

# 1 GHz to 8 GHz, Low Noise Amplifier with Integrated Temperature Sensor and Enable and Disable Function

## FEATURES

- ▶ Single positive supply: 5 V and  $I_{DQ}$  of 90 mA nominal
- ▶ RBIAS drain current adjustment pin
- ▶ Integrated temperature sensor
- ▶ Integrated enable and disable function
- ▶ Gain: 20 dB typical from 3 GHz to 4.5 GHz
- ▶ OIP3: 35.5 dBm typical from 1 GHz to 4.5 GHz
- ▶ Noise figure: 1 dB typical from 3 GHz to 6 GHz
- ▶ Extended operating temperature range:  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- ▶ RoHS-compliant, 3 mm  $\times$  3 mm, 16-lead LFCSP

## APPLICATIONS

- ▶ Telecommunications
- ▶ Test instrumentation
- ▶ Military

## GENERAL DESCRIPTION

The ADL8108 is a highly integrated, 1 GHz to 8 GHz, low noise amplifier (LNA). On-chip features include input and output AC coupling capacitors, an integrated bias inductor, an integrated temperature sensor, and an enable or disable pin (VPD).

Typical gain, output power 1 dB compression (OP1dB), third-order intercept point (OIP3), second-order intercept point (OIP2), and noise figure are 20 dB, 22 dBm, 35.5, 42 dBm, and 1 dB, respectively, from 3 GHz to 4.5 GHz. The nominal operating current ( $I_{DQ}$ ), which can be adjusted, is 90 mA operating from a 5 V supply voltage ( $V_{DD}$ ). Operation at 3 V is also supported.

The ADL8108 is fabricated on a pseudomorphic high electron mobility transistor (pHEMT) process. This device is housed in an RoHS-compliant, 3 mm  $\times$  3 mm, 16-lead LFCSP package and is specified for operation over an extended temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

## FUNCTIONAL BLOCK DIAGRAM

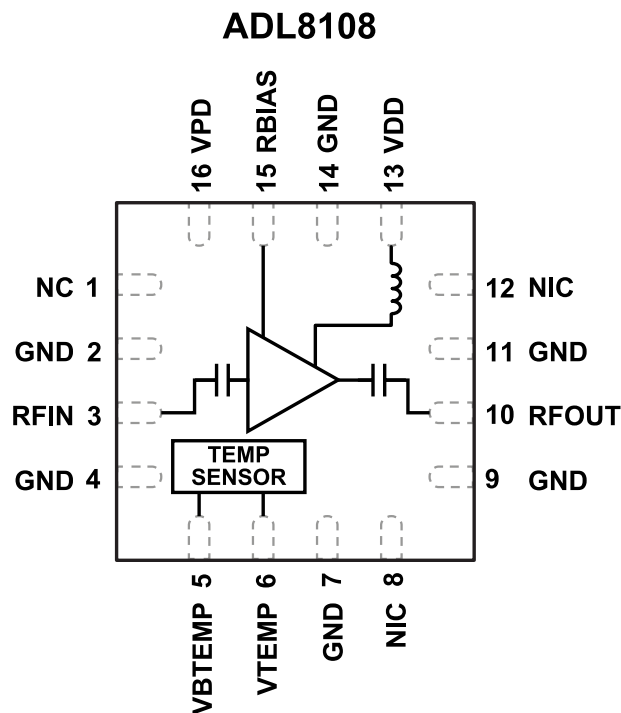


Figure 1. Functional Block Diagram

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REVISION HISTORY

10/2024—Revision 0: Initial Version

## SPECIFICATIONS

## 1 GHz TO 3 GHz FREQUENCY RANGE

$V_{DD} = 5\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ , bias resistance ( $R_{BIAS}$ ) = 1270  $\Omega$ , VPD voltage ( $V_{PD}$ ) = 0 V, and  $T_{CASE} = 25^\circ\text{C}$ , unless otherwise noted.

Table 1. 1 GHz to 3 GHz Frequency Range

| Parameter                       | Min  | Typ   | Max | Unit                 | Test Conditions/Comments                                         |
|---------------------------------|------|-------|-----|----------------------|------------------------------------------------------------------|
| FREQUENCY RANGE                 | 1    |       | 3   | GHz                  |                                                                  |
| GAIN                            | 20.5 | 22.5  |     | dB                   |                                                                  |
| Gain Variation over Temperature |      | 0.006 |     | dB/ $^\circ\text{C}$ |                                                                  |
| NOISE FIGURE                    |      | 1.2   |     | dB                   |                                                                  |
| RETURN LOSS                     |      |       |     |                      |                                                                  |
| Input (S11)                     |      | 11    |     | dB                   |                                                                  |
| Output (S22)                    |      | 14.5  |     | dB                   |                                                                  |
| OUTPUT                          |      |       |     |                      |                                                                  |
| OP1dB                           | 20   | 22    |     | dBm                  |                                                                  |
| Saturated Power ( $P_{SAT}$ )   |      | 23    |     | dBm                  |                                                                  |
| OIP3                            |      | 35.5  |     | dBm                  | Measurement taken at output power ( $P_{OUT}$ ) per tone = 8 dBm |
| OIP2                            |      | 42    |     | dBm                  | Measurement taken at $P_{OUT}$ per tone = 8 dBm                  |
| POWER ADDED EFFICIENCY (PAE)    |      | 40.5  |     | %                    | Measured at $P_{SAT}$                                            |

## 3 GHz TO 4.5 GHz FREQUENCY RANGE

$V_{DD} = 5\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ ,  $R_{BIAS} = 1270\text{ }\Omega$ ,  $V_{PD} = 0\text{ V}$ , and  $T_{CASE} = 25^\circ\text{C}$ , unless otherwise noted.

Table 2. 3 GHz to 4.5 GHz Frequency Range

| Parameter                       | Min | Typ   | Max | Unit                 | Test Conditions/Comments                        |
|---------------------------------|-----|-------|-----|----------------------|-------------------------------------------------|
| FREQUENCY RANGE                 | 3   |       | 4.5 | GHz                  |                                                 |
| GAIN                            | 18  | 20    |     | dB                   |                                                 |
| Gain Variation over Temperature |     | 0.006 |     | dB/ $^\circ\text{C}$ |                                                 |
| NOISE FIGURE                    |     | 1     |     | dB                   |                                                 |
| RETURN LOSS                     |     |       |     |                      |                                                 |
| Input                           |     | 9.5   |     | dB                   |                                                 |
| Output                          |     | 13    |     | dB                   |                                                 |
| OUTPUT                          |     |       |     |                      |                                                 |
| OP1dB                           | 20  | 22    |     | dBm                  |                                                 |
| $P_{SAT}$                       |     | 23    |     | dBm                  |                                                 |
| OIP3                            |     | 35.5  |     | dBm                  | Measurement taken at $P_{OUT}$ per tone = 8 dBm |
| OIP2                            |     | 42    |     | dBm                  | Measurement taken at $P_{OUT}$ per tone = 8 dBm |
| PAE                             |     | 37    |     | %                    | Measured at $P_{SAT}$                           |

## SPECIFICATIONS

## 4.5 GHz TO 6 GHz FREQUENCY RANGE

$V_{DD} = 5\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ ,  $R_{BIAS} = 1270\ \Omega$ ,  $V_{PD} = 0\text{ V}$ , and  $T_{CASE} = 25^\circ\text{C}$ , unless otherwise noted.

Table 3. 4.5 GHz to 6 GHz Frequency Range

| Parameter                       | Min  | Typ   | Max | Unit  | Test Conditions/Comments                        |
|---------------------------------|------|-------|-----|-------|-------------------------------------------------|
| FREQUENCY RANGE                 | 4.5  |       | 6   | GHz   |                                                 |
| GAIN                            | 16   | 18.5  |     | dB    |                                                 |
| Gain Variation over Temperature |      | 0.007 |     | dB/°C |                                                 |
| NOISE FIGURE                    |      | 1     |     | dB    |                                                 |
| RETURN LOSS                     |      |       |     |       |                                                 |
| Input                           |      | 9.5   |     | dB    |                                                 |
| Output                          |      | 13    |     | dB    |                                                 |
| OUTPUT                          |      |       |     |       |                                                 |
| OP1dB                           | 18.5 | 21    |     | dBm   |                                                 |
| $P_{SAT}$                       |      | 23    |     | dBm   |                                                 |
| OIP3                            |      | 35    |     | dBm   | Measurement taken at $P_{OUT}$ per tone = 8 dBm |
| OIP2                            |      | 48    |     | dBm   | Measurement taken at $P_{OUT}$ per tone = 8 dBm |
| PAE                             |      | 33.5  |     | %     | Measured at $P_{SAT}$                           |

## 6 GHz TO 8 GHz FREQUENCY RANGE

$V_{DD} = 5\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ ,  $R_{BIAS} = 1270\ \Omega$ ,  $V_{PD} = 0\text{ V}$ , and  $T_{CASE} = 25^\circ\text{C}$ , unless otherwise noted.

Table 4. 6 GHz to 8 GHz Frequency Range

| Parameter                       | Min | Typ   | Max | Unit  | Test Conditions/Comments                        |
|---------------------------------|-----|-------|-----|-------|-------------------------------------------------|
| FREQUENCY RANGE                 | 6   |       | 8   | GHz   |                                                 |
| GAIN                            |     | 16.5  |     | dB    |                                                 |
| Gain Variation over Temperature |     | 0.008 |     | dB/°C |                                                 |
| NOISE FIGURE                    |     | 1.5   |     | dB    |                                                 |
| RETURN LOSS                     |     |       |     |       |                                                 |
| Input                           |     | 10.5  |     | dB    |                                                 |
| Output                          |     | 14.5  |     | dB    |                                                 |
| OUTPUT                          |     |       |     |       |                                                 |
| OP1dB                           |     | 19.5  |     | dBm   |                                                 |
| $P_{SAT}$                       |     | 21.5  |     | dBm   |                                                 |
| OIP3                            |     | 34    |     | dBm   | Measurement taken at $P_{OUT}$ per tone = 8 dBm |
| OIP2                            |     | 50    |     | dBm   | Measurement taken at $P_{OUT}$ per tone = 8 dBm |
| PAE                             |     | 26.5  |     | %     | Measured at $P_{SAT}$                           |

## SPECIFICATIONS

## DC SPECIFICATIONS

Table 5. DC Specifications

| Parameter                           | Min | Typ  | Max | Unit | Test Conditions/Comments |
|-------------------------------------|-----|------|-----|------|--------------------------|
| SUPPLY CURRENT                      |     |      |     |      |                          |
| $I_{DQ}$                            |     | 90   |     | mA   | $V_{PD} = 0V$            |
|                                     |     | 10   |     | mA   | $V_{PD} = 5V$            |
| Amplifier Current ( $I_{DQ\_AMP}$ ) |     | 86.9 |     | mA   |                          |
| RBIAS Current ( $I_{RBIAS}$ )       |     | 3.1  |     | mA   |                          |
| SUPPLY VOLTAGE                      |     |      |     |      |                          |
| $V_{DD}$                            | 3   | 5    | 5.5 | V    |                          |

Table 6. Logic Control ( $V_{PD}$ )

| Parameter                      | Min | Typ | Max      | Unit | Test Conditions/Comments                                       |
|--------------------------------|-----|-----|----------|------|----------------------------------------------------------------|
| DIGITAL CONTROL INPUT          |     |     |          |      |                                                                |
| Low, Amplifier On State        | 0   |     | 0.3      | V    |                                                                |
| High, Amplifier Off State      | 1.9 |     | $V_{DD}$ | V    |                                                                |
| VPD Input Current ( $I_{PD}$ ) |     | 1   |          | mA   | $V_{PD} = 5V$                                                  |
| SWITCHING TIME                 |     |     |          |      |                                                                |
| Amplifier On State Time        |     | 15  |          | ns   | 50% of the $V_{PD}$ falling edge to the output envelope at 90% |
| Amplifier Off State Time       |     | 10  |          | ns   | 50% of the $V_{PD}$ rising edge to the output envelope at 10%  |

Table 7. Temperature Sensor

| Parameter                                                                           | Min | Typ  | Max | Unit            |
|-------------------------------------------------------------------------------------|-----|------|-----|-----------------|
| VTEMP Voltage ( $V_{TEMP}$ ) Output Voltage ( $V_{OUT}$ ), $T_{CASE} = 25^{\circ}C$ |     | 2.45 |     | V               |
| $V_{TEMP}$ Temperature Coefficient, $T_{CASE} = -55^{\circ}C$ to $+125^{\circ}C$    |     | 3.4  |     | mV/ $^{\circ}C$ |
| VBTEMP Voltage ( $V_{BTEMP}$ ) Input Current                                        |     | 2    |     | mA              |

## ABSOLUTE MAXIMUM RATINGS

Table 8. Absolute Maximum Ratings

| Parameter                                                                                                                                        | Rating                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| $V_{DD}$                                                                                                                                         | 7 V                                             |
| $V_{PD}$                                                                                                                                         | $V_{DD}$                                        |
| RF Input Power Survivability (RFIN)                                                                                                              | 27 dBm                                          |
| Continuous Power Dissipation ( $P_{DISS}$ ),<br>$T_{CASE} = 85^{\circ}\text{C}$ (Derate 20.8 mW/ $^{\circ}\text{C}$ Above $85^{\circ}\text{C}$ ) | 1.88 W                                          |
| Temperature                                                                                                                                      |                                                 |
| Storage Range                                                                                                                                    | $-65^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ |
| Operating Range                                                                                                                                  | $-55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ |
| Nominal Channel ( $T_{CASE} = 85^{\circ}\text{C}$ , $V_{DD} = 5\text{ V}$ ,<br>$I_{DQ} = 90\text{ mA}$ , Input Power ( $P_{IN}$ ) = Off)         | $107^{\circ}\text{C}$                           |
| Maximum Channel                                                                                                                                  | $175^{\circ}\text{C}$                           |

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

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

$\theta_{JC}$  is the channel to case thermal resistance.

Table 9. Thermal Resistance<sup>1</sup>

| Package Type                                              | $\theta_{JC}$ | Unit                 |
|-----------------------------------------------------------|---------------|----------------------|
| CP-16-35                                                  |               |                      |
| Quiescent, $T_{CASE} = 25^{\circ}\text{C}$                | 40            | $^{\circ}\text{C/W}$ |
| Worst Case <sup>2</sup> , $T_{CASE} = 85^{\circ}\text{C}$ | 48            | $^{\circ}\text{C/W}$ |

<sup>1</sup> Thermal resistance varies with operating conditions.

<sup>2</sup> Across all specified operating conditions

## ELECTROSTATIC DISCHARGE (ESD) RATINGS

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

Human body model (HBM) per ANSI/ESDA/JEDEC JS-001.

## ESD Ratings for ADL8108

Table 10. ADL8108, 16-Lead LFCSP

| ESD Model | Withstand Threshold (V) | Class |
|-----------|-------------------------|-------|
| HBM       | $\pm 250$               | 1A    |

## 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

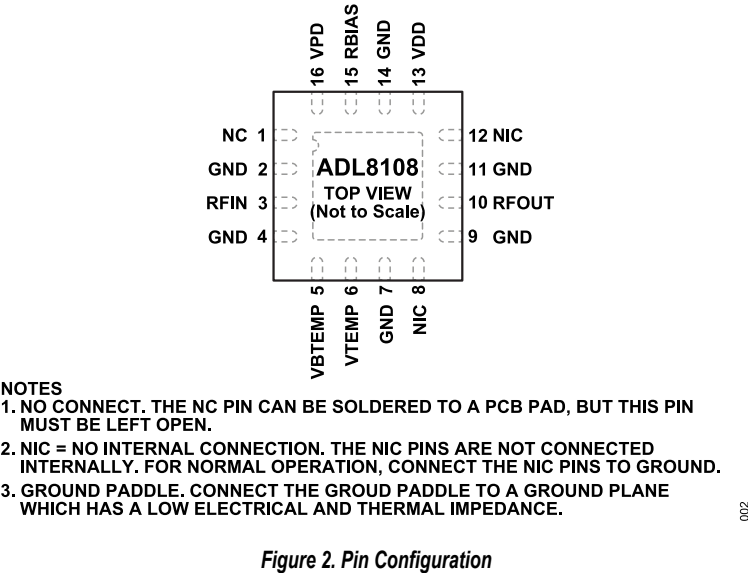


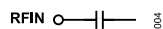
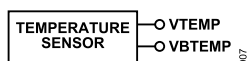
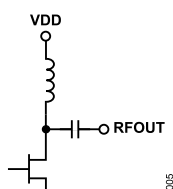
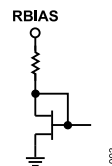
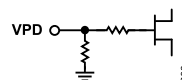
Figure 2. Pin Configuration

Table 11. Pin Function Descriptions

| Pin No.            | Mnemonic      | Description                                                                                                                                                                                                                                                                                                   |
|--------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                  | NC            | No Connect. The NC pin can be soldered to a PCB pad, but this pin must be left open.                                                                                                                                                                                                                          |
| 2, 4, 7, 9, 11, 14 | GND           | Ground. Connect the GND pins to a ground plane that has low electrical and thermal impedance. See <a href="#">Figure 3</a> for the interface schematic.                                                                                                                                                       |
| 3                  | RFIN          | RF Input. RFIN is AC-coupled and matched to 50 Ω. See <a href="#">Figure 4</a> for the interface schematic.                                                                                                                                                                                                   |
| 5                  | VBTEMP        | Bias Voltage for the Temperature Sensor. See <a href="#">Figure 5</a> for the interface schematic.                                                                                                                                                                                                            |
| 6                  | VTEMP         | Temperature Sensor Output Voltage. See <a href="#">Figure 5</a> for the interface schematic.                                                                                                                                                                                                                  |
| 8, 12              | NIC           | No Internal Connection. The NIC pins are not connected internally. For normal operation, connect the NIC pins to ground.                                                                                                                                                                                      |
| 10                 | RFOUT         | RF Output. The RFOUT pin is AC-coupled and matched to 50 Ω. See <a href="#">Figure 6</a> for the interface schematic.                                                                                                                                                                                         |
| 13                 | VDD           | Drain Bias. Connect the VDD pin to the supply voltage. See <a href="#">Figure 6</a> for the interface schematic.                                                                                                                                                                                              |
| 15                 | RBIAS         | Bias Setting Resistor. Connect a resistor between RBIAS and VDD to set the quiescent drain current. See the typical application circuit (see <a href="#">Figure 96</a> ) and <a href="#">Table 12</a> to <a href="#">Table 15</a> for more details. See <a href="#">Figure 7</a> for the interface schematic. |
| 16                 | VPD           | Power-Down Control. To enable the ADL8108, connect the VPD pin to the ground. To disable the ADL8108, connect the VPD pin to the VDD pin. See <a href="#">Figure 8</a> for the interface schematic.                                                                                                           |
|                    | GROUND PADDLE | Ground Paddle. Connect the ground paddle to a ground plane which has a low electrical and thermal impedance.                                                                                                                                                                                                  |

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

## INTERFACE SCHEMATICS

*Figure 3. GND Interface Schematic**Figure 4. RFIN Interface Schematic**Figure 5. VTEMP and VBTEMP Interface Schematic**Figure 6. RFOUT and VDD Interface Schematic**Figure 7. RBIAS Interface Schematic**Figure 8. VPD Interface Schematic*



## TYPICAL PERFORMANCE CHARACTERISTICS

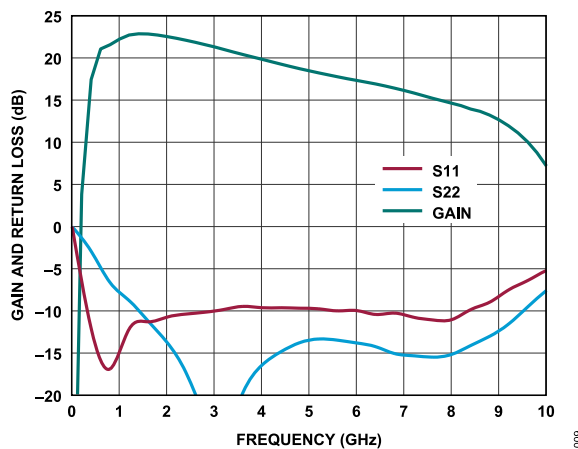
AMPLIFIER ON STATE ( $V_{PD} = 0$  V)

Figure 9. Broadband Gain and Return Loss vs. Frequency, 10 MHz to 10 GHz,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA

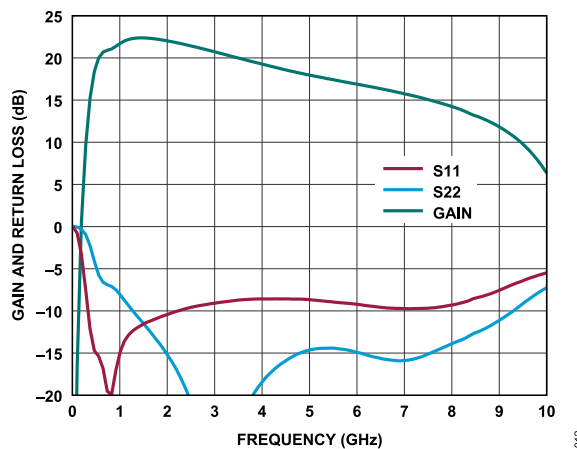


Figure 12. Broadband Gain and Return Loss vs. Frequency, 10 MHz to 10 GHz,  $V_{DD} = 3$  V,  $I_{DQ} = 60$  mA

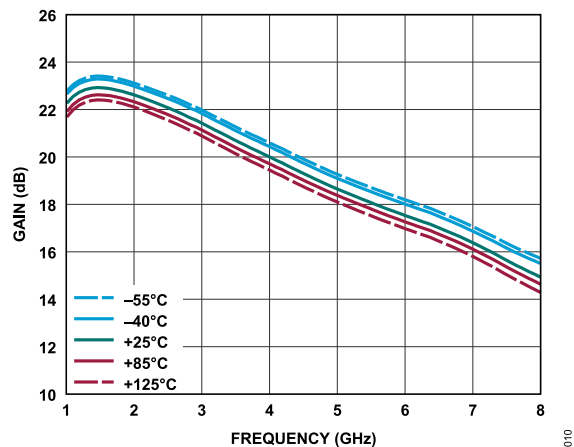


Figure 10. Gain vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA

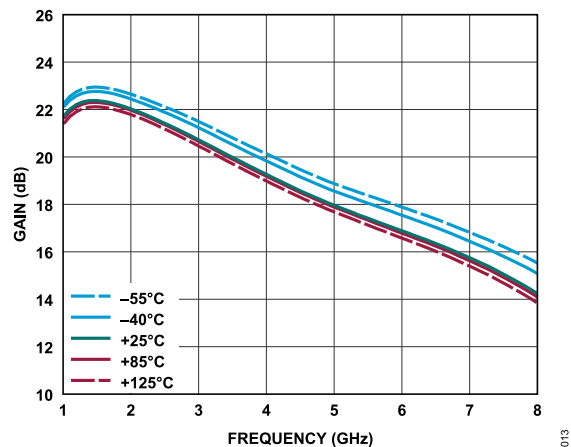


Figure 13. Gain vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3$  V,  $I_{DQ} = 60$  mA

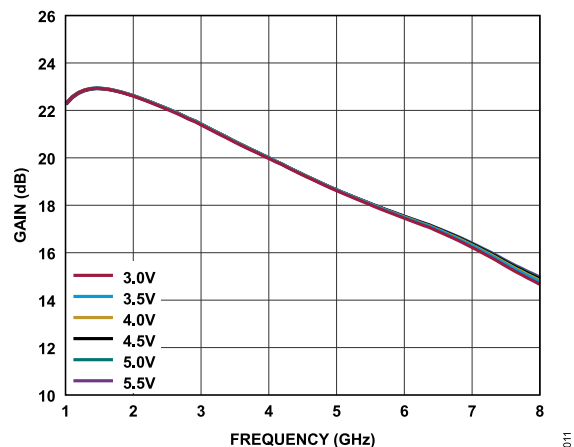


Figure 11. Gain vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 90$  mA

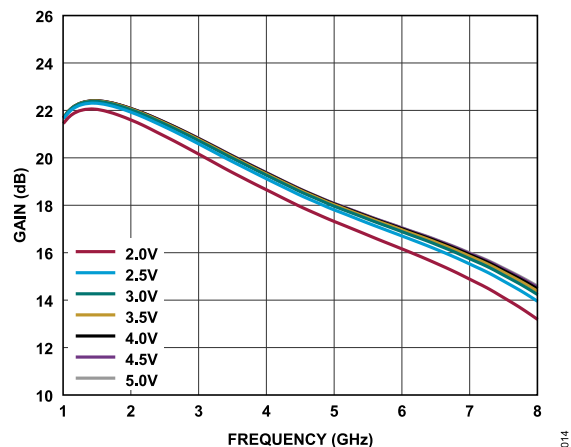


Figure 14. Gain vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 60$  mA

## TYPICAL PERFORMANCE CHARACTERISTICS

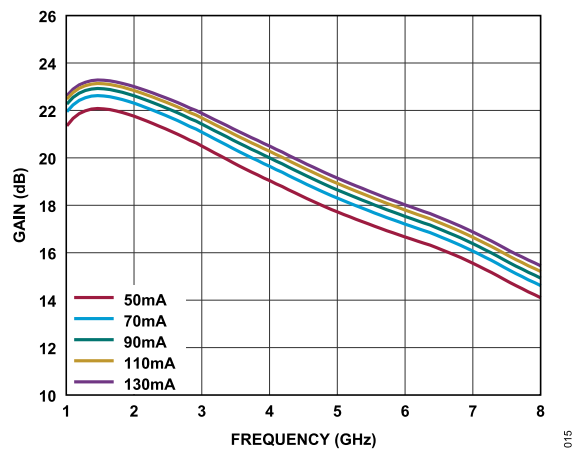


Figure 15. Gain vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 5\text{ V}$

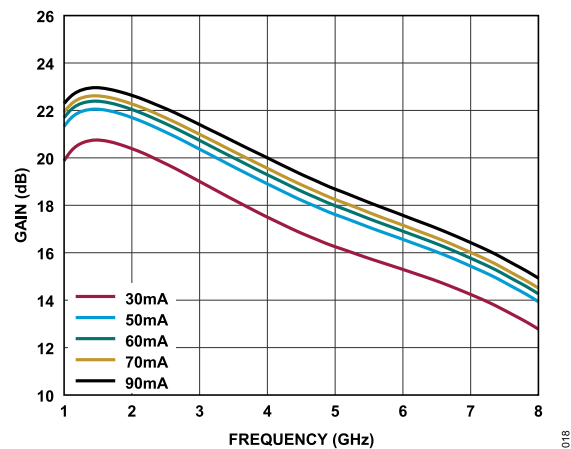


Figure 18. Gain vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 3\text{ V}$

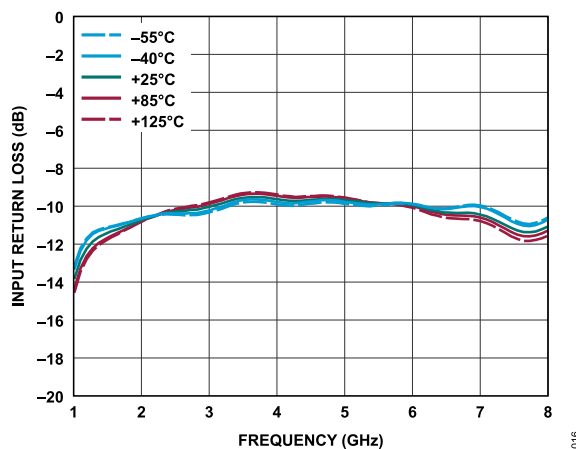


Figure 16. Input Return Loss vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ ,  $R_{BIAS} = 1270\ \Omega$

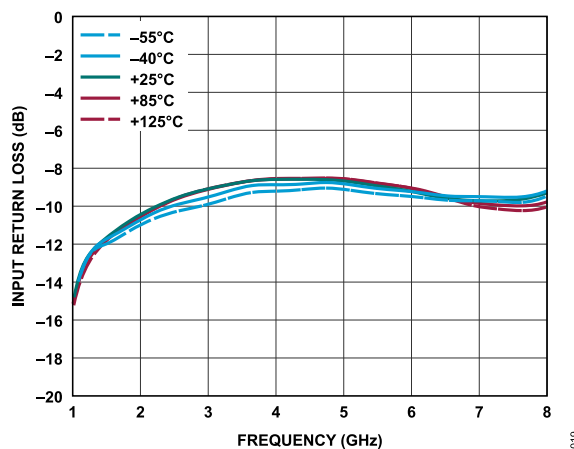


Figure 19. Input Return Loss vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3\text{ V}$ ,  $I_{DQ} = 60\text{ mA}$ ,  $R_{BIAS} = 698\ \Omega$

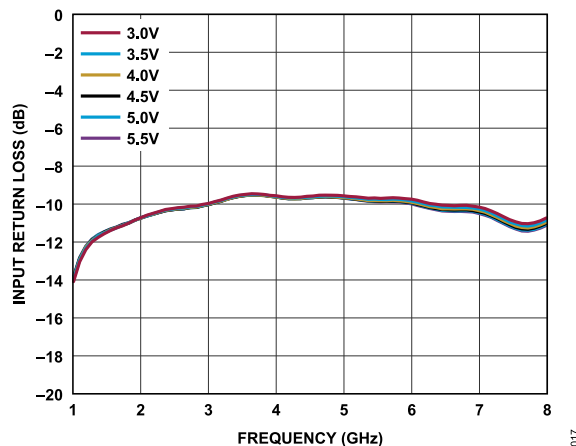


Figure 17. Input Return Loss vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 90\text{ mA}$

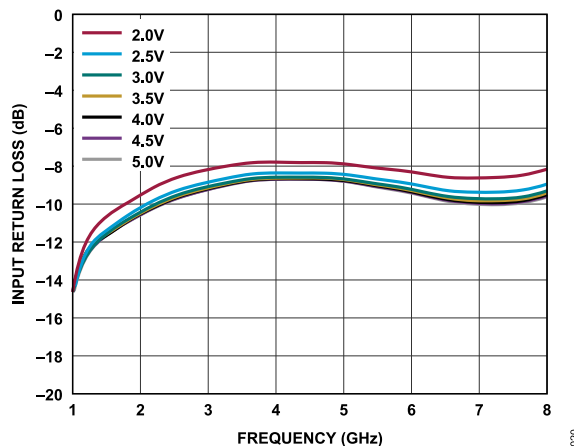


Figure 20. Input Return Loss vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 60\text{ mA}$

## TYPICAL PERFORMANCE CHARACTERISTICS

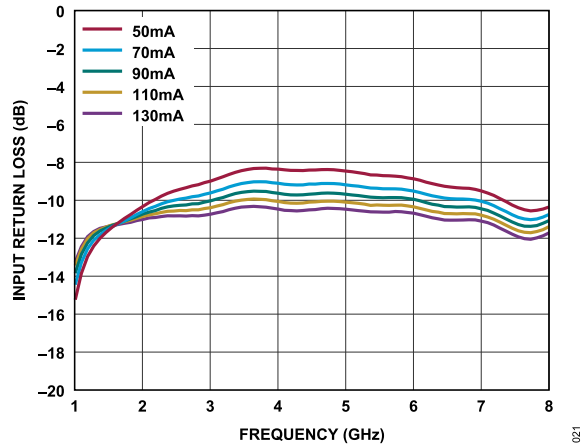


Figure 21. Input Return Loss vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

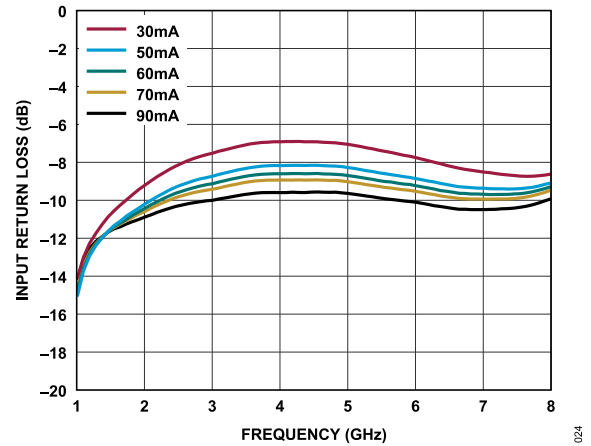


Figure 24. Input Return Loss vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 3$  V

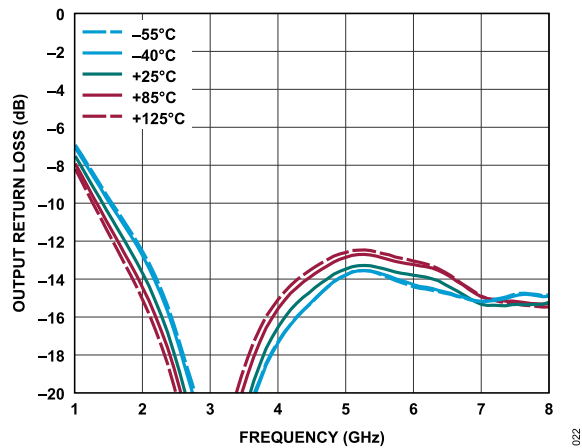


Figure 22. Output Return Loss vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA,  $R_{BIAS} = 1270 \Omega$

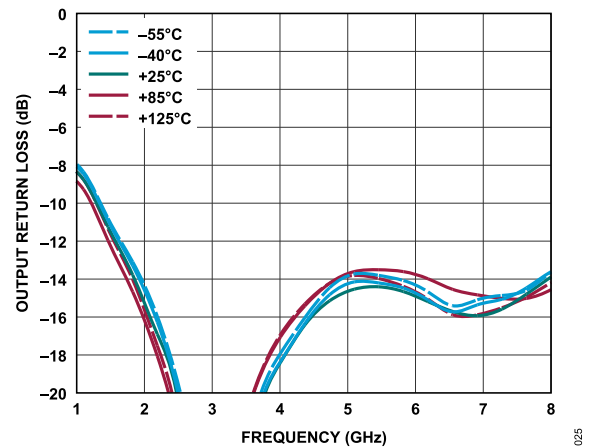


Figure 25. Output Return Loss vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3$  V,  $I_{DQ} = 60$  mA,  $R_{BIAS} = 698 \Omega$

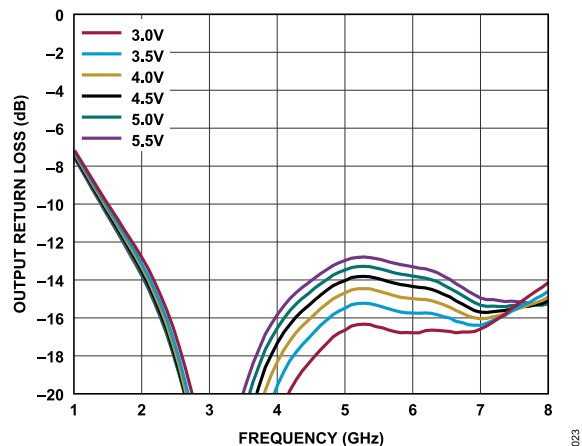


Figure 23. Output Return Loss vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 90$  mA

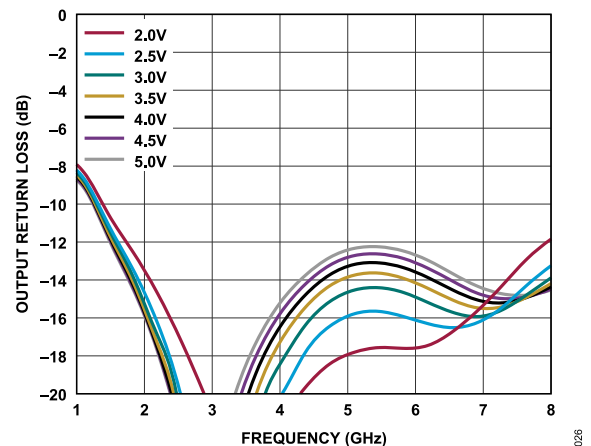


Figure 26. Output Return Loss vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 60$  mA

## TYPICAL PERFORMANCE CHARACTERISTICS

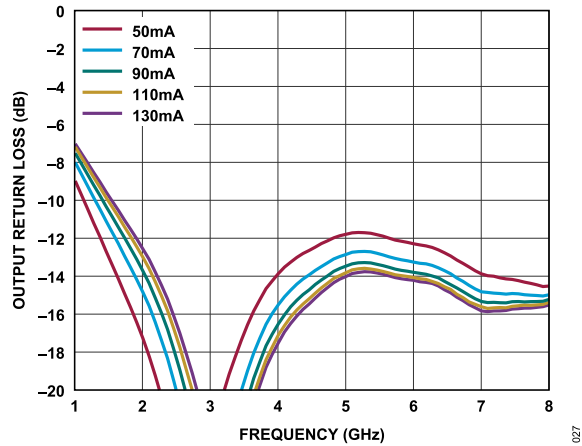


Figure 27. Output Return Loss vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

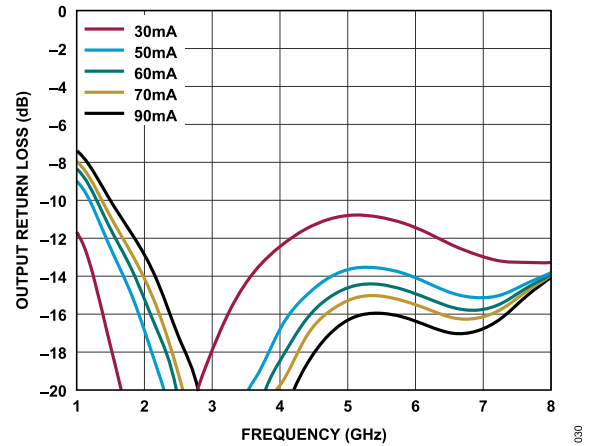


Figure 30. Output Return Loss vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz, and  $V_{DD} = 3$  V

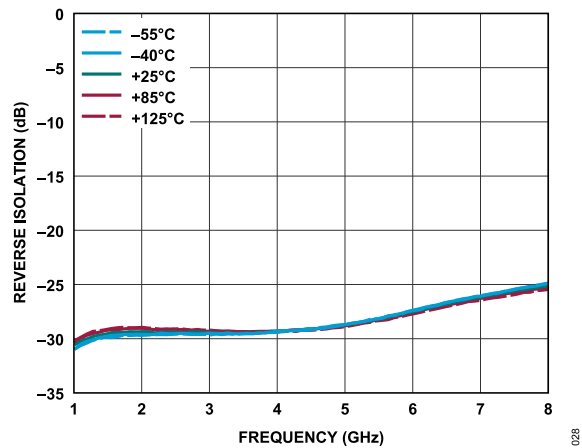


Figure 28. Reverse Isolation vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA,  $R_{BIAS} = 1270 \Omega$

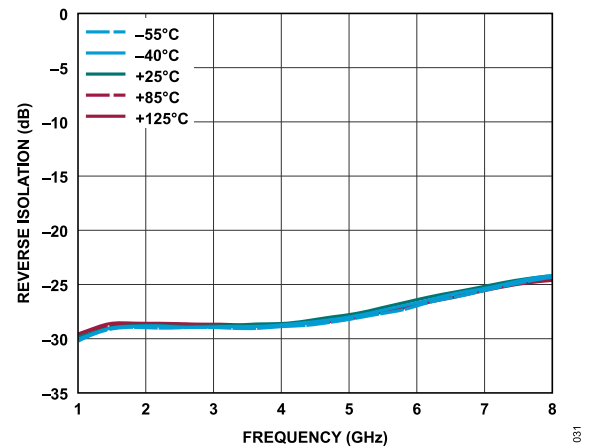


Figure 31. Reverse Isolation vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3$  V,  $I_{DQ} = 60$  mA,  $R_{BIAS} = 698 \Omega$

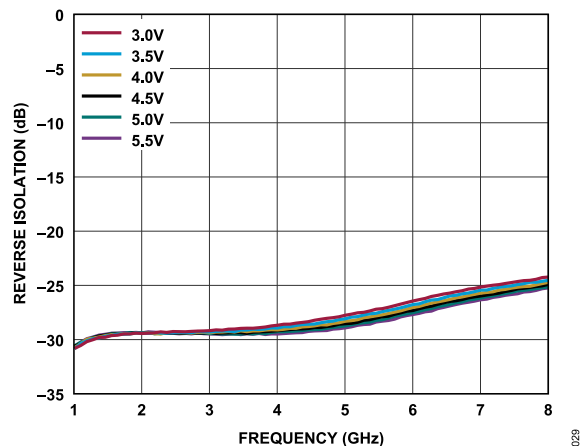


Figure 29. Reverse Isolation vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 90$  mA

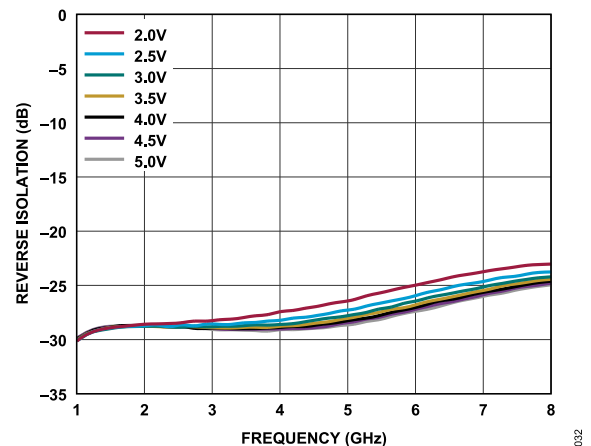


Figure 32. Reverse Isolation vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 60$  mA

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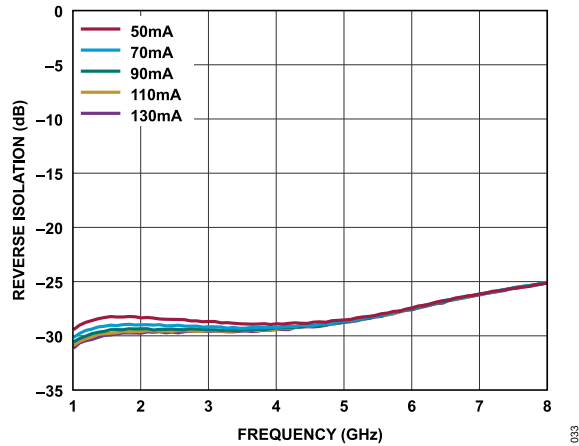


Figure 33. Reverse Isolation vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

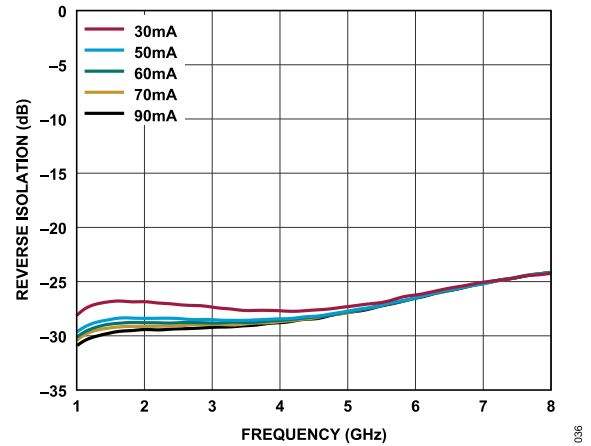


Figure 36. Reverse Isolation vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 3$  V

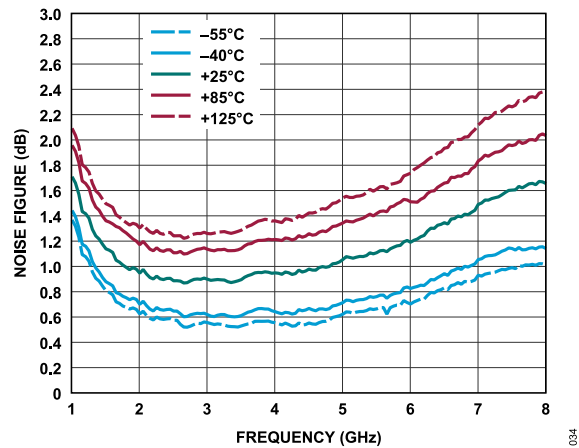


Figure 34. Noise Figure vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA,  $R_{BIAS} = 1270$  Ω

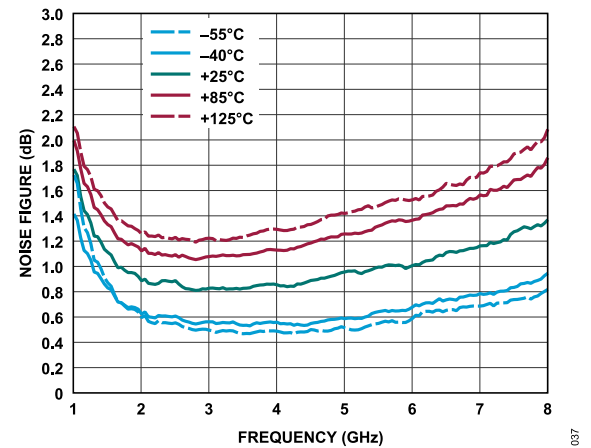


Figure 37. Noise Figure vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3$  V,  $I_{DQ} = 60$  mA,  $R_{BIAS} = 698$  Ω

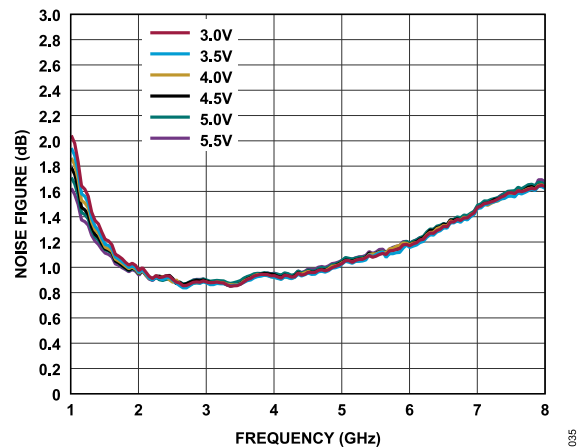


Figure 35. Noise Figure vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 90$  mA

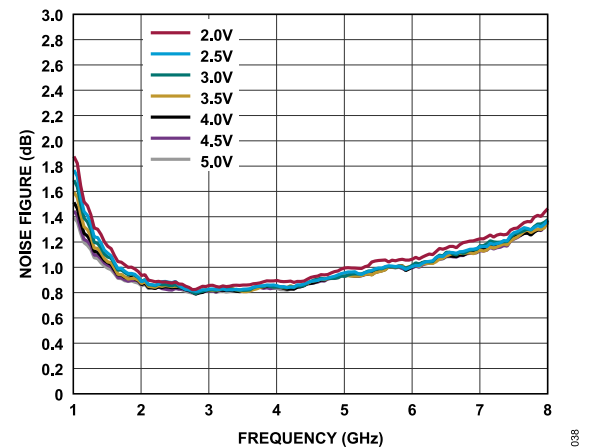


Figure 38. Noise Figure vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 60$  mA

## TYPICAL PERFORMANCE CHARACTERISTICS

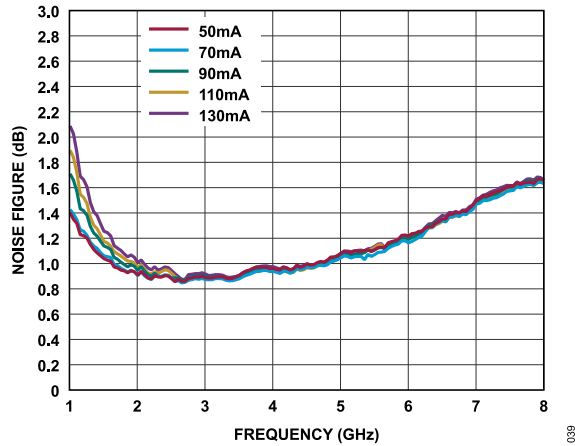


Figure 39. Noise Figure vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

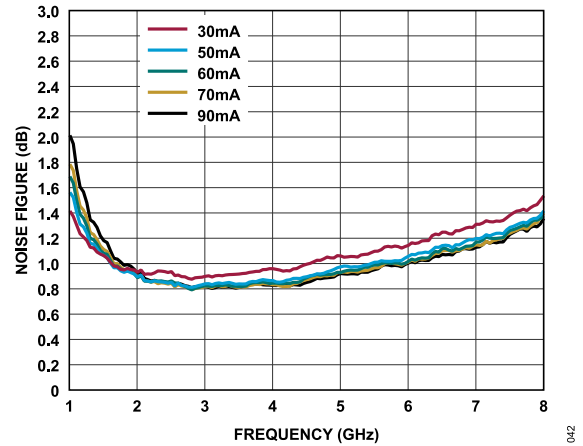


Figure 42. Noise Figure vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 3$  V

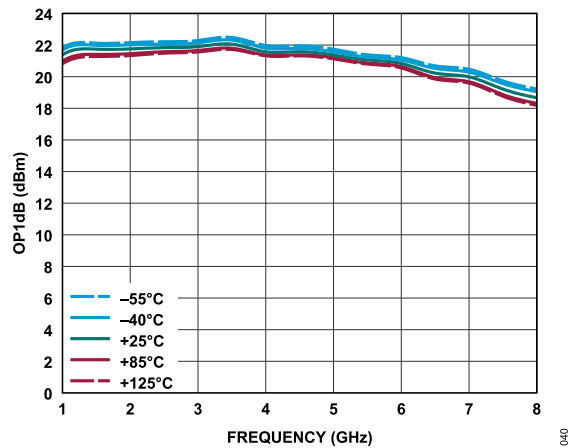


Figure 40. OP1dB vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA,  $R_{BIAS} = 1270$   $\Omega$

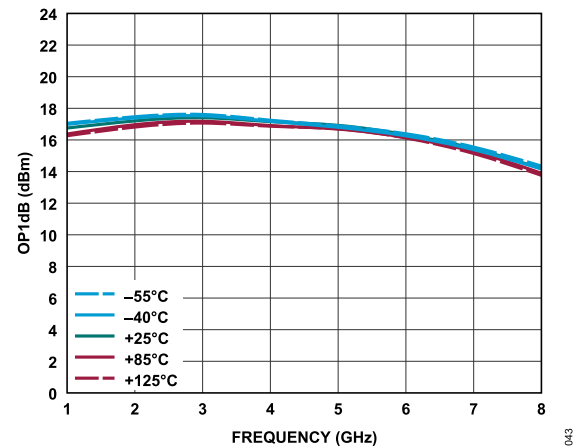


Figure 43. OP1dB vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3$  V,  $I_{DQ} = 60$  mA,  $R_{BIAS} = 698$   $\Omega$

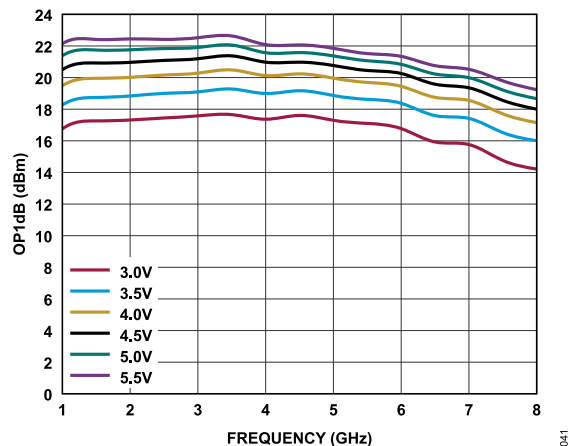


Figure 41. OP1dB vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 90$  mA

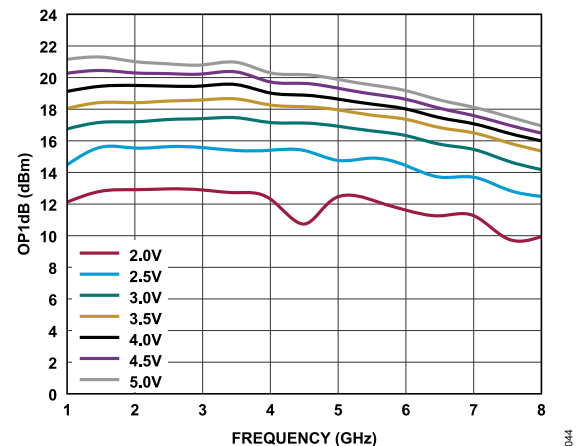


Figure 44. OP1dB vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 60$  mA

## TYPICAL PERFORMANCE CHARACTERISTICS

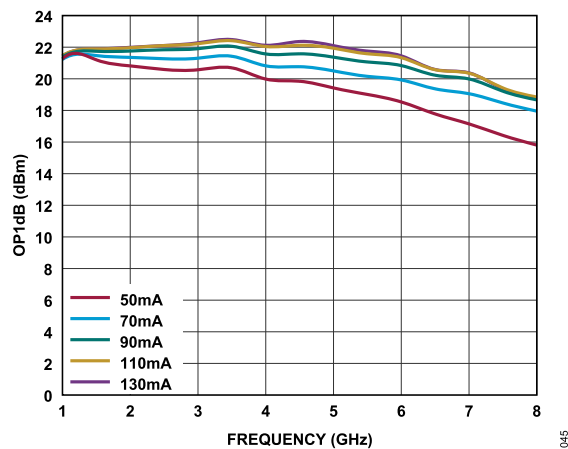


Figure 45. OP1dB vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

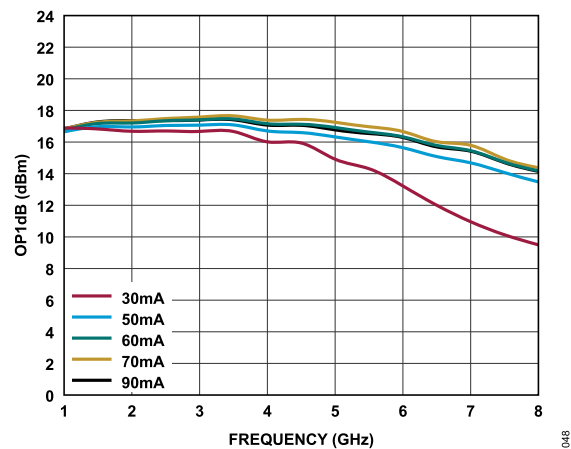


Figure 48. OP1dB vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 3$  V

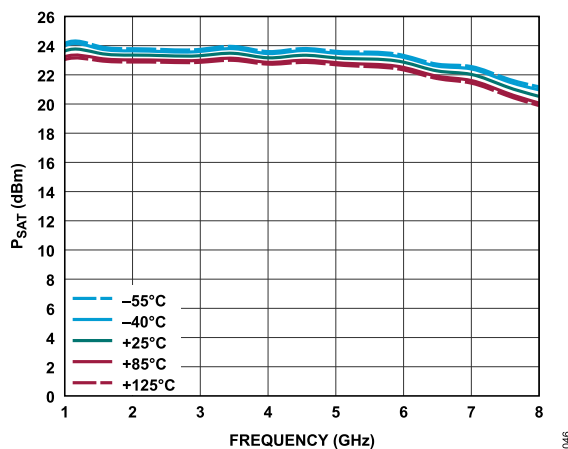


Figure 46.  $P_{SAT}$  vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA

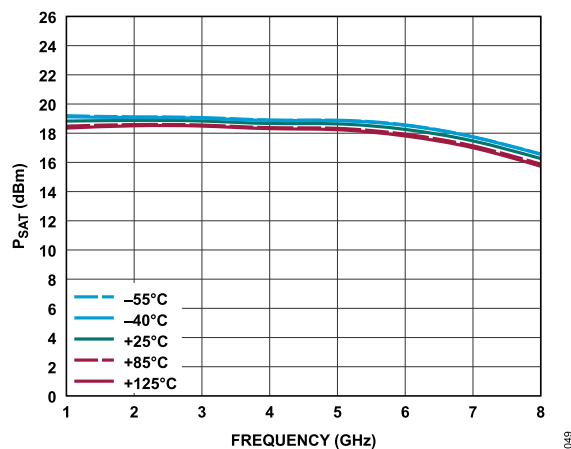


Figure 49.  $P_{SAT}$  vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3$  V,  $I_{DQ} = 60$  mA,  $R_{BIAS} = 698 \Omega$

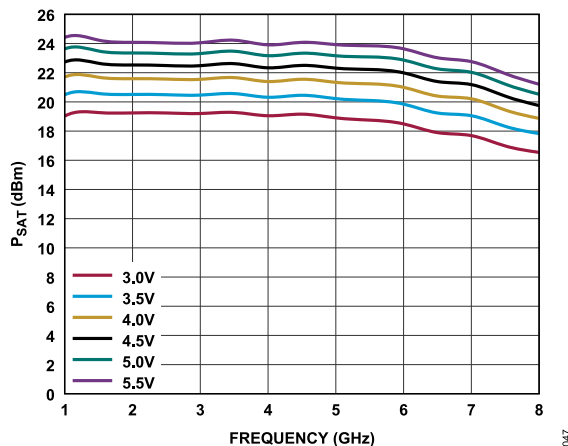


Figure 47.  $P_{SAT}$  vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 90$  mA

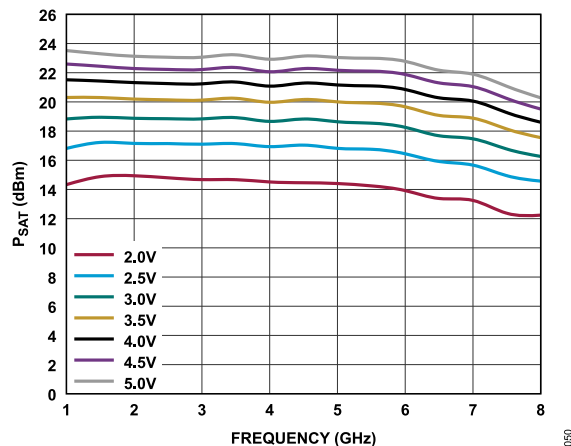


Figure 50.  $P_{SAT}$  vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 60$  mA

## TYPICAL PERFORMANCE CHARACTERISTICS

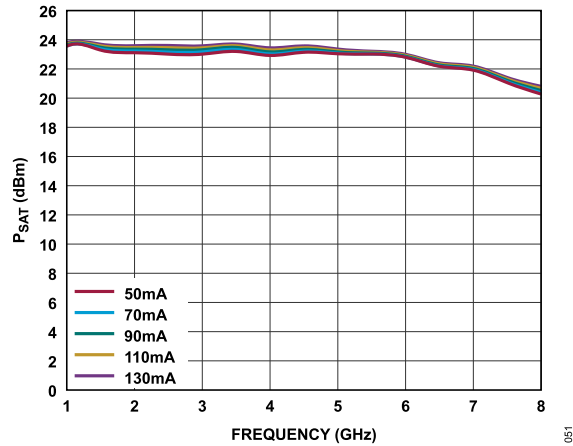


Figure 51.  $P_{SAT}$  vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

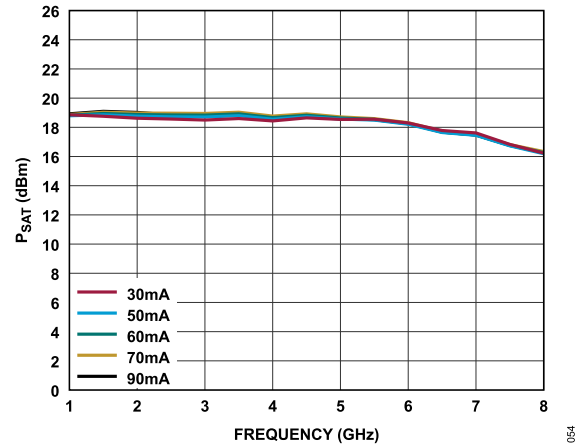


Figure 54.  $P_{SAT}$  vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 3$  V

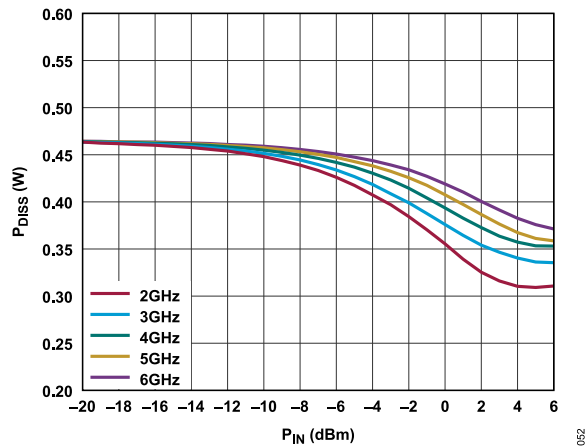


Figure 52.  $P_{DISS}$  vs.  $P_{IN}$  at  $T_{CASE} = 85^{\circ}\text{C}$ ,  $V_{DD} = 5$  V,  $R_{BIAS} = 1270\ \Omega$

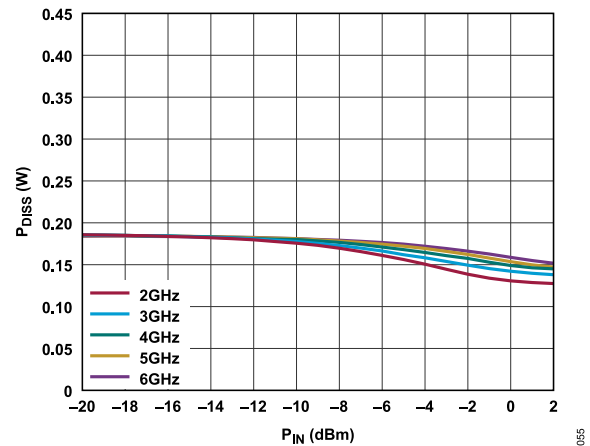


Figure 55.  $P_{DISS}$  vs.  $P_{IN}$  at  $T_{CASE} = 85^{\circ}\text{C}$ ,  $V_{DD} = 3$  V,  $R_{BIAS} = 698\ \Omega$

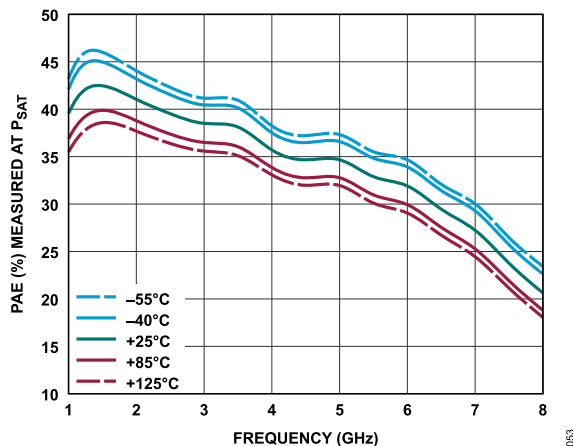


Figure 53. PAE vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA,  $R_{BIAS} = 1270\ \Omega$

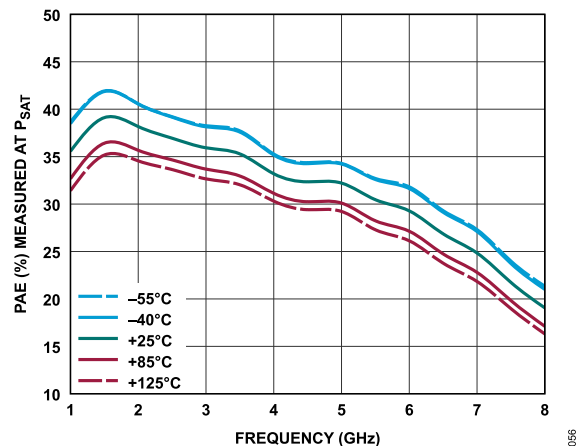


Figure 56. PAE Measured at  $P_{SAT}$  vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3$  V,  $I_{DQ} = 60$  mA,  $R_{BIAS} = 698\ \Omega$



## TYPICAL PERFORMANCE CHARACTERISTICS

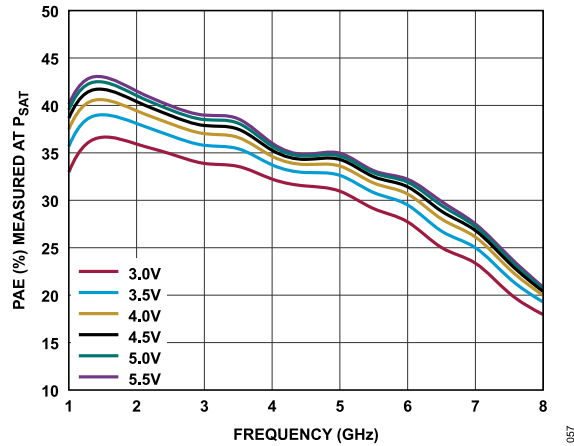


Figure 57. PAE Measured at  $P_{SAT}$  vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 90$  mA

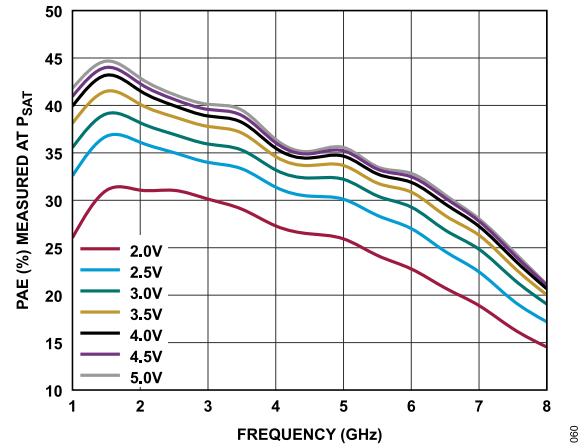


Figure 60. PAE Measured at  $P_{SAT}$  vs. Frequency for Various Supply Voltages, 1 GHz to 8 GHz,  $I_{DQ} = 60$  mA

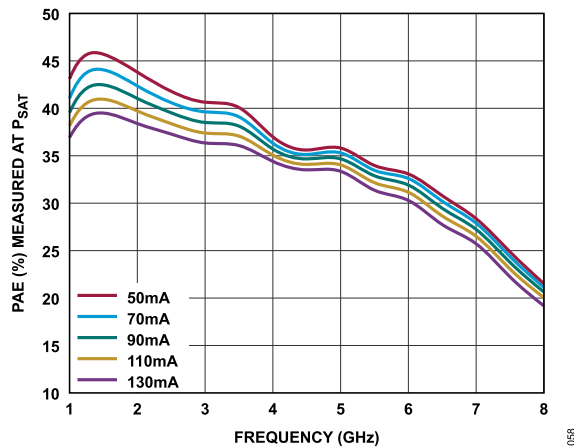


Figure 58. PAE Measured at  $P_{SAT}$  vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

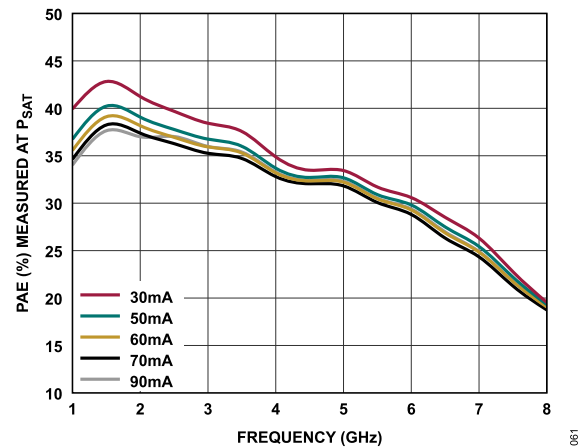


Figure 61. PAE Measured at  $P_{SAT}$  vs. Frequency for Various  $I_{DQ}$  Values, 1 GHz to 8 GHz,  $V_{DD} = 3$  V

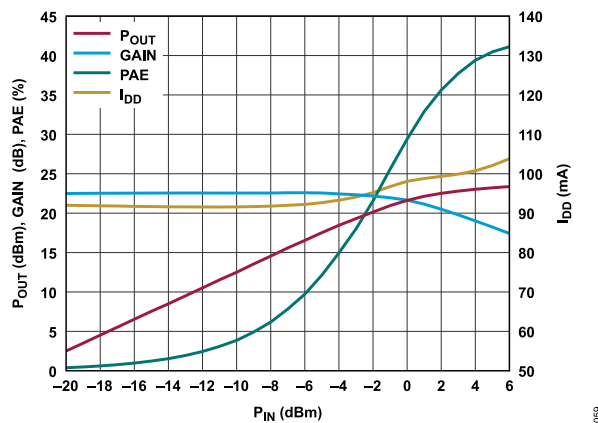


Figure 59.  $P_{OUT}$ , Gain, PAE and Drain Current ( $I_{DD}$ ) vs.  $P_{IN}$ , Power Compression at 2 GHz,  $V_{DD} = 5$  V,  $R_{BIAS} = 1270 \Omega$

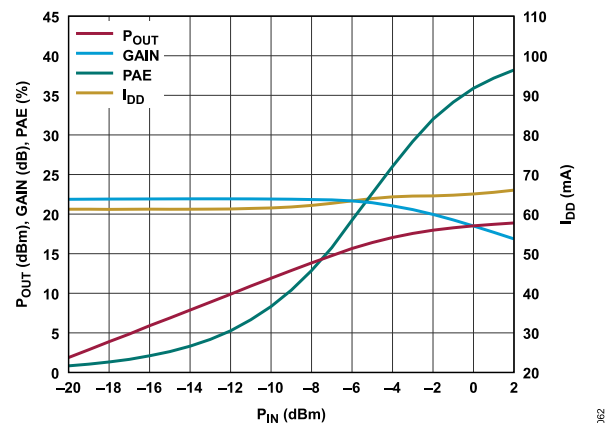


Figure 62.  $P_{OUT}$ , Gain, PAE, and  $I_{DD}$  vs.  $P_{IN}$ , Power Compression at 2 GHz,  $V_{DD} = 3$  V,  $R_{BIAS} = 698 \Omega$

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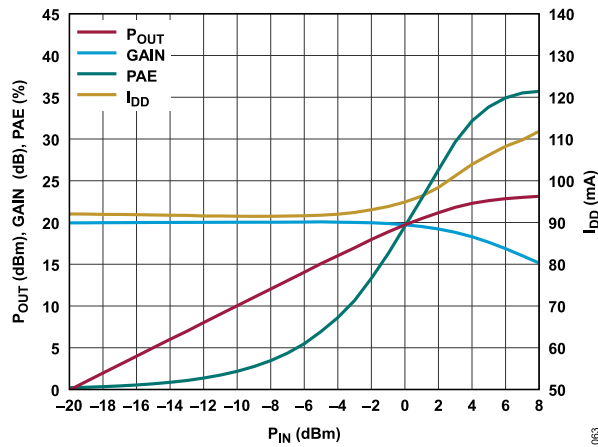


Figure 63.  $P_{OUT}$ , Gain, PAE, and  $I_{DD}$  vs.  $P_{IN}$ , Power Compression at 4 GHz,  $V_{DD} = 5\text{ V}$ ,  $R_{BIAS} = 1270\ \Omega$

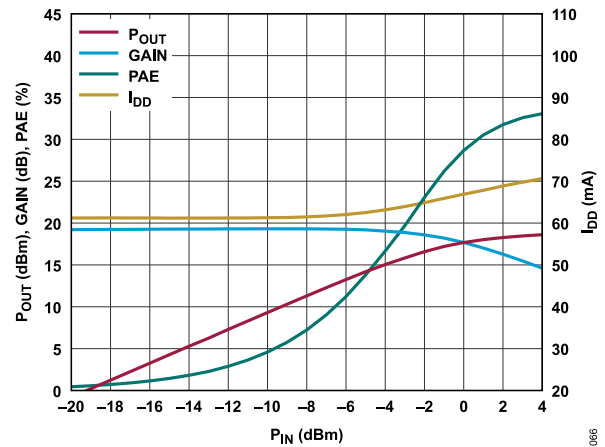


Figure 66.  $P_{OUT}$ , Gain, PAE, and  $I_{DD}$  vs.  $P_{IN}$ , Power Compression at 4 GHz,  $V_{DD} = 3\text{ V}$ ,  $R_{BIAS} = 698\ \Omega$

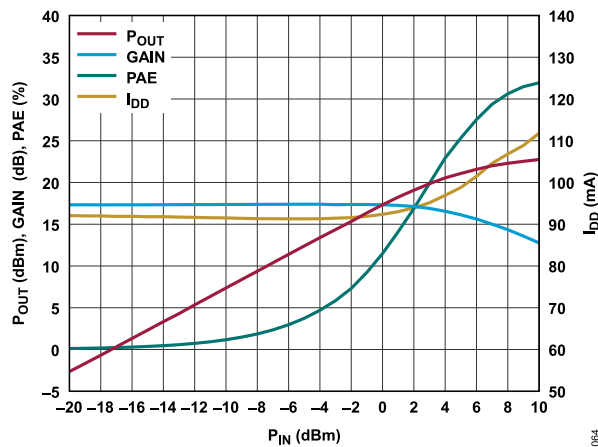


Figure 64.  $P_{OUT}$ , Gain, PAE, and  $I_{DD}$  vs.  $P_{IN}$ , Power Compression at 6 GHz,  $V_{DD} = 5\text{ V}$ ,  $R_{BIAS} = 1270\ \Omega$

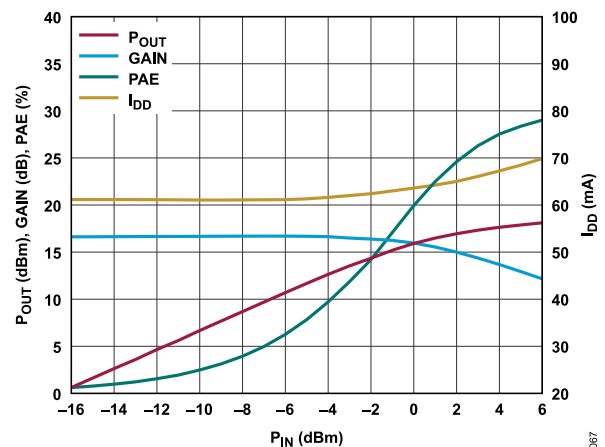


Figure 67.  $P_{OUT}$ , Gain, PAE, and  $I_{DD}$  vs.  $P_{IN}$ , Power Compression at 6 GHz,  $V_{DD} = 3\text{ V}$ ,  $R_{BIAS} = 698\ \Omega$

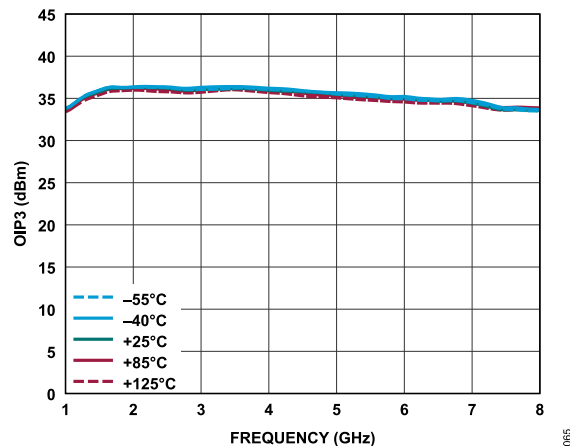


Figure 65. OIP3 vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ ,  $R_{BIAS} = 1270\ \Omega$ ,  $P_{OUT}$  per Tone = 8 dBm

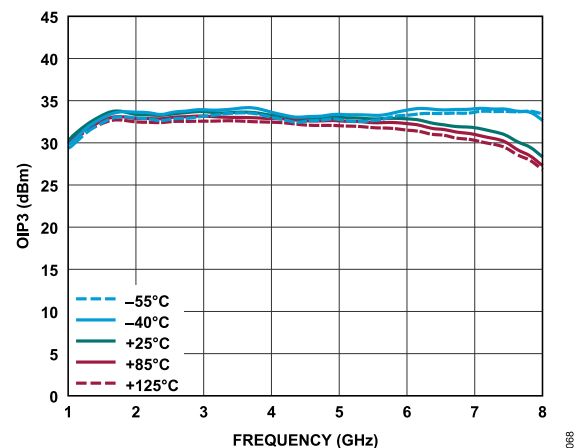


Figure 68. OIP3 vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 3\text{ V}$ ,  $I_{DQ} = 60\text{ mA}$ ,  $R_{BIAS} = 698\ \Omega$ ,  $P_{OUT}$  per Tone = 4 dBm

## TYPICAL PERFORMANCE CHARACTERISTICS

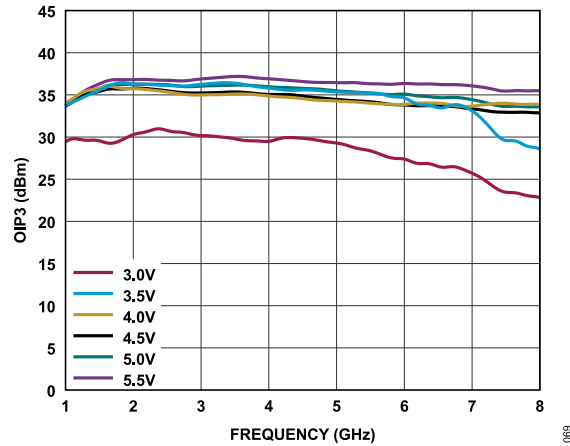


Figure 69. OIP3 vs. Frequency for Various Supply Voltages,  
 $I_{DQ} = 90 \text{ mA}$ ,  $P_{OUT}$  per Tone = 8 dBm

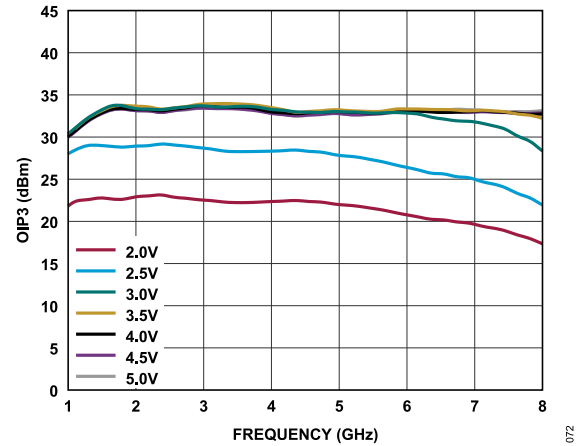


Figure 72. OIP3 vs. Frequency for Various Supply Voltages,  
 $I_{DQ} = 60 \text{ mA}$ ,  $P_{OUT}$  per Tone = 4 dBm

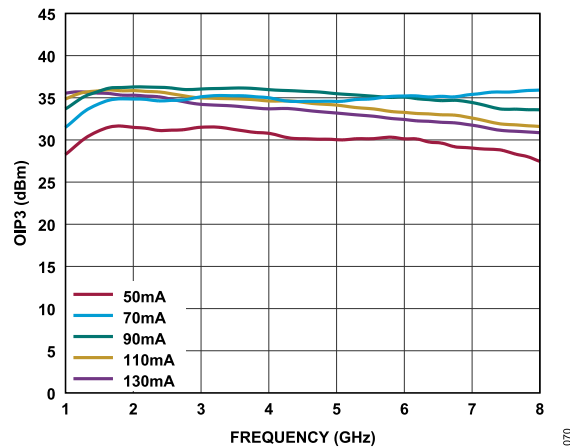


Figure 70. OIP3 vs. Frequency for Various  $I_{DQ}$  Values,  
 $V_{DD} = 5 \text{ V}$ ,  $P_{OUT}$  per Tone = 8 dBm

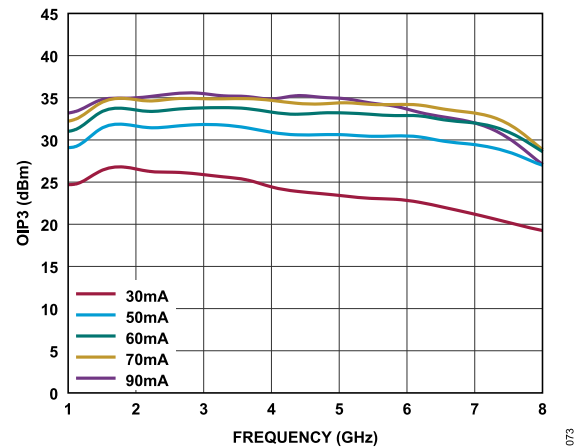


Figure 73. OIP3 vs. Frequency for Various  $I_{DQ}$  Values,  
 $V_{DD} = 3 \text{ V}$ ,  $P_{OUT}$  per Tone = 4 dBm

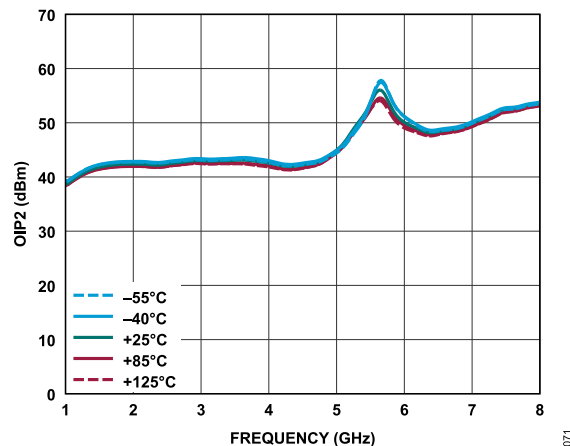


Figure 71. OIP2 vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  
 $V_{DD} = 5 \text{ V}$ ,  $I_{DQ} = 90 \text{ mA}$ ,  $R_{BIAS} = 1270 \Omega$ ,  $P_{OUT}$  per Tone = 8 dBm

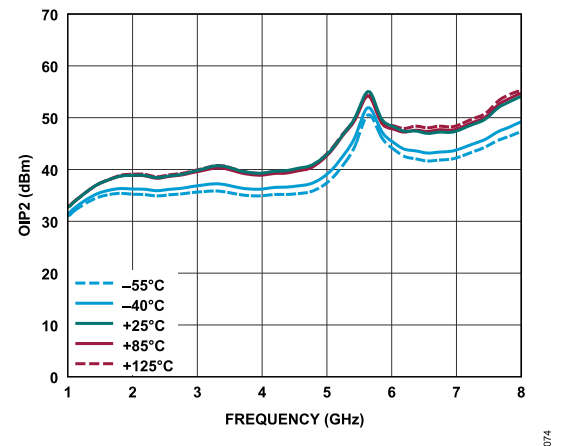


Figure 74. OIP2 vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  
 $V_{DD} = 3 \text{ V}$ ,  $I_{DQ} = 60 \text{ mA}$ ,  $R_{BIAS} = 698 \Omega$ ,  $P_{OUT}$  per Tone = 4 dBm

## TYPICAL PERFORMANCE CHARACTERISTICS

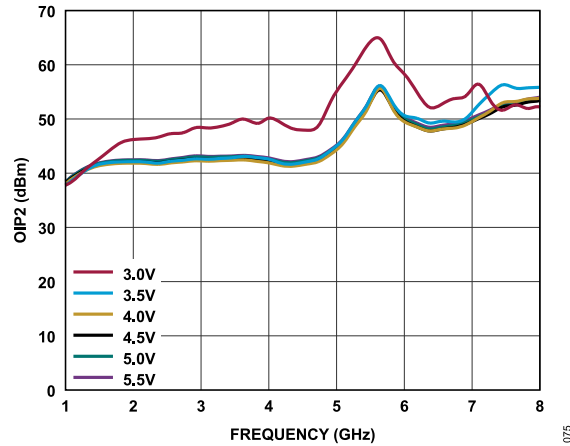


Figure 75. OIP2 vs. Frequency for Various Supply Voltages,  
 $I_{DQ} = 90 \text{ mA}$ ,  $P_{OUT}$  per Tone = 8 dBm

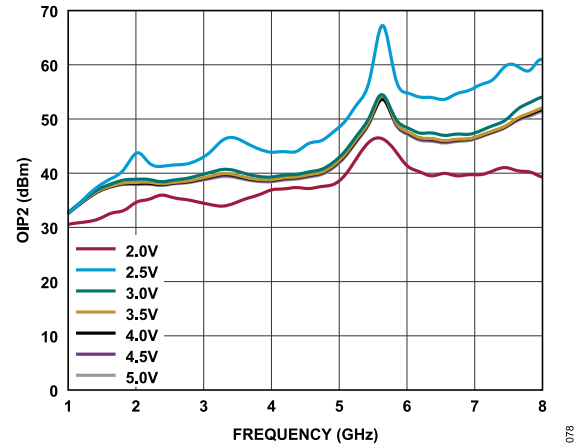


Figure 78. OIP2 vs. Frequency for Various Supply Voltages,  
 $I_{DQ} = 60 \text{ mA}$ ,  $P_{OUT}$  per Tone = 4 dBm

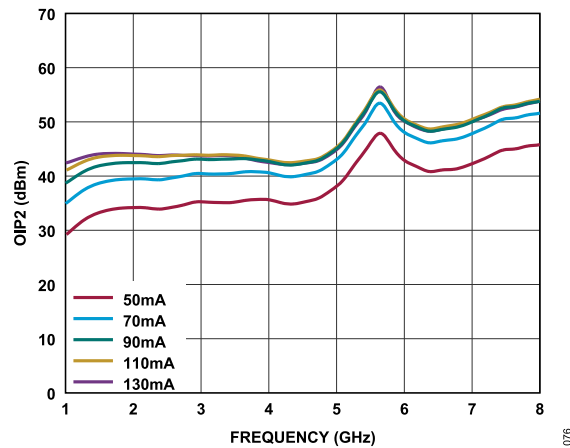


Figure 76. OIP2 vs. Frequency for Various  $I_{DQ}$  Values,  
 $V_{DD} = 5 \text{ V}$ ,  $P_{OUT}$  per Tone = 8 dBm

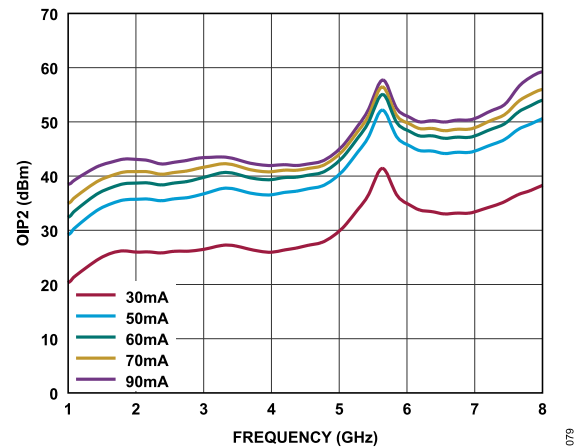


Figure 79. OIP2 vs. Frequency for Various  $I_{DQ}$  Values,  
 $V_{DD} = 3 \text{ V}$ ,  $P_{OUT}$  per Tone = 4 dBm

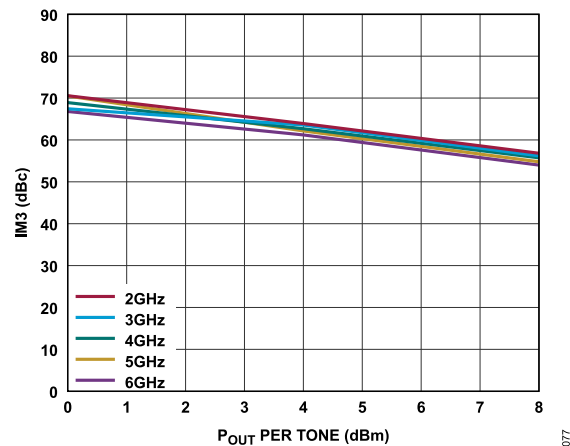


Figure 77. Output IM3 vs  $P_{OUT}$  per Tone for Various Frequencies,  
 $V_{DD} = 5 \text{ V}$ ,  $R_{BIAS} = 1270 \Omega$

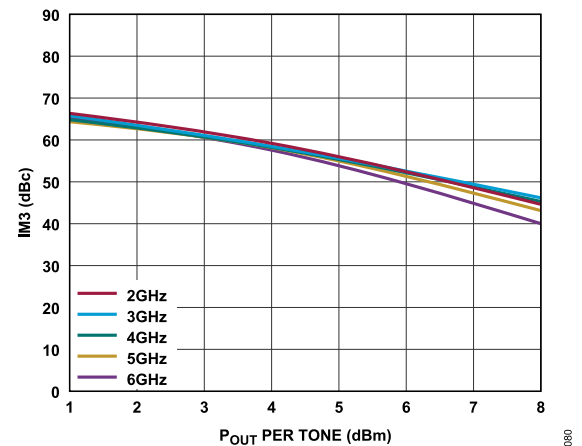


Figure 80. Output IM3 vs  $P_{OUT}$  per Tone for Various Frequencies,  
 $V_{DD} = 3 \text{ V}$ ,  $R_{BIAS} = 698 \Omega$

## TYPICAL PERFORMANCE CHARACTERISTICS

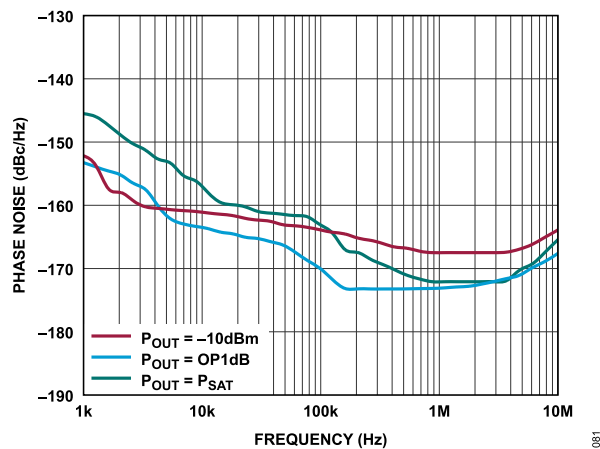


Figure 81. Phase Noise vs. Frequency at 3 GHz for Various  $P_{OUT}$  Values,  
 $V_{DD} = 5\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ ,  $R_{BIAS} = 1270\ \Omega$

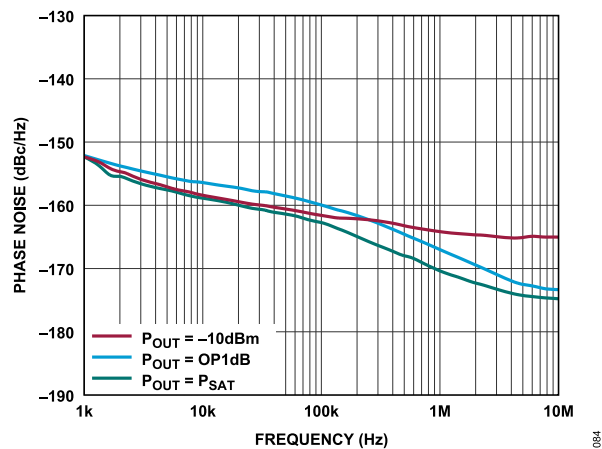


Figure 84. Phase Noise vs. Frequency at 5.5 GHz for Various  $P_{OUT}$  Values,  
 $V_{DD} = 5\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ ,  $R_{BIAS} = 1270\ \Omega$

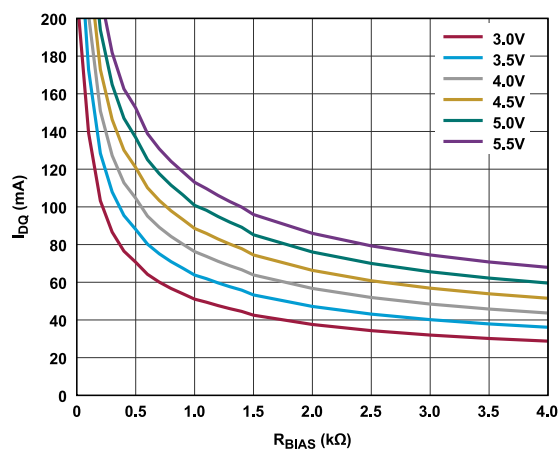


Figure 82.  $I_{DQ}$  vs.  $R_{BIAS}$  Values for Various Supply Voltages,  
 $0\ \Omega$  to  $4\text{ k}\Omega$

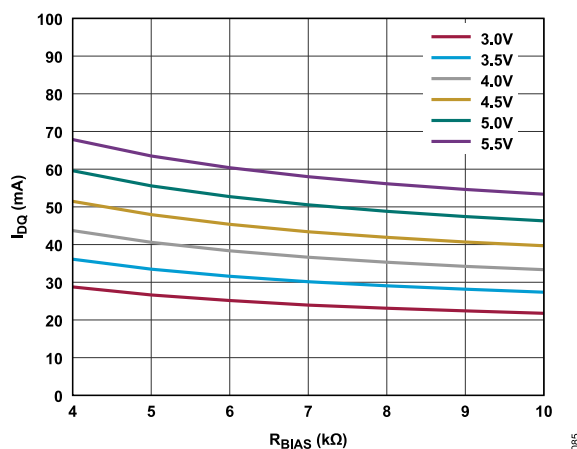


Figure 85.  $I_{DQ}$  vs.  $R_{BIAS}$  Values for Various Supply Voltages,  
 $5\text{ k}\Omega$  to  $10\text{ k}\Omega$

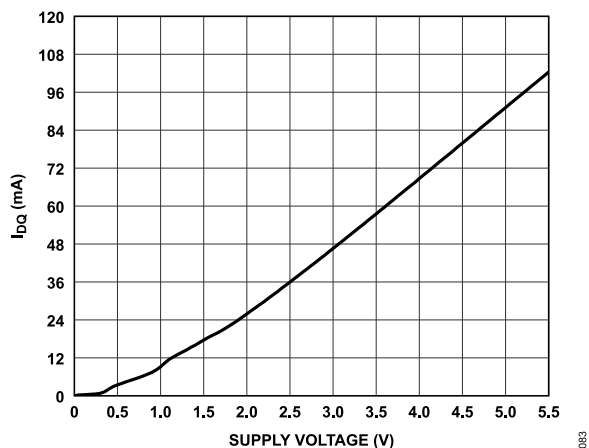


Figure 83.  $I_{DQ}$  vs. Supply Voltage,  $R_{BIAS} = 1270\ \Omega$

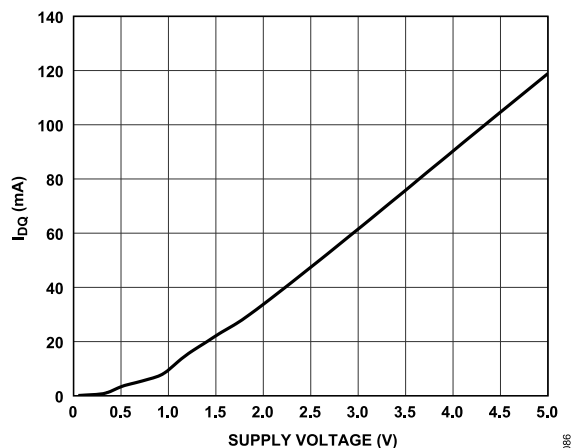


Figure 86.  $I_{DQ}$  vs. Supply Voltage,  $R_{BIAS} = 698\ \Omega$

TYPICAL PERFORMANCE CHARACTERISTICS

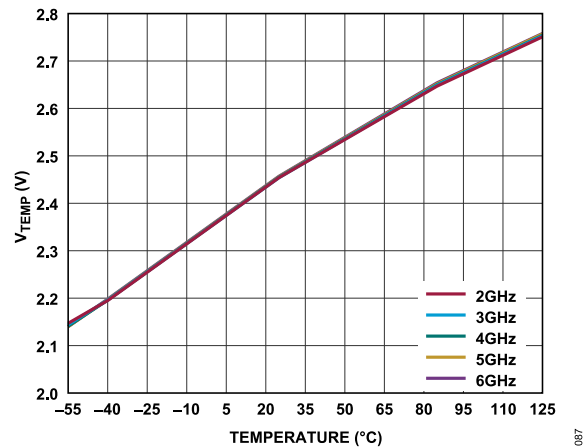


Figure 87.  $V_{TEMP}$  vs. Temperature for Various Frequencies,  $P_{OUT} = 20$  dBm,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA,  $R_{BIAS} = 1270 \Omega$

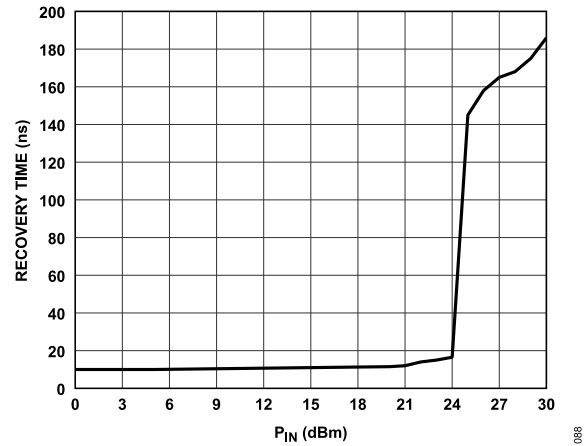


Figure 88. Overdrive Recovery Time vs.  $P_{IN}$  at 6 GHz, Recovery to Within 90% of Small Signal Gain Value,  $V_{DD} = 5$  V,  $I_{DQ} = 90$  mA,  $R_{BIAS} = 1270 \Omega$

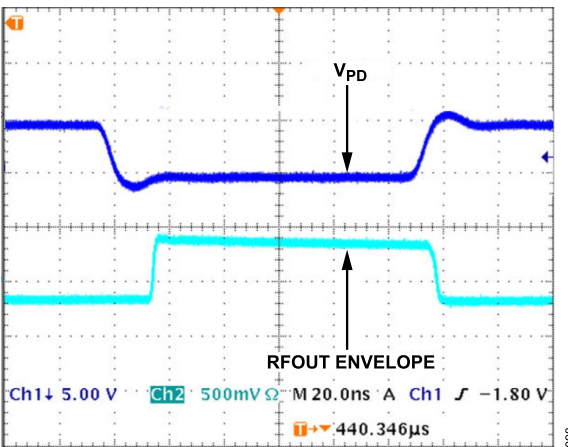


Figure 89. On and/or Off Response of the RFOUT Envelope Timing When the VPD Pin Is Toggled

## TYPICAL PERFORMANCE CHARACTERISTICS

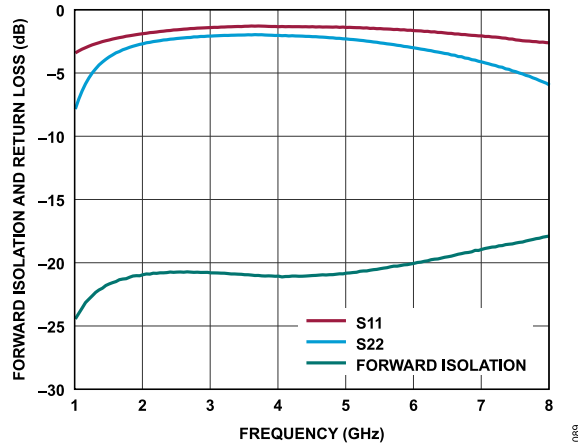
AMPLIFIER OFF STATE ( $V_{PD} = V_{DD}$ )

Figure 90. Forward Isolation and Return Loss vs. Frequency, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

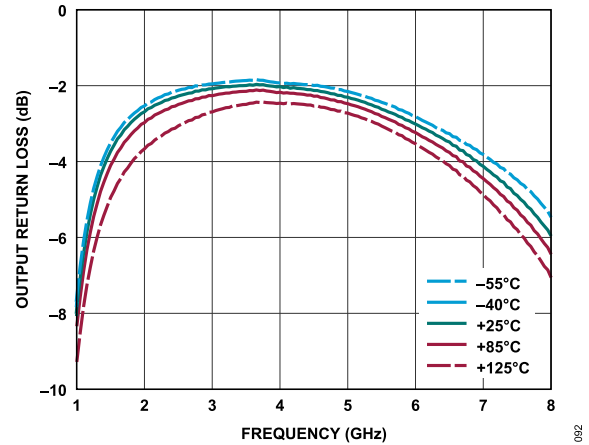


Figure 93. Output Return Loss vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

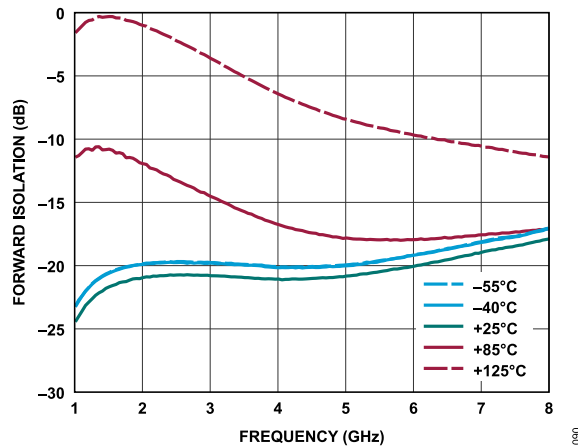


Figure 91. Forward Isolation vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

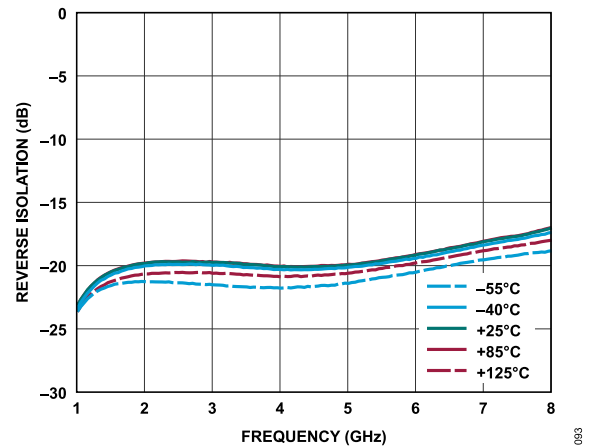


Figure 94. Reverse Isolation vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

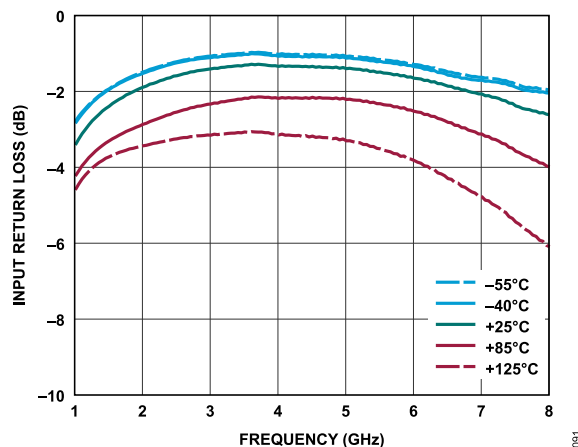


Figure 92. Input Return Loss vs. Frequency for Various Temperatures, 1 GHz to 8 GHz,  $V_{DD} = 5$  V

## THEORY OF OPERATION

The ADL8108 is a wideband LNA with integrated AC-coupling capacitors, a bias inductor, a temperature sensor, and an enable or disable function. Figure 95 shows the simplified architecture of the ADL8108.

The ADL8108 has AC-coupled, single-ended input and output ports with impedances that are nominally equal to  $50\ \Omega$  over the 1 GHz to 8 GHz frequency range. No external matching components are required. To adjust the quiescent current, connect an external resistor between the RBIAS and VDD pins.

The ADL8108 contains an integrated temperature sensor. The temperature sensor is biased using the VBTEMP pin. The voltage that is proportional to the device temperature can be measured on the VTEMP pin.

The ADL8108 also has an enable or disable function. By pulling the VPD pin low or high, the ADL8108 can be enabled or disabled, respectively.

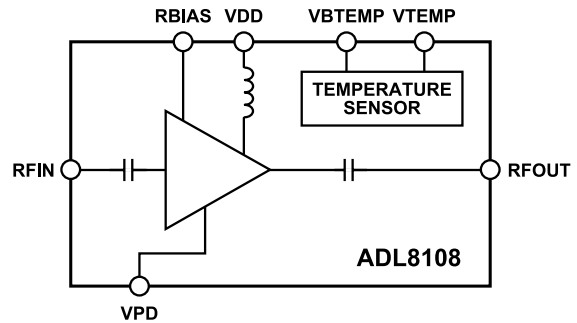


Figure 95. Simplified Architecture

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## APPLICATIONS INFORMATION

The basic connections for operating the ADL8108 over the specified frequency range are shown in Figure 96. No external biasing inductor is required, which allows the 5 V supply to be connected to the VDD pin. It is recommended to use 100 pF and 1000 pF power-supply decoupling capacitors. The power-supply decoupling capacitors shown in Figure 96 represent the configuration used to characterize and qualify the ADL8108.

To set  $I_{DQ}$ , connect a resistor (R2) between the RBIAS and VDD pins. A default value of 1270  $\Omega$  is recommended, which results in a nominal  $I_{DQ}$  of 90 mA. Table 12 shows how  $I_{DQ}$  and  $I_{DQ\_AMP}$  vary vs.  $R_{BIAS}$ . The RBIAS pin also draws a current that varies with the value of  $R_{BIAS}$  (see Table 12). Do not leave the RBIAS pin open.

The VTEMP pin provides an output voltage that is proportional to the die temperature. The VTEMP pin has a high output resistance that must be buffered using an op-amp. To activate the temperature sensor, connect the VBTEMP pin to VDD. If the temperature sensor is not used, the VBTEMP and VTEMP pins can be grounded or left open.

The VPD pin provides a convenient method to power down the ADL8108. To disable the amplifier, connect the VPD pin to a supply. To enable the amplifier, connect the VPD pin to ground.

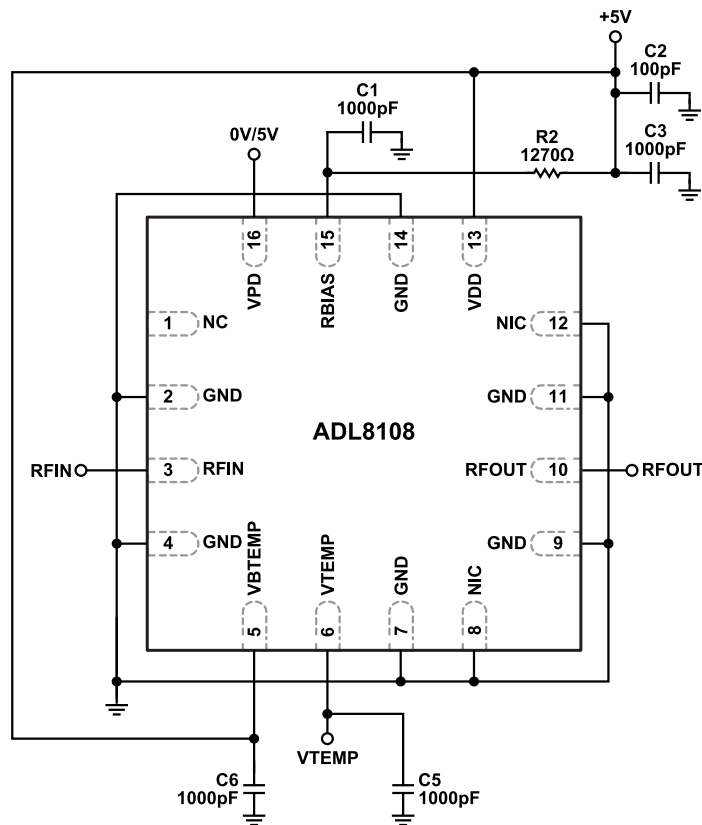


Figure 96. Typical Application Circuit

## APPLICATIONS INFORMATION

## RECOMMENDED BIAS SEQUENCING

Correct sequencing of the DC and RF power is required to safely operate the ADL8108. During power up, apply VDD before the RF power is applied to RFIN, and during power off, remove the RF power from RFIN before VDD is powered off.

**Table 12. Recommended Bias Resistor Values for  $V_{DD} = 5\text{ V}$**

| $R_{BIAS}$ ( $\Omega$ ) | $I_{DQ}$ (mA) | $I_{DQ\_AMP}$ (mA) | $I_{RBIAS}$ (mA) |
|-------------------------|---------------|--------------------|------------------|
| 6810                    | 50            | 49.4               | 0.6              |
| 2394                    | 70            | 68.3               | 1.7              |
| 1270                    | 90            | 86.9               | 3.1              |
| 795                     | 110           | 105.4              | 4.6              |
| 545                     | 130           | 123.7              | 6.3              |

**Table 13. Recommended Bias Resistor Values for  $V_{DD} = 3\text{ V}$**

| $R_{BIAS}$ ( $\Omega$ ) | $I_{DQ}$ (mA) | $I_{DQ\_AMP}$ (mA) | $I_{RBIAS}$ (mA) |
|-------------------------|---------------|--------------------|------------------|
| 3570                    | 30            | 29.4               | 0.6              |
| 1050                    | 50            | 48.1               | 1.9              |
| 698                     | 60            | 57.3               | 2.7              |
| 511                     | 70            | 66.6               | 3.4              |
| 296                     | 90            | 84.9               | 5.1              |

**Table 14. Recommended Bias Resistor Values for Various Supply Voltages,  $I_{DQ} = 90\text{ mA}$**

| $R_{BIAS}$ ( $\Omega$ ) | $V_{DD}$ (V) | $I_{DQ\_AMP}$ (mA) | $I_{RBIAS}$ (mA) |
|-------------------------|--------------|--------------------|------------------|
| 296                     | 3.0          | 84.9               | 5.1              |
| 471                     | 3.5          | 85.5               | 4.5              |
| 678                     | 4.0          | 86.0               | 4.0              |
| 940                     | 4.5          | 86.5               | 3.5              |
| 1270                    | 5.0          | 87.0               | 3.0              |
| 1705                    | 5.5          | 87.4               | 2.6              |

**Table 15. Recommended Bias Resistor Values for Various Supply Voltages,  $I_{DQ} = 60\text{ mA}$**

| $R_{BIAS}$ ( $\Omega$ ) | $V_{DD}$ (V) | $I_{DQ\_AMP}$ (mA) | $I_{RBIAS}$ (mA) |
|-------------------------|--------------|--------------------|------------------|
| 182                     | 2.0          | 56.2               | 3.8              |
| 406                     | 2.5          | 56.8               | 3.2              |
| 698                     | 3.0          | 57.3               | 2.7              |
| 1120                    | 3.5          | 57.8               | 2.2              |
| 1695                    | 4.0          | 58.2               | 1.8              |
| 2516                    | 4.5          | 58.6               | 1.4              |
| 3758                    | 5.0          | 58.9               | 1.1              |

## RECOMMENDED POWER MANAGEMENT CIRCUIT

Figure 97 shows a recommended power management circuit for the ADL8108. The LT8607 step-down regulator is used to step down a 12 V rail to 5.5 V, which is then applied to the LT3042 low dropout (LDO) linear regulator to generate a low noise 5 V output. While the circuit shown in Figure 97 has an input voltage of 12 V, the input range to the LT8607 can be as high as 42 V.

The 5.5 V regulator output ( $V_{REG}$ ) of the LT8607 is set by the R4A and R5A resistors according to the following equation:

$$R5A = R4A / ((V_{REG} / 0.778 \text{ V}) - 1) \quad (1)$$

The switching frequency ( $f_{SW}$ ) is set to 2 MHz by the 18.2 kΩ resistor (R2A) on the RT pin of the LT8607. The LT8607 data sheet provides a table of resistor values that can be used to select other switching frequencies ranging from 0.2 MHz to 2.200 MHz.

$V_{OUT}$  of the LT3042 is set by the R3B resistor connected to the SET pin, according to the following equation:

$$R3B = V_{OUT} / 100 \mu\text{A} \quad (2)$$

The resistors on the PGFB pins of the LT3042 are chosen to trigger the power-good (PG) signal when the output reaches 90% of its target voltage of 5 V. The PG open-collector output is pulled up to the 5 V output to give users a convenient 0 V or 5 V output voltage.

The LT8607 can source a maximum current of 750 mA, and the LT3042 can source a maximum current of 200 mA. If the power supply voltage is developed as a bus supply to serve multiple components, higher current devices can be used. The LT8608 and LT8609 step-down regulators can source a maximum current of 1.5 A and 3 A, respectively, and these devices are pin-compatible with the LT8607. The LT3045 linear regulator, which is pin-compatible with the LT3042, can source a maximum current up to 500 mA.

Table 16. Recommended Resistor Values to Set to Various LT3042 and LT8607 Output Voltages

| LT3042 LDO $V_{OUT}$ and Power Good Threshold |          |          |          | LT8607 $V_{REG}$          |          |          |
|-----------------------------------------------|----------|----------|----------|---------------------------|----------|----------|
| $V_{OUT}$ (V)                                 | R3B (kΩ) | R5B (kΩ) | R6B (kΩ) | Recommended $V_{REG}$ (V) | R4A (MΩ) | R5A (kΩ) |
| 2.0                                           | 20       | 453      | 90.9     | 2.5                       | 1        | 453      |
| 3.0                                           | 30.1     | 453      | 56.2     | 3.5                       | 1        | 287      |
| 3.3                                           | 33.2     | 453      | 51.1     | 3.8                       | 1        | 255      |
| 4.0                                           | 40.2     | 453      | 41.2     | 4.5                       | 1        | 210      |
| 5.0                                           | 49.9     | 453      | 32.4     | 5.5                       | 1        | 165      |

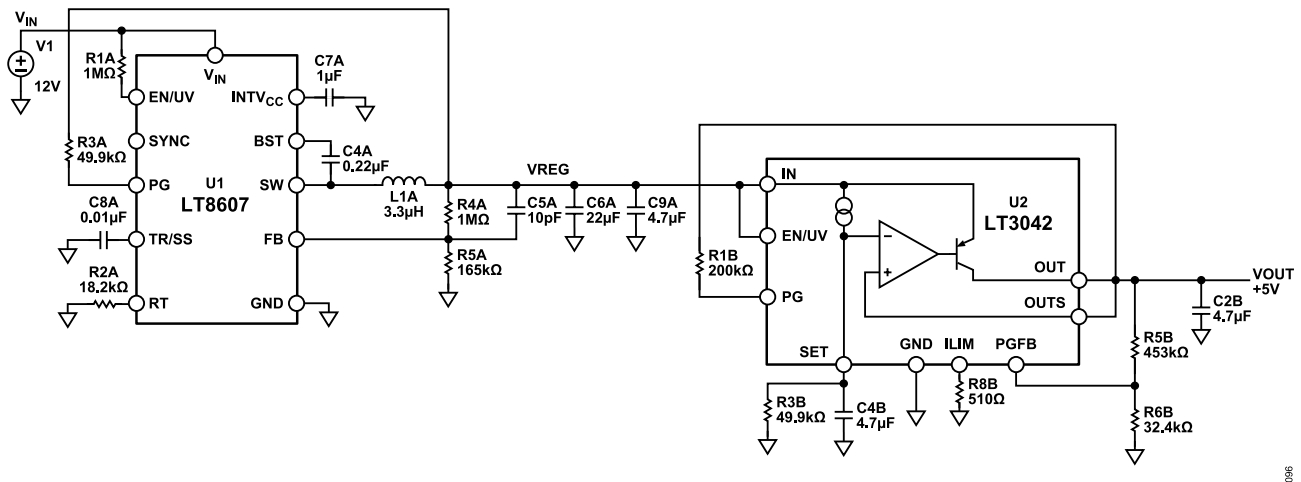
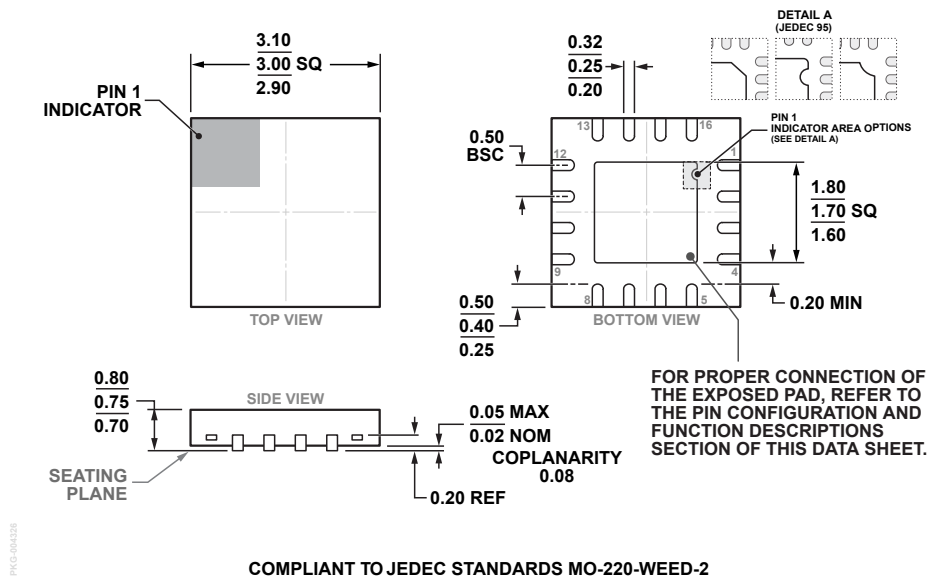


Figure 97. Recommended Power Management Circuit

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-220-WEED-2

Figure 98. 16-Lead Lead Frame Chip Scale Package [LFCSP]  
3 mm × 3 mm Body and 0.75 mm Package Height  
(CP-16-35)  
Dimensions Shown in millimeters

ORDERING GUIDE

| Model <sup>1, 2</sup> | Temperature Range | Package Description                  | Packing Quantity | Package Option |
|-----------------------|-------------------|--------------------------------------|------------------|----------------|
| ADL8108ACPZN          | -55°C to +125°C   | 16-Lead LFCSP, 3 mm × 3 mm × 0.75 mm | Tape, 1          | CP-16-35       |
| ADL8108ACPZN-R7       | -55°C to +125°C   | 16-Lead LFCSP, 3 mm × 3 mm × 0.75 mm | Reel, 1500       | CP-16-35       |

<sup>1</sup> Z = RoHS Compliant Part.

<sup>2</sup> The lead finish of the ADL8108ACPZN and ADL8108ACPZN-R7 is nickel palladium gold

EVALUATION BOARDS

| Model <sup>1</sup> | Description      |
|--------------------|------------------|
| ADL8108-EVALZ      | Evaluation Board |

<sup>1</sup> Z = RoHS Compliant Part.