Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BI-WEEKLY REPORT, February 29, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEM OPERATION

1.1 Whirlwind I System

(S. H. Dodd)

Although some improvement has been made in the operation of the marginal checking equipment, it is still out of adjustment enough to cause appreciable loss of time during marginal checking periods. Work is continuing toward improving the situation. A new marginal checking system design is progressing rapidly and should result in a much more reliable system.

A new program for checking electrostatic storage deflection shift as a function of duty cycle found a shift of about 1/2 of a spot diameter. A series of investigations of this trouble showed it to be probably caused by shifting plate current in the 715 amplifier tubes. Several of these tubes have been tested by Frost's group and initial indications are that a current shift is present in some of the old tubes but that recent tube replacements show no drift. This trouble will be investigated further and a new amplifier design will be considered.

All storage tubes were checked for their ability to hold a positive array for a period of one hour. Four tubes lost spots and required an increased V_{HG} to restore normal operation.

The parity digit has been in operation during most of the past bi-weekly period. The parity check looks very promising in determining which storage tubes cause trouble during application periods. In the future the parity digit will be used at all times.

(H. L. Ziegler)

The nature of ES maintenance work remains unchanged with the emphasis still on improving reliability. All additions and alterations to ES have been postponed until the desired reliability has been attained.

1.1 Whirlwind I System (continued)

(H. L. Ziegler) (continued)

Because of this, most tubes that are being removed from the system are being replaced because of low performance rather than because of complete failure as in the past.

Operation of some tubes has been considerably improved by a new focusing procedure that makes use of a new program. This program checks for vertical spot interaction as well as for horizontal.

Other work is being done on duty-cycle deflection shifts, optimum rewrite times, and in determining the effects of reading on the spot being read.

(N. Daggett)

An interesting trouble has been encountered in the ES deflection system. A small but definite shift in deflection voltage occurs with certain duty cycles, having a time constant of approximately 1 second. It appears that this shift is caused by a change in plate current in the 715B's used for the deflection output amplifiers. As soon as time permits, those 715B's exhibiting signs of changing plate current will be replaced to see if this cures the trouble completely.

(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 15 February through 28 February:

Number of assigned hours	70
Number of transient errors	19
Number of steady state errors	5
Number of intermittent errors	28
Percentage of assigned time usable	87
Percentage of assigned time usable since March 1951	86

1.1 Whirlwind I System (continued)

(H. F. Mercer)

Storage Tube Failures in WWI

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

RT-298 and RT-300 were both rejected because of poor margins after 97 and 260 hours of operation respectively.

RT-278 was rejected after 604 hours of operation because of Holding-Gun failure; Holding-Gun current was zero.

RT-241 was rejected after 1585 hours of operation because of a bad area on the storage surface.

(H. F. Mercer)

Storage Tube Complement in WWI

In the last bi-weekly, dated February 15th, the Hours of Operation for all tubes in Bank B were erroneously reported, with the exception of digits 1 and 8, which were correct.

The compiled hours of operation during that bi-weekly period were inadvertently added to the Hours at Installation instead of to the previously recorded Hours of Operation.

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

Digit	Tube	Hrs. at Install.	Hrs. of Operation
0	RT-233	4722	1638
1	ST-500	6113	247
2	RT-247	5198	1162
3	RT-234	4705	1655
4	ST-501	6242	118
5	RT-237	4714	1646
6	RT-231	4687	1673
7	ST-508	6321	39
8	ST-505	6176	184
9	RT-244	4726	1634
10	RT-246	4773	1587
11	RT-248	4861	1499
12	RT-258	5207	1253
13	RT-282	5417	943
14	RT-230-R2	4726	1634
15	RT-255	5150	1210
16	RT-506-1	6218	142

1.1 Whirlwind I System (continued)

(H. F. Mercer) (continued)

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 29. ES Clock hours this date, 6360.

(L. O. Leighton)

Component Failures in WWI

The following failures of electrical components have been reported since February 15, 1952:

Crystals	No. of Failures	Hours of Operation	Reason for Failure
D-357	5	4800 - 5012	4 - Drift 1 - Open
Capacitor			
1.0 mfd (Bath tub)	1	7334	Oil leakage
Tubes			
7AD7	2	1000 - 2000	1 - Mechanical 1 - Low I_b
	3	4000 - 5000	2 - Low I_b 1 - Mechanical
	3	5000 - 6000	3 - Low I_b
	1	6000 - 7000	Change in characteristics
6SN7	1	5047	Low I_b
6AS7	1	833	Mechanical
2C51	1	8964	Open
C16J	3	1-2927 1-5588 1-6491	Change in characteristics
5U4G	2	2-6926	1 - Mechanical 1 - Low I_b
	1	4393	1 - Low I_b
VR150	1	6926	Change in characteristics

1.2 Five-Digit Multiplier

(C. N. Paskauskas)

The multiplier has been operating since Jan. 29, 1952 without error.

During the period of this report no components were replaced.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.14 Input Output

(J. A. O'Brien)

The design of the plug-in flip-flop has been modified to include an extra complement input and a delay line. The space factor in the plug-in unit is important and an investigation of delay line construction has resulted in a design which appears to be satisfactory.

Delays of up to 0.1 microsecond at an impedance level of about 200 ohms can be obtained by winding #30 wire over copper foil or a 1/4-inch phenolic rod.

Insulation between wire and foil is 1/4 inch "Mylar"(A) plastic film. The maximum length of the delay lines would be about 3 inches.

(A. Werlin)

The schematic diagrams and assemblies for the plug-in unit flip-flop, gate and B.A., Switch, and dual B.A. are now complete. The layout and inter-connections of all these plug-in units in the form of terminal equipment is being designed and will soon be ready.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes

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

The dependance of interface resistance upon vacuum tube operating point has been studied somewhat further. After some difficulty, it was found that a serious lack of reproducibility was due to dirty pins on the tube under test. Trouble was also encountered when several volts of low frequency noise were found on the laboratory 250-volt line. Operation of amplifiers from a separate supply

2.21 Vacuum Tubes (continued)

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

eliminated this latter difficulty. Somewhat more work on this subject is planned.

Two difficulties with vacuum tubes have been encountered during this last period, both of which were associated with changes occurring in times of a second or so.

The first of these troubles concerned 6AG7 tubes used as flip-flops in the STRT. A loss of restorer pulses caused the flip-flops in the deflection voltage generators to remain in one position for a long period of time over one weekend. All the flip-flop tubes had to be removed the following Monday since none of the flip-flops were operable. All these tubes were found to have low plate current. In general, this low plate current correlated with interface resistance, but the plate current was much lower than could be explained by the amount of interface resistance found by pulse measurements. The behavior of the interface resistance was studied using the transconductance bridge setup. There it was found that the interface resistances increased by a factor of three in a period of several seconds after the plate current was turned on. This higher value of interface resistance approximately explained the low plate current. As has been mentioned in previous bi-weeklies, an effort is being made to obtain 6AG7 tubes not subject to interface resistance.

The second trouble was also associated with storage tube deflection systems; however, this time the location was the deflection decoders and deflection voltage amplifiers of WWI. Here it was found that a duty-factor change in position corresponding to about 1 percent of the deflection voltage was giving occasional trouble, in particular with push-button operation. The 7X6 switching diodes were tested and exonerated. Later the decoders were measured with the deflection amplifiers removed and isolated; the decoders were exonerated. The time constant of the change seemed to eliminate any change in resistors, which should have a considerably longer time constant. Hence the 715B deflection amplifier tubes were suspected and studied. Only 4 tubes have been tested thus far; however, it has been found that one of these tubes has a plate current which changes about 5 ma out of 150 when the plate current is first turned on by removing bias. It is planned to test the remaining 12 715B tubes in the deflection voltage amplifiers before March 10 and to replace defective tubes on that date. Testing time will be scheduled so as to interfere with WWI operation, as this small deflection shift does not ordinarily give any trouble. All defective tubes will be replaced at once, since various d-c level and balance adjustments must be made when these tubes are replaced.

2.22 Transistors

(N. T. Jones)

Tests on the Transistor Dynamic Characteristics Panel are finished and the panel has been used in measuring the recently received transistors.

Receipt of fifteen Bell A1698, five Bell A1768 and five GE G11A transistors has temporarily swamped R. Schmidt and his measuring equipment. B. Klein is making the d-c point measurements for most of these transistors.

An experiment for measuring transit time and hole storage has been set up. One Raytheon CK716 has been observed to date. Demand for the test equipment elsewhere in the group has slowed operations. These measurements are scheduled for all transistors and will evolve into a standard test for our incoming transistors.

A circuit has been designed using a transistor blocking oscillator driving a Heineck pulse amplifier to give us a life test of type A1698 transistors. This circuit is partially built and should be started by the fifth of March.

(B. Klein)

I have joined the transistor group during the past bi-weekly period. I have completed the d-c point measurements on ten new Bell 1698's just received. At present, I am working on analysis of two transistor circuits for A. Heineck.

(R.J. Callahan)

A circuit to test the back resistance of crystal diodes has been set up. The actual testing has been delayed because of the unavailability of test equipment.

A flip-flop employing a base stabilized transistor has been analyzed, built, and tested under the direct supervision of J. Jacobs.

The experimental work on variation of collector back resistance with collector voltage has been completed, and the results will be published in E-451 by N. Jones and R. Callahan.

2.23 Crystal Diodes

(H. B. Frost, S. Twicken)

Additional tests of the back resistance of crystal diodes under dynamic conditions have been made. It has been found that crystals which have very high back resistance under d-c conditions may have very low back resistance for some tenths of a microsecond after a forward current of 5 ma is cut off. Tentatively, this major change in back resistance seems to be associated with low forward resistance, although this has not been fully checked.

Mr. E.G. Shower of the Radio Receptor Co. visited the Laboratory on March 28. He brought sample lots of diodes manufactured by his company, which is now in pilot production of germanium diodes. Some of these diodes were tested to determine their dynamic back resistance characteristics. They were not exceptional.

2.3 Ferromagnetic and Ferroelectric Cores

(B. Widrowitz)

16 x 16 Metallic Array

Reliability of the test setup is being improved in two ways. It is planned to use plug-in flip-flops in place of the breadboard address selectors. Also, the gate and delay units that establish the read and write gate durations will be replaced by delay lines and Burroughs flip-flops.

The plug-in flip-flop panels are in the shop. Meanwhile, the problems of mounting and driving the delay lines are being considered.

(E. Guditz, K. Olsen, W. Papian)

Ceramic Array and Switch

The 1-by-1 testing of the 256 cores in the array revealed an error in the geometry of the sensing winding. This was corrected by a new winding and tests repeated over one third of the cores in the array. Sensing winding output voltage magnitudes for ONE's ranged from 1.0 to 1.7 volts; for ZERO's the range was 0.0 to 0.5 volts; the bulk of the data clustered very close to the mean values. It was decided to drop this type of testing temporarily and proceed to 2-by-2 operation.

Two additional switch cores were wound, tested, and installed. A memory square whose corners contained "good" cores (as judged from the 1-by-1 tests) was chosen and put into operation. In the present mode the contents of each core of the four is read to an external

2.3 Ferromagnetic and Ferroelectric Cores (continued)

(E. Guditz, K. Olsen, W. Papian)

flip-flop, then rewritten in the core. The address flip-flops are then indexed to the next address where the process is repeated. Several information patterns have been run in this fashion with seeming reliability and with ONE-ZERO ratios of about 4:1 as expected. Repetition rates at present in use are low.

Some experimental work is under way to determine the length and nature of the delay-line effect of driving a large number of switch-core windings in series. Following this a 4-by-4 will be attempted.

(R. Best)

Pulse Test Equipment

The general-purpose hard tube core tester has been received from the shop and is undergoing test. It is primarily for testing ferrite cores, but may also be used for testing metallic cores.

Another general-purpose tester is being designed primarily for testing metals. It will be simpler than anything we now have, and suitable for use by outside concerns.

(D. R. Brown)

Hysteresis Loops

We now have large rings (General Ceramics die No. F-108) of MF-666, MF-1118 and MF-1147. Hysteresis loops for these will be obtained by two methods: (1) using 60-cycle sine-wave excitation, RC integrator, and oscilloscope display; and (2) using ballistic galvanometer.

Single Core Pulse Tester

Panels for the General Ceramics single-core pulse tester are complete and all units, including the power supply, have arrived.

(W. Ogden)

Single Core Pulse-Test Equipment

Testing of the MF 1118 (259) Ferramic Core was continued. Two families of curves were plotted relating core performance to temperature. The following prints are available:

2.3 Ferromagnetic and Ferroelectric Cores (continued)

(W. Ogden) (continued)

SA-48300 - Disturbed Zero vs temperature

SA-48301 - Disturbed One vs temperature

Measurements are in progress to relate core performance to the rise time of the driving pulses, and a second group are planned to study core performance at high PRF's. One type 1118 Ferramic Core was switched at 100 kc with no apparent change in output.

(J. H. Baldridge)

Procedures for the analysis of iron and manganese in Ferroelectric and Ferromagnetic materials are being revised. A standard solution of ceric ammonium sulfate has been prepared and standardized. Apparatus is being prepared for use of the Mitscherlich sealed-tube method for dissolution of materials.

(H.D. Neumann)

Measurements of the initial permeability for ferromagnetic semiconductors were continued. In the radio frequency range a coaxial line and an impedance bridge were employed, and at 300 mc a slotted line and standing wave detector.

(R. D. Robinson)

Pulse Transformers

A [1:1] transformer which approximately duplicates the WWI [1:1] Hypersil core transformer has been made from Ferramic H material using a ring-shape core with ID = 3/16" and OD = 3/8", and having 27 turns of No. 36 wire for each winding. In this transformer it was found necessary to have the windings separated rather than layer-wound.

A preliminary test indicates that it is possible and practical to make a pulse transformer for WW with two secondaries, giving a [3:1] and [1:1] universal unit.

We are beginning to get quotations from manufacturers on our own design of a C-shape core. Depending upon how stringent our tolerance demands are in shape dimensions and quantity orders, the price per core would vary from approximately 50 cents to $3.00 per assembly.

2.3 Ferromagnetic and Ferroelectric Cores

(R. E. Hunt)

Toroid Winder

Work is progressing at a satisfactory rate on developing this machine. Last week we got together with Mr. G .O. Johnson, of Project Lincoln, and Mr. Zimmerman, of Cambridge Research Center, to discuss mutual problems concerning small toroids.

We looked again at the Boesch Machine, located at CRC. This is also basically the machine that Project Lincoln will buy. It is the best machine available, but much too large for our small wedding-ring cores. Both projects will be highly interested in our machine if successful. We hope to put some work in to the machine shop within a week.

(D. A. Buck)

Ferroelectrics

Two .008"-thick samples of BARIUM TITANATE CERAMIC were made by the Laboratory for Insulation Research for the ferroelectric memory thesis. Hysteresis-loop equipment has been assembled for tests.

Residual strains in the test model of the ferroelectric switch were relieved by slow-cooling in an oil bath from above the Curie temperature.

Ferrites

Attempts are being made to obtain exceedingly pure iron rods which will be oxidized at a high temperature and then used as a raw material in the fabrication of experimental ferrites. This method is necessary to obtain iron oxide of high purity since commercially available oxides are not suitable.

2.6 Component Analysis

(B.B. Paine)

Tests are being performed on various makes and types of precision resistors to determine their stability with time and load. The results of these tests should give a basis for choosing the precision resistor to be standardized upon.

I am trying to coordinate and revise the tests to be applied to all components received by the lab. Several pieces of equipment to facilitate effective acceptance testing have been built, and it is hoped that a good testing program may be begun when the stockroom moves to the Whittemore building and space is available.

3.0 STORAGE TUBES

3.2 Test

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

During this period the following tubes were pretested: ST506-1, ST507, ST508, ST510 and ST512. Preliminary observations were made on ST509, ST511 and ST513. Of these, ST507 was satisfactory; ST510 was rejected because of an air inclusion; the rest were marginal. In ST506-1, the holding gun was off center; ST508 had a weak HVG; ST512 had high minimum collector voltage.

Some older tubes were examined to gain more information about holding stability and lower switching.

The data on the history of lower switching voltage has been compiled and a graph (about 1/3 complete) is being plotted.

Difficulty experienced with non-uniform spacing in the array and failure to return to the same spot was traced to the loading action of the "rotating" circuit on the deflection amplifier. Larger coupling condensers which give compensation across VR tubes in the output circuit remedied the trouble.

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

During this last period, the following tubes were examined at the STRT: ST506-1, ST507, ST508, ST509, ST512 and RT241.

ST506-1 was passed and sent to Whirlwind.

ST507, ST508 and ST509 all required a V_{HG} of more than 100 volts to pass a static holding test of one hour. Tubes ST507 and ST508 were given this test with $V_{AC} = V_{HG} = 100$ and passed it very well. However, the margins in 32 x 32 operation were decreased. On the other hand, raising V_{HG} to 120 volts while keeping V_{AC} at 400 improved both static holding and the dynamic margins. These tubes have been sent to Whirlwind for operation under the latter conditions. ST509 has not been so thoroughly tested as the other two tubes, and its disposition awaits further results.

3.2 Test (continued)

ST512 is in much the same category as the aforementioned tubes, i.e., it requires a high V_{HG}, but it has good margins with V_{AC} = 400 and V_{HG} = 100 volts. Some difficulty has been observed with loss of emission from both guns. The gun emission will be checked over the next few days before a decision is made on this tube.

RT241 was rejected from Whirlwind for a bad spot on its surface. This spot was checked on the STRT and found to be covering about four mosaic squares. It will be examined further in the TVD.

The program of standardizing measuring methods, mentioned in the last bi-weekly, continues. The Simpson meter used to measure V_F and V_K is being calibrated on all its important scales. A Rawson meter is now being used for setting the heater voltage on the high-velocity gun. Some experimental work on the relationship between minimum HG time and W SPG is contemplated.

(T. S. Greenwood)

During the past bi-weekly period two of the tubes with Philips type "L" cathodes failed due to filament burnout.

The first of these, RT267, had been previously reported as having practically no emission. The drop in emission, presumably caused by a power failure, occurred at 1300 hours. The filament burnout came without known external causes at 2200 hours. The second tube to fail was RT294. At about 1000 hours, the emission of this tube fell to 1/3 normal. An attempt to reactivate this tube was made by raising its fialment voltage. This was only temporarily successful, for within 70 hours after the filament was returned to normal voltage, the emission fell to preactivation values. A week later at 1300 hours of life, the filament burned out.

Life test continues on RT264, RT265, and RT268.

(H. J. Platt)

The study of WWI methods of evaluating and testing storage tubes continues.

3.2 Test (continued)

Work on the Alignment Demonstrator is progressing. Power for the unit will be standard laboratory voltages. However, the +500 volts and -300 volts will be supplied separately from two new 5 amp. regulated supplies which will also supply the storage tube test area. A d-c circuit beaker box has been received and is being installed together with the voltage interlocking panel described in the last bi-weekly.

Two Holding Gun Power Supplies and a Tektronix Scope-mobile truck have been added to our equipment in the past two weeks. The direct-coupled holding-gun driver is now being build using a pentode as constant current source. With this tube as the lower branch of a divider network, it is possible to change voltage levels while maintaining full signal transfer between stages. This is described further in Library Files Number 1680.

A tentative block diagram has been drawn up to supply the basic timing needs of the Alignment Demonstrator.

(A. M. Stein)

The test setup which will be used for studies of current distribution of the HV beam was finally debugged and is in operating condition. Data was taken to check on the performance of the equipment. The information obtained compares favorably with that achieved with the equipment formerly in use.

By means of television readout, it was observed that large spots are not exactly circular in shape but tend to assume the shape of an ellipse. The elliptic area is most noticeable near the high velocity gun neck. In addition, large spots frequently have peaks or depressions around the circumference of the spot.

The increase in spot radius as a function of W plus time is less rapid in the case of the 300-series tubes than the 400-series up to about 20,000 microseconds. Beyond this time the reverse is true , i.e. the 400-series tubes show a smaller increase in spot radius than the 300-series.

3.2 Test (continued)

Various investigations on the above behavior have been without success; parameters such as V_{ac} were found to have little effect. It is hoped that studies of a variable throw tube may prove to be informative.

4.0 TERMINAL EQUIPMENT

4.1 Typewriter and Tape Punch

(L. H. Norcott)

Modifications of "old" flexowriter typewriter #88764 have been completed and the typewriter returned to the tape preparation room. This leaves only one typewriter (#88883) available for preparing tapes in the "old" flexo code.

Specification sheets A.A.R.-1-A, "Specifications for Printer Oiled Perforator Tape", have been obtained from the Association of American Railroads; and attempts have been made to oil some of our present paper tape in accordance with their instructions. Results to date have not been too satisfactory.

Commercial Controls Corporation informs us that they obtained three rolls of a lighter weight opaque gray tape which they have sent out for oiling. After it has been oiled, they plan to send us the three sample rolls for testing on our "FL" punches and photoelectric reader.

4.2 Magnetic Tape

(B. Ginsburg, K. McVicar)

Our computer time is currently being used to make extended reliability checks on the interim system and to test some new amplifier and read-record switch panels built by J. Forgie.

A report on the interim magnetic tape system and the circuits used therein is in preparation and should be finished within the next bi-weekly period.

(E. P. Farnsworth)

Magnetic tape reading and recording amplifiers have been designed. One channel of each has been built and tested.

When construction of the remaining channels is completed, the Flexowriter equipment will be operated by magnetic tape for system test.

(J. W. Forgie)

The circuit schematic for the new Magnetic Tape Read-Record Switch and Reading Amplifier panel has been turned over to the drafting room. A chassis layout incorporating certain

4.0 TERMINAL EQUIPMENT (Continued)

4.2 Magnetic Tape (Continued)

(J. W. Forgie) (Continued)

changes from standard construction practice is being made. The changes are necessary to obtain passable operation for the low-level audio circuits encountered in this panel. Testing of the circuits is meanwhile continuing.

4.3 Display

(R. H. Gould)

The new decoders continue to give satisfactory operation. Trouble with one plug-in switch unit was probably caused by bad contact on its plug. Its tubes and circuit were normal and it operated properly when put back in place.

A "stopped clock" wait period of about 48 microseconds now occurs after the read-in to the vertical decoder and before the intensification of the scopes. The intensification and interlock times are now the same and are about 64 microseconds. The total display order time is now about one-fifth the time necessary with the old decoders so that display-limited programs will now operate faster.

The gs order will soon be available as a third display order to provide another filtered display. Its operation as the camera-indexing order will not be affected except for the addition of the 48 microsecond wait period which is negligible with respect to the total order time. One switch will be needed to keep the camera from indexing when gs is used as a display order.

The Fairchild camera will be mounted on the shelf-mounted 16" display scope in the test control room on an almost-permanent basis. Only when demonstrating display to large groups will the camera be removed and it will be the responsibility of the remover to replace it and reset any changed adjustments.

4.5 Terminal Equipment Planning

(E. S. Rich)

An important factor in speeding up the installation and testing of the new terminal equipment system will be familiarizing the personnel concerned with the details of its operation. Effort is being made to work out diagrams and explanations which are clearer, more concise, and more complete than what

4.0 TERMINAL EQUIPMENT (Continued)

4.5 Terminal Equipment Planning (Continued)

(E. S. Rich) (Continued)

is now available. Plans are also being made for a comprehensive instruction program to acquaint interested parties with the functioning of the system, especially the magnetic drums, so that as little time as possible will be lost in debugging the equipment after it is installed.

5.0 INSTALLATION AND POWER

5.2 Power Supplies and Control

(R. C. Jahn)

Marginal Checking

The occasional oscillation of the marginal checking generator has been traced to poor contact of the rotating brush of the pot in the automatic control panel. This brush has been grounded through a 2000 ohm resistor, in order to provide a low impedance input to the regulator amplifier at all times, and thus prevent the occurence of oscillations due to faulty pot contact.

(J. J. Gano)

D.C. Supplies

The -150 volt supply developed occasional 30 cycle per second oscillations of 2 volts peak to peak, and frequent transients of this magnitude. The cause was traced to a small pulse entering through the AC trigger signal of the pulse generator for thyratron firing. This spurious pulse would produce misfiring of the tube. At times the pulse was so located that the associated thyratron would misfire every other cycle, producing the 30 cycle oscillation. As a temporary remedy the pulse can be shifted sufficiently to prevent this, but care must be taken not to generate an annoying 60 cycle ripple, should the shifting become large.

A search for the source of the pulse will be made in order to eliminate it.

5.0 INSTALLATION AND POWER (Continued)

5.2 Power Supplies and Control (Continued)

(G. A. Kerby)

The 500/400/300 volt, 5 amp regulator, serial no. 1, is now giving fair performance. Some circuit changes have been made to remove a 75 kilocycle oscillation and also to insure stability over the range of adjustments, controls and thermal drift.

A 20 cycle oscillation still remains to be cleared up. It is thought to be either due to the rectifier tubes or due to long time constant interaction in the regulator itself.

6.0 BLOCK DIAGRAMS

(R. P. Mayer)

Attention, Programmers! You wouldn't think of doing a dv without an sl! But, do you always think of following an sa with something which clears special add memory? Apparently much time and effort is wasted by failure to do this, not because it always results in trouble, but because it rarely does - and so is painful to track down. To review the situation: if an sa is used for a double-length operation the programmer has no trouble following the latest issue of "A Short Guide to Coding", but if the sa is used simply to prevent an overflow alarm then the overflow must not be allowed to interfere with subsequent orders. If the first ca, cs, or cm (after any sa) is going to bring in a number which must be exact (ie: which must not have 2^{-15} added or subtracted from it), then special add memory must be cleared between this instruction and the previous sa. The required clearing will occur automatically on ad, su, sa, ao, mr, mh, dv, sl, sr, or sf. If one of these does not happen to exist in the program, then a dummy must be inserted, for example: ad RC 0, or sl*0, or (if BR and AC are not important, as just before ca) sl 0 can be used. Study the latest "Short Guide to Coding" for further details, you already make it a rule to dv and then sl. Now make it a rule to sa and then clear it.

(J. H. Hughes)

C. P. O. 54 has been connected as "Vertical Decoder Clear" for the new display decoders. It is on Time Pulse 7, qd and qf.

C. P. O. 111 is assigned for "S-Scope Intensify," Time Pulse 3. It is intended that qs be hooked up as a third scope display order, with a toggle switch to control whether the camera is used or the display.

I've been working with Daggett & Hunt on Block Diagrams for the proposed new Marginal Checking System.

(Frank Heart)

Time has been spent in continued study of current work on In-Out Block Diagrams. Some preliminary consideration has been given to problems of representation of In-Out sequences which are not identical each time used.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Operation

(J.T. Gilmore)

During the past bi-weekly period 41 hours and 6 minutes were made available to the Mathematics Group. Of this time, 4 hours and 22 minutes were lost due to computer trouble. The following is an account of how the usable time was spent.

Problem #	Title	Minutes Used
4	Floating Point and Extra Precision Interpretive Subroutines (Programmed Arithmetic, PA)	45
8	Magnetic Flux Density Study	122
13	Point-by-Point Scope Plotting of Calibrated Axes (Output Camera, OC 2)	43
21	Optical Constants of Thin Metal Films	84
23	Print-Out of Contents of Storage (Post-Mortem Error Diagnosis, PM)	74
24	Matrices, Determinants, and Systems of Linear Equations	36
26	Subroutine Orientation Procedures	104
28	Ambipolar Diffusion	101
30	Digitally-Controlled Milling Machine Program	52
37	n-th Root Approximation for Subroutines	34
38	Typewriter Print-Out for Subroutines	62
41	Binary Matrix Product Statistics	26
42	Spherical Waves - Numerical Integration of Hyperbolic Partial Differential Equations via Characteristics	274
45	Crystal Structure	70
47	Partial Differential Equations of Engine - Part 1	25

8.1 Operation (continued)

(J.T. Gilmore) (continued)

Problem #	Title	Minutes Used
48	Gust Loads on Rigid Airplanes in Two Degrees of Freedom	18
49	Meteor Computation II	354
50	Lattice Analogy Applied to Shear Walls	196
52	Oil Reservoir Depletion Analysis by Iteration	8
55	Solution of 2nd Order Non-Linear Ordinary Differential Equation	34
57	Runge-Kutta Differential Equation	62
CONVERSION		320
	TOTAL	36 hours 44 minutes

Total Number of Programs Operated = 128

Usable Time Percentage = 89.3%

8.2 Procedures

(J. T. Gilmore)

There are an increasing number of programs being written which require the conversion of floating point and multiple length numbers. There has also been an increase in the number of requests for printed records of storage and usually these requests call for large sections of storage. Because of this, work on the semi-direct read-in conversion program has been accelerated. This program will be capable of converting regular instructions, subroutines, single and double length decimal fractions, and floating point numbers. It also will utilize magnetic tape for storing the binary form of the instruction and numbers doing the read-in conversion process and then replace itself with this binary information once it has completed the conversion. This means that after a converted program has been operated, its initial binary form will still be on magnetic tape. Therefore, it will be possible to compare the contents of electrostatic storage with that of the magnetic tape and cause a storage print-out of only those registers whose contents have been changed.

8.2 Procedures (continued)

(J.T. Gilmore) (continued)

Of course with a little refinement only those registers which may be questionable can be examined so as not to cause unnecessary print outs. This will be done by a storage print-out routine which is being written simultaneously with the new conversion program.

A sufficient input check on the magnetic tape has been devised so as to insure that the converted programs will be put into storage in exactly the form desired by the programmer. It should also aid magnetic tape people to determine how reliable the system actually is when in continual use.

The Fairchild Camera has been changed to photograph displays on the sixteen-inch scope. It is hoped that the quality of the scope photographs will improve with this change. Also, in order to lighten the burden of our present photographer, our new operator will begin training on developing and printing the photographs taken by the Fairchild Camera. This change should decrease considerably the present delay between the operation of display programs and the delivery of the results.

(J.W. Carr III)

A complete set of subroutines for "machine integers", i.e., decimal integers determined from the contents of one machine storage register, are now available and will be distributed soon for Subroutine Library Notebooks. These include initial zero suppression, print final zero, and print from AC or ES.

(J.M. Frankovich)

Programmers who make use of the 24,6,0 number system are currently able to do this by incorporating the PA 2.2t subroutine in a program and indicating to the computer operator that a special input conversion program is to be used. However, this system at the moment usually implies that the corner of ES storage occupied by Gilmore's program cannot be used by the programmer. A 5-5-6 tape, T 957-2, has been prepared consisting of the two 24,6,0 subroutine PA 2.2t and OT 102.1t, which can be read into storage on top of Gilmore's program after it is no longer needed. This procedure allows a programmer using the 24,6,0 system to use all of ES storage. However, the programmer must now indicate to the computer that this tape T 957-2 is to be used.

The last version of the special 24,6,0 input conversion program (T 873-4) will reject nullifier but no other undesired character on the Flexo tape. This program will soon be replaced by Gilmore's new conversion program which will convert numbers in several number systems as well as reject any kind of undesired characters.

8.3 Problems

(D. G. Aronson)

The first phase of the crystal structure problem (#45) has been completed. A procedure has been set up for calculating crystal structure factors on an arbitrary grid. Test runs in a case where results are available showed excellent agreement with values obtained by other means. A program (T 987) is available for Fourier Synthesis of the form

$$\rho(x_{i1}y_j) = \sum_{k=o}^{k\ max} \sum_{h=h_{min}^{k}}^{h_{max}^{(k)}} F_{hk} \cos 2\pi (hx_i + ky_j)$$

where $\{F_{hk}\}$, $\{h_{min}^{(k)}\}$, $\{h_{max}^{(k)}\}$, k_{max}, $\{x_i\}$, $\{y_j\}$ are given. A method of having WWI print contour maps of a crystal projection is being considered. Work of this nature has been carried out successfully on the EDSAC (c.f. Bennett & Kendrew, Acta Crystallographica, Vol. 5, pt. 1, 1952). Further investigations are being planned on methods of mechanizing the various numerical procedures used by Crystalographers.

(J.W. Carr III)

Dr. Clay Perry and Mrs. Nancy Dismuke were here for the past week, representing Oak Ridge National Laboratories on solution of the Beta-Ray Spectrometer problem. This problem consists of evaluation of solutions to a certain hypergeometric ordinary differential equation for a large number of parameters, to be used by physicists in nuclear decay calculations. Dr. Perry and Mrs. Dismuke are now in the process of coding the solution, and initial tests will begin on portions of the problem very soon. A special complex number routine, containing the orders ca, cs, ad, su, cm, mr, dv, sp, ta, ts, and ex is being written for use with this problem, which calls for numerous operations with complex arithmetic.

First solutions were obtained on the first set of boundary values for the Partial Differential Equation of a Piston Engine, programmed by Mr. Tsai, of Sloan Lab, MIT. The results agreed very satisfactorily with check points, and a full output of the required values will be run on the machine soon. Further boundary values and a test run on a solution of the equation itself along characteristics is now planned.

Tapes are now ready and tests planned on the General Ordinary Differential Equation Solution programmed by Dr. Laning. The general eigenvalue solution tape, programmed by Mr. Meckler, is now ready for test.

8.3 Problems (continued)

(J.M. Frankovich)

Problem #49

The extrapolation of a high order ordinary differential equation from given initial conditions has been programmed by Messrs.Tom Drake and Jim Dailey. Each step of the extrapolation is carried out by means of the method of successive approximation, using Simpson's rule for the necessary integrations, and all computations are carried out in the 24,6,0 system. Several exploratory runs have been made on WW in the past two weeks and complete runs to match terminal conditions will be attempted this week.

Problem #30

Mr. Runyon of the Servo Lab (Bldg 32) is writing a program which will convert information typed in the Flexo coder used either here or at the Servo Lab. to the NMM code. Complete results have not yet been obtained from the program which will prepare instructions for the milling machine to cut circular arcs.

(F. Helwig)

A new problem (#56) has been proposed by Dr. Wachendorff of the Retina Foundation. This problem is of a somewhat general nature and is concerned with the computation of optical lens systems by determining chromatic aberrations, aberration coefficients and ray tracing.

The first part of the problem is concerned with the tracing of a paraxial ray which starts near the optical axis and lies in the optical plane. A program to do this has been written by Dr. Wachendorff and is being checked. Computations will be done in the (45,0,0) number system since 8-digit accuracy is desired in the results.

(E.S. Kopley)

G.D. Galletly's "Solution of a Pin-Connected Lattice-type Structure Statically Indeterminate to the Sixth Degree or Higher" has been successfully run for parameters 1 and 11. It is expected that the program will be run with all 27 parameters on March 1.

Several difficulties not anticipated in this program arose during last week. One of them was to determine the lower bound of all criteria so that the greatest accuracy might be obtained employing (15,0,0).

8.3 Problems (continued)

(E.S. Kopley) (continued)

Another difficulty lay in the fact that each of the parameters might conceivably have a different lower bound criteria. This necessitated taking several freedoms with the computer in order to expedite obtaining useful results.

8.4 Subroutines

(D.G. Aronson)

1. Partial Jordan Elimination (30,0,0) - the initial test of this routine was not completely satisfactory since the accuracy was less than anticipated. Improvements are being considered.

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

3. Sin-Cosin (24,6,0) - To be tested.

4. All trig. functions (24,6,0) - To be tested

(J.M. Frankovich)

A defect in the output conversion and printing subroutine for floating point number system (15,15,0 and 24,6,0) has been corrected. The present versions are:

T 879-3 (OT 101.1t) 15,15,0 MRA Output Subroutine

T 829-5 (OT 102.1t) 24,6,0 MRA Output Subroutine

Both of these subroutines will give a column layout of numbers.

Experience with the 24,6,0 interpretive subroutine PA 2.2t has shown it to be quite useful to programmers. Certain improvements and variations seem to be indicated however. Those which will be considered in writing new (complementary) versions are operating speed, multiple multiple-register-accumulator, B-boxes, use of the ql instruction and use of slightly different number systems, e.g., 25,5,0.

(F. Helwig)

A (45,0,0) interpretive subroutine which can perform the additional operations cm, sl, sr, sf, dv and rc has been written and is being tested.

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
R-204	A Head for Static Reading of Magnetic Recording. M. S. Thesis	72	1-15-52	D. H. A. Hageman
E-421-1	Transistor Bibliography	8	2-19-52	N. T. Jones
E-449	The CADAC Computer	21	2-15-52	E. A. Emerson, A. M. Werlin
E-450	Whirlwind I Terminal Equipment (Talk given at Digital Computer Laboratory Seminar January 22, 1952)	6	2-21-52	E. S. Rich
M-1393	WWI Drawing and Panel Change Procedures	1	2-15-52	S. H. Dodd
M-1398	Reporting on Troubles Affecting Computer Reliability	1	2-15-52	S. H. Dodd
M-1399	Bi-Weekly Report, February 15, 1952	31	2-15-52	
M-1401	Regenerative Transistor Pulse Amplifiers: M. S. Thesis Proposal	6	2-18-52	A. W. Heineck
M-1403	The Display of Arabic Numerals on a Cathode Ray Tube. M. S. Thesis Proposal	10	2-19-52	F. A. Irish
M-1404	Transistor Group Experimental Procedures	3	2-20-52	N. T. Jones
M-1406	General Notes on Negative Resistance Transistor Circuits	1	2-21-52	J. F. Jacobs, N. T. Jones
M-1409	Progress Report No. 1, M. S. Thesis: A System for Testing M. I. T. Electrostatic Storage Tubes	2	1-15-52 to 2-22-52	H. J. Platt
M-1410	Results of Numerical Solutions of Linear Parabolic Partial Differential Equations	9	2-14-52	J. D. Porter

LIBRARY FILES

No.	Identifying Information	Source
.004	European Scientific Notes: 15 January, 1952	ONR/London
47	Technical Information Pilot: January 3, January 17, 1952	ONR/Library of Congress
113	General Radio Experimenter: February, 1952	General Radio Co.
180	Bulletin of the Document Office: February 15, 1952	R. L. E./MIT
597	Reports on Research: February, 1952	MIT
1250	Research Reviews: February, 1952	ONR/Washington
1577	Ferrite Development: Third Quarterly Progress Report, October 1 - December 31, 1951	General Ceramics and Steatite Corp.
1671	Nuclear Science Abstracts: Cumulative Index, 1951; February 15, 1952	U. S. Atomic Energy Commission
1708	Characteristics of Communication Systems: Report No. R-233-50, PIB-178. June 18, 1951	A. E. Laemmel, Microwave Research Institute, Polytechnic Institute of Brooklyn

9.1 Publications (Continued)

LIBRARY FILES (Continued)

No.	Identifying Information	Source
1712	A Study of the Prediction of Compositron-Resistor Life. September 30, 1951	D. J. B. Bridges, W. T. Sackett, J. H. Graham, Battelle Mem'l Inst.
1713	Magnetic Amplifier Investigation: Engineering Report No. 37, D. I. C. 6506, January 15, 1952	R. Kramer, Servo Lab./MIT
1714	Inverting Modified Matrices: Memorandum Report No. 42, June 14, 1950	M. A. Woodbury, Statistical Rsch. Gp., Inst. for Advanced Study
1715	The JAINCOMP Computers: AIEE Paper presented January 24, 1952	D. H. Jacobs, Jacobs Instrument Co.
1716	The Study of Telemeter. November 30, 1951	Int'l Telemeter Corp.
1718	Observation of Magnetic Domains by Kerr Effect	H. J. Williams, F. G. Foster

Oil and Gas Journal: February 18, February 22, 1952

9.2 PROCUREMENT AND STOCKS

(H. B. Morley)

Some of the major orders for 1700 Plug-in units have been placed. The remainder of the orders are awaiting decision on what is needed.

During the last few weeks the delivery promises given by some vendors and representatives have improved. Whether this is factual and/or temporary remains to be proven. To take advantage of this situation every effort will be made to place orders for critical materials. However - the overall delivery picture is not too encouraging.

New personnel has been added to this Dept. to cope with the increased work load. We should be able to take care of all requests more efficiently. Long range plans include revision and reclassification of Kardex to coincide with new and revised Standards as approved by the Committee, and revision of paper work systems and catalogue files.

New items submitted for test and evaluation:

IRC BTS composition resistors
IRC BW wire wound resistors
IRC DCC carbon deposition resistors

(H. W. Hodgen)

Efforts are being made to shorten the time required for the drafting, revision, approval and publication of standards. Under ideal conditions, it would appear that at least four weeks would be required to process a class. Just how near this goal we can come remains to be seen, as it depends on a number of variable factors. At present we are hampered with a backlog of material which must be prepared for publication.

A part-time student has been employed to assist in the drafting and preparation of standards, which should eventually result in materially shortening the time required for processing.

The Multilith master sheets for standards are now available, and sections on resistors, relays and fuses are being prepared for printing. Capacitors and wire should be completed by the end of the next bi-weekly period.

9.3 Construction

(F. F. Manning)

Production Control

The following units have been completed since February 15, 1952:

80 Video Cables (Corderman)
1 Core Tester (Breadboard)
1 Core Tester Driver (Breadboard)
5 Signal Plate coupling ST Mount
15 T2 Transformers Signal Plate Coupling
39 Video Cables (Brown)
1 Photoelectric Tape Reader Control

The following units are under construction:

2 ESD Output Panels
30 Delay Lines
30 A-C Circuit Breaker Boxes
10 D-C Circuit Breaker Boxes
1 - 15 Volt D-C Supply (Control Section)
1 - 48 Volt D-C Supply (Control Section)
1 - 30 Volt D-C Supply (Control Section)
4 - Multivibrator Frequency Divider
1 - 15A, 100 Volt Variable D-C Pwr Supply
5 - ST Mounts
3 - Mod DCIOR for Magnetic Tape Control

9.4 Drafting

(A. M. Falcione)

1. New Drawings:

A. Model 2 Pulg-In Units, WWI

Final decisions regarding these units have now been reached, and we are now working towards the completion of all drawings. We will make drawings in the following order for each particular unit:

Gate Buffer Amplifier Unit
Gate Tube Unit
Flip-Flop Unit
Buffer Amplifier
Switch Unit

9.4 Drafting (continued)

(A. M. Falcione) (continued)

B. R F Monitor

We are in the process of making a complete set of drawings for this unit. The panel and chassis, together with covers, will be painted and engraved. The Circuit Schematic number is B-50917, Assembly drawing and Parts List is D-50891.

C. 15 Amp 100 Volt Variable D-C Power Supply

Complete drawings for this unit have been completed and will be ready for grading in the next few days. Drawing numbers are as follows: Circuit Schematic, B-50509; Assembly and Parts List, D-50569; Aluminum Panel, D-50570; Chassis, E-50571.

2. Thesis Drawings:

Engineers who are in the process of writing theses to be submitted this term are urged to submit their drawings to drafting as soon as possible. In view of the large amount of drafting time which will be required to complete the twelve theses this semester, it would be greatly appreciated if engineers would submit their drawings at the earliest possible date. To date, other than the thesis drawings for Ted Roess and one drawing for H. Platt, no other drawings have been received.

10.0 General

(John C. Proctor)

New Staff

Robert A. Pacl is a staff member working with Taylor's group. He received his B.S. in Physics from the Illinois Institute of Technology. He was in the Navy for two years and worked as analyst with Hallicrafters for two years.

New Non-Staff

Katherine Campbell is a secretary working part-time with Adams' group. She also works in the Numerical Analysis Lab.

Donald Davison is a part-time student technician working with Hodgdon.

Romeo DiCicco is a technician working with Wiercinski.

Salvatore A. DiFazio is a technician working with Grant. He has had several years' experience in radio work.

John Donohue is a night janitor working at Whittemore.

Marian Fasick is a secretary working with Bob Nelson. She has had a number of years' experience in secretarial work.

Richard Greenwood is a technician working with Wiercinski.

Walter Kates is an administrative assistant in the Purchasing Office. He has been a motion picture projectionist for several years and was in the Air Force five years.

Daniel McGrath is also an administrative assistant in the Purchasing Office. He has done similar work at MIT, along with previous experience in accounting and office management.

Victor Silverstein is a technician working with Grant. He has worked for several years in radio repair and TV.

Benjamin Stahl is a technical assistant working with Wieser's group as a programmer. He was in the Air Force for one year.

Ernest Strait is a part-time student technician working with vacuum tube data correlation.

10.0 General (continued)

(John C. Proctor) (continued)

Terminated Staff

Arthur Blachman

Terminated Non-Staff

Howard Briscoe

Peter Conrad

Wilma Franz

Azadooy Karaian

Jay Koogle

William Totty