



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 ;*****
                                0003 ;      sm.asm:
                                0004 ;      Routine, demonstrating how to implement a stack
                                0005 ;      manager capable of handling more than 2
                                0006 ;      subsequent subroutine calls.
                                0007 ;      Note: Since this is a demo, NOP has been used
                                0008 ;      where normally the body of the subroutine would
                                0009 ;      reside.
                                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
                                0054 ;
0007 0000                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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