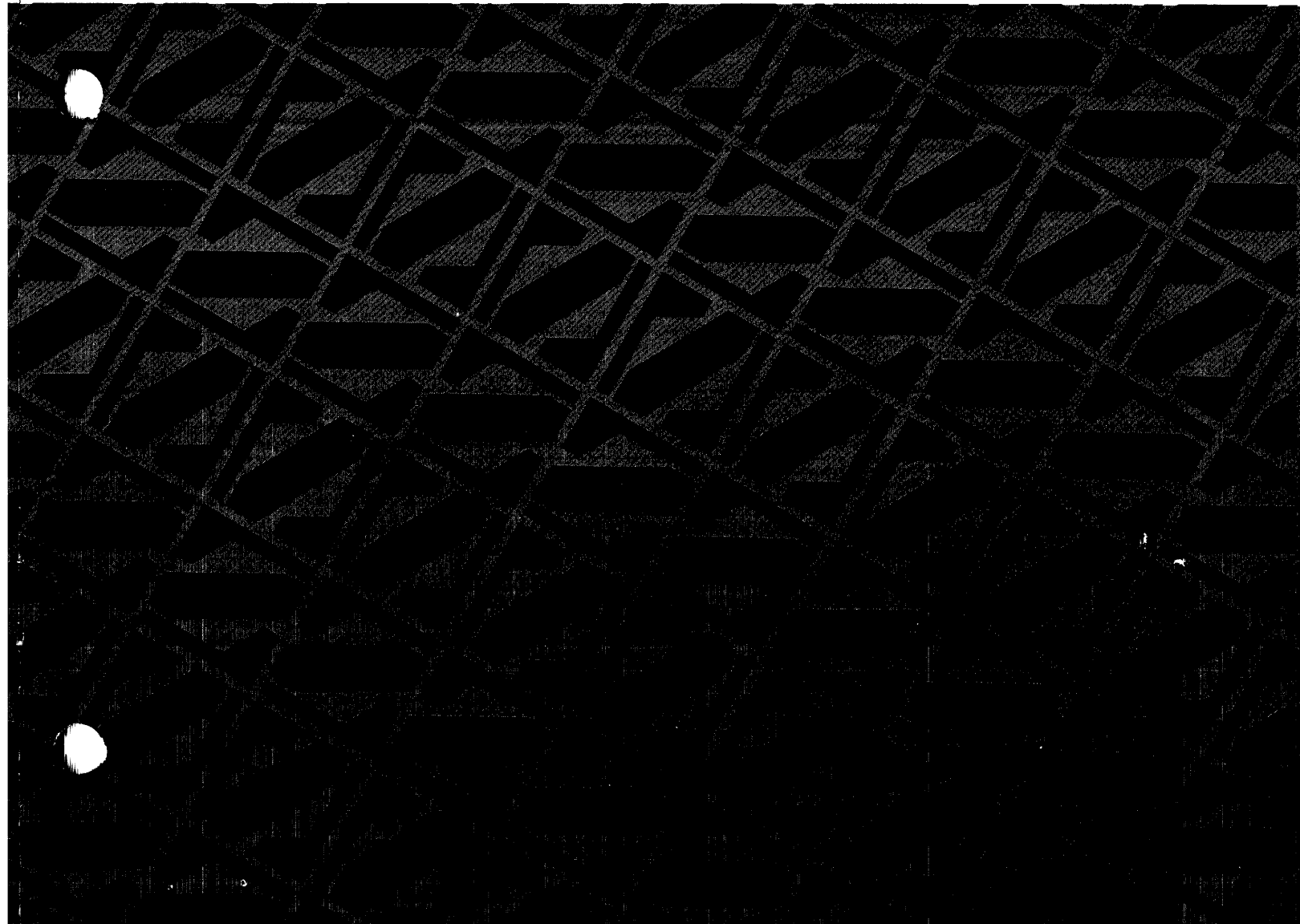


**National Semiconductor**

Pub. No. 4340137A

# **IMP-16C**

## **ROMDI Listing**



**Integrated MicroProcessor-16C**

**IMP-16C  
ROMDI LISTING**

**PRELIMINARY**

**4 April 1973**

**National Semiconductor Corporation**  
2900 Semiconductor Drive  
Santa Clara, California 95051

## INTRODUCTION

The listing of the Read Only Memory Diagnostic Program (ROMDI) is presented on the following pages.

ROMDI is a compact CPU diagnostic that is written in the IMP-16 Assembler language, whose revision level appears at the top of first page.

ROMDI tests the Central Processing Unit (CPU) on the IMP-16C card on a "go/no-go" basis. If the test indicates a failure, the particular malfunctioning device is not designated. To test individual devices in the IMP-16C CPU, first, it must be assured that all other CPU devices and the other components on the IMP-16C are functioning.

There are four RALUs (Register, Arithmetic, and Logic Units) and one CROM (Control Read-Only Memory) in the IMP-16C CPU. For example, a particular RALU may be tested by first assuring that the CROM and three of the other RALUs on the IMP-16C are functioning. In this case, if the test passes, the RALU under test is functioning; but if the test fails, the RALU under test is malfunctioning.

Instructions for performing ROMDI are given in the listing.

REVISION-C 11/20/72  
 ROMDI 000137A 04/04/73

73095 18531749

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1 0000      ;      -- NO CONCATENATION FOR THIS ASSEMBLY --      *DUMMY**
2 0000      ;      .TITLE ROMDI,'000137A 04/04/73'      00000010
3 0000      ;      00000020
4 0000      ;      MAIN PROGRAM IN ROM, X'FE00-X'FFFF, ENTRY POINT X'FFFE      00000030
5 0000      ;      00000040
6 0000      ;      ROMDI IS A GO-NOGO CPU DIAGNOSTIC DESIGNED FOR THE IMP-16C.      00000050
7 0000      ;      THE PROGRAM FITS INTO 4 8X256-BIT PROMS IN THE FOLLOWING      00000060
8 0000      ;      MANNER:      00000070
9 0000      ;      00000080
10 0000     ;      00000090
11 0000     ;      ADDRESSES      BITS      PROM      DIAGRAM      00000100
12 0000     ;      00000110
13 0000     ;      ROMDI1 RIGHT X'FE00-X'FEFF 0-7 ATZ 3H      00000120
14 0000     ;      ROMDI1 LEFT X'FE00-X'FEFF 8-15 AUA 3F      00000130
15 0000     ;      ROMDI2 RIGHT X'FF00-X'FFFF 0-7 AUB 3G      00000140
16 0000     ;      ROMDI2 LEFT X'FF00-X'FFFF 8-15 AUC 3E      00000150
17 0000     ;      00000160
18 0000     ;      ENTERING THE PROGRAM AT ADDRESS FFFE TRANSFERS CONTROL TO A      00000170
19 0000     ;      PANEL ROUTINE WHICH PERFORMS THE FOLLOWING FUNCTIONS IN      00000180
20 0000     ;      RESPONSE TO DEPRESSION OF THE INDICATED SWITCHES:      00000190
21 0000     ;      00000200
22 0000     ;      SWITCH      FUNCTION      00000210
23 0000     ;      00000220
24 0000     ;      LOAD ADDRESS      LOADS THE CONTENTS OF THE SWITCH REGISTER      00000230
25 0000     ;      INTO ACCUMULATOR 2 AND DISPLAYS THE CONTENTS      00000240
26 0000     ;      OF THE MEMORY LOCATION ADDRESSED BY ACCUM-      00000250
27 0000     ;      ULATOR 2.      00000260
28 0000     ;      00000270
29 0000     ;      LOAD DATA      LOADS THE CONTENTS OF THE SWITCH REGISTER      00000280
30 0000     ;      INTO ACCUMULATOR 0, STORES ACCUMULATOR 0      00000290
31 0000     ;      INTO THE MEMORY LOCATION ADDRESSED BY      00000300
32 0000     ;      ACCUMULATOR 2, AND DISPLAYS ACCUMULATOR 0.      00000310
33 0000     ;      EXECUTE      TRANSFERS CONTROL TO THE MEMORY LOCATION      00000320
34 0000     ;      INDICATED BY THE SWITCH REGISTER.      00000330
35 0000     ;      00000340
36 0000     ;      UPON ENTRY TO THE PANEL ROUTINE, ACCUMULATORS 0,1,2, AND 3      00000350
37 0000     ;      ARE SAVED IN MEMORY LOCATIONS 4,5,6 AND 7, RESPECTIVELY.      00000360
38 0000     ;      THE CONTENTS OF AN ACCUMULATOR MAY BE SET BY ALTERING ITS      00000370
39 0000     ;      CORRESPONDING MEMORY LOCATION.      00000380
40 0000     ;      00000390
41 0000     ;      IF JUMP CONDITION 15 IS HIGH WHEN EITHER 'INITIALIZE' OR      00000400
42 0000     ;      'EXECUTE' IS DEPRESSED, THE DIAGNOSTIC WILL BE CONTINUOUSLY      00000410
43 0000     ;      REEXECUTED UNTIL EITHER THE JUMP CONDITION GOES LOW OR AN      00000420
44 0000     ;      ERROR CONDITION IS DETECTED.      00000430
45 0000     ;      00000440
46 0000     ;      IF THE DIAGNOSTIC EXECUTES SUCCESSFULLY, THE PROGRAM SETS      00000450
47 0000     ;      FLAG 8 AND RETURNS CONTROL TO THE PANEL ROUTINE. IF THE      00000460
48 0000     ;      PROGRAM DETECTS AN ERROR CONDITION, IT SETS FLAG 15 AND      00000470
49 0000     ;      HALTS.      00000480
50 0000     ;      00000490
51 0000     ;      THE DIAGNOSTIC ENTRY POINT IS X'FE00.      00000500
52 0000     ;      .PAGE      00000510
53 0000     ;      EQUATES      00000520
54 0000     ;      00000530
55 0000 0000 A R0      =      0      00000540
56 0000 0001 A R1      =      1      00000550
57 0000 0002 A R2      =      2      00000560
58 0000 0003 A R3      =      3      00000570
59 0000     ;      00000580
60 0000     ;      ...BRANCH CONDITIONS      00000590
61 0000 0008 A STKFL    =      8      00000600
62 0000 0001 A ZRO      =      1      00000610
63 0000 0002 A PZRO     =      2      00000620
64 0000 0003 A ODD      =      3      00000630
65 0000 0004 A BIT1     =      4      00000640
66 0000 0005 A NZERO    =      5      ; NOT EQUAL ZERO      00000650
67 0000 0009 A INTEN    =      9      00000660
68 0000 000A A CYOV     =     10      00000670
69 0000 000B A NZRO     =     11      ; NEGATIVE OR ZERO      00000680
70 0000     ;      00000690
71 0000     ;      ...FLAG ADDRESSES      00000700
72 0000 0001 A IENFL    =      1      00000710
73 0000 0002 A SELX     =      2      00000720
74 0000     ;      00000730
75 0000 FE00 A ROMAD    =      X'FE00      00000740
    
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76 0000      ;
77 0000 000F A ILOC      =      15      ; TEST LOC FOR INDIRECT TEST      00000750
78 0000      ; .PAGE      00000760
79 0000      ; .ASECT      00000770
80 0000 FFFE A      ; .=ROMAD*X'1FE      00000780
81 FFFE 21E0 A ENTRY: JMP      PANEL      ;TRANSFER TO PANEL SERVICE ROUTINE      00000790
82 FFFF      ;      00000800
83 FFFF      ;      00000810
84 FFFF FE00 A      ; .=ROMAD      00000820
85 FE00      ;      00000830
86 FE00      ; TEST REGISTER 0, SKG, SKNE, MEMORY TRANSFERS      00000840
87 FE00      ;      00000850
88 FE00 815C A START: LD      R0,MIN1      00000860
89 FE01 F15B A      SKNE      R0,MIN1      00000870
90 FE02 2101 A      JMP      .+2      00000880
91 FE03 217E A      JMP      ERR1      00000890
92 FE04 F159 A      SKNE      R0,X7FFF      00000900
93 FE05 217C A      JMP      ERR1      00000910
94 FE06 A00A A      ST      R0,10      ;INITIALIZE FOR ISZ, DSZ TEST      00000920
95 FE07 E157 A      SKG      R0,ZERO      00000930
96 FE08 2101 A      JMP      .+2      00000940
97 FE09 2178 A      JMP      ERR1      00000950
98 FE0A 4801 A      AISZ      R0,1      00000960
99 FE0B 215F A      JMP      ERR      00000970
100 FE0C 1101 A      BOC      ZRO,+.2      00000980
101 FE0D 2174 A      JMP      ERR1      00000990
102 FE0E 5000 A      CAI      R0,0      ;ONE'S COMPLEMENT      00001000
103 FE0F F14D A      SKNE      R0,MIN1      00001010
104 FE10 2101 A      JMP      .+2      00001020
105 FE11 2170 A      JMP      ERR1      00001030
106 FE12 5000 A      CAI      R0,0      ; ONE'S COMPLEMENT      00001040
107 FE13 F14B A      SKNE      R0,ZERO      00001050
108 FE14 2101 A      JMP      .+2      00001060
109 FE15 216C A      JMP      ERR1      00001070
110 FE16 8149 A      LD      R0,ONE      00001080
111 FE17 5001 A      CAI      R0,1      ;TWO'S COMPLEMENT      00001090
112 FE18 F144 A      SKNE      R0,MIN1      00001100
113 FE19 2101 A      JMP      .+2      00001110
114 FE1A 2167 A      JMP      ERR1      00001120
115 FE1B 5001 A      CAI      R0,1      ;TWO'S COMPLEMENT      00001130
116 FE1C 48FF A      AISZ      R0,-1      00001140
117 FE1D 2164 A      JMP      ERR1      00001150
118 FE1E      ; .PAGE      00001160
119 FE1E      ;      00001170
120 FE1E      ; TEST INDIRECT ADDRESSING      00001180
121 FE1E      ;      00001190
122 FE1E 8542 A      LD      R1,XFACE      ;INITIALIZE ILOC      00001200
123 FE1F A40F A      ST      R1,ILOC      00001210
124 FE20 9146 A      LD      R0,@INDPNT      00001220
125 FE21 F00F A      SKNE      R0,ILOC      00001230
126 FE22 2101 A      JMP      .+2      00001240
127 FE23 215E A      JMP      ERR1      00001250
128 FE24 4E01 A      LI      R2,1      00001260
129 FE25 C940 A      ADD      R2,LINDPT      ;ADD ADDRESS OF INDPNT      00001270
130 FE26 813B A      LD      R0,XF0F0      00001280
131 FE27 B200 A      ST      R0,@(R2)      00001290
132 FE28 5001 A      CAI      R0,1      00001300
133 FE29 C011 A      ADD      R0,ILOC+2      00001310
134 FE2A 1557 A      BOC      NZERO,ERR1      00001320
135 FE2B      ; .PAGE      00001330
136 FE2B      ;      00001340
137 FE2B      ; TEST STACK AND INTERRUPTS      00001350
138 FE2B      ;      00001360
139 FE2B 0980 A      PFLG      IENFL      ; DISABLE INTERRUPTS      00001370
140 FE2C 1955 A      BOC      INTEN,ERR1      00001380
141 FE2D 0900 A      SFLG      IENFL      ; ENABLE INTERRUPTS      00001390
142 FE2E 1901 A      BOC      INTEN,+.2      00001400
143 FE2F 2152 A      JMP      ERR1      00001410
144 FE30 8138 A      LD      R0,IEP      ; INITIALIZE INTERRUPT ENTRY ADDRESS      00001420
145 FE31 A001 A      ST      R0,1      00001430
146 FE32 8137 A      LD      R0,IEP+1      00001440
147 FE33 A002 A      ST      R0,2      00001450
148 FE34 4EF0 A      LI      R2,-16      ; EMPTY STACK      00001460
149 FE35 4400 A      PULL      R0      00001470
150 FE36 4A01 A      AISZ      R2,1      00001480
151 FE37 21FD A      JMP      .-2      00001490
152 FE38 1849 A      BOC      STKFL,ERR1      00001500
153 FE39 4EF9 A      LI      R2,-7      ; PUSH X'ASAS AND X'5A5A ONTO STACK      00001510
154 FE3A 8128 A      LD      R0,XA5A5      00001520

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155 FE3B 8528 A LD R1,X5A5A 00001540
156 FE3C 4000 A PUSH R0 00001550
157 FE3D 4100 A PUSH R1 00001560
158 FE3E 4A01 A AISZ R2,1 00001570
159 FE3F 21FC A JMP .-3 00001580
160 FE40 4000 A PUSH R0 00001590
161 FE41 4100 A PUSH R1 ; SHOULD FILL STACK, CAUSE INTERRUPT 00001600
162 FE42 213F A JMP ERR1 00001610
163 FE43 1801 A INENTY: BOC STKFL,..+2 ; TEST JUMP CONDITION 00001620
164 FE44 213D A JMP ERR1 00001630
165 FE45 193C A BOC INTEN,ERR1 00001640
166 FE46 5400 A XCHRS R0 00001650
167 FE47 4100 A PUSH R1 00001660
168 FE48 4500 A PULL R1 ; INTERRUPTS SHOULD BE DISABLED 00001670
169 FE49 1838 A BOC STKFL,ERR1 00001680
170 FE4A 8120 A LD R0,ERR ;IF INTERRUPT, TRANSFER TO ERROR ROUTINE 00001690
171 FE4B A002 A ST R0,2 00001700
172 FE4C 4100 A PUSH R1 ;REFILL STACK; ERROR IF INTERRUPT OCCURS 00001710
173 FE4D 1801 A BOC STKFL,..+2 00001720
174 FE4E 2133 A JMP ERR1 00001730
175 FE4F 4EF8 A LI R2,-8 ; TEST CONTENTS OF STACK 00001740
176 FE50 4400 A PLOOP: PULL R0 00001750
177 FE51 F112 A SKNE R0,X5A5A 00001760
178 FE52 2101 A JMP .+2 00001770
179 FE53 212E A JMP ERR1 00001780
180 FE54 4400 A PULL R0 00001790
181 FE55 F10D A SKNE R0,XA5A5 00001800
182 FE56 2101 A JMP .+2 00001810
183 FE57 212A A JMP ERR1 00001820
184 FE58 4A01 A AISZ R2,1 00001830
185 FE59 21F6 A JMP PLOOP 00001840
186 FE5A 4400 A PULL R0 ; STACK SHOULD BE EMPTY 00001850
187 FE5B 1526 A BOC NZERO,ERR1 00001860
188 FE5C 210F A JMP SBRTST 00001870
189 FE5D FFFF A MIN1: .WORD -1 00001880
190 FE5E 7FFF A X7FFF: .WORD X'7FFF 00001890
191 FE5F 0000 A ZERO: .WORD 0 00001900
192 FE60 0001 A ONE: .WORD 1 00001910
193 FE61 FACE A XFACE: .WORD X'FACE 00001920
194 FE62 F0F0 A XF0F0: .WORD X'F0F0 00001930
195 FE63 A5A5 A XA5A5: .WORD X'A5A5 00001940
196 FE64 5A5A A X5A5A: .WORD X'5A5A 00001950
197 FE65 000F A I15: .WORD 15 00001960
198 FE66 FE67 A LINDPT: .WORD INDPNT 00001970
199 FE67 000F A INDPNT: .WORD ILOC,ILOC+2 00001980
FE68 0011 A
200 FE69 2500 A IEP: JMP @,+1 ; TO INITIALIZE LOCS 1 AND 2 00001990
201 FE6A FE43 A .WORD INENTY ; MUST BE IN LOC IEP+1 00002000
202 FE6B FF8C A ERR: .WORD ERROR 00002010
203 FE6C .PAGE 00002020
204 FE6C ; 00002030
205 FE6C ; TEST SUBROUTINE LINKAGES(JSR, JSR@, RTS, RTI) 00002040
206 FE6C ; 00002050
207 FE6C 4F00 A SBRTST: LI R3,0 00002060
208 FE6D 4300 A PUSH R3 00002070
209 FE6E 290D A JSR SUBR 00002080
210 FE6F 4B0A A RETN: AISZ R3,10 00002090
211 FE70 FDF4 A SKNE R3,I15 00002100
212 FE71 2101 A JMP .+2 00002110
213 FE72 210F A JMP ERR1 00002120
214 FE73 4F00 A LI R3,0 00002130
215 FE74 2D12 A JSR @SBRAD 00002140
216 FE75 4B0A A AISZ R3,10 00002150
217 FE76 FDEE A SKNE R3,I15 00002160
218 FE77 2101 A JMP .+2 00002170
219 FE78 2109 A JMP ERR1 00002180
220 FE79 1901 A BOC INTEN,..+2 ; INTERRUPTS SHOULD BE ENABLED BY RTI 00002190
221 FE7A 2107 A JMP ERR1 00002200
222 FE7B 210D A JMP TMWRT 00002210

223 FE7C .SPACE 2 00002220
224 FE7C 4500 A SUBR: PULL R1 ; JSR TEST 00002230
225 FE7D F50A A SKNE R1,RTNAD ; CHECK THAT RETURN ADDRESS SAVED 00002240
226 FE7E 4B05 A AISZ R3,5 00002250
227 FE7F 8508 A LD R1,RTNAD ; ENSURE CORRECT RETURN ADDRESS 00002260
228 FE80 4100 A PUSH R1 00002270
229 FE81 0200 A RTS 00002280

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230 FE82                .SPACE 2                00002290
231 FE82 2500 A ERR1:   JMP      @,+1          00002300
232 FE83 FF8C A        .WORD  ERROR          00002310

233 FE84                .SPACE 2                00002320
234 FE84 4805 A SUBR1:  AISZ    R3,5          ; FOR JSR"          00002330
235 FE85 0100 A        RTI                      00002340
236 FE86 21FB A        JMP      ERR1          00002350

237 FE87                .SPACE 2                00002360
238 FE87 FE84 A SBRAD: .WORD  SUBR1          00002370
239 FE88 FE6F A RTNAD: .WORD  RETN          00002380
240 FE89                .PAGE                      00002390
241 FE89                ;                          00002400
242 FE89                ; TEST MEMORY WRITE AND INDEXING 00002410
243 FE89                ;                          00002420
244 FE89 4E00 A TMWRT:  LI      R2,0          ;WRITE MEMORY FROM LOC 32 THRU 47 00002430
245 FE8A 4C01 A        LI      R0,1          ;WITH INTEGERS 1 THRU 16          00002440
246 FE8B A220 A MLOOP:  ST      R0,32(R2)          00002450
247 FE8C 4801 A        AISZ    R0,1          00002460
248 FE8D 4A01 A        AISZ    R2,1          00002470
249 FE8E E97B A        SKG     R2,015          00002480
250 FE8F 21FB A        JMP     MLOOP          00002490
251 FE90 4FF0 A        LI      R3,-16          ;COMPARE LOCS 32 THRU 47 WITH INTEGERS 00002500
252 FE91 4C01 A        LI      R0,1          ;USING NEGATIVE INDEXING          00002510
253 FE92 F330 A CLOOP:  SKNE    R0,48(R3)          00002520
254 FE93 2101 A        JMP     .+2          00002530
255 FE94 21ED A        JMP     ERR1          00002540
256 FE95 4801 A        AISZ    R0,1          00002550
257 FE96 4801 A        AISZ    R3,1          00002560
258 FE97 21FA A        JMP     CLOOP          00002570
259 FE98                .PAGE                      00002580
260 FE98                ;                          00002590
261 FE98                ; TEST REGISTER-TO-REGISTER PLUS AND, XOR FUNCTIONS 00002600
262 FE98                ;                          00002610
263 FE98 817C A        LD      R0,M1          ;R0=-1          00002620
264 FE99 856E A        LD      R1,01          ;R1=1          00002630
265 FE9A 3400 A        RADD   R1,R0          ;R0=0          00002640
266 FE9B 15E6 A        ROC    NZERO,ERR1          00002650
267 FE9C 8174 A        LD      R0,HA5A5          ;R0=X'A5A5          00002660
268 FE9D 3281 A        RCPY   R0,R2          ;R2=X'A5A5          00002670
269 FE9E 3181 A        RCPY   R0,R1          ;R1=X'A5A5          00002680
270 FE9F 5200 A        CAI    R2,0          ;R2=X'A5A5          00002690
271 FEA0 3882 A        RXOR   R2,R0          ;R0=-1          00002700
272 FEA1 4801 A        AISZ   R0,1          ;R0=0          00002710
273 FEA2 210F A        JMP     ERR1          00002720
274 FEA3 3983 A        RAND   R2,R1          ;R1=0          00002730
275 FEA4 4900 A        AISZ   R1,0          00002740
276 FEA5 210C A        JMP     ERR1          00002750
277 FEA6 4FFF A        LI     R3,-1          ;R3=-1          00002760
278 FEA7 3C80 A        RXCH   R3,R0          ;R3=0,R0=-1          00002770
279 FEA8 3282 A        RXOR   R0,R2          ;R2=X'A5A5          00002780
280 FEA9 4801 A        AISZ   R0,1          ;R0=0          00002790
281 FEAA 2107 A        JMP     ERR1          00002800
282 FEAB 4800 A        AISZ   R3,0          00002810
283 FEAC 2105 A        JMP     ERR1          00002820
284 FEAD F963 A        SKNE   R2,HA5A5          00002830
285 FEAE 2101 A        JMP     .+2          00002840
286 FEAF 2102 A        JMP     ERR1          00002850
287 FEB0 8D62 A        LD     R3,HF0F0          ;R3=X'F0F0          00002860
288 FEB1 4DFF A        LI     R1,-1          ;R1=-1          00002870
289 FEB2 3D83 A        RAND   R3,R1          ;R1=X'F0F0          00002880
290 FEB3 3782 A        RXOR   R1,R3          ;R3=0          00002890
291 FEB4 3881 A        RCPY   R2,R0          ;R0=X'A5A5          00002900
292 FEB5 3380 A        RXCH   R0,R3          ;R3=X'A5A5,R0=0          00002910
293 FEB6 15CB A        ROC    NZERO,ERR1          00002920
294 FEB7 3680 A        RXCH   R1,R2          ;R2=X'F0F0,R1=X'A5A5          00002930
295 FEB8 3883 A        RAND   R2,R3          ;R3=X'A0A0          00002940
296 FEB9 FD56 A        SKNE   R3,HA0A0          00002950
297 FEBA 2101 A        JMP     .+2          00002960
298 FEBB 21C6 A        JMP     ERR1          00002970
299 FEBC                ;                          00002980
300 FEBC                ; TEST LOGICAL-OR FUNCTION          00002990
301 FEBC                ;                          00003000
302 FEBC 8150 A        LD     R0,HA5A5          ;TEST 1V0 AND 0V1          00003010
303 FEBD 6953 A        OR     R0,HA5A5          00003020
304 FEFE 4801 A        AISZ   R0,1          00003030

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305	FEBF	21C2	A	JMP	ERR1		00003040
306	FEC0	854A	A	LD	R1,H5050	!TEST 0V0 AND 1V1	00003050
307	FEC1	6D51	A	OR	R1,HF0F0		00003060
308	FEC2	F550	A	SKNE	R1,HF0F0		00003070
309	FEC3	2101	A	JMP	.*2		00003080
310	FEC4	218D	A	JMP	ERR1		00003090
311	FEC5			.PAGE			00003100
312	FEC5		;				00003110
313	FEC5		;	TEST ARITHMETIC FUNCTIONS			00003120
314	FEC5		;				00003130
315	FEC5	4C01	A	LI	R0,1	!1+(-1)	00003140
316	FEC6	C14E	A	ADD	R0,M1		00003150
317	FEC7	158A	A	BOC	NZERO,ERR1		00003160
318	FEC8	0A00	A	SFLG	SELX	! TEST FOR OVERFLOW	00003170
319	FEC9	1A88	A	BOC	CYOV,ERR1		00003180
320	FECA	0A80	A	PFLG	SELX	! TEST FOR CARRY	00003190
321	FECB	1A01	A	BOC	CYOV,.*2		00003200
322	FEC	2185	A	JMP	ERR1		00003210
323	FECD	8141	A	LD	R0,H8000	!X*8000-1	00003220
324	FECE	D139	A	SUB	R0,D1		00003230
325	FECF	F13E	A	SKNE	R0,H7FFF		00003240
326	FED0	2101	A	JMP	.*2		00003250
327	FED1	2180	A	JMP	ERR1		00003260
328	FED2	1A01	A	BOC	CYOV,.*2	! TEST FOR CARRY	00003270
329	FED3	21AE	A	JMP	ERR1		00003280
330	FED4	0A00	A	SFLG	SELX	! TEST FOR OVERFLOW	00003290
331	FED5	1A01	A	BOC	CYOV,.*2		00003300
332	FED6	21AB	A	JMP	ERR1		00003310
333	FED7	8136	A	LD	R0,H7FFF	!X*7FFF+1	00003320
334	FED8	C12F	A	ADD	R0,D1		00003330
335	FED9	F135	A	SKNE	R0,H8000		00003340
336	FEDA	2101	A	JMP	.*2		00003350
337	FEDB	21A6	A	JMP	ERR1		00003360
338	FEDC	1A01	A	BOC	CYOV,.*2	! TEST FOR OVERFLOW	00003370
339	FEDD	21A4	A	JMP	ERR1		00003380
340	FEDE	0A80	A	PFLG	SELX	! TEST FOR CARRY	00003390
341	FEDF	1AA2	A	BOC	CYOV,ERR1		00003400
342	FEE0	812D	A	LD	R0,H7FFF	! X*7FFF-X*8000	00003410
343	FEE1	D12D	A	SUB	R0,H8000		00003420
344	FEE2	F132	A	SKNE	R0,M1		00003430
345	FEE3	2101	A	JMP	.*2		00003440
346	FEE4	219D	A	JMP	ERR1		00003450
347	FEE5	1A9C	A	BOC	CYOV,ERR1	!ANOMALY - NO CARRY GENERATED	00003460
348	FEE6	0A00	A	SFLG	SELX		00003470
349	FEE7	1A01	A	BOC	CYOV,.*2	!SHOULD HAVE OVERFLOW	00003480
350	FEE8	2199	A	JMP	ERR1		00003490
351	FEE9			.PAGE			00003500
352	FEE9		;				00003510
353	FEE9		;	TEST SKIP IF GREATER			00003520
354	FEE9		;				00003530
355	FEE9	8D1E	A	LD	R3,D1	!1>-1	00003540
356	FEEA	ED2A	A	SKG	R3,M1		00003550
357	FEEB	2196	A	JMP	ERR1		00003560
358	FEEC	ED1A	A	SKG	R3,D0	!1>0	00003570
359	FEED	2194	A	JMP	ERR1		00003580
360	FEED	ED19	A	SKG	R3,D1	!1>1	00003590
361	FEED	2101	A	JMP	.*2		00003600
362	FEF0	2191	A	JMP	ERR1		00003610
363	FEF1	ED17	A	SKG	R3,D2	!1>2	00003620
364	FEF2	2101	A	JMP	.*2		00003630
365	FEF3	218E	A	JMP	ERR1		00003640
366	FEF4	8919	A	LD	R2,H7FFF		00003650
367	FEF5	E919	A	SKG	R2,H8000	!X*7FFF>X*8000	00003660
368	FEF6	218B	A	JMP	ERR1		00003670
369	FEF7	8917	A	LD	R2,H8000	!X*8000>X*7FFF	00003680
370	FEF8	E915	A	SKG	R2,H7FFF		00003690
371	FEF9	2101	A	JMP	.*2		00003700
372	FEFA	2187	A	JMP	ERR1		00003710
373	FEFB	8519	A	LD	R1,M1		00003720
374	FEFC	E50A	A	SKG	R1,D0	!-1>0	00003730
375	FEFD	2101	A	JMP	.*2		00003740
376	FEFE	2183	A	JMP	ERR1		00003750
377	FEFF	3081	A	NOP			00003760
378	FF00	E514	A	SKG	R1,M1	!-1>-1	00003770
379	FF01	2102	A	JMP	.*3		00003780
380	FF02	2500	A	JMP	@,.*1		00003790
381	FF03	FF8C	A	.WORD	ERROR		00003800
382	FF04	E511	A	SKG	R1,M2	!-1>-2	00003810
383	FF05	21FD	A	JMP	.-2	!REF .-2 IN ORDER TO REACH ERR1	00003820
384	FF06	2110	A	JMP	TISZ	!CONTINUE TESTING	00003830



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385 FF07          .PAGE          00003840
386 FF07          ;              00003850
387 FF07          ;              00003860
388 FF07          ;              00003870
389 FF07 0000 A D0:  .WORD      0      00003880
390 FF08 0001 A D1:  .WORD      1      00003890
391 FF09 0002 A D2:  .WORD      2      00003900
392 FF0A 000F A D15: .WORD     15      00003910
393 FF0B 5050 A H5050: .WORD    X'5050      00003920
394 FF0C 5555 A H5555: .WORD    X'5555      00003930
395 FF0D 5A5A A H5A5A: .WORD    X'5A5A      00003940
396 FF0E 7FFF A H7FFF: .WORD    X'7FFF      00003950
397 FF0F 8000 A H8000: .WORD    X'8000      00003960
398 FF10 A0A0 A HA0A0: .WORD    X'A0A0      00003970
399 FF11 A5A5 A HA5A5: .WORD    X'A5A5      00003980
400 FF12 AAAA A HAAAA: .WORD    X'AAAA      00003990
401 FF13 F0F0 A HF0F0: .WORD    X'F0F0      00004000
402 FF14 FACE A HFACE: .WORD    X'FACE      00004010
403 FF15 FFFF A M1:  .WORD     -1      00004020
404 FF16 FFFE A M2:  .WORD     -2      00004030
405 FF17          .PAGE          00004040
406 FF17          ;              00004050
407 FF17          ;              00004060
408 FF17 780A A TISZ:  ..TEST ISZ AND DSZ  ISZ      10      ;TEST VALUE -1
409 FF18 2173 A      JMP      ERROR      00004070
410 FF19 780A A      ISZ      10      ; TEST VALUE 0
411 FF1A 2101 A      JMP      .+2          00004080
412 FF1B 2170 A      JMP      ERROR      00004090
413 FF1C 7C0A A      DSZ      10      ;TEST VALUE 1
414 FF1D 216E A      JMP      ERROR      00004100
415 FF1E 7C0A A      DSZ      10      ;TEST VALUE 0
416 FF1F 2101 A      JMP      .+2          00004110
417 FF20 216B A      JMP      ERROR      00004120
418 FF21          .PAGE          00004130
419 FF21          ;              00004140
420 FF21          ;              00004150
421 FF21          ;              00004160
422 FF21 4CFF A      LI      R0,-1        ; TEST VALUE -1
423 FF22 1169 A      BOC     ZR0,ERROR   00004170
424 FF23 1268 A      BOC     PZR0,ERROR  00004180
425 FF24 1301 A      BOC     ODD,.,+2    00004190
426 FF25 2166 A      JMP      ERROR      00004200
427 FF26 1401 A      BOC     BIT1,.,+2   00004210
428 FF27 2164 A      JMP      ERROR      00004220
429 FF28 1801 A      BOC     NZR0,.,+2   00004230
430 FF29 2162 A      JMP      ERROR      00004240
431 FF2A 1501 A      BOC     NZERO,.,+2  00004250
432 FF2B 2160 A      JMP      ERROR      00004260
433 FF2C 4801 A      AISZ    R0,1        00004270
434 FF2D 215E A      JMP      ERROR      00004280
435 FF2E 1101 A      BOC     ZR0,.,+2    00004290
436 FF2F 215C A      JMP      ERROR      00004300
437 FF30 1201 A      BOC     PZR0,.,+2   00004310
438 FF31 215A A      JMP      ERROR      00004320
439 FF32 1359 A      BOC     ODD,ERROR   00004330
440 FF33 1458 A      BOC     BIT1,ERROR  00004340
441 FF34 1801 A      BOC     NZR0,.,+2   00004350
442 FF35 2156 A      JMP      ERROR      00004360
443 FF36 1555 A      BOC     NZERO,ERROR 00004370
444 FF37 A000 A      ST      R0,0        00004380
445 FF38 4801 A      AISZ    R0,1        ;ASSUME CARRY-IN WORKS
446 FF39 A000 A      ST      R0,0        00004390
447 FF3A 7C00 A      DSZ     0            00004400
448 FF3B 2150 A      JMP      ERROR      ;TEST IF AISZ CAUSED SKIP
449 FF3C 114F A      BOC     ZR0,ERROR   ;AISZ SKIPPED ON NON-ZERO
450 FF3D 1201 A      BOC     PZR0,.,+2   ;TEST VALUE 1
451 FF3E 214D A      JMP      ERROR      00004410
452 FF3F 1301 A      BOC     ODD,.,+2    00004420
453 FF40 214B A      JMP      ERROR      00004430
454 FF41 144A A      BOC     BIT1,ERROR  00004440
455 FF42 1849 A      BOC     NZR0,ERROR  00004450
456 FF43 1501 A      BOC     NZERO,.,+2  00004460
457 FF44 2147 A      JMP      ERROR      00004470
458 FF45 4801 A      AISZ    R0,1        00004480
459 FF46 1345 A      BOC     ODD,ERROR   ;TEST VALUE 2
460 FF47 1401 A      BOC     BIT1,.,+2   00004490
461 FF48 2143 A      JMP      ERROR      00004500
462 FF49          .PAGE          00004510
463 FF49          ;              00004520

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464 FF49      ; TEST IF RALU FLAGS CAN BE SET AND CLEARED VIA STACK. ALSO      00004630
465 FF49      ; TEST CYOV FLAG                                          00004640
466 FF49      ;                                                         00004650
467 FF49 4C00 A LI R0,0                                           00004660
468 FF4A 4DFF A LI R1,-1                                          00004670
469 FF4B 4100 A PUSH R1                                           00004680
470 FF4C 0280 A PULLF                                           ;FLAGS SHOULD ALL BE SET      00004690
471 FF4D 4000 A PUSH R0                                           00004700
472 FF4E 0080 A PUSHF                                           00004710
473 FF4F 4600 A PULL R2                                           ;R2 SHOULD CONTAIN -1        00004720
474 FF50 F9C4 A SKNE R2,M1                                          00004730
475 FF51 2101 A JMP .+2                                           00004740
476 FF52 2139 A JMP ERROR                                           00004750
477 FF53 0A00 A SFLG SELX                                           ;TEST OVERFLOW                00004760
478 FF54 1A01 A BOC CYOV,..+2   ;SHOULD BE SET                00004770
479 FF55 2136 A JMP ERROR                                           00004780
480 FF56 0A80 A PFLG SELX                                           ;TEST CARRY                    00004790
481 FF57 1A01 A BOC CYOV,..+2   ;SHOULD BE SET                00004800
482 FF58 2133 A JMP ERROR                                           00004810
483 FF59      ;                                                         00004820
484 FF59      ; ...TRY TO CLEAR FLAGS                                          00004830
485 FF59 4000 A PUSH R0                                           00004840
486 FF5A 0280 A PULLF                                           00004850
487 FF5B 4100 A PUSH R1                                           00004860
488 FF5C 0080 A PUSHF                                           00004870
489 FF5D 4400 A PULL R0                                           00004880
490 FF5E 152D A BOC NZERO,ERROR   ;ASSUME JUMP CONDITION WORKS  00004890
491 FF5F 0A00 A SFLG SELX                                           ;TEST OVERFLOW                00004900
492 FF60 1A2B A BOC CYOV,ERROR   ;SHOULD NOT BE SET          00004910
493 FF61 0A80 A PFLG SELX                                           ;TEST CARRY                    00004920
494 FF62 1A29 A BOC CYOV,ERROR   ;SHOULD NOT BE SET          00004930
495 FF63      ; .PAGE                                                         00004940
496 FF63      ;                                                         00004950
497 FF63      ; TEST SHIFT WITHOUT LINK                                          00004960
498 FF63      ;                                                         00004970
499 FF63 0A80 A PFLG SELX                                           ; DO NOT INCLUDE LINK IN SHIFT 00004980
500 FF64 4C00 A LI R0,0                                           00004990
501 FF65 4000 A PUSH R0                                           00005000
502 FF66 0280 A PULLF                                           ; CLEAR LINK                    00005010
503 FF67 81AD A LD R0,M1                                           00005020
504 FF68 5C0F A SHL R0,15                                          00005030
505 FF69 F1A5 A SKNE R0,H8000   00005040
506 FF6A 2101 A JMP .+2                                           00005050
507 FF6B 2120 A JMP ERROR                                           00005060
508 FF6C 0080 A PUSHF                                           00005070
509 FF6D 4400 A PULL R0                                           00005080
510 FF6E 1201 A BOC PZR0,..+2   ; LINK SHOULD NOT BE SET      00005090
511 FF6F 211C A JMP ERROR                                           00005100
512 FF70 819E A LD R0,H8000   00005110
513 FF71 5CF1 A SHR R0,15                                          00005120
514 FF72 48FF A AISZ R0,-1                                          00005130
515 FF73 2118 A JMP ERROR                                           00005140
516 FF74 4CFF A LI R0,-1                                          00005150
517 FF75 5CF1 A SHR R0,15                                          00005160
518 FF76 48FF A AISZ R0,-1                                          00005170
519 FF77 2114 A JMP ERROR                                           00005180
520 FF78      ;                                                         00005190
521 FF78      ; CHECK ROTATE WITHOUT LINK                                          00005200
522 FF78      ;                                                         00005210
523 FF78 8199 A LD R0,HAAAA   ; LINK WAS CLEARED PREVIOUSLY  00005220
524 FF79 5801 A ROL R0,1                                           00005230
525 FF7A F191 A SKNE R0,H5555   00005240
526 FF7B 2101 A JMP .+2                                           00005250
527 FF7C 210F A JMP ERROR                                           00005260
528 FF7D 0080 A PUSHF                                           ; TEST LINK                    00005270
529 FF7E 4500 A PULL R1                                           00005280
530 FF7F 758F A SKAZ R1,H8000   00005290
531 FF80 2108 A JMP ERROR                                           ; LINK SHOULD BE ZERO        00005300
532 FF81 58FE A ROR R0,2                                           00005310
533 FF82 F189 A SKNE R0,H5555   00005320
534 FF83 2101 A JMP .+2                                           00005330
535 FF84 2107 A JMP ERROR                                           00005340
536 FF85 0080 A PUSHF                                           ; TEST LINK                    00005350
537 FF86 4500 A PULL R1                                           00005360
538 FF87 7587 A SKAZ R1,H8000   00005370
539 FF88 2103 A JMP ERROR                                           ; LINK SHOULD BE ZERO        00005380
540 FF89 5801 A ROL R0,1                                           00005390
541 FF8A F187 A SKNE R0,HAAAA   00005400
542 FF8B 2105 A JMP SHLNK                                           00005410
543 FF8C      ;                                                         00005420

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544 FF8C 4CFF A ERROR: LI R0,-1 00005430
545 FF8D 0F00 A SFLG 7 ;NO-GO INDICATOR 00005440
546 FF8E 0000 A HALT ;ERROR OCCURRED 00005450
547 FF8F 2500 A JMP @,+1 ;REEXECUTE FROM BEGINNING 00005460
548 FF90 FFFE A .WORD ENTRY 00005470
549 FF91 .PAGE 00005480
550 FF91 ; 00005490
551 FF91 ; TEST SHIFT WITH LINK 00005500
552 FF91 ; 00005510
553 FF91 0A00 A SHLNK: SFLG SELX ; INCLUDE LINK IN SHIFTS 00005520
554 FF92 4C01 A LI R0,1 00005530
555 FF93 5C10 A SHL R0,16 00005540
556 FF94 1101 A BOC ZR0,+2 00005550
557 FF95 21F6 A JMP ERROR 00005560
558 FF96 0080 A PUSHF 00005570
559 FF97 4500 A PULL R1 00005580
560 FF98 750F A SKAZ R1,X8000 ; ASSUME SKAZ WORKS 00005590
561 FF99 2101 A JMP +2 00005600
562 FF9A 21F1 A JMP ERROR 00005610
563 FF9B 5CF0 A SHR R0,16 00005620
564 FF9C F109 A SKNE R0,11 ; ASSUME SKNE WORKS 00005630
565 FF9D 2101 A JMP +2 00005640
566 FF9E 21ED A JMP ERROR 00005650
567 FF9F 0080 A PUSHF 00005660
568 FFA0 4400 A PULL R0 00005670
569 FFA1 7106 A SKAZ R0,X8000 00005680
570 FFA2 21E9 A JMP ERROR 00005690
571 FFA3 2106 A JMP ROTLNK 00005700
572 FFA4 .PAGE 00005710
573 FFA4 ; 00005720
574 FFA4 ; TEST ROTATE WITH LINK 00005730
575 FFA4 ; 00005740
576 FFA4 5554 A H5554: .WORD X'5554 00005750
577 FFA5 0555 A H0555: .WORD X'D555 00005760
578 FFA6 0001 A I1: .WORD 1 00005770
579 FFA7 5555 A X5555: .WORD X'5555 00005780
580 FFA8 8000 A X8000: .WORD X'8000 00005790
581 FFA9 AAAA A XAAAA: .WORD X'AAAA 00005800
582 FFAA 89FE A ROTLNK: LD R2,XAAAA 00005810
583 FFAB 4D00 A LI R1,0 ; SET LINK=0 00005820
584 FFAC 4100 A PUSH R1 00005830
585 FFAD 0280 A PULLF 00005840
586 FFAE 5A01 A ROL R2,1 00005850
587 FFAF F9F4 A SKNE R2,H5554 00005860
588 FF80 2101 A JMP +2 00005870
589 FFB1 21DA A JMP ERROR 00005880
590 FF82 0080 A PUSHF 00005890
591 FFB3 4400 A PULL R0 00005900
592 FFB4 12D7 A BOC PZR0,ERROR ; LINK SHOULD BE SET 00005910
593 FFB5 5AFE A ROR R2,2 00005920
594 FFB6 F9F0 A SKNE R2,X5555 00005930
595 FFB7 2101 A JMP +2 00005940
596 FFB8 21D3 A JMP ERROR 00005950
597 FFB9 0080 A PUSHF 00005960
598 FFBA 4400 A PULL R0 00005970
599 FFB8 4800 A AISZ R0,0 00005980
600 FFBC 21CF A JMP ERROR ; LINK SHOULD NOT RE SET 00005990
601 FFB0 5A01 A ROL R2,1 00006000
602 FFB6 F9EA A SKNE R2,XAAAA 00006010
603 FFBF 2101 A JMP +2 00006020
604 FFC0 21CB A JMP ERROR 00006030
605 FFC1 0080 A PUSHF 00006040
606 FFC2 4400 A PULL R0 00006050
607 FFC3 4800 A AISZ R0,0 00006060
608 FFC4 21C7 A JMP ERROR ; LINK SHOULD NOT BE SET 00006070
609 FFC5 4CFF A LI R0,-1 00006080
610 FFC6 4000 A PUSH R0 00006090
611 FFC7 0280 A PULLF ; SET LINK 00006100
612 FFC8 5A01 A ROL R2,1 00006110
613 FFC9 F9DD A SKNE R2,X5555 00006120
614 FFCA 2101 A JMP +2 00006130
615 FFCE 21C0 A JMP ERROR 00006140
616 FFCC 0080 A PUSHF 00006150
617 FFCD 4400 A PULL R0 00006160
618 FFCE 12B0 A BOC PZR0,ERROR ; LINK SHOULD BE SET 00006170
619 FFCE 5AFE A ROR R2,2 00006180
620 FFD0 F9D4 A SKNE R2,H0555 00006190
621 FFD1 2101 A JMP +2 00006200
622 FFD2 21B9 A JMP ERROR 00006210
623 FFD3 0080 A PUSHF 00006220

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624	FFD4	4400	A	PULL	R0					00006230
625	FFD5	71D2	A	SKAZ	R0,X8000					00006240
626	FFD6	21B5	A	JMP	ERROR					00006250
627	FFD7	5A01	A	ROL	R2,1					00006260
628	FFD8	F9D0	A	SKNE	R2,XAAAA					00006270
629	FFD9	2101	A	JMP	.+2					00006280
630	FFDA	21B1	A	JMP	ERROR					00006290
631	FFDB	0080	A	PUSHF						00006300
632	FFDC	4400	A	PULL	R0					00006310
633	FFDD	12AE	A	ROC	PZRO,ERROR					00006320
634	FFDE	0800	A	SFLG	0					00006330
635	FFDF	A004	A	PANEL: ST	0,4					00006340
636	FFE0	A405	A	ST	1,5					00006350
637	FFE1	A806	A	ST	2,6					00006360
638	FFE2	AC07	A	ST	3,7					00006370
639	FFE3	9119	A	LD	0,#STADD					00006380
640	FFE4	1F10	A	BOC	15,EXIT					00006390
641	FFE5	0600	A	ROUT:	ROUT					00006400
642	FFE6	1C03	A	WAIT:	BOC					00006410
643	FFE7	1D07	A	BOC	12,LA					00006420
644	FFE8	170A	A	BOC	13,LD					00006430
645	FFE9	21FC	A	BOC	7,EX					00006440
646	FFEA	1CFF	A	LA:	JMP					00006450
647	FFEB	0400	A	BOC	12,LA					00006460
648	FFEC	32B1	A	RIN	0					00006470
649	FFED	8200	A	RCPY	0,2					00006480
650	FFEE	21F6	A	LD	0,(2)					00006490
651	FFEF	1DFF	A	JMP	ROUT					00006500
652	FFF0	0400	A	LD:	BOC					00006510
653	FFF1	A200	A	RIN	13,LD					00006520
654	FFF2	21F2	A	ST	0,(2)					00006530
655	FFF3	17FF	A	JMP	ROUT					00006540
656	FFF4	0400	A	EX:	BOC					00006550
657	FFF5	4000	A	EXIT:	RIN					00006560
658	FFF6	8004	A	PUSH	0					00006570
659	FFF7	8405	A	LD	0,4					00006580
660	FFF8	8806	A	LD	1,5					00006590
661	FFF9	8C07	A	LD	2,6					00006600
662	FFFA	0880	A	LD	3,7					00006610
663	FFFB	0F80	A	PFLG	0					00006620
664	FFFC	0200	A	PFLG	7					00006630
665	FFFD	FE00	A	RTS						00006640
666	FFFE	FFFE	A	STADD:	.WORD					00006650
					START					
					ENTRY					
					.END					

\*\*\*\*\* 0 ERRORS IN ASSEMBLY \*\*\*\*\*

BIT1	CLLOOP	CYOV	D0	D1	D15	D2	ENTRY	ERR	ERR1										
0004	A	FE92	A	000A	A	FF07	A	FF08	A	FF0A	A	FF09	A	FFFE	A	FE6B	A	FE82	A
ERROR	EX	EXIT	H5050	H5554	H5555	H5A5A	H7FFF	H8000	HA0A0										
FF8C	A	FFF3	A	FFF5	A	FF0B	A	FFA4	A	FF0C	A	FF0D	A	FF0E	A	FF0F	A	FF10	A
HASAS	HAAAA	HD555	HFOF0	HFACE	I1	I15	IENFL	IEP	ILOC										
FF11	A	FF12	A	FFA5	A	FF13	A	FF14	A	FFA6	A	FE65	A	0001	A	FE69	A	000F	A
INDPNT	INENTY	INTEN	LA	LD	LINDPT	M1	M2	MIN1	MLOOP										
FE67	A	FE43	A	0009	A	FFEA	A	FFEF	A	FE66	A	FF15	A	FF16	A	FE5D	A	FE8B	A
NZERO	NZRO	ODD	ONE	PANEL	PLLOOP	PZRO	R0	R1	R2										
0005	A	000B	A	0003	A	FE60	A	FFDF	A	FE50	A	0002	A	0000	A	0001	A	0002	A
R3	RETN	ROMAD	ROTLNK	ROUT	RTNAD	SBRAD	SBRTST	SELX	SHLNK										
0003	A	FE6F	A	FE00	A	FFAA	A	FFE5	A	FE88	A	FE87	A	FE6C	A	0002	A	FF91	A
STADD	START	STKFL	SUBR	SUBR1	TISZ	TMWRT	WAIT	X5555	X5A5A										
FFFD	A	FE00	A	0008	A	FE7C	A	FE84	A	FF17	A	FE89	A	FFE6	A	FFA7	A	FE64	A
X7FFF	X8000	XA5A5	XAAAA	XF0F0	XFACE	ZERO	ZRO												
FE5E	A	FFA8	A	FE63	A	FFA9	A	FE62	A	FE61	A	FE5F	A	0001	A				

1E08 F8FE

NOTE: It is most important to insert ROMs into the correct sockets. The picture below shows the appropriate location and supercedes the information contained in the ROMDI listing.

