QRP Labs QCX Accessory Kits

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In the August 2019 issue of *QST*, I reviewed the QRP Labs QCX transceiver kit and mentioned two useful accessory kits — the QLG1 GPS processor and the 20 W dummy load. The QLG1 is a small (3.6 × 2.5 inch) PC board that converts the QRP Labs QCX transceiver into a WSPR (Weak Signal Propagation Reporter) beacon transmitter (see the sidebar, "What is WSPR?").

Most WSPR installations use both a transmitter and receiver — often the home station transceiver turned down to just a few watts — along with software hosted on the station PC. The QLG1 works with the QCX transceiver and its firmware to perform the WSPR transmit function without using an external PC. By going to the **wsprnet.org** website, you can see a log of reports from stations receiving your transmissions.

Building the QLG1 PC Board

The finished QLG1 is shown in Figure 6. In the middle of the board is a surface-mount satellite receiver IC, which is already installed when the kit arrives. The builder installs a handful of through-hole components to complete the receiver, including a satellite patch antenna that mounts on the opposite side of the board. The PC board acts as a ground plane for this antenna.

Bottom Line

The QRP Labs QLG1 GPS receiver and 20 W dummy load are inexpensive and useful accessories for the QCX transceiver. The QLG1 adds WSPR operation, and it might surprise you how far the 5 W signal can travel.

Assembly is rather quick and simple. The instructions are clear and well illustrated. As usual with today's kits, you will need a pencil tip soldering iron (40 W or so), thin solder, a good light, and perhaps a magnifying aid.

There are several decisions to make while building the board. First, if you look carefully at the assembled board in Figure 6, notice that the three indicator LEDs are mounted on the opposite side of the board from most of the other parts. In use, the board is turned upside down so the patch antenna faces up. It makes sense to mount the indicator LEDs on the same side of the board as the antenna so they are visible when the antenna faces the sky.

The second decision is related to the antenna. If you want to use your own external GPS satellite antenna, the board accepts an SMA connector in place of the supplied patch antenna.
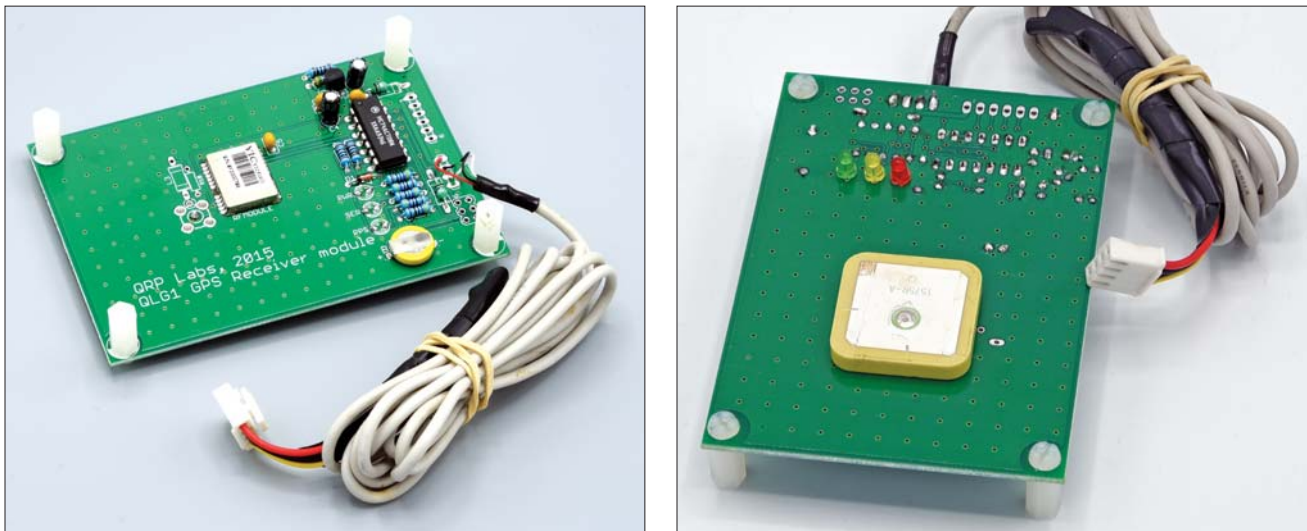
Figure 6 — The assembled QLG1 board, top and bottom. The top side, with the GPS receiver and most of the components, has plastic stand-offs on each corner for support when the board is inverted. The patch antenna and indicator LEDs on the other side face up during operation. The PC board acts as a counterpoise for the patch antenna, and its size and layout were optimized for best antenna performance.

The instructions detail how to make this change.

The final decision is how to build the cable connecting the QLG1 to the QCX transceiver. You will need to supply a cable with appropriate connectors; none come with the kit. A four-conductor shielded cable is recommended, with the shield connected only to the ground pin on the QCX transceiver side. I used an old computer USB cable with the ends cut off. It had four colored wires inside a shield. The maximum suggested cable length is 3 meters.

While assembling the QCX transceiver, you most likely installed a set of four pins on the right edge of its board for the QLG1 connection. The pins are spaced 0.1 inch apart, which is a common PC board header spacing. (If you don't have a connector handy, I found that a four-pin IC socket, turned upside down, will fit the four pins.) I soldered the other end of the cable directly to the four pads on the QLG1 board.

The only difficulty with this interconnection is that, as described in the QCX review last month, you have to remove the top cover from the transceiver enclosure to connect or disconnect the cable. The QLG1 should only

Timestamp	Call	MHz	SNR	Drift	Grid	Pwr	Reporter	RGrid	km	az
2019-05-29 09:44	N1II	7.040012	-9	0	FN31	5	N5CEY	EL16gq	2770	241
2019-05-29 09:44	N1II	7.040009	+5	-1	FN31	5	KD6RF	EM22	2187	250
2019-05-29 09:44	N1II	7.040002	-25	-1	FN31	5	AD0RM	DM68cd	2971	274
2019-05-29 09:44	N1II	7.040009	-17	0	FN31	5	KA5LUG	EM31ls	2078	245
2019-05-29 09:44	N1II	7.040001	-26	0	FN31	5	W3LLA	DN70ln	2671	279
2019-05-29 09:44	N1II	7.040003	-22	0	FN31	5	VK7JJ	QE38lr	16708	257
2019-05-29 09:34	N1II	7.040010	-15	-1	FN31	5	N5CEY	EL16gq	2770	241
2019-05-29 09:24	N1II	7.040003	-19	-1	FN31	5	VO1DZA	GN37po	1743	60
2019-05-29 09:24	N1II	7.040009	-26	-1	FN31	5	N5CEY	EL16gq	2770	241
2019-05-29 09:14	N1II	7.039999	-15	-4	FN31	5	K3FEF	FN21mh	161	264
2019-05-29 09:14	N1II	7.040008	-11	-1	FN31	5	N5CEY	EL16gq	2770	241
2019-05-29 09:04	N1II	7.040001	-11	-2	FN31	5	K2JY	EM40xa	1988	236
2019-05-29 09:04	N1II	7.039996	-11	-2	FN31	5	K3FEF	FN21mh	161	264
2019-05-29 09:04	N1II	7.040005	-22	-2	FN31	5	N5CEY	EL16gq	2770	241

Figure 7 — Reception reports for my some of my 40-meter WSPR beacon transmissions displayed on the **wsprnet.org** website.

What is WSPR?

Originally developed by Joe Taylor, K1JT, WSPR (Weak Signal Propagation Reporter) implements a digital protocol designed for checking propagation paths using low-power transmissions. Transmissions include the station's call sign, Maidenhead grid locator, and transmitter power in dBm (decibels referenced to 1 milliwatt; 0 dBm = 1 mW). Stations around the world receive and decode the transmissions and report the results (stations heard and signal strengths) on the internet. You can use it to see how propagation is at any particular time or to compare antenna performance.

WSPR is one of the modes included in the popular *WSJT-X* digital communications software package, and an older standalone version, WSPR 2, is still available. For more information, see **physics.princeton.edu/pulsar/k1jt/wspr.html**.

be connected when the WSPR Beacon mode is on, or when using the alignment menu items for 20 MHz and 27 MHz crystal calibration. It should be disconnected at other times (such as during CW operation). See the QCX assembly manual for details.

Setup for WSPR

The software to use the WSPR mode is contained in the QCX transceiver's firmware. To simplify the setup, the QCX instruction manual offers some typical settings for Menu 6, the Beacon menu:

6.1 Set **BEACON** to **ON**

6.2 Set **MODE** to **WSPR** (reset it to **CW** when you return to that mode).

6.3 Set **FREQUENCY** to a WSPR channel (see the list of frequencies in the QCX manual). Note that the frequencies listed on the **wsprnet.org** website are for the dial frequency while in USB mode. Set your QCX transmitter frequency to the actual frequency, which is 1,500 Hz higher than the USB dial frequency. For example, 7040.1 kHz is a 40-meter WSPR frequency that corresponds to a USB dial frequency of 7038.6 kHz.

6.4 Set **FRAME** to 10. You will then transmit every 10 minutes (transmitting too often is considered impolite).

6.5 Set **START** to 0, 2, 4, 6, or 8. This setting specifies the number of minutes past the hour that the first transmission of each hour will start. (WSPR transmissions always start on the 2nd second of even minutes.) Thereafter, it will repeat at the interval specified by the **FRAME** parameter set in Menu 6.4.

6.6 Set **WSPR CALL** to your call sign. This gets a bit tricky — read the instructions carefully. If you have a "2 × 3" call sign such as WB1GCM, just enter it. Because my call sign — N1II — has a single-letter prefix, it must be preceded by a space, which is a specific character in the available alphabet. Because my suffix is only two letters, it must be followed by a space character. If your call sign (or your location — next step) contains a

number 1, make sure you select the number 1, not the character represented by a single vertical dash.

6.7 Set **WSPR LOCATOR** to the first four digits of your Maidenhead grid locator (in my case, FN31). There are a number of online sites that will help you find your grid locator (see **www.arrl.org/grid-squares**).

6.8 Set **WSPR POWER** to your transmitter power in dBm. *The ARRL Handbook* and other references have tables to convert power in watts to dBm, or you can search for an online calculator. The QCX has a 5 W transmitter, equivalent to 37 dBm.

6.9 Set **TIME** to UTC as accurately as possible.

The entire system works well even if you cannot get a good look at the satellites. However, if you can place the unit (with the antenna facing up) in view of the satellites, the GPS satellite downlink will do the following:

1) Recalibrate the 27 MHz reference oscillator and 20 MHz system clock for the GPS unit and the QCX.

2) Correct any drift in the transmitter frequency setting you entered in Menu 6.3.

3) Correct the real-time clock you set in Menu 6.9.

4) Refine your Maidenhead location, if necessary.

Up and Running

After completing the setup — and remembering to turn power off, reconnect the cable, and turn power on — you are now running in the WSPR beacon mode. It is best to keep an antenna or dummy load connected to the QCX antenna jack at all times. Running the transmitter without a load may damage the finals.

You can see what is going on by looking at the three LEDs. The red LED (**PWR**) indicates power on. The yellow LED (**SER**) flashes when data is being transmitted. The green LED (**PPS**) flashes once per second for a tenth of a second when a satellite signal is detected. If you have a power meter in line or can listen on another receiver, you will confirm that the transmitter is putting out a signal every 10 minutes — assuming you set the **FRAME** time to 10.

I tested WSPR operation with both the 40- and 80-meter versions of the QCX transceiver. Some 40-meter reception reports from **wsprnet.org** are shown in Figure 7. For example, the top line shows that at 0944Z on May 29, N1II in FN31 was heard on 7.040012 MHz

Figure 8 — A **wsprnet.org** map display of stations receiving some of my 80-meter WSPR beacon transmissions.

by N5CEY in grid EL16gq. N1II was transmitting with 5 W, and his signal report was –9 dB (signal-to-noise ratio — SNR) over a distance of 2,770 kilometers.

Figure 8 shows a map version of reception reports from the **wsprnet.org** website. This map is from some of my 80-meter transmissions, and propagation that evening was great, with reports from all over the US, a number of stations in Europe and Africa, and even a stray report from Antarctica.

So if you get tired of making QRP CW contacts with your QCX, turn on the WSPR function and see where your signal is going!

Dummy Load Kit

QRP Labs also offers a 20 W dummy load (see Figure 9). It consists of 20 1 kΩ, 1 W resistors, which you assemble as a sandwich between two PC boards. The transmitter is connected through a BNC connector, and a diode and 10 nF capacitor are mounted across the load. Assembly instructions are available for download from the QRP Labs website.

In the package are 22 identical resistors. After mounting 20 resistors, one of the spares is used as a jumper connecting the two boards. The diode and capacitor act as a peak voltage detector, which you can use with a standard high-impedance digital voltmeter (DVM) to get an approximation of transmitter output power. At the end of

Figure 9 — The dummy load consists of a sandwich of two printed boards with 20 resistors in the middle. A BNC connector, diode, and capacitor are mounted to the lower board.

the assembly instructions are curves that correlate the voltage measured with a DVM to power. Note that variations in the diode and DVM characteristics will result in slightly different curves than the ones given in the manual.

If you take the hint in the assembly manual and cut the resistors as shown in Figure 10, so that each row of resistors has leads of a different height, assembly time is an hour or
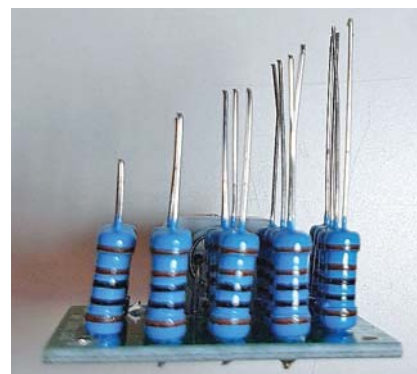

Figure 10 — Rather than trying to get 20 resistor leads to slide into 20 holes simultaneously, the instructions suggest cutting the leads as shown so that you only have to get four at a time to go in — start with the longest set. [QRP Labs, photo]

perhaps two. Doing it this way, you are fitting only four resistor leads at a time through the top board. If you leave the lead lengths all the same and try to get the 20 resistor leads through the 20 holes in the top board all at once, it will probably be a longer and more frustrating experience.

After the assembly, you will have a compact 20 W dummy load, air cooled, measuring approximately 1¹¹⁄₁₆ × 1⅜ inches by ⅝ inch high (excluding the BNC connector).

Manufacturer: QRP Labs, Mugla, Turkey; **www.qrp-labs.com**. Price: QLG1 GPS receiver kit, $23 (assembled, $30); dummy load kit, $8.50. Postal service airmail shipping to the US typically takes 2 – 3 weeks and starts at $5.