

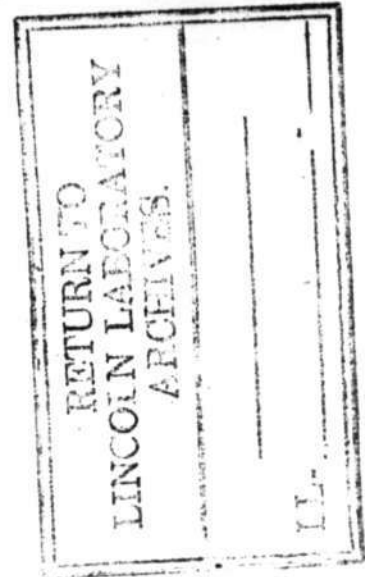
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Memorandum M-743

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts



SUBJECT: BI-WEEKLY REPORT, PART I, DECEMBER 24, 1948

To: 6345 Engineers

From: Jay W. Forrester

1.0 WHIRLWIND I COMPUTER ELEMENTS

1.1 Listed by Block Diagram Number

(H. F. Mercer)

The following WWI panels (production units) have been received from Sylvania to date:

1	106	Time Pulse Distributor Output
1	112	Restorer Pulse Generator
1	301	A-Register, Digit 0
33	301/103	A-Register, Digits 1-15 / Program Register Digits 0-15
1	302	Accumulator, Digit 0
11	302	Accumulator, Digit 1-15
16	303/403	B-Register/In-Out Register, Digits 0-15
1		Bus Driver Arithmetic Rack
32		Control Pulse Output Units
2		Digit Interlock Panels
15		Fixed Voltage Switching Panels
13		Fuse Indicator Panels

106 Time Pulse Distributor Output

(K. E. McVicar)

Preliminary resistance and voltage measurements have been made on the TPDO panel and video testing has been started.

111 Synchronizer

(A. K. Susskind)

A breadboard of five push-button pulse synchronizing units and blocking oscillator is being tested. A few minor changes have been made in the design. Performance has been fully satisfactory.

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112 Restorer Pulse Generator

(J. A. O'Brien)

Revision of the design of the restorer pulse generator has been completed and tested. The block schematic has been changed to show the new connections and the circuit schematic is undergoing changes. The layout drawing will not be corrected until after the shop has rewired the panel.

300 Arithmetic Control

(G. G. Hoberg & W. N. Papian)

All arithmetic control units have been tested and found satisfactory.

Except for the addition of oscillation-suppressor resistors and the grounding of 7AD7 shields in the cathode-follower circuits on 4 panels (in accordance with a recent basic-circuit modification), all of arithmetic control is ready for installation in the computer room.

301 A-Register

(G. C. Sumner)

Testing of the complete A-register in the WWI arithmetic element racks was begun December 15. The restorer pulse and clear channels have been tested and have performed according to expectations. Further test of the AR is being discontinued until the accumulator has been received.

303 B-Register

(G. C. Sumner)

Testing of the complete B-register in the WWI Racks is in progress but has been interrupted to allow further installation of power cabling. Testing will be resumed December 28 at which time performance characteristics of the shifting channels will be determined. The restorer line has been checked and found satisfactory.

404 Comparison Register Check

(J. A. O'Brien)

The block diagram of the comparison register check circuit has been changed to improve its ability to check the input-output signals.

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700 Operator's Console

(C. W. Watt)

Most of the temporary video cabling for the console has been made up, and is now being installed. A-c and d-c master control switches have been installed, and bias interlock for the electronic gear on the console is being provided.

(G. G. Hoberg)

An up-to-date block diagram of the temporary console has been issued (E-33028-1) and about 60% of the test equipment called for has been mounted on the racks.

This available test equipment, in conjunction with the experimental models of the time-pulse distributor and clock-pulse control, will provide all basically necessary console functions. Work on the integration of the system has begun.

(R. H. Gould)

The experimental breadboard model of the time pulse distributor and the clock pulse control have been mounted in the temporary console and interconnected with the standard test equipment. They will undergo some further testing as integral parts of the temporary console.

(A. K. Susskind)

A simple alarm indicator circuit has been designed. Clearing of the alarm indicators is carried out in such a manner that the alarm circuit is ready to receive a second alarm before the actual restart pulse goes to the computer. The shop has been requested to build a breadboard of the circuit. The breadboard will probably be put into the temporary console.

1.2 System Engineering

(C. W. Watt)

Installation: Temporary power control was completed, and the relay circuits were tested. Power was applied to all circuits, first with panel connectors removed, and then with panels plugged in. No serious wiring errors were detected, and the fuse indication, blown fuse interlock, bias interlock, and a-c interlock circuits were all made to operate with a minimum of trouble.

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1.2 System Engineering (continued)

Considerable work remains to be done. Wiring to all the elements of flip-flop storage, to arithmetic control, to the voltage variation and to the bulk of the fuse indication panels remains to be put in, and it is expected that the present crew of draftsmen will be busy with wiring design and installation drawings until March, 1949.

Actual installation will be complicated in the future because it must be dovetailed with testing, and must not interfere with it.

1.23 Video Cabling

(R. H. Murch)

Installation of B-register video cables will be completed by Monday, December 27.

The main bus video cables from flip-flop storage to arithmetic element were received from Sylvania today. They will be installed by Tuesday, December 28.

1.3 Auxiliary Equipment1.31 Power Supplies

(J. J. Gano)

Test Power for Arithmetic Element - The output waveforms of the d-c power supplies have been examined with a synchroscope, and each of them has been found to contain a high frequency transient (about one mc), having a duration of three or four cycles and a peak amplitude of the order of one or two volts. The transient has a repetition rate of 360 cycles per second, occurring upon the firing of each of the six thyratrons of the six phase rectifier. A study is being made to reduce the amplitude.

(C. R. Wieser)

Test Power for Arithmetic Element - The WVI plate alternator has been temporarily connected so that one phase furnishes filament power.

The Power Equipment Co. d-c supplies for +250, +150, +120, +90 and -150 volts are connected and furnishing power to the arithmetic element. The 500 ma temporary regulator for

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1.31 Power Supplies (continued)

-15 volts is operating. The +48 volt temporary supply will be cut out early next week and replaced by the Power Equipment +48 volt supply which is almost completely installed.

WTI Filament Power - The adaptor plates for the 100 HP motor are finished and are being installed. Arrangements have been made to reconnect the alternator field for 125-volt excitation.

1.32 Air Conditioning

(J. C. Proctor)

The refrigerant piping has been given a final test and released to the pipe coverers for insulation. This is a short job and will probably be done next week. The compressors have been aligned and are ready to be put into operation.

The Carrier sheet metal man has returned to connect the main supply duct to the air-in ducts.

All controls necessary are in operation to provide cooling air to the equipment by utilizing outside air as soon as the cabinets are completed.

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<u>W/I Drawing List</u>	<u>Block Diagram</u>	<u>Block Schematic</u>	<u>Circuit Schematic</u>
System	B-37071-5		
Control	B-37098-4		
Master Clock	B-37159-1		
101 Pulse Generator	B-37155-2	B-32385	E-32333-3
102 Program Counter	B-37062-4	B-32213-1	D-31516-4
103 Program Register	B-37067-2	B-39289-1	D-31276-8
104 Control Switch	B-37066-3	T60GS00-4-C	Z60GS00-A W60GS00-1-A Z60GS00-2-A
105 Operation Matrix		S600M00	Z600M00-1-C
Control-Pulse Output		R60CP00	S60CP00-1-B
106 Time-Pulse Distributor	B-37068-3	T60PD00-8-B	
106 Time-Pulse Distributor Counter		T60PD00-3-A	Y60PD00-C
106 Time-Pulse Distributor Output		T60PD00-4-B	Z60PD00-1-B
109 Clock-Pulse Control	B-39817-1	C-32642-2	R-31916-3
110 Frequency Divider	B-37154-2	B-32264-1	R-31729-1
111 Synchronizer	- -	- -	- -
112 Restorer-Pulse Generator	B-37160-1	B-32209-4	D-31909-7
200 Storage	C-37156-1		
201 Storage Switch	B-37121-1	B-32855 T60GS00-4-C	Z60GS00-A Z60GS00-2-A E-32830-1 R-32722-1
202 Toggle-Switch Storage	B-37122-3		E-32711
202 Toggle-Switch Storage Output		C-32080	E-32721-2
203 Flip-Flop Storage Output	B-37060-5	B-32269-1	E-31635-4
203 Flip-Flop Storage Register	B-37057-4	B-32268-1	E-31621-4
203 Flip-Flop Storage Control	B-37061-7	D-32106-2	
301 A-Register, Digits 1-15	B-37056-2	B-31211-3	D-31276-8

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<u>WWI Drawing List (continued)</u>	<u>Block Diagram</u>	<u>Block Schematic</u>	<u>Circuit Schematic</u>
301 A-Register, Digit 0	B-37056-2 B-37072-7	B-31574-1	D-31573-3
302 Accumulator, Digits 1-14	B-37063-5	D-31213-3	R-31275-4
302 Accumulator, Digit 0	B-37096-5	D-32851	R-32850
302 Accumulator, Digit 0, Aux. Panel	B-37096-5	B-32492-2	D-32602-1
303 B-Register	B-37097-3 B-37069-3	B-31212-4	D-31277-5
304 Sign Control & 308 Divide-Error Control	B-37072-7	C-31576-3	E-31619-2
305 Step Counter 305 Step Counter Output	B-37074-5	D-31828-1 A-32723-1	D-39764-1 D-32735-1
306 Multiply & 307 Shift Control	B-37072-7	C-31532-3	E-31588-4
308 Divide Control	B-37072-7	C-31552-3	R-31718-4
309 Special Add Memory & ACO Carry	B-37072-7	C-31575-4	E-31632-1
310 Point-Off Control	B-37072-7	C-31600-6	E-31717-5
403 In-Out Register	B-37119-2	B-32434-1	D-31277-5
404 Comparison Register	B-37120-2	B-32578-1	E-32576-2
601 Check Register	B-39816-2	B-32577-1	E-32576-2
601 Check Register Check		B-32018	E-32023
Bus Connections	C-37124-3	C-37123-3	
Bus Driver, Arithmetic Element		A-32297-1	D-31727-6
Bus Driver, Flip-Flop Storage		A-32296-1	D-31726-6
Register Driver, Type I		B-32207-1	E-32261-3
Register Driver, Type II		A-32691-2	D-32690-2
Fuse Indication Panel			W60PPO0-7-D
Voltage Variation Panel			W60PPO0-6-B
WWI Power-Connector Pin Connections			B-31955-5

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2.0 WHIRLWIND I RESEARCH

2.2 Components

2.23 Vacuum Tube Studies

(John Olivieri)

Construction of a new sample test rack is almost complete. This will allow more tubes to be tested simultaneously. Better metering facilities are being provided on this rack.

The tube tester has been equipped with jacks to allow each meter to be periodically checked and compared with a precision meter.

Ten 7AD7, ten 7AK7, and five 6SN7's have been prepared and sent to B. Murch. These tubes will be used to check suspected tubes in computer circuits. These tubes are distinguished by a yellow stripe.

100 5687 tubes are being carefully tested in order to ascertain any discrepancies which are leading to the high mortality rate.

2.3 Systems

2.31 Five-Digit Multiplier

(E. S. Rich & B. Frost)

The investigation of marginal checking methods on the Multiplier has been continued. Studies of flip-flop checking indicate that a method is available for showing whether flip-flop instability is due to tube unbalance or to deteriorated grid or clamping crystals. Such an indication is obtained by comparing the screen voltage variations that can be tolerated for short and for long restorer periods. Restorer periods of 8 μ sec and 64 μ sec were used in the tests made.

Methods were worked out for checking the limits of voltage variation that can be tolerated by gate tubes, buffer amplifiers, etc. Measurements showed that relatively wide margins exist in the operation of these circuits.

It was found that the test equipment also seems to have a satisfactory margin of safe operation. Some minor

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2.31 Five-Digit Multiplier (Continued)

changes in non-standard test equipment were necessary to give this margin. It seems advisable to modify the standard register panels to allow flip-flop marginal checking. This is being considered by the Test Equipment Committee.

Original plans to use G. E. Scaling Units for counting errors have been discarded because of the unreliability of these counters. However, a relay type counter has been constructed which is sensitive to single errors. Although its resolution time is a few hundredths of a second, it is expected that this device will give valuable information about the Multiplier operation which has not been available previously.

Plans have been worked out for providing an automatic stop which will leave all flip-flops restoring in the position they held at the time of the error. This can be used in a life test during working hours and will be arranged to sound an alarm. One additional register panel is required to give this feature.

It is hoped that most of the details preliminary to starting a life test will be worked out in the next week. The modifications to the standard test equipment may take longer than this, however.

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3.0 SPECIAL CIRCUITS

3.2 Test Equipment

3.21 Standard

(R. L. Massard)

Video Amplifier.

A second model 3-B Amplifier is almost lined up. The first of this series has been installed in a Sylvania Model 5 double-beam 'scope.

(H. Kenosian)

Register and Gate Panels. The register panels and gate panels are being modified. The principal changes include changing the plate voltage of the gate tubes to +250 volts, and grounding the internal shield of the 7AD7 flip flop and trigger tubes. These changes improve the amplitude characteristics of these panels considerably and should result in better reliability.

Voltage Calibrator. The voltage calibrator prototype is complete. About six units will be constructed for laboratory use. Its main function is to calibrate the deflection sensitivity of a scope amplifier and to compare unknown pulse amplitudes with a known amplitude which can be varied from 0.5 to 125 volts.

3.22 Special

(R. V. Read)

Development of a circuit to be used in studying the interface problem is in the breadboard stage. The circuit utilizes hard tubes with a 4D32 supplying the 10 ampere pulse which is to saturate the tube under test. It is hoped that a square pulse of this magnitude can be used to reveal characteristics of the cathode interface.

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4.0 BLOCK DIAGRAMS

(R. P. Mayer and J. M. Salzer)

In conjunction with the block-diagram revisions, the block diagram for the Arithmetic Element is undergoing a complete revision with the object of organizing and simplifying its appearance.

Several of the revised block diagrams are now available. They are: B-37155-2, B-37154-2, B-37160-1, CB-37124-3, B-37122-3, CB-37057-4, CB-37060-5, B-37061-7.

Memorandum M-741, Special Display, is a more or less detailed discussion of the interconnections between, and the theory of operation of, the equipment required for providing the special display mentioned in section 3.85 of R-127.

Memorandum M-737, Changes in Test Storage Switch, explains the existence and use of certain switches that are provided in the output lines of the Test Storage Switch for the purpose of making it possible to provide either toggle switch or FF registers in Test Storage.

Memorandum M-738, Alteration of Clock Pulse Control, modifies CPC so that: (1) its operation is easily understood and remembered, (2) the "mode" and "speed" controls are entirely separated, and (3) changing to push-button operation (as done in the temporary console, etc.) does not interfere with the proper completion of AE operations.

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