10 MHz to 8000 MHz Bypass Amplifier

Data Sheet **ADL8111**

FEATURES

Small signal gain of 12.5 dB typical from 10 MHz to 500 MHz
Broad operation from 10 MHz to 8000 MHz
OIP3 of 34 dBm typical from 10 MHz to 500 MHz
Internal amplifier state, output P1dB of 17 dBm typical from 5000 MHz to 8000 MHz
Noise figure of 2.8 dB typical from 10 MHz to 500 MHz
Low insertion loss of 2 dB typical for the internal bypass switch state from 10 MHz to 500 MHz
Wide operating temperature range of −40°C to +85°C
RoHS-compliant, 6 mm × 6 mm, 28-terminal LGA
ESD rating of ±750 V (Class 1B)

APPLICATIONS

Military
Test instrumentation
Communications

FUNCTIONAL BLOCK DIAGRAM

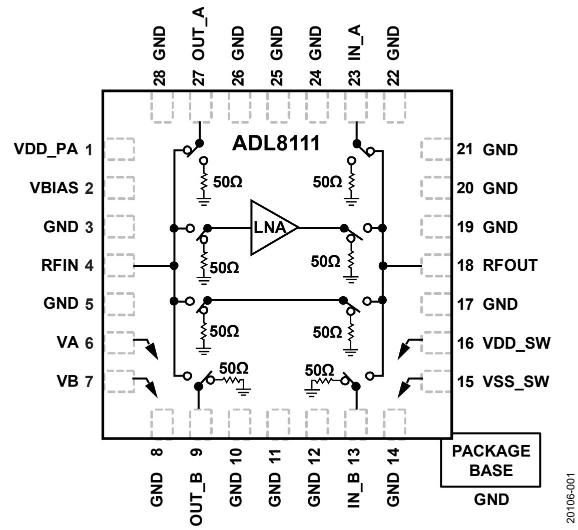

Figure 1.

GENERAL DESCRIPTION

The ADL8111 is a low noise amplifier (LNA) with a nonreflective bypass switch that provides broadband operation from 10 MHz to 8000 MHz. The ADL8111 provides a low noise figure of 2.8 dB with a high output third-order intercept (OIP3) of 34 dBm simultaneously, which delivers a high dynamic range. The ADL8111 provides a gain of 12.5 dB that is stable over frequency, temperature, power supply, and from device to device.

The integration of an amplifier and two single-pole, quad-throw (SP4T) nonreflective switches allows multiple gain and linearity values. The addition of switches also offers high input intercept performance and prevents distortion on the high signal level applications.

The ADL8111 has a high electrostatic discharge (ESD) rating of ±750 V (Class 1B) and is fully specified for operation across a wide temperature range of −40°C to +85°C. The ADL8111 is offered in a 6 mm × 6 mm, 28-terminal land grid array (LGA) package.

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

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REVISION HISTORY

4/2019—Revision 0: Initial Version

SPECIFICATIONS

Drain bias voltage (VDD_PA) = +5 V, quiescent drain supply current (I_{DQ_PA}) = 70 mA, negative bias voltage (VSS_SW) = −3.3 V, positive bias voltage (VDD_SW) = +3.3 V, and T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
OVERALL FUNCTION					
Frequency Range		10		5000	MHz
INTERNAL AMPLIFIER STATE					
Small Signal Gain		11.2	12.5		dB
Gain Flatness			±0.5		dB
Input Return Loss			24		dB
Output Return Loss			17		dB
Radio Frequency (RF) Settling Time					
	50% VA/VB to 0.5 dB margin of final RFOUT		170		ns
	50% VA/VB to 0.1 dB margin of final RFOUT		260		ns
Switching Speed					
Rise Time (t_{RISE}) and Fall Time (t_{FALL})	10% to 90% RFOUT		40		ns
Turn On Time (t_{ON}) and Turn Off Time (t_{OFF})	50% VA/VB to 90%/10% RF		160		ns
Output 1 dB Compression (P1dB)		17	19.5		dBm
Output Third-Order Intercept (OIP3)			34		dBm
Noise Figure			2.8		dB
VDD_PA		3.0	5.0	5.5	V
INTERNAL BYPASS SWITCH STATE					
Insertion Loss			2		dB
RF Settling Time					
	50% VA/VB to 0.5 dB margin of final RFOUT		175		ns
	50% VA/VB to 0.1 dB margin of final RFOUT		260		ns
Switching Speed					
t_{RISE}/t_{FALL}	10% to 90% RFOUT		60		ns
t_{ON}/t_{OFF}	50% VA/VB to 90%/10% RF		160		ns
Input Third-Order Intercept (IIP3)			58		dBm
0.5 dB Compression (P0.5dB)			34		dBm
P1dB			35		dBm
Return Loss On State			18		dB
Return Loss Off State			30		dB
VDD_SW		3.0	3.3	3.6	V
VSS_SW		−3.6	−3.3	−3.0	V
EXTERNAL BYPASS A AND EXTERNAL BYPASS B STATES					
Insertion Loss			1		dB
RF Settling Time					
	50% VA/VB to 0.5 dB margin of final RFOUT		180		ns
	50% VA/VB to 0.1 dB margin of final RFOUT		230		ns
Switching Speed					
t_{RISE}/t_{FALL}	10% to 90% RFOUT		70		ns
t_{ON}/t_{OFF}	50% VA/VB to 90%/10% RF		175		ns
IIP3			59		dBm
P0.5dB			35.5		dBm
P1dB			36		dBm
Return Loss On State			22		dB
Return Loss Off State			25		dB
VDD_SW		3.0	3.3	3.6	V
VSS_SW		−3.6	−3.3	−3.0	V

VDD_PA = +5 V, I_{DQ_PA} = 70 mA, VSS_SW = −3.3 V, VDD_SW = +3.3 V, and T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
OVERALL FUNCTION					
Frequency Range		5000		8000	MHz
INTERNAL AMPLIFIER STATE					
Small Signal Gain		10.6	11.5		dB
Gain Flatness			±1		dB
Input Return Loss			14		dB
Output Return Loss			16		dB
P1dB			17		dBm
OIP3			32		dBm
Noise Figure			4.5		dB
VDD_PA		3.0	5.0	5.5	V
INTERNAL BYPASS SWITCH STATE					
Insertion Loss			2.7		dB
IIP3[1]			58		dBm
P0.5dB			34		dBm
Return Loss On State			18		dB
Return Loss Off State			22		dB
VDD_SW		3.0	3.3	3.6	V
VSS_SW		−3.6	−3.3	−3.0	V
EXTERNAL BYPASS A AND EXTERNAL BYPASS B STATES[2]					
Insertion Loss			1.5		dB
IIP3			57.5		dBm
P0.5dB			34.5		dBm
Return Loss On State			17		dB
Return Loss Off State			20		dB
VDD_SW		3.0	3.3	3.6	V
VSS_SW		−3.6	−3.3	−3.0	V

[1] IIP3 and compression data for the internal bypass and the External Bypass B states is the same as the External Bypass A state data.
[2] External Bypass A and External Bypass B were tested with an external 50 Ω transmission line on the evaluation board.

Table 3. Total Supply Current by V_{DD}

Parameter	Min	Typ	Max	Unit
Supply Current				
VDD_PA = 5 V		70		mA
VDD_SW = +3.3 V		30		µA
VSS_SW = −3.3 V		30		µA

Table 4. Logic Control Voltage

Digital Control Inputs	Min	Typ	Max	Unit	Current
Low	0		0.8	V	<1 µA typical
High	1.4		VDD_SW + 0.3	V	<1 µA typical

ABSOLUTE MAXIMUM RATINGS

Table 5.

Parameter	Rating
VDD_PA	+7 V dc
VDD_SW Range	−0.3 V to +3.7 V
VSS_SW Range	−3.7 V to +0.3 V
Control Voltage (VA, VB) Range	−0.3 V to VDD + 0.3 V
RF Input Power (RFIN) – Internal Amplifier State	20 dBm
RFIN – Internal Bypass, External Bypass A, External Bypass B	31 dBm
RFIN (IN_A, OUT_A, IN_B, and OUT_B) Termination Path (VDD_SW, VA, VB = 3.3 V, VSS = −3.3 V, T_A = 85°C, and Frequency = 2 GHz)	28 dBm
Hot Switch Power Level (IN_A, OUT_A, IN_B, and OUT_B), VDD_SW = 3.3 V, T_A = 85°C, and Frequency = 2 GHz	30 dBm
Hot Switch Power Level (Internal Amplifier State)	20 dBm
Continuous Power Dissipation, P_{DISS} (T_A = 85°C, Derate 6.8 mW/°C Above 85°C)	0.61 W
Channel Temperature	175°C
Maximum Peak Reflow Temperature (Moisture Sensitivity Level 3, MSL3)[1]	260°C
Storage Temperature Range	−40°C to +125°C
Operating Temperature Range	−40°C to +85°C
ESD Sensitivity (Human Body Model)	Class 1B (Passed ±750 V)

[1] See the Ordering Guide section for additional information.

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 the 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 6. Thermal Resistance

Package Type	θ_{JC}	Unit
CC-28-3[1]	148	°C/W

[1] θ_{JC} was determined by simulation under the following conditions: the heat transfer is due solely to thermal conduction from the channel through the ground paddle to the PCB, and the ground paddle is held constant at an 85°C operating temperature.

POWER DERATING CURVES

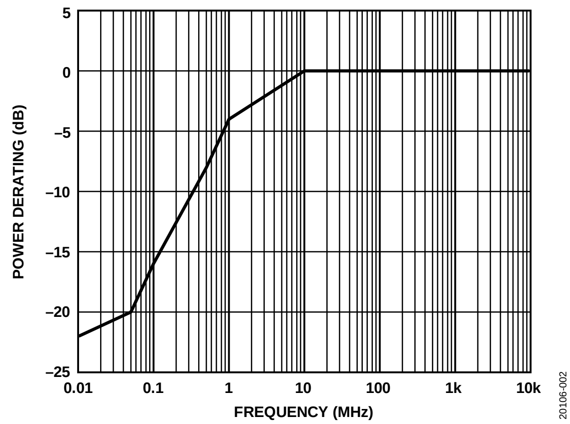


Figure 2. Power Derating for RFIN Port

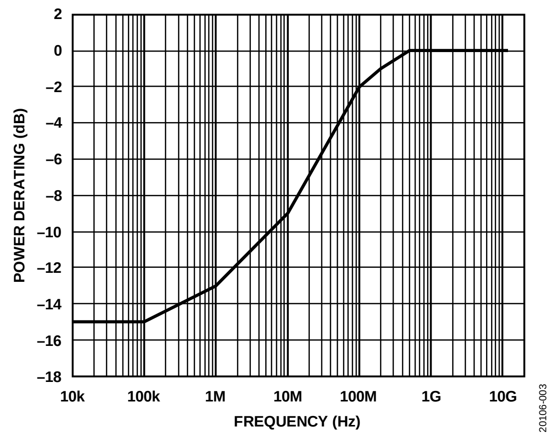


Figure 3. Power Derating for Terminated Path

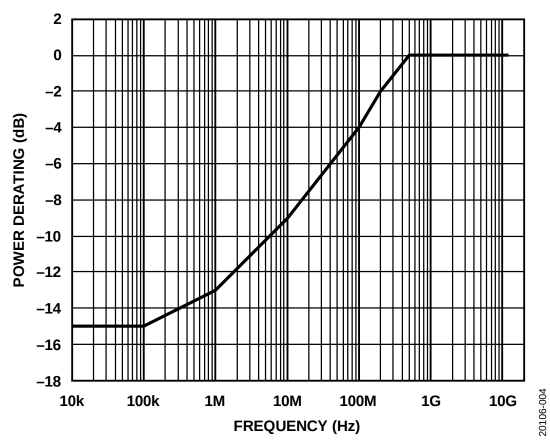
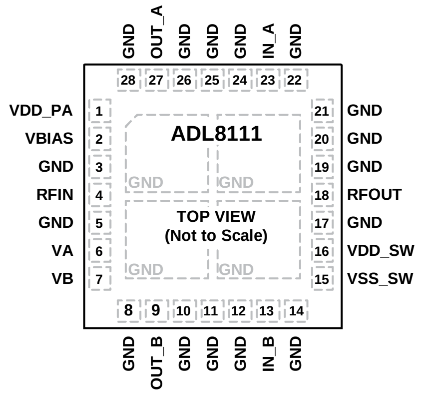


Figure 4. Power Derating for Hot Switching Power

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



NOTES
1. EXPOSED PAD. THE EXPOSED PAD MUST BE CONNECTED TO RF AND DC GROUND.

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Figure 5. Pin Configuration—Top View Not to Scale

Table 7. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	VDD_PA	Drain Bias Voltage. See Table 2.
2	VBIAS	Current Mirror Bias Resistor Pin. Use this pin to set the current to the internal resistor by the external resistor. See Figure 9 for the interface schematic.
3, 5, 8, 10 to 12, 14, 17, 19 to 22, 24 to 26, 28	GND	RF and DC Ground. See Figure 6 for the interface schematic.
4	RFIN	RF Input. These pins are dc-coupled and matched to 50 Ω. A dc blocking capacitor is required if the RF line potential is not equal to 0 V dc.
6, 7	VA, VB	Control Input. See Table 2, Table 4, and Table 5. See Figure 8 and Figure 7 for the interface schematics.
9, 13	OUT_B, IN_B	These pins are dc-coupled and matched to 50 Ω. A dc blocking capacitor is required if the RF line potential is not equal to 0 V dc.
15	VSS_SW	Negative Bias Voltage. See Table 2.
16	VDD_SW	Positive Bias Voltage. See Table 2.
18	RFOUT	RF Output. This pin is dc-coupled and matched to 50 Ω. A dc blocking capacitor is required if the RF line potential is not equal to 0 V dc.
23, 27	IN_A, OUT_A	These pins are dc-coupled and matched to 50 Ω. A dc blocking capacitor is required if the RF line potential is not equal to 0 V dc.
	EPAD	Exposed Pad. The exposed pad must be connected to RF and dc ground.

INTERFACE SCHEMATICS

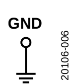

Figure 6. GND Interface Schematic

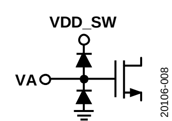

Figure 8. VA Interface Schematic

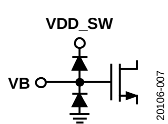

Figure 7. VB Interface Schematic

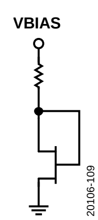

Figure 9. VBIAS Interface Schematic

TYPICAL PERFORMANCE CHARACTERISTICS

EXTERNAL BYPASS A STATE

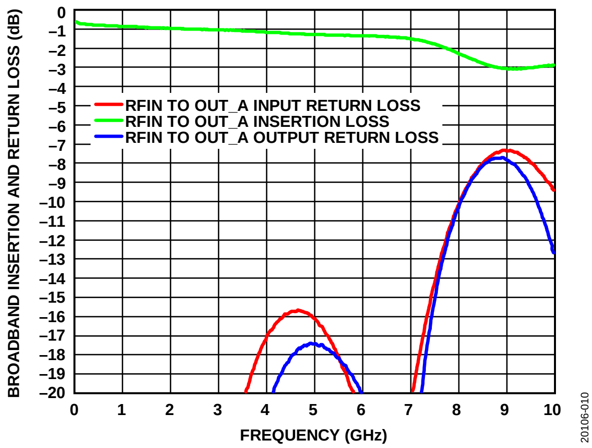

Figure 10. Broadband Insertion and Return Loss vs. Frequency, State = External Bypass A, Path = RFIN to OUT_A (Refer to Figure 75 for the Test Circuit)

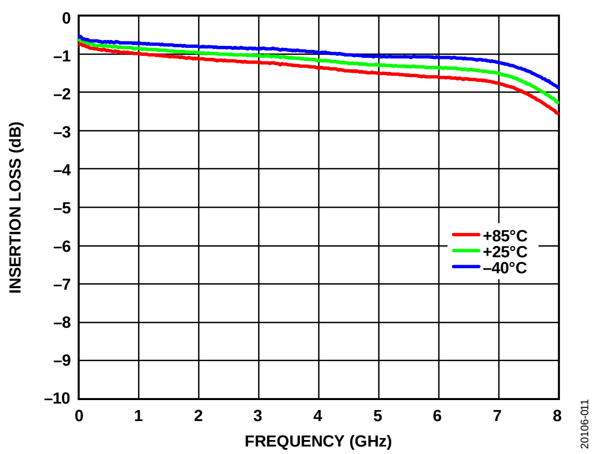

Figure 11. Insertion Loss Over Temperature vs. Frequency, State = External Bypass A, Path = RFIN to OUT_A (Refer to Figure 75 for the Test Circuit)

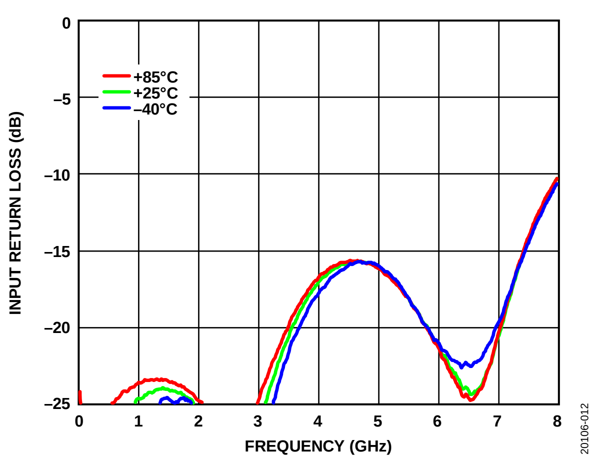

Figure 12. Input Return Loss Over Temperature vs. Frequency, State = External Bypass A, Path = RFIN to OUT_A (Refer to Figure 75 for the Test Circuit)

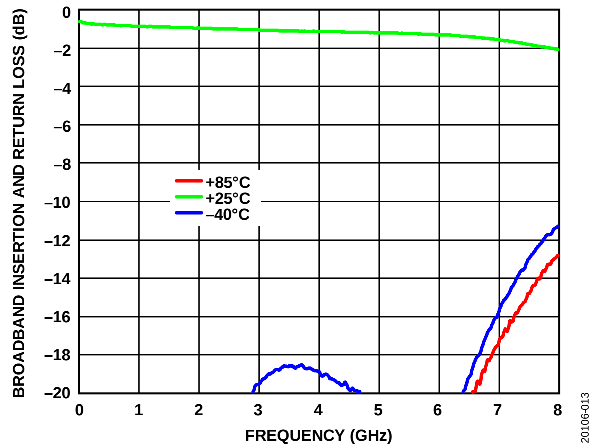

Figure 13. Broadband Insertion and Return Loss vs. Frequency, State = External Bypass A, Path = IN_A to RFOUT (Refer to Figure 75 for the Test Circuit)

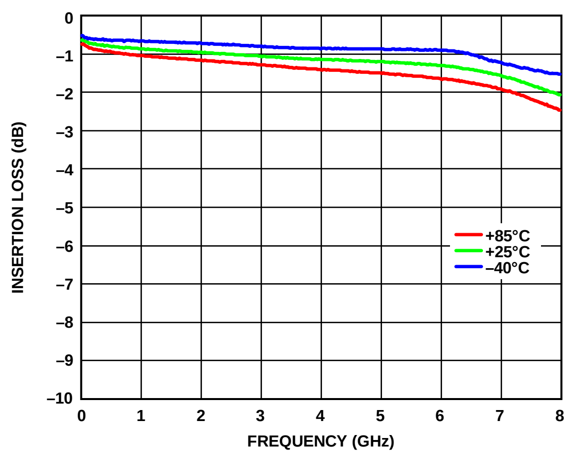

Figure 14. Insertion Loss Over Temperature vs. Frequency, State = External Bypass A, Path = IN_A to RFOUT (Refer to Figure 75 for the Test Circuit)

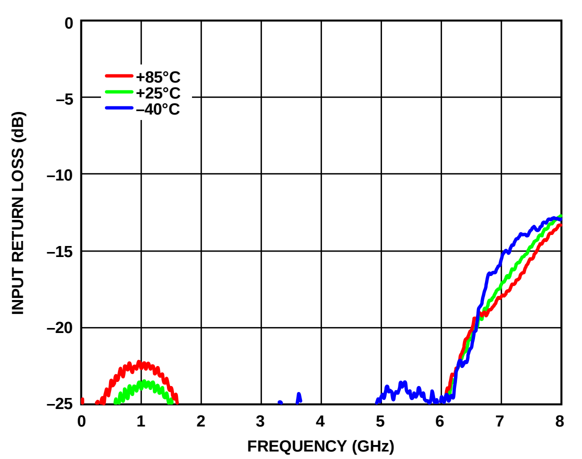

Figure 15. Input Return Loss Over Temperature vs. Frequency, State = External Bypass A, Path = IN_A to RFOUT (Refer to Figure 75 for the Test Circuit)

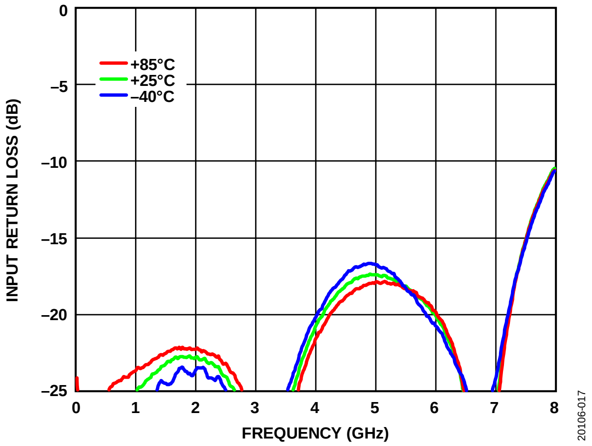

Figure 16. Input Return Loss Over Temperature vs. Frequency, State = External Bypass A, Path = RFIN to OUT_A (Refer to Figure 75 for the Test Circuit)

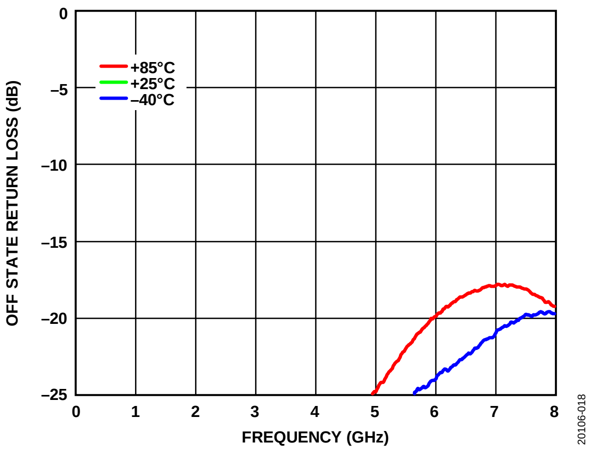

Figure 17. Off State Return Loss vs. Frequency Over Temperature, State = External Bypass A, Path = OUT_B (Refer to Figure 75 for the Test Circuit)

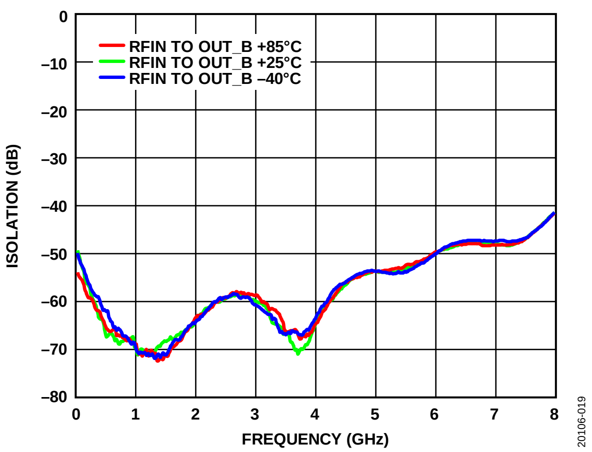

Figure 18. Isolation vs. Frequency Over Temperature, State = External Bypass A (Refer to Figure 75 for the Test Circuit)

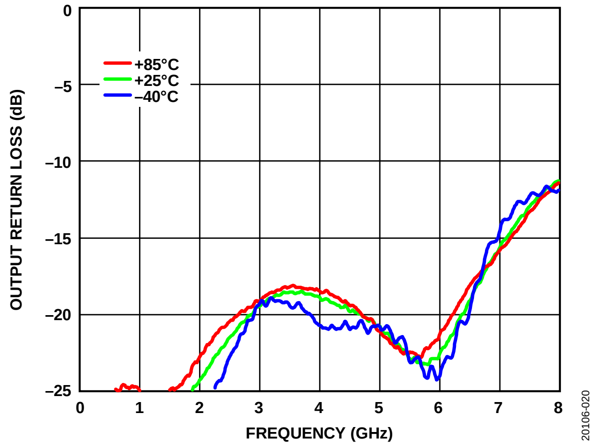

Figure 19. Output Return Loss Over Temperature vs. Frequency, State = External Bypass A, Path = IN_A to RFOUT (Refer to Figure 75 for the Test Circuit)

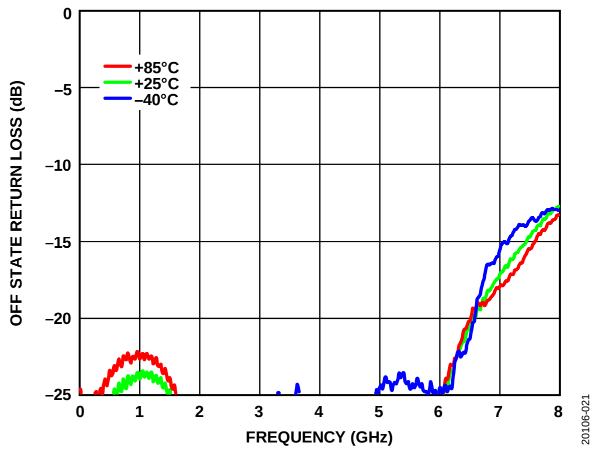

Figure 20. Off State Return Loss vs. Frequency Over Temperature, State = External Bypass A, Path = IN_B (Refer to Figure 75 for the Test Circuit)

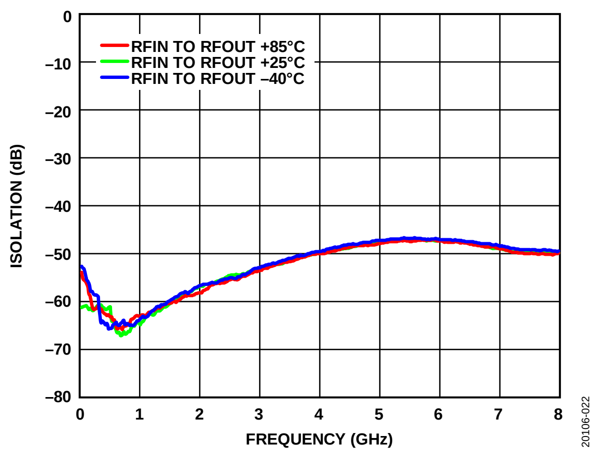

Figure 21. Isolation vs. Frequency Over Temperature, State = External Bypass A (Refer to Figure 75 for the Test Circuit)

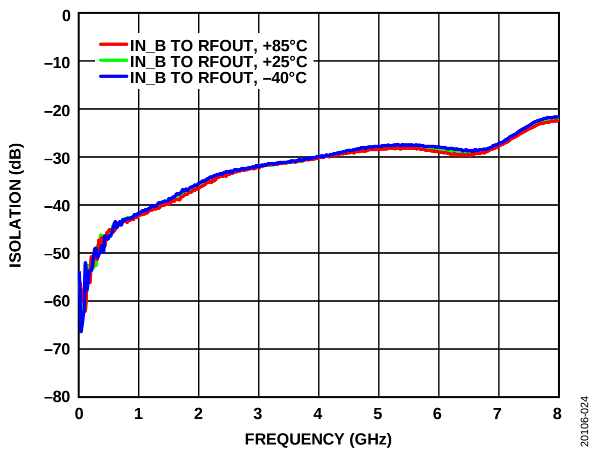

Figure 22. Isolation vs. Frequency Over Temperature, State = External Bypass A (Refer to Figure 75 for the Test Circuit)

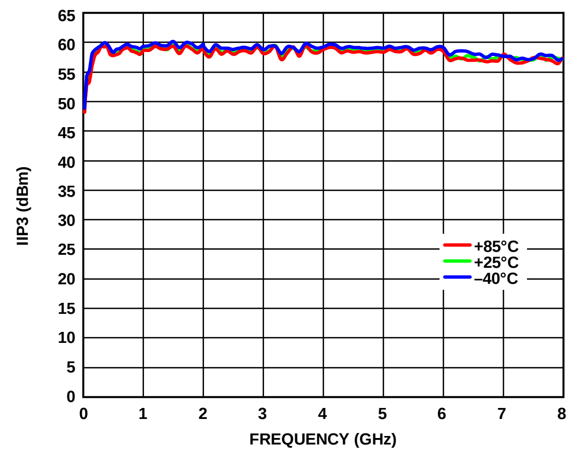

Figure 24. IIP3 vs. Frequency Over Temperature, State = External Bypass A, Path = RFIN to OUT_A or IN_A to RFOUT (Refer to Figure 75 for the Test Circuit)

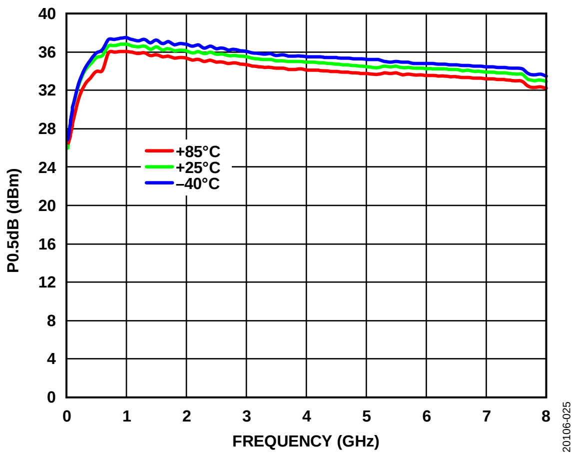

Figure 23. P0.5dB vs. Frequency Over Temperature, State = External Bypass A, Path = RFIN to OUT_A or IN_A to RFOUT (Refer to Figure 75 for the Test Circuit)

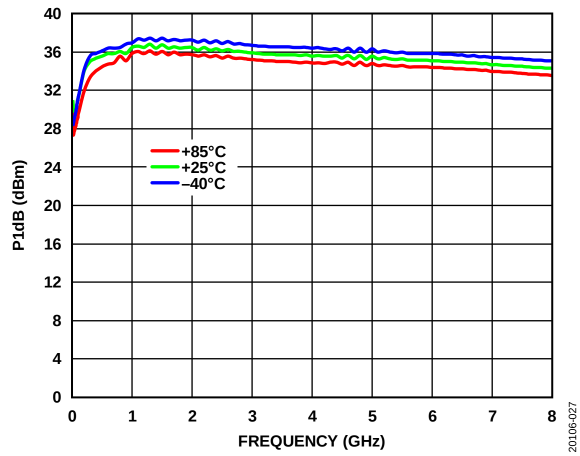

Figure 25. P1dB Compression vs. Frequency Over Temperature, State = External Bypass A, Path = RFIN to OUT_A or IN_A to RFOUT (Refer to Figure 75 for the Test Circuit)

INTERNAL AMPLIFIER STATE

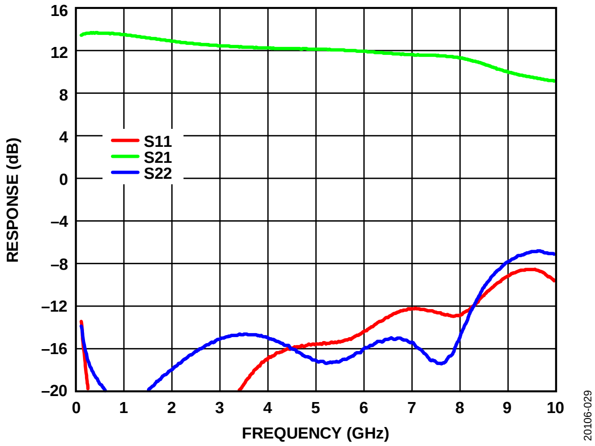

Figure 26. Broadband Gain and Return Loss vs. Frequency (100 MHz to 10 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

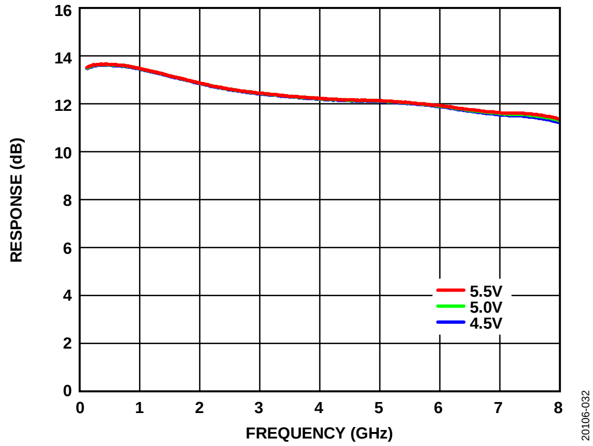

Figure 29. Gain vs Frequency Over VDD (100 MHz to 10 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

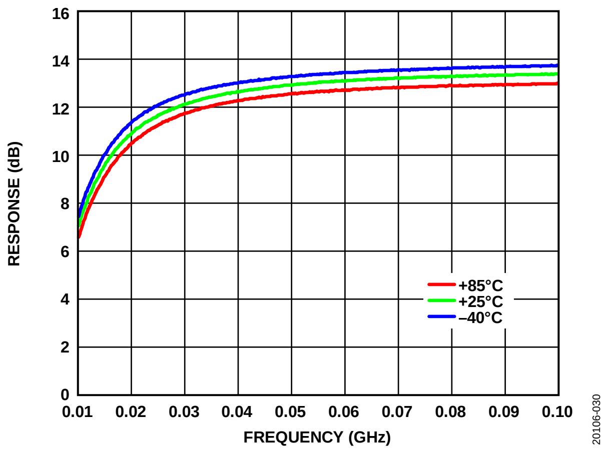

Figure 27. Gain Over Temperature vs. Frequency (10 MHz to 100 MHz) State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

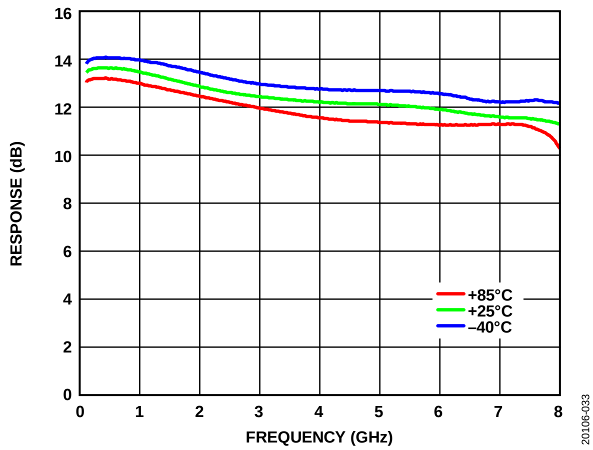

Figure 30. Gain vs. Frequency Over Temperature (100 MHz to 10 GHz) State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

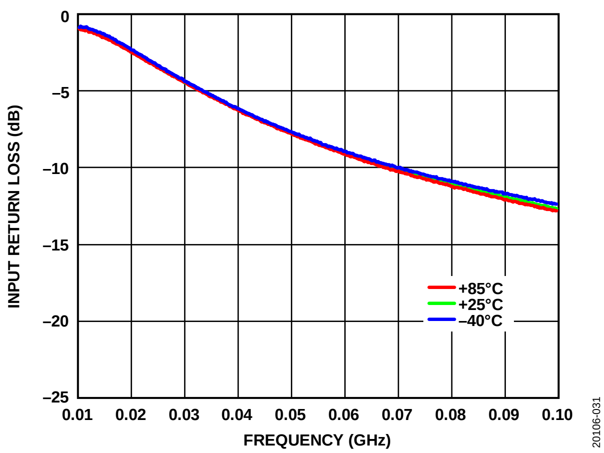

Figure 28. Input Return Loss vs. Frequency (10 MHz to 100 MHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

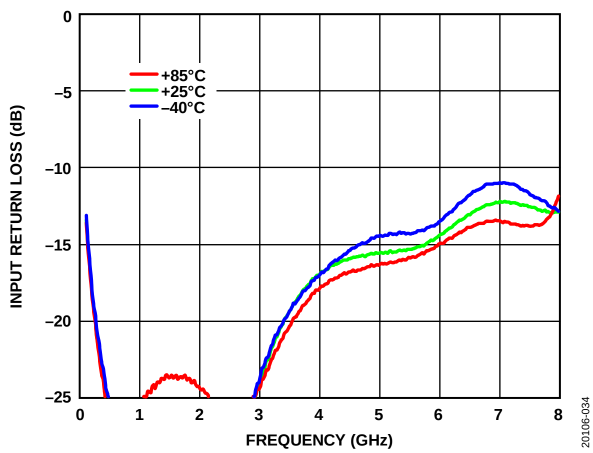

Figure 31. Input Return Loss vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

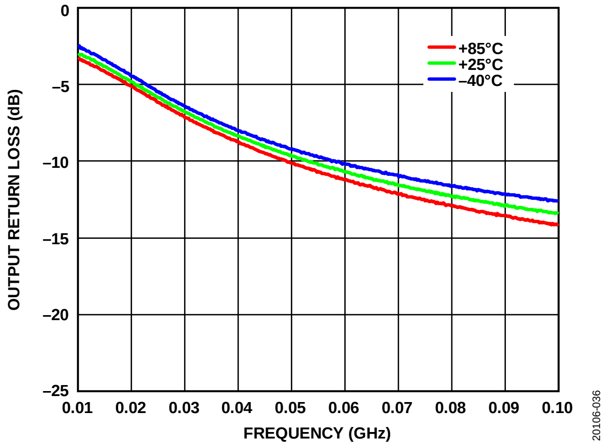

Figure 32. Output Return Loss vs. Frequency (10 MHz to 100 MHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

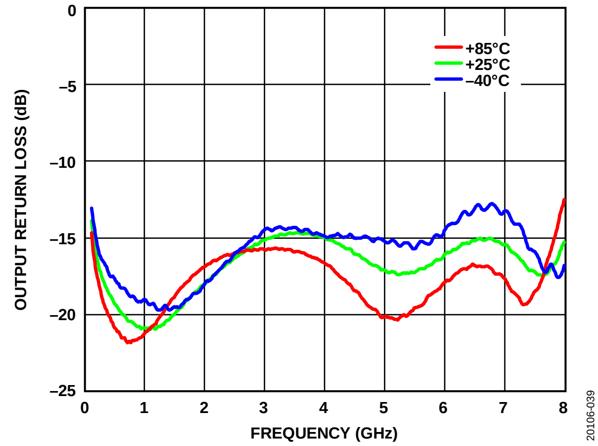

Figure 35. Output Return Loss vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

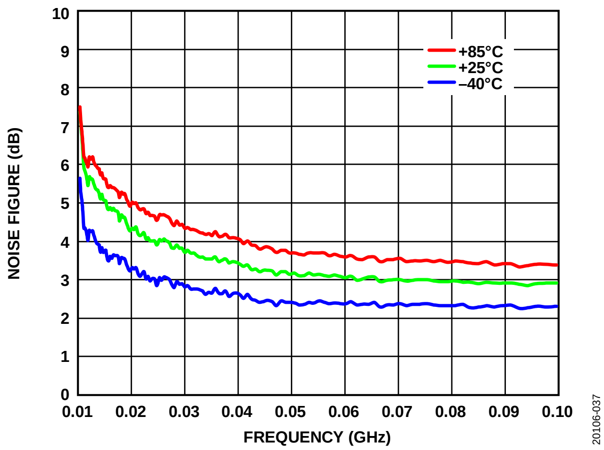

Figure 33. Noise Figure vs. Frequency Over Temperature (10 MHz to 100 MHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

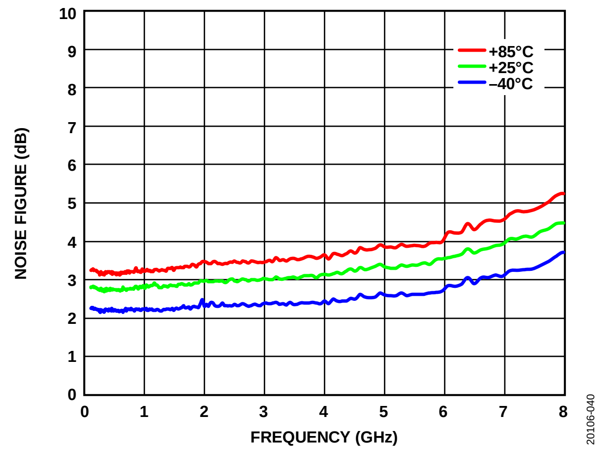

Figure 36. Noise Figure vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

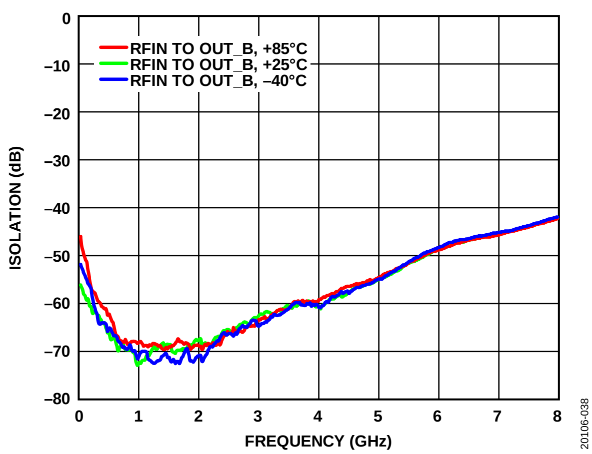

Figure 34. Isolation vs. Frequency Over Temperature, State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

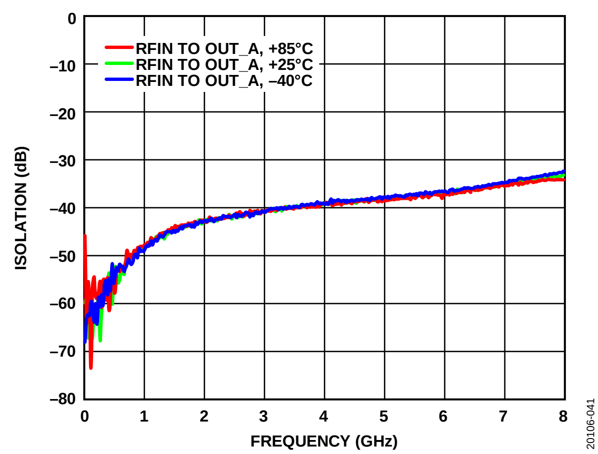

Figure 37. Isolation vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

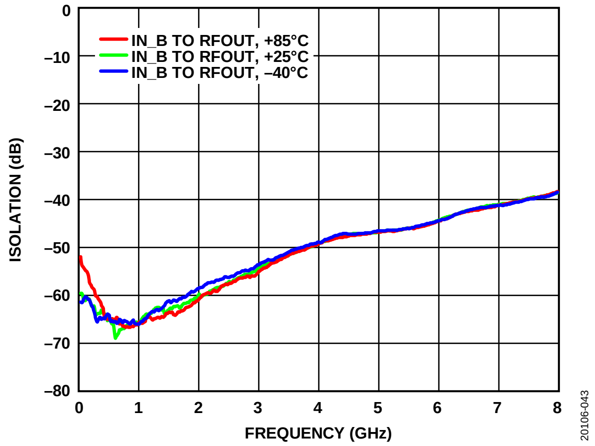

Figure 38. Isolation vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

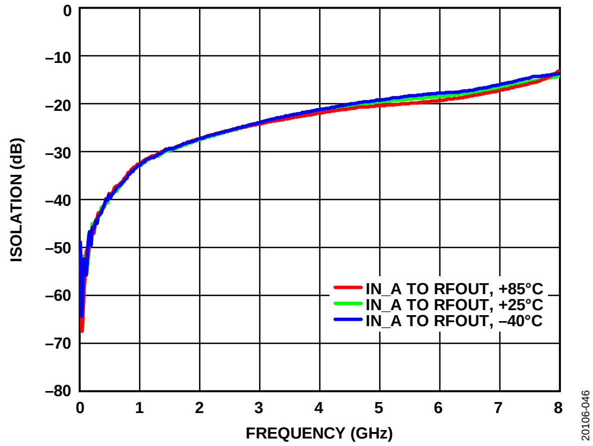

Figure 41. Isolation vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

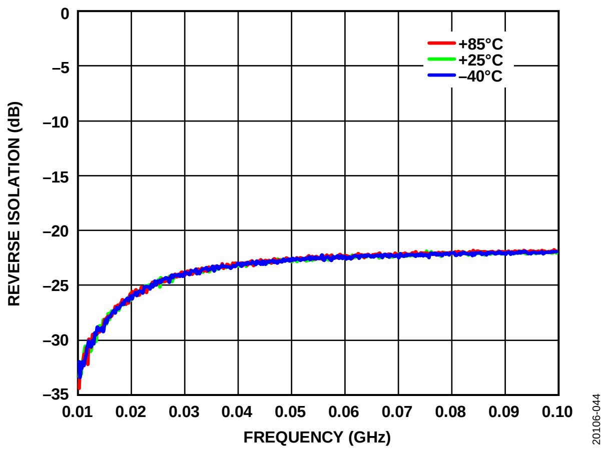

Figure 39. Reverse Isolation vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

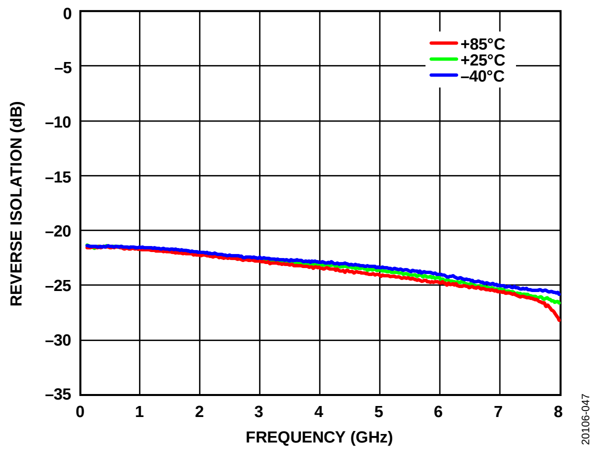

Figure 42. Reverse Isolation vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

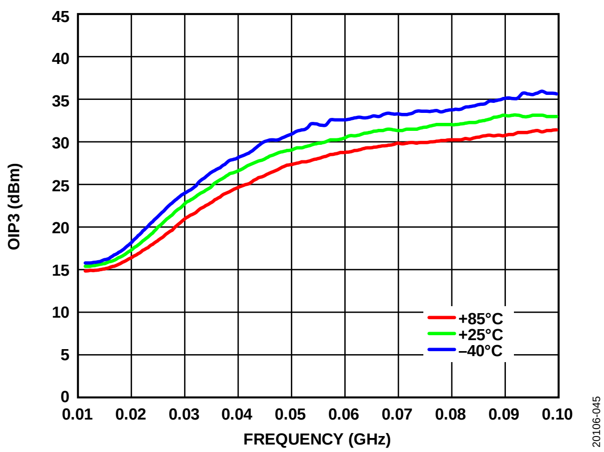

Figure 40. OIP3 vs. Frequency Over Temperature (10 MHz to 100 MHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

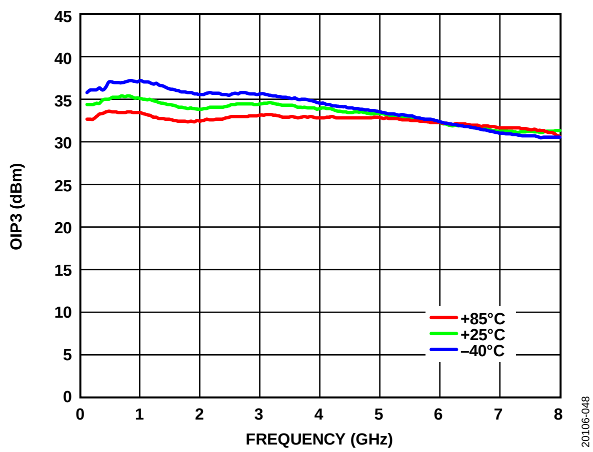

Figure 43. OIP3 vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

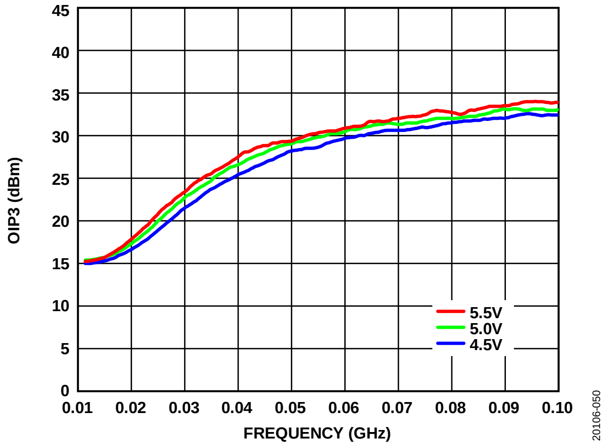

Figure 44. OIP3 vs. Frequency Over VDD (10 MHz to 100 MHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

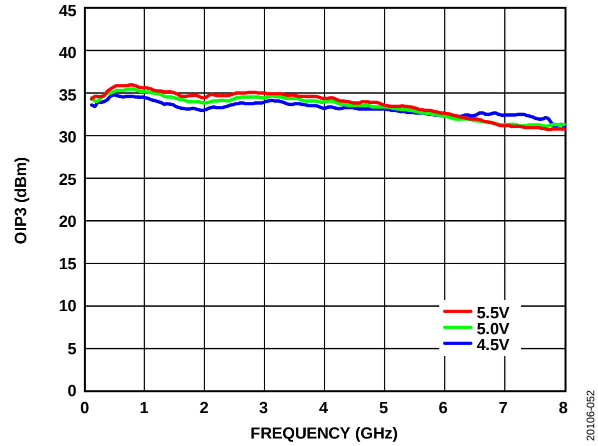

Figure 46. OIP3 vs. Frequency Over VDD (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

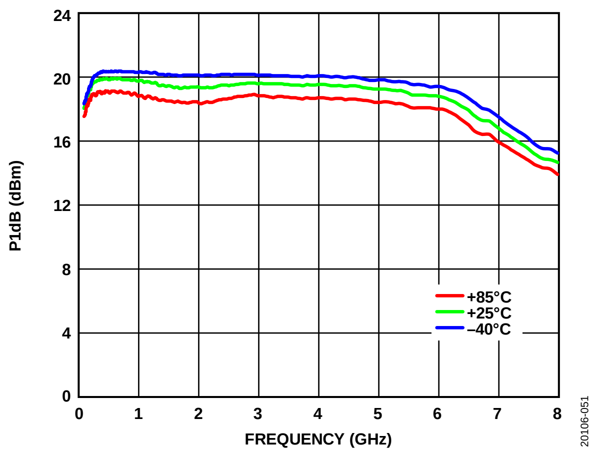

Figure 45. P1dB vs. Frequency Over Temperature (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

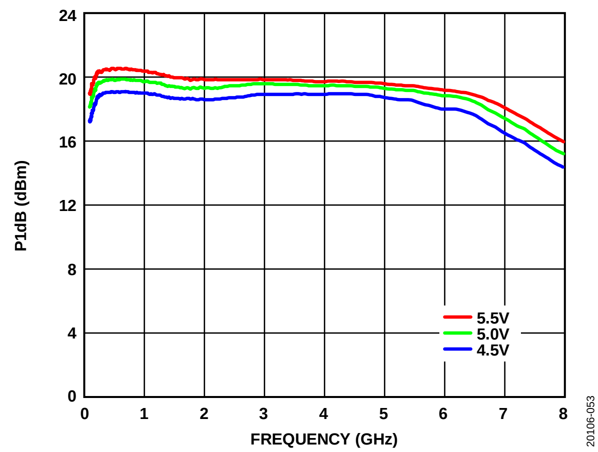

Figure 47. P1dB vs. Frequency Over VDD (100 MHz to 8 GHz), State = Internal Amplifier (Refer to Figure 76 for the Test Circuit)

INTERNAL BYPASS STATE

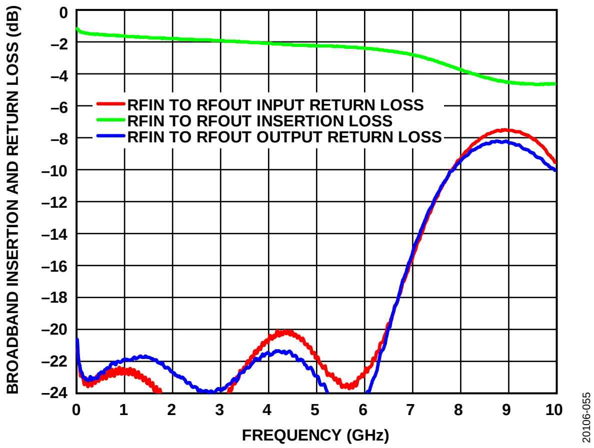

Figure 48. Broadband Insertion and Return Loss vs. Frequency, State = Internal Bypass (Refer to Figure 77 for the Test Circuit)

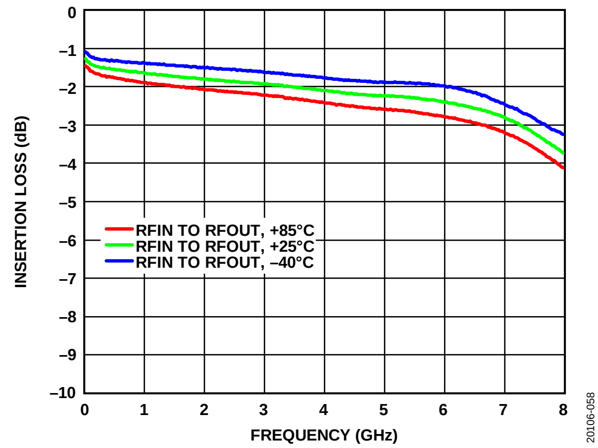

Figure 51. Insertion Loss Over Temperature vs. Frequency, State = Internal Bypass (Refer to Figure 77 for the Test Circuit)

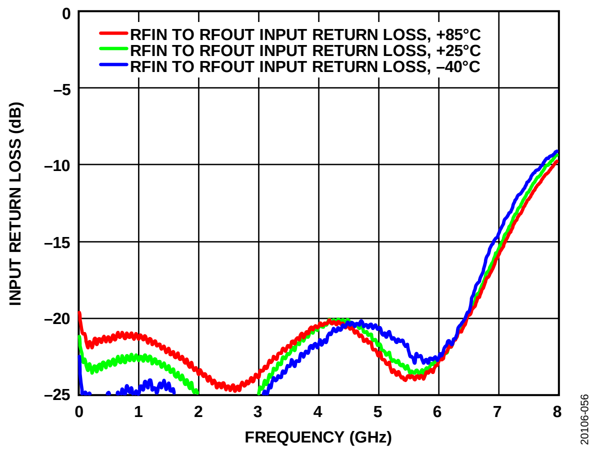

Figure 49. Input Return Loss Over Temperature vs. Frequency, State = Internal Bypass (Refer to Figure 77 for the Test Circuit)

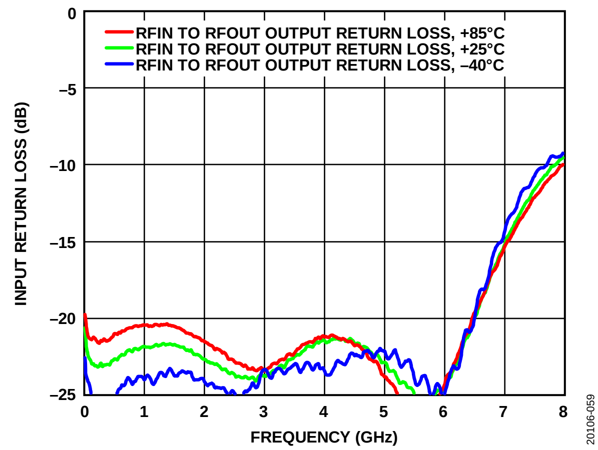

Figure 52. Output Return Loss Over Temperature vs. Frequency, State = Internal Bypass (Refer to Figure 77 for the Test Circuit)

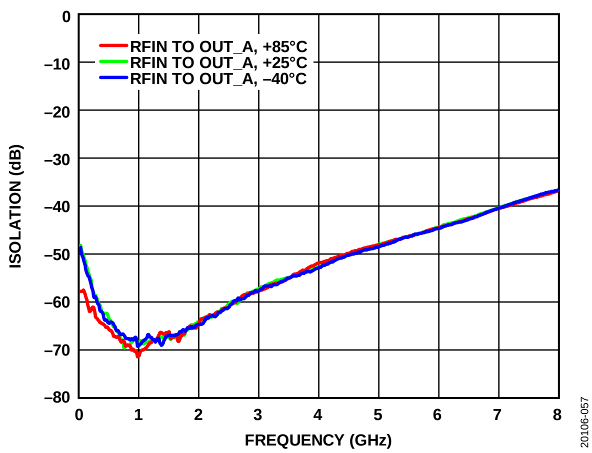

Figure 50. Isolation vs. Frequency Over Temperature, State = Internal Bypass (Refer to Figure 77 for the Test Circuit)

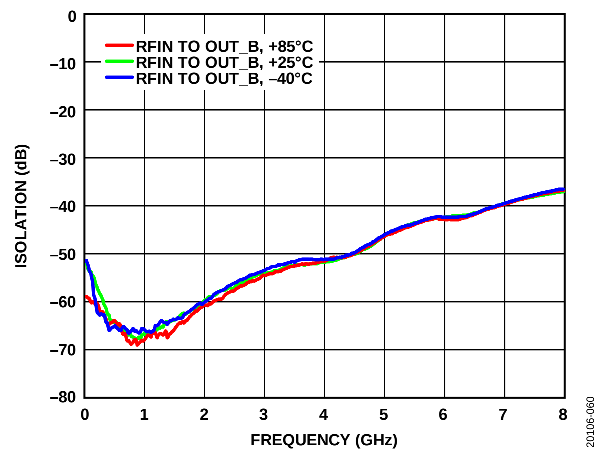

Figure 53. Isolation vs. Frequency Over Temperature, State = Internal Bypass (Refer to Figure 77 for the Test Circuit)

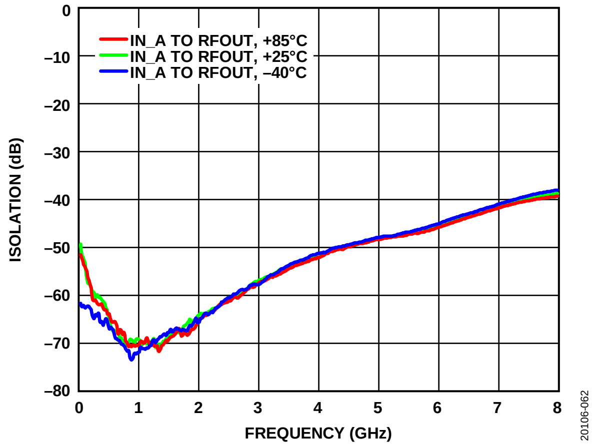

Figure 54. Isolation vs. Frequency Over Temperature,
State = Internal Bypass (Refer to Figure 77 for the Test Circuit)

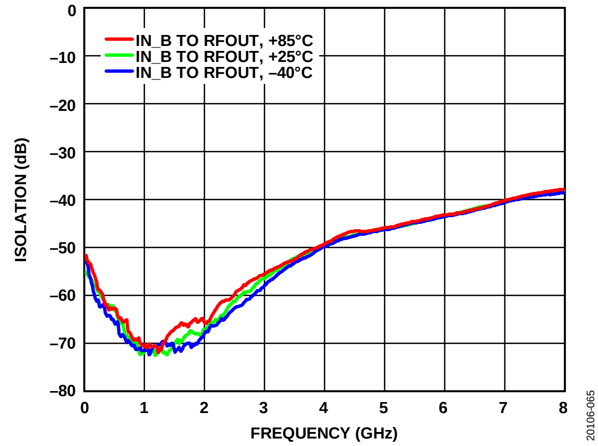

Figure 57. Isolation vs. Frequency Over Temperature,
State = Internal Bypass (Refer to Figure 77 for the Test Circuit)

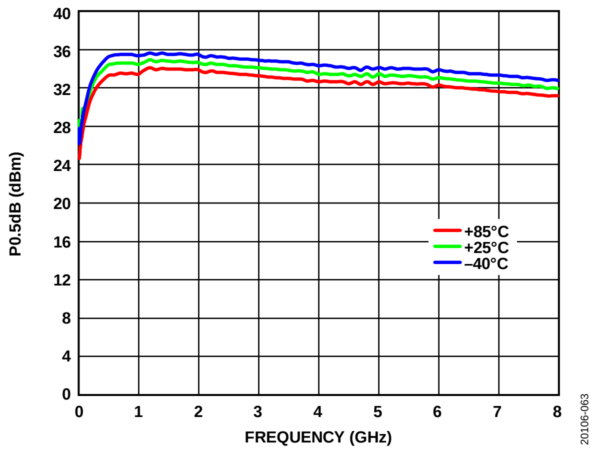

Figure 55. P0.5dB vs. Frequency Over Temperature,
State = Internal Bypass, Path = RFIN to RFOUT (Refer to Figure 77 for the Test Circuit)

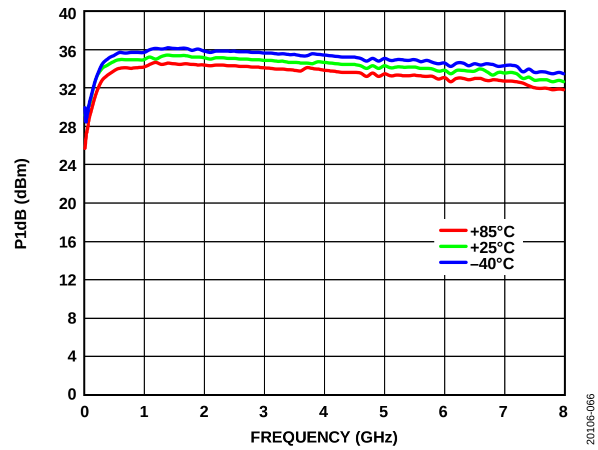

Figure 58. P1dB vs. Frequency Over Temperature,
State = Internal Bypass, Path = RFIN to RFOUT (Refer to Figure 77 for the Test Circuit)

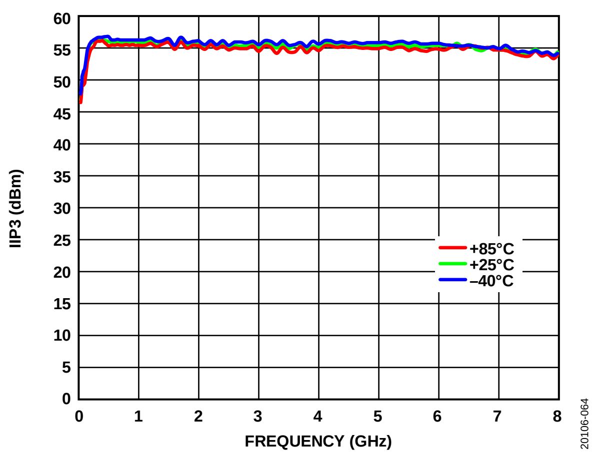

Figure 56. IIP3 vs. Frequency Over Temperature,
State = Internal Bypass, Path = RFIN to RFOUT (Refer to Figure 77 for the Test Circuit)

EXTERNAL BYPASS B STATE

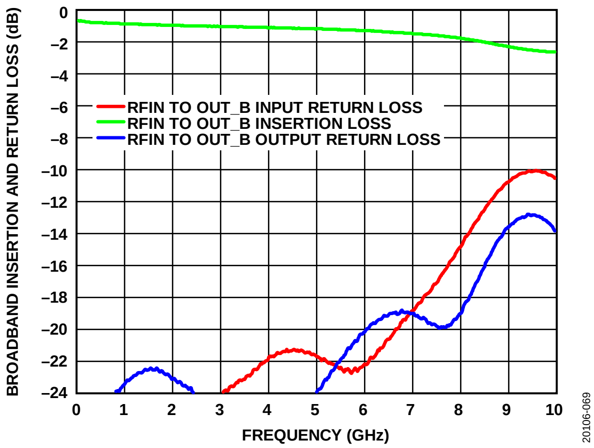

Figure 59. Broadband Insertion and Return Loss vs. Frequency, State = External Bypass B, Path = RFIN to OUT_B (Refer to Figure 78 for the Test Circuit)

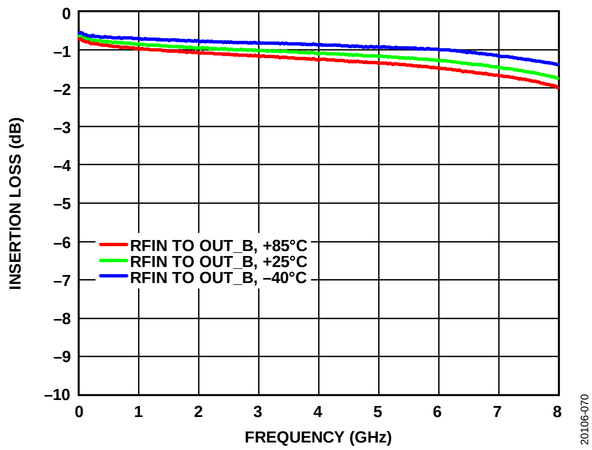

Figure 60. Insertion Loss Over Temperature vs. Frequency, State = External Bypass B, Path = RFIN to OUT_B (Refer to Figure 78 for the Test Circuit)

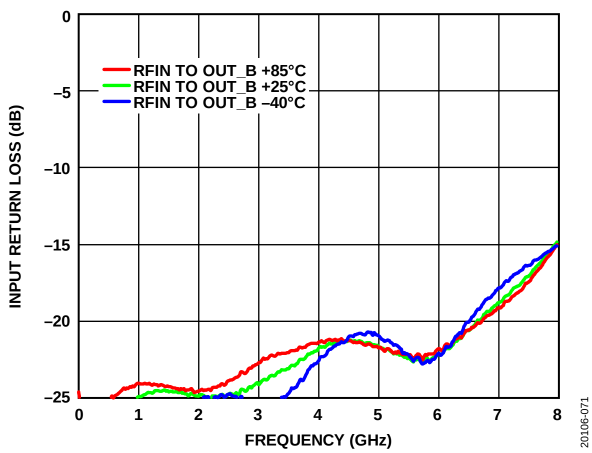

Figure 61. Input Return Loss Over Temperature vs. Frequency, State = External Bypass B, Path = RFIN to OUT_B (Refer to Figure 78 for the Test Circuit)

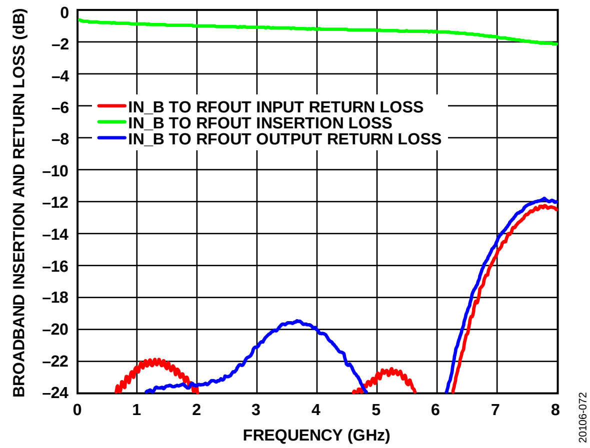

Figure 62. Broadband Insertion and Return Loss vs. Frequency, State = External Bypass B, Path = IN_B to RFOUT (Refer to Figure 78 for the Test Circuit)

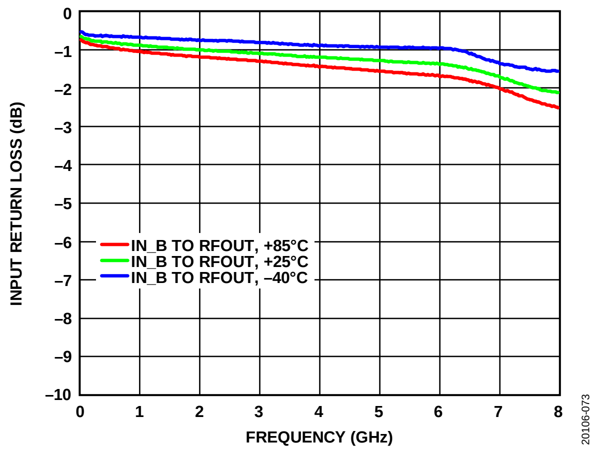

Figure 63. Insertion Loss Over Temperature vs. Frequency, State = External Bypass B, Path = IN_B to RFOUT (Refer to Figure 78 for the Test Circuit)

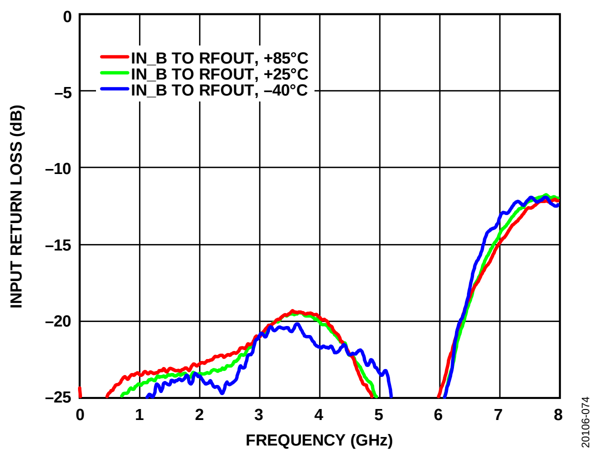

Figure 64. Input Return Loss Over Temperature vs. Frequency, State = External Bypass B, Path = IN_B to RFOUT (Refer to Figure 78 for the Test Circuit)

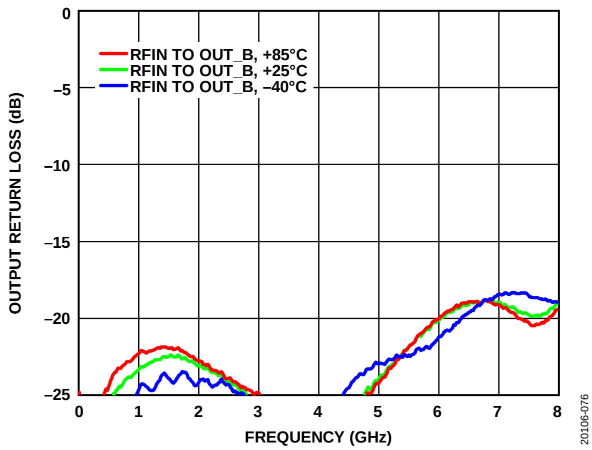

Figure 65. Output Return Loss Over Temperature vs. Frequency, State = External Bypass B, Path = RFIN to OUT_B (Refer to Figure 78 for the Test Circuit)

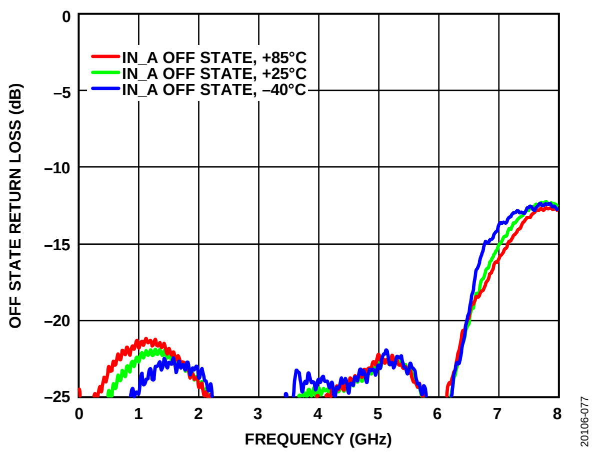

Figure 66. Off State Return Loss vs. Frequency Over Temperature, State = External Bypass B, Path = IN_A (Refer to Figure 78 for the Test Circuit)

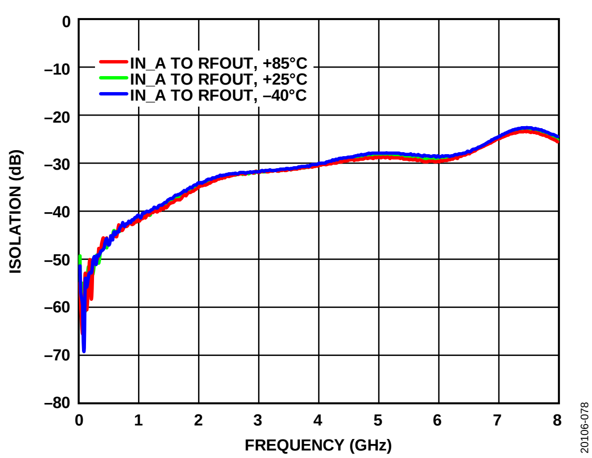

Figure 67. Isolation vs. Frequency Over Temperature, State = External Bypass B (Refer to Figure 78 for the Test Circuit)

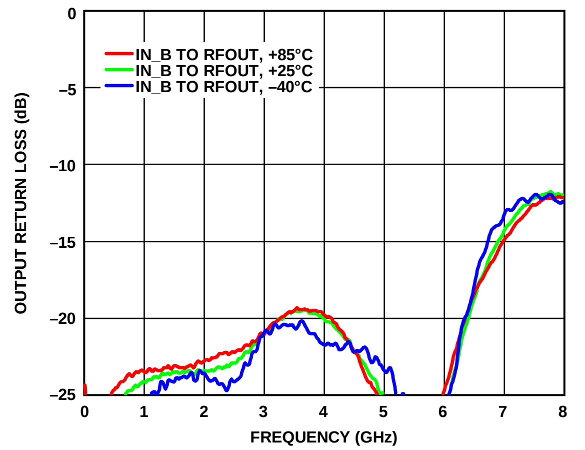

Figure 68. Output Return Loss Over Temperature vs. Frequency, State = External Bypass B, Path = IN_B to RFOUT (Refer to Figure 78 for the Test Circuit)

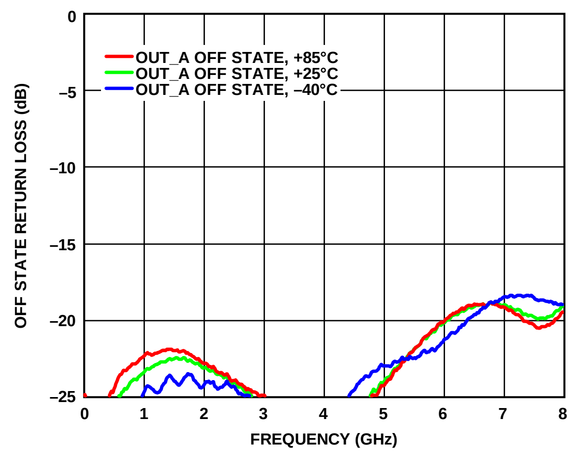

Figure 69. Off State Return Loss vs. Frequency Over Temperature, State = External Bypass B, Path = OUT_A (Refer to Figure 78 for the Test Circuit)

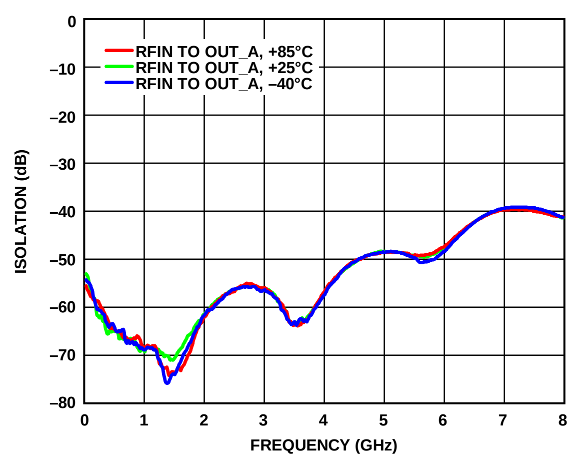

Figure 70. Isolation vs. Frequency Over Temperature, State = External Bypass B (Refer to Figure 78 for the Test Circuit)

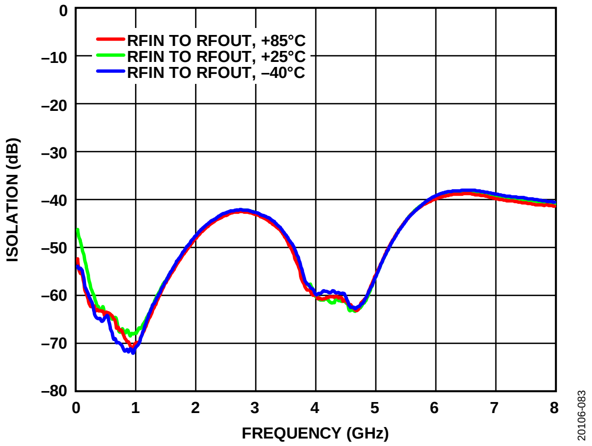

Figure 71. Isolation vs. Frequency Over Temperature, State = External Bypass B (Refer to Figure 78 for the Test Circuit)

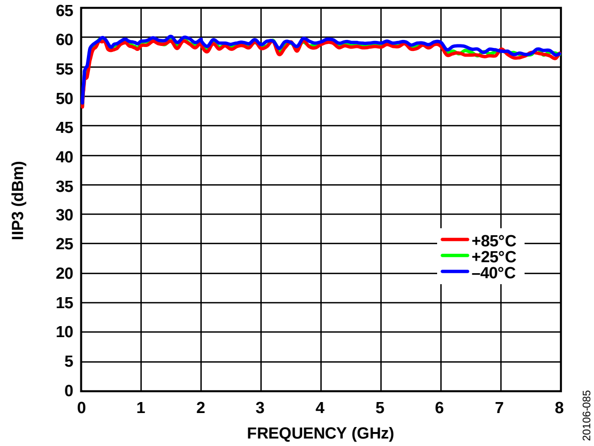

Figure 73. IIP3 vs. Frequency Over Temperature, State = External Bypass B, Path = RFIN to OUT_B or IN_B to RFOUT (Refer to Figure 78 for the Test Circuit)

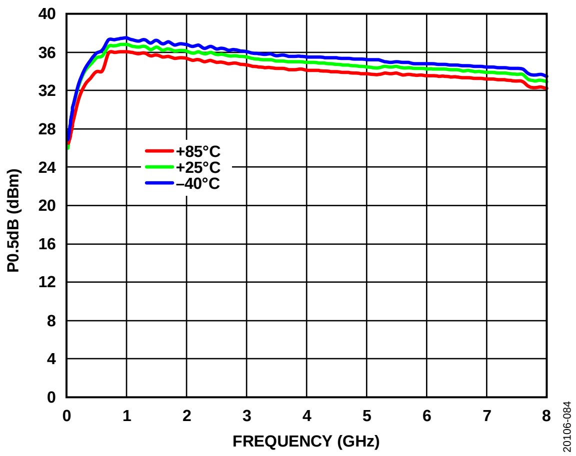

Figure 72. P0.5dB vs. Frequency Over Temperature, State = External Bypass B, Path = RFIN to OUT_B or IN_B to RFOUT (Refer to Figure 78 for the Test Circuit)

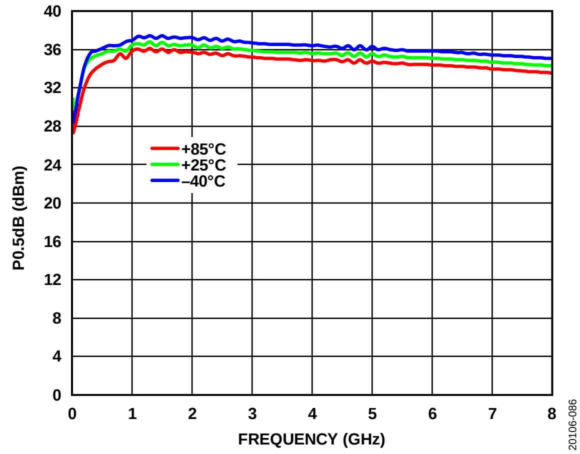

Figure 74. P0.5dB vs. Frequency Over Temperature, State = External Bypass B, Path = RFIN to OUT_B or IN_B to RFOUT (Refer to Figure 78 for the Test Circuit)

TEST CIRCUITS

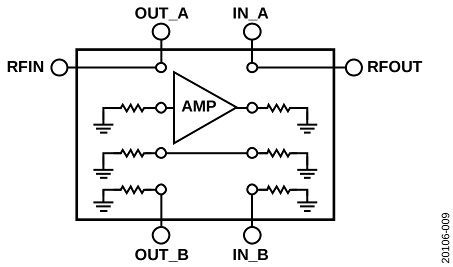

Figure 75. External Bypass A State

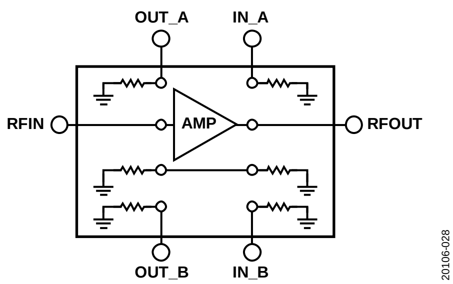

Figure 76. Internal Amplifier State

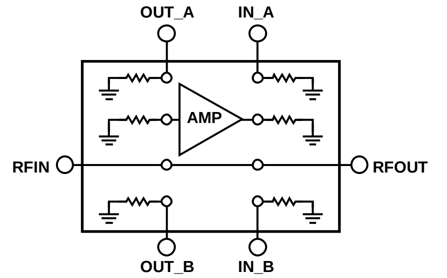

Figure 77. Internal Bypass State

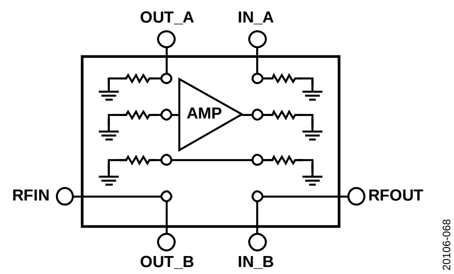

Figure 78. External Bypass B State

THEORY OF OPERATION

The ADL8111 integrates an amplifier with two switching networks located at the RF input and output. The internal amplifier uses a gallium arsenide (GaAs) LNA die from the HMC8411. The switching network employs robust silicon-on-insulator (SOI) technology for fast switching and a short settling time. This integrated solution has four different signal path states available: an internal amplifier, an internal bypass, External Bypass A, and External Bypass B. Signal path states are controlled through the digital pins, VA and VB, using 1.4 V high and 0 V low logic (see Figure 79 to Figure 82). The internal amplifier is biased up by applying 5 V to VDD_PA, and the internal switches are biased up by applying +3.3 V and −3.3 V to VDD_SW and VSS_SW, respectively. DC bias to the switches is independent of the LNA. Turning off bias to VDD_PA to the LNA provides better isolation between RF ports.

SIGNAL PATH STATES FOR DIGITAL CONTROL INPUTS

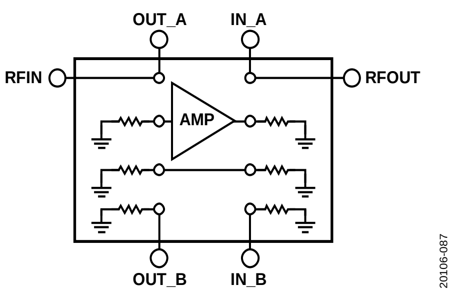

Figure 79. External Bypass A, VA = 0 V and VB = 0 V

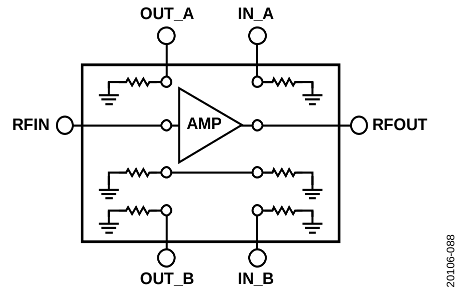

Figure 80. Internal Amplifier, VA = 0 V and VB = 3.3 V

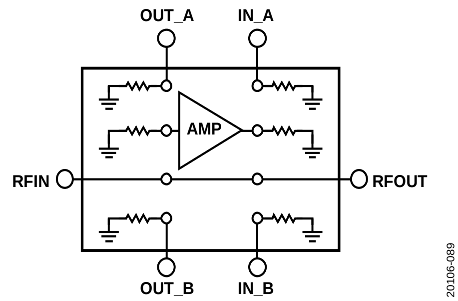

Figure 81. Internal Bypass, VA = 3.3 V and VB = 0 V

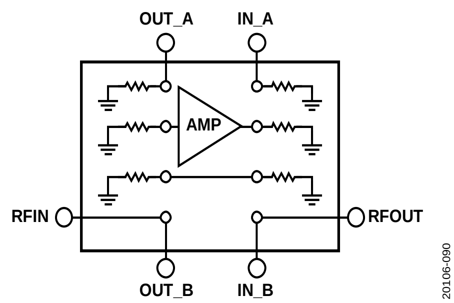

Figure 82. External Bypass B, VA = 3.3 V and VB = 3.3 V

Table 8. Truth Table

	Digital Control Inputs		
State Name	**VA**	**VB**	**Signal Path State**
External Bypass A	Low	Low	RFIN to OUT_A, IN_A to RFOUT
Internal Amplifier	Low	High	RFIN to RFOUT through amplifier path
Internal Bypass	High	Low	RFIN to RFOUT through bypass path
External Bypass B	High	High	RFIN to OUT_B, IN_B to RFOUT

APPLICATIONS INFORMATION

The basic connections for operating the ADL8111 are shown in Figure 83. A 5 V dc bias is supplied to the amplifier on VDD_PA, +3.3 V dc bias supply to VDD_SW and −3.3 V dc bias supply to VSS_SW.

VA and VB are digital inputs set path states shown in Table 7. High logic state is set at 1.4 V and low logic state is set at 0 V.

The LNA within the ADL8111 operates in self-biased mode where the VBIAS pin is connected to a 560 Ω external resistor to achieve a 70 mA supply current. Refer to Table 9 for the recommended resistor values to achieve different I_{DQ} currents.

RECOMMENDED BIAS SEQUENCING

During Power-Up

The recommended bias sequence during power-up follows:

1. Set VDD_SW = 3.3 V.
2. Set VSS_SW = −3.3 V.
3. Set VDD_PA = 5 V.
4. Apply the RF signal.

During Power-Down

The recommended bias sequence during power-down follows:

1. Turn off the RF signal.
2. Set VDD_PA = 0 V.
3. Set VSS_SW = 0 V.
4. Set VDD_SW = 0 V.

The bias conditions, VDD_PA = 5 V at I_{DQ} = 70 mA, is the recommended operating point to achieve optimum performance. The data used in this data sheet was taken with the recommended bias condition. Using the HMC8411 with different bias conditions can provide different performance than what is shown in the Typical Performance Characteristics section.

Table 9. Recommended Bias Resistor Values at VDD_PA = 5 V

R_{BIAS} (Ω)	I_{DQ} (mA)
226	85
560	70
1.1 k	55

EVALUATION PCB

The ADL8111-EVALZ is the evaluation board for the ADL8111 with fully populated components as shown in Figure 83 and its schematic shown in Figure 84. The board is fabricated with four layers using Rogers 4350. Signal lines have characteristic impedance of 50 Ω. Package ground leads and the exposed paddle are soldered to the ground plane. Adequate amounts of via holes connect the top and bottom ground planes. The evaluation board is available from Analog Devices, Inc., upon request. Gerber files can be found on the ADL8111 product webpage.

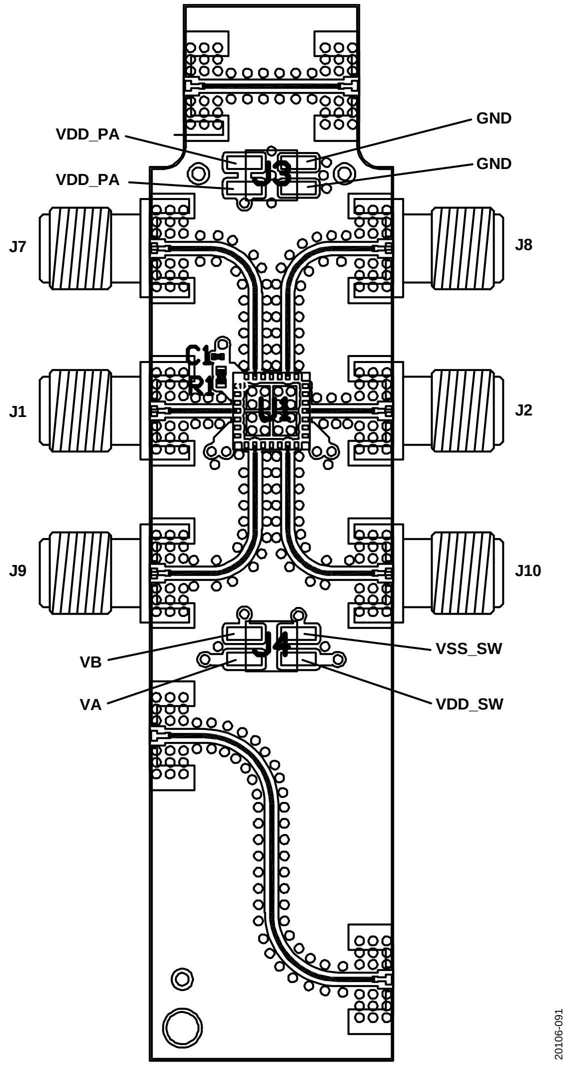

Figure 83. ADL8111-EVALZ Evaluation Board PCB

EVALUATION BOARD SCHEMATIC

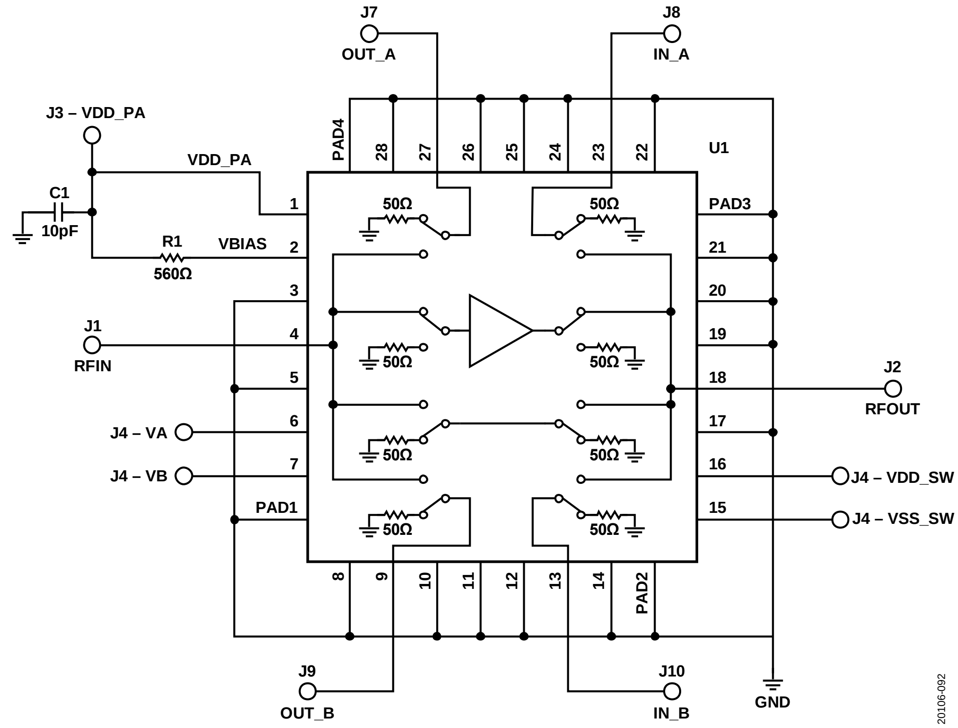

Figure 84. ADL8111-EVALZ Evaluation Board Schematic

Table 10. Bill of Material for Evaluation PCB ADL8111-EVALZ

Item	Description
J1, J2, J7, J8, J9, J10	SRI SMA RF connectors
J3, J4	DC header pins
U1	ADL8111
C1	10 pF, 5% tolerance, 0201, ceramic capacitor
R1	560 Ω, 1/16 W, 0402, thick film resistor

OUTLINE DIMENSIONS

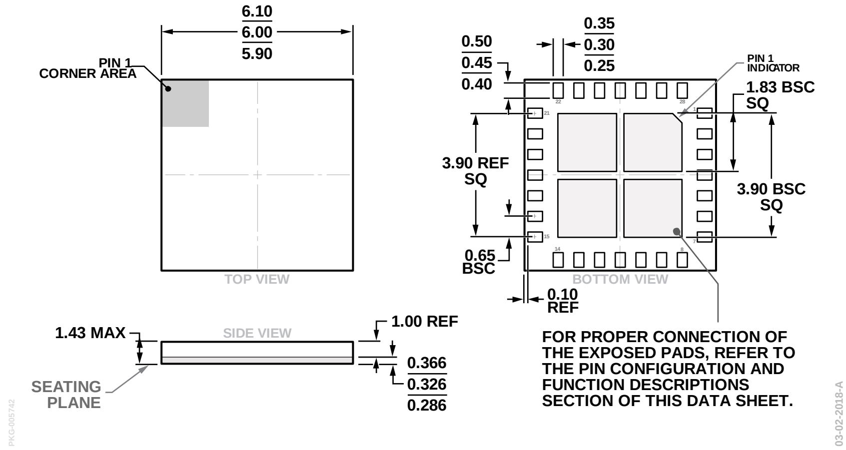

Figure 85. 28-Terminal Land Grid Array [LGA]
(CC-28-3)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	MSL Rating[2]	Package Description	Package Option
ADL8111ACCZN	−40°C to +85°C	MSL3	28-Terminal Land Grid Array [LGA]	CC-28-3
ADL8111ACCZN-R7	−40°C to +85°C	MSL3	28-Terminal Land Grid Array [LGA]	CC-28-3
ADL8111-EVALZ			Evaluation Board	

[1] All models are RoHS compliant parts.
[2] See the Absolute Maximum Ratings section for additional information.

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