



Electromechanical Timer Replacement

99 Minute Timer

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OVERVIEW

This 99 minute timer replaces the electro-mechanical timer. The hardware is made simple and economical. The timer is very simple to operate. Two 7-segment displays are provided to display minutes from 0 to 99. To simplify operation, only two push-on switches are provided to set minutes. Each switch is dedicated to each display.

"TENS OF MIN SW" increments tens of minutes display from 0 through 9 at each push and "UNITS OF MIN SW" increments units of minutes displays from 0 through 9 at each push. Debouncing of switches is taken care by software.

APPLICATION OPERATION

The TMR0 prescaler is set to x16. Software checks TMR0 for 250 rollovers, which happens every 4 msec. 4 msec is counted 25 times to generate 100 msec, from which seconds and minutes are generated.

Every 100 msec the keyboard is read and the required minutes display (TENS or UNITS) is incremented at the rate of 2 Hz.

If the displayed minutes is equal to 0 then relay is put off and UNITS DISPLAY's decimal point is not flashing to indicate the timer is off.

If displayed minutes is not equal to 0, then a relay is turned on and UNITS DISPLAY's decimal point is flashed to indicate the timer is active. During this mode the display decrements every minute till it reaches 0, where the relay is put off.

Note 1: Total instruction time [one loop]:

Approximately 375 μ sec, maximum.

2: Set Processor configuration word as
0000 0000 1010b.

- a) $\overline{\text{MCLR}}$ tied to VDD (internally).
- b) Code protection off.
- c) WDT disabled.
- d) Internal RC oscillator.

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APPENDIX A: SOURCE CODE

```
;          define ram ports and data ;          ***** ;
DEFINE PORT
;          *****
;DEFINE PORTS
;*****
gp0          equ      0
gp1          equ      1
gp2          equ      2
gp3          equ      3
gp4          equ      4
gp5          equ      5
;DISPLAY PORT
;*****
disp_data    equ      gp0
disp_clk     equ      gp1
disp_strobe  equ      gp2
;KEYBOARD PORT
;*****
;units_key   equ      gp3
;tens_key    equ      gp4
;RELAY PORT
;*****
relay        equ      gp5
;*****
;DEFINE RAM
units        equ      08h          ;minutes unit display
tens         equ      units+1      ;minutes tens display
counter_4ms  equ      tens+1       ;incremented every 4 msec
counter_100ms equ      counter_4ms+1 ;incremented every 100 msec
seconds      equ      counter_100ms+1
oldkey       equ      seconds+1    ;for key debouncing
newkey       equ      oldkey+1     ;----- , , -----
key          equ      newkey+1     ;key pressed data
digit_inc    equ      key+1        ;inc units display if bo = 1
                                     ;inc tens display if b1 = 1
tmr_comp     equ      digit_inc+1  ;tmr0 comparator register
scrtch0      equ      tmr_comp+1
scrtch1      equ      scrtch0+1
scrtch2      equ      scrtch1+1
;*****
;DEFINE FLAGS AND BITS
b0          equ      0
b1          equ      1
b2          equ      2
b3          equ      3
b4          equ      4
b5          equ      5
b6          equ      6
b7          equ      7
;key
;***
;          equ      b0
;          equ      b1
;          equ      b2
units_key    equ      b3
tens_key     equ      b4
;          equ      b5
;          equ      b6
;          equ      b7
;digit_inc
;*****
units_inc    equ      b0
tens_inc     equ      b1
;          equ      b2
```

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```
;          equ      b3
;          equ      b4
;          equ      b5
;          equ      b6
;          equ      b7
;*****
#define data_hi      bsf      GPIO, disp_data
#define data_lo      bcf      GPIO, disp_data
#define clk_hi       bsf      GPIO, disp_clk
#define clk_lo       bcf      GPIO, disp_clk
#define strobe_hi    bsf      GPIO, disp_strobe
#define strobe_lo    bcf      GPIO, disp_strobe
#define relay_on     bsf      GPIO, relay
#define relay_off    bcf      GPIO, relay
;***** EOF DEF_RAM.ASM *****
;
;          SUBS.ASM
;          *****
;read key port in key
read_keys      movf      newkey, w          ;debouncing taken care by s/w
               movwf     oldkey
               movf      GPIO, w           ;read newkeys
               andlw     00011000b         ;gp3, gp4 are key ports
               movwf     newkey
               comf      newkey, f         ;complement since active low
               andwf     oldkey, w         ;key=oldkey AND compl(newkey)
               movwf     key
;indicate to display routine units or tens key pressed
               btfsc     key, units_key
               bsf      digit_inc, units_inc
               btfsc     key, tens_key
               bsf      digit_inc, tens_inc
               return
;*****
init_ports     movlw     0                 ;all lo
               movwf     GPIO
               movlw     00011000b         ;port g0-g2,g5 o/p & gp3,gp4 i/p
               tris      GPIO
               clrf      TMR0              ;clr tmr0 & prescaler
               movlw     11000011b        ;tmr0 enable with 1:16 prescaler
               option
               return
;***** EOF SUBS.ASM *****
;
;          TABLES.ASM
;          *****
;7 segments decoded data. lo is segment on & hi is segment off
get_seg        addwf     PCL, f
;              ABCDEFGP          ;P is decimal point
retlw  00000011b    ;0
retlw  10011111b    ;1
retlw  00100101b    ;2
retlw  00001101b    ;3
retlw  10011001b    ;4
retlw  01001001b    ;5
retlw  01000001b    ;6
retlw  00011111b    ;7
retlw  00000001b    ;8
retlw  00011001b    ;9
dec_pt         equ      1111110b          ;decimal point bit
;***** EOF TABLES.ASM *****
```

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```
;          TIMER.ASM
;          *****
; [ milindh@tifrvax.tifr.res.in ]
;Set Processor configuration word as = 0000 0000 1010 b.
;  a] -MCLR tied to VDD (internally).
;  b] Code protection off.
;  c] WDT disabled.
;  d] Internal RC oscillator [4 MHZ].
list      p=12c508, r=dec
          include "d:\pic\mpasm\p12c508.inc"

;define ram
          include "def_ram.asm"
;processor start
          org      0
          goto     start
;define legends and table
          include  "tables.asm"
;subroutines
          include  "subs.asm"
;initialize and start
start
          clrf     key
          clrf     oldkey
          clrf     newkey
          clrf     digit_inc
          clrf     units
          clrf     tens
          clrf     counter_4ms
          clrf     counter_100ms
          clrf     seconds
          movlw    250          ;4000us tmr0 (1:16 prescaler * 250 )
          movwf    tmr_comp
          call     init_ports   ;init ports & timer
main
          movf     tmr_comp, w   ;is tmr0 = tmr_comp (4 msec over?)
          xorwf    TMR0, w
          btfss    STATUS, Z     ;skip if = 250
          goto     main
          movlw    250
          addwf    tmr_comp, f    ;update 4 msec compare register
          incf     counter_4ms, f
          movlw    25
          xorwf    counter_4ms, w ;is 4ms * 25 = 100ms over ?
          btfss    STATUS, Z     ;skip if = 100ms
          goto     main
          clrf     counter_4ms
;***** 100 MSEC OVER *****
          incf     counter_100ms, f
          movlw    10
          xorwf    counter_100ms, w ;is 100ms * 10 = 1sec over ?
          btfss    STATUS, Z     ;skip if 1 sec over
          goto     main21        ;jmp if 1 sec not over
          clrf     counter_100ms ;1 sec over
          incf     seconds, f
          movlw    60
          xorwf    seconds, w    ;is 1 minute over ?
          btfss    STATUS, Z     ;skip if 1 min over
          goto     main21
;***** 1 MINUTE OVER *****
          clrf     seconds
          ;process relay and display
          ;if tens & units both = 0 then rly off and out
          ;else relay on & decrement display & out
          movf     tens, w
          iorwf    units, w
          btfss    STATUS, Z
          goto     main1
          relay_off
```

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```

        goto    main21
main1    relay_on
        movf    units, f
        btfss   STATUS, Z
        goto    main2
        movlw   9
        movwf   units
        decf    tens, f
        goto    main21
main2    decf    units, f
;***** EXECUTED EVERY 100 MSEC *****
main21   call    read_keys
;** DISPLAY ROUTINE TO BE EXECUTED EVERY 500 MSEC **
        ;process display every 500 msec
        ;if unit key pressed increment unit display
        ;if tens key pressed increment tens display
        ;flash unit display's dec. pt. every second if units & tens
        ;not equal to zero i.e. indicate timer is active
        ;execute display routine in counter_100ms = 0 or 5
        movf    counter_100ms, w
        btfsc   STATUS, Z
        goto    main3
        xorlw   5
        btfss   STATUS, Z
        goto    main
        ;if units_key pressed then inc units display between 0 thr. 9
        ;if tens_key pressed then inc tens display between 0 thr. 9
main3    btfss   digit_inc, units_inc
        goto    main4
        bcf     digit_inc, units_inc
        ;inc units display. if units = 10 then units = 0
        incf    units, f
        movlw   10
        xorwf   units, w
        btfsc   STATUS, Z          ;skip if not equal
        clrf    units
main4    btfss   digit_inc, tens_inc
        goto    main5
        bcf     digit_inc, tens_inc
        ;inc tens display. if tens = 10 then tens = 0
        incf    tens, f
        movlw   10
        xorwf   tens, w
        btfsc   STATUS, Z          ;skip if not equal
        clrf    tens
        ;convert decimal in units & tens to decoded segment data
        ;for led display in scrтч1 & 2 for transmission
main5    movf    tens, w
        call    get_seg
        movwf   scrтч1
        movf    units, w
        call    get_seg
        movwf   scrтч2
        ;flash (toggle) decimal point every 500ms if timer active
        ;i.e. if timer not equal to zero i.e. relay on, then flash
        ;decimal point else, do not to indicate relay off
        movf    tens, w
        iorwf   units, w
        btfsc   STATUS, Z          ;skip to flash dp
        goto    main6              ;jmp if 0 to no flash
        movf    counter_100ms, f
        btfss   STATUS, Z          ;toggle-on dec pt if counter_100ms = 0
        goto    main6              ;else jmp out to toggle-off
        ;flash dp of units display
        movlw   dec_pt
        andwf   scrтч2, f
```

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```
        ;transmit data from scrтч1 thr scrтч1 to display circuit (msb first).
main6      movlw    16                ;no of bit to tx
           movwf    scrтч0
main61     rlf      scrтч2, f         ;check msb
           rlf      scrтч1, f
           btfsc    STATUS, C        ;data hi if cy=1 else lo
           goto     main62
           data_lo
           goto     main63
main62     data_hi
main63     nop                    ;delay
           nop
           clk_hi                ;toggle clk to push data
           nop
           nop
           clk_lo
           nop
           nop
           decfsz   scrтч0, f         ;next bit
           goto     main61
           strobe_hi              ;strobe data nop
           nop
           strobe_lo
           data_lo                ;leave data lo
           goto     main
           end
; ***** EOF MAIN.ASM *****
```



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