



# WJ-8940B RECEIVING SYSTEM

290.50

## FEATURES

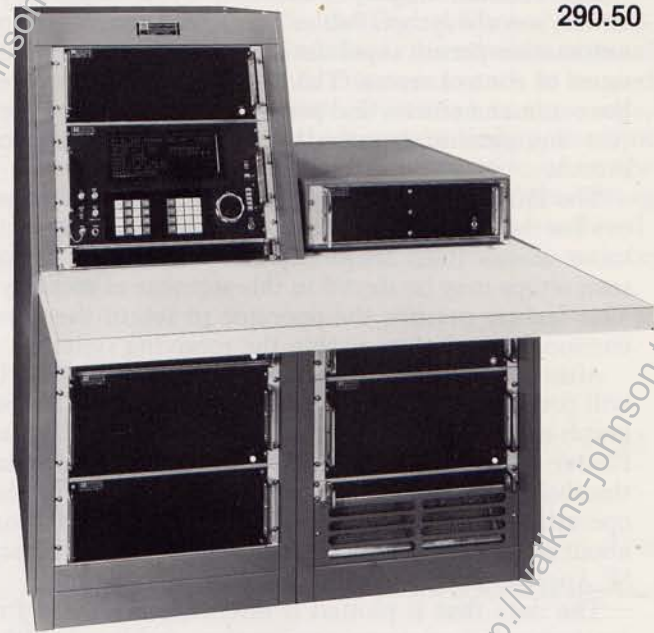
- RF signal measurement or analysis over the frequency range 1 kHz to 1 GHz (optional 20 Hz to 18 GHz)
- Receiver sensitivity and features designed to test to MIL-STD-461B and TEMPEST requirements
- Semi-automatic operating modes: fixed tune, sector scan, repetitive scan, and remote control
- Built-in IC's for automatic self-calibration
- 17 standard IF bandwidths from 200 Hz to 50 MHz for analysis of narrowband and broadband signals
- Audio, video, X-Y, plotter, and printer outputs for signal analysis, display, or recording
- Optional software packages and field service

## INTRODUCTION

The WJ-8940B Receiving System is a multipurpose system designed for EMC and TEMPEST investigations, wideband RF ambient signal surveys, and visual analysis of narrowband and broadband signals. In its standard configuration, this system tunes from 1 kHz to 999.999999 MHz with a 1 Hz tuning resolution and provides 17 selectable IF bandwidths ranging from 200 Hz to 50 MHz in a 1-2-5 sequence. IF detection modes include AM, AM/AGC, FM, CW and LOG. With the addition of available options, the tuning range may be expanded to 20 Hz to 18 GHz and the bandwidth selection from 5 Hz to 500 MHz.

In the Log detection mode, peak, average, or quasi-peak detectors provide calibrated signal amplitudes which are automatically corrected for measurement variables such as RF attenuation, IF bandwidth, narrowband or broadband mode, and system gain variations. The use of programmable correction tables to account for external gains or losses, in addition to the automatic system calibration and corrections, provides data which may be directly compared to a specification limit.

A plotter interface and a serial interface are provided for graphic and tabular output of spectrum data. Audio, video and IF outputs are provided for signal analysis. Analog X-Y outputs are provided for amplitude vs. frequency oscilloscope displays.



## EQUIPMENT CONFIGURATION

The standard WJ-8940B System consists of the following six units integrated into a rack enclosure:

- Digital Control Unit (DCU)
- Tuner/Synthesizer Unit (TSU)
- IF Demodulator (IFD)
- Auxiliary Synthesizer (AS)
- Power Supply (PS)
- Circuit Breaker Panel (CB)

Each of these assemblies is modular in design and built to the highest quality and workmanship standards.

## DIGITAL CONTROL UNIT

The DCU controls all of the internal functions of the WJ-8940B Receiving System. All data and timing required by the TSU, IFD and AS are internally generated by the 16-bit microprocessor in response to the operator's commands. This information is transferred to the other units over individual 16-bit wide parallel busses. The bus structure has been designed so that expansion of the system, by the addition of an ELF extender, microwave extender or wideband demodulator, may be performed without having to add other interfaces to the DCU. Operator interface with the DCU consists of a 32-key keyboard for entering commands, a tuning wheel for frequency control, analog gain controls for audio and AM IF gain and a

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256-character alphanumeric display for display of current WJ-8940B operating parameters and measurement results. The design of the front panel keyboards, controls and 256-character display allow easy operation with a minimum of operator training.

Instructional displays, accessed by a single key-stroke, are always available. The layout and degree of automation permit rapid data acquisition with a minimum of control errors. The DCU checks and verifies the command entries and prompts the operator to correct any entries that the DCU cannot interpret or execute.

The DCU contains a segment of non-volatile memory for the storage of receiving system setups. A maximum of one fixed frequency setup and eight sector scan setups may be stored in this segment of memory. This feature permits the operator to retain the most commonly used scans within the receiving system.

After the completion of each sector scan, the DCU will produce, at the request of the operator, a scaled graph of the scanned spectrum on a HP-7475 Digital Plotter. The operator may also include labeled axis, threshold data, and a header that includes all of the operating parameters of the scan. For information about other digital plotters that may be used, contact SP Applications Engineering.

The data that is plotted is internally corrected for receiver gain variations, attenuation, and bandwidth. Other data corrections, such as antenna factors and cable losses, may also be included in the plotted data. The operator has the capability to tune the WJ-8940B for investigation of any signal on the graph by using the pen position controls of the HP-7475 Plotter. Communication between the DCU and the plotter is via an RS-232 Serial Interface operating at 1200 baud.

A terminal or printer may be connected to a second serial interface in the DCU to obtain a tabular listing of the results of a scan. This data table includes the sector number of the scan, the frequencies and the amplitudes of the measurements that were taken. The start and stop frequencies of the data table listing are programmable and, if a threshold had been previously plotted, only those points that equalled or exceeded the threshold may be listed.

Analog X, Y, Z outputs are also available for driving a storage oscilloscope when performing scans. This gives the operator a real time visual display of the activity in the scanned spectrum without having to produce a hardcopy plot on the digital plotter.

### TUNER/SYNTHESIZER UNIT

The TSU provides frequency coverage from 1 kHz to 1 GHz. The local oscillator signals for the TSU conversion stages are generated by internal synthesizers which are locked to the reference frequency of the AS and cascaded with the RF output of the AS. Utilizing this technique, the TSU can attain a frequency resolution of 1 Hz across the entire tuning range of the receiving system. Advanced design techniques have been utilized to yield high second and third order intermodulation intercept points to effectively minimize internally generated spurious responses. The RF input to the TSU is through one of six selectable sensor inputs allowing antennas or probes covering different frequency ranges to be simultaneously connected to the system. A set of one fixed tuned and

ten varactor tuned bandpass filters are used for preselection in the TSU. The preselectors may be bypassed if desired. An RF attenuator with 70 dB of range in 10 dB steps is included in the TSU to attenuate signals outside the dynamic range of the receiving system. The attenuator can be operated manually or, when in the LOG mode, in the automatic range mode where the attenuation level is determined by RF and IF saturation detectors. Also included in the TSU are the impulse generators used for automatic self-calibration.

### IF DEMODULATOR

The IFD provides narrowband and broadband demodulation and measurement of IF signals from the Tuner/Synthesizer Unit. There are 17 IF bandwidths centered at 100 kHz, 21.4 MHz and 160 MHz available in the IFD. These bandwidths are in a 1-2-5 sequence from 200 Hz to 50 MHz. The IFD also contains the circuitry to demodulate all three IF's in AM, AM/AGC, CW, FM and LOG modes. The video bandwidth of the receiving system is equal to or greater than the selected IF bandwidth. The video processor subsystem of the IFD provides calibrated measurements of the received signals when in the LOG detection mode. It also provides the capability to make measurements in PEAK, AVERAGE or QUASI-PEAK modes with selectable window widths which may be synchronized externally.

### OPERATING MODES

The WJ-8940B Receiving System has four major operating modes which are useful for many aspects of EMC/TEMPEST testing:

- Fixed Frequency Mode
- Sector Scan Mode
- Repetitive Sector Scan Mode
- Remote Control Mode

The first three modes are the local modes with all necessary controls located on the DCU control panel. Remote operation of the system is via the IEEE-488 interface bus using a controller or computer. The local operating modes and features are available within the receiving system without the need for an external controller and custom software. The Fixed Frequency mode allows the operator to use the WJ-8940B as a manual receiver to monitor a specific point in the spectrum, or to manually tune or scan the spectrum. The DCU front panel indicates the status of the receiver control functions and the measured signal amplitude. The RF signal amplitude is displayed, when in LOG mode, in either dBuV or dBuV/MHz. In other detection modes, a number relative to the signal strength is displayed with no descriptive units of measurement. When operating in the LOG mode a calibration sequence is automatically executed when any operating parameter is changed or when the receiver is tuned beyond preset calibration frequency points. The receiver may be calibrated at any time by depressing the "CAL" button located on the left-hand keyboard.

In Sector Scan mode, the WJ-8940B is programmed to scan between two points in the frequency spectrum. All parameters necessary for system operation are pre-programmed by the operator. Data acquisition begins when the operator depresses a single button to begin

the scan of any one of the eight sectors. Calibration of the receiver automatically occurs at the beginning of each scan. Calibration data is acquired using the built-in impulse generators at preset frequencies throughout the selected scan range. Amplitude measurements taken during the scan are stored in the DCU. This stored data is automatically corrected with internal calibration data, attenuator data and, if selected, Data Correction File data. Upon completion of a Sector Scan, the data can be output to an optional digital-interactive plotter or an optional printer, providing a hardcopy of the acquired scan data.

The Repetitive Sector Scan mode is used to scan one or more sectors cyclically until halted manually or automatically when the selected threshold level is

exceeded. Operational capability is similar to the Sector Scan mode with data output in an analog X-Y-Z format for display on a storage oscilloscope. No data is stored in this mode.

The Remote Control mode permits all of the local capabilities to be exercised, using an external controlling device. In this mode, the Digital Control Unit becomes an intelligent interface, translating external computer commands into microcommands to be used by the system components. Operation in this mode, using customer-furnished equipment and applications software, allows the system to be customized to the needs of a particular application. For example, testing scans may be fully automated, data may be archived, and custom plot or data hardcopy formats may be created.

## SPECIFICATIONS

Frequency Range.....	1 kHz to 999.999999 MHz*
Reception Modes.....	LOG, AM, AM/AGC, FM, CW
Sensor Selection:	
Inputs.....	Six
Isolation.....	60 dB
Switching Time.....	Less than 20 ms
Input Attenuator:	
Range.....	0 to 70 dB in 10 dB steps
Selection.....	Local, Remote, or Automatic as function of RF or IF overload
Switching Time.....	Less than 50 ms
RF Input Power Burnout:	
Average.....	2 watts, maximum
Peak.....	100 watts, 1 $\mu$ sec., 0.001 duty ratio, maximum
Input Impedance.....	50 ohms
Input VSWR.....	Less than 2.5:1 Preselect or Bypass Mode
AM/FM Sensitivity.....	See Table 1
Noise Figure** maximum	
5 kHz - 500 MHz.....	10 dB
500 MHz - 1000 MHz.....	12 dB
Image Rejection.....	Greater than 90 dB
IF Rejection.....	Greater than 90 dB
LO Leakage at Input Port.....	Less than -90 dBm
Preselector:	
1 kHz - 100 kHz.....	Fixed Tuned
100 kHz - 1 GHz.....	Varactor Tuned
Bypass mode provided	
Intermodulation Intercept Point:	
Third Order.....	-10 dBm
Second Order.....	+40 dBm
IF Bandwidths (6 dB points).....	17, from 200 Hz to 50 MHz, in 1, 2, 5 sequence***
IF Output Center Frequencies.....	100 kHz, 21.4 MHz, and 160 MHz
IF Output Level (at AGC Threshold).....	-30 dBm, minimum, into 50 ohms
Signal Monitor Outputs.....	21.4 MHz and 160 MHz
Signal Monitor Output Level.....	10 dB greater than RF input level, into 50 ohms
Video Output Impedance.....	50 ohms
Video Output Level:	
Log, AM, CW:	
100 kHz IF (10 kHz BW).....	0.5 volts peak-to-peak
21.4 MHz IF (2 MHz BW).....	0.5 volts peak-to-peak
160 MHz IF (50 MHz BW).....	0.5 volts peak-to-peak
FM (10 kHz, 2 MHz, 20 MHz BW).....	1.0 volt peak-to-peak
Audio Output Level.....	3 mW into 600 ohms; 10 mW into 2 kilohm phones
Audio Gain Control Range.....	Greater than 40 dB
Digital Plotter Output.....	Direct Control of Tektronix 4662 Digital Plotter****; RS-232 serial interface
Storage Oscilloscope Output.....	Analog X, Y, 0 - 10V; Z Blanking TTL Level
Video Measurement Modes.....	Peak, Average, Quasi-peak
Log Mode Dynamic Range (from system rms noise level to 1 dB compression):	
100 kHz IF.....	90 dB
21.4 MHz IF.....	80 dB
160 MHz IF.....	55 dB
Amplitude Accuracy.....	$\pm$ 3 dB

**Control Modes:**

Local .....  
 Remote.....

**Remote Control Parameters.....**

**Frequency Tuning:**

Manual .....  
 Scan .....

Scan Widths.....

Step Size.....

Frequency Resolution.....

Frequency Accuracy.....

Display .....

Operating Temperature Range\*\*\*\*\*.....

Power Requirements.....

Full operation by front-panel controls to provide semi-automatic operation  
 Automatic operation with external controller, IEEE-488 1975, Standard Interface. (TTL-compatible interface, I/O structured for parallel 16-bit data words optional)  
 Frequency, IF Bandwidth, Preselector, Step Size, Detection Mode, Sensor, RF Attenuation, Detector Time Constant, AM IF Gain, Calibrate

Keyboard entry, Tuning Wheel, Digital Plotter Joystick  
 Single Sweep one sector, Repetitive Sweep single or multiple sectors

Start and Stop frequencies presettable from front panel for each sector; eight sectors available

Variable step size

1 Hz, from 1 kHz to 999.999999 MHz

$2 \times 10^{-9}$  per 24 hrs.

All data and command information will be displayed on 256-character plasma display

0° to 40°C

115/220 VAC, 48 - 62 Hz, 400 Hz operation available

\*Tuned frequency coverage down to 20 hertz available within ELF extender. Microwave extender available up to 18 GHz.

\*\*Noise figure greater than 10 MHz is measured in accordance with WJ Standard Test Method 402. Below 10 MHz, noise figure is calculated from CW sensitivity.

\*\*\*Optional Bandwidths available: NBIF, 5 Hz to 100 Hz; WBD, 100 MHz to 500 MHz.

\*\*\*\*Digital Plotter optional, available at extra cost.

\*\*\*\*\*Operation within published specification guaranteed at 25°C ± 5°C.

**TABLE 1**

System Noise Fig.	Receiver AM*, Sensitivity in dBm																
	200	500	1K	2K	5K	10K	20K	50K	100K	200K	500K	1M	2M	5M	10M	20M	50M
11 dB	-121	-117	-114	-111	-107	-104	-101	-97	-94	-91	-87	-84	-81	-77	-74	-71	-67
13 dB	-119	-115	-112	-109	-105	-102	-99	-95	-92	-89	-85	-82	-79	-75	-72	-69	-65
15 dB	-117	-113	-110	-107	-103	-100	-97	-93	-90	-87	-83	-80	-77	-73	-70	-67	-63

\*AM The input signal level in DBM, AM modulated 50% by a 1 kHz tone, will produce 10 dB (S + N)/N minimum when used with a tuner having a noise figure as specified in the Table.

