QST

Product Reviews

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CQV-SWR120 SWR Power Meter

Rigol DS1202Z-E Oscilloscope

Siglent Tech Oscilloscope

CQV-SWR120 SWR Power Meter

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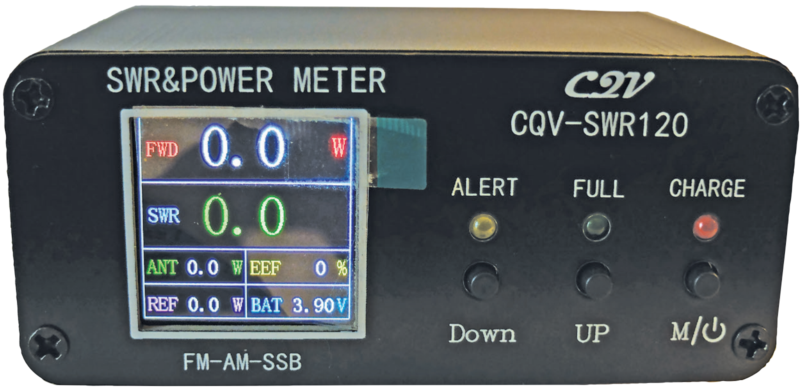

In the world of amateur radio, achieving optimal antenna performance is crucial for clear and efficient communication. To ensure your antenna is operating at its best, monitoring the standing wave ratio (SWR) and output power is essential. When I was asked to evaluate this low-cost meter, the CQV-SWR120, I approached it as a portable operator. In this review, I examine this power meter's features, functionality, and overall performance, to help you make an informed decision about this important piece of equipment. This test instrument is even more important for portable radio operators, as deployed antennas typically require an antenna tuner and a reliable, small, and lightweight meter that can fit in a backpack. I never bring a power meter with me, as it's too big and a needle-based meter can be fragile. I do pack a portable digital SWR meter, but having something to measure power at the same time and cover the 6-meter band is of great interest to me. Having multiple data points measured and a unique alerting feature increases its functionality.

Features and Design

The CQV-SWR120 meter is thoughtfully designed to provide reliable measurements of SWR and power levels. Its compact form factor and user-friendly interface make it suitable for both novice and experienced operators. Without a schematic, I had a look inside, and it appears to be the typical Bruene type of coupler with diode detectors feeding a PIC chip. This type of design is more accurate than low-cost resistive-type couplers. The meter features an easy-to-read OLED 240 × 240 digital display with clear markings and multiple measurement data points, allowing for quick and precise readings. A USB-C charging jack is used to charge the internal 3.7 V 1000 mAh battery using a typical 5 V 1 A cell phone charger. There are three LED indicators for the battery state on the front panel. You need to turn the unit on via its rear-facing power switch in order to charge the internal battery. I found out by accident that it also has a power-saving function where the display will turn off after a set amount of time and turn on again when transmit power is applied. See Table 1 for the unit specifications.

Instructions were not included, but I figured it out. On power up, the display shows "Hello," the designer call sign, BG5CQV, and the current software version 4.01. AM, FM, and SSB modes are supported, but it does not offer a PEP display for SSB. I think there may be software updates available, but I was unable to find any information.

Table 1
CQV-SWR120 SWR Power Meter Manufacturer's Specifications

Operating frequency:	1.8 – 54 MHz
Measuring range:	0.5 – 120 W (SSB mode can reach up to 200 W)
Standing wave range:	1 – 99.9
Charging interface:	Type USB-C, 5 V / 1 A
Internal battery:	3.7 V / 1000 mAh
Interface type:	UHF (SL16) SO-239 equivalent
Cabinet size:	3.5 × 2.5 × 1.5 inches
Weight:	6.7 ounces

Bottom Line

The CQV-SWR120 SWR power meter is compact and lightweight for portable use, and the simultaneous display of all parameters is convenient. Get reliable readings on the go with this low-cost, tiny RF power meter.

If you hold the **DOWN** button longer than 1 second, you can set the SWR alarm (2.0 default) using the **UP** and **DOWN** buttons, and then press **M** to save the settings. If you hold the **UP** button longer than 1 second, you can set the shutdown delay time (10 seconds default) to one of your choosing, and then press **M** to save the settings. If you hold the **M** button longer than 1 second, it will turn the unit off. One thing I found peculiar was that the rear switch can be used to turn the meter on or off, but the front switch can be used only to turn it off. The operation is very simple, and I don't see a need to make changes from the default settings. The inclusion of two plastic covers for the SO-239 connectors prevents them from scratching other equipment when the unit is tossed into a backpack.

I also found that a quick press of the left button turns on the SWR buzzer alarm, the middle button changes the language between Chinese and English, and the right-most button selects the data presented on five different screens.

Functionality, Performance, and Accuracy

The SWR120 excels in functionality, providing reliable measurements and a range of useful features. It allows you to measure SWR, forward power, and reflected power, enabling you to determine the efficiency of your antenna system and identify potential issues. The SWR reading is particularly important, as it indicates how well the antenna is matched to the transmission line, directly impacting the performance of your transmit signal. I always strive to operate with an SWR below 2:1 to avoid becoming a member of the "blown finals club."

The display does get washed out in the bright sun, making reading difficult. I am looking at using a small cardboard hood to help shade the display to improve readability. I also added four rubber feet to prevent the unit from moving around or scratching the top of my radios.

One of the standout features of the SWR120 is its broad frequency range, covering 1.8 – 54 MHz. The power measurement capability is also commendable, supporting power levels up to 200 W on SSB, with 120 W stated for the other modes.

Ease of Use

The SWR120 is exceptionally user-friendly, making it accessible to operators of all skill levels. Its intuitive design and simple operation enable quick setup and hassle-free measurements. Connecting the meter to your antenna system is straightforward using the rear-panel SO-239 connectors (see Figure 1), and the clear digital display and bright LEDs provide instant visual

Figure 1 — The CQV-SWR120 rear panel view.

feedback. I chose menu #3 mode display, which shows forward power and SWR in bigger letters than the other data points.

The SWR alarm feature is very useful, as a buzzer will sound if the SWR is greater than the 2:1 set point. I have not seen this feature in other portable meters. I was operating POTA at a beach in Halifax when I did not see that the wind had knocked down my Buddistick antenna. The SWR jumped up on transmit, I noticed a loss of receive signal strength, and I saw on the Icom IC-705 display that the SWR was 10:1. The audible alarm would have quickly told me I had an issue. I also tried adjusting my 40-year-old MFJ-1610 manual antenna tuner with the Buddistick antenna. I used the Icom VS-3 Bluetooth microphone to key up and adjusted the counterpoise until the buzzer stopped. Sure enough, the SWR was below the 2:1 set point. I could use this as an audible SWR meter in the field to assist in antenna tuning.

I also noticed that the front-panel LED and SWR display indicate status in three ways, with a default alert set point at 2.0. The SWR display itself is green at 1.5, and the green LED comes on; it's yellow from 1.6 to 2.4, and the yellow alert LED comes on with the buzzer above 2.0; and it's red at 2.5, with the red LED turning on. So, you can quickly get a visual of what the SWR is at any time. The buzzer can be turned off in the settings menu.

Table 2
CQV-SWR120 SWR Power Meter SWR Chart

	------ 50 Ω Resistive Load ------		-- 100 Ω Resistive Load --	
Band (m)	Power Out (W)	SWR	Power Out (W)	SWR
160	2.0	1.0	1.9	2.2
80	2.0	1.0	2.0	2.2
40	2.1	1.0	2.1	2.2
30	2.1	1.0	2.1	2.2
20	2.1	1.0	2.1	2.2
17	2.1	1.0	2.1	2.2
15	2.1	1.0	2.2	2.2
12	2.1	1.0	2.2	2.2
10	2.1	1.0	2.2	2.2
6	2.0	1.1	2.2	2.0

Lab Notes: CQV-SWR120 SWR Power Meter

For the price, it is good. The battery voltage didn't drop much in the few hours I was testing it. As you can see in Figures A, B, and C, compared to the ARRL Lab wattmeter, the meter over-reports some of the figures, but for a quick, easy, and inexpensive device, it's a good little tool to have, especially if you use a radio that doesn't already have these features built in. — *George Spatta, W1GKS, ARRL Laboratory Manager*

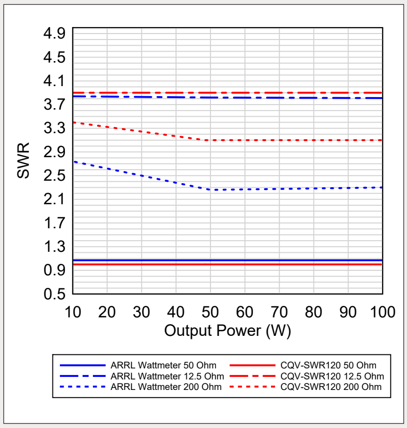

Figure A — The CQV-SWR120 power meter compared to the ARRL Lab wattmeter at 3.800 MHz.

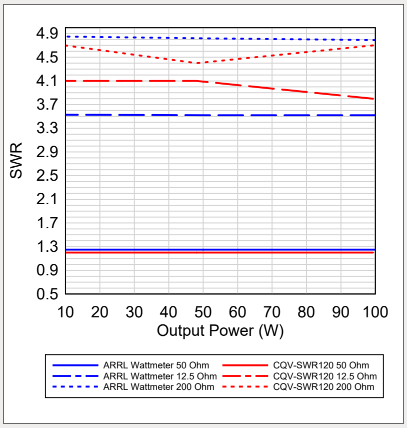

Figure B — The CQV-SWR120 power meter compared to the ARRL Lab wattmeter at 14.200 MHz.

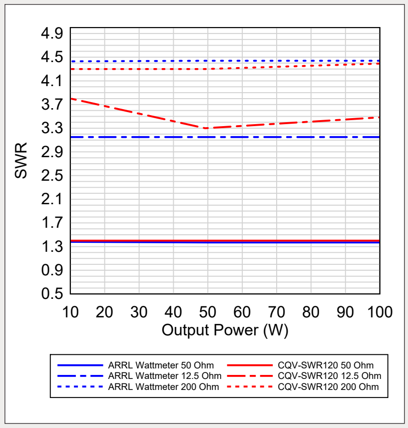

Figure C — The CQV-SWR120 power meter compared to the ARRL Lab wattmeter at 28.500 MHz.

I ran the meter during ARRL Field Day, and it performed as I expected it to while operating at 100 W. The alarm tripped when a passing rain shower kicked up high winds and caused one of the sides of my Chameleon tactical dipole to rub against a 2-meter **J** pole that was deployed by another ham too close to my antenna. I ran out and lowered the **J** pole a few feet, and the problem was solved.

If the internal battery voltage falls below 3.4 V, an alert buzzer sounds, indicating a charge cycle is required.

I set the power output of my Icom IC-705 to 20%, which showed 2 W using a Bird 43 meter into a 50 and 100 Ω resistive load. You can see my results in Table 2.

Durability and Build Quality

The SWR120 is built to withstand the rigors of regular use, with its aluminum case construction that also offers RF shielding. My only concern is that the display could be damaged, but I pack it carefully. I may choose to add some small rails on either side.

I put the meter in an X-access organizer pouch (from Decathlon) with SO-239-to-BNC adapters, a short PL-259 patch cord, a USB-C charging cable, and a Goal Zero Power Bank. This makes it easy to grab

Figure 2 — The CQV-SWR120 size compared to the Icom IC-705.

and go and allows me to use it with any radio. See Figure 2 for a size comparison with my Icom IC-705. Maybe someone can create a snap-on cover using a 3D printer to protect the display and/or work as a sun hood.

Conclusion

The SWR120 SWR power meter is a valuable tool for any amateur radio operator seeking reliable antenna and radio measurements. Although I looked at it from a portable operator perspective, there is no reason that it would not also be useful in the home shack (I did use it on Field Day at 100 W). Its compact design, broad frequency range, and intuitive operation make it an ideal choice for both beginners and seasoned enthusiasts. Whether you're adjusting your antenna for optimal performance, troubleshooting potential issues, or simply monitoring power levels, the SWR120 delivers consistent and accurate readings. Its durable construction ensures it will remain a reliable tool in your arsenal for years to come. For precise antenna tuning and efficient communication, the SWR120 SWR power meter is a worthwhile investment that will enhance your amateur radio experience.

Manufacturer: Unbranded (design by Zehua He, BG5CQV), available from various online retailers. Price: from $49 to $70.

Oscilloscopes — Rigol DS1202Z-E and Siglent Technologies SDS1104X-E

Reviewed by Paul Danzer, N1II
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In the last 8 to 10 years, oscilloscopes, along with many other electronic devices, have transitioned from an analog to a digital design. While it may still be possible to find a few low-cost analog "student scopes," most analog units available today are used. These used units may be a good value for hams, unless you worry about parts replacement; as for their calibration, it may be good enough for your applications.

Today, there are a number of digital oscilloscopes available in the price range of $200 to $500. Because they are completely solid state, they are usually smaller, lower weight, and not totally dependent on component stability to retain their accuracy. In fact, many of them depend heavily on only one timing component — often a 10 MHz source from which other times and frequencies are derived.

In addition to the transition to digital, there has been a great improvement in the capabilities of analog-to-digital (A/D) converters, which are needed to bring the analog waveforms being examined into the scope digital processing. Some units take advantage of the presence of one or more microprocessors, digital memory, and precise timing to include other capabilities in the same box, such as counters and even waveform (square wave, pulse, etc.) generators.

The oscilloscopes chosen for this review were selected not only to examine their basic capabilities but also to provide a comparison of the capabilities available in this price range today. Table 3 is a comparison of the published capabilities of the two units reviewed here; three other units will be presented in a future issue of *QST*. While some manufacturers may use one standard and definition, other manufacturers may measure the same parameter by a different standard or with a slightly different meaning.

Most oscilloscopes consist of the following hardware blocks, strung in series: an A/D converter for input, a digital processor or microcomputer with memory, a display driver, and a display such as an LCD panel. There are several benefits and problems associated with this design. In the days of analog oscilloscopes, storage scopes (which allowed keeping a visible waveform on the screen until it was erased) tended to be very expensive.

Digital oscilloscopes convert the input analog trace to a set of digital words. There is usually a button labeled **RUN/STOP** near the screen. When you want to freeze the observed waveform, the **STOP** button stops the processor from taking in any new data, and the last set or sets are kept in memory. In other words, functioning as a storage scope is inherent in the design at little or no extra cost. In addition, several sets of data — perhaps one set from channel 1 and one set from channel 2 — are already in memory, and the microprocessor can perform various arithmetic functions and display the results.

Again, with little or no cost, the processor and memory can be configured to act as a waveform generator, with

Table 3
Oscilloscopes (2 units) (not tested in the ARRL Lab)

Models	Rigol DS1202Z-E	Siglent SDS1104X-E
Bandwidth (sine wave)	200 MHz	100 MHz
Rise time	≤3.5 nS	≤3.5 nS
Horizontal scale	2 nS/div – 50 S/div	1 ns/div – 100 s/div
Sample rate	1 GSa/s (single-channel), 500 MSa/s (dual-channel)	1 GSa/s single channel of a pair, 500 MS/s both channels
Display	7-inch color LCD	7-inch color LCD
Display resolution	800 × 480 pixels	800 × 480 pixels
Channels	2	4
Max record length	For a single channel, 24 Mpts	For a single channel, 14 Mpts
Sampling rate/time accuracy	±25 ppm	Rate is 1 GSa/s if all four channels are used
Input coupling	dc, ac, ground	dc, ac, ground
Input impedance	1 MΩ in parallel with 15 pF	1 MΩ in parallel with 15 pF
Max input voltage	400 V (ac + dc, peak)	400 V (ac + dc, p to p)
Gain accuracy	±3 to 4%, less than 3%	5 mV/div – 10 V/div
Vertical sensitivity	500 µ/div – 10 V/div	500 µ/div – 10 V/div
Trigger types	Selectable	Selectable
Trigger modes	Seven types	Auto, normal, single
Automatic measurement	More than 20 types (period, frequency, duty)	38 types, displays four measurements at the same time
Waveform math	19 selectable	+, –, *, /, FFT, d/dt, integral dt, sqr root
Waveform storage	N/A	Max 80,000 frames
I/O ports	LAN, USB, trigger out	USB to PC, USB flash drive
Calibrator	Yes	Yes
Built-in help menu	Yes	Yes
Protocol decoding	Four types	Many
Waveform types	See text	See text

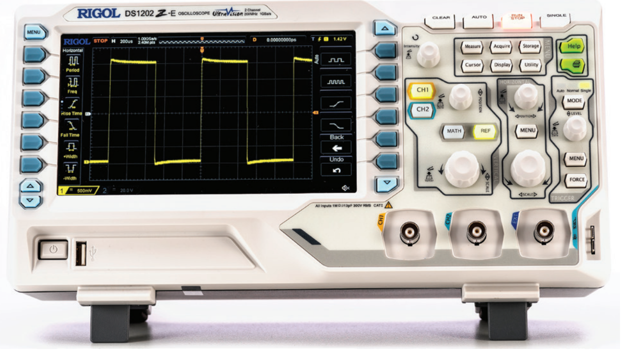
selectable sine waves, square waves, and other synthesized waveforms. Because there is already a time base or clock within the oscilloscope, a digital counter can also be included.

There are, however, some problems associated with digital oscilloscopes. Often they are advertised and sold with a statement such as “This is a 50 MHz scope.” This may be true, and they will accurately display a 50 MHz sine wave, but most other waveforms require harmonics of the base frequency to be added to the base to make the new waveform. This is just another way to say that a “50 MHz” scope will not necessarily properly display a 50 MHz square wave, unless there is some additional processing to ensure proper response rise times and other edges. This can be explained by the Nyquist theorem, which states that a signal must be sampled at least twice as fast as the highest-frequency component of the signal to accurately reconstruct the waveform. Keep in mind that the Nyquist rate is a minimum; generally, scopes are designed for a higher rate than this lower limit. Frequency components higher than half the sample rate are mistakenly interpreted as low-frequency components, a phenomenon known as “aliasing.” So according to the Nyquist theorem, a 50 MHz scope would be useful measuring signals up to about 25 MHz.

Another common problem is the division of resources. It is not unusual to find, buried well within the fine print, a statement limiting a particular parameter (often the bandwidth) to the specified value if only one channel is selected. If both channels are active, the value is divided in two. Unfortunately, this omission may well be inadvertent.

Rigol DS1202Z-E: Two-Channel 200 MHz Digital Oscilloscope

This relatively lightweight (slightly less than 6.4 pounds) oscilloscope may look familiar. It resembles a matching Rigol signal generator reviewed in the March 2023 issue of *QST*. It measures approximately 12.3 × 6.5 × 4.8 inches, excluding the pop-up handle and tiltable



feet. Rigol is a well-known exporter of test equipment from China.

The 7-inch (as measured diagonally) TFT liquid display has a resolution of 800 × 480 pixels. The design specification is 16 million colors (24-bit true color).

After unpacking this unit, you will probably have to read the instruction manual to best use this oscilloscope. Along the bottom edge of the front panel are four connectors — three BNC and one USB, plus the power switch, a waveform test point, and a ground point. There are also more than 40 pushbuttons and knobs facing you.

Fortunately, by going to the Rigol website (**https://rigolna.com**) and selecting **SUPPORT/TECHNICAL SUPPORT/OSCILLOSCOPES**, you can download four documents totaling almost 500 pages of information. The Quick Start Guide is only a handful of pages, and the 220-page User Guide is well indexed. Also worth viewing is a video tutorial on oscilloscope terminology and the meaning of many specification numbers. There are several videos, including one that explains the relationship between bandwidth and rise time. Another shows the relationship between sample rate and record length. The specific numbers for this model of oscilloscope can be found on the Rigol website in the "DS1000E/D Series Oscilloscope Specifications" file.

The model selected for this review has two channels, 200 MHz bandwidth, a real-time sample rate of 1 giga samples per second (GSa/s), and memory depth of 24 mega points (Mpts), or number of samples that can be recorded in memory. A similar model is available, with the bandwidth limited to 100 MHz.

Included in the Package

Currently, there is no instruction book or CD included with the oscilloscope. Therefore, you will have to go to the manufacturer's website for the instructions. Other items in the shipping carton include: two probes with interchangeable color identification rings; the probe compensation adjustment, a screw, in the probe handle; a miniature screwdriver packaged with the two probes, along with safety covers and grounding springs; the probe setting (1X or 10X attenuation), which is a slide switch on the probe body; a warranty form to be returned to Rigol; an accuracy certification certificate; a packing list with a QR code on the reverse side to bring up the Quick Start Guide; and an ac power cord and a USB type A-to-B cable. End to end, the probe assembly measures 50 inches. *Caution:* the compensation screw head is very small; patience may be necessary while making adjustments.

Bottom Line

The Rigol DS1202Z-E is a full-featured oscilloscope with certifications and accuracy traceability. It has many features and capabilities that some hams will not need but are a real help to others.

Before You Start

Adjust the legs to make the front panel comfortably visible. The next step is to connect the ac line cord at the right rear of the enclosure (see Figure 3). After pressing the power button, the unit does a self-test, followed (if all is well) by a welcome screen.

The next two steps probably do not have to be repeated unless a problem arises. Instructions in the Quick Start Guide take you through the steps of a short "function inspection." A three-step routine for probe compensation checking and adjustment of both probes finishes the initial checkout. Probe compensation is the process in which the probe capacitance is adjusted to compensate for the effects of the input capacitance of the scope. Properly adjusting the probe compensation is necessary to ensure accuracy and linearity in the measurement results.

There is one other feature you might want to look at before using the unit. Toward the upper right corner of the front is a green **HELP** button. There are nine pushbuttons on the left of the screen. Press the top **MENU** button, and the two bottom light blue buttons will take you through the help menu choices.

Common Controls

Oscilloscopes have a usual set of controls — namely, horizontal or sweep rate, vertical or V/cm, and a trigger section. While older analog scopes had the knobs calibrated in units per division — a division was usually one centimeter, as seen on the graticule over the

Figure 3 — The Rigol DS1202Z-E rear panel view.

screen — most digital scopes, like this one, read out the settings in numerical form on the screen.

In the control area of this scope, there is a portion devoted to both channel selection and vertical scale. The vertical setting of each channel is independent. The channels are selected by pressing one or both **CH** buttons. The top knob is labeled **POSITION**, and the bottom knob is labeled **SCALE**. The voltage scale selected is read out in numbers on the lower left of the screen in a color corresponding to the channel selected. Pressing the **SCALE** knob selects the rate at which you change the scale.

The **MATH** button, when pressed, turns on the vertical row of buttons just to the right of the screen. Several choices then can be made by pressing the button keyed to the math legend at the top of the list. Applicable submenu choices are selected by the rotary control just above the channel select buttons. This shows up as a brief set of choices in a box to the left of the selected function. The Quick Start Guide has a concise explanation of the controls in the **VERTICAL** section.

The **HORIZONTAL** section, just to the right of the **VERTICAL** section, has similar controls. The bottom control selects the horizontal time division or sweep rate, and the value is shown on the screen at the top near the left edge. This control also sets the expanded sweep rate by pressing it in, and is used in conjunction with the **MENU** button in this section.

Finally, the third common setting, **TRIGGER**, is on the right of the **HORIZONTAL** section. The trigger level is adjusted up and down by the level control when the **MODE** button selects **NORMAL**. The numerical value is read out on the lower left of the graticule area of the screen. A horizontal dotted line pops up and reminds you of your setting. Selection of the **AUTOMATIC** mode sets the trigger point.

The **MENU** button in this section brings up a set of selection keys on the right side of the display. The voltage value of the trigger selection point is read out on the top left of the screen. The User Guide lists seven different trigger parameters, as well as 15 different trigger types, that can be selected.

Finally, the **FORCE** key manually generates a trigger, and under certain conditions whatever trigger is active generates a pulse that is output at a BNC connector on the right side of the enclosure.

More System Buttons

At the top right of the panel, there are several system function buttons. The green **HELP** button brings up the internal help menu. The other green button can be used in two ways: to save the current screen to a USB storage device, such as a flash drive; or to send the selected contents to the printer when a PictBridge printer is connected to the front-panel USB port. Discussion of the PictBridge interface is beyond the scope of this review. The format of the storage function is selectable through another menu.

The **RUN/STOP** button in the same row allows freezing of the display when red. When green, the scope continuously displays the input waveform. **AUTO** is designed to make the display decisions for you, setting the vertical scale, time base or sweep rate, and trigger point for what it considers an optimum display. Testing of this function showed an unexpected result. **AUTO** works as expected if only one channel is used. The best performance was obtained when the second channel was off (channel light was not on).

The **CLEAR** button works in conjunction with the **RUN/STOP** button. If the **RUN/STOP** is on (red), the display will be blank. Pressing the **RUN/STOP** again will restore continuous waveform display.

Pressing the final **SINGLE** button on the top row starts a single triggered signal acquisition. Just below the **CLEAR** button is a rotary control that is used to select certain settings when in menu choices that require a selection.

Pressing the display button followed by a long push of the rotary control allows changing the display intensity by rotating this control. A bar line on the lower left of the graticule area shows the display intensity setting you have chosen.

Function Menus and Automation

The six buttons in the area labeled **MENU** are used to control both system functions, such as the display intensity just described, and automation of many of the oscilloscope's capabilities. For example, pressing the **DISPLAY** button followed by a number of menu selections provides control of the display type, persistence time, waveform intensity, and graticule settings.

Many of the automation capabilities require only one or two buttons to push to run; however, it may take traversing a steep learning curve in order to set up the function. For example, storing the display and associated data takes four pages of information to set it up. It requires making a file system and determining what format certain elements should be stored in (e.g., GIF, TIFF, BMP).

The interface for a computer is detailed in another full document, the "Programming Guide-En," which can be downloaded from the same source as the other two documents. The connection is made through the supplied USB cable, but no software is supplied.

The manufacturer lists the following capabilities and others: hardware waveform recording and playback; recording up to 60,000 frames of a dynamic signal and playing them back; decoding and triggering on serial bus systems, including RS232, UART, I2C, and SPI; gathering data in hex, binary, or ASCII, and exporting to an event table for further analysis; automatically measuring 37 waveform parameters (with statistics); and FFT functions using display or memory data.

In Summary

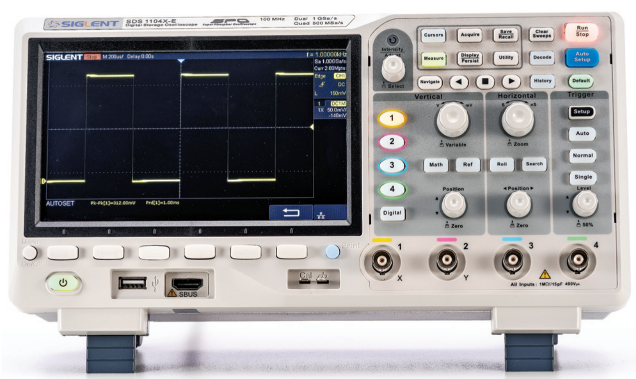
This is a full-featured oscilloscope, with many features and capabilities that some hams will not need but are a help to others. With the included certifications and accuracy traceability, at least when delivered, it can certainly make life easier for some hams. Having 500 pages of instructions is no different than the two books that came with my new hybrid vehicle; you only have to read the sections covering features in which you are interested.

Manufacturer: Rigol USA, 10220 SW Nimbus Ave., Suite K-7, Portland, Oregon 97223, **https://rigolna.com**. Price: $339.

Siglent Technologies SDS1104X-E 100 MHz Digital Oscilloscope

This Siglent oscilloscope is roughly 12.25 × 10 × 5.25 inches (including knobs and other protrusions), weighs about 5.75 pounds, and has a 7-inch TFT LCD (800 × 480). However, a glance at the unit gives you a surprise — it is a four-channel unit (rather than the usual two). In addition, it is a commercial-use unit with certifications and performance traceability.

Why four channels? I was once debugging a logic system design, and I needed to monitor four points simultaneously to find and solve a problem. When you need to look at four waveforms, as raw data, you need four channels. Although it might not be often, you will be glad you have the capability.



One of the problems with a multi-channel instrument is remembering which probe (and channel) is connected to which signal. It might be a bit confusing with two simultaneous channels; with four channels, you can easily lose track of which is which. This unit uses four colors, and everything correlated to an individual channel is color marked: yellow, red, blue, and green correspond to channels 1 through 4, respectively. Common buttons, when pressed, light up in a very pale, but very visible, green, or in a few cases pale pink.

While some capabilities are rather complex and require serial selections with the controls, most settings are limited to a single pushbutton. This reduces the need to split our attention between the scope and an instruction book.

The SDS1104X-E model acts as though it is two dual-channel oscilloscopes that can be used independently or combined to act as a single scope. It has two GSa/s A/D converters and two 14 Mpt memory modules. If all channels are selected, each channel has a sample rate of 500 MSa/s and a standard record length of 7 Mpts. When only a single channel per ADC is active, the maximum sample rate is 1 GSa/s, and the maximum record length is 14 Mpts.

The maximum vertical sensitivity is 500 μV/div. In addition to having a large family of triggering modes, decoding capability for several bus types is included. The million-point FFT capability is one of the mathematical functions available and provides a view of a signal spectrum.

While the model examined for this review — as well as its lesser models of the same family — provides significant capability, a great deal of patience and learning most likely will be required to take advantage of many of the built-in abilities. If this is your first exposure to modern digital oscilloscopes, even the terminology used (GSa/s, Mpts, and so on) may require an amount

Bottom Line

The Siglent SDS1104X-E is an oscilloscope with certifications and accuracy traceability. It can be used without a lot of explanation as a basic oscilloscope for users without extensive experience. But it's also an industrial-strength scope with a wide range of capabilities.

Figure 4 — The Siglent SDS1104X-E rear panel view.

of studying. The User Manual (see the next section) has an introductory section starting on page 76.

Included in the Package

In addition to the main unit, the package contains a calibration certificate with traceability information. The reverse side of this certificate includes date recommendations for recalibration. The only other paper included is a 23-page Quick Start booklet, to be discussed later. Four probes are each individually packaged with a set of color-identifying rings.

Each package also contains a miniature screwdriver to adjust the probe compensation. *Caution:* the compensation screw head is very small; patience may be necessary while making adjustments. Each probe comes with a grounding clip. Like with many similar probes, considerable force was required to press the grounding clip open; a mechanical aid, such as a pair of pliers, may be needed. It also includes a standard power line cord and a USB A-to-B cable.

The ac power connector is on the rear panel of the unit (see Figure 4), just above the right-hand foot. On the right edge are several signal connectors. The top one is the **LAN** connector, followed by a port designated for a USB device. This accepts the USB cable supplied for communications with a personal computer or other external control system. The third socket down is a type A USB port, like the one on the front panel. The lowest connector, a BNC, is used to output certain information or triggers described in the various manuals.

Instructions and Guidance

While the Quick Start booklet has a great deal of information, you will find more information on the Siglent website (**www.siglentamerica.com**). There are six different PDF documents to download, the User Manual, the Quick Start booklet, and the data sheet.

Before You Start

In addition to plugging in the line cord and setting up the feet, the Quick Start booklet suggests you do a functional check by attaching each of the probes, one at a time, to the front-panel test point. You should see a square wave and use this opportunity to adjust the probe compensation to make the square wave waveform appear square. To familiarize yourself, you can use this as a chance to change the settings on a vertical channel and the horizontal channel, followed by pressing the blue **AUTO SETUP** button close to the top left of the front panel. In a few seconds, the result should be a display that the scope sees as optimized. In practice, you can use this as a starting point for viewing almost any kind of input waveform.

Common Controls on the Front Panel

In the right center of the front panel are four sets of controls that, in one way or another, are common to all digital oscilloscopes. Because this is a four-channel scope, there is a difference here. Most often, on two-channel scopes, there are two sets of controls for the vertical (sensitivity) setting. On a four-channel scope, this would occupy a great deal of panel space, so the first is a vertical column of numbers from one to four, which are used to select one of the four channels. The next vertical section controls the vertical settings. The next column of controls is the horizontal settings or sweep speed. The final vertical set is used to control the sweep trigger selections.

Because most oscilloscopes have three setting groups (vertical, horizontal, and trigger), they are considered common controls. In addition, this scope has four channels, and therefore needs four selection buttons and four input jacks. The vertical row of pushbuttons just to the right of the display is associated with the four BNC connectors on the bottom right edge.

Just below the display are two special-use pushbuttons and six soft switch buttons. Calling the six buttons "soft switches" is another way of saying they are context sensitive — that is, they have different functions depending on the item being controlled. To the left of these soft switches is the **MENU ON/OFF** control. As an example, if you press the **UTILITY** button (in the center of the 18 pushbuttons on the top right), a menu of utility selections appears on the bottom edge of the screen. Pressing the **MENU ON/OFF** button will clear this displayed menu.

To the right of the soft switch is a button labeled **PRINT**. A search of all available documents does not result in any information about using this button to print. However, this button is described as a shortcut to the data storage routine.

On the bottom of the soft switch, you will find the power button on the left. Just to the right of this button is the USB connector used to plug in a flash drive for storage, and on its right is a socket labeled **SBUS**. This is a proprietary connector, and the instructions advise against using it to connect to anything but a Siglent-approved device, such as a set of logic probes. Finally, there is a 5 V dc square wave test point and grounding points for system test and probe compensation just below the **PRINT** button.

In addition to the four probe selection buttons, the **VERTICAL** section to the right of the display contains the vertical position control. The result of turning the position control can be seen on the display. The top rotary control sets the vertical gain. When this knob is rotated, the resulting scale of volts or mV/div flashes in a window in the center of the display. In some modes, this value is also echoed in a data block on the top right of the display.

Also located in the **VERTICAL** section is the **MATH** button. After pressing this button, the math function shows up on the bottom of the display as labels for the soft switches. The math function is selected by the leftmost soft switch in the display section of the panel. Finally, the **REFERENCE** button brings up a waveform of known value, which can be compared with the waveform connected to any probe.

The **HORIZONTAL** section is like the **VERTICAL** section. The bottom rotary control moves the displayed waveform sideways. The top rotary control is the equivalent of the sweep speed control in older oscilloscopes. Changing this control, the new horizontal sweep value is shown for a short time in the middle of the display.

Pressing the top rotary control in the **VERTICAL** section changes the speed of rotation from coarse to fine. Pressing the top rotary control in the **HORIZONTAL** section selects a piece of the waveform and expands the waveform around the selected point.

Trigger selection, in both the height of the waveform and the type of waveform, is set by a few buttons in the **TRIGGER** section. For normal use, you would probably select either the **AUTO** trigger button or the **NORMAL** trigger button. The trigger level is set with the bottom rotary control.

A unique trigger is called the "runt trigger." Given a set of repetitive pulses, a high-level value is set somewhere below the top level of the input, and the low-level value is set somewhere above the bottom of this waveform. Any pulse that occurs within the difference between the high level and low level is seen visually as a shorter pulse than the rest. This is considered a runt pulse and can be selected as the trigger — as might happen in a sequence of pulses when one pulse fails and shows up as a runt.

Along the top of the right-hand part of the display is a set of 16 buttons and a rotary control on the far left of this section. Normally, this control is used to set the brightness of the waveform, the brightness of the graticule, and the transparency of information over a waveform. First, a **DISPLAY / PERSIST** button has to be pressed, and then the control varies the selected brightness. With some of the other functions, this rotary control acts as a universal knob to make selections within the use of these other modes.

Each of the buttons in this top section brings up various related menus for use in the automated functions. The **RUN STOP** button is on the top right of this array. It is used to freeze the display at any time you want. The **AUTO SETUP** button was described previously. A typical operation starts by pressing these buttons, such as the **UTILITY** button. This brings up a set of labels on the display just over the soft switches. Some button selections bring up what is called multiple "pages" of choices, as controlled by pressing the right-hand soft switch.

The Quick Start booklet lists these buttons and controls with brief — often very brief — descriptions. Full explanations of each, with their associated menus and submenus, as well as the button press sequences, are given in detail in the User Manual.

In Summary

This oscilloscope can be used in two ways: first, as a basic oscilloscope whose controls and basic scope functions are arranged so that a user without extensive experience can see a wide range of waveforms and make basic measurements without a lot of explanation or training; and second, as an industrial-strength scope with a wide range of capabilities that may require a learning curve. With accuracy, traceability, and preprogrammed measurement functions, it can be used in applications where automated measurement functions are used over and over, such as testing on a production line. The online documentation is extensive and even includes two application notes as demonstrations of what can be done.

Manufacturer: Siglent Technologies North America, Inc., 6557 Cochran Rd., Solon, Ohio 44139, **www.siglentna.com**. Price: $499.

Cushcraft ASQ-6 6-Meter Squalo Antenna

Reviewed by Phil Salas, AD5X
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Back in 1965, I attended my first ARRL Field Day with a local club in Howard County, Maryland (my home county at the time). I was very impressed with the 6-meter AM activities (Gonset Communicators were the radios used), and I vowed to get on that band myself. In 1966, with the help of a summer job and Dad paying for half, I purchased a Lafayette HA-650 2.5 W input 6-meter AM transceiver. For the antenna, I chose a Cushcraft Squalo. The price was just $12.50 back then. I had a ball with that radio and antenna combination. From Maryland, I often worked up and down the east coast, into the center of the US, and even down into Cuba — not bad for probably a 1 W output AM transceiver!

So now, I wanted an omnidirectional antenna to monitor 6 meters. Because the Squalo is still around, I purchased one. The price is a bit higher now, though — almost 20 times higher!

Overview

The ASQ-6 Squalo, or square halo, is a horizontally polarized omnidirectional antenna. It is a half-wave dipole folded into a square. Unlike the Squalo I purchased in 1966, which had a gamma-match feed, the current Squalo uses a ferrite balun. However, like the original, the current Squalo is rated at 200 W PEP. It is designed to mount on a 1.25-inch OD TV-style mast.

Figure 6 — All the parts for the Cushcraft ASQ-6 Squalo antenna.

Figure 5 — The Cushcraft ASQ-6 boxed up.

Bottom Line

The Cushcraft ASQ-6 Squalo provides omnidirectional performance on the 6-meter band. It is great for casual operations on the Magic Band.

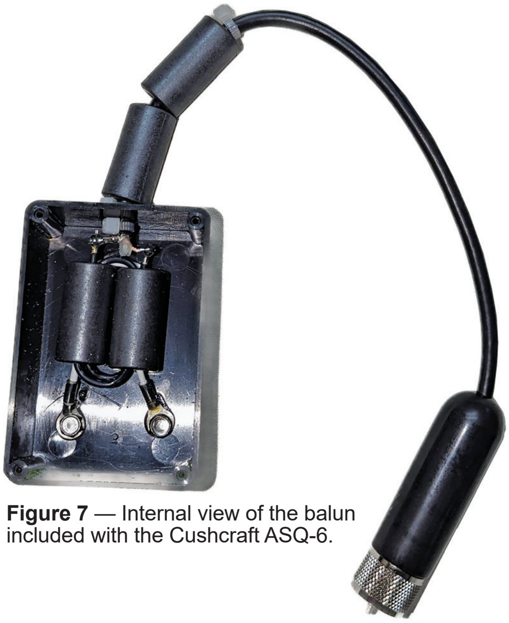

Figure 7 — Internal view of the balun included with the Cushcraft ASQ-6.

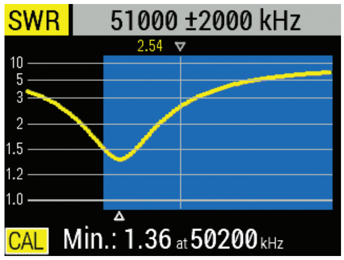

Figure 8 — The Cushcraft ASQ-6 tuned SWR curve.

Figure 9 — The Cushcraft ASQ-6 Squalo mounted on the reviewer's chimney.

Assembly, Tuning, and Mounting

The ASQ-6 comes fully disassembled in a 3 × 4 × 45-inch box. All hardware is aluminum, fiberglass, and stainless steel (except for the galvanized mast bracket; see Figures 5 and 6).

The first thing I noticed was that the balun output screws were loose. There were no lock washers under the mounting nuts. I opened the balun box in order to add two #8 stainless-steel split lock washers. I made one other change. As you can see in Figure 7, there is a white nylon tie wrap holding the two external ferrites in place. I replaced this with a sun-resistant black tie wrap. It will be interesting to see how well the plastic balun box holds up to the elements over time.

The actual assembly took only about 30 minutes (see the lead photo). The only mildly confusing instruction was that the balun could be attached to either insulator. However, it is apparent that it can only be attached to the larger insulator. Also, for ease of assembly, attach the balun brackets to the balun first, and then to the insulator. It would have been nice if Cushcraft had included a couple of tie wraps, which are necessary for attaching the balun cable and your feed line to the boom and mast.

The boom sets the Squalo boom length dimension to 25.25 inches (tubing center to center), so tuning occurs by adjusting the antenna width. The assembly manual suggests a width of 32 inches for resonance at 50.125 MHz (the SSB calling frequency). I temporarily mounted the ASQ-6 on an 8-foot pole, leaning against a wooden fence, in order to check resonance. I found that rather than 32 inches, I needed to adjust the width to 28.75-inch tubing center to center. Figure 8 shows the SWR curve, which has the lowest SWR at 50.2 MHz. Later, I found that when I mounted the Squalo in its final position on my chimney (see Figure 9), the resonant frequency dropped 80 kHz, to 50.120 MHz.

Operation and Conclusion

I've been having a lot of fun again on 6-meter CW and SSB. From my location in central Texas, I've easily worked all over the continental US with my 100 W Elecraft K3. While not a high-performance antenna, the ASQ-6 Squalo will provide plenty of contacts when 6 meters is open. And no rotator is necessary!

Manufacturer: Cushcraft (MFJ Enterprises), 300 Industrial Park Rd., Starkville, Mississippi 39759, **www.mfjenterprises.com**. Price: $220.