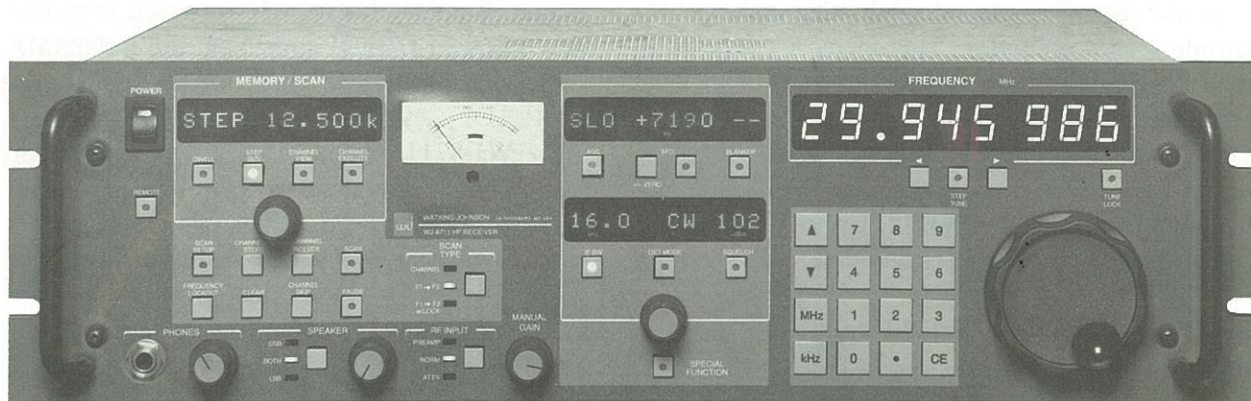


192.00

# Digital HF Receiver

## WJ-8711



## Description

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

Functions such as noise blanking, IF filtering, AGC, demodulation, BFO and passband tuning are accomplished through the use of Digital Signal Processing (DSP) techniques. Filters with superior amplitude and group delay characteristics are achieved with digital stability and repeatability. Standard selectable IF bandwidths are 0.3, 1.0, 3.2, 6.0, and 16.0 kHz. Available detection modes are AM, FM, CW, USB, LSB and ISB. A tunable BFO can be adjusted in 10 Hz steps over a  $\pm 8000$  Hz range and passband tuning is available to further enhance the reception of CW signals. Gain control can be accomplished manually or automatically, with fast and slow AGC modes available. The squelch threshold is adjustable from 0 to  $-135$  dBm or it can be disabled. A noise blanking feature can also be enabled to effectively eliminate the adverse effects of impulsive noise.

## Features

- *Frequency Coverage From 5 kHz to 30 MHz In 1 Hz Steps*
- *High Dynamic Range: +30 dBm Third Order Intercept Typical*
- *Digital Filtering Provides Five or More IF Bandwidths Up to 16 kHz With Exceptional Shape Factors.*
- *AM, FM, CW, USB, LSB and ISB Detection Modes Standard*
- *Fast, Flexible Scanning With 100 Memory Channels*
- *Large Readable LED Displays and User-Friendly Controls*
- *Noise Blanking and Passband Tuning*
- *Internal Switchable Preamplifier and Attenuator*
- *Operator-Selectable RS-232 or CSMA Remote Control*
- *Built-In Self Test*
- *Optional Suboctave Preselector*

In addition to fixed-frequency tuning, the WJ-8711 provides a fast, flexible scanning capability. Three scan modes are available: channel scan, F1-F2 scan and F1-F2 scan with lockouts. For all scan modes, the dwell time can be set from 0.5 to 20 seconds or infinite. In channel scan mode, 100 programmable memory channels are available. Sectors of memory can be specified for individual channel scans, allowing the available memory to be subdivided into multiple search scenarios. The operator can specify certain channels to be skipped without having to delete 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. Up to 100 independent frequency lockouts can be stored.

The WJ-8711 can be operated locally via the front panel or remotely via one of two selectable serial interfaces. Measuring 5.25 inches  $\times$  19 inches, the microprocessor-controlled front panel provides a user-friendly operator interface with dedicated, logically arranged controls and large, easy to read LED displays. **Figure 1** illustrates the organization of the front panel and highlights some of the features available to the local operator.

A majority of the WJ-8711 operator-selectable parameters are controllable and accessible via an RS-232 remote interface. A Carrier Sense Multiple Access with Collision Detection (CSMA) with a limited instruction set interface may be enabled in lieu of RS-232 to allow the WJ-8711 to be controlled using a command protocol similar to several popular consumer receivers. Selection of the active interface is made via an internal switch setting or by front panel entry. The factory should be contacted for a detailed list of remote control commands in order to eliminate any confusion over the extent of the available commands included in each type of interface.

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

The WJ-8711 can be used as a tabletop receiver or mounted in a standard 19-inch equipment rack occupying 5.25 inches of vertical rack space. The internal power supply accepts 97 to 253 VAC, 47 to 63 Hz line power and automatically adjusts to the input line voltage. Total power consumption of the unit is less than 35 watts.

DEDICATED CONTROLS FOR SCANNING AND MEMORY FUNCTION

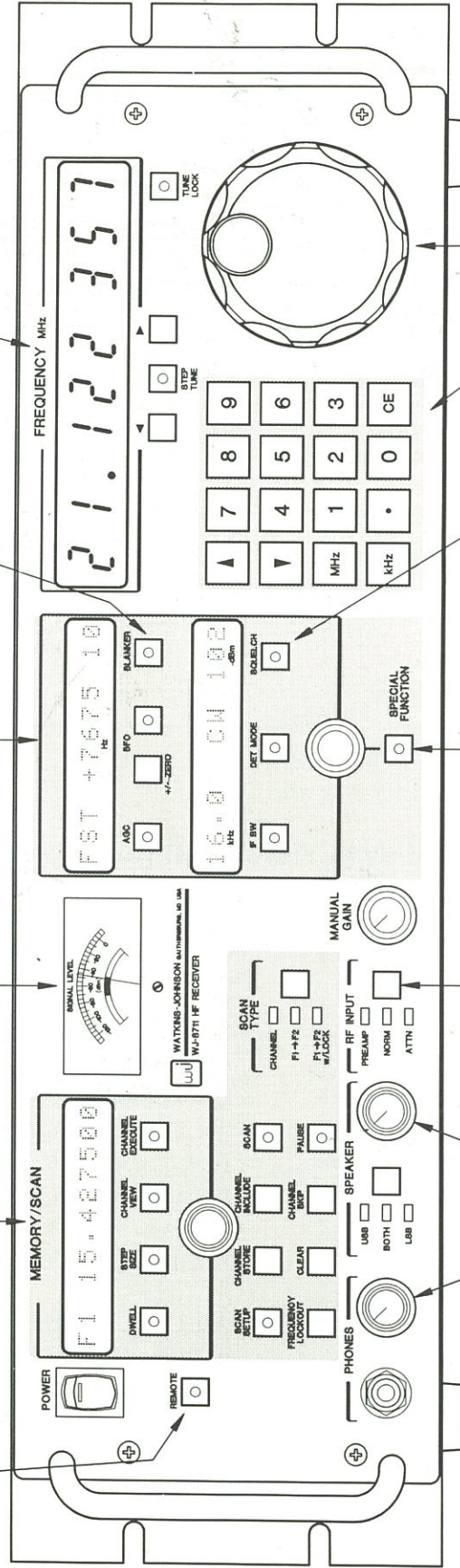
REMOTE CONTROL VIA RS-232 OR CSMA/CD

MOST FREQUENTLY USED FUNCTIONS CONVENIENTLY NEAR THE TUNING CONTROLS

STRENGTH METER CALIBRATED IN dBm

LARGE LED FREQUENCY READOUT TO 1Hz RESOLUTION

PRECISION DSP NOISE BLANKER



SELECTABLE RF INPUT PRE-AMP OR ATTENUATION

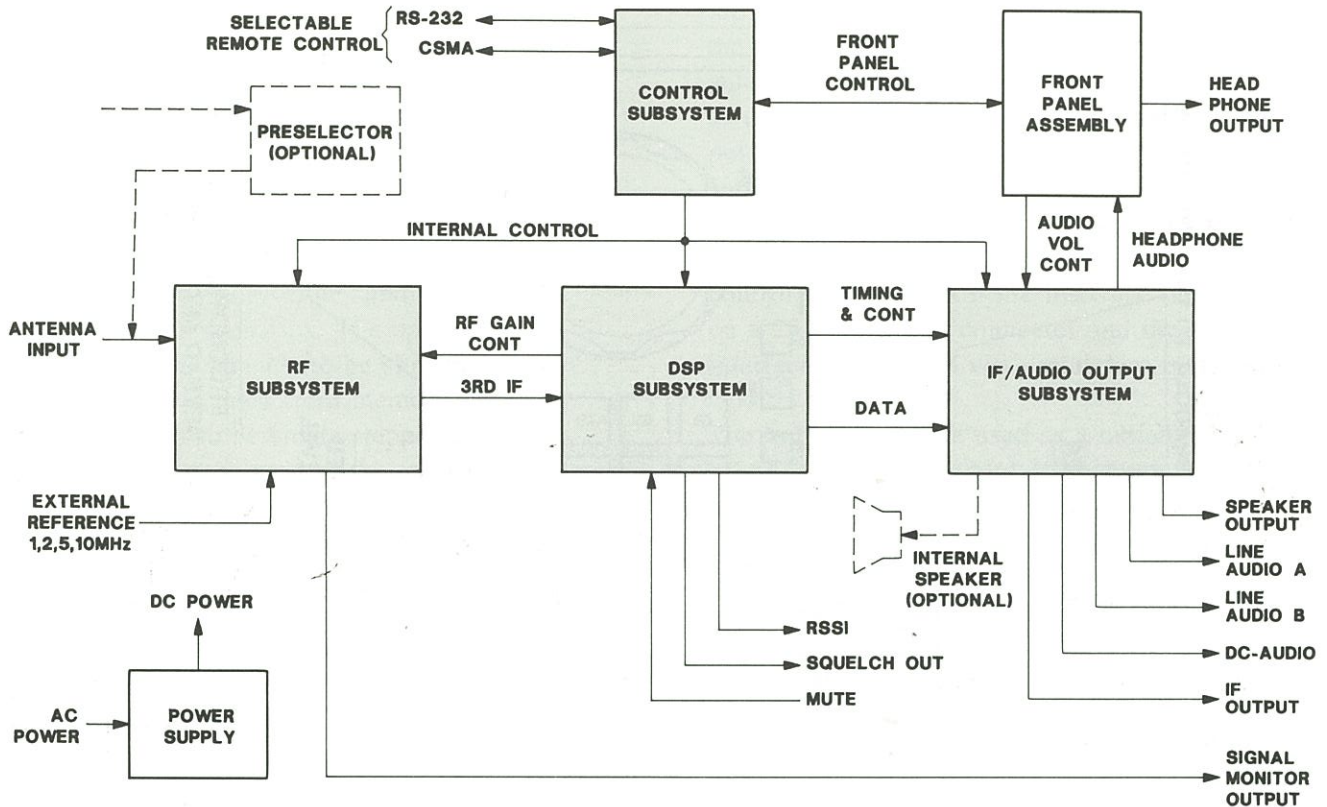
INDEPENDENT SPEAKER AND HEADPHONE CONTROLS

QUICK ACCESS TO AUXILIARY FUNCTIONS SUCH AS PASSBAND TUNING AND BUILT-IN TEST

CALIBRATED SQUELCH LEVEL

ERGONOMICALLY DESIGNED KEYPAD AND TUNING KNOB FOR EASY FREQUENCY ENTRY

Figure 1. WJ-8711 Front Panel Features



**Figure 2. WJ-8711 Functional Block Diagram**

## Functional Description

As illustrated in **Figure 2**, the WJ-8711 can be divided into four functional subsystems: the RF Subsystem, the DSP Subsystem, the IF/Audio Output Subsystem and the Control Subsystem.

**Figure 3** provides a functional block diagram of the RF Subsystem. The 5 kHz to 30 MHz RF signal is applied to the receiver's antenna input, is lowpass filtered and is then either amplified, attenuated or routed to the normal through-path based on user selection. The signal is then mixed 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

bandwidth of the signal to approximately 30 kHz before mixing it with the 40 MHz second LO to produce a second IF at 455 kHz. A sample of this second IF is provided on a rear panel for connection to a signal display unit. After passing through the second IF filter, the signal is mixed 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 which can be locked to an external reference input of 1, 2, 5 or 10 MHz. The WJ-8711 automatically senses and switches to the external reference upon application of signal. All critical timing signals used in the DSP and IF/Audio Output Subsystems are also derived from this reference.

## Specifications

|                              |  |
|------------------------------|--|
| Frequency Range              | 5 kHz to 30 MHz (Tunable to 0 Hz, degraded performance below 500 kHz)  |
| Tuning Resolution            | 1 Hz   |
| Internal Reference Stability | Better than 0.7 PPM (0 to 50°C)  |
| External Reference Frequency | Accepts 1, 2, 5 or 10 MHz ( $\pm 1$ PPM or better, 200 mV p-p into high impedance load). Automatically switches to external reference upon application of signal |
| Synthesizer Lock Time        | Less than 10 msec typical  |

### Antenna Input

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

**Third Order Intercept Point** . . . . . +30 dBm typical, +25 dBm minimum (for signals separated by 50 kHz minimum)

**Second Order Intercept Point** . . . . . +60 dBm typical

**Noise Figure** . . . . . 14 dB maximum (11 dB maximum with preamplifier engaged)

**Detection Modes** . . . . . AM, FM, CW, USB, LSB and ISB (Consult factory for additional demodulation modes)

### Sensitivity (500 kHz – 30 MHz)

| Modulation                   | IF BW    | S + N/N Min      | Without Preamp<br>dBm/ $\mu$ V |
|------------------------------|----------|------------------|--------------------------------|
| AM (50% mod. at 400 Hz)      | 6.0 kHz  | 10 dB            | -103/(1.58)                    |
| FM (4.8 kHz dev. 400 Hz mod) | 16.0 kHz | 17 dB<br>(SINAD) | -99/(2.50)                     |
| USB/LSB/ISB                  | 3.2 kHz  | 10 dB            | -112/(0.56)                    |
| CW                           | 0.3 kHz  | 16 dB            | -116/(0.35)                    |

### CW Sensitivity, 5 kHz – 500 kHz, without Preamp (0.3 kHz IF Bandwidth)

|                  |  |
|------------------|--|
| 50 kHz – 500 kHz | -113/(0.5) dBm/ $\mu$ V typical for 16 dB S + N/N  |
| 20 kHz – 50 kHz  | -105/(1.27) dBm/ $\mu$ V typical for 16 dB S + N/N |
| 5 kHz – 20 kHz   | -78/(28) dBm/ $\mu$ V typical for 16 dB S + N/N    |

### IF Bandwidths

(See typical plots in  
Figure 4, 5, 6)

| 3 dB<br>Bandwidth | (Maximum)<br>Shape Factor<br>(3/60 dB) | (Typical)<br>Group Delay<br>(100% of 3 dB BW) |
|-------------------|--|---|
| 0.3 kHz           | 1.35:1 maximum                         | 50 $\mu$ S                                    |
| 1.0 kHz           | 1.40:1 maximum                         | 30 $\mu$ S                                    |
| 3.2 kHz           | 1.25:1 maximum                         | 30 $\mu$ S                                    |
| 6.0 kHz           | 1.25:1 maximum                         | 40 $\mu$ S                                    |
| 16.0 kHz          | 1.25:1 maximum                         | 60 $\mu$ S                                    |
| USB/LSB/ISB       | 1.25:1 maximum                         | 30 $\mu$ S                                    |

(Consult factory for alternate or additional IF bandwidths)

**IF Output**

|                  |                   |
|------------------|-------------------|
| Center Frequency | .455 kHz, nominal |
| 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 (– 6 dB) minimum       |
| Output Level     | .30 dB above RF input, nominal |
| Output Impedance | .50 ohms, nominal              |
| Connector Type   | .BNC female                    |

**Gain Control Modes**

|                 |   |
|-----------------|---|
| AGC Range       | .Manual, AGC Fast and Slow  |
| AGC Threshold   | .100 dB minimum   |
|                 | .Approximately – 108 dBm (0.9 $\mu$ V) in 16 kHz bandwidth. Approximately – 125 dBm (0.12 $\mu$ V) in 300 Hz bandwidth. (Threshold is matched with IF bandwidth and is typically 10 dB above noise floor) |
| AGC Attack Time | .15 msec typical  |
| AGC Decay Time  | .Fast: 25 msec typical<br>Slow: 4 seconds typical   |

**Selectable Front End Gain/Attenuation**

|                   |                      |
|-------------------|----------------------|
| Preamplifier Gain | .10 dB ( $\pm$ 2 dB) |
| Attenuation       | .15 dB ( $\pm$ 2 dB) |

**Beat Frequency Oscillator (BFO)**

|                   |                 |
|-------------------|-----------------|
| Tuning Range      | . $\pm$ 8000 Hz |
| Tuning Resolution | .10 Hz          |

**Image Rejection** . . . . . 90 dB minimum

**IF Rejection** . . . . . 85 dB minimum, greater than 90 dB typical

**Local Oscillator Phase Noise (See Figure 7)** . . . . . – 110 dBc @ 1 kHz offset, typical

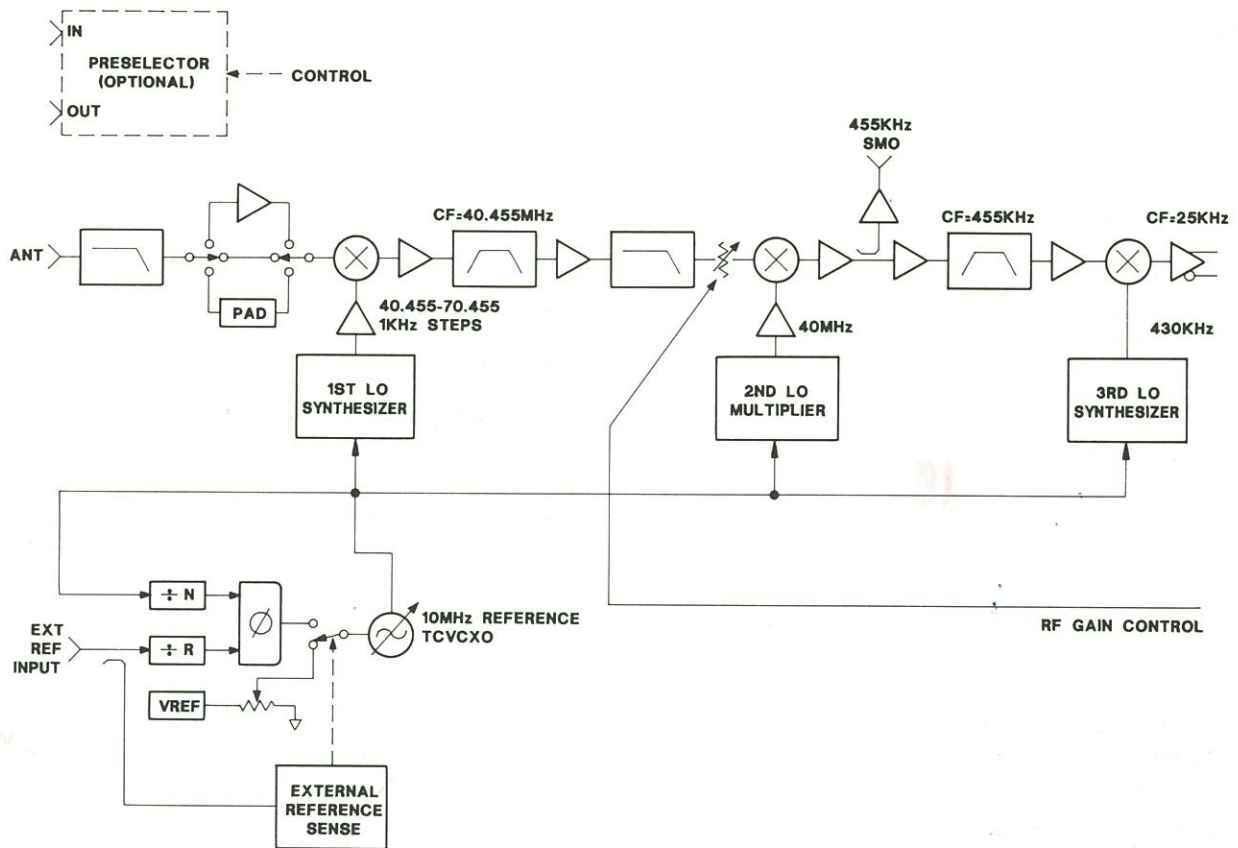
**Reciprocal Mixing** . . . . . With a desired signal of 25  $\mu$ V in the 3.2 kHz IF bandwidth, the desired signal-to-noise ratio is greater than 20 dB, when an undesired signal 70 dB higher in amplitude and 35 kHz removed in frequency is present.

**Cross Modulation** . . . . . With a desired signal of 10  $\mu$ V an undesired signal 86 dB higher, 30% AM modulated produces less than 10% cross modulation for frequency separation of greater than 50 kHz in the 1 kHz IF bandwidth.

**Blocking** . . . . . A 1 watt signal produces less than 5% distortion at the Line Audio and IF outputs.

**Line Audio Outputs**

|                   |   |
|-------------------|---|
| Number of Outputs | .Two center-tapped, balanced outputs. For ISB mode, USB and LSB on separate outputs. For all other modes, audio signal is common to both outputs. |
| Output Level      | .0 dBm nominal into 600 ohm load  |
| Connector Type    | .Screw Terminals  |



**Figure 3. WJ-8711 RF Subsystem Functional Block Diagram**

The DSP Subsystem performs the majority of the signal processing functions within the receiver. The third IF signal from the RF Subsystem is digitized to 16 bits of resolution at a sampling rate of 100 kHz. This digitized IF signal is applied to a programmable DSP chip which 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 Slow or Manual)
- Signal Strength and Squelch Functions
- Signal Demodulation and BFO
- Generation of a Multiplexed Digital Data Stream Containing One or Two 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 are routed 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 are processed to provide a two-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 IF signal is upconverted to 455 kHz, passed through a bandpass roofing filter to remove mixer products, buffered and routed 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 CSMA interface. 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.

## Options

The options for the WJ-8711 include a switched suboctave preselector, and an internally-mounted speaker. Due to the modularity of the design and the inherent flexibility of the DSP techniques employed, many specific customer requirements can be supported. Consult the factory for options such as additional or alternate IF bandwidths, detection modes, Input/Output/Control requirements or mechanical configurations.

### WJ-8711/PRE-Suboctave Preselector

This option provides filtering of the RF input spectrum to reduce broadband signal energy into the receiver and to enhance the second order intermodulation performance. Eleven separate filter bands are provided, each covering a segment of the overall tuning range. The receiver automatically selects the filter band appropriate to the tuned frequency. The operator can bypass the filters if preselection is not desired.

### WJ-8711/SPK-Internal Speaker

This option provides an 8-ohm, 4-inch speaker mounted to the top cover of the receiver. This speaker is internally connected to the same speaker output signal provided at the rear panel of the unit. ISB channel selection and volume control are provided at the front panel. This option can either be factory-installed or provided as a field-installable kit.

## Inputs/Outputs

- Antenna Input (BNC)
- Signal Monitor Output (BNC)
- External Reference Input (BNC)
- IF Output (BNC)
- Line Audio Output A (Terminal Block)
- Line Audio Output B (Terminal Block)
- Speaker Output (Terminal Block)
- DC-Coupled Audio Output (Terminal Block)
- Received Signal Strength Indicator (Terminal Block)
- Squelch Output (Terminal Block)
- Mute Input (Terminal Block)
- CSMA Remote Interface (Miniature Phone Jack)
- RS-232 Remote Interface (25-Pin Female D-Shell)
- Power Input (IEC 3-Pin)
- Headphone (Standard 1/4" Stereo)



### Speaker Output

|                           |   |
|---------------------------|---|
| Number of Outputs         | One output. For ISB mode, USB and LSB can be selected individually or combined. (Internal Speaker optional) |
| Bandwidth                 | 100 Hz to 13 kHz  |
| Output Level              | Adjustable up to 1 watt into 8 ohm load   |
| Total Harmonic Distortion | Less than 3% at 1 watt  |
| Connector Type            | Screw terminals   |

### Headphone Output

|                   |  |
|-------------------|--|
| Number of Outputs | Two unbalanced outputs. For ISB mode, one output contains USB (left channel), the other contains LSB (right channel). In all other modes, the audio signal is common to both outputs |
| Output Level      | Adjustable up to 10 mW into 600 ohm load   |
| Connector Type    | Standard 1/4" 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                     |
| CSMA                         | Carrier Sense/Multiple Access with Collision Detection; half duplex; rear panel miniature phone jack |
| Baud Rates (Both Interfaces) | 75, 150, 300, 600, 1200, 2400, 4800 and 9600; selectable by internal switches or front panel entry.  |

### Environmental

|                          |                     |             |       |
|--------------------------|---------------------|-------------|-------|
| 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°C to +50°C

Storage Temperature . . . . . -40°C to +70°C

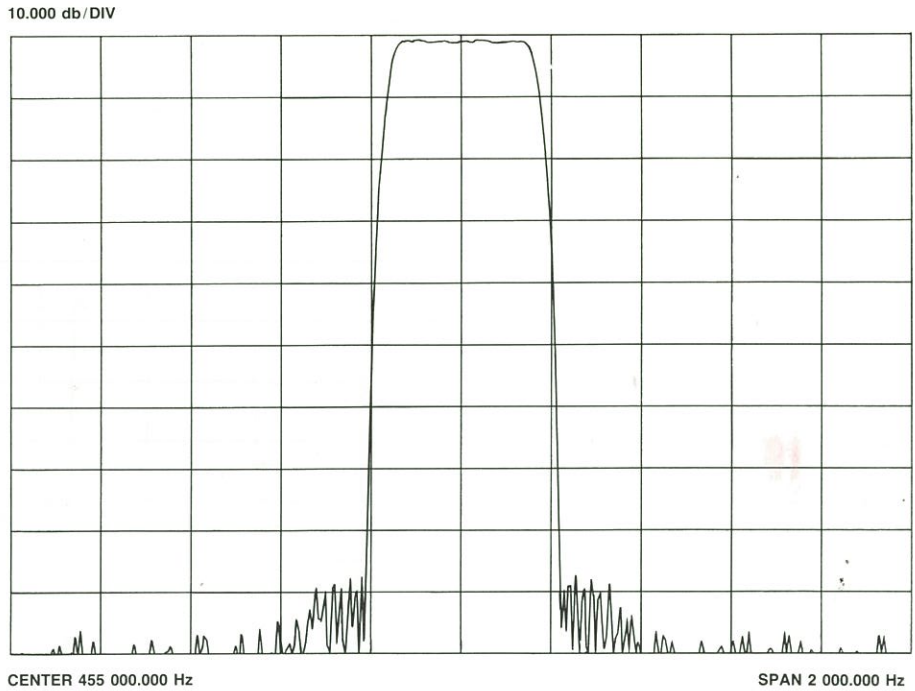
Humidity . . . . . 10 Cyclic days (240 Hrs.) Procedure III for Continuous Exposure to 95% RH.

Altitude . . . . . 50,000 ft. non-operating  
24,000 ft. operating

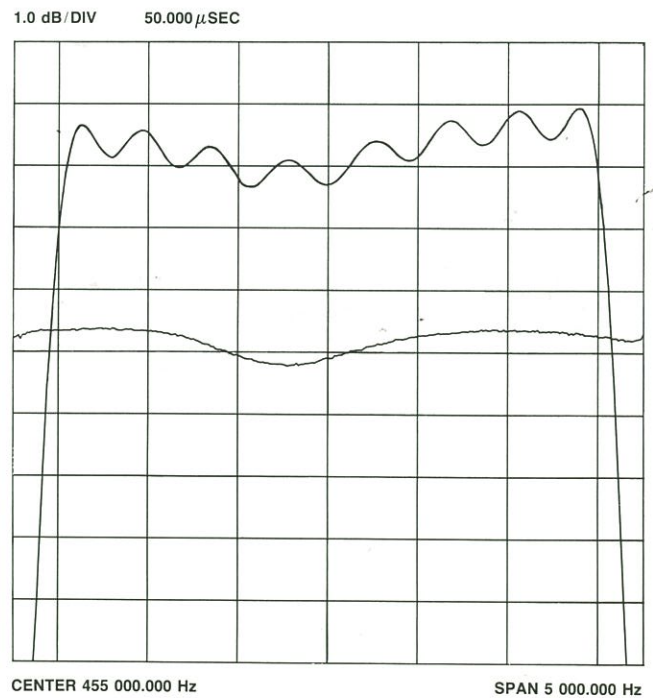
Vibration<sup>(1)</sup> . . . . . A. Basic Transportation (Secure Cargo)  
Category 1 – Random Vibration 1.04G's  
Non-Operating – 2 Hours.  
B. Ground Mobile (Wheeled or Tracked Vehicle)  
Category 8 – Random Vibration 6.0G's Operating  
15 Minutes.  
C. Marine (Shipboard) Vessel not specified  
Category 9 – Random Vibration 1.0G's Operating  
2 Hours.  
D. Environmental Stress – NAVMAT-P-9492  
Random Vibration 6.0G's Operating 15 Minutes  
for Design Qualification. 3.0G's Non-Operating  
10 Minutes for Production Screening (ESS).

|                                      |  |
|--------------------------------------|--|
| <b>Shock<sup>(1)</sup></b> . . . . . | . Bench Handling (Field Service) 8 drops total onto a horizontal hard wooden surface – operating.          |
| <b>MTBF</b> . . . . .                | . In excess of 14,000 hrs. Estimated in accordance with MIL-HDBK 217E for Ground Fixed; +40°C environment. |
| <b>Power Requirements</b> . . . . .  | . 97 to 253 VAC, 47 to 440 Hz  |
| <b>Power Consumption</b> . . . . .   | . 35 watts typical with options  |
| <b>Dimensions</b> . . . . .          | . 5.25 × 19.0 × 16.0 inches (excluding connectors and controls)  |
| <b>Weight</b> . . . . .              | . Less than 12 pounds  |

<sup>(1)</sup> All vibration and shock testing was accomplished without the use of isolation mounts. Unless otherwise specified, the vertical (Z) mounting axis was the direction of applied force.

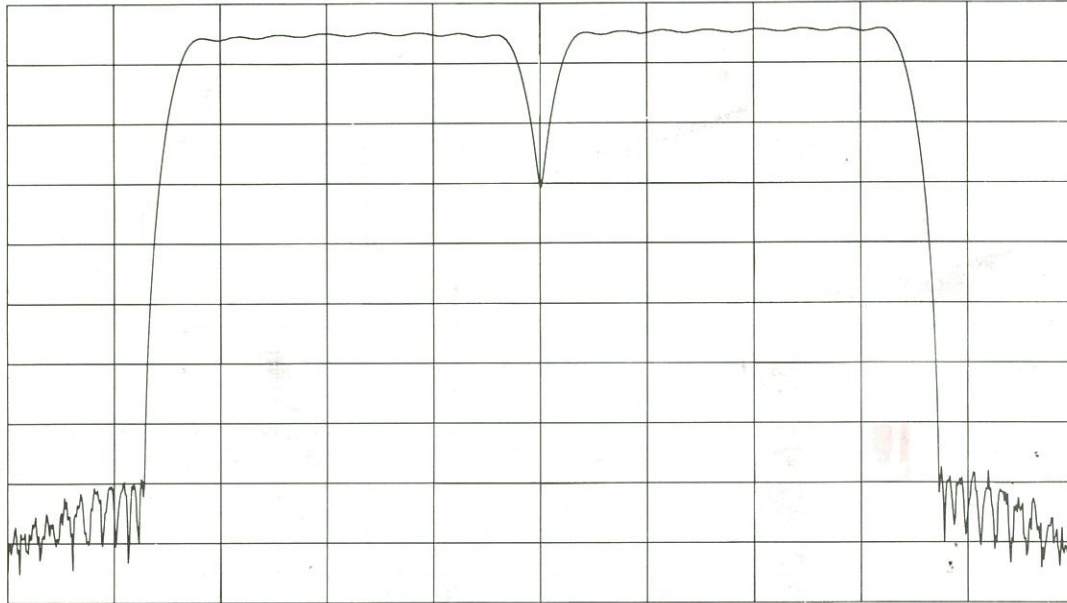


**Figure 4. WJ-8711 Typical 300 Hz IF Filter Amplitude Response**



**Figure 5. WJ-8711 Typical SSB IF Filter Group Delay and Passband Ripple**

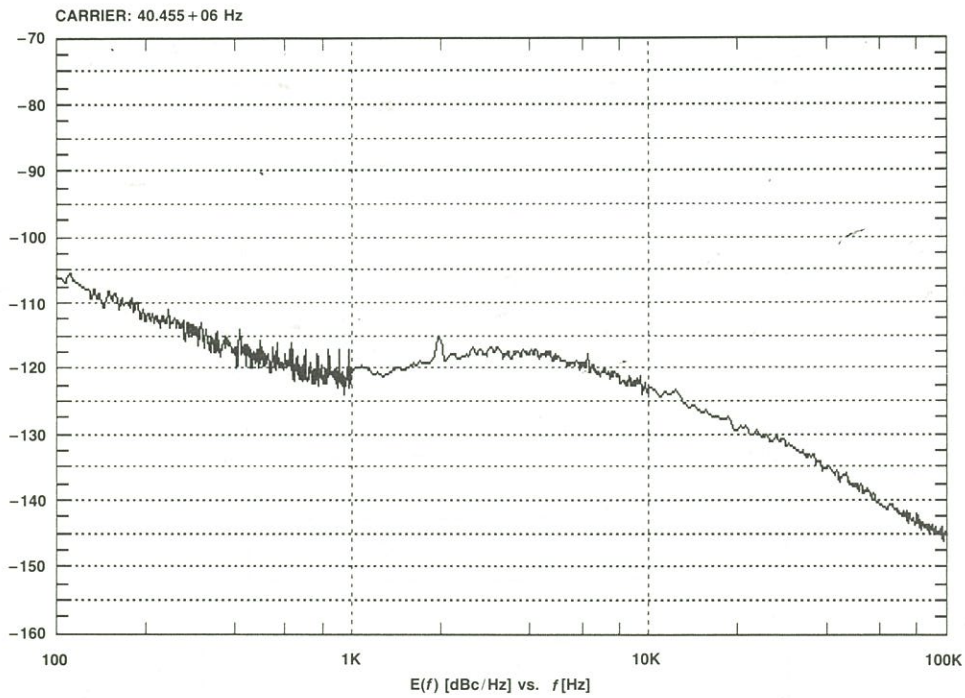
10 dB / DIV



CENTER 455 000.000 Hz

SPAN 10 000.0 Hz

**Figure 6. WJ-8711 Typical ISB (USB/LSB) IF Filter Amplitude Response**



**セキテクノトロン株式会社**  
**SEKI TECHNOTRON CORP.**

本社/〒103 東京都中央区日本橋小網町16-16 ☎(03)3669-4121(代)

●お問い合わせ、資料のご請求は： **電子システム部**

アプリケーション・ラボ/〒135 東京都江東区木場5-6-30 ☎(03)3820-1711(代) FAX(03)3820-1729  
テクニカル・センター/〒193 東京都八王子市千人町3-2-6 ☎(0426)64-3011 FAX(0423)64-3051  
大阪営業所/〒564 大阪府吹田市江坂町1-12-28 ☎(06)386-1232 FAX(06)386-7033  
米国現地法人/SEOCAL, INC. カリフォルニア州ハロアルト市 ☎(415)322-0790 FAX(415)322-7059