ELLIOTT 903

Volume 1: FUNCTIONAL SPECIFICATION

Part 2: BASIC 903 COMPUTER UNIT

Section 3: INITIAL INSTRUCTIONS (I. I)

Contents

Chapter 1: INTRODUCTION

1.1 Functions and Uses.

Initial Instructions (I. I.) on the 903 are a short self-contained routine providing a "bootstrap" method of reading in and storing binary tapes. They are permanently held in a fixed area of the store, and so may be used to input a tape, particularly for the initial loading of a program.

The routine operates as follows. A jump to location 8181, effected manually via the control unit, enters a fixed program. This program reads in groups of characters in a special format and assembles the groups into words, which it places in locations 8177, 8178 and 8179; it then immediately transfers control to location 8177. By suitable choice of the three words in locations 8177 to 8179 inclusive, the fixed program may be re-entered, to read in any number of further words in the special format and to place them in successive locations, so that the final word goes into 8179. Control is then again transferred to location 8177.

The I. I. routine operates on program priority level 1.

1.2 Preparation of tapes for I. I.

The beginning of each program tape which is to be read in by I. I. must be punched as follows:-

(a) an 8-bit marker character representing the binary 76

(b) following the marker character, three 7-digit characters (bit 8 of each character must always be zero). When they have been read in, bits 4-1 of the first of these characters and bits 7-1 of the other two will have been assembled into one 18-bit word forming a computer instruction. The characters are assembled as they are read from tape, i. e. bits 4-1 of character 1 become the most significant instruction digits.

(a) and (b) must then be repeated twice more on the tape, so that it contains 3 groups of three instruction characters as just described, each group being preceded by a marker character. Provided the tape is prepared in this way, entering the I. I. routine via the control unit will cause the first three program instructions to be read into the computer; the short routine formed by these instructions should be written so that when it is entered it will cause the rest of the tape to be read in.

The I. I. routine disregards blanks punched in certain places on the tape. Blanks are permissible immediately before or after each of the groups of 4 characters described in (a) and (b) above; they are not permissible, however, between the characters making up the groups, as this would prevent the intended instruction from being assembled.

1. 3 Storage and preservation.

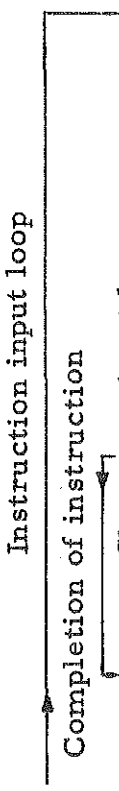
Locations 8180 to 8191 inclusive contain the I. Is and are thus not available to program for storage of information. They may, however, be read by program either as fixed instructions or as numbers. Any attempt to overwrite them results in no change in the contents of the relevant location, although the instruction appears to have been carried out normally.

Chapter 2: IMPLEMENTATION OF INSTRUCTIONS

2. 1 Coding and Operation.

The I. I. routine is coded and stored as shown in the following table. The B-register is used as a count to ensure that 3 program instructions are input, and is set to - 3 as the first step of the routine. The accumulator is then set so that its becoming negative will indicate that the last character of an instruction is about to be input. a is then shifted left and characters input until a complete instruction has been assembled, and this is then stored in location 8177. b is then increased and tested to see if it is positive; the test ensures that the instruction input loop is repeated twice more, and the instructions are stored in locations 8178 and 8179. The final instruction of the I. I. routine then transfers control to 8177, which contains the first of the instructions just read in.

Provided the input tape has been punched as described in Chapter 1, subsection 2, the I. I. routine will be obeyed as shown below. A detailed explanation of the effects of the character input loop is given in the next subsection:-



Location	Instruction B	F	N	Effect
8180	/	15	8189	c(8180) = - 3
8181		0	8180	b: = c(8180) i. e. b:= - 3 (count set for no. of instructions to be input)
8182		4	8189	Sets accumulator initially. a: = bit pattern 001000000000000001. This ensures that the accumulator will not become negative as a result of shifts until the first marker character makes it negative.
8183		15	2048	Shifts a left 7 places. Inputs character from tape reader and places it in a (7-1). The first time this instruction is obeyed it will input the marker character; subsequently it will input characters making up the instruction word.
8184		9	8186	Jumps to location 8186 if a is negative i. e. if last of the 3 instruction characters is about to be read in.
8185		8	8183	Jumps to 8183 (a is positive). This will have the effect of shifting and inputting characters until a is negative.
8186		15	2048	Shifts a left 7 places. Inputs last character from tape reader and places it in a (7-1). Therefore a: = instruction word

Instruction input loop (contd.)

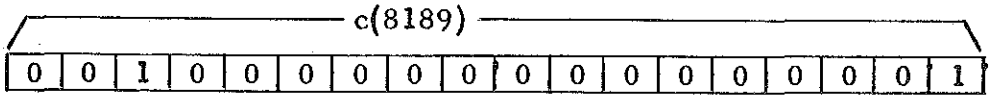
Location	Instruction B	F	N	Effect
8187	/	5	8180	Stores instruction word
8188		10	0001	b: = b + 1
8189		4	0001	a: = b
8190		9	8182	Jumps to 8182 if a is negative, i. e. instruction tests count. This instruction will repeat the loop until the first 3 program words have been loaded into locations 8177, 8178 and 8179.
8191		8	8177	Jumps to 8177 (a is positive). This causes the first program instruction to be obeyed.

2. 2 Character reading by L I.

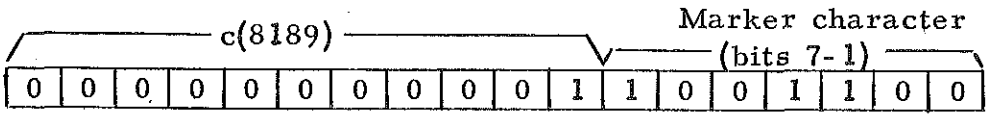
The shifting and reading of characters, and the assembling in A of a complete program word, is effected by the I. I. routine instruction as shown below. Blanks between the execution of instruction 8182 and the reading of the first marker character are ignored; it should be noted that if they are encountered in that area, bit 8 of the second diagram and bit 15 of the third diagram will be zero instead of 1.

Instruction stored in — Bit pattern in A achieved by instruction

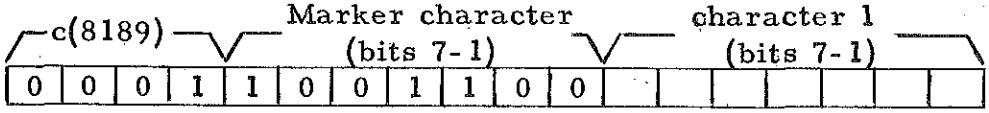
8182



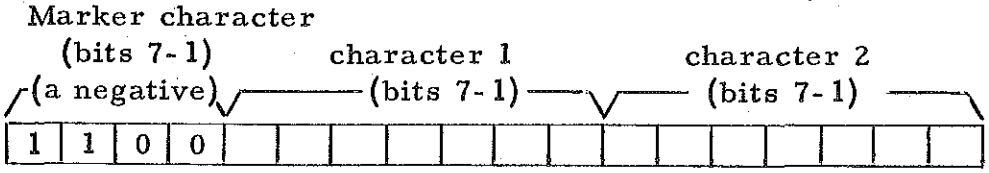
8183 (1st time)



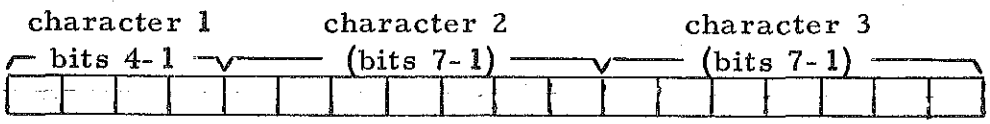
8183 (2nd time)



8183 (3rd time)



8186



Bits 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Reference should be made to Section 1. 2. 6. of this Manual for a full explanation of input from the paper tape unit.

2. 3 Entry and Exit Procedures.

2. 3. 1 Entry to I. I. routine.

Entry to I. I. is effected via the control console as follows:-

(a) Set the WG keys to the bit pattern representing 8181(1111111110101)

(b) Press the JUMP button. This will cause the number 8181 to be placed in the Sequence Control Register. The next instruction which is obeyed is therefore the one held in 8181, the first instruction of the I. I. routine.

2. 3. 2 Program entry by triggering.

The final instruction of the I. I. routine transfers control to the instruction stored in 8177, this being the first of the three instructions just read in. Provided the three instructions in 8177-8179 are written as indicated in the following list, they will re-enter the I. I. routine and read in a program of x words:-

Location	Instruction B	F	N	Effect
8177		0	8179	b: = - x (count set)
8178		8	8182	Jump to 8182 if a positive
8179			(-x)	- no. of words to be input

Because the I. I. routine transfers control to 8177, a jump instruction read into that location by the last use of the I. I. routine will ensure a triggered entry to the program.

2. 3. 3 Program entry via Control Unit.

In some cases, it may not be desired to trigger an immediate entry to the program input and stored by I. I. In such cases, the computer must be "stopped", and then entry may be effected, when required, via the control console. Procedure may be as follows:-

(a) location 8177 must hold the instruction 8 8177. This has the effect of continually placing 8177 in S, giving a dynamic stop.

(b) when the program is to be entered, the required starting address must be set up on the WG buttons and then the JUMP button must be depressed. This causes a jump to program priority level 1.