5.5 GHz to 14 GHz, GaAs MMIC Fundamental Mixer

Data Sheet

HMC558ACHIPS

FEATURES

Conversion loss: 8 dB typical at 5.5 GHz to 10 GHz
Local oscillator (LO) to radio frequency (RF) isolation: 45 dB
LO to intermediate frequency (IF) isolation: 35 dB (typical)
Input third-order intercept (IIP3): 18 dBm (typical)
Input P1dB: 10 dBm (typical)
Input second-order intercept (IIP2): 50 dBm
Passive, double balanced topology
Wide IF bandwidth: dc to 6 GHz
8-pad bare die

APPLICATIONS

Point to point microwave radios
Point to multipoint radios
Military end use
Instrumentation, automatic test equipment (ATE), and sensors

FUNCTIONAL BLOCK DIAGRAM

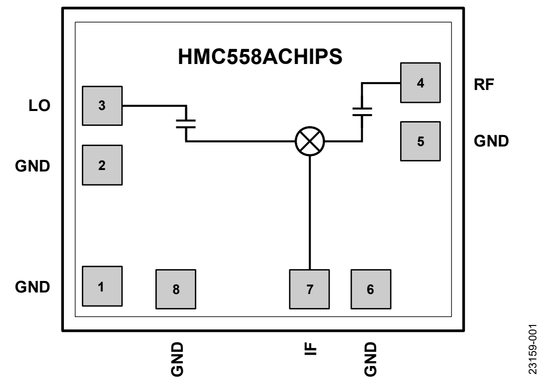

Figure 1.

GENERAL DESCRIPTION

The HMC558ACHIPS is a general-purpose, double balanced mixer that can be used as an upconverter or a downconverter between 5.5 GHz and 14 GHz. This mixer is fabricated in a gallium arsenide (GaAs), metal semiconductor field effect transistor (MESFET) process and requires no external components or matching circuitry. The HMC558ACHIPS optimized balun structures provide high, 45 dB local oscillator (LO) to RF isolation. These balun structures also provide 35 dB of LO to intermediate frequency (IF) isolation.

Rev. 0 Document Feedback

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Technical Support **www.analog.com**

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REVISION HISTORY

3/2020—Revision 0: Initial Version

SPECIFICATIONS

T_A = 25°C, IF = 100 MHz, and LO = 15 dBm for upper sideband. All measurements were performed as a downconverter, unless otherwise noted.

Table 1.

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
FREQUENCY					
RF Pad		5.5		14	GHz
IF Pad		dc		6	GHz
LO Pad		5.5		14	GHz
LO AMPLITUDE		9	15	20	dBm
5.5 GHz TO 10 GHz PERFORMANCE					
Downconverter					
Conversion Loss			8	9	dB
Single Sideband Noise Figure	Measurements taken with external LO amplifier		8.5		dB
Input Third-Order Intercept (IP3)	1 MHz separation between inputs	15	18		dBm
Input 1 dB Compression Point (P1dB)			10		dBm
Input Second-Order Intercept (IP2)	1 MHz separation between inputs		50		dBm
Upconverter					
Conversion Loss			7		dB
Input IP3	1 MHz separation between inputs		19		dBm
Input P1dB			15		dBm
Isolation					
RF to IF		13	16		dB
LO to RF		35	45		dB
LO to IF		28	35		dB
10 GHz TO 14 GHz PERFORMANCE					
Downconverter					
Conversion Loss			9	11	dB
Single Sideband Noise Figure	Measurements taken with external LO amplifier		9.5		dB
Input IP3	1 MHz separation between inputs	18	21		dBm
Input P1dB			12		dBm
Input IP2	1 MHz separation between inputs		57		dBm
Upconverter					
Conversion Loss			8		dB
Input IP3	1 MHz separation between inputs		17		dBm
Input P1dB			10		dBm
Isolation					
RF to IF		16	19		dB
LO to RF		30	40		dB
LO to IF		30	35		dB

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
RF Input Power	25 dBm
LO Input Power	25 dBm
IF Input Power	25 dBm
IF Source/Sink Current	3 mA
Maximum Junction Temperature	175°C
Continuous P_{DISS} (T = 85°C) (Derate 5.5 mW/°C Above 85°C)	495 mW
Operating Temperature Range	−40°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature Range (Soldering 60 sec)	−65°C to +150°C
Electrostatic Discharge (ESD) Sensitivity	
Human Body Model (HBM)	2500 V (Class 2)
Field Induced Charged Device Model (FICDM)	1000 V (Class C5)

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required.

θ_{JC} is the junction to case thermal resistance.

Table 3. Thermal Resistance

Package Type	Non JEDEC Junction to Case Thermal Resistance (θ_{JC})	Unit
C-8-23[1]	103	°C/W

[1] The non JEDEC junction to case value was simulated under the following conditions: the heat transfer is due solely to thermal conduction from the channel through the ground pad to the PCB, and the ground pad is held constant at the operating temperature of 85°C.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

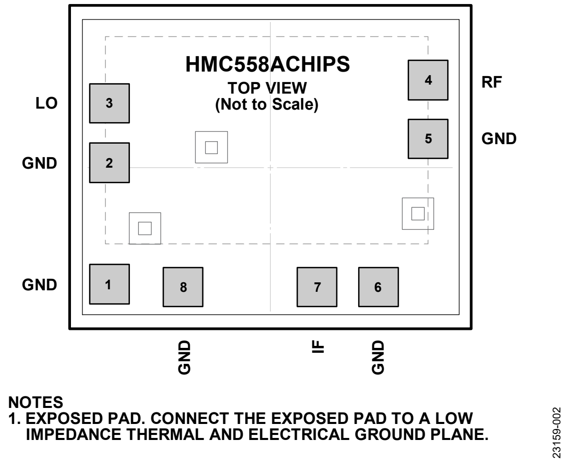

Figure 2. Pad Configuration

Table 4. Pad Function Descriptions

Pad No.	Mnemonic	Description
1, 2, 5, 6, and 8	GND	Ground. See Figure 6 for the ground interface schematic.
3	LO	Local Oscillator Pad. This pad is ac-coupled and matched to 50 Ω. See Figure 4 for the LO interface schematic.
7	IF	DC-Coupled IF. For applications not requiring operation to dc, dc block this port externally using a series capacitor with a value chosen to pass the necessary IF frequency range. For operation to dc, this pad must not source or sink more than 3 mA of current, or device nonfunction and possible device failure may result. See Figure 5 for the IF interface schematic.
4	RF	RF Pad. This pad is ac-coupled internally and matched to 50 Ω. See Figure 3 for the RF interface schematic.
	EPAD	Exposed Pad. Connect the exposed pad to a low impedance thermal and electrical ground plane.

INTERFACE SCHEMATICS

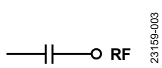

Figure 3. RF Interface

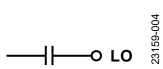

Figure 4. LO Interface

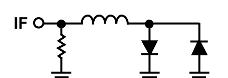

Figure 5. IF Interface

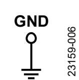

Figure 6. Ground Interface

TYPICAL PERFORMANCE CHARACTERISTICS

DOWNCONVERTER PERFORMANCE

IF = 100 MHz, Upper Sideband (Low-Side LO)

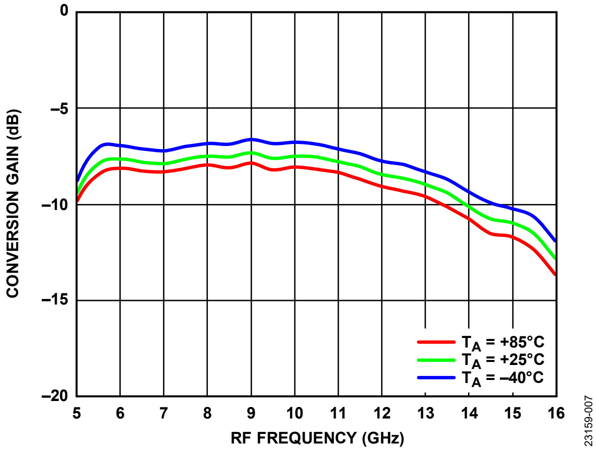

Figure 7. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

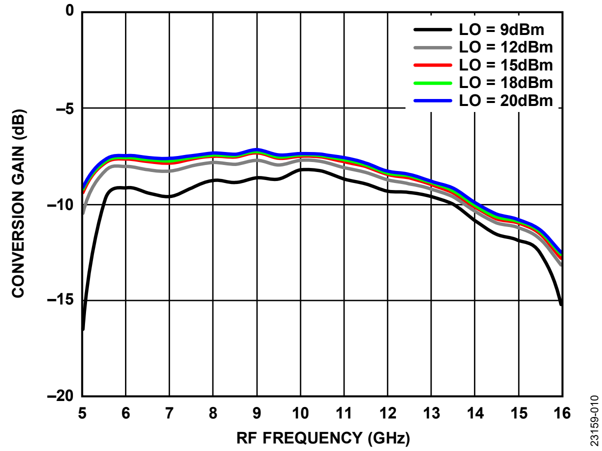

Figure 10. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

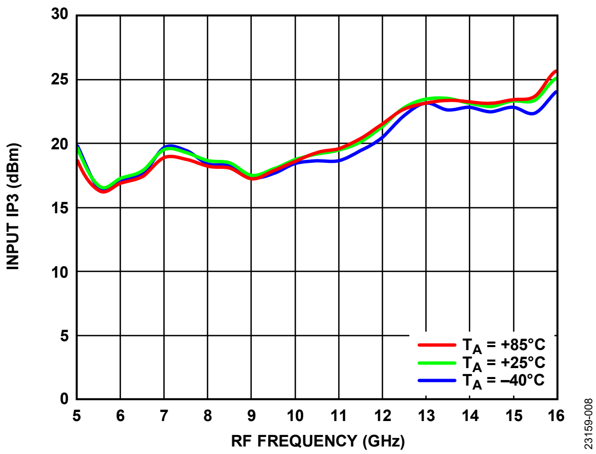

Figure 8. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

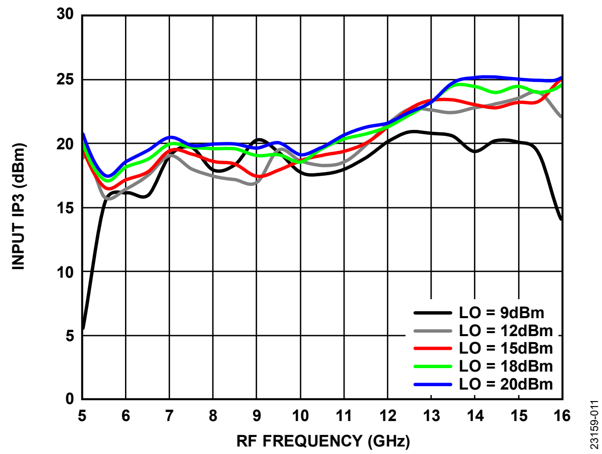

Figure 11 . Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

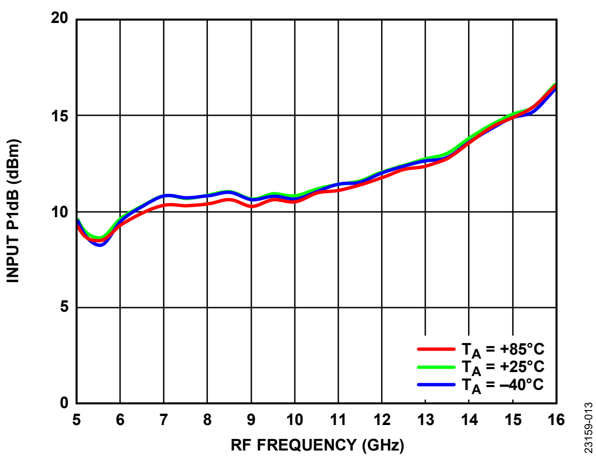

Figure 9. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

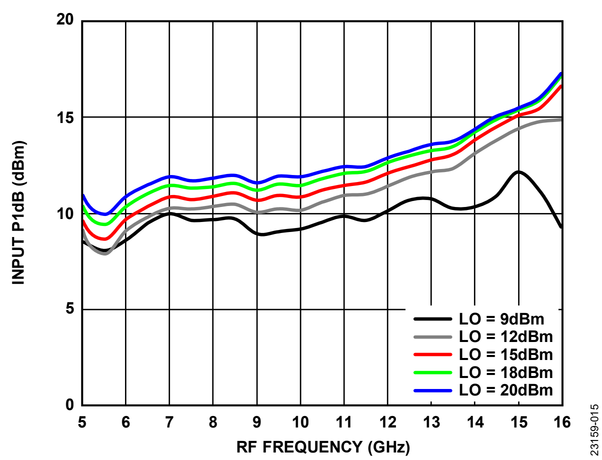

Figure 12. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

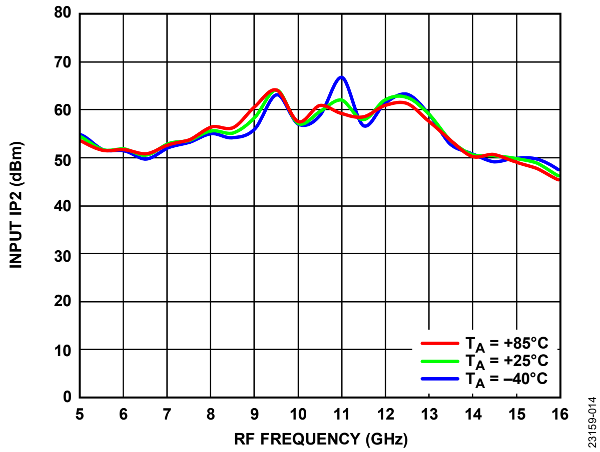

Figure 13. Input IP2 vs. RF Frequency at Various Temperatures, LO = 15 dBm

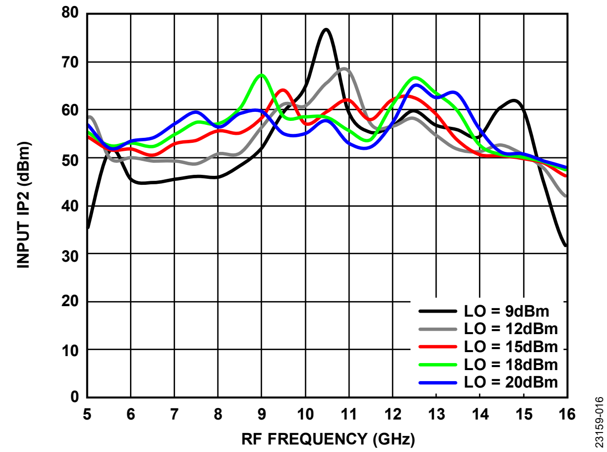

Figure 14. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 100 MHz, Lower Sideband (High-Side LO)

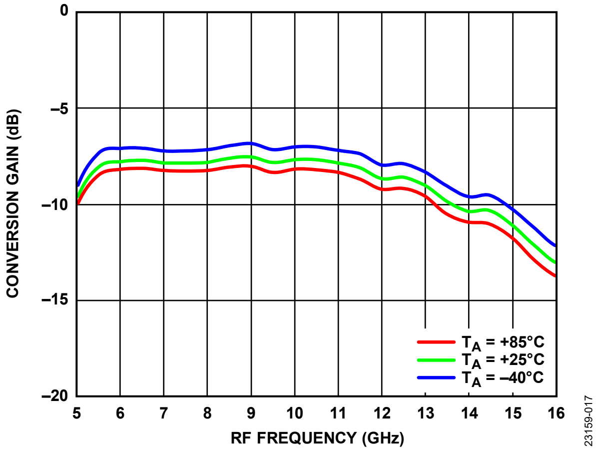

Figure 15. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

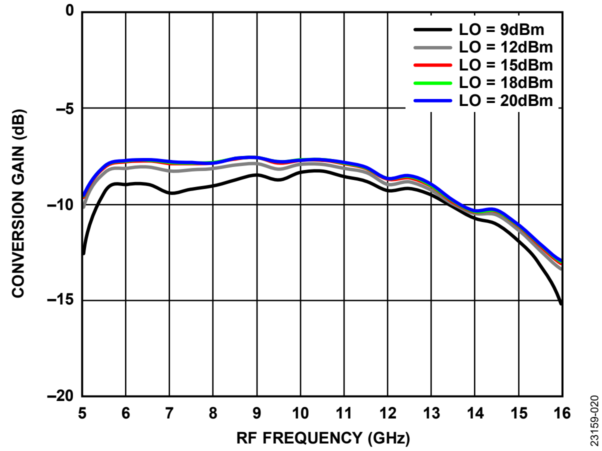

Figure 18. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

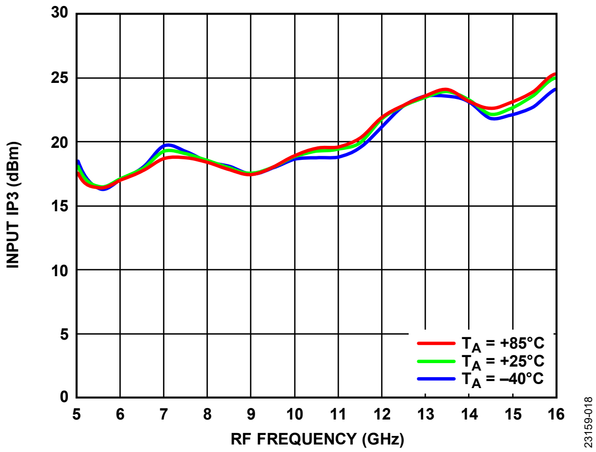

Figure 16. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

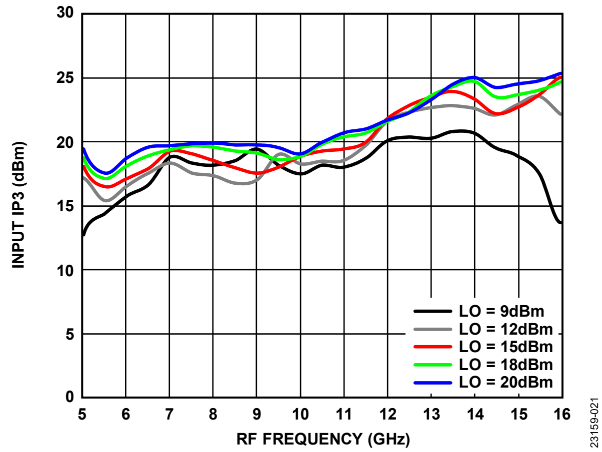

Figure 19. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

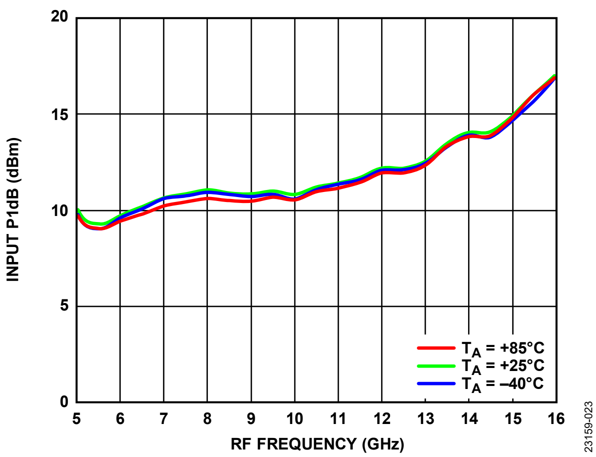

Figure 17. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

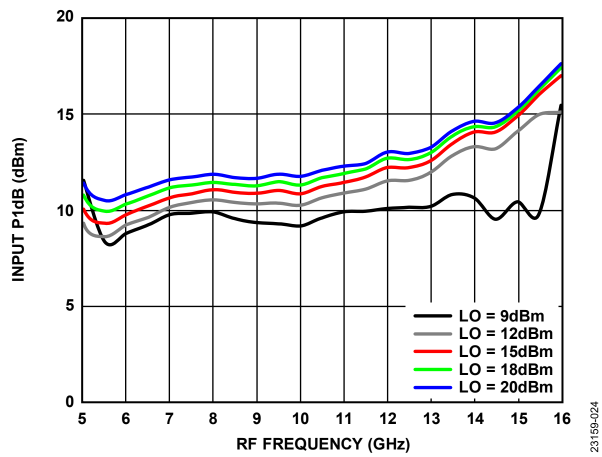

Figure 20. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 2000 MHz, Upper Sideband (Low-Side LO)

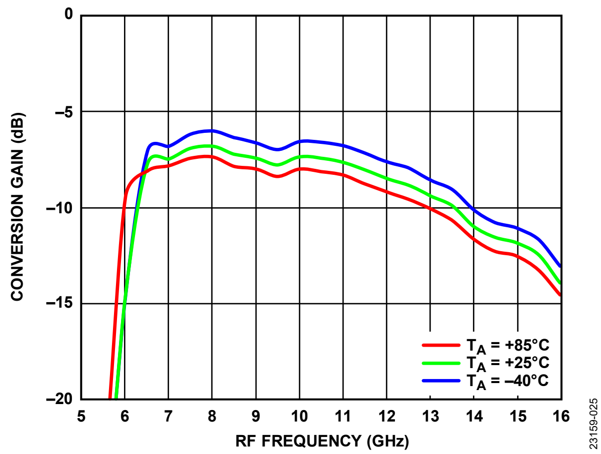

Figure 21. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

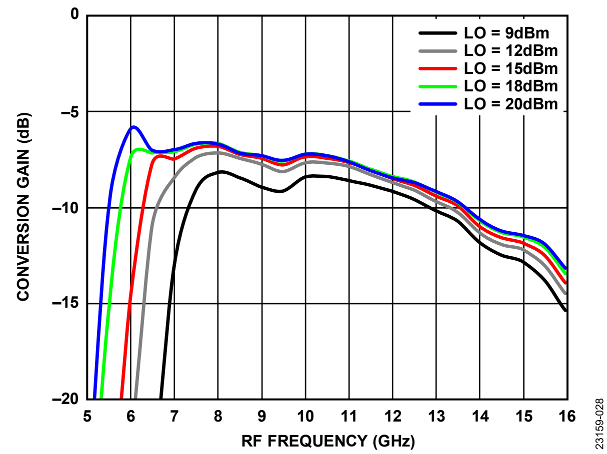

Figure 24. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

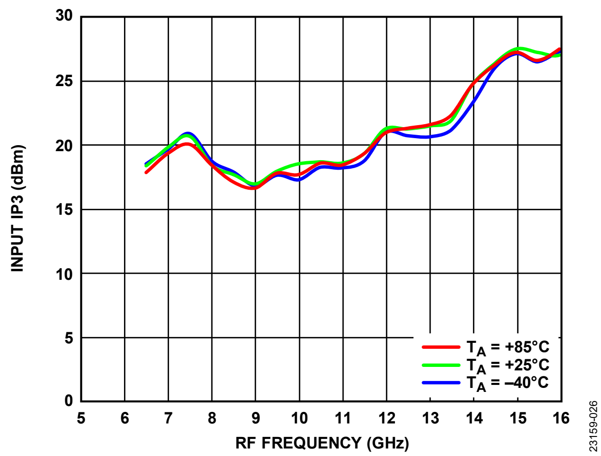

Figure 22. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

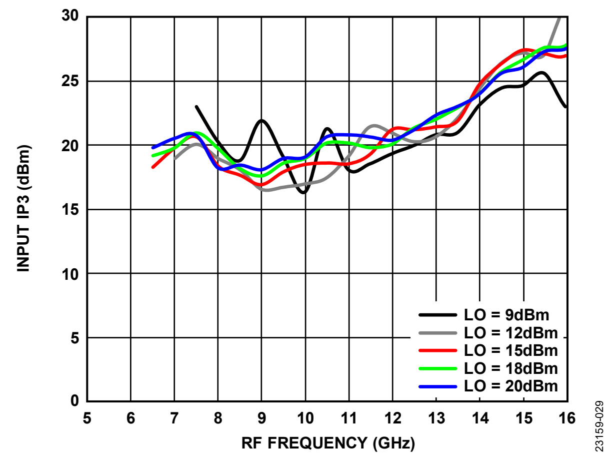

Figure 25. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

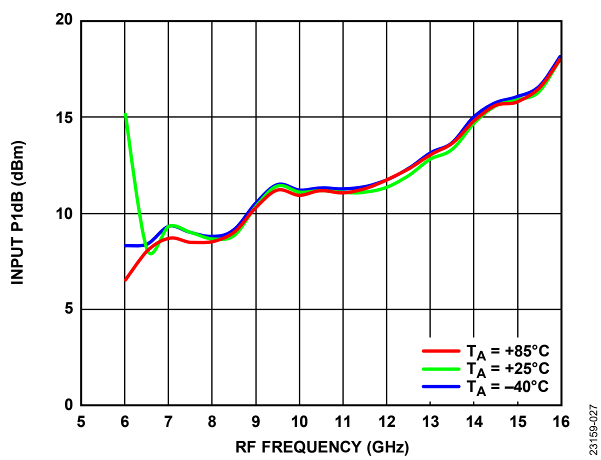

Figure 23. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

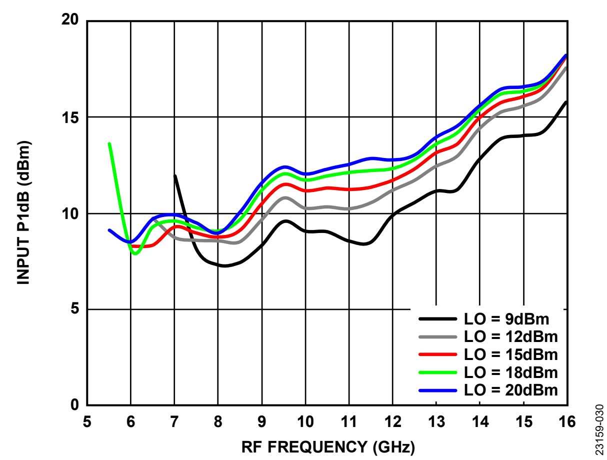

Figure 26. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

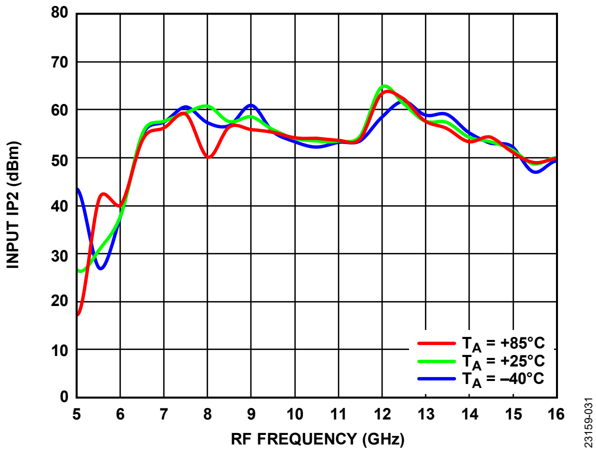

Figure 27. Input IP2 vs. RF Frequency at Various Temperatures, LO = 15 dBm

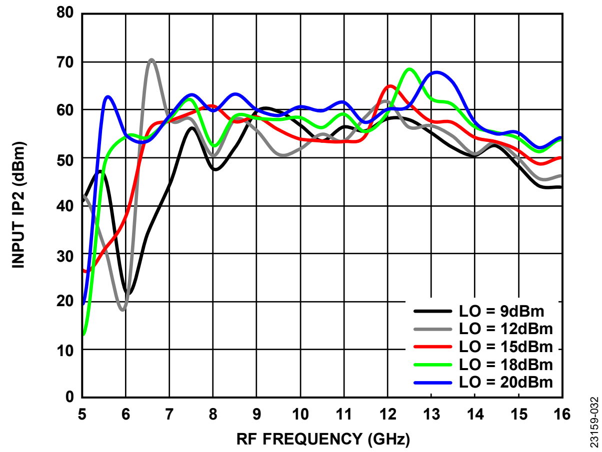

Figure 28. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 2000 MHz, Lower Sideband (High-Side LO)

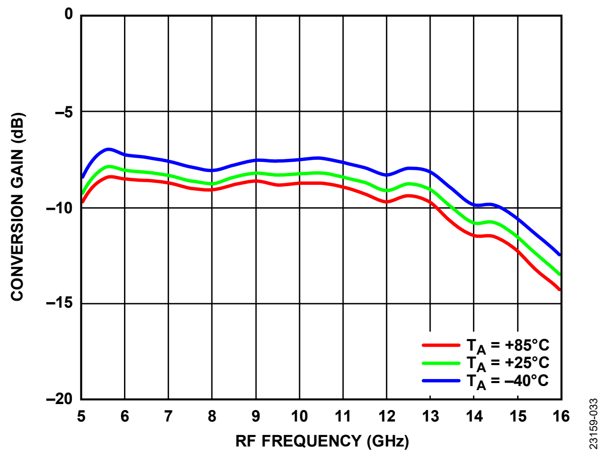

Figure 29. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

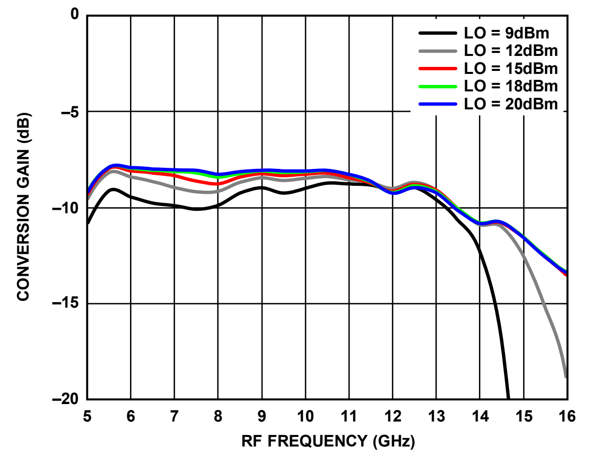

Figure 32. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

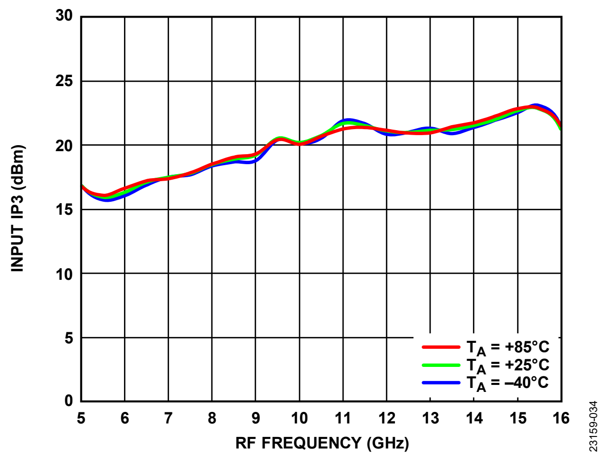

Figure 30. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

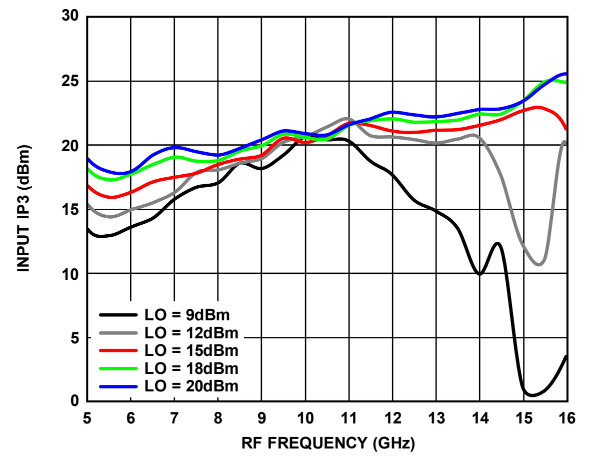

Figure 33. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

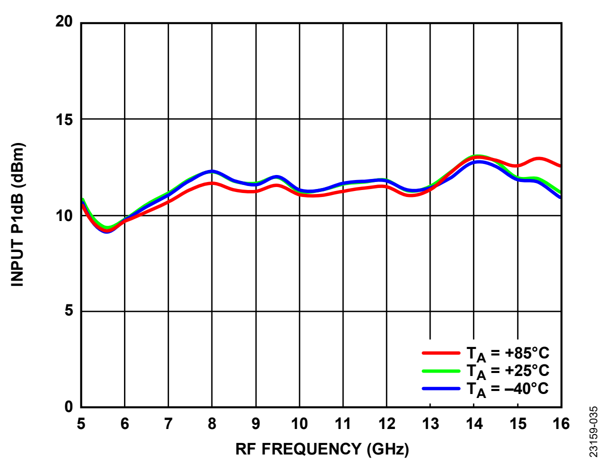

Figure 31. Input P1dB vs. RF Frequency at Various LO Power Levels, LO = 15 dBm

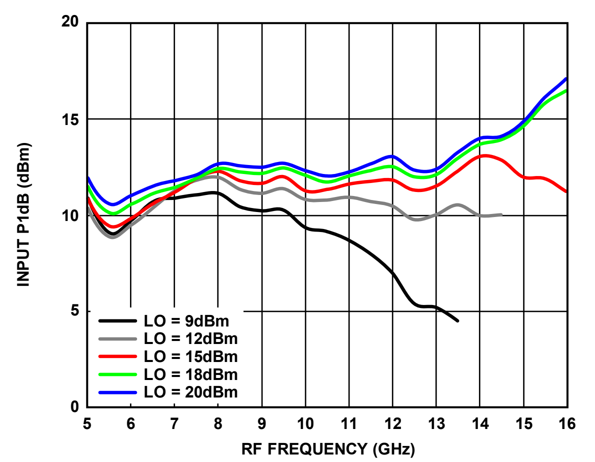

Figure 34. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 6000 MHz, Upper Sideband (Low-Side LO)

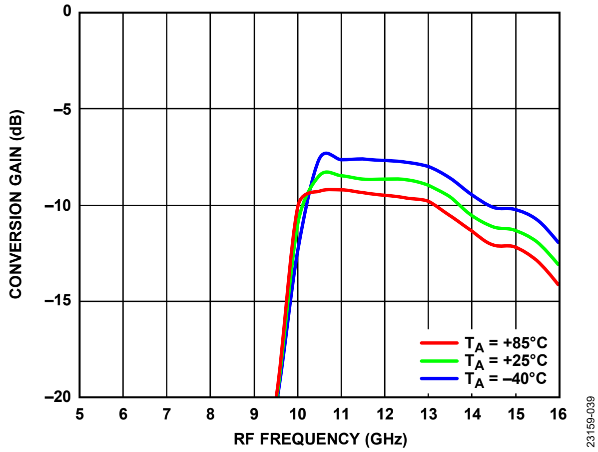

Figure 35. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

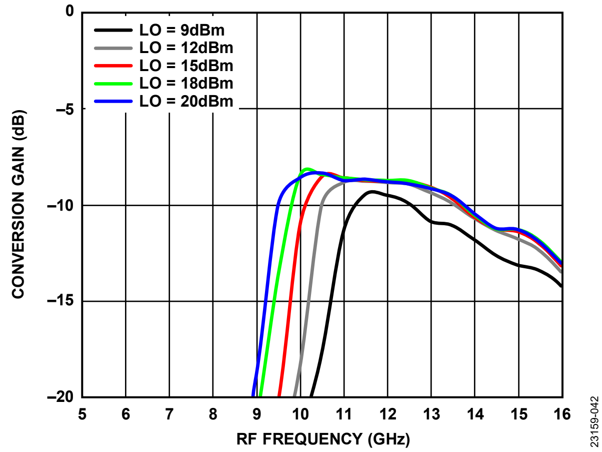

Figure 38. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

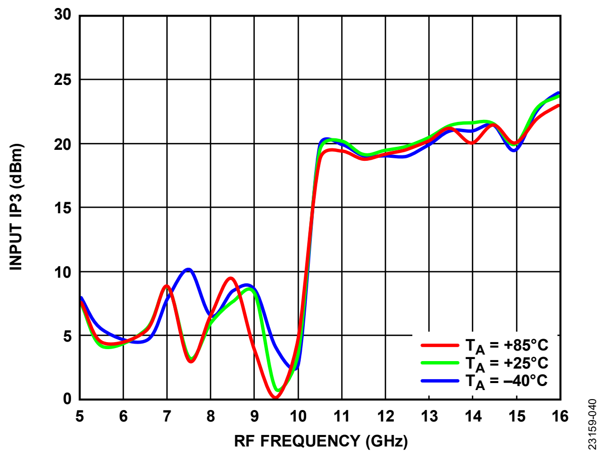

Figure 36. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

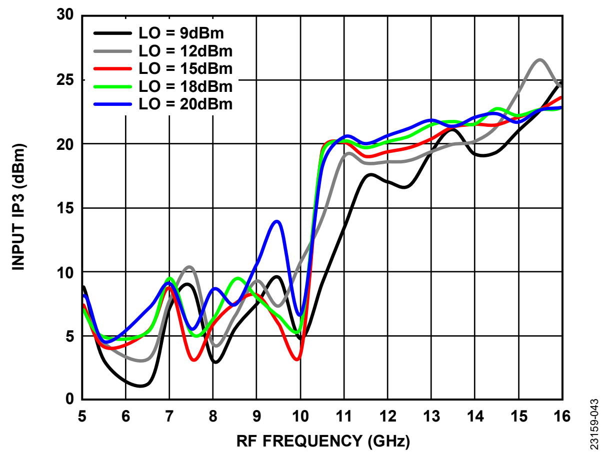

Figure 39. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

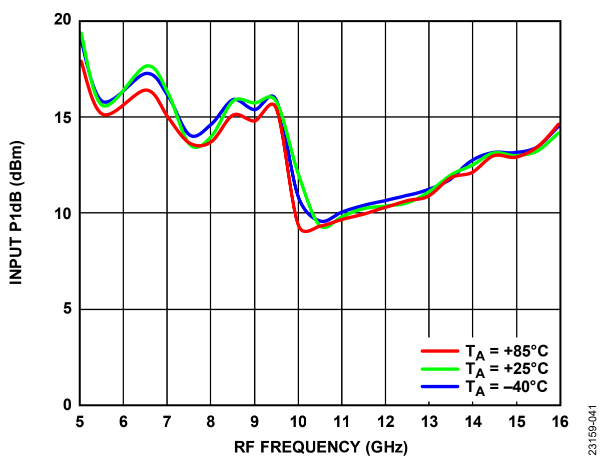

Figure 37. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

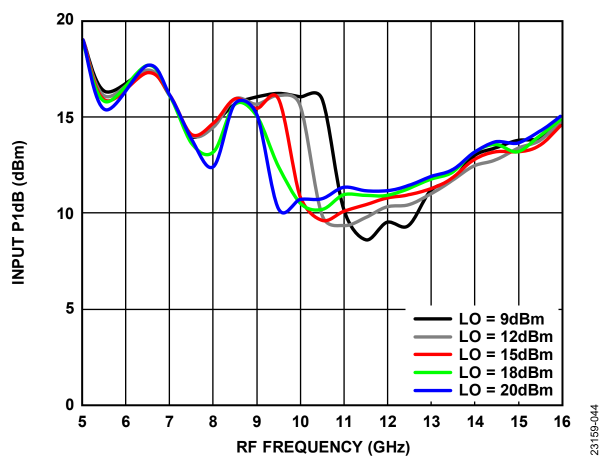

Figure 40. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

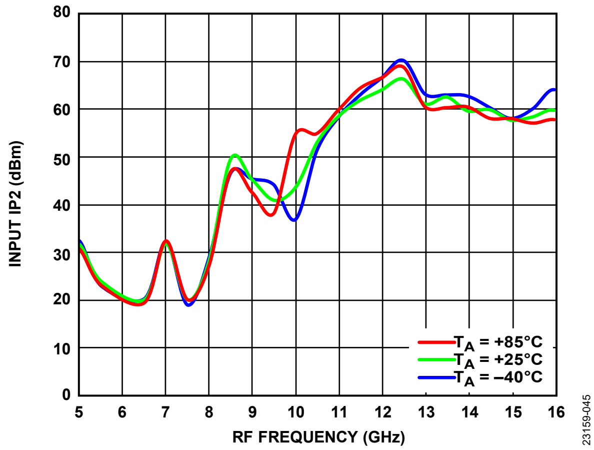

Figure 41. Input IP2 vs. RF Frequency at Various Temperatures, LO = 15 dBm

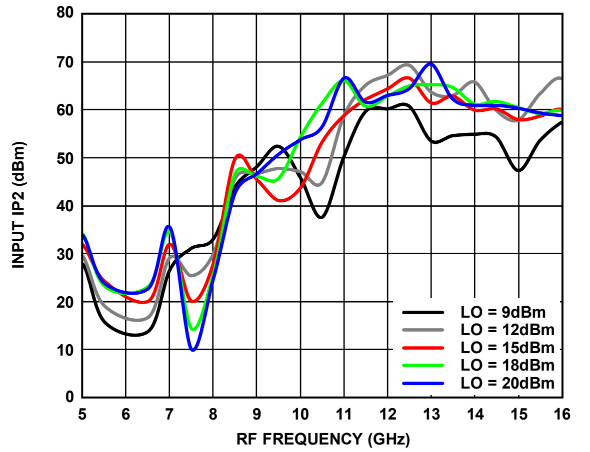

Figure 42. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 6000 MHz, Lower Sideband (High-Side LO)

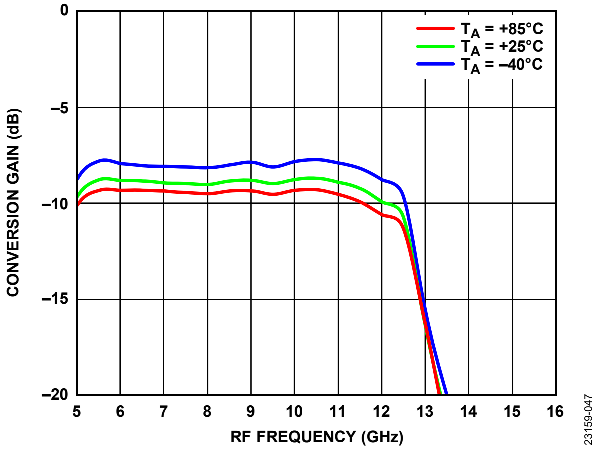

Figure 43. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

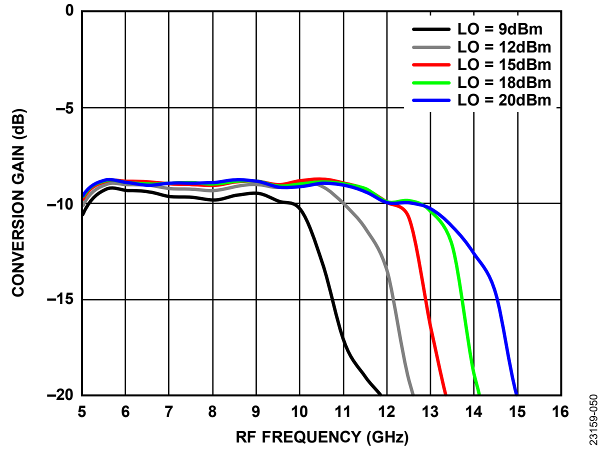

Figure 46. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

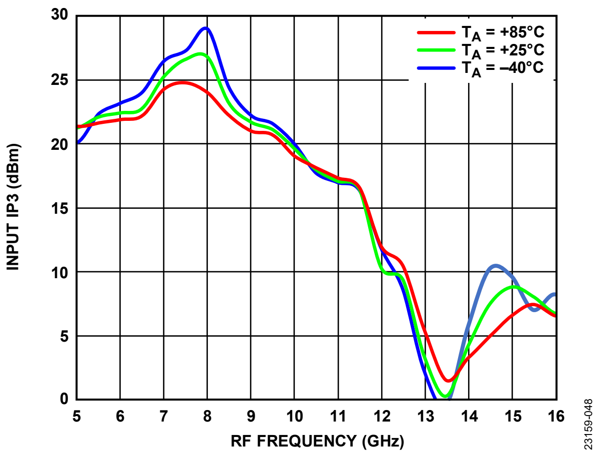

Figure 44. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

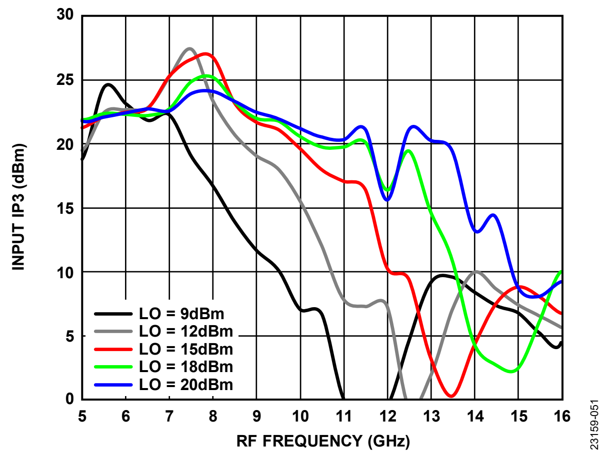

Figure 47. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

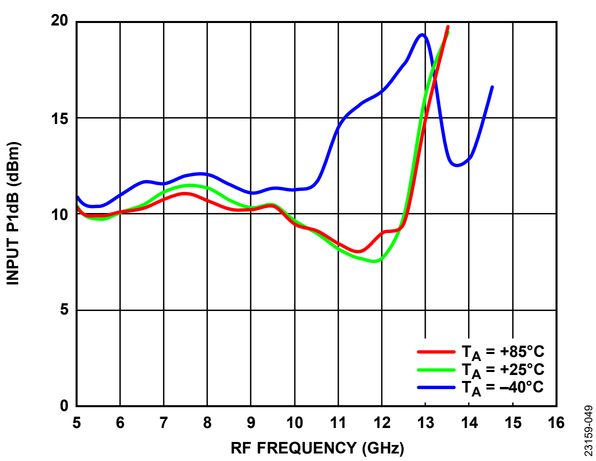

Figure 45. Input P1dB vs. RF Frequency at Various LO Power Levels, LO = 15 dBm

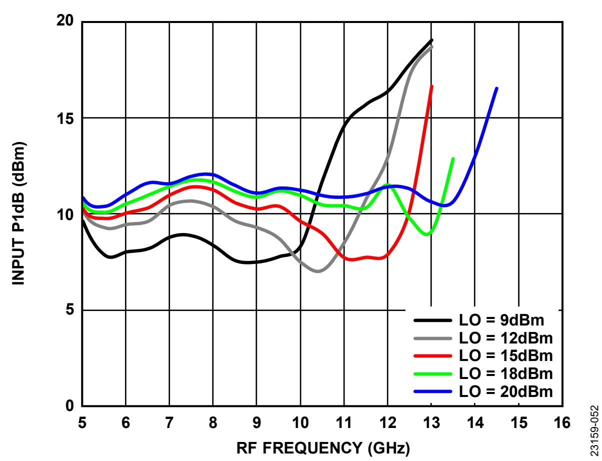

Figure 48. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

UPCONVERTER PERFORMANCE

IF = 100 MHz, Upper Sideband (Low-Side LO)

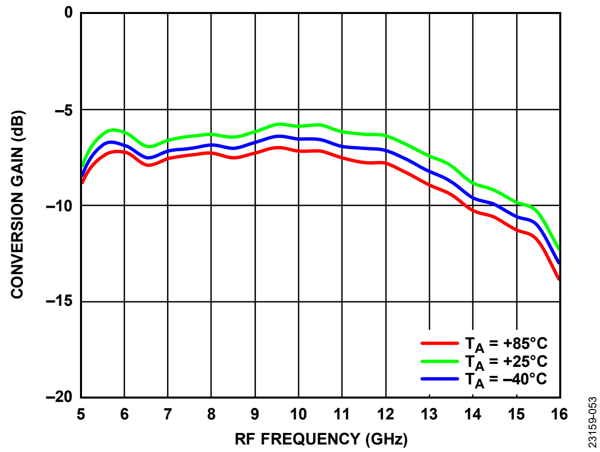

Figure 49. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

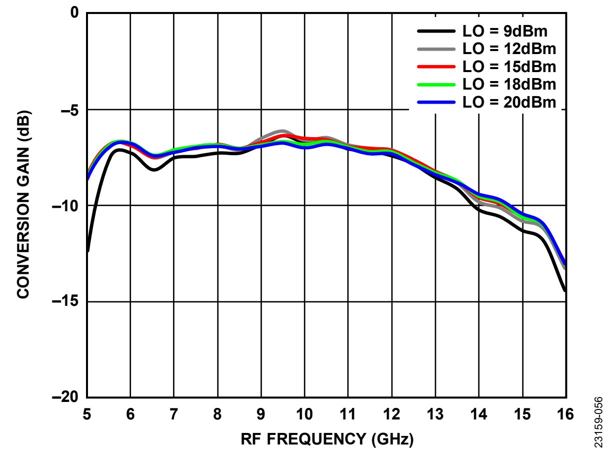

Figure 52. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

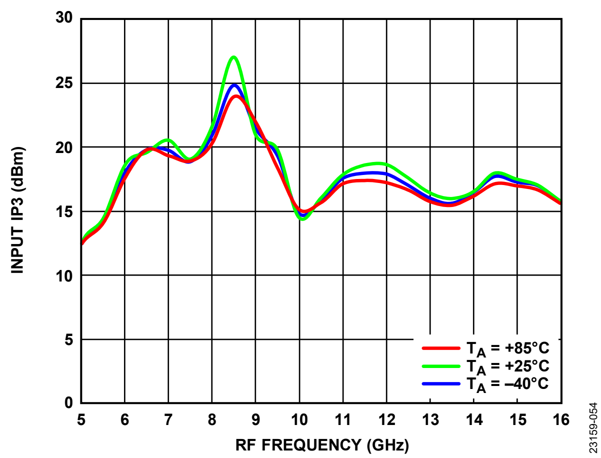

Figure 50. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

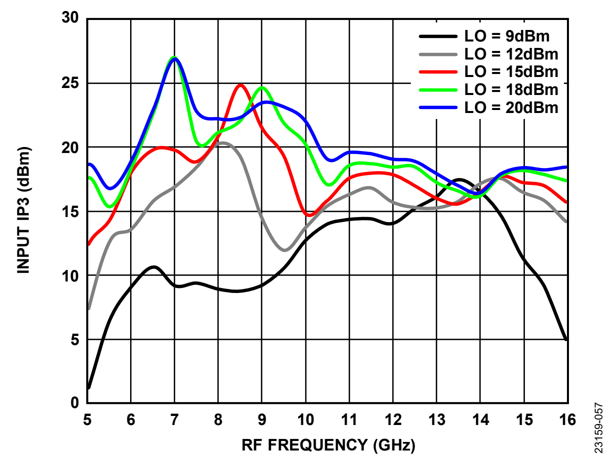

Figure 53. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

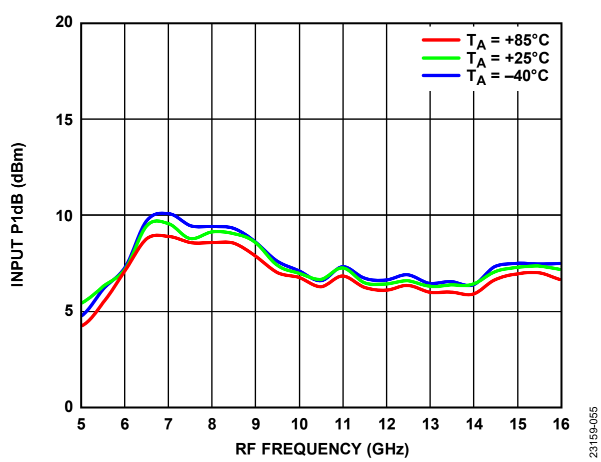

Figure 51. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

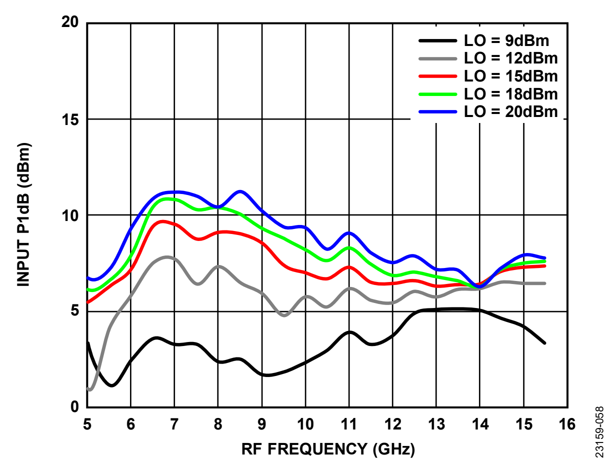

Figure 54. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

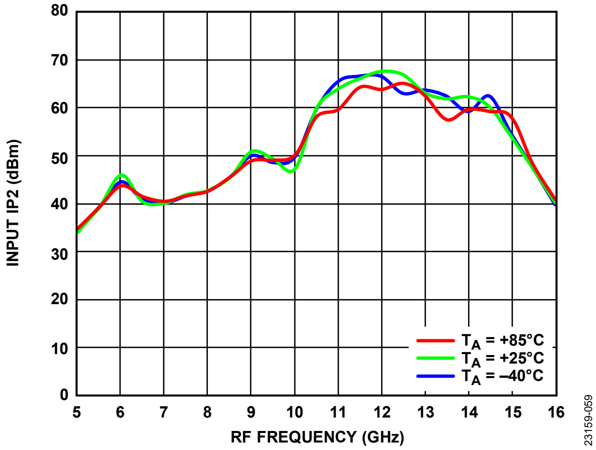

Figure 55. Input IP2 vs. RF Frequency at Various Temperatures, LO = 15 dBm

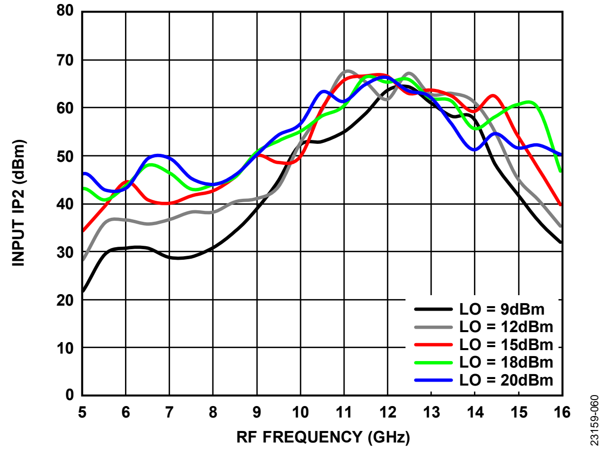

Figure 56. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 100 MHz, Lower Sideband (High-Side LO)

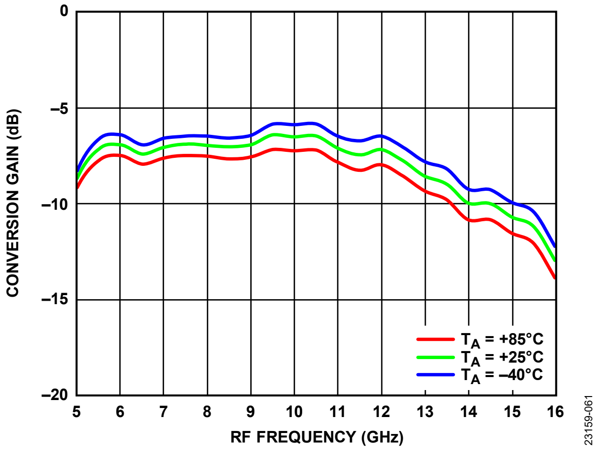

Figure 57. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

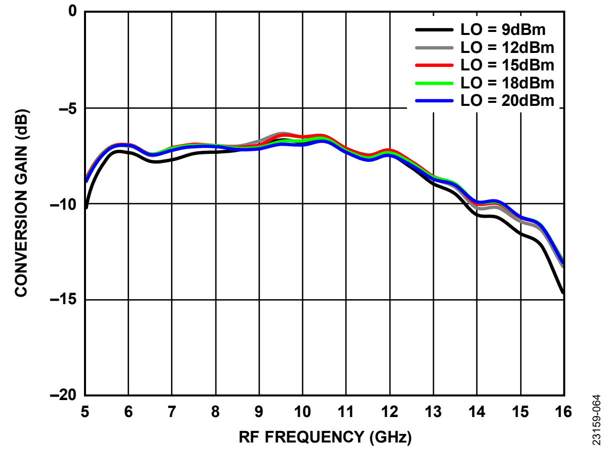

Figure 60. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

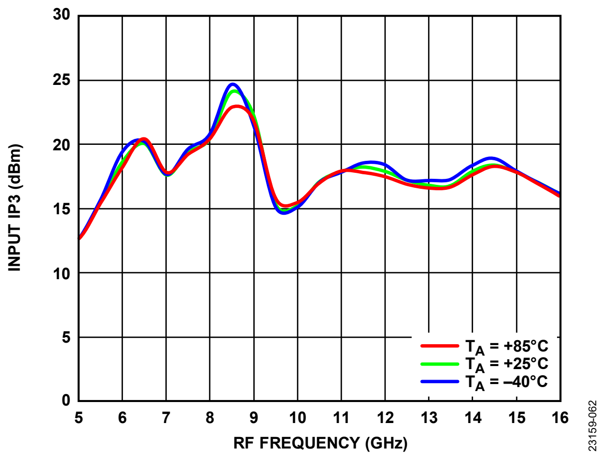

Figure 58. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

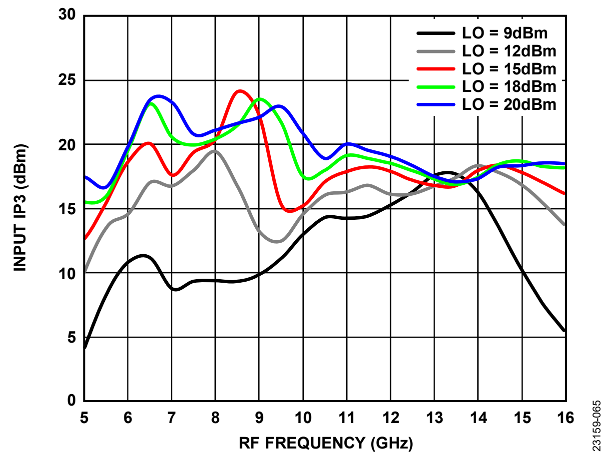

Figure 61. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

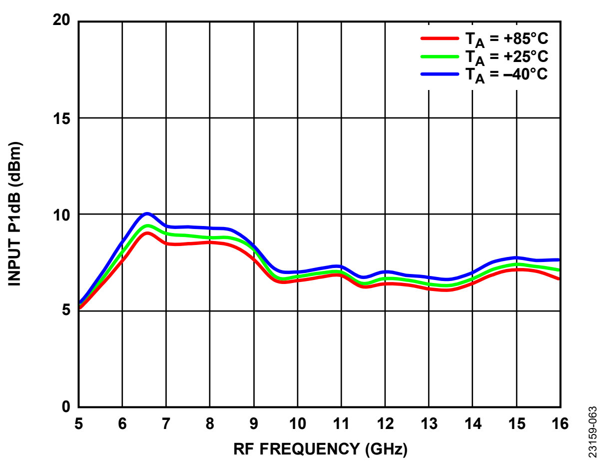

Figure 59. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

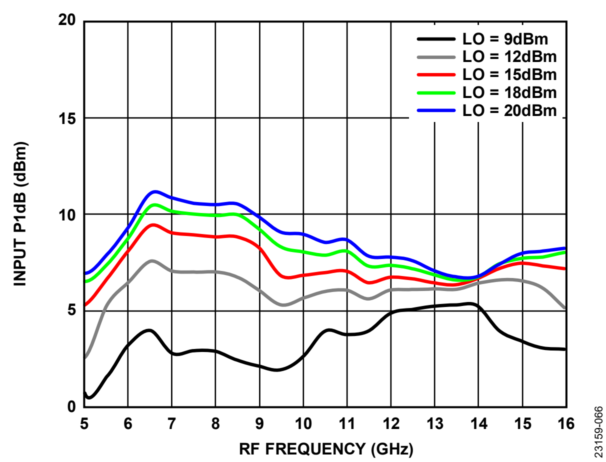

Figure 62. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 2000 MHz, Upper Sideband (Low-Side LO)

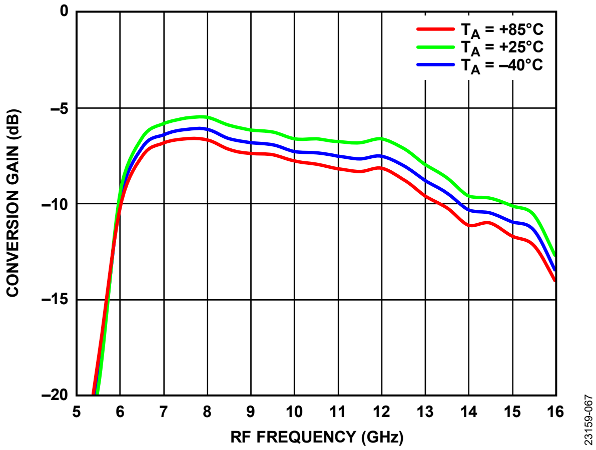

Figure 63. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

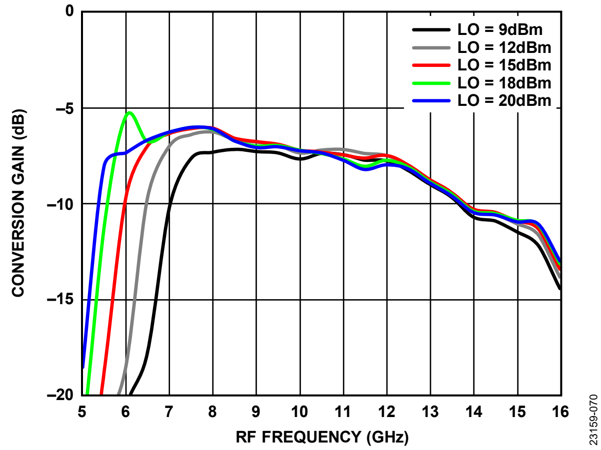

Figure 66. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

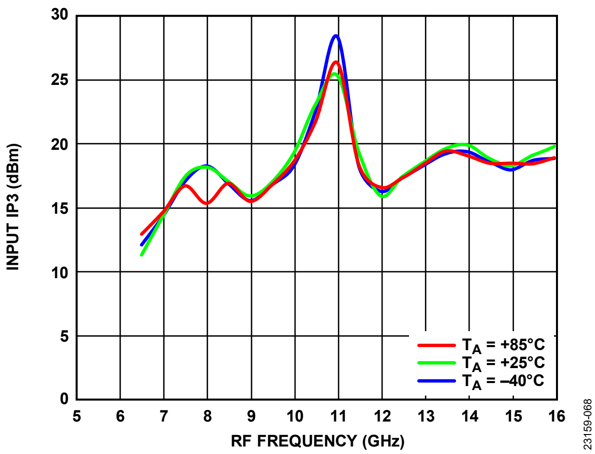

Figure 64. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

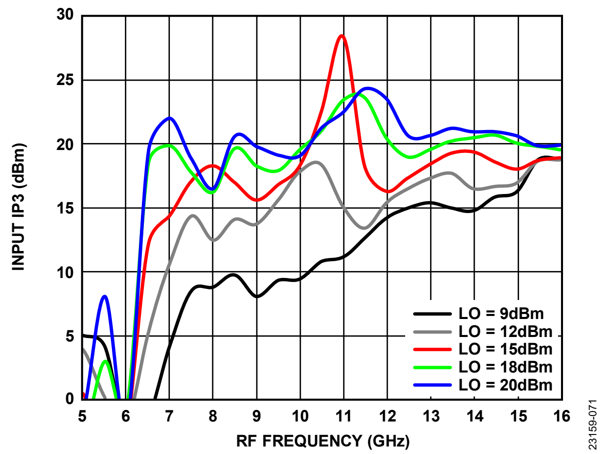

Figure 67. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

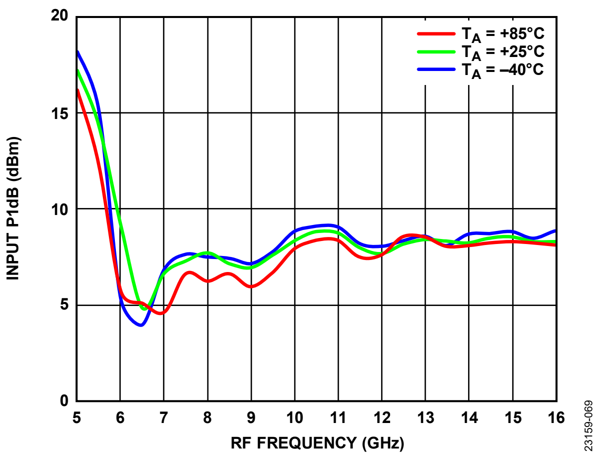

Figure 65. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

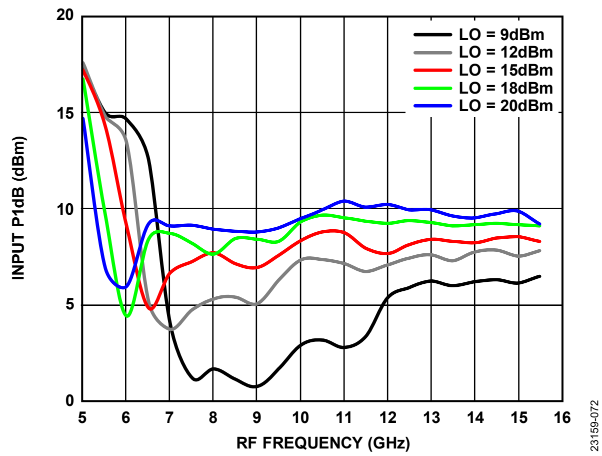

Figure 68. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

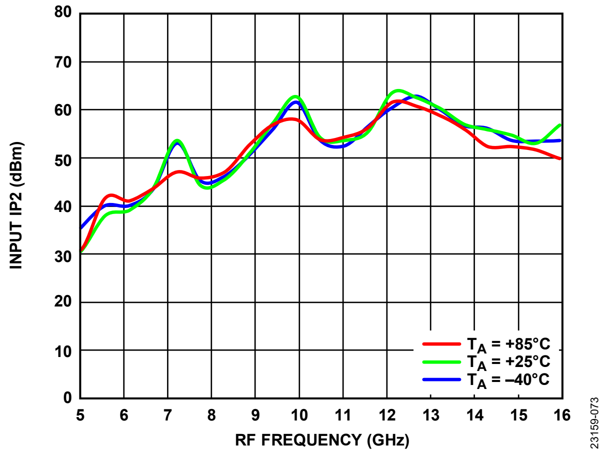

Figure 69. Input IP2 vs. RF Frequency at Various Temperatures, LO = 15 dBm

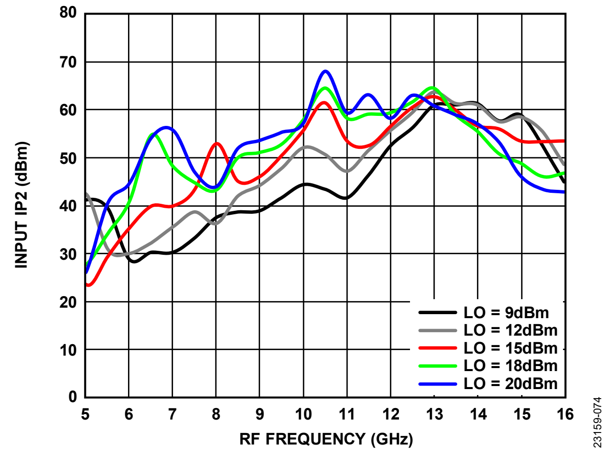

Figure 70. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 2000 MHz, Lower Sideband (High-Side LO)

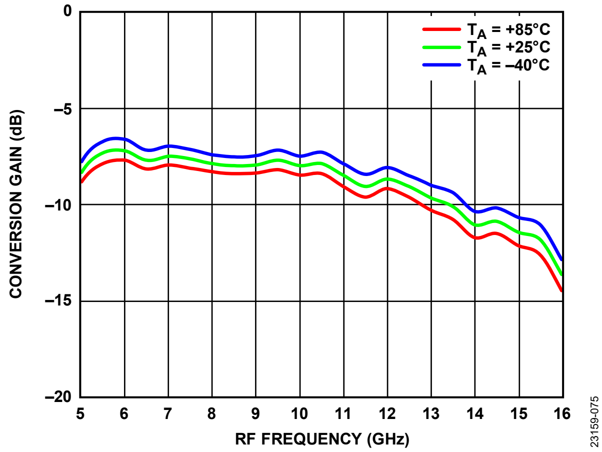

Figure 71. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

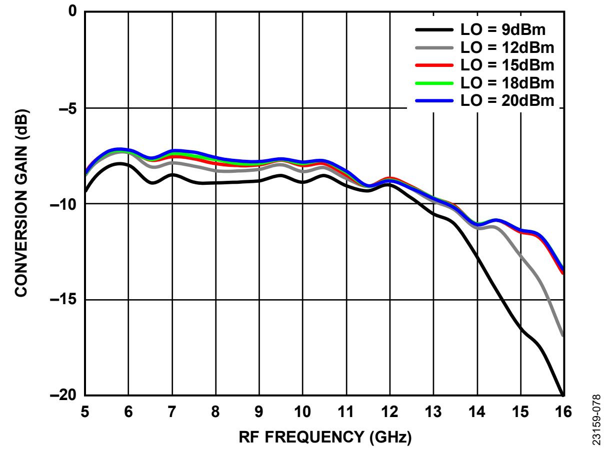

Figure 74. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

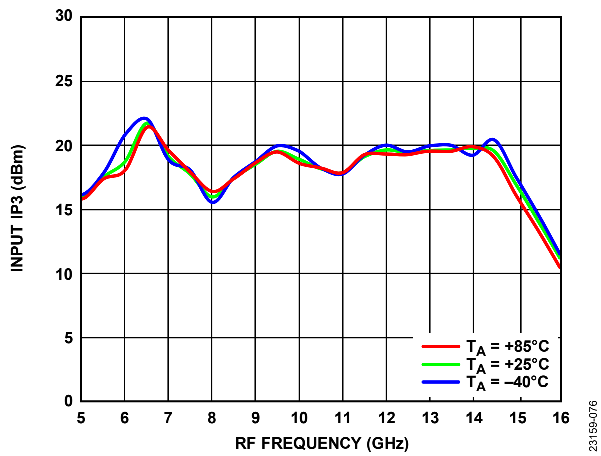

Figure 72. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

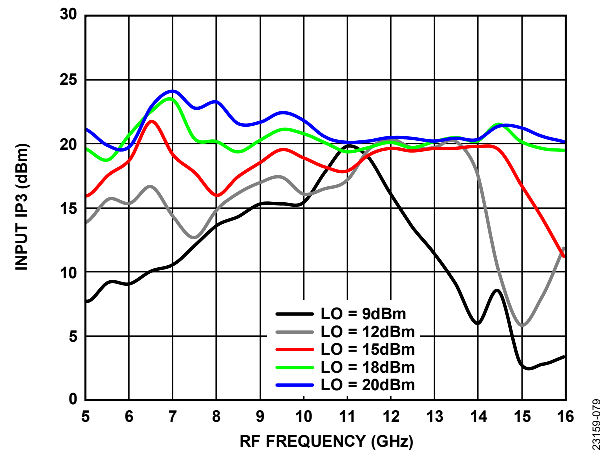

Figure 75. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

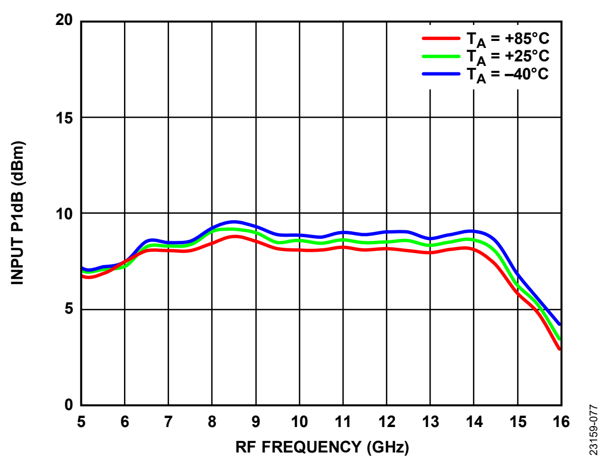

Figure 73. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

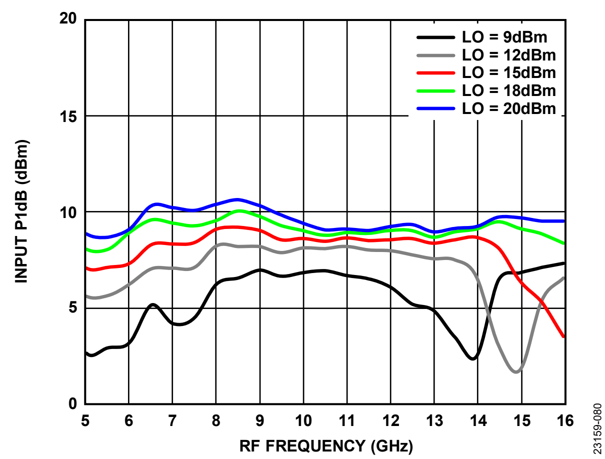

Figure 76. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 6000 MHz, Upper Sideband (Low-Side LO)

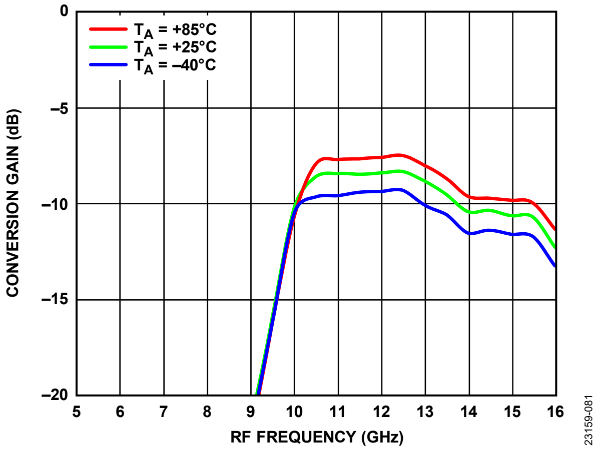

Figure 77. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

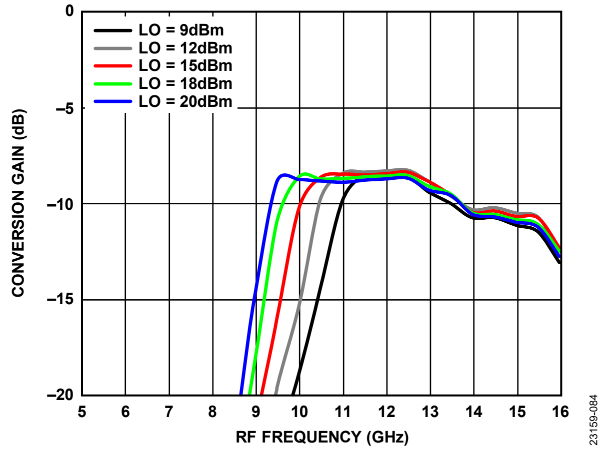

Figure 80. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

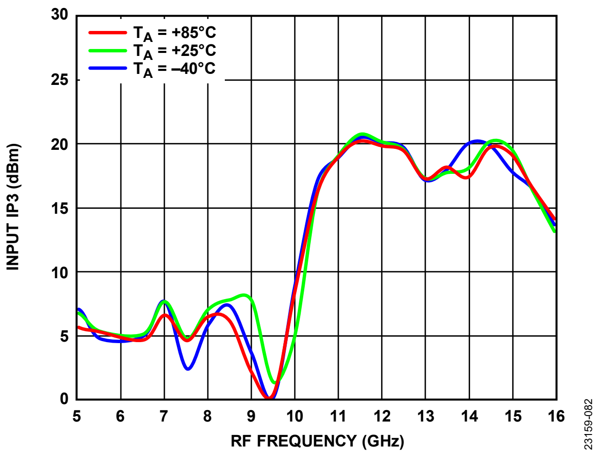

Figure 78. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

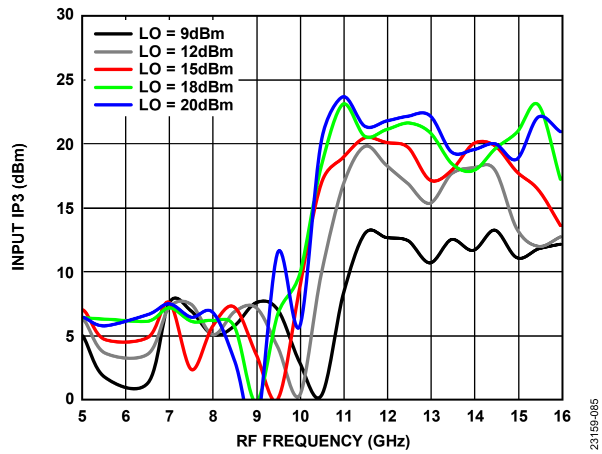

Figure 81. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

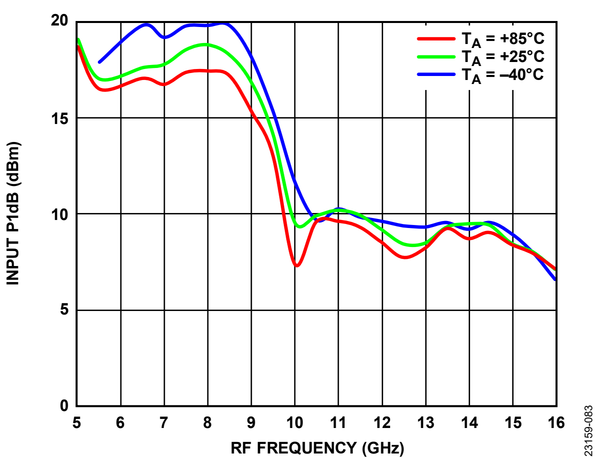

Figure 79. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

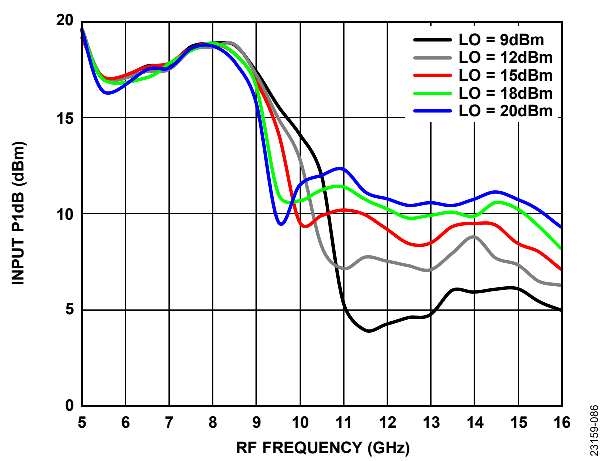

Figure 82. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

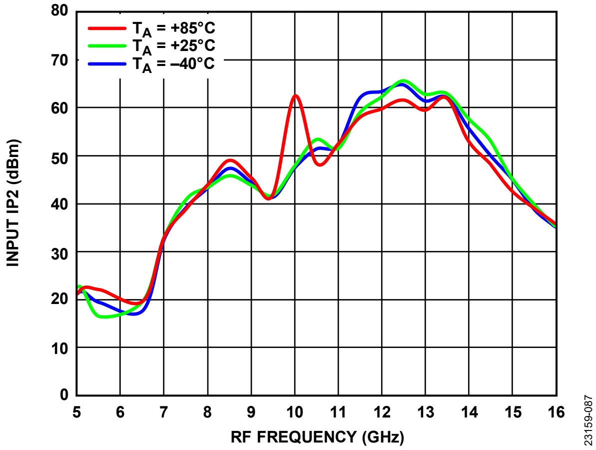

Figure 83. Input IP2 vs. RF Frequency at Various Temperatures, LO = 15 dBm

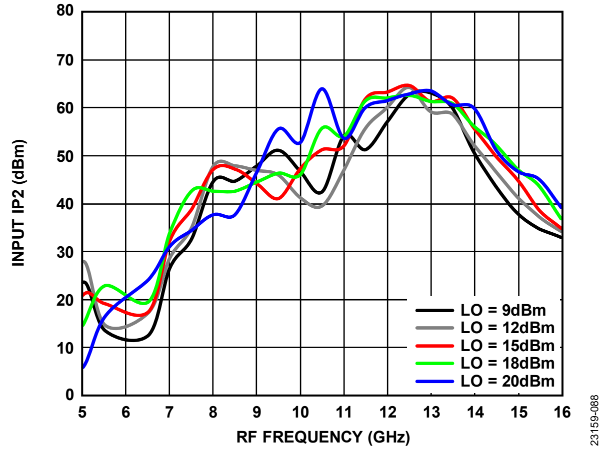

Figure 84. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

IF = 6000 MHz, Lower Sideband (High-Side LO)

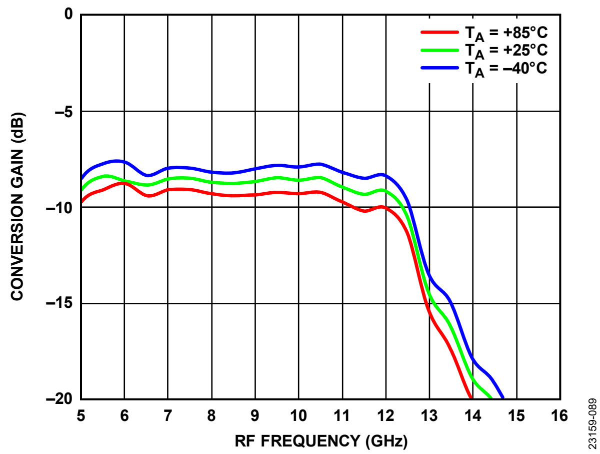

Figure 85. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 15 dBm

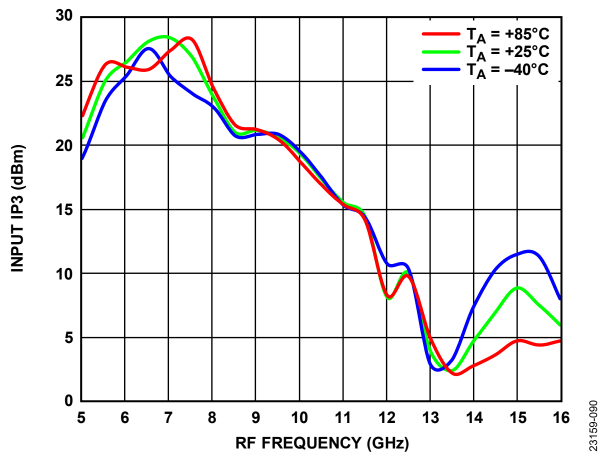

Figure 86. Input IP3 vs. RF Frequency at Various Temperatures, LO = 15 dBm

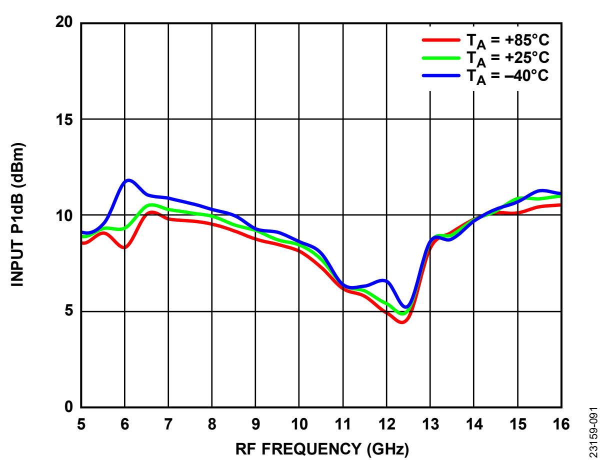

Figure 87. Input P1dB vs. RF Frequency at Various Temperatures, LO = 15 dBm

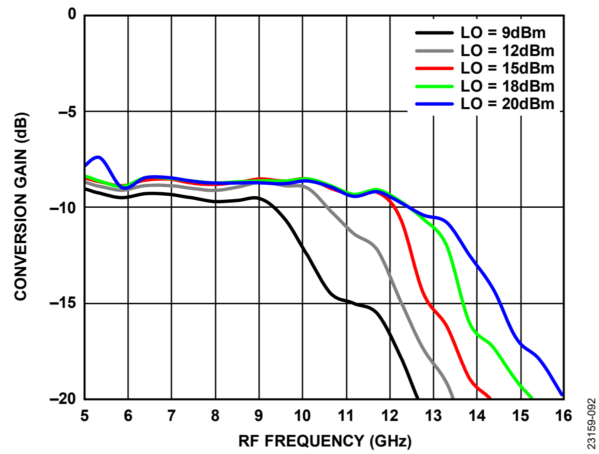

Figure 88. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

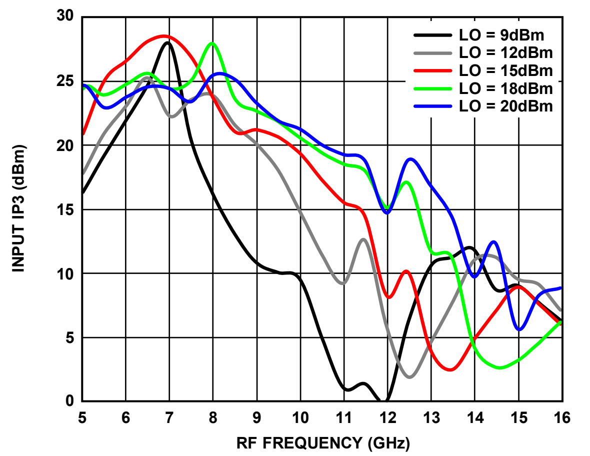

Figure 89. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

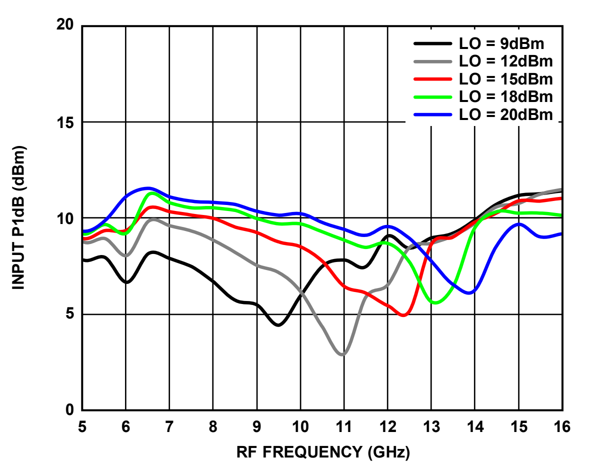

Figure 90. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

ISOLATION AND RETURN LOSS

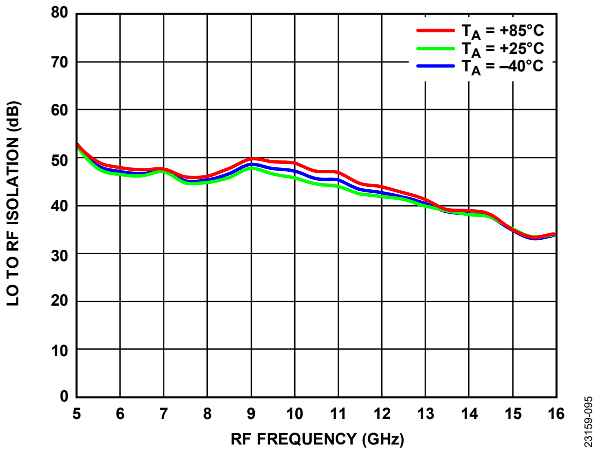

Figure 91. LO to RF Isolation vs. RF Frequency at Various Temperatures, LO = 15 dBm

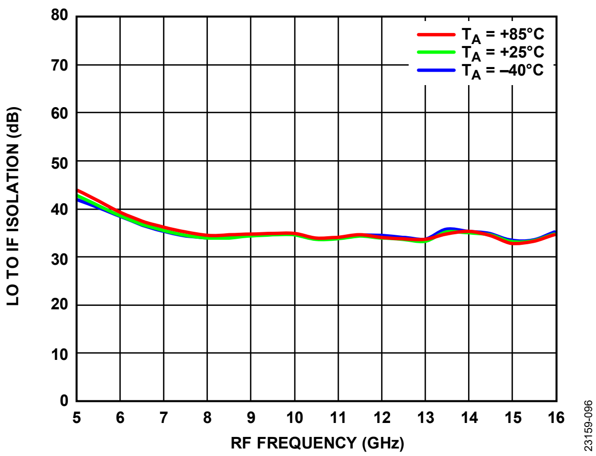

Figure 92. LO to IF Isolation vs. RF Frequency at Various Temperatures, LO = 15 dBm

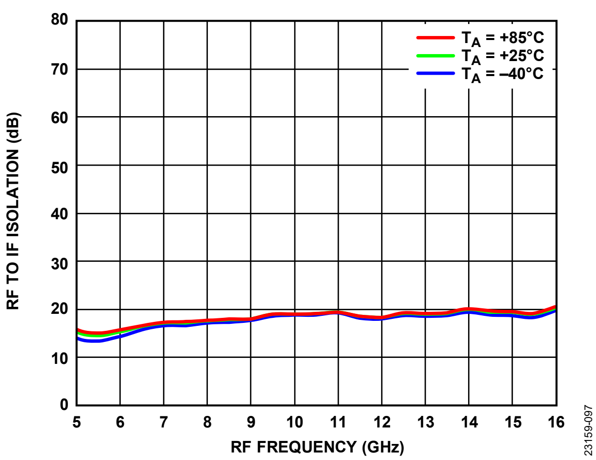

Figure 93. RF to IF Isolation vs. RF Frequency at Various Temperatures, LO = 15 dBm

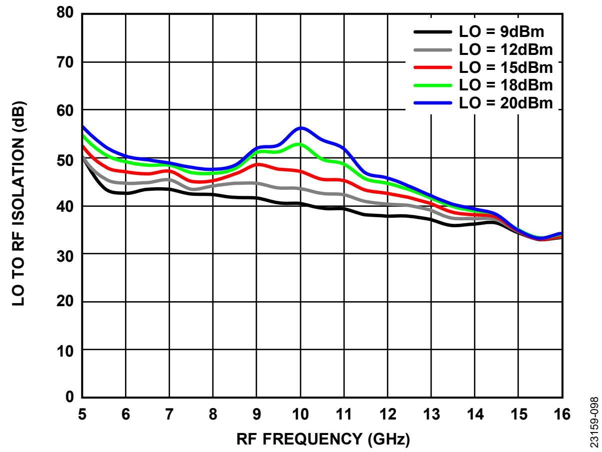

Figure 94. LO to RF Isolation vs. RF Frequency at Various LO Power Levels, $T_A = 25°C$

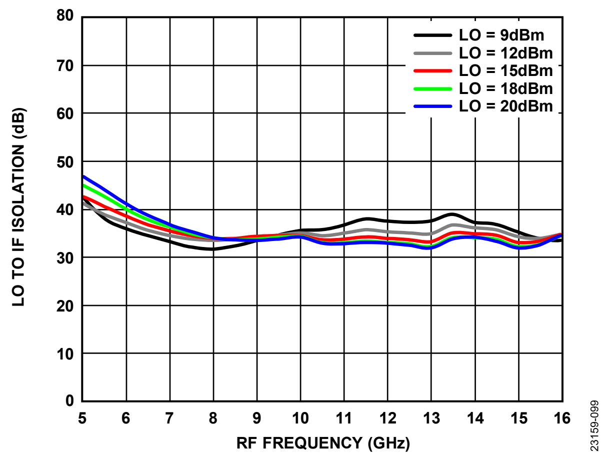

Figure 95. LO to IF Isolation vs. RF Frequency at Various LO Power Levels, $T_A = 25°C$

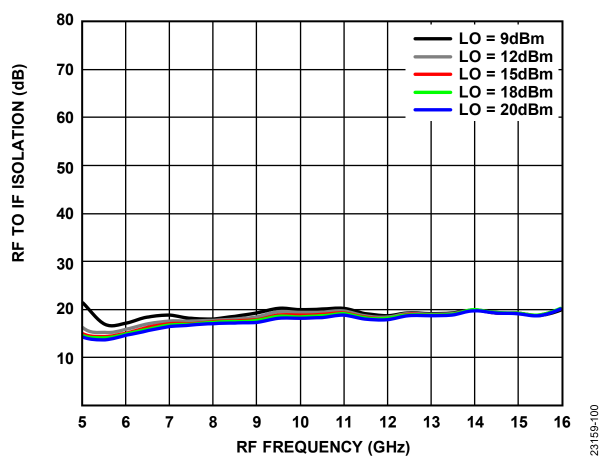

Figure 96. RF to IF Isolation vs. RF Frequency at Various LO Power Levels, $T_A = 25°C$

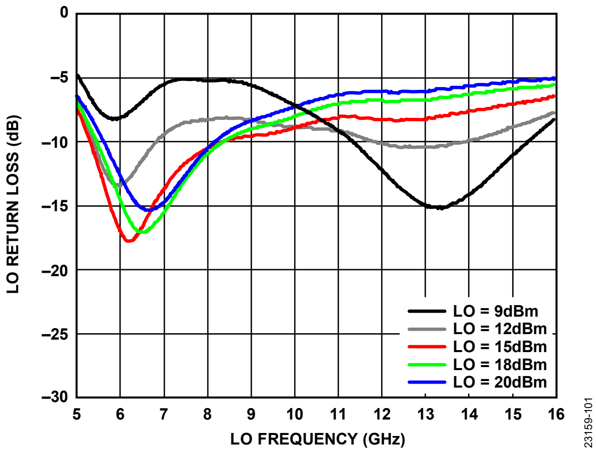

Figure 97. LO Return Loss vs. LO Frequency at LO = 15 dBm, T_A = 25°C

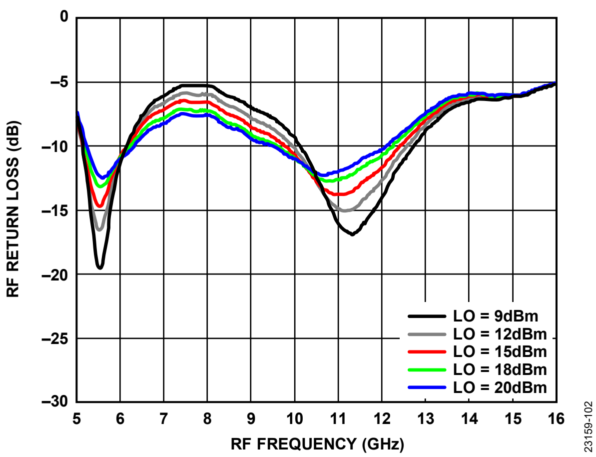

Figure 98. RF Return Loss vs. RF Frequency at Various LO Power Levels, T_A = 25°C, LO = 10 GHz

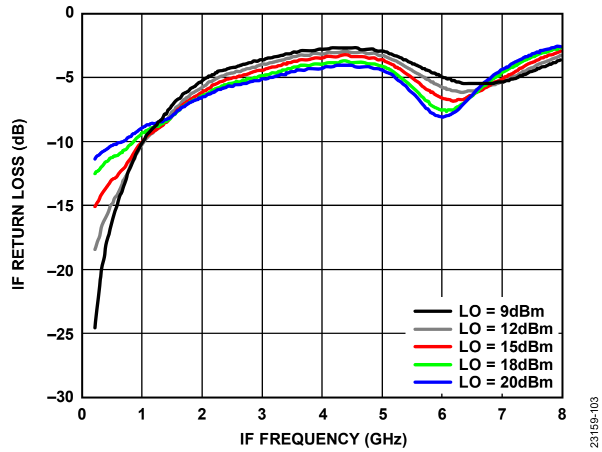

Figure 99. IF Return Loss vs. IF Frequency at Various LO Power Levels, T_A = 25°C, LO = 10 GHz

IF BANDWIDTH—DOWNCONVERTER

LO Frequency = 6 GHz, Upper Sideband

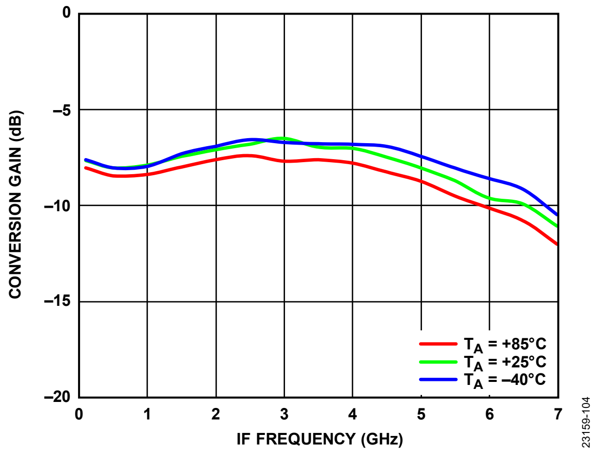

Figure 100. Conversion Gain vs. IF Frequency at Various Temperatures, LO = 15 dBm

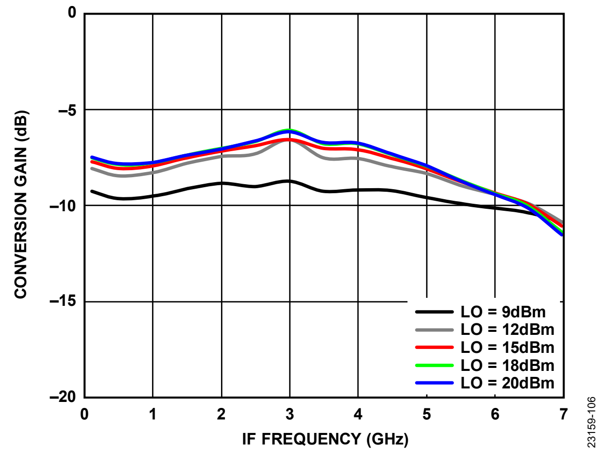

Figure 102. Conversion Gain vs. IF Frequency at Various LO Power Levels, T_A = 25°C

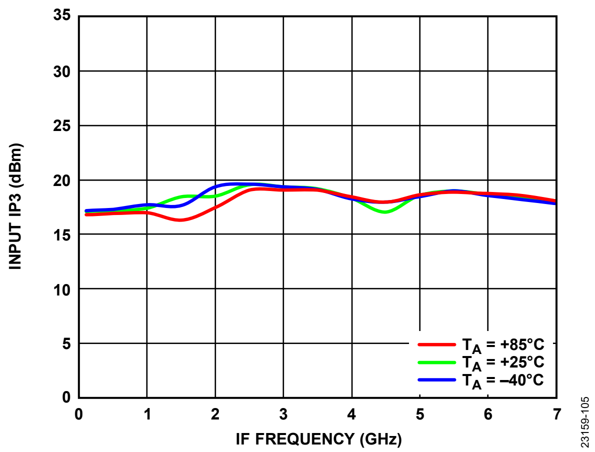

Figure 101. Input IP3 vs. IF Frequency at Various Temperatures, LO = 15 dBm

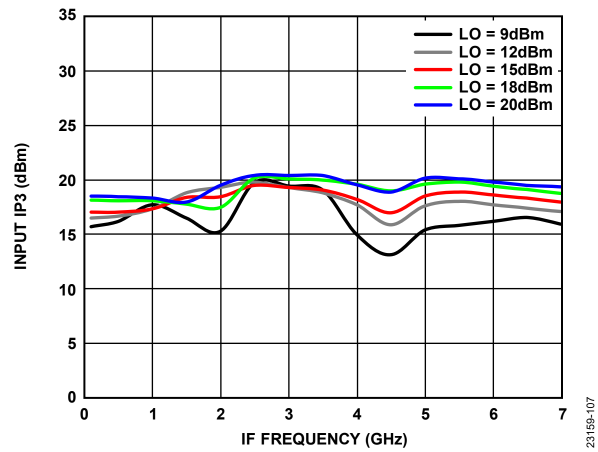

Figure 103. Input IP3 vs. IF Frequency at Various LO Power Levels, T_A = 25°C

LO Frequency = 13 GHz, Lower Sideband

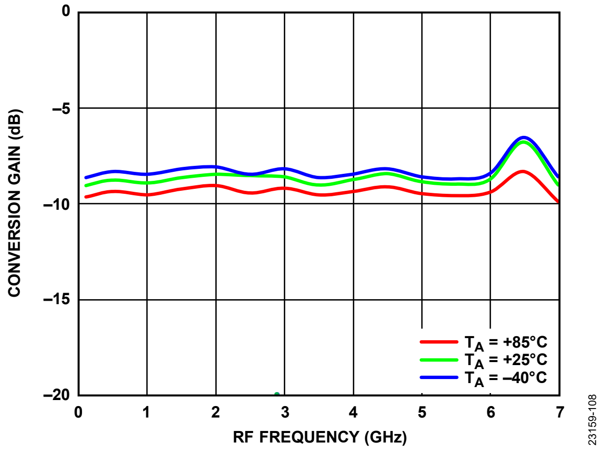

Figure 104. Conversion Gain vs. IF Frequency at Various Temperatures, LO = 15 dBm

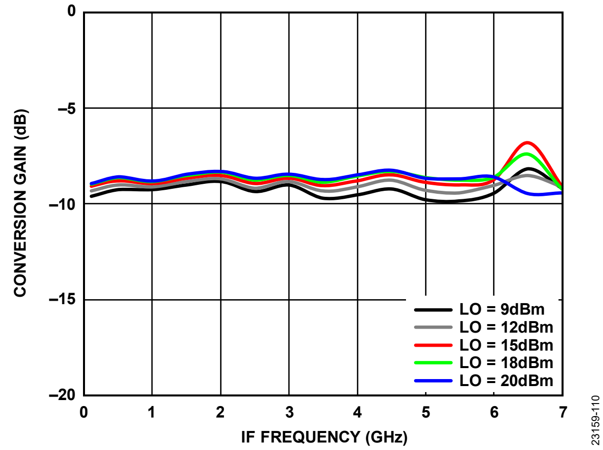

Figure 106. Conversion Gain vs. IF Frequency at Various LO Power Levels, T_A = 25°C

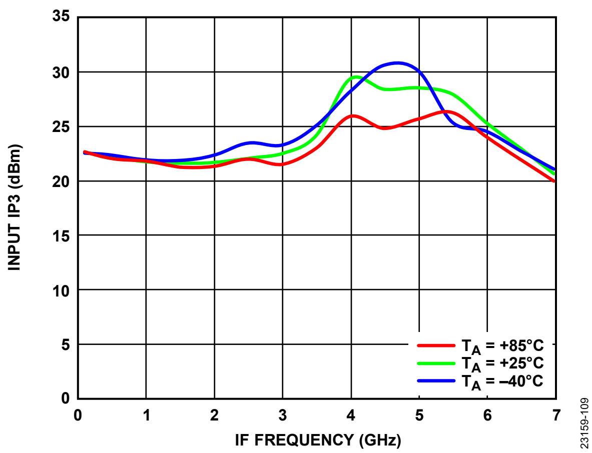

Figure 105. Input IP3 vs. IF Frequency at Various Temperatures, LO = 15 dBm

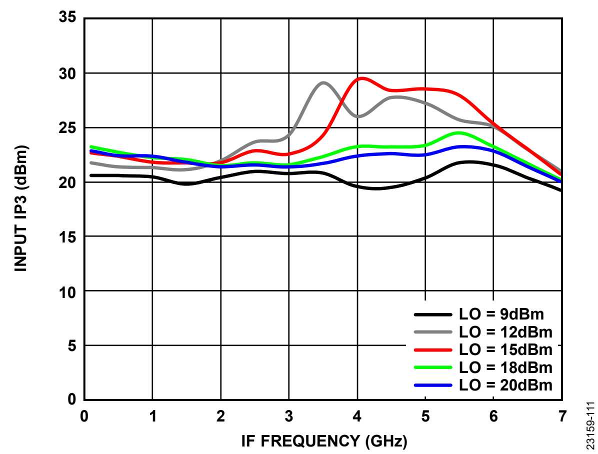

Figure 107. Input IP3 vs. IF Frequency at Various LO Power Levels, T_A = 25°C

SPURIOUS PERFORMANCE

LO Harmonics

LO = 15 dBm, and all values in dBc are below the input LO level and measured at the RF port. N/A means not applicable.

Table 5. LO Harmonics at RF

	N_{LO} Spur at RF Port (dBc)			
LO Frequency (GHz)	**1**	**2**	**3**	**4**
5	49	49	59	75
6	44	44	52	78
7	45	42	43	72
8	43	42	50	63
9	44	47	57	62
11	41	61	54	63
12	40	69	57	79
14	36	66	50	N/A

LO = 15 dBm, and all values in dBc are below the input LO level and measured at the IF port. N/A means not applicable.

Table 6. LO Harmonics at IF

	N_{LO} Spur at IF Port (dBc)			
LO Frequency (GHz)	**1**	**2**	**3**	**4**
5	41	55	54	78
6	36	62	56	76
7	33	58	50	78
8	32	58	57	78
9	33	62	60	76
11	35	63	53	62
12	34	64	59	67
14	35	64	58	N/A

M × N Spurious Outputs

Downconversion, Upper Sideband

Spur values are (M × RF) − (N × LO). RF = 6.1 GHz, LO = 6 GHz, RF power = −10 dBm, and LO power = +15 dBm. Mixer spurious products are measured in dBc from the IF output power level. N/A means not applicable.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × RF	**1**	8	0	18	24	44
	2	65	54	63	66	83
	3	80	78	67	67	72
	4	74	78	81	84	>90

Downconversion, Lower Sideband

Spur values are (M × RF) − (N × LO). RF = 13.9 GHz, LO = 14 GHz, RF power = −10 dBm, and LO power = +15 dBm. Mixer spurious products are measured in dBc from the IF output power level. N/A means not applicable.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × RF	**1**	10	0	39	53	32
	2	61	70	78	72	71
	3	63	71	78	73	76
	4	N/A	63	70	79	>90

Upconversion, Upper Sideband

Spur values are (M × IF_{IN}) + (N × LO). IF_{IN} = 0.1 GHz, LO = 6 GHz, IF_{IN} power = −10 dBm, and LO power = +15 dBm. Mixer spurious products are measured in dBc from the RF output power level. N/A means not applicable.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × IF_{IN}	**−5**	>90	83	84	81	77
	−4	>90	86	83	81	76
	−3	>90	68	70	70	76
	−2	71	57	70	70	76
	−1	81	0	18	19	54
	0	N/A	12	12	20	48
	+1	80	0	19	20	52
	+2	73	66	72	71	77
	+3	>90	64	69	74	75
	+4	>90	83	83	79	77
	+5	>90	85	82	80	76

Upconversion, Lower Sideband

Spur values are (M × IF_{IN}) + (N × LO). IF_{IN} = 0.1 GHz, LO = 14 GHz, IF_{IN} power = −10 dBm, and LO power = +15 dBm. Mixer spurious products are measured in dBc from the RF output power level. N/A means not applicable.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × IF_{IN}	**−5**	>90	78	72	65	N/A
	−4	>90	81	70	62	N/A
	−3	>90	62	72	64	N/A
	−2	68	53	70	58	N/A
	−1	74	0	38	23	N/A
	0	N/A	1	32	16	N/A
	+1	74	0	46	24	N/A
	+2	68	71	71	62	N/A
	+3	>90	62	72	61	N/A
	+4	>90	78	71	64	N/A
	+5	>90	78	73	64	N/A

THEORY OF OPERATION

The HMC558ACHIPS is a general-purpose, double balanced mixer that can be used as an upconverter or downconverter between 5.5 GHz and 14 GHz. This mixer is fabricated in a GaAs MESFET process, and requires no external components or matching circuitry. When used as downconverter, the HMC558ACHIPS downconverts RF between 5.5 GHz and 14 GHz to IF between dc and 6 GHz. When used as upconverter, the HMC558ACHIPS upconverts IF between dc and 6 GHz to RF between 5.5 GHz and 14 GHz.

APPLICATIONS INFORMATION

TYPICAL APPLICATION CIRCUIT

Figure 108 shows the typical application circuit for the HMC558ACHIPS. The HMC558ACHIPS is a passive device and does not require any external components. The LO and RF pads are internally ac-coupled. The IF pad is internally dc-coupled. For applications not requiring operation to dc, dc block these ports externally using a series capacitor of a value chosen to pass the necessary IF frequency range. When IF operation to dc is required, do not exceed the IF source and sink current rating specified in the Absolute Maximum Ratings section.

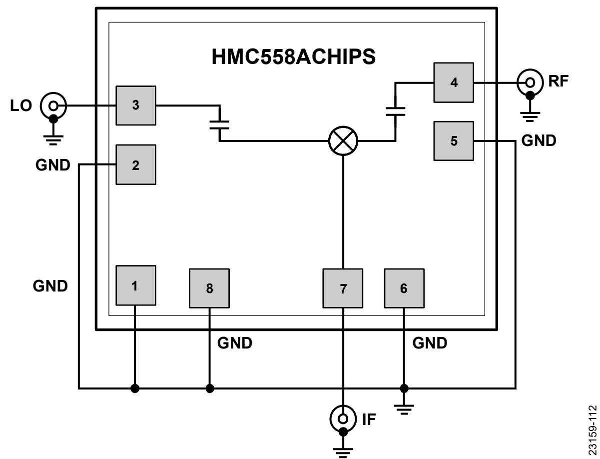

Figure 108. Typical Application Circuit

MOUNTING AND BONDING TECHNIQUES

Attach the die directly to the ground plane eutectically or with conductive epoxy. To bring RF to and from the chip, 50 Ω microstrip transmission lines on 0.127 mm (0.005") thick alumina thin film substrates are recommended (see Figure 109). If using 0.254 mm (0.010") thick alumina thin film substrates, raise the die 0.150 mm (0.006") so that the surface of the die is coplanar with the surface of the substrate. A way to accomplish this is to attach the 0.102 mm (0.004") thick die to a 0.150 mm (0.006") thick molybdenum heat spreader (moly tab) which is then attached to the ground plane (see Figure 110). Place microstrip substrates as close to the die as possible to minimize bond wire length. Typical die to substrate spacing is 0.076 mm (0.003").

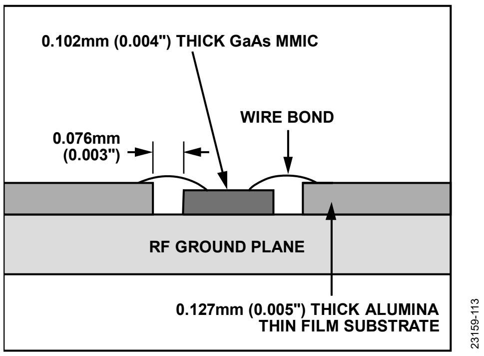

Figure 109. Bonding RF Pads to 5 mil Substrate

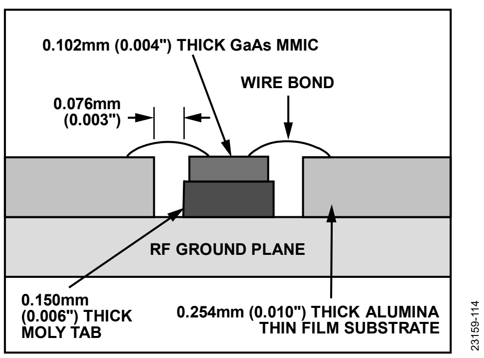

Figure 110. Bonding RF Pads to 10 mil Substrate

HANDLING PRECAUTIONS

Follow the precautions in the Storage section, Cleanliness section, Static Sensitivity section, Transients section, and General Handling section to avoid permanent damage.

Storage

All bare dice are placed in either waffle- or gel-based ESD protective containers and then sealed in an ESD protective bag for shipment. Once the sealed ESD protective bag is open, store all dies in a dry nitrogen environment.

Cleanliness

Handle the chips in a clean environment. Do not attempt to clean the chip using liquid cleaning systems.

Static Sensitivity

Follow ESD precautions to protect against ESD strikes.

Transients

Suppress instrument and bias supply transients while bias is applied. Use shielded signal and bias cables to minimize inductive pickup.

General Handling

Handle the chip along the edges with a vacuum collet or with a sharp pair of bent tweezers. The surface of the chip has fragile air bridges and must not be touched with vacuum collet, tweezers, or fingers

MOUNTING

The chip is back metallized and can be die mounted with gold (Au)/tin (Sn) eutectic preforms or with electrically conductive epoxy. The mounting surface must be clean and flat.

Eutectic Die Attach

An 80/20 gold and tin preform is recommended with a work surface temperature of 255°C and a tool temperature of 265°C. When hot 90/10 nitrogen(N)/hydrogen (H) gas is applied, the tool tip temperature must be 290°C. Do not expose the chip to a temperature greater than 320°C for more than 20 seconds. No more than 3 seconds of scrubbing is required for attachment.

Epoxy Die Attach

Apply a minimum amount of epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip when the chip is placed into position. Cure epoxy per the schedule of the manufacturer.

WIRE BONDING

Ball or wedge bond with 0.025 mm (0.00098") diameter pure gold wire is recommended. Thermosonic wire bonding with a nominal stage temperature of 150°C and a ball bonding force of 40 grams to 50 grams or a wedge bonding force of 18 grams to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wire bonds. Wire bonds must be started on the chip and terminate on the package or substrate. All bonds must be as short as possible <0.31 mm (0.01220").

OUTLINE DIMENSIONS

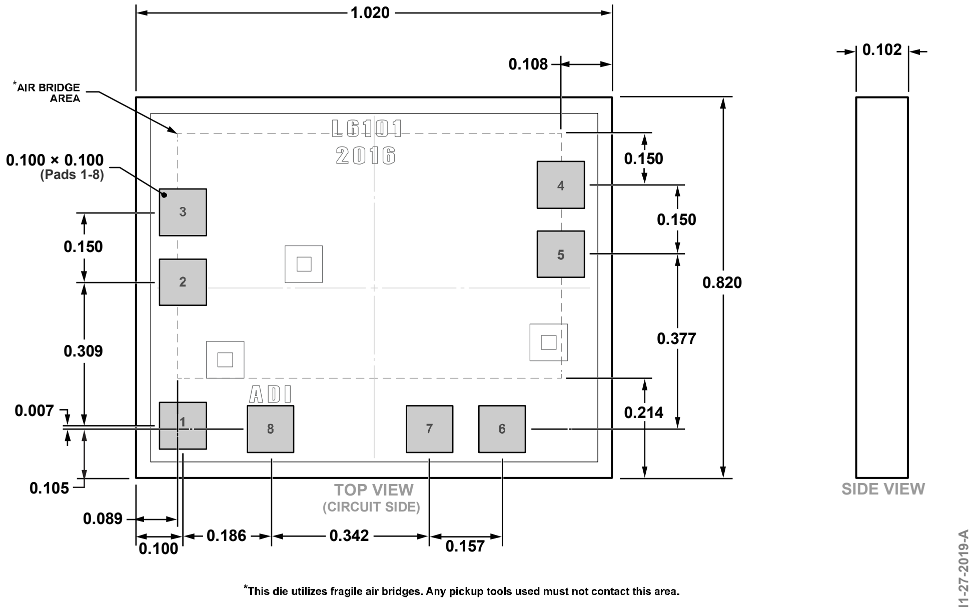

Figure 111. 8-Pad Bare Die [CHIP]
(C-8-23)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option
HMC558A	−40°C to +85°C	8-Pad Bare Die [CHIP]	C-8-23
HMC558A-SX	−40°C to +85°C	8-Pad Bare Die [CHIP]	C-8-23

[1] The HMC558A and HMC558A-SX are RoHS compliant parts.