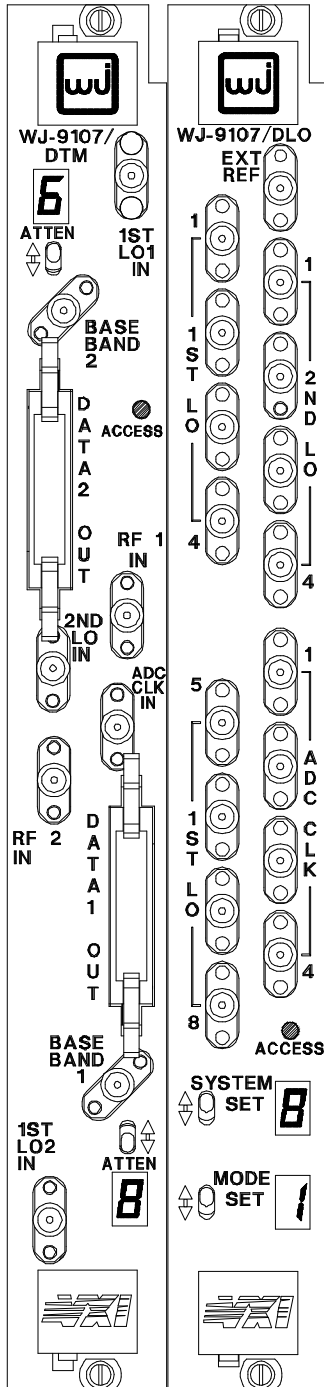


May 1997

Wideband Telecom Tuner WJ-9107



Features

- ❑ Covers Cellular & PCS Frequency Bands
800 to 1000 MHz
1700 to 2000 MHz
- ❑ 7-band Preselection
- ❑ High SFDR: 75 dB
- ❑ 25-MHz Bandwidth
- ❑ VXI Register-based Control
- ❑ Two 6U C-Size VXI card Slots
- ❑ 1-MHz Tuning Resolution
- ❑ 12-bit A/D Converter
- ❑ High Degree of Channel-to-channel Matching
- ❑ Multichannel-ready configuration

WJ designed its WJ-9107 Wideband Telecom Tuner for the acquisition of cellular and PCS signals for multi-channel applications requiring a high degree of phase and amplitude matching and stability. The WJ-9107 consists of a dual-channel tuner or converter and a dual-tuned synthesizer, each of which is housed in single-slot C-size VXI module. The nomenclature for these two units are the WJ-9107/DTM Dual-tuner Module and the WJ-9107/DLO Dual Local Oscillator (LO) Module respectively. Each WJ-9107/DTM converter channel has the ability to digitize 25-MHz bandwidth for Digital Signal Processing (DSP). The WJ-9107/DLO Module provides synthesized tuning over Analog and Digital Cellular, Analog and Digital Cordless, Wireless Data, and PCS bands. Since each DLO Module has two independent synthesizers, both forward and reverse communications channels may be digitized. The WJ-9107 Wideband Telecom Tuner is ideal for systems in the cellular and PCS frequency bands, which require both flexibility and adaptability in assigning

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tuners the task of multiple signal acquisition in dense signal environments. Careful attention was paid to amplitude and phase stability, allowing these tuners to be used in adaptive beam-forming and multichannel acquisition systems.

WJ used VXI-bus technology in the development of the WJ-9107 Wideband Tuner because of its Open System philosophy, as well as its suitability for RF and analog circuit design. Both the DTM and the DLO modules are register-based VXI modules that an operator may control from the VXI-bus interface, or from toggle switches available on the front panels.

Dual-tuner Module (WJ-9107/DTM)

The DTM consists of two identical tuners, each of which converts the RF input to a digitized output. Each tuner performs the functions of:

- Input protection and preselection
- Gain control
- Frequency translation
- Signal amplification and filtering
- 12-bit A/D

The RF tuner translates a 25-MHz-wide slice of the tuned spectrum to baseband. This occurs via a dual-conversion process with a first IF of 160-MHz. An analog baseband is provided as a front-panel output.

An input switch routes the RF input signal to one of seven preselector filters (three for the cellular band and four for the PCS band). Two banks of filters, with a pre-amp between them, provides the selectivity for image rejection and LO radiation, and improves tuner performance for out-of-band signals. The tuner also includes input-overload protection for signals greater than +30 dBm. After filtering, the tuner routes the signal through a step attenuator that provides 28 dB of gain control in 4-dB steps. The VXI register-based interface controls this step attenuator.

After passing through the step attenuator, the signal downconverts to a 160-MHz first IF via a high dynamic range mixer. SAW bandpass filters obtain sharp shape factors and provide linear phase characteristics. The first IF provides another 28 dB of gain control.

The final conversion to baseband also uses a high dynamic range mixer. The spurious outputs of this mixer are critical and can limit the Spur-free Dynamic Range (SFDR) performance of the tuner. The $N \times N$ (2x2, 3x3, etc.) products are key, since they fall within the IF passband. Another 4-dB of gain control is provided at baseband. The baseband

amplifiers exhibit extremely low harmonic content. The baseband signal is provided for an analog output and digitized by a 12-bit A/D converter with a 65-MHz sample clock. The A/D is a state-of-the-art low-power device with a minimum of 75-dB SFDR.

Dual-LO Synthesizer (WJ-9107/DLO)

The DLO is comprised of two independent first-LO synthesizers, a second-LO synthesizer, and an ADC-clock generator. All of these are locked to a common internal 100-MHz reference oscillator.

To achieve a level of modularity, the DLO is divided into several functions contained on four assemblies:

- First-LO (dual)
- Second-LO and ADC Clock
- Reference Oscillator
- VXI Interface board

First-LO Assembly

The first-LO assembly contains two independent first-LO synthesizers, output distribution plus switching. Proven shielding methods ensure sufficient isolation to achieve low output spurious between the two first-LOs, as well as high isolation between DTM channels.

The frequency plan of the DTM tuners requires the first-LO to tune from 972 to 1148 MHz for the 800 to 1000 MHz band and 1872 to 2148 MHz for the 1700 to 2000 MHz band. To accomplish this tuning range, the first-LO is comprised of a Coarse Step Generator used to provide 50-MHz steps, and a PLL to provide the 1-MHz fine steps. A variety of unique designs achieve low phase noise with 5-ms lock times. An example is a multistage locking scheme and a non-PLL Coarse Step Generator that combine to provide a less complex synthesizer design with very low phase noise and less than 5-ms lock-time performance.

Second-LO & ADC-Clock Assembly

The second-LO and ADC-clock are both single-loop PLL synthesizers. Their frequencies are based on the 100-MHz reference oscillator located on a daughter-card to the second-LO and ADC-clock assembly. The second-LO uses a 1.2-MHz reference to generate the required 176.25-MHz output and a 5-MHz reference to generate the 65-MHz ADC-clock frequency. Both have four-output power splitters. The low division ratios of the divide-by-N provides low phase noise contribution to the aggregate phase noise and allows the use of low-cost components.

The second-LO and ADC-clock are contained on a single board to allow modification of the ADC-clock rate, which requires changes in the second-LO frequency to maintain the output spectrum centered at $F_s/4$.

Reference Oscillator Assembly

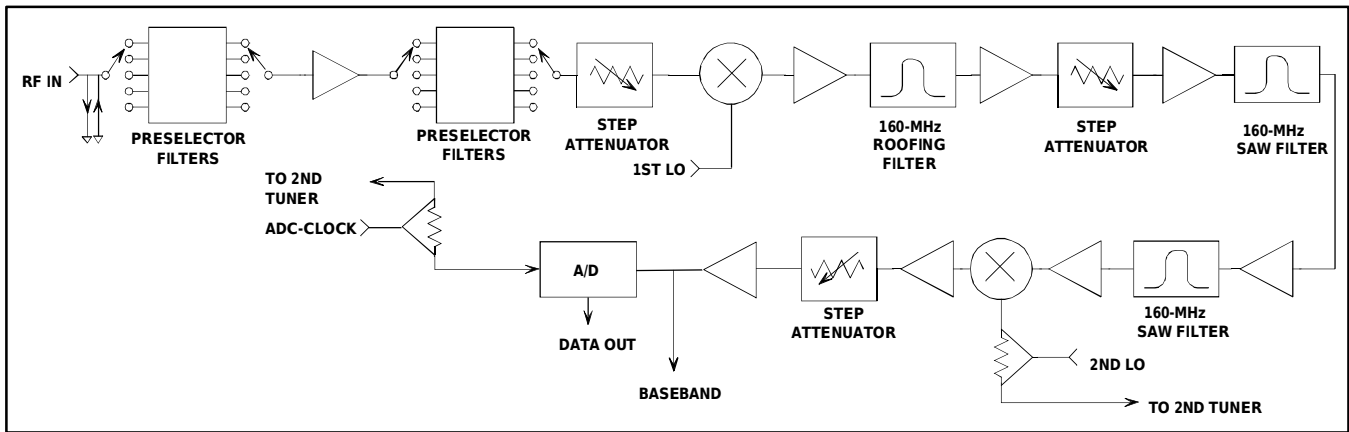
The reference generator uses a low phase noise, ovenized 100-MHz reference oscillator (or OCXO). The OCXO will phase lock to an external 10-MHz reference when an external reference is detected at the External Reference input connector. If no external reference is detected, then the reference stability is that of the OCXO or better than ± 0.5 PPM. An internal adjustment sets its frequency when not locked to an external reference.

VXI Interface Assembly

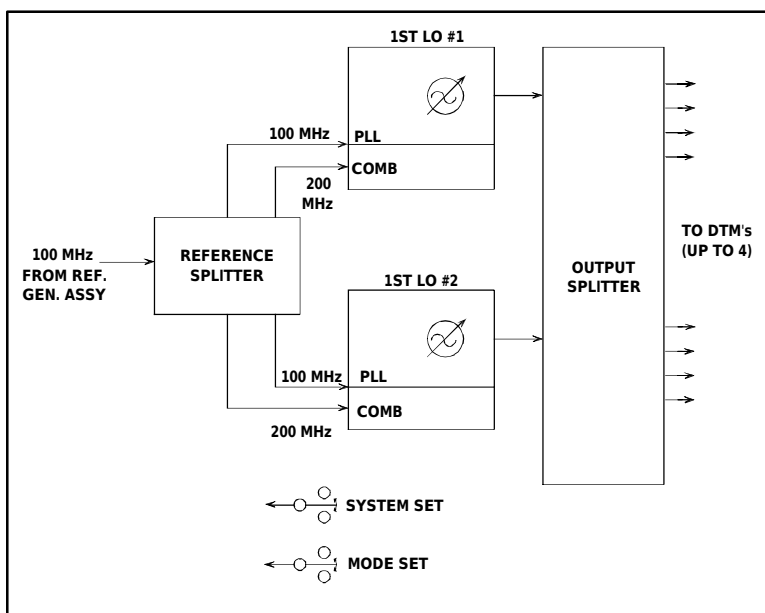
The VXI Interface Assembly provides the interface to the VXI bus and controls the first-LO and second-LO assemblies.

System Configurations

An operator can use the WJ-9107 Wideband Telecom Tuner in a variety of configurations. The minimum configuration consists of one DTM and one DLO. In this configuration, the DLO module provides four outputs to the Dual-tuner Module: two first LOs, one second LO and an A/D clock. The two first LO outputs can be configured as coherent or independently tuned. The second-LO and A/D clock outputs are fixed frequency signals, which are split internal to the Dual-tuner Module. Therefore only one each of these signals is required per DTM. Additional configurations using a single DLO module and up to four DTM are possible. The possible configurations are shown in the System Configurations Table.



WJ-9107/DTM RF Block Diagram

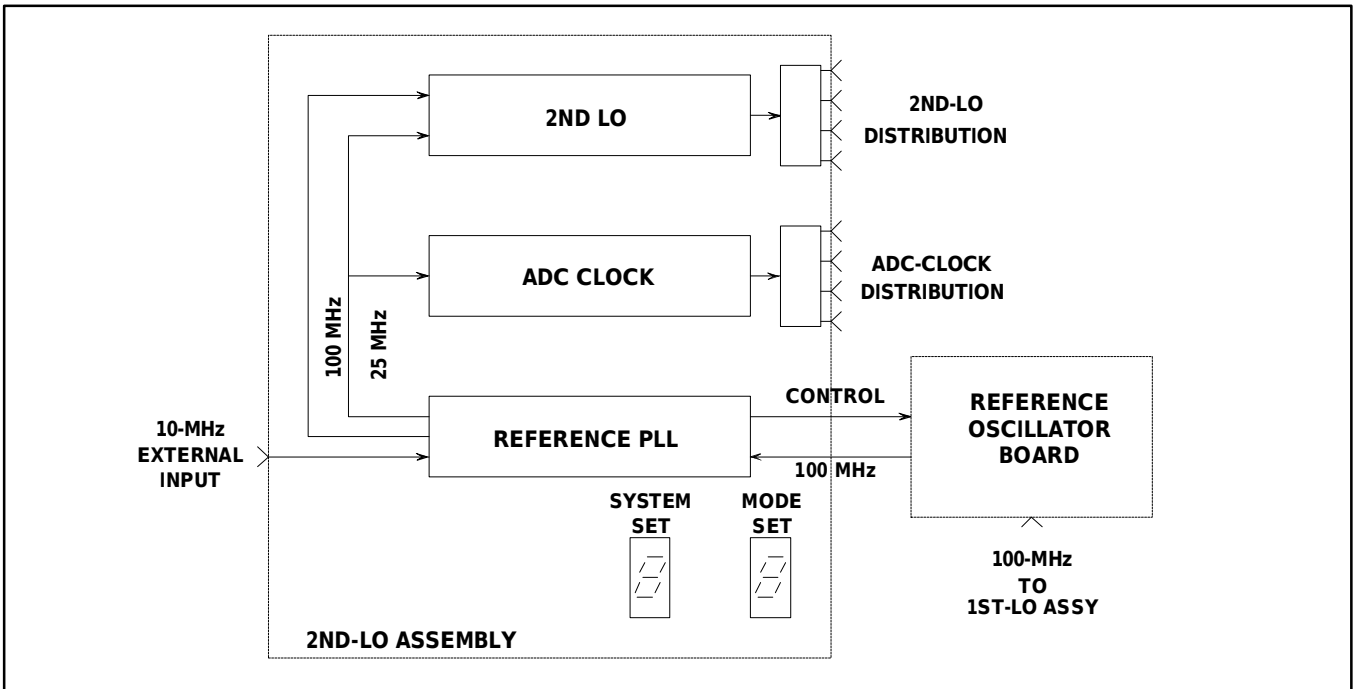


WJ-9107/DLO & Reference Block Diagram

WJ-9107 System Configurations*

Number of WJ-9107/DTMs	Forward/Reverse Channel Outputs	Coherent Outputs
1	1/1	2
2	2/2	4
3	3/3	6
4	4/4	8

*All configurations described utilize a single WJ-9107/DLO Module



WJ-9107/DLO 2nd-LO Assembly Block Diagram

Specifications

Tuning**Frequency Range**

Cellular Band	800 to 1000 MHz
PCS Band	1700 to 2000 MHz

Bandwidth 25 MHz, nominal

Preselection 7-band Preselector

Bandwidth 1 dB

Band 1 798 to 882 MHz

Band 2 858 to 942 MHz

Band 3 918 to 1002 MHz

Band 4 1698 to 1792 MHz

Band 5 1768 to 1862 MHz

Band 6 1838 to 1932 MHz

Band 7 1908 to 2002 MHz

Tuning Resolution 1 MHz

Tuning Time 5 msec, max

Internal Reference Stability

Accuracy 5×10^{-7} (over 0° to 50°C)

Aging 1×10^{-6} parts per year

External Reference Input

Frequency 10 MHz

Level 0 dBm, nominal

Impedance 50Ω

Dynamic Performance**At Analog IF Output, Max Gain**

Out-of-band input 2nd order +55 dBm¹

Out-of-band input 3rd order +14 dBm^{1,2}

In-band output 2nd order +78 dBm³

In-band output 3rd order +39 dBm³

At Digital IF Output, Maximum Gain

Single-tone SFDR 75 dBFS⁴

Two-tone SFDR 75 dBFS⁴

RF Input

Impedance 50Ω, nominal

VSWR 2.5:1 max

Input Level for Full-scale Output -43 dBm, nominal

Gain Variation over Frequency ±4 dB

Analog Baseband Output

Center Frequency 16.25 MHz ($F_{\text{SAMP}}/4$)

Level -14 dBm, nominal

Bandwidth (2 dB) 25 MHz minimum

A/D-converter Output

Frequency 65 MHz

Resolution 12 bits

Level Differential ECL w/clock

RF Gain 47 dB, nominal

RF Attenuator

Maximum Attenuation 60 dB

Resolution 4 dB

Accuracy 2.0 dB or 10% of attenuator setting, whichever is greater; monotonic

Adjustment Speed 5 msec, max

Damage Input Signal Level +30 dBm, min

Noise Figure

800 to 1000 MHz 15 dB

1700 to 2000 MHz 17 dB

IF-filter Shape Factor (1dB:80dB)	1.44, max
Image Rejection	>80 dB
IF Rejection	>80 dB
Conducted LO Radiation	<-90 dBm
LO Phase Noise (Typical)	
Offset	10 Hz-50 dBc/Hz
	100 Hz-80 dBc/Hz
	1 kHz-90 dBc/Hz
	10 kHz-110 dBc/Hz
	100 kHz-115 dBc/Hz
	1 MHz-125 dBc/Hz
	>10 MHz-135 dBc/Hz
VXI Interface	
Device Type	Register-based, VXI Servant
Data Transfer Capability	A16, D16
Module Size	C-Size
Slots Used	
WJ-9107/DTM	1 Slot
WJ-9107/DLO	1 Slot
Control Library	C drivers available
Temperature Range⁵	
Operating	-20° to +55°C
Non-Operating	-40° to +70°C
Specification Compliance	25°C ± 5°C
Power Consumption	
WJ-9107/DTM	40 W, nominal
WJ-9107/DLO Module	40 W, nominal
Cooling Requirements	To maintain a 10°C rise the modules require 14 CFM (6.6 //s) of air at 0.33 in (8.5 mm) of water.
Humidity	0 to 95%, non condensing
Altitude	50,000 ft (15250 meters), non-operating 10,000 ft (3048 meters), operating
Shock	Designed to MIL-STD-810D, bench handling

¹ Out-of-band intercept point defined as outside first-IF filter

² 20-MHz tone separation

³ Referenced to the A/D input

⁴ Single Tones @ -1 dBFS or 2-Tones @ -7 dBFS each

⁵ All specifications fully compliant between 20° and 30°C. Contact factory for compliance at other temperatures.