

AOR AR2300 Black Box Receiver

By Bob Grove, W8JHD



We have recently witnessed the release of several computer-hosted receivers from a number of manufacturers, including WiNRADiO®, Icom, and Perseus. While many other receivers have full-function panel hardware as well as computer control capability, the “black boxes” are non-functional without a computer.

Many traditionalists (and that includes me) responded skeptically at first, suspecting that the very presence of the required computer would mean radio frequency interference (RFI) from the host computer’s oscillators.

While that was at first true, especially if the antenna was co-located with the computer, better-shielded receivers and computers have improved that – but still, it’s best to keep the antenna at a distance!

There are two architectural approaches to receiver design: analog and digitized. Analog receivers utilize traditional double- and triple-conversion (superheterodyne) techniques which preserve the original signal waveforms.

Software defined receiver (SDRs), on the other hand, digitize the spectrum bandwidth and computer-process the desired signal for detection and demodulation.

There is an ongoing debate among manufacturers as to just how much of the receiver’s spectral bandwidth must be software defined before the product can legitimately be called a software defined receiver. Some manufacturers digitize the entire RF bandwidth, while others digitize only the IF and lower frequency stages.

❖ The Newest Release

In the September 2010 issue we reviewed the AR5001D, AOR’s predecessor to their new AR2300. The 5001D is a stand-alone receiver, while the new 2300 is a computer-hosted, black-box version of the same receiver.

It employs digitization at the third intermediate frequency (45 MHz) for signal processing of bandwidth, spectrum display, and demodulation, and it utilizes direct digital sampling of the first 25 MHz or RF spectrum as well. The oscillator utilizes direct digital synthesis (DDS).

Dual watch (simultaneous reception on two frequencies) and even triple watch can be accommodated within certain frequency limits.

The 2300 will talk to any PC running Windows XP operating system or higher (I used the Windows Vista operating system for this review), and can be controlled remotely through an optional LAN accessory. The default communication speed is 115,200 bps, but alter-

native choices include 9,600, 19,200, 38,400, and 57,600 bps.

❖ The Box

Measuring 8-1/2”W x 2-3/4”H x 11-1/4”D and weighing a husky 6.6 pounds, the 2300 is roughly the size of a small desktop receiver. But since it has no adjustable controls, it is loaded with access ports for the host computer.

The front panel offers a rocker-style power switch, an LED pilot lamp, a receptacle for a Secure Digital (SD) memory card, a 1/4” headphone jack, an RCA video output connector, and even an internal speaker – a nice touch in which the system does not require the computer’s audio card or an external multimedia speaker system.

The LED doubles as a boot-up indicator; when the power switch is first thrown, the LED color is amber, but within roughly two seconds, it turns green indicating the “go” status. Loading the control panel then takes an additional four seconds after you click the mouse on that icon.

The rear panel is clustered with connectors: Two N-style antenna connectors (40 kHz-3.15 GHz and 25 MHz-3.15 GHz, selectable), 45 MHz BNC Intermediate Frequency (IF) output (15 MHz bandwidth), 10 MHz SMA reference oscillator input, 3.5 mm speaker output (2 watts at 8 ohms), 12-13.8 VDC at 1.2 A coaxial power jack, USB 2.0 interface port, 3.5 mm stereo line output, digital I/Q (optional), USB connector, LAN interface DB-style connector, and an 8-pin accessory connector for external audio, GPS, and voltage options.

Accessories packed with the 2300 include the 120 VAC/12 VDC power supply, USB interface cable, owner’s manual, driver CD, and a quick-lookup software guide sheet.

❖ Functional Overview

The 2300 features a continuous 40 kHz to 3150 MHz (3.15 GHz) frequency coverage (800 MHz cellular frequencies are blocked on the consumer version) with AM, synchronous AM, FM, WFM, stereo FM, CW, USB, LSB, and ISB mode detection.

Available options include in-phase/quadrature (I/Q) (1 MHz BW, 25-3150 MHz reception only), APCO P25 digital decoding, and voice inversion decoding. The voice inversion decoding option is available to government/military clients only.

IF bandwidths from 200 Hz to 300 kHz are mode dependent, and the unit IF shift function allows a signal to be removed from adjacent-

channel interference. Automatic notch filtering as well as noise reduction and noise blanker circuitry further reduces interference.

To compensate for strong-signal overload, or weak signal strengths, both a two-step attenuator (-10/-20 dB) and a preamplifier may be invoked.

Frequency resolution is 1 Hz with a pin-point 1 ppm readout, which may be further refined to 0.01 ppm with an optional GPS input signal. Frequencies may be stepped in any whole-Hertz interval from 1 Hz to 999,999 kHz.

Up to 2,000 frequencies in 40 banks may be stored and scanned at 100 channels per second. For rapidly searching swaths of spectrum, up to 1,200 discrete frequencies or start/stop ranges may be passed.

Four separate VFOs are available to store 14 receiver settings including frequency, step, memory channel, bank, tone, antenna, attenuator, and seven other selections.

For VHF/UHF signals, an offset function permits the user to enter a second frequency for toggling, such as repeater input/output pairs or two-frequency simplex.

Squelch levels can be set for CTCSS (sub-audible tone) and DCS (digital) activation as well as voice activation to avoid hanging on open carriers. Squelch may be momentarily disabled by pressing a MONI (monitor) key. DTMF tones can be decoded and displayed as numbers, letters, and symbols.

Signal contents may be recorded in WAV file format on the SD card; a 1 GHz card capacity can store up to 15 hours of audio.

NTSC and PAL video outputs are available from a rear-panel connector intended to be connected to an external video monitor for detection of wireless surveillance cameras. The IF direction can be reversed as required for reception of some wireless cameras.

❖ The 2300 Specs

Sensitivity is excellent in the critical VHF/UHF spectrum from 25-3150 MHz. It’s typically 0.7 microvolts for NFM signals and 0.3 microvolts for SSB. I was able to hear fringe UHF signals very clearly.

Equally important, the dynamic range keeps the products of overload interference to a minimum. Third-order intermodulation is factory specified at a respectable +20 dBm at HF, +12 dBm at VHF, and +7 dBm at UHF.

Digital IF filtering offers a choice of selectivity depending upon the mode chosen. Nominal bandwidths are 200 kHz, 500 kHz, 1

kHz, 3 kHz, 6 kHz, 15 kHz, 30 kHz, 100 kHz, 200 kHz, and 300 kHz.

Digital filtering for single-signal selectivity provides excellent shape factors as shown below for the standard -3 dB / -80 dB rolloff points.

CW (500 Hz)	380 Hz / 500 Hz (1.3:1)
AM (6 kHz)	5.5 kHz / 6.9 kHz (1.25:1)
SSB (3 kHz)	2.7 kHz / 3.1 kHz (1.15:1)
NFM (15 kHz)	14.2 kHz / 15.6 kHz (1.1:1)
WFM (200 kHz)	200 kHz / 250 kHz (1.3:1)

❖ On-Screen Control

A wide variety of functions are accessible by popping up visual control boxes: S meter, mode, AF/RF/Squelch, FFT spectrum display, audio/video options, direct-entry keypad, frequency offset, HF control, and a choice of signal spike or waterfall on the spectrum display.

All of the boxes can be rearranged in place, but only the spectrum display can be resized to fit a custom screen layout.

❖ Spectrum display

For anyone searching for radio signals, a spectrum display is essential. Signals may pop up anywhere, but if you can see it, you can grab it! The 2300 graphic display presents an adjustable span of spectrum from 800 kHz to 10 MHz wide for quick capture of signal spikes.

An adjustable baseline can be set anywhere on the graph for signal-strength reference. Spikes can be automatically numbered from 1-10 in order of relative signal strength. An attenuator / preamplifier bar can be adjusted as desired.

Fourier transform (FFT) sampling is done 15 samples per second, and the display frequency steps may be selected at 5, 6.25, 8.33, 9, 10, 12.5, 20 (default), 25, 30, 50, or 100 kHz.

The waterfall presentation works very well, displaying signal activity over time for all frequencies within up to 10 MHz, or as narrow as 800 kHz, full bandwidth. The color selection and saturation (intensity) can be adjusted as well, changing hues to match signal strengths from -30 to -110 dB. The speed of the waterfall presentation can be slide-bar adjusted from 15 to 90 seconds of visibility before it rolls out of view.

❖ Let's try it out

After some trouble loading the software from the CD provided, our resident computer guru, Bill Grove, found a way to copy it from a website and it loaded flawlessly. We expect this problem to be corrected by the time you read this review.

Sensitivity was excellent, and even the weakest receivable signals showed up as spikes on the spectrum display. Audio recovery in all modes was crisp and clean.

The 2300 has a de-emphasis ability for FM and WFM to reduce attendant noise. Background hiss adds to the noise on wide-bandwidth signals, so broadcasters include treble pre-emphasis which can then be de-emphasized by a suitably-equipped receiver to reduce the screechy highs and hiss as well.

The auto mode setting is quite effective and will probably be utilized during the majority of

listening time. This feature automatically sets the appropriate mode, selectivity, and tuning step for any frequency entered. If desired, another choice is just one click away.

The DSP noise reduction function works quite well on SSB signals; it is available in three successive levels of suppression chosen for the least amount of processor-induced distortion.

The auto notch filter instantly acquires the pitch of an offending, single-tone interference source like an off-frequency heterodyne, and does a great job suppressing it. It even works well when the tone is interfering with music! Like the noise reduction function, the notch filter offers three levels of attenuation.

❖ The Bottom Line

The new AOR AR2300 "Black Box" is a versatile receiving station with very wide frequency coverage, fast-scan memory, conventional spike spectrum display, waterfall display, multimode demodulation, and probably 99 percent of nearly anyone's functional requirements.

Software improvements and upgrades are offered on the web as they become available.

The AOR AR2300 receiver is FCC approved and available from Grove Enterprises for \$3,299.95 (RCV60-G). For more information or to order go to www.grove-ent.com on the internet or call 1-800-438-8155.

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AOR AR2300 "Black Box" Receiver

The AR2300 communications receiver from AOR is ideally suited for radio and spectrum monitoring in various commercial and government applications, as well as for use in radio investigation services.

The AR2300 offers:

- Signal detection
- Signal search in frequency and memory scan mode
- Spectrum occupancy and on-the-air monitoring
- Coverage and field-strength check
- Signal and spectrum analysis through optional I/Q software

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Applications may include:

- .. Monitoring and storage of up to 2000 frequencies, receiving modes, antenna port, attenuator settings, constant monitoring of one frequency or scanning of selected frequencies.
- .. Searching a frequency range with freely selectable start and stop frequencies and step widths of 0.01 kHz (10Hz) to 999.99 kHz.
- .. Detection of undesired emissions including pulsed emissions.
- .. Detection of unlicensed transmitters communicating illegally or interfering with licensed transmission.
- .. Protection against eavesdropping by detecting miniature transmitters (bugs)



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