# 700 MHz to 1000 MHz GaAs Matched RF PA Predriver

Data Sheet **ADL5322**

## FEATURES

- **Internally matched to 50 Ω input and output**
- **Internally biased**
- **Operating frequency: 700 MHz to 1000 MHz**
- **Gain: 20 dB**
- **OIP3: 45 dBm**
- **P1 dB: 27 dBm**
- **Noise figure: 5 dB**
- **3 mm × 3 mm LFCSP**
- **Power supply: 5 V**

## APPLICATIONS

**CDMA2000, WCDMA, and GSM base station transceivers and high power amplifiers**

## FUNCTIONAL BLOCK DIAGRAM

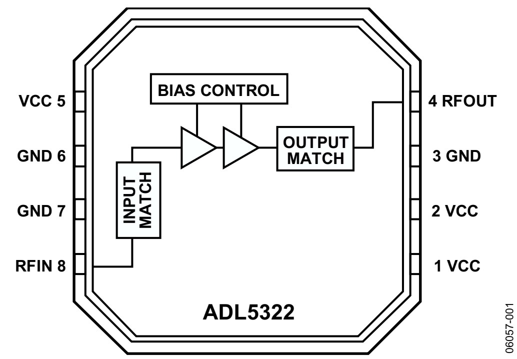


*Figure 1.*

## GENERAL DESCRIPTION

The ADL5322 is a high linearity GaAs driver amplifier that is internally matched to 50 Ω for operation in the 700 MHz to 1000 MHz frequency range. The amplifier, which has a gain of 20 dB, is specially designed for use in the output stage of a cellular base station radio or as an input preamplifier in a multicarrier base station power amplifier. Matching and biasing are all on-chip. The ADL5322 is available in a Pb-free, 3 mm × 3 mm, 8-lead LFCSP package with an operating temperature from −40°C to +85°C.

**Rev. A** Document Feedback



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# TABLE OF CONTENTS



## REVISION HISTORY

**1/14—Rev. 0 to Rev. A:**

Changes to Figure 2 ... 5
Added Figure 12, Renumbered Sequentially ... 7
Added Exposed Pad Notation to Outline Dimensions ... 11
Changes to Ordering Guide ... 11

**7/06—Revision 0: Initial Version**

# SPECIFICATIONS

$V_{CC}$ = 5 V, $T_A$ = 25°C.

**Table 1.**

| Parameter | Test Conditions/Comments | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| FREQUENCY RANGE | | 700 | | 1000 | MHz |
| GAIN | Frequency = 850 MHz | 19 | 20.3 | 21.4 | dB |
| vs. Frequency | 832 MHz to 870 MHz | | ±0.125 | | dB |
| vs. Temperature | −40°C to +85°C | | ±1 | | dB |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.1 | | dB |
| | Frequency = 900 MHz | 18.6 | 19.9 | 21.1 | dB |
| vs. Frequency | 869 MHz to 894 MHz | | ±0.125 | | dB |
| vs. Temperature | −40°C to +85°C | | ±1 | | dB |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.1 | | dB |
| | Frequency = 950 MHz | 18.3 | 19.6 | 20.8 | dB |
| vs. Frequency | 925 MHz to 960 MHz | | ±0.125 | | dB |
| vs. Temperature | −40°C to +85°C | | ±1.1 | | dB |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.1 | | dB |
| P1 dB | Frequency = 850 MHz | 27.0 | 27.7 | | dBm |
| vs. Frequency | 832 MHz to 870 MHz | | ±0.1 | | dBm |
| vs. Temperature | −40°C to +85°C | | ±1 | | dBm |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.3 | | dBm |
| | Frequency = 900 MHz | 27.3 | 27.9 | | dBm |
| vs. Frequency | 869 MHz to 894 MHz | | ±0.1 | | dBm |
| vs. Temperature | −40°C to +85°C | | ±1 | | dBm |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.4 | | dBm |
| | Frequency = 950 MHz | 26.7 | 27.5 | | dBm |
| vs. Frequency | 925 MHz to 960 MHz | | ±0.2 | | dBm |
| vs. Temperature | −40°C to +85°C | | ±1 | | dBm |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.4 | | dBm |
| NOISE FIGURE | Frequency = 830 MHz to 960 MHz | | 5 | | dB |
| INPUT RETURN LOSS | Frequency = 830 MHz to 960 MHz | | −10 | | dB |
| OUTPUT RETURN LOSS | Frequency = 830 MHz to 960 MHz | | −10 | | dB |
| OIP3 | Carrier spacing = 1 MHz, $P_{OUT}$ = 5 dBm per carrier | | | | |
| | Frequency = 850 MHz | | 44.8 | | dBm |
| vs. Frequency | 832 MHz to 870 MHz | | ±0.25 | | dBm |
| vs. Temperature | −40°C to +85°C | | ±3.0 | | dBm |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.5 | | dBm |
| | Frequency = 900 MHz | | 45.3 | | dBm |
| vs. Frequency | 869 MHz to 894 MHz | | ±0.25 | | dBm |
| vs. Temperature | −40°C to +85°C | | ±2.7 | | dBm |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.8 | | dBm |
| | Frequency = 950 MHz | | 44.4 | | dBm |
| vs. Frequency | 925 MHz to 960 MHz | | ±0.25 | | dBm |
| vs. Temperature | −40°C to +85°C | | ±2.2 | | dBm |
| vs. Voltage | 5 V, @ 5% (4.75 V to 5.25 V) | | ±0.8 | | dBm |
| POWER SUPPLY | | | | | |
| Supply Voltage | | 4.75 | 5 | 5.25 | V |
| Supply Current | $P_{OUT}$ = 5 dBm | | 320 | | mA |
| Operating Temperature | | −40 | | +85 | °C |

# ABSOLUTE MAXIMUM RATINGS

**Table 2.**

| Parameter | Rating |
|---|---|
| Supply Voltage, VPOS | 6 V |
| Input Power (re: 50 Ω) | 18 dBm |
| Equivalent Voltage | 1.8 V rms |
| $\theta_{JC}$ (Soldered) | 28.5°C/W |
| Maximum Junction Temperature | 150°C |
| Operating Temperature Range | −40°C to +85°C |
| Storage Temperature Range | −65°C to +150°C |
| Soldering Temperature | 260°C |

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

## 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

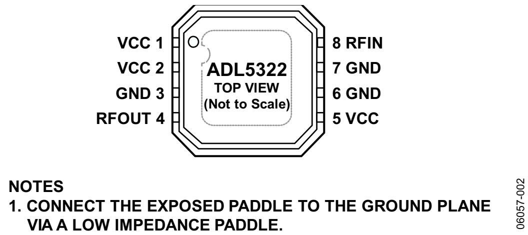


*Figure 2. Pin Configuration*

**Table 3. Pin Function Descriptions**

| Pin No. | Mnemonic | Description |
|---|---|---|
| 1, 2, 5 | VCC | Positive 5 V Supply Voltage. Bypass these three pins with independent power supply decoupling networks (100 pF, 10 nF, and 10 μF). |
| 3, 6, 7 | GND | Device Ground. |
| 4 | RFOUT | RF Output. Internally matched to 50 Ω. |
| 8 | RFIN | RF Input. Internally matched to 50 Ω. |
| N/A | EP | Exposed Paddle. Connect to the ground plane via a low impedance path. |

**Table 4. S-Parameters**

| Frequency | ADL5322 (1, 1) | ADL5322 (1, 2) | ADL5322 (2, 1) | ADL5322 (2, 2) |
|---|---|---|---|---|
| 700.0 MHz | 0.210/109.457 | 0.002/97.018 | +11.221/−158.622 | 0.436/150.470 |
| 720.0 MHz | 0.195/104.437 | 0.002/93.284 | +11.108/−166.579 | 0.392/145.211 |
| 740.0 MHz | 0.179/99.101 | 0.002/87.856 | +11.013/−174.596 | 0.345/137.443 |
| 760.0 MHz | 0.165/93.363 | 0.002/86.137 | 10.931/177.282 | 0.295/133.051 |
| 780.0 MHz | 0.151/86.953 | 0.002/78.668 | 10.856/169.006 | 0.242/125.612 |
| 800.0 MHz | 0.138/79.928 | 0.002/74.072 | 10.781/160.613 | 0.187/116.434 |
| 820.0 MHz | 0.125/71.950 | 0.002/68.940 | 10.698/152.065 | 0.130/102.897 |
| 840.0 MHz | 0.114/62.829 | 0.002/62.269 | 10.605/143.342 | 0.079/76.154 |
| 860.0 MHz | 0.103/52.162 | 0.002/56.742 | 10.493/134.489 | 0.061/18.090 |
| 880.0 MHz | 0.095/39.531 | 0.002/56.696 | 10.361/125.433 | +0.098/−26.962 |
| 900.0 MHz | 0.090/24.952 | 0.003/43.549 | 10.210/116.239 | +0.153/−46.741 |
| 920.0 MHz | 0.088/9.188 | 0.003/37.254 | 10.033/106.889 | +0.211/−58.300 |
| 940.0 MHz | +0.090/−7.350 | 0.003/29.904 | 9.837/97.326 | +0.269/−66.606 |
| 960.0 MHz | +0.095/−23.642 | 0.003/24.334 | 9.614/87.600 | +0.324/−73.265 |
| 980.0 MHz | +0.104/−39.131 | 0.003/16.521 | 9.364/77.609 | +0.376/−78.914 |
| 1.000 GHz | +0.115/−53.477 | 0.003/8.139 | 9.081/67.342 | +0.424/−83.911 |

# TYPICAL PERFORMANCE CHARACTERISTICS

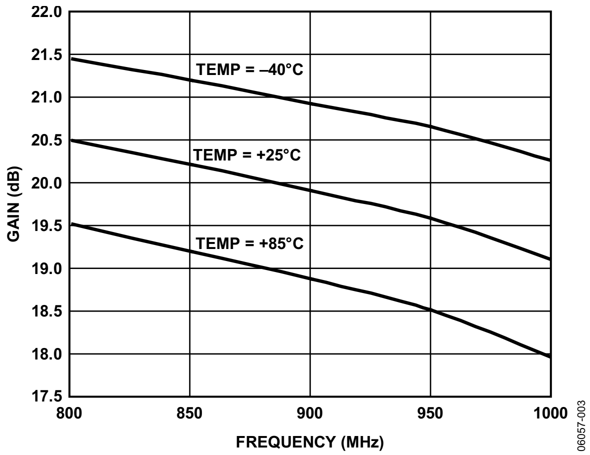


*Figure 3. Gain vs. Frequency, $V_{CC}$ = 5 V, $T_A$ = −40°C, +25°C, and +85°C*

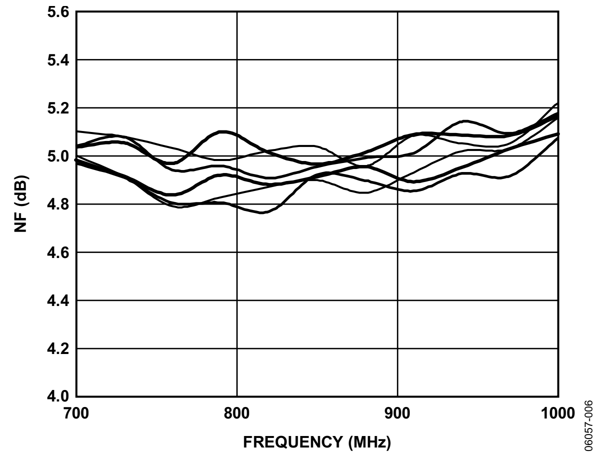


*Figure 6. Noise Figure vs. Frequency, Multiple Devices, $V_S$ = 5 V, $T_A$ = 25°C*

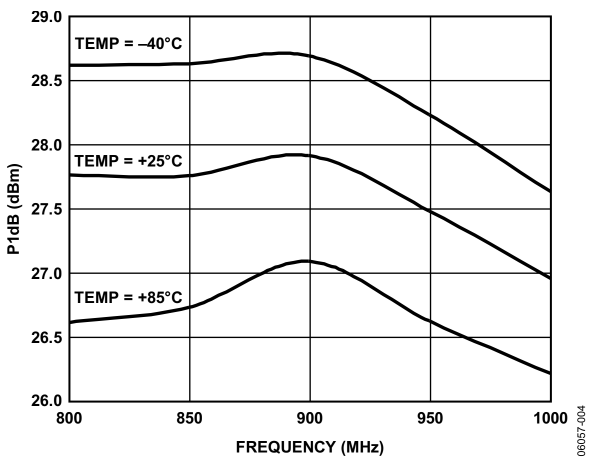


*Figure 4. P1 dB vs. Frequency, $V_{CC}$ = 5 V, $T_A$ = −40°C, +25°C, and +85°C*

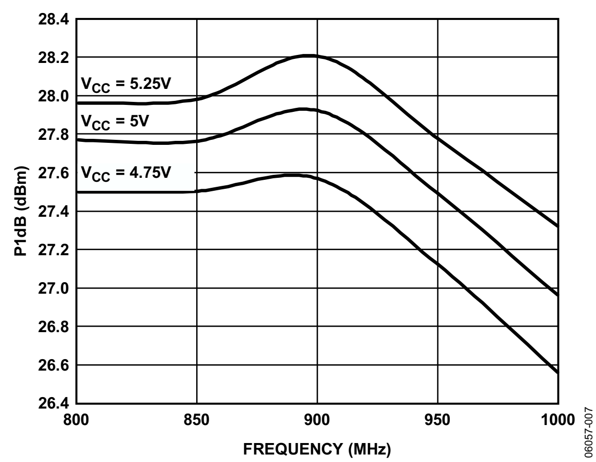


*Figure 7. P1 dB vs. Frequency, $V_{CC}$ = 4.75 V, 5 V, and 5.25 V, $T_A$ = 25°C*

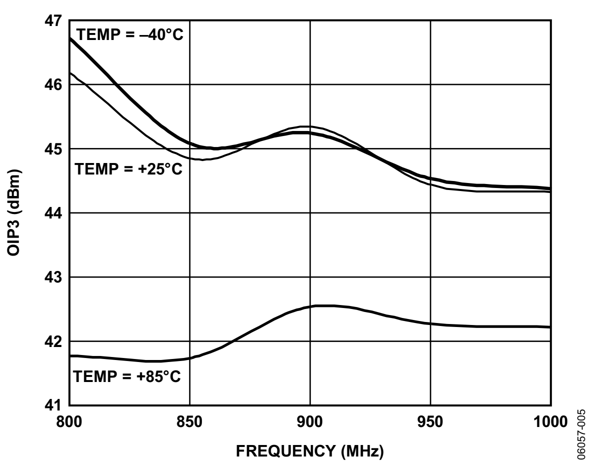


*Figure 5. OIP3 vs. Frequency, $V_{CC}$ = 5 V, $T_A$ = −40°C, +25°C, and +85°C*

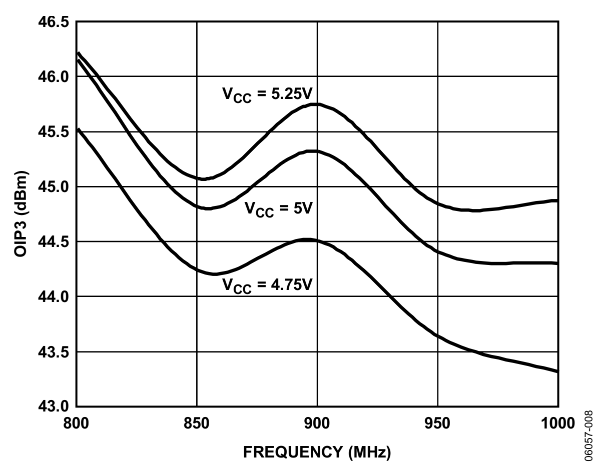


*Figure 8. OIP3 vs. Frequency, $V_{CC}$ = 4. 75 V, 5 V, and 5.25 V, $T_A$ = 25°C*

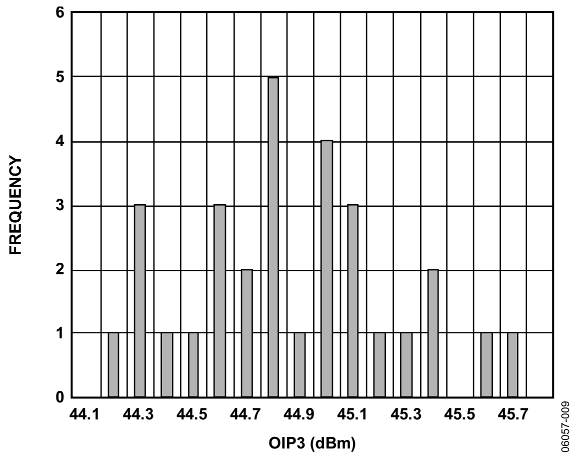


*Figure 9. Distribution of OIP3 at 850 MHz*

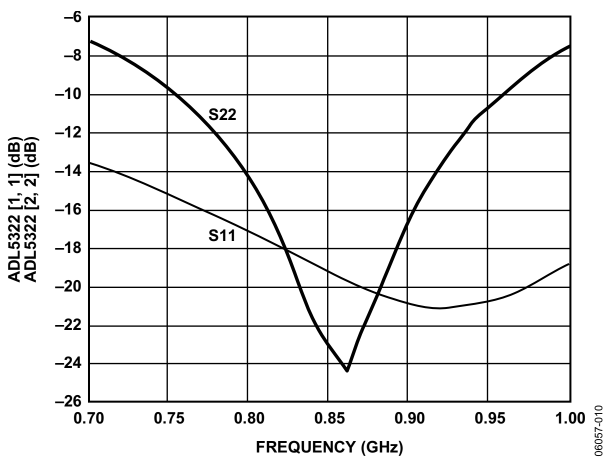


*Figure 10. Input S11 and Output S22 Return Loss vs. Frequency*

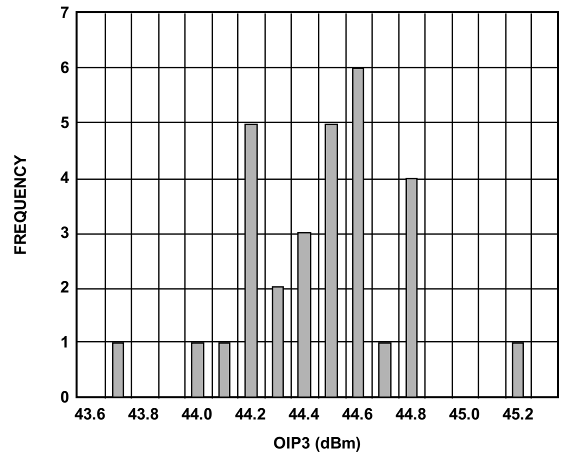


*Figure 11. Distribution of OIP3 at 950 MHz*

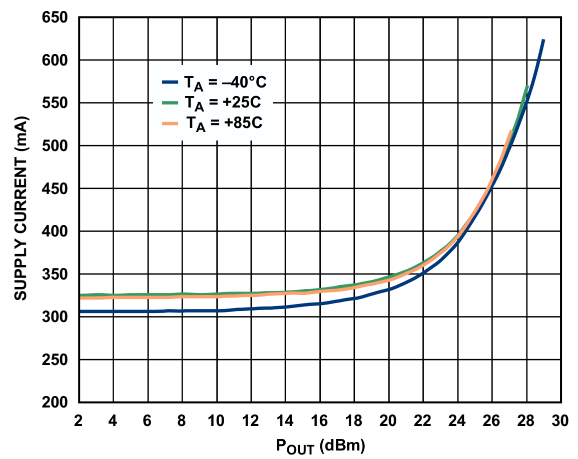


*Figure 12. Supply Current vs. $P_{OUT}$ and Temperature $V_{CC}$ = 5 V, $T_A$ = −40°C, +25°C, and +85°C*

# BASIC CONNECTIONS

Figure 15 shows the basic connections for operating the ADL5322. Each of the three power supply lines should be decoupled with 10 µF, 10 nF, and 100 pF capacitors. Pin 3, Pin 6, Pin 7, and the exposed paddle under the device should all be connected to a low impedance ground plane. If multiple ground planes are being used, these should be stitched together with vias under the device to optimize thermal conduction. See recommended land pattern in Figure 13.

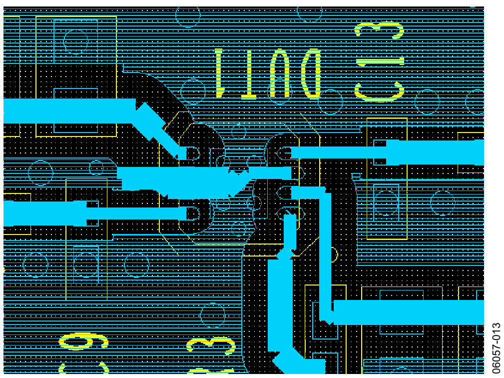


*Figure 13. Recommended Land Pattern*

## CDMA2000 DRIVING APPLICATION

Figure 14 shows a plot of the spectrum of an ADL5323 driving at 4-carrier CDMA2000 signal at 0 dBm per carrier (total carrier power = 6 dBm), centered at 880 MHz. At 750 kHz and 1.98 MHz offset, adjacent channel power ratios of −59 dBc and −84 dBc (measured in 30 kHz with respect to the 1.22 MHz carrier) are observed. At 4 MHz carrier offset, −73 dBc is measured in a 1 MHz bandwidth (−133 dBm/Hz). Note that the spectrum of the four carriers is slightly rounded due the frequency response of the cavity-tuned filter that was used to filter out the noise and distortion of the source signal.

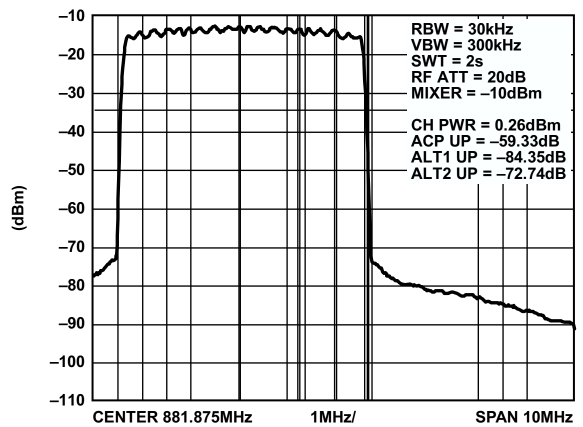


*Figure 14. Spectrum of 4 Adjacent CDMA2000 Carriers Centered at 880 MHz; Total Carrier Power = 6 dBm (0 dBm per Carrier)*

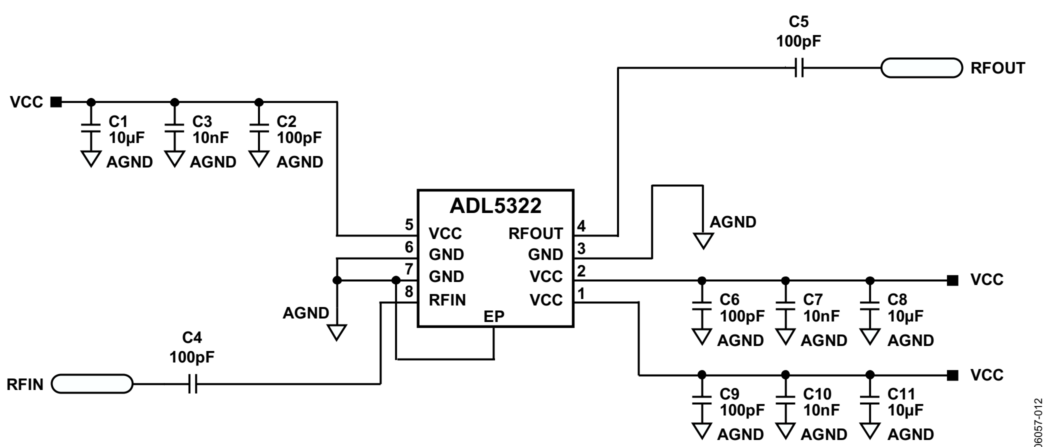


*Figure 15. Basic Connections*

Figure 16 shows how ACP varies with output power level. The close-in ACP is a function of the signal coding and is unaffected by output headroom at these power levels. The ACP measured at 1.98 MHz carrier offset is −72 dBc at 10 dBm output power (12 dB below the required 60 dBc). At 4 MHz carrier offset, the noise and distortion measured in a 1 MHz bandwidth is −75 dBm at 6 dBm (total) output power (0 dBm per carrier). In a 50 dBm transmitter, this corresponds to an antenna-referred output power of −31 dBm (1 MHz), which is 18 dB below what is required by the CDMA2000 standard.

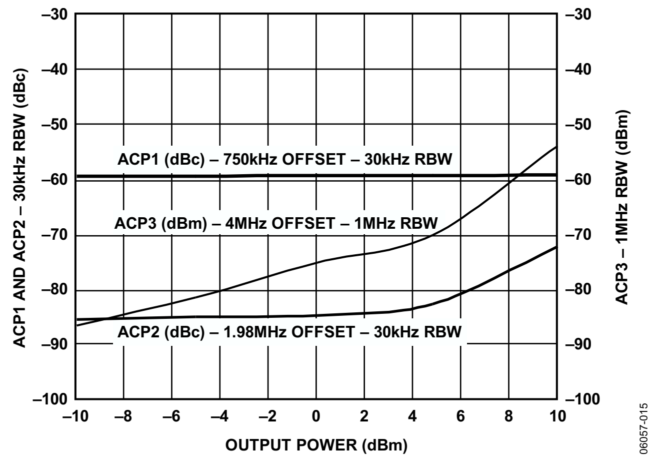


*Figure 16. CDMA2000 ACP vs. Output Power per Carrier; 4 Adjacent Carriers*

# EVALUATION BOARD

Figure 18 shows the schematic of the ADL5322 evaluation board. The board is powered by a single supply in the 4.75 V to 5.25 V range. The power supply is decoupled on each of the three power supply pins by 10 µF, 10 nF, and 100 pF capacitors. See Table 5 for exact evaluation board component values. Note that all three VCC pins (Pin 1, Pin 2, and Pin 5) should be independently bypassed as shown in Figure 18 for proper operation.

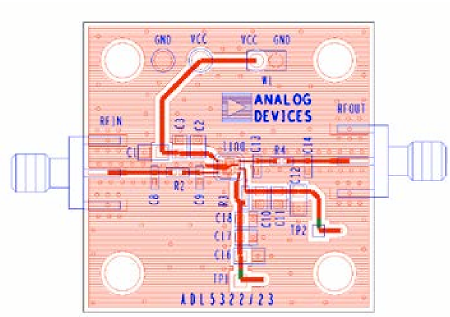


*Figure 17. Evaluation Board Component Side View*

**Table 5. Evaluation Board Components**

| Component | Function | Default Value |
|---|---|---|
| DUT1 | Driver amplifier | ADL5322 |
| C1, C12, C16 | Low frequency bypass capacitors | 10 µF, 0603 |
| C3, C11, C17 | Low frequency bypass capacitors | 10 nF, 0402 |
| C2, C10, C18 | High frequency bypass capacitors | 100 pF, 0402 |
| C8, C9, C13, C14, R3 | Open | Open, 0402 |
| R2, R4 | AC coupling capacitors | 100 pF, 0402 |

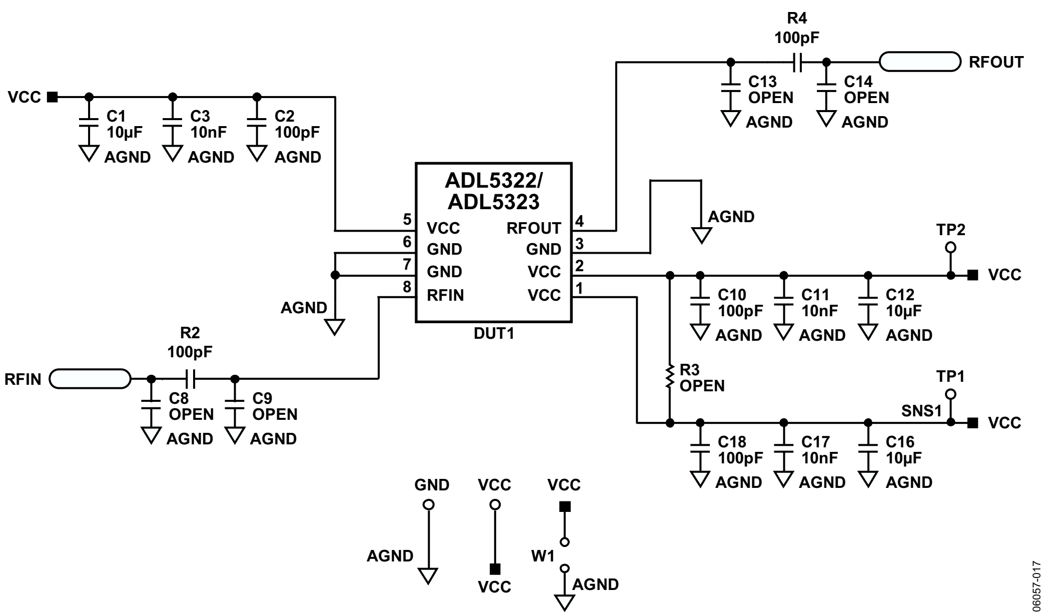


*Figure 18. Evaluation Board Schematic*

# OUTLINE DIMENSIONS

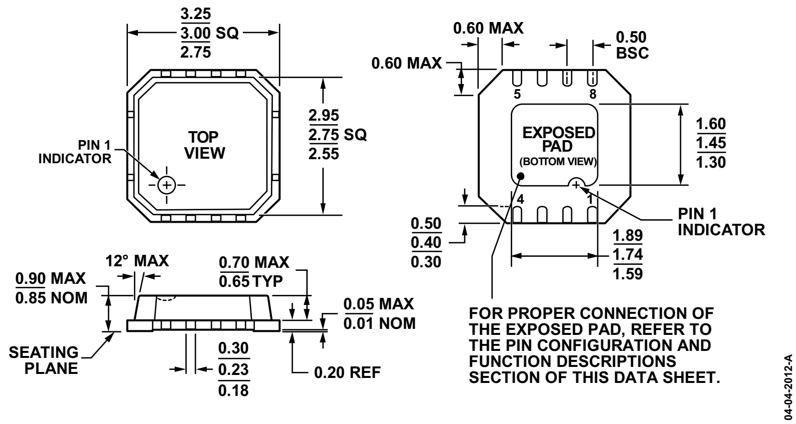


*Figure 19. 8-Lead Lead Frame Chip Scale Package [LFCSP_VD]*
*3 mm × 3 mm Body, Very Thin, Dual Lead*
*(CP-8-2)*
*Dimensions shown in millimeters*

## ORDERING GUIDE

| Model[1] | Temperature Range | Package Description | Package Option | Branding | Ordering Quantity |
|---|---|---|---|---|---|
| ADL5322ACPZ-R7 | −40°C to +85°C | 8-Lead LFCSP_VD, 7" Tape and Reel | CP-8-2 | OP | 1500 |
| ADL5322ACPZ-WP | −40°C to +85°C | 8-Lead LFCSP_VD, Waffle Pack | CP-8-2 | OP | 50 |
| ADL5322-EVALZ | | Evaluation Board | | | 1 |

[1] Z = RoHS Compliant Part.

## NOTES