

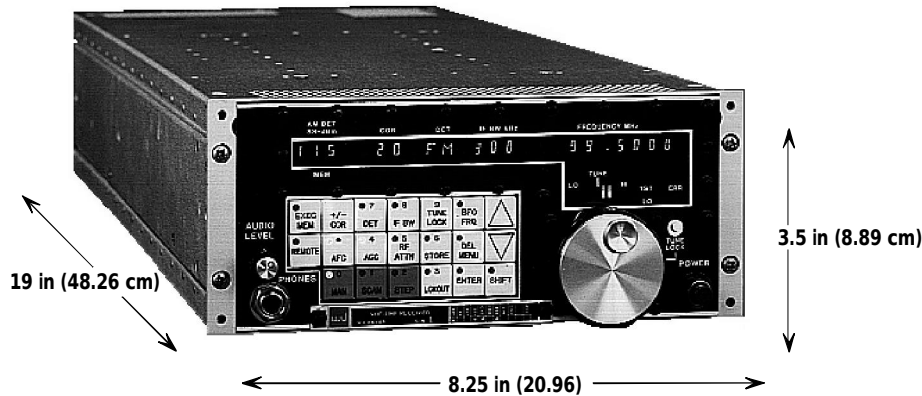
# Technical Data



WATKINS-JOHNSON

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## VHF/UHF Compact Receiver WJ-8615P



### Description

The WJ-8615P microprocessor-controlled receiver monitors or searches the 20 to 500 MHz frequency range. Two units, mounted side-by-side, fit into a standard 19-inch (48.26 cm) equipment rack, occupying only 3.5 inches (8.89 cm) of vertical rack space.

Fully synthesized Local Oscillators (LO) allow accurate tuning throughout the 20 to 500 MHz tuning range, with a 100-Hz tuning resolution. Frequency coverage is expandable from 2 to 1600 MHz with frequency extender (FEX) options. Three IF bandwidths (IFBW) ranging from 3.2 kHz to 8 MHz come with the unit. Two additional bandwidths are readily accepted, giving a total of five selectable IFBW's. AM, FM, CW and Pulse detection modes are standard. Independent Sideband (ISB) for upper, lower, or simultaneous upper and lower sideband detection is optional.

The front panel features an LED alphanumeric window and backlit keypad, allowing dark room operation. During routine operation, the window displays:

- Signal strength
- COR threshold level
- Detection mode
- IF bandwidth
- Tuned frequency

### Features

- Frequency range: 20 to 500 MHz (2 to 1600 MHz with FEX)
- Compact size
- High dynamic range
- Modular construction
- Microprocessor-control
- AM, FM, CW, Pulse & optional ISB modes
- Battery backed-up memory, clock & calendar
- IEEE-488 bus compatible, talk/listen
- Low close-in phase noise
- 3 standard IFBW's from 3.2 kHz to 8 MHz
- Front panel & remote control
- Log of signal acquisition with date & time to RS-232 printer or audio tape
- Simultaneous output of demodulated audio & log data formatted for 2-channel audio recorder
- Handoff of front-panel setup to other receivers
- Optional built-in tracking preselector
- Low in-band intermodulation products

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This material provides up-to-date general information on product performance and use. It is not contractual in nature, nor does it provide warranty of any kind.

An operator can tune the receiver using the tuning wheel or numeric keypad. Frequently changed parameters are adjusted using the increment (INC)/decrement (DEC) keys or numeric keypad.

Parameters that require occasional adjustment are accessed by clearly labeled menus. Decisions are easily reviewed, changed or cancelled while in the menu. The receiver prompts the operator and prevents selection of illegal parameters. The display also warns of operator errors and helps to locate hardware failures.

The WJ-8615P scan-step-lockout functions allow an operator to step through a sequence of preprogrammed discrete frequencies in search of signal activity. In either the scan or step mode, signals greater than the programmed COR level will halt the sequence. Depending on its current configuration, a receiver may remain at that frequency for a time or simply log the signal into its internal queue, or to an external printer, before resuming the sequence. If configured differently, the receiver may halt the sequence until a signal has disappeared, or dwell after the signal has disappeared. This allows time to monitor a push-to-talk response. The WJ-8615P Receiver includes 150 channels of battery backed-up memory for storing scan and step parameters. An operator can partition these 150 memory channels between scan and step channels to optimize available memory space.

Associated with scan mode, the lockout feature permits an operator to exclude portions of the frequency segment to prevent undesired signals from interrupting the scan. The menu allows an operator to enter lockouts by tuning the receiver, and finding the lower and upper boundaries of an unwanted signal. The unit provides 300 memory locations for lockout storage.

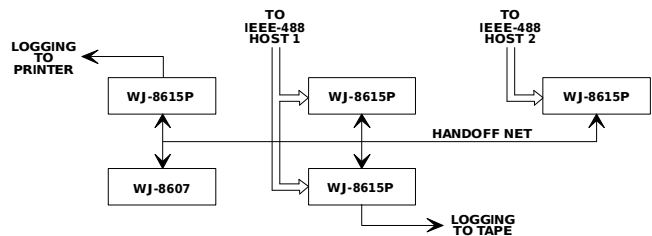
Logging is a standard WJ-8615P feature that provides a permanent record of signal activity without host supervision and with a minimum of external equipment. When enabled, a serial port sends detailed information about each intercepted signal to an RS-232 compatible printer or terminal. The printer shows the date and time a scan or step sequence is initiated, and provides a description of the new sequence. The unit then logs each acquired signal by date, time, frequency, and signal strength.

The WJ-8615P also outputs log data in FSK format for direct recording onto audio tape. The receiver can record demodulated signals on one channel of a two-channel tape recorder with log data on the other channel. The unit tags each signal with date, time, frequency, signal strength, and other parameters. Later,

when tapes are analyzed, an operator can use a WJ-9863 Decoder to extract the FSK data from the cassette and convert it to RS-232 format. The WJ-9863 connects a tape playback machine to a terminal or printer, which displays the log of each signal during playback.

Handoff is also a standard feature that links one WJ-8615P to as many as 29 WJ-8615P or WJ-8607 Receivers. The serial, bi-directional Handoff Net allows the local operator of any WJ-8615P to send a handoff message to any other receiver, and set it to the same frequency and front-panel parameters. By using the Handoff Net, an operator of a single receiver can scan or step almost continuously, pausing only long enough to hand off signals of interest to other receivers.

Figure 1 shows how the Handoff Net can connect stand-alone receivers or receivers that are otherwise connected using an IEEE-488 bus. A single Handoff Net can connect selected receivers from many different IEEE-488 buses. This access to receivers outside an immediate system optimizes equipment use and multiplies emergency backups.



**Figure 1. Receiver Handoff Net**

## Functional Description

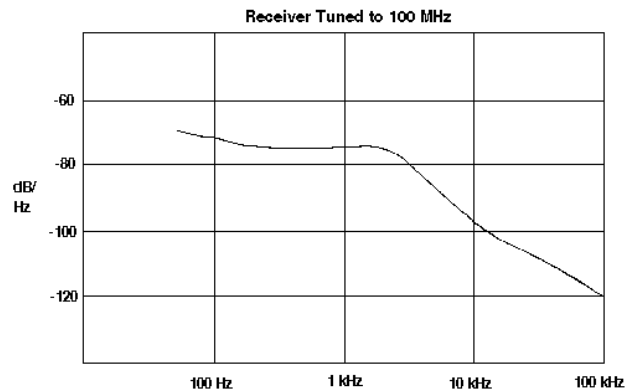
Figure 2 illustrates how an operator can use the 20 to 500 MHz basic receiver without any preselection. A tracking preselector option provides improved intermodulation performance for both second- and third-order intermodulation products. An operator can tune in the 500 to 1600 MHz range by using optional FEX modules that contain the UHF synthesizer, downconverter, and a three-band preselector. The unit processor downconverts UHF (450 to 250 MHz) as VHF.

A single plug-in module contains the VHF preamplifier, first converter, first IF, and second converter that are required to convert 20 to 500 MHz signals to an IF frequency of 21.4 MHz. The first mixer converts the 20 to 500 MHz RF signal to 555 MHz with a first LO tuning frequency range 577.50 to 1057.50 MHz in 5-MHz steps. The first IF is centered at 555 MHz and

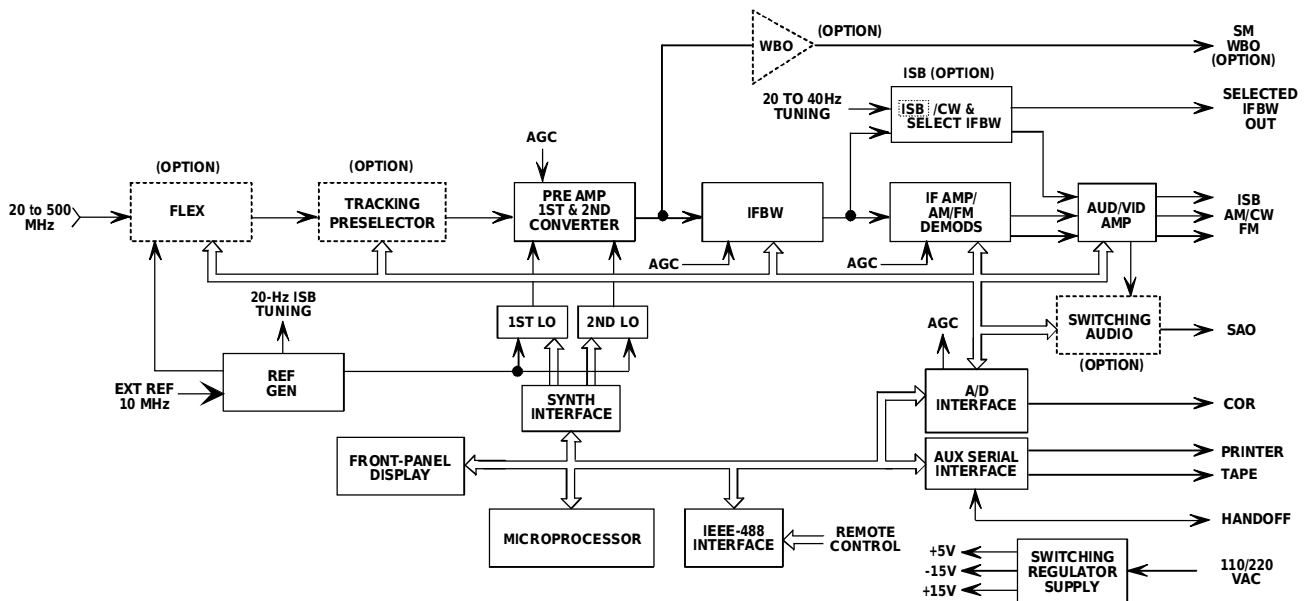
is approximately 12-MHz wide. The second LO, which is also synthesized, tunes from 536.10 to 531.10 MHz in 100-Hz steps to convert the first IF from 555 MHz to 21.4 MHz.

An IFBW filter module accepts up to five IFBW filters. After an operator selects the final IFBW, the receiver predetects the IF signal, then amplifies and routes it to AM, FM and CW Demodulators, as well as to an optional ISB module providing both upper and lower SSB demodulation.

The WJ-8615P microprocessor does more than simply interface front-panel controls and the remote control bus to receiver circuits. The unit also monitors all receiver detectors via Analog to Digital (A/D) inputs to the receiver interface module. Functions such as AGC, AFC and COR are derived in software.



**Figure 3. Typical Receiver Phase Noise**



**Figure 2. WJ-8615P Receiver Functional Block Diagram by Module**

## Specifications

<b>Frequency Range</b> .....	20 to 500 MHz (2 to 1600 MHz with FEX)
<b>Frequency Resolution</b> .....	100 Hz, synthesized
<b>RF Input Impedance</b> .....	50 ohms, nominal
<b>Input VSWR</b> .....	2.5:1 typ 3:1, max
<b>Noise Figure</b> .....	8 dB, max (12 dB, 500 to 1200 MHz with FEX) Add 1.5 dB for FEX option (2 to 500 MHz) Add 2.5 dB for Tracking Preselector option (2 to 500 MHz)
<b>Intermodulation:</b>	
2nd-order Intercept Point .....	+20 dBm, min (+45 dBm typical with preselector, except 2 to 20 MHz)
3rd-order Intercept Point .....	0 dBm, min (+3 dBm with preselector)
<b>Internal Frequency Accuracy</b> .....	$\pm 1 \times 10^{-6}$ (0 to 50°C)
<b>External Reference Input</b> .....	10 MHz at 0 dBm nominal
<b>Image Rejection</b> .....	90 dB, min
<b>Final IF Rejection (21.4 MHz)</b> .....	90 dB, min above 30 MHz
<b>LO Phase Noise</b> .....	-100 dBc/Hz at 20 kHz from Fc
<b>Tuning Speed</b> .....	10 msec, max to within 10 kHz
<b>Signal Monitor Output</b> .....	15 dB above RF input (WBO option -30 dBm out)
<b>Gain Control Modes</b> .....	Manual; Automatic; 100 dB range, min
<b>Internally-Generated Spurious</b> .....	<-115 dBm equivalent input
<b>LO Level at RF Input</b> .....	-90 dBm, max
<b>Demodulation Modes</b> .....	AM, FM, CW & Pulse (ISB optional)
<b>Video Outputs (Simultaneous)</b> .....	AM, Pulse 0.5 V peak FM, 0.5 V peak into 93 ohms
<b>Video Response</b> .....	DC to 1/2 IFBW
<b>Audio Outputs</b> .....	10 mW, min into 600 ohms
<b>AM/FM Audio Response</b> .....	0.1 to 15 kHz
<b>Variable BFO</b> .....	$\pm 4$ kHz in 40-Hz steps ( $\pm 2$ kHz in 20-Hz steps with SSB)
<b>ISB (Option)</b> .....	200 to 3200 Hz
<b>COR/Squelch</b> .....	Adjustable threshold to 80 dB above noise floor for selected IFBW
<b>IFBW's</b> .....	3 standard 2 additional as options (See Table 1)

\*\*Note: An order must specify the three IFBW's selected as standard.

**IF Shape Factor** ..... See Table 1  
**Temperature Range** ..... Operating 0 to 50°C  
Non-Operating -20 to 80°C  
**Power Requirements** ..... 115/230 Vac +15%, 47 to 63 Hz  
**Power Consumption** ..... 45 W nominal

### Weight & Dimensions

Height	Width	Depth	Weight
3.5 in (8.89 cm)	8.25 in (20.96 cm)	19 in (48.26 cm)	25 lbs (11.31 kg)

### Specifications for the WJ-8615P/FEX16

**Noise Figure** ..... 9.5 dB, typ; 12.5 dB, max (500 to 1100 MHz)  
**3rd-order Intercept Point** ..... 11.5 dB, typ; 14.5 dB, max (1100 to 1600 MHz)  
0 dBm, typ; -5 dBm, min (500 to 1600 MHz)  
**Image Rejection** ..... 70 dB, min (500 to 1600 MHz)  
**Final IF Rejection** ..... 75 dB, min (500 to 1600 MHz)  
**Maximum RF Input Without Damage** ..... +20 dBm

**Table I. IF Shape Factors**

Bandwidth (kHz) <sup>1</sup>	Max Shape Factor 60:3 dB BW	20 to 500 Mhz Sensitivity (dBm) <sup>2</sup>
3.2 <sup>3</sup>	3:1	-107
6.4	3:1	-107
10	3:1	-107
20	3:1	-104
50	3:1	-100
75	3:1	-98
100	3:1	-97
250	4:1	-93
300	4:1	-92
500	4:1	-90
1000	4:1	-87
2000	4:1	-84
4000	4:1	-81
8000	4:1	-78

<sup>1</sup> Consult factory for specific IFBW configurations.

<sup>2</sup> Sensitivity Conditions without preselection or frequency extender.

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

AM-- Input signal AM modulation 50% by a 1-kHz tone produces a minimum video output (S+N/N) in ratio of 10 dB.

FM-- Input signal FM modulated at a 1-kHz rate, with a peak deviation equal to 30% of the selected IFBW produces a minimum video output (S+N/N) ratio of 17 dB. (Note: A 400-Hz modulation rate is required for the 10-kHz and 6.4-kHz IFBWs, and 200-Hz modulation is required for the 3.2-kHz IFBW.)

**Table 2. Connectors**

I/O	Function	Type
Input	Antenna	N
	External Reference	BNC
	AC	3-pin IEC
Output	AM/FM video	BNC
	Phone	1/4" stereo
	Logging, handoff port	15-pin "D"
	SM or optional wideband 21.4-MHz IF	BNC
	Selected bandwidth 21.4-MHz IF	BNC
	FM monitor	BNC
Bidirectional	Remote control	IEEE-488
Other	COR	BNC

**Table 3. Options**

Nomenclature	Function	Physical Characteristics
<b>WJ-8515/FEX11</b> Frequency Extender	<ul style="list-style-type: none"> <li>● Extends tuning range from 500 up to 1100 MHz</li> </ul>	<ul style="list-style-type: none"> <li>● Completely enclosed subassemblies composed of:                             <ul style="list-style-type: none"> <li>- UHF preselector</li> <li>- UHF preamplifier mixer</li> <li>- UHF LO Synthesizer</li> <li>- RF switch</li> </ul> </li> </ul>
<b>WJ-8615P/FEX12</b> Frequency Extender	<ul style="list-style-type: none"> <li>● Extends tuning range from 500 up to 1200 MHz</li> </ul>	<ul style="list-style-type: none"> <li>● Same as WJ-8615P/FEX11</li> </ul>
<b>WJ-8615P/FEX16</b> Frequency Extender	<ul style="list-style-type: none"> <li>● Extends tuning range from 500 up to 1600 MHz</li> </ul>	<ul style="list-style-type: none"> <li>● Self-contained subassembly mounts inside the main receiver in the same space provided for the WJ-8615P/FEX11</li> <li>● Factory can retrofit standard WJ-8615Ps</li> </ul>
<b>WJ-8615P/ISB</b> Independent Sideband	<ul style="list-style-type: none"> <li>● Detects upper, lower, or both sideband signals</li> </ul>	<ul style="list-style-type: none"> <li>● 2 independent audio outputs for:                             <ul style="list-style-type: none"> <li>- upper sideband signal</li> <li>- lower sideband signal</li> </ul> </li> <li>● Automatic selection of narrowest bandwidth (a 6.4-, 10- or 20-kHz IFBW is preferred for the 1st bandwidth)</li> </ul>
<b>WJ-8615P/HFE</b> High Frequency Extension	<ul style="list-style-type: none"> <li>● Enables tuning from 2 to 500 MHz</li> </ul>	<ul style="list-style-type: none"> <li>● 15-dB typical noise figure</li> <li>● Not required with WJ-8615P/PRE</li> </ul>
<b>WJ-8615P/PRE</b> Tracking Preselector	<ul style="list-style-type: none"> <li>● Provides bandpass filtering of the RF spectrum between 20 &amp; 500 MHz</li> <li>● <i>Bypass</i> mode allows 2 to 500 MHz frequency coverage</li> </ul>	<ul style="list-style-type: none"> <li>● Nominal 10% 3-dB bandwidth</li> <li>● Preselector uses 4 separate, tunable filter bands, each covering a different segment of the overall range</li> </ul>
<b>WJ-8615P/SAO</b> Selected Audio Output	<ul style="list-style-type: none"> <li>● Provides a bus-controllable audio output from a receiver to a controller, or any device from which the receiver is remotely operated</li> </ul>	
<b>WJ-8615P/WBO</b> Wideband Output	<ul style="list-style-type: none"> <li>● Provides a leveled wideband 21.4-MHz IF output signal with a constant bandwidth of at least 4.0 MHz</li> </ul>	<ul style="list-style-type: none"> <li>● Maintains output level: -30 dBm</li> <li>● Gain control through an internal AGC circuit maintains output at <math>\pm 6</math> dB of rated level with input level changes from -75 to -5 dBm</li> </ul>