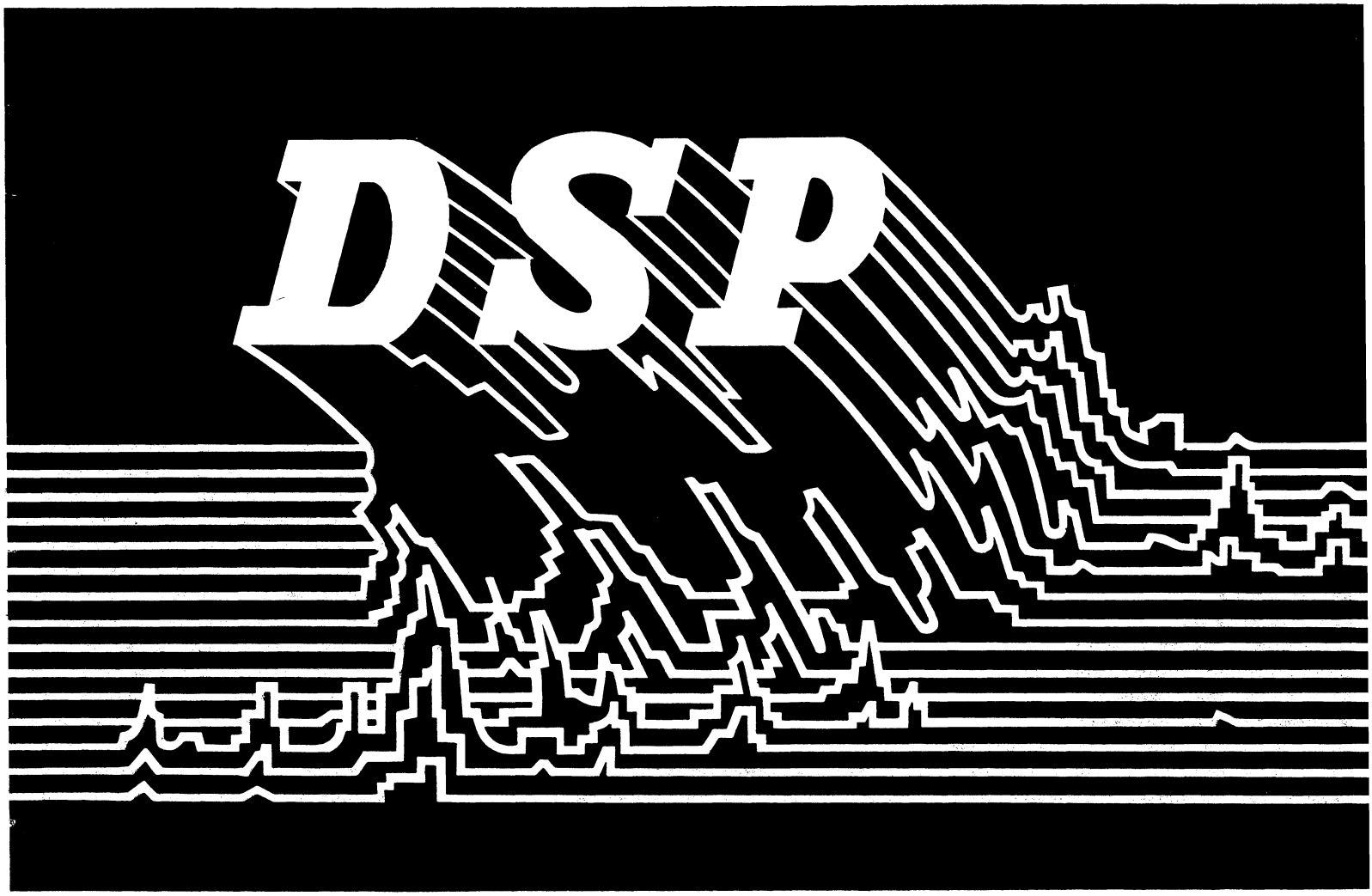
Low Cost Controller for DSP56001



MOTOROLA

Low Cost Controller for DSP56001

Prepared by: John Ralston, Micro Application Group, East Kilbride, Scotland

INTRODUCTION

The DSP56001 has 512 words of full speed on-chip program RAM (PRAM) memory. The PRAM can be loaded via the HOST port interface of the DSP56001 under control of special on-chip bootstrap hardware at RESET. An external controller using this feature could be used to BOOTSTRAP a DSP56001 via the HOST interface. This means there would be no requirement for EPROMs or RAM on the DSP56001 external bus, provided that the program resides in 512 words or less. The following application shows how a MC68008 based circuit can be used as a low cost controller which utilises this feature. The circuit has the added advantages of being able to reset each of the DSP56001 it controls and down load a new program, hence providing overlay capability, and to act as an I/O controller for the DSPs.

CIRCUIT DESCRIPTION

The overview of the controller is shown in Figure 1 and the schematics are in Figure 4. The main sections of the controller are:-

The decode consists of two 3 to 8 line (**U15** and **U24**) decocoders. **U15** provides the chip selects for the peripherals. The selects are conditioned with DS* via **U17** to **U22**, to ensure the correct data hold times. **U24** generates the selects for the memory devices. The lower two selects are transposed at system reset to allow the MC68008 to boot from EPROM and then have the vector table available in RAM. This is achieved by **U27** being reset by **POWERON*** and set by the first access to the second select line from **U24**. The Q and the Q* outputs of **U27** are used to determine which select passes through **U28** and **U29** to generate **CEMONITOR*** or **CERAM0***.

The serial communication is provided by the two serial channels of a MC68681 **DUART**. This provides a terminal and host link for development use.

The parallel I/O is made up form three MC68230s **PI/T**. This provides 72 lines of I/O, of which two are used to give independent reset control over the two DSPs.

The interrupt control logic is based on **U3** to **U7** to encode the request level. The DSPs produce a level 5 interrupt request and the other peripherals produce a level 2 interrupt request. There is provision for a software abort which generates a level 7 interrupt request. The interrupt acknowledge cycle is decoded by **U36** and **U37** and passed into a chain of priority decoders built from cascade OR gates. See circuit DIAGRAM sheet 3 of 7.

The memory map of the controller is shown in Figure 2. The memory, RAM and EPROM, is in two parts. The first consists of an EPROM containing the monitor program. In the initial design TUTOR† was used, and a byte wide static RAM **MC60256-12**, used as the work area of the monitor. These devices were controlled by the signals **CEMONITOR*** and **CERAM0***. To use this method the monitor EPROM should be layed out as in figure 3. The second part of the memory selects **CS_SEL2*** and **CS_SEL3*** which could be either RAM or EPROM. These would initially be RAM to allow the development of the application program.

The DSP56001 Host Interface is used by the MC68008 to download information into the DSPs. The MC68008 has control over the individual DSPs reset lines via PI/T1 PC0 (**CONTROL0***) and PC1(**CONTROL1***). To allow the system reset **RESET*** to reset the DSPs **CONTROL0*** and **CONTROL1** are conditioned with **RESET*** by **U61** and **U62** respectively. Figure 5 contains a short program which resets either of the DSPs and downloads data/code to the internal RAM of the DSPs. The program makes use of the TUTOR monitor I/O handling to perform the user interface.

† TUTOR is a firmware package which provides a self contained programming and operating environment. TUTOR is a freeware product available from MOTOROLA.

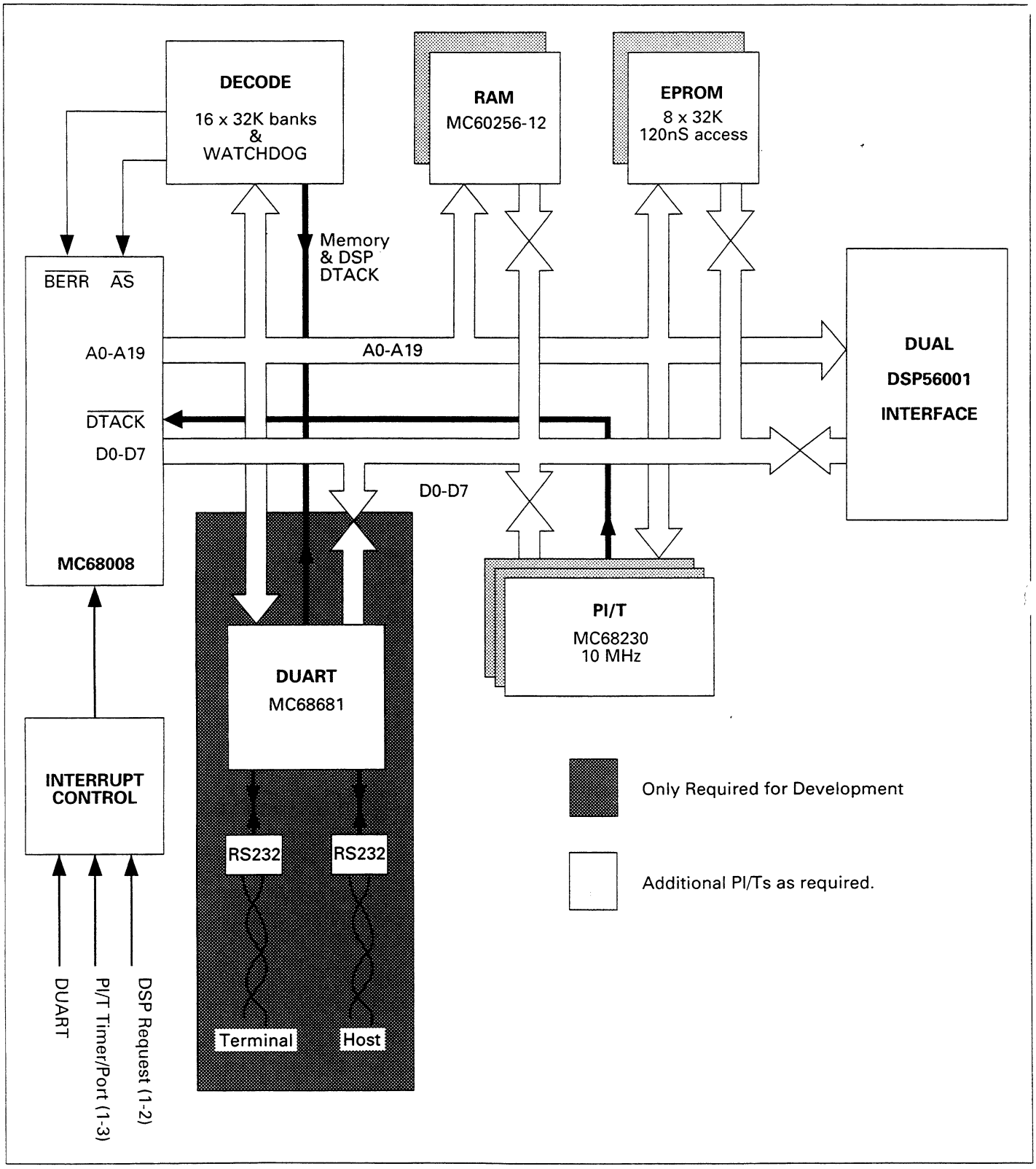


Figure 1
MC68008 Controller For Two DSP56001

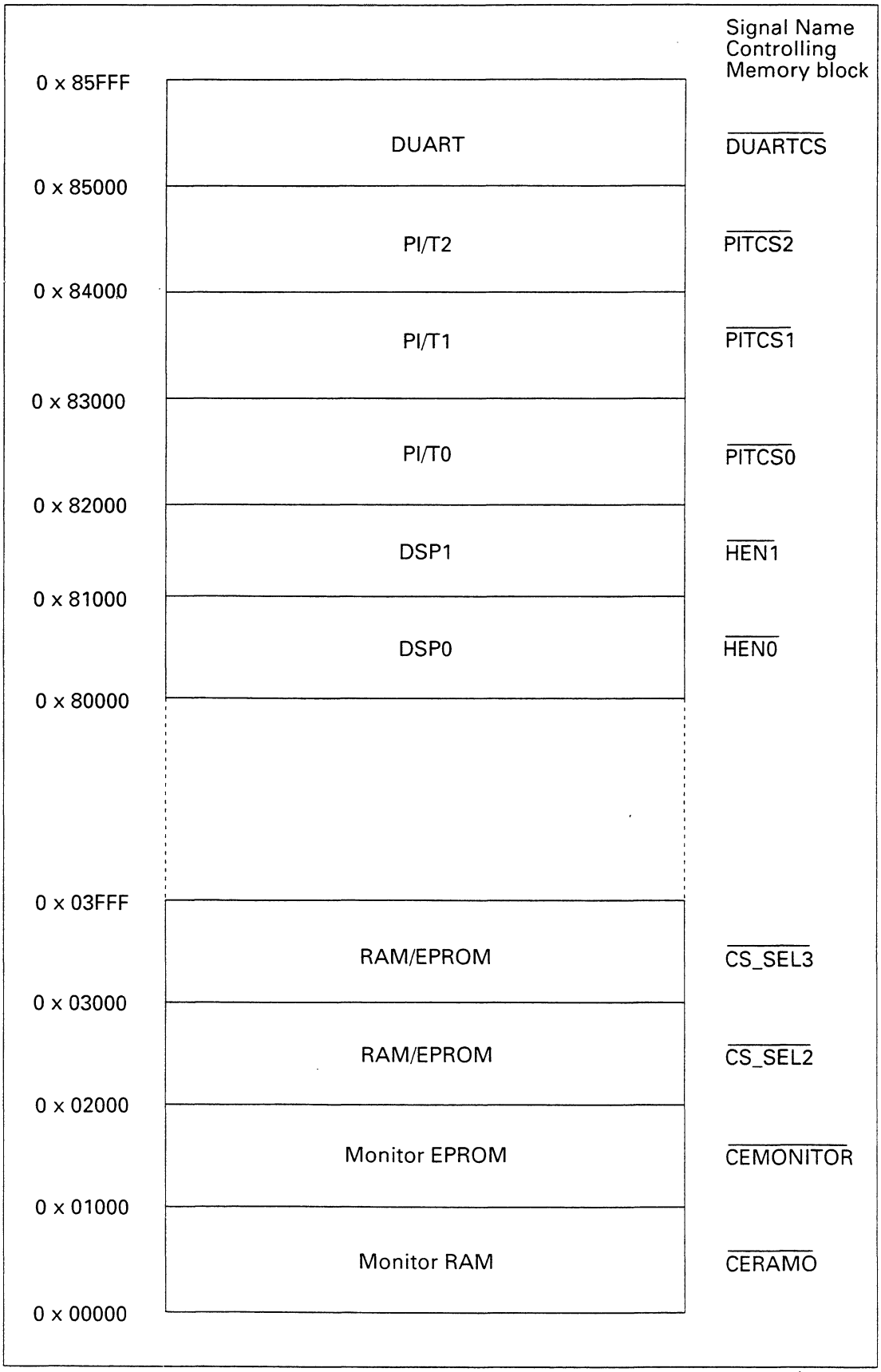


Figure 2
MEMORY MAP

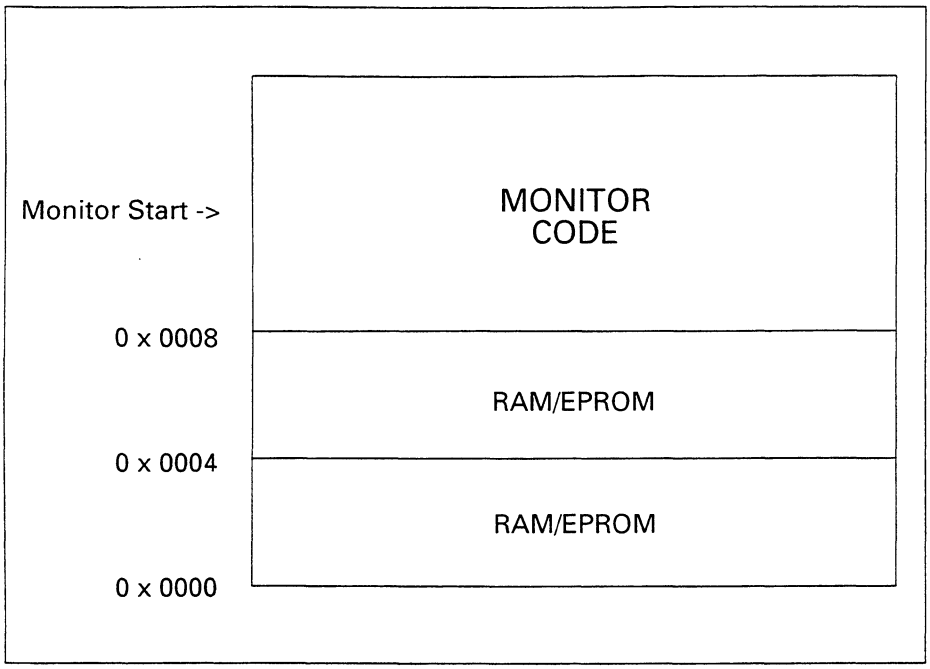


Figure 3
LAYOUT OF Monitor EPROM

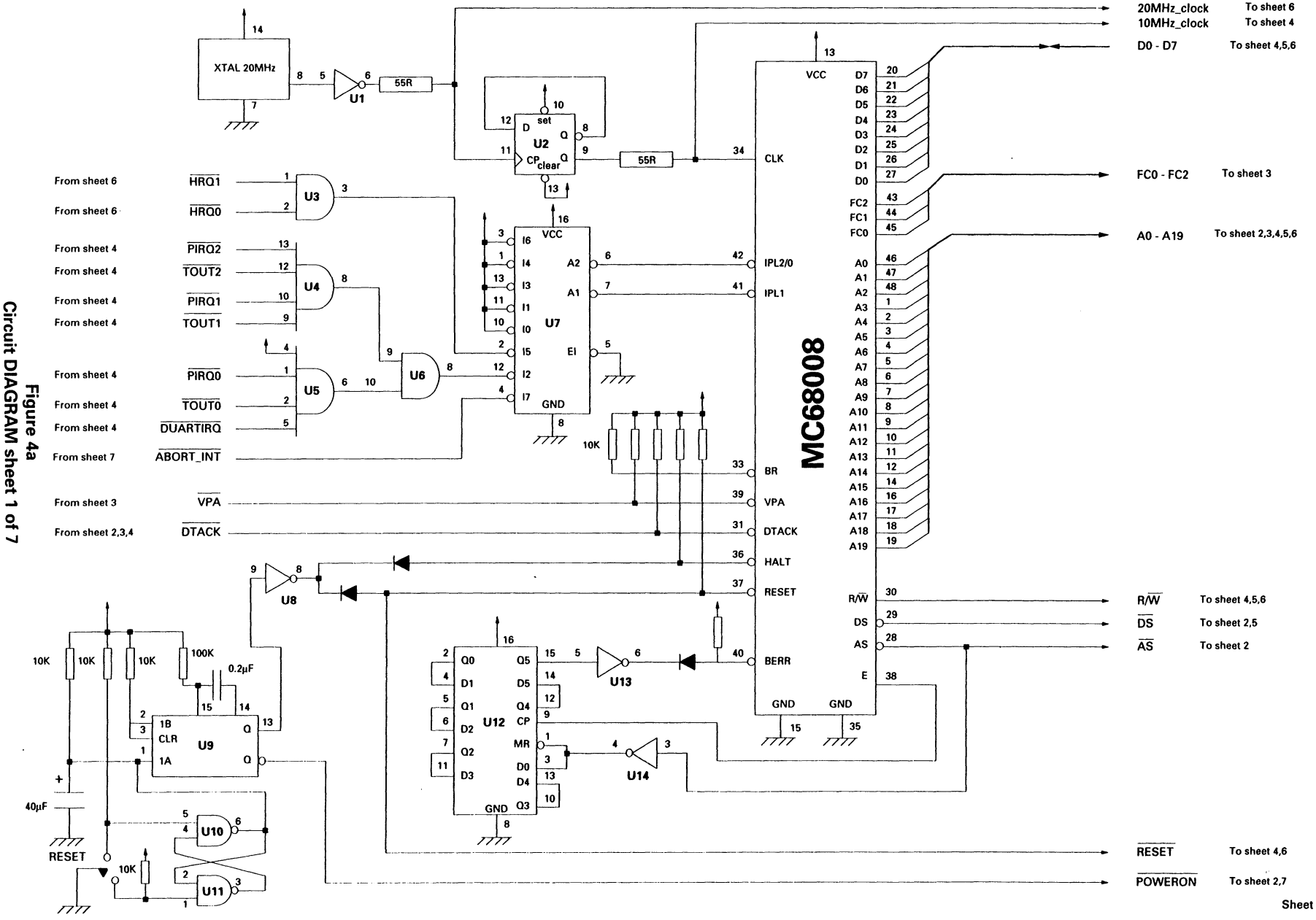


Figure 4a
Circuit DIAGRAM sheet 1 of 7

Sheet 1 of 7

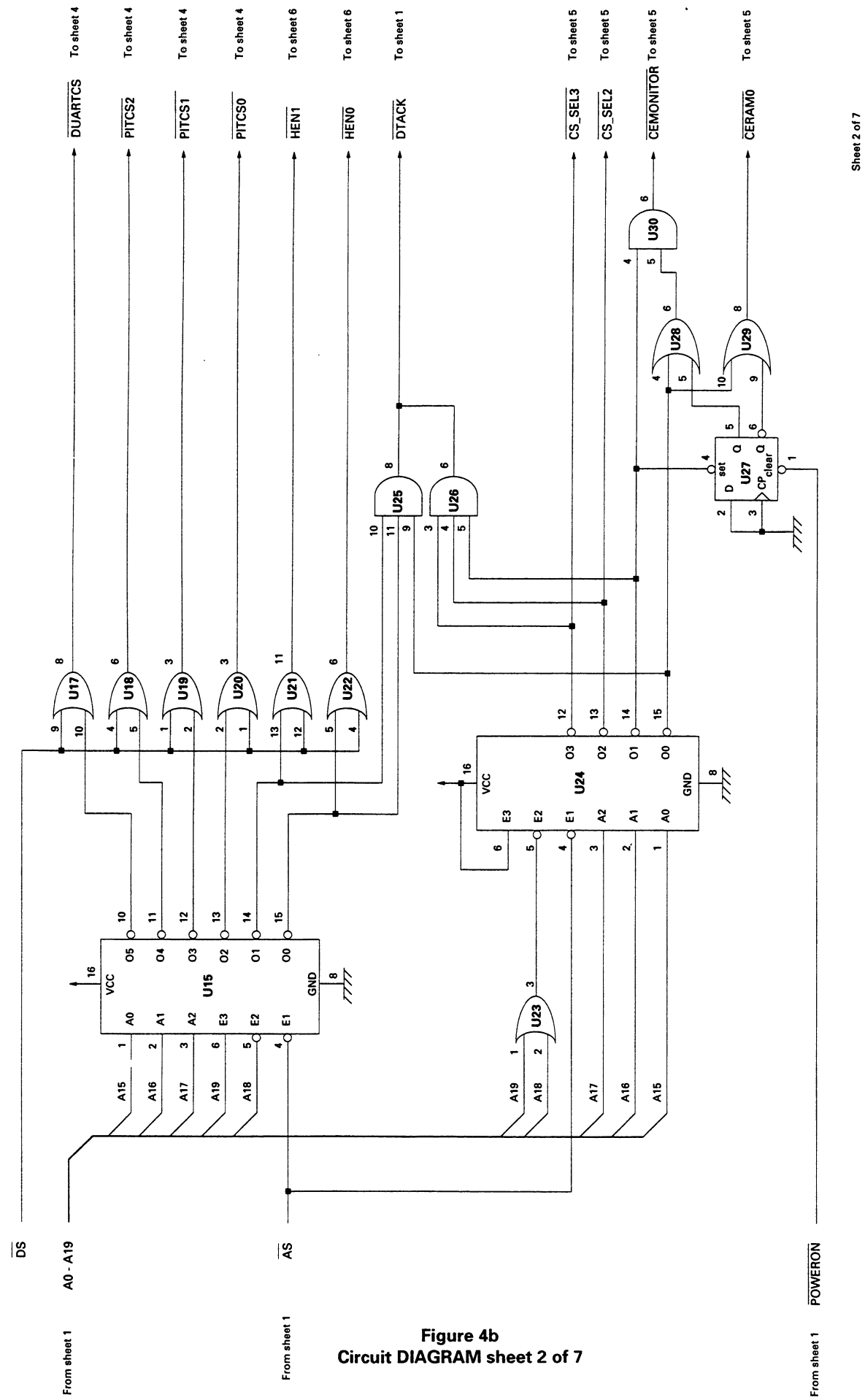


Figure 4b
Circuit DIAGRAM sheet 2 of 7

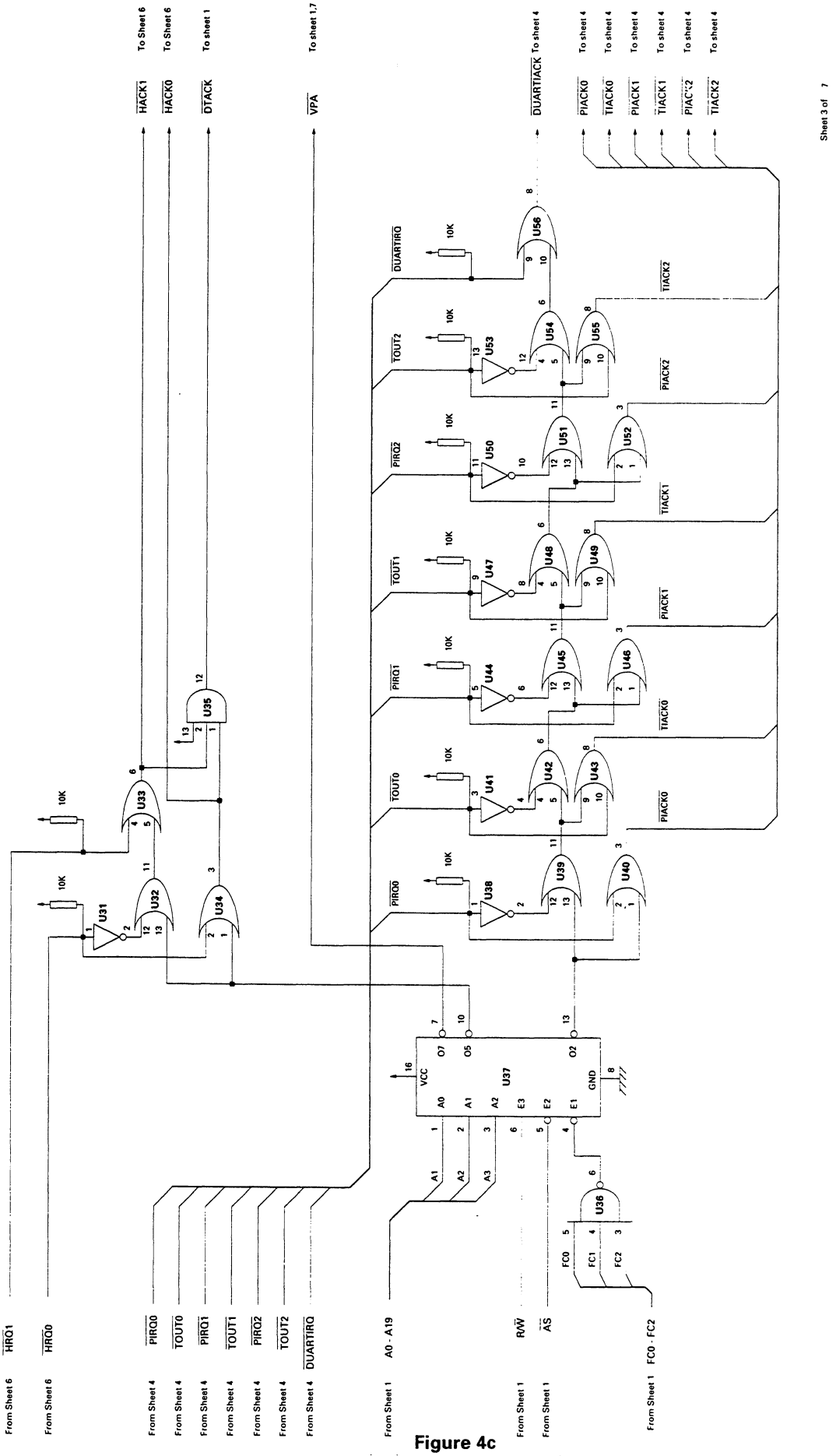
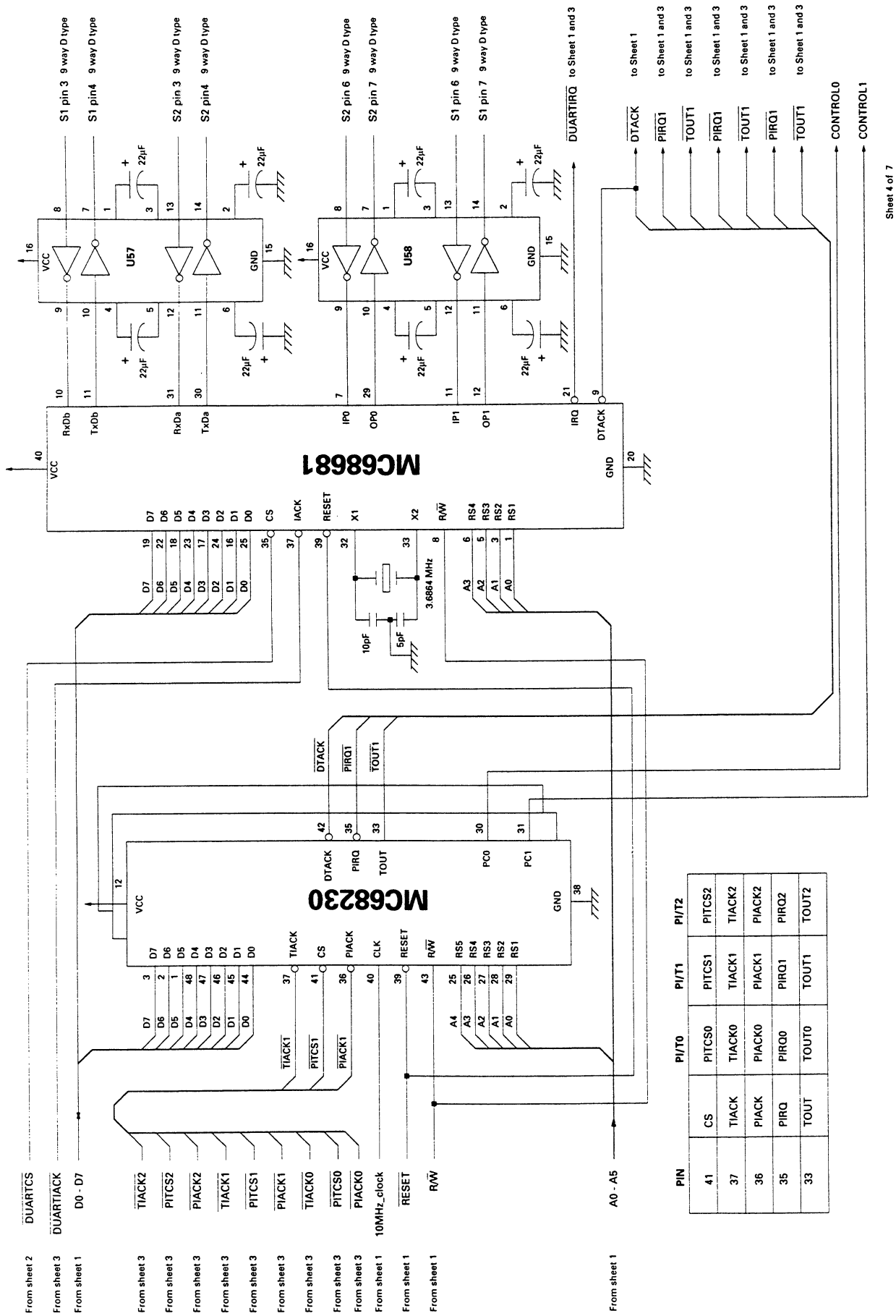
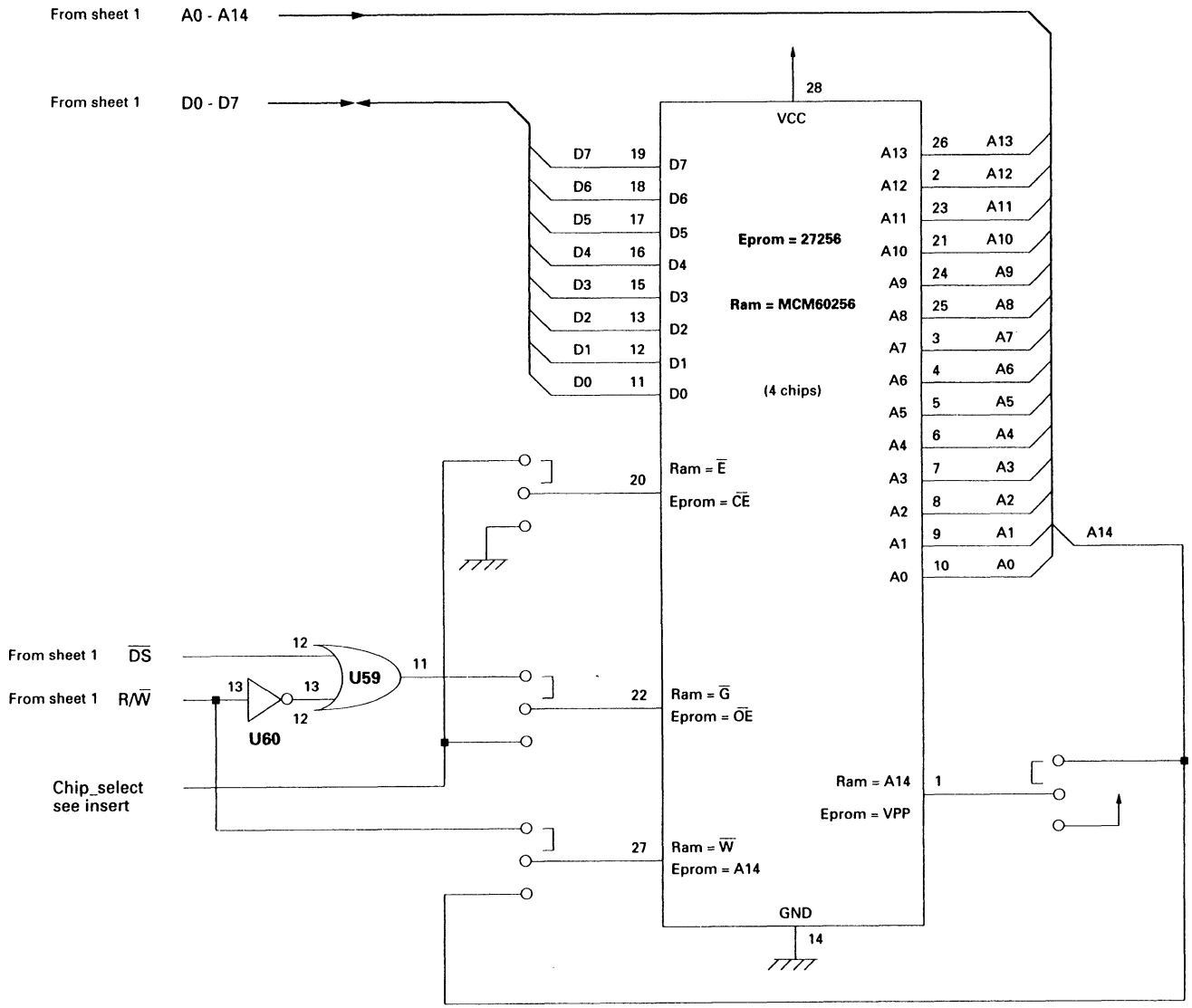


Figure 4c
Circuit DIAGRAM sheet 3 of 7

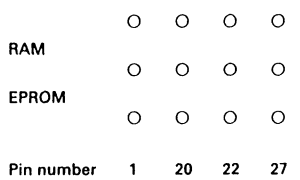


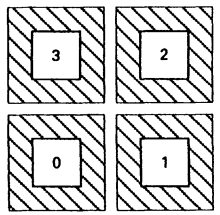
PIN		PI/T0	PI/T1	PI/T2
41	CS	PITCS0	PITCS1	PITCS2
37	TIACK	TIACK0	TIACK1	TIACK2
36	PIACK	PIACK0	PIACK1	PIACK2
35	PIRQ	PIRQ0	PIRQ1	PIRQ2
33	TOUT	TOUT0	TOUT1	TOUT2

Figure 4d
Circuit DIAGRAM sheet 4 of 7



Jumper positioning for each chip.





Relative position of jumper blocks

Chip Postion	Chip_Select
0	CERAM0
1	CEMONITOR
2	CS_SEL2
3	CS_SEL3

Figure 4e
Circuit DIAGRAM sheet 5 of 7

Sheet 5 of 7

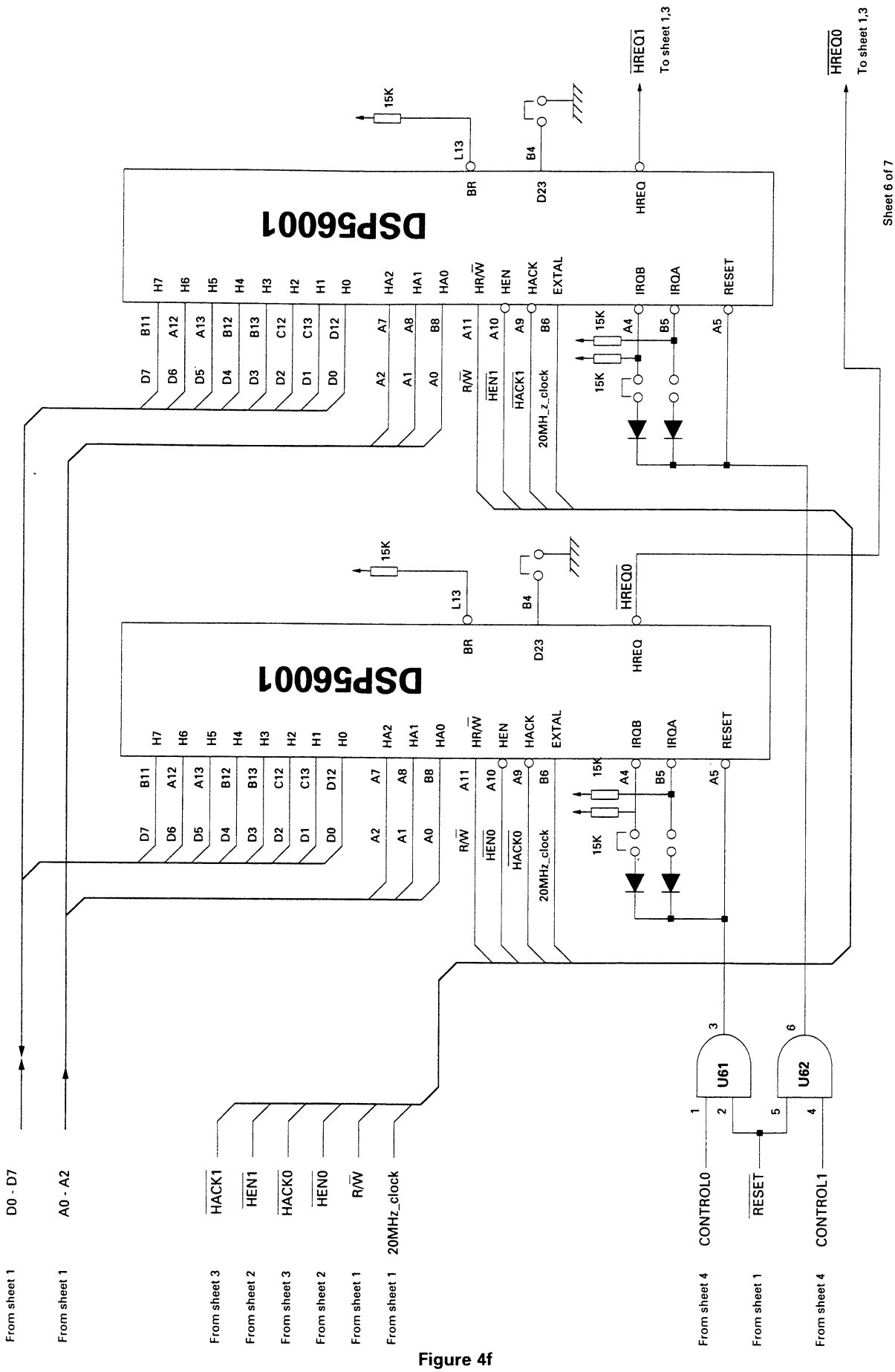


Figure 4f
Circuit DIAGRAM sheet 6 of 7

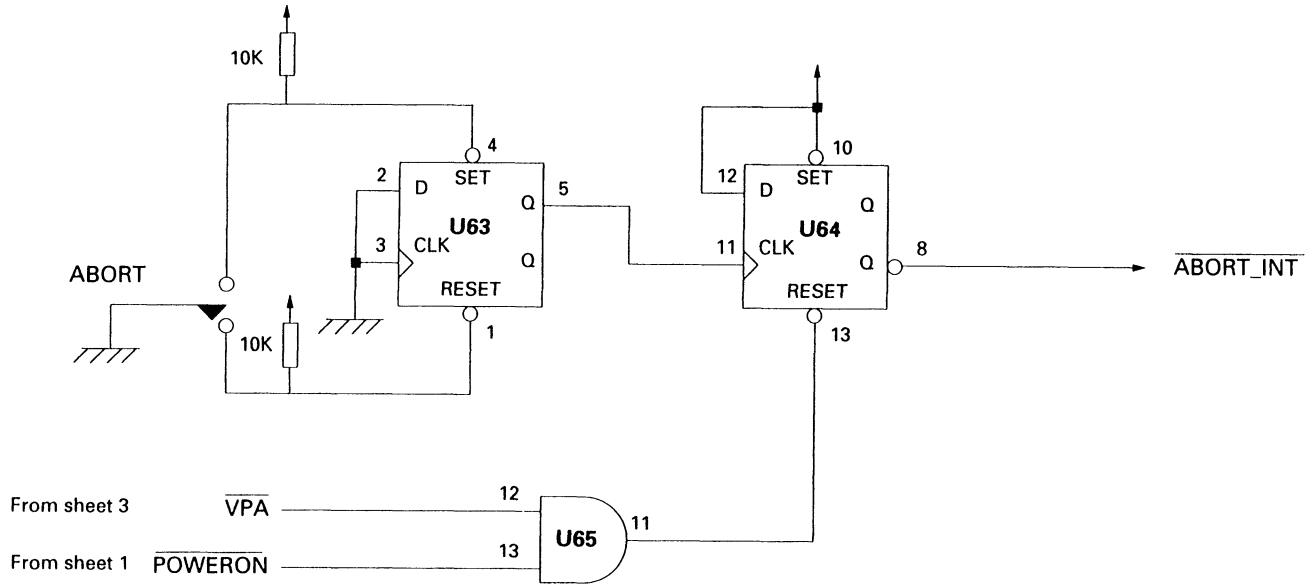


Figure 4g Circuit DIAGRAM sheet 7 of 7

CHIP number	Device
U15	74LS138
U24	74LS138
U25,U26,U35	74LS15
U12	74LS174
U17,U20,U21,U22	74LS32
U7	74LS148
U37	74LS138
U36	74LS10
U39,U40,U42,U43	74LS32
U45,U46,U48,U49	74LS32
U51,U52,U54,U55	74LS32
U32,U33,U34,U56	74LS32
U38,U41,U43,U47,U59,U53	74LS04
U8,U13,U14,U31,U59	74LS04
U4,U5	74LS21
U23,U28,U29,U58	74F32
U3,U6,U30,U65	74F08
U2,U27	74F74
U9	74LS123
U1	74F04
U18,19	74LS32
U57	MAX232
U63,U64	74LS74
U58	MAX232
U10,U11	74LS00
U61,U62	74LS08

Figure 5
Listing

```
Motorola M68020 ASM Version  1.10   dspcmds.sa                    03/09/89 16:48:11

                                OPT      P=68000,MEX,BRS,CRE
                        DSPCMD  IDNT     1,1
                                XDEF     DLCMD
                                XDEF     DRCMD
            0000000C            SECTION  12


                        **********************
                        *
                        *       Monitor TRAP 14 calls
                        *
                        **********************

            000000FC    FIXADD  EQU      252      ! Append string to buffer
            000000FB    FIXBUF  EQU      251      ! Initialize A5 and A6 to 'BUFFER'
            000000FA    FIXDATA EQU      250      ! Initialize A6 to 'BUFFER' and append string to buffer.
            000000F9    FIXDCRLF EQU     249      ! Move 'CR', 'LF', string to buffer.
            000000F8    OUTCH   EQU      248      ! Output single character to port 1.
            000000F7    INCHE   EQU      247      ! Input a single character from port 1.
            000000F3    OUTPUT  EQU      243      ! Output string to port 1.
            000000F2    OUTPUT21 EQU     242      ! Output string to port 2.
            000000F1    PORTIN1 EQU      241      ! Input string from port 1.
            000000F0    PORTIN20 EQU     240      ! Input string from port 2.
            000000EC    HEX2DEC EQU      236      ! Convert hex value to ASCII encoded decimal.
            000000EB    GETHEX  EQU      235      ! Convert ASCII character to hex.
            000000EA    PUTHEX  EQU      234      ! Convert 1 hex digit to ASCII.
            000000E9    PNT2HX  EQU      233      ! Convert 2 hex digits to ASCII.
            000000E8    PNT4HX  EQU      232      ! Convert 4 hex digits to ASCII.
            000000E7    PNT6HX  EQU      231      ! Convert 6 hex digits to ASCII.
            000000E6    PNT8HX  EQU      230      ! Convert 8 hex digits to ASCII.
            000000E4    MONITOR EQU      228      ! Go to the MONITOR.
            000000E2    GETNUMA EQU      226      ! Convert ASCII encoded hex binary hex.
            000000E1    GETNUMD EQU      225      ! Convert ASCII encoded decimal to binary hex.
            000000E0    PORTIN1N EQU     224      ! Input string from port 1; no automatic line feed.

            0000000E    MFUNC   EQU      14

                        ***********************************************
                        *
                        *       PI/T   Register Offsets
                        *        MC68230
                        *
                        ***********************************************

            00000000    PGCR    EQU      0
            00000001    PSRR    EQU      1
            00000002    PADDR   EQU      2
            00000003    PBDDR   EQU      3
            00000004    PCDDR   EQU      4
            00000005    PIVR    EQU      5
            00000006    PACR    EQU      6
            00000007    PBCR    EQU      7
            00000008    PADR    EQU      8
            00000009    PBDR    EQU      9
            0000000A    PAAR    EQU      $0A
            0000000B    PBAR    EQU      $0B
            0000000C    PCDR    EQU      $0C
```

```
 59            0000000D     PSR0     EQU      $0D
 60            00000010     TCR      EQU      $10
 61            00000011     TIVR     EQU      $11
 62            00000013     CPRH     EQU      $13
 63            00000014     CPRM     EQU      $14
 64            00000015     CPRL     EQU      $15
 65            00000017     CNTRH    EQU      $17
 66            00000018     CNTRM    EQU      $18
 67            00000019     CNTRL    EQU      $19
 68            0000001A     TSR      EQU      $1A
 69
 70                         ****************************************
 71                         *
 72                         *        PI/T Base addresses
 73                         *
 74                         ****************************************
 75
 76            00098000     PIT1     EQU      $98000
 77
 78                         ****************************************
 79                         *
 80                         *        DSP HOST PORT REGISTERS
 81                         *          DSP56001
 82                         *
 83                         ****************************************
 84
 85            00000000     ICR      EQU      0
 86            00000001     CVR      EQU      1
 87            00000002     ISR      EQU      2
 88            00000003     IVR      EQU      3
 89            00000005     RXH      EQU      5
 90            00000006     RXM      EQU      6
 91            00000007     RXL      EQU      7
 92            00000005     TXH      EQU      5
 93            00000006     TXM      EQU      6
 94            00000007     TXL      EQU      7
 95
 96                         ****************************************
 97                         *
 98                         *        Interrupt Control bits
 99                         *         (Register ICR definition of bits)
100                         *
101                         ****************************************
102
103           00000000     RREQ     EQU      0
104           00000001     TREQ     EQU      1
105           00000003     HF0      EQU      3
106           00000004     HF1      EQU      4
107           00000005     HM0      EQU      5
108           00000006     HM1      EQU      6
109           00000007     INIT     EQU      7
110
111                        ****************************************
112                        *
113                        *        COMMAND BITS
114                        *
115                        ****************************************
116
```

```
                00000007        HC      EQU     7

                                ****************************************
                                *
                                *       INTERRUPT STATUS BITS
                                *
                                ****************************************

                00000007        HREQ    EQU     7
                00000006        DMA     EQU     6
                00000004        HF3     EQU     4
                00000003        HF2     EQU     3
                00000002        TRDY    EQU     2
                00000001        TXDE    EQU     1
                00000000        RXDF    EQU     0

                                ****************************************
                                *
                                *     DSP BASE ADDRESSES
                                *
                                ****************************************

                00080000        DSP0    EQU     $80000
                00088000        DSP1    EQU     $88000

                                ****************************************
                                *
                                *          MESSAGE SPACE
                                *
                                ****************************************

                0000000D        CR      EQU     $0D
                0000000A        LF      EQU     $0A

C 00000000 0D0A54696D65 MS01:   DC.B    CR,LF,'Time out on DSP #'
C          00000013     MS01E:  EQU     *

C 00000013 0D0A         MCRLF:  DC.B    CR,LF
C          00000015     MCRLFE: EQU     *

C 00000015 0D0A436F6465 MS02:   DC.B    CR,LF,'Code transfer ',CR,LF
C 00000027 537461727420         DC.B    'Start address (hex):'
C          0000003B     MS02E:  EQU     *

C 0000003B 0D0A456E6420 MS03:   DC.B    CR,LF,'End address (hex): '
C          00000050     MS03E:  EQU     *

C 00000050 0D0A5472616E MS04:   DC.B    CR,LF,'Transfer to DSP # ? '
C          00000066     MS04E:  EQU     *

C 00000066 0D0A436F6D65 MS05:   DC.B    CR,LF,'Come only 1536 decimal bytes ',CR,LF
C          00000087     MS05E:  EQU     *

C 00000087 0D0A54686572 MS06:   DC.B    CR,LF,'There are only dsp 0 and dsp 1 ',CR,LF
C          000000AA     MS06E:  EQU     *

C 000000AA 0D0A52455345 MS07:   DC.B    CR,LF,'RESET A DSP'
```

```
175 C 000000B7 0D0A456E7465          DC.B     CR,LF,'Enter DSP # (0 - 1) '
176 C          000000CD     MS07E:   EQU      *
177
178 C 000000CD 0D0A54686572 MS08:    DC.B     CR,LF,'There is only dsp 0 and dsp 1 ',CR,LF
179 C          000000EF     MS08E:   EQU      *
180
181
182                         ****************************************
183                         *
184                         *       MACROS
185                         *
186                         ****************************************
187
188                         CALLMON  MACRO    .PRAM1              ! Call TUTOR I/O Functions
189                                  MOVE.B   #\1,D7
190                                  TRAP     #MFUNC
191                                  ENDM
192
193                         MESSOP   MACRO    .START,.END         ! Display a message on the terminal
194                                  MOVE.L   #\1,A5
195                                  MOVE.L   #\2,A6
196                                  CALLMON  OUTPUT
197                                  ENDM
198
199                         MESSIP   MACRO    ! Read in information from the terminal
200                                  CALLMON  FIXBUF
201                                  CALLMON  PORTIN1
202                                  CALLMON  GETNUMD
203                                  ENDM
204
205                         ****************************************
206                         *
207                         *  Command to RESET a DSP
208                         *
209                         ****************************************
210 C 000000F0 00000000              DS.L     0
211 C 000000F0              DRCMD:
212 C 000000F0 4E71                 NOP
213 C 000000F2                      MESSOP   MS07,MS07E              ! Request the DSP number
    C 000000F2 2A7C000000AA         MOVE.L   #MS07,A5
    C 000000F8 2C7C000000CD         MOVE.L   #MS07E,A6
    C 000000FE                      CALLMON  OUTPUT
    C 000000FE 1E3C00F3             MOVE.B   #OUTPUT,D7
    C 00000102 4E4E                 TRAP     #MFUNC
214 C 00000104                      MESSIP                           ! To reset.
    C 00000104                      CALLMON  FIXBUF
    C 00000104 1E3C00FB             MOVE.B   #FIXBUF,D7
    C 00000108 4E4E                 TRAP     #MFUNC
    C 0000010A                      CALLMON  PORTIN1
    C 0000010A 1E3C00F1             MOVE.B   #PORTIN1,D7
    C 0000010E 4E4E                 TRAP     #MFUNC
    C 00000110                      CALLMON  GETNUMD
    C 00000110 1E3C00E1             MOVE.B   #GETNUMD,D7
    C 00000114 4E4E                 TRAP     #MFUNC
215 C 00000116 0C8000000000         CMPI.L   #0,D0                   ! Make sure that it is either
216 C 0000011C 6720                 BEQ.S    DROK                    ! 0 or 1.
217 C 0000011E 0C8000000001         CMPI.L   #1,D0
218 C 00000124 6718                 BEQ.S    DROK
```

```
219 C 00000126                          MESSOP   MS08,MS08E          ! They do not know what is
    C 00000126 2A7C000000CD             MOVE.L   #MS08,A5
    C 0000012C 2C7C000000EF             MOVE.L   #MS08E,A6
    C 00000132                          CALLMON  OUTPUT
    C 00000132 1E3C00F3                 MOVE.B   #OUTPUT,D7
    C 00000136 4E4E                     TRAP     #MFUNC
220 C 00000138                          CALLMON  MONITOR             ! on the system so return.
    C 00000138 1E3C00E4                 MOVE.B   #MONITOR,D7
    C 0000013C 4E4E                     TRAP     #MFUNC
221 C 0000013E                  DROK:
222 C 0000013E 207C00098000             MOVE.L   #PIT1,A0            ! Point to the PI/T that
223 C 00000144 01A8000C                 BCLR.B   D0,PCDR(A0)         ! controls the DSPs
224 C 00000148 323CFFFF                 MOVE.W   #$FFFF,D1           ! reset lines. Force a logic low.
225 C 0000014C                  WAITLP:
226 C 0000014C 51C9FFFE                 DBF      D1,WAITLP           ! Now wait the reset low time.
227 C 00000150 01E8000C                 BSET.B   D0,PCDR(A0)         ! Force a logic high.
228 C 00000154                          CALLMON  MONITOR             ! Return.
    C 00000154 1E3C00E4                 MOVE.B   #MONITOR,D7
    C 00000158 4E4E                     TRAP     #MFUNC
229
230                             ****************************************
231                             *
232                             *  DSP LOAD COMMAND
233                             *
234                             *  Copy data between two specified
235                             *  memory locations into the designated
236                             *  DSPs host port interface.
237                             *
238                             ****************************************
239
240 C 0000015A                  DLCMD:
241 C 0000015A 2A7C00000050             MOVE.L   #MS04,A5            ! Get dsp number
242 C 00000160 2C7C00000066             MOVE.L   #MS04E,A6
243 C 00000166                          CALLMON  OUTPUT
    C 00000166 1E3C00F3                 MOVE.B   #OUTPUT,D7
    C 0000016A 4E4E                     TRAP     #MFUNC
244 C 0000016C                          MESSIP
    C 0000016C                          CALLMON  FIXBUF
    C 0000016C 1E3C00FB                 MOVE.B   #FIXBUF,D7
    C 00000170 4E4E                     TRAP     #MFUNC
    C 00000172                          CALLMON  PORTIN1
    C 00000172 1E3C00F1                 MOVE.B   #PORTIN1,D7
    C 00000176 4E4E                     TRAP     #MFUNC
    C 00000178                          CALLMON  GETNUMD
    C 00000178 1E3C00E1                 MOVE.B   #GETNUMD,D7
    C 0000017C 4E4E                     TRAP     #MFUNC
245 C 0000017E 0C8000000000             CMPI.L   #0,D0
246 C 00000184 6608                     BNE.S    MAYBE1
247 C 00000186 267C00080000             MOVE.L   #DSP0,A3
248 C 0000018C 6010                     BRA.S    CONT1
249 C 0000018E                  MAYBE1:
250 C 0000018E 0C8000000001             CMPI.L   #1,D0
251 C 00000194 660000B8                 BNE.L    DERR
252 C 00000198 267C00088000             MOVE.L   #DSP1,A3
253 C 0000019E                  CONT1:
254 C 0000019E                          MESSOP   MS02,MS02E          ! Ask for start address
    C 0000019E 2A7C00000015             MOVE.L   #MS02,A5
    C 000001A4 2C7C0000003B             MOVE.L   #MS02E,A6
```

```
    C 000001AA                          CALLMON  OUTPUT
    C 000001AA 1E3C00F3                 MOVE.B   #OUTPUT,D7
    C 000001AE 4E4E                     TRAP     #MFUNC
255 C 000001B0                          MESSIP
    C 000001B0                          CALLMON  FIXBUF
    C 000001B0 1E3C00FB                 MOVE.B   #FIXBUF,D7
    C 000001B4 4E4E                     TRAP     #MFUNC
    C 000001B6                          CALLMON  PORTIN1
    C 000001B6 1E3C00F1                 MOVE.B   #PORTIN1,D7
    C 000001BA 4E4E                     TRAP     #MFUNC
    C 000001BC                          CALLMON  GETNUMD
    C 000001BC 1E3C00E1                 MOVE.B   #GETNUMD,D7
    C 000001C0 4E4E                     TRAP     #MFUNC
256 C 000001C2 2240                     MOVE.L   D0,A1                ! Start address
257 C 000001C4                          MESSOP   MS03,MS03E           ! Ask for finishing address
    C 000001C4 2A7C0000003B             MOVE.L   #MS03,A5
    C 000001CA 2C7C00000050             MOVE.L   #MS03E,A6
    C 000001D0                          CALLMON  OUTPUT
    C 000001D0 1E3C00F3                 MOVE.B   #OUTPUT,D7
    C 000001D4 4E4E                     TRAP     #MFUNC
258 C 000001D6                          MESSIP
    C 000001D6                          CALLMON  FIXBUF
    C 000001D6 1E3C00FB                 MOVE.B   #FIXBUF,D7
    C 000001DA 4E4E                     TRAP     #MFUNC
    C 000001DC                          CALLMON  PORTIN1
    C 000001DC 1E3C00F1                 MOVE.B   #PORTIN1,D7
    C 000001E0 4E4E                     TRAP     #MFUNC
    C 000001E2                          CALLMON  GETNUMD
    C 000001E2 1E3C00E1                 MOVE.B   #GETNUMD,D7
    C 000001E6 4E4E                     TRAP     #MFUNC
259 C 000001E8 2440                     MOVE.L   D0,A2                ! End address
260 C 000001EA 9089                     SUB.L    A1,D0                ! END - START
261 C 000001EC 6348                     BLS      ADERR                ! address error
262 C 000001EE 0C80000005FF             CMPI.L   #$5FF,D0
263 C 000001F4 6240                     BHI      ADERR                ! > 512 WORDS IE
264 C 000001F6                MLOOP1:
265 C 000001F6 4280                     CLR.L    D0
266 C 000001F8                MLOOP:
267 C 000001F8 082B00010002             BTST.B   #TXDE,ISR(A3)        ! READY TO RECEIVE
268 C 000001FE 661C                     BNE.S    OK                   ! Wait to see if we can talk to
269 C 00000200 5280                     ADDQ.L   #1,D0                ! this DSP.
270 C 00000202 66F4                     BNE.S    MLOOP
271 C 00000204                          MESSOP   MS01,MS01E           ! Oh well tell him we failed.
    C 00000204 2A7C00000000             MOVE.L   #MS01,A5
    C 0000020A 2C7C00000013             MOVE.L   #MS01E,A6
    C 00000210                          CALLMON  OUTPUT
    C 00000210 1E3C00F3                 MOVE.B   #OUTPUT,D7
    C 00000214 4E4E                     TRAP     #MFUNC
272 C 00000216                          CALLMON  MONITOR              ! GO BACK
    C 00000216 1E3C00E4                 MOVE.B   #MONITOR,D7
    C 0000021A 4E4E                     TRAP     #MFUNC
273 C 0000021C                OK:
274 C 0000021C 17590005                 MOVE.B   (A1)+,TXH(A3)
275 C 00000220 17590006                 MOVE.B   (A1)+,TXM(A3)
276 C 00000224 17590007                 MOVE.B   (A1)+,TXL(A3)
277 C 00000228 B5C9                     CMPA.L   A1,A2
278 C 0000022A 64CA                     BCC.S    MLOOP1
279 C 0000022C 08D30003                 BSET.B   #HF0,ICR(A3)
```

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 280 C 00000230                          CALLMON  MONITOR
     C 00000230 1E3C00E4                 MOVE.B   #MONITOR,D7
     C 00000234 4E4E                     TRAP     #MFUNC
 281 C 00000236                ADERR:
 282 C 00000236                          MESSOP   MS05,MS05E          ! remind user that the DSPs have
     C 00000236 2A7C00000066             MOVE.L   #MS05,A5
     C 0000023C 2C7C00000087             MOVE.L   #MS05E,A6
     C 00000242                          CALLMON  OUTPUT
     C 00000242 1E3C00F3                 MOVE.B   #OUTPUT,D7
     C 00000246 4E4E                     TRAP     #MFUNC
 283                           *                                 ! a limited amount of on board
 284                           *                                 ! memory.
 285 C 00000248                          CALLMON  MONITOR
     C 00000248 1E3C00E4                 MOVE.B   #MONITOR,D7
     C 0000024C 4E4E                     TRAP     #MFUNC
 286 C 0000024E                DERR:
 287 C 0000024E                          MESSOP   MS06,MS06E          ! Tell user there are only two of them.
     C 0000024E 2A7C00000087             MOVE.L   #MS06,A5
     C 00000254 2C7C000000AA             MOVE.L   #MS06E,A6
     C 0000025A                          CALLMON  OUTPUT
     C 0000025A 1E3C00F3                 MOVE.B   #OUTPUT,D7
     C 0000025E 4E4E                     TRAP     #MFUNC
 288 C 00000260                          CALLMON  MONITOR
     C 00000260 1E3C00E4                 MOVE.B   #MONITOR,D7
     C 00000264 4E4E                     TRAP     #MFUNC
 289
 290                                     END

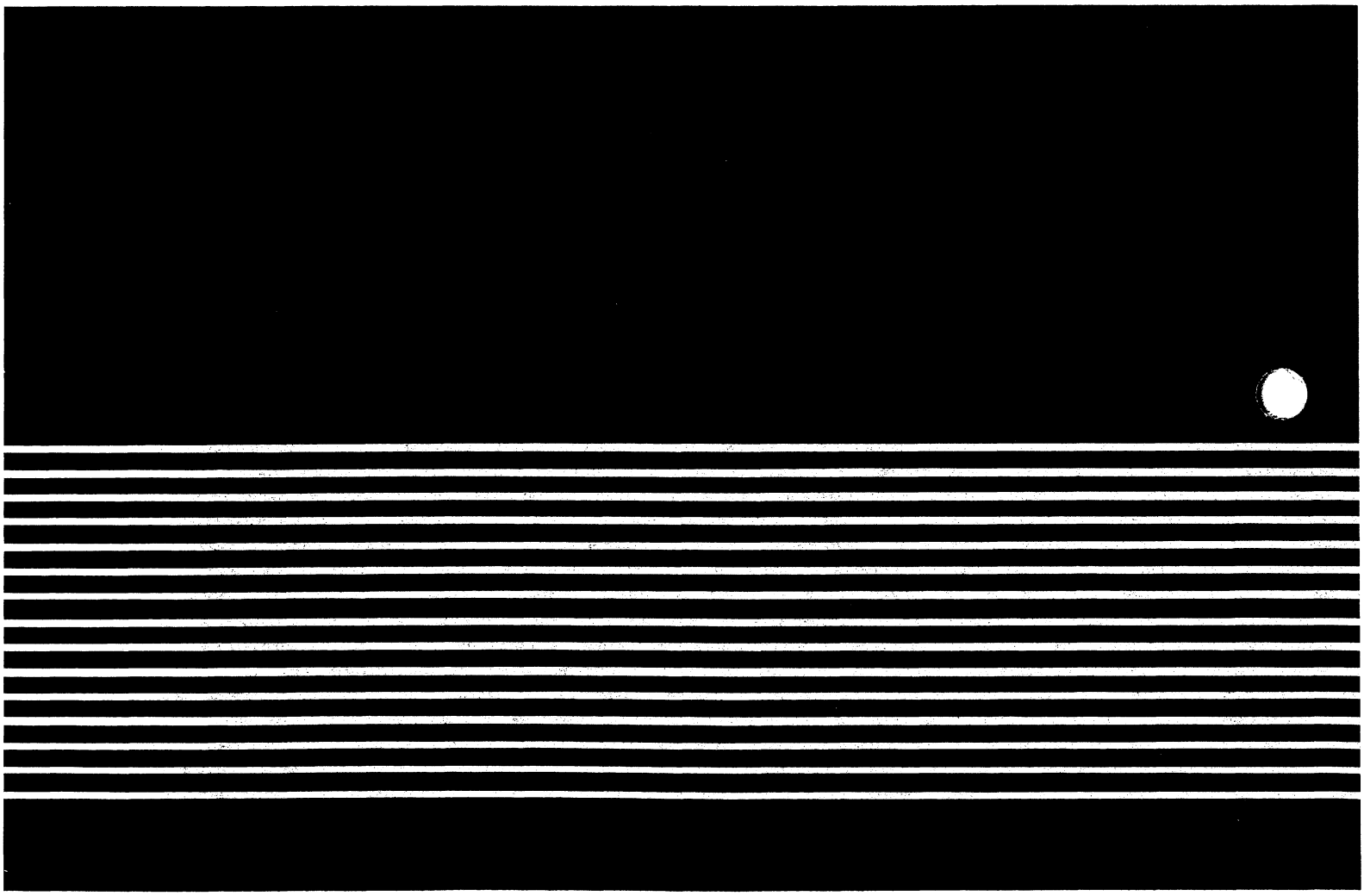
****** TOTAL ERRORS      0--
****** TOTAL WARNINGS    0--
```

```
Motorola M68020 ASM Version  1.10   dspcmds.sa

SYMBOL TABLE LISTING

SYMBOL NAME      SECT   VALUE       CROSS-REF (LINENUMBERS)

ADERR              C   00000236   -281    261    263
CALLMON     MACR   *              -188    213    214    219  220  228  243  244  254  255  257  258  271  272
                                   280    282    285    287  288
CONT1              C   0000019E   -253    248
CR                     0000000D   -149    152    155    158  162  165  168  171  174  175  178
DERR               C   0000024E   -286    251
DLCMD       XDEF   C   0000015A   -240     -4
DRCMD       XDEF   C   000000F0   -211     -5
DROK               C   0000013E   -221    216    218
DSP0                   00080000   -140    247
DSP1                   00088000   -141    252
FIXBUF                 000000FB    -16    214    244    255  258
GETNUMD                000000E1    -34    214    244    255  258
HF0                    00000003   -105    279
ICR                    00000000    -85    279
ISR                    00000002    -87    267
LF                     0000000A   -150    152    155    158  162  165  168  171  174  175  178
MAYBE1             C   0000018E   -249    246
MCRLF              C   00000013   -155
MESSIP      MACR   *              -199    214    244    255  258
MESSOP      MACR   *              -193    213    219    254  257  271  282  287
 FUNC                  0000000E    -37    213    214    219  220  228  243  244  254  255  257  258  271  272
                                   280    282    285    287  288
MLOOP              C   000001F8   -266    270
MLOOP1             C   000001F6   -264    278
MONITOR                000000E4    -32    220    228    272  280  285  288
MS01               C   00000000   -152    271
MS01E              C   00000013   -153    271
MS02               C   00000015   -158    254
MS02E              C   0000003B   -160    254
MS03               C   0000003B   -162    257
MS03E              C   00000050   -163    257
MS04               C   00000050   -165    241
MS04E              C   00000066   -166    242
MS05               C   00000066   -168    282
MS05E              C   00000087   -169    282
MS06               C   00000087   -171    287
MS06E              C   000000AA   -172    287
MS07               C   000000AA   -174    213
MS07E              C   000000CD   -176    213
MS08               C   000000CD   -178    219
MS08E              C   000000EF   -179    219
OK                 C   0000021C   -273    268
OUTPUT                 000000F3    -21    213    219    243  254  257  271  282  287
PCDR                   0000000C    -58    223    227
PIT1                   00098000    -76    222
PORTIN1                000000F1    -23    214    244    255  258
TXDE                   00000001   -131    267
TXH                    00000005    -92    274
TXL                    00000007    -94    276
TXM                    00000006    -93    275
WAITLP             C   0000014C   -225    226
```



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