

198.01

WJ-8700 DUAL VLF/HF RECEIVER



FEATURES

- Frequency Coverage From 5 kHz to 32 MHz
- Compact Size, Two Receivers In 3.5-Inch Half Rack
- High Dynamic Range
- Microprocessor Controlled With 8-Line By 40-Character Display for Menu-Driven Operation
- AM, FM, CW, LSB, USB Detection Modes
- Five IF Bandwidths
- Scan, Step and Lockout With 100 Memory Channels
- Suboctave Preselector
- RF Input Overvoltage Protection
- Multiple Receiver Control Capability

DESCRIPTION

The WJ-8700 Dual VLF/HF Receiver is a compact microprocessor-controlled receiver intended to monitor or search the 5 kHz to 32 MHz frequency range. Two fully independent receivers are contained in the unit, sharing only the common power supply, reference time base, and front panel controller. The compact size permits the mounting of four receivers in 3.5 inches of vertical space in a standard 19-inch rack. The completely modular design

approach allows for rapid and easy service. The front panel utilizes a "Supertwist" 8x40 character, illuminated Liquid Crystal Display to provide a display of the receiver settings. All receiver functions are menu driven with softkey access to different menu levels, providing powerful programming capability. Parameter entry is accomplished via the numeric keypad or the "adjust" control knob on the front panel. The front panel can control either of the two receivers in the chassis or up to 29 other receivers within a system network. With the exception of the headphone audio output level and the unit's bus address, all operator-selectable parameters are controllable and accessible via the optional IEEE-488 or RS-232 remote interface.

Fully synthesized local oscillators provide precise tuning from 5 kHz to 32 MHz in 10 Hz steps. External reference frequency input and output are provided which allow daisy chaining of the master reference signal. A tunable BFO tunes ± 9.999 kHz in 1 Hz steps for accurate tuning of CW and SSB signals.

The WJ-8700 Receiver features six operator-selectable final IF bandwidth slots. Five of the final IF filters are included in the base price of the unit and are available in various configurations. As an option, certain bandwidth

configurations substitute a lower sideband filter in one of the standard five filter slots and include an additional upper sideband filter, allowing ISB detection. Another feature of the receiver permits the final IF filter to be bypassed altogether, allowing the bandwidth to be set by the first IF filter. (Refer to the Options section for a description of the available standard sets of IF filters.) Consult the factory for additional information regarding special filter configurations for unique applications.

All receiver outputs are available on the rear panel of the unit, with the exception of the front panel mounted headphone jack. The antenna inputs, signal monitor outputs, and predetected IF outputs are all available on BNC-type connectors. The audio, FM monitor, and signal strength outputs are available on standard DB-25-type connectors.

FUNCTIONAL DESCRIPTION

Figure 1 provides a functional block diagram of one channel of the WJ-8700 Receiver signal path. The RF signal applied to the receiver antenna input passes through one of 11 bands of input preselection filters which are switched based on tuned frequency. After preselection, the signal is mixed with the first local oscillator and upconverted to the first IF frequency of 40.455 MHz. The first local oscillator tunes from 40.460 MHz to 72.455 MHz in 10 Hz steps; thus, providing full tuning coverage from 5 kHz to 32 MHz. The first IF filter limits the bandwidth to 16 kHz or 8 kHz, depending on the chosen bandwidth option. A sample of the first IF is provided on a rear panel connector for routing to a signal display unit. The output of the first IF filter is passed to the second mixer where the signal is downconverted to 455 kHz utilizing a fixed 40 MHz second local oscillator. The signal is then filtered in one of six operator-selectable bandpass filters. A bypass switch is provided to permit bypassing the 455 kHz bandpass filters, thereby allowing the first IF filter to set the bandwidth. A prefiltered sample of the 455 kHz IF signal is available as an option in lieu of the 40.455 MHz IF output.

After passing through the selectable bandpass filters, the filtered IF signal enters a variable gain IF amplifier. AGC is applied to the receiver front end and IF stages to maintain maximum dynamic range and minimize signal distortion. Several selectable AGC hold times are available to the operator in order to tailor the reception to the signal environment. After passing through the variable gain IF stages, the signal is applied to the demodulator circuits. AM demodulation is accomplished using a synchronous detector, which provides high dynamic range and linear detection. CW and SSB detection are accomplished utilizing a product detector. A tunable BFO permits signal clarification over a tuning range of ± 9.99 kHz in 1 Hz steps. With the appropriate bandwidth set option installed in the receiver, ISB detection is available with simultaneous demodulation of upper and lower sideband signals. FM demodulation is accomplished using a quadrature detector. A sample of the FM demodulator output is available on a rear panel connector at all times, regardless of the selected detection mode.

The audio routing is very flexible in the WJ-8700 Receiver. The front panel headphone jack is a stereo connector which lets the operator connect the audio from one of the receivers to both ears or one receiver to each ear. The "NET" interface bus routes not only control signals, but also the audio from the selected receiver. (See the Capabilities/Applications section for a discussion of the "NET" interface bus.)

Figure 2 shows the overall receiver block diagram including the front panel unit and optional remote interface option. The microprocessor motherboard provides the interconnections between the receiver modules and control signals required for communication between the microprocessor and the receiver modules. The power supply, front panel and time base reference modules are shared by both receiver channels.

Figure 3 shows the mechanical module layout of the receiver. Each receiver channel consists of four plug-in modules. One option slot is available per receiver channel for future expansion. Two option slots are also available in the digital section of the receiver. The remote interface option is shown for clarity.

CAPABILITIES/APPLICATIONS

The WJ-8700 Receiver is a highly flexible receiver designed for systems applications requiring versatile control capability. An optional remote interface is available for either RS-232 or IEEE-488 control. Included with the remote interface is a special "NET" connector that is a dedicated control and audio routing bus designed for operator control of up to 29 other similar receivers.

Figure 4 shows a diagram of one possible system interconnection utilizing the WJ-8700 Receiver. The diagram shows system interconnections for control via the IEEE-488 interface and the "NET" control bus. The individual message paths allow both host and "NET" controllers to access the individual receivers in the system. Each receiver maintains a control token identifying the device which is currently in control of that receiver. The token is available for use by either the host interface, the front panel, or the net interface, which permits independent use of the receivers by each controlling device.

Each WJ-8700 frame requires one primary IEEE-488 address, while each individual receiver in the WJ-8700 is given an individual secondary address (1 and 2). The individual secondary address allows independent remote control of each receiver; therefore, up to 28 individual receiver channels (14 WJ-8700 Dual Receivers) can be placed on a single unexpanded IEEE-488 interface.

The W-J "NET" interface bus lets any attached unit with a front panel control any individual receiver on the "NET." The "NET" may only be accessed by a single front panel device at any given time, and it allows full control of the selected receiver from the designated front panel. Also, up to 29 devices may be interconnected and handoff operations between like devices is provided. Another receiver compatible with the "NET" is the WJ-8607 Miniceptor when it is installed in a WJ-9902 or WJ-9908 Equipment Frame. The WJ-9607 Front Panel Controller is also "NET" compatible.

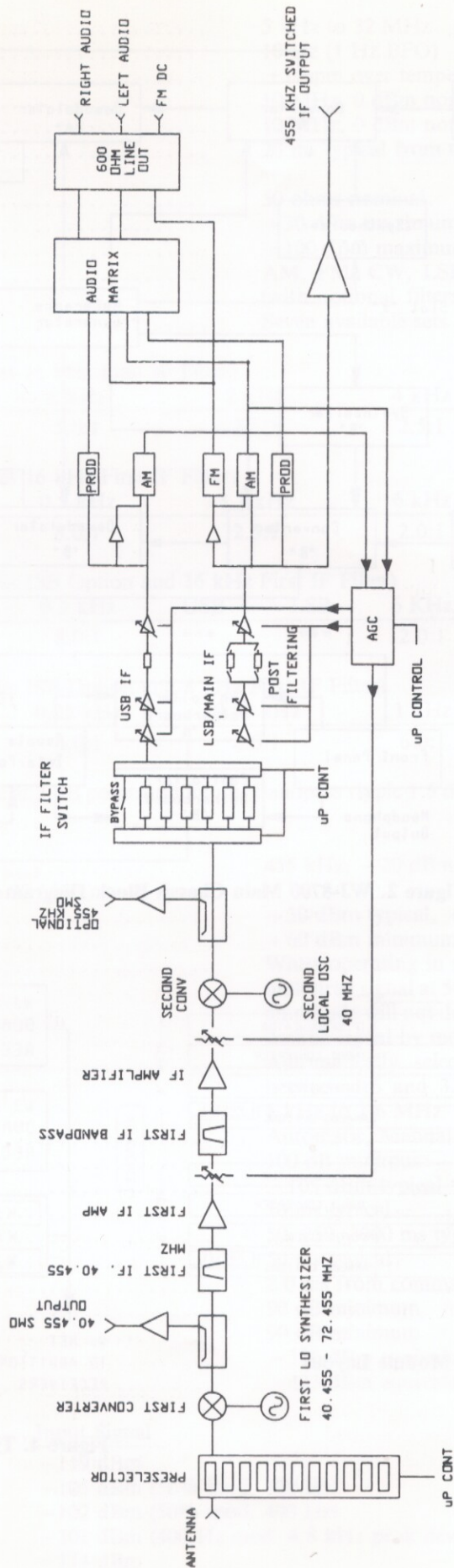


Figure 1. WJ-8700 Signal Path Functional Block Diagram

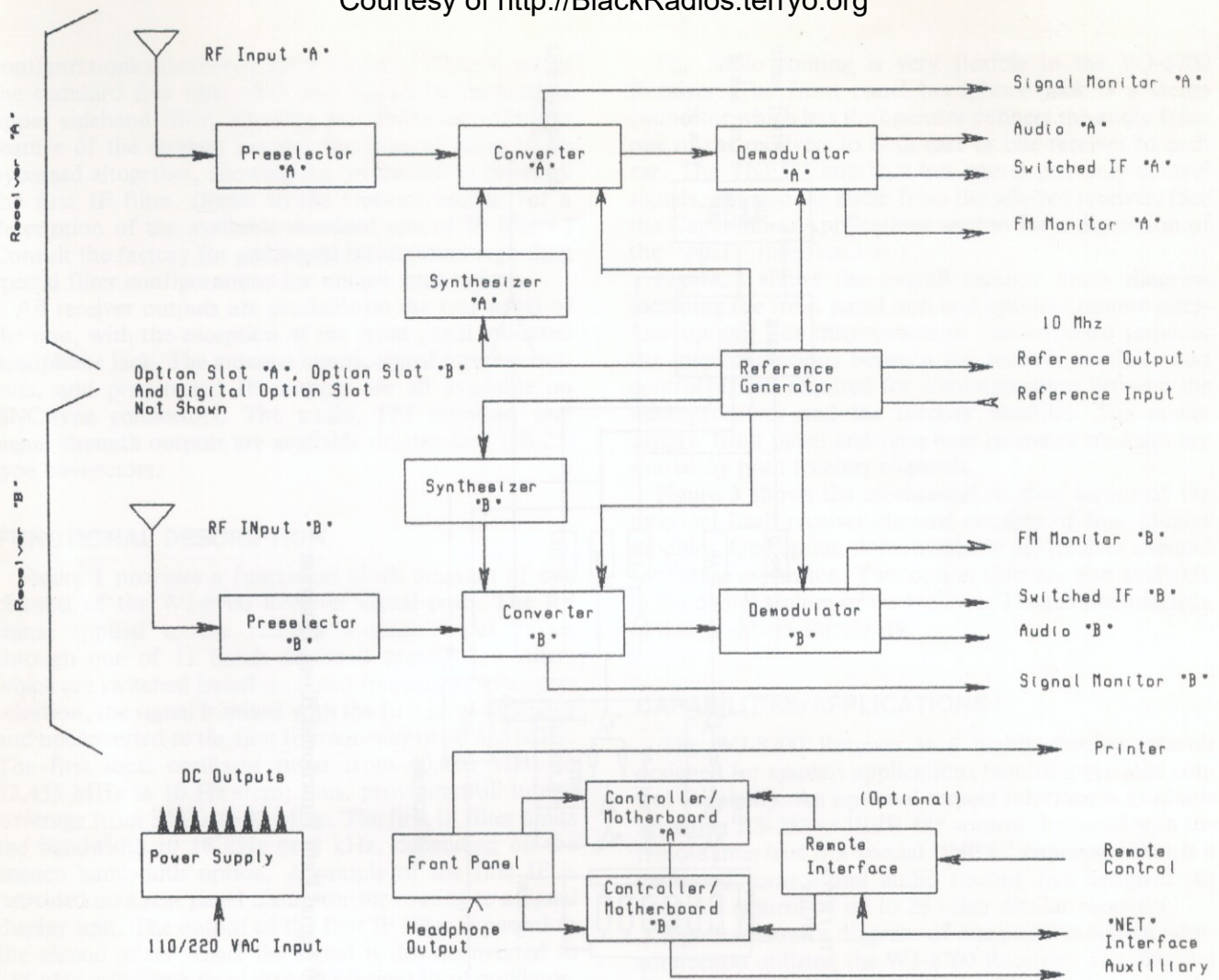


Figure 2. WJ-8700 Main Chassis Block Diagram

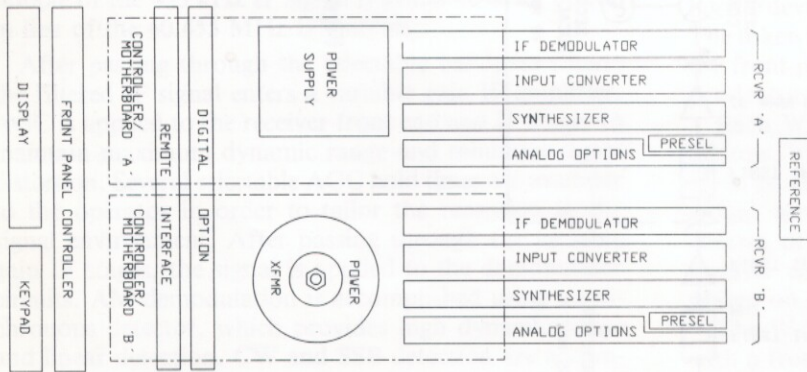


Figure 3. WJ-8700 Receiver Module Layout

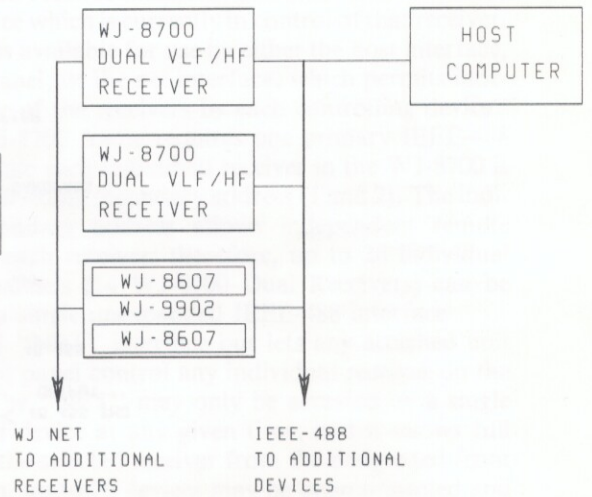


Figure 4. Typical WJ-8700 System Interconnection

SPECIFICATIONS

Frequency Range	5 kHz to 32 MHz
Tuning Resolution	10 Hz (1 Hz BFO)
Internal Reference Stability	± 1 ppm over temperature
External Reference Input	10 MHz, 0 dBm nominal
External Reference Output	10 MHz, 0 dBm nominal
Synthesizer Lock Time	20 ms typical from tuning command
Antenna Input	
Impedance	50 ohms nominal
Protection	+ 30 dBm maximum, auto-resetting
Conducted LO at RF Input	- 100 dBm maximum
Detection Modes	AM, FM, CW, LSB, USB, ISB (with optional filters installed)
IF Bandwidths	Seven available sets

Set 1: -6 dB Bandwidths (Includes 16 kHz First IF Filter)

Shape Factor	0.5 kHz	1 kHz	2 kHz	4 kHz	8 kHz	16 kHz
60 dB to 6 dB	8.0:1	5.0:1	2.5:1	2.5:1	4.0:1	3.0:1

Set 2: -3 dB Bandwidths (Includes 16 kHz First IF Filter)

Shape Factor	0.25 kHz	0.5 kHz	3.2 kHz	6 kHz	12 kHz	16 kHz
60 dB to 3 dB	4.0:1	8.0:1	2.5:1	2.0:1	3.0:1	3.0:1

Set 3: -3 dB Bandwidths (Includes ISB Option and 16 kHz First IF Filter)

Shape Factor	0.25 kHz	0.5 kHz	USB	LSB	6 kHz	12 kHz	16 kHz
60 dB to 3 dB	4.0:1	8.0:1	***	***	2.0:1	3.0:1	3.0:1

Set 4: -3 dB Bandwidths (Includes ISB Option and 8 kHz First IF Filter)

Shape Factor	0.10 kHz	0.25 kHz	0.50 kHz	1 kHz	USB	LSB	8 kHz
60 dB to 3 dB	10.0:1	4.0:1	8.0:1	6.0:1	***	***	3.0:1

ISB Filter Characteristics: 2900 Hz at 3 dB points minimum. Bandpass ripple 1.5 dB p-p maximum. (60 dB bandwidth, 4.3 kHz maximum)

Predetected IF Output	455 kHz, -20 dBm nominal
Signal Handling Capabilities (1 to 30 MHz)	
3rd Order Intercept Point	+ 30 dBm typical, +27 dBm minimum
2nd Order Intercept Point	+60 dBm minimum
Reciprocal Mix	When operating in a 4 kHz BW at rated sensitivity, an undesired signal at 50 kHz separation and 80 dB higher in amplitude will not degrade the signal-to-noise ratio of the desired signal by more than 3 dB
Preselection	Automatically selected suboctave filters in 9 bands between 1.6 and 32 MHz. Two low-pass filters from 5 kHz to 1.6 MHz
Gain Control Modes	Automatic, Manual
Range	100 dB minimum
AGC Threshold	- 105 dBm typical
AGC Attack Time	10 ms typical
AGC Hold Time (Selectable)	50, 250, 3000 ms typical
AGC Decay Time	50 ms typical
AGC Dump	2.0 ms from command
IF Rejection	90 dB minimum
Image Rejection	90 dB minimum
Internally-Generated Spurious	- 120 dBm equivalent input maximum
Single Tone Spurious Rejection	- 123 dBm equivalent for - 50 dBm input signals
Sensitivity (1 MHz to 30 MHz)	

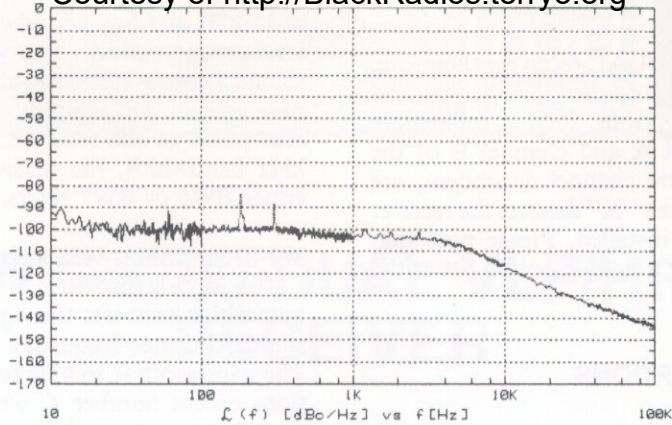
	<u>IF BW</u>	<u>Input Signal</u>	<u>Audio (S+N)/N</u>
CW	0.25 kHz	- 119 dBm	16 dB
AM	6.00 kHz	- 105 dBm (50% mod. 400 Hz)	10 dB
AM	12.0 kHz	- 102 dBm (50% mod. 400 Hz)	10 dB
FM	16.0 kHz	- 101 dBm (400 Hz mod. 4.8 kHz peak deviation)	17 dB
ISB	2.90 kHz	- 114 dBm	10 dB

Add 3 dB for all sensitivity specifications for tuned frequencies between 30 and 32 MHz.

CW Sensitivity (5 kHz to 1 MHz) (0.25 kHz IF Bandwidth) 500 kHz to 1 MHz	A - 117 dBm signal will produce at least 16 dB (S + N)/N at the audio output A - 112 dBm signal will produce at least 16 dB (S + N)/N at the audio output A - 60 dBm signal will produce at least 16 dB (S + N)/N at the audio output
50 kHz to 500 kHz	-95 dBc/Hz maximum at 1 kHz offset
5 kHz to 50 kHz	Centered at 40.455 kHz, 500 kHz minimum BW, 0 dB above RF
Phase Noise	
Signal Monitor Output	
Audio Outputs	
Power Output	100 mW RMS into 16 ohms, one output per receiver channel, unbalanced
(Rear Panel ¼ " Stereo)	0 dBm into 600 ohms, two per receiver channel
Line Level Output	
(Rear Panel)	
Headphone Output	2 mW RMS into 16 ohms, one per chassis
(Front Panel ¼ " Stereo)	
FM Monitor	
Power Interrupt	DC coupled, 0.25 volts per kHz, into 600 ohms Stores memory channel data for up to five years. Upon power restoration, receiver returns to previously tuned channel or frequency
Power Requirements	115/230 VAC ±10%, 48 to 420 Hz
Power Consumption	75 watts maximum
Environmental	
Operating Temperature Range	-20 to +60 °C
Full Specification Compliance	20 to 30 °C
Relative Humidity	Per MIL-STD-810D (Method 507.2)
Vibration	
Random	Per MIL-STD-810D (Method 514.3)
Sinusoidal	Per MIL-STD-167.1
Shock	Per MIL-STD-810C
Mechanical	
Size	8.5" wide × 3.5" high × 20" deep
Weight	Less than 30 pounds

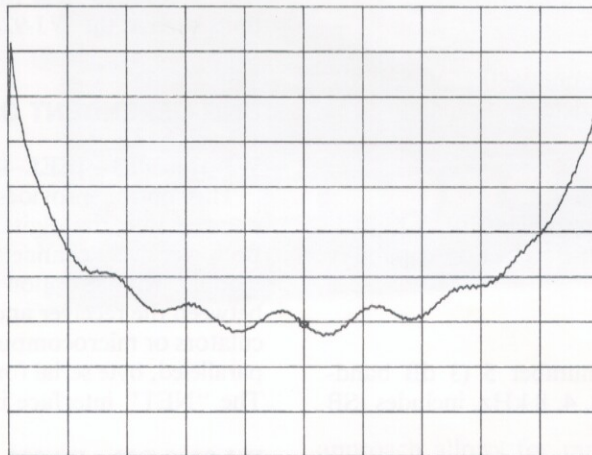
Connectors, Input/Output (Rear Panel Except Where Noted)

<u>Function</u>	<u>Type</u>	<u>Quantity/Description</u>
Antenna	BNC	One per receiver
Signal Monitor	BNC	One per receiver
Switched IF	BNC	One per receiver
External Reference Input	BNC	One per chassis
External Reference Output	BNC	One per chassis
Headphone	¼ " Stereo, front panel	One per chassis
Audio	¼ " Stereo	One per chassis
Line Audio	25-pin male	One per chassis
Remote Bus	Option dependent	One per chassis
Printer	9-pin female	One per chassis
Auxiliary	25-pin female	One per chassis
NET	9-pin male	One per chassis
Power Input	IEC 3-pin	One per chassis



Typical WJ-8700 Phase Noise

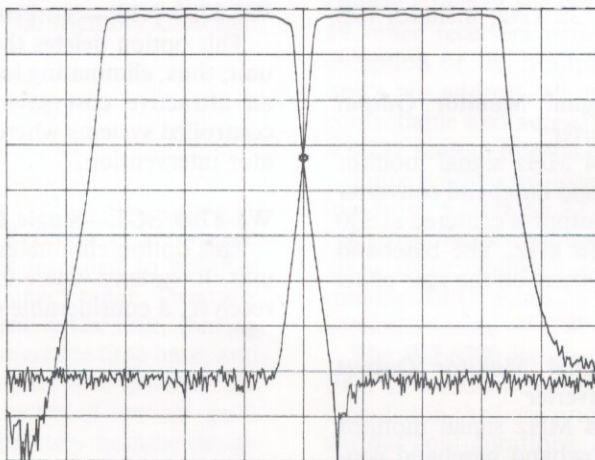
/DIV 250.00μSEC MARKER 453 200.000Hz



CENTER 453 200.000Hz SPAN 3 000.000Hz

Typical Sideband Filter Delay Response

/DIV 10.000dB MARKER 455 000.000Hz



CENTER 455 000.000Hz SPAN 10 000.000Hz

Typical ISB Filter Response

OPTIONS

The WJ-8700 Receiver is a DUAL receiver; therefore, certain optional features can be installed in either channel A or channel B of the unit. Options, such as the remote interface, cover both channel A and channel B of the unit. Those options, which are channel dependent, are designated WJ-8700/X where the "X" denotes the receiver channel where the option is installed. Please note that each receiver channel requires a unique option list at the time of order.

CHANNEL-DEPENDENT OPTIONS

WJ-8700/XBW1

IF bandwidth configuration number 1: 0.5, 1, 2, 4, 8, 16 kHz (see text).

WJ-8700/XBW2

IF bandwidth configuration number 2: 0.25, 0.5, 3.2, 6, 12, 16 kHz (see text).

WJ-8700/XBW3

IF bandwidth configuration number 3: 0.25, 0.5, USB, LSB, 6, 12, 16 kHz, includes ISB detection capability (see text).

WJ-8700/XBW4

IF bandwidth configuration number 4: 0.10, 0.25, 0.5, 1, USB, LSB, 8 kHz, includes ISB detection capability (see text).

WJ-8700/XBW5

IF bandwidth configuration number 5 (3 dB bandwidths): 0.25, 0.50, LSB, USB, 2, 4, 8 kHz, includes ISB detection capability.

WJ-8700/XBW6

IF bandwidth configuration number 6 (3 dB bandwidths): 0.50, 2, LSB, USB, 4, 8, 32 kHz, includes ISB detection capability.

WJ-8700/XBW7

IF bandwidth configuration number 7 (3 dB bandwidths): 1, LSB, USB, 4, 8, 16, 32 kHz, includes ISB detection capability.

WJ-8700/XOP1—21.4 MHz Signal Monitor Output With Wideband Baseband Converter

This option combines the 21.4 MHz signal monitor output option (SM2) and a wideband baseband converter into one module. The baseband output is centered at 130 kHz and has a bandwidth of 256 kHz. The baseband output replaces the switched IF output on the rear panel of the receiver.

WJ-8700/XOP2—21.4 MHz Signal Monitor Output With Narrowband Baseband Converter

This option combines the 21.4 MHz signal monitor output option (SM2) and a narrowband baseband converter into one module. The baseband output is centered

at 15 kHz and has a bandwidth of 20 kHz. The output is leveled automatically at 2 volts peak-to-peak ± 3 dB for signals from -105 to -5 dBm at the antenna input. The baseband output replaces the switched IF output on the rear panel of the receiver. In order to maintain the 20 kHz bandwidth, the receiver must be configured with either BW6 or BW7 filters.

WJ-8700/XSM1—455 kHz Signal Monitor Output

This option provides a simple cabling change in the unit which converts the signal monitor output from the standard center frequency of 40.455 MHz to 455 kHz. The bandwidth is 16 kHz for all IF bandwidth configurations except number 4, which is 8 kHz. No additional modules are required.

WJ-8700/XSM2—21.4 MHz Signal Monitor Output

This option provides an additional frequency converter module which is installed in the designated receiver channel option slot. The first IF frequency of 40.455 kHz is converted to 21.4 MHz for use with spectral display units such as the WJ-9205 and WJ-9206 Signal Monitors.

UNIT-DEPENDENT OPTIONS

WJ-8700/488—IEEE-488 Remote Control Interface

This option provides an additional module which is plugged into the digital control section of the receiver. Both receiver channels are controlled via this single module. The 488 option provides talk and listen capabilities between the receiver and external equipment, such as calculators or microcomputers. The data is transferred in bit paralleled, byte serial form, permitting rapid data transfer. The "NET" interface is included with this option.

WJ-8700/232—RS-232 Remote Control Interface

This option provides an additional module which is plugged into the digital control section of the receiver. Both receiver channels are controlled via this single module. The RS-232C option provides remote capabilities for the WJ-8700 Receiver by providing Talk/Listen capabilities. The "NET" interface is included with this option.

WJ-8700/NFP—No Front Panel Option

This option deletes the front panel assembly from the unit; thus, eliminating local control. This option becomes an attractive cost savings feature in large computer-controlled systems where there is no need for local operator intervention.

WJ-8700/SGL—Single Receiver Option

This option eliminates receiver channel "B" from the unit. In systems where there is no requirement for a dual receiver, a considerable cost savings may be realized.