October 2019

Diamond X50A Dual-Band Base Station Antenna

MFJ-849 HF/VHF/UHF SWR/Wattmeter

Mark J. Wilson, K1RO, k1ro@arrl.org

Product Review

Explore the *QST* Product Review Archive
www.arrl.org/qst-product-review-and-short-takes-columns
Search reviews by year or issue of publication, or by manufacturer's name.

Monitor Sensors TVTR2 2200-Meter Transverter

Reviewed by Eric M. Tichansky, NO3M
no3m@no3m.net

In the July 2018 issue of *QST*, we reviewed the Monitor Sensors TVTR1 630-meter transverter.[1] The overall construction, design, and performance was impressive. This month, we'll take a look at the TVTR1's companion, the Monitor Sensors TVTR2 2200-meter transverter.

The 2200-meter band covers the range of 135.7 – 137.8 kHz and is our lowest Amateur Radio allocation. It is also our narrowest band at only 2.1 kHz wide (less than the bandwidth of a typical SSB signal). While there are currently only a small number of stations capable of making two-way contacts while operating down there, the ranks continue to grow.

Needless to say, getting an effective station set up on 2200 meters is challenging, even for operators who have experience on 630 meters. Despite that, there have already been some impressive accomplishments, including transatlantic contacts completed by Paul Kelley, N1BUG, and transcontinental two-way contacts between my station and Ward Wheaton, K7PO, and Larry Molitor, W7IUV, during this past winter low-band operating season. The current Worked All States (WAS) leader on the band is Wayde Bartholomew, K3MF, in eastern Pennsylvania, with a count of 11 states. Keep in mind that all these feats are being performed with an effective isotropic radiated power (EIRP) of 1 W, or in many cases, less.

As is the situation with 630 meters, very few commercial solutions exist to generate a signal at a respectable power level on 2200 meters. The situation is exacerbated by the fact that antenna efficiencies are typically much lower than what is achievable on 630 meters, usually less than 1%.

Construction, Architecture, and Features

We won't rehash the details of the TVTR2's construction, circuit topology, features, or installation and setup. They are essentially the same as the TVTR1 630-meter transverter, and readers can find those details in the July 2018 *QST* review. To easily translate the RF frequency (135.7 – 137.8), the IF frequency is upconverted to 1805.7 – 1807.8. Any transceiver that operates on the 160-meter band and is capable of adjusting its output power down to 5 W or less can be used as the IF radio. However, the same precautions apply with regard to increased phase noise and broadband noise from the exciter radio at low power levels per Rob Sherwood, NCØB, as noted in the TVTR1 review.

Bottom Line

The Monitor Sensors TVTR2 takes a lot of the effort out of getting established on the 2200-meter band.

Just as in the earlier review article, it can't be emphasized enough — the Monitor Sensors series of transverters are designed to withstand serious abuse and should hold up in even the most unforgiving situations. This is particularly important with respect to 2200-meter operation. One scenario that may be experienced frequently is transmitting into a highly reactive load. Antennas on 2200 meters are very "short" electrically (i.e., reactive) and have very sharp tuning. Being off-resonance even tens of hertz will result in a gross mismatch, but the TVTR2 will protect itself by sufficiently reducing the output power until the match is corrected.

Linearity and Stability versus Operating Mode

Generally speaking, the prevalent operating modes on 2200 meters are derivatives of JT9 digital modes and WSPR. This past winter saw a resurgence of the JT9 "slow" modes, namely JT9-2 and JT9-5. These variations have a 2- and 5-minute transmit/receive cycle, respectively. (For more on these modes, see **www.472khz.org/SlowJT9/**.)

[1]E. Tichansky, NO3M, "Monitor Sensors TVTR1 630-Meter Transverter," Product Review, *QST*, pp. 44 – 48.

Figure 1 — The Monitor Sensors TVTR2 rear panel.

Table 1
Monitor Sensors TVTR2, serial number 0144

Used with Icom IC-7100

Manufacturer's Specifications	Measured in ARRL Lab
Frequency range: 135.7 – 137.8 kHz. Converts to 1.8057 – 1.8078 MHz.	As specified.
Power requirements: 15 A at 13.8 V dc.	At 13.8 V dc: Transmit, 11.5 A at 50 W RF output. Receive, 122 mA.
Modes: CW, SSB, WSPR, and all other data modes.	As specified. (Modulation performed by companion 1.8 MHz transceiver.)
Receive sensitivity: –125 dBm.	MDS (noise floor), 500 Hz BW: –123 dBm.
IF rejection: >75 dB.	75 dB (measured at 160 meters).
Power output: 50 W.	As specified.
Driving power: Typically 3 – 5 W.	See "Lab Notes."
Spurious and harmonic suppression: >50 dB.	47 dB (second harmonic); all other harmonics, ≥65 dB. Meets FCC requirements.
Transmit IMD: –33/–45 dB 3rd/5th order.	Not measured. See "Lab Notes" sidebar.
TR switching time: not specified.	PTT key down to RF output, 10 ms. PTT key up to receive, 26 ms.

Size (height, width, depth): 3.0 × 4.3 × 12.7 inches (including protrusions). Weight, 3.5 lbs.

While the TVTR2 sports a linear final amplifier, it is not necessary with the JT modes, as they are phase coherent FSK (single carrier). The only other mode in general use on the band is CW. While a linear amplifier is preferred to preserve the exciter's keyed waveshaping, it is also not a requirement, as a switch mode (Class D or E) amplifier can be keyed via its MOSFET supply line with appropriate shaping. In that case, a constant carrier input is required. Anyone remember the days of keying a Class C amp stage and backwave? Of course, because the TVTR2 has a linear amplifier, it simplifies things and also leaves the door open for easy experimentation with other modes that may require linear operation.

When the slower JT9 modes started to become more common, a number of TVTR2 owners noticed less-than-optimal frequency stability. This was not noticed in the original TVTR1 review, because all the modes tested at that time were either of shorter duration or lower duty cycle. Monitor Sensors came up with a solution by relocating the internal oscillator to an area where there is very little temperature variation, thereby stabilizing the oscillator. Modification information can be found on the Monitor Sensors website, and the modification kit is free of charge upon request. All transverters (TVTR1 and TVTR2) shipped since January 2019 already have the modification applied.

Power Output

The TVTR2 is rated at 50 W output using a 13.8 V dc supply. This output

Lab Notes: Monitor Sensors TVTR2 2200-Meter Transverter

Bob Allison, WB1GCM, Assistant Laboratory Manager

Harmonics and spurious emissions from the Monitor Sensors TVTR2 meet FCC requirements. The second harmonic is 47 dB below the fundamental. All other harmonics outside and within the AM broadcast band have 65 dB or greater attenuation.

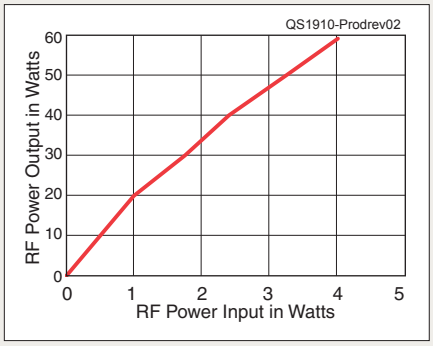


Figure 2 — Monitor Sensors TVTR2 transverter RF power input versus output.

Figure 2 shows that input versus output power is almost a straight line, meaning that the amplification of the TVTR2 is linear. To assure linearity, do not exceed 4 W of drive power to the transverter (the TVTR2 has an internal 0 – 14 dB attenuator to fine-tune the drive level). Consider placing 5 or 10 dB of attenuation at the output of the transceiver driving the TVTR2 to make adjusting the drive level easier. As noted in the text, phase noise and broadband noise are sometimes lower when a transceiver is run at higher output power.

I didn't measure transmit intermodulation distortion (IMD), because typical SSB transmissions do not fit within the 2.1 kHz wide 2200-meter amateur band. As described in the text, JT9 and CW are the modes of choice on this band.

Strong signals from local AM broadcast stations didn't cause any signal blocking at 2200 meters. WRYM, on 840 kHz, measured –4 dBm at the antenna jack and WPOP, at 1410 kHz, measured –2 dBm at the antenna jack. An antenna tuning circuit designed for 2200 meters will greatly attenuate AM broadcast stations, and a tuner is definitely needed, considering a full-sized, half-wave dipole at this frequency is more than 3,400 feet long.

will generally be less effective as compared to its 630-meter counterpart due to the typically lower efficiency of transmit antennas on 2200 meters. Despite that, on-air operation produced respectable results from the NO3M station, including contacts over a few hundred miles.

If more power is desired to extend the effective communications range or reach the 1 W EIRP limit, an external amplifier will be required. Some 2200-meter operators have modified Hafler audio amplifiers to do the job, and the TVTR2 makes a fine exciter for that setup. Otherwise, as noted earlier, a linear is not necessary for the popular modes in use on 2200 meters, and a Class D or E amplifier with higher efficiency could be used. However, most switching amplifiers require very low RF input (typically 1 mW) and an attenuator on the TVTR2 output would be necessary.

Wish List

One of the items on the wish list when we reviewed the TVTR1 630-meter transverter was the inclusion of a dedicated receive antenna port and associated transmit-receive (TR) switching. That desire is no different with the TVTR2. Unless the transmit antenna exhibits some azimuthal directivity (which is almost never the case, especially on 2200 meters), a dedicated receive antenna (or antennas) is essential to achieve the next level of success. It is true that an external TR switch could be integrated into the station setup to accommodate receive antenna routing, but having a switching mechanism internal to the transverter would be more convenient and result in less clutter.

Conclusion

The TVTR2 is a fine example of quality workmanship and design. It is one of the few commercial options available at this time to facilitate operation on the 2200-meter amateur band. It makes at least part of establishing a station on our lowest frequency band less arduous and should withstand almost any possible abuse, whether operator-induced or otherwise. The station owner will have to consider whether the 50 W output is adequate given the transmit antenna in use, or if a follow-up amplifier may be desirable.

Manufacturer: Monitor Sensors, Unit 1, 42 Cessna Drive, Caboolture QLD 4510, Australia; **www.monitorsensors.com**. Price: $660 plus shipping (DHL air shipment to ARRL HQ was about $60).

Argent Data Systems Tracker4 APRS Tracker/TNC/Gateway

Reviewed by Jim MacKenzie, VE5EV/VE5EIS
jim@photojim.ca

I've enjoyed tinkering and experimenting with the Automatic Packet Reporting System (APRS) — a system for sending position reports and short messages via packet radio — for a couple of years now, and it continues to fascinate me. If you're not familiar with APRS, see the sidebar, "An APRS Primer," to learn more.

[2]J. MacKenzie, VE5EV/VE5EIS, "WiMo Pico APRS APRS Transmitter/Tracker," Product Review, *QST*, Sep. 2018, pp. 43 – 46.

Bottom Line

This tracker is far more than just a tracker, and can handle almost any APRS job once you figure out its peculiarities.

In the September 2018 issue of *QST*, I reviewed the WiMo PicoAPRS, which is a tiny device with basic functionality.[2] This is the opposite — a less-compact device, but with a tremendously versatile suite of capabilities.

Introduction

Argent Data Systems has been making APRS-related products for several years. The Tracker4 was released in 2018 as an evolution to its prior Tracker3 product. With its varied ports and connections, the device is clearly

An APRS Primer

The Automatic Packet Reporting System (APRS) was devised in the late 1990s by Bob Bruninga, WB4APR (**www.aprs.org**). At its simplest, it's a telemetry system that allows the transmission of position packets from hams, either directly to other amateurs, or via a digipeater that repeats the packets (presumably with superior range and power). It also has a useful message feature that lets you send and receive messages. (Digipeaters and iGates can get messages to hams far out of your VHF radio range.) And while APRS is usually used on the 2-meter band (144.390 MHz), it can also be used on HF, which can be especially useful in isolated areas far from digipeaters. Modern digipeaters often relay the packets to the internet by serving as an iGate (internet gateway). If you have a nearby iGate, you can look up the position of hams in your area at **www.aprs.fi**.

designed for the ham who likes to experiment. The front of the device (see Figure 3) has a DE-9 RS-232 port for connection to a weather station; a pair of activity light emitting diodes (LEDs), and a ten-position, 0.150-inch terminal block that has power, RS-485, Dallas 1-Wire, and three analog inputs.

On the back (see Figure 4) is a 2.1 × 5.5 millimeter, center-positive dc power jack (6 – 24 V input); a DE-9 jack for radio interfacing and power; a reverse-SMA Wi-Fi antenna jack; a standard SMA jack for a GPS antenna; and a USB mini-B connector that can power the device and serve as a data connection to a computer.

The Tracker4 is supplied with Wi-Fi and GPS antennas, as well as a USB cable. Unfortunately, the USB cable that came with my device was defective, but these cables are standard enough that I just grabbed a spare one from my basement.

Getting Started

At initial power-up, the tracker sets up a Wi-Fi hotspot to which you can connect for configuration. The device has a web interface (see Figure 5) for configuring your Wi-Fi network as well as other parameters. I had a great deal of difficulty getting these configurations to work at first. The device's serial console proved to be a benefit to me as I worked around these problems, and I was able to configure my network manually that way. (See Figure 6 for a sense of how the console appears.) The console is probably best left to hams with some deep computer familiarity, although anyone who used packet radio terminal node controllers (TNCs) back in the 1980s or '90s shouldn't feel too far out of their element here.

You can update the firmware through either the serial console or web interface. At least two firmware updates were made during my review period, so you will want to check periodically to see if any new updates exist. (The main device firmware and the Wi-Fi firmware are separate, and the device will update them separately.) The latest Wi-Fi firmware seems to have solved a lot of my issues. Still, some patience is likely required. As this review wrapped up, Argent Data Systems indicated that they were working on an update that changes the look of the web interface and adds new features, including a live in-browser oscilloscope view with audio monitor to check the incoming signal.

At this point, you have to choose what you are going to do with the tracker. It has some rich opportunities available to you — a simple tracker (that can receive APRS packets and report on their contents, and also transmit your telemetry packets), an iGate (a device that forwards received APRS packets to the internet), a digipeater (which repeats received packets, usually at higher power and with a better-located antenna system, to increase the effective range of all users' APRS telemetry), or a weather station (that can send weather packets in APRS format). Some of these capabilities can be combined; for instance, you can have a combination iGate/digipeater/weather station.

Note that a radio isn't included. This is essentially a small computer to do the heavy lifting. Argent sells (at additional cost) various transmit/receive cables to interface with various transceiver models. I acquired cables for my Kenwood TH-F6A handheld and my go-box-mounted Kenwood TM-271A mobile radio. These cables seem straightforward if you prefer to fabricate your own. A minor configuration change (**HT PTT**) needs to be made if you use a handheld radio that uses a single jack for both receiving and transmitting. (My Kenwood didn't need this change.) The Argent-supplied radio data cables thought-

Figure 3 — The Argent Tracker4 front panel.

Figure 4 — The Argent Tracker4 rear panel.

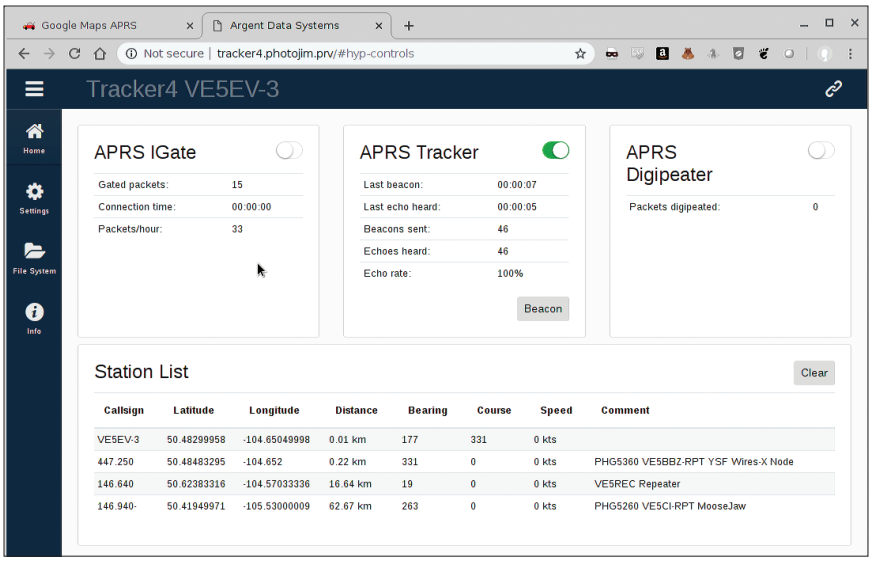


Figure 5 — The Argent Tracker4 web interface screen.

```
Radio control commands

TONE        <freq> <time> [fs] Generate tone at <freq> Hz for <time> (ms)
PLAY        <file> Play a WAV file
DTMFSEND    Send DTMF digits
STATUS      Enable or disable status bar
SHOW        Show configuration parameters
SET         Set config parameter (key=value)
PTT         <on | off | auto> Set push to talk for current channel

Tracker commands

BEACON      <text> Send a plain text AX.25 beacon
POSITION    Display or set position
MONITOR     [ON | OFF] Enable or disable packet display
MYCALL      Set APRS callsign
IGATE       Connect to IGate
MHEARD      List heard stations
SNOOP       Monitor serial port data
```

Figure 6 — A portion of the Argent Tracker4 console interface screen.

fully include a lighter plug for powering for the Tracker4 for mobile applications, although you can equally power it via a USB connection or an optional ac-operated power adapter.

If connected to a computer, in addition to drawing power via USB and supplying the serial console I described earlier, the device also presents a 24 MB file storage area. This can be used to store small audio files which can be transmitted, or text files, or anything you can think of that would be useful. Additionally, Microsoft Windows users have a .inf driver file here so that their computers can automatically configure the hardware devices. (Linux and macOS users will find that the device configures automatically without this extra data.)

What You Can Do With It

If APRS interests you, I can see a lot of possible projects for this device:

- A portable APRS tracker. While not as compact as the PicoAPRS, the device is still small. It can work in both standard and "KISS" mode (basically a smart or a dumb mode, respectively) for interfacing with computers, laptops, tablets, and phones. (*APRSDroid* would be a particularly good way to interface with it if you use an Android phone or tablet. I've yet to find a satisfactory iPhone/iPad APRS client that will interface with an external tracker.)
- A permanent iGate and/or digipeater. The case thoughtfully includes screw-mounting holes, so you could mount this near a permanent radio setup to serve your neighborhood or city to relay APRS packets to other users or to the internet. (Some areas already have excellent APRS infrastructure, but many areas lack it, so this could be a fun project if you are in such an area.)
- A temporary, portable iGate/digipeater. Combined with a 2-meter transceiver in a go-box or otherwise fitted to be reasonably transportable, and a Wi-Fi cellular hotspot, you could set up APRS infrastructure in an area that normally lacks it. I took mine on my annual visit to the International Ham Fest in July at the International Peace Garden on the US-Canada border near Boissevain, Manitoba, and Dunseith, North Dakota. (For details, see **ve4qk.org/ve4qk/ihf.htm** — it's a great event and well worth visiting.)
- A mobile iGate. Many rural areas through which I travel lack any APRS infrastructure. I plan to experiment with the Tracker4 to relay received packets to the internet via a hotspot during my travels. (My drive to the International Ham Fest has me out of APRS iGate range for almost 4 hours, so that is a good opportunity to experiment.)
- A weather relay station. You'll need to add an RS-232-compatible weather station, but once you do, you can transmit APRS packets with local weather conditions for the convenience of hams. I notice quite a few cities have infrastructure such as this.

Comments on Operation

This tracker has a definite learning curve to it. In part, that is because of the large number of features that it presents. However, once you get the networking configured, things become a lot simpler. Enabling the digipeater or iGate features is really

simple — literally the click of a button or a simple text command via console. Switching from one mode to another is a very basic operation.

You can program the device using a fairly straightforward scripted language via its BASIC computer-language interpreter. (I admit that I'm still wrapping my head around what a person could do with this, even though I'm an experienced BASIC programmer.) This invites all sorts of customization possibilities and the potential for some interesting projects. Experimentation is right at your fingertips.

Argent offers online support forums that seem to be decently monitored — a handy resource should you have any problems.

Final Thoughts

For users with a little patience, this device is attractively priced and has a lot of flexibility for such a compact device. If your needs change, you can continue to find useful applications for it. While I wouldn't recommend it as a ham's first APRS device, if you've caught the APRS bug, the Tracker4 could be a really interesting, fun, and potentially highly useful purchase.

Manufacturer: Argent Data Systems, **www.argentdata.com**. Price: Tracker 4, $139; radio interface cables, $17 each.

Dr.Duino Arduino Uno Starter Kit

Reviewed by Glen Popiel, KW5GP
kw5gp@arrl.net

One of the things that makes the Arduino microcontroller so fun and easy to work with is its size. You can build any number of interesting and practical Arduino projects without having your project spread across an entire workspace. My usual method for prototyping an Arduino project is on a breadboard, with all of the necessary components and wires conveniently plugged into the breadboard, and the Arduino laying somewhere off to the side, attached to the breadboard circuit by connecting wires.

Needless to say, this often leads to wires coming loose when you move things around as you work on your project. Troubleshooting with a voltmeter, oscilloscope, and other test equipment is not always easy, because you often cannot connect to the desired testing point without moving things around and having even more wires come loose.

Bottom Line

With the included training package, Facebook support group, and the Dr.Duino board, this kit is a nice and affordable development platform for both beginning and advanced Arduino hobbyists.

Overview

Not long ago, I discovered the Dr.Duino board, which helps alleviate many of these issues when developing and testing Arduino projects. The Dr.Duino board is a prototyping and debugging shield for the popular Arduino Uno microcontroller. The board fits just like a standard shield on top of the Arduino board, and it allows you to quickly and easily develop and troubleshoot projects built around the Arduino. (A shield is a board that can be plugged into headers on top of the Arduino PC board to extend its capabilities.)

The Dr.Duino Arduino Uno Starter Kit bundle reviewed here includes a free 12-lesson Arduino Crash Course video training curriculum from the Programming Electronics Academy, along with access to the Dr.Duino Facebook group. This private Facebook group is exclusively for Dr.Duino owners, and is a great place to ask questions, get help with your Arduino projects, and share ideas. When you purchase the Dr.Duino, you also have the option of joining their mailing list, which features interesting Arduino project links and information from time to time.

Building the Kit

Shipped as a kit, the Dr.Duino is easy to assemble, with all of the surface-mount components pre-soldered to

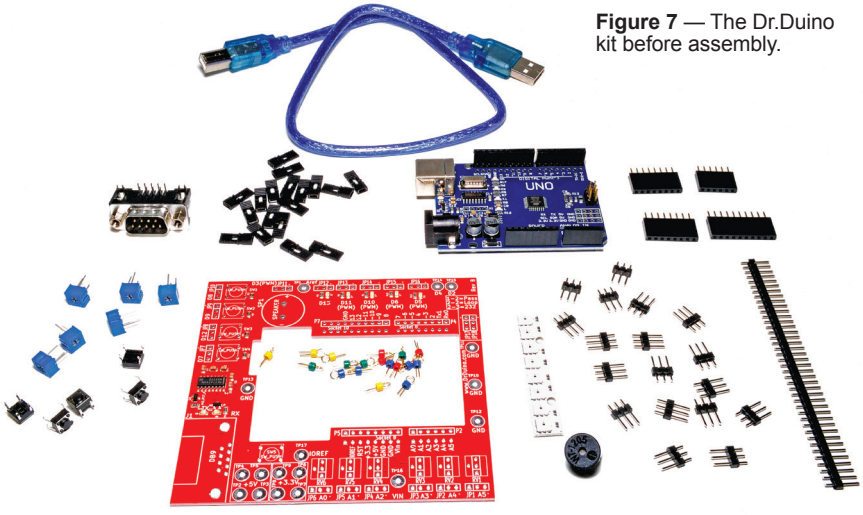


Figure 7 — The Dr.Duino kit before assembly.

the board. It includes an Arduino Uno-compatible board and a NeoPixel strip with eight LEDs as part of the kit. Figure 7 shows the Dr.Duino board and the remainder of the kit contents prior to assembly.

The step-by-step assembly instructions are well written, accompanied by detailed color photos, and easy to follow. It took me about 2 hours to solder all of the components to the board, and then load and run the test sketch. (In the Arduino world, the software program information is referred to as a "sketch.") While the instructions recommend using "no-clean" solder, I used regular rosin-core solder without any issues.

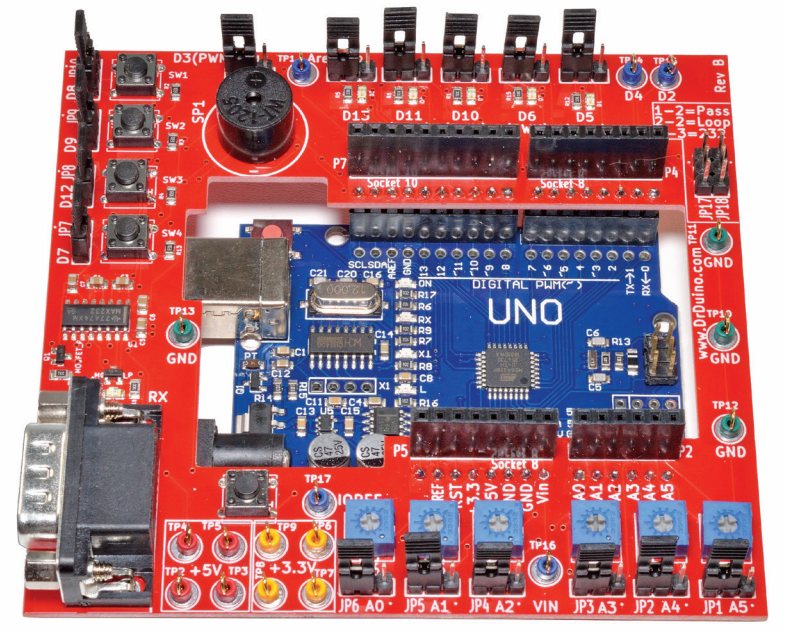


Figure 8 — The completed Dr.Duino board with the Arduino Uno attached.

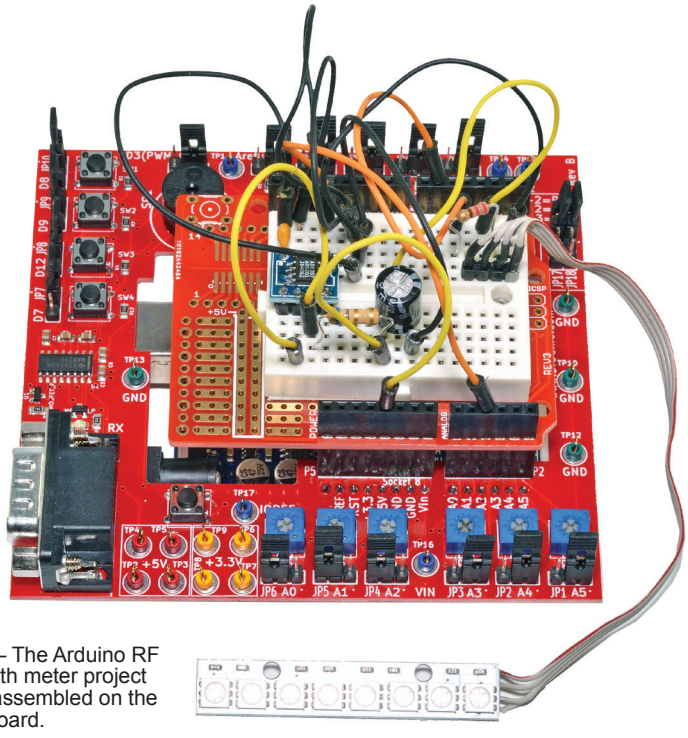


Figure 9 — The Arduino RF field strength meter project prototype assembled on the Dr.Duino board.

The board itself is nicely laid out, with crisp, clear, silkscreened component descriptors, along with color-coded test point loops for attaching probes and test clips. When assembly is complete, the Arduino Uno is mounted to the bottom of the Dr.Duino board using the Arduino's shield connectors, as shown in Figure 8. One concern I have is with the connector for the USB A-type cable connecting the PC to the Uno possibly shorting against the bottom of the Dr.Duino board. Using a small piece of electrical tape on the bottom of the Dr.Duino board, or replacing the standard Arduino Uno with a version that uses a mini or micro USB connector, is a quick and simple workaround.

For prototyping and testing, the Dr.Duino has four pushbutton switches, five LEDs, six potentiometers, and a piezo buzzer that can provide inputs and outputs for your project. Each Arduino I/O pin is brought out to a header and jumper that allows you to patch the I/O pin to the onboard switches, LEDs, or potentiometers, or pass the signal on through to a shield that can be attached to the top of the Dr.Duino board.

The Dr.Duino board also has a standard nine-pin RS-232 connector connected to the Arduino's serial I/O pins and a pair of jumpers that allow you to use either the Arduino's onboard USB port or the RS-232 serial port. This feature could come in handy when working with CAT control circuits for older transceivers with RS-232 connectors instead of the USB serial connectors used today.

Putting Dr.Duino to Work

Once I had everything together, I downloaded the test sketch from the Dr.Duino website to ensure that everything was working properly. The sketch tests and verifies that each switch and potentiometer and the piezo buzzer are installed correctly. This test sketch can also serve as a good starting point to learn to use the Arduino with the Dr.Duino board to

simulate the input and output to and from your test projects.

Once testing was complete, I built a small project to get a feel for developing with the Dr.Duino board. Figure 9 shows a small breadboard shield mounted to the top of the Dr.Duino with the working prototype of an Arduino RF field strength meter project that uses an Analog Devices AD8307 logarithmic amplifier chip in place of the traditional diode detector, vastly improving the sensitivity of the field strength meter. The NeoPixel display is used to provide a green, yellow, and red colorized LED bar-graph indication of signal strength. The finished test project worked perfectly and was very easy to assemble and troubleshoot with the Dr.Duino board.

The Dr.Duino Arduino Uno Starter Kit is worth it for just the Dr.Duino board itself. When you add in the extras, such as the Arduino Uno-compatible board, the NeoPixel strip, and the online training and Facebook support group, this is a great deal for both beginning and advanced Arduino hobbyists.

Manufacturer: Dr.Duino, **www.drduino.com**. Price: The bundle described here is available to *QST* readers for $59 — see **exclusive.drduino.com/DrDuino-FLASH-SALE-QST**.

Diamond X50A Dual-Band Base Station Antenna

Reviewed by Steve Ford, WB8IMY
QST *Editor*
wb8imy@arrl.org

The Diamond X50A is a 2-meter and 70-centimeter antenna designed primarily for FM and digital applications. While most base stations are within homes and other permanent structures, the X50A would also be well suited for temporary setups such as public service activities. It is lightweight (less than 3 pounds) and assembles in minutes.

The X50A operates as three phased ¼-wavelength elements on 2 meters and three ⅝-wavelength elements on 70 centimeters. It is fed with a single coaxial feed line and is rated for 200 W continuous-duty power.

The antenna is physically rugged. The antenna elements are enclosed within a white fiberglass tube, and the base hardware is stainless steel. At just 67 inches in length, the X50A is rated to survive winds up to 135 MPH.

Bottom Line

Diamond's X50A is a rugged and capable home station vertical antenna for 2 meters and 70 centimeters.

Assembly and Testing

The X50A assembles in less than 10 minutes. You simply screw in the three short radials and attach the support pipe. Before securing the support pipe, however, you must feed your coaxial cable through the pipe and

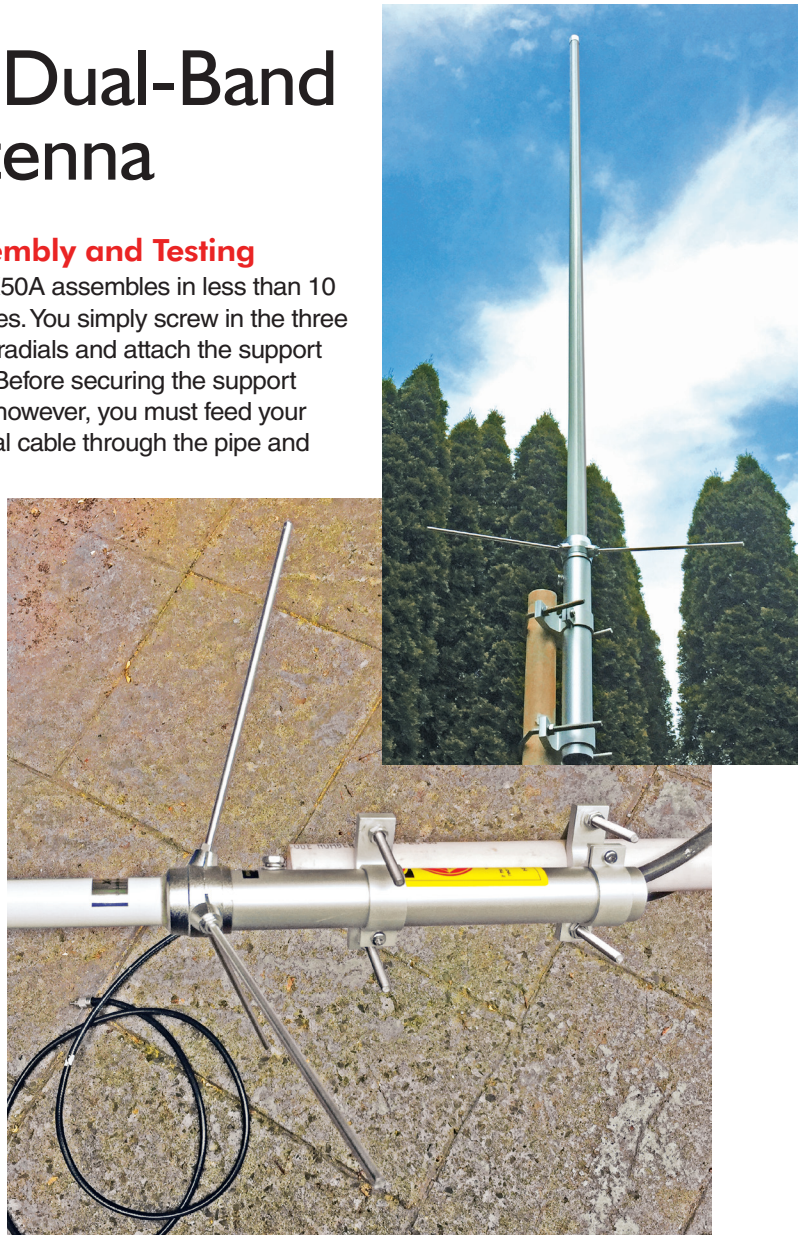


Figure 10 — The Diamond X50A assembles in less than 10 minutes. The coaxial cable is attached to the base of the antenna through a short support pipe. The support pipe is then attached to a mast using two **U**-bolts.

attach the cable to the SO-239 connector at the base of the antenna (see Figure 10). With the support pipe in place, all that remains is to slide on the mast clamps.

For this review, I clamped the X50A to a 12-foot length of PVC pipe. The U-bolts provided with the kit can accommodate masts between 1 3/16 and 2 7/16 inches in diameter.

There is no tuning necessary; once the antenna is on the mast, it is good to go. I swept X50A with an analyzer on 2 meters and saw less than a 1.3:1 SWR from 144 to 148 MHz. On 70 centimeters, the X50A offered an SWR of less than 1.5:1 from 435 to 450 MHz.

On The Air

I set up the X50A at just 15 feet above the ground, but even at such a relatively low height, the antenna demonstrated surprising performance. Using a 50 W FM transceiver, I was able to make simplex contacts on 2 meters and 70 centimeters with stations that were nearly 30 miles away. Considering the fact that my home is in a shallow valley, I was impressed.

The X50A is obviously not intended for satellite operating, but I tried anyway and managed to make contacts through several FM repeater birds. I could hear them remarkably well and received good reports. It is just more proof that you don't necessarily need an elaborate antenna system to enjoy Amateur Satellites.

Manufacturer: Diamond Antenna, 312 Swanson Dr. Suite B, Lawrenceville, GA 30043; **www.diamondantenna.net**. Price: $99.95.

Weller D650 and 9400 Soldering Guns

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

Today many home workshops have a 20 or 40 W pencil soldering iron — just what is needed to work on a printed circuit board. Sometimes, however, this is not enough power. For example, a 20 W iron will not allow you to solder the braid on a PL-259 coaxial cable connector or make a good connection to #12 AWG antenna wire. This is a role for a much more powerful iron, and readily-available Weller soldering guns are a popular choice.

The Classic Weller D650

The Weller D650 (see Figure 11) is a heavy-duty, dual-heat (200 or 300 W), pistol-shaped iron. Squeeze the trigger one step for the 200 W setting. Continue to squeeze and power increases to 300 W. This is not the lightest tool — you will be holding and aiming a 3-pound tool in one hand. (Thanks to Greg Bryson, KA1NGF, for weighing these soldering guns on his accurate shipping scale.) The D650 measures approximately 10 inches from tip to back end, 6 inches top to bottom of the handle, and 2 inches at its thickest part.

According to the manufacturer, it comes up to full heat in 6 seconds. I found that the tip was already hot as soon as I looked down to place the tip near a connection to solder.

In the D650 instruction booklet, Weller notes they have been manufacturing soldering guns since 1945. There are two tip styles — those secured with nuts, and those secured with set

Bottom Line

These classic Weller soldering guns heat quickly and can be used for a number of jobs in the workshop. A standard 100 W soldering iron with a large chisel tip may be a better choice for PL-259 connectors, though.

Figure 11 — The Weller D650 soldering gun.

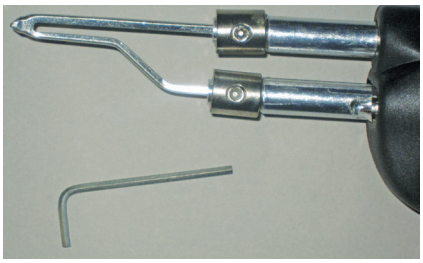


Figure 12 — When the heating element (the tip) requires replacement, a standard Allen wrench is used to loosen the two screws, the old tip pulled out, then new one inserted and the two screws tightened.

screws. On the review unit, tips are easily replaced by loosening two set screws with a ⅛-inch Allen wrench (see Figure 12). Tip life depends on the amount of use, and Weller offers replacement tips for about $10 for a package of two. Weller also offers other tip styles suitable for cutting or smoothing rope, plastic or other materials, and a number of third-party tips are available as well.

I have had one of these soldering guns for more than 15 years, and have found only two items that may require maintenance. The set screws holding the tips in place can loosen, and the heat will be reduced. However, a slight tightening easily fixes this problem. The unit has two miniature incandescent light bulbs focused on the work area. These can loosen and may need to be firmly screwed back in.

Clint Millett, VE3CMQ, recently described his technique for repairing the mechanism that holds the tips in place.[3] This should not be a major concern for most of us; he notes he has had this model for more than 40 years.

There is one hack that you might consider. It does take a bit of practice to select the lower heat setting on this device. As pointed out by William Fishback, W1IKU, you can rewire the switch so a full press is the lower heat setting and a partial press the higher setting.[4]

For the review, we ordered just the D650 soldering gun, but Weller also offers the D650PK kit, which includes a case and some solder. The D550 is similar, rated at 260/200 W.

Weller 9400PKS Soldering Gun Kit

The Weller model 9400 soldering gun (see Figure 13) is a slightly smaller, less powerful soldering gun that weighs just 1¼ pounds. It has two settings — 100 and 140 W. Three bright LEDs provide light on the item you are soldering, replacing the two miniature incandescent bulbs of the classic D650. It is also somewhat less bulky and easier to handle.

The 9400PKS kit includes a protective plastic case, a small roll of solder, the normal soldering tip, and an Allen wrench to change tips. Two other tips are included — a cutting tip and a smoothing tip. (These same tips are available for the Weller D650.) As with the D650, I pressed the trigger and the tip was hot by the time I moved it in place to solder.

Figure 13 — The Weller 9400 soldering gun.

Figure 14 — The two different synthetic rope samples show how the end frays when cut with a knife. The other two ends were cut with the Weller 9400 gun and cutting tip, which melts the rope as it cuts.

The cutting tip is an interesting accessory. I often use synthetic rope to support my antennas. After cutting the rope with a knife or a pair of clippers, the end frays and fans out. The rope cutting tip makes a clean cut and melts the cut end, so it won't fray (see Figure 14).

A use for the smoothing tip is less obvious. I took a piece of thermoplastic of unknown origin, cut one side with a hacksaw and drilled a large hole in it. I tested the smoothing tip on the cut edge and around the edge of the drilled hole. It did just what you would expect — melted and smoothed the rough and sharp edges. Of course, a small file or a piece of emery cloth would do just as well. This might be useful for making antenna insulators.

Changing the tips back and forth only took a few seconds with the included Allen wrench. Replacement tips are available from a number of sources.

Field Testing the Weller Soldering Guns

For many years, I have used a large, heavy-duty soldering iron with a tip about ⅜ inch in diameter, tapering to a square-cut tip. The power rating tag and the UL label are long gone, but the broad tip has been used many times to solder UHF (PL-259) connectors. The tip is very efficient to transfer heat to the item being soldered.

Using a Kill-A-Watt power meter from the local hardware store, I measured the power input and the corresponding voltage and current for the old soldering iron. The result, surprisingly, was around 100 W. I assumed that the Weller D650 on the high-power (300 W) setting would be able to solder the shield on a PL-259 with or without a reducer for RG-58. The D650 did the job, but not as easily and cleanly as my old iron. Apparently, the much smaller Weller tip does not have enough thermal mass to quickly heat the connector barrel enough to melt solder into the four holes for soldering the coaxial cable braid. You can use it for this purpose, but not as easily as an old broad-tip iron.

By coincidence, when I was testing the Weller soldering guns, my 80-meter dipole fell down. With the help of Rich Roznoy, K1OF, we hoisted the dipole back up, but first had to do some soldering. The fallen end of the dipole used a dog bone-style barrel insulator, and dragging that end of the dipole near my house, we used the D650 to solder the end. It had more than enough heat for this task. I also took some #12 AWG bare wire and soldered it around an egg insulator. Again, no problem.

I did not repeat these tests with the Weller 9400. This lighter weight unit uses the same size tip and is only rated at 140 W in the high-power position, so it would be adequate for soldering the antenna wire but probably not the UHF connector. It did, however, do a very good job cutting the antenna support rope and leaving the end melted so it did not unravel.

Manufacturer: Weller, **www.weller-tools.com**. Available from many sources. Price (Amazon): Weller D650, $60 (note that the Weller D650PK, a kit including case, tip, and solder, may be available for around the same price); Weller 9400PKS (kit including case and several tips), $40.

Notes

[3]C. Millett, VE3CMQ, "New Life for Weller Soldering Guns," Hints & Hacks, *QST* Apr. 2019, p. 66.

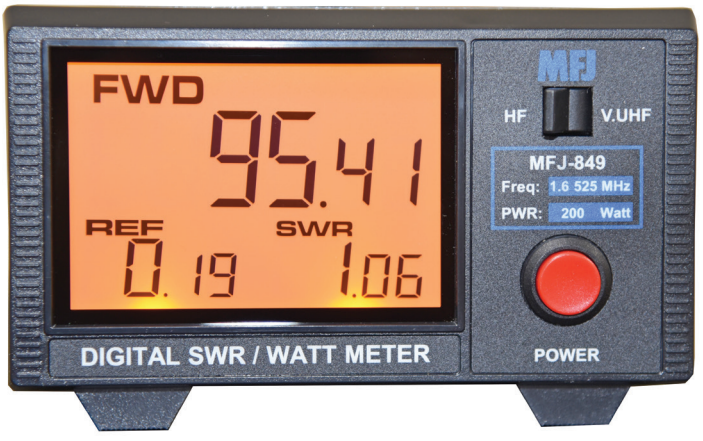
[4]W. Fishback, "Reversing the Heat Control Switch of Weller Soldering Guns," Hints and Kinks, *QST*, May 1956, p. 75. (Thanks to George Peters, K1EHW, for pointing out this Hints and Kinks item.)

MFJ-849 HF/VHF/UHF SWR/Wattmeter

Reviewed by Mark Wilson, K1RO
QST *Product Review Editor*
k1ro@arrl.org

The MFJ-849 SWR/wattmeter covers 1.6 to 60 and 125 to 525 MHz and measures average power up to 200 W. Forward power, reflected power, and SWR are displayed simultaneously on an easy-to-read 3.5-inch backlit LCD. The unit requires a 12 V dc power supply, and a power cable is supplied.

The rear panel (see Figure 15) has four SO-239 connectors, two labeled **TX** for the transceiver, and two labeled **ANT** for the antenna. One set is used for bands in the 1.6 to 60 MHz range, and the other for the 125 to 525 MHz range. A front-panel switch selects the range (**HF** or **V.UHF**). There's a switch to turn the power on and off, and that's it for controls. The instruction sheet is just one page and is available from the MFJ website.



Bottom Line

The MFJ-849 SWR/power meter is simple to use, accurate, and offers a bright, easy-to-read display.

Lab Tests

Table 2 shows the results of testing in the ARRL Lab. Power readings were close to the expected levels, with accuracy falling off slightly at 440 MHz. SWR readings were very accurate throughout the HF range with a variety of known loads. (These loads

Figure 15 — The MFJ-849 rear panel. There are two sets of connectors, one for the HF bands, and the other for VHF/UHF.

Visit https://youtu.be/Fnmf0yuN6Ic to see our review of the MFJ-849 HF/VHF/UHF SWR/Wattmeter on YouTube.

have not been characterized above 28 MHz, so the Lab did not test the SWR feature at higher frequencies.)

The MFJ-849 is a good choice for stations with HF/VHF/UHF capability running up to 200 W. The large, bright display shows everything you need to know at a glance.

Manufacturer: MFJ Enterprises, P.O. Box 494, Mississippi State, MS 39762; **www.mfjenterprises.com**. Price: $180.

Table 2
MFJ-849 HF/VHF/UHF Wattmeter

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency range: 1.6 – 60 and 125 – 525 MHz. Calibration points: 14, 50, 145, 435 MHz.	As specified. Tested in amateur bands only.
RF power range: 0 – 200 W. Minimum power for SWR indication: 1 W.	As specified.
Accuracy: ±5%.	See measurements below.
Insertion loss: <0.1 dB.	1.8 MHz, 0.04 dB; 14 MHz, 0.06 dB; 28 MHz, 0.08 dB; 50 MHz, 0.09 dB; 144 MHz, 0.18 dB; 440 MHz, 0.63 dB.
Power requirements: 12 – 13.8 V dc.	At 13.8 V dc, 59 mA.

Size (height, width, depth): 3.4 × 5.5 × 4.8 inches, including protrusions. Weight, 1.7 lbs.

Actual Forward Power	Indicated Power on MFJ-849					
Frequency (MHz)	**1.8**	**14**	**28**	**50**	**144**	**440**
5 W CW	5.6	5.6	5.5	5.6	5.5	5.9
50 W CW	53.8	53.3	52.5	53.2	52.9	58.0
100 W CW	109.3	106.5	106.2	106.6	106.0	114.4

Actual Forward Power levels determined with HP-437B milliwatt power meter and known attenuation of all cables, connectors, and power attenuators.

SWR (using 10 W input)

	----------MFJ-849 Readings ----------		
SWR	**1.8 MHz**	**14 MHz**	**28 MHz**
1:1	1.02	1.04	1.02
2:1 (25 Ω)	2.01	1.99	2.01
2:1 (100 Ω)	1.88	1.94	1.92
3:1	2.87	2.94	2.95
4:1	3.91	4.0	3.89

New Products

RIGOL Announces New 2 GHz MSO8000 Series Digital Oscilloscope

RIGOL Technologies has significantly expanded its UltraVision II oscilloscope portfolio with the introduction of the MSO8000 Series Digital Oscilloscope. Logic analysis, protocol analysis, spectrum analysis, and waveform generation are all built into the instrument, maximizing utility. With the new jitter and real-time eye analysis option, engineers can now accurately analyze serial transmissions for failures caused by timing, noise, bandwidth, and interference. Learn more at **www.RIGOLna.com/products/digital-oscilloscopes/MSO8000/**.