

Preliminary Product Specification

Common Applications

- Benchtop DVT (Designer Verification Testing)
- Harmonic Performance Testing in High Volume Production Test
- RF Design and Characterization
- 802.11ax (6425 to 7125 MHz) testing on legacy 6 GHz Instruments

Summary

The SC2250 extends the useful range of traditional 6GHz RF instruments for operation at microwave frequencies up to 18GHz. It provides excellent integration capability with modular instruments such as National Instrument's Vector Signal Transceiver (VST). Selectable filtering is provided for signal conditioning applications requiring spurious and harmonic rejection.



Figure 1 - SC2250 – Unparalleled Value in an 18 GHz Microwave Extension

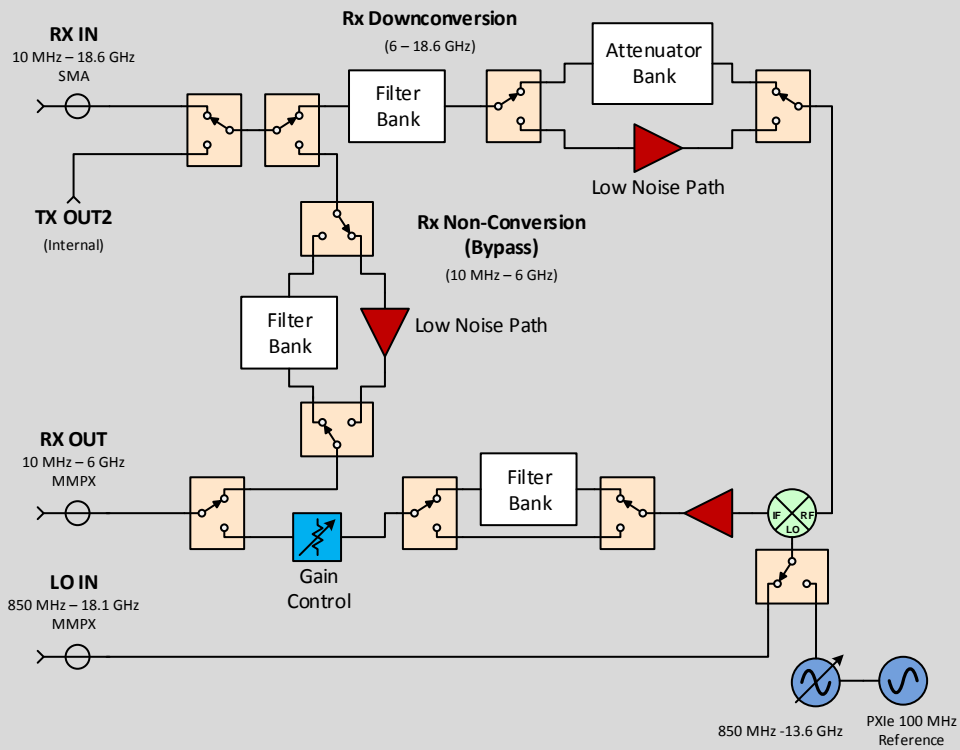
Description

Both up and down-conversion functions are housed in a single-slot PXIe module. An independent local oscillator (LO) is available for each path. Optional LO input ports are provided to support measurements requiring extremely low phase noise performance.

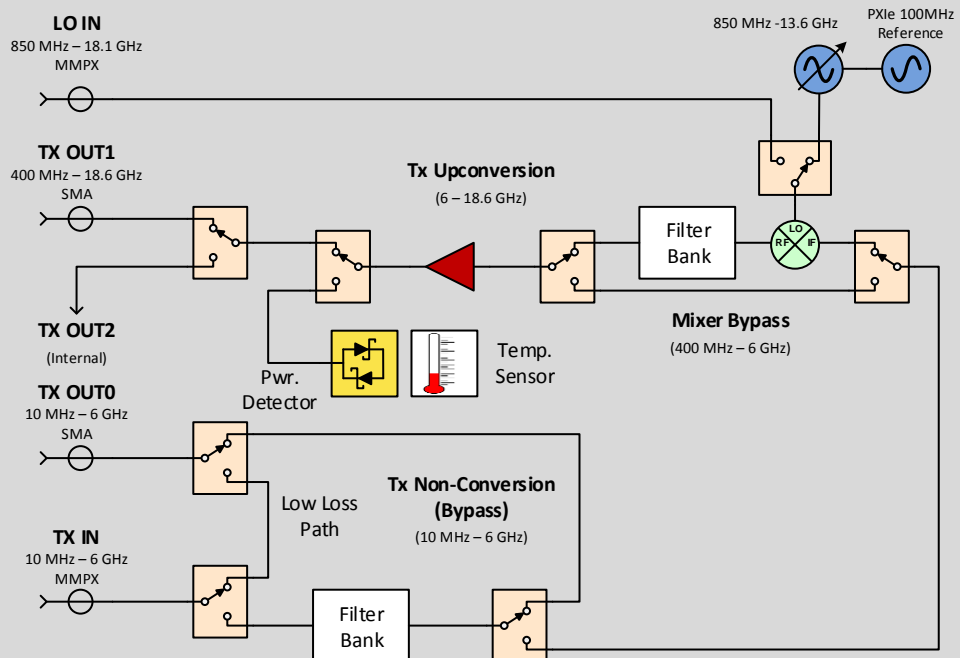
The receive down-converter includes a non-conversion (bypass) path to minimize setup complexity when the mixer is not required. The bypass path includes a filter bank and low noise amplifier for signal conditioning purposes. For harmonic measurement applications, high pass filters are enabled to reject the fundamental signal and provide better dynamic range. The down-converted signal can be passed through a 5GHz intermediate frequency (IF) filter for spurious rejection prior to output from the module.

Like its counterpart, the up-conversion path includes non-conversion and signal conditioning capabilities. User calibration of the instrument is possible using the internal loop back signal in the up-converter and the power detector.

Receive (Down-Conversion Path) Block Diagram



Transmit (Up-Conversion Path) Block Diagram



Definitions

The following definitions describe the specifications listed below:

- *Typical* values cover the expected performance for the majority of units operating in an ambient temperature range of 23 °C ± 5 °C that are not covered by warranty. Typical values may not be verified on all units shipped from the factory.
- *Minimum* and *Maximum* values describe the warranted product performance of units operating in the temperature range of $T_{cal} \pm 5^{\circ}\text{C}$.

Specifications are subject to change without notice. For the most recent SC2250 specifications, visit www.signalcraft.com.

Receive (Rx) Path Specifications

Rx Conversion Path

<i>Parameter</i>	<i>Minimum</i>	<i>Typical</i>	<i>Maximum</i>	<i>Freq Band, MHz</i>	<i>Comments</i>
Input Frequency (MHz)	>6000	-	18600		Configuration of input and output frequency must result in an LO frequency within the specified range of the LO source. $F_{Lo(min)} \leq F_{IN} - F_{OUT} \leq F_{Lo(max)}$
Output Frequency (MHz)	500	-	6000		
Internal Local Oscillator Frequency (MHz)	850	-	13600		
External Local Oscillator Input Frequency (MHz)	850	-	18100		
Input Power (dBm)	-	-	+20		Absolute maximum peak power, no damage
External Local Oscillator Input Power (dBm)	0	-	+10		
Gain (dB)	-1.2	0	1.2	6000 - 18600	LNA enabled, IF = 5.117GHz, IF BPF disabled
	-14.8	-8.6	-	6000 - 6500	LNA bypassed ² ,
	-7.1	-5.2	-	6500 - 12000	IF = 5.117 GHz,
	-9.0	-7.1	-	12000 - 15000	IF BPF disabled
	-13.1	-10.6	-	15000 - 18600	
Gain Variation Over Temperature (dB/°C)	-	-0.065	-		
Harmonic Conversion Gain Calibration Accuracy (dB) ³	-	-	1.29		$T_{cal} \pm 2^{\circ}\text{C}$
	-	-	1.54		$T_{cal} \pm 5^{\circ}\text{C}$
Gain Calibration Accuracy (dB)	-	-	1.43		$T_{cal} \pm 2^{\circ}\text{C}$
	-	-	1.68		$T_{cal} \pm 5^{\circ}\text{C}$
1dB Input Compression (dBm)	-	0.2	-	6000 - 9000	LNA enabled,
	-	2.6	-	9000 - 12000	IF = 5.117 GHz,
	-	5.5	-	12000 - 18000	IF BPF disabled
	-	18.8	-	6000 - 9000	LNA bypassed,
	-	21.9	-	9000 - 12000	IF=5.117 GHz,
	-	24.3	-	12000 - 18000	IF BPF disabled

Table 1 - Rx Conversion Path Performance

¹ T_{cal} is the Factory Calibration Temperature which can be queried through the sc2250 instrument driver

² Additional Rx front end attenuation options of 5 dB and 10 dB available.

³ Use `si2250_ConfigureHarmonicConverter` function to achieve specified calibration accuracy.

Rx Non-Conversion (Bypass) Path

<i>Parameter</i>	<i>Minimum</i>	<i>Typical</i>	<i>Maximum</i>	<i>Freq Band, MHz</i>	<i>Comments</i>
Input Frequency (MHz)	10	-	6000		
Output Frequency (MHz)	10	-	6000		
Input Power (dBm)	-	-	+20		Absolute maximum, no damage
Filtered Insertion Loss (dB)	-	7.1	7.7	1400 - 1800	Refers to loss seen by harmonic frequencies passing through
	-	7.7	8.8	1800 - 3200	
	-	8.6	9.8	3200 - 4200	
	-	8.9	10.0	4200 - 6000	
Direct Insertion Loss (dB)	-	5.1	5.7	10 - 1000	No Filter
	-	7.9	8.7	1000 - 6000	
LNA Gain (dB)	10.4	11.6	-	10 - 100	
	13.3	14.3	-	100 - 1000	
	8.5	9.5	-	1000 - 6000	
Gain Calibration Accuracy (dB)	-	-	0.57		$T_{cal} \pm 2^{\circ}\text{C}$
	-	-	0.51		$T_{cal} \pm 5^{\circ}\text{C}$
LNA Noise Figure (dB)	-	18.0	-	10	
	-	5.9	-	50 - 1000	
	-	7.7	-	1000 - 6000	
LNA 1dB Input Compression (dBm)	-	3.8	-	10 - 1000	
	-	4.0	-	1000 - 6000	
Stopband Rejection (dBc)	-	48.4	-	710 - 960	Rejection of Fundamental for 2 nd Harmonic Passthrough
	-	58.9	-	1710 - 2700	
	-	48.8	-	710 - 960	Rejection of Fundamental for 3 rd Harmonic Passthrough
-	71.0	-	1710 - 2000		
Internal Local Oscillator Tuning Time (ms)	-	-	3.5	850 - 13600	

Table 2 - Rx Non-Conversion Path Performance

Rx Path Harmonic Contribution

<i>Parameter</i>	<i>2nd Harmonic</i>	<i>3rd Harmonic</i>	<i>Freq Fundamental, MHz</i>	<i>Comments</i>
Instrument Harmonic Contribution (dBc)	-85.1	-70.5	710 - 960	Harmonic levels generated by the instrument, Typical, Input Power = +20 dBm
	-79.3	-73.8	1710 - 2700	
	-76.8	-75.9	3400 - 4200	
	-84.3	-79.0	4900 - 5950	

Table 3 - Rx Path Harmonic Performance

Transmit (Tx) Path Specifications

Tx Conversion Path

<i>Parameter</i>	<i>Minimum</i>	<i>Typical</i>	<i>Maximum</i>	<i>Freq Band, MHz</i>	<i>Comments</i>
Input Frequency (MHz)	500	-	6000		Configuration of input and output frequency must result in an LO frequency within the specified range of the LO source. $F_{OUT} - F_{IN} = F_{LO}$
Output Frequency (MHz)	>6000	-	18600		
Internal Local Oscillator Frequency (MHz)	850	-	13600		
External Local Oscillator Input Frequency (MHz)	850	-	18100		
Input Power (dBm)	-	-	+20		Absolute maximum, no damage
External Local Oscillator Input Power (dBm)	0	-	+10		
Gain (dB)	0	2.0	-	6000 - 10000	Input Freq = 5 GHz
	-3.4	-1.5	-	10000 - 14000	
	-2.3	2.6	-	14000 - 18600	
Gain variation by temperature (dB/°C)	-	-0.07	-		
Gain Calibration Accuracy (dB)	-	-	1.11		$T_{cal} \pm 2^{\circ}\text{C}$
	-	-	1.41		$T_{cal} \pm 5^{\circ}\text{C}$
1 dB Output Compression (dB)	-	10.6	-	6000 - 10000	
	-	7.2	-	10000 - 14000	
	-	8.0	-	14000 - 18000	
Internal Local Oscillator Tuning Time (ms)	-	-	3.5	850 - 13600	
Power Detector Measurement Range (dBm)	-5	-	+5	1000 - 18600	

Table 4 - Tx Conversion Path Performance

Tx Non-Conversion (Bypass) Path

<i>Parameter</i>	<i>Minimum</i>	<i>Typical</i>	<i>Maximum</i>	<i>Freq Band, MHz</i>	<i>Comments</i>
Input Frequency (MHz)	10	-	6000		
OUT 0 Output Frequency (MHz)	10	-	6000		
OUT 1 Output Frequency (MHz)	400	-	6000		
Input Power (dBm)	-	-	+20		Absolute maximum, no damage
OUT 0 Filtered Insertion Loss (dB)	-	6.9	7.6	10 - 1000	
	-	7.9	8.7	1000 - 2600	
	-	9.2	10.2	2600 - 3600	
OUT 0 Direct Insertion Loss (dB)	-	8.8	9.6	3600 - 6000	
	-	2.3	2.8	10 - 1000	
OUT 0 Gain Calibration Accuracy (dB)	-	3.7	4.3	1000 - 6000	
	-	-	0.52		$T_{cal} \pm 2^{\circ}\text{C}$
	-	-	0.61		$T_{cal} \pm 5^{\circ}\text{C}$

OUT 0 Stopband Rejection (dB)	-	54.1	-	710 - 960	Rejection of 2 nd Harmonic
	-	41.4	-	1710 - 2700	
	-	60.7	-	3400 - 3600	
	-	60.9	-	4900 - 5950	
	-	66.4	-	710 - 960	Rejection of 3 rd Harmonic
	-	55.4	-	1710 - 2700	
	-	62.1	-	3400 - 3600	
	-	50.9	-	4900 - 5950	
OUT 1 Gain (dB)	-6.1	-4.7	-	1000 - 2000	Direct path though input filter bank.
	-3.9	-2.2	-	2000 - 4000	
	2.7	4.3	-	4000 - 6000	
OUT 1 Gain Calibration Accuracy (dB)	-	-	0.94		$T_{cal} \pm 2^{\circ}\text{C}$
	-	-	1.10		$T_{cal} \pm 5^{\circ}\text{C}$
OUT 1 1dB Output Compression (dBm)	-	17.4	-	2000-3000	
	-	15.9	-	3000-6000	

Table 5 - Tx Non-Conversion Path Performance

Hardware Front Panel

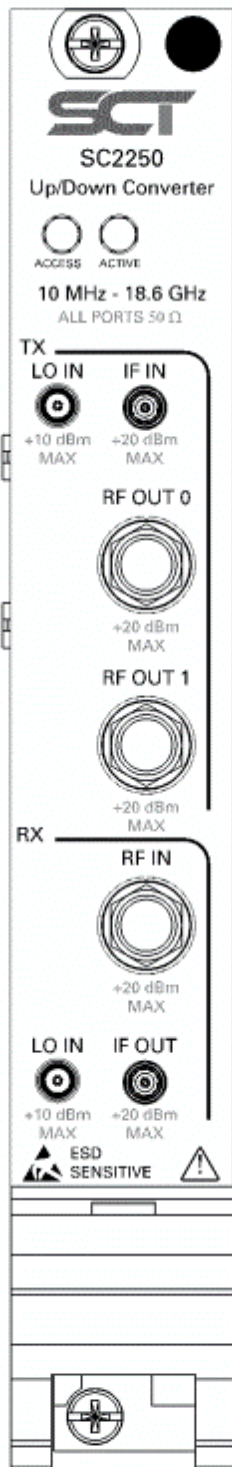


Figure 2 - SC2250 Up/Down Converter Front Panel

TX

LO IN	
Connector	MMPX Jack (female)
Impedance	50 Ω
Coupling	AC
Maximum Input Power	+10 dBm
DC voltage at input	± 10 V typical
IF IN	
Connector	MMPX Jack (female)
Impedance	50 Ω
Coupling	AC
Maximum Input Power	+20 dBm
DC voltage at input	± 10 V typical
RF OUT 0	
Connector	SMA (female)
Impedance	50 Ω
Coupling	AC
Maximum Output Power	+20 dBm
DC voltage at input	± 10 V typical
RF OUT 1	
Connector	SMA (female)
Impedance	50 Ω
Coupling	AC
Maximum Output Power	+20 dBm
DC voltage at input	± 10 V typical

RX

LO IN	
Connector	MMPX Jack (female)
Impedance	50 Ω
Coupling	AC
Maximum Input Power	+10 dBm
DC voltage at input	± 10 V typical
IF OUT	
Connector	MMPX Jack (female)
Impedance	50 Ω
Coupling	AC
Maximum Output Power	+20 dBm
DC voltage at input	± 10 V typical
RF IN	
Connector	SMA (female)
Impedance	50 Ω
Coupling	AC
Maximum Input Power	+20 dBm
DC voltage at input	± 10 V typical

Power Requirements

<i>PXle Power Rail (V_{DC})</i>	<i>Typical Current (mA)</i>	<i>Typical Power (W)</i>
+3.3	1388	4.6
+12	665	8.0

Table 6 – DC Power Requirements

Calibration

Interval 1 year

Physical Characteristics

Dimensions 3U, One Slot, PXle Module
21.6 × 2.0 × 13.0 cm (8.5 × 0.8 × 5.1 in.)

Weight 635 g (22.4 oz)

Environment

Operating

Ambient Temperature Range 0°C to 50°C

Relative Humidity Range 10% to 90%, noncondensing

Storage

Ambient Temperature Range -40°C to 70°C

Relative Humidity Range 5% to 95%, noncondensing

Compliance and Certifications

Safety

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1:2013: Class A emissions; Basic Immunity
- AS/NZS CISPR 11: Group 1, Class A
- FCC Part 15/B: Class A emissions
- ICES-001: Group 1, Class A
- KN11: Group 1, Class A



Support

Technical support is available through our website, www.signalcraft.com/support, or by contacting us at support@signalcraft.com.

Warranty

Full one-year parts and labor when used under normal installation and operation conditions. Repair services are available for products no longer covered under warranty.

Ordering Information

Send inquiries to info@signalcraft.com.