Kit 36. 4 1/2 DIGIT COUNTER

This Kit is designed to be a building block where a counter is required as part of a larger system. The Harris 7224 IC and a liquid crystal display driven by it form the main part of the system. All of the pins available in the 7224 have been brought out for easy connection for any required purpose such as a counter or frequency meter.

The display has been constructed so that it may be cut off and located away from the main circuit board connected by flat ribbon cable. The PCB has a printed overlay on it so that the position of all the components is clearly indicated and construction only takes a few minutes.

Note that you should study the Data Sheet on the 7224 before you use the Kit. You can get it from

www.intersil.com

By making the Kit completely general purpose the input pins have not been buffered or protected so that it is relatively easy to damage the IC with out-of-range high input signals. Some hints are given below but it is up to you to design the necessary protection circuit on the input before you turn it on.

The kit is constructed on a single-sided printed circuit board (PCB). Protel Autotrax and Schematic were used to design the board.

ASSEMBLY INSTRUCTIONS

Assembly is a matter of following the overlay to tell you where to put the components. There are several important points to watch.

1. The LCD is mounted on two 40 pin IC sockets which you must cut apart using your side cutters. This allows the LCD to sit above the 7224 chip and save space. Make sure you get the LCD and the 7224 chip around the correct way. These two components should be the last items added to the PCB.

2. Note the 9 links to connect on top of the PCB. Six of the links are under the LCD and 7224.

CIRCUIT DESCRIPTION

The schematic diagram is shown in on the next page. To see if the Kit works connect STORE (pin 34) and LZBIN (pin 29) both to ground and then switch on the power supply. Touch the RESET to ground (the 0V on the terminal block.) The LCD should reset to zero.

STORE controls internal latches which transfer decoded display data from the count decoders to the display drivers. When pin 34 is pulled high (as in this circuit) the latches are transparent and the display updates in real time. If STORE is taken low then the last count value is latched and displayed while actual counting still continues. Taking STORE off low will update the displayed count as it is pulled high again by the pullup resistor.

COUNT/INHIBIT is used to stop the normal counting operation without the need to physically disconnect the COUNT input. Take it to ground to activate it in a similar way described in the previous paragraph for the STORE input. These signals can demonstrate the principle of how a frequency meter operates. Attach the Count input and Reset the system. After exactly one second take Count/inhibit to low (to stop the counter) then take Store to low (to freeze the number on the LCD.) The number on the display will show the frequency of the Count input between 1 Hz and 19,999 Hz. By using a crystal oscillator to measure the count in smaller time periods (0.1 seconds, 0.01 seconds) then higher frequencies can be measured. In addition some control logic can be added to put the decimal point in the right position. Such a frequency meter was published in Popular Electronics, 7/1992, p 53.

All the functional pins of the 7224 have been brought out for maximum flexibility in design. Large tracks and pads are used to make the Kit as robust as possible.

The Kit has its own 5V regulated supply on board for the 7224. This allows a relatively wide range of voltage inputs to the Kit from +6V to 10V secured into the terminal block. Make sure to connect them the correct way around. The +5V is made available at one of the connector pins.

Decimal Point. A jumper selects the decimal point or minus sign in the LCD. Displays are driven by applying a symmetrical square wave to the back plane (BP.) To turn on a segment a waveform 180^{o} out of phase with the BP (but of equal amplitude) is applied to that segment. To get the dp/- the external circuit inverts the BP output with an FET and applies it to the required input by the jumper. Pull down resistors in an SIL package are applied to the unused inputs. This is necessary if the counter is used in high static field environments.

Buffered Inputs. As mentioned in the Introduction by making the Kit completely general purpose the inputs to the 7224 have been left relatively unprotected. If input potential differences greater than 6.5V are applied to the inputs then damage to the IC may result. Simple input buffering circuits like that shown in Figure 2 should be connected to the RESET, COUNT INHIBIT and COUNT lines if inputs from sources operating on other power supply units are used. Inputs of a wide range of voltages (typically 2 to 20V) can then be applied. Of course these are inverting buffers so, for example, RESET must now be taken high to reset the unit.

WHAT TO DO IF IT DOES NOT WORK

Poor soldering is the most likely reason that the Kit will not work. Check all solder joints carefully under a good light. Next check that all components are in their correct

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position on the PCB. Thirdly, follow the track with a voltmeter to check the potential differences at various arts of the circuit. Did you add the 9 jumper links on top of the PCB? Is the battery fully charged?

WHAT TO LEARN FROM THIS KIT

The Kit shows how much of electronics today can be contained in a single chip. Many commercial low to medium cost frequency meters are nothing more than this kit, some switches and passive components and a plastic case. The main reason today for the failure of meters is more likely due to switch contact and mechanical failure rather than failure of the electronics itself.

Components

Resistors 5%, 1/4W	
100K brown black yellow	1
SIL1 100K resistor network	1
SIL2 100K resistor network	1
FET	1
78L05 regulator	1
2 pole terminal block	1
7224 IC	1
40 pin IC sockets	3
LCD VI-509-DP-RC	1
6 pin header & harness	1
10 pin dual header x 5 position	1
jumper	1
Kit 36 pcb	1
SPDT pcb-mounted switch	1
9V battery snap	1