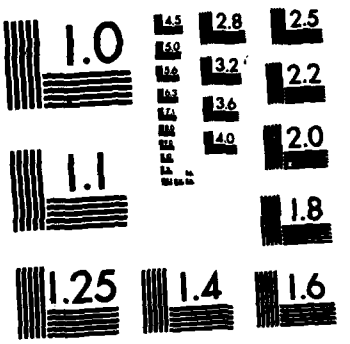
AD-A124 182 MAPPER: A DEBUGGING AID FOR USE WITH THE MAP MAINTENANCE TEST PANEL(U) DEFENCE RESEARCH ESTABLISHMENT PACIFIC VICTORIA (BRITISH COLUMBIA) 1/1

UNCLASSIFIED P M HOLTHAM APR 82 DREP-TM-82-4 F/G 9/2 NL



Victoria, B.C.

Technical Memorandum 82-4

MAPPER: A DEBUGGING AID FOR USE WITH THE MAP MAINTENANCE TEST PANEL

P.M. Holtham

April 1982

Research and Development Branch

Department of National Defence

(3)

DEFENCE RESEARCH ESTABLISHMENT PACIFIC
VICTORIA, B.C.

DREP Technical Memorandum 82-4

MAPPER

A DEBUGGING AID FOR USE WITH THE MAP MAINTENANCE TEST PANEL

P. M. Holtham

June 1980

Approved by:

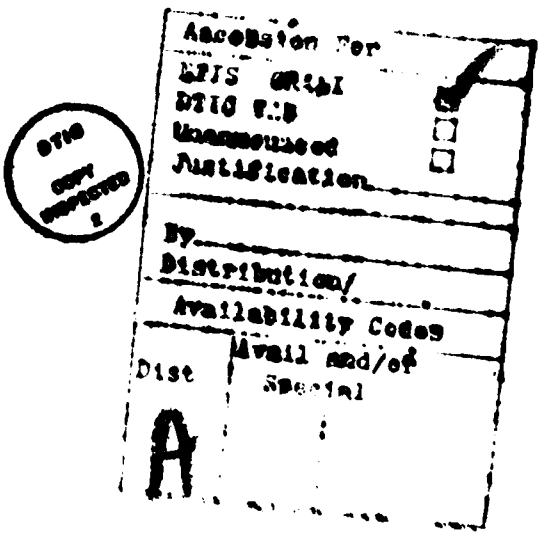
W. Z. [illegible]

Chief/DREP

RESEARCH AND DEVELOPMENT BRANCH
DEPARTMENT OF NATIONAL DEFENCE
CANADA

ABSTRACT

A program is presented which enables communication with the Macro Arithmetic Processor manufactured by CSP Inc., through the EIA port of the Maintenance Test Panel. The user can list, edit or execute code from MAP memory, examine system flags or pseudo-memory, and with slight extension, load processors or change status words. The program is totally relocatable (including bus relocatable), and can thus be placed alongside existing software. The program was written to aid the construction and debugging of a Host Interface Controller, and was also used when making host related modifications to the Host Interface Module, or when writing the software device service routine or driver.



1. INTRODUCTION

The Macro Arithmetic Processor 200 (MAP) manufactured by CSP Inc., is a powerful 32-bit arithmetic processor than can, at least in principle, be interfaced to any main frame or minicomputer. For many brands of computer, CSP Inc. provide both the hardware and software interfacing, but in the case of our own minicomputer, a Texas Instruments 980B with the DX 980*E operating system, this support was not offered. We therefore had to develop, in house, the hardware interface, the so called Host Interface Controller or HIC, as well as the software driver and device service routine (DSR).

During this development, the Maintenance Test Panel (MTP) proved invaluable. It elevated the MAP from a 'black box', within which one could rarely, if at all, tell what was happening, to a 'front panel' unit with all the consequent benefits. These were primarily that one could enter commands directly into the MAP without need to go through the HIC, and that one could examine MAP memory to see whether attempted transfers from the host had been successful.

It soon became clear that programming the MAP through the EIA port of the MTP would greatly increase the panel's power, and allow much more rapid examination and modification of MAP memory than the conventional toggle switch entry would permit. MAPPER was therefore devised, and by using it program loops could be suitably written for the Host Interface Module (HIM) or the Central System Processing Unit (CSPU), and then executed to aid in the

location of the source of some bug. Furthermore, since the MAP could now be programmed and run entirely in the absence of a host or HIC, it was possible on several occasions to distinguish between bugs in the interface package being constructed, and periodic faults that developed in the MAP itself.

The aim of the present article, therefore, is to outline the use of MAPPER so that it might be used by others intending to interface a similar processor.

The program is clearly of major benefit for systems that are under development, since at this time the program 'LOOK', written by CSP Inc., cannot be used. It does, however, also have its role in a working system. By loading MAPPER alongside a MAP code module that is being tested and debugged (and which contains several strategically placed CSPU halt instructions), control can be passed to MAPPER and the past progress of the MAP code reviewed. After perhaps some modification of either the code or variables, the next portion of MAP code could be executed, and so on.

In the following sections, we discuss the basic commands of MAPPER together with the techniques for loading the program. Extensions of the basic commands are then discussed, and a complete assembly listing of the program is given. The nature of this article assumes the reader has some familiarity with the MAP architecture and software as covered in the CSP reference manuals.

2. BASIC COMMANDS

When ready to receive a new command, the program prompts the user with the single character '#'. Five basic commands can then be entered as follows:

#Fi	change the data bus to bus i for the A and W commands below, ie. the data will be taken from bus i.
#S	return the flag status to the flag LED display on the MTP.
#Xiabcd	start executing the code on bus i at location abcd. (Note: the data bus is left unchanged.)
#Aabcd ijkl mnop	alter the word at location abcd, replacing the old contents (ijkl) with mnop. ijkl are automatically displayed and mnop must be entered. If the command is terminated with a line-feed, the address is incremented, the next location's contents displayed, and the program waits for their modification. Alternatively, by terminating with a carriage-return, the command is finished and the program reprompts the user. A line-feed after 'ijkl' will immediately open the next location.
#Wabcd ijkl	write out the contents of abcd sequential locations starting at the address ijkl. The addresses are also printed.

Both the A and W commands process data on whichever bus has last been entered via the F command. When the program is initially loaded, the bus is set automatically to the program bus.

An incorrect character (ie. not 0-9 or A-F) entered in an argument to a command, results in the command being terminated and ignored. In the case of the A command, the contents of any opened location remain unchanged.

3 LOADING

The program is fully relocatable, and will function on any bus. To accomplish relocatability, the address switches on the panel are read to determine the program's base address. Normally, these switches will have been set during the load procedure, so caution is needed if MAPPER is entered by a 'JUMP' or 'CALL' instruction from another program. The switches must then be set accordingly.

The load procedure is as follows:

on bus 1: follow the standard EIA autoload procedure as outlined in the MTP documentation.

on bus 2 or 3: as the MTP does not permit direct autoload access to other than bus 1, the unit must be fooled. With MAPPER on bus 1, execute the following commands

```
#F2
#A0000 ???? 0880
#X20000
```

and the MAP will halt with bus 2 as the program bus. After pressing the address reset (avoiding the reset), one can now autoload onto the present bus.

There is however one caution. If MAPPER resides on bus 2 or 3, and a jump to another bus is executed, then there is no means to return to MAPPER via the front panel controls.

In our system, the source program was compiled on a main frame computer using the CSP Inc. Assembler compiler. The compiled output was written to magnetic cassette which could be mounted on a Texas Instruments Silent 700 terminal for loading as outlined above.

4. EXTENSION OF BASIC COMMANDS

The five commands outlined above provide a basic set of functions for manipulating MAP core. To perform more complex functions, such as addressing pseudo-memory, changing system flags, or loading processors etc., a sequence of basic commands can be combined, or a block of code can be written into core using MAPPER, and then executed. If such procedures are used extensively, they could be incorporated into MAPPER as new commands.

Two common requirements that we had while developing the HIC and software, were to read the HIM status word HISTAT, and modify the system flag SYSFLG. These were accomplished as follows:

4.1. Addressing Pseudo-Memory

To read 16-bit words from pseudo-memory, the contents of location 3E (relative to the MAPPER start address) should be changed to 0011_{16}. This sets the data bus to 1, and will effectively add 10000_{16} to any address supplied by the W or A commands, thereby accessing pseudo-memory. A further command #Fi will reset word 3E.

One can thus look at HISTAT by using the sequence

#Fj	set data bus to bus containing MAPPER
#A003E ???? 0011	change location 3E (relative to start address, assumed here to be zero)
#AFFCC ijkl C.R.	display contents of HISTAT
#Fi	reset word 3E.

4.2. Changing Sysflg

The HIM status word, HISTAT, could be changed by first writing into core and then executing the following code (assumed here to be at location 0800_{16}):

```
MOVIR  R0, $LIT        9000 $LIT     load up the literal ( 7 bits)
LLS    R0, 1           3A01          and shift left one
ADDIR  R0, $F801       9C00 F801     form the move literal instruction
MOVRM  R0, $0807       E000 0807     and store it in next location
MOVLM  $1FFCE          F801 FFCE     execute it to change SYSFLG
JMP    MAPPER          8000 0000     return to MAPPER (here at loc 0)
```

Other functions, such as loading the HIM, for example, can be achieved by similar means.

5. PROGRAM LISTING

The following pages give a listing of MAPPER obtained as output from the assembler compiler.

```
                    (0001) *      MAPPER:   MAINTENANCE TEST PANEL PROGRAM
                    (0002) *
                    (0003) *
                    (0004) *
                    (0005) *      P.M. HOLTHAM, 1980, DEFENCE RESEARCH OF CANADA,
                    (0006) *                          ESQUIMALT, VICTORIA,
                    (0007) *                          B.C., CANADA.
                    (0008) *
                    (0009) *
                    (0010) *      PROGRAM FULLY RELOCATABLE
                    (0011) *
                    (0012) *
                    (0013) *
                    (0014) *      ADD OPERATORS
                    (0015)         OPADD   MOVMC, (1 .LS. 14)+(34 .LS. 8)+(X'E8')
                    (0016)         OPADD   MOVCM, (1 .LS. 14)+(30 .LS. 8)+(X'EA')
                    (0017)         OPADD   MOVDI, (1 .LS. 14)+(26 .LS. 8)+(X'0A')
                    (0018)         OPADD   MOVSO, (1 .LS. 14)+(26 .LS. 8)+(X'0D')
                    (0019)         OPADD   MOVDO, (1 .LS. 14)+(26 .LS. 8)+(X'0C')
                    (0020)         OPADD   MOVSI, (1 .LS. 14)+(26 .LS. 8)+(X'0B')
                    (0021) *
                    (0022) *
                    (0023) *
                    (0024) *      DEFINE WORDS
           00000E70 (0025)         RETT=$0E70
           00002000 (0026)         NOPP=$2000
           0000000A (0027)         LF=$A
           0000000D (0028)         CR=$D
           00000003 (0029)         FLAGDISPLAY=3
           0001FFCE (0030)         SYSFLG=$1FFCE
                    (0031) *
                    (0032) *
                    (0033) *
                    (0034) *     REGISTER USAGE
                    (0035) *       R0 STACK POINTER
                    (0036) *       R1 COUNTER IN OUT4
                    (0037) *       R2 USED FOR I/O STATUS
                    (0038) *       R3 ASCII I/P OR O/P CHARCCTER
                    (0039) *       R4 PACKED HEX FOR I/P OR O/P
                    (0040) *       R5 TEMP STORAGE - NOTE: A SUB CALL MAY CHANGE
                    (0041) *       R6 PSEUDO BASE REG FOR RELOCATION
                    (0042) *       R7 COUNTER IN W ROUTINE
                    (0043) *      NOTE: ALL CALLS MUST BE MADE WITHOUT A REGISTER
                    (0044) *            SAVE, SINCE THE STACK POINTER IS RESET
                    (0045) *
                    (0046) *
                    (0047) *
                    (0048) *
                    (0049) *
00000  0A80     (0050) HOME    MOVDI R0,0              /SORT OUT THE RELOCATION
00001  CC0C008A (0051)         MOVZM AFLAG(R6)         /CLEAR ASK FLAG
00003  4060     (0052)         MOVRR R6 R0             /SET UP BASE REG
00004  9C000124 (0053)         ADDIR R0,...K           /STACK POINTER RESET
00006  860C010A (0054)         CALL R0,CL...(R6)
00008  90300023 (0055)         MOVIR R3,'#'
0000A  860C008B (0056)         CALL R0,WRITE(R6)
```

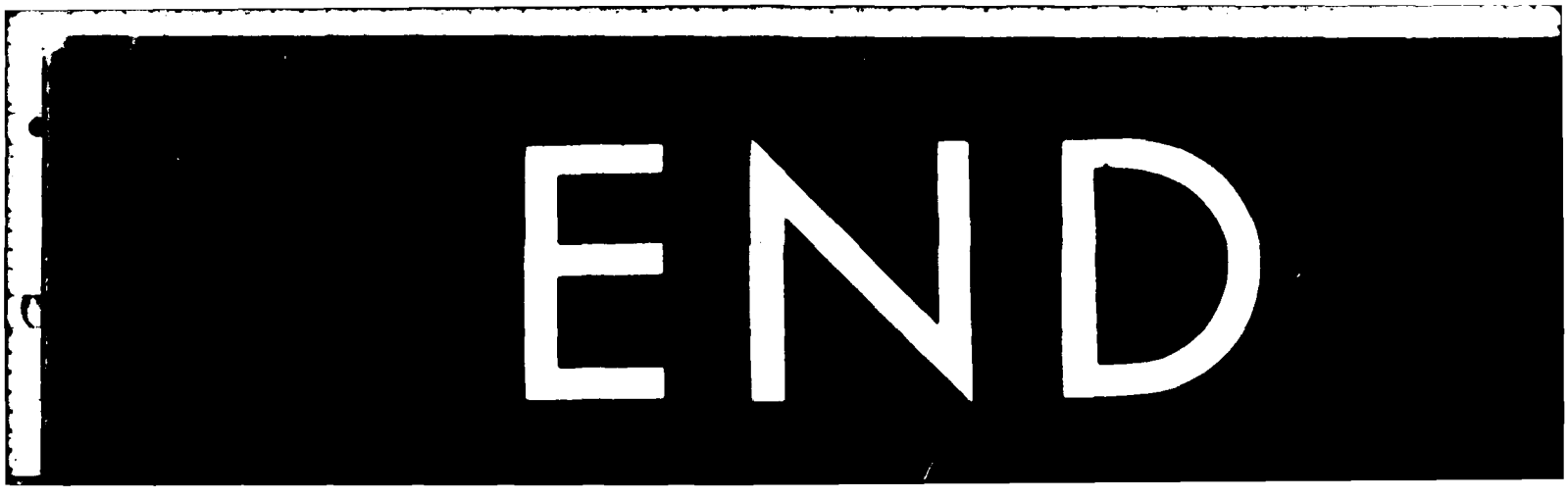
```
0000C  0AD1      (0057)          MOVDI R5,1              /CLEAR ANY INPUT CHAR
0000D  860C00A8  (0058)          CALL R0,CHAR(R6)        /WAIT FOR INPUT IN R3
0000F  92300041  (0059)          CMPIR R3,'A'
00011  801C0061  (0060)          JMP AA(R6),EQ
00013  92300058  (0061)          CMPIR R3,'X'
00015  801C0028  (0062)          JMP XX(R6),EQ
00017  92300046  (0063)          CMPIR R3,'F'
00019  801C003A  (0064)          JMP FF(R6),EQ
0001B  92300057  (0065)          CMPIR R3,'W'
0001D  801C0040  (0066)          JMP WW(R6),EQ
0001F  92300053  (0067)          CMPIR R3,'S'
00021  801C0024  (0068)          JMP SS(R6),EQ
00023  20C5      (0069)          HOP ABOR
               (0070) *
               (0071) *
               (0072) *
00024  F051FFCE  (0073) SS       MOVMR R5,SYSFLG         /GET STATUS
00026  0DD3      (0074)          MOVSO R5,FLAGDISPLAY
00027  2128      (0075)          HOP HOME
               (0076) *
               (0077) *
               (0078) *
00028  860C00C2  (0079) XX       CALL R0,NUM(R6)         /READ BUS
0002A  3A3C      (0080)          LLS R3,12               /SHIFT TO CORRECT PLACE
0002B  4076      (0081)          MOVRR R7,R3             /STORE IT IN R7
0002C  860C0113  (0082)          CALL R0,GET4(R6)        /GET ADDRESS
0002E  EA0C0124  (0083)          MOVCM STACK(R6)         /NB: R0 MUST POINT TO
               (0084) *                                 /    TO STACK
00030  2601      (0085)          INCR R0,1
00031  7050CFFC  (0086)          MOVWK R5,R0,$CFFC
00033  4C5E      (0087)          ADDRR R5,R7
00034  844C0124  (0088)          MOVRML R4,STACK(R6)
00036  E80C0124  (0089)          MOVMC STACK(R6)         /RESET THE CSW
               (0090)          EVEN
00038  0000      (0091) ADDR2    DATA 0,0
00039  0000
               (0092) *
               (0093) *
0003A  860C00C2  (0094) FF       CALL R0,NUM(R6)         /GET BUS
0003C  3A34      (0095)          LLS R3,4
0003D  E03C0038  (0096)          MOVRM R3,ADDR2(R6)      /STORE IT
0003F  2140      (0097)          HOP HOME
               (0098) *
               (0099) *
00040  860C0113  (0100) WW       CALL R0,GET4(R6)        /GET NUMBER TO DO
00042  90502000  (0101)          MOVIR R5,NOPP
00044  E05C0058  (0102)          MOVRM R5,INSTR(R6)
00046  4078      (0103)          MOVRR R7,R4             /COUNT
00047  860C010A  (0104)          CALL R0,CRLF(R6)
00049  860C0113  (0105) ENTER    CALL R0,GET4(R6)        /GET START
0004B  E04C0039  (0106)          MOVRM R4,ADDR2+1(R6)
0004D  2004      (0107)          HOP GO
0004E  F04C0039  (0108) LOOP2    MOVMR R4,ADDR2+1(R6)    /GET ADDRESS
00050  860C00EE  (0109)          CALL R0,OUT4(R6)        /OUTPUT IT
00052  860C0103  (0110) GO       CALL R0,SPACES(R6)
00054  F0CC0038  (0111)          MOVMR R4,@ADDR2(R6)     /GE  WORD
```

```
00056  860C00EE (0112)         CALL R0,OUT4(R6)        /O/P IT
00058  2000     (0113) INSTR    NOP                     /OTHER SUB WILL CHANGE
00059  E50C0039 (0114)         INCM ADDR2+1(R6)        /INCR ADDRESS
0005B  860C010A (0115)         CALL R0,CRLF(R6)
0005D  2771     (0116)         DECR R7,1               /DECR COU T
0005E  811C004E (0117)         JMP LOOP2(R6),NE
00060  2161     (0118)         HOP HOME
                (0119) *
                (0120) *
                (0121) *
00061  90500E70 (0122) AA       MOVIR R5,RETT
00063  E05C0058 (0123)         MOVRM R5,INSTR(R6)
00065  860C0049 (0124)         CALL R0,ENTER(R6)
00067  E50C008A (0125)         INCM AFLAG(R6)          /SET THE AFLAG
00069  2002     (0126)         HOP OVER
0006A  860C004E (0127) NXT     CALL R0,LOOP2(R6)
0006C  860C0103 (0128) OVER    CALL R0,SPACES(R6)
0006E  CC0C0089 (0129)         MOVZM LFFLAG(R6)        /LINE FEED FLAG
00070  860C0113 (0130)         CALL R0,GET4(R6)        /NEW CONTENTS
00072  E20C0089 (0131)         CMPMZ LFFLAG(R6)        /WAS THERE A LINE FEED
00074  811C0082 (0132)         JMP INC(R6),NE          /YES. INCREMENT AND REDO
00076  E0CC0038 (0133)         MOVRM R4,@ADDR2(R6)     /STORE THEM
00078  860C00A8 (0134)         CALL R0,CHAR(R6)        /CHECK FOR TERMINATOR
0007A  9230000D (0135)         CMPIR R3,CR             /CARRIAGE RETURN
0007C  801C0000 (0136)         JMP HOME(R6),EQ
0007E  9230000A (0137)         CMPIR R3,LF             /LINE FEED?
00080  811C00B7 (0138)         JMP ERROR(R6),NE
00082  E50C0039 (0139) INC     INCM ADDR2+1(R6)        /INCR ADDRESS
00084  9030000D (0140)         MOVIR R3,CR
00086  860C008B (0141)         CALL R0,WRITE(R6)
00088  211F     (0142)         HOP NXT
00089  0000     (0143) LFFLAG  DATA 0
0008A  0000     (0144) AFLAG   DATA 0
                (0145) *
                (0146) *
                (0147) *
0008B  4056     (0148) WRITE   MOVRR R5,R3             /OUTPUT THE CHAR
0008C  860C0093 (0149)         CALL R0,READY(R6)       /WAIT AND O/P
0008E  4E5A     (0150)         SUBRR R5,R5             /SET UP AND DO 3 NULLS
0008F  860C0093 (0151)         CALL R0,READY(R6)       /WAIT AND O/P
00091  860C0093 (0152)         CALL R0,READY(R6)       /WAIT AND O/P
00093  0BA1     (0153) READY   MOVSI R2,1              /STATUS OF PRINTER
00094  9A200001 (0154)         ANDIR R2,1              /STATUS OF PRINTER
00096  8D2C0093 (0155)         DJN R2,READY(R6)        /REWAIT IF NOT READY
00098  0CD1     (0156)         MOVDO R5,1
00099  9230000A (0157)         CMPIR R3,LF
0009B  801C00A2 (0158)         JMP DLY(R6),EQ
0009D  9230000D (0159)         CMPIR R3,CR
0009F  801C00A2 (0160)         JMP DLY(R6),EQ
000A1  0E70     (0161) BACK    RETURN
                (0162) *
000A2  90504A00 (0163) DLY     MOVIR R5,$4A00          /SET UP REPEAT
000A4  1C50     (0164)         RPT R5
000A5  90120000 (0165)         MOVIR R1,0(R1)
000A7  2107     (0166)         HOP BACK
                (0167) *
```

```
                    (0168) *
000A8   0BA1        (0169) CHAR   MOVSI R2,1          /INPUT A CHAR
000A9   9A200030    (0170)        ANDIR R2,$30        /STATUS
000AB   9E200010    (0171)        SUBIR R2,$10
000AD   803C00A8    (0172)        JMP CHAR(R6),LT     /NO CHAR YET
000AF   811C00B7    (0173)        JMP ERROR(R6),NE    /TWO CHARS!
000B1   0AB1        (0174)        MOVDI R3,1          /LEAVE PREFIC ON
000B2   9A30007F    (0175)        ANDIR R3,$7F        /STRIP UNDEFINED  BITS
000B4   860C008B    (0176)        CALL R0,WRITE(R6)   /ECHO
000B6   0E70        (0177)        RETURN
                    (0178) *
                    (0179) *
000B7   90300024    (0180) ERROR  MOVIR R3,'$'
000B9   860C008B    (0181)        CALL R0,WRITE(R6)
000BB   860C008B    (0182)        CALL R0,WRITE(R6)
000BD   860C008B    (0183)        CALL R0,WRITE(R6)
000BF   860C008B    (0184)        CALL R0,WRITE(R6)
000C1   21C2        (0185)        HOP HOME
                    (0186) *
                    (0187) *
                    (0188) *
000C2   860C00A8    (0189) NUM    CALL R0,CHAR(R6)    /TO INPUT A NUMBER AND
                    (0190) *                          /ABORT IF ILLEGAL
000C4   92300030    (0191)        CMPIR R3,'0'        /MUST BE > OR = 0
000C6   803C00D9    (0192)        JMP ABOR1(R6),LT    /SPECIAL ABORT FOR 1ST
                    (0193) *                          /CHARACTER
000C8   92300039    (0194)        CMPIR R3,'9'        /MUST BE < OR = ZERO
000CA   812C00D6    (0195)        JMP OK(R6),LE
000CC   92300041    (0196)        CMPIR R3,'A'        /MUST BE > OR = 0
000CE   803C00E9    (0197)        JMP ABOR(R6),LT
000D0   92300046    (0198)        CMPIR R3,'F'        /MUST BE < OR = 0
000D2   802C00E9    (0199)        JMP ABOR(R6),GT
000D4   9C300009    (0200) OK2    ADDIR R3,9          /ADD 9 FOR A-F
000D6   9A30000F    (0201) OK     ANDIR R3,$F         /STRIP OFF GARBAGE
000D8   0E70        (0202)        RETURN
                    (0203) *
000D9   E20C008A    (0204) ABOR1  CMPMZ AFLAG(R6)
000DB   801C00E9    (0205)        JMP ABOR(R6),EQ     /STRAIGHT OFF TO ABOR IF
                    (0206) *                          /NOT IN THE 'A' ROUTINE
000DD   9230000D    (0207)        CMPIR R3,CR
000DF   801C0000    (0208)        JMP HOME(R6),EQ     /TERMINATE THE A ROUTINE
000E1   9230000A    (0209)        CMPIR R3,LF
000E3   811C00E9    (0210)        JMP ABOR(R6),NE
000E5   E50C0089    (0211)        INCM LFFLAG(R6)     /SET THE LINE FEED FLAG
000E7   2702        (0212)        DECR R0,2           /DECR STACK TO GO BACK
                    (0213) *                          /ONE ROUTINE
000E8   0E70        (0214)        RETURN
                    (0215) *
000E9   9030003F    (0216) ABOR   MOVIR R3,'?'
000EB   860C008B    (0217)        CALL R0,WRITE(R6)
000ED   21EE        (0218)        HOP HOME
000EE   90100004    (0219) OUT4   MOVIR R1,4          /UNPACK AND OUTPUT FOUR
                    (0220) *                          /HEX CHARACTERS.
                    (0221) *                          /RESET COUNTER
000F0   3A42        (0222)        LLS R4,2
000F1   3E4E        (0223) LOOP3  ROR R4,14           /DATA ROTATED
```

```
000F2  5038000F (0224)         MOVKR R3,R4,$F        /PICK OF RIGHT CHAR
                (0225) *                             /AND MOVE TO R3
000F4  92300009 (0226)         CMPIR R3,9            /0-9 OR A-F
000F6  812C00FA (0227)         JMP ALPHA(R6),LE      /JUMP FOR 0-9 ONLY
000F8  9C300007 (0228)         ADDIR R3,$11-$A       /A-F ADD PREFIX NOTING
                (0229) *                             /$30 DONE NEXT LINE
000FA  9C300030 (0230) ALPHA   ADDIR R3,$30          /0-9 ADD ASCI PREFIX
000FC  860C008B (0231)         CALL R0,WRITE(R6)
000FE  9E100001 (0232)         SUBIR R1,1            /DECR COUNT
00100  1810     (0233)         SKP EQ
00101  2111     (0234)         HOP LOOP3
00102  0E70     (0235)         RETURN
                (0236) *
                (0237) *
00103  903000A0 (0238) SPACES  MOVIR R3,$A0          /O/P 2 SPACES
00105  860C008B (0239)         CALL R0,WRITE(R6)
00107  860C008B (0240)         CALL R0,WRITE(R6)
00109  0E70     (0241)         RETURN
                (0242) *
                (0243) *
0010A  9030000D (0244) CRLF    MOVIR R3,CR
0010C  860C008B (0245)         CALL R0,WRITE(R6)
0010E  9030000A (0246)         MOVIR R3,LF
00110  860C008B (0247)         CALL R0,WRITE(R6)
00112  0E70     (0248)         RETURN
                (0249) *
00113  860C00C2 (0250) GET4    CALL R0,NUM(R6)       /SUBROUTINE TO READ
                (0251) *                             /FOUR ASCII CHARACTERS
00115  3A3C     (0252)         LLS R3,12             /STRIP PREFIXES AND PACK
00116  4046     (0253)         MOVRR R4,R3           /R3 USED IN READ
00117  860C00C2 (0254)         CALL R0,NUM(R6)       /R4 USED FOR O/P
00119  3A38     (0255)         LLS R3,8              /R2 USED BY READ
0011A  4C46     (0256)         ADDRR R4,R3           /R1 IS ZERO SO NO
                (0257) *                             /REGISTER STORE
0011B  860C00C2 (0258)         CALL R0,NUM(R6)       /R0 IS STACK POINTER
0011D  3A34     (0259)       LLS R3,4
0011E  4C46     (0260)       ADDRR R4,R3
0011F  860C00C2 (0261)       CALL R0,NUM(R6)
00121  4C46     (0262)       ADDRR R4,R3
00122  0E70     (0263)       RETURN
                (0264) *
                (0265) *
00123  0800     (0266)         EVEN
00124  0000     (0267) STACK   DATA 0
00125           (0268)         END
```

```
AA:         00061 (0060)(0122)
ABOR:       000E9 (0069)(0197)(0199)(0205)(0210)(0216)
ABOR1:      000D9 (0192)(0204)
ADDR2:      00038 (0091)(0096)(0106)(0108)(0111)(0114)(0133)(0139)
AFLAG:      0008A (0051)(0125)(0144)(0204)
ALPHA:      000FA (0227)(0230)
BACK:       000A1 (0161)(0166)
CHAR:       000A8 (0058)(0134)(0169)(0172)(0189)
CR:         0000D (0028)(0135)(0140)(0159)(0207)(0244)
CRLF:       0010A (0054)(0104)(0115)(0244)
DLY:        000A2 (0158)(0160)(0163)
ENTER:      00049 (0105)(0124)
ERROR:      000B7 (0138)(0173)(0180)
FF:         0003A (0064)(0094)
FLAGDISP:   00003 (0029)(0074)
GET4:       00113 (0082)(0100)(0105)(0130)(0250)
GO:         00052 (0107)(0110)
HOME:       00000 (0050)(0075)(0097)(0118)(0136)(0185)(0208)(0218)
INC:        00082 (0132)(0139)
INSTR:      00058 (0102)(0113)(0123)
LF:         0000A (0027)(0137)(0157)(0209)(0246)
LFFLAG:     00089 (0129)(0131)(0143)(0211)
LOOP2:      0004E (0108)(0117)(0127)
LOOP3:      000F1 (0223)(0234)
NOPP:       02000 (0026)(0101)
NUM:        000C2 (0079)(0094)(0189)(0250)(0254)(0258)(0261)
NXT:        0006A (0127)(0142)
OK:         000D6 (0195)(0201)
OK2:        000D4 (0200)
OUT4:       000EE (0109)(0112)(0219)
OVER:       0006C (0126)(0128)
READY:      00093 (0149)(0151)(0152)(0153)(0155)
RETT:       00E70 (0025)(0122)
SPACES:     00103 (0110)(0128)(0238)
SS:         00024 (0068)(0073)
STACK:      00124 (0053)(0083)(0088)(0089)(0267)
SYSFLG:     1FFCE (0030)(0073)
WRITE:      0008B (0056)(0141)(0148)(0176)(0181)(0182)(0183)(0184)(0217)(0231)
                  (0239)(0240)(0245)(0247)
WW:         00040 (0066)(0100)
XX:         00028 (0062)(0079)
```


END