T4 TIMER - PROJECT DESCRIPTION - rev. 5.9

REVISION HISTORY

Rev.5.9 - Aug13, 2018
- Addition of new modes 9 (machine run time) and mode 10 (On-delay)

Rev.5.8 - April 5, 2018
- Circuit board layout changes to accommodate the larger module SMS0417: move JP2, eliminate D3, replace F2.
- Additional positions on JP1 for "spray rinse modes".
- Also screw mounting holes, DIP switch instead jumpers, update legend. (see picture in section 2)
- Change mode chart nomenclature from letters to numbers. (so numbers correspond with the DIP switch numbering.)

Rev.5.7 - March 11, 2018
- Overwrite mode 1 with mode 8 from v5.6 (early warning on LED1).
- Added feature to count *up* in Mode 6 and new mode 1 (former mode 8) if time is set to zero and cycle starts.
- Overwrite mode 8 with a new behavior called "spray rinse".
- Add "early warning" feature to mode 2, 7.
- Change behavior of mode 3. (see chart) Relay is now continuously closed throughout cycle . Interrupted cycle now indicated by BZ and LED2 instead of RLY.
- New mode 9 for future use.

Rev.5.6 - Dec 20, 2017
- Mode 3 changed to include the "early warning" behaviour. see page 7.

Rev.5.5 - Sep 16, 2017
- Mode 8 - a short buzzer sound added at same time as early LED.
- Mode 6 - overwrite with a new mode 6 called "early LED2" similar to mode 8.

Rev.5.4 - Nov, 2016
- Non-volatile memory
- Early warning mode. 8

Rev.5.2 - Oct27, 2016
- 3.1 - "removed the PB illuminates during timing cycle."

Rev.5.1 - Oct26, 2016
- 5.3 - PB1 always has a effect on the buzzer.

T4 TIMER - PROJECT DESCRIPTION - rev. 5.9

- 5.5 - LED1 LED1 description added
- 6.1 - description simplified. Chart added to clarify mode 1.

Rev.5 - Aug1, 2016
- 4.7 - non-volatile memory when powered from AC power. (in all modes)
- 5.3 - PB1 continuously closed.
- 5.4 - LED2 should be a strobing pattern.
- 6.1 - change to mode 1 addition of a "count up" function.
- 6.4 - new "pausing" mode.
- 6.5 - reduce a BZ output from 2 seconds to a chirp. Eliminate BZ sound.
- 6.6 - Modify behavior so there is no zero display after cycle ends. (eliminates a button press)
- 6.8 - new "early LED1" mode.

Rev 4
- 6.1.2 "chaser dots" instead of colon flashing.

_____

1. OVERVIEW
The project is to create a timer board that will interface with an LCD module - Sunman model SMS0408E2. The timer can run from either 9V battery or converted AC power.
When running from battery it should consume a minimum amount of power. (3V operation)

2. PHYSICAL
3. The pcb should physically attach to the SMS0408E2 module by ribbon cable in the available 8 holes. Alternatively, module SMS0417 may be connected if a pair of jumper holes is connected.

4. There will be one 22mm button to start/stop the cycle, (PB1) and two momentary 16mm dome buttons to set the time. (PB2 and PB3 connected by wires to the main TB)

5. One 9-12VDC buzzer, and two 9-12VDC LEDs (LED1 and LED2) connected to the main terminal block on the pcb. LED1 is the button LED, LED2 is an external beacon LED drawing 55mA.
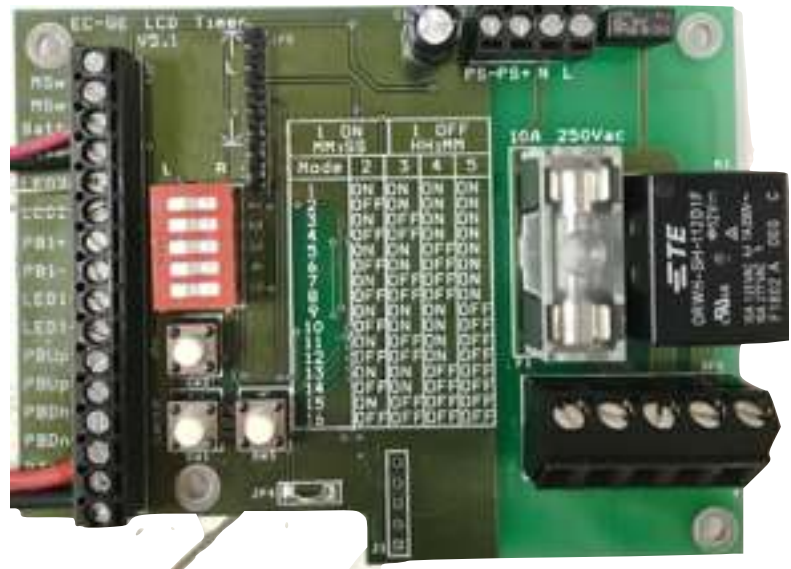
6. DIP switch GH-7186-ND to allow selection of different operating modes.
7. Tact switches (DK EG4566CT-ND with 5mm lead spacing) located on the pcb.
8. Please teardrop all through hole pads that are to be soldered.

3. BATTERY VERSION
The following applies to the "battery version".
1. The relay, power terminal block, fuse, D3 will not be populated on the pcb.

4. AC VERSION
The following applies to the "AC version".
1. Double throw relay (PB1321-ND). 5-position terminal block so user can choose N.O.
2. N.C.. The neutral terminals should be located on one end of the terminal block because in most cases (when a piggyback plug is used) the second neutral position will not be used. (Digi-key ED2704-ND + ED2703-ND linked together)
3. Please select a voltage convertor that can safely run from a16V power supply.
4. The "LED driver" power supply AC side would connect to a 16-position terminal block with 3.5 mm pitch. ED2739-ND. Terminal positions: BZ, PB1, PB2, PB3, LCD backlight, LED1 (on PB1), LED2 (beacon),
5. Fuse for mains power: Digi-key 486-1228-ND. (Fuse holder DigiKey WK6245 and cover WK6246)
6. Non-volatile memory so the last time is kept in memory in case of a power interruption.

5. GENERAL BEHAVIORS
1. Display Logic
A. When in MM:SS mode, the 4 digits the time is displayed as MM:SS up to 99m: 59s.
B. When displaying in HH:MM, it will not be obvious from the display that the timer is counting, so use the 4 dots at the bottom of the display to "chase" from left to right to indicate its counting down, and right-to-left when counting up.
C. In HH:MM mode In the HH:MM mode the time is HH:MM until the time gets to 99 minutes at which time the display reverts to MM:SS until the cycle is over.
D. Low battery voltage to be indicated by displaying the static message "Lo:bt" when not actively timing. When it is timing, there should be no such message.

2. PB2 and PB3 - Setting time

A. The two digits left of the colon are incremented by PB2 and decremented by PB3. (regardless if display is indicating HH:MM or MM:SS) Holding PB1 for 1.0 seconds while simultaneously pressing PB2 or PB3 will change the digits *right* of the colon instead. In any case if PB1 or PB2 is held down, the digits race forward quickly. (increment to the next higher number every 100ms)

B. Depressing PB2 and PB3 together should clear the display to zero.

3. PB1

When PB1 is pressed momentarily, the countdown time cycle should start. When the time has counted down to zero. Timer should continue to count *up* until PB1 is pushed again to stop the cycle.

PB1 always has an effect on the buzzer when pressed: either a chirp, or long beep, or it stops the sound.

4. LED2

This output should always be flashing in a strobe pattern like this: 200ms on, 200ms off for duration of 1 second, followed by 2 seconds where LED is off. (like the I.S. pcbs)

5. LED1

Always steady on. (not flashing)

6. DEFAULT TIMES

Unless otherwise noted, (as in mode 8) please make the default times after programming as follows: cycle time= 15 seconds, early time= 5 seconds.

6. MODES

SWITCH POSITION 1 determines HH:MM or MM:HH.   With POSITION A *on* the pins, the timer displays MM:SS. OFF the pins is HH:MM. Positions 2,3,4,5 determine the other behaviours as in chart.

MODE	SWITCH POSITION					DESCRIPTION
	1	**2**	**3**	**4**	**5**	
1	L / R	R	R	R	R	EARLY WARNING ON LED1
2	L / R	L	R	R	R	MANUAL STOP - CANNOT CANCEL
3	L / R	R	L	R	R	MECHANICAL TRIGGER WITH EARLY WARNING
4	L / R	L	L	R	R	PAUSING
5	L / R	R	R	L	R	AUTOMATIC STOP - WITH CANCEL
6	L / R	L	R	L	R	EARLY WARNING ON LED2
7	L / R	R	L	L	R	GUARD DUTY
8	L / R	L	L	L	R	SRAY RINSE
9	L / R	R	R	R	L	MACHINE RUN TIME
10	L / R	L	R	R	L	ON DELAY
11	L / R	R	L	R	L	FUTURE USE
12	L / R	L	L	R	L	FUTURE USE
13	L / R	R	R	L	L	FUTURE USE
14	L / R	L	R	L	L	FUTURE USE
15	L / R	R	L	L	L	FUTURE USE
16	L / R	L	L	L	L	FUTURE USE

1. Mode 1 - EARLY LED1

LED1 activates before the end of a cycle. to give an early warning to an operator. The amount of "early warning" time is settable as follows: holding all three buttons simultaneously for 5 seconds; then when the 3 buttons are released, the timer is in a state to set the "early" time. (indicated by the display blinking) The "early" time is set in the same way as the time is normally set with PB1,PB2, PB3.. After the "early" time is set, the display flashes this time for 5 seconds and then after that the time becomes "locked in" and the flashing stops.

For example:all 3 buttons are depressed for 5 seconds, then released. Using PB1 and PB2 a time is set for 40 seconds. This time blinks for 5 seconds and then displays steadily. Operator must now set the desired countdown time again if it is to be different from the "early" time of 40 sec.. When the next cycle runs, PB1 illuminates 40 seconds before the end of the cycle. At the end off the cycle, BZ/ LED2/relay activate as usual. This "early time" is erased (set to zero) by holding all 3 buttons down for 5 seconds.

PB1		↓					↓	
DISPLAY	TIME 1	COUNTDOWN					OVERRUN	TIME 1
LED1				EARLY TIME				
LED2								
BZ		CHIRP			2 SEC.			
RLY	OPEN	CLOSED						OPEN

MODE 1 - CHART 1 — EARLY LED1

2 SEC.

PB1		↓				↓		↓
DISPLAY	TIME 1	COUNTDOWN				LAST TIME FLASHING		TIME 1
LED1				EARLY TIME				
LED2								
BZ		CHIRP		2 SEC		2 SEC		CHIRP
RLY	OPEN	CLOSED				OPEN		

MODE 1 - CHART 2 — EARLY LED1 WITH CANCELLATION

PB1		↓		↓		
DISPLAY	00:00		COUNTUP		00:00	
LED1						
LED2				2 sec.		
BZ		CHIRP		CHIRP		
RLY	OPEN		CLOSED		OPEN	

MODE 1 - CHART 3 — COUNT UP

2. Mode 2 - MANUAL STOP, CANNOT CANCEL

- Same as cycle 1 but cycle cannot be cancelled.
- Setting "early warning" is the same as other modes. See mode 1 for details.

PB1		↓					↓	
DISPLAY	TIME1	COUNTDOWN				OVERUN		TIME1
LED1								
LED2				EARLY WARNING				
BZ		CHIRP		2 sec.				
RLY	OPEN	CLOSED				OPEN		

MODE 2 - CANNOT CANCEL

3. Mode 3 - MECHANICAL TRIGGER

For applications where PB1 is closed for the entire cycle by a mechanical switch. The cycle cannot be cancelled during timing. If the mechanical switch is interrupted, a warning is given. LED2 and BZ activate for 5 seconds initially, then chirp for short duration ~200ms every 3 seconds, for the remainder of the cycle.

.

PB1	↓						↑
DISPLAY	TIME 1	COUNTDOWN				OVERRUN	TIME 1
LED1				EARLY TIME			
LED2							
BZ		CHIRP		2 SEC.			
RLY	OPEN	CLOSED					OPEN

MODE 3 - CHART 1 — EARLY LED1 (NORMAL OPERATION)

INTERRUPTION

PB1		↓	↑	↓				↑
DISPLAY	TIME 1	COUNTDOWN					OVERRUN	TIME 1
LED1						EARLY TIME		
LED2			2 sec.	5 sec.	200ms	5 sec.	200ms	
BZ		CHIRP		2 sec.		CHIRP		CHIRP
RLY	OPEN	CLOSED						OPEN

MODE 3 - CHART 2 — EARLY LED1 (WITH AN INTERRUPTION)

** An interruption starts a pattern where BZ and LED2 chirps a warning.

4. Mode 4 - PAUSING

A. Counts down from a set value but time can be paused by pressing PB1. When paused, the display flashes the time.

B. If PB1 is pressed again the countdown resumes. (and display stops flashing) PB1 can be pressed to pause the timing an unlimited number of times. After the set time has elapsed, BZ/LED1/LED2/relay act as usual.

C. If set time starts is zero then it counts *up* and can be paused/resumed in the same way. Count-up can be terminated when by holding PB1 for 2 seconds. In this case BZ sounds to indicate the cycle is cancelled.

PB1		↓		↓		↓			↓
DISPLAY	TIME	COUNTDOWN		HOLD		COUNTDOWN		OVERRUN	TIME
LED1									
LED2									
BZ		CHIRP		CHIRP		CHIRP			
RLY	OPEN	CLOSED		OPEN		CLOSED			OPEN

MODE 4 - CHART 1 — PAUSING COUNT DOWN

2 SEC.

PB1		↓		↓		↓		↓		↓
DISPLAY	00:00	COUNT UP		HOLD		COUNT UP		HOLD		00:00
LED1										
LED2										
BZ		CHIRP		CHIRP		CHIRP		CHIRP		2 SEC
RLY	OPEN	CLOSED		OPEN		CLOSED		OPEN		

MODE 4 - CHART 2 — PAUSING COUNT UP

5. Mode 5 -AUTO STOP WITH CANCEL

Buzzer does not sound at the end of a cycle that runs to completion - it only sounds if the cycle is cancelled. (as shown)

PB1		↓			
DISPLAY	TIME	COUNTDOWN			TIME
LED1					
LED2					2 SEC
BZ		CHIRP			
RLY	OPEN	CLOSED			OPEN

MODE 5 - CHART 1 — AUTO STOP WITH NO CANCELLATION

2 SEC.

PB1		↓		↓		↓
DISPLAY	TIME	COUNTDOWN		LAST TIME FLASHING		TIME
LED1						
LED2						
BZ		CHIRP		2 sec.		CHIRP ††
RLY	OPEN	CLOSED		OPEN		

MODE 5 - CHART 2 — AUTO STOP WITH A CANCELLATION

6. EARLY LED2

Identical to mode 1 except the behaviors of LED1 and LED2 are reversed from mode 1. See mode 1 for written description.

PB1								
DISPLAY	TIME 1		COUNTDOWN				OVERRUN	TIME 1
LED1								
LED2				EARLY TIME				
BZ		CHIRP			2 SEC.			
RLY	OPEN		CLOSED				OPEN	

MODE 6 - CHART 1 - EARLY LED2

PB1						2 SEC.		
DISPLAY	TIME 1		COUNTDOWN			LAST TIME FLASHING		TIME 1
LED1								
LED2				EARLY TIME				
BZ		CHIRP		2 SEC		2 SEC		CHIRP
RLY	OPEN		CLOSED			OPEN		

MODE 6 - CHART 2 - EARLY LED2 WITH CANCELLATION

PB1					
DISPLAY	00:00		COUNTUP		00:00
LED1					
LED2					
BZ		CHIRP		CHIRP	
RLY	OPEN		CLOSED		OPEN

MODE 6- CHART 3 — COUNT UP

7. Mode7 - GUARD DUTY

- Counts down but the time is reset to the starting value if PB1 is pressed anytime before the end of a cycle. If time elapses then LED2 and relay activate. (this is like the doomsday counter on the TV show "Lost") Cycle cannot be stopped except by disconnecting power.

- Setting "early warning" is the same as other modes. See mode 1 for details.

									MISSED		
PB1		↓		↓		↓			⬭	↓	
DISPLAY	TIME	††		††		FULL COUNTDOWN			OVERUN		
LED1			✤		✤		✤				
LED2											
BZ		CHIRP		CHIRP		CHIRP					CHIRP
RLY	OPEN								CLOSED	OPEN	

MODE 7 - GUARD DUTY

††   PARTIAL COUNTDOWN

✤   EARLY WARNING

8. Mode 8 - SPRAY RINSE

• Designed to activate a spray rinse at the end of a cycle. If contact with a N.O proximity sensor is closed the cycle starts. The sensors will be connected to PB input.

• When a time cycle is activated, the relay close is delayed by TIME2, then relay closes for TIME1.

• TIME2 is set in the same way as the "early warning" in mode 1. (Hold down all three buttons etc.)

• Display should be in seconds:hundredths (so the maximum time possible is 99:99 sec.)

• After programming, the default times should be TIME2= 1.00 seconds, TIME1= 5.00 seconds.

• There is no need to change to another resolution other than seconds/hundredths such as hours/mins by removing jumper A from the pins.   Therefore there is a vacant mode 9 if jumper A is off the pins for future use.

PROX								
DISPLAY	TIME 1			TIME 2 - C.D.		TIME1 - C.D.		TIME 1
LED1								
LED2								
BZ		CHIRP		CHIRP				CHIRP
RLY	OPEN					CLOSED		OPEN

MODE 8 - CHART 1

9. Mode 9 - MACHINE RUN TIME

- Purpose: to track running hours on a machine.
- Counting starts when triggered by MSw, stops when MSw is off. (chart 9.1)
- Counting can also be controlled by presence/absence of power. (chart 9.2)
- PB1 immediately resets time. (like guard duty cycle #7)
- If time starts at zero, then it counts up with no alarm. In this case there is no alarm to silence, so PB1 resets time only.
- Time can be also reset *before* the countdown has elapsed.
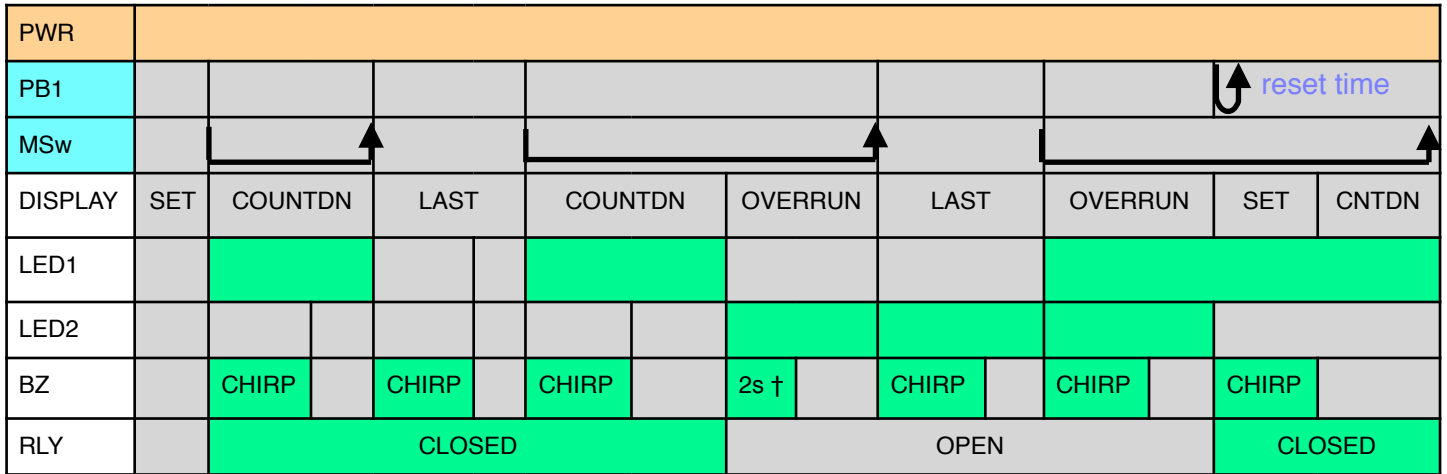- This will only be used with line power. (not 9V battery)

PWR										
PB1									↱↑ reset time	
MSw		⌐→↑		⌐→→→↑			⌐→→→↑			↑
DISPLAY	SET	COUNTDN	LAST	COUNTDN	OVERRUN	LAST	OVERRUN		SET	CNTDN
LED1		🟩		🟩			🟩			
LED2					🟩	🟩	🟩			
BZ		CHIRP	CHIRP	CHIRP	2s †	CHIRP	CHIRP		CHIRP	
RLY		CLOSED			OPEN				CLOSED	

CHART 9.1 - Machine runtime.

† 500ms BZ chirp every 5 minutes after countdown is complete, while unit is counting. (not while idle)

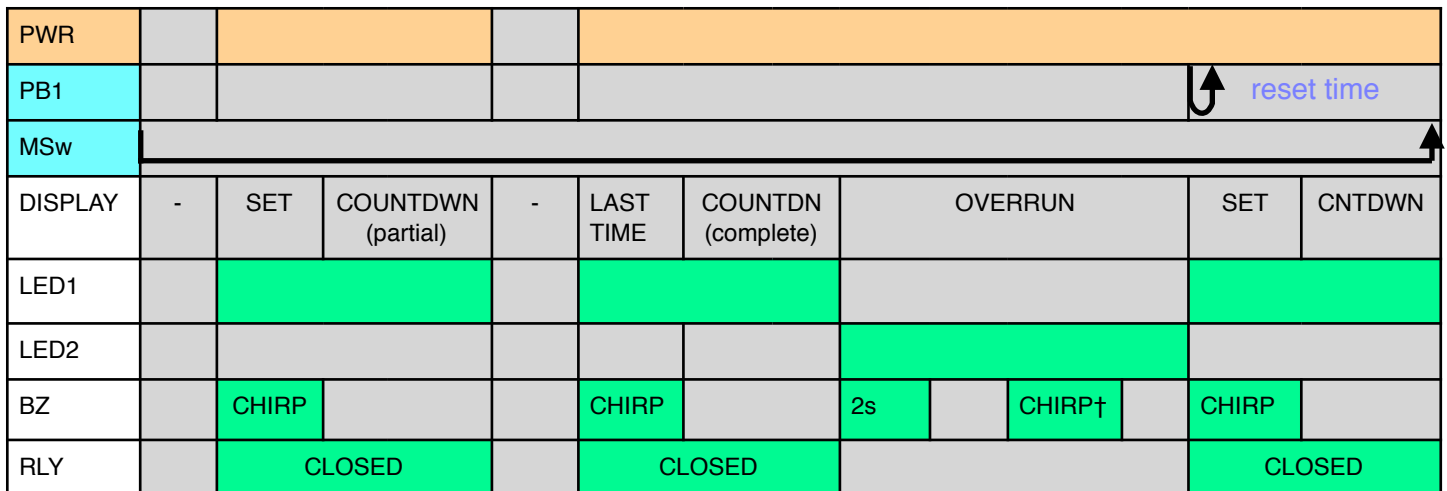| PWR		🟧		🟧						
PB1									↱↑ reset time	
MSw	⌐→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→→↑									
DISPLAY	-	SET	COUNTDWN (partial)	-	LAST TIME	COUNTDN (complete)	OVERRUN		SET	CNTDWN
LED1		🟩			🟩					🟩
LED2							🟩			
BZ		CHIRP			CHIRP		2s	CHIRP†	CHIRP	
RLY		CLOSED			CLOSED				CLOSED	

CHART 9.2 - Machine runtime - intermittent power

† 500ms BZ chirp every 5 minutes after countdown is complete, while unit is counting. (not while idle)

10. Mode 10 ON-DELAY

- Ability to set a delay time before countdown cycle begins.
- Delay is programed by holding down 3 buttons (PB1, PB2, PB3) for 5 seconds. (like programming the "early warning" in mode 1 and 6.
- When cycle starts, set time displays, and the "chaser dots" on the bottom of the screen activate (left to right) until the programmed delay is over, then countdown begins as normal.
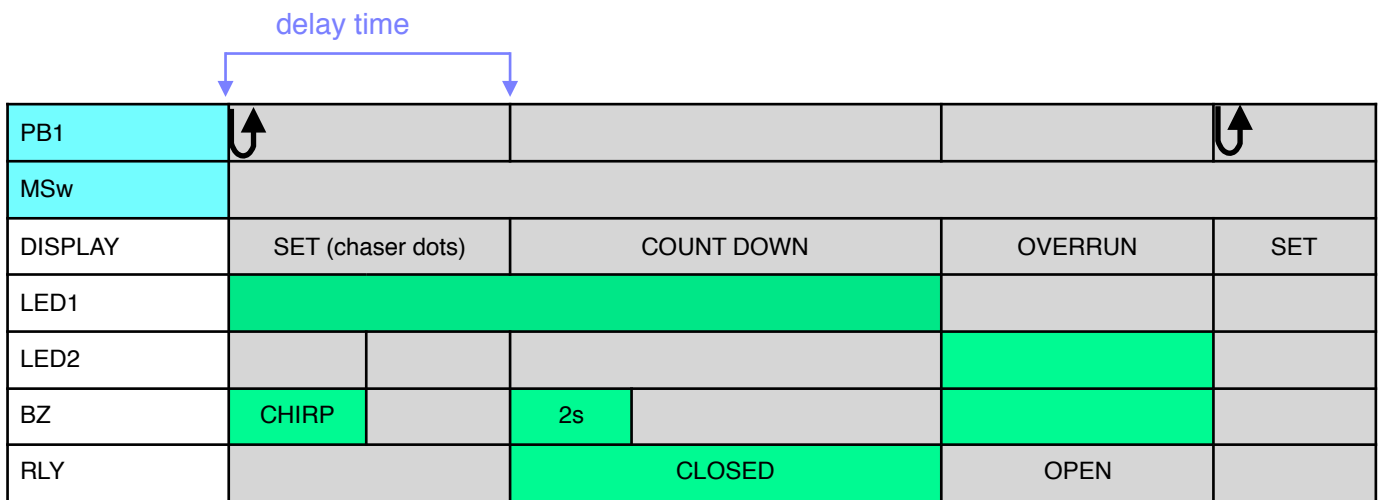- Cancel cycle by holding PB1 down 2s..
- MSw not used.

delay time

PB1	↻					↻
MSw						
DISPLAY	SET (chaser dots)		COUNT DOWN		OVERRUN	SET
LED1						
LED2						
BZ	CHIRP		2s			
RLY			CLOSED		OPEN	

CHART 10.1 - CYCLE 10 COMPLETE CYCLE

delay time

long press to cancel

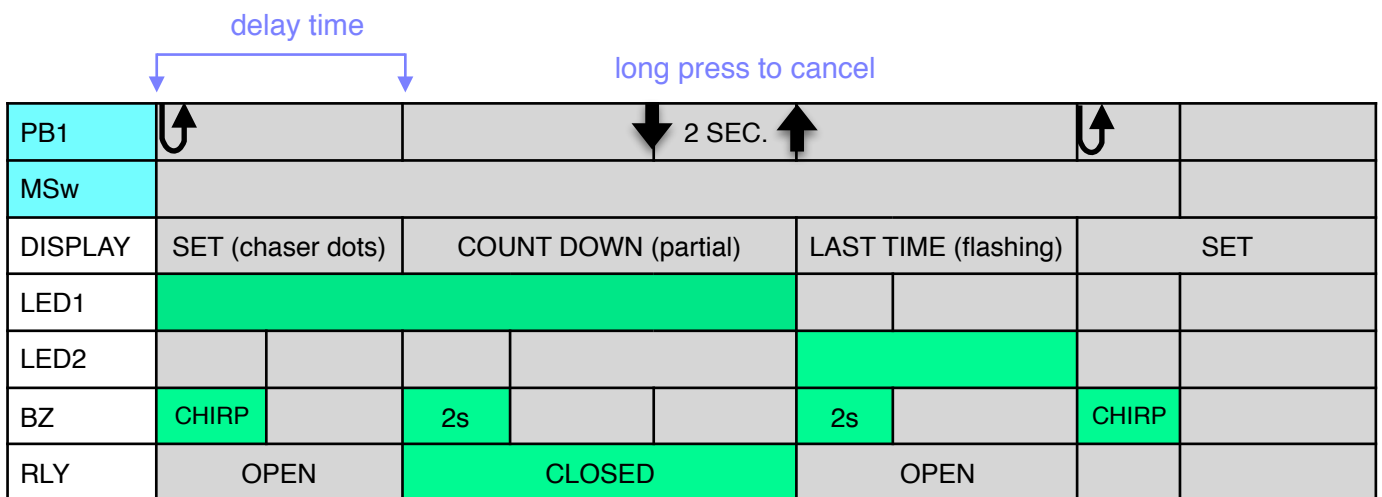|						
PB1	↻		2 SEC.		↻	
MSw						
DISPLAY	SET (chaser dots)	COUNT DOWN (partial)		LAST TIME (flashing)		SET
LED1						
LED2						
BZ	CHIRP		2s		2s		CHIRP	
RLY	OPEN		CLOSED		OPEN		

CHART 10.2 - CYCLE 10 WITH CANCELLATION