

## Introduction

Thank you for purchasing a QRPometer. We hope you will enjoy building it and find it a useful addition to your QRP station. This kit was conceived to fill a need within the hobby for an inexpensive, highly accurate VSWR and RF power meter for QRP power levels. The QRPometer uses simple analog signal-processing circuitry to provide a set of essential measurement features not previously available in a single unit.

High quality, double sided, printed circuit board construction is used, with solder mask and silk screened component reference designators. All components are through-hole for easy assembly. NO toroids are required. All controls and jacks are PCB mounted, and a single, four conductor ribbon cable is the only wiring necessary. The QRPometer can be constructed by beginners as well as experienced builders. Construction time is approximately 3 hours, depending on experience level. The only equipment required for calibration of the QRPometer is a digital voltmeter, and a QRP transmitter.

## First Steps

Before getting started with building the QRPometer, take some time to organize and familiarize yourself with the parts provided and check them against the Bill of Material. Building over a cookie sheet is recommended to minimize parts being lost. To prevent static damage, it is recommended that the ICs not be removed from their anti-static packaging until you are ready to install them. If parts are missing in your kit, send an email to our kitter Rich Fowler, K8MEG, at [k8meg.rich@gmail.com](mailto:k8meg.rich@gmail.com). He will promptly provide replacements.

Schematic and parts-placement files are provided as part of documentation package. It is highly recommended to print a couple of copies for reference during construction. As you build, use a highlighter to mark off parts that have been soldered onto the PCB on one copy. When you think you are done, you can check that copy to verify that all of the parts have been installed.

## Step 1 – Connectors

The first step of assembly is to install the connectors on the PC board. J1 and J2 are RCA connectors for RF input and output from the PC board. Insert them into the board, and solder the center tab first. Make sure the connectors are flush with the board, and reheat the center pin joint if necessary to reposition them. Then, solder the three mounting tabs of each connector to the board, and trim flush with the board.

- ( ) J1 – RCA connector
- ( ) J2 – RCA connector

Connectors J3 and J4 are the PC-mounted snap-on connectors for the 9v battery. Notice that J3 is the male, and J4 is the female, and are shown on the silkscreen. To assure proper positioning, snap a 9v battery to the clips prior to soldering. Again, make sure the connectors are flush with the board, and

resolder if necessary. Remove the 9v battery when completed.

J3 -Male 9v battery clip  J4 -  
Female 9v battery clip

### Step 2 – Capacitors

Insert and solder, and check off each when completed. Double check the values, as they may look very similar.

Part Number Value Label   
C1 0.01 103  C2 0.01 103  
 C3 0.001 102  C4 0.1  
104  C5 0.01 103  C6  
0.01 103  C7 0.1 104   
C8 0.1 104  C9 0.01 103 (  
 C10 0.01 103  C11 0.1  
104  C12 0.1 104  C13  
0.01 103  C14 0.01 103   
C15 0.1 104  C16 0.1 104

### Step 3 – Diodes

The QRPometer contains four identical 1N914-type diodes

D1 1N914  D2  
1N914  D3 1N914 (  
 D4 1N914

### Step 4 – Resistors

Resistors R1-R8 are 100 ohm, 2W parts. All others are 1%, 1/4W devices. **IMPORTANT:**  
Resistors R11, R36 and R40 are NOT to be installed until after calibration!

Part Number Value Label  R1 100, 2W Brown-Black-  
Black-Black  R2 100, 2W Brown-Black-Black-Black   
R3 100, 2W Brown-Black-Black-Black  R4 100, 2W  
Brown-Black-Black-Black  R5 100, 2W Brown-Black-  
Black-Black  R6 100, 2W Brown-Black-Black-Black

( ) R7 100, 2W Brown-Black-Black-Black ( ) R8 100, 2W  
Brown-Black-Black-Black

Double check the soldering on these resistors – the larger pads on the board require extra heat or time to prevent cold solder joints.

( ) Save one of the resistor leads, and insert and solder on the back of the board at the jumper position marked TEST, between SW1 and SW2 positions.

( ) R9 24.9k Red-Yellow-White-Red ( ) R10 24.9k  
Red-Yellow-White-Red ( ) R11 **NO NOT  
INSTALL NOW!** ( ) R12 49.9k Yellow-White-  
White-Red ( ) R13 100k Brown-Black-Black-Orange  
( ) R14 100k Brown-Black-Black-Orange ( ) R15  
1.0M Brown-Black-Black-Yellow ( ) R16 100k  
Brown-Black-Black-Orange ( ) R17 24.9k Red-  
Yellow-White-Red ( ) R18 4.75k Yellow-Violet-  
Green-Brown ( ) R19 4.75k Yellow-Violet-Green-  
Brown ( ) R20 100k Brown-Black-Black-Orange ( )  
R21 100k Brown-Black-Black-Orange ( ) R22 100k  
Brown-Black-Black-Orange ( ) R23 604k Blue-  
Black-Yellow-Orange ( ) R24 10.0k Brown-Black-  
Black-Red ( ) R25 100k Brown-Black-Black-Orange  
( ) R26 1.0M Brown-Black-Black-Yellow ( ) R27  
1.0M Brown-Black-Black-Yellow ( ) R28 49.9k  
Yellow-White-White-Red ( ) R29 39.0k Orange-  
White-Black-Red ( ) R30 100k Brown-Black-Black-  
Orange ( ) R31 1.21k Brown-Red-Brown-Brown ( )  
R32 2.74k Red-Violet-Yellow-Brown ( ) R33 1k 10  
turn potentiometer ( ) R34 100k Brown-Black-Black-  
Orange ( ) R35 1.0M Brown-Black-Black-Yellow ( )  
R36 **DO NOT INSTALL NOW!** ( ) R37 24.9k Red-  
Yellow-White-Red ( ) R38 4.75k Yellow-Violet-  
Green-Brown ( ) R39 1.0M Brown-Black-Black-  
Yellow ( ) R40 **DO NOT INSTALL NOW!** ( ) R41  
2.0M Red-Black-Black-Yellow ( ) R42 1.65k  
Brown-Blue-Green-Brown ( ) R43 24.9k Red-  
Yellow-White-Red ( ) R44 100k Brown-Black-  
Black-Orange ( ) R45 49.9k Yellow-White-White-  
Red ( ) R46 49.9k Yellow-White-White-Red ( ) R47  
604k Blue-Black-Yellow-Orange

Step 5 – Integrated Circuits Remove from anti-static packaging, and install. Pay attention to the orientation of the ICs, which should correspond to the marking on the silkscreen.

- ( ) U1 LM337L TO-92
- ( ) U2 TLC274 14-pin DIP
- ( ) U3 TLC555 8-pin DIP
- ( ) U4 TLC274 14-pin DIP

#### Step 6 – Switches

The two, 3PDT switches are mounted directly to the PC board. **IMPORTANT:** Match the outline of the switches to the silkscreen to assure proper orientation. The switch levers are to toggle up and down, not left-to-right! The pins are a snug fit in the PC board holes, but with firm pressure they will go through. Be sure they bottom out against the board. Remove all hardware from the switches, and temporarily place the top board over the switches to assure proper switch spacing before soldering into place.

- ( ) SW1 ( )
- SW2

#### Step 7 – LCD Meter

The LCD meter must be modified to shift the default decimal point position. On the back of the LCD meter, there is a set of three pairs of pads, of which one pair is shorted with a solder blob. Carefully desolder that blob, and with solder, short out the next pair of pads adjacent to this.

When installing the LCD into the front panel, be certain that it is in the correct orientation. The four connector pins of the LCD meter should be at the left side of the display – directly over the '4SQRP' label on the top of the board.

Place the meter face down on your work surface, and place the board face down over it. Applying pressure on the board near the four corners of the meter opening, Push the board down over the meter until it rests on the meter bezel.

Separate the individual strands of the ribbon cable about 1/2” on each end, and strip back about 1/4” of insulation on each end. Solder onto the four pads at the edge of the board. You may wish to use a permanent marker to mark on wire of the cable to be certain its polarity is correct when attaching it. Notice the labeling on the meter connector pins matches that on the board outputs. Wrap the matching wire around the corresponding meter pin and solder.

#### Step 8 – Calibration

There is one test point on the board, above the TX connector. This is labeled TP-1. Insert a fresh 9v battery into the battery clips, and flip the bottom switch up into the ON position. With a digital voltmeter, measure the voltage between this test point and ground. You may use one of the hardware mounting holes in the corners of the board as a ground point. Adjust the trim pot R33 until this voltage reads 5.00v.

Locate a QRP RF power source of 0.5W to 5W power level. Connect this to the TX connector, J1. Flip both switches into the up positions, so that the meter is ON and measuring VSWR. Apply 0.5W to 5W of RF power to the TX connector, and adjust the calibration pot on the back of the LCD meter until the display reads "1.00". It is **IMPORTANT** to unkey the transmitter before turning off the QRPometer! The QRPometer is now calibrated!

Remove the 9v battery. Snip off the test jumper on the back of the board between the two switches. Install R11, R36 and R40:

( ) R11 49.9k Yellow-White-White-Red ( ) R36  
100k Brown-Black-Black-Orange ( ) R40 1.0M  
Brown-Black-Black-Yellow

### Step 9 – Final Assembly

Install the hardware in each corner of the board. A screw is inserted into each corner through the top of the meter board. On the back, a spacer is placed over each screw. The screws are then inserted through the mounting holes in the corners of the bottom board, over which lock washers and nuts installed.

Adhesive rubber feet are supplied with the kit, which are then attached to the bottom of the QRPometer, near the mounting screw holes. You are done!

How to use the QRPometer The QRPometer is inserted between the QRP rig and the tuner or antenna. In the OFF condition, the QRPometer is bypassed, and may be left in-line without signal loss.

When the QRPometer is switched ON, it may be operated either as a Power meter or VSWR meter. In the PWR mode, a 50 ohm, 16 watt dummy load is switched in, and the connection to the Antenna disconnected. This permits testing of a QRP transmitter without radiating QRM. The accuracy of the power meter is typically 2% or better from 100 mW to over 10W.

In the VSWR mode, a resistor bridge type circuit is switched in. This inserts 6 dB of attenuation between the QRP rig and antenna, which limits the VSWR presented to the rig to less than 2:1 during tune-up into an unknown antenna. This is a valuable feature for use with QRP transmitters that lack any VSWR protection. Once the VSWR of the antenna circuit has been nulled, the QRPometer should be switched out to remove this attenuation.

If the QRPometer is operated in the VSWR mode with no applied power, you will notice the display will slowly increment up or down. This is due to the analog mathematics of the board attempting to calculate the ratio of forward and reflected power, which are both zero.

The accuracy of the VSWR meter is typically 5%, so that at minimum VSWR, the meter may read something other than 1.00. Tuning for the smallest number will, nonetheless provide a 50 ohm match.