SQTP^{SM} Specification for PIC16C5X/5XA

Serialized Quick Turn Programming Specification for PIC16C5X/5XA

OVERVIEW

Serialization is a method of programming PIC16C5X and PIC16C5XA microcontrollers whereby each chip is programmed with a slightly different code. Typically, all locations are programmed with the same basic code except for a few continuous bytes which are programmed with a different number (referred to as 'key' or 'ID number' or 'serial number') in each member. Typical applications of such programming are remote transmitters for car alarms or garage door openers where each unit must have a different access code.

Microchip offers a flexible SQTP program, whereby a customer can simply specify the nature of serialization. The 'serial number' generation and programming will be taken care of by the factory.

1.0 DEVICES CURRENTLY SUPPORTED

Other device types are being added. Please consult a Microchip representative or Microchip sales person.

Device	Oscillator Type	Package
PIC16C54	XT, RC, LP, HS	PDIP, SOIC, SSOP
PIC16C55	XT, RC, LP, HS	PDIP, SOIC, SSOP
PIC16C56	XT, RC, LP, HS	PDIP, SOIC, SSOP
PIC16C57	XT, RC, LP, HS	PDIP, SOIC, SSOP
PIC16C54A	XT, RC, LP, HS	PDIP, SOIC, SSOP
PIC16C58A	XT, RC, LP, HS	PDIP, SOIC, SSOP

2.0 SERIALIZATION SCHEME SUPPORTED

2.1 Locations:

The serial number must reside in continuous locations with up to eight locations used. Furthermore these locations must be coded as 8NN (RETLW NN, where NN=8-bit random code) in the finished product. For details on how the RETLW instruction is typically used for serialization purposes, please see Appendix A. The customer code must be supplied without the serial code in these locations. These locations must be 8FFh in the customer code provided to Microchip. Microchip will insert the serial code at these locations during programming. Hex files must be in Intel hex 8-bit merged format. See Appendix B for details.

2.2 Numbering Schemes:

Random: Truly random numbers are generated. However, there is no guarantee that the numbers will be non-repeating although the probability of such an occurrence will be infinitesimally small for a reasonably large field.

Pseudo-Random*: Pseudo-random sequences of requested length (e.g. 32-bit long if four locations are used) starting with a 'seed value' selected by the factory. The customer may optionally specify the starting value.

Pseudo-random sequences, by definition are non-repeating. See Appendix C for polynomials used to generate the numbers.

Sequential: Sequential numbers are generated. User specifies the "starting number" and an increment value. In sequential numbering, the least significant digit is in the lowest memory location. The increment value must be between 1 and 255.

Numbers are always in hex and not in BCD or any other format.

3.0 PROGRAMMING SEQUENCE

The factory will program the "basic code" first, then program the serial number and finally program the code-protection fuse. Program memory will be verified at each stage except after code protection. Optionally, the factory may choose to program the "basic code" and the "serial number" at the same time. The customer may specify an ID number (four hex digits) to be programmed in the ID locations or elect to leave them unprogrammed.

4.0 SAMPLES

Three (3) verification samples will be provided. These will be programmed with factory selected random or sequential codes in the serialization locations. The three parts will be programmed with three different serial codes. If order entry has been completed, then the samples will reflect the first three codes. If code protection is requested, then one of the three samples will be code protected.

5.0 THE FOLLOWING LIMITATIONS APPLY TO THE SQTP PROGRAM

1. During shipment of serialized parts, no particular sequence can be guaranteed.
2. In sequential or pseudo-random numbering scheme, there may be missing serial numbers (e.g. due to QC sampling).
3. A list of serial numbers programmed can not be provided, nor will such a list be generated or maintained by Microchip.
4. For sequential and pseudo-random numbering schemes, Microchip will maintain last number used in last shipment and use the next number as the starting number for the next shipment. The customer should be prepared to provide a "new starting number" in the event the flow is disrupted due to unforeseen events.

APPENDIX A:

Implementing a table in the program memory of PIC16C5X and PIC16C5XA:

The PIC16C5X and the PIC16C5XA family uses Harvard architecture, in which the program memory is separate from data memory. All instructions operate on data that is fetched from the register file or data memory. Since there are no instructions to read from or write to the program memory, simply storing data words in program memory is of no use. There is, however, a simple and elegant way to implement constant tables in the program memory by using the RETLW instruction. This instruction returns from a subroutine as well as loads an 8-bit constant into the W register. The following example shows how to get a byte of “serial information” from the table stored at location 000h in PIC16C54:

```
          ORG    0      ;store serial numbers
          RETLW  0FFh
          RETLW  0FFh
          RETLW  0FFh
          RETLW  0FFh
          RETLW  0FFh
          RETLW  0FFh
          RETLW  0FFh
          RETLW  0FFh   ;end of serial
                        ;numbers
    •
    •
main_prog ORG    XYZ    ;This is main program
    •
    •
    MOVLW byte_num      ;byte_num = 0 for 1st
                        ;byte
    CALL  get_1byte;
    •
    •
get_1byte MOVWF  PC     ;write W to program
                        ;counter
                        ;W = offset = 0 for
                        ;1st byte
                        ;end of get_1byte sub
                        ;routine
    •
    •
    •
    END
```

The next example shows how a serial number may reside at location other than 000h.

```
main_prog ORG    XYZ   ;This is main program
    •
    •
    MOVLW byte_num     ;byte_num = 0 for 1st
                       ;byte
    CALL  get_1byte;
    •
    •
get_1byte ADDWFPC      ;W = offset
          RETLW  0ffh ;
          RETLW  0ffh ;
          RETLW  0ffh ;
          RETLW  0ffh ;
          RETLW  0ffh ;
          RETLW  0ffh ;
          RETLW  0ffh ;
          RETLW  0ffh ;end of serial
                       ;numbers
    •
    •
    END
```

APPENDIX B:

Standard hex file format for serial programming:

The hex file containing the ‘serial numbers’ will be in Intel hex 8-bit format. Since the PIC16C5X and the PIC16C5XA have 12-bit data words, all addresses are doubled in this hex format. Each line of the hex file will be for a new part. Each line can contain only up to 16 bytes (i.e. eight PIC16C5X, PIC16C5XA instruction words). The format is as follows:

```
:NNAAAATTHHHHHH......HHCC
```

where:

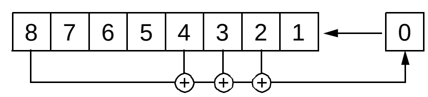
NN	=	byte count on current line (max 10h allowed)
AAAA	=	address in four hex digits
TT	=	record type, always 00 except 01 for EOF
HH	=	Two digit hex data byte
CC	=	Two digit hex checksum

APPENDIX C:

Pseudo-random numbers are generated using modulo-2 primitive polynomials. This method guarantees to produce a sequence of maximal length, i.e., cycle through all possible sequence of n bits before it repeats. By providing a seed value as the initial bit pattern (the only combination not used is all 0's), one can get 2n-1 random bits before the sequence repeats itself. Microchip will only support pseudo-random serial numbers for bit lengths 8, 16, 24, 32, 40, 48, 56 and 64 (i.e., 1-8 locations). The polynomials used are:

8 bit:	x8 + x4 + x3 + x2 + 1
16 bit:	x16 + x5 + x3 + x2 + 1
24 bit:	x24 + x4 + x3 + x + 1
32 bit:	x32 + x7 + x5 + x3 + x2 + x + 1
40 bit:	x40 + x5 + x4 + x3 + 1
48 bit:	x48 + x7 + x5 + x4 + x2 + x + 1
56 bit:	x56 + x7 + x4 + x2 + 1
64 bit:	x64 + x4 + x3 + x + 1

To implement the 8-bit polynomial requires XORing the non-zero bits of the polynomial (shown as a shift register below) and shift on the resetting bit back into the shift register.



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