Experiment 10: Schmitt Trigger – I

By: Moe Wasserman
College of Engineering
Boston University
Boston, Massachusetts

Purpose:

To observe the relationship between input and output voltages in a Schmitt trigger circuit.

Method:

The input and output waveforms to a Schmitt trigger will be observed on a dual-trace oscilloscope. Controls on the computer screen will set the amplitude of the input waveform and the value of the reference voltage that determines the triggering level for output polarity switching.

In the experiment that follows this one, the hysteresis loop in the voltage transfer function of the Schmitt trigger will be displayed.

In the Schmitt trigger used in this experiment, V_1 is the input voltage at which the output switches from positive to negative, and V_2 is the voltage at which the opposite transition occurs. The width of the hysteresis loop is

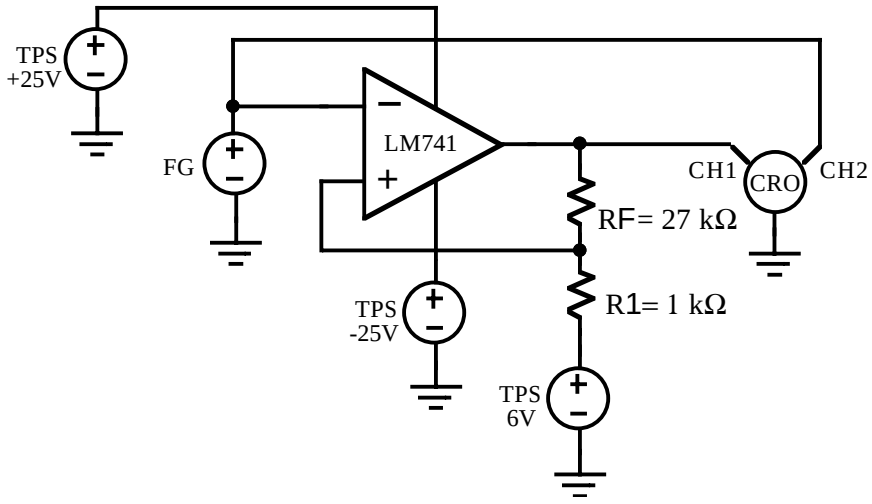
$$V_1 - V_2 = 2V_{CC}\frac{1}{1+\gamma} \quad \text{(10-1)},$$ where γ is the resistor ratio R_F/R_1 (see the schematic).

The midpoint of the loop is located at

$$\frac{V_1 + V_2}{2} = v_{REF}\frac{\gamma}{1+\gamma} \quad \text{(10-2)}.$$

Hardware Setup:

Build the conventional Schmitt trigger circuit shown below. Although the resistor values are not critical, the values shown provide a good starting point. Use 10x probes for the oscilloscope inputs.



The multimeter is not used here because the input and output waveforms will be observed on the benchtop oscilloscope.

Software Setup:

Configure the function generator for a 1-kHz triangular waveform with no offset, and set load = infinity as usual. Set the oscilloscope timebase to 200 µs/div, using channel 2 as the triggering source. Set the channel 1 sensitivity to 5 V/div, using the 10x probe, and set the channel 2 sensitivity to 1 V/div, using the 10x probe.

The **AMPLITUDE** input terminal of the function generator component driver is controlled by a Real Slider or Knob. Since there is no sequencing of input values in this experiment, speed of response is not an issue. Therefore the component driver can be removed since it provides no advantage; the **AMPLITUDE** input terminal can be placed directly on the instrument panel.

The triple power supply Direct I/O driver needs one input terminal and the following four commands:

```
WRITE TEXT "output on"
WRITE TEXT "appl p25v,15,0.1"
WRITE TEXT "output:track on"
WRITE TEXT "appl p6v,",a,",0.01"
```

The positive 25 V supply is first set to 15 V for V_{CC}. Then tracking is turned on to set the -25 V supply automatically to the same magnitude for V_{EE}. The last command sets the 6 V supply to the value that appears at the input terminal. This value is determined by another knob or slider.

Procedure:

Set the reference voltage to zero and start the program. Both waveforms should be visible on the oscilloscope screen. If you wish to change the vertical scale sensitivities you must open the oscilloscope instrument panel, unless you want to add components to the software layout. Slowly increase the input amplitude until you observe a change in the output waveform. Record the input value where this occurs. Sketch what you see and explain it.

Repeat the procedure with a reference voltage near 2 volts. Again record the critical input voltage and explain the new output waveform.

Predict what will happen if you interchange the output leads from the 6 V power supply. Then make the change and repeat the sequence with the same 2 V output, again recording and explaining the result. Was your prediction correct?

Now predict what will happen if you interchange the two feedback resistors. Make this change and repeat the measurements, again explaining what you see. Was your prediction correct?

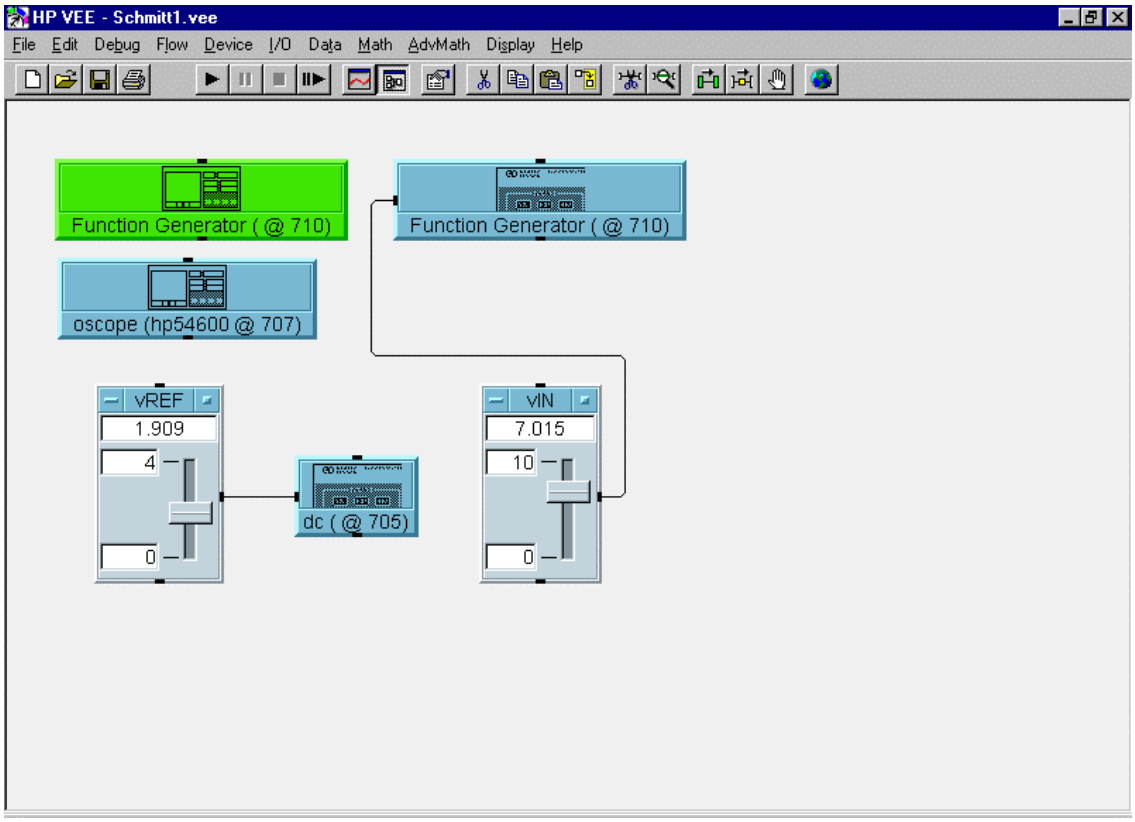


Fig. 10-3 Agilent VEE Setup