

# Application 1: Count Down Timer

This program will count down from the packed BCD number in the HL register pair to 0 at a time increment determined by the hex number in the DE register pair. When the count = 0, the alarm will sound and the LEDs will light. The alarm can be discontinued and the program terminated by pressing any key on the keypad. After typing in the program, load the HL and DE register pairs as follows :

Load the HL register pair with the desired time interval.  
Format = packed BCD range = 9999 to 0001

Load DE register pair with the time scaler.  
Format = hex range = 0001h to FFFFh

The time scaler determines how many hundredths of seconds must pass before the counter is decremented. The time interval between decrements will be ((time scaler) / 100) seconds. For example, if the scaler is 0064h (100 decimal) the timer will decrement once a second. If the scaler is 1770h (6000 decimal) the timer will count decrement once every 60 seconds.

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;-----;
;.....EQUATES.....;
;-----;

FFE9 =      VEC7HLF:      EQU      0FFE9H ;INT 7.5 VECTOR
0000 =      SCALELO:     EQU      00H     ;307200HZ / 768 =
004C =      SCALEHI:     EQU      4CH     ;100HZ TICK RATE
0014 =      TIMERLO:     EQU      14H     ;TIMER PORTS
0015 =      TIMERHI:     EQU      15H
00CD =      TIMCMD:      EQU      0CDH    ;TIMER FUNC. COMMAND
0010 =      CMDREG:      EQU      10H     ;TIMER COMMAND PORT
001A =      INTMASK:     EQU      1AH     ;INTERRUPT MASK
FF01 =      TIMPROG:     EQU      0FF01H ;RTC PROG START ADDR
000C =      SERVC:      EQU      0CH     ;EMOS SERVICES
0012 =      SERV12:     EQU      12H
000B =      SERV0B:     EQU      0BH
1000 =      MOS:        EQU      1000H   ;MOS CALL LOCATION
00FF =      LIGHT:      EQU      0FFH    ;ALARM LED ON PATTERN
0000 =      DARK:       EQU      0       ;ALARM LED OFF PATTERN

;-----;
FF01          ORG      TIMPROG
;-----;

;-----;
;.....INITIALIZE.....;
;-----;

FF01 F3      START:    DI          ;DISABLE INTERRUPTS
FF02 22AEFF  SHLD     TIM1        ;LOAD H/L TO TIMER1
FF05 EB      XCHG
FF06 22A4FF  SHLD     SCALER       ;D/E CONTAINS SCALER
FF09 2157FF  LXI      H,TIMERS    ;ON 7.5 INTERRUPT
FF0C 22E9FF  SHLD     VEC7HLF     ;VECTOR TO RTC
FF0F 3E00    MVI      A,SCALELO   ;SET LOW COUNT BYTE
FF11 D314    OUT      TIMERLO     ;OF TIMER CHIP

FF13 3E4C    MVI      A,SCALEHI   ;SET HIGH COUN T BYTE
FF15 D315    OUT      TIMERHI     ;OF TIMER CHIP

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FF17 3ECD          MVI      A,TIMCMD      ;SET TIMER CHIP FOR
FF19 D310          OUT      CMDREG        ;100 HZ SQUARE WAVE
FF1B 3E01          MVI      A,01H          ;SET ALARM FLAG TO
FF1D 32B0FF        STA      ALRMFLAG      ;ARM ALARM
FF20 2AA4FF        LHL      SCALER        ;INITIALIZE TIMER 0
FF23 22ACFF        SHLD     TIMO          ;
FF26 3E1A          MVI      A,INTMASK      ;UNMASK 7.5 AND 5.5
FF28 30            SIM          ;INTERRUPTS
FF29 FB           EI            ;ENABLE INTERRUPTS

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;-----;
;.....MAIN PROGAM.....;
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FF2A 0E12          DOTIME:  MVI      C,SERV12   ;USE SERVICE 12
FF2C 2AAEFF        LHL      TIM1          ;TO DISPLAY TIMER 1
FF2F EB           XCHG          ;DE WILL BE DISPLAYED
FF30 CD0010        CALL     MOS           ;CALL MOS
FF33 3AB0FF        LDA      ALRMFLAG      ;IF ALARM IS ON
FF36 FE01          CPI      01H          ;GO WAIT FOR KEY
FF38 CA2AFF        JZ       DOTIME        ;ELSE DISPLAY TIMER
FF3B 0E12          MVI      C,SERV12   ;MAKE SURE WE DISPLAY
FF3D 2AAEFF        LHL      TIM1          ;ONE LAST TIME TO
FF40 EB           XCHG          ;DISPLAY TERMINAL
FF41 CD0010        CALL     MOS           ;COUNT
FF44 0E0B          MVI      C,SERV0B   ;STRIKE ANY KEY
FF46 CD0010        CALL     MOS           ;TO STOP ALARM
FF49 20            RIM          ;SPEAKER OFF
FF4A F640          ORI      40H
FF4C E67F          ANI      7FH
FF4E 30            SIM
FF4F 0E0C          MVI      C,SERV0C   ;LEDS OFF
FF51 1E00          MVI      E,DARK
FF53 CD0010        CALL     MOS
FF56 FF           RST      7           ;RETURN TO MOS

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;-----;
;.....7.5 INTERRUPT HANDLER.....;
;-----;

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FF57 F5           TIMERS:  PUSH     PSW
FF58 E5           PUSH     H
FF59 2AACFF        LHL      TIM0          ;GET TIM0
FF5C 7D           MOV      A,L          ;IF ITS NOT ZERO
FF5D B4           ORA      H
FF5E C29CFF        JNZ     DECTIMO       ;DECREMENT TIM0
FF61 2AA4FF        LHL      SCALER        ;ELSE TIM0 = 100
FF64 22ACFF        SHLD     TIM0          ;RELOAD TIM0
FF67 3AAEFF        LDA      TIM1          ;GET TIM1 LOW
FF6A C699          ADI      99H          ;DECREMENT
FF6C 27           DAA          ;DECIMAL ADJUST
FF6D 32AEFF        STA      TIM1          ;STORE TIM1 LOW
FF70 3AAFFF        LDA      TIM1+01H     ;GET TIM1 HIGH
FF73 CE99          ACI      99H          ;DECREMENT
FF75 27           DAA          ;DECIMAL ADJUST
FF76 32AFFF        STA      TIM1+01H     ;STORE TIM1 HIGH
FF79 2AAEFF        LHL      TIM1          ;GET TIM1
FF7C 7D           MOV      A,L          ;IF ITS NOT ZERO
FF7D B4           ORA      H
FF7E C2A0FF        JNZ     EXITTIME     ;EXIT
FF81 3AB0FF        LDA      ALRMFLAG      ;IF ALARM HAS
FF84 FE00          CPI      00H          ;BEEN ACTIVATED
FF86 CAA0FF        JZ       EXITTIME     ;EXIT
FF89 3E00          MVI      A,00H        ;ELSE, ZERO ALARM
FF8B 32B0FF        STA      ALRMFLAG      ;FLAG & ACTIVATE
FF8E 20            RIM          ;SPEAKER ON
FF8F F6C0          ORI      0C0H

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FF91 30          SIM
FF92 0E0C       MVI      C ,SERVC      ;LEDS ON
FF94 1EFF       MVI      E ,LIGHT
FF96 CD0010     CALL     MOS
FF99 C3A0FF     JMP      EXITTIME ;EXIT
FF9C 2B         DECTIM0: DCX      H          ;DECREMENT TIM0
FF9D 22ACFF     SHLD     TIM0
FFA0 E1         EXITTIME: POP     H          ;RECOVER REGISTERS
FFA1 F1         POP     PSW
FFA2 FB         EI
FFA3 C9         RET              ;RETURN
;-----;
;.....SUBROUTINES.....;
;-----;

;-----;
;.....DATA STORAGE.....;
;-----;
FFA4 SCALER:     DS      02H      ;DETERMINES TIME INCR.
FFA6 DISPBUFF:  DS      06H      ;DISPLAY BUFFER
FFAC TIM0:       DS      02H
FFAE TIM1:       DS      02H      ;SOFTWARE TIMER 1
FFB0 ALRMFLAG:  DS      01H      ;ALARM FLAG.0 = NO ALRM
;-----;
FFB1          END

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The machine language for the program is listed below.

ADDRESS	DATA	DESCRIPTION	ADDRESS	DATA	DESCRIPTION
FF01	F3	DI	FF1D	32	STA FFB0
FF02	22	SHLD FFAE	FF1E	B0	
FF03	AE		FF1F	FF	
FF04	FF		FF20	2A	LHLD FFA4
FF05	EB	XCHG	FF21	A4	
FF06	22	SHLD FFA4	FF22	FF	
FF07	A4		FF23	22	SHLD FFAC
FF08	FF		FF24	AC	
FF09	21	LXI H,FF57	FF25	FF	
FF0A	57		FF26	3E	MVI A,1A
FF0B	FF		FF27	1A	
FF0C	22	SHLD FFE9	FF28	30	SIM
FF0D	E9		FF29	FB	EI
FF0E	FF		FF2A	0E	MVI C,12
FF0F	3E	MVI A,00	FF2B	12	
FF10	00		FF2C	2A	LHLD FFAE
FF11	D3	OUT 14	FF2D	AE	
FF12	14		FF2E	FF	
FF13	3E	MVI A,4C	FF2F	EB	XCHG
FF14	4C		FF30	CD	CALL 1000
FF15	D3	OUT 15	FF31	00	
FF16	15		FF32	10	
FF17	3E	MVI A,CD	FF33	3A	LDA FFB0
FF18	CD		FF34	B0	
FF19	D3	OUT 10	FF35	FF	
FF1A	10		FF36	FE	CPI 01
FF1B	3E	MVI A,01	FF37	01	
FF1C	01				

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ADDRESS	DATA	DESCRIPTION	ADDRESS	DATA	DESCRIPTION
FF38	CA	JZ FF2A	FF76	32	STA FFAF
FF39	2A		FF77	AF	
FF3A	FF		FF78	FF	
FF3B	0E	MVI C,12	FF79	2A	LHLD FFAE
FF3C	12		FF7A	AE	
FF3D	2A	LHLD FFAE	FF7B	FF	
FF3E	AE		FF7C	7D	MOV A,L
FF3F	FF		FF7D	B4	ORA H
FF40	EB	XCHG	FF7E	C2	JNZ FFA0
FF41	CD	CALL 1000	FF7F	A0	
FF42	00		FF80	FF	
FF43	10		FF81	3A	LDA FFB0
FF44	0E	MVI C,0B	FF82	B0	
FF45	0B		FF83	FF	
FF46	CD	CALL 1000	FF84	FE	CPI 00
FF47	00		FF85	00	
FF48	10		FF86	CA	JZ FFA0
FF49	20	RIM	FF87	A0	
FF4A	F6	ORI 40	FF88	FF	
FF4B	40		FF89	3E	MVI A,00
FF4C	E6	ANI 7F	FF8A	00	
FF4D	7F		FF8B	32	STA FFB0
FF4E	30	SIM	FF8C	B0	
FF4F	0E	MVI C,0C	FF8D	FF	
FF50	0C		FF8E	20	RIM
FF51	1E	MVI E,00	FF8F	F6	ORI C0
FF52	00		FF90	C0	
FF53	CD	CALL 1000	FF91	30	SIM
FF54	00		FF92	0E	MVI C,0C
FF55	10		FF93	0C	
FF56	FF	RST 7	FF94	1E	MVI E,FF
FF57	F5	PUSH PSW	FF95	FF	
FF58	E5	PUSH H	FF96	CD	CALL 1000
FF59	2A	LHLD FFAC	FF97	00	
FF5A	AC		FF98	10	
FF5B	FF		FF99	C3	JMP FFA0
FF5C	7D	MOV A,L	FF9A	A0	
FF5D	B4	ORA H	FF9B	FF	
FF5E	C2	JNZ FF9C	FF9C	2B	DCX H
FF5F	9C		FF9D	22	SHLD FFAC
FF60	FF		FF9E	AC	
FF61	2A	LHLD FFA4	FF9F	FF	
FF62	A4		FFA0	E1	POP H
FF63	FF		FFA1	F1	POP PSW
FF64	22	SHLD FFAC	FFA2	FB	EI
FF65	AC		FFA3	C9	RET
FF66	FF				
FF67	3A	LDA FFAE			
FF68	AE				
FF69	FF				
FF6A	C6	ADI 99			
FF6B	99				
FF6C	27	DAA			
FF6D	32	STA FFAE			
FF6E	AE				
FF6F	FF				
FF70	3A	LDA FFAF			
FF71	AF				
FF72	FF				
FF73	CE	ACI 99			
FF74	99				
FF75	27	DAA			