

FEATURES

Radio frequency (RF) 2 × 2 transceiver with integrated 12-bit DACs and ADCs

Wide bandwidth: 325 MHz to 3.8 GHz

Supports time division duplex (TDD) and frequency division duplex (FDD) operation

Tunable channel bandwidth (BW): up to 20 MHz

Receivers: 6 differential or 12 single-ended inputs

Superior receiver sensitivity with a noise figure: 3 dB

Receive (Rx) gain control

Real-time monitor and control signals for manual gain

Independent automatic gain control (AGC)

Dual transmitters: 4 differential outputs

Highly linear broadband transmitter

Transmit (Tx) error vector magnitude (EVM): -34 dB

Tx noise: ≤ -157 dBm/Hz noise floor

Tx monitor: 66 dB dynamic range with 1 dB accuracy

Integrated fractional N synthesizers

2.4 Hz local oscillator (LO) step size

CMOS/LVDS digital interface

APPLICATIONS

3G enterprise femtocell base stations

4G femtocell base stations

Wireless video transmission

GENERAL DESCRIPTION

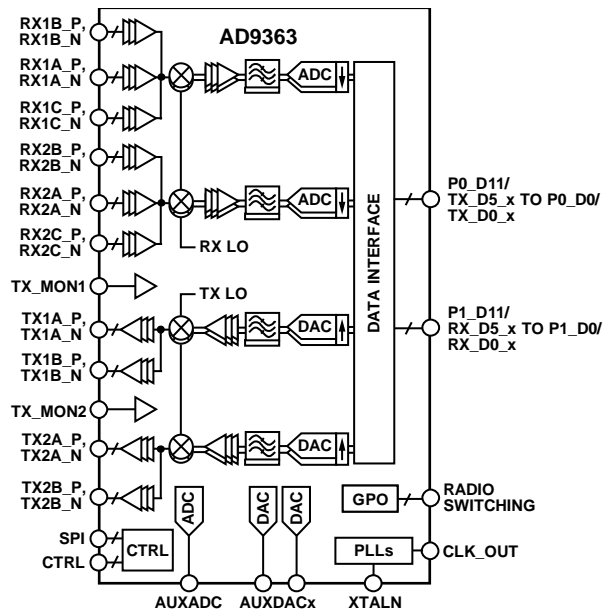
The **AD9363** is a high performance, highly integrated RF agile transceiver designed for use in 3G and 4G femtocell applications. Its programmability and wideband capability make it ideal for a broad range of transceiver applications. The device combines an RF front end with a flexible mixed-signal baseband section and integrated frequency synthesizers, simplifying design-in by providing a configurable digital interface to a processor. The **AD9363** operates in the 325 MHz to 3.8 GHz range, covering most licensed and unlicensed bands. Channel bandwidths from less than 200 kHz to 20 MHz are supported.

The two independent direct conversion receivers have state-of-the-art noise figure and linearity. Each Rx subsystem includes independent automatic gain control (AGC), dc offset correction, quadrature correction, and digital filtering, thereby eliminating the need for these functions in the digital baseband. The **AD9363** also has flexible manual gain modes that can be externally controlled. Two high dynamic range ADCs per channel digitize the received I and Q signals and pass them through configurable decimation filters and 128-tap finite impulse response (FIR) filters to produce a 12-bit output signal at the appropriate

Rev. D

[Document Feedback](#)

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

FUNCTIONAL BLOCK DIAGRAM

NOTES

1. SPI, CTRL, P0_D11/TX_D5_x TO P0_D0/TX_D0_x, P1_D11/RX_D5_x TO P1_D0/RX_D0_x, AND RADIO SWITCHING CONTAIN MULTIPLE PINS.

Figure 1.

10589-001

sample rate.

The transmitters use a direct conversion architecture that achieves high modulation accuracy with ultralow noise. This transmitter design produces a best-in-class Tx EVM of -34 dB, allowing significant system margin for the external power amplifier (PA) selection. The on-board Tx power monitor can be used as a power detector, enabling highly accurate Tx power measurements.

The fully integrated phase-locked loops (PLLs) provide low power fractional N frequency synthesis for all receive and transmit channels. Channel isolation, demanded by FDD systems, is integrated into the design. All voltage controlled oscillators (VCOs) and loop filter components are integrated.

The core of the **AD9363** can be powered directly from a 1.3 V regulator. The IC is controlled via a standard 4-wire serial port and four real-time I/O control pins. Comprehensive power-down modes are included to minimize power consumption during normal use. The **AD9363** is packaged in a 10 mm × 10 mm, 144-ball chip scale package ball grid array (CSP_BGA).

TABLE OF CONTENTS

| | | | |
|--|----|--|----|
| Features | 1 | 2.4 GHz Frequency Band | 24 |
| Applications | 1 | Theory of Operation | 28 |
| Functional Block Diagram | 1 | General | 28 |
| General Description | 1 | Receiver | 28 |
| Revision History | 2 | Transmitter | 28 |
| Specifications | 3 | Clock Input Options | 28 |
| Current Consumption—VDD_INTERFACE | 8 | Synthesizers | 28 |
| Current Consumption—VDDD1P3_DIG and VDDAx (Combination of All 1.3 V Supplies) | 11 | Digital Data Interface | 29 |
| Absolute Maximum Ratings | 15 | Enable State Machine | 29 |
| Reflow Profile | 15 | SPI Interface | 30 |
| Thermal Resistance | 15 | Control Pins | 30 |
| ESD Caution | 15 | GPO Pins (GPO_3 to GPO_0) | 30 |
| Pin Configuration and Function Descriptions | 16 | Auxiliary Converters | 30 |
| Typical Performance Characteristics | 20 | Packaging and Ordering Information | 32 |
| 800 MHz Frequency Band | 20 | Outline Dimensions | 32 |
| | | Ordering Guide | 32 |

REVISION HISTORY

11/2016—Revision D: Initial Version

SPECIFICATIONS

Electrical characteristics at VDD_GPO = 3.3 V, VDD_INTERFACE = 1.8 V, and all other VDDx pins (VDDA1P3_TX_LO, VDDA1P3_TX_VCO_LDO, VDDA1P3_RX_LO, VDDA1P3_RX_VCO_LDO, VDDA1P3_RX_RF, VDDA1P3_RX_TX, VDDA1P3_TX_LO_BUFFER, VDDA1P3_TX_SYNTH, VDDA1P3_RX_SYNTH, VDDD1P3_DIG, and VDDA1P3_BB) = 1.3 V, T_A = 25°C, unless otherwise noted.

Table 1.

| Parameter ¹ | Symbol | Min | Typ | Max | Unit | Test Conditions/Comments |
|--|--------|-----|------|------|---------|--|
| RECEIVERS, GENERAL | | | | | | |
| Center Frequency | | 325 | | 3800 | MHz | |
| Rx Bandwidth | | | | 20 | MHz | |
| Gain | | | | | | |
| Minimum | | | 0 | | dB | |
| Maximum | | | 74.5 | | dB | At 800 MHz |
| | | | 73.0 | | dB | At 2300 MHz (RX1A_x, RX2A_x) |
| | | | 72.0 | | dB | At 2300 MHz (RX1B_x, RX1C_x, RX2B_x, RX2C_x) |
| Gain Step | | | 1 | | dB | |
| Received Signal Strength Indicator | RSSI | | | | | |
| Range | | | 100 | | dB | |
| Accuracy | | | ±2 | | dB | |
| RECEIVERS, 800 MHz | | | | | | |
| Noise Figure | NF | | 2.5 | | dB | Maximum Rx gain |
| Third-Order Input Intermodulation Intercept Point | IIP3 | | -18 | | dBm | Maximum Rx gain |
| Second-Order Input Intermodulation Intercept Point | IIP2 | | 40 | | dBm | Maximum Rx gain |
| Local Oscillator (LO) Leakage | | | -122 | | dBm | At Rx front-end input |
| Quadrature | | | | | | |
| Gain Error | | | 0.2 | | % | |
| Phase Error | | | 0.2 | | Degrees | |
| Modulation Accuracy (EVM) | | | -34 | | dB | 19.2 MHz reference clock |
| Input Return Loss | S11 | | -10 | | dB | |
| RX1x_x to RX2x_x Isolation | | | | | | |
| RX1A_x to RX2A_x, RX1C_x to RX2C_x | | | 70 | | dB | |
| RX1B_x to RX2B_x | | | 55 | | dB | |
| RX2_x to RX1_x Isolation | | | | | | |
| RX2A_x to RX1A_x, RX2C_x to RX1C_x | | | 70 | | dB | |
| RX2B_x to RX1B_x | | | 55 | | dB | |
| RECEIVERS, 2.4 GHz | | | | | | |
| Noise Figure | NF | | 3 | | dB | Maximum Rx gain |
| Third-Order Input Intermodulation Intercept Point | IIP3 | | -14 | | dBm | Maximum Rx gain |
| Second-Order Input Intermodulation Intercept Point | IIP2 | | 45 | | dBm | Maximum Rx gain |
| Local Oscillator (LO) Leakage | | | -110 | | dBm | At Rx front-end input |
| Quadrature | | | | | | |
| Gain Error | | | 0.2 | | % | |
| Phase Error | | | 0.2 | | Degrees | |
| Modulation Accuracy (EVM) | | | -34 | | dB | 40 MHz reference clock |
| Input Return Loss | S11 | | -10 | | dB | |
| RX1x_x to RX2x_x Isolation | | | | | | |
| RX1A_x to RX2A_x, RX1C_x to RX2C_x | | | 65 | | dB | |
| RX1B_x to RX2B_x | | | 50 | | dB | |

| Parameter ¹ | Symbol | Min | Typ | Max | Unit | Test Conditions/Comments |
|--|--------|-----|----------|------|----------|---------------------------|
| RX2x_x to RX1x_x Isolation RX2A_x to RX1A_x, RX2C_x to RX1C_x RX2B_x to RX1B_x | | | 65 50 | | dB dB | |
| RECEIVERS, 3.5 GHz | | | | | | |
| Noise Figure | NF | | 3.3 | | dB | Maximum Rx gain |
| Third-Order Input Intermodulation Intercept Point | IIP3 | | -15 | | dBm | Maximum Rx gain |
| Second-Order Input Intermodulation Intercept Point | IIP2 | | 44 | | dBm | Maximum Rx gain |
| Local Oscillator (LO) Leakage Quadrature | | | -100 | | dBm | At Rx front-end input |
| Gain Error | | | 0.2 | | % | |
| Phase Error | | | 0.2 | | Degrees | |
| Modulation Accuracy (EVM) | | | -34 | | dB | 40 MHz reference clock |
| Input Return Loss | S11 | | -10 | | dB | |
| RX1x_x to RX2x_x Isolation RX1A_x to RX2A_x, RX1C_x to RX2C_x RX1B_x to RX2B_x | | | 60 48 | | dB dB | |
| RX2x_x to RX1x_x Isolation RX2A_x to RX1A_x, RX2C_x to RX1C_x RX2B_x to RX1B_x | | | 60 48 | | dB dB | |
| TRANSMITTERS, GENERAL | | | | | | |
| Center Frequency | | 325 | | 3800 | MHz | |
| Tx Bandwidth | | | | 20 | MHz | |
| Power Control Range | | | 90 | | dB | |
| Power Control Resolution | | | 0.25 | | dB | |
| TRANSMITTERS, 800 MHz | | | | | | |
| Output Return Loss | S22 | | -10 | | dB | 1 MHz tone into 50 Ω load |
| Maximum Output Power | | | 8 | | dBm | 19.2 MHz reference clock |
| Modulation Accuracy (EVM) | | | -34 | | dB | |
| Third-Order Output Intermodulation Intercept Point | OIP3 | | 23 | | dBm | |
| Carrier Leakage | | | -50 | | dBc | 0 dB attenuation |
| | | | -32 | | dBc | 40 dB attenuation |
| Noise Floor | | | -157 | | dBm/Hz | 90 MHz offset |
| Isolation TX1x_x to TX2x_x TX2x_x to TX1x_x | | | 50 50 | | dB dB | |
| TRANSMITTERS, 2.4 GHz | | | | | | |
| Output Return Loss | S22 | | -10 | | dB | 1 MHz tone into 50 Ω load |
| Maximum Output Power | | | 7.5 | | dBm | 40 MHz reference clock |
| Modulation Accuracy (EVM) | | | -34 | | dB | |
| Third-Order Output Intermodulation Intercept Point | OIP3 | | 19 | | dBm | |
| Carrier Leakage | | | -50 | | dBc | 0 dB attenuation |
| | | | -32 | | dBc | 40 dB attenuation |
| Noise Floor | | | -156 | | dBm/Hz | 90 MHz offset |
| Isolation TX1x_x to TX2x_x TX2x_x to TX1x_x | | | 50 50 | | dB dB | |
| TRANSMITTERS, 3.5 GHz | | | | | | |
| Output Return Loss | S22 | | -10 | | dB | 1 MHz tone into 50 Ω load |
| Maximum Output Power | | | 7.0 | | dBm | 40 MHz reference clock |
| Modulation Accuracy (EVM) | | | -34 | | dB | |

| Parameter ¹ | Symbol | Min | Typ | Max | Unit | Test Conditions/Comments |
|--|--------|-----|------|-----|--------|--------------------------|
| Third-Order Output Intermodulation Intercept Point | OIP3 | | 18 | | dBm | |
| Carrier Leakage | | | -50 | | dBc | 0 dB attenuation |
| | | | -31 | | dBc | 40 dB attenuation |
| Noise Floor | | | -154 | | dBm/Hz | 90 MHz offset |
| Isolation | | | | | | |
| TX1 to TX2 | | | 50 | | dB | |
| TX2 to TX1 | | | 50 | | dB | |

¹ When referencing a single function of a multifunction pin in the parameters, only the portion of the pin name that is relevant to the specification is listed. For full pin names of multifunction pins, refer to the Pin Configuration and Function Descriptions section.

Table 2.

| Parameter ¹ | Symbol | Min | Typ | Max | Unit | Test Conditions/Comments |
|--|--------|---------------------|-------------------|---------------------|-------|---|
| TX MONITOR INPUTS (TX_MON1, TX_MON2) | | | | | | |
| Maximum Input Level | | | 4 | | dBm | |
| Dynamic Range | | | 66 | | dB | |
| Accuracy | | | 1 | | dB | |
| LO SYNTHESIZER | | | | | | |
| LO Frequency Step | | | 2.4 | | Hz | 2.4 GHz, 40 MHz reference clock |
| Integrated Phase Noise | | | 0.3 | | °rms | 100 Hz to 100 MHz |
| REFERENCE CLOCK (REF_CLK) | | | | | | |
| Input Frequency Range | | 10 | | 80 | MHz | REF_CLK is the input to the XTALN pin |
| Input Signal Level | | | 1.3 | | V p-p | External oscillator AC-coupled external oscillator |
| AUXILIARY ADC | | | | | | |
| Resolution | | | 12 | | Bits | |
| Input Voltage | | | | | | |
| Minimum | | | 0.05 | | V | |
| Maximum | | | VDDA1P3_BB – 0.05 | | V | |
| AUXILIARY DAC | | | | | | |
| Resolution | | | 10 | | Bits | |
| Output Voltage | | | | | | |
| Minimum | | | 0.5 | | V | |
| Maximum | | | VDD_GPO – 0.3 | | V | |
| Output Current | | | 10 | | mA | |
| DIGITAL SPECIFICATIONS (CMOS) | | | | | | |
| Logic Inputs | | | | | | |
| Input Voltage High | | VDD_INTERFACE × 0.8 | | VDD_INTERFACE | V | |
| Input Voltage Low | | 0 | | VDD_INTERFACE × 0.2 | V | |
| Input Current High | | -10 | | +10 | µA | |
| Input Current Low | | -10 | | +10 | µA | |
| Logic Outputs | | | | | | |
| Output Voltage High | | VDD_INTERFACE × 0.8 | | VDD_INTERFACE | V | |
| Output Voltage Low | | 0 | | VDD_INTERFACE × 0.2 | V | |
| DIGITAL SPECIFICATIONS (LVDS) | | | | | | |
| Logic Inputs | | | | | | |
| Input Voltage Range | | 825 | | 1575 | mV | Each differential input in the pair |
| Input Differential Voltage Threshold | | -100 | | +100 | mV | |

| Parameter ¹ | Symbol | Min | Typ | Max | Unit | Test Conditions/Comments |
|---|---------------|-----------------------|------|-----------------------|----------|---|
| Receiver Differential Input Impedance | | | 100 | | Ω | |
| Logic Outputs | | | | | | |
| Output Voltage High | | | | 1375 | mV | |
| Output Voltage Low | | 1025 | | | mV | |
| Output Differential Voltage | | 150 | | | mV | Programmable in 75 mV steps |
| Output Offset Voltage | | | 1200 | | mV | |
| GENERAL-PURPOSE OUTPUTS | | | | | | |
| Output Voltage High | | $VDD_GPO \times 0.8$ | | VDD_GPO | V | |
| Output Voltage Low | | 0 | | $VDD_GPO \times 0.2$ | V | |
| Output Current | | | 10 | | mA | |
| SPI TIMING | | | | | | $VDD_INTERFACE = 1.8\text{ V}$ |
| SPI_CLK | | | | | | |
| Period | t_{CP} | 20 | | | ns | |
| Pulse Width | t_{MP} | 9 | | | ns | |
| SPI_EN Setup to First SPI_CLK Rising Edge | t_{SC} | 1 | | | ns | |
| Last SPI_CLK Falling Edge to SPI_ENB Hold | t_{HC} | 0 | | | ns | |
| SPI_DI | | | | | | |
| Data Input Setup to SPI_CLK | t_S | 2 | | | ns | |
| Data Input Hold to SPI_CLK | t_H | 1 | | | ns | |
| SPI_CLK Rising Edge to Output Data Delay | | | | | | |
| 4-Wire Mode | t_{CO} | 3 | | 8 | ns | |
| 3-Wire Mode | t_{CO} | 3 | | 8 | ns | |
| Bus Turnaround Time, Read (Master) | t_{HZM} | t_H | | $t_{CO(MAX)}$ | ns | After baseband processors (BBP) drives the last address bit |
| Bus Turnaround Time, Read (Slave) | t_{HZS} | 0 | | $t_{CO(MAX)}$ | ns | After AD9363 drives the last data bit |
| DIGITAL DATA TIMING (CMOS), $VDD_INTERFACE = 1.8\text{ V}$ | | | | | | |
| DATA_CLK_x Clock Period | t_{CP} | 16.276 | | | ns | 61.44 MHz |
| DATA_CLK_x and FB_CLK_x Pulse Width | t_{MP} | 45% of t_{CP} | | 55% of t_{CP} | ns | |
| Tx Data | | | | | | |
| Setup to FB_CLK_x | t_{STX} | 1 | | | ns | |
| Hold to FB_CLK_x | t_{HTX} | 0 | | | ns | |
| DATA_CLK_x to Data Bus Output Delay | t_{DDR} | 0 | | 1.5 | ns | TX_FRAME_x, PO_Dx, and P1_Dx |
| DATA_CLK_x to RX_FRAME_x Delay | t_{DDV} | 0 | | 1.0 | ns | |
| Pulse Width | | | | | | |
| ENABLE | t_{ENPW} | t_{CP} | | | ns | |
| TXNRX | $t_{TXNRXPW}$ | t_{CP} | | | ns | FDD independent enable state machine (ENSM) mode |
| TXNRX Setup to ENABLE | $t_{TXNRXSU}$ | 0 | | | ns | TDD ENSM mode |
| Bus Turnaround Time | | | | | | TDD mode |
| Before Rx | t_{RPRE} | $2 \times t_{CP}$ | | | ns | |
| After Rx | t_{RPST} | $2 \times t_{CP}$ | | | ns | |
| Capacitive Load | | | 3 | | pF | |
| Capacitive Input | | | 3 | | pF | |

| Parameter ¹ | Symbol | Min | Typ | Max | Unit | Test Conditions/Comments |
|--|----------------------|------------------------|-----|------------------------|------|--|
| DIGITAL DATA TIMING (CMOS), VDD_INTERFACE = 2.5 V | | | | | | |
| DATA_CLK_x Clock Period | t _{CP} | 16.276 | | | ns | 61.44 MHz |
| DATA_CLK_x and FB_CLK_x Pulse Width | t _{MP} | 45% of t _{CP} | | 55% of t _{CP} | ns | |
| Tx Data | | | | | | |
| Setup to FB_CLK_x | t _{STX} | 1 | | | ns | TX_FRAME_x, P0_Dx, and P1_Dx |
| Hold to FB_CLK_x | t _{HTX} | 0 | | | ns | |
| DATA_CLK_x to Data Bus Output Delay | t _{DDR} | 0.25 | | 1.25 | ns | |
| DATA_CLK_x to RX_FRAME_x Delay | t _{DDV} | 0.25 | | 1.25 | ns | |
| Pulse Width | | | | | | |
| ENABLE | t _{ENPW} | t _{CP} | | | ns | FDD independent ENSM mode TDD ENSM mode TDD mode |
| TXNRX | t _{TXNRXPW} | t _{CP} | | | ns | |
| TXNRX Setup to ENABLE | t _{TXNRXSU} | 0 | | | ns | |
| Bus Turnaround Time | | | | | | |
| Before Rx | t _{RPRE} | 2 × t _{CP} | | | ns | |
| After Rx | t _{RPST} | 2 × t _{CP} | | | ns | |
| Capacitive Load | | | 3 | | pF | |
| Capacitive Input | | | 3 | | pF | |
| DIGITAL DATA TIMING (LVDS) | | | | | | |
| DATA_CLK_x Clock Period | t _{CP} | 4.069 | | | ns | 245.76 MHz |
| DATA_CLK_x and FB_CLK_x Pulse Width | t _{MP} | 45% of t _{CP} | | 55% of t _{CP} | ns | |
| Tx Data | | | | | | |
| Setup to FB_CLK_x | t _{STX} | 1 | | | ns | TX_FRAME_x and TX_Dx |
| Hold to FB_CLK_x | t _{HTX} | 0 | | | ns | |
| DATA_CLK_x to Data Bus Output Delay | t _{DDR} | 0 | | 1.5 | ns | |
| DATA_CLK_x to RX_FRAME_x Delay | t _{DDV} | 0 | | 1.0 | ns | |
| Pulse Width | | | | | | |
| ENABLE | t _{ENPW} | t _{CP} | | | ns | FDD independent ENSM mode TDD ENSM mode |
| TXNRX | t _{TXNRXPW} | t _{CP} | | | ns | |
| TXNRX Setup to ENABLE | t _{TXNRXSU} | 0 | | | ns | |
| Bus Turnaround Time | | | | | | |
| Before Rx | t _{RPRE} | 2 × t _{CP} | | | ns | |
| After Rx | t _{RPST} | 2 × t _{CP} | | | ns | |
| Capacitive Load | | | 3 | | pF | |
| Capacitive Input | | | 3 | | pF | |
| SUPPLY CHARACTERISTICS | | | | | | |
| 1.3 V Main Supply | | 1.267 | 1.3 | 1.33 | V | |
| VDD_INTERFACE Supply | | | | | | |
| CMOS | | 1.2 | | 2.5 | V | |
| LVDS | | 1.8 | | 2.5 | V | |
| VDD_GPO Supply | | 1.3 | 3.3 | 3.465 | V | When unused, must be set to 1.3 V |
| Current Consumption | | | | | | |
| VDDx, Sleep Mode | | | 180 | | μA | Sum of all input currents |
| VDD_GPO | | | 50 | | μA | No load |

¹ When referencing a single function of a multifunction pin in the parameters, only the portion of the pin name that is relevant to the specification is listed. For full pin names of multifunction pins, refer to the Pin Configuration and Function Descriptions section.

CURRENT CONSUMPTION—VDD_INTERFACE

Table 3. VDD_INTERFACE = 1.2 V

| Parameter | Min | Typ | Max | Unit | Test Conditions/Comments |
|--|-----|-----|-----|------|--------------------------------|
| SLEEP MODE | | 45 | | μA | Power applied, device disabled |
| ONE Rx CHANNEL, ONE Tx CHANNEL, DOUBLE DATA RATE (DDR) | | | | | |
| LTE10 | | | | | |
| Single Port | | 2.9 | | mA | 30.72 MHz data clock, CMOS |
| Dual Port | | 2.7 | | mA | 15.36 MHz data clock, CMOS |
| LTE20 | | | | | |
| Dual Port | | 5.2 | | mA | 30.72 MHz data clock, CMOS |
| TWO Rx CHANNELS, TWO Tx CHANNELS, DDR | | | | | |
| LTE3 | | | | | |
| Dual Port | | 1.3 | | mA | 7.68 MHz data clock, CMOS |
| LTE10 | | | | | |
| Single Port | | 4.6 | | mA | 61.44 MHz data clock, CMOS |
| Dual Port | | 5.0 | | mA | 30.72 MHz data clock, CMOS |
| LTE20 | | | | | |
| Dual Port | | 8.2 | | mA | 61.44 MHz data clock, CMOS |
| GSM | | | | | |
| Dual Port | | 0.2 | | mA | 1.08 MHz data clock, CMOS |
| WiMAX 8.75 MHz | | | | | |
| Dual Port | | 3.3 | | mA | 20 MHz data clock, CMOS |
| WiMAX 10 MHz | | | | | |
| Single Port | | | | | |
| TDD Rx | | 0.5 | | mA | 22.4 MHz data clock, CMOS |
| TDD Tx | | 3.6 | | mA | 22.4 MHz data clock, CMOS |
| FDD | | 3.8 | | mA | 44.8 MHz data clock, CMOS |
| WiMAX 20 MHz | | | | | |
| Dual Port | | | | | |
| FDD | | 6.7 | | mA | 44.8 MHz data clock, CMOS |

Table 4. VDD_INTERFACE = 1.8 V

| Parameter | Min | Typ | Max | Unit | Test Conditions/Comments |
|---------------------------------------|-----|------|-----|------|--------------------------------|
| SLEEP MODE | | 84 | | μA | Power applied, device disabled |
| ONE Rx CHANNEL, ONE Tx CHANNEL, DDR | | | | | |
| LTE10 | | | | | |
| Single Port | | 4.5 | | mA | 30.72 MHz data clock, CMOS |
| Dual Port | | 4.1 | | mA | 15.36 MHz data clock, CMOS |
| LTE20 | | | | | |
| Dual Port | | 8.0 | | mA | 30.72 MHz data clock, CMOS |
| TWO Rx CHANNELS, TWO Tx CHANNELS, DDR | | | | | |
| LTE3 | | | | | |
| Dual Port | | 2.0 | | mA | 7.68 MHz data clock, CMOS |
| LTE10 | | | | | |
| Single Port | | 8.0 | | mA | 61.44 MHz data clock, CMOS |
| Dual Port | | 7.5 | | mA | 30.72 MHz data clock, CMOS |
| LTE20 | | | | | |
| Dual Port | | 14.0 | | mA | 61.44 MHz data clock, CMOS |
| GSM | | | | | |
| Dual Port | | 0.3 | | mA | 1.08 MHz data clock, CMOS |
| WiMAX 8.75 MHz | | | | | |
| Dual Port | | 5.0 | | mA | 20 MHz data clock, CMOS |
| WiMAX 10 MHz | | | | | |
| Single Port | | | | | |
| TDD Rx | | 0.7 | | mA | 22.4 MHz data clock, CMOS |
| TDD Tx | | 5.6 | | mA | 22.4 MHz data clock, CMOS |
| FDD | | 6.0 | | mA | 44.8 MHz data clock, CMOS |
| WiMAX 20 MHz | | | | | |
| Dual Port | | | | | |
| FDD | | 10.7 | | mA | 44.8 MHz data clock, CMOS |

Table 5. VDD_INTERFACE = 2.5 V

| Parameter | Min | Typ | Max | Unit | Test Conditions/Comments |
|---------------------------------------|-----|------|-----|------|--------------------------------|
| SLEEP MODE | | 150 | | μA | Power applied, device disabled |
| ONE Rx CHANNEL, ONE Tx CHANNEL, DDR | | | | | |
| LTE10 | | | | | |
| Single Port | | 6.5 | | mA | 30.72 MHz data clock, CMOS |
| Dual Port | | 6.0 | | mA | 15.36 MHz data clock, CMOS |
| LTE20 | | | | | |
| Dual Port | | 11.5 | | mA | 30.72 MHz data clock, CMOS |
| TWO Rx CHANNELS, TWO Tx CHANNELS, DDR | | | | | |
| LTE3 | | | | | |
| Dual Port | | 3.0 | | mA | 7.68 MHz data clock, CMOS |
| LTE10 | | | | | |
| Single Port | | 11.5 | | mA | 61.44 MHz data clock, CMOS |
| Dual Port | | 10.0 | | mA | 30.72 MHz data clock, CMOS |
| LTE20 | | | | | |
| Dual Port | | 20.0 | | mA | 61.44 MHz data clock, CMOS |
| GSM | | | | | |
| Dual Port | | 0.5 | | mA | 1.08 MHz data clock, CMOS |
| WiMAX 8.75 MHz | | | | | |
| Dual Port | | 7.3 | | mA | 20 MHz data clock, CMOS |
| WiMAX 10 MHz | | | | | |
| Single Port | | | | | |
| TDD Rx | | 1.3 | | mA | 22.4 MHz data clock, CMOS |
| TDD Tx | | 8.0 | | mA | 22.4 MHz data clock, CMOS |
| FDD | | 8.7 | | mA | 44.8 MHz data clock, CMOS |
| WiMAX 20 MHz | | | | | |
| Dual Port | | | | | |
| FDD | | 15.3 | | mA | 44.8 MHz data clock, CMOS |

CURRENT CONSUMPTION—VDD_x (COMBINATION OF ALL 1.3 V SUPPLIES)

Table 6. TDD Mode, 800 MHz

| Parameter | Min | Typ | Max | Unit | Test Conditions/Comments |
|-----------------|-----|-----|-----|------|--------------------------|
| ONE Rx CHANNEL | | | | | Continuous Rx |
| 5 MHz BW | | 180 | | mA | |
| 10 MHz BW | | 210 | | mA | |
| 20 MHz BW | | 260 | | mA | |
| TWO Rx CHANNELS | | | | | Continuous Rx |
| 5 MHz BW | | 265 | | mA | |
| 10 MHz BW | | 315 | | mA | |
| 20 MHz BW | | 405 | | mA | |
| ONE Tx CHANNEL | | | | | Continuous Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 340 | | mA | |
| -27 dBm | | 190 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 360 | | mA | |
| -27 dBm | | 220 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 400 | | mA | |
| -27 dBm | | 250 | | mA | |
| TWO Tx CHANNELS | | | | | Continuous Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 550 | | mA | |
| -27 dBm | | 260 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 600 | | mA | |
| -27 dBm | | 310 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 660 | | mA | |
| -27 dBm | | 370 | | mA | |

Table 7. TDD Mode, 2.4 GHz

| Parameter | Min | Typ | Max | Unit | Test Conditions/Comments |
|-----------------|-----|-----|-----|------|--------------------------|
| ONE Rx CHANNEL | | | | | Continuous Rx |
| 5 MHz BW | | 175 | | mA | |
| 10 MHz BW | | 200 | | mA | |
| 20 MHz BW | | 240 | | mA | |
| TWO Rx CHANNELS | | | | | Continuous Rx |
| 5 MHz BW | | 260 | | mA | |
| 10 MHz BW | | 305 | | mA | |
| 20 MHz BW | | 390 | | mA | |
| ONE Tx CHANNEL | | | | | Continuous Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 350 | | mA | |
| -27 dBm | | 160 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 380 | | mA | |
| -27 dBm | | 220 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 410 | | mA | |
| -27 dBm | | 260 | | mA | |
| TWO Tx CHANNELS | | | | | Continuous Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 580 | | mA | |
| -27 dBm | | 280 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 635 | | mA | |
| -27 dBm | | 330 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 690 | | mA | |
| -27 dBm | | 390 | | mA | |

Table 8. FDD Mode, 800 MHz

| Parameter | Min | Typ | Max | Unit | Test Conditions/Comments |
|----------------------------------|-----|------|-----|------|--------------------------|
| ONE Rx CHANNEL, ONE Tx CHANNEL | | | | | Continuous Rx and Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 490 | | mA | |
| -27 dBm | | 345 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 540 | | mA | |
| -27 dBm | | 395 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 615 | | mA | |
| -27 dBm | | 470 | | mA | |
| TWO Rx CHANNELS, ONE Tx CHANNEL | | | | | Continuous Rx and Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 555 | | mA | |
| -27 dBm | | 410 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 625 | | mA | |
| -27 dBm | | 480 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 740 | | mA | |
| -27 dBm | | 600 | | mA | |
| ONE Rx CHANNEL, TWO Tx CHANNELS | | | | | Continuous Rx and Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 685 | | mA | |
| -27 dBm | | 395 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 755 | | mA | |
| -27 dBm | | 465 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 850 | | mA | |
| -27 dBm | | 570 | | mA | |
| TWO Rx CHANNELS, TWO Tx CHANNELS | | | | | |
| 5 MHz BW | | | | | |
| 7 dBm | | 790 | | mA | |
| -27 dBm | | 495 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 885 | | mA | |
| -27 dBm | | 590 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 1020 | | mA | |
| -27 dBm | | 730 | | mA | |

Table 9. FDD Mode, 2.4 GHz

| Parameter | Min | Typ | Max | Unit | Test Conditions/Comments |
|----------------------------------|-----|------|-----|------|--------------------------|
| ONE Rx CHANNEL, ONE Tx CHANNEL | | | | | Continuous Rx and Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 500 | | mA | |
| -27 dBm | | 350 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 540 | | mA | |
| -27 dBm | | 390 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 620 | | mA | |
| -27 dBm | | 475 | | mA | |
| TWO Rx CHANNELS, ONE Tx CHANNEL | | | | | Continuous Rx and Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 590 | | mA | |
| -27 dBm | | 435 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 660 | | mA | |
| -27 dBm | | 510 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 770 | | mA | |
| -27 dBm | | 620 | | mA | |
| ONE Rx CHANNEL, TWO Tx CHANNELS | | | | | Continuous Rx and Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 730 | | mA | |
| -27 dBm | | 425 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 800 | | mA | |
| -27 dBm | | 500 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 900 | | mA | |
| -27 dBm | | 600 | | mA | |
| TWO Rx CHANNELS, TWO Tx CHANNELS | | | | | Continuous Rx and Tx |
| 5 MHz BW | | | | | |
| 7 dBm | | 820 | | mA | |
| -27 dBm | | 515 | | mA | |
| 10 MHz BW | | | | | |
| 7 dBm | | 900 | | mA | |
| -27 dBm | | 595 | | mA | |
| 20 MHz BW | | | | | |
| 7 dBm | | 1050 | | mA | |
| -27 dBm | | 740 | | mA | |

ABSOLUTE MAXIMUM RATINGS**Table 10.**

| Parameter | Rating |
|---|------------------------------------|
| VDDx to VSSx | −0.3 V to +1.4 V |
| VDD_INTERFACE to VSSx | −0.3 V to +3.0 V |
| VDD_GPO to VSSx | −0.3 V to +3.9 V |
| Logic Inputs and Outputs to VSSx | −0.3 V to VDD_INTERFACE + 0.3 V |
| Input Current to Any Pin Except Supplies | ±10 mA |
| RF Inputs (Peak Power) | 2.5 dBm |
| Tx Monitor Input Power (Peak Power) | 9 dBm |
| Package Power Dissipation | $(T_{JMAX} - T_A)/\theta_{JA}$ |
| Maximum Junction Temperature (T_{JMAX}) | 110°C |
| Temperature Range | |
| Operating | −40°C to +85°C |
| Storage | −65°C to +150°C |
| Reflow | 260°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.

REFLOW PROFILE

The AD9363 reflow profile is in accordance with the JEDEC JESD20 criteria for Pb-free devices. The maximum reflow temperature is 260°C.

THERMAL RESISTANCE

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

Careful attention to PCB thermal design is required.

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

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

Table 11. Thermal Resistance

| Package Type | Airflow Velocity (m/sec) | θ_{JA} ² | θ_{JC} ³ | Unit |
|-----------------------|--------------------------|----------------------------|----------------------------|------|
| BC-144-7 ¹ | 0 | 32.3 | 9.6 | °C/W |
| | 1.0 | 29.6 | N/A ⁴ | °C/W |
| | 2.5 | 27.8 | N/A ⁴ | °C/W |

¹ Per JEDEC JESD51-7, plus JEDEC JESD51-5 2S2P test board.

² Per JEDEC JESD51-2 (still air) or JEDEC JESD51-6 (moving air).

³ Per MIL-STD-883, Method 1012.1.

⁴ N/A means not applicable.

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

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|--------|--------------------|----------------------|-------------|-----------|-----------|----------------|----------------|---------------|--------------------|----------------|---------------|
| A | RX2A_N | RX2A_P | DNC | VSSA | TX_MON2 | VSSA | TX2A_N | TX2A_P | TX2B_N | TX2B_P | VDDA1P1_TX_VCO | VSSA |
| B | VSSA | VSSA | AUXDAC1 | GPO_3 | GPO_2 | GPO_1 | GPO_0 | VDD_GPO | VDDA1P3_TX_LO | VDDA1P3_TX_VCO_LDO | TX_VCO_LDO_OUT | VSSA |
| C | RX2C_P | VSSA | AUXDAC2 | TEST/ENABLE | CTRL_IN0 | CTRL_IN1 | VSSA | VSSA | VSSA | VSSA | VSSA | VSSA |
| D | RX2C_N | VDDA1P3_RX_RF | VDDA1P3_RX_TX | CTRL_OUT0 | CTRL_IN3 | CTRL_IN2 | P0_D9/TX_D4_P | P0_D7/TX_D3_P | P0_D5/TX_D2_P | P0_D3/TX_D1_P | P0_D1/TX_D0_P | VSSD |
| E | RX2B_P | VDDA1P3_RX_LO | VDDA1P3_TX_LO_BUFFER | CTRL_OUT1 | CTRL_OUT2 | CTRL_OUT3 | P0_D11/TX_D5_P | P0_D8/TX_D4_N | P0_D6/TX_D3_N | P0_D4/TX_D2_N | P0_D2/TX_D1_N | P0_D0/TX_D0_N |
| F | RX2B_N | VDDA1P3_RX_VCO_LDO | VSSA | CTRL_OUT6 | CTRL_OUT5 | CTRL_OUT4 | VSSD | P0_D10/TX_D5_N | VSSD | FB_CLK_P | VSSD | VDDD1P3_DIG |
| G | VSSA | RX_VCO_LDO_OUT | VDDA1P1_RX_VCO | CTRL_OUT7 | EN_AGC | ENABLE | RX_FRAME_N | RX_FRAME_P | TX_FRAME_P | FB_CLK_N | DATA_CLK_P | VSSD |
| H | RX1B_P | VSSA | VSSA | TXNRX | VSSA | VSSA | VSSD | P1_D11/RX_D5_P | TX_FRAME_N | VSSD | DATA_CLK_N | VDD_INTERFACE |
| J | RX1B_N | VSSA | VDDA1P3_RX_SYNTH | SPI_DI | SPI_CLK | CLK_OUT | P1_D10/RX_D5_N | P1_D9/RX_D4_P | P1_D7/RX_D3_P | P1_D5/RX_D2_P | P1_D3/RX_D1_P | P1_D1/RX_D0_P |
| K | RX1C_P | VSSA | VDDA1P3_TX_SYNTH | VDDA1P3_BB | RESET | SPI_EN | P1_D8/RX_D4_N | P1_D6/RX_D3_N | P1_D4/RX_D2_N | P1_D2/RX_D1_N | P1_D0/RX_D0_N | VSSD |
| L | RX1C_N | VSSA | VSSA | RBIAS | AUXADC | SPI_DO | VSSA | VSSA | VSSA | VSSA | VSSA | VSSA |
| M | RX1A_P | RX1A_N | DNC | VSSA | TX_MON1 | VSSA | TX1A_P | TX1A_N | TX1B_P | TX1B_N | DNC | XTALN |

| | |
|---|--|
| ANALOG I/O | DC POWER |
| DIGITAL I/O | GROUND |
| DO NOT CONNECT | |

Figure 2. Pin Configuration, Top View

Table 12. Pin Function Descriptions

| Pin No. | Type ¹ | Mnemonic | Description |
|--|-------------------|----------------------|--|
| A1, A2 | I | RX2A_N, RX2A_P | Receive Channel 2 Differential A Inputs. Alternatively, each pin can be used as a single-ended input. Unused pins must be tied to ground. |
| A3, M3, M11 | NC | DNC | Do Not Connect. Do not connect to these pins. |
| A4, A6, A12, B1, B2, B12, C2, C7 to C12, F3, G1, H2, H3, H5, H6, J2, K2, L2, L3, L7 to L12, M4, M6 | GND | VSSA | Analog Ground. Tie these pins directly to the VSSD digital ground on the PCB (one ground plane). |
| A5 | I | TX_MON2 | Transmit Channel 2 Power Monitor Input. If this pin is unused, tie it to ground. |
| A7, A8 | O | TX2A_N, TX2A_P | Transmit Channel 2 Differential A Outputs. Unused pins must be tied to 1.3 V. |
| A9, A10 | O | TX2B_N, TX2B_P | Transmit Channel 2 Differential B Outputs. Unused pins must be tied to 1.3 V. |
| A11 | P | VDDA1P1_TX_VCO | Transmit VCO Supply Input. Connect to B11. |
| B3 | O | AUXDAC1 | Auxiliary DAC 1 Output. If using the auxiliary DAC, connect a 0.1 μF capacitor from this pin to ground. |
| B4 to B7 | O | GPO_3 to GPO_0 | 3.3 V Capable General-Purpose Outputs. |
| B8 | I | VDD_GPO | 2.5 V to 3.3 V Supply for the AUXDAC and General-Purpose Output Pins. If the VDD_GPO supply is not used, this supply must be set to 1.3 V. |
| B9 | I | VDDA1P3_TX_LO | Transmit Local Oscillator (LO) 1.3 V Supply Input. |
| B10 | I | VDDA1P3_TX_VCO_LDO | Transmit VCO LDO 1.3 V Supply Input. Connect to B9. |
| B11 | O | TX_VCO_LDO_OUT | Transmit VCO LDO Output. Connect to A11 and to a 1 μF bypass capacitor in series with a 1 Ω resistor to ground. |
| C1, D1 | I | RX2C_P, RX2C_N | Receive Channel 2 Differential C Inputs. Alternatively, use each pin as a single-ended input. Unused pins must be tied to ground. |
| C3 | O | AUXDAC2 | Auxiliary DAC 2 Output. If using the auxiliary DAC, connect a 0.1 μF capacitor from this pin to ground. |
| C4 | I | TEST/ENABLE | Test Input. Ground this pin for normal operation. |
| C5, C6, D5, D6 | I | CTRL_IN0 to CTRL_IN3 | Control Inputs. Use these pins for manual Rx gain and Tx attenuation control. |

| Pin No. | Type ¹ | Mnemonic | Description |
|---|-------------------|--|---|
| D2 | I | VDDA1P3_RX_RF | Receiver 1.3 V Supply Input. Connect to D3. |
| D3 | I | VDDA1P3_RX_TX | Receiver and Transmitter 1.3 V Supply Input. |
| D4, E4 to E6, F4 to F6, G4 | O | CTRL_OUT0, CTRL_OUT1 to CTRL_OUT3, CTRL_OUT6 to CTRL_OUT4, CTRL_OUT7 | Control Outputs. These pins are multipurpose outputs that have programmable functionality. |
| D7 | I/O | P0_D9/TX_D4_P | Digital Data Port 0, Data Bit 9/Transmit Differential Input Bus, Data Bit 4. This is a dual function pin. As P0_D9, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D4_P, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| D8 | I/O | P0_D7/TX_D3_P | Digital Data Port 0, Data Bit 7/Transmit Differential Input Bus, Data Bit 3. This is a dual function pin. As P0_D7, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D3_P, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| D9 | I/O | P0_D5/TX_D2_P | Digital Data Port 0, Data Bit 5/Transmit Differential Input Bus, Data Bit 2. This is a dual function pin. As P0_D5, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D2_P, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| D10 | I/O | P0_D3/TX_D1_P | Digital Data Port 0, Data Bit 3/Transmit Differential Input Bus, Data Bit 1. This is a dual function pin. As P0_D3, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D1_P, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| D11 | I/O | P0_D1/TX_D0_P | Digital Data Port 0, Data Bit 1/Transmit Differential Input Bus, Data Bit 0. This is a dual function pin. As P0_D1, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D0_P, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| D12, F7, F9, F11, G12, H7, H10, K12 | GND | VSSD | Digital Ground. Tie these pins directly to the VSSA analog ground on the PCB (one ground plane). |
| E1, F1 | I | RX2B_P, RX2B_N | Receive Channel 2 Differential B Inputs. Alternatively, each pin can be used as a single-ended input. Unused pins must be tied to ground. |
| E2 | I | VDDA1P3_RX_LO | Receive LO 1.3 V Supply Input. |
| E3 | I | VDDA1P3_TX_LO_BUFFER | Transmitter LO Buffer 1.3 V Supply Input. |
| E7 | I/O | P0_D11/TX_D5_P | Digital Data Port 0, Data Bit 11/Transmit Differential Input Bus, Data Bit 5. This is a dual function pin. As P0_D11, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D5_P, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| E8 | I/O | P0_D8/TX_D4_N | Digital Data Port 0, Data Bit 8/Transmit Differential Input Bus, Data Bit 4. This is a dual function pin. As P0_D8, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D4_N, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| E9 | I/O | P0_D6/TX_D3_N | Digital Data Port 0, Data Bit 6/Transmit Differential Input Bus, Data Bit 3. This is a dual function pin. As P0_D6, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D3_N, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| E10 | I/O | P0_D4/TX_D2_N | Digital Data Port 0, Data Bit 4/Transmit Differential Input Bus, Data Bit 2. This is a dual function pin. As P0_D4, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D2_N, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| E11 | I/O | P0_D2/TX_D1_N | Digital Data Port 0, Data Bit 2/Transmit Differential Input Bus, Data Bit 1. This is a dual function pin. As P0_D2, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D1_N, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| E12 | I/O | P0_D0/TX_D0_N | Digital Data Port 0, Data Bit 0/Transmit Differential Input Bus, Data Bit 0. This is a dual function pin. As P0_D0, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D0_N, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| F2 | I | VDDA1P3_RX_VCO_LDO | Receive VCO LDO 1.3 V Supply Input. Connect to E2. |

| Pin No. | Type ¹ | Mnemonic | Description |
|----------|-------------------|---------------------------|---|
| F8 | I/O | P0_D10/TX_D5_N | Digital Data Port 0, Data Bit 10/Transmit Differential Input Bus, Data Bit 5. This is a dual function pin. As P0_D10, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 0. Alternatively, as TX_D5_N, it functions as part of the LVDS 6-bit Tx differential input bus with internal LVDS termination. |
| F10, G10 | I | FB_CLK_P, FB_CLK_N | Feedback Clock Inputs. These pins receive the FB_CLK signal that clocks in Tx data. In CMOS mode, use FB_CLK_P as the input and tie FB_CLK_N to ground. |
| F12 | I | VDDD1P3_DIG | 1.3 V Digital Supply Input. |
| G2 | O | RX_VCO_LDO_OUT | Receive VCO LDO Output. Connect to G3 and to a 1 μ F bypass capacitor in series with a 1 Ω resistor to ground. |
| G3 | I | VDDA1P1_RX_VCO | Receive VCO Supply Input. Connect to G2. |
| G5 | I | EN_AGC | Manual Control Input for Automatic Gain Control (AGC). |
| G6 | I | ENABLE | Control Input. This pin moves the device through various operational states. |
| G7, G8 | O | RX_FRAME_N, RX_FRAME_P | Receive Digital Data Framing Outputs. These pins transmit the RX_FRAME signal that indicates whether the Rx output data is valid. In CMOS mode, use RX_FRAME_P as the output and leave RX_FRAME_N unconnected. |
| G9, H9 | I | TX_FRAME_P, TX_FRAME_N | Transmit Digital Data Framing Inputs. These pins receive the TX_FRAME signal that indicates when Tx data is valid. In CMOS mode, use TX_FRAME_P as the input and tie TX_FRAME_N to ground. |
| G11, H11 | O | DATA_CLK_P, DATA_CLK_N | Receive Data Clock Outputs. These pins transmit the DATA_CLK signal that the BBP uses to clock the Rx data. In CMOS mode, use DATA_CLK_P as the output and leave DATA_CLK_N unconnected. |
| H1, J1 | I | RX1B_P, RX1B_N | Receive Channel 1 Differential B Inputs. Alternatively, use each pin as a single-ended input. Unused pins must be tied to ground. |
| H4 | I | TXNRX | Enable State Machine Control Signal. This pin controls the data port bus direction. A logic low selects the Rx direction; a logic high selects the Tx direction. |
| H8 | I/O | P1_D11/RX_D5_P | Digital Data Port P1, Data Bit 11/Receive Differential Output Bus, Data Bit 5. This is a dual function pin. As P1_D11, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D5_P, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| H12 | I | VDD_INTERFACE | 1.2 V to 2.5 V Supply for Digital I/O Pins (1.8 V to 2.5 V in LVDS Mode). |
| J3 | I | VDDA1P3_RX_SYNTN | Receiver Synthesizer 1.3 V Supply Input. |
| J4 | I | SPI_DI | SPI Serial Data Input. |
| J5 | I | SPI_CLK | SPI Clock Input. |
| J6 | O | CLK_OUT | Output Clock. This pin can be configured to output either a buffered version of the external input clock (the digital controlled crystal oscillator (DCXO)) or a divided-down version of the internal ADC sample clock (ADC_CLK). |
| J7 | I/O | P1_D10/RX_D5_N | Digital Data Port 1, Data Bit 10/Receive Differential Output Bus, Data Bit 5. This is a dual function pin. As P1_D10, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D5_N, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| J8 | I/O | P1_D9/RX_D4_P | Digital Data Port 1, Data Bit 9/Receive Differential Output Bus, Data Bit 4. This is a dual function pin. As P1_D9, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D4_P, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| J9 | I/O | P1_D7/RX_D3_P | Digital Data Port 1, Data Bit 7/Receive Differential Output Bus, Data Bit 3. This is a dual function pin. As P1_D7, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D3_P, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| J10 | I/O | P1_D5/RX_D2_P | Digital Data Port 1, Data Bit 5/Receive Differential Output Bus, Data Bit 2. This is a dual function pin. As P1_D5, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D2_P, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| J11 | I/O | P1_D3/RX_D1_P | Digital Data Port 1, Data Bit 3/Receive Differential Output Bus, Data Bit 1. This is a dual function pin. As P1_D3, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D1_P, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |

| Pin No. | Type ¹ | Mnemonic | Description |
|---------|-------------------|------------------|--|
| J12 | I/O | P1_D1/RX_D0_P | Digital Data Port 1, Data Bit 1/Receive Differential Output Bus, Data Bit 0. This is a dual function pin. As P1_D1, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D0_P, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| K1, L1 | I | RX1C_P, RX1C_N | Receive Channel 1 Differential C Inputs. Alternatively, use each pin as a single-ended input. Tie unused pins to ground. |
| K3 | I | VDDA1P3_TX_SYNTH | Transmitter Synthesizer 1.3 V Supply Input. Connect this pin to a 1.3 V regulator through a separate trace to a common supply point. |
| K4 | I | VDDA1P3_BB | Baseband 1.3 V Supply Input. Connect this pin to a 1.3 V regulator through a separate trace to a common supply point. |
| K5 | I | <u>RESET</u> | Asynchronous Reset Input. A logic low resets the device. |
| K6 | I | <u>SPI_EN</u> | SPI Enable. Set this pin to logic low to enable the SPI bus. |
| K7 | I/O | P1_D8/RX_D4_N | Digital Data Port 1, Data Bit 8/Receive Differential Output Bus, Data Bit 4. This is a dual function pin. As P1_D8, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D4_N, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| K8 | I/O | P1_D6/RX_D3_N | Digital Data Port 1, Data Bit 6/Receive Differential Output Bus, Data Bit 3. This is a dual function pin. As P1_D6, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D3_N, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| K9 | I/O | P1_D4/RX_D2_N | Digital Data Port 1, Data Bit 4/Receive Differential Output Bus, Data Bit 2. This is a dual function pin. As P1_D4, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D2_N, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| K10 | I/O | P1_D2/RX_D1_N | Digital Data Port 1, Data Bit 2/Receive Differential Output Bus, Data Bit 1. This is a dual function pin. As P1_D2, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D1_N, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| K11 | I/O | P1_D0/RX_D0_N | Digital Data Port 1, Data Bit 0/Receive Differential Output Bus, Data Bit 0. This is a dual function pin. As P1_D0, it functions as part of the 12-bit bidirectional parallel CMOS level Data Port 1. Alternatively, as RX_D0_N, it functions as part of the LVDS 6-bit Rx differential output bus with internal LVDS termination. |
| L4 | I | RBIAS | Bias Input Reference. Connect this pin through a 14.3 k Ω (1% tolerance) resistor to ground. |
| L5 | I | AUXADC | Auxiliary ADC Input. If this pin is unused, tie it to ground. |
| L6 | O | SPI_DO | SPI Serial Data Output in 4-Wire Mode, High-Z in 3-Wire Mode. |
| M1, M2 | I | RX1A_P, RX1A_N | Receive Channel 1 Differential A Inputs. Alternatively, use each pin as a single-ended input. Tie unused pins to ground. |
| M5 | I | TX_MON1 | Transmit Channel 1 Power Monitor Input. If this pin is unused, tie it to ground. |
| M7, M8 | O | TX1A_P, TX1A_N | Transmit Channel 1 Differential A Outputs. Tie unused pins to 1.3 V. |
| M9, M10 | O | TX1B_P, TX1B_N | Transmit Channel 1 Differential B Outputs. Tie unused pins to 1.3 V. |
| M12 | I | XTALN | Reference Frequency Connection. Connect the external clock source to XTALN. |

¹ I is input, NC is not connected, GND is ground, O is output, P is power, and I/O is input/output.

TYPICAL PERFORMANCE CHARACTERISTICS

ATTEN is the attenuation setting. f_{LO_RX} and f_{LO_TX} are the receive and transmit local oscillator frequencies, respectively.

800 MHz FREQUENCY BAND

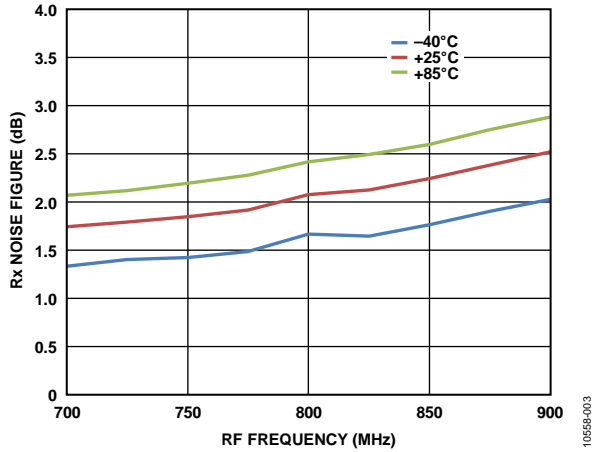


Figure 3. Rx Noise Figure vs. RF Frequency

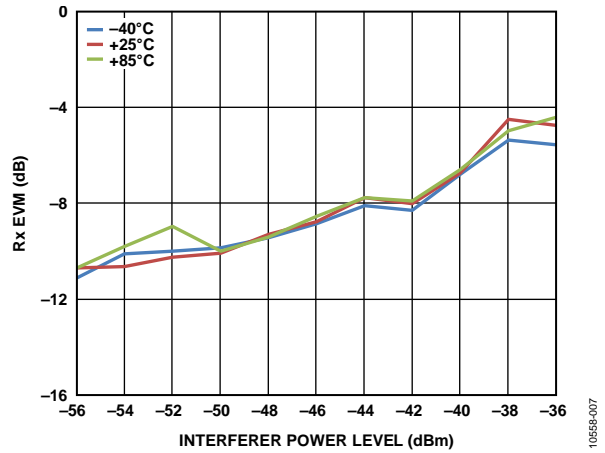


Figure 6. Rx EVM vs. Interferer Power Level, LTE 10 MHz Signal of Interest with $P_{IN} = -90$ dBm, 5 MHz OFDM Blocker at 17.5 MHz Offset

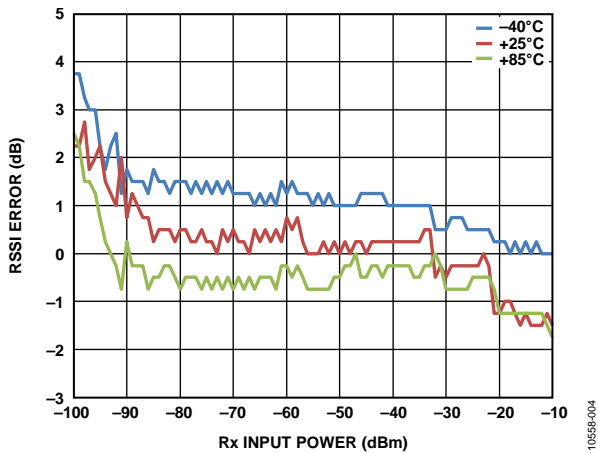


Figure 4. RSSI Error vs. Rx Input Power, LTE 10 MHz Modulation (Referenced to -50 dBm Input Power at 800 MHz)

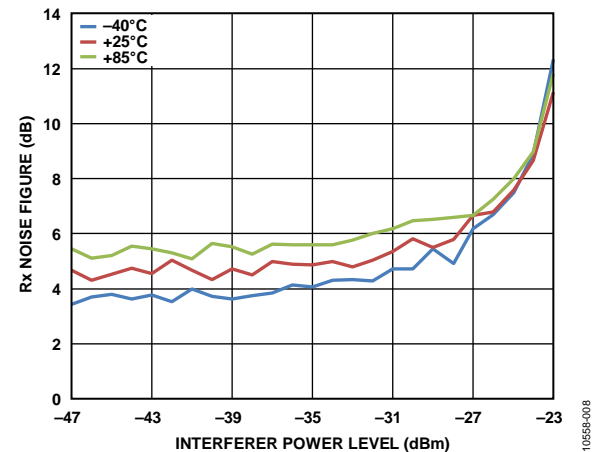


Figure 7. Rx Noise Figure vs. Interferer Power Level, Enhanced Data Rates for GSM Evolution (EDGE) Signal of Interest with $P_{IN} = -90$ dBm, Continuous Wave (CW) Blocker at 3 MHz Offset, Gain Index = 64

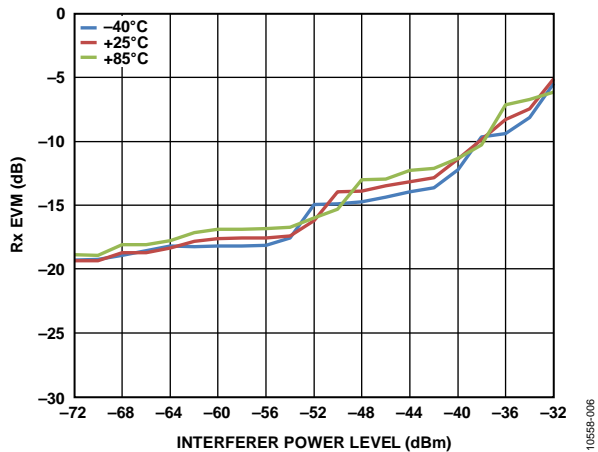


Figure 5. Rx EVM vs. Interferer Power Level, LTE 10 MHz Signal of Interest with $P_{IN} = -82$ dBm, 5 MHz Orthogonal Frequency Division Multiplexing (OFDM) Blocker at 7.5 MHz Offset

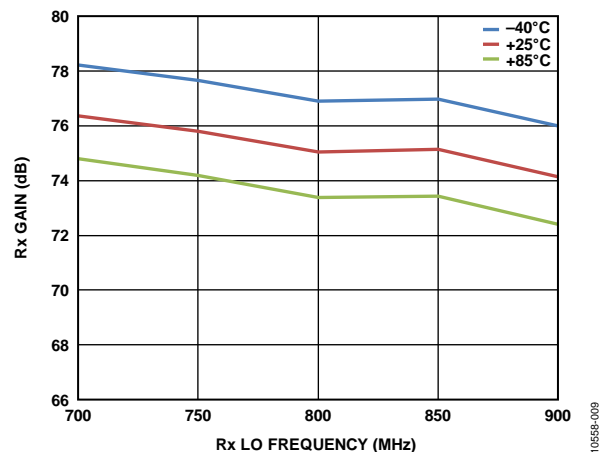


Figure 8. Rx Gain vs. Rx LO Frequency, Gain Index = 76 (Maximum Setting)

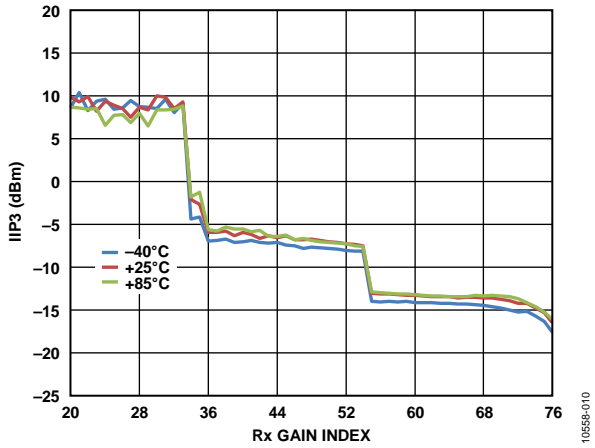


Figure 9. Third-Order Input Intercept Point (IIP3) vs. Rx Gain Index, $f_1 = 1.45$ MHz, $f_2 = 2.89$ MHz, GSM Mode

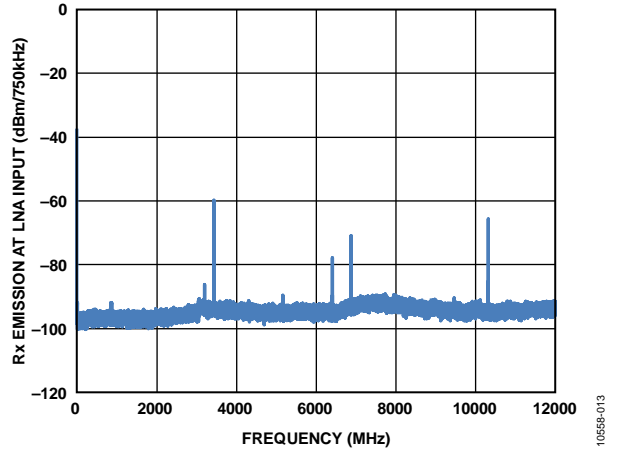


Figure 12. Rx Emission at LNA Input vs. Frequency, DC to 12 GHz, $f_{LO_RX} = 800$ MHz, LTE 10 MHz, $f_{LO_TX} = 860$ MHz

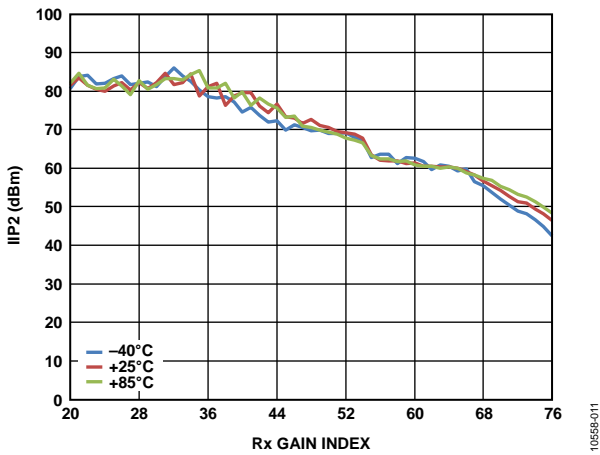


Figure 10. Second-Order Input Intercept Point (IIP2) vs. Rx Gain Index, $f_1 = 2.00$ MHz, $f_2 = 2.01$ MHz, GSM Mode

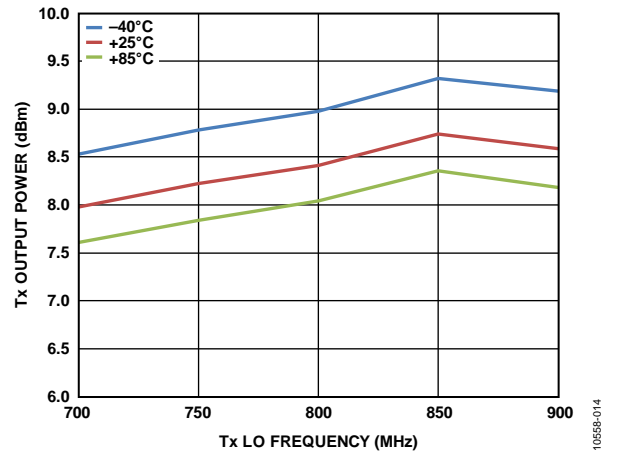


Figure 13. Tx Output Power vs. Tx LO Frequency, Attenuation Setting = 0 dB, Single-Tone Output

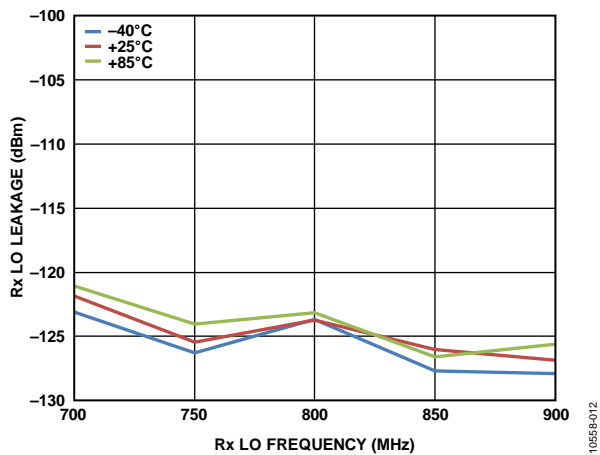


Figure 11. Rx LO Leakage vs. Rx LO Frequency

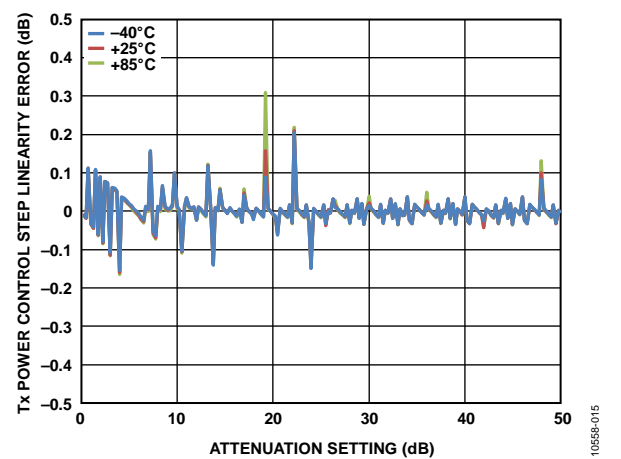


Figure 14. Tx Power Control Step Linearity Error vs. Attenuation Setting

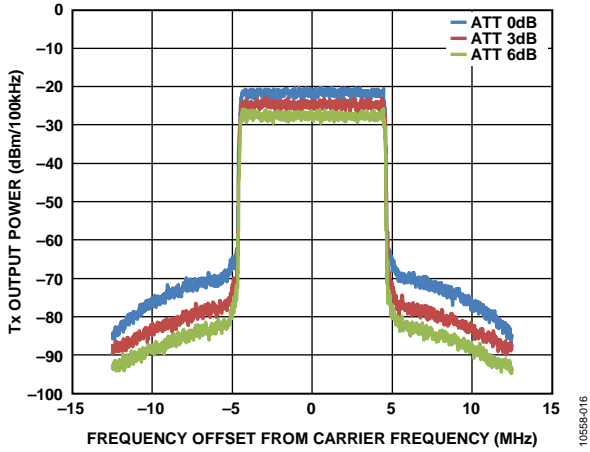


Figure 15. Tx Output Power vs. Frequency Offset from Carrier Frequency, $f_{LO_TX} = 800$ MHz, LTE 10 MHz Downlink (Digital Attenuation Variations Shown)

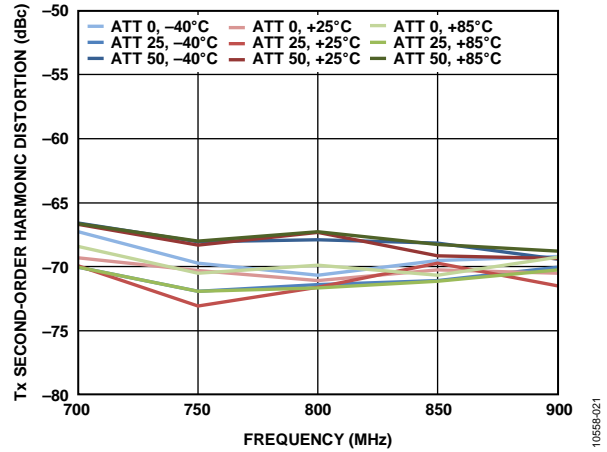


Figure 18. Tx Second-Order Harmonic Distortion (HD2) vs. Frequency

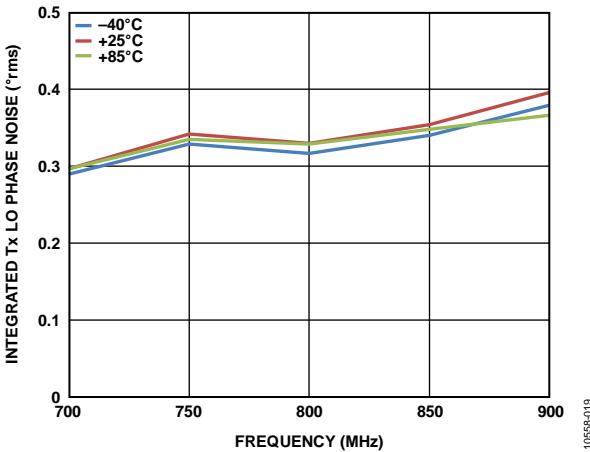


Figure 16. Integrated Tx LO Phase Noise vs. Frequency, 19.2 MHz REF_CLK

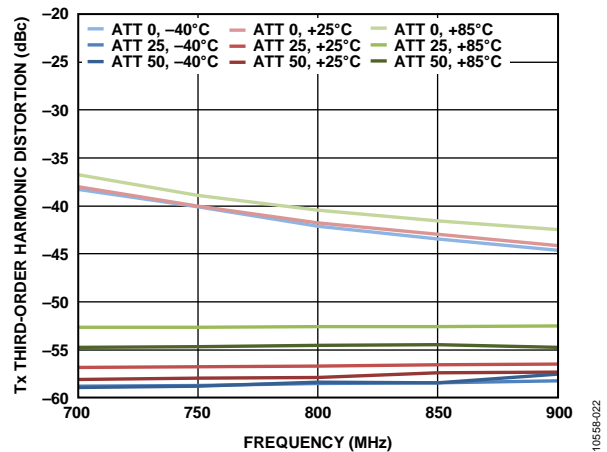


Figure 19. Tx Third-Order Harmonic Distortion (HD3) vs. Frequency

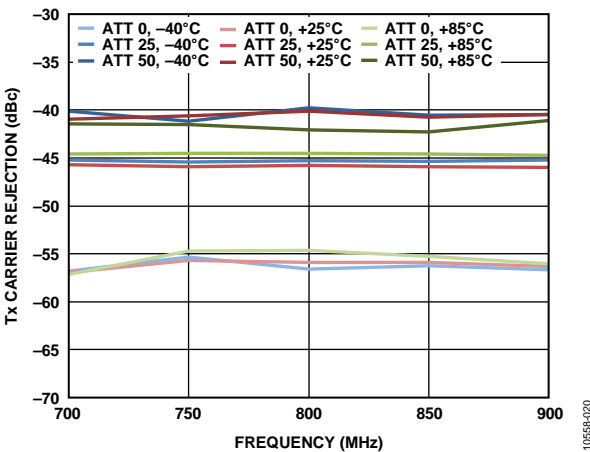


Figure 17. Tx Carrier Rejection vs. Frequency

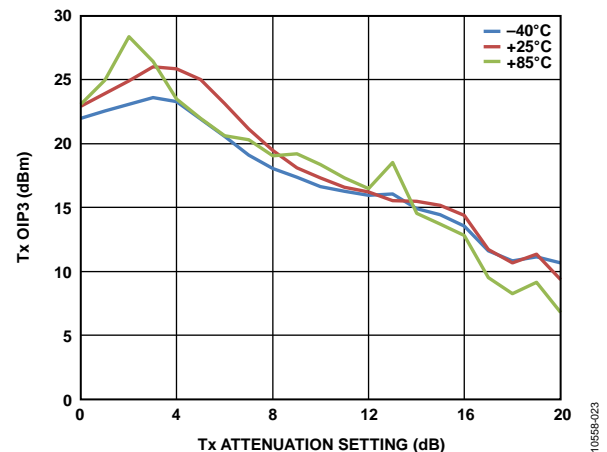


Figure 20. Tx Third-Order Output Intercept Point (OIP3) vs. Tx Attenuation Setting

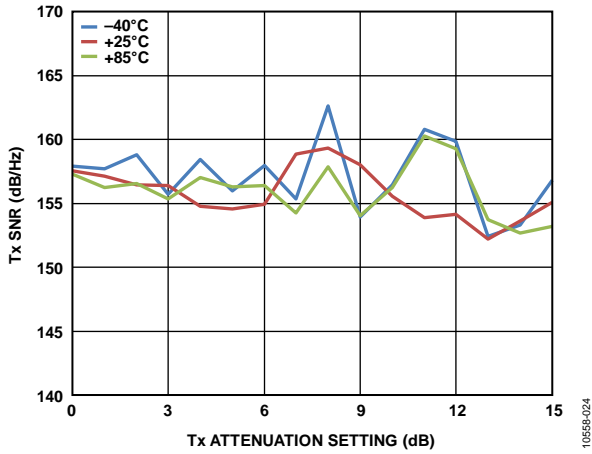


Figure 21. Tx Signal-to-Noise Ratio (SNR) vs. Tx Attenuation Setting, LTE 10 MHz Signal of Interest with Noise Measured at 90 MHz Offset

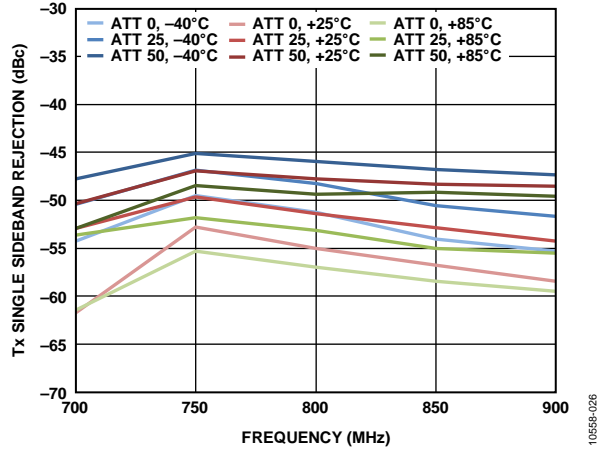


Figure 22. Tx Single Sideband Rejection vs. Frequency, 1.5375 MHz Offset

2.4 GHz FREQUENCY BAND

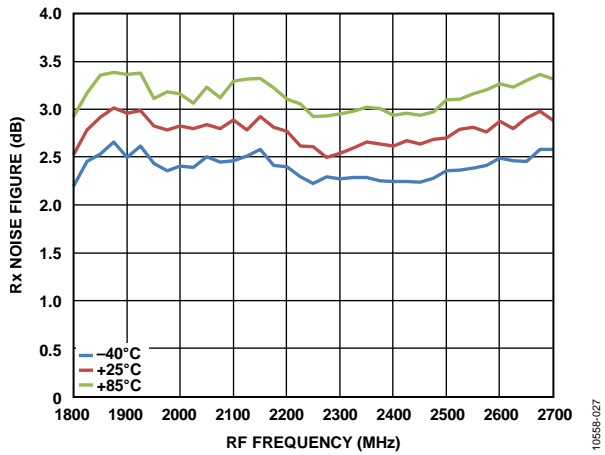


Figure 23. Rx Noise Figure vs. RF Frequency

10558-027

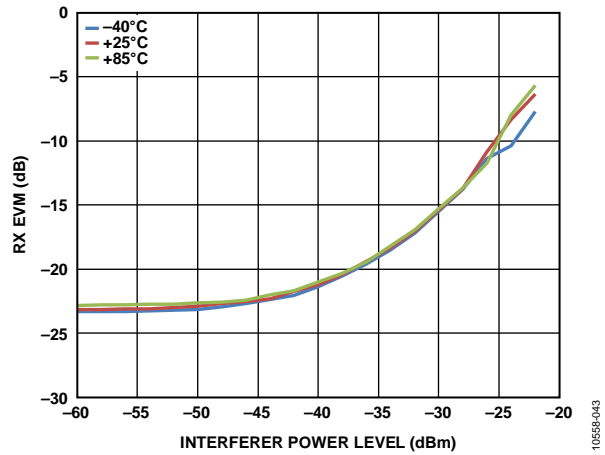


Figure 26. Rx EVM vs. Interferer Power Level, LTE 20 MHz Signal of Interest with $P_{IN} = -75$ dBm, LTE 20 MHz Blocker at 40 MHz Offset

10558-043

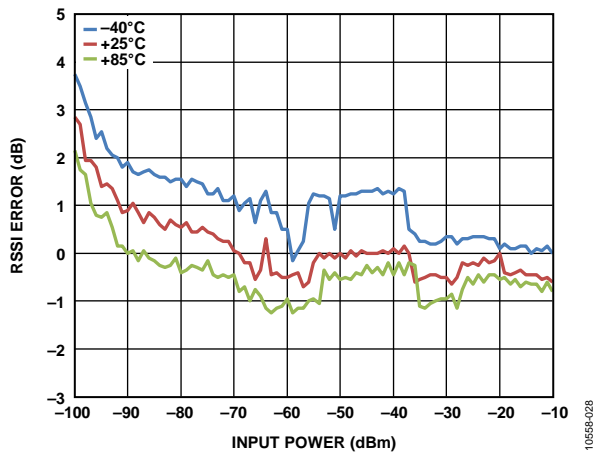


Figure 24. RSSI Error vs. Input Power (Referenced to -50 dBm Input Power at 2.4 GHz)

10558-028

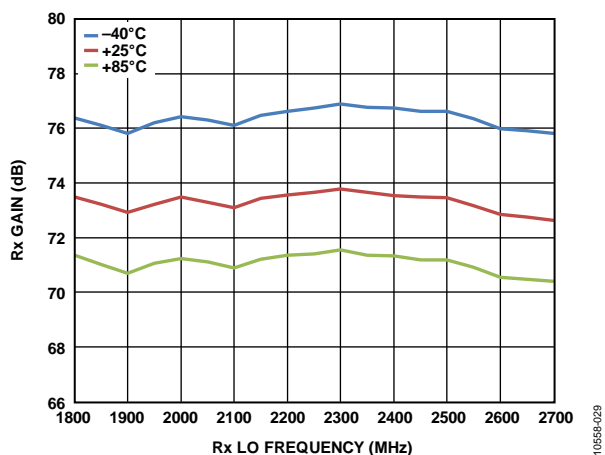


Figure 27. Rx Gain vs. Rx LO Frequency, Gain Index = 76 (Maximum Setting)

10558-028

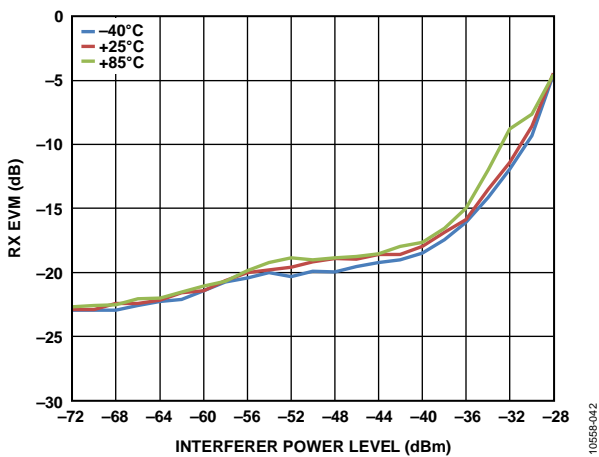


Figure 25. Rx EVM vs. Interferer Power Level, LTE 20 MHz Signal of Interest with $P_{IN} = -75$ dBm, LTE 20 MHz Blocker at 20 MHz Offset

10558-042

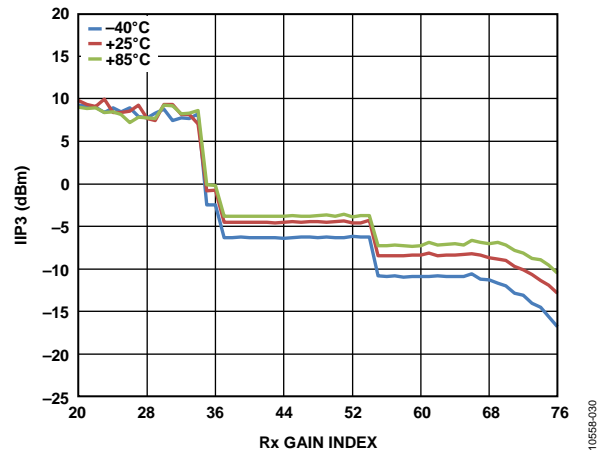


Figure 28. Third-Order Input Intercept Point (IIP3) vs. Rx Gain Index, $f_1 = 30$ MHz, $f_2 = 61$ MHz

10558-030

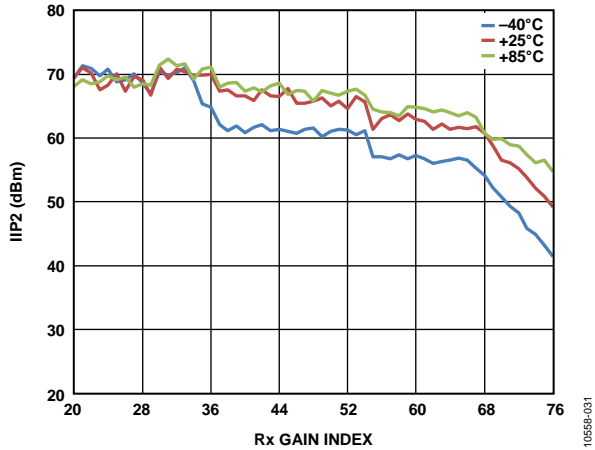


Figure 29. Second-Order Input Intercept Point (IIP2) vs. Rx Gain Index, $f_1 = 60$ MHz, $f_2 = 61$ MHz

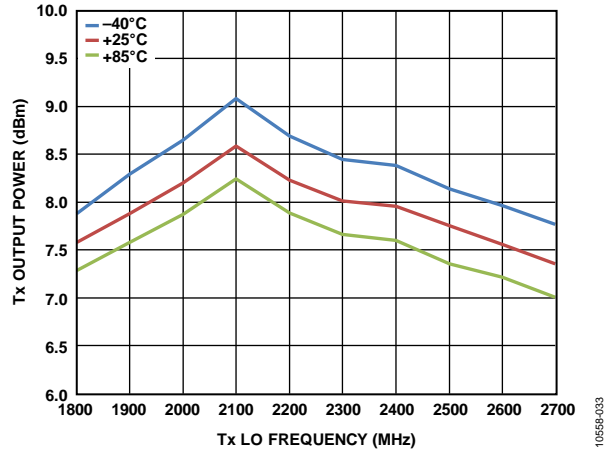


Figure 32. Tx Output Power vs. Tx LO Frequency, Attenuation Setting = 0 dB, Single-Tone Output

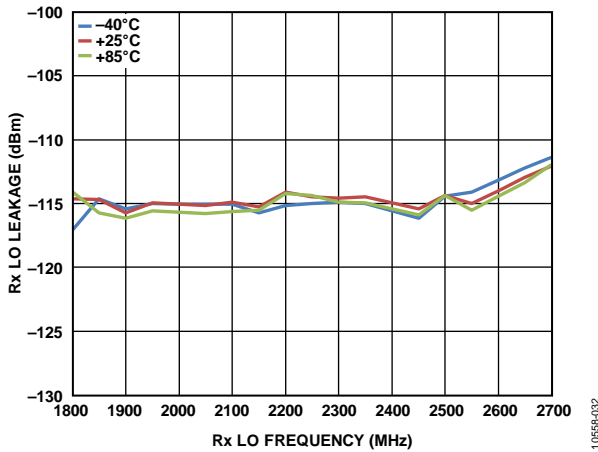


Figure 30. Rx Local Oscillator (LO) Leakage vs. Rx LO Frequency

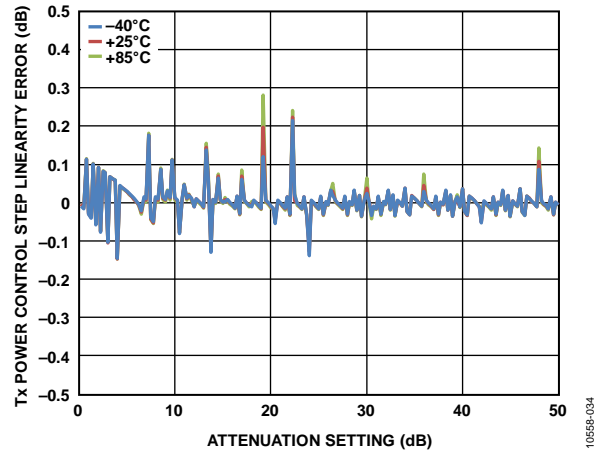


Figure 33. Tx Power Control Step Linearity Error vs. Attenuation Setting

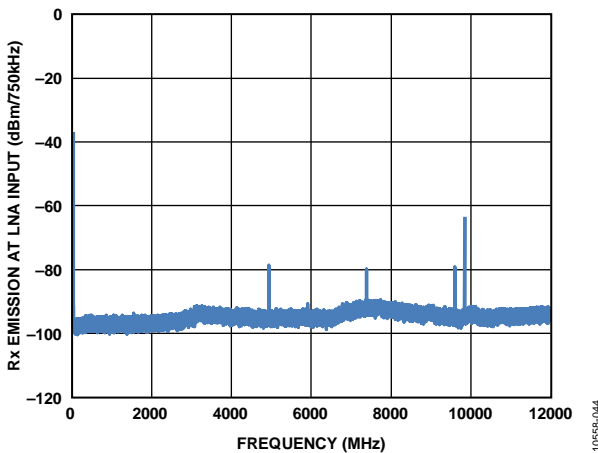


Figure 31. Rx Emission at LNA Input vs. Frequency, DC to 12 GHz, $f_{LO,RX} = 2.4$ GHz, LTE 20 MHz, $f_{LO,TX} = 2.46$ GHz

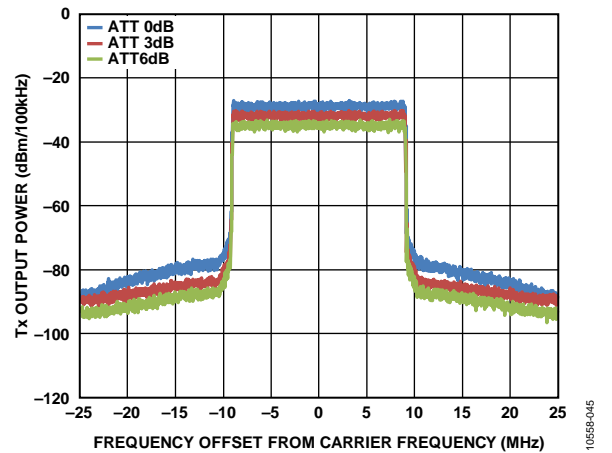


Figure 34. Tx Output Power vs. Frequency Offset from Carrier Frequency, $f_{LO,TX} = 2.3$ GHz, LTE 20 MHz Downlink (Digital Attenuation Variations Shown)

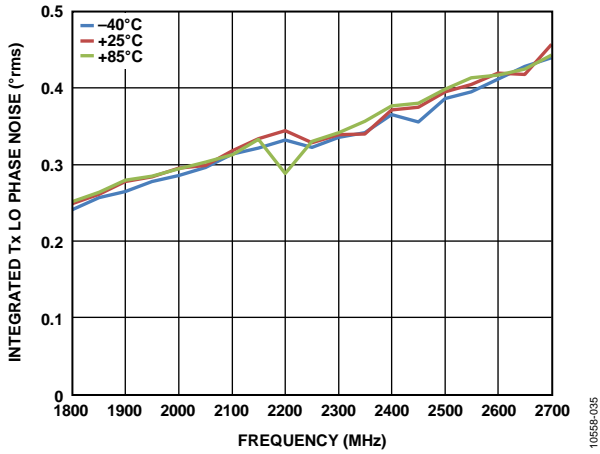


Figure 35. Integrated Tx LO Phase Noise vs. Frequency, 40 MHz REF_CLK

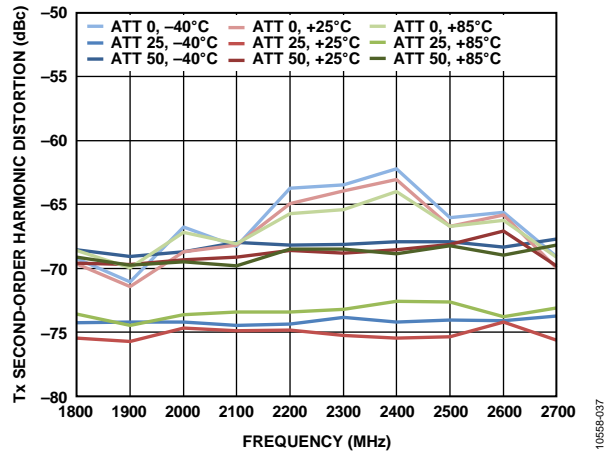


Figure 37. Tx Second-Order Harmonic Distortion (HD2) vs. Frequency

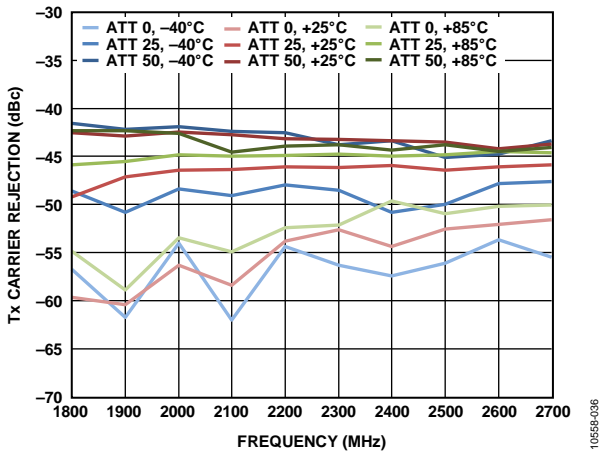


Figure 36. Tx Carrier Rejection vs. Frequency

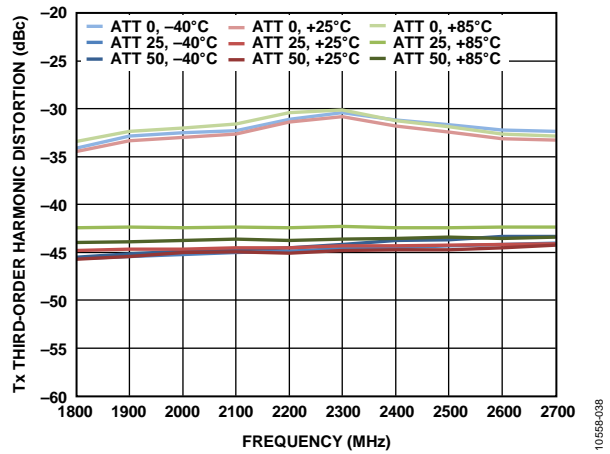


Figure 38. Tx Third-Order Harmonic Distortion (HD3) vs. Frequency

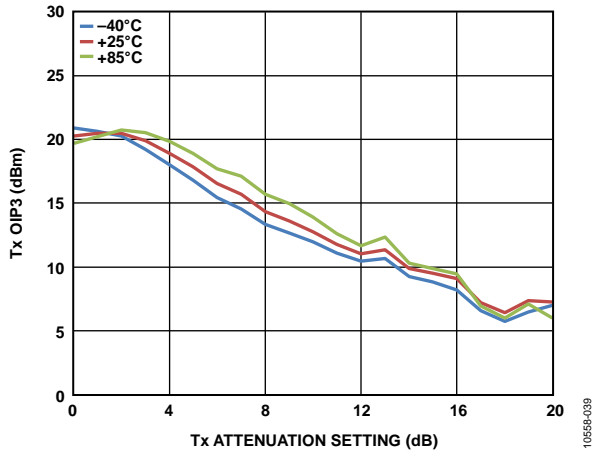


Figure 39. Tx Third-Order Output Intercept Point (OIP3) vs. Tx Attenuation Setting

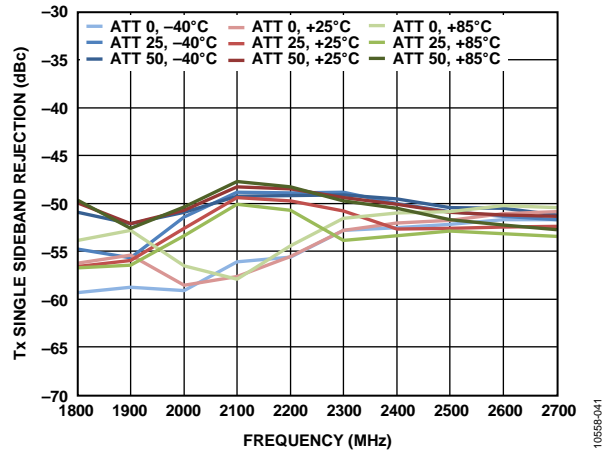


Figure 41. Tx Single Sideband Rejection vs. Frequency, 3.075 MHz Offset

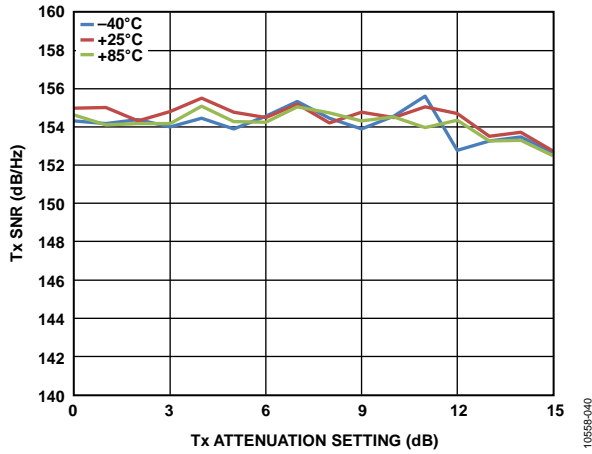


Figure 40. Tx Signal-to-Noise Ratio (SNR) vs. Tx Attenuation Setting, LTE 20 MHz Signal of Interest with Noise Measured at 90 MHz Offset

THEORY OF OPERATION

GENERAL

The [AD9363](#) is a highly integrated radio frequency (RF) transceiver capable of being configured for a wide range of applications. The device integrates all RF, mixed-signal, and digital blocks necessary to provide all transceiver functions in a single device. Programmability allows this broadband transceiver to be adapted for use with multiple communication standards, including FDD and TDD systems. This programmability also allows the device to interface to various BBPs using a single 12-bit parallel data port, dual 12-bit parallel data ports, or a 12-bit low voltage differential signaling (LVDS) interface.

The [AD9363](#) also provides self calibration and AGC systems to maintain a high performance level under varying temperatures and input signal conditions. In addition, the device includes several test modes that allow system designers to insert test tones and create internal loopback modes to debug their designs during prototyping and optimize their radio configuration for a specific application.

RECEIVER

The receiver section contains all blocks necessary to receive RF signals and convert them to digital data that is usable by a BBP. Two independently controlled channels can receive signals from different sources, allowing the device to be used in multiple input, multiple output (MIMO) systems while sharing a common frequency synthesizer.

Each channel has three inputs that can be multiplexed to the signal chain, making the [AD9363](#) suitable for use in diversity systems with multiple antenna inputs. The receiver is a direct conversion system that contains a low noise amplifier (LNA) followed by matched in-phase (I) and quadrature (Q) amplifiers, mixers, and band shaping filters that downconvert received signals to baseband for digitization. External LNAs can also be interfaced to the device, allowing designers the flexibility to customize the receiver front end for their specific application.

Gain control is achieved by following a preprogrammed gain index map that distributes gain among the blocks for optimal performance at each level. This gain control can be achieved by enabling the internal AGC in either fast or slow mode or by using manual gain control, allowing the BBP to make the gain adjustments as needed. Additionally, each channel contains independent RSSI measurement capability, dc offset tracking, and all circuitry necessary for self calibration.

The receivers include 12-bit, sigma-delta (Σ - Δ) ADCs and adjustable sample rates that produce data streams from the received signals. The digitized signals can be conditioned further by a series of decimation filters and a fully programmable 128-tap FIR filter with additional decimation settings. The sample rate of each digital filter block can also be adjusted by changing the decimation factors to produce the desired output data rate.

TRANSMITTER

The transmitter section consists of two identical and independently controlled channels that provide all digital processing, mixed-signal, and RF blocks necessary to implement a direct conversion system while sharing a common frequency synthesizer. The digital data received from the BBP passes through a fully programmable 128-tap FIR filter with interpolation options. The FIR output is sent to a series of interpolation filters that provide additional filtering and data rate interpolation prior to reaching the DAC. Each 12-bit DAC has an adjustable sampling rate. Both the I and Q channels are fed to the RF block for upconversion.

After being converted to baseband analog signals, the I and Q signals are filtered to remove sampling artifacts and provide band shaping, and then they are passed to the upconversion mixers. At this point, the I and Q signals are recombined and modulated on the carrier frequency for transmission to the output stage. The output stage provides attenuation control that provides a range of output levels while keeping the output impedance at 50 Ω . A wide range of attenuation adjustment with fine granularity is included to help designers optimize SNR.

Self calibration circuitry is included in the transmit channel to provide internal adjustment capability. The transmitter also provides a Tx monitor block that receives the transmitter output and routes it back through an unused receiver channel to the BBP for signal monitoring. The Tx monitor blocks are available only in TDD mode operation while the receiver is idle.

CLOCK INPUT OPTIONS

The [AD9363](#) uses a reference clock provided by an external oscillator or clock distribution device (such as the [AD9548](#)) connected to the XTALN pin. The frequency of this reference clock can vary from 10 MHz to 80 MHz. This reference clock supplies the synthesizer blocks that generate all data clocks, sample clocks, and local oscillators inside the device.

SYNTHESIZERS

RF PLLs

The [AD9363](#) contains two identical synthesizers to generate the required LO signals for the RF signal paths—one for the receiver and one for the transmitter. PLL synthesizers are fractional N designs that incorporate completely integrated VCOs and loop filters. In TDD mode, the synthesizers turn on and off as appropriate for the Rx and Tx frames. In FDD mode, the Tx PLL and the Rx PLL can be activated at the same time. These PLLs require no external components.

BB PLL

The AD9363 also contains a baseband PLL (BB PLL) synthesizer that generates all baseband related clock signals. These signals include the ADC and DAC sampling clocks, the DATA_CLK signal (see the Digital Data Interface section), and all data framing signals. The BB PLL is programmed from 700 MHz to 1400 MHz based on the data rate and sample rate requirements of the system.

DIGITAL DATA INTERFACE

The AD9363 data interface uses parallel data ports (P0 and P1) to transfer data between the device and the BBP. The data ports can be configured in either single-ended CMOS format or differential LVDS format. Both formats can be configured in multiple arrangements to match system requirements for data ordering and data port connections. These arrangements include single port data bus, dual port data bus, single data rate, double data rate, and various combinations of data ordering to transmit data from different channels across the bus at appropriate times.

Bus transfers are controlled using simple hardware handshake signaling. The two ports can be operated in either bidirectional (TDD) mode or in full duplex (FDD) mode, where half the bits are used for transmitting data and half are used for receiving data. The interface can also be configured to use only one of the data ports for applications that do not require high data rates and require fewer interface pins.

DATA_CLK Signal

The AD9363 outputs the DATA_CLK signal that the BBP uses to sample receiver data. The signal is synchronized with the receiver data such that data transitions occur out of phase with DATA_CLK. The DATA_CLK can be set to a rate that provides single data rate (SDR) timing, where data is sampled on each rising clock edge, or it can be set to provide double data rate (DDR) timing, where data is captured on both rising and falling clock edges. SDR or DDR timing applies to operation using either a single port or both ports.

FB_CLK Signal

For transmit data, the interface uses the FB_CLK signal as the timing reference. The FB_CLK signal allows source synchronous timing with rising edge capture for burst control signals and either rising edge capture (SDR mode) or both edge capture (DDR mode) for transmit signal bursts. The FB_CLK signal must have the same frequency and duty cycle as DATA_CLK.

RX_FRAME and TX_FRAME Signals

The device generates an RX_FRAME output signal whenever the receiver outputs valid data. This signal has two modes: level mode (the RX_FRAME signal stays high as long as the data is valid) and pulse mode (the RX_FRAME signal pulses with a 50% duty cycle). Similarly, the BBP must provide a TX_FRAME signal that indicates the beginning of a valid data transmission with a rising edge. Like the RX_FRAME signal, the TX_FRAME signal stays high throughout the burst or it pulses with a 50% duty cycle.

ENABLE STATE MACHINE

The AD9363 transceiver includes an ENSM that allows real-time control over the current state of the device. The device can be placed in several different states during normal operation, including

- Wait—power save, synthesizers disabled
- Sleep—wait with all clocks and the BB PLL disabled
- Tx—Tx signal chain enabled
- Rx—Rx signal chain enabled
- FDD—Tx and Rx signal chains enabled
- Alert—synthesizers enabled

The ENSM has two control modes: SPI control and pin control.

SPI Control Mode

In SPI control mode, the ENSM is controlled asynchronously by writing to SPI registers to advance the current state to the next state. SPI control is considered asynchronous to the DATA_CLK signal because the SPI clock can be derived from a different clock reference and can still function properly. The SPI control ENSM mode is recommended when real-time control of the synthesizers is not necessary. SPI control can be used for real-time control as long as the BBP can perform timed SPI writes accurately.

Pin Control Mode

In pin control mode, the enable functions of the ENABLE pin and the TXNRX pin allow real-time control of the current state. The ENSM allows TDD or FDD operation, depending on the configuration of the corresponding SPI register. The ENABLE and TXNRX pin control mode is recommended if the BBP has extra control outputs that can be controlled in real time, allowing a simple 2-wire interface to control the state of the device. To advance the current state of the ENSM to the next state, drive the enable function of the ENABLE pin by either a pulse (edge detected internally) or a level.

When a pulse is used, it must have a minimum pulse width of one cycle of the FB_CLK signal. In level mode, the ENABLE and TXNRX pins are also edge detected by the AD9363 and must meet the same minimum pulse width requirement of one cycle of the FB_CLK signal.

In FDD mode, the ENABLE and TXNRX pins can be remapped to serve as real-time Rx and Tx data transfer control signals. In this mode, the ENABLE pin assumes the receive on (RXON) function (controls when the Rx path is enabled and disabled), and the TXNRX pin assumes the transmit on (TXON) function (controls when the Tx path is enabled and disabled). The ENSM must be controlled by SPI writes in this mode while the ENABLE and TXNRX pins control all data flow. For more information about RXON and TXON, see the AD9363 reference manual, available from [Integrated Wideband RF Transceiver Design Resources](#).

SPI INTERFACE

The AD9363 uses a serial peripheral interface (SPI) to communicate with the BBP. The SPI can be configured as a 4-wire interface with dedicated receive and transmit ports, or it can be configured as a 3-wire interface with a bidirectional data communication port. This bus allows the BBP to set all device control parameters using a simple address data serial bus protocol.

Write commands follow a 24-bit format. The first six bits set the bus direction and number of bytes to transfer. The next 10 bits set the address where data is to be written. The final eight bits are the data to be transferred to the specified register address (MSB to LSB). The AD9363 also supports an LSB first format that allows the commands to be written in LSB to MSB format. In this mode, the register addresses are incremented for multibyte writes.

Read commands follow a similar format with the exception that the first 16 bits are transferred on the SPI_DI pin, and the final eight bits are read from the AD9363, either on the SPI_DO pin in 4-wire mode or on the SPI_DI pin in 3-wire mode.

CONTROL PINS

Control Outputs (CTRL_OUT7 to CTRL_OUT0)

The AD9363 provides eight simultaneous real-time output signals for use as interrupts to the BBP. These outputs can be configured to output a number of internal settings and measurements that the BBP uses when monitoring transceiver performance in different situations. The control output pointer register selects the information that is output to these pins, and the control output enable register determines which signals are activated for monitoring by the BBP. Signals used for manual gain mode, calibration flags, state machine states, and the ADC output are among the outputs that can be monitored on these pins.

Control Inputs (CTRL_IN3 to CTRL_IN0)

The AD9363 provides four edge detected control input pins. In manual gain mode, the BBP uses these pins to change the gain table index in real time.

GPO PINS (GPO_3 TO GPO_0)

The AD9363 provides four 3.3 V capable general-purpose logic output pins: GPO_3, GPO_2, GPO_1, and GPO_0. These pins control other peripheral devices such as regulators and switches via the AD9363 SPI bus, or they function as slaves for the internal AD9363 state machine.

AUXILIARY CONVERTERS

AUXADC

The AD9363 contains an auxiliary ADC that monitors system functions such as temperature or power output. The converter is 12 bits wide and has an input range of 0.05 V to VDDA1P3_BB – 0.05 V. When enabled, the ADC is free running. SPI reads provide the last value latched at the ADC output. A multiplexer in front of the ADC allows the user to select between the AUXADC input pin and a built-in temperature sensor.

AUXDAC1 and AUXDAC2

The AD9363 contains two identical auxiliary DACs that can provide power amplifier (PA) bias or other system functionality. The auxiliary DACs are 10 bits wide, have an output voltage range of 0.5 V to VDD_GPO – 0.3 V and a current drive of 10 mA, and can be directly controlled by the internal ENSM.

POWERING THE AD9363

The AD9363 must be powered by the following three supplies: the analog supply (VDDx = 1.3 V), the interface supply (VDD_INTERFACE = 1.8 V), and the GPO supply (VDD_GPO = 3.3 V).

For applications requiring optimal noise performance, split and source the 1.3 V analog supply from low noise, low dropout (LDO) regulators. Figure 42 shows the recommended method.

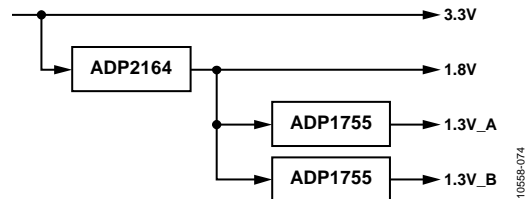


Figure 42. Low Noise Power Solution for the AD9363

For applications where board space is at a premium, and optimal noise performance is not an absolute requirement, provide the 1.3 V analog rail directly from a switcher, and adopt a more integrated power management unit (PMU) approach. Figure 43 shows this approach.

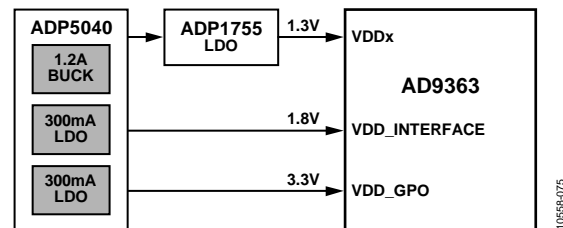


Figure 43. Space Optimized Power Solution for the AD9363

APPLICATIONS INFORMATION

For additional information about how to program the [AD9363](#) device, see the [AD9363](#) reference manual, and for additional information about the [AD9363](#) registers, see the [AD9363](#) register map reference manual, both of which are available by registering at the [Integrated Wideband RF Transceiver Design Resources](#) web page and clicking **Download the AD9363 Design File Package**. The register map is provided as a convenient and informational resource about low level operation of the device; however, it is not recommended for creating user software.

Analog Devices, Inc., provides complete drivers for the [AD9363](#) for both bare metal/no operating system (no OS) and Linux operating systems. The [AD9361](#), [AD9363](#), and [AD9364](#) share the same application program interface (API). For the [AD9361](#) drivers, visit the following online locations:

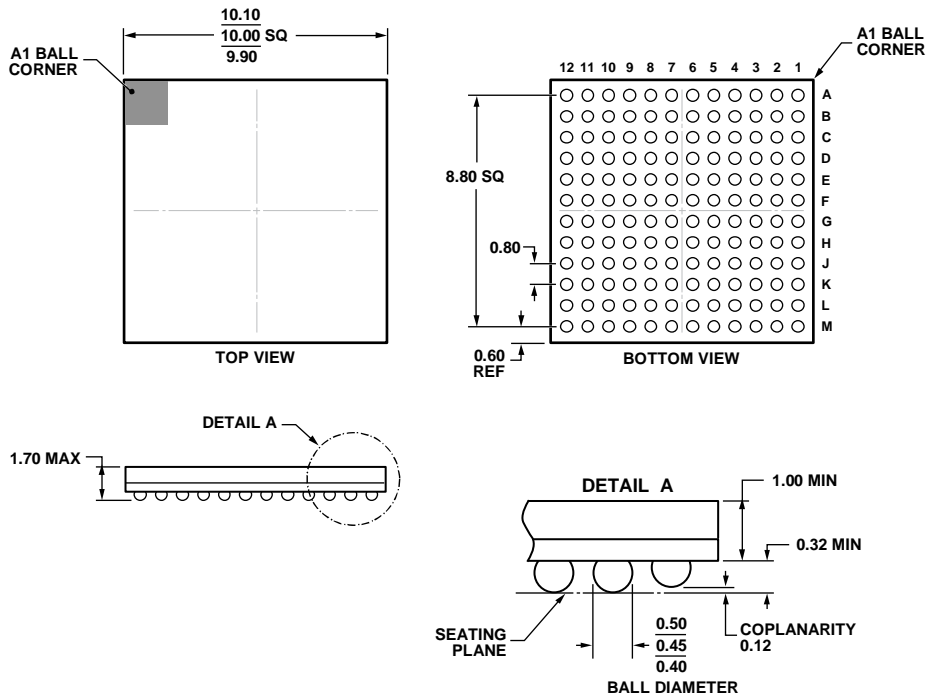
- [Linux](#) wiki page
- [No OS](#) wiki page

For support for these drivers, visit the following online locations:

- [Linux Engineer Zone®](#) page
- [No OS Engineer Zone](#) page

PACKAGING AND ORDERING INFORMATION

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-275-EEAB-1.

11-18-2011-A

Figure 44. 144-Ball Chip Scale Package Ball Grid Array [CSP_BGA] (BC-144-7)
Dimensions shown in millimeters

ORDERING GUIDE

| Model ¹ | Temperature Range | Package Description | Package Option |
|--------------------|-------------------|---|----------------|
| AD9363ABCZ | -40°C to +85°C | 144-Ball Chip Scale Package Ball Grid Array [CSP_BGA] | BC-144-7 |
| AD9363ABCZ-REEL | -40°C to +85°C | 144-Ball Chip Scale Package Ball Grid Array [CSP_BGA] | BC-144-7 |
| ADRV9363-W/PCBZ | | Evaluation Board, 325 MHz to 3800 MHz Matching Circuits | |

¹ Z = RoHS Compliant Part.

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А