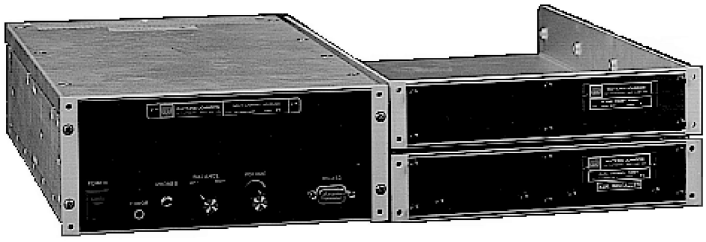
Technical Data

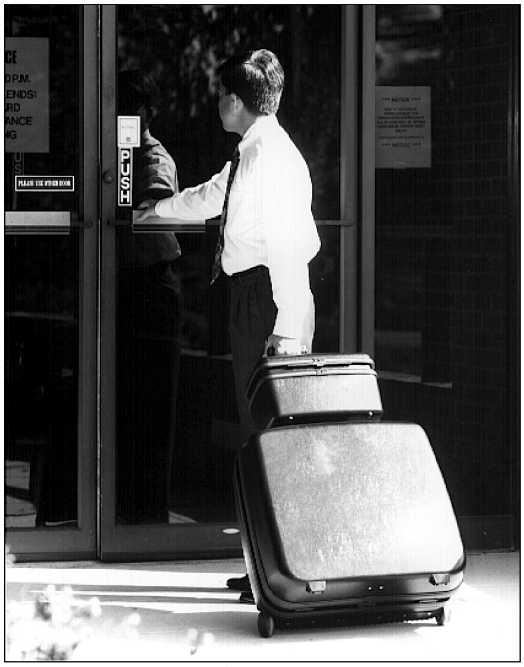
WATKINS-JOHNSON

May 1997

Multichannel Receiving System
WJ-8664

WJ-8664/MRS





WJ-8664/PRT

MODEL #	HEIGHT	WIDTH	DEPTH	WEIGHT
Complete WJ-8664/PRT	10.5 in[1] (26.67 cm)	24.0 in* (60.96 cm)	22.6 in* (57.41 cm)	67 lbs Approx (25.79 kg)
WJ-8664/MCR	3.47 in (8.81 cm)	8.32 in (21.13 cm)	17.62 in (44.75 cm)	13 lbs (5.85 kg)
WJ-866X/DCT	1.71 in (4.34 cm)	8.32 in (21.13 cm)	17.62 in (44.75 cm)	7 lbs (3.15 kg)

* Closed

Features

- ❑ *Effective acquisition & monitoring of various communications systems*
- ❑ *Simultaneous monitoring of 6 audio- or control-channels*
- ❑ *Control-code recognition*
- ❑ *Conversation targeting based on prioritized list of up to 100 entries*
- ❑ *Windows™-based applications program*
- ❑ *RS-232 remote control*
- ❑ *Built-in test capability*

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The WJ-8664 Multichannel Receiving System combines analog and Digital Signal Processing (DSP) to provide a compact, flexible capability against the EAMPS, NMT-450/900, ETACS, or Inmarsat-A communications systems. The system adapts to various operating environments and comes in a WJ-8664/PRT (portable) or WJ-8664/MRS (rack-mountable) configuration. At the heart of both the PRT and MRS configurations are the WJ-866X/DCT (Dual-channel Tuner) and the WJ-8664/MCR (Multichannel Receiver) (Figure 1).

The WJ-866X/DCT is housed in a 1.75 x 8.25 x 15.5 inch (4.44 x 20.95 x 39.37 cm) package. The unit accepts two RF inputs routed to two internal wideband converter channels. Both channels are tunable over a 20 to 1000 MHz range in 1-MHz steps, and each provides an output IF centered at 70 MHz. Each converter channel can tune either the entire forward (base-to-mobile) or reverse (mobile-to-base) cellular band. The DCT receives its control and power inputs from the MCR. During Inmarsat-A applications, the DCT receives its RF inputs from an 866X/FE (portable) or WJ-866X/FE (rack-mountable) Frequency Extender.

TheWJ-8664 system cables the output wideband IFs of the DCT to the MCR and routes them to six narrowband channel tuners for subsequent processing. Each channel tuner in the MCR can monitor individual conversations, or control channels, on either the forward or reverse cellular band.

The WJ-8664 system supports a variety of operating modes. In the simplest mode, the operator need only provide a prioritized list of up to 100 targets. Depending on the selected communications system, targets can consist of phone, serial, and mobile identification numbers for cellular systems. They can also consist of the identifier numbers for Ship Earth Stations (SES), Coastal Earth Stations (CES), and Terrestrial Networks (TER) for Inmarsat-A systems. The WJ-8664 then uses an intelligent scanning scheme, based on knowledge of the selected system characteristics, to locate active-control and voice/telex channels. The system compares intercepted information to the target list and monitors channel activity. If desired, the operator may specify directly the frequencies or bands searched for control data or audio. The operator may also specify a random search mode that uses no priority phone-number list, and monitors conversations as detected.

An operator can also specify combinations of targeted and random modes. Regardless of the search mode, the system constantly analyzes monitored conversations to detect frequency hand-off commands. If detected, the system automatically uses the hand-off data to retune the channel so as to not disrupt conversation monitoring.

RS-232 remote control is standard in both the portable and rack-mountable configurations. Ethernet 10 Base-T remote control is optional. All WJ-8664 parameters are controllable and accessible through the remote interface, except for headphone volume control. A PC/AT-compatible notebook computer (NBC),which connects to the WJ-8664's RS-232 port, provides local control via the WJ-8664 Applications Program.

Four option slots in the MCR allow additional post-processing of any received voice channel, which easily meets any specific customer needs. In the PRT configuration, two of these slots are occupied: one by a 12-channel audio reconstruction module (AUD), the other by a SCSI interface that records and playbacks audio, and Signal-Related Information (SRI), to and from a Cartridge Tape Subsystem (CTS). Other options include primary level CEPT and T1 PCM output formatters. See the WJ-866X Configuration Matrix Data Sheet.

WJ-8664/PRT

The WJ-8664/PRT is a capable self-contained surveillance system packaged in a convenient ABS-molded carrying case (Figure 2) that includes:

- WJ-866X/DCT
- WJ-8664/MCR
- WJ-866X/AUD
- WJ-866X/CTS
- 866X/PRE Preamplifier/Splitter
- DC/AC Converter
- 866X/NBC

The interior of the main carrying case contains foam inserts specifically designed to the dimensions of the installed equipment, ensuring minimal movement during transport. An operator can use the system right inside the case, which further protects the equipment and reduces set-up time.

WJ-8664/MRS

The WJ-8664/MRS is a rack-mountable receiving system that can operate as a standalone surveillance device, or as part of a larger system requiring cellular intercept and monitoring capabilities. The major components of the MRS are the DCT and the MCR (Figure 3). An 866X/BFP (Blank Front Panel) provides a rack mounting aid for the DCT.

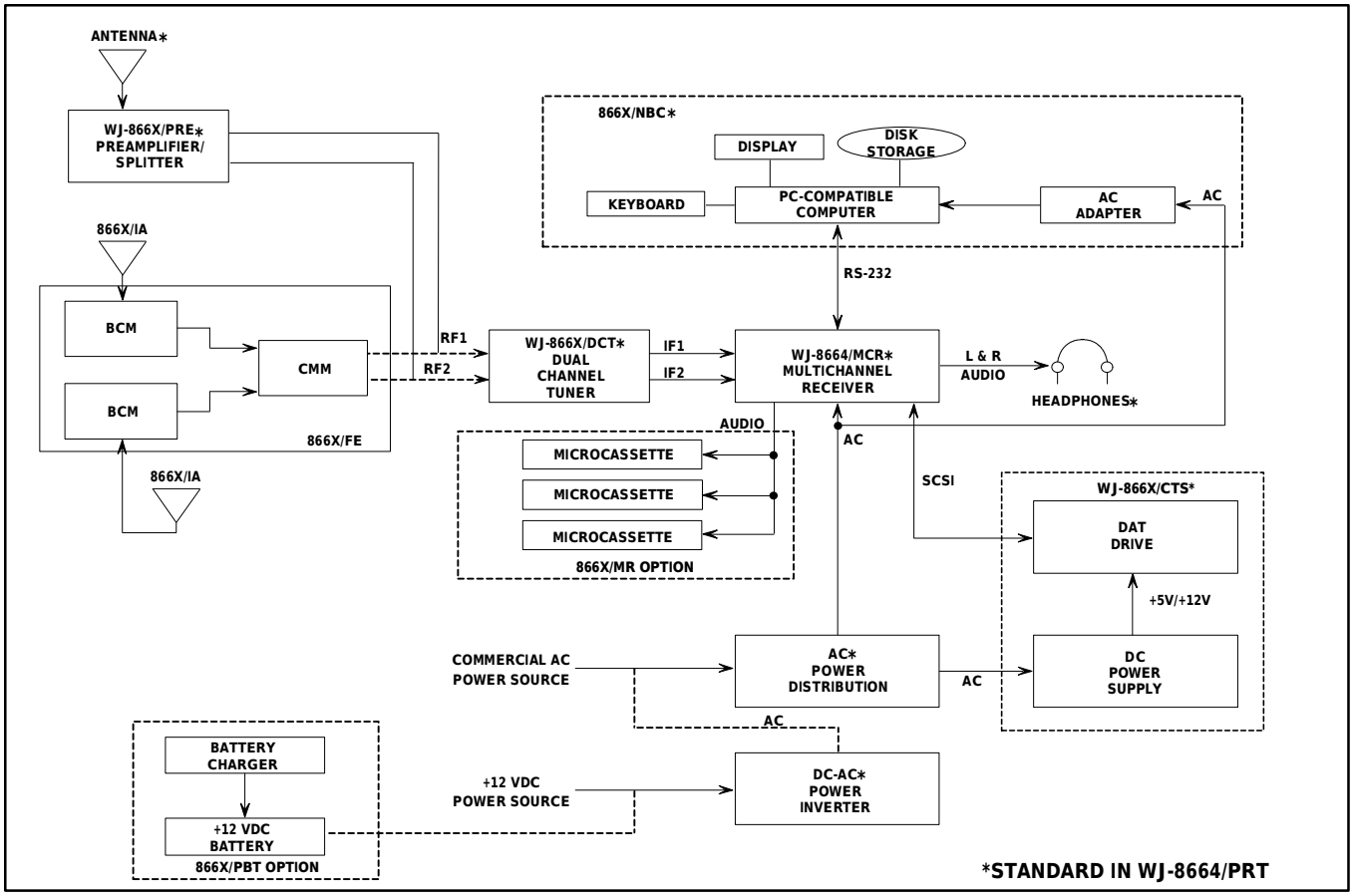

Figure 1. WJ-8664 System Block Diagram

WPG83

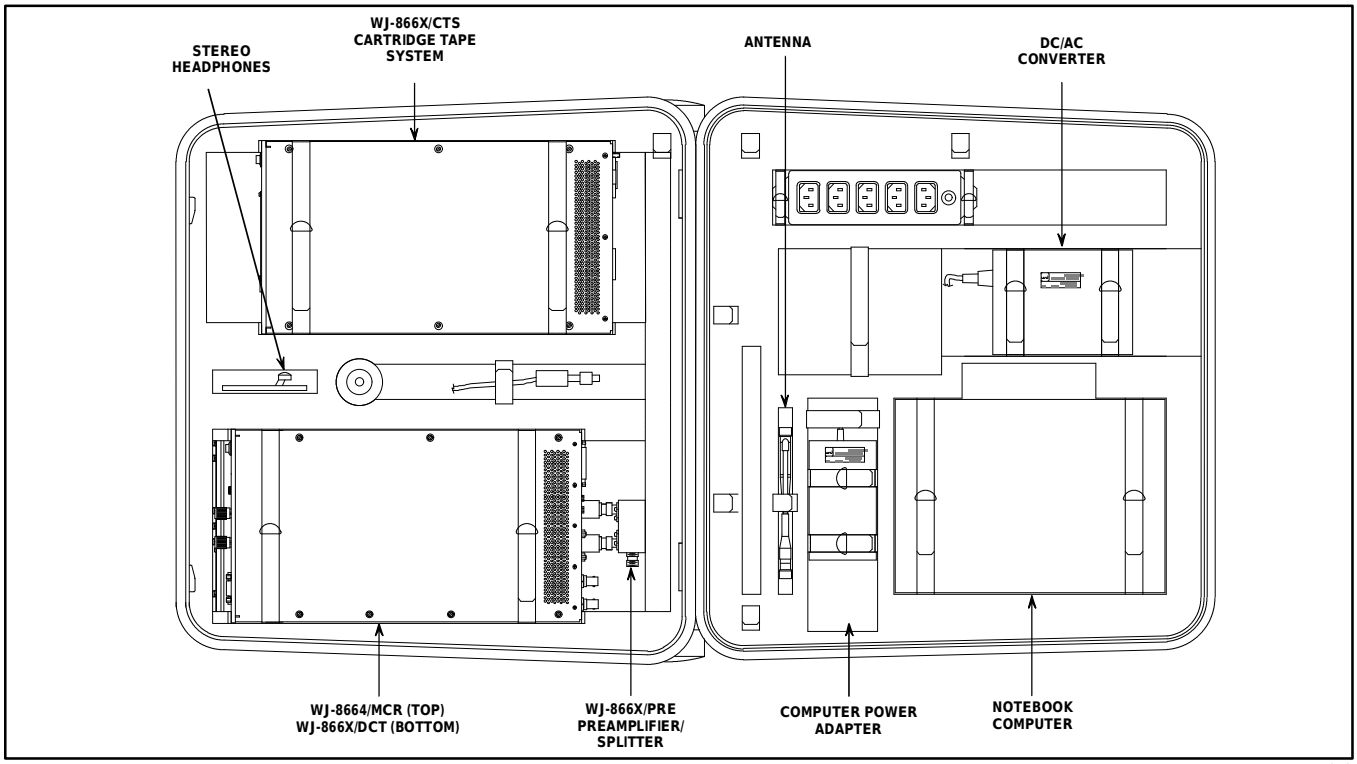

Figure 2. WJ-8664/PRT (Portable Receiving System)

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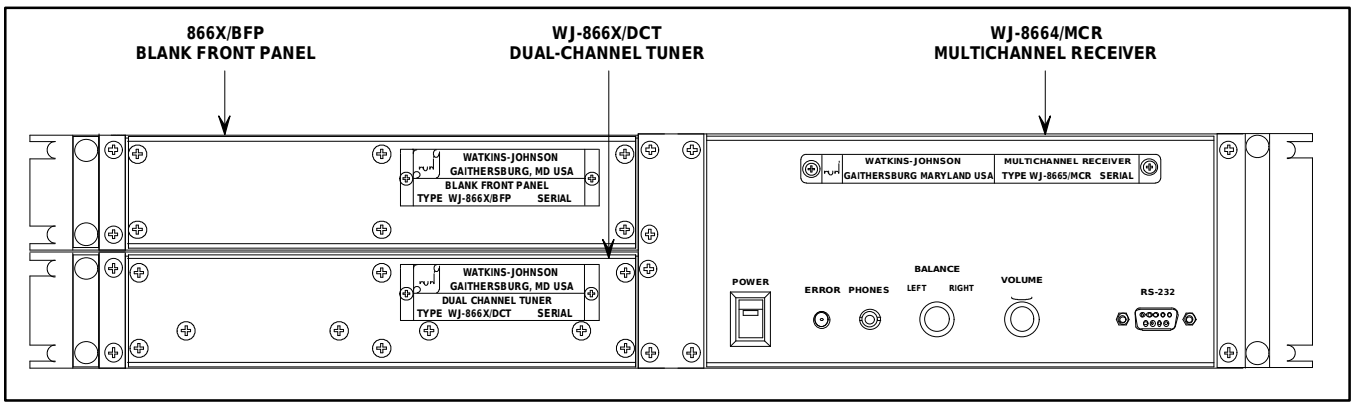


Figure 3. WJ-8664/MRS (Multichannel Receiving System)

The MCR is a 3.5-inch (8.89 cm) half-rack unit. The DCT and BFP are both 1.75-inch (4.44 cm) half-rack units that can be attached together to create either a 3.5-inch (8.89 cm) half-rack or a 1.75-inch (4.44 cm) full-rack configuration.

To target an Inmarsat-A system, an 866X/FE or WJ-866X/FE option must be purchased separately. Refer to the WJ-866X Configuration Matrix Data Sheet.

Applications Program Software

The PRT and MRS provide complete capability for intercept and monitoring of the target communications system. Each system also comes with WJ-8664 Applications Program software that supports:

- Analysis of system
- Database generation
- Priority phone-list setup
- Scan/monitoring strategy setup
- Manual receiver control

This graphical user interface (GUI) runs from an NBC with Windows$_{TM}$ version 3.0 or greater, and gives an operator complete control of the system. WJ conveniently installs Windows$_{TM}$ and the Applications Program on the notebook computer (NBC) prior to shipment from the factory.

Upon initial configuration of the receiver, an operator selects the target communications system and executes a system survey. During the survey process, the receiver uses an intelligent scanning scheme, based on its knowledge of the selected cellular system, to locate active voice and control channels. When completed, the system displays the results for the operator. In addition, the program automatically sets up the six receiving channels individually, to monitor the strongest forward- or reverse-control channels (monitor receivers) or intercepted priority phone (voice) traffic (hand-off receivers).

Once the operator configures the system, he can enter priority phone numbers and electronic serial numbers as targets of the surveillance mission. Using the Target list window, an operator can enter up to 100 target numbers from low to high priority. Wildcard numbers entered in the Target List (Figure 4) allow the receiver to report and monitor all intercepted activity, based on the availability of receiving channels. Once the receiver is actively searching for targets of interest, the operator can monitor the Tracking Status window to acquire real-time voice and message traffic.

Numerous windows are available to the operator for effective system setups in accordance with the signal environment. An 866X/GPSR (General-Purpose Receiver) option provides even more flexibility. When an operator configures the system with GPSR, it operates as a narrowband receiver. Several detection modes are available in GPSR mode: AM, FM, CW, USB, LSB, and ISB. Fourteen IF bandwidths are also available ranging from 0.1 to 30 kHz. While in this mode, the operator has access to an IF panoramic display (Figure 6) and an RF spectral display (Figure 7). In the RF spectral display, the operator can enter up to 10 bands to lock out unwanted frequencies in the active scan.

General System Applications

The WJ-8664 architecture incorporates several features that facilitate integration within a larger system. The MCR's modular construction makes the unit easy to maintain with a minimum amount of downtime. A thorough built-in test capability permits quick detection and isolation of hardware faults to the board level. Many of the installed boards exist in multiple quantities, which reduces the required inventory for spares. The modular construction is key

to configuring the WJ-8664 to best satisfy operational requirements. If the operator incorporates off-the-shelf or custom option cards, in many cases they eliminate the need for external equipment. Drop-in alternate remote-control interfaces accommodate a variety of system control schemes.

Options

A user needs to order both the PRT and MRS as basic systems plus options. Processing options include 866X/AMPS, 866X/NMT, 866X/TACS, 866X/INM-A, and 866X/GPSR. A user can configure any combination of these in the WJ-8664, but can only activate one at a time. Option-card slots in the MCR permit the installation of a variety of data formatters or signal processing options. Four option slots are available in the MCR of the MRS configuration, while the PRT has two option slots. Operators can install option cards in any combination, subject to the available slot restriction and the availability of rear-panel space for Input/Output (I/O) connectors. Various options enhance the PRT capabilities while maintaining its portability. Refer to the WJ-866X Configuration Matrix Data Sheet.

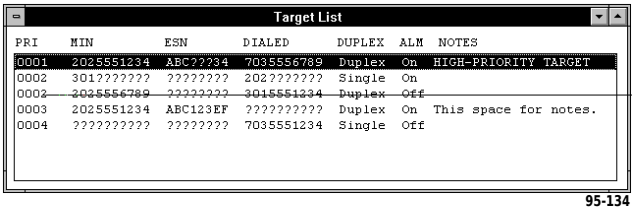


*Figure 4. Target List Window**

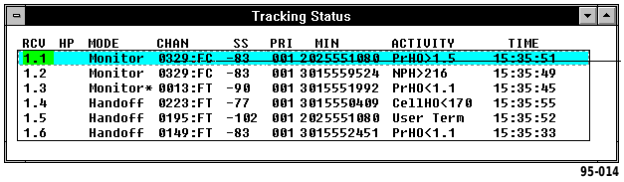


*Figure 5. Tracking Status Window**

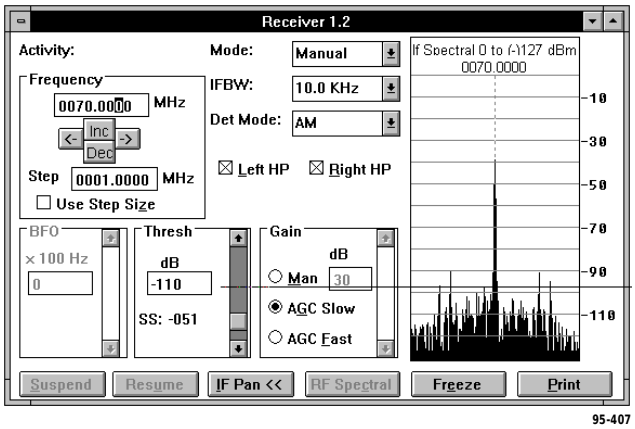


*Figure 6. IF Pan Display**

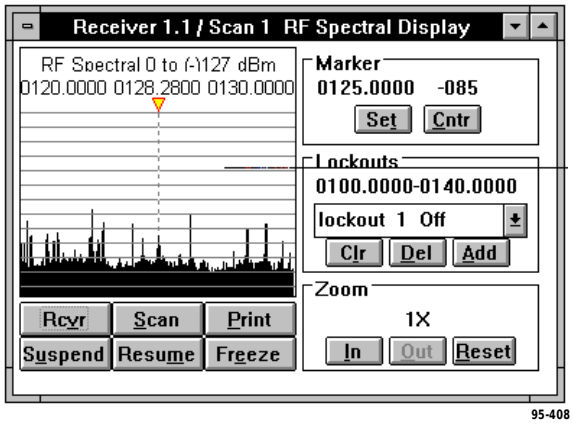


*Figure 7. RF Spectral Display**

*The windows above are reduced for use in this data sheet and appear much smaller than their actual size.

Specifications

RF Characteristics

Frequency Range	**20 to 1000 MHz**
Frequency Resolution	**100 Hz synthesized**
RF Input Impedance	**50 ohms**
Input VSWR	**2.5:1 typical; 3:1 max**
Noise Figure	**15 dB, max (20 to 50 MHz); 10 dB, max (50 to 1000 MHz)**
1-dB Compression Point	**-5 dBm, max**
Intermodulation	
2nd-Order Intercept Point	**+50 dBm, min**
3rd-Order Intercept Point	**+5 dBm, min**
Image Rejection	**80 dB**
IF Rejection	**70 dB**
IF Modulation	**10-Hz rms (300 Hz to 3 kHz)**
LO Tuning Speed	
To within 1 kHz of Final Frequency	**5 msec**
Internally Generated Spurious	**< -110 dBm, equivalent**
LO Level at RF Input	**-90 dBm, max**
Sensitivity	**-116 dBm for 12-dB SINAD (Signal, Noise & Distortion)**
Selectivity	**>80 dB for >100-kHz offset**

System Characteristics: (Cellular Mode)

Number of Channels	**6 control- or voice-channels monitored simultaneously**
Standards Processed	**Selectable EAMPS, NMT-450/900, ETACS, & Inmarsat-A**

System Characteristics: (Optional 866X/GPSR Mode)

Number of Receivers	**6 independent receivers**
Detection Modes	**AM, FM, CW, USB, LSB, ISB**
IF Bandwidths (kHz)	**0.1, 0.2, 0.5, 1.0, 2.0, 3.2, 5.0, 6.4, 8.0, 10.0, 15.0, 20.0, 25.0 30.0**
IF Pan Display	**30-kHz display bandwidth**

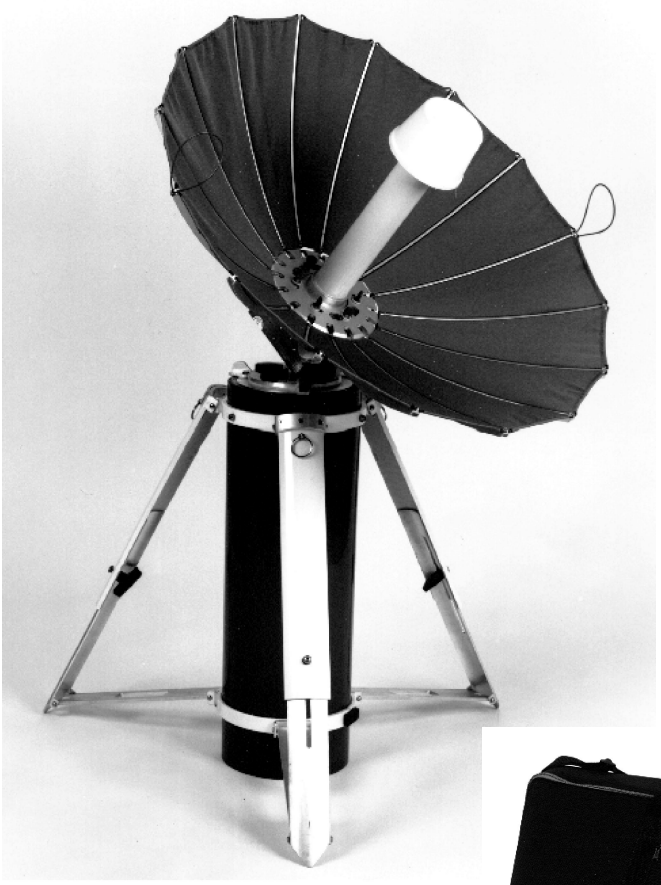
Output Characteristics:

Digital Output (Standard)	**Parallel TDM data bus; 16-bit linearly-coded audio data with word & framing clocks**
Frequency Response	**175 to 3825 Hz (-3 dB)**
Banpass Ripple	**±0.35 dB, max (600 to 3400 Hz)**

Adjacent Channel Rejection	60 dB, min (300 & 3700 Hz)
Total Harmonic Rejection	0.1%, max (820-Hz test tone at nominal output)
Residual Noise	57 dB, min below nominal output
Noise Power Ratio (NPR)	50 dB, min (600-channel noise load -7 dBm)
Differential Group Delay	75 µsec, max (400 to 3825 Hz)
Incidental FM	1.00-Hz rms (0 to 15 MHz tuned frequency) 1.25-Hz rms (15 to 20 MHz tuned frequency)
Analog Output (Optional in MRS)	High-fidelity audio; 16-bit D/A Converter with 2X oversampling, available in 12-channel increments (AUD Option)
Output Impedance	600 ohms, unbalanced
Nominal Output Level	1 Vrms into 600 ohms (AGC mode)
Output Connector	D-type, 25-pin female
Frequency Response	175 to 3825 Hz (-3 dB)
Bandpass Ripple	±0.35 dB, max (600 to 3400 Hz)
Adjacent Channel Rejection	60 dB, min (300 & 3700 Hz)
Total Harmonic Rejection	0.1%, max (820-Hz test tone at nominal output)
Residual Noise	57 dB, min below nominal output
Noise Power Ratio (NPR)	50 dB, min (600 channel noise load -7 dBm)
Differential Group Delay	75 µsec, max
Incidental FM	1.0-Hz rms (0 to 15 MHz tuned frequency) 1.25 Hz rms (15 to 20 MHz tuned frequency)
Audio Attenuation Range	30 dB, nominal
Headphone Audio	Toll-quality stereo; independent channel selection & volume control for each side
Output Impedance	600 ohms, unbalanced
Nominal Output Level	Adjustable up to 8 dBm into 600 ohms
Control	
Remote	RS-232 control port for PC/AT-compatible computer, with WJ-8664 Applications Program software
Frequency Reference	
Internal Reference Stability	±3 x 10^{-7} max
Internal Reference Aging	±3 x 10^{-9} drift per day, max
External Reference	Accepts 1, 2, 5, or 10 MHz (±1 PPM), 200 mV peak-to-peak min into a high-impedance load; automatically switches to external reference upon application of signal
Reference Output	10 MHz, 0 dBm nominal into 50 ohms

Physical Environment

Specifications	WJ-8664/PRT	WJ-8664/MRS
Temperature Range		
Operating	0 to 50°C	0 to 50°C
Meets All Specifications	10 to 40°C	10 to 40°C
Power Requirements	115/230 Vac ±10% (48 to 72 Hz, 380 to 420 Hz) 10 to 16 Vdc	115/230 Vac +10% (48 to 72 Hz, 380 to 420 Hz)
Power Consumption	120 W, approx (ac input) 135 W, approx (dc input)	66 W approx



866X/IA Inmarsat Antenna Option

An 866X/IA Inmarsat Antenna option is available for users who desire immediate turnkey operation in either PRT or MRS configurations. This portable parabolic antenna assembly (shown right) enables interception of microwave traffic in mobile-to-satellite or satellite-to-land communicaitons. Using two IAs with the system allows simultaneous monitoring of both uplink and downlink tranmissions. The antenna comes with its own carrying bag and is deployed in minutes. When this option is ordered with either the PRT or MRS, the block-converter module (part of the 866X/FE) is mounted to the base of the antenna prior to shipment from the factory.