

Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART I, AUGUST 20, 1948
To: 6345 Engineers
From: Jay W. Forrester

1.0 WHIRLWIND I COMPUTER ELEMENTS

1.1 Listed by Block Diagram Number

103 Program Register

(H. Fahnestock)

Assembly of the phenolic panel, video components and wiring harnesses for all digits of the program register has been completed at Sylvania.

104 Control Switch

(H. Fahnestock)

Sylvania's layout of the indicator panel of the control switch has been approved. This completes the video layouts of the control switch.

201 Storage Switch

(M. Hayes)

Circuit schematics of the storage switch output panel, and switch panel will soon be ready and are found in Dwgs. R-32732 and R-32759 respectively. With these, all the schematics of the storage switch are available, and will be turned over to Sylvania for construction.

300 Arithmetic Control

(H. H. Taylor)

Step Counter. The drawings of the step counter have been graded. Construction should begin immediately. As this is the largest panel in arithmetic control and rather late in starting, every effort should be made to complete it at an early date.

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300 Arithmetic Control (Con't.)

(G. G. Hoberg)

After necessary circuit modifications final tests are being made on the ACO Carry and Special Add Memory panel.

301 A-Register

(H. Fahnestock)

Assembly of the phenolic panel, video components and wiring harnesses for all digits of the A-register except AR-0 has been completed at Sylvania.

(N. H. Taylor)

A-Register 0-Digit. The Sylvania drawings on this panel have been approved and returned to Sylvania.

301/103 A-Register - Program Register

(N. H. Taylor)

The A-register specifications are ready to be issued. Work on this panel is on schedule, and we should be able to install the A-register on October 3 as planned.

(R. H. Gould)

Some changes have been recommended on the A-register to improve performance and tests are being made on the prototype panel with these changes incorporated. The final test specifications are being held until these tests are finished as changes in limits of operation may occur.

302 Accumulator

(G. C. Sumner)

The layout of the AC-0 auxiliary panel has been completed. The circuit schematic of that panel has been issued under the number D-32602. The circuit schematic of the accumulator zero digit has been sent to the drafting room.

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305 Step Counter

(M. Hayes)

Block and circuit schematics for the step counter output panels have been completed and are found in Dwg. A-32723 and D-32735 respectively.

601 Check Register

(C. Rowland)

A breadboard model of the check register check panel has been completed, and experimentation to determine satisfactory circuits is underway.

700 Operator's Console

(N. H. Taylor)

It has been decided that a preliminary set-up will be made in the operator's room to be available before the final operator's console. A series of conferences has started to decide what standard test equipment and what new designs will be needed in order to do the initial testing on the arithmetic portion of WWI.

1.2 System Engineering**1.21 Power Control and Distribution**

(E. S. Rich)

Panel Selection Equipment for Marginal Checking. A summary of the detailed operation of the voltage-variation panel selection equipment has been prepared in draft form. Its immediate purpose is to supplement the circuit schematic in testing the relay circuits.

(C. W. Watt)

WWI Installation. Laying of the 7" base channels in the computer room began Aug. 9, and is nearly completed. Parts are on hand for the racks, and installation of the power bay will proceed at once. Installation of racks and wireways for the power supplies is progressing well. These should be installed by Aug. 30.

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1.21 Power Control & Distribution (Con't.)

Panel Selection Rack. Preliminary tests have been made on the relay and crossbar switch assembly, which indicate that the design is satisfactory. Completion of the wiring awaits delivery of toggle switches.

Power Distribution Rack. A shunt panel, for ammeter shunts, has been designed and drawn up. Other details are now being laid out.

Power Busses. All material has been ordered, and drawing details are completed. The fabrication remains to be done.

1.22 Power Cabling

(G. W. Watt)

Orders have been placed with the Gavitt Manufacturing Co., Brookfield, Mass. for all the preformed power cables designed to date. Material will be shipped to them next week.

1.24 Driver Panels

(R. H. Gould)

The final test specifications for the bus driver panel have been written in the form decided upon after a conference on the subject. They will be ready for approval after final typing.

(N. H. Taylor)

Final test specifications on the bus driver panel are being prepared and will soon be issued. As the prototype has been accepted this unit is completely clear and ready for construction.

1.25 Time Schedules

(R. A. Osborne)

The task of making up revised time schedules will be completed today. Prints will be distributed to interested parties early next week.

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1.3 Auxiliary Equipment

1.31 Power Supplies

(J. J. Gano)

Synchronous motor regulator. Frequency response curves on the exciter-amplifier have been made. A breadboard assembly of the sensing and error detecting circuit is being constructed.

(L. J. Nardone)

Variable Voltage. Frequency response and phase shift measurements have continued to be made on the variable-voltage supply. Curves have been obtained to compare the phase shift and response of the variable-voltage supply at given frequencies for varying values of output filter capacitance.

1.32 Air Conditioning

(R. A. Osborne)

The erection of the pent house is complete. The majority of Carrier's equipment has been hoisted up to the roof, and assembly and installation should begin in the next week.

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<u>WWI 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	A-37155-1	B-32385	E-32333-2
102 Program Counter	B-37062-4	B-32213-1	D-31516-4
103 Program Register	B-37067-2	B-39289-1	D-31276-7
104 Control Switch	B-37066-3	T60CS00-4-C	Z60CS00-A W60CS00-1-A Z60CS00-2
105 Operation Matrix		S600M00	Z600M00-1-B
Control Pulse Output		R60CP00	S60CPC0-1-B
106 Time Pulse Distributor	B-37068-3	T60PDO0-8-B	
106 Time Pulse Distributor Counter		T60PDO0-3-A	Y60PDO0-B
106 Time Pulse Distributor Output		T60PDO0-4-A	Z60PDO0-1-A
109 Clock Pulse Control	B-39817-1	C-32642	R-31916
110 Frequency Divider	A-37154-1	B-32264-1	R-31729-1
111 Synchronizer	---	---	---
112 Restorer Pulse Generator	A-37160	B-32209-2	D-31909-5
200 Storage	C-37156-1	B-31150	
201 Storage Switch	B-37121-1	C-31152	R-32722
202 Toggle Switch Storage			E-32711 E-32721
203 Flip-Flop Storage Output	B-37060-4	B-32269	E-31635-3
203 Flip-Flop Storage Register	B-37057-3	B-32268	E-31621-3
301 A-Register	B-37056-2	B-31211-3	D-31276-7

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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 Zero Digit	B-37056-2 B-37072-7	B-31574	D-31573-2
302 Accumulator	B-37063-5	D-31213-2	E-31275-3
302 ACC Zero Digit	B-37096-5		
302 ACC Zero Aux.	B-37096-5	B-32492-2	D-32802
303 B-Register	B-37097-3 B-37089-3	B-31212-3	D-31277-3
304 Sign Control & 308 Divide Error Control		C-31576-2	E-31619-1
305 Step Counter	B-37074-5	D-31828	D-39764
306 Multiply & 307 Shift Control		C-31532-3	E-31588-2
308 Divide Control		C-31552-2	R-31718-3
309 Special Add Memory & ACO Carry		C-31575-2	E-31632-1
310 Point Off Control		C-31600-4	E-31717-2
403 In-Out Register	B-37119-2	B-32434-1	D-31277-3
404 Comparison Register	B-37120-2	B-32578	E-32576
601 Check Register	B-39816-2	B-32577	E-32576
Bus Driver, Arithmetic Element		A-32297-1	D-31727-5
Bus Driver, Flip-Flop Storage		A-32296-1	D-31726-5
Register Driver, Type I		B-32207	E-32261-2
Register Driver, Type II		A-32691	D-32690
Fuse Indication Panel			W60PP00-7-C
Voltage Variation Panel			W60PP00-6
WWI Power Connector Pin Connections			C-31955-4

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WWI Installation Drawing List

(H. S. Lee)

The following drawings have been completed:

External Power Cables:

Accumulator	C-32573-4
Bus Driver	C-32655-2
A-Register	C-32659-2
Check Register	C-32660-2
Program Counter	C-32657-2
B-Register	C-32658-2
Program Register	C-32656-2

Overhead Cables:

D-C Cable WWI Rows A, E, F, Digits 8-15	B-32557-1
D-C Cable WWI Rows F-P, Digits 8-15	B-32558-1
D-C Cable WWI Rows A, E, F, Digits 0-7	B-32461-1
D-C Cable WWI Digits 0-7 to 8-15	B-32460-1

Arithmetic Element Racks:

Cable No. 1	B-32497-1
2	B-32498-1
3	B-32499-1
4	B-32500-2
5	B-32501-1
6	B-32502-1
7	B-32559-1
8	B-32623-1
9	B-32624-1

Filament Power Panel	C-32589
Filament Power Cir. Schematic	A-32663
Transformer Terminal Shield	
Sub Installation (2)	C-32443
(1)	B-32436
Power Supply & Control Room	D-37580
" " " "	
Side Elev.	D-37581
Power Supply Racks - Wireway Inst.	E-37584
" " " Details & Inst.	E-37583

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2.0 WHIRLWIND I RESEARCH

2.1 Circuits

2.11 Flip-Flop Design and Stability

(H. Fahnestock)

Sylvania has been advised that all WWI flip-flops will have two changes. The 820 ohm 2-watt cathode resistor will be replaced by a 1200 ohm 2-watt resistor. The restorer input line will have a 68 ohm 1-watt resistor added in series with the input capacitor.

(R.L. Best)

Tests have been made on a flip-flop loaded with 4 gate tubes. These indicate that some trouble may be experienced with the flip-flop being triggered by feedback from the gate tubes. Twelve micromicrofarads between each gate tube grid and suppressor lessens this danger, but makes the flip-flop extremely hard to trigger when large pulses are applied to the gate tubes.

All the WWI block diagrams have been reviewed to determine the worst operating conditions at present called for, and these situations are being reproduced and analyzed one at a time in the test set-up.

2.16 Basic Circuits

(Edwin S. Rich)

Revisions of the Basic-Circuit drawings have been made and will be completed by the drafting room the first of next week. A memo will be issued describing the changes.

(A. K. Susskind)

Tests of the trigger tube circuit have been started. Some of the characteristics to be determined are prf sensitivity, input impedance, gain, effect of supply voltage variations, and pulse shape reproduction.

(J. M. Hunt)

Consideration has been given to deterioration of buffer amplifier and trigger tube performance resulting from operation with marginal tubes. In simple circuits, such as buffer amplifiers, it appears probable that circuit performance can be predicted with acceptable accuracy by reference to properly chosen static characteristics of the marginal tubes.

2.2 Components2.22 Pulse Transformers

(J.M. Salzer)

The translation of "Der Impulstransformator" by Dr. Grasi has been completed.

2.23 Vacuum-Tube Studies

(J. M. Hunt)

An explanation of the reduction of gate tube plate current at high emission current has been prepared and is included in Engineering Notes E-139, in which report A. Susskind outlines the results of extensive measurements of 7AK7 characteristics.

(D.R. Brown)

7AK7. Fifty 7AK7's were sent from Emporium on August 13 but have not been received here. This is delaying our pre-burning schedule; we needed 100 tubes August 16. Two hundred tubes are being shipped on August 20 or 23. Another 200 tubes will be sent August 27.

(A.K. Susskind)

Measurements of 7AK7 characteristics have been completed. Report E-139 describes the results.

(Ray L. Ellis)

Data obtained in the past few weeks on 7AD7 tubes may be of help in answering questions concerning high screen current in these tubes.

The following tests have been made on several tubes with both high and low screen grid current and from both the L7P and B8B productions:

- Standard WWI 7AD7 tests
- Ionization tests
- Cathode leakage tests
- Flip-Flop simulation tests
- Families of plate and screen grid current characteristics curves
- Plate current characteristics curves with shield tied to plate
- High screen grid current tests

2.2 Components

2.23 Vacuum-Tube Studies (Cont.)

(Ray L. Ellis) (Cont.)

Emission tests

Activity tests

Correlation between high screen grid current and control-grid cut-off

Floating suppressor grid vs. grounded suppressor

Average characteristics from standard WWI tests on three groups of 100 tubes tested in April, June and August.

2.3 Systems

2.31 Five-Digit Multiplier

(N.H. Taylor)

J. J. O'Brien will take over the work on the five-digit multiplier which has been done to date by N. Daggett. E. Rich will work closely with this project so that future development may best benefit from multiplier experience. Every effort will be made to obtain quantitative data on the reliability of the five-digit multiplier. Modifications will be made where necessary so that effectiveness of marginal checking as a means of improving reliability may be studied.

3.0 SPECIAL CIRCUITS

3.2 Test Equipment

(N. H. Taylor)

At a recent meeting with Sylvania it was agreed that M.I.T. will supply sufficient test equipment to set up 3 semi-systems test positions at Sylvania. Every effort is being made to have the first of these available for testing by August 25. The other two will be made available as they are needed.

3.21 Standard Test Equipment

(N. H. Taylor)

Because of the increased demands for standard test equipment increased quantities of gate and delay units, master clocks, and scope synchronizers have been ordered by the Test Equipment Committee.

(H. Kenosian)

Pulse Standardizer: Final design on the breadboard has been completed. This unit will be built as a dual unit on a 5" panel. Pulses having repetition rates up to 3 megacycles can be standardized. The preliminary circuit schematic number is SA40013.

Cathode Follower Probe: This unit will be ready for test as soon as a video amplifier is complete.

(R. L. Massard)

Henry Amplifier: One of the four amplifiers delivered by Sylvania has been modified and successfully lined up. The half-power point (upper) is about 16 megacycles, and the gain is around 240, depending on tubes of course. It will now be tested with clock-pulses, but no difficulties are expected. Work has been begun on the modification of the other three amplifiers and power supplies.

4.0 BLOCK DIAGRAMS

(J. Salzer, R. Mayer, E. Blumenthal)

Revision of all block diagrams is continuing.

(R. Mayer)

The three memos on Electrostatic Storage Control are being brought up to date with the current block-diagram revisions before being issued, since R. R. Everett has not yet had time to approve them.

One important change is that Electrostatic Storage is assigned unit number 800, and is abbreviated "ES". The memos, therefore, are on "ES Control", rather than on EST Control.

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5.0 CHECKING METHODS

(G. C. Sumner)

The study of trouble location for the flip-flop registers is virtually complete. Computer control is being considered at the present time. After this, there remains the study of the overall sequence of trouble location. A statement of progress for an earlier period is contained in M-584.

In the course of the investigation the following modification of the WWI restorer pulse generator was found desirable and has been proposed--that provision be made for the insertion of a single push-button pulse on the restorer line. This would permit switching all FF's simultaneously to the one-position after the computer has been initially cleared. This very cheaply provides a great deal of information, the most important being whether or not FF indicator lights are functioning correctly.

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