Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, October 10, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEMS OPERATION

1.1 Whirlwind I System

1.11 Operation (D. Morrison)

The following is an estimate by the Computer Operators of the usable percentage of assigned operation time and the number of computer errors for the period 26 September - 10 October 1952:

Number of assigned hours	68
Usable percentage of assigned time	76
Usable percentage of assigned time since March, 1951	84
Number of transient errors	3
Number of steady-state errors	6
Number of intermittent errors	11

The usable percentage of assigned time is lower than usual due to the addition of the new in-out system.

(A. J. Roberts, H. L. Ziegler)

Storage reliability has been fair during the past biweekly period. We have resumed taking HVG transfer characteristics and have raised the heater voltage accordingly in a few digits. A storage tube containing a positive ion collector ring should be installed during the next period.

Chapter 4 of the WWI Service Manual has been distributed.

(N. L. Daggett)

The work of replacing the more important test equipment panels of Test Control by modified D-C IOR panels should be completed by October 11. Location of these panels in C-row will bring them under marginal checking control, thereby improving system reliability. In addition, elimination of the test equipment will make modifications to the system and maintenance of adequate video cable records much easier.

1.11 Operation (continued)

(N. L. Daggett, continued)

In modifying the D-C IOR panels for this use, changes were made to eliminate the more obvious defects of the basic D-C IOR flip-flop circuit. A rather striking improvement in margins has resulted, an improvement such that these panels should be among our most stable flip-flops, rather than our worst, as is the case for the present D-C IOR.

(S. H. Dodd)

Time schedules for MITE, Drums, and other equipment to be installed in WWI are being reviewed. Some revision is necessary because of delays in deliveries of outside supplies. Newitt will be able to devote more time to following schedules and helping to break bottlenecks.

1.12 Component Failures in WWI (L. O. Leighton)

The following failures of electrical components have been reported since September 25, 1952:

Component	No. of Failures	Hours of Operation	Reasons for Failure
Crystal			
D-357	1	12468	low R_b
D-358	1	1952	low R_b
1N34A	1	0 - 1000	low R_b
1N38A	2	0 - 1000	low R_b
	2	1000 - 2000	low R_b
Transformers			
Pulse 5:1	2	13067	open secondary
Tubes			
6Y6G	1	102	flicker short
6L6G	1	6440	low I_b
	1	7282	low I_b
2JC6J	1	14229	firing intermittently
ELC6J	1	802	would not conduct
12AY7	1	928	poor cut off
6SN7	1	5282	flicker short
	1	13394	flicker short

1.12 Component Failures in WWI (continued)

Component	No. of Failures	Hours of Operation	Reasons for Failure
Tubes			
7AD7	2	4000 - 5000	1-flicker short;1-low I_b
	4	5000 - 6000	2-flicker short;2-low I_b
	1	6000 - 7000	flicker short
	2	9000 - 10000	2-low I_b
	2	13000 - 14000	2-low I_b
3E29	1	12778	flicker short
	1	13658	gassy
	1	14176	flicker short
6X5	2	14204	low I_b
6AN5	1	3718	gassy
5963 (or) 12AU7	1	1001	flicker short

1.13 Storage Tube Failures in WWI (L. O. Leighton)

There were no storage tube failures reported during this biweekly period.

1.14 Storage Tube Complement in WWI (L. O. Leighton)

Following is the storage tube complement as of 2400 October 9, 1952:

Digit	Tube	Hours of Installation	Hours of Operation
0 B	ST-619-C-1	10069	276
1 B	ST-606-1	9599	746
2 B	ST-612	9575	770
3 B	ST-601	8524	1826
4 B	ST-516	6641	3709
5 B	ST-548-1	8299	2050
6 B	ST-534-2	7469	2881
7 B	ST-540	7937	2413
8 B	ST-549	8259	2091
9 B	ST-519	6624	3726
10 B	ST-544-1	8683	1667
11 B	ST-542	8148	2203
12 B	ST-608-1	8918	1433
13 B	RT-258	5207	5143
14 B	ST-541-1	7961	2389
15 B	ST-603	8322	2027
16 B	ST-533	7801	2459
16 A	ST-613	9046	1304

1.14 Storage Tube Complement in WWI (continued)

ES Clock hours as of 2400 October 9, 1952 10345

Average life hours of tubes in service 2173

Average life hours of last 5 rejected tubes 2917

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.13 Arithmetic Element and Arithmetic Control

N.B.S. Circuits (S.L. Thompson)

The circulating pulse flip-flop has been completed. 1N34 diodes have been substituted for the 1N38 diodes specified in the original circuit because 1N38 diodes are not available. Also, ten per cent resistors have been used instead of the five per cent resistors used by the Bureau of Standards.

The voltages used in the circuit are within the ratings of the 1N34 diodes, but two of these diodes have failed during the past two weeks.

The operation of this circuit is not yet acceptable. The circuit does operate, but operation is not reliable. The timing of the input pulses and certain applied potentials have to be carefully adjusted. It has been particularly difficult to complement the flip-flop from "one" to "zero". "One" is represented by a pulse circulating through a delay line, and it has been difficult to inhibit this circulating pulse.

Logic and circuits used by the Bureau of Standards are more fully described in E-478.

Circulating-Pulse Flip-Flop (B. Remis)

A circulating pulse flip-flop whose outputs are very nearly d-c levels of +10 or -30 volts, has been built in a breadboard form. The flip-flop requires two pulsed inputs; one a synchronizing 0.5 μsec square wave, and two, a 0.3 μsec negative pulse with prf of 1 mc. This second input is called a clamping input and insures a negative output from the flip-flop if no "one" is being stored.

Construction was just completed and the flip-flop stores zeros and ones correctly on a static basis. Additional circuitry is being built to switch periodically from "ones" to "zero" and to observe the resulting waveforms.

2.13 Arithmetic Element and Arithmetic Control (continued)

Arithmetic Elements Study (A. Heineck)

Study is continuing on Ordvac, Seac, and other systems. Sam Thompson has almost completed the work on a single circulating flip-flop of the Seac type. Three such flip-flops will next be combined to form a counter.

A two-stage diode adder that works on d-c levels, rather than pulses, will soon be constructed. Such an adder could be used in a d-c system like Cadac, Ordvac, or the computer being studied by Dick Remis.

2.14 Input-Output (J.A. O'Brien)

The magnetic drum matrix for in-out switch control of magnetic drums has been designed and is now in the drafting department.

The changes and additions to the in-out system for installation of Phase II (drums) is being worked on in detail. Drawings are being changed; modification notices are being written. It is expected that this work will be completed early in November.

(R.H. Gould)

The sixteen intensity lines for the display scopes have been installed. Addresses of the si order from 0600 to 0617 (octal) inclusive will now give intensification. It is requested that the intensity, of the display scopes (particularly the 16" scopes) be kept low to avoid burning of the phosphor. An easily visible spot will not burn the phosphor even though it stays in one place indefinitely. Burned spots are not caused by proper use of the scope.

It has been decided to modify the photoelectric-tape-reader control so that the PETR is inactivated within 5 microseconds of a change in the in-out switch. A program alarm will not, therefore, be produced if the PETR is stopped in the middle of a block of information. However, either blank tape or a series of nonsense characters that will print can be used to provide the necessary stopping space between information blocks. The latter facility was requested by C.W. Adams to add to the flexibility of the system.

Stories of varying vagueness about improper operation of the in-out system reach the in-out group by devious paths and cause grave concern, but they cannot be acted upon because essential data is lacking. All who suspect failure of any of the in-out equipment are urged and

2.14 Input-Output (continued)

requested to write down what happened, what the positions of the in-out switch and in-out control flip-flops were and where in what program the suspected failure occurred. The address of the last si order correctly performed before the failure and any intervening rc or rd orders should also be given. These notes may be given to the systems group or directly to the in-out group. If all of the above information is entered in the WWI log, a note referring to the log entry will suffice.

M.I.T.E. (R. Paddock, A. Werlin)

The past two weeks have seen the final phases of testing the three-panel M.I.T.E. prototype. To determine the operation of an actual counter, a complete eight-section counter was built and initially checked for pulse propagation; this check showed pulses of fairly good waveshape but of unpredictable amplitude due to overdriven gates. In correcting this difficulty it was determined that the optimum termination at the carry-gate outputs was 120 ohms.

A series of flip-flop complement marginal checks showed that a d-c return from the junction of the mixing crystals in the flip-flop grid circuit was of questionable merit.

Marginal checks were made for screen and plate voltages on all carry-gates available for testing in the eight-section counter and for screen voltages on all counter flip-flops; from these checks were determined the initial marginal checking specifications for the M.I.T.E.

A mounting bracket for the switch-unit pots was designed to match the redesigned local flip-flop indication-light brackets.

2.2 Vacuum Tubes and Crystals

2.22 Transistors

General (N.T. Jones)

A considerable portion of the last biweekly period was spent in catching up on the work done in the transistor section during my vacation.

2.22 Transistors (continued)

Life Tests (N. T. Jones)

The transistor life tests have now been operating 1200 hours continuously. As yet no large scale change in characteristics has taken place in the units in any of the tests.

Transistor Switching Problems (N.T. Jones)

Two discussions were held with Professor Adler of Project Lincoln to outline the problems involved and the methods of analysis of switching in transistor circuits, especially when the collector is saturated. This subject is being discussed as a possible S.M. thesis.

Testing (I. Aronson)

Two more shipments of RCA TA-165's have been received. Of these, 12 have been completely processed and 12 have been d-c tested only. In addition, d-c tests were made on 10 British units, (Standard Telephone & Cables Ltd.), 10 Raytheon CK 716's, and 23 RCA TA-165's which were previously rejected for low alpha.

Experiments (I. Aronson)

N. Pribble is continuing his experiment to determine triggering requirements of a one-transistor flip-flop. The progress can be summarized as follows:

1. The negative resistance characteristics were obtained for five transistors to be used in the test.

2. Curves were plotted of pulse width versus amplitude required for triggering at various emitter bias levels. Four of these curves are for going from the "off" to "on" state, and two are for the "on" to "off" state.

3. Base and collector photographs were taken at various trigger widths as the switching point was approached. Photographs were taken for only one transistor, but 13 others were observed for similarity of waveform. In addition, base and collector waveforms were observed at various trigger amplitudes as the switching point was approached.

2.22 Transistors (continued)

Test Equipment (I. Aronson)

Some thought has been given to building an alpha vs. i_e display unit. In order to try the various ways of obtaining this display, available equipment was set up to do the job. Sufficient information was obtained from this test to carry out the design of such a device. This will be done as soon as time permits.

The IBM diode characteristic tester has been built in breadboard form. Work is being done to include additional features that are important to us. As soon as the necessary changes and additions are tested in breadboard form, we will have a finished model built in our shop.

Visitors (I. Aronson, N. T. Jones)

Dr. B. Alexander and N. Golden of Sylvania visited the Transistor Group on September 30, 1952, to discuss computer applications of transistors. They brought with them 11 Sylvania samples which were put through all our regular tests.

Transistor measurements, tests, and characteristics were discussed with H. Heath and J. Goetz of IBM on Thursday, October 9.

Analysis of the Transistor Equivalent Circuit (W. Klein)

A memorandum (M-1662) has been prepared giving the results of a complete analysis of the transistor equivalent circuit with pure resistance loading.

Transistor-Driven Matrix Switch (W. Klein)

The results of the investigation of a transistor-driven matrix switch are being reviewed for possible presentation in a memorandum.

Transistor Accumulator (D. Eckl, R. Callahan)

The total time on the accumulator is now 872 hours. The operating speed (156 problems/sec) and the test problem (12 x 15) remain unchanged. Operation is still considerably better in the evening than during the day. An indication of the type of reliability being obtained during the evening hours is given by the following data:

2.22 Transistors (continued)

26	Sept.	18.5 hours	0 errors
27 - 28	Sept.	37 hours	1 error
29	Sept.	15 hours	0 errors
30	Sept.	15 hours	0 errors
1	Oct.	14 hours	0 errors
7	Oct.	16 hours	0 errors

The error-free runs were made from approximately 1700 to 0800 except during the weekend. On evenings not listed continuous errors were recorded after a certain time. In most cases these have been due to a change in the amplitude of an add or carry command pulse obtained from the test equipment. Errors during the day still continue at 4-5 per hour.

A rack mounting for the battery power supply used in the transistor work has been completed and installed.

Felker System of Bit Storage (R.H. Gerhardt)

Testing of the breadboard model is continuing. It was learned that it would be very difficult to make the circuit complement because there was not enough power in the circulating pulse to drive inhibiting gates successfully. However, I was able to set and clear the circuit. Additional test equipment was received and the circuit was set and cleared at a rate above 150 kc.

The circuit uses one transistor blocking oscillator to set and one to clear. From the transistor life test data it seems that the life expectancy of these transistors will be high.

The transformers are being built and potted for a four-bit register which is to be built next week.

2.3 Ferromagnetic and Ferroelectric Cores

2.31 Magnetic-Core Materials

Hysteresis Temperature Test (C.D. Morrison)

The data from the test has been tabulated and curves of maximum squareness ratio, coercivity, and flux density vs temperature have been plotted. These curves plus a sequential picture arrangement of the hysteresis loop at each temperature is being printed in the drafting room and will be printed in a report together with a description of the experiment.

Hysteresis Loops on Cores Under Stress (C.D. Morrison)

Data was taken on Ferroxcube 4B for different values of ampere turns and different values of stress. The stress was applied by the core buster. This data will be correlated with the pulse-test data taken on the same core under the same stresses.

Chemical and Ceramic Facility (F.E. Vinal)

As correspondence did not develop suitable kiln facilities, several manufacturers were visited to discuss the problem. It appears on the basis of facilities, staff, and experience that the Harper Electric Furnace Corp. of 39 River Street, Buffalo, N.Y. is best qualified to undertake the job. They have submitted a quotation. Contractors' bids for changes and installation of the laboratories are at hand except that a satisfactory bid has not yet been received to clean out and fix up the Corliss Engine room. This bid should be at hand in a few days. A number of the larger equipment items are now on order with delivery dates running 60-90 days.

Preparation of Ferromagnetic Materials (J. Sacco, F. Vinal)

Work has been started on a new mixture, DCL-2-2, which has essentially the same composition as LIR-62-13 II A. The main objective is to determine any variation in the properties of the finished toroids due to changes in the procedure during the preliminary preparation.

Several replies have been received from companies which manufacture resins for impregnating ceramic materials. On the basis of available information, monomeric methyl methacrylate seems most suitable.

Core Stresses (P.K. Baltzer)

Preliminary hysteresis and pulse data, for Ferroxcube 4B while under various applied stresses, has been collected and correlated. The results indicate that an extensive experiment of the same sort would be very profitable.

2.31 Magnetic-Core Materials (continued)

Extensive data has been collected, but has not been evaluated or correlated. When this experiment is completed, an E-note will be written describing the results.

Magnetics, Inc. Cores (W. Ogden)

A trip was made to Magnetics, Inc., to check a new batch of 1/8-mil cores. Approximately 50 percent of the cores in a batch of 500 were acceptable, having the following average characteristics:

Optimum Driving Current	210 ma
Switching Time	9.5 μsec
Disturbed-One Signal	25 mv

Quality control is to be improved further with special attention to the annealing process, bobbin dimensions, and tape-winding procedures. It is hoped that poor cores from a given batch can be refired giving a higher total yield.

Test (R.F. Jenney)

The production tester is nearing completion and is expected to be in use the middle of next week.

Some cores from Westinghouse were tested but they are not satisfactory because of long switch time and disturbance sensitivity.

(J.D. Childress)

The auto-current stepper logic has been assembled and tested.

(J.D. Childress, P.K. Baltzer)

A magnetic-core tester has been assembled. This tester uses the Model III Driver thereby providing Read, Write, and Disturb Pulses of 3.0 amps max., 3.0 amps max., and 1.5 amps max. respectively. The logic provides for both symmetric and asymmetric disturbs.

Measurement of Pulsed Voltages (J.R. Freeman)

The amplitude of voltage pulses may be determined by measuring a d-c voltage which is matched against the pulse amplitudes. A portable device for accomplishing this has been designed, built, and tested for convenience of use and accuracy. Pulsed voltages between 1 and 45 volts may be measured with the present instrument to within 0.1 volt or less.

2.31 Magnetic-Core Materials (continued)

Ferromagnetic Ceramic Toroids and Preparations (G. Economos, J. Baldrige)

Continuation of the investigation on the best square-loop body has brought out some interesting points. First of all, there is an indication that the firing procedure followed is not a determining factor. A complex schedule (2 hours at 1400°C, then 4 hours at 1300°C) gave R_{sm} values of about 0.58 (3A10). Firing to a single peak temperature (1400°) for 8 hours gave R_{sm} values of about 0.64 (3A13). The best R_{sm} value obtained thus far (0.70 for 3A15) has been obtained by firing at 1350°C for four hours. Correlation of the densities of these materials shows that an ultimate high density need not produce the best square-loop: 3A15 with R_{sm} of 0.70 was 4.33 gm/cc and 3A13 with R_{sm} of 0.64 was 4.50 gm/cc (average values cited).

The procedure with F-108 toroids has been to spot check certain variables and determine their reproducibility. A new 3A10 body has been prepared from previously mixed oxides by G. Economos and a completely new reproduction of this has been prepared by J. Baldrige. These will be fired separately to show how completely this body can be duplicated.

Volume production of F-305 toroids of the elementary ferrites and the square-loop ferrite body has begun. To date about 300 toroids have been delivered covering the various combinations of variables as forming pressure, firing temperature and firing time. This same procedure will be used with F-109 toroids as soon as the die is delivered. The latter toroids require less material than the F-108 type and still can be used on the automatic loop tracer. From these, a more accurate study can be made of the various magnetic parameters.

2.32 Magnetic-Core Memory

Switch-Core Study (A. Katz)

A note describing and analyzing experiments made to date is being prepared. Further experimenting will begin when the "staircase" generator previously described is reassembled.

The Sensing Panel Development (C.A. Laspina)

The sensing panel was tried on the 16 x 16 metallic array and the operation was marginal. The sensing winding in the array is at +250 and variations in the +250 line are amplified by the panel causing poor operation. A small time constant input circuit will be tried which should be insensitive to the relatively slow variations in the +250 line.

2.32 Magnetic-Core Memory (continued)

Z-Axis Driver (C.A. Laspina)

A driver was designed and built which provides two continuous ranges of current, 75-250 ma and 500-800 ma and is undergoing test.

Delta Noise Problem (W. Ogden)

Measurement of delta noise was continued using the single-core pulse-test equipment, model 1, with the help of Jack Raffel.

The 1/8-mil metallic cores as a group produce the smallest delta output, small enough so that it should be of little concern when planning large arrays. Ceramic cores as a group are second with a delta output that would not become serious until the size of the array exceeds 64 x 64. The 1/4-mil metallic cores as a group produce a large delta output and special means should be used to compensate for it when building an array with these cores.

Core Packaging Problem (W. Ogden)

Two model 8 x 8 arrays have been constructed as part of a study of the core packaging problem. Several more such models are planned and suggestions or criticism would be welcomed.

Ceramic Array #1 (E.A. Guditz)

In attempting to increase the operating speed of the array some prf sensitivity in the vacuum tube drivers was uncovered. This must be corrected before the work can continue.

A special form of δ_{ns} "noise" has been observed and is being investigated. An engineering note is being prepared on the subject.

Ceramic Array II (J.L. Mitchell)

When the memory was put back into operation after testing the switch cores and correcting the winding errors in the switch cores the array was able to hold patterns of "ones" and "zeros" and also operated successfully in a cycling mode. The outputs of the switch cores were found to be uniform within a range of about plus or minus 5%. These results seem to indicate that switch cores that are wound correctly can be put into a memory array and be expected to operate successfully.

2.32 Magnetic-Core Memory (continued)

The memory which is made up of MF 1118-259 cores is now operating with H_m = 2.4 amperes and a read-write time of 6 microseconds neglecting the flip-flop setup time. The driving current operating margins are about plus or minus 10%.

16 x 16 Metallic Array, Mod. I (B. Widrowitz, S. Fine)

Data is being compiled for an E-note on delta noise and the sensing problem of this array.

It was found that considerable improvement in zero-to-one discrimination with only a small increase in switching time can be realized by increasing driver rise times from the range 1/2 μsec to 3/2 μsec up to 5 μsec to 10 μsec.

A recent development which shows great promise for the improvement of zero-to-one discrimination has resulted from the work of Guditz on the Ceramic Array Mod. I. It was discovered that the two possible cores containing undisturbed "ones" on the selected X and Y coordinate lines may produce composite noises that represent a large portion of the noises observed at a given address in the 16 x 16 metallic array. A 6-μsec half-amplitude disturb pulse is now applied to an XY winding, following each read-rewrite cycle, which is capable of disturbing the undisturbed "ones" wherever they may be in the array plane. Formerly, the array would hardly hold a checkerboard pattern. Now it holds this with a smallest ONE to largest ZERO ratio being about 10 to 1. The full consequences of this development are yet to be investigated.

2.33 Magnetic-Core Circuits (H.K. Rising)

A theoretical investigation is being made of the general problem of signal gain in core circuits. An E-note is being prepared which will describe some of the general rules for core circuit design and point out the limitations of tubeless core circuits.

(G.R. Briggs)

Work has been completed on E-475, describing the resistance-coupled gate core. It is being typed and the diagrams are in the drafting room. Further experimental work has been dropped for the time being, to enable me to work with H.K. Rising on general magnetic circuit problems. We hope to be able soon to have rigorous proofs of certain theorems in connection with magnetic circuit theory which H.K. Rising has developed during the past several months.

2.34 Ferroelectric Materials

Ferroelectric Pulse Tester (J. Woolfe)

Several modifications in the trigger circuit have been incorporated in the pulse tester. This has been done in order to prevent the thyratron from oscillating.

2.5 Basic Circuits

Gate Tube - Buffer Amplifier (H.J. Platt)

A gate tube-buffer combination to work in conjunction with the MTC plug-in flip-flop was tested and passed as satisfactory. The output of this circuit was split in phase by a transformer. The negative portion complements the next flip-flop while the positive part senses the gate tube hung on the following flip-flop.

The combination of the GT-BA and the plug-in flip-flop will produce a suitable counter. The circuit will count with pulses 50 v high and 0.22 μsec wide as well as with standard pulses. After one stage, the wide pulse is shaped to 20 volts 0.11 μsec.

Plug-in Flip-flop (H.J. Platt)

Investigation is being carried out to see whether the MTC plug-in flip-flop can be used to drive the matrix drivers in the memory line selection matrix of MTC.

The matrix driver is a 6BL7 cathode follower with both halves in parallel. The grids of the 6BL7 are connected directly to the plate of the flip-flop. It is desired that the rise and fall times of the cathode follower be made as short as possible. Another problem will be to determine how much capacitive loading of the cathode follower will affect the flip-flop.

Preliminary results indicate that it will be possible to use the flip-flop as desired.

Plug-in Units (F. Irish)

The gate-generator circuit used in the Type 1 Register Driver is being modified so that it can be packaged into a plug-in-unit. The difficulty in packaging this circuit arises from the absense of three standard voltages from the plug-in-unit mounting panel: -30 volts, +120 volts, and +150 volts.

An experimental model of this modified gate-generator has been built, and it is now being tested. It is sufficiently different from the present gate-generator, so that the new model will not be able to be marginal checked in the same fashion. No satisfactory method, as yet, has been found for marginal checking this new circuit.

(H. Boyd)

An E-note is now being prepared on the 12AU7 two-megacycle flip-flop, and investigation is now under way on the reliability of this and other types of flip-flops.

2.7 Memory Test Computer

Block Diagrams (W.A. Hosier)

Finished sketches are now on hand for block schematics of several parts of the MTC system: accumulator, A-register, alarm panel, program counter, and step counter. Probably these are close enough to final for graded drawings to be made from them. Similar sketches of the memory, control, and terminal equipment can be made when certain aspects of the designs are frozen: in the memory, the type of core, with attendant driving and sensing circuits; in control, the practicability of long delay lines, possibly as long as ten microseconds; in terminal equipment, whether paper tape or new IBM binary punch-card equipment is to be used. An overall system diagram and a diagram of the console, or test control, should be forthcoming shortly.

A series of weekly talks on elementary details of MTC operation and logical structure has been given, principally for interested members of the components sections of Group 62.

Circuits (D. Shansky)

Due to a change in the outlook of magnetic core materials, the memory line selection circuits have been redesigned and are now being breadboarded. The memory line driver is now required to furnish currents in the range of 100 ma to 800 ma. This will be accomplished in two steps, a range of 80 to 120 ma with rise times of 1 μsec and pulse lengths of the order of 10 μsec, and a range of 400 to 800 ma with rise times better than 0.3 μsec and pulse lengths of the order of 2 μsec. This will make the memory driver flexible enough to accept both ceramic cores and metallic cores without necessitating a redesign and redevelopment of the memory driving circuits.

Power Supply Regulators (R.G. Farmer)

During one week of the biweekly period I have been designing series tube regulators for the MTC power supplies. During the last week I have been attending the indoctrination lectures.

Production Control (H. Smead)

Production Control prepared a detailed schedule for the production of MTC units, with estimated man-power requirements and starting and completion dates.

The plug-in flip-flops for MTC have been sent out to the vendor for fabrication. Three-hundred-fifty pulse transformers have been requested from Production Control for MTC requirements.

2.7 Memory Test Computer (continued)

Console and Facilities (R. von Buelow)

The console for MTC will consist of a long table on top of which will be four 19" x 17-1/2" cabinets. In addition to the usual things, toggle switch storage will be on the console.

Final decisions were made on the floor plan of the computer. Requests were made to move the lighting and plumbing to accomodate the air conditioning. Drawings have been made and the specifications prepared for the air conditioning. They are ready to be sent out for bids.

3.0 STORAGE TUBES

3.1 Construction (P. Youtz)

The 600-series storage tubes, constructed this past biweekly period as replacements for Bank B, continue to have a small Faraday cage on the target assembly, and the holding gun one inch closer to the target surface. These cages are used to investigate the beam distortion and deflection shift caused by positive ions.

One research tube, which was a 600-series storage tube containing both a Faraday cage and an ion collector plate, was constructed and checked for ion deflection shift this past period. Since the test results on this tube were very satisfactory, a limited production of these tubes has been started for use in ES row.

Test results on research tubes with stannic-oxide coatings instead of dag indicated that these tubes also had the deflection-shift phenomena in spite of their improved vacuum. However, efforts are being continued to develop techniques for producing a stable stannic-oxide coating. Tubes with improved vacuum should permit higher holding-gun currents with less harm to the high-velocity gun cathode.

Four research tubes were constructed and processed to study the conversion and activation processing of Philips "L" cathodes.

3.2 Test

Pretest (D. M. Fisher)

During the last biweekly period, ST630-C-2, ST631-C, ST632-C and RT339-C were pretested. These four tubes passed the required specifications at the TVD and are to be tested at the STRT.

A troublesome intermittent arcing in a high voltage power supply was finally located. It was taking place between the foil of a tubular electrolytic condenser and its mounting clamp.

Storage Tube Reliability Tester (R. E. Hegler)

During this biweekly period an attempt was made to check ST626-C at the STRT. While adjusting the signal plate coupling unit for correct r-f readout, it was noted that L-8 did not have sufficient range. This coil was replaced and the correct adjustment was obtained. It was also noted that the high-velocity-gun socket appeared loose. This was also replaced.

3.3 Research and Development (C. L. Corderman)

Testing of RT334-C was completed during this period. This tube had a regular screen frame ring supported two inches from the auxiliary-collector frame. This extra ring gave only a slight reduction in the amount of ion deflection shift which indicated that the ring was not able to disperse the ions as fast as they were being created by the holding-beam electrons. It was very effective in controlling the holding-beam shape at the target, however, and if it is necessary to improve the restoring current at the corners of the surface, such a ring should be very useful.

The third ion-trap tube to be constructed, RT339-C, utilized a circular, stainless-steel plate, almost equal in size to the inside diameter of the tube. This plate was attached about one-half inch back from the end of the holding-gun second anode. This plate is insulated from the second anode by a sheet of mica, and has a semi-circular notch cut out in the vicinity of the high-velocity gun neck.

This plate had very little effect upon the holding-beam shape. As its potential was varied from -25 to +400 volts with respect to the holding-gun cathode, the holding-beam diameter changed by less than one-half inch. However, its effect upon the ion cloud is quite remarkable; and, when the plate is at holding-gun cathode potential, the ion cloud appears to be completely non-existent. It has performed satisfactorily throughout seventy-five hours of tests and is now being put into a mount for life testing at the STRT. Indications at pretest were that the collector-to-surface spacing was too non-uniform for the tube to be suitable for computer use.

Three more tubes of this type have been scheduled in order to obtain further results, and to try out assembly techniques. Since it is highly desirable to seal the holding gun in the tube after the body seal has been made, the problems of having the plate inside the tube and then making a good mechanical and electrical bond to the holding gun are being explored.

Some work is being done on the reduction of r-f feedthrough in the first twenty-four storage tube mounts which do not have all of the modifications outlined by W. J. Nolan in Memorandum M-1097.

Type "L" Cathode (T. S. Greenwood)

During the last biweekly period, four research tubes containing "L" cathodes were processed. The first of these, RT335, was subjected to a slower-than-normal conversion and a normal heat activation. The state of activation was followed by momentarily drawing current during the activation schedule. It was found that essentially no activation occurred for the first hour, after which activation was quite rapid.

In RT335 the limiting aperture of the G_2 cylinder was not bombed after the conversion schedule, and during the aging period the cathode emission fell to one-half its initial value. The tube was subsequently bombed and reactivated. Following this, the emission was stable during aging.

3.3 Research and Development (continued)

RT336 and RT337 were used in an attempt to confirm this finding of emission instability. However, in neither tube did failure to bomb the limiting aperture result in emission failure during aging. In the case of RT336, an accelerated conversion schedule was used which resulted in a reduction in the normal low-temperature pressure peak. Since this peak is probably due to a reaction which liberates CO, a slower conversion was run on RT337. The resultant pressures on this tube were then very close to those in RT335. In RT338, the G_1 cylinder was not bombed. No apparent poisoning occurred in either activation or aging.

On the basis of the findings on these four tubes, it is clear that satisfactory pre-firing and bakeout of the guns is sufficient for production usage. Whether commercial RCA guns can be used without special cleaning procedures remains to be determined.

Pulse Readout (A. J. Cann)

During this bi-weekly period a usable video readout was obtained for the first time. It was used to gate a "read" pulse just as the r-f readout did, and allowed the Alignment-Demonstrator to operate normally. The margins are a bit narrow and the time required is 5 μseconds instead of the desired 1 or 2 μseconds, but improvements are under way. A variable delay line was built which, in conjunction with a Delay Line Panel, gives delays up to 1.0 μsecond in 0.01 μsecond steps. Using this line, the timing margins on the "read" pulse were found to be not nearly as narrow as had been feared. No trouble is expected from this source. TV readout was tried, but the picture is too highly differentiated to be of any use. Some sort of pulsed TV readout will have to be used.

The filters used at present are a third order Butterworth low pass for the signal-plate gate, and a third order Butterworth high pass for the readout. Plans for the future include investigation of fourth order filters and pulses which are shorter than 0.1 μsecond.

Faraday Cage Studies (J. Jacobowitz)

I am continuing the study of the oscillations which have been observed in the Faraday cage currents at critical holding-gun OFF times.

Velocity Distribution Measurement (C. T. Kirk)

During this biweekly period, construction on the unit to determine holding-beam velocity distribution progressed satisfactorily. A pulse generator for driving the holding gun grid was designed and built with the following specifications: peak-to-peak voltage = 120 volts, pulse repetition rate = 100 kilocycles, and pulse width = 0.5 microseconds.

4.0 TERMINAL EQUIPMENT

4.1 Typewriter and Tape Punch (L. H. Norcott)

During the past two weeks modification of our long-carriage FL Flexowriters was completed.

At the request of Charles Adams, additional contacts have been added to the "TAPE FEED" stacks of all eight of our FL Flexowriters. This modification makes it possible for tape preparation personnel to punch "feedholes-only" even when the 7th-Hole Switch is left in the "on" position.

4.3 Display (D. J. Neville)

The DuMont 304-H Oscilloscope, modified to increase stability, is now in use in WWI display. A second scope has been modified, and neither scope has noticeable drift. The modified DuMont scope seems to be very satisfactory for Display.

The external control box, designed for simplified operation and control of the oscilloscope is also in use, and appears to be beneficial. E-note write-ups on both projects are in progress.

4.4 Magnetic Drums (J. A. O'Brien)

Some difficulties with cross-talk appeared in the magnetic-drum circuits in the last biweekly period. ERA suggested alternate methods of correcting the trouble and in cooperation with them we have decided upon the most suitable method of correction. They will correct their equipment and we have made the necessary alterations in the design of the computer drum-control instructions.

Initial drum testing is expected to start at ERA on the 20th of October. K. McVicar will be there during the testing period to follow the tests and to pick up all of the information that he can.

(P. W. Stephan)

A blocking oscillator circuit is being developed which stretches a 0.1-μsec pulse into a 0.5-μsec half-sine-wave pulse, for use with the drum.

A memorandum, M-1659, describes the tests to be performed on the auxiliary drum before its connection to the computer.

5.0 INSTALLATION AND POWER

5.2 Power Supplies and Control

+250 D-C Supply WWI (J. J. Gano)

Oscillations of 20 cps and 6 cps, 0.5 to 1.0 volts, continue to appear at the output. These oscillations originate at the output of the plate alternator and are amplified because of the additional path for the input voltage through the sinusoidal trigger signal at the grids of the clipping amplifiers.

The additional path can be eliminated by a phase alignment circuit as used for the -150 supply. The introduction of this circuit necessitates other changes. Upon completion of the regulator for the new generator some quick means of making these changes will be studied.

Whittemore Building D-C Supplies (R. Jahn)

One of the new Power Equipment Company power supplies was installed last Wednesday. After two days of operation, the output voltage climbed to a point beyond the range of the voltage adjust control. This supply has been taken out of service and replaced with the temporary 30-volt rectifier until thorough tests have been made.

New Filament Supply (G. A. Kerby)

The new filament contactor has arrived and is about half installed. Further measurements of the parameters of the alternator and its exciter have been taken with the MG running to assist in final design of the regulator.

Tests of the regulator prototype circuits are in progress and will further assist in determining the final design. These will take a few more days.

6.0 BLOCK DIAGRAMS (B. E. Morriss)

Most of the period has been spent studying various changes in the buffer drum system proposed by ERA, and how these changes will affect our use of the equipment.

During the coming period PETR will be modified to operate as follows: PETR will continue to generate program alarms if the unit is selected and a piece of data is sent to IOR before the previous data has been removed by an rd order, but no alarms will be generated after the unit is dismissed even though the unit passes over data. If the unit is dismissed in the middle of a block no alarm is given, and succeeding in-out

6.0 BLOCK DIAGRAMS (Continued)

orders will be performed correctly although in returning to PETR all data which has coasted under the head will be missed.

7.0 CHECKING METHODS

7.4 Marginal Checking

Marginal Checking System, Mod II (J. H. Hughes)

The drafting room now has the circuit schematic and suggested layout for the marginal checking control relay panel. I am now working out the circuit schematic and layout for the marginal checking control panel.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Programs and Computer Operation

Progress during this bi-weekly period on each general applications problem is given below in terms of programming hours spent by laboratory personnel (exclusive of time spent by outsiders working on some of the problems), minutes of computer time used, and progress reports as submitted by the programmers in question.

11. Point-by-Point Scope Plotting of Alpha-Numerical Characters (Output Camera, O.C.): Kopley, 1 hour; WWI, 33 minutes

40. Input Conversion Using Magnetic Tape Storage: Kopley, 45 hours; Frankovich, 60 hours; Porter, 51 hours; Demurjian, 55.5 hours; Helwig, 60 hours; Briscoe, 58 hours; WWI, 19 hours, 57 minutes

The two special routines that print out numbers as decimal fractions or as decimal integers have been tested and found to perform as desired. These routines will be called in automatically if the programmer requests only decimal fraction or integer print-outs in his program. The form of the print-out will be determined by his sample number as described in the last bi-weekly.

A general program has been written that will print out any number a programmer may request. These numbers may include scale factors and may be single length, double length or floating point. They will be printed out in any form specified. This program will be tested during the next bi-weekly period.

A program has been written that will allow a programmer either to type out numbers or to display them on an oscilloscope and photograph them (numeriscope). The form of output obtained is determined by the entry point into this general routine. This routine will be read into ES automatically if the programmer calls for both typing and numeriscope. Provision is made in the program for automatically framing the film and repositioning the scope beam if the programmer has called for a number of rows to be displayed in excess of the number that can be actually put on the scope. This routine has been tested, corrected and should be completed after its next test.

Portions of the new comprehensive conversion program have been successfully tested on the computer, using paper tape units in place of the final magnetic tape units. The basic remaining problem involves the amalgamation of this program with the programs for the automatic selection of programmed arithmetic and output subroutines for use in the program being converted. This complete conversion program is expected to be tested next week.

An adoptation program for the programmed arithmetic section of the new comprehensive conversion program and a read in program has been written

8.1 Programs and Computer Operation (continued)

and are being tested.

A program for the conversion of generalized decimal numbers, i.e., numbers of the form

$$\pm d_n \cdots d_1 \cdot d_{-1} \cdots d_{-n} \times 2^p \times 10^q$$

is being written.

73. Demonstration Program: McQuillan, 4 hours; Mackey, 4 hours; WWI, 42 minutes

The Factorial problem, used for demonstration purposed, has been successfully operated, but this program is being revised in order to obtain a more satisfactory printing lay-out.

Computer time, hours	
Programs	21 hours, 34 minutes
Conversion	5 hours, 43 minutes
Demonstration	0
Total	27 hours, 17 minutes
Total time assigned	29 hours, 43 minutes
Usable time, percentage	92.6%
Number of programs operated	39

9.0 FACILITIES AND CENTRAL SERVICES

9.1 Publications

(Diana Belanger)

The following material has been received in the Library, Room W2-301, and is available to laboratory personnel.

LABORATORY REPORTS

No.	Title	No. of Pages	Date	Author
R-214	A High-Speed Counter Employing Transistors	102	7-15-52	J. F. Jacobs
E-485	Transistor Test Equipment	7	10-1-52	I. Aronson
M-1651	Bi-Weekly Report, Sept. 26, 1952	32	9-26-52	
M-1652	Basing Procedures	4	9-29-52	A. C. Haacke
M-1653	Engineering Relationships with IBM	2	9-29-52	A. P. Kromer
M-1654	Suggested Automobile Route from MIT to IBM	1	9-30-52	A. P. Kromer
M-1655	Laboratory Personnel	13	10-1-52	
M-1657	Test Equipment Committee Meeting of Sept. 29, 1952	3	9-30-52	L. Sutro
M-1659	Tentative Schedule for Delivery and Testing of Auxiliary Drum System	10	10-1-52	K. McVicar P. Stephan
M-1663	IBM Industrially Classified Information	1	10-3-52	H. Fahnestock
M-1664	Conference on Thin Evaporated Metal Films	3	10-6-52	A. L. Loeb
M-1665	September 1952 Storage and Research Tube Summary	4	10-1-52	D. M. Fisher
M-1669	Internal Publications of the Arithmetic Element Section	5	10-7-52	J. F. Jacobs
M-1670	Records of Test Equipment	1	10-7-52	L. Sutro
M-1671	Computer Operation Reports	2	10-8-52	D. A. Morrison

LIBRARY REPORTS

No.	Identifying Information	Source
2060	Digital Computers and their Applications, C. Adams	MIT Summer Session Notes
2062	Electronic Data Processing Machines	International Business Machs.
2063	American Air Filter Catalogue	Amer. Air Filter Co.
2064	A Machine System for Accepting, Storing, and Searching Engineering Data on Electronic Components	Battelle Memorial Inst.
2065	Magnetic Components for Computers, Business Machines, Electronic Systems	Magnetic Research Co.
2066	Progress Report, Z. Bay	Contract N7onr 419, Task 6
2068	The Corrosion Resistance of Tin and Tin Alloys	Tin Research Insititute
2069	Geda, Electronic Differential Analyzer	Goodyear Aircraft
2072	Theory of Specific Heats, Dr. H. Brooks	Harvard University
2073	Air Traffic Control and the National Security	Air Coordinating Comm.
2076	Defense Calculator: Preliminary Operator's Reference Manual	International Business Machs.

9.1 Publications (Continued)

LIBRARY REPORTS (Continued)

No.	Identifying Information	Source
2077	Defense Calculator: Misc. Memos	International Business Machines
2078	Defense Calculator: Circuit Design Manual	International Business Machines
2079	Defense Calculator: Preliminary Reference Manual for the Card Reader, Card Punch and Printer	International Business Machines
2081	An Optical Model for Nucleon-Nuclei Scattering	Physical Review, 7/52
2082	The Sums of the Dihedral and Trihedral Angles in a Tetrahedron	American Math. Monthly
2083	Seminar on Finite Projective Planes, Summer 1952	I. N. A.
2084	The AN/DKT-7()15-Channel PPM Telemetering Transmitter	Naval Research Lab.
2086	Ferrites, I and II, A. E. Van Arkel, E. J. Verwey	Reprint
1636	On the Relaxation Method for Linear Inequalities	National Bureau Stand.
2088	Ferromagnetic Compounds of Manganese with Perovskite Structure	Physica, 3/50
2087	Nim, A Game with a Complete Mathematical Theory	Harvard University
2090	A Solar Aspect Indicator for a Rocket	Naval Research Lab.
2091	A High-Speed Magnetic-Core Output Printer	Lab. for Electronics
2092	Bell System Technical Journal, Cumulative Index	1942-1951
2093	On the Convergence of a Difference Equation to a Solution of the Equation of Diffusion	Ballistic Research Lab.
B-225	MATRIZEN, R. Zurmuhl, 1950	Spinger-Verlag
B-226	CONSCIOUSNESS AND BEHAVIOR, J. Culbertson, 1950	Wm. C. Brown Co.
B-227	AMERICAN MEN OF SCIENCE, J. Cattell, Editor, 1949	The Science Press
B-228	HIGH SPEED COMPUTING DEVICES, Engin. Research Association, 1950	McGraw-Hill Co.
B-229	ELECTRONICS FOR ENGINNERS, M. & V. Zeluff, 1945	McGraw-Hill Co.
B-230	STORAGE TUBES AND THEIR BASIC PRINCIPLES, M. Knoll, B. Kazan, 1952	J. Wiley & Sons, Inc.
B-231	TEMPERATURE, ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY, American Institute of Physics, 1941	Reinhold Pub. Co.
B-232	NUMERISCHE BEHANDLUNG VON DIFFERENTIAL GLEICHUNGEN, Dr. Lothar Collatz, 1951	Springer-Verlag

JOURNALS

"Industrial Distribution", October, 1952
"Electrical Manufacturing", October, 1952
"Monthly Catalog, U. S. Government Publications", September, 1952
"Bell Technical Journal", September, 1952

9.2 Standards, Purchasing, and Stock

Procurement and Stock (H.B. Morley)

Delivery of 5000 1N38A Crystals is promised for November 1.

New personnel have joined Purchasing: Frank Sullivan replaces Bob Adams as buyer; Eleanor Crockett is a new secretary; Delight Nease is the new file clerk.

Stock control planning continues progressively.

A new mail room has been set up at the end of the first floor corridor. This should provide better mail service, and give this office more working space.

Standards (H.W. Hodgdon)

No new or revised standards issued this period.

A numbering system for standard components has been decided upon which will be used for purposes of stocking, stock control, and parts lists. The system will retain the basic standards numbers now in use, identifying individual items by suitable suffixes.

9.3 Construction (R.E. Hunt)

We are expanding our plastics facilities because of increased demand for experimental work. Don Baumgartner will handle this work, and will be interested in plastic packaging work from all sources.

Production Control (F.F. Manning)

The following units have been completed since September 26.

CR#	Qty	Unit title	Originator
1492-27	1	Plug-in Gate Buffer	Watt
1492-28	1	Plug-in D-C Flip-Flop	Watt
1492-29	1	Plug-in Dual Buffer	Watt
1492-30	1	Plug-in Switch Unit Mod II	
1618	1	5 A -400 V Rectifier	Kerby
1788	10	8 Plug D-C Power Strips	Sutro
1889-2	1	Power Control Indication Panel	Sandy
1900-2A	600	Jumper Wires	Sandy
1954	60	Video Cables	Leary
1958	2	Core Driver Mod V	Sutro
1977	10	Tektronix Coupling Unit	Sutro
2000-1	108	Video Cables	Norman

9.3 Construction (continued)

CR#	Qty	Unit title	Originator
2000-2	57	Video Cables	Norman
1905	1	Indicator Panel	Holmes
		The following units are under construction:	
1617	1	-300 Volt, 5 amp Regulator	Kerby
1283	1	600 Volt, 10 amp Rectifier	Hunt
1958	10	Core Driver Mod V	Test Equip Com.
1986	1	Core Driver Mod VI	Boyd
1889-3	1	Power Supply Control Panel #2	Sandy
1889-1	1	Power Control Panel #2	Sandy
1995	2	Delay Lines	Gerhardt
1987	24	RF Choke for WWI Signal Plate Coupling	Holmes
1778	3	Rack Power Control	Corderman
2000-3	44	Video Cables	Norman
1684	15	Low Speed 26 Counters (Held for modification)	Test Equip Com.
1889-4	1	Blown Fuse Location	Sandy
1667	1	Check Register	Watt
1805	1	Print-out Reading Amp	Farnsworth
1793	10	Multivibrator Frequency Dividers	Test Equip Com.
1900-1B	5	Vertical Fusing Strips	Sandy
1633-4	50	Bench Channels	Manning
1981	1	Cathode Drift Studies	Frost
1983	as reqd	Plug-in Units Modifications (Issued units to be brought up to date)	Smead
1789	15	D-C Power Strips (4 Plug)	Test Equip Com.
		The following units have been completed since Sept. 26 by outside vendor:	
1580	18	D-C Filter Panel Assy	Watt
		The following units are under construction by outside vendors:	
1696	24	Assy Voltage Variation Switching Panel Mod II	Hunt
1697	50	Assy Fixed Voltage Switching Panel Mod II	Hunt
1703	16	Assy Fuse Indication and Rack Interlock Panel	Hunt
1837	300	1:1 Pulse Transformer using ferrite ring core	Brown
1900-3E	380	External Power Cables	Sandy

9.4 Drafting (A.M. Falcione)

1. New Drawings

Title	Cir.Sch.	Assy & PL	Al Panel
Power Supply for Fil. Alt. Reg. Mod II	C-52535	E-52587	E-52697
Core Tester Mod V (T.E.)	C-52170	D-52622	C-52172
In-Out Register Input Mixer (WWI)	B-52595	D-52596	D-52682
Toroid Coil Winder (MTC)	B-52295	E-52251	
In-Out Sw. Mag. Drum Matrix (WWI)	D-52609	D-52694	D-52610
Sub-Assy & Detail Std. Al Panel (MTC)			R-52706
Sub-Assy & Detail Melamine Strip for Plug-in Mtg Panel (MTC)			E-52707
MT Print-out Index Pulse Counter (WWI)	C-51866	D-52061	D-52154 D-52155

2. Toroid Winder Drawings

The complete drawings and parts lists for this unit have been checked and signed and are now awaiting the grading signatures. There are approximately ninety-eight drawings to this unit.

3. Print Distribution to Outside Vendors

In order to clarify the system of submitting prints to outside vendors for Bid Quotations or for survey of Industrial Facilities, a memo is being written outlining the methods and procedures to be followed in detail.

10.0 GENERAL

New Staff (J.C. Proctor)

Inez Hazel, a new member of C. Adams group, has a BA from Hunter College in Math with a Physics minor and also has completed some of the work toward her MA. She has had 7-1/2 years relevant experience, including 3 years with Raytheon in computer programming.

Staff Terminations (J.C. Proctor)

Eric Mutch

10.0 GENERAL (continued)

New Non-Staff (R.A. Osborne)

Robert Kyle has returned to Wieser's group as a Lab Assistant following a tour of duty with the U.S. Navy.

Donald Baumgartner is a technician working with Hunt.

Evelyn Franzosa is a new messenger girl assigned to the Whittemore Building.

Rhea Freeman is a new Lab assistant assigned to Adams' group.

Nancy Heselton is a new secretary in the Personnel Office.

Augustine Kish is a new Lab assistant assigned to Gano.

Anthony Mazzone is a new Lab assistant working with Prentice.

Robert Schultz, an MIT student, has joined Taylor's group, working part time.

John Kaufman is an MIT student assigned to work part-time with the Storage Tube Group.

Arvid Strom, an MIT student, is also working part-time with the Storage Tube Group.

Richard Taylor is an MIT student working on a part-time basis with Paine.

Alice Kowilcik is now secreatary to Kromer, transferring from the Personnel Office.

Non-Staff Terminations

Robert Adams
Elaine Halpern
Michael Mazur