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# V/UHF Receiver Fast Miniceptor WJ-8607A



The WJ-8607A is a small, frequency agile, lightweight V/UHF receiver designed for limited space applications. Its compact size, fast tuning speed, automatic internal functions and high-level interface make it ideal for a multitude of system applications including commercial frequency management.

The WJ-8607A supports the high-level interface and automatic functions of the WJ-8607 Miniceptor, allowing access to powerful Miniceptor Control Software (MCS-1) applications, such as mission storage/retrieval and sweep data logging, and analysis.

WJ-8607A's frequency agility is the key to its tuning speed. When tuning manually, the receiver settles to within 10 kHz of final frequency in less than 300  $\mu$ Sec from the receipt of a frequency command. In sweep mode, the average time for the receiver to take 25-kHz increments is less than 200  $\mu$ Sec. The WJ-8607A features the high dynamic range, low phase noise, multiple detection modes and excellent selectivity of larger receivers.

The fully synthesized, low phase noise local oscillators (LO) provide accurate tuning over the basic range of 2 to 512 MHz. The tuning range is extendible to 2000 MHz with an 8607A/FE frequency extender or to 3000 MHz with an 8607A/3GFE frequency extender. Although the

## Features

- 00 Sec tuning (worst case) to within 10 kHz
- 20 to 512 MHz frequency range (2000 MHz with FE) (3000 MHz with 3GFE)
- High dynamic range tracking preselector (20 to 512 MHz with 10% nominal bandwidth)
- Low phase noise
- 68HC16 microcontroller
- SWEEP, STEP & Lockout, with channel occupancy
- Compatible with existing commercial interfaces
- Small size: 1.5 x 6.5 x 10.5 in (3.81 x 16.51 x 26.67 cm)
- Modular Construction: 4 circuit boards using SMT
- Low Power: 19 W
- Light Weight: 5.5 lbs (2.48 kg)
- High linearity demodulators
- Self-test of power supply & synthesizer operation
- Tunable IF output frequency

HEIGHT	1.5 in (3.81 cm)	DEPTH	10.5 in (26.67 cm)* 13.35 in (33.90 cm)**
WIDTH	6.5 in (16.51 cm)	WEIGHT	5.5 lbs (2.48 kg)* 7.0 lbs (3.18 kg)**

\* standard

\*\* with FE or GFE

### \* Restricted International Distribution\*

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receiver is designed for V/UHF operation, tuning to 2 MHz provides a modest HF performance. Three IF bandwidths (IFBW) are standard. The unit has space for two additional bandwidths. A wide selection of IF filters are available ranging from 3.2 kHz to 8 MHz. In addition, an operator may bypass the IF filters to yield a bandwidth of approximately 12 MHz.

The WJ-8607A demodulates AM, FM, CW, and Pulse type signals. Optional Single Sideband (SSB) detection provides upper or lower sideband demodulation in a 3.2-kHz bandwidth without sacrificing any of the five available IFBW positions. In CW or SSB detection modes, a Beat Frequency Oscillation (BFO) command provides 10-Hz resolution. The receiver uses a synchronous detector as the AM demodulator, which yields a more linear transfer function than traditional techniques.

The WJ-8607A achieves an outstanding third-order intercept point of +6 dBm, while maintaining a typical noise figure of only 8 dB. A built-in tracking preselector with a nominal bandwidth of 10 percent reduces the interference caused by out-of-band signals.

The receiver has two IF outputs. The wideband IF output provides nominally 10 dB of gain above the RF input with a 12-MHz bandwidth. When the unit includes a wideband output option, it provides a leveled -30 dBm output. The selected IFBW output provides a sample of the predetected 21.4-MHz IF at a level of -30 dBm.

Two unique features of the WJ-8607A are its translated IF output and switched audio output. The translated IF output allows the operator to translate the 21.4-MHz IF down to an IF output with a maximum center frequency of 2 MHz. When enabled, the translated IF is routed to the video output jack, in lieu of the normal detected video signal. The switched audio output allows an operator to bus together multiple audio signals from similar sources to a common point for selection.

## Control

The WJ-8607A allows for two types of remote interface:

- Standard Asynchronous Serial Interface (860XA/SER)
- Optional Hewlett-Packard Interface Loop (860XA/HPIL)

Customers must specify their preferred interface configuration at time of order. If an HPIL option is installed, an Asynchronous Serial interface is also available. However, an operator can only activate one interface at a time as determined by the receiver DIP switch.

The asynchronous serial interface offers communication data rates of up to 230.4 Kbaud, and supports any one of the following interface standards via internal DIP switch setting:

- Single-drop full-duplex RS-232
- Single-drop full-duplex RS-422
- Multidrop half-duplex protocol RS-232
- Multidrop half-duplex protocol RS-422
- Multidrop half-duplex RS-485

The single-drop interface allows connection from a controller to a single receiver. It supports interface protocols such as XON-XOFF, ENQ-ACK/NAK and Service Request by sending an ESC character, followed by a status byte.

The multidrop interface allows connection from a controller to multiple receivers. An operator can connect and control up to 30 receivers via a multidrop RS-485 or RS-422 interface. An RS-232 interface permits the interconnection of up to six receivers. Multidrop interfaces support address commands and require an operator to address the receiver before communicating with a controller. It supports an ACK/NAK verification protocol where upon receiving a completed message, the receiver issues an ACK or NAK character to assure the validity of the data transmission.

The standard WJ-9908A or WJ-9902 equipment frames require an HPIL option before installing WJ-860XA receivers. The HPIL is a low-power interruptible and addressable serial interface loop supported by many controlling devices, such as personal computers. An operator can hook up and control up to 31 receivers to this interface. An internal DIP switch allows the selection of different HPIL addresses for the receiver. WJ-8607A supports HPIL basic talker-functions /addressed-listener operations, generates Service Requests, and outputs data at approximately 3 Kbytes per second.

## Capabilities/Applications

The WJ-8607A uses a Motorola 68HC16 Micro-controller for functions such as AGC, AFC, synthesizer tuning, and remote interface. The receiver provides three basic modes of operation:

- MANUAL (fixed-frequency operation)
- SWEEP (contiguous coverage of up to 10 start-to-stop frequency sectors)
- STEP (preprogrammed discrete frequencies)

The WJ-8607A is interactive in all of its modes and alerts the host computer of signal activity. While in either the SWEEP or STEP mode, the receiver logs individual signals in the coverage area and reports only changes in signal presence to the host computer. This greatly reduces overhead time required by the host computer, since it eliminates the need to sort data from each sweep and determine which signals are new and which are repeats. In SWEEP mode, the receiver locks out portions of the RF spectrum and excludes previously identified portions of the spectrum from the coverage area. Non-volatile memory provides storage for up to 200 SWEEP or STEP setups, and 200 lockout bands.

Application solutions requiring high dynamic range, fast tuning speed, low power, and portability are easy using the WJ-8607A. The small size and low weight are particularly attractive when configuring man-portable systems. This receiver is also well-suited for applications where low EMI/RFI emissions are important.

## Functional Description

As shown in the block diagram, an RF input signal passes through a voltage-tuned tracking preselector that rejects out-of-band signals, thus improving the second-order intercept point of the receiver. The preselector bandwidth is nominally 10 percent from 20 to 512 MHz. When the receiver includes an FE, signals in the 512 to 2000 MHz range are filtered with suboctave filters and converted to the VHF range in 11 bands. After the unit filters the input signal, the signal passes through an RF amplifier and low-pass filter before entering the first mixer, where it is mixed with the first LO and upconverted to 691 MHz.

The first LO tunes from 692.5 to 1205 MHz in 2.5-MHz steps. The upconverted IF signal at 691 MHz is amplified and filtered before it enters the second mixer. Here it is mixed with the second LO, which tunes from 686.6001 to 671.1000 MHz in 100-Hz steps. The output from the second mixer is centered at 21.4 MHz, and is filtered and amplified before entering the switchable IFBW filters. The receiver provides a sample of the prefiltered signal for the signal monitor or optional wideband output.

The WJ-8607A can have up to five IFBWs installed. The fifth IF position requires a bandwidth of 250 kHz or greater. An additional feature permits the bypassing of IF filters on command, allowing total determination of the bandwidth by the tracking preselector, first IF filter, and final IF roofing filter. With a simple control command, an operator can also bypass the tracking preselector. This is particularly desirable when the operator requires relatively wide bandwidths at a low-tuned frequency.

After the signal passes through the selected IF filter, it goes through several stages of IF amplification and gain control. A sample of the bandlimited IF signal is provided at -30 dBm. Synchronous detectors, which provide highly linear and stable performance, accomplish AM and FM detection. A final conversion to 500 kHz provides SSB detection. The optional SSB detector includes a high-selectivity 3.2-kHz-wide filter for good adjacent channel rejection.

Receiver LED Indicators

LED Code	Action Indicated
<b>RUN*</b>	<b>Active microprocessor</b>
<b>COR</b>	<b>Presence of a signal over COR threshold</b>
<b>ERR</b>	<b>Functional error</b>
<b>Power</b>	<b>dc power present</b>

\* When RUN LED blinks, receiver is in **CONFIGURATION mode**, which is reserved for factory usage or downloading IFBW and options configurations into memory.



Receiver Connectors

I/O	Function	Type
Input	Antenna	SMA
	External Reference Input	SMB
	HPIL Input	LEMO 2-Pin*
	DC Input	LEMO 3-Pin
Output	Selected Video Output	SMB
	FM Monitor Output	SMB
	Signal Monitor Output of Optional WBO	SMB
	Selected 21.4-MHz IF Output	SMB
	Switched Audio Output	SMB
	Line Audio Output	SMB
	HPIL Output	LEMO 2-Pin*
	Phone Output	1/8th inch Miniature Stereo Jack
	Bidirectional	AUX
Serial Interface 1		LEMO 6-Pin
Serial Interface 2		Microminiature 15-Pin Male

\*Available only with HPIL option installed

IF Shape Factors

Bandwidth (kHz)	Shape Factor 60:3 dB BW	Sensitivity (dBm) <sup>1</sup> 20 to 512 MHz
3.2 <sup>2,3</sup>	3:1	-107
6.4 <sup>2</sup>	3:1	-105
10 <sup>2</sup>	3:1	-104
10G	3:1 <sup>4</sup>	-104
20 <sup>2</sup>	3:1	-101
25G	3:1 <sup>4</sup>	-101
50 <sup>2</sup>	3:1	-97
50G	3:1 <sup>4</sup>	-97
75 <sup>2</sup>	3:1	-95
100 <sup>2</sup>	3:1	-94
250	4:1	-90
300	4:1	-89
500	4:1	-87
1000	4:1	-84
2000	4:1	-81
4000	4:1	-78
8000	4:1	-75

<sup>1</sup> Sensitivity Conditions based on 20 to 512 MHz receiver; add 4 dB for FE.

AM— An input signal AM modulated 50% by a 1-kHz tone produces a minimum video output S+N/N ratio of 10 dB.

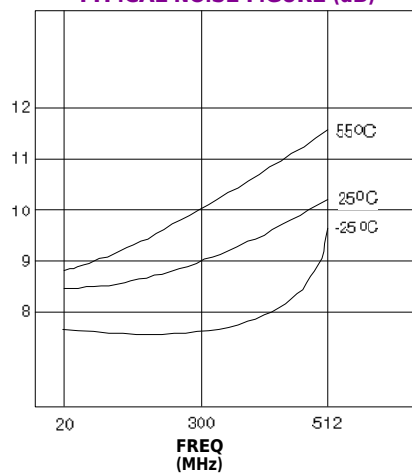
FM— An input signal FM modulated at a 1-kHz rate with a peak deviation = to 30% of the selected IFBW produces a minimum video output S+N/N ratio of 17 dB. (Note: IFBWs 10 kHz require a 400-Hz modulation rate.)

<sup>2</sup>Not used in 5th bandwidth position.

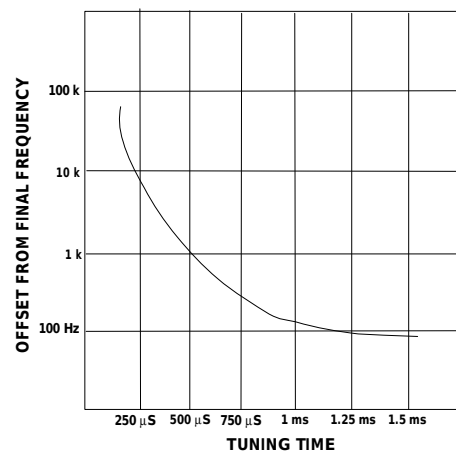
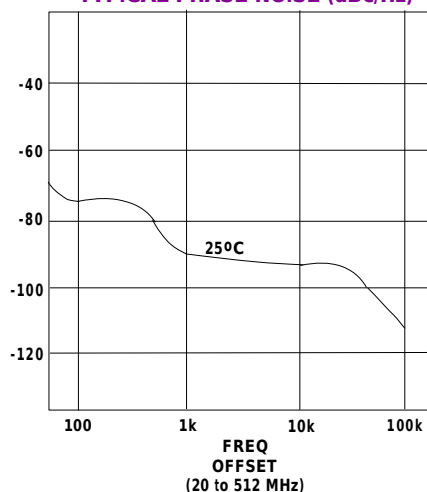
<sup>3</sup>With the 3.2-kHz bandwidth, the audio and video outputs are 6 dB less than published specifications.

<sup>4</sup>Denotes Gaussian filters, shape factor 3:1 from 60:6 dB required for high-speed operations in BWs <100 kHz.

TYPICAL NOISE FIGURE (dB)



TYPICAL PHASE NOISE (dBc/Hz)



Typical Performance Graphs

WJ-8607A Worst-case Tuning Time (2 to 512 MHz)

## Specifications

<b>Frequency Range</b> .....	20 to 512 MHz (2000 MHz with FE, 3000 MHz with 3GFE) Tuning allowed to 2 MHz
<b>Tuning Resolution</b> .....	100 Hz, synthesized
<b>Internal Reference Accuracy</b> .....	$\pm 1$ part in $10E^{-6}$ (0 to 50°C)
<b>External Reference Frequency</b> .....	Selectable, 1, 5 or 10 MHz; 0-dBm nominal input level
<b>Detection Modes</b> .....	AM, FM, CW & Pulse standard (SSB optional)
<b>RF Input Impedance</b> .....	50 ohms, nominal
<b>Preselection</b> .....	Tracking Preselector, 20 to 512 MHz 10% nominal bandwidth with bypass mode (5 suboctave filters, 512 to 2000 MHz with FE) (9 suboctave filters, 512 to 3000 MHz with 3GFE)
<b>Input VSWR</b> .....	2.0:1, typical 3.0:1, max at the tuned frequency
<b>Noise Figure</b> .....	12 dB, max (20 to 512 MHz with Preselector on) 8 dB, typical (5 to 512 MHz with Preselector off) 15 dB, max (512 to 2000 MHz with FE) 15 dB, max (512 to 3000 MHz with 3GFE)
<b>Intermodulation:</b>	
<b>2nd-order Intercept Point</b> .....	+45 dBm (20 to 512 MHz with Preselector on) +35 dBm (512 to 3000 MHz)
<b>3rd-order Intercept Point</b> .....	+6 dBm (20 to 512 MHz with Preselector on) 0 dBm (512 to 3000 MHz) +5 dBm, typical (2 to 20 MHz)
<b>Image Rejection</b> .....	80 dB, min 90 dB, typical
<b>IF Rejection</b>	
<b>21.4 MHz</b> .....	90 dB, min above 30 MHz
<b>691 MHz</b> .....	90 dB, min with Preselector on
<b>FE IF Rejection (Variable)</b> .....	75 dB, min with FE
<b>LO Phase Noise at 20-kHz Offset</b> .....	-93 dBc/Hz (20 to 512 MHz)
<b>LO Phase Noise at 20-kHz Offset in FE Bands</b> .....	-88 dBc/Hz (512 to 1410 MHz) -85 dBc/Hz (1410 to 3000)
<b>Receiver Tuning Speed</b> .....	300 $\mu$ Sec, max (from receipt of the last data byte of binary frequency message to within 10 kHz of the final frequency) Except when tuning from non-FE to FE frequency, max tuning time is 5 msec. 3GFE tuning time is 1 mSec, typical
<b>SWEEP Tuning Speed</b> .....	200 $\mu$ Sec, typical for 25-kHz steps
<b>Signal Monitor Output</b> .....	Nominally 10 dB above RF input (WBO provides -30 dBm leveled)
<b>Gain Control Modes</b> .....	Manual, automatic, 100-dB min range
<b>AM Stability</b> .....	6 dB, max change from AGC threshold to 100 dB above AGC threshold (-5 dBm, max input)
<b>Internally Generated Spurious</b> .....	<-110 dBm equivalent input (20 to 3000 MHz)
<b>LO Level at RF Input</b> .....	-100 dBm, typical -90 dBm, max
<b>Switched Video Output</b> .....	0.5 V peak-to-peak into 50 ohms (30% deviation in FM or 50% AM modulation)
<b>Video Frequency Response</b> .....	dc to 1/2 the IF bandwidth, -3 dB



<b>Line Audio Output</b> .....	5 mW, min into 32 ohms
<b>Headphone Output</b> .....	5 mW, min into 32 ohms
<b>Switched Audio Output</b> .....	400 mV rms into 600 ohms
<b>Audio Frequency Response</b> .....	200 Hz to 15 kHz, min
<b>FM Monitor Output</b> .....	0.5 V peak-to-peak with 30% FM deviation, dc-coupled, 100-kHz max bandwidth, 10K-ohm load
<b>Ultimate FM S+N/N</b> .....	40 dB, min (in a 50-kHz bandwidth)
<b>Reciprocal Mixing</b> .....	With an input at rated sensitivity level in 20-kHz bandwidth, an out-of-band signal 350-kHz removed and 70-dB higher in level will not degrade the S+N/N of the desired signal by more than 3 dB
<b>Selected IF Output</b> .....	Centered at 21.4 MHz, -30 dBm nominal output level
<b>IF Bandwidths</b> .....	5 plus bypass mode (3 supplied & 2 optional); See Table on page 5 for selection
<b>IF Shape Factor</b> .....	See Table on page 5
<b>Translated IF Output</b> .....	2-MHz max center frequency Output on the selected video jack Suitable for predetection recording
<b>COR/Squelch</b> .....	Adjustable for 0 to 55 dB above the noise floor of the selected bandwidth
<b>Power Requirements</b> .....	12 Vdc (+10 to 16 Vdc)
<b>Power Consumption</b> .....	21 W, nominal (20 to 512 MHz); add 5 W for FE
<b>Remote Interface</b> .....	HPIL (optional), RS-232C, RS-422A, RS-485 (supports only 1 at a time)
<b>Maximum RF Input Without Damage</b> .....	+20 dBm

### Environmental Specifications

<b>Receiver Case Temperature</b>	
<b>Operating Temperature Range</b> .....	-25 to +55°C, see performance graphs on page 5
<b>Full Specification Compliance</b> .....	+20 to +30°C
<b>Non-operating</b> .....	-40 to +70°C
<b>Shock</b> .....	Meets the environmental conditions of MIL-E-5400T, paragraph 3.2.24.6.1 pertaining to equipment shock
<b>Vibration</b> .....	Meets the environmental conditions of MIL-STD-810D, method 514.3, section I-3.2.4, category 4—propeller aircraft. Figure 514.3-25(a) defines the power spectral density with $L_i = 0.3$ (g <sup>2</sup> /Hz) and $F_i = 68$ Hz
<b>Humidity</b> .....	Meets the environmental conditions of MIL-STD-810D Method 507.2 with optional environmental upgrade

## Options

Model #	Function	Physical Characteristics
<b>8607A/ENV</b> Environmental	Meets MIL-STD-810D Method 507.2, Humidity	Conformally coated
<b>8607A/FE</b> Frequency Extender	Extends UHF tuning range from 512 to 2000 MHz by blockconverting 11 bands of the RF spectrum above 512 MHz into the normal tuning range	<ul style="list-style-type: none"> <li>• Adds 2.85 in (7.23 cm) to length</li> <li>• Additional PC assemblies: <ul style="list-style-type: none"> <li>- LO</li> <li>- RF converters with suboctave bandpass filters</li> </ul> </li> </ul>
<b>8607A/3GFE</b> Frequency Extender	Extends UHF tuning range from 512 to 3000 MHz by blockconverting 14 bands of the RF spectrum above 512 MHz into the normal tuning range	<ul style="list-style-type: none"> <li>• Adds 2.85 in (7.23 cm) to length</li> <li>• Additional PC assemblies: <ul style="list-style-type: none"> <li>- LO</li> <li>- RF Converter with suboctave bandpass filters</li> </ul> </li> </ul>
<b>8607/IFBW</b> IF Bandwidth	Up to 5 IFBWs	<ul style="list-style-type: none"> <li>• 3 IFBWs standard</li> <li>• 2 IFBWs optional (IF filter <math>\geq</math> 250 kHz)</li> </ul>
<b>8607A/HPIL</b> Hewlett Packard Interface Loop	Permits installation of receivers in WJ-9902 or WJ-9908 frames.	HPIL Remote Interface
<b>8607/SSB</b> Single Sideband	<ul style="list-style-type: none"> <li>• Converts IF signal from 21.4 MHz to 500 kHz for filtering &amp; demodulation</li> <li>• Allows demodulation of upper or lower sideband signals</li> </ul>	For Optimum SSB Operation, at least 1 of the 5 IF filters should be between 10 & 20 kHz
<b>8607/WBO</b> Wideband Output	Provides -30 dBm output level at 21.4-MHz (min BW of 8 MHz)	<ul style="list-style-type: none"> <li>• Mounts inside chassis</li> <li>• Eliminates Signal Monitor output</li> </ul>
<b>8607/MCS-1</b> Miniceptor Control Software	Provides applications software for: <ul style="list-style-type: none"> <li>- Receiver control/RF Pan display</li> <li>- Mnemonic control</li> <li>- Quick, reset/flush operations</li> <li>- Missions storage/retrieval</li> <li>- Sweep data logging &amp; analysis</li> </ul>	<ul style="list-style-type: none"> <li>• MS-DOS-based*</li> <li>• Requires as minimum: <ul style="list-style-type: none"> <li>- 386/16 MHz PC</li> <li>- EGA, VGA or SVGA monitor</li> <li>- Com port</li> </ul> </li> <li>• Supplied on 5.25 &amp; 3.5 inch disks with manual</li> </ul>
<b>8607A/DSO</b> Digital Scan Output	<ul style="list-style-type: none"> <li>• Provides sweep data for RF Pan presentation on WJ-9207 Display</li> <li>• Provides sweep data stream via RS-232 interface at 9600 baud</li> </ul>	Firmware option

\*MS-DOS is a trademark of Microsoft Corporation