Product Reviews

May 2023

Xiegu G106 5 W QRP Transceiver

Lynovation CTR2-Mini+Radio Controller

Xiegu G106 5 W QRP Transceiver

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I have had the opportunity to review the Xiegu X5105, X6100, and G90 transceivers. So I was pleased to be able to review the G106, the latest QRP radio from Xiegu.

The Xiegu G106 is a compact transceiver covering the 80- through 10-meter ham bands, along with a general-coverage receiver that tunes continuously from 550 kHz to 29.7 MHz (see Table 1). It also covers the 88 – 108 MHz FM broadcast band (receive only). The cast aluminum metal case has a solid feel to it. Operating modes are CW, SSB, and AM. Included with the G106 is the speaker/microphone, a power cord, and the manual. If you wish to operate digital modes, and/or provide a computer interface for computer control and firmware updates, you must purchase the optional DE-19 interface unit. The G106 has a built-in speaker. An external speaker or headphones must be plugged into a 3.5-millimeter mono jack on the speaker/microphone. All normal operating parameters, including a spectrum display, are displayed on a 1.7-inch diagonal black-and-white screen. The spectrum display is 48 kHz wide and is centered on your tuned frequency. There is no waterfall display.

The G106 includes split-frequency operation (both within a band and on separate bands) and has a receiver preamplifier. While it has fixed bandwidth filters for AM and SSB, it has 50 Hz, 250 Hz, and 500 Hz selectable filters for CW. There are 50 memory channels available. There is no RIT, receiver attenuator, noise blanker, or digital noise reduction. The G106 does not display SWR, nor does it have VOX for SSB or AM. And it does not include an internal auto-tuner.

Interfaces and Controls

All operating controls are on the front and top of the G106, as you can see in the lead photo and Figure 1. An RJ11 (four-pin) speaker/microphone jack is on the front panel, along with the volume control, main tuning knob, and four multi-function buttons. On the top of the G106 are the power, mode, and band-switch buttons. Figure 2 shows the rear of the G106, where you will find the BNC RF connector, a 3.5-millimeter key interface, a 3.5-millimeter COM port, a mini-DIN8 accessory port, and a 2.5 × 5.5-millimeter dc power interface.

The volume and tuning controls are multi-function. A metal rim around these two controls provides some protection for the controls and the front panel. When

Figure 1 — Topside controls.

Bottom Line

The Xiegu G106 is a rugged, compact, 5 W portable transceiver. While it has fewer features than other QRP transceivers, it is also priced below much of the competition.

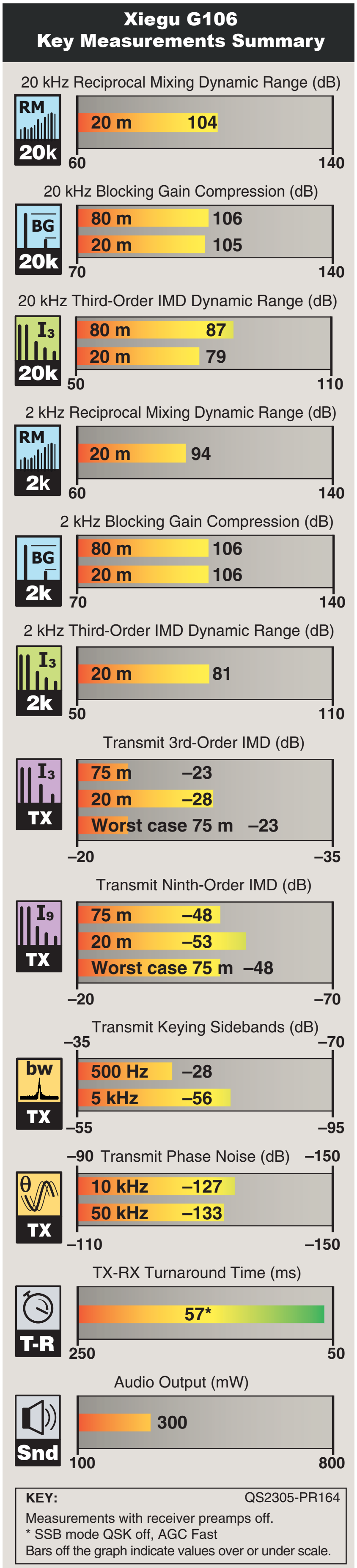

Table 1

Xiegu Communication G106, serial no. V8W#Q81055
Firmware: V1.2 Sept 20, 2022

FCC ID# 2ANLH-G106

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive: 0.5 – 30 MHz; 88 – 108 MHz (WFM). Transmit: 3.5 – 4.0 MHz; 7 – 7.3 MHz; 10.1 – 10.15 MHz; 14 – 14.35 MHz; 18.068 – 18.168 MHz; 21 – 21.45 MHz; 24.89 – 24.99 MHz; 28 – 29.7 MHz.	As specified. Transmit: As specified, plus 5.331 – 5.405 MHz.
Power requirement: 9 – 15 V dc. Transmit: 2.8 A max. Receive: 370 mA max.	At 13.8 V dc: Transmit: 2 A (max). Receive: 320 mA, (no signal, max. volume, max. lights) 314 mA (backlight off).
Modes of operation: SSB, CW, AM, FM.	As specified.
Receiver	**Receiver Dynamic Testing**
CW sensitivity:	Noise floor (MDS), 500 Hz BW:
Noise floor (MDS): Not specified; 3.5 – 30 MHz (CW): 0.25 µV (–119 dBm).	*Preamp Off* / *Preamp On* 3.52 MHz: –115 dBm / 0.39 µV; –132 dBm / 0.06 µV 14.020 MHz: –112 dBm / 0.54 µV; –130 dBm / 0.07 µV
AM sensitivity: 3.5 – 30 MHz (AM): 10 µV (–87 dBm).	For 10 dB (S+N)/N, 1 kHz tone, 30% mod. *Preamp Off* / *Preamp On* 3.885 MHz: –86 dBm / 11.9 µV; –102 dBm / 1.70 µV
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz BW: 20 kHz offset *Preamp off/on*; 5/2 kHz offset *Preamp off* 3.5 MHz: 106 / 105 dB; 106 / 106 dB 14 MHz: 105 / 105 dB; 106 / 106 dB
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: 104 / 100 / 94 dB

Lab Notes: Xiegu G106 5 W QRP Transceiver

The ARRL Lab encountered a few quirky issues while testing this radio. It is standard procedure for the Lab to update the firmware to the latest version on any radio we purchase for Product Review testing. We strongly recommend that hams do the same when they get their new rig home, to benefit from any improvements that the manufacturer included in the update. A new firmware update came out just after we started testing, so I updated from V1.0 to V1.2 (the latest version available at the time of testing).

I noticed that the power output had changed! Although it was still within Xiegu's specifications, the power was reduced by about 1 W on all bands and modes of operation. Another issue I observed was that by adjusting the mic gain to more than 20, the IMD products drastically increased, which would cause splatter on the air. I would be cautious setting the gain significantly higher, keeping the output below the rated power of 5 W PEP.

I also observed during the blocking gain compression dynamic range test several receiver spurious responses (birdies). Most were weak, but a few were strong enough that they could interfere with actual received signals, especially at closer spacings. These birdies did not prevent proper measurements from being made, but they were there.

Manufacturer's Specifications — Measured in the ARRL Lab

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

Band/Preamp	*Spacing*	*Measured IMD Level*	*Measured Input Level*	*IMD DR*
3.5 MHz/off	20 kHz	–115 dBm	–28 dBm	87 dB
		–97 dBm	–22 dBm	
14 MHz/off	20 kHz	–112 dBm	–33 dBm	79 dB
		–97 dBm	–27 dBm	
14 MHz/on	20 kHz	–130 dBm	–43 dBm	87 dB
		–97 dBm	–30 dBm	
14 MHz/off	5 kHz	–112 dBm	–31 dBm	81 dB
		–97 dBm	–20 dBm	
14 MHz/off	2 kHz	–112 dBm	–31 dBm	81 dB
		–97 dBm	–20 dBm	

Manufacturer's Specifications	Measured in the ARRL Lab
Second-order intercept point: Not specified.*	Preamp off/on: 14 MHz, +53/+51 dBm.
S-meter sensitivity: Not specified.	For S-9 signal, preamp off/on: 14 MHz, 86.0/43.6 µV.
Receiver processing delay time: Not specified.	25 ms.
Audio output: 0.3 W into 8 Ω @10% T.H.D.	0.1 W into 8 Ω at <1% T.H.D.
IF/audio response: Not specified.	CW: 515 – 1105 Hz, SSB: 59 – 2200 Hz, AM: 38 – 3900 Hz.
Transmitter	**Transmitter Dynamic Testing**
Power output: >5 W @ 13.8 V dc.	At 13.8 Vdc 5.2 to 10.4 W. At 9 Vdc: 14 MHz, 0.07 W.
Spurious and harmonic suppression: HF: >50 dB.	>–57 dBc Meets the FCC limits for spurious emissions.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order, 5 W PEP: –28/–41/–55/–53 dB PEP 20 m –23/–42/–41/–48 dB PEP (worst case, 75 m).
CW keyer range: Not specified.	5 to 50 WPM, default = 20 WPM iambic modes A and B.
CW keying characteristics: Not specified.	See Figures A and B.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	57 ms.
Receive-transmit turnaround time (TX delay): Not specified.	SSB, 10 ms.
Transmit phase noise: Not specified.	See Figure C.

Size (height, width, depth): 1.6 × 4.7 × 5.3 inches, not including protrusions.

Weight: 1.6 pounds.

*Second-order intercept points were determined using S-5 reference.

During testing, the frequency and mode get changed quite a bit depending on the test being performed. To save some time, I saved the commonly used frequency/mode pairs in memory locations. While switching from VFO to memory channel modes, the operating mode frequently did not change to the mode that was stored in the memory channel. Changing to a different memory channel and then back to the desired channel seemed to fix this problem most of the time, though the behavior was somewhat inconsistent.

This rig is far from stellar on CW transmit. Most modern rigs use internal DSP to shape the CW keying to obtain a reasonable waveform that does not generate key clicks. This transmitter does not, and as you can see in Figure A, the RF envelope rises very quickly at the beginning of each keying element. Figure B shows the resultant keying sidebands of this poorly shaped waveform. This rig has keying sidebands that are 20 – 40 dB worse than some of the better rigs we have tested lately. Fortunately, this is a QRP rig, so most of the time, the key clicks won't cause interference to other users, but when conditions are right, QRP can be loud. In that case, you may get some reports of key clicks from other users, or from an ARRL Official Observer! This would be especially likely if an external amplifier is used with this radio. The transmit third-order IMD on 75 meters is also poor, which will generate splatter on adjacent channels. — *George Spatta, W1GKS, ARRL Assistant Lab Manager*

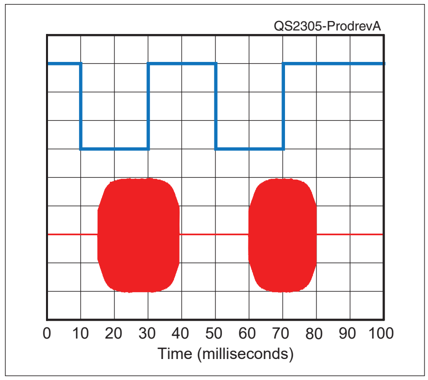

Figure A — CW keying waveform for the G106 showing the first two dits using external keying. Equivalent keying speed is 60 WPM. The upper trace is the key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 5 W output on the 14 MHz band, using QSK set to **ON**. The first-dit rise time is 3.7 ms; the fall time is 3.5 ms. The second-dit rise time is 3.9 ms; the fall time is 3.5 ms. The first-dit on delay is 5.7 ms; the off delay is 8.8 ms. The second-dit on delay is 10.4 ms; the off delay is 9.5 ms.

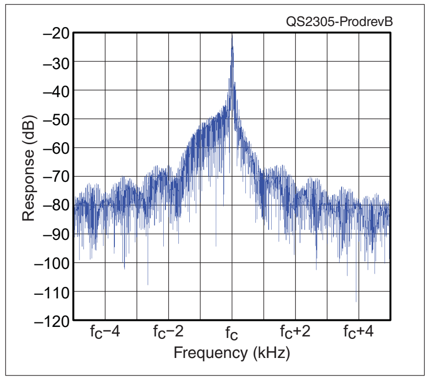

Figure B — Spectral display of the Xiegu G106 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying and the default rise time setting. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 200 ms. The transmitter was being operated at 5 W PEP output on the 14 MHz band, and this plot shows the transmitter output ± 5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in decibels.

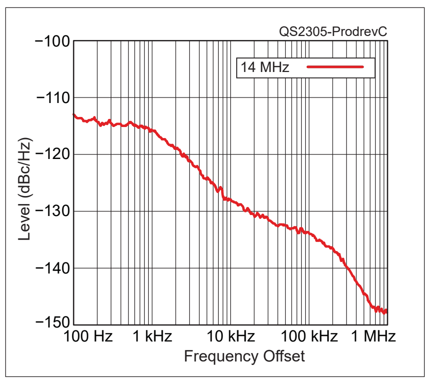

Figure C — The spectral display of the Xiegu G106 transmitter output during phase-noise testing. Power output is 5 W on the 14 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows phase noise 100 Hz to 1 MHz from the carrier. The reference level is –100 dBc/Hz, and the vertical scale is 10 dB per division.

Figure 2 — Rear panel connectors.

tapped, the volume control selects between the internal speaker and the speaker in the speaker/microphone. Besides tuning, the main tuning control is also used to select any one of the five menu pages, and to adjust menu parameters. On the top side of the radio, tapping the **MODE** button cycles through the **AM**, **LSB**, **USB**, and **CW** modes. Pressing and holding the **MODE** button turns the preamplifier on and off. Tapping the **BAND** buttons cycles the radio through the different ham bands, and pressing and holding the **BAND** buttons changes the tuning step. All of the buttons have an excellent tactile feel, and the two controls feel solid and are wobble-free.

Firmware Update

The latest firmware is available from **https://xiegu.eu**. At the time of this writing, the latest update was labeled "V1.2B03." This added three transmit power settings (low, medium, and high). As this review unit had an earlier firmware version, I went through the G106 firmware update procedure. This procedure is included with the firmware update download and requires that you download and install the *Tera Term* terminal emulator software. While not as simple as my Elecraft KX3 update procedure, it is not difficult. As mentioned earlier, Xiegu states that the DE-19 is required to interface the G106 with your computer. However, I found that an FTDI 3.3 V TTL USB-to-serial 3.5-millimeter adapter works fine. You can find this adapter for less than $20 at **www.amazon.com**.

A Bit More Testing

You will find my test results in Tables 3 – 6 at **www.arrl.org/qst-in-depth**. As the G106 now has three power settings, I first checked the actual power on several of the bands (see Table 3). Because the specified voltage range is 9 – 15 V dc, I also checked

Solid-State Keying Interface for Xiegu Transceivers

The Xiegu DE-19 accessory provides a keying interface that will work with most external amplifiers. However, unless you are using the Xiegu XPA125B amplifier, the DE-19 is overkill, as the ALC and band data interface is not compatible with non-Xiegu amplifiers. Therefore, I decided to build my own interface, which is applicable for keying any device with an open-circuit keying input up to 80 V dc, and a maximum enable current of 0.5 A. I have verified that this interface works with the G106, the G90, and the X5105.

The Xiegu ACC connector is a miniDIN8 female with the pinouts shown in Figure 3. I found that the PTT output measured 8 V dc on receive, and 0 V dc when transmitting. Figure 4 shows the schematic of the keying interface. The LED is not necessary, but I like visual indication when the PTT output is active, and Figure 5 shows the Xiegu amplifier-keying interface schematic.

Construction

The parts list is shown in Table 2. The keying interface uses a miniDIN8 cable with one connector cut off. While the circuit is easily built on a small piece of perf board, I implemented the circuit on a small printed circuit board (PCB). The connection points and component locations for my PCB are shown in Figure 5, and the completed unit is shown in Figure 6. The #4 hole provides for a PCB mount if desired.

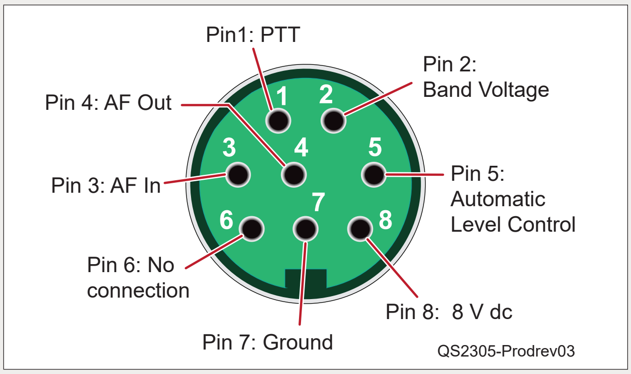

Figure 3 — Xiegu accessory port pinouts and descriptions.

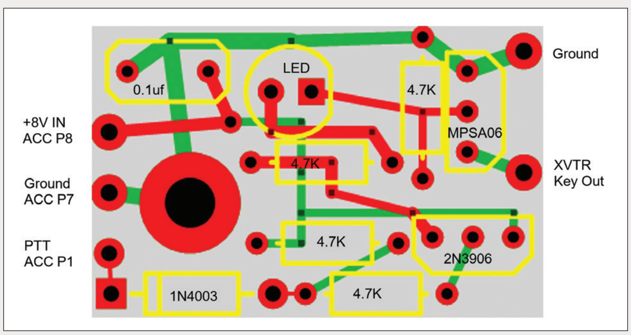

Figure 4 — Keying interface PCB layout.

the maximum output power at 9, 13.8, and 15 V dc. Table 4 shows the test results.

Because the G106 does not have an internal autotuner, I wanted to see how it would do with some reasonable mismatches. Table 5 shows the output power when transmitting at high power into high-impedance and low-impedance 2:1 and 3:1 SWR resistive loads. It is interesting that the G106 seems to have no problem with low-impedance loads — at least up to a 3:1 SWR.

Finally, I checked the S-meter reading against my Elecraft XG3 signal generator and a precision step attenuator on 40, 20, and 10 meters. The Elecraft XG3 level of accuracy specification is ± 1 dB. The results are shown in Table 6. Note that the G106 does a nice job of tracking signals at the rate of 6 dB per S-unit.

General Operation

When adding your power connector of choice (a Powerpole® in my case) to the supplied dc cable, keep in mind that the G106 does not have reverse polarity protection.

I found the G106 easy to operate. You will need to get into the menu for some settings, such as memory save and recall, transmit power, CW filters, CW speed, break-in delay, and some other less-used settings. Once you go through the menu a time or two, it will become second nature. Tapping any of the four multifunction buttons below the display brings up the menu, and the tuning control is then used to select between the five menu screens. There is no internal antenna tuner; however, the menu permits cycling from a paddle to a straight key, so you can use your paddle to put out a carrier for tuning an external antenna tuner if needed. Or you can use the AM mode.

CW Operation

The G106 internal keyer speed range is 5 to 50 WPM, and the CW pitch is adjustable from 500 to 1000 Hz (800 Hz default). You cannot select the opposite CW sideband; however, I have rarely used this feature on other transceivers. I could not hear ringing on even the narrow 50 Hz CW filter. T/R switching uses an internal relay, and you can hear the relay click. The break-in delay is settable from 0 to 1000 ms; however, the T/R delay is no shorter than about 50 ms. I wound up preferring about a 500 ms break-in delay to minimize relay clicking.

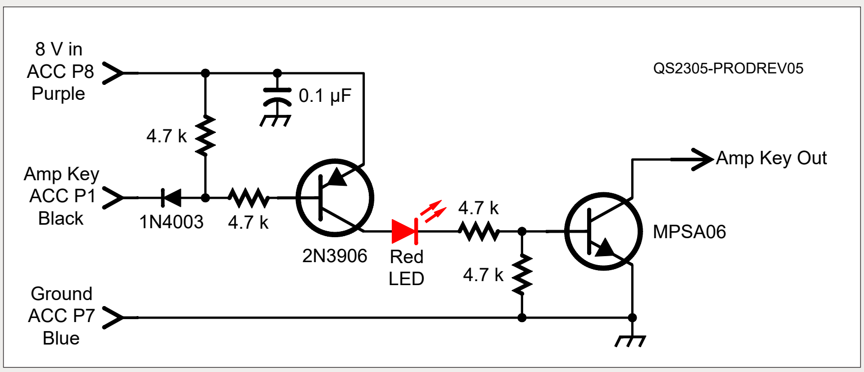

Figure 5 — Xiegu amplifier-keying interface schematic.

Table 2
The DIY Parts List: Flexible Amp-Key Interface

QTY	Description	Mouser/ Part Number
1	0.1 µf 100 V capacitor	81-SR211C104KAR
1	MPSA06 transistor	512-MPSA06
1	1N4003 diode	63-1N4003G
1	2N3906 PNP transistor	512-2N3906TA
4	4.7 K resistor	660-MF1/4LCT52R472J
1	Red LED (3000 mcd)	755-SLI-570UT3F
1	Plastic box 1.97 × 1.38 × 0.79 inches	546-1551GBK
1	Phono jack	534-580
1	MiniDIN8 cable	**www.amazon.com**

Figure 6 — The DIY Xiegu keying interface.

SSB Operation

The microphone gain can be adjusted in the menu, though the default setting is fine for the supplied speaker/microphone. You may need to change this setting if you change microphones. There are no receive and transmit audio equalization filters or transmit speech processing. The receive filter bandwidth is fixed at about 2400 Hz.

Digital Modes

The G106 can be operated with a computer for RTTY, PSK, JT65, or any of the other popular digital modes. However, you must purchase the optional DE-19 interface unit. Use the **L-D** or **U-D** modes for lower or upper sideband data transmission. The **L-D** and **U-D** modes disable the microphone, and permit external audio input only through the ACC interface.

On the Air

I did not test the G106 on digital modes, as I am primarily a CW and SSB QRP operator. I operated on 40, 30, 20, and 17 meters using my 43-foot vertical. At the maximum power level (~5 W), I had no problems making CW contacts on any of the bands. I like to use headphones, especially when operating CW, so I did not like having to use the speaker/microphone for the headphone interface. A headphone jack on the radio would have been nice.

SSB operation was a bit more of a challenge at the 5 W level. However, by focusing on calling strong stations, I could normally make contacts, especially on 20 and 17 meters. The audio reports were all quite good. I noticed one interesting little glitch. When operating either SSB or AM, pressing the PTT button produces a momentary full-output power spike. This is a very short-duration spike. Receiving stations heard it as a click.

Conclusion

The G106 is a minimally featured SDR 5 W radio. However, this makes operation easier than more complex radios. For more information, you can download the G106 user manual from **www.radioddity.com**.

Manufacturer: Xiegu. Distributed and supported in the US by select US distributors. Price: G106 HF transceiver, $320; DE-19 keying interface, $70.

Lynovation CTR2-Mini+ Radio Controller

Reviewed by Sean Klechak, W9FFF
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In the September 2022 issue of *QST*, an article featured the CTR2-Mini, a radio controller designed by Lynn Hansen, KU7Q. To briefly summarize the CTR2-Mini, it's a convenient way to control an HF transceiver via CAT control. Controlling a radio via the Mini has many benefits, including a colorful screen and easy-to-access menus. The CTR2 project piqued my interest, as I believe that some of the items used in this project will continue to evolve and be developed for amateur radio use. The use of Wi-Fi and an application programming interface (API) allows for multiple systems to communicate with each other and provide control, such as is the case with FlexRadio systems, which utilize an API to get and send commands and get information about the current status of the radio.

Subsequently, I was provided an opportunity to test the CTR2-Mini+, their latest of the CTR2 series. I

Bottom Line

The CTR2-Mini+ is everything you want it to be. It can be used to control your radio locally or remotely, and you can use it for its programmable keys or even to practice Morse code.

found multiple ways to effectively incorporate this radio controller into my daily amateur radio use. Compared to *SmartSDR*, the CTR2-Mini+ is easier to utilize as a radio controller for several reasons. The most noticeable upgrade to the CTR2-Mini is the controller's front panel, which now includes a six-button keypad. These buttons provide programmable shortcuts to rapidly access an operator's most used or favorite features.

On my desktop computer, I utilize a keyboard and a mouse to remotely control my FLEX-6400. This approach works fine, as long as I am sitting at my desktop, which is the problem; I'm increasingly less at my desktop, and more often than not working on a tablet with *SmartSDR* to access my Flex radio. A tablet does the job. Yes, there is a touchscreen on the tablet. Still, a touchscreen with no keyboard becomes a lesson in patience when navigating *SmartSDR*, FlexRadio's graphical software for controlling a radio. There are also several other options that make it possible to control a Flex radio remotely, including the utilization of a Stream Deck and *FRStack* software, or the utilization of Node-RED-based flows to control the Flex radio.

Description

I received the Mini+ as an assembled unit. At approximately 5 × 5.5 × 3.5 inches, the Mini+ is small enough to be carried around and utilized while traveling, easily fitting in a camera bag, a convenient way to carry my various electronics. A 2.4-inch LCD screen (the Wio Terminal) is attached to a black plastic case that has several control options. On the top portion of the case, there are six buttons labeled **1** through **5** and **PTT**, a power **OFF** and volume (**VOL**) knob, an encoder knob, a sidetone speaker, and a sidetone headphone jack. The rear panel (see Figure 7) includes many ports, a 12 V dc input (**12VDC**), **CAT I/O**, a PTT key output (**PTT/K OUT**), **RADIO I/O**, a paddle input (**PDDL IN**), and a PTT key input (**PTT/K IN**).

The Mini+ is just over 13 ounces in weight without the power supply. The pushbuttons on the Mini+ are placed in rows of two, spring-loaded, color coded, and labeled **1**, **2**, **3**, **4**, **5**, and **PTT**. On the bottom portion of the black plastic case are two brass hex spacers that help to provide an angle for the Mini+ to rest, and still allow for the operator to clearly see and utilize all buttons and the LCD screen. The hex spacers are removable, as they just unscrew from the case. Before turning on the Mini+, I made sure it was going to fit in my bag, which it did. So far, the Mini+ seemed to be well built.

Figure 7 — The CTR2-Mini+ back panel has connections for footswitches, paddles, 12 V dc input, CAT cables, and multi-radio links.

My first step in getting the Flex set up for use with the CTR2-Mini+ was to download and print the 69-page user manual (see **https://ctr2.lynovation.com/ctr2-mini-operation-manual**). I initially felt overwhelmed by the sheer size of the user manual, but most of it is used as a reference, as opposed to step-by-step instructions to operate the device.

Firmware Update

One of the things I noticed in the manual and on the website was the potential firmware update. The Wio Terminal included in this device is the brains of the operation. Inside the Wio is a programming code, which is in charge of everything the CTR2-Mini+ does — listening for input from each of the buttons, connecting to Wi-Fi, telling the radio to adjust the squelch, and activating the PTT. The firmware update was my first step in the exploration of the unit, as I wanted to ensure I had the latest features and bug fixes, if any. Updating the firmware was easy (see **https://ctr2.lynovation.com**). On the download page, I quickly found the latest firmware, dated December 31, 2022 (CTR-Mini_v113000), and downloaded it to my computer. I then found the instructions on the website:

> Connect the Wio Terminal to your PC. This can be done on Windows, Linux, or Mac.
> 1. Quickly double-click the power button (pushing it down past the "On" position twice) on the Wio to put it into programming mode.
> 2. Your PC's file browser should open with the Arduino folder selected. If not, navigate to it. It will be with your removable drives.
> 3. Copy and paste the CURRENT.UF2 file in the CTR2-Mini_v10xxxx.zip link below into the Arduino folder, replacing the original CURRENT.UF2 file.

That's how easy it is to upgrade the firmware. At the bottom of the page I was able to see the revisions included in this firmware; this addressed fixes to not only the firmware of the device, but also the instructions in the user manual. During the time I tested the product, I saved personal settings multiple times and then upgraded the firmware. I can confirm that a firmware upgrade does not remove user-created personal profiles/settings.

Setting Up the Radio Connection

With the firmware update complete, I browsed through the Quick Start Guide on page 9 of the manual. Step 3b explained how to connect a Flex radio with the CTR2 Mini+. This involves connecting the Wio portion of the Mini+ to the local Wi-Fi, entering the radio IP address information in the Wio, and directing the CAT control to TCP port 4992. I was doing this remotely (from outside of my personal network) by connecting the CTR2-Mini+ to my Flex radio. To connect my Flex to the CTR2 remotely, you must open port 4992 on your home router (or the router where your Flex radio is located). It's mentioned in the manual that there is potential to expose the Flex radio to be controlled by anyone on the internet at this point, as it doesn't require authentication to access and control. I found this information to be incredibly valuable and accurate.

In the future, I may choose to configure some sort of VPN to prevent bad actors from taking control of my radio. Additionally, when testing the Wi-Fi connectivity with the CTR2-Mini+, I tried both 2.4 GHz and 5 GHz networks. After double-checking case sensitivity in my network name and password, I did not have any issues connecting. Inputting the network name and password requires the use of the encoder/VFO knob and the blue button on the face of the Wio Terminal.

Now the Mini+ was connected to my Flex radio. There were about eight different directions in which I wanted to go. Keeping things as simple as possible, I started turning knobs and pressing buttons to check out their functionality and my abilities. I realized the game plan I was formulating was to customize the pushbuttons, get a feel for the navigation through the menus, use the Mini+ to operate CW with one of my iambic paddles, and use the PTT button alongside my Bluetooth headphones, which will be synced to my tablet. The Mini+ doesn't currently have the ability to send and receive audio, so I leverage the Mini+ with my Bluetooth headphones to give me the ability to listen and communicate through *SmartSDR*, while still controlling through the Mini+. The advantage of using my Bluetooth headphones is that they're 100% portable, and *SmartSDR* has great transmit equalization options. Additionally, I can activate the PTT button in *SmartSDR* through the Mini+ controller, without accessing *SmartSDR*. I am aware that I could use VOX, but I am not comfortable with VOX going off at any audio level — especially if I am somewhere busy, like a coffee shop.

Programming the CTR2-Mini+

With the aforementioned ideas in mind, I decided to program each of the five pushbuttons that were available first (refer to page 17 of the user manual). Programming the buttons is easy. On the main screen, tap the encoder. Once the encoder is pressed, a menu displays different options. Utilize the encoder to scroll to **CONFIGURATION**, and tap the encoder again. Once inside the configuration menu, there are several options that could be set: programming function buttons, programming (**C**) buttons (buttons located on the Wio Terminal), changing the theme/color sequence of the graphical user interface (GUI) presented on the Wio screen, and many other options. Within the configuration menu, certain sub-settings may be configured by using the encoder and blue button on the Wio or by using a key. I used my paddle to type my call sign, W9FFF. I enjoy the ability to configure my Mini+ with a key, as it allows me to practice Morse code.

Additional options for configuring the text data include using terminal mode. Terminal mode is used by connecting a USB cable to the Wio Terminal and to a computer, setting the baud rate in Windows, opening the *Tera Term* software, and utilizing a command prompt-style screen to configure the settings. Although this option won't always be practical, it became straightforward to leverage the initial setup feature of the Mini+.

As for configuring the buttons, there are two different banks for programming buttons, so really, the five buttons you can program may be utilized twice. The bank used will depend on the time the button is pressed. I programmed each of the pushbuttons within both banks to my liking, having a combination of the ability to change modes and bands, tune the radio, as well as other various features that I'd utilize most.

During this time, I learned about C-button programming. The C button is located on the top of the Wio device. When selecting the programming, I was able to choose between most of the same options as I could program with the standard pushbuttons. I opted to program my C button to open the **MODE** menu, which will help me rapidly change between the different modes.

Practicing CW with the CTR2-Mini+

Feeling confident that the buttons were programmed to my liking, I now wanted to utilize my CW key through the Mini+. I've wanted to improve my Morse code skills, and I've made use of many tools and techniques to continue to learn. The Mini+ has come in handy, as it has a practice mode under the keyer menu. In this menu, I was able to choose a variety of practice techniques, focusing on fixed- or random-length letters, call signs, numbers, custom uploaded practice files, and more.

For the sake of practice and familiarity, I chose to listen to Q codes to learn them. The Mini+ allows for adjustment of both speed and spacing of letters, and utilizes the Koch training method to help teach Morse code. However, I was unable to set these below 15 WPM. The speed may be increased faster than 15 WPM, but 15 WPM is actually a feature. This forced me to learn the characters and code by ear, not by mentally processing the combination of dits and dahs. I can attest that I am not good with code. I can send it with relative ease, but I am unable to process it by ear. I have been spending about 10 – 15 minutes a day picking an option within the menu and listening. When I think I understand a Q code, for example, I look at the on-screen trainer to see how well I did. The trainer tool is useful as a way to keep me learning, but it is not the primary purpose of my Mini+.

Using the CTR2-Mini+ as an Operation Tool

In order to utilize the Mini+ with my tablet and a set of Bluetooth headphones, I tested both of my Bose Avantree headphones. They both have Bluetooth capability, so I can sync them to my tablet (see Figure 8). This configuration allows me to not only listen to my Flex radio, but utilize the headphones' built-in microphone to transmit to my Flex radio.

The Mini+ activates the PTT button in the event that I am utilizing SSB mode. As mentioned earlier, I've never been comfortable with VOX as a PTT activation method, especially in public settings. Utilizing FlexRadio's *SmartSDR* software to activate the PTT is possible, but I must be inside the *SmartSDR* software to utilize that feature. If I am working within another application, pressing an external PTT button makes things very simple. I sometimes utilize the Mini+ in public places; by plugging in an audio cable to the headphone (**HP**) port on the top portion of the Mini+, I can also use CW mode with an external keyer. Plugging into the **HP** port allows me to hear the tones I am generating from my key, while also utilizing the tablet and headphones to continue to hear the airwaves.

Figure 8 — A simple solution that utilizes the CTR2-Mini+, a tablet, and an iambic paddle for remote CW use. Not pictured are headphones that plug into the HP port.

This setup works well for me. Being able to operate and change bands, frequencies, filter widths, and even slices with the Flex radio is a convenient option to have. While operating remotely, I can easily access all of the possibilities by tapping the VFO encoder a few times or leveraging my user-defined buttons. An easily accessible remote meter panel has an excellent user interface that allows me to view a combination of my S-meter, power meter, ALC meter, and compressor meter all at the same time. Additionally, while operating remotely and with specific ports open at the Flex radio's location, I can place the Mini+ into GUI mode, which gives me a graphical panadapter. This allows me to see where signals may be on the spectrum for the band in which I am operating.

Support

I previously mentioned that I upgraded the firmware to this device. While utilizing some features of the Mini+, I observed what may have been a bug in the current firmware. I believe it had to do with an array being called for the numerical Morse code characters.

I reached out to Mr. Hansen and informed him of my findings, and was surprised to receive a prompt response and an updated firmware emailed to me that evening. The support provided in this experience was great and personable. From browsing articles online, it appears that Mr. Hansen is open to hearing ideas regarding the Mini+ features, and I am convinced that this will help the future popularity of the Mini+ and other CTR2 devices.

In Summary

The Mini+ has the capability to control multiple radios via one device. It really can be what you want it to be, and if you have questions regarding the Mini+, I encourage you to browse through the manual to determine if this product is a solution for something you are working on now or may be working on in the future.

Although this article was written while using my Flex radio, the CTR2-Mini+ is supported for CAT control by a variety of different radios. It has great potential to conveniently access features to your current radio, as well as train with Morse code. This product has many features, with the potential for more to come in the future.

Taking into consideration the current features offered, the quick response to support, and the overall build quality, I consider (for the price tag) a fully assembled CTR2-Mini+ to be a good value. I am excited to watch for the future development of this product.

Manufacturer: Lynovation, **www.lynovation.com**. Price: $140 for the assembled unit. For more details on the kit version, please visit the manufacturer's website.

TinyGS – An Application of LoRa Technology

Reviewed by
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Some of the exciting aspects of amateur radio are the introduction of new technology, the repurposing of an existing device, and the exploration of an area in radio that is unfamiliar. Now-retired *QST* Editor Steve Ford, WB8IMY, in the ARRL Eclectic Tech podcast (**http://www.arrl.org/eclectic**) discussed amateur radio applications of long-range (LoRa) boards, which are tiny 70-centimeter data transceivers, readily available at **www.ebay.com** or **www.amazon.com** for about $27 each. LoRa technology can be used to create small area networks, and is ubiquitous in cities with modern parking meters, connecting credit cards with your bank at street level. In the April 2021 column, guest author Anthony Le Cren, F4GOH/KF4GOH, described the tracking of radiosondes with the use of these devices and a smartphone app called MySondy GO. Amateurs living in large cities may be challenged to locate weather balloons in their areas, but those living elsewhere are likely to have more success with this.

TTGO LoRA ESP32 board.

While many hams make contacts via satellite, the number of active amateur satellites will soon be dwarfed by the number of picosatellites that carry LoRa modules into orbit, and these are readily accessible to amateurs with simple equipment. As described at **www.tinygs.com**, "TinyGS is an open network of

Bottom Line

The TinyGS board is a low-cost 70-centimeter transceiver. At this reasonable price, it would be consistent with the amateur spirit to explore the world of LoRa and see what else can be done.

ground stations distributed around the world to receive and operate LoRa satellites, weather probes and other flying objects, using cheap and versatile modules." Many of the satellites are designed by students at universities worldwide and are launched by commercial rockets from many countries. The power output of these satellites is often less than 1 W, with 500 mW being common. The Norby satellite usually runs at 2000 mW, but on occasion will be cranked up to 7000 mW. Because these picosatellites are in low Earth orbit, their operative lifetime is limited, and they are expected to self-destruct, to avoid adding to the problem of orbital debris. While downloads currently consist of only telemetry data, one pair of amateurs managed to exchange messages via an older satellite using TinyGS. The future offers hams an opportunity to try to expand on these capabilities, as LoRa technology becomes more common.

The website **https://github.com/G4lile0/TinyGS** shows complete details about TinyGS. A number of suitable devices are available on the internet, such as the TTGO LoRa32 V2.1 ESP32 Bluetooth Wi-Fi Wireless Module (433Mhz), but see the more specific list on GitHub. There are units that work at 915 MHz and other frequencies (see the lead photo), but as there are no satellites currently using those frequencies, 433 MHz units are recommended. While "Meshtastic" boards are available, they are more specialized than what is needed for TinyGS. Most boards come with a 4-centimeter-long stubby antenna, but reception with them is limited. The system can easily be improved with the use of a simple 440 MHz ground plane or even a mobile collinear antenna placed on a metal baking pan. While a low-noise amplifier will also enhance reception, this would be a good opportunity to try out more complex antennas, such as a quadrifilar helix antenna, an eggbeater, or a parasitic Lindenblad.

Getting Started

Connect the board to a USB port on a desktop computer, and identify the COM port assigned for the specific board. Be sure to use the CP210x drivers. From the GitHub site, download the TinyGS uploader, which is available in Windows, macOS, and Linux versions. Using the proper COM port, execute the program and install the firmware. The *Telegram* app (desktop or smartphone version) is required to obtain a login to the TinyGS dashboard on your board. The TinyGS community site on *Telegram* will direct you to the TinyGS Personal Bot, which will give you a login link. An MQTT username and password will be assigned. Save these, as they will be needed later.

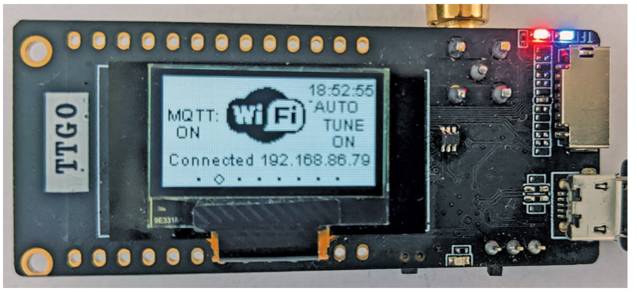

Figure 9 — TinyGS IP address.

Figure 10 — TinyGS map.

From the TinyGS website, open the dashboard and configure the needed parameters. Name your station, assign a password for future access to the dashboard, and provide the local Wi-Fi network name and password, the latitude and longitude coordinates, the time zone, and the MQTT username and password. Only licensed amateur radio operators can transmit; otherwise, accept the default settings. If there are problems communicating with the board, be certain that you are connecting to the board's network (TinyGS) and not your local network. After configuring the board, reconnect to it via your local network.

Using an antenna with a wide view of the sky, power the board with a small USB power bank or a solar panel. This is a good opportunity to experiment with alternative power sources, to allow the antenna to be placed where power may not be readily available. The board will automatically link to the web via Wi-Fi. The screen will show the IP address assigned to the device, as well as a map with the satellite nearest to your QTH (see Figures 9 – 11). The system will automatically keep the board tuned to the appropriate frequency, which changes with each satellite. The screen will display specific satellite information, while the downloaded packets, as well as the transmission points, are posted to the TinyGS web page. Depending on your location and antenna, it is possible to receive as many as 10 – 12 packets or more each day

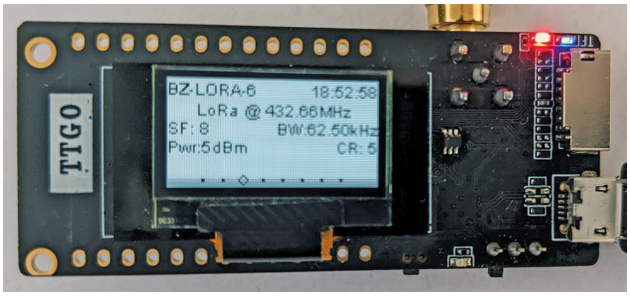

Figure 11 — TinyGS satellite data.

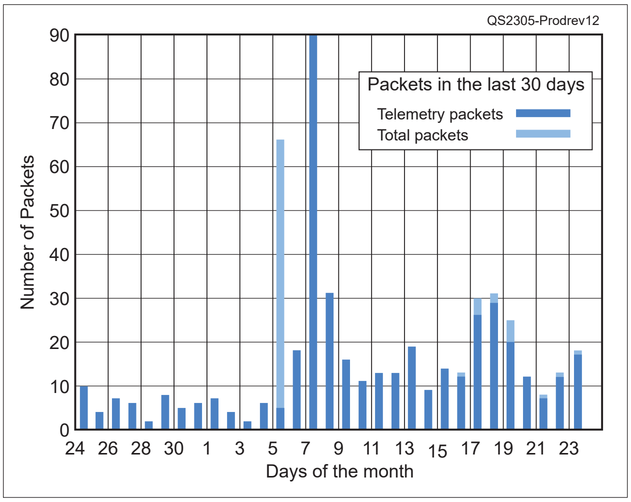

Figure 12 — Packets received.

(see Figure 12), but this can vary by the number of orbit paths of the satellites over a given QTH (see Figure 13). The sudden increase in packets received on the fifth day of this particular month (February 2023) represents the launch of several additional satellites simultaneously. The data received is aggregated, and the status of each satellite is closely monitored by satellite designers and their faculty (see Figures 12 and 13).

Conclusion

While there are an increasing number of users in the US and Canada, there are many others in Europe who are on the TinyGS network. TinyGS is more than just an introduction to satellite radio reception; it can be used as an educational tool, to encourage learning about coding on non-standard boards, antenna development, and consideration of alternative power

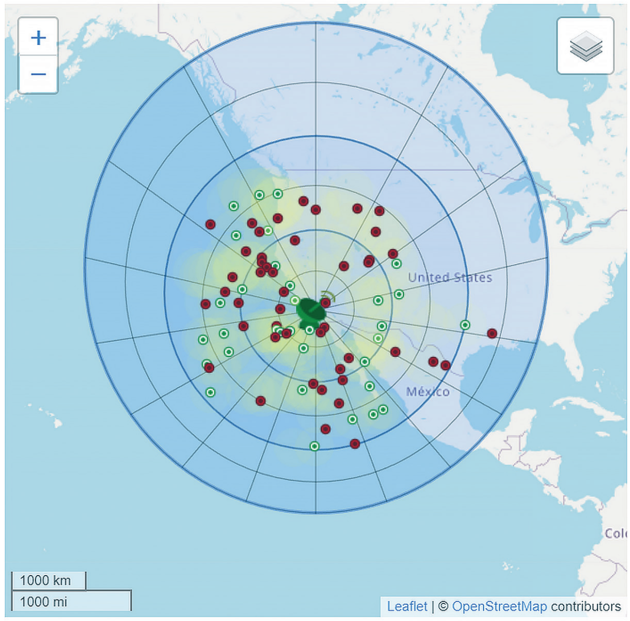

Figure 13 — Packets sent.

sources. Alternatively, students might be interested in connecting with others in the construction of a pico-satellite. LoRa is a relatively new technology, and both MySondy GO and TinyGS seem to be just the beginning of the application of these devices. As Steve Ford, WB8IMY, said, at such a reasonable price, it would be consistent with the amateur spirit to explore the world of LoRa and see what else can be done.

Manufacturer: LILYGO, **www.lilygo.cc**. Price: Between $20 and $30. Available from different online sources.

See *QST* in Depth for More!

Visit www.arrl.org/qst-in-depth for the following supplementary materials and updates:

- ✓ Table 3: The Xiegu G106 Power Levels Measured at 13.8 V dc
- ✓ Table 4: The Xiegu G106 Output Power and Current Draw vs Input Voltage
- ✓ Table 5: SWR Impact on the Xiegu G106 Transmit Power
- ✓ Table 6: The Xiegu G106 S-Meter Accuracy