Figure 1-1. Type WJ-8888 Receiver

SECTION I
GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

The WJ-8888 Receiver is designed to receive AM, FM, CW, LSB, USB, and ISB emissions over the range of 0.5 MHz to 30 MHz. The receiver has three operating modes: Local, Memory, and Remote. In the local mode, the receiver is tuned manually by the operator, and operating parameters are selected by pressing appropriate front-panel pushbuttons. The buttons illuminate, and the tuned frequency is displayed on a seven-digit LED numeric display. Resolution of the display is 10 Hz over the entire tuning range. The locally-selected operating parameters and tuned frequency may be entered into a selected memory channel, if desired. Four thumbwheel-selectable memory channels are provided in standard models. Units with eight, twelve, or sixteen memory channels are available as an option. In the memory mode, the front panel pushbuttons and the tuned-frequency numeric display indicate the contents of a selected memory while the receiver continues to operate with the most recent locally-selected tuned frequency and operating parameters. The receiver frequency and operating parameters may be changed to those of the memory, if desired, simply by pressing a button. The receiver then returns automatically to the local mode. In the remote mode, the receiver tuned frequency and operating parameters are set by a remote digital device. The front panel numeric indicator and controls display this data, although the front panel controls are ineffective. Remote operation may be selected by the remote device as well as from the front panel if an internal jumper is connected. Tuned frequency and operating parameter data is provided to the remote device upon interrogation while in any operating mode. Communication with the remote device is by means of a 64-bit data word and appropriate address and trigger inputs.

Pushbutton-selectable parameters in addition to operating mode are IF bandwidth, detection mode, gain mode, and meter function. Four standard IF bandwidths, 0.5, 2, 4, and 8 kHz, and two spares reserved for customer selection are provided. Detection modes are AM, AM with noise limiter, FM, CW fixed (locked), CW variable, independent sideband (ISB), lower sideband (LSB), and upper sideband (USB). The latter three modes are for SSB reception. The ISB detection mode permits simultaneous reception of both upper and lower sideband signals, with a separate demodulator used for each sideband. Separate AGC loops in each demodulator permit independent gain control for each sideband. The 8 kHz IF bandwidth is automatically selected when an SSB detection mode is selected. In the CW variable mode, BFO frequency can be set with a front-panel control knob and then locked to the set frequency. In the CW fixed detection mode the BFO is automatically locked to the IF center frequency. Selectable gain modes are Normal AGC, Hold AGC, and Manual. Hold AGC provides the normal AGC function plus a time delay which becomes active when the signal drops out. This AGC mode is used primarily with USB or LSB SSB reception. Normal AGC in

conjunction with independent USB and LSB AGC loops is automatically selected when the ISB detection mode is selected. Manual gain may be selected while in any detection mode. In the manual gain mode, rf gain is adjusted with a front panel control knob. This knob is ineffective in the AGC modes. Two pushbuttons permit the operator to choose between signal strength and line audio for monitoring on a front panel meter.

In addition to the above controls and indicators, the front panel includes squelch and audio level controls, an ISB audio sideband select switch, a phones jack, and a receptacle that receives the output of an accessory tuning control. The rear panel contains various connectors for providing AM and FM monitor outputs, USB, LSB, line audio, and phone audio outputs, antenna input, computer control/monitor inputs and outputs, provisions for an external clock input, a tuning-voltage monitor output, and signal monitor and predetection IF outputs.

Two notable features of the receiver are power fail-safe operation and variable-rate tuning. If a power failure occurs or when the operator de-energizes the receiver, the current tuned frequency and operating parameters are stored in a non-volatile MOS memory separate from the operator controlled memory. When power is restored, the receiver returns to its previous operating conditions. Variable rate tuning allows a single control knob to provide both high-resolution tuning and high-speed low-resolution tuning. When the rate of rotation of the tuning knob is less than about one revolution per second, frequency change is about 10 Hz for every three degrees of rotation and is linearly proportional to rotational speed. For rotational rates higher than one revolution per second, frequency change is exponentially proportional to the rate of rotation. Thus slightly increased rotational rates produce intermediate tuning rates, and very rapid band-edge to band-edge tuning is easily achieved at higher rotational rates.

To enhance the receiver's versatility, a number of options are available in addition to the memory and customer-selected bandwidth options. The receiver may be ordered without preselection sub-octave filters when the receiver is used in a low signal density environment or if preselection is accomplished by the associated antenna network. An optional logarithmic IF amplifier is available to provide a log video output to the rear panel. In standard units, a standard serial synchronous input/output (I/O) module is installed. A serial asynchronous I/O module is also available. In systems where master/slave or remote operation of receiver groups is desired, the remote/slave receivers can be supplied without front panel controls and frequency readout. A compact table-top remote tuning unit, the WJ-9588 Tuning Control Box, a Master/Slave Control Unit, the WJ-9526, and a Signal Monitor, the WJ-9188, are available as accessories.

1.2 MECHANICAL CHARACTERISTICS

The receiver mounts in a standard 19-inch equipment rack, and occupies 5.25 inches of vertical rack space. The main chassis, front, side, rear, and internal compartment panels, and top and bottom covers are constructed of aluminum. The front panel is overlaid with a black bezel etched with control markings. All of the pushbuttons are mounted on a plug-in printed-circuit card

positioned behind the front panel, and extend through cutouts in the front panel. The pushbutton mountings are also screwed down to the front panel so that the front panel serves as support for the printed-circuit card. All of the remaining controls and the line audio/signal strength meter are mounted directly on the front panel. The tuned frequency numeric display is mounted on a card positioned behind a cutout in the front panel, over which a protective window is installed. The audio phones jack and accessory optional tuning receptacle are also mounted on the front panel. The front panel with all controls and indicators and the two associated printed-circuit cards are removable as a unit for servicing and when the receiver is used exclusively in the remote control mode.

Behind these components are additional plug-in digital control and LO synthesizer cards. A bulkhead for mechanical support and shielding separates all digital cards from the RF/IF modules toward the rear of the chassis. The bulkhead as well as the right side panel are perforated as required to control air flow from the blower. IF, demodulator, and audio plug-in cards are mounted in a separate shielding enclosure in the rear compartment. Three nickle-plated brass chassis in the rear compartment house the input converter assembly, the input preselector plug-in cards, and the input bandpass filter. The power transformer and two regulator cards are mounted in the rear compartment, with power supply filter capacitors underneath. One of the regulator cards is enclosed in an aluminum box for shielding purposes. Miscellaneous rectifier diodes, connectors, and passive circuit components are mounted on the chassis or are wired to terminals on the printed-circuit card receptacles.

The rear panel mounts all input, output, accessory, and interface connectors, with the exception of the above-mentioned phones jack and optional tuning control connector. AC line fuses, line-voltage selector switch, permanently-attached power cord, and blower air filter are on the rear panel. The inside-rear panel mounts a blower and an ac line filter to which the power cord is attached.

1.3 EQUIPMENT SUPPLIED

This equipment consists of the WJ-8888 Receiver and three mating multi-pin plugs (see Table 2-1). Selected IF bandwidth, I/O module, memory, and log IF options are normally installed at the factory before shipping.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The WJ-8888 requires a 50-ohm antenna input. Headphones (600 ohms or greater impedance) such as Telex Model HM-5 are required for use of the front panel audio output. A computer or other control device must be used for remote operation, and other rear-panel input and output interfacing devices must be supplied by the user according to the application of the receiver. Refer to Section II of this manual for details of the rear-panel inputs and outputs. An optional tuning control box and a master/slave control unit are available as accessories, but are not necessary for general operaton.

Table 1-1. WJ-8888 Receiver, Specifications

Tuning Range	0.5-30 MHz
Preselection	Sub-octave filters automatically switched
Input Impedance	50 ohms, unbalanced
Oscillator Radiation	10 μV or less at receiver input
IF Bandwidths (3 dB)	4 standard and two options
Standard	0.5, 2, 4, and 8 kHz
Options	0.2, 1, 3, 6, 12, and 16 kHz
Detection Modes	AM Noise Limiter, AM, CW Fixed, CW Variable, FM, Upper, Lower, and Independent Sideband
Gain Control Modes	Manual, Normal AGC, Hold AGC
AGC and Manual Range	100 dB minimum for input signals above 2 μV
AGC Threshold	2.0 μV minimum
AGC Attack Time	20 ms
AGC Release Time	Normal AGC, 0.1 second; Hold AGC, 2 seconds
Control Modes	Local, Memory, and Remote
Sensitivity	
AM Sensitivity	The input signal levels indicated in Table 1-2, 50% amplitude modulated at a 400 Hz rate will produce a 10 dB (S + N)/N ratio at the audio output (1 kHz and greater IF bandwidths).
CW Sensitivity	The CW input signal levels indicated in Table 1-2 will produce a 16 dB (S + N)/N ratio at the audio output.
FM Sensitivity	The input signal levels indicated in Table 1-2, frequency modulated at a deviation equal to 30% of the IF bandwidth, at a rate equal to 10% of the IF bandwidth or 400 Hz, whichever is less, will produce a 17 dB (S + N)/N ratio at the audio output (6 kHz and greater IF bandwidths).
LSB, USB, ISB	0.56 μV for 10 dB (S + N)/N or greater
Outputs:	
Line Audio	1 mW minimum, transformer coupled, balanced, into 600 ohms at 2.0 μV or greater input level
Audio Distortion	Less than 5%
Audio Amplifier Frequency Response	Flat within 3 dB from 100 Hz to 15 kHz

Table 1-1. WJ-8888 Receiver, Specifications (Continued)

Phones	10 mW minimum into 600 ohms, front panel adjusted
ISB (LSB, USB)	Two transformer coupled balanced outputs, each providing 1 mW into 600-ohm load at 0.56 μV input level.
IF	455 kHz, 50 mV minimum at 2.0 μV or greater input level
Signal Monitor	455 kHz center frequency, 35 kHz bandwidth
Log Video (Optional)	Logarithmic to within ± 1 dB over a 60 dB range. Maximum output is 1 V dc into 2 kilohm load.
IF Rejection	Greater than 100 dB
Image Rejection	Greater than 100 dB
Unwanted Sideband Rejection	50 dB at 350 Hz from carrier center frequency
Intermodulation:	
Third Order Input Intercept Point	+20 dBm minimum for signal separation greater than 50 kHz
Second Order Input Intercept Point	+60 dBm minimum
Cross Modulation	With a desired signal at 50 μV, an undesired signal at 50 mV more than 50 kHz away, amplitude modulated 50% produces an output at least 20 dB below the output level of the desired signal in the 2 kHz IF bandwidth.
Tuning Speed (Remote)	5 ms typical, 15 ms maximum;
Manual Tuning	Variable rate, function of rotation speed of tuning knob. Rate is linear at low rotation speeds and exponential above one revolution per second. The minimum tuning increment is 10 Hz.
Frequency Selection (Local)	Single tuning knob
Frequency Stability	6×10^{-8} per day, 2×10^{-6} per year
Frequency Display	7 digit LED (dot matrix) display
Remote Control	By synchronous or asynchronous serial data word. Data word is applied to or received from the computer via line driver and line receiver. TTL differential pairs. Clock, address, and trigger lines are included with synchronous I/O. Synchronous data word format shown

Table 1-1. WJ-8888 Receiver, Specifications (Continued)

	in Figure 3-1. Refer to Figure 4-28 for serial synchronous I/O timing. Table 2-1 shows interface connector pin designations.
Synchronous I/O Control Lines:	
Input Trigger	Differential pair, TTL strobe pulse, positive logic, 8 ms minimum pulse width. Commands receiver to supply clock signal for synchronous transfer of data to receiver.
Clock Input/Output	Two clock outputs, each TTL differential pair. One clock accompanies data output, other clocks data from controlling device (computer). Each clock pulse train 25 kHz at 10% duty cycle. May be wire-OR'ed together.
Receiver Address	One differential pair, TTL level, Receiver addressed on logic 1
Memory	Four channel memory capacity supplied. Up to sixteen channels in groups of four channels may be supplied as an option. Tuned frequency and operating parameters may be stored in any selected memory channel for later recall. Memory non-volatile on power fail or when receiver turned off.
AC Power Interrupt	When power fails or the receiver is turned off, the current tuned frequency and operating parameters are stored in a separate non-volatile memory. When power is restored, the receiver returns to operation in the remote mode at the most recent operating point.
Non-Remote Control Functions	Phone level, squelch, memory channel select, and RF/Audio meter
Meter	Indicates relative RF input signal level or line audio output level, as selected with front-panel pushbutton.
Dimensions	19 inches wide, 5.25 inches high, 19.5 inches deep (from back of front panel to tips of rear protective handles
Weight	Approximately 40 pounds

Table 1-1. WJ-8888 Receiver, Specifications (Continued)

Operating Temperature	0° C to 50° C (32° F to 122° F)
Power Consumption	Approximately 0.8 A at 115 V ac, 0.4 A at 220 V ac (90 watts, approximately)
Input Power Requirements	115/220 V ac ± 10%, 48 to 62 Hz.

Table 1-2. Sensitivity

IF Bandwidth kHz	Input Level Microvolts	dBm
0.2	0.28	-115.5
0.5	0.45	-114
1.0	0.64	-111
2.0	0.89	-108
3.0	1.2	-105.5
4.0	1.3	-105
6.0	1.7	-102.5
8.0	1.8	-102
12.0	2.4	- 99.5