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;------------------------------------------------------
;
;                        QSOxx.ASM
;
;                        QSOcorder
;
;           Digital Audio "Instant Replay" Unit
;
;
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;
;------------------------------------------------------
;          For personal, noncommercial use only.
;------------------------------------------------------
;
; NOTE:   version number and date appear on
;         ROM page 3, and on the top of the
;         following lines.
;
; v. 2.3 - 10/17/93 - include NOPs for JNT1 on pwr-up
; v. 2.2 - 09/29/93 - remove unnecessary subroutines
; v. 2.1 - 08/10/93 - change manual reboot method
; v. 2.0 - 08/09/93 - add manual record mode
; v. 1.2 - 08/07/93 - include clear RAM routine
; v. 1.1 - 08/07/93 - shorten record loop to 42/55
; v. 1.0 - 08/06/93 - original program
;
;------------------------------------------------------
;
; This program runs on an Intel 8748H (high speed version)
; microcontroller to allow "Instant Replay" of received
; communications quality audio.  It requires two 62256
; RAMs (32K x 8), an Analog Devices AD7569 8-bit audio
; I/O port, a 74LS374/574 demultiplexing latch, and
; analog antialiasing and reconstruction lowpass filters,
; and speaker driver amplifier, such as an LM380.
;
; The crystal required is 11 MHz (or 11.0592 MHz, which
; exceeds the specification of the 8748H, but not by very
; much, and should work fine in most instances).
;
; Three switches to control the system are connected as
; follows:
;          T0 (pin 1) - 10 second repeat pushbutton
;          T1 (pin 39)- 5 second repeat pushbutton
;          INT (pin 6) - Sample rate selector
;                        (open   = 13.41 kHz)
;                        (ground = 17.55 kHz)
;
; The sample rate determines the quality of the replayed
; audio, as well as the duration.  At the slow rate, the
; "10 second" switch plays for 9.8 seconds, and the
; "5 second" switch plays for 4.9 seconds.  At the fast
; rate, the times are 7.5 and 3.7 seconds.  At the slow
; rate, there will be some reconstruction noise, since
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; the storage algorithm uses a /2 decimation, and a
; corresponding x2 interpolation, with simple 2-point
; averaging digital filtering.  With the 3 kHz, 3rd order
; Chebyshev lowpass filters, this causes images from the
; sampling/decimation to be heard.  A 3 kHz input signal
; will image to a resulting -30 dB at the fast rate, and
; -10 dB at the slow rate.  Thus, the trade-off is between
; better quality vs. longer record time.  Fortunately,
; ham radio applications will involve signals with little
; high frequency power.
;
; There are 42 states between samples at the fast rate,
; and 55 states at the slow rate.  With the 11.0592 MHz
; clock, each state takes about 1.356 microseconds,
; = (15/11.0592) microseconds.
;
; The RAM address is multiplexed onto Port 1, and
; demultiplexed with the 74LS374 latch.  The latch
; holds the MS bits, and Port 1 holds the LS bits.
; The MS bit of the latch operates the overload LED.
; Data transfers are made on the "BUS."  Port 2 is used
; to construct the control signals as follows:
;
;   Port bit     Pin        Signal
;     P27         38        CS1- to RAM 1
;     P26         37        CS0- to RAM 0
;     P25         36        WE-  to RAMs
;     P24         35        OE-  to RAMs
;     P23         24        WR-  to AD7569
;     P22         23        ST-  to AD7569
;     P21         22        RD-  to AD7569
;     P20         21        LATCH- to 74LS374
;
;Note:  ST- starts the A/D converter on the falling edge.
;       It is a normally-low signal.
;
; Registers used are as follows:
;
;   R7 - MS start address in buffer/temp constant 0
;   R6 - LS start address in buffer
;   R5 - MS end address
;   R4 - Temporary sample storage
;   R3 - Temporary sample storage
;   R2 - MS current address pointer
;   R1 - LS current address pointer
;   R0 - sample average
;
;There are two modes of operation in the QSOcorder:
;
; AUTOMATIC MODE:
; ---------------
; When a "play" is requested, R7/R6 hold the computed
; starting "play address."  This is either 5 seconds
; or 10 seconds earlier than the present buffer address.
; R5 is used to hold the MS end address, so the "play"
; knows when to stop and return to the "start" address
; to continue playing.  R2/R1 are used as a temporary
; address during playing.  When playing is no longer
; requested, R5/R6 are put into R2/R1 to continue
; recording.  This will cause recording to begin at the
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                        ; same place it was halted when the play request was made.
                        ; Playing continues as long as a play button is pressed.
                        ;
                        ; An "Overload LED" is connected to the latch MSB and is
                        ; used to set the receiver audio gain.  Adjust the
                        ; receiver audio until the LED just flickers, and then
                        ; back-off the setting a small amount.  Too much receiver
                        ; audio will cause some distortion, and too little will
                        ; allow quantizing noise to be heard.
                        ;
                        ;
                        ; MANUAL MODE:
                        ; -----------
                        ; Manual mode is entered by holding the 10-second push-
                        ; button down while powering-up the system.  It will then
                        ; enter the 1 second memory clear routine, and finally
                        ; enter manual mode and light up the LED.  This indicates
                        ; it is idling, and ready for a record command.  The record
                        ; command consists of a quick press of the 10 second button.
                        ; The LED will extinguish, and a 10 second recording will
                        ; be made, after which the system lights up the LED and
                        ; awaits a play command.  This is similarly caused by a quick
                        ; press of the 10 second button.  It will play the complete
                        ; 10 seconds, and return to the play-idle state, awaiting
                        ; another play command.  Whenever the LED is on, in either
                        ; idle state, the mode may be cancelled by a quick press
                        ; of the 5 second button.  The system will then enter the
                        ; automatic mode immediately.  The manual mode can only
                        ; be reentered by the power-up technique described above.
                        ;
                        ; The playback sample rate in manual mode will vary
                        ; depending on whether the 10 second button is being
                        ; pressed.  This will also happen during record mode.
                        ; The variation is from 17.55 kHz to 16.75 kHz which
                        ; causes a noticible change on music but is barely
                        ; detectable on voice.
                        ;
                        ; There is a 1 second delay (with LED on) upon power-up
                        ; in either mode, for the RAM-clear routine.
                        ;
                        ;------------------------------------------------------------
                        ;------------------ Memory Page 0 ----------------------
                        ;------------------------------------------------------------
0000                            ORG     0000H               ;Start of EPROM memory

0000 15         START   DIS     I                   ;Turn off external interrupt
0001 35                 DIS     TCNTI               ;...and timer counter int
0002 5400               CALL    INIT                ;Initialize ports and data
0004 26CB               JNT0    MANA                ;Manual record mode request
0006 00                 NOP                         ;Room for JNT1 on power up
0007 00                 NOP                         ;Same
0008 541C               CALL    CLEAR               ;Clear all of RAM memory

                        ;----------------- Using RAM chip 0 ---------------------
                        ;-------------------- RECORD --------------------------
                        ;Reset the start address to previous end address
000A 76B7       REC0X   JF1     PLAY0A              ;If manual, keep playing
000C FD         RECMAN  MOV     A,R5                ;Get MS end addr byte
000D AA                 MOV     R2,A                ;Put into counter
000E FE                 MOV     A,R6                ;Get LS end addr byte
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000F A9                     MOV     R1,A            ;Put into counter
0010 BF00                   MOV     R7,#0           ;Constant zero

             ;Start the A/D converter                               states
0012 8A04    REC0    ORL     P2,#00000100B   ;ST- = 1               2
0014 9AFB            ANL     P2,#11111011B   ;ST- = 0               2 A/D
0016 861A            JNI     FAST0A          ;Fast sampling?        2
0018 5498            CALL    WAIT13          ;No, add 13 states   (13)

             ;Read the A/D converter into accum
001A 81      FAST0A  MOVX    A,@R1           ;Dummy to reset BUS    2
001B 9AFD            ANL     P2,#11111101B   ;RD- = 0               2
001D 08              INS     A,BUS           ;Read A/D on BUS       2
001E 8A02            ORL     P2,#00000010B   ;RD- = 1               2

             ;Send accum data to D/A converter
0020 02              OUTL    BUS,A           ;Send data to BUS      2
0021 9AB6            ANL     P2,#10110110B   ;WR-,LATCH-,CS0-=0     2
0023 8A08            ORL     P2,#00001000B   ;WR- = 1               2 D/A
0025 AC              MOV     R4,A            ;Save sample           1

             ;Check whether overload is occurring.  F0=1=yes.
0026 FA              MOV     A,R2            ;MS byte addr          1
0027 537F            ANL     A,#01111111B    ;Turn LED on           2
0029 B62F            JF0     ON0A            ;Should be on?         2
002B 4380            ORL     A,#10000000B    ;No, turn off          2
002D 0433            JMP     OFF0A           ;Continue              2
002F 00      ON0A    NOP                     ;Pad timing          (1)
0030 00              NOP                     ;                    (1)
0031 00              NOP                     ;                    (1)
0032 00              NOP                     ;                    (1)

             ;Put sample average into RAM at current address
             ;Send address to latches
0033 39      OFF0A   OUTL    P1,A            ;Out to port 1         2
0034 8A01            ORL     P2,#00000001B   ;LATCH- = 1            2
0036 F9              MOV     A,R1            ;LS byte addr          1
0037 39              OUTL    P1,A            ;Out to port 1         2

             ;Send data to RAM
0038 F8              MOV     A,R0            ;Get sample average    1
0039 02              OUTL    BUS,A           ;Put onto BUS          2
003A 9ADF            ANL     P2,#11011111B   ;WE- = 0               2
003C 8A24            ORL     P2,#00100100B   ;WE-=1, ST-=1          2

             ;Start the A/D converter
003E 9AFB            ANL     P2,#11111011B   ;ST- = 0               2 A/D
0040 8644            JNI     FAST0B          ;Fast sampling?        2
0042 5498            CALL    WAIT13          ;No, add 13 states   (13)

             ;Read the A/D converter into accum
0044 81      FAST0B  MOVX    A,@R1           ;Dummy to reset BUS    2
0045 9AFD            ANL     P2,#11111101B   ;RD- = 0               2
0047 08              INS     A,BUS           ;Read A/D data on BUS  2
0048 8A42            ORL     P2,#01000010B   ;RD-=1;CS0-=1          2

             ;Send accum data to D/A converter
004A 02              OUTL    BUS,A           ;Send data to BUS      2
004B 9AF7            ANL     P2,#11110111B   ;WR- = 0               2
004D 8A08            ORL     P2,#00001000B   ;WR- = 1               2 D/A
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                   ;Check for overload - set F0 if yes.
004F 85            CLR   F0              ;LED flag off          1
0050 9655          JNZ   OFF0B           ;Overload?             2
0052 95            CPL   F0              ;Yes!  Turn on        (1)
0053 0458          JMP   ON0B            ;Continue             (2)
0055 00    OFF0B   NOP                   ;Pad timing            1
0056 00            NOP                   ;                      1
0057 00            NOP                   ;                      1


                   ;Find the average
0058 6C    ON0B    ADD   A,R4            ;Add old sample        1
0059 67            RRC   A               ;Average the two       1
005A A8            MOV   R0,A            ;Save for later        1


                   ;Increment address counters in R2:R1
005B F9            MOV   A,R1            ;Get LS byte           1
005C 0301          ADD   A,#1            ;Bump LS byte          2
005E A9            MOV   R1,A            ;Replace               1
005F FA            MOV   A,R2            ;Get MS byte           1
0060 7F            ADDC  A,R7            ;Add carry + (R7=0)    1
0061 AA            MOV   R2,A            ;Replace               1
0062 F2C7          JB7   TEST1A          ;Change RAM?           2


0064 566C  TEST0   JT1   TA              ;T1 up?  Check T0      2
0066 FA            MOV   A,R2            ;No, fix start addr
0067 D380          XRL   A,#10000000B    ;Addr 5 secs back
0069 AF            MOV   R7,A            ;Save as MS start
006A 0472          JMP   PL0             ;Now play


006C 3612  TA      JT0   REC0            ;T0 up?  Keep rec.     2
006E 7612          JF1   REC0            ;Manual, ignore T0


0070 FA            MOV   A,R2            ;Addr 10 secs back
0071 AF            MOV   R7,A            ;Save as MS start


0072 F9    PL0     MOV   A,R1            ;LS byte addr
0073 AE            MOV   R6,A            ;Save LS start/end
0074 FA            MOV   A,R2            ;Get MS addr end
0075 AD            MOV   R5,A            ;Save as MS end


                   ;Set starting address for playing
0076 FF    START0  MOV   A,R7            ;Get MS start
0077 AA            MOV   R2,A            ;Into counter
0078 FE            MOV   A,R6            ;Get LS start
0079 A9            MOV   R1,A            ;Into counter


                   ;----------------- PLAY -----------------------
                   ;Get a byte from current address into accum
                   ;Send address to latches
007A 81    PLAY0   MOVX  A,@R1           ;Dummy to reset BUS    2
007B 9ABF          ANL   P2,#10111111B   ;CS0- = 0              2
007D FA            MOV   A,R2            ;MS byte addr          1
007E 4380          ORL   A,#10000000B    ;Turn off LED          2
0080 39            OUTL  P1,A            ;Out to port 1         2
0081 9AFE          ANL   P2,#11111110B   ;LATCH- = 0            2
0083 8A01          ORL   P2,#00000001B   ;LATCH- = 1            2
0085 F9            MOV   A,R1            ;LS byte addr          1
0086 39            OUTL  P1,A            ;Out to port 1         2
0087 9AEF          ANL   P2,#11101111B   ;OE- = 0               2
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0089 08                   INS     A,BUS            ;Read RAM data on BUS 2
008A 8A10                 ORL     P2,#00010000B    ;OE- = 1              2
008C 8A40                 ORL     P2,#01000000B    ;CS0- = 1            2

              ;Find the average
008E AB                   MOV     R3,A             ;Save sample for now  1
008F 6C                   ADD     A,R4             ;R4 = old sample      1
0090 67                   RRC     A                ;Find average         1
0091 00                   NOP                      ;Pad timing           1
0092 00                   NOP                      ;                     1
0093 00                   NOP                      ;                     1
0094 00                   NOP                      ;                     1
0095 00                   NOP                      ;                     1

              ;Send accum data to D/A converter
0096 869A                 JNI     FAST0C           ;Fast sampling?       2
0098 5498                 CALL    WAIT13           ;No, add 13 states  (13)
009A 02        FAST0C     OUTL    BUS,A            ;Send data to BUS     2
009B 9AF7                 ANL     P2,#11110111B    ;WR- = 0              2
009D 8A08                 ORL     P2,#00001000B    ;WR- = 1              2 D/A

              ;Increment address counters in R2:R1
009F F9                   MOV     A,R1             ;Get LS byte          1
00A0 0301                 ADD     A,#1             ;Bump LS byte         2
00A2 A9                   MOV     R1,A             ;Replace              1
00A3 FA                   MOV     A,R2             ;Get MS byte          1
00A4 1300                 ADDC    A,#0             ;Add carry            2
00A6 AA                   MOV     R2,A             ;Replace              1
00A7 F2C9                 JB7     TST1A            ;Change RAM?          2

00A9 F9                   MOV     A,R1             ;Get LS addr          1
00AA DE                   XRL     A,R6             ;At end?              1
00AB 96B1                 JNZ     TST0             ;Not yet              2

00AD FA                   MOV     A,R2             ;Get MS addr
00AE DD                   XRL     A,R5             ;At end?
00AF C676                 JZ      START0           ;Yes, restart

00B1 56B5      TST0       JT1     TB               ;T1 up?               2
00B3 04B7                 JMP     PLAY0A           ;No, play sound       2

00B5 360A      TB         JT0     REC0X            ;Finished playing?

00B7 FB        PLAY0A     MOV     A,R3             ;Recall new sample    1
00B8 AC                   MOV     R4,A             ;Make into old        1
00B9 5498                 CALL    WAIT13           ;Wait 13 states      13
00BB 00                   NOP                      ;Pad timing           1

              ;Send sample to D/A converter
00BC 86C0                 JNI     FAST0D           ;Fast sampling?       2
00BE 5498                 CALL    WAIT13           ;No, add 13 states  (13)
00C0 02        FAST0D     OUTL    BUS,A            ;Send data to BUS     2
00C1 9AF7                 ANL     P2,#11110111B    ;WR- = 0              2
00C3 8A08                 ORL     P2,#00001000B    ;WR- = 1              2 D/A
00C5 047A                 JMP     PLAY0            ;Keep playing         2

00C7 245E      TEST1A     JMP     TEST1            ;Cross page jumps
00C9 24AD      TST1A      JMP     TST1
00CB 4440      MANA       JMP     MANUAL
```

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                        ;----------------------------------------------------------
                        ;----------------- Memory Page 1 ----------------------
                        ;----------------------------------------------------------
0100                    ORG     0100H


                        ;---------------- Using RAM chip 1 --------------------
                        ;-------------------- RECORD ------------------------------
                        ;Reset the start address to previous end address
0100 76B3       REC1X   JF1     PLAY1A          ;If manual, keep playing
0102 FD                 MOV     A,R5            ;Get MS end addr byte
0103 AA                 MOV     R2,A            ;Put into counter
0104 FE                 MOV     A,R6            ;Get LS end addr byte
0105 A9                 MOV     R1,A            ;Put into counter
0106 BF00               MOV     R7,#0           ;Constant zero


                        ;Start the A/D converter
0108 8A04       REC1    ORL     P2,#00000100B   ;ST- = 1              2
010A 9AFB               ANL     P2,#11111011B   ;ST- = 0              2 A/D
010C 8610               JNI     FAST1A          ;Fast sampling?       2
010E 5498               CALL    WAIT13          ;No, add 13 states  (13)


                        ;Read the A/D converter into accum
0110 81         FAST1A  MOVX    A,@R1           ;Dummy to reset BUS   2
0111 9AFD               ANL     P2,#11111101B   ;RD- = 0              2
0113 08                 INS     A,BUS           ;Read A/D data on BUS 2
0114 8A02               ORL     P2,#00000010B   ;RD- = 1              2


                        ;Send accum data to D/A converter
0116 02                 OUTL    BUS,A           ;Send data to BUS     2
0117 9A76               ANL     P2,#01110110B   ;WR-,LATCH-,CS1-=0    2
0119 8A08               ORL     P2,#00001000B   ;WR- = 1              2 D/A
011B AC                 MOV     R4,A            ;Save sample          1


                        ;Check whether overload is occurring.  F0=1=yes.
011C FA                 MOV     A,R2            ;MS byte addr         1
011D 537F               ANL     A,#01111111B    ;Turn LED on          2
011F B625               JF0     ON1A            ;Should be on?        2
0121 4380               ORL     A,#10000000B    ;No, turn off         2
0123 2429               JMP     OFF1A           ;Continue             2
0125 00         ON1A    NOP                     ;                    (1)
0126 00                 NOP                     ;                    (1)
0127 00                 NOP                     ;                    (1)
0128 00                 NOP                     ;                    (1)


                        ;Put sample average into RAM at current address
                        ;Send address to latches
0129 39         OFF1A   OUTL    P1,A            ;Out to port 1        2
012A 8A01               ORL     P2,#00000001B   ;LATCH- = 1           2
012C F9                 MOV     A,R1            ;LS byte addr         1
012D 39                 OUTL    P1,A            ;Out to port 1        2


                        ;Send data to RAM
012E F8                 MOV     A,R0            ;Get sample average   1
012F 02                 OUTL    BUS,A           ;Put onto BUS         2
0130 9ADF               ANL     P2,#11011111B   ;WE- = 0              2
0132 8A24               ORL     P2,#00100100B   ;WE-=1, ST-=1         2


                        ;Start the A/D converter
0134 9AFB               ANL     P2,#11111011B   ;ST- = 0              2 A/D
0136 863A               JNI     FAST1B          ;Fast sampling?       2
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0138 5498               CALL    WAIT13          ;No, add 13 states  (13)

                        ;Read the A/D converter into accum
013A 81         FAST1B  MOVX    A,@R1           ;Dummy to reset BUS    2
013B 9AFD               ANL     P2,#11111101B   ;RD- = 0               2
013D 08                 INS     A,BUS           ;Read A/D data on BUS  2
013E 8A82               ORL     P2,#10000010B   ;RD-=1;CS1-=1          2

                        ;Send accum data to D/A converter
0140 02                 OUTL    BUS,A           ;Send data to BUS      2
0141 9AF7               ANL     P2,#11110111B   ;WR- = 0               2
0143 8A08               ORL     P2,#00001000B   ;WR- = 1               2 D/A

                        ;Check for overload - set F0 if yes.
0145 85                 CLR     F0              ;LED flag off          1
0146 964B               JNZ     OFF1B           ;Overload?             2
0148 95                 CPL     F0              ;Yes!  Turn on        (1)
0149 244E               JMP     ON1B            ;Continue             (2)
014B 00         OFF1B   NOP                     ;Pad timing            1
014C 00                 NOP                     ;                      1
014D 00                 NOP                     ;                      1

                        ;Find the average
014E 6C         ON1B    ADD     A,R4            ;Add old value         1
014F 67                 RRC     A               ;Average the two       1
0150 A8                 MOV     R0,A            ;Save for later        1

                        ;Increment address counters in R2:R1
0151 F9                 MOV     A,R1            ;Get LS byte           1
0152 0301               ADD     A,#1            ;Bump LS byte          2
0154 A9                 MOV     R1,A            ;Replace               1
0155 FA                 MOV     A,R2            ;Get MS byte           1
0156 7F                 ADDC    A,R7            ;Add carry + (R7=0)    1
0157 AA                 MOV     R2,A            ;Replace               1
0158 F25E               JB7     TEST1           ;Change RAM?           2
015A 76C3               JF1     MAN2A           ;Manual, stop rec.
015C 0464               JMP     TEST0           ;Yes

015E 5666      TEST1   JT1     TC              ;T1 up?  Check T0      2
0160 FA                MOV     A,R2            ;No, fix start addr
0161 D380               XRL     A,#10000000B    ;Addr 5 secs back
0163 AF                 MOV     R7,A            ;Save as MS start
0164 246A               JMP     PL1             ;Now play

0166 3608      TC      JT0     REC1            ;T0 up?  Keep rec.     2

0168 FA                MOV     A,R2            ;Addr 10 secs back
0169 AF                MOV     R7,A            ;Save as MS start

016A F9        PL1     MOV     A,R1            ;LS byte addr
016B AE                MOV     R6,A            ;Save LS start/end
016C FA                MOV     A,R2            ;Get MS addr end
016D AD                MOV     R5,A            ;Save as MS end

                        ;Set starting address for playing
016E FF        START1  MOV     A,R7            ;Get MS start
016F AA                MOV     R2,A            ;Into counter
0170 FE                MOV     A,R6            ;Get LS start
0171 A9                MOV     R1,A            ;Into counter
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                    ;------------------ PLAY -------------------------
                    ;Get a byte from current address into accum
                    ;Send address to latches
0172 81     PLAY1   MOVX    A,@R1           ;Dummy to reset BUS      2
0173 9A7F           ANL     P2,#01111111B   ;CS1- = 0                2
0175 FA            MOV     A,R2            ;MS byte addr            1
0176 4380          ORL     A,#10000000B    ;Turn off LED            2
0178 39            OUTL    P1,A            ;Out to port 1           2
0179 9AFE          ANL     P2,#11111110B   ;LATCH- = 0              2
017B 8A01          ORL     P2,#00000001B   ;LATCH- = 1              2
017D F9            MOV     A,R1            ;LS byte addr            1
017E 39            OUTL    P1,A            ;Out to port 1           2
017F 9AEF          ANL     P2,#11101111B   ;OE- = 0                 2
0181 08            INS     A,BUS           ;Read RAM data on BUS    2
0182 8A10          ORL     P2,#00010000B   ;OE- = 1                 2
0184 8A80          ORL     P2,#10000000B   ;CS1- = 1                2

                    ;Find the average
0186 AB            MOV     R3,A            ;Save sample for now     1
0187 6C            ADD     A,R4            ;R4 = old sample         1
0188 67            RRC     A               ;Find average            1
0189 00            NOP                     ;Pad timing              1
018A 00            NOP                     ;                        1
018B 00            NOP                     ;                        1
018C 00            NOP                     ;                        1
018D 00            NOP                     ;                        1

                    ;Send accum data to D/A converter
018E 8692          JNI     FAST1C          ;Fast sampling?          2
0190 5498          CALL    WAIT13          ;No, add 13 states      (13)
0192 02     FAST1C  OUTL    BUS,A           ;Send data to BUS        2
0193 9AF7          ANL     P2,#11110111B   ;WR- = 0                 2
0195 8A08          ORL     P2,#00001000B   ;WR- = 1                 2 D/A

                    ;Increment address counters in R2:R1
0197 F9            MOV     A,R1            ;Get LS byte             1
0198 0301          ADD     A,#1            ;Bump LS byte            2
019A A9            MOV     R1,A            ;Replace                 1
019B FA            MOV     A,R2            ;Get MS byte             1
019C 1300          ADDC    A,#0            ;Add carry               2
019E AA            MOV     R2,A            ;Replace                 1
019F F2A5          JB7     TE              ;Change RAM?             2
01A1 76C3          JF1     MAN2A           ;Manual, stop play
01A3 04B1          JMP     TST0            ;Yes

01A5 F9     TE      MOV     A,R1            ;Get LS addr             1
01A6 DE            XRL     A,R6            ;At end?                 1
01A7 96AD          JNZ     TST1            ;Not yet                 2

01A9 FA            MOV     A,R2            ;Get MS addr             1
01AA DD            XRL     A,R5            ;At end?                 1
01AB C66E          JZ      START1          ;Yes, restart            2

01AD 56B1   TST1    JT1     TD              ;T1 up?                  2
01AF 24B3          JMP     PLAY1A          ;No, play sound          2

01B1 3600   TD      JT0     REC1X           ;Finished playing?

01B3 FB     PLAY1A  MOV     A,R3            ;Recall new sample       1
01B4 AC            MOV     R4,A            ;Make into old           1
```

```
01B5 5498              CALL    WAIT13           ;Wait 13 states       13
01B7 00                NOP                      ;Pad timing           1

              ;Send sample to D/A converter
01B8 86BC              JNI     FAST1D           ;Fast sampling?       2
01BA 5498              CALL    WAIT13           ;No, add 13 states   (13)
01BC 02        FAST1D  OUTL    BUS,A            ;Send data to BUS     2
01BD 9AF7              ANL     P2,#11110111B    ;WR- = 0              2
01BF 8A08              ORL     P2,#00001000B    ;WR- = 1              2 D/A
01C1 2472              JMP     PLAY1            ;Keep playing         2


01C3 4454      MAN2A   JMP     MAN2             ;Cross page jumps


              ;-----------------------------------------------------------
              ;------------------ Memory Page 2 ----------------------
              ;-----------------------------------------------------------
0200                   ORG     0200H


              ;-------------------------------------------------------
0200           INIT    ;Initialize ports, BUS, and memories
0200 C5                SEL     RB0              ;Use RAM register bank 0
0201 E5                SEL     MB0              ;...and EPROM mem bank 0
0202 23FF              MOV     A,#11111111B     ;All ones
0204 39                OUTL    P1,A             ;Port 1 = 11111111B
0205 02                OUTL    BUS,A            ;BUS    = 11111111B
0206 23FB              MOV     A,#11111011B     ;ST- idles low
0208 3A                OUTL    P2,A             ;Port 2 = 11111011B
0209 BF00              MOV     R7,#0            ;MS start addr
020B BE00              MOV     R6,#0            ;LS start addr
020D BD00              MOV     R5,#0            ;MS end addr
020F BC00              MOV     R4,#0            ;Temp sample storage
0211 BB00              MOV     R3,#0            ;Temp sample storage
0213 BA00              MOV     R2,#0            ;MS curr addr
0215 B900              MOV     R1,#0            ;LS curr addr
0217 B87F              MOV     R0,#127          ;sample average
0219 85                CLR     F0               ;Overload LED off
021A A5                CLR     F1               ;Automatic mode
021B 93                RETR


              ;-------------------------------------------------------
021C           CLEAR   ;Clear RAM memory, two bytes at a time
021C 237F              MOV     A,#127           ;"zero" sample voltage
021E 02                OUTL    BUS,A            ;Send to BUS/RAM
021F BA00              MOV     R2,#00000000B    ;MS address = 0; LED on
0221 B900              MOV     R1,#00000000B    ;LS address = 0
0223 9A3F              ANL     P2,#00111111B    ;CS0-,CS1-=0

0225 FA        MORCLR  MOV     A,R2             ;MS address
0226 39                OUTL    P1,A             ;To latch
0227 9AFE              ANL     P2,#11111110B    ;LATCH-=0
0229 8A01              ORL     P2,#00000001B    ;LATCH-=1
022B F9                MOV     A,R1             ;LS address
022C 39                OUTL    P1,A             ;To port 1
022D 9ADF              ANL     P2,#11011111B    ;WE-=0
022F 8A20              ORL     P2,#00100000B    ;WE-=1

0231 F9                MOV     A,R1             ;LS address
0232 0301              ADD     A,#1             ;Bump address
0234 A9                MOV     R1,A             ;Replace
0235 FA                MOV     A,R2             ;MS address
```

```
0236 1300             ADDC    A,#0            ;Add carry
0238 AA               MOV     R2,A            ;Replace
0239 F23D             JB7     NOCLR           ;More than 32k ?
023B 4425             JMP     MORCLR          ;Continue


023D 8AC0    NOCLR    ORL     P2,#11000000B   ;CS0-,CS1-=1
023F 93               RETR                    ;Finished


             ;-----------------------------------------------------
0240         MANUAL   ;Manual record/play mode requested
0240 541C             CALL    CLEAR           ;Clear all of RAM memory
0242 2642    MAN3     JNT0    MAN3            ;Wait for key up
0244 5484             CALL    DEBOUN          ;Debounce key
0246 5474             CALL    LEDON           ;Turn on LED


             ;Get a sample and output to DAC
0248 5464    WAIT1    CALL    SAMPLE          ;A/D and D/A
024A 465E             JNT1    CANCEL          ;Press T1 to cancel
024C 3648             JT0     WAIT1           ;T0 up, wait


024E 547C             CALL    LEDOFF          ;Turn off LED
0250 A5               CLR     F1              ;Ready to set F1
0251 B5               CPL     F1              ;F1=1, LED is off
0252 040C             JMP     RECMAN          ;Record from start


0254         MAN2     ;Back from recording or playing 64k
0254 5474             CALL    LEDON           ;Turn on LED


             ;Get a sample and output to DAC
0256 5464    WAIT2    CALL    SAMPLE          ;A/D and D/A
0258 465E             JNT1    CANCEL          ;Press T1 to cancel
025A 3656             JT0     WAIT2           ;Wait for T0 press


025C 047A             JMP     PLAY0           ;Now play 64k


025E         CANCEL   ;T1 was pressed while in Memory Idle modes.
025E                  ;Cancel Memory mode.
025E 5400             CALL    INIT            ;Initialize & clear flag
0260 547C             CALL    LEDOFF          ;Turn off LED
0262 040A             JMP     REC0X           ;"Warm" reboot


             ;-----------------------------------------------------
0264         SAMPLE   ;Do A/D and D/A conversion
0264 8A04             ORL     P2,#00000100B   ;ST- = 1
0266 9AFB             ANL     P2,#11111011B   ;ST- = 0
0268 81               MOVX    A,@R1           ;Dummy to reset BUS
0269 9AFD             ANL     P2,#11111101B   ;RD- = 0
026B 08               INS     A,BUS           ;Read A/D on BUS
026C 8A02             ORL     P2,#00000010B   ;RD- = 1
026E 02               OUTL    BUS,A           ;Send data to BUS
026F 9AF7             ANL     P2,#11110111B   ;WR- = 0
0271 8A08             ORL     P2,#00001000B   ;WR- = 1
0273 93               RETR


             ;-----------------------------------------------------
0274         LEDON    ;Turn on LED
0274 537F             ANL     A,#01111111B    ;Turn on LED
0276 39               OUTL    P1,A            ;Out to port 1
0277 9AFE             ANL     P2,#11111110B   ;LATCH- = 0
0279 8A01             ORL     P2,#00000001B   ;LATCH- = 1
```

```
027B 93                 RETR

            ;-------------------------------------------------------------
027C            LEDOFF  ;Turn off LED
027C 4380               ORL     A,#10000000B    ;Turn off LED
027E 39                 OUTL    P1,A            ;Out to port 1
027F 9AFE               ANL     P2,#11111110B   ;LATCH- = 0
0281 8A01               ORL     P2,#00000001B   ;LATCH- = 1
0283 93                 RETR


            ;-------------------------------------------------------------
0284            DEBOUN  ;Wait 50 milliseconds
0284 548F               CALL    MS10            ;Wait 10 ms.
0286 548F               CALL    MS10            ;Wait 10 ms.
0288 548F               CALL    MS10            ;Wait 10 ms.
028A 548F               CALL    MS10            ;Wait 10 ms.
028C 548F               CALL    MS10            ;Wait 10 ms.
028E 93                 RETR


            ;-------------------------------------------------------------
028F            MS10    ;Use timer to time 10 ms., approximately.
028F                    ;Timer counts at a rate of xtal/15/32 Hz
028F                    ;= 23.04 kHz (43.4028 us/count).
028F 231A               MOV     A,#26           ;230 counts
0291 62                 MOV     T,A             ;Into timer
0292 55                 STRT    T               ;Start timer
0293 1697       NOTFIN  JTF     TIMFIN          ;Finished
0295 4493               JMP     NOTFIN
0297 93         TIMFIN  RETR


            ;-------------------------------------------------------------
0298            WAIT13  ;Wait 13 states including CALL and RETR
0298 00                 NOP
0299 00                 NOP
029A 00                 NOP
029B 00                 NOP
029C 00                 NOP
029D 00                 NOP
029E 00                 NOP
029F 00                 NOP
02A0 00                 NOP
02A1 93                 RETR


            ;-------------------------------------------------------------
            ;------------------ Memory Page 3 ----------------------
            ;-------------------------------------------------------------


            ;-------------------------------------------------------------
03B0                    ORG     03B0H

03B0            NOTICE  ;Copyright notice takes from 03B0H to 03FEH

03B0 20286329           DB      ' (c) copyright 1993,'
03C4 20526579           DB      ' Reyer & Associates,'
03D8 20574139           DB      ' WA9VNJ QSOcorder'
03E9 20766572           DB      ' version 2.3'
03F5 2031302F           DB      ' 10/17/93'
03FE 20                 DB      ' '

0000                    END
```

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