Technical Data

WATKINS-JOHNSON

April 1997

Multichannel Digital Tuner
WJ-9104A Series

The WJ-9104A series of Multichannel Digital Tuners provide up to eight RF channels, with a center frequency range of 25 to 2000 MHz (tunable 10 to 2600 MHz), with a maximum tuning speed of 60 microseconds. The standard unit is the WJ-9104A-6. The WJ-9104A is suitable for various applications, which include precision DF, rapid signal analysis, and antenna beamforming. Amplitude and phase distortion within each channel is minimized, as is amplitude and phase mismatch among channels.

An operator can configure the tuner channels via remote control to tune independently, or in a phase-coherent Direction Finding (DF) mode where channels share common Local Oscillators (LOs). In either operating mode, each tuner channel provides a digitized 10-MHz instantaneous IF bandwidth (IFBW) sampled at 25.6 MHz with 12 bits of precision.

A high-speed Small Computer System Interface (SCSI-2) handles remote operation and control of the WJ-9104A-X. A Direct-tuning Control interface allows precision triggering and timing. The unit configuration may include either an ac or dc power supply. It consumes

Features

- ❑ *Up to 8 phase-coherent or independently tunable channels*
- ❑ *Center frequency range of 25 to 2000 MHz (tunable 10 to 2600 MHz)*
- ❑ *75-dB Spur-free Dynamic Range (SFDR)*
- ❑ *60 μs tuning speed*
- ❑ *10-MHz instantaneous BWs (others available)*
- ❑ *Digitized IF outputs from each channel at 12 bits of precision*
- ❑ *Low phase & amplitude mismatch among channels*
- ❑ *SCSI-2 remote control*

HEIGHT 5.25 in (13.3 cm) ***DEPTH** 25 in (63.5 cm)
WIDTH 19 in (48.3 cm) **WEIGHT** 70 lbs (31.7 kg)

* Including handles & connectors, fitted for standard EIA 19-in slides

Restricted International Distribution

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Printed in the U.S.A.

700 watts when fully loaded. The WJ-9104A-X is packaged in a single, standard, full-rack chassis, and weighs less than 70 pounds (31.7 kg) fully loaded.

Functional Description

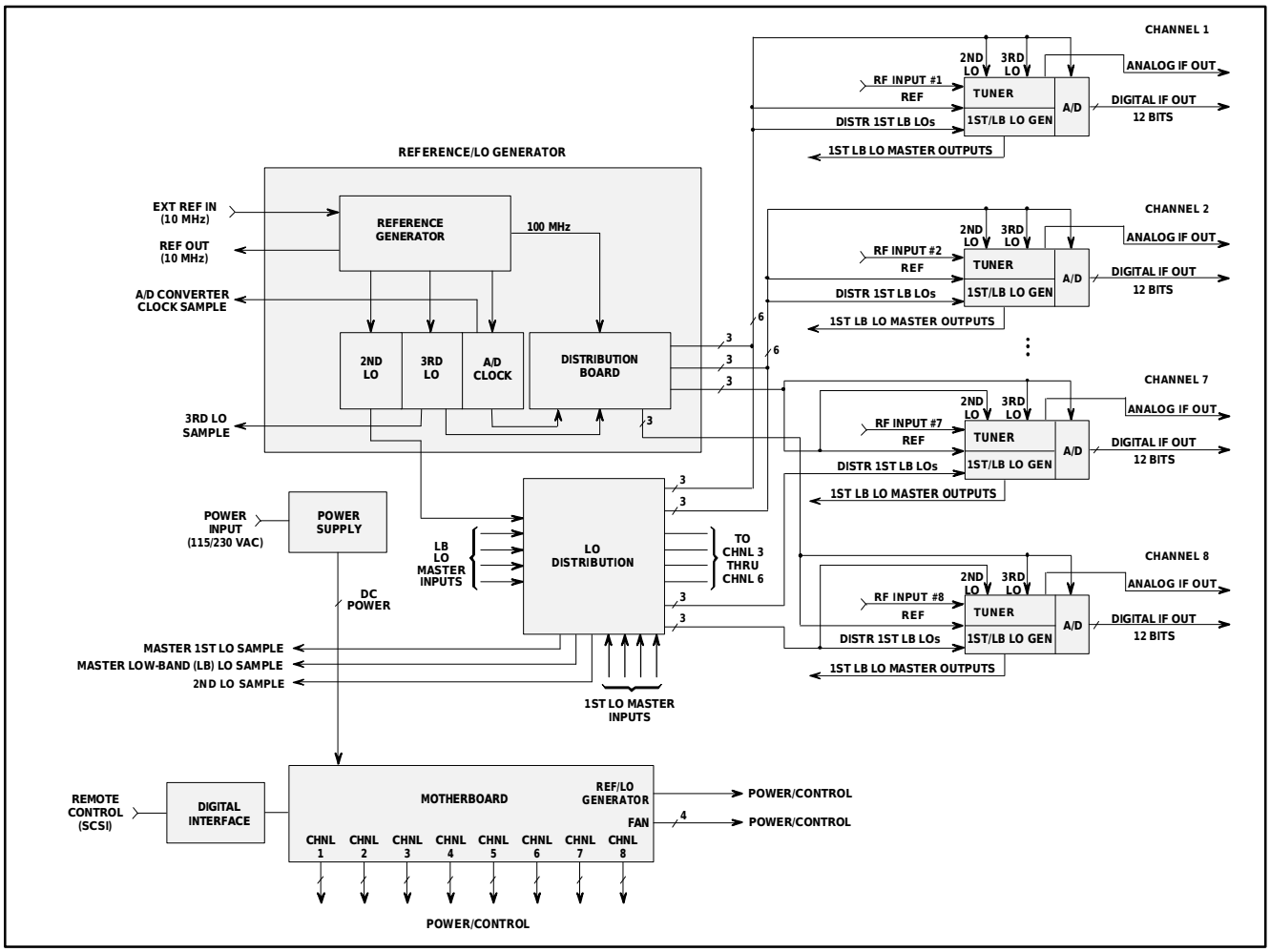
WJ-9104A-6 consists of a:

- Reference/LO Generator Module
- LO Distribution Module
- Digital Interface Board
- Motherboard
- Power Supply
- Up to eight Digital Tuner Modules (WJ-9104A/DTM-X)

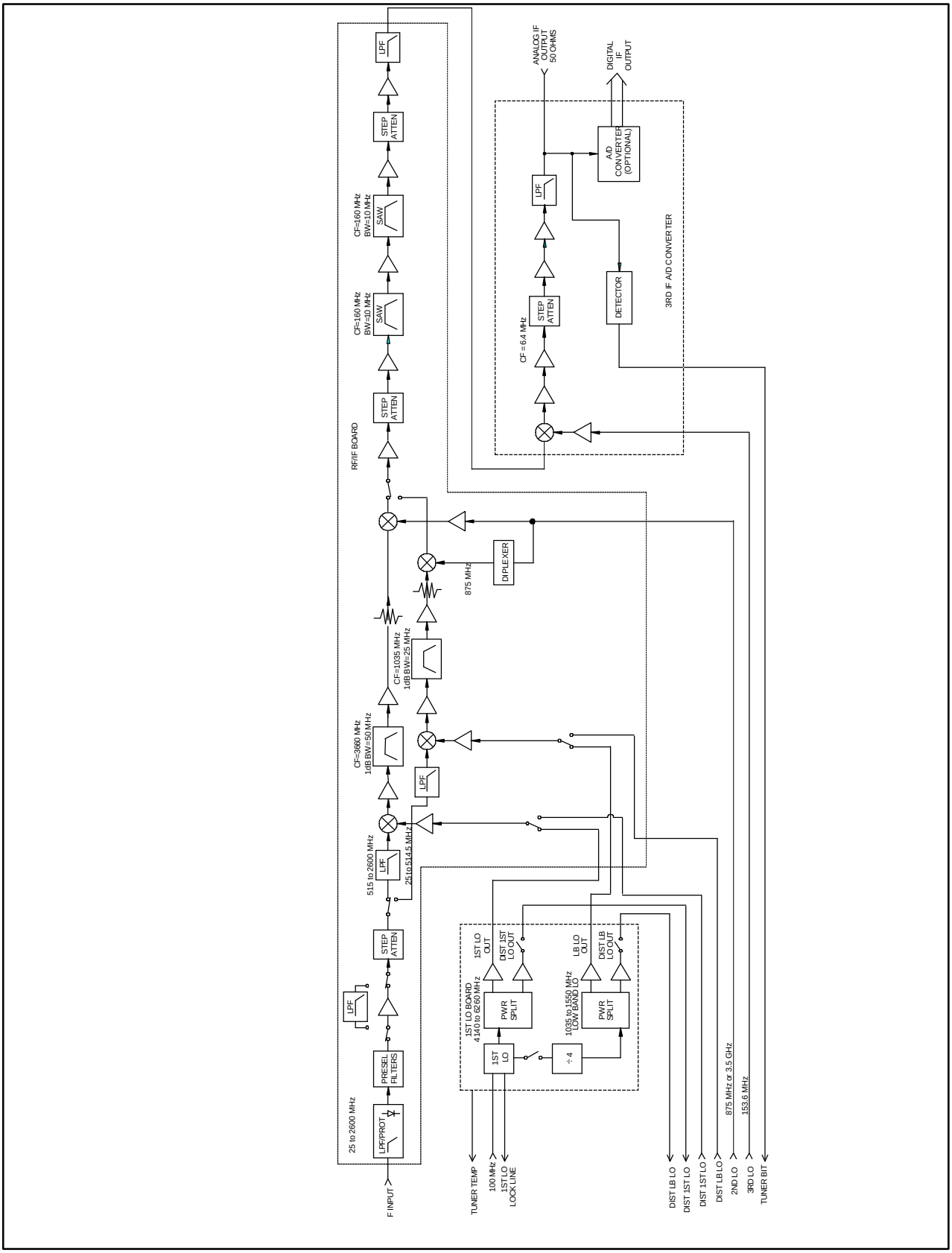
The diagram of an individual WJ-9104A/DTM-6 shows the design as a three-stage superheterodyne receiver followed by a high-speed analog-to-digital (A/D) converter. Each tuner module contains suboctave preselectors (20 to 2600 MHz), 40 dB of RF gain control, 40 dB of IF gain control, first- and low-band LOs, and an A/D converter. The WJ-9104A-6 mainframe provides power, control, frequency reference, second and third LOs, and the sampling clocks for the A/D converters. Each tuner module digitizes a 10-MHz IFBW at 25.6 MHz with 12 bits of precision. The presampled analog IF signal is also an output.

Other Configurations

The WJ-9104A design supports a variety of configurations. By changing the LO distribution scheme, the unit can support up to four dual-channels, or a combination of dual-channels and independent channels. Contact the factory to discuss substituting IFBWs, sample rates, or removing A/D converters. See table on page 6 for a few possible configrations.



WJ-9104A-6 Multichannel Wideband Digital Tuner Block Diagram



WJ-9104A/DTM-6 RF-path Block Diagram

Specifications for WJ-9104A-6

Architecture

Eight independently tunable digital tuners, any number of which are configurable for phase-coherent DF operation.

Tuning

Center Frequency Range	**25 to 2000 MHz (tunable 10 to 2600 MHz) Suboctave preselection across entire range**
Tuning-step Size	**500 kHz**
Tuning Speed	**60 µSec, max to within 1.5 kHz (between any 2 frequencies in same band)**
Reference Frequency	
Accuracy	**5 x 10^{-7} over 0 to +50°C**
Aging	**1 x 10^{-6} parts per year**
External-reference Input	**10 MHz at 0 dBm nominal, 50 ohms**
Remote Control	**SCSI-2**

Gain

Overall Gain	**49 dB, ±3 dB**
Gain Control	
Range	**60 dB in 2-dB steps**
Accuracy	**0.5 dB or 6% of attenuation setting, whichever is greater; attenuation shall be monotonic**
Settling Time	**50 µS, max**

RF Inputs

Impedance	**50 ohms, nominal**
VSWR	**2.5:1, max**
Input Power without Damage	**+30 dBm**
RF Input Level for Full-scale Output	**-43 dBm, ±3 dB (at max gain setting)**
Re-radiation	**< -90 dBm, 1 to 2000 MHz < -80 dBm, 2 to 6 GHz**
Input Intercept Point[1] (min)	
Out-of-band input 2nd-order	**+55 dBm**
Out-of-band input 3rd-order	**+15 dBm, measured for 2 signals separated by 60 MHz**

Baseband Outputs

Center Frequency	**6.4 MHz**
Instantaneous Bandwidth (2.5-dB)	**10 MHz, nominal**
Ultimate Rejection	**80 dB at frequencies ≥7.8 MHz from the center frequency**
Passband Amplitude Variation	**3 dB, max over 95% of the 10-MHz passband at 25°C**
Passband Phase Variation	**50°, max over 95% of the 10-MHz passband at 25°C**

[1] **For two tones outside the 1st IF filter.**

Full-scale Analog Output Sample Level

A/D converter bypassed	+6 dBm, nominal
A/D converter installed	-20 dBm (26 dB below A/D converter full-scale input)

Digital Output

Clock rate	25.6 MHz, derived from internal reference
Format	Parallel 12-bit differential ECL, two's complement binary; differential ECL Data Valid clock
Sample Outputs	1st LO Master Lowband LO Master 2nd LO 3rd LO A/D converter clock 10-MHz reference

Dynamic Performance

Spur Levels (max)

Internally Generated	Fixed- tuned spurs: 12 or Less below -95 dBm per channel. All other below -115 dBm, referenced to the RF input

SFDR at Digital IF Output, Max Gain

Equivalent Full-scale Ouput Level	+6 dBm, typical
Single-tone SFDR (-1 dBFS Output)	-75 dBFS
Two-tone SFDR (-7 dBFS Output)	-75 dBFS
Noise Figure (max)	15 dB, 25 to 514.5 MHz 16 dB, 515 to 2000 MHz

Phase Noise (max)

	25 to 500 MHz (dBc/Hz)	500 to 2000 MHz (dBc/Hz)
1 kHz	-100	-100
10 kHz	-110	-110
100 kHz	-118	-110
1 MHz	-118	-110
>10 MHz	-130	-125

Rejection

IF	>80 dB
Image	>80 dB
Channel-to-channel Isolation	>60 dB, Phase-coherent DF Mode >80 dB, Independent Mode
Power Requirements	115/230 Vac, ±10%, 50 to 60 Hz (single phase)
Power Switch	Illuminated, front panel
Power Consumption	700 W, max

Temperature Range

Operating	0 to +50°C
Full Specification Compliance	0 to +40°C
Storage	-30 to +55°C
Cooling	Inlet air through filters on front panel Exhaust air through rear panel
Altitude	Operational at 10,000 ft (Maximum ambient +30°C)

Physical Characteristics

Emissions	**Designed to meet MIL-STD-461C requirements**
Shock/Vibration	**Designed to function when subjected to vibrations as specified by MIL-STD-810E (method 516.4, procedure VI)**

Tuner Connectors

I/O	Function	Type
Inputs	**RF** **10-MHz External Reference** **AC Power**	**1 SMA per channel** **1 SMA** **1 Standard IEC ac power**
Outputs	**Digital IF** **Analog IF Sample** **Internal 10-MHz Reference** **First-LO Master Sample** **Low-band LO Master Sample** **2nd-LO Sample** **3rd-LO Sample** **A/D Converter Clock Sample** **SCSI Remote Interface Daisychain**	**1 Amplimite 0.050 SCSI-2 per channel** **1 SMA per channel** **1 SMA** **1 SMA** **1 SMA** **1 SMA** **1 SMA** **1 SMA** **1 Amplimite 0.050 SCSI-2**
Bidirectional	**SCSI Remote Interface** **Direct-tuning Control**	**1 Amplimite 0.050 SCSI-2** **1 subminiature 15-pin high-density *D***

Some Possible Configurations

# of Channels X IFBWs (MHz)	IF Output	Power	Internal Configurations
8 x 10	**Analog**	**28 Vdc**	**8 channels (Independent or any number of DF)**
5 x 10	**Analog or Digital**	**115 Vac (50 Hz)**	**2 dual channels, 1 independent channel**
8 x 10	**Digital**	**115 Vac (400 Hz)**	**8 channels (independent or any number of DF)**
8 x 10	**Digital**	**115 Vac (400 Hz)**	**4 dual channels**
8 x 2	**Digital**	**115 Vac (400 Hz)**	**8 channels (Independent or any number of DF)**
8 x 10	**Digital**	**115 Vac (60 Hz)**	**8 channels (Independent or any number of DF)**