Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BI-WEEKLY REPORT, FEBRUARY 15, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEM OPERATION

1.1 Whirlwind I System

(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 1 February through 14 February:

Number of assigned hours	73
Number of transient errors	12
Number of steady state errors	7
Number of intermittent errors	11
Percentage of assigned time usable	84
Percentage of assigned time usable since March, 1951	85

(S. H. Dodd)

General reliability of Electrostatic Storage Row has been slightly improved during the past bi-weekly period. There still remains, however, a large number of tests which should be made in order to determine the best method of adjustment of the Bank B tubes.

Troubles in the Marginal Checking system and the Power Supplies have consumed so much Computer time during the past bi-weekly period that we have been unable to perform these tests on Electrostatic Storage. The Marginal Checking trouble has been vigorously investigated and several improvements in the present system operation have been made. Plans are also under consideration for construction of a new Marginal Checking system which would use the new Crossbar Switch. This system will be designed for greater flexibility than the present system and adequately interlocked for protection against incorrect use by the operator.

The new Plug-In Display Decoders have been lined up and are now in operation. Experience to date shows them to be very satisfactory.

1.1 Whirlwind I System (continued)

(H. L. Ziegler)

For the present, most ES work is being directed towards maintaining safe operating margins on the Bank B storage tubes. Those with low margins are being replaced by new tubes as they become available.

A new test program has been written to check certain modes of ES operation that are not being checked by the present test programs. This program operates as intended but has not had sufficient use as yet for an evaluation of its effectiveness.

(N. L. Daggett)

There have been an unusually large number of intermittent failures in the computer during the last two weeks. Although many were tube failures, they nevertheless emphasize the need for careful workmanship, both in the components themselves and in assembly of these components.

Orders are already placed for an improved version of the 2C51 tube type which has given the most trouble with intermittents.

(L. O. Leighton)

Component Failures in WWI

The following failures of electrical components have been reported since February 1, 1952:

Component	No. of Failures	Hours of Operation	Reason for Failure
7AD7	1	3984	Mechanical
6SN7	1	4640	Mechanical
2C51	3	2 - 2042 1 - 5216	2 - Mechanical 1 - Open
6AS7	2	649	Mechanical

(H. F. Mercer)

Storage Tube Failures in WWI

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

RT-250-R1 was rejected after 274 hours of operation because of poor margins. As RT-250 the tube was in operation for 222 hours; total hours on RT-250=496.

1.1 Whirlwind I System (continued)

RT-251-R1 was rejected after 102 hours of operation because of poor margins and because a spot near the center of the array would not erase. As RT-251 the tube was in operation for 120 hours; total hours on RT-251=222.

(H. F. Mercer)

Storage Tube Complement in WWI

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

Bank B

Digit	Tube	Hours at Install.	Hours of Oper.
0	RT233	4722	4912
1	ST500	6113	67
2	RT247	5198	5388
3	RT234	4705	4895
4	RT278	5638	5828
5	RT237	4714	4904
6	RT231	4687	4877
7	RT241	4737	4927
8	RT298	6079	101
9	RT244	4726	4916
10	RT246	4773	4963
11	RT248	4861	5051
12	RT258	5207	5397
13	RT282	5417	5607
14	RT230-R2	4726	4916
15	RT255	5150	5340
16	RT300	5958	6148

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 February 15. ES clock hours this date 6180.

The storage tube complement of Bank A is not included in this report because voltages were removed from the storage tubes in this Bank on February 5th to prevent an unnecessary accumulation of hours on the tubes. ES clock hours at the time power was removed 6018.

1.2 Five-Digit Multiplier

(C. N. Paskauskas)

During the period of this report the multiplier ran without error. No components were replaced as a result of Marginal Checking or other causes.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.14 Input-Output

(A. Werlin)

The plug-in units mounting panel for the proposed terminal equipment has been designed and sent to drafting. The method of feeding power to the plug-in units on the panel has been determined and plans are under way to modify the existing plug-in flip-flop and to design the new switch gates and buffer amplifiers. The plug-in frames will be made of sheet aluminum with camloc fasters so that all of the cannon plug terminals will be available. A list of all of the components necessary for the terminal equipment has been compiled and sent to procurement so that delivery dates and availability of the components is determined.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes

(H. B. Frost, L. Sutro)

Modifications to the tube shop test equipment are proceeding nicely. The modifications to the vacuum tube pulse current tester, which have been awaiting parts since August, have now been completed. These modifications make the measurement of interface resistance somewhat easier. Vacuum tube microammeters for reading small currents are now being installed in each tube tester console.

Additional difficulties have been encountered with 6AS7G tubes. Private conversation with the type engineer indicates that these tubes were in trouble for a considerable period of time, but that things have now cleared up. In the meantime, important 6AS7G applications in WWI are being watched closely. A life test has been started using the latest lot we have on hand.

Additional measurements of interface resistance have been made to determine the effect of various operating points on the value of resistance. Very considerable dependence upon operating points has been found, in particular at low cathode currents and high screen voltages. This point will be investigated further as time permits.

2.22 Transistors

(N. T. Jones, J. F. Jacobs)

E-447, Transistor Parameter Variations and E-448, Variations of Transistor Collector Resistance Due to Self Heating, have been published in the last bi-weekly period. Receipt of 12 new Raytheon

2.22 Transistors (continued)

(N. T. Jones, J.F. Jacobs) (continued)

CK716's, on Tuesday February 12, added load to the parameter measuring section, R. Schmidt and N. Jones.

Work on variations of transistor collector resistance with applied collector voltages is being done by B. Callahan, S. Teicher, N. Pribbles and N. Jones. These experiments are nearing completion.

The dynamic characteristics panel has been completed by Marino and is now undergoing testing.

The special regulated power supply design has been completed and tested by L. Riley and B. Schultz and the first unit is being constructed by Schultz. L. Riley is mounting, wiring and constructing the necessary auxiliaries for a bank of wet batteries for low voltage transistor circuit supplies.

A. Heineck has been reviewing the work done by Bell Labs on transistor pulse amplifiers. His thesis proposal entitled Transistor Regenerative Pulse Amplifiers is in the process of being published as an M-Note. The first such amplifier was built with a GE transistor. It triggered with a 0.2 μs pulse of 0.5 volts amplitude produced an 8 volt 1.2 μs pulse. Rise time was 0.25 μs.

A thorough analysis of stabilized transistor characteristics has been carried out by J. Jacobs. Through this work a design procedure has been set up for one type of single transistor flip-flop. Such a circuit is to be built and thoroughly tested by B. Callahan. This circuit is based upon the design from Bell Labs as modified by Dr. Rediker.

A preliminary analysis has been completed by B. Callahan on the grounded emitter "S" curve transistor circuit. The design of such a circuit has been planned.

2.23 Crystal Diodes

(H. B. Frost)

A conference was held with Mr. J. Yamron, of the Instrumentation Lab., on crystal diode troubles. He has been having serious trouble with crystal diodes operated at high ambient temperatures (60°C). In several cases, those crystals which showed high hole storage operated very poorly. Prof. Adler is also interested in this problem and is examining rejected crystals. Complete correlation between poor high temperature performance and hole storage is by no means certain at this time.

2.3 Ferromagnetic and Ferroelectric Cores

(W. N. Papian)

The transient introduced into the group's activity by the move to the Whittemore Building had a time constant of about 1 day; operations were approaching normalcy by around Friday the 8th.

New people are arriving at a high rate; an informal series of lectures about ferromagnetic activity should start in a week or so.

(B. Widrowitz)

16 x 16 Metallic Array

The test setup has been completely restored, and all previous modes of operation are now possible.

New driver-current controls were installed and calibrated. They allow rapid and accurate current setting, which greatly facilitates the adjustment of equal X and Y currents. The range of adjustment was increased, so that current levels for 2 to 1 and 3 to 1 selection systems are available.

Reliable operation with a 5-microsecond switching time has been accomplished by using the Z axis in 3 to 1 selection. Marginal operation was possible with a 4-microsecond switching time, with rather poor signal-to-noise ratios.

(E. A. Guditz)

Ceramic Array and Switch

During the last period the ceramic array has been used to test switch cores made of the same material (1118) as the memory cores.

Logical equipment has been assembled to provide a simple cycle of operation which is being used to test the switch cores and to determine the degree of uniformity existing among all the memory cores in the array. The memory is operated, essentially, as a full 16 x 16 array, but coordinate switching is accomplished by unsoldering output leads from the switch cores and moving them to successive coordinate lines. Sensing-winding output-voltage waveforms which include a ONE and a twice-disturbed ZERO have been sketched and peak amplitudes for each position are being recorded.

2.3 Ferromagnetic and Ferroelectric Cores (continued)

(D. R. Brown)

Single Core Pulse Test

Systematic tests using Bill Papian's single core pulse tester have started. The first material being investigated is MF-1118. Results are presented as curves of switch time, disturbed one signal amplitude, disturbed zero signal amplitude, and non-selected signal amplitude as a function of driving current amplitude. Sets of curves will be obtained and different current rise times, ambient temperatures and prf's.

Single Core Pulse Tester

Dick Best has designed drivers for a new single-core pulse tester similar to Bill Papian's original. This will be set up at General Ceramics in New Jersey so that new material can be tested where they are made. The tester will use standard Burroughs test equipment and will be run from a Burroughs 1901-A Power Supply. The setup will be operated here before it is moved to New Jersey around the first of March.

Laboratory for Insulation Research

The first ferrites from Laboratory on Insulation Research will probably come to us in the form of large torroids. A die has been ordered from General Ceramics, their die number F-108.

(J. H. Baldridge)

Solutions of stannous chloride, mercuric chloride, and potassium permanganate have been prepared. The latter has been standardized against U.S. Bureau of Standards sodium oxalate. Several practise analyses have been made on a magnetite sample prepared in this laboratory.

(R. Best)

Pulse Test Equipment

A general-purpose hard-tube core tester has been designed and is being built in the shop. It is planned that Dave Brown will use this in his work at General Ceramics and Steatite Co.

(W. Ogden)

Single-Core Pulse-Test Equipment

The core-testing Pulse Amplifier was modified to reduce "ringing" in the core driving pulses, and a slope control was added.

2.3 Ferromagnetic and Ferroelectric Cores (continued)

The modified test equipment was used to check several Ferramic cores type MF1118(259) and a series of curves were plotted. The following prints are available:

SA-48298-G Switching Time and Critical Ratios for MF1118(259)

SA-48299-G Output Signals - MF1118(259)

(D. A. Buck)

Magnetic Materials

Liaison with the Laboratory for Insulation Research is proceeding smoothly. The possibility of obtaining large single crystals of naturally-occurring ferrites for switching-time studies is being investigated. If available, they may greatly accelerate single-crystal studies. One large crystal of Franklimite, a manganese-zink ferrite whose composition is similar to one of the commercial ceramics, is already under study.

Tests on the near-complete furnaces for ceramic studies are most favorable. One die for pressing ceramic cores has been delivered by the WWI machine shop and is ready for use. Our chemist has set up his laboratory in room 20-C-001 and is at present running analyses on compounds involved in the ceramics processes.

A study is being made into the mathematics relating the frequency-domain tests to the time-domain tests on ferroelectric and ferromagnetic cores.

(H. K. Rising)

Magnetic-Core Computer Elements

I have investigated the literature for information on previous work with magnetic-core devices as computer elements. Particular attention was paid to circuits with gating action for possible incorporation into an adder. Several circuit configurations were tested on paper using the results of the above investigation. As yet, no satisfactory circuit has been devised.

(H. D. Neumann)

The period covered by this bi-weekly report was spent on becomming familiar with measurement procedures of the dielectric constant and initial permeability as a function of frequency for ferromagnetic semi-conductors. Measurements were made on two materials in the low frequency range of 100 c. to 100 kc.

2.3 Ferromagnetic and Ferroelectric Cores (continued)

(R. C. Sims)

Magnetic-Core Computer Elements

I have been engaged in getting oriented in the field of computer devices employing magnetic materials. Have tried to qualitatively design or extend existing designs of magnetic gating and flip-flop circuits, and have investigated the possibility of using some of these circuits in an adder.

(R. D. Robinson)

Pulse Transformers

We have asked for quotations on ring and U-shaped cores from various manufacturers.

The optimum practical windings for ring-type pulse transformers to be used in plug-in units is being determined. These will be 1:1 and 3:1 ratio transformers. Consideration is being given to corrosion-resisting materials and to suitable initial insulation for covering the cores prior to winding in order to prevent abrasion of wires.

A study of specific computer circuits where pulse transformers are used is being made to determine the optimum characteristics desired of a pulse transformer.

(R. E. Hunt)

A bobbin for the Toroid Winder was received from the machine shop. This came out very well and did not require excessive amount of manpower to produce. We have since wound several of the small 3/16" ID ring cores, using this bobbin by hand. The operation seems to be very good.

The windings are slightly loose, but I believe this is easily overcome. This has been demonstrated to most of the people intimately concerned with small Toroids in the Project. Everyone seems to be highly enthusiastic so I will proceed to design a machine around this bobbin. Quite possibly we could obtain a usable machine from this within a month or two.

2.5 Basic Circuits

(J. A, O'Brien)

Some effort has been spent in the design of a general plug-in-unit mounting panel, and a set of basic plug-in-unit. This design is quite similar to the units used for the new decoders, but with a few mechanical changes. It is hoped that this new design will permit the construction of a large amount of new equipment with a minimum amount of engineering and drafting. This equipment will also be used for test equipment.

3.0 STORAGE TUBES

3.1 Construction

(P. Youtz)

The test program on the lower switching voltage in storage tubes indicated that some measures had to be taken immediately to improve the secondary emission characteristics of the beryllium mosaic. In the storage tubes beginning with ST504, the beryllium mosaic has received an additional oxidation. This has lowered the switching voltage of these tubes to approximately 55 volts.

Storage tubes have also been plagued recently with some non-uniform areas on the target. Several tubes were tested carefully to locate the cause of this non-uniformity and were later dissected to verify the results. It was discovered that small pieces of lint and dag were lodged on the collector and auxiliary collector screens. The glass-working techniques were modified to protect the target assembly from any of these contaminations. The first two tubes worked under this revised procedure did not have any non-uniform areas.

3.2 Test

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

During this period, the following tubes were pre-tested: ST500, 502, 503, 504, 505 and RT253-R2. ST502, 504 and RT253-R2 were rejected for surface blemishes. ST502 had a short between collector and A_2. Two others were marginal. ST500 was marginal because of high lower switching voltage, and ST503 because of a weak high velocity gun. ST505 was satisfactory.

Some special tests were carried out on these and older tubes in an effort to find out more about holding stability and lower switching voltage. Data is being accumulated for the plotting of a single graph showing the history of lower switching voltage in all the storage tubes made to date.

(A. M. Stein)

Work continues on the assembly of the revised test set-up to be used for studies of beam current distribution.

3.2 Test (continued)

Some thought is being given to the possibility that for large spots the shape of spot is related to some extent to the lineup of the high-velocity-gun elements. Once the test setup is completed some investigation in that direction will be made to check on the above assumption.

(H. J. Platt)

Work has progressed on the Alignment-Demonstrator which is being built for testing storage tubes. Most of the pulse equipment is on hand. However, the hardware and circuitry for power distribution has been slow in arriving. During the past week, a voltage interlocking panel for all voltages to be used has been build and tested. Design of a d-c coupled, holding-gun driver is in progress.

A survey is being made of the testing methods used for Bank B storage tubes. A correlation study of the WW1 and STRT test results is also being undertaken.

(C. L. Corderman, J. Jacobowitz)

During this period, four 500-series tubes were checked at the STRT and sent to Whirlwind. Four other tubes were examined but have not been passed because of a high V_{HG} requirement or shorted electrodes.

ST500, 501, 504 and 505 were passed, and RT302, 303, 304 and ST503 were rejected. RT302 requires a V_{HG} of 140 volts; RT303 has a short between the two collectors; RT304 has several dark spots (presumed to be lint between the collector screens); and, ST503 requires a V_{HG} of 130 volts for holding a positive array.

We have recently had several overnight system failures as a result of power troubles. It appears that one phase of the incoming power has excessively high line voltage since several independent supplies on one phase only have blown fuses and pilot lights. However, since line voltage trouble has not been reported elsewhere in the building, it may be that an intermittent is present somewhere in the power distribution system of the STRT. Some overnight recording of pertinent voltages will be carried out in an attempt to isolate the trouble.

3.2 Test (continued)

Calibration curves were taken for the video gate drivers, r-f pulser, and voltmeters used in checking out storage tubes. This was done in an attempt to obtain better correlation, if possible, with the results found in Whirlwind. The test program was also modified to resemble the Whirlwind program more closely. One remaining difference is that a polka dot pattern is used for both spot interaction and single write frames instead of alternating columns and alternating arrays. Also, the switching between the two modes is done electronically after two frames, rather than by changing a toggle switch.

Margins of operation with this program are taken and, where pertinent, converted to currents from a pulse transfer characteristic which has been added to the test procedure.

(T. S. Greenwood)

The Philips "L-type" cathodes on life test have accumulated the following total hours.

RT264	2278 hours
RT265	2063 hours
RT267	1943 hours
RT268	1803 hours
RT294	1039 hours

The first two tubes have been continually pulsed to a bias of ∱5V with a duty factor of less than 1%, and both have as good or better emission t[illegible]at the start of the test. RT264 was subjected to a s[illegible] transient at 500 hrs. which caused its emission to fall to [illegible]al. It had completely recovered in 300 hours.

RT268 was operated continuously at a d-c bias of -10V. Its emission has shown negligible change. However, RT267 has deteriorated. This tube was pulsed to a grid bias of ∱20V. At about 1300 hours, a power failure occurred causing a net bias of ∱45 volts. When the power was restored, its emission was about 50% normal and over the past 600 hours it has fallen steadily to 5% normal emission. RT294 has normal emission.

3.2 Test (continued)

Throughout the tests all tubes have been subject to several severe transient shocks and excessive grid drives, and in practically all cases complete recovery from the effects of these shocks has been noted. In many cases, the recovery has been slow, but probably could have been speeded by an activation procedure. Overall experience indicates that this type of cathode has very favorable life characteristics.

Some time was spent during the last bi-weekly period studying the block diagrams of the STRT preparatory to work on this equipment.

4.0 TERMINAL EQUIPMENT

4.1 Typewriter and Tape Punch

(L. H. Norcott)

Modifications of our third "FL" Flexowriter have been completed so that all of our present "FL" equipment can now be used for tape preparation.

Modification of "old" typewriter #88764 is under way. New typebars have been installed, and the selector system is being modified to produce tapes in the "FL" code. This typewriter will be available to the tape preparation personnel by February 20th.

Old typewriter #88883 remains unmodified, and will prepare tapes in the "old" code only.

4.2 Magnetic Tape

(J. A. O'Brien)

The circuit schematics for the flip-flops in Magnetic Tape Control have been drawn and delivered to the drafting room.

There are still several circuits associated with magnetic tape control that have not been designed, and these will be drawn up as time permits.

(B. Ginsburg, K. McVicar)

Most of the computer time scheduled for the magnetic-tape system is being used to make extended accuracy checks. Bob Walquist has written a very flexible program for testing the magnetic-tape system which permits reading in both directions. One fact which this program has already uncovered is that the anticipated difficulty with timing when reading in the forward direction is non-existent, at least with our present equipment.

Jim Forgie has been working on a modification of the read-record switch panels and the reading amplifiers, and part of our computer time is being used to test breadboards of his circuits.

(J. W. Forgie)

Tests of the new reading amplifier are under way using the present magnetic-tape equipment with the computer. Since the new amplifier gives an output pulse considerably earlier than the old amplifiers, there is a fundamental timing incompatibility which makes the testing of the new amplifier with the present system difficult. A second amplifier of the new design is being constructed which can be used with a modified read-record switch to facilitate the testing of the amplifier design under normal operating conditions.

4.2 Magnetic Tape (continued)

(E. P. Farnsworth)

The magnetic-tape printing-out system is now operating satisfactorily in conjunction with the six digit code generator and magnetic tape simulator. Flexibility of the code generator and simulator has been increased so that the Flexowriter code for all symbols on the keyboard can now be generated and the printing accuracy has been checked.

Magnetic-tape reading amplifiers are now being designed to permit operation of the equipment from magnetic tape. These amplifiers will be relatively simple as no mode or channel switching transient or re-recording problems are involved.

4.3 Display

(R. H. Gould)

The new 11-digit display decoders have been in operation in the system for about a week and appear to be giving very satisfactory results. Difficulties in aligning one of the decoders were caused by leakage in the switch tubes. This was remedied by changing the reference voltage slightly.

The necessary delay (about 30μs) between the read-in of the vertical decoder and the intensification of the 16-inch scope will be obtained by stopping the clock on the decoder read-in and counting a delay with the In-Out Delay Counter. All display scopes will be intensified after this delay. A new CPO unit will be used to clear the Vertical Decoder just before it is read into rather than after the scope intensification.

5.0 INSTALLATION AND POWER

5.2 Power Supplies and Control

(G. Kerby)

The 600/500/400 v, 5A rectifier was circuit-checked and tested. The magnetic circuit breaker now in use in this and similar units is far too sensitive a device to hold in during the various line transients. For example, when multiple 6AS7G's are used, as in the regulator, failure of one presumably should not interrupt service. Even more immediate is the transient caused by turning on plate voltage. This trips the Heinemann "instantaneous" type right away.

All other Heinemann curves suggest that they are ill-suited to the size transients (25A to 50A) that occur. However, for final appraisal some study should be made of the overall transient problem in all equipments and another protection scheme considered to avoid unnecessary interruptions of service.

A study was made of switch arcing to determine the best arrangement for the Laboratory bench boxes. Satisfactory circuits with standard equipment will be used. A modification of the standard multi-voltage switch was tried and it proved to have approximately five times the current capacity of the standard switch. Only one additional normally "make" contact and a half-watt resistor are required.

Test of the 500 v, 10A regulator (Whirlwind) shows that it regulates ripple voltage well since it is reduced to less than 0.01 volts p to p. However, the transient response is one hundred times poorer than predicted. The feedback amplifier loop is being studied to determine the cause of this loss of performance.

Test of two 500v, 5A regulator (Corderman) is delayed due to wiring problems and failure of the feedback amplifier loop to operate. These may be related.

The second 600/500/400 v, 5A rectifier has been received an circuit-checked. It will be checked for operation immediately, although, as above.

A 300-volt regulator is being considered. In the interest of simplification and standardization the 600/500/400 v., 5A rectifier probably will be used together with the 500/400/300 v regulator.

All rectifier (mercury vapor) plate circuits are being revised to include separate fusing so that a direct indication will be given in circuit failure.

6.0 BLOCK DIAGRAMS

(F. Heart)

I am now spending part time working on In-Out Block Diagrams. During the past bi-weekly period I have been reading memos, studying block diagrams, and generally becoming familiar with the work to date.

(J. H. Hughes)

I have checked the "Up-to-the-Minute" Control Matrix drawing against the actual circuits. The only discrepancy is that CPO 92 is on time pulse 2, not 4 as shown.

7.0 CHECKING METHODS

7.4 Marginal Checking

(J. H. Hughes)

I am writing a memo describing the Programmed Marginal Checking system as it was to operate, so that when the Marginal Checking system has been worked over and Programmed Marginal Checking is again considered there will be written material to help jog the memory of the engineers concerned with it.

(R. E. Hunt)

The Marginal Checking system has been given a thorough going-over in an effort to make it more reliable. Its circuitry is so redundant and haywire that this is very difficult.

I believe we have been fairly successful, however, and with the exception of one fault, that of transients at the end of the cycle, I believe the system to be reliably usable until we can replace it. Some work is being done to work out some circuitry to be used in the new system. This work will continue until we have some basic circuits better than the ones that now give us trouble.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 OPERATION

(J. T. Gilmore)

During the past bi-weekly period 40 hours and 30 minutes were made available to the Mathematics Group. Of this time 5 hours and 17 minutes were lost due to computer trouble. The following is an account of how the usable time was spent:

Problem #	Title	Hours	Minutes
4	Floating Point and Extra Precision Interpretive Subroutines	3	15
8	Magnetic Flux Density	1	45
13	Point-by-Point Scope Plotting of Calibrated Axes	2	58
21	Optical Constants of Thin Metal Films		19
23	Print-Out of Contents of Storage (Post Mortem Error Diagnosis, PM)		8
26	Subroutine Orientation Procedures	4	56
30	Digitally-Controlled Milling Machine Problem		26
38	Typewriter Print Out for Subroutines		13
42	Spherical Waves - Numerical Integration of Hyperbolic Partial Differential Equations via Characteristics	5	51
45	Crystal Structure	2	11
46	Torpedo Depth Response	1	25
49	Problem For Project Meteor	1	9
	Demonstration	3	30
	Conversion to 5-5-6	5	39
	TOTAL	35 hours	17 minutes

Number of Programs Operated = 100

Usable Time Percentage = 87.1%

8.0 MATHEMATICS, CODING, AND APPLICATIONS (continued)

8.2 Procedures

(J. T. Gilmore)

A new method of typing programs was put into use during the past bi-weekly. This method provides a check on converted words being transferred to their assigned storage locations. It has proven to be quite valuable to finding tape errors which might have caused computer time to be wasted as well as that of the programmer's in trouble shooting the error.

Because so many new programs are using the floating point and multiple length number systems, the present direct conversion program has been modified to treat (24,6,0) and (30,0,0) numbers by John Frankovich and Frank Helwig. However, a direct conversion program using magnetic tape should increase the input efficiency of these number systems.

(F. Helwig)

The (30,0,0) , (45,0,0) and (60,0,0) input conversion programs were rewritten so as to ignore nullify characters and initial tabs and carriage returns. These programs have now been tested and are available for use on the computer.

8.3 Problems

(J. T. Gilmore)

Data produced by a program involving the numerical integration of hyperbolic partial differential equations via characteristics was found to be quite reliable by Professor Lin and Miss Phyllis Fox (author) of the Mathematics Department. Additional parameters will be operated next week and then the program will be rewritten using the 24,6,0 number system. The single length precision was useful in testing the method for ultimate results the floating point system is necessary.

The floating point system is also being applied to the Ambipolar Diffusion problem written by Mr. Robert Minnick for the M.I.T. Physics Department and to a program being written by Mr. F.M. Verzuh of the M.I.T. Statistical Services Department. In conjunction with Mr. Verzuh's program a floating point conversion program is being written to convert data prepared by Mr. Verzuh's IBM equipment.

(F. Helwig)

#48 - A program for a solution of the simultaneous integro differential equations has been submitted by Mr. Brenner. This will be checked for errors and submitted to the tape room.

(J. W. Carr III)

Four general, completely automatic tapes were written and testing begun on them during the past two-weeks period. A general characteristic equation routine for symmetric matrices was written by Mr. Meckler

8.0 MATHEMATICS, CODING, AND APPLICATIONS (Continued)

8.3 Problems (Continued)

(J. W. Carr III) (Continued)

of the Physics Department and then programmed for automatic assembly. Upon insertion of the proper value of n, where n is the order of the matrix, and upon insertion of the values of the elements of the matrix, the program automatically stores itself in consecutive registers (a function of n) and prints out the characteristic equation. At present, this program will handle up to 12 by 12 matrices. Final testing on it will begin next week. This program is in (24,6,0) number form.

Two simultaneous ordinary differential equation programs have been written by Dr. Laning of the Instrumentation Laboratory. These two programs are in (24,6,0) and (30,0,0) number form. The two are coded in the most general form, for an arbitrary time-step, and with the number of simultaneous equations being given by a preset parameter n. Arbitary start and stop conditions (number of time-steps, size of answer, etc) are also able tc be inserted. These two programs have been typed and are undergoing test. The method used is the simple Runge-Kutta of third order accuracy.

A further program, to fifth order accuracy in the time-step, is being written by Donna Neeb. This will also be automatically assembled, with arbitrary value of n and of the time-step h. An arbitary function can be inserted on the right-side of any equation, as in the Laning program.

An automatic conversion program has been written for the 100,000 random numbers that were reproduced onto paper tape by the M.I.T. Statistics Lab, under the supervision of Frank Verzuh. This program will punch out the random binary digits 15 to a register, with the sign position always being plus. These will be grouped in groups of 50, available for call-in by a special random number subroutine which will place a random zero or one in the accumulator every time control is transferred to it.

(D. M. Neeb)

Mr. Robert Kramer of the Servo Lab (M.I.T.) has submitted a trajectory problem (#46). The problem consists of four simultaneous equations which have been put in a form suitable for solution by the Runge-Kutta Method. The problem has been coded in the (15,15,0) system and results have been obtained for time-steps of 0.01 sec. and 0.005 sec. It is now planned to re-code this problem in the (24,6,0) system.

The Optical Constants of Thin Metal Films problem (#21) which was originally coded in the (15,0,0) system is being re-written using the (24,6,0) system. The new program will be completely automatic and will print the results instead of using a scope display.

(E. S. Kopley)

A tape (T935) has been prepared for the first parameter of the problem "Solution of a Pin-Connected Lattice-Type Structure Static-

8.0 MATHEMATICS, CODING, AND APPLICATIONS (Continued)

8.3 Problems (Continued)

(E.S. Kopley) (Continued)

ally Indeterminate to the Sixth Degree or Higher." After this program has been successfully run, twenty six more parameter will successively replace the original parameter and it is hope that the main program and all the parameters will be put on one tape.

(M. Demurjian)

Mr. Rudolph Cypser of the Electrical Engineering Department at M.I.T. is now programming problem #54 "Optimizing the Use of Water Storage in a Combined Hydro-thermal Electric System." At present the (24,6,0) number system is being used.

The system whose operation is to be optimized consists of hydro-electric generating facilities, thermal generating plants, water storage facilities and a distribution network which must supply a given load. It involves the solution of a Calculus of Variations problem by the gradient method.

(D. G. Aronson)

A tape (912-3) for the calculation of crystal structure factors (problem 45) was run during the period. Although the computation ran without a hitch the results obtained are in poor agreement with similar results obtained on I.B.M. equipment. The reasons for this discrepancy are being investigated and further computation will be carried out in the next period.

8.4 Subroutines

(F. Helwig)

The following subroutines have been written and are in the process of being typed and tested:

OT o.1t - Page layout subroutine for accumulator print-out
OT o 1ot - Page layout subroutine for accumulator print-out (Interpreted)
PA 3.6t - Operations on real (30,0,0) numbers (includes the additional orders cm,sr,sl,sf,dv and rc).

(D. G. Aronson)

Two matrix inversion programs are being prepared and tested as subroutines. They are: Partial Jordan Elimenation (30,0,0) and Gauss Relaxation (24,6,0).

A number of other routines prepared by members of the Morse group are being worked on and will be submitted to the Library.

8.0 MATHEMATICS, CODING, AND APPLICATIONS (Continued)

8.4 Subroutines (Continued)

(E. S. Kopley)

Four E. S. storage display subroutines have been successfully run and pictures have been taken of them. A (24,6,0) display subroutine is awaiting testing.

A subprogram has been written that will record on magnetic tape the contents of any number of banks of consecutive registers. The programmer will use μ, for the address of the first register to be recorded and μ_2 for the last one of the particular bank being recorded. The subroutine will permit the programmer to compute between the recording of blocks by indicating the number of blocks to be recorded consecutively as a program parameter present in the AC on entering the subroutine. The ql order was found useful in this subroutine.

A subroutine that will read into E. S. storage from magnetic tape is being written. It is expected that the tape will be run in a forward motion for reading in preceded by the tape running backward after recording. This will enable the programmer to read in any particular block or any set of consecutive blocks. An rs* o order will be useful in the above subprograms so that the computer and tape may be easily stopped without resorting to toggle switches or test storage.

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 Laboratory Personnel.

LABORATORY REPORTS

No.	Title	No. of Pages	Date	Author
E-445	Improvements to the Model 2 Crystal Tester	2	2-1-52	B. B. Paine
E-446	Operations 0-5, Revisions	2	2-4-52	R. P. Mayer
E-447	Transistor Parameter Variations	1	2-5-52	J. F. Jacobs, N. T. Jones
E-448	Variation of Transistor Collector Resistance Due to Self Heating	2	2-5-52	J. F. Jacobs, N. T. Jones
M-1374	Outline of Perforated-Tape Handling Equipment for WWI	3	1-18-52	C. W. Adams
M-1384	Trouble Location Procedures	7	2-1-52	D. A. Kemper
M-1386	Bi-Weekly Report, February 1, 1952	29	2-1-52	
M-1388	Laboratory Personnel: February 1, 1952	4	2-1-52	
M-1390	January 1952 Storage and Research Tube Summary	4	2-7-52	A. J. Cann
M-1391	Flexowriter Equipment Planning and Progress Report	4	2-7-52	L. H. Norcott
M-1392	Approval and Issue of Revised Standards	2	2-8-52	H. W. Hodgdon
M-1395	The Dynamic Analysis of Regulated D. C. Power Supplies. M.S. Thesis Proposal	9	2-4-52	J. J. Gano
M-1396	Sample Problems for Applicants for Employment	9	2-11-52	D. R. Israel
A-199-1	Supplement 2: Procedure for Marking Classified Information	1	2-7-52	J. C. Proctor
C-119	Notes on a Series of Lectures on Polynomial Approximation Given to the Mathematics Group by Professor Philip Franklin	25	12-20-51	F. C. Helwig

LIBRARY FILES

No.	Identifying Information	Source
.004	European Scientific Notes: December 15, 1951; January 1, 1952; Contents, 1951	ONR/London
47	Technical Information Pilot: December 12; December 19, 1951	ONR/Library of Congress
150	Fundamental Research on Raw Materials Used for Electron Emissivity on Indirectly Heated Cathodes Seventh Engineering Report: 1 November, 1951 to 31 January, 1952	J. Cardell, Raythron Mfg. Co.

9.1 Publications (Continued)

LIBRARY FILES (Continued)

No.	Identifying Information	Source
271	Design and Operation of Digital Calculating Machinery. Progress Report No. 21 covering period November 10 to February 10, 1952	Computation Lab. Harvard University
559	Technical News Bulletin: February, 1952	National Bureau of Standards
884	Progress Report No. 27, D. I. C. Project 6873, February 5, 1952	Servomechanisms Lab. MIT
963	Signal Corps Electronic Computer Research and Development. Quarterly Report No. 7, July 4, 1951 to October 3, 1951	Moore School of Electrical Eng., Univ. of Pennsylvania
1672	On the Approximation of Linear Elliptic Differential Equations by Difference Equations with Positive Coefficients. NBS Report 1377, Project 1101-11-5100. December 19, 1951	T. S. Motzkin W. Wasow National Bureau of Standards
1679	Tentative Classification of Methods and Bibliography on Solving Systems of Linear Equations. Institute for Numerical Analysis Report 52-7. September 4, 1951	G. E. Forsythe National Bureau of Standards
1680	Patent Agreement No. 2,554,469. Direct Current Level Changer for Direct Coupled Amplifiers. Filed September 14, 1945, Granted May 22, 1951	R. A. Minzer
1681	Two Existence Theorems for Systems of Linear Inequalities. N. B. S. Report 1356. December 12, 1951	L. M. Blumenthal National Bureau of Standards
1682	Über Einige Methoden der Relaxationsrechnung. Reprint from Zeitschrift für Angewandte Mathematik und Physik, Vol. III, 1952.	E. Stiefel
1683	A Speech Analyzer and Detector System. Report No. E5074. June, 1951	C. P. Smith Communications Lab. AFCRL
1684	Research on Atmospheric Pressure Changes. Technical Report No. 9, April 15, 1951	Meteorology Dept. MIT
1685	Power Supplies, Engineering Reports, and Data. Final Report on Phase II. October 31, 1951	Bendix Aviation Co. Red Bank Division
1690	Technical Data Digest: February, 1952	Central Air Documents Office
1696	A Magnetic Amplifier Controller for a Power Servo-Motor. December 1, 1951	B. F. Cassidy Servomechanisms Lab. MIT
1697	Report of Progress in the Investigation of the Characteristics of a Water Cooled Cylindrical Magnetic Particle Clutch and Recommendations for Future Investigation. Engineering Memorandum No. 26, D. I. C. 6506. January 14, 1952	E. Cutting J. Jursik Servomechamisms Lab. MIT
1698	Composito Mathematica: Kernel Functions and Conformal Mapping: Studies in Partial Differential Equations	S. Bergman M. Schiffer

Publications (Continued)

LIBRARY FILES

No.	Identifying Information	Source
1699	An Example of a Two-Dimensional Compactum Whose Topological Square is Three-dimensional; and On Dimensional Full-Valuedness of Compacta. American Mathematical Society Translation No. 48, 1951	V. Boltyanskii American Math. Soc.
1700	The Theory of Measurements on Random Time Functions Technical Report No. 125, May 15, 1951	R. A. Johnson D. Middleton Cruft Lab./Harvard U.
1701	The General Problems of the Theory of Quasi-Conformal Mappings of Plane Regions. American Mathematical Society Translation No. 46, 1951	M. Lavrenta'ev American Mathematical Society
1702	Relation Between Autocorrelation Function and Transitional Probabilities for Binary Data. PNR-106, November 15, 1950	G. A. Miller Psycho-Acoustic Lab. Harvard University
1703	On Cauchy-Riemann Equation in Higher Dimensions, NBS Report 1404. December 4, 1951	E. Stiefel National Bureau of Standards
1704	The Probability of a Correct Result with a Certain Rounding Off Procedure: Reprint from Proceedings of the American Mathematical Society, June, 1951	W. S. Loud

Journals

Electrical Engineering: February, 1952
Machine Design: February, 1952
Oil amd Gas Journal: February 11, 1952
Proceedings of the I.R.E.: February, 1952

Books

B-176	Petroleum Reservoir Efficiency and Well Spacing: 1952	Committee on Reservoirs Standard Oil Company Humble Oil Company
B-177	Hearings before the Subcommittee of the Committee on Appropriations, House of Representatives, Eighty-First Congress, Department of Commerce Appropriation Bill for 1950	United States Government
B-178	Tables of the Error Function and of Its First Twenty Derivatives: 1951	Computation Laboratory Harvard University
B-179	The Transistor: Selected Reference Material on Characteristics and Applications: 1951	Staff, Bell Telephone Laboratory
B-180	Applied Inorganic Analysis: 1929	W. F. Hildebrand G.E.F. Lundell

9.2 Procurement and Stock

(H. B. Morley)

It is of great importance that anyone requesting material to be ordered should know and inform the Purchasing Department of the applicable project No. and the intended use within the project. This information must be available to enable this department to properly classify and charge such items to the correct account.

Estimates of prices and deliveries have been prepared for the proposed construction of approximately 1600 Plug-In Units. Orders will be placed as soon as authorization is received.

All the requested special transformers for WW1 spares have been ordered.

In these days of shortages, conservation of materials becomes increasingly important. All unused components should be returned to stock separately from salvage materials.

Procurement of construction items will be facilitated if parts lists descriptions can be made more accurate and complete.

New items submitted for test and consideration:

Germanium Crystal Sockets	-	Grayhill Mfg. Co.
Teflon Insulated Wire	-	Holliday-Hathaway Co.
Ejecting Type Fuse Clip	-	Holliday-Hathaway Co.

Standards

(H. W. Hodgdon)

The printing and distribution of new standards has been held in abeyance this period pending availability of forms to be use with the Multigraph machine, which should be ready next week. The preparation of new material has continued, and sections on resistors and fuses are ready for printing as soon as forms are received. The principal change in fuses is the omission of the 4AG size, leaving only the 3AG

9.2 Standards (continued)

and 8AG sizes of small glass fuses in standards. In the resistor section, RMA values have been standardized for all types, and a line of deposited carbon resistors in 1% tolerance has been added.

Wiring color codes have been discussed at length by the Committee, and a decision reached to adopt a simplified code based on the proposed JAN specification. The Committee spent considerable time on a preliminary discussion of capacitors, and is considering the replacement of low value micas with tubular ceramics, and the adoption of a new miniature hermetically sealed paper capacitor to replace present types.

A plan has been adopted to submit drafts of new standards approved by the Committee to a group of key engineers for further comment and suggestion. This plan is outlined in detail in Memorandum M-1392.

9.3 Construction

(F. F. Manning)

Production Report

The following units have been completed since February 1, 1952.

15 Lab Bench wiring and cabling
2 Array Switch Drivers
4 Mod. D. C. In-Out Registers
1. Assy - IOC Counter Panel (FF01) serial #29.
1. Assy - IOC Counter Panel (FF02) serial #27.
1. Assy - IOC Counter Panel (FF03) serial #30.
1. Assy - IOC Counter Panel (FF04) serial #24.
2 600/500/400 Volt, 5 Amp Rectifier
2 Vacuum Tube Voltmeter chassis
74 Video Cables

The following units are under Construction
80 Video Cables (Leary)
2 ESD Output Panels
1 Photoelectric Tape Reader Control
30 Delay Lines
1 Core Tester
1 Core Tester Driver

9.3 Construction (continued)

30 A. C. Circuit Beaker Boxes
10 D. C. Circuit Breaker Boxes
1 -15 Volt D. C. Supply (Control Section).
1 -48 Volt D. C. Supply (Control Section).
39 Video Cables (Brown)
3 Mod. DC In-Out Registers

The Shop Schedules will be complete for distribution within the next few days. They will show the work load of units forthcoming for drafting, sheet metal, machine, and assembly shops respectively.

A new Construction Requisition will be forthcoming that parallels along the same lines as the Construction Requisition that is now in use. It has been changed in style to ease the typing and to include some additional information required to obtain a more even flow of units through their fabricating stages.

9.4 Drafting

(A. M. Falcione)

1. New Drawings:

A. Model 2 Plug-In Units, WWI

The Circuit Schematic for the D C Flip-Flop, Gate-Buffer-Amplifier, and the Buffer Amplifier have been received and drawn. The Assembly drawings were 50% complete when word was received to stop all drawings until further engineering changes were made.

B. 520, Magnetic Tape Control

Circuit Schematics and Assembly drawings together with lamicoid labels for the follwing three units are practically complete:

TITLE	Circuit Schematic	Parts List	Assembly
Transient Control	D-50802	E-50808	E-50808
Block Mark Memory	D-50799	E-50818	E-50818
Record Pulse Generator	D-50796	E-50797	E-50797

The above three units are modified 403, D C In-Out Registers

9.4 Drafting (continued)

C. Mode Switching Flip-Flop Panel

Circuit Schematic number is D-50853, the Block Schematic, B-50854.

2. Thesis Drawings

Information has been received to the effect that twelve engineers are expecting to submit their masters theses this semester. All engineers are advised that theses drawings must be completed in drafting by May 9th. This department would greatly appreciate receiving the thesis drawings as soon as possible. It is estimated that each thesis will require an average of 35 drawings, which will involve a considerable number of drawings.

3. Delays

The cooperation of all engineers would be greatly appreciated in supplying complete circuitry information when submitting Circuit Schematics to drafting, especially those units which require assembly drawings for shop manufacture. In particular, the information which has been greatly lacking has been the designation of specific parts, especially with regards to capacitors, special resistors, relays and switches. In many cases, engineers do not furnish sufficient information on the Circuit Schematic, by which a parts lists can be properly compiled, and consequently, much drafting time is lost because the lay-out draftsman needs the information before an accurate lay-out can be made. All WWI Circuit Schematics will now be screened by the writer and lacking information will be requested from each individual engineer.

10.0 GENERAL

(J. C. Proctor)

New Staff

Harold Donko is a new staff member, not as yet assigned to a specific group. He has received his B.S. in M.E. from the Illinois Institute of Technology.

Donald Eckl is a new staff member working with Norm Taylor. He received his Ph.D. in Physics from the University of Toronto. He was an instructor in sonar in the Navy for two years.

William A. Klein is a new staff member, not as yet assigned to a specific group. He has received his B.S. in mathematics from the Illinois Institute of Technology.

Joseph McCusker is a new DIC staff member working with Brown. He was formerly a research assistant in the storage tube group, receiving his M.S. in E.E. in 1949. After leaving here he taught a year at Penn. State, then went to Oak Ridge to work for Carbide & Carbon Corp.

Donald A. Morrison is a new staff member working with Norm Daggett. He was in the Army Signal Corps for five years, part of the time as an instructor. For the last five years he has been at Bell Aircraft.

Alan Perlis has returned to the Laboratory to work with Wieser's group. He has his Ph.D. in math from MIT. During the war he was an Air Force Intelligence Officer. He has worked at the Underwater Sound Lab and the Aberdeen Proving Ground.

Carl Schultz is a new staff member working with Norm Taylor. He has his B.S. in E.E. from the University of Wisconsin. He was in the Army Signal Corps for four years. He was a research assistant at the University of Denver and an engineer with the Consumers Power Co.

Saul Twicken is a new DIC staff member working with Frost. He has a B.S. in E.E. from Northeastern. He has been a student engineer at Raytheon and a junior engineer at Sylvania Electric Products Co.

New Non-Staff

Melvin Aronson is a technician working on building wiring. He has had many year's experience as a technician.

Davis Bates is a technican working in Dave Brown's group. He has attended Brown University.

Corinne Donnellon is a draftsman. She graduated from the School of Practical Art in Boston and was a draftsman with Raytheon for one year.

10.0 GENERAL (continued)

New Non-Staff (continued)

Chester Geissler is a draftsman. He attended the Vesper George School of Art and was in the Navy for three years.

Azadooy Karaian is a secretary working for Norm Taylor. She has been a secretary for a number of years with commercial organizations.

David Keast is a part-time student technician working with Jacobs.

Jean Kresser is a secretary in the Whittemore Building. She has been a secretary for three years in an industrial company.

Anthony Kyricos is a technician working for Grant. He has been a technician for a number of years.

Thora Linsky is a secretary working with Bob Nelson. She has an M.S. from Simmons College and has had merchandising experience.

Ruth Mohr is a technical assistant working with Adams' group. She has an M.A. from the Bridgewater State Teachers College in Massachusetts, and has taught school for two years.

George Pierce is a student technician from Northeastern Univ. working on storage tube construction.

Robert Schultz is a part-time student technician working with Jacobs.

Howard Walker is a technician working in Adams' group.

Wendell Wilson is a technician in the stock room. He has had experience as a machine operator amd a self-employed TV serviceman.

Terminated Non-Staff

Donald Krezek