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Bulletin No. SUB2-D
Drawing No. LP0777
Released 12/13

SUB-CUB 1/2 - COMPLETE 6-DIGIT COMPONENT COUNTERS

APPLICATIONS INCLUDE:

- VENDING MACHINES
- VIDEO GAMES
- COMPUTERS
- UTILITY METERS
- OFFICE COPIERS
- P.C.'S
- FLOW METERS
- TEST EQUIPMENT
- DISPENSING EQUIP.
- MACHINE CONTROLS
- MEDICAL EQUIPMENT
- PORTABLE INSTRUMENTS

* ACCESSORY HARDWARE AVAILABLE FOR PANEL MOUNTING SUB-CUB 2

- LSI COUNTER CHIP WITH LCD DISPLAY
- SNAP MOUNTS DIRECTLY ON P.C. BOARD

- *SUB-CUB 1 - 0.2" (5 mm) HIGH DISPLAY*
- *SUB-CUB 2 - 0.35" (8.9 mm) HIGH DISPLAY*
- *SOLDERLESS, ELASTOMERIC INTERCONNECTS*
- *ULTRA-LOW POWER*
  5 V: SUB-CUB 1 AND 2
  3.3 V: SUB-CUB 1 ONLY
- *LATCHABLE DISPLAY WITH LEADING ZERO BLANKING*
- *COUNT RATES TO 10 KHz*
- *IDEAL IN APPLICATIONS FOR:*
  REGISTER, STATUS & USAGE COUNTING
  FREQUENCY, EPUT, & RPM INDICATION
  TIMER, PULSE-WIDTH & PERIOD READOUT

DESCRIPTION

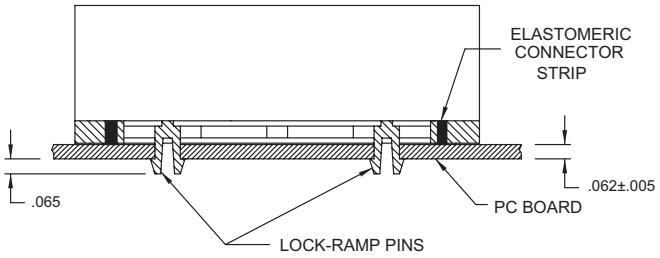
As a completely self-contained counter/display module, SCUB1/SCUB2 (5 V) and SCUB1LV (3.3 V) can be treated like an I.C. The module contains a custom counter/driver chip that performs all the counting functions together with a 6-digit LCD readout. The latchable display with the separate reset function permits the module to be used as frequency or rate meter, timer, phase-angle or pulse width indicator and for other complex readout requirements in addition to simple high speed counting.

The module is ideal for internal *"on-board"* applications where a readout of count, frequency, time, etc. is needed within a circuit enclosure for maintenance, diagnostic, tune-up, or other data readout requirements. The SUB-CUB 2, with its larger display, can also be mounted with the convenient bezel kit to provide a very flexible and econmical panel instrument.

SUB-CUBs snap-mount directly on 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 internal connections are made with elastomeric connectors that provide corrosion-proof, gas tight, interface contacts for high reliability.

MOUNTING & DIMENSIONS

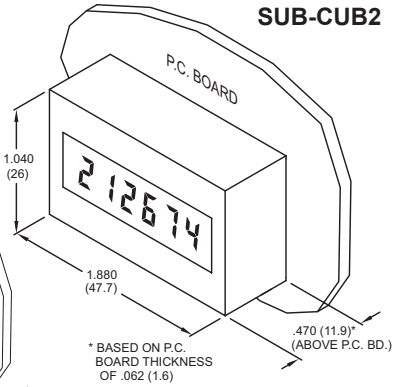
Snap in mounting on the P.C. Board is facilitated by two, split, lock-ramp pins which engage mounting holes drilled in the P.C. Board. The silicone rubber elastomeric connectors compress to accommodate P.C. Board thickness variation of ±0.005" *(0.13 mm)*.



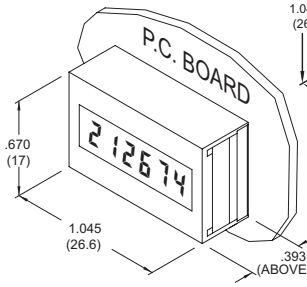
DIMENSIONS

In Inches (mm)

SUB-CUB2



SUB-CUB1

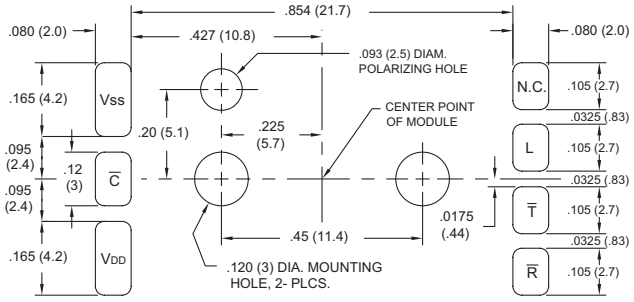


P.C. BOARD LAYOUT

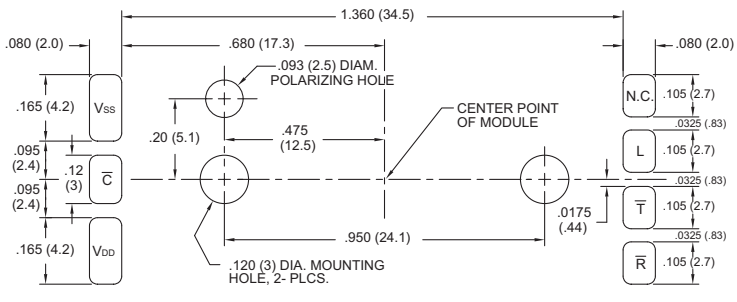
P.C. Board pads may be gold or tin-lead plated. Pad surface must be flat without excessive tin-lead build-up. *(Layout views are from SUB-CUB mounting side of board.)*

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

All other tolerances ±0.005" (0.13 mm)



SCUB1/SCUB1LV



SCUB2

DEVICE CONNECTIONS *

COUNT ($\overline{C}$) - CMOS, Schmidt Trigger; counter increments on negative going transition.

RESET ($\overline{R}$) - CMOS, Schmidt Trigger; counter is reset to zero when input is low. Counter should always be reset to zero whenever power is first applied to the unit.

LATCH (L) - CMOS, Schmidt Trigger; when pulled low, the latches are transparent and display is updated as new counts are received. When latch input is pulled high, the display registers count existing immediately prior to activating the latch.

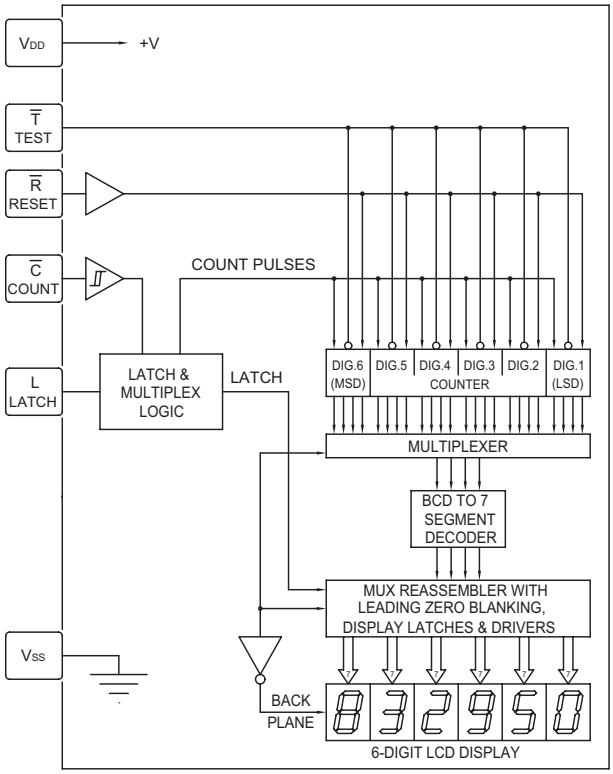
TEST ($\overline{T}$) - CMOS, Schmidt Trigger; Input must be connected to V_{DD}. This input is used by manufacturer during factory testing.

V_{DD} - +VDC Supply.

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

* All unused inputs must be tied to either V_{DD} or V_{SS}, 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}	-0.5 to +5.25	VDC
Input Voltage, All Inputs	V_I	-0.5 to (VDD +0.5)	VDC
Operating Temperature	T_A	-35 to +85	°C
Storage Temperature	T_{STG}	-35 to +85	°C

ELECTRICAL CHARACTERISTICS V_{DD} TYP, 25 °C UNLESS OTHERWISE SPECIFIED

SYMBOL	PARAMETER	UNIT	TEST CONDITION	SCUB1/SCUB2			SCUB1LV		
				MIN.	TYP	MAX	MIN.	TYP	MAX
V_{DD}	Supply Voltage	VDC		3.5	5.0	5.25	2.7	3.3	3.6
I_{DD}	Supply Current	µA	10 KHz Count Rate		55			30	
I_{DDQ}	Quiescent Current	µA	0 on display		45			20	
V_{IH}	Input High Voltage	VDC		2.45		3.675	1.89		2.52
V_{IL}	Input Low Voltage	VDC		1.575		2.3625	1.215		1.62
I_{IL}	Input Leakage Current	µA	$V_{DD} \geq V_{IN} \geq V_{SS}$		0.01			0.01	
Frequency	Count Frequency	KHz		10			10		
T_{RST}	Reset Pulse Width	µsec		25			25		
T_{LATCH}	Latch Pulse Width	µsec		25			25		

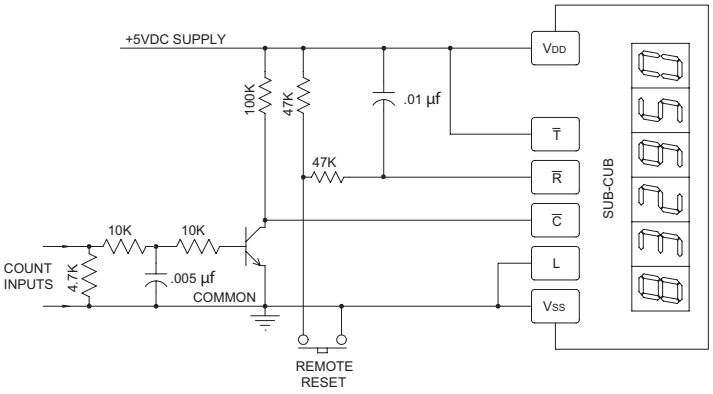
TYPICAL APPLICATIONS

COUNT & CONTROL FROM REMOTE INPUTS

Inputs to SUB-CUB are CMOS inputs and must be adequately buffered if remote *"off-board"* signal sources are used. This illustration shows a SUB-CUB being used in an elementary counting application to depict some of the buffering methods that can be used.

The Count Input is buffered by the NPN Transistor input circuit. The base resistance is split into two 10 K resistors, with a filter cap to eliminate spurious counts due to electrical interference pickup. The filter network will allow count rates to 10 KHz with Symetrical +5 V input count pulses. The 4.7 K across the input would not be required if the circuit supplying the count pulses has a low off-state output impedance.

The Remote Button-actuated Reset input is buffered by a simple RC circuit consisting of two 47 K resistors and a 0.01 µf capacitor.



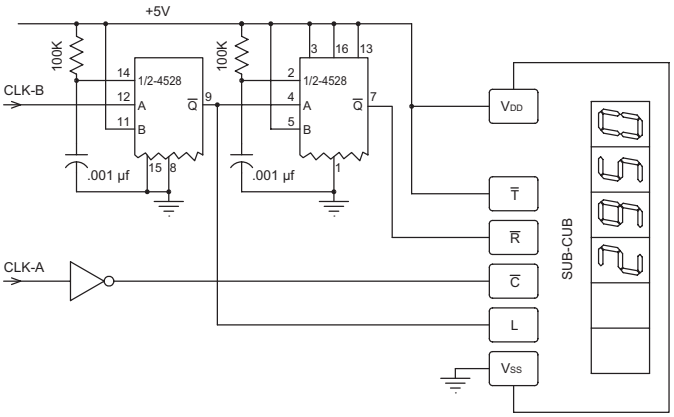
FREQUENCY, SPEED, FLOW, SPEED-RATIO, PERIOD & CYCLE TIME INDICATIONS

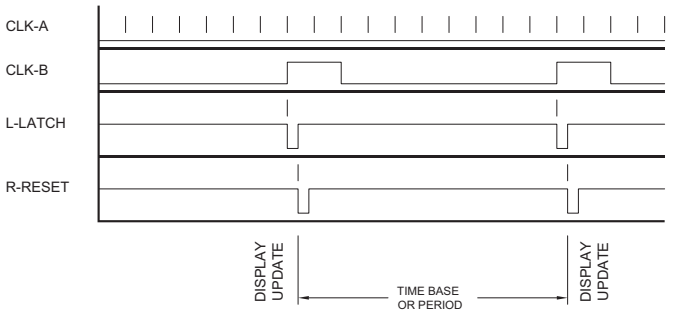
This circuit uses a dual monostable I.C. to generate the proper latch and reset coordination required for frequency or time-period readouts.

When frequency readout is desired, the pulse train whose frequency is to be displayed, is applied to the CLK-A input, *(the inverter, in the CLK-A input, causes the SUB-CUB to increment on the positive going edge of CLK-A pulses and can be onitted if negative edge incrementing is satisfactory).* The CLK-B input is supplied with standard time-base pulses whose period determines the measuring time. For frequency measurement, this time is 1 second so CLK-B input would be supplied with 1 pulse/sec. from a crystal clock or line-reference divider. At the positive going edge of each CLK-B pulse, the first monostable opens the SUB-CUB latch momentarily to update the display to the count existing at that instant of time. Immediately after the latch closes, freezing the updated count on the display, the internal counter in the SUB-CUB display is reset to zero in preparation for a new counting cycle. Thus, at the end of each measuring time interval the SUB-CUB display is updated to readout the number of pulses received during the period, while it is accumulating new counts for the next update.

Frequency ratio can be displayed by replacing the standard time-base *(CLK-B)* input with a pulse train related to the second variable *(or denominator)* of the ratio. Normally this pulse train is divided by 10, 100, or 1000 before being applied to the CLK-B input to provide a higher resolution reading.

For period or cycle-time indication, CLK-A and B inputs are simply interchanged. CLK-A input is now supplied with standard Clock Pulses, say 1 Hz to readout in seconds, while the pulse train whose period is being measured is applied to the CLK-B input.

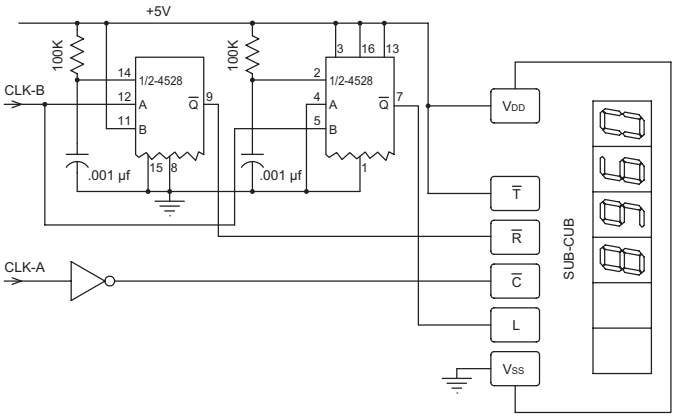




PULSE WIDTH OR DWELL-TIME READOUT

This circuit also uses two monostables, however for pulse-width readout they function at two different times.

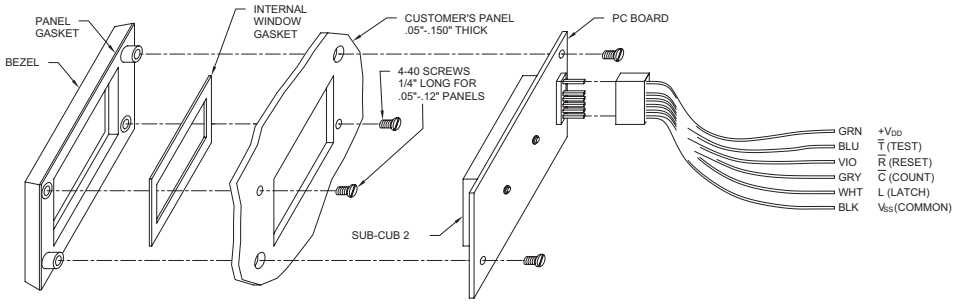
A train of standard clock pulses, whose period determines the readout increments, is applied to the CLK-A input. For example if readout in seconds is desired, CLK-A would receive 1 pulse/second, or 1 Hz The pulse whose width is to be measured is applied to CLK-B input. At the positive going edge of the CLK-B pulse, the first monostable momentarily resets the SUB-CUB internal counter to zero, and it then begins accumulating counts from the CLK-A time reference pulses. At the conclusion of the CLK-B pulse, the negative going edge momentarily opens the SUB-CUB display latch, and the number of time-reference pulses that have been counted, since reset, is latched on the display to provide a direct readout of CLK-B pulse-width.



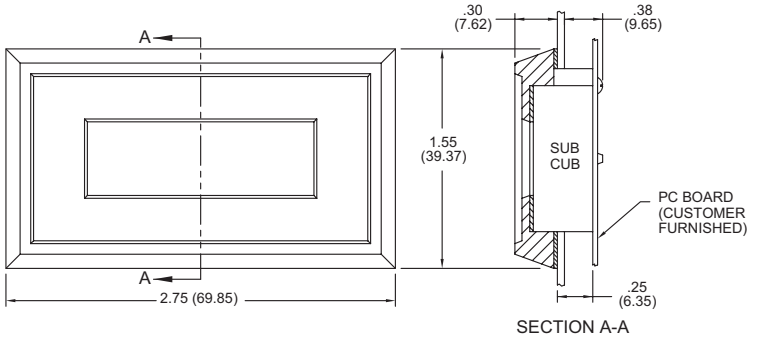
PANEL BEZEL KIT FOR THE SUB-CUB 2 (P/N HWK40000)

This kit provides a convenient way to adapt the SUB-CUB 2 to 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

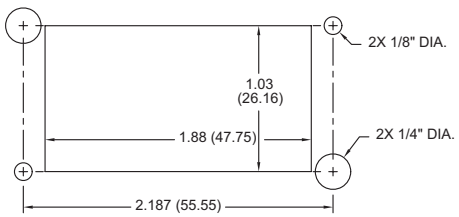


DIMENSIONS & PANEL CUT-OUT In inches (mm)



SECTION A-A

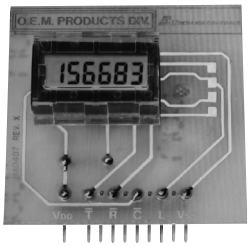
PANEL CUT-OUT FRONT VIEW

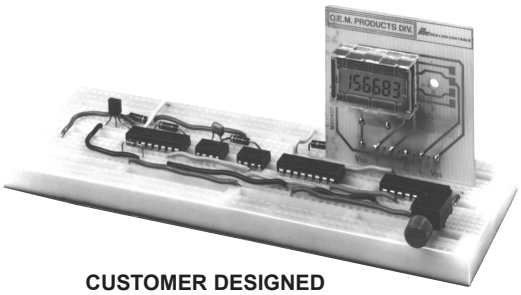


EVALUATION BOARD

The SUB-CUB evaluation board, DMOSCB02, can be used for bread board evaluation of the SCUB1 or SCUB2. The SCUB will mount directly to the evaluation board and all connections to the SCUB are made accessible via header pins. Note that the DMOSCB02 evaluation board does not include the SUB-CUB Display/Counter Module, which must be ordered separately.

SUB-CUB MOUNTING BOARD P/N DMOSCB02





CUSTOMER DESIGNED BREAD BOARD

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
SCUB1	SUB-CUB 1 Display/Counter Module	SCUB1000
SCUB1LV	SUB-CUB 1 Low Voltage Display/Counter Module	SCUB1LV0
SCUB2	SUB-CUB 2 Display/Counter Module	SCUB2000
HWK 4	*SUB-CUB 2 Panel Bezel Kit with P.C. Board & Cable	HWK40000
HWK 3	*SUB-CUB 2 Panel Bezel Kit w/o P.C. Board & Cable	HWK30000
	SUB-CUB Mounting P.C. Board	DMOSCB02
* SUB-CUB Evaluation Board Does Not Include SUB-CUB Dislay/Counter Module. Order SUB-CUB Module Separately.		

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