RED LION CONTROLS

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SUB-CUB-T - COMPLETE 5 1/2-DIGIT COMPONENT TIMER/COUNTER

- *LSI TIMER/COUNTER CHIP WITH CRYSTAL CONTROLLED OSCILLATOR AND 0.35" (9 mm) HIGH LCD DISPLAY*

- *SNAP MOUNTS DIRECTLY ONTO P.C. BOARD*

- *SOLDERLESS, ELASTOMERIC INTERCONNECTS*

- *ULTRA LOW POWER, 15 µA @ 5.0 VDC TYPICAL*

- *TIMES IN HOURS, 0.1 HOURS, 0.01 HOURS, AND 0.1 MINUTES*

- *COUNTS IN X1, ÷10, ÷100, AND ÷1000*

- *DEBOUNCE SELECTABLE IN COUNTER MODES*

- *COUNT RATES UP TO 500 KHz*

- *ANNUNCIATOR TO INDICATE TIMER RUNNING*

- *ACCEPTS AC VOLTAGE ON SIGNAL INPUT DIRECTLY THROUGH INPUT RESISTOR*

DESCRIPTION

As a completely self-contained timer/counter/display module, the SUB-CUB-T can be treated as a component, just like any other I.C. The module contains a low power integrated circuit *(that performs all of the timing and counting functions),* a 32.768 KHz quartz crystal *(which provides a stable time reference)* and a 5 1/2-digit LCD readout. The SUB-CUB-T has 4 Control inputs which when set either high or low, determine the mode of operation. The BP and WINK outputs can be used to select either no decimal point, or a decimal point in the first or second position. The SIGNAL input is used to activate the timer *(when in the timing modes)* or to increment the counter *(when in the counting modes).*

The SUB-CUB-T is ideal for internal *"on board"* applications where a readout of elapsed time or count is needed within a circuit enclosure for maintenance, diagnostic, or other data readout requirements. It can also be mounted with a convenient bezel kit to provide a very flexible and economical panel instrument.

The SUB-CUB-T snap-mounts directly onto any 1/16" P.C. Board that has been etched to provide a mating interconnect pad pattern with two mounting holes and a polarizing *"key"* hole. Interconnections to the P.C. Board, as well as the internal connections, are made with elastomeric connectors that provide a corrosion-proof, gas-tight, interface contact for high reliability.

MOUNTING & DIMENSIONS

Snap-in mounting onto P.C. Board is facilitated by two, split, lock-ramp pins which engage mounting holes drilled into the P.C. Board. The silicone rubber elastomeric connectors compress to accommodate P.C. Board thickness variation of ±0.005".

DIMENSIONS
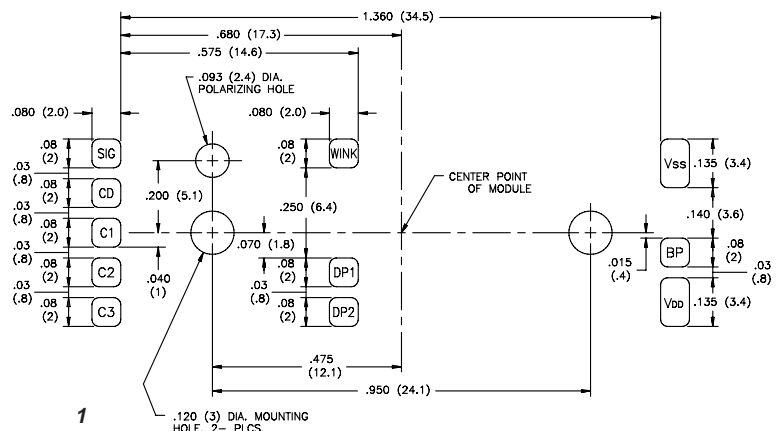*In Inches (mm)*
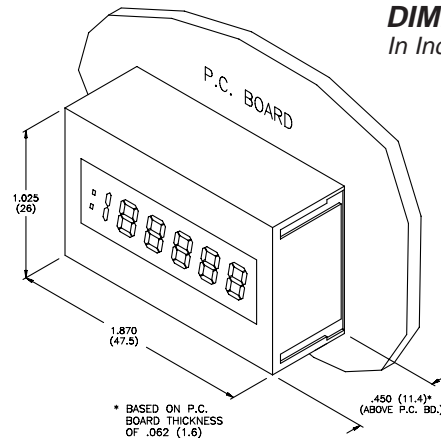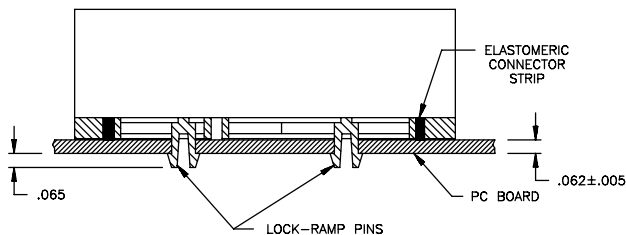
P.C. BOARD LAYOUT

P.C. Board pads may be gold or tin-lead plated. Pad surface must be flat without excessive tin-lead build-up. *(Layout view is from SUB-CUB-T mounting side of board.)*

Pad area must be clean and free of contaminants so that proper electrical contact can be made.

Note: All hole size tolerances ±0.003" (0.08 mm)
   All other tolerances ±0.005" (0.13mm)

DEVICE CONNECTIONS *

SIG - CMOS input with series 4.7 K resistor.

    Timer Modes - SUB-CUB-T accumulates time when SIG is at V_{DD}, SUB-CUB-T stops timing when SIG is at V_{SS}.

    Counter Modes - SUB-CUB-T increments a count on the rising edge of the SIG input.

C0-C3 - CMOS latched inputs. These inputs select the mode of operation of the SUB-CUB-T. Refer to "MODE SELECTION".

WINK - CMOS output. Connect this output to either DP1 or DP2 input to enable a decimal point.

DP1 - LCD input. Connect this input to the WINK output to enable the first position decimal point. Connect to BP to disable this decimal point.

DP2 - LCD input. Connect this input to the WINK output to enable the second position decimal point. Connect to BP to disable this decimal point.
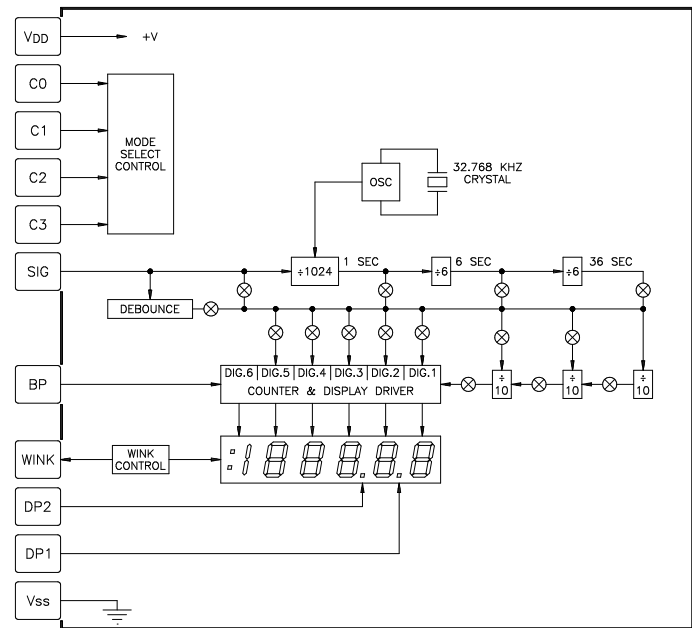
BP - CMOS output. Connect this output to either DP1 or DP2 to disable a decimal point.

V_{DD} - 2.5 to 5.5 VDC supply.

V_{SS} - Common for D.C. Supply and Inputs.

* All unused inputs must be tied to V_{SS} or V_{DD}, whichever is appropriate.

BLOCK DIAGRAM

CAUTION

    This device contains CMOS circuitry which requires special anti-static handling to the same degree required by standard CMOS integrated circuits. Units should be stored in the conductive packaging used to ship the devices. Containers should be opened and units handled only on a conductive table top by personnel wearing wrist-strap grounding equipment. These devices have the same protection circuits as standard CMOS devices to prevent damage to inputs due to nominal over-voltage.

MAXIMUM RATINGS (VOLTAGE REF. TO V_{SS})

RATING	SYMBOL	VALUE	UNIT
DC Supply Voltage	V_{DD}	6.0	V
Input Voltage, All Inputs except SIG	V_I	-0.3 to (V_{DD} +0.3)	V
Input Voltage, SIG Input only	V_{IS}	9.7	VAC or DC
Operating Temperature*	T_A	-35 to +85	°C
Storage Temperature	T_{STG}	-35 to +85	°C
* Extended high and low temperature ranges available, consult factory.			

ELECTRICAL CHARACTERISTICS V_{DD} = 5 V ±10% UNLESS OTHERWISE SPECIFIED

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
V_{DD}	Supply Voltage	2.5		5.5	V	
I_{DD}	Supply Current			15.0	µA	
V_{IH}	Input High Voltage	3.5		9.7	V	*
V_{IL}	Input Low Voltage			1.5	V	
I_{SS}	Signal Input Current			3.0	µA	Signal @ V_{DD} or V_{SS}
ICO	Control Input Current		1.0	90	µA	** C0-C3 @ V_{DD} or V_{SS}
FLS	Count Speed w/Debounce		30	40	Hz	Modes 4, 6, 8, & 10.
FHS	Count Speed w/o Debounce	100	500		KHz	Modes 5, 7, 9, & 11.
TRS	Reset Pulse Width		5	10	µS	
T_{ACC}	Timer Accuracy			0.05	%	All time ranges.

  * An internal 4.7 K series resistor will protect the SIG input from input voltages up to 9.7 V AC or DC (w/V_{DD} = 5.0). At higher input voltages, an external resistor should be used to limit the input current to less than 1 mA.

  ** Inputs C0-C3 are latched internally and will draw little or no current after switching. During switching, a 90 µA peak current may be drawn for up to 10 nS.

MODE SELECTION

The SUB-CUB-T can be programmed to operate in one of four timing modes or in one of eight counting modes. Mode selection is accomplished by connecting the four CONTROL inputs *(C0, C1, C2, & C3)* to the appropriate voltage level *(Where 0 = V_{SS}, and 1 = V_{DD})*. Refer to the chart below.

MODE	C3	C2	C1	C0	MODE DESRIPTION
0	0	0	0	0	Hours Timer
1	0	0	0	1	0.1 Hours Timer
2	0	0	1	0	0.01 Hours Timer
3	0	0	1	1	0.1 Minutes Timer
4	0	1	0	0	X1 Counter w/Debounce
5	0	1	0	1	X1 Counter w/o Debounce
6	0	1	1	0	÷10 Counter w/Debounce
7	0	1	1	1	÷10 Counter w/o Debounce
8	1	0	0	0	÷100 Counter w/Debounce
9	1	0	0	1	÷100 Counter w/o Debounce
10	1	0	1	0	÷1000 Counter w/Debounce
11	1	0	1	1	÷1000 Counter w/o Debounce
12	1	1	0	0	
13	1	1	0	1	Factory Test Modes
14	1	1	1	0	
15	1	1	1	1	Reset Mode *

* The reset mode (Mode 15) can be used to reset the Timer/Counter to 0. The SUB-CUB-T should NOT be left in this mode for longer than a few seconds; otherwise damage to the LCD may result.

TIMER OPERATION

The SUB-CUB-T can be programmed to operate in one of four time intervals *(See Mode Selection Chart)*. When operated as a timer, the SUB-CUB-T display will show *"00000"* when initially reset. The SUB-CUB-T will start to accumulate time at the selected time interval when the SIG input is connected to V_{DD}. The COLON LCD segments will flash at a 1 Hz rate for the period of time that SIG is held high. When the LCD display reaches 99999, the display will increment to 100000. A maximum display of 199999 can be displayed. On the next time interval, the display will wrap around to 00000.

COUNTER OPERATION

The SUB-CUB-T can be programmed to operate in one of eight count modes; four modes with debounce and four modes without debounce *(See Mode Selection Chart)*. When operated as a counter, the SUB-CUB-T will reset to 00000 and will increment on the rising edge of the SIG input. A maximum of 199999 counts can be displayed before the SUB-CUB-T wraps around to 00000.

DECIMAL POINT SELECTION

The SUB-CUB-T is capable of displaying a decimal point in either the first position or the second position, as well as no decimal point. If selected, the decimal point will flash at a 1 Hz rate *(along with the LCD COLON)* in all timer modes while the SIG input is activated. When the SIG input is de-activated, the selected decimal point will remain *"ON"*. Use the following table to determine the proper connections for the desired decimal point position.

DISPLAY	DP2	DP1
00000	CONNECT TO BP	CONNECT TO BP
0000.0	CONNECT TO BP	CONNECT TO WINK
000.00	CONNECT TO WINK	CONNECT TO BP

TYPICAL APPLICATION

AC MOTOR RUN TIME

An equipment manufacturer is interested in knowing the total run time of a motor for service purposes. The timer must be capable of operating directly from the power line and must be able to record time in 1/10 hour increments.

The SUB-CUB-T can be used in this application. Since the SUB-CUB-T can accept either an AC or DC signal input, no blocking diodes are required. To protect the SIG input from damage due to overvoltage, R1 is used to limit the input current to less than 1 mA.


TYPICAL APPLICATION
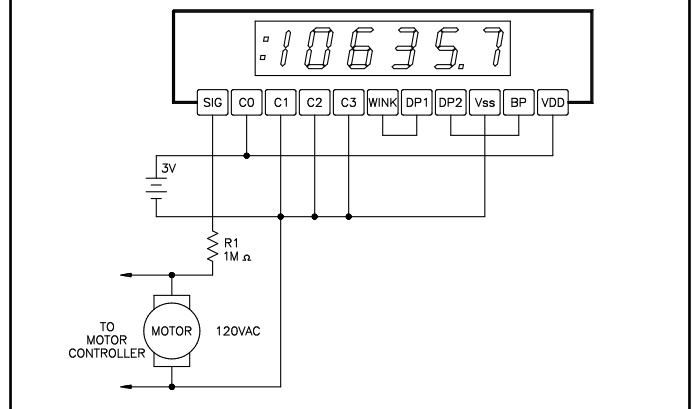
PORTABLE PARTICAL COUNTER WITH ELAPSED TIME INDICATOR

An equipment builder has been contracted to supply a hand-held device which is capable of measuring and recording both partical counts and sample time. The partical counts should be measured in units of 1,000. The counter should be able to accept a signal rate of up to 1,000 counts per second. An elapsed time indicator measuring time in 1/100 of hours is needed to report the length of sampling time. A RUN switch should enable both the counter and the timer. A common RESET switch should clear both units. Both devices must be able to operate from a 4.5 VDC battery pack and must consume a minimum of power to prolong battery life.

The SUB-CUB-T can be used to satisfy both requirements. The COUNTER should be operated in the *"÷1000 Count w/o Debounce"* mode *(Mode 11)*. The 0 to 4.5 VDC output pulse of the Partical Sensor can be

connected directly to the counter input. Both DP1 and DP2 are connected to the BP output to disable the decimal points. The TIMER should be operated in the *"0.01 Hours"* mode *(Mode 2)*. The SIG input is enabled when the RUN switch is closed. The 100 K pull-down resistor will disable the SIG input when the RUN switch is opened. The value of this resistor is kept high to reduce power consumption. DP2 is enabled by connecting it to the WINK output. DP1 is disabled by connecting it to the BP output. Both the COUNTER and the TIMER are cleared by pressing the RESET button. This will place the SUB-CUB-T's in the RESET mode *(Mode 15)*. When the RESET switch is opened, both units will return to their normal modes of operation.
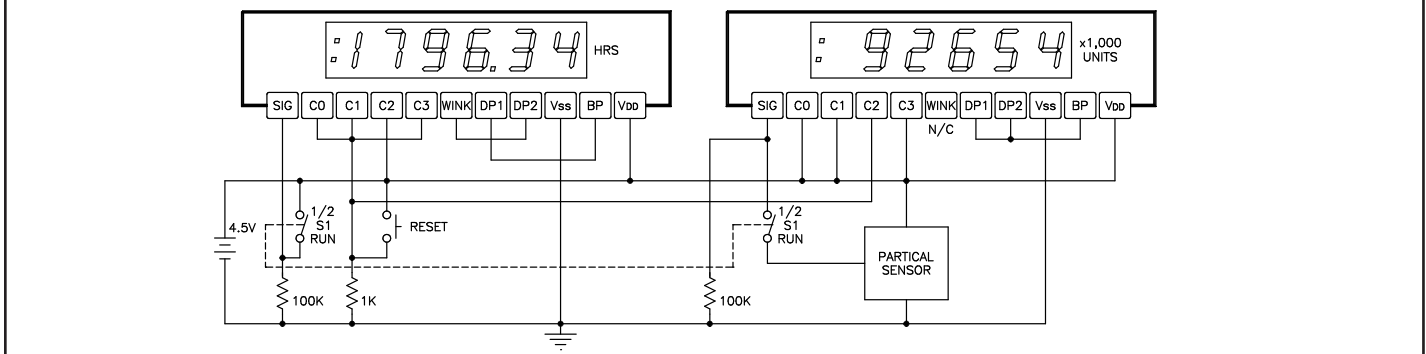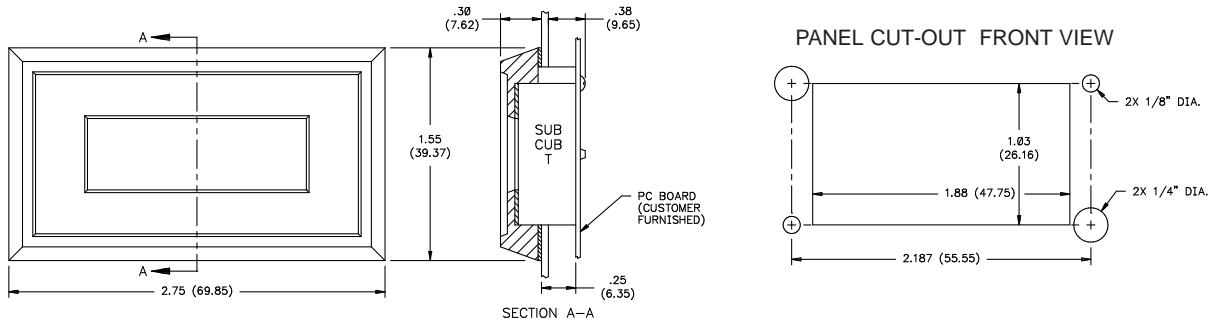
PANEL BEZEL KIT FOR THE SUB-CUB-T (P/N HWK60000)

This kit provides a convenient way to adapt the SUB-CUB-T for panel mounting. The kit includes the black plastic bezel, the panel and internal window gaskets, P.C. Board, 12" ribbon cable and mounting screws.
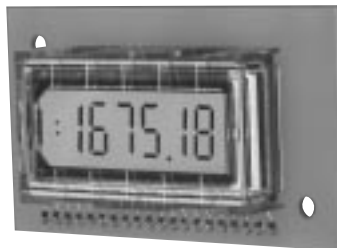
ASSEMBLY
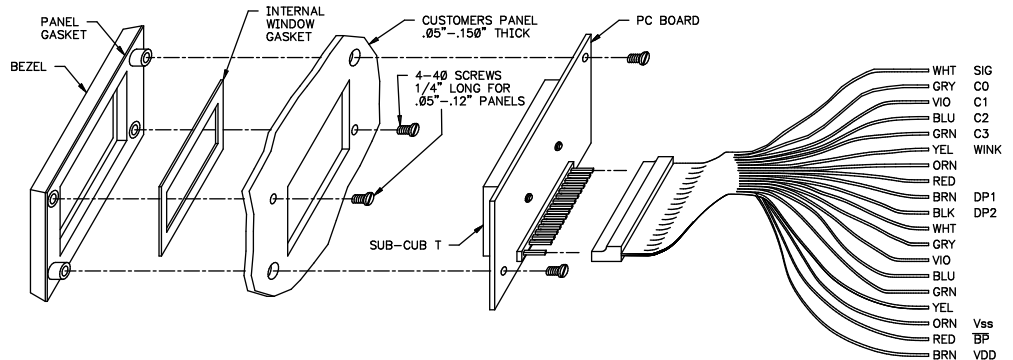
DIMENSIONS & PANEL CUT-OUT   "In inches (mm)

SUB-CUB-T PROTOTYPING BOARD (P/N DMOSCB04)

This board is a handy way of doing experimental and prototyping work with the SUB-CUB-T. It easily plugs onto standard 0.1" spacing bread boards. This in turn, greatly simplifies bread board work.

SUB-CUB-T
PROTOTYPING
BOARD
P/N DMOSCB04

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
SCUBT	SUB-CUB Timer/Counter Module	SCUBT200
HWK 3	*Panel Bezel Kit w/o P.C. Board & Cable	HWK30000
HWK 6	*Panel Bezel Kit w/ P.C. Board & Cable	HWK60000
-	Prototype P.C. Board	DMOSCB04
* Does not include SUB-CUB-T Display/Timer Module. Order SUB-CUB-T separately.		