

Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: WWI CONTROL SWITCHES AND PUSHBUTTONS FOR NORMAL OPERATION OF THE COMPUTER

To: Group 61 and Applications Group

From: J. H. Hughes

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Abstract: This memorandum presents a table of the controls used in normal operation of the WWI Computer, their physical locations, and what they do. It also tells you how to use these controls for some common procedures.

INTRODUCTION

The toggle switches and pushbuttons listed in the attached table are all you normally need for controlling the computer, except for data handling for the Air Defense Project. All other switches in Test Control are for maintenance and trouble shooting; they should be left alone when you are running a program.

HOW TO USE THE CONTROLS FOR COMMON PROCEDURES

1.0 How to Read in a Program from Flexowriter Tape

1.1 5-5-6 Tape

Put the beginning end of the tape in the Photoelectric Tape Reader, taking care that it is going from right to left and that the solid row of seventh holes is on the side near you.

Press the READ IN button and the tape will be read in.

If you turn on the STOP ON si-1 switch the computer will stop at the end of read-in, and you can take care of any special resets that the program may need. Otherwise the program will start up as soon as read-in is finished.

1.2 Standard Tape

Before you can read in standard tape you must read in the Direct Conversion Program tape, T-2046. You do this by following the procedure in 1.1 above, with the STOP ON si-1 switch turned on. Then put the Standard

Tape that you want to read in into the PETR, put the Program Counter Reset Switches to 2037 (octal) and press the START OVER button. The Standard Tape will be read in.

Note that the Direct Conversion Program is stored in ES registers 1251 through 2037 (octal). This means that you cannot do a direct read-in of a program on standard tape if it uses these registers. Instead you must have the tape converted to 5-5-6 form in the usual way.

2.0 What to do if You Get an Alarm

2.1 Parity Alarm. Call a technician.

2.2 During Read-In by Direct Conversion Program

2.21 Program Alarm. Usually means that there is not enough room in storage for both your program and the conversion program. Have the tape converted to 5-5-6 form. *} some time*

2.22 Conversion program stops with PC holding 00001: means that the conversion program has found an error in the tape. Send the tape back to tape room for fixing. If program stops with PC holding 1613 this is normal end of read-in.

2.3 During Read-In of 5-5-6 Tape

2.31 Program Alarm. Usually means that the tape is in the PETR crooked or upside down or backwards. Try again. *} note*

2.32 Check Alarm, Program Counter holding 00007. Means that the Sum Check has found an error in the tape. Send it back to the tape room for fixing. If PC holds any other number the alarm is probably the result of a transient error. Try read-in again. *} always true*

2.4 During the Program

2.41 Overflow, Divide Error or Program Alarms mean that there is something wrong with the program. See Section 3.0 on trouble-shooting programs.

2.42 Parity check alarms, unprogrammed check alarms or inactivity alarms are probably due to computer malfunction. Call a technician.

3.0 How to Trouble Shoot a Program

3.1 General

When you have trouble with a program you must decide whether to use the computer to help you find out what is wrong or simply to record the contents of the most significant registers (PC, PR, AC, etc., according to

the kind of alarm) and try and work out what is wrong at your desk. If there is no great rush to get the program fixed and running by a certain date, then it is probably better to use your time rather than the computer's to find out where the program goes awry and why. If, on the other hand, the problem is a rush job, then the computer can give valuable help in the quick detection of program trouble, and you may be justified in using computer time for this purpose.

3.2 Post Mortem Subroutines

The Applications Group has devised a number of subroutines which may be used to print out parts of the program in various ways. One of the most straightforward of these is the "Storage Print Out" subroutine, which prints out the contents of ES so that you can see what has happened in the program up to the time when an alarm happened.

3.3 Selected Pulse

It is possible to run the program through in sections, stopping the computer every time some particular order is given. You do this by throwing the STOP ON SELECTED PULSE switch on. The Time Pulse is selected by the TP Selector in TC 5-3. Do not use TP 5. The order (or two orders) is selected by the plug leads located out back at the Operation Matrix.

3.4 Order by Order

It is possible, but rarely desirable, to run the program through order by order simply by reading in with the STOP ON si-1 switch on and then pressing the ORDER BY ORDER button once for each order. This is the least efficient way of using computer time to trouble shoot your program.

4.0 Manual Insertion

It is possible to change manually the contents of a register of ES by using the following procedure.

In Flip-Flop Register 2	Reset Switches	put the	"word" you want to insert.
" " " "	3 " "	" "	instruction "ca 2".
" " " "	4 " "	" "	instruction "ts x" where
			x is the address of the
			ES register to be changed.
" " " "	5 " "	" "	"si 0".

In PC reset switches put 00003.

Press the START OVER button, and the job is done.

SIGNED

J. H. Hughes
J. H. Hughes

APPROVED

N. L. Daggett
N. L. Daggett

CONTROLS USED IN NORMAL OPERATION OF WWI

TYPE OF SWITCH	NAME	LOCATION	WHAT IT DOES
P.B.	ERASE ES	Console & TC5-1	Charges whole surface of every storage tube to the zero state. Do not press unless computer is stopped.
P.B.	READ IN	Console & TC3-5	Stops computer if running. Resets Program Counter to the beginning of the read-in program (which is in Toggle Switch Storage). Restarts computer, which then reads in the tape with the Photoelectric Tape Reader. Flexo-reader may be used by putting a special read-in program in Toggle Switch Storage. At the end of read-in the program starts, or the computer stops if the STOP ON <u>si-1</u> switch is on. TP3 FF Reset is suppressed from time READ-IN button is pressed until read-in is complete.
P.B.	CLEAR ALARM	Console & TC3-5	Clears alarm indication any time and that is all.
P.B.	START OVER	Console & TC3-5	Clears most flip-flops in the computer, resets Flip-Flop Storage, resets Control Switch to <u>ck</u> , resets PC to number held in Program Counter Reset Switches, restarts the computer.
P.B.	START (OVER) AT 40	Console & TC3-5	Same as START OVER except resets PC to 40.
P.B.	STOP (Formerly CHANGE TO P.B.)	Console & TC	Stops the computer from any state. (Do not confuse with "stop clock" which may be called for by various parts of the computer to allow them to complete their job before the computer's main cycle of 8 time pulses continues.)
P.B.	START CLOCK	Console & TC3-5	Restarts computer if hung up in "stop clock". (This might be caused by an "illegal" in-out order.)
P.B.	RESTART	Console & TC3-5	Restarts the computer from the P.B. mode. (Will not restart from "stop clock".)

TYPE OF SWITCH	NAME	LOCATION	WHAT IT DOES
P.B.	ORDER BY ORDER	Console & TC3-8	If computer is stopped, restarts it. Lets computer run to next TP5, and stops.
P.B.	EXAMINE	Console & TC3-8	Starts over and runs to TP5. This enables you to inspect in the PR the contents of the register whose address is in the PC Reset Switches. (Contents are displayed in PR.)
T.S.	STOP ON <u>si-1</u>	Console	If switch is on (up) lets <u>si-1</u> stop the computer.
T.S.	STOP ON SEL. PULSE	Console	If switch is on (up) lets selected Time Pulse of Selected Order stop the computer.
T.S.	DISPLAY SELECTORS	With each display scope	Each switch permits appropriate display to appear on scope.
T.S.'s	FFS RESET switches	With each set of FFS indicators in TC-2	Specify number to which FFS registers will be reset if FFS reset called for.
T.S.'s	PC RESET switches	TC3-8	Specify the number to which Program Counter will be reset on START OVER or EXAMINE.
P.B.	RESET ALL FFS	FF reset panel	If computer is stopped, resets all digits of all Flip-Flop Storage registers to numbers specified by Flip-Flop Reset Switches and D-C insertion plugs.
P.B.	SELECTIVE FFS RESET & RE-START (PB)	FF reset panel TC3-7	Resets those of the FFS registers selected by the switches next to it, and restarts computer (if stopped).
P.B.	SELECTIVE FFS RESET IN MANUAL (PEM)	FFS reset panel	If computer is stopped, resets those of the FFS registers selected by the switches next to it.
T.S.	FFS RESET BY TP3	FFS reset panel	Causes every TP3 to reset those of the FFS registers selected by the switches next to it, except during read-in.

TYPE OF SWITCH	NAME	LOCATION	WHAT IT DOES
T.S.	FFS RESET BY PCEC	FFS reset panel	Causes the PC End Carry to reset those of the FFS registers selected by the switches next to it.
T.S.	FFS RESET BY <u>rs</u>	FFS reset panel	Causes TP3 of every <u>rs</u> order to reset those of the FFS registers selected by the switches next to it.

INPUT PROGRAM, OCTOBER, 1952

DECIMAL

	0	+0x2 ⁻¹⁵	
	6---→ 1	+1x2 ⁻¹⁵	Conditional stop
	(19) 2	Flip Flop Reg #2	(sp y)
	(12,10) 3	Flip Flop Reg #3	(word counter)
	(16, 8) 4	Flip Flop Reg #4	(accumulated sum-mod-one)
	(17) 5	Flip Flop Reg #5	(final sum-mod-one)
	20---→(15,9) 6	Flip Flop Reg #6	(ts x or ck 5 or sp 1 or sp 21)
	7.	sa 4	add new word to sum-mod-one
	8	ts 4	store new sum
	9	ao 6	increase ts x instruction by one
	10	ao 3	increase word counter by one
	<u>11</u>	<u>cp 18</u>	if word counter is negative, read in next word
	23, 27---→ 12	ts 3	reset word counter
	13	rd 13	read initial word from tape
	<u>14</u>	<u>cp 12</u>	if word is negative, reset counter
	15	ts 6	if word is positive, place it in 6
	16	ex 4	reset sum-mod-one in case this is WORD block
	17	ts 5	store the previously accumulated sum-mod-one in 5 in case this is CK block
	11---→ 18	rd 18	read word from tape
	19	ts 2	place it in 2 in case this is SP block
	<u>20</u>	<u>sp 6</u>	perform next the instruction in 6
	556 Input---→ 21	si 139	select photoelectric reader word input
	22	cao	prepare to reset word counter
	<u>23</u>	<u>sp 12</u>	
	Magnetic Input---→ 24	si 66	select magnetic tape reader forward
	25	rd 25	read first word of block
	<u>26</u>	<u>cp 12</u>	if negative, reset counter and proceed to read in
	27	sp 24	if positive, select input again to skip to next block
	28	immaterial	these words are not now needed and are
	29	immaterial	assigned no
	30	immaterial	value at present
	31	CLOCK	

Contents assigned to registers 24 through 30 will be changed when the auxiliary drum is installed.

DL-615

INTERPRETED ORDER CODE

WWI Order	Interpreted Order	Name	Decimal	Binary
si			0	00000
rs	itsc	cycle transfer to storage	1	00001
bi	iexc	cycle exchange	2	00010
rd	icac	cycle clear and add	3	00011
bo	icsc	cycle clear and subtract	4	00100
rc	iadc	cycle add	5	00101
	isuc	cycle subtract	6	00110
	imrc	cycle multiply	7	00111
ts	idvc	cycle divide	8	01000
td	ispc	cycle subprogram	9	01001
ta			10	01010
ck	icr	cycle reset	11	01011
	ict	cycle count	12	01100
ex	iat	add and transfer	13	01101
cp	iti	transfer index	14	01110
sp	sp	subprogram	15	01111
ca	ici	cycle increase	16	10000
cs	icd	cycle decrease	17	10001
ad	icx	cycle exchange	18	10010
su	ita	transfer address	19	10011
cm	icp	conditional subprogram	20	10100
sa	its	transfer to storage	21	10101
ao	iex	exchange	22	10110
dm	ica	clear and add	23	10111
mr	ics	clear and subtract	24	11000
mh	iad	add	25	11001
dv	isu	subtract	26	11010
slr	imr	multiply and round-off	27	11011
srr	idv	divide	28	11100
sf	isp	interpreted transfer control	29	11101
clc			30	11110

DESIGNATIONS OF IN-OUT EQUIPMENT
(si addresses for all units listed)

Jan. 27, 1953

Unit	0	1	2	3	Mode
Display scopes	600 octal 384 decimal	601 octal 385 decimal	602 octal 386 decimal		Customary use: Each scope has switches 0, 1 & 2 on it. When all are 0 for each scope, display will appear on all scope
Printers		(Rm. 222) 215 octal 141 decimal	(Computer Rm.) 225 octal 149 decimal	(Not in use) 235 octal 157 decimal	print one character on an <u>rc</u>
Punch	204 octal 132 decimal 205 octal 133 decimal 206 octal 134 decimal 207 octal 135 decimal				punches one character with 7th digit suppressed punches one character with 7th digit punched punches three characters with 7th digit suppressed punches three characters with 7th digit punched
Photoelectric tape reader	211 octal 137 decimal 213 octal 139 decimal				line-by-line (reads 1 line for each <u>rd</u>) word-by-line, or automatic 5 - 56 (assembles 3 lines into 1 word for each <u>rd</u>) Reader runs free until dismissed by <u>si 600</u>
Flexo mechanical tape reader	200 octal 128 decimal 202 octal 130 decimal				line-by-line (reads 1 line for each <u>si + rd</u>) word-by-line, or automatic 5 - 56 (assembles 3 lines into 1 word for each <u>si + rd</u> , stopping automatically after word is assembled)
Camera	500 octal 320 decimal				index camera
Magnetic tape				(Assoc. with delayed-output equipment)	
	100 octal 64 decimal	110 octal 72 decimal	120 octal 80 decimal	130 octal 88 decimal	re-record, forward
	101 octal 65 decimal	111 octal 73 decimal	121 octal 81 decimal	131 octal 89 decimal	re-record, reverse
	102 octal 66 decimal	112 octal 74 decimal	122 octal 82 decimal	132 octal 90 decimal	read, forward
	103 octal 67 decimal	113 octal 75 decimal	123 octal 83 decimal	133 octal 91 decimal	read, reverse
	104 octal 68 decimal	114 octal 76 decimal	124 octal 84 decimal	134 octal 92 decimal	stop mode forward
	105 octal 69 decimal	115 octal 77 decimal	125 octal 85 decimal	135 octal 93 decimal	stop mode reverse
	106 octal 70 decimal	116 octal 78 decimal	126 octal 86 decimal	136 octal 94 decimal	record, forward
	107 octal 71 decimal	117 octal 79 decimal	127 octal 87 decimal	137 octal 95 decimal	record, reverse