Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BI-WEEKLY REPORT, March 14, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEM OPERATION

1.1 Whirlwind I System

(S.H. Dodd)

Some of the storage tubes which we have recently obtained from the storage tube group have been much better than average in reliability of operation and in available margins. If we continue to get tubes of this caliber, prospects are very encouraging for increasing the reliability of storage row to the point where frequent adjustments of gate amplitudes are unnecessary. There are enough marginal tubes in operation at the present time, however, to require many gate amplitude adjustments to keep storage in reasonable operating shape.

The parity check system has been very useful in indicating which storage tubes are causing trouble and has also shown up some unknown low margins in storage tube operation. The parity digit itself has several times been used to replace storage digits which were failing because of inadequate storage tubes. This replacement has been very satisfactory and has allowed reliable operation when it would otherwise not have been obtained.

The deflection trouble noted in the last bi-weekly was definitely traced to plate current variations in some of the 715C amplifiers. These tubes were replaced and this particular deflection trouble disappeared. Another deflection trouble, however, was uncovered. This trouble showed a deflection shift as a function of repetition rate and is now being investigated. Present evidence points to a deflection difficulty in the storage mount or the storage tube itself, but no reason for the shift has been found. Investigation of this trouble will continue.

(H.L. Ziegler)

The situation with regard to ES work remains about the same with the emphasis still on improving theoverall reliability of operation.

Major attention is now being given to the poor register of the reading beam on previously written spots. This poor registering of the read beam is known to be a function of the reading repetition rate

1.1 Whirlwind I System (continued)

(H.L. Ziegler) (continued)

but why this is so is not known at the present time.

This reading difficulty shows up as a change in operating margins on the ES Deflection marginal checking lines. These changes consist of a shift of margins without an increase in range, an increase of the range of margins without a shift, and a combination of these two. Also, a few of the digits show no PRF sensitivity.

It has been pretty definitely established that this effect is not traceable to the deflection system; more than this can not be stated at this time.

(H.F. Mercer)

Operation

The following is an estimate by the Computer operators of the usable percentage of assigned operation time and the errors due to the computer. This covers the period 29 February through 13 March.

Number of assigned hours	88
Number of transient errors	12
Number of steady state errors	6
Number of intermittent errors	38
Percentage of assigned time usable	72
Percentage of assigned time usable since March 1951	85

(H.F. Mercer)

Storage Tube Failures in WWI

The following storage tube failures were reported during this bi-weekly period:

Tube	Hours of Operation	Reason for failure
ST-514	10	Intermittent operation
ST-507	105	Poor margins; severe after storage and HV gun failure.
ST-501	197	Poor margins and excessive drift.
RT-282	971	Poor margins
RT-248	1531	Poor margins
RT-246	1666	Poor margins and excessive drift.
RT-244	1707	Poor margins and HV gun failure

1.1 Whirlwind I System (continued)

(H. F. Mercer) (continued)

Tube	Hours of Operation	Reason for failure
RT-231	1720	Poor margins and HV gun weak.

(H. F. Mercer)

Storage Tube Complement in WWI

Following is the storage tube complement of Bank B as of this date:

Digit	Tube	Hrs. at Install	Hrs. of Operation
0	RT233	4722	1836
1	ST500	6113	445
2	RT247	5198	1360
3	RT234	4705	1853
4	ST509	6439	119
5	RT237	4714	1844
6	ST503	6407	151
7	ST508	6321	237
8	ST505	6176	382
9	ST515	6433	125
10	ST513	6437	121
11	ST511	6392	166
12	RT258	5207	1351
13	ST517	6493	65
14	RT230-R2	4726	1832
15	RT255	5150	1408
16	ST506-1	6218	340

One column gives ES Clock hours at the time of installation for each tube and another column gives the total hours of operation in the computer for each tube through March 14. ES Clock hours this date 6558.

(L. O. Leighton)

Component Failures in WWI

The following failures of electrical components have been reported since February 29, 1952:

Tubes	No. of failures	Hrs. of Operation	Reason for failure
7AD7	1	6043	Grid emission
C16J	1	3565	Change in characteristics

1.1 Whirlwind I System (continued)

(L.O. Leighton) (continued)

Tubes	No. of Failures	Hours of Operation	Reason for failure
715	8	2 - 2500-2900	1 open heater 1 leakage
		6 - 8000-8300	4 low I_b 1 high resistance (Plate connection) 1 gas

1.2 Five-Digit Multiplier

(C.N. Paskauskas)

On March 2 the multiplier started making occasional errors which were finally traced to a 6AG7 which had developed a tap short.

The multiplier was shut down on March 11 for 24 hours to install 35 ceramic disc and tubular condensers for a life test run.

During the period of this report no components were replaced as a result of marginal checking.

As a result of trouble-shooting the following were replaced:

2 6AG7 FF tubes (11586 and 13665 hrs in service)

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.14 Input-Output

(R.H. Gould)

Power has been applied to the switch panels of the In-Out Switch, the In-Out Switch Register Driver and the In-Out Switch Bus Driver. Qualitative checks using the 8-position matrix and the Flexowriter matrix as load have shown that the panels work as expected. Tests using standardized matrix simulating loads are planned to get quantitative data on the flip-flops and matrix drivers of the switch panels. This data may show means of decreasing rise time of the switch.

(A. Werlin)

The layout and interconnection drawings of the plug-in units associated with the terminal equipment have been completed. Details of the few modified units of the system are being laid out and will be sent to drafting. The details of the delay line to be used in the plug-in flip-flop are being drawn up by the drafting room. The assembly drawings of all of the plug-in units and the mounting panel are also being completed by the drafting room.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes

(H.B. Frost, L. Sutro, S. Twicken)

The interface resistance test set using the transconductance bridge in conjunction with a complementary network is being redesigned prior to rebuilding. The objects of the redesign are to make several improvements:

1. Eliminate the need for external meters by building the necessary meters into the equipment.

2. Provide a wider range of variables in the complementary network.

3. Improve the shielding to reduce the effects of extraneous noise.

All tube testing specifications are being revised and brought up to date. These specifications have not been revised for two years. It is expected that complete test specifications, together with limits, will be issued in the standards book when the present work is completed.

2.21 Vacuum Tubes (continued)

(H.B. Frost, L. Sutro, S. Twicken) (continued)

All 715 tubes used in the WWI deflection amplifiers were tested as scheduled on Monday, March 10. A total of 5 tubes were replaced because of excessive changes in the plate current when keyed on. The changes ranged from 15 to 3 ma, only one tube showing the higher value. In addition, one tube was replaced because of excessive gas, one tube for excessive leakage, and one tube for one burned-out heater (out of four heaters per tube). This burn-out occurred during the test. The five tubes which had unstable plate current had over 8000 hours use; of the other defective tubes one was over 8000 hours, the remainder between 2 and 3 thousand hours. Since the trouble was corrected when the tubes were replaced and since suitable marginal checking means are available, this problem does not seem too serious.

Type 2051 tubes and the ARINC equivalent, the 5670, are in short supply. An order which has been in since November has delivery promised for July. At the present time, this type should not be used in experimental equipment where another type will serve without serious loss of performance.

2.22 Transistors

(J. Jacobs, R. Callahan)

A two-transistor flip-flop has been built and operated. Both transistors utilize base stabilization and load switching. The flip-flop was fed from a transistor pulse amplifier which produced pulses of 14 volts amplitude and 0.6 microsecond width.

The flip-flop operated at frequencies up to 300 kilocycles while marginal operation was obtained at 600 kilocycles. The output pulses were of the order of 9 volts amplitude with a rise time of 0.4 microsecond.

(A. Heineck)

Three days, during the past two weeks, were spent investigating a single-transistor flip-flop. The remaining time was used to develop a two-transistor flip-flop. In fact, the whole group attacked the problem of a two-transistor flip-flop, each member investigating a different design. Those which show promise will be further studied.

A clear cut need arose for both a positive and negative transistor pulse amplifier. The next few weeks will be spent improving the positive pulse amplifier now available and developing a negative pulse amplifier.

2.22 Transistors (continued)

(N.T. Jones)

Engineering Report E-451, Variation of Collector Resistance with Collector Voltage, was completed and published.

Standard measurements of the transistors received during the previous bi-weekly period were completed and tabulated during this period. Measurements were also made on six GE transistors belonging to Professor Caldwell and eight Raytheons from AFCRL.

The parameters defined in E-441, Standardized Transistor Parameter Measurements, were discussed with Dr. Robert Rediker and Irwin Lebow from Project Lincoln during the week of March 1. A similar discussion was held on March 14 with three engineers from AFCRL. These discussions, plus laboratory evaluation, will lead to a final set of meaningful parameters.

The circuit for measuring transit time, hole dispersion, and hole storage was set up and some measurements were made. Certain GE and Bell transistors pass a current pulse having a rise time of 0.05 microsecond without change in wave shape, and without time delay through the transistor. Much additional work is to be done to give the complete picture of the high speed response of transistors. The data taken so far will be published as an M-Note in the near future, with the full report earmarked as an E-note to be published in a few weeks.

The life test, mentioned in the last bi-weekly report, has been deferred because of the accidental burn-out of four transistors recently and the lack of the wet battery d-c supply.

(W.A. Klein)

The analyses of two circuits have been completed. The completed analysis of the grounded emitter circuit is to be prepared for M-note publication during the next bi-weekly period. The analysis of the second circuit was checked experimentally with result that the analysis was verified.

In cooperation with Arthur Heineck, the input characteristics of the base stabilized circuit were measured and the results used to predict triggering voltages for this circuit used as a flip-flop. The results of this work are being prepared for publication as an M-note.

2.23 Crystal Diodes

(H.B. Frost, S. Twicken)

Additional diodes of several manufacturers have been tested for dynamic back resistance immediately following 5 ma forward current. Raytheon diodes appear to be poorest in this respect, with G.E. and Sylvania intermediate, and Hughes best. Sufficient data has not been

2.23 Crystal Diodes (continued)

(H.B. Frost, S. Twicken)

accumulated to give anything but a qualitative picture of the situation.

An additional circuit following the design of J.H. Wright of SEAC has been constructed. This circuit is somewhat simpler to use and gives data which is easier to interpret. However, it does not give a good indication of the static back resistance. Mr. Wright presented extensive data on this subject at the recent IRE convention.

2.3 Ferromagnetic and Ferroelectric Cores

(B. Widrowitz)

16 x 16 Metallic Array

Buffer amplifiers that operate between flip-flop panels and the read and write current gate generators have been designed and put into operation. Rise and fall times of the drivers have been set at 1/2 microsecond while under control of the flip-flops.

Other buffer amplifiers have been designed to operate between the plug-in flip-flop address selectors and the X and Y crystal matrices.

The array has run for many errorless hours at a 4 kc prf with a switching time of 5μs. in the 3:1 selecting-current ratio mode.

(E. Guditz, W. Papian)

Ceramic Array and Switch I

Data taken on the delay-line effect of the series-driven switch-core primaries indicate that no serious trouble should be encountered with the present setup until the array gets to be a 16-by-16 or larger.

Four-by-four squares have been operated over the 256-core array. Fairly stable operation was accomplished over some portions; the entire top row and 14 scattered cores did not operate stably. Data is being gathered while preparations for 8-by-8 operation continue.

(K.H. Olsen)

Ceramic Array and Switch II

A second ceramic array is being assembled so that the first array will not be slowed down by the thesis research. The new array will be used first to study the design of a switch and to obtain data for an equivalent circuit of the switch. Most of the equipment has been assembled and it is believed that the thesis will not be delayed by this new project.

2.3 Ferromagnetic and Ferroelectric Cores (continued)

(R.C. Sims)

Magnetic-Core Computer Elements

A thesis proposal entitled "A Binary Adder Using a Magnetic-Core Flip-Flop", is in preparation.

A good portion of the thesis will be an investigation of a magnetic-core flip-flop which is a modification of a circuit designed and built by Dudley Buck. The circuit and test equipment used by Buck and Guditz have been located and the data (a considerable amount) that was taken by Guditz has been gone over. The starting point of the thesis will be some further consideration of this data and some more experimental work with this equipment.

(R. Best)

Pulse-Test Equipment

A general purpose metallic core tester is now in the shop. It is simpler than anything we now have, and will be suitable for use by outside concerns.

(D.R. Brown)

Pulse-Test Equipment

The single-core tester for General Ceramics is now complete and will be set up in New Jersey next week.

(H.D. Neumann)

Measurements of the initial permeability for ferromagnetic semi-conductors were made at 3000 mc.

(R.D. Robinson)

Pulse Transformers

We received some sample torroids from Stackpole Carbon Co. which apparently are a satisfactory material for our pulse transformers. These cores are quoted at 5¢ per core, which is a more reasonable quotation than we have been getting from other companies. On the basis of this we have asked Stackpole to quote on our C-shape.

An interesting treatise on pulse transformer design by N.F. Moody was found in the library of Bldg. 20. This seems to be the best information source on low power pulse transformers of which we have knowledge.

2.3 Ferromagnetic and Ferroelectric Cores (continued)

(R.D. Robinson) (continued)

We are going to have to either build or buy a signal source capable of producing square waves of 0.1 μsec duration with a rise time at least as good as 0.01 μsec at amplitudes up to 15 or 20 volts. This source is needed to take some quantitative data on judging pulse transformer cores. Suggestions for such a signal source are welcome.

A small coil winder for winding coils on a form for C-shapes was built and found quite useful.

(R.E. Hunt)

Pulse Transformers

We are proceeding towards getting into production on small plastic imbedded pulse transformers, wound on 3/8" OD Ferrite Cores. A method of tumbling the cores to remove the sharp corners has been evolved. This can be accomplished cheaply on a mass production basis.

A further method for applying a sprayed-on coat of lacquer to the cores has been evolved. This also can be done cheaply and rapidly. We will make up two dozen of these transformers for further tests by the systems group and B. Paine.

(W. Ogden)

Single-Core Pulse-Test Equipment

Testing of the MF 1118 (259) Ferramic Core was continued and several additional curves were plotted. The following prints are available:

SA-48319-G	Disturbed One and Disturbed Zero vs Temperature
SA-48324-G	Disturbed Signal Ratio vs Temperature
SA-48320-G	Disturbed One Family at various Pulse Rise Times
SA-48321-G	Disturbed Zero Family at various Pulse Rise Times
SA-48322-G	Disturbed One and Disturbed Zero vs Pulse Rise Time
SA-48323-G	Disturbed Signal Ratio vs Pulse Rise Time

2.6 Component Analysis

(B.B. Paine)

The third summary of component analysis has just been issued as M-1423. This includes comments on a few of the new components seen at the IRE Convention.

Since one manufacturer of ceramic capacitors has mentioned that they may not be entirely satisfactory in pulse circuits, we have replaced all the micas in one digit of the A-Register and selected capacitors in one digit of the B-Register and the Accumulator of the five-digit multiplier with appropriate ceramic tubulars and diskaps.

Hipot testing equipment has been built for checking terminal strips, BNC connectors, and the like.

3.0 STORAGE TUBES

3.2 Test

(P. Youtz)

Experiments with the processing techniques of storage tubes were continued in order to produce tubes with lower minimum V_{HG}. After a series of experiments, ST517 was processed to reproduce the results obtained with ST505. Since ST517 was satisfactory, we have processed all succeeding tubes in a similar manner. These recent tubes have had a lower V_{HG}. However, the shrinkage of recent storage tubes has been high because of buckling mica targets. We have dissected enough tubes to locate the cause of the trouble and have remedied it.

Two special electron guns have been obtained from the Advanced Development Laboratories of IBM. These guns will be studied in special research tubes this next period.

(A. J. Cann, R. E. Hegler)

During this period, eight tubes were pretested: ST514, ST513, ST515, ST517, ST516, RT278-R1 and RT308.

ST514 was marginal, maximum V_{HG} was 190 V.

ST513 was marginal, high minimum V_{HG} and some surface blemishes.

ST516 and ST515 were marginal, high minimum V_{HG}.

RT278-R1 was rejected because of low maximum V_{HG}, due to a loose collector screen.

RT308 was rejected because of a loose collector screen. A spot just to the right of center would switch positive at V_{HG} = 115 V. This was sent to STRT for further investigation.

ST517 was satisfactory.

The point of lower switching was examined on some old tubes to complete a graphical history.

The storage tube summary for the month of February has been written and will be published next week (M-1422)

One tested 500 V regulator and one untested 600 V rectifier have been received from Gordon Kerby.

The file of drawings of the TVD is now complete.

3.0 STORAGE TUBES (Continued)

3.2 Test (Continued)

(J. Jacobowitz, T. S. Greenwood, C. L. Corderman)

The following storage tubes were examined at the STRT and found to be satisfactory for use in the computer: ST509, ST511, ST513, ST514, ST515, ST516 and ST517.

RT308, which was rejected at pretest because of a loose collector screen, was also tested at the STRT. Although there was ample evidence of a loose collector, the tube had good margins under normal operating conditions.

ST514, which also had a loose screen, gave considerable trouble in the computer. Various tests were performed in an attempt to make the tube fail in spite of the large margins on the normal test program. The only thing uncovered was that the tube had difficulty in cycling a single negative spot through a positive array but there may have been trouble in the external equipment. Further tests will be undertaken to determine a suitable test to be included in the checkout of all tubes.

In our last bi-weekly we mentioned that ST512 was still under observation because of a loss of emission in both guns. During this period, the guns failed completely and the tube was reprocessed as ST512-R1. However, in the reprocessing the high velocity gun was rotated so much that it was necessary to use a smaller array than normal. Under these conditions, the tube had a relatively narrow range of operation. The tube also exhibited pronounced after-storage effects following a week-end test.

Using RT305, which had a calcium tungstate surface, we were able to study a 32 x 32 array visually. The effects of varying the dag voltage, the focusing voltage, the average deflection level and the beam current were recorded photographically. In addition to the expected keystoning effect, a curvature of the array was noticed. It was found that large and small spots focus best under different conditions, but that there is an average deflection level at which spots from both large and small currents focus best. The level of the vertical plates seems more important than the level of the horizontal plates, with the point of optimum focus being approximately equal to the second anode.

One very interesting effect which has been observed many times, but which should be mentioned because it was shown so

3.0 STORAGE TUBES (Continued)

3.2 Test (Continued)

(J. Jacobowitz, T. S. Greenwood, C. L. Corderman) (Continued)

graphically in this tube, is the rather large shift in the HV beam position when the holding gun is turned on and off. The magnitude of this shift seems to be more than could be reasonably expected.

RT244 was rejected from Whirlwind because of low margins and this condition was verified at the STRT. The data needs to be repeated, however, for a shift in V_{A2}, due to a faulty rack power control unit, was later discovered. This tube was also useful for a series of special tests attempting to simulate and study the recent deflection-shift troubles observed in the deflection system of the computer. Our program consisted of writing a plus array, then shifting the array until errors would occur while simply reading. A battery was installed in the -150 return of the deflection amplifier and margins were observed as a function of the RSPG for fast and slow reading cycles. So far no definite conclusions seem possible except that we were not able to duplicate the results found in Whirlwind. These tests will be repeated because of the drop in the V_{A2} voltage.

(H. J. Platt)

Tubes from Bank B which have low margins are now being released from Whirlwind. Heretofore, all rejects from the computer have been "dead" tubes. Thus, we now have storage tubes which we can test to obtain comparison data on the testing methods.

Six tubes have been rejected for low margins to date. They are RT244, RT246, RT248, RT282, RT300 and ST501. The hours of operation in the computer for these storage tubes varies from one to sixteen-hundred hours. As time is available on the TVD and the STRT, these tubes are being given the standard tests. The direct-coupled holding gun grid driver discussed in the last bi-weekly has proved to be a little cumbersome because two additional negative voltages are needed. It was thought that a floating power supply added to the -300 volt within the driver's chassis would suffice. However, the number of tubes and components does not seem to be warranted. Therefore, I have returned to using an 829B flip-flop circuit which will have enough drive to cut off the holding gun. A breadboard is now under construction.

3.0 STORAGE TUBES (Continued)

3.2 Test (Continued)

(H. J. Platt) (Continued)

Regulators for the -150, -120 and -90 voltages are being built. The first of two 500/400/300 volt regulators and rectifiers has been received from G. Kerby.

A connecting strip for the filament voltages on the standard 12-pin Jones plug rack power strips has been designed. This jumper eliminates the eight #10 jumpers for each strip. Since many rack power strips are due to be delivered shortly, these connecting strips may prove to be useful. The drawing number is SA-51047.

The first week of the last bi-weekly period was spent in attending the I.R.E. Convention in New York.

(A. M. Stein)

Various tests were performed to determine optimum V_F read and V_F write on 300 and 400-series storage tubes at varying acceleration voltages. Optimum V_F write was defined as that V_F which produced the smallest maximum radius of a positively written spot. Optimum V_F read was considered to be that V_F producing maximum readout as seen on an oscilloscope. In general, optimum V_F read was somewhat lower than optimum V_F write.

Further tests were made to establish the effects of negative ions produced within the high-velocity-gun structure on positive spot size. In the 300-series tubes, it was found that at acceleration voltages of 2500 volts, effects of negative ions are first noticed at W/ times of 200,000 microseconds. This corresponds to a positive spot written by electrons of approximately 500 mills average radius. In the 400-series tubes, effects of negative ions are not noticed until W/ times of approximately 10 seconds.

4.0 TERMINAL EQUIPMENT

4.2 Magnetic Tape

(J. A. O'Brien)

The overall Block Schematic of the complete Magnetic Tape Control system has been drawn and is almost ready for drafting. The circuit schematics for all but one of the components are in the drafting room, and layout sketches are being prepared to be turned over to drafting.

(E. P. Farnsworth)

The three-channel redundant-reading magnetic-tape amplifiers have sufficient excess gain in the presence of a blemish to permit the addition of appreciable inverse feedback around each stage. Gain stabilization and circuit simplicity are the chief advantages gained. Signal-to-noise ratio is more than adequate, and vibration and shock mounting or isolation of the amplifiers does not appear necessary to prevent microphonic response.

5.0 INSTALLATION AND POWER

5.2 Power Supplies and Control

(R. Jahn)

D.C. Supplies

The 30-cycle oscillation which was noticed on the output of the +150 volt supply was caused by small voltage pulses on the A.C. line produced by commutation of the -15 and -30 volt supplies. These pulses caused misfiring of a thyratron. Temporary line filters have been installed in the -15 and -30 volt supplies, and the +150 volt supply now operates satisfactorily.

The -15, -30, and -48 volt regulator panels are nearly complete. The -48 volt panel will be installed next weekend.

D.C. Power Supplies for Whittemore Building

The +120 and -150 volt supplies were received from Power Equipment Company, and a number of components were moved from their original confined locations to new positions which will

5.0 INSTALLATION AND POWER (Continued)

5.2 Power Supplies and Control (Continued)

(R. Jahn) (Continued)

facilitate trouble-shooting and maintenance. These supplies will be installed about March 24, together with the present bleeders for -15, -30 and +90 volts.

(J. J. Gano)

New D.C. Supply, -150 Volts, 25 Amperes

Steady-state regulation for load and line variations and dynamic regulation for a step load are well within purchase specifications. Dynamic regulation for a step of supply voltage is about one-half that specified. A phase-shifting circuit to center the A.C. trigger voltage of the pulse-generating tubes at the cut-off voltage has been inserted, resulting in a reduction of the open-loop steady-state effect of the supply voltage on the output voltage. Results should be similar when the loop is closed. Dynamic compensation will also be incorporated to try to cancel the effect of line disturbances.

Open-loop frequency response tests on the rectifier and filter section, and the ripple-suppression section have been completed.

(G. A. Kerby)

The troublesome low frequency oscillation in the 500/400/300 volt, 5A, serial 1, regulator was due to a faulty gas tube voltage regulator and its associated large time-constant circuit. With this corrected, the unit adjusted and tested satisfactorily at 500 volt, and was delivered to Corderman.

Serial 2 is being tested at 300 volt output. It appears to be less stable then serial 1, but it should respond to adjustments readily. Delivery should be possible in a few days.

6.0 BLOCK DIAGRAMS

(J. H. Hughes)

C.P.O. 111 has been hooked up as a third scope display order. A switch, "no index on qs", can be used to prevent operation of the

6.0 BLOCK DIAGRAMS (Continued)

(J. H. Hughes) (Continued)

camera. Qs does not transfer to storage like qh, qd, and qt.

The new 11-digit decoders give finer resolution on the scope display so that I believe stereo-presentation to be practical. I have written a program to try this out.

(F. E. Heart)

Consideration has been given to the question of a block diagram showing the sequence and logic of the proposed scope output operation with the new in-out system. So far no finished results.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Operation

(J.T. Gilmore)

During the past bi-weekly period 52 hours and 55 minutes of computer time were made available to the mathematics group. Of this time, 10 hours and 3 minutes were lost due to computer trouble. The following is an account of how the usable time was spent.

Prob. No.	Name	Programmer	Minutes
4	Floating Point and Extra Precision Interpretive Subroutines (Programmed Arithmetic, PA)	Helwig	47
8	Magnetic Flux Density Study	Helwig	6
21	Optical Constants of Thin Metal Films	Neeb	34
23	Print-Out of Contents of Storage (Post-Mortem Error Diagnosis, PM)	Combelic	51
24	Matrices, Determinants, and Systems of Linear Equations	Aronson	9
26	Subroutine Orientation Procedures	Carr	74
28	Ambipolar Diffusion	Gilmore Minnick	81
30	Digitally-Controlled Milling Machine Program	Frankovich	47
37	n-th Root Approximation for Subroutines	Demurjian	10
38	Typewriter Print-Out for Subroutines	Demurjian Helwig	47
41	Binary Matrix Product Statistics	Carr Rotenberg	91
42	Spherical Waves - Numerical Integration of Hyperbolic Partial Differential Equations via Characteristics	Gilmore Fox	183
43	Generation of Random Numbers	Rotenberg	13
45	Crystal Structure	Aronson	46
46	Torpedo Depth Response	Neeb	38

8.1 Operation (continued)

(J.T. Gilmore) (continued)

Prob No.	Name	Programmer	Minutes
47	Partial Differential Equations of Engine - Part I	Carr	352
49	Meteor Computation II	Frankovich	470
50	Lattice Analogy Applied to Shear Walls	Galletly, Gilmore Kopley	534
55	Solution of 2nd Order Non-Linear Ordinary Differential Equation	Adams	62
57	Runge-Kutta Differential Equation	Carr	43
58	Determination of Energy Levels of Oxygen Molecule	Carr	44
60	Calculation of Deuteron Energy Levels	Combelic	24
	TOTAL TIME USED FOR PROGRAMS		38 hours
	CONVERSION		3 hours, 42 minutes
	TOTAL		42 hours, 3 minutes

TOTAL# OF PROGRAMS OPERATED= 129

Usable Time Percentage = 79.5%

8.2 Procedures

(J.T. Gilmore)

The conversion program which will deal with floating-point numbers and multiple-length fractions and which will use magnetic tape as temporary storage during the read-in-conversion process should be ready by the end of the next bi-weekly period. The storage print-out routine which will utilize the magnetic tape to find those registers which have changed during the operation of a program will follow the conversion program by a week.

8.3 Problems

(J.T. Gilmore)

Problem # 28

The floating-point version of the Ambipolar diffusion problem written by Bob Minnick of the Harvard Computation Laboratory for Professor Allis of the MIT Physics Department is in the trouble shooting stage.

Problem #42

Two more sets of parameters were operated in the single-length program which performs the numerical integration of a hyperbolic partial differential equation via characteristics. The results were satisfactory according to the author, Miss Phyllis Fox of the MIT Mathematics Department.

(D.G. Aronson)

Problem #45

A set of electron density values was computed from data submitted by the originator (Dr. Abrahams, MIT EE Dept.). The machine-plotted contour map scheme (c.f., previous bi-weekly report) has been coded (T 1034) and preliminary results are quite satisfactory. A new phase of the problem involving the solution of under determined systems of linear equations by least squares is being studied. It is planned to start coding this phase of the problem in the coming period.

Problem #42

A program for computing the 5th root of a (24,6,0) number by Newton's process has been written and is being tested. It is planned to investigate the Unwin equations using (24,6,0) numbers.

Problem #24

The program for partial Jordan Elimination (T 950-2) has been rewritten (see Section 8.4). A memorandum (M-1424) has been written summarizing the lectures given at Harvard by Professor E.Stiefel, of E.T.H., on successive approximation methods for solving systems of linear equations. One of the methods described by Stiefel, the conjugate gradient method, is being coded for WWI. Plans are under way to compute the inverses of a family of matrices which arise in the problem of optimum table making (c.f., H.R.J. Grosch, Proceedings Scientific Computation Forum, I.B.M. (1948).)

8.3 Problems (continued)

(F. Helwig)

Problem #56

A program for the determination of the pupil of entrance of an optical system was written by Dr. Wachendorff and is at present being checked and rewritten. Computations will be done in the (24,6,0) number system.

(J. Frankovich)

Problem #30

Mr. Runyon has completed a new program for the conversion of decimal Flexo coded information to the NMM code for use by the Servo Lab's digitally-controlled milling machine. The program will be used to prepare control tapes for the machine, which is expected to be finished within the next two weeks.

8.4 Subroutines

(F. Helwig)

The following two types of fixed-point interpretive routines are being considered:

1° Fixed-point interpretive subroutines with multiple register B-register

2° Fixed-point interpretive subroutines with B-Boxes

Programs of these types have been sketched out but have not yet been formally written as subroutines.

(D.G. Aronson)

1. Partial Jordan Elimination (30,0,0) - rewritten and under test.

2. Gauss- Relaxation (24,6,0,) - to be tested

3. Sin-cos (24,6,0) - under test

4. All trig-functions (24,6,0,) - under test

5. 5th root by Newton's Method (24,6,0) - under test

8.4 Subroutines (continued)

(J. Frankovich)

The subroutine which will compute the square root of the number in the Multiple Register Accumulator (MRA) of a (24,6,0) interpretive subroutine has been tested and placed in the library of subroutines. Another subroutine has been written which will display points on an output display scope with routines corresponding to the (24,6,0) or (15,15,0) numbers in the MRA.

9.0 FACILITIES AND CENTRAL SERVICES

9.1 Publications

(Anola Ryan)

The following material has been received in the Library, Room 217, and is available to all Project Personnel.

LABORATORY REPORTS

No.	Title	No. of Pages	Date	Author
SR 28	Summary Report Number 28: Fourth Quarter, 1951	30		
R-90-1	The Binary System of Numbers	9	Revised 2-29-52	M. F. Mann
E-451	Variation of Transistor Collector Resistance with Collector Voltage	3	3-3-52	N. T. Jones R. J. Callahan
M-1400	Stabilized Transistor as a Four Terminal Non-Linear Network	12	3-6-52	J. F. Jacobs
M-1408	Quarterly Report, Contract N5ori-06002: July through September, 1951	2		W. K. Linvill
M-1412	Precautions and Operating Notes for the Project Whirlwind R-F Induction Heater	3	2-28-52	F. H. Caswell
M-1413	Selected Readings for New Staff Members	6	2-20-52	R. R. Rathbone J. N. Ulman
M-1414	Progress Report No. 1, M. S. Thesis: Current Distribution in the High Velocity Beam in the M. I. T. Electrostatic Storage Tube	2	(2-15-52 (to (3-1-52	A. M. Stein
M-1415	Bi-Weekly Report, February 29, 1952	33	2-29-52	
M-1416	Laboratory Personnel	4	3-6-52	
M-1418	Laboratory Telephones	1	3-5-52	H. Fahnestock
M-1423	Summary of Component Analysis During January-Feburary, 1952	4	3-12-52	B. B. Paine
A-119	Supplement 3: New Identification Badges	1	3-12-52	J. C. Proctor

LIBRARY FILES

Technical Reports

No.	Identifying Information	Source
.004	European Scientific Notes: February 1, 1952	ONR/London
559	Technical News Bulletin: March, 1952	Ntl. Bur. Stds.
747	Research Activities of the Institute for Numerical Analysis: October through December, 1951	Ntl. Bur. Stds.
748	Projects and Publications of the National Applied Mathematics Laboratories: October through December, 1951	Ntl. Bur. Stds.
1671	Nuclear Science Abstracts: Abstracts 1065-1370. February 29, 1952	Atomic Energy Commission

9.1 Publications (Continued)

LIBRARY FILES (Continued)

No.	Identifying Information	Source
1690	Technical Data Digest: March 1952	Central Air Documents Office
1727	On a Mathematical Theory of the Reaction of Cells to X-Ray Radiation. Reprint from Mathematical Physics, Vol. 12, 1950	E. Pinney U. of California
1728	Investigations on the Stability of Forced Vibrations in Non-Linear Systems: Part 1: A Comprehensive Stability Criterion. Technical Report No. 18, Pt. 1	K. Klotter E. Pinney Stanford University
1729	A Study of the Magnetic Amplifier Model Theory: Engineering Report No. 36, D.I.C. 6506. January 15, 1952	H. H. Woodson Servo Lab./MIT
1730	An Electronic Scaler for Telemetered Data Reduction. Project Meteor Report No. 75. September, 1951	W. F. Santelman R. L. E./MIT
1731	Electronic Assembly Technique, Wiring by Welding Method. Interim Development Reports 6 through 13. January 1, 1951 to September 1, 1951	Radio Frequency Laboratories
1732	An FM Multiplier of High Accuracy and Wide Range. Technical Report No. 213. October 4, 1951.	R. Price R. L. E./MIT

Journals

Design News: March 1, 1952
Electrical Engineering: March, 1952
Electrical Manufacturing: March, 1952
Oil and Gas Journal: March 3, 1952
Physics Abstracts: February, 1952
U. S. Government Publications: Monthly Catalogue: February, 1952

Books

No.	Identifying Information	Author
	New Books in Eastman Library - December 16, 1951 to January 31, 1952	Eastman Library/MIT
B-181	Navy Training Manual: Electronic Technicians Mate Third Class	U. S. Navy
B-182	Navy Training Manual: Electronic Technicians Mate Second Class	U. S. Navy
B-183	Measurements in Electrical Engineering: Part I and Part II. Purdue University, 1948.	R. B. Marshall
B-184	Stick and Rudder. Whittlesey House, 1944	W. Langeweische

9.2 Standards, Purchasing, and Stock

(H.B. Morley)

Procurement and Stock

The first actual directive for material ordered by this Laboratory has been received. This has taken approximately two months from the initial request to the final grant. It seems evident from observations of the proceedings involved that we will be offered assistance by the contract expeditor before a directive is granted. This assistance will be suggestions of alternate suppliers who can presumably make quick delivery, but it should be noted that such alternates may not always meet our Standards and are usually much higher priced. We shall make every effort to investigate such suggestions.

The number of orders placed in February exceeded January which was the previous high. Orders are currently being placed at nearly twice the rate of a year ago this date. Charts are being prepared to show the rate of expansion.

Most of the material for Plug-in Flip-Flops has been ordered. Decisions are being awaited as to the exact requirements for the balance.

With the new personnel now getting familiar with the workings of this department there will be a steady improvement of their efficiency and any suggestions or criticisms will be accepted in a cooperative spirit and will be given consideration.

An expediting file has been started which, it is hoped, will indicate the relationship between promised delivery, actual delivery and expediting action. These records will be kept only on critical items sold by our major suppliers.

(H.W. Hodgdon)

Preparation of Multilith masters for standards on fuses, relays, and resistors has occupied most of the past bi-weekly period. One of the part-time students is engaged in copying drawings and sketches on the masters. Introduction and Application Design Notes sections are being prepared for these three classes, and the complete sections should be ready for printing next week.

Two days were spent at the IRE Show in New York, where many personal contacts were made with manufacturers, new products were viewed, catalog data obtained, etc.

A second part-time student has been employed, who will principally be engaged in designing and making sample boards for graphic display of standard stock.

9.3 Construction

(F.F. Manning)

Production Control

The following units have been completed since February 22, 1952:

6 Delay Lines (Widrowitz)
E-Row Vertical Fusing Strip Covers
10 Video Cables (Corderman)
234 Lamicoid Labels cemented to Burroughs Test Equipment
25 Terminators (91Ω) (Olsen)
4 Push Button Pulse Generators (Breadboard) Papian
2 Multivibrator Pulse Generators (Breadboard) Papian
200 Terminators (91Ω) (Mercer)
30 Delay Lines (Paine)
30 A-C Circuit Breaker Box
1 -15 Volt D-C Power Supply
1 -48 Volt D-C Power Supply
3 Modified D-C In-Out Registers:
- 1 Transient Control (Magnetic Tape) serial #33
- 1 Block Mark Memory (Magnetic Tape) serial #32
- 1 Record Pulse Generator (Magnetic Tape) serial #31

The following units are under construction:

2 ESD Output Panels
10 D-C Circuit Breaker Boxes
1 -30 Volt D-C Power Supply
4 Multivibrator Frequency Dividers
1 15 Amp, 100 Volt Variable D-C Power Supply
5 Storage Tube Mounts
1 Battery Charger (Breadboard)
1 Two Channel Gate Mixer Amplifier
1 IOC Reset Control
152 Video Cables (Olsen)
2 PEC Power Supplies (Modifications)
30 Clip Leads (Olsen)

9.4 Drafting

(A.M. Falcione)

1. New Drawings:

A. Model II Plug-In Units, WWI

Final drawings for five different models of Plug-In Units are now being checked.

9.4 Drafting (continued)

(A.M. Falcione)

Title	Circuit Schematic	Assembly & Parts List
Gate Buffer Amplifier Unit	C-50827	C-50831
Gate Tube Unit	C-50950	C-51023
Flip-Flop Unit	C-50825	C-50838
Buffer Amplifier	C-50826	C-50830
Switch Unit	B-50828	C-50840

B. Plug-In Mounting Panels

The assembly drawings and details for the two mounting panels, one a 26" panel and the other a 19" test equipment panel, will be ready for checking within the next few days.

Title	Circuit Schematic	Assembly & Parts List
26" Panel	C-50813	D-51024
19" Panel	C-51028	D-51029

C. R-F Monitor

A complete set of drawings for this unit together with parts lists will be ready for grading in the next few days.

D. Overhead Wireways

Drawings for overhead wireways which will connect the present wireways in test control to new power racks, P16 & 17, and to the racks in room 224, will be ready for grading the first of next week.

2. Supplement # 1 to Administrative Memorandum A-128 entitled "Multilith Reproduction Procedures" is in the process of being typed. It will be issued to all secretaries during the coming week. This memo should be used by all secretaries to guide them in the handling and typing of multilith masters.

10.0 GENERAL

(J.C. Proctor)

New Staff

Walter Wells, who received his BS in Electrical Engineering from MIT in February, is now working in Wieser's group with Linvill. He served in the U.S. Army Signal Corps for three years and while at MIT, he was a cooperative engineer with the Philco Corporation.

Daniel Goldenberg is also working with Wieser's group. He received his BS in mathematics and physics from the City College of New York and had been employed as an applied mathematician with the U.S. Army Signal Corps Engineering Laboratory in New Jersey for two years.

George Briggs has joined Taylor's group. He received his AB from Cornell and will receive his PhD in June in Physics from the University of Illinois. Until recently, he had been working as a research assistant at the University of Illinois and previously was an electronic physicist at Los Alamos.

Milton I. Brand, who has been an analytical design engineer with Pratt & Whitney for the past four years, has been assigned to Wieser's group. Prior to receiving his BS in mathematics and physics from Trinity College, he had served three years with the U.S. Navy.

New Non-Staff

Rita Censale is a secretary now working with Proctor and Osborne, having transferred from the Development Office at MIT.

Sylvia Chaplain is a secretary assigned to Wieser's group.

Elizabeth Sanderson is a secretary to Norm Taylor.

Jo Ann Cowles is the messenger in the Whittemore Building.

Sergio Valdes is a part-time student from MIT working with Watt and Hodgdon on standards.

Robert Walsh, a part-time student assigned to Wieser's group, is also from MIT.

Richard Onanian is another part-time student working with Wieser's group while attending B.U.

Leonard Ross, an electronic technician, is working with Paul Grant in the Whittemore Building.

10.0 **GENERAL** (continued)

(J.C. Proctor) (continued)

Demetri Parfenuk, who has had experience in radio repair and TV, has also been assigned to work with Paul Grant as a technician.

Charles Maloy is a technician working with Loren Prentice.

Lewis L. Lucy is a former TV repairman now working with Paul Grant as a technician.