15 GHz to 67 GHz, GaAs, MMIC, Double Balanced Mixer

Preliminary Technical Data

ADMV1550

FEATURES

Conversion loss (downconverter): 7 dB typical
LO to RF isolation: 40 dB typical
Input IP3 (downconverter): 20 dBm typical
18-terminal, RoHS compliant, 4 mm × 4 mm LGA package

APPLICATIONS

Microwave and very small aperture terminal (VSAT) radios
Test equipment
Military electronic warfare (EW)
Electronic countermeasure (ECM)
Command, control, communications, and intelligence (C3I)

FUNCTIONAL BLOCK DIAGRAM

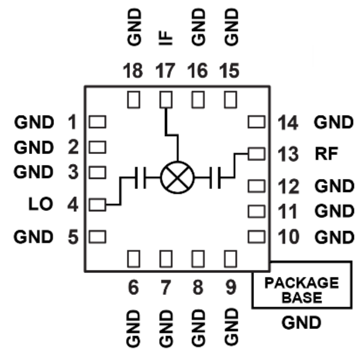

Figure 1.

GENERAL DESCRIPTION

The ADMV1550 is a general-purpose, double balanced mixer in a leadless, RoHS compliant, surface-mount technology (SMT) package that can be used as an upconverter or down-converter between 15 GHz and 67 GHz. The wide bandwidth from 0 GHz to 20 GHz on the intermediate frequency (IF) port allows flexible frequency planning to avoid spurious products. This mixer is fabricated in a gallium arsenide (GaAs), monolithic microwave integrated circuit (MMIC) process and requires no external components or matching circuitry. The ADMV1550 provides excellent local oscillator (LO) to radio frequency (RF) and LO to IF suppression due to optimized balun structures. The mixer operates with an LO amplitude above 15 dBm. The RoHS compliant ADMV1550 eliminates the need for wire bonding, allowing the use of surface-mount manufacturing techniques.

Rev. PrB

Document Feedback

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700

Technical Support
www.analog.com

TABLE OF CONTENTS

SPECIFICATIONS

T_A = 25°C, IF = TBD MHz, LO = 15 dBm for the upper sideband, unless otherwise noted. All measurements performed as a downconverter on the evaluation printed circuit board (PCB), unless otherwise noted.

Table 1.

Parameter	Symbol	Min	Typ	Max	Unit
FREQUENCY RANGE					
RF Pin		15		67	GHz
IF Pin		DC		20	GHz
LO Pin		15		67	GHz
LO AMPLITUDE		10	15	20	dBm
15 GHz to 67 GHz Performance					
Downconverter					
Conversion Loss			7		dB
Single Sideband Noise Figure	SSB NF		7		dB
Input Third-Order Intercept	IP3		20		dBm
Input 1 dB Compression Point	P1dB		12		dBm
Input Second-Order Intercept	IP2		50		dBm
Upconverter					
Conversion Loss			7		dB
Input Third-Order Intercept	IP3		20		dBm
Input 1 dB Compression Point	P1dB		11		dBm
ISOLATION					
15 GHz to 67 GHz Performance					
LO to IF			40		dB
RF to IF			25		dB
LO to RF			40		dB

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
RF Input Power	TBD dBm
LO Input Power	TBD dBm
IF Input Power	TBD dBm
IF Source or Sink Current	TBD mA
Peak Reflow Temperature	260°C
Maximum Junction Temperature	TBD°C
Continuous Power Dissipation, P_{DISS} (T_A = 85°C, Derate TBD mW/°C Above 85°C)	TBD mW
Operating Temperature Range	−55°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering 60 sec)	260°C
Electrostatic Discharge (ESD) Sensitivity	
Human Body Model (HBM)	TBD
Field-Induced Charged Device Model (FICDM)	TBD

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 PCB design and operating environment. Careful attention to PCB thermal design is required.

θ_{JA} is the natural convection, junction to ambient thermal resistance measured in a one cubic foot sealed enclosure.

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

Table 3. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
CC-18-2[1]	TBD	TBD	°C/W

[1] Test Condition 1: JEDEC standard JESD51-2.

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

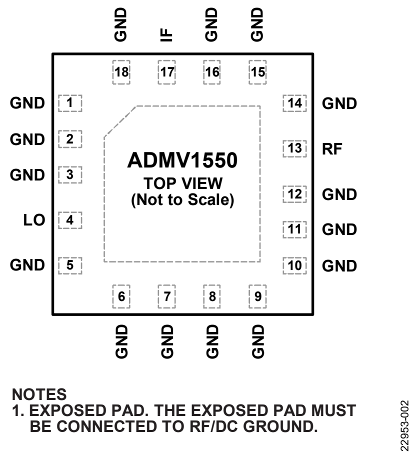

Figure 2. Pin Configuration

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 2, 3, 5 to 12, 14, 15, 16, 18	GND	Ground. These pins must be connected to RF/dc ground. See Figure 3 for the interface schematic.
4	LO	Local Oscillator Port. This pin is ac-coupled and matched to 50 Ω. See Figure 4 for the interface schematic.
13	RF	Radio Frequency Port. This pin is ac-coupled and matched to 50 Ω. See Figure 5 for the interface schematic.
17	IF	Intermediate Frequency Port. This pin is dc-coupled and matched to 50 Ω. For applications not requiring operation to dc, dc block this port externally using a series capacitor of a value chosen to pass the necessary RF frequency range. For operation to dc, this pin must not source or sink more than 3 mA of current. Otherwise, die malfunction or die failure may result. See Figure 6 for the interface schematic.
	EPAD	Exposed Pad. The exposed pad must be connected to RF/dc ground.

INTERFACE SCHEMATICS

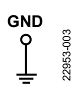

Figure 3. GND Interface Schematic

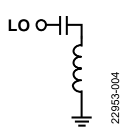

Figure 4. LO Interface Schematic

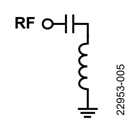

Figure 5. RF Interface Schematic

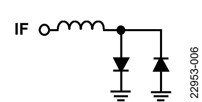

Figure 6. IF Interface Schematic

TYPICAL PERFORMANCE CHARACTERISTICS

DOWNCONVERTER PERFORMANCE, IF = 1 GHz

Upper Sideband (Low-Side LO)

TBD

Figure 7. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 8. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 9. Input IP2 vs. RF Frequency at Various Temperatures, LO = 13 dBm

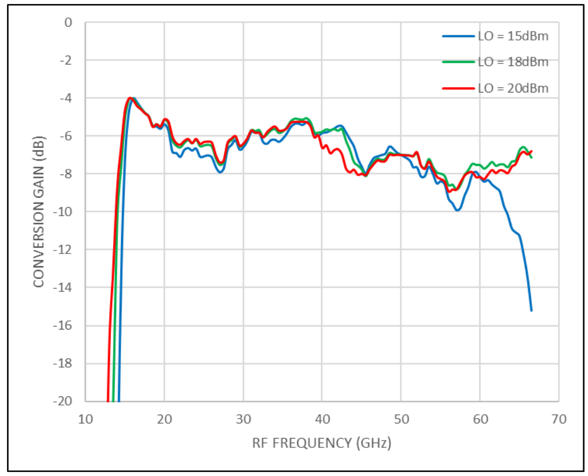

Figure 10. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

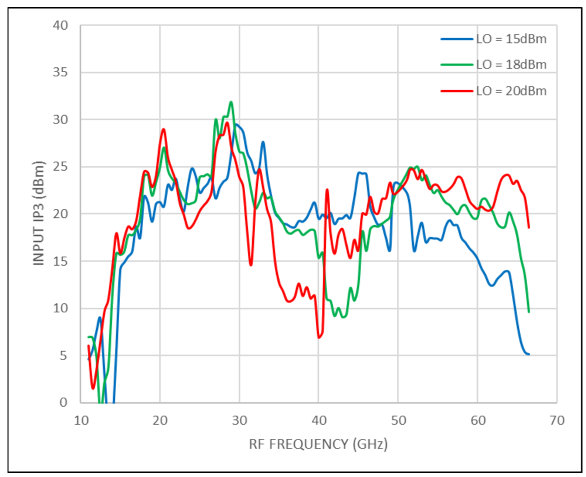

Figure 11. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

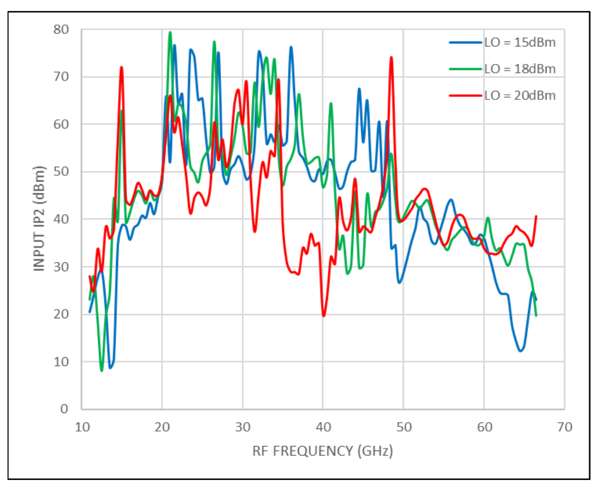

Figure 12. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

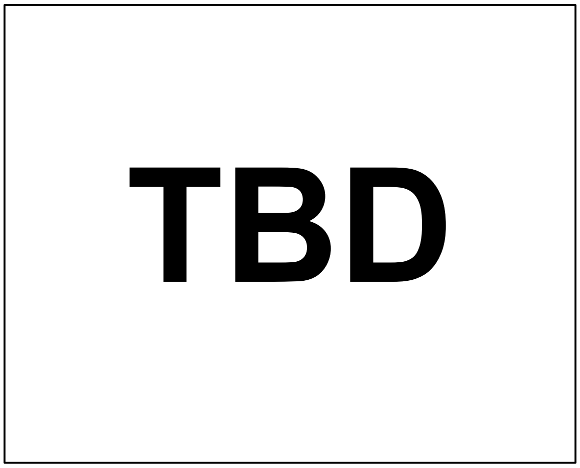

Figure 13. Input P1dB vs. RF Frequency at Various Temperatures, LO = 13 dBm

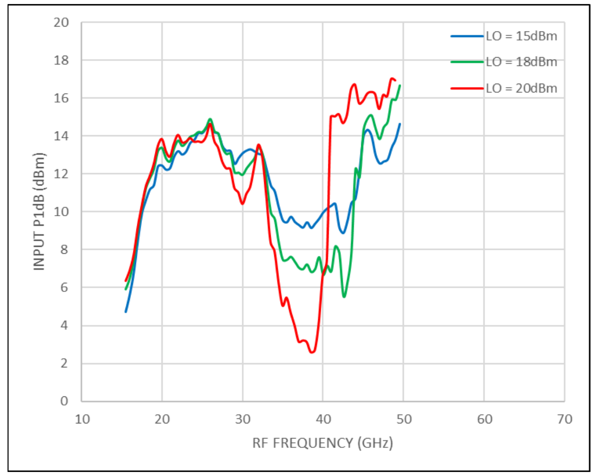

Figure 14. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

Lower Sideband (High-Side LO)

TBD

Figure 15. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 16. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 17. Input IP2 vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

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

TBD

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

TBD

Figure 20. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

TBD

Figure 21. Input P1dB vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 22. Noise Figure vs. RF Frequency at LO = 13 dBm, T_A = 25°C

TBD

Figure 23. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

DOWNCONVERTER PERFORMANCE, IF = 10 GHz

Upper Sideband (Low-Side LO)

TBD

Figure 24. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

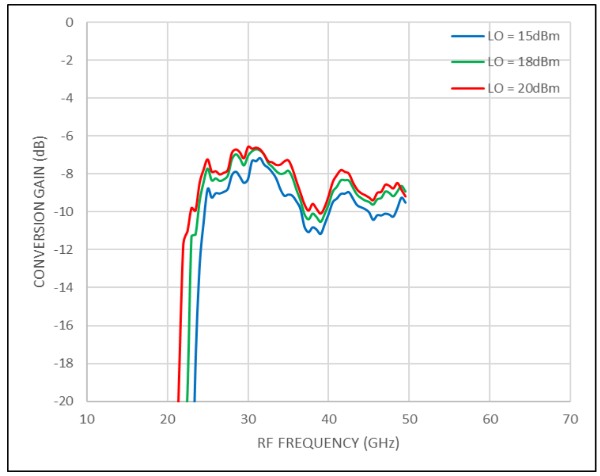

Figure 27. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

TBD

Figure 25. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

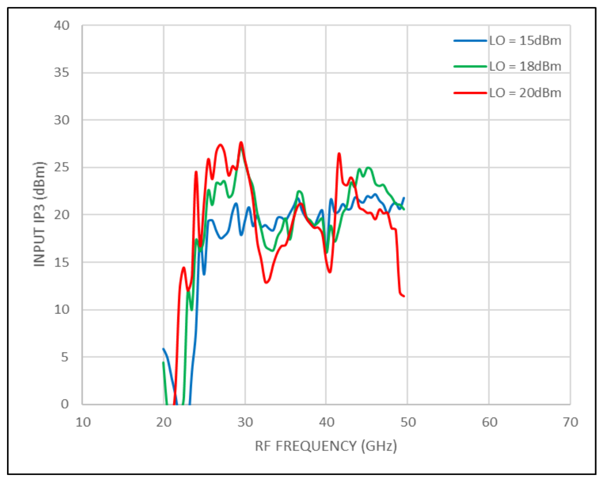

Figure 28. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

TBD

Figure 26. Input IP2 vs. RF Frequency at Various Temperatures, LO = 13 dBm

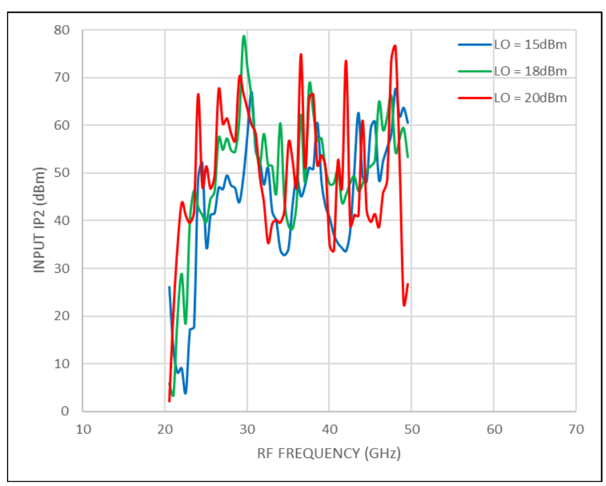

Figure 29. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

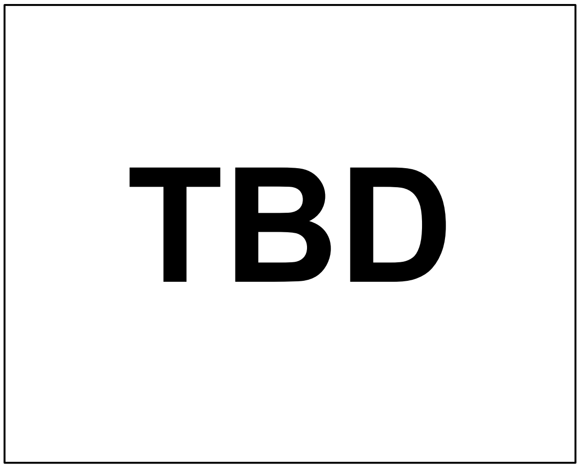

Figure 30. Input P1dB vs. RF Frequency at Various Temperatures, LO = 13 dBm

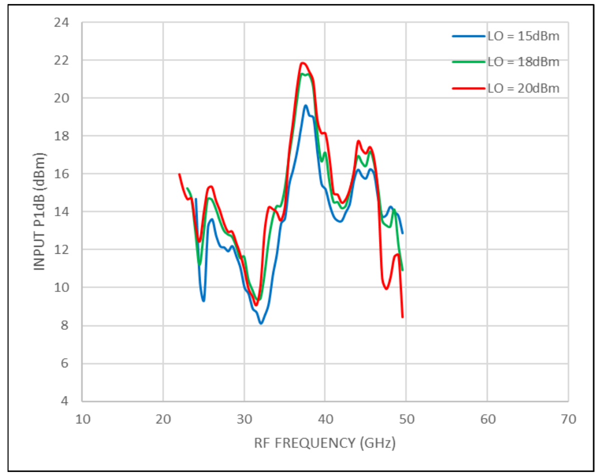

Figure 31. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

Lower Sideband (High-Side LO)

TBD

Figure 32. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 33. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 34. Input IP2 vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 35. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

TBD

Figure 36. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

TBD

Figure 37. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

DOWNCONVERTER PERFORMANCE, IF = 15 GHz

Upper Sideband (Low-Side LO)

TBD

Figure 38. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

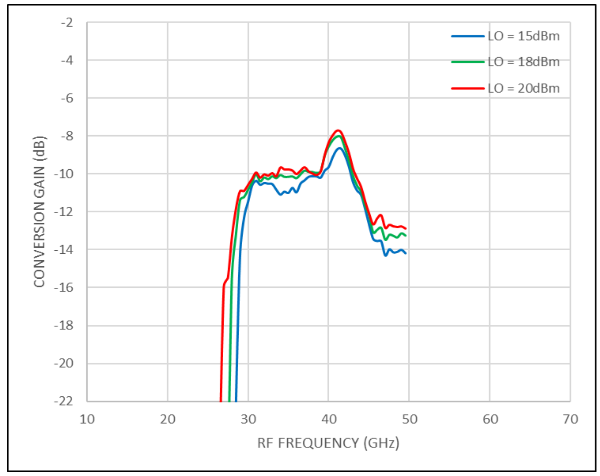

Figure 41. Conversion Gain vs RF Frequency at Various LO Power Levels, T_A = 25°C

TBD

Figure 39. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

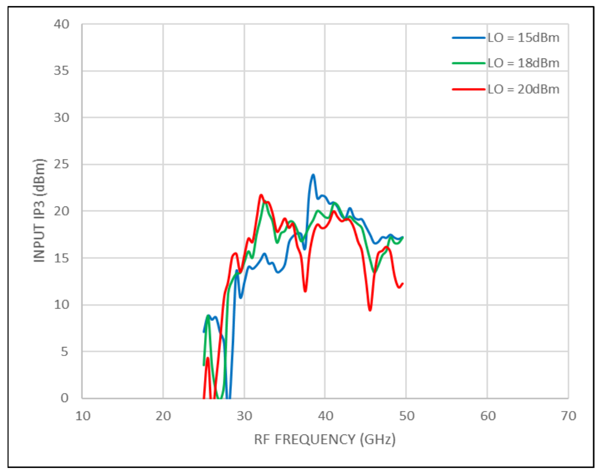

Figure 42. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

TBD

Figure 40. Input IP2 vs. RF Frequency at Various Temperatures, LO = 13 dBm

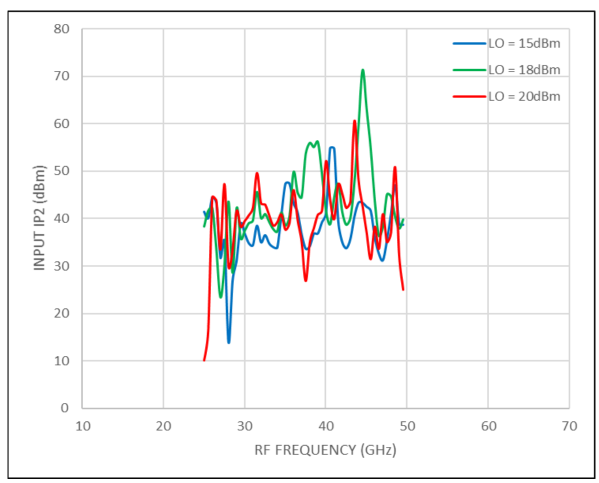

Figure 43. Input IP2 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

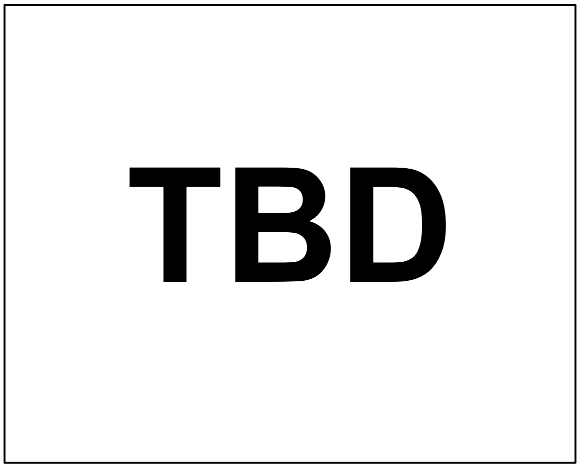

Figure 44. Input P1dB vs. RF Frequency at Various Temperatures, LO = 13 dBm

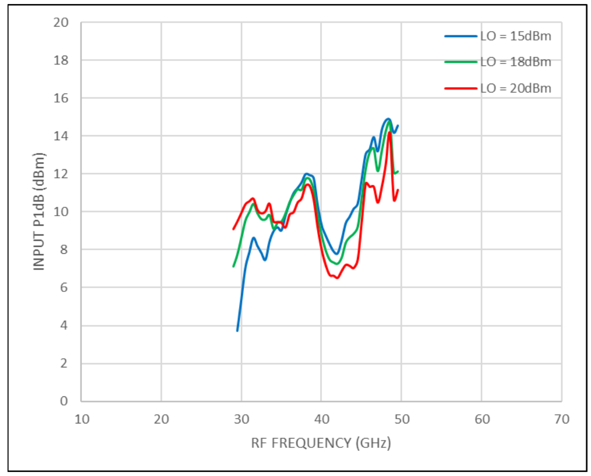

Figure 45. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

Lower Sideband (High-Side LO)

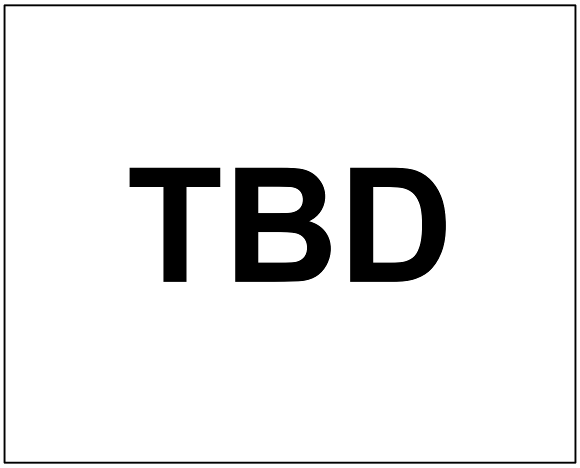

Figure 46. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

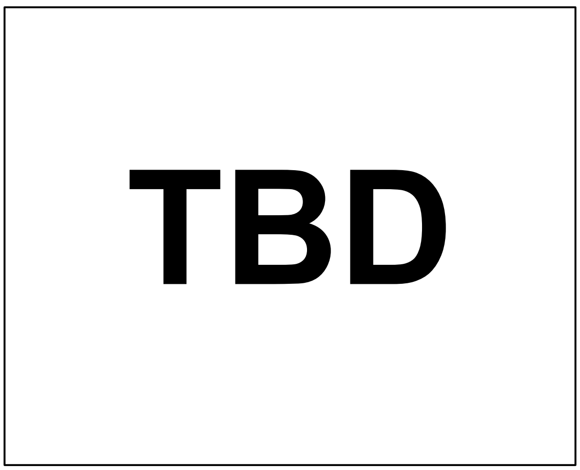

Figure 47. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

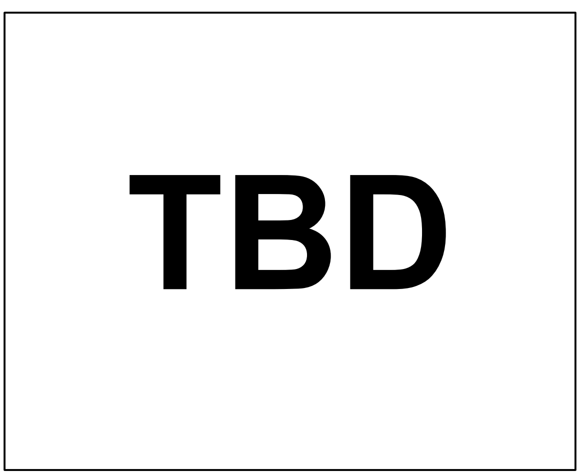

Figure 48. Input P1dB vs. RF Frequency at Various Temperatures, LO = 13 dBm

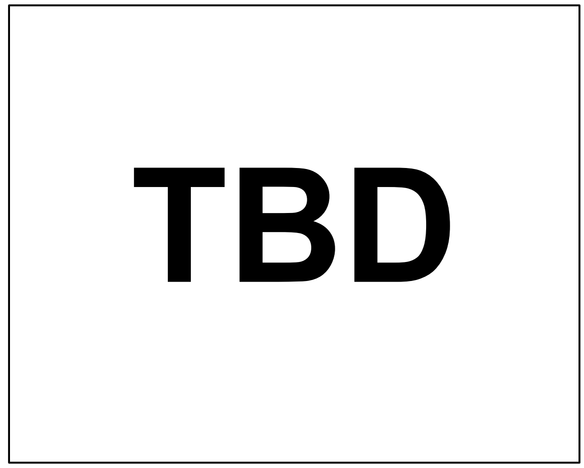

Figure 49. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

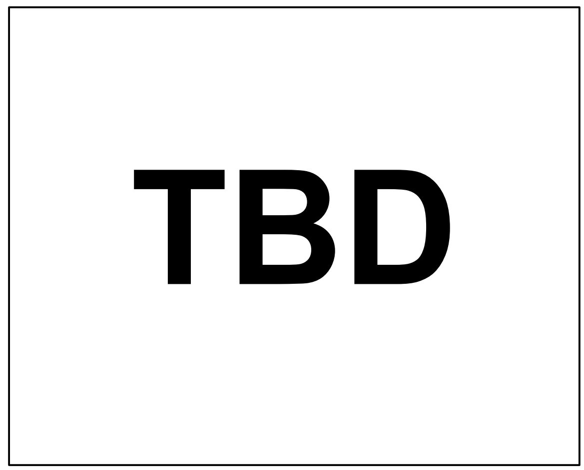

Figure 50. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

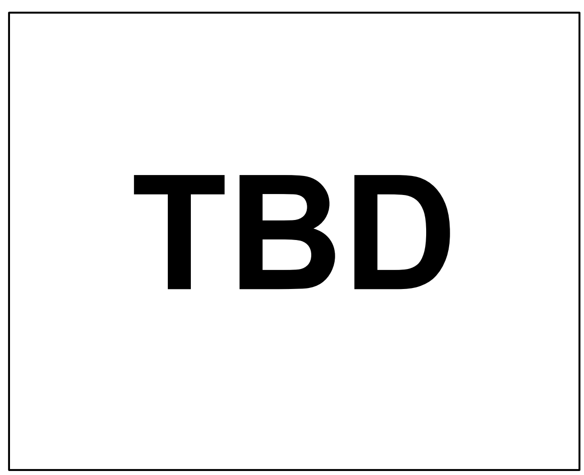

Figure 51. Input P1dB vs. RF Frequency at Various LO Power Levels, T_A = 25°C

UPCONVERTER PERFORMANCE, IF = TBD MHz

Upper Sideband (Low-Side LO)

TBD

Figure 52. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 53. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

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

TBD

Figure 55. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

Lower Sideband (High-Side LO)

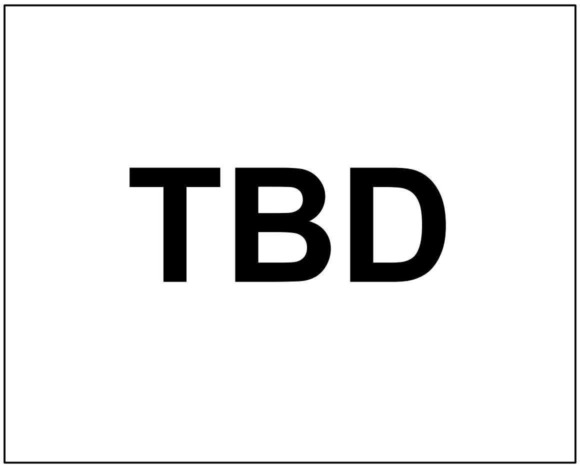

Figure 56. Conversion Gain vs. RF Frequency at Various Temperatures, LO = 13 dBm

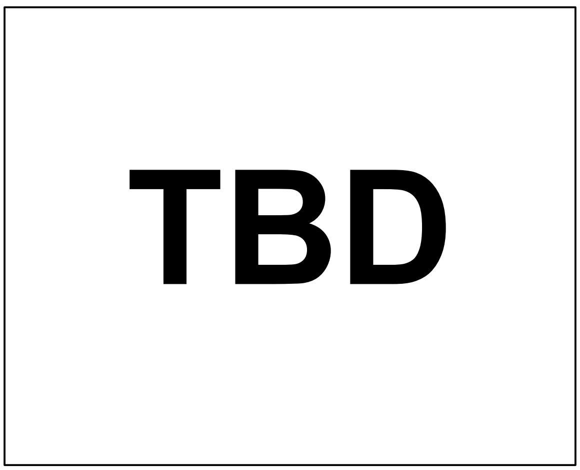

Figure 57. Input IP3 vs. RF Frequency at Various Temperatures, LO = 13 dBm

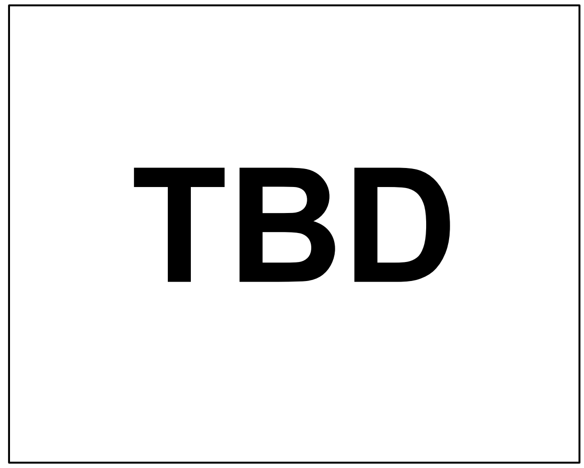

Figure 58. Conversion Gain vs. RF Frequency at Various LO Power Levels, T_A = 25°C

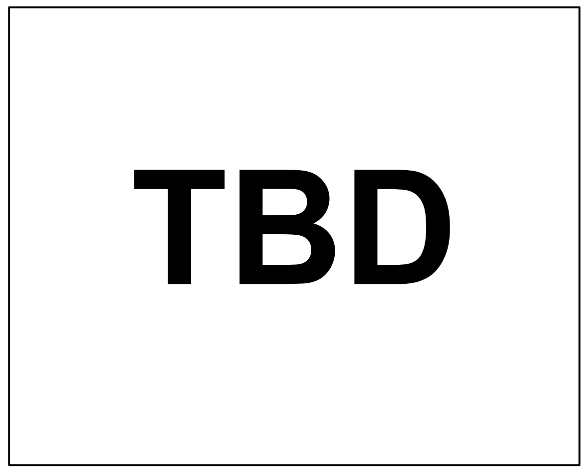

Figure 59. Input IP3 vs. RF Frequency at Various LO Power Levels, T_A = 25°C

Isolation and Return Loss

TBD

Figure 60. LO to RF Isolation vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 61. LO to IF Isolation vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 62. RF to IF Isolation vs. RF Frequency at Various Temperatures, LO = 13 dBm

TBD

Figure 63. LO to RF Isolation vs. RF Frequency at Various LO Power Levels, T_A = 25°C

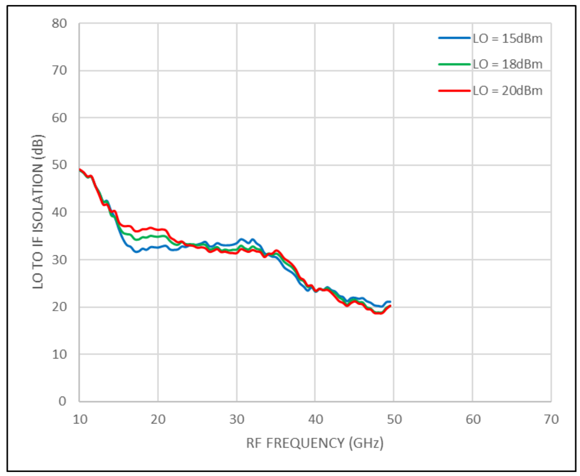

Figure 64. LO to IF Isolation vs. RF Frequency at Various LO Power Levels, T_A = 25°C

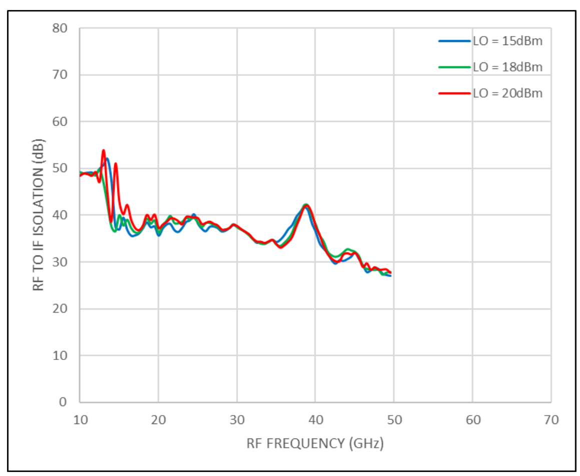

Figure 65. RF to IF Isolation vs. RF Frequency at Various LO Power Levels, T_A = 25°C

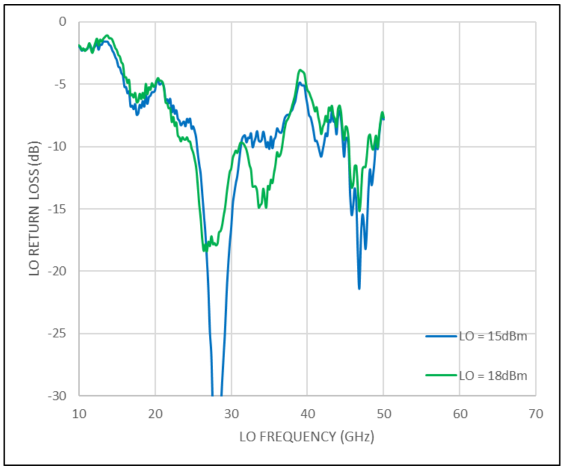

Figure 66. LO Return Loss vs. LO Frequency at Various LO Power Levels, T_A = 25°C

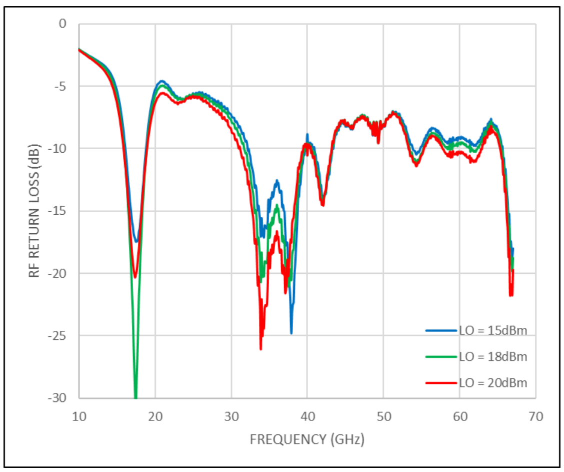

Figure 67. RF Return Loss vs. RF Frequency at Various LO Power Levels, T_A = 25°C, LO = 40 GHz

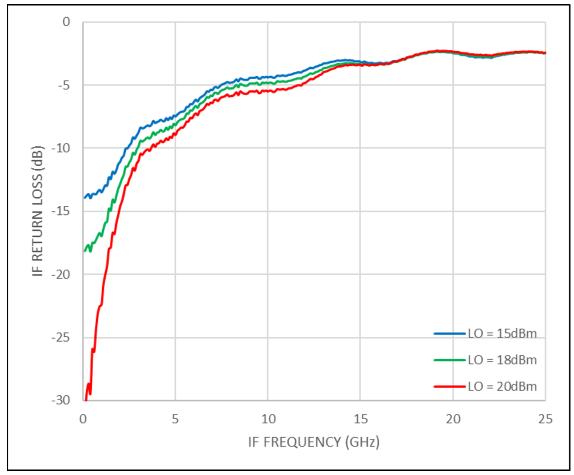

Figure 68. IF Return Loss vs. IF Frequency at Various LO Power Levels, T_A = 25°C, LO = 40 GHz

IF BANDWIDTH—DOWNCONVERTER

Upper Sideband, LO Frequency = 20 GHz

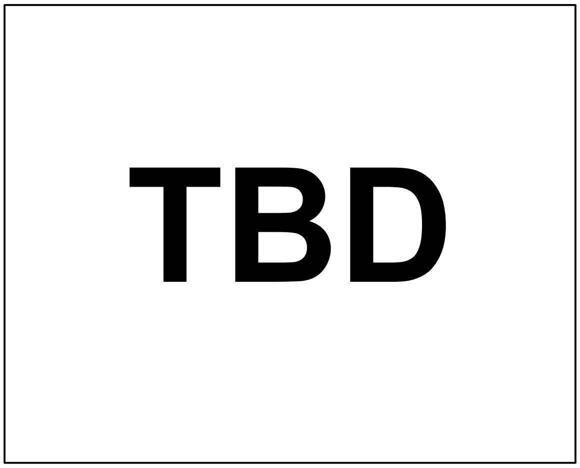

Figure 69. Conversion Gain vs. IF Frequency at Various Temperatures, LO = 13 dBm

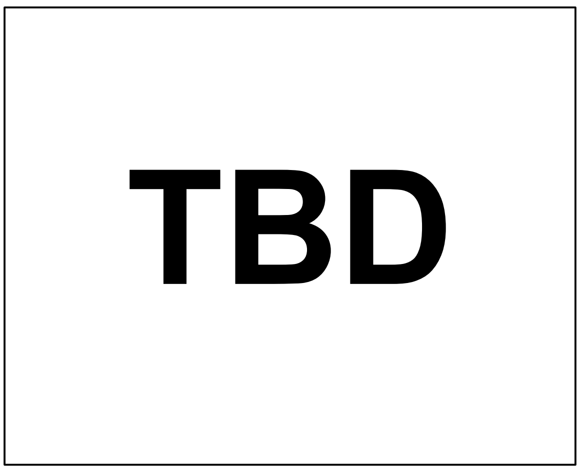

Figure 70. Input IP3 vs. IF Frequency at Various Temperatures, LO = 13 dBm

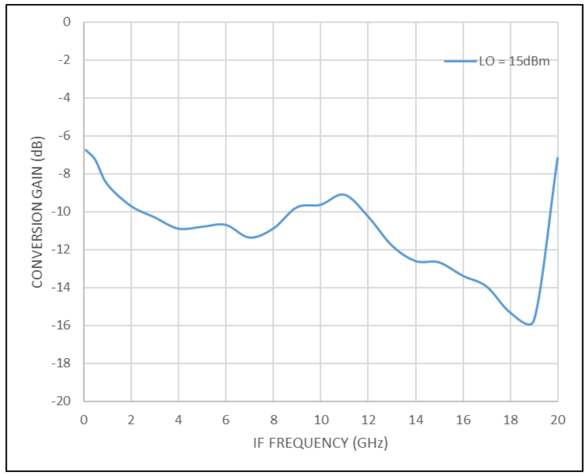

Figure 71. Conversion Gain vs. IF Frequency at Various LO Power Levels, T_A = 25°C

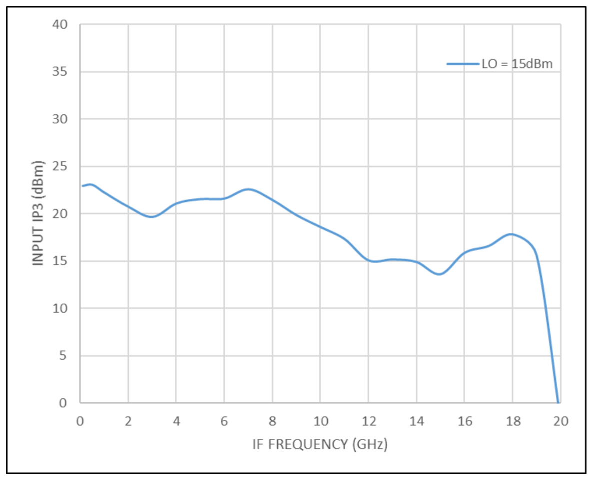

Figure 72. Input IP3 vs. IF Frequency at Various LO Power Levels, T_A = 25°C

Upper Sideband, LO Frequency = 25 GHz

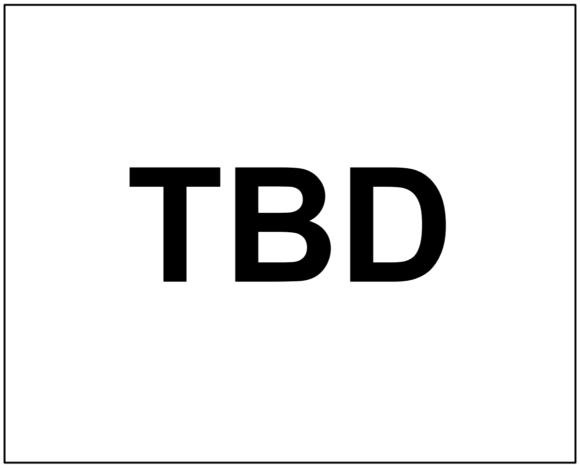

Figure 73. Conversion Gain vs. IF Frequency at Various Temperatures, LO = 13 dBm

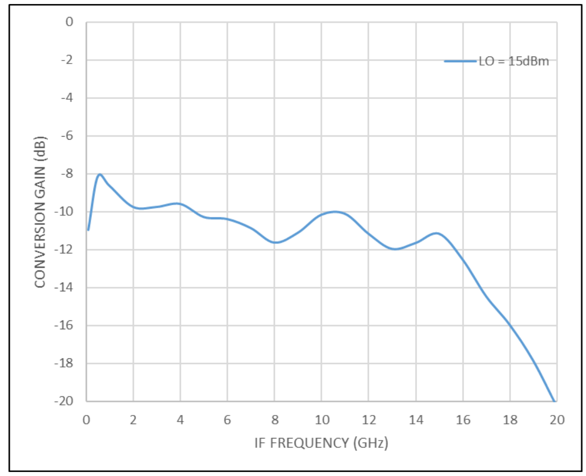

Figure 75. Conversion Gain vs. IF Frequency at Various LO Power Levels, T_A = 25°C

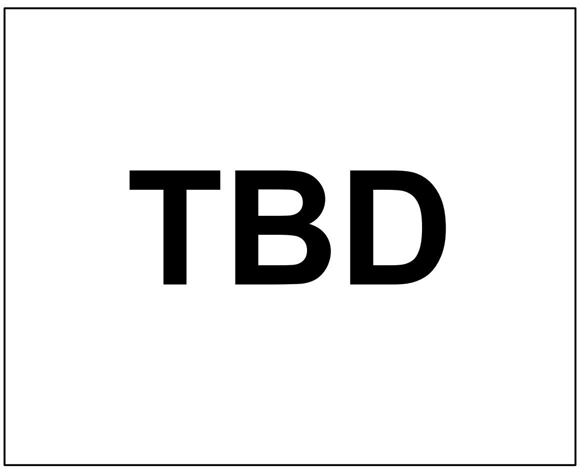

Figure 74. Input IP3 vs. IF Frequency at Various Temperatures, LO = 13 dBm

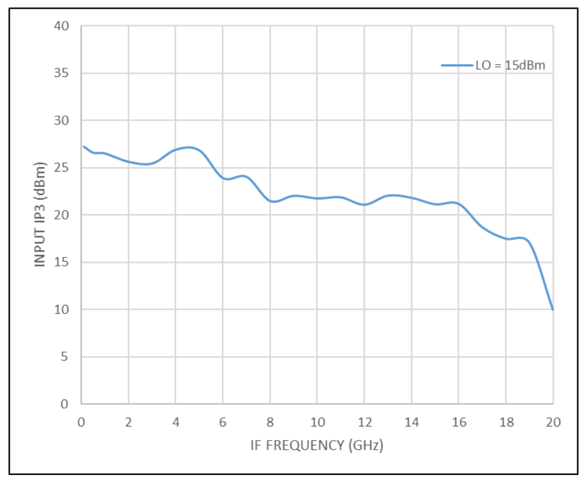

Figure 76. Input IP3 vs. IF Frequency at Various LO Power Levels, T_A = 25°C

Upper Sideband, LO Frequency = 30 GHz

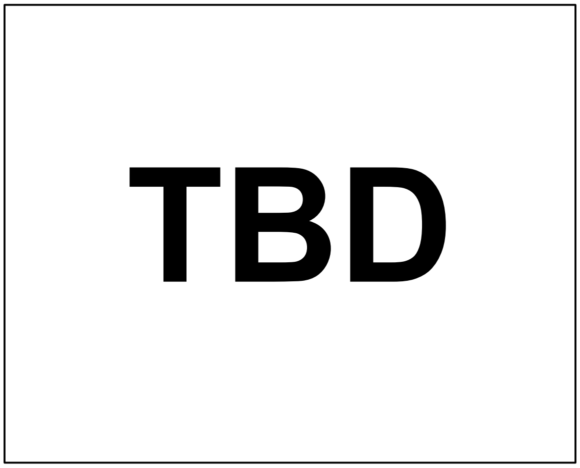

Figure 77. Conversion Gain vs. IF Frequency at Various Temperatures, LO = 13 dBm

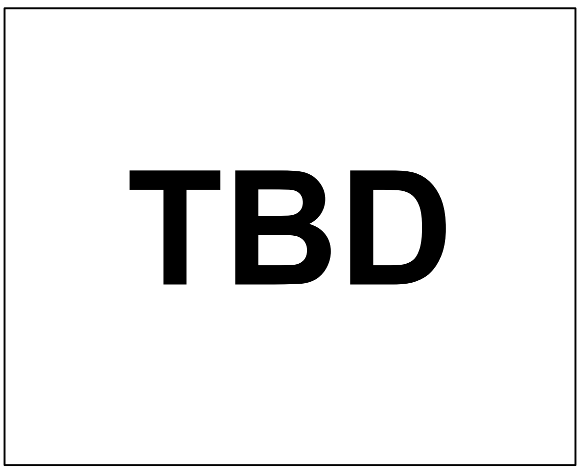

Figure 78. Input IP3 vs. IF Frequency at Various Temperatures, LO = 13 dBm

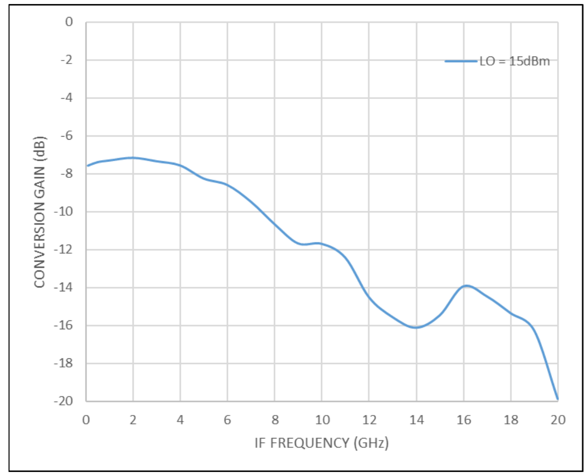

Figure 79. Conversion Gain vs. IF Frequency at Various LO Power Levels, T_A = 25°C

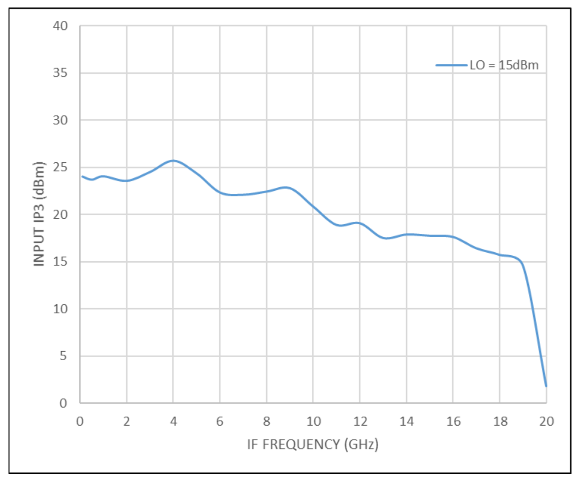

Figure 80. Input IP3 vs. IF Frequency at Various LO Power Levels, T_A = 25°C

Upper Sideband, LO Frequency = 40 GHz

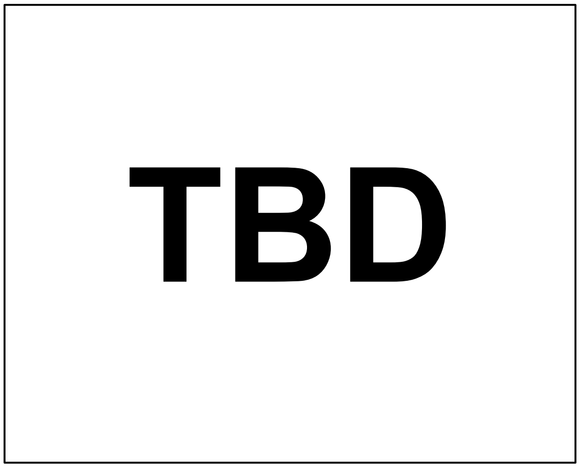

Figure 81. Conversion Gain vs. IF Frequency at Various Temperatures, LO = 13 dBm

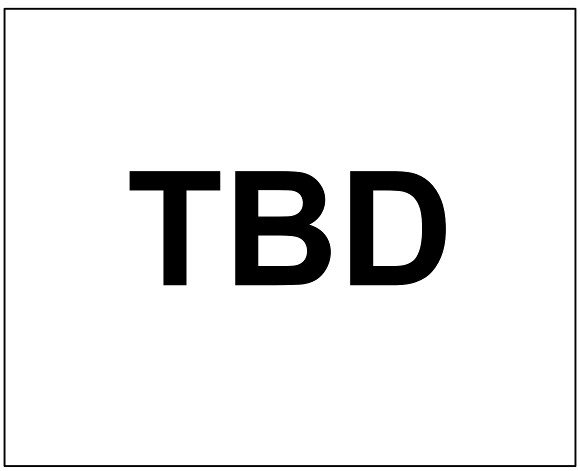

Figure 82. Input IP3 vs. IF Frequency at Various Temperatures, LO = 13 dBm

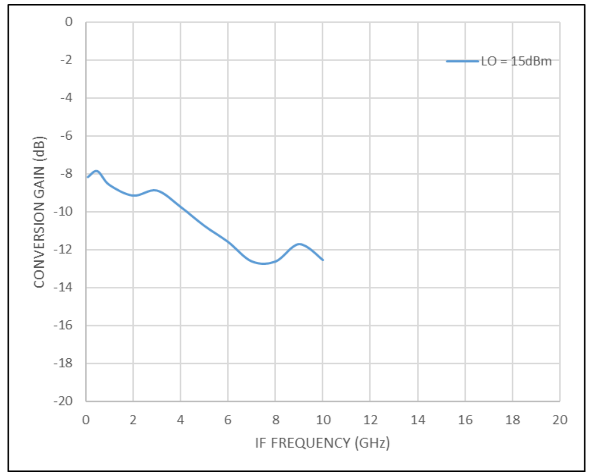

Figure 83. Conversion Gain vs. IF Frequency at Various LO Power Levels, T_A = 25°C

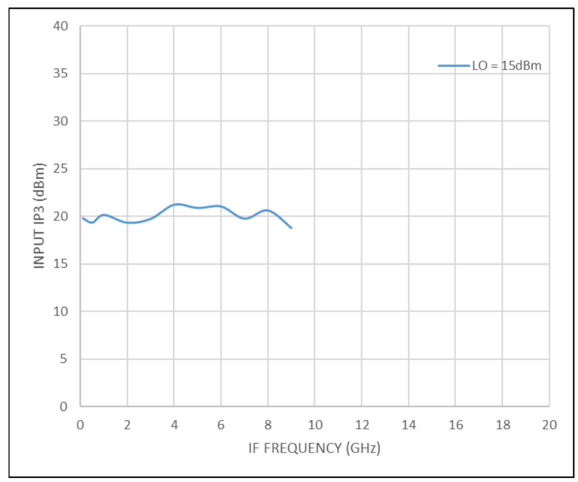

Figure 84. Input IP3 vs. IF Frequency at Various LO Power Levels, T_A = 25°C

SPURIOUS AND HARMONICS PERFORMANCE

Mixer spurious products are measured in dBc from the IF output power level. N/A means not applicable or beyond 50 GHz.

LO Harmonics

LO = 18 dBm, all values in dBc are below input LO level and are measured at the RF port.

Table 5. LO Harmonics at RF

	N × LO Spur at RF Port			
LO Frequency (GHz)	1	2	3	4

LO = 18 dBm, all values in dBc are below input LO level and are measured at the IF port.

Table 6. LO Harmonics at IF

	N × LO Spur at IF Port			
LO Frequency (GHz)	1	2	3	4

M × N Spurious Outputs

Downconverter, Upper Sideband

Spur values are (M × RF) − (N × LO).

IF_{OUT} = 9.99GHz

RF = 29.99 GHz at −10 dBm, LO = 20 GHz at 18 dBm.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × RF	**0**	N/A	-3	+12	N/A	N/A
	1	+30	0	+30	+36	+90
	2	N/A	+67	+76	+82	+68
	3	N/A	N/A	+60	+69	+78
	4	N/A	N/A	N/A	N/A	+66

RF = 34.99 GHz at −10 dBm, LO = 25 GHz at 18 dBm.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × RF	**0**	N/A	-6	+90	N/A	N/A
	1	+29	0	+26	+19	N/A
	2	N/A	+56	+67	+55	+70
	3	N/A	N/A	N/A	+71	+72
	4	N/A	N/A	N/A	N/A	+67

RF = 39.99 GHz at −10 dBm, LO = 30 GHz at 18 dBm.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × RF	**0**	N/A	-8	N/A	N/A	N/A
	1	+19	0	+28	N/A	N/A
	2	N/A	+51	+64	+57	+61
	3	N/A	N/A	N/A	+66	+82
	4	N/A	N/A	N/A	N/A	+63

RF = 44.99 GHz at −10 dBm, LO = 35 GHz at 18 dBm.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × RF	**0**	N/A	-12	N/A	N/A	N/A
	1	+25	0	+37	N/A	N/A
	2	N/A	N/A	+70	+66	N/A
	3	N/A	N/A	N/A	+65	+73
	4	N/A	N/A	N/A	N/A	+62

RF = 49.99 GHz at −10 dBm, LO = 40 GHz at 18 dBm.

		N × LO				
		0	**1**	**2**	**3**	**4**
M × RF	**0**	N/A	-16	N/A	N/A	N/A
	1	+22	0	+38	N/A	N/A
	2	N/A	N/A	+68	+71	N/A
	3	N/A	N/A	N/A	+68	+73
	4	N/A	N/A	N/A	N/A	+64

Downconverter, Lower Sideband

Spur values are (M × RF) − (N × LO).

IF_{OUT} = 9.99GHz

RF = 15.01 GHz at −10 dBm, LO = 25 GHz at 18 dBm.

		N × LO				
		0	1	2	3	4
M × RF	0	N/A	-7	+13	N/A	N/A
	1	+22	0	+36	N/A	N/A
	2	+69	+69	+70	+59	N/A
	3	+60	+70	+78	+70	N/A
	4	N/A	+67	+73	+74	+63

RF = 20.01 GHz at −10 dBm, LO = 30 GHz at 18 dBm.

		N × LO				
		0	1	2	3	4
M × RF	0	N/A	-6	N/A	N/A	N/A
	1	+39	0	+30	N/A	N/A
	2	+65	+54	+67	+53	N/A
	3	N/A	+69	+76	+69	N/A
	4	N/A	N/A	+71	+74	+62

RF = 25.01 GHz at −10 dBm, LO = 35 GHz at 18 dBm.

		N × LO				
		0	1	2	3	4
M × RF	0	N/A	-10	N/A	N/A	N/A
	1	+28	0	+28	N/A	N/A
	2	N/A	+59	+72	N/A	N/A
	3	N/A	+65	+75	+68	N/A
	4	N/A	N/A	+68	+77	+65

RF = 30.01 GHz at −10 dBm, LO = 40 GHz at 18 dBm.

		N × LO				
		0	1	2	3	4
M × RF	0	N/A	-17	N/A	N/A	N/A
	1	+25	0	+23	N/A	N/A
	2	N/A	+46	+69	N/A	N/A
	3	N/A	N/A	+75	+66	N/A
	4	N/A	N/A	+63	+83	+63

RF = 35.01 GHz at −10 dBm, LO = 45 GHz at 18 dBm.

		N × LO				
		0	1	2	3	4
M × RF	0	N/A	-17	N/A	N/A	N/A
	1	+26	0	N/A	N/A	N/A
	2	N/A	+55	+51	N/A	N/A
	3	N/A	N/A	+65	+72	N/A
	4	N/A	N/A	N/A	+77	+67

RF = 40.01 GHz at −10 dBm, LO = 50 GHz at 18 dBm.

		N × LO				
		0	1	2	3	4
M × RF	0	N/A	-16	N/A	N/A	N/A
	1	+23	0	N/A	N/A	N/A
	2	N/A	+64	+58	N/A	N/A
	3	N/A	N/A	+73	+69	N/A
	4	N/A	N/A	N/A	+75	+65

Upconverter, Upper Sideband

Spur values are (M × IF) + (N × LO). IF_{IN} = TBD MHz at −10 dBm, LO = TBD GHz at 13 dBm.

		N × LO			
		0	1	2	3
M × IF	−5				
	−4				
	−3				
	−2				
	−1				
	0				
	+1				
	+2				
	+3				
	+4				
	+5				

THEORY OF OPERATION

The ADMV1550 is a general-purpose, double balanced mixer that can be used as an upconverter or a downconverter from 15 GHz to 67 GHz.

When used as a downconverter, the ADMV1550 downconverts radio frequencies between 15 GHz and 67 GHz to intermediate frequencies between dc and 20 GHz.

When used as an upconverter, the mixer upconverts intermediate frequencies between dc and 20 GHz to radio frequencies between 15 GHz and 67 GHz.

APPLICATIONS INFORMATION

TYPICAL APPLICATION CIRCUIT

Figure 85 shows the typical application circuit for the ADMV1550. The ADMV1550 is a passive device and does not require any external components. The LO and RF pins are internally ac-coupled. The IF pin is internally dc-coupled. For applications not requiring operation to dc, dc block this port 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.

TBD

Figure 85. Typical Application Circuit

EVALUATION PCB INFORMATION

Use RF circuit design techniques for the circuit board used in the application. Ensure that signal lines have 50 Ω impedance and connect the package ground leads and the exposed pad directly to the ground plane (see Figure 86). Use a sufficient number of via holes to connect the top and bottom ground planes. The evaluation circuit board shown in Figure 86 is available from Analog Devices, Inc., upon request.

Table 7. List of Materials for Evaluation PCB ADMV1550-EVALZ

Item	Description

[1] TBD is the raw bare PCB identifier. Reference ADMV1550-EVALZ when ordering complete evaluation PCB.

TBD

Figure 86. Evaluation PCB Top Layer

OUTLINE DIMENSIONS

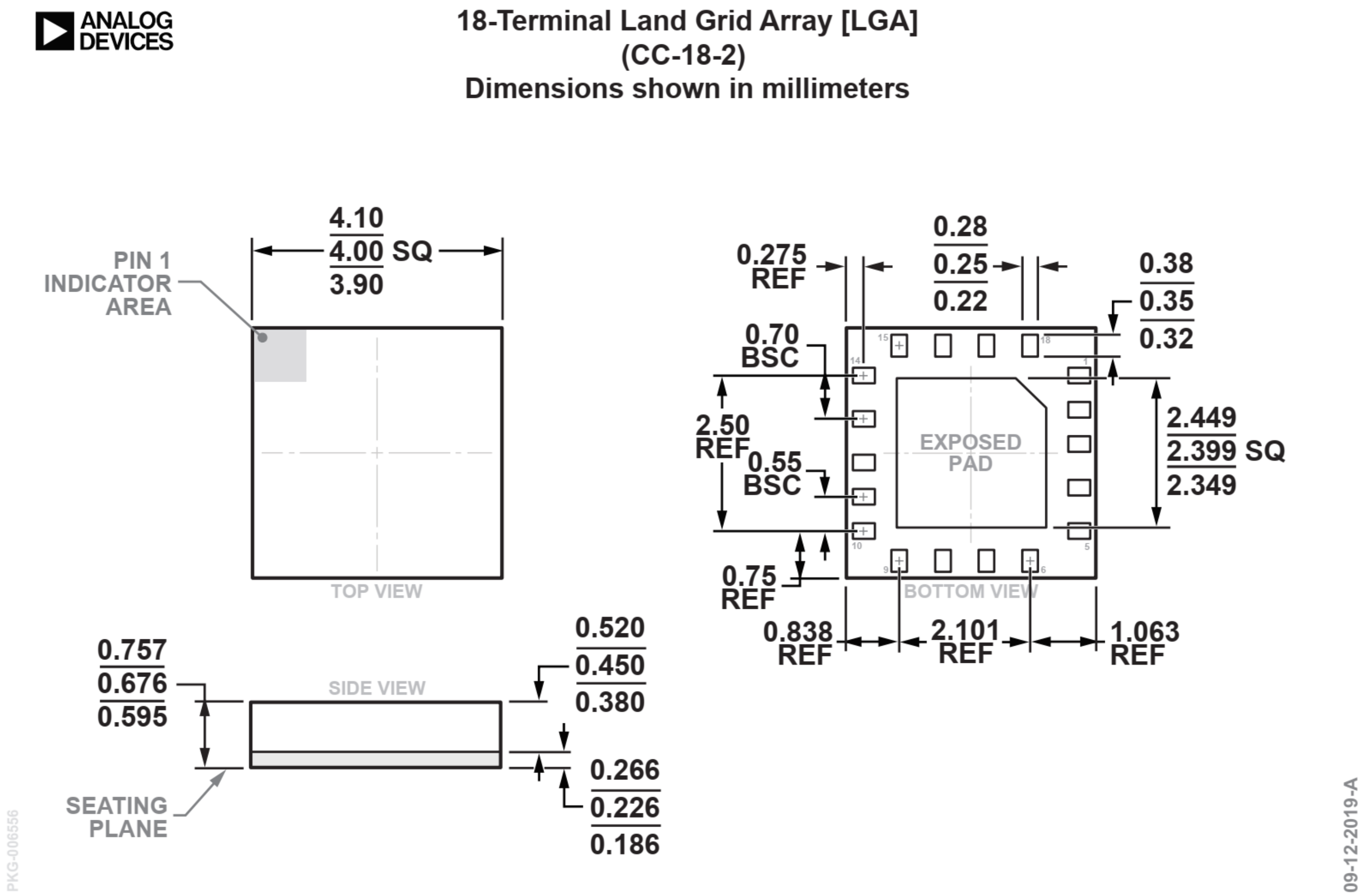

Figure 87. 18-Terminal Land Grid Array [LGA]
4.00 x 4.00 mm Body and 0.676 mm Package Height
(CC-18-2)
Dimensions shown in millimeters