

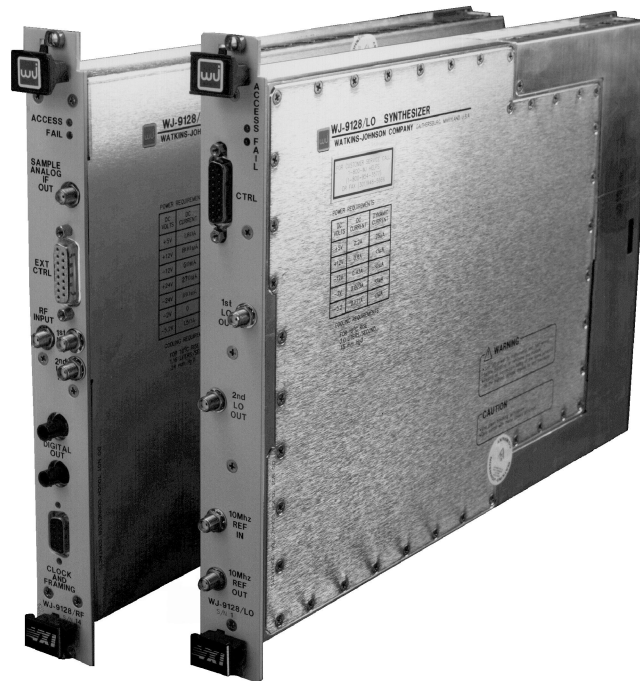
Technical Data



WATKINS-JOHNSON

May 1996

HF Tuner WJ-9128-X



WJ designed the WJ-9128 HF Tuner for system applications requiring high dynamic range and performance. It covers the 0.1 to 32 MHz frequency range, providing up to 88 dB of instantaneous Spur-Free Dynamic Range (SFDR) in a 2-MHz bandwidth.

The tuner uses state-of-the-art architecture and component technology. WJ has implemented direct and frequency-converted baseband tuning to ensure maximum performance for any frequency input. The unit also owes its performance to unique circuit-design techniques and components including a Watkins-Johnson proprietary mixer.

The WJ-9128 tuner consists of an RF Tuner Module and a Local Oscillator (LO) Synthesizer Module. Each is housed in a single-width C-size VXI module.

Features

- 0.1 to 32 MHz frequency coverage
- High spur-free dynamic range: up to 88 dB, minimum
- 2-MHz bandwidth
- 250-kHz tuning resolution
- Internal 14-bit A/D converter
- Built-in test circuitry
- High-speed fiber-optic digital output
- VXI form factor

RFTUNER*

SIZE	9.2x1.2x13.4in (23.26x3.04x34.03cm)	WEIGHT	5.5lbs (2.48 kg)
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LOSYNTHESIZER*

SIZE	9.2x1.2x13.4in (23.36x3.04x34.03cm)	WEIGHT	6.2lbs (2.81 kg)
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*C-size

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All International sales of WJ equipment are subject to USA export license approval.

This material provides up-to-date general information on product performance and use. It is not contractual in nature, nor does it provide warranty of any kind.

RF Tuner

The RF tuner contains the RF signal path from RF input to baseband digital output including the functions:

- Input protection
- Gain control
- Frequency translation
- Signal amplification and filtering
- Noise source for built-in test
- Fiber-optic interface for digital data output

The RF tuner provides a baseband output 2-MHz wide. It features two frequency band paths to convert incoming signals to baseband:

- Direct 0.1 to 2 MHz low-band path
- Dual-conversion 2 to 32 MHz high-band path

The unit routes both signal paths to an internally supplied Analog-to-Digital (A/D) converter.

An input switch routes the RF input signal to one of two low-pass filters. These filters improve tuner performance for out-of-band signals. The tuner also includes input overload protection for signals greater than +30 dBm. After filtering, the unit routes the signal through a step attenuator that provides 47 dB of gain control in 1-dB steps.

After passing through the step attenuator, the signal path splits based on the band of frequencies desired. The tuner switches the lower frequency band (0.1 to 2 MHz) to a signal path that includes an amplifier and another low-pass filter, which provide the necessary anti-aliasing performance. The tuner switches the upper frequency band (2 to 32 MHz) to a signal path where it is amplified and upconverted to a 70-MHz first IF; then amplified, filtered, and downconverted to near baseband. SAW bandpass filters obtain sharp shape factors and provide consistent group delay characteristics.

The low- and high-band frequency paths again come together for final amplification, impedance transformation, and filtering. These baseband amplifiers exhibit extremely low spurious output.

An on board A/D converter digitizes the final IF. This tuner provides up to 88-dB SFDR. A more economical A/D can provide 82-dB minimum SFDR performance. The lower-cost A/D converter is available with the WJ-9128-1/RF and WJ-9128-2/RF. See the RF Tuner Module Options table for details. The tuner takes the digital stream from the A/D and encodes it onto a fiber-optic serial bus using AMD's popular TAXI interface. WJ provides two ST-type fiber-optic connectors on the front panel of the RF tuner module. An internal noise source at the front end of the RF tuner provides for built-in test operations.

LO Synthesizer

The LO Synthesizer module houses four functions required for HF Tuner operation:

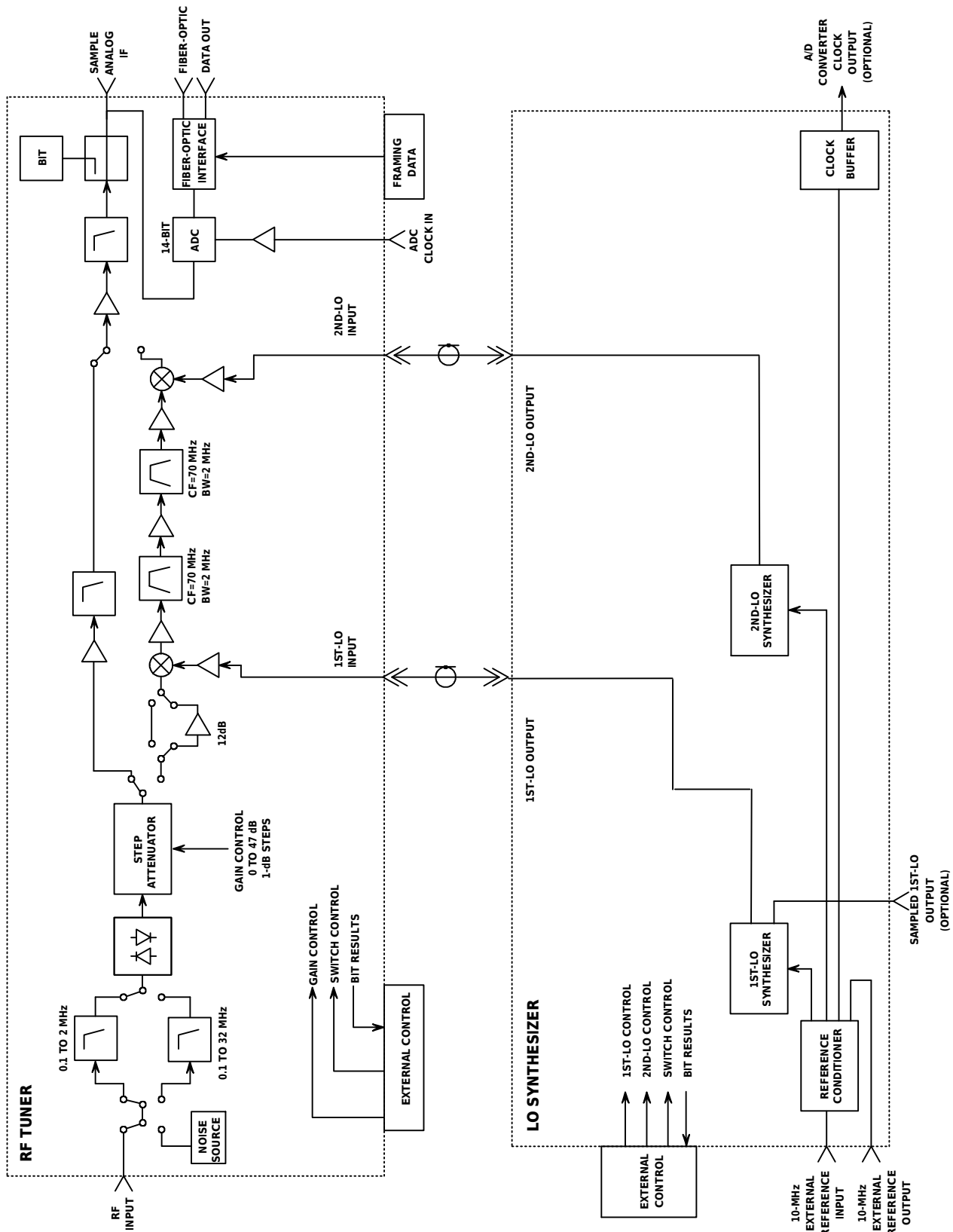
- First-LO synthesizer
- Second-LO synthesizer
- Reference conditioner
- A/D converter clock (optional)

WJ's synthesizers maintain the highest performance possible. WJ has engineered very low-phase-noise synthesizers to minimize degradation of the dynamic range provided by the tuner.

The unit generates the first LO from an internal 20-MHz reference using a Phase-Locked Loop (PLL) synthesizer. The first LO is tunable in 250-kHz steps and exhibits tuning speeds less than 500 microseconds. A fixed-frequency crystal oscillator and PLL generate the second LO and the A/D converter clock.

A reference conditioner provides a low-phase-noise 20-MHz signal to generate the first and second LO signals. It contains a VCXO that either provides the 20-MHz reference signal directly or locks onto an external 10-MHz reference signal for increased frequency accuracy.

Contact the factory for multichannel synthesizer requirements.



The block diagram demonstrates how an operator simply connects the front-panel ports for operation as a stand-alone tuner.

Specifications

Frequency Range	0.1 to 32 MHz (degraded performance from 0.1 to 0.5 MHz)
Conversion Scheme	
0.1 MHz to 2 MHz	Direct path, no conversions
2.0 MHz to 32 MHz	Double conversion
Tuning Resolution	250 kHz
Tuning Time	250 μ sec, typical 500 μ sec, max
Internal Reference Stability	5×10^{-7} (over 0 to 50°C)
External Reference Input/Output	
Frequency	10 MHz
Level	0 to +3 dBm
Impedance	50 Ω
1st-LO Output	
Frequency	70 to 102 MHz
Level	0 to +3 dBm
Impedance	50 Ω
Resolution	250 kHz
2nd-LO Output	
Frequency	See LO synthesizer module options
Level	0 to +3 dBm
Impedance	50 Ω
A/D Converter Clock Input	
Frequency	See RF tuner module options
Level	ECL
A/D Converter Clock Output (Optional)	
Frequency	See LO synthesizer module options
Level	ECL
RF Input	
Impedance	50 Ω , unbalanced
VSWR	2.5:1 max
RF Gain	
Without Preamp Engaged	31 dB \pm 2dB (@ 25°, \pm 3dB over full temperature range)
With Preamp Engaged	43 dB \pm 2dB (@ 25°, \pm 3dB over full temperature range)
RF Attenuator	
Maximum Attenuation	47 dB
Resolution	1 dB
Preamp	12 dB (conversion path only)
Adjustment Speed	250 μ sec, typical
Total Gain Control	59 dB in 1-dB steps
Maximum Operating Signal Level	
Preamp Engaged, No Attenuation	-35 dBm, typical
Damage Input Signal Level	+30 dBm, min
Dynamic Range	See RF tuner module options

3rd-order Intercept Point¹
 Output, in-bandwidth 42 dBm, typical
 Input, out-of-bandwidth 25 dBm, typical

2nd-order Intercept Point¹
 Input, out-of-bandwidth 60 dBm, typical

Noise Figure 15 dB, max

IF Filter Shape Factor (2 dB:95 dB) 1.56, max

Analog Baseband Output

0.1 to 2 MHz Path
 Center Frequency 1.05 MHz
 Bandwidth (2 dB) 1.9 MHz
 Impedance 50Ω
 Level -20 dB relative to A/D input, typical

2 to 32 MHz
 Center Frequency See RF module options
 Bandwidth (2 dB) 2.0 MHz
 Impedance 50Ω
 Level -20 dB, relative to A/D input, typical

Image Rejection > 90 dB, min

IF Rejection > 90 dB, min

Internally Generated Spurious -130 dBm, typical

Conducted LO Radiation -100 dBm, max

LO Phase Noise (Typical)
 Offset 1 kHz -125 dBc/Hz
 10 kHz -125 dBc/Hz
 100 kHz -130 dBc/Hz
 1 MHz -140 dBc/Hz

Operating Temperature 0 to 50°C

Storage Temperature -40 to +70°C

Humidity 0 to 95%, non-condensing

Altitude 50,000 feet (15250 meters), non-operating
 24,000 feet (7300 meters), operating

Shock Designed to MIL-STD-810D, bench handling

Power Consumption

Module	Current						Total Watts	Max Watts
	+5V	-5.2 V	+12 V	-12 V	+24 V	-24 V		
WJ-9128-X/RF	1.78A	1.49A	.77A	.056A	.262A	.178A	37.14	40
WJ-9128-X/LO	.850A	.900A	.400A	.015A	.018A	0.0A	14.3	15

¹Intercept point measurements made at analog input to the A/D converter.

WJ-9128-X

Tuner Connectors

Module	I/O	Functions	Type
RF TUNER	Inputs	RF Input 1st LO 2nd LO Power Control Clock/Framing Data	SMA SMA SMA VXI Interface 15-pin micro-D or VXI 9-pin micro-D
	Outputs	Sample Analog Baseband Fiber-optic Data (1 & 2)	SMA ST
LO SYNTHESIZER	Inputs	External Reference External 1st LO Power Control	SMA SMA VXI Interface 15-pin micro-D or VXI
	Outputs	1st LO 2nd LO External Reference A/D Clock (optional)	SMA SMA SMA SMA

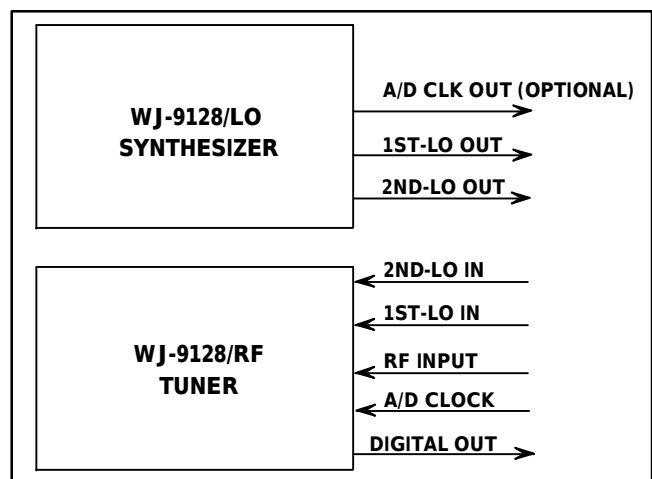
RF Tuner Module Options

RF Module	2nd-LO Input Frequency (MHz)	Analog Baseband Center Frequency (MHz)	A/D Sample Rate (MHz)	SFDR* (dB)	Control Interface
WJ-9128/RF	66.25	3.75	5.0	88	Front Panel
WJ-9128-1/RF	66.25	3.75	5.0	82	Front Panel
WJ-9128-2/RF	68.72	1.28	5.12	82	VXI Bus

LO Synthesizer Module Options

LO Module	2nd-LO Output Frequency (MHz)	A/D Clock Output Frequency (MHz)	Control Interface
WJ-9128/LO	66.25	N/A	Front Panel
WJ-9128-1/LO	68.72	5.12	VXI BUS

*Note: Dynamic range may degrade over temperature. Dynamic range is referenced to the full-scale input level of the A/D with one tone at -1 dBFS or two tones at -7 dBFS.



Single-channel Configuration