AN646

Interfacing Motorola 68HC11 to Microchip SPI™ Serial EEPROMS

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INTRODUCTION

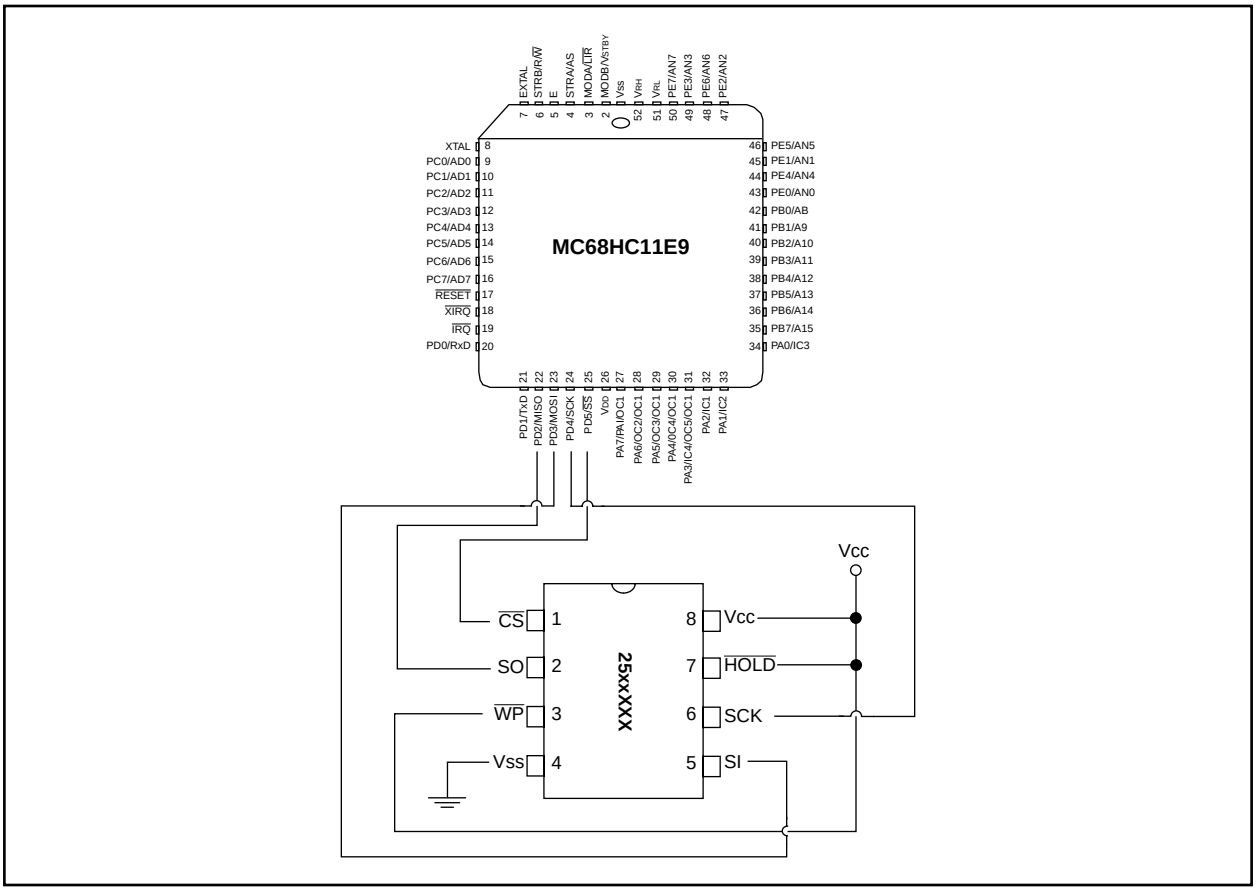
There are many different microcontrollers on the market today that are being used in embedded control applications. Many of these embedded control systems need non-volatile memory. Because of their small footprint, byte level flexibility, low I/O pin requirement, low power consumption, and low cost, Serial EEPROMs are a popular choice for non-volatile storage.

Microchip addresses these needs by offering a full line of Serial EEPROMs covering industry standard serial communication protocols for 2-wire, 3-wire, and SPI communication. Serial EEPROM devices are available in a variety of densities, operational voltage ranges, and packaging options.

Microchip realizes that its customer base is very broad, and because of this, different microcontrollers are used to interface to SPI Serial EEPROMs. One of the microcontrollers used in these applications is the Motorola 68HC11. In order to simplify the design process, Microchip has written an assembly code routine to communicate with our SPI parts that is verified and tested to function properly on a 68HC11.

Figure 1 describes the hardware schematic for the interface between Microchip's SPI devices and the Motorola 68HC11E9. The schematic shows the connections necessary between the microcontroller and the serial EEPROM, and the software was written assuming these connections. Appendix A contains a listing of the SPI source code.

FIGURE 1: CIRCUIT FOR MC68HC11E9



SPI is a trademark of Motorola.

Please check the Microchip BBS for the latest version of the source code. Microchip's Worldwide Web Address: www.microchip.com; Bulletin Board Support: MCHIPBBS using CompuServe® (CompuServe membership not required).

APPENDIX A: SOURCE CODE

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an646.asm              Assembled with CASM   03/19/1997  16:10  PAGE 1


                 1  ;*****************************************************************
                 2  ;* This code demonstrates how the Microchip SPI Devices
                 3  ;* can be interfaced to the SPI port of the 68HC11 microcontroller.
                 4  ;* The interface uses the three SPI lines (SCK,MOSI and MISO) on
                 5  ;* the 68HC11 Microcontroller for the clock (SCK), data out (SO)
                 6  ;* and data in (SI). A chip select (CS) is generated with a
                 7  ;* general purpose port line (PD5). The 68HC11 is placed into the
                 8  ;* master mode which allows use of the slave select input (SS) for
                 9  ;* other things.  The code uses the 0 mode (CPOL = 0,  CPHA = 0)
                10  ;* of operation to define clock polarity and phase. MODE 3
                11  ;* (CPOL = 1, CPHA = 1) could also have been used.  The  baud rate
                12  ;* set at one eighth of the clock frequency (SPR0 = 0,  SPR1 = 0)
                13  ;*
                14  ;* This code shows a read and write operation, as well  as data
                15  ;* polling, setting the write enable latch, clearing the  write
                16  ;* enable latch, writing and reading the block protect
                17  ;* register
                18  ;*****************************************************************
                19
                20  ; LOAD VALUES FOR USE LATER
                21
                22
0000            23  MASKCS  EQU     $20             ;MASK THE CHIP ENABLE BIT
0000            24  DDRD    EQU     $09             ;PORTD DATA DIRECTION REGISTER
0000            25  PORTD   EQU     $08             ;PORT D ADDRESS
0000            26  SPCR    EQU     $28             ;SPI CONTROL REGISTER
0000            27  SPSR    EQU     $29             ;SPI STATUS REGISTER
0000            28  SPDR    EQU     $2A             ;SPI DATA REGISTER
0000            29  ADDRLO  EQU     $80             ;LOW ADDRESS LOCATION
0000            30  ADDRHI  EQU     $81             ;HIGH ADDRESS LOCATION
0000            31  RDATA   EQU     $82             ;READ DATA SCRATCH PAD LOCATION
0000            32  SDATA   EQU     $83             ;SEND DATA SCRATCH PAD LOCATION
                33
                34  ;*****************************************************
                35  ;* SET RESET VECTOR TO THE BEGINNING OF THE PROGRAM
                36  ;*****************************************************
                37  ;        ORG     $FFFE           ;RESET VECTOR TO PROGRAM ENTRY POINT
                38  ;        FDB     $E000
                39
                40  ;*********************************
                41  ;* BEGINNING OF PROGRAM EXECUTION
                42  ;*********************************
                43
B600            44    ORG     $B600           ;BEGINNING ADDRESS OF EXECUTABL E CODE
                45
B600 8E00FF     46  BEGIN   LDS     #$00FF          ;INITIALIZE STACK POINTER
B603 CE1000     47    LDX     #$1000          ;INITIALIZE PAGE OFFSET LOCATION
B606 863F       48    LDAA    #$3F            ;LOAD ACCUMULATOR WITH 3F HEX
B608 A709       49    STAA    DDRD,X          ;MAKE ALL PORTD PINS OUTPUTS
B60A 8650       50    LDAA    #$50            ;SPI (MODE 0,0), USE #$5C FOR (MODE 1,1)
B60C A728       51    STAA    SPCR,X          ;STORE VALUE IN THE SPI CONTROL REG
B60E A629       52    LDAA    SPSR,X          ;READ MICRO SPI STATUS REG, CLEAR SPIF
B610 8655       53    LDAA    #$55            ;LOAD ACCUMULATOR A WITH 2E HEX
B612 9780       54    STAA    ADDRLO          ;STORE THIS VALUE IN ADDRESS LOW
B614 8600       55    LDAA    #$00            ;LOAD ACCUMULATOR A WITH 00 HEX
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B616 9781        56    STAA    ADDRHI          ;STORE THIS VALUE IN ADDRESS HIGH
                 57  ; SEND THE WRITE ENABLE SEQUENCE (WREN)
B618 BDB6EE      58    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW  ROUTINE
B61B 8606        59    LDAA    #$06            ;LOAD THE WRITE SELECT COMMAND
B61D 9783        60    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B61F BDB6E1      61    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B622 BDB6F2      62    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                 63  ; SEND THE WRITE STATUS REGISTER SEQUENCE (WRSR)
B625 BDB6EE      64    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW ROUTINE
B628 8601        65    LDAA    #$01            ;LOAD THE WRITE STATUS  REGISTER COMMAND
B62A 9783        66    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B62C BDB6E1      67    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B62F 8600        68    LDAA    #$00            ;LOAD ZERO'S INTO THE STATUS REGISTER
B631 9783        69    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B633 BDB6E1      70    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B636 BDB6F2      71    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                 72  ; WAIT THE REQUIRED 5mS FOR THE WRITE CYCLE TIMER Twc
B639 BDB6F6      73    JSR     DELAY           ;JUMP TO THE DELAY SUBROUTINE
                 74  ; SEND THE WRITE ENABLE SEQUENCE (WREN)
B63C BDB6EE      75    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW SUBROUTINE
B63F 8606        76    LDAA    #$06            ;LOAD THE WRITE ENABLE COMMAND
B641 9783        77    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B643 BDB6E1      78    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B646 BDB6F2      79    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                 80  ; SEND THE READ STATUS REGISTER SEQUENCE (RDSR)
B649 BDB6EE      81    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW SUBROUTINE
B64C 8605        82    LDAA    #$05            ;LOAD THE READ STATUS REGISTER COMMAND
B64E 9783        83    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B650 BDB6E1      84    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B653 BDB6E1      85    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE (READ)
B656 BDB6F2      86    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                 87  ; SEND THE WRITE SEQUENCE (WRITE)
B659 BDB6EE      88    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW SUBROUTINE
B65C 8602        89    LDAA    #$02            ;LOAD THE WRITE COMMAND
B65E 9783        90    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B660 BDB6E1      91    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
                 92  ; ***COMMENT OUT FOR USE WITH 25XX010, 25XX020, OR 25XX040*************
B663 9681        93    LDAA    ADDRHI          ;LOAD ACCA WITH ADDRHI
B665 9783        94    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B667 BDB6E1      95    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
                 96  ; ****************************************************************
B66A 9680        97    LDAA    ADDRLO          ;LOAD ACCA WITH ADDRLO
B66C 9783        98    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B66E BDB6E1      99    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B671 86AA       100    LDAA    #$AA            ;LOAD ACCA WITH HEX AA
B673 9783       101    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B675 BDB6E1     102    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B678 BDB6F2     103    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                104  ; PERFORM DATA POLLING (RDSR BIT 0)
B67B BDB6EE     105    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW ROUTINE
B67E 8605       106    LDAA    #$05            ;LOAD THE READ STATUS REGISTER COMMAND
B680 9783       107    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B682 BDB6E1     108    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
                109  ;
B685 8630       110    LDAA    #$30            ;GIVE THE SPI DEVICE TIME TO SET WIP
B687 4A         111    LOOP    DECA            ;DECREMENT ACCUMULATOR A
B688 26FD       112    BNE     LOOP            ;BRANCH IF NOT EQUAL TO LOOP
                113  ;
B68A BDB6E1     114  POLLING JSR     OUTBYTE   ;READ THE DATA IN THE STATUS REGISTER
B68D 8601       115    LDAA    #$01            ;LOAD ACCA WITH 1 HEX
B68F 9482       116    ANDA    RDATA           ;AND ACCA WITH THE RECEIVED DATA
B691 26F7       117    BNE     POLLING         ;BRANCH IF NOT = TO POLLING
B693 BDB6F2     118    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                119  ; SEND THE READ SEQUENCE, READ ADDRESS 0X55
B696 BDB6EE     120    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW ROUTINE
B699 8603       121    LDAA    #$03            ;LOAD THE READ COMMAND
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B69B 9783       122    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B69D BDB6E1     123    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
                124  ; ***COMMENT OUT FOR USE WITH 25XX010, 25XX020, OR 25XX040*************
B6A0 9681       125    LDAA    ADDRHI          ;LOAD ACCA WITH ADDRHI
B6A2 9783       126    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B6A4 BDB6E1     127    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
                128  ; ***************************************************************
B6A7 9680       129    LDAA    ADDRLO          ;LOAD ACCA WITH ADDRLO
B6A9 9783       130    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B6AB BDB6E1     131    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B6AE BDB6E1     132    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE (READ)
B6B1 BDB6F2     133    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                134  ; SEND THE WRITE ENABLE SEQUENCE (WREN)
B6B4 BDB6EE     135    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW ROUTINE
B6B7 8606       136    LDAA    #$06            ;LOAD THE WRITE ENABLE COMMAND
B6B9 9783       137    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B6BB BDB6E1     138    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B6BE BDB6F2     139    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                140  ; SEND THE WRITE DISABLE SEQUENCE (WRDI)
B6C1 BDB6EE     141    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW ROUTINE
B6C4 8604       142    LDAA    #$04            ;LOAD THE WRITE DISABLE COMMAND
B6C6 9783       143    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B6C8 BDB6E1     144    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B6CB BDB6F2     145    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
                146  ; SEND THE READ STATUS REGISTER SEQUENCE
B6CE BDB6EE     147    JSR     CSLOW           ;JUMP TO THE CHIP SELECT LOW ROUTINE
B6D1 8605       148    LDAA    #$05            ;LOAD THE READ STATUS REGISTER COMMAND
B6D3 9783       149    STAA    SDATA           ;STORE THE VALUE IN THE SDATA LOCATION
B6D5 BDB6E1     150    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE
B6D8 BDB6E1     151    JSR     OUTBYTE         ;JUMP TO THE SEND BYTE ROUTINE (READ)
B6DB BDB6F2     152    JSR     CSHIGH          ;JUMP TO THE CHIP SELECT HIGH ROUTINE
B6DE 7EB600     153    JMP     BEGIN           ;LOOP UNTIL RESET
                154
                155
                156  ;*****************************************************************************
                157  ;* THIS ROUTINE SENDS A BYTE OUT TO THE SPI PART. THEN IT READS WHAT IS SENT
                158  ;* BACK ON THE DO PIN.  DATA IS SENT OUT FROM THE 68HC11 ON THE MOSI PIN AND
                159  ;*  READ IN ON THE MISO PIN.  THE CLOCK IS GENERATED BY THE SCK PIN. THIS
                160  ;*  POLLS THE SPIF BIT IN THE SPSR TO SEE IF THE TRANSFER HAS BEEN COMPLETED
                161  ;*  WHEN COMPLETE THE DATA READ IS AVAILABLE IN THE SPDR SPI DATA REGISTER
                162  ;*****************************************************************************
                163
B6E1 9683       164  OUTBYTE LDAA    SDATA             ;LOAD A WITH WHAT'S IN SDATA
B6E3 A72A       165    STAA    SPDR,X            ;SEND BYTE OUT PART
B6E5 1F2980FC   166  WAIT1   BRCLR   SPSR,X,$80,WAIT1  ;WAIT FOR BYTE TO BE SENT
B6E9 A62A       167    LDAA    SPDR,X            ;READ BYTE BACK INTO ACCA
B6EB 9782       168    STAA    RDATA             ;STORE THE READ IN LOCATION RDATA
B6ED 39         169    RTS                       ;RETURN FROM SUBROUTINE
                170
                171  ;*********************
                172  ;* SET CE (PD5) LOW
                173  ;*********************
                174
B6EE 1D0820     175  CSLOW   BCLR    PORTD,X,MASKCS          ;SET CE LOW
B6F1 39         176    RTS                       ;RETURN FROM SUBROUTINE
                177
                178  ;*********************
                179  ;* SET CE (PD5) HIGH
                180  ;*********************
                181
B6F2 1C0820     182  CSHIGH  BSET    PORTD,X,MASKCS          ;SET CE HIGH
B6F5 39         183    RTS                       ;RETURN FROM SUBROUTINE
                184
                185  ;*********************
                186  ;* DELAY SUBROUTINE
                187  ;*********************
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                188  ;DELAY 250 (0xFA) * 400Ns X 50 (0x32)
                189
B6F6 8632       190  DELAY   LDAA    #$32                  ;LOAD ACCA WITH HEX 32
B6F8 C6FA       191  DEC2    LDAB    #$FA                  ;LOAD ACCB WITH FA HEX
B6FA 5A         192  DEC1    DECB                          ;DECREMENT ACCB
B6FB 26FD       193    BNE     DEC1                    ;BRANCH IF NOT EQUAL TO DEC1
B6FD 4A         194    DECA                            ;DECREMENT ACCA
B6FE 26F8       195    BNE     DEC2                    ;BRANCH IF NOT EQUAL TO DEC2
B700 39         196    RTS                             ;RETURN FROM SUBROUTINE
                197
```

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