SignalCore™
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# Datasheet

## SC5319A/SC5320A

## 20 GHz to 40 GHz RF Downconverter

Rev 1.0

www.signalcore.com

# Table of Contents

# 1. Definition of Terms

The following terms are used throughout this datasheet to define specific conditions:

| | |
|---|---|
| **Specification (spec)** | Defines expected statistical performance within specified parameters which account for measurement uncertainties and changes in performance due to environmental conditions. Protected by warranty. |
| **Typical Data (typ)** | Defines the expected performance of an average unit without specified parameters. Not protected by warranty. |
| **Nominal Values (nom)** | Defines the average performance of a representative value for a given parameter. Not protected by warranty. |
| **Measured Values (meas.)** | Defines the expected product performance from the measured results gained from individual samples. |

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

# 2. Description

The SC5319A/SC5320A is a Ka band broadband single stage downconverter, with input RF range from 20 GHz to 40 GHz, external LO frequency range from 10 GHz to 20 GHz, and output IF range from 100 MHz to 4.5 GHz. This module features an internal synthesized local oscillator, RF preamplifier, and variable gain control, making it a compact and versatile standalone downconverter module. With the option for an external LO signal, the SC5319A/SC5320A may be configured for SISO applications or paired together with multiple units for MIMO applications such as ground-based satellite communications, point-to-point radio, and test instrument systems.

The product also features a bypass path to route the rf signal directly to the next stage without conversion. The follow-on stage could be a lower frequency converter such as the SC5317A/SC5318A K band downconverter, forming a 6 GHz to 40 GHz downconverter.

For systems requiring spectral selectivity, especially those used in open environments such as spectral monitoring, RF and IF bandpass filters may be placed before the RF input and after IF output ports respectively to suppress unwanted signals and improve out-of-band noise. An external IF filter will also provide further suppression of out-of-band internally generated spurious signals and LO leakages.

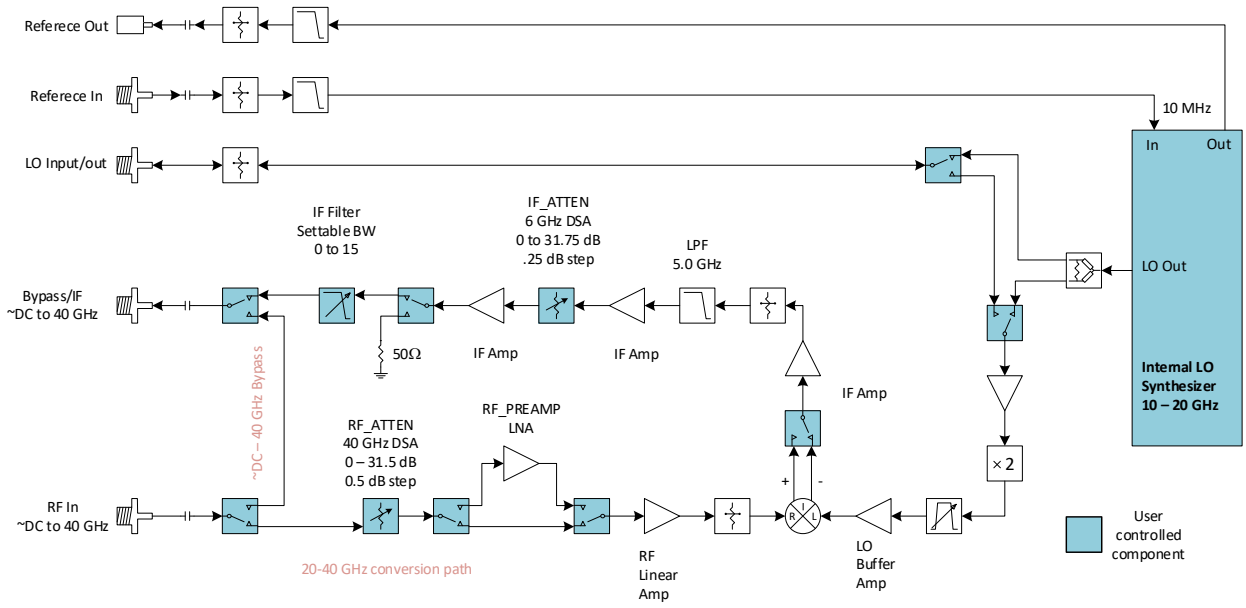


*Figure 1. SC5319A/SC5320A Block Diagram*

# 3. Conversion Specifications

| | | |
|---|---|---|
| **RF Input Range** | | |
| Conversion Path | LO > RF @ 2G IF | 19 GHz to (38 GHz – IF) |
| | LO < RF @ 2G IF | (20 GHz + IF) to 40 GHz |
| Direct Path | | 100 MHz to 40 GHz |
| **External LO range** | | 10 GHz to 20 GHz |
| **IF output frequency**[1] | | 100 MHz to 4500 MHz |
| **IF output Polarity**[2] | LO > RF | Inverted |
| | LO < RF | Non-inverted |
| **IF bandwidth (3 dB)**[3] | | 2000 MHz Typical |

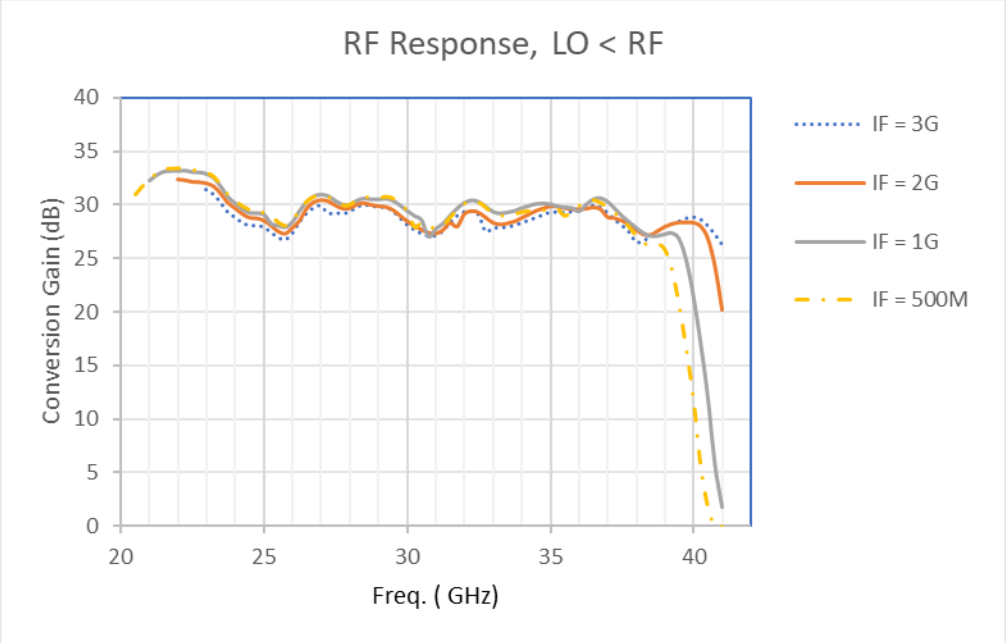


*Figure 2. Measured conversion path RF response for different IF with RF > LO; If an external LO is used, the power is set at 5 dBm.*

[1] IF output frequency is defined as the usable frequency range for all differences of | LO – RF | and that LO and RF is limited to 20 to 38 GHz.
[2] The IF output polarity is inverted when the IF spectrum sense is in the opposite direction with respect to the input RF spectrum. This happens when the LO frequency is higher than the input RF.
[3] The range of the IF bandwidth is determined by the boundaries of the spectrum whose amplitude varies less than 3 dB.


*Figure 3. Measured conversion path RF response for different IF with LO > RF; If an external LO is used, the power is set at 5 dBm.*

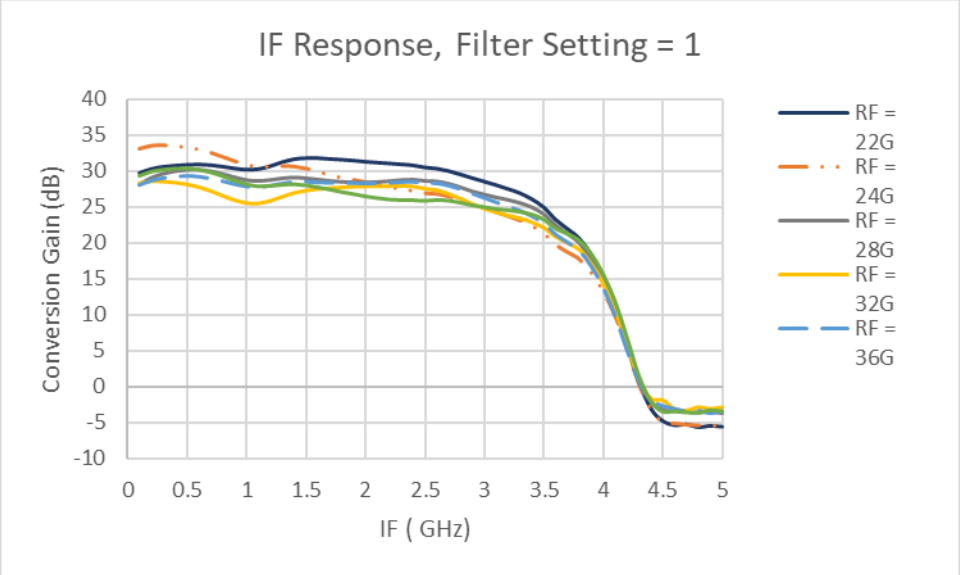


*Figure 4. Measured IF response for different RF frequencies. LO < RF. If an external LO is used, set power to 5 dBm. IF filter setting = 1.*

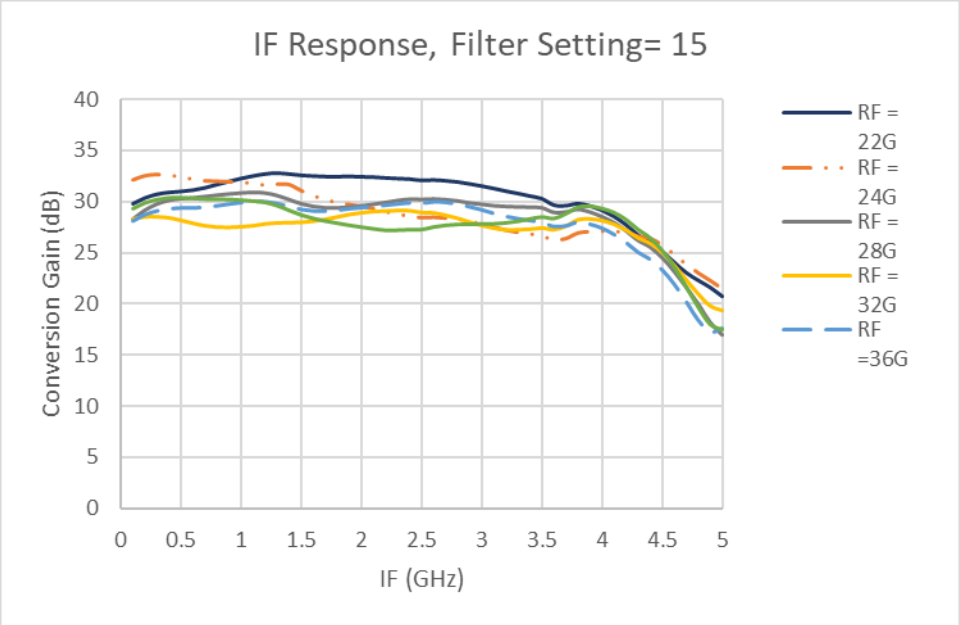


*Figure 5. Measured IF response for different RF frequencies. LO < RF. If an external LO is used, set power to 5 dBm. IF filter setting = 15.*

## 4. Amplitude Specifications

| | | |
|---|---|---|
| **Input Range** | AC (preamplifier disabled) | +20 dBm max |
| | AC (preamplifier enabled) | +7 dBm max |
| | DC[4] | 0 V |
| **Attenuation Range** | RF | 0 to 31 in 0.5 dB steps |
| | IF | 0 to 31 in 0.5 dB steps |
| | | |
| **Input Voltage Standing Wave Ratio (VSWR)** | | |
| Preamp off, 0 dB input RF attenuation | 20 GHz to 26 GHz | TBD |
| | 26 GHz to 40 GHz | TBD |
| Preamp on, 0 dB input RF attenuation | 20 GHz to 26 GHz | TBD |
| | 26 GHz to 40 GHz | TBD |

[4] Large and fast DC transients could damage the input solid state devices. Slow ramp up of DC to 10 V is sustainable.

| | | |
|---|---|---|
| **Gain Range** | Minimum[5] | -30 dB nom |
| | Maximum (preamplifier disabled)[6] | 30 dB nom |
| | Maximum (preamplifier enabled)[6] | 55 dB nom |
| **Preamplifier Gain** | | 25 dB nom |
| **Direct Path Loss** | | 6 dB typical |
| **RF Amplitude Response**<br>(25°C to 45°C device temperature) | RF Gain Flatness Response at Fixed IF | 5 dB nom |
| **IF Flatness**<br>(25°C to 45°C device temperature) | IF In-Band Response Flatness Over 3 GHz | 3 dB typical |

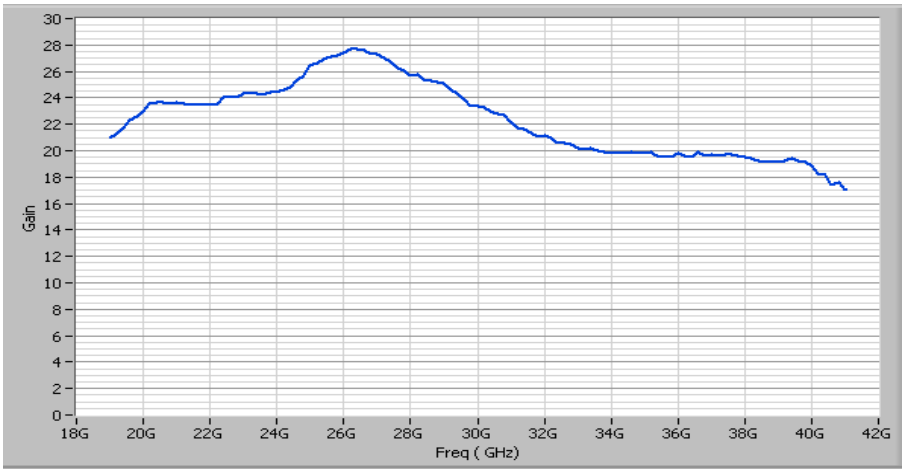


*Figure 6. Nominal RF pre-amplifier response.*

| | | |
|---|---|---|
| **RF Port Local Oscillator Leakage** | Preamplifier disabled, no RF attenuation | < -60 dBm typical |
| | Preamplifier enabled, no RF attenuation | < -75 dBm typical |
| **IF Port Local Oscillator Leakage** | IF enabled, no IF attenuation | < -60 dBm typical |
| | IF disabled, no IF attenuation | < -80 dBm typical |

[5] Minimal gain is specified when all attenuators, both RF and IF attenuators, are set to their maximum values and the RF pre-amplifier is disabled.
[6] Maximum conversion gain is specified when all the attenuators are set to 0 dB attenuation.

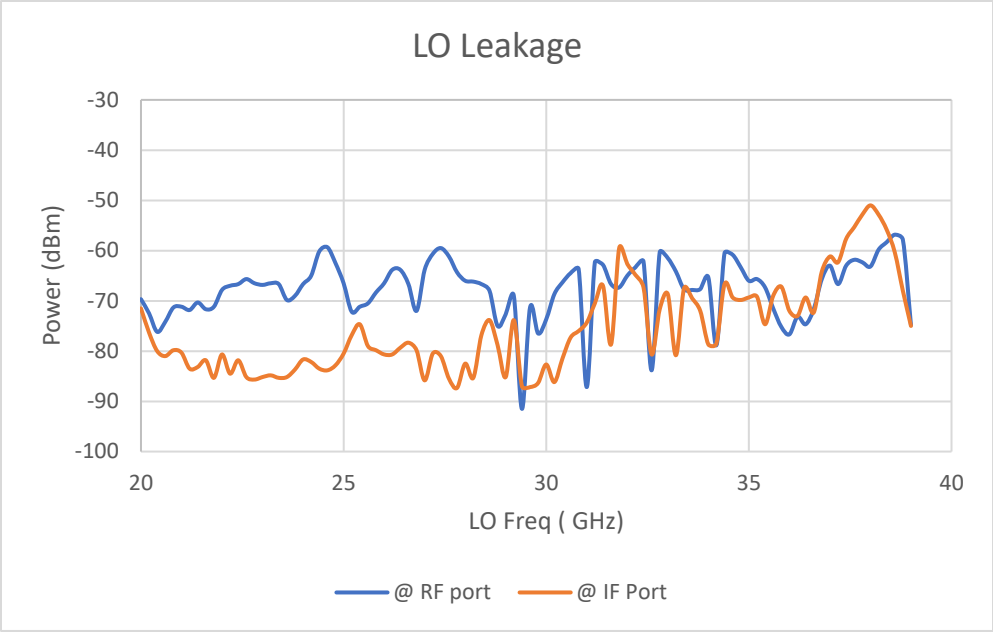


*Figure 7. LO leakage measurement.*

## 5. Dynamic Range Specifications

| | | |
|---|---|---|
| | Spurious Response | |
| Residual Spurious Signals[7] | RF < 29 GHz | < -70 dBm typ |
| | RF > 29 GHz | < -80 dBm typ |
| RF Induced Spurious Signals[8] | | < -60 dBc typ |

[7] Spurious signals at the IF port in the absence of RF input signals are due to internal LO associated signals.
[8] Spurious signals at the IF port induced by the presence of a RF signal.

Input Noise Density (25°C to 40°C device temperature nominal)[9]

| Preamplifier Disabled | 22 GHz | 30 GHz | 38 GHz |
|---|---|---|---|
| Noise Floor (dBm/Hz) | -151 | -149 | -144 |
| Noise Figure (dB) | 23 | 25 | 30 |

| Preamplifier Enabled | 22 GHz | 30 GHz | 38 GHz |
|---|---|---|---|
| Noise Floor (dBm/Hz) | -161 | -160 | -158 |
| Noise Figure (dB) | 13 | 14 | 16 |

Input Third-Order Intermodulation (IIP3, dBm)

| | 20 GHz – 26 GHz | 26 GHz – 34 GHz | 34 GHz – 40 GHz |
|---|---|---|---|
| Preamplifier disabled | 14 | 12 | 9 |
| Preamplifier enabled | -8 | -9 | -10 |

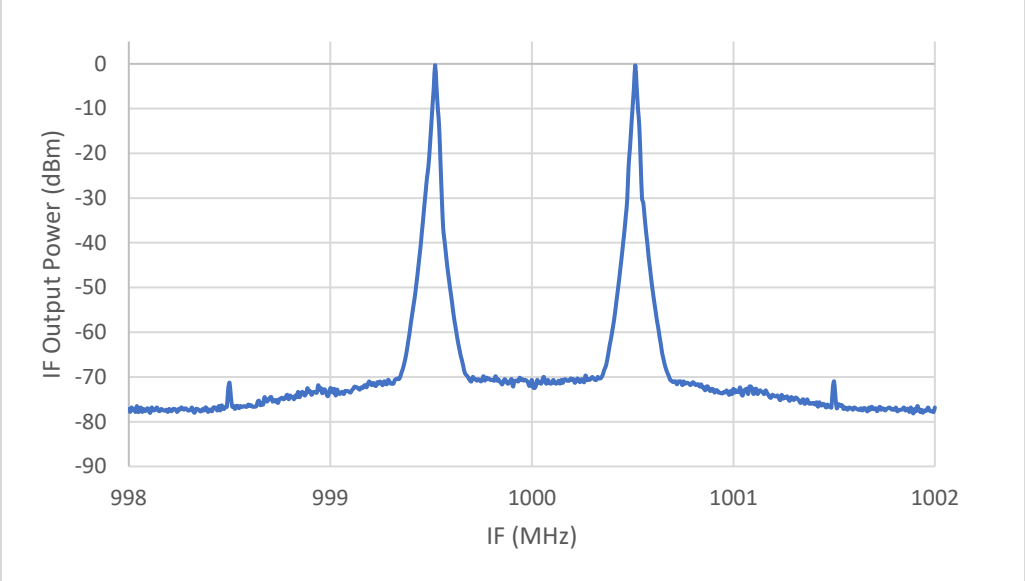


*Figure 8. Plots show the typical IMD performance with two -20 dBm input signals centered at 26 GHz, LO at 25 GHz, 0 dB RF attenuation, preamp disabled, and IF attenuation set for gain equal to 20 dB.*

[9] Noise (thermal) density is referred to the input of the device.

Input Compression Point (dBm)

| | 19GHz – 22 GHz | 22 GHz – 30 GHz | 30 GHz – 40 GHz |
|---|---|---|---|
| Preamplifier disabled<br>RF Atten = 0, Gain = 0 | >6 | >7 | >8 |
| Preamplifier enabled | -18 | -15 | -15 |

Output Compression Point (dBm)

| | 20 GHz – 36GHz | 36.0 GHz – 40 GHz | |
|---|---|---|---|
| RF Atten = 0, IF Atten = 0 | >17 | >18 | |

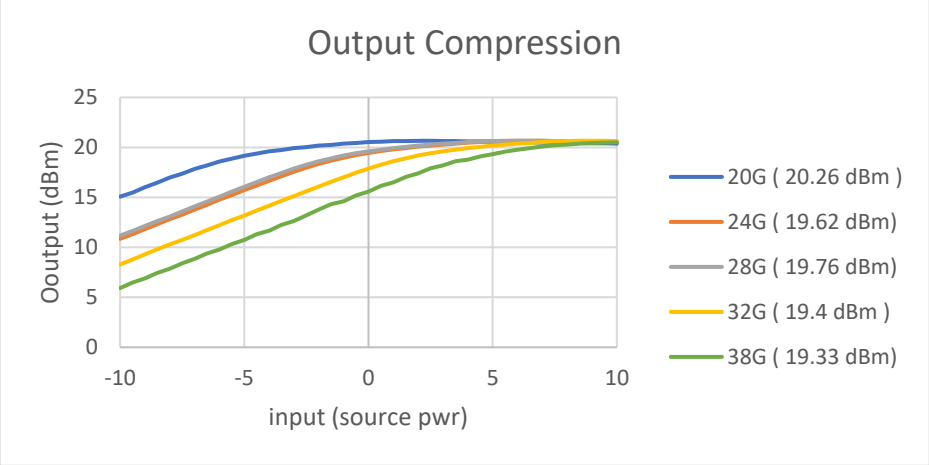


*Figure 9. Output IF P1dB measurement: RF Atten = 0, IF Atten = 0*

## 6. Internal LO Specifications

| | | |
|---|---|---|
| **LO Frequency Range** | | 1 0 GHz to 20 GHz |
| **LO Tuning** | Frequency Step Resolution | 1 Hz |
| | Lock and Settling Times | 1 ms typical |
| **Output Power** | | 0 dBm min, 7 dBm max |

| | | |
|---|---|---|
| **Frequency Reference**[10] | | |
| Technology | | OCXO |
| Accuracy | | ± [(aging x last adjustment time lapse) + temp stability + cal accuracy] |
| Initial Calibration Accuracy | | ± 20 ppb |
| Temperature Stability[11] | 20°C to 50°C | ± 25 ppb |
| | 0°C to 80°C | ± 50 ppb |
| Aging | | ± 30 ppb for first year |
| **Frequency Accuracy** | | ± (frequency reference accuracy in Hz * RF frequency) Hz |

LO Phase Noise

| Offset/LO | 10 GHz | 14 GHz | 18 GHz | 20 GHz |
|---|---|---|---|---|
| 100 Hz | -82 | -80 | -78 | -78 |
| 1 kHz | -105 | -103 | -100 | -99 |
| 10 kHz | -115 | -113 | -111 | -110 |
| 100 kHz | -116 | -113 | -112 | -110 |
| 1 MHz | -115 | -115 | -114 | -112 |
| 10 MHz | -134 | -134 | -132 | -130 |

[10] The frequency reference refers to the device's internal 10 MHz OCXO time-base. Accuracy is in parts-per-billion, or ppb ($1x10^{-9}$).
[11] These are device temperatures as read back for its internal temperature sensor.

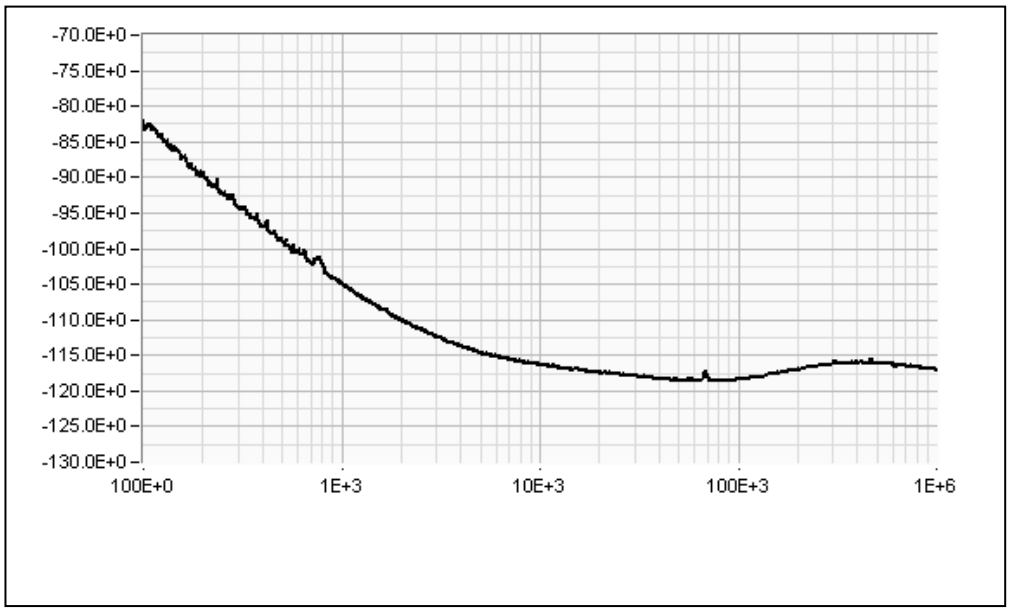


*Figure 10. Typical measured LO sideband noise synth. Frequency @ 14 GHz*

| | | |
|---|---|---|
| **LO Related Sideband Spurious Signals** | < 200 kHz | -55 dBc |
| | > 200 kHz | -60 dBc |

## 7. Port Specifications

| | | |
|---|---|---|
| **Reference Input/Out** | | |
| Reference | Reference Center Frequency | 10 MHz |
| | Amplitude | Input: -3 dBm min / +10 dBm<br>Output: 3 dBm typical |
| | Phase-Lock Range | ± 3 ppm (typ) |
| | Impedance | 50 Ω nominal |
| | Coupling | AC |
| | Connector Type | Input: SMA female<br>Output: MMCX female |

| | | |
|---|---|---|
| **LO Input/LO Output** | | |
| External LO input | Frequency Range | 10 GHz to 20 GHz |
| | Input Amplitude | +3 dBm min / +7 dBm max |
| Synth LO output | Frequency Range | 10 GHz to 20 GHz |
| | Output Amplitude | +0 dBm min / +7 dBm max |
| | Impedance | 50 Ω nominal |
| | Connector Type | SMA female |
| | Coupling | AC |
| **RF Input/Output** | Input Impedance | 50 Ω |
| | Coupling | AC |
| | Connector Type | Female 2.92 |
| **IF Output** | Output Impedance | 50 Ω |
| | Coupling | AC |
| | Connector Type | SMA female |

# 8. General Specifications

| | | |
|---|---|---|
| **Environmental** | | |
| Device Operating Temperature | | 0°C to +75°C |
| Storage Temperature | | -40°C to +85°C |
| Operating Relative Humidity | | 10% to 90%, non-condensing |
| Storage Relative Humidity | | 5% to 90%, non-condensing |
| Operating Shock | | 30 g, half-sine pulse, 11 ms duration |
| Storage Shock | | 50 g, half-sine pulse, 11 ms duration |
| Operating Vibration | | 5 Hz to 500 Hz, 0.31 $g_{rms}$ |
| Storage Vibration | | 5 Hz to 500 Hz, 2.46 $g_{rms}$ |
| Altitude | | 2,000 m maximum (maintain 25°C maximum ambient temperature) |
| **Physical** | | |
| Dimensions (W x H x D, max envelope) | SC5320A | 3.7” x 0.75” x 6.1” |
| | SC5319A PXIe | 1 slot |
| Weight | | 1.0 lb. |
| Input Voltage | | 12 VDC |
| Power Consumption | Internal LO Disabled | 12 W max |
| | Internal LO Enabled | 25 W max |
| Communication Interface | | PXIe, USB and RS-232 / SPI |

| | | |
|---|---|---|
| **EMC and Product Safety** | Designed to meet the requirements of: | 2014/30/EU: EN 61326-1:2013 EN 55011:2009<br>2014/35/EU: EN 61010-1 |
| **Warranty** | | 3 years parts and labor on defects in materials or workmanship |

# 9. Revision Table

| Revision | Revision Date | Description |
|---|---|---|
| 0.1 | July 19, 2021 | Preliminary |
| 0.2 | Nov 23, 2021 | Corrected bypass loss |
| 1.0 | Apr 12, 2022 | Updated graphs and corrected grammar |
| | | |
| | | |

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