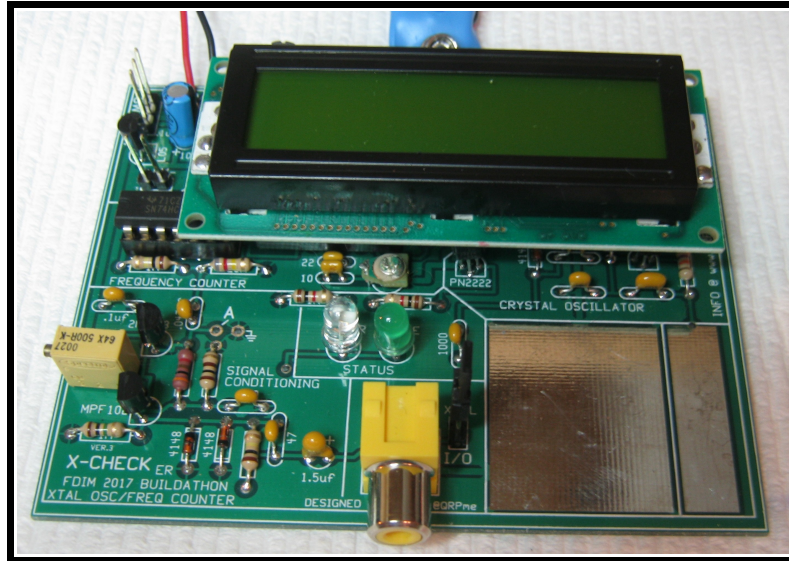


# X-CHECKer



FDIM 2017 CRYSTAL GRINDING BUILDATHON  
CRYSTAL OSCILLATOR & FREQUENCY COUNTER

from  
W1REX & QRPme

6/14/2017

The X-CHECKer kit is a Frequency Counter with integrated Crystal Oscillator section specifically designed to facilitate the Grinding of quartz crystals to move them up in frequency to a more desirable location. Two contact plates in the Oscillator section of the board are designed to enable both measurement of crystals still inside their holders and FT-243 crystal slabs removed from their respective holders. An integrated microprocessor based frequency counter will count and display the frequency on an LCD display module. The Crystal Oscillator circuit is broad banded and will oscillate crystals into the 10m band. The Frequency Counter section will display frequencies up to about 25Mhz but can be pushed to about 50Mhz with some simple mods.

The circuit board dispenses with component designators as the component values are marked directly on the board adjacent to the part. It can easily be built using only the parts list. This quick assembly guide will enhance the already straight forward build procedure..

It is probably easiest to build the kit in sections and in the following order: Power, Crystal Oscillator, Status, Signal, Signal Conditioning, Frequency Counter and finally LCD Display.

### Section 1: POWER

The Power section has only 7 parts. Pay attention to the polarity of the 9V battery input, LM7805 voltage regulator and the 10uf capacitor. Install the LM7805 with the plastic body standing up off the pcb by 1/4" or so. The switch is actually a 3 pin male Molex style header connector with a small shorting jumper acting as the switching element. Note that there are 3 pins on the connector with 2 pins shorted together....basically forming a SPDT switch with one side or throw shorted creating a SPST power switch. The shorting jumper is connected to the 2 pins closest to the 9v battery snap to turn the unit on. Kinda opposite the silk screen markings but if you replace the Molex header with a true SPDT or SPST toggle switch, then the silk screen markings match the switch lever operation. After all the parts are mounted, you can check the switch action and correct operation of the 5 volt regulator using a volt-ohmmeter. Unplug the battery and continue to the

next section.

## Section 2: CRYSTAL OSCILLATOR

The Crystal Oscillator section has 11 parts. Check the orientation of the parts with the silk screen alignment for the 2 transistors and 2 diodes. The two transistors should be standing off the pcb by about  $\frac{1}{4}$ ". This may be important if they should ever need replacing. Nothing else out of the ordinary in this section except for soldering the single SIP pin on the top of the narrow crystal plate. Easiest method to solder the SIP pin is to plug something like a resistor into it and then use the resistor for a handle while soldering. The Crystal Oscillator section requires the next section to be built before it can be tested.

## Section 3: STATUS

There are 5 parts in this section. Take special note that the capacitor on the right side of the section is marked wrong on the silk screen layout. It should be a 47pf cap and not a 1000pf cap. Pay attention to the orientation of the 2 LEDs with the flat sides matching the flats on the silk screen with their bodies about 1/4" off the pcb. Once the parts in this section are soldered in, you can test the POWER LED by turning on and off the power switch with the battery installed. The GREEN LED will light up when a GOOD crystal is touched to the 2 plates.

## Section 4: SIGNAL

Only 3 parts in the Signal section..... Install the yellow right angle RCA connector and then the 2 pin straight header just to the right of it. When you install the shorting jumper across the 2 pins, the crystal oscillator output is coupled into the signal conditioning circuit along WITH any signal coming into the RCA jack so the jack should have nothing plugged into it. Removing the jumper disconnects the crystal oscillator from the signal conditioning circuit so the RCA jack is now the source for the frequency signal to be measured.

## Section 5: SIGNAL CONDITIONER

This section contains 17 parts. Orientation is important with: the 1.5uf cap,

two 1N4148 diodes, 2N4403 transistor and the MPF102 FET. Adjustment of the pot is easier when the trimmer screw is facing to the left. Depending upon the source for the parts, sometimes the trimmers have their adjustment screws on the top facing up... With no crystal on the oscillator plates OR with the I/O 2 pin jumper NOT installed, you need to adjust the voltage at test point A to be 2.5 volts. The frequency signal 'rides' on top of that 2.5 volts to create the high and low voltages to operate the Schmitt trigger inputs on the HC132 logic gate. Gary O'Neil, K3GO, has worked up a nice mod for this section which extends the useful range of the signal to 50Mhz with a good signal sensitivity. Although you can make this mod after you completely build the kit, it would be easier if you perform the mods right from the get go. Consult the MOD document in the documents files....

#### Section 6: FREQUENCY COUNTER

There are 9 parts in the frequency counter section. Install the IC sockets first with the indicator notch on the left hand side matching the silk screen outline. Make sure that the ICs notches and the socket notches match up when inserting the ICs into the sockets. The 4Mhz crystal is another part that should stand off the pcb by about 1/4" after soldering.

#### Section 7: LCD MODULE

This section is very simple with only 3 parts. Stand the contrast pot at least 1/4" off the pcb to clear the lip of the TR-3 relay track in case you might use that later. I install the SIP female headers for the LCD module on the pcb and then install the SIP male header pins on the LCD module. A trick to making the 2 8 pin SIP line up nice and neat when soldering is to insert an 8 pin SIP male header split between the 2 female headers. This keeps the female headers in a nice straight line while soldering. Later, you can insert the male headers into the pads on the LCD module and then plug the three pieces into the already soldered female headers to keep them lined up for soldering.

#### Section 8: OPTIONAL TCXO/OXO ACCURATE CLOCK

This section is unpopulated. If you should want to improve the accuracy of

the X-CHECKer, you could remove the 4Mhz crystal and bring in an accurate 4Mhz clock in from an outside source. I've found the unit, once calibrated, accurate enough for its intended purpose, measuring FT-243 crystal blanks while in the process of grinding them to new frequencies.

The values of most of the parts are silk screened right on the pcb. The following parts list denotes the parts and their identification marks. You can either build it by the outline above or just install all the parts and hope it works. A video of this 'complete build and hope' method is in the video links on the web page.

Rex W1REX

# FDIM 2017 CRYSTAL GRINDING BUILDATHON CRYSTAL OSCILLATOR & FREQUENCY COUNTER

## RESISTORS

100ohms (BRN-BLK-BRN)  
300ohms (ORG-BLK-BRN)  
1Kohms Qty=3 (BRN-BLK-RED)  
47K (YEL-VIO-ORG)  
100K (BRN-BLK-YEL)  
820K (GRY-RED-YEL)  
1M Qty=2 (BRN-BLK-GRN)  
  
500ohm trim pot  
20Kohm trim pot

## CAPACITORS

10pf (10)  
22pf (22)  
47pf Qty=2 (470)  
    {ONE @ 1000 in status section}  
150pf (151)  
470pf (471)  
680pf (681)  
1000pf Qty=2 (102)  
    {TWO in oscillator section}  
.047uf (473)  
.1uf Qty=3 (104)  
1.5uf  
10uf  
  
4-20pf trimmer cap

## SEMICONDUCTORS

MPF102 transistor  
PN2222A transistor Qty=2  
2N4403 transistor  
78L05 voltage regulator  
74HC132 integrated circuit  
1N4148 diode Qty=4  
Green LED  
Red LED  
4Mhz crystal  
PIC16C622 microprocessor  
2x16 LCD Display

## MISCELLANEOUS

1x8x.1" male Molex header Qty=3  
1x8x.1" female Molex header QTY=2  
1x2x.1" shorting jumper Qty=2  
18pin IC socket  
14pin IC socket  
RCA female jack  
9volt battery snap  
single SIP socket pin  
calibration crystal

## BUILDER SOURCED STUFF

1/2" or 3/4" copper pipe cap  
fine gauge flexible wire  
small lead weights