

PRODUCT CODE: DEC-8E-XBINA-A-D  
PRODUCT NAME: Self-Starting Binary Loader  
User's Manual  
  
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## CHAPTER

		<u>Page</u>
1.1	ABSTRACT	1
2.1	EQUIPMENT	1
3.1	MEMORY REQUIREMENTS	1
4.1	OPERATING INSTRUCTIONS	1
4.1.1	With the MI8-E Bootstrap Loader	2
4.1.2	With the Switch Register	2
4.1.3	Checksum Errors	3
4.1.4	Special Conditions	3
5.1	PAPERTAPE FORMAT	4
6.1	GENERATING TAPES TO BE LOADED WITH SS BIN	6

## SELF-STARTING BINARY LOADER (SS BIN)

### 1.1 ABSTRACT

The Self-Starting Binary Loader (SS BIN) reads and stores 12-bit data words from binary format papertape from either the low speed reader or the high speed reader. If a starting address is supplied the program will be started at the completion of loading.

### 2.1 EQUIPMENT

The SS BIN requires a PDP-8/E or PDP-8/M with either a low speed papertape reader or a PC8-E high speed reader. It may be used with MI8-E Bootstrap (RIM) Loader.

### 3.1 MEMORY REQUIREMENTS

The SS BIN occupies locations 7600-7755 and location 7777 of one memory field. It may reside in any memory field, as long as the RIM loader is in locations 7756-7776 of the same field. Use of the data break facility, which affects locations 7746-7755 of field 0, will not affect SS BIN. Data may be loaded into fields 0-7.

### 4.1 OPERATING INSTRUCTIONS

SS BIN is loaded with the RIM loader as the first part of a two part tape. The format of these tapes is described in the section on papertape format. The second part, separated from SS BIN by leader/trailer, is the object program or data to be loaded. Instructions are given below for use without a switch register and with the MI8-E, and for use with a switch register and without the MI8-E. If the object program is not attached to SS BIN or if there is more than one object tape, see the section on special conditions later in this document.

#### 4.1.1 With the MI8-E Bootstrap Loader

1. Place the initial leader/trailer of SS BIN over the read head of the selected reader. If the low speed reader is to be used, turn the main switch to ON-LINE and the reader control to START. If the high speed reader is to be used, set its control to ON-LINE.
2. Activate the SW switch, located on the lower left of the front panel, by moving it from the down to the up position. This will load and start the RIM loader. It will load SS BIN, which will start itself, load the object program and start the program. (If no switch register is present, it is essential that the object program specify a starting address).

#### 4.1.2 With the Switch Register

1. Be certain that the RIM loader for the appropriate reader is in memory. This procedure is described in Introduction to Programming, Appendix E1.
2. Place the initial leader/trailer of SS BIN under the read head of the selected reader. If the low speed reader is to be used, turn the main switch to ON-LINE and the reader control to START. If the high speed reader is to be used, set its control to ON-LINE.
3. Set the instruction field and data field to the field of the RIM loader. This is done by multiplying the field number by 11, setting the result on the switch register, and pressing EXT D ADDR LOAD.
4. Set the switch register to 7756, which is the starting address of the RIM loader.
5. Press ADDR LOAD, CLEAR, and CONTINUE. This will start the RIM loader. It will load SS BIN, which will start itself and load the object program. If a starting address was specified, the program will be started. If no starting address was specified, SS BIN will halt at the beginning of the final leader/trailer with the accumulator (AC) set to  $\emptyset$

#### 4.1.3 Checksum Errors

At the end of each binary tape is a two frame code called the checksum. Its calculation is explained in the section on papertape format.

It is used to determine if the same holes were read by SS BIN as were punched in the tape. It was calculated once when the tape was punched and again as it is being loaded by SS BIN. The two totals must agree. If they do not, an error has been made and SS BIN halts with the AC equal to the difference in the calculations. If a starting address was specified, the program is not started. The tape should be reloaded, beginning at step 1 of the appropriate procedure. If SS BIN halts again with the AC equal to the same number as in the previous load, the fault is probably with the tape. If SS BIN halts with the AC equal to a different non-zero number, the fault is probably with the reader. If the AC is 0 or if the program starts, the load was good.

#### 4.1.4 Special Conditions

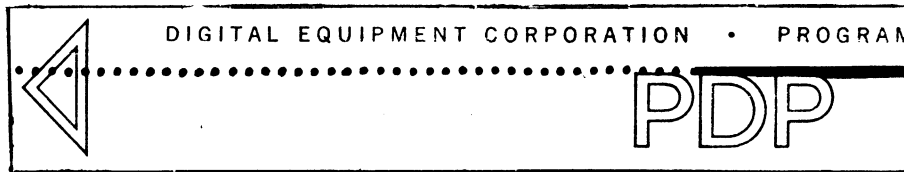
If there is a switch register and there are additional tapes to be loaded, they may be loaded after the loader has halted with the AC equal to 0, as in step 5 above. Place a tape in the reader and press CONTInue. If the load was good SS BIN will again halt with the AC equal to 0. If a starting address is specified, it must be on the last tape loaded. If no switch register is present, additional tapes, if preceded by SS BIN, may be loaded with the MI8-E in the same manner as the first tape.

SS BIN will remain in memory unless locations 76000-7745 are used for another purpose. If a switch register is present, tapes without SS BIN attached may be loaded later by placing them in the reader and starting at 7777.

If SS BIN is not attached to the object tape, the following procedure may be followed:

1. Examine the SS BIN tape. Carefully remove any tape after the final leader/trailer which contains characters other than leader/trailer or blank tape. Be sure the end of the tape is torn smoothly and squarely. With scissors remove the last inch of sprocket holes,

as in the example which follows. Do not cut into any of the 8 information channels of the tape. This is to prevent extraneous characters from being read from the end of the tape.



2. Load SS BIN alone according to the procedure described for a normal load. When the tape has run out of the reader, the reader will halt, but the computer will not (the RUN light will be on).
3. If the Teletype reader is being used, set the switch to STOP; if the high speed reader is being used, set the switch to OFF-LINE.
4. Remove the SS BIN tape and insert the object program tape with leader/trailer or blank tape under the read head. Set the reader switch to START if the Teletype is used or ON-LINE if the high speed reader is used. The tape will be loaded in the usual way. If the SS BIN tape has not been trimmed, it may still be used, but the reader must be turned off as in step 3 before the end of the tape is reached.

#### 5.1 PAPERTAPE FORMAT

RIM and SS BIN expect the papertapes to be in the following format:

1. Leader/trailer (ASCII code 2000).
2. Self-starting Binary loader in RIM format.
3. Checksum of SS BIN or two frames of leader/trailer.
4. Leader/trailer or blank tape.
5. Program to be loaded, beginning with an origin setting. If it is to be loaded into a field other than the field of the loaders, it must also begin with a field setting.
6. An origin setting at the end of the program, if it is to be started by SS BIN.
7. Checksum of the program portion of the tape.
8. Leader/trailer.

There are 8 channels (or columns) in a papertape.. If the tape is held vertically, with the arrows pointing up, the leftmost channel on the printed side is channel 8; the rightmost is channel 1. The small holes are the sprocket holes. In the examples, 1 signifies a punched hole.

Examples of format:

TAPE CHANNEL	MEANING	NOTES
87 654 S 321 10 000 . 000	leader/trailer	There should be at least an inch where it is required.
11 011 . 000	field setting	Channels 7 and 8 identify a field setting. Channels 4, 5, and 6 contain the number of the field; in this case, 3.
01 000 . 010 00 011 . 100	origin setting	Channel 7 identifies an origin setting. Channels 6, 5, 4, and 3, 2, 1 of both frames indicate the address; in this case, 0234.
00 111 . 110 00 101 . 100	data word	Two frames are necessary for each 12 bit data word. Channels 7 and 8 of each are not punched. In this case, the word is 7654.

SS BIN itself must be in RIM format. This means that origin and data words are alternated for the length of the tape; for example:

01 111 . 110	origin	7600
00 000 . 000		
00 100 . 011	data	4323
00 010 . 011		
01 111 . 110	origin	7601
00 000 . 001		
00 111 . 000	data	7041
00 100 . 001		

The RIM loader places each data word into the location specified by the previous origin.

The object tape must be in binary format. It should begin with an origin setting or with a field setting and an origin setting.

Until a field setting is found, the program will be placed in the same field as SS BIN. The first word of data following the origin will be placed in the location specified by that origin. Successive data words will be placed in sequential locations following that until another origin or more leader/trailer is found. No notice is taken of page boundaries. After location 7777 of a field is loaded, loading continues with location 0 of the same field. The field setting is used to specify into which field the data is to be loaded.

If the object program is to be started by SS BIN, the starting address may be given as an origin setting immediately preceding the checksum. It should be preceded by a field setting. SS BIN will transfer control to the object program at the address indicated with the instruction field and data field equal to the field specified in the latest field setting, or in the field of SS BIN if no field settings were found.

The checksum is a sum of all the frames punched on the tape except the leader/trailer and field settings. For example, the data word 7654 would be added into the checksum as 76+54 or 152 (octal). Any bits carried beyond 12 bits are ignored. The checksum is punched as a data word immediately before the final leader/trailer. As the tape is loaded, SS BIN adds the frames and accumulates its own checksum. When the tape has been loaded, the punched checksum is compared with the one accumulated by the SS BIN. If they are not the same, an error has occurred.

Some assemblers, including PAL III and MACRO-8, will punch error messages into the binary tapes on the Teletype punch if errors occur during assembly. These are preceded and followed by rubouts (ASCII code 377--all 8 channels punched). SS BIN will ignore all data between the rubouts.

#### 6.1 GENERATING TAPES TO BE LOADED WITH SS BIN

The starting address for the object program may be generated with an origin statement as the last statement of the source program. If the source program contains literals, the FIELD pseudo-op should be used to cause the page 0 literals and links to be punched, to punch the field setting, and to supply an origin of 00200. The actual starting address may be supplied after the FIELD pseudo-op.

If OS/8 is being used to produce the binary tapes, the /B option of PIP may be used to combine the binary file of SS BIN and the object program. The resulting combined file may then be punched as one tape.

If the papertape assemblers are used, SS BIN should be copied first, and then the punch turned off. The source program may then be assembled. When the assembler is ready to punch the object program, the punch should be turned on. This will cause the object program to be punched onto the same tape as SS BIN.

The source tape of SS BIN produces a RIM format tape with a checksum. SS BIN will cause the RIM loader to ignore this checksum. SS BIN may, therefore, be assembled with any of the PAL-type PDP-8 assemblers.

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/SELF-STARTING BINARY LOADER .  
/NOVEMBER 1971 SM  
/COPYRIGHT 1971 DIGITAL EQUIPMENT CORPORATION  
/ MAYNARD, MASSACHUSETTS 01754

9	6007	CAF=6007				
10	7767	RIMS2=7767				
11	7761	RIMR1=7761				
12	7776	COUNT=7776				
13						
14	7600	*7600				
15	07600	END,	JMS ASSEMB	/PUT CHECKSUM TOGETHER		
16	7601	*	CIA			
17	07601		TAD CKSUM	/GET TOTAL		
18	7602	*	SZA	/GOOD LOAD?		
19	07602		HLT	/NO==HALT AND DISPLAY DISCREPENCY		
20	7603	*	TAD SWITCH	/WAS LAST DATA AN ORIGIN?		
21	07603		SZA CLA			
22	7604	*	JMP .+7	/NO==DO NOT START EXECUTION		
23	07604		CAF	/YES==RESTORE MACHINE STATE TO START		
24	7605	*	TAD FLD			
25	07605		IAC			
26	7606	*	DCA .+1	/SET INSTRUCTION FIELD TO LAST LOADED FIELD		
27	07606		HLT			
28	7607	*	JMP I ORIGIN	/**EXIT TO LOADED PROGRAM**		
29	07607		HLT	/LOAD O.K. NOT SELF START		
30	5216	*	KCC			
31	7610	*	RFC			
32	6007	*	RDF			
33	7611	*	TAD CDF0	/SET FIELD FROM SWITCHES		
34	1252	*	DCA FLD			
35	7612	*	TAD MASK			
36	7001	*	DCA LEAD	/SET UP TO IGNORE BLANK TAPE & LEADER/TRAILER		
37	7613	*	JMS FETCH	/GET FIRST CHARACTER		
38	7614	*	JMP .-1	/IGNORE UNTIL FIRST REAL DATA		
39	7402	*	TAD LT	/CHARACTER IS ORIGIN OR DATA		
40	7615	*				
41	07615					
42	5747	*				
43	7616	*				
44	07616					
45	7402	M376,				
46	7617	*				
47	6032	BEGIN,				
48	7620	*				
49	6014	*				
50	7621	*				
51	07621					
52	7622	*				
53	1341	*				
54	07622					
55	7623	*				
56	3252	*				
57	7624	*				
58	07624					
59	1342	*				
60	7625	*				
61	07625					
62	3274	*				
63	7626	*				
64	07626					
65	4261	*				
66	7627	*				
67	5226	*				
68	7630	*				
69	07630					
70	1343	*				





```

162 /INPUT ROUTINE
163 /SET BY INITIALIZATION CODE FOR EITHER ASR33 OR HIGH SPEED READER
164 /ENTER WITH AC=0
165 /EXIT WITH CHARACTER IN AC AND IN CHAR
166
167
168
169 7706 0000 READ, 0
170 7707 *
171 07707 3376 DCA COUNT /PREPARE TO TIME OUT
172 7710 *
173 07710 2376 ISZ COUNT /IF OUT OF TAPE
174 7711 *
175 07711 5321 JMP WAIT
176 7712 *
177 07712 6036 NOTAPE, KRB /OR RCC=6016
178 7713 *
179 07713 6031 TAPE, KSF /OR RSF=6011
180 7714 *
181 07714 5310 JMP -=4
182 7715 *
183 07715 6036 KRB /OR RCC=6016
184 7716 *
185 07716 3346 DCA CHAR
186 7717 *
187 07717 1346 TAD CHAR
188 7720 *
189 07720 5706 JMP I READ /--RETURN--
190 7721 *
191 07721 1265 WAIT, TAD M40
192 7722 *
193 07722 3344 DCA INIT
194 7723 *
195 07723 2344 ISZ INIT
196 7724 *
197 07724 5323 JMP -=1
198 7725 *
199 07725 5315 JMP TAPE
200
201 /HANDLER FOR FIELD SETTING
202 /ENTERED FROM FETCH
203
204
205 7726 *
206 07726 0255 FSET, AND C70 /MASK OUT ALL BUT FIELD NUMBER
207 7727 *
208 07727 1341 TAD CDF0 /GET REST OF CDF
209 7730 *
210 07730 3252 DCA FLD /INSERT WHERE IT WILL BE EXECUTED
211 7731 *
212 07731 5263 JMP FETCH+2

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/SUBROUTINE TO ASSEMBLE TWO CHARACTERS INTO ONE WORD FOR STORAGE
/ENTER WITH AC=0
/EXIT WITH WORD IN AC

7732 * ASSEMB, 0
0000 *
7733 * TAD WORD1
1350 *
7734 * CLL RTL
7106 *
7735 * RTL
7006 *
7736 * RTL
7006 *
7737 * TAD WORD2
1351 *
7740 * JMP I ASSEMB /---RETURN--
5732 /CONSTANTS
7741 *
6201 * CDF0, CDF 0
7742 *
0257 * MASK, AND C177
7743 *
1304 * LT, TAD M200

```

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276
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278

/INITIALIZATION CODE
/USED ONCE ONLY--MAY BE OVERWRITTEN BY DATA BREAKS

/TEMPORARY STORAGE LOCATIONS
/MAY ALSO BE OVERWRITTEN BY DATA BREAKS

7744 *
7200 INIT, CLA
7745 *
1361 TAD RIMR1
7746 *
3312 CHAR, OCA NOTAPE
7747 *
1367 ORIGIN, TAD RIMS2
7750 *
3313 WORD1, OCA TAPE
7751 *
1361 WORD2, TAD RIMR1
7752 *
3315 CKSUM, OCA TAPE+2
7753 *
1242 SWITCH, TAD RESTOR
7754 *
3372 OCA 7772
7755 *
5217 JMP BEGIN

7777 /STARTING ADDRESS FOR MANUAL START
5217 *7777 JMP BEGIN

7772 /LOCATION TO OVERLAY RIM AND START LOADER
5344 *7772 JMP INIT

$

```

ASSEMB 7732  
BEGIN 7617  
CAF 6007  
CDF0 7741  
CHAR 7746  
CKSUM 7752  
COUNT 7776  
C177 7657  
C70 7655  
END 7600  
FETCH 7661  
FLD 7652  
FSET 7726  
INIT 7744  
LEAD 7674  
LOAD 7632  
LT 7743  
MASK 7742  
M200 7704  
M300 7701  
M376 7616  
M40 7665  
NOTAPE 7712  
ORIGIN 7747  
READ 7706  
RESTOR 7642  
RIMR1 7761  
RIMS2 7767  
SUM 7646  
SWITCH 7753  
TAPE 7713  
WAIT 7721  
WORD1 7750  
WORD2 7751  
279

ASSEMB	15	82	123	131	133	219#	231
BEGIN	45#	267	272				
CAF	9#	31					
CDF0	51	207	234#				
CHAR	70	141	149	185	187	253#	
CKSUM	19	68	96	261#			
COUNT	12#	171	173				
C177	110#	236					
C70	106#	205					
END	15#	80					
FEICH	59	78	121#	139	147	157	161
FLD	33	53	86	100#	209		211
FSET	155	205#					
INIT	193	195	249#	276			
LEAD	57	66	143#				
LOAD	68#	98					
LT	63	238#					
MASK	55	236#					
M200	159#	238					
M300	151	153#					
M376	43#	127					
M40	129#	191					
NOTAPE	177#	253					
ORIGIN	41	88	102	108	255#		
READ	74	125	169#	189			
RESTOR	84#	263					
RIMR1	11#	251	259				
RIMS2	10#	255					
SUM	92#	112					
SWITCH	25	90	104	263#			
TAPE	179#	199	257	261			
WAIT	175	191#					
WORD1	72	92	221	257#			
WORD2	76	94	229	259#			