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MAXIM

SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

General Description

The MAX2044 single, high-linearity upconversion/downconversion mixer provides +32.5dBm input IP3, 8.5dB noise figure, and 7.7dB conversion loss for 2300MHz to 4000MHz LTE, WiMAX™, and MMDS wireless infrastructure applications. With an ultra-wide 2600MHz to 4300MHz LO frequency range, the MAX2044 can be used in either low-side or high-side LO injection architectures for virtually all 2.5GHz and 3.5GHz applications.

In addition to offering excellent linearity and noise performance, the MAX2044 also yields a high level of component integration. This device includes a double-balanced passive mixer core, an LO buffer, and on-chip baluns that allow for single-ended RF and LO inputs. The MAX2044 requires a nominal LO drive of 0dBm, and supply current is typically 138mA at V_{CC} = 5.0V or 121mA at V_{CC} = 3.3V.

The MAX2044 is pin similar with the MAX2029/MAX2031 650MHz to 1000MHz mixers and the MAX2039/MAX2041/MAX2042 1700MHz to 3000MHz mixers, making this entire family of up/downconverters ideal for applications where a common PCB layout is used for multiple frequency bands.

The MAX2044 is available in a compact 20-pin thin QFN (5mm x 5mm) package with an exposed pad. Electrical performance is guaranteed over the extended -40°C to +85°C temperature range.

Applications

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

- **2300MHz to 4000MHz RF Frequency Range**
- **2600MHz to 4300MHz LO Frequency Range**
- **50MHz to 500MHz IF Frequency Range**
- **7.7dB Conversion Loss**
- **8.5dB Noise Figure**
- **+32.5dBm Typical Input IP3**
- **21dBm Typical Input 1dB Compression Point**
- **68dBc Typical 2RF - 2LO 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 Similar with the MAX2029/MAX2031 Series of 650MHz to 1000MHz Mixers and the MAX2039/MAX2041/MAX2042 Series of 1700MHz to 3000MHz Mixers**
- **Single 5.0V or 3.3V Supply**
- **External Current-Setting Resistor Provides Option for Operating Device in Reduced-Power/Reduced-Performance Mode**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX2044ETP+	-40°C to +85°C	20 Thin QFN-EP*
MAX2044ETP+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.

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SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND.....-0.3V to +5.5V
IF+, IF-, LOBIAS to GND..... -0.3V to (V_{CC} + 0.3V)
RF, LO Input Power..... +20dBm
RF, LO Current (RF and LO is DC shorted to GND through a balun)..... .....50mA
Continuous Power Dissipation (Note 1).....5W
θ_{JA} (Notes 2, 3)..... +38°C/W
θ_{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 RF or LO 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}			138	155	mA

3.3V SUPPLY DC ELECTRICAL CHARACTERISTICS

(Typical Application Circuit, V_{CC} = 3.0V to 3.6V, no input RF or LO 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, 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		121	135	mA

RECOMMENDED AC OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RF Frequency Range	f_{RF}	*Typical Application Circuit* with C1 = 3.3nH and C12 = 0.3pF, see Table 1 for details (Note 5)	2300		3000	MHz
		Typical Application Circuit with C1 = 8.2pF and C12 not installed, see Table 1 for details (Note 5)	3000		4000	
LO Frequency	f_{LO}	(Note 5)	2600		4300	MHz
IF Frequency	f_{IF}	Using an M/A-Com MABAES0029 1:1 transformer as defined in the *Typical Application Circuit*, IF matching components affect the IF frequency range (Note 5)	50		500	MHz
LO Drive	P_{LO}	(Note 5)	-3	0	+3	dBm

5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS (DOWNCONVERTER MODE, 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} = 0dBm, f_{RF} = 3100MHz to 3900MHz, f_{LO} = 2800MHz to 3600MHz, f_{IF} = 300MHz, $f_{RF} > f_{LO}$, T_C = -40°C to +85°C. Typical values are at V_{CC} = 5.0V, P_{RF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 3500MHz, f_{LO} = 3200MHz, f_{IF} = 300MHz, T_C = +25°C. All parameters are guaranteed by design, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Conversion Loss	L_C	T_C = +25°C (Notes 7, 8)		7.2	7.7	8.5	dB
Loss Variation vs. Frequency	ΔL_C	f_{RF} = 3100MHz to 3900MHz, over any 100MHz band			0.15		dB
		f_{RF} = 3100MHz to 3900MHz, over any 200MHz band			0.25		
Conversion Loss Temperature Coefficient	TC_{CL}	f_{RF} = 3100MHz to 3900MHz, T_C = -40°C to +85°C			0.01		dB/°C
Input Compression Point	IP_{1dB}	(Note 9)			21		dBm
Third-Order Input Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone (Note 7, 8)		28.3	32.5		dBm
		f_{RF} = 3500MHz, f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone. T_C = +25°C (Notes 7, 8)		30.0	32.5		
Third-Order Input Intercept Point Variation Over Temperature		f_{RF} = 3100MHz to 3900MHz, f_{IF} = 300MHz, f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone, T_C = -40°C to +85°C			±0.5		dBm
Noise Figure	NF_{SSB}	Single sideband, no blockers present (Notes 7, 10)			8.5	10	dB
		Single sideband, no blockers present, T_C = +25°C (Notes 7, 10)			8.5	9.2	
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	+8dBm blocker tone applied to RF port, $f_{BLOCKER}$ = 3750MHz, f_{RF} = 3500MHz, f_{LO} = 3200MHz, P_{LO} = 0dBm, V_{CC} = 5.0V, T_C = +25°C (Notes 7, 10, 11)			17.5	20	dB
2RF - 2LO Spurious Rejection	2 x 2	f_{SPUR} = f_{LO} + 150MHz, T_C = +25°C	P_{RF} = -10dBm (Notes 7, 10)	62	68		dBc
			P_{RF} = 0dBm (Notes 7, 8)	52	58		
		f_{SPUR} = f_{LO} + 150MHz	P_{RF} = -10dBm (Notes 7, 10)	60	68		
			P_{RF} = 0dBm (Notes 7, 8)	50	58		

SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS (DOWNCONVERTER MODE, 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} = 0dBm, f_{RF} = 3100MHz to 3900MHz, f_{LO} = 2800MHz to 3600MHz, f_{IF} = 300MHz, $f_{RF} > f_{LO}$, T_C = -40°C to +85°C. Typical values are at V_{CC} = 5.0V, P_{RF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 3500MHz, f_{LO} = 3200MHz, f_{IF} = 300MHz, T_C = +25°C. All parameters are guaranteed by design, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
3RF - 3LO Spurious Rejection	3 x 3	$f_{SPUR} = f_{LO}$ + 100MHz, T_C = +25°C	P_{RF} = -10dBm (Notes 7, 10)	82	89		dBc
			P_{RF} = 0dBm (Notes 7, 8)	62	69		
		$f_{SPUR} = f_{LO}$ + 100MHz	P_{RF} = -10dBm (Notes 7, 10)	81	89		
			P_{RF} = 0dBm (Notes 7, 8)	61	69		
RF Input Return Loss	RL_{RF}	LO on and IF terminated into a matched impedance			16		dB
LO Input Return Loss	RL_{LO}	RF and IF terminated into a matched impedance			14		dB
IF Output Impedance	Z_{IF}	Nominal differential impedance at the IC's IF outputs			50		Ω
IF Output Return Loss	RL_{IF}	RF terminated into 50Ω, LO driven by a 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*			16		dB
RF-to-IF Isolation		f_{RF} = 3500MHz, P_{LO} = +3dBm (Note 8)		33	42		dB
LO Leakage at RF Port		f_{LO} = 2500MHz to 4000MHz, P_{LO} = +3dBm (Notes 7, 8)			-31		dBm
2LO Leakage at RF Port		P_{LO} = +3dBm			-35		dBm
LO Leakage at IF Port		P_{LO} = +3dBm (Note 8)			-28		dBm

3.3V SUPPLY AC ELECTRICAL CHARACTERISTICS (DOWNCONVERTER MODE, f_{RF} = 3100MHz to 3900MHz, LOW-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 at V_{CC} = 3.3V, P_{RF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 3500MHz, f_{LO} = 3200MHz, f_{IF} = 300MHz, T_C = +25°C, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Conversion Loss	L_C				7.7		dB
Loss Variation vs. Frequency	ΔL_C	f_{RF} = 3100MHz to 3900MHz, over any 100MHz band			0.1		dB
Conversion Loss Temperature Coefficient	TC_{CL}	f_{RF} = 3100MHz to 3900MHz, T_C = -40°C to +85°C			0.009		dB/°C
Input Compression Point	IP_{1dB}	(Note 9)			19.5		dBm
Third-Order Input Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone			29.5		dBm
Third-Order Input Intercept Variation Over Temperature		f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone, T_C = -40°C to +85°C			±0.2		dB
Noise Figure	NF_{SSB}	Single sideband, no blockers present			8.5		dB
Noise Figure Temperature Coefficient	TC_{NF}	Single sideband, no blockers present, T_C = -40°C to +85°C			0.018		dB/°C
2RF - 2LO Spurious Rejection	2 x 2	f_{SPUR} = f_{LO} + 150MHz	P_{RF} = -10dBm		69		dBc
			P_{RF} = 0dBm		64		
3RF - 3LO Spurious Rejection	3 x 3	f_{SPUR} = f_{LO} + 100MHz	P_{RF} = -10dBm		73.3		dBc
			P_{RF} = 0dBm		63.3		
RF Input Return Loss	RL_{RF}	LO on and IF terminated into a matched impedance			18		dB
LO Input Return Loss	RL_{LO}	RF and IF terminated into a matched impedance			19		dB
IF Output Impedance	Z_{IF}	Nominal differential impedance at the IC's IF outputs			50		Ω
IF Output Return Loss	RL_{IF}	RF terminated into 50Ω, LO driven by a 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*			14.5		dB
RF-to-IF Isolation		f_{RF} = 3100MHz to 3900MHz, P_{LO} = +3dBm			41		dB
LO Leakage at RF Port		f_{LO} = 2800MHz to 3600MHz, P_{LO} = +3dBm			-30		dBm
2LO Leakage at RF Port		f_{LO} = 2800MHz to 3600MHz, P_{LO} = +3dBm			-25.6		dBm
LO Leakage at IF Port		f_{LO} = 2800MHz to 3600MHz, P_{LO} = +3dBm			-27		dBm

SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS (DOWNCONVERTER MODE, 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 at V_{CC} = 5.0V, P_{RF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 2600MHz, f_{LO} = 2900MHz, f_{IF} = 300MHz, T_C = +25°C, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Conversion Loss	L_C				8.1		dB
Loss Variation vs. Frequency	ΔL_C	f_{RF} = 2300MHz to 2900MHz, over any 100MHz band			0.15		dB
Conversion Loss Temperature Coefficient	TC_{CL}	f_{RF} = 2300MHz to 2900MHz, T_C = -40°C to +85°C			0.008		dB/°C
Third-Order Input Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone			34		dBm
Third-Order Input Intercept Variation Over Temperature		f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone, T_C = -40°C to +85°C			±0.2		dB
2LO - 2RF Spurious Rejection	2 x 2	$f_{SPUR} = f_{LO}$ - 150MHz	P_{RF} = -10dBm		67		dBc
			P_{RF} = 0dBm		62		
3LO - 3RF Spurious Rejection	3 x 3	$f_{SPUR} = f_{LO}$ - 100MHz	P_{RF} = -10dBm		79		dBc
			P_{RF} = 0dBm		69		
RF Input Return Loss	RL_{RF}	LO on and IF terminated into a matched impedance			23		dB
LO Input Return Loss	RL_{LO}	RF and IF terminated into a matched impedance			17		dB
IF Output Impedance	Z_{IF}	Nominal differential impedance at the IC's IF outputs			50		Ω
IF Output Return Loss	RL_{IF}	RF terminated into 50Ω, LO driven by a 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*			13.6		dB
RF-to-IF Isolation		f_{RF} = 2300MHz to 2900MHz, P_{LO} = +3dBm			39		dB
LO Leakage at RF Port		f_{LO} = 2600MHz to 3200MHz, P_{LO} = +3dBm			-29.5		dBm
2LO Leakage at RF Port		f_{LO} = 2600MHz to 3200MHz, P_{LO} = +3dBm			-43		dBm
LO Leakage at IF Port		f_{LO} = 2600MHz to 3200MHz, P_{LO} = +3dBm			-28.6		dBm

5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS (DOWNCONVERTER MODE, f_{RF} = 3100MHz to 3900MHz, 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 at V_{CC} = 5.0V, P_{RF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 3500MHz, f_{LO} = 3800MHz, f_{IF} = 300MHz, T_C = +25°C, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Conversion Loss	L_C				7.8		dB
Loss Variation vs. Frequency	ΔL_C	f_{RF} = 3100MHz to 3900MHz, over any 100MHz band			0.15		dB
Conversion Loss Temperature Coefficient	TC_{CL}	f_{RF} = 3100MHz to 3900MHz, T_C = -40°C to +85°C			0.008		dB/°C
Third-Order Input Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone			31.5		dBm
Third-Order Input Intercept Variation Over Temperature		f_{RF1} - f_{RF2} = 1MHz, P_{RF} = 0dBm per tone, T_C = -40°C to +85°C			±0.2		dB
2LO - 2RF Spurious Rejection	2 x 2	$f_{SPUR} = f_{LO}$ - 150MHz	P_{RF} = -10dBm		67		dBc
			P_{RF} = 0dBm		62		
3LO - 3RF Spurious Rejection	3 x 3	$f_{SPUR} = f_{LO}$ - 100MHz	P_{RF} = -10dBm		76.7		dBc
			P_{RF} = 0dBm		66.7		
RF Input Return Loss	RL_{RF}	LO on and IF terminated into a matched impedance			17.7		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			50		Ω
IF Output Return Loss	RL_{IF}	RF terminated into 50Ω, LO driven by a 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*			15		dB
RF-to-IF Isolation		f_{RF} = 3100MHz to 3900MHz, P_{LO} = +3dBm			41		dB
LO Leakage at RF Port		f_{LO} = 3400MHz to 4200MHz, P_{LO} = +3dBm			-30		dBm
2LO Leakage at RF Port		f_{LO} = 3400MHz to 4200MHz, P_{LO} = +3dBm			-21		dBm
LO Leakage at IF Port		f_{LO} = 3400MHz to 4200MHz, P_{LO} = +3dBm			-27.2		dBm

SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS (UPCONVERTER OPERATION, f_{RF} = 3100MHz to 3900MHz, LOW-SIDE LO INJECTION)

(*Typical Application Circuit* with tuning elements outlined in **Table 2**, RF and LO ports are driven from 50Ω sources. Typical values are for T_C = +25°C, V_{CC} = 5.0V, P_{IF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 3500MHz, f_{LO} = 3300MHz, f_{IF} = 200MHz, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Loss	L_C			7.7		dB
Conversion Loss Variation vs. Frequency	ΔL_C	f_{RF} = 3100MHz to 3900MHz, over any 100MHz band		0.2		dB
		f_{RF} = 3100MHz to 3900MHz, over any 200MHz band		0.25		
Conversion Loss Temperature Coefficient	TC_{CL}	T_C = -40°C to +85°C		0.01		dB/°C
Input Third-Order Intercept Point	IIP3	f_{IF1} = 200MHz, f_{IF2} = 201MHz, P_{IF} = 0dBm/tone		33.5		dBm
IIP3 Variation with T_C		f_{IF1} = 200MHz, f_{IF2} = 201MHz, P_{IF} = 0dBm/tone, T_C = -40°C to +85°C		±0.2		dB
LO ± 2IF Spur	1 x 2	LO - 2IF		61.6		dBc
		LO + 2IF		60.2		
LO ± 3IF Spur	1 x 3	LO - 3IF		78.2		dBc
		LO + 3IF		80.3		
Output Noise Floor		P_{OUT} = 0dBm (Note 11)		-165		dBm/Hz

3.3V SUPPLY AC ELECTRICAL CHARACTERISTICS (UPCONVERTER OPERATION, f_{RF} = 3100MHz to 3900MHz, LOW-SIDE LO INJECTION)

(*Typical Application Circuit* with tuning elements outlined in **Table 2**, RF and LO ports are driven from 50Ω sources. Typical values are for T_C = +25°C, V_{CC} = 3.3V, P_{IF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 3500MHz, f_{LO} = 3200MHz, f_{IF} = 200MHz, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Loss	L_C			8		dB
Conversion Loss Variation vs. Frequency	ΔL_C	f_{RF} = 3100MHz to 3900MHz, over any 100MHz band		0.2		dB
		f_{RF} = 3100MHz to 3900MHz, over any 200MHz band		0.25		
Conversion Loss Temperature Coefficient	TC_{CL}	T_C = -40°C to +85°C		0.01		dB/°C
Input Third-Order Intercept Point	IIP3	f_{IF1} = 200MHz, f_{IF2} = 201MHz, P_{IF} = 0dBm/tone		29.5		dBm
IIP3 Variation with T_C		f_{IF1} = 200MHz, f_{IF2} = 201MHz, P_{IF} = 0dBm/tone, T_C = -40°C to +85°C		±0.2		dB

3.3V SUPPLY AC ELECTRICAL CHARACTERISTICS (UPCONVERTER OPERATION, f_{RF} = 3100MHz to 3900MHz, LOW-SIDE LO INJECTION) (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 2**, RF and LO ports are driven from 50Ω sources. Typical values are for T_C = +25°C, V_{CC} = 3.3V, P_{IF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 3500MHz, f_{LO} = 3200MHz, f_{IF} = 200MHz, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
LO ± 2IF Spur	1 x 2	LO - 2IF		58.9		dBc
		LO + 2IF		57.8		
LO ± 3IF Spur	1 x 3	LO - 3IF		69.4		dBc
		LO + 3IF		69.5		
Output Noise Floor		P_{OUT} = 0dBm (Note 11)		-165		dBm/Hz

Note 5: 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 0.5dB loss at f_{IF} = 300MHz due to the 1:1 impedance transformer. Output measurements were taken at IF outputs of the *Typical Application Circuit*.

Note 7: Guaranteed by design and characterization.

Note 8: 100% production tested for functional performance.

Note 9: Maximum reliable continuous input power applied to the RF or IF port of this device is +20dBm from a 50Ω source.

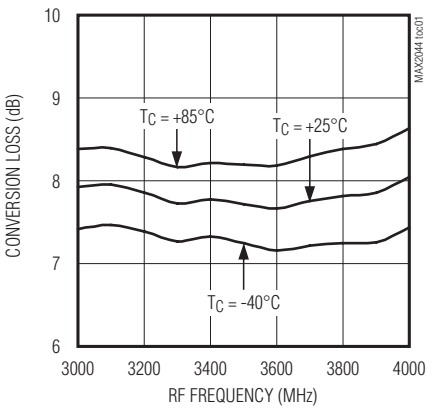
Note 10: Not production tested.

Note 11: 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*.

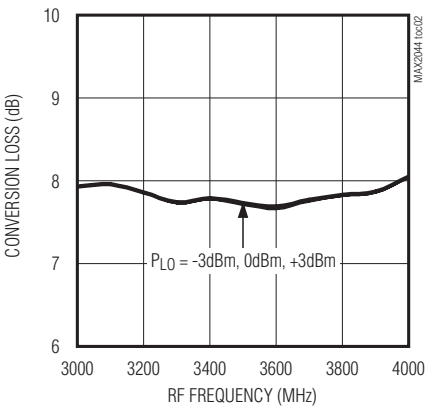
Typical Operating Characteristics

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

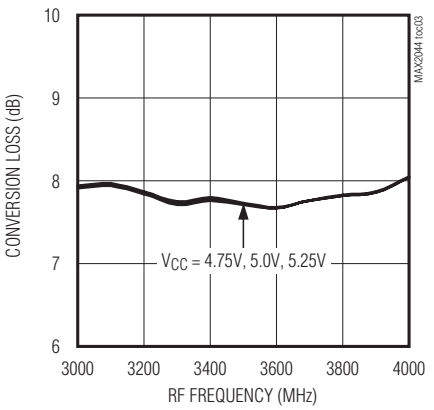
CONVERSION LOSS vs. RF FREQUENCY



CONVERSION LOSS vs. RF FREQUENCY



CONVERSION LOSS vs. RF FREQUENCY

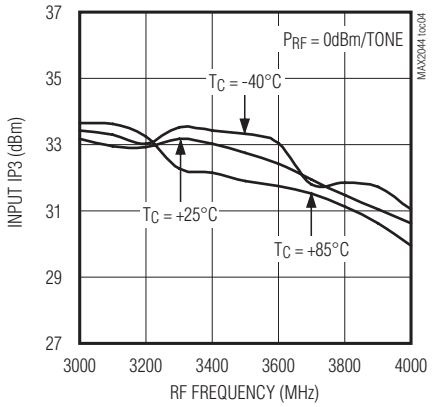


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

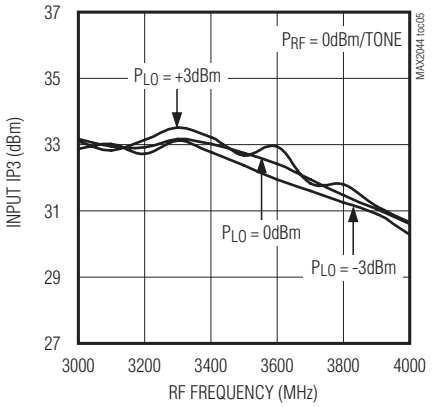
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

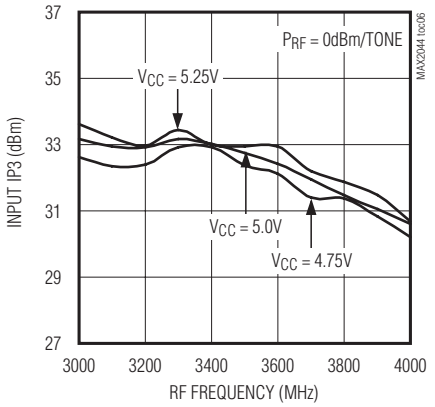
INPUT IP3 vs. RF FREQUENCY



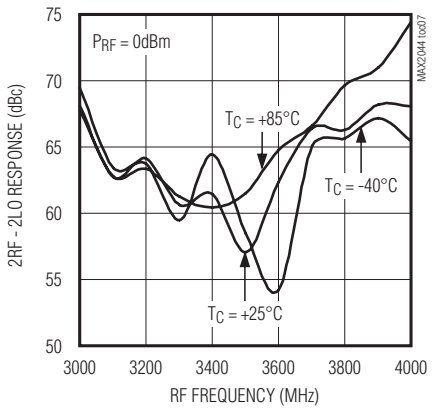
INPUT IP3 vs. RF FREQUENCY



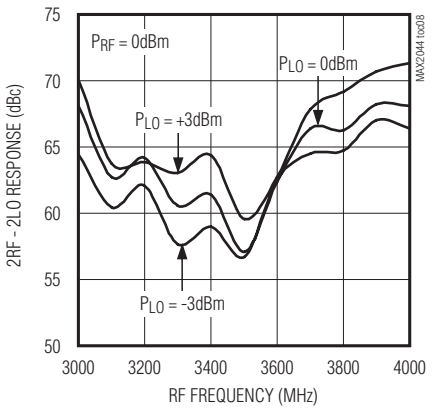
INPUT IP3 vs. RF FREQUENCY



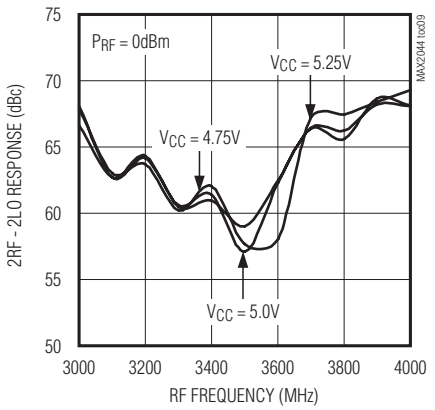
2RF - 2LO RESPONSE vs. RF FREQUENCY



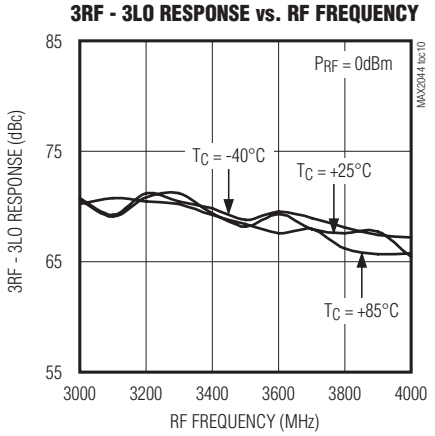
2RF - 2LO RESPONSE vs. RF FREQUENCY



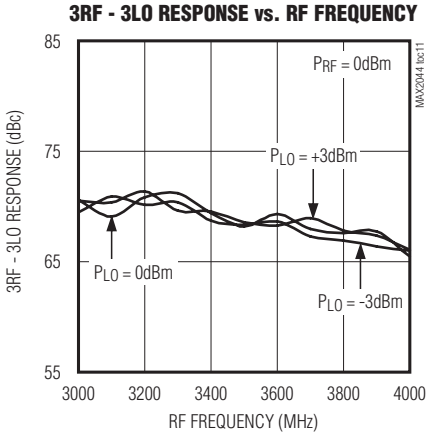
2RF - 2LO RESPONSE vs. RF FREQUENCY



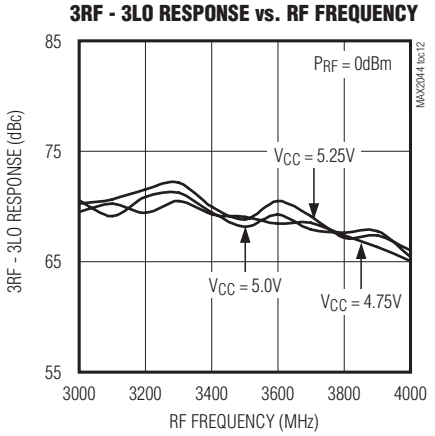
3RF - 3LO RESPONSE vs. RF FREQUENCY



3RF - 3LO RESPONSE vs. RF FREQUENCY



3RF - 3LO RESPONSE vs. RF FREQUENCY

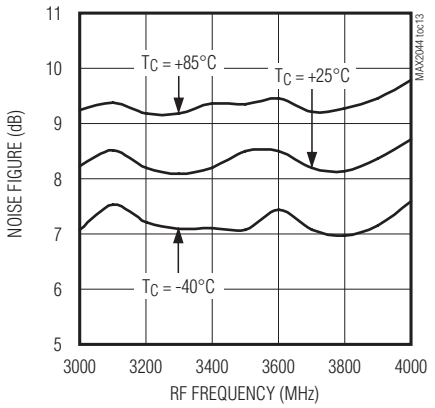


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

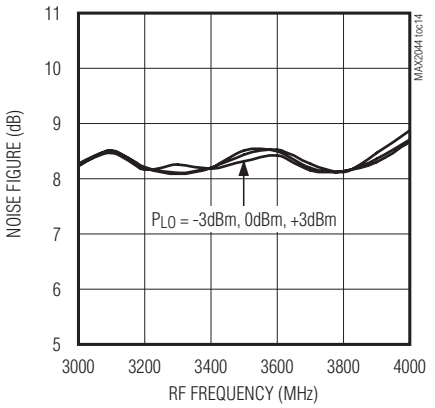
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

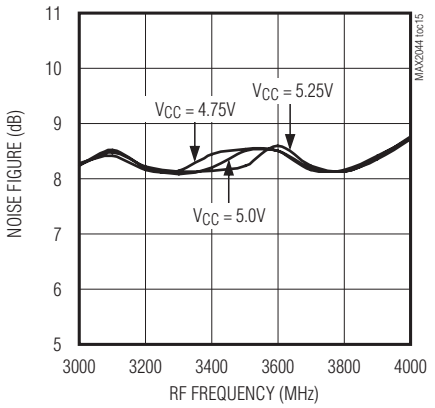
NOISE FIGURE vs. RF FREQUENCY



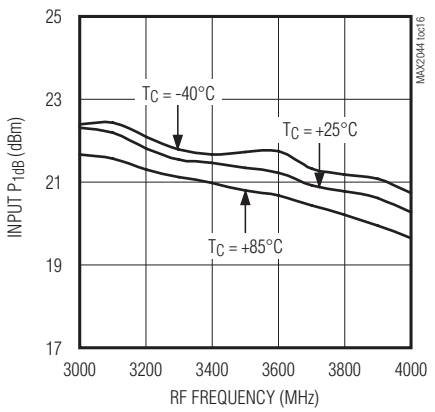
NOISE FIGURE vs. RF FREQUENCY



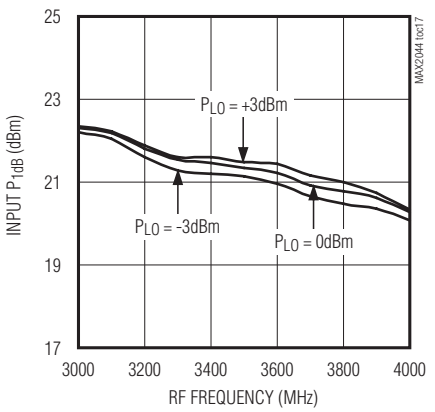
NOISE FIGURE vs. RF FREQUENCY



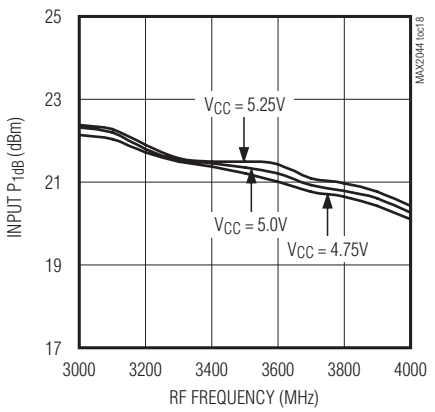
INPUT P_{1dB} vs. RF FREQUENCY



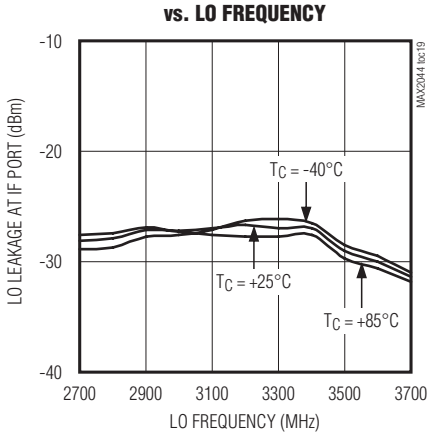
INPUT P_{1dB} vs. RF FREQUENCY



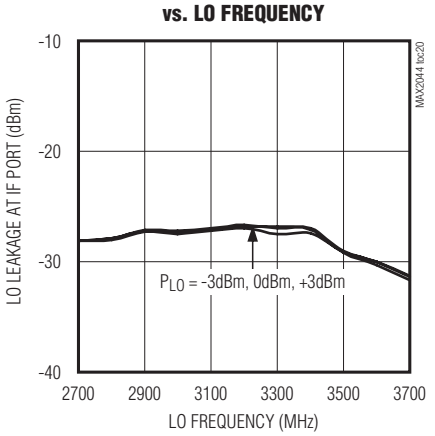
INPUT P_{1dB} vs. RF FREQUENCY



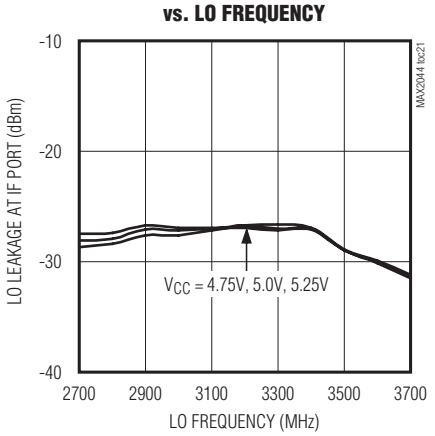
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



LO LEAKAGE AT IF PORT vs. LO FREQUENCY



LO LEAKAGE AT IF PORT vs. LO FREQUENCY

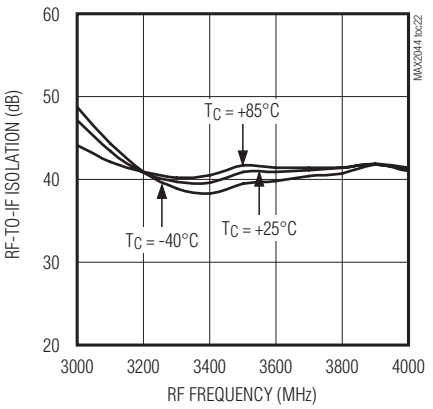


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

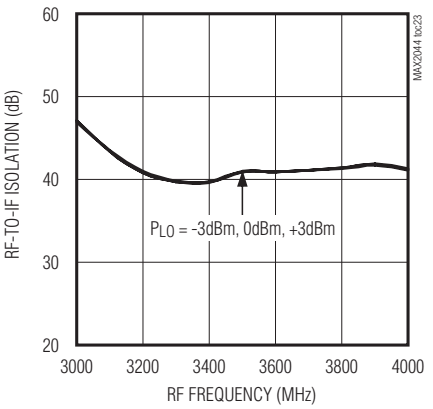
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

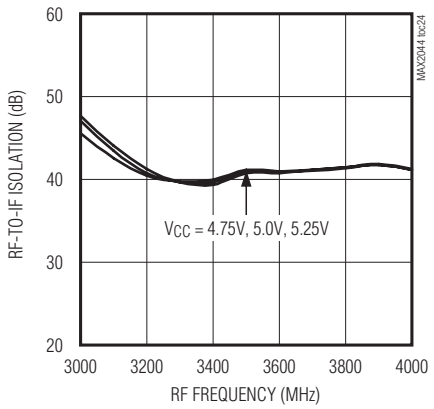
RF-TO-IF ISOLATION vs. RF FREQUENCY



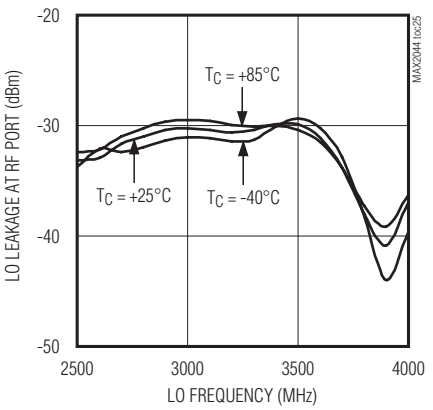
RF-TO-IF ISOLATION vs. RF FREQUENCY



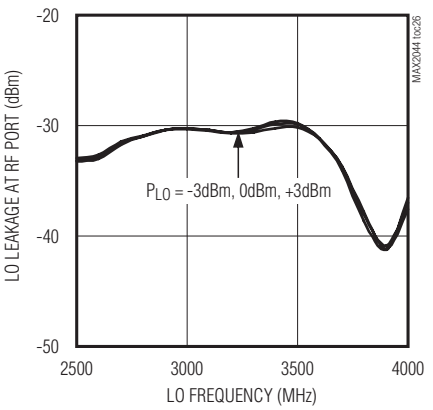
RF-TO-IF ISOLATION vs. RF FREQUENCY



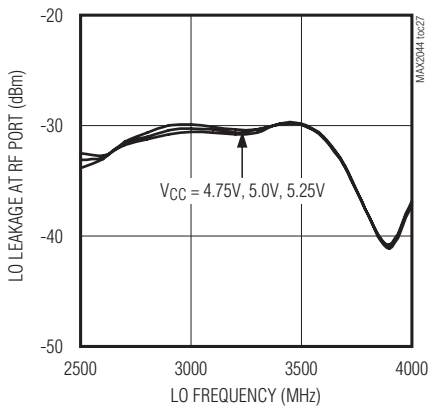
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



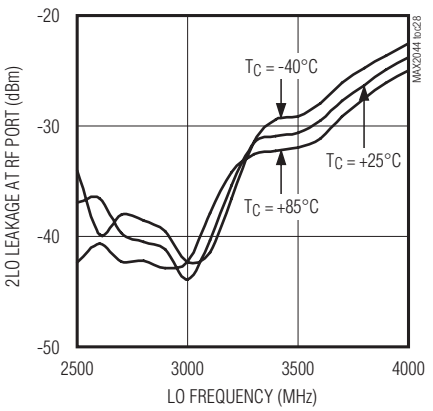
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



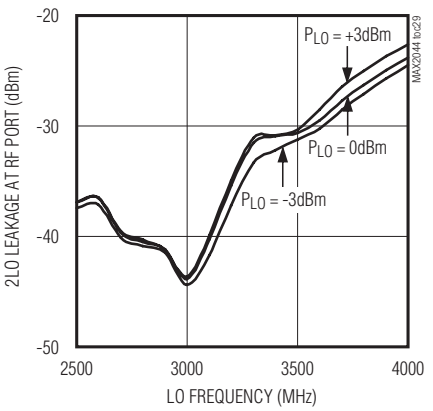
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



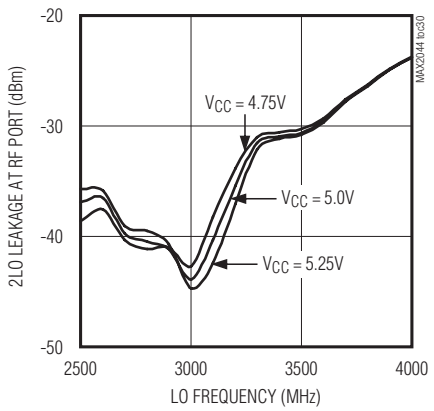
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



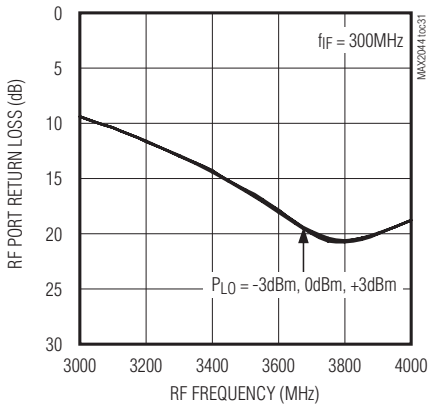
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



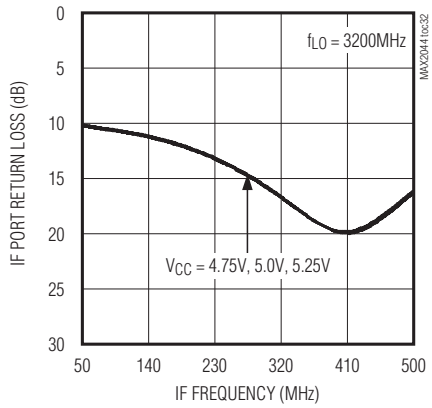
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

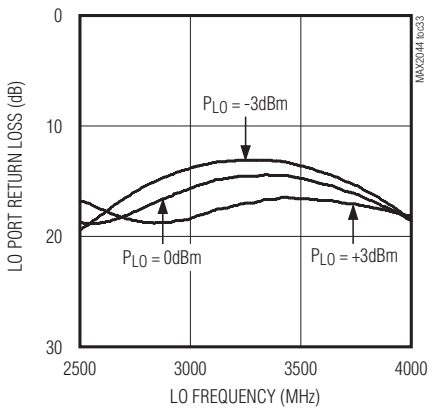
RF PORT RETURN LOSS vs. RF FREQUENCY



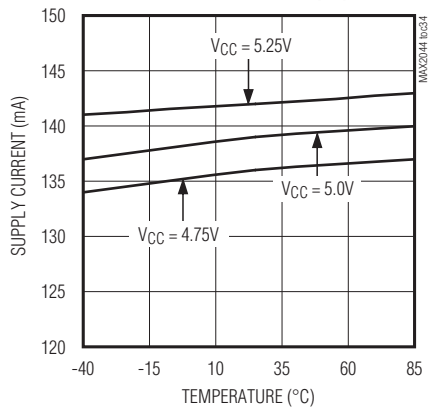
IF PORT RETURN LOSS vs. IF FREQUENCY



LO PORT RETURN LOSS vs. LO FREQUENCY



SUPPLY CURRENT vs. TEMPERATURE (T_C)

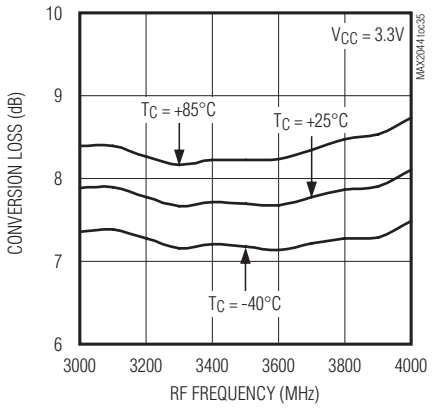


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

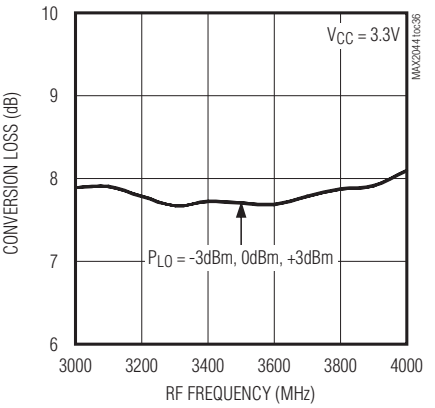
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 3.3V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

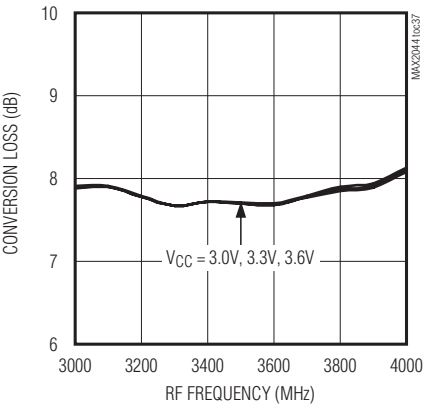
CONVERSION LOSS vs. RF FREQUENCY



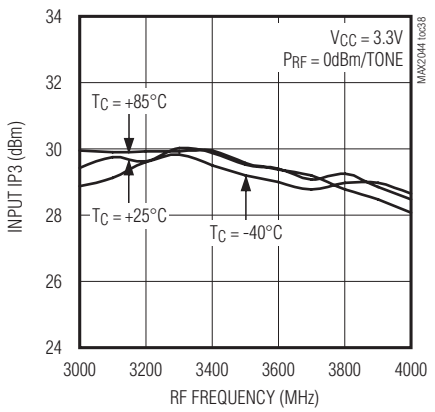
CONVERSION LOSS vs. RF FREQUENCY



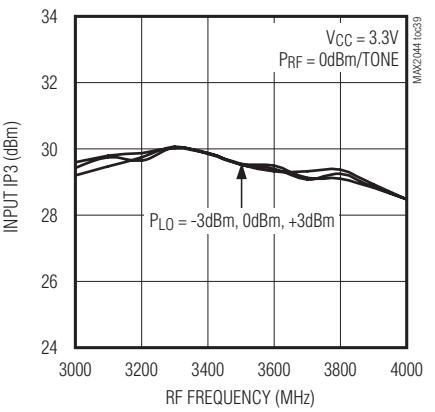
CONVERSION LOSS vs. RF FREQUENCY



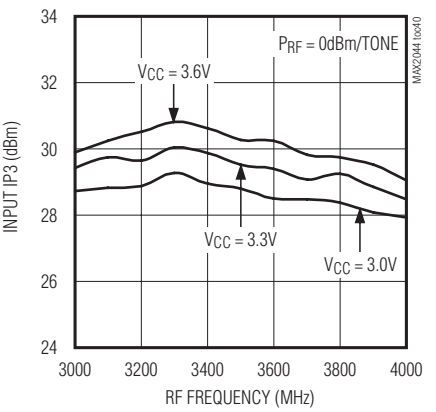
INPUT IP3 vs. RF FREQUENCY



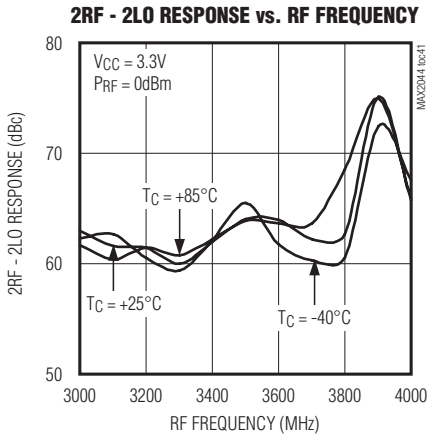
INPUT IP3 vs. RF FREQUENCY



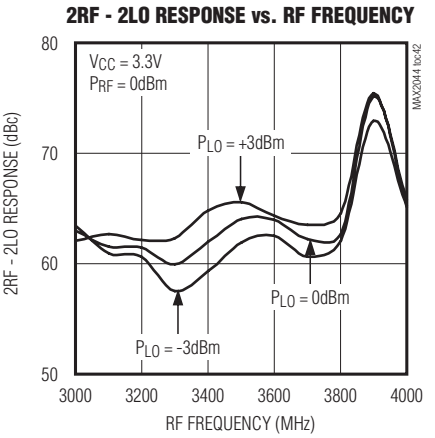
INPUT IP3 vs. RF FREQUENCY



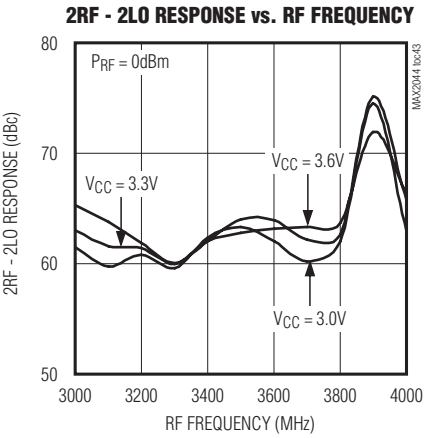
2RF - 2LO RESPONSE vs. RF FREQUENCY



2RF - 2LO RESPONSE vs. RF FREQUENCY



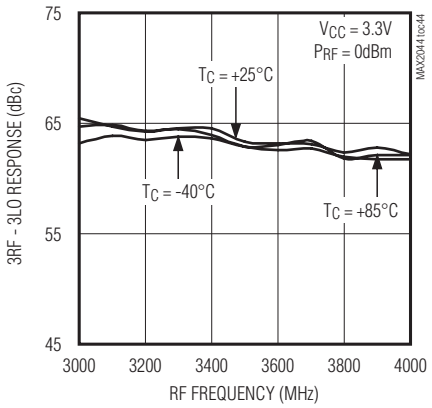
2RF - 2LO RESPONSE vs. RF FREQUENCY



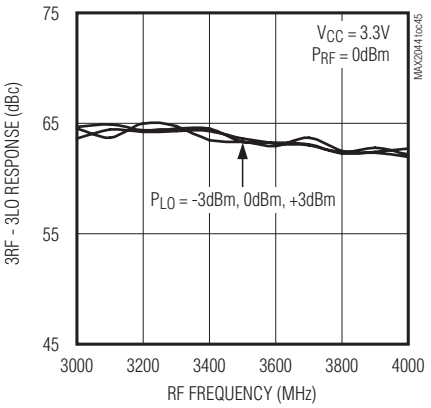
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 3.3V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

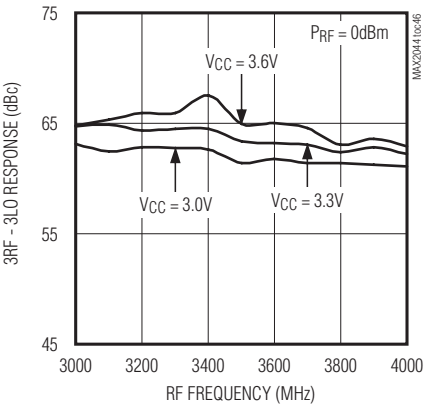
3RF - 3LO RESPONSE vs. RF FREQUENCY



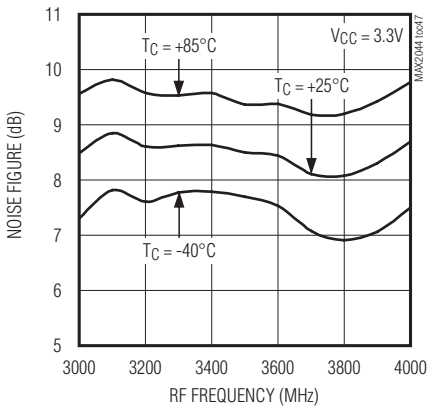
3RF - 3LO RESPONSE vs. RF FREQUENCY



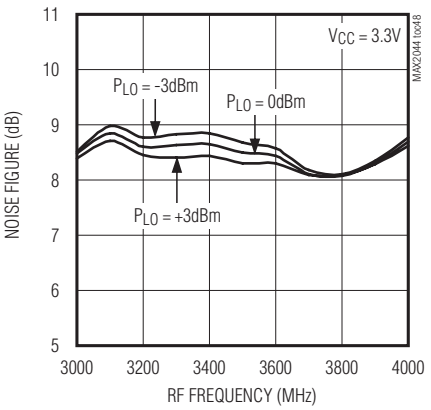
3RF - 3LO RESPONSE vs. RF FREQUENCY



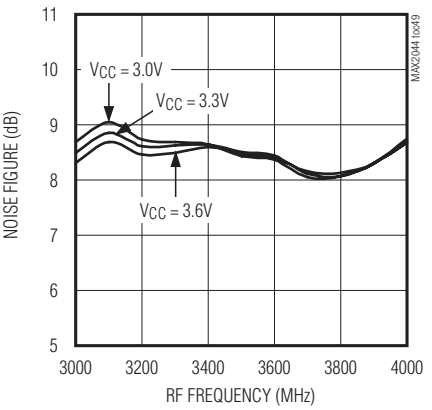
NOISE FIGURE vs. RF FREQUENCY



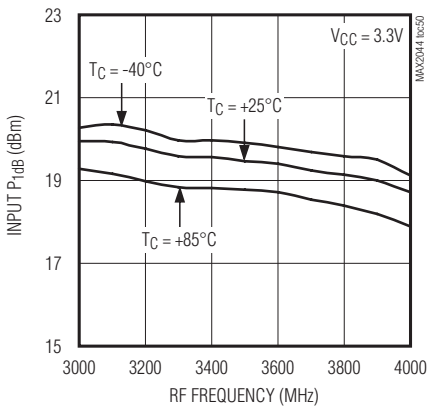
NOISE FIGURE vs. RF FREQUENCY



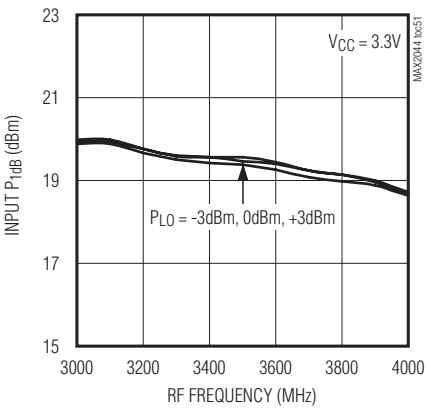
NOISE FIGURE vs. RF FREQUENCY



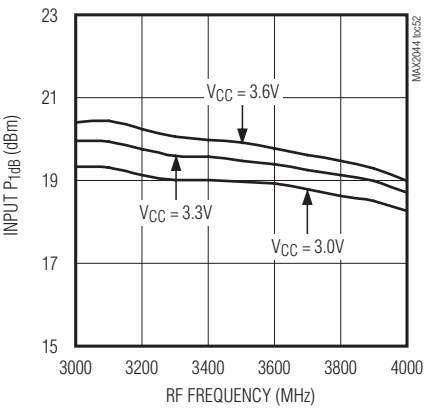
INPUT P_{1dB} vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY

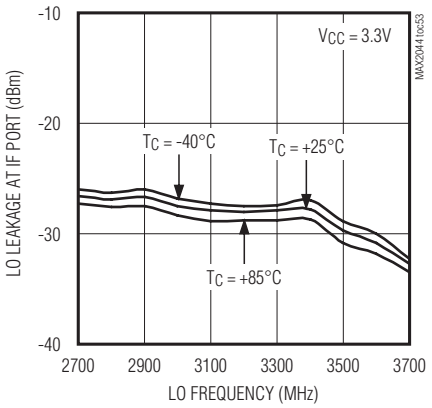


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

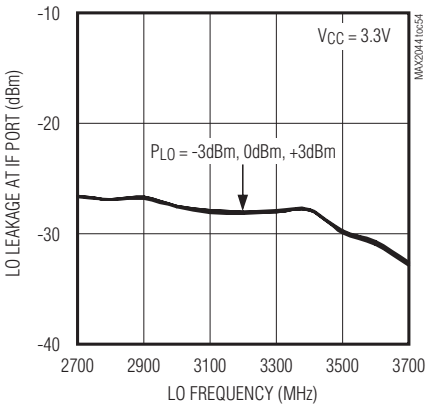
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 3.3V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

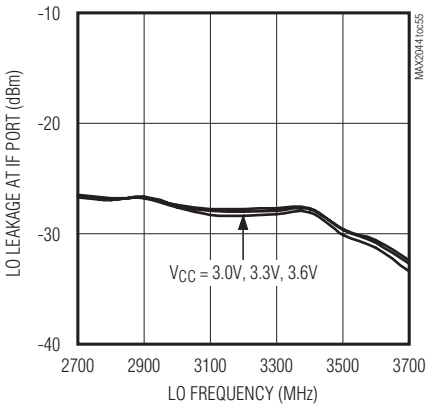
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



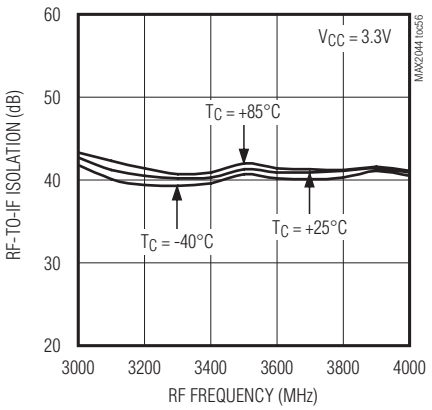
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



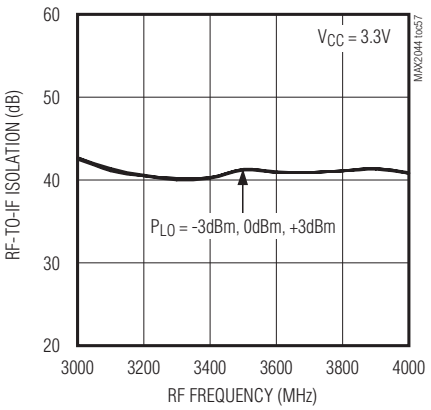
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



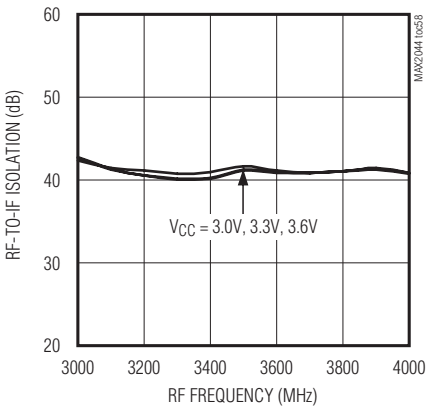
RF-TO-IF ISOLATION vs. RF FREQUENCY



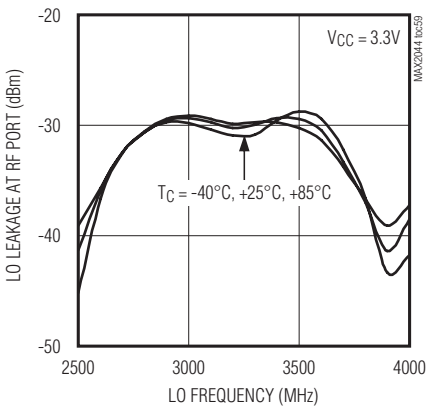
RF-TO-IF ISOLATION vs. RF FREQUENCY



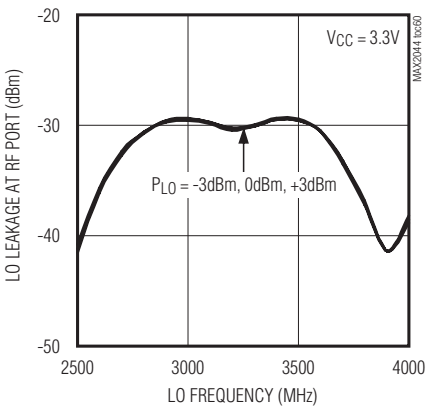
RF-TO-IF ISOLATION vs. RF FREQUENCY



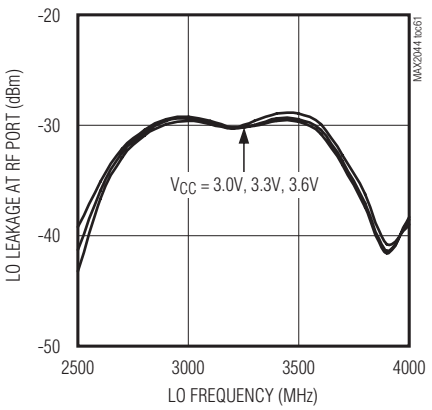
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



LO LEAKAGE AT RF PORT vs. LO FREQUENCY



LO LEAKAGE AT RF PORT vs. LO FREQUENCY

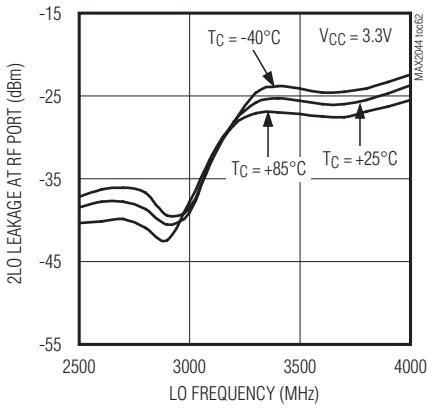


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

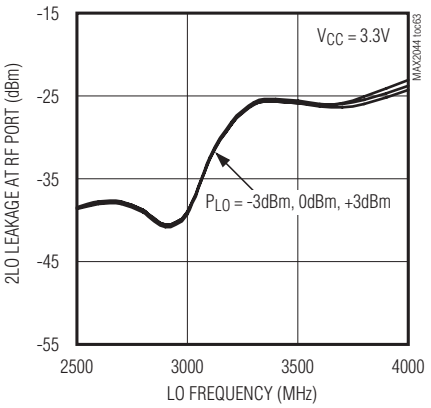
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 3.3V, f_{RF} = 3000MHz to 4000MHz, LO is low-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

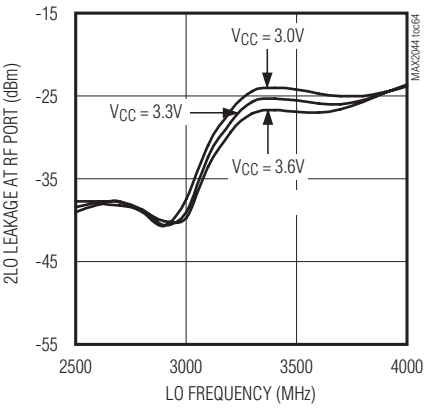
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



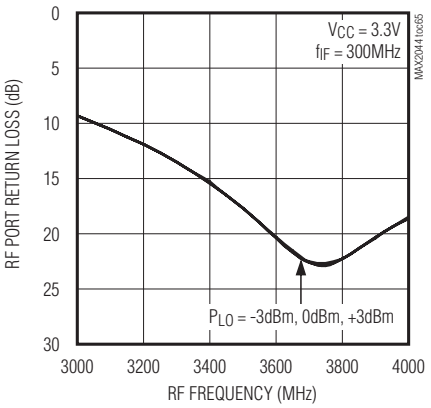
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



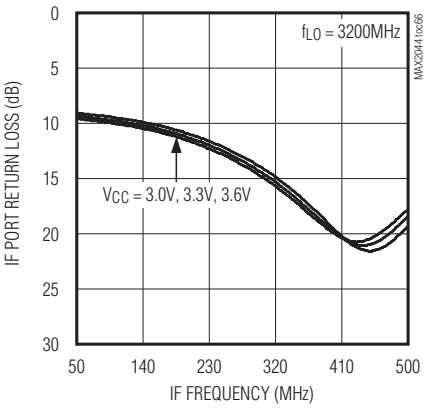
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



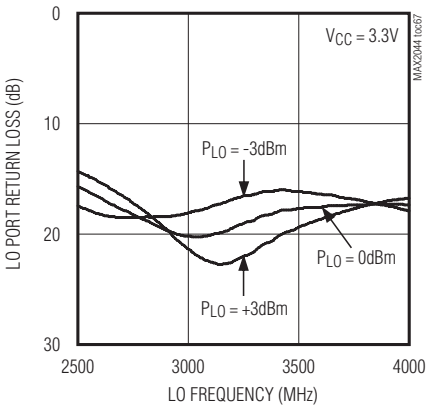
RF PORT RETURN LOSS vs. RF FREQUENCY



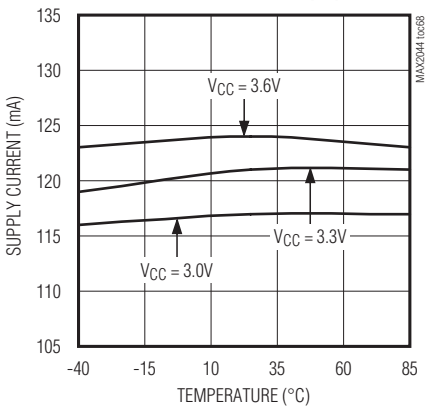
IF PORT RETURN LOSS vs. IF FREQUENCY



LO PORT RETURN LOSS vs. LO FREQUENCY



SUPPLY CURRENT vs.TEMPERATURE (T_C)

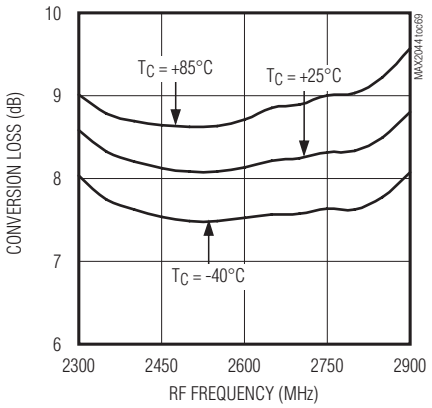


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

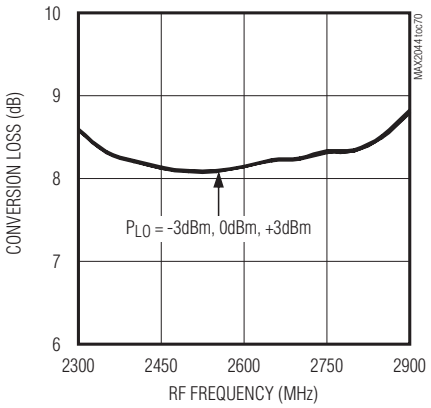
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 2300MHz to 2900MHz, LO is high-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

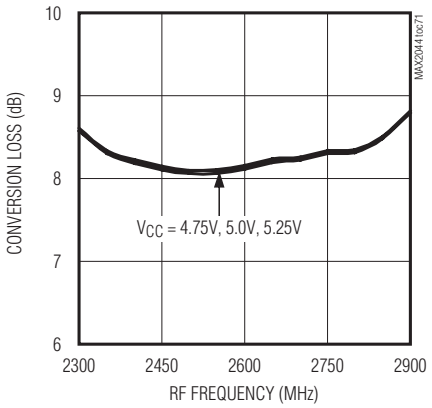
CONVERSION LOSS vs. RF FREQUENCY



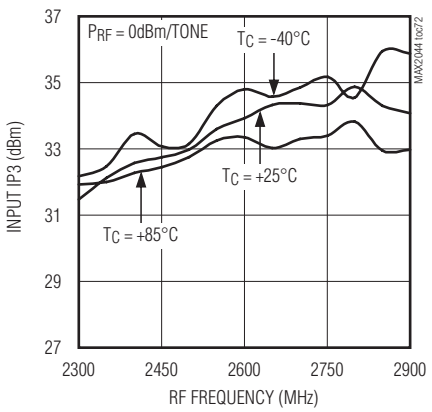
CONVERSION LOSS vs. RF FREQUENCY



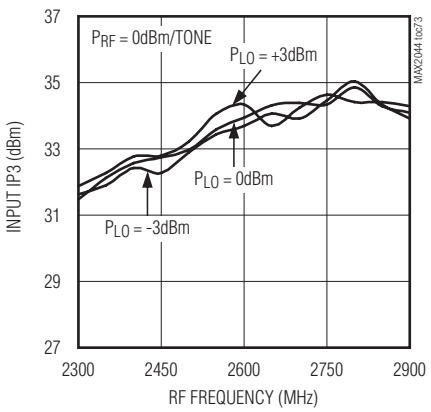
CONVERSION LOSS vs. RF FREQUENCY



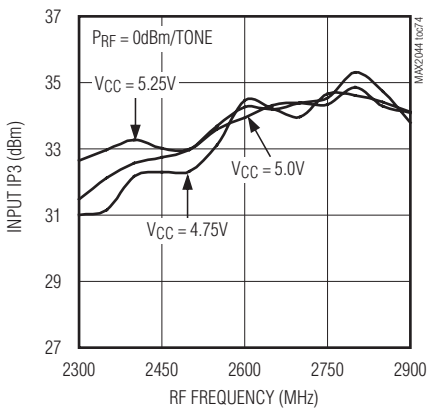
INPUT IP3 vs. RF FREQUENCY



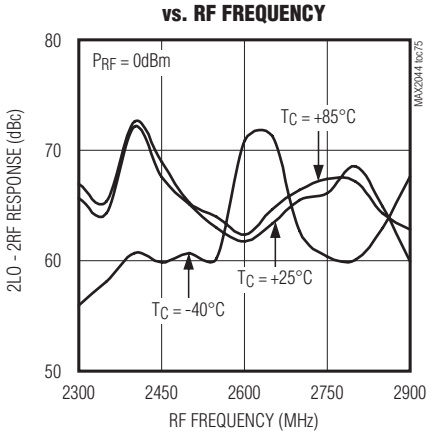
INPUT IP3 vs. RF FREQUENCY



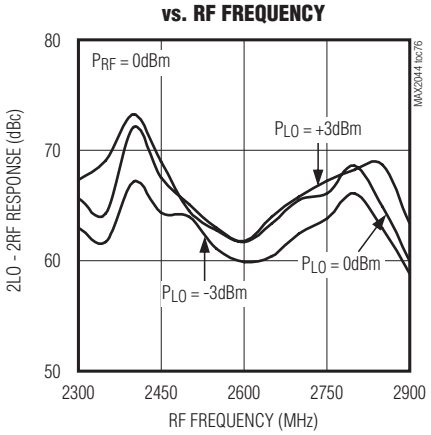
INPUT IP3 vs. RF FREQUENCY



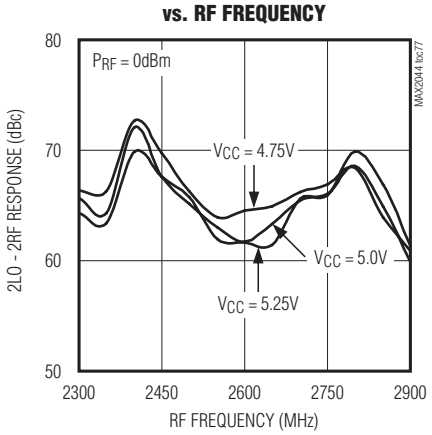
2LO - 2RF RESPONSE vs. RF FREQUENCY



2LO - 2RF RESPONSE vs. RF FREQUENCY



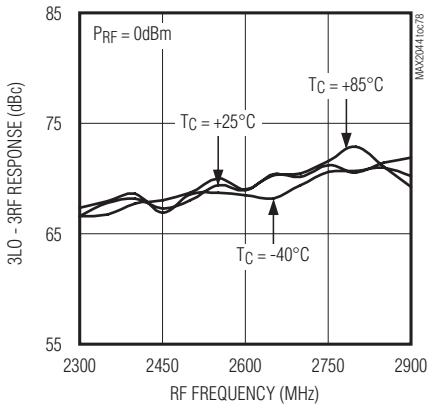
2LO - 2RF RESPONSE vs. RF FREQUENCY



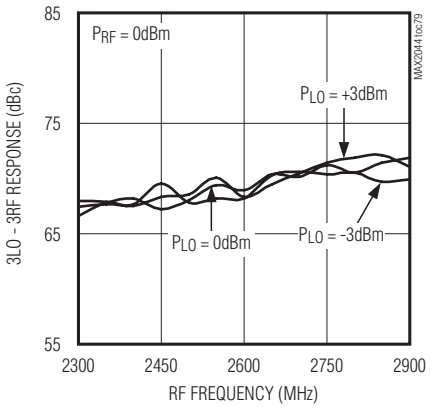
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 2300MHz to 2900MHz, LO is high-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

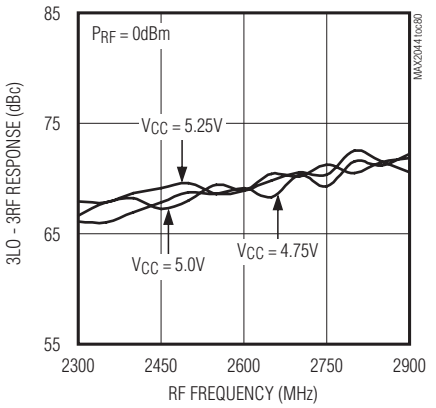
3LO - 3RF RESPONSE vs. RF FREQUENCY



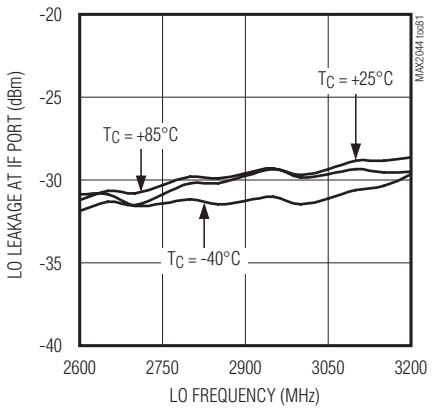
3LO - 3RF RESPONSE vs. RF FREQUENCY



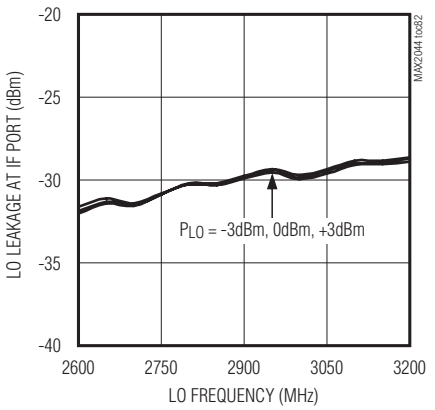
3LO - 3RF RESPONSE vs. RF FREQUENCY



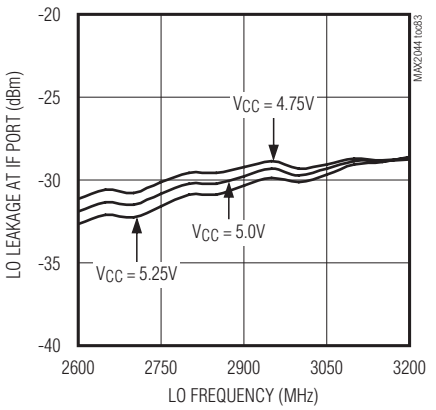
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



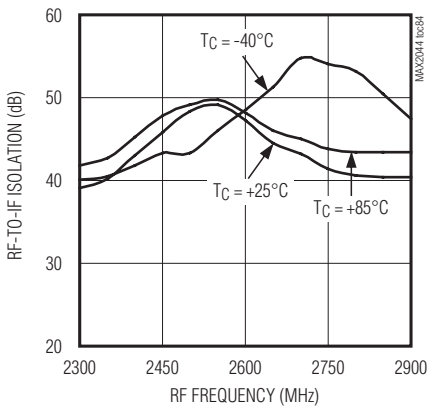
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



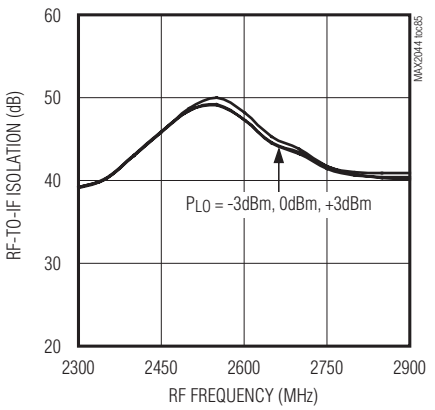
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



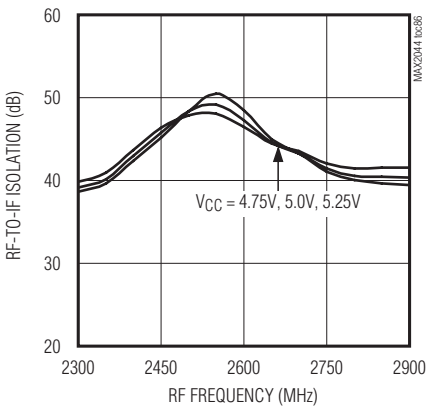
RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY

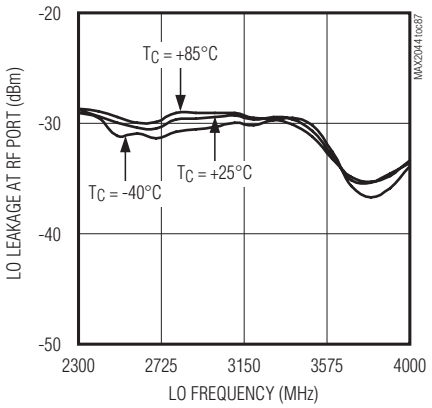


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

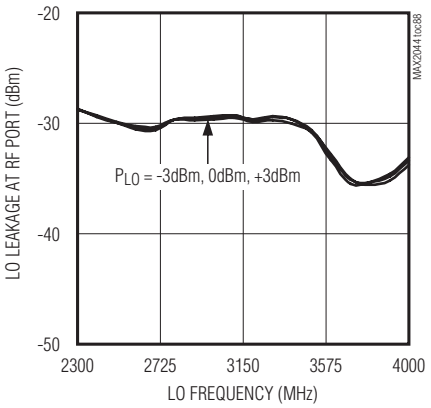
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 2300MHz to 2900MHz, LO is high-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

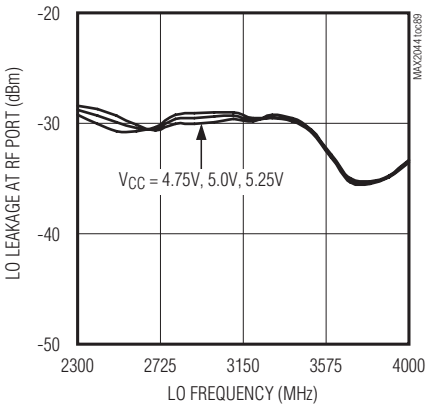
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



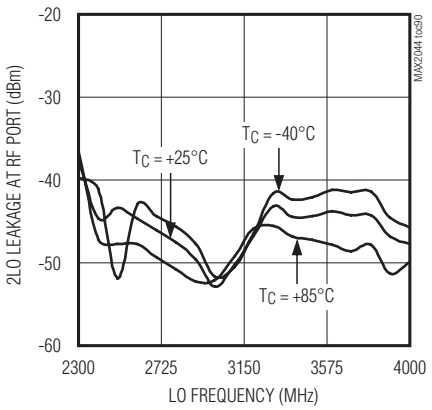
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



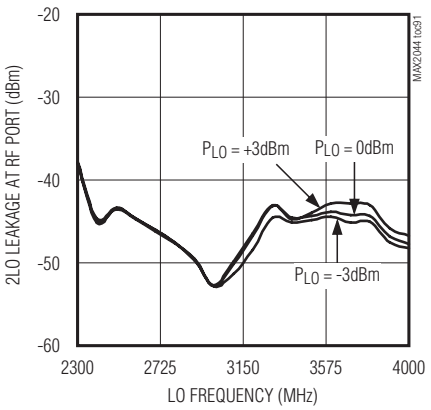
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



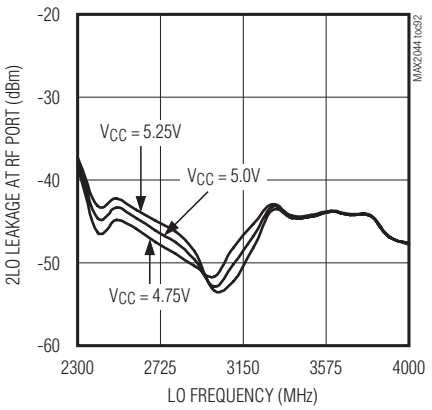
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



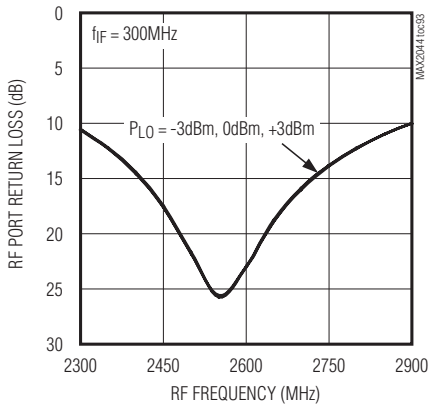
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



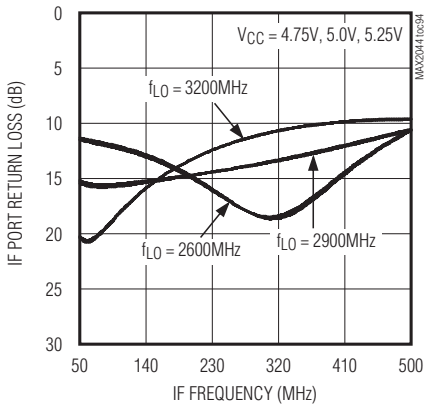
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 2300MHz to 2900MHz, LO is high-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

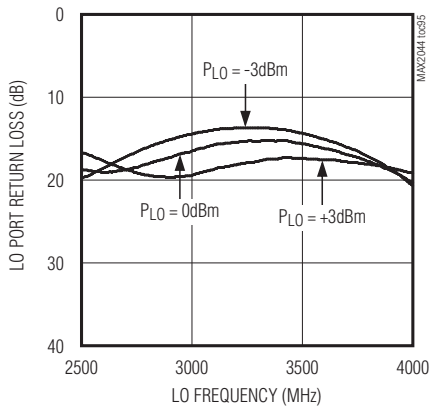
RF PORT RETURN LOSS vs. RF FREQUENCY



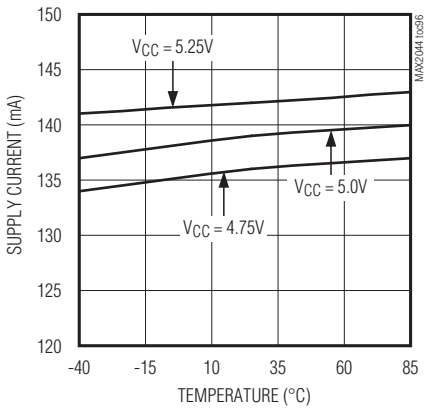
IF PORT RETURN LOSS vs. IF FREQUENCY



LO PORT RETURN LOSS vs. LO FREQUENCY



SUPPLY CURRENT vs. TEMPERATURE (T_C)

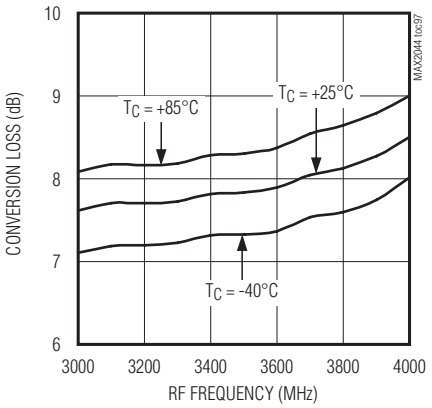


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

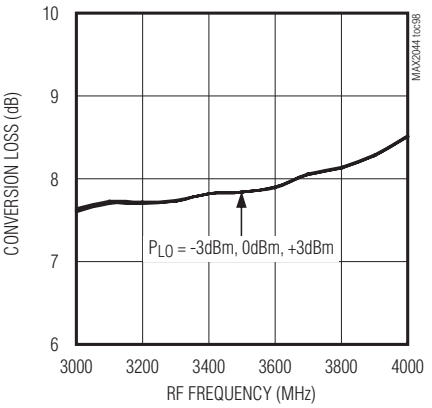
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is high-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

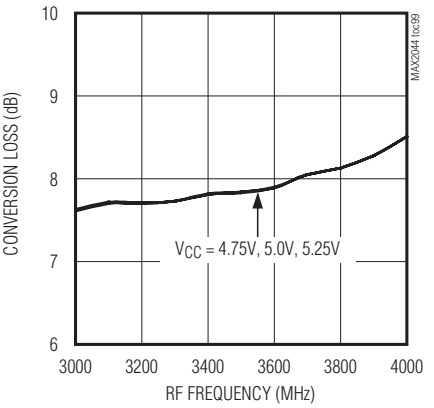
CONVERSION LOSS vs. RF FREQUENCY



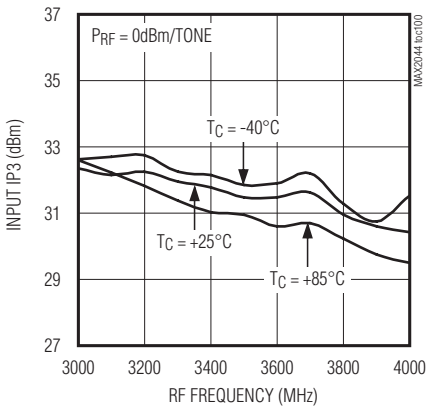
CONVERSION LOSS vs. RF FREQUENCY



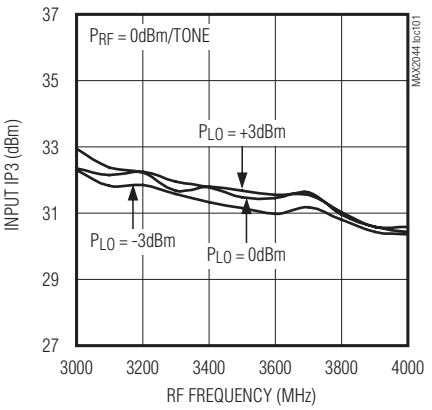
CONVERSION LOSS vs. RF FREQUENCY



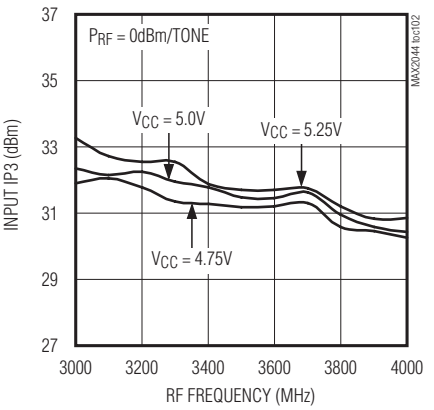
INPUT IP3 vs. RF FREQUENCY



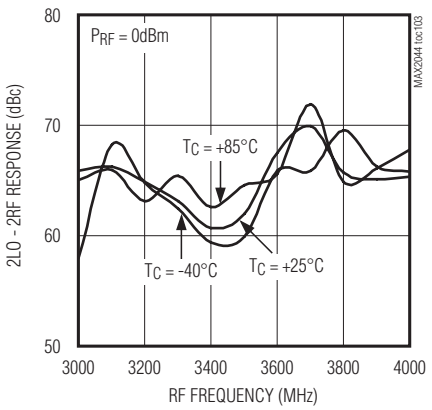
INPUT IP3 vs. RF FREQUENCY



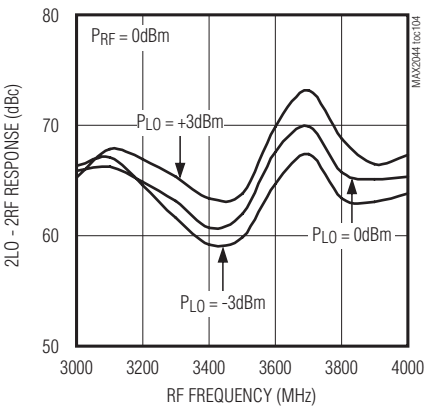
INPUT IP3 vs. RF FREQUENCY



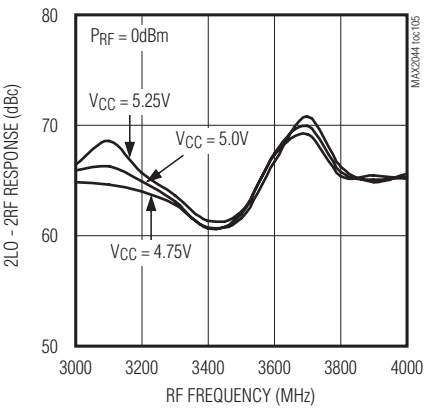
2LO - 2RF RESPONSE vs. RF FREQUENCY



2LO - 2RF RESPONSE vs. RF FREQUENCY



2LO - 2RF RESPONSE vs. RF FREQUENCY

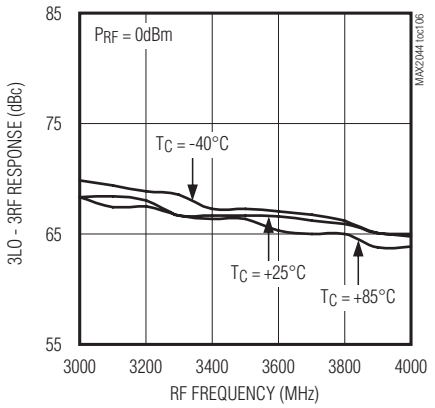


SiGe, High-Linearity, 3000MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

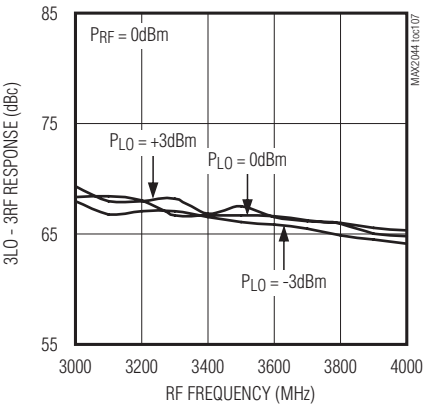
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is high-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

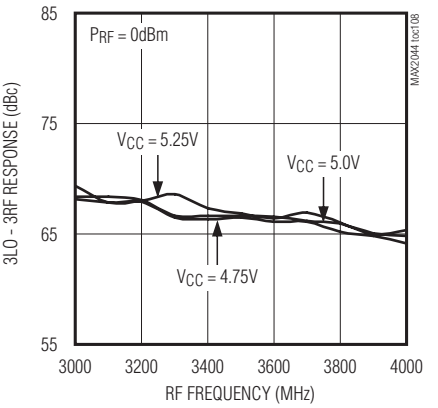
3LO - 3RF RESPONSE vs. RF FREQUENCY



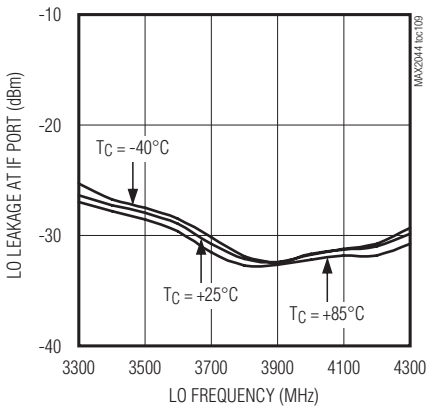
3LO - 3RF RESPONSE vs. RF FREQUENCY



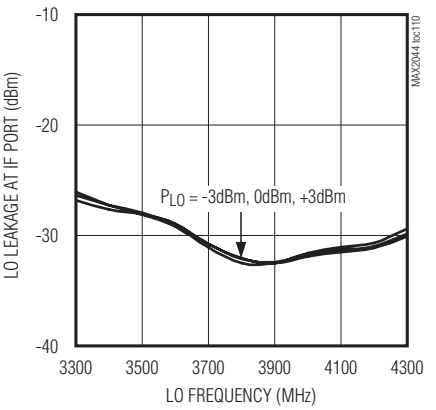
3LO - 3RF RESPONSE vs. RF FREQUENCY



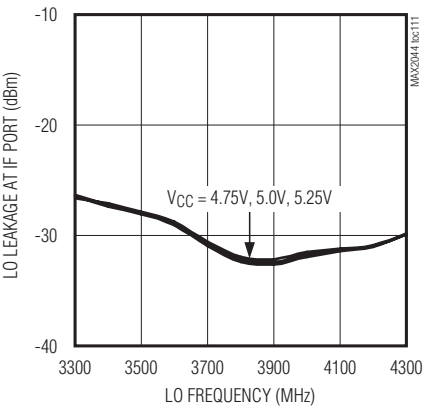
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



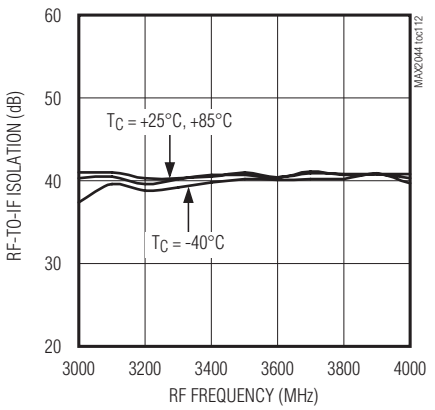
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



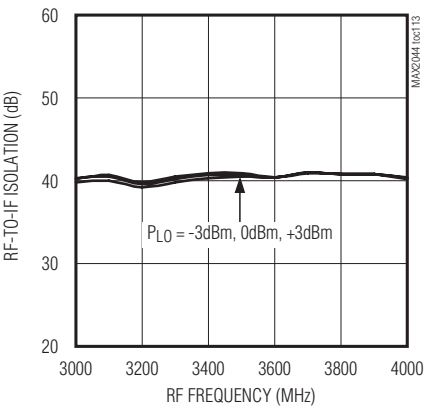
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



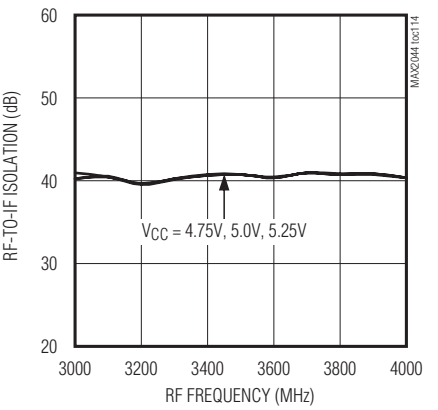
RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY

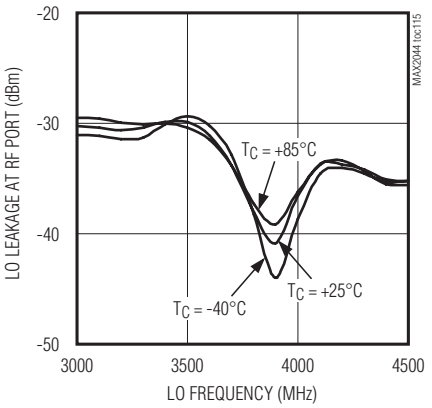


SiGe, High-Linearity, 2300MHz to 4000MHz Upconversion/Downconversion Mixer with LO Buffer

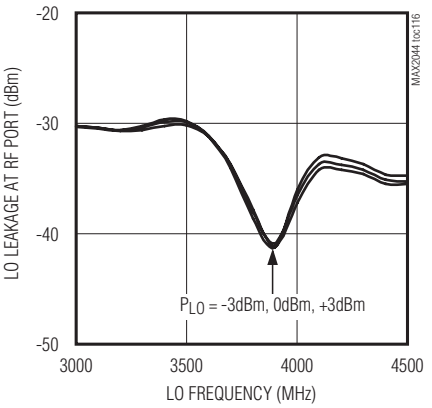
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is high-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

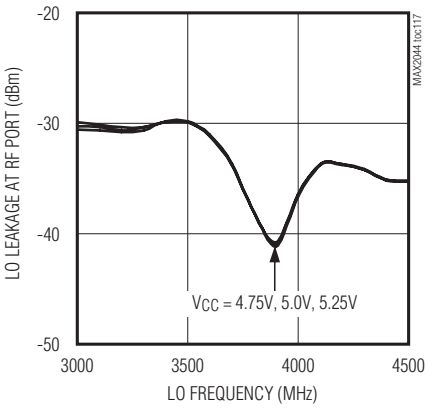
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



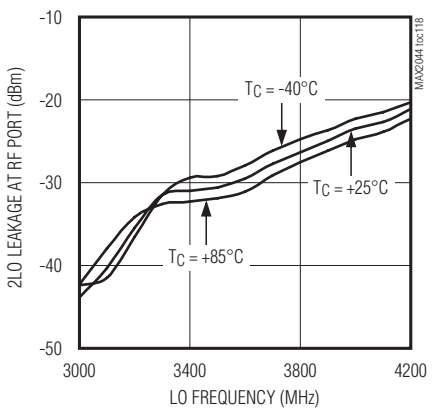
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



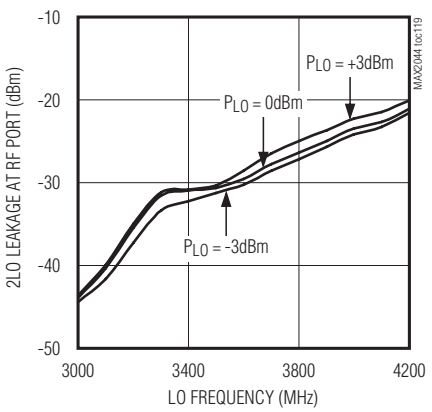
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



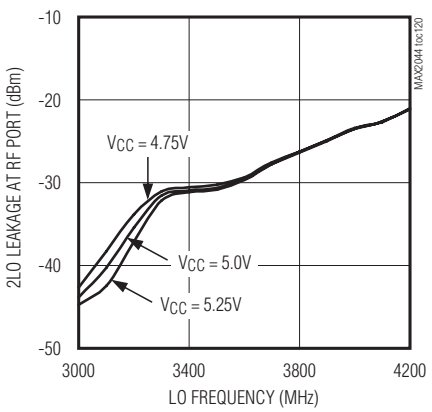
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



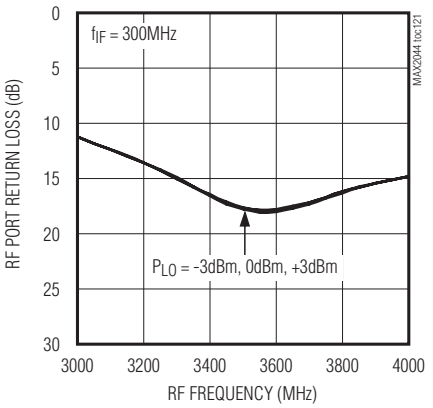
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



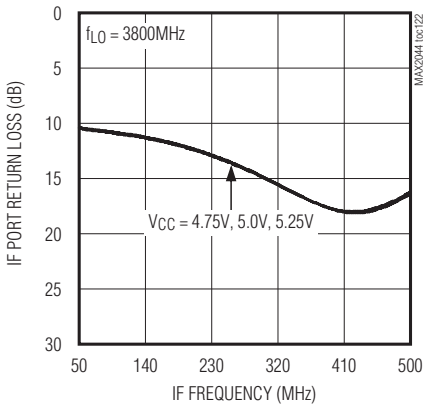
Typical Operating Characteristics (continued)

(*Typical Application Circuit* with tuning elements outlined in **Table 1, Downconverter Mode, V_{CC} = 5.0V, f_{RF} = 3000MHz to 4000MHz, LO is high-side injected** for a 300MHz IF, P_{RF} = 0dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

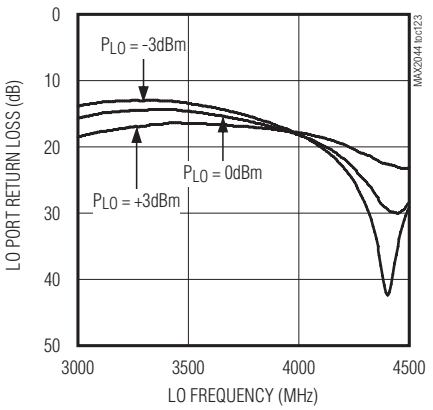
RF PORT RETURN LOSS vs. RF FREQUENCY



IF PORT RETURN LOSS vs. IF FREQUENCY



LO PORT RETURN LOSS vs. LO FREQUENCY



SUPPLY CURRENT vs. TEMPERATURE (T_C)