Handy Dandy Little Circuits #34

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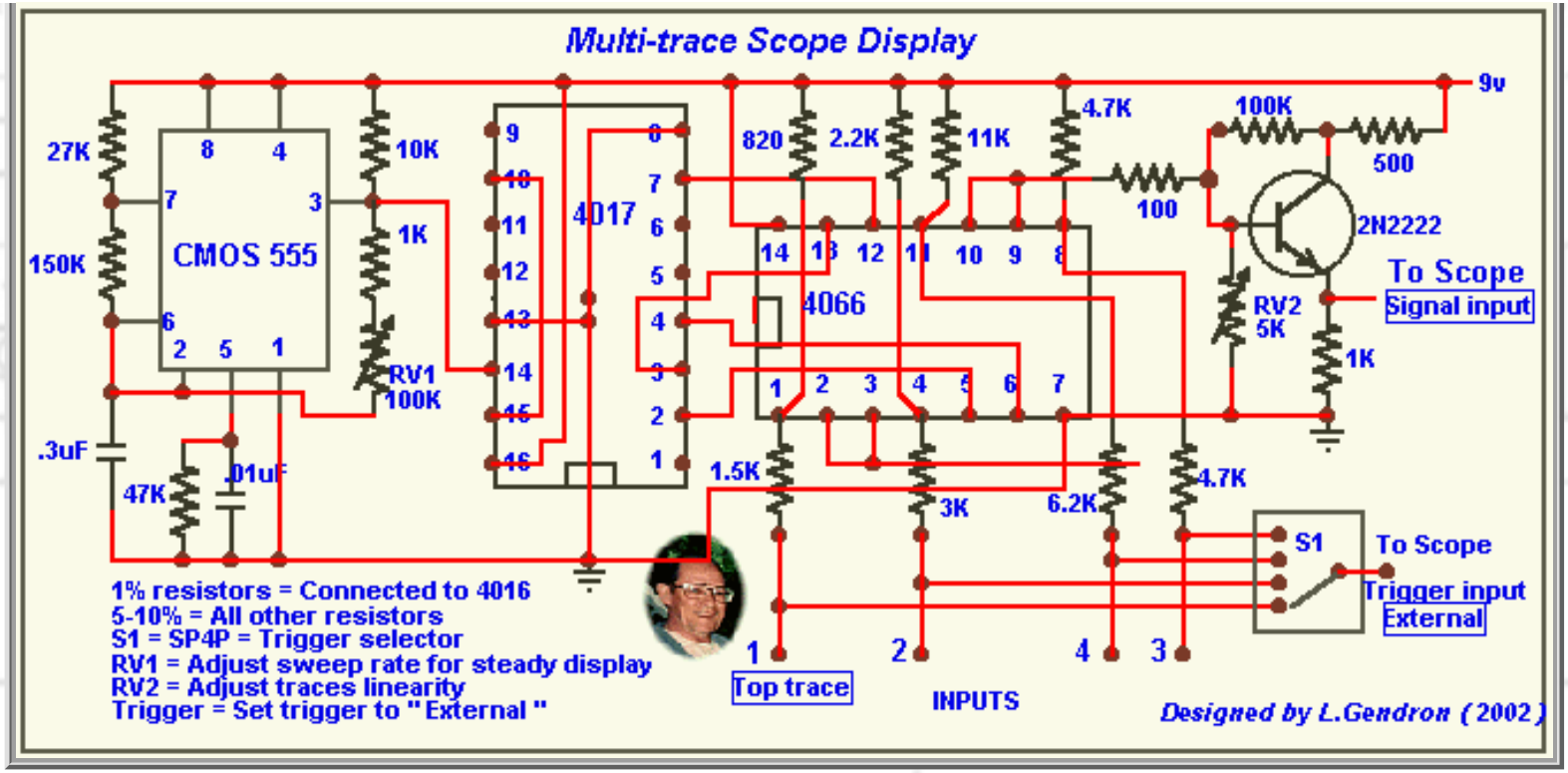
Multi -Trace Scope Display

Introduction

Next to a multimeter I find my oscilloscope the most usefull instrument . As the saying goes " Seeing is believing " , although I have a basic two traces scopes I sometime wished it had more than two traces to see more than two signals in a circuit . I decided to tackle the problem by designing a very basic circuit to obtain four traces on one channel and came up with the circuit below using as few and readily available components as possible .

There are some dedicated add-on instruments for digital applications but they cannot be used for linear signals . The circuit shown below can be used for both digital and analog signal and has only two adjustments plus the option of a trigger source depending on the signals being displayed .

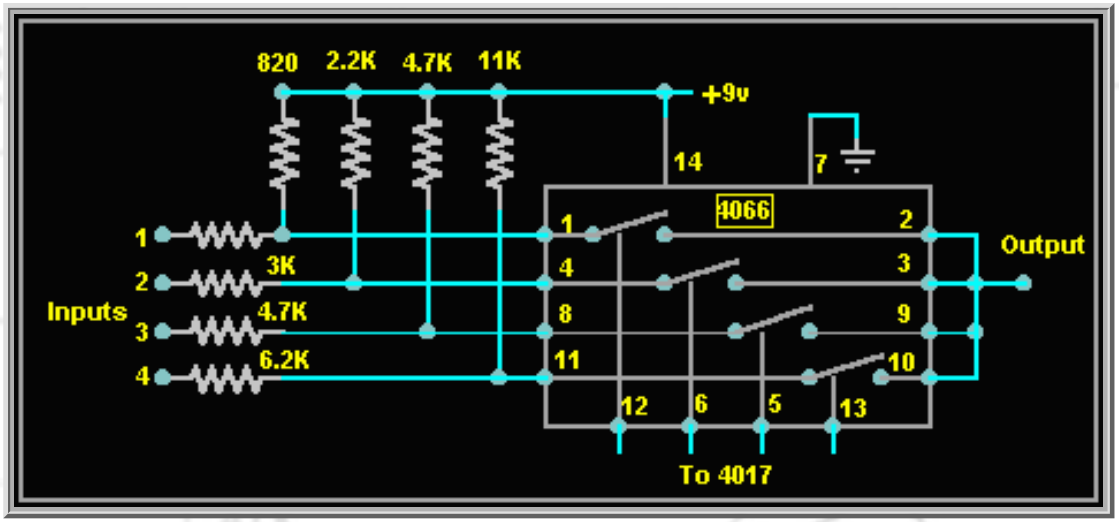


The circuit at first look , appears to be complicated but in reality it is not . The pins setup for the 4066 IC is such that it does complicate the point to point connections to it .

How does it works ?

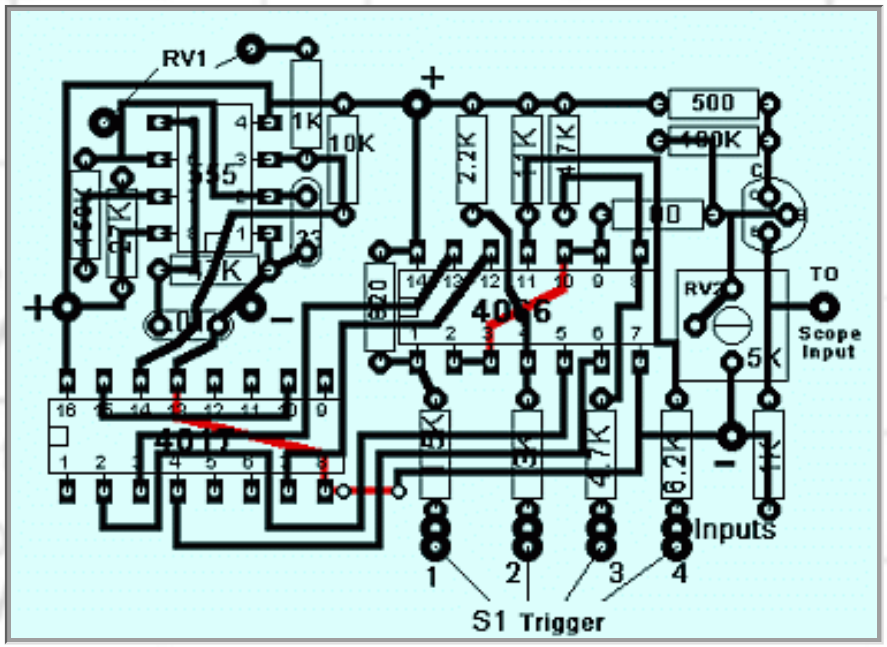
In order to obtain four or more traces we must first have an oscillator to produces some timing pulses or square waves and for this application a CMOS 555 IC timer is used . The train of pulses or frequency is adjustable with RV1 and the square waves are taken from pin 3 and connected to the trigger input pin 14 of CMOS 4017 IC which is a Decade Counter

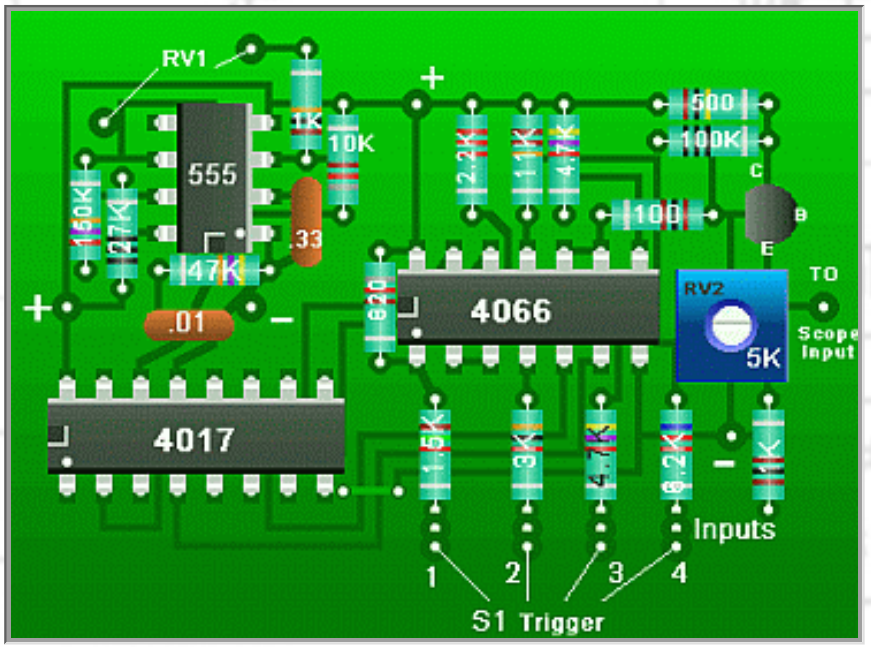
For each pulse input the 4017 will count from 1 to 10 and can be programmed to count to a number and recycle . For our purpose we need an output count of 1 to 4 and this is accomplished by connecting pin 15 to pin 10 .
Four outputs are now available is sequence starting with pin 3 = #1 , pin 2 = #2 , pin 4 = #3 and pin 7 = #4 . These outputs are now used to activate four switches that are available on the CMOS 4066 IC called a Quad Bilateral Switch . To better understand the set-up a drawing of the switches and associated resistors is shown below .



The resistors connected to each of the four inputs of the switches are 1% and form a voltage divider for each input pulling up each trace toward the supply source . The four traces are equally spaced on the scope display and RV2 is used to make a finer adjustment for linearity of the display if required . As shown all outputs are connected together through a 100 ohms resistor to the base of the output transistor and the composite signal is taken from the emitter then connected to the selected scope channel for viewing . A small on/off switch can be added to the 9 volts battery and the total current drawn is only 15 mA .

Note : The 100 ohms resistor is used as a bridge on the PCB and can be omitted and a jumper installed instead .





Using the circuit.

Inputs and outputs of the circuit are not sensitive to the signals processed through the switches and produce no distortion . Because of the voltage dividers used there is a signal loss of 2 to 1 but this can be compensated by the scope gain setting . Any method of connecting the different types of signal to the inputs can be used , jumpers , hard wiring or permanent wiring set-up using leads with connectors .

The system should first be used without any signal input , there should be four traces equally spaced on the scope and if needed the linearity may be adjusted with RV2 . Lineraity may also need re-adjusting as the battery voltage gradually decreases , the system will operate well down to 5 volts supply but will require more gain from the scope .

To further check the system , connect all inputs together and apply a signal , sine , sqare, triangle will equally do well , adjust the scope gain for full viewing then adjust "Time/Div " for a still or near still display then adjust RV1 for a steady display . The scope trigger source should be set to the channel being used .
Depending on the type of signals being displayed a fixed display may not be possible with tendency to drift and an external trigger is called for . No sweat ,from the circuit "trigger" switch (S1) connect to the scope input trigger and set the scope trigger to " EXTERNAL " , with S1 select the most suitable of the signal inputs then adjust the scope sweep trigger level . The system will work with any number of signal inputs with only a trace showing where a signal is missing , this is good for signal tracing , don't you think ?

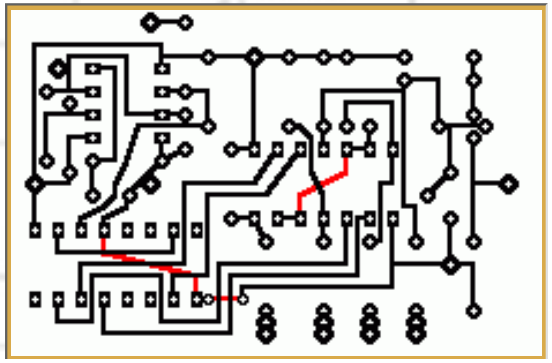
Another method of trigger setting using two channels can be used .With the scope trigger set to " Alternate "mode , connect the multiple trace to one channel and the trigger signal from the circuit to the other channel and set the trigger source to the trigger channel . Now you have five signal traces and the trigger signal can be your digital clock signal from which other signals can be compared , this is ideal for b-c-d binary viewing . Experimenting with the system is the only way to find out what it can do , I was really pleased with its performance and I hope you will also .

Construction

Please use sockets for all ICs . Before installing the sockets wire the jumpers shown in red under the sockets . Use the PCB layout or the graphical layout for point to point wiring and components positioning . As I mentionned above , any kind of connection schemes can be used for the inputs . As for the signal and trigger outputs a simple connector can be used which will allow you to connect with the scope leads .

I almost forgot to mention it , make sure to bring out a "ground " connecting point for the scope .

The PCB is actual size



You can download Data Sheets for the CMOS ICs used in this circuit .

If you have any comments or questions email me at :
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HOME