Using the QRPme O*Scope FUN board

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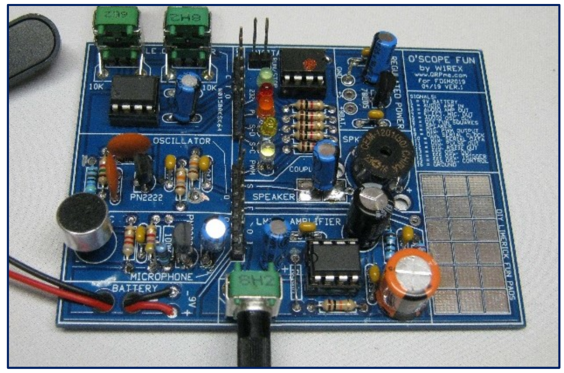
Manufacturer Link: O*Scope Fun Board



You just finished soldering-up your QRPme oscilloscope FUN board – now what? Where do you start? If you are like me, you plugged in a 9V battery and were relieved to see a few blinking LEDs. So far, so good. It is time to probe it with your oscilloscope.

If you are using the DSO150 oscilloscope, put the FUN board aside for a moment and learn how to control the scope first. The controls, while logically laid out, take some time to figure out – even if you are an oscilloscope master. A good review of the controls is here. Or check out my tutorial at w8bh.net.

Once you are familiar with the scope, try your hand at the following eight experiments.

Experiment #1: Oscilloscope review

Learn the oscilloscope controls and display the scope's built-in 1 kHz square wave. I mean it. Unless you are familiar with the scope, you won't have much luck with what follows. Detailed instructions here.

Experiment #2: Audio oscillator.

Connect the scope ground lead to the ground loop on the FUN board, and connect the probe j-hook to the audio oscillator pin (pin #3 on J2).

Rex says that output should be about 1V peak to peak, so set V/DIV to 0.2V. This will make the waveform height about 5 blocks. Set trigger level at 0.1 – 0.2V. Since the audio frequency is about 750 Hz, a single cycle should take just over 1mS. So, a good setting for SEC/DIV would be either 1mS or 0.5mS. Press OK to put the waveform on hold. Press and hold OK to see the measurement overlay. What does the frequency say? What is the amplitude? Mine says 796 Hz and 0.54 Vpp.

Experiment #3: 555 timer – part 1.

Apply power to the timer chip by putting a jumper on the top 2 pins of the 4-pin header. Connect the scope ground lead to the ground loop on the FUN board, and connect the probe j-hook to the timer output pin (pin #4 on J3).

The timer output is a 9V square wave, so set V/DIV to either 2V or 5V. Set the trigger level between 2V-6V. If the output frequency is around 10 kHz, a SEC/DIV setting smaller than 1mS would be best: try 0.1mS to start.

The multi-turn potentiometer on the right varies the output frequency from roughly 3 kHz to 40 kHz. The left multi-turn potentiometer will vary the duty cycle from roughly 20% to 80%. Turn on the measurement overlay (Press and hold OK button), then try varying the potentiometers.

Experiment #4: 555 timer – part 2.

Find the timing capacitor (0.022 uF) to the right of the chip. Increase the capacitance by adding another capacitor in parallel. A pair of J-hook test leads will let you do this without replacing the cap. Try any value in the 0.01 uF to 0.1 uF range. You should see the output frequency drop.

Now move the probe tip from the timer output pin to the timer trigger pin (pin #3 on J3). You will need to adjust the trigger level. My waveform has Vmin around 2.5V and Vmax at 5.4V. So the trigger level will need to be between those values. Do you see a saw-tooth wave?

Experiment #5: Pulse-width modulation.

Connect the scope ground lead to the ground loop on the FUN board, and connect the probe j-hook to the PWM output pin (pin #1 on J2). This is a digital output from the on-board PIC microcontroller with a 5V amplitude. Set V/DIV to 2V and VPos about 1 block from the bottom. I measure an output frequency of about 3 kHz, so a SEC/DIV setting of 0.1 mS will do. Set the trigger level midway between 0-5V. Press/Hold the OK button to turn on the measurement overlay, if it isn't currently on. Notice that the frequency is constant, but the duty cycle changes. My duty cycle changes from about 10% to 95%.

Experiment #6: RS-232 output.

Up until now we have used the scope in AUTO mode. In AUTO mode the scope is constantly updating the display. To investigate this signal, we are going to use SINGle mode instead. In SINGle mode, the scope waits until it detects an upwardly going edge, records the waveform, then halts until it is restarted by the user.

Let's start with the clock pulses. Put the probe on signal SC (pin #7 of J3). Set V/DIV to 2V and VPos about 1 block from the bottom. Set the trigger mode to SING, the edge setting to upgoing, and the trigger level midway between 0-5V. The pulses are very narrow: 20 microseconds. So set SEC/DIV to 50uS. Press OK to start the scope; when it encounters an upgoing pulse it will display the pulse train and halt the display. Press SEC/DIV so that 50uS is not highlighted. Now turn the knob to see the entire pulse train. There should be 8 pulses.

Now put the probe on signal SD (pin #8 of J3). Keeping all other setting the same, change SEC/DIV to 0.1mS. Press OK to release hold and examine the display. There will be a series of pulses, each about 0.14mS in width.

Now put the probe on signal 232 (pin #5 of J3). Keeping all other setting the same, change SEC/DIV to 5mS. Press OK to release hold and examine the display. There will be a series of pulses, each about 4mS in width, with the entire pulse train about 40mS long.

Experiment #7: Microphone output.

The electret mic and single transistor amp will easily put out a few hundred millivolts. Connect the probe tip to the microphone output (pin #5 on J2). Try the following settings: V/DIV 50mV, SEC/DIV 1-2 mS, Trig mode AUTO, Trig Level ~80mV. Put your mouth close to the microphone and call CQ. Once you see a waveform, try changing the trig mode to SINGle, which will capture and freeze the waveform. Press OK to release the hold, and try a whistle.

Experiment #8: LM386 Amplifier output.

Use the microphone as an audio input source for the amplifier: connect a jumper wire from the microphone output to the LM386 amplifier input (pins #5 & 7 on J2). Connect the scope probe to the amplifier output (pin #6 on J2). It is difficult to fit the probe tip on the header pin when the jumper wire is in place, so cut a jumper in half, strip/tin one of the wire ends, and use that as a probe extension.

Compared to the microphone circuit above, the amplifier output voltage is significantly higher. Try a V/DIV setting of 0.5V, SEC/DIV 1 mS, Trig Mode AUTO, Trig Level ~0.2V.

Now change the amplifier input to the audio oscillator. Turn the audio output pot to minimum (counter-clockwise) and jumper pins #3 and #7 on J2. Apply power to the audio oscillator by jumpering the bottom two pins of the 4-pin header. Try the following settings: V/DIV 1V, SEC/DIV 0.5mS, Trig Mode AUTO, Trig Level ~0.2V. Slowly turn the volume control clockwise and notice the waveform increase in amplitude. You will also have to move the vertical baseline up, since the output generates voltage above and below ground potential. Turn on the measurement overlay (Hold OK). Check the frequency output (about 750 Hz, duty cycle ~ 50%) and voltage output. At lower volumes the output should be a perfect sine wave. As you increase the output, notice how the waveform begins to get distorted. Increase the output further and the tops of the waves will flatten = voltage clipping. At what voltage does this occur?

Now disconnect the probe from the amplifier output, and connect the amplifier output to the on-board speaker (jumper pins #2 and 6 on J2). Pins #3 and 7 should already be jumpered. Do you hear the tone? Put a piece of adhesive tape over the pinhole on the top of the speaker to improve the sound output. Now clip the scope probe to the (+) lead of the speaker's electrolytic cap. Increase the volume, and notice how the quality of the tone changes when clipping occurs.

Miscellany

With the scope on battery power, I noticed that I would occasionally lose trigger. Make sure that the vertical cursor corresponds with the 0V level of the waveform. If it doesn't, VPos can be reset to 0V by the following procedure:

1. Attach probe tip to test lug on oscilloscope
2. Move coupling switch to GND position
3. Press and hold V/DIV until 'Doing Vpos Alignment' message appears.

If your 0V baseline keeps changing, you are likely using a battery supply that's almost exhausted. Replace your battery, or consider using a 9V DC adapter instead.