

# Product Review

Edited by Joe Bottiglieri, AA1GW • Assistant Technical Editor

## 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*Frequency coverage: 0.1-30 MHz.<sup>1</sup>Power requirements: 100, 120, 200 or 240 V ac ±10%;  
12-16 V dc at 1.9 A max.

Modes of operation: SSB, CW, AM, FM, AFSK.

*Receiver*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.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.

FM sensitivity, 12 dB SINAD: 1.6-30 MHz, 0.5 µV.

Blocking dynamic range: Not specified.

Two-tone, third-order IMD dynamic range:  
Not specified.

Third-order intercept: Not specified.

Second-order intercept: Not specified.

FM adjacent channel rejection: Not specified.

FM two-tone, third-order IMD dynamic range: Not specified.

S-meter sensitivity: Not specified.

Squelch sensitivity: Not specified.

Receiver audio output: 1.0 W at 10% THD into 4 Ω.

IF/audio response: Not specified.

Spurious rejection, 60 dB; image rejection: 70 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.

<sup>1</sup>0.1 MHz-2 GHz with optional CHE-199 wideband converter (cellular phone frequencies are blocked).<sup>2</sup>Measurement was noise-limited at the value indicated.<sup>3</sup>Third-order intercept points were determined using S5 reference.*Measured in the ARRL Lab*

As specified.

DC current drain: 1.3 A tested at 13.8 V dc.

As specified.

*Receiver Dynamic Testing*

Minimum discernible signal (noise floor), 500 Hz filter:

1.0 MHz -135 dBm

3.5 MHz -138 dBm

14 MHz -135 dBm

10 dB (S+N)/N, 1-kHz tone, 30% modulation:

1.0 MHz 0.45 µV

3.8 MHz 0.35 µV

For 12 dB SINAD: 29 MHz, 0.32 µV.

Blocking dynamic range, 500 Hz filter:

3.5 MHz 128 dB<sup>2</sup>14 MHz 125 dB<sup>2</sup>

Two-tone, third-order IMD dynamic range, 500 Hz filter:

3.5 MHz 92 dB

14 MHz 91 dB

3.5 MHz +3.1 dBm<sup>3</sup>14 MHz +4.5 dBm<sup>3</sup>

+73 dBm.

20 kHz channel spacing: 29 MHz, 78 dB.

20 kHz channel spacing: 29 MHz, 78 dB.<sup>2</sup>

S9 signal at 14.2 MHz: 69 µV.

At threshold, SSB, 14 MHz, 0.34 µV; FM, 29 MHz, 0.46 µV.

2.7 W at 10% THD into 4 Ω.

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).

First IF rejection, 14 MHz, 109 dB; image rejection,

14 MHz, 113 dB.

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 multi-function **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  $\pm 10$  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 **ATTenuator** 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  $\Omega$ ) 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.

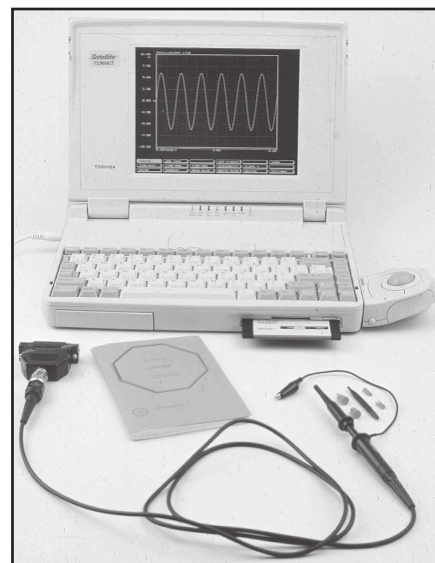
## The TiePie Engineering $\mu$ Scope

*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  $\mu$ Scope will fill the bill nicely.