AN614

Interfacing the 8051 with 2-wire Serial EEPROMs

INTERFACING MICROCHIP SERIAL EEPROMS TO THE INTEL 8051 FAMILY OF MICROCONTROLLERS

Many designers today are implementing embedded systems that require low cost non-volatile memory. Microchip has addressed this need with a full line of serial EEPROMs, in a variety of memory configurations, using the industry-standard 2 or 3-wire communication protocols. The theory and application of these protocols are addressed in detail in Microchip's application note AN536.

Microchip recognizes that its broad customer base uses a variety of micro-controllers; many firmware related questions have been asked concerning interfacing the 8051 family and its derivatives.

The purpose of this app note is to provide assembly language examples of 8051 code for the various serial EEPROMs available from Microchip. These routines are intended to provide the basic operating kernels for storing data to or retrieving data from a serial EEPROM.

All of the routines in this application note are available, as source code, for downloading from Microchip's worldwide website at www.microchip.com. The file to download is 00614.zip.

This app note covers all of Microchip's 2-wire serial devices. Note that some devices have features not supported in others, and therefore, some sections of the code presented here may not be applicable to a particular part. We have attempted to label those special sections to minimize confusion.

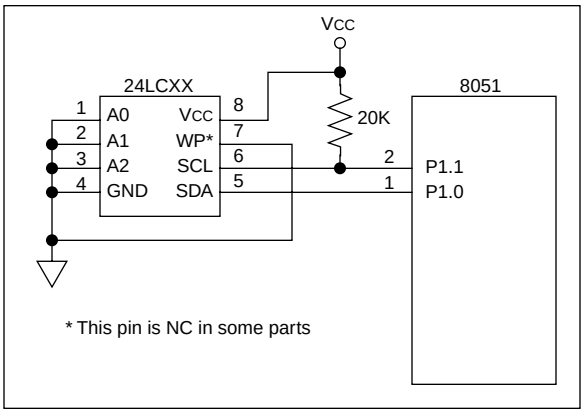
The code includes a simple loop-type shell to enable it to be executed (with an emulator) without the user having to write any other routines. The various address and data pointers must be set to the desired values by hand, before each execution cycle.

TIMING DATA

Clock and data timing is accomplished by software. There are two sets of timing specifications: 100 kHz and 400 kHz. Assuming a 12 MHz 8051 clock, extra NOP's have been added to slow timing down to 100 kHz. See Note 1 in the listing. If a 16 MHz clock is used, additional NOP's are required for 100 kHz operation. See Note 2 in the listing. For 400 kHz operation, the NOP's labelled Note 1 or Note 2 are not needed. If not needed the NOP's may be left out.

Below is the connection diagram used for this app note. Do not forget the pull-up resistor!

WIRING DIAGRAM



Please check the Microchip's website for the latest version of the source code @ www.microchip.com

APPENDIX A: SOURCE CODE

```
                1   $MOD51
                2   ;REGISTER ASSIGNMENTS
                3   ;
                4   ;R1  DATA OR DATA POINTER
                5   ;R2  LOOP COUNTER REGISTER
                6   ;R3  ADDRESS, HI BYTE
                7   ;R4  ADDRESS, LOW BYTE
                8   ;R5
                9   ;R6  BYTE COUNT FOR PAGE OPERATIONS
                10
                11  ;PIN ASSIGNMENTS:
                12  ;Port 1 bit 0 is data
                13  ;Port 1 bit 1 is clock
                14  ;
                15  ;These routines assume chip address = 0
                16  ;
                17  ;The oscillator frequency assumed for this app note is 12 MHz
                18  ;
                19  ;These routines use software timing loops. They may have to be
                20  ;adjusted if a different oscillator frequency is used.
                21  ;
                22  ;NOTE 1 These NOP's added for timing delays on 'C' parts, OR 'LC' parts
                23  ;    where Vcc <  4.5V and the oscillator frequency is 12 MHz.
                24  ;    This allows a bit rate of 100kHz.
                25  ;NOTE 2 Use these NOP's with a 16MHz oscillator and 100kHz bit rate.
                26  ;    For 400kHz bit rate, the NOP's in Note 1 and Note 2 are not req'd.
                27  ;
                28  ;The EEPROM will be busy after a write cycle is initiated
                29  ;for up to 10mS per page (or per byte if a byte write). This app note
                30  ;assumes the user will delay the appropriate time after write, or check
                31  ;for Busy status. A subroutine is provided to check the Busy Status.
                32  ;
                33  ;RAM DEFINITIONS
----            34  DSEG
0030            35  ORG         30H
0030            36  BYTSTR:     DS      20H             ;STORAGE FOR READ DATA
                37  ;
                38  ;CONSTANTS -- REDEFINE AS NECESSARY
                39  ;
00A0            40  WTCMD       EQU     10100000B       ;WRITE DATA COMMAND Note 3
00A1            41  RDCMD       EQU     10100001B       ;READ DATA COMMAND Note 3
0040            42  RDEND       EQU     01000000B       ;READ HIGH-ENDURANCE BLOCK NUMBER COMMAND
0000            43  ADDRH       EQU     0
0000            44  ADDRL       EQU     0
0055            45  DTA         EQU     55H
0008            46  BYTCNTEQU     8
                47  ;
                48  ;Note 3 Some chip or byte address bits are embedded in the control byte.
                49  ;Refer to the data sheet for exact configuration, which varies from part
                50  ;to part.
                51  ;
                52  ; ***************************************************************************
                53  ; This section contains test loop routines. They form a simple operating
                54  ; shell to allow the 2-wire interface code to be tested in a stand-alone
                55  ; mode.  Using an emulator, change "NONE" to one of the four listed
                56  ; routines to test that function.  The address and data constants can
                57  ; also be set as desired.
                58  ; If using a 32Kbit or higher density serial EEPROM, change the called
                59  ; routines by adding 'L' to the end of the name.  This is required
                60  ; because these parts use TWO address bytes.  The 'L' routines send out
                61  ; the extra address byte.
                62  ; ***************************************************************************
```

```
----           63  CSEG
0000           64  ORG         0
0000  020003   65  JMP         START
0003  7590FF   66  START:      MOV     P1,#0FFH       ;INIT PORT1
0006  12000B   67  CALL        NONE                   ;TEST LOOP INSERT PROPER ADDRESS HERE
0009  80F8     68  JMP         START
               69
000B  22       70  NONE:       RET
               71  ;*
               72  ;* WRITE ONE BYTE TO EEPROM
               73  ;* The Address Pointer is the address in the EEPROM.  The byte to be sent
               74  ;*  to the EEPROM is stored in the constant 'DTA'
               75  ;*
000C  7B00     76  TESTWR:     MOV     R3,#ADDRH      ;LOAD ADDRESS POINTER FOR HIGH DENSITY ONLY
000E  7C00     77              MOV     R4,#ADDRL      ;LOAD ADDRESS POINTER FOR ALL DEVICES
0010  7955     78              MOV     R1,#DTA        ;LOAD DATA BYTE
0012  120037   79              CALL    BYTEW          ;CALL PAGE WRITE ROUTINE
0015  22       80              RET
               81
               82  ;*
               83  ;* WRITE A BLOCK OF DATA TO EEPROM
               84  ;* The address pointer is the address in EEPROM where data will start.
               85  ;* The byte pointer is the starting address of RAM containing the block
               86  ;* of data to be sent. The byte count indicates how many bytes to send to
               87  ;* the EEPROM. The number of bytes that can be sent before a STOP command
               88  ;* is issued is dependent on EEPROM type.  Refer to the data book for
               89  ;* specific values.
               90  ;*
0016  7B00     91  BLKWR:      MOV     R3,#ADDRH      ;LOAD ADDRESS POINTER FOR HIGH DENSITY ONLY
0018  7C00     92              MOV     R4,#ADDRL      ;LOAD ADDRESS POINTER FOR ALL DEVICES
001A  7930     93              MOV     R1,#BYTSTR     ;LOAD BYTE POINTER
001C  7E08     94              MOV     R6,#BYTCNT     ;LOAD BYTE COUNT
001E  120048   95              CALL     PAGEW         ;CALL PAGE WRITE ROUTINE
0021  22       96              RET
               97
               98  ;*
               99  ;* READ ONE BYTE FROM EEPROM
              100 ;* The address pointer is the address of the desired byte in EEPROM.
              101 ;* The byte will be returned in R1.
              102 ;*
0022  7B00    103 TESTRD:     MOV     R3,#ADDRH      ;LOAD ADDRESS POINTER FOR HIGH DENSITY ONLY
0024  7C00    104             MOV     R4,#ADDRL      ;LOAD ADDRESS POINTER FOR ALL DEVICES
0026  120082  105             CALL    BYTERD         ;CALL BYTE READ ROUTINE.
0029  F9      106             MOV     R1,A           ;SAVE THE BYTE
002A  22      107             RET
              108
              109 ;*
              110 ;* READ A BLOCK FROM EEPROM
              111 ;* The address pointer is the starting address of the desired data block
              112 ;* in EEPROM.  The data pointer is the starting address in RAM where data
              113 ;* will be stored. The byte count indicates how many bytes should be read
              114 ;* The entire EEPROM may be read with one READ command this way.
              115 ;*
002B  7B00    116 BLOKRD:     MOV     R3,#ADDRH      ;LOAD ADDR POINTER FOR HIGH DENSITY ONLY
002D  7C00    117             MOV     R4,#ADDRL      ;LOAD ADDRESS POINTER FOR ALL DEVICES
002F  7930    118             MOV     R1,#BYTSTR     ;LOAD DATA POINTER
0031  7E08    119             MOV     R6,#BYTCNT     ;LOAD BYTE COUNT
0033  12005C  120             CALL    BLKRD          ;CALL BLOCK READ ROUTINE
0036  22      121             RET
              122
              123 ;* END OF TEST LOOP
              124 ;*************************************************************
              125
              126
              127 ;*************************************************************
              128 ; This routine writes a byte of data to EEPROM
```

```
                129 ; The EEPROM address is assumed to be in R4.  See NOTE 3
                130 ; The DATA to be written is asumed to be in R1
                131 ;*************************************************************
0037  74A0        132 BYTEW:      MOV     A,#WTCMD        ;LOAD WRITE COMMAND
0039  12012F      133             CALL    OUTS            ;SEND IT
003C  EC          134             MOV     A,R4            ;GET BYTE ADDRESS
003D  120167      135             CALL    OUT             ;SEND IT
0040  E9          136             MOV     A,R1            ;GET DATA
0041  120167      137             CALL    OUT             ;SEND IT
0044  1201A6      138             CALL    STOP            ;SEND STOP CONDITION
0047  22          139             RET
                140
                141 ;*****************************************************************
                142 ; THIS ROUTINE WRITES A PAGE OF DATA TO EEPROM
                143 ; The EEPROM start address is assumed to be in R4.  See NOTE 3
                144 ; The DATA pointer is in R1
                145 ; The BYTE count is in R6
                146 ; The number of bytes that can be transferred depends upon the
                147 ; EEPROM used
                148 ;*****************************************************************
0048  74A0        149 PAGEW:      MOV     A,#WTCMD        ;LOAD WRITE COMMAND
004A  12012F      150             CALL    OUTS            ;SEND IT
004D  EC          151             MOV     A,R4            ;GET LOW BYTE ADDRESS
004E  120167      152             CALL    OUT             ;SEND IT
0051  E7          153 BTLP:       MOV     A,@R1           ;GET DATA
0052  120167      154             CALL    OUT             ;SEND IT
0055  09          155             INC     R1              ;INCREMENT DATA POINTER
0056  DEF9        156             DJNZ    R6,BTLP         ;LOOP TILL DONE
0058  1201A6      157             CALL    STOP            ;SEND STOP CONDITION
005B  22          158             RET
                159
                160
                161 ;*************************************************************************
                162 ; THIS ROUTINE READS A BLOCK OF DATA FROM EEPROM AT A SPECIFIED ADDRESS
                163 ; EEPROM address in R4.  See NOTE 3.
                164 ; Stores data at RAM location pointed to by R1
                165 ; Byte count specified in R6.  May be 1 to 256 bytes
                166 ;*************************************************************************
005C  74A0        167 BLKRD:      MOV     A,#WTCMD        ;LOAD WRITE COMMAND TO SEND ADDRESS
005E  12012F      168             CALL    OUTS            ;SEND IT
0061  EC          169             MOV     A,R4            ;GET LOW BYTE ADDRESS
0062  120167      170             CALL    OUT             ;SEND IT
0065  74A1        171             MOV     A,#RDCMD        ;LOAD READ COMMAND
0067  12012F      172             CALL    OUTS            ;SEND IT
006A  12018D      173 BRDLP:      CALL    IN              ;READ DATA
006D  F7          174             MOV     @R1,a           ;STORE DATA
006E  09          175             INC     R1              ;INCREMENT DATA POINTER
006F  DE04        176             DJNZ    R6,AKLP         ;DECREMENT LOOP COUNTER
0071  1201A6      177             CALL    STOP            ;IF DONE, ISSUE STOP CONDITION
0074  22          178             RET                     ;DONE, EXIT ROUTINE
                179
0075  C290        180 AKLP:       CLR     P1.0            ;NOT DONE, ISSUE ACK
0077  D291        181             SETB    P1.1
0079  00          182             NOP                     ;NOTE 1
007A  00          183             NOP
007B  00          184             NOP
007C  00          185             NOP                     ;NOTE 2
007D  00          186             NOP
007E  C291        187             CLR     P1.1
0080  80E8        188             JMP     BRDLP           ;CONTINUE WITH READS
                189
                190 ;*****************************************************************
                191 ; THIS ROUTINE READS A BYTE OF DATA FROM THE EEPROM
                192 ; The EEPROM address is in R4.  See Note 3
                193 ; Returns the data byte in R1
                194 ;*****************************************************************
```

```
0082  74A0     195 BYTERD:     MOV     A,#WTCMD        ;LOAD WRITE COMMAND TO SEND ADDRESS
0084  12012F   196             CALL    OUTS            ;SEND IT
0087  EC       197             MOV     A,R4            ;GET LOW BYTE ADDRESS
0088  120167   198             CALL    OUT             ;SEND IT
008B  12008F   199             CALL    CREAD           ;GET DATA BYTE
008E  22       200             RET
               201
               202 ;*****************************************************************
               203 ; THIS ROUTINE READS A BYTE OF DATA FROM EEPROM
               204 ; From EEPROM current address pointer.
               205 ; Returns the data byte in R1
               206 ;*****************************************************************
008F  74A1     207 CREAD:      MOV     A,#RDCMD        ;LOAD READ COMMAND
0091  12012F   208             CALL    OUTS            ;SEND IT
0094  12018D   209             CALL    IN              ;READ DATA
0097  F9       210             MOV     R1,A            ;STORE DATA
0098  1201A6   211             CALL    STOP            ;SEND STOP CONDITION
009B  22       212             RET
               213
               214 ;*****************************************************************
               215 ; The next four routines are used with the the 24xx32 or 24xx65 only.
               216 ; These parts require two address bytes, and these routines send the
               217 ; second byte out.  Other than this, these routines are the same as the
               218 ; previous four.
               219 ;*****************************************************************
               220 ; THIS ROUTINE READ A BLOCK OF DATA FROM EEPROM AT A SPECIFIED ADDRESS
               221 ; This routine is for the 24LC32 or 24LC65.
               222 ; EEPROM address in R3:R4.
               223 ; Stores data at RAM locatoin pointed to by R1
               224 ; Byte count specified in R6.  May be 1 to 256 bytes
               225 ;*****************************************************************
009C  74A0     226 BLKRDL:     MOV     A,#WTCMD        ;LOAD WRITE COMMAND TO SEND ADDRESS
009E  12012F   227             CALL    OUTS            ;SEND IT
00A1  EB       228             MOV     A,R3            ;GET HI BYTE ADDRESS
00A2  120167   229             CALL    OUT             ;SEND IT
00A5  EC       230             MOV     A,R4            ;GET LOW BYTE ADDRESS
00A6  120167    231            CALL    OUT             ;SEND IT
00A9  74A1     232             MOV     A,#RDCMD        ;LOAD READ COMMAND
00AB  12012F   233             CALL    OUTS            ;SEND IT
00AE  80BA     234             JMP     BRDLP           ;CONTINUE WITH DATA READ
               235
               236 ;*****************************************************************
               237 ; This routine writes a byte of data to EEPROM
               238 ; This routine is for the 24LC32 or 24LC65
               239 ; The EEPROM address is assumed to be in R3:R4
               240 ; The DATA to be written is assumed to be in R1
               241 ;*****************************************************************
00B0  74A0     242 BYTEWL:     MOV     A,#WTCMD        ;LOAD WRITE COMMAND
00B2  12012F   243             CALL    OUTS            ;SEND IT
00B5  EB       244             MOV     A,R3            ;GET HI BYTE ADDRESS
00B6  120167   245             CALL    OUT             ;SEND IT
00B9  EC       246             MOV     A,R4            ;GET LOW BYTE ADDRESS
00BA  120167   247             CALL    OUT             ;SEND IT
00BD  E9       248             MOV     A,R1            ;GET DATA
00BE  120167   249             CALL    OUT             ;SEND IT
00C1  1201A6   250             CALL    STOP            ;SEND STOP CONDITION
00C4  22       251             RET
               252
               253 ;*****************************************************************
               254 ; THIS ROUTINE WRITES A PAGE OF DATA TO EEPROM
               255 ; This routine is for the 24LC32 or 24LC65
               256 ; The EEPROM start address is assumed to be in R3:R4
               257 ; The DATA pointer is in R1
               258 ; The BYTE count is in R6
               259 ; The number of bytes that can be transfered depends on the
               260 ; EEPROM in use
               261 ;*****************************************************************
```

```
00C5  74A0     262 PAGEWL:     MOV     A,#WTCMD        ;LOAD WRITE COMMAND
00C7  12012F   263             CALL    OUTS            ;SEND IT
00CA  EB       264             MOV     A,R3            ;GET HIYTE ADDRESS
00CB  120167   265             CALL    OUT             ;SEND IT
00CE  EC       266             MOV     A,R4            ;GET LOW BYTE ADDRESS
00CF  120167   267             CALL    OUT             ;SEND IT
00D2  E7       268 BTLPL:      MOV     A,@R1           ;GET DATA
00D3  120167   269             CALL    OUT             ;SEND IT
00D6  09       270             INC     R1              ;INCREMENT DATA POINTER
00D7  DEF9     271             DJNZ    R6,BTLPL        ;LOOP TILL DONE
00D9  1201A6   272             CALL    STOP            ;SEND STOP CONDITION
00DC  22       273             RET
               274
               275 ;************************************************************************
               276 ; THIS ROUTINE READS A BYTE OF DATA FROM THE EEPROM
               277 ; This routine is for the 24CL32 or 24LC65
               278 ; The EEPROM address is in R3:R4
               279 ; Returns the data byte in R1
               280 ;************************************************************************
00DD           281 BYTERDL:
00DD  74A0     282             MOV     A,#WTCMD        ;LOAD WRITE COMMAND TO SEND ADDRESS
00DF  12012F   283             CALL    OUTS            ;SEND IT
00E2  EB       284             MOV     A,R3            ;GET HI BYTE ADDRESS
00E3  120167   285             CALL    OUT             ;SEND IT
00E6  EC       286             MOV     A,R4            ;GET LOW BYTE ADDRESS
00E7  120167   287             CALL    OUT             ;SEND IT
00EA  118F     288             CALL    CREAD           ;GET DATA BYTE
00EC  22       289             RET
               290 ;
               291 ; SUBROUTINES
               292 ;
               293 ;************************************************************************
               294 ; This routine test for WRITE DONE condition
               295 ; by testing for an ACK.
               296 ; This routine can be run as soon as a STOP condition
               297 ; has been generated after the last data byte has been sent
               298 ; to the EEPROM. The routine loops until an ACK is received from
               299 ; the EEPROM. No ACK will be received until the EEPROM is done with
               300 ; the write operation.
               301 ;************************************************************************
00ED  74A0     302 ACKTST:     MOV     A,#WTCMD        ;LOAD WRITE COMMAND TO SEND ADDRESS
00EF  7A08      303            MOV     R2,#8           ;LOOP COUNT -- EQUAL TO BIT COUNT
00F1   C290     304            CLR     P1.0            ;START CONDITION -- DATA = 0
00F3  00        305            NOP                     ;NOTE 1
00F4  00        306            NOP
00F5  00        307            NOP
00F6  00       308             NOP                     ;NOTE 2
00F7  00       309             NOP
00F8  C291     310             CLR     P1.1            ;CLOCK = 0
00FA  33       311 AKTLP:      RLC     A               ;SHIFT BIT
00FB  5005     312             JNC     AKTLS
00FD  D290     313             SETB    P1.0            ;DATA = 1
00FF  020104   314             JMP     AKTL1           ;CONTINUE
0102  C290     315 AKTLS:      CLR     P1.0            ;DATA = 0
0104  D291     316 AKTL1:      SETB    P1.1            ;CLOCK HI
0106  00       317             NOP                     ;NOTE 1
0107  00       318             NOP
0108  00       319             NOP
0109  00       320             NOP                     ;NOTE 2
010A  00       321             NOP
010B  C291     322             CLR     P1.1            ;CLOCK LOW
010D  DAEB     323             DJNZ    R2,AKTLP        ;DECREMENT COUNTER
010F  D290     324             SETB    P1.0            ;TURN PIN INTO INPUT
0111  00       325             NOP                     ;NOTE 1
0112  00       326             NOP                     ;NOTE 2
0113  D291     327             SETB    P1.1            ;CLOCK ACK
```

```
0115  00       328            NOP                     ;NOTE 1
0116  00       329            NOP
0117  00       330            NOP
0118  00       331            NOP                     ;NOTE 2
0119  00       332            NOP
011A  309002   333            JNB     P1.0,EXIT       ;EXIT IF ACK (WRITE DONE)
011D  80CE     334            JMP     ACKTST          ;START OVER
011F  C291     335 EXIT:      CLR     P1.1            ;CLOCK LOW
0121  C290     336            CLR     P1.0            ;DATA LOW
0123  00       337            NOP                     ;NOTE 1
0124  00       338            NOP
0125  00       339            NOP
0126  00       340            NOP                     ;NOTE 2
0127  00       341            NOP
0128  D291     342            SETB    P1.1            ;CLOCK HIGH
012A  00       343            NOP
012B  00       344            NOP
012C  D290     345            SETB    P1.0            ;STOP CONDITION
012E  22       346            RET
               347
               349
               350 ;************************************************************************
               351 ; THIS ROUTINE SENDS OUT CONTENTS OF THE ACCUMULATOR
               352 ; to the EEPROM and includes START condition.  Refer to the data sheets
               353 ; for discussion of START and STOP conditions.
               354 ;************************************************************************
               355
012F  7A08     356 OUTS:      MOV     R2,#8           ;LOOP COUNT -- EQUAL TO BIT COUNT
0131  D290     357            SETB    P1.0            ;INSURE DATA IS HI
0133  D291     358            SETB    P1.1            ;INSURE CLOCK IS HI
0135  00       359            NOP                     ;NOTE 1
0136  00       360            NOP
0137  00       361            NOP
0138  00       362            NOP                     ;NOTE 2
0139  00       363            NOP
013A  C290     364            CLR     P1.0            ;START CONDITION -- DATA = 0
013C  00       365            NOP                     ;NOTE 1
013D  00       366            NOP
013E  00       367            NOP
013F  00       368            NOP                     ;NOTE 2
0140  00       369            NOP
0141  C291     370            CLR     P1.1            ;CLOCK = 0
0143  33       371 OTSLP:     RLC     A               ;SHIFT BIT
0144  5005     372            JNC     BITLS
0146  D290     373            SETB    P1.0            ;DATA = 1
0148  02014D   374            JMP     OTSL1           ;CONTINUE
014B  C290     375 BITLS:     CLR     P1.0            ;DATA = 0
014D  D291     376 OTSL1:     SETB    P1.1            ;CLOCK HI
014F  00       377            NOP                     ;NOTE 1
0150  00       378            NOP
0151  00       379            NOP
0152  00       380            NOP                     ;NOTE 2
0153  00       381            NOP
0154  C291     382            CLR     P1.1            ;CLOCK LOW
0156  DAEB     383            DJNZ    R2,OTSLP        ;DECREMENT COUNTER
0158  D290     384            SETB    P1.0            ;TURN PIN INTO INPUT
015A  00       385            NOP                     ;NOTE 1
015B  00       386            NOP                     ;NOTE 2
015C  00       387            NOP
015D  D291     388            SETB    P1.1            ;CLOCK ACK
015F  00       389            NOP                     ;NOTE 1
0160  00       390            NOP
0161  00       391            NOP
0162  00       392            NOP                     ;NOTE 2
0163  00       393            NOP
0164  C291     394            CLR     P1.1
```



```
0166 22        395 RET
               396
               397 ;*****************************************************************
               398 ; THIS ROUTINE SENDS OUT CONTENTS OF ACCUMLATOR TO EEPROM
               399 ; without sending a START condition.
               400 ;*****************************************************************
               401
0167  7A08     402 OUT:        MOV     R2,#8           ;LOOP COUNT -- EQUAL TO BIT COUNT
0169  33       403 OTLP:       RLC     A               ;SHIFT BIT
016A  5005     404             JNC     BITL
016C  D290     405             SETB    P1.0            ;DATA = 1
016E  020173   406             JMP     OTL1            ;CONTINUE
0171  C290     407 BITL:       CLR     P1.0            ;DATA = 0
0173  D291     408 OTL1:       SETB    P1.1            ;CLOCK HI
0175  00       409             NOP                     ;NOTE 1
0176  00       410             NOP
0177  00       411             NOP
0178  00       412             NOP                     ;NOTE 2
0179  00       413             NOP
017A  C291     414             CLR     P1.1            ;CLOCK LOW
017C  DAEB     415             DJNZ    R2,OTLP         ;DECREMENT COUNTER
017E  D290     416             SETB    P1.0            ;TURN PIN INTO INPUT
0180  00       417             NOP                     ;NOTE 1
0181  00       418             NOP                     ;NOTE 2
0182  00       419             NOP
0183  D291     420             SETB    P1.1            ;CLOCK ACK
0185  00       421             NOP                     ;NOTE 1
0186  00       422             NOP
0187  00       423             NOP
0188  00       424             NOP                     ;NOTE 2
0189  00       425             NOP
018A  C291     426             CLR     P1.1
018C  22       427             RET
               428
               429 ;*****************************************************************
               430 ; THIS ROUTINE READS IN A BYTE FROM THE EEPROM
               431 ; and stores it in the accumulator
               432 ;*****************************************************************
               433
018D  7A08      434 IN:        MOV     R2,#8           ;LOOP COUNT
018F  D290      435            SETB    P1.0            ;SET DATA BIT HIGH FOR INPUT
0191  C291      436 INLP:      CLR     P1.1            ;CLOCK LOW
0193  00        437            NOP                     ;NOTE 1
0194  00       438             NOP
0195  00       439             NOP
0196  00       440             NOP
0197  00        441            NOP                     ;NOTE 2
0198  00       442             NOP
0199  D291     443             SETB    P1.1            ;CLOCK HIGH
019B  C3        444            CLR     C               ;CLEAR CARRY
019C  309001   445             JNB     P1.0,INL1       ;JUMP IF DATA = 0
019F  B3       446             CPL     C               ;SET CARRY IF DATA = 1
01A0  33       447 INL1:       RLC     A               ;ROTATE DATA INTO ACCUMULATOR
01A1  DAEE     448             DJNZ    R2,INLP         ;DECREMENT COUNTER
01A3  C291     449             CLR     P1.1            ;CLOCK LOW
01A5  22       450             RET
               451
               452
01A6   C290    453 STOP:       CLR     P1.0            ;STOP CONDITION SET DATA LOW
01A8  00       454             NOP                     ;NOTE 1
01A9  00       455             NOP
01AA  00       456             NOP
01AB  00       457             NOP                     ;NOTE 2
01AC  00       458             NOP
01AD  D291     459             SETB    P1.1            ;SET CLOCK HI
01AF  00       460             NOP                     ;NOTE 1
```

```
01B0  00      461             NOP
01B1  00      462             NOP
01B2  00      463             NOP                     ;NOTE 2
01B3  00      464             NOP
01B4  D290    465             SETB    P1.0            ;SET DATA HIGH
01B6  22      466             RET
              467
              468 ;*********************************************************************
              469 ; These routines contain special commands for the 24LC65 SMART SERIAL
              470 ; EEPROM
              471 ; SET SECURE BLOCK ASSUMES
              472 ; START BLOCK 0 & BLOCK LENGTH OF 1.  The
              473 ; numbers are implicit in the commands.
              474 ; Refer to the data sheet for details.
              475 ;*
01B7  7B80    476 SETSEC:     MOV     R3,#80H         ;SEND COMMAND AND STARTING BLOCK NUMBER
01B9  7C00    477             MOV     R4,#0           ;
01BB  7981    478             MOV     R1,#81H         ;COMMAND FOR NUMBER OF BLOCKS TO SECURE
01BD  1137    479             CALL    BYTEW           ;EXECUTE
01BF  22      480             RET
              481
              482 ;*
              483 ; READ SECURE BLOCK NUBER(S)
              484 ; RETURNS BLOCK NUMBER IN R1 AND BLOCKCOUNT IN R2
              485 ; (UPPER NIBBLES WILL BE 1'S)
              486 ;*
              487
01C0  74A0    488 RDSEC:      MOV     A,#WTCMD        ;LOAD WRITE COMMAND TO SEND ADDRESS
01C2  312F    489             CALL    OUTS            ;SEND IT
01C4  7480    490             MOV     A,#80H          ;LOAD COMMAND
01C6  3167    491             CALL    OUT             ;SEND IT
01C8  7400    492             MOV     A,#0            ;LOAD COMMAND
01CA  3167    493             CALL    OUT             ;SEND IT
01CC  74C0    494             MOV     A,#0C0H         ;LOAD COMMAND
01CE  3167    495             CALL    OUT             ;SEND IT
01D0  318D    496             CALL    IN              ;READ STARTING BLOCK NUMBER
01D2  F9      497             MOV     R1,A            ;STORE IT
01D3  00      498             NOP                     ;NOTE 1
01D4  00      499             NOP
01D5  00      500             NOP
01D6  00      501             NOP                     ;NOTE 2
01D7  00      502             NOP
01D8  C290    503             CLR     P1.0            ;ISSUE ACK
01DA  D291    504             SETB    P1.1
01DC  00      505             NOP                     ;NOTE 1
01DD  00      506             NOP
01DE  00      507             NOP
01DF  00      508             NOP                     ;NOTE 2
01E0  00      509             NOP
01E1  C291    510             CLR     P1.1
01E3  318D    511             CALL    IN              ;READ NUMBER OF BLOCKS
01E5  FA      512             MOV     R2,A            ;STORE IT
01E6  31A6    513             CALL    STOP            ;SEND STOP CONDITION
01E8  22      514             RET
              515
              516
              517 ;*
              518 ; SET HIGH-ENDURANCE BLCOK NUMBER
              519 ; ASSUMES BLOCK 0
              520 ;*
01E9  7B80    521 SETHI:      MOV     R3,#080H        ;LOAD COMMAND AND BLOCK NUMBER
01EB  7C00    522             MOV     R4,#0
01ED  7900    523             MOV     R1,#0           ;SET DATA = 0
01EF  1137    524             CALL    BYTEW           ;EXECUTE
01F1  22      525             RET
              526
```



```
                527 ;*
                528 ; READ HIGH ENDURANCE BLOCK NUMBER
                529 ; RETURNS BLOCK NUMBER IN R1 (UPPER NIBBLE WILL BE 1'S)
                530 ;*
01F2  7B80      531 READHI:        MOV     R3,#080H        ;LOAD COMMAND
01F4  7C00      532                MOV     R4,#0
01F6  1201FA    533                CALL    HIEND           ;EXECUTE
01F9  22        534                RET
                535
01FA  74A0      536 HIEND:         MOV     A,#WTCMD        ;LOAD WRITE COMMAND TO SEND ADDRESS
01FC  312F      537                CALL    OUTS            ;SEND IT
01FE  EB        538                MOV     A,R3            ;GET HI BYTE ADDRESS
01FF  3167      539                CALL    OUT             ;SEND IT
0201  EC        540                MOV     A,R4            ;GET LOW BYTE ADDRESS
0202  3167      541                CALL    OUT             ;SEND IT
0204  7440      542                MOV     A,#RDEND        ;LOAD READ COMMAND
0206  3167      543                CALL    OUT             ;SEND IT
0208  318D      544                CALL    IN              ;READ DATA
020A  F9        545                MOV     R1,A            ;STORE DATA
020B  31A6      546                CALL    STOP            ;SEND STOP CONDITION
020D  22        547                RET
                548
                549 ;END of 24LC65 Routines
                550 ;*****************************************************************
                551 END
                552
VERSION 1.2h ASSEMBLY COMPLETE, 0 ERRORS FOUND
```

NOTES:

Note the following details of the code protection feature on PICmicro® MCUs.

- The PICmicro family meets the specifications contained in the Microchip Data Sheet.
- Microchip believes that its family of PICmicro microcontrollers is one of the most secure products of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the PICmicro microcontroller in a manner outside the operating specifications contained in the data sheet. The person doing so may be engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable”.
- Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our product.

If you have any further questions about this matter, please contact the local sales office nearest to you.

DNV Certification, Inc. USA — ANSI-RAB QMS ACCREDITED — DNV MSC The Netherlands Accredited by the RvA — DNV — ISO 9001 / QS-9000 REGISTERED FIRM

Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999. The Company’s quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs and microperipheral products. In addition, Microchip’s quality system for the design and manufacture of development systems is ISO 9001 certified.

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200 Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: http://www.microchip.com

Rocky Mountain
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-7456

Atlanta
500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770-640-0034 Fax: 770-640-0307

Boston
2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Chicago
333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas
4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Detroit
Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Kokomo
2767 S. Albright Road
Kokomo, Indiana 46902
Tel: 765-864-8360 Fax: 765-864-8387

Los Angeles
18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

New York
150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose
Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto
6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia
Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing
Microchip Technology Consulting (Shanghai) Co., Ltd., Beijing Liaison Office
Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu
Microchip Technology Consulting (Shanghai) Co., Ltd., Chengdu Liaison Office
Rm. 2401, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-6766200 Fax: 86-28-6766599

China - Fuzhou
Microchip Technology Consulting (Shanghai) Co., Ltd., Fuzhou Liaison Office
Unit 28F, World Trade Plaza
No. 71 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7503506 Fax: 86-591-7503521

China - Shanghai
Microchip Technology Consulting (Shanghai) Co., Ltd.
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen
Microchip Technology Consulting (Shanghai) Co., Ltd., Shenzhen Liaison Office
Rm. 1315, 13/F, Shenzhen Kerry Centre,
Renminnan Lu
Shenzhen 518001, China
Tel: 86-755-2350361 Fax: 86-755-2366086

Hong Kong
Microchip Technology Hongkong Ltd.
Unit 901-6, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India
Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaugnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan
Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471- 6166 Fax: 81-45-471-6122

Korea
Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore
Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-334-8870 Fax: 65-334-8850

Taiwan
Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark
Microchip Technology Nordic ApS
Regus Business Centre
Lautrup hoj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France
Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - ler Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany
Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Italy
Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom
Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

01/18/02