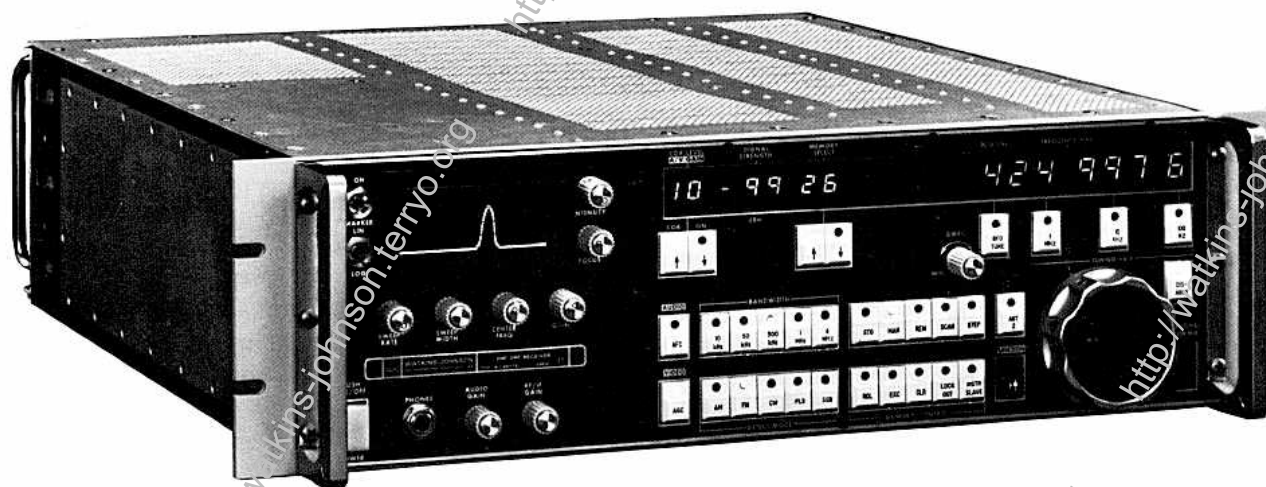


# WJ-8617B RECEIVER



## FEATURES

- Frequency Range 20-500 MHz (1100 MHz with FE Option)
- Fully Synthesized Tuning
  - 100 Hz Resolution
  - 3 msec typically between any two frequencies
  - Low phase noise
- AM, FM, CW and Pulse Detection Modes (SSB, Log Video, and Variable BFO optional)
- Optional, LOG/LIN Signal Monitor
- Modular Construction for Low MTTR
- Low RFI – Designed to MIL-STD-461A
- 5 Selectable IF Bandwidths (optional)

## DESCRIPTION

The WJ-8617B is a general purpose, cost effective, digitally controlled VHF/UHF receiver. Mounted in a standard 19" rack this receiver offers built-in automatic preselection, internal microprocessor control, multiple

remote control interface options, high dynamic range and low MTTR. The front panel permits complete control of the versatile microprocessor. The receiver will accept two selectable RF inputs and offers separate audio and video outputs as well as IF, Carrier Operated Relay (COR) and FM monitor output. Optionally available are wide band IF, signal monitor, built in test and X, Y, Z outputs for a digitally refreshed display. The receiver may use its highly stable internal reference generator or accept an input from an external 1 MHz reference.

## MODES OF OPERATION

In the manual mode the tuning and operation is as in any other receiver; however, it may store in its 16 channels of memory (96 optional) discreet parameters such as tuned frequency, IF bandwidth, detection mode, RF input selection, AFC and/or AGC on/off, and COR threshold. The receiver may also be used in the Master/Slave mode with any one of a group of WJ-8617B's being designated the controller (Master) and have complete control over the

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OCTOBER 1982

Supersedes Technical Data Sheet  
 175.50 dated October 1981  
 And Technical Data Sheet 175.75  
 dated September 1980

operating parameters of the individually addressed slave units. (Slave units may also be WJ-8619 Receivers).

These receivers may be used in a Step or Scan Mode. The parameters stored in each channel will be recalled as the unit steps through selected preset channels, stopping when a signal exceeds the COR threshold. In the scan mode it will search between operator determined, ascending presets of frequency pairs again stopping when COR is exceeded. Dwell time may be varied by a front panel control from approximately a 1.0 msec minimum to 10 seconds maximum. Post dwell may be selected with an internal switch.

## CAPABILITIES/APPLICATIONS

A high degree of flexibility is achieved in the WJ-8617B primarily because of the high powered Motorola 6800 Microprocessor. Extensive use is made of the 6800 interrupt feature enabling the internal system to quickly respond to hardware circumstances without wasting time continually checking status. To make intelligent decisions possible within the receiver, analog and digital information is supplied from various receiver substations. This, in combination with complete control of the RF and synthesizer sections, allows sophisticated algorithms to perform complex functions such as SCAN and AFC without operator intervention once the command is initiated.

For example, the receiver is commanded to SCAN and AFC is manually activated. The SCAN mode allows a rapid search in an unknown RF environment through operator entered bands of interest, stopping at all signals which exceed the operator preset COR threshold. The receiver scans in steps of one half the selected IF bandwidth; thus when energy is detected it is unlikely that a signal will be centered in the IF bandpass. Because AFC is "on" the synthesizer will retune to center the signal enabling full intelligence to be recovered. Alternately if the signal is unwanted it may be locked out at precisely its center frequency. This Lock-Out function permits the exclusion of selected frequencies from the SCAN to prevent the receiver from repeatedly stopping on these signals in subsequent scans.

Customers with unique requirements will find tailoring the WJ-8617B generally involves little more than internal software changes to implement solutions heretofore necessitating a small system under computer control. One such tailored package might be specified spectrum sampling to ascertain polarization characteristics of signals exceeding a certain power level. Another example may be Audio Countermeasures. Detection of an unknown emitter first requires identification and logging of known phenomenon in the RF spectrum; to accomplish this many discreet

frequencies must be cataloged. Here the memory may be allocated with a few bytes per channel thus giving over 1000 "channels" of memory. The basis for such an approach would be to scan a selected spectrum, lock out known emitters and "alarm" on any new emission.

Yet another example would be a pan or sector or "pan/sec" scan. Again this can be implemented with software changes. Once implemented one WJ-8617B could replace a larger, heavier, costlier panoramic type receiving system and generally offer more sophisticated signal processing, further decreasing the need for peripheral equipment.

The above offers a few possibilities for "custom receiving", it should however be noted that an extensive array of off-the-shelf options encourage expanded system application without tailored software. Available options include: several digital I/O possibilities, SSB, variable synthesized B.F.O. (V.B.F.O.) and others. Please see "Options" descriptions beginning on page 6.

## FUNCTIONAL DESCRIPTION

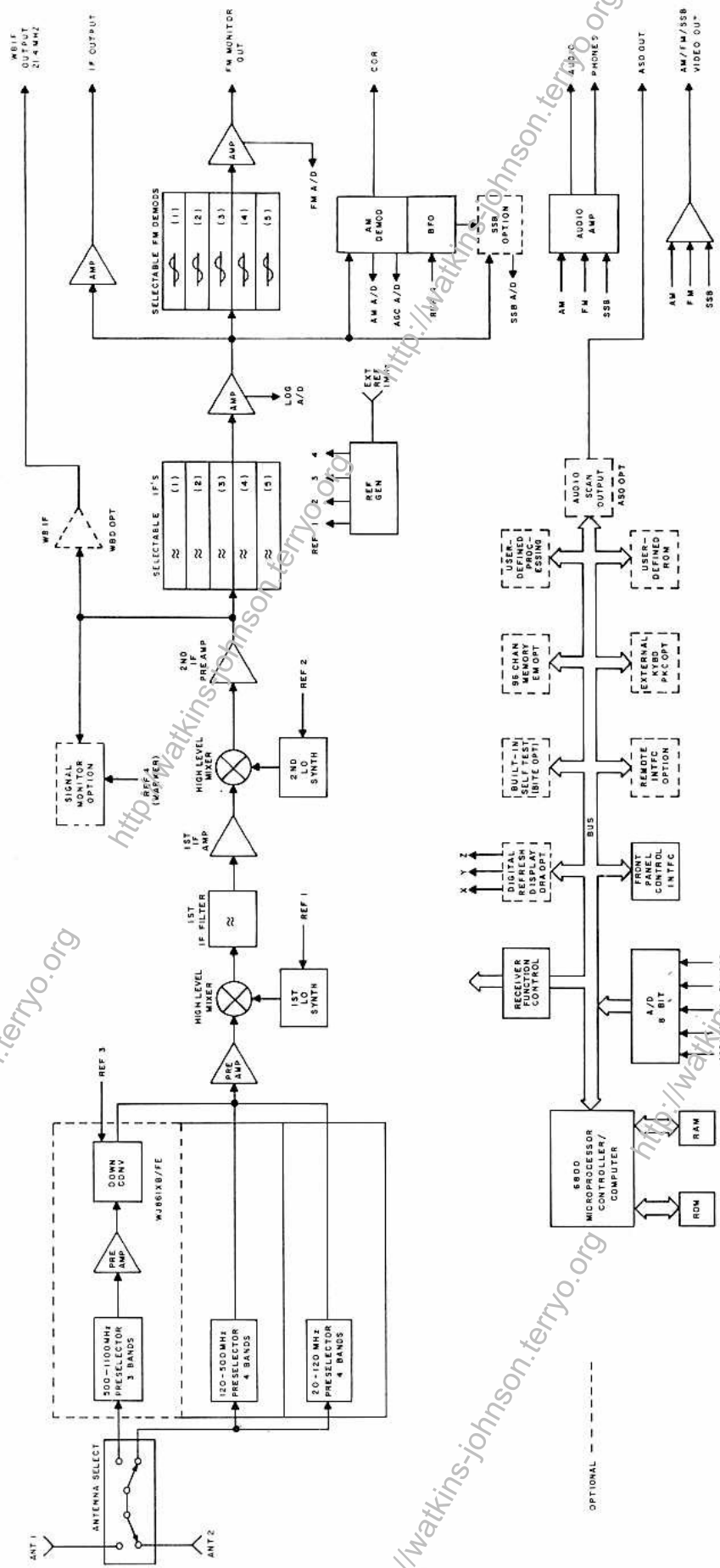
A simplified receiver block diagram is shown in Figure 1. Referring to Figure 1, the VHF portion of the receiver incorporates an eight-band suboctave preselector between 20-500 MHz, improving 2nd order intermodulation performance and spurious signal rejection. The 500-1100 MHz range is tuned with three additional preselectors and down-converted to 450-250 MHz and processed as VHF.

The first mixer converts the 20-500 MHz RF signal to 551.5 MHz with a first LO covering the frequency range 572-1052 MHz. This LO is synthesized in 1-MHz steps. Typical performances are depicted in Figure 2. The first IF Bandwidth is approximately 8 MHz wide. This allows wide IF Bandwidth responses while still providing good selectivity. The double-balanced first mixer holds intermodulation products to a minimum. The second mixer converts the 551.5 MHz IF to 21.4 MHz.

The second LO tunes 529.6 to 530.6 MHz in 100 Hz steps. The tuning speed of both the first LO and second LO is typically 5 ms (see Figure 2) allowing the receiver to quickly scan or step to each frequency.

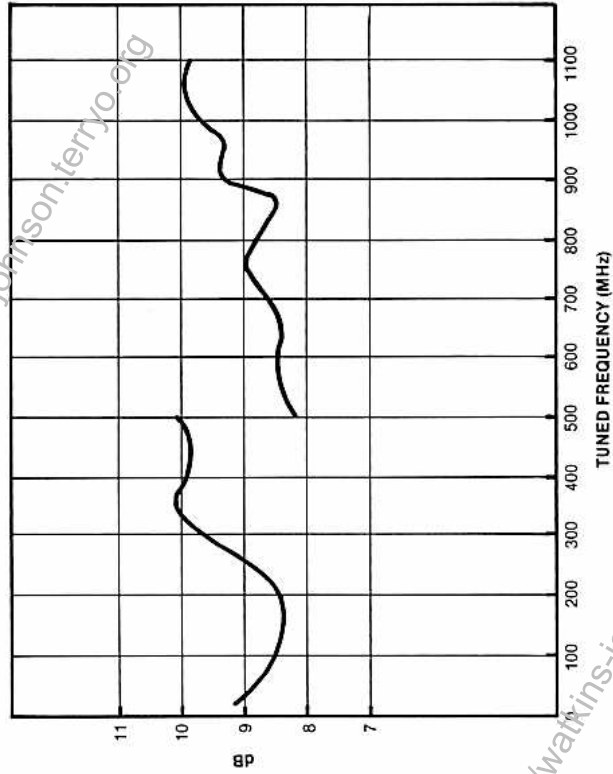
Up to five IF bandwidths with matching frequency discriminators can be customer-selected ranging from 10 kHz to 4 MHz. The fifth IF bandwidth position must be configured with a bandwidth of 500 kHz or greater. The single sideband option may also be installed which adds USB and LSB filters to the receiver.

Processing after final IF filtering includes a 40 dB range log IF, AM detector, and AGC range of 100 dB, AGC and simultaneous AM and FM video processing.

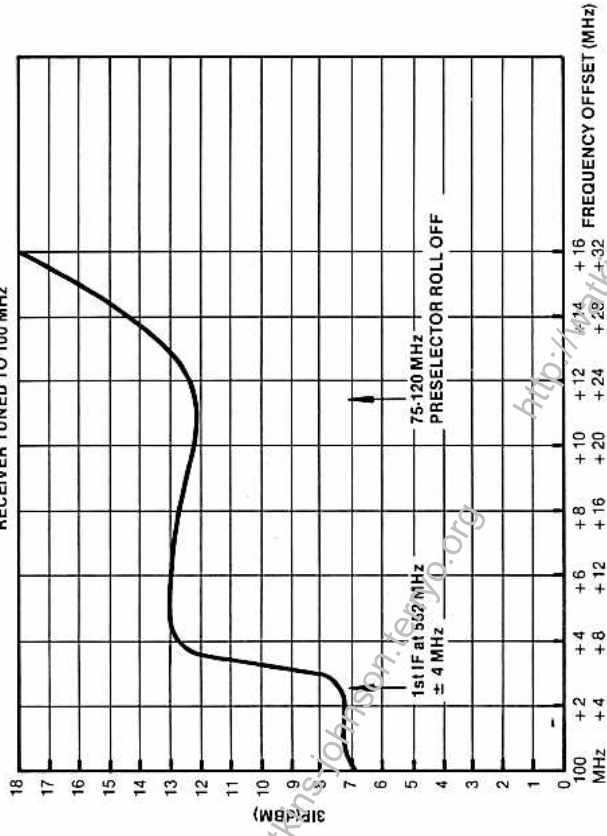


Figures 1  
WJ-8617B Receiver  
Simplified Block Diagram

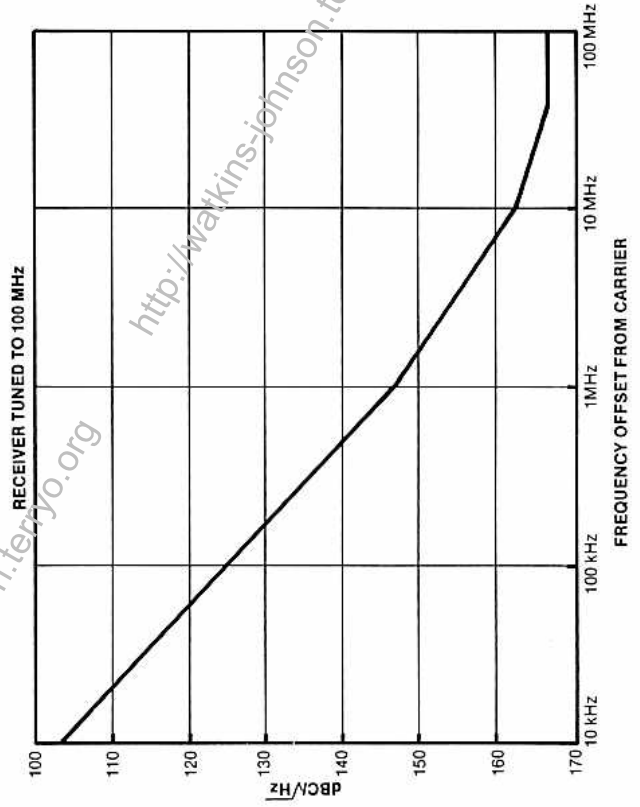
WJ-8617B NOISE FIGURE



WJ-8617B 3RD ORDER INTERCEPT VERSUS OFFSET FREQUENCY  
RECEIVER TUNED TO 100 MHz



WJ-8617B PHASE NOISE



WJ-8617B SYNTHESIZER LOCK UP TIME

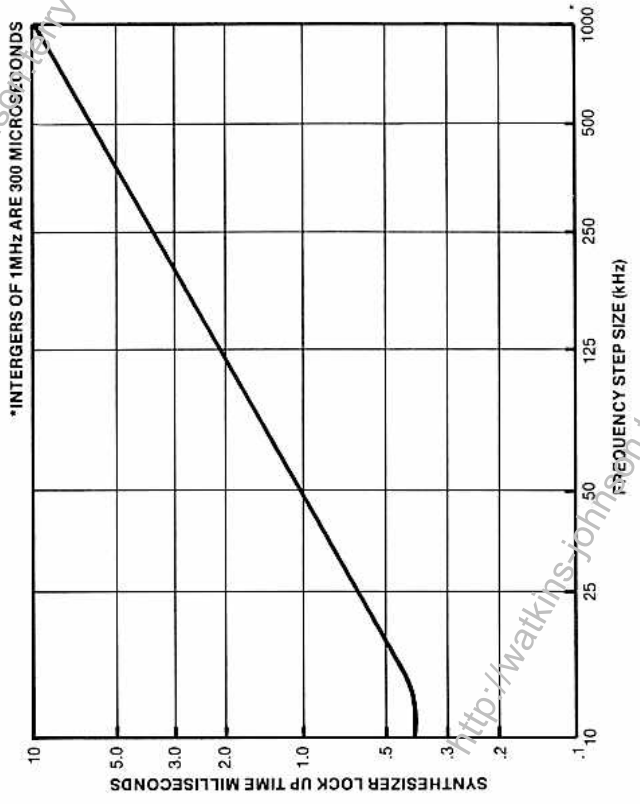


Figure 2  
Typical Performances

# SPECIFICATIONS

Frequency Range:	
WJ-8617B .....	20 - 500 MHz
WJ-8617B (with FE option) .....	20 - 1100 MHz
Detection Modes .....	AM, FM, CW and Pulse standard; Variable BFO and SSB optional (other modes are available on special order)
Tuning Scheme .....	Frequency synthesized local oscillators locked to internal reference
Reference Accuracy .....	1 part in $10^{-7}$ or external 1 MHz reference input.
Tuning Resolution .....	100 Hz
Synthesizer Tuning Speed .....	3 msec typical, 10 msec maximum.
Input Impedance .....	50 $\Omega$
Input VSWR .....	2.5:1 Typical
	3.0:1 Maximum
Noise Figure .....	9.5 dB typical, 11 dB maximum
Third Order Intercept Point .....	+8 dBm typical +3 dBm minimum (20-500 MHz)
	0 dBm typical, -5 dBm minimum (500-1100 MHz)
Second Order Intercept Point .....	+50 dBm, minimum,
Ultimate FM S+N/N .....	40 dBm minimum in 50 kHz BW
Oscillator Phase Noise (20 kHz from the carrier) .....	-105 dBc typical
Preselection .....	Automatically switched, suboctave (1.66:1) bandpass filters
LO Radiation .....	-100 dbm typical;
Image Rejection .....	90 dB minimum
IF Rejection .....	90 dB minimum
Internal Spurious .....	Equivalent to -115 dBm maximum at the RF input
Reciprocal Mixing .....	With an input signal at a rated sensitivity level; an out-of-band signal removed 350 kHz in the 20 kHz IF bandwidth at a level of 70 dB above rated sensitivity will not degrade the desired output signal ratio (S + N)/N by more than 3 dB
Final IF .....	21.4 MHz, -30 dBm Nominal Output Level
IF Bandwidths .....	5 IF Bandwidths. At least one IF bandwidth must be installed for receiver operation. (To be selected from Table 1)
	Note: 5th IF BW position must be 500 kHz or greater.
IF Shape Factor .....	See Table 1

TABLE 1

Bandwidth (kHz)	Max Shape Factor 3:60 dB BW	20-1100 MHz Sensitivity (dBm)†
6	3:1	-105
10	3:1	-104
20	3:1	-101
50	3:1	-97
75	3:1	-95
100	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

15 kHz, 30 kHz and 40 kHz also available on special order.

†Sensitivity Conditions:

AM - Input signal AM modulated 50% by a 1 kHz tone, will produce a minimum video output (S + N)/N ratio of 10 dB.

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

AM Stability .....	6 dB maximum from AGC threshold to a level 100 dB above AGC threshold (maximum input -5 dBm)
--------------------	--



Switched Video Output . . . . .	1 volt peak to peak; nominal, into 91 ohm load for FM with peak frequency deviation at 30% of the IF Bandwidth and AM with 50% modulation. DC coupled for FM and AM
FM Monitor . . . . .	DC coupled FM output, 1 volt peak to peak minimum, into 91 ohm load
Video Amplifier Frequency Response . . . . .	DC to $\approx 1/2$ IF Bandwidth for FM Monitor; DC to $\approx 1/2$ IF Bandwidth for AM/FM switched video output
Line Audio Output . . . . .	10 mW, minimum, into 600 ohms for 50% AM or FM peak frequency deviation equivalent to 30% of the IF bandwidth
Audio Amplifier Distortion . . . . .	2.5% typical, 3% max
COR/Squelch . . . . .	Adjustable threshold from noise level to approximately 40 dB above noise. COR provides 100 mA current "sink-to-ground" for switching; +24 Vdc maximum external voltage (External current limiting must be provided)
<b>Signal Monitor: (optional)</b>	
Sweep Width . . . . .	0 - 4 MHz continuously adjustable
Resolution . . . . .	10 kHz
Sweep Rate . . . . .	Adjustable to 15 - 25 Hz
Marker . . . . .	Center frequency (locked to receiver frequency standard)
Display . . . . .	Lin/Log
CRT . . . . .	1 x 3 inches nominal dimensions
PAN . . . . .	Provides pan display during SCAN mode with optional digitally refreshed display (DRD)
<b>Temperature Range:</b>	
Operating . . . . .	0°C to 50°C
Non-Operating . . . . .	-20°C to 80°C
Power Requirement . . . . .	110, 120/220, 240 Vac, 47 - 400 Hz, 100 watts nominal
Dimensions . . . . .	19-inch rack mount, 18 inch depth, excluding connectors and handles, and 5.25 inch panel height
Weight . . . . .	50 pounds, approximately

**Receiver Inputs/Outputs:**

- Antenna Input (Type N)(2)
- External Reference Input (BNC)
- Optional Tuning Input (Front-Panel)
- Optional Remote Control In/Out (IEEE-488)(RS-232C) (MIL-STD-188C)
- Optional Wideband 21.4 MHz IF Output (BNC)
- Selected Bandwidth 21.4 MHz IF Output (TNC)
- COR (BNC)
- Optional Log Video (BNC)
- FM Monitor Output (BNC)
- AM/FM Video Output (BNC)
- Audio Output (600Ω BNC, Rear-Panel Adjustable)
- Phone Output (Front-Panel, Front-Panel Adjustable)
- Optional Display X-Y-Z Outputs (BNC)
- AC Input
- Connectors as required for options ASO/DFC/RLOG

**OPTIONS:**

**WJ-861X/MS – Master/Slave**

The Master/Slave function permits the control of up to 29 additional Master/Slave equipped receivers, utilizing the front panel controls of one of the receivers. Each receiver must be equipped with an IEE-488 Interface. Switch #6 of the DIP switch on the IEE-488 must be in position on each receiver and the remaining 5 switches are set to a binary number between 0 and 30 to designate the receiver address. Only one receiver can function as the master unit at a given time and the remaining receivers function as slave units when addressed.

**WJ-861X/LOC – Lockout includes extended memory**

Scan Lock-out is an optional function that is available when the Extended Memory option (EM) is incorporated in the receiver. This function permits the exclusion of selected signals from the scan to prevent the receiver from locking onto undesired signals. Lock-out data is stored in the higher order memory channels, in ascending order, according to frequency (channel 95 will store the highest lock-out frequency). The channel recall and deletion mode permits the recall and display of the information stored in the lock-out channels. It also permits revision of lock-out memory by permitting the deletion of channels where lock-out is no longer desired. To activate the Recall mode, the receiver

must be in either Scan Continue or Manual mode of operation.

**WJ-861X/RLOG – Record Logging**

The RLOG option extends the capabilities of the Scan and Step modes of operation by permitting all signals, in excess of the programmed COR level, to be automatically classified and logged. Whenever the Scan or Step mode is initiated, the logging function is automatically activated to provide signal data to an external logging device (CRT or printer), via a rear panel LOGGING connector. When first activated, the receiver will output data, giving the receiver parameters stored in each of the memory channels, programmed for the Scan or Step operation. In the Step mode, one line is printed for each programmed memory channel and in the Scan mode, one line is printed for each pair of memory channels. Then each time a signal greater than the programmed COR level is detected, a line will be printed giving the signal frequency, cycle, signal strength, type of modulation, and the percent of AM and FM modulation present on the signal. The cycle number corresponds to the number of times that the receiver has gone through the the scan or step sequence and the type of modulation is classified as: AM, FM, CW or "???" (unable to determine due to more than one type of modulation).

Channels which have previously been locked-out (option) are not output.

#### **WJ-861XB/BITE – Built-In Test Equipment**

The Built-In Test option (BITE) performs nineteen operational tests on the receiver and compares the test results with limits contained in the BITE memory. If the results of any of the tests are outside of the specified limits, the test sequence will stop and an "E" will be displayed on the front panel of the receiver. The number of the failed test will be displayed in the MEMORY SELECT window and, where relevant, a relative number, representing the results obtained from the test, will be displayed in the SIGNAL STRENGTH window. When applicable, the frequency and bandwidth where the failure occurred will also be displayed. If all of the tests are within the specified limits, the word END will appear in the FREQUENCY window, indicating that the receiver is fully operational. BITE is fully remote controllable.

#### **WJ-861X/SM – Signal Monitor**

The signal Monitor (SM) allows the operator to see spectrum activity out to  $\pm 2$  MHz around the tuned frequency. A marker locked to the reference frequency is provided for center tuning. The sweep rate is adjustable and the resolution is 10 kHz. The display is 1 by 3 inches and has a 40 dB log range or linear mode. During receiver Scan mode the SM is in a PAN display if the DRD option is installed.

#### **WJ-861XB/PKC – Plug-in Key Control**

The Plug-in Keyboard option (PKC) provides a means of rapidly inputting frequency information into the receiver. The keyboard plugs into the existing optional tuning connector on the receiver front panel and permits receiver tuning, memory programming and the initiation of lock-out channels.

#### **WJ861X/DRD – Digitally Refreshed Display**

With this option incorporated, the receiver microprocessor is capable of providing a signal strength-versus-frequency plot on the signal monitor or an external display. The horizontal and vertical information is made available to the external equipment via the X OUT and Y OUT BNC connectors on the receiver rear panel.

#### **WJ-861X/CUR – Cursor**

Cursor is an optional mode of operation that is available when the Digital Refreshed Display and an active Function (F $\uparrow$ ) pushbutton are installed. In this mode, a portion of the RF spectrum can be scanned with a signal strength vs. frequency display of the scanned frequencies displayed on the signal monitor of the receiver. The tuning knob can then be rotated to position a cursor over any of the signal pips displayed on the signal monitor. When the cursor is positioned over the signal pip, the frequency of that signal is displayed in the frequency window of the digital display.

#### **WJ-861X/ASO – Audio Scan Output**

The Audio Scan Output option (ASO) provides an audio frequency output that is representative of the tuned frequency of the WJ-8617B receiver. The output frequency varies linearly from 200 Hz (when start is tuned) to 11 kHz (when stop is tuned). This provides an audible tone up to one hundred thousandth of the tuned RF Frequency. A DC level scan is also provided via an internal switch.

#### **WJ861XB/FE – 500-1100 MHz Frequency Extension**

The UHF Frequency Extender option (FE) will extend the frequency range from 500 to 1100 MHz. The option consists of a UHF preselector, and UHF preamp/mixer and a 4 band LO module.

#### **WJ-861XB/SSB – Single Side Band**

This module provides both upper sideband and lower sideband detection along with special AGC characteristics. Selection of the narrowest bandwidth is automatic and a 6 kHz IF bandwidth is preferred. Lower (L) or upper (U) sideband selection is shown in the display window when the

SSB Key is depressed.

#### **WJ-861XB/MFS – Main Frame Spares**

The Main Frame Spares Kit (MFS) contains all the plug-in modules of the WJ-861XB, less options, and includes power supply spare parts. Option spares must be ordered separately. This list typically supports receiver operation for a one year period.

#### **WJ-861X/VBFO – Variable BFO**

This option installs in place of the standard BFO sub-assembly, (A4A5) and provides an operator-controllable BFO frequency, during CW operation. The frequency can be varied by  $\pm 7.99$  kHz about a 21.4 MHz center, in 10 Hz steps. In addition to the BFO output, 32.1 MHz and 10.7 MHz outputs are provided, for use when the Single-Sideband option (SSB) is incorporated.

#### **WJ-861XB/DAV – Digital Audio/Video**

This option permits the operator to adjust the output video and audio level from the front panel over a 30 dB range. The audio or video level is shown on the COR window. DAV is also remotely controllable.

#### **WJ-861XB/LOGV – Log Video Detection**

A zero to plus eight volt level into a 600 ohm load is supplied at a rear panel connector when the input signal rises above the noise floor by 60 dB.

#### **WJ-861X/IFBW – IF Band Width**

IF Band Widths with matching discriminators available are: 6 kHz, 10 kHz, 15 kHz, 20 kHz, 30 kHz, 50 kHz, 75 kHz, 100 kHz, 250 kHz, 300 kHz, 500 kHz, 1 MHz, 2 MHz, and 4 MHz. Up to 5 bandwidths can be selected if one bandwidth is 500 kHz or greater. Special group delay equalized filters of 400 kHz, 800 kHz, and 1 MHz are also available for noise power ratios of greater than 40 dB.

#### **WJ-861X/EM – Extended Memory**

The RAM option (EM) extends the capabilities of the receiver by providing an additional 1536 bytes of Random-Access-Memory. This option, along with the microprocessor standard memory, provides up to 96 operator programmable memory channels for use in the Step mode and up to 48 frequency bands in the Scan mode. Also available is a real time clock for use with RLOG.

#### **WJ861X/488 – IEEE 488 Digital Interface**

The IEEE-488 Interface option (488) provides remote capabilities for the receiver by interfacing with a large array of compatible instruments. The 488 option provides talk and listen capabilities between the receiver and external equipment such as calculators, microcomputers, or other IEEE-488 equipped receivers (when at least one of the receivers is equipped with an IEEE-488 Bus Controller). The data is transferred between units in bit-parallel, byte serial form, permitting rapid data transfer.

#### **WJ-861X/232 – RS 232C Digital Interface.**

The RS-232 Asynchronous Interface bus is a standardized interface used to interface with computer peripheral equipment, such as computer terminals and line printers. It is available as an option for all of the receivers in the WJ-861X-series. The 232 option provides remote capabilities for the WJ-8617B receiver and permits the receiver to function as part of a system by providing TALK/LISTEN capabilities.

#### **WJ-861X/ROM – Extended Read Only Memory**

The extended EPROM option is available for all receivers. This option consists of four EPROM'S each providing 2048 memory locations, or a total of 8 k bytes of memory space. This Read-Only-Memory stores additional software to permit expansion of the microprocessor program. The EPROM option can also be programmed to perform special tasks, as defined by the user. These special functions can include recognition of specific signal characteristics, perform special subroutines, etc.

### WJ-861X/WBO – Wide Band IF Output

The WBO option module mounts to the underside of the receiver and provides an output to a WBO connector (J20) mounted on the receiver rear panel. With this option incorporated, a sample of the 21.4 MHz IF signal is provided to the rear panel for use by external equipment. The WBO module contains its own AGC circuitry which provides a constant -30 dBm signal level with a 4 MHz bandwidth. A gain control and an AGC control on the WBO circuit board permit adjustment of the output level and the AGC thresh-

old. Without WBO, the WB IF output level is 15 dB above the RF input.

### WJ-861XB/NRT – Noise Riding Threshold

Noise-Riding-Threshold (NRT) measures the ratio of a signal carrier level with the RF background noise and activates the audio and COR outputs when the operator selected threshold is exceeded. This circuitry has a threshold adjustment range of 20 dB that is set using the COR Up/Down pushbuttons on the receiver front panel.

Cross Reference Option																							
Chosen Option	L O C	M S	C U R	R L O G	B I T E	V B F O	P K C	D R D	E M	4 8 8	2 3 2	W B O	A S O	F E	S S B	S M	D A V	N R T	D F C	S M	I F B W	L O G	
LOC	X								I														
MS		X								R													
CUR			X					R															
RLOG				X	C						R		E							C			
BITE				C	X								C							C			
VBFO						X																	
PKC							X																
DRD								X													R		
EM									X														
488										X	E												
232				E						E	X												
WBO												X											
ASO				E	C								X							C			
FE														X									
SSB															X							S	
SM																X							
DAV																	X	E					
NRT																	E	X					
DFC				C	C								C	R						X			
SM																					X		
IFBW															S							X	
LOGV																							X

C = Consult factory to use cross reference option

E = Chosen option excludes cross reference option

I = Chosen option includes cross reference option

R = Chosen option requires cross reference option

S = Chosen option suggests minimum IFBW of 6 kHz

**I CAN TELL YOU MORE!  
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