QST

Product Reviews

June 2025

Banggood SDR TX/RX Switch

Icom IC-R15 Communications Receiver

Product Review

Icom IC-R15 Communication Receiver

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The Icom IC-R15 is a handheld receiver for reception of AM, FM, and wide FM signals between 76 and 500 MHz. It offers a sophisticated dual-receiver design intended to appeal to enthusiasts who need versatile frequency coverage and user-friendly features.

Description

Measuring 2.3 × 4.6 × 1.3 inches (not including protrusions) and weighing about 9 ounces, the IC-R15 is not compact, per se, though it would likely fit within spacious pockets. If you'd rather carry the radio on your belt, Icom includes a robust clip that attaches to the back.

The colorful 1¾-inch (diagonal) TFT LCD screen provides a clear, easy-to-read display, even in bright daylight. In low-light conditions, the IC-R15's backlit buttons make operating much easier.

Immediately beneath the display you will find a multi-selection switch with a center button (think of the center button as an **ENTER** key). This is surrounded by six function buttons and a front-panel power on/off button.

Check the left side of the IC-R15 and you'll discover a slot for a microSD memory card (not included). On the opposite side of the case, there is a USB-C port, which serves as an interface for computer programming, but it also functions as a battery-charging jack. The IC-R15 ships with its own USB-C cable, but for charging you must provide your own power source. This could be a traditional 5 V USB wall-wart charger, a computer USB port, or whatever 5 V dc source you have on hand. Icom also offers a drop-in charger, known as the BC-223, as an option (compatible with the previous IC-R30 receiver).

According to the user manual, the rechargeable BP-287 3280 mAh lithium-ion battery pack (also compatible with the previous IC-R30 receiver) provides up to 13 hours of continuous use. This may be conservative. Even after about 8 hours of continuous monitoring, I noticed that the battery display still indicated an 80% charge remaining.

On the same side as the USB port, the IC-R15 also offers a 3.5-millimeter headphone jack. A female SMA antenna jack graces the top of the radio (a flexible helical antenna is included), along with two concentric knobs. The top knob controls frequency selection and scrolls through menu options, while the bottom knob functions as a volume control.

According to Icom, the IC-R15 features superior IPX7 waterproofing and pro-grade construction.

Frequency Display and Scanning

The IC-R15 is highly intuitive to operate, so much so that I was able to use it straight from the box without consulting the manual. You'd think a radio with two separate receivers would be complicated from the start, but the Icom engineers went out of their way to make the IC-R15 as easy to enjoy as possible.

The frequencies of the dual receivers are displayed in two separate bands labeled A and B. The factory default mode is to display the bands in split screen at start-up, one atop the other, but you can also configure the IC-R15 to display just one band at a time. Volume and squelch levels can be set independently for each band.

Bottom Line

The Icom IC-R15 is the perfect VHF/UHF analog receiver for newcomers, as an introduction to ham radio, but also for more advanced listeners.

Table 1 — Icom IC-R15 Communication Receiver S/N 15001274, Firmware 1.02

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: 108 – 500 MHz, 88 – 108 MHz commercial FM broadcast.	As specified.
Power requirements: 5.0 V dc (±5%) from USB (charging only), 3.6 V dc using the supplied battery pack. Receiving: 360 mA. Standby: 150 mA. Power saving: 80 mA.	Battery pack max voltage (100% charge): 3.98 V dc. Maximum volume, no signal, lights on/off, one receive channel: 370/300 mA. Maximum volume, no signal, lights on, two receive channels: 465 mA. Standby, one receive channel, power save on/off: 72/138 mA.
Modes of operation: A and B bands — FM/FM-N/AM/AM-N; WX (Weather, 10 channels), FM radio (WFM, commercial broadcast frequencies only).	As specified.

Receiver / **Receiver Dynamic Testing**

AM sensitivity: 10 dB S/N, 1 kHz, 30% modulation:
108 – 142 MHz: ≤0 dBµ.
222 – 249.995 MHz: ≤0 dBµ.
250 – 400 MHz: ≤5 dBµ.

10 dB (S+N)/N, 1 kHz tone, 30% modulation:

	Band A		*Band B*		
	AM	*AM-N*	*AM*	*AM-N*	
120 MHz	–113/0.51		–113/0.49		dBm/µV
240 MHz	–114/0.46	–115/0.40	–114/0.47	–115/0.39	dBm/µV
280 MHz	–113/0.52	–112/0.55	–113/0.49	–114/0.45	dBm/µV
350 MHz	–112/0.55	–113/0.52	–113/0.52	–114/0.45	dBm/µV

FM sensitivity: 12 dB SINAD, 1 kHz, 3.5 kHz deviation:
108 – 249.995 MHz: ≤–8 dBµ.
250 – 299.995 MHz: ≤–3 dBµ.
300 – 500 MHz: ≤–5 dBµ.

12 dB SINAD, 1 kHz, 3 kHz deviation:

	Band A		*Band B*		
	FM	*FM-N*	*FM*	*FM-N*	
100 MHz[1]	–118/0.28				dBm/µV
162.4 MHz	–124/0.15		–124/0.15		dBm/µV
146.02 MHz	–124/0.14	–124/0.14	–125/0.13	–125/0.13	dBm/µV
223.50 MHz	–125/0.13	–125/0.13	–125/0.13	–125/0.13	dBm/µV
440.02 MHz	–121/0.19	–122/0.17	–122/0.18	–122/0.17	dBm/µV

FM adjacent channel rejection:
AM/FM: ≥50 dB.
WFM: ≥35 dB.

20 kHz spacing:

	Band A		*Band B*		
	FM	*FM-N*	*FM*	*FM-N*	
146.02 MHz	67[2]	70[2]	69[2]	68[2]	dB
223.50 MHz	69[2]	70[2]	69[2]	69[2]	dB
440.02 MHz	66[2]	67[2]	64[2]	64[2]	dB

FM two-tone third-order IMD dynamic range: Not specified.

At 20 kHz/10 MHz spacing:

	Band A		*Band B*		
	FM	*FM-N*	*FM*	*FM-N*	
146.02 MHz	58/66	56/65	58/66	58/66	dB
223.50 MHz	58/63	58/63	58/63	58/63	dB
440.02 MHz	67/69[2]	67/69[2]	65/70[2]	67/70[2]	dB

FM two-tone second-order IMD dynamic range: Not specified.

	Band A	*Band B*	
146 MHz	82	79	dB
446 MHz	85	84	dB

S-meter sensitivity: Not specified.

For full-scale bar graph reading: 146 MHz, 1.57 µV; 223 MHz, 1.92 µV; 440 MHz, 2.43 µV.

Squelch sensitivity: Not specified.

	Min Threshold Setting	*Max Threshold Setting*	
146 MHz	–116/0.34	–106/1.16	dBm/µV
223 MHz	–114/0.44	–104/1.49	dBm/µV
440 MHz	–114/0.44	–103/1.66	dBm/µV

Audio output: ≥0.12 W (8Ω, 10% THD). — As specified.

Size (height, width, depth, including protrusions): 5.25 × 2.25 × 1.25 inches.
Weight: 0.55 pound with antenna and battery.

[1] Broadcast FM (wide FM).
[2] The unit was noise limited at the value(s) shown.

When it comes to scanning, the dual-receiver design really comes into its own. You can set up two scans to run simultaneously on separate bands, which is a remarkable thing to see. Once again, the radio is so easy to operate that a single press of the **SCAN** button instantly displays your options in plain English. You can scan the band of your choice, using the parameters of your choice, all without consulting the user manual.

The receiver scans at blinding speeds, sweeping through 150 frequencies per second in VFO mode. The IC-R15 includes a range of scanning options, including Full Scan, Program Scan, Memory Scan, and Tone Scan.

Scanning is particularly smooth thanks to the IC-R15's voice squelch control (VSC) feature. With VSC enabled, the radio will automatically skip any signal that lacks a human voice. The VSC worked remarkably well, and I found it to be a godsend when running memory-write scans in particular. It isn't foolproof, but it does a fine job of avoiding most noise bursts, random beeps, and so on.

The IC-R15 treats FM broadcast reception as a separate mode. You access it by pressing the **MENU** button and then using the multi-selection control to highlight and select **FM RADIO** in the display. Even with headphones, reception is monaural only.

Memories

Memories are critical for any modern scanning receiver, and the IC-R15 is generous with 2,000 separate slots. You can store signals in memory groups that the IC-R15 refers to as "categories." This is a huge help in keeping all of your memories organized for easy access. You can even choose among a collection of icons (such as an airplane symbol for an aeronautical frequency) to add to memory labels in the display.

It is interesting to note that the IC-R15 comes preprogrammed with "marine VHF" and "airband" memory categories. The marine VHF memories are populated with all of the standard marine channels, but the airband category is subdivided into frequency memories for several airports: Narita and Kansai (Japan), Dulles (Washington, DC), Frankfurt (Germany), and Heathrow (United Kingdom). The frequencies include tower, ground, approach, departure, and more.

While the IC-R15's memories can be programmed from the front-panel buttons, it is much easier to do with software. There is an Icom programming software called *CS-R15*; it's not free, and at the time this review was written, the software was not available from any retailer in the US, but according to Icom it should be available by the time the review is published. But RT Systems (**www.rtsystemsinc.com**) also offers a software package for the IC-R15 that includes a dedicated cable. The RT Systems cable is necessary because the software won't communicate with the IC-R15 without it; the Icom-supplied cable is not compatible.

Speaking of programming, the IC-R15 allows you to access the microSD memory card with your computer and edit its data directly. For this function you can use the supplied USB cable. You simply install the card of your choice, select the card-reading mode, and plug in the cable. Your computer then treats the card like a separate hard drive.

There is also a function that permits CI-V control of the radio via the USB cable, though at the time this review was written I couldn't locate CI-V control software specifically written for the IC-R15.

Listening In

Using the helical antenna indoors — inside an aluminum-sided house, no less — I found plenty of signals to enjoy. Granted, many public service systems have switched to digital, but several in my area still use analog FM. There was a healthy population of amateur FM repeaters, too. The popularity of digital systems notwithstanding, analog FM still dominates the ham community.

The IC-R15's speaker is small, but the audio sounded clean regardless. Audio fidelity was much better in headphones, as you'd expect. I tried a pair of wired headphones, but I also had the pleasure of using the IC-R15's Bluetooth functionality to pair the radio with my wireless earbuds.

The IC-R15 was sensitive enough that I was able to use it — and its helical antenna — to eavesdrop on signals from the International Space Station without difficulty. I even had an opportunity to decode slow scan TV transmissions from the station simply by feeding the IC-R15 audio to my computer.

Of course, attaching a better antenna makes a world of difference. After connecting my external outdoor antenna, I was deluged with signals and there were times when I had to resort to the IC-R15's attenuator function due to sheer overload. This is understandable, as a handheld receiver will have the proper sensitivity to perform with a small antenna, and signals may overload when connected to a higher-gain external antenna. Tying the handheld to an external antenna defeats the purpose of portability, but it is an interesting exercise just the same.

If you have a memory card installed, the IC-R15 will allow you to record anything you hear. Recording is toggled on and off from a front-panel button, and the audio is saved to the card as a .wav file. You can play these files through the radio or offload them to your computer.

Conclusion

The Icom IC-R15 is a feature-rich receiver that caters well to hobbyists and serious users alike. I even put it to use as a test receiver on my workbench.

Yes, there are other more expansive receivers on the market that include digital reception, but with so many agencies switching to encrypted systems, the return on investment may be questionable.

It is also true that for an additional expenditure you can find handheld receivers that toss HF reception into the feature mix. However, unless you anchor the radio to a superior antenna, the results are often disappointing.

Overall, the Icom IC-R15 offers excellent value if you are in the market for an intelligently designed scanning receiver that offers excellent performance while keeping user-friendliness among its top priorities.

Manufacturer: Icom America, 12421 Willows Rd. NE, Kirkland, WA 98034, **www.icomamerica.com**. Price: $559.95.

InnovAntennas 1712DUO HF Antenna

Reviewed by Ward Silver, NØAX
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The LFA Design

When reviewing "WARC band" beams, one option caught my eye — the two-element 1712DUO LFA beam from InnovAntennas, shown in the lead photo. The LFA driven-element design was created by InnovAntennas owner Justin Johnson, GØKSC, for Yagis in the VHF/UHF bands. He describes the basic LFA Yagi in the 25th edition of *The ARRL Antenna Book* as follows:

> The LFA (Loop-Fed Array) replaces the tips of the driven element with an extended folded-dipole type feed laid flat on the boom. Thus, both sides of the driven loop are in line with the parasitic elements, rather than extending above or below the boom. Unlike a traditional folded dipole driven element, the feed point of the LFA design is in line with the boom and all elements…The LFA design leads to a symmetrical pattern in both the E and H planes.

The LFA is an evolution of Yagi design that provides more consistent performance across a band and reduces side lobes that pick up off-axis noise, both from horizontal directions and from ground-level sources. While this is a more significant problem at VHF/UHF, the benefits of reducing receive noise and interference are also useful on the higher HF amateur bands. You can find out more about LFA designs in

[Image courtesy of DX Engineering]

The ARRL Antenna Book and from GØKSC's LFA design description at **www.g0ksc.co.uk/g0ksc-articles/intro-lfa.html**.

Folded-dipole driven-element designs have been common on VHF/UHF for many years, but not so much on HF. One benefit of the LFA design is a direct-feed 50 Ω impedance that does not require matching, such as by a gamma match or transformer. The feed point must be insulated from the boom, but because

Bottom Line

The InnovAntennas 1712DUO antenna complements a traditional tribander and is more effective on 17 and 12 meters. It's also well designed and constructed such that it should provide years of solid service.

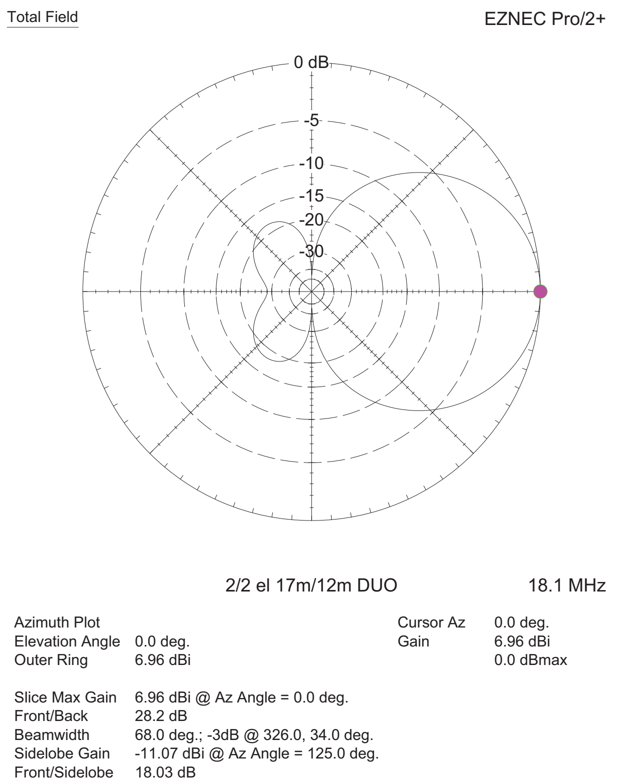

Figure 1 — The 1712DUO 17-meter pattern. The two-element beam has a fairly wide beamwidth but the front-to-back and front-to-side ratios are quite good. [Image courtesy of InnovAntennas]

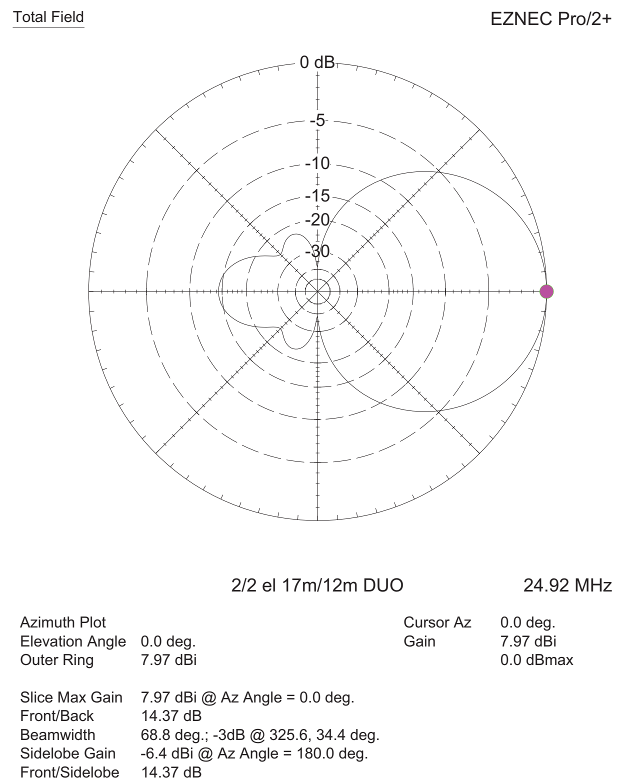

Figure 2 — The 1712DUO 12-meter pattern. The two-element beam has a fairly wide beamwidth but the front-to-back and front-to-side ratios are quite good. [Image courtesy of InnovAntennas]

the element is electrically balanced, the center of the loop's opposite side is an RF-neutral point and can be connected to the antenna boom for mechanical stability. A feed-line choke should be used to prevent interaction with the coax shield.

Overview and Specifications

The 1712DUO is a two-element Yagi with an LFA driven element and single-conductor director on each band. Only the 17-meter driven element is connected to the feed line. The adjacent 12-meter driven element is excited by open-sleeve coupling. To ensure consistent coupling, a pair of plastic spacers hold the driven elements in alignment.

InnovAntennas products are distributed in the US by DX Engineering. The 1712DUO manual may be downloaded from the DX Engineering web page at **www.dxengineering.com/parts/iva-18480-0004**.

Element spacing is optimized for gain and front-to-back ratio across the relatively narrow 17- and 12-meter bands (200 kHz wide, 0.6% and 0.4% wide, respectively). See the manufacturer's specifications in Table 2. Free-space azimuth patterns for 17 and 12 meters are shown in Figures 1 and 2. In comparison, the two-element, 6-foot boom monoband designs in *The ARRL Antenna Book* have about 1 dB less gain and much lower front-to-back ratios. Table 2 also gives the main mechanical specifications.

It is important to manage expectations — regardless of driven-element design, the 1712DUO is still a two-

Table 2 — InnovAntennas 1712DUO HF Antenna

Manufacturer's Advertised Specifications (not tested in the ARRL Lab)

Band	Gain	Front-to-Back Ratio
17 meters	6.9 dBi	28.6 dB
12 meters	7.2 dBi	14.4 dB

SWR bandwidth:	200 kHz both bands
Power rating:	5000 W
Feed-point impedance:	50 Ω
Antenna feed-line connection:	Terminal studs
Wind surface area:	7.6 square feet (0.7 square meter)
Weight:	30 pounds (14 kilograms)
Boom length:	5.12 feet (1.56 meters)
Max. half-element length:	14 feet (4.26 meters)
Turning radius:	14.4 feet (4.39 meters)

Figure 3 — The elements are mounted on an aluminum plate using a STAUFF-style tubing clamp and stainless-steel hardware.

element Yagi. Its excellent front-to-side and front-to-back ratios reduce off-azimuth interference and noise, making the antenna sound a little louder than the usual two-element Yagis.

Mechanically, this is a very compact antenna with a boom length of just over 5 feet. The elements are much longer with the 17-meter driven element extending 14 feet on each side of the boom, creating a turning radius of 14.4 feet. The extra tubing required to construct the LFA elements makes the wind surface area of 7.6 square feet (0.7 square meter) somewhat higher than a single-tube driven-element Yagi design. This antenna can be handled by a HAM-IV-class rotator on the top of a mast, or inside a lattice tower combined with a small tribander, such as the A3S at 4.4 square feet. In temporary installations, it can be easily turned by hand.

The 1712DUO is a fairly narrowband design, and interaction with other antennas will typically result in a large shift in minimum SWR frequency or higher-than-expected SWR. If other antennas will be near the 1712DUO, check their elements or structural components, such as the boom, for resonance or a low impedance on 17 or 12 meters. For example, a 40-2CD "Shorty Forty" beam has a pronounced 17-meter resonance (and is quite useful on that band) that would affect the 1712DUO. To avoid interaction, consider orienting the 1712DUO so its elements are perpendicular to nearby conductors.

Construction

The antenna has a square boom that is different from the round tubing of most small Yagis. The element mounting plates have one bolt through the boom — this sets element spacing. Four bolts then capture the boom with a threaded plate on the other side.

Each element is attached to its mounting plate with a STAUFF clamp, as seen in Figure 3. Stainless-steel bolts and nylon-insert nuts are used throughout. STAUFF clamps have become quite popular and give a more secure attachment than the usual U-bolts. Both insulating and all-metal clamps are used. The square boom and extra-sturdy clamps and plates result in an assembled weight of 30 pounds.

The boom-to-mast assembly uses the usual U-bolts and saddles to accommodate 1.5- to 2-inch-diameter masts. Because the boom is square, it will not rotate in the boom-to-mast clamp as with round tubing. Note that the antenna is not weight-balanced along the boom, which should be taken into account as the antenna is lifted into position and secured. Once mounted, this should not be a problem, as the antenna weighs only 30 pounds.

Individual element sections are relatively short, with none longer than 4.3 feet (1.3 meters) before assembly. Sections are held together with stainless-steel hose clamps. The slotted end of each element was prop-

Figure 4 — The antenna parts as received from the manufacturer.

Figure 5 — The 1712DUO elements and boom assembled prior to adding the boom-to-mast plate and plastic element stabilization strips.

erly deburred so there was no binding on insertion. Personally, I prefer bolts or rivets for assembling telescoping element sections because the hose clamps are intended for use on compressible plastic or rubber tubing, not for metal-to-metal joints. (Also, see the note on thermal cycling later.) Hose clamps also tend to snag on ropes and guys if not wrapped with electrical tape. Nevertheless, they are sufficient for this design.

The LFA loops are formed with a U-shaped piece of tubing that slides into the outer element. The antenna is tuned by sliding both U-shaped sections in and out in equal amounts, so the element remains symmetric with respect to the boom. The dimensions given were accurate, and no adjustment was required after assembly. SWR was initially tested with the boom vertical and the driven element about 10 feet off the ground. (This is a good technique to check HF Yagi assembly before lifting the antenna into final position.)

Due to the antenna's high-Q design, its resonant frequency and SWR dip minimum are quite sensitive to the final installation environment, so adjustment may be required when it is installed in its final location.

Assembly Notes

The antenna is shipped with the elements in several bundles and hardware in sealed bags (shown in Figure 4). A detailed bill of materials is provided, and I recommend a part-by-part check to ensure you have everything before starting the assembly. The cover drawing suggests a 3 kW bead balun should be used, but one is not supplied with the antenna and will have to be obtained separately.

Note that the antenna pieces and hardware are all metric. Most of the hardware is available in the US, but the tubing is not, except from specialty suppliers. The antenna I received had two tubing sections of an incorrect diameter. My provider shipped replacements promptly. No spare nuts or bolts are provided, but they are standard metric sizes available in the US. You might want to get a few spares locally in case you lose or misplace anything. To build the antenna, you will need a 10-millimeter and 7-millimeter metric socket or nut driver, a metric hex key set (3⁄16- and 5⁄32-inch hex keys will also work), and a tape measure with a metric scale.

The manual provided is rather sparse, with assembly instructions limited to a sequence of drawings, similar to certain Scandinavian furniture makers. The drawings are very clear and quite detailed but assume a bit of skill and experience in putting together antennas. There is no discussion of how the antenna works (see the InnovAntennas website), troubleshooting, or a suggested order of assembly beyond figure numbering.

Before beginning, study the manual drawings carefully, especially the plan view titled "Antenna Construction" on page 2, to be sure you understand each major subassembly. Separate the hose clamps by size and the tubing by diameter and length so you use only the right parts for each element. Perform a loose assembly to check for parts and lengths before final assembly of each element. Don't tighten the bolts and nuts on the element mounting plates until you double-check element lengths and orientation of the feed-point hardware. Use a small tri square to be sure the element mounting plates and elements are perpendicular to the boom before tightening. Figure 5 shows the antenna with all elements mounted on the boom.

As with all aluminum and stainless-steel assemblies, you should use protective lubricants to protect the hardware and connections. Figure 3 shows my two favorites: small amounts of Jet-Lube Anti-Seize on threaded stainless-steel fasteners and a thin, even coating of SS-30 Anti-Seize on aluminum tubing joints.

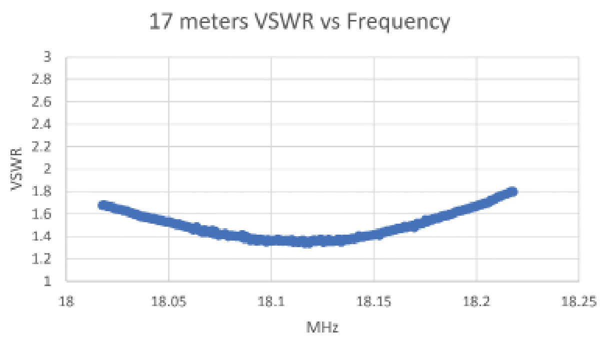

Figure 6 — Measured SWR for 17 meters with the antenna installed 25 feet above ground on a telescoping aluminum mast.

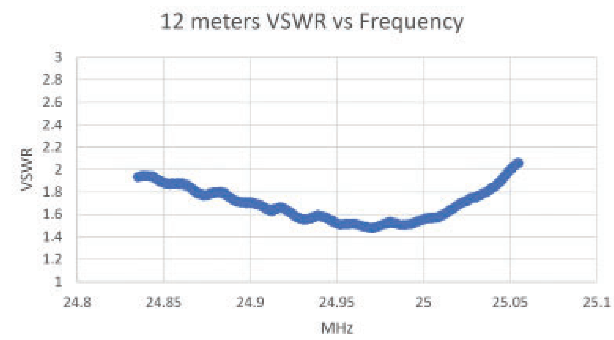

Figure 7 — Measured SWR for 12 meters with the antenna installed 25 feet above ground on a telescoping aluminum mast.

An antioxidant compound such as Noalox or Penetrox can be substituted for SS-30. Have some shop rags handy to keep your hands and tools clean!

Pay particular attention to the feed-point orientation before final driven-element assembly and tightening all clamps. If you plan on using a full 1.5 kW, rotating the feed point so the attachment screws are parallel to the boom avoids creating a space that can capture debris or insect nests, which can arc. If you use a feed-line choke balun, consider how you will mount it and the coaxial feed line before tightening the driven-element clamps. The lead photo shows the balun oriented toward, and the coaxial feed line wrapping around, the end of the boom. You can also orient the coax and balun toward the boom-to-mast clamp.

A final note — mechanical fasteners usually loosen with thermal cycling, no matter how tight they seem after initial assembly. If possible, let the antenna sit outside through at least one day-night cycle and then do a final tightening of each clamp and bolt. You may be surprised at how much additional tightening is possible, particularly of the hose clamps!

The 1712DUO On the Air

After assembly, I operated with the antenna mounted on a temporary mast at a height of about 25 feet above ground. This is about 0.5 wavelength on 17 meters and 0.8 wavelength on 12 meters. This is typical for portable operation on a telescoping mast or on a roof-mounted tripod for a permanent station. SWR measurements are shown in Figures 6 and 7.

The antenna can be partially disassembled and carried on a vehicle roof rack for portable operation. I would also recommend this antenna as a nice complement to a triband Yagi, mounted above it by at least 6 feet and ensuring that the tribander has no resonances on 17 or 12 meters.

Even at the low height, the performance of this two-element beam is a distinct upgrade over a wire ½-wave or trap dipole and would be a dramatic improvement over a ¼-wave ground plane or loaded whip. Mounted higher above ground, this antenna could hold its own against conventional three-element designs. Remember that it is a two-element Yagi and maintain appropriate expectations!

I was able to compare the 1712DUO on the mast to a nearby XR5-T multiband two-element Yagi at about 60 feet up. From Reverse Beacon Network reports from transmission comparisons and FT8 reception signal-to-noise ratio values, the 1712DUO was within 1 S-unit of the higher antenna on lower-angle paths. There were some short-skip, high-angle reports where the 1712DUO was more than an S-unit better than the higher antenna — a valuable reminder that the lower elevation angles are not always best, particularly for domestic propagation around North America. To the side and rear, the two antennas were about the same on comparable paths.

Summary

Adding the 1712DUO to complement a traditional tribander or wire antennas is a good strategy to be more effective on 17 and 12 meters. Similarly, it would be a good choice for a special event or expedition needing a dedicated 17- and 12-meter beam. The antenna is well designed and constructed such that it should provide years of solid service.

Manufacturer: InnovAntennas Limited, 20 Sanders Rd., Canvey Island, Essex SS8 9NY, UK, **www.innovantennas.com**. Distributed in the US by DX Engineering. Price: $829.99.

Banggood SDR TX/RX Switch

Reviewed by Phil Salas, AD5X
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Adding an external SDR receiver to an existing transceiver is becoming popular due to the low cost of these receivers and the additional features they can add. These features include spectrum and waterfall displays, which older transceivers don't have. And these SDRs often cover additional frequency ranges not covered by many transceivers. You can easily and inexpensively connect an SDR to your existing transceiver with the Banggood SDR TX/RX Switch.

Switch Description

The SDR TX/RX switch selects either your transceiver or SDR receiver based on RF sensing from your transceiver. It can also use a push-to-talk (PTT) input from your transceiver. An internal jumper (see Figure 8) determines whether the transceiver and SDR receiver paths are both active during receive, or just the SDR receiver. Normal operation uses the transceiver for transmitting, and the SDR receiver for receiving. When the jumper is removed, both receivers are active. In this case, the RF input is split and sent to both the transceiver and the SDR. Audio from both the transceiver and SDR receiver can be connected to the SDR TX/RX switch. The audio output from the SDR TX/RX switch can then be fed to an external speaker. When connected in this manner, the receiver's audio is muted when transmitting. This is an important feature, in that unmuted receiver audio, when transmitting, can be extremely irritating even with high isolation between the transmit and receive paths.

The lead photo shows the front of the switch, and Figure 9 shows the rear panel; the transceiver and antenna interfaces are UHF connectors. The SDR RF interface is an SMA connector. If used, the PTT input is a 3.5-millimeter mono connector. The transceiver and SDR audio inputs and the audio output are all 3.5-millimeter mono connectors. The 13.8 V dc input uses a 2.1 × 5.5-millimeter jack. An SMA/SMA cable, a 3.5-millimeter pendant cable, and a 2.1 × 5.5-millimeter pendant cable are supplied with the SDR TX/RX switch. There is no on/off switch, though a green power LED lights when the unit is powered. PTT

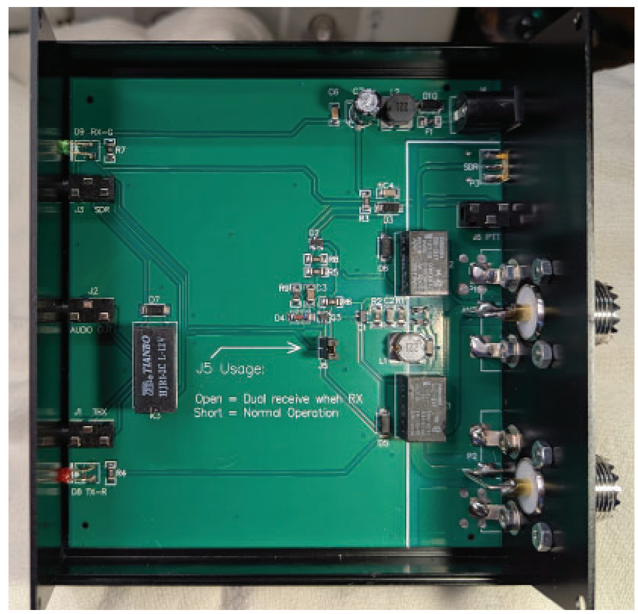

Figure 8 — Internal view of the SDR TX/RX switch.

Figure 9 — Rear of the SDR TX/RX switch.

Bottom Line

The Banggood SDR TX/RX Switch provides an inexpensive and simple means of adding a separate receiver (SDR or otherwise) to your existing station.

Table 3 — Banggood SDR TX/RX Switch

Manufacturer's Specifications (not tested in the ARRL Lab)

Impedance:	50 Ω
Frequency range:	dc – 160 MHz
Maximum transmit power:	100 W
RF sensing threshold:	<10 mW (test frequency is 1.8 MHz – 30 MHz)
Enable/release timing:	<20 ms enable, <190 ms release
Insertion loss:	<0.3 dB @ 144 MHz (typically 0.2 dB)
Receive isolation:	>38 dB @ 144 MHz (typically 40 dB)
Power supply:	13.8 V dc 200 mA
Dimensions:	4.9 × 4.3 × 2 inches (126 × 119 × 52 millimeters)
Weight:	15 ounces (430 grams)
Gas discharge protection	

switching is designed to interface with any amp-key interface that provides a contact closure to ground. When the TX/RX switch is in the transmit mode, either due to RF sensing or the PTT input, a red transmit LED is illuminated. This same red LED is constantly illuminated when both receive paths are active during receive (when the internal jumper is removed). Relays are used for both RF and audio switching. If PTT switching is used with both the SDR TX/RX switch and an external amplifier, you will have to use an amplifier keying splitter cable. Finally, no documentation comes with the SDR TX/RX switch, but the manual can be found on the Banggood website (see **https://usa.banggood.com/SDR-Transceiver-and-Receiver-Switch-Antenna-Sharer-TR-Switch-Box-with-Gas-Discharge-Protection-160MHz-p-1734290.html**). The published specifications are shown in Table 3.

Performance Measurements

I began my tests by looking at SWR/return loss and insertion loss. All measurements were made with an Array Solutions VNAuhf. The VNAuhf was calibrated using N/UHF and N/SMA adapters. The insertion loss through path was calibrated using a microwave 3 dB attenuator in series to improve the return loss of the through cable and VNAuhf input impedance.

Figure 10 shows the TX-to-antenna SWR/return loss, and Figure 11 shows the TX-to-antenna insertion loss.

As you can see, the input is capacitive below about 120 MHz and inductive above this frequency. There is apparently a resonance in the through path — possibly between the relay contacts and the relay coils. The SWR is about 1.5:1 on 10 meters, and about 2:1 on 6 meters. And insertion loss is about 0.5 dB on 10 meters and 1.0 dB on 6 meters. This is certainly not consistent with the published insertion loss specifications. Based on these measurements, I would not recommend transmitting above 10 meters when using this switch.

I next looked at insertion loss from the antenna port to the SDR port (normal operation), and insertion loss to both the radio port and the SDR port when both receive paths are active. Any loss here impacts the noise figure of the SDR receiver. The measurements are shown in Figures 11, 12, and 13.

As you can see in Figure 12, for normal operation (SDR path only on receive), the loss on 6 meters is only about 0.3 dB, and about 0.6 dB on 2 meters. Figures 13 and 14 show the insertion loss for the SDR and transceiver receive paths, respectively, when both receive paths are active. About 4 dB of insertion loss is added to both receiver paths due to splitting the RF signal.

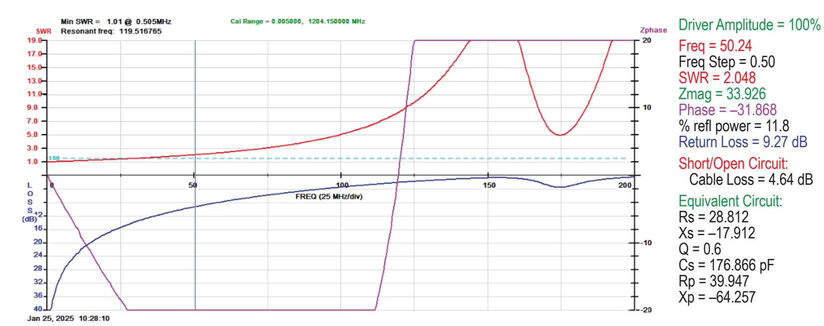

Figure 10 — TX/ANT SWR/return loss.

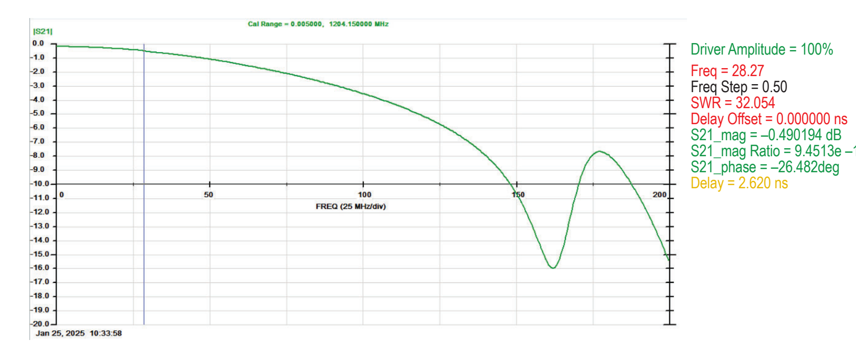

Figure 11 — TX/ANT insertion loss.

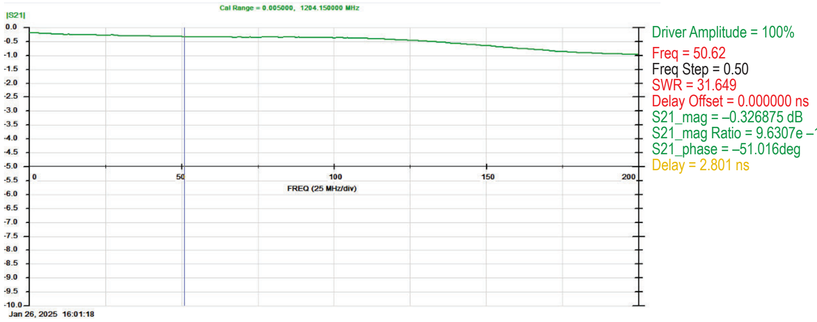

Figure 12 — ANT/SDR insertion loss.

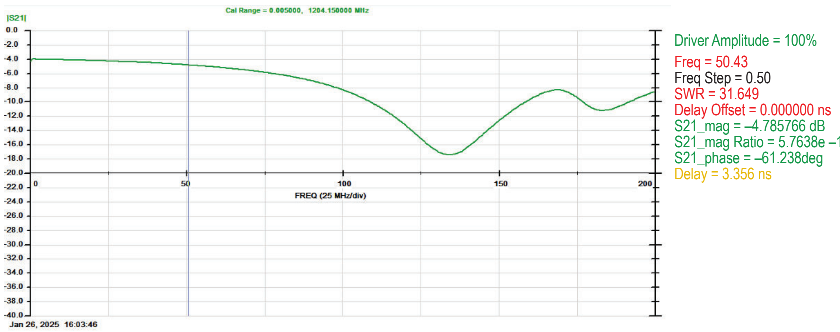

Figure 13 — Antenna/SDR dual receive.

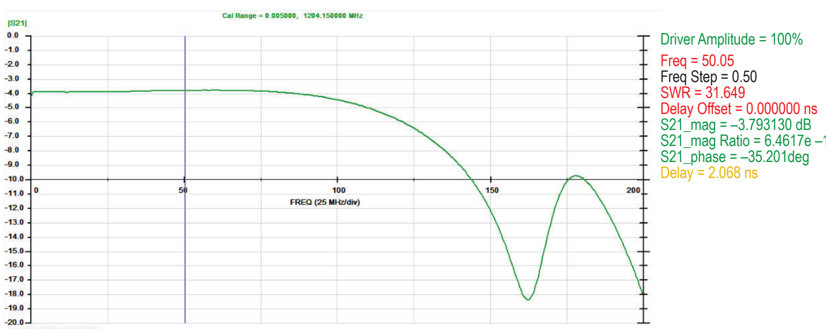

Figure 14 — Antenna/radio dual receive.

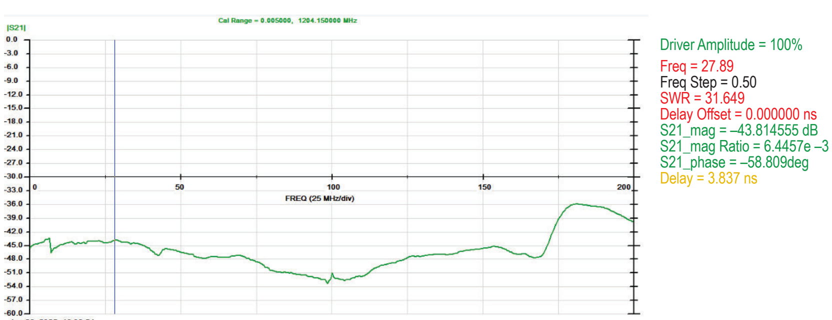

Figure 15 — TX/RX SDR isolation.

Finally, I looked at isolation between the TX/RX SDR port when in the transmitting mode. For a 100 W transmitter, you want any leaked RF power to be less than about 10 mW so as not to damage your SDR. That means that you would want at least 40 dB of isolation if you are using a 100 W transmitter. The data shown in Figure 15 shows a minimum isolation of almost 44 dB.

Before using the switch, it is important to understand the relay operation times. We certainly don't want to damage an SDR, or hot-switch the transmitter by transmitting before the relays have had time to operate. We will first look at the RF sense timing.

Figure 16 shows the transmit relay enable timing when the TX/RX switch senses RF. The upper trace is the transceiver RF output, and the lower trace is the TX/RX switch antenna RF output. RF sensing is much better than specified, at about 2.5 ms sense to switch. However, during the 2.5 ms, the transmitter is being hot-switched. I was only transmitting a few watts, but you can see the impact on the transmitter output during the relay switching. Perhaps a 2.5 ms hot-switch is not a problem for some transceivers. However, it makes me uncomfortable. As the RF sensing prevents the relays from disengaging until RF goes away, there was no hot-switching when the relays were disabled.

Next, I looked at the transmitter output when using the PTT input from the transceiver to enable the TX/RX switch. You can see in Figure 17 that there is no hot-switching. And the reason can be seen in Figure 18. The lower trace shows the PTT input, and the upper trace is the transmitter output. As you can see, PTT occurs almost 15 ms before the RF output occurs.

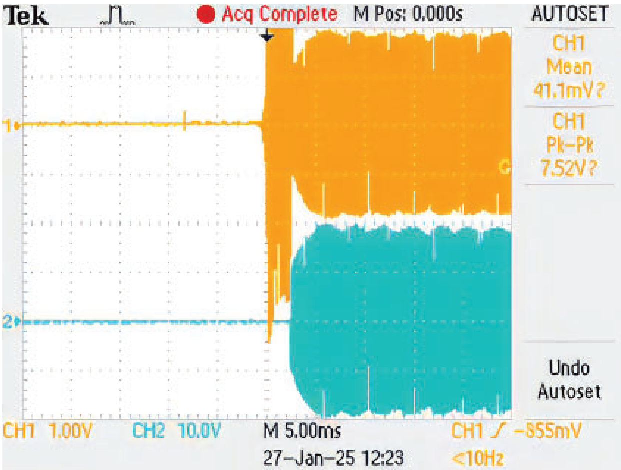

Figure 16 — Upper trace is the transmitter output. Lower trace is the TX/RX switch RF output during RF sensing.

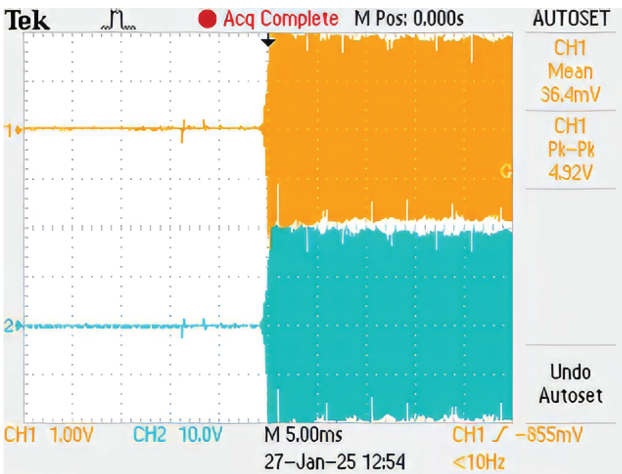

Figure 17 — Transmitter output and TX/RX switch output with PTT switching.

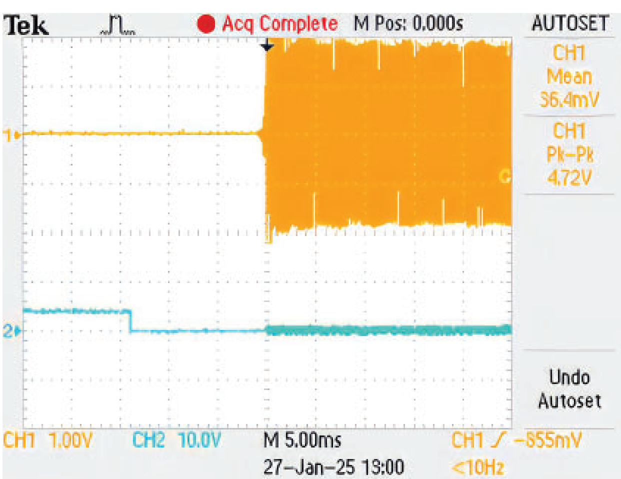

Figure 18 — PTT input to the TX/RX switch occurs ~15 ms before RF is enabled, thus preventing hot-switching.

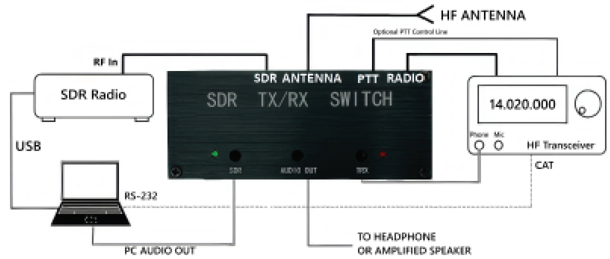

Figure 19 — A typical setup using a computer-controlled SDR with the SDR TX/RX switch.

Using the SDR TX/RX Switch

Figure 19 shows a typical setup. Alternately, the SDR can be a standalone receiver that is individually tuned rather than under control of a computer.

I operated the SDR TX/RX switch with my Yaesu FT-710 transceiver and Xiegu X5105 as a second receiver. If you're using a transceiver as a second receiver, make sure not to transmit, as you can't transmit into the SDR SMA port and this will cause damage. Connecting the audio outputs of both radios to the SDR TX/RX switch was a necessity. Even though there is >40 dB of isolation, the leaked signal into the receiver is still very strong. For example, with 40 dB of isolation in the TX/RX switch, a 100 W transmitter will be at +10 dBm into the SDR. An S-9 signal is –73 dBm, so when your receiver is on the same frequency as the transmitter, you will have a very strong (S9+43 dB) receive signal when you are transmitting. While this level will not harm your SDR, the audio output while transmitting is very loud and irritating. This is why it is important to use the audio muting capability of the TX/RX switch.

Also, because of the fast sensing, I found a lot of relay chatter when using RF sensing with both CW and SSB. The relays are not noisy, but you can hear them if you are not using headphones. Using PTT solves this problem, as the TX delay on CW and PTT on SSB keep the SDR TX/RX switch in the TX mode during transmissions.

Conclusion

The Banggood SDR TX/RX Switch provides an inexpensive and simple means of adding a separate receiver (SDR or otherwise) to your existing station. And while the SDR may be used up to 160 MHz, you should limit your transmissions to 1.8 – 30 MHz and use the PTT input to prevent hot-switching.

Manufacturer: Banggood, **www.banggood.com**. Price: $31.99.