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Japan Radio Company NRD-545 DSP Receiver

Reviewed By Rick Lindquist, N1RL
Senior News Editor

SWLs, BCLs *and hams* take note! Japan Radio Company has introduced the NRD-545, a receiver that does all of its filtering in its DSP IF. The NRD-545 comes from a long heritage of fine JRC SWL/BCL receivers. We reviewed its most immediate predecessor, the NRD-535 HF receiver, in May 1997 (see "Product Review," *QST*, May 1997, page 68). The NRD-545 is the fifth generation in the JRC general-coverage line. It's the first to offer DSP, and it carries the DSP concept through to full execution in this unit: There are no optional crystal filters available for the NRD-545. All filtering is done in the DSP IF (20.2 kHz).

The first thing that struck me about the NRD-545 was its physical resemblance to the '535. While the internal design might have been updated, the external styling definitely has not been, but that was fine with me. I found the sizeable knobs and display comfortable and easy to manage. (Besides, it reminded me of my Kenwood TS-850S, and it's approximately the same size, too.)

Features

In addition to the flexibility afforded by DSP, the basic receiver covers from LF (100 kHz) through HF (30 MHz). You can get an optional wideband converter unit to expand the tuning range up through UHF (2 GHz). The CHE-199 converter is primarily designed for AM, FM and wideband FM (even FM stereo). A "power on" procedure for temporarily engaging one of the alternative modes (USB, LSB, CW or RTTY) in this frequency range is described in the manual. Receiver performance in these additional modes above 30 MHz is not specified or guaranteed. The converter did not become available until after we'd ordered our unit.

The '545 uses one-chip DDS to yield 1-Hz step frequency selection. Tuning is done by a varactor diode-based electronic tuning system. This is a triple-conversion receiver, with IFs at 70.455 MHz and 455 kHz plus the DSP IF at 20.2 kHz. AGC is looped back to the first IF amp from a digital/analog converter that follows the DSP IF.

Mega Memory Madness

The '545 has 1000 channels of memory. That's an increase from 200 in the '535. One note is in order here, however. We were not able to figure out how to enter a frequency into memory without referring to the Instruction Manual. Even after resorting to the manual it was confusing—the instructions in the book did not quite match markings on the radio's front-panel controls. The manual persists in calling the control labeled **AGC T/BWC** the "**FINE**" control, although this legend does not appear anywhere on the front panel.

Memory channels will save frequency, mode, IF filter bandwidth (ie, **WIDE**, **INTER** or **NARROW**, but not the variable **BWC** setting), attenuator, AGC and tuning step. Memory channels will not retain specific setting of the variable **BWC** control, only the wide, intermediate or narrow settings JRC assigns to each mode.

AM Listening Enhancements

A lot of AM BC and SW listeners prefer to have synchronous detection. As in the '535, the NRD-545 offers its "exalted carrier, selectable sideband" (*ECSS*) feature. This reduces—sometimes greatly—the distortion caused by selective fading in AM signals (where the carrier can fade and leave only the sidebands) by providing a local, synchronously locked "carrier" signal. You then are free to pick upper or lower sideband for listening.

> **BOTTOM LINE**
>
> The NRD-545 appears to be a worthy successor to the popular and enduring NRD-535 and offers improved performance with the flexibility of DSP.

This feature works quite nicely on the NRD-545, and makes AM BC reception a real pleasure, especially for distant, nighttime signals. The built-in speaker is quite good, and a tone control lets you tweak the frequency response somewhat.

The '545 offers a front-panel selectable **AMS** mode for enhanced AM listening. The manual says it permits you to "listen to AM broadcasts in hi-fi." Yes folks—this is *AM stereo*. While there are still a handful of AM broadcast stations transmitting in this mode (aka C-Quam), the number is steadily declining. Unfortunately the headphone jack does not provide separate left and right channel outputs. In order to investigate this aspect of the '545 you will need to connect a stereo amplifier—or your PC's sound card line input—to the two rear-panel line-level outputs. Groovy!

Speaking of AM, via the "user setup" (menu), you can select 10-kHz or 9-kHz tuning steps to accommodate different Standard Broadcast band tuning schemes, as well as a variety of other possible settings, timer relay operation, BFO offset, RTTY parameters and noise reduction.

Front Panel Stuff

The front panel has a lot of controls, but it's not overly busy. JRC keeps down the clutter in part by getting triple duty out of the single **AGC T/BWC** control, which—depending on which little button you press—adjusts the variable bandwidth and the AGC time constant or serves as a channel selector in memory mode. It might take users some time to acclimate themselves to

Table 1

Japan Radio Co, NRD-545 DSP, serial number 05112

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: 0.1-30 MHz.[1]	As specified.
Power requirements: 100, 120, 200 or 240 V ac ±10%; 12-16 V dc at 1.9 A max.	DC current drain: 1.3 A tested at 13.8 V dc.
Modes of operation: SSB, CW, AM, FM, AFSK.	As specified.
Receiver	*Receiver Dynamic Testing*
SSB/CW sensitivity, 2.4 kHz bandwidth, 10 dB S/N: 0.1-0.5 MHz, 5 µV; 0.5-1.6 MHz, 2 µV; 1.6-30 MHz, 0.3 µV.	Minimum discernible signal (noise floor), 500 Hz filter: 1.0 MHz –135 dBm 3.5 MHz –138 dBm 14 MHz –135 dBm
AM sensitivity, 10 dB S/N: 0.1-0.5 MHz, 16 µV; 0.5-1.6 MHz, 6.3 µV; 1.6-30 MHz, 2 µV.	10 dB (S+N)/N, 1-kHz tone, 30% modulation: 1.0 MHz 0.45 µV 3.8 MHz 0.35 µV
FM sensitivity, 12 dB SINAD: 1.6-30 MHz, 0.5 µV.	For 12 dB SINAD: 29 MHz, 0.32 µV.
Blocking dynamic range: Not specified.	Blocking dynamic range, 500 Hz filter: 3.5 MHz 128 dB[2] 14 MHz 125 dB[2]
Two-tone, third-order IMD dynamic range: Not specified.	Two-tone, third-order IMD dynamic range, 500 Hz filter: 3.5 MHz 92 dB 14 MHz 91 dB
Third-order intercept: Not specified.	3.5 MHz +3.1 dBm[3] 14 MHz +4.5 dBm[3]
Second-order intercept: Not specified.	+73 dBm.
FM adjacent channel rejection: Not specified.	20 kHz channel spacing: 29 MHz, 78 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz channel spacing: 29 MHz, 78 dB.[2]
S-meter sensitivity: Not specified.	S9 signal at 14.2 MHz: 69 µV.
Squelch sensitivity: Not specified.	At threshold, SSB, 14 MHz, 0.34 µV; FM, 29 MHz, 0.46 µV.
Receiver audio output: 1.0 W at 10% THD into 4 Ω.	2.7 W at 10% THD into 4 Ω.
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth): CW-N (500 Hz filter): 555-1091 Hz (536 Hz); CW-W: 274-2027 Hz (1753 Hz); USB: 286-2874 Hz (2588 Hz); LSB: 283-2879 Hz (2596 Hz); AM: 243-1954 Hz (1711 Hz).
Spurious rejection, 60 dB; image rejection: 70 dB.	First IF rejection, 14 MHz, 109 dB; image rejection, 14 MHz, 113 dB.

Size (height, width, depth): 5.1×13.0×11.2 inches; weight, 16.5 pounds.

Note: Unless otherwise noted, all dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.

[1]0.1 MHz-2 GHz with optional CHE-199 wideband converter (cellular phone frequencies are blocked).

[2]Measurement was noise-limited at the value indicated.

[3]Third-order intercept points were determined using S5 reference.

this arrangement.

In addition to large fluorescent numerals on the display, there's an analog-style S "meter" that's really comprised of fluorescent segments. The S meter is not tied to the AGC.

The pass band shift (**PBS**) control operates at IF to shift the DSP filter ±2.3 kHz. It works very well, and it's hard to detect that it's operating in the DSP IF as opposed to a conventional IF strip.

Adjusting bandwidth is simple but a bit perplexing at the same time. There are three overall **FILTER** settings, **WIDE**, **INTER** and **NARROW**. These big buttons are adjacent to the large, conventional-style tuning knob (it reminds me a bit of the one on the old Kenwood TS-520 with its analog apron). But the receiver also has a variable bandwidth control (it's a function of the multifunction **AGC T/BWC** knob). This can override the "primary" filter setting, but if you change the "primary" filter (say, from **WIDE** to **INTER**), the receiver goes back to a default bandwidth for the mode you're in. Bandwidth is displayed on the front panel.

If you ever wished for more control over the AGC than the typical fast, medium, slow and off settings you'll find on the average receiver, the NRD-545 is a dream come true. You can use the **AGC T** function to adjust the AGC time constant anywhere from a snappy 0.045 second to a torpid 5.15 seconds. No matter what you're listening to, you ought to be able to find a setting to suit your tastes somewhere in that range. The radio displays the AGC time constant on the front panel display. You also can turn the AGC off altogether, but that's another button, and it's not anywhere near the knob you use to adjust the AGC time constant.

The DSP noise reduction is great. The only complaint is that JRC makes you go into the menu to adjust the effect beyond the default setting. Many modern receivers or transceivers let you do this with a front-panel control.

There's a front-panel mini-phone jack that supplies audio output for hooking up a recorder or feeding your PC sound card. The radio also includes a built in clock with provisions to control an external device from a timer. It will switch a maximum of 24 V at 3 A. Timer on/off times can be programmed into the first 20 memories.

An interesting feature: An RTTY demodulator for several standard shift rates is built in. You can display demodulated output on a PC using the built-in serial (RS-232) interface.

Performance

I was impressed by the HF performance of the NRD-545, especially given the total reliance on DSP instead of crystal or ceramic filters. This is, overall, a sensitive receiver. It also does not apply huge amounts of attenuation in the Standard Broadcast band or LF segments. Sensitivity numbers we measured were less than 1 µV in any given filter setting at 1 MHz in the AM mode. It also had good sensitivity down in the nether regions (we measured –127 dBm at 100 kHz). By the way, this receiver has an attenuator but not a specific preamp.

Blocking dynamic range at 3.5 MHz came in at 128 dB (noise-limited), which is excellent performance. Two-tone, third-order IMD dynamic range topped 90 dB in the HF spectrum. Also terrific!

On HF SSB, the combination of the passband shift (**PBS**) and the bandwidth control (**BWC**) did the trick on a crowded 40-meter phone band. It was comparable to the performance on my competition-grade transceiver with its optional crystal filtering engaged.

Reception of CW was very good—but not great, however. The **BWC** lets you crank down the bandwidth to 10 Hz—although 100 Hz is about as low as you'd want to go for CW. In fact, 100 Hz is quite nice in that mode under certain extreme circumstances. On a busy contest band, the NRD-545 usually could pull out even a relatively weak CW signal from the rest of the crowd. But close-in signals also can pump the AGC and affect readability, something I typically can avoid with my transceiver and its pair of cascaded 400-Hz crystal filters (even leaving the external DSP box off).

The NRD-545's **PBS** control is a big help in QRM avoidance, though. In fact, outside of the **MAIN TUNING** knob, it's one of the most useful controls on the front panel.

The **NOTCH** control also was helpful for reducing QRM. It has two settings. Push the button next to the control once and it's a manual notch control that you can even use on CW—to knock out a nearby offending signal or to do a little bandpass shaping. Push the button again and the LED turns red to indicate notch tracking. This is an autonotch feature (for voice modes) that locks onto and tracks offending heterodynes within a range of ±10 kHz. Get outside the 10 kHz range, however, and the notch filter automatically shuts off. In the ARRL Lab, we measured a whopping 60 dB notch depth!

One control a lot of listeners don't often think of in terms of enhancing signal readability is the **ATT**enuator button. The NRD-545 does not have a selectable preamp as found on many transceivers—not that it suffers from this. As we said, the sensitivity is more than adequate. The **ATT** button is great when you're dealing with several strong signals in relatively close proximity. Reducing the receiver's gain by pressing the **ATT** button (it's supposed to pad it down 20 dB) is quite helpful in those kinds of situations.

Scan and Sweep

The NRD-545 can be set to scan between specific memory channels, or within one of 20 banks (50 channels each) of memory channels. You can also "sweep" all frequencies between two selected limits or within one of ten sweep range memories. Scanning speed is adjustable from 0.3 to 5 seconds per channel (0.2 to 3.3 channels per second); sweep speed can be varied between 2 and 20 frequencies per second. Scan delay—the time the receiver will stop to listen on any given frequency—can be varied from 0 to 10 seconds. CTCSS tone squelch is not available.

Computer Control

It's possible to control the NRD-545 directly from a personal computer using the serial port on the rear panel (DB-25 connector). All you need are a null-modem serial cable and the *Windows*-based software. (You can download *Windows 95* software and a software operator's manual from JRC/Japan's Web site, see: **http://www.jrc.co.jp/product/comm/e-comm/pc545-e.html/**.)

The available software provides a virtual front panel of the '545 and allows you to control most of the features of the radio with your mouse. While under computer control, the actual front-panel controls of the radio are deactivated—all operations are performed using your PC.

One of the more notable additional features provided by computer interconnection is a very well implemented band scope display. Unlike some of the other scopes we've seen, receive audio is audible while the frequency sweep is in progress, making initially identifying interesting "hits" easy. When the sweep is complete, double click on a displayed peak and the radio will tune to that frequency. A separate RTTY receive program is also included.

The '545's Instruction Manual provides all of the control commands so you can alternatively issue commands to the NRD-545 using any terminal program with the parameters set to 4800 bps N-8-1. Or, if you're creative enough, you could roll your own programming software.

Other Features

The NRD-545 is a fine-sounding receiver, even using the built-in speaker. It has a tone control, which JRC says can function as "a RTTY demodulation filter fine-adjustment control." The radio cranks out nearly 3 W of audio, and there are provisions to connect an external speaker at the rear panel.

The rear panel also provides for a low-Z (50 Ω) or high-Z antenna connection. The rear panel can also supply 10.8 V dc at 30 mA. This radio has a built-in ac power supply. You can operate the radio from 100, 120, 220 and 240 V ac or from 12-16 V dc. JRC includes an ac line cord *and* a dc power cable.

A connection point for a built-in muting circuit is also mounted in the rear-panel. This would come in handy if, for example, you wanted to use the NRD-545 in conjunction with a separate transmitter or transceiver.

The days of the beautifully matched transmitter/receiver pairs, such as those made by Collins, Drake, Hallicrafters and others, are probably gone forever. I can't help but imagine the impressive station that would result if JRC would only provide us with a matching transmitter. (Perhaps one that would cover up through the GHz range!) I suppose you could link one up with one of their JST-245 or '145 transceivers, but somehow—it just wouldn't be the same…

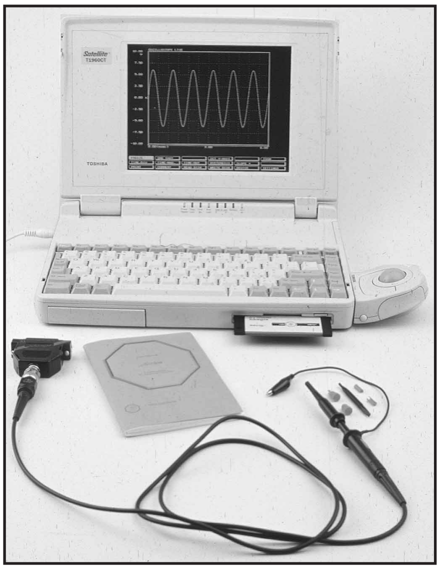
Manufacturer: Japan Radio Co Ltd, 1011 S W Klickitat Way, Building B, Suite 100, Seattle, WA 98134; 206-654-5644; fax 206-264-1168. Manufacturer's suggested retail price: $2000. CHE-199 wideband converter: $400. TCXO CGD-197 temperature compensated crystal oscillator: $130.

The TiePie Engineering μScope

Reviewed by Michael Tracy, KC1SX
ARRL Lab Test Engineer

As an apartment dweller, my "shack" is really just a small corner of a room. Like many hams, I also have a limited budget, so I have acquired a collection of radios and other gear (mostly from hamfests) that needs a little "TLC." Consequently, I have found myself in need of certain pieces of test equipment to help me get the items in my collection working again. Unfortunately, because my shack space and budget for test equipment is rather limited (and I'd rather spend money on more radios!), the nice oscilloscopes, meters and other items in the glossy test equipment catalogs just don't fit my needs. Although I have picked up a couple of older 'scopes in my hamfest travels, they also need a little work. Needless to say, when I was offered the opportunity to check out a new mini, multi-function PC test accessory that is also fairly affordable and easily fits my available space, I jumped at the chance. Also, as a long-time computer junkie, I was intrigued by the PC-based approach, which seems to be a growing trend.

Although TiePie Engineering hasn't yet made a name for itself in the US (the company is based in the Netherlands), that may soon change, judging by the respectable line of test equipment products offered in their catalog.



BOTTOM LINE

If you need a compact, multi-function test instrument for dc to high audio frequencies and you already have a PC in the shack, the μScope will fill the bill nicely.

When I received the TiePie µScope package, I was surprised at just how small and light it was. When I opened it, the reason became obvious—the hardware looks like a hooded DB-25 connector, except that where the cable normally exits, there is a female BNC connector. Also included in the package is a 1×/10× switchable probe with several interchangeable tips, the software (on one 3½ inch, 720k floppy) and the manual (a handy 4 × 6 inch, 68-page booklet).

Although the name implies that this product is primarily an oscilloscope, that is not the case at all—the µScope's functions also include a dual-display voltmeter, spectrum analyzer and transient recorder. The voltmeter can be set to measure peak to peak voltage (for ac) or *true* RMS (for dc or ac) or it can be set to read either a minimum or maximum value. It can also measure power in W or dBm, the frequency and the crest factor of the signal you are reading. However, each of the two "voltmeter" screen displays only provide readings for one of these items at a time, so you can't measure frequency, RMS and maximum simultaneously, for example. The spectrum analyzer features both a "live" and "hold" mode and includes a special function that determines the distortion of the displayed spectrum (you are prompted for a reference fundamental frequency). The transient recorder takes periodic voltage samples and saves them in a file. You can capture up to 30,000 samples. The time period between samples can be varied anywhere from 0.01 to 300 seconds. (At the slowest rate, you can record events once every 5 minutes for 104 days!)

Now that you know what it does, you need to know what the µScope doesn't do—RF measurements. Because the fastest sampling rate of the A to D converter is 100,000 samples per second, the theoretical upper frequency limit of the µScope is about 50 kHz. (To reproduce a signal without aliasing, the sample frequency must be more than twice as high as the maximum signal frequency.) However, because of the simple method the µScope uses to reproduce the sampled waveform, the maximum practical frequency that you can measure without excessive waveform distortion is just a bit above 25 kHz. The effects of aliasing and the measurement limitations of the µScope are spelled out quite clearly in the manual. For those who need an RF capable instrument and have a more generous budget, TiePie makes a number of other models of PC based instruments that are suitable to the task. These other models aren't quite as small as the µScope, but they will still take up far less bench space than a conventional oscilloscope.

Although many hams like to "dive right in" and "twiddle the knobs" on a piece of new equipment, in this case it really is important to read at least some of the manual first so that you are familiar with the basics. The first thing worth noting is that the µScope software is a DOS program. While the program will run in a DOS window under *Windows 3.x* or *Windows 95*, it will not give correct results—the program needs to communicate with the hardware without being interrupted by other program tasks. The obvious disadvantage is that you won't be able to run other programs on the same PC at the same time. The advantage is that you can use the µScope with any old PC (although the maximum sampling rate is slower on some older PCs, such as a 4 MHz 8086 machine). In fact, a 286 or 386 laptop would make a perfect companion for this multi-function instrument. The hardware attaches to a printer port, so if your computer only has one and you still want to use the printer, you'll have to decide if you want to install a second port, use an external switchbox or just keep swapping cables around. Since the µScope gets its power from the port, you won't need an ac outlet if you go portable with a laptop computer.

Like a lot of other single-floppy DOS software, there is no install program on the µScope program disk. Instead, you just copy all the files on the floppy to a convenient directory on the PC's hard drive (the software can be run directly from the floppy, but a hard drive installation is faster and more convenient for keeping files of

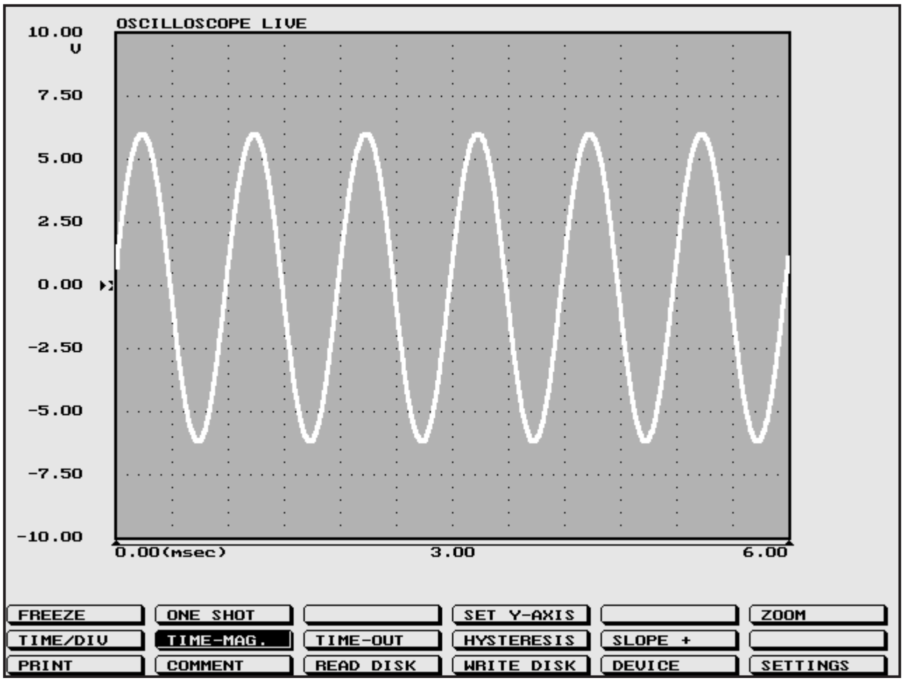


Figure 1—The µScope's oscilloscope display of a 1-kHz sine wave.

Table 2
TiePie Engineering µScope: accuracy

Frequency Signal Generator†	*Frequency* µScope	*RMS Voltage @ 5 kHz* Signal Generator†	*RMS Voltage @ 5 kHz* µScope
0.5 kHz	0.496 kHz	1.00 V ac	0.94 V ac
1.000 kHz	1.000 kHz	1.50 V ac	1.25 V ac
1.500 kHz	1.500 kHz	2.00 V ac	1.60 V ac
2.000 kHz	1.996 kHz	5.00 V ac	3.63 V ac
5.000 kHz	4.990 kHz	7.50 V ac	5.XX V ac
7.500 kHz	7.508 kHz	10.0 V ac	7.XX V ac
10.00 kHz	9.98 kHz[1]		Readings unstable above 10V
12.50 kHz	12.46 kHz[1]		
20.00 kHz	18.88 kHz[2]		
30.00 kHz	29.73 kHz[2]		
35.00 kHz	34.63 kHz[3]		
38.00 kHz	37.3X kHz		

†Calibrated HP-8116 signal generator
XDigit unstable (varying by 5 or more)
[1]Moderate waveform distortion on µScope display screen.
[2]Severe waveform distortion on µScope display screen.
[3]Waveform shape on µScope display screen not useful above 30 kHz.

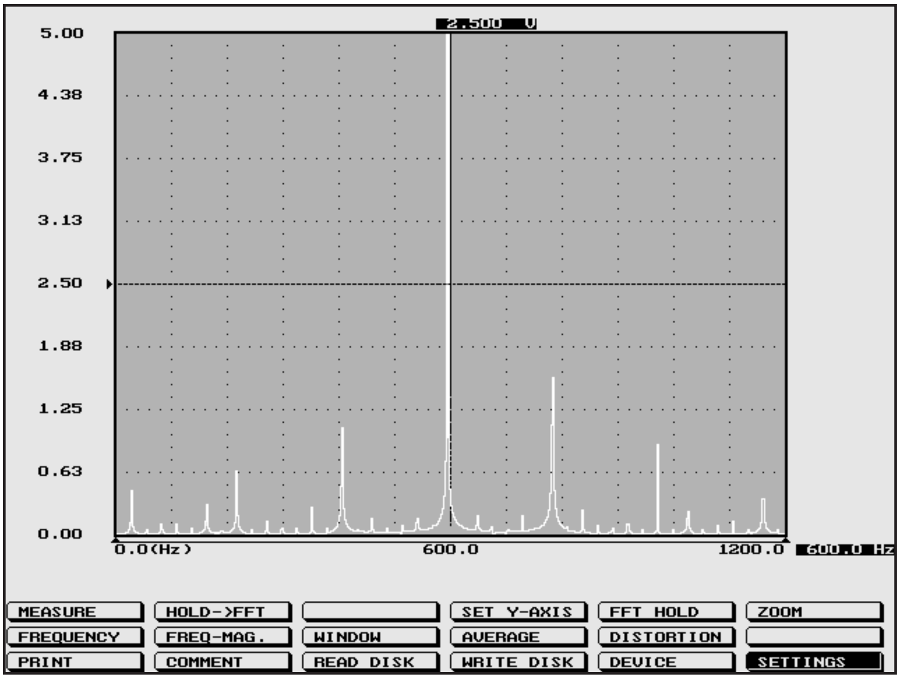


Figure 2—The spectral display of a 5V, 600 Hz square wave with the µScope in the spectrum analyzer mode. Notice the position readings for the measurement cursor at the top center and to the lower right of the display field. The cursor crosshair is shown set to the center of the screen (2.500 V, 600 Hz).

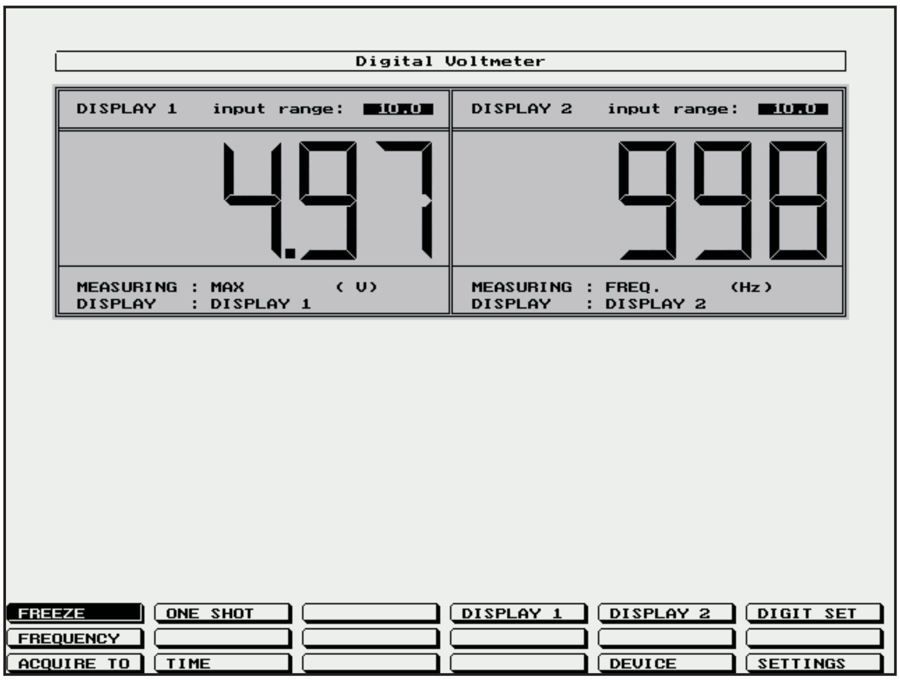


Figure 3—The µScope's digital voltmeter function, showing voltage and frequency. See the text for information on its additional measurement capabilities.

captured data). A mouse is not required to run the program, but it does make it easier to work with some of the µScope's more interesting features (more on this later). When the program is started, you see a welcome screen flash by and then the oscilloscope screen appears. The trace display window is large, occupying about the top three-quarters of the screen. Across the bottom are three rows and six columns of control and function "buttons." The currently selected button appears in reverse video and the selection can be changed with the cursor keys or the mouse (the highlight follows the mouse pointer). The default display color scheme is basic white on a black background with a cyan trace, but you can change either of these to one of 16 other colors to suit your personal tastes.

The program is fairly intuitive. Once I had the basics down, I only had to refer to the manual for an explanation of a few minor details. The oscilloscope and voltmeter screens offer voltage autoranging, so you only have to be concerned about keeping the input voltage within the hardware's limit of ±20 V (the included 10x probe gives you a range of ±200 V at the probe tip). A striking difference between the program's oscilloscope display and the CRT of most 'scopes (older ones, at least) is that the voltage and time scales are marked directly on the screen in the units they represent. You don't have to convert divisions and values per division to know, for example, that a TTL signal you might be looking at is varying between 0.3 and 4.5 V dc. In the hold (storage) mode, the 'scope screen has a cross-hair cursor that you can position anywhere within the display window for more precise measurements. This is one of the times when the mouse comes in real handy, since the keyboard control of the cursor position is rather slow and awkward. The voltage and time values for the cursor's location appear in reverse video at the top and bottom of the display area, respectively. You can also use the cross-hair cursor to make relative measurements easily. To do so, the reference position is set to a relative zero (the displayed coordinates reset to zero) and any subsequent movement of the cursor will show values relative to the point you initially selected.

In spectrum analyzer mode, voltage autoranging is not available, but the maximum displayed value can be toggled between 20, 10, 5 and 2.5 volts. You can also set it to a log scale (reading in dB). The same cross-hair cursor used for the oscilloscope also appears on the spectrum analyzer screen and can be used to the same advantage. The spectrum analyzer defaults to the hold mode and a new set of samples is taken only when you press the measure button. While the analyzer is sampling, a message box pops up and says, "measuring, please wait..." Although you can switch the analyzer to a live mode, it is inconvenient to use because the aforementioned message stays on the screen, preventing you from accessing any of the control buttons. The escape key stops the sampling process and cancels the message, however.

Data displayed on the oscilloscope and spectrum analyzer screens can be saved to disk and then loaded and redisplayed at a later time. The transient recorder data is always saved to disk (in addition to being plotted on the display). The voltmeter function also allows you save readings to a disk file and will continue to do so until you stop the process. (When the instrument is in this mode, a message box pops up to let you know readings are being saved to prevent you from unknowingly filling up your hard drive.)

Live output, captured output and saved

data can all be sent to a printer, *but the choice of printers is limited*. You'll need to have either an HP-compatible laser printer or an Epson-compatible dot matrix printer. The printer in my shack doesn't emulate either of these, so I had to make use of one of the HP LaserJets at work. This printer normally resides on the network, but I temporarily disconnected it for testing purposes (because our network is Windows based, I couldn't try using the printer while it was still on the network. I don't have access to a DOS based network, so I don't know if the µScope will allow network printing). Printout quality on the laser was excellent and the trace window is $4^1/_4 \times 6^3/_8$ inches on a standard $8^1/_2 \times 11$ sheet.

One of the flea market specials in my collection is a no-name audio CW filter. I was curious as to what its bandwidth and passband shape was, but previously had no convenient way to find out. I hooked it up to my receiver and tuned to a noisy section of 80 meters. I used the µScope's spectrum analyzer function to view the passband spectrum. The display showed rather shallow filter skirts with a –6 dB bandwidth of about 400 Hz. Not ideal, but not bad for a filter I picked up for next to nothing.

Next I decided to check the effect of the weight control on my Curtis 8044-based keyer. I only operate CW on occasion, so I have a bit of trouble discerning by ear what the actual effect of this control is. With the µScope's oscilloscope display, it was easy to measure the dit and dah times and adjust the weight control for a 1:3 nominal ratio. (Sharp-eyed readers will note that this is something that we also did in our August 1997 *QST* Product Review of the Radio Shack ProbeScope.)

Another "bargain table special" that I had picked up is a homebrew power supply. I wanted to see if the filter capacitors were working as well as they should, so I put a full load on the supply and used the µScope to check the peak-to-peak ripple voltage. A quick check of the *ARRL Handbook* section on power supply filter calculations showed that the caps were indeed working "up to snuff."

The TiePie Engineering µScope is a good value for those who have a computer in the shack and need a collection of audio-frequency test instruments. Although its performance may not be quite as good as some of the full size (and higher-priced) alternatives, it offers a wide variety of measurements capabilities in a compact and economical package.

Manufacturer: TiePie Engineering, Koperslagersstraat 37, 8601 WL, Sneek, The Netherlands; **http://www.tiepie.nl/**. TiePie products are distributed in the US by Conway Engineering, 8393 Capwell Drive, Oakland, CA 94621; 800-626-6929; 510-568-4028, fax: 510-568-1397; **http://www.conway-engineering.com/**. Price: $119.

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

[In order to present the most objective reviews, ARRL purchases equipment off the shelf from dealers. ARRL receives no remuneration from anyone involved with the sale or manufacture of items presented in the Product Review or New Products columns.—*Ed.*]

The ARRL-purchased Product Review equipment listed below is for sale to the highest bidder. Prices quoted are minimum acceptable bids, and are discounted from the purchase prices. All equipment is sold without warranty.

Yaesu FT-8100R 2-meter/70-cm FM mobile Transceiver (see "Product Review," November 1998 *QST*). Minimum Bid: $330.

ICOM IC-207H 2-meter/70-cm FM Mobile Transceiver (see "Product Review," November 1998 *QST*). Minimum Bid: $240.

Standard C510A 2-meter/70-cm FM handheld transceiver with with CPB510DA Docking adapter 50 W mobile converter (see "Product Review," April 1998 *QST* and November 1998 *QST*). Sold as a package only. Minimum Bid: $435.

Kenwood TM-G707A 2-meter/70-cm FM Mobile Transceiver (see "Product Review," November 1998 *QST*). Minimum Bid: $245.

Alinco DJ-190T 2-meter FM handheld transceiver (see "Product Review," December 1997 *QST*). Minimum Bid: $130.

Alinco DJ-280TH 1.25-cm FM handheld transceiver (see "Product Review," January 1999 *QST*). Minimum Bid: $150.

Pryme PR-222 1.25-cm FM handheld transceiver (see "Product Review," January 1999 *QST*). Minimum Bid: $145.

PC Electronics TC70-10 70-cm ATV Transceiver with transmit crystals for 439.25 and 434.0 MHz (see "Product Review," December 1998 *QST*). Minimum Bid: $345.

MFJ-224 2-meter FM Analyzer (2 units available) (see "Product Review," November 1998 *QST*). Minimum Bid: $110 each.

Sealed bids must be submitted by mail and must be postmarked on or before March 1, 1999. Bids postmarked after the closing date will not be considered. Bids will be opened seven days after the closing postmark date. In the case of equal high bids, the high bid bearing the earliest postmark will be declared the successful bidder.

In your bid, clearly identify the item you are bidding on, using the manufacturer's name and model number, or other identification number, if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by ARRL. Please include a daytime telephone number. The successful bidder will be advised by telephone or by mail. No other notifications will be made, and no information will be given to anyone other than successful bidders regarding final price or identity of the successful bidder. If you include a self-addressed, stamped postcard with your bid and you are not the high bidder on that item, we will return the postcard to you when the unit has been shipped to the successful bidder.

Please send bids to Bob Boucher, Product Review Bids, ARRL, 225 Main St, Newington, CT 06111-1494.