

# WJ-8628A-4 VHF/UHF MASTER ACQUISITION RECEIVER



### FEATURES

- 20 to 512 MHz Frequency Coverage (20 to 1400 MHz With FE Option; 20 to 2000 MHz with FE2 Option)
- Fully Synthesized With 100 Hz Tuning Resolution
- AM, FM, CW, SSB, Pulse Detection Modes
- Microprocessor Front Panel With Indicating 48-Character LCD Display
- Full Local or Remote Control
- Memory Channel Scan Operations (F1 - F2 Optional)
- Master/Slave Operation With Up to 34 WJ-862X-1 Intercept and Monitor Receivers
- All Front Panel Functions Fully Compatible With WJ-862X-4 Series Companion VLF and HF Receivers

## DESCRIPTION

The WJ-8628A-4 is a microprocessor controlled VHF/UHF Acquisition Receiver packaged in a one-half rack configuration. The receiver is fully functional when mounted in a WJ-9040 EFR100 as part of a WJ-9040 Sub-system. The basic unit is capable of continuous coverage of RF activity in the 20 to 512 MHz frequency range with tuning resolution as fine as 100 Hz. Optional frequency extenders are available which expand the range, allowing coverage of the entire 20 to 2000 MHz spectrum.

The WJ-8628A-4 inherits its RF performance from the WJ-8628A-1 One-Quarter Rack Receiver which, in its entirety, is packaged inside of the WJ-8628A-4 Receiver unit. Five selectable IF bandwidth filters are provided in the range of 2.85 kHz to 8 MHz. AM, FM, CW, SSB (with 2.85 kHz IF BW) and Pulse detection modes are standard. The internal tracking RF preselector enhances the RF performance of the WJ-8628A-4, yielding a high third order intercept point (+3 dBm, typical), 80 dB of IF and Image rejection, and less than -100 dBm LO radiation, while maintaining a low noise figure of 9 dB, typical.

The front panel and control sections have been designed

to enhance operator effectiveness through simplicity of control. All functions are accessible with a minimum of keystrokes. A numeric key pad allows direct, random access entry of frequency commands, BFO setting, and squelch threshold (COS). The 48-character LCD display presents operating parameters and status using both alphanumeric and graphic display formats. Operator aids have been built into the display firmware which assist the operator during sequences such as scan table setup routines, and which provide prompts when an entry is erroneously entered. Dedicated push buttons are used for commonly used functions such as detection mode, IF bandwidth, and gain mode. Additional, dual function keys are employed to facilitate control of memory channels, scan table setup, and for effecting control of handoff/slave receivers.

Inside the WJ-8628A-4, space has been allocated for options which include: a 500 to 1400 MHz Frequency Extender (FE), a 500 to 2000 MHz Frequency Extender (FE2), a Digitally Refreshed Display (DRD) option, and Noise Riding Threshold (NRT) circuitry.



Figure 1  
WJ-8628A-4 and WJ-8626A-4 In a 5 kHz to 2000 MHz  
Dual Receiver Configuration

## CONTROL MODES

The WJ-8628A-4 is capable of operating in three distinct control modes:

1. **LOCAL MODE**—In this mode, the local operator has complete control of the WJ-8628A-4 through the microprocessor based digital front panel. All receiver modes, i.e., frequency, IF bandwidth, detection modes, etc., may be manipulated. In addition, the local operator may access available memory which allows channel scan of up to 99 preprogrammed memory channels and optional

frequency (F1-F2) sectors scan routines. These routines can be set up, initiated, and monitored locally.

2. **REMOTE MODE**—Complete remote control is provided via either IEEE-488 parallel or RS-232 serial interface formats. Through the interface port, an external processing device, such as a computer, may control and monitor all parameters and status of the receiver using simple ASCII mnemonics. This includes loading memory channels and activating scanning routines.

3. MASTER/SLAVE MODE—One of the more unique features of the WJ-8628A-4 Receiver is its ability to perform as a receiver controller. In this capacity, the WJ-8628A-4 can control and monitor up to 34 WJ-9040 system-compatible VLF/HF/VHF/UHF handoff and monitor receivers. The graphic display on the front panel

of the WJ-8628A-4, in conjunction with the bidirectional control scheme, allows the operator to easily switch control from one receiver to another. Through common control firmware, the operating sequences and display data are always consistent, appearing as though the selected receiver were behind the front panel.

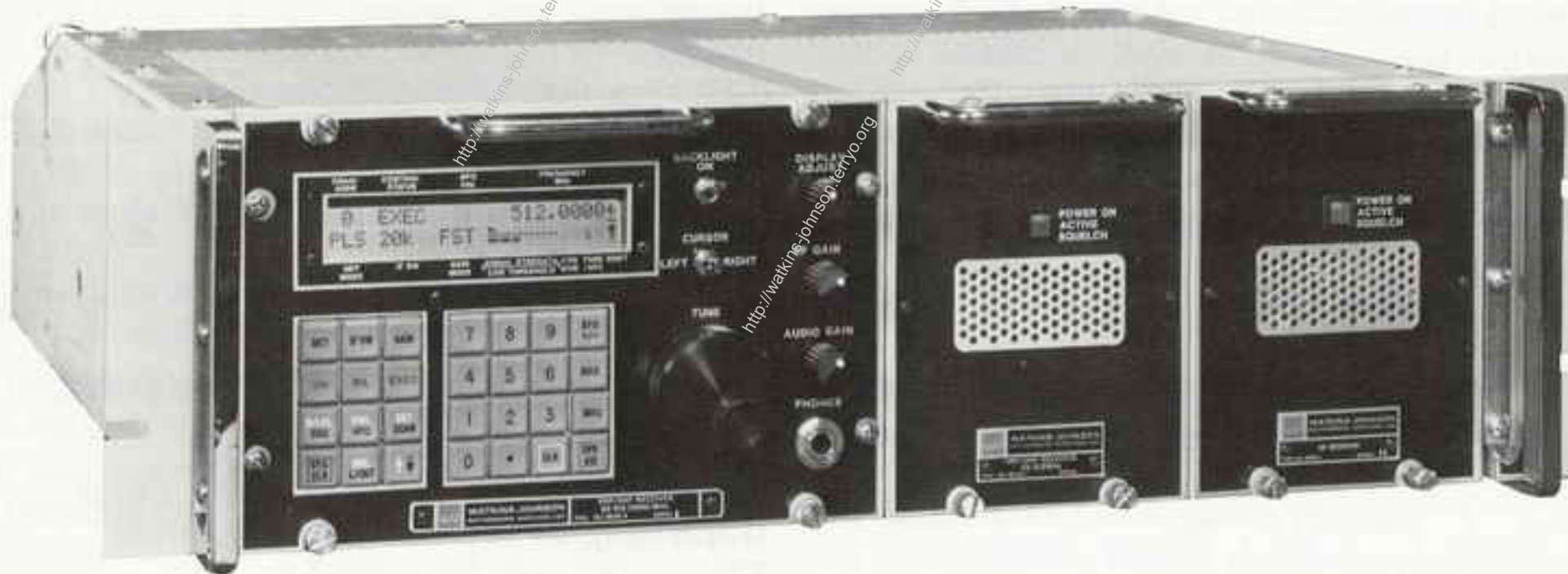
## CAPABILITIES AND APPLICATIONS

The flexibility and performance of the WJ-8628A-4 Receiver, coupled with its compact size and low power consumption, combine to make it suitable for a variety of applications.

The WJ-8628A-4 may be easily configured with other WJ-9040 receivers to form a number of distinct subsystems, each tailored to meet specific operational requirements. Highly effective signal intercept, collection, and monitor systems may be realized in a cost effective manner, while working within stringent space and power constraints. Figure 1 depicts a single equipment frame HF through UHF acquisition and monitor system capable of continuous 5 kHz to 2000 MHz frequency coverage. Identical operator interface exists between the two one-half rack receivers, thus enhancing operator efficiency. Frequency entry, order of operations, scan routine setup, etc., are consistent throughout both units. Due to the onboard microprocessor and memory located in each receiver, simultaneous scan routines are permitted. In the baseline configuration, a total of 300 memory channels are available in this single equipment frame.

The subsystem pictured in Figure 2 consists of the WJ-8628A-4, a WJ-8628A-1 (20 to 512 MHz) Intercept and Monitor Receiver, and a WJ-8626A-1 (5 kHz to 30 MHz) Intercept and Monitor Receiver. This configuration provides 5 kHz to 2000 MHz frequency coverage with three independent, full function receiver channels, each optimized for their respective frequency bands. A total of 15 IF bandwidth filters, ranging from 200 Hz to 8 MHz, can be included in the system. The one-quarter rack receivers may be used to extend the frequency range or for double-demodulation purposes.

Because of the inherent flexibility of the WJ-9040 System and its components, the WJ-8628A-4 may be used with a variety of components, including receivers and other peripheral equipment, to fill the needs of many types of requirements. Resulting systems can range in size from single frame subsystems, as described herein, to configurations as large as eight equipment frames.



**Figure 2**  
WJ-8628A-4 Configured With a WJ-8628A-1 and WJ-8626A-1 In a  
5 kHz to 2000 MHz Master/Slave Subsystem

## SPECIFICATIONS

Frequency Range.....	20 to 512 MHz (1400 MHz with FE option; 2000 MHz with FE2 option)
Tuning Resolution .....	Selectable decades, 100 Hz to 100 MHz
BFO .....	21.4 MHz $\pm$ 4 kHz to 10 Hz steps
Detection Modes.....	AM, FM, CW, SSB, Pulse
Reference Frequency Stability.....	$\pm$ 1 ppm from 0 to 50°C $\pm$ 3 ppm per year (using reference from WJ-9040 SRM105A Site Reference Module)
Tuning Speed.....	5 msec, typical 10 msec, maximum to within 100 Hz
Phase Noise.....	-100 dBc/Hz at 10 kHz offset (see Figure 5)
Image Rejection.....	80 dB (20 to 512 MHz) 60 dB (500 to 1400 MHz), FE 80 dB (500 to 2000 MHz), FE2
IF Rejection.....	80 dB (20 to 512 MHz) 70 dB (500 to 1400 MHz), FE 80 dB (500 to 2000 MHz), FE2
Noise Figure.....	9 dB typical, 10 dB maximum (20 to 512 MHz) 11 dB, typical 13 dB maximum with FE and FE2 options
Input VSWR.....	2.0:1, typical; 3.0:1 maximum
Input Impedance.....	50 ohms, unbalanced
Third Order Intercept Point.....	+3 dBm typical, 0 dBm minimum (20 to 512 MHz) 0 dBm, typical, -5 dBm minimum (500 to 2000 MHz)
Second Order Intercept Point.....	+50 dBm
Preselection .....	Voltage tuned filters at 10% (nominal) RF frequency (20 to 512 MHz) Suboctave (500 to 2000 MHz)
LO Radiation.....	-100 dBm, -90 dBm (500 to 2000 MHz)
Internal Spurious.....	-115 dBm, equivalent RF Input
IF Bandwidths.....	5 selectable (See Table 1, WJ-9928A-X)
IF Shape Factor.....	See Table 1
IF Output.....	21.4 MHz, -20 dBm nominal at sensitivity level
Signal Monitor Output.....	21.4 MHz, 6 MHz nominal BW
AM Stability With AGC.....	6 dB change from AGC threshold to 100 dB above threshold (maximum -10 dBm)
Manual Gain Control.....	100 dB
AGC Range.....	100 dB
Video Output.....	0.35 V rms nominal into 75 ohms
Video Response.....	DC to 1/2 selected IF BW (FM) 200 Hz to 1/2 IF BW for AM
Audio Response.....	200 Hz to 10 kHz, 1.25 V rms into 600 ohms at sensitivity
Squelch (COR) Range.....	Noise level to 50 dB above noise. COR hold for approximately 4 seconds after signal drops
Scanning .....	F1 - F2 (Optional) five sectors Memory Scan: 99 channels
Weight .....	21 lbs. (9.66 kg) including FE option
Size .....	5.25 inches high (132.1 mm), 8.0 inches wide (101.6 mm), 14.38 inches deep (365.3 mm)
Power Consumption.....	22 watts DC (with FE option)
Input Power Requirements.....	+29, +18.3, -18.3, +8.2 VDC supplied by the WJ-9040 EFR100
External Frequency Reference.....	50 MHz sinewave at 0 dBm from WJ-9040 SRM105A Phase Noise: -115 dBc/Hz, 100 Hz offset -145 dBc/Hz, 10 kHz offset

## FUNCTIONAL DESCRIPTION

A simplified block diagram of the WJ-8628A-4 is shown in Figure 3. The RF input signal (20 to 512 MHz) is filtered by a voltage tuned preselector, presenting a nominal 10% bandwidth. The RF module is of a dual conversion design. For an RF input of 20 to 275 MHz, the first IF frequency is 326.6 MHz and finally converted to 21.4 MHz with use of a 305.2 MHz second Local Oscillator (LO). RF inputs in the 275 to 512 MHz range are converted to a 1st IF of 126.6 MHz and then converted to 21.4 MHz with a 105.2 MHz second LO.

The 1st and 2nd LO's are synthesized from a 50 MHz reference provided by the SRM105A Site Lockable Frequency Reference installed in the equipment frame. The 1st LO tunes in 200 kHz steps and fine resolution of 100 Hz is provided by the 2nd LO.

A 21.4 MHz signal monitor (SM) output is provided at a nominal level of 5 dB above the incoming RF level. The 21.4 MHz IF is routed out of the RF module to the IF module through a coax cable.

In the IF module the IF is first amplified then filtered according to the selected IF bandwidth. Post-filtered detection of AM, FM, CW, SSB and Pulse are accomplished as shown to provide the desired audio, video and predetected IF output. The IF module can house up to five IF bandwidth filters. Each IF bandwidth set is comprised of an IF filter and FM demodulator. The BFO, generated in the synthesizer module, is used for SSB and CW detection and has a range of  $\pm 4$  kHz with 10 Hz resolution. This BFO is routed to the IF module over a coaxial cable.

The 500 to 1400 MHz FE option consists of a Synthesizer module and an RF module (see Figure 3). The Synthesizer module generates a 800 MHz or 1000 MHz LO derived from the 50 MHz reference provided by the WJ-9040 SRM105A. The RF module first filters the incoming RF using four suboctave filters. The RF is then amplified and mixed with either the 800 MHz or 1000 MHz LO. The resulting IF is either 100 MHz to 300 MHz or 100 MHz to 400 MHz, depending on the RF input fre-

quency. The output of the RF module is then routed to the 20 MHz to 512 MHz tuner section of the receiver. The 20 MHz to 1400 MHz input is through a single SMA-type connector, but can be simply reconfigured to break that spectrum into two bands (20 MHz to 500 MHz and 500 MHz to 1400 MHz).

A 500 to 2000 MHz option (FE2) is also available as shown in Figure 4. The synthesizer circuit generates 880, 960, 1200, 1360, and 1520 MHz LO's from the 50 MHz reference provided by the WJ-9040 SRM105A. The RF circuit provides suboctave filters for preselection as shown in Figure 4. The RF is mixed with the appropriate LO frequency to create a resulting IF frequency between 235 MHz and 512 MHz. The LO frequency is switched ten times as the RF frequency is tuned from 500 MHz to 2000 MHz. The 235 to 512 MHz IF output is routed to the RF input of the 20 to 500 MHz RF module of the WJ-8628A Receiver. The 20 to 2000 MHz RF input to the FE2 is a single SMA-type connector.

Figure 5 provides a graph of the excellent SSB phase noise of the basic receiver and the phase noise of the receiver with the FE and FE2 options installed.

Local control of the WJ-8628A-4 is achieved through a full function front panel head and an accompanying Display/Control Module. The Control Module also provides interface to the WJ-9040 Equipment Frame through the backplane receptacle, and to an external controller through RS-232 or IEEE-488 Interface formats. For control within the WJ-8628A-4, a 40 line interface bus is used between the Control Module and the other receiver modules.

The front panel of the WJ-8628A-4 incorporates a numerical keypad for direct, random access entry of frequency commands, BFO, COS, and gain levels. A general purpose keypad includes keys for setting up all other receiver parameters. A 2-row by 24-column Liquid Crystal Display (LCD) with Electroluminescent (EL) backlighting displays all receiver modes, status, and operator prompts.

## OPTIONS

### **WJ-9040 DIO488/232—IEEE-488 or RS-232 Interface**

The WJ-8628A-4 Receiver can accept either IEEE-488 or RS-232 interface options directly. These options are normally placed in the WJ-9040 IOM108 Input/Output Module.

### **WJ-8628A-4/DRD—Digitally Refreshed Display**

This option is used in conjunction with the SCAN option to display RF activity within the prescribed limits of a sector. This presentation can be displayed on the WJ-9040 SDU100 or any suitable X-Y display. Display cursor position is controlled by the receiver tune controls.

### **WJ-8628A-4/FE—Frequency Extender**

The FE option extends the frequency coverage up to 1400 MHz.

### **WJ-8628A-4/FE2—Frequency Extender**

The FE2 option extends the frequency coverage up to 2000 MHz.

### **WJ-8628A-4/MH—Master/Handoff**

This option enables the WJ-8628A-4 to communicate with up to 34 WJ-9040 compatible receivers. Handoff, control, and status monitoring are via the WJ-8628A-4 front panel controls.

**WJ-8628A-4/NRT—Noise Riding Threshold**

With the NRT option the audio squelch gate is triggered by high passed integrated FM video noise at the FM demodulator output. This allows the operator to set the carrier to noise ratio at which the squelch will be activated from approximately 3 to 40 dB with front panel controls. The NRT option is effective for IF bandwidths of 10 kHz to 1 MHz.

**WJ-8628A-4/SCAN—F1 - F2 Scan**

This option permits the WJ-8628A-4 Receiver to perform frequency scan (F1 - F2) routines. Included are provisions for five frequency sectors. The operator may select start frequency, stop frequency, step increment, and associated receiver parameters, i.e.: IF bandwidth, detection mode, etc., for each of the five sectors. Up to 25 lockouts may be programmed, five for each sector, causing the receiver to ignore signal activity in specified portions of the sectors.

**Table 1**  
**IF Bandwidth Options and Sensitivity**

	<b>3 dB IF Bandwidth</b>	<b>RF Input Level (dBm)*</b>	<b>IF RF Input (microvolts)</b>	<b>Shape Factor (typical)</b>
WJ-9928A/2.85K	2.85 kHz	-110	0.7	2.5:1
WJ-9928A/10K	10 kHz	-105	1.3	2.5:1
WJ-9928A/20K	20 kHz	-102	1.8	2.5:1
WJ-9928A/50K	50 kHz	-98	2.9	2.5:1
WJ-9928A/100K	100 kHz	-95	4.0	2.5:1
WJ-9928A/200K	200 kHz	-92	5.7	2.5:1
WJ-9928A/500K	500 kHz	-88	9.0	4.0:1
WJ-9928A/1M	1 MHz	-85	12.9	3.8:1
WJ-9928A/2M	2 MHz	-82	18.0	3.0:1
WJ-9928A/4M	4 MHz	-79	25.0	3.0:1
WJ-9928A/8M	8 MHz	-76	35.0	3.0:1

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 modulated at 1 kHz with a peak deviation equal to 1/3 of selected IF bandwidth will produce a minimum video output (S + N/N) ratio of 17 dB. (Note: a 400 Hz tone is required for 2.85 kHz, 10 kHz, and 20 kHz IF Bandwidths)

NOTE: Receiver is not Gain/Bandwidth compensated below 10 kHz Bandwidth.

\*RF input levels are increased by 3 dB when FE option is installed.

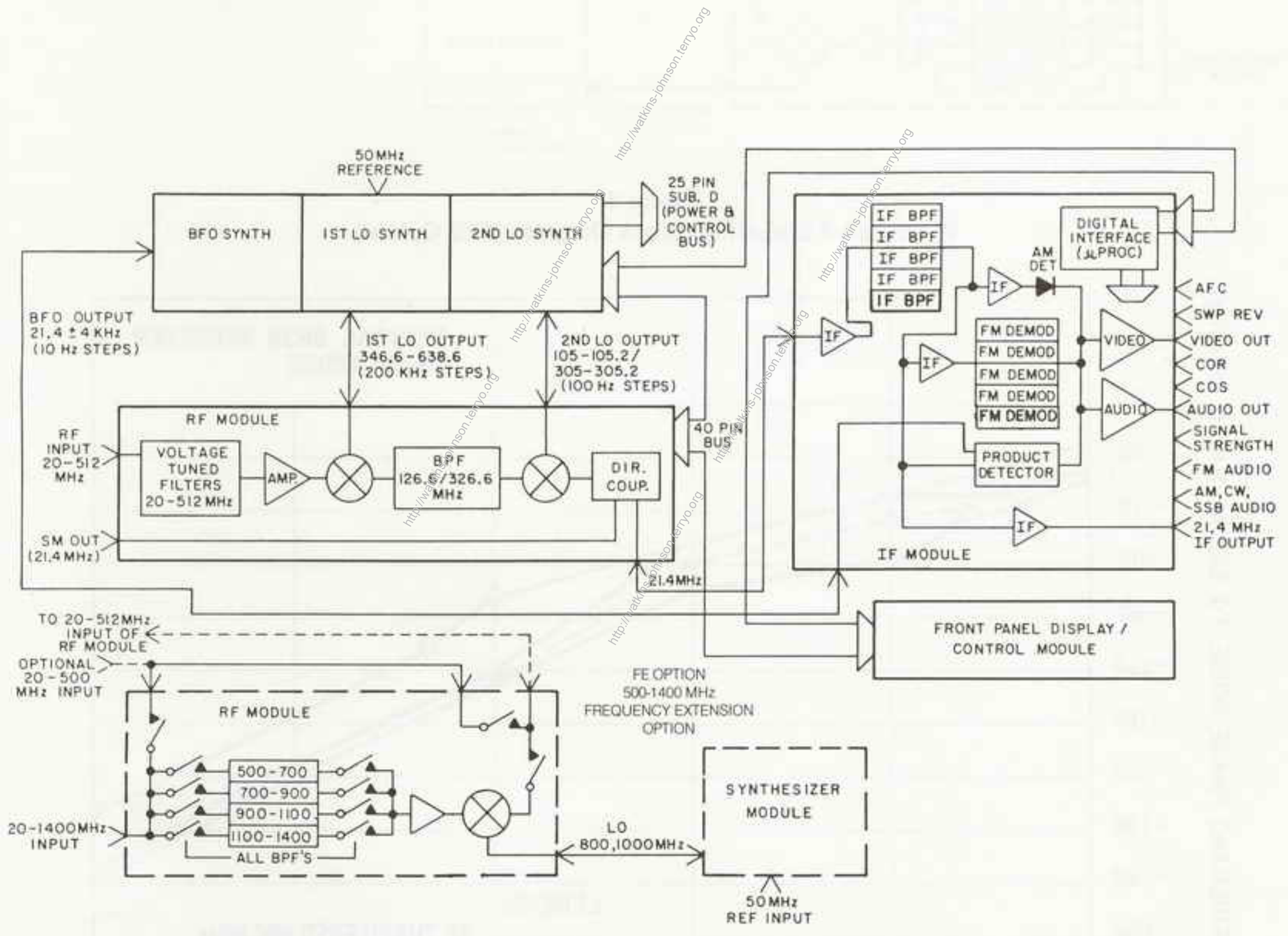
# WJ-8628A-4 RECEIVER CONNECTIONS

A twenty-five (25) pin D series connector supports the standard WJ-9040 System digital control I/O, DC input voltages, and System Polled I/O structure.

RF .....	SMA Female Connector (2 connectors with FE option)
SM output .....	SMA Female Connector
Selected Video Output .....	SMA Female Connector
IF Output .....	SMA Female Connector
50 MHz Reference Input .....	SMA Female Connector
Auxiliary I/O connector .....	9 PIN SRE Female Connector

**Pin Assignments:**

- A. Ground
- B. FM Audio Output (1.25 Vrms, 600 ohms)
- C. AM/CW/SSB Audio Output (1.25 Vrms, 600 ohms)
- D. Signal Strength Output (Analog, 0.1 to 10 V nominal into 10K ohms)
- E. Carrier Operated Relay (open collector, 30 mA sink to ground for switching +24 Volt maximum external voltage)
- F. Carrier Operated Squelch (0 to 5 Vdc)
- H. Sweep Reverse (+10 V to +15 V = noninverted spectrum; Open = inverted spectrum)
- J. Squelched Audio Output (1.25 Vrms, 600 ohms)
- K. AFC ( $\pm 2.5$  Vdc over IF bandwidth into 1K ohm)



**Figure 3**  
**WJ-8628A-4 Simplified Block Diagram (FE Option)**

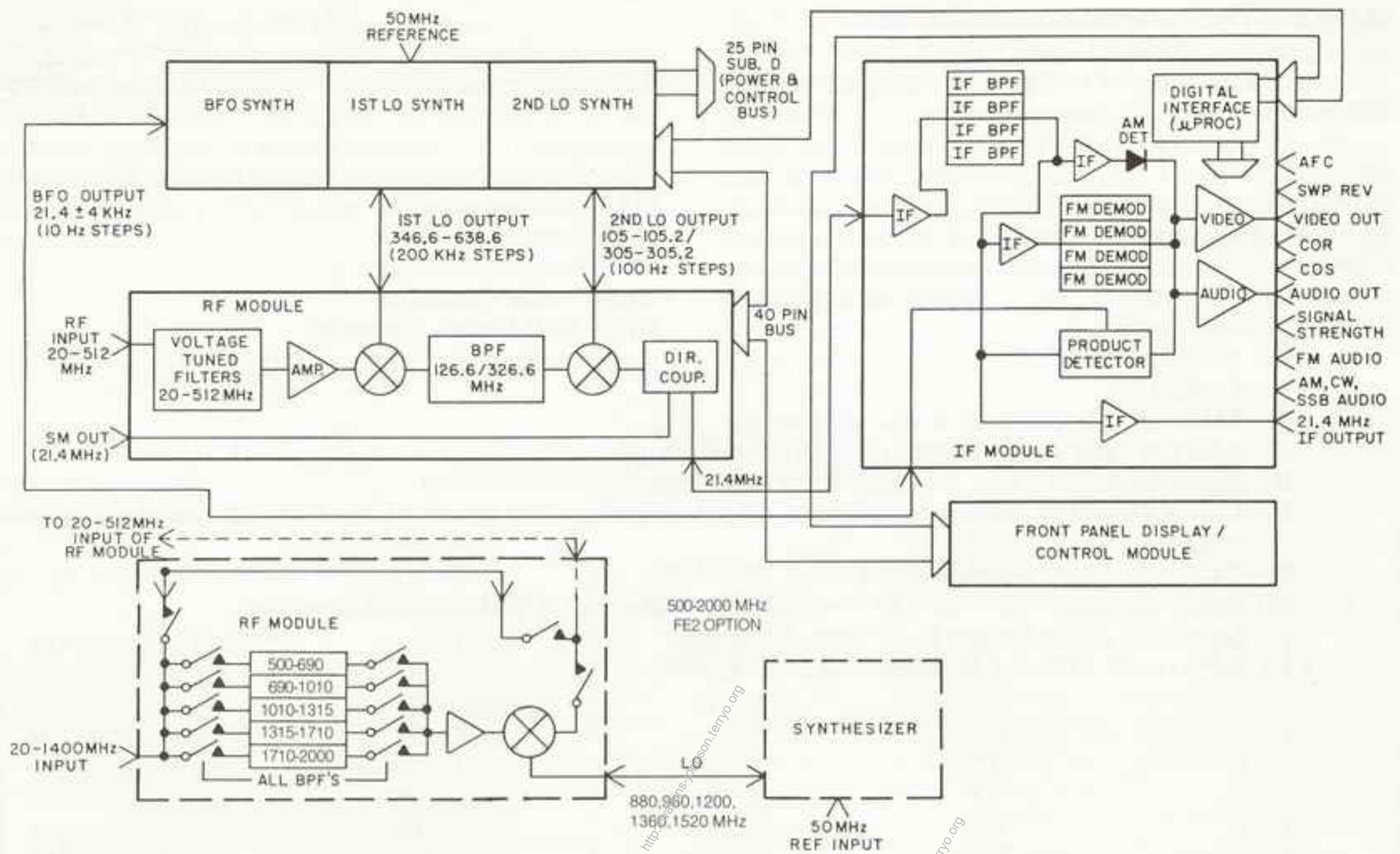


Figure 4  
WJ-8628A-4 Simplified Block Diagram (FE2 Option)

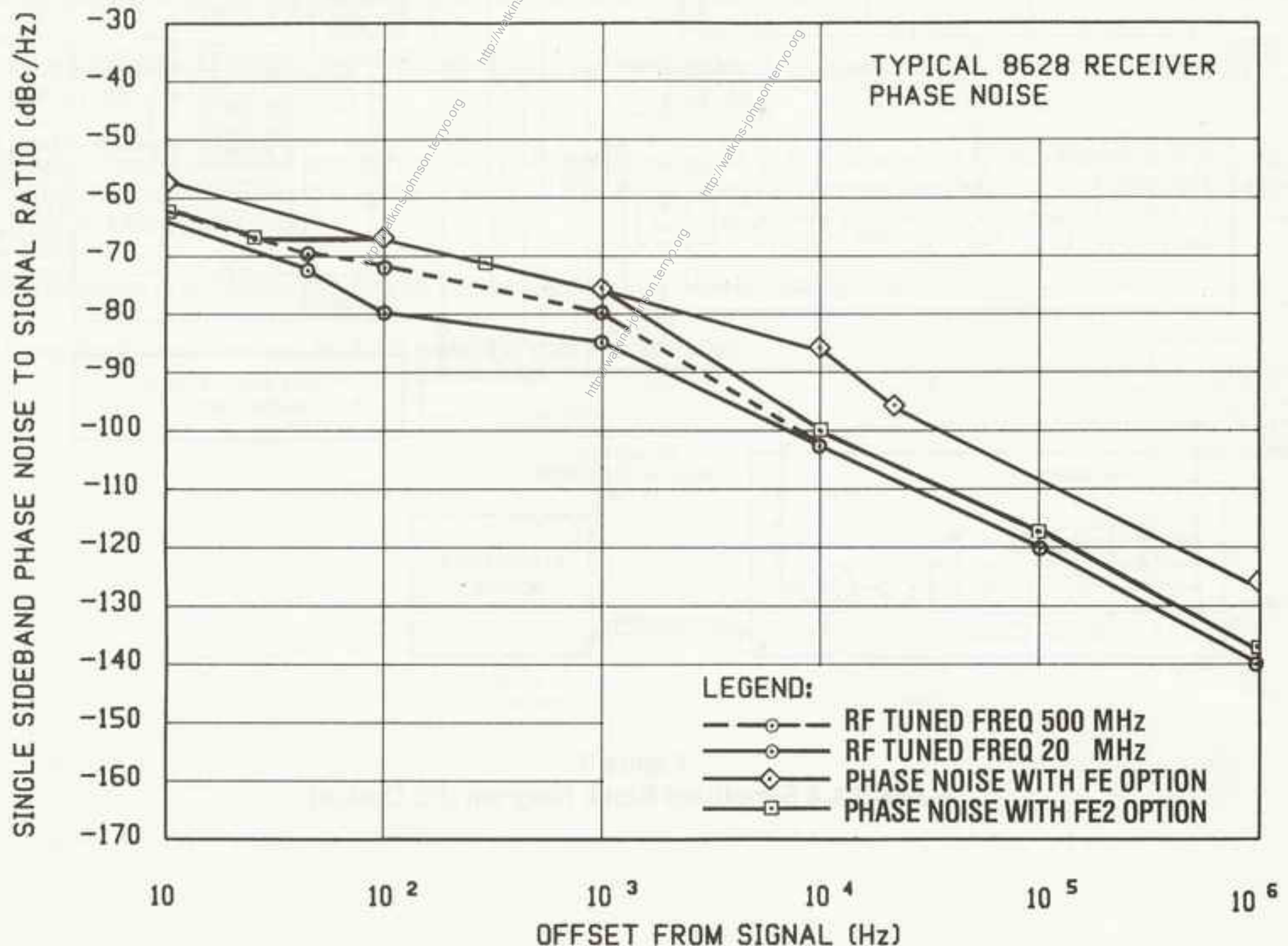


Figure 5  
WJ-8628A-4 SSB Phase Noise