19-4402; Rev 1; 5/09

# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer



## General Description

The MAX19996A single, high-linearity downconversion mixer provides 8.7dB conversion gain, +24.5dBm IIP3, and 9.8dB noise figure for 2000MHz to 3900MHz WCS, LTE, WiMAX™, and MMDS wireless infrastructure applications. With an ultra-wide LO frequency range of 2100MHz to 4000MHz, the MAX19996A can be used in either low-side or high-side LO injection architectures for virtually all 2.5GHz and 3.5GHz applications. For a 2.5GHz variant tuned specifically for low-side injection, refer to the MAX19996 data sheet.

In addition to offering excellent linearity and noise performance, the MAX19996A also yields a high level of component integration. This device includes a double-balanced passive mixer core, an IF amplifier, and an LO buffer. On-chip baluns are also integrated to allow for single-ended RF and LO inputs. The MAX19996A requires a nominal LO drive of 0dBm, and supply current is typically 230mA at $V_{CC}$ = 5.0V, or 150mA at $V_{CC}$ = 3.3V.

The MAX19996A is pin compatible with the MAX19996 2000MHz to 3000MHz mixer. The device is also pin similar with the MAX9984/MAX9986/MAX9986A 400MHz to 1000MHz mixers and the MAX9993/MAX9994/MAX9996 1700MHz to 2200MHz mixers, making this entire family of downconverters ideal for applications where a common PCB layout is used for multiple frequency bands.

The MAX19996A is available in a compact 5mm x 5mm, 20-pin thin QFN with an exposed pad. Electrical performance is guaranteed over the extended -40°C to +85°C temperature range.

## Applications

2.3GHz WCS Base Stations

2.5GHz WiMAX and LTE Base Stations

2.7GHz MMDS Base Stations

3.5GHz WiMAX and LTE Base Stations

Fixed Broadband Wireless Access

Wireless Local Loop

Private Mobile Radios

Military Systems

## Features

- ♦ **2000MHz to 3900MHz RF Frequency Range**
- ♦ **2100MHz to 4000MHz LO Frequency Range**
- ♦ **50MHz to 500MHz IF Frequency Range**
- ♦ **8.7dB Conversion Gain**
- ♦ **9.8dB Noise Figure**
- ♦ **+24.5dBm Typical Input IP3**
- ♦ **11dBm Typical Input 1dB Compression Point**
- ♦ **67dBc Typical 2LO-2RF Spurious Rejection at $P_{RF}$ = -10dBm**
- ♦ **Integrated LO Buffer**
- ♦ **Integrated RF and LO Baluns for Single-Ended Inputs**
- ♦ **Low -3dBm to +3dBm LO Drive**
- ♦ **Pin Compatible with the MAX19996 2000MHz to 3000MHz Mixer**
- ♦ **Pin Similar with the MAX9993/MAX9994/MAX9996 Series of 1700MHz to 2200MHz Mixers and the MAX9984/MAX9986/MAX9986A Series of 400MHz to 1000MHz Mixers**
- ♦ **Single 5.0V or 3.3V Supply**
- ♦ **External Current-Setting Resistors Provide Option for Operating Device in Reduced-Power/Reduced-Performance Mode**

## Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE |
|---|---|---|
| MAX19996AETP+ | -40°C to +85°C | 20 Thin QFN-EP* |
| MAX19996AETP+T | -40°C to +85°C | 20 Thin QFN-EP* |

*+Denotes a lead(Pb)-free/RoHS-compliant package.*

**EP = Exposed pad.*

*T = Tape and reel.*

***Pin Configuration/Functional Diagram appears at end of data sheet.***

*WiMAX is a trademark of WiMAX Forum.*

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## ABSOLUTE MAXIMUM RATINGS

$V_{CC}$ to GND ....................-0.3V to +5.5V
IF+, IF-, LO to GND ....................-0.3V to ($V_{CC}$ + 0.3V)
RF, LO Input Power ....................+12dBm
RF, LO Current (RF and LO is DC shorted to GND through a balun)....................50mA
Continuous Power Dissipation (Note 1) ....................5.0W
$\theta_{JA}$ (Notes 2, 3)....................+38°C/W
$\theta_{JC}$ (Notes 1, 3)....................13°C/W
Operating Case Temperature Range (Note 4)....................$T_C$ = -40°C to +85°C
Junction Temperature ....................+150°C
Storage Temperature Range ....................-65°C to +150°C
Lead Temperature (soldering, 10s) ....................+300°C

**Note 1:** Based on junction temperature $T_J = T_C + (\theta_{JC} \times V_{CC} \times I_{CC})$. This formula can be used when the temperature of the exposed pad is known while the device is soldered down to a PCB. See the *Applications Information* section for details. The junction temperature must not exceed +150°C.

**Note 2:** Junction temperature $T_J = T_A + (\theta_{JA} \times V_{CC} \times I_{CC})$. This formula can be used when the ambient temperature of the PCB is known. The junction temperature must not exceed +150°C.

**Note 3:** Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maxim-ic.com/thermal-tutorial**.

**Note 4:** $T_C$ is the temperature on the exposed pad of the package. $T_A$ is the ambient temperature of the device and PCB.

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## 5.0V SUPPLY DC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit*, $V_{CC}$ = 4.75V to 5.25V, no input AC signals. $T_C$ = -40°C to +85°C, unless otherwise noted. Typical values are at $V_{CC}$ = 5.0V, $T_C$ = +25°C, all parameters are production tested.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | | 4.75 | 5.0 | 5.25 | V |
| Supply Current | $I_{CC}$ | | | 230 | 245 | mA |

## 3.3V SUPPLY DC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit*, $V_{CC}$ = 3.0V to 3.6V, no input AC signals. $T_C$ = -40°C to +85°C, unless otherwise noted. Typical values are at $V_{CC}$ = 3.3V, $T_C$ = +25°C, parameters are guaranteed by design and not production tested, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | | 3.0 | 3.3 | 3.6 | V |
| Supply Current | $I_{CC}$ | Total supply current, $V_{CC}$ = 3.3V | | 150 | | mA |

## RECOMMENDED AC OPERATING CONDITIONS

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| RF Frequency Range | $f_{RF}$ | *Typical Application Circuit* with C1 = 8.2pF, see Table 1 for details (Note 5) | 2000 | | 3000 | MHz |
| | | *Typical Application Circuit* with C1 = 1.5pF, see Table 1 for details (Note 5) | 3000 | | 3900 | |
| LO Frequency | $f_{LO}$ | (Note 5) | 2100 | | 4000 | MHz |
| IF Frequency | $f_{IF}$ | Using Mini-Circuits TC4-1W-17 4:1 transformer as defined in the *Typical Application Circuit*, IF matching components affect the IF frequency range (Note 5) | 100 | | 500 | MHz |
| | | Using Mini-Circuits TC4-1W-7A 4:1 transformer as defined in the *Typical Application Circuit*, IF matching components affect the IF frequency range (Note 5) | 50 | | 250 | |
| LO Drive | $P_{LO}$ | | -3 | 0 | +3 | dBm |

## 5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS—$f_{RF}$ = 2300MHz TO 2900MHz, HIGH-SIDE LO INJECTION

(*Typical Application Circuit* with tuning elements outlined in **Table 1**, $V_{CC}$ = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources, $P_{LO}$ = -3dBm to +3dBm, $P_{RF}$ = -5dBm, $f_{RF}$ = 2300MHz to 2900MHz, $f_{IF}$ = 300MHz, $f_{LO}$ = 2600MHz to 3200MHz, $f_{RF} < f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are for $T_C$ = +25°C, $V_{CC}$ = 5.0V, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2900MHz, $f_{IF}$ = 300MHz. All parameters are guaranteed by design and characterization, unless otherwise noted.) (Note 6)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Small-Signal Conversion Gain | | $f_{RF}$ = 2300MHz to 2900MHz, $T_C$ = +25°C (Note 7) | 7.9 | 8.7 | 9.2 | dB |
| Gain Variation vs. Frequency | $\Delta G_C$ | $f_{RF}$ = 2305MHz to 2360MHz | | 0.1 | | dB |
| | | $f_{RF}$ = 2500MHz to 2570MHz | | 0.1 | | |
| | | $f_{RF}$ = 2570MHz to 2620MHz | | 0.1 | | |
| | | $f_{RF}$ = 2500MHz to 2690MHz | | 0.2 | | |
| | | $f_{RF}$ = 2700MHz to 2900MHz | | 0.3 | | |
| Conversion Gain Temperature Coefficient | $TC_{CG}$ | $T_C$ = -40°C to +85°C | | -0.012 | | dB/°C |
| Single Sideband Noise Figure | $NF_{SSB}$ | No blockers present | | 9.8 | 12 | dB |
| | | $f_{RF}$ = 2600MHz, $f_{IF}$ = 300MHz, $P_{LO}$ = 0dBm, $V_{CC}$ = +5.0V, $T_C$ = +25°C, no blockers present | | 9.8 | 10.5 | |
| Noise Figure Temperature Coefficient | $TC_{NF}$ | $f_{RF}$ = 2300MHz to 2900MHz, single sideband, no blockers present, $T_C$ = -40°C to +85°C | | 0.018 | | dB/°C |
| Noise Figure Under Blocking | $NF_B$ | +8dBm blocker tone applied to RF port, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2900MHz, $f_{BLOCKER}$ = 2400MHz, $P_{LO}$ = 0dBm, $V_{CC}$ = +5.0V, $T_C$ = +25°C (Note 8) | | 18 | 22 | dB |

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## 5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS—$f_{RF}$ = 2300MHz TO 2900MHz, HIGH-SIDE LO INJECTION (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1**, $V_{CC}$ = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources, $P_{LO}$ = -3dBm to +3dBm, $P_{RF}$ = -5dBm, $f_{RF}$ = 2300MHz to 2900MHz, $f_{IF}$ = 300MHz, $f_{LO}$ = 2600MHz to 3200MHz, $f_{RF} < f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are for $T_C$ = +25°C, $V_{CC}$ = 5.0V, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2900MHz, $f_{IF}$ = 300MHz. All parameters are guaranteed by design and characterization, unless otherwise noted.) (Note 6)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Input 1dB Compression Point | $IP_{1dB}$ | $T_C$ = +25°C (Note 9) | | 9.5 | 11 | | dBm |
| | | $f_{RF}$ = 2600MHz $T_C$ = +25°C (Notes 7, 9) | | 10 | 11 | | |
| Third-Order Input Intercept Point | IIP3 | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm, $T_C$ = +25°C (Note 7) | | 22.5 | 24.5 | | dBm |
| IIP3 Variation with $T_C$ | | $f_{RF}$ = 2300MHz to 2900MHz, $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm, $T_C$ = -40°C to +85°C | | | ±0.3 | | dB |
| 2LO-2RF Spur Rejection | 2 x 2 | $f_{SPUR}$ = $f_{LO}$ - 150MHz | $P_{RF}$ = -10dBm | 60 | 67 | | dBc |
| | | | $P_{RF}$ = -5dBm | 55 | 62 | | |
| 3LO-3RF Spur Rejection | 3 x 3 | $f_{SPUR}$ = $f_{LO}$ - 100MHz | $P_{RF}$ = -10dBm | 75 | 85 | | dBc |
| | | | $P_{RF}$ = -5dBm | 65 | 75 | | |
| RF Input Return Loss | $RL_{RF}$ | LO on and IF terminated into a matched impedance | | | 17.5 | | dB |
| LO Input Return Loss | $RL_{LO}$ | RF and IF terminated into a matched impedance | | | 19.5 | | dB |
| IF Output Impedance | $Z_{IF}$ | Nominal differential impedance at the IC's IF outputs | | | 200 | | Ω |
| IF Output Return Loss | $RL_{IF}$ | RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*; see the *Typical Operating Characteristics* for performance vs. inductor values | $f_{IF}$ = 450MHz, L1 = L2 = 120nH | | 25 | | dB |
| | | | $f_{IF}$ = 350MHz, L1 = L2 = 270nH | | 25 | | |
| | | | $f_{IF}$ = 300MHz, L1 = L2 = 390nH | | 25 | | |
| RF-to-IF Isolation | | $P_{LO}$ = +3dBm (Note 7) | | 27 | 30 | | dB |
| LO Leakage at RF Port | | $P_{LO}$ = +3dBm | | | -28.6 | -22.8 | dBm |
| 2LO Leakage at RF Port | | $P_{LO}$ = +3dBm | | | -29.7 | | dBm |
| LO Leakage at IF Port | | $P_{LO}$ = +3dBm (Note 7) | | | -28.4 | | dBm |

## 3.3V SUPPLY AC ELECTRICAL CHARACTERISTICS—$f_{RF}$ = 2300MHz TO 2900MHz, HIGH-SIDE LO INJECTION

(*Typical Application Circuit* with tuning elements outlined in **Table 1**, RF and LO ports are driven from 50Ω sources. Typical values are for $T_C$ = +25°C, $V_{CC}$ = 3.3V, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2900MHz, $f_{IF}$ = 300MHz, unless otherwise noted.) (Note 6)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Small-Signal Conversion Gain | $G_C$ | | | 8.3 | | dB |
| Gain Variation vs. Frequency | $\Delta G_C$ | $f_{RF}$ = 2300MHz to 2900MHz, any 100MHz band | | 0.15 | | dB |
| Conversion Gain Temperature Coefficient | $TC_{CG}$ | $T_C$ = -40°C to +85°C | | -0.012 | | dB/°C |
| Single Sideband Noise Figure | $NF_{SSB}$ | No blockers present | | 9.6 | | dB |
| Noise Figure Temperature Coefficient | $TC_{NF}$ | Single sideband, no blockers present, $T_C$ = -40°C to +85°C | | 0.018 | | dB/°C |
| Input 1dB Compression Point | $IP_{1dB}$ | (Note 9) | | 7.75 | | dBm |
| Third-Order Input Intercept Point | IIP3 | $f_{RF1}$ = 2600MHz, $f_{RF2}$ = 2601MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm | | 19.7 | | dBm |
| IIP3 Variation with $T_C$ | | $f_{RF1}$ = 2600MHz, $f_{RF2}$ = 2601MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm, $T_C$ = -40°C to +85°C | | ±0.5 | | dB |
| 2LO-2RF Spur Rejection | 2 x 2 | $f_{SPUR}$ = $f_{LO}$ - 150MHz, $P_{RF}$ = -10dBm | | 64 | | dBc |
| | | $f_{SPUR}$ = $f_{LO}$ - 150MHz, $P_{RF}$ = -5dBm | | 59 | | |
| 3LO-3RF Spur Rejection | 3 x 3 | $f_{SPUR}$ = $f_{LO}$ - 100MHz, $P_{RF}$ = -10dBm | | 74 | | dBc |
| | | $f_{SPUR}$ = $f_{LO}$ - 100MHz, $P_{RF}$ = -5dBm | | 64 | | |
| RF Input Return Loss | $RL_{RF}$ | LO on and IF terminated into a matched impedance | | 17.5 | | dB |
| LO Input Return Loss | $RL_{LO}$ | RF and IF terminated into a matched impedance | | 19.5 | | dB |
| IF Output Impedance | $Z_{IF}$ | Nominal differential impedance at the IC's IF outputs | | 200 | | Ω |
| IF Output Return Loss | $RL_{IF}$ | RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*; see the *Typical Operating Characteristics* for performance vs. inductor values; $f_{IF}$ = 450MHz, L1 = L2 = 120nH | | 25 | | dB |
| | | $f_{IF}$ = 350MHz, L1 = L2 = 270nH | | 25 | | |
| | | $f_{IF}$ = 300MHz, L1 = L2 = 390nH | | 25 | | |
| RF-to-IF Isolation | | $f_{RF}$ = 2300MHz to 2900MHz, $P_{LO}$ = +3dBm | | 38 | | dB |
| LO Leakage at RF Port | | $f_{LO}$ = 2600MHz to 3200MHz, $P_{LO}$ = +3dBm | | -30 | | dBm |
| 2LO Leakage at RF Port | | $f_{LO}$ = 2600MHz to 3200MHz, $P_{LO}$ = +3dBm | | -31 | | dBm |
| LO Leakage at IF Port | | $f_{LO}$ = 2600MHz to 3200MHz, $P_{LO}$ = +3dBm | | -34 | | dBm |

# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

## 5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS—$f_{RF}$ = 2300MHz TO 2900MHz, LOW-SIDE LO INJECTION

(*Typical Application Circuit* with tuning elements outlined in **Table 1**, $V_{CC}$ = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources. $P_{LO}$ = -3dBm to +3dBm, $P_{RF}$ = -5dBm, $f_{RF}$ = 2300MHz to 2900MHz, $f_{IF}$ = 300MHz, $f_{LO}$ = 2000MHz to 2600MHz, $f_{RF} > f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are for $T_C$ = +25°C, $V_{CC}$ = 5.0V, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2300MHz, $f_{IF}$ = 300MHz, all parameters are guaranteed by design and characterization, unless otherwise noted.) (Note 6)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Small-Signal Conversion Gain | $G_C$ | $f_{RF}$ = 2300MHz to 2900MHz, $T_C$ = +25°C (Note 7) | | 8.2 | 8.9 | 9.5 | dB |
| Gain Variation vs. Frequency | $\Delta G_C$ | $f_{RF}$ = 2300MHz to 2900MHz, any 100MHz band | | | 0.1 | | dB |
| Conversion Gain Temperature Coefficient | $TC_{CG}$ | $T_C$ = -40°C to +85°C | | | -0.012 | | dB/°C |
| Single Sideband Noise Figure | $NF_{SSB}$ | No blockers present | | | 9.5 | 12.5 | dB |
| | | $f_{RF}$ = 2600MHz, $f_{IF}$ = 300MHz, $P_{LO}$ = 0dBm, $V_{CC}$ = +5.0V, $T_C$ = +25°C, no blockers present | | | 9.5 | 10.5 | |
| Noise Figure Temperature Coefficient | $TC_{NF}$ | Single sideband, no blockers present, $T_C$ = -40°C to +85°C | | | 0.018 | | dB/°C |
| Input 1dB Compression Point | $IP_{1dB}$ | $T_C$ = +25°C (Note 9) | | 9.5 | 10.7 | | dBm |
| Third-Order Input Intercept Point | IIP3 | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm, $T_C$ = +25°C (Note 7) | | 22 | 24.05 | | dBm |
| IIP3 Variation with $T_C$ | | $f_{RF}$ = 2300MHz to 2900MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm, $T_C$ = -40°C to +85°C | | | ±0.5 | | dB |
| 2RF-2LO Spur Rejection | 2 x 2 | $f_{SPUR}$ = $f_{LO}$ + 150MHz | $P_{RF}$ = -10dBm | 63 | 68 | | dBc |
| | | | $P_{RF}$ = -5dBm | 58 | 63 | | |
| 3RF-3LO Spur Rejection | 3 x 3 | $f_{SPUR}$ = $f_{LO}$ + 100MHz | $P_{RF}$ = -10dBm | 79 | 84 | | dBc |
| | | | $P_{RF}$ = -5dBm | 69 | 74 | | |
| RF Input Return Loss | $RL_{RF}$ | LO on and IF terminated into a matched impedance | | | 19 | | dB |
| LO Input Return Loss | $RL_{LO}$ | RF and IF terminated into a matched impedance | | | 18 | | dB |
| IF Output Impedance | $Z_{IF}$ | Nominal differential impedance at the IC's IF outputs | | | 200 | | Ω |
| IF Output Return Loss | $RL_{IF}$ | RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*; see the *Typical Operating Characteristics* for performance vs. inductor values | $f_{IF}$ = 450MHz, L1 = L2 = 120nH | | 25 | | dB |
| | | | $f_{IF}$ = 350MHz, L1 = L2 = 270nH | | 25 | | |
| | | | $f_{IF}$ = 300MHz, L1 = L2 = 390nH | | 25 | | |
| RF-to-IF Isolation | | $f_{RF}$ = 2600MHz, $P_{LO}$ = +3dBm | | 29 | 36 | | dB |
| LO Leakage at RF Port | | $f_{LO}$ = 1800MHz to 2900MHz, $P_{LO}$ = +3dBm | | | -28 | -20 | dBm |
| 2LO Leakage at RF Port | | $f_{LO}$ = 1800MHz to 2900MHz, $P_{LO}$ = +3dBm | | | -29 | -19 | dBm |
| LO Leakage at IF Port | | $f_{LO}$ = 1800MHz to 2900MHz, $P_{LO}$ = +3dBm | | | -24 | | dBm |

## 5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS—$f_{RF}$ = 3100MHz TO 3900MHz, LOW-SIDE LO INJECTION

(*Typical Application Circuit* with tuning elements outlined in **Table 1**, $V_{CC}$ = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources, $P_{LO}$ = -3dBm to +3dBm, $P_{RF}$ = -5dBm, $f_{RF}$ = 3100MHz to 3900MHz, $f_{IF}$ = 300MHz, $f_{LO}$ = 2800MHz to 3600MHz, $f_{RF}$ > $f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are for $T_C$ = +25°C, $V_{CC}$ = 5.0V, $P_{LO}$ = 0dBm, $f_{RF}$ = 3500MHz, $f_{LO}$ = 3200MHz, $f_{IF}$ = 300MHz. All parameters are guaranteed by design and characterization, unless otherwise noted.) (Note 6)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Small-Signal Conversion Gain | $G_C$ | $T_C$ = +25°C (Note 7) | | 7.5 | 8.0 | 8.5 | dB |
| Gain Variation vs. Frequency | $\Delta G_C$ | $f_{RF}$ = 3450MHz to 3750MHz, any 100MHz band | | | 0.15 | | dB |
| | | $f_{RF}$ = 3450MHz to 3750MHz, any 200MHz band | | | 0.3 | | |
| Conversion Gain Temperature Coefficient | $TC_{CG}$ | $T_C$ = -40°C to +85°C | | | -0.012 | | dB/°C |
| Single Sideband Noise Figure | $NF_{SSB}$ | No blockers present | | | 10.5 | 13.5 | dB |
| | | $f_{RF}$ = 3500MHz, $f_{IF}$ = 300MHz, $P_{LO}$ = 0dBm, $V_{CC}$ = +5.0V, $T_C$ = +25°C, no blockers present | | | 10.5 | 11.6 | |
| Noise Figure Temperature Coefficient | $TC_{NF}$ | $f_{RF}$ = 3100MHz to 3900MHz, single sideband, no blockers present, $T_C$ = -40°C to +85°C | | | 0.018 | | dB/°C |
| Noise Figure Under Blocking | $NF_B$ | +8dBm blocker tone applied to RF port, $f_{RF}$ = 3500MHz, $f_{LO}$ = 3200MHz, $f_{BLOCKER}$ = 3750MHz, $P_{LO}$ = 0dBm, $V_{CC}$ = +5.0V, $T_C$ = +25°C (Note 8) | | | 18.7 | 21 | dB |
| Input 1dB Compression Point | $IP_{1dB}$ | $f_{RF}$ = 3500MHz (Note 9) | | 10 | 12 | | dBm |
| Third-Order Input Intercept Point | IIP3 | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm (Note 7) | | 23 | 25 | | dBm |
| IIP3 Variation with $T_C$ | | $f_{RF}$ = 3100MHz to 3900MHz, $f_{IF}$ = 300MHz, $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm, $T_C$ = -40°C to +85°C | | | ±0.3 | | dB |
| 2RF-2LO Spur Rejection | 2 x 2 | $f_{SPUR}$ = $f_{LO}$ + 150MHz | $P_{RF}$ = -10dBm | 60 | 69 | | dBc |
| | | | $P_{RF}$ = -5dBm | 55 | 64 | | |
| 3RF-3LO Spur Rejection | 3 x 3 | $f_{SPUR}$ = $f_{LO}$ + 100MHz | $P_{RF}$ = -10dBm | 78 | 86 | | dBc |
| | | | $P_{RF}$ = -5dBm | 68 | 76 | | |
| RF Input Return Loss | $RL_{RF}$ | LO on and IF terminated into a matched impedance | | | 20 | | dB |
| LO Input Return Loss | $RL_{LO}$ | RF and IF terminated into a matched impedance | | | 16.5 | | dB |
| IF Output Impedance | $Z_{IF}$ | Nominal differential impedance at the IC's IF outputs | | | 200 | | Ω |

# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

## 5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS—$f_{RF}$ = 3100MHz TO 3900MHz, LOW-SIDE LO INJECTION (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1**, $V_{CC}$ = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources, $P_{LO}$ = -3dBm to +3dBm, $P_{RF}$ = -5dBm, $f_{RF}$ = 3100MHz to 3900MHz, $f_{IF}$ = 300MHz, $f_{LO}$ = 2800MHz to 3600MHz, $f_{RF}$ > $f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are for $T_C$ = +25°C, $V_{CC}$ = 5.0V, $P_{LO}$ = 0dBm, $f_{RF}$ = 3500MHz, $f_{LO}$ = 3200MHz, $f_{IF}$ = 300MHz. All parameters are guaranteed by design and characterization, unless otherwise noted.) (Note 6)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| IF Output Return Loss | $RL_{IF}$ | RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*; see the *Typical Operating Characteristics* for performance vs. inductor values | $f_{IF}$ = 450MHz, L1 = L2 = 120nH | | 25 | | dB |
| | | | $f_{IF}$ = 350MHz, L1 = L2 = 270nH | | 25 | | |
| | | | $f_{IF}$ = 300MHz, L1 = L2 = 390nH | | 25 | | |
| RF-to-IF Isolation | | $f_{RF}$ = 2600MHz $P_{LO}$ = +3dBm (Note 7) | | 23 | 27 | | dB |
| LO Leakage at RF Port | | $f_{LO}$ = 2800MHz to 3600MHz $P_{LO}$ = +3dBm | | | -31 | -20 | dBm |
| 2LO Leakage at RF Port | | $P_{LO}$ = +3dBm | | | -27 | | dBm |
| LO Leakage at IF Port | | $P_{LO}$ = +3dBm (Note 7) | | | -29.5 | -20 | dBm |

## +5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS—$f_{RF}$ = 3100MHz TO 3900MHz, HIGH-SIDE LO INJECTION

(*Typical Application Circuit* with tuning elements outlined in **Table 1**, $V_{CC}$ = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources, Typical values are for $T_C$ = +25°C, $V_{CC}$ = 5.0V, $P_{LO}$ = 0dBm, $f_{RF}$ = 3500MHz, $f_{LO}$ = 3800MHz, $f_{IF}$ = 300MHz. Parameters are guaranteed by design and not production tested.) (Note 6)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Small-Signal Conversion Gain | $G_C$ | | | | 7.6 | | dB |
| Gain Variation vs. Frequency | $\Delta G_C$ | $f_{RF}$ = 3450MHz to 3750MHz, any 100MHz band | | | 0.15 | | dB |
| | | $f_{RF}$ = 3450MHz to 3750MHz, any 200MHz band | | | 0.3 | | |
| Conversion Gain Temperature Coefficient | $TC_{CG}$ | $T_C$ = -40°C to +85°C | | | -0.012 | | dB/°C |
| Single Sideband Noise Figure | $NF_{SSB}$ | No blockers present | | | 10.9 | | dB |
| Noise Figure Temperature Coefficient | $TC_{NF}$ | Single sideband, no blockers present, $T_C$ = -40°C to +85°C | | | 0.018 | | dB/°C |
| Input 1dB Compression Point | $IP_{1dB}$ | (Note 9) | | | 12.4 | | dBm |
| Third-Order Input Intercept Point | IIP3 | $f_{RF1}$ = 3500MHz, $f_{RF2}$ = 3501MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm | | | 24.7 | | dBm |
| IIP3 Variation with $T_C$ | | $f_{RF1}$ = 3500MHz, $f_{RF2}$ = 3501MHz, $P_{RF1}$ = $P_{RF2}$ = -5dBm, $T_C$ = -40°C to +85°C | | | ±0.5 | | dB |
| 2LO-2RF Spur Rejection | 2 x 2 | $f_{SPUR}$ = $f_{LO}$ - 150MHz | $P_{RF}$ = -10dBm | | 69 | | dBc |
| | | | $P_{RF}$ = -5dBm | | 64 | | |

## +5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS—$f_{RF}$ = 3100MHz TO 3900MHz, HIGH-SIDE LO INJECTION (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1**, $V_{CC}$ = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources, Typical values are for $T_C$ = +25°C, $V_{CC}$ = 5.0V, $P_{LO}$ = 0dBm, $f_{RF}$ = 3500MHz, $f_{LO}$ = 3800MHz, $f_{IF}$ = 300MHz. Parameters are guaranteed by design and not production tested.) (Note 6)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| 3LO-3RF Spur Rejection | 3 x 3 | $f_{SPUR}$ = $f_{LO}$ - 100MHz | $P_{RF}$ = -10dBm | | 90 | | dBc |
| | | | $P_{RF}$ = -5dBm | | 80 | | |
| RF Input Return Loss | $RL_{RF}$ | LO on and IF terminated into a matched impedance | | | 22 | | dB |
| LO Input Return Loss | $RL_{LO}$ | RF and IF terminated into a matched impedance | | | 16.3 | | dB |
| IF Output Impedance | $Z_{IF}$ | Nominal differential impedance at the IC's IF outputs | | | 200 | | Ω |
| IF Output Return Loss | $RL_{IF}$ | RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*; see the *Typical Operating Characteristics* for performance vs. inductor values | $f_{IF}$ = 450MHz, L1 = L2 = 120nH | | 25 | | dB |
| | | | $f_{IF}$ = 350MHz, L1 = L2 = 270nH | | 25 | | |
| | | | $f_{IF}$ = 300MHz, L1 = L2 = 390nH | | 25 | | |
| RF-to-IF Isolation | | $f_{RF}$ = 3100MHz to 3700MHz, $P_{LO}$ = +3dBm | | | 26.6 | | dB |
| LO Leakage at RF Port | | $f_{LO}$ = 3400MHz to 4000MHz, $P_{LO}$ = +3dBm | | | -38 | | dBm |
| 2LO Leakage at RF Port | | $f_{LO}$ = 3400MHz to 4000MHz, $P_{LO}$ = +3dBm | | | -13.5 | | dBm |
| LO Leakage at IF Port | | $f_{LO}$ = 3400MHz to 4000MHz, $P_{LO}$ = +3dBm | | | -27 | | dBm |

**Note 5:** Not production tested. Operation outside this range is possible, but with degraded performance of some parameters. See the *Typical Operating Characteristics*.

**Note 6:** All limits reflect losses of external components, including a 0.8dB loss at $f_{IF}$ = 300MHz due to the 4:1 impedance transformer. Output measurements were taken at IF outputs of the *Typical Application Circuit*.

**Note 7:** 100% production tested for functional performance.

**Note 8:** Measured with external LO source noise filtered so that the noise floor is -174dBm/Hz. This specification reflects the effects of all SNR degradations in the mixer including the LO noise, as defined in Application Note 2021: *Specifications and Measurement of Local Oscillator Noise in Integrated Circuit Base Station Mixers*.

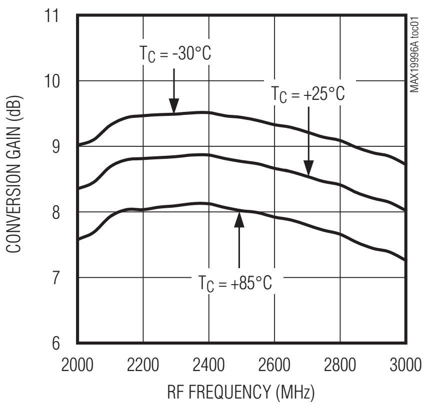
**Note 9:** Maximum reliable continuous input power applied to the RF port of this device is +12dBm from a 50Ω source.

# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

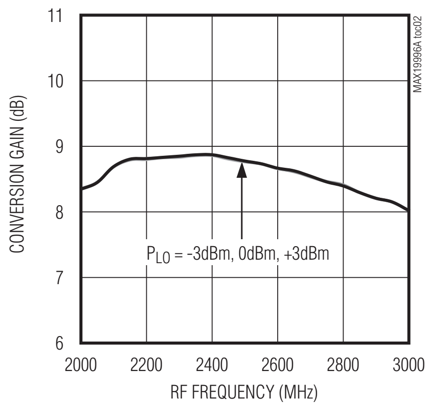
## Typical Operating Characteristics

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 2000MHz to 3000MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

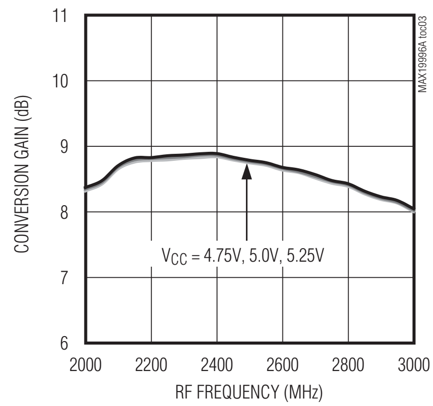
**CONVERSION GAIN vs. RF FREQUENCY**



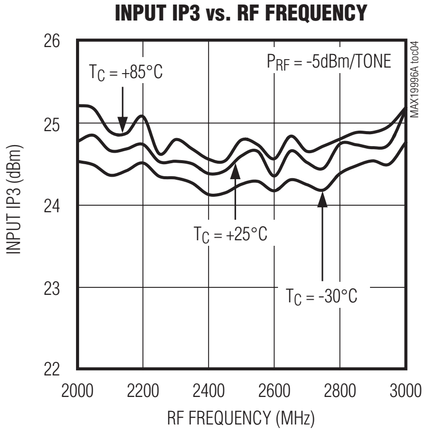

**CONVERSION GAIN vs. RF FREQUENCY**



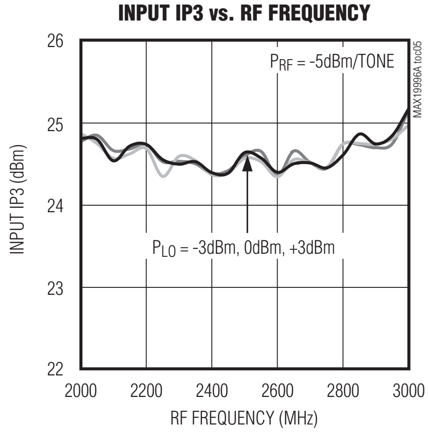

**CONVERSION GAIN vs. RF FREQUENCY**



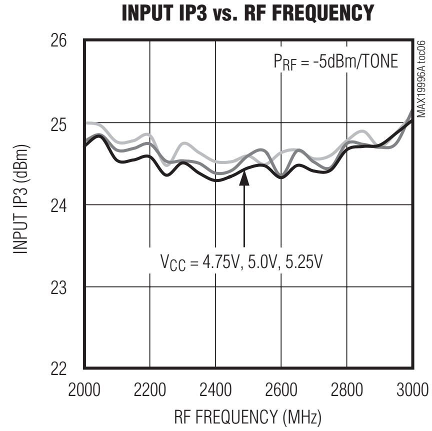

**INPUT IP3 vs. RF FREQUENCY**



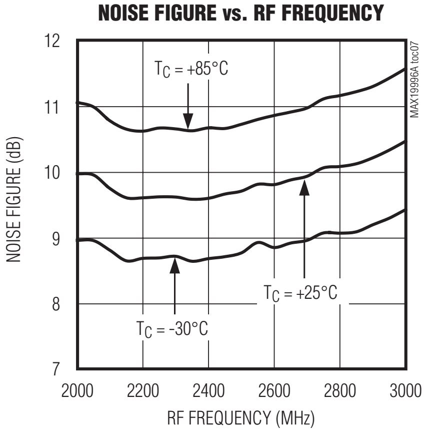

**INPUT IP3 vs. RF FREQUENCY**



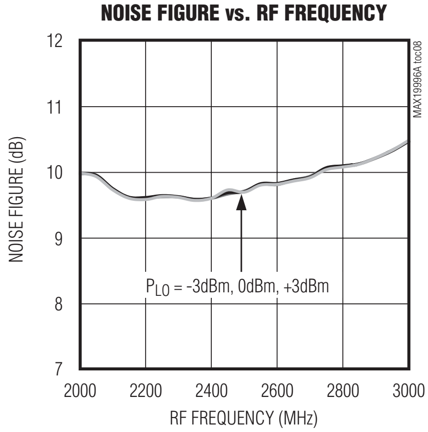

**INPUT IP3 vs. RF FREQUENCY**



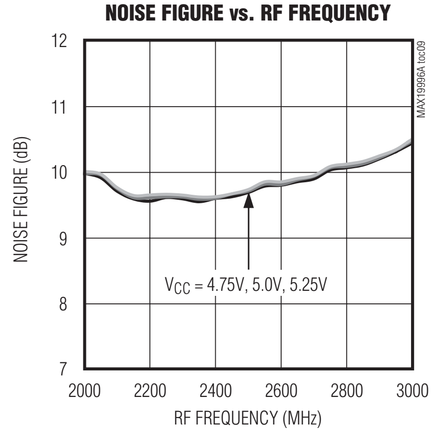

**NOISE FIGURE vs. RF FREQUENCY**




**NOISE FIGURE vs. RF FREQUENCY**



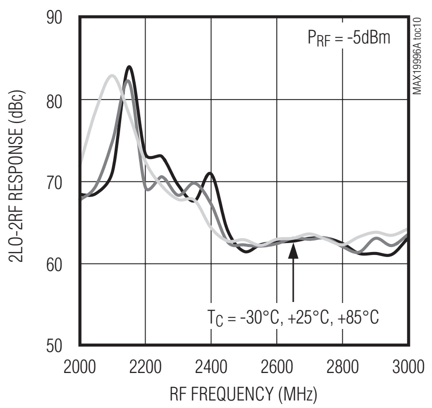

**NOISE FIGURE vs. RF FREQUENCY**



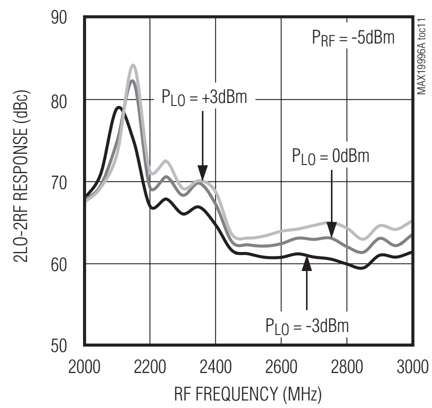
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 2000MHz to 3000MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

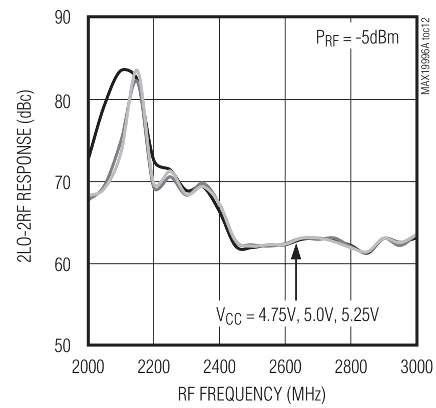
**2LO-2RF RESPONSE vs. RF FREQUENCY**



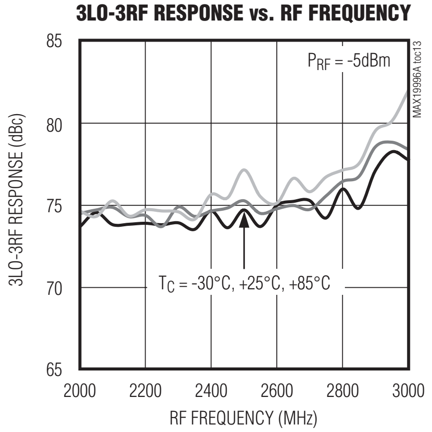

**2LO-2RF RESPONSE vs. RF FREQUENCY**



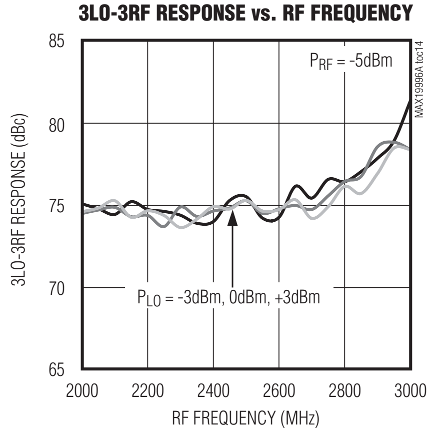

**2LO-2RF RESPONSE vs. RF FREQUENCY**



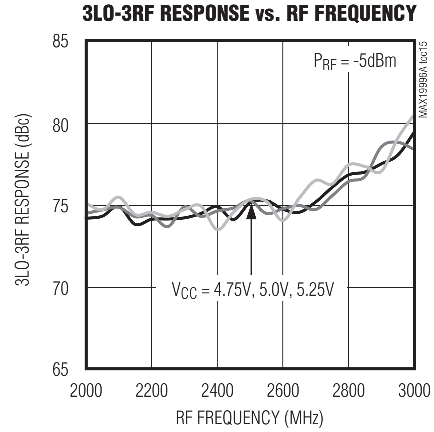

**3LO-3RF RESPONSE vs. RF FREQUENCY**



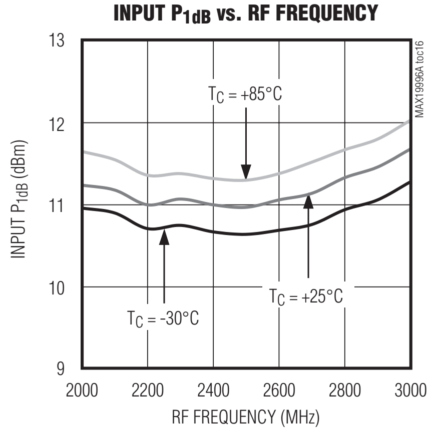

**3LO-3RF RESPONSE vs. RF FREQUENCY**



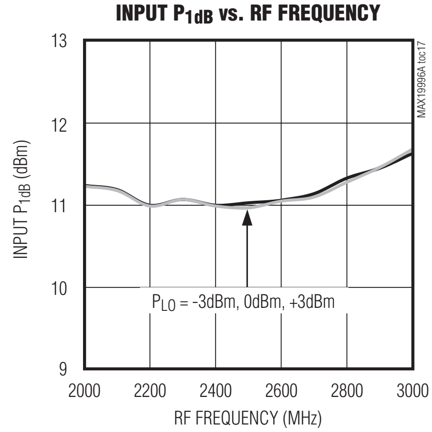

**3LO-3RF RESPONSE vs. RF FREQUENCY**



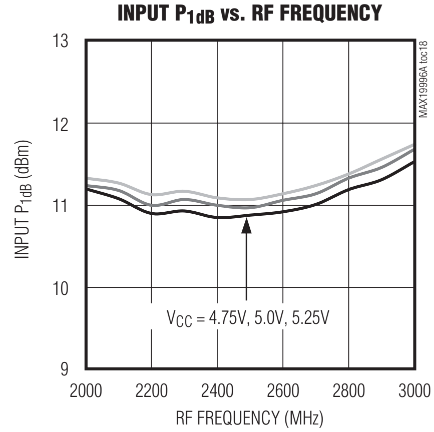

**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**

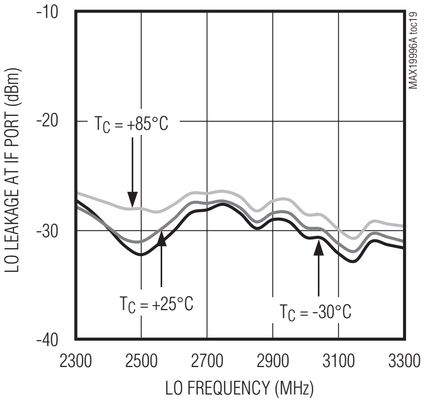


# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

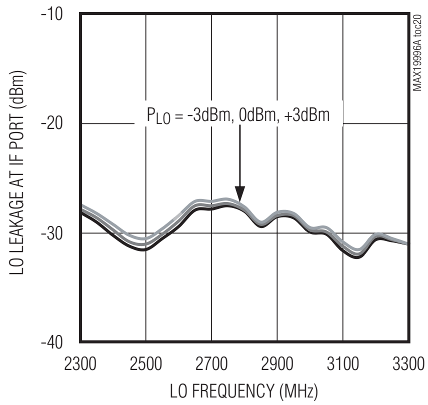
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 2000MHz to 3000MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

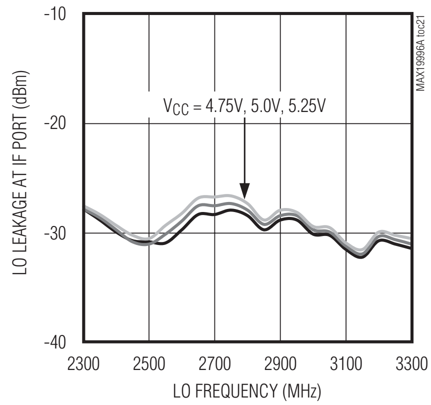
**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



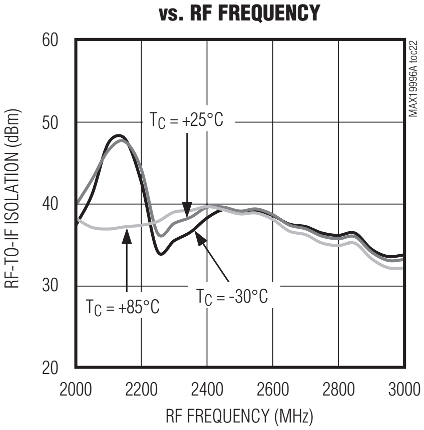

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



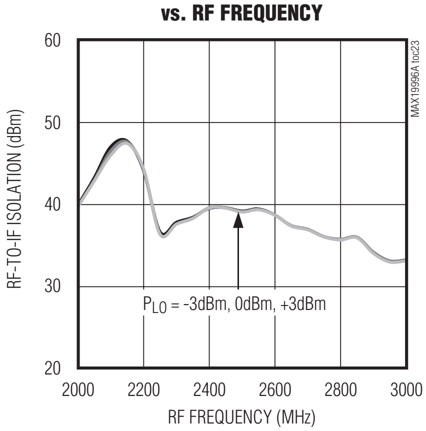

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



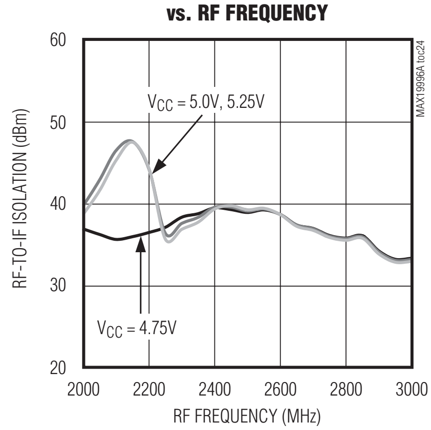

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



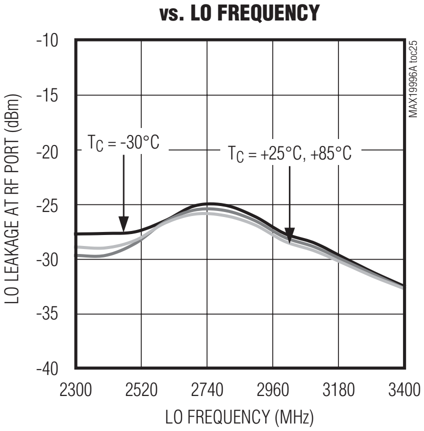

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



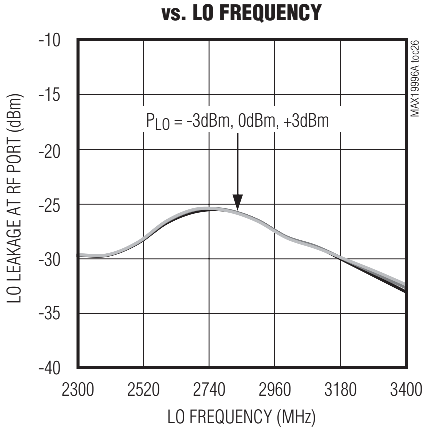

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



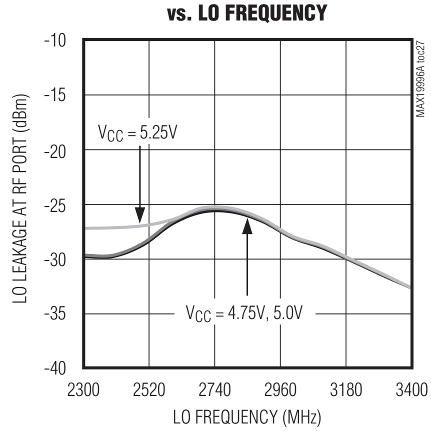

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**




**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



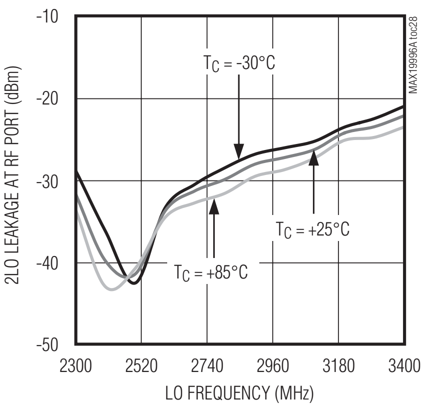

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



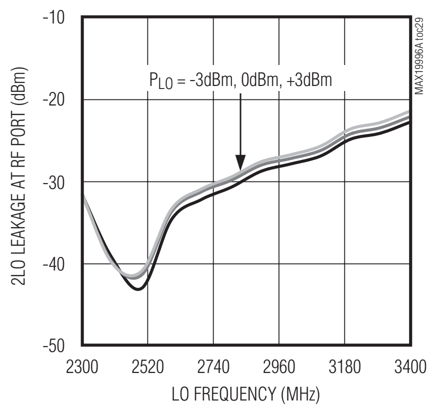
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 2000MHz to 3000MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

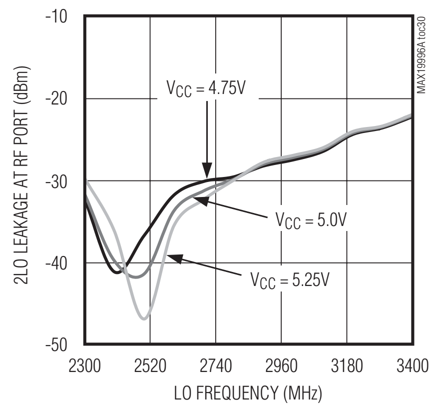
**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



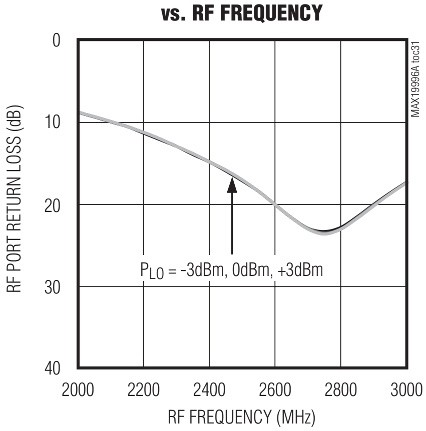

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



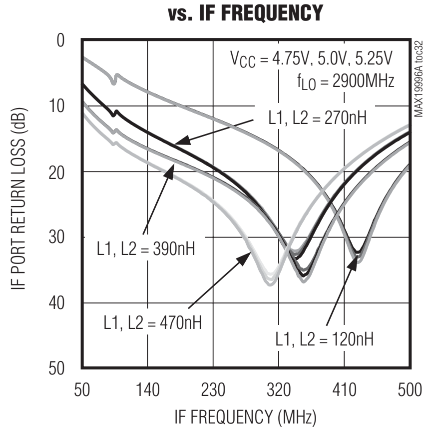

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



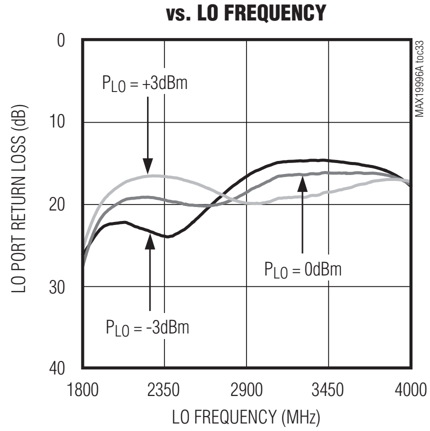

**RF PORT RETURN LOSS vs. RF FREQUENCY**



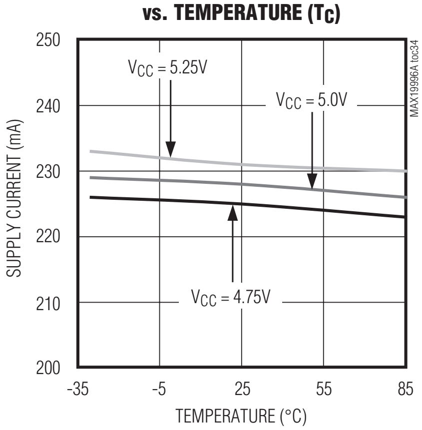

**IF PORT RETURN LOSS vs. IF FREQUENCY**



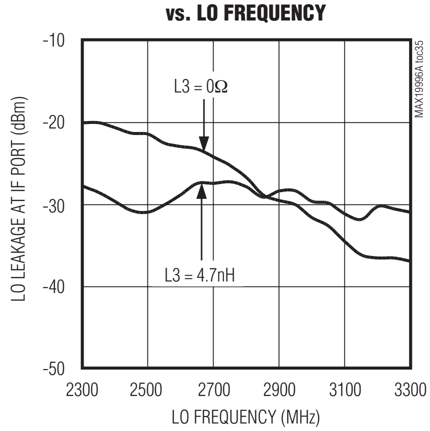

**LO PORT RETURN LOSS vs. LO FREQUENCY**



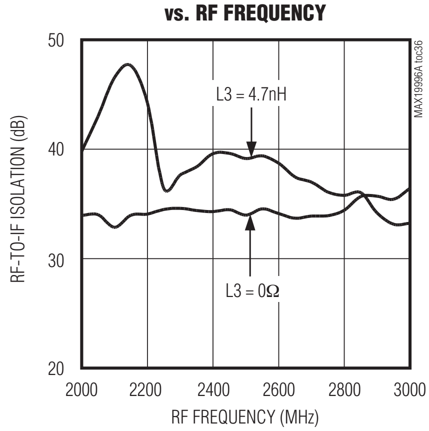

**SUPPLY CURRENT vs. TEMPERATURE ($T_C$)**




**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**




**RF-TO-IF ISOLATION vs. RF FREQUENCY**

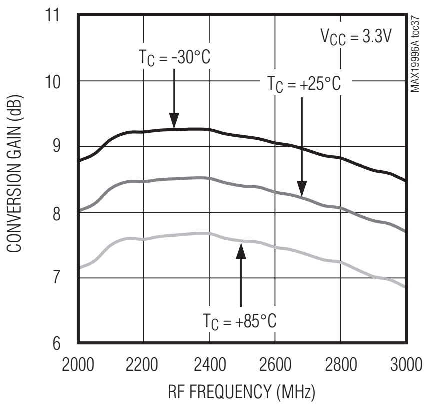


# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

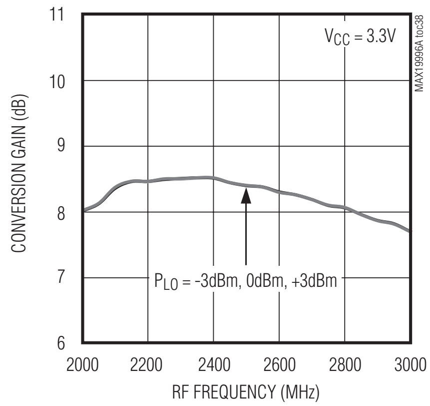
## Typical Operating Characteristics

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 3.3V, $f_{RF}$ = 2000MHz to 3000MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

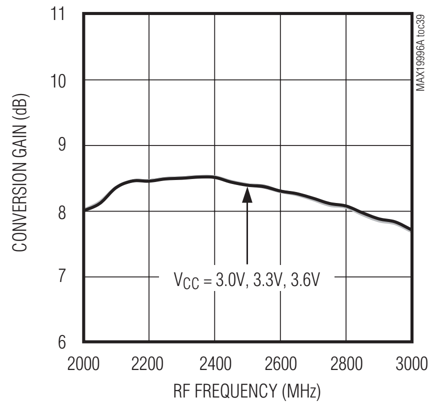
**CONVERSION GAIN vs. RF FREQUENCY**



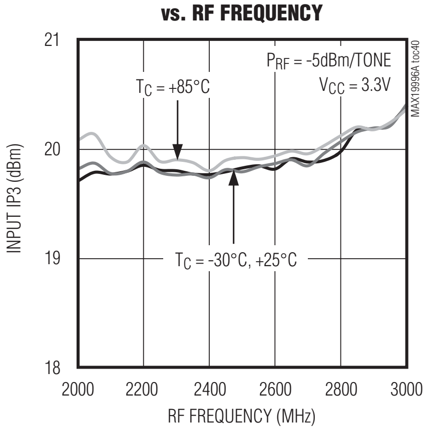

**CONVERSION GAIN vs. RF FREQUENCY**



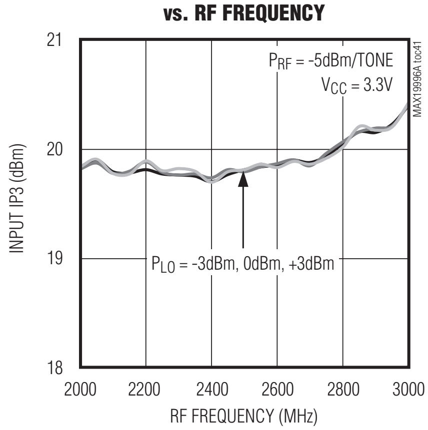

**CONVERSION GAIN vs. RF FREQUENCY**




**INPUT IP3 vs. RF FREQUENCY**




**INPUT IP3 vs. RF FREQUENCY**

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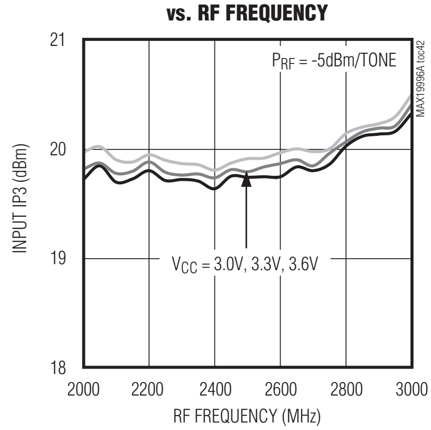
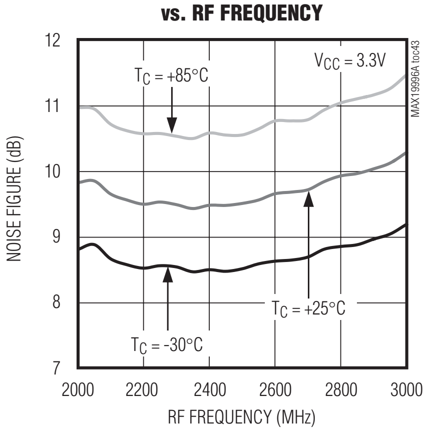
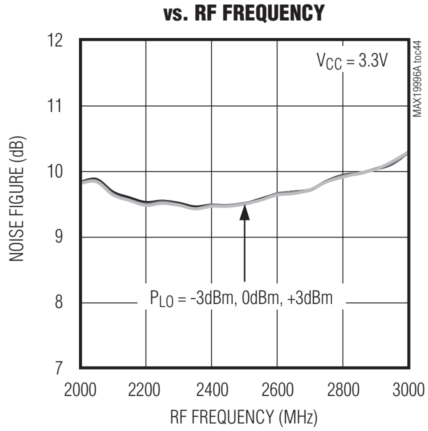


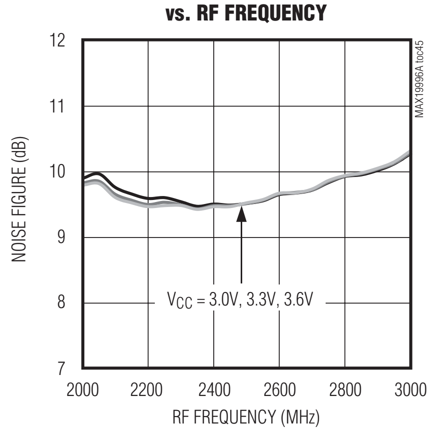

**NOISE FIGURE vs. RF FREQUENCY**




**NOISE FIGURE vs. RF FREQUENCY**



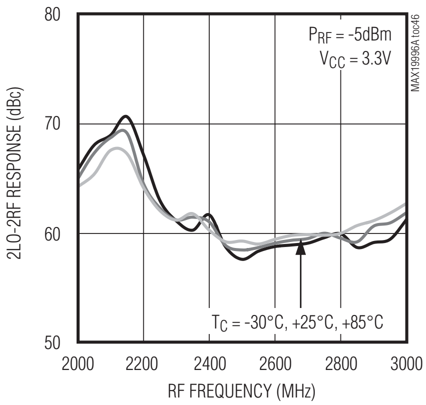

**NOISE FIGURE vs. RF FREQUENCY**



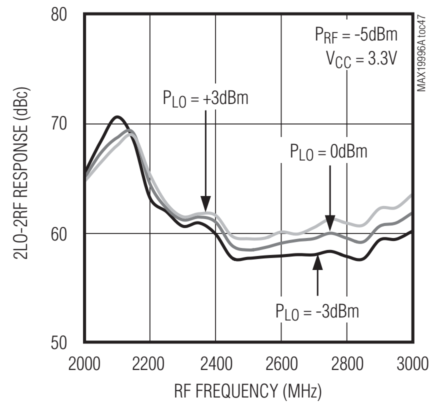
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 3.3V, $f_{RF}$ = 2000MHz to 3000MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

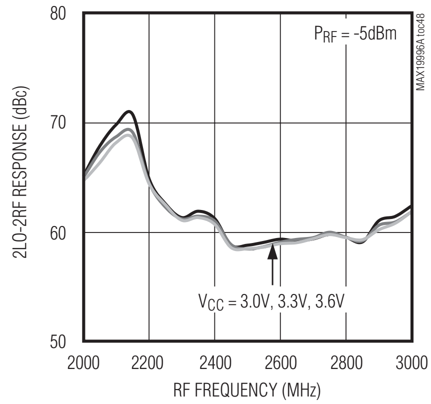
**2LO-2RF RESPONSE vs. RF FREQUENCY**



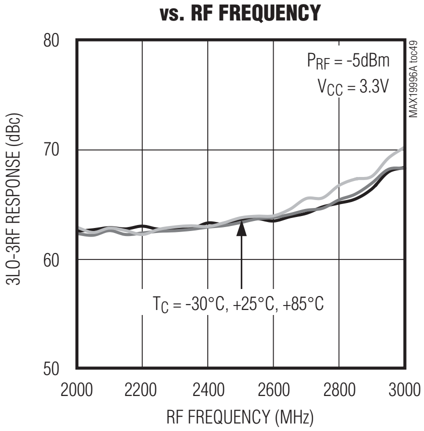

**2LO-2RF RESPONSE vs. RF FREQUENCY**



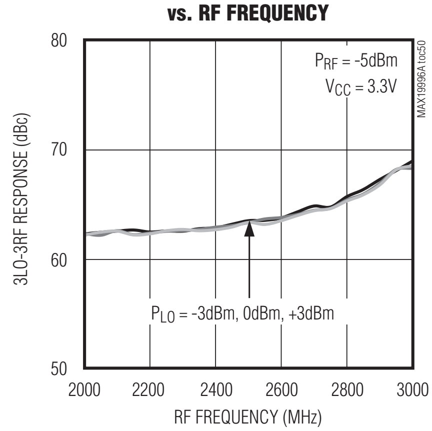

**2LO-2RF RESPONSE vs. RF FREQUENCY**



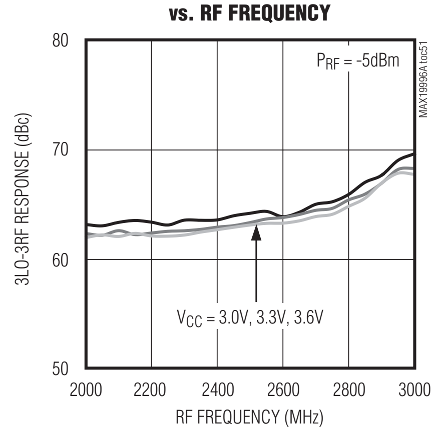

**3LO-3RF RESPONSE vs. RF FREQUENCY**



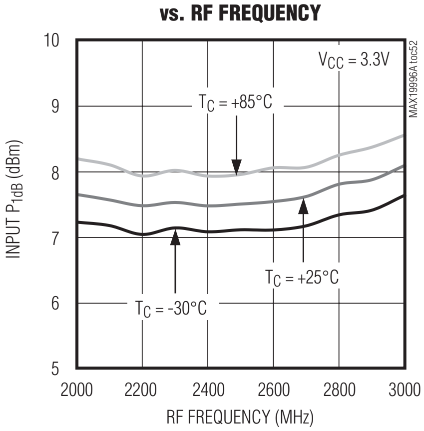

**3LO-3RF RESPONSE vs. RF FREQUENCY**



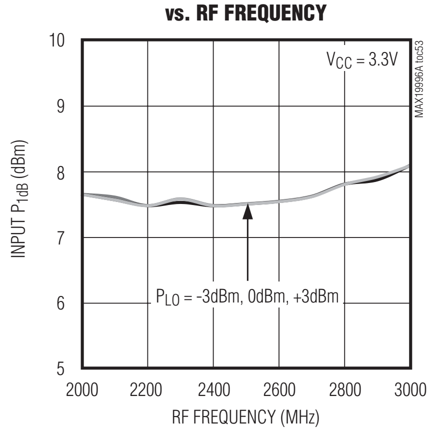

**3LO-3RF RESPONSE vs. RF FREQUENCY**



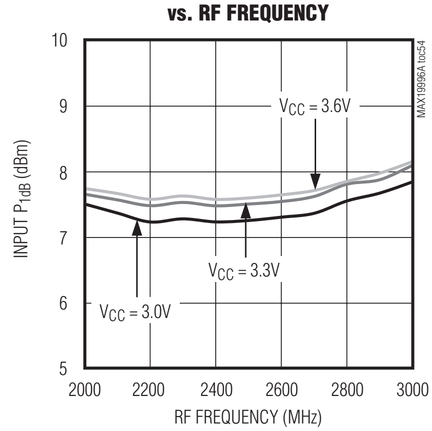

**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**

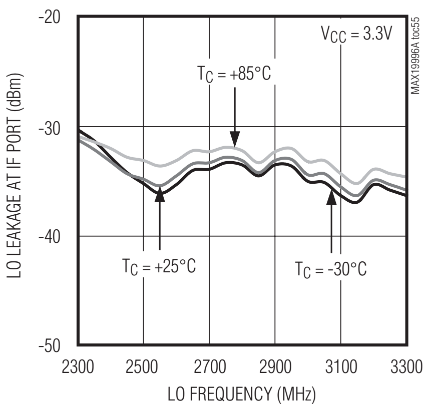


# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

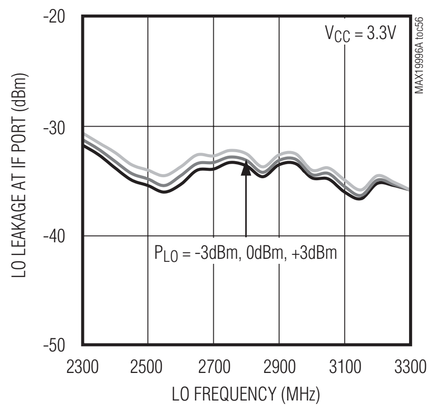
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 3.3V, $f_{RF}$ = 2000MHz to 3000MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

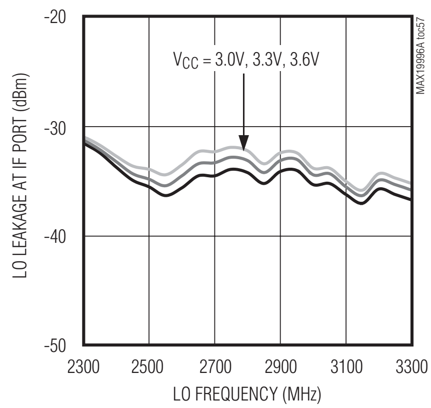
**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



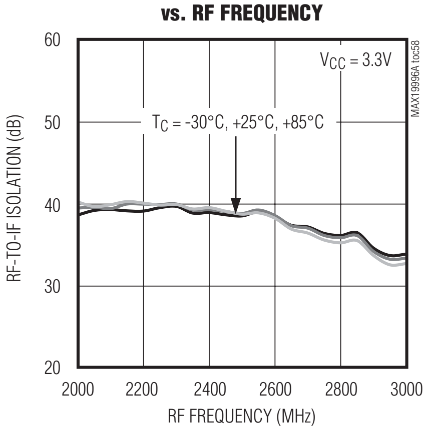

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



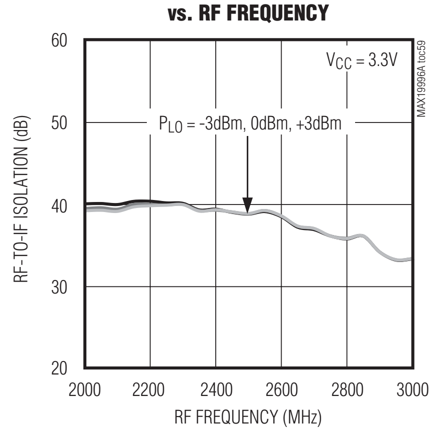

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



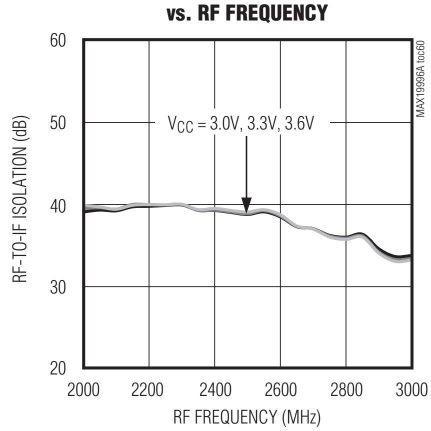

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



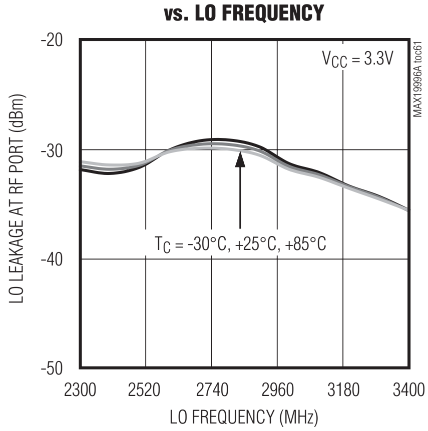

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



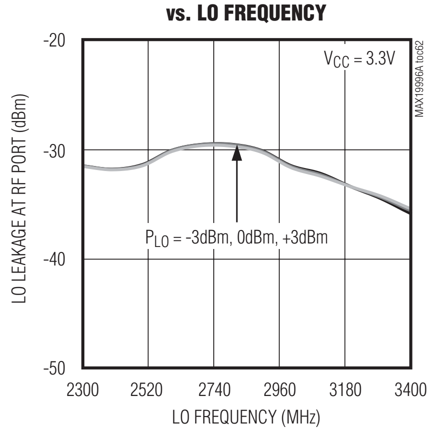

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



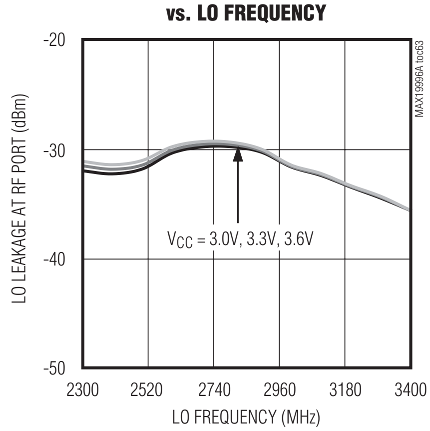

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**




**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



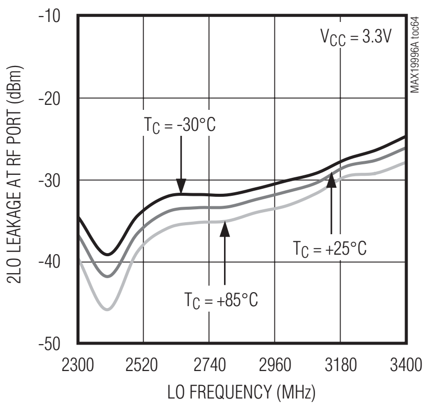

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



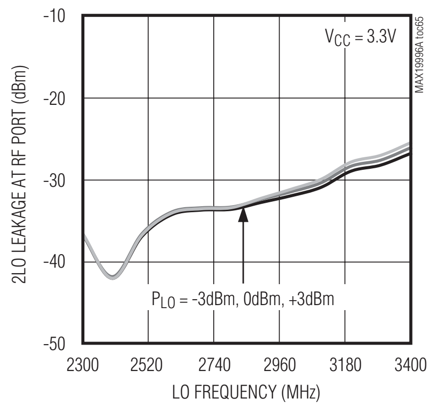
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 3.3V, $f_{RF}$ = 2000MHz to 3000MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

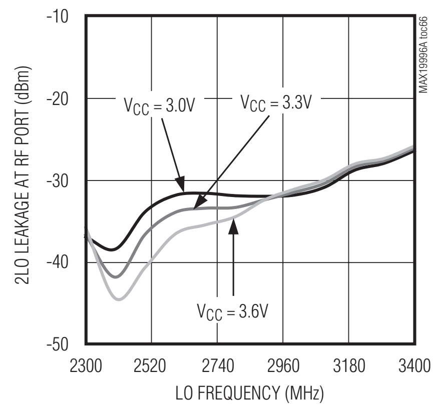
**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



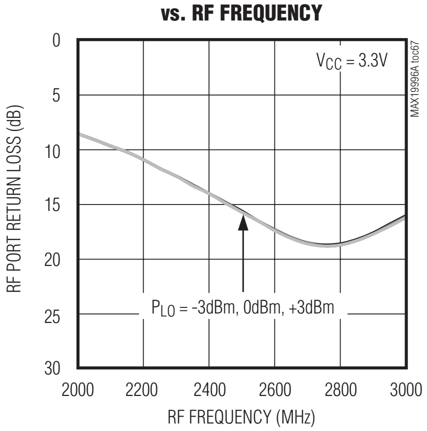

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



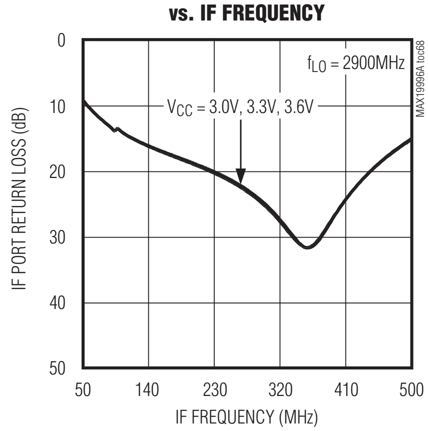

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



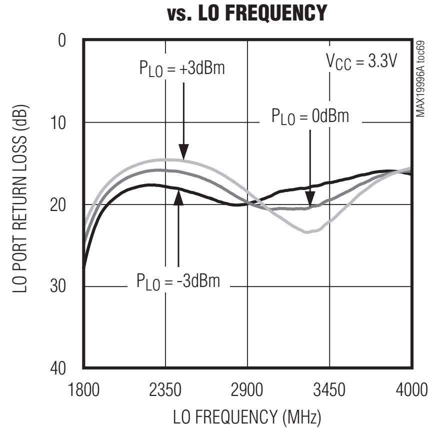

**RF PORT RETURN LOSS vs. RF FREQUENCY**



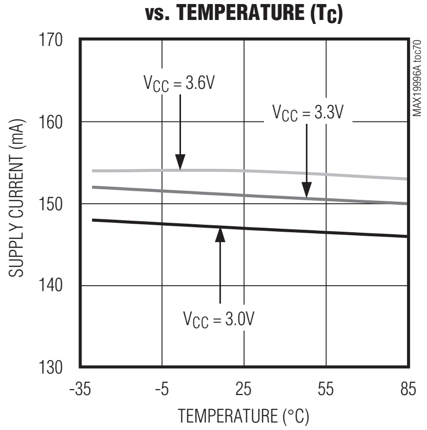

**IF PORT RETURN LOSS vs. IF FREQUENCY**



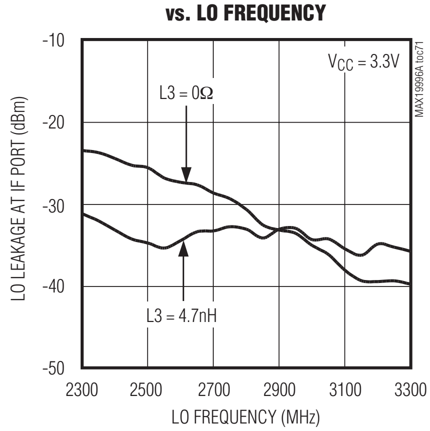

**LO PORT RETURN LOSS vs. LO FREQUENCY**



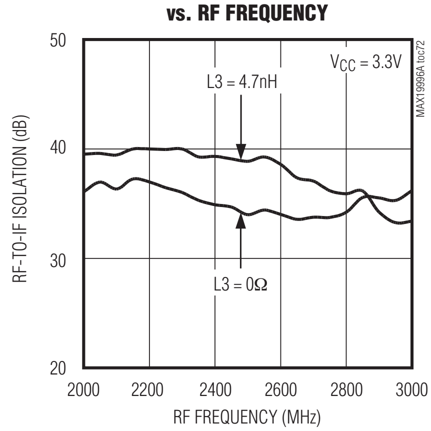

**SUPPLY CURRENT vs. TEMPERATURE ($T_C$)**




**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**




**RF-TO-IF ISOLATION vs. RF FREQUENCY**

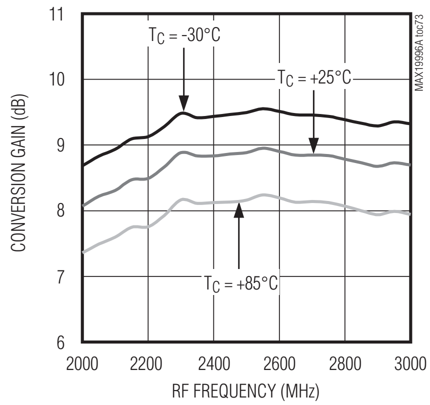


# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

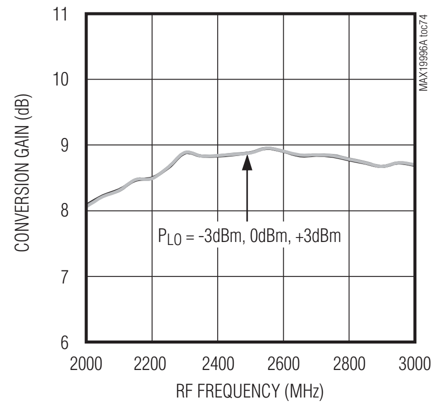
## Typical Operating Characteristics

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 2000MHz to 3000MHz, LO is low-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

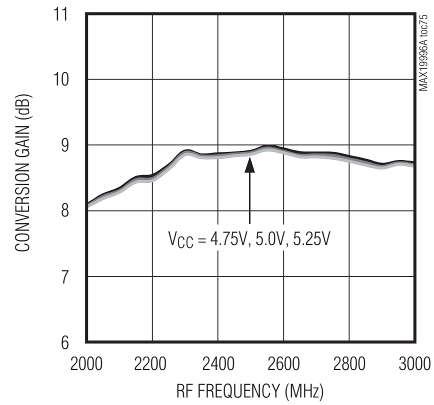
**CONVERSION GAIN vs. RF FREQUENCY**



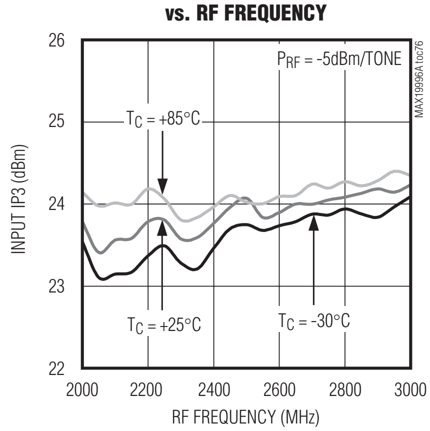

**CONVERSION GAIN vs. RF FREQUENCY**



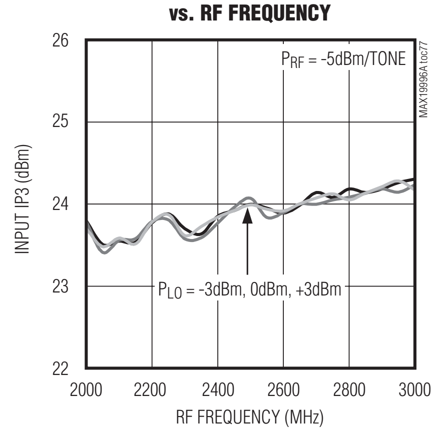

**CONVERSION GAIN vs. RF FREQUENCY**



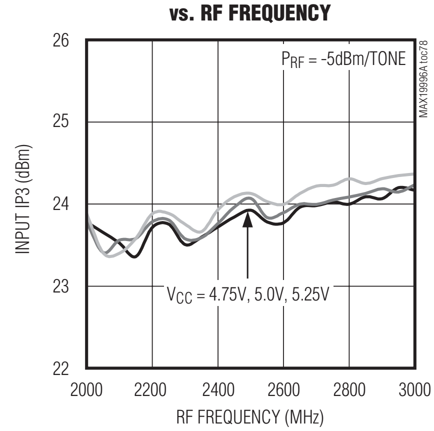

**INPUT IP3 vs. RF FREQUENCY**



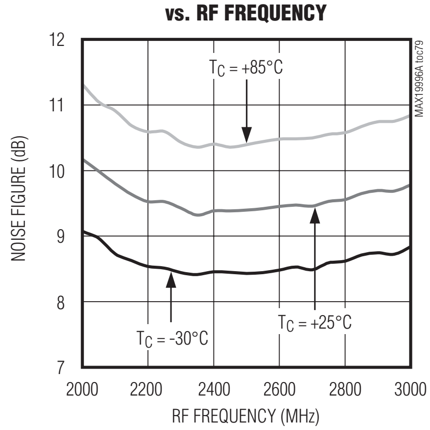

**INPUT IP3 vs. RF FREQUENCY**



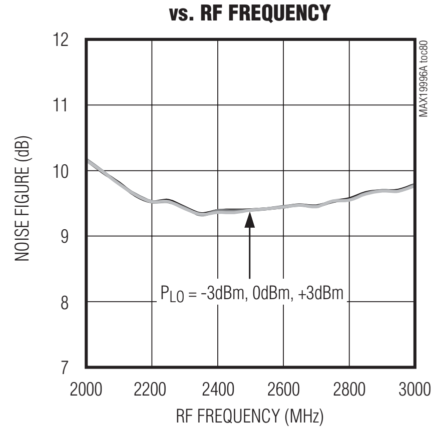

**INPUT IP3 vs. RF FREQUENCY**



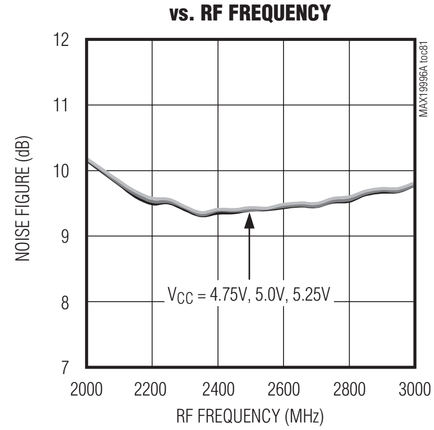

**NOISE FIGURE vs. RF FREQUENCY**




**NOISE FIGURE vs. RF FREQUENCY**



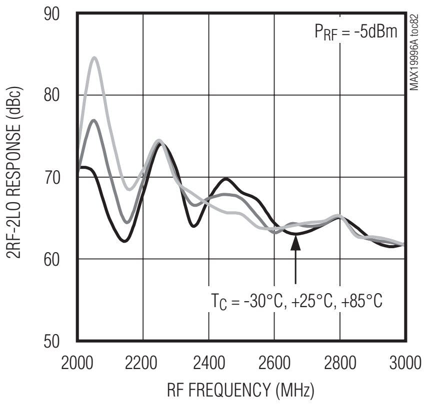

**NOISE FIGURE vs. RF FREQUENCY**



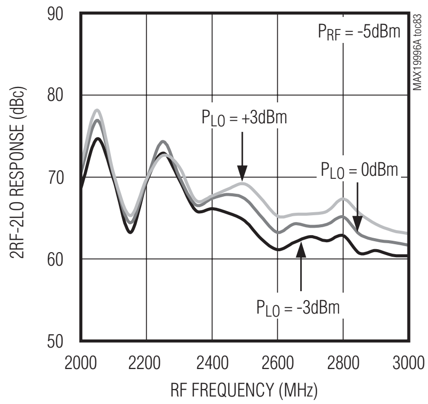
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 2000MHz to 3000MHz, LO is low-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

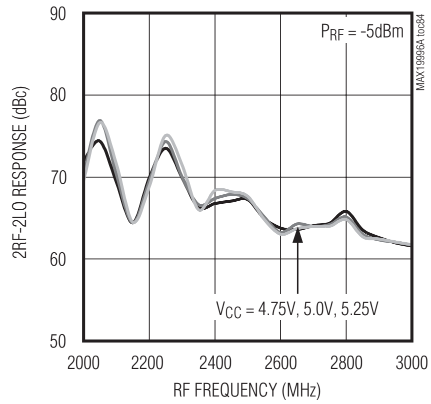
**2RF-2LO RESPONSE vs. RF FREQUENCY**



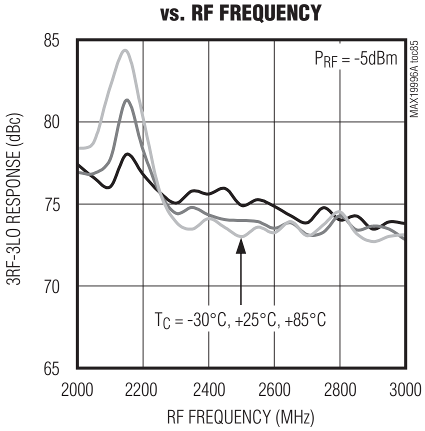

**2RF-2LO RESPONSE vs. RF FREQUENCY**



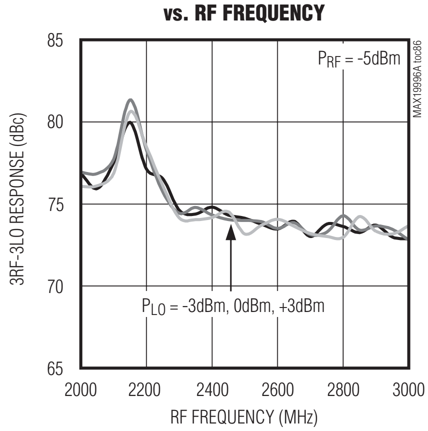

**2RF-2LO RESPONSE vs. RF FREQUENCY**



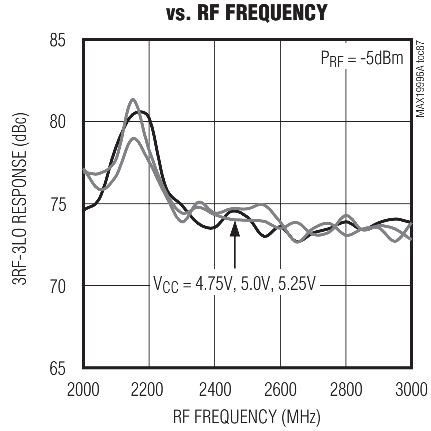

**3RF-3LO RESPONSE vs. RF FREQUENCY**



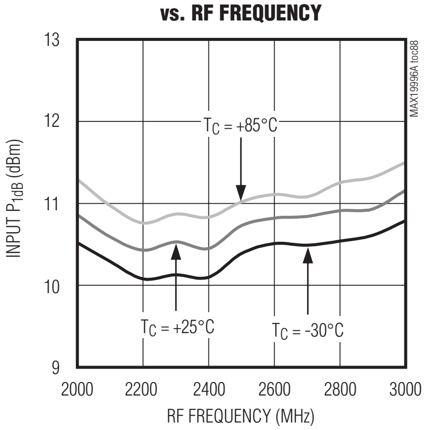

**3RF-3LO RESPONSE vs. RF FREQUENCY**



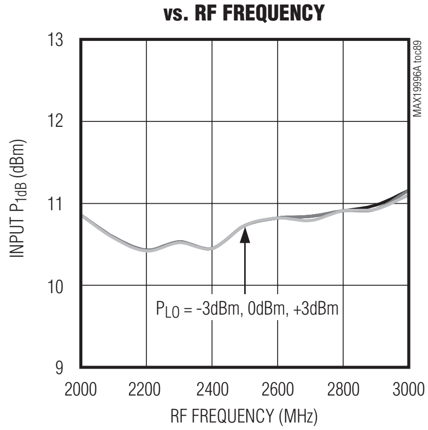

**3RF-3LO RESPONSE vs. RF FREQUENCY**



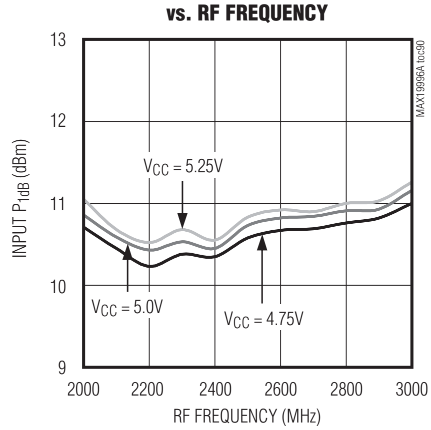

**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**

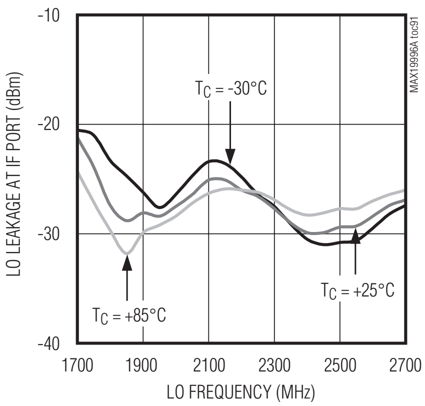


# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

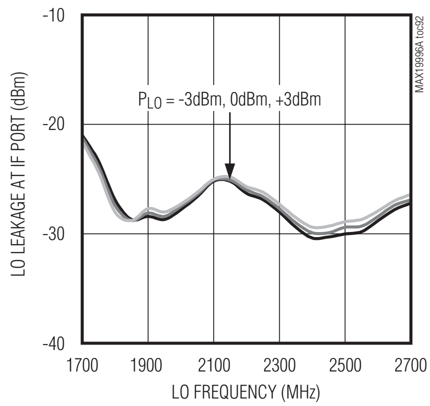
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 2000MHz to 3000MHz, LO is low-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

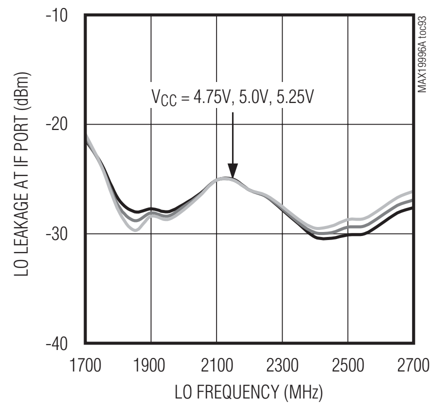
**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



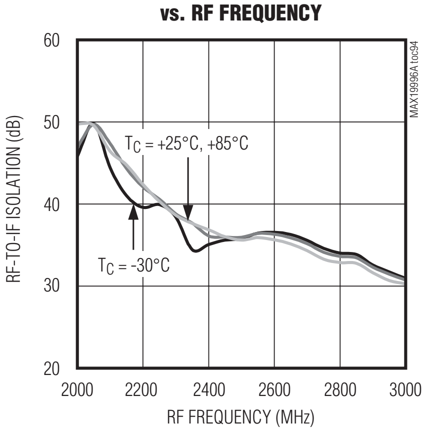

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



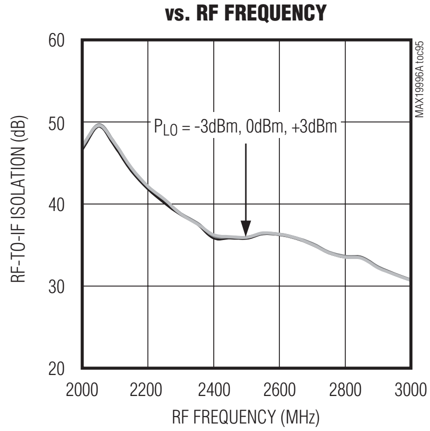

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



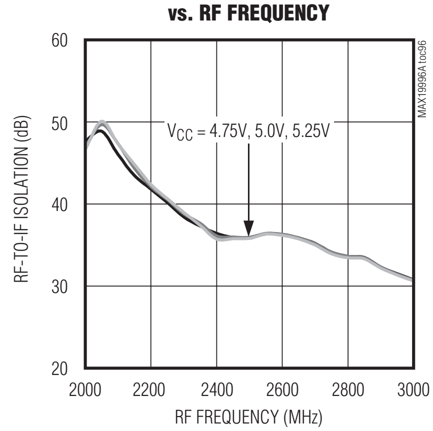

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



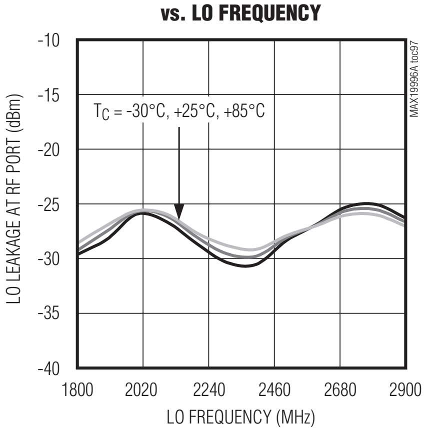

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



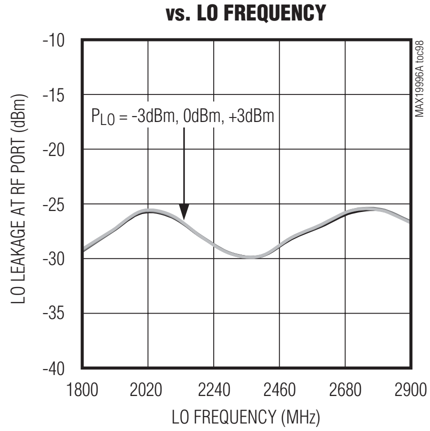

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



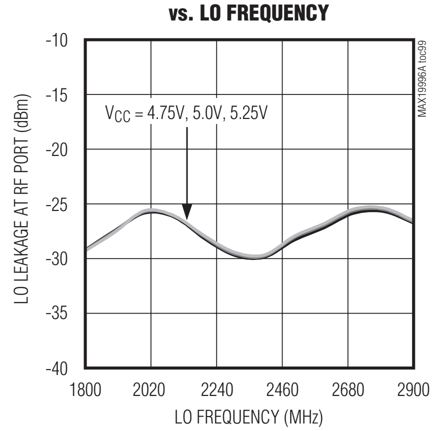

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**




**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



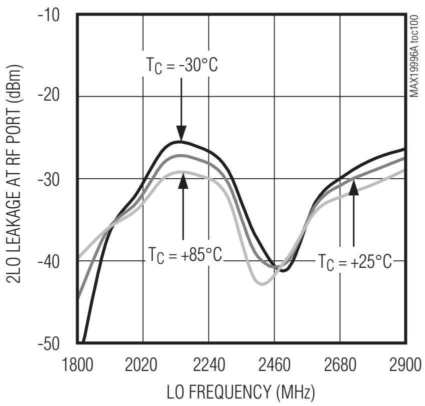

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



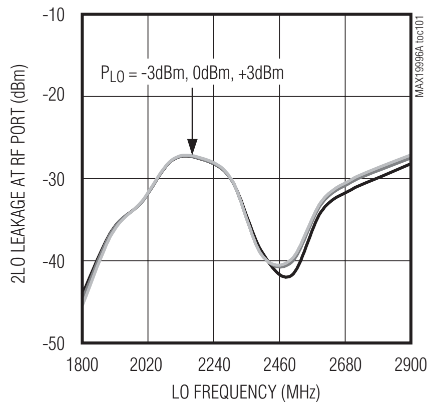
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 2000MHz to 3000MHz, LO is low-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

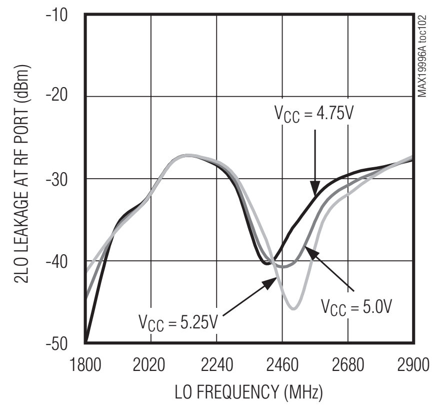
**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



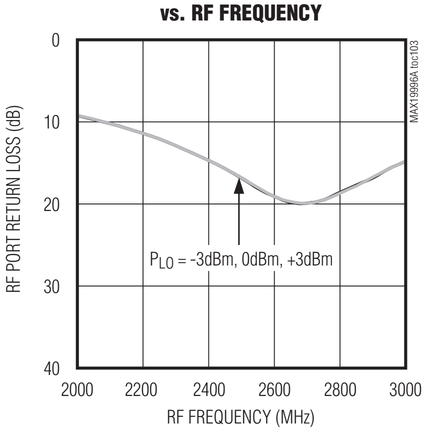

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



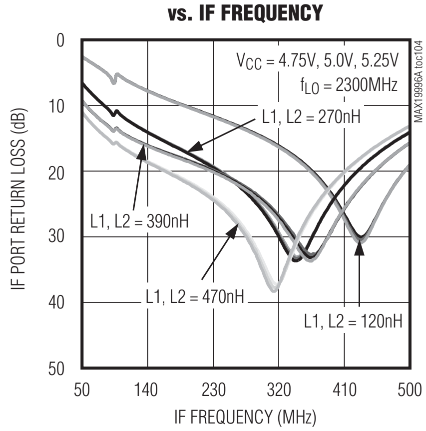

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



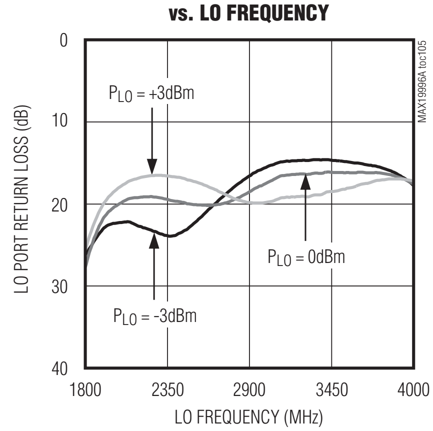

**RF PORT RETURN LOSS vs. RF FREQUENCY**



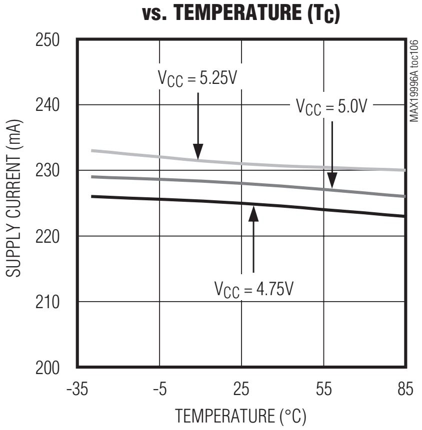

**IF PORT RETURN LOSS vs. IF FREQUENCY**



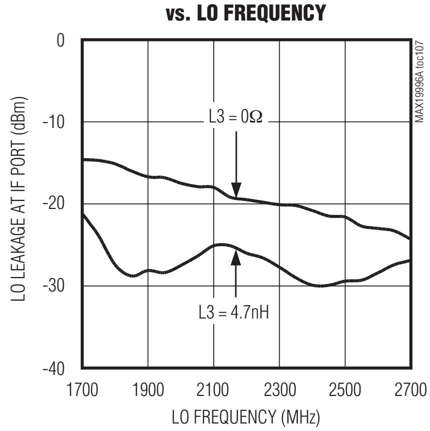

**LO PORT RETURN LOSS vs. LO FREQUENCY**



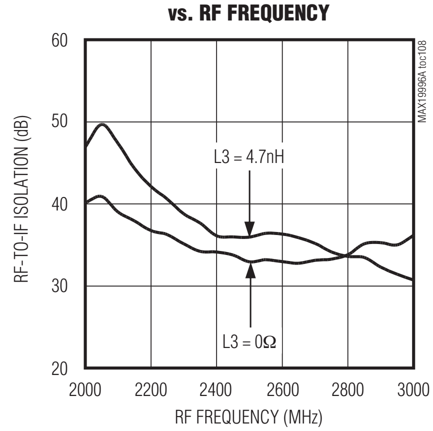

**SUPPLY CURRENT vs. TEMPERATURE ($T_C$)**




**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**




**RF-TO-IF ISOLATION vs. RF FREQUENCY**

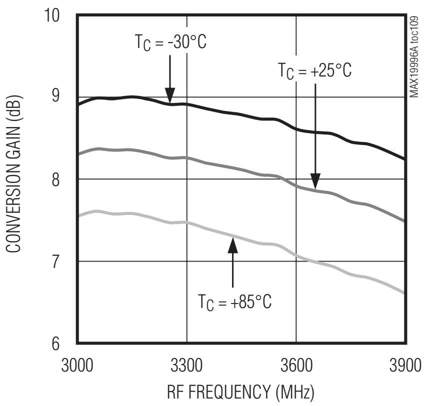


# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

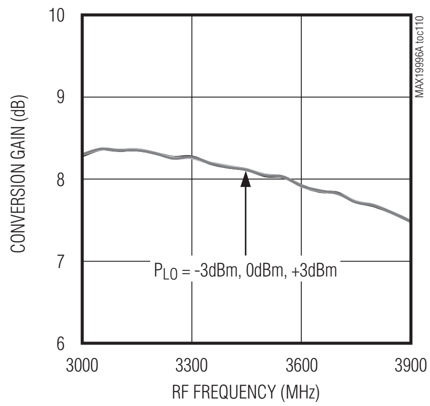
## Typical Operating Characteristics

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 3000MHz to 3900MHz, LO is low-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

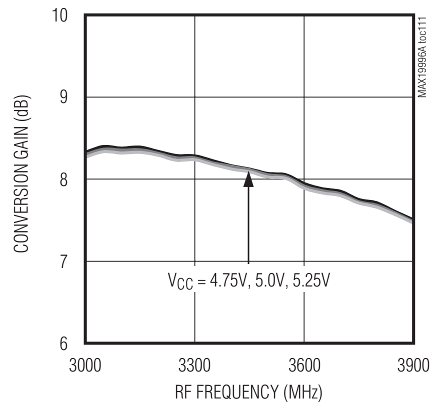
**CONVERSION GAIN vs. RF FREQUENCY**



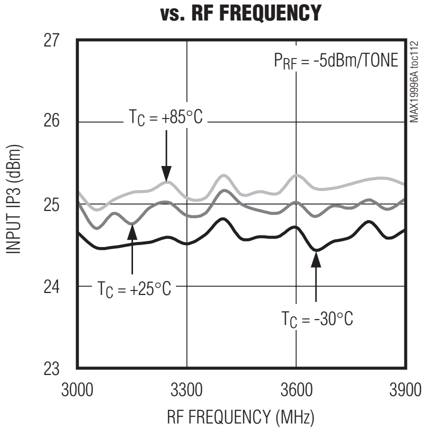

**CONVERSION GAIN vs. RF FREQUENCY**



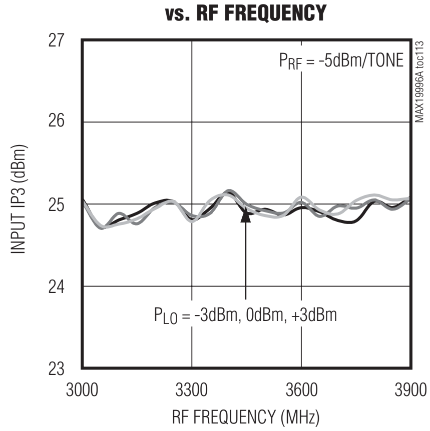

**CONVERSION GAIN vs. RF FREQUENCY**



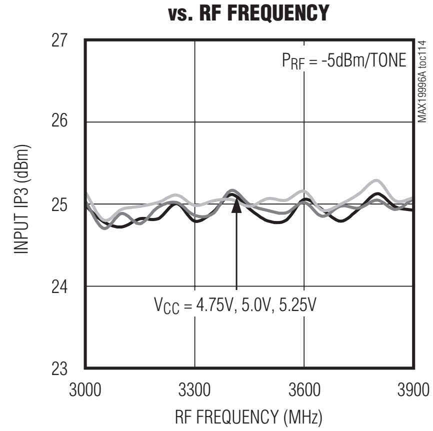

**INPUT IP3 vs. RF FREQUENCY**



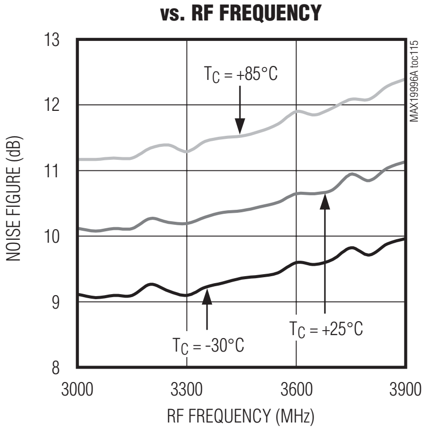

**INPUT IP3 vs. RF FREQUENCY**



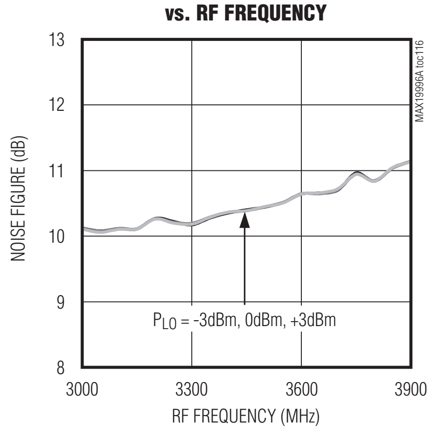

**INPUT IP3 vs. RF FREQUENCY**



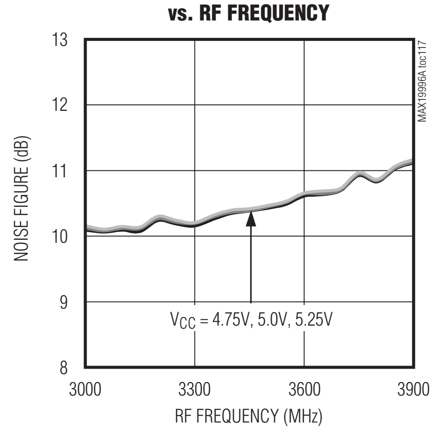

**NOISE FIGURE vs. RF FREQUENCY**




**NOISE FIGURE vs. RF FREQUENCY**



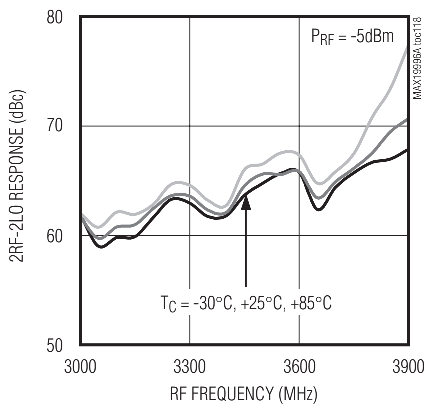

**NOISE FIGURE vs. RF FREQUENCY**



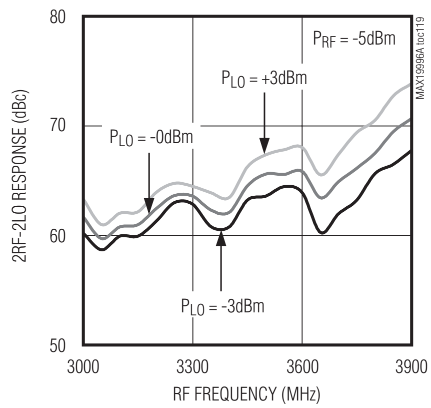
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 3000MHz to 3900MHz, LO is low-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

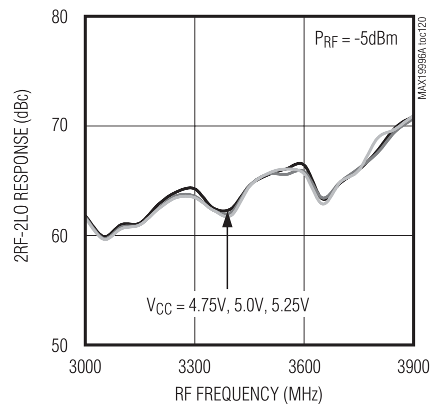
**2RF-2LO RESPONSE vs. RF FREQUENCY**



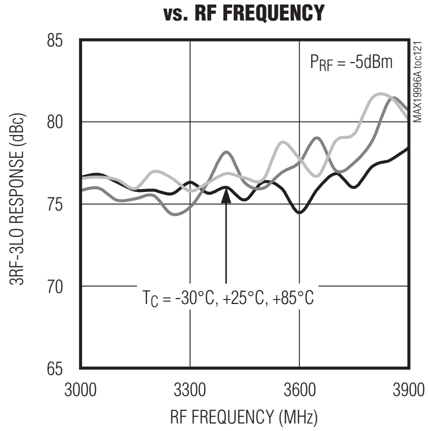

**2RF-2LO RESPONSE vs. RF FREQUENCY**



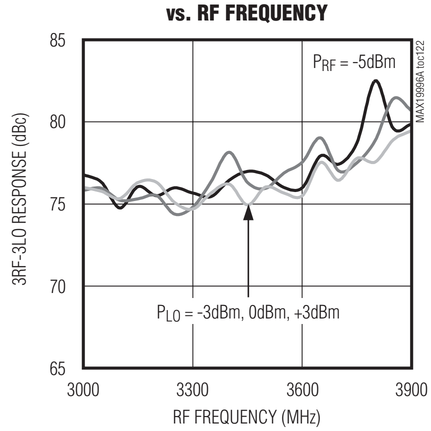

**2RF-2LO RESPONSE vs. RF FREQUENCY**



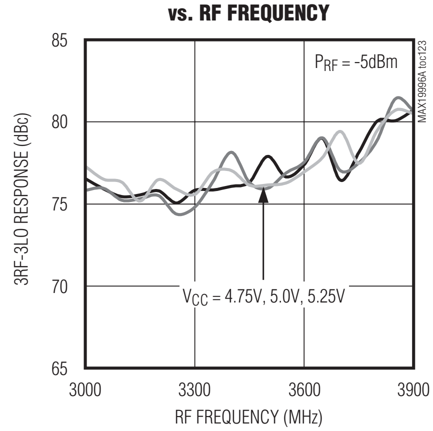

**3RF-3LO RESPONSE vs. RF FREQUENCY**



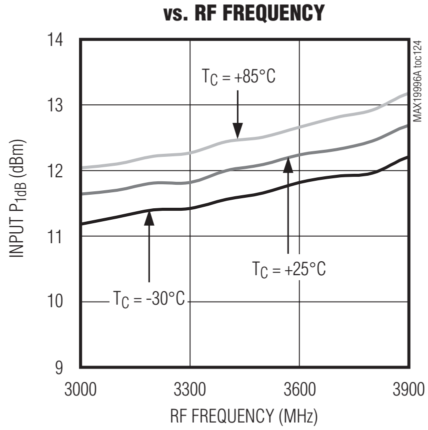

**3RF-3LO RESPONSE vs. RF FREQUENCY**



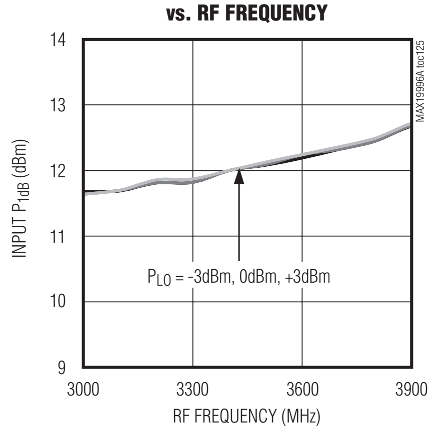

**3RF-3LO RESPONSE vs. RF FREQUENCY**



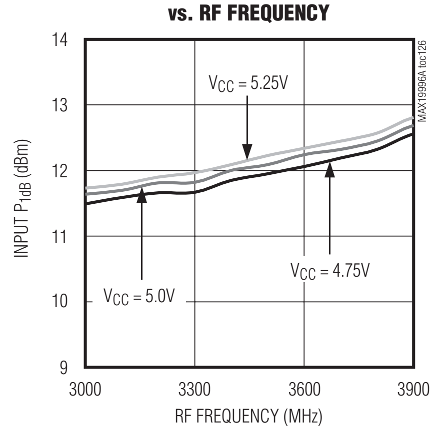

**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**



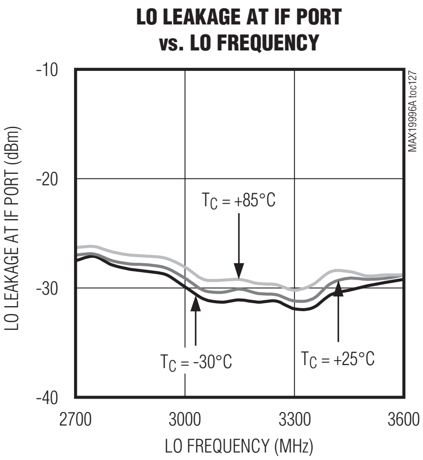

**INPUT $P_{1dB}$ vs. RF FREQUENCY**

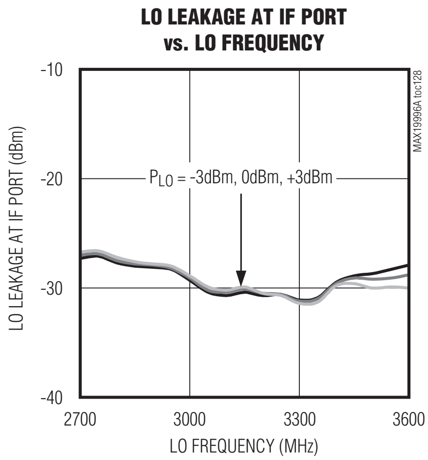


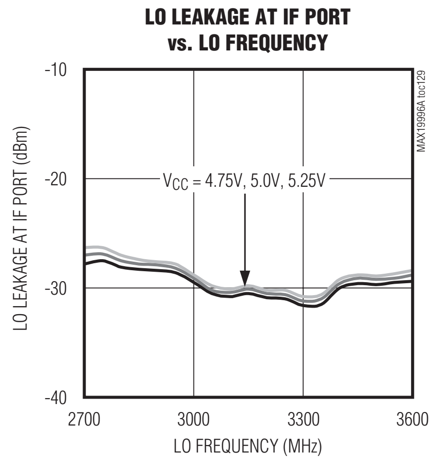
# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

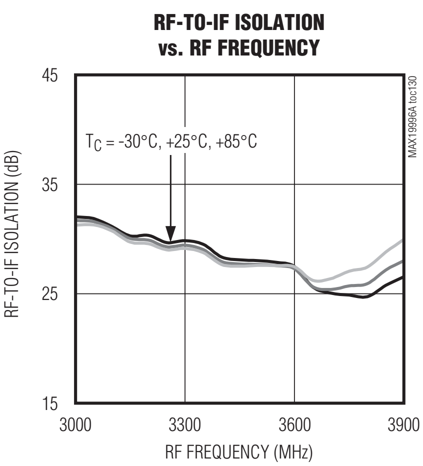
## Typical Operating Characteristics (continued)

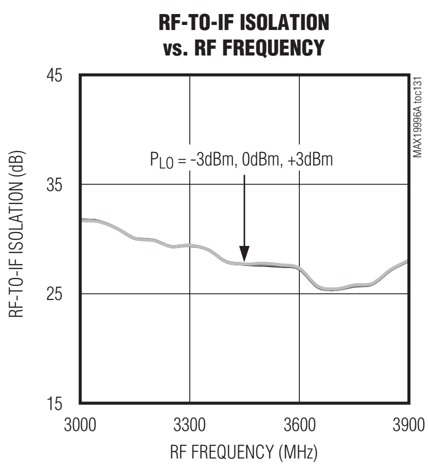
(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 3000MHz to 3900MHz, LO is low-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

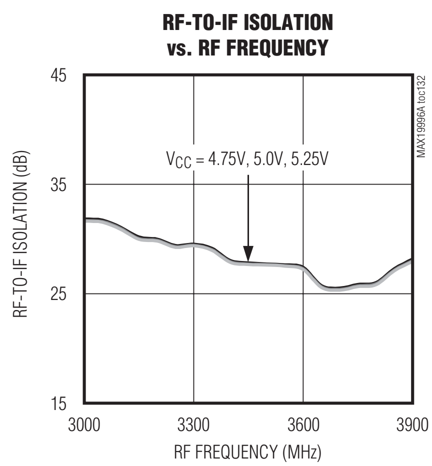


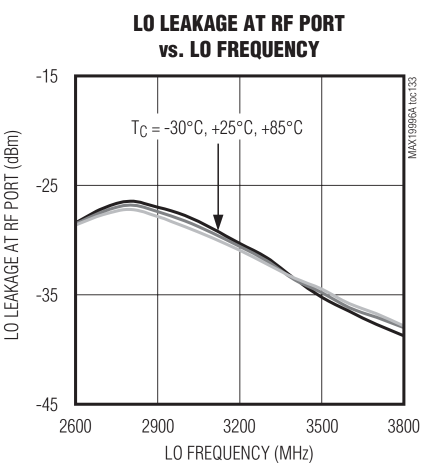



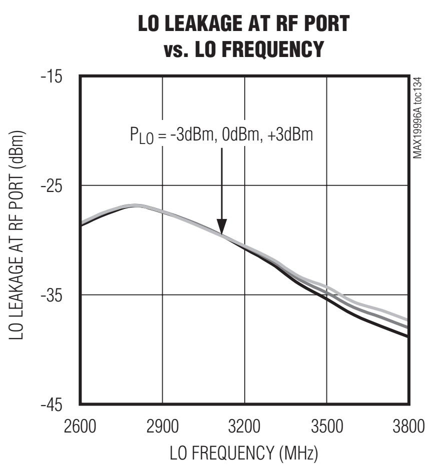



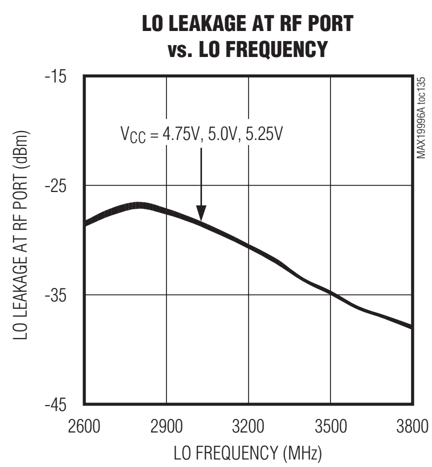



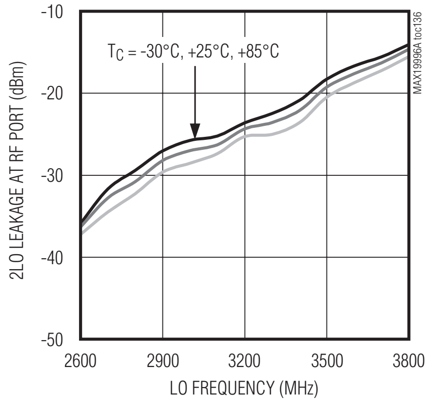



# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

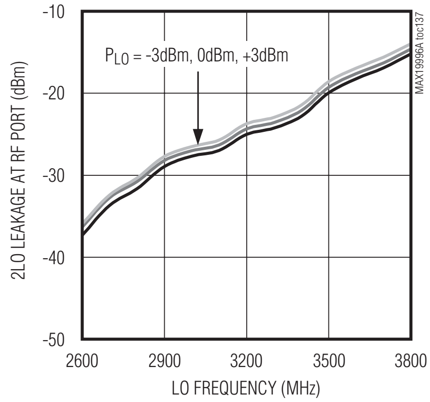
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 3000MHz to 3900MHz, LO is low-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

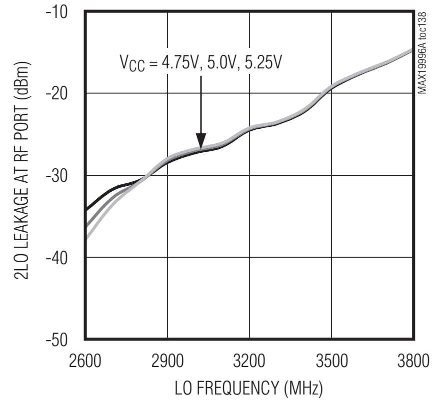
**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



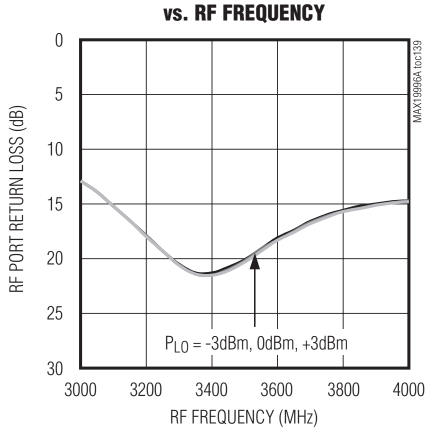

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



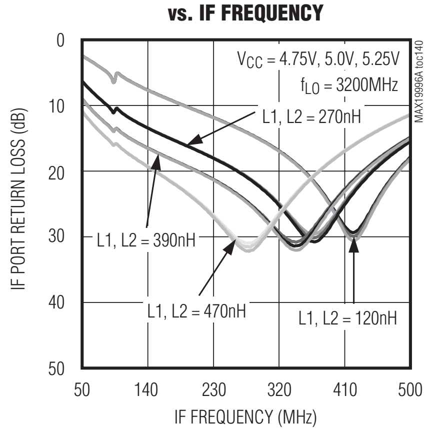

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



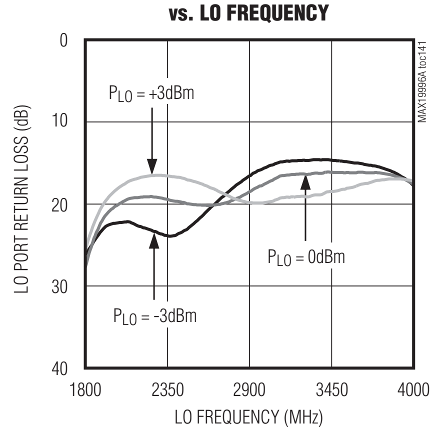

**RF PORT RETURN LOSS vs. RF FREQUENCY**



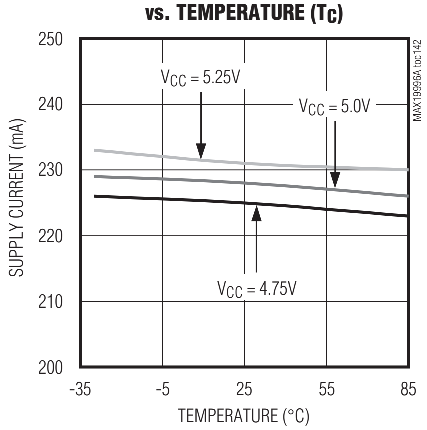

**IF PORT RETURN LOSS vs. IF FREQUENCY**



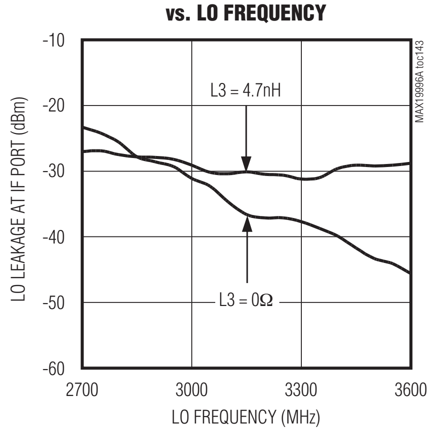

**LO PORT RETURN LOSS vs. LO FREQUENCY**



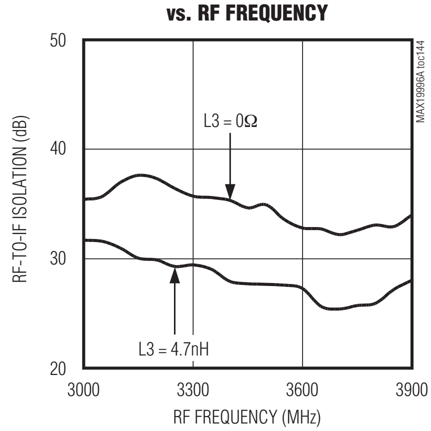

**SUPPLY CURRENT vs. TEMPERATURE ($T_C$)**




**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**




**RF-TO-IF ISOLATION vs. RF FREQUENCY**

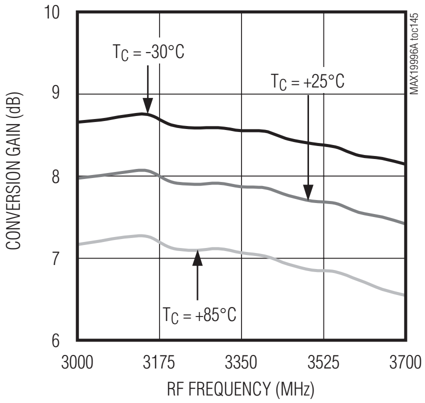


# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

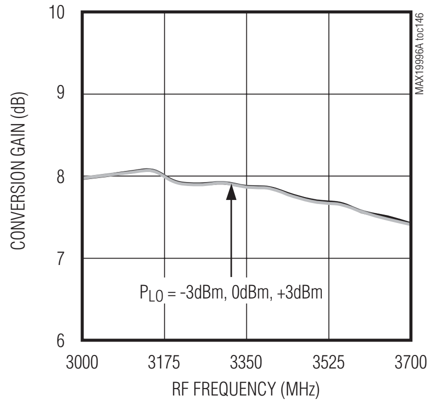
## Typical Operating Characteristics

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 3000MHz to 3700MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

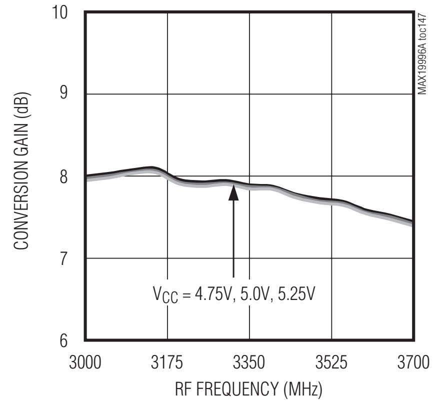
**CONVERSION GAIN vs. RF FREQUENCY**



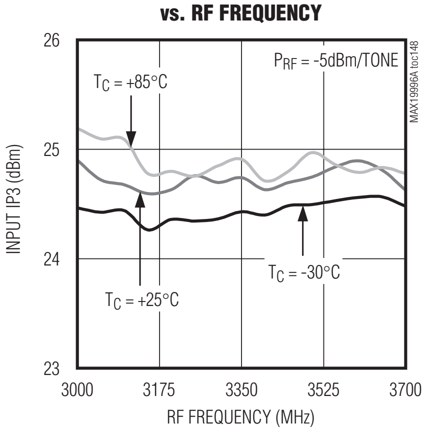

**CONVERSION GAIN vs. RF FREQUENCY**



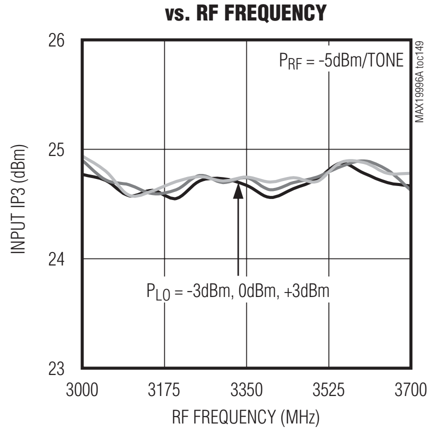

**CONVERSION GAIN vs. RF FREQUENCY**



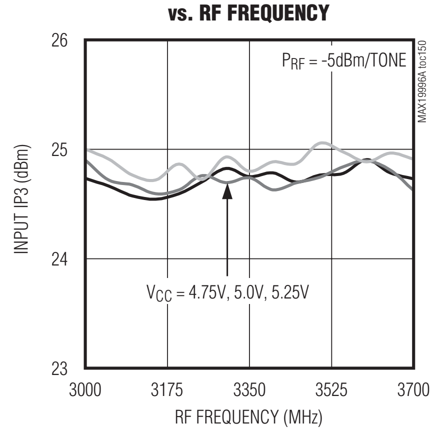

**INPUT IP3 vs. RF FREQUENCY**



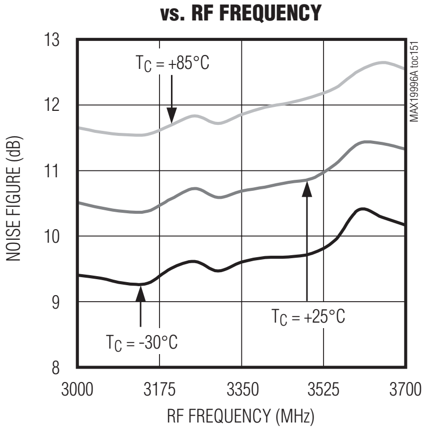

**INPUT IP3 vs. RF FREQUENCY**



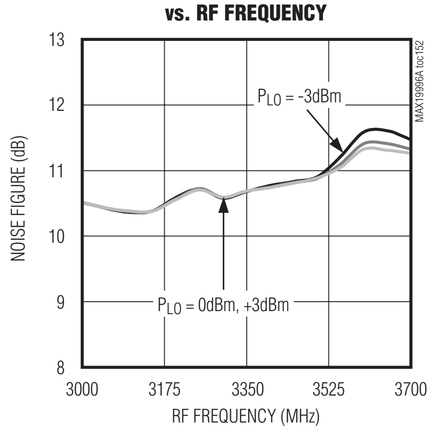

**INPUT IP3 vs. RF FREQUENCY**



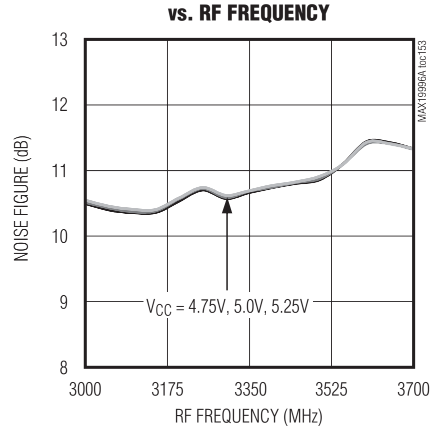

**NOISE FIGURE vs. RF FREQUENCY**




**NOISE FIGURE vs. RF FREQUENCY**



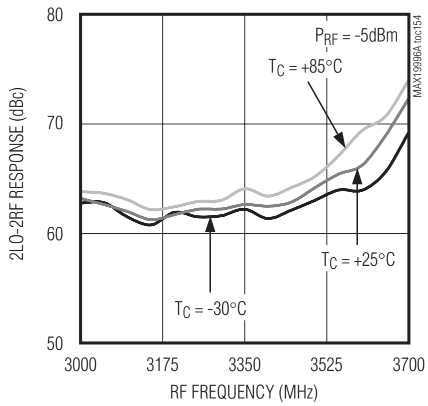

**NOISE FIGURE vs. RF FREQUENCY**



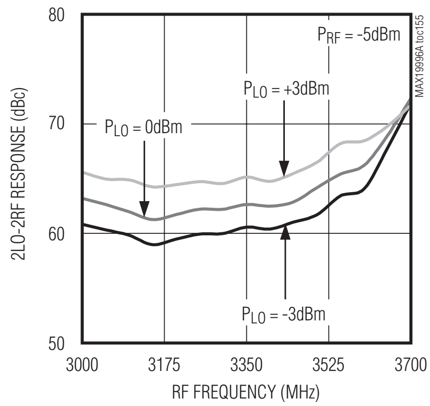
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 3000MHz to 3700MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

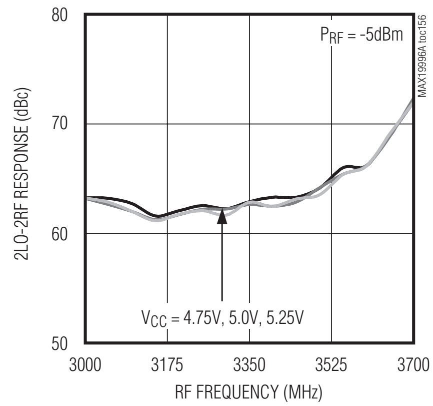
**2LO-2RF RESPONSE vs. RF FREQUENCY**



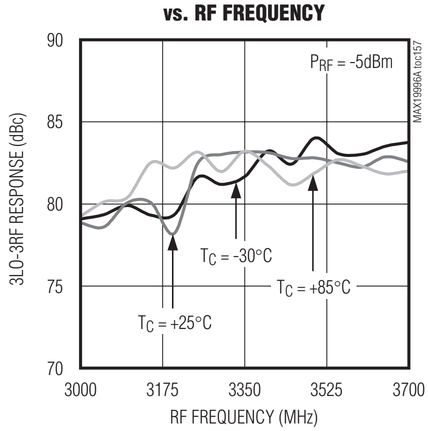

**2LO-2RF RESPONSE vs. RF FREQUENCY**



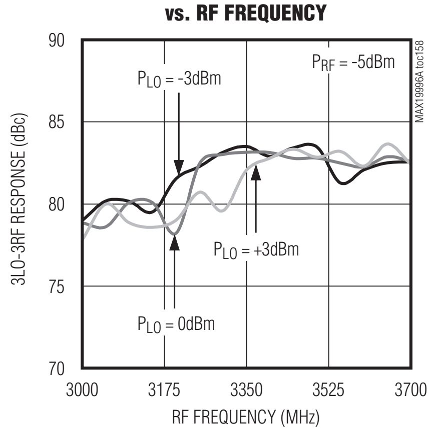

**2LO-2RF RESPONSE vs. RF FREQUENCY**



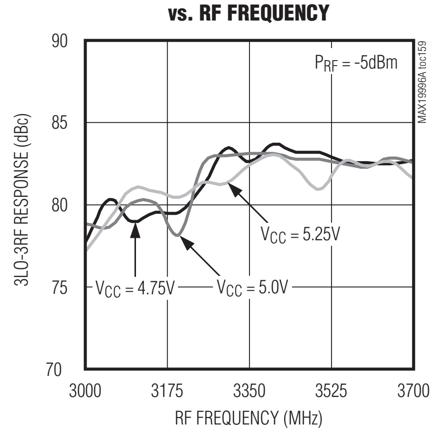

**3LO-3RF RESPONSE vs. RF FREQUENCY**



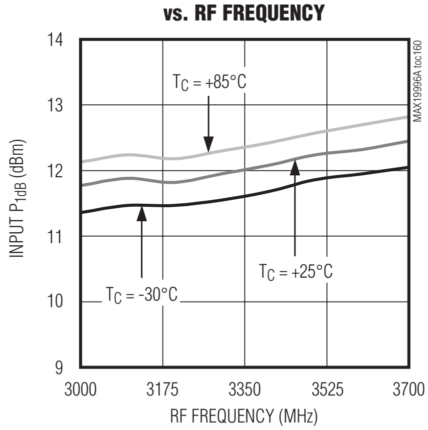

**3LO-3RF RESPONSE vs. RF FREQUENCY**



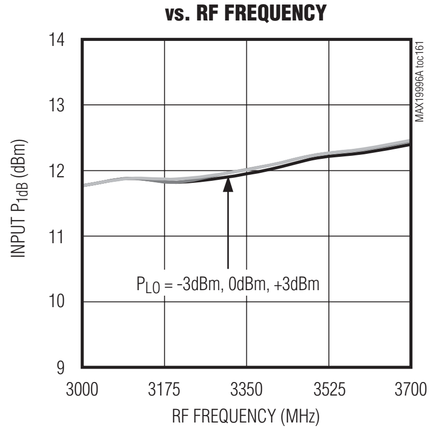

**3LO-3RF RESPONSE vs. RF FREQUENCY**



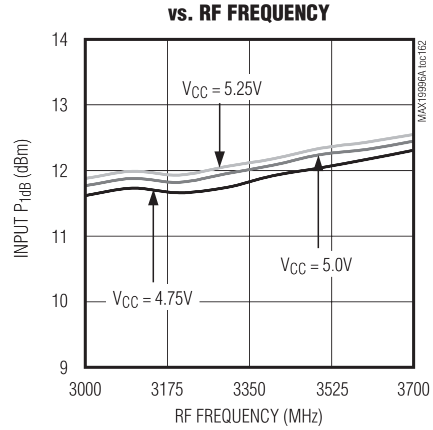

**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**




**INPUT $P_{1dB}$ vs. RF FREQUENCY**

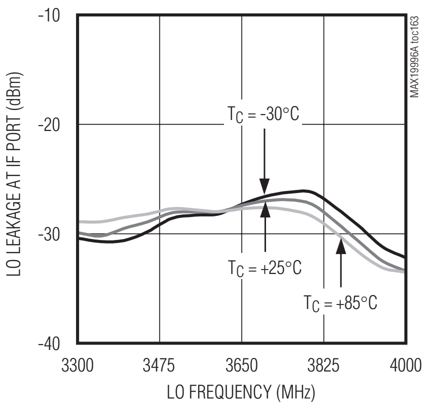


# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

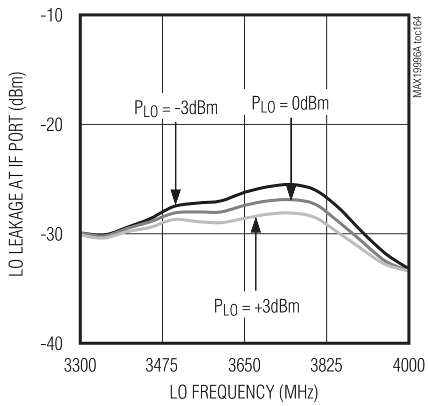
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 3000MHz to 3700MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

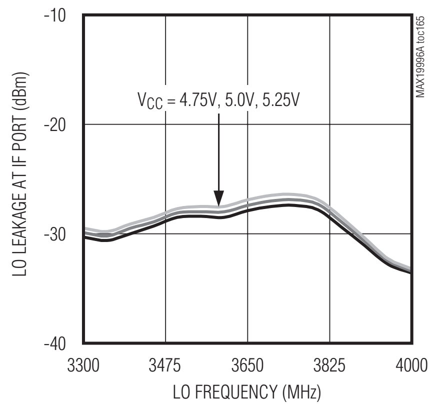
**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



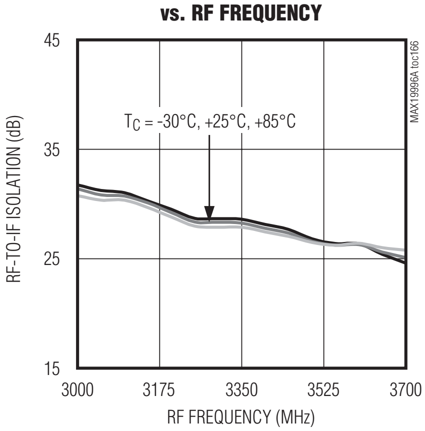

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



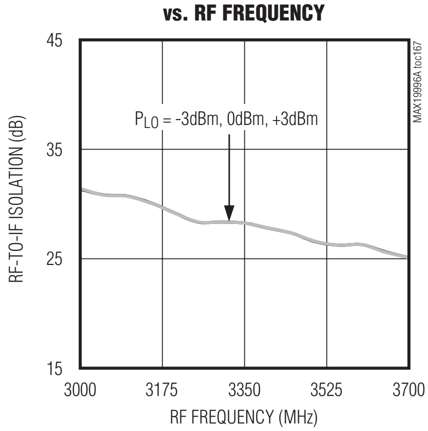

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**



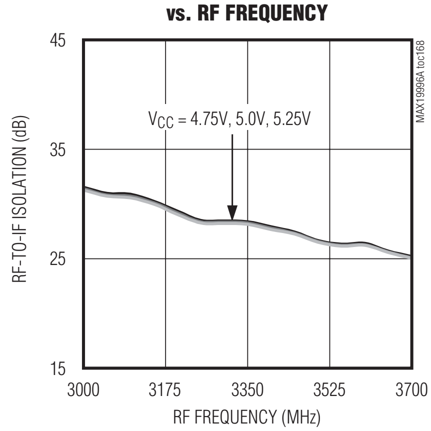

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



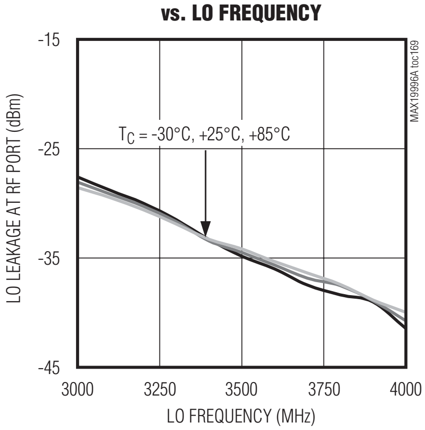

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



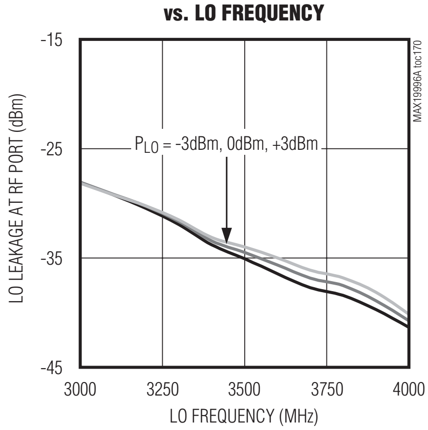

**RF-TO-IF ISOLATION vs. RF FREQUENCY**



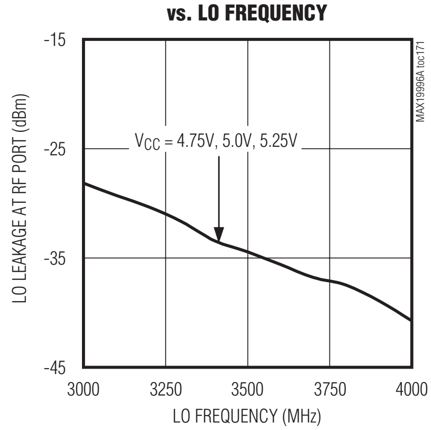

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**




**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



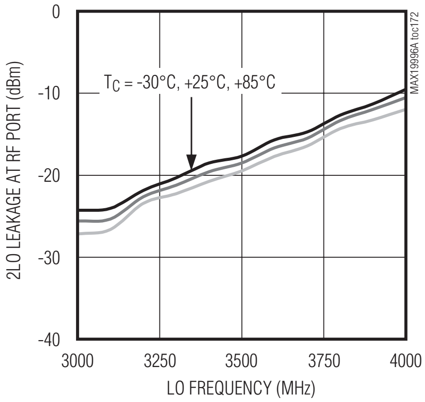

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



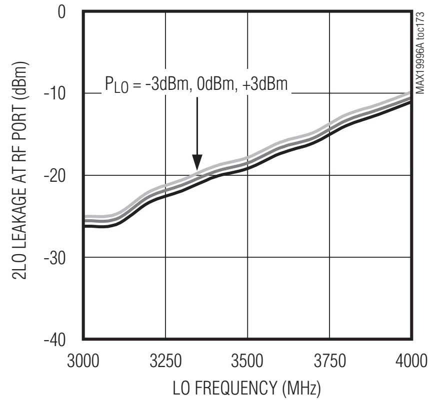
## Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, $V_{CC}$ = 5.0V, $f_{RF}$ = 3000MHz to 3700MHz, LO is high-side injected** for a 300MHz IF, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $T_C$ = +25°C, unless otherwise noted.)

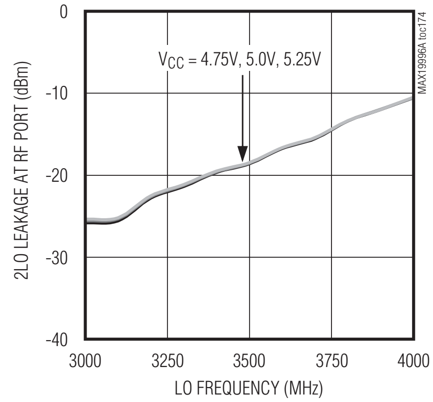
**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



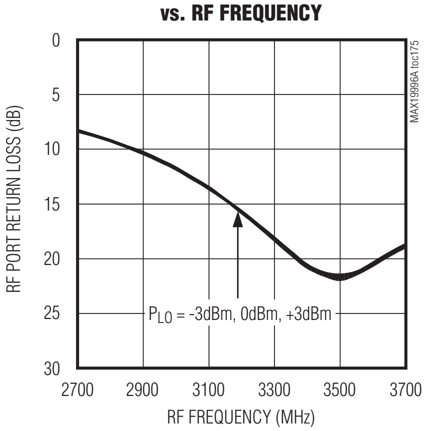

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



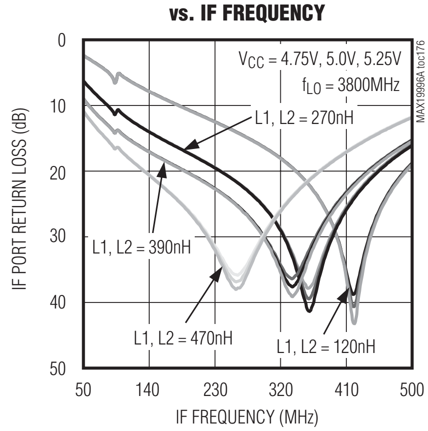

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY**



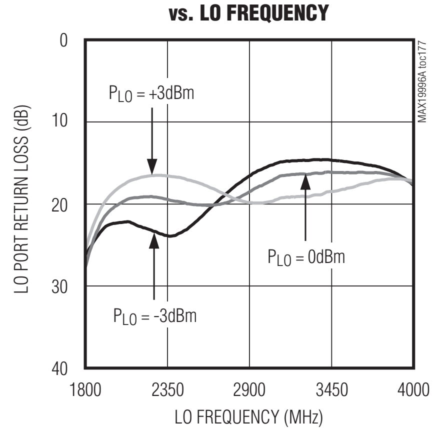

**RF PORT RETURN LOSS vs. RF FREQUENCY**



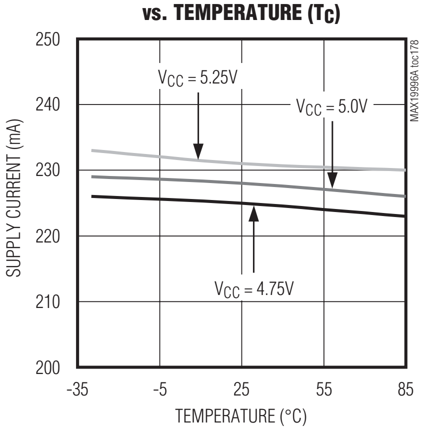

**IF PORT RETURN LOSS vs. IF FREQUENCY**



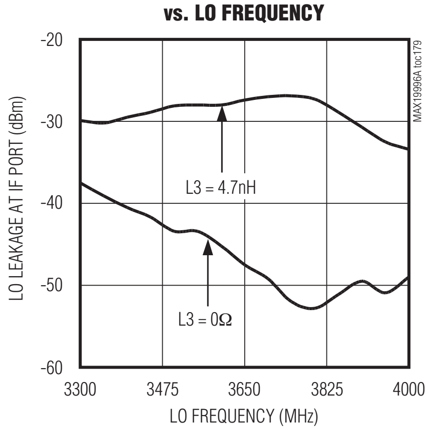

**LO PORT RETURN LOSS vs. LO FREQUENCY**



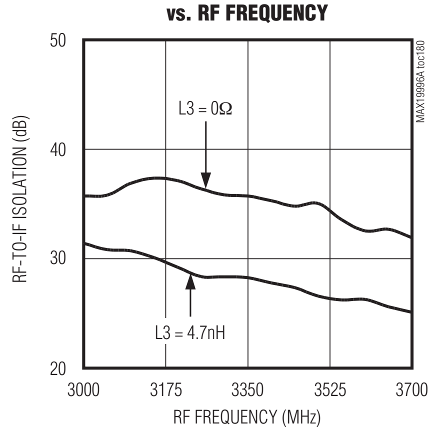

**SUPPLY CURRENT vs. TEMPERATURE ($T_C$)**




**LO LEAKAGE AT IF PORT vs. LO FREQUENCY**




**RF-TO-IF ISOLATION vs. RF FREQUENCY**



# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

## Pin Description

| PIN | NAME | FUNCTION |
|---|---|---|
| 1, 6, 8, 14 | $V_{CC}$ | Power Supply. Bypass to GND with 0.01µF capacitors as close as possible to the pin. |
| 2 | RF | Single-Ended 50Ω RF Input. Internally matched and DC shorted to GND through a balun. Requires an input DC-blocking capacitor. |
| 3, 4, 5, 10, 12, 13, 17 | GND | Ground. Internally connected to the exposed pad. Connect all ground pins and the exposed pad (EP) together. |
| 7 | LOBIAS | LO Amplifier Bias Control. Output bias resistor for the LO buffer. Connect a 604Ω 1% (230mA bias condition) from LOBIAS to ground. |
| 9, 15 | N.C. | Not internally connected. Pins can be grounded. |
| 11 | LO | Local Oscillator Input. This input is internally matched to 50Ω. Requires an input DC-blocking capacitor. |
| 16 | LEXT | External Inductor Connection. Connect an inductor from this pin to ground to increase the RF-to-IF and LO-to-IF isolation (see the *Typical Operating Characteristics* for typical performance vs. inductor value). |
| 18, 19 | IF-, IF+ | Mixer Differential IF Output. Connect pullup inductors from each of these pins to $V_{CC}$ (see the *Typical Application Circuit*). |
| 20 | IFBIAS | IF Amplifier Bias Control. IF bias resistor connection for the IF amplifier. Connect a 698Ω 1% (230mA bias condition) from IFBIAS to GND. |
| — | EP | Exposed Pad. Internally connected to GND. Solder this exposed pad to a PCB pad that uses multiple ground vias to provide heat transfer out of the device into the PCB ground planes. These multiple via grounds are also required to achieve the noted RF performance. |

## Detailed Description

When used as a high-side LO injection mixer in the 2300MHz to 2900MHz RF band, the MAX19996A provides 8.7dB of conversion gain and +24.5dBm of IIP3 with a typical noise figure of 9.8dB. The integrated baluns and matching circuitry allow for 50Ω single-ended interfaces to the RF and the LO ports. The integrated LO buffer provides a high drive level to the mixer core, reducing the LO drive required at the MAX19996A's input to a -3dBm to +3dBm range. The IF port incorporates a differential output, which is ideal for providing enhanced 2LO-2RF performance.

Specifications are guaranteed over broad frequency ranges to allow for use in WCS, LTE, WiMAX, and MMDS base stations. The MAX19996A is specified to operate over an RF input range of 2000MHz to 3900MHz, an LO range of 2100MHz to 4000MHz, and an IF range of 50MHz to 500MHz. The external IF components set the lower frequency range (see the *Typical Operating Characteristics* for details). Operation beyond these ranges is possible (see the *Typical Operating Characteristics* for additional information).

### RF Input and Balun

The MAX19996A RF input provides a 50Ω match when combined with a series DC-blocking capacitor. This DC-blocking capacitor is required as the input is internally DC shorted to ground through the on-chip balun. When using an 8.2pF DC-blocking capacitor, the RF port input return loss is typically 14dB over the RF frequency range of 2300MHz to 2900MHz. A return loss of 15dB over the 3000MHz to 3900MHz range can be achieved by changing the DC-blocking capacitor to 1.5pF.

### LO Inputs, Buffer, and Balun

With a broadband LO drive circuit spanning 2100MHz to 4000MHz, the MAX19996A can be used in either low-side or high-side LO injection architectures for virtually all 2.5GHz and 3.5GHz applications. The LO input is internally matched to 50Ω, requiring only a 2pF DC-blocking capacitor. A two-stage internal LO buffer allows for a -3dBm to +3dBm LO input power range. The on-chip low-loss balun, along with an LO buffer, drives the double-balanced mixer. All interfacing and matching components from the LO inputs to the IF outputs are integrated on-chip.

### High-Linearity Mixer

The core of the MAX19996A is a double-balanced, high-performance passive mixer. Exceptional linearity is provided by the large LO swing from the on-chip LO buffer. When combined with the integrated IF amplifiers, IIP3, 2LO-2RF rejection, and noise-figure performance are typically +24.5dBm, 67dBc, and 9.8dB, respectively.

### Differential IF Output Amplifier

The MAX19996A has an IF frequency range of 50MHz to 500MHz, where the low-end frequency depends on the frequency response of the external IF components. The MAX19996A mixer is tuned for a 300MHz IF using 390nH external pullup bias inductors. Lower IF frequencies would require higher inductor values to maintain a good IF match. The differential, open-collector IF output ports require these inductors to be connected to $V_{CC}$.

Note that these differential ports are ideal for providing enhanced 2LO-2RF and 2RF-2LO performance. Single-ended IF applications require a 4:1 (impedance ratio) balun to transform the 200Ω differential IF impedance to a 50Ω single-ended system. Use the TC4-1W-17 4:1 transformer for IF frequencies above 200MHz and the TC4-1W-7A 4:1 transformer for frequencies below 200MHz. The user can use a differential IF amplifier or SAW filter on the mixer IF port, but a DC block is required on both IF+/IF- ports to keep external DC from entering the IF ports of the mixer.

## Applications Information

### Input and Output Matching

The RF input provides a 50Ω match when combined with a series DC-blocking capacitor. Use an 8.2pF capacitor value for RF frequencies ranging from 2000MHz to 3000MHz. A 1.5pF capacitor value should be used to match the RF port for the 3000MHz to 3900MHz band. The LO input is internally matched to 50Ω; use a 2pF DC-blocking capacitor to cover operations spanning the 2100MHz to 4000MHz LO range. The IF output impedance is 200Ω (differential). For evaluation, an external low-loss 4:1 (impedance ratio) balun transforms this impedance down to a 50Ω single-ended output (see the *Typical Application Circuit*).

### Reduced-Power Mode

The MAX19996A has two pins (LOBIAS, IFBIAS) that allow external resistors to set the internal bias currents. Nominal values for these resistors are given in Table 1. Larger value resistors can be used to reduce power dissipation at the expense of some performance loss. If ±1% resistors are not readily available, substitute with ±5% resistors.

Significant reductions in power consumption can also be realized by operating the mixer with an optional supply voltage of 3.3V. Doing so reduces the overall power consumption by up to 57%. See the *3.3V Supply AC Electrical Characteristics—$f_{RF}$ = 2300MHz to 2900MHz, High-Side LO Injection* table and the relevant 3.3V curves in the *Typical Operating Characteristics* section to evaluate the power vs. performance tradeoffs.

### LEXT Inductor

Short LEXT to ground using a 0Ω resistor. For applications requiring improved RF-to-IF and LO-to-IF isolation, L3 can be changed to optimize performance (see the *Typical Operating Characteristics*). However, the load impedance presented to the mixer must be so that any capacitances from IF- and IF+ to ground do not exceed several picofarads to ensure stable operating conditions. Since approximately 90mA flows through LEXT, it is important to use a low-DCR wire-wound inductor.

### Layout Considerations

A properly designed PCB is an essential part of any RF/microwave circuit. Keep RF signal lines as short as possible to reduce losses, radiation, and inductance. The load impedance presented to the mixer must be so that any capacitance from both IF- and IF+ to ground does not exceed several picofarads. For the best performance, route the ground pin traces directly to the exposed pad under the package. The PCB exposed pad **MUST** be connected to the ground plane of the PCB. It is suggested that multiple vias be used to connect this pad to the lower-level ground planes. This method provides a good RF/thermal-conduction path for the device. Solder the exposed pad on the bottom of the device package to the PCB. The MAX19996A evaluation kit can be used as a reference for board layout. Gerber files are available upon request at **www.maxim-ic.com**.

### Power-Supply Bypassing

Proper voltage-supply bypassing is essential for high-frequency circuit stability. Bypass each $V_{CC}$ pin with the capacitors shown in the *Typical Application Circuit* and Table 1.

## Table 1. Component Values

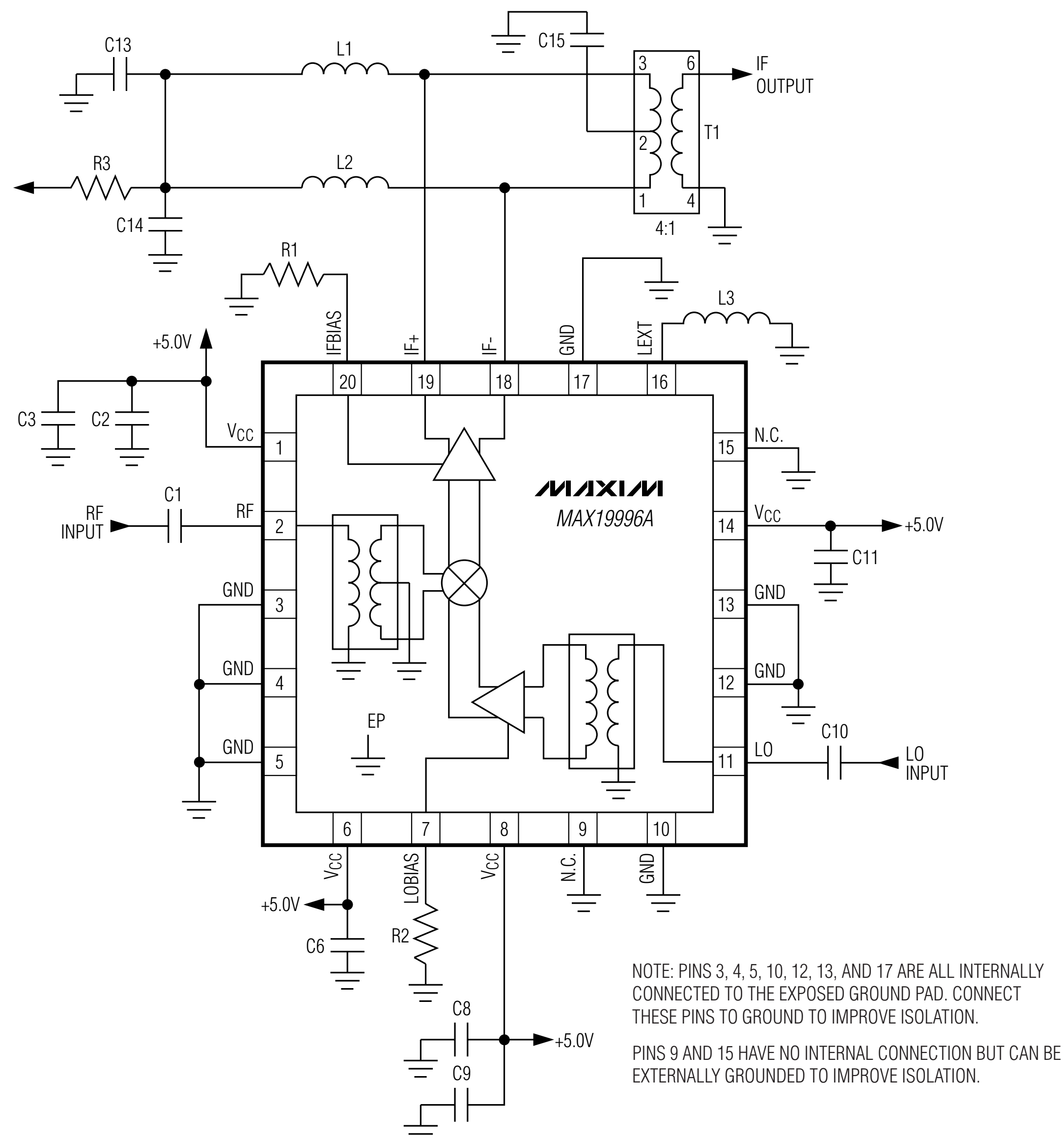
| DESIGNATION | QTY | DESCRIPTION | COMPONENT SUPPLIER |
|---|---|---|---|
| C1 | 1 | 8.2pF microwave capacitor (0402). Use for RF frequencies ranging from 2000MHz to 3000MHz. | Murata Electronics North America, Inc. |
| | | 1.5pF microwave capacitor (0402). Use for RF frequencies ranging from 3000MHz to 3900MHz. | |
| C2, C6, C8, C11 | 4 | 0.01µF microwave capacitors (0402) | Murata Electronics North America, Inc. |
| C3, C9 | 0 | Not installed, capacitors | — |
| C10 | 1 | 2pF microwave capacitor (0402) | Murata Electronics North America, Inc. |
| C13, C14 | 2 | 1000pF microwave capacitors (0402) | Murata Electronics North America, Inc. |
| C15 | 1 | 82pF microwave capacitor (0402) | Murata Electronics North America, Inc. |
| L1, L2 | 2 | 390nH wire-wound high-Q inductors* (0805) (see the *Typical Operating Characteristics*) | Coilcraft, Inc. |
| L3 | 1 | 4.7nH wire-wound high-Q inductor (0603) | Coilcraft, Inc. |
| R1 | 1 | 698Ω ±1% resistor (0402). Use for **$V_{CC}$ = 5.0V** applications. | Digi-Key Corp. |
| | | 1.1kΩ ±1% resistor (0402). Use for **$V_{CC}$ = 3.3V** applications. | |
| R2 | 1 | 604Ω ±1% resistor (0402). Use for **$V_{CC}$ = 5.0V** applications. | Digi-Key Corp. |
| | | 845Ω±1% resistor (0402). Use for **$V_{CC}$ = 3.3V** applications. | |
| R3 | 1 | 0Ω resistor (1206) | Digi-Key Corp. |
| T1 | 1 | 4:1 IF balun TC4-1W-17* | Mini-Circuits |
| U1 | 1 | MAX19996A IC (20 TQFN-EP) | Maxim Integrated Products, Inc. |

**Use 470nH inductors and TC4-1W-7A 4:1 balun for IF frequencies below 200MHz.*

### *Exposed Pad RF/Thermal Considerations*

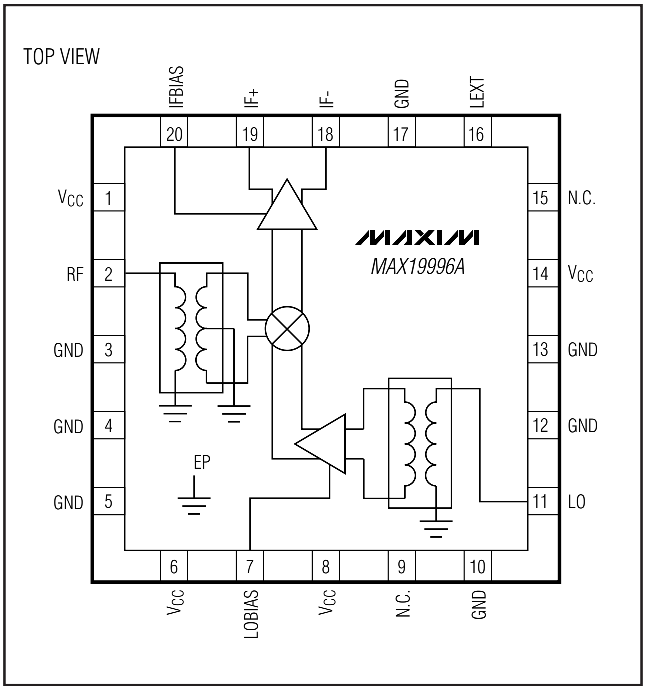
The exposed pad (EP) of the MAX19996A's 20-pin thin QFN-EP package provides a low thermal-resistance path to the die. It is important that the PCB on which the MAX19996A is mounted be designed to conduct heat from the EP. In addition, provide the EP with a low-inductance path to electrical ground. The EP **MUST** be soldered to a ground plane on the PCB, either directly or through an array of plated via holes.

## Typical Application Circuit



# SiGe, High-Linearity, 2000MHz to 3900MHz Downconversion Mixer with LO Buffer

## Pin Configuration/ Functional Diagram




## Chip Information

PROCESS: SiGe BiCMOS

## Package Information

For the latest package outline information and land patterns, go to **www.maxim-ic.com/packages**.

| PACKAGE TYPE | PACKAGE CODE | DOCUMENT NO. |
|---|---|---|
| 20 Thin QFN-EP | T2055+3 | **21-0140** |

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|---|---|---|---|
| 0 | 1/09 | Initial release | — |
| 1 | 5/09 | Updated *Electrical Characteristics* table limits | 6 |