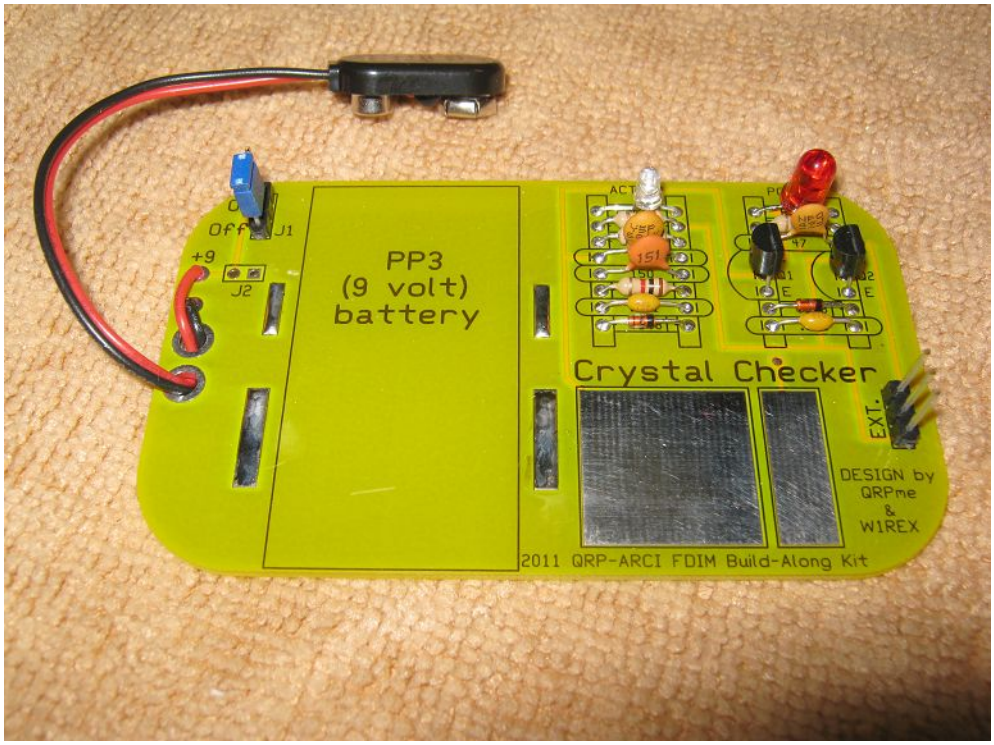


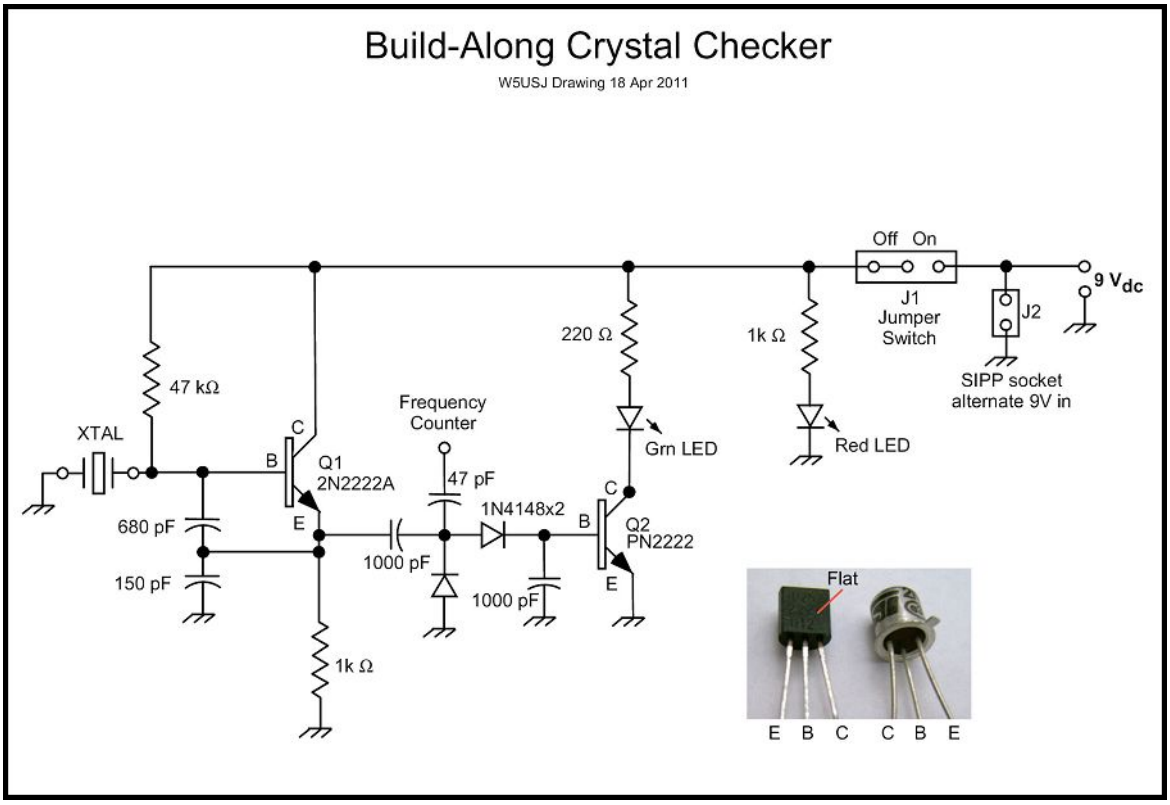
QRPme Crystal Checker Kit
Featured in
FDIM 2011 Build-Along

This crystal checker circuit was first presented in a workshop given by WA3OPY, AC5UR & W1REX a few years ago at the 4 States QRP Club gathering called Ozarkcon. I built several checkers, Manhattan style in tuna cans, to use in that workshop. I have updated that circuit and present it here in a printed circuit board form to fit directly in the ubiquitous shirt pocket tin... It was originally built to test FT243 crystal blanks while grinding but touching any crystal to the plates will work too.

The 4SQRP crystal grinding workshop was a hands-on demonstration on how to re-grind out-of-band FT243 crystals to put them on QRP watering hole frequencies. WA3OPY and AC5UR both work at International Crystal Manufacturing and are very familiar with commercial crystal grinding and manufacturing techniques. I had a very large collection of out-of-band FT243 crystals and put together the necessary support equipment and materials to host the workshop. We took 69xx FT243 crystals, ground them by hand and ended up with spot on 7030 FT243 crystals. Remember, you always have to start with a crystal that is lower in frequency than what you want. Grinding a crystal makes it thinner, causing it to oscillate at a higher frequency..

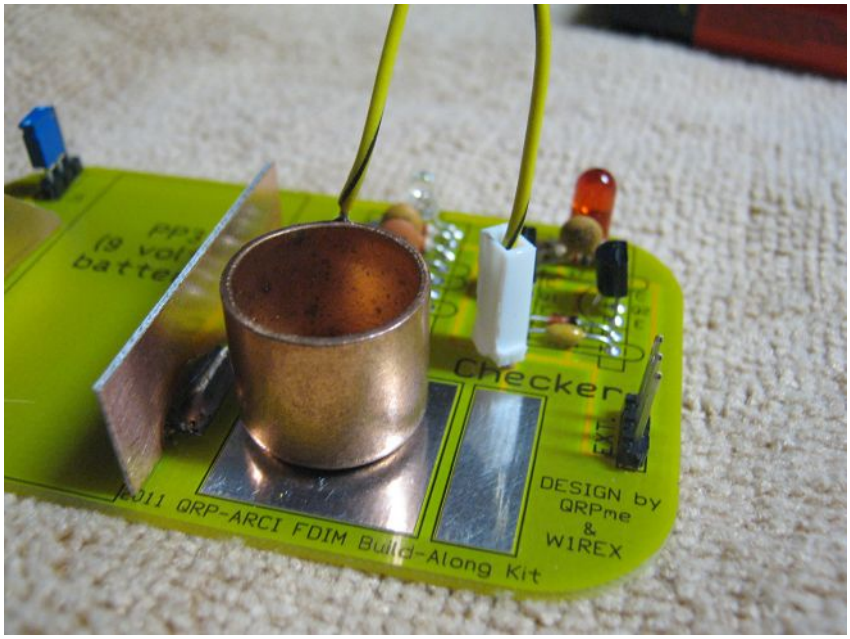
The 'perfect crystal'; just a little out of band to make it of little interest to the majority of hams; BUT, close enough so that a little grinding will bring the frequency up to a nice QRP location!

The basic circuit for the crystal checker was found in the book **QRP Basics** by George Dobbs, G3RJV and adapted for crystal grinding purposes by me, W1REX. It is a fairly straight forward Colpitts oscillator with fairly generic component values that will allow it to oscillate over a wide HF spectrum. The oscillator is followed by a peak detector formed by the 2 diodes and the 1000pf cap. An active crystal will generate peaks large enough to turn on Q2 and light the green LED. A dud crystal will NOT oscillate so no peaks are generated and the green LED remains unlit. The original QRP Basics circuit had a 220 ohm resistor in series with each LED. In reality, the red LED is a only a power on indicator and doesn't need to draw that kind of current, so the 220 ohm resistor just below the red LED on the circuit board can be replaced be a 1K resistor to conserve battery power.



The versatility on the QRPme crystal checker circuit lies in the two large open pads. The large square pad is the active side of the crystal circuit while the smaller rectangular pad is connected to the ground plane. Touching an unknown crystal's leads to the two plates will test the crystal. Any number of crystal lead styles can be placed across the test pads. The secret to grinding FT243 crystals and having them come very close to your desired frequency lies with the pads. Here is the secret….

Take a ½" copper pipe cap and solder a piece of wire to it. On the loose end of the wire, solder on a single female header receptacle for a .025" post. Scrape the solder mask from the underside of the hole between the h & e above the rectangular pad. Solder in a wire wrap pin or any other .025" post. Now you can clip the ½" pipe cap lead to the post.



Get a tube of BBs, steel or lead shot and perform the following procedure:

1. Attach a frequency counter to the top 2 pins of the small 3 pin male header connector to the right of the test pads. The top pin is the oscillator output and the middle pin is ground.
2. Measure and record the frequency of the untouched FT243 crystal still in the holder.
3. Disassemble the FT243, and place the crystal blank down on the large square pad.
4. Place the pipe cap on top of the crystal to create the second electrode.
5. Add shot to the pipe cap until your current frequency counter reading is the same as the untouched crystal. When you reach the same frequency, the pipe cap weight is applying the same force on the crystal blank as the spring inside the FT243 case.
6. Keep the same amount of shot inside the pipe cap while working on the current crystal.
7. Now when you grind a little off the blank, you can clean it up and test the frequency without having to keep reassembling the FT243 holder. The oscillator output frequency should track close to the frequency you will get when you put the crystal back inside the holder.

Building Notes:

1. There are only 14 components to the crystal checker circuit and the values are screened on the board right where the components are to be installed.
2. Remember to check the orientation of several parts against the silk screen designators: the round sides of the transistors are indicated on the silk screen and the bar or stripe on the diodes and the flat side of the LEDs are indicated by a line through the part outline on the silkscreen.
3. J2 was used only by the Build-Along builders as a socket to insert the 9 volt battery snap leads without soldering.
4. The 2 large holes just below the + & - pads at the far left of the board are 9 volt battery snap strain relief holes. Thread the 9 volt battery snap leads down thru the bottom hole and back up the top hole. Solder the + & - leads to the pads just above the holes. Pull the leads back through the holes until the leads are taught. Place a little hot glue on the snap leads where they are connected to the + & - leads to prevent them from wiggling around and breaking off.
5. The 4 small rectangular pads on either side of the battery outline are to solder bare pieces of pcb stock to create 'sides' to the battery compartment preventing excessive movement by the 9 volt battery.
6. Don't forget to add an insulator under the board when installing it in an Altoids tin. Tracing the board on the plastic lid of a 2 pound coffee can or a stiff piece of cardboard and then cutting it out makes a great insulator pad.
7. The EXT connector is for sending the oscillator output to a frequency counter. The top pin is the crystal frequency while the center pin is ground.

We ground the FT243 crystal blanks using a small plain rubber stamp as a crystal blank holder (to apply even pressure to the blank) and used small figure 8 grinding patterns. We used Bon Ami scouring powder obtained from a local hardware store and pieces of 3/8" plate glass for the grinding surface. Remember to grind lightly and test often. When you grind a crystal PAST your target frequency, it is hard to get it back to where you want it…

Enjoy!

Rex Harper
W1REX