LNR Precision LD-5 QRP Transceiver

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The QRP world has seen the introduction of a number of new transceivers over the past year, either in kit form or assembled and ready to use right out of the box. One of the newest additions in the ready-to-use category is the LD-5 QRP transceiver available from LNR Precision. It covers 40, 30, 20, 17, and 15 meters. RF output power is adjustable, 5 W nominal. In addition to CW and SSB, the radio is capable of PSK, RTTY, and SSTV operation with a companion computer with sound card and software.

The LD-5 is actually an SDR in a box with switches and knobs, and so it offers quite a few features for a small transceiver such as multiple bandwidth filters, noise blanker, notch filter, speech compressor, built-in CW keyer and more. There are also some performance anomalies, as discussed in the accompanying sidebar from the ARRL Lab. It is possible to upgrade the firmware via the USB port. In fact, three revisions were downloaded during the review period.

There is a fairly comprehensive manual available online featuring color illustrations. I might suggest printing it out in the landscape mode for easier viewing. The manual could do a better job of explaining some of the settings and connections, but you can figure it out from what's there and LNR responded quickly by email to a few questions we had.

A Compact Package

The LD-5 is a bit larger than the previous QRP radios from LNR, but it still is very compact and sleek looking at approximately 2.8 × 5.5 × 4.2 inches. It weighs in at just 19 ounces without the microphone. While this may not be classified strictly as a Trail Friendly Radio it is still reasonably small enough to be taken in a backpack. The LD-5 may be powered by a 10.5 to 15 V dc power source and has polarity protection circuit. The Lab measured the maximum current draw on transmit at 1.55 A, something to consider if you plan on taking it on a hiking trip and using strictly battery power.

The front panel sports a highly legible LCD display with blue backlighting and the characters in white. The display backlight can be set to always be on, be on for 3 seconds whenever a switch or the encoder is activated, or it can be switched off to save 45 mA of current drain.

There are 13 push buttons for the various functions, along with the volume control and the main tuning knob. The buttons feel sturdy with a positive action. I like that the tuning knob features smooth tuning that reminds me of using a full-size rig — no detents as often found in radios in this class. I also like the feet that swing down to allow you to tilt the unit for easy viewing. A clear plastic escutcheon provides good protection to the display and main tuning knob skirt area.

The key, mic, headphone, and line in/out connections (all 3.5 mm phone jacks) are on the left panel. The computer control (USB), antenna (BNC), PTT out (phono), dc power input jack (coaxial) and a speaker are on the right hand side. The built-in speaker is a nice plus in a compact transceiver such as this if you should ever forget the earphones or want to keep accessories

Bottom Line

The LNR Precision LD-5 packs a lot of features into a tiny QRP transceiver capable of SSB, CW, and digital operation. It's got a few performance anomalies, but overall is enjoyable and satisfying to use.

to a minimum while traveling. The line in/out jack is for connecting a computer sound card for digital modes.

Out of the Box

When I was first introduced to low power work, very simple radios such as the classic Tuna Tin 2 transmitter featured in *QST* were popular. It's amazing how far equipment technology has advanced in modern QRP radios.

For me, the most exciting part of checking out a new radio is actually using it in the shack. My first impression of the LD-5 was very good. The receiver seems very sensitive with many signals heard on the active bands providing good copy on both SSB and CW. The display normally shows a signal strength reading on receive and on transmit indicates power output or SWR depending on the menu setting. The controls are user friendly and I quickly became accustomed to the functions.

The LD-5 provides full band coverage on the five amateur bands it was designed for, but it does not provide continuous receive from 7 to 22 MHz as one might think from first looking at the manual. Band selection is easy just by pushing the up or down arrow buttons. An updated manual on the LNR website describes a method to expand the receive-only capabilities to cover 80 and 160 meters.

The LD-5 has two VFOs, convenient for split frequency operation or jumping from one end of the band to the other after setting appropriate frequencies. Tuning past the band edge causes the coverage to loop back to the opposite band edge. For instance, tuning past 7.300 returns you to 7.000, a nice feature giving you the opportunity to either tune back down the band or tune up from the bottom end.

Tuning steps are selectable — 10 Hz, 100 Hz, 1 kHz, and 10 kHz — either by pressing the STEP button or by pushing on the tuning knob. A small indicator on the display screen shows which step is engaged.

The radio features 100 memories that store frequency, mode and other radio settings, providing plenty of storage for even the most ardent user. To store a frequency, first tune it in using either VFO. Set the mode and any other features you wish to store. Press MEMO, use the VFO knob to bring up the memory location you wish to store

Test Results from the ARRL Lab

The keying waveform plot in Figure 6 shows somewhat unusual behavior. Three dits were transmitted at 60 WPM for this plot, using the standard Product Review test setup and conditions. Upon keying the transmitter, there's a low level artifact that precedes the first transmitted dit. The shape of the first dit indicates that full power output does not occur immediately at the beginning of this dit.

We found that at slower speeds, the artifact is not present, but the odd shaped first dit remains. I investigated for possible on air effects by asking *QST* Product Review Editor Mark Wilson, K1RO, to meet me on 40 meters during excellent band conditions. Mark gave a critical listen to the LD-5's CW signal and could not hear any unwanted effects from the keying shape of this first dit. The transmitted signal sounded fine.

Figure 7 shows the output of the LD-5 during keying sideband testing. Usually the result is a single signal that tapers off into the spectrum analyzer's noise floor. As expected from the LD-5's soft keying waveform, this test shows rather narrow sidebands for the main signal. However, the main CW signal is accompanied by discrete spurious signals ±3 kHz of the fundamental frequency. The position of the "spurs" is dependent on the frequency of the LD-5's CW pitch control. In this case, the pitch was adjusted to 600 Hz with a resulted four spurs appearing on each side of the carrier.

I suspect these spurs are present because CW is generated by an audio tone is used to modulate the single sideband portion of the transmitter. The tone generator has harmonics, which are transmitted along with the desired signal. While this may look unusual, this method of keying has been used in the past with acceptable results. Note that the power of each spur is 46 dB or lower below the carrier, which translates to only 1.25 µW of power for the worst case spur. K1RO could not detect any of the spurs during our on-air tests, even though signals were quite strong. The spurs could bother nearby stations if the LD-5 is used with an amplifier.

I had the opportunity to operate the LD-5 while staying in Dayton, Ohio, for the 2015 Hamvention. There was a tree in a convenient location outside my second story hotel window to attach a thin 23 foot wire. Using a small LC antenna tuner and 23 foot counterpoise stretched across my hotel room, I managed to work stations several hundred miles distant on 40 and 30 meters, and a handful of European stations on 20 meters in the CW mode, with good reports. It's a fun radio with a good quality feel.
— *Bob Allison, WB1GCM, ARRL Senior Test Engineer*

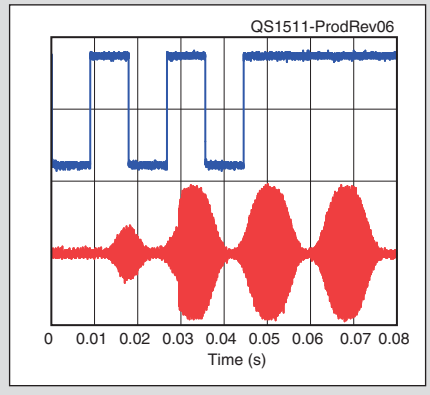

Figure 6 — CW keying waveform for the LNR Precision LD-5 showing the first three dits using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) The low-level artifact before the first dit is not present at slower CW speeds — see the sidebar. Horizontal divisions are 10 ms. The transceiver was being operated at 5 W output on the 14 MHz band.

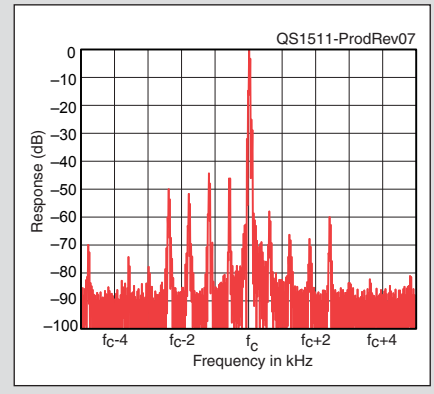

Figure 7 — Spectral display of the LNR Precision LD-5 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 5 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

(0-99), press the down-arrow button and press MEMO again. To recall a stored memory channel, press MEMO, tune the VFO dial to the desired memory location, press the up-arrow and press MEMO again. This all sounds confusing but becomes second nature after you have entered in several memories.

Over twenty different settings are controlled in the menu. Just push to enter, select the desired setting by the up/down buttons and push again to exit. For example, AGC is adjustable from a menu, as is CW pitch.

There are four bandwidth selections available for SSB and CW. Filters 1 – 3 for each mode are set at the factory. The ARRL Lab measured the CW filters at 800/500/200 Hz and the SSB filters at 2700/2400/2000 Hz. Filter #4 is user adjustable from a menu, 50 – 2400 Hz for CW and 250 – 3400 Hz for SSB.

The receiver includes a noise blanker and digital noise reduction. Both are adjustable over a wide range. The noise reduction works very well. It does add some distortion, but it greatly improves intelligibility, even when set to maximum (100).

A hand mic is included for SSB operation. The LD-5 offers some features found on full-size radios — VOX, a speech compressor, three-band transmit audio equalizer and transmit monitor. The mid-range for the equalizer worked best for casual QSOs. The high frequency setting added some punch for pileups or tough conditions, but did not sound as pleasing. WB1GCM experimented with the speech compressor. It adds some punch, and he found that a setting of 30 (range is 0-100) sounded the best with his voice. Bob also found the SSB notch filter effective against carriers.

Metering and Protection

You can check the power supply voltage by pressing the F (function) button and then the MENU button. This is very useful when operating on a battery supply. I did find that with the review unit it sometimes took several attempts to switch back and forth.

The LD-5 has a built-in power meter and SWR indicator. Lab tests showed that for a 25 Ω resistive load (2:1 SWR), the LD-5 indicated 2.5:1 SWR. For a 100 Ω resistive load (also 2:1 SWR), it indicated 7.5.1. We contacted LNR Precision about this, and they replied that it is a known issue but did not have a solution. I would recommend using an external SWR meter for unknown antennas and for adjusting an antenna tuner. The radio has built-in SWR protection, and the manual states that the radio will deliver full power into an SWR of 3:1 or less. At a greater mismatch, the protection circuit lowers the power output. The inaccurate SWR indicator causes a problem here. With both of the 2:1 SWR loads described above, the LD-5 reduced power to about 2.5 W. In summary: The LD-5 needs a very

Table 4
LNR Precision LD-5, serial number n/a

Frequency coverage: 7 – 22 MHz.	Receive and transmit, 7 – 7.3, 10 – 10.15, 14 – 14.350, 18.068 – 18.168, 21 – 21.45 MHz.
Power consumption: receive, 350 mA; transmit, 1 – 2 A (typical) at 10.5 – 15 V dc.	At 13.8 V dc: Receive, 485 mA (max display brightness, max volume, no signal), 440 mA (min display brightness, max volume). Transmit, 0.95 – 1.55 A (10 – 100 % transmit power).
Modes of operation: SSB, CW, digital.	As specified.
Receiver	**Receiver Dynamic Testing**
Sensitivity: 0.2 µV (–121 dBm) with preamp.	Noise floor (MDS), 500 Hz bandwidth: *Preamp off* / *Preamp on* 7.0 MHz –125 dBm / –133 dBm 14 MHz –125 dBm / –133 dBm 21 MHz –124 dBm / –130 dBm
Noise figure: Not specified.	Preamp off/on: 14 MHz, 22/14 dB.
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz bandwidth: *20 kHz offset Preamp off/on* / *5/2 kHz offset Preamp off* 14 MHz 117/111 dB* / 117/117 dB*
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: 112/105/104 dB.*

ARRL Lab Two-Tone IMD Testing** (500 Hz bandwidth)

Band/Preamp	*Spacing*	*Measured IMD Level*	*Input Level*	*Measured IMD DR*	*Calculated IP3*
14 MHz/Off	20 kHz	–125 dBm –97 dBm	–30 dBm –21 dBm	95 dB	+18 dBm +17 dBm
14 MHz/On	20 kHz	–133 dBm –97 dBm	–46 dBm –33 dBm	87 dB	+6 dBm –1 dBm
14 MHz/Off	5 kHz	–125 dBm –97 dBm	–35 dBm –23 dBm	90 dB	+10 dBm +14 dBm
14 MHz/Off	2 kHz	–125 dBm –97 dBm	–35 dBm –23 dBm	90 dB	+10 dBm +14 dBm

Second-order intercept point: Not specified.	Preamp off/on, 14 MHz, +43/+9 dBm; 21 MHz, +53/+52 dBm.
Notch filter depth: 6 – 40 dB.	0 – 35 dB.

Manufacturer's Specifications	Measured in the ARRL Lab
S meter sensitivity: Not specified.	S-9 signal, preamp off/on: 14 MHz, 2.14 mV/385 µV.
Receiver audio output: 200 mW.	490 mW into 8 Ω. THD @ 1 V_{RMS}, 1.75%.
IF/audio response: Not specified.	Range at –6 dB points (bandwidth): CW (500 Hz): 360 – 850 Hz (490 Hz) Equivalent Rectangular BW: 496.5 Hz USB (2.4 kHz): 316 – 3690 Hz (2374 Hz) LSB (2.4 kHz): 314 – 2692 Hz (2378 Hz)
Image rejection: Not specified.	71 dB.
Transmitter	**Transmitter Dynamic Testing**
Power output: 3.5 – 8 W.	7 MHz, 0.25 – 3.4 W; 10.1 MHz, 0.5 – 5.6 W; 14 MHz, 0.6 – 5.3 W; 18.1 MHz, 0.5 – 4.7 W; 21 MHz, 0.6 – 5.1 W.
Spurious-signal and harmonic suppression: Not specified.	46 dB.† Complies with FCC emission standards.
SSB carrier suppression: Not specified.	52 dB.
Undesired sideband suppression: Not specified.	39 dB.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order, 5 W PEP: –30/–39/–41/–52 dBc (worst case, 21 MHz) –35/–45/–52/–55 dBc (typical).
CW keyer speed range: Not specified.	4 to 52 WPM, iambic mode A or B.
CW keying characteristics: Not specified.	See Figures 6 and 7.
Transmit-receive turn-around time (PTT release to 50% audio output): Not specified.	S-9 signal, AGC fast, 71 ms.
Receive-transmit turn-around time (tx delay): Not specified.	82 ms.
Transmitted phase noise: Not specified.	See Figure 8.
Size (height, width, depth): 2.8 × 5.5 × 4.2 inches including protrusions. Weight: 1.25 lbs.	
Price: $575.	

*AGC could not be disabled. Blocking gain compression and reciprocal mixing were measured with AGC on.
**ARRL Product Review testing includes Two-Tone IMD results at several signal levels. Two-Tone, 3rd-Order Dynamic Range figures comparable to previous reviews are shown on the first line in each group. The "IP3" column is the calculated Third-Order Intercept Point. Second-order intercept points were determined using –97 dBm reference.
†Spurious emissions ±3 kHz from carrier in CW mode; harmonic output was significantly less.

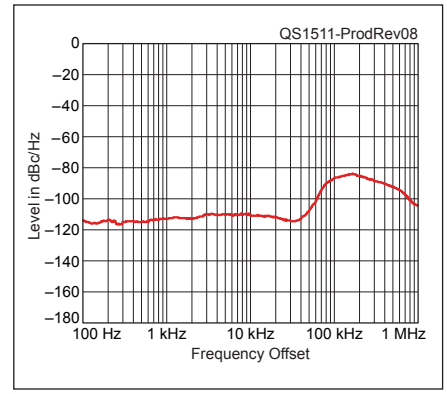

Figure 8 — Spectral display of the LNR Precision LD-5 transmitter output during phase noise testing. Power output is 5 W on the 14 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dBc/Hz.

good SWR to deliver full power, so you will probably need to add a small antenna tuner to your station to operate the LD-5 at full power into many typical antennas.

On the Air

How does the LD-5 work in the shack? I was very favorably impressed with its operation and had no trouble making CW and SSB contacts around the East Coast in a leisurely operating timeframe in the evenings on 40 meters. I also used it during Field Day to check the performance in crowded conditions and I was impressed. My home testing was done using a basic 40 meter dipole only about 10 feet high. This likely closely duplicates portable operating conditions. WB1GCM loaned me a small antenna tuner, which I needed to use with my 40 meter dipole to get full output across the band.

At lunch one day, WB1GCM and I enjoyed making stateside and DX contacts on 20 meter SSB using the Lab's SteppIR Yagi. We received good audio reports using the stock microphone.

The PRF/ATT (preamp/attenuator) button was useful for pulling in the weak ones or taming the overload from nearby W1AW transmissions. CW operation is semi break-in with adjustable delay.

All in all, I found it to be a very good performing radio — fun to operate, and worthy of consideration when considering equipment for low power operation. I liked the physical design, especially the smooth tuning dial, and the radio appears to be durable.

I have long enjoyed QRP operation. It requires more patience, timing, and persistence but the resulting QSOs can be very satisfying. The enthusiasm of the QRP group is contagious, and new records for distance worked with low power levels are constantly being achieved. You too can work 500 or even 1000 miles using 1 W. Think outside of the box and give QRP a try, but be forewarned it can be addictive!

Manufacturer: LNR Precision, Randleman, NC 27317; tel 336-672-1818; **www.lnrprecision.com**.