INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
34100 TRIESTE (ITALY) - P.O.B. 586 - MIRAMARE - STRADA COSTIERA 11 - TELEPHONES: 224281/2/3/4/5/6
CABLE: CENTRATOM - TELEX 460392-I

SMR/90 - 45

COLLEGE ON MICROPROCESSORS:

TECHNOLOGY AND APPLICATIONS IN PHYSICS

7 September - 2 October 1981

SOLUTIONS TO THE EXERCISE

on

Digital to Analog Converter and Timer 8253

D. CROSETTO
Istituto Nazionale di Fisica
Nucleare
Corso Massimo d'Azeglio 46
10125 Torino
Italy

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/ CUFOM MODULE NAME, ENTRY POINTS, EXTERNAL SYMBOLS                    VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE    13.29.54.
0                                                                                                                    1
0
0     NAME OF MODULE  : SAWTOO
0     PROGRAM TYPE    : SUBPROGRAM
0     EXTERNAL REFER. : -NONE-
0     S E C T I O N S:
      -----------
0       PROGRAM SECTION      : 0016 IS HIGHEST ADDRESS USED,  ENTRY POINTS ARE:
                               -NONE-
1                                                              CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR    81/10/01, PAGE
                                                               VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE    13.29.55.

   LINE  ADDR  CODE  EXTENSIONS    .   S O U R C E  -  S T A T E M E N T                              73...80

      1  0000                                NAM    SAWTOO
      2                                      *************************************************************
      3                                      *
      4                                      * PROGRAM TO GENERATE A SAWTOOTH WAVEFORM ON AN OSCILLOSCOPE.
      5                                      *
      6                                      * THE FREQUENCY OF THE WAVEFORM CAN BE SELECTED BY PRESSING
      7                                      * THE KEY FROM 0-F ON THE KEYBOARD OF THE KIT
      8                                      *
      9                                      *************************************************************
     10                                      *
     11          BF60                        ADCONV EQU    $BF60   ADDR. DIGITAL TO ANALOG PERIP.
     12          1FFE                        DEL1   EQU    $1FFE           MEM. REG.
     13          E41C                        KYFLAG EQU    $E41C
     14          F1EF                        RDKEY  EQU    $F1EF
     15                                      *
     16  0000    BD    F1EF                  INIT   JSR    RDKEY           GET KEY
     17  0003    B7    1FFE                         STAA   DEL1           SAVE VALUE OF KEY PRESSED
     18  0006    B6    1FFE                  LOOP2  LDAA   DEL1
     19  0009    5A                                 DEC B
     20  000A    7D    E41C                  LOOP3  TST    KYFLAG         TEST IF FREQENCY HAS BEEN CHANGED
     21  000D    26    F1                           BNE    INIT
     22  000F    F7    BF60                         STAB   ADCONV         OUTPUT VALUE TO DAC
     23  0012    4A                                 DEC A
     24  0013    27    F1                           BEQ    LOOP2          BRA, EXTERNAL LOOP
     25  0015    20    F3                           BRA    LOOP3          BRA, INTERNAL LOOP
     26  0017                                       END
1                                                              CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR    81/10/01, PAGE
                                                               VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE    13.29.57.
IDENTIFIER CROSS REFERENCE:

ADCONV    0000BF60 EQU    2/11     2/22
DEL1      00001FFE EQU    2/12     2/17     2/18
INIT      00000000 REL    2/16     2/21
KYFLAG    0000E41C EQU    2/13     2/20
LOOP2     00000006 REL    2/18     2/24
LOOP3     0000000A REL    2/20     2/25
RDKEY     0000F1EF EQU    2/14     2/16
SAWTOO             PRG    2/01

0END OF ASM 6800-     0.932 CP SECONDS ASSEMBLY TIME.
1


1
PAGE 1          81/10/01.  13.30.06.          CUFOM LINKAGE EDITOR (1.1)
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0       PROGRAM SECTION       : 002B IS HIGHEST ADDRESS USED;  ENTRY POINTS ARE:
                              -NONE-                                                  81/10/01. PAGE
1                                                                                     13.25.14.

                                                                                      73...80        2
LINE  ADDR  CODE  EXTENSIONS      S O U R C E  -  S T A T E M E N T

    1  0000                                NAM     TRIANG
    2                                      *
    3                                      ********************************************************************************
    4                                      *
    5                                      * PROGRAM TO GENERATE A TRIANGULAR WAVEFORM ON AN OSCILLOSCOPE
    6                                      *
    7                                      * THE FREQUENCY OF THE WAVEFORM CAN BE SELECTED BY PRESSING
    8                                      * THE KEY FROM 0-F ON THE KEYBOARD OF THE KIT.
    9                                      *
   10                                      * AUTHOR: D. CROSETTO
   11                                      *
   12                                      * TRIESTE, 1981 SEPT. 30TH
   13                                      *
   14                                      ********************************************************************************
   15                                      *
   16        BF60                          ADCONV  EQU     $BF60           ADDR. DIGITAL TO ANALOG PERIF.
   17        1FFE                          DEL1    EQU     $1FFE           MEM. REG.
   18        E41C                          KYFLAG  EQU     $E41C
   19        F1EF                          RDKEY   EQU     $F1EF
   20                                      *
   21  0000  BD    F1EF                    INIT    JSR     RDKEY           GET KEY
   22  0003  B7    1FFE                            STAA    DEL1            SAVE VALUE OF KEY PRESSED
   23  0006  B6    1FFE                    DECLOP  LDAA    DEL1
   24  0009  5A                                    DEC B
   25  000A  27    0D                              BEQ     INCLOP          TEST IF END. OF DECREMENT
   26  000C  7D    E41C                    LOOP1   TST     KYFLAG          TEST IF FREQUENCY HAS BEEN CHANGED
   27  000F  26    EF                              BNE     INIT
   28  0011  F7    BF60                            STAB    ADCONV          OUTPUT VALUE TO DAC
   29  0014  4A                                    DEC A
   30  0015  27    EF                              BEQ     DECLOP          BRA. TO EXTERNAL LOOP
   31  0017  20    F3                              BRA     LOOP1           BRA. TO INTERNAL LOOP
   32  0019  B6    1FFE                    INCLOP  LDAA    DEL1
   33  001C  5C                                    INC B
   34  001D  27    E7                              BEQ     DECLOP          TEST IF END OF INCREMENT
   35  001F  7D    E41C                    LOOP2   TST     KYFLAG          TEST IF FREQUENCY HAS BEEN CHANGED
   36  0022  26    DC                              BNE     INIT
   37  0024  F7    BF60                            STAB    ADCONV          OUTPUT VALUE TO DAC
   38  0027  4A                                    DEC A
   39  0028  27    EF                              BEQ     INCLOP          BRA. EXTERNAL LOOP
   40  002A  20    F3                              BRA     LOOP2           BRA. INTERNAL LOOP
   41  002C                                        END

                                                                                      81/10/01. PAGE
1                                                                                     13.25.16.
IDENTIFIER CROSS REFERENCE:

ADCONV   0000BF60 EQU   2/16    2/28    2/37
DECLOP   00000006 REL   2/23    2/30    2/34
DEL1     00001FFE EQU   2/17    2/22    2/23    2/32
INCLOP   00000019 REL   2/25    2/32    2/39
INIT     00000000 REL   2/21    2/27    2/36
KYFLAG   0000E41C EQU   2/18    2/26    2/35
LOOP1    0000000C REL   2/26    2/31
LOOP2    0000001F REL   2/35    2/40
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1                                                    CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR      81/10/01, PAGE
 CUFOM MODULE NAME, ENTRY POINTS, EXTERNAL SYMBOLS   VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE     13.32.37.
0
0
0     NAME OF MODULE  : SINUS
0     PROGRAM TYPE    : SUBPROGRAM
0     EXTERNAL REFER. : -NONE-
0     S E C T I O N S:
      ----------------
0       PROGRAM SECTION       : 00D3 IS HIGHEST ADDRESS USED,  ENTRY POINTS ARE:
                                -NONE-
1                                                    CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR      81/10/01, PAGE
                                                     VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE     13.32.37.

 LINE  ADDR  CODE  EXTENSIONS      S O U R C E  -  S T A T E M E N T                              73...80
    1                             *
    2  0000                             NAM     SINUS
    3                             ********************************************************************************
    4                             *
    5                             * PROGRAM TO GENERATE A SINUSOIDAL VOLTAGE WAVEFORM ON AN OSCILLOSCOPE
    6                             *
    7                             * THE FREQUENCY OF THE WAVEFORM CAN BE SELECTED BY PRESSING THE KEY
    8                             * FROM 0-F ON THE KEYBOARD OF THE KIT.
    9                             *
   10                             * AUTHOR: D. CROSETTO
   11                             *
   12                             * TRIESTE, 1981 SEPT. 30TH
   13                             *
   14                             ********************************************************************************
   15                             *
   16         1FFE                DEL1    EQU     $1FFE           MEM. REG.
   17         8F60                ADCONV  EQU     $8F60           ADDR. DIGITAL TO ANALOG PERIPH.
   18         E41C                KYFLAG  EQU     $E41C
   19         F1EF                RDKEY   EQU     $F1EF
   20  0000   80 83 86 8A 8D 91   TABLE   FCB     128,131,134,138,141,145,148,152,155,158,162,165,168,171
   21  000E   AE B1 B4 B7 BA BD           FCB     174,177,180,183,186,189,192,194,197,199,202,204,206
   22  001B   D0 D2 D4 D6 D8 D9           FCB     208,210,212,214,216,217,219,220,221,223,224,225,225,226
   23  0029   E3 E3 E3 E4                FCB     227,227,227,228
   24  002D   E3 E3 E3 E3 E2 E1           FCB     227,227,227,227,226,225,225,224,223,221,220,219,217,216
   25  003B   D6 D4 D2 D0                FCB     214,212,210,208
   26  003F   CE CC CA C7 C5 C2           FCB     206,204,202,199,197,194,192,189,186,183,180,177,174,171
   27  004D   A8 A5 A2 9E                FCB     168,165,162,158
   28  0051   9B 98 94 91 8D 8A          FCB     155,152,148,145,141,138,134,131,128,125,122,118,115,111
   29  005F   6C 68 65 62                FCB     108,104,101,98
   30  0063   5E 5B 58 55 52 4F          FCB     94,91,88,85,82,79,76,73,70,67,64,62,59,57
   31  0071   36 34 32 30 2E 2C          FCB     54,52,50,48,46,44,42,40,39,37
   32  007B   24 23 21 20 1F 1F          FCB     36,35,33,32,31,31,30,29,29,29,28,29,29
   33  0089   1D 1D 1E 1F 1F 20          FCB     29,29,30,31,31,32,33,35,36,37
   34  0093   27 28 2A 2C 2E 30          FCB     39,40,42,44,46,48,50,52,54,57,59,62,64,67
   35  00A1   46 49 4C 4F 52 55          FCB     70,73,76,79,82,85,88,91,94,98
   36  00AB   65 68 6C 6F 73 76          FCB     101,104,108,111,115,118,122,125
   37         00B2+               ENDTAB  EQU     *-1
   38                             *
   39  00B3   BD   F1EF           INIT    JSR     RDKEY           GET KEY
   40  00B6   B7   1FFE                   STAA    DEL1            SAVE VALUE OF KEY PRESSED
   41  00B9   CE   0000+          LOOP2   LDX     #TABLE          POINTER TO THE 1ST VALUE OF THE TABLE
   42  00BC   B6   1FFE           LOOP3   LDAA    DEL1
   43  00BF   08                          INX
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      44  00C0  8C    0082+                  CPX     #ENDTAB         TEST IF END OF TABLE
      45  00C3  27    F4                     BEQ     LOOP2
      46  00C5  7D    E41C           LOOP1   TST     KYFLAG          TEST IF FREQUENCY HAS BEEN CHANGED
      47  00C8  26    E9                     BNE     INIT
      48  00CA  E6    00                     LDAB    0,X             GET VALUE FROM TABLE
      49  00CC  F7    BF60                   STAB    ADCONV          OUTPUT VALUE TO DAC
      50  00CF  4A                           DEC A
1                                                                    CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE
                                                                     VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE    13.32.39.

    LINE  ADDR  CODE  EXTENSIONS      S O U R C E   S T A T E M E N T                              73....80

       1  00D0  27    EA                     BEQ LOOP3               BRA, EXTERNAL LOOP
       2  00D2  20    F1                     BRA     LOOP1           BRA TO INTERNAL LOOP
       3  00D4                               END
1                                                                    CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE
IDENTIFIER CROSS REFERENCE.                                          VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE    13.32.39.

ADCONV    0000BF60 EQU    2/17      2/49
DEL1      00001FFE EQU    2/16      2/40      2/42
ENDTAB    000000B2 EQU    2/37      2/44
INIT      00000083 REL    2/39      2/47
KYFLAG    0000E41C EQU    2/18      2/46
LOOP1     000000C5 REL    2/46      3/02
LOOP2     000000B9 REL    2/41      2/45
LOOP3     000000BC REL    2/42      3/01
RDKEY     0000F1EF EQU    2/19      2/39
SINUS               PRG   2/02
TABLE     00000000 REL    2/20      2/41

END OF ASM 6800=    2.866 CP SECONDS ASSEMBLY TIME.
1

1
 PAGE 1          81/10/01.  13.32.48.          CUFOM LINKAGE EDITOR (1.1)

 ==0==)  "" LINKED (VERSION 1.1) ON CDC/NOS/BE ( 81/10/01.).


 ---------- FROM "CUFIN" ----------


 ==1==)  FROM MODULE % SINUS
 ==1==)
 ==1==)  CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR,  VERS. 1.0
 ==1==)  RUN AT CERN'S CDC COMPUTER CENTRE   81/10/01. 13.32.37.
              RELOCATABLE SECTION  3   SIZE=0004(    212)   OFFSET=00000   PROGRAM


 )))))) 0 ERROR  DETECTED IN INPUT MODULES <<<<<<<<
1PAGE 1          81/10/01.  13.33.25.          CUFOM => MOTOROLA  TRANSLATOR (1.1)

 THE CONTROL CARD PARAMETERS ARE
 -------------------------------

 OPTION INPUT  FILE IS=  OPTIONS
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CUFOM  INPUT  FILE IS=  CUFOUT
BINARY OUTPUT FILE IS=  LOADMOD
LIST   OUTPUT FILE IS=  LISTING


THE SECTION ORIGINS ARE SPECIFIED AS FOLLOWS
--------------------------------------------

     1      SECTION(3,RELOCATABLE,07PROGRAM)=00A0.
1PAGE 2           81/10/01.  13.33.25.          LOAD MAP FOR CUFOM -) MOTOROLA  TRANSLATOR (1.1)

 MODULE    ENTRY       SECTION          ADDRESSES %        PROCESSOR COMMENTS
 NAME      NAME      TYPE AND NAME  MEMORY  ORIGIN  LISTING

                                                          LINKED (VERSION 1.1) ON CDC/NOS/BE ( 81/10/01.)
 SINUS
                                                          CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR,  VERS. 1.0
                                                          RUN AT CERN'S CDC COMPUTER CENTRE   81/10/01. 13.32.37.

 NO TRANSFER ADDRESS SPECIFIED FOR THIS MODULE


 )))))) 0 ERROR  DETECTED IN CUFOM INPUT FILE <<<<<<<<
$REVERT,CCL
/BEGIN,PRINT,,FN=LSTSND,UN=MFCROSE
1                                                         CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR      81/10/01. PAGE
 CUFOM MODULE NAME, ENTRY POINTS, EXTERNAL SYMBOLS        VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE     10.15.43.
 0
 0
 0      NAME OF MODULE : SOUND
 0      PROGRAM TYPE   : SUBPROGRAM
 0      EXTERNAL REFER.: -NONE-
 0      S E C T I O N S:
        ----------------
 0         PROGRAM SECTION       : FFFFFFFE IS HIGHEST ADDRESS USED,  ENTRY POINTS ARE:
                                   -NONE-
 0         ABSOLUTE SECTION      : 1FAE IS HIGHEST ADDRESS USED,  ENTRY POINTS ARE:
                                   -NONE-
1                                                         CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR      81/10/01. PAGE
                                                          VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE     10.15.43.

 LINE  ADDR  CODE  EXTENSIONS    .    S O U R C E  -  S T A T E M E N T                    73...80

    1  0000  .                          NAM     SOUND
    2                                   *
    3                                   ************************************************************
    4                                   * THE KEYBOARD ON THE MICROPROCESSOR KIT
    5                                   * IS USED AS A MUSICAL INSTRUMENT KEYBOARD
    6                                   *
    7                                   * AUTHOR: D. CROSETTO
    8                                   * TRIESTE, 1981 SEPT, 28TH
    9                                   *
   10                                   ************************************************************
   11                                   *
   12        FFFF                       DELAY   EQU     $FFFF           DURATION OF THE NOTE
   13        83                         GO      EQU     $83
   14        E41C                       KYFLAG  EQU     $E41C
```

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 15          0130                INIZIO EQU   $130            STARTING ADD. OF MUSIC TEXT ENTERED
 16          0100                LENGTH EQU   $100            MEM. REG.
 17          0106                PLGTH  EQU   $106            MEM. REG.
 18          0104                PNPLAY EQU   $104            MEM. REG. POINTER MUSIC EXEC.
 19          F1EF                RDKEY  EQU   $F1EF
 20          0102                TEMP   EQU   $102            MEM. REG.
 21          BF40                TIMA   EQU   $BF40           ADDR. TIMER 0
 22          3F                  TIMCW  EQU   $3F             CONTROL WORD TIMER 0
 23          BF43                TIMW   EQU   $BF43           ADDR. CONTROL WORD TIMER
 24  1F00                                   ORG   $1F00
 25  1F00  1143  1021  0909      FRETAB FDB   $1143,$1021,$909,$857,$763
 26  1F0A  0680  0607  0572             FDB   $680,$607,$572,$509,$454,$428
 27  1F16  0381  0340  0303             FDB   $381,$340,$303,$286
 28                              *
 29                              *
 30  1F1E  CE    0130            INIT   LDX   #INIZIO         INITIALISE
 31  1F21  FF    0104                   STX   PNPLAY          VARIABLES
 32  1F24  7F    0100                   CLR   LENGTH
 33  1F27  7F    0101                   CLR   LENGTH+1
 34  1F2A  86    3F                     LDAA  #TIMCW          TIMER
 35  1F2C  B7    BF43                   STAA  TIMW
 36  1F2F  CE    1F00            ENTER  LDX   #FRETAB
 37  1F32  7D    E41C                   TST   KYFLAG          LOOP
 38  1F35  27    F8                     BEQ   ENTER           ENTER MUSIC
 39  1F37  BD    F1EF                   JSR   RDKEY
 40  1F3A  81    83                     CMPA  #GO             TEST IF PLAY MUSIC
 41  1F3C  27    31                     BEQ   PLAY
 42  1F3E  BD    1FA9                   JSR   KYVAL           TEST IF VALID KEY
 43  1F41  24    EC                     BCC   ENTER           YES, ENTER MUSIC
 44  1F43  FF    0102                   STX   TEMP
 45  1F46  48                           ASLA
 46  1F47  BB    0103                   ADDA  TEMP+1
 47  1F4A  B7    0103                   STAA  TEMP+1
 48  1F4D  FE    0102                   LDX   TEMP
 49  1F50  A6    00                     LDAA  0,X
 50  1F52  E6    01                     LDAB  1,X
```



```
LINE  ADDR  CODE  EXTENSIONS     S O U R C E - S T A T E M E N T                    73....80

  1  1F54  FE    0104                   LDX   PNPLAY
  2  1F57  A7    00                     STAA  0,X
  3  1F59  08                           INX
  4  1F5A  E7    00                     STAB  0,X
  5  1F5C  08                           INX
  6  1F5D  FF    0104                   STX   PNPLAY
  7  1F60  F7    BF40                   STAB  TIMA            OUTPUT FREQUENCY
  8  1F63  B7    BF40                   STAA  TIMA            TO TIMER
  9  1F66  FE    0100                   LDX   LENGTH
 10  1F69  08                           INX                   INCREMENT LENGTH
 11  1F6A  FF    0100                   STX   LENGTH          OF TEXT
 12  1F6D  20    C0                     BRA   ENTER
 13                              *
 14  1F6F  7D    E41C            PLAY   TST   KYFLAG          IF KEYPRESSED
 15  1F72  26    2F                     BNE   EXIT            STOP MUSIC
 16  1F74  FE    0100                   LDX   LENGTH
 17  1F77  FF    0106                   STX   PLGTH           GET LENGTH
 18  1F7A  CE    0130                   LDX   #INIZIO         GET "INIZIO" MUSIC
```

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   19  1F7D  FF    0102                STX     TEMP
   20  1F80  FE    0102          LPLAY LDX     TEMP
   21  1F83  A6    00                  LDAA    0,X
   22  1F85  08                        INX                     GET FREQUENCY
   23  1F86  E6    00                  LDAB    0,X
   24  1F88  08                        INX
   25  1F89  F7    BF40                STAB    TIMA            OUTPUT FREQUENCY
   26  1F8C  B7    BF40                STAA    TIMA
   27  1F8F  FF    0102                STX     TEMP
   28  1F92  FE    0106                LDX     PLGTH
   29  1F95  09                        DEX
   30  1F96  27    D7                  BEQ     PLAY            TEST LENGTH=0
   31  1F98  FF    0106                STX     PLGTH
   32  1F9B  CE    FFFF                LDX     #DELAY          GET DELAY OF THE NOTE
   33  1F9E  09                  LDELAY DEX
   34  1F9F  26    FD                  BNE     LDELAY
   35  1FA1  20    DD                  BRA     LPLAY
   36  1FA3  BD    F1EF          EXIT  JSR     RDKEY
   37  1FA6  7E    1F1E                JMP     INIT            START AGAIN
   38                            *
   39                            *
   40                            ***************************************************
   41                            *
   42                            * SUBROUTINE TO TEST IF KEYBORD IS
   43                            * A VALID NUMBER.
   44                            * CARRY=1 KEY VALID (NUMBER ) $F)
   45                            * CARRY=0 KEY INVALID.
   46                            ***************************************************
   47                            *
   48  1FA9  BD    F1EF          KYVAL JSR     RDKEY
   49  1FAC  81    10                  CMPA    #$10
   50  1FAE  39                        RTS
1                                                       CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE
                                                        VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE    10.15.45.

   LINE  ADDR  CODE  EXTENSIONS      S O U R C E  =  S T A T E M E N T                          73....80

      1  1FAF                        END
1                                                       CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE
                                                        VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE    10.15.45.
   IDENTIFIER CROSS REFERENCE.

   DELAY    0000FFFF EQU   2/12    3/32
   ENTER    00001F2F ABS   2/36    2/38    2/43    3/12
   EXIT     00001FA3 ABS   3/15    3/36
   FRETAB   00001F00 ABS   2/25    2/36
   GO       00000083 EQU   2/13    2/40
   INIT     00001F1E ABS   2/30    3/37
   INIZIO   00000130 EQU   2/15    2/30    3/18
   KYFLAG   0000E41C EQU   2/14    2/37    3/14
   KYVAL    00001FA9 ABS   2/42    3/48
   LDELAY   00001F9E ABS   3/33    3/34
   LENGTH   00000100 EQU   2/16    2/32    2/33    3/09    3/11    3/16
   LPLAY    00001F80 ABS   3/20    3/35
   PLAY     00001F6F ABS   2/41    3/14    3/30
   PLGTH    00000106 EQU   2/17    3/17    3/28    3/31
   PNFLAY   00000104 EQU   2/18    2/31    3/01    3/06
   RDKEY    0000F1EF EQU   2/19    2/39    3/36    3/48
   SOUND            PRG   2/01
   TEMP     00000102 EQU   2/20    2/44    2/46    2/47    2/48    3/19    3/20    3/27
   TIMA     0000BF40 EQU   2/21    3/07    3/08    3/25    3/26
   TIMCW    0000003F EQU   2/22    2/34
   TIMW     0000BF43 EQU   2/23    2/35
```

```
/ LSTMUS NOT FOUND. AT 000121.
$REVERT,ABORT.CCL
/CATLIST,/UN=CROSE
 EMPTY CATALOG.
/BEGIN,PRINT,,FN=LMUSIC,UN=MPCROSE
1                                                    CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE    1
 CUFOM MODULE NAME. ENTRY POINTS. EXTERNAL SYMBOLS   VERS. 1.0. RUN AT CERN'S CDC COMPUTER CENTRE    18.21.14.
0
0
0     NAME OF MODULE : MUSIC2
0     PROGRAM TYPE   : SUBPROGRAM
0     EXTERNAL REFER.: INIZIO

0     S E C T I O N S:
      ----------------
0       PROGRAM SECTION      : 0084 IS HIGHEST ADDRESS USED.  ENTRY POINTS ARE:
                                -NONE-
1                                                    CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE    2
                                                     VERS. 1.0. RUN AT CERN'S CDC COMPUTER CENTRE    18.21.14.

 LINE  ADDR  CODE  EXTENSIONS      S O U R C E  -  S T A T E M E N T                              73...80
    1  0000                       NAM    MUSIC2
    2                             XREF   INIZIO
    3  0000                       OPT    REL,MEX
    4                            *
    5                            ********************************************************************
    6                            *
    7                            * PROGRAM TO PLAY THREE TONE MUSIC
    8                            *
    9                            * SINCE THE PROGRAM DOESN'T WORK ON INTERRUPT,
   10                            * THE CPU TIME OF THE MICROPROCESOR IS OCCUPIED
   11                            * ENTIRELY TO EXECUTE DELAYS.
   12                            *
   13                            * AUTHOR: D. CROSETTO
   14                            *
   15                            * TRIESTE, 1981 SEPT. 28TH.
   16                            ********************************************************************
   17  0000                       PSCT
   18                            *
   19  0000  02                  DELAY  RMB    2
   20  0002  02                  LENGTH RMB    2              MEM. REG.
   21  0004  02                  DUMMY  RMB    2
   22  0006  02                  TEMP   RMB    2              MEM. REG.
   23  0008  02                  TEMPO  RMB    2              MEM. REG.
   24  000A  02                  PNPLAY RMB    2              MEM. REG. POINTER MUSIC EXEC.
   25                              INSERT                                                    INCLUDED
   26                            *                                                         INCLUDED
   27                            ********************************************************* INCLUDED
   28                            *                                                         INCLUDED
   29                            * LIST OF DIVIDERS FOR THE MUSIC PROGRAMS                  INCLUDED
   30                            * THESE DIVIDERS GENERATE TUNED NOTES ON A                 INCLUDED
   31                            * PROGRAMMABLE TIMER 8253 WHICH HAS A                      INCLUDED
   32                            * FREQENCY = 300,000HZ AS CLOCK INPUT                     INCLUDED
   33                            *                                                         INCLUDED
   34                            ********************************************************* INCLUDED
   35                            *                                                         INCLUDED
   36        2301                DO3    EQU    $2301                                       INCLUDED
   37        2168                DOS3   EQU    $2168
```

```
  38   2042                RE3    EQU   $2042                                  INCLUDED
  39   1930                RES3   EQU   $1930                                  INCLUDED
  40   1824                MI3    EQU   $1824                                  INCLUDED
  41   1719                FA3    EQU   $1719                                  INCLUDED
  42   1617                FAS3   EQU   $1617                                  INCLUDED
  43   1526                SOL3   EQU   $1526                                  INCLUDED
  44   1445                SOLS3  EQU   $1445                                  INCLUDED
  45   1360                LA3    EQU   $1360                                  INCLUDED
  46   1284                LAS3   EQU   $1284                                  INCLUDED
  47   1216                SI3    EQU   $1216                                  INCLUDED
  48   1143                DO4    EQU   $1143                                  INCLUDED
  49   1080                DOS4   EQU   $1080                                  INCLUDED
  50   1021                RE4    EQU   $1021                                  INCLUDED
1                                                CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR   81/10/01. PAGE   3
                                                 VERS. 1.0. RUN AT CERN'S CDC COMPUTER CENTRE   18.21.15.

LINE  ADDR  CODE  EXTENSIONS      S O U R C E  -  S T A T E M E N T          73...80

   1        0962                RES4   EQU   $962                                   INCLUDED
   2        0909                MI4    EQU   $909                                   INCLUDED
   3        0857                FA4    EQU   $857                                   INCLUDED
   4        0808                FAS4   EQU   $808                                   INCLUDED
   5        0763                SOL4   EQU   $763                                   INCLUDED
   6        0721                SOLS4  EQU   $721                                   INCLUDED
   7        0680                LA4    EQU   $680                                   INCLUDED
   8        0642                LAS4   EQU   $642                                   INCLUDED
   9        0607                SI4    EQU   $607                                   INCLUDED
  10        0572                DO5    EQU   $572                                   INCLUDED
  11        0540                DOS5   EQU   $540                                   INCLUDED
  12        0509                RE5    EQU   $509                                   INCLUDED
  13        0481                RES5   EQU   $481                                   INCLUDED
  14        0454                MI5    EQU   $454                                   INCLUDED
  15        0428                FA5    EQU   $428                                   INCLUDED
  16        0404                FAS5   EQU   $404                                   INCLUDED
  17        0381                SOL5   EQU   $381                                   INCLUDED
  18        0360                SOLS5  EQU   $360                                   INCLUDED
  19        0340                LA5    EQU   $340                                   INCLUDED
  20        0321                LAS5   EQU   $321                                   INCLUDED
  21        0303                SI5    EQU   $303                                   INCLUDED
  22        0286                DO6    EQU   $286                                   INCLUDED
  23        0270                DOS6   EQU   $270                                   INCLUDED
  24        0254                RE6    EQU   $254                                   INCLUDED
  25        0240                RES6   EQU   $240                                   INCLUDED
  26        0227                MI6    EQU   $227                                   INCLUDED
  27        0216                FA6    EQU   $216                                   INCLUDED
  28        40                  T64    EQU   64                                    INCLUDED
  29        20                  T32    EQU   32                                    INCLUDED
  30        10                  T16    EQU   16                                    INCLUDED
  31        08                  T8     EQU   8                                     INCLUDED
  32        04                  T4     EQU   4                                     INCLUDED
  33        02                  T2     EQU   2                                     INCLUDED
  34        01                  T1     EQU   1                                     INCLUDED
  35        03                  T3     EQU   3                                     INCLUDED
  36        06                  T6     EQU   6                                     INCLUDED
  37        0A                  T10    EQU   10                                    INCLUDED
  38        05                  T5     EQU   5                                     INCLUDED
  39        02                  NO     EQU   $2                                    INCLUDED
  40        0F                  ALLEG  EQU   15                                    INCLUDED
  41        14                  ANDAN  EQU   20                                    INCLUDED
```

```
                                                                                                    INCLUDED
                                                                                                    INCLUDED
                                                                                                    INCLUDED
  42        1E                  MODER   EQU     30
  43        28                  PIANO   EQU     40
  44        FE                  ENDT    EQU     $FE
  45
  46        3F                  TIMCWA  EQU     $3F         CONTROL WORD TIMER 0
  47        7E                  TIMCWB  EQU     $7F         CONTROL WORD TIMER 1
  48        BF                  TIMCWC  EQU     $BF         CONTROL WORD TIMER 2
  49        BF43                TIMW    EQU     $BF43       ADDR. CONTROL WORD TIMER
  50        BF40                TIMA    EQU     $BF40       ADDR. TIMER 0
1                                                           CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE   4
                                                            VERS. 1.0. RUN AT CERN'S CDC COMPUTER CENTRE    18.21.15.

LINE  ADDR  CODE  EXTENSIONS    . . S O U R C E  -  S T A T E M E N T                              73....80

   1        BF41                TIMB    EQU     $BF41       ADDR. TIMER 1
   2        BF42                TIMC    EQU     $BF42       ADDR. TIMER 2
   3                            *
   4                            *
   5  000C                      PSCT
   6                            *
   7  000C  86  3F              INIT    LDAA    #TIMCWA     INITIALISE
   8  000E  B7  BF43                    STAA    TIMW
   9  0011  86  7F                      LDAA    #TIMCWB     TIMERS
  10  0013  B7  BF43                    STAA    TIMW
  11  0016  86  BF                      LDAA    #TIMCWC
  12  0018  B7  BF43                    STAA    TIMW
  13  001B  B6  0000*                   LDAA    INIZIO      TEMPO
  14  001E  B7  0008+                   STAA    TEMPO
  15  0021  CE  0001*                   LDX     #INIZIO+1   POINTER TO START OF MUSIC
  16  0024  FF  000A+                   STX     PNPLAY
  17  0027  86  FE                      LDAA    #ENDT
  18  0029  08                  LLENGT  INX
  19  002A  A1  00                      CMPA    0,X         LENGTH
  20  002C  26  FB                      BNE     LLENGT
  21  002E  09                          DEX
  22  002F  FF  0002+                   STX     LENGTH
  23  0032  FE  000A+           PLAY    LDX     PNPLAY      TEST IF END OF PLAY
  24  0035  BC  0002+                   CPX     LENGTH
  25  0038  23  48                      BLS     EXIT
  26  003A  FE  000A+                   LDX     PNPLAY
  27  003D  A6  00                      LDAA    0,X         GET FREQUENCY
  28  003F  08                          INX
  29  0040  E6  00                      LDAB    0,X         TIMER 0
  30  0042  08                          INX
  31  0043  F7  BF40                    STAB    TIMA        OUTPUT FREQUENCY TIMER 0
  32  0046  B7  BF40                    STAA    TIMA
  33  0049  A6  00                      LDAA    0,X         GET FREQUENCY TIMER 1
  34  004B  08                          INX
  35  004C  E6  00                      LDAB    0,X
  36  004E  08                          INX
  37  004F  F7  BF41                    STAB    TIMB        OUTPUT FREQUENCY TIMER 1
  38  0052  B7  BF41                    STAA    TIMB
  39  0055  A6  00                      LDAA    0,X         GET FREQUENCY TIMER 2
  40  0057  08                          INX
  41  0058  E6  00                      LDAB    0,X
  42  005A  08                          INX
  43  005B  F7  BF42                    STAB    TIMC        OUTPUT FREQENCY TIMER 2
  44  005E  B7  BF42                    STAA    TIMC
  45  0061  A6  00                      LDAA    0,X         GET TEMPO
```

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   46  0063  08                                INX
   47  0064  F6    0008+                       LDAB    TEMPO
   48  0067  1B                                ABA
   49  0068  FF    000A+                       STX     PNPLAY
   50  0068  B7    0000+                       STAA    DELAY
1                                                    CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE   5
                                                     VERS. 1.0. RUN AT CERN'S CDC COMPUTER CENTRE    18.21.16.

 LINE  ADDR  CODE  EXTENSIONS      .   S O U R C E  -  S T A T E M E N T                          73...80

    1  006E  C6    FF                          LDAB    #$FF
    2  0070  F7    0001+                       STAB    DELAY+1         GET NOTE DELAY
    3  0073  FE    0000+                       LDX     DELAY
    4  0076  FF    0004+          LDELAY       STX     DUMMY
    5  0079  FF    0004+                       STX     DUMMY
    6  007C  09                                DEX
    7  007D  26    F7                          BNE     LDELAY
    8  007F  7E    0032+                       JMP     PLAY
    9  0082  7E    000C+          EXIT         JMP     INIT
   10                             *
   11  0085                                    END
1                                                    CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR     81/10/01. PAGE   6
 IDENTIFIER CROSS REFERENCE.                         VERS. 1.0. RUN AT CERN'S CDC COMPUTER CENTRE    18.21.17.

 ALLEG    0000000F EQU    3/40
 ANDAN    00000014 EQU    3/41
 DELAY    00000000 REL    2/19    4/50    5/02    5/03
 DOS3     00002168 EQU    2/37
 DOS4     00001080 EQU    2/49
 DOS5     00000540 EQU    3/11
 DOS6     00000270 EQU    3/23
 DO3      00002301 EQU    2/36
 DO4      00001143 EQU    2/48
 DO5      00000572 EQU    3/10
 DO6      00000286 EQU    3/22
 DUMMY    00000004 REL    2/21    5/04    5/05
 ENDT     000000FE EQU    3/44    4/17
 EXIT     00000082 REL    4/25    5/09
 FAS3     00001617 EQU    2/42
 FAS4     00000808 EQU    3/04
 FAS5     00000404 EQU    3/16
 FA3      00001719 EQU    2/41
 FA4      00000857 EQU    3/03
 FA5      00000428 EQU    3/15
 FA6      00000216 EQU    3/27
 INIT     0000000C REL    4/07    5/09
 INIZIO           EXT    2/02    4/13    4/15
 LAS3     00001284 EQU    2/46
 LAS4     00000642 EQU    3/08
 LAS5     00000321 EQU    3/20
 LA3      00001360 EQU    2/45
 LA4      00000680 EQU    3/07
 LA5      00000340 EQU    3/19
 LDELAY   00000076 REL    5/04    5/07
 LENGTH   00000002 REL    2/20    4/22    4/24
 LLENGT   00000029 REL    4/18    4/20
 MI3      00001824 EQU    2/40
 MI4      00000909 EQU    3/02
 MI5      00000454 EQU    3/14
```

0 EXTERNAL REFER.: -NONE-
0 S E C T I O N S:

0 PROGRAM SECTION : FFFFFFFE IS HIGHEST ADDRESS USED. ENTRY POINTS ARE:
-NONE-

0 DATA SECTION : 02E7 IS HIGHEST ADDRESS USED. ENTRY POINTS ARE:
INIZIO

LINE	ADDR	CODE	EXTENSIONS	SOURCE - STATEMENT (73...80)	
1	0000			NAM TEXT2	
2				XDEF INIZIO	
3	0000			OPT REL,MEX	
4				*	
5				**********	
6				* A. VIVALDI "LA PRIMAVERA"	
7				*	
8				**********	INCLUDED
9				INSERT	INCLUDED
10				*	INCLUDED
11				**********	INCLUDED
12				*	INCLUDED
13				* LIST OF DIVIDERS FOR THE MUSIC PROGRAMS	INCLUDED
14				* THESE DIVIDERS GENERATE TUNED NOTES ON A	INCLUDED
15				* PROGRAMMABLE TIMER 8253 WHICH HAS A	INCLUDED
16				* FREQENCY = 300.000HZ AS CLOCK INPUT	INCLUDED
17				*	INCLUDED
18				**********	INCLUDED
19				*	INCLUDED
20	2301			DO3 EQU $2301	INCLUDED
21	2168			DOS3 EQU $2168	INCLUDED
22	2042			RE3 EQU $2042	INCLUDED
23	1930			RES3 EQU $1930	INCLUDED
24	1824			MI3 EQU $1824	INCLUDED
25	1719			FA3 EQU $1719	INCLUDED
26	1617			FAS3 EQU $1617	INCLUDED
27	1526			SOL3 EQU $1526	INCLUDED
28	1445			SOLS3 EQU $1445	INCLUDED
29	1360			LA3 EQU $1360	INCLUDED
30	1284			LAS3 EQU $1284	INCLUDED
31	1216			SI3 EQU $1216	INCLUDED
32	1143			DO4 EQU $1143	INCLUDED
33	1080			DOS4 EQU $1080	INCLUDED
34	1021			RE4 EQU $1021	INCLUDED
35	0962			RES4 EQU $962	INCLUDED
36	0909			MI4 EQU $909	INCLUDED
37	0857			FA4 EQU $857	INCLUDED
38	0808			FAS4 EQU $808	INCLUDED
39	0763			SOL4 EQU $763	INCLUDED
40	0721			SOLS4 EQU $721	INCLUDED
41	0680			LA4 EQU $680	INCLUDED
42	0642			LAS4 EQU $642	INCLUDED
43	0607			SI4 EQU $607	INCLUDED
44	0572			DO5 EQU $572	INCLUDED
45	0540			DOS5 EQU $540	INCLUDED
46	0509			RE5 EQU $509	INCLUDED

```
 47      0481                   RESS   EQU    $481                                                     INCLUDED
 48      0454                   MI5    EQU    $454                                                     INCLUDED
 49      0428                   FA5    EQU    $428                                                     INCLUDED
 50      0404                   FA55   EQU    $404                                                     INCLUDED
                                                        CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR    81/10/01. PAGE  3
1                                                       VERS. 1.0. RUN AT CERN'S CDC COMPUTER CENTRE    18.22.19.

 LINE ADDR  CODE EXTENSIONS      S O U R C E  -  S T A T E M E N T                         73...80

   1      0381                  SOL5   EQU    $381                                                     INCLUDED
   2      0360                  SOLS5  EQU    $360                                                     INCLUDED
   3      0340                  LA5    EQU    $340                                                     INCLUDED
   4      0321                  LAS5   EQU    $321                                                     INCLUDED
   5      0303                  SI5    EQU    $303                                                     INCLUDED
   6      0286                  D06    EQU    $286                                                     INCLUDED
   7      0270                  D056   EQU    $270                                                     INCLUDED
   8      0254                  RE6    EQU    $254                                                     INCLUDED
   9      0240                  RES6   EQU    $240                                                     INCLUDED
  10      0227                  MI6    EQU    $227                                                     INCLUDED
  11      0216                  FA6    EQU    $216                                                     INCLUDED
  12      40                    T64    EQU    64                                                       INCLUDED
  13      20                    T32    EQU    32                                                       INCLUDED
  14      10                    T16    EQU    16                                                       INCLUDED
  15      08                    T8     EQU    8                                                        INCLUDED
  16      04                    T4     EQU    4                                                        INCLUDED
  17      02                    T2     EQU    2                                                        INCLUDED
  18      01                    T1     EQU    1                                                        INCLUDED
  19      03                    T3     EQU    3                                                        INCLUDED
  20      06                    T6     EQU    6                                                        INCLUDED
  21      0A                    T10    EQU    10                                                       INCLUDED
  22      05                    T5     EQU    5                                                        INCLUDED
  23      02                    NO     EQU    $2                                                       INCLUDED
  24      0F                    ALLEG  EQU    15                                                       INCLUDED
  25      14                    ANDAN  EQU    20                                                       INCLUDED
  26      1E                    MODER  EQU    30                                                       INCLUDED
  27      28                    PIANO  EQU    40                                                       INCLUDED
  28      FE                    ENDT   EQU    $FE                                                      INCLUDED
  29
  30                            NOTE     MACR
  31                                   FDB    \0,\1,\2
  32                                   FCB    \3
  33                                   FDB    \4,\5,\6
  34                                   FCB    \7
  35                                   ENDM
  36                            *
  37                            *
  38 0000                              ORG    0
  39 0000                              DSCT
  40 0000 0F                    INIZIO FCB     ALLEG
  41                                   NOTE    MI3,SI4,MI5,T8,NO,NO,NO,T1
  42 0001 1824  0607  0454        FDB MI3,SI4,MI5                                                      NOTE
  43 0007 08                      FCB T8                                                               NOTE
  44 0008 0002  0002  0002        FDB NO,NO,NO                                                         NOTE
  45 000E 01                      FCB T1                                                               NOTE
  46                              ENDM                                                                 NOTE
  47                                   NOTE    MI3,MI5,SOLS5,T8,MI3,NO,NO,T1
  48 000F 1824  0454  0360        FDB MI3,MI5,SOLS5                                                    NOTE
  49 0015 08                      FCB T8                                                               NOTE
  50 0016 1824  0002  0002        FDB MI3,NO,NO                                                        NOTE
```

13

```
LINE  ADDR  CODE  EXTENSIONS          SOURCE - STATEMENT .....73....80
   1  001C  01                       FCB T1                                NOTE
   2                                 ENDM                                  NOTE
   3                                       NOTE   MI3,MI5,SQLS5,T8,NO,NO,NO,T1   NOTE
   4  001D  1824  0454  0360         FDB MI3,MI5,SQLS5                     NOTE
   5  0023  08                       FCB T8                                NOTE
   6  0024  0002  0002  0002         FDB NO,NO,NO                          NOTE
   7  002A  01                       FCB T1                                NOTE
   8                                 ENDM
   9                                       NOTE   MI3,MI5,SQLS5,T8,MI3,NO,NO,T1  NOTE
  10  002B  1824  0454  0360         FDB MI3,MI5,SQLS5                     NOTE
  11  0031  08                       FCB T8                                NOTE
  12  0032  1824  0002  0002         FDB MI3,NO,NO                         NOTE
  13  0038  01                       FCB T1                                NOTE
  14                                 ENDM
  15                                       NOTE   MI3,MI5,FAS5,T4,MI3,MI5,NO,T1  NOTE
  16  0039  1824  0454  0404         FDB MI3,MI5,FAS5                      NOTE
  17  003F  04                       FCB T4                                NOTE
  18  0040  1824  0454  0002         FDB MI3,MI5,NO                        NOTE
  19  0046  01                       FCB T1                                NOTE
  20                                 ENDM
  21                                       NOTE   MI3,MI5,MI5,T4,NO,NO,NO,T1  NOTE
  22  0047  1824  0454  0454         FDB MI3,MI5,MI5                       NOTE
  23  004D  04                       FCB T4                                NOTE
  24  004E  0002  0002  0002         FDB NO,NO,NO                          NOTE
  25  0054  01                       FCB T1                                NOTE
  26                                 ENDM
  27                                       NOTE   MI3,SQLS5,SI5,T16,NO,SQLS5,SI5,T1  NOTE
  28  0055  1824  0360  0303         FDB MI3,SQLS5,SI5                     NOTE
  29  005B  10                       FCB T16                               NOTE
  30  005C  0002  0360  0303         FDB NO,SQLS5,SI5                      NOTE
  31  0062  01                       FCB T1                                NOTE
  32                                 ENDM
  33                                       NOTE   MI3,SQLS5,SI5,T8,MI3,NO,NO,T1  NOTE
  34  0063  1824  0360  0303         FDB MI3,SQLS5,SI5                     NOTE
  35  0069  08                       FCB T8                                NOTE
  36  006A  1824  0002  0002         FDB MI3,NO,NO                         NOTE
  37  0070  01                       FCB T1                                NOTE
  38                                 ENDM
  39                                       NOTE   MI3,SQLS5,SI5,T4,MI3,NO,NO,T1  NOTE
  40  0071  1824  0360  0303         FDB MI3,SQLS5,SI5                     NOTE
  41  0077  04                       FCB T4                                NOTE
  42  0078  1824  0002  0002         FDB MI3,NO,NO                         NOTE
  43  007E  01                       FCB T1                                NOTE
  44                                 ENDM
  45                                       NOTE   MI3,FAS5,LA5,T4,NO,NO,NO,T1  NOTE
  46  007F  1824  0404  0340         FDB MI3,FAS5,LA5                      NOTE
  47  0085  04                       FCB T4                                NOTE
  48  0086  0002  0002  0002         FDB NO,NO,NO                          NOTE
  49  008C  01                       FCB T1                                NOTE
  50                                 ENDM
```


LINE ADDR CODE EXTENSIONS SOURCE - STATEMENT ....73....80

```
                                                    NOTE    MI3,MI5,SOLS5,T8,MI3,NO,NO,T1                                   NOTE
  1
  2  0080  1824  0454  0360                        FDB MI3,MI5,SOLS5                                                    NOTE
  3  0093  08                                      FCB T8                                                               NOTE
  4  0094  1824  0002  0002                        FDB MI3,NO,NO                                                        NOTE
  5  009A  01                                      FCB T1                                                               NOTE
  6                                                ENDM
  7                                                   NOTE    MI3,MI5,SOLS5,T8,NO,NO,NO,T1                             NOTE
  8  009B  1824  0454  0360                        FDB MI3,MI5,SOLS5                                                    NOTE
  9  00A1  08                                      FCB T8                                                               NOTE
 10  00A2  0002  0002  0002                        FDB NO,NO,NO                                                         NOTE
 11  00A8  01                                      FCB T1                                                               NOTE
 12                                                ENDM
 13                                                   NOTE    MI3,MI5,SOLS5,T8,MI3,NO,NO,T1                            NOTE
 14  00A9  1824  0454  0360                        FDB MI3,MI5,SOLS5                                                    NOTE
 15  00AF  08                                      FCB T8                                                               NOTE
 16  00B0  1824  0002  0002                        FDB MI3,NO,NO                                                        NOTE
 17  00B6  01                                      FCB T1                                                               NOTE
 18                                                ENDM
 19                                                   NOTE    MI3,MI5,FAS5,T4,MI3,MI5,NO,T1                            NOTE
 20  00B7  1824  0454  0404                        FDB MI3,MI5,FAS5                                                     NOTE
 21  00BD  04                                      FCB T4                                                               NOTE
 22  00BE  1824  0454  0002                        FDB MI3,MI5,NO                                                       NOTE
 23  00C4  01                                      FCB T1                                                               NOTE
 24                                                ENDM
 25                                                   NOTE    MI3,MI5,MI5,T4,NO,NO,NO,T1                               NOTE
 26  00C5  1824  0454  0454                        FDB MI3,MI5,MI5                                                      NOTE
 27  00CB  04                                      FCB T4                                                               NOTE
 28  00CC  0002  0002  0002                        FDB NO,NO,NO                                                         NOTE
 29  00D2  01                                      FCB T1                                                               NOTE
 30                                                ENDM
 31                                                   NOTE    MI3,SOLS5,SI5,T16,NO,SOLS5,SI5,T1                        NOTE
 32  00D3  1824  0360  0303                        FDB MI3,SOLS5,SI5                                                    NOTE
 33  00D9  10                                      FCB T16                                                              NOTE
 34  00DA  0002  0360  0303                        FDB NO,SOLS5,SI5                                                     NOTE
 35  00E0  01                                      FCB T1                                                               NOTE
 36                                                ENDM
 37                                                   NOTE    MI3,SOLS5,SI5,T8,MI3,NO,NO,T1                            NOTE
 38  00E1  1824  0360  0303                        FDB MI3,SOLS5,SI5                                                    NOTE
 39  00E7  08                                      FCB T8                                                               NOTE
 40  00E8  1824  0002  0002                        FDB MI3,NO,NO                                                        NOTE
 41  00EE  01                                      FCB T1                                                               NOTE
 42                                                ENDM
 43                                                   NOTE    MI3,SOLS5,SI5,T4,MI3,NO,NO,T1                            NOTE
 44  00EF  1824  0360  0303                        FDB MI3,SOLS5,SI5                                                    NOTE
 45  00F5  04                                      FCB T4                                                               NOTE
 46  00F6  1824  0002  0002                        FDB MI3,NO,NO                                                        NOTE
 47  00FC  01                                      FCB T1                                                               NOTE
 48                                                ENDM
 49                                                   NOTE    MI3,FAS5,LA5,T4,NO,NO,NO,T1                              NOTE
 50  00FD  1824  0404  0340                        FDB MI3,FAS5,LA5
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                                                                                                        73....80
LINE  ADDR  CODE  EXTENSIONS      S O U R C E  -  S T A T E M E N T                                                 NOTE
  1  0103  04                                      FCB T4                                                           NOTE
  2  0104  0002  0002  0002                        FDB NO,NO,NO                                                     NOTE
  3  010A  01                                      FCB T1
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                                    ENDM                                                                NOTE
                                         NOTE     MI3,MI5,SOLS5,T8,NO,NO,NO,T1                          NOTE
0108 1824 0454 0360                 FDB MI3,MI5,SOLS5                                                   NOTE
0111 08                             FCB T8                                                              NOTE
0112 0002 0002 0002                 FDB NO,NO,NO                                                        NOTE
0118 01                             FCB T1                                                              NOTE
                                    ENDM
                                         NOTE     MI3,FAS5,LA5,T4,MI3,NO,NO,T1                          NOTE
0119 1824 0404 0340                 FDB MI3,FAS5,LA5                                                    NOTE
011F 04                             FCB T4                                                              NOTE
0120 1824 0002 0002                 FDB MI3,NO,NO                                                       NOTE
0126 01                             FCB T1                                                              NOTE
                                    ENDM
                                         NOTE     MI3,SOLS5,SI5,T4,NO,NO,NO,T1                          NOTE
0127 1824 0360 0303                 FDB MI3,SOLS5,SI5                                                   NOTE
012D 04                             FCB T4                                                              NOTE
012E 0002 0002 0002                 FDB NO,NO,NO                                                        NOTE
0134 01                             FCB T1                                                              NOTE
                                    ENDM
                                         NOTE     LA3,FAS5,LA5,T8,NO,NO,NO,T1                           NOTE
0135 1360 0404 0340                 FDB LA3,FAS5,LA5                                                    NOTE
013B 08                             FCB T8                                                              NOTE
013C 0002 0002 0002                 FDB NO,NO,NO                                                        NOTE
0142 01                             FCB T1                                                              NOTE
                                    ENDM
                                         NOTE     LAS3,MI5,SOLS5,T8,NO,NO,NO,T1                         NOTE
0143 1284 0454 0360                 FDB LAS3,MI5,SOLS5                                                  NOTE
0149 08                             FCB T8                                                              NOTE
014A 0002 0002 0002                 FDB NO,NO,NO                                                        NOTE
0150 01                             FCB T1                                                              NOTE
                                    ENDM
                                         NOTE     SI3,RES5,FAS5,T8,SI3,RES5,NO,T1                       NOTE
0151 1216 0481 0404                 FDB SI3,RES5,FAS5                                                   NOTE
0157 08                             FCB T8                                                              NOTE
0158 1216 0481 0002                 FDB SI3,RES5,NO                                                     NOTE
015E 01                             FCB T1                                                              NOTE
                                    ENDM
                                         NOTE     SI3,RES5,RES5,T8,NO,NO,NO,T1                          NOTE
015F 1216 0481 0481                 FDB SI3,RES5,RES5                                                   NOTE
0165 08                             FCB T8                                                              NOTE
0166 0002 0002 0002                 FDB NO,NO,NO                                                        NOTE
016C 01                             FCB T1                                                              NOTE
                                    ENDM
                                         NOTE     NO,NO,SI4,T8,NO,NO,NO,T1                              NOTE
016D 0002 0002 0607                 FDB NO,NO,SI4                                                       NOTE
0173 08                             FCB T8                                                              NOTE
0174 0002 0002 0002                 FDB NO,NO,NO
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LINE ADDR CODE EXTENSIONS    . S O U R C E - S T A T E M E N T                          73...80
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                                    FCB T1                                                              NOTE
                                    ENDM                                                                NOTE
                                         NOTE     MI3,SI4,MI5,T8,NO,NO,NO,T1                            NOTE
0178 1824 0607 0454                 FDB MI3,SI4,MI5                                                     NOTE
0181 08                             FCB T8                                                              NOTE
0182 0002 0002 0002                 FDB NO,NO,NO                                                        NOTE
0188 01                             FCB T1
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                                    ENDM
                                          NOTE      MI3,MI5,SOLS5,T8,MI3,NO,NO,T1
 8
 9                                  FDB MI3,MI5,SOLS5
10  0189  1824  0454  0360          FCB T8
11  018F  08                        FDB MI3,NO,NO
12  0190  1824  0002  0002          FCB T1
13  0196  01                        ENDM
14                                        NOTE      MI3,MI5,SOLS5,T8,NO,NO,NO,T1
15                                  FDB MI3,MI5,SOLS5
16  0197  1824  0454  0360          FCB T8
17  019D  08                        FDB NO,NO,NO
18  019E  0002  0002  0002          FCB T1
19  01A4  01                        ENDM
20                                        NOTE      MI3,MI5,SOLS5,T8,MI3,NO,NO,T1
21                                  FDB MI3,MI5,SOLS5
22  01A5  1824  0454  0360          FCB T8
23  01AB  08                        FDB MI3,NO,NO
24  01AC  1824  0002  0002          FCB T1
25  01B2  01                        ENDM
26                                        NOTE      MI3,MI5,FAS5,T4,MI3,MI5,NO,T1
27                                  FDB MI3,MI5,FAS5
28  01B3  1824  0454  0404          FCB T4
29  01B9  04                        FDB MI3,MI5,NO
30  01BA  1824  0454  0002          FCB T1
31  01C0  01                        ENDM
32                                        NOTE      MI3,MI5,MI5,T4,NO,NO,NO,T1
33                                  FDB MI3,MI5,MI5
34  01C1  1824  0454  0454          FCB T4
35  01C7  04                        FDB NO,NO,NO
36  01C8  0002  0002  0002          FCB T1
37  01CE  01                        ENDM
38                                        NOTE      MI3,SOLS5,SI5,T16,NO,SOLS5,SI5,T1
39                                  FDB MI3,SOLS5,SI5
40  01CF  1824  0360  0303          FCB T16
41  01D5  10                        FDB NO,SOLS5,SI5
42  01D6  0002  0360  0303          FCB T1
43  01DC  01                        ENDM
44                                        NOTE      MI3,SOLS5,SI5,T8,MI3,NO,NO,T1
45                                  FDB MI3,SOLS5,SI5
46  01DD  1824  0360  0303          FCB T8
47  01E3  08                        FDB MI3,NO,NO
48  01E4  1824  0002  0002          FCB T1
49  01EA  01                        ENDM
50
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                                                                        73...80
LINE  ADDR  CODE  EXTENSIONS      S O U R C E - S T A T E M E N T
                                          NOTE      MI3,SOLS5,SI5,T4,MI3,NO,NO,T1
 1                                  FDB MI3,SOLS5,SI5
 2  01EB  1824  0360  0303          FCB T4
 3  01F1  04                        FDB MI3,NO,NO
 4  01F2  1824  0002  0002          FCB T1
 5  01F8  01                        ENDM
 6                                        NOTE      MI3,FAS5,LA5,T4,NO,NO,NO,T1
 7                                  FDB MI3,FAS5,LA5
 8  01F9  1824  0404  0340          FCB T4
 9  01FF  04                        FDB NO,NO,NO
10  0200  0002  0002  0002          FCB T1
11  0206  01
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                                        ENDM                                                    NOTE
                                             NOTE     MI3,MI5,SOLS5,T8,MI3,NO,NO,T1             NOTE
                                        FDB MI3,MI5,SOLS5                                       NOTE
                                        FCB T8                                                  NOTE
                                        FDB MI3,NO,NO                                           NOTE
                                        FCB T1                                                  NOTE
                                        ENDM
                                             NOTE     MI3,MI5,SOLS5,T8,NO,NO,NO,T1              NOTE
                                        FDB MI3,MI5,SOLS5                                       NOTE
                                        FCB T8                                                  NOTE
                                        FDB NO,NO,NO                                            NOTE
                                        FCB T1                                                  NOTE
                                        ENDM
                                             NOTE     MI3,MI5,SOLS5,T8,MI3,NO,NO,T1             NOTE
                                        FDB MI3,MI5,SOLS5                                       NOTE
                                        FCB T8                                                  NOTE
                                        FDB MI3,NO,NO                                           NOTE
                                        FCB T1                                                  NOTE
                                        ENDM
                                             NOTE     MI3,MI5,FAS5,T4,MI3,MI5,NO,T1             NOTE
0231 1824 0454 0404                     FDB MI3,MI5,FAS5                                        NOTE
0237 04                                 FCB T4                                                  NOTE
0238 1824 0454 0002                     FDB MI3,MI5,NO                                          NOTE
023E 01                                 FCB T1                                                  NOTE
                                        ENDM
                                             NOTE     MI3,MI5,MI5,T4,NO,NO,NO,T1                NOTE
023F 1824 0454 0454                     FDB MI3,MI5,MI5                                         NOTE
0245 04                                 FCB T4                                                  NOTE
0246 0002 0002 0002                     FDB NO,NO,NO                                            NOTE
024C 01                                 FCB T1                                                  NOTE
                                        ENDM
                                             NOTE     MI3,SOLS5,SI5,T16,NO,SOLS5,SI5,T1         NOTE
0240 1824 0360 0303                     FDB MI3,SOLS5,SI5                                       NOTE
0253 10                                 FCB T16                                                 NOTE
0254 0002 0360 0303                     FDB NO,SOLS5,SI5                                        NOTE
025A 01                                 FCB T1                                                  NOTE
                                        ENDM
                                             NOTE     MI3,SOLS5,SI5,T8,MI3,NO,NO,T1             NOTE
0258 1824 0360 0303                     FDB MI3,SOLS5,SI5
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1
LINE  ADDR  CODE  EXTENSIONS          S O U R C E  -  S T A T E M E N T          73...80

                                                                                        NOTE
0261 08                                 FCB T8                                          NOTE
0262 1824 0002 0002                     FDB MI3,NO,NO                                   NOTE
0268 01                                 FCB T1                                          NOTE
                                        ENDM
                                             NOTE     MI3,SOLS5,SI5,T4,MI3,NO,NO,T1     NOTE
0269 1824 0360 0303                     FDB MI3,SOLS5,SI5                               NOTE
026F 04                                 FCB T4                                          NOTE
0270 1824 0002 0002                     FDB MI3,NO,NO                                   NOTE
0276 01                                 FCB T1                                          NOTE
                                        ENDM
                                             NOTE     MI3,FAS5,LA5,T4,NO,NO,NO,T1       NOTE
0277 1824 0404 0340                     FDB MI3,FAS5,LA5                                NOTE
027D 04                                 FCB T4                                          NOTE
027E 0002 0002 0002                     FDB NO,NO,NO                                    NOTE
0284 01                                 FCB T1
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                                ENDM                                                    NOTE
                                     NOTE    MI3,MI5,SOLS5,T8,NO,NO,NO,T1               NOTE
0285 1824 0454 0360             FDB MI3,MI5,SOLS5                                       NOTE
028B 08                         FCB T8                                                  NOTE
028C 0002 0002 0002             FDB NO,NO,NO                                            NOTE
0292 01                         FCB T1                                                  NOTE
                                ENDM
                                     NOTE    MI3,FAS5,LA5,T4,MI3,NO,NO,T1
0293 1824 0404 0340             FDB MI3,FAS5,LA5                                        NOTE
0299 04                         FCB T4                                                  NOTE
029A 1824 0002 0002             FDB MI3,NO,NO                                           NOTE
02A0 01                         FCB T1                                                  NOTE
                                ENDM
                                     NOTE    MI3,SOLS5,SI5,T4,NO,NO,NO,T1
02A1 1824 0360 0303             FDB MI3,SOLS5,SI5                                       NOTE
02A7 04                         FCB T4                                                  NOTE
02A8 0002 0002 0002             FDB NO,NO,NO                                            NOTE
02AE 01                         FCB T1                                                  NOTE
                                ENDM
                                     NOTE    LA3,FAS3,LA5,T8,NO,NO,NO,T1
02AF 1360 1617 0340             FDB LA3,FAS3,LA5                                        NOTE
02B5 08                         FCB T8                                                  NOTE
02B6 0002 0002 0002             FDB NO,NO,NO                                            NOTE
02BC 01                         FCB T1                                                  NOTE
                                ENDM
                                     NOTE    LAS3,MI5,SOLS5,T8,NO,NO,NO,T1
028D 1284 0454 0360             FDB LAS3,MI5,SOLS5                                      NOTE
02C3 08                         FCB T8                                                  NOTE
02C4 0002 0002 0002             FDB NO,NO,NO                                            NOTE
02CA 01                         FCB T1                                                  NOTE
                                ENDM
                                     NOTE    SI3,RES5,FAS5,T16,NO,NO,NO,T1
02C8 1216 0481 0404             FDB SI3,RES5,FAS5                                       NOTE
02D1 10                         FCB T16                                                 NOTE
02D2 0002 0002 0002             FDB NO,NO,NO                                            NOTE
1                                                   CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR    81/10/01. PAGE 10
                                                    VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE   18.22.28.

LINE ADDR CODE EXTENSIONS       S O U R C E - S T A T E M E N T                 73....80

02D8 01                         FCB T1                                                  NOTE
                                ENDM                                                    NOTE
                                     NOTE    NO,NO,NO,T8,NO,NO,NO,T8
02D9 0002 0002 0002             FDB NO,NO,NO                                            NOTE
02DF 08                         FCB T8                                                  NOTE
02E0 0002 0002 0002             FDB NO,NO,NO                                            NOTE
02E6 08                         FCB T8                                                  NOTE
                                ENDM                                                    NOTE
02E7 FE                              FCB    ENDI
02E8                                 END
1                                                   CROSS ASSEMBLER FOR MOTOROLA 6800 PROCESSOR    81/10/01. PAGE 11
IDENTIFIER CROSS REFERENCE.                         VERS. 1.0, RUN AT CERN'S CDC COMPUTER CENTRE   18.22.29.

ALLEG    0000000F EQU    3/24        3/40
ANDAN    00000014 EQU    3/25
DOS3     00002168 EQU    2/21
DOS4     00001080 EQU    2/33
DOS5     00000540 EQU    2/45
DOS6     00000270 EQU    3/07
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