DX Engineering DXE-RG-5000 and DXE-RG-5000HD Receiver Guards

Reviewed by Carl Luetzelschwab, K9LA
k9la@arrl.net

In the spring of 2015, I added a KD9SV two-direction Beverage-on-ground antenna (also known as an RBOG, with the "R" standing for reversible) to my low-noise receive antenna arsenal for 160 meters. My review of the KD9SV RBOG appeared in the September/October 2015 issue of *NCJ* (*National Contest Journal*, published by the ARRL).

I wanted northeast/southwest coverage with this new antenna, and that unfortunately resulted in the RBOG running under one of the elevated radials on my 160 meter inverted L transmit antenna. Spurred on by the *QST* review of the Array Solutions AS-RXFEP Receiver Front End Protector, I decided to measure how much RF came into the shack on the RBOG feed line on 160 meters while transmitting on the 160 meter inverted L. By the way, I highly recommend reading the review for general information on protecting your receiver's front end.[4]

Using a commercial diode detector (and RF attenuators as needed), I measured just under +20 dBm at the end of the appropriate coax in the shack when transmitting at 1000 W into the inverted L. At 1500 W, I estimate the level to be around +21 dBm.

[4]J. Hallas, W1ZR, "Array Solutions AS-RXFEP Receiver Front End Protector," Product Review, *QST*, May 2014, pp 56 – 57.

The KD9SV RBOG has a preamp in the control unit in the shack with two transistors in a push-pull source-follower configuration. The maximum input power of the transistors used (either Avago ATF-33143 PHEMTs or Filtronic FPD-750SOT343 PHEMTs) is specified at around +20 dBm. The preamp design does have back-to-back 1N4448 diodes at the input, and my simulation with *ADS* (*Advanced Design System*) shows that the diodes start limiting around +5 dBm input. At +21 dBm input (what I estimate coming down the coax at full legal limit), there's about +10 dBm getting to the preamp.

This scenario sheds light on why it would be prudent to add more protection to prevent damage to the transistor in the preamp. Although my scenario appears to be acceptable, it's better to err on the safe side. Using more protection is advised.

Bottom Line

The RG-5000 and RG-5000HD Receiver Guards from DX Engineering offer superb receiver front end protection when using a separate receive antenna. There are some differences between the two models, as described in the text.

The DX Engineering Receiver Guards

DX Engineering offers two front end protectors for use with receiving antennas. I tested both of them for use in my station.

The DXE-RG-5000 is intended to be used with high-sensitivity receivers as it starts to protect at signal levels around

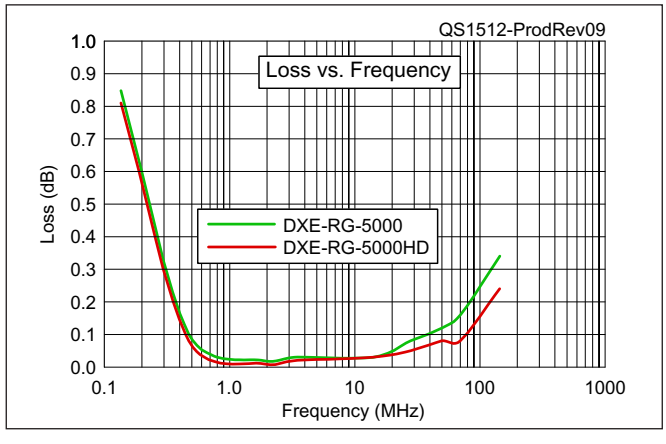

Figure 7 — Loss vs frequency for the RG-5000 and RG-5000HD. The data points (from left to right) are the following amateur bands: 137 kHz. 475 kHz, 1.8 MHz, 3.5 MHz, 14 MHz, 28 MHz, 50 MHz, 70 MHz, and 144 MHz.

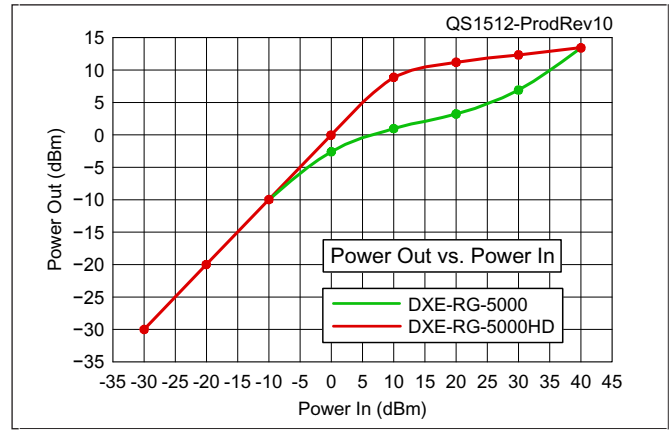

Figure 8 — Power output versus power input for the RG-5000 and RG-5000HD.

Table 10
DX Engineering RG-5000 and RG-5000HD

Manufacturer's Specifications	Measured in ARRL Lab
Frequency range: 0.5 to 150 MHz.	As specified.
Insertion loss: Typically <0.15 dB to 50 MHz; <0.3 dB 50 – 150 MHz.	*Freq (MHz)* / *RG-5000 (dB)* / *RG-5000HD (dB)* 0.137 / 0.85 / 0.81 0.475 / 0.10 / 0.08 1.8 / 0.02 / 0.01 3.5 / 0.03 / 0.02 14 / 0.03 / 0.03 28 / 0.08 / 0.05 50 / 0.12 / 0.08 70 / 0.16 / 0.08 144 / 0.34 / 0.24
Maximum output level at 10 W input: RG-5000, +10 dBm; RG-5000HD, +14 dBm.	Measured at 14 MHz: *Input level (dBm)* / *Output level (dBm) RG-5000* / *RG-5000HD* –20 (0.01 mW) / –20 / –20 –10 (0.1 mW) / –10.1 / –10 0 (1 mW) / –2.6 / 0 +10 (10 mW) / +0.8 / +8.7 +20 (100 mW) / +3.1 / +11.1 +30 (1 W) / +6.8 / +12.2 +40 (10 W) / +13.2 / +13.3
1 dB compression point: Not specified.	RG-5000, +1.3; RG-5000HD, +8.6 dBm.
Size (height, width, depth): 2.0 × 3.6 × 1.5 inches, including protrusions; weight: 4 oz.	
Price: RG-5000, $74.95; RG-5000HD, $84.95.	

ARRL Lab Two-Tone IMD Testing
Testing a Kenwood TS-590SG transceiver with and without RG-5000 and RG-5000HD to determine dynamic range degradation (500 Hz bandwidth, 500 Hz roofing filter, 20 kHz spacing)

	Desired Input Signal	IMD Input Signal	IMD DR	IP3
Without RG-5000	–129 dBm	–23 dBm	106 dB	+30.0 dBm
With RG-5000	–129 dBm	–36 dBm	93 dB	+10.5 dBm
With RG-5000HD	–129 dBm	–23 dBm	106 dB	+30.0 dBm
Without RG-5000	–120 dBm	–21 dBm		+28.5 dBm
With RG-5000	–120 dBm	–33 dBm		+10.5 dBm
With RG-5000HD	–120 dBm	–21 dBm		+28.5 dBm
Without RG-5000	–107 dBm	–16 dBm		+29.5 dBm
With RG-5000	–107 dBm	–28 dBm		+11.5 dBm
With RG-5000HD	–107 dBm	–16 dBm		+29.5 dBm
Without RG-5000	–97 dBm	–13 dBm		+29.0 dBm
With RG-5000	–97 dBm	–26 dBm		+9.5 dBm
With RG-5000HD	–97 dBm	–13 dBm		+29.0 dBm
Without RG-5000	–73 dBm	–6 dBm		+27.5 dBm
With RG-5000	–73 dBm	–18 dBm		+9.5 dBm
With RG-5000HD	–73 dBm	–6 dBm		+27.5 dBm
Without RG-5000	–55 dBm	0 dBm		+27.5 dBm
With RG-5000	–12 dBm	0 dBm		+6.0 dBm
With RG-5000HD	–44 dBm	0 dBm		+22.0 dBm

0 dBm. Third-order IMD (intermodulation distortion), second-harmonic generation, and third-harmonic generation may be compromised at very high received signal levels (more on this later).

The DXE-RG-5000HD starts to protect at signal levels around +10 dBm. The result of this is better third-order IMD performance, better second-harmonic generation performance, and better third-harmonic generation performance.

Table 10 compares the ARRL Lab measured performance to the manufacturer's specification (where applicable). To help visualize the tabular performance, I've plotted some of the data, too.

Figure 7 plots the insertion loss versus frequency of both DX Engineering models. Note that the loss versus frequency data includes our two new low-frequency bands. Yes, the loss is a bit higher at 137 kHz, but that shouldn't be a problem on this band in the real world. Thus these units help protect receiver front ends or external preamps from roughly 100 kHz through 150 MHz. This might include skimmer receivers at your location. Additionally, an SWL (shortwave listener) could use one of the DX Engineering Receiver Guards if need be.

Figure 8 plots the protection characteristics at 14 MHz of both DX Engineering models in terms of output power versus input power. As stated earlier, the DXE-RG-5000 is seen to begin protecting at an input of around 0 dBm (when the Pout vs Pin curve begins deviating from a straight line), and the output power is limited to approximately +13 dBm. Similarly, the DXE-RG-5000HD is seen to begin protecting at an input of around +10 dBm, and the output is also limited to approximately +13 dBm. Both devices were able to handle their rated 10 W continuous input.

With respect to the third-order IMD, the ARRL Lab performed the usual Product Review third-order IMD dynamic range tests on a TS-590SG on 14 MHz without and with the two models in the line to the receiver. These results are summarized in Table 10. The DXE-RG-5000 degraded the IMD performance of the TS-590SG at interfering signal levels around –36 dBm (about S9 + 40 dB). The DXE-RG-5000HD degraded the IMD performance of the TS-590SG at interfering signal levels around 0 dBm (S9 + 73 dB). Those are mighty big signals that are not likely to be encountered in normal operation — unless you're in a multitransmitter contest environment, you have a very nearby ham neighbor, or you are near an AM broadcast station antenna.

I also installed each model at the antenna input to my TEN-TEC OMNI-7 transceiver. The OMNI-7 has general coverage receive, so I could tune to a strong local AM broadcast station to assess the impact of the protector. When tuned within 7 kHz of WFCV here in Fort Wayne on

1090 kHz (an S9 + 42 dB signal), I could tell no difference in the adjacent channel splatter with either model. This is not a rigorous objective test, but it was the best real-world test I could perform easily at my location.

Which model you choose will be dependent on your operating habits. For casual operating, the DXE-RG-5000 should be sufficient. The DXE-RG-5000HD would be best for multitransmitter environments, a nearby ham neighbor, or a nearby AM broadcast station.

The manual for the DX Engineering Receiver Guards is 16 pages, and it includes figures detailing 10 different (but typical) installations. That should cover most scenarios.

Manufacturer: DX Engineering, 1200 Southeast Ave, Tallmadge, OH 44278; tel 800-777-0703; **www.dxengineering.com**.