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AN ASSEMBLER AND SIMULATOR FOR THE 8048/8748/8035 INTEL MICROCO--ETC(U)

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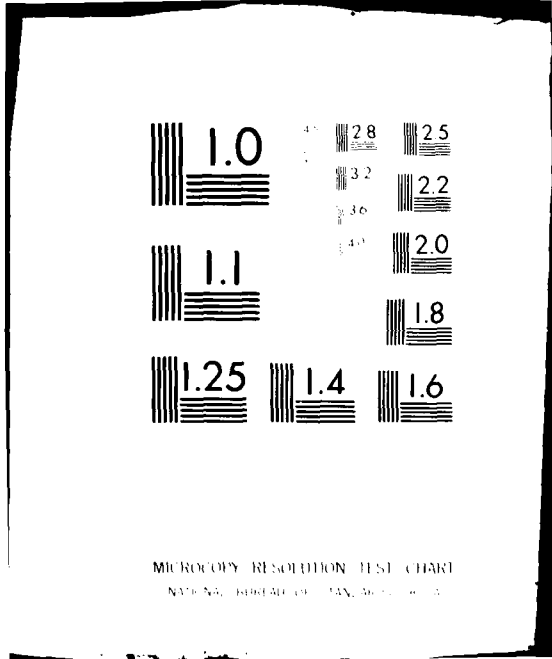
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AN ASSEMBLER AND SIMULATOR FOR  
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- R. Carbonneau
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AN ASSEMBLER AND SIMULATOR FOR  
THE 8048/8748/8035 INTEL MICROCOMPUTERS

by

R. Carbonneau, B. Montminy and P. Côté

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DEFENCE RESEARCH ESTABLISHMENT

VALCARTIER

Tel: (418) 844-4271

Québec, Canada

January/janvier 1980

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RESUME

Nous présentons un programme FORTRAN servant à la traduction des mnémoniques en code machine et à la simulation d'un programme écrit pour les micro-ordinateurs de type 8048/8748/8035. Ce programme, qui permet l'utilisation du langage symbolique d'Intel et l'emploi d'étiquettes pour les instructions "sauts", simule exactement le comportement du micro-ordinateur dans les applications réelles. Il permet en outre la simulation d'interruptions et l'impression des résultats intermédiaires. (NC)

ABSTRACT

↙  
A FORTRAN program used to translate man-readable statements into machine-understandable code and to simulate a program written for the Intel 8048/8748/8035 microcomputers is described. This program allows programming of the microprocessor in symbolic language and the use of labels for jump instructions. The simulator duplicates exactly the behavior of the microcomputer in a real-world application. It is also possible to simulate interrupts and print out intermediate results. (U)

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## 1.0 INTRODUCTION

An assembler and simulator for the 8080 microprocessor has already been described. The first version (Ref. 1) written in APL was superseded by a new version written in FORTRAN-IV language (Ref. 2).

On the basis of the previous experience, an assembler and simulator was written for the Intel 8048/8748/8035 microcomputers in FORTRAN-IV language. Files are used to store any assembler program and the simulated microprocessor memory to permit unlimited-length program edition. It is also possible to transfer directly the data generated by the assembler to a 8748/PROM programmer similar to the one described in Ref. 3.

The FORTRAN language permits the fast execution of the program instructions and the use of the editor supplied with a computer system.

The FORTRAN program first translates the Intel 8048/8748/8035 program into machine language; gives an address to all labels; finds errors in the program, if any; and executes the program exactly as the microcomputer. It also simulates interrupts and prints out intermediate data during execution. The technique used in this program is the same as that used in Ref. 2 and may be extended to any other microprocessor or microcomputer.

Section 2.0 briefly describes the principle of operation of the assembler and the simulator, Section 3.0 gives details of their use and Section 4.0 the procedure to follow to program the 8748 or the PROMs for the 8035. The work was performed at DREV between June and July, 1977 under PCN 33A10, Improvement to equipment.

## 2.0 PRINCIPLE OF OPERATION

### 2.1 The Assembler

Program assembling is done by a two-pass assembler. In the first pass, all the binary coding of instructions is accomplished except for the coding of jump addresses in all jump and call instructions. A table containing all labels with their respective addresses is also constructed. Any syntax error, illegal instruction or illegal argument will also be detected in the first pass. The second pass is exclusively used to give values to byte 2 and byte 3 of all jump and call instructions. Illegal jumps will be detected in the first or in the second pass.

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During the assembling, the ROM content is kept on the computer file system (file #2) up to a maximum of 4096 memory positions, and two other files are also constructed; these are only scratch pad files used in the simulation.

The present program limitations, 5000 lines and 500 labels, are artificial and may be changed if the need arises.

## 2.2 The Simulator

After the program has been assembled, a simulation may begin. The simulation faithfully represents the operation of the microcomputer in a real-world application. In particular, the jumps, the calls to subroutines, the returns from subroutines, the stack, the flags and the internal and external RAM are manipulated in the same way as in the 8048/8748/8035 microcomputers. It is also possible to print out the microcomputer status, at any time, with the PRIN command and to output a memory map of 64 bytes located between 0 and 1088 from the data memory. These print-outs will not interfere with the result of the assembling. These commands are used to analyze and to monitor the program. Similarly, it is also possible to simulate both external and timer/event-counter interrupts at any point in the program.

A few other special instructions may be used throughout the program; their complete description is given in the next section.

## 3.0 UTILIZATION OF THE PROGRAM

One must first write his program in a file with a currently available editor on a computer system. The program must then be copied in order to remove any deleted line and to reorder any fractional numbered line. On the DREV editor, the command is "COPY name OVER name, 1" where name is the file name.

### 3.1 Basic Instruction Set

The following remarks should be taken into account while writing the program.

1) There must be at least one instruction per line. Each instruction may optionally be followed by a semicolon and a comment. The maximum length of a line is 128 characters. There is no restriction on the comment content.

2) An instruction may be optionally preceded by a label and a colon. The latter is used only if a label is present. The label may be of any length, but only the first four (4) characters will be meaningful. During the assembling, a label table is constructed and is printed at the end. The only restriction on the label characters is that they must not be a space, a semicolon or a colon. Nonexecutable instructions should not have a label.

3) All instructions must be followed by their appropriate arguments. These are described in Ref. 4 and are reproduced in Appendix A. There must be a space between the mnemonic and the first argument and a comma between the arguments of a two-argument-instruction. Numerical arguments A must respect the following convention: A shall be a nonfractional decimal number with  $0 \leq A < 256$ .

4) The mnemonic MOVP3 used by Intel is replaced by MOV3 in the assembler/simulator.

### 3.2 Special Instructions

A few special instructions have been added to the basic instruction set to facilitate the assembling and the simulation. These are:

1) PRIN

This instruction is used without argument and will print out the processor status, i.e. the following: program counter (PC), instruction line number, accumulator, registers R0 to R7, stack pointer (SP), 4 flags (Carry, intermediate carry, F0 and F1), enable external interrupt (IEX), enable timer interrupt (ITIM), memory bank select (MB) and register bank (BS) flip-flops, and a special counter, ST, which calculates the number of cycles elapsed since the beginning of the simulation (if the processor is working at 6 MHz, one cycle represents 2.5  $\mu$ s. PRIN will not affect the assembling and should be used to help in debugging a program.

2) INTE AND INTT

These instructions simulate an interrupt that will happen exactly at the position where the instruction is put in the program. INTE simulate an external interrupt, whereas INTT simulates an interrupt from the timer event-counter. No argument is needed. The assembled program will not be changed by these instructions. They may be used anywhere in the program to know the effect of an interrupt happening at this particular point.

3) END

This instruction must be the last one of a given program. No argument is needed and assembling is unaffected.

4) ASSI

This special instruction is used to assign a number ( $0 \leq A < 256$ ) to a particular ROM address. One instruction must be used for each byte to be assigned. Simulation is not affected.

5) MAP

One uses this instruction, during the simulation, to print any 64-byte block of the 1088-byte data memory and this, without affecting the assembling. A numerical argument is required: MAP 0 is used to the print internal data memory block and Map 1 to Map 16, to print external data memory blocks (64 bytes).

6) VAR

The VAR instruction is used to assign an address to a label which is not part of the program being assembled. It affects only the assembling. A label is required for this instruction with, as a right argument, the address to be associated to it.

7) BASE

This instruction is used to change the program counter value. The instruction following BASE in the program will have the value of the argument of BASE as program counter.

8) ASSD

This instruction may be used to facilitate the addressing of a portion of a program in a relocatable context. The first argument must be a label and the second one must represent the address where the label address will be stored (two bytes are written). This instruction affects only the assembling.

NOTE: All nonexecutable instructions immediately following a CALL, JMP, JMPP, DJNZ and conditional Jumps will not be executed during the simulation. There is no restriction for the assembling.

Once the FORTRAN program, given in Appendix B, has been compiled (the object program is called OBJ2) and your program is ready, the procedure is started by typing

```
SET F:1,DC/NAME;IN
SET F:2,DC/F2;INOUT;SAVE
SET F:3,DC/F3;INOUT;SAVE
SET F:4,DC/F4;INOUT;SAVE
```

Where NAME identifies the file in which the 8048 program is stored. F2 is the memory file, whereas F3 and F4 are two additional scratch pad files. These SETs should be entered only once per LOGON. The execution of OBJ2 is initiated by RUN OBJ2.

### 3.3 Error Messages

- 1) Label error: A label is missing or there are two or more similar ones.
- 2) Argument error: The argument is unacceptable or is missing.
- 3) Syntax error: Probably a nonexisting instruction.
- 4) BAD KEY or MISSING RECORD: An attempt has been made to write or read in an undefined record. If this happens during the simulation, one must check if:
  - a) The stack pointer or the stack content is wrong;
  - b) the program is longer than 5000 lines; or if
  - c) there are more than 500 labels.

### 4.0 INTERFACE WITH THE 8748/PROM PROGRAMMER

The 8048, 8748 and 8035 microcomputers differ from each other as follows:

- a) The 8048 data memory is a ROM. It must then be mask-programmed at the factory;
- b) the 8748 program memory is an EPROM; and
- c) the 8035 has no internal program memory.

Consequently, only the 8748 can be programmed by a special programmer, whereas for the 8035 the program has to be put into a conventional PROM.

To permit the transfer of the assembled program from the computer to the programmer, the following steps should be taken.

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The following program MOR is compiled and linked to APLFNS.LPR

```

1.000      INTEGER TYPE(2),SIZE(2)
2.000      INTEGER R(256,4)
3.000      TYPE(1)=2
4.000      TYPE(2)=2
5.000      SIZE(1)=1
6.000      SIZE(2)=1024
7.000      PRINT 2
8.000  2    FORMAT('WHAT IS THE STARTING MEMORY PAGE?')
9.000      DEFINE FILE 2(256,256,U,ICA)
10.000     READ 1,N
11.000     1  FORMAT(I)
12.000     N=N+1
13.000     READ(2'N')(R(I,1),I=1,256)
14.000     READ(2'N+1')(R(I,2),I=1,256)
15.000     READ(2'N+2')(R(I,3),I=1,256)
16.000     READ(2'N+3')(R(I,4),I=1,256)
17.000     CALL FTIE(5,'FA')
18.000     CALL PREPLACE(5,1,R,SIZE,TYPE)
19.000     CALL FUNTIE(5)
20.000     CALL EXIT
21.000     END

```

The object program is called MORP and its execution is initiated by

```
START MORP
```

To the question "What is the starting memory page?", one must answer by a number A ( $0 \leq A < 15$ ). The program will then transfer 4 pages (1024 bytes) in an APL file named FA. When the following operations are completed:

```

APL
)LOAD W
ASSPROM
)SAVE

```

a vector A of 1024 elements is saved in the workspace W. This vector is directly accessible by a PROM programmer similar to the one described in Ref. 3 but adapted to the 8748/8035 microcomputers. The listing of ASSPROM is:

```

VASSPROM
[1] 'FA'FTIE 6
[2] A←FREAD 6,1
[3] FUNTIE 6
V

```

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#### 5.0 CONCLUSION

An assembler and simulator for the 8048, 8748 and 8035 micro-computers has been written. Its performance and speed are similar to those of the assembler and simulator used for the 8080.

After the assembling performed in two passes, it is possible to execute the program while simulating the exact microcomputer behavior. This simulator will considerably speed up design and debugging of programs written for the 8048 series microcomputers.

The technique used for this assembler and simulator can be accommodated to any type of microprocessor or microcomputer.

#### 6.0 ACKNOWLEDGEMENTS

The authors express special thanks to Mr. J.-N. Bérubé who has developed the technical programming used throughout this work.

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7.0 REFERENCES

1. Bérubé, J.N., "An assembler and a simulator for the 8080 microprocessor" DREV M-2402/76, June 1976, UNCLASSIFIED
2. Bérubé, J.N., Carbonneau, R., Montminy, B., Côté, P., "An improved version of an assembler and simulator for the 8080 microprocessor" DREV R-4124/78, November 1978, UNCLASSIFIED
3. Montminy, B., Bérubé, J.N., Carbonneau, R., Côté, P., "An Automatic Programmer for the 2708/2704 Erasable Programmable Read Only Memory" DREV R-4131/79, February 1979, UNCLASSIFIED
4. Intel MCS-48 Microcomputer User's Manual, November 1976.

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APPENDIX A

INSTRUCTION SET

No.	INSTRUCTIONS	ACCEPTED ARGUMENTS	REMARKS
1	ADD	A,R <sub>R</sub> A,@R A,#data	R <sub>R</sub> = R0 to R7 R = R0 or R1 0 ≤ data ≤ 255
2	ADDC	A,R <sub>R</sub> A,@R A,#data	
3	ANL	A,R <sub>R</sub> A,@R A,#data P1,#data P2,#data BUS,#data	
4	ORL	A,R <sub>R</sub> A,@R A,#data P1,#data P2,#data BUS,#data	
5	XRL	A,R <sub>R</sub> A,@R A,#data	

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No.	INSTRUCTIONS	ACCEPTED ARGUMENTS	REMARKS
6	INC	A R <sub>r</sub> @R	
7	DEC	A R <sub>r</sub>	
8	CLR	A C F0 F1	
9	CPL	A C F0 F1	
10	DA	A	
11	SWAP	A	
12	RL	A	
13	RLC	A	
14	RR	A	
15	RRC	A	
16	IN	A,P1 A,P2	
17	OUTL	P1,A P2,A BUS,A	
20	INS	A,BUS	
21	MOVD	A,P <sub>p</sub> P <sub>p</sub> ,A	P <sub>p</sub> = P4 to P7
22	ANLD	P <sub>p</sub> ,A	

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No.	INSTRUCTIONS	ACCEPTED ARGUMENTS	REMARKS
23	ORLD	P <sub>p</sub> ,A	
24	JMPP	@A	
25	JMP	LABEL	
26	DJNZ	R <sub>r</sub> , LABEL	
27	JC	LABEL	
28	JNC	LABEL	
29	JZ	LABEL	
30	JNZ	LABEL	
31	JTO	LABEL	
32	JNTO	LABEL	
33	JT1	LABEL	
34	JNT1	LABEL	
35	JF0	LABEL	
36	JF1	LABEL	
37	JTF	LABEL	
38	JNI	LABEL	
39 to 46	JB0 to JB7	LABEL	
47	CALL	LABEL	
48	RET		
49	RETR		
50	MOV	A, R <sub>r</sub>	
		A, 3R	
		A, #data	
		R <sub>r</sub> , A	
		@R, A	
		R <sub>r</sub> , #data	
		@R, #data	
		A, PSW	
		PSW, A	
		A, T	
		T, A	

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No.	INSTRUCTIONS	ACCEPTED ARGUMENTS	REMARKS
51	XCH	A, R <sub>T</sub> A, @R	
52	XCHD	A, @R	
53	MOVX	A, @R @R, A	
54	MOVP	A, @A	
55	MOV3	A, @A	
56	STRT	T CNT	
57	STOP	TCNT	
58	EN	TCNTI I	
59	DIS	TCNTI I	
60	SEL	RB0 RB1 MB0 MB1	
61	ENTO	CLOCK	
62	NOP		
63	INTE		
64	PRIN		
65	END		
66	ASSI	AA, data	0 ≤ AA ≤ 4096
67	MAP	0 to 16	
68	LABEL: VAR	AA	
69	BASE	AA	
70	ASSD	LABEL, AA	
71	INTT		



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```

47.000      GOTO 708
48.000 802 K=CTT(2)+REG
49.000      GOTO 708
50.000 803 K=CTT(3)+(REG*16)
51.000      GOTO 708
52.000 804 K=CTT(4)
53.000      GOTO 708
54.000 805 K=CTT(5)
55.000      GOTO 708
56.000 806 K=CTT(6)
57.000      GOTO 708
58.000 807 K=CTT(7)
59.000      GOTO 708
60.000 808 K=CTT(8)+32*REG
61.000 708 IF(K.GT.999)GOTO 509
62.000      IF(INST.EQ.26)GOTO 704
63.000      GOTO 707
64.000 509 PRINT 510,JJ
65.000 510 FORMAT ('WRONG ARGUMENTS AT LINE ',I5)
66.000      GOTO 409
67.000 547 CALL S1(I,IR12(1),L,1)
68.000      IF(L.EQ.215)GOTO 548
69.000      IF(L.NE.194)GOTO 509
70.000      K=K3+69
71.000      GOTO 550
72.000 548 CALL S1(I,IR12(1)+1,L,2)
73.000      DO 549 L1=241,242
74.000      IF(L.EQ.L1)GOTO 551
75.000 549 CONTINUE
76.000      GOTO 509
77.000 551 K=K3+L1-171
78.000 550 CALL CTE(I,IR12(3)+1,IR12(4),DAT1)
79.000      GOTO 704
80.000 701 CALL SYNTAXE(I,IR12(1),IR12(2),IR12(3),IR12(4),CODE,REG,DAT1,
81.000 1JJ,IR2P,INST)
82.000      IF (CODE.EQ.1.OR.CODE.EQ.8) K=K1+REG
83.000      IF (CODE.EQ.2) K=K2+REG
84.000      IF (CODE.EQ.3)GOTO 702
85.000      IF(CODE.EQ.4)K=K3
86.000      IF (INST.EQ.50.AND.CODE.EQ.0)GOTO 527
87.000      IF(INST.EQ.3.AND.CODE.EQ.0)GOTO 547
88.000      IF(INST.EQ.4.AND.CODE.EQ.0)GOTO 547
89.000      IF(INST.EQ.53.AND.CODE.EQ.0)GOTO 577
90.000      IF(CODE.EQ.6.OR.CODE.EQ.7)GOTO 527
91.000      IF(CODE.EQ.0)GOTO 409
92.000 707 CALL WRI(K,IPC)
93.000      GOTO 409
94.000 702 K=K3
95.000 704 CALL WRI(K,DAT1,IPC)
96.000      GOTO 409
97.000 1 K1=104

```

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98.000		K2=96
99.000		K3=3
100.000		GOTO 701
101.000	2	K1=120
102.000		K2=112
103.000		K3=19
104.000		GOTO 701
105.000	3	K1=88
106.000		K2=80
107.000		K3=83
108.000		GOTO 701
109.000	4	K1=72
110.000		K2=64
111.000		K3=67
112.000		GOTO 701
113.000	5	K1=216
114.000		K2=208
115.000		K3=211
116.000		GOTO 701
117.000	6	CALL SET(CTT)
118.000		CTT(4)=23
119.000		CTT(1)=24
120.000		CTT(2)=16
121.000		GOTO 703
122.000	7	CALL SET(CTT)
123.000		CTT(4)=7
124.000		CTT(1)=200
125.000		GOTO 703
126.000	8	CALL SET(CTT)
127.000		CTT(4)=39
128.000		CTT(5)=151
129.000		CTT(8)=133
130.000		GOTO 703
131.000	9	CALL SET(CTT)
132.000		CTT(4)=55
133.000		CTT(5)=167
134.000		CTT(8)=149
135.000		GOTO 703
136.000	10	CALL SET(CTT)
137.000		CTT(4)=87
138.000		GOTO 703
139.000	11	CALL SET(CTT)
140.000		CTT(4)=71
141.000		GOTO 703
142.000	12	CALL SET(CTT)
143.000		CTT(4)=231
144.000		GOTO 703
145.000	13	CALL SET(CTT)
146.000		CTT(4)=247
147.000		GOTO 703
148.000	14	CALL SET(CTT)

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```
149.000      CTT(4)=119
150.000      GOTO 703
151.000      15 CALL SET(CTT)
152.000      CTT(4)=103
153.000      GOTO 703
154.000      16 K1=9
155.000      GOTO 701
156.000      17 K1=57
157.000      K3=2
158.000      GOTO 701
159.000      20 K=8
160.000      GOTO 707
161.000      21 CALL SET(CTT)
162.000      CTT(1)=60
163.000      GOTO 703
164.000      22 CALL SET(CTT)
165.000      CTT(1)=156
166.000      GOTO 703
167.000      23 CALL SET(CTT)
168.000      CTT(1)=140
169.000      GOTO 703
170.000      24 K=179
171.000      GOTO 707
172.000      25 K=4
173.000      GOTO 704
174.000      26 IR2P=0
175.000      CALL SET(CTT)
176.000      CTT(1)=232
177.000      GOTO 703
178.000      27 K=JUMP(INSF-26)
179.000      GOTO 704
180.000      48 K=131
181.000      GOTO 707
182.000      49 K=147
183.000      GOTO 707
184.000      50 S=0
185.000      K1=248
186.000      K2=240
187.000      K3=35
188.000      GOTO 701
189.000      51 CALL SET(CTT)
190.000      CTT(1)=40
191.000      CTT(2)=32
192.000      GOTO 703
193.000      52 CALL SET (CTT)
194.000      CTT(2)=48
195.000      GOTO 703
196.000      53 S=0
197.000      K2=128
198.000      GOTO 701
199.000      54 K=163
```

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```
200.000      GOTO 701
201.000    55  K=227
202.000      GOTO 707
203.000    577  IF(S.EQ.1)GOTO 509
204.000      S=1
205.000      K2=144
206.000      GOTO 578
207.000    56  CALL SET(CTT)
208.000      CTT(7)=85
209.000      CTT(5)=69
210.000      GOTO 703
211.000    57  K=101
212.000      GOTO 707
213.000    58  CALL SET(CTT)
214.000      CTT(7)=37
215.000      CTT(6)=5
216.000      GOTO 703
217.000    59  CALL SET (CTT)
218.000      CTT(7)=53
219.000      CTT(6)=21
220.000      GOTO 703
221.000    60  CALL SET(CTT)
222.000      CTT(3)=197
223.000      GOTO703
224.000    61  K=117
225.000      GOTO 707
226.000    62  K=0
227.000      GOTO 707
228.000    527  IF(CODE.EQ.6)K=199
229.000      IF(CODE.EQ.7)K=66
230.000      IF(CODE.EQ.7.AND.S.EQ.1)K=98
231.000      IF (CODE.EQ.6.AND.S.EQ.1)K=215
232.000      IF(CODE.EQ.7.OR.CODE.EQ.6)GOTO 707
233.000      IF (S.EQ.1)GOTO 528
234.000      S=1
235.000      K1=168
236.000      K2=160
237.000    578  TB=IR12(1)
238.000      TF=IR12(2)
239.000      IR12(2)=IR12(+ )
240.000      IR12(1)=IR12(3)
241.000      IR12(4)=TF
242.000      IR12(3)=TB
243.000      GOTO 701
244.000    528  CALL S1(I,IR12(3),L,3)
245.000      IF (L.EQ.124)GOTO 529
246.000      IF(L.NE.217)GOTO 509
247.000      CALL S1 (I,IR12(3)+1,L,4)
248.000      DO 533 L1=240,247
249.000      IF (L1.EQ.L) GOTO 537
250.000    533  CONTINUE
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251.000      GOTO 509
252.000 537  CALL WR1 (184+L1-240,IPC)
253.000      GOTO 539
254.000 529  CALL S1 (I,IR12(3)+1,L,5)
255.000      IF(L.NE.217) GOTO 509
256.000      CALL S1(I,IR12(3)+2,L,6)
257.000      DO 531 L1=240,241
258.000      IF(L1.EQ.L)GOTO 532
259.000 531  CONTINUE
260.000      GOTO 509
261.000 532  CALL WR1 (176+L1-240,IPC)
262.000 539  CALL CTE(I,IR12(1)+1,IR12(2),K)
263.000      CALL WR1 (K,IPC)
264.000      GOTO 409
265.000 81   JJ=0
266.000      IPC=0
267.000 415  JJ=JJ+1
268.000      CALL SI(JJ,1,LABP,LAB,INST,IR1P,IR2P,IR12,I)
269.000      IF(INST.EQ.26)IR12(1)=IR12(3)
270.000      IF(INST.EQ.26)IR12(2)=IR12(4)
271.000      IF(INST.GE.25.AND.INST.LT.48) CALL LABEL(I,IR12(1),
272.000 1IR12(2),LABR,IPCR,IPC,LABC,JJ,INST)
273.000      IF(INST.GE.25.AND.INST.LT.48)GOTO 415
274.000      IF(INST.EQ.65)GO TO 412
275.000      IF(INST.EQ.69)GO TO 504
276.000      IF(INST.EQ.70)GOTO 505
277.000      IF (INST.GE.63)GO TO 415
278.000      IPC=IPC+1
279.000      IF(IR2P.EQ.0)GOTO 415
280.000      CALL S1(I,IR12(3),L,7)
281.000      IF(L.NE.123)GOTO415
282.000      IPC=IPC+1
283.000      GOTO 415
284.000 505  CALL CTE(I,IR12(1),IR12(2),K1)
285.000      K1=K1-1
286.000      CALL LABEL(I,IR12(3),IR12(4),LABR,IPCR,K1,LABC,JJ,INST)
287.000      GOTO 415
288.000 466  FORMAT (I)
289.000 412. PRINT974
290.000 974  FORMAT('END OF ASSEMBLING')
291.000      IF(LABC.EQ.0)GOTO 485
292.000      PRINT 478
293.000 478  FORMAT(//,'THE LABELS ARE, WITH THEIR ADDRESSES')
294.000      DO 477 J=1,LABC
295.000 477  PRINT 479,IPCR(J),LABR(J)
296.000 479  FORMAT(5X,I8,5X,A4)
297.000      WRITE(2'NC(1))(IBUF(1,J),J=1,256)
298.000 485  JJ=0
299.000      PRINT 503
300.000 503  FORMAT('DO YOU WANT A SIMULATION? YES=1,NO=0')
301.000      READ 466,K3
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302.000      IST=0
303.000      IF(K3.NE.1) GO TO 281
304.000      IPC=0
305.000      SP=0
306.000      BUSV=0
307.000      MB=0
308.000      BS=0
309.000      IEI=0
310.000      ITCNTI=0
311.000      F0=0
312.000      F1=0
313.000 410   JJ=JJ+1
314.000      CALL SI(JJ,2,LABP,LAB,INST,IR1P,IR2P,IR12,I)
316.000      GOTO (201,202,203,204,205,206,207,208,209,210,211,212,
317.000      1213,214,215,216,217,410,410,220,
318.000      2221,222,223,224,225,226,227,228,229,230,231,232,233,234,
319.000      3235,236,237,238,239,239,239,239,
320.000      4239,239,239,239,247,248,249,250,251,252,253,254,255,256,
321.000      5257,258,259,260,261,262,263,264,
322.000      6265,266,267,268,269,270,271),INST
323.000      GO TO 410
324.000 201   K1=104
325.000      K2=96
326.000      K3=3
327.000      K5=0
328.000 405   CALL GETOP(K1,K2,K3,K,IPC,K8,IST,IDM,BS)
329.000      CALL ICY(ICY1,(K+K5),ACC)
330.000 333   ACC=ACC+K+K5
331.000      CALL CAR(ICAR,ACC,256)
332.000      GOTO 410
333.000 202   K1=120
334.000      K2=112
335.000      K3=19
336.000      K5=ICAR
337.000      GOTO 405
338.000 787   IST=IST+1
339.000      CALL REWR(IPC-1,1,K4,0)
340.000      CALL REWR(IPC,1,K,0)
341.000      K10=ACC
342.000      GOTO(154,153,152),K9-K4
343.000 152   ACC=BUS
344.000      IF (BUSV.EQ.0)PRINT 483
345.000      GOTO 155
346.000 153   ACC=P1
347.000      GOTO 155
348.000 154   ACC=P2
349.000 155   IPC=IPC+1
350.000      GOTO 788
351.000 203   CALL GETOP(88,80,83,K,IPC,K8,IST,IDM,BS)
352.000      K9=155
353.000      K6=2
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354.000      I1=2
355.000  444  K7=0
356.000      K5=1
357.000      IF(K8.EQ.1)GOTO 787
358.000  788  DO 442 J=1,8
359.000      K3=0
360.000      K1=K-(K/2)*2
361.000      K2=ACC-(ACC/2)*2
362.000      IF ((K1+K2).EQ.K6.OR.(K1+K2).EQ.I1)K3=1
363.000      K7=K3*K5+K7
364.000      ACC=ACC/2
365.000      K=K/2
366.000  442  K5=K5*2
367.000      ACC=K7
368.000      IF(K8.EQ.0)GOTO 410
369.000      GOTO(354,353,352),K9-K4
370.000  352  BUS=ACC
371.000      PRINT 435,JJ,BUS
372.000      GOTO 411
373.000  353  P1=ACC
374.000      PRINT 436,JJ,1,P1
375.000      GOTO 411
376.000  354  P2=ACC
377.000      PRINT 436,JJ,2,P2
378.000  411  ACC=K10
379.000      GOTO 410
380.000  483  FORMAT ('NO DATA ON BUS')
381.000  204  CALL GETOP(72,64,67,K,IPC,K8,IST,IDM,BS)
382.000      K9=139
383.000      K6=1
384.000      I1=2
385.000      GOTO 444
386.000  205  CALL GETOP(216,208,211,K,IPC,K8,IST,IDM,BS)
387.000      K9=0
388.000      K6=1
389.000      I1=1
390.000      GOTO 444
391.000  206  K=1
392.000      CALL INCOP(23,24,16,K,IPC,IST,K8,ACC,IDM,BS)
393.000  899  CALL CAR(K,ACC,256)
394.000      GOTO 410
395.000  207  K=-1
396.000      CALL INCOP(7,200,0,K,IPC,IST,K8,ACC,IDM,BS)
397.000      GOTO 899
398.000  208  CALL REWR (IPC,1,K4,0)
399.000      IF(K4.EQ.39) ACC=0
400.000      IF(K4.EQ.151) ICAR=0
401.000      IF(K4.EQ.133) F0=0
402.000      IF(K4.EQ.165) F1=0
403.000  446  IPC=IPC+1
404.000      IST=IST+1

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405.000      GOTO 410
406.000 209  CALL REWR (IPC,1,K4,0)
407.000      IF (K4.EQ.55) ACC=255-ACC
408.000      IF(K4.EQ.167) ICAR=ABS(ICAR-1)
409.000      IF(K4.EQ.149) F0=ABS(F0-1)
410.000      IF(K4.EQ.181) F1=ABS(F1-1)
411.000      GOTO 446
412.000 212  ACC=ACC*2
413.000      CALL CAR(K,ACC,256)
414.000      ACC=ACC+K
415.000      GOTO 446
416.000 213  ACC=ACC*2+ICAR
417.000      CALL CAR(ICAR,ACC,256)
418.000      GOTO 446
419.000 214  K1=ACC/2
420.000      ACC=K1+128*(ACC-K1*2)
421.000      GOTO 446
422.000 215  K1=ACC/2
423.000      K2=ACC-K1*2
424.000      ACC=K1+ICAR*128
425.000      ICAR=K2
426.000      GOTO 446
427.000 210  K1=ACC/16
428.000      K2=ACC-K1*16
429.000      IF(K2.GE.10.OR.ICY1.EQ.1)ACC=ACC+6
430.000      K1=ACC/16
431.000      IF(K1.GE.10.OR.ICAR.EQ.1)ACC=ACC+6*16
432.000      ICAR=0
433.000      CALL CAR(ICAR,ACC,256)
434.000      GOTO 446
435.000 211  K1=ACC/16
436.000      K2=ACC-(K1*16)
437.000      ACC=K1+K2*16
438.000      GOTO 446
439.000 216  CALL REWR (IPC,1,K4,0)
440.000      PRINT 465,JJ,IPC,K4-8
441.000 465  FORMAT('AT LINE NO ',I5,' (PC=',I4,') INPUT AT PORT NO '
442.000      1,I2,' IS:')
443.000      READ 466,K1
444.000      ACC=K1
445.000 437  IST=IST+1
446.000      GOTO 446
447.000 217  CALL REWR (IPC,1,K4,0)
448.000      IF (K4.EQ.2)PRINT 435,JJ,ACC
449.000      IF (K4.EQ.57.OR.K4.EQ.58)PRINT 436,JJ,K4-56,ACC
450.000 435  FORMAT('AT LINE NO ',I5,' BUS LATCHED AT ',I3)
451.000 436  FORMAT('AT LINE NO ',I5,' OUTPUT PORT NO ',I1,' LATCHED AT ',I3)
452.000      IF(K4.NE.2)GOTO 391
453.000      BUS=ACC
454.000      BUSV=1
455.000      GOTO 437
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456.000 391 IF(K4.EQ.57)P1=ACC
457.000 IF(K4.EQ.58)P2=ACC
458.000 GOTO 437
459.000 474 PRINT 975
460.000 975 FORMAT('NO DATA ON BUS')
461.000 GOTO 437
462.000 220 PRINT 998,JJ,IPC
463.000 998 FORMAT('AT LINE NO ',I5,' (PC=',I4,') INPUT FROM BUS IS:')
464.000 READ 466,K1
465.000 ACC=K1
466.000 GOTO 437
467.000 221 CALL REWR (IPC,1,K4,0)
468.000 IF(K4.LE.15) GOTO 439
469.000 PRINT 432,JJ,K4-56,ACC-(ACC/16)*16
470.000 432 FORMAT('AT LINE NO ',I5,' EXPANSION PORT NO',I2,' IS',I3)
471.000 PEXP(K4-59)=ACC-ACC/16
472.000 PEXPV(K4-59)=1
473.000 GOTO 437
474.000 439 PRINT 931,JJ,IPC,K4-8
475.000 931 FORMAT ('AT LINE NO ',I5,'(PC= ',I4,')INPUT'
476.000 1' AT EXPANSION PORT',I2,' IS:')
477.000 READ 466 ,K1
478.000 ACC=K1-(K1/16)*16
479.000 PEXP(K4-11)=ACC
480.000 PEXPV(K4-11)=1
481.000 GOTO 437
482.000 222 CALL REWR (IPC,1,K4,0)
483.000 K4=K4-155
484.000 IF (PEXPV(K4).EQ.0) GOTO 576
485.000 K6=2
486.000 GOTO 978
487.000 576 PRINT 977,JJ
488.000 977 FORMAT ('NODATA ON PORT AT LINE ',I5)
489.000 GOTO 437
490.000 223 CALL REWR (IPC,1,K4,0)
491.000 K4=K4-139
492.000 IF(PEXPV(K4).EQ.0)GOTO 576
493.000 K6=1
494.000 978 K7=0
495.000 K8=ACC
496.000 K9=PEXP(K4)
497.000 K5=1
498.000 DO 563 J=1,4
499.000 K3=0
500.000 K1=K-(K/2)*2
501.000 K2=K8-(K8/2)*2
502.000 IF((K1+K2).EQ.K6.OR.(K1+K2).EQ.2)K3=1
503.000 K7=K3*K5+K7
504.000 K8=K8/2
505.000 K9=K9/2
506.000 563 K5=K5*2
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507.000      PEXP(K4)=K7
508.000      PRINT 564,JJ,K4+3,K7
509.000  564  FORMAT('AT LINE NO ',I5,' EXPANSION PORT ',I2,
510.000      1' LOGICALLY CHANGED TO ',I3)
511.000      GOTO 437
512.000  224  IPC=ACC+(IPC/256)*256
513.000      632  IST=IST+2
514.000  633  CALL REWR (IPC,3,K1,0)
515.000      JJ=K1-1
516.000      GOTO 410
517.000  225  CALL REWR (IPC,1,K1,0)
518.000      IPC=IPC+1
519.000      CALL REWR (IPC,1,K2,0)
520.000  656  IPC=K2+((K1/32)*256)+MB*2048
521.000      IST=IST+2
522.000      GOTO 633
523.000  226  K=-1
524.000      CALL INCOP(0,232,0,K,IPC,IST,K8,ACC,IDM,BS)
525.000      IST=IST+1
526.000      IPC=IPC+1
527.000      IF(K8.EQ.0) GOTO 410
528.000      IPC=IPC-1
529.000      CALL REWR (IPC,1,K1,0)
530.000      IPC=K1+(IPC/256)*256
531.000      GOTO 633
532.000  657  IST=IST+2
533.000      GOTO 410
534.000  227  IPC=IPC+2
535.000      IF(ICAR.EQ.0) GOTO 657
536.000  699  IPC=IPC-2
537.000      CALL REWR (IPC+1,1,K1,0)
538.000      IPC=K1+(IPC/256)*256
539.000      GOTO 632
540.000  228  IPC=IPC+2
541.000      IF(ICAR.EQ.1)GOTO 657
542.000      GOTO 699
543.000  229  IPC=IPC+2
544.000      IF(ACC.NE.0)GOTO 657
545.000      GOTO 699
546.000  230  IPC=IPC+2
547.000      IF(ACC.EQ.0)GOTO 657
548.000      GOTO 699
549.000  231  K2=0
550.000      K3=1
551.000  908  IPC=IPC+2
552.000      PRINT 928,JJ,K2
553.000  928  FORMAT('AT LINE NO ',I5,' T',I1,' SIGNAL IS:')
554.000      READ 466,K1
555.000      IF(K1.NE.K3)GOTO 657
556.000      GOTO 699
557.000  232  K2=0
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558.000      K3=0
559.000      GOTO 908
560.000 233  K2=1
561.000      K3=1
562.000      GOTO 908
563.000 234  K2=1
564.000      K3=0
565.000      GOTO 908
566.000 235  IPC=IPC+2
567.000      IF(F0.NE.1)GOTO 657
568.000      GOTO 699
569.000 236  IPC=IPC+2
570.000      IF(F1.NE.1) GOTO 657
571.000      GOTO 699
572.000 237  IPC=IPC+2
573.000      PRINT 929,JJ
574.000 929  FORMAT('AT LINE NO ',I5,' TIMER FLAG IS:')
575.000      READ 466,K1
576.000      IF(K1.NE.1)GOTO 657
577.000      GOTO 699
578.000 238  IPC=IPC+2
579.000      IF(IEI.NE.0)GOTO 657
580.000      GOTO 699
581.000 239  CALL REWR (IPC,1,K1,0)
582.000      K1=K1/32
583.000      K1=2**K1
584.000      K1=ACC/K1
585.000      K1=K1-(K1/2)*2
586.000      IPC=IPC+2
587.000      IF (K1.NE.1)GOTO 657
588.000      GOTO 699
589.000 247  IF (INST.EQ.63.OR.INST.EQ.71)GOTO 839
590.000      IPC=IPC+2
591.000 839  K1=IPC-(IPC/256)*256
592.000      ICY1=ICY1-(ICY1/2)*2
593.000      ICAR=ICAR-(ICAR/2)*2
594.000      K2=(IPC/256)+16*BS+32*F0+64*ICY1+128*ICAR
595.000      IF(K2.GT.2047)K2=K2-2048
596.000      IDM(9+SP*2)=K1
597.000      IDM(10+SP*2)=K2
598.000      SP=SP+1
599.000      IF(SP.NE.8) GOTO 901
600.000 469  PRINT 471,JJ
601.000 471  FORMAT ('STACK POINTER OVERFLOWS AT LINE ',I5)
602.000      CALL EXIT
603.000 901  IF(INST.EQ.63.OR.INST.EQ.71)GOTO 791
604.000      CALL REWR (IPC-2,1,K1,0)
605.000      CALL REWR (IPC-1,1,K2,0)
606.000      GOTO 656
607.000 248  K3=0
608.000 721  SP=SP-1
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609.000 IF(SP.EQ.-1)GOTO 469
610.000 K1=IDM(9+SP*2)
611.000 K2=IDM(10+SP*2)
612.000 IF (K3.EQ.0)GOTO 722
613.000 K3=K2/16
614.000 BS=K3-(K3/2)*2
615.000 K3=K3/2
616.000 P0=K3-(K3/2)*2
617.000 K3=K3/2
618.000 ICY1=K3-(K3/2)*2
619.000 K3=K3/2
620.000 ICAR=K3-(K3/2)*2
621.000 722 IPC=K1+256*(K2-(K2/16)*16)+MB*2048
622.000 IST=IST+2
623.000 GOTO 633
624.000 249 K3=1
625.000 GOTO 721
626.000 250 CALL GETOP(248,240,35,K,IPC,K8,IST,IDM,BS)
627.000 IF(K8.EQ.1) GOTO 907
628.000 ACC=K
629.000 GOTO 410
630.000 907 CALL REWR (IPC-1,1,K4,0)
631.000 IF(K4.GE.168.AND.K4.LE.175)IDM(1+K4-168+(24*BS))=ACC
632.000 IF(K4.EQ.160.OR.K4.EQ.161)GOTO 859
633.000 IF(K4.GE.176.OR.K4.LE.98) GOTO 858
634.000 GOTO 410
635.000 859 K=IDM(1+K4-160+(24*BS))
636.000 860 K=K-(K/64)*64
637.000 IDM(1+K)=ACC
638.000 GOTO 410
639.000 858 IF (K4.NE.66) GOTO 813
640.000 PRINT 811,JJ
641.000 811 FORMAT('AT LINE NO ',I5,' TIMER-EVENT/COUNTER VALUE IS:')
642.000 READ 466,K1
643.000 IF (K1.GT.255.OR.K1.LT.0) GOTO 811
644.000 ACC=K1
645.000 GOTO 410
646.000 813 IF (K4.NE.98) GOTO 816
647.000 PRINT 815,JJ,ACC
648.000 815 FORMAT ('AT LINE NO ',I5,' TIMER-EVENT/COUNTER PRESET AT ',I3)
649.000 GOTO 410
650.000 816 CALL REWR (IPC,1,K3,0)
651.000 IF (K4.LT.184) GOTO 817
652.000 IF(K4.GT.191)GOTO 819
653.000 IDM(1+K4-184+(24*BS))=K3
654.000 818 IST=IST+1
655.000 IPC=IPC+1
656.000 GOTO 410
657.000 817 K=IDM(1+K4-176+(24*BS))
658.000 K=K-(K/64)*64
659.000 IDM(1+K)=K3
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660.000      GOTO 818
661.000      819 IF(K4.EQ.215)GOTO 820
662.000      ACC=(128*ICAR)+(64*ICY1)+(32*F0)+(16*BS)+8*SP
663.000      GOTO 410
664.000      820 SP=ACC-(ACC/8)*8
665.000      K1=ACC/16
666.000      BS=K1-(K1/2)*2
667.000      K1=K1/2
668.000      F0=K1-(K1/2)*2
669.000      K1=K1/2
670.000      ICY1=K1-(K1/2)*2
671.000      K1=K1/2
672.000      ICAR=K1-(K1/2)*2
673.000      GOTO 410
674.000      251 CALL REWR (IPC,1,K4,0)
675.000      IF (K4.GE.40) GOTO 733
676.000      K=IDM(1+K4-32+(24*BS))
677.000      K=K-(K/64)*64
678.000      K1=IDM(1+K)
679.000      IDM(1+K)=ACC
680.000      734 ACC=K1
681.000      GOTO 446
682.000      733 K1=IDM(1+K4-40+(24*BS))
683.000      IDM(1+K4-40+(24*BS))=ACC
684.000      GOTO 734
685.000      252 CALL REWR (IPC,1,K4,0)
686.000      K=IDM(1+K4-48+(24*BS))
687.000      K=K-(K/64)*64
688.000      K2=IDM(1+K)
689.000      K1=K2-(K2/16)*16
690.000      IDM(1+K)=((K2/16)*16)+(ACC-(ACC/16)*16)
691.000      ACC=K1+(ACC/16)*16
692.000      GOTO 446
693.000      253 CALL REWR (IPC,1,K4,0)
694.000      PRINT 767,JJ
695.000      767 FORMAT('AT LINE NO ',I5,' HARDWARED BANK SWITCHING FOR EXTERNAL '
696.000      1'DATA MEMORY IS (0-3):')
697.000      READ 466,K3
698.000      BUSV=0
699.000      IF(K4.GT.129) GOTO 766
700.000      ACC=IDM(65+(256*K3)+IDM(1+K4-128+(24*BS)))
701.000      765 IST=IST+1
702.000      GOTO 446
703.000      766 IDM(65+(256*K3)+IDM(1+K4-144+(24*BS)))=ACC
704.000      GOTO 765
705.000      254 IPC=IPC+1
706.000      K3=ACC+(IPC/256)*256
707.000      917 CALL REWR (K3,1,K4,0)
708.000      ACC=K4
709.000      IST=IST+2
710.000      GOTO 410
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711.000 255 IPC=IPC+1
712.000      K3=ACC+3*256
713.000      GOTO 917
714.000 256 CALL REWR (IPC,1,K4,0)
715.000      IF (K4.EQ.85) PRINT 430,JJ
716.000      IF (K4.EQ.69) PRINT 431,JJ
717.000 430 FORMAT('AT LINE NO ',I5,' TIMER ENABLED')
718.000 431 FORMAT('AT LINE NO ',I5,' EVENT COUNTER ENABLED')
719.000      GOTO 446
720.000 257 PRINT 492,JJ
721.000 492 FORMAT('AT LINE NO ',I5,' TIMER /EVENT COUNTER DISABLED')
722.000      GOTO 446
723.000 258 CALL REWR (IPC,1,K4,0)
724.000      IF(K4.EQ.37) GOTO 833
725.000      PRINT 434,JJ
726.000 434 FORMAT('AT LINE NO',I5,' EXTERNAL INTERRUPT ON')
727.000      IEI=1
728.000      GOTO 446
729.000 833 PRINT 495,JJ
730.000 495 FORMAT('AT LINE NO',I5,' TIMER-EVENT/COUNTER INTERRUPT ON')
731.000      ITCNTI=1
732.000      GOTO 446
733.000 259 CALL REWR (IPC,1,K4,0)
734.000      IF (K4.EQ.53) GOTO 834
735.000      PRINT 496,JJ
736.000 496 FORMAT('AT LINE NO',I5,' EXTERNAL INTERRUPT OFF')
737.000      IEI=0
738.000      GOTO 446
739.000 834 PRINT 497,JJ
740.000 497 FORMAT('AT LINE NO',I5,' TIMER-EVENT/COUNTER INTERRUPT OFF')
741.000      ITCNTI=0
742.000      GOTO 446
743.000 260 CALL REWR (IPC,1,K4,0)
744.000      IF (K4.EQ.197) BS=0
745.000      IF (K4.EQ.213) BS=1
746.000      IF (K4.EQ.229) MB=0
747.000      IF (K4.EQ.245) MB=1
748.000      GOTO 446
749.000 261 PRINT 438,JJ
750.000 438 FORMAT('AT LINE NO',I5,' CLOCK PRESENT ON TEST PIN 0')
751.000 262 GOTO 446
752.000 263 IF (IEI.EQ.0) GOTO 410
753.000      PRINT 971,JJ
754.000 971 FORMAT('AT LINE NO ',I5,' EXTERNAL INTERRUPT BEING SERVED')
755.000      IEI=0
756.000      GOTO 247
757.000 271 IF(ITCNTI.EQ.0) GOTO 410
758.000      PRINT 472,JJ
759.000 472 FORMAT('AT LINE NO',I5,' TIMER-EVENT/COUNTER INTERRUPT
760.000 1' BEING SERVED')
761.000      ITCNTI=0
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762.000      GOTO 247
763.000 781  IF (INST.EQ.63) IPC=3
764.000      IF (INST.EQ.71) IPC=7
765.000      GOTO 633
766.000 264  PRINT 473,JJ,IPC,ACC,(IDM(BS*24+K),K=1,8),SP,IST,ICAR,
767.000      1ICY1,IEI,ITCNTI,MB,BS,F0,F1
768.000 473  FORMAT(' LINE  PC  ACC  R0   R1   R2   R3   R4   R5'
769.000      1'  R6  R7  SP STEP CAR  AC  IEX ITIM  MB'
770.000      2'  BS  F0  F1',/,21I5)
771.000      GOTO 410
772.000 265  GOTO 485
773.000 266  GOTO 410
774.000 267  CALL CTE(I,IR12(1),IR12(2),K)
775.000 499  DO 597 J=1,64
776.000      597  KS(J)=IDM(J+K*64)
777.000      PRINT 500,JJ,K,KS
778.000      GOTO 410
779.000 500  FORMAT('AT LINE NO',I5,' MEMORY MAP NO ',I4,'IS:',/,4(16I6,/))
780.000 268  GOTO 410
781.000 269  GOTO 410
782.000 270  GOTO 410
783.000 82   CALL CTE(I,IR12(1),IR12(2),K)
784.000      CALL CTE(I,IR12(3),IR12(4),K1)
785.000      CALL REWR(K,1,K1,1)
786.000      GOTO 409
787.000 85   CALL CTE(I,IR12(1),IR12(2),IPC)
788.000      IL=IPC+1
789.000      GO TO 409
790.000 504  CALL CTE(I,IR12(1),IR12(2),IPC)
791.000      GOTO 415
792.000 84   CALL CTE(I,IR12(1),IR12(2),K)
793.000      IPCR(LABC)=K
794.000      GOTO 409
795.000 281  WRITE(2'NC(1))(IBUF(1,J),J=1,256)
795.500      WRITE(4'NC(3))(IBUF(3,J),J=1,256)
796.000 467  CALL EXIT
797.000      END
798.000      SUBROUTINE CTE(I,LB,LF,IR)
799.000      DIMENSION I(32)
800.000      DECODE(LF,2,I)LB-1,LF-LB+1,IR
801.000 2   FORMAT(NX,IN)
802.000      RETURN
803.000      END
804.000      SUBROUTINE REWR (IAD,NF,K,M)
805.000      COMMON IBUF(3,256),NC(3),IFL(3)
806.000      K1=IAD/256
807.000      K2=IAD-K1*256+1
808.000      K1=K1+1
809.000      IF(K1.NE.NC(NF)) GO TO 1
810.000 6   IF (M) 2,3,2
811.000 3   K=TRIP(NF,K2)

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812.000 RETURN
813.000 2 IBUF(NF,K2)=K
814.000 IFL(NF)=1
815.000 RETURN
816.000 1 IF(IFL(NF)) 4,5,4
817.000 5 READ(NF+1'K1)(IBUF(NF,J),J=1,256)
818.000 NC(NF)=K1
819.000 GO TO 6
820.000 4 WRITE(NF+1'NC(NF))(IBUF(NF,J),J=1,256)
821.000 IFL(NF)=0
822.000 GO TO 5
823.000 END
824.000 SUBROUTINE WR1(I,J,IPC)
825.000 CALL REWR(IPC,1,I,1)
826.000 CALL REWR(IPC+1,1,J,1)
827.000 IPC=IPC+2
828.000 RETURN
829.000 END
830.000 SUBROUTINE WR1(I,IPC)
831.000 CALL REWR(IPC,1,I,1)
832.000 IPC=IPC+1
833.000 RETURN
834.000 END
835.000 SUBROUTINE CAR(IC,I,IM)
836.000 IC=0
837.000 IF(I.LT.IM) GO TO 1
838.000 IC=1
839.000 I=I-IM
840.000 RETURN
841.000 1 IF(I.GE.0) RETURN
842.000 IC=1
843.000 I=I+IM
844.000 RETURN
845.000 END
846.000 SUBROUTINE REGRR(IPC,K)
847.000 CALL REWR(IPC,1,K1,0)
848.000 K2=K1/16
849.000 K1=K1/64
850.000 K=K2-K1*4
851.000 K=K*2+1
852.000 RETURN
853.000 END
854.000 SUBROUTINE REGR(IPC,IRR,K)
855.000 DIMENSION IRR(10)
856.000 CALL REWR(IPC,1,K,0)
857.000 K=K-(K/8)*8
858.000 IF(K.EQ.6) GO TO 1
859.000 K=IRR(K+1)
860.000 RETURN
861.000 1 CALL REWR(IRR(5)*256+IRR(6),1,K,0)
862.000 RETURN
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863.000      END
864.000      SUBROUTINE FFZSP(IZER,ISIG,IPAR,L)
865.000      IZER=0
866.000      IF(L.EQ.0) IZER=1
867.000      ISIG=0
868.000      IF(L.GE.128) ISIG=1
869.000      IPAR=0
870.000      I=L
871.000      DO 1 J=1,8
872.000      IPAR=I-(I/2)*2+IPAR
873.000 1     I=I/2
874.000      IPAR=IABS(IPAR-(IPAR/2)*2-1)
875.000      RETURN
876.000      END
877.000      SUBROUTINE S1(I,N,L,J)
878.000      DIMENSION I(32)
879.000      DATA MASK/82000000FF/
880.000      1 M=1+(N-1)/4
881.000      2 K=N-(M-1)*4
882.000      3 II=ISL(I(M),8*(K-4))
883.000      5 L=IAND(MASK,II)
884.000      4 RETURN
885.000      END
886.000      SUBROUTINE SEARCH(I,NC,LB,LF,CP,PC)
887.000      INTEGER CP,PC
888.000      DIMENSION I(32)
889.000      DO 1 N=LB,LF
890.000      CALL S1(I,N,L,8)
891.000      IF(L.EQ.NC) GO TO 2
892.000 1     CONTINUE
893.000      CP=0
894.000      RETURN
895.000 2     CP=1
896.000      PC=N
897.000      RETURN
898.000      END
899.000      SUBROUTINE SI(J,K,LBP,LAB,INST,IR1P,IR2P,IR12,I)
900.000      DIMENSION INS(71),IR12(4),I(32)
901.000      DATA INS/4HADD,4HADDC,4HANL,4HORL,4HXRL,4HINC,
902.000      14HDEC,4HCLR,4HCPL,4HDA,4HSWAP,4HRL,4HRLC,
903.000      24HRR,4HRRC,4HIN,4HOUTL,4H****,4H0000,4HINS,
904.000      34HMOVD,4HANLD,4HORLD,4HJMPP,4HJMP,4HDJNZ,4HJC,
905.000      44HJNC,4HJZ,4HJNZ,4HJTO,4HJNT0,4HJT1,4HJNT1,
906.000      54HJF0,4HJF1,4HJTF,4HJNI,4HJB0,4HJB1,4HJB2,
907.000      64HJB3,4HJB4,4HJB5,4HJB6,4HJB7,4HCALL,4HRET,
908.000      74HRETR,4HMOV,4HXCH,4HXCHD,4HMOVX,4HMOVP,4HMOV3,
909.000      84HSTRT,4HSTOP,4HEN,4HDIS,4HSEL,4HENTO,4HNOP,
910.000      94HINTE,4HPRIN,4HEND,4HASSI,4HMAP,4HVAR,4HBASE,
911.000      44HASSD,4HINTT/
912.000      INTEGER CP,PC
913.000      ENCODE (128,12,7)

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914.000 12 FORMAT(4H )
915.000 CALL DIRECT READ(1,I,32,J)
916.000 IR1P=0
917.000 IR2P=0
918.000 LB=1
919.000 LF=128
920.000 CALL SEARCH(I,94,LB,LF,CP,PC)
921.000 IF(CP.EQ.1) LF=PC-1
922.000 CALL CLSP(I,LF,-1)
923.000 LABP=0
924.000 CALL CLSP(I,LB,1)
925.000 CALL SEARCH(I,122,LB,LF,CP,PC)
926.000 IF(CP.EQ.1) GO TO 2
927.000 13 CALL CLSP(I,LB,1)
928.000 CALL SEARCH(I,64,LB,LF,CP,PC)
929.000 LFF=LF
930.000 IF(CP.EQ.1) LFF=PC-1
931.000 GO TO 4
932.000 2 IF(K.NE.0) GO TO 6
933.000 LABP=1
934.000 LAB=4H
935.000 LK=1
936.000 DO 7 L1=LB,PC-1
937.000 CALL S1(I,L1,L,9)
938.000 IF(L.EQ.1H )GO TO 7
939.000 L=ISL(L,8*(4-LK))
940.000 MASK=ISC(8ZFFFFFF00,8*(4-LK))
941.000 LAB=IOR(IAND(MASK,LAB),L)
942.000 IF(LK.EQ.4) GO TO 6
943.000 7 LK=LK+1
944.000 6 LB=PC+1
945.000 GO TO 13
946.000 4 INST=4H
947.000 LK=1
948.000 DO 9 L1=LB,LB+3
949.000 CALL S1(I,L1,L,10)
950.000 IF(L1.GT.LFF)L=64
951.000 L=ISL(L,8*(4-LK))
952.000 MASK=ISC(8ZFFFFFF00,8*(4-LK))
953.000 INST=IOR(IAND(MASK,INST),L)
954.000 9 LK=LK+1
955.000 14 LB=LFF+1
956.000 DO 10 L1=1,71
957.000 IF(INS(L1).EQ.INST) GO TO 11
958.000 10 CONTINUE
959.000 11 INST=L1
960.000 CALL CLSP(I,LF,-1)
961.000 IF(LB.GT.LF) RETURN
962.000 IR1P=1
963.000 CALL CLSP(I,LB,1)
964.000 CALL SEARCH(I,107,LB,LF,CP,PC)
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965.000      IR12(1)=LB
966.000      IF(CP.EQ.1) GO TO 1
967.000      IR12(2)=LF
968.000      RETURN
969.000      1 LK=PC-1
970.000      CALL CLSP(I,LK,-1)
971.000      IR12(2)=LK
972.000      IR2P=1
973.000      LB=PC+1
974.000      CALL CLSP(I,LB,1)
975.000      IR12(3)=LB
976.000      IR12(4)=LF
977.000      RETURN
978.000      END
979.000      SUBROUTINE CLSP(I,LB,J)
980.000      DIMENSION I(32)
981.000      2 CALL S1(I,LB,L,11)
982.000      IF(L.NE.64)RETURN
983.000      LB=LB+J
984.000      GOTO 2
985.000      END
986.000      SUBROUTINE LABEL(I,K1,K2,LABR,IPCR,K3,LABC,JJ,INST)
987.000      DIMENSION I(32),LABR(500),IPCR(500)
988.000      DECODE (K2,1,I)K1-1,K
989.000      1  FORMAT(NX,A4)
990.000      LAI=0
991.000      DO 2 J=1,LABC
992.000      IF(K.EQ.LABR(J)) LAI=LAI+1
993.000      2  IF(K.EQ.LABR(J)) LAB=IPCR(J)
994.000      IF(LAI.EQ.1)GOTO 3
995.000      PRINT 4,LAI,K
996.000      4  FORMAT('THERE ARE ',I3,' LABELS CALLED ',A4)
997.000      3  K3=K3+1
998.000      IF(INST.EQ.25.OR.INST.EQ.47.OR.INST.EQ.70)GOTO 17
999.000      K1=(K3-1)/256
1000.000     IF(INST.EQ.26)K1=K3/256
1001.000     K2=LAB/256
1002.000     IF(K1.NE.K2.AND.INST.NE.70)GOTO 23
1003.000     LAB=LAB-K2*256
1004.000     CALL WR1(LAB,K3)
1005.000     RETURN
1006.000     23  PRINT 7,K,JJ
1007.000     GOTO 50
1008.000     6  IF(K1.GT.15) PRINT 7,K,JJ
1009.000     IF(K1.LE.15)PRINT 8,K,JJ
1010.000     7  FORMAT('LABEL ',A4,' NOT ACCESSIBLE FROM LINE ',I5)
1011.000     8  FORMAT('MB MUST BE 1 FOR THE LABEL ',A4,' TO BE '
1012.000     1'ACCESSED FROM LINE ',I5)
1013.000     IF(K1.GT.15)GOTO 50
1014.000     LAB=LAB-2048
1015.000     17  K1=LAB/256

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1016.000      IF(K1.GT.7)GOTO 6
1017.000      K2=4+K1*32
1018.000      IF (INST.EQ.47)K2=20+K1*32
1019.000      LAB=LAB-K1*256
1020.000      IF (INST.EQ.70)GOTO 18
1021.000      CALL WRI(K2,LAB,K3-1)
1022.000  50   K3=K3+1
1023.000      RETURN
1024.000  18   K2=K1
1025.000      CALL WRI(K2,LAB,K3)
1026.000      RETURN
1027.000      END
1028.000      SUBROUTINE SYNTAXE (I,LB1,LF1,LB2,LF2,CODE,REG,DAT,
1029.000  1JJ,IR2P,INST)
1030.000      DIMENSION I(32)
1031.000      INTEGER CP,PC,CODE,REG,DAT,TB,TF
1032.000      TB=LB1
1033.000      TF=LF1
1034.000      CODE=0
1035.000      REG=0
1036.000      DAT=0
1037.000      IF(INST.GE.21.AND.INST.LE.23)GOTO 650
1038.000      IF(INST.NE.17)GOTO 608
1039.000      LB1=LB2
1040.000      LF1=LF2
1041.000      LB2=TB
1042.000      LF2=TF
1043.000  608  CALL S1(I,LB1,L,12)
1044.000      IF(IR2P.EQ.0)GOTO 611
1045.000      IF (L.NE.193.OR.LB1.NE.LF1)GOTO 604
1046.000      CALL S1(I,LB2,L,13)
1047.000      IF(L.EQ.124) GOTO 601
1048.000      IF(L.EQ.123)GOTO 602
1049.000      IF(L.EQ.215)GOTO 612
1050.000      IF(L.EQ.194)GOTO 615
1051.000      IF(L.EQ.227)GOTO 644
1052.000      IF(L.NE.217) GOTO 604
1053.000  9    CALL S1(I,LB2+1,L,14)
1054.000      DO 10 L1=240,247
1055.000      IF(L1.EQ.L)      GOTO 11
1056.000  10   CONTINUE
1057.000      GOTO 604
1058.000  644  CODE=7
1059.000      RETURN
1060.000  11   CODE=1
1061.000  14   REG=L1-240
1062.000      RETURN
1063.000  601  CALL S1(I,LB2+1,L,15)
1064.000      IF(L.NE.217) GOTO 604
1065.000  34   CALL S1(I,LB2+2,L,16)
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1067.000      IF (L1.EQ.L)GOTO      13
1068.000      12 CONTINUE
1069.000      GOTO 604
1070.000      13 CODE=2
1071.000      REG=L1-240
1072.000      IF(INST.EQ.60)CODE=3
1073.000      IF(DAT.EQ.1)REG=REG+2
1074.000      RETURN
1075.000      602 CALL CTE (I,LB2+1,LF2,K)
1076.000      IF(K.LT.0.OR.K.GT.255) GOTO604
1077.000      CODE=3
1078.000      DAT=K
1079.000      RETURN
1080.000      657 CODE=6
1081.000      RETURN
1082.000      604 IF(INST.EQ.50.OR.INST.EQ.53.OR.INST.EQ.3.OR.INST.EQ.4)RETURN
1083.000      PRINT 605,JJ
1084.000      605 FORMAT ('WRONG ARGUMENTS AT LINE ',I5)
1085.000      RETURN
1086.000      611 IF(L.NE.193)GOTO 613
1087.000      615 CODE=4
1088.000      RETURN
1089.000      612 CALL S1(I,LB2+1,L,17)
1090.000      IF(L.EQ.226)GOTO 657
1091.000      DO 16 L1=241,242
1092.000      IF(L1.EQ.L)GOTO 17
1093.000      16 CONTINUE
1094.000      GOTO 604
1095.000      614 CALL S1(I,LB2+1,L,18)
1096.000      DO 24 L1=240,241
1097.000      IF (L1.EQ.L)GOTO 25
1098.000      24 CONTINUE
1099.000      GOTO 604
1100.000      25 REG=L1-240
1101.000      GOTO 18
1102.000      17 REG=L1-241
1103.000      18 CODE=8
1104.000      RETURN
1105.000      613 LB2=LB1
1106.000      IF(L.EQ.217.AND.INST.EQ.60)GOTO 34
1107.000      IF(L.EQ.217)GOTO 9
1108.000      IF (L.EQ.124)GOTO 601
1109.000      IF (L.EQ.195)CODE=5
1110.000      IF(L.EQ.212)DAT=1
1111.000      IF(L.EQ.212)GOTO 34
1112.000      IF (L.EQ.201)CODE=6
1113.000      IF (L.EQ.227)CODE=7
1114.000      IF(L.EQ.198)GOTO 614
1115.000      IF (CODE.EQ.0)GOTO 604
1116.000      RETURN
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1118.000      IF(INST.NE.21.OR.L.EQ.193)GOTO 651
1119.000      IF(DAT.EQ.48)GOTO 604
1120.000      LB1=LB2
1121.000      LF1=LF2
1122.000      LB2=TB
1123.000      LF2=TF
1124.000      DAT=48
1125.000      GOTO 650
1126.000  651  IF(L.NE.193.OR.LB2.NE.LF2)GOTO 604
1127.000      CALL S1(I,LB1,L,20)
1128.000      IF(L.NE.215)GOTO 604
1129.000      CALL S1(I,LB1+1,L,21)
1130.000      DO 19 L1=244,247
1131.000      IF(L1.EQ.L)GOTO 21
1132.000  19  CONTINUE
1133.000      GOTO 604
1134.000  21  REG=(L1-DAT)-244
1135.000      CODE=1
1136.000      RETURN
1137.000      END
1138.000      SUBROUTINE SET(CTE)
1139.000      DIMENSION CTE(10)
1140.000      DO 2 J=1,10
1141.000      CTE(J)=1000
1142.000  2  CONTINUE
1143.000      RETURN
1144.000      END
1145.000      SUBROUTINE GETOP(K1,K2,K3,K,IPC,K8,IST,IDM,BS)
1146.000      DIMENSION IDM(1088)
1147.000      CALL REWR(IPC,1,K4,0)
1148.000      K8=0
1149.000      K=1029
1150.000      IF (K4.GE.K1.AND.K4.LE.(K1+7))K=IDM(1+K4-K1+(24*BS))
1151.000      IF (K4.NE.K2.AND.K4.NE.(K2+1))GOTO 800
1152.000      K=IDM(1+K4-K2+(24*BS))
1153.000      K=K-(K/64)*64
1154.000      K=IDM(1+K)
1155.000  800  IST=IST+1
1156.000      IPC=IPC+1
1157.000      IF (K4.EQ.K3)GOTO 3
1158.000      IF(K.EQ.1029)K8=1
1159.000      RETURN
1160.000  3  IST=IST+1
1161.000      CALL REWR(IPC,1,K,0)
1162.000      IPC=IPC+1
1163.000      RETURN
1164.000      END
1165.000      SUBROUTINE INCOP(K1,K2,K3,K,IPC,IST,K8,ACC,IDM,BS)
1166.000      DIMENSION IDM(1088)
1167.000      INTEGER ACC
1168.000      K8=1
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```
1169.000      IPC=IPC+1
1170.000      IST=IST+1
1171.000      CALL REWR (IPC-1,1,K4,0)
1172.000      IF (K4.EQ.K1)ACC=ACC+K
1173.000      IF (K4.GE.K2.AND.K4.LE.(K2+7))IDM(1+K4-K2+(24*BS))=K+IDM
1174.000      1(1+K4-K2+(24*BS))
1175.000      IF(IDM(1+K4-K2+(24*BS)).EQ.0)      K8=0
1176.000      CALL CAR(K9,IDM(1+K4-K2+(24*BS)),256)
1177.000      IF(K4.NE.K3.AND.K4.NE.(K3+1)) RETURN
1178.000      K9=IDM(1+K4-K3+(24*BS))
1179.000      K9=K9-(K9/64)*64
1180.000      IDM(1+K9)=K+IDM(1+K9)
1181.000      CALL CAR(K9,IDM(1+K9),256)
1182.000      RETURN
1183.000      END
1184.000      SUBROUTINE ICY(ICY1,K,I)
1185.000      K1=K-(K/16)*16
1186.000      K2=I-(I/16)*16
1187.000      ICY1=0
1188.000      IF((K1+K2).GE.16)ICY1=1
1189.000      RETURN
1190.000      END
--EOF HIT AFTER 1190.
```

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CRDV R-4162/80 (NON CLASSIFIE)

Bureau - Recherche et Développement, MDN, Canada.  
CRDV, C.P. 880, Courcellette, Qué. G0A 1R0

"Assembleur et simulateur pour les micro-ordinateurs 8048/8748/8035"  
par R. Carboneau, B. Montminy et P. Côté

Nous présentons un programme FORTRAN servant à la traduction des mnémoniques en code machine et à la simulation d'un programme écrit pour les micro-ordinateurs de type 8048/8748/8035. Ce programme, qui permet l'utilisation du langage symbolique d'Intel et l'emploi d'étiquettes pour les instructions "sauts", simule exactement le comportement du micro-ordinateur dans les applications réelles. Il permet en outre la simulation d'interruptions et l'impression des résultats intermédiaires.  
(NC)

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