



Software Stack Management

INTRODUCTION

The PIC16C5X has a stack which is only 2 deep, as a result of which only two nested calls can be made (i.e. only one call within a call routine). If more than two levels of subroutine nesting is required, this application note can be used to implement a stack manager to handle the flow of the calls.

Note: Since the amount of RAM on the PIC16CXX is limited, it would be prudent to determine the maximum number of nested calls which have to be made in a program and define the stack length appropriately.

IMPLEMENTATION

This application note implements a 5-deep stack, so 5 nested calls can be made without overflowing the stack. NCALL is defined as a MACRO which will be used instead of the mnemonic CALL, when a subroutine call is made. The NCALL routine, "pushes" the return PC value on the "stack" and then executes the called subroutine. At the end of the subroutine, instead of using the RETLW k instruction, a GOTO RETURN is executed, where RETURN is a routine which "pops" the return PC value from the "stack" and resumes the normal flow of the program.

Note: Since Software Stack Management utilizes the FSR register, and indirect addressing, the user should restore the "original" values to the FSR register if it is utilized elsewhere in the program.

The routines, as described in this application note, will work only if the called routine is within the first 256 words for each program. If the user desires to branch over to the other low 256-byte program pages, as in the PIC16C57, then the status byte should be saved along with the PC.

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```
LOC OBJECT CODE      LINE SOURCE TEXT
                                0001      list p=16c54,f=inhx8m
                                0002 ;*****
0002                                0003 ;      sm.asm:
0004                                0004 ;      Routine, demonstrating how to implement a stack
0005                                0005 ;      manager capable of handling more than 2
0006                                0006 ;      subsequent subroutine calls.
0007                                0007 ;      Note: Since this is a demo, NOP has been used
0008                                0008 ;      where normally the body of the subroutine would
0009                                0009 ;      reside.
0010                                0010 ;*****
                                0011 ;
0002                                0012      PC      EQU      2
0004                                0013 FSR      EQU      4
                                0014 ;
                                0015 ;
0008                                0016 STACK  EQU      8      ;define stack top
                                0017 ;*****
                                0018 ;NOTE: the next 5 locations in RAM should be reserved for the
                                0019 ;"STACK" implementation. Please do not use any ram locations
                                0020 ;from decimal 8 to decimal 12.
                                0021 ;*****
                                0022 ;
                                0023      ORG      01FF
01FF 0A07                                0024      GOTO      START
                                0025 ;
                                0026      ORG      0
                                0027 ;
0000 0C08                                0028 INIT      MOVLW   STACK ;load "stack" as indirect pointer
0001 0024                                0029      MOVWF   FSR      ;      /
0002 0A07                                0030      GOTO      START ;      /
                                0031 ;
                                0032 ;*****
                                0033 ;define NCALL as a MACRO used instead of the
                                0034 ;mnemonic CALL.
                                0035 ;
                                0036 NCALL  MACRO  LABEL
                                0037      MOVF   PC,W   ;save PC on "stack"
                                0038      MOVWF  0      ;      /
                                0039      INCF   FSR    ;Inc. "stack" pointer.
                                0040      GOTO   LABEL  ;jump to routine
                                0041      ENDM
                                0042 ;
                                0043 ;return from subroutine NCALL
                                0044 ;
0003 00E4                                0045 RETURN  DECF    FSR    ;point to last "stack" location
0004 0C03                                0046      MOVLW   3      ;add 3 and output value from FSR
0005 01C0                                0047      ADDWF   0,W      ;      /
0006 0022                                0048      MOVWF   PC      ;load in PC as next executable
                                0049 ;      instruction
                                0050 ;
                                0051 ;*****
                                0052 ;
```

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```
LOC OBJECT CODE LINE SOURCE TEXT
0007 0000          0054 ;
          0055 START  NOP
          0056          NCALL  TOM
0008 0202          M      MOVF  PC,W   ;save PC on "stack"
0009 0020          M      MOVWF 0      ; /
000A 02A4          M      INCF  FSR   ;Inc. "stack" pointer.
000B 0A0F          M      GOTO  TOM   ;jump to routine
000C 0000          0057  NOP      ;body of main routine
000D 0000          0058  NOP      ; /
000E 0003          0059  SLEEP
          0060 ;
000F 0000          0061 TOM   NOP
          0062          NCALL  DICK
0010 0202          M      MOVF  PC,W   ;save PC on "stack"
0011 0020          M      MOVWF 0      ; /
0012 02A4          M      INCF  FSR   ;Inc. "stack" pointer.
0013 0A16          M      GOTO  DICK  ;jump to routine
0014 0000          0063  NOP      ;body of routine TOM
0015 0A03          0064  GOTO  RETURN
          0065 ;
0016 0000          0066 DICK  NOP
          0067          NCALL  HARRY
0017 0202          M      MOVF  PC,W   ;save PC on "stack"
0018 0020          M      MOVWF 0      ; /
0019 02A4          M      INCF  FSR   ;Inc. "stack" pointer.
001A 0A1D          M      GOTO  HARRY  ;jump to routine
001B 0000          0068  NOP      ;body of routine DICK
001C 0A03          0069  GOTO  RETURN
          0070 ;
001D 0000          0071 HARRY  NOP      ;body of routine HARRY
001E 0000          0072  NOP      ; /
001F 0A03          0073  GOTO  RETURN
          0074 ;
          0075 ;
          0076          END
          0077
          0078
```

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SYMBOL TABLE

LABEL	VALUE
DICK	0016
FSR	0004
HARRY	001D
INIT	0000
PC	0002
RETURN	0003
STACK	0008
START	0007
TOM	000F

MEMORY USAGE MAP ('X' = Used, '-' = Unused)

```
0000 : XXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX  _____
0040 : _____
0180 : _____
01C0 : _____X
```

All other memory blocks unused.

Errors : 0
Warnings : 0

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