ELLIOTT 903

Volume   1:   FUNCTIONAL SPECIFICATION

Part   2:   THE BASIC 903 COMPUTER UNIT
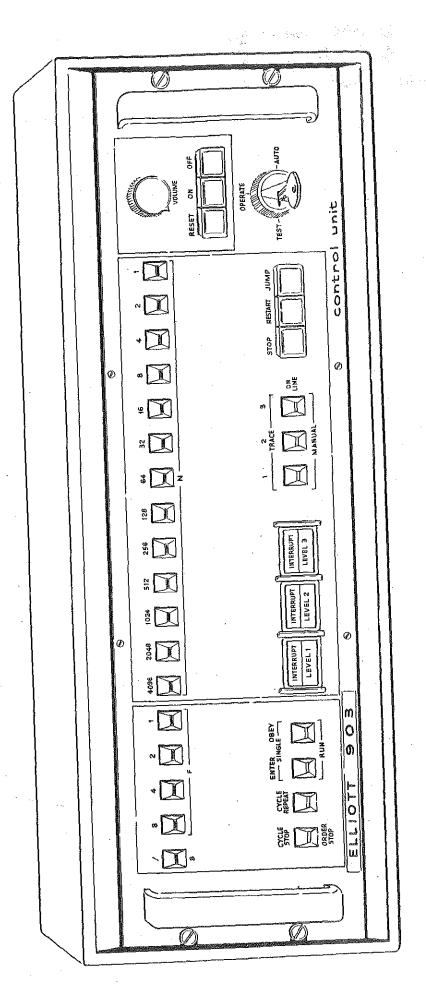
Section 5:   CONTROL UNIT

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Figure A: 903 Control Unit

Chapter   1:   INTRODUCTION

1. 1   General.

   The Control Unit is mounted on a plinth and is normally placed on the basic computer desk, but as it is free standing it may be placed on any desk. The panel (see Figure 1) carries a Master Control switch, a number of keys including the Word Generator (WG) keys, and a loudspeaker with VOLUME control knob. Some of the buttons contain lamps which, when illuminated, give visible indication of the effect of pressing the button, and the loudspeaker gives audible evidence that the program is running.

   The Master Control switch allows the computer to operate in three modes - AUTO, OPERATE and TEST. In the Auto mode most of the controls on the unit are inoperative and control over the operation of the computer must be effected by program. In the Operate mode the controls may be used by an operator, who may therefore control the operation of the computer. In the Test mode the controls may be used for engineering test purposes, or for program testing; Test mode controls as used in program testing are tabulated in this section, but the use of the mode by engineers is described in Volume 4 of this manual.

   The mains switch for the installation, which is the ON button mounted on the console, turns on the 903 central processor and the paper tape and teleprinter controller.

   Details of weights and dimensions, power requirements and environmental conditions are given in Section 1. 2. 9.

Chapter 2: CONTROLS AND KEYS

2.1 Auto, Operate and Test controls.

Note: Entries in the "Operative Mode" column indicate in which mode the controls are functional, and have the following significance:-

A = Auto
O = Operate
T = Test

NAME	OPERATIVE MODE	DESCRIPTION	EFFECT OF DEPRESSING BUTTON	LAMP LIT WHEN	NOTES
JUMP	O, T	White button, spring-loaded.	Initiates transfer of control to instruction in location specified by N keys of WG.		Address keys of WG must be set by operator before button is depressed (see subsection 3.2 of this chapter.
STOP	O, T	White button, spring-loaded. Red insert lamp.	Program will stop at end of instruction currently being obeyed, but processor still operational.	Computer has stopped obeying instructions i.e. after current instruction. Also lit when RESET button depressed.	After STOP has been pressed the contents of all registers are unaltered, and the program may be restarted only by pressing RESTART.
RESTART	O, T	White button, spring-loaded.	Program will continue from point at which it stopped.		
ON	A, O, T	White button, spring-loaded. Green insert lamp.	(1) Activates system power supplies required by computer. System is switched on with all devices reset to their known start conditions. (2) If system is in Auto mode, it initiates transfer of control to the instruction in 8177, which is then obeyed (see Section 1.2.3).	All power supplies are on.	Sequence of switching - on of power supplies is determined by power supply unit.
OFF	A, O, T	White button, spring-loaded. Red insert lamp.	Activates sequential switching-off of power supplies to computer. Main store shut down, but information not corrupted or destroyed.	Primary power supply live but computer in Off state i.e. non-operational.	Sequence of switching - off of power supplies determined by power supply unit.

NAME	OPERATIVE MODE	DESCRIPTION	EFFECT OF DEPRESSING BUTTON	LAMP LIT WHEN	NOTES
RESET	A, O, T	White button, spring-loaded. Yellow insert lamp.	RESET signal sent to all devices, which are then reset to their known start conditions. Any transfers in progress or any INTERRUPTS awaiting service are terminated. STOP lamp is lit.	Reset state has been achieved.	(1) The Reset state may be terminated only by a jump to start program operations. Such a jump is generated either by depressing the ON button while the computer is Off and in the Auto mode, or by depressing JUMP while the computer is in the Operate mode. (2) Depressing RESET while in the Auto mode will cause a jump to 8177.
VOLUME	A, O, T	White knob with pointer.	Clockwise rotation of this knob increases volume of monitor loudspeaker which gives audible indication that the program is running.	–	–

NAME	OPERATIVE MODE	DESCRIPTION	EFFECT OF DEPRESSING/RAISING KEY	NOTES
ENTER	T	3-position key. No insert.	Manipulation to either up ot down position copies into A the number set up on the N keys of WG. Depression of the key causes the number to be copied once only (single shot mode); raising it causes the number to be copied continuously until the key is returned to the central position.	Use of this control is effective only if the computer has been stopped by depression of the STOP button.
OBEY	T	3-position key. No insert.	Manipulation to either up or down position causes the computer to obey the instruction set up on the WG keys. Depression of the key causes the instruction to be obeyed at once; raising it causes the instruction to be obeyed continuously until the key is returned to the central position.	Use of this control is effective only if the computer has been stopped by depression of the STOP button. If no F keys have been depressed before OBEY is pressed, function O is obeyed; if no N keys have been depressed, the instruction is treated as if its address were location O.
ORDER STOP/ CYCLE STOP	T	3-position key. No insert.	Depression of the key puts the computer in the Order Stop state. This causes the computer to stop. Once the key has been depressed and the computer has stopped, the obeying of successive program instructions one at a time may be effected each time by operation of the RESTART control. Raising the key puts the computer in the Cycle Stop state, and causes it to obey one logic step in the microprogram. Once the key has been raised and this Step obeyed, the obeying of successive steps may be effected each time by operation of the RESTART control.	See also CYCLE REPEAT and RESTART.
CYCLE REPEAT	T	2-position key (up and central). No insert.	Raising the key causes the computer to repeat a logic step in the microprogram. If CYCLE STOP is not set, this step will be obeyed continuously until CYCLE REPEAT is returned to the central position; if CYCLE STOP is set, it will be repeated each time RESTART is operated.	See also ORDER STOP/ CYCLE STOP and RESTART.

2. 2 Word Generator.

The WG (see Figure A) consists of 18 two-position keys which correspond to the 18 bits of the computer word, and are numbered according to the three groups (B, F and N) of an instruction; the tips have small inserts as follows:-

B (18)   - yellow

F (17-14) - red

N (13-1) - green

The depression of any one of the keys represents a one in that position of the computer word.

When the computer is in the Operate mode, the N keys (13-1) may be used as a method of program entry as follows:-

(i)   depression of the relevant N keys will specify an address between 0 and 8191 inclusive.

(ii)   depression of the JUMP button will cause the address set up on the N keys to be stored in the S-register, and control will then be transferred to the instruction whose address is held in S.

Note that the program entry address can be only within the first 8192 words of store, i. e. within the basic core store module.

2. 3 Program level INTERRUPT controls and indicators.

These are illustrated in Figure 1 and consist of three spring-loaded push-buttons, each of which contains two lamps. Each upper lamp is red and is marked "INTERRUPT"; each lower lamp is green and is marked "LEVEL 1", "LEVEL 2" or "LEVEL 3". The push-buttons are associated with program priority levels 1, 2 and 3 and are functional in the Operate mode; their use is described in this subsection.

There are also 3 three-position keys, labelled 1, 2 and 3 and situated to the right of the push-buttons. They are associated with program priority levels as indicated by their numberings, and the three positions are Manual, On-line and Trace. Use of these keys in the Manual and On-line positions is described here; their use in the Trace position is described in Sub-section 2. 4. of this chapter.

When the computer is in the Operate mode and it is proposed to use the program level interrupt buttons, the keys must be in the Manual position and this ensures that only INTERRUPTS generated via the control panel will be operated. Depression of a button will then cause an INTERRUPT from the relevant level to be sent to the central processor, and the red lamp will be lit to show that the signal has been received; the lamp goes out as soon as the signal is being dealt with by the processor. Control is then transferred to the level which is interrupting and the green lamp is illuminated to show that the program on that level is being obeyed. The green lamp goes out when control is transferred to another level.

When the computer is in the Auto mode the buttons cannot be used, and the keys must be set to the On-line position. This ensures that the processor will obey only INTERRUPTS sent by peripheral devices, and not those generated by any erroneous depression of the Program Level buttons.

2.4 Trace facility.

The trace facility may be used for the checking of programs during testing runs, and may be operated when programs are running on two or more levels under the program priority system. It thus comprises an additional facility to the program priority level system and is extremely useful during testing runs, although it is unlikely to be required during a production run. The 3 three-position keys to the right of the Program Level Interrupt buttons are used for trace purposes, and it will be noted from the numbering above the buttons that Trace is possible only on levels 1, 2 and 3.

The facility operates as follows. Before or at any point during the computer run any one of the three keys may be raised to the Trace position, and this will generate a permanent INTERRUPT on the relevant program level. The program on that level will then be checked, as long as the permanent INTERRUPT lasts, according to the instructions of the program which is controlling the testing. Such a permanent INTERRUPT condition is overridden when the relevant key is returned to the Manual position.

Suppose that trace is required on level 3. When the key has been depressed, a permanent INTERRUPT on level 3 will be generated as explained above, and while it continues the sequence of operations will be as follows:-

(1)   Jump immediately to level 3.

(2)   Obey the program on level 3.

(3)   Obey Program Terminate instruction on level 3
        (15 7168)

(4)   Return to level 4.

(5)   Obey one instruction of the program on level 4.

(6)   Repeat from (1) - (6)

In this example, the program on level 3 would normally be written to monitor in any way required the operation on level 4; it could, for example, cause the contents of A to be printed each time the above cycle is obeyed. It will be noted that the computer must obey the Program Terminate instruction on the trace level, and then at least one instruction on another level, before it can return to the level which gave the Program Terminate.

The trace facility is subject to the normal rules of the Program Interrupt System (see subsection 2. 3.). Simultaneous operation of the Trace and Program Interrupt facilities is, however, unlikely to produce a useful effect.

Chapter   3:   FEATURES OF THE UNIT

3.1   Master Control.

The Master Control is a three-position Yale-type switch which enables the unit to be locked in any one of the three modes Auto, Operate or Test.   When the Master Control is in the TEST position the key cannot be removed.

3.2   Auto Mode.

In this mode the only controls which are functional are ON, OFF, RESET and the monitor loudspeaker VOLUME control (see Chapter 2 for functions); all other necessary control over the operation of the computer must be effected by program.   When the computer is switched on in the Auto mode control will be transferred to location 8177 so that a jump instruction stored in that location by the Initial Instructions routine will trigger the program (see Section 1. 2. 3).

3.3   Operate Mode.

In this mode control over the operation of the computer may be effected by use of the buttons and keys on the Control Unit; the Initial Instructions routine may be used to input binary tapes (see Section 1. 2. 3), and the trace facility may be used to check the operation of programs which are being tested (see sub-section 3. 4. of this chapter).   The controls functional in the Auto mode - ON, OFF, RESET and VOLUME control - are operative in the Operate mode with the following additions: WG keys (N keys only), JUMP, STOP, RESTART and PROGRAM LEVEL controls (see Chapter 2 for functions).

3.4   Test Mode.

The function of the TEST mode, as far as the programmer is concerned, is to provide a "single-shot" method of operating the computer so that the effect of obeying each instruction or logic step (singly or continuously) may be observed as required.   Its use for fault-finding by engineers is described in Volume 4 of this manual.   The controls operative in this mode are: ORDER STOP/CYCLE STOP, CYCLE REPEAT, ENTER, and OBEY, and their uses for program testing are tabulated in Chapter 2, subsection 2, of this section.