WATKINS-JOHNSON

174.05

WJ-8605 VHF/UHF SURVEILLANCE RECEIVER

FEATURES

- **20 to 512 MHz Frequency Range**
- **High Dynamic Range**
- **Low Phase Noise**
- **200 Microsecond Switching Speed**
- **Small Size: 1.65 Inches × 6.5 Inches × 10.5 Inches**
- **Modular Construction: Four Circuit Boards Using Surface Mount Technology**
- **Low Power: 18 Watts**
- **Light Weight: 5 Pounds**
- **High Linearity Demodulators**
- **Self Test of Power Supply and Synthesizer Operation**

DESCRIPTION

The WJ-8605 is a small, lightweight VHF/UHF receiver for use in limited space applications. This receiver's compact size, fast tuning speed, and flexible capabilities with one remote control interface, provide a multitude of systems applications. It features the high dynamic range, low phase noise, large signal handling, and selectivity of larger receivers, achieving an outstanding third order intercept point of +5 dBm while maintaining a typical noise figure of only 8 dB.

The fully synthesized, low phase noise local oscillators provide fast, accurate tuning over the basic range of 20 to 512 MHz. When tuned, the local oscillators settle to within 10 kHz of the selected frequency in less than 200 microseconds for any frequency step. Although the receiver is not specified for operation below 20 MHz, tuning to 2 MHz is allowed for applications where modest HF performance is acceptable. An additional feature of the WJ-8605 is its ability to select an increased tuning speed mode designated as TURBO. When Turbo is selected, the settling time of the local oscillators is reduced by approximately 50 percent, resulting in 100-microsecond switching. However, the phase noise at offsets between 20 kHz and 200 kHz is increased by approximately 6 to 10 dB.

Selectivity is provided by two IF bandwidths—25 and 50 kHz. These filters are Gaussian type to complement the fast tuning capability of the receiver. IF selectivity is also enhanced by additional post-filtering which results in the ultimate rejection of out-of-band signals by more than 100 dB.

Demodulation modes include AM and FM. The AM detector uses a synchronous delay line technique that is

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responsible for greater than 35 dB linear AM. In FM, a crystal discriminator is used for stable center frequency detection. Simultaneous AM and FM are available as well as a 60-dB Log display output, which can be monitored to determine input signal levels and gain adjustments required.

Two IF outputs are provided with the receiver. The signal monitor output provides nominally 10 dB of gain above the RF input with 10 MHz of bandwidth. The selected IF bandwidth output provides a sample of the predetected 21.4 MHz IF at nominally 85 dB above the RF input. Manual Gain Control is available with over 90 dB of range to adjust the output signal levels for post-processing. Automatic gain control is not available.

MODES OF CONTROL

Control of the WJ-8605 is via a 16-bit parallel bus and two receiver handshake lines. The following parameters may be controlled via this bus:

- Frequency (Upper and Lower Bytes)
- Bandwidth (25 kHz/50 kHz)
- RF Attenuation, 0 to 90 dB
- Detection (AM/FM)
- Turbo (100 Microsecond Tuning Mode)
- Tuning Speed (100/200 Microseconds)

All commands and data are implemented in a binary format.

RECEIVER INPUTS/OUTPUTS

- Antenna Input (SMA)
- DC Input (Multipin)
- Selected Video Output (SMB)
- FM Monitor Output (SMB)
- Phone Output 1/8" Miniature Stereo Jack
- Signal Monitor Output (SMB)
- Selected 21.4 MHz IF Output (SMB)
- Switched Audio Output (SMB)
- Line Audio Output (SMB)
- Parallel Data Input (Subminiature D)
- Log Display (SMB)

CAPABILITIES/APPLICATIONS

The WJ-8605 is intended to be used in high speed acquisition, high probability of intercept systems. Its fast tuning and high dynamic range make it useful as either a master acquisition receiver or as a fast handoff receiver. Portable surveillance subsystems are easily built using the WJ-8605. The small size and low weight are particularly attractive when configuring man-portable systems. This receiver is also well suited for applications where low EMI/RFI emissions are important.

FUNCTIONAL DESCRIPTION

A simplified receiver block diagram is shown in Figure 1. Referring to Figure 1, the RF input signal passes through an RF amplifier and low-pass filter before entering the first mixer where it is mixed with the first local oscillator and upconverted to 692 MHz.

The first local oscillator tunes from 694 MHz to 1204 MHz in 2-MHz steps. The upconverted IF signal at 692 MHz is amplified and filtered before it enters the second mixer where it is mixed with the second local oscillator which tunes from 668.6 MHz to 670.6 MHz in 100-Hz steps. The output from the second mixer is centered at 21.4 MHz and is filtered and amplified before entering the switchable IF bandwidth filters. A sample of the prefiltered signal is provided for the signal monitor output at a 10-MHz bandwidth determined by the first IF filter and the final IF roofing filter.

After the signal is filtered in the selected IF filter, it passes through several stages of IF amplification and gain control. A sample of the band-limited IF signal is provided at approximately 85 dB above RF input. Synchronous AM detection and a crystal discriminator in FM provide highly linear and stable demodulation.

RECEIVER LED INDICATORS

- Power
- LO Lock

SPECIFICATIONS

Frequency Range	20 to 512 MHz. Tuning allowed to 2 MHz
Tuning Resolution	100 Hz, synthesized
Internal Reference Accuracy	±1 part in 10E –6 (0 to 50 °C)
Detection Modes	AM, FM
RF Input Impedance	50 ohms nominal
Input VSWR	2.0:1 typical, 3.0:1 maximum at the tuned frequency
Noise Figure	8 dB typical, 11 dB maximum
Intermodulation:	
2nd Order Intercept Point	+20 dBm minimum
3rd Order Intercept Point	+5 dBm
Image Rejection	80 dB minimum
IF Rejection:	
21.4 MHz	80 dB minimum
691 MHz	80 dB minimum

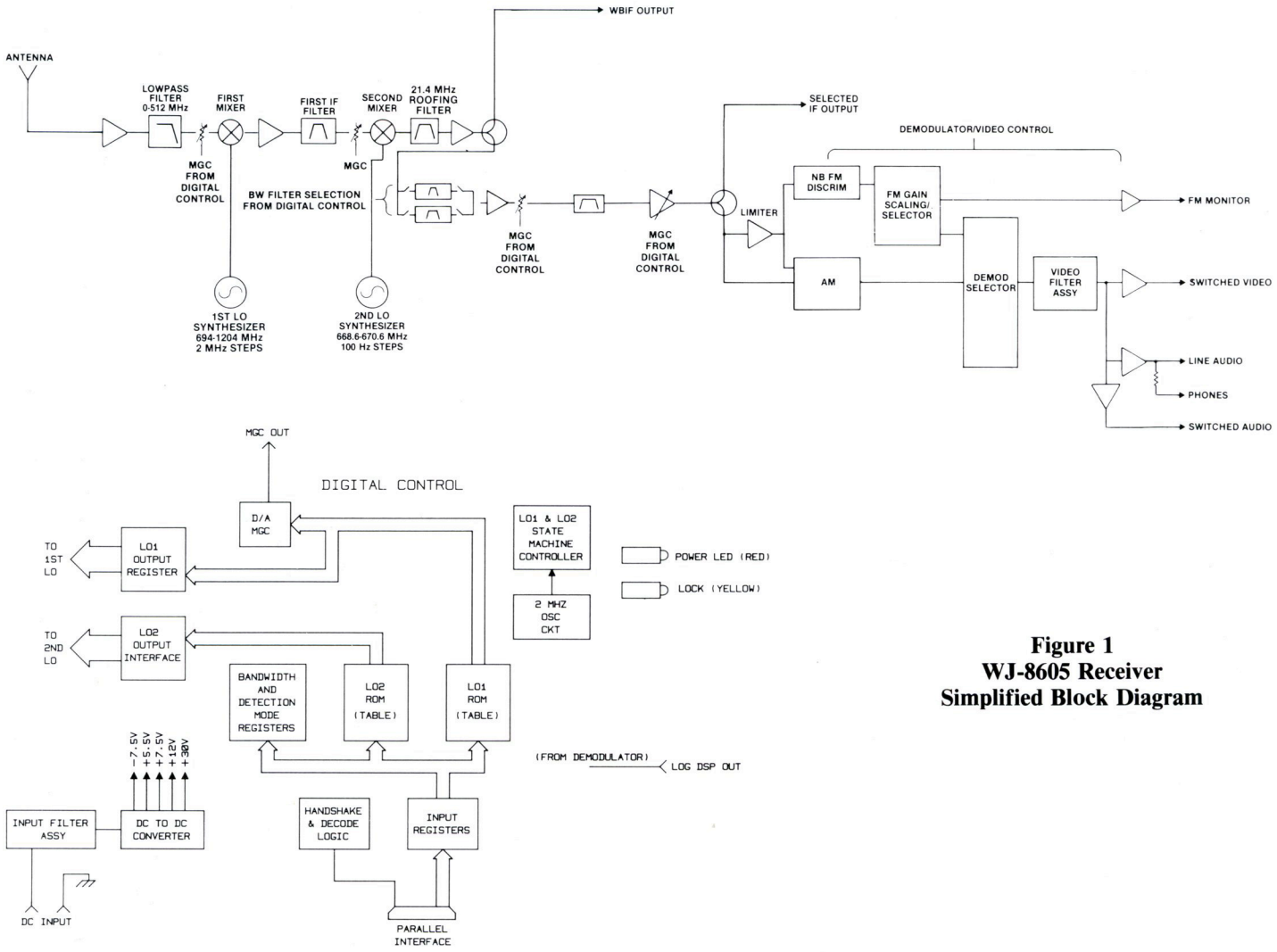

Figure 1
WJ-8605 Receiver
Simplified Block Diagram

LO Phase Noise at 20 kHz Offset	−95 dBc/Hz
Synthesizer Tuning Speed	200 microseconds maximum (from receipt of the last data byte to within 10 kHz of the final frequency) 300 microseconds to within 1 kHz 500 microseconds to within 100 Hz
Signal Monitor Output	Nominally 10 dB above RF input
Gain Control	Manual, 90 dB minimum range
Internally-Generated Spurious	Less than −110 dBm equivalent input
LO level at RF Input	−100 dBm typical, −90 dBm maximum
Switched Video Output	0.5 volts peak-to-peak into 50 ohms (30 percent deviation in FM or 50 percent AM modulation)
Video Frequency Response	DC to 1/2 the IF bandwidth, −3 dB
Line Audio Output	5 mW minimum into 32 ohms
Headphone Output	5 mW minimum into 32 ohms
Switched Audio Output	400 mV RMS into 600 ohms
Audio Frequency Response	200 Hz to 15 kHz minimum
Ultimate FM S+N/N	44 dB minimum in a 50 kHz bandwidth
Reciprocal Mixing	With an input at rated sensitivity level in a 25 kHz bandwidth, an out-of-band signal 350 kHz removed and 60 dB higher in level will not degrade the S+N/N of the desired signal by more than 3 dB

Selected IF Output	Centered at 21.4 MHz, −20 dBm nominal output level
IF Bandwidths	25 kHz and 50 kHz, Gaussian
IF Shape Factor	See Table 1
Weight	5 pounds nominal
Dimensions	1.65″ × 6.5″ × 10.5″
Power Requirements	12 volts DC (+9 to 16 VDC)
Power Consumption	18 watts nominal
Maximum RF Input Without Damage	+20 dBm

TABLE 1

3 dB Bandwidth (kHz)	Shape Factor 60:6 dB BW	Sensitivity (dBm)* 20 to 512 MHz
25	3:1	−100
50	3:1	−97

*Sensitivity Conditions: Based on 20 to 512 MHz receiver.

AM—An input signal AM modulated 50 percent by a 1-kHz tone will produce a minimum video output S+N/N ratio of 10 dB.

FM—An input signal FM modulated at a 1-kHz rate with a peak deviation equal to 30 percent of the selected IF BW will produce a minimum video output S+N/N ratio of 17 dB. (Note: A 400-Hz modulation rate is required for IF bandwidths of 10 kHz or less.)

ENVIRONMENTAL SPECIFICATIONS

Temperature	
Operating Temperature Range	−25 to +55 °C. See Figure 2 for typical performance
Full Specification Compliance	+20 to +30 °C
Non-operating	−40 to +70 °C
Shock	Meets the environmental conditions of MIL-E-5400T, paragraph 3.2.24.6.1 pertaining to equipment shock
Vibration	Meets the environmental conditions of MIL-STD-810D, method 514.3, section I-3.2.4, category 4—propeller aircraft. Figure 514.3-25(a) defines the power spectral density with Li = 0.3 (g^2/Hz), and Fi = 68 Hz
Humidity	95% relative humidity non-condensing

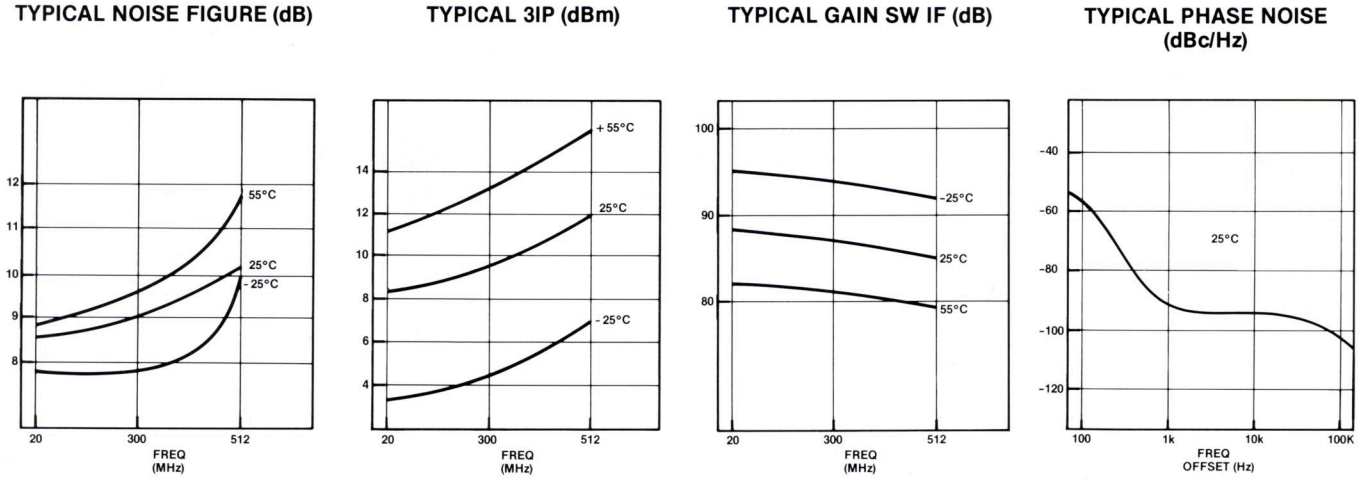

Figure 2
Typical Performance Graphs

REMOTE COMMANDS STRUCTURE

The Remote Commands Structure consists of:

- 16-Bit Data Bus
- Two Handshake Lines
- One Ground

16-Bit Data Bus Format

Commands	Bus															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FRQLB/EXC	0	0	[. . . . . frequency in 100 Hz, 0-9999 . . . . .]													
FRQUB	0	1	0	0	0	[frequency in 1 MHz, 0-512 . . . . .]										
RCVCNTL/EXC	1	0	0	[T]	0	0	0	0	1	0	[	BW data	][	DET	]	
ATN/EXC	1	0	1	0	0	0	0	0	0	[	. . . . . ATN data					]

FRQLB/EXC = Lower word frequency (0 to 9999 in 100 Hz) and execute frequency command.
FRQUB = Upper word frequency (0 to 512 in MHz) command.
RCVCNTL/EXC = Receiver control and execute command.

[BW data] = 0 0 0 ⟶ not used
0 0 1 ⟶ Bandwidth 1, 20 kHz
0 1 0 ⟶ Bandwidth 2, 50 kHz
0 1 1 ⟶ not used
1 0 0 ⟶ not used
1 0 1 ⟶ not used
1 1 0 ⟶ not used
1 1 1 ⟶ not used

[DET] = 0 0 0 ⟶ AM
0 0 1 ⟶ FM

[T] = 1 ⟶ Turbo
0 ⟶ Normal

ATN/EXC = Attenuation and Execute command.
= [ATN data] = 0 to 90

Two Handshake Lines

- DAV Input: This line indicates data is valid from the controller.
- NDAC Output: This line indicates data is accepted by WJ-8605.