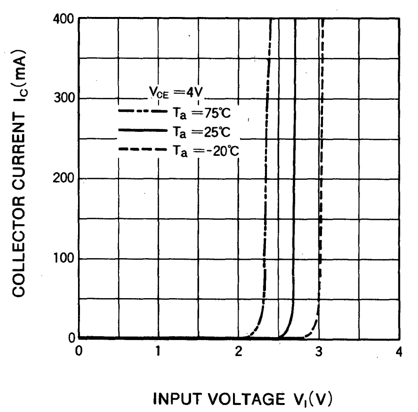
* : A typical value is at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIL

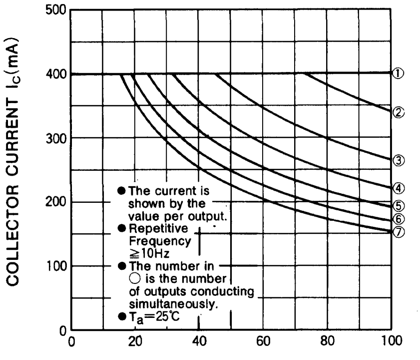


OUTPUT CURRENT CHARACTERISTICS

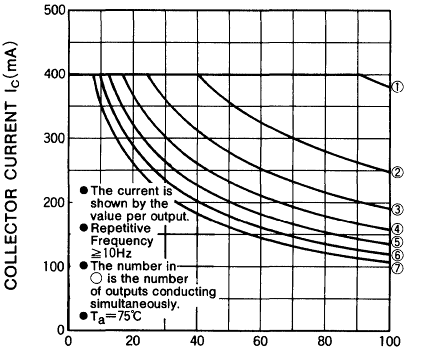


MITSUBISHI ELECTRIC

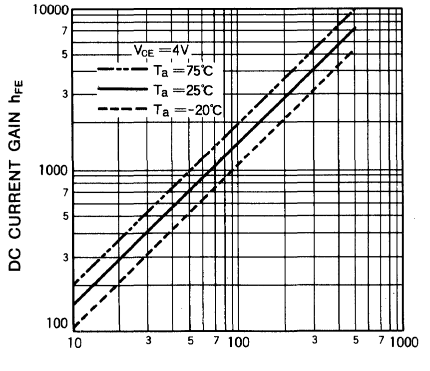
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54521P

5-UNIT 500mA DARLINGTON TRANSISTOR ARRAY

DESCRIPTION

The M54521P, 5-channel sink driver, consists of 10 NPN transistors connected to form high current gain driver pairs.

FEATURES

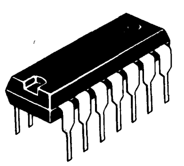
- Output sustaining voltage to 30V
- High output sink current to 500mA
- Wide operating temperature range (Ta =−20∼+75℃)

APPLICATIONS

- Relay and printer drivers
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

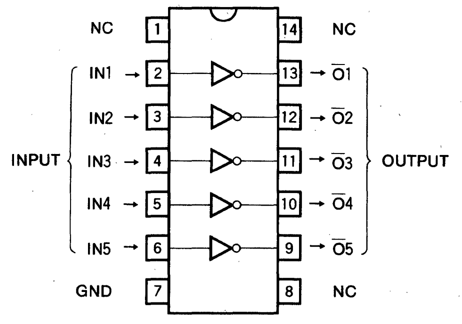
FUNCTION

The M54521P is comprised of five NPN darlington driver pairs. All emitters and the substrate are connected together to pin 7. The output are capable of sinking 500mA and will withstand 30V in the OFF state.



14-pin molded plastic DIL

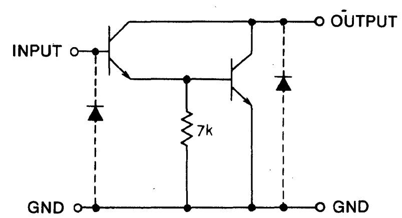
PIN CONFIGURATION (TOP VIEW)



Outline 14P4

NC : NO CONNECTION

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	30	V
I_C	Collector current	Transistor ON	500	mA
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				30	V
I_C	Collector current per channel	Percent duty cycle less than 10%			400	mA
		Percent duty cycle less than 55%			200	mA
I_{IH}	"H" Input current	I_C=200mA	1			mA
		I_C=400mA	2			
I_{IL}	"L" Input current				10	μA

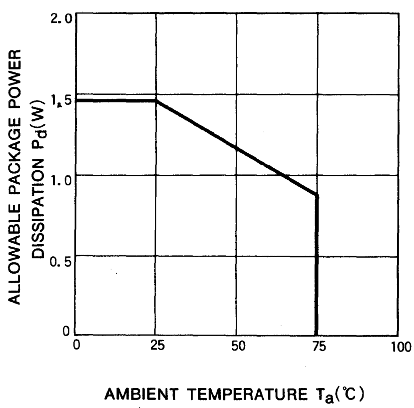
ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ*	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA	30			V
$V_{CE(sat)}$	Output saturation voltage	V_I=2mA, I_C=400mA			2.4	V
		V_I=1mA, I_C=200mA			1.6	V
V_I	Input voltage	I_I=1mA		1.35	1.7	V

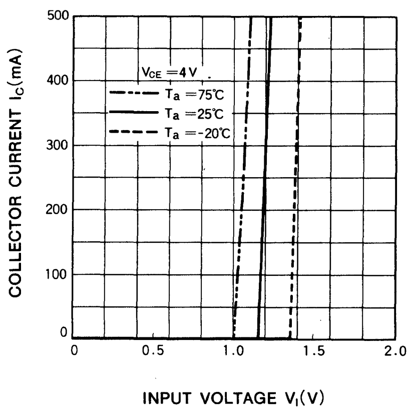
* : A typical value is at T_a=25℃.

TYPICAL CHARACTERISTICS

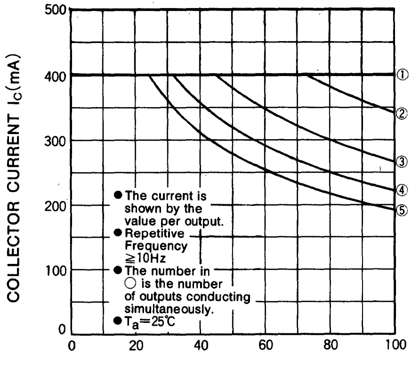
ALLOWABLE AVERAGE POWER DISSIPATION



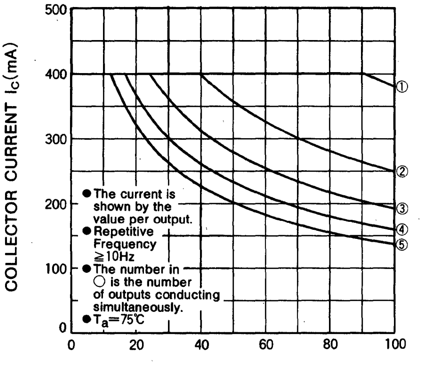
OUTPUT CURRENT CHARACTERISTICS



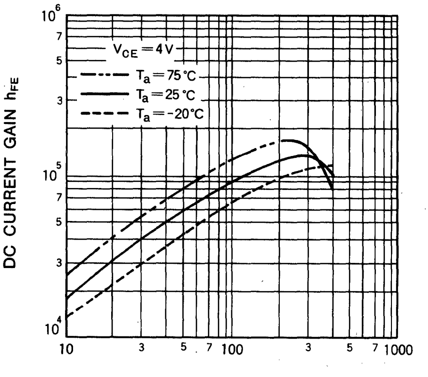
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



MITSUBISHI ELECTRIC

M54522P

8-UNIT 400mA DARLINGTON TRANSISTOR ARRAY

DESCRIPTION

The M54522P, 8-channel sink driver, consists of 16 NPN transistors connected to form eight high current gain driver pairs.

FEATURES

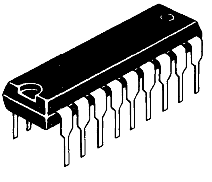
- High output sustaining voltage to 40V
- High output sink current to 400mA
- Integral diodes for transient suppression
- PMOS Compatible input
- Wide operating temperature range (T_a = −20∼+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing between MOS/BIPOLAR logics and high power loads

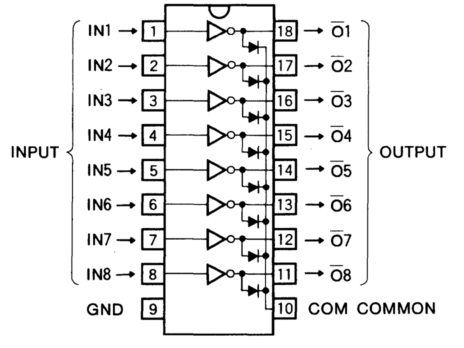
FUNCTION

The M54522P is comprised of eight NPN darlington driver pairs with 20kΩ series input resistors. Each output has an integral diode for inductive load transient suppression. The cathodes of the diodes are connected together to pin 10. All emitters and the substrate are connected to pin 9. The output are capable of sinking 400mA and will withstand 40V in the OFF state.



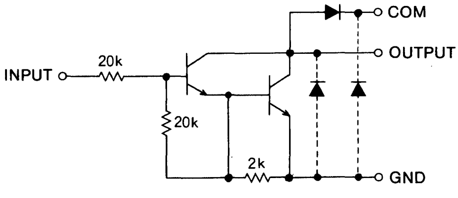
18-pin molded plastic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 18P4

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	40	V
I_C	Collector current	Transistor ON	400	mA
V_I	Input voltage		40	V
I_F	Clamp diode forward current		400	mA
V_R	Clamp diode reverse voltage		40	V
P_d	Power dissipation	T_a=25℃	1.79	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

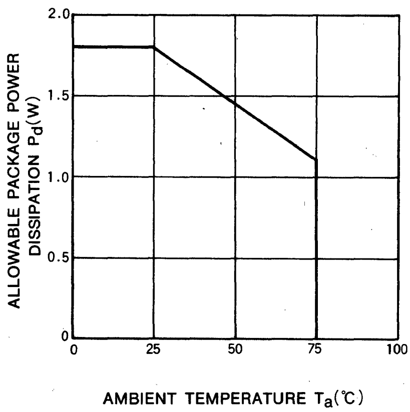
Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage		0		40	V
I_C	Collector current per channel	Percent duty cycle less than 7%	0		400	mA
		Percent duty cycle less than 30%	0		200	mA
V_{IH}	"H" Input voltage	I_C=400mA	8			V
		I_C=200mA	4			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			0.5	V

ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

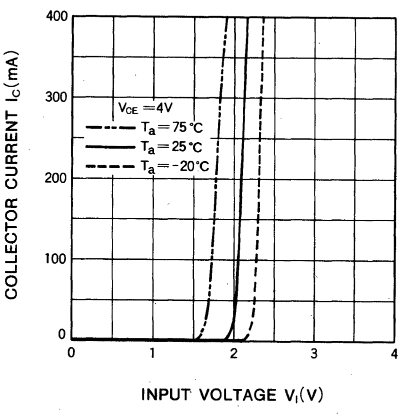
Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA	40			V
$V_{CE(sat)}$	Output saturation voltage	V_I=8V, I_C=400mA			2.4	V
		V_I=4V, I_C=200mA			1.6	V
I_I	Input current	V_I=17V			1.8	mA
V_F	Clamp diode forward voltage	I_F=400mA			2.4	V
V_R	Clamp diode reverse voltage	I_R=100μA	40			V
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=300mA, T_a=25℃	1000			

TYPICAL CHARACTERISTICS

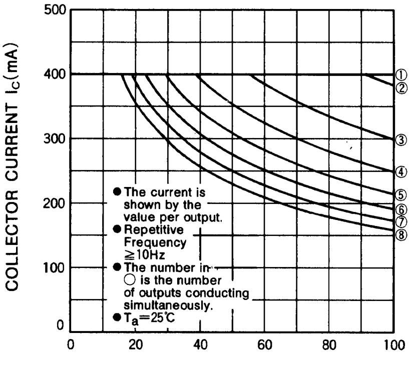
ALLOWABLE AVERAGE POWER DISSIPATION



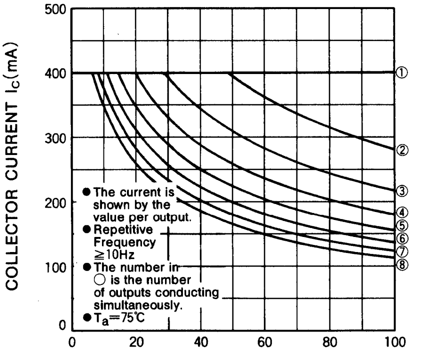
OUTPUT CURRENT CHARACTERISTICS



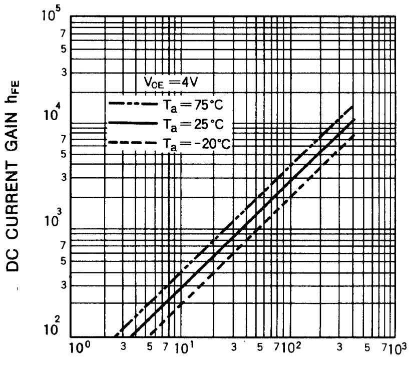
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54523P

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION

The M54523P, 7-channel sink driver, consists of 14 NPN transistors connected to form seven high current gain driver pairs.

FEATURES

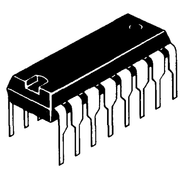
- High output sustaining voltage to 50V
- High output sink current to 500mA
- Integral diodes for transient suppression
- PMOS Compatible input
- Wide operating temperature range (T_a = −20∼+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics.

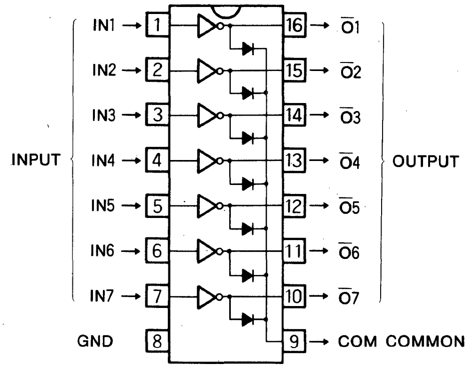
FUNCTION

The M54523P is comprised of seven NPN darlington driver pairs with 2.7kΩ series input resistors. Between pin 9 and each output, there are integral diodes for inductive load transient suppression. All emitters and the substrate are connected together to pin 8. The outputs are capable of sinking 500mA and will withstand 50V in the OFF state.



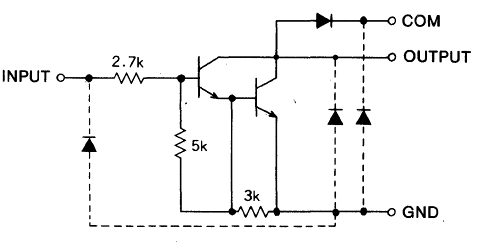
16-pin metal-sealed ceramic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
I_C	Collector current	Transistor ON	500	mA
V_I	Input voltage		30	V
I_F	Clamp diode forward current		500	mA
V_R	Clamp diode reverse voltage		50	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				50	V
I_C	Collector current per channel	Percent duty cycle less than 8%			400	mA
		Percent duty cycle less than 30%			200	mA
V_{IH}	"H" Input voltage	I_C=400mA	3.85			V
		I_C=100mA	3.4			V
V_{IL}	"L" Input voltage				0.5	V

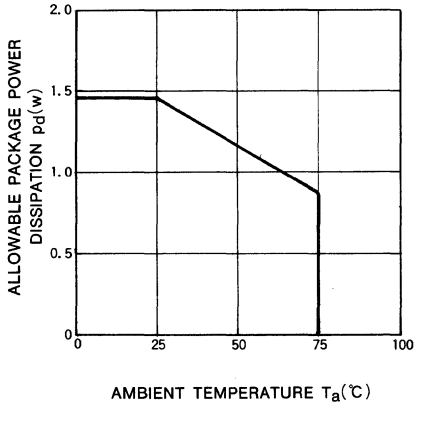
ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ*	Limits Max	Unit
$I_{O(leak)}$	Output leakage current	V_{CE}=50V			100	μA
$V_{CE(sat)}$	Output saturation voltage	V_I=3.85V, I_C=400mA		1.3	2.4	V
		V_I=3.85V, I_C=200mA			1.6	V
I_I	Input current	V_I=3.85V		0.95	1.8	mA
		V_I=25V		9	18	mA
V_F	Clamp diode forward voltage	I_F=400mA		1.5	2.4	V
I_R	Clamp diode leakage voltage				100	μA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=350mA, T_a=25℃	1000			

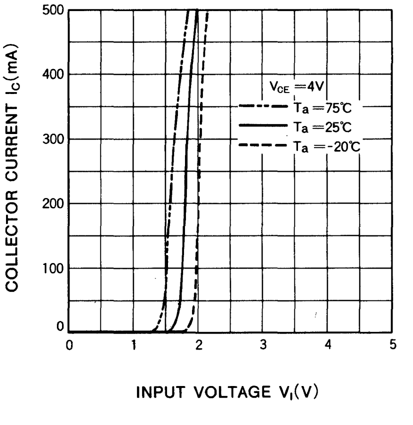
* : All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

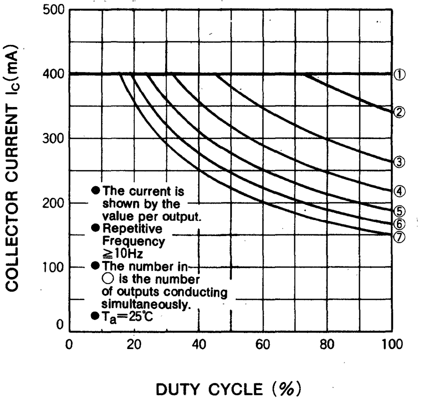


OUTPUT CURRENT CHARACTERISTICS

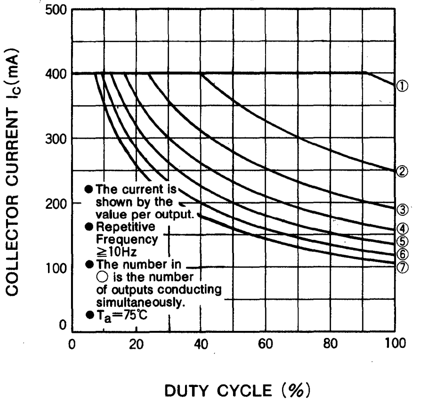


7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

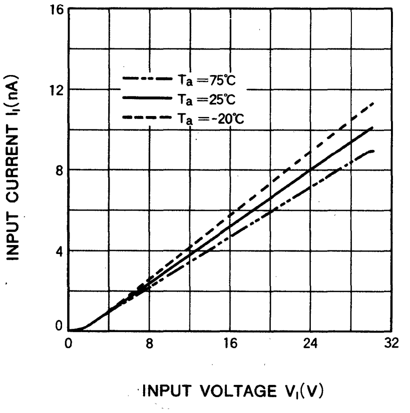
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



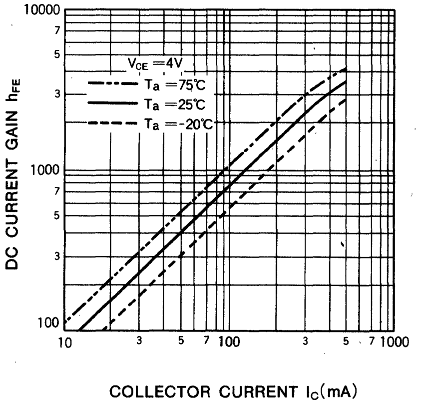
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



INPUT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54524P

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION

The M54524P, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

FEATURES

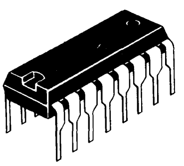
- High output sustaining voltage to 50V
- High output sink current to 500mA
- Integral diodes for transient suppression
- Wide operating temperature range (T_a =−20∼+75℃)

APPLICATIONS

- Relay and printer drivers
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

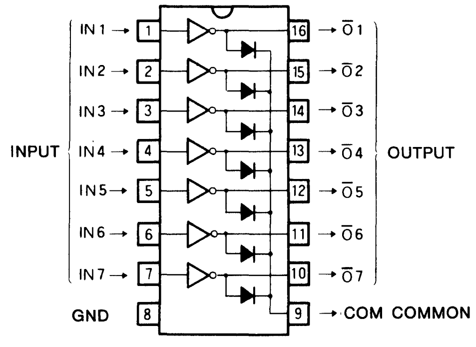
FUNCTION

The M54524P is comprised of seven NPN darlington driver pairs. Between pin 9 and each output, there are integral diodes for inductive load transient suppression. All emitters and the substrate are connected together to pin 8. The outputs are capable of sinking 500mA and will withstand 50V in the OFF state.



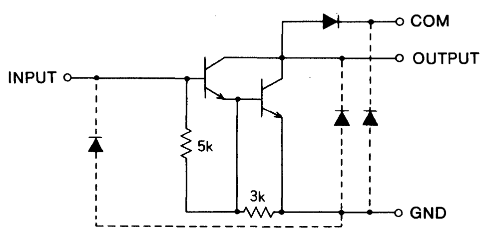
16-pin molded plastic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
I_C	Collector current	Transistor ON	500	mA
I_F	Clamp diode forward current		500	mA
V_R	Clamp diode reverse voltage		50	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_O	Output voltage				50	V
I_C	Collector current per channel	Percent duty cycle less than 8%			400	mA
		Percent duty cycle less than 30%			200	mA
I_{IH}	"H" Input current	I_C=400mA	1			mA
I_{IL}	"L" Input current				20	μA

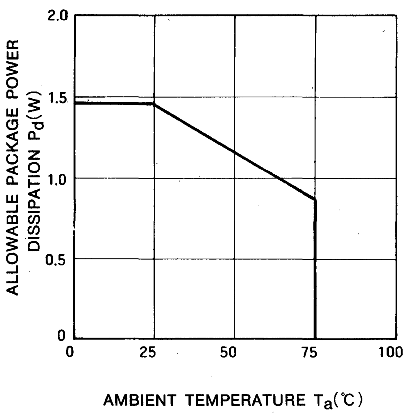
ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ*	Max	
$I_{O(leak)}$	Output leakage current	V_{CE}=50V			100	μA
$V_{CE(sat)}$	Output saturation voltage	I_I=1mA, I_C=400mA		1.3	2.4	V
		I_I=1mA, I_C=200mA			1.6	V
V_I	Input voltage	I_I=1mA		1.35	1.7	V
V_F	Clamp diode forward voltage	I_F=400mA		1.5	2.4	V
I_R	Clamp diode leakage current	V_R=50V			100	μA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=350mA, T_a=25℃	1000			

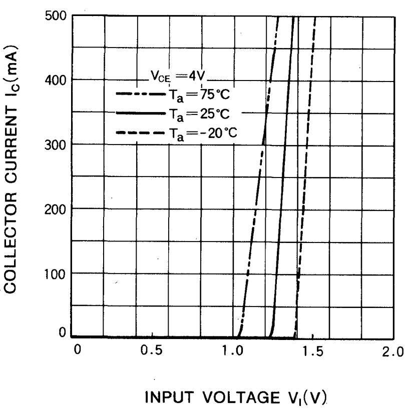
* : All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



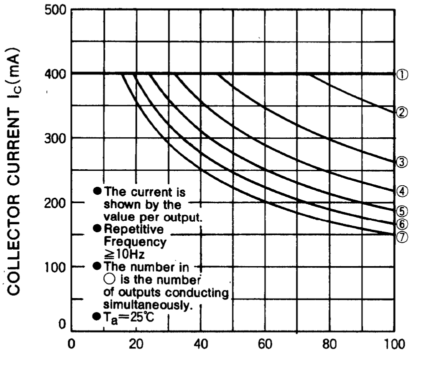
OUTPUT CURRENT CHARACTERISTICS



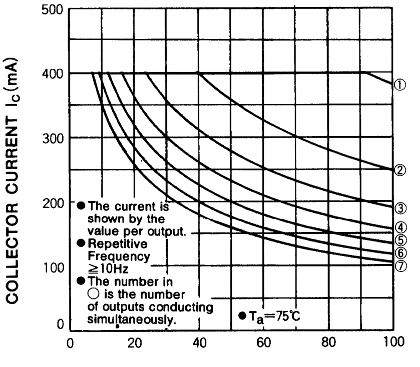
MITSUBISHI ELECTRIC

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

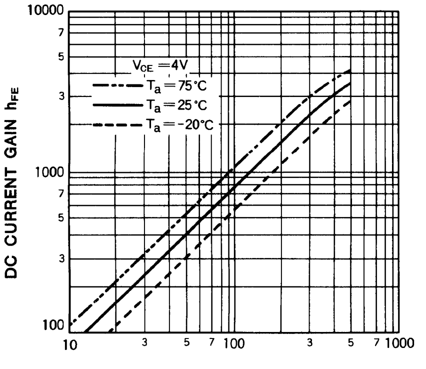
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54525P

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

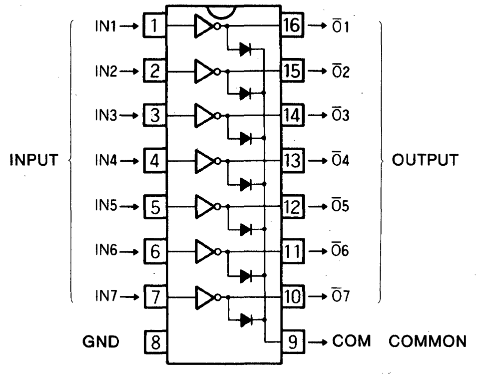
DESCRIPTION
The M54525P, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

FEATURES
- High output sustaining voltage to 50V
- High output sink current to 500mA
- Integral diodes for transient suppression
- 24V PMOS compatible input
- Wide operating temperature range (T_a =−20∼+75℃)

APPLICATIONS
- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

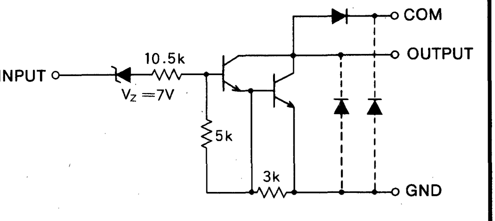
FUNCTION
The M54525P is comprised of seven NPN darlington driver pairs. Each input has a Zener diode and 10.5kΩ resistor in series to limit the input current. Between pin 9 and each output, there are integral diodes for inductive load transient suppression. All emitters and the substrate are connected together to pin 8. The outputs are capable of sinking 500mA and will withstand 50V in the OFF state.

PIN CONFIGURATION (TOP VIEW)

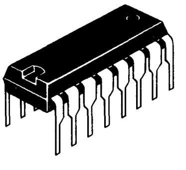


Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
I_C	Collector current	Transistor ON	500	mA
V_I	Input voltage		30	V
I_F	Clamp diode forward current		500	mA
V_R	Clamp diode reverse voltage		50	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				50	V
I_C	Collector current per channel	Percent duty cycle less than 8%			400	mA
		Percent duty cycle less than 30%			200	mA
V_{IH}	"H" Input voltage	I_C=400mA	17			V
V_{IL}	"L" Input voltage				6	V

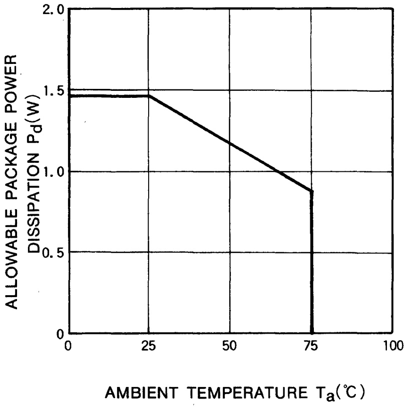
ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits Min	Limits Typ*	Limits Max	Unit
$I_{O(leak)}$	Input leakage current	V_{CE}=50V	I_I=0mA			100	μA
			V_I=6V			500	μA
$V_{CE(sat)}$	Output saturation voltage	V_I=17V, I_C=400mA			1.3	2.4	V
		V_I=17V, I_C=200mA				1.6	V
I_I	Input current	V_I=17V			0.85	1.8	mA
		V_I=25V			1.6	3.2	mA
V_F	Clamp diode forward voltage	I_F=400mA			1.5	2.4	V
I_R	Clamp diode leakage current	V_R=50V				100	μA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=350mA, T_a=25℃		1000			

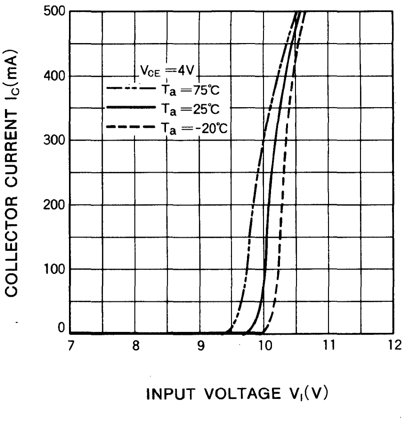
* : All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

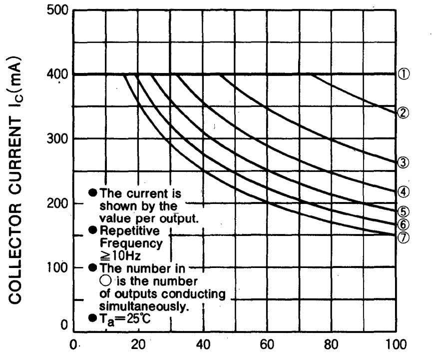


OUTPUT CURRENT CHARACTERISTICS

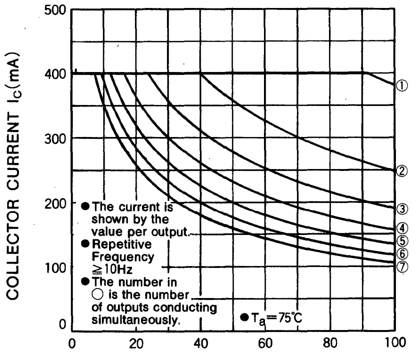


7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

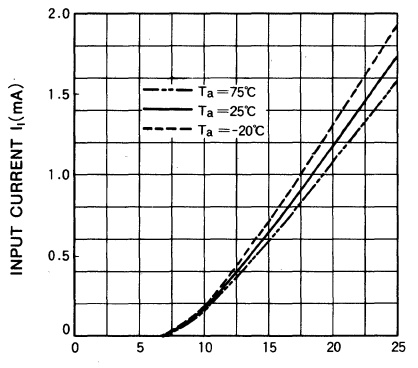
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



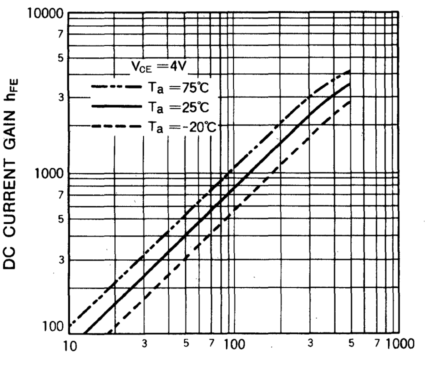
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



INPUT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54526P

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION

The M54526P, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

FEATURES

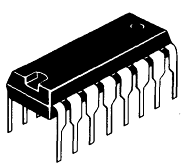
- High output sustaining voltage to 50V
- High output sink current to 500mA
- Integral diodes for transient suppression
- PMOS compatible input
- Wide operating temperature range ($T_a = -20 \sim +75$℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

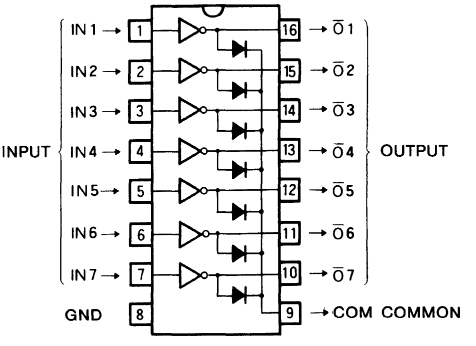
FUNCTION

The M54526P is comprised of seven darlington driver pairs with 10.5kΩ series input resistors. Between pin 9 and each output, there are integral diodes for inductive load transient suppression. All emitters and the substrate are connected together to pin 8. The outputs are capable of sinking 500mA and will withstand 50V in the OFF state.



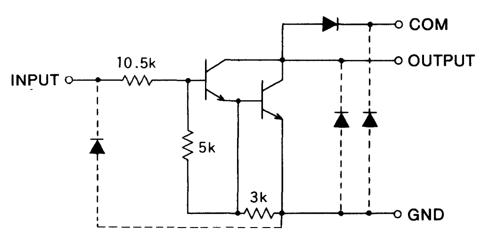
16-pin molded plastic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS ($T_a = -20 \sim +75$℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
I_C	Collector current	Transistor ON	500	mA
V_I	Input voltage		30	V
I_F	Clamp diode forward current		500	mA
V_R	Clamp diode reverse voltage		50	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

7-UNIT 500mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_O	Output voltage				50	V
I_C	Collector current per channel	Percent duty cycle less than 8%			400	mA
		Percent duty cycle less than 30%			200	mA
V_{IH}	"H" Input voltage	I_C=400mA	8	10		V
V_{IL}	"L" Input voltage				0.5	V

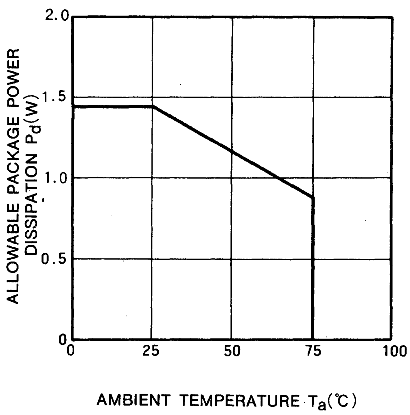
ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ*	Max	
$I_{O(leak)}$	Output leakage current	V_{CE}=50V			100	μA
$V_{CE(sat)}$	Output saturation voltage	V_I=8V, I_C=400mA		1.3	2.4	V
		V_I=8V, I_C=200mA			1.6	V
I_I	Input current	V_I=10V		0.9	1.5	mA
		V_I=25V			4.1	mA
V_F	Clamp diode forward voltage	I_F=400mA		1.5	2.4	V
I_R	Clamp diode leakage current	V_R=50V			100	μA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=350mA, T_a=25℃	1000			

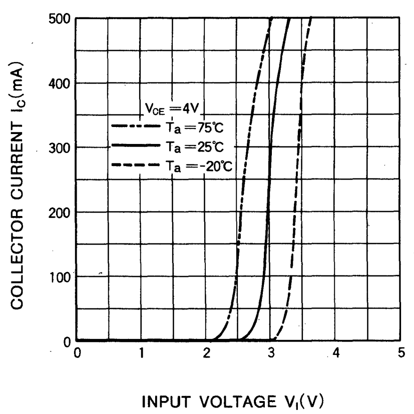
* : All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

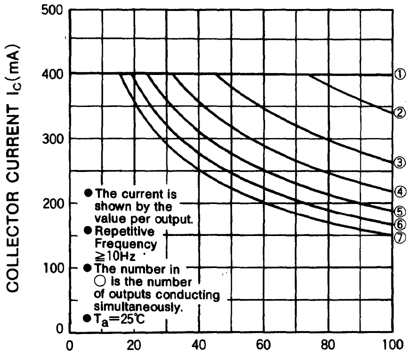


OUTPUT CURRENT CHARACTERISTICS

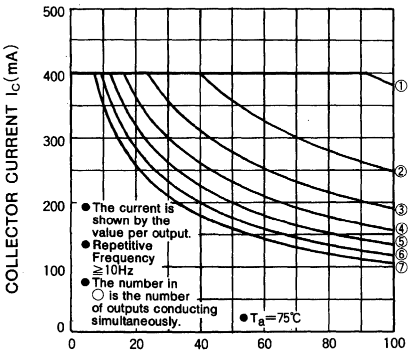


MITSUBISHI ELECTRIC

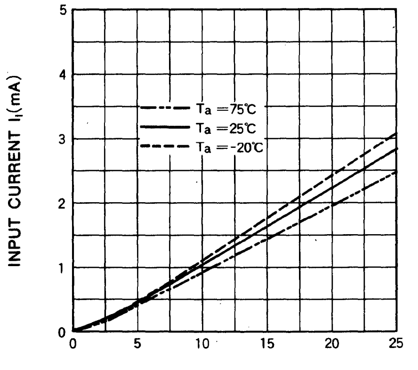
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



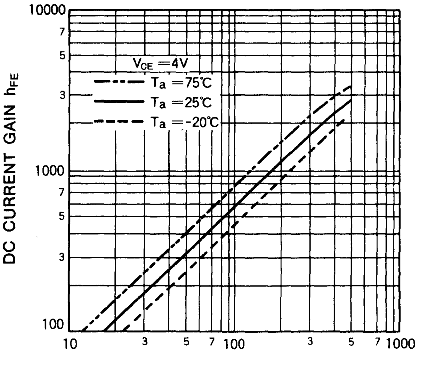
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



INPUT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54527P

6-UNIT 150mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION

The M54527P, 6-channel sink driver, consists of 12 NPN transistors connected to form high current gain driver pairs.

FEATURES

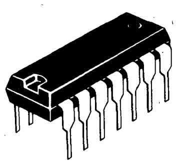
- High output sustaining voltage to 40V
- Output sink current to 150mA
- PMOS compatible input
- Integral diode for transient suppression
- Wide input voltage range from −40V to +40V
- Wide operating temperature range (T_a = −20∼+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

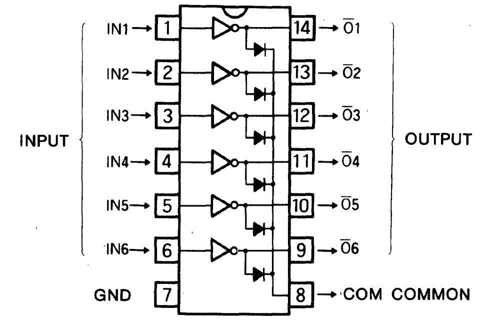
FUNCTION

The M54527P is comprised of six darlington driver pairs. Each input has a diode and 20kΩ resistor in series to allow a negative voltage input. Between pin 8 and each output, there are integral diodes for inductive load transient suppression. All emitters and the substrate are connected together to pin 7. The outputs are capable of sinking 150mA and will withstand 40V in the OFF state.



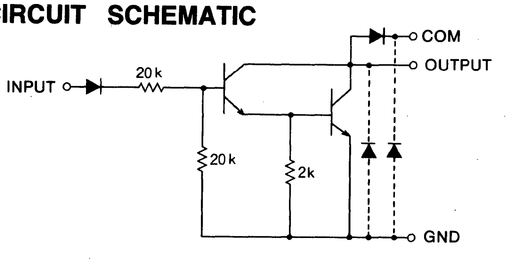
14-pin molded plastic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 14P4

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	40	V
I_C	Collector current	Transistor ON	150	mA
V_I	Input voltage		−40, 40	V
$I_{F(D)}$	Clamp diode forward current		150	mA
$V_{R(D)}$	Clamp diode reverse voltage		40	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				40	V
I_C	Collector current per channel	Percent duty cycle less than 50%			150	mA
V_{IH}	"H" Input voltage	I_C=150mA	7			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			1	V

MITSUBISHI ELECTRIC

6-UNIT 150mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

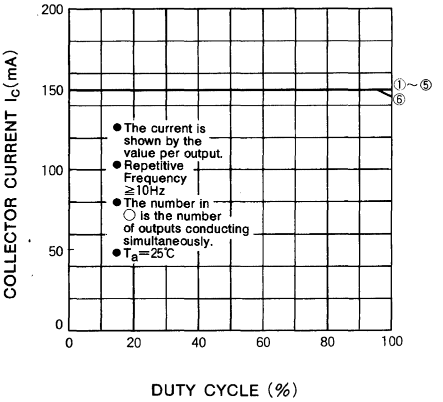
ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ*	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA	40			V
$V_{CE(sat)}$	Output saturation voltage	V_I=7V, I_C=150mA		1.4	1.7	V
		V_I=7V, I_C=100mA		1.2	1.4	V
I_I	Input current	V_I=18V		0.9	1.8	mA
		V_I=35V		1.9	5	mA
I_R	Input leakage current	V_I=−35V			−20	μA
$V_{F(D)}$	Clamp diode forward voltage	$I_{F(D)}$=150mA			1.6	V
$I_{R(D)}$	Clamp diode leakage current	$V_{R(D)}$=40V			100	μA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=150mA, T_a=25℃	800			

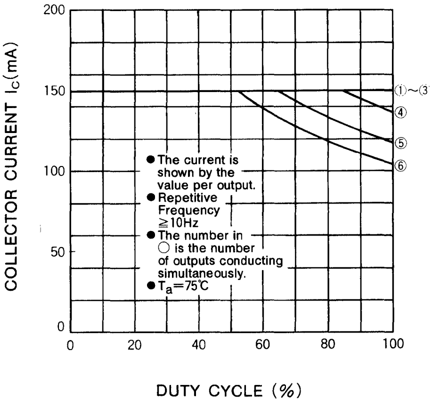
＊: All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

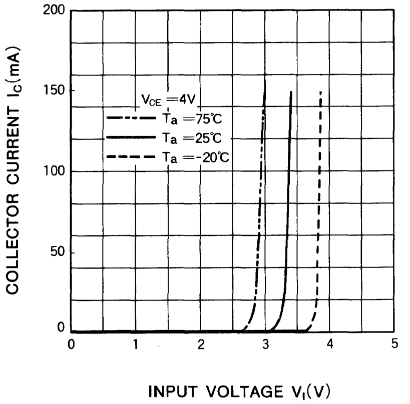
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



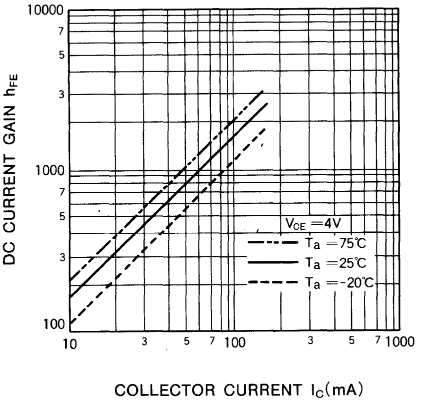
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS

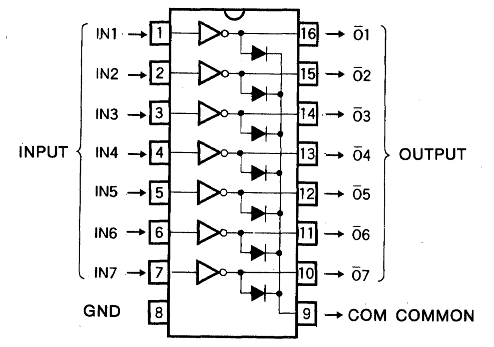


M54528P

7-UNIT 150mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION
The M54528P, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

PIN CONFIGURATION (TOP VIEW)

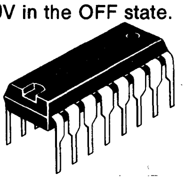


Outline 16P4

FEATURES
- High output sustaining voltage to 40V
- Output sink current to 150mA
- Efficient I/O pin layout
- PMOS compatible input
- Integral diodes for transient suppression
- Wide input voltage range from −40V to +40V
- Wide operating temperature range (T_a = −20∼+75℃)

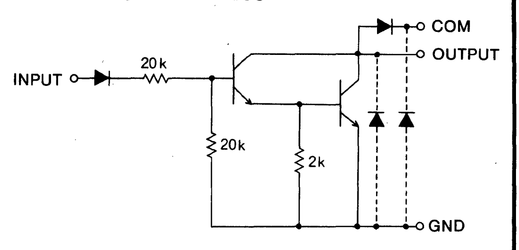
APPLICATIONS
- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

FUNCTION
The M54528P is comprised of seven darlington driver pairs. Each input has a diode and 20kΩ resistor in series to allow a negative voltage input. Between pin 9 and each output, there are integral diodes for inductive load transient suppression. All emitters and the substrate are connected together to pin 8. The outputs are capable of sinking 150mA and will withstand 40V in the OFF state.



16-pin molded plastic DIL

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	40	V
I_C	Collector current	Transistor ON	150	mA
V_I	Input voltage		−40	V
			40	V
I_F	Clamp diode forward current		150	mA
V_R	Clamp diode reverse voltage		40	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				40	V
I_C	Collector current per channel	Percent duty cycle less than 40%			150	mA
V_{IH}	"H" input voltage	I_C=150mA	7			V
V_{IL}	"L" input voltage	$I_{O(leak)}$=50μA			1	V

MITSUBISHI ELECTRIC

7-UNIT 150mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

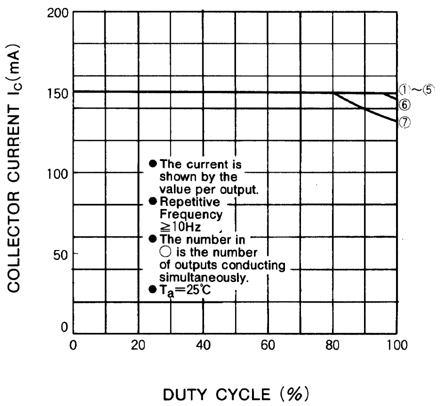
ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ*	Max	
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA	40			V
$V_{CE(sat)}$	Output saturation voltage	V_I=7V, I_C=150mA		1.4	1.7	V
		V_I=7V, I_C=100mA		1.2	1.4	V
I_I	Input current	V_I=18V		0.9	1.8	mA
		V_I=35V		1.9	5	mA
I_R	Input leakage current	V_I=−35V			−20	μA
$V_{F(D)}$	Clamp diode forward voltage	$I_{F(D)}$=150mA			1.6	V
$I_{R(D)}$	Clamp diode leakage current	$V_{R(D)}$=40V			100	μA
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=150mA, T_a=25℃	800			

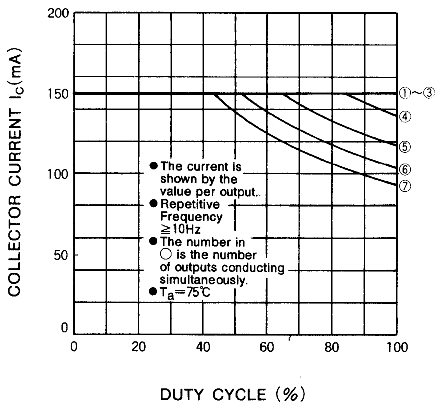
* : All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

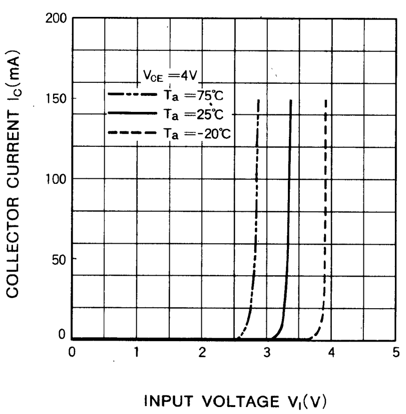
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



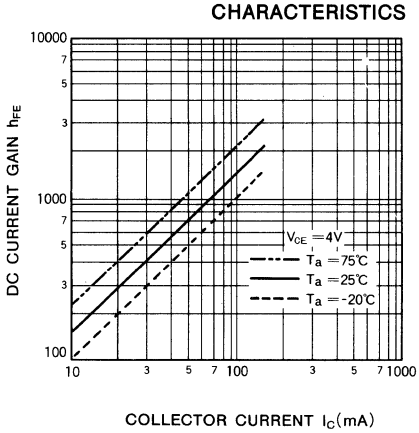
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54529P

5-UNIT 320mA TRANSISTOR ARRAY WITH STROBE

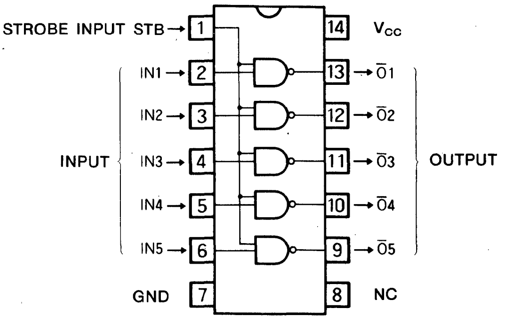
DESCRIPTION
The M54529P, 5-channel sink driver, consists of 10 NPN transistors connected to form high current gain driver pairs.

FEATURES
- Output sustaining voltage to 20V
- High output sink current to 320mA
- PMOS Compatible input with strobe control
- Wide operating temperature range (T_a=−20∼+75℃)

APPLICATIONS
- Relay and printer driver
- LED and incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

FUNCTION
The M54529P uses a predriver stage. Each input has a diode and 20kΩ resistor in series to have a wide input voltage range from −25V to +20V. All input can be controlled simultaneously by a strobe input at pin 1. The power supply of the predrivers is connected to pin 14. All emitters and the substrate are connected together to pin 7. The outputs are capable of sinking 320mA and will withstand 20V in the OFF state.

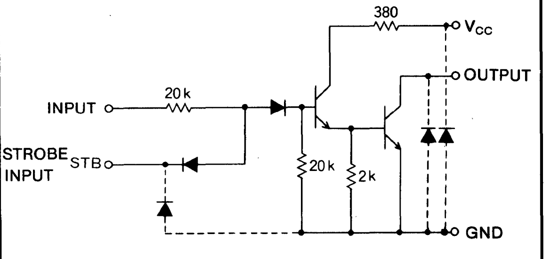
PIN CONFIGURATION (TOP VIEW)



Outline 14P4

NC : NO CONNECTION

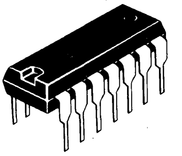
CIRCUIT SCHEMATIC



UNIT : Ω

FUNCTIONAL TABLE

IN	STB	OUT
L	L	H
H	L	H
L	H	H
H	H	L



14-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	320	mA
V_I	Input voltage		−25, 20	V
$V_{I(STB)}$	Strobe input voltage		20	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

5-UNIT 320mA TRANSISTOR ARRAY WITH STROBE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		3		8	V
V_O	Output voltage				20	V
I_C	Collector current per channel	Percent duty cycle less than 33%, V_{CC}=6.5V			300	mA
		Percent duty cycle less than 80%, V_{CC}=6.5V			150	mA
V_{IH}	"H" Input voltage	I_C=300mA	7			V
		I_C=150mA	6			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			1	V
$V_{IH(STB)}$	"H" Input voltage (strobe input)		2.4			V
$V_{IL(STB)}$	"L" Input voltage (strobe input)				0.2	V

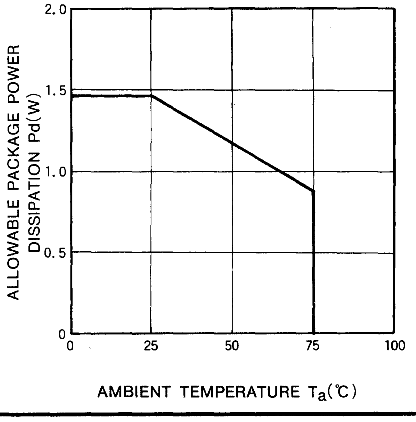
ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits Min	Limits Typ*	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	V_{CC}=8V, V_I=7V, $V_{I(STB)}$=0.2V I_{CEO}=100μA		20			V
$V_{CE(sat)}$	Output saturation voltage	V_I=7V	V_{CC}=6.5V, I_C=250mA		0.5	0.85	V
		$V_{I(STB)}$=2.4V	V_{CC}=3V, I_C=120mA		0.3	0.5	V
I_I	Input current	V_{CC}=8V, V_I=18V, $V_{I(STB)}$=2.4V			0.9	1.8	mA
I_R	Input leakage current	V_{CC}=8V, V_I=−25V				−20	μA
$I_{I(STB)}$	Strobe input current	V_{CC}=8V, V_I=7V all input $V_{I(STB)}$=0.2V			−4		mA
$I_{R(STB)}$	Strobe input leakage current	V_{CC}=8V, V_I=0V, $V_{I(STB)}$=20V				10	μA
I_{CC}	Supply current	V_{CC}=8V, V_I=7V all input $V_{I(STB)}$=2.4V				170	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=6.5V, I_C=300mA, T_a=25℃		1000			

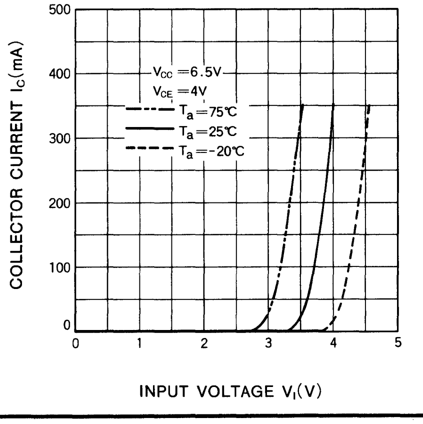
* : All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

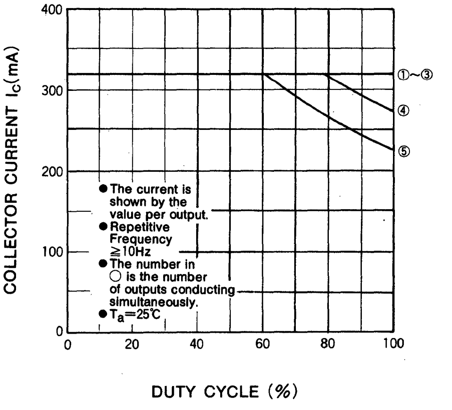
ALLOWABLE AVERAGE POWER DISSIPATION



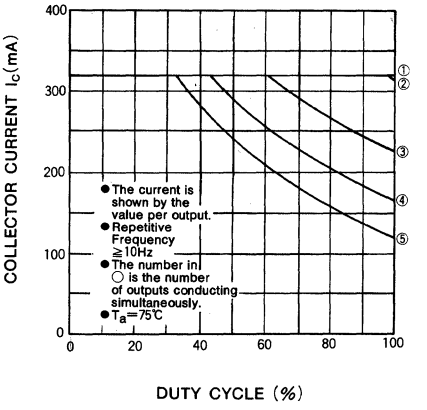
OUTPUT CURRENT CHARACTERISTICS



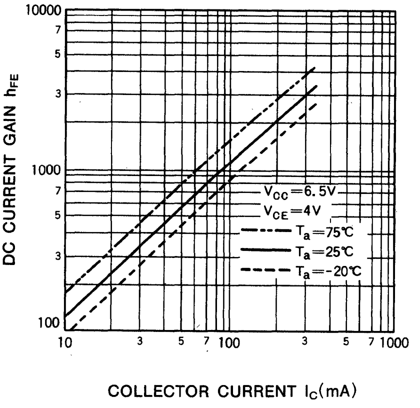
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54529AP

5-UNIT 320mA TRANSISTOR ARRAY WITH STROBE

DESCRIPTION

The M54529AP, 5-channel sink driver, consists of 10 NPN transistors connected to form high current gain driver pairs.

FEATURES

- Output sustaining voltage to 20V
- High output sink current to 320mA
- CMOS compatible input with strobe control
- Wide operating temperature range (T_a = −20∼+75℃)

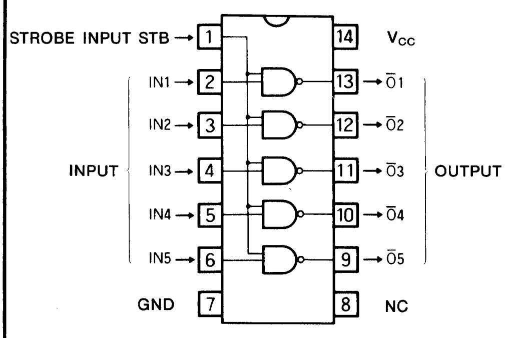
APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

FUNCTION

The M54529AP uses a predriver stage. Each input has a diode and 30kΩ resistor in series to have a wide input voltage range from −25V to +20V. All input can be controlled simultaneously by a strobe input at pin 1. The power supply of the predrivers is connected to pin 14. All emitters and the substrate are connected together to pin 7 . The outputs are capable of sinking 320mA and will withstand 20V in the OFF state.

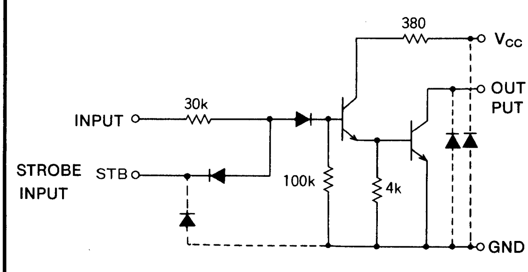
PIN CONFIGURATION (TOP VIEW)



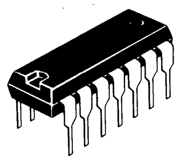
Outline 14P4

NC : NO CONNECTION

CIRCUIT SCHEMATIC



UNIT : Ω



14-pin molded plastic DIL

FUNCTIONAL TABLE

IN	STB	OUT
L	L	H
H	L	H
L	H	H
H	H	L

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	320	mA
V_I	Input voltage		−20, 20	V
$V_{I(STB)}$	Strobe input voltage		20	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

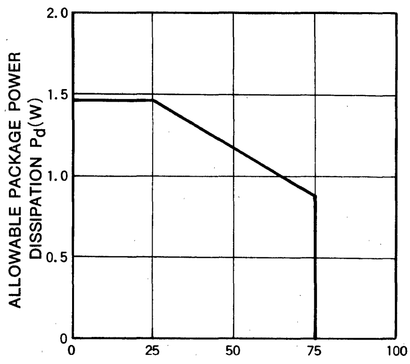
Symbol	Parameter		Limits Min	Typ	Max	Unit
V_{CC}	Supply voltage		3	5	8	V
V_O	Output voltage				20	V
I_C	Collector current per channel	Percent duty cycle less than 33%, V_{CC}=6.5V			300	mA
		Percent duty cycle less than 80%, V_{CC}=6.5V			150	mA
V_{IH}	"H" Input voltage	I_C=150mA	3.5			V
		I_C=300mA	5			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			1	V
$V_{IH(STB)}$	"H" Input voltage (strobe input)		2.4			V
$V_{IL(STB)}$	"L" Input voltage (strobe input)				0.2	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

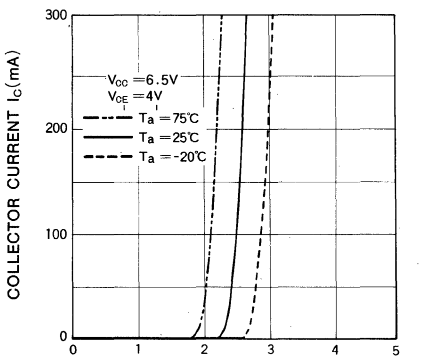
Symbol	Parameter	Test conditions		Limits Min	Typ	Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	V_{CC}=8V, V_I=8V, $V_{I(STB)}$=0.2V I_{CEO}=100μA		20			V
$V_{CE(sat)}$	Output saturation voltage	$V_{I(STB)}$=2.4V	V_{CC}=6.5V, V_I=5V, I_C=250mA			0.85	V
			V_{CC}=3V, V_I=3.5V, I_C=150mA			0.6	V
I_I	Input current	V_{CC}=5V, V_I=3.5V, $V_{I(STB)}$=2.4V				120	μA
I_R	Input leakage current	V_{CC}=8V, V_I=−20V				−20	μA
$I_{I(STB)}$	Strobe input current	V_{CC}=5V, V_I=5V all input $V_{I(STB)}$=0.2V				−1.5	mA
$I_{R(STB)}$	Strobe input leakage current	V_{CC}=8V, V_I=0V, $V_{I(STB)}$=20V				10	μA
I_{CC}	Supply current	V_{CC}=8V, V_I=5V all input $V_{I(STB)}$=2.4V				170	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=6.5V, I_C=300mA, T_a=25℃		1000			

TYPICAL CHARACTERISTICS

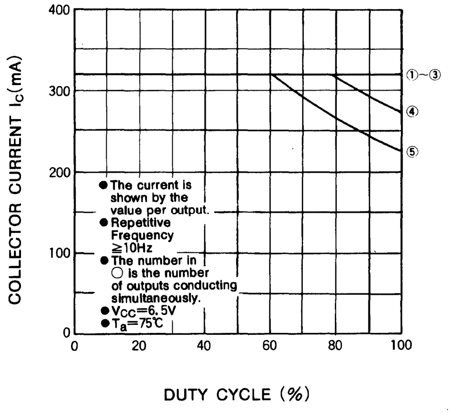
ALLOWABLE AVERAGE POWER DISSIPATION



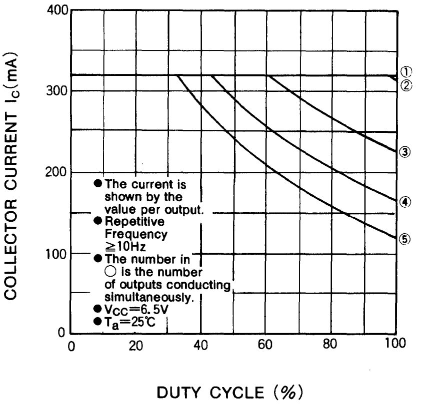
OUTPUT CURRENT CHARACTERISTICS



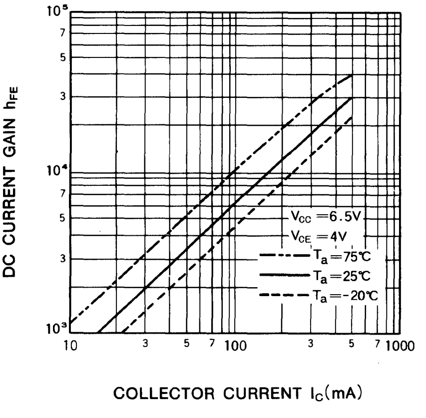
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54530P

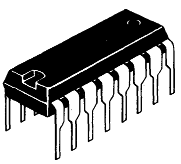
7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION
The M54530P, 7-channel sink driver, consists of 14 NPN transistors connected to form seven high current gain driver pairs.

FEATURES
- High output sustaining voltage to 40V
- High output sink current to 400mA
- Integral diodes for transient suppression
- PMOS compatible input
- Wide operating temperature range (T_a = −20∼+75℃)

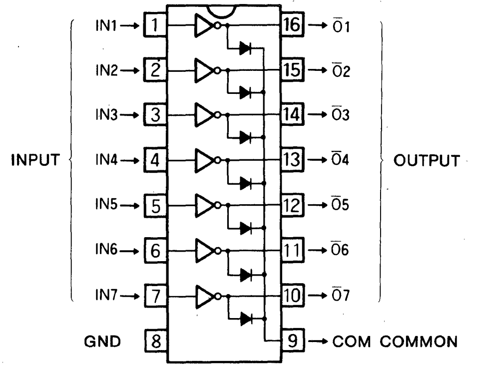
APPLICATIONS
- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

FUNCTION
The M54530P is comprised of seven NPN darlington driver pairs with 20kΩ series input resistors. Between pin 9 and each output, there are integral diodes for inductive load transient suppression. All emitters and the substrate are connected together to pin 8 . The outputs are capable of sinking 400mA and will withstand 40V in the OFF state.



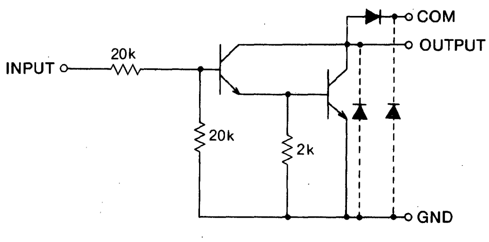
16-pin molded plastic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	40	V
I_C	Collector current	Transistor ON	400	mA
V_I	Input voltage		40	V
I_F	Clamp diode forward current		400	mA
V_R	Clamp diode reverse voltage		40	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

RECOMMENDED OPERATIONAL CONDITIONS ($T_a=-20\sim+75°C$, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				40	V
I_C	Collector current per channel	Percent duty cycle less than 8%			400	mA
		Percent duty cycle less than 30%			200	mA
V_{IH}	"H" Input voltage	$I_C=400mA$	8			V
		$I_C=200mA$	5			V
V_{IL}	"L" Input voltage	$I_{O(leak)}=50\mu A$			0.5	V

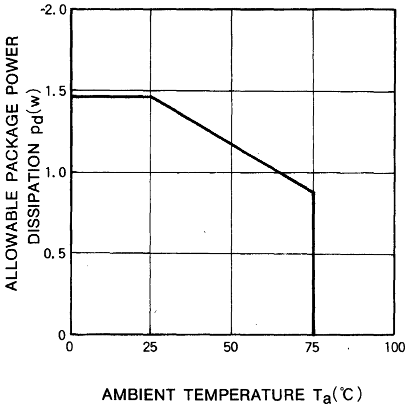
ELECTRICAL CHARACTERISTICS ($T_a=-20\sim+75°C$, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ*	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	$I_{CER}=100\mu A$	40			V
$V_{CE(sat)}$	Output saturation voltage	$V_I=8V$, $I_C=400mA$		1.3	2.4	V
		$V_I=5V$, $I_C=200mA$		1	1.6	V
I_I	Input current	$V_I=17V$		0.85	1.8	mA
		$V_I=35V$			3.8	mA
V_F	Clamp diode forward voltage	$I_{F(D)}=400mA$		1.5	2.4	V
V_R	Clamp diode reverse voltage	$V_{R(D)}=100\mu A$	40			V
h_{FE}	DC forward current gain	$V_{CE}=4V$, $I_C=300mA$, $T_a=25°C$	1000			

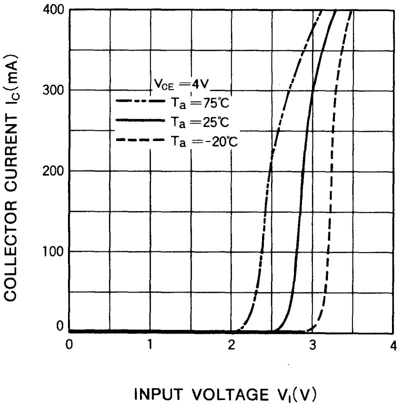
* : All typical values are at $T_a=25°C$.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

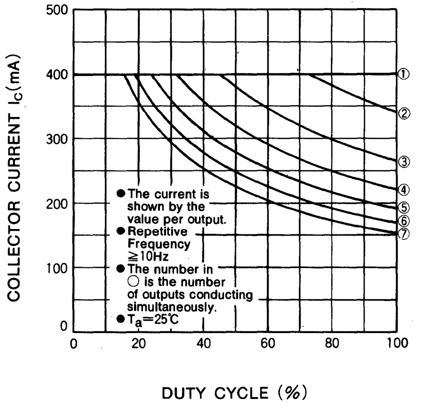


OUTPUT CURRENT CHARACTERISTICS

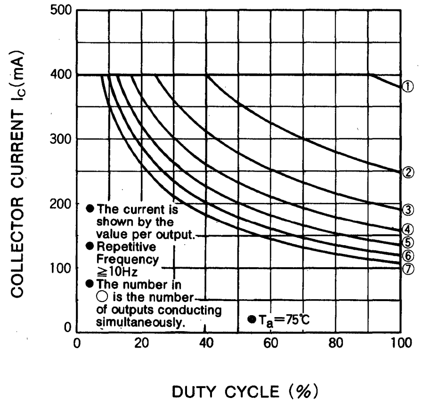


7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

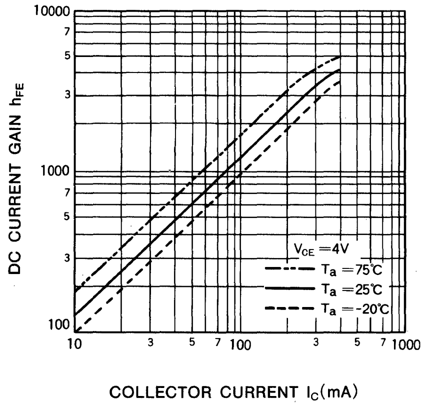
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54531P

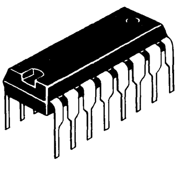
7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION
The M54531P, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

FEATURES
- High output sustaining voltage to 40V
- High output sink current to 400mA
- Integral diodes for transient suppression
- PMOS compatible input
- Wide input voltage range from −40V to +40V
- Wide operating temperature range (T_a =−20~+75℃)

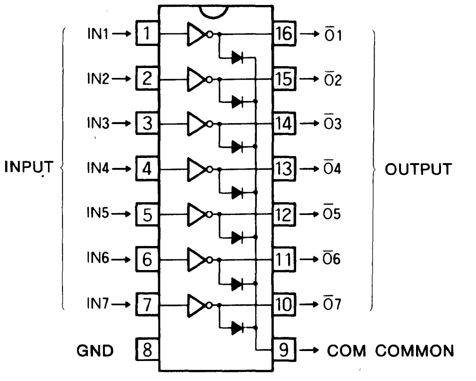
APPLICATIONS
- Relay and printer driver
- LED and incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

FUNCTION
The M54531P is comprised of seven NPN darlington driver pairs. Each input has a diode and 20kΩ resistor in series to allow a negative voltage input. Between pin 9 and each out, there are integral diodes for inductive load transient suppression. All emitters and the substrate are connected together to pin 8 . The outputs are capable of sinking 400mA and will withstand 40V in the OFF state.



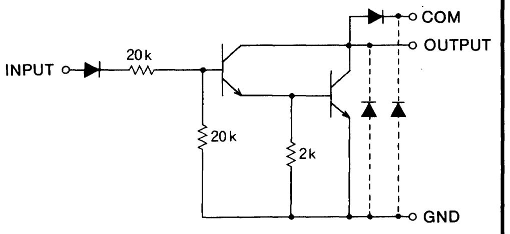
16-pin molded plastic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	40	V
I_C	Collector current	Transistor ON	400	mA
V_I	Input voltage		−40, 40	V
$I_{F(D)}$	Clamp diode forward current		400	mA
$V_{R(D)}$	Clamp diode reverse voltage		40	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				40	V
I_C	Collector current per channel	Percent duty cycle less than 8%			400	mA
		Percent duty cycle less than 30%			200	mA
V_{IH}	"H" Input voltage	I_C=400mA	9			V
		I_C=200mA	6			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			1	V

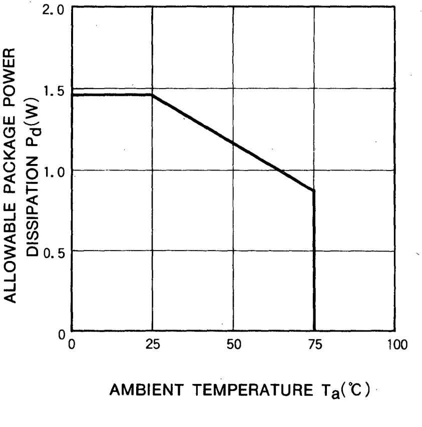
ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ*	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA	40			V
$V_{CE(sat)}$	Output saturation voltage	V_I=9V, I_C=400mA		1.3	2.4	V
		V_I=6V, I_C=200mA		1	1.6	V
I_I	Input current	V_I=18V		0.85	1.8	mA
		V_I=35V			3.8	mA
I_R	Input leakage current	V_I=−35V			−20	μA
$V_{F(D)}$	Clamp diode forward voltage	$I_{F(D)}$=400mA		1.5	2.4	V
$V_{R(D)}$	Clamp diode reverse voltage	$I_{R(D)}$=100μA	40			V
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=300mA, T_a=25℃	1000			

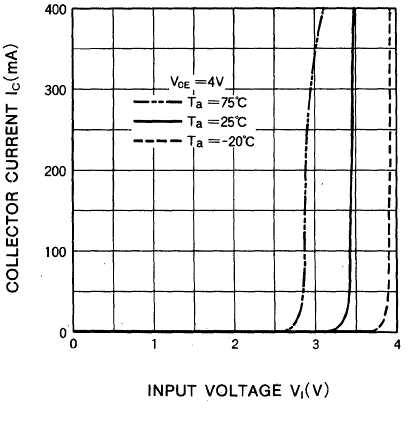
* : All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

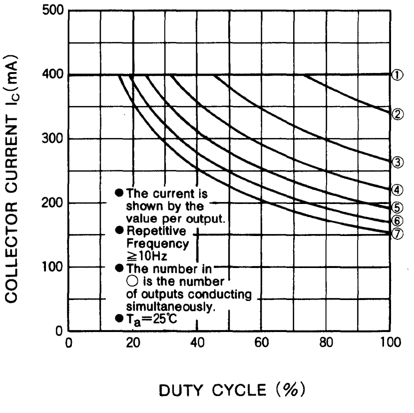


OUTPUT CURRENT CHARACTERISTICS

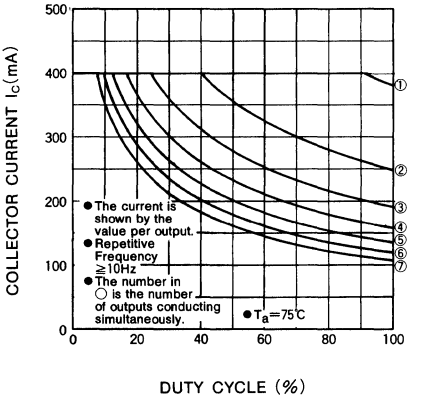


7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

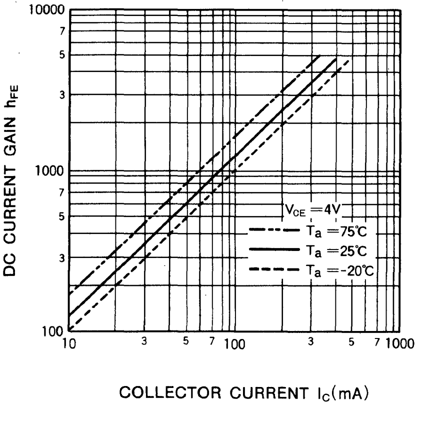
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54532P

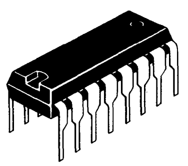
4-UNIT 1.5A DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION
The M54532P, 4-channel sink driver, consists of 8 NPN transistors connected to form high current gain driver pairs.

FEATURES
- High output sustaining voltage to 50V
- High output sink current to 1.5A
- Integral diodes for transient suppression
- Wide operating temperature range (T_a =−20∼+75℃)

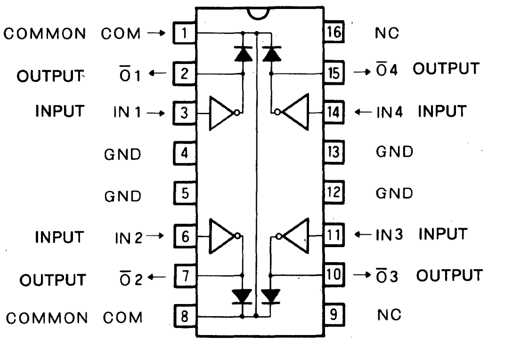
APPLICATIONS
- Relay and printer driver
- Display driver

FUNCTION
The M54532P is comprised of eight NPN darlington driver pairs with 340Ω series input resistors. Each output has a diode for inductive load transient suppression and the cathodes of the diodes are connected to pin 8 . The outputs are capable of sinking 1.5A and will withstand 50V in the OFF state.



16-pin molded plastic DIL

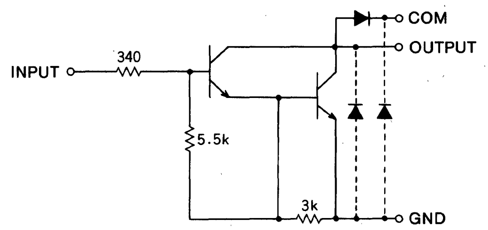
PIN CONFIGURATION (TOP VIEW)



Outline 16P4

NC : NO CONNECTION

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
I_C	Collector current	Transistor ON	1.5	A
V_I	Input voltage		10	V
$I_{F(D)}$	Clamp diode forward current		1.5	A
			1.25	A
$V_{R(D)}$	Clamp diode reverse voltage		50	V
P_d	Power dissipation	T_a=25℃	1.92	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

4-UNIT 1.5A DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_O	Output voltage				50	V
I_C	Collector current per channel	Percent duty cycle less than 4%			1.25	A
		Percent duty cycle less than 18%			700	mA
V_{IH}	"H" Input voltage	I_C=1.25A	3			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			0.4	V

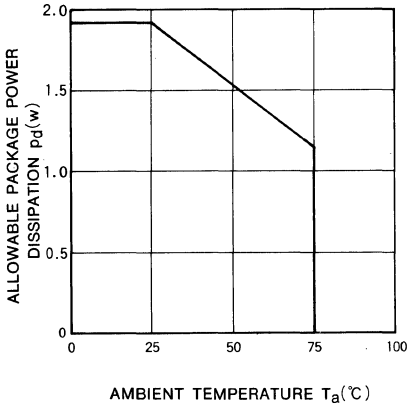
ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits Min	Limits Typ*	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA		50			V
$V_{CE(sat)}$	Output saturation voltage	I_I=2mA	I_C=1.25A			2.2	V
			I_C=700mA			1.7	
I_I	Input current	V_I=3V			5	8.5	mA
V_F	Clamp diode forward voltage	I_F=1.25A				2.3	V
V_R	Clamp diode reverse voltage	I_R=100μA		50			V
h_{FE}	DC forward current gain	V_{CE}=4V, I_C=1A, T_a=25℃		800			

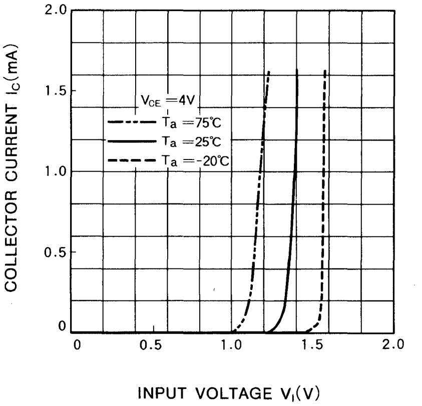
* : A typical value is at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

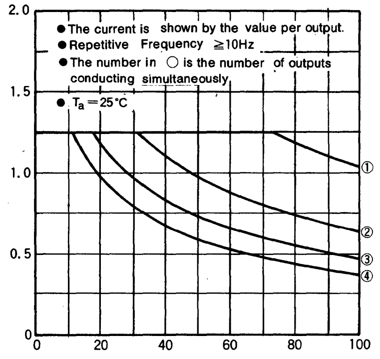


OUTPUT CURRENT CHARACTERISTICS

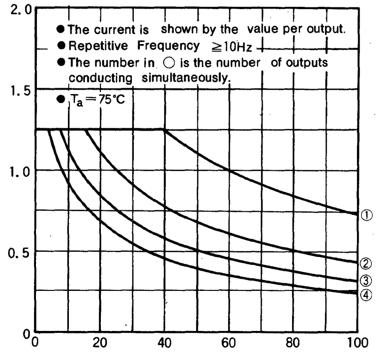


4-UNIT 1.5A DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

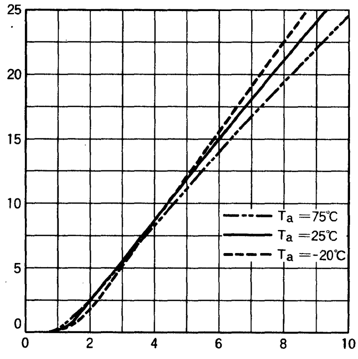
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



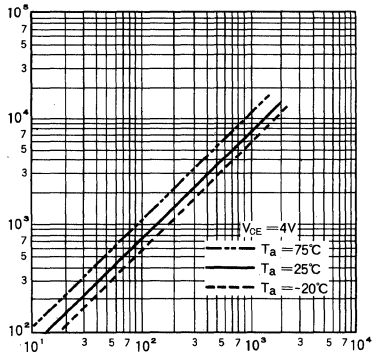
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



INPUT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54533P

6-UNIT 320mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

DESCRIPTION

The M54533P, 6-channel sink driver, consists of 12 NPN transistors to form high current gain driver pairs.

FEATURES

- Output breakdown voltage to 20V
- High output sink current to 320mA
- Integral diode for transient suppression
- Strobe control input
- Wide input voltage range from −25V to +20V
- Wide operating temperature range (T_a =−20∼+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver

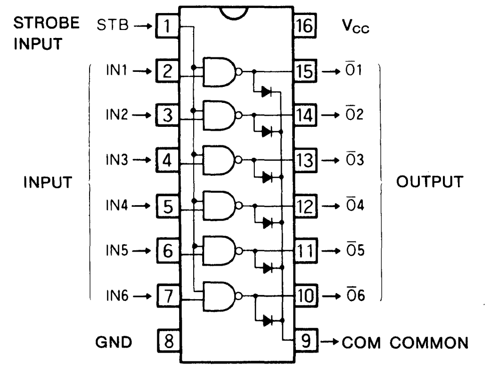
FUNCTION

The M54533P uses a predriver stage. Each input has a diode and 20kΩ resistor in series to allow a negative voltage input. All input can be controlled simultaneously by a strobe input at pin 1.

The power supply of the predrivers is connected to pin 16. All emitters and the substrate are connected together to pin 8. Each output has an integral diode for inductive load transient suppression and the cathodes of the diodes are connected to pin 9.

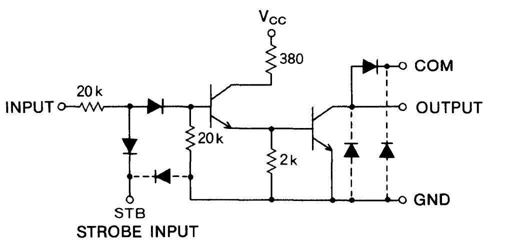
The outputs are capable of sinking 320mA and will withstand 20V in the OFF state.

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

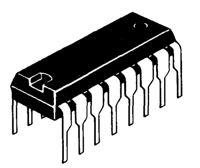
CIRCUIT SCHEMATIC



UNIT : Ω

FUNCTIONAL TABLE

IN	STB	OUT
L	L	H
H	L	H
L	H	H
H	H	L



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	320	mA
V_I	Input voltage		−25, 20	V
$V_{I(STB)}$	Strobe input voltage		20	V
$V_{R(D)}$	Clamp diode reverse voltage		20	V
$I_{F(D)}$	Clamp diode forward current		320	mA
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

6-UNIT 320mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

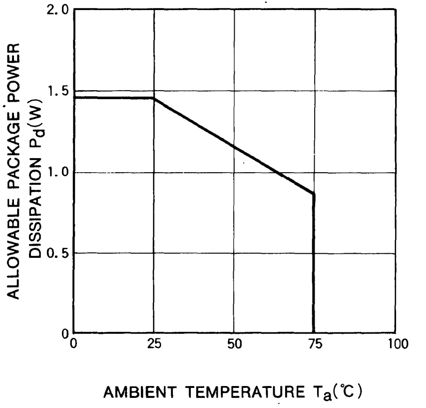
Symbol	Parameter		Limits Min	Typ	Max	Unit
V_{CC}	Supply voltage		3		8	V
V_O	Output voltage				20	V
I_C	Collector current per channel	Percent duty cycle less than 25%, V_{CC}=6.5V			300	mA
		Percent duty cycle less than 65%, V_{CC}=6.5V			150	mA
V_{IH}	"H" Input voltage	I_C=300mA	7			V
		I_C=150mA	5			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			1	V
$V_{IH(STB)}$	"H" Input voltage (strobe input)		2.4			V
$V_{IL(STB)}$	"L" Input voltage (strobe input)				0.2	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

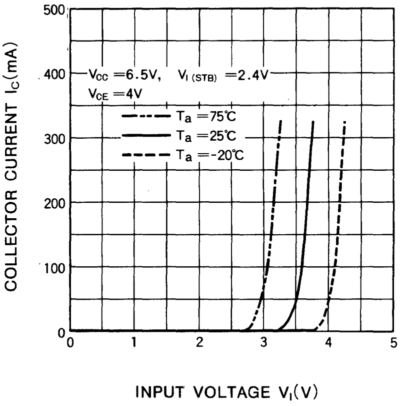
Symbol	Parameter	Test conditions		Limits Min	Typ	Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	V_{CC}=8V, V_I=18V, $V_{I(STB)}$=0.2V I_{CEO}=100μA		20			V
$V_{CE(sat)}$	Output saturation voltage	V_I=7V $V_{I(STB)}$=2.4V	V_{CC}=6.5V, I_C=250mA		0.5	0.85	V
			V_{CC}=3V, I_C=120mA		0.3	0.5	V
I_I	Input current	V_{CC}=8V, V_I=18V, $V_{I(STB)}$=2.4V			0.8	1.8	mA
I_R	Input leakage current	V_{CC}=8V, V_I=−25V				−20	μA
$I_{I(STB)}$	Strobe input current	V_{CC}=8V, V_I=18V (all input), $V_{I(STB)}$=0.2V			−4		mA
$I_{R(STB)}$	Strobe input leakage current	V_{CC}=8V, V_I=0V, $V_{I(STB)}$=20V				20	μA
$V_{F(D)}$	Clamp diode forward voltage	$I_{F(D)}$=320mA			1.4	2.4	V
$V_{R(D)}$	Clamp diode reverse voltage	$I_{R(D)}$=100μA		20	40		V
I_{CC}	Supply current	V_{CC}=8V, V_I=7V (all input) $V_{I(STB)}$=2.4V				200	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=6.5V, I_C=300mA, T_a=25℃		1000			

TYPICAL CHARACTERISTICS

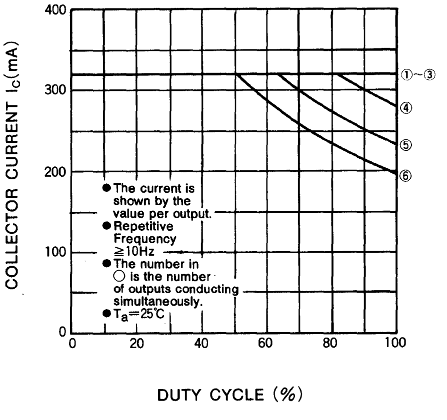
ALLOWABLE AVERAGE POWER DISSIPATION



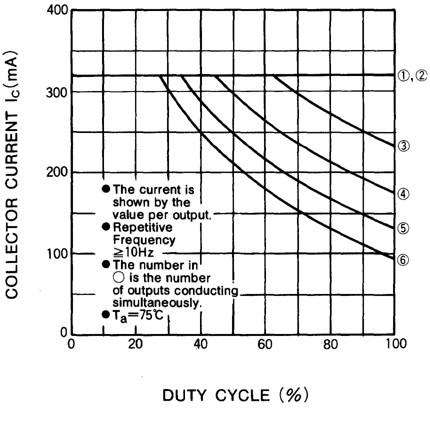
OUTPUT CURRENT CHARACTERISTICS



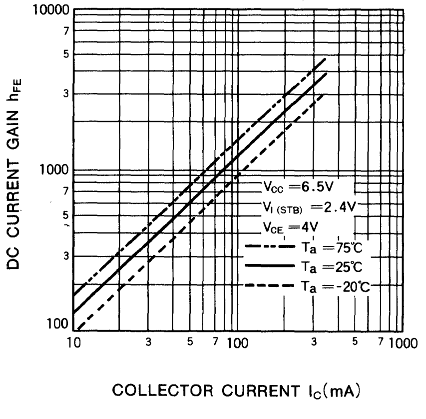
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54534P

6-UNIT 320mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

DESCRIPTION
The M54534P, 6-channel sink driver, consists of 12 NPN transistors connected to form high current gain driver pairs.

FEATURES
- Output breakdown voltage to 20V
- High output sink current to 320mA
- Integral diodes for transient suppression
- Strobe control input
- Wide input voltage range from −25V to +20V
- Wide operating temperature range (T_a = −20∼+75℃)

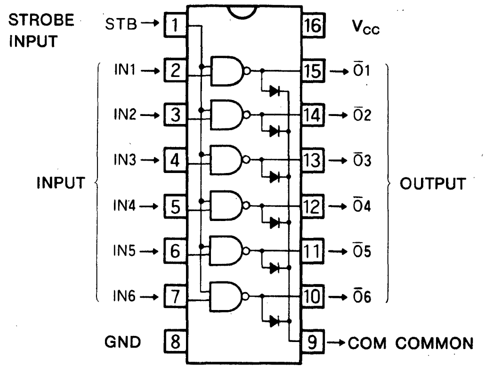
APPLICATIONS
- Relay and printer driver
- LED or incandescent display digit driver

FUNCTION
The M54534P uses a predriver stage. Each input has a diode and 1.6kΩ resistor in series to allow a negative voltage input. All input can be controlled simultaneously by a strobe input at pin 1.

The power supply of the predrivers is connected to pin 16. Each output has an integral diode for inductive load transient suppression and the cathodes of the diodes are connected to pin 9. All emitters and the substrate are connected together to pin 8.

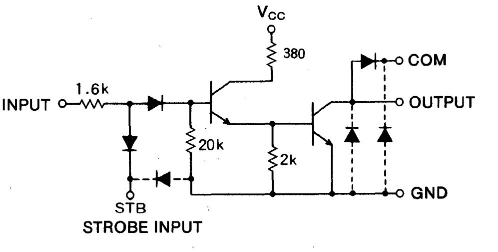
The outputs are capable of sinking 320mA and will withstand 20V in the OFF state.

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

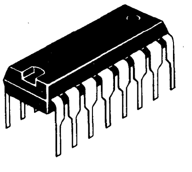
CIRCUIT SCHEMATIC



UNIT : Ω

FUNCTIONAL TABLE

IN	STB	OUT
L	L	H
H	L	H
L	H	H
H	H	L



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	320	mA
V_I	Input voltage		−25, 20	V
$V_{I(STB)}$	Strobe input voltage		20	V
$V_{R(D)}$	Clamp diode reverse voltage		20	V
$I_{F(D)}$	Clamp diode forward current		320	mA
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20～+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		3		8	V
V_O	Output voltage				20	V
I_C	Collector current per channel	Percent duty cycle less than 25%, V_{CC}=6.5V			300	mA
		Percent duty cycle less than 65%, V_{CC}=6.5V			150	mA
V_{IH}	"H" Input voltage	I_C=300mA	3.2			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			0.7	V
$V_{IH(STB)}$	"H" Input voltage (strobe input)		2.4			V
$V_{IL(STB)}$	"L" Input voltage (strobe input)				0.2	V

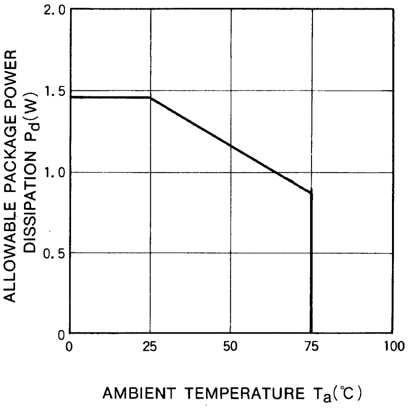
ELECTRICAL CHARACTERISTICS (T_a=−20～+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits Min	Limits Typ*	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	V_{CC}=8V, V_I=3.2V, $V_{I(STB)}$=0.2V, I_{CEO}=100μA		20			V
$V_{CE(sat)}$	Output saturation voltage	V_I=3V	V_{CC}=6.5V, I_C=250mA		0.5	0.85	V
		$V_{I(STB)}$=2.4V	V_{CC}=3V, I_C=120mA		0.3	0.5	V
I_I	Input current	V_{CC}=8V, V_I=3.2V, $V_{I(STB)}$=2.4V				1.4	mA
I_R	Input leakage current	V_{CC}=8V, V_I=−25V				−20	μA
$I_{I(STB)}$	Strobe input current	V_{CC}=8V, V_I=3.2V (all input), $V_{I(STB)}$=0.2V			−7.9		mA
$I_{R(STB)}$	Strobe input leakage current	V_{CC}=8V, V_I=0V, $V_{I(STB)}$=20V				20	μA
$V_{F(D)}$	Clamp diode forward voltage	$I_{F(D)}$=320mA			1.4	2.4	V
$V_{R(D)}$	Clamp diode reverse voltage	$I_{R(D)}$=100μA		20	40		V
I_{CC}	Supply current	V_{CC}=8V, V_I=3.2V (all input), $V_{I(STB)}$=2.4V				200	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=6.5V, I_C=300mA, T_a=25℃		1000			

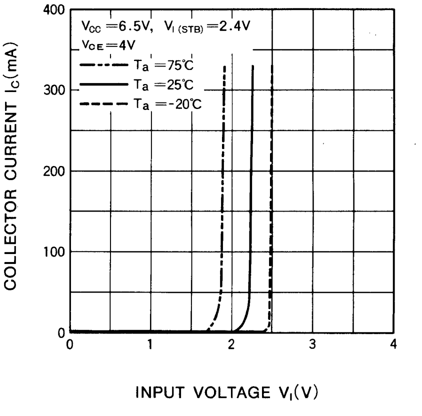
* : All typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

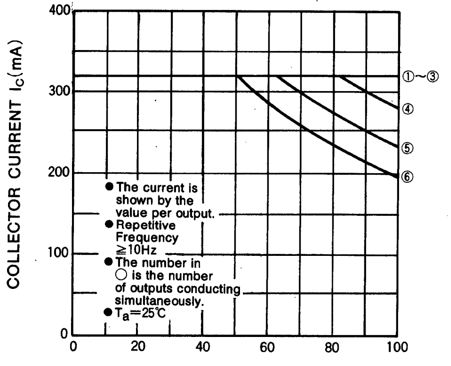
ALLOWABLE AVERAGE POWER DISSIPATION



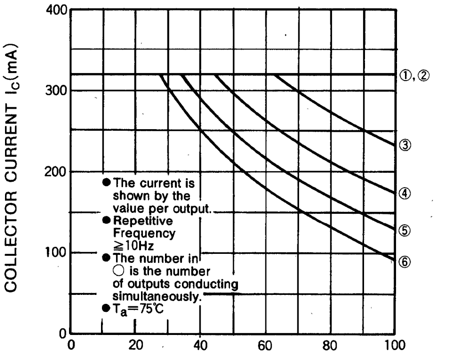
OUTPUT CURRENT CHARACTERISTICS



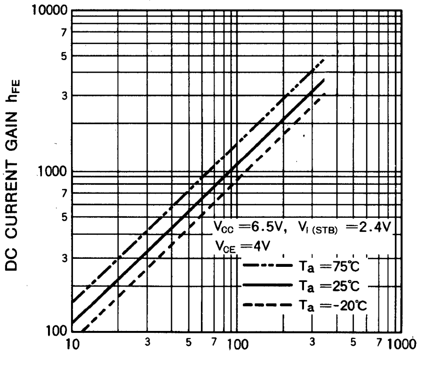
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54535P

7-UNIT 150mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

DESCRIPTION

The M54535P, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

FEATURES

- Output sink current to 150mA
- Strobe input control
- PMOS Compatible input
- Wide operating temperature range (T_a = −20∼+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

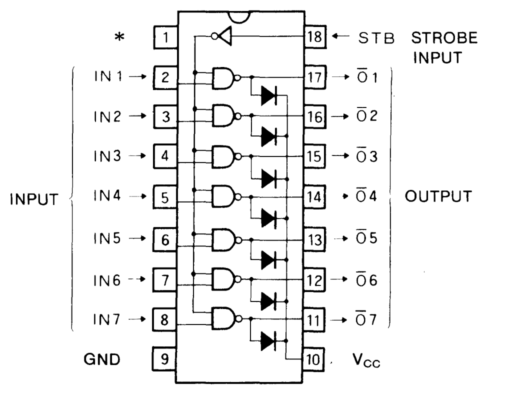
FUNCTION

The M54535P uses a predriver stage. Each input has a diode and 20kΩ resistor in series to allow a negative voltage input. All inputs can be controlled simultaneously by a strobe input at pin 18. Each output has an integral diode for inductive load transient suppression.

The cathodes of the diodes and the power supply of the predrivers are connected to pin 10. All emitters and the substrate are connected together to pin 9.

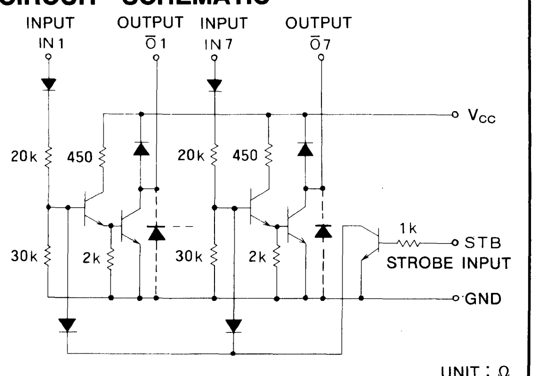
The outputs are capable of sinking 150mA and will withstand 10V in the OFF state.

PIN CONFIGURATION (TOP VIEW)



Outline 18P4

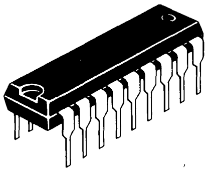
CIRCUIT SCHEMATIC



UNIT : Ω

FUNCTIONAL TABLE

IN	STB	OUT
L	L	H
H	L	L
L	H	H
H	H	H



18-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_O	Output voltage	Transistor OFF	V_{CC}	V
I_C	Collector current	Transistor ON	150	mA
V_I	Input voltage		−25, 20	V
$V_{I(STB)}$	Strobe input voltage		20	V
$V_{R(D)}$	Clamp diode reverse voltage		10	V
$I_{F(D)}$	Clamp diode forward current		150	mA
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Typ	Max	Unit
V_{CC}	Supply voltage		3		8	V
V_O	Output voltage	V_{CC}=10V			10	V
I_C	Collector current per channel	Percent duty cycle less than 65%			150	mA
V_{IH}	"H" Input voltage	I_C=100mA	7			V
V_{IL}	"L" Input voltage				0.8	V
$V_{IH(STB)}$	"H" Input voltage (strobe input)	V_I=12V	1.3			V
		V_I=20V	2.4			
$V_{IL(STB)}$	"L" Input voltage (strobe input)				0.2	V

ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

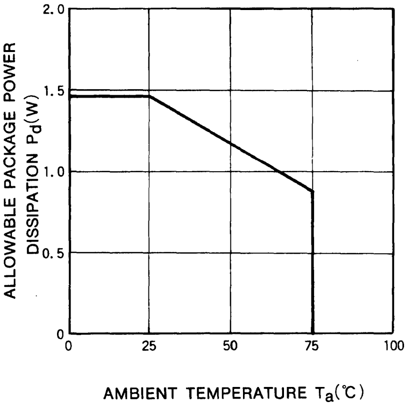
Symbol	Parameter	Test conditions		Limits Min	Typ*	Max	Unit
$V_{CE(sat)}$	Output saturation voltage	$V_{I(STB)}$=0.2V, V_{CC}=6V, I_I=300μA, I_C=100mA				0.3	V
		V_I=7V, $V_{I(STB)}$=0.2V	V_{CC}=3V, I_C=100mA			0.3	V
			V_{CC}=8V, I_C=150mA			0.5	V
$I_{O(leak)}$	Output leak current	V_{CC}=8V, V_I=0.8V, V_O=8V, $V_{I(STB)}$=0.2V				50	μA
I_I	Input current	V_{CC}=8V, V_I=12V, $V_{I(STB)}$=0.2V				1	mA
I_R	Input leakage current	V_{CC}=8V, V_I=−25V				−20	μA
$I_{I(STB)}$	Strobe input current	V_I=12V, $V_{I(STB)}$=2.4V				3	mA
$V_{F(D)}$	Clamp diode forward voltage	$I_{F(D)}$=150mA				2.1	V
$V_{R(D)}$	Clamp diode reverse voltage	$I_{R(D)}$=100μA		10			V
I_{CC}	Supply current	V_{CC}=8V, V_I=12V all input, $V_{I(STB)}$=0.2V			120	200	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=6V, I_C=150mA, T_a=25℃		700			

* : The typical value is at T_a=25℃.

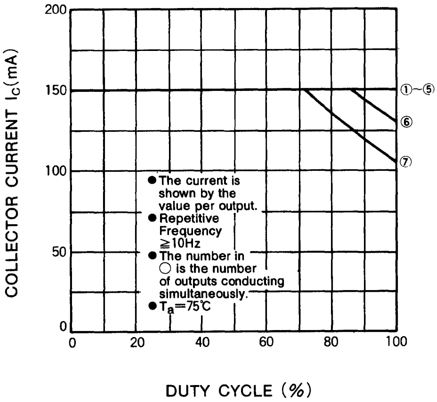
7-UNIT 150mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

TYPICAL CHARACTERISTICS

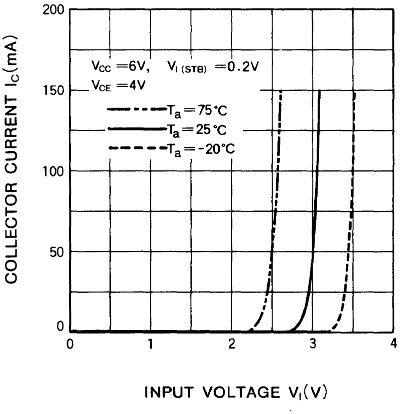
ALLOWABLE AVERAGE POWER DISSIPATION



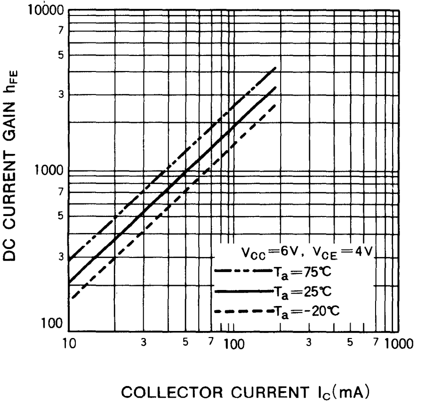
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54536P

7-UNIT 150mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

DESCRIPTION

The M54536P, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

FEATURES

- Output sink current to 150mA
- Strobe input control
- TTL Compatible input
- Wide operating temperature range (T_a=−20~+75℃)

APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

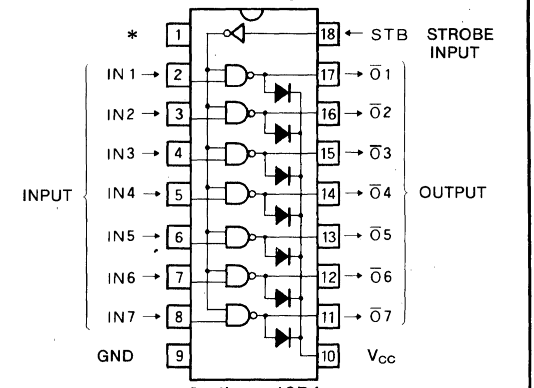
FUNCTION

The M54536P uses a predriver stage. Each input has a diode and 20kΩ resistor in series to allow a negative voltage input. All inputs can be controlled simultaneously by a strobe input at pin 18. Each output has an integral diode for inductive load transient suppression.

The cathodes of the diodes and the power supply of the predrivers are connected to pin 10. All emitters and the substrate are connected together to pin 9.

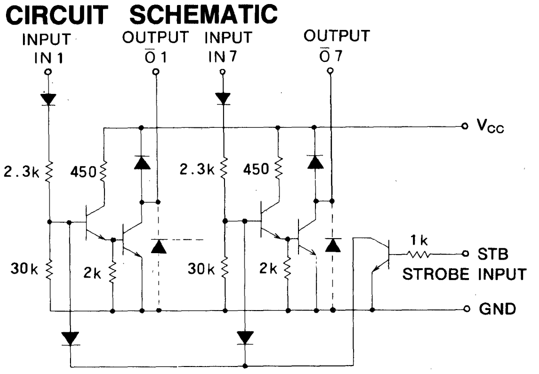
The outputs are capable of sinking 150mA and will withstand 10V in the OFF state.

PIN CONFIGURATION (TOP VIEW)



Outline 18P4

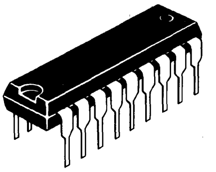
CIRCUIT SCHEMATIC



UNIT : Ω

FUNCTION TABLE

IN	STB	OUT
L	L	H
H	L	L
L	H	H
H	H	H



18-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−25~+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_O	Output voltage	Transistor OFF	V_{CC}	V
I_C	Collector current	Transistor ON	150	mA
V_I	Input voltage		−25, 10	V
$V_{I(STB)}$	Strobe input voltage		20	V
$V_{R(D)}$	Clamp diode reverse voltage		10	V
$I_{F(D)}$	Clamp diode forward current		150	mA
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−25~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		3		8	V
V_O	Output voltage	V_{CC}=10V			10	V
I_C	Collector current per channel	Percent duty cycle less than 65%			150	mA
V_{IH}	"H" Input voltage	I_C=100mA	3.2			V
V_{IL}	"L" Input voltage				0.8	V
$V_{IH(STB)}$	"H" Input voltage (strobe input)	V_I=3.5V	1.3			V
		V_I=10V	2.4			
$V_{IL(STB)}$	"L" Input voltage (strobe input)				0.2	V

ELECTRICAL CHARACTERISTICS (T_a=−25~+75℃, unless otherwise noted)

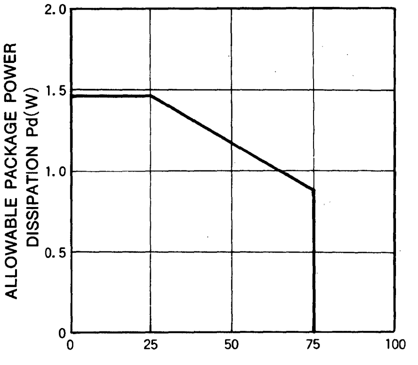
Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ*	Max	
$V_{CE(sat)}$	Output saturation voltage	$V_{I(STB)}$=0.2V, V_{CC}=6V, I_I=300μA, I_C=100mA				0.3	V
		V_I=3.2V, $V_{I(STB)}$=0.2V	V_{CC}=3V, I_C=100mA			0.3	V
			V_{CC}=8V, I_C=150mA			0.5	V
$I_{O(leak)}$	Output leak current	V_{CC}=8V, V_I=0.8V, V_O=8V, $V_{I(STB)}$=0.2V				50	μA
I_I	Input current	V_{CC}=8V, V_I=3.5V, $V_{I(STB)}$=0.2V				1.2	mA
I_R	Input leakage current	V_{CC}=8V, V_I=−25V				−20	μA
$I_{I(STB)}$	Strobe input current	V_I=3.5V, $V_{I(STB)}$=2.4V				3	mA
$V_{F(D)}$	Clamp diode forward voltage	$I_{F(D)}$=150mA				2.1	V
$V_{R(D)}$	Clamp diode reverse voltage	$I_{R(D)}$=100μA		10			V
I_{CC}	Supply current	V_{CC}=8V, V_I=3.5V (all input), $V_{I(STB)}$=0.2V			120	200	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=6V, I_C=150mA, T_a=25℃		700			

* : A typical value is at T_a=25℃.

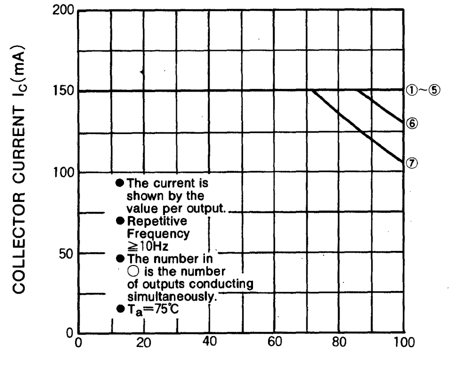
7-UNIT 150mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

TYPICAL CHARACTERISTICS

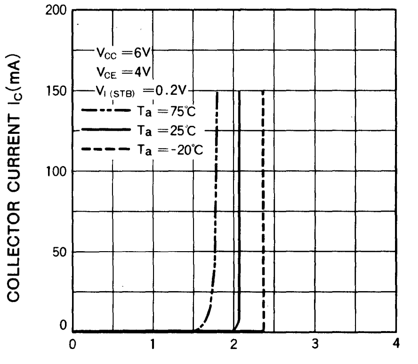
ALLOWABLE AVERAGE POWER DISSIPATION



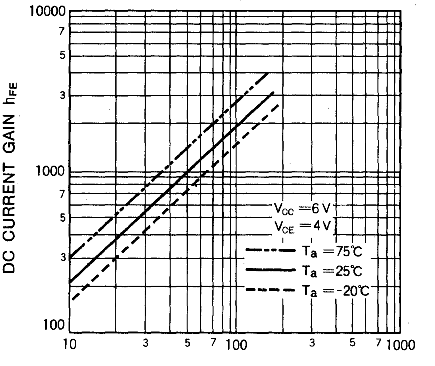
ALLOWABLE COLLECT CURRENT AS A FUNCTION OF DUTY CYCLE



OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



MITSUBISHI ELECTRIC

M54537P

7-UNIT 350mA TRANSISTOR ARRAY

DESCRIPTION

The M54537P, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

FEATURES

- Output breakdown voltage to 20V
- High output sink current to 250mA
- PMOS Compatible input
- Low output saturation voltage
- Wide operating temperature range (T_a =−20~+75℃)

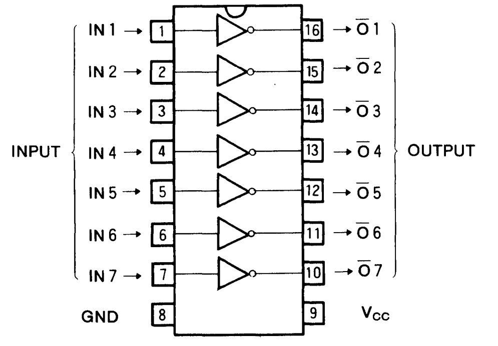
APPLICATIONS

- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

FUNCTION

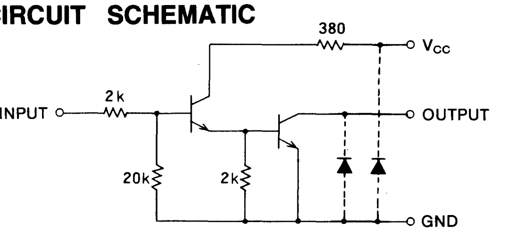
The M54537P uses a predriver stage with 2kΩ series input resistor. The power supply of the predrivers is connected to pin 9 . All emitters and the substrate are connected together to pin 8 . The outputs are capable of sinking 250mA and will withstand 20V in the OFF state.

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

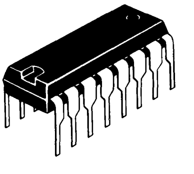
CIRCUIT SCHEMATIC



UNIT : Ω

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−25~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Typ	Max	Unit
V_{CC}	Supply voltage		3		8	V
V_O	Output voltage				20	V
I_C	Collector current per channel	V_{CC}=6.5V Percent duty cycle less than 40%			250	mA
I_C	Collector current per channel	V_{CC}=6.5V Percent duty cycle less than 65%			150	mA
V_{IH}	"H" Input voltage	I_C=250mA	3			V
V_{IL}	"L" Input voltage	$I_{O\,(leak)}$=50μA			0.3	V



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−25~+75℃, unless otherwise noted)

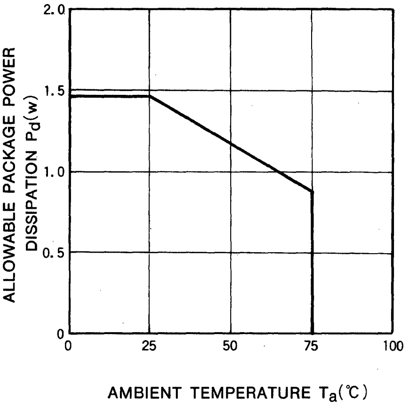
Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	350	mA
V_I	Input voltage		10	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

ELECTRICAL CHARACTERISTICS (T_a=−25~+75℃, unless otherwise noted)

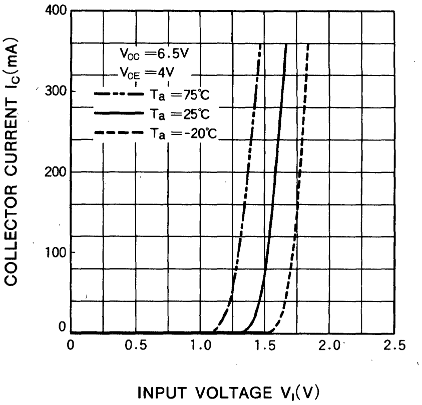
Symbol	Parameter	Test conditions		Limits Min	Typ	Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	V_{CC}=8V, I_{CEO}=100μA		20			V
$V_{CE(sat)}$	Output saturation voltage	V_I=3V	V_{CC}=6.5V, I_C=250mA			0.5	V
			V_{CC}=3V, I_C=150mA			0.35	V
I_I	Input current	V_{CC}=8V, V_I=3.2V				1.5	mA
		V_{CC}=8V, V_I=10V				7.3	mA
I_{CC}	Supply current	V_{CC}=8V, V_I=3.2V				190	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=6.5V, I_C=250mA, T_a=25℃		1000			

TYPICAL CHARACTERISTICS

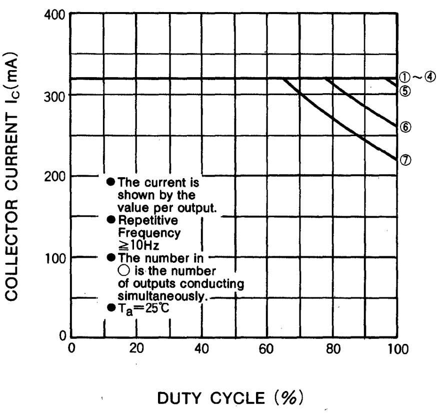
ALLOWABLE AVERAGE



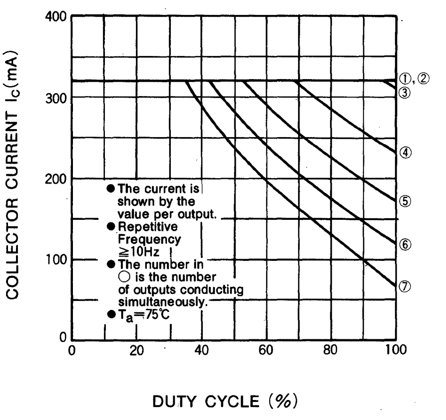
OUTPUT CURRENT CHARACTERISTICS



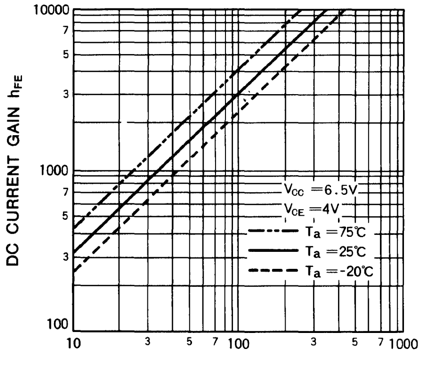
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54538P

7-UNIT 350mA TRANSISTOR ARRAY AND MOTOR DRIVER

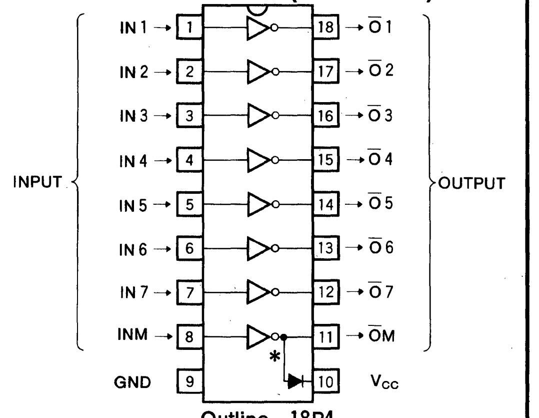
DESCRIPTION
The M54538P, 7-channel sink driver and a motor driver, is designed for use in a thermal printer.

FEATURES
- Output breakdown voltage to 20V
- High output sink current to 350mA
- Wide operating temperature range (T_a =−20∼+75℃)

APPLICATIONS
- Thermal printer driver
- LED or incandescent display driver
- Interfacing for standard MOS/BIPOLAR logic

FUNCTION
The M54538P is designed for use in a thermal printer, consisting 7-channel thermal head driver and a D-C or stepper motor driver.
The output of the motor driver has a diode for inductive load transient suppression.
The outputs of the sink drivers are capaple of sinking 350mA and will withstand 20V in the OFF state.

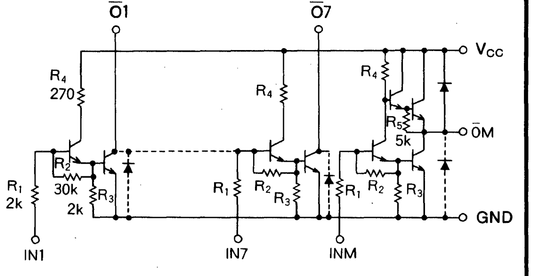
PIN CONFIGURATION (TOP VIEW)



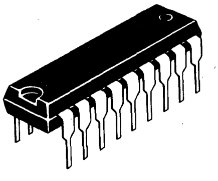
Outline 18P4

* : MOTOR DRIVER

CIRCUIT SCHEMATIC



UNIT : Ω



18-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions		Limits	Unit
V_{CC}	Supply voltage			10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	Ō1 to Ō7 Outputs	20	V
			ŌM Output	V_{CC}	V
I_C	Collector current	Transistor ON		350	mA
V_I	Input voltage			10	V
I_F	Clamp diode forward current	Pulse width≦35ms, Percent duty cycle≦5%		700	mA
				350	mA
P_d	Power dissipation	T_a=25℃		1.47	W
T_{opr}	Operating ambient temperature range			−20∼+75	℃
T_{stg}	Storage temperature range			−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

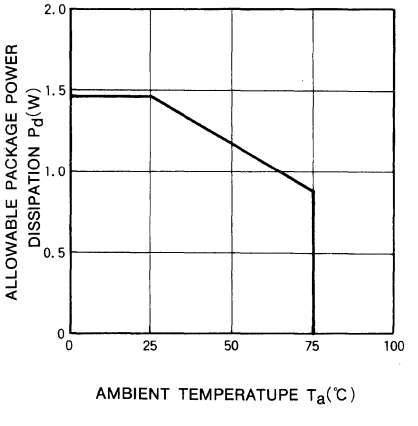
Symbol	Parameter		Limits Min	Typ	Max	Unit
V_{CC}	Supply voltage		3		6	V
V_O	Output voltage				20	V
I_C	Collector current per channel	Percent duty cycle less than 30%, V_{CC}=6V			250	mA
		Percent duty cycle less than 35%, V_{CC}=6V			170	mA
V_{IH}	"H" Input voltage	I_C=250mA	3.2			V
		I_C=150mA	2.4			V
V_{IL}	"L" Input voltage				0.3	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

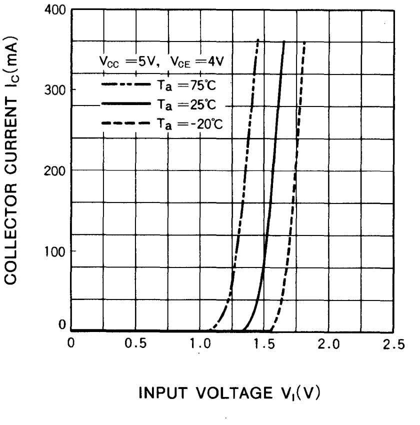
Symbol	Parameter	Test conditions	Limits Min	Typ	Max	Unit
$I_{O(leak)}$	Input leakage current	V_{CC}=6V, V_I=0.4V, V_{CE}=20V			50	μA
$V_{CE(sat)}$	Output saturation voltage	V_{CC}=3.5V, V_I=3V, I_C=250mA			0.6	V
		V_{CC}=3V, V_I=2.4V, I_C=150mA			0.4	V
$V_{OH(M)}$	"H" Output voltage (motor driver)	V_{CC}=6V, $I_{OH(M)}$=−250mA	2.4			V
I_I	Input current	V_{CC}=6V, V_I=3.2V			1.5	mA
		V_{CC}=6V, V_I=10V			7.3	mA
$V_{F(M)}$	Clamp diode forward voltage	$I_{F(M)}$=350mA			3	V
I_{CC}	Supply current	V_{CC}=6V, V_I=3.2V (all input)			235	mA
h_{FE}	DC forward current gain	V_{CC}=5V, V_{CE}=4V, I_C=250mA, T_a=25℃	1000			

TYPICAL CHARACTERISTICS

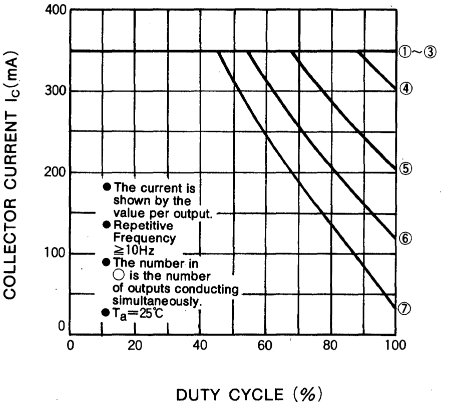
ALLOWABLE AVERAGE POWER DISSIPATION



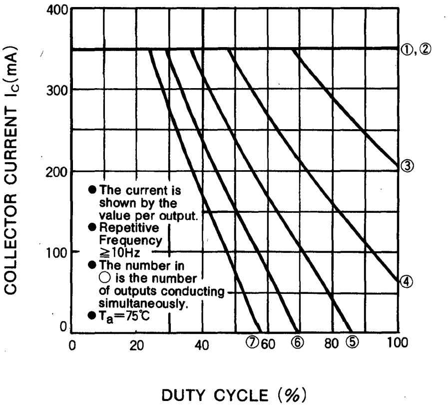
OUTPUT CURRENT CHARACTERISTICS



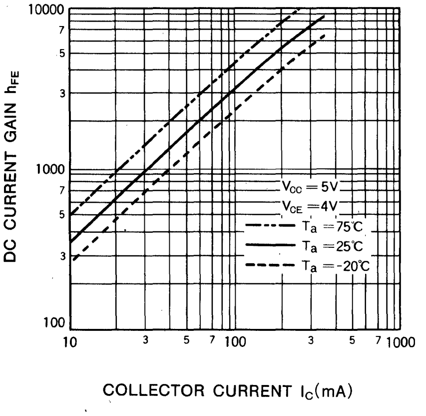
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54539P

6-UNIT 700mA TRANSISTOR ARRAY WITH CLAMP DIODE

DESCRIPTION

The M54539P, 6-channel sink driver, consists of 12 NPN transistors connected to form high current gain driver pairs.

FEATURES

- Output breakdown voltage to 20V
- High output sink current to 700mA
- Integral diodes for transient suppression
- Wide operating temperature range (T_a=−20~+75℃)

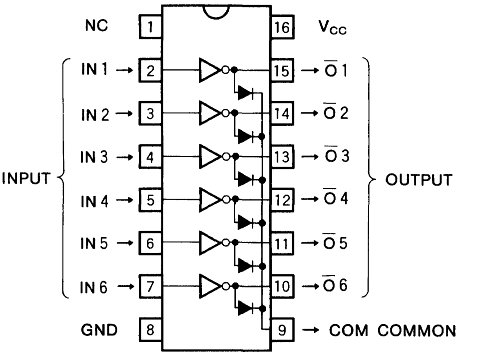
APPLICATIONS

- Relay and solenoid driver
- LED or incandescent display driver
- Thermal head driver

FUNCTION

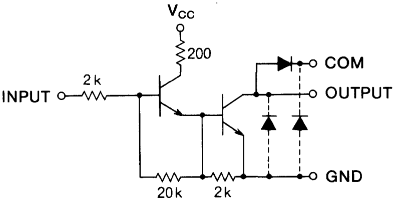
The M54539P uses a predriver stage with 2kΩ series input resistor. The power supply of the predrivers is connected to pin 16. Each output has an integral diode for inductive load transient suppression and the cathodes of the diodes are connected to pin 9 . All emitters and the substrate are connected together to pin 8 . The outputs are capable of sinking 700mA and will withstand 20V in the OFF state.

PIN CONFIGURATION (TOP VIEW)



Outline 16P4 NC : NO CONNECTION

CIRCUIT SCHEMATIC



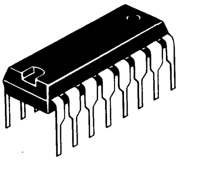
UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	700	mA
V_I	Input voltage		10	V
V_R	Clamp diode reverse voltage		20	V
I_F	Clamp diode forward current	Pulse width≦35ms, Percent duty cycle≦5%	700	mA
			350	mA
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		3	5	7	V
V_O	Output voltage				20	V
I_C	Collector current per channel	The three outputs conducting simultaneously Percent duty cycle less than 20%			700	mA
		The three outputs conducting simultaneously Percent duty cycle less than 90%			200	mA
V_{IH}	"H" Input voltage	I_C=450mA	3			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			0.3	V



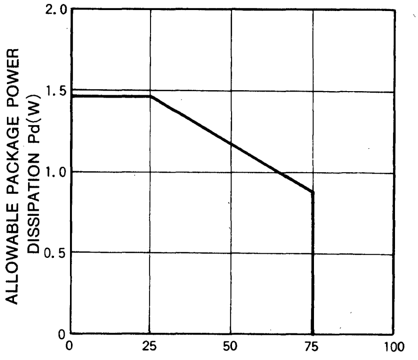
16-pin molded plastic DIL

ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
$V_{(BR)CEO}$	Output sustaining voltage	V_{CC}=7V, I_{CEO}=100μA		20			V
$V_{CE(sat)}$	Output saturation voltage	V_{CC}=5V	I_C=450mA			0.8	V
		V_I=3V	I_C=200mA			0.45	V
I_I	Input current	V_{CC}=7V, V_I=3.2V				1.4	mA
V_R	Clamp diode reverse voltage	I_R=100μA		20			V
V_F	Clamp diode forward voltage	I_F=350mA				2.7	V
I_{CC}	Supply current	V_{CC}=7V, V_I=3.2V (all input)				300	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=6V, I_C=300mA, T_a=25℃		3000			

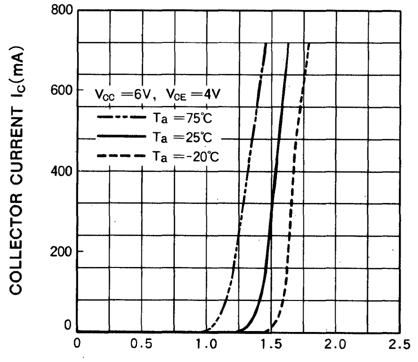
TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



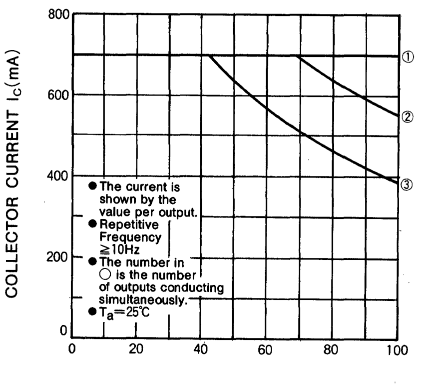
AMBIENT TEMPERATURE T_a(℃)

OUTPUT CURRENT CHARACTERISTICS



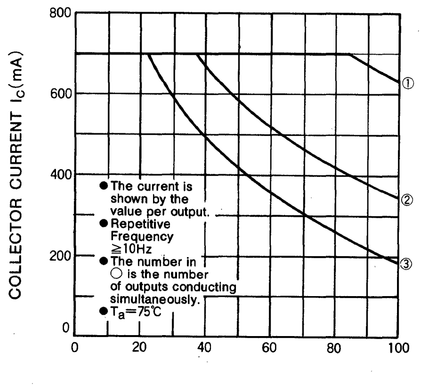
INPUT VOLTAGE V_I(V)

ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DUTY CYCLE (%)

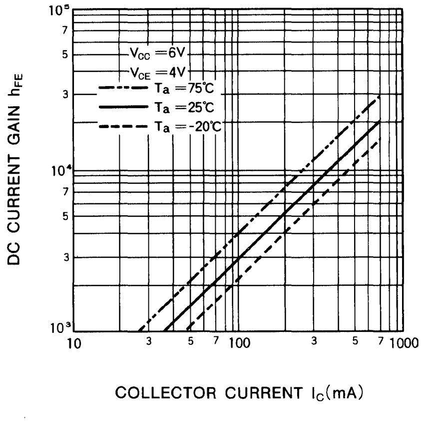
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DUTY CYCLE (%)

6-UNIT 700mA TRANSISTOR ARRAY WITH CLAMP DIODE

DC CURRENT GAIN CHARACTERISTICS



M54540AL

BI-DIRECTIONAL MOTOR DRIVER

DESCRIPTION

The M54540AL, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for a low power D-C motor control.

FEATURES

- Small single-in-line package
- Integral diodes for transient suppression
- PMOS compatible input

APPLICATION

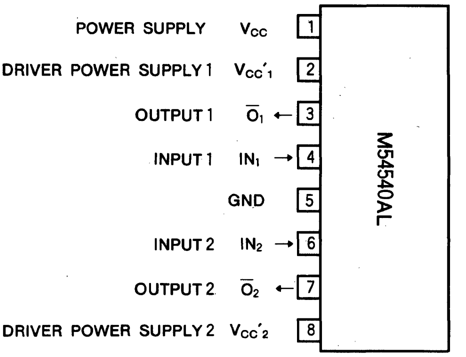
Audio cassette tape recorder

FUNCTION

The M54540AL, full bridge motor driver, has the logic circuitry and non-darlington power drivers for bidirection control of D-C motors operating at currents of up to 600mA.

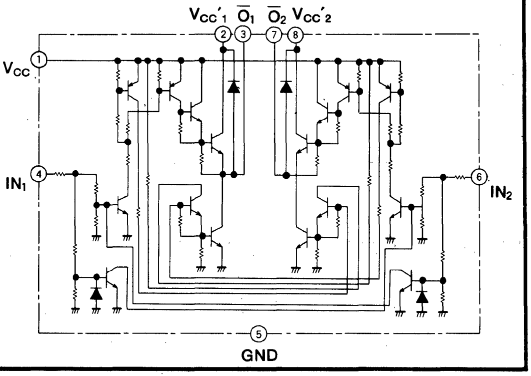
The power supplies for the logic circuitry and the drivers are separated so that the applied voltage to the motor can be controlled by the V_{CC}' of the driver supply voltage.

PIN CONFIGURATION (TOP VIEW)



Outline 8P5

CIRCUIT SCHEMATIC



LOGIC TRUTH TABLE

Input		Output		Note
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	"OFF" state	"OFF" state	Open
H	L	H	L	↻
L	H	L	H	↺
H	H	"OFF" state	"OFF" state	Open

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.3～+12	V
V_{CC}'	Driver supply voltage		−0.3～V_{CC}	V
V_I	Input voltage		−0.3～V_{CC}	V
V_O	Output voltage		−0.3～V_{CC}+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms, Repetitive cycle 0.2Hz max	±600	mA
I_O	Continuous output current		±120	mA
P_d	Power dissipation	T_a=60℃	850	mW
T_{opr}	Operating ambient temperature range		−10～+60	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

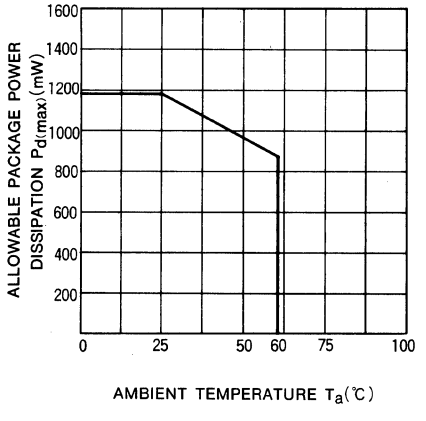
Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		6	10	11	V
I_O	Continuous output current				±100	mA
V_{IH}	"H" Input voltage		3	5	V_{CC}	V
V_{IL}	"L" Input voltage			0	0.4	V
T_{off}	Input switching interval	It is prohibited to switch the inputs at the same time.	10	300		ms

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

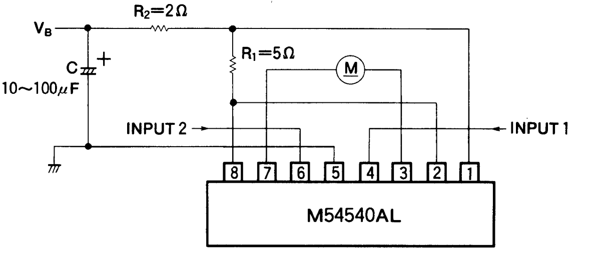
Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	$V_{CC}=V_{CC}'=20V$	$V_O=12V$			100	μA
		$V_{I1}=V_{I2}=3V$	$V_O=0V$			−100	
V_{OH}	"H" Output saturation voltage	$V_{CC}=V_{CC}'=10V$	$V_{I1}=3V$, $V_{I2}=0V$	8			V
		$I_{OH}=-100mA$	$V_{I1}=0V$, $V_{I2}=3V$				
V_{OL}	"L" Output saturation voltage	$V_{CC}=V_{CC}'=10V$	$V_{I1}=3V$, $V_{I2}=0V$			0.6	V
		$I_{OL}=100mA$	$V_{I1}=0V$, $V_{I2}=3V$				
I_{IH}	"H" Input current	$V_{CC}=V_{CC}'=10V$	$V_{I1}=3V$			500	μA
			$V_{I2}=3V$				
I_{CC}	Supply current	$V_{CC}=V_{CC}'=12V$	$V_{I1}=3V$, $V_{I2}=0V$		28	40	mA
			$V_{I1}=0V$, $V_{I2}=3V$				
			$V_{I1}=0V$, $V_{I2}=0V$		0		mA
			$V_{I1}=3V$, $V_{I2}=3V$				

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



TYPICAL APPLICATION



Note
1. It is prohibited to switch the both inputs simultaneously. The inputs should be driven separately to avoid high crossover current.
2. The pins 1 , 2 and 8 are separated and shall be connected externally.

M54541L

BI-DIRECTIONAL MOTOR DRIVER

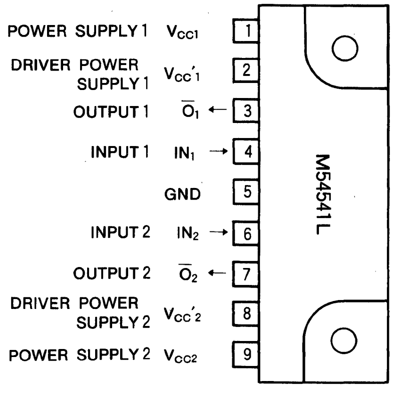
DESCRIPTION
The M54541L, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for D-C motor control.

FEATURES
- 9-pin single-in-line power tab package
- Integral diodes for transient suppression
- 800mA output current
- PMOS compatible input

APPLICATIONS
- Audio cassette tape recorder
- Video cassette recorder

FUNCTION
The M54541L, full bridge motor driver, has the logic circuitry and darlington-pair power drivers for bidirectional control of D-C motors operating at currents up to 800mA. The power supplies for the logic circuitry and the drivers are separated so that the applied voltage to the motor can be controlled by the V_{CC}' of the driver power supply voltage.

PIN CONFIGURATION (TOP VIEW)

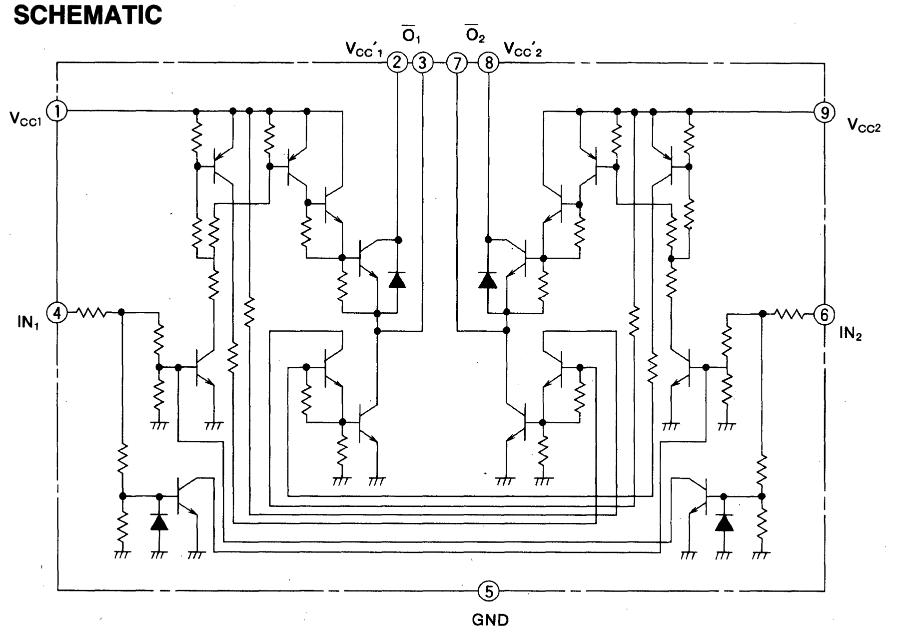


Outline 9P9

LOGIC TRUTH TABLE

Input		Output		Note
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	"OFF" state	"OFF" state	Open
H	L	H	L	↻
L	H	L	H	↺
H	H	"OFF" state	"OFF" state	Open

CIRCUIT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.5～+16	V
V_{CC}'	Driver supply voltage		−0.5～V_{CC}	V
V_I	Input voltage		−0.5～V_{CC}	V
V_O	Output voltage		−0.5～V_{CC}+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms, Repetitive cycle 0.2Hz max	±800	mA
I_O	Continuous output current		±220	mA
P_d	Power dissipation	T_a=60℃	900	mW
T_{opr}	Operating ambient temperature range		−10～+60	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		6	14	15	V
I_O	Continuous output current				±200	mA
V_{IH}	"H" Input voltage		3	5	V_{CC}	V
V_{IL}	"L" Input voltage			0	0.4	V
T_{off}	Input switching interval	It is prohibited to switch the inputs at the same time.	10	300		ms

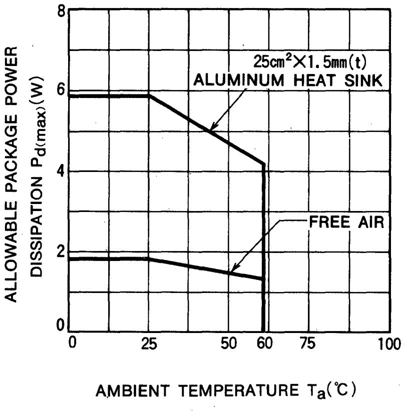
ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits Min	Limits Typ*	Limits Max	Unit
$I_{O(leak)}$	Output leakage current	$V_{CC}=V_{CC}'$=20V	V_O=20V			100	μA
		$V_{I1}=V_{I2}$=3V	V_O=0V			−100	
V_{OH}	"H" Output saturation voltage	$V_{CC}=V_{CC}'$=12V	V_{I1}=3V, V_{I2}=0V	9.9	10.4		V
		I_{OH}=−200mA	V_{I1}=0V, V_{I2}=3V				
V_{OL}	"L" Outuput saturation voltage	$V_{CC}=V_{CC}'$=12V	V_{I1}=3V, V_{I2}=0V		0.3	0.7	V
		I_{OL}=200mA	V_{I1}=0V, V_{I2}=3V				
I_{IH}	"H" Input current	$V_{CC}=V_{CC}'$=12V	V_{I1}=3V			500	μA
			V_{I2}=3V				
I_{CC}	Supply current	$V_{CC}=V_{CC}'$=16V	V_{I1}=3V, V_{I2}=0V		35	50	mA
			V_{I1}=0V, V_{I2}=3V				
			V_{I1}=0V, V_{I2}=0V		0		mA
			V_{I1}=3V, V_{I2}=3V				

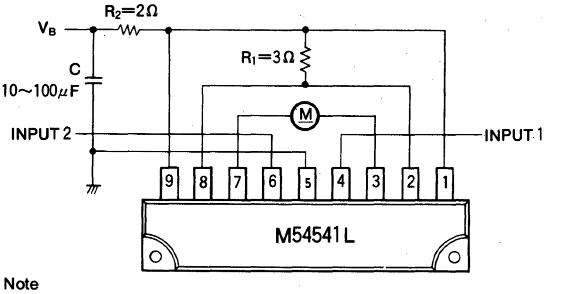
* : The all typical values are at T_a=25℃.

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



TYPICAL APPLICATION



Note

1. It is prohibited to switch the both input simultaneously. The inputs should be driven separately to avoid high crossover current.
2. The pins 1, 9 and 2, 8 are separated and shall be connected externally.

M54542L

BI-DIRECTIONAL MOTOR DRIVER

DESCRIPTION

The M54542L, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for D-C motor control.

FEATURES

- 9-pin single-in-line power tab package
- Integral diodes for transient suppression
- 1. 2A output current
- PMOS compatible input

APPLICATIONS

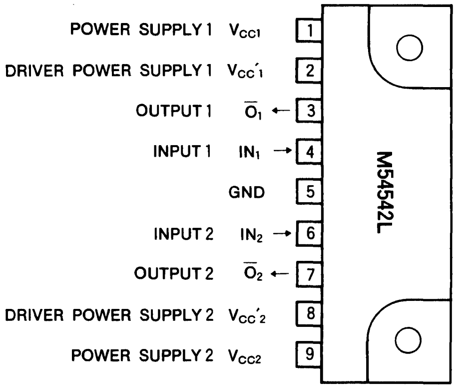
- Audio, video cassette recorders
- Floppy disk driver

FUNCTION

The M54542L, full bridge motor driver, has the logic circuitry and darlington-pair power drivers for bidirectional control of D-C motors operating at currents up to 1. 2A.

The power supplies for the logic circuitry and the drivers are separated so that the applied voltage to the motor can be controlled by the V_{CC}' of the driver power supply voltage.

PIN CONFIGURATION (TOP VIEW)

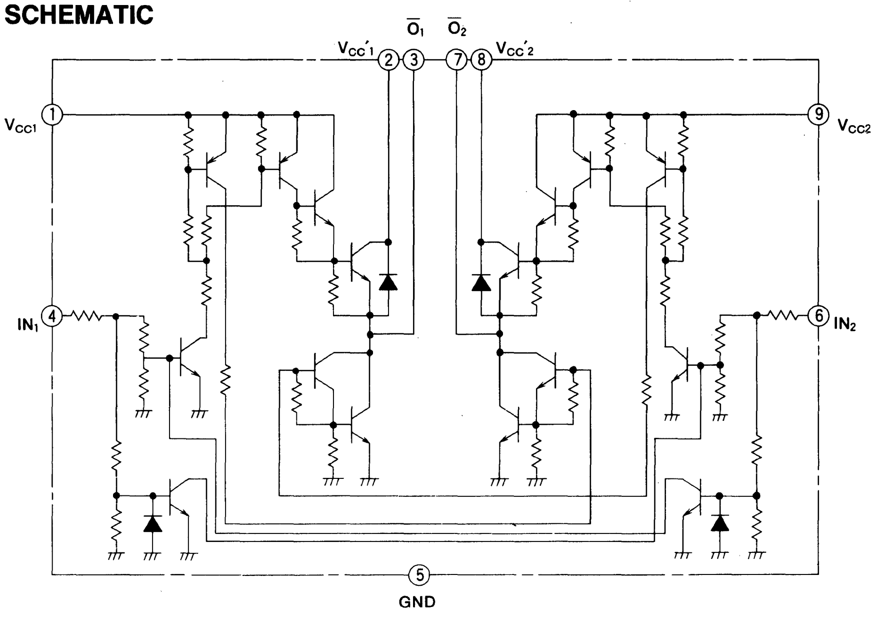


Outline 9P9

LOGIC TRUTH TABLE

INPUT		OUTPUT		NOTE
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	"OFF" state	"OFF" state	Open
H	L	H	L	↻
L	H	L	H	↺
H	H	"OFF" state	"OFF" state	Open

CIRCUIT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.5～+16	V
V_{CC}'	Driver voltage		−0.5～V_{CC}	V
V_I	Input voltage		−0.5～V_{CC}	V
V_O	Output voltage		−0.5～V_{CC}+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms Repetitive cycle 0.2Hz max	±1200	mA
I_O	Continuous output current		±330	mA
P_d	Power dissipation	T_a=60℃	1000	mW
T_{opr}	Operating ambient temperature range		−10～+60	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		6	14	15	V
I_O	Continuous output current				±300	mA
V_{IH}	"H" Input voltage		3	5	V_{CC}	V
V_{IL}	"L" Input voltage			0	0.4	V
T_{OFF}	Input switching interval	It is prohibited to switch the inputs at the same time.	10	300		ms

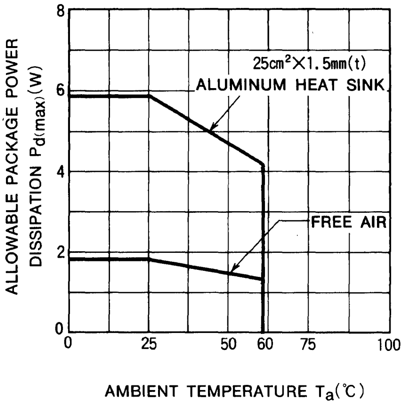
ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ*	Max	
$I_{O(leak)}$	Output leakage current	$V_{CC}=V_{CC}'$=20V $V_{I1}=V_{I2}$=3V	V_O=20V			100	μA
			V_O=0V			−100	
V_{OH}	"H" Output saturation voltage	$V_{CC}=V_{CC}'$=12V I_{OH}=−300mA	V_{I1}=3V, V_{I2}=0V V_{I1}=0V, V_{I2}=3V	9.7	10.2		V
V_{OL}	"L" Output saturation voltage	$V_{CC}=V_{CC}'$=12V I_{OL}=300mA	V_{I1}=3V, V_{I2}=0V V_{I1}=0V, V_{I2}=3V		0.9	1.4	V
I_{IH}	"H" Input current	$V_{CC}=V_{CC}'$=12V	V_{I1}=3V V_{I2}=3V			500	μA
I_{CC}	Supply current	$V_{CC}=V_{CC}'$=16V	V_{I1}=3V, V_{I2}=0V V_{I1}=0V, V_{I2}=3V		7	10	mA
			V_{I1}=0V, V_{I2}=0V V_{I1}=3V, V_{I2}=3V		0		mA

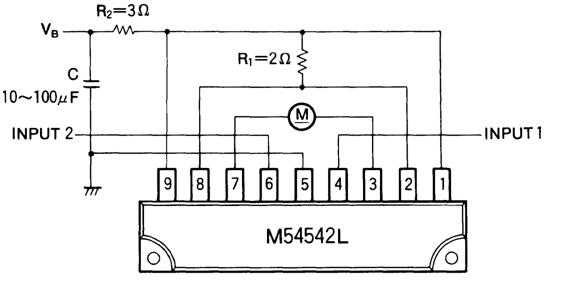
* : The all typical values are at T_a=25℃

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



TYPICAL APPLICATION



Note

1. It is prohibited to switch the both inputs simultaneously. The inputs should be driven separately to avoid high crossover current.
2. The pins 1 , 9 and 2 , 8 are separated and shall be connected externally.

M54543L

BI-DIRECTIONAL MOTOR DRIVER

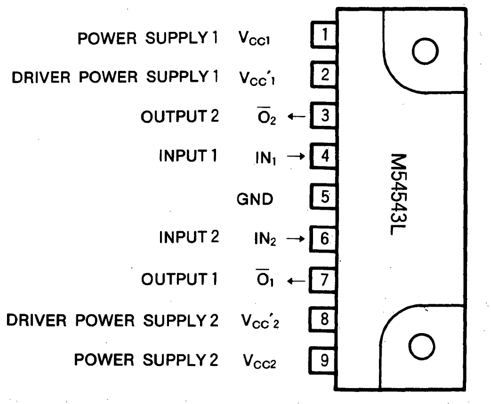
DESCRIPTION
The M54543L, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for D-C motor control.

FEATURES
- Wide operating voltage range ($V_{CC} = 4 \sim 16V$)
- TTL, PMOS and CMOS compatible input
- Low output saturation voltage
- Integral diodes for transient suppression
- 1.2A output current
- Braking mode input

APPLICATION
Audio, video cassette recorder

FUNCTION
The M54543L, full bridge motor driver, has the logic circuitry and non-darlington power drivers for bidirectional control of D-C motors operating at currents up to 1.2A. A braking mode by switching the both inputs high may make easier to control the motor. The both of the separated power supplies for the logic circuitry and the drivers are usable for motor speed control.

PIN CONFIGURATION (TOP VIEW)

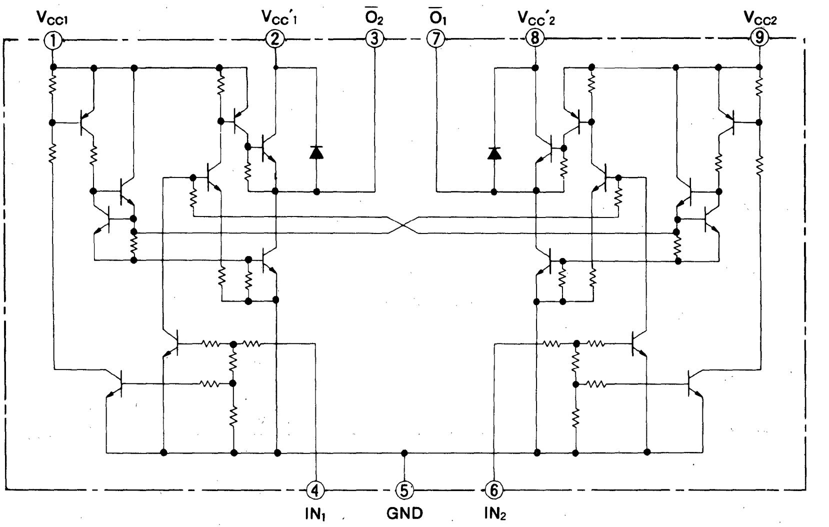


Outline 9P9

LOGIC TRUTH TABLE

INPUT		OUTPUT		NOTE
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	"OFF" state	"OFF" state	Open
H	L	H	L	↻
L	H	L	H	↺
H	H	L	L	Braking

CIRCUIT SCHEMATIC



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC\,(1)}$	Supply voltage (1)		−0.5～+16	V
$V_{CC\,(2)}$	Supply voltage (2)	With an external heat sink (3000mm²X1.5mm)	−0.5～+20	V
V_{CC}'	Driver supply voltage		−0.5～+16	V
V_I	Input voltage		0～V_{CC}	V
V_O	Output voltage		−0.5～V_{CC}'+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms: Repetitive cycle 0.2Hz max	±1.2	A
$I_{O\,(1)}$	Continuous output current (1)		±330	mA
$I_{O\,(2)}$	Continuous output current (2)	With an external heat sink (3000mm²X1.5mm)	±600	mA
P_d	Power dissipation	T_a=75℃	1.15	W
T_{opr}	Operating ambient temperature range		−10～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

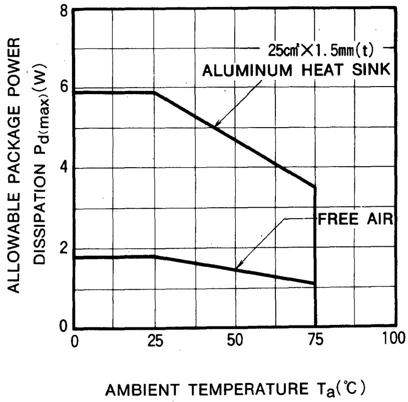
Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4	12	15	V
I_O	Continuous output current				±300	mA
V_{IH}	"H" Input voltage		2		V_{CC}	V
V_{IL}	"L" Input voltage		0		0.4	V
t_B	Motor braking interval		100			ms

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions			Limits			Unit
					Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	$V_{CC}=V_{CC}'$=20V		V_O=20V			100	μA
		$V_{I1}=V_{I2}$=0V		V_O=0V			−100	
$V_{OH\,(1)}$	"H" Output saturation voltage (1)	$V_{CC}=V_{CC}'$=12V	V_{I1}=2V	$I_{OH\,(1)}$=−300mA	10.8			V
			V_{I2}=0V	$I_{OH\,(1)}$=−500mA	10.7			
$V_{OH\,(2)}$	"H" Output saturation voltage (2)	$V_{CC}=V_{CC}'$=12V	V_{I1}=0V	$I_{OH\,(2)}$=−300mA	10.8			V
			V_{I2}=2V	$I_{OH\,(2)}$=−500mA	10.7			
$V_{OL\,(1)}$	"L" Output saturation voltage (1)	$V_{CC}=V_{CC}'$=12V	V_{I1}=0V	$I_{OL\,(1)}$=300mA			0.5	V
			V_{I2}=2V	$I_{OL\,(1)}$=500mA			0.65	
			$V_{I1}=V_{I2}$=2V				0.65	
$V_{OL\,(2)}$	"L" Output saturation voltage (2)	$V_{CC}=V_{CC}'$=12V	V_{I1}=2V	$I_{OL\,(2)}$=300mA			0.5	V
			V_{I2}=0V	$I_{OL\,(2)}$=500mA			0.65	
			$V_{I1}=V_{I2}$=2V				0.65	
$I_{IH\,(1)}$	"H" Input current (1)	$V_{CC}=V_{CC}'$=12V, V_{I1}=2V, V_{I2}=0V			70		200	μA
$I_{IH\,(2)}$	"H" Input current (2)	$V_{CC}=V_{CC}'$=12V, V_{I1}=0V, V_{I2}=2V			70		200	μA
I_{CC}	Supply current	$V_{CC}=V_{CC}'$=16V		V_{I1}=2V, V_{I2}=0V			40	mA
				V_{I1}=0V, V_{I2}=2V				
				$V_{I1}=V_{I2}$=2V			60	mA
				$V_{I1}=V_{I2}$=0V		0		mA

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



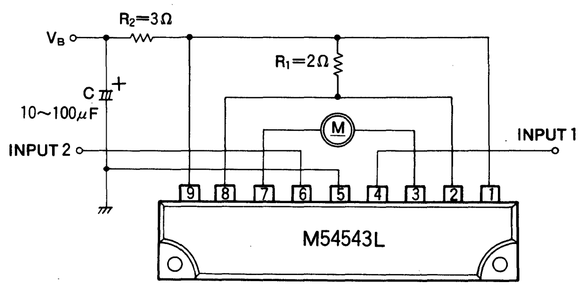
Note

When the V_{CC}' is lower than the V_{CC}, the current will flow from the V_{CC} to the V_{CC}' and may drive the motor.

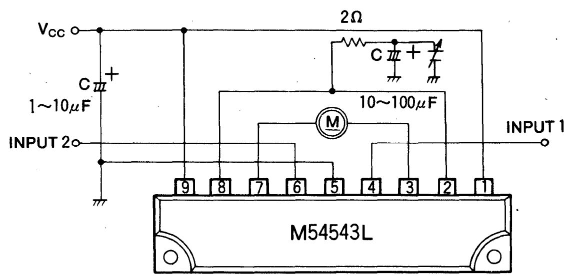
The M54544L may be recommended to have the wider control voltage range of the V_{CC}'.

TYPICAL APPLICATION

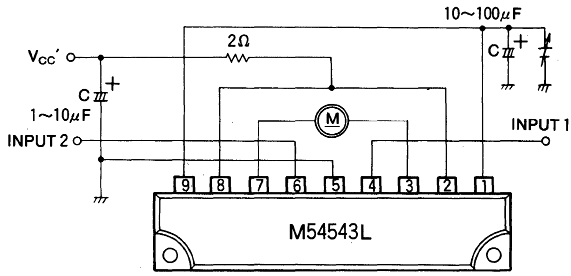
1)



2) Motor speed control by the V_{CC}'



3) Motor speed control by the V_{CC}



M54543AL

BI-DIRECTIONAL MOTOR DRIVER

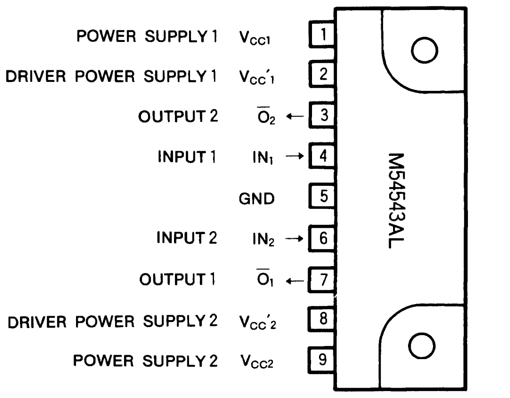
DESCRIPTION
The M54543AL, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for D-C motor control.

FEATURES
- Wide operating voltage range ($V_{CC} = 4 \sim 16V$)
- TTL, PMOS and CMOS compatible input
- Low output saturation voltage
- Integral diodes for transient suppression
- 1. 2A output current
- Braking mode input
- Internal thermal shutdown protection

APPLICATION
Audio, video cassette recorder

FUNCTION
The M54543AL, full bridge motor driver, has the logic circuitry and non-darlington power drivers for bidirectional control of D-C motors operating at currents up to 1. 2A. A braking mode by switching the both inputs high may make easier to control the motor. The both of the separated power supplies for the logic circuitry and the drivers are usable for motor speed control.

PIN CONFIGURATION (TOP VIEW)

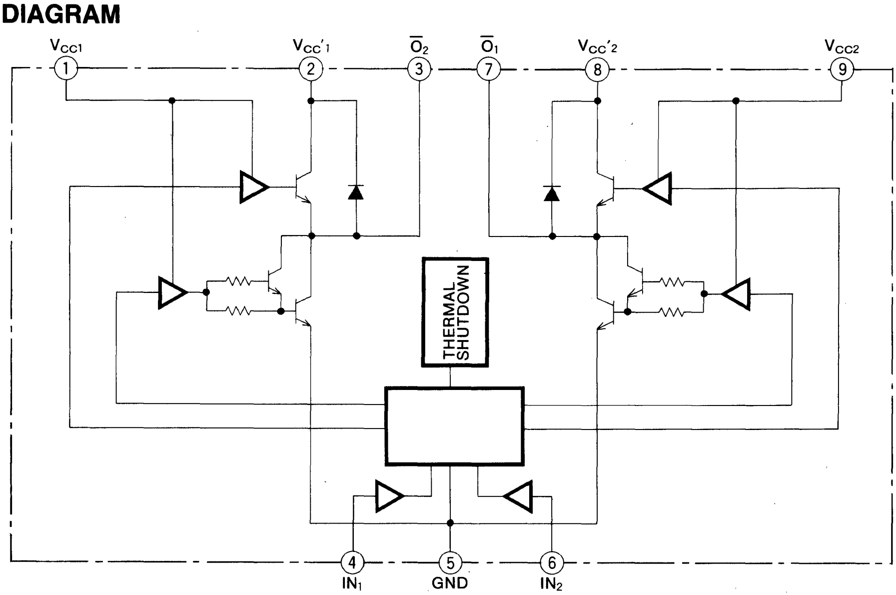


Outline 9P9

LOGIC TRUTH TABLE

INPUT		OUTPUT		NOTE
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	"OFF" state	"OFF" state	Open
H	L	H	L	↻
L	H	L	H	↺
H	H	L	L	Braking

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC(1)}$	Supply voltage (1)		−0.5～+16	V
$V_{CC(2)}$	Supply voltage (2)	With an external heat sink ($3000mm^2$×1.5mm)	−0.5～+20	V
V_{CC}'	Driver supply voltage		−0.5～+16	V
V_I	Input voltage		0～V_{CC}	V
V_O	Output voltage		−0.5～V_{CC}'+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms: Repetitive cycle 0.2Hz max	±2	A
$I_{O(1)}$	Continuous output current (1)		±330	mA
$I_{O(2)}$	Continuous output current (2)	With an external heat sink ($3000mm^2$×1.5mm)	±600	mA
P_d	Power dissipation	T_a=75℃	1.15	W
T_{opr}	Operating ambient temperature range		−10～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

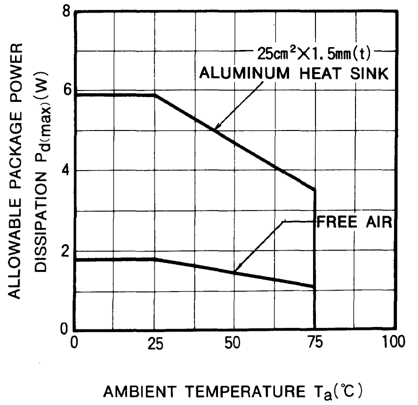
Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4	12	15	V
I_O	Continuous output current				±300	mA
V_{IH}	"H" Input voltage		2		V_{CC}	V
V_{IL}	"L" Input voltage		0		0.4	V
t_B	Motor braking interval		100			ms
$T_{j(shut)}$	Thermal shutdown temperature	Junction temperature		150		℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions			Limits			Unit
					Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	V_{CC}=V_{CC}'=20V, V_{I1}=V_{I2}=0V		V_O=20V			100	μA
				V_O=0V			−100	
$V_{OH(1)}$	"H" Output saturation voltage (1)	V_{CC}=V_{CC}'=12V	V_{I1}=2V	$I_{OH(1)}$=−200mA	10.8			V
			V_{I2}=0V	$I_{OH(1)}$=−500mA	10.7			
$V_{OH(2)}$	"H" Output saturation voltage (2)	V_{CC}=V_{CC}'=12V	V_{I1}=0V	$I_{OH(2)}$=−200mA	10.8			V
			V_{I2}=2V	$I_{OH(2)}$=−500mA	10.7			
$V_{OL(1)}$	"L" Output saturation voltage (1)	V_{CC}=V_{CC}'=12V	V_{I1}=0V	$I_{OL(1)}$=200mA			0.5	V
			V_{I2}=2V	$I_{OL(1)}$=500mA			1.35	
			V_{I1}=V_{I2}=2V				1.35	
$V_{OL(2)}$	"L" Output saturation voltage (2)	V_{CC}=V_{CC}'=12V	V_{I1}=2V	$I_{OL(2)}$=200mA			0.5	V
			V_{I2}=0V	$I_{OL(2)}$=500mA			1.35	
			V_{I1}=V_{I2}=2V				1.35	
$I_{IH(1)}$	"H" Input current (1)	V_{CC}=V_{CC}'=12V, V_{I1}=2V, V_{I2}=0V			50		120	μA
$I_{IH(2)}$	"H" Input current (2)	V_{CC}=V_{CC}'=12V, V_{I1}=0V, V_{I2}=2V			50		120	μA
I_{CC}	Supply current	V_{CC}=V_{CC}'=16V		V_{I1}=2V, V_{I2}=0V			20	mA
				V_{I1}=0V, V_{I2}=2V				
				V_{I1}=V_{I2}=2V			20	mA
				V_{I1}=V_{I2}=0V			4	mA

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



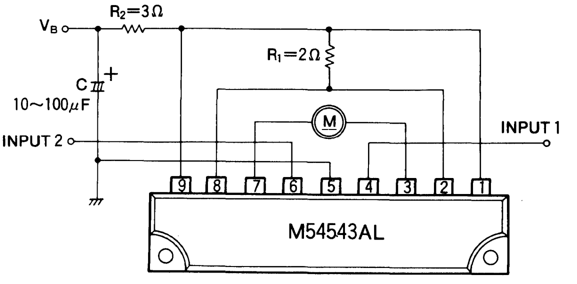
Note

When the V_{CC}' is lower than the V_{CC}, the current will flow from the V_{CC} to the V_{CC}' and may drive the motor.

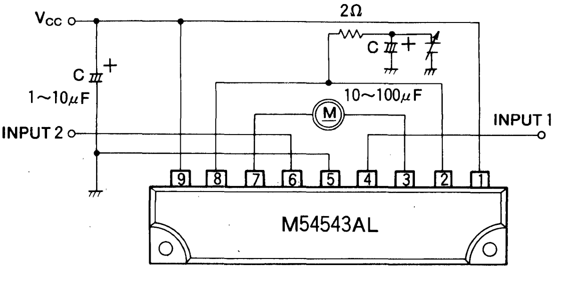
The M54544AL may be recommended to have the wider control voltage range of the V_{CC}'.

TYPICAL APPLICATION

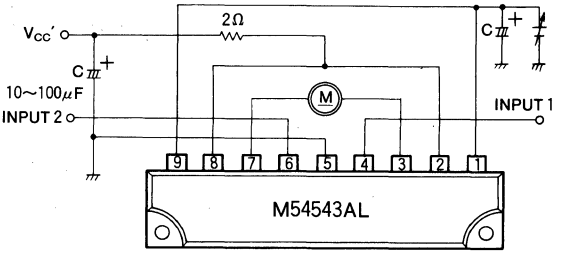
1)



2) Motor speed control by the $V_{CC'}$



3) Motor speed control by the V_{CC}



M54544L

BI-DIRECTIONAL MOTOR DRIVER

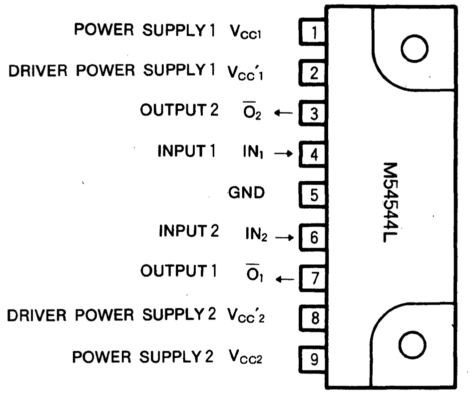
DESCRIPTION
The M54544L, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for D-C motor control.

FEATURES
- Wide operating voltage range (V_{CC}= 4 ~16V)
- TTL, PMOS and CMOS compatible input
- Low output saturation voltage
- Integral diodes for transient suppression
- 1.2A output current
- Braking mode input

APPLICATION
Audio, video cassette recorders

FUNCTION
The M54544L, full bridge motor driver, has the logic circuitry and non-darlington power drivers for bidirectional control of D-C motors operating at currents up to 1.2A. A braking mode by switching the both inputs high may make easier to control the motor. The both of the separated power supplies for the logic circuitry and the drivers are usable for motor speed control. The power supply for the predriver is connected with the driver power supply to have a wider control range of motor supply voltage.

PIN CONFIGURATION (TOP VIEW)

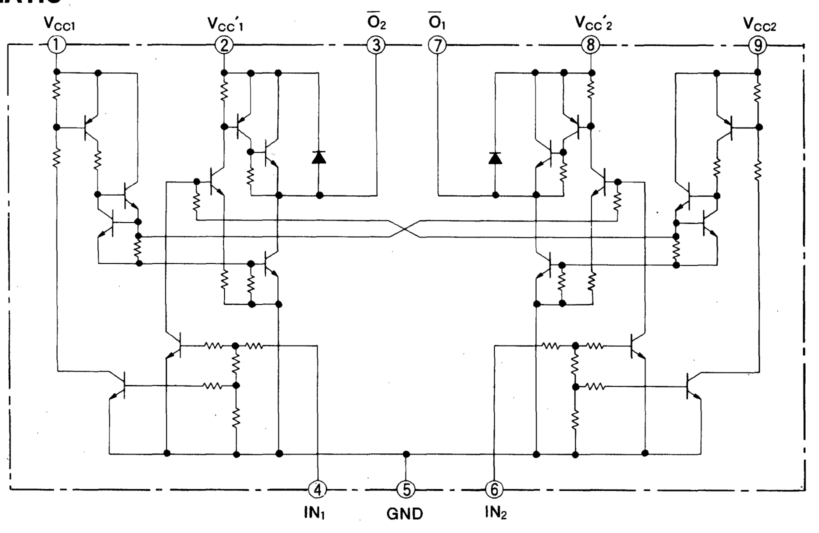


Outline 9P9

LOGIC TRUTH TABLE

Input		Output		Note
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	"OFF" state	"OFF" state	Open
H	L	H	L	
L	H	L	H	
H	H	L	L	Braking

CIRCUIT SCHEMATIC



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC(1)}$	Supply voltage (1)		−0.5～+16	V
$V_{CC(2)}$	Supply voltage (2)	With an external heat sink (3000mm^2×1.5mm)	−0.5～+20	V
V_{CC}'	Driver supply voltage		−0.5～+16	V
V_I	Input voltage		0～V_{CC}	V
V_O	Output voltage		−0.5～V_{CC}'+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms: Repetitive cycle 0.2Hz max	±1.2	A
$I_{O(1)}$	Continuous output current (1)		±330	mA
$I_{O(2)}$	Continuous output current (2)	With an external heat sink (3000mm^2×1.5mm)	±600	mA
Pd	Power Dissipation	T_a=75℃	1.15	W
Topr	Operating ambient temperature range		−10～+75	℃
Tstg	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

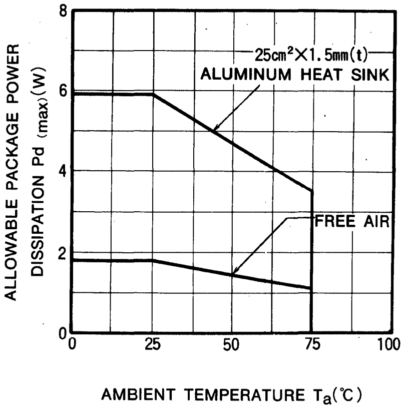
Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4	12	15	V
I_O	Continuous output current				±300	mA
V_{IH}	"H" Input voltage		2		V_{CC}	V
V_{IL}	"L" Input voltage		0		0.4	V
t_B	Motor braking interval		100			ms

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions			Limits			Unit
					Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	V_{CC}=V_{CC}'=20V		V_O=20V			100	μA
		V_{I1}=V_{I2}=0V		V_O=0V			−100	
$V_{OH(1)}$	"H" Output saturation voltage (1)	V_{CC}=V_{CC}'=12V	V_{I1}=2V	$I_{OH(1)}$=−300mA	10.8			V
			V_{I2}=0V	$I_{OH(1)}$=−500mA	10.7			
$V_{OH(2)}$	"H" Output saturation voltage (2)	V_{CC}=V_{CC}'=12V	V_{I2}=2V	$I_{OH(2)}$=−300mA	10.8			V
				$I_{OH(2)}$=−500mA	10.7			
$V_{OL(1)}$	"L" Output saturation voltage (1)	V_{CC}=V_{CC}'=12V	V_{I1}=0V	$I_{OL(1)}$=300mA			0.5	V
			V_{I2}=2V	$I_{OL(1)}$=500mA			0.65	
			V_{I1}=V_{I2}=2V				0.65	
$V_{OL(2)}$	"L" Output saturation voltage (2)	V_{CC}=V_{CC}'=12V	V_{I1}=2V	$I_{OL(2)}$=300mA			0.5	V
			V_{I2}=0V	$I_{OL(2)}$=500mA			0.65	
			V_{I1}=V_{I2}=2V				0.65	
$I_{IH(1)}$	"H" Input current (1)	V_{CC}=V_{CC}'=12V, V_{I1}=2V, V_{I2}=0V			70		200	μA
$I_{IH(2)}$	"H" Input current (2)	V_{CC}=V_{CC}'=12V, V_{I1}=0V, V_{I2}=2V			70		200	μA
I_{CC}	Supply current	V_{CC}=V_{CC}'=16V		V_{I1}=2V, V_{I2}=0V			30	mA
				V_{I1}=0V, V_{I2}=2V				
				V_{I1}=V_{I2}=2V			60	mA
				V_{I1}=V_{I2}=0V		0		mA

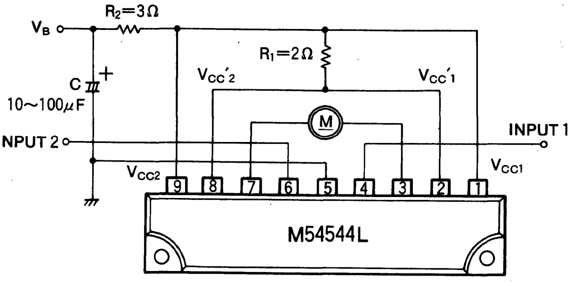
TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

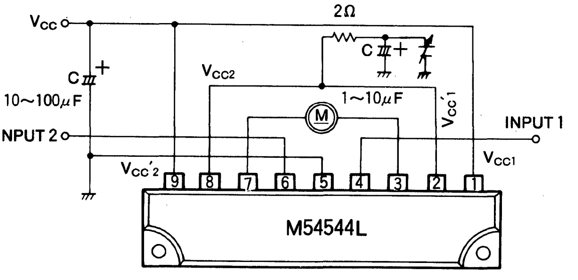


TYPICAL APPLICATION

1)



2) MOTOR SPEED CONTROL BY THE V_{CC}'



M54544AL

BI-DIRECTIONAL MOTOR DRIVER

DESCRIPTION

The M54544AL, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for D-C motor control.

FEATURES

- Wide operating voltage range (V_{CC}= 4 ~16V)
- TTL, PMOS and CMOS compatible input
- Low output saturation voltage
- Integral diodes for transient suppression
- 1. 2A output current
- Braking mode input
- Internal thermal shutdown protection

APPLICATION

Audio, video cassette recorders

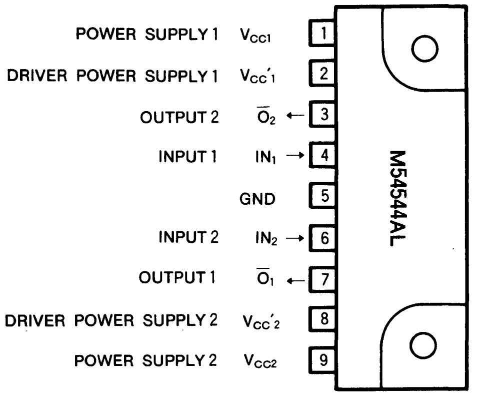
FUNCTION

The M54544AL, full bridge motor driver, has the logic circuitry and non-darlington power drivers for bidirectional control of D-C motors operating at currents up to 1. 2A. A braking mode by switching the both inputs high may make easier to control the motor. The both of the separated power supplies for the logic circuitry and the drivers are usable for motor speed control. The power supply for the predriver is connected with the driver power supply to have a wider control range of motor supply voltage.

LOGIC TRUTH TABLE

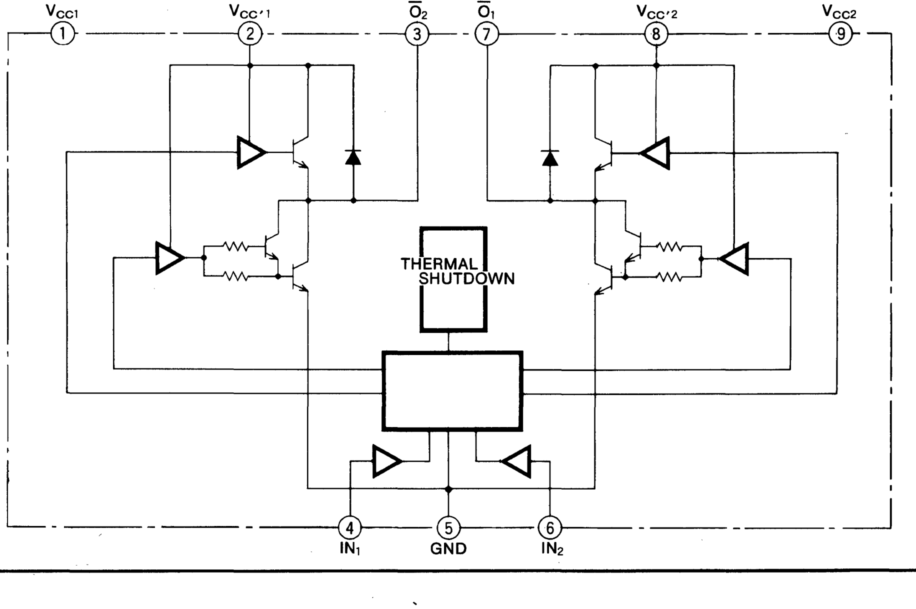
Input		Output		Note
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	"OFF" state	"OFF" state	Open
H	L	H	L	○
L	H	L	H	○
H	H	L	L	Braking

PIN CONFIGURATION (TOP VIEW)



Outline 9P9

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC(1)}$	Supply voltage (1)		−0.5～+16	V
$V_{CC(2)}$	Supply voltage (2)	With an external heat sink (3000mm^2×1.5mm)	−0.5～+20	V
V_{CC}'	Driver supply voltage		−0.5～+16	V
V_I	Input voltage		0～V_{CC}	V
V_O	Output voltage		−0.5～V_{CC}'+2.5	V
$I_{O(max)}$	Peak output current	Repetitive cycle 0.2Hz max	±2	A
$I_{O(1)}$	Continuous output current (1)		±330	mA
$I_{O(2)}$	Continuous output current (2)	With an external heat sink (3000mm^2×1.5mm)	±600	mA
Pd	Power Dissipation	T_a=75℃	1.15	W
Topr	Operating ambient temperature range		−10～+75	℃
Tstg	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

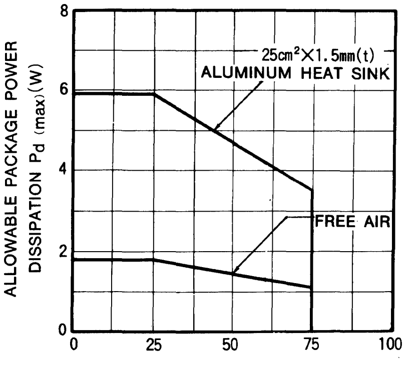
Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4	12	15	V
I_O	Continuous output current				±300	mA
V_{IH}	"H" Input voltage		2		V_{CC}	V
V_{IL}	"L" Input voltage		0		0.4	V
t_B	Motor braking interval		10	100		ms
$T_{j(shut)}$	Thermal shutdown temperature	junction temperature		150		℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions			Limits			Unit
					Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	$V_{CC}=V_{CC}'$=20V, $V_{I1}=V_{I2}$=0V		V_O=20V			100	μA
				V_O=0V			−100	
$V_{OH(1)}$	"H" Output saturation voltage (1)	$V_{CC}=V_{CC}'$=12V	V_{I1}=2V, V_{I2}=0V	$I_{OH(1)}$=−200mA	10.8			V
				$I_{OH(1)}$=−500mA	10.7			
$V_{OH(2)}$	"H" Output saturation voltage (2)	$V_{CC}=V_{CC}'$=12V	V_{I1}=0V, V_{I2}=2V	$I_{OH(2)}$=−200mA	10.8			V
				$I_{OH(2)}$=−500mA	10.7			
$V_{OL(1)}$	"L" Output saturation voltage (1)	$V_{CC}=V_{CC}'$=12V	V_{I1}=0V, V_{I2}=2V	$I_{OL(1)}$=200mA			0.5	V
				$I_{OL(1)}$=500mA			1.35	
			$V_{I1}=V_{I2}$=2V	$I_{OL(1)}$=500mA			1.35	
$V_{OL(2)}$	"L" Output saturation voltage (2)	$V_{CC}=V_{CC}'$=12V	V_{I1}=2V, V_{I2}=0V	$I_{OL(2)}$=200mA			0.5	V
				$I_{OL(2)}$=500mA			1.35	
			$V_{I1}=V_{I2}$=2V	$I_{OL(2)}$=500mA			1.35	
$I_{IH(1)}$	"H" Input current (1)	$V_{CC}=V_{CC}'$=12V, V_{I1}=2V, V_{I2}=0V			50		120	μA
$I_{IH(2)}$	"H" Input current (2)	$V_{CC}=V_{CC}'$=12V, V_{I1}=0V, V_{I2}=2V			50		120	μA
I_{CC}	Supply current	$V_{CC}=V_{CC}'$=16V		V_{I1}=2V, V_{I2}=0V / V_{I1}=0V, V_{I2}=2V			15	mA
				$V_{I1}=V_{I2}$=2V			20	mA
				$V_{I1}=V_{I2}$=0V			4	mA

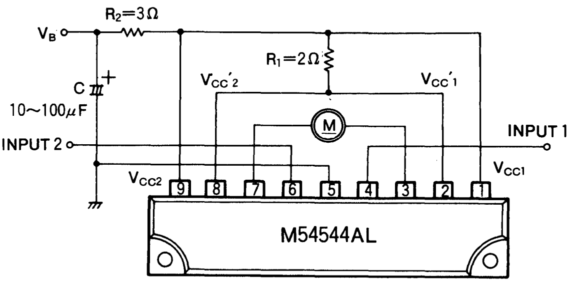
TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

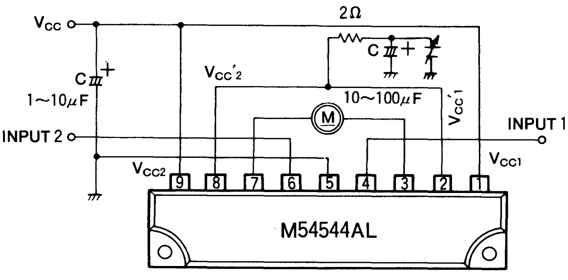


TYPICAL APPLICATION

1)



2) MOTOR SPEED CONTROL BY THE V_{CC}'



M54545L

BI-DIRECTIONAL MOTOR DRIVER

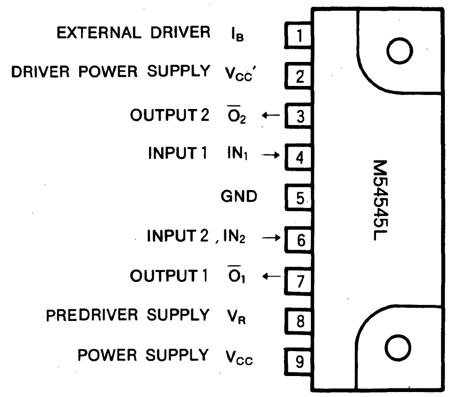
DESCRIPTION
The M54545L, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for D-C motor control.

FEATURES
- Wide operating voltage range ($V_{CC} = 3 \sim 16V$)
- Low output saturation voltage
- Integral diodes for transient suppression
- 1.2A output current
- Braking mode input
- Low standby current

APPLICATION
Audio, video cassette recorder

FUNCTION
The M54545L, full bridge motor driver, has the logic circuitry and the quasi-darlington power driver for bidirectional control of D-C motors operating at currents up to 1.2A. A braking mode by switching the both inputs high may make easier to control the motor. The power supplies for the logic circuitry, the predrivers and the power drivers are separated so that the application circuit with the M54545L can be easily optimized for lower power consumption.

PIN CONFIGURATION (TOP VIEW)

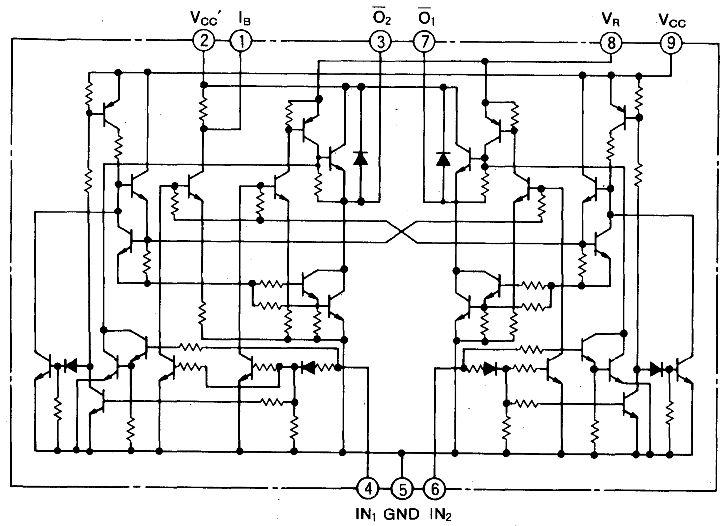


Outline 9P9

LOGIC TRUTH TABLE

Input		Output			Note
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	I_B	
L	L	"OFF" state	"OFF" state	H	Off
H	L	H	L	H	↻
L	H	L	H	L	↺
H	H	L	L	H	Braking

CIRCUIT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.5～+16	V
V_R	Predriver supply voltage		−0.5～+16	V
V_{CC}'	Driver supply voltage		−0.5～+16	V
V_I	Input voltage		0～V_{CC}	V
V_O	Output voltage		−0.5～V_{CC}'+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms V_{CC}≧5V : Repetitive cycle 0.2Hz max	±1.2	A
I_O	Continuous output current		±330	mA
P_d	Power dissipation	T_a=75℃	1.15	W
T_{opr}	Operating ambient temperature range		−10～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

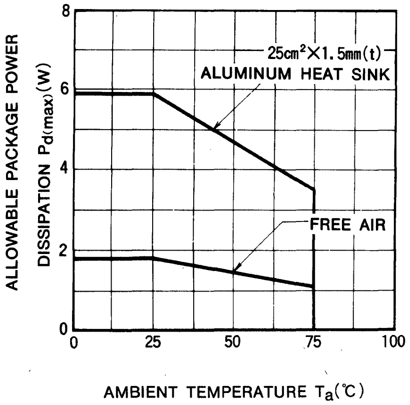
Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		3	12	15	V
I_O	Continuous output current				±200	mA
V_{IH}	"H" Input voltage		3		V_{CC}	V
V_{IL}	"L" Input voltage		0		0.4	V
t_B	Motor braking interval		100			ms

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	V_{CC}=V_R=V_{CC}'=16V	V_O=16V			100	μA
		V_{I1}=V_{I2}=0V	V_O=0V			−100	
$V_{OH(1)}$	"H" Output saturation voltage (1)	V_{CC}=V_R=V_{CC}'=12V	V_{I1}=3V, V_{I2}=0V	10.8			V
$V_{OH(2)}$	"H" Output saturation voltage (2)	I_{OH}=−200mA	V_{I1}=0V, V_{I2}=3V	10.8			V
$V_{OL(1)}$	"L" Output saturation voltage (1)	V_{CC}=V_R=V_{CC}'=12V	V_{I1}=0V, V_{I2}=3V			0.4	V
		$I_{OL(1)}$=200mA	V_{I1}=3V, V_{I2}=3V				
$V_{OL(2)}$	"L" Output saturation voltage (2)	V_{CC}=V_R=V_{CC}'=12V	V_{I1}=3V, V_{I2}=0V			0.4	V
		$I_{OL(2)}$=200mA	V_{I1}=3V, V_{I2}=3V				
$I_{IH(1)}$	"H" Input current (1)	V_{CC}=V_R=V_{CC}'=12V	V_{I1}=3V, V_{I2}=0V			700	μA
$I_{IH(2)}$	"H" Input current (2)	V_{CC}=V_R=V_{CC}'=12V	V_{I1}=0V, V_{I2}=3V			700	μA
I_{CC}	Supply current	V_{CC}=V_R=V_{CC}'=12V	V_{I1}=0V, V_{I2}=0V			5	mA
			V_{I1}=3V, V_{I2}=0V			10	mA
			V_{I1}=0V, V_{I2}=3V				
I_B	I_B Output current	V_{CC}=V_R=V_{CC}'=12V, V_{IB}=12V, V_{I1}=0V, V_{I2}=3V		1.0		15.0	mA

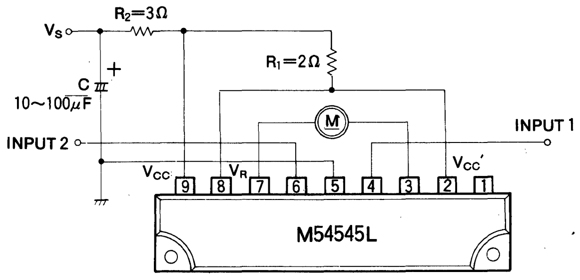
TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

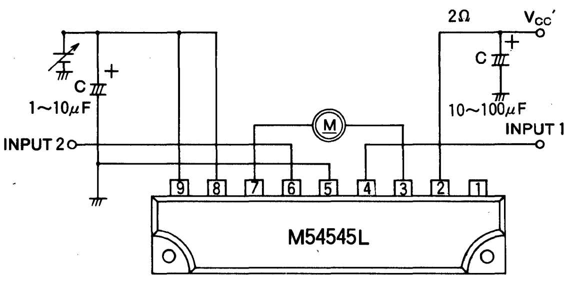


TYPICAL APPLICATION

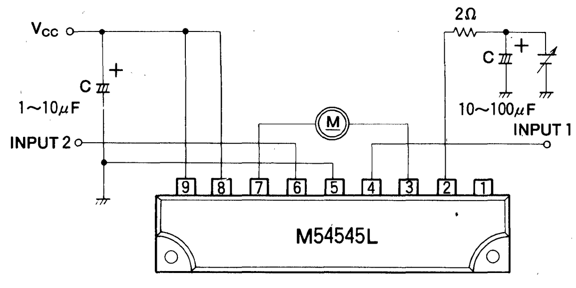
1)



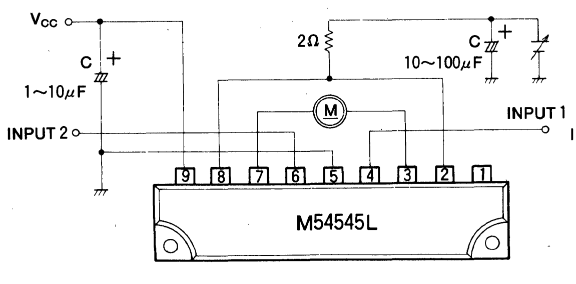
2) Motor speed control by the V_R and V_{CC}



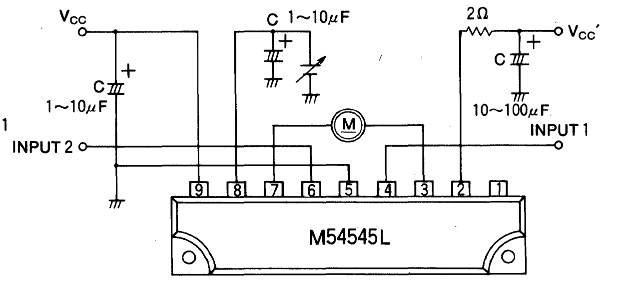
3) Motor speed control by the V_{CC}'



4) Motor speed control by the V_R and V_{CC}'



5) Motor speed control by the V_R



M54546L

BI-DIRECTIONAL MOTOR DRIVER

DESCRIPTION

The M54546L, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for D-C motor control.

FEATURES

- Wide operating voltage range (V_{CC}= 4 ~16V)
- TTL, PMOS and CMOS compatible input
- Low output saturation voltage
- Integral diodes for transient suppression
- Small single-in-line package
- Braking mode input

APPLICATION

Audio, video cassette recorder

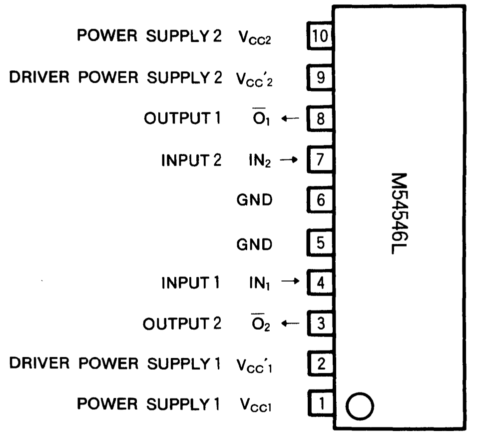
FUNCTION

The M54546L, full bridge motor driver, has the logic circuitry and non-darlington power drivers for bidirectional control of D-C motors operating at currents up to 700mA. A braking mode by switching the both inputs high may make easier to control the motor. The both of the separated power supplies for the logic circuitry and the drivers are usable for motor speed control. The power supply of the predriver is connected with the driver power supply to have a wider control range of motor supply voltage.

LOGIC TRUTH TABLE

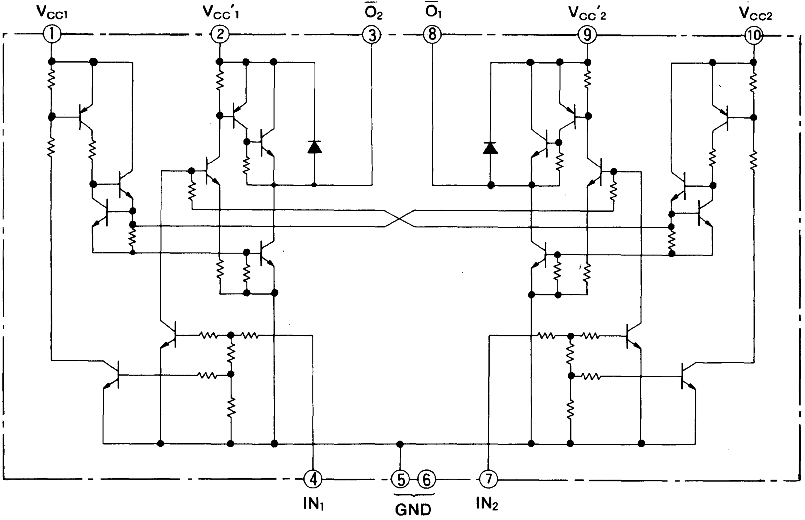
INPUT		OUTPUT		NOTE
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	"OFF" state	"OFF" state	Open
H	L	H	L	↻
L	H	L	H	↺
H	H	L	L	Braking

PIN CONFIGURATION (TOP VIEW)



Outline 10P5

CIRCUIT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.5~+16	V
V_{CC}'	Driver supply voltage		−0.5~+16	V
V_I	Input voltage		0~V_{CC}	V
V_O	Output voltage		−0.5~V_{CC}'+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms: Repetitive cycle 0.2Hz max	±700	mA
I_O	Continuous output current		±150	mA
P_d	Power dissipation	T_a=75℃	600	mW
T_{opr}	Operating ambient temperature range		−10~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4	12	15	V
I_O	Continuous output current				±300	mA
V_{IH}	"H" Input voltage		2		V_{CC}	V
V_{IL}	"L" Input voltage		0		0.4	V
t_B	Motor braking interval		100			ms

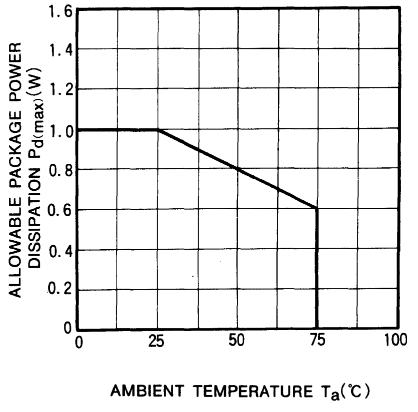
ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions			Limits			Unit
					Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	$V_{CC}=V_{CC}'$=20V, $V_{I1}=V_{I2}$=2V		V_O=20V			100	μA
				V_O=0V			−100	
$V_{OH(1)}$	"H" Output saturation voltage (1)	$V_{CC}=V_{CC}'$=12V	V_{I1}=2V, V_{I2}=0V	$I_{OH(1)}$=−50mA	11.0			V
				$I_{OH(1)}$=−100mA	10.9			
$V_{OH(2)}$	"H" Output saturation voltage (2)	$V_{CC}=V_{CC}'$=12V	V_{I1}=0V, V_{I2}=2V	$I_{OH(2)}$=−50mA	11.0			V
				$I_{OH(2)}$=−100mA	10.9			
$V_{OL(1)}$	"L" Output saturation voltage (1)	$V_{CC}=V_{CC}'$=12V	V_{I1}=0V, V_{I2}=2V	$I_{OL(1)}$=50mA			0.3	V
				$I_{OL(1)}$=100mA			0.35	
			$V_{I1}=V_{I2}$=2V	$I_{OL(1)}$=100mA			0.35	
$V_{OL(2)}$	"L" Output saturation voltage (2)	$V_{CC}=V_{CC}'$=12V	V_{I1}=2V, V_{I2}=0V	$I_{OL(2)}$=50mA			0.3	V
				$I_{OL(2)}$=100mA			0.35	
			$V_{I1}=V_{I2}$=2V	$I_{OL(2)}$=100mA			0.35	
$I_{IH(1)}$	"H" Input current (1)	$V_{CC}=V_{CC}'$=12V, V_{I1}=2V, V_{I2}=0V			70		200	μA
$I_{IH(2)}$	"H" Input current (2)	$V_{CC}=V_{CC}'$=12V, V_{I1}=0V, V_{I2}=2V			70		200	μA
I_{CC}	Supply current	$V_{CC}=V_{CC}'$=16V		V_{I1}=2V, V_{I2}=0V			30	mA
				V_{I1}=0V, V_{I2}=2V				
				$V_{I1}=V_{I2}$=2V			60	mA
				$V_{I1}=V_{I2}$=0V		0		mA

MITSUBISHI ELECTRIC

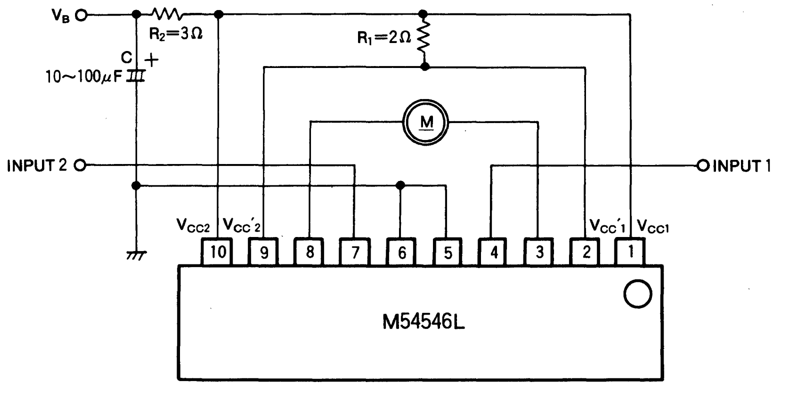
TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

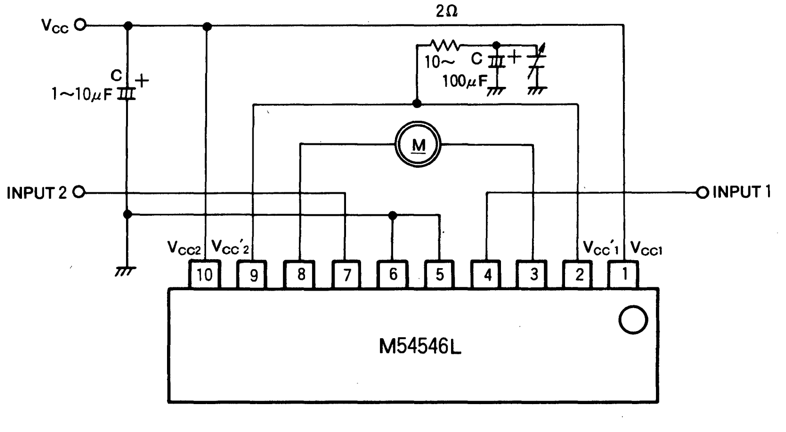


TYPICAL APPLICATION

1)



2) MOTOR SPEED CONTROL BY THE V_{CC}'



M54547P

BI-DIRECTIONAL MOTOR DRIVER WITH OP AMP AND TRANSISTOR ARRAY

DESCRIPTION

The M54547P, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver and dual general purpose NPN darlington pairs.

FEATURES

- 600mA output current
- Braking mode input
- Integral operational amplifier at direction control input
- Output transient suppression

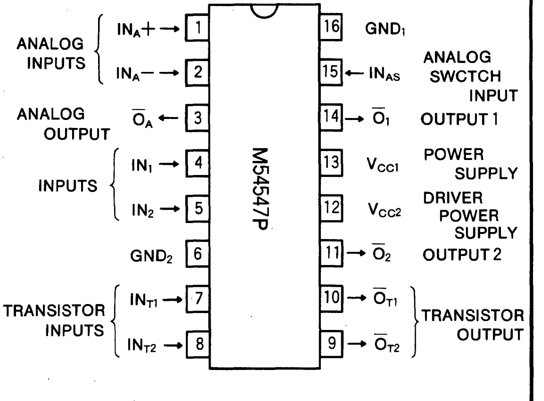
APPLICATION

Audio, video cassette recorder

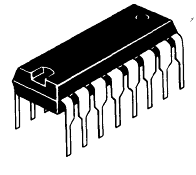
FUNCTION

The M54547P, full bridge motor driver, has the logic circuitry and darlington power drivers for bidirectional control of D-C motors operating at currents up to 600mA. The operational amplifier is connected to the direction control input through an analog switch controlled by pin 15 input. By switching the IN_{AS} input high and the IN_1 input low, the output of the amplifier appears at the output $\overline{O}_1$ so that the voltage across the bridge output is altered linearly by the amplifier input. The internal NPN darlington pairs are capable of sinking 300mA and will withstand 20V in the OFF state.

PIN CONFIGURATION (TOP VIEW)

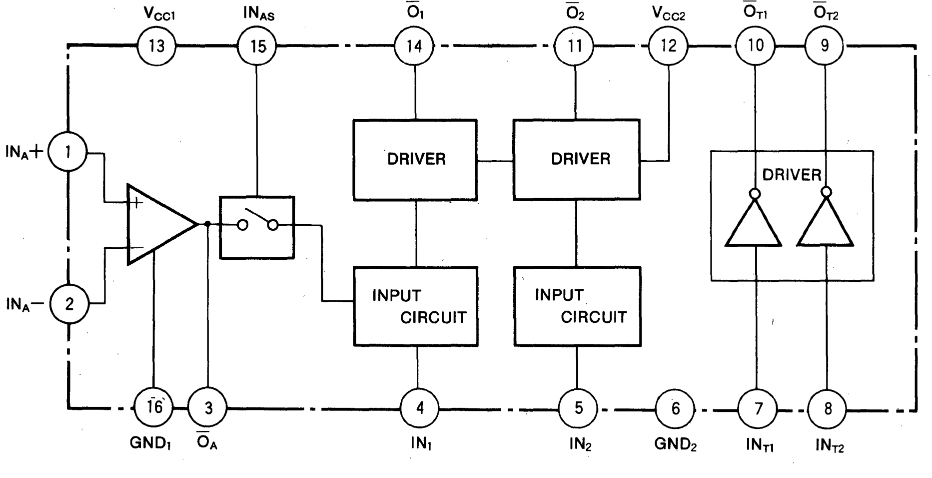


Outline 16P4



16-pin molded plastic DIL

BLOCK DIAGRAM



BI-DIRECTIONAL MOTOR DRIVER WITH OP AMP AND TRANSISTOR ARRAY

LOGIC TRUTH TABLE

Input			Output		Note
IN_{SW}	IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	L	H	H	Braking
L	L	H	H	L	
L	H	L	L	H	
L	H	H	L	L	Braking
H	L	L	A*	H	Analog
H	L	H	A*	L	Analog
H	H	L	L	H	
H	H	H	L	L	Braking

A* : The output voltage is controlled by the amplifier output.

ABSOLUTE MAXIMUM RATINGS (T_a=25℃,unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC1}	Supply voltage		−0.5～+16	V
V_{CC2}	Driver supply voltage		−0.5～+16	V
V_I,V_{IAS}	Input voltage		0～V_{CC}	V
V_O	Output voltage		−0.5～V_{CC2}+2.5V	V
I_{OP}	Peak output current	t_{op}=10ms : Repetitive cycle 0.2Hz max	±600	mA
I_O	Continuous output current		±150	mA
V_{CEO}	Collector-emitter applied voltage(transistor array)		20	V
I_C	Collector current(transistor array)		300	mA
V_I	Input voltage(Transistor array)		10	V
P_d	Power dissipation	T_a=25℃	1.47	W
		T_a=60℃	1.06	
T_{opr}	Operating ambient temperature range		−10～+60	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min	Typ	Max	
V_{CC1}	Supply voltage	4	12	15	V
I_O	Continuous output current			±100	mA
V_{IH}	Input voltage(motor driver)	3		V_{CC}	V
V_{IL}	(IN_1, IN_2, IN_{AS})	0		0.6	
t_B	Motor braking interval	100			ms
V_{IH}	Transistor array input voltage	4		10	V
V_{IL}	(IN_{T1}, IN_{T2})	0		0.6	

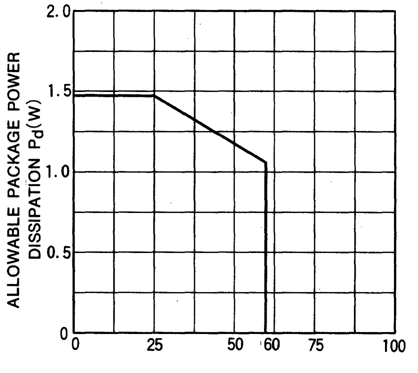
BI-DIRECTIONAL MOTOR DRIVER WITH OP AMP AND TRANSISTOR ARRAY

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

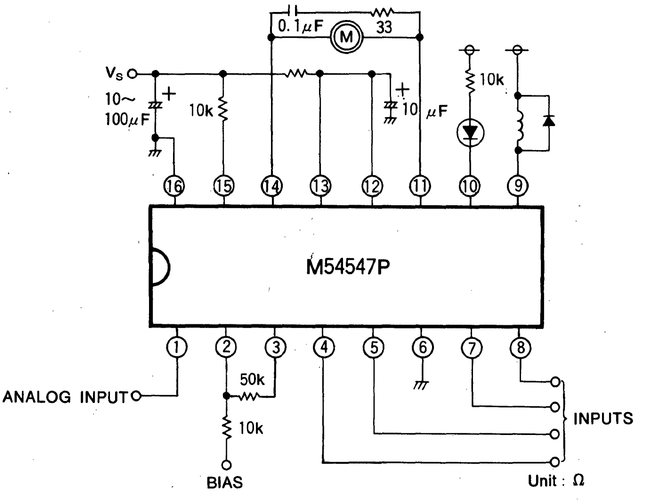
Symbol	Parameter	Test conditions		Limits Min	Limits Typ	Limits Max	Unit
$I_{O(leak)}$	Output leakage current($\overline{O}_1$, $\overline{O}_2$)	$V_{CC1}=V_{CC2}$=16V	V_O=0V			±100	μA
		$V_{IN1}=V_{IN2}=V_{IAS}$=0V	V_O=16V				
V_{OH}	"H"Output saturation voltage($\overline{O}_1$, $\overline{O}_2$)	$V_{CC1}=V_{CC2}$=12V	V_{IN1}=0V, V_{IN2}=3V	10.3			V
		I_O=−150mA	V_{IN1}=3V, V_{IN2}=0V				
V_{OL}	"L"Output saturation voltage($\overline{O}_1$, $\overline{O}_2$)	$V_{CC1}=V_{CC2}$=12V	V_{IN1}=0V, V_{IN2}=3V			1.2	V
		I_O=150mA	V_{IN1}=3V, V_{IN2}=0V				
I_I	Input current(IN_1, IN_2, IN_{AS})	V_{CC1}=12V, V_I=3V				0.3	mA
$I_{O(leak)}$	Output leakage current($\overline{O}_{T1}$, $\overline{O}_{T2}$)	V_O=30V, V_I=0.6V				100	μA
V_{OC}	"L"Output saturation voltage	V_I=4V	I_C=100mA			1.3	V
			I_C=200mA			1.5	
I_I	Input current	V_I=4V				0.8	mA
A_O	OP Amp open-loop-gain			40			dB
I_{CC1}	Supply current	V_{CC1}=12V, $V_{IN1}=V_{IN2}=V_{IAS}$=3V				6	mA

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



TYPICAL APPLICATION



MITSUBISHI ELECTRIC

M54548L

BI-DIRECTIONAL MOTOR DRIVER WITH MOTOR SPEED CONTROL

DESCRIPTION
The M54548L, BI-DIRECTIONAL MOTOR DRIVER, consists of a full bridge power driver designed for use in a D-C motor control circuit. The internal operational amplifier is capable for controlling the voltage across the bridge outputs.

FEATURES
- Wide operating voltage range
- NMOS and CMOS compatible input
- 1.2A output current
- Integral operational amplifier for output source voltage
- Output transient suppression
- Braking mode input

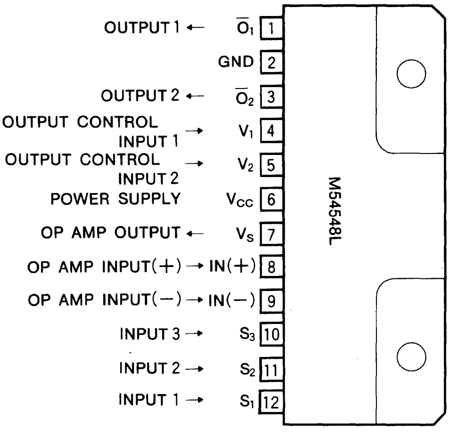
APPLICATION
Audio, video cassette recorder

FUNCTION
The M54548L, full bridge motor driver, has the logic circuitry and the quasi-darlington power driver for bidirectional control of D-C motors operating at current up to 1.2A. The inputs, S_1, S_2 and S_3, are capable to control the bridge output polarity and also to select the supply voltage of the predriver from the voltages drived by V_1, V_2 or the output of the operational amplifier.

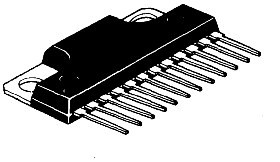
LOGIC TRUTH TABLE

Input			Output		Driver power supply	Note
S_1	S_2	S_3	$\overline{O_1}$	$\overline{O_2}$		
L	L	L	"OFF" state	"OFF" state	—	STOP
L	L	H	H	L	OP AMP OUTPUT	PLAY(+)
L	H	L	L	H	OP AMP OUTPUT	PLAY(−)
L	H	H	H	L	V_2	FF(2)
H	L	L	L	H	V_2	REW(2)
H	L	H	H	L	V_1	FF(1)
H	H	L	L	H	V_1	REW(1)
H	H	H	L	L	V_S	BRAKING

PIN CONFIGURATION (TOP VIEW)

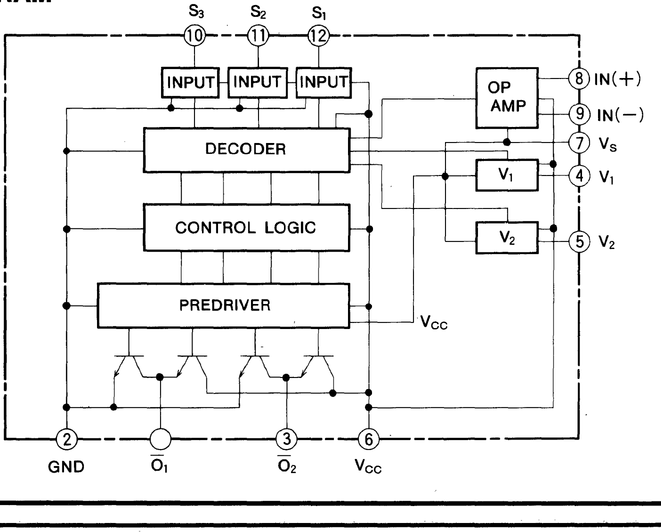


Outline 12P9



12-pin molded plastic SIL

BLOCK DIAGRAM



BI-DIRECTIONAL MOTOR DRIVER WITH MOTOR SPEED CONTROL

ABSOLUTE MAXIMUM RATINGS (T_a =25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage	With an external heat sink (3000mm²X1.5mm^t)	−0.5～+18	V
V_I	Input voltage	4 Pin, 5 Pin	−0.5～+14or V_{CC}	V
			−0.5～V_{CC}	
V_O	Output voltage		−0.5～V_{CC}+2.5	V
$I_{O(max)}$	Peak output current	t_{op}=10ms; Repetitive cycle 0.2Hz max	±1.2	A
$I_{O(1)}$	Continuous output current (1)		±300	mA
$I_{O(2)}$	Continuous output current (2)	With an external heat sink (3000mm²X1.5mm^t)	±600	mA
P_d	Power dissipation	T_a =75℃	1.2	W
T_{OPr}	Operating ambient temperature range		−10～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

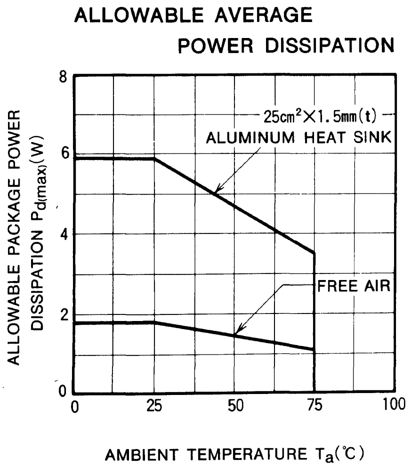
RECOMMENDED OPERATING CONDITIONS (T_a =25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4	12	16	V
I_O	Continuous output current				±200	mA
V_{IH}	"H" input voltage		3			V
V_{IL}	"L" input voltage				1	V
t_S	Motor braking interval		100			ms

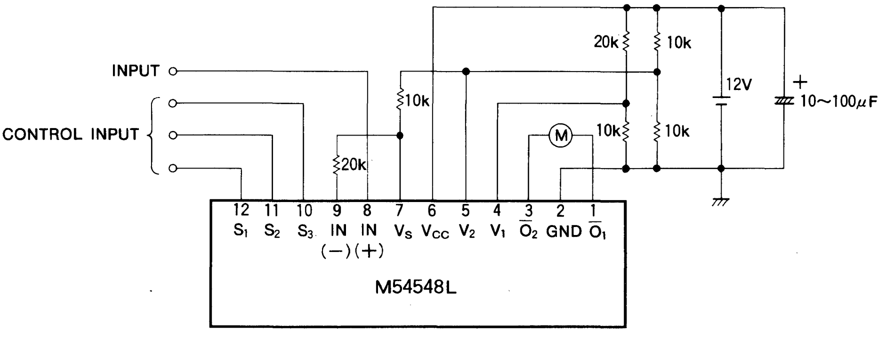
ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions			Min	Typ	Max	Unit
$I_{O(leak)}$	Output leakage current	V_{S1}=0V, V_{S2}=0V, V_{S3}=0V	V_O=0V, V_{CC}=V_S=20V				−100	μA
			V_O=14V, V_{CC}=V_S=14V				+100	
$V_{OH(1)}$	"H" Output saturation voltage (1)	V_{CC}=16V, $V_{IN(-)}$=0V, $V_{IN(+)}$=3V	V_{S1}=V_{S2}=0V, V_{S3}=3V	I_{OH}=−200mA	13			V
				I_{OH}=−500mA	12.8			
$V_{OH(2)}$	"H" Output saturation voltage (2)	V_{CC}=16V, $V_{IN(-)}$=0V, $V_{IN(+)}$=3V	V_{S1}=V_{S3}=0V, V_{S2}=3V	I_{OH}=−200mA	13			V
				I_{OH}=−500mA	12.8			
$V_{OL(1)}$	"L" Output saturation voltage (1)	V_{CC}=16V, $V_{IN(-)}$=0V, $V_{IN(+)}$=3V	V_{S1}=V_{S3}=0V, V_{S2}=3V	I_{OL}=200mA			0.5	V
				I_{OL}=500mA			1.4	
$V_{OL(2)}$	"L" Output saturation voltage (2)	V_{CC}=16V, $V_{IN(-)}$=0V, $V_{IN(+)}$=3V	V_{S1}=V_{S2}=0V, V_{S3}=3V	I_{OL}=200mA			0.5	V
				I_{OL}=500mA			1.4	
I_{IH}	"H" Input current	V_{CC}=16V, V_{IS}=3V (S_1, S_2, S_3)					10	μA
I_{IL}	"L" Input current	V_{CC}=16V, V_{IS}=0V (S_1, S_2, S_3)					−20	μA
I_{CC}	Supply current	V_{CC}=16V, V_{S1}=V_{S2}=V_{S3}=3V					25	mA
A	Op amp open-loop-gain				50			dB

TYPICAL CHARACTERISTICS



TYPICAL APPLICATION



Unit : Ω

M54549L

DUAL BI-DIRECTIONAL MOTOR DRIVER

DESCRIPTION

The M54549L, DUAL BI-DIRECTIONAL MOTOR DRIVER, consists of two separated full bridge power drivers designed for use in a D-C motor control circuit.

FEATURES

- Two separated full bridge driver
- Wide operating voltage range (V_{CC} =4~16V)
- TTL, PMOS and CMOS compatible input
- Low output saturation voltage
- Integral diodes for transient suppression
- 2A output current
- Braking mode input
- Internal thermal shutdown protection

APPLICATION

Audio, video cassette recorder

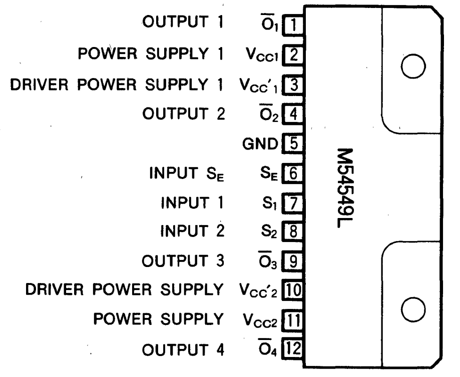
FUNCTION

The M54549L, dual full bridge power drivers, has the logic circuitry and dual quasi-darlington power drivers for bi-directional control of D-C motors operating at currents up to 1.2A. The input SE selects the one of the bridges and the inputs S_1 and S_2 determines the output polarity of the designated bridge.

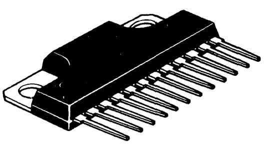
LOGIC TRUTH TABLE

Input			Output				Note	
S_E	S_1	S_2	$\overline{O}_1$	$\overline{O}_2$	$\overline{O}_3$	$\overline{O}_4$	Output $\overline{O}_1,\overline{O}_2$	Output $\overline{O}_3,\overline{O}_4$
0	0	0	OFF	OFF	OFF	OFF	Open	Open
0	1	0	1	0	OFF	OFF	↻	Open
0	0	1	0	1	OFF	OFF	↺	Open
0	1	1	0	0	OFF	OFF	Braking	Open
1	0	0	OFF	OFF	OFF	OFF	Open	Open
1	1	0	OFF	OFF	1	0	Open	↻
1	0	1	OFF	OFF	0	1	Open	↺
1	1	1	OFF	OFF	0	0	Open	Braking

PIN CONFIGURATION (TOP VIEW)

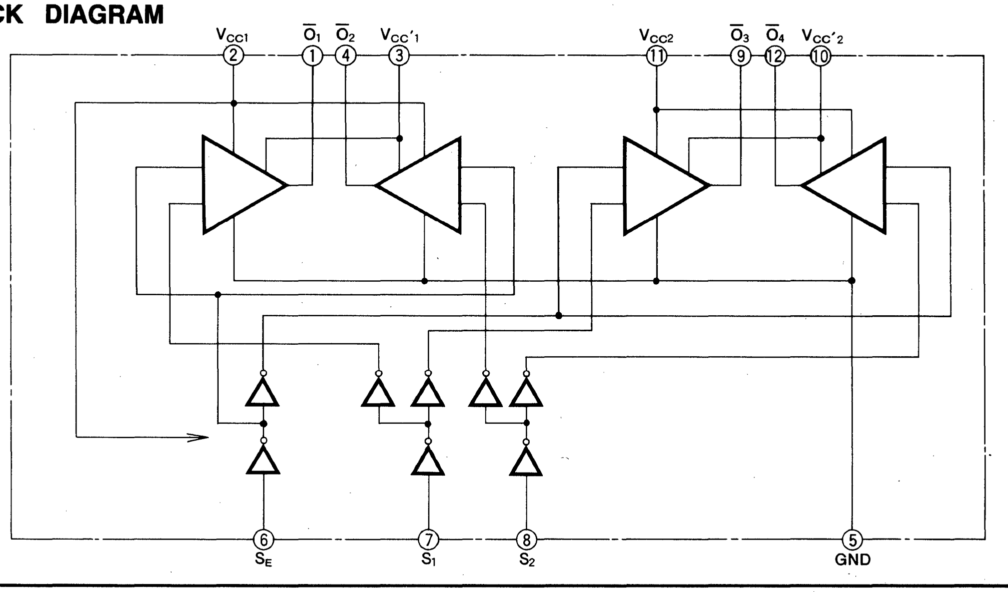


Outline 12P9



12-pin molded plastic SIL

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC(1)}$	Supply voltage (1)		−0.5～+18	V
$V_{CC(2)}$	Supply voltage (2)	With an external heat sink(3000mm^2×1.5mm)	−0.5～+18	V
V_{CC}'	Driver supply voltage		−0.5～+18	V
V_I	Input voltage		0～V_{CC}	V
V_O	Output voltage		−2～V_{CC}'+2.5	V
$I_{O(max)}$	Output peak current	Top=10ms. repetitive cycle 0.2Hz max	±2	A
$I_{O(1)}$	Continuous output current (1)		±330	mA
$I_{O(2)}$	Continuous output current (2)	With an external heat sink(3000mm^2×1.5mm)	±600	mA
P_d	Power dissipation	T_a=75℃	1.20	W
T_{opr}	Operating ambient temperature range		−10～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

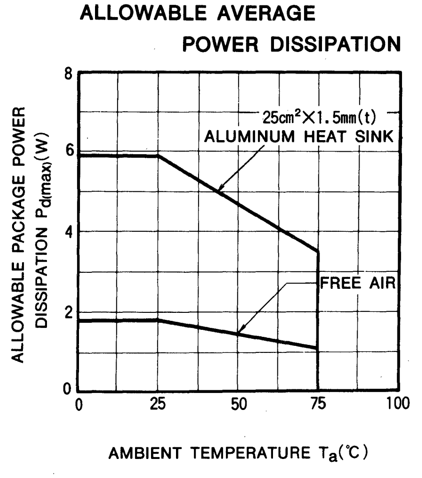
RECOMMENDED OPERATING CONDITIONS (T_a=25℃, unless otherwise noted)

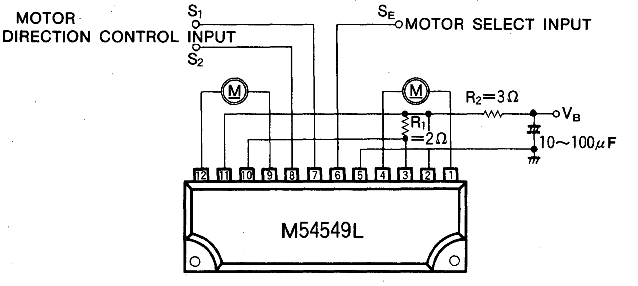
Symbol	Parameter	Conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4	12	16	V
I_O	Output current				±300	mA
V_{IH}	"H"Input voltage	Inputs S_1, S_2 and S_E	2		V_{CC}	V
V_{IL}	"L"Inputs voltage	Input S_1, S_2 and S_E	0		0.4	V
t_S	Input switching interval	It is prohibited to switch the inputs at the same time.	100			ms
T_{OFF}	Thermal shutdown temperature	Junction temperature		150		

ELECTRICAL CHARACTERISTICS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	V_{CC}=V_{CC}'=18V	V_O=18V			100	μA
		V_{S1}=V_{S2}=0V, V_{SE}=0Vor2V	V_O=0V			−100	
$V_{OH(1)}$	"H"Output saturation voltage (1)	V_{CC}=V_{CC}'=12V	$I_{OH(1)}$=−200mA	10.8			V
			$I_{OH(1)}$=−500mA	10.7			
$V_{OL(1)}$	"L"Output saturation voltage	V_{CC}=V_{CC}'=12V	I_{OL}=200mA			0.5	V
			$I_{OL(1)}$=500mA			1.35	
I_{IH}	"H"Input current	V_{CC}=V_{CC}'=12V, V_I=2V		70		200	μA
I_{IL}	"L"Input current	V_{CC}=V_{CC}'=12V, V_I=0V		70		200	μA
I_{CC}	Supply current	V_{CC}=V_{CC}'=12V	V_{SE}=0V, V_{S1}=V_{S2}=0V			10	mA
			V_{SE}=0V, V_{S1}=V_{S2}=0V				
			V_{SE}=0V, V_{S1}=0V, V_{S2}=2V			20	mA

TYPICAL APPLICATION





M54560P

7-UNIT 150mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

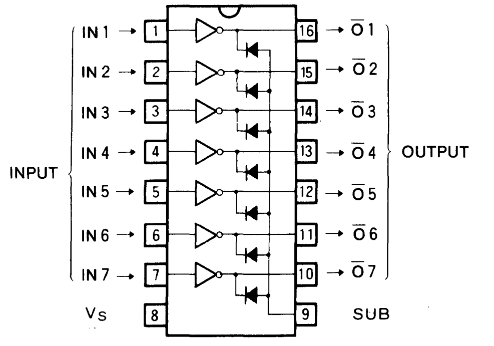
DESCRIPTION
The M54560P, 7-channel source driver, consists of 7 PNP and 7 NPN transistors, connected to form high current gain driver with PNP action.

FEATURES
- High output sustaining voltage to 40V
- Output source current to 150mA
- Integral diode for transient suppression
- Active "L" input
- Wide operating temperature range (T_a =−20∼+75℃)

APPLICATIONS
- Relay and printer driver
- LED, incandescent or fluorescent display driver
- Interfacing for standard MOS/BIPOLAR logics

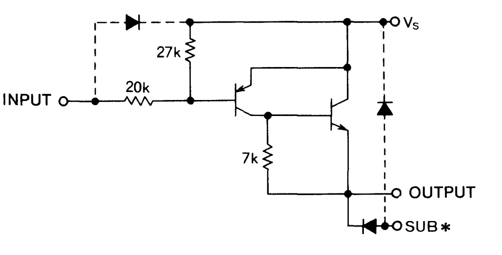
FUNCTION
The M54560P is comprised of seven PNP-NPN darlington source driver pairs with 20kΩ series input resistors. Each output has an integral diode for inductive load transient suppression. The anodes of the diodes and the substrate connected together to pin 9 . The outputs are capable of driving 150mA and are rated for operation with output voltages of up to 40V. The output is turned ON by switching the input low.

PIN CONFIGURATION (TOP VIEW)

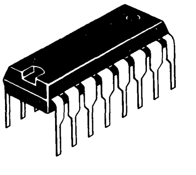


Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Output is in "L"	40	V
V_S	Supply voltage		40	V
V_I	Input voltage		0, 40	V
I_O	Output current	Per channel current at "H"output	−150	mA
I_F	Clamp diode forward current		−150	mA
V_R	Clamp diode reverse voltage		40	V
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

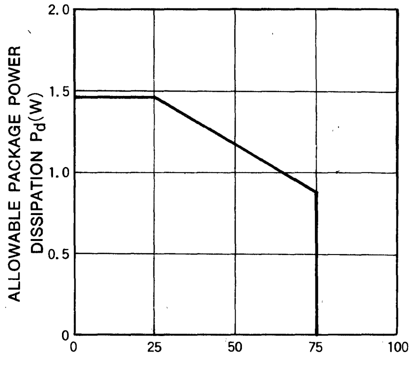
Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_S	Supply voltage				40	V
I_O	Output current per channel	Percent duty cycle less than 90%			−100	mA
		Percent duty cycle less than 100%			−50	mA
V_{IH}	"H" Input voltage		V_S−0.2			V
V_{IL}	"L" Input voltage	I_O=−100mA			V_S−5	V
		I_O =−50mA			V_S−3.5	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

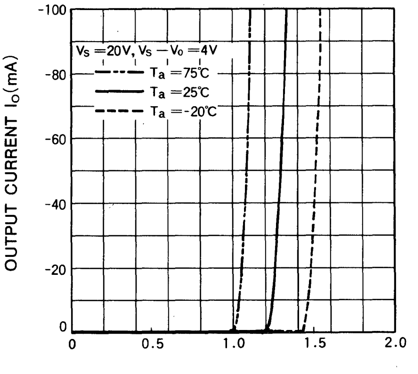
Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
$I_{S(leak)}$	Supply leakage current	V_S=40V			100	μA
$V_{CE(sat)}$	Output saturation voltage	V_I=V_S−5V, I_O=−100mA			1.5	V
		V_I=V_S−3.5V, I_O=−50mA			1.2	V
I_I	Input voltage	V_I=V_S−8.5V			−670	μA
V_F	Clamp diode forward voltage	I_F=−100mA			−2.4	V
V_R	Clamp diode reverse voltage	I_R=100μA	40			V
h_{FE}	DC forward current gain	V_S−V_O=4V, I_O=−100mA, T_a=25℃	500			

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



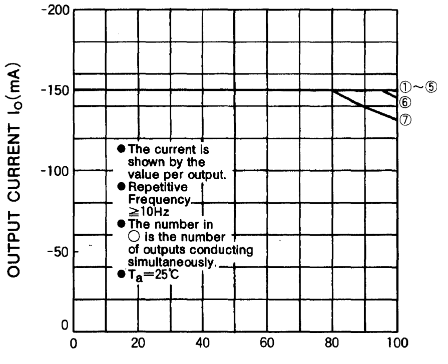
OUTPUT CURRENT CHARACTERISTICS



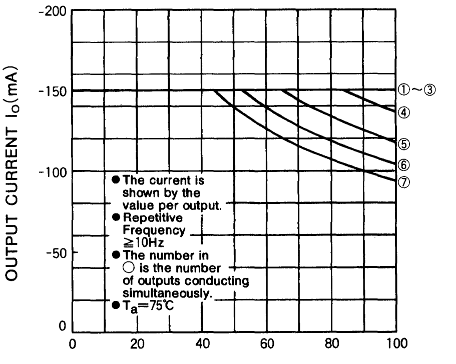
MITSUBISHI ELECTRIC

7-UNIT 150mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

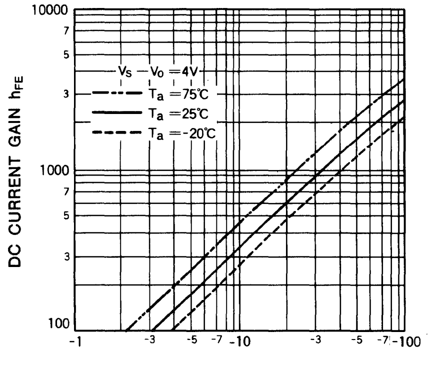
ALLOWABLE OUTPUT CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE OUTPUT CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54561P

7-UNIT 300mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

DESCRIPTION

The M54561P, 7-channel source driver, consists of 7 PNP and 14 NPN transistors connected to form high current gain driver with PNP action.

FEATURES

- High output sustaining voltage to 40V
- High output source current to 300mA
- Integral diode for transient suppression
- Active "L" input
- Wide operating temperature range (T_a =−20∼+75℃)

APPLICATIONS

- Relay and printer driver
- LED, incandescent or fluorescent display driver
- Active "L" input
- Interfacing for standard MOS/BIPOLAR logics

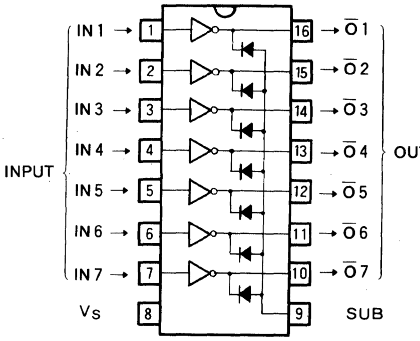
FUNCTION

The M54561P functions like a PNP transistor and the compound PNP/NPN/NPN output provides high current gain. Each output has an integral diode for inductive load transient suppression and the anodes of the diodes and the substrate are connected together to pin 9.

The output are capable of driving 300mA and are rated for operation with output voltage up to 40V.

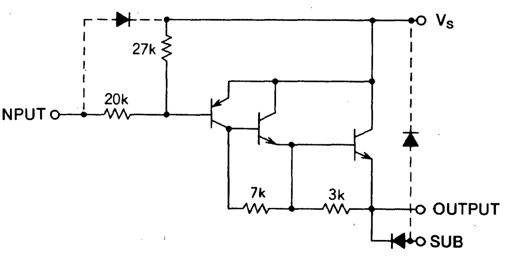
The output is turned ON by switching the input low.

PIN CONFIGURATION (TOP VIEW)

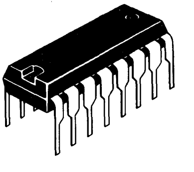


Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Output is in "L"	40	V
V_S	Supply voltage		40	V
V_I	Input voltage		0, 40	V
I_O	Output current	Per channel current at "H"output	−300	mA
I_F	Clamp diode forward current		−300	mA
V_R	Clamp diode reverse voltage		40	V
P_d	Power dissipation	T_a =25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

MITSUBISHI ELECTRIC

7-UNIT 300mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

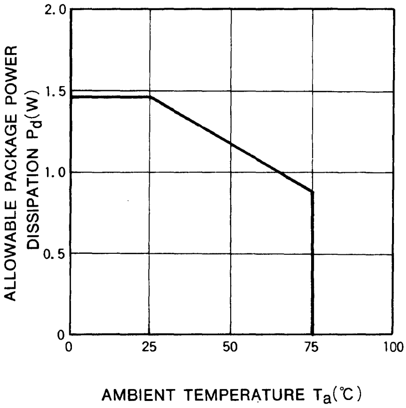
Symbol	Parameter		Limits Min	Typ	Max	Unit
V_S	Supply voltage				40	V
I_O	Output current per channel	Percent duty cycle less than 15%			−250	mA
		Percent duty cycle less than 50%			−100	mA
V_{IH}	"H" Input voltage		V_S−0.2			V
V_{IL}	"L" Input voltage	I_O=−250mA			V_S−3	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

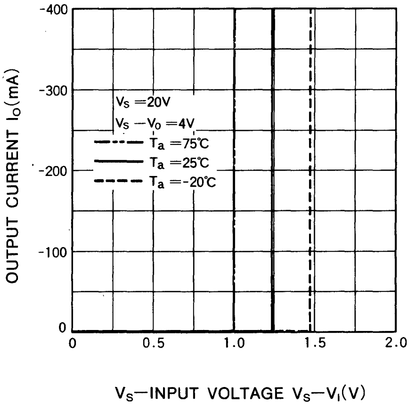
Symbol	Parameter	Test conditions	Limits Min	Typ	Max	Unit
$I_{S(leak)}$	Supply leakage current	V_S=40V			100	μA
$V_{CE(sat)}$	Output saturation voltage	V_I=V_S−3V, I_O=−250mA			2.3	V
		V_I=V_S−3V, I_O=−100mA			2.0	V
I_I	Input current	V_I=V_S−3.5V			−250	μA
V_F	Clamp diode forward voltage	I_F=−300mA			−2.4	V
V_R	Clamp diode reverse voltage	I_R=100μA	40			V
h_{FE}	DC forward current gain	V_S−V_O=4V, I_O=−300mA, T_a=25℃	1000			

TYPICAL CHARACTERISTICS

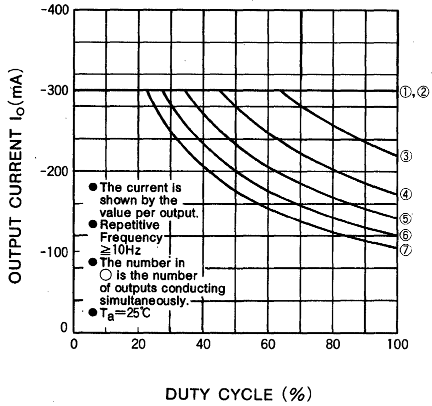
ALLOWABLE AVERAGE POWER DISSIPATION



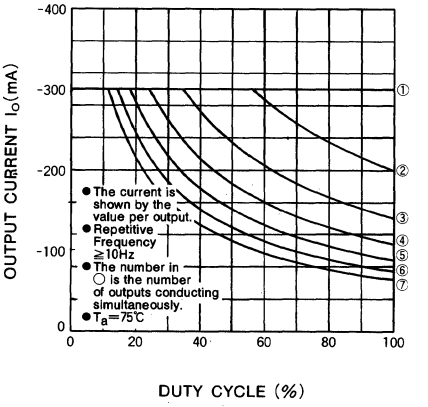
OUTPUT CURRENT CHARACTERISTICS



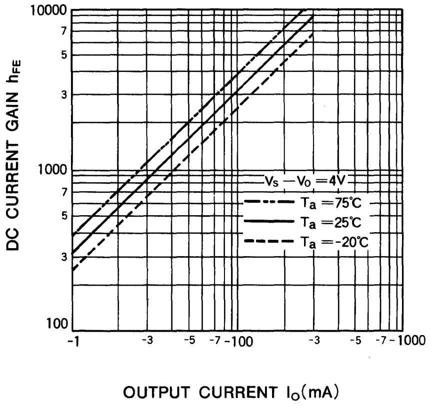
ALLOWABLE OUTPUT CURRENT AS A FUNCTIONAL OF DUTY CYCLE



ALLOWABLE OUTPUT CURRENT AS A FUNCTIONAL OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



MITSUBISHI ELECTRIC

M54562P

8-UNIT 500mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

DESCRIPTION

The M54562P, 8-channel source driver, is designed for use with +6 to +16V MOS logic systems.

FEATURES

- High output sustaining voltage to 50V
- High output source current to 500mA
- Integral diode for transient suppression
- 6~16V CMOS compatible input
- Wide operating temperature range (T_a = −20~+75℃)

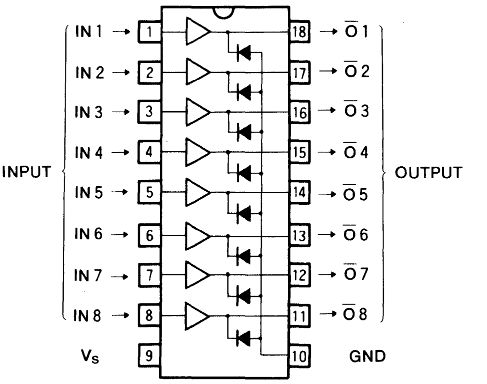
APPLICATIONS

- Relay and printer driver
- LED, incandescent or fluorescent display driver
- Interfacing for standard MOS/BIPOLAR logics

FUNCTION

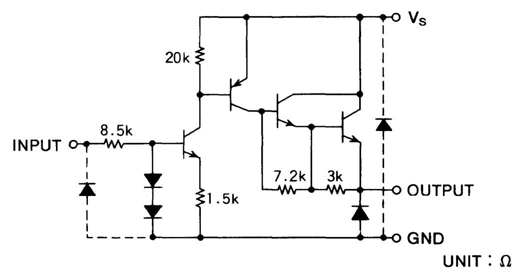
The driver of the M54562P is comprised of a NPN invertor and compound PNP/NPN/NPN output source driver, and the output is turned ON by an active high input level. Each output has an integral diode for inductive load transient suppression. The outputs are capable of driving 500mA and are rated for operation with output voltage up to 50V.

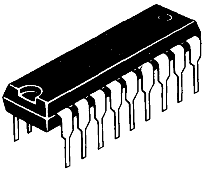
PIN CONFIGURATION (TOP VIEW)



Outline 18P4

CIRCUIT SCHEMATIC





18-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a = −20~+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Output is in "L"	50	V
V_S	Supply voltage		50	V
V_I	Input voltage		0, 30	V
I_O	Output current	Per channel current at "H" output	−500	mA
I_F	Clamp diode forward current		−500	mA
V_R	Clamp diode reverse voltage		50	V
P_d	Power dissipation	T_a=25℃	1.79	W
T_{opr}	Operating ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

8-UNIT 500mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75°C, unless otherwise noted)

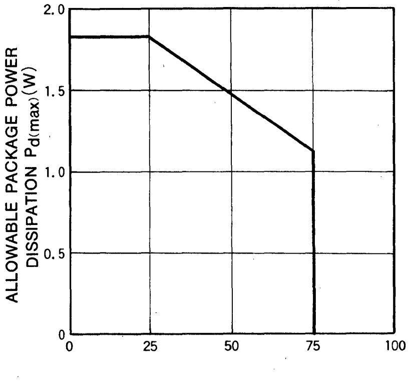
Symbol	Parameter		Limits Min	Typ	Max	Unit
V_S	Supply voltage				50	V
I_O	Output current per channel	Percent duty cycle less than 8%			−350	mA
		Percent duty cycle less than 55%			−100	mA
V_{IH}	"H" Input voltage	I_O=−350mA	4	5		V
V_{IL}	"L" Input voltage				0.2	V

ELECTRICAL CHARACTERISTICS (T_a=−20~+75°C, unless otherwise noted)

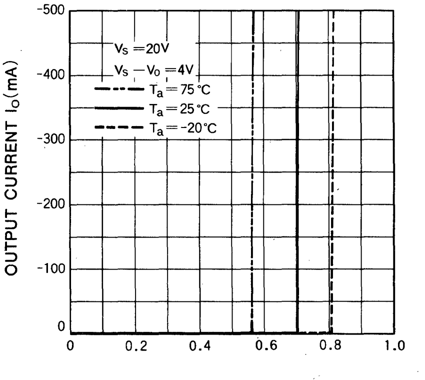
Symbol	Parameter	Test conditions	Limits Min	Typ	Max	Unit
I_S (leak)	Supply leak current	V_S=50V, V_I=0.2V			100	μA
V_{CE} (sat)	Output saturation voltage	V_S=10V, V_I=4V, I_O=−350mA			2.4	V
		V_S=10V, V_I=4V, I_O=−100mA			2.0	V
I_I	Input current	V_I=5V			0.75	mA
		V_I=25V			4.7	mA
I_S	Supply current	V_S=50V, V_I=5V			6.5	mA
V_F	Clamp diode forward voltage	I_F=−350mA			−2.4	V
V_R	Clamp diode reverse voltage	I_R=100μA	50			V

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

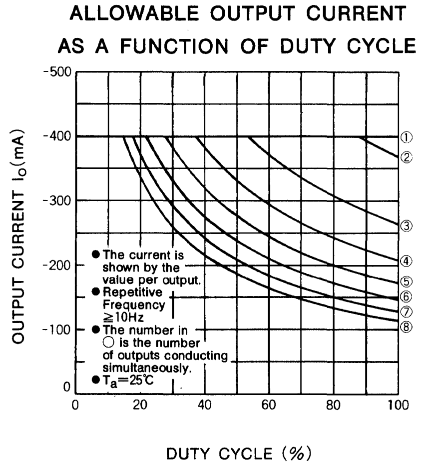


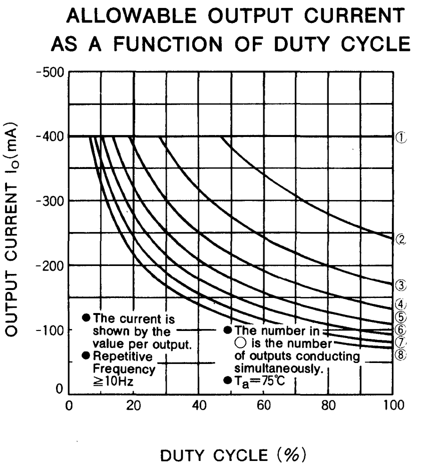
OUTPUT CURRENT CHARACTERISTICS

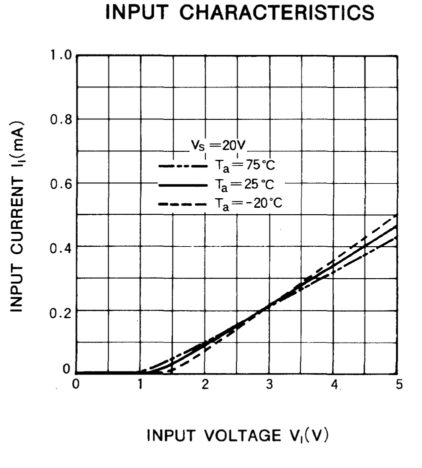


MITSUBISHI ELECTRIC

8-UNIT 500mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY







M54563P

8-UNIT 500mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

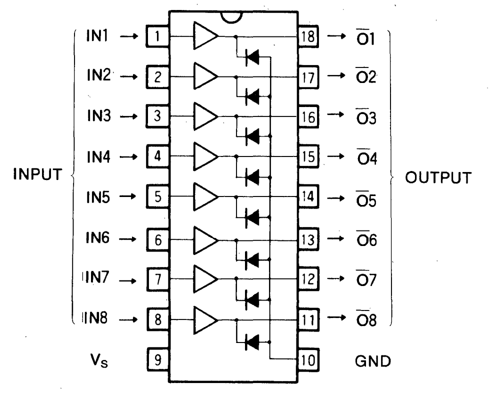
DESCRIPTION
The M54563P, 8-channel source driver, is designed for use with + 6 to +16V MOS logic systems.

FEATURES
- High output sustaining voltage to 50V
- High output source current to 500mA
- Integral diode for transient suppression
- Wide operating temperature range (T_a=−20∼+75℃)

APPLICATIONS
- Relay and printer driver
- LED, incandescent or fluorescent display driver
- Interfacing for standard MOS/BIPOLAR logics

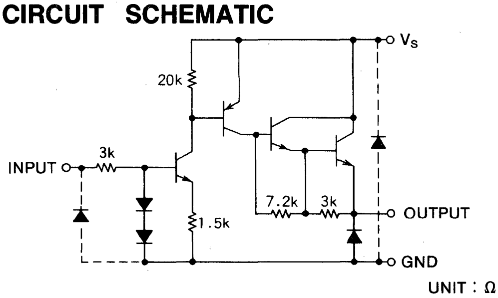
FUNCTION
The driver of the M54563P is comprised of a NPN invertor and compound PNP/NPN/NPN output source driver and the output is turned ON by an active high input level. Each output has an integral diode for inductive load transient suppression. The outputs are capable of driving 500mA and are rated for operating with output voltage up to 50V.

PIN CONFIGURATION (TOP VIEW)

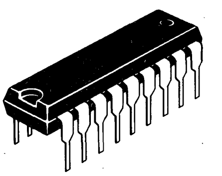


Outline 18P4

CIRCUIT SCHEMATIC



UNIT : Ω



18-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
V_S	Supply voltage		50	V
V_I	Input voltage		0, 10	V
I_O	Output current	Transistor OFF	−500	mA
I_F	Clamp diode forward current		−500	mA
V_R	Clamp diode reverse voltage		50	V
P_d	Power dissipation	T_a = 25℃	1.79	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

8-UNIT 500mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

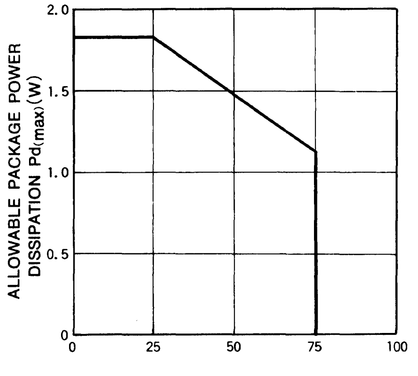
Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_S	Supply voltage				50	V
I_O	Output current per channel	Percent duty cycle less than 8%			−350	mA
		Percent duty cycle less than 55%			−100	mA
V_{IH}	"H" input voltage	I_O=−350mA	2.4			V
V_{IL}	"L" input voltage				0.2	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits Min	Limits Typ	Limits Max	Unit
$I_{S(leak)}$	Supply leakage current	V_S = 50 V, V_I = 0.2 V			100	μA
$V_{CE(sat)}$	Output saturation voltage	V_S = 10 V, V_I = 2.4 V, I_O = −350 mA			2.4	V
		V_S = 10 V, V_I = 2.4 V, I_O = −100 mA			2	V
I_I	Input current	V_I = 3 V			1	mA
		V_I = 10 V			5	mA
I_S	Supply current	V_S = 50 V, V_I = 3 V			6.5	mA
V_F	Clamp diode forward voltage	I_F = −350 mA			−2.4	V
V_R	Clamp diode reverse voltage	I_R = 100 μA	50			V

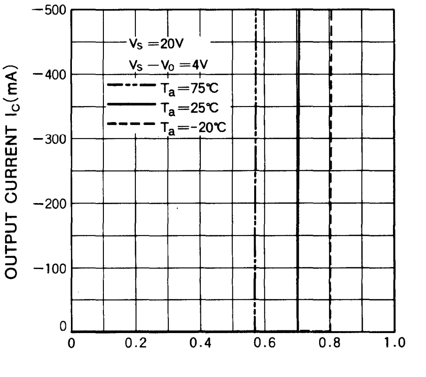
TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION



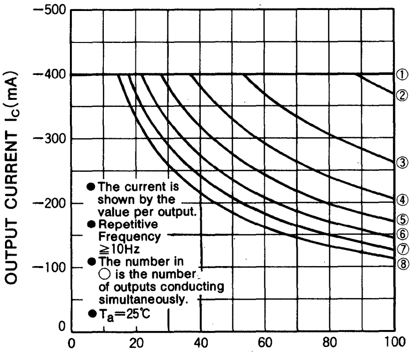
AMBIENT TEMPERATURE T_a(℃)

OUTPUT CURRENT CHARACTERISTICS

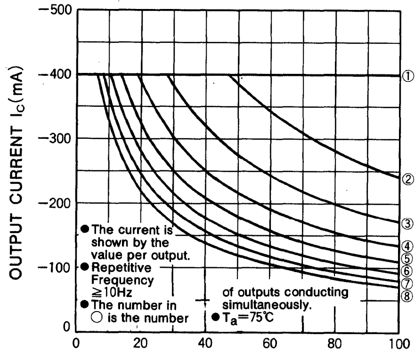


INPUT VOLTAGE V_I(V)

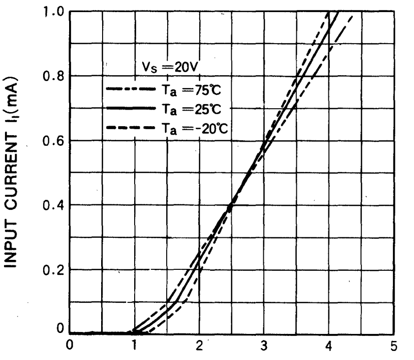
ALLOWABLE OUTPUT CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE OUTPUT CURRENT AS A FUNCTION OF DUTY CYCLE



INPUT CHARACTERISTICS



M54564P

8-UNIT 500mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

DESCRIPTION

The M54564P, 8-channel source driver, is designed for interfacing between low power digital logic and a fluorescent display.

FEATURES

- High output sustaining voltage to 50V
- High output source current to 500mA
- CMOS, TTL Compatible input
- Internal pull-down resistors
- Wide operating temperature range (T_a = −20～+75℃)

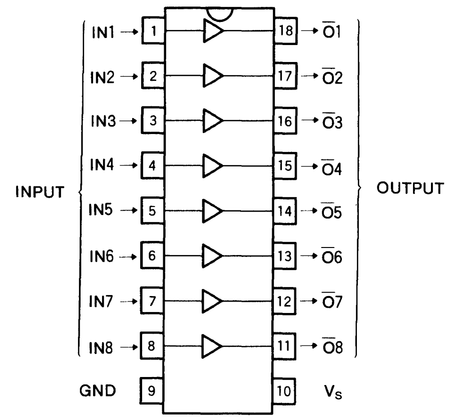
APPLICATIONS

- Relay and printer driver
- LED, incandescent or fluorescent display driver
- Interfacing for standard MOS/BIPOLAR logic

FUNCTION

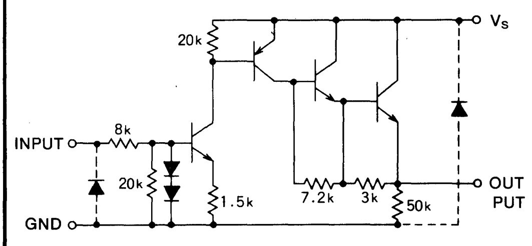
The driver of the M54564P is comprised of a NPN invertor and compound PNP/NPN/NPN output source driver and the output is turned ON by an active high input level. Each output has 50kΩ pull-down resistor suitable for driving fluorescent displays. The outputs are capable of driving 500mA and are rated for operation with output voltage up to 50V.

PIN CONFIGURATION (TOP VIEW)

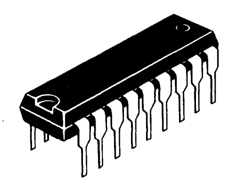


Outline 18P4

CIRCUIT SCHEMATIC



UNIT : Ω



18-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a = −20～+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CEO}	Output sustaining voltage		50	V
V_s	Supply voltage		50	V
V_I	Input voltage		0, 30	V
I_O	Output current		−500	mA
P_d	Power dissipation	T_a=25℃	1.79	W
T_{opr}	Operating ambient temperature range		−20～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a = −20∼+75℃, unless otherwise noted)

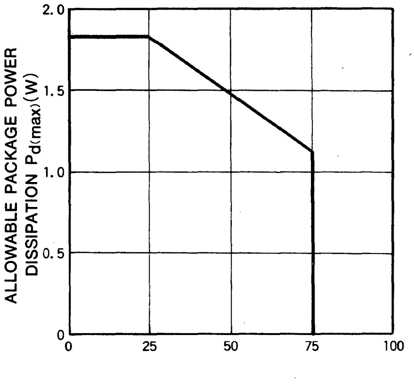
Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_S	Supply voltage				50	V
I_O	Output current per channel	Percent duty cycle less than 8%			−350	mA
		Percent duty cycle less than 60%			−100	mA
V_{IH}	"H" input voltage	I_O=−350mA	4			V
V_{IL}	"L" input voltage				0.2	V

ELECTRICAL CHARACTERISTICS (T_a = −20∼+75℃, unless otherwise noted)

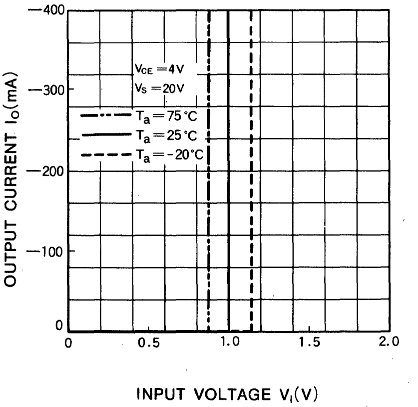
Symbol	Parameter	Test conditions		Limits Min	Limits Typ	Limits Max	Unit
$I_{S(leak)}$	Supply leak current	V_S=50V, V_I=0.2V				100	μA
$V_{CE(sat)}$	Output saturation voltage	V_S=10V	I_O=−350mA			2.4	V
		V_I=4V	I_O=−100mA			2	V
I_I	Input current	V_I=4V				0.7	mA
		V_I=25V				4.7	mA
I_S	Supply current	V_S=50V, V_I=4V				6.5	mA

TYPICAL CHARACTERISTICS

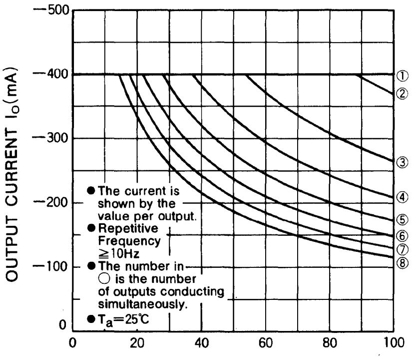
ALLOWABLE AVERAGE POWER DISSIPATION



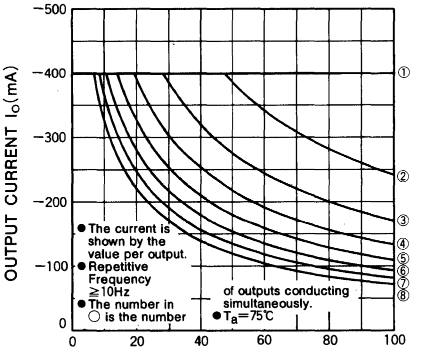
OUTPUT CURRENT CHARACTERISTICS



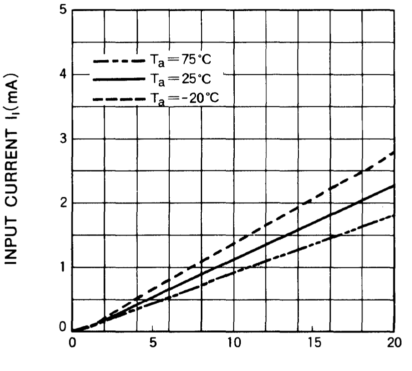
ALLOWABLE OUTPUT CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE OUTPUT CURRENT AS A FUNCTION OF DUTY CYCLE



INPUT CHARACTERISTICS



M54565P

8-UNIT 50mA TRANSISTOR ARRAY (INPUT “L” ACTIVE)

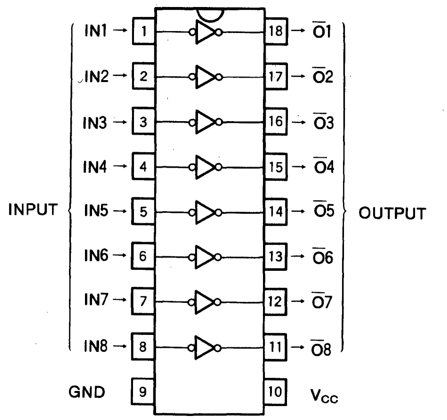
DESCRIPTION
The M54565P, 8-channel sink driver, consists of 7 PNP and 7 NPN transistors connected to form high current gain driver pairs.

FEATURES
- Output breakdown voltage to 20V
- Output sink current to 50mA
- Wide operating temperature range (T_a = −20∼+75℃)
- “L” Active Input

APPLICATIONS
- LED or incandescent display driver
- Interfacing for standard MOS/BIPOLAR logics

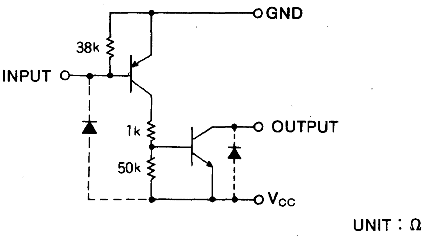
FUNCTION
The M54565P is comprised of eight PNP-NPN non darlington sink drivers. It functions from 2 V of supply voltage and features low output saturation voltage. The output is turned ON by switching the input low.

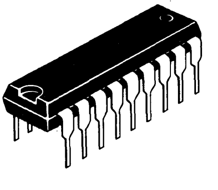
PIN CONFIGURATION (TOP VIEW)



Outline 18P4

CIRCUIT SCHEMATIC





18-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	50	mA
V_I	Input voltage		0, V_{CC}	V
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

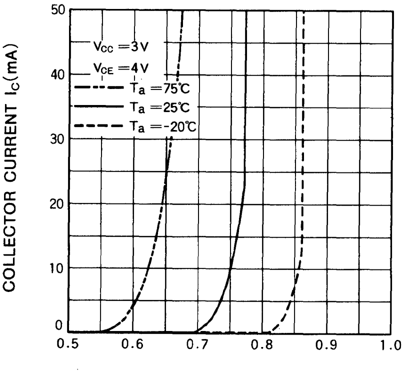
Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		2		6	V
V_O	Output voltage				20	V
I_C	Collector current				20	mA
I_{IH}	"H" Input current				8	μA
I_{IL}	"L" Input current	I_O=40mA	−200			μA

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

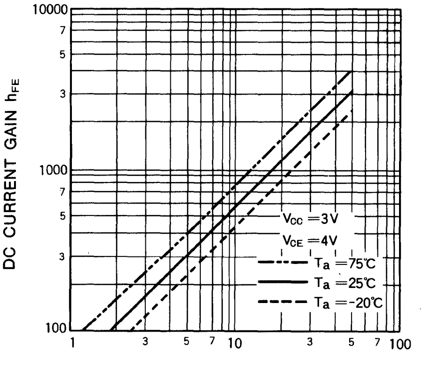
Symbol	Parameter	Test conditions		Limits Min	Limits Typ	Limits Max	Unit
$I_{O(leak)}$	Output leakage current	V_{CC}=6V, V_O=20V				50	μA
$V_{CE(sat)}$	Output saturation voltage	V_{CC} = 3 V	I_C=20mA			0.17	V
		I_I=−200μA	I_C=40mA			0.23	V
V_I	Input voltage	V_{CC} = 2 V, I_I=−200μA		1			V
I_{CC}	Supply current	V_{CC}= 3 V, I_I=−200μA				4	mA
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=3V, I_C=40mA, T_a=25℃		800			

TYPICAL CHARACTERISTICS

OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54566P

7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY (INPUT "L" ACTIVE)

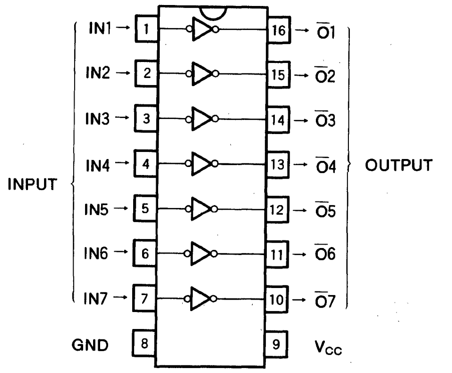
DESCRIPTION
The M54566P, 7-channel sink driver, consists of 7 PNP and 14 NPN transistors connected to form high current gain driver pairs.

FEATURES
- High output sustaining voltage to 50V
- High output sink current to 400mA
- "L" Active input
- Wide operating temperature range (T_a =−20∼+75℃)

APPLICATIONS
- Relay and printer driver
- Interfacing between standard MOS/BIPOLAR logics

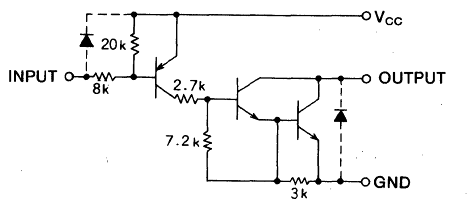
FUNCTION
The M54566P is comprised of seven PNP invertors with 8 kΩ series input resistors and NPN darlington sink drivers. The output is turned ON by switching the input low. The outputs are capable of sinking 400mA and will withstand 50V in the OFF state.

PIN CONFIGURATION (TOP VIEW)

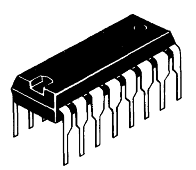


Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
V_I	Input voltage		0, 10	V
I_C	Collector current	Transistor ON	400	mA
P_d	Power dissipation	T_a =25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY (INPUT "L" ACTIVE)

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

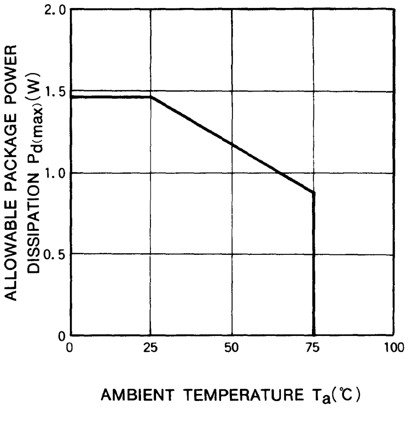
Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		4	5	8	V
I_C	Collector current per channel	Percent duty cycle less than 10%			350	mA
		Percent duty cycle less than 30%			200	mA
V_{IH}	"H" input voltage	$I_{O\,(leak)}$=50μA	V_{CC}−0.2			V
V_{IL}	"L" input voltage	I_C=350mA	0		V_{CC}−3	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

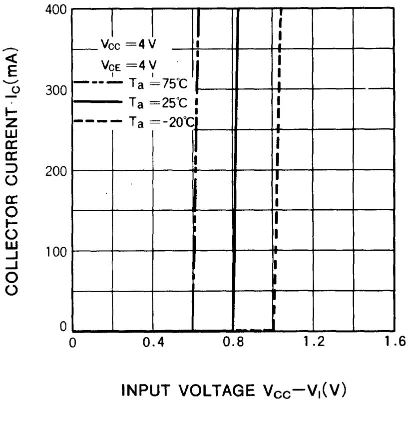
Symbol	Parameter	Test conditions		Limits Min	Limits Typ	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA		50			V
$V_{CE\,(sat)}$	Output saturation voltage	V_I = V_{CC} −3V	I_C=350 mA			2.2	V
			I_C=200 mA			1.6	V
I_I	Input current	V_I = V_{CC} −3.5 V				−0.58	mA
I_{CC}	Supply current	V_{CC}=5 V, V_I = V_{CC} −3.5 V				3	mA
h_{FE}	DC forward current gain	V_{CE}=4 V, V_{CC}=5 V, I_C=350 mA, T_a=25℃		2000			

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

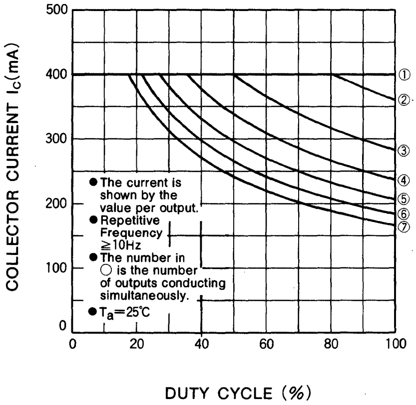


OUTPUT CURRENT CHARACTERISTICS

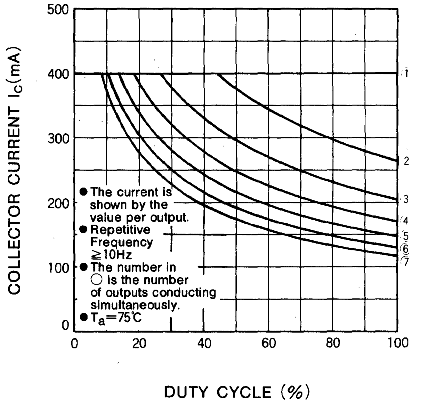


7-UNIT 400mA DARLINGTON TRANSISTOR ARRAY (INPUT "L" ACTIVE)

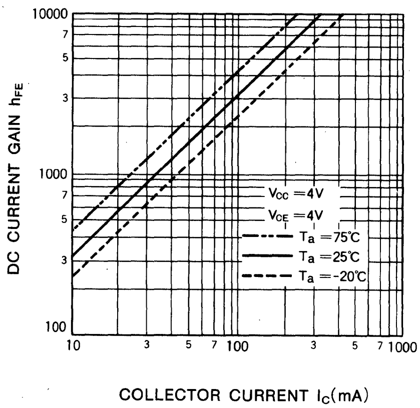
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54567P

4-UNIT 1.5A DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

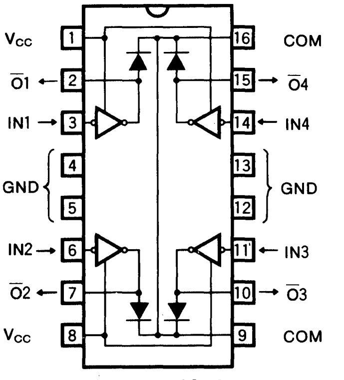
DESCRIPTION
The M54567P, 4-channel sink driver, consists of 4 PNP and 14 NPN transistors to form high current gain driver pairs.

FEATURES
- High output sustaining voltage to 50V
- High output current to 1.5A
- Integral diodes for transient suppression
- NMOS Compatible input
- Wide operating temperature range (T_a =−20∼+75℃)

APPLICATIONS
- Relay and printer driver
- LED or incandescent display digit driver

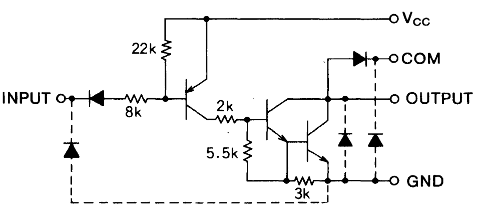
FUNCTION
The M54567P is comprised of four PNP invertors with 8kΩ series input resistors and NPN darlington sink drivers. Each output has an integral diode for inductive load transient suppression and the anodes of the diode connected to pins 9 and 16. The outputs are capable of sinking 1.5A and will withstand 50V in the OFF state.

PIN CONFIGURATION (TOP VIEW)

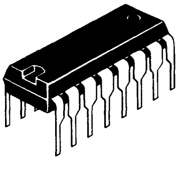


Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
V_I	Input voltage		30	V
I_C	Collector current	Transistor ON	1.5	A
V_R	Clamp diode reverse voltage		50	V
I_F	Clamp diode forward current	Pulse width≦10ms, Repetitive cycle≦10Hz	1.5	A
			1	A
P_d	Power dissipation	T_a =25℃	1.92	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

4-UNIT 1.5A DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

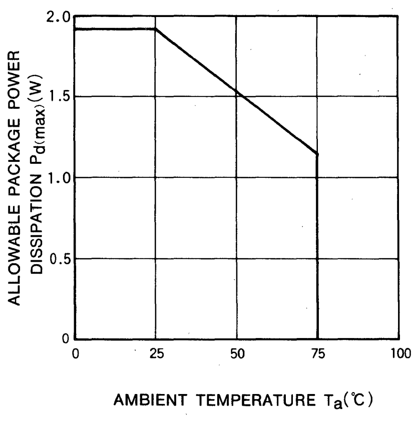
Symbol	Parameter		Limits Min	Typ	Max	Unit
V_{CC}	Supply voltage		4	5	6	V
V_O	Output voltage		0		40	V
I_C	Collector current per channel	All units ON Percent duty cycle≦ 4 %	0		1.25	A
		All units ON Percent duty cycle≦18%	0		0.7	
V_{IH}	"H" Input voltage	$I_{O(leak)}$=50μA	V_{CC}−0.5			V
V_{IL}	"L" Input voltage	I_C=1.25A			V_{CC}−3.5	V

ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

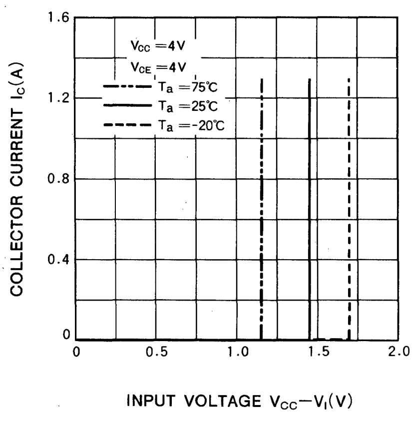
Symbol	Parameter	Test conditions		Limits Min	Typ	Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO}=100μA		50			V
I_{CC}	Supply current	V_{CC} = 6 V, V_I =0.5V			3.0	4.5	mA
$V_{CE(sat)}$	Output saturation voltage	V_{CC} = 4 V	I_C =1.25A			2.2	V
		V_I =0.5V	I_C =0.7A			1.7	
I_I	Input current	V_I =V_{CC} −3.5V				−0.6	mA
		V_I =V_{CC}− 6 V				−0.95	
V_R	Clamp diode reverse voltage	I_R=100μA		50			V
V_F	Clamp diode forward voltage	I_F=1.25A				2.3	V
h_{FE}	DC forward current gain	V_{CC} =4V, V_{CE} =4V, I_C =1A, T_a =25℃		4000			

TYPICAL CHARACTERISTICS

ALLOWABLE AVERAGE POWER DISSIPATION

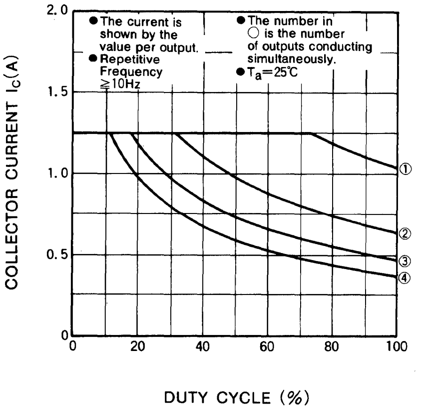


OUTPUT CURRENT CHARACTERISTICS

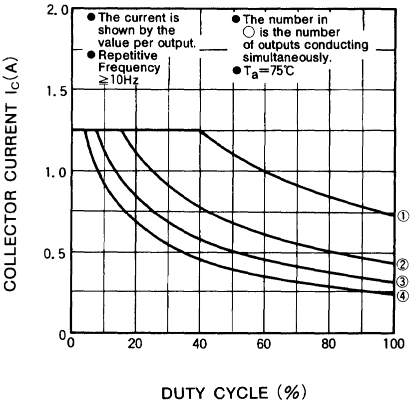


4-UNIT 1.5A DARLINGTON TRANSISTOR ARRAY WITH CLAMP DIODE

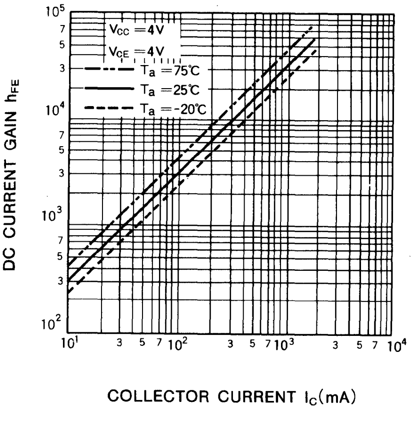
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54568L

4-UNIT 30mA PNP TRANSISTOR ARRAY

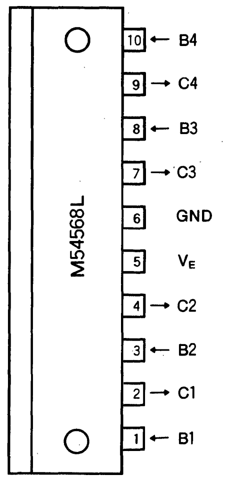
DESCRIPTION
The M54568L, general purpose transistor array, consists of 4 PNP transistors connected in a commom-emitter configuration.

FEATURES
- 20V breakdown
- 30mA output source current capability
- Wide operating temperature range (T_a=−20∼+75℃)

APPLICATION
LED or incandescent display driver

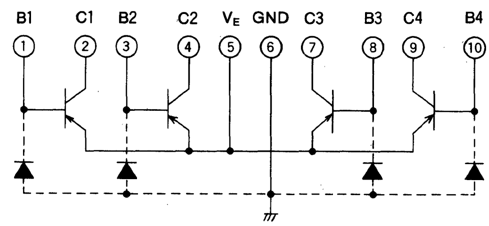
FUNCTION
The M54568L is comprised of 4 PNP transistors. ALL emitters are connected to pin 5 . Each transistor is capable of switching 30mA and will withstand 20V in the OFF state.

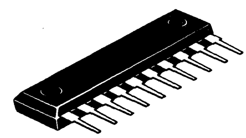
PIN CONFIGURATION (TOP VIEW)



Outline 10P5

CIRCUIT SCHEMATIC





10-pin molded plastic SIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CBO}	Collector-base sustaining voltage	Base voltage : 0V	−40	V
V_{EBO}	Emitter-base sustaining voltage	Base voltage : 0V	−40	V
V_{CEO}	Collector-emitter sustaining voltage	Emitter voltage : 0V	−20	V
I_C	Collector current per transistor		−30	mA
I_B	Base current per transistor		−20	mA
P_d	Power dissipation	T_a =25℃	1000	mW
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20~+75℃, unless otherwise noted)

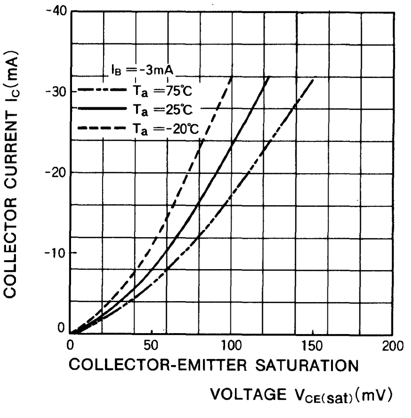
Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
I_C	Collector current	I_B=−3mA	0		−20	mA
I_B	Base current		0		−10	mA
V_E	Emitter current		−0.3		20	V
V_B	Base voltage		−0.3		V_E	V

ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

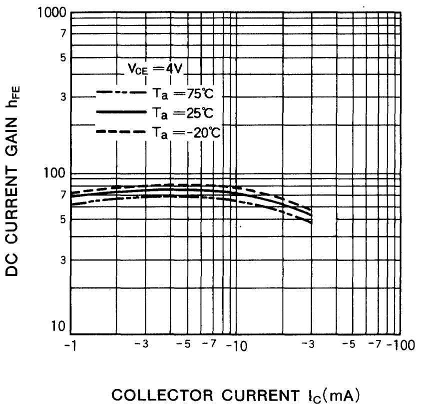
Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
$V_{(BR)CBO}$	Collector-emitter sustaining voltage	I_C=−10μA, V_B=0 V, V_E : OPEN		−40			V
$V_{(BR)EBO}$	Emitter-base sustaining voltage	I_E=−10μA, V_B=0 V, V_C : OPEN		−40			V
$V_{(BR)CEO}$	Collector-emitter sustaining voltage	I_C=−100μA, V_E=0 V, V_B : OPEN		−20			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_C=−20 mA, I_B=−3 mA, V_E=5 V				−0.3	V
		I_C=−2 mA, I_B=−0.2 mA, V_E=5 V				−0.28	
h_{FE}	DC forward current gain	V_{CE}=−4 V	I_C=−2 mA	20			
		T_a=25℃	I_C=−20 mA	15			

TYPICAL CHARACTERISTICS

OUTPUT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54569P

8-UNIT 30mA PNP TRANSISTOR ARRAY

DESCRIPTION

The M54569P, general purpose transistor array, consists of 8 PNP transistors connected in a common-emitter configuration.

FEATURES

- 20V breakdown
- 30mA output source current capability
- Wide operating temperature range (T_a = −20∼+75℃)

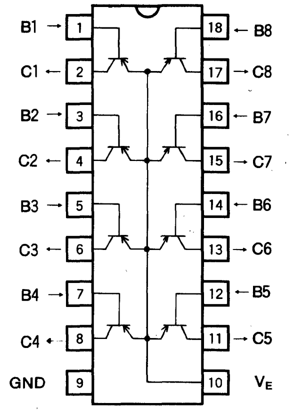
APPLICATION

LED or incandescent display driver

FUNCTION

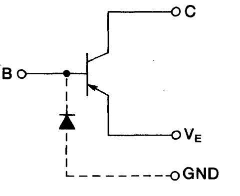
The M54569P is comprised of 8 PNP transistors. All emitters are connected to pin 10. Each transistor is capable of switching 30mA and will withstand 20V in the OFF state.

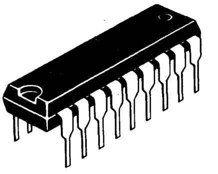
PIN CONFIGURATION (TOP VIEW)



Outline 18P4

CIRCUIT SCHEMATIC





18-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CBO}	Collector-base sustaining voltage	Base voltage : 0V	−40	V
V_{EBO}	Emitter-base sustaining voltage	Base voltage : 0V	−40	V
V_{CEO}	Collector-emitter sustaining voltage	Emitter voltage : 0V	−20	V
I_C	Collector current per transistor		−30	mA
I_B	Base current per transistor		−20	mA
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

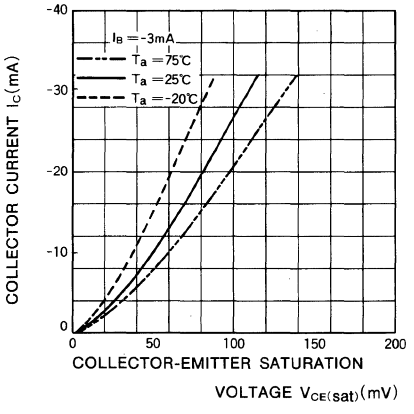
Symbol	Parameter		Limits Min	Typ	Max	Unit
I_C	Collector current	I_B=−3mA	0		−20	mA
I_B	Base current		0		−10	mA
V_E	Emitter voltage		−0.3		20	V
V_B	Base voltage		−0.3		V_E	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

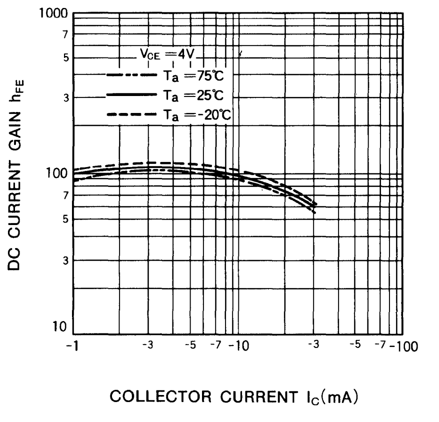
Symbol	Parameter	Test conditions		Limits Min	Typ	Max	Unit
$V_{(BR)CBO}$	Collector-emitter sustaining voltage	I_C=−10μA, V_B=0V V_E : OPEN		−40			V
$V_{(BR)EBO}$	Emitter-base sustaining voltage	I_E=−10μA, V_B=0V V_C : OPEN		−40			V
$V_{(BR)CEO}$	Collector-emitter sustaining voltage	I_C=−100μA, V_E=0V V_B : OPEN		−20			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_C=−20mA I_B=−3mA, V_E=5V				−0.3	V
		I_C=−2mA I_B=−0.2mA, V_E=5V				−0.28	
h_{FE}	DC forward current gain	V_{CE}=−4V	I_C=−2mA	20			
		T_a=25℃	I_C=−20mA	15			

TYPICAL CHARACTERISTICS

OUTPUT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54571P

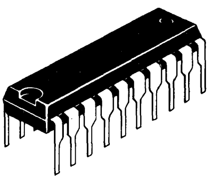
6-UNIT 350mA TRANSISTOR ARRAY AND MOTOR DRIVER

DESCRIPTION
The M54571P, 6-channel sink driver and voltage regulator, is designed for use with a small printer.

FEATURES
- High output sustaining voltage to 40V
- High output sink current to 350mA
- Voltage regulator with a control circuit
- Wide operating temperature range (T_a=−20∼+75℃)

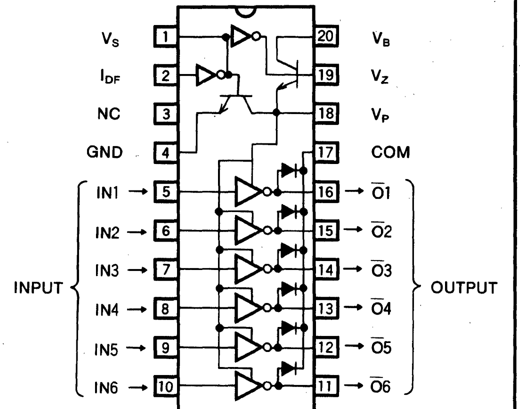
APPLICATION
Small calculator printer driver

FUNCTION
The M54571P is designed for driving a small serial printer made by CITIZEN and EPSON, and consists of 6 relay drivers and 1.2A motor driver. Each driver has 4.3kΩ series input resistor and output transient suppression diode. The driver outputs are capable of sinking 350mA and will withstand 43V in the OFF state. The output of the motor driver at pin 18 can drive 1.2A.



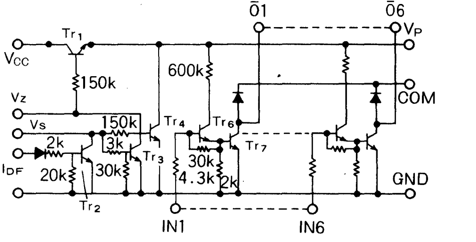
20-pin molded plastic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 20P4 NC : NO CONNECTION

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Rating	Unit
V_{CC}	Supply voltage		40	V
V_{CEO}	Output sustaining voltage		40	V
I_{C1}	Collector current	T_{r1}	100	mA
I_{C2}		T_{r2}	100	
I_{C3}		T_{r3}	100	
I_{C4}		T_{r4} Spike current 2A max Pulse width≦ 5 ms, Duty cycle≦ 5 %	1200	
I_{C7}		T_{r7} (Per channel)	350	
V_I	Input voltage	IN1∼IN6	40	V
$V_{I(IDF)}$			40	
$V_{R(IDF)}$	Input reverse voltage		−45	V
$V_{R(D)}$	Clamp diode reverse voltage		40	V
$I_{F(D)}$	Clamp diode forward current		350	mA
Pd	Power dissipation	T_a =25℃	1.79	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

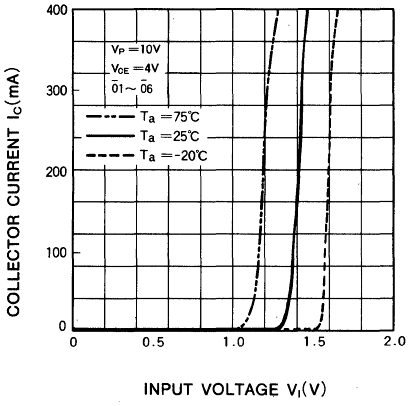
Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		8		40	V
V_P	Supply voltage		4		18	V
V_S	Reference voltage			10		V
I_C	Collector current	$\bar{O}1$∼$\bar{O}6$			250	mA
		$\bar{O}1$∼$\bar{O}6$			100	
$V_{I(IDF)}$	Input voltage				−35	V
			9		17	
V_I		IN1∼IN6	9		17	
V_O	Output voltage	$\bar{O}1$∼$\bar{O}6$			40	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

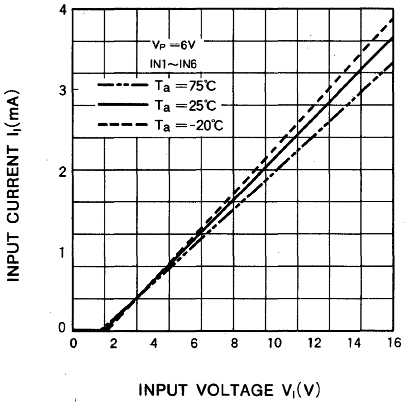
Symbol	Parameter		Test conditions	Limits			Unit
				Min	Typ	Max	
$V_{BR(CEO)}$	Output sustaining voltage		I_{CEO}=100μA, V_P=5V, ($\bar{0}1$∼$\bar{0}7$)	40			V
$V_{CE(sat)}$	Collector emitter saturation voltage	01 ∫ 07	V_P=6.5V, V_I=3V, I_C=250mA			0.8	V
			V_P=3V, V_I=2.4V, I_C=120mA			0.5	
		T_{r1}	I_B=1mA, I_C=10mA, V_P=0V			0.5	
		T_{r2}	$V_{I(IDF)}$=10V, I_{VS}=100mA			0.5	
		T_{r3}	$V_{I(Vs)}$=3V, I_{VZ}=30mA, $V_{I(IDF)}$=0V			0.4	
		T_{r4}	I_{VS}=50mA, I_{VP}=0.3V, $V_{I(IDF)}$=0V			0.45	
			I_{VS}=80mA, I_{VP}=1A, $V_{I(IDF)}$=0V			1.2	
I_I	Input current		V_P=6V, V_I=10V, (IN1∼IN6)			3.5	mA
$I_{I(IDF)}$			$V_{I(IDF)}$=10V			6.5	
$I_{I(Vs)}$			$V_{I(Vs)}$=3V, $V_{I(IDF)}$=0V			26	
$I_{R(IDF)}$	Input leakage current		$V_{R(IDF)}$=−35V			−20	μA
$V_{F(D)}$	Clamp diode forward voltage		$I_{F(D)}$=250mA			2.4	V
I_{VP}	Supply current		V_P=17V, V_I=10V (all input)			240	mA
			V_P=5V, V_I=10V (all input)			60	
h_{FE} 1	DC forward current gain	T_{r4}	I_C=50mA, V_{CE}=4V, T_a=25℃	100			
h_{FE} 2	DC forward current gain	T_{r4}	I_C=1A, V_{CE}=4V, T_a=25℃	80			
h_{FE} 3	DC forward current gain	$\bar{0}1$∼$\bar{0}7$	V_P=6.5V, I_C=350mA, V_{CE}=4V, T_a=25℃	1000			

TYPICAL CHARACTERISTICS

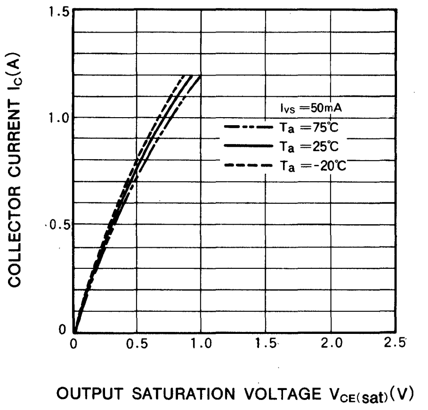
OUTPUT CURRENT CHARACTERISTICS



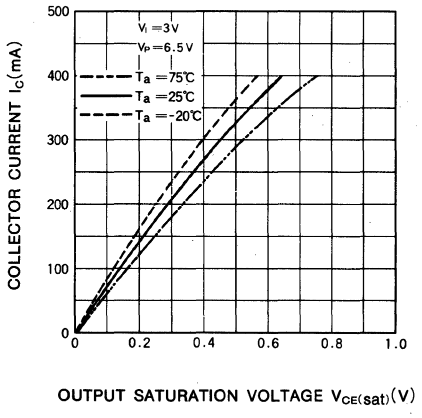
INPUT CHARACTERISTICS



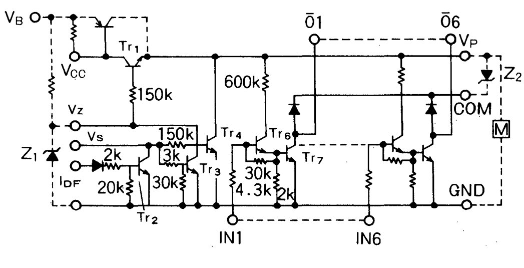
MOTOR DRIVER OUTPUT SATURATION CHARACTERISTICS



MAGNET RELAY DRIVER OUTPUT SATURATION CHARACTERISTICS



TYPICAL APPLICATION



NOTE

	V_B	V_{Z1}	Z_2	Magnet Relay Drive Current
EPSON Printer	15~40V	18V	—	90mA
CITIZEN Printer	3 ~ 9 V	6 V	connect between the V_P and the COM	250mA

M54576

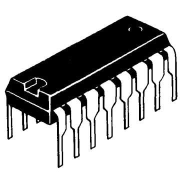
7-UNIT 30mA TRANSISTOR ARRAY (INPUT "L" ACTIVE)

DESCRIPTION
The M54576P/FP, 7-channel sink driver, consists of 28 NPN transistors connected to form high current gain driver pairs.

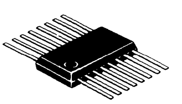
FEATURES
- 30V output breakdown
- 30mA output sink current capability
- CMOS compatible input
- Low output saturation voltage
- Wide operating temperature range (T_a = −20∼+75℃)

APPLICATION
LED or incandescent display digit driver

FUNCTION
The M54576P/FP is comprised of seven NPN invertors with diodes and 23k Ω resistors in series to the input and non darlington NPN sink drivers. The output is turned ON by switching the input low. The outputs are capable of sinking 30mA and will withstand 30V in the OFF state. The M54576FP features a small flat mold package.

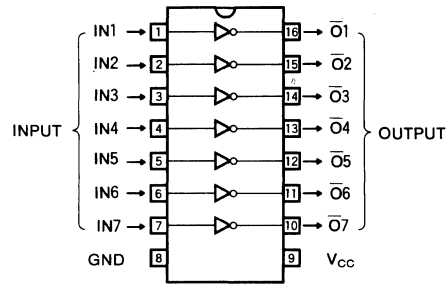


16-pin molded plastic DIL



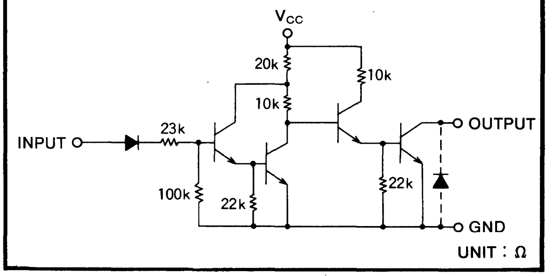
16-pin molded plastic FLAT

PIN CONFIGURATION (TOP VIEW)



Outline 16P2 (M54576FP)
Outline 16P4 (M54576P)

CIRCUIT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS (T_a=25℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		13	V
V_{CEO}	Output sustaining voltage	Transistor OFF	30	V
I_C	Collector current	Transistor ON	30	mA
V_I	Input voltage		−20, 13	V
P_d	Power dissipation	T_a=25℃	1.47/0.56	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

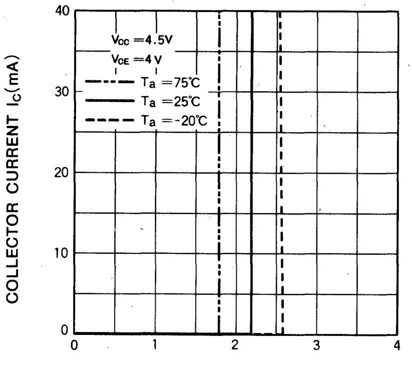
Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		4	5	13	V
I_C	Collector current per channel			10	20	mA
V_{IH}	"H" Input voltage		3			V
V_{IL}	"L" Input voltage	I_C=20mA			1	V

ELECTRICAL CHARACTERISTICS (T_a=−20~+75℃, unless otherwise noted)

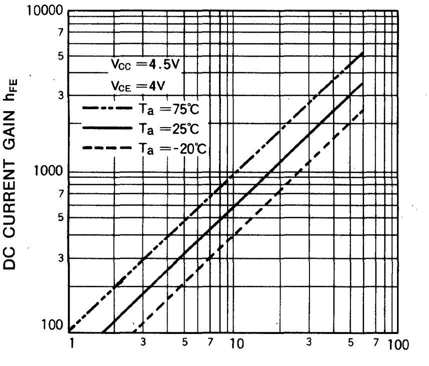
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$I_{O(leak)}$	Output leakage current	V_{CE}=30V, V_I=3V, V_{CC}=6V			100	μA
$V_{CE(sat)}$	Output saturation voltage	V_{CC}=4.5V, V_I=1V, I_C=10mA			0.25	V
		V_{CC}=6V, V_I=1V, I_C=20mA			0.35	
I_I	Input current	V_{CC}=4.5V, V_I=3V	30		90	μA
I_{CC}	Supply current	V_{CC}=4.5V, V_I=1V			6.3	mA
		V_{CC}=13V, V_I=1V			18	
h_{FE}	DC forward current gain	V_{CE}=4V, V_{CC}=4.5V, I_C=20mA, T_a=25℃	500			

TYPICAL CHARACTERISTICS

OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



MITSUBISHI ELECTRIC

M54577

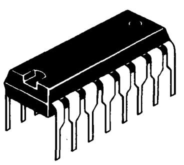
7-UNIT 30mA TRANSISTOR ARRAY

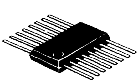
DESCRIPTION
The M54577P/FP, 7-channel sink driver, consists of 14 NPN transistors connected to form high current gain driver pairs.

FEATURES
- Output breakdown voltage to 30V
- Output sink current to 30mA
- PMOS, CMOS Compatible input
- Low output saturation voltage
- Wide operating temperature range (T_a = −20～+75℃)

APPLICATION
LED or incandescent display digit driver

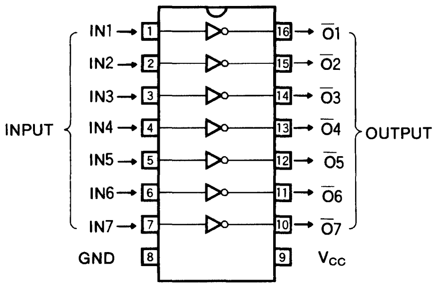
FUNCTION
The M54577P/FP uses a predriver stage with a diode and 23kΩ resistor in series to the input. The power supply of the predrivers is connected to pin 9. The outputs are capable of sinking 30mA and will withstand 30V in the OFF state. The M54577FP features a small flat mold package.





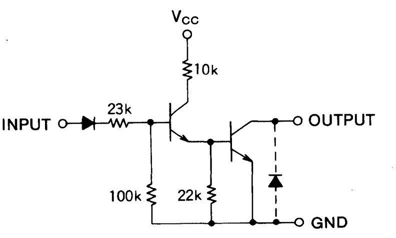
16-pin molded plastic DIL　16-pin molded plastic FLAT

PIN CONFIGURATION (TOP VIEW)



Outline 16P2 (M54577FP)
Outline 16P4 (M54577P)

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a=−20～+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		13	V
V_{CEO}	Output sustaining voltage	Transistor OFF	30	V
I_C	Collector current	Transistor ON	30	mA
V_I	Input voltage		−20, 13	V
T_{opr}	Operating ambient temperature range		−20～+75	℃
T_{stg}	Storage temperature range		−55～+125	℃

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20～+75℃, unless otherwise noted)

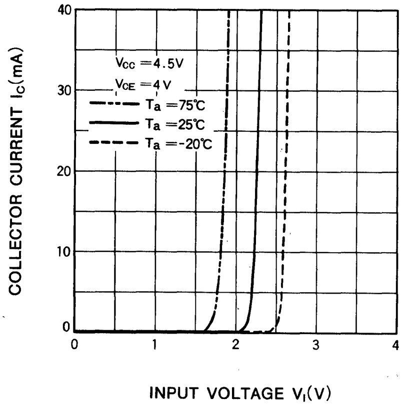
Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4.5	5	13	V
I_C	Collector current per channel			10	20	mA
V_{IH}	"H" Input voltage	I_C=20mA	3			V
V_{IL}	"L" Input voltage				1	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

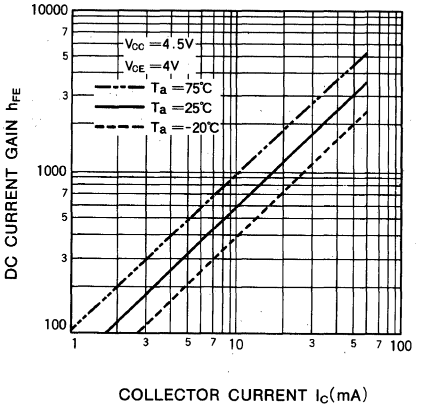
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$I_{O\ (leak)}$	Output leak current	V_{CE} =30 V			100	μA
$V_{CE\ (sat)}$	Output saturation voltage	V_{CC} =4.5 V, V_I =3 V, I_C =10 mA			0.25	V
		V_{CC} =6 V, V_I =3 V, I_C =20 mA			0.35	
I_I	Input current	V_{CC} =4.5 V, V_I =3 V	30		90	μA
I_{CC}	Supply current per channel (an only output conducting)	V_{CC} =4.5 V, V_I =3 V			0.9	mA
		V_{CC} =13 V, V_I =3 V			2.3	
h_{FE}	DC forward current gain	V_{CE} =4 V, V_{CC} =4.5 V, I_C =20 mA, T_a =25℃	500			

TYPICAL CHARACTERISTICS

OUTPUT CURRENT CHARACTERISTICS



DC CURRENT GAIN CHARACTERISTICS



M54578P

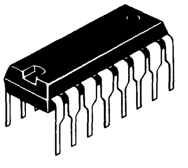
6-UNIT 700mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

DESCRIPTION
The M54578P, 6-channel sink driver, consists of 12 NPN transistors connected to form high current gain driver pairs.

FEATURES
- 20V breakdown
- High output sink current to 700mA
- PMOS Compatible
- Wide operating temperature range (T_a =−20∼+75℃)

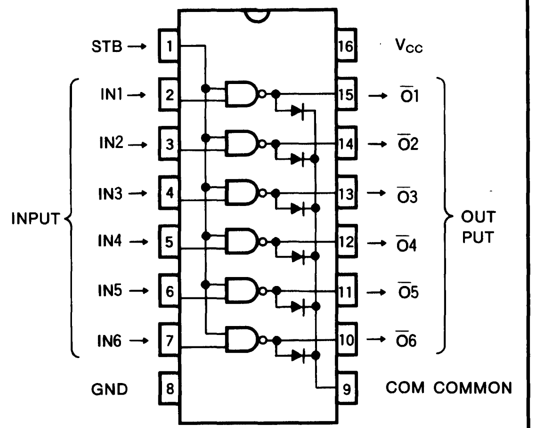
APPLICATIONS
- Relay and printer driver
- LED or incandescent display digit driver
- Interfacing for standard MOS/BIPOLAR logics

FUNCTION
The M54578P uses a predriver stage. Each input has a diode and 2 kΩ resistor in series to allow a negative voltage input. All input can be controlled simultaneously by a strobe input at pin 1 . The power supply of the predrivers is connected to pin 16. Each output has an integral diode for inductive load transient suppression and the cathodes of the diodes are connected to pin 9 . All emitters and the substrate are connected together to pin 8 . The outputs are capable of sinking 700mA and will withstand 20V in the OFF state.



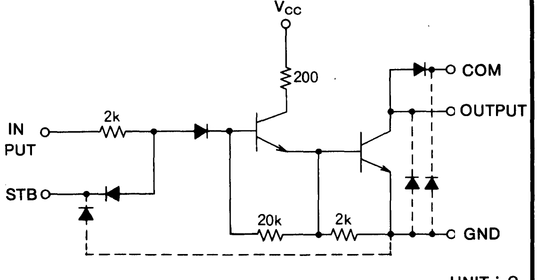
16-pin molded plastic DIL

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω

ABSOLUTE MAXIMUM RATINGS (T_a≒−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		10	V
V_{CEO}	Output sustaining voltage	Transistor OFF	20	V
I_C	Collector current	Transistor ON	700	mA
V_I	Input voltage		−25, 20	V
$V_{I(STB)}$	Strobo input voltage		20	V
$V_{R(D)}$	Clamp diode reverse voltage		20	V
$I_{F(D)}$	Clamp diode forward current	Pulse width≦35ms, Duty cycle≦ 5 %	700	mA
			350	mA
P_d	Power dissipation	T_a=25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20∼+75	℃
T_{stg}	Storage temperature range		−55∼+125	℃

6-UNIT 700mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_{CC}	Supply voltage		3	5	8	V
V_O	Output voltage				20	V
I_C	Collector current per channel	The three outputs conducting simultaneously Percent duty cycle less than 20%			700	mA
		The three outputs conducting simultaneously Percent duty cycle less than 90%			200	
$V_{IH(STB)}$	"H" Input voltage (strobe input)		2.4			V
$V_{IL(STB)}$	"L" Input voltage (strobe input)				0.2	V
V_{IH}	"H" Input voltage	I_C=450mA, V_{CC}=5V	3.5			V
		I_C=700mA, V_{CC}=6V	5			V
V_{IL}	"L" Input voltage	$I_{O(leak)}$=50μA			0.8	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

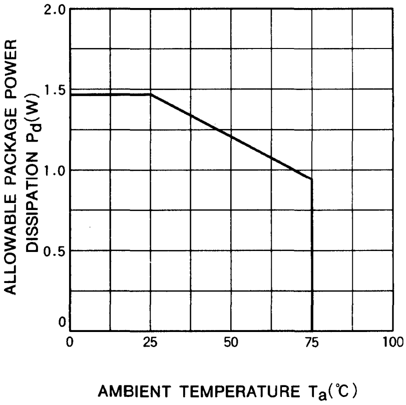
Symbol	Parameter	Test conditions		Limits Min	Limits Typ	Limits Max	Unit
$V_{(BR)CEO}$	Output sustaining voltage	V_{CC}=7V, $V_{I(STB)}$=0.4V V_I=3.5V, I_{CEO}=100μA		20			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{CC}=5V	I_C=450mA			0.8	V
		V_I=3.5V	I_C=200mA			0.45	
I_I	Input current	V_{CC}=7V, V_I=3.5V $V_{I(STB)}$=2.4V				1.4	mA
I_R	Input leakage current	V_{CC}=7V, V_R=−25V				−20	μA
$I_{I(STB)}$	Strobe input current	V_{CC}=7V, $V_{I(STB)}$=0.4V V_I=3.5V (all input)				−10.7	mA
$I_{R(STB)}$	Strobe input leakage current	V_{CC}=7V, V_I=0V, $V_{I(STB)}$=20V				20	μA
$V_{F(D)}$	Clamp diode forward current	$I_{F(D)}$=600mA				5	V
$V_{R(D)}$	Clamp diode reverse voltage	$I_{R(D)}$=100μA		20			V
I_{CC}	Supply current	V_{CC}=8V, $V_{I(STB)}$=2.4V V_I=3.5V (all input)				320	mA
h_{FE}	DC forward current gain	V_{CC}=5V V_{CE}=4V, I_C=450mA, T_a=25℃		2000			

MITSUBISHI ELECTRIC

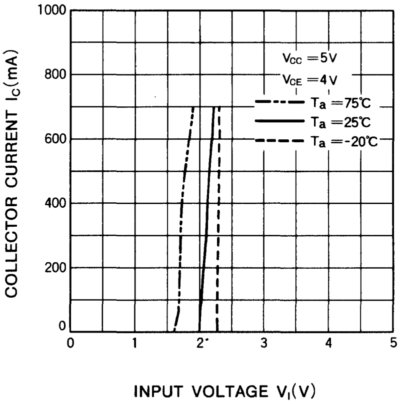
6-UNIT 700mA TRANSISTOR ARRAY WITH CLAMP DIODE AND STROBE

TYPICAL CHARACTERISTICS

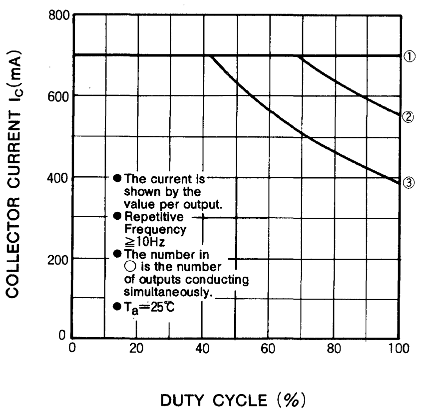
ALLOWABLE AVERAGE POWER DISSIPATION



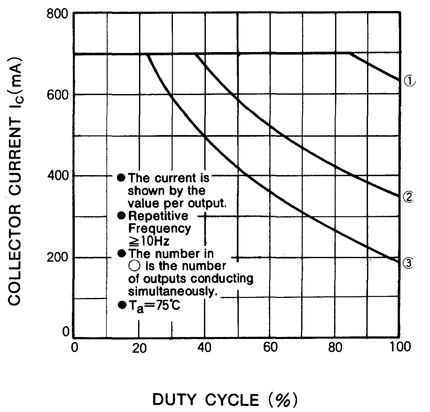
OUTPUT CURRENT CHARACTERISTICS



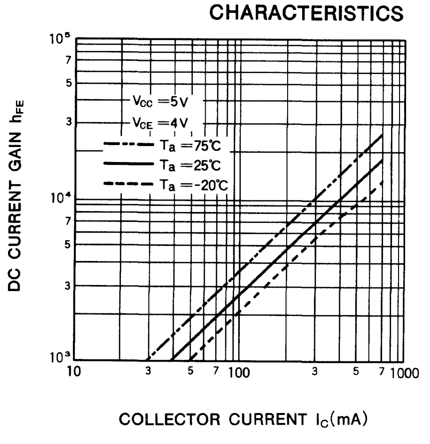
ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



ALLOWABLE COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



DC CURRENT GAIN CHARACTERISTICS



M54580P

7-UNIT 150mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

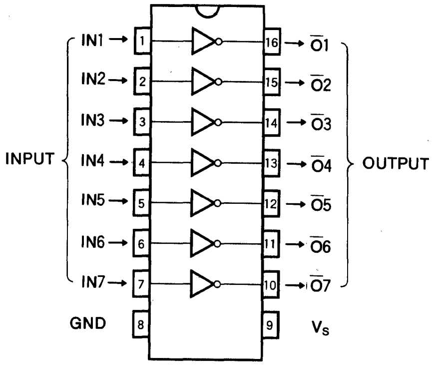
DESCRIPTION
The M54580P, 7-channel source driver, consists of 7 PNP and 7 NPN transistors connected to form high current gain driver with PNP action.

FEATURES
- High output sustaining voltage to 50V
- High output source current to 150mA
- Wide operating temperature range (T_a =−20~+75℃)

APPLICATIONS
- Relay and printer driver
- LED, incandescent or fluorescent display driver
- Interfacing for standard MOS/BIPOLAR logics

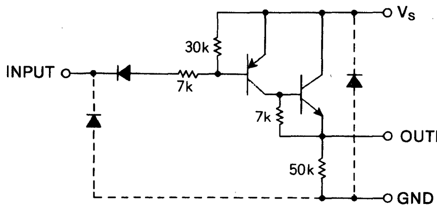
FUNCTION
The M54580P is comprised of seven PNP-NPN darlington source driver pairs with a diode and 7 kΩ resistor in series to the input. The output is turned ON by switching the input low. Each output has 50kΩ pull-down resistor suitable for driving fluorescent displays. The outputs are capable of driving 100mA and are rated for operation with output voltage up to 50V.

PIN CONFIGURATION (TOP VIEW)

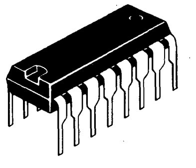


Outline 16P4

CIRCUIT SCHEMATIC



UNIT : Ω



16-pin molded plastic DIL

ABSOLUTE MAXIMUM RATINGS (T_a=−20~+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_S	Supply voltage		50	V
V_{CEO}	Output sustaining voltage	Transistor OFF	50	V
V_I	Input voltage		0, V_S	V
I_O	Output current	Transistor OFF	−150	mA
P_d	Power dissipation	T_a =25℃	1.47	W
T_{opr}	Operating ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−55~+125	℃

7-UNIT 150mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY

RECOMMENDED OPERATIONAL CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

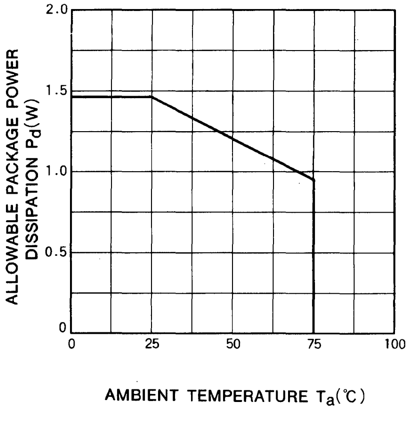
Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_S	Supply voltage		4		50	V
I_O	Output current per channel	All outputs conducting simultaneously Percent duty cycle less than 85%			−100	mA
		All outputs conducting simultaneously Percent duty cycle less than 100%			−50	
V_{IH}	"H" input voltage	$I_{O(leak)}$=50μA	V_S−0.4			V
V_{IL}	"L" input voltage	I_O=−100mA	0		V_S−3.2	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

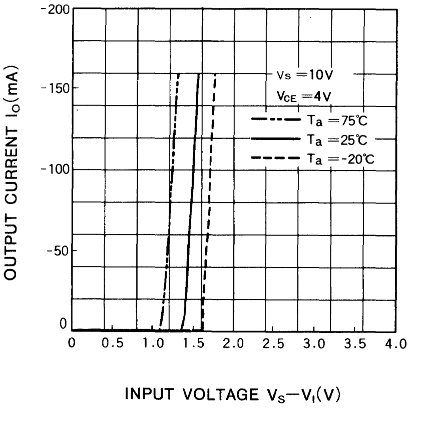
Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
$V_{(BR)CEO}$	Output sustaining voltage	I_{CEO} = 100μA		50			V
$V_{CE(sat)}$	Output saturation voltage	V_I = V_S−3.2V	I_O =−100mA			1.5	V
			I_O =−50mA			1.2	
I_I	Input current	V_I = V_S−3.5V				−0.6	mA
		V_I = V_S−6V				−0.95	
I_R	Input leakage current	V_I =40V				100	μA
h_{FE}	DC forward current gain	V_{CE} =4V, V_S =10V, I_C =−100mA, T_a=25°C		800			

TYPICAL CHARACTERISTICS

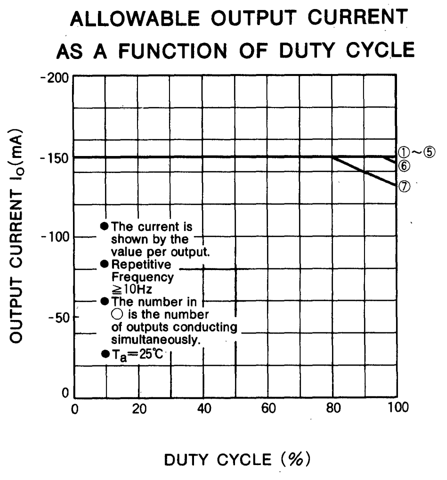
ALLOWABLE AVERAGE POWER DISSIPATION

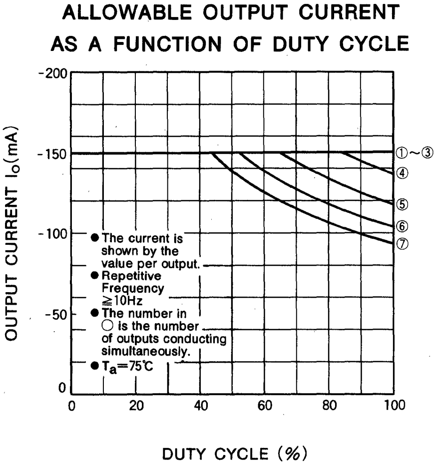


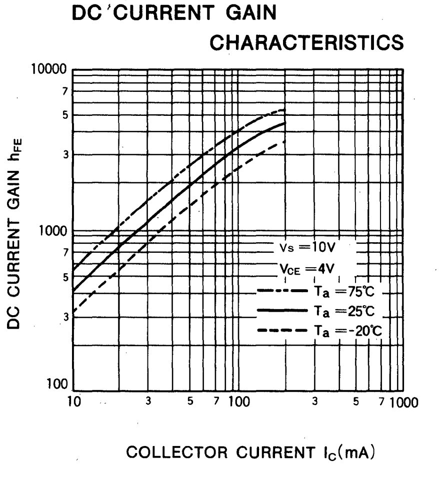
OUTPUT CURRENT CHARACTERISTICS



7-UNIT 150mA SOURCE TYPE DARLINGTON TRANSISTOR ARRAY







MITSUBISHI ELECTRIC

M54847AP

2-DIGIT BCD-7SEGMENT DECODER/DRIVER

DESCRIPTION

The M54847AP, a monolithic integrated circuit fabricated with using a bipolar I^2L technology, is 2 digits BCD-to-seven segment decoder/drivers designed for a TV channel display.

FEATURES

- Direct drive for common cathode LED displays operating at currents up to 10mA.
- Direct drive for vacuum fluorescent displays within its output limitation of −25V* (Referenced to V_{CC}=5V)
- Serial or parallel selectable data inputs.
- Continuous output brightness control.

APPLICATION

Channel display for TV Receiver

FUNCTION

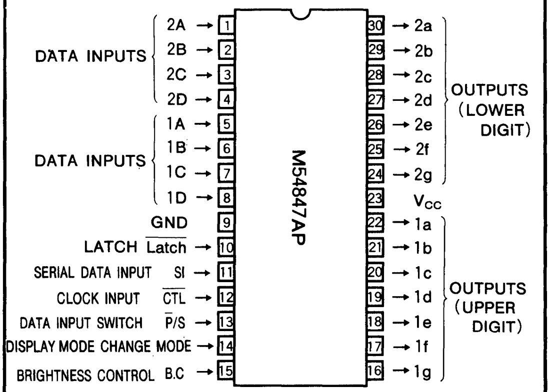
The M54847AP, 2 digit BCD-to-seven segment decorder/drivers, directly drives static LED or vacuum fluorescent displays with the following numerals and characters;

MODE I; Numbers from 00 to 99

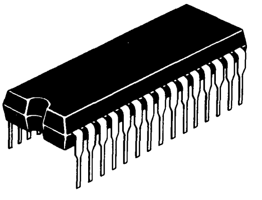
MODE II; Numbers from 0 to 39

and characters AU, CA and --

PIN CONFIGURATION (TOP VIEW)

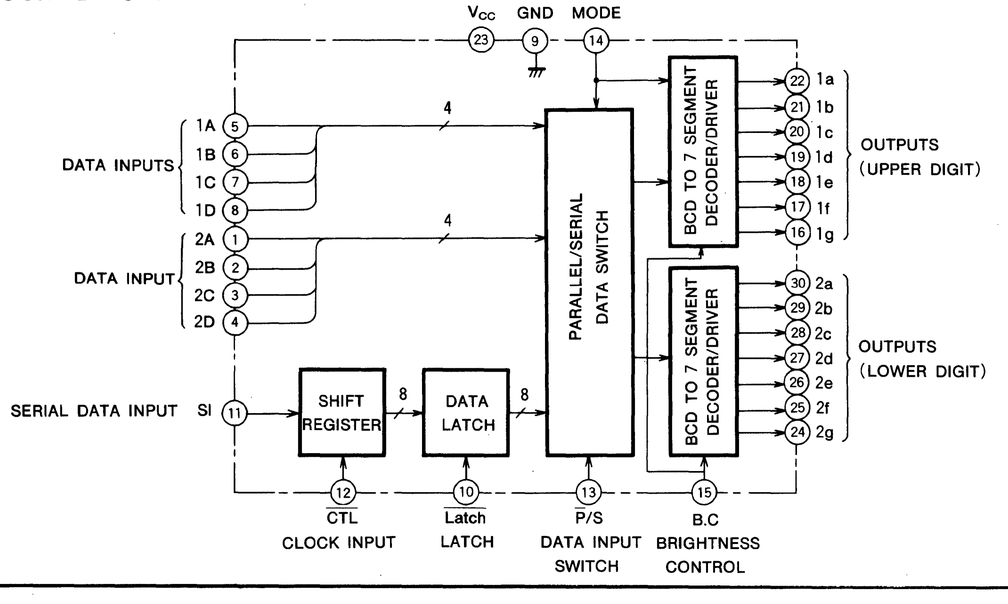


Outline 30P4B



30-pin molded plastic DIL (SHRINK)

BLOCK DIAGRAM



OPERATION

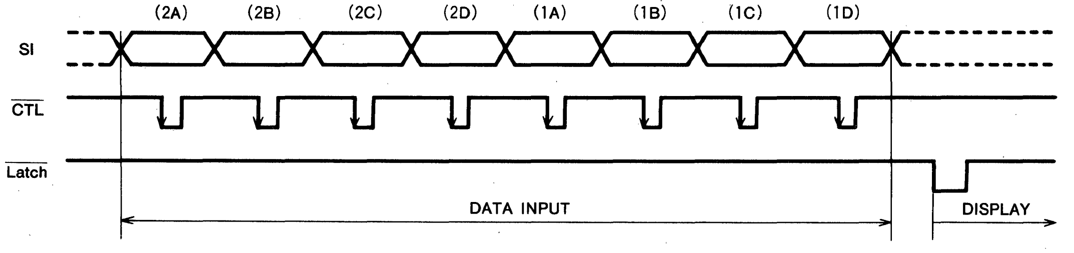
● DISPLAY

1) By switching the MODE input high, the outputs display the both digits as the function table Ⅰ.
2) By switching the MODE input low, the outputs display the digits as the function table Ⅱ.

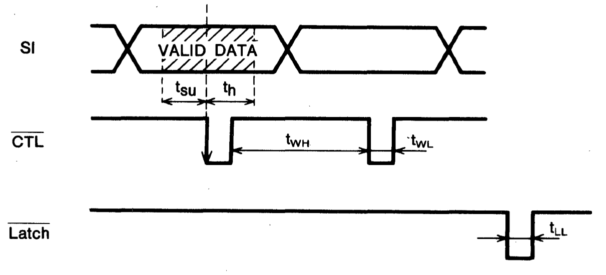
● Serial data input

The serial data present at the input is transfered to the shift register on the negative-going edge of the $\overline{\text{CTL}}$ input pulse, during the $\overline{\text{Latch}}$ input is high. By switching the $\overline{\text{Latch}}$ input low, the displays are changed as the new data.

SERIAL DATA INPUT TIMING CHART



INPUT TIMING CHART



MINIMUM VALUE

$t_{su}=20\mu s$

$t_h=20\mu s$

$t_{WH}=30\mu s$

$t_{WL}=10\mu s$

$t_{LL}=10\mu s$

FUNCTION TABLE (MODE Ⅰ)

Data input				Output							Display
A	B	C	D	a	b	c	d	e	f	g	
L	L	L	L	H	H	H	H	H	H	L	0
H	L	L	L	L	H	H	L	L	L	L	1
L	H	L	L	H	H	L	H	H	L	H	2
H	H	L	L	H	H	H	H	L	L	H	3
L	L	H	L	L	H	H	L	L	H	H	4
H	L	H	L	H	L	H	H	L	H	H	5
L	H	H	L	H	L	H	H	H	H	H	6
H	H	H	L	H	H	H	L	L	L	L	7
L	L	L	H	H	H	H	H	H	H	H	8
H	L	L	H	H	H	H	H	L	H	H	9
L	H	L	H	L	L	L	L	L	L	H	-
H	H	L	H	H	L	L	H	H	H	H	E
L	L	H	H	H	L	L	H	H	H	L	C
H	L	H	H	L	L	L	L	L	L	L	Blank
L	H	H	H	L	L	H	H	H	L	H	o
H	H	H	H	L	L	L	L	L	L	L	Blank

FUNCTION TABLE (MODE Ⅱ)

Data input		Data input 1A, 1B 2A～2D	Display	
1C	1D		Upper digit	Lower digit
L	L	×	*1	*1
H	L	×		
L	H	×		
H	H	—	*2	*3

Note : *1. Only the segment g is activated.
*2. When the both inputs, IC and ID are the "H" state, the upper digit displays as the following table.

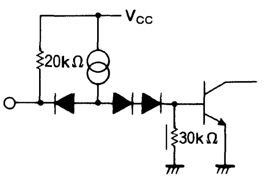
Data Input				Output							Display
1A	1B	1C	1D	1a	1b	1c	1d	1e	1f	1g	
L	L	H	H	L	L	L	L	L	L	L	Blank
H	L	H	H	L	H	H	L	L	L	L	1
L	H	H	H	H	H	L	H	H	L	H	2
H	H	H	H	H	H	H	H	L	L	H	3

Note : *3. Same with the Function table (Mode Ⅰ)

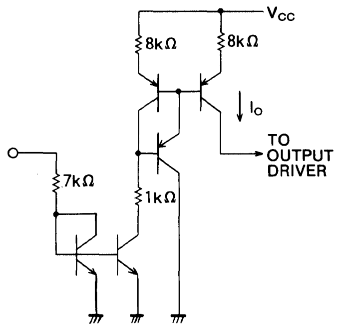
2-DIGIT BCD-7SEGMENT DECODER/DRIVER

I/O CIRCUIT SCHEMATIC

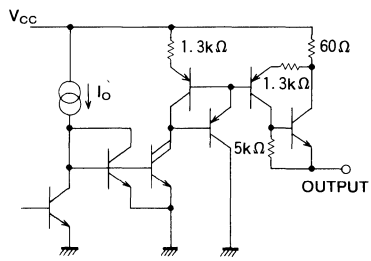
All inputs except the B.C (1A~1D, 2A~2D, $\overline{\text{Latch}}$, SI, $\overline{\text{CTL}}$, $\overline{\text{P}}$/S, MODE)



B.C Input



Outputs (1a~1g, 2a~2g)



ABSOLUTE MAXIMUM RATINGS (T_a=−10~+60℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.5~+7	V
V_I	Input voltage		−0.5~+V_{CC}	V
$V_{CC}-V_O$	Applied voltage between V_{CC} and output		−0.5~+35	V
T_{opr}	Operating ambient temperature range		−10~+60	℃
T_{stg}	Storage temperature range		−40~+125	℃
P_d	Power dissipation	T_a=60℃	800	mW

RECOMMENDED OPERATING CONDITIONS (T_a=−10~+60℃, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4.5	5	6	V
I_{seg}	Output segment current				−10	mA
V_O	Output sustaining voltage in the OFF state, V_{CC}=5V				−25	V

ELECTRICAL CHARACTERISTICS (T_a=−10~+60℃, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
V_{IH}	"H" Input voltage	V_{CC}=4.5~6V		2		V_{CC}	V
V_{IL}	"L" Input voltage	V_{CC}=4.5~6V		0		0.6	V
I_{IH}	"H" Input current	V_{CC}=6V	B.C Input	0.5	0.75	1.2	mA
		V_{IH}=6V	Other Inputs			50	μA
I_{IL}	"L" Input current	V_{CC}=6V	B.C Input			50	μA
		V_{IL}=0V	Other Inputs	−280	−400	−650	
I_{seg}	Output segment current	V_{CC}=5V, V_O=3V, with the B.C input connected to the V_{CC}		−10			mA
I_{slk}	Leakage segment current	V_{CC}=5V, V_O=−25V				−50	μA
I_{CC1}	Supply current	V_{CC}=6V, All I/O pins are opened			4	8	mA

Note : The typical values are the value at V_{CC}=5V, T_a=25℃.

M54940P

8-DIGIT FLUORESCENT DISPLAY DRIVER FOR MICROCOMPUTER

DESCRIPTION

The M54940P, a monolithic integrated circuit fabricated with using an IIL technology, is designed for driving an 8-digit, 7-segment fluorescent display.

FEATURES

- Separated power supplies; 5V (Logic circuit), and 35V (Output circuit)
- Integral scanning oscillator circuit for display

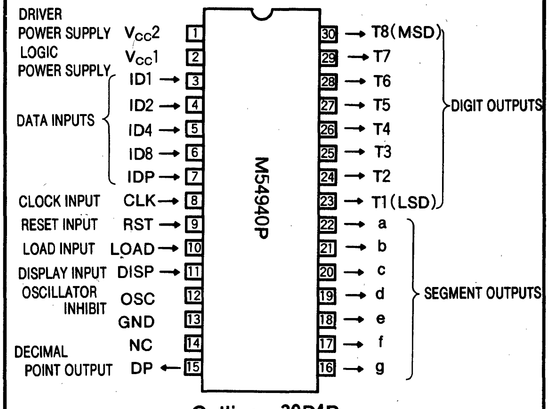
APPLICATIONS

- Micro computer display
- Digital equipment for consumer and Industrial use.

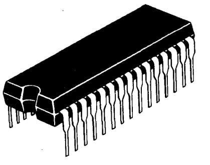
FUNCTION

The M54940P, having a 5-bit×8-digit memory, is a decoder driver for dynamic displaying of a vacuum fluorescent tubes. The data for one digit section is organized into a 4-bit BCD and an 1-bit decimal point. The data memory consists of a shift register and a latch, and is capable of displaying the previous data while the data is being transported.

PIN CONFIGURATION (TOP VIEW)

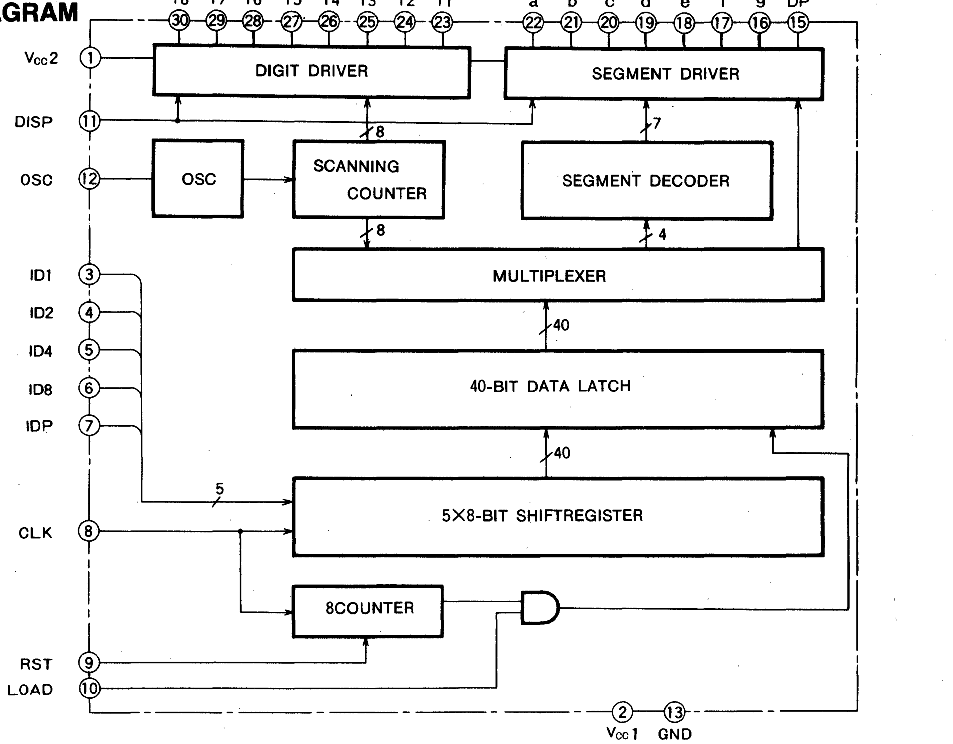


Outline 30P4B NC : NO CONNECTION



30-pin molded plastic DIL(SHRINK)

BLOCK DIAGRAM



MITSUBISHI ELECTRIC

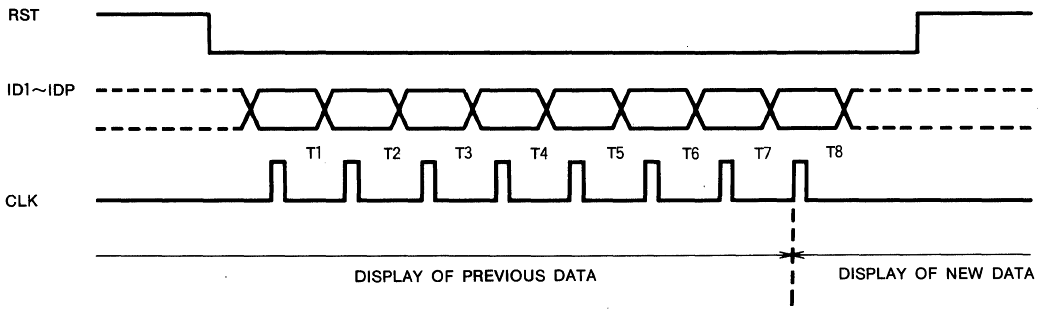
INPUT PIN FUNCTION

1) OSC : External capacitor connecting terminal for the oscillator circuit.
2) ID 1, ID 2, ID 3, ID 4, ID 5 : BCD Data Input; refer to the numerical Designations-resultant displays for the relation of the input data to the display.
3) I_{DP} : decimal point data Input
4) CLK : Data transport clock Input: the data can be input at a positive-going edge of the CLK
5) RST : Reset Input : the CLK input counter is reset at "H".
6) LOAD : Signal Input to load the data latch with the data of the shift register. The Input LOAD will not be accepted until the 8th CLK Input has been received.
7) DISP : When it is set to "H" it displays. When it is set to "L", the display is inhibitted. During the display inhibition period, both the segment and digit outputs will be at "L".

TIMING CHART

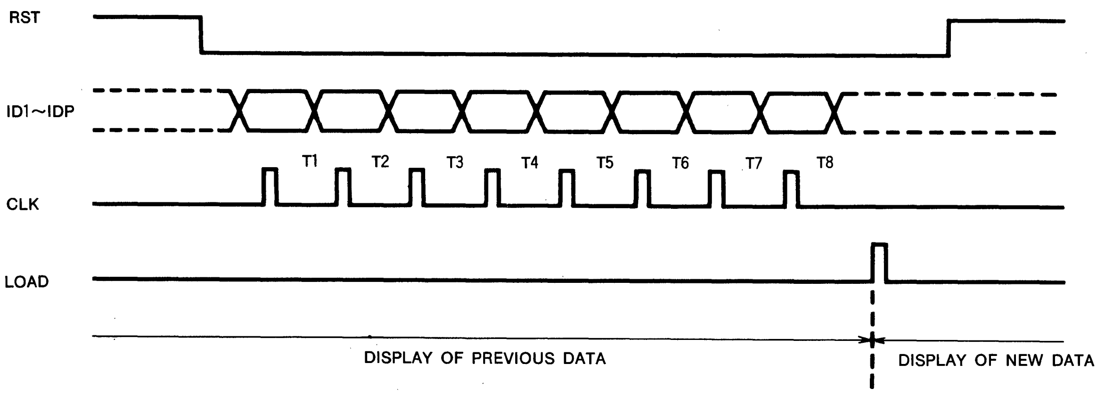
DATA PROGRAMMING

(1) USING CLK AND RST inputs with LOAD=" H ".



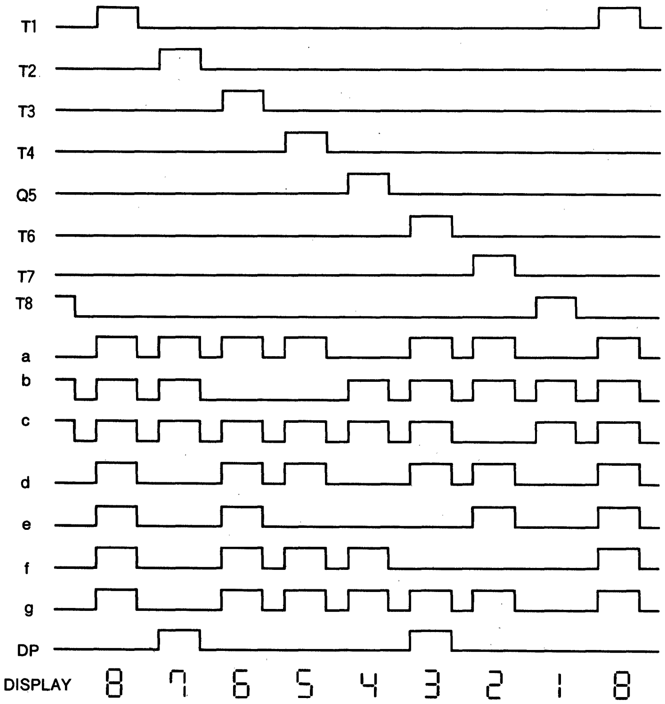
When LOAD is kept at " H ", LOAD is automatically done at the 8th CLK input when RST=" L ".
However, while RST=" L ", if there is a 9th CLK input, the 9th data will be loaded and displayed.

(2) Using CLK, RST and LOAD inputs.



After the 8th clock input, the LOAD is valid only in the period while RST=" L ".
Furthermore, if there is 9th CLK input before the LOAD input, the LOAD input is ignored.

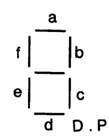
OUTPUT TIMING CHART



NUMERICAL DESIGNATIONS-RESUITANT DISPLAYS

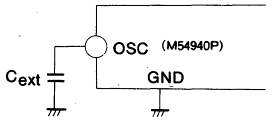
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
BCD DATA	ID1	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
	ID2	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H	H
	ID4	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H	H
	ID8	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
Display		0	1	2	3	4	5	6	7	8	9	-	E	P	L	¬	Blank

∗The decimal point, independent of BCD data, is output when the decimal bit of the corresponding digit is at " H ".
Furthermore, when the decimal point bit is set at " H " at plural digits, plural decimal points are displayed.



OSCILLATOR CIRCUIT

1) External connection



2) Oscillation period

$t_{OSC} \fallingdotseq 20\, C_{ext} \times 10^{-3} [\mu s]$ (Typ.)
(Unit of C_{ext}; [pF])

DISPLAYS IMMEDIATELY "AFTER POWER ON."

The display which appears immediately after "power-on" is indefinable. During the period bofore the regular data is transported the display can be erased if DISP input is set at " L ".

ABSOLUTE MAXIMUM RATINGS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC1}	Logic supply voltage		−0.3∼+9	V
V_{CC2}	Driver supply voltage		−0.3∼+38	V
V_I	Input voltage		−0.3∼$V_{CC}1$	V
V_O	Output voltage		0∼$V_{CC}2$	V
T_{stg}	Storage temperature range		−55∼+150	℃
T_{opr}	Operating temperature range		−20∼+75	℃
P_d	Power dissipation		600	mW

RECOMMENDED OPERATING CONDITIONS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min	Typ	Max	
V_{CC1}	Logic supply voltage	4	5	7	V
V_{CC2}	Driver supply voltage	10	30	35	V

ELECTRICAL CHARACTERISTICS (T_a=−20∼+75℃, $V_{CC}1$=5V, $V_{CC}2$=35V, unless otherwise noted)

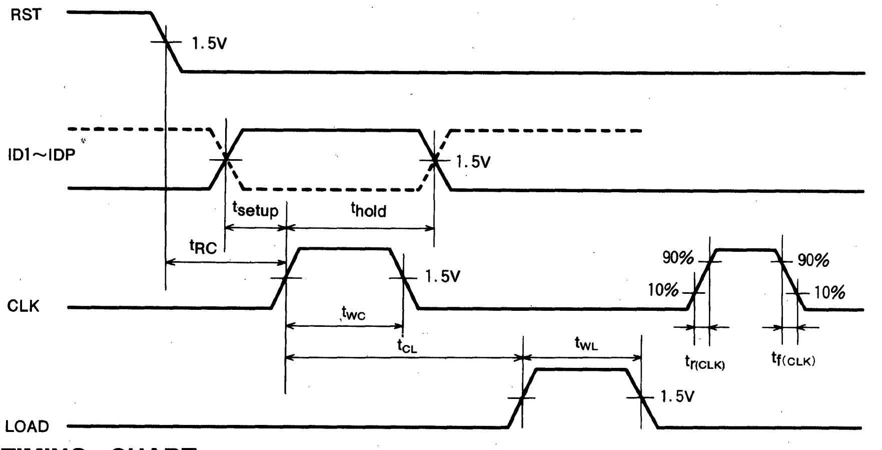
Symbol	Parameter		Test Conditions	Limits			Unit
				Min	Typ	Max	
V_{IH}	" H " Input voltage		$V_{CC}1$ =4∼7V	2.7		$V_{CC}1$	V
V_{IL}	" L " Input voltage		V_{CC}= 1 =4∼7V	0		0.7	V
I_{IH}	" H " Input current		V_{IH}=5V		0	20	μA
I_{IL}	" L " Input current		V_{IL}=0V		−0.25	−0.4	mA
V_{OH}	" H " Output voltage	Digit output	I_{OH}=−10mA	33	33.8		V
		Segment output	I_{OH}=−2mA	33	34*		
V_{OL}	" L " Output voltage		I_{OL}=0mA		0	2	V
I_{CC1}	Logic circuit current		Input : open All segment outputs; ON		12	22	mA
I_{CC2}	Driver circuit current		Output : Open All segment outputs : ON		8	14	mA
t_{OSC}	Oscillation Period		C_{ext}=1000pF	10	20	40	μs

*Typical values are measured at 25℃

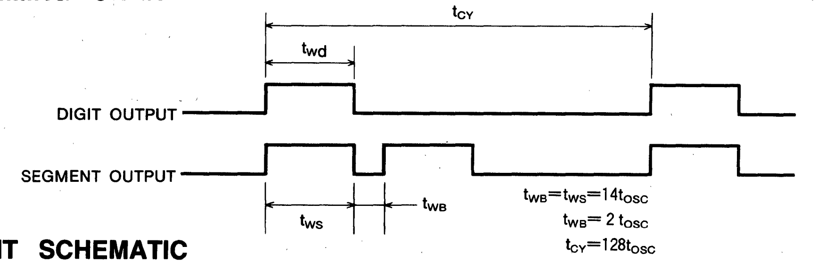
TIMING CHARACTERISTICS (T_a=−20∼+75℃, unless otherwise noted)

Symbol	Parameter	Test Conditions	Limits			Unit
			Min	Typ	Max	
f_{CLK}	Clock Frequency				100	kHz
f_{OSC}	Oscillation frequency		10		100	kHz
t_{WC}	Clock pulse width		2			μs
t_{WL}	Load Pulse width		2			μs
t_{setup}	Data setup time (DATA→CLK)		4			μs
t_{hold}	Data Hold time(CLK→DATA)		2			μs
t_{RC}	Reset-clock time(RST→CLK)		4			μs
t_{CL}	Clock-load, time(CLK→LOAD)		4			μs
$t_{r(CLK)}$	Clock pulse rise time				10	μs
$t_{f(CLK)}$	Clock pulse fall time				10	μs

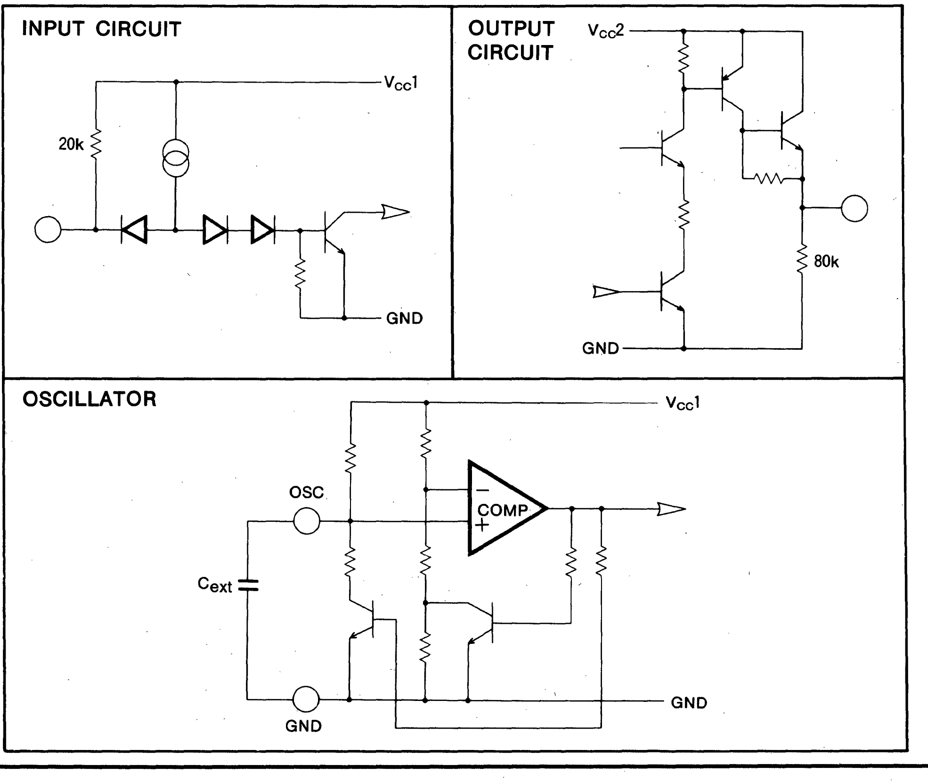
INPUT TIMING CHART



OUTPUT TIMING CHART



I/O CIRCUIT SCHEMATIC



M58479P
M58482P

CMOS COUNTER/TIMERS

DESCRIPTION

The M58479P and M58482P are electronic timer ICs developed by aluminum-gate CMOS technology. Use of these ICs makes possible timer devices without mechanical elements, which have reduced power dissipation, superior reliability, and higher noise immunity. The M58479P is specifically designed for high noise immunity while the M58482P particularly features low power dissipation.

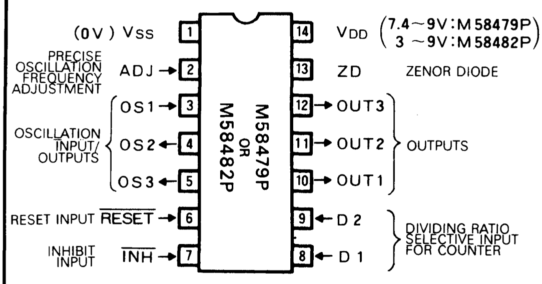
FEATURES

- Low power dissipation
  M58479P: 2mW (typ.), 7.5mW (max.)
  M58482P: 200μW (typ.), 750μW (max.)
- Superior noise immunity
- Single power supply with a zenor diode
- Internal RC oscillator
- Precise oscillation frequency regulating capability
- Extremely broad time-delay range (50ms~4800h)
- Time-delay settable to 10, 60, or 600 times fundamental time (1024 times oscillation period)
- M58479P has automatic-reset function during power engagement
- Built-in reset and inhibit functions
- Residual time display possible by adding Mitsubishi's M53290P and M53242P IC

APPLICATIONS

- Electronic timer or counter with broad time-delay range (50ms~4800h)

PIN CONFIGURATION (TOP VIEW)



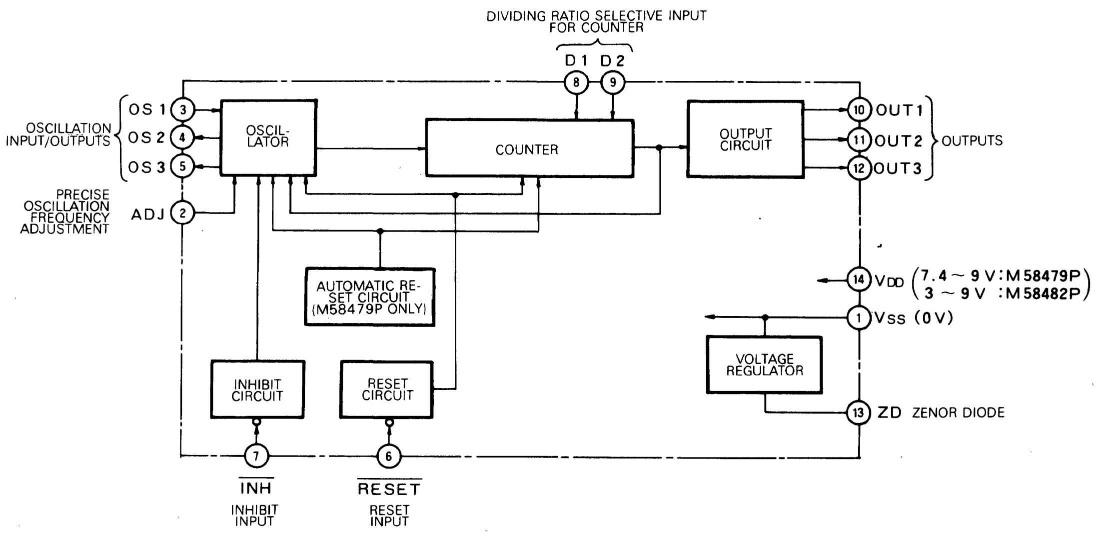
Outline 14P4

FUNCTION

These devices make possible extremely long clock performance, by counting pulse signals from the RC oscillator. It has precise oscillation frequency adjustment, automatic-reset, reset, and inhibit functions.

There are three outputs. When the time duration is up, OUT1 turns from low to high and OUT2 from high to low. OUT3 can be connected to M53290P and M53242P TTLs for residual time display.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Limits	Unit
V_{DD}	Supply voltage	With respect to V_{SS}	$-0.3 \sim 9.5$	V
V_I	Input voltage	With respect to V_{SS}	$V_{SS} \leq V_I \leq V_{DD}$	V
Pd	Maximum power dissipation	Ta=25°C	250	mW
Topr	Operating free-air temperature range		$-30 \sim 75$	°C
Tstg	Storage temperature range		$-40 \sim 125$	°C

RECOMMENDED OPERATING CONDITIONS (Ta = −30 ~ 75°C, unless otherwise noted.)

Symbol	Parameter		Limits Min	Limits Typ	Limits Max	Unit
V_{DD}	Supply voltage	M58479P	7.4		9	V
		M58482P	3		9	V
I_{ZD}	Zenor current				10	mA
R_{FC}	Feedback resistance		0.005		10	MΩ
C_{FC}	Oscillation capacitance		0.001		1	μF
R_{FC}	Resistance for fine-adjustment of oscillation frequency		0		100	kΩ
V_{IH}	High-level input voltage, $\overline{RESET}$, $\overline{INH}$, D_1, D_2		$0.7 \times V_{DD}$	V_{DD}	V_{DD}	V
V_{IL}	Low-level input voltage, $\overline{RESET}$, $\overline{INH}$, D_1, D_2		0	0	$0.3 \times V_{DD}$	V

ELECTRICAL CHARACTERISTICS (Ta=25°C, unless otherwise noted.)

Symbol	Parameter		Test conditions	Limits Min	Limits Typ	Limits Max	Unit
V_{ZD}	Zenor voltage		I_{ZD}=2mA	7.4	8.2	9	V
			I_{ZD}=10mA	7.5	8.2	9	V
I_{DD}	Supply current	M58479P	V_{DD}=7.5V, C_{FC}=0.01μF, R_{FC}=1MΩ R_{ADJ}=0Ω, Input/output open		0.25	1	mA
		M58482P	V_{DD}=7.5V, C_{FC}=0.01μF, R_{FC}=1MΩ R_{ADJ}=0Ω, Input/output open		25	100	μA
V_{RE}	Supply voltage at the time of automatic-reset release	M58479P		3.1		5.4	V
V_{TR}	Transition voltage of first inverter in the oscillator		V_{DD}=7.5V, R_{ADJ}=0Ω	2.9		4.8	V
R_I	Pull-up resistance: $\overline{RESET}$, $\overline{INH}$, D1, D2 inputs	M58479P		10	20	30	kΩ
		M58482P		25	50	75	kΩ
I_{OH}	High-level output current, OUT1 and OUT2 outputs		V_{DD}=7.5V, V_O=0V	5	10		mA
I_{OL}	Low-level output current, OUT1, OUT2, and OUT3 outputs		V_{DD}=7.5V, V_O=7.5V	10	20		mA
I_{OZH}	Off-state output current, OUT3 output		V_{DD}=7.5V, V_O=7.5V			1	μA
I_{OL}	Low-level output current: OUT1, OUT2, and OUT3 outputs		V_{DD}=7.5V, V_O=0.4V	1.6			mA
I_{OL}	Low-level output current: OUT1, OUT2, and OUT3 outputs	M58482P	V_{DD}=4.5V, V_O=0.4V	1.6			mA
V_{OL}	Low-level output voltage: OUT1, OUT2, and OUT3 outputs		V_{DD}=7.5V			0.1	V

FUNCTIONAL DESCRIPTION

Voltage Regulator

A zenor diode is on-chip, making it easy to obtain a constant voltage regulator circuit. Since the zenor diode terminal (ZD) is independent of the power terminal (V_{DD}), it can be used as a constant voltage power supply for the total system.

Oscillator

Oscillation is obtained by connecting an external resistor (feedback resistor R_{FC}) between terminals OS1 and OS3 and an external capacitor (oscillation capacitor C_{FC}) between terminals OS1 and OS2. The values of the external resistor and capacitor can then be changed to vary the oscillation period and thus change the time delay. Oscillation period T_0 is obtained by the following equation:

$$T_0 = -R_{FC} \cdot C_{FC} \left\{ \ell n \frac{V_{TR}}{V_{DD}+V_{BE}} + \ell n \frac{V_{DD}-V_{TR}}{V_{DD}+V_{BE}} \right\} \cdots (1)$$

Where,

R_{FC} : Resistance of external resistor
C_{FC} : Capacitance of external capacitor
V_{TR} : Transition voltage of the first inverter in the oscillation circuit
V_{DD} : Supply voltage
V_{BE} : Forward rising voltage of the diode in terminal OS1 (0.3~0.7V)

Automatic-Reset Function

The M58479P has a power-supply voltage-detection circuit on-chip, so that the counter is automatically reset by the rising edge of the supply voltage when power is turned on. The reset is then released, making the oscillator ready to function and the counter ready to start counting.

The M58482P can also be provided with the same automatic-reset function by connecting capacitor between terminals $\overline{\text{RESET}}$ and V_{SS}.

Reset Function

When the $\overline{\text{RESET}}$ input turns low (V_{SS}), oscillation of the oscillator can be stopped and the counter reset.

Inhibit Function

When terminal $\overline{\text{INH}}$ turns low (V_{SS}) while the timer is in action, the oscillation halts. When input $\overline{\text{INH}}$ is turned high or returned to OPEN afterwards, it starts to count residual time.

Counter

This counter consists of an 11-stage 1/2 frequency divider, a 2-stage 1/10 frequency divider and a 1-stage 1/6 frequency divider. As shown in the table below, timer duration can be changed by varying the number of pulses counted according to the combination of the input levels on terminals D1 and D2.

D1	D2	Number of pulses counted	Time delay	Typical time delay applied
H	H	1024	T_1	1 min
L	H	1024 × 10	$T_1 \times 10$	10 min
H	L	1024 × 10 × 6	$T_1 \times 10 \times 6$	1h
L	L	1024 × 10 × 6 × 10	$T_1 \times 10 \times 6 \times 10$	10h

Where, $T_1 = T_0 \times 1024$
T_0 is the value obtained from equation (1)

Output Circuits

The chips have three outputs: OUT1 changes from low to high and OUT2 from high to low as soon as the time duration is up. Either can be used to drive a transistor by connecting it to the transistor base. OUT1 can drive a thyristor when connected to the thyristor gate.

OUT3 is an open-drain output with period 1/8 of the time delay, and can be used to drive a TTL in a separate (5V) power supply line. Thus, if a M53290P counter and a M53242P binary-to-decimal decoder are connected to OUT3, with their output connected to a light-emitting diode, residual time will be displayed on the LED. When not in use, OUT3 should be connected to V_{SS}.

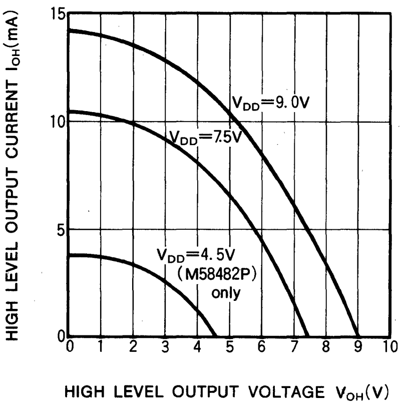
Fine Adjustment of Oscillation Period

A variable resistor can be connected between terminals ADJ and V_{SS}, enabling precise adjustment of the period of the oscillator. However, when not used for fine adjustment, ADJ should be connected to V_{SS}.

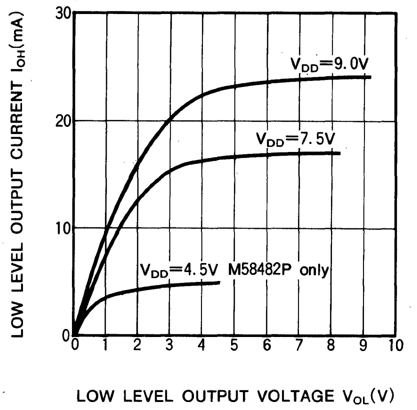
TYPICAL CHARACTERISTICS (T_a=+25℃, unless otherwise noted)

See "9. ELECTRICAL CHARACTERISTICS" for absolute values

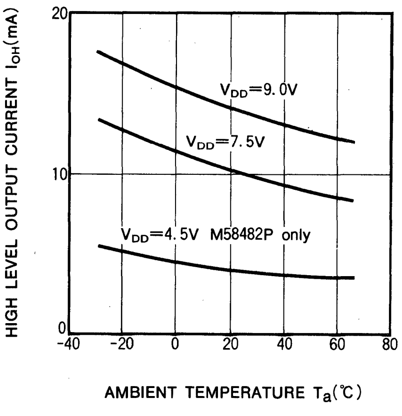
(1) $I_{OH}-V_{OH}$ (OUT 1, OUT 2)



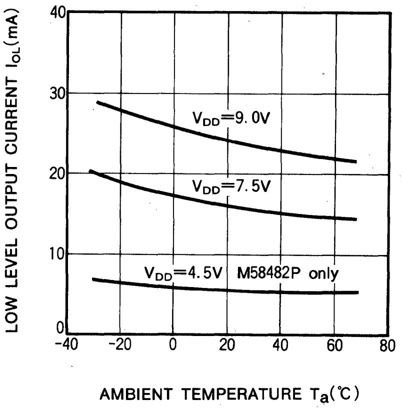
(2) $I_{OH}-V_{OL}$ (OUT 1, OUT 2, OUT 3)



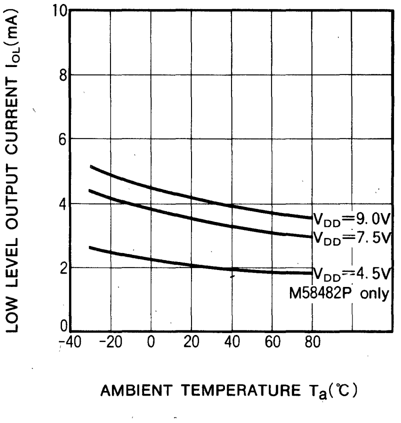
(3) $I_{OH}-T_a$ (OUT 1, OUT 2) V_{OH}=DV



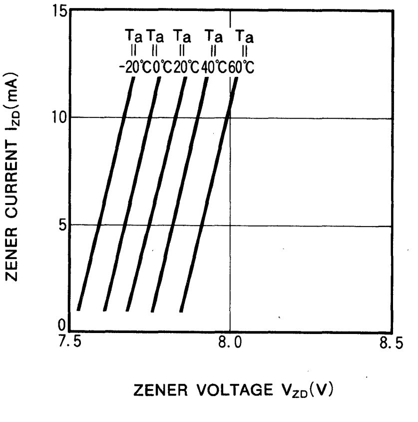
(4) $I_{OL}-T_a$ (OUT 1, OUT 2, OUT 3) $V_{OL}-V_{DD}$



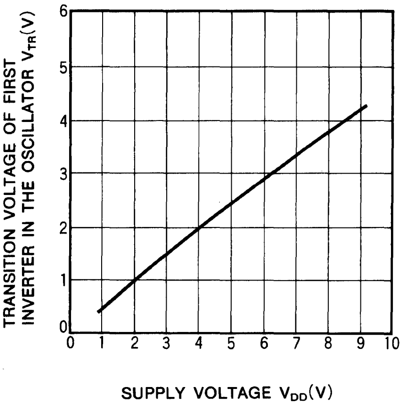
(5) $I_{OL}-T_a$ (OUT 1, OUT 2, OUT 3) V_{OL}=0.4V



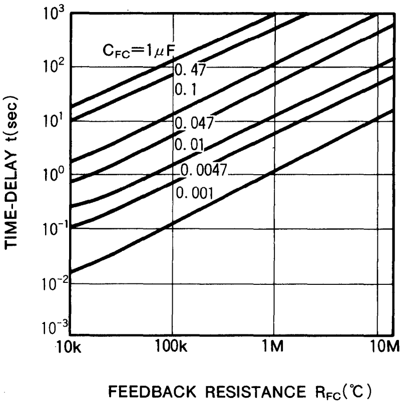
(6) I_{ZD} V_{ZD}



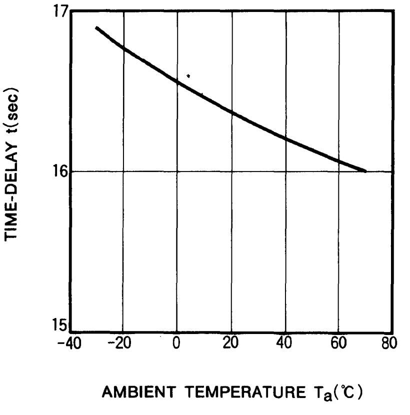
(7) V_{TR}—V_{DD}



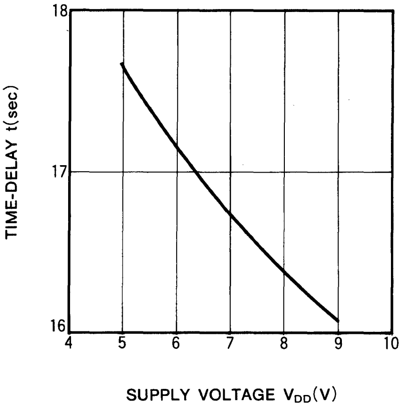
(8) t=R_{FC}
V_{DD}=7.5V, ADJ: SHORTED WITH V_{SS},
D1 ~D2: OPEN OR "H",
C_{FC}=0.001~ 1 μF



(9) t—Ta
V_{DD}=7.5V ADJ: SHORTED WITH V_{SS},
D1, D2: OPEN OR "H",
R_{FC}= 1 MΩ, C_{FC}=0.01μF



(10) t—V_{DD}
ADJ: SHORTED WITH V_{SS},
D1, D2:OPEN OR "H"
R_{FC}=1MΩ, C_{FC}=0.1μF



OSCILLATION FREQUENCY

The oscillation period of M58479P and M58482P are formularized as follows.

$$T_O = -R_{FC}C_{FC}\left\{\ell n\frac{V_{TR}}{V_{DD}+V_{BE}} + \ell n\frac{V_{DD}-V_{TR}}{V_{DD}+V_{BE}}\right\} \quad (1)$$

The value in { } of (1) takes the maximum value at $V_{TR}=V_{DD}/2$. For example, under the condition of $V_{DD}=7.5V$, the relation of the V_{TR} and the value in { } is shown in Figure 1 .

Regarding the Figure 1 , the value in { } of (1) at $V_{DD}=7.5V$ is, in a range of $V_{BE}=0.3\ell \sim 0.7V$ and $V_{TR}=2.9\sim4.8V$, −1.647, −1.464.

The oscillation period can be figured out theoretically by the (1) formula; however, as 'the oscillation is executed by the charge and discharge of R_{FC}, C_{FC}, the correction parameter R_{FC} by the output impedence of OS 2 and OS 3 is added in the (1) formula as:

$$T_O = -(R_{FC}+\Delta R_{FC})C_{FC}\left\{\ell n\frac{V_{TR}}{V_{DD}+V_{BE}} + \ell n\frac{V_{DD}-V_{TR}}{V_{DD}+V_{BE}}\right\} \quad (2)$$

At this time, the value of the correction parameter ΔR_{FC} will be around $5.5\pm2.5k\Omega$.

For the circuit designing, set the oscillation constant regarding to the above matters.

TIMER ADJUSTMENT

Following is the method of adjusting time-delay keeping the external resistance R_{FC} and capacitor C_{FC} fixed.

(1) The method to verify R_{ADJ} value with inserting the parallelly connected R_{ADJ} and C_{ADJ} into ADJ-VSS

As described already, the oscillation period To is calculated with (1) formula, as the relation of V_{TR} and the minimum value when $V_{TR}=V_{DD}/2$. This means the To can be varied by changing the V_{TR} value. This method is performed by adjusting the time-delay by the V_{TR}.

The ADJ is connected to a N-Channel-FET source of the first inverter of oscillator as Figure 3 illustrates. When the parallelly connected resistance R_{ADJ} and capacitance C_{ADJ} are inserted between ADJ and V_{SS} and the R_{ADJ} changes its value, the voltage of the ADJ varies by the current in the R_{ADJ}, and this results the change of V_{TR}.

As the R_{ADJ} value gets larger, the value of the V_{TR} is increased from that at $R_{ADJ}=0\Omega$. The value of V_{TR} at $R_{ADJ}=0\Omega$ is in the range of $2.9\sim4.8V(V_{DD}=7.5V)$. Therefore, as Figure 2 indicates, the variation way and the variation rate of the oscillation period To when the resistance R_{ADJ} gets larger are found according to the V_{TR} value at $R_{ADJ}=0\Omega$ and are not constant.

The capacitance C_{ADJ} to be parallelly inserted into the resistance R_{ADJ} has a function of making a variation rate of the To toward R_{ADJ} large.

On the resistance R_{ADJ} and the capacitance C_{ADJ}, please follow the ranges below.

$R_{ADJ}=0\sim100k\Omega$

$C_{ADJ}=100\sim1000pF$

When the ADJ is not used for the oscillation period adjustment, short to the V_{SS}.

TRANSITION VOLTAGE OF FIRST INVERTER IN THE OSCILLATOR

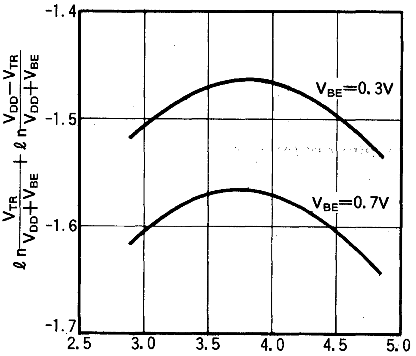


Fig. 1. V_{TR} VS $\ell n\frac{V_{TR}}{V_{DD}+V_{BE}} + \ell n\frac{V_{DD}-V_{TR}}{V_{DD}+V_{BE}}$

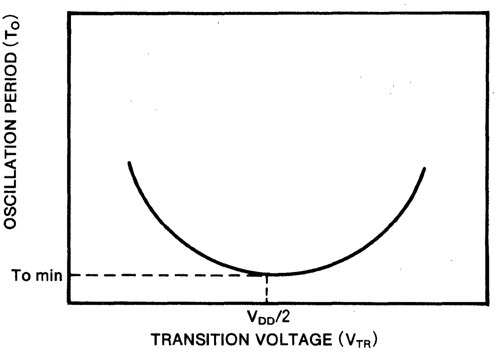


Fig. 2. Oscillation period (T_O) VS Transition Voltage (V_{TR})

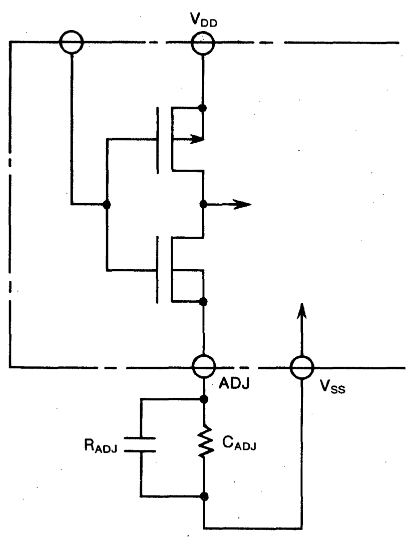


Fig.3 External connection diagram of oscillation frequency adjustment method (1)

(2) The method to verify resistance R_B value with inserting the resistance R_B and capacitance C_B connected in series between OS 1 and OS 2.

The oscillation period To is found by the same method as the (1) formula in principle, but a little more complicated.

In principle, the variation way, and the variation rate of the oscillation period To with the resistance R_B are constant, and not be different by process parameter (V_{TR} etc).

Figure 4 illustrates the external connection diagram of resistances R_{FC}, R_B and capacitance C_{FC}, C_B. In addition, the Figure 5 shows the relation of the time-delay T ($=T_O$ x 1024) with R_B at $C_{FC}=C_B$, $R_{FC}=1\ M\Omega$, and the time-delay variation rate ΔT at $R_B=250k\ \Omega$. As shown in Figure 6, the To takes the maximum value near $R_B=250k\Omega$ according to $C_{FC}=C_B=10^3$, 10^4, 10^5pF.

The change of the time-delay T with the resistance R_{FC} keeping the R_B constant will take poor linearity as the value of R_B increases. Therefore, try to keep the resistance R_B in a range of 0 ~150kΩ.

For that, take the $R_B=50k\Omega$ first and change its value in the range of 0 ~150kΩ to adjust the time-delay at the maximum value of R_{FC}, so the adjustment of ±7% becomes possible.

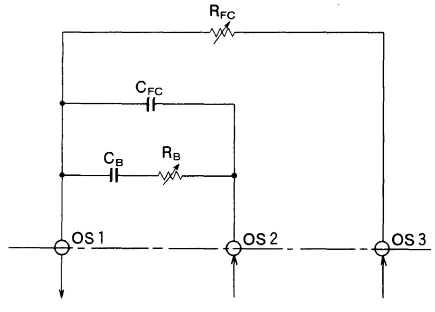


Fig. 4. External connection diagram of oscillation frequency adjustment method (2)

Fig. 5. (a) R_B—T (Method 2)
$C_{FC}=C_B=10^3$pF
$R_{FC}=1M\Omega$
ADJ is shorted with V_{SS}

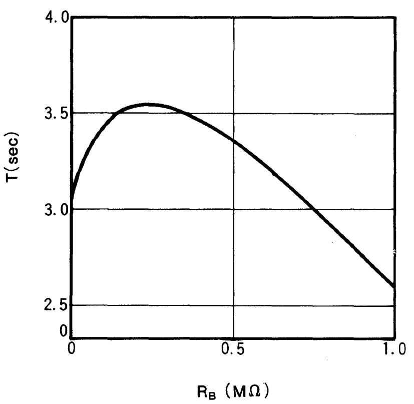


Fig. 5. (b) R_B—T (Method 2)
$C_{FC}=C_B=10^4$pF
$R_{FC}=1\ M\Omega$
ADJ is shorted with V_{SS}

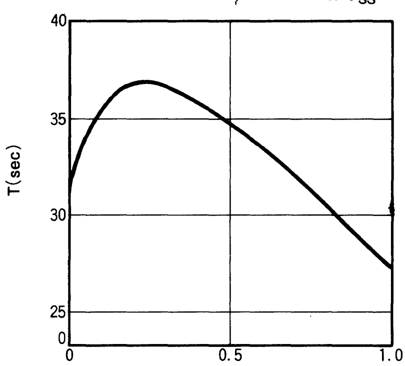


Fig. 5. (c) R_B—T (Method 2)
$O_{FC}=C_H=10^5$pF
$R_{FC}=1\text{M}\Omega$
ADJ is shorted with V_{SS}

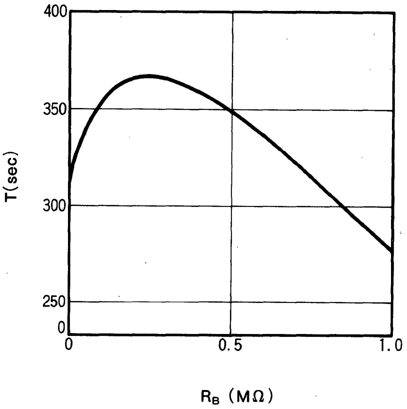
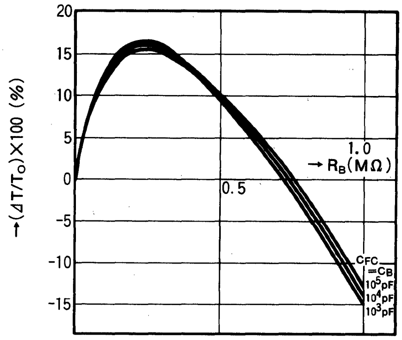


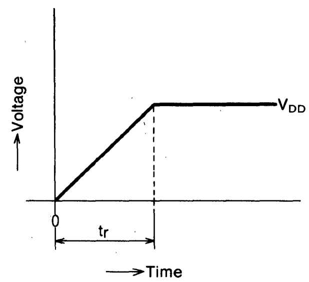
Fig. 6. R_B—$(\Delta T/T_O)\times100$(Method 2)
$R_{FC}=1\text{M}\Omega$
$\Delta T=T-T_O$
$T_O=T(Rb-0\Omega)$



POWER-ON FUNCTION

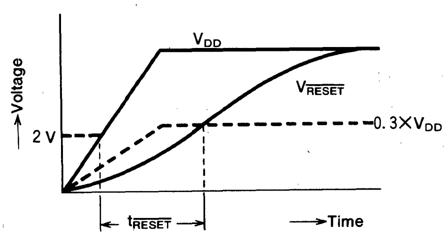
(1) M58479P

The power-on reset function will start when the power is on since the M58479P builts the supply voltage detection circuit in it; however, it is necessary to keep the rising time of power (tr) more than 1 ms as shown below.

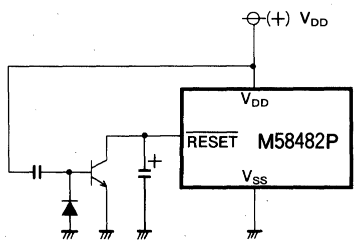


(2) M58482P

The power-on reset function will start by inserting the capacitance between the $\overline{\text{RESET}}$ and V_{SS} when the power is on as same as the M58479P. In order to have an accurate performance on the power-on reset function, keep $t_{\overline{RESET}}$ over 1msec on the condition of $V_{\overline{RESET}} \leqq 0.3 \times V_{DD}$ when V_{DD} is over 2 V, as illustrated below.

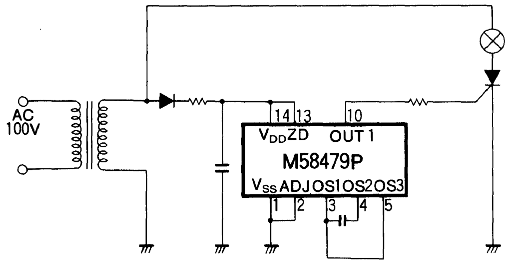


In case the power is on again after it is off and the voltage of $\overline{\text{RESET}}$ $V_{\overline{RESET}}$ is not perfectly down, the $t_{\overline{RESET}}$ must be also kept in over 1msec, which was mentioned in the above diagram. When the prescribed condition is not satisfied, add the circuit illustrated below to the $\overline{\text{RESET}}$and make the power-on reset function accurately. In this case, make sure to select an external capacitance to satisfy the $V_{\overline{RESET}} \geqq$ 1 msec.

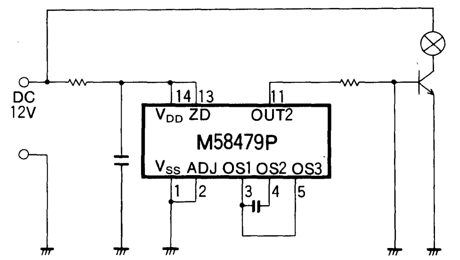


APPLICATION CIRCUITS

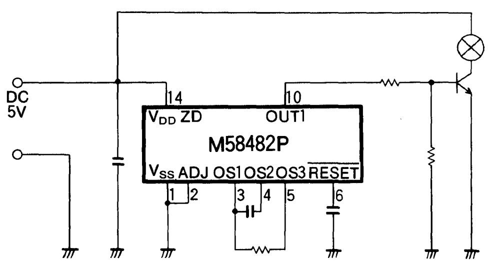
(1) **Use of AC supply**



(2) **Use of DC supply**



(3) **Use of DC supply (low supply voltage)**

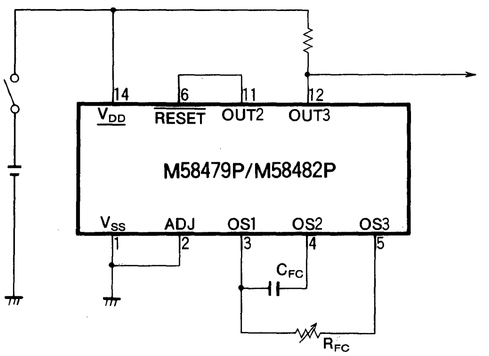


Both M58479P and M58483P build zenor diodes in them so that they can adopt AC supply (100V), DC supply (12V) according to external circuits.

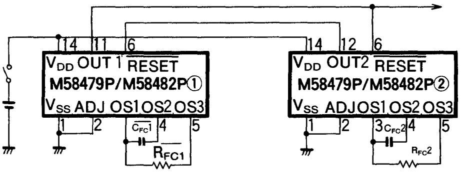
If the supply voltage is relatively high, when a power-on reset is required without an external circuit, employ the M58479P.

On the other hand, if a low supply voltage or low power dissipation is required, or if a power supply with a heavy fluctuation on lower voltage is used, employ the M58482P (M58479P may have a reset when V_{DD} is below 5. 4V).

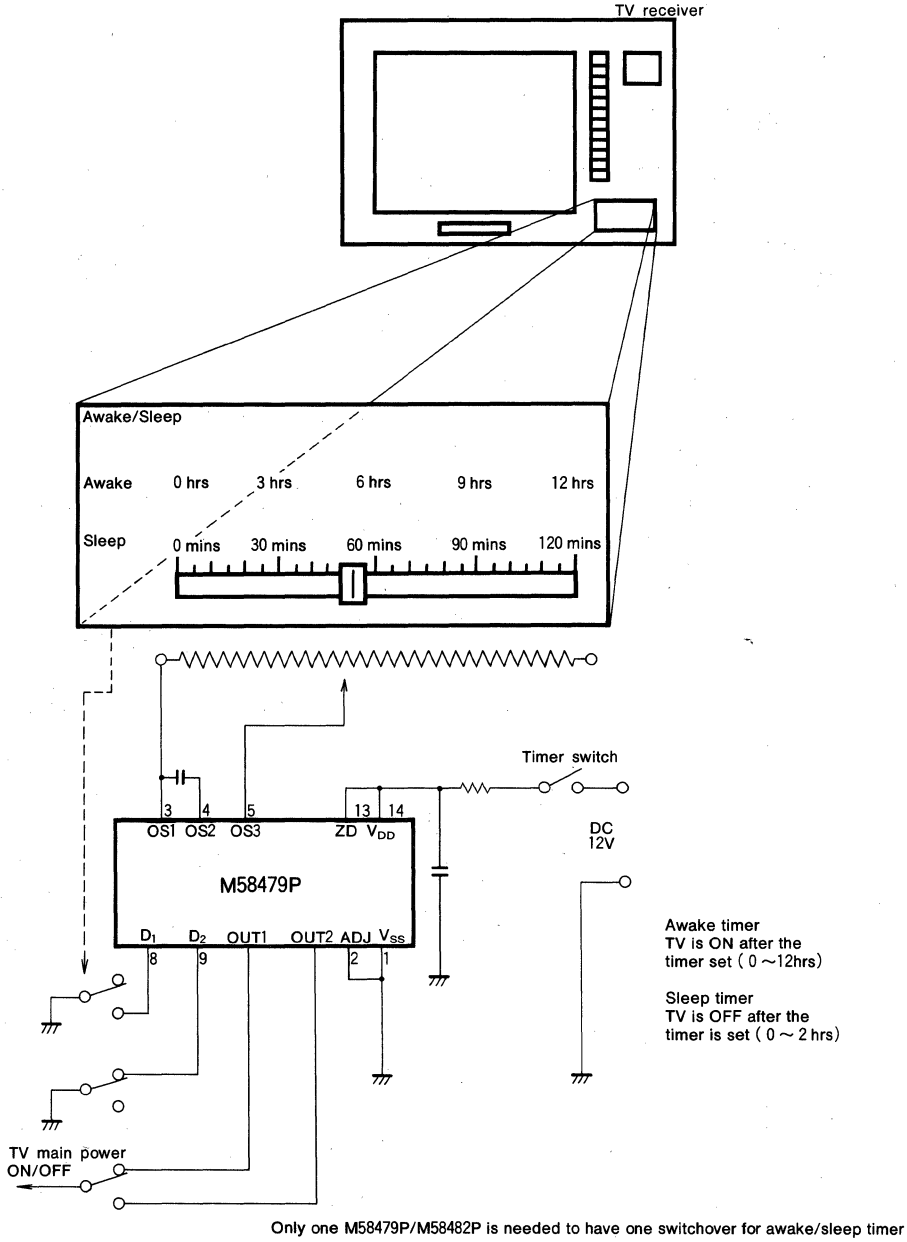
(4) **While power is being on,**
A pulse of 50% duty of which period is defined by R_{FC} and C_{FC}, is output from OUT 3 .



(5) **While power is being on,**
a (duty changeable) pulse of which a "L" period is defined by R_{FC1}, C_{FC1}, and a "H" period is by R_{FC2}, C_{FC2}, is output from OUT 1 of M58479P/M58482P①.



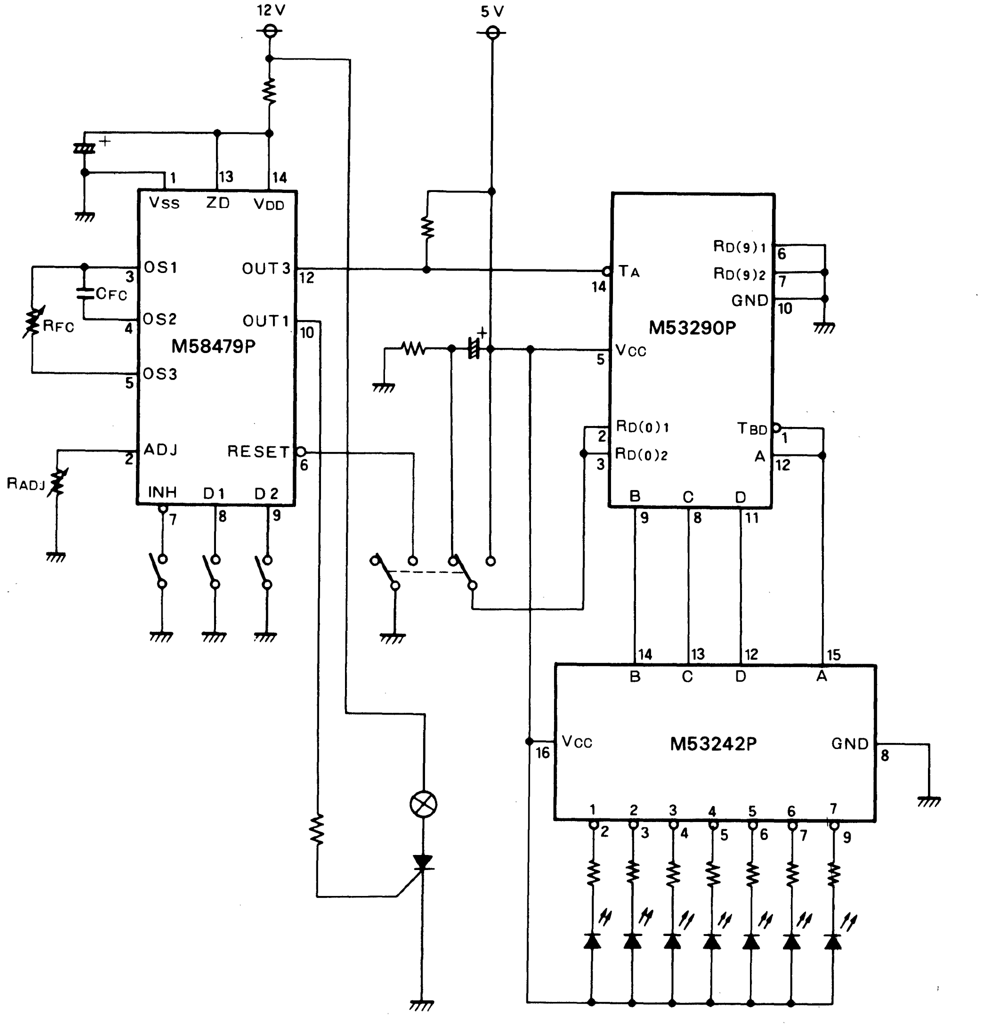
(6) An example of awake/sleep timer



Only one M58479P/M58482P is needed to have one switchover for awake/sleep timer

The application above is just a one example and the M58479P/M58482P can be widely used for home entertainment and industry.

(8) Circuit to display a timer in process



MC911

HIGH-SPEED SWITCHING/SILICON EPITAXIAL TYPE (COMMON ANODE)

DESCRIPTION

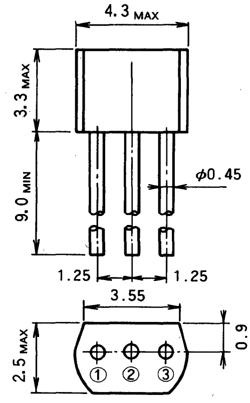
The MC911 is a silicon epitaxial double diode employing small epoxy molded package.
It is designed for high-speed switching applications.
Owing to the small terminal capacitance and the short switching time (reverse recovery time), this diode usable not only for high-speed switching applications but also for protection, bias and other circuits.
Moreover, this is small in size and double, it is suitable for high-density mounting applications.

FEATURES

- Small terminal capacitance
- High speed switching
- High voltage
- Double device and compact format reduce dimensions and enhance high-density mounting.

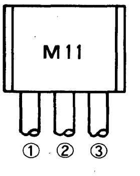
OUTLINE DRAWING

UNIT : mm

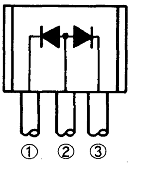


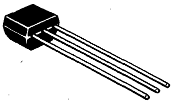
TERMINAL CONNECTIONS
① : CATHODE 1
② : ANODE(COMMON) EIAJ : —
③ : CATHODE 2 JEDEC : —

MARK



INTERNAL CONNECTIONS





3-pin molded plastic SIL

ABSOLUTE MAXIMUM RATINGS (T_a=25℃)

Symbol	Parameter	Limits	Unit
V_{RM}	Peak reverse voltage	75	V
V_R	Reverse voltage	50	V
I_{FSM}	Forward surge current	4	A
I_{FM}	Peak forward current	300	mA
I_O	Average rectified current	100	mA
P_T	Power dissipation	300	mW
T_j	Junction temperature	+125	℃
T_{stg}	Storage temperature	−55～+125	℃

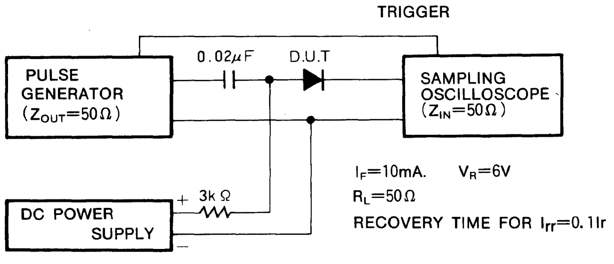
ELECTRICAL CHARACTERISTICS (T_a=25℃)

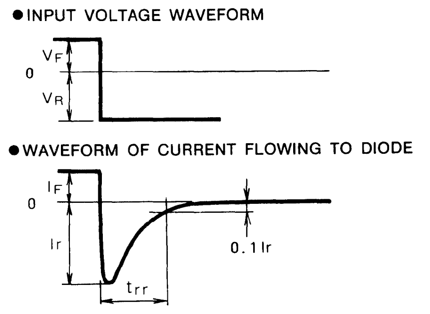
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{F1}	Forward voltage	I_F=10mA		0.77	0.9	V
V_{F2}	Forward voltage	I_F=50mA		0.9	1.0	V
V_{F3}	Forward voltage	I_F=100mA		0.95	1.2	V
I_R	Reverse current	V_R=50V			0.1	μA
C_t	Terminal capacitance	V_R=0, f=1MHz		2.8	4.0	pF
t_{rr}	Reverse recovery time	(See measurement circuit)			4.0	ns

MITSUBISHI ELECTRIC

**HIGH-SPEED SWITCHING/SILICON EPITAXIAL TYPE
(COMMON ANODE)**

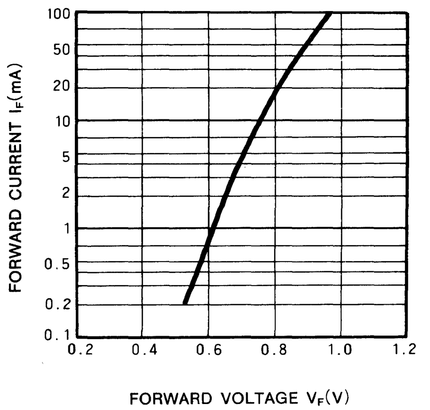
REVERSE RECOVERY TIME(Trr) MEASUREMENT CIRCUIT



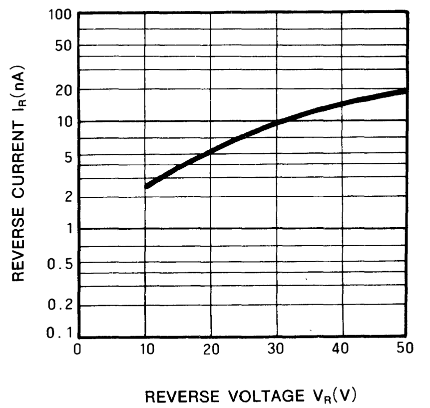


TYPICAL CHARACTERISTICS

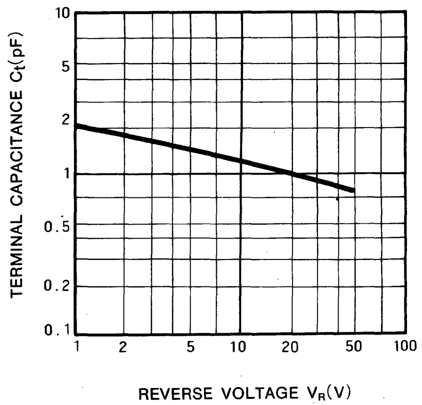
FORWARD CURRENT VS FORWARD VOLTAGE



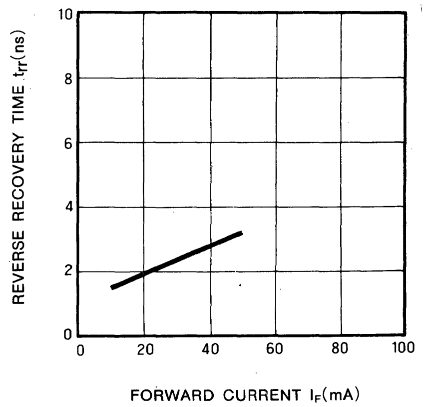
REVERSE CURRENT VS REVERSE VOLTAGE



TERMINAL CAPACITANCE VS REVERSE VOLTAGE



REVERSE RECOVERY TIME VS FORWARD CURRENT



MC921

HIGH-SPEED SWITCHING/SILICON EPITAXIAL TYPE (COMMON CATHODE)

DESCRIPTION

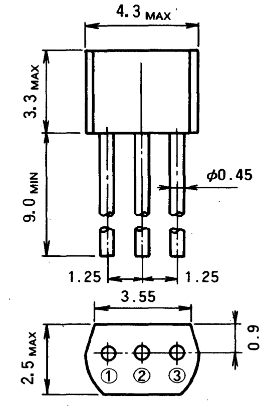
The MC921 is a silicon epitaxial double diode employing small epoxy molded package.
It is designed for high-speed switching applications.
Owing to the small terminal capacitance and the short switching time (reverse recovery time), this diode usable not only for high-speed switching applications but also for protection, bias and other circuits.
Moreover, this is small in size and double, it is suitable for high-density mounting applications.

FEATURES

- Small terminal capacitance
- High speed switching
- High voltage
- Double device and compact format reduce dimensions and enhance high-density mounting.

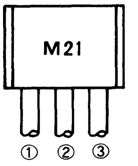
OUTLINE DRAWING

UNIT : mm

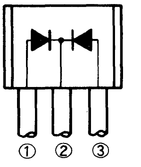


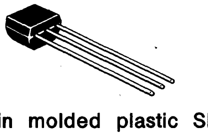
TERMINAL CONNECTIONS
① : ANODE 1
② : CATHODE(COMMON) EIAJ : –
③ : ANODE 2 JEDEC : –

MARK



INTERNAL CONNECTIONS





3-pin molded plastic SIL

ABSOLUTE MAXIMUM RATINGS (Ta=25℃)

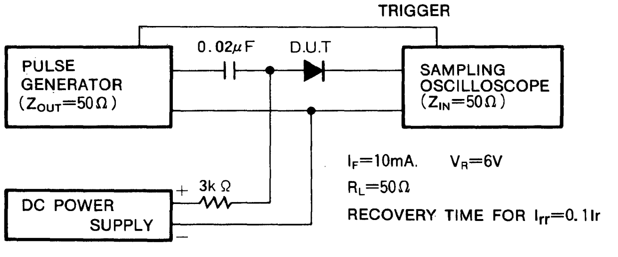
Symbol	Parameter	Limits	Unit
V_{RM}	Peak reverse voltage	75	V
V_R	Reverse voltage	50	V
I_{FSM}	Forward surge current	4	A
I_{FM}	Peak forward current	300	mA
I_O	Average rectified current	100	mA
P_T	Power dissipation	300	mW
T_j	Junction temperature	+125	℃
T_{stg}	Storage temperature	−55∼+125	℃

ELECTRICAL CHARACTERISTICS (Ta=25℃)

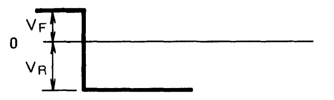
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{F1}	Forward voltage	I_F=10mA		0.72	0.9	V
V_{F2}	Forward voltage	I_F=50mA		0.85	1.0	V
V_{F3}	Forward voltage	I_F=100mA		0.9	1.2	V
I_R	Reverse current	V_R=50V			0.1	μA
Ct	Terminal capacitance	V_R=0, f=1MHz		1.0	4.0	pF
t_{rr}	Reverse recovery time	(See measurement circuit)			3.0	ns

HIGH-SPEED SWITCHING/SILICON EPITAXIAL TYPE (COMMON CATHODE)

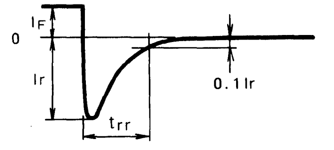
REVERSE RECOVERY TIME(T_{rr}) MEASUREMENT CIRCUIT



● INPUT VOLTAGE WAVEFORM

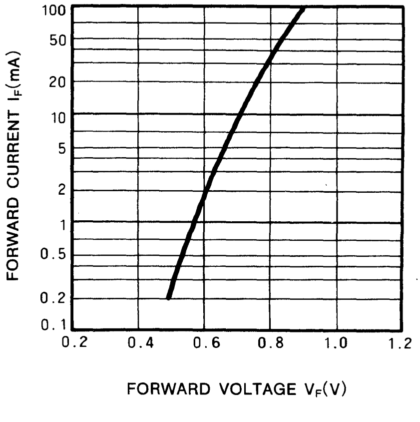


● WAVEFORM OF CURRENT FLOWING TO DIODE

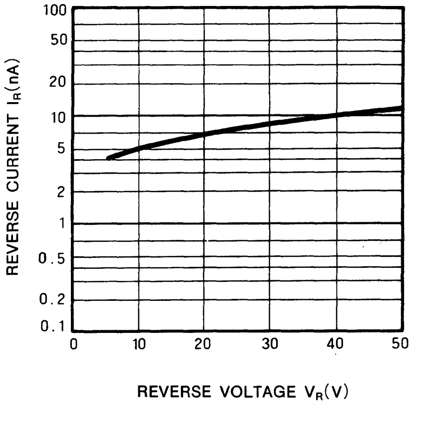


TYPICAL CHARACTERISTICS

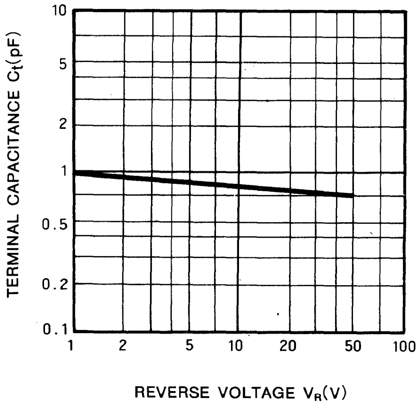
FORWARD CURRENT VS FORWARD VOLTAGE



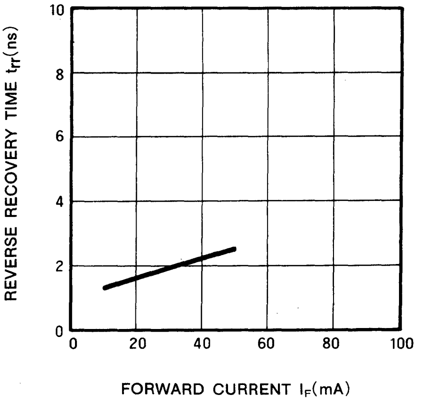
REVERSE CURRENT VS REVERSE VOLTAGE



TERMINAL CAPACITANCE VS REVERSE VOLTAGE



REVERSE RECOVERY TIME VS FORWARD CURRENT



MC931

HIGH-SPEED SWITCHING/SILICON EPITAXIAL TYPE (SERIES TYPE)

DESCRIPTION

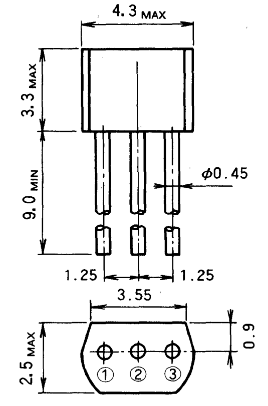
The MC931 is a silicon epitaxial double diode employing small epoxy molded package.
It is designed for high-speed switching applications.
Owing to the small terminal capacitance and the short switching time (reverse recovery time), this diode usable not only for high-speed switching applications but also for protection, bias and other circuits.
Moreover, this is small in size and double, it is suitable for high-density mounting applications.

FEATURES

- Small terminal capacitance
- High speed switching
- High voltage
- Two devices connected in series
- Good maching characteristics
- Double device and compact format reduce dimensions and enhance high-density mounting.

OUTLINE DRAWING

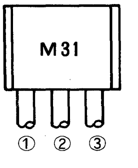
UNIT : mm



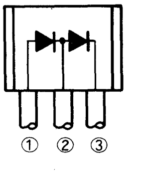
TERMINAL CONNECTIONS
① : ANODE 1
② : CATHODE 1 + ANODE 2
③ : CATHODE 2

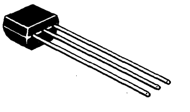
EIAJ : –
JEDEC : –

MARK



INTERNAL CONNECTIONS





3-pin molded plastic SIL

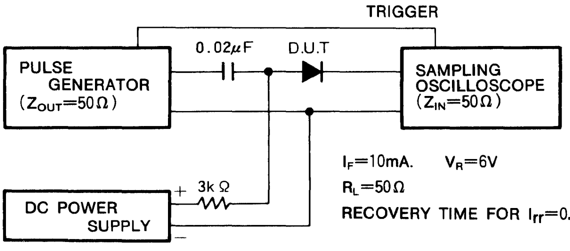
ABSOLUTE MAXIMUM RATINGS (T_a=25℃)

Symbol	Parameter	Limits	Unit
V_{RM}	Peak reverse voltage	75	V
V_R	Reverse voltage	50	V
I_{FSM}	Forward surge current	4	A
I_{FM}	Peak forward current	300	mA
I_O	Average rectified current	100	mA
P_T	Power dissipation	300	mW
T_j	Junction temperature	+125	℃
T_{stg}	Storage temperature	−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃)

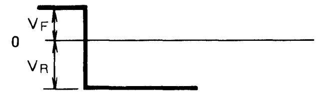
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{F1}	Forward voltage	I_F=10mA		0.68	0.9	V
V_{F2}	Forward voltage	I_F=50mA		0.82	1.0	V
V_{F3}	Forward voltage	I_F=100mA		0.92	1.2	V
I_R	Reverse current	V_R=50V			0.1	μA
C_t	Terminal capacitance	V_R=0, f=1MHz		1.2	4.0	pF
t_{rr}	Reverse recovery time	(See measurement circuit)			4.0	ns

REVERSE RECOVERY TIME(T_{rr}) MEASUREMENT CIRCUIT

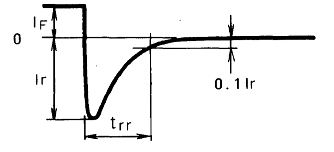


I_F=10mA. V_R=6V
R_L=50Ω
RECOVERY TIME FOR I_{rr}=0.1Ir

● INPUT VOLTAGE WAVEFORM

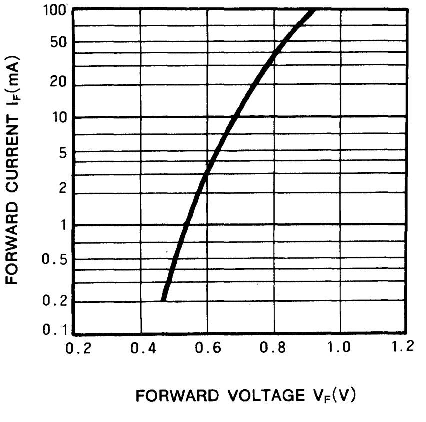


● WAVEFORM OF CURRENT FLOWING TO DIODE

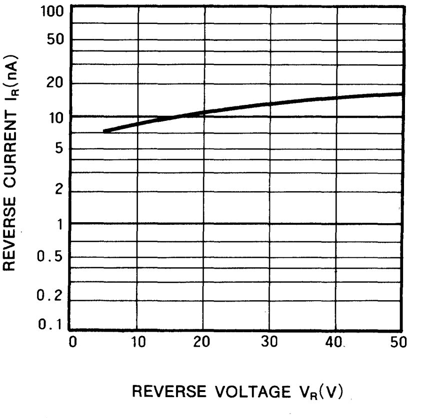


TYPICAL CHARACTERISTICS

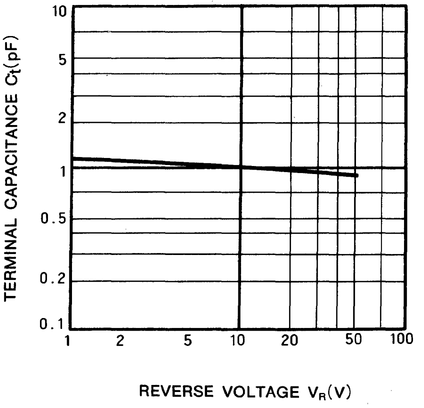
FORWARD CURRENT VS FORWARD VOLTAGE



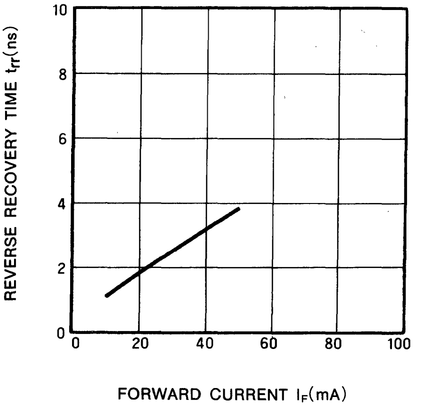
REVERSE CURRENT VS REVERSE VOLTAGE



TERMINAL CAPACITANCE VS REVERSE VOLTAGE



REVERSE RECOVERY TIME VS FORWARD CURRENT



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