

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

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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 EXTD 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

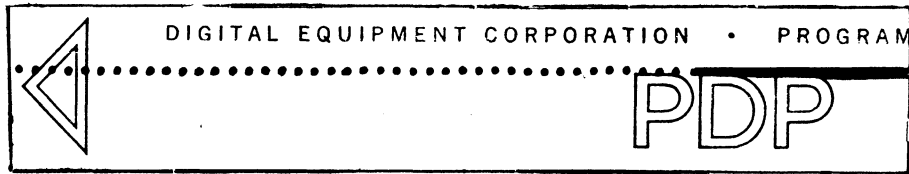
If there is a switch register and there are additional tapes to be loaded, they may be loaded after the loader has halted with the AC equal to 0, as in step 5 above. Place a tape in the reader and press CONTINUE. If the load was good SS BIN will again halt with the AC equal to 0. If a starting address 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 7600-7745 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 00 000 . 000	origin	7600
00 100 . 011 00 010 . 011	data	4323
01 111 . 110 00 000 . 001	origin	7601
00 111 . 000 00 100 . 001	data	7041

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

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/ 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				
18	7602	*	TAD CKSUM	/GET TOTAL	
19	07602				
20	7603	*	SZA	/GOOD LOAD?	
21	07603				
22	7604	*	HLT	/NO--HALT AND DISPLAY DISCREPENCY	
23	07604				
24	7605	*	TAD SWITCH	/WAS LAST DATA AN ORIGIN?	
25	07605		SZA CLA		
26	7606	*			
27	07606		JMP .+7	/NO--DO NOT START EXECUTION	
28	7607	*	CAF	/YES--RESTORE MACHINE STATE TO START	
29	07607		TAD FLD		
30	7610	*	IAC		
31	07610		DCA .+1	/SET INSTRUCTION FIELD TO LAST LOADED FIELD	
32	7611	*	HLT		
33	07611		JMP I ORIGIN	/**EXIT TO LOADED PROGRAM**	
34	7612	*			
35	07612		HLT	/LOAD O.K. NOT SELF START	
36	7613	*			
37	07613				
38	7614	*			
39	07614				
40	7615	*			
41	07615				
42	7616	*			
43	07616				
44	7617	*			
45	07617				
46	7620	*			
47	07620				
48	7621	*			
49	07621				
50	7622	*			
51	07622				
52	7623	*			
53	07623				
54	7624	*			
55	07624				
56	7625	*			
57	07625				
58	7626	*			
59	07626				
60	7627	*			
61	07627				
62	7630	*			
63	07630				


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/SUBROUTINE TO FETCH A CHARACTER FROM INPUT TAPE
/RETURNS TO CALL+1 IF LEADER/TRAILER
/RETURNS TO CALL+2 IF DATA OR ORIGIN
/HANDLES FIELD SETTINGS AND RUBOUTS

7661 *
0000 0
7662 *
3332 DCA ASSEMB /RESET RUBOUT SWITCH
7663 *
4306 JMS READ /FETCH A CHARACTER
7664 *
1216 TAD M376
7665 *
7740 SMA SZA CLA /IS IT A RUBOUT?
7666 *
2332 ISZ ASSEMB /YES--WAS SWITCH -1?
7667 *
1332 TAD ASSEMB
7670 *
7010 RAR /NO--
7671 *
7630 SZL CLA /IS RUBOUT SWITCH SET?
7672 *
5263 JMP FETCH+2 /YES--IGNORE CHARACTER
7673 *
1346 TAD CHAR /CHARACTER IS GOOD DATA
7674 *
7402 HLT /WILL BE TAD M200 OR AND C177
7675 *
7650 SNA CLA /IS IT LEADER/TRAILER?
7676 *
5661 JMP I FETCH /YES--RETURN--
7677 *
1346 TAD CHAR
7700 *
1301 TAD M300
7701 *
7500 SMA /IS IT A FIELD SETTING?
7702 *
5326 JMP FSET /YES--HANDLE IT
7703 *
2261 ISZ FETCH /NO--ORIGIN OR DATA
7704 *
7600 7600 /CLA
7705 *
07705 JMP I FETCH /--RETURN--

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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
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179
180
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07706	7706	*.	READ, 0	
07707	7707	*.	DCA COUNT	/PREPARE TO TIME OUT
07710	7710	*.	ISZ COUNT	/IF OUT OF TAPE
07711	7711	*.	JMP WAIT	
07712	7712	*.	NOTAPE, KRB	/OR RCC=6016
07713	7713	*.	TAPE, KSF	/OR RSF=6011
07714	7714	*.	JMP .-4	
07715	7715	*.	KRB	/OR RCC=6016
07716	7716	*.	DCA CHAR	
07717	7717	*.	TAD CHAR	
07720	7720	*.	JMP I READ	/--RETURN--
07721	7721	*.	TAD M40	
07722	7722	*.	DCA INIT	
07723	7723	*.	ISZ INIT	
07724	7724	*.	JMP .-1	
07725	7725	*.	JMP TAPE	
07725	5315			
			/HANDLER FOR FIELD SETTING	
			/ENTERED FROM FETCH	
07726	7726	*.	FSET, AND C70	/MASK OUT ALL BUT FIELD NUMBER
07727	7727	*.	TAD CDF0	/GET REST OF CDF
07730	7730	*.	DCA FLD	/INSERT WHERE IT WILL BE EXECUTED
07731	7731	*.	JMP FETCH+2	
07731	5263			


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

7732 *
0000 ASSEMB, 0
7733 *
1350 TAD WORD1
7734 *
7106 CLL RTL
7735 *
7006 RTL
7736 *
7006 RTL
7737 *
1351 TAD WORD2
7740 *
5732 JMP I ASSEMB /---RETURN--
/CONSTANTS
7741 *
6201 CDF 0
7742 *
0257 MASK, AND C177
7743 *
1304 LT, TAD M200
07732
07733
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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, DCA NOTAPE
7747 *
1367 ORIGIN, TAD RIMS2
7750 *
3313 WORD1, DCA TAPE
7751 *
1361 WORD2, TAD RIMR1
7752 *
3315 CKSUM, DCA TAPE+2
7753 *
1242 SWITCH, TAD RESTOR
7754 *
3372 DCA 7772
7755 *
5217 JMP BEGIN

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

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

$

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ASSEMB	7732
BEGIN	7617
CAF	6007
CF0	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

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#			