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HobbyPCB RS-UV3 Radio Shield

An Arduino-friendly low-power tri-band VHF/UHF transceiver, ready for ham experimenters.

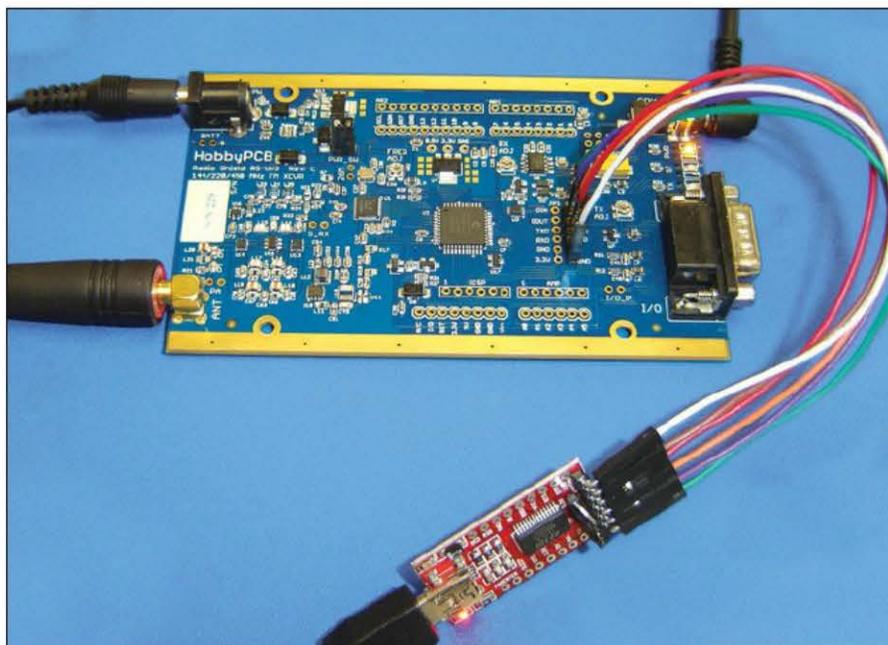
Reviewed by Martin Ewing, AA6E
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Overheard in the ARRL Lab: “That’s a neat board; I’d like to have one.”

The RS-UV3 Radio Shield is a component for experimentation, not a “plug and play” ham transceiver. But it’s quite a component, containing the vital innards of a VHF/UHF transceiver for amateur FM (or limited CW) operation on the 144, 222, and 430 MHz bands, but with an incredibly flexible interface potential. You can wire it into a custom repeater or beacon system or plug it together with an Arduino or other computer for all kinds of applications.

The board is designed around an “SDR transceiver on a chip” (RDA1846S) plus a PIC microcontroller. (Full schematics are provided.) The PIC device supports an extensive ASCII control language that sets up the transceiver operation. You can work with the PIC through various serial interface options, including an optional USB adapter, your own TTL serial device, or through an Arduino UNO or equivalent microcontroller. The RS-UV3 is billed as a “Radio Shield,” meaning that it acts as an Arduino peripheral device. You can completely control the radio through the serial interface, or, once you’ve set up a desired mode and frequency, you can operate the radio with push-to-talk control using the optional hand microphone/speaker.

You can choose from many operating modes, based on FM or CW (transmit only). These include simplex or repeater voice operation (programmable offsets and CTCSS, up to nine channels), DTMF codes, CW or MCW beacon operation, and more. (Tones can be sent, but there is no tone decoding provided. That could be an Arduino function.) AX25 data modes (1200 or 9600 bps) are possible, but you need an additional modem, such as an Automatic Packet Reporting System (APRS) device or terminal node controller (TNC).



The range of applications for the RS-UV3 is limited only by the imagination. You could:

- set up inexpensive repeater control links
- explore the 222 MHz band, where there is not much commercial equipment
- set up beacons transmitting on one band, or multiplexing over three bands using MCW or CW
- build your own handheld transceiver by adding an LCD screen and buttons to an Arduino controller

- build a portable repeater with two boards, a duplexer, and control features running on an Arduino controller
- make a special receiver for RFI sensing. And more!

Lab Results

Our ARRL Lab tests give the RS-UV3 transmitter a clean report, meeting the FCC requirements. It covers the 144, 222, and 450 MHz US ham bands and a good range (for receive) above and below. Full power output of 200 mW was measured on 144 and 222 MHz, but on our initial unit (serial number 232) there was some fall-off above 400 MHz — down to 90 mW at 450 MHz. This unit was returned, and the manufacturer revised the 70 centimeter band output filtering. The new unit (serial number 267) delivered at least 250 mW across the 420 – 450 MHz amateur band.

The CW transmissions have very short rise and fall times that produce significant key

Bottom Line

The HobbyPCB RS-UV3 is a capable, low-power FM transceiver that works on the 144, 222, and 450 MHz bands. It’s ready for whatever applications you can dream up.

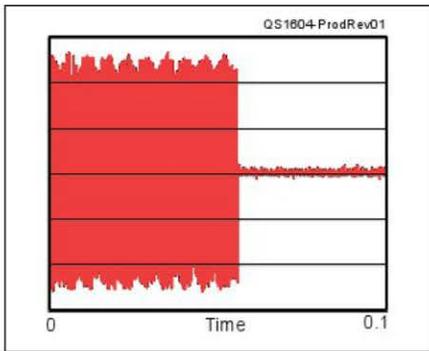


Figure 1 — CW keying waveform for the HobbyPCB RS-UV3. The envelope shows very short rise and fall times and can produce key clicks (see text).

clicks, as shown in Figure 1. This may be tolerable for low-power VHF/UHF use, however. Modulated CW (MCW) is available and produces a nice clean signal, but that mode is not allowed in the CW-only portion of the 2 meter band (144 – 144.1 MHz).

The board tolerates input voltages from 9 to 16 V dc, making it easy to operate with batteries. The optional wall transformer produces 12 V power. The onboard regulator will power a user-supplied Arduino UNO, if attached. A triband flexible antenna is available, along with a speaker-mic.

Command Set

The RS-UV3 offers some 52 commands that you can invoke through the Arduino or USB interface. There are a number of commands that set up the operating mode: audio levels, filtering, power level, and so on. You can select receive and transmit frequency, tones, and other parameters.

You can set beacon transmit IDs in CW or FM MCW. You can transmit CW or MCW messages up to 28 characters long. The nine memory channels can be used to hold preset frequencies, tone frequency, squelch setting, and power levels. You can monitor many other parameters, including signal strength, noise level, board temperature, and supply voltage.

First Arduino Project

I interfaced my Arduino UNO to the RS-UV3. I needed to engineer a way to communicate between boards, starting with finding suitable header connectors. (HobbyPCB might consider supplying these with the board, along with an application note showing a basic Arduino project.) My goal was to write a simple communica-

Table 1
HobbyPCB RS-UV3, Revision C, serial number 267

Manufacturer's Specifications	Measured in ARRL Lab
Frequency coverage: 136 – 174, 200 – 260, 400 – 520 MHz.	Receive, 134 – 173.325, 200 – 260, 400 – 520 MHz. Transmit, 134 – 173.325, 200 – 260, 400 – 519.999 MHz.
Modes: FM, CW (transmit only).	As specified.
Power requirements: Receive, 180 mA maximum; transmit, 400 mA maximum at 9 – 16 V dc.	Receive, 270 mA (max volume, external speaker). Transmit: high power, 146 MHz, 296 mA; 223 MHz, 294 mA; 440 MHz, 310 mA; low power, 305 mA.
Receiver	Receiver Dynamic Testing
Sensitivity: For 12 dB SINAD, 0.22 μ V.	12 dB SINAD: 0.18 μ V (146 MHz), 0.17 μ V (223 MHz), 0.16 μ V (440 MHz).
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset: 60 dB (146 MHz); 61 dB (223 MHz); 61 dB (440 MHz). 10 MHz offset: 65 dB (146 MHz); 66 dB (223 MHz); 66 dB (440 MHz).
Adjacent-channel rejection: Not specified.	20 kHz offset: 71 dB (146 MHz), 72 dB (223 MHz), 72 dB (440 MHz).
Squelch sensitivity: Not specified.	146 MHz: 0.07 μ V (min), 2.3 μ V (max); 223 MHz: 0.08 μ V (min), 2.16 μ V (max); 440 MHz: 0.08 μ V (min), 2.57 μ V (max).
Audio output: Not specified.	605 mW at 8.5% THD into 8 Ω . THD at 1 V _{RMS} , 1.5%.
Transmitter	Transmitter Dynamic Testing
Power output: 200 mW.	At 13.8 V dc: 146 MHz (high/low), 350/10 mW; 223 MHz, 350/10 mW, 440 MHz, 250/10 mW.*
Spurious signal and harmonic suppression: >50 dB.	146 MHz, 52 dB; 223 MHz, 62 dB; 440 MHz, 58 dB. Meets FCC requirements.
Transmit-receive turnaround time (PTT release to 50% of full audio output): Not specified.	Squelch on, S-9 signal: 35 ms.
Receive-transmit turnaround time ("tx delay"): Not specified.	17 ms.
Size (height, width, depth): 0.7 x 4.0 x 5.5 inches (with protrusions). Weight: 1.5 ounces.	
Price: \$89.99; FTDI USB to serial adapter board, \$7.50; enclosure, \$30.00; flexible triband antenna, \$15; speaker-mic, \$15. User supplied option: Arduino UNO (about \$25) and header connectors from many sources, such as www.adafruit.com .	
*RF power output is the same with optional wall power unit and at 9 V dc (minimum operating voltage).	

tions program that would let me give radio commands from the PC keyboard, where I used the Arduino development system. This should be nearly equivalent to the hardware USB connection, while forming a basis for future Arduino programming.

I had to choose two I/O pins to use for serial I/O. (I also could have used the serial I/O line provided at the DB-9 I/O connector.) I discovered that the Arduino's USB port is tied to its hardware serial UART port, so I had to use the "SoftwareSerial" library to make a software serial port for the radio using general-purpose I/O pins. My

Arduino "sketch" (C++ program) simply sends characters from the keyboard to the radio and from the radio to the computer screen. (The program listing is available on the ARRL website.¹)

If you don't want to use the Arduino, you can use the optional USB-serial interface to receive commands from a PC. (You can't use both at the same time.) There are useful tips in HobbyPCB's online forum.

You can do a lot with the Arduino, but its

¹The file is available for download from www.arrl.org/qst-in-depth.

processor power and memory are limited. Fortunately, the RS-UV3 can also be interfaced to more powerful computer boards such as the Raspberry Pi that support audio input and output, graphic displays, Wi-Fi, and more.

Summing Up

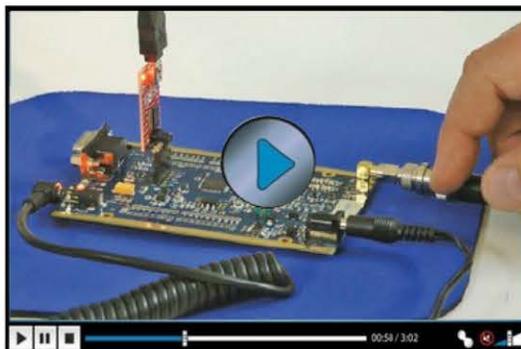
I encountered just a few “gotchas” working with the RS-UV3. As mentioned already, the unit does not include header connectors for interfacing the Arduino. After installing my Arduino, I recognized a short circuit hazard between the Arduino’s USB connector and the radio board, fixed with a little electrical tape. In general some more support for newbie users would help — a couple of tutorials and suggested Arduino

or USB hook-ups should help.

This is a remarkably flexible unit that calls out for experimentation on the ham bands. It does require some interfacing to make

it usable, but it can be the basis for many projects.

Manufacturer: HobbyPCB, tel 646-580-4722; www.hobbypcb.com.



[Click here for a video overview of the HobbyPCB RS-UV3 Radio Shield.](#)

RM Italy HLA 305V 160 – 10 Meter Amplifier

*Reviewed by Bob Allison, WB1GCM
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Operating with 5 W or less RF power output (QRP) can be fun and rewarding. When conditions are good, the majority of stations heard can be worked. When the band conditions change for the worse, QRP operation is more challenging and sometimes frustrating. Personally, I like to finish a contact with a proper goodbye rather than simply fading into the noise. Having more RF power out to the antenna using a linear RF power amplifier would be handy in such cases.

Historically, just about all commercially built power amplifiers needed 60 to 100 W to achieve a specified power output of 600 W or more. For the QRP enthusiast, building one at home has always been an option, as seen in *QST*’s Homebrew Challenge II (*QST*, May 2010, pp 30 – 31).

Recently, a few commercially built power amplifiers suitable for QRP power input have appeared on the market. RM Italy’s HLA 305V is such an amplifier that provides a lot of power output with a little power input.

Overview

The RM Italy HLA 305V is a no-tune, 160

through 10 meter solid-state amplifier that uses four MRF455 power transistors in a class AB configuration. The amplifier can switch bands automatically or manually. In automatic mode, the amplifier’s built-in frequency counter triggers the selection

of the appropriate band-pass filter. A 5 to 10 W transmitter will create 200 to 250 W output.

Out of the Box

The amplifier is rather flat — not very high, not too wide, but nearly 18 inches deep (including protrusions). Cooling fins protrude from the top and sides of the deep royal blue metallic case. On the review unit, a “V” version, there are two 5-inch diameter cooling fans located on top to draw heat away from the cooling fins. (The standard HLA 305 does not include the fans.) The front panel has a knob for automatic/manual band changing, along with a minuscule



Bottom Line

The RM Italy HLA 305V makes many watts from just a few watts, with ease and style. Stick with the low power (200 W) setting for the cleanest signal.