TECHNICAL DATA SHEET

WJ-8711A

Digital HF Receiver

The WJ-8711A is a fully synthesized, general-purpose HF receiver for monitoring RF communications from 5 kHz to 30 MHz with 1-Hz tuning resolution. By combining analog and digital signal processing (DSP), the WJ-8711A achieves high performance at low cost.

DSP techniques accomplish functions such as noise blanking, IF filtering, AGC, demodulation, Beat Frequency Oscillator (BFO) and passband tuning. Filters with superior amplitude and group delay characteristics are achieved with digital stability and repeatability. The receiver has 66 standard selectable IF bandwidths. Available detection modes are AM, SAM, FM, CW, USB, LSB and ISB. An operator can adjust the tunable BFO in 10-Hz steps over a ±8000 Hz range, and the available passband tuning further enhances the reception of CW signals. Gain control is manual or automatic, with fast, medium, and slow AGC modes. An operator can adjust the squelch threshold from 0 to -135 dBm, or disable it. Enabling the noise blanking feature effectively eliminates the adverse effects of impulsive noise.

In addition to fixed-frequency tuning, the WJ-8711A provides fast, flexible scanning in three modes: channel scan, F1-F2 scan and F1-F2 scan with lockouts. Dwell times are available for all scan modes from 0.5 to 20 seconds or infinite. The channel-scan mode provides 100 programmable memory channels. The operator can specify sectors of memory for individual channel scans, allowing the subdivision of available memory into multiple search scenarios. Operators can specify that the receiver skip certain channels without deleting them from memory. Memory channels can also be single-stepped manually. In both F1-F2 scan modes, the step size is user-selectable from 1 Hz to 25 kHz. The receiver can store up to 100 independent frequency lockouts.

An operator can control the WJ-8711A locally via the front panel or remotely via the serial interface. Measuring 5.25 x 19 inches, (13.34 x 48.26 cm), the microprocessor-controlled front panel provides a user-friendly operator interface with dedicated, logically arranged controls and large, easy-to-read LED displays.

FEATURES

- Frequency coverage from 5 kHz to 30 MHz in 1-Hz steps
- High dynamic range: +30 dBm 3rd-order intercept typical
- Digital filtering provides 66 IF bandwidths up to 16 kHz with exceptional shape factors
- AM, SAM, FM, CW, USB, LSB & ISB Detection Modes Standard
- Fast, flexible scanning with 100 memory channels
- Large readable LED displays & user-friendly controls
- 3 variable AGC decay settings
- Noise blanking & passband tuning
- Tunable IF Notch Filter
- Internal switchable preamplifier & attenuator
- Standard remote interface (optional Multidrop RS-232, RS-485, RS-422, CSMA, or IEEE-488)
- Built-in self test
- Optional Suboctave Preselector
- Optional Digital Data Output

HEIGHT	5.25 in (13.36 cm)	**DEPTH**	20.0 in (50.80 cm)
WIDTH	19.0 in (48.26 cm)	**WEIGHT**	15 lbs (6.78 kg)

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A majority of the WJ-8711A operator-selectable parameters are controllable and accessible via an RS-232 remote interface. RS-485, RS-422, and IEEE-488 interfaces are optional.

All receiver inputs and outputs are on the rear panel of the unit with the exception of the front-panel-mounted headphone jack. The receiver provides antenna and external-reference inputs, as well as the signal monitor and predetected IF outputs, via BNC connectors. Speaker and dual-balanced line audio outputs are on a terminal strip along with dc-coupled audio, RSSI and squelch outputs, and a mute-control input. The RS-232 interface is through a 25-pin D-shell connector.

A tunable IF notch allows an operator to tune a Digital Notch Filter through the selected IF Bandwidth (IFBW), in order to eliminate undesired signals within the IF Passband. Typical notch 3-dB bandwidth is 10 to 20 percent of the selected IFBW and provides 50-dB of rejection (typical). The notch filter is a nonlinear phase IIR Filter that an operator should not use when flat group-delay response is required. It is not available in CW detection mode.

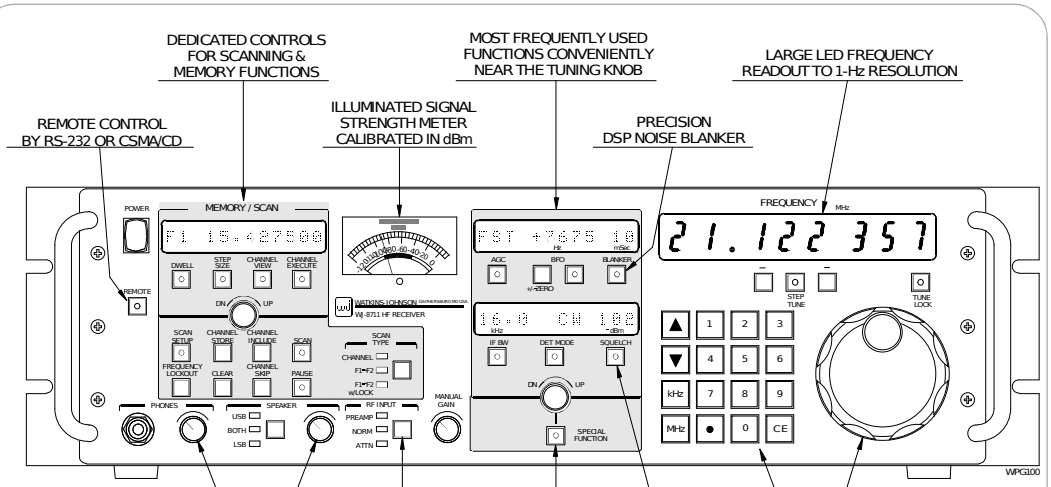
OPTIONS

The standard Digital HF Receiver comes in a variety of mechanical configurations.

FUNCTIONAL DESCRIPTION

The WJ-8711A has four functional subsystems: RF, DSP, IF/Audio Output and Control. The receiver applies the 5 kHz to 30 MHz RF signal to its antenna input, lowpass filters it, and then amplifies, attenuates or routes it to the normal through-path based on user selection. The unit then mixes the signal with the first local oscillator (LO), which tunes from 40.455 MHz to 70.455 MHz in 1-kHz steps, to produce a first-IF of 40.455 MHz. The first-IF filter limits the bandwidths of the signal to approximately 30 kHz before mixing it with the 40-MHz second LO to produce a second IF at 455 kHz.The rear panel provides a connection for the second IF to a signal display unit. After passing through the second IF filter, the signal mixes with the 430-kHz third LO to produce the third IF centered at 25 kHz.

All LOs are derived from an internal 10-MHz oscillator locked to an external reference input of 1, 2, 5 or 10 MHz. The WJ-8711A automatically senses and switches to the



WJ-8711A FR0NT-PANEL FEATURES

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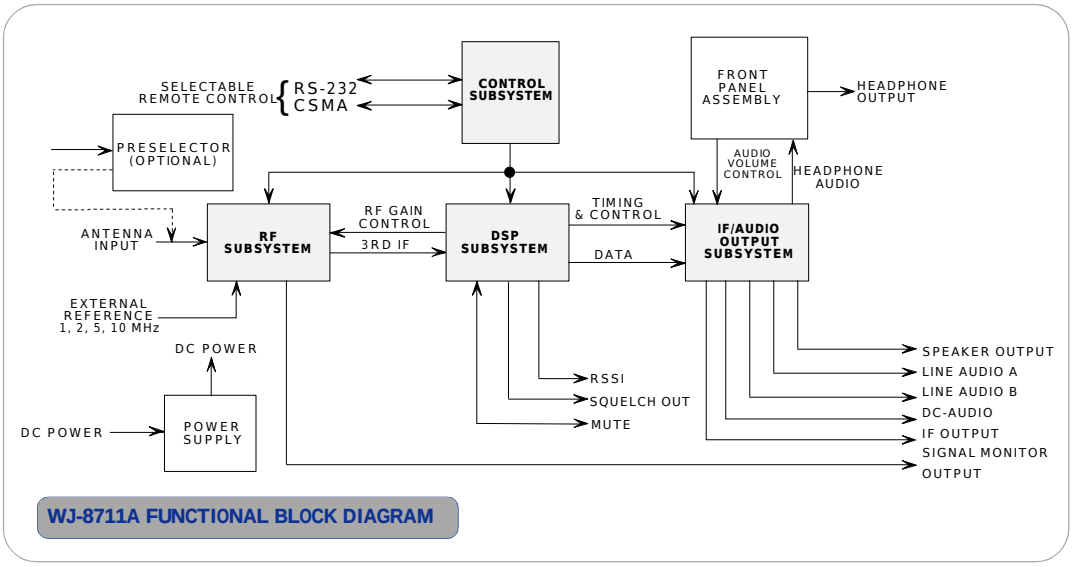
external reference upon application of signal. All critical timing signals used in the DSP and IF/Audio Output Subsystems also derive from this reference.

The DSP Subsystem performs the majority of the receiver's signal processing functions. The receiver digitizes the third-IF signal from the RF Subsystem to 16 bits of resolution at a sampling rate of 100 kHz. It then applies this digitized IF signal to a programmable DSP chip that performs the following functions based on operator selection of the receiver's parameters:

- Noise blanking
- Fine tuning to 1-Hz resolution
- IF filtering
- Gain control (AGC Fast, AGC Medium, AGC Slow, or Manual)
- Signal strength and squelch functions
- Signal demodulation and BFO
- Generation of a multiplexed digital data stream containing 1 or 2 demodulated audio channels and a post-filtered IF signal

The IF/audio output subsystem performs the analog reconstruction of the IF and audio signals provided by the DSP subsystem in digital form. The analog audio signals route through two distinct signal paths to accommodate ISB detection mode. In all other detection modes, both paths contain identical audio signals. These two audio paths provide a 2-channel headphone output, two balanced 600-ohm line audio outputs and an 8-ohm speaker output containing one or both audio channels in ISB mode. After analog reconstruction, the receiver upconverts the IF signal to 455 kHz, passes it through a bandpass roofing filter to remove mixer products, then buffers and routes it to the rear-panel IF-output connector.

The microprocessor-based control subsystem performs the receiver's internal control, acts as an interface with the front panel, and provides a remote control function through either the RS-232 or the optional RS-485, RS-422, or IEEE-488 interfaces. The control subsystem also monitors hardware status within the receiver and, when commanded, performs a built-in test sequence that isolates circuit faults to the module level.



WJ-8711A FUNCTIONAL BLOCK DIAGRAM

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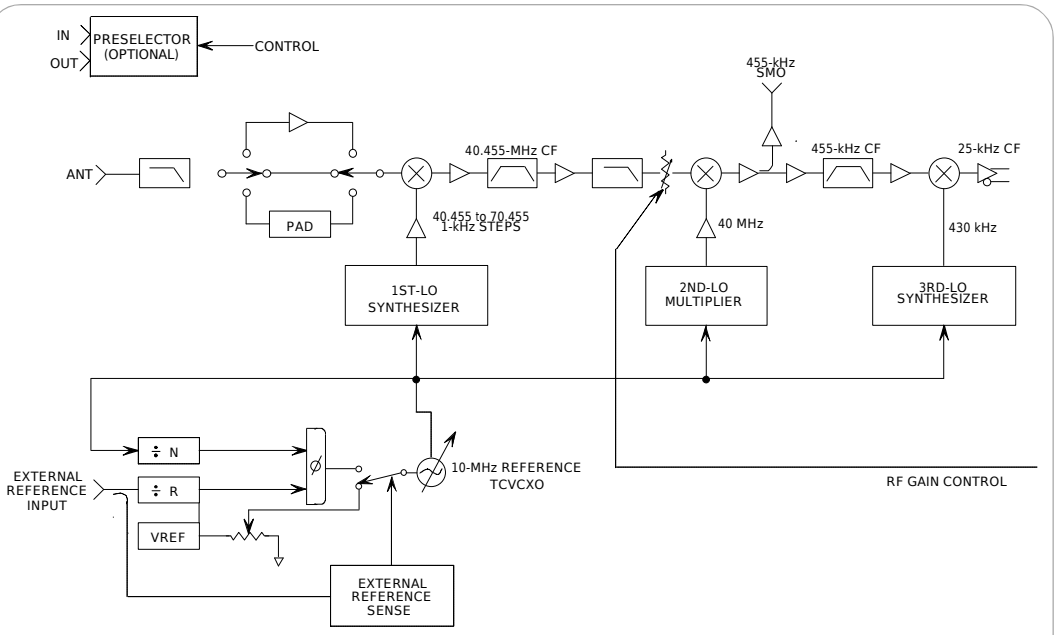

WJ-8711A RF SUBSYSTEM FUNCTIONAL BLOCK DIAGRAM

INPUT/OUTPUT CONNECTORS

I/O	Function	Type
Input	Antenna	BNC
	External Reference	BNC
	Power	IEC 3-pin
	Mute	Terminal Block
Output	Signal Monitor	BNC
	IF	BNC
	Line Audio Output A & B	Terminal Blocks
	Speaker	Terminal Block
	DC-coupled Audio	Terminal Block
	Squelch	Terminal Block
	Headphone	Standard 0.25-in (0.63 cm)
	Stereo jack	
	Received Signal Strength Indicator	Terminal Block
Bidirectional	CSMA Remote Interface	0.12-in (0.3 cm) miniature stereo jack
	RS-232 Remote Interface	25-pin female D-shell

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SPECIFICATIONS*

Frequency Range ..... 5 kHz to 30 MHz (tunable to 0 Hz, degraded performance below 500 kHz)

Tuning Resolution ..... 1 Hz

Internal Reference Stability ..... >0.7 PPM (0 to 50°C)
>0.2 PPM (0 to 50°C) with REF option

External Reference Frequency ..... Accepts 1, 2, 5 or 10 MHz (±1 PPM or better, 200 mV rms into high impedance load); automatically switches to external reference upon application of signal

Synthesizer Lock Time ..... <10 msec, typical

Antenna Input
Impedance ..... 50 ohms, nominal
VSWR ..... 2:1, max at receiver's tuned frequency
Maximum Input Signal ..... +30 dBm
Connector ..... BNC, female

3rd-order Intercept Point ..... +30 dBm, typical
+ 25 dBm, min (for signals separated by 50 kHz, min)

2nd-order Intercept Point ..... +60 dBm, typical

Noise Figure ..... 14 dB, max (11 dB, max with preamplifier engaged)

Detection Modes ..... AM, SAM, FM, CW, USB, LSB & ISB (consult factory for additional demodulation modes)

SENSITIVITY 500 kHz TO 300 MHz

Modulation	IFBW (kHz)	(Minimum) S+N/N (dB)	Without Preamp Minimum dBm/(μV)
AM (50% mod. at 400 Hz)	6.0	10	-103/(1.58)
FM (4.8 kHz dev. 400 Hz mod)	16.0	17	-99/(2.50)
USB/LSB/ISB	3.2	10	-112/(0.56)
CW	0.3	16	-116/(0.35)

CW sensitivity 5 to 500 kHz, without Preamp (0.3 kHz IFBW)

50 to 500 kHz	-113 dBm/0.5 μV typical for 16 dB S+N/N
20 to 50 kHz	-105 dBm/1.27 μV typical for 16 dB S+N/N
5 to 20 kHz	-78 dBm/28 μV typical for 16 dB S+N/N

IF Output
Center Frequency ..... 455 kHz, nominal
12.5 kHz w/IFDS option
Output Level ..... -20 dBm, nominal
Output Impedance ..... 50 ohms, nominal
Connector Type ..... BNC, female

Signal Monitor Output
Center Frequency ..... 455 kHz, nominal; inverted
Bandwidth ..... 30 kHz (-6dB), min
Output Level ..... 30 dB above RF input, nominal
Output Impedance ..... 50 ohms, nominal
Connector Type ..... BNC, female

*Specifications subject to change without notice.

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Gain Control Modes	Manual, AGC Fast, Medium, Slow
AGC Range	100 dB, min
AGC Threshold	Approximately -108 dBm (0.9 μV) in 16-kHz BW Approximately -125 dBm (0.12 μV) in 300-Hz BW (Threshold matched with IFBW, typically 10 dB above noise floor)
AGC Attack Time	5 msec, typical
AGC Decay Time	Fast: 10 to 100 msec, variable Medium: 100 msec to 1 second, variable Slow: 1 to 5 seconds, variable
Selectable Front-end Gain/Attenuation	
Preamplifier Gain	10 dB (±2 dB)
Attenuation	15 dB (±2 dB)
BFO	
Tuning Range	±8000 Hz
Tuning Resolution	10 Hz
First Image Rejection	90 dB, min
IF Rejection	85 dB, min (>90 dB, typical)
LO Phase Noise	-110 dBc at 1-kHz offset, typical
Reciprocal Mixing	With a desired signal of 25 mV in the 3.2-kHz IFBW, the desired signal-to-noise ratio (SNR) is >20 dB, when an undesired signal 70-dB higher in amplitude and 35-kHz removed in frequency is present.
Cross Modulation	With a desired signal of 10 mV, an undesired signal 86-dB higher, 30% AM modulated produces <10% cross modulation for frequency separation of >50 kHz in the 1-kHz IFBW.
Internal Spurious	<-114 dBm referred to the RF input
Blocking	An unwanted 1 mV signal separated 20 kHz from a desired signal of 1 mV will not cause the IF output to fall by more than 3 dB.
Line Audio Outputs	
Number of Outputs	2 center-tapped, balanced outputs ISB mode, USB & LSB on separate outputs All other modes, audio signal common to both outputs
Output Level	0 dBm, nominal into 600-ohm load
Connector Type	Screw terminals
Speaker Output	
Number of Outputs	1 output. For ISB mode, select USB & LSB individually or combined. (Internal speaker optional).
Bandwidth	100 Hz to 13 kHz
Output Level	Adjustable up to 500 mW into 8-ohm load
Total Harmonic Distortion	<3% at 1 W
Connector Type	Screw terminals
Headphone Output	
Number of Outputs	2, unbalanced ISB mode: 1 output contains USB (left channel), 1 output contains LSB (right channel) All other modes, audio signal common to both outputs
Output Level	Adjustable up to 10 mW into 600-ohm load
Connector Type	Standard 0.25-in (0.63 cm) stereo jack
Remote Control	RS-232 or CSMA; selectable by internal switch or front panel entry
RS-232	Full duplex, 3-wire serial interface; rear-panel 25-pin female D-shell connector

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Baud Rates (Both Interfaces)	75, 150, 300, 600, 1200, 2400, 4800 & 9600; selectable by internal switches or front-panel entry
MIL-STD-810D Test Method	
A. Low Temperature	Test Method 502.2
B. High Temperature	Test Method 501.2
C. Humidity	Test Method 507.2
D. Altitude	Test Method 500.2
E. Vibration	Test Method 514.3
F. Shock	Test Method 516.3
Operating Temperature	0 to +50°C
Storage Temperature	-40 to +70°C
Humidity	10 cyclic days (240 hours); Procedure III for continuous exposure to 95% RH
Altitude	50,000 ft (15,240 meters) non-operating 24,000 ft (7,315 meters) operating
Vibration[1]	
A. Basic Transporation (secure cargo) Category 1	Random vibration 1.04Gs non-operating (2 hours)
B. Ground mobile (wheeled or tracked vehicle) Category 8	Random vibration 6.0Gs operating (15 minutes)
C. Marine (shipboard vessel not specified) Category 9	Random vibration 1.0Gs operating (2 hours)
D. Environmental stress (NAVMAT-P-9492)	Random vibration 6.0Gs operating (15 minutes for design qualifications) 3.06Gs nonoperating [10 minutes for production screening (ESS)]
Shock[1]	Bench handling (field service) 8 drops total onto a horizontal hard wooden surface, operating
MTBF	In excess of 10,000 hours; estimated in accordance with MIL-HDBK 217E for Ground Fixed; +40°C environment
EMC	EN50081-1 (radiated & conducted emissions to EN55022, Class B)
	EN50082-1 (including IEC 801-2:1984, IEC 801-3:1984 & IEC 801-4:1988)
	EN55020 (Immunity for Receivers)
Safety	IEC 1010-1:1990+A1/EN61010:1993
Power Requirements	97 to 253 Vac (47 to 440 Hz) Auto Switching
Power Consumption	35 W, typical with options

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IF FILTER SPECIFICATION

3-dB BW (kHz)	(Maximum) Shape Factor (3/60 dB)	(Typical) Group Delay Variation (100% of 3-dB BW)
0.3	1.35:1	50 µS
1.0	1.40:1	30 µS
3.2	1.25:1	30 µS
6.0	1.25:1	40 µS
16.0	1.25:1	60 µS
USB/LSB/ISB (3.2)	1.25:1	30 µS

IF FILTERS (NOMINAL 3-dB BANDWIDTH IN Hz)

56	113	226	450	900	1800	3600	7200	14400
63	125	250	500	**1000**	2000	4000	8000	16000
69	138	275	550	1100	2200	4400	8800	
75	150	**300**	600	1200	2400	4800	9600	
81	163	325	650	1300	2600	5200	10400	
88	175	350	700	1400	2800	5600	11200	
94	188	375	850	1500	3000	**6000**	12000	
100	200	400	800	1600	**3200**	6400	12800	

The 900 through 3200 Hz bandwidths are available in SSB detection mode.

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