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maxim integrated™

# MAX19997A

# Dual, SiGe High-Linearity, 1800MHz to 2900MHz Downconversion Mixer with LO Buffer

## General Description

The MAX19997A dual downconversion mixer is a versatile, highly integrated diversity downconverter that provides high linearity and low noise figure for a multitude of 1800MHz to 2900MHz base-station applications. The MAX19997A fully supports both low- and high-side LO injection architectures for the 2300MHz to 2900MHz WiMAX™, LTE, WCS, and MMDS bands, providing 8.7dB gain, +24dBm input IP3, and 10.3dB NF in the low-side configuration, and 8.7dB gain, +24dBm input IP3, and 10.4dB NF in the high-side configuration. High-side LO injection architectures can be further extended down to 1800MHz with the addition of one tuning element (a shunt inductor) on each RF port.

The device integrates baluns in the RF and LO ports, an LO buffer, two double-balanced mixers, and a pair of differential IF output amplifiers. The MAX19997A requires a typical LO drive of 0dBm and a supply current guaranteed below 420mA to achieve the targeted linearity performance.

The MAX19997A is available in a compact 6mm x 6mm, 36-pin TQFN lead-free package with an exposed pad. Electrical performance is guaranteed over the extended temperature range, from $T_C$ = -40°C to +100°C.

## Applications

2.3GHz WCS Base Stations

2.5GHz WiMAX and LTE Base Stations

2.7GHz MMDS Base Stations

UMTS/WCDMA and cdma2000® 3G Base Stations

PCS1900 and EDGE Base Stations

PHS/PAS Base Stations

Fixed Broadband Wireless Access

Wireless Local Loop

Private Mobile Radios

Military Systems

## Features

- **1800MHz to 2900MHz RF Frequency Range**
- **1950MHz to 3400MHz LO Frequency Range**
- **50MHz to 550MHz IF Frequency Range**
- **Supports Both Low-Side and High-Side LO Injection**
- **8.7dB Conversion Gain**
- **+24dBm Input IP3**
- **10.3dB Noise Figure**
- **+11.3dBm Input 1dB Compression Point**
- **70dBc Typical 2 x 2 Spurious Rejection at $P_{RF}$ = -10dBm**
- **Dual Channels Ideal for Diversity Receiver Applications**
- **Integrated LO Buffer**
- **Integrated LO and RF Baluns for Single-Ended Inputs**
- **Low -3dBm to +3dBm LO Drive**
- **Pin Compatible with the MAX19999 3000MHz to 4000MHz Mixer**
- **Pin Similar to the MAX9995 and MAX19995/MAX19995A 1700MHz to 2200MHz Mixers and the MAX9985 and MAX19985A 700MHz to 1000MHz Mixers**
- **42dB Channel-to-Channel Isolation**
- **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 |
|---|---|---|
| MAX19997AETX+ | -40°C to +100°C | 36 TQFN-EP* |
| MAX19997AETX+T | -40°C to +100°C | 36 TQFN-EP* |

*+Denotes a lead(Pb)-free/RoHS-compliant package.*
**EP = Exposed pad.*
*T = Tape and reel.*

*WiMAX is a trademark of WiMAX Forum.*

*cdma2000 is a registered trademark of Telecommunications Industry Association.*

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

***For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maximintegrated.com.***

*19-4288; Rev 4; 1/13*

## ABSOLUTE MAXIMUM RATINGS

$V_{CC}$ to GND .....-0.3V to +5.5V
RF_, LO to GND .....-0.3V to +0.3V
IFM_, IFD_, IFM_SET, IFD_SET, LO_ADJ_M, LO_ADJ_D to GND .....-0.3V to ($V_{CC}$ + 0.3V)
RF_, LO Input Power .....+15dBm
RF_, LO Current (RF_ and LO is DC shorted to GND through balun) ..... ...50mA
Continuous Power Dissipation (Note 1) .....6.5W
Operating Case Temperature Range (Note 4) .....$T_C$ = -40°C to +100°C
Junction Temperature .....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C
Soldering Temperature (reflow) .....+260°C

## PACKAGE THERMAL CHARACTERISTICS

Junction-to-Ambient Thermal Resistance ($\theta_{JA}$) (Notes 2, 3).....38°C/W
Junction-to-Board Thermal Resistance ($\theta_{JB}$).....12.2°C/W
Junction-to-Case Thermal Resistance ($\theta_{JC}$) (Notes 1, 3).....7.4°C/W

**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.maximintegrated.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* optimized for the **standard RF band (see Table 1)**, no input RF or LO signals applied, $V_{CC}$ = 4.75V to 5.25V, $T_C$ = -40°C to +85°C. Typical values are at $V_{CC}$ = 5.0V, $T_C$ = +25°C, unless otherwise noted. R1, R4 = 750Ω, R2, R5 = 698Ω.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | | 4.75 | | 5.25 | V |
| Total Supply Current | $I_{CC}$ | $V_{CC}$ = 5.0V | | 388 | 420 | mA |
| | | $V_{CC}$ = 5.25V | | 390.4 | | |
| $V_{CC}$ (Pin 4) Supply Current (Main and Diversity Paths) | | $V_{CC}$ = 5.25V | | 2.5 | | mA |
| $V_{CC}$ (Pin 10) Supply Current (Diversity Path) | | $V_{CC}$ = 5.25V | | 8.9 | | mA |
| $V_{CC}$ (Pin 16) Supply Current (Diversity Path) | | $V_{CC}$ = 5.25V | | 109.3 | | mA |
| $V_{CC}$ (Pin 21) Supply Current (Main and Diversity Paths) | | $V_{CC}$ = 5.25V | | 28.3 | | mA |
| $V_{CC}$ (Pin 30) Supply Current (Main Path) | | $V_{CC}$ = 5.25V | | 109.3 | | mA |
| $V_{CC}$ (Pin 36) Supply Current (Main Path) | | $V_{CC}$ = 5.25V | | 8.9 | | mA |
| IFM Bias Supply Current (Main Path) | | Total bias feeding IFM- and IFM+ through R3, L1 and L2; $V_{CC}$ = 5.25V | | 61.6 | | mA |
| IFD Bias Supply Current (Diversity Path) | | Total bias feeding IFD+ and IFD- through R6, L3 and L4; $V_{CC}$ = 5.25V | | 61.6 | | mA |

## +3.3V SUPPLY DC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit* optimized for the **standard RF band (see Table 1)**, no input RF or LO signals applied, $V_{CC}$ = 3.0V to 3.6V, $T_C$ = -40°C to +85°C. Typical values are at $V_{CC}$ = 3.3V, $T_C$ = +25°C, unless otherwise noted. R1, R4 = 1.1kΩ, R2, R5 = 845Ω.)

| 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 | | 279 | 310 | mA |

## RECOMMENDED AC OPERATING CONDITIONS

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| RF Frequency Without External Tuning | $f_{RF}$ | (Note 5) | 2400 | | 2900 | MHz |
| RF Frequency with External Tuning | $f_{RF}$ | See Table 2 for an outline of tuning elements optimized for 1950MHz operation; optimization at other frequencies within the 1800MHz to 2400MHz range can be achieved with different component values; contact the factory for details | 1800 | | 2400 | MHz |
| LO Frequency | $f_{LO}$ | (Notes 5, 6) | 1950 | | 3400 | 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 (Notes 5, 6) | 100 | | 550 | MHz |
| | | Using alternative Mini-Circuits TC4-1W-7A 4:1 transformer, IF matching components affect the IF frequency range (Notes 5, 6) | 50 | | 250 | |
| LO Drive Level | $P_{LO}$ | | -3 | | +3 | dBm |

## +5.0V SUPPLY, HIGH-SIDE LO INJECTION AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit* optimized for the **standard RF band (see 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, $f_{LO}$ = 2650MHz to 3250MHz, $f_{IF}$ = 350MHz, $f_{RF} < f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are at $V_{CC}$ = 5.0V, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2950MHz, $f_{IF}$ = 350MHz, $T_C$ = +25°C, unless otherwise noted.) (Note 7)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Conversion Gain | $G_C$ | $f_{RF}$ = 2400MHz to 2900MHz, $T_C$ = +25°C (Notes 8, 9, 10) | 8.1 | 8.7 | 9.3 | dB |
| | | $T_C$ = +100°C | | 8.1 | | |
| Conversion Gain Flatness | | $f_{RF}$ = 2305MHz to 2360MHz | | 0.15 | | dB |
| | | $f_{RF}$ = 2500MHz to 2570MHz | | 0.15 | | |
| | | $f_{RF}$ = 2570MHz to 2620MHz | | 0.1 | | |
| | | $f_{RF}$ = 2500MHz to 2690MHz | | 0.15 | | |
| | | $f_{RF}$ = 2700MHz to 2900MHz | | 0.15 | | |
| Gain Variation Over Temperature | $TC_{CG}$ | $f_{RF}$ = 2300MHz to 2900MHz, $T_C$ = -40°C to +100°C | | -0.01 | | dB/°C |

## +5.0V SUPPLY, HIGH-SIDE LO INJECTION AC ELECTRICAL CHARACTERISTICS (continued)

(*Typical Application Circuit* optimized for the **standard RF band (see 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, $f_{LO}$ = 2650MHz to 3250MHz, $f_{IF}$ = 350MHz, $f_{RF} < f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are at $V_{CC}$ = 5.0V, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2950MHz, $f_{IF}$ = 350MHz, $T_C$ = +25°C, unless otherwise noted.) (Note 7)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Input Compression Point | $IP_{1dB}$ | (Notes 8, 9, 11) | 9.6 | 11.3 | | dBm |
| Third-Order Input Intercept Point | IIP3 | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF}$ = -5dBm per tone (Notes 8, 9) | 22.0 | 24 | | dBm |
| | | $f_{RF}$ = 2600MHz, $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF}$ = -5dBm per tone, $T_C$ = +25°C (Notes 8, 9) | 22.5 | 24 | | |
| | | $P_{RF}$ = -5dBm/tone, $f_{RF1}$ - $f_{RF2}$ = 1MHz, $T_C$ = +100°C | | 24.2 | | |
| Third-Order Input Intercept Point Variation Over Temperature | | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $T_C$ = -40°C to +100°C | | ±0.3 | | dBm |
| Noise Figure | $NF_{SSB}$ | Single sideband, no blockers present $f_{RF}$ = 2400MHz to 2900MHz (Notes 6, 8, 10) | | 10.4 | 12.5 | dB |
| | | Single sideband, no blockers present, $f_{RF}$ = 2400MHz to 2900MHz , $T_C$ = +25°C (Notes 6, 8, 10) | | 10.4 | 11.4 | |
| Noise Figure Temperature Coefficient | $TC_{NF}$ | Single sideband, no blockers present, $T_C$ = -40°C to +100°C | | 0.018 | | dB/°C |
| Noise Figure Under Blocking Conditions | $NF_B$ | $f_{BLOCKER}$ = 2412MHz, $P_{BLOCKER}$ = 8dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2950MHz, $P_{LO}$ = 0dBm, $V_{CC}$ = 5.0V, $T_C$ = +25°C (Notes 8, 12) | | 22.5 | 25 | dB |
| 2LO - 2RF Spur | 2 x 2 | $f_{RF}$ = 2600MHz, $f_{LO}$ = 2950MHz, $P_{RF}$ = -10dBm, $f_{SPUR}$ = $f_{LO}$ - 175MHz (Note 8) | 62 | 69 | | dBc |
| | | $P_{RF}$ = -10dBm, $T_C$ = +100°C | | 68 | | |
| | | $f_{RF}$ = 2600MHz, $f_{LO}$ = 2950MHz, $P_{RF}$ = -5dBm, $f_{SPUR}$ = $f_{LO}$ - 175MHz (Notes 8, 9) | 57 | 64 | | |
| | | $P_{RF}$ = -5dBm, $T_C$ = +100°C | | 63 | | |
| 3LO - 3RF Spur | 3 x 3 | $f_{RF}$ = 2600MHz, $f_{LO}$ = 2950MHz, $P_{RF}$ = -10dBm, $f_{SPUR}$ = $f_{LO}$ - 116.67MHz, $T_C$ = +25°C (Note 8) | 73 | 84 | | dBc |
| | | $P_{RF}$ = -10dBm, $T_C$ = +100°C | | 85 | | |
| | | $f_{RF}$ = 2600MHz, $f_{LO}$ = 2950MHz, $P_{RF}$ = -5dBm, $f_{SPUR}$ = $f_{LO}$ - 116.67MHz, $T_C$ = +25°C (Notes 8, 9) | 63 | 74 | | |
| | | $P_{RF}$ = -5dBm, $T_C$ = +100°C | | 75 | | |
| RF Input Return Loss | | LO on and IF terminated into a matched impedance | | 14 | | dB |

## +5.0V SUPPLY, HIGH-SIDE LO INJECTION AC ELECTRICAL CHARACTERISTICS (continued)

(*Typical Application Circuit* optimized for the **standard RF band (see 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, $f_{LO}$ = 2650MHz to 3250MHz, $f_{IF}$ = 350MHz, $f_{RF} < f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are at $V_{CC}$ = 5.0V, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2950MHz, $f_{IF}$ = 350MHz, $T_C$ = +25°C, unless otherwise noted.) (Note 7)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| LO Input Return Loss | | RF and IF terminated into a matched impedance | | 13 | | dB |
| IF Output Impedance | $Z_{IF}$ | Nominal differential impedance at the IC's IF outputs | | 200 | | Ω |
| IF Output Return Loss | | RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit* | | 21 | | dB |
| RF-to-IF Isolation | | | | 25 | | dB |
| | | $T_C$ = +100°C | | 24 | | |
| LO Leakage at RF Port | | (Notes 8, 9) | | -28 | | dBm |
| 2LO Leakage at RF Port | | | | -33 | | dBm |
| LO Leakage at IF Port | | | | -18.5 | | dBm |
| | | $T_C$ = +100°C | | -17.8 | | |
| Channel Isolation | | RFMAIN (RFDIV) converted power measured at IFDIV (IFMAIN) relative to IFMAIN (IFDIV), all unused ports terminated to 50Ω | 38.5 | 43 | | dB |
| | | $T_C$ = +100°C | | 43.4 | | |

## +5.0V SUPPLY, LOW-SIDE LO INJECTION AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit* optimized for the **standard RF band (see 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, $f_{LO}$ = 1950MHz to 2550MHz, $f_{IF}$ = 350MHz, $f_{RF} > f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are at $V_{CC}$ = 5.0V, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $f_{IF}$ = 350MHz, $T_C$ = +25°C, unless otherwise noted.) (Note 7)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Conversion Gain | $G_C$ | $f_{RF}$ = 2400MHz to 2900MHz, $T_C$ = +25°C (Notes 8, 9, 10) | 8.1 | 8.7 | 9.3 | dB |
| Conversion Gain Flatness | | $f_{RF}$ = 2305MHz to 2360MHz | | 0.2 | | dB |
| | | $f_{RF}$ = 2500MHz to 2570MHz | | 0.15 | | |
| | | $f_{RF}$ = 2570MHz to 2620MHz | | 0.2 | | |
| | | $f_{RF}$ = 2500MHz to 2690MHz | | 0.25 | | |
| | | $f_{RF}$ = 2700MHz to 2900MHz | | 0.25 | | |
| Gain Variation Over Temperature | $TC_{CG}$ | $f_{RF}$ = 2300MHz to 2900MHz, $T_C$ = -40°C to +85°C | | -0.01 | | dB/°C |
| Input Compression Point | $IP_{1dB}$ | (Notes 6, 8, 11) | 9.6 | 11.3 | | dBm |

## +5.0V SUPPLY, LOW-SIDE LO INJECTION AC ELECTRICAL CHARACTERISTICS (continued)

(*Typical Application Circuit* optimized for the **standard RF band (see 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, $f_{LO}$ = 1950MHz to 2550MHz, $f_{IF}$ = 350MHz, $f_{RF} > f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are at $V_{CC}$ = 5.0V, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $f_{IF}$ = 350MHz, $T_C$ = +25°C, unless otherwise noted.) (Note 7)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Third-Order Input Intercept Point | IIP3 | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF}$ = -5dBm per tone (Notes 8, 9) | 21.6 | 23 | | dBm |
| | | $f_{RF}$ = 2600MHz, $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF}$ = -5dBm per tone, $T_C$ = +25°C (Notes 8, 9) | 22 | 23.8 | | dBm |
| Third-Order Input Intercept Point Variation Over Temperature | | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $T_C$ = -40°C to +85°C | | ±0.3 | | dBm |
| Noise Figure | $NF_{SSB}$ | Single sideband, no blockers present $f_{RF}$ = 2400MHz to 2900MHz (Notes 6, 8) | | 10.3 | 13.0 | dB |
| | | Single sideband, no blockers present, $f_{RF}$ = 2400MHz to 2900MHz, $T_C$ = +25°C (Notes 6, 8) | | 10.3 | 11.3 | |
| Noise Figure Temperature Coefficient | $TC_{NF}$ | Single sideband, no blockers present, $T_C$ = -40°C to +85°C | | 0.018 | | dB/°C |
| Noise Figure Under Blocking Conditions | $NF_B$ | $f_{BLOCKER}$ = 2793MHz, $P_{BLOCKER}$ = 8dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $P_{LO}$ = 0dBm, $V_{CC}$ = 5.0V, $T_C$ = +25°C (Notes 6, 8, 12) | | 22 | 25 | dB |
| 2RF - 2LO Spur | 2 x 2 | $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $P_{RF}$ = -10dBm, $f_{SPUR}$ = $f_{LO}$ + 175MHz, $T_C$ = +25°C (Note 8) | 62 | 67 | | dBc |
| | | $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $P_{RF}$ = -5dBm, $f_{SPUR}$ = $f_{LO}$ + 175MHz, $T_C$ = +25°C (Notes 8, 9) | 57 | 62 | | |
| 3RF - 3LO Spur | 3 x 3 | $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $P_{RF}$ = -10dBm, $f_{SPUR}$ = $f_{LO}$ + 116.67MHz, $T_C$ = +25°C (Note 8) | 78 | 83 | | dBc |
| | | $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $P_{RF}$ = -5dBm, $f_{SPUR}$ = $f_{LO}$ + 116.67MHz, $T_C$ = +25°C (Notes 8, 9) | 68 | 73 | | |
| RF Input Return Loss | | LO on and IF terminated into a matched impedance | | 16 | | dB |
| LO Input Return Loss | | RF and IF terminated into a matched impedance | | 11.5 | | dB |

## +5.0V SUPPLY, LOW-SIDE LO INJECTION AC ELECTRICAL CHARACTERISTICS (continued)

(*Typical Application Circuit* optimized for the **standard RF band (see 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, $f_{LO}$ = 1950MHz to 2550MHz, $f_{IF}$ = 350MHz, $f_{RF} > f_{LO}$, $T_C$ = -40°C to +85°C. Typical values are at $V_{CC}$ = 5.0V, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $f_{IF}$ = 350MHz, $T_C$ = +25°C, unless otherwise noted.) (Note 7)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| IF Output Impedance | $Z_{IF}$ | Nominal differential impedance at the IC's IF outputs | | 200 | | Ω |
| IF Output Return Loss | | RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit* | | 20 | | dB |
| RF-to-IF Isolation | | | | 23.5 | | dB |
| LO Leakage at RF Port | | (Notes 8, 9) | | -31 | -24 | dBm |
| 2LO Leakage at RF Port | | | | -27 | | dBm |
| LO Leakage at IF Port | | | | -9.6 | | dBm |
| Channel Isolation | | RFMAIN (RFDIV) converted power measured at IFDIV (IFMAIN) relative to IFMAIN (IFDIV), all unused ports terminated to 50Ω (Notes 8, 9) | 38.5 | 42 | | dB |

## +3.3V SUPPLY, LOW-SIDE LO INJECTION AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit* optimized for the **standard RF band (see Table 1)**. Typical values are at $V_{CC}$ = 3.3V, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $f_{IF}$ = 350MHz, $T_C$ = +25°C, unless otherwise noted.) (Note 7)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Conversion Gain | $G_C$ | (Note 9) | | 8.5 | | dB |
| Conversion Gain Flatness | | $f_{RF}$ = 2305MHz to 2360MHz | | 0.2 | | dB |
| | | $f_{RF}$ = 2500MHz to 2570MHz | | 0.15 | | |
| | | $f_{RF}$ = 2570MHz to 2620MHz | | 0.15 | | |
| | | $f_{RF}$ = 2500MHz to 2690MHz | | 0.25 | | |
| | | $f_{RF}$ = 2700MHz to 2900MHz | | 0.15 | | |
| Gain Variation Over Temperature | $TC_{CG}$ | $f_{RF}$ = 2300MHz to 2900MHz, $T_C$ = -40°C to +85°C | | -0.01 | | dB/°C |
| Input Compression Point | $IP_{1dB}$ | | | 7.7 | | dBm |
| Third-Order Input Intercept Point | IIP3 | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $P_{RF}$ = -5dBm per tone | | 19.7 | | dBm |
| Third-Order Input Intercept Variation Over Temperature | | $f_{RF1}$ - $f_{RF2}$ = 1MHz, $T_C$ = -40°C to +85°C | | ±0.5 | | dBm |
| Noise Figure | $NF_{SSB}$ | Single sideband, no blockers present | | 9.7 | | dB |
| Noise Figure Temperature Coefficient | $TC_{NF}$ | Single sideband, no blockers present, $T_C$ = -40°C to +85°C | | 0.018 | | dB/°C |

## +3.3V SUPPLY, LOW-SIDE LO INJECTION AC ELECTRICAL CHARACTERISTICS (continued)

(*Typical Application Circuit* optimized for the **standard RF band (see Table 1)**. Typical values are at $V_{CC}$ = 3.3V, $P_{RF}$ = -5dBm, $P_{LO}$ = 0dBm, $f_{RF}$ = 2600MHz, $f_{LO}$ = 2250MHz, $f_{IF}$ = 350MHz, $T_C$ = +25°C, unless otherwise noted.) (Note 7)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| 2RF - 2LO Spur | 2 x 2 | $P_{RF}$ = -10dBm, $f_{SPUR} = f_{LO}$ + 175MHz | | 74 | | dBc |
| | | $P_{RF}$ = -5dBm, $f_{SPUR} = f_{LO}$ + 175MHz | | 69 | | |
| 3RF - 3LO Spur | 3 x 3 | $P_{RF}$ = -10dBm, $f_{SPUR} = f_{LO}$ + 116.67MHz | | 74 | | dBc |
| | | $P_{RF}$ = -5dBm, $f_{SPUR} = f_{LO}$ + 116.67MHz | | 64 | | |
| RF Input Return Loss | | LO on and IF terminated into a matched impedance | | 16 | | dB |
| LO Input Return Loss | | RF and IF terminated into a matched impedance | | 11 | | dB |
| IF Output Impedance | $Z_{IF}$ | Nominal differential impedance at the IC's IF outputs | | 200 | | Ω |
| IF Output Return Loss | | RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit* | | 26 | | dB |
| RF-to-IF Isolation | | | | 25 | | dB |
| LO Leakage at RF Port | | | | -36 | | dBm |
| 2LO Leakage at RF Port | | | | -31 | | dBm |
| LO Leakage at IF Port | | | | -13.5 | | dBm |
| Channel Isolation | | RFMAIN (RFDIV) converted power measured at IFDIV (IFMAIN) relative to IFMAIN (IFDIV), all unused ports terminated to 50Ω | | 42 | | dB |

**Note 5:** Operation outside this range is possible, but with degraded performance of some parameters. See the *Typical Operating Characteristics*.

**Note 6:** Not production tested.

**Note 7:** All limits reflect losses of external components, including a 0.8dB loss at $f_{IF}$ = 350MHz due to the 4:1 impedance transformer. Output measurements taken at the IF outputs of *Typical Application Circuit*.

**Note 8:** Guaranteed by design and characterization.

**Note 9:** 100% production tested for functional performance.

**Note 10:** RF frequencies below 2400MHz require external RF tuning similar to components listed in Table 2.

**Note 11:** Maximum reliable continuous input power applied to the RF or IF port of this device is +12dBm from a 50Ω source.

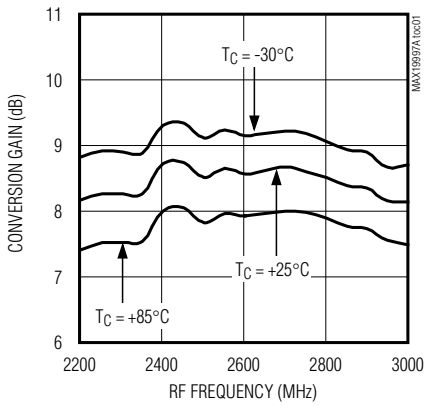
**Note 12:** Measured with external LO source noise filtered so the noise floor is -174dBm/Hz. This specification reflects the effects of all SNR degradations in the mixer, including the LO noise as defined in Application Note 2021: *Specifications and Measurement of Local Oscillator Noise in Integrated Circuit Base Station Mixers*.

# Dual, SiGe High-Linearity, 1800MHz to 2900MHz Downconversion Mixer with LO Buffer

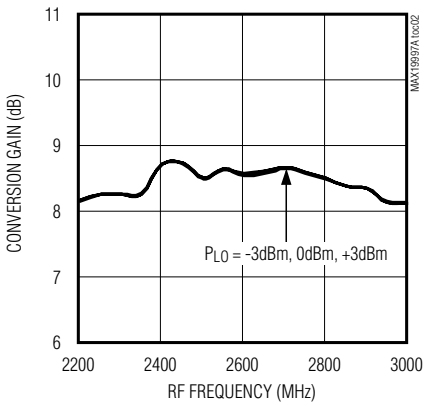
## Typical Operating Characteristics

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

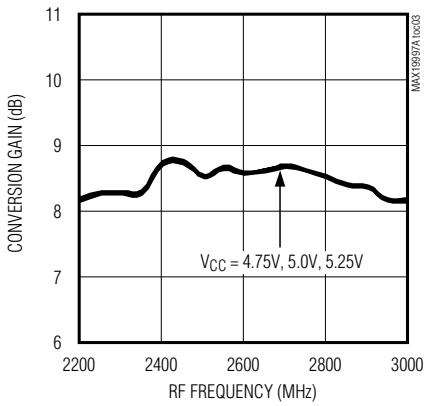
**CONVERSION GAIN vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



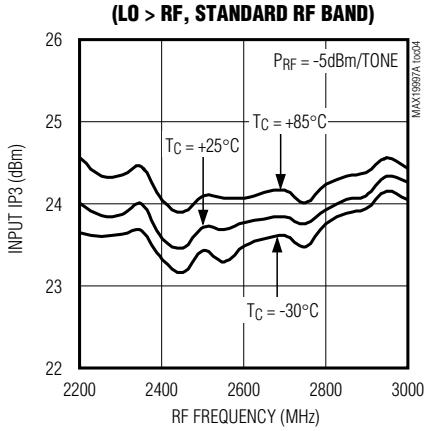

**CONVERSION GAIN vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



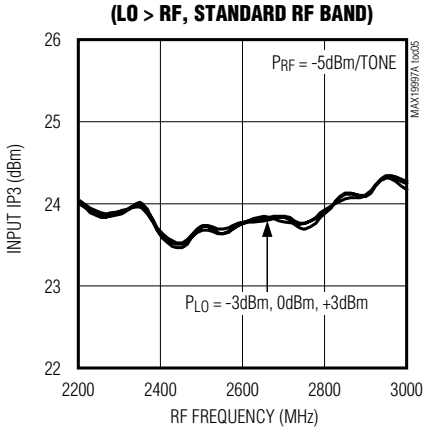

**CONVERSION GAIN vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



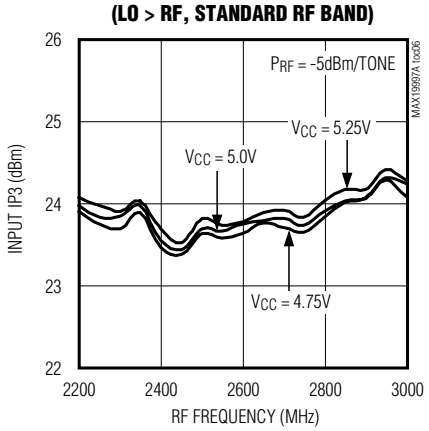

**INPUT IP3 vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



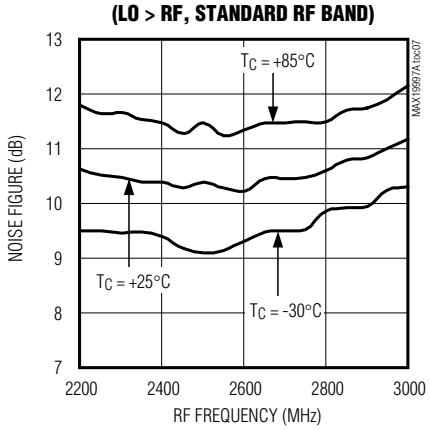

**INPUT IP3 vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



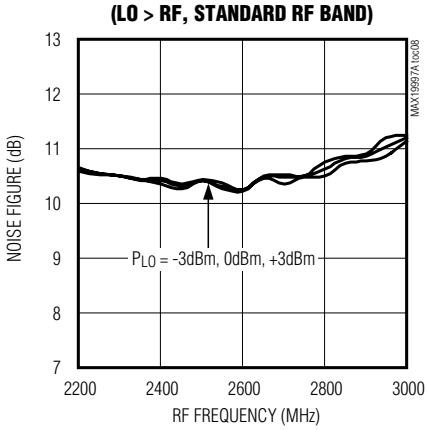

**INPUT IP3 vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



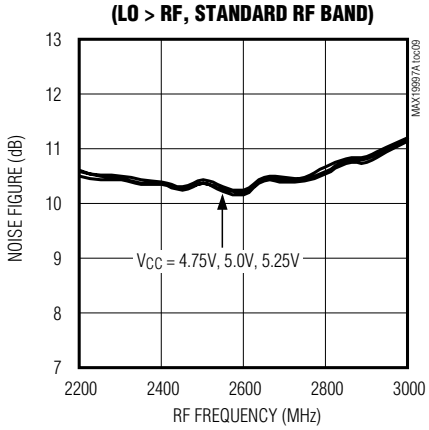

**NOISE FIGURE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**




**NOISE FIGURE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



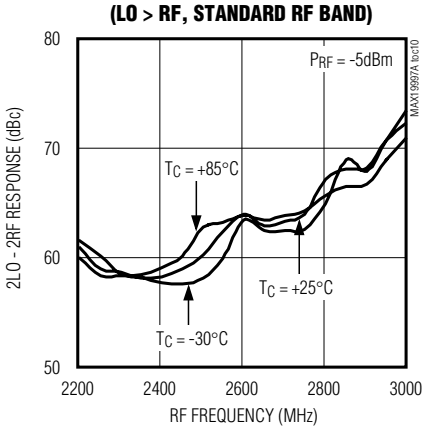

**NOISE FIGURE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



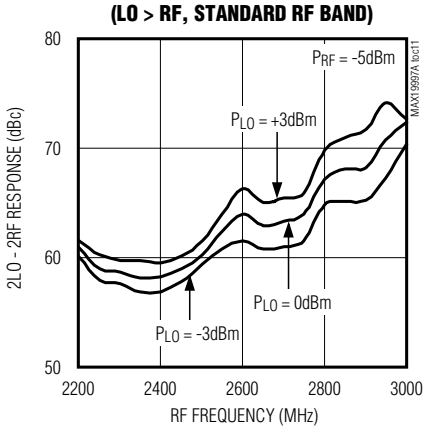
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

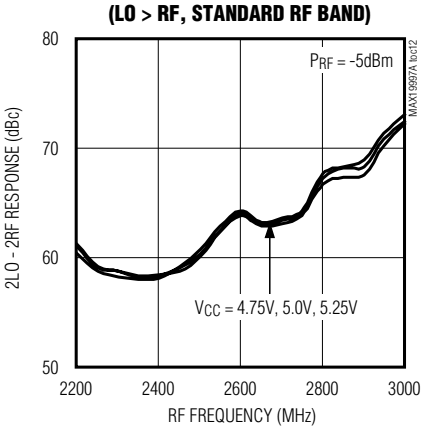
**2LO - 2RF RESPONSE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



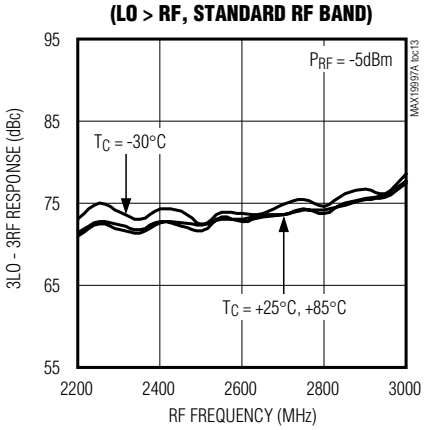

**2LO - 2RF RESPONSE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



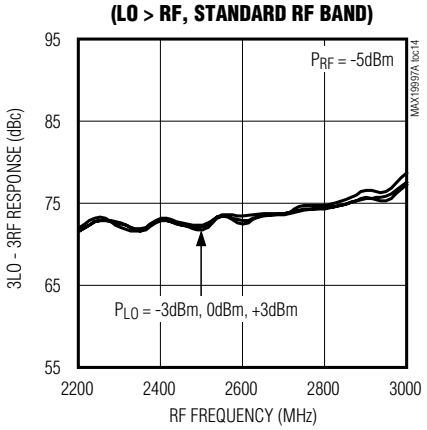

**2LO - 2RF RESPONSE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



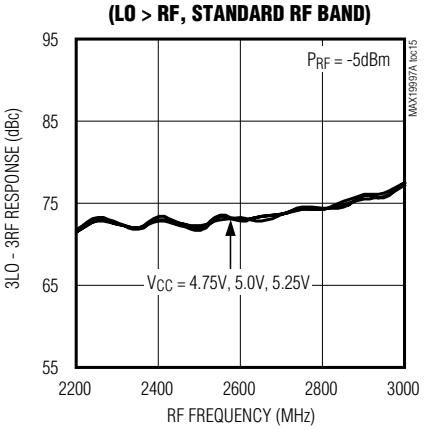

**3LO - 3RF RESPONSE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



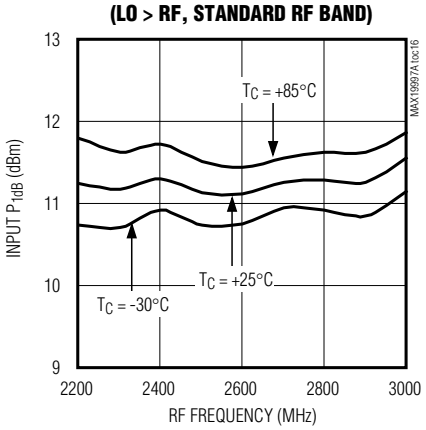

**3LO - 3RF RESPONSE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



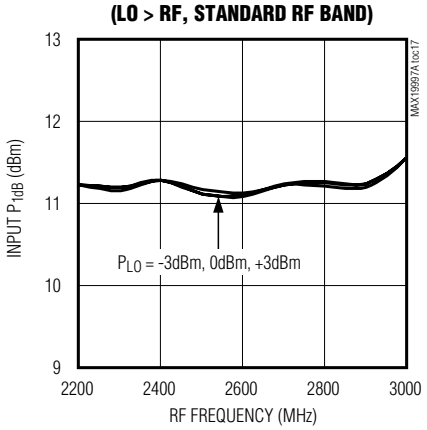

**3LO - 3RF RESPONSE vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



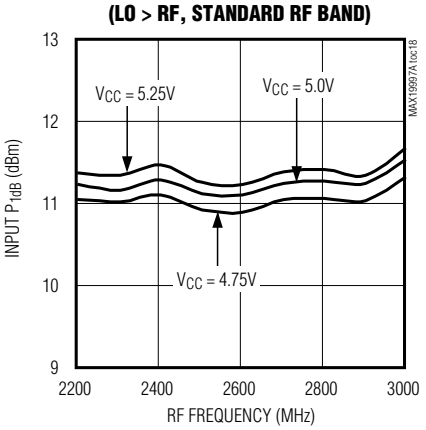

**INPUT $P_{1dB}$ vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**




**INPUT $P_{1dB}$ vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



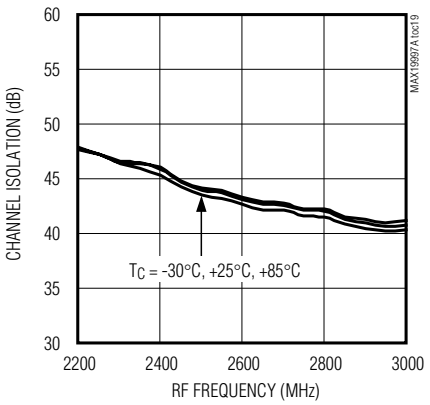

**INPUT $P_{1dB}$ vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



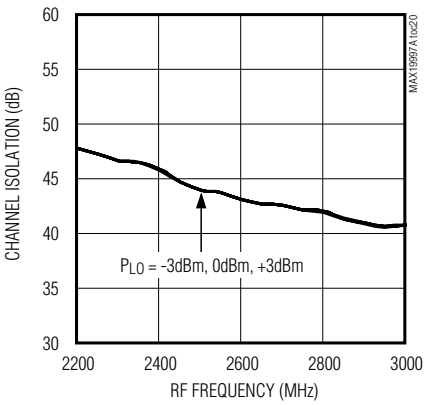
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

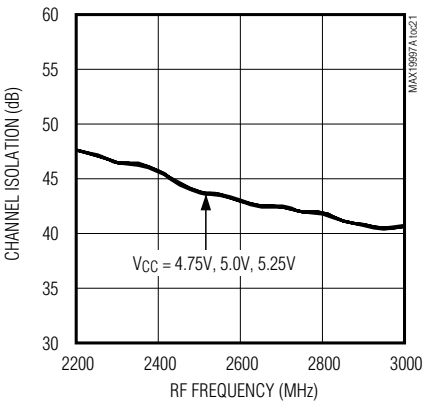
**CHANNEL ISOLATION vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



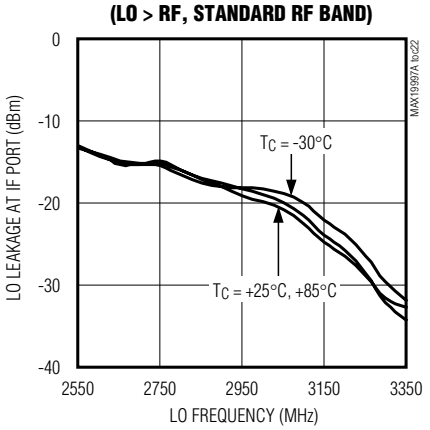

**CHANNEL ISOLATION vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



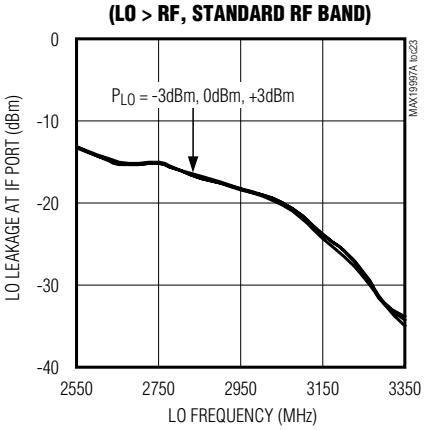

**CHANNEL ISOLATION vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



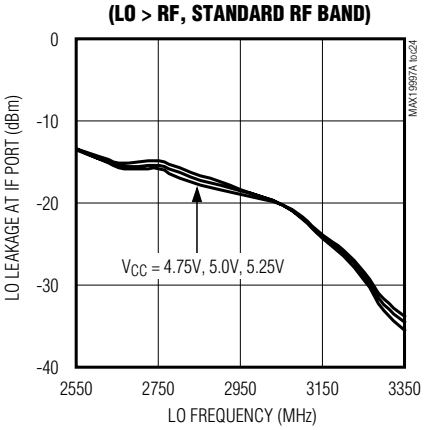

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



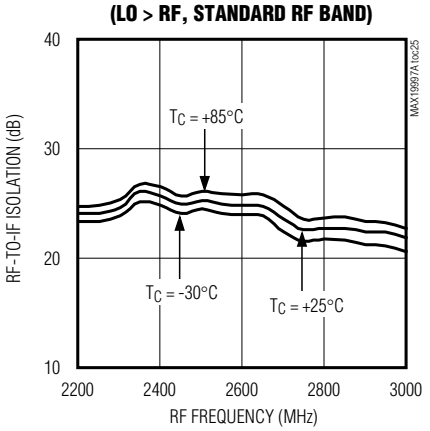

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



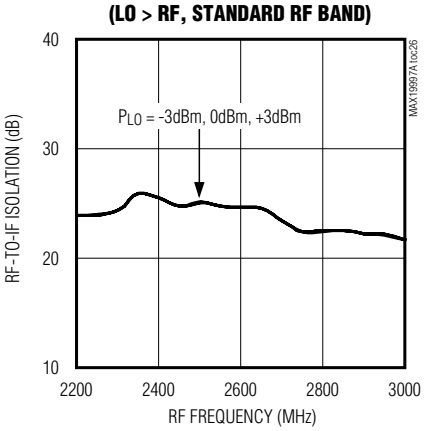

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



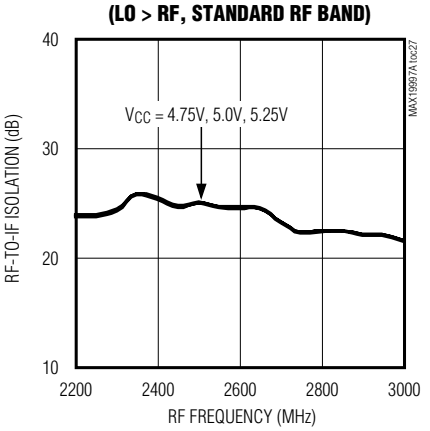

**RF-TO-IF ISOLATION vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**




**RF-TO-IF ISOLATION vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



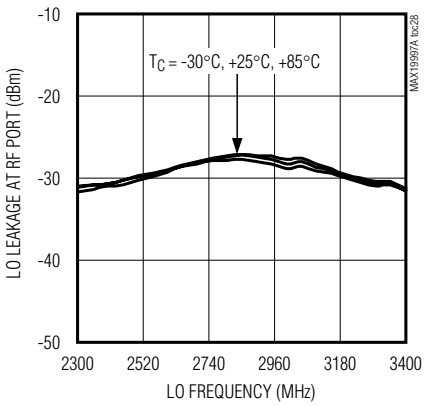

**RF-TO-IF ISOLATION vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



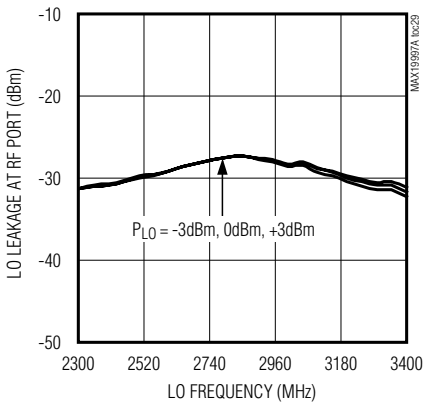
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

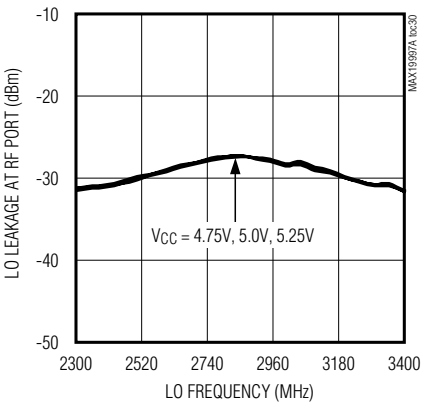
**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



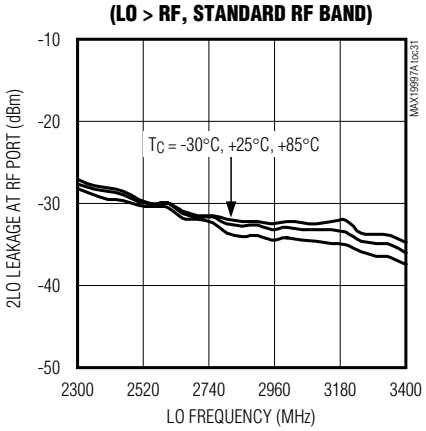

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



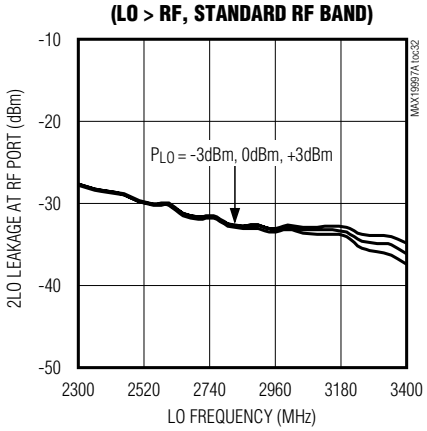

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



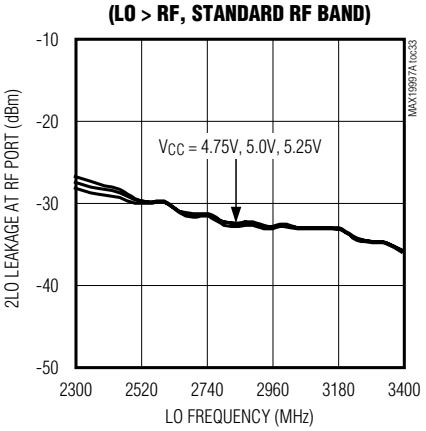

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**




**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



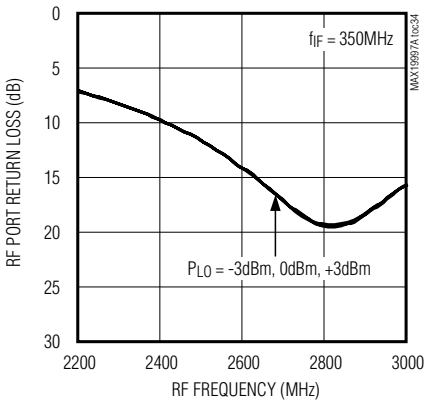

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



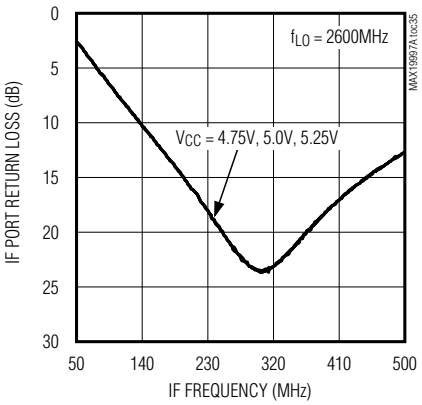
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

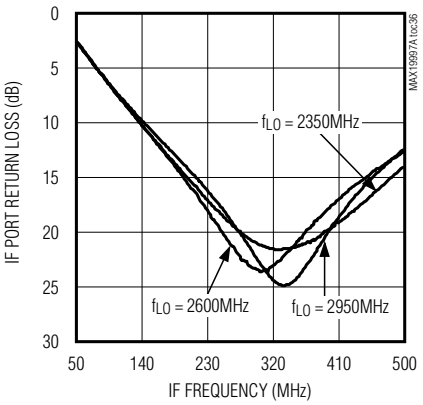
**RF PORT RETURN LOSS vs. RF FREQUENCY (LO > RF, STANDARD RF BAND)**



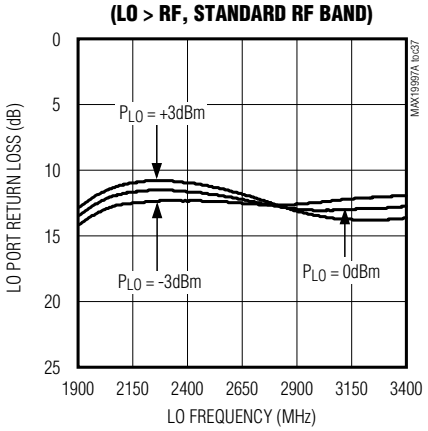

**IF PORT RETURN LOSS vs. IF FREQUENCY (LO > RF, STANDARD RF BAND)**



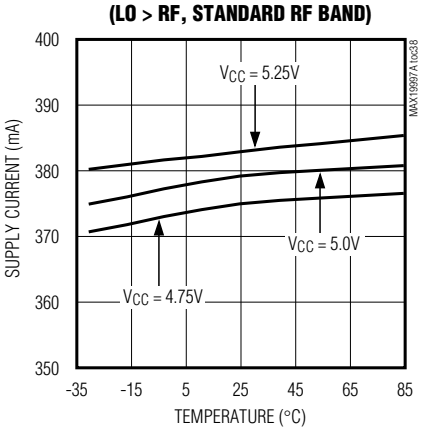

**IF PORT RETURN LOSS vs. IF FREQUENCY (LO > RF, STANDARD RF BAND)**




**LO PORT RETURN LOSS vs. LO FREQUENCY (LO > RF, STANDARD RF BAND)**



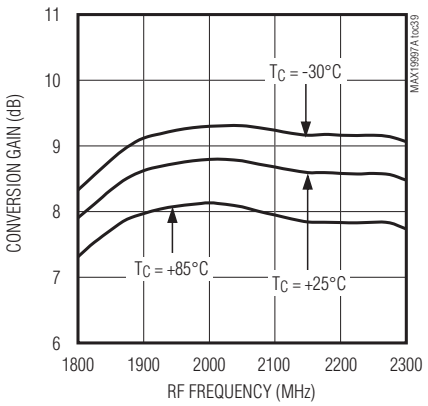

**SUPPLY CURRENT vs. TEMPERATURE ($T_C$) (LO > RF, STANDARD RF BAND)**



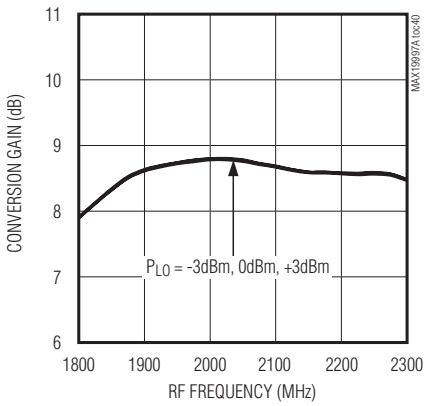
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **extended RF band (see Table 2), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

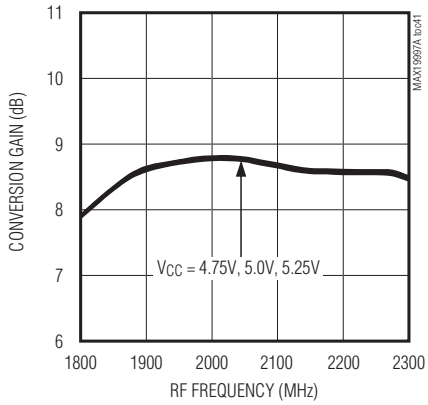
**CONVERSION GAIN vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



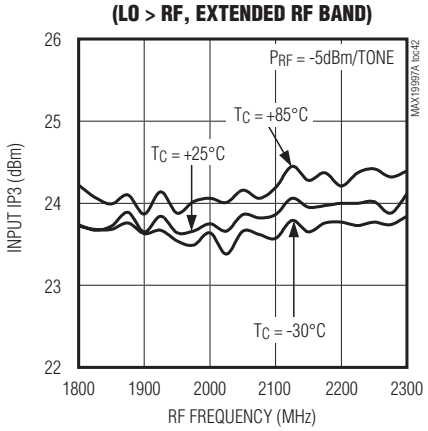

**CONVERSION GAIN vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



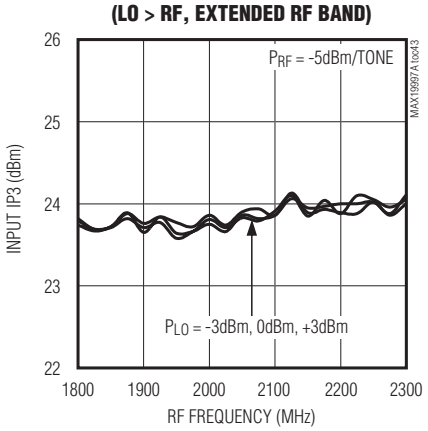

**CONVERSION GAIN vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



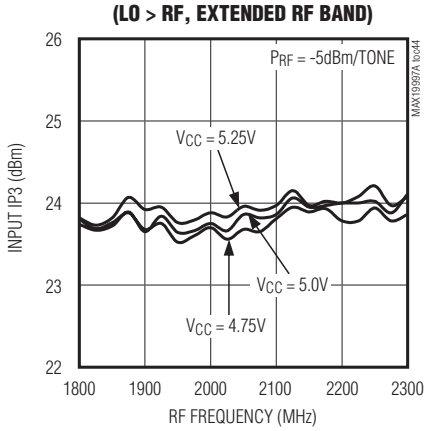

**INPUT IP3 vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



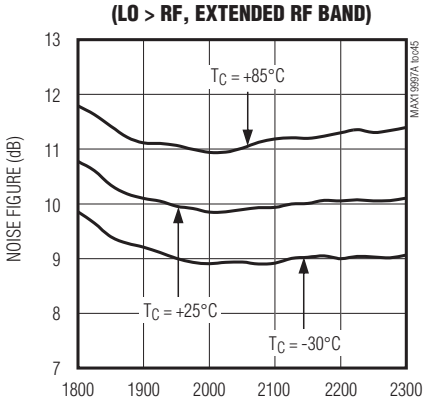

**INPUT IP3 vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



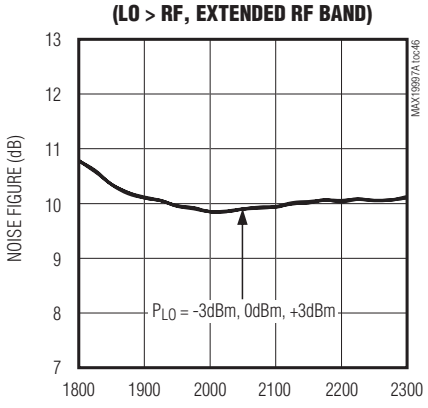

**INPUT IP3 vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



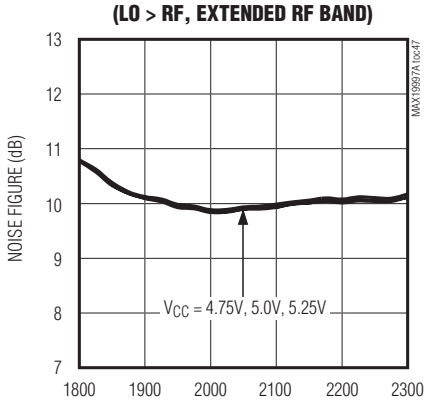

**NOISE FIGURE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**




**NOISE FIGURE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



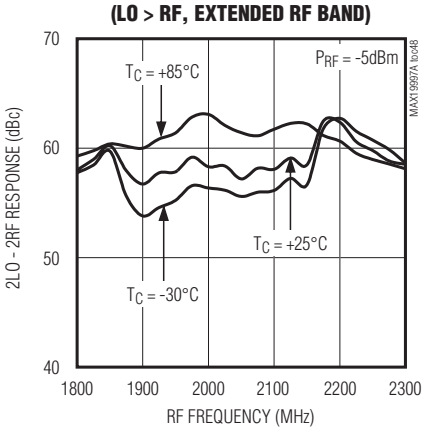

**NOISE FIGURE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



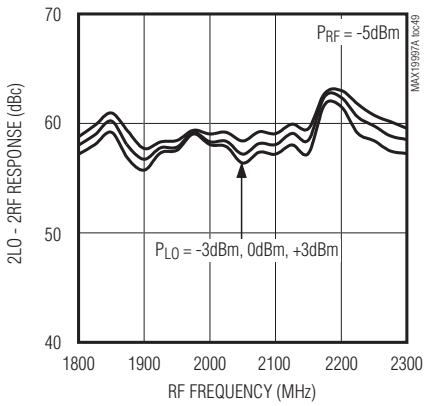
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **extended RF band (see Table 2), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

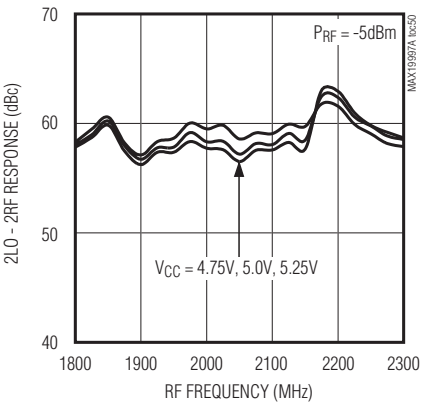
**2LO - 2RF RESPONSE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



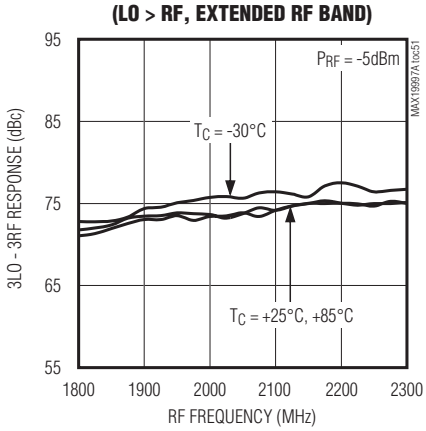

**2LO - 2RF RESPONSE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



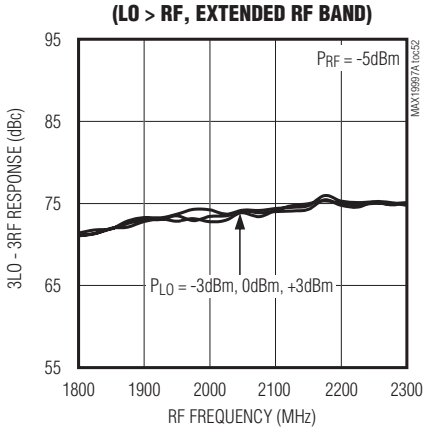

**2LO - 2RF RESPONSE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



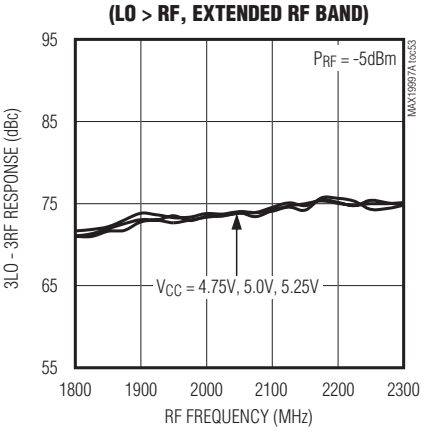

**3LO - 3RF RESPONSE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



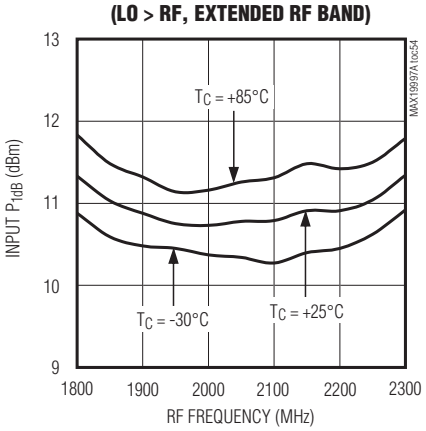

**3LO - 3RF RESPONSE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



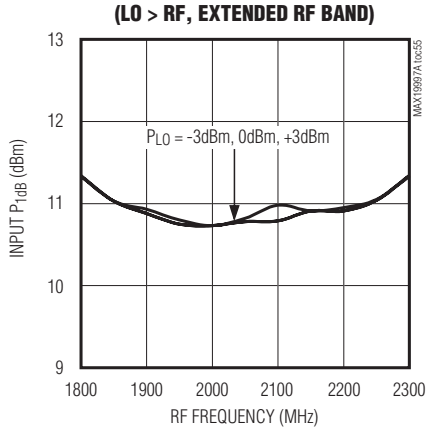

**3LO - 3RF RESPONSE vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



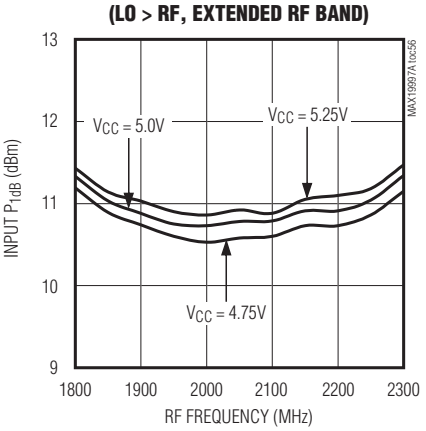

**INPUT $P_{1dB}$ vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**




**INPUT $P_{1dB}$ vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



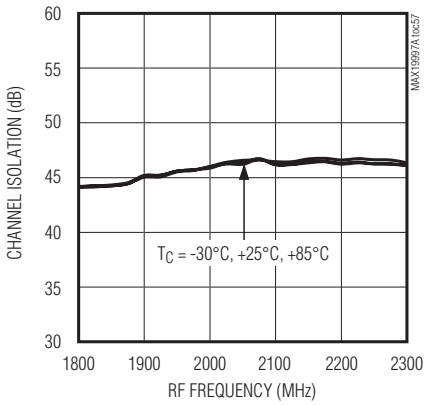

**INPUT $P_{1dB}$ vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



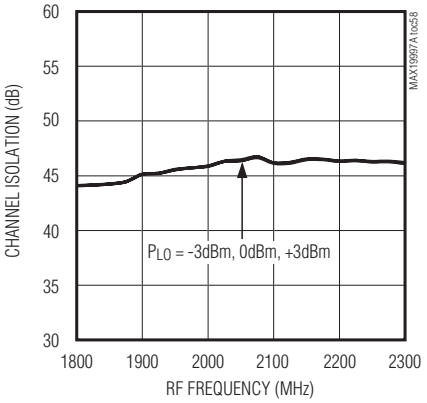
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **extended RF band (see Table 2), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

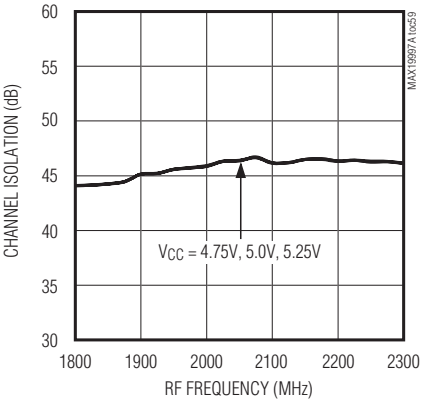
**CHANNEL ISOLATION vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



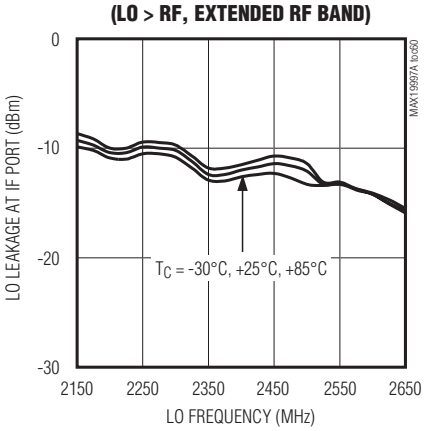

**CHANNEL ISOLATION vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



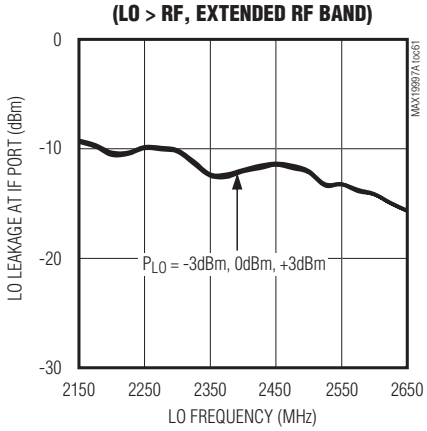

**CHANNEL ISOLATION vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



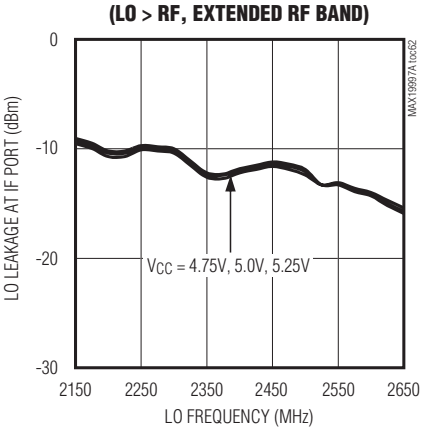

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**



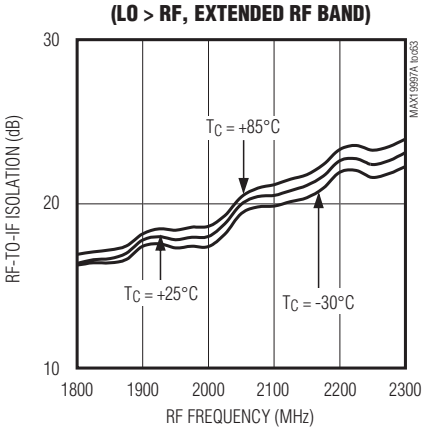

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**



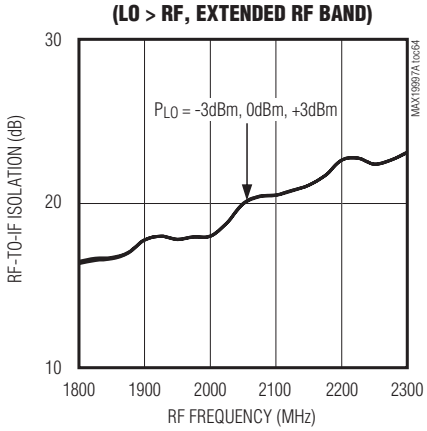

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**



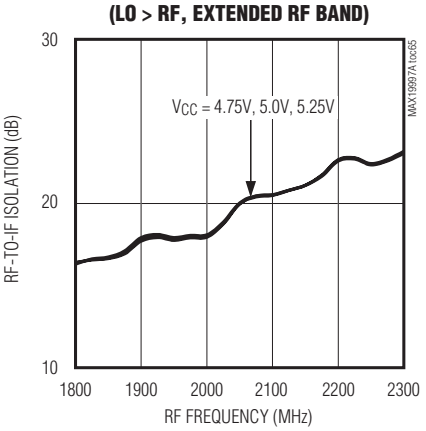

**RF-TO-IF ISOLATION vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**




**RF-TO-IF ISOLATION vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



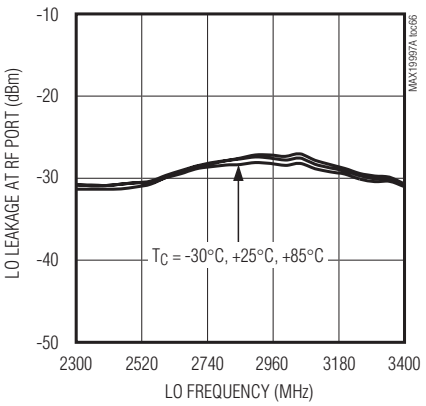

**RF-TO-IF ISOLATION vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



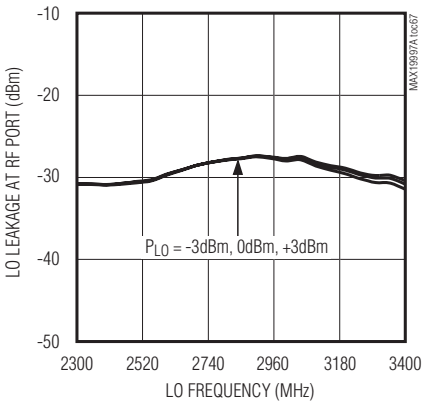
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **extended RF band (see Table 2), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

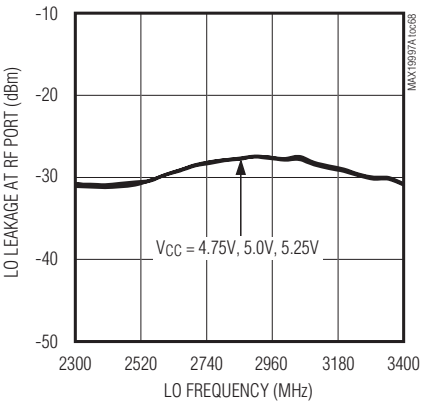
**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**



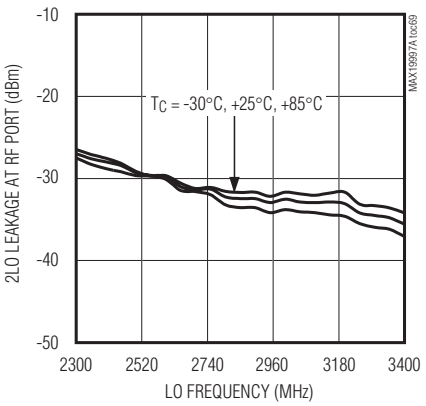

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**



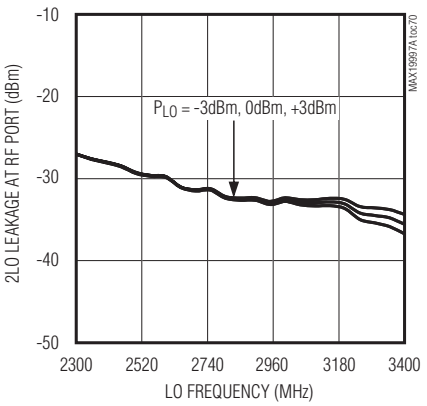

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**



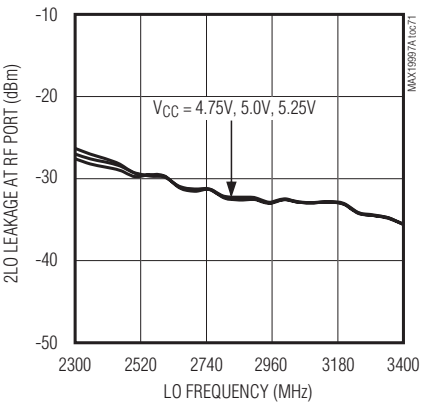

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**




**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**



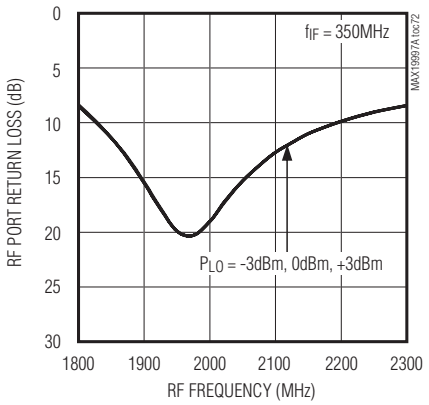

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**



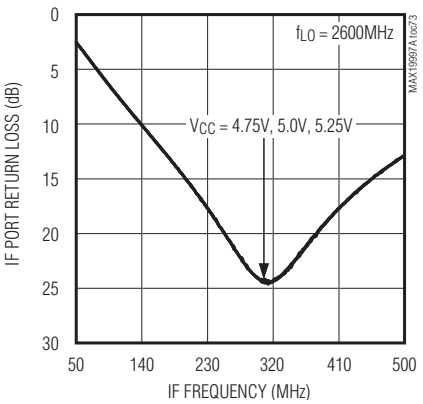
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **extended RF band (see Table 2), $V_{CC}$ = 5.0V, LO is high-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

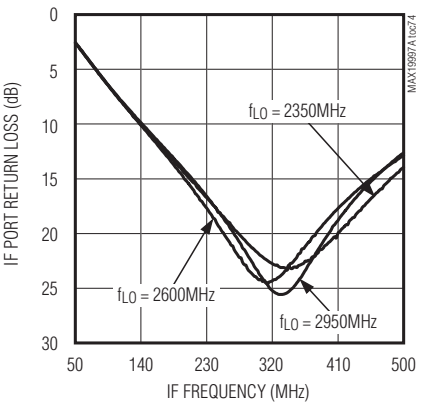
**RF PORT RETURN LOSS vs. RF FREQUENCY (LO > RF, EXTENDED RF BAND)**



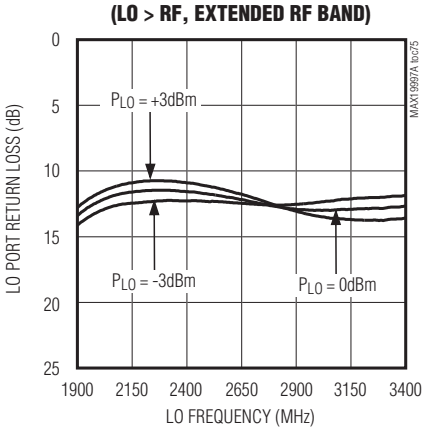

**IF PORT RETURN LOSS vs. IF FREQUENCY (LO > RF, EXTENDED RF BAND)**



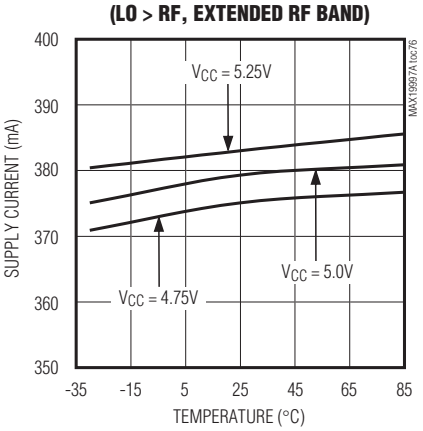

**IF PORT RETURN LOSS vs. IF FREQUENCY (LO > RF, EXTENDED RF BAND)**




**LO PORT RETURN LOSS vs. LO FREQUENCY (LO > RF, EXTENDED RF BAND)**




**SUPPLY CURRENT vs. TEMPERATURE ($T_C$) (LO > RF, EXTENDED RF BAND)**

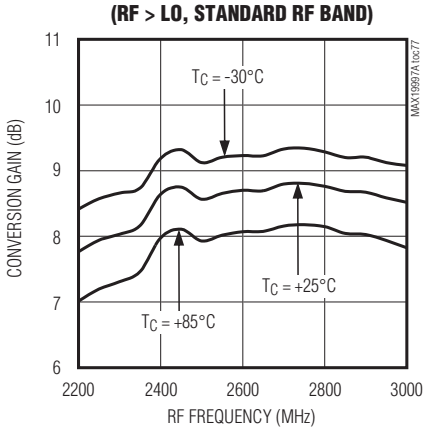


# Dual, SiGe High-Linearity, 1800MHz to 2900MHz Downconversion Mixer with LO Buffer

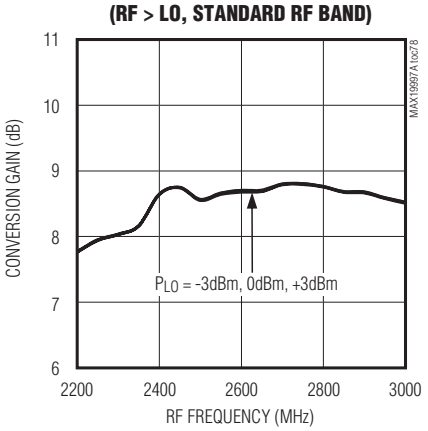
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is low-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

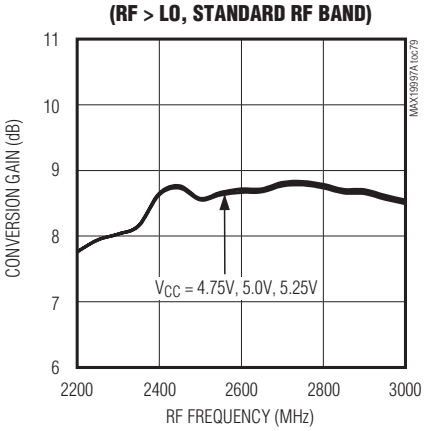
**CONVERSION GAIN vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



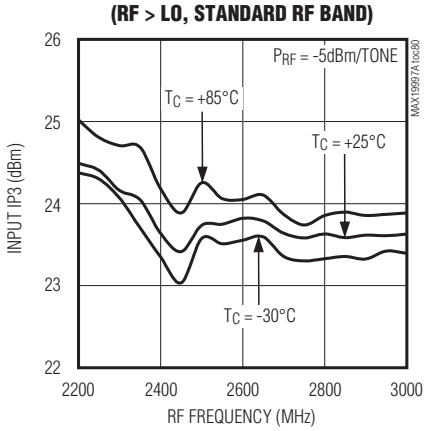

**CONVERSION GAIN vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



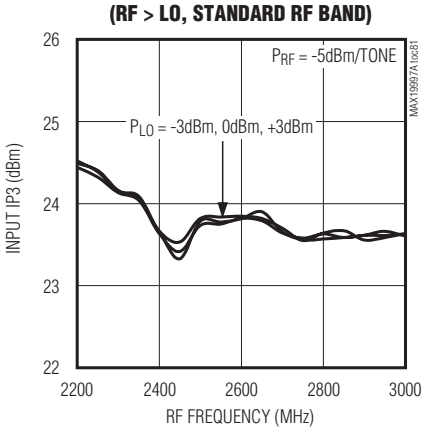

**CONVERSION GAIN vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



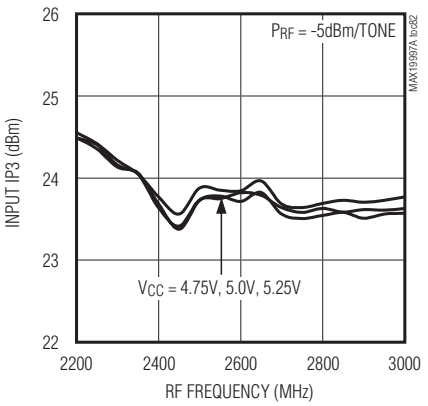

**INPUT IP3 vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



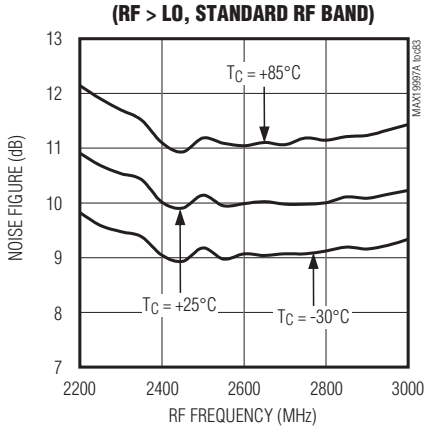

**INPUT IP3 vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



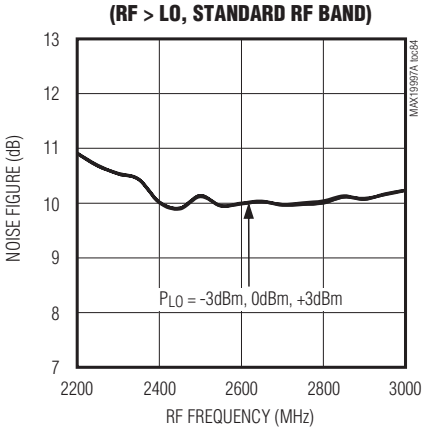

**INPUT IP3 vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



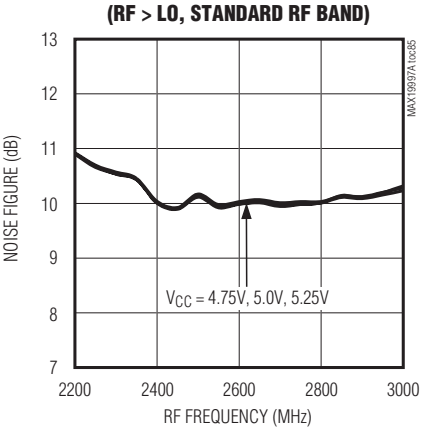

**NOISE FIGURE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**




**NOISE FIGURE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



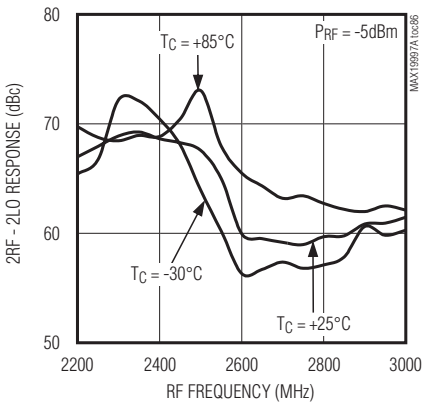

**NOISE FIGURE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



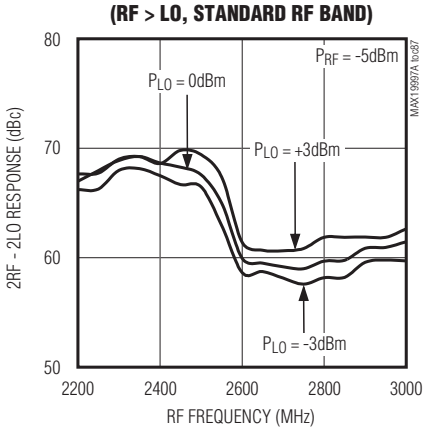
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is low-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

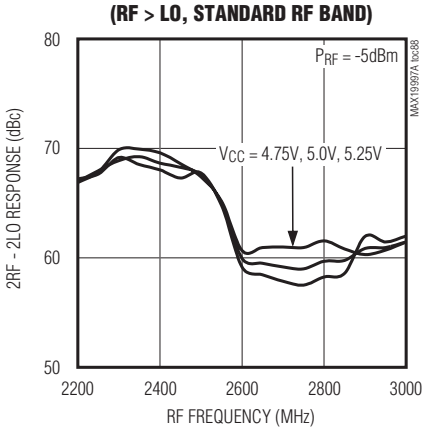
**2RF - 2LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



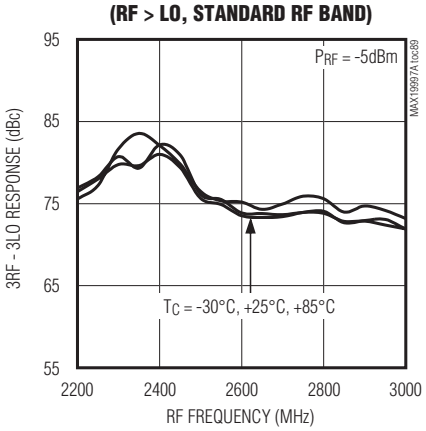

**2RF - 2LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



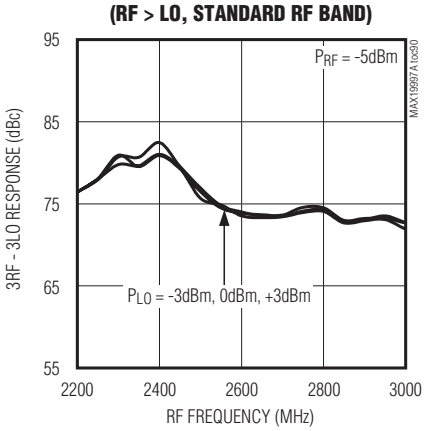

**2RF - 2LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



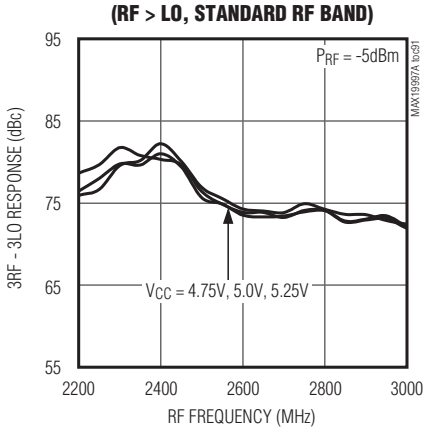

**3RF - 3LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



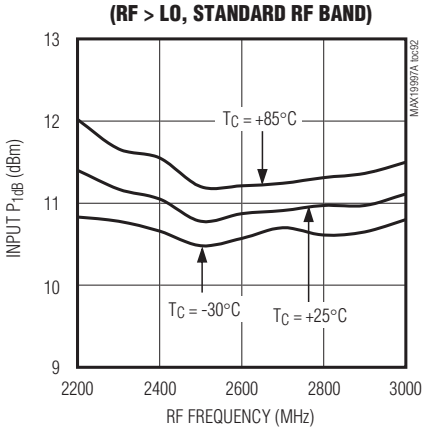

**3RF - 3LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



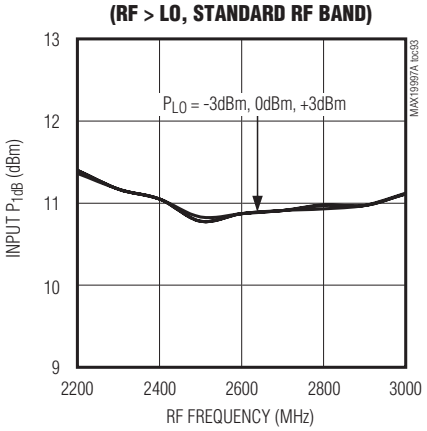

**3RF - 3LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



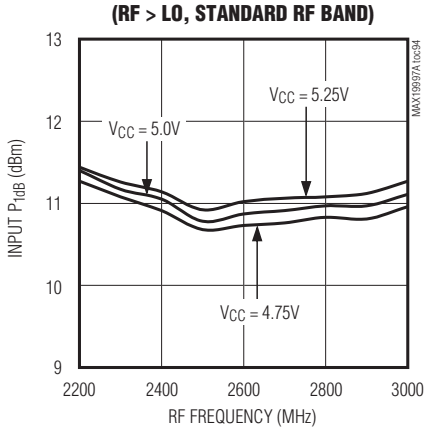

**INPUT $P_{1dB}$ vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**




**INPUT $P_{1dB}$ vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



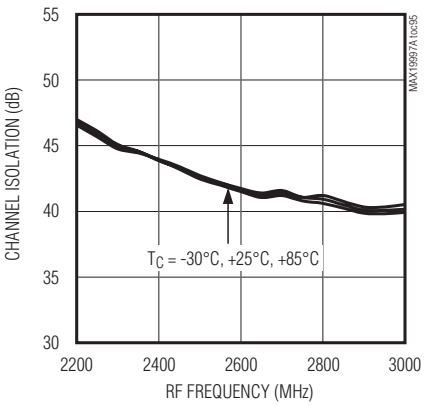

**INPUT $P_{1dB}$ vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



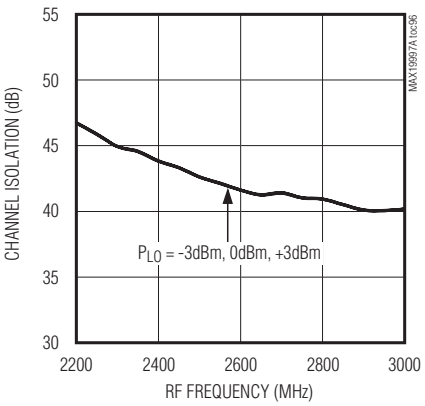
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is low-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

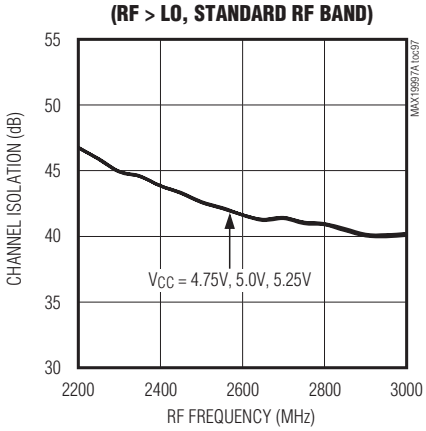
**CHANNEL ISOLATION vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



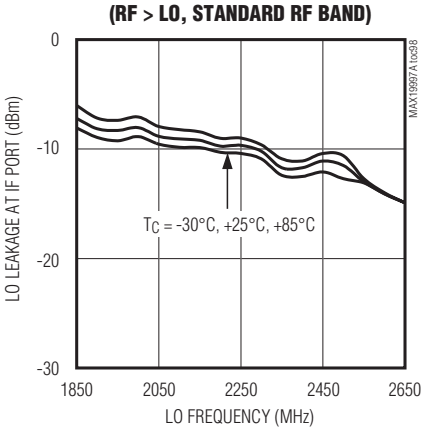

**CHANNEL ISOLATION vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



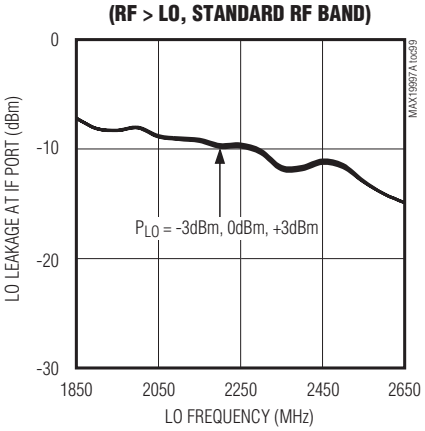

**CHANNEL ISOLATION vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



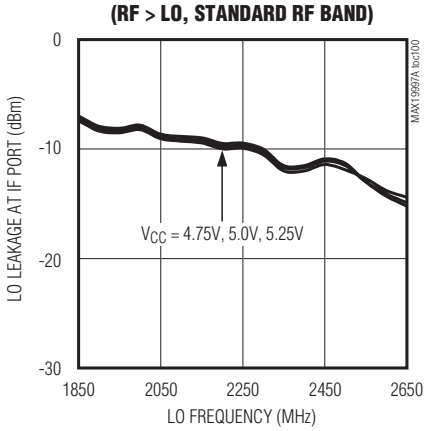

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



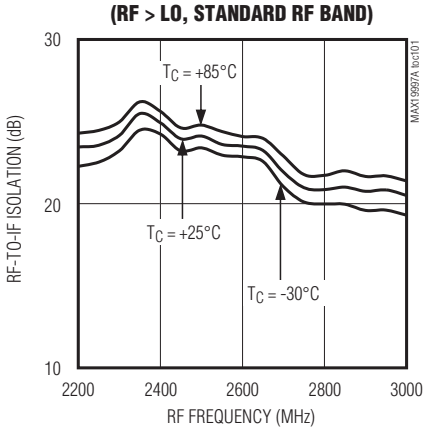

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



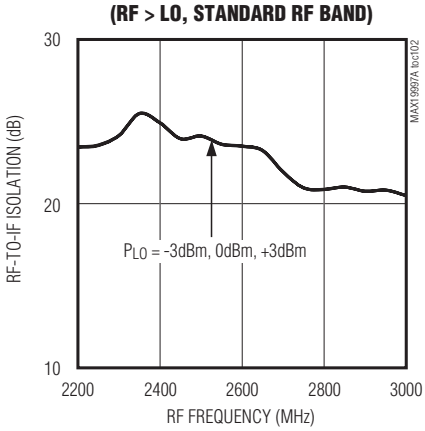

**LO LEAKAGE AT IF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



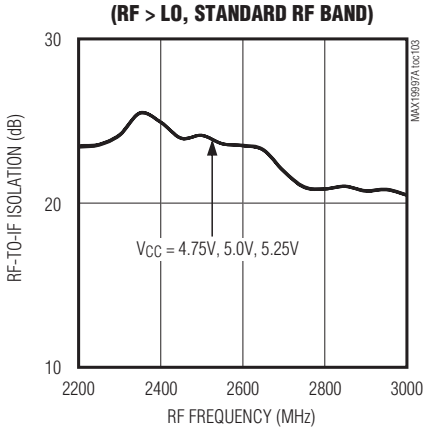

**RF-TO-IF ISOLATION vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**




**RF-TO-IF ISOLATION vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



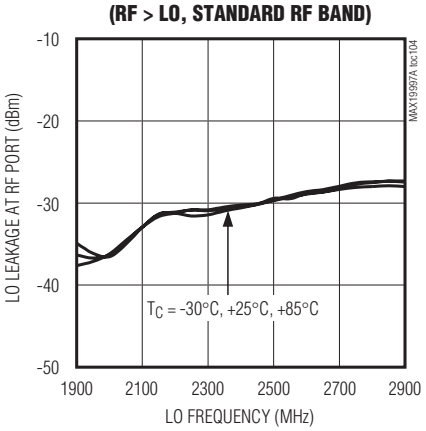

**RF-TO-IF ISOLATION vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



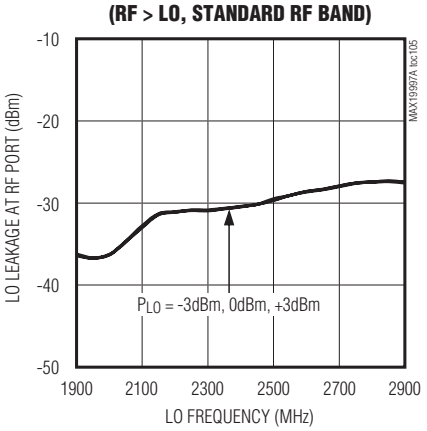
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is low-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

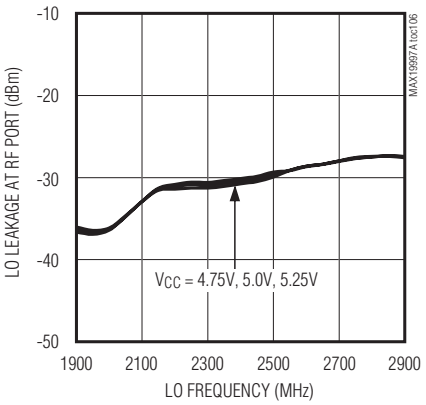
**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



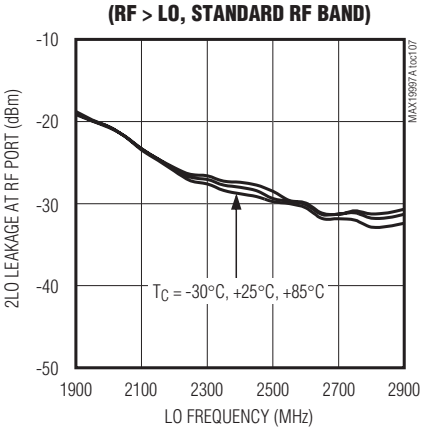

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



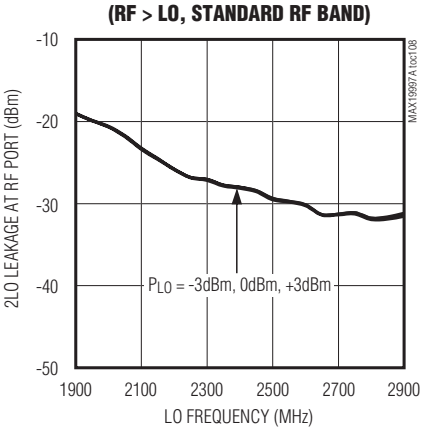

**LO LEAKAGE AT RF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



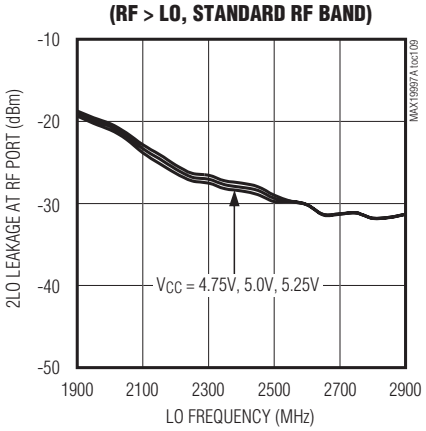

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**




**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



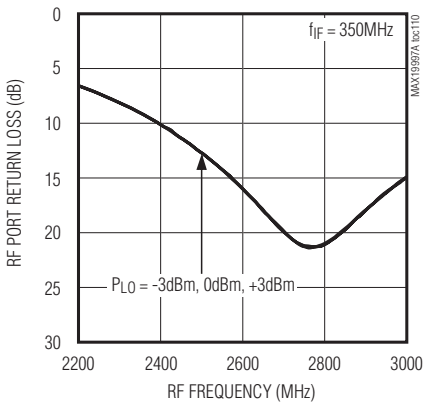

**2LO LEAKAGE AT RF PORT vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



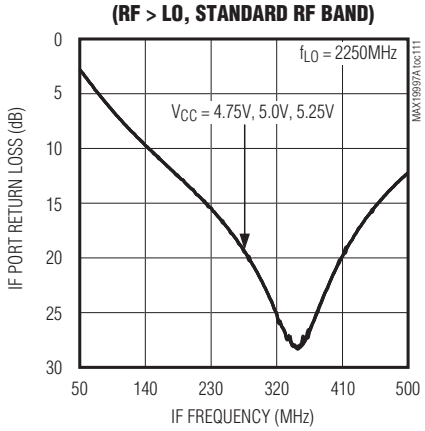
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 5.0V, LO is low-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

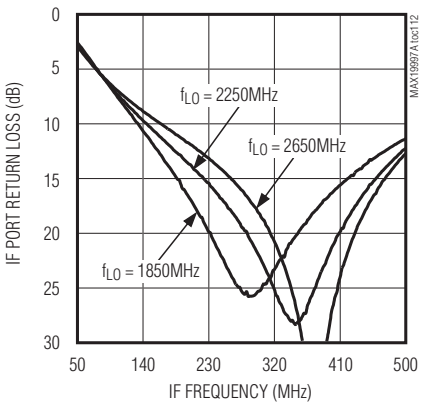
**RF PORT RETURN LOSS vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



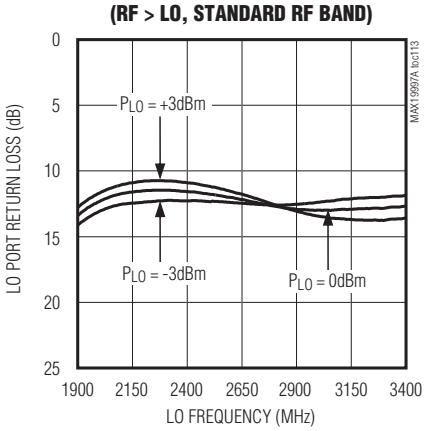

**IF PORT RETURN LOSS vs. IF FREQUENCY (RF > LO, STANDARD RF BAND)**



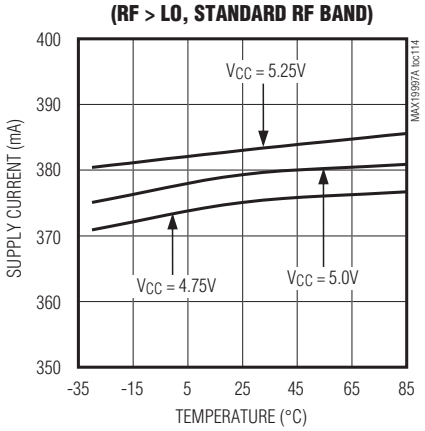

**IF PORT RETURN LOSS vs. IF FREQUENCY (RF > LO, STANDARD RF BAND)**




**LO PORT RETURN LOSS vs. LO FREQUENCY (RF > LO, STANDARD RF BAND)**



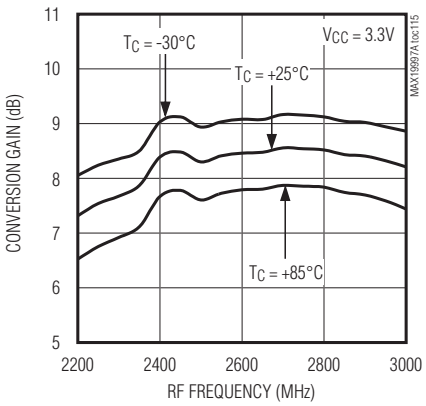

**SUPPLY CURRENT vs. TEMPERATURE ($T_C$) (RF > LO, STANDARD RF BAND)**



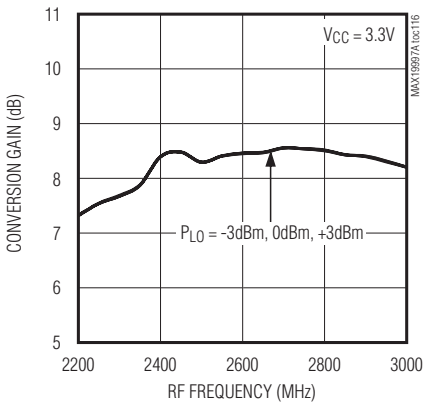
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 3.3V, LO is low-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

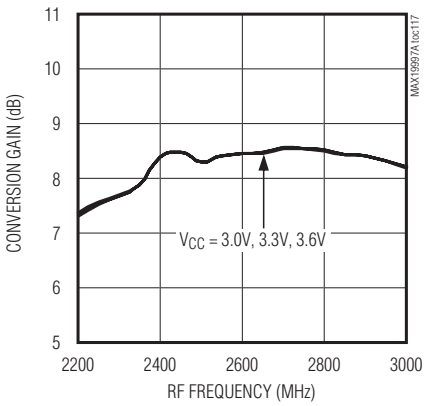
**CONVERSION GAIN vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



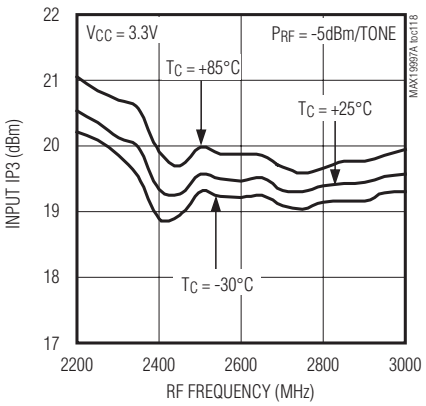

**CONVERSION GAIN vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



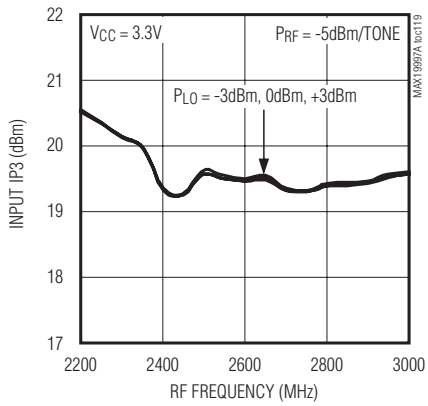

**CONVERSION GAIN vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



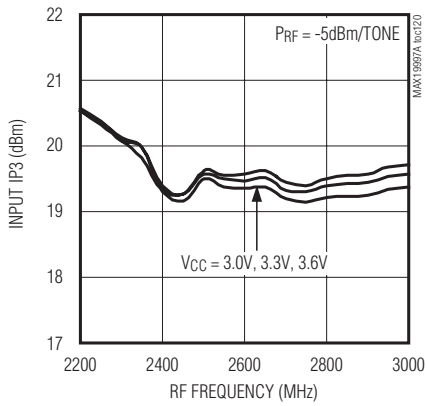

**INPUT IP3 vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



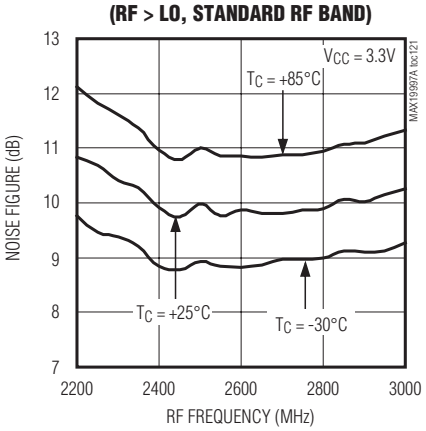

**INPUT IP3 vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



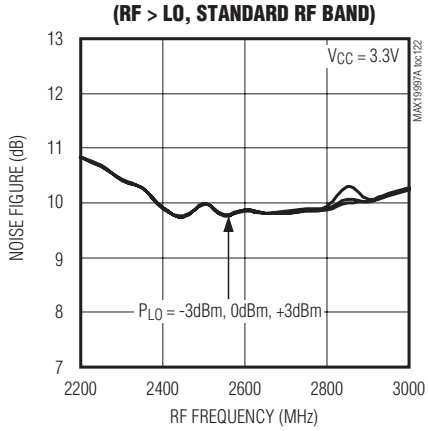

**INPUT IP3 vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



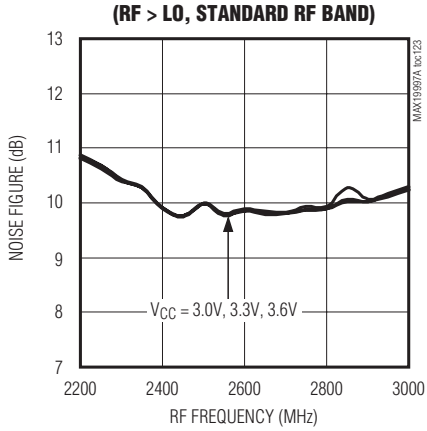

**NOISE FIGURE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**




**NOISE FIGURE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



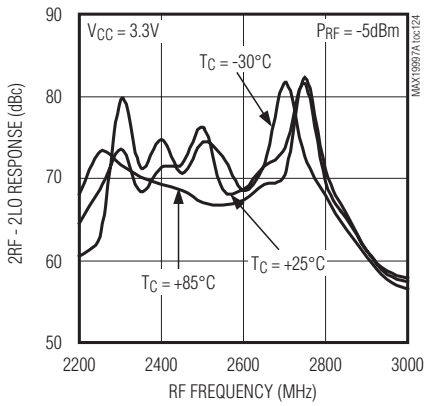

**NOISE FIGURE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



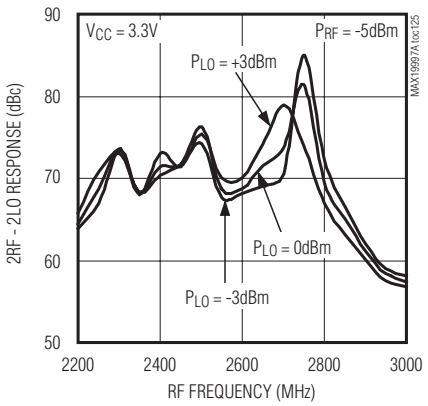
## Typical Operating Characteristics (continued)

(*Typical Application Circuit*, **standard RF band (see Table 1), $V_{CC}$ = 3.3V, LO is low-side injected** for a 350MHz IF, $P_{LO}$ = 0dBm, $P_{RF}$ = -5dBm, $T_C$ = +25°C, unless otherwise noted.)

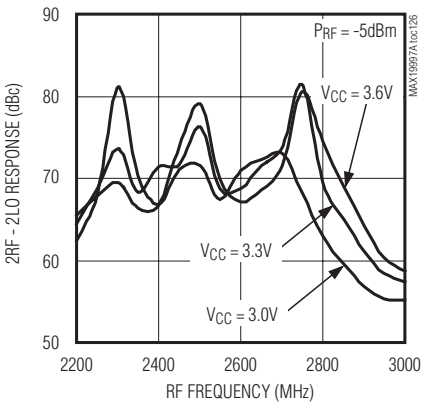
**2RF - 2LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



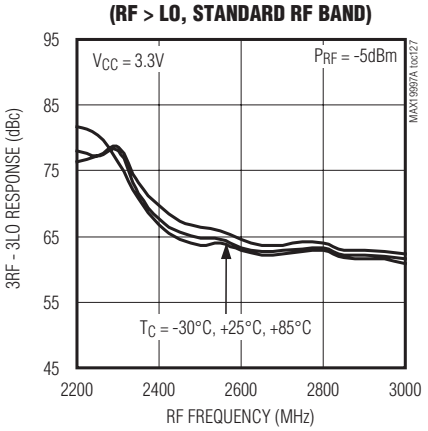

**2RF - 2LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



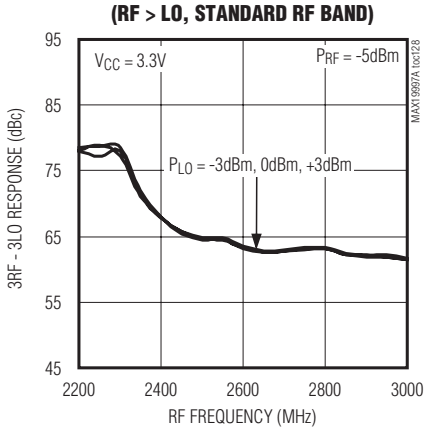

**2RF - 2LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



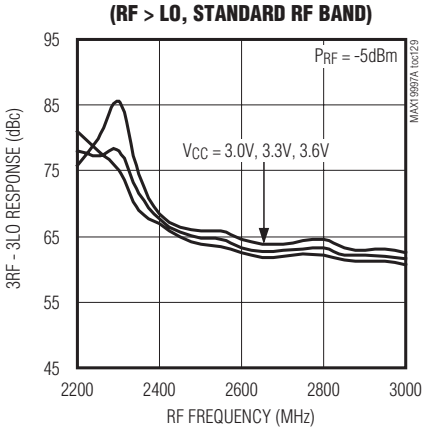

**3RF - 3LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



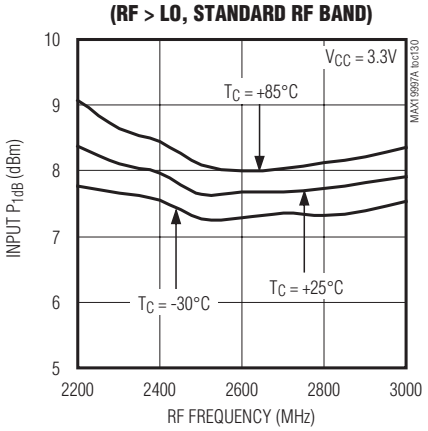

**3RF - 3LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**



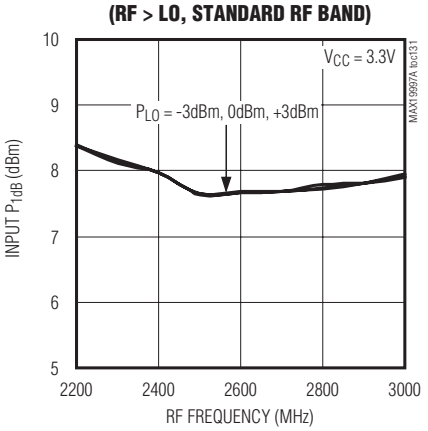

**3RF - 3LO RESPONSE vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**




**INPUT $P_{1dB}$ vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**




**INPUT $P_{1dB}$ vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**




**INPUT $P_{1dB}$ vs. RF FREQUENCY (RF > LO, STANDARD RF BAND)**