CONTROL DATA®
3256-A/B/C, 3659-A
LINE PRINTER CONTROLLERS

REFERENCE MANUAL

REVISION RECORD

REVISION	DESCRIPTION
A	Manual released; this publication obsoletes the 3256-A, 3659-A Line Printer Controllers section
(10-1-70)	of the 3000 SERIES PERIPHERAL EQUIPMENT Reference Manual, Pub. No. 60108800. Information
	contained herein is the same as that found in Rev. U of the obsolete manual.

Publication No.
60332500

PREFACE

This publication contains reference information for CONTROL DATA® 3256-A/B/C, 3659-A Line Printer Controllers which may be used in conjunction with standard Control Data 300 series data channels. The reader should be familiar with characteristics of the 3000 series data channels.

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FIGURES

TABLES

3659 LINE PRINTER CONTROLLER

3256-A/B/C, 3659-A LINE PRINTER CONTROLLERS

The CONTROL DATA* 3256 and 3659 Line Printer Controllers facilitate printing of data received from standard 3000 Series data channels. Either controller may be used to operate the CONTROL DATA 501 Printer (1,000 lines per minute) or the 505 Printer (500 lines per minute). (See Figure 1.)

This manual describes the disassembly of data received from the data channel. It also describes the Connect, Function, and Status codes and provides pertinent programming information.

FUNCTIONAL DESCRIPTION

3256 CONTROLLER

The 3256 Controller has one write control. This control can be physically attached** to one 3000 Series data channel. Thus, the 3256 Controller can be connected by the channel at any time without the possibility of a connect reject.

A special error checking option may be installed in the 3256 Controller. See 3256 Error Checking Option for programming information.
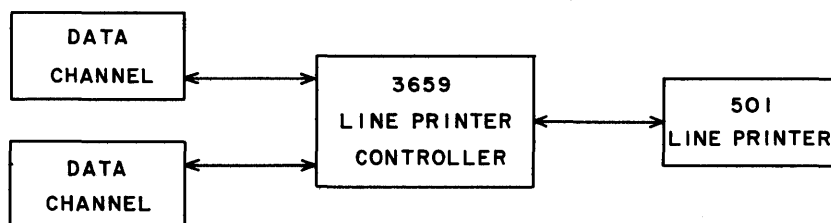

Figure 1. Typical Configuration

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**Though a control may be physically attached to a data channel, it does not respond to Function or Input/Output instructions until it has been connected by a Connect instruction.

3659 CONTROLLER

The 3659 Controller has two write controls. Each control can be physically attached to one 3000 Series data channel. Either channel, through its associated control, can communicate with the printer provided it is not in use or reserved by the other channel.

The data channels serving the 3659 Controller need not be associated with the same central processor.

With the preceding exceptions, the following information is applicable to both controllers.

PRINT OPERATION

The printer system (controller plus basic printer) disassembles a series of 12-bit bytes from the data channel into 6-bit BCD codes and prints a character corresponding to each code.

In a printed line, the character designated by the upper 6 bits of a byte precedes the character corresponding to the lower 6 bits. Each line of print contains up to 136 characters; thus, 68 bytes are required to form a full line.

The controller forms each line of print in a buffer memory. After 68 bytes have been received, the controller temporarily stops accepting data and begins the actual print operation. When the line has been printed, the controller starts to form the next line in the buffer memory. After a line is printed, the paper is automatically advanced one space if not other spacing operation is programmed.

If the data channel terminates an Output operation before a full line is formed, the partial line is printed. A new Output operation starts a new line.

Disassembly is automatically suppressed when a 6-bit Character Output operation is initiated by one of the following instructions:*

1) OUTC Character-Addressed Output from Storage in which H (bit 18) = 0
2) OTAC Output Character from A

During this type of Output operation, the upper 6 bits of each byte contain zeros. The printer system accepts only the lower 6 bits of each byte; thus a total of 136 bytes are required to form a full line. When the data channel terminates the Character Output operation, the printer system returns to the normal Disassembly mode of operation.

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*Applicable to 3100/3200 systems only

PAPER ADVANCE

The printer system has a very flexible paper advancing system that is controlled by function codes. Certain function codes, such as Single Space and Double Space, cause spacing operations to occur directly. Other codes turn spacing control over to the printer's format tape reader. If no spacing operations are programmed by means of the function codes, the printer automatically single spaces after each line is printed. The eight-level format tape reader can be used to provide any page format desired. A loop of punched tape is the controlling medium. Loops of various lengths can be used to provide different page lengths.

A tape loop contains one frame for each line on the page format. During any spacing operation, the format tape advances one frame each time the paper advances one line. Paper spacing can be programmed to begin automatically after a line is printed or upon receipt of certain function codes. Once a spacing operation begins, the paper (and the tape loop) advances until a hole is detected in a preselected position on the tape.

There are two main types of spacing codes: preprint spacing codes and postprint spacing codes.

A preprint spacing code initiates a one-time spacing operation. An example of these codes is Select Format Tape Level 1 for Preprint Spacing (code 0021). This code causes the paper to advance until a hole is detected in the first level of the tape loop.

Postprint spacing codes setup automatic spacing operations which occur after each line is printed. These codes remain in effect until cleared. An example of these codes is Select Format Tape Level 5 for Postprint Spacing (code 0005). When this code is in effect, a spacing operation begins after each line is printed. The paper advances until a hole is detected in the fifth level of the tape loop.

Tape levels one through six are used to control preprint and postprint spacing operations. A punch in level seven is used to designate the last line of a form. A function code is available that advances the paper to the last line. The top of the form is designated by a punch in level eight. The printer can be programmed to advance paper until the reader senses a hole in level eight.

The section on function codes following Table 1 describes each of the paper spacing codes. Preparation of the format tape is discussed in the Operation and Programming section.

BUFFER MEMORY

These controllers store one line of data (up to 136 characters) in a magnetic core memory until the data is printed. This feature permits the data channel to load one line of characters into the memory at high speed. The data channel can then disconnect to service another device while the slower printing operation is being performed.

PRINTING RATE

A printer system using the 501 Printer can operate at a maximum rate of 1,000 lines per minute. The 505 Printer can print at rates up to 500 lines per minute. To maintain maximum printing rates for either printer, certain programming restrictions must be observed. These restrictions are outlined in the Operation and Programming section.

CONNECT

A control must be connected to its data channel before it can respond to either a Select/ Function instruction or a Write instruction. The connection is accomplished by the Connect instruction; the Connect code (N000) is the lower 12 bits of this instruction. Each control examines every Connect code transmitted from its attached data channel. A control connects and returns a Reply* to the data channel if:

1) The printer is not connected to or reserved by the other data channel.**

2) The N portion of the Connect code matches the setting of the Equipment Number switch.

3) A transmission parity error is not detected.

If the 3659 Controller is connected to or reserved by another data channel or if a Write operation is still in process, a Reject signal*** is returned to the data channel requesting the connect. Equipment status is also made available to that data channel so that the cause for the reject may be determined.

If the N portion of the Connect code does not match the setting of the Equipment Number switch, neither a Reject nor a Reply is returned to the channel from this equipment. Equipment status is not made available to the channel. If the controller is already connected, it automatically disconnects. It does, however, remain reserved for that

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*A Reply signal tells the central processor to process the next instruction.

**3659 Controller (the two-channel controller) only

***A Reject signal tells the central processor to read the next instruction at the reject jump address contained in the Connect instruction.

channel until released, cleared, or given a new equipment number. If neither a Reply nor a Reject is returned to the data channel from any of its attached equipments within 100 microseconds, the central processor generates an Internal Reject.

If a parity error is detected in a Connect code, the device does not connect* and neither a Reject nor a Reply is returned to the data channel. Instead, a red indicator in the Equipment Number switch of each equipment detecting the error lights. These parity error conditions must be cleared by either a Clear Channel instruction or a Master Clear prior to a new connect attempt.

The 3659 Controller contains a channel reservation feature. It may be unconnected and unreserved, connected to a data channel, or reserved by a data channel.

An unconnected and unreserved printer may be connected by any channel serving the controller. Once a channel is connected to a particular unit (i. e., a communication path is established), the printer remains reserved for that channel even though the channel disconnects the printer by connecting (or attempting to connect) to another unit or equipment. Once the printer is reserved by a channel, no other channel has access to it. Since neither a Clear Channel instruction nor a Master Clear from the nonreserving channel has an effect on the printer system, care must be taken to release it when it is not essential to the current program. If more than one channel attempts to connect simultaneously, a scanner determines the channel to be connected.

FUNCTION

Function codes are used to prepare the connected control and/or printer for an Output operation (they have no effect on unconnected controls). Function codes comprise the lower 12 bits of a Select/Function instruction and are transmitted to the control on the 12 data lines. See Table 1 for a complete list of function codes. A detailed description of each code follows the table.

There are two classifications of function codes: operating and nonoperating. Operating codes** cause paper motion and are divided into preprint and postprint codes.

Preprint operating codes initiate paper motion, cause the control to become Busy, and are self-clearing. These codes include: Single Space, Double Space, Advance to Last Line, Page Eject, and Select Format Tape Level X for Preprint Spacing.

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*If the device is connected, it automatically disconnects.
**Operating codes cause the control to become Busy.

Postprint codes do not initiate paper motion. Instead, paper motion is initiated automatically following the printing of a line of data. The postprint codes are Auto Page Eject and Select Format Tape Level X for Postprint Spacing. They may be cleared by the Clear Format Selection code, the Select Format Tape Level X for Preprint Spacing code, a Clear Channel instruction, or a Master Clear.

The remaining codes are considered nonoperating. They are not accepted during a printing operation but are accepted while an operating function is being executed.

A control examines only one code at a time. First, it checks for parity errors. If none are found, it returns a Reply provided the function code is legal and the request can be performed. If the code is illegal or if it cannot be performed, a Reject is returned to the channel.

If a parity error is detected, the requested function is not performed, a Parity Error signal is returned to the data channel, and a red indicator in the Equipment Number switch lights. Since neither a Reply nor a Reject is returned to the data channel, the central processor generates an Internal Reject after a wait of 100 microseconds.

These parity error indications must be cleared by either a Clear Channel instruction or a Master Clear. The equipment must then be reconnected before a new function code can be examined by the control.

INTERRUPTS

Interrupts provide a means for attaining optimum utilization of a system's capabilities. Basically, the system interrupts (halts) the main program and initiates an interrupt processing program* when an Interrupt signal is detected by the processor.

The controllers can be programmed to send an Interrupt signal to the processor when any one of the conditions specified by the three interrupts** materializes.

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*See the system reference manual for the addresses pertinent to interrupt processing.

**See explanation of function codes following Table 1 for a list of these conditions.

A Select Interrupt code permits the controller to consider as a group* several of the operating conditions which may occur. If a specific interrupt has been selected and if at least one of the conditions specified by it occurs in the connected unit, the controller sends an Interrupt signal to the processor. If the interrupt system in the processor has been set to recognize the interrupt, the main program is interrupted and control is transferred to a specific program address. Status sensing and followup operations may follow. If desired, control may be returned to the main program by an appropriate Jump instruction located at the close of the interrupt processing program.

If the processor's interrupt system has not been enabled, it is still possible to sense for these conditions via Sense Status and Copy Status instructions written into the main program.

Regardless of which of the above actions is followed, the Interrupt signal remains up until cleared by reselecting the interrupt, selecting release, or master clearing the system. The Interrupt signal is transmitted on the equipment's interrupt line via the data channel currently connected to or reserving the equipment or, in the case of a single-channel controller, via the physically connected data channel whether or not the channel is currently servicing the equipment.

The eight-position (0-7) Equipment Number switch determines the number of the line on which the Interrupt signal is transmitted. For example, if the Equipment Number switch is set at 5, all Interrupt signals coming from this control are transmitted on interrupt line 5. Since each equipment attached to a data channel has a unique equipment number, each uses a different interrupt line. A Channel Product Register Jump Instruction** or a Copy Status Instruction*** can identify the equipment sending the Interrupt signal by inspecting the interrupt lines.

STATUS

Status codes permit the monitoring of several control/unit operating conditions. These codes are made available to the data channel over 12 status lines following a connect or a rejected connect attempt. Sense Status and Copy Status instructions make these codes available to the central processor.

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*See explanation of function codes following Table 1 for a breakdown of the three possible groups.

**3600/3800 systems

***3100/3200/3400 systems

See Table 1 for a complete list of these codes. If two or more conditions exist simultaneously, the Status Response code is the sum of the individual codes. A detailed description of each code follows the table.

PARITY CHECKING (TRANSMISSION)

Connect codes, function codes, and data are transmitted between the data channel and the controller in odd parity (i.e., the number of "1" bits transmitted must be odd. If the number of "1" bits in a data byte is even, a "1" is transmitted on the parity line to make the total number of "1" bits odd.* If the number of "1" bits in the data byte is odd, the "1" is not transmitted on the parity line.

A transmission parity error exists if the total number of "1" bits transmitted on the 12 data lines plus the parity line is even, indicating that a bit has been lost or picked up.

Parity Error in a Connect Code

If a parity error is detected in a Connect code, the device does not connect** and neither a Reject nor a Reply is returned to the data channel. Instead, a red indicator in the Equipment Number switch of each equipment detecting the error lights. These parity error conditions must be cleared by either a Clear Channel instruction or a Master Clear prior to a new connect attempt.

Parity Error in a Function Code

If a parity error is detected, the requested functions are not performed, a Parity Error signal is returned to the data channel, and a red indicator in the Equipment Number switch lights. Since neither a Reject or a Reply is returned to the data channel, the central processor generates an Internal Reject after a wait of 100 microseconds. These parity error indications must be cleared by a Clear Channel instruction or a Master Clear.*** The equipment must then be reconnected before a new function code can be examined by the controller.

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*Do not confuse this line with the parity error line.

**If the device is connected, it automatically disconnects.

***Though operations may continue normally, the validity of a new function code and/or data prior to a Master Clear or Clear Channel instruction is questionable.

Parity Error in Output Data

If a transmission parity error is detected during a Write operation, the control sends both a Reply and a Parity Error signal to the data channel. A red indicator in the Equipment Number switch also lights.

The data is stored in printer memory but not printed. Three options are available at this point.

1) A Clear Channel instruction or a Master Clear may be executed. In this case, the control must be reconnected, the appropriate function reselected, and the line of data transmitted to the printer a second time.

2) The STOP switch and then the START switch may be pressed. In this case, only the line of data in printer memory is printed.

3) The PARITY ERROR OVERRIDE switch may be pressed. In this mode, printing continues without regard to parity errors. In the last two cases, the validity of the data printed is questionable.

Parity error indications are cleared by pressing the STOP and START switches in sequence, a Clear Channel instruction, or a Master Clear. If the stop/start sequence is used, the input/output parity bit in the data channel remains set.

Input/Output Parity Error Bit in the Data Channel

The input/output parity error bit is set whenever a transmission parity error is detected. If the error is detected by the external equipment, the bit is set by the Parity Error signal.

In 3400/3600/3800 systems, an Interrupt signal is generated when this bit sets. If the interrupt system has not been set to detect the setting of this bit, the bit may be sensed to detect parity error conditions.

In 3100/3200 systems, the bit must be sensed if transmission parity error conditions are to be detected by the central processor.

Refer to the appropriate system reference manual for more information on the input/ output parity error bit.

3256 ERROR CHECKING OPTION

An optional error checking feature is available for the 3256 Controller. This option automatically checks each line printed for:

1) A positive printout of a character* in each column programmed for printing.

2) An erroneous printout of a character in a column not programmed for printing.

3) A printout of more than one character per column (overprint).

If a print error is detected, the following occurs:

1) A "1" is sent on the error status line (status bit 10).

2) The controller sends an Interrupt signal if Interrupt on Abnormal End of Operation has been selected.

CODES

Tables 1 and 2 list the codes applicable to the printer system. Connect, Function and Status codes are defined in the section following Table 1. In all discussion of codes, bit 0 is the rightmost bit.

TABLE 1. CONNECT, FUNCTION, AND STATUS CODES

Connect	
Connect Printer	N000**
Function	
Release and Disconnect	0000, 0040
Single Space	0001
Double Space	0002
Advance to Last Line	0003
Page Eject	0004
Auto Page Eject	0005
Suppress Space	0006
Clear Format Selection	0010
Select Format Tape Level 1 for Postprint Spacing	0011
Select Level 2	0012
Select Level 3	0013

*This check does not assure that the correct character was printed.

**N = equipment number of the control

TABLE 1. CONNECT, FUNCTION, AND STATUS CODES (Cont'd)

Function (Cont'd)	
Select Level 4	0014
Select Level 5	0015
Select Level 6	0016
Select Preprint Spacing	0020
Select Format Tape Level 1 for Preprint Spacing	0021
Select Level 2	0022
Select Level 3	0023
Select Level 4	0024
Select Level 5	0025
Select Level 6	0026
Select Interrupt on Ready and Not Busy	0030
Release Interrupt on Ready and Not Busy	0031
Select Interrupt on End of Operation	0032
Release Interrupt on End of Operation	0033
Select Interrupt on Abnormal End of Operation	0034
Release Interrupt on Abnormal End of Operation	0035

Status	
Ready	XXX1
Busy	XXX2
Paper Out	XX1X
Last Line of Form	XX2X
Interrupt on Ready and Not Busy	X2XX
Interrupt on End of Operation	X4XX
Interrupt on Abnormal End of Operation	1XXX
Error*	2XXX
Reserved (by other channel)	4XXX

CONNECT CODE

*Connect Printer (N000)***

This code connects the printer. N must match setting of Equipment Number switch.

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*From 3256 Controllers equipped with the error checking option only

**N = equipment number of the control

Release and Disconnect (0000 and 0040)

These codes which clear the existing connect, channel reserve, and existing interrupt selections are effective only if received from the connected data channel. Either one is recognized and replied to by the printer immediately upon receipt.

Single Space (0001)

This code advances paper one line. It does not clear postprint spacing selections. It is self-clearing.

Double Space (0002)

This code advances paper two lines. It does not clear postprint spacing selections, and it is self-clearing.

Advance to Last Line (0003)

This code advances paper until a hole is detected in format tape level seven. The last line of the form that may be printed should then be in position for printing. This code does not clear postprint spacing selections. It is self-clearing.

Page Eject (0004)

This code advances paper until a hole is detected in format tape level eight. The first line of the new form to be printed should then be in position for printing. This code does not clear postprint spacing selections. It is self-clearing.

Auto Page Eject (0005)

This code, together with the detection of a hole in format tape level seven, advances the paper until a hole is detected in format tape level 8. Format tape level seven indicates the last line of the form that may be printed. Format tape level eight indicates the first line of the new form that may be printed. Auto Page Eject takes precedence over all other postprint spacing selections.

Suppress Space (0006)

This code suppresses the next postprint spacing operation. It is ignored by preprint spacing operations, and it is self-clearing.

Clear Format Selection (0010)

This code clears all format selections as well as Auto Page Eject. It then places the printer in Postprint Automatic Single Space mode.

Select Format Tape Level X for Postprint Spacing (001X)*

These codes cause automatic advancement of paper following each print operation. Advancement continues until a hole is detected in the selected level. The selections are cleared by Clear Format Selection (0010), Select Preprint Spacing (0020), a Clear Channel instruction, or a Master Clear.

Select Preprint Spacing (0020)

This code clears all postprint spacing selections except Auto Page Eject. It must be used prior to selecting a tape format level for preprint spacing. It does not initiate paper motion.

Select Format Tape Level X for Preprint Spacing (002X)*

These codes initiate the advancement of paper. Advancement continues until a hole is detected in the selected level. These selections are self-clearing.

Select Interrupt on Ready and Not Busy (0030)

This code causes the control to send an Interrupt signal to the processor when the printer system is Ready and Not Busy (i.e., power is applied, paper is in position, the START switch is lighted, data is not being transmitted to printer memory, and no paper motion is in progress). The control accepts and replies to this code on receipt. Once up, the Interrupt signal remains up until cleared by reselecting the interrupt (0030), selecting release (0031), Clear Channel instruction, or Master Clear.

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*X designates any one of the lower 6 tape levels.

Release Interrupt on Ready and Not Busy (0031)

This code clears an Interrupt on Ready and Not Busy selection and the Ready and Not Busy Interrupt signal if it is up. The control accepts and replies to this code on receipt.

Select Interrupt on End of Operation (0032)

This code causes the control to send an Interrupt signal to the processor when a line of data has been printed. (Selected postprint paper motion is also initiated at this time.) The code also causes an Interrupt signal to be returned 14 milliseconds after completion of any preprint paper motion if memory has not been reloaded.

If memory is loaded during preprint paper motion, an Interrupt signal is returned following printing of the data only.

The control accepts and replies to this code on receipt. Once up, the Interrupt signal remains up until cleared by reselecting the interrupt (0032), selecting release (0033), Clear Channel instruction, or Master Clear.

Release Interrupt on End of Operation (0033)

This code clears an Interrupt on End of Operation selection and the End of Operation Interrupt signal if it is up. The control accepts and replies to this code on receipt.

Select Interrupt on Abnormal End of Operation (0034)

This code causes the control to send an Interrupt signal to the processor when an abnormal end of operation occurs. The control accepts and replies to this code on receipt. Once up, the Interrupt signal remains up until cleared by reselecting the interrupt (0034), selecting release (0035), Clear Channel instruction, or Master Clear.

Release Interrupt on Abnormal End of Operation (0035)

This code clears an Interrupt on Abnormal End of Operation selection and the Abnormal End of Operation Interrupt signal if it is up. The control accepts and replies to this code on receipt.

STATUS CODES

Ready (XXX1)

Bit 0 is set when the printer is mechanically Ready.

Busy (XXX2)

Bit 1 is set when data is being printed, paper is being advanced, or memory is being loaded.

Paper Out (XX1X)

Bit 3 is set when there is no paper under the print head.

Last Line of Form (XX2X)

Bit 4 is set when a hole is detected in format tape level seven. This should indicate the last line of the form in position for printing.

Interrupt on Ready and Not Busy (X2XX)

Bit 7 is set if Interrupt on Ready and Not Busy is selected and this condition now exists.

Interrupt on End of Operation (X4XX)

Bit 8 is set if Interrupt on End of Operation is selected and at least one condition specified by the selection exists.

Interrupt on Abnormal End of Operation (1XXX)

Bit 9 is set if Interrupt on Abnormal End of Operation is selected and at least one condition specified by the selection now exists.

Error (2XXX)*

Bit 10 is set when a print error is detected.

Reserved (by other channel) (4XXX)**

Bit 11 is set when the printer is reserved by the other channel.

CHARACTER CODES

Table 2 lists the printer Character Set and the corresponding codes. Both internal and external BCD codes are shown for each character. Normally, the printer prints according to the internal BCD codes. However, if the computer is operating in 1604 mode, *** external BCD codes must be sent to the printer.

Table 3 shows the printer characters in the order that they appear on the printer drum. To maintain the maximum printing rate, successive characters must fall within 48 consecutive rows on the drum. Table 3 aids the programmer in selecting a 48-row section of the drum.

TABLE 2. CHARACTERS ARRANGED BY INTERNAL BCD CODES

Internal BCD	External BCD	Character Printed		Internal BCD	External BCD	Character Printed
00	12	0		13	13	=
01	01	1		14	14	≠
02	02	2		15	15	≤
03	03	3		16	16	%
04	04	4		17	17	[
05	05	5		20	60	+
06	06	6		21	61	A
07	07	7		22	62	B
10	10	8		23	63	C
11	11	9		24	64	D
12	00	: (colon)		25	65	E

*From 3256 Controller equipped with error checking option
**3659 Controller only
***3600/3800 systems only

TABLE 2. CHARACTERS ARRANGED BY INTERNAL BCD CODES (Cont'd)

Internal BCD	External BCD	Character Printed		Internal BCD	External BCD	Character Printed
26	66	F		53	53	$
27	67	G		54	54	*
30	70	H		55	55	↑
31	71	I		56	56	↓
32	72	<		57	57	>
33	73	.		60	20	blank
34	74	)		61	21	/
35	75	≥		62	22	S
36	76	⌐ (NOT)		63	23	T
37	77	;		64	24	U
40	40	-		65	25	V
41	41	J		66	26	W
42	42	K		67	27	X
43	43	L		70	30	Y
44	44	M		71	31	Z
45	45	N		72	32	]
46	46	O		73	33	,
47	47	P		74	34	(
50	50	Q		75	35	→
51	51	R		76	36	≡
52	52	v (OR)		77	37	∧ (AND)

TABLE 3. CHARACTERS ARRANGED BY CHARACTER ROWS

Character Row	Character Printed	Internal BCD	External BCD		Character Row	Character Printed	Internal BCD	External BCD
1	0	00	12		10	9	11	11
2	1	01	01		11	A	21	61
3	2	02	02		12	B	22	62
4	3	03	03		13	C	23	63
5	4	04	04		14	D	24	64
6	5	05	05		15	E	25	65
7	6	06	06		16	F	26	66
8	7	07	07		17	G	27	67
9	8	10	10		18	H	30	70

TABLE 3. CHARACTERS ARRANGED BY CHARACTER ROWS (Cont'd)

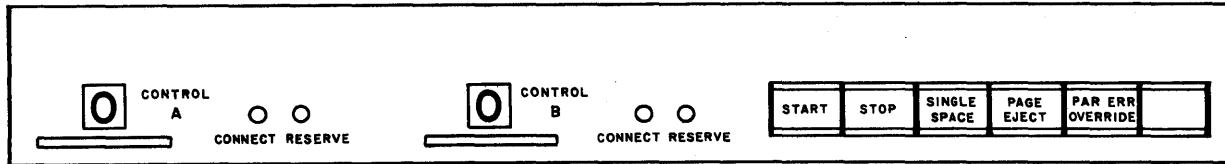| Character Row	Character Printed	Internal BCD	External BCD		Character Row	Character Printed	Internal BCD	External BCD
19	I	31	71		44	* (asterisk)	54	54
20	J	41	41		45	, (comma)	73	33
21	K	42	42		46	≠ (not equal)	14	14
22	L	43	43		47	$ (dollar sign)	53	53
23	M	44	44		48	: (colon)	12	00
24	N	45	45		49	≤ (less than or equal)	15	15
25	O	46	46					
26	P	47	47		50	% (per cent)	16	16
27	Q	50	50		51	[(open bracket)	17	17
28	R	51	51					
29	S	62	22		52	] (closed bracket)	72	32
30	T	63	23		53	→ (right arrow)	75	35
31	U	64	24		54	≡ (identity)	76	36
32	V	65	25		55	∧ (logical AND)	77	37
33	W	66	26					
34	X	67	27		56	∨ (logical OR)	52	52
35	Y	70	30		57	¬ (logical NOT)	36	76
36	Z	71	31					
37	. (period)	33	73		58	↑ (arrow up)	55	55
38	- (minus)	40	40		59	↓ (arrow down)	56	56
39	+ (plus)	20	60		60	> (greater than)	57	57
40	= (equals)	13	13					
41	((open parenthesis	74	34		61	< (less than)	32	72
					62	≥ (greater than or equal)	35	75
42	) (closed parenthesis)	34	74		63	; (semi-colon)	37	77
					64	blank (no character)	60	20
43	/ (slash)	61	21					

SWITCHES AND INDICATORS

Figure 2. 3659 Controller Switch and Indicator Panel

EQUIPMENT NUMBER SWITCH

An eight-position Equipment Number switch is associated with each control. The setting of this switch (0-7) designates the control and corresponds to the N portion of the Connect code. It also determines the number of the interrupt transmission line used by the equipment.

A white indicator in this switch is lighted whenever power is applied to the control. A red indicator in this switch is lighted when a transmission parity error is detected. The Parity Error indicator is turned off by a Clear Channel instruction, Master Clear, or by pressing the STOP and START switches in sequence.

RESERVE INDICATORS

The RESERVE indicator associated with a control is lighted when the control is reserved by its associated data channel.

CONNECT INDICATORS

The CONNECT indicator associated with a control is lighted when the control is connected to its associated data channel.

START SWITCH

This momentary-contact switch puts the printer under computer control. A white indicator in the switch lights when the printer is Ready.

This switch may also be used to force the completion of a page if the printer has stopped due to a low paper supply. One line is printed each time the switch is pressed. This action may be repeated until a hole is detected in format tape level eight. The START switch is of no further value until the paper supply is replenished. Then it causes printing to continue without a loss of information.

STOP SWITCH

This momentary-contact switch causes the controller to become Not Ready. If data is being transferred to printer memory when the switch is pressed, the loading continues to completion. No other data is accepted by the control while the switch is lighted.

CAUTION

Turn off the printer before turning off the 3659/3256 Controller.

SINGLE SPACE SWITCH

This switch advances the paper one line.

PAGE EJECT SWITCH

This switch advances the paper until a hole is detected in format tape level eight. The first line of the new form to be printed on should then be in position for printing.

PARITY ERROR OVERRIDE SWITCH*

This alternate-action switch provides the option of printing or stopping on detection of a data transmission parity error. If the switch is not lighted, operation stops when printer memory is loaded. If it is lighted, printing continues without regard to parity errors.

ERROR OVERRIDE SWITCH

This alternate-action switch provides the option of printing or stopping on detection of either a parity error or a print error. If the switch is not lighted and either type of error is detected, operation stops when printer memory is loaded. If it is lighted, printing continues without regard to errors.

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*This switch is replaced by an ERROR OVERRIDE switch on 3256 Controllers modified for print error checking.

OPERATION AND PROGRAMMING

OPERATION

Format Tape Preparation

The eight-level format tape is of punched Mylar, approximately 13 inches long, joined
in a continuous loop. This tape contains a number of frames equal to, or a multiple of,
the number of lines on the printed page. If short forms are to be printed, duplicate hole
patterns for several forms can be punched in the tape. Because of the physical charac-
teristics of the reader mechanism, the tape must have a minimum length of 6-1/2 inches.
During any spacing operation, the format tape is advanced one frame each time the
paper advances one line.

As shown in Figure 3, the format tape includes a row of feed holes which engage cogs
on a metal drum and drive the tape. Tape levels one through eight are monitored by a
photocell assembly, and paper is stopped when the selected level is sensed. Levels are
selected by issuing the desired function codes. Selecting any level one through six
for postprint spacing provides a means of extending the automatic single space feature
to include more than one line. For example, if function code 0014 is selected, paper
starts moving after each line is printed and continues to move until the photocells sense
a hole in level four of the tape. By using the preprint function codes, paper may be
moved before printing. Preprint spacing operations are also controlled by holes in tape
levels one through six.

Level eight must always contain only one hole punched in the first frame. This level may
be selected by function code 0004 or by pressing the PAGE EJECT switch on the control
panel. When selected, level eight moves paper to the top of the form.

Level seven must also contain only one hole which corresponds to the last line of print.
This hole may be punched in any frame according to the desired format. In the example
shown, the hole in level seven is in frame 62, consequently, the last line was printed on
line 62 of the paper.

In the example (Figure 3), level three contains holes in every third frame, and level
two contains holes in every second. This is a convenient arrangement because the
sample form contains a number of triple spaces and double spaces. Selecting level three
allows printing in lines 7, 10, and 13, double-spacing the main heading and triple-spacing
to the column headings and the first tabulated figures.

FORMAT TAPE

LEVEL NUMBERS

8 7 6 5 4   3 2 1

SAMPLE PAGE LAYOUT

LEVEL 8
(TOP OF PAGE)

LEVEL 5
(FIRST LINE OF FORM)

(2 SPACES)   XXXXXXXX

XXXXXXXXXXXXXXXXXXXXX

(3 SPACES)

LEVEL 3   XXXXXX   XXXXXX   XXXXXX

(3 SPACES)

XXXX   XXXX   XXXX

LEVEL 2   XXXX   XXXX   XXXX

XXXX   XXXX   XXXX

XXXX   XXXX   XXXX

XXXX   XXXX   XXXX

COLUMNS DOUBLE-SPACED

XXXX   XXXX   XXXX

XXXX   XXXX   XXXX

XXXX   XXXX   XXXX

XXXX   XXXX   XXXX

XXXX   XXXX   XXXX

66 TAPE
FRAMES

Figure 3. Spacing Example

LEVEL 4   XXXX   XXXX   XXXX

(3 SPACES)

LEVEL 7
(LAST LINE OF FORM)   XXXXXXXXXXXX

FEED HOLES

DIRECTION
OF MOTION

Referring again to the sample page, note that a line is to be printed eight lines from the bottom on the page. To do this, punch a hole in frame 59 of level four. Also, the double space function used in the preceding lines of print must be cleared and level four selected.

The last line to be printed is three spaces below the preceding line and, as mentioned above, is controlled by level seven of the tape.

After the last line has been printed, level eight must be selected to move paper to the top of the form.

Clearing the Controller

Prior to the initial use of the printer, the system should be cleared. There are four possible ways of clearing the controller:

1) Clear Channel (100 microseconds)
   This instruction:
   a) Clears all activity in the data channel.
   b) Clears any connection the channel may have with the printer.
   c) Releases any reservation the channel may have for the printer.
   d) Performs a Master Clear on write and function logic. No status signals are available to the data channel after executing this instruction.

2) Release and Disconnect (0000 and 0040)
   This function code clears any connection and reservation the channel may have with the printer. The printer must be connected to the channel when this function code is issued. It does not clear reservations made by the other channel.

3) Power On Master Clear
   When power is applied to the controller, printer connections and reservations are cleared. Logic is also cleared. No status signals are available to the data channel after power is applied.

4) External Master Clear
   A Master Clear disconnects the controller, clears the channel reservation, and clears all logic. No status signals are available from the controller after a Master Clear.

Function Codes - Release and Disconnect (0000 and 0040)

Should either of these two codes be received by the control while a line is being printed, the printing operation continues to completion. This is true even if the other channel* connects and issues either a Clear Channel instruction or a Master Clear during this time interval. Since these codes clear existing interrupt selections, the releasing channel does not receive new Interrupt signals. However, should the newly connected channel request interrupts, it receives them when the appropriate conditions occur.

Printing Rate (501 Printer)

A 1,000-line per minute printing rate (up to 136 characters per line) can be maintained on the 501 Printer if:

1) The character set is confined to any 48 consecutive rows on the printer drum (see Table 3).

2) Single spacing is maintained between lines.

3) The data channel begins to load a new line of data into the buffer memory within 11 milliseconds after the End of Operation interrupt is generated at the end of the previous line.

The buffer memory can be fully loaded in 3.5 milliseconds.

Table 3 shows the order of characters on the printer drum and aids the programmer in selecting a 48-row character set. If all 64 characters are used, the printing rate may be reduced to 800 lines per minute with single spacing.

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*3659 Controller only

COMMENT SHEET

MANUAL TITLE ___3256-A/B/C, 3659-A LINE PRINTER CONTROLLERS___

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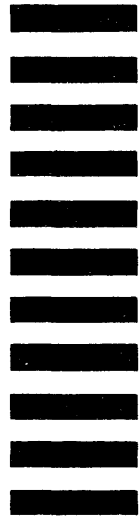
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