MMIC SURFACE MOUNT

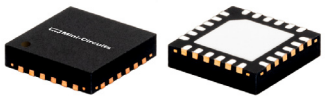
IQ Mixer

SMIQ-6243H+

50Ω Level 18 (LO Power +18dBm) 6 to 24 GHz

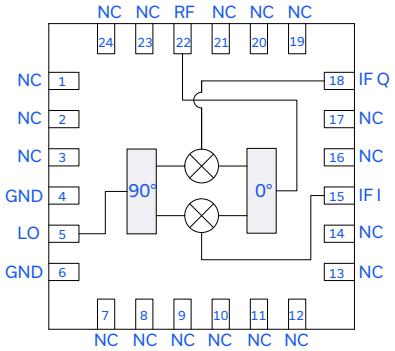
THE BIG DEAL

- Wideband RF & LO, 6 to 24 GHz
- Wideband IF, DC to 6 GHz
- Excellent Image Rejection, Typ. 32dB
- High LO-RF Isolation, Typ. 41 dB
- High Input IP3, Typ. +25 dBm
- Usable as Image Reject Mixer & SSB Converter
- 4x4 mm, 24-Lead QFN- Style Package



Generic photo used for illustration purposes only

FUNCTIONAL DIAGRAM



APPLICATIONS

- Test and Measurement Equipment
- 5G mmWave and Back Haul Radio
- Satellite Communications
- Radar, EW and ECM Defense Systems

PRODUCT OVERVIEW

The SMIQ-6243H+ is a passive, wideband in phase/quadrature (I/Q) mixer fabricated using GaAs HBT technology. The SMIQ-6243H+ is usable as a single-sideband upconverter for transmit applications or an image rejection mixer for receiver applications. The SMIQ-6243H+ is ideal for wideband frequency translation applications that require inherent rejection of image signals and spurious mixing products. The mixer covers a wide frequency range with RF and LO frequency range of 6 to 24 GHz and an IF frequency range of DC to 6 GHz. As a passive mixer, the SMIQ-6243H+ offers lower noise figure than active mixers ensuring superior dynamic range for high performance applications. The mixer is housed in a compact 4x4 mm QFN style package and no DC bias is needed for operation.

KEY FEATURES

Feature	Advantages
High Image Rejection, 32 dB typical	Provides inherent rejection of unwanted image signals without the need to external filtering
High LO-RF Isolation, 41 dB typical	Enables excellent carrier rejection in single-sideband operation upconvert transmit applications
High LO-IF Isolation, 43 dB typical	Minimizes filtering requirements needed to ensure signal integrity
Wide Bandwidth, 6 to 24 GHz	Useful in wideband systems or in several narrowband systems requiring fewer components
Wide IF Bandwidth, DC to 6 GHz	Useable for first and second down converter applications. IF as low as DC enables use in phase detector applications.
Small size, 4x4 MCLP package.	Tiny footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB.

REV. OR
ECO-017255
SMIQ-6243H+
MCL NY
230324

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ELECTRICAL SPECIFICATIONS[1] AT 25°C, Z_0=50Ω, LO POWER = +18 dBm, UNLESS OTHERWISE NOTED.

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Unit
RF Frequency Range		6		24	GHz
LO Frequency Range		6		24	GHz
IF Frequency Range		DC		6	GHz
LO Power		+17	+18	+20	dBm
Conversion Loss[2]	6 - 20 20 - 24		8.3 9.8	10.7 11.6	dB
Amplitude Unbalance	6 - 20 20 - 24		±0.1 ±0.1	±1.6 ±0.7	dB
Phase Unbalance (Relative to 90°)	6 - 20 20 - 24		4 2	13 6	deg
Image Rejection[3] (Tested as a Downconverter)	6 - 20 20 - 24		30 37		dBc
Single Sideband Rejection[4] (Tested as an Upconverter)	6 - 20 20 - 24		31 29		dBc
LO-RF Isolation	6 - 20 20 - 24	34 30	42 37		dB
LO-I Isolation	6 - 20 20 - 24	30 22	47 31		dB
LO-Q Isolation	6 - 20 20 - 24	32 24	45 33		dB
RF-I Isolation	6 - 20 20 - 24	17 23	37 40		dB
RF-Q Isolation	6 - 20 20 - 24	18 24	41 43		dB
Input Power at 1dB Compression	6 - 24		+10		dBm
Input IP3 (I) Lower Side Band	6 - 20 20 - 24		+20 +25		dBm
Input IP3 (Q) Lower Side Band	6 - 20 20 - 24		+20 +25		dBm
Input IP3 (I) Upper Side Band	6 - 20 20 - 24		+20 +25		dBm
Input IP3 (Q) Upper Side Band	6 - 20 20 - 24		+20 +25		dBm

1. Measured on Mini-Circuits Characterization/Evaluation Test Board TB-SMIQ-6243HC+. See Figures 2, 3, & 4. Board loss de-embedded to the device. Unless otherwise specified, IF = 200 MHz
2. Conversion loss (dB) = RF Power (dBm) minus worse of I/Q Port Power (dBm) minus 3dB theoretical loss of an Ideal External Hybrid, measured as a Down Converter. See measurement block diagram Figure 2.
3. Level of undesired image signal below desired RF signal. See measurement block diagram Figure 3.
4. Level of undesired sideband below desired sideband. See measurement Block Diagram Figure 3.

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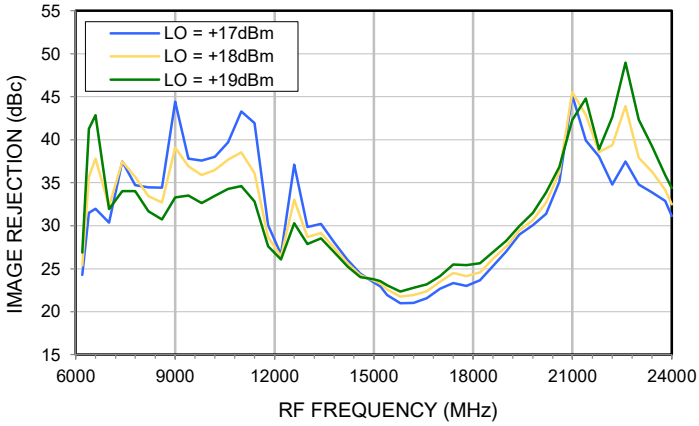
TYPICAL PERFORMANCE GRAPHS

IMAGE REJECTION (DOWNCONVERTER) @ IF = 200 MHz



SSB REJECTION (UPCONVERTER) @ IF = 200 MHz

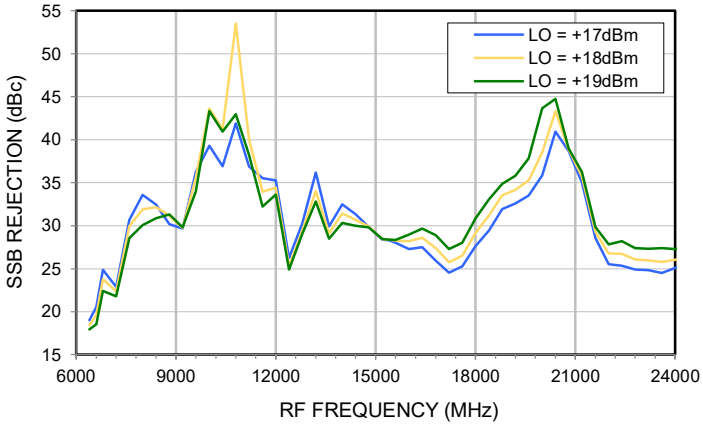
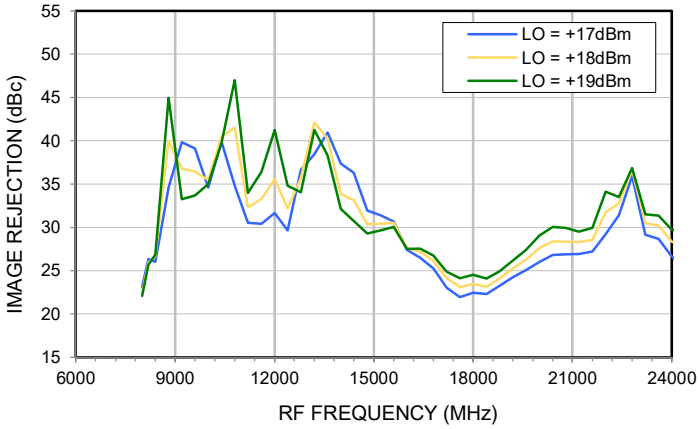


IMAGE REJECTION (DOWNCONVERTER) @ IF = 2000 MHz



SSB REJECTION (UPCONVERTER) @ IF = 2000 MHz

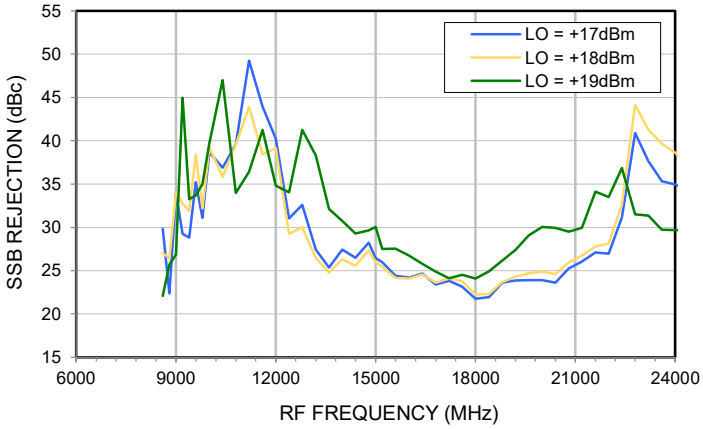
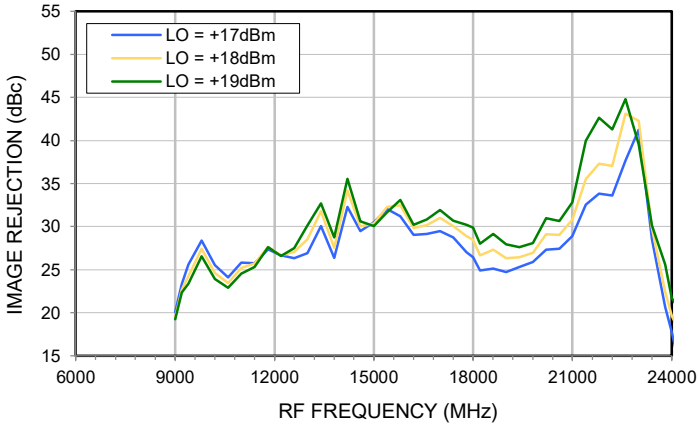
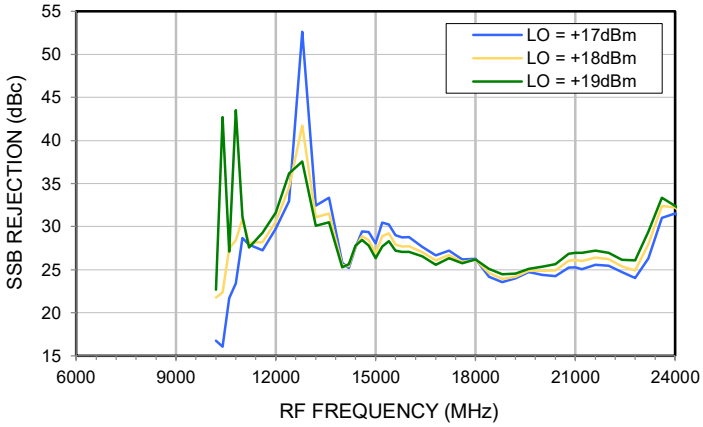


IMAGE REJECTION (DOWNCONVERTER) @ IF = 3000 MHz



SSB REJECTION (UPCONVERTER) @ IF = 3000 MHz



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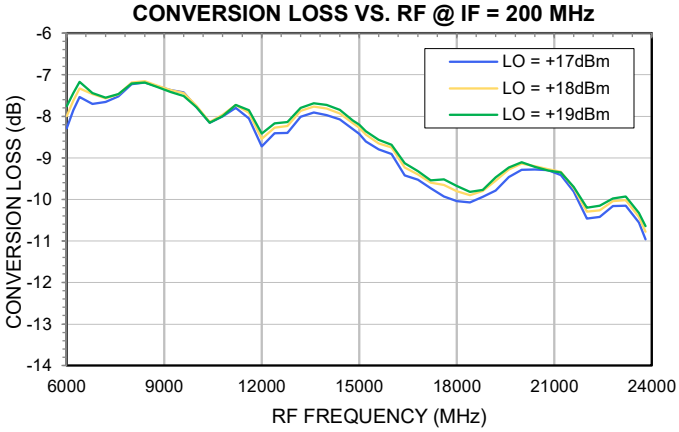
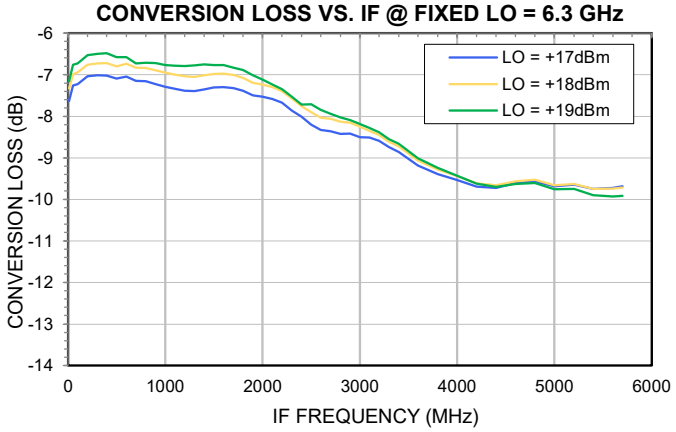
50Ω Level 18 (LO Power +18dBm) 6 to 24 GHz

TYPICAL PERFORMANCE GRAPHS

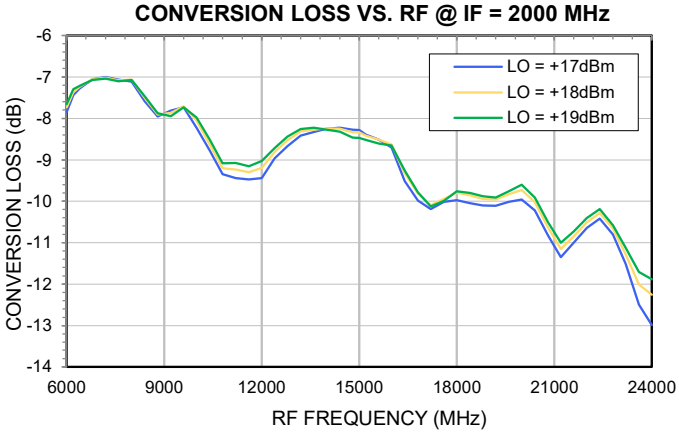
CONVERSION LOSS VS. RF @ IF = 200 MHz



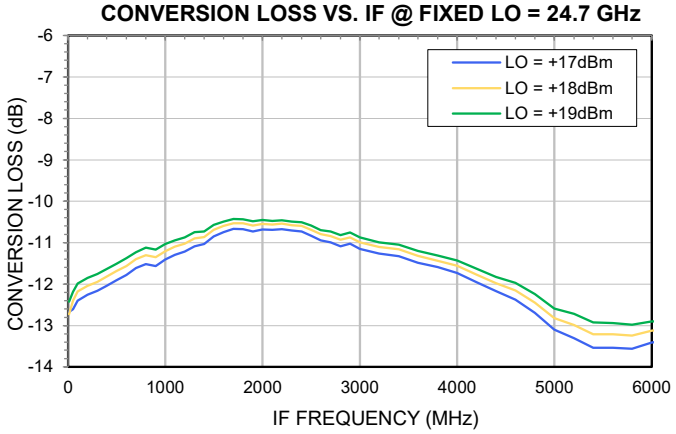
CONVERSION LOSS VS. IF @ FIXED LO = 6.3 GHz



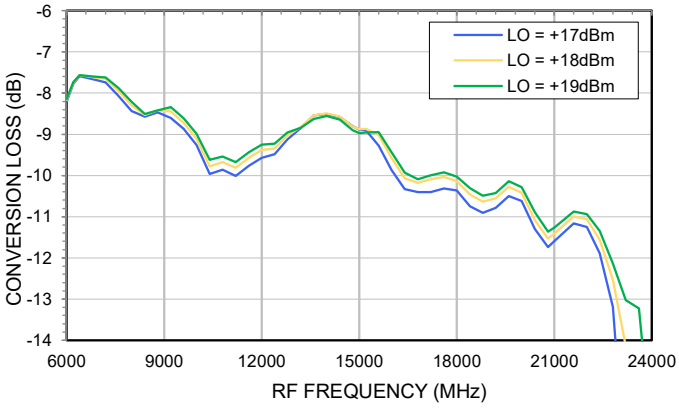
CONVERSION LOSS VS. RF @ IF = 2000 MHz



CONVERSION LOSS VS. IF @ FIXED LO = 24.7 GHz



CONVERSION LOSS VS. RF @ IF = 3000 MHz



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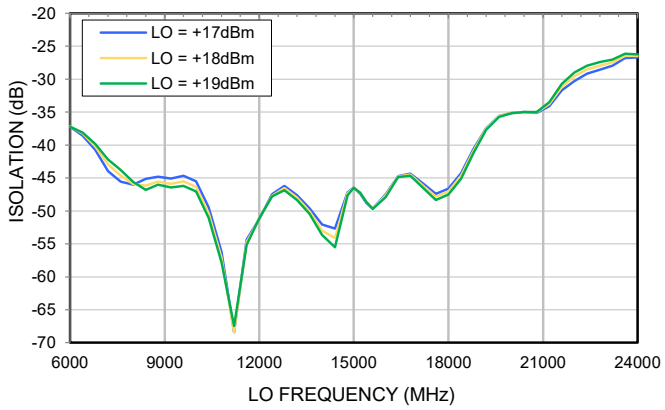
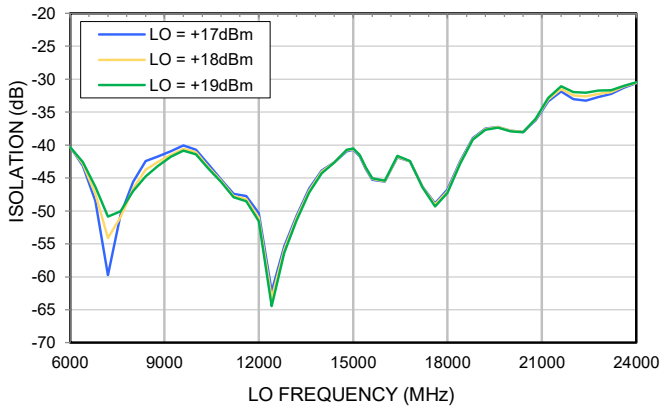
TYPICAL PERFORMANCE GRAPHS

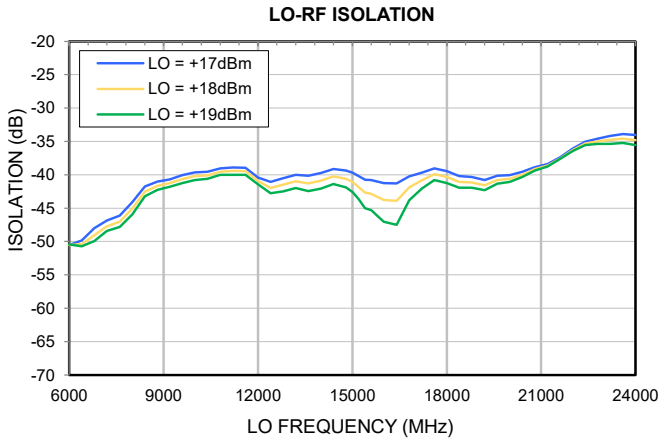
LO-I ISOLATION



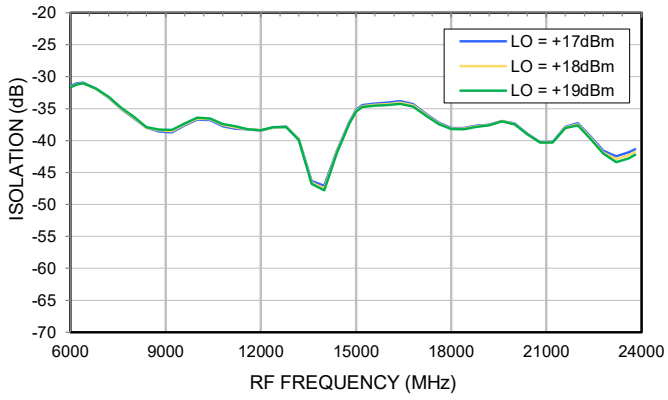
LO-Q ISOLATION



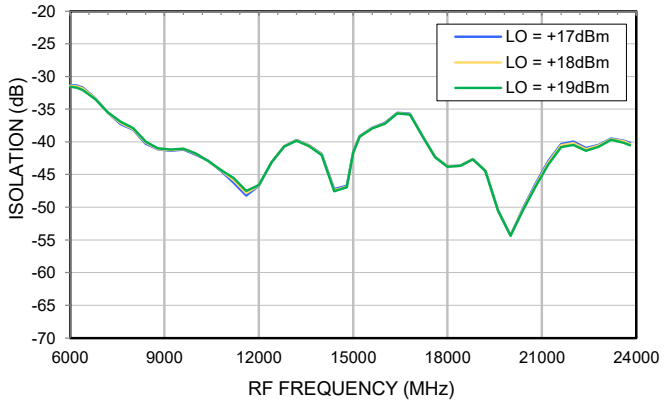
LO-RF ISOLATION



RF-I ISOLATION



RF-Q ISOLATION



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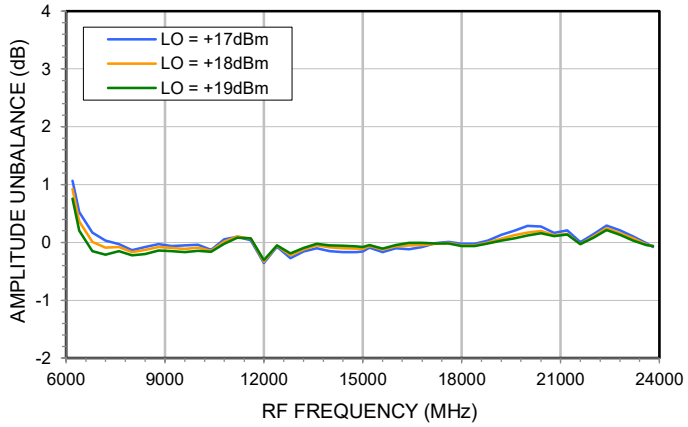
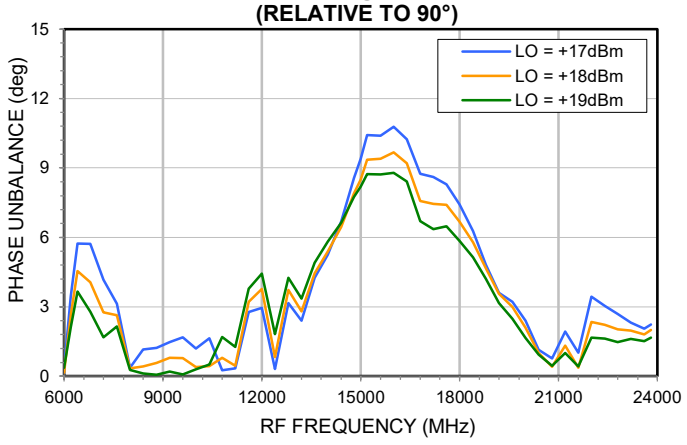
TYPICAL PERFORMANCE GRAPHS

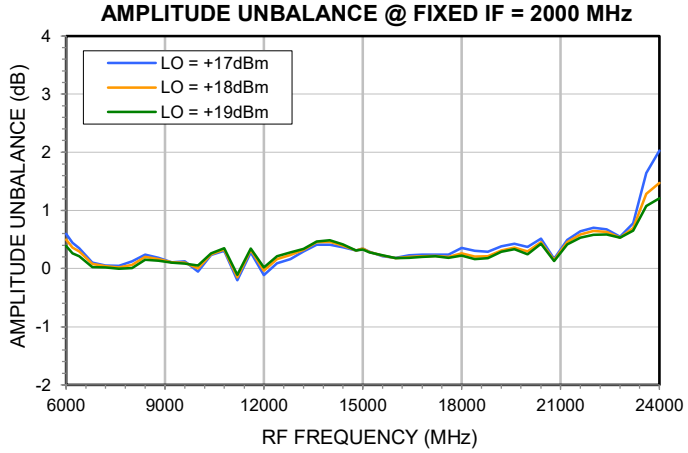
AMPLITUDE UNBALANCE @ FIXED IF = 200 MHz



PHASE UNBALANCE @ FIXED IF = 200 MHz (RELATIVE TO 90°)



AMPLITUDE UNBALANCE @ FIXED IF = 2000 MHz



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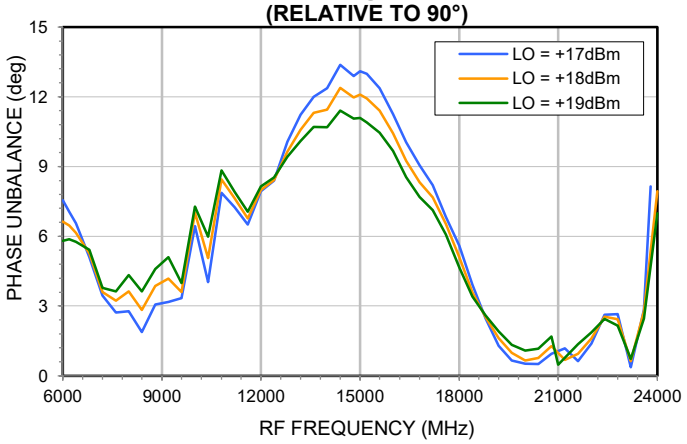
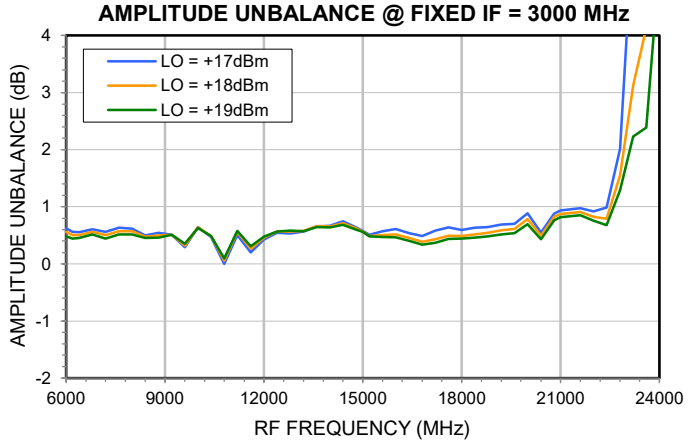


AMPLITUDE UNBALANCE @ FIXED IF = 3000 MHz



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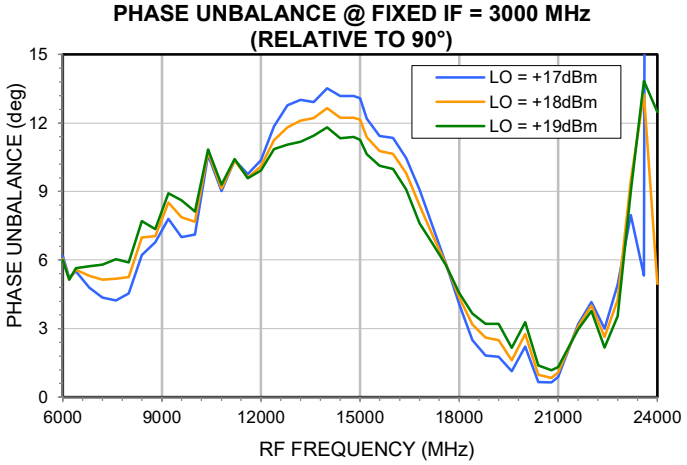

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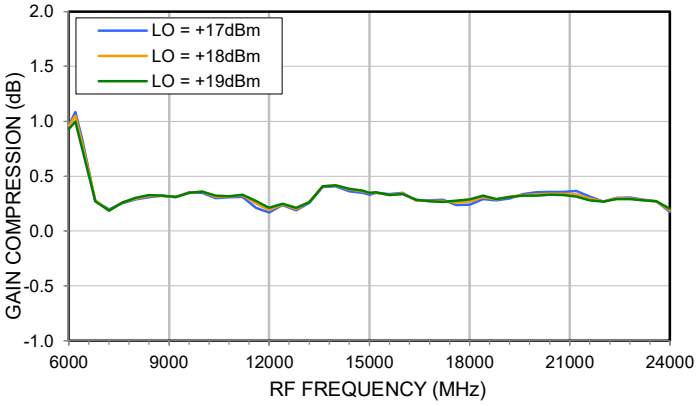
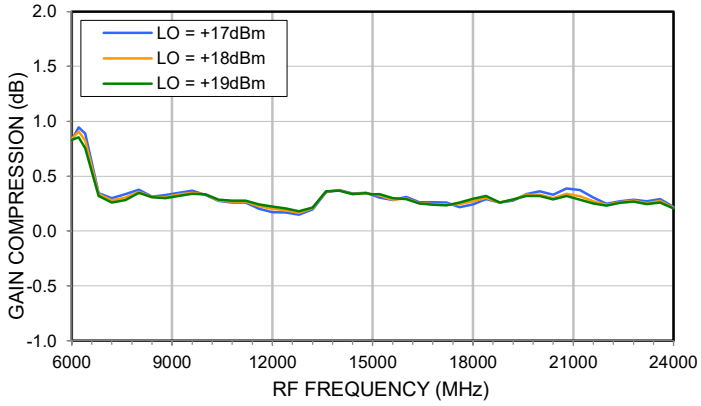
TYPICAL PERFORMANCE GRAPHS

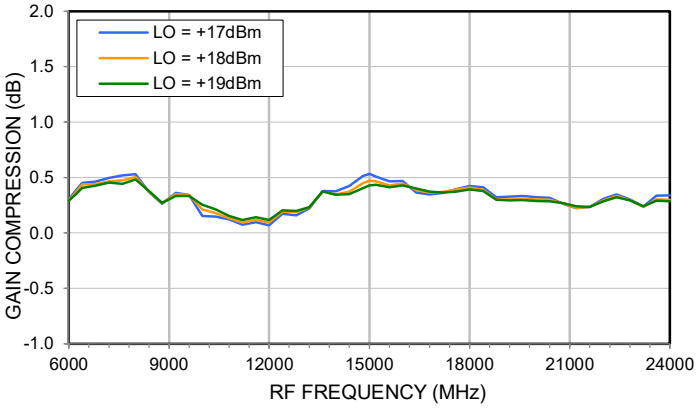
GAIN COMPRESSION (I) @ FIXED IF = 200 MHz
RF INPUT POWER = +10dBm



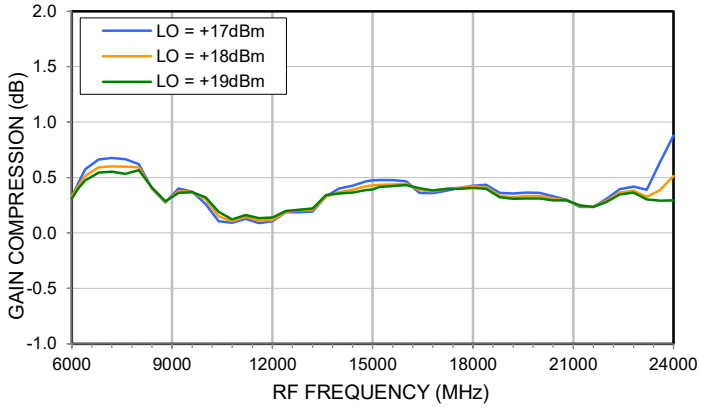
GAIN COMPRESSION (Q) @ FIXED IF = 200 MHz
RF INPUT POWER = +10dBm



GAIN COMPRESSION (I) @ FIXED IF = 2000 MHz
RF INPUT POWER = +10dBm



GAIN COMPRESSION (Q) @ FIXED IF = 2000 MHz
RF INPUT POWER = +10dBm



GAIN COMPRESSION (I) @ FIXED IF = 3000 MHz
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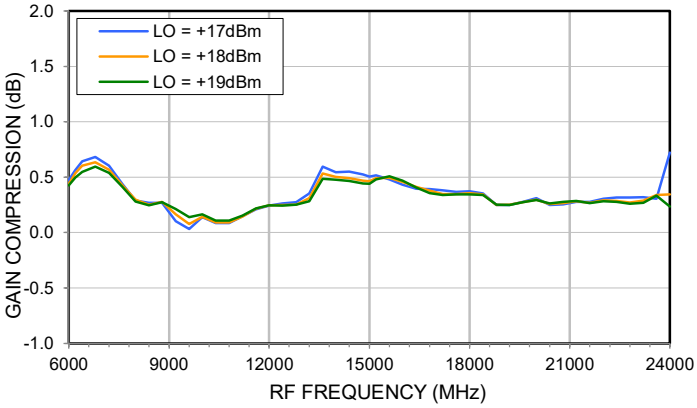

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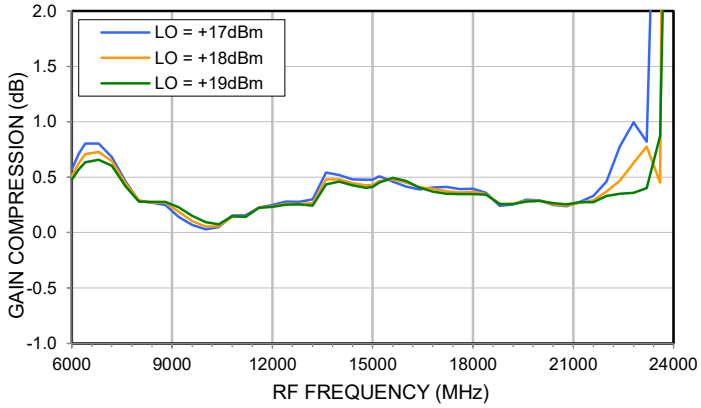

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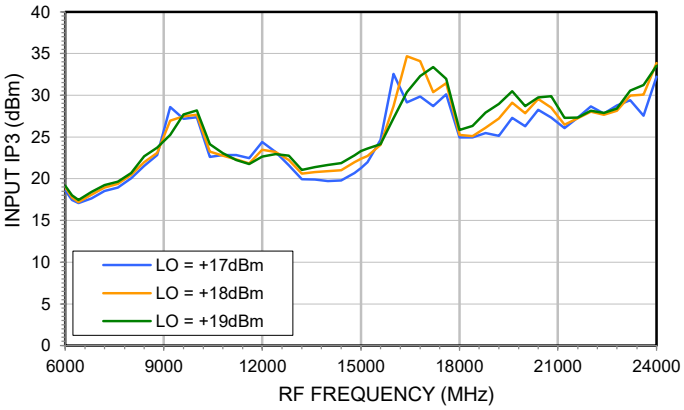
50Ω Level 18 (LO Power +18dBm) 6 to 24 GHz

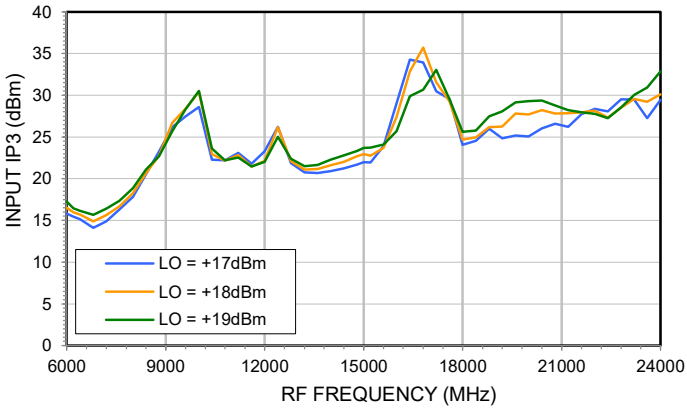
TYPICAL PERFORMANCE GRAPHS

P_{IN} = -10 dBm/Tone with 1 MHz spacing (RF2 = RF1 + 1 MHz)

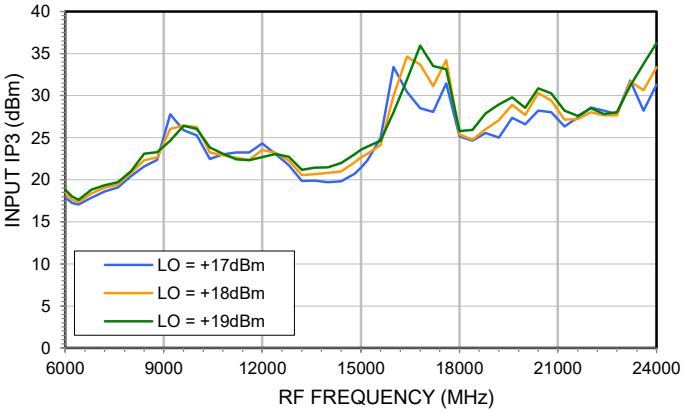
INPUT IP3 LOWER SIDE BAND (I)
@ FIXED IF = 200 MHz



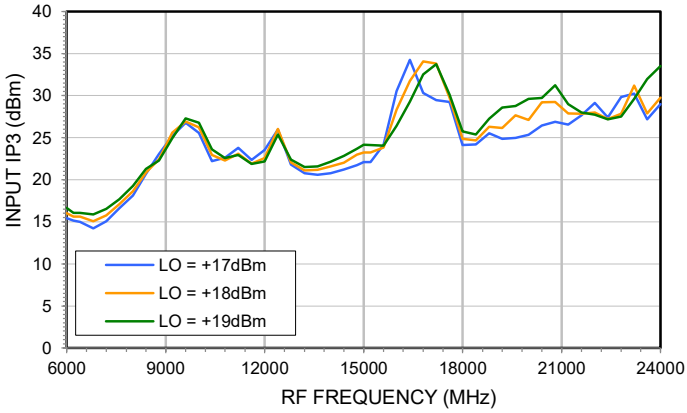
INPUT IP3 LOWER SIDE BAND (Q)
@ FIXED IF = 200 MHz



INPUT IP3 UPPER SIDE BAND (I)
@ FIXED IF = 200 MHz



Input IP3 UPPER SIDE BAND (Q)
@ FIXED IF = 200 MHz



INPUT IP3 LOWER SIDE BAND (I)
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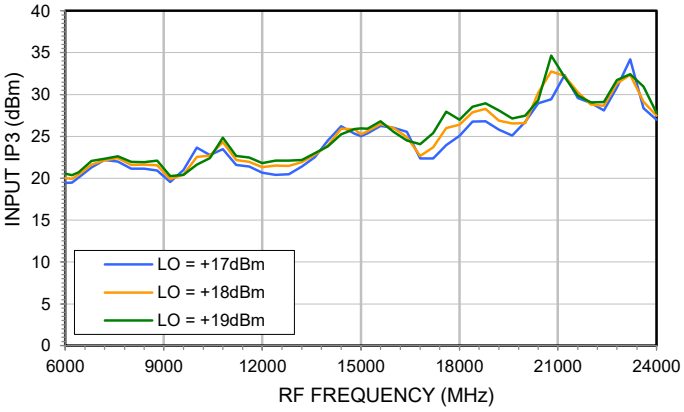

INPUT IP3 LOWER SIDE BAND (Q)
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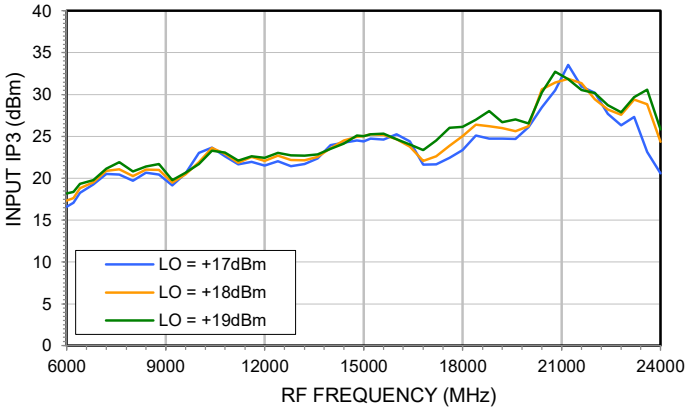

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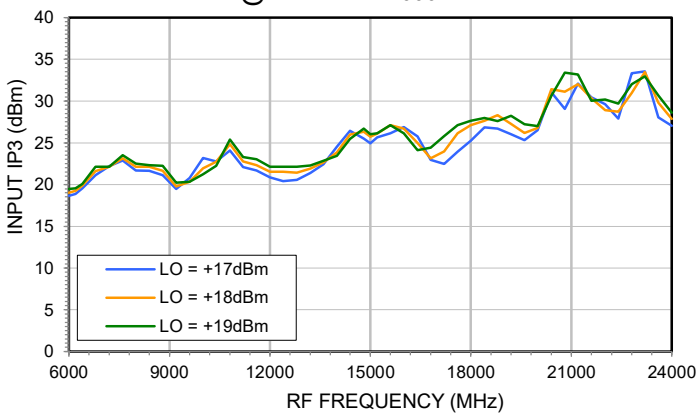

INPUT IP3 UPPER SIDE BAND (Q)
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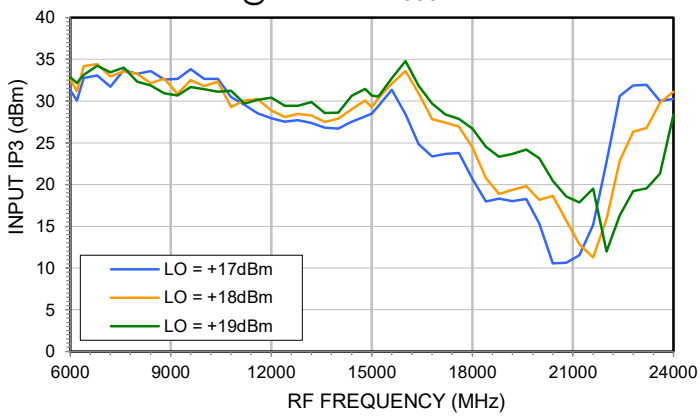

INPUT IP3 LOWER SIDE BAND (I)
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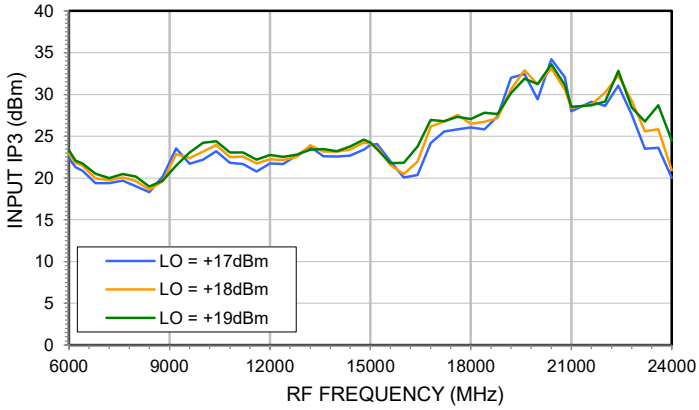

INPUT IP3 LOWER SIDE BAND (Q)
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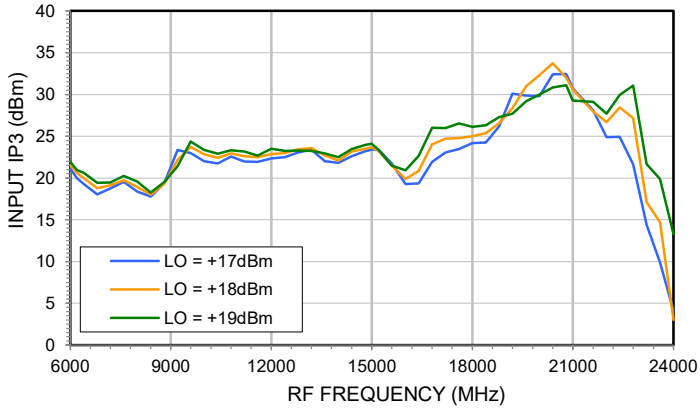

INPUT IP3 UPPER SIDE BAND (I)
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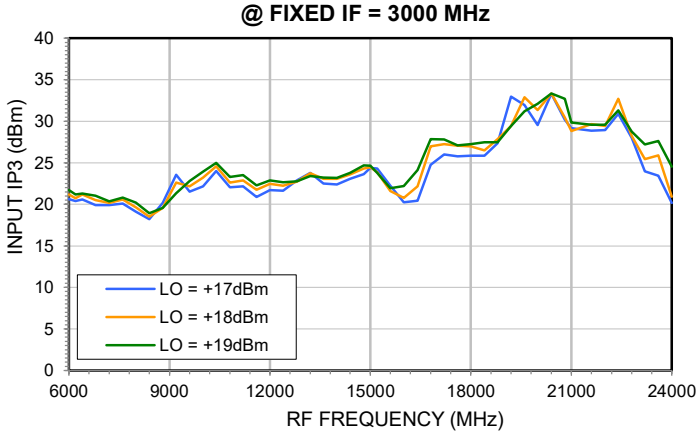

INPUT IP3 LOWER SIDE BAND (Q)
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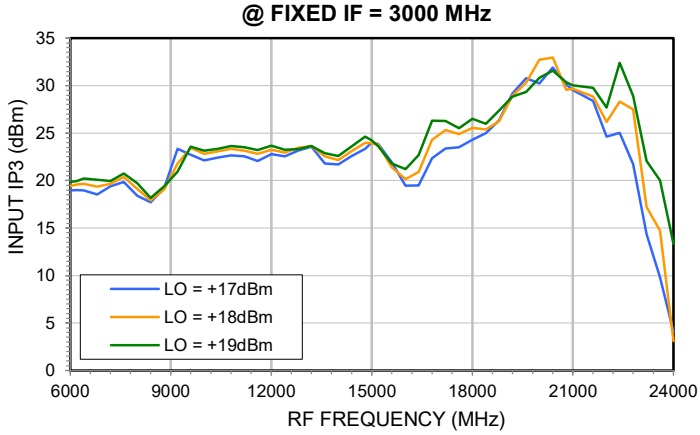


ABSOLUTE MAXIMUM RATINGS[5]

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-65°C to 150°C
Maximum Junction Temperature	175 °C
RF Power	+25 dBm
LO Power	+25 dBm
IF Current	16 mA

5. Permanent damage may occur if any of these limits are exceeded. Electrical maximum ratings are not intended for continuous normal

ESD RATING

	Class	Voltage Range	Reference Standard
HBM	1A	250 to <500V	ANSI/ESDA/JEDEC JS-001-2017
CDM	C4	500 to <1000V	JESD22-C101F

ESD HANDLING PRECAUTION: This device is designed to be Class 1A for HBM.Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E /JEDEC J-STD-033C.

IQ Mixer

SMIQ-6243H+

50Ω Level 18 (LO Power +18dBm) 6 to 24 GHz

FUNCTIONAL DIAGRAM

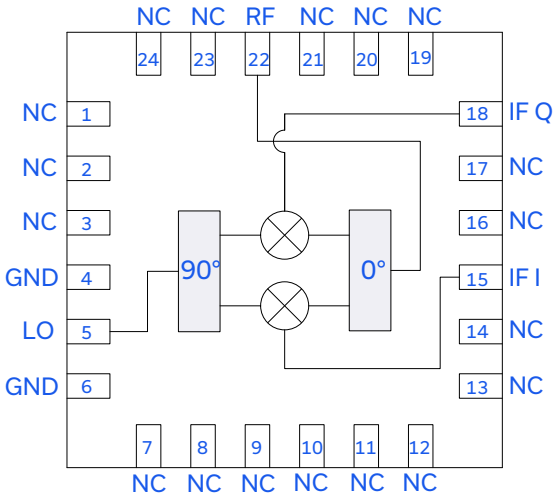
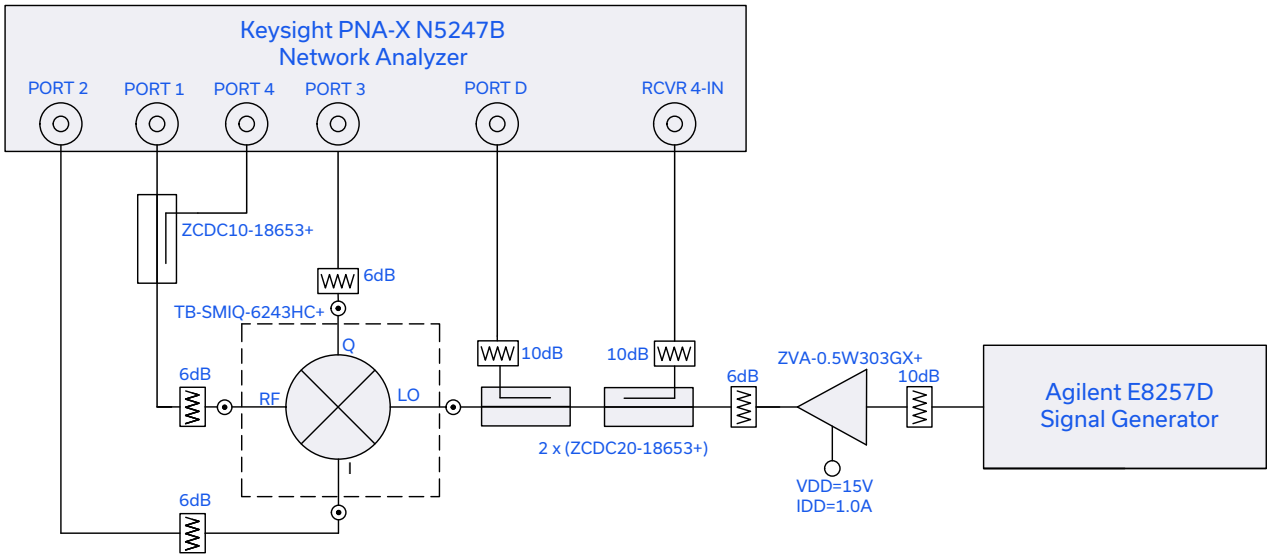


Figure 1. SMIQ-6243H+ Functional Diagram

PAD CONNECTIONS

Function	Pad #	Description
RF	22	RF Port. Connects to RF Output for Up converters or RF Input for Down converters.
LO	5	LO Port. Connects to LO Input.
IF I	15	IF I Port. Connects to the IF I Input for Up converters or IF I Output for Down converters.
IF Q	18	IF Q Port. Connects to the IF Q Input for Up converters or IF Q Output for Down converters.
GND	4, 6, Paddle	Connects to bottom ground.
NC	1-3, 7-14, 16-17, 19-21, 23-24	No connection

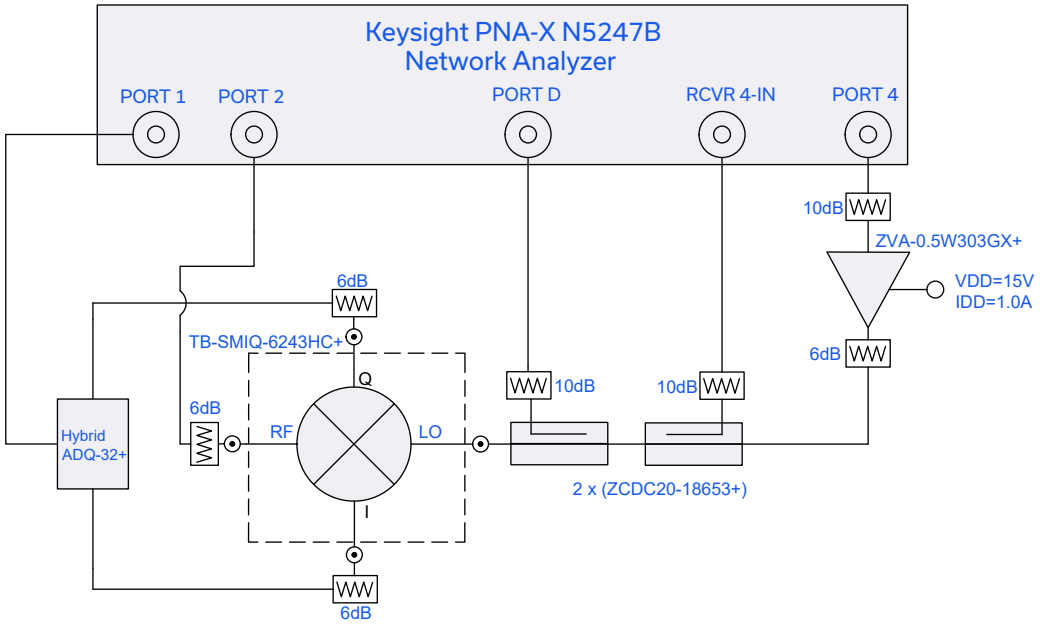
CHARACTERIZATION TEST CIRCUITS



10 dB attenuators P/N BW-E10-1W653+
6 dB attenuators P/N BW-E6-1W653+

Figure 2. Block diagram of test circuit used to characterize: Conversion Loss, Amplitude Unbalance, Phase Unbalance, Isolation, Return Loss, and Input IP3

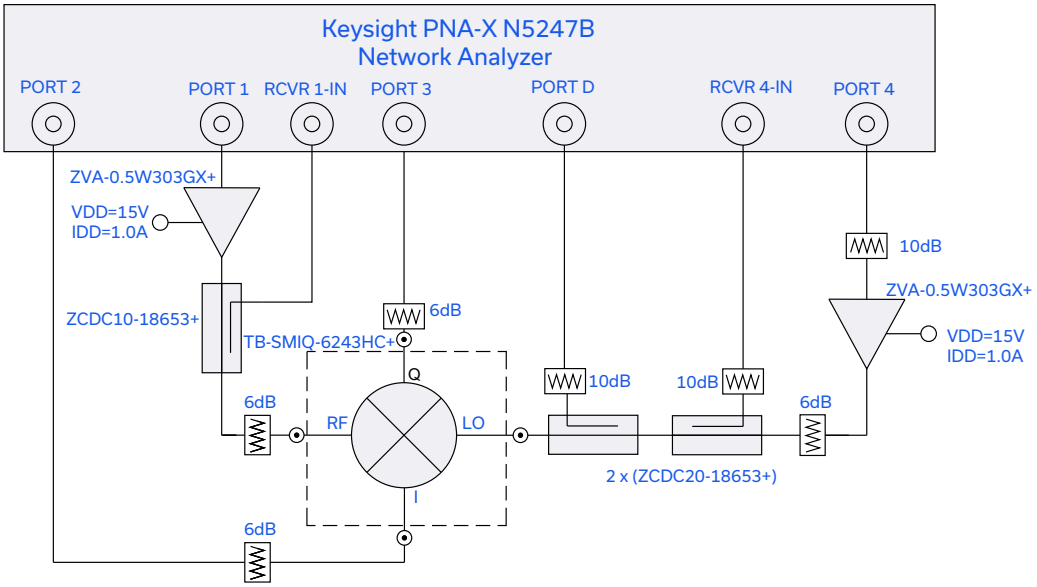
Test conditions:
For Conversion Loss, Return Loss and Isolation
RF Input Power = -10 dBm, LO Input Power = +17 to +19 dBm, IF = 200 MHz, 2 GHz, and 3 GHz
For Input IP3: RF Input Power = -10 dBm/Tone, LO Input Power =+17 to +19 dBm. Two tones, spaced 1 MHz apart



10 dB attenuators P/N BW-E10-1W653+
6 dB attenuators P/N BW-E6-1W653+

Figure 3. Block diagram of Test Circuit used for characterization of Image Rejection and Single Side Band Rejection

Test conditions:
RF Input Power = -10 dBm, LO Input Power =+17 to +19 dBm, IF = 200 MHz, 2 GHz, and 3 GHz



10 dB attenuators P/N BW-E10-1W653+
6 dB attenuators P/N BW-E6-1W653+

Figure 4. Block diagram of test circuit used to characterize: Compression

Test conditions:
RF Input Power = -10 dBm and +10 dBm, LO Input Power = +17 to +19 dBm, IF = 200 MHz, 2 GHz, and 3 GHz
Compression = (Conversion Loss @ RF Power = +10 dBm) – (Conversion Loss @ RF Power = -10 dBm)

APPLICATION CONFIGURATION FOR IMAGE REJECT AND SINGLE SIDE BAND MIXER

In Image Reject or Single Sideband Upconverter applications an external 90° Hybrid is needed. Refer to Mini-Circuits extensive portofolio of 90° Hybrids.

IMAGE REJECT MIXER APPLICATION

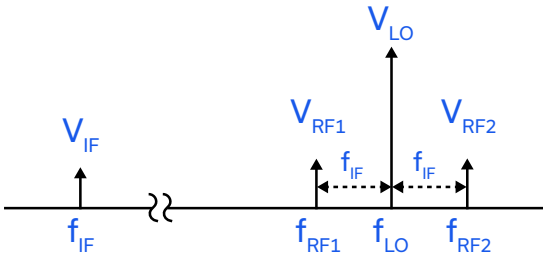


Figure 5. Spectral representation of Signals

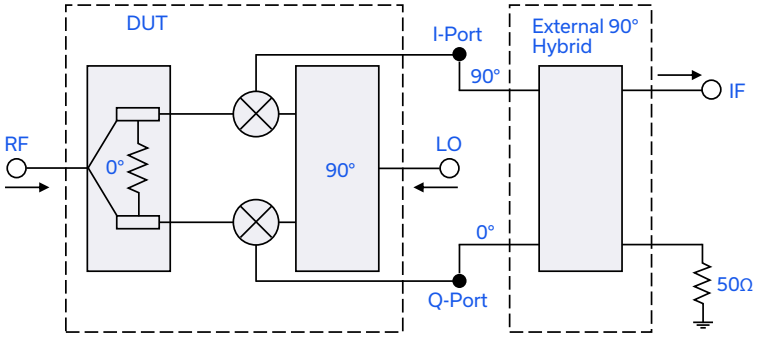


Figure 6. Block Diagram of Image Reject Mixer

If f_{RF1} is the desired signal and f_{RF2} is the image, connect the I port of DUT to the 90° port of the external hybrid and the Q port to the 0° port of the hybrid. This will send the f_{RF2}-f_{LO} IF signal to the terminated output of the external 90° hybrid and desired IF signal f_{LO}- f_{RF1} to IF port.

If f_{RF2} is the desired signal and f_{RF1} is the image signal, connect the I port of DUT to the 0 deg port of the external 90° hybrid and the Q port to the 90° port of the external hybrid. This will send f_{LO}- f_{RF1} IF signal to the terminated output of the external 90° hybrid and desired IF signal f_{RF2}- f_{LO} to IF port.

SINGLE SIDE BAND (SSB) UPCONVERTER APPLICATION

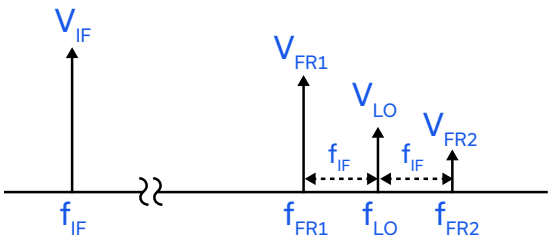


Figure 7. Spectral representation of Signals

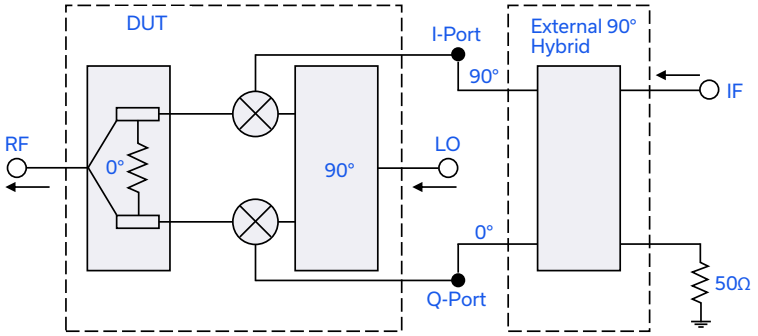


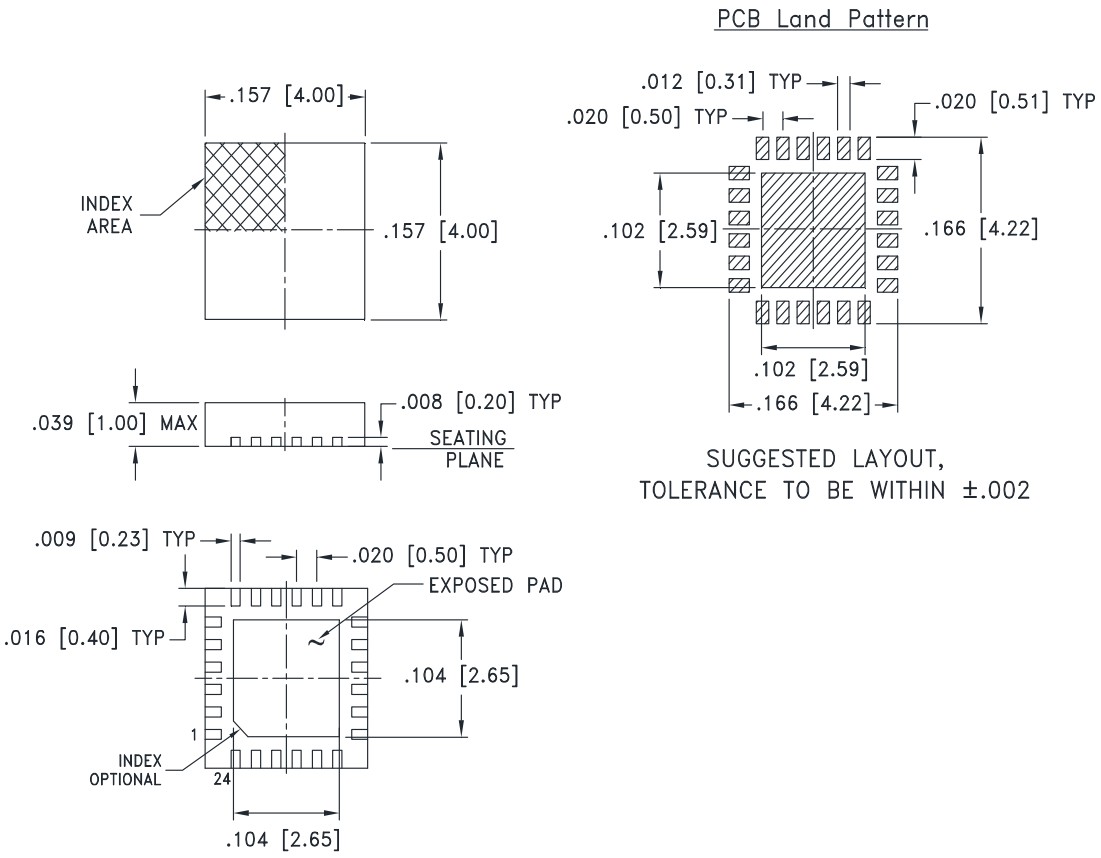
Figure 8. Block Diagram of Single Side Band Mixer

For upper side band selection connect the I port to the 90° port of the external 90° hybrid and the Q port to the 0° port of the external hybrid. This will send the lower sideband band signal to the isolation resistor of the 0° RF splitter in DUT and upper sideband at RF port.

For lower side band selection connect the I port to the 0° port of the external 90° hybrid and the Q port to the 90° port of the hybrid. This will send the upper sideband band signal to the isolation resistor of the 0° RF splitter in DUT and lower sideband out of RF port.

Refer to Mini-Circuits blog, I&Q Mixers, Image Reject Down-Conversion & Single Sideband (SSB) Up-Conversion for a detailed explanation.

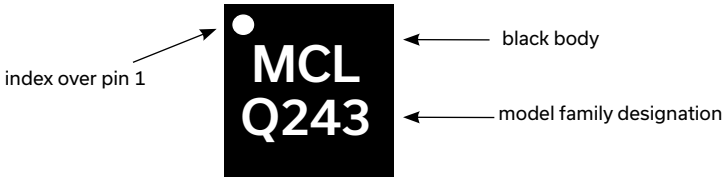
CASE STYLE DRAWING



Weight: .04 Grams
Dimensions are in inches [mm]. Tolerances: 2 Pl. + .01; 3 Pl. + .005

Figure 9. DG1847 Case Style Drawing

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

Figure 10. SMIQ-6243H+ Product Marking