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19-5197; Rev 0; 4/10

Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

General Description

The MAX19994A dual-channel downconverter is designed to provide 8.4dB of conversion gain, +25dBm input IP3, +14dBm 1dB input compression point, and a noise figure of 9.8dB for 1200MHz to 2000MHz diversity receiver applications. With an optimized LO frequency range of 1450MHz to 2050MHz, this mixer supports both high- and low-side LO injection architectures for the 1200MHz to 1700MHz and 1700MHz to 2000MHz RF bands, respectively.

In addition to offering excellent linearity and noise performance, the device also yields a high level of component integration. This device includes two double-balanced passive mixer cores, two LO buffers, a dual-input LO selectable switch, and a pair of differential IF output amplifiers. Integrated on-chip baluns allow for single-ended RF and LO inputs. The MAX19994A requires a nominal LO drive of 0dBm and a typical supply current of 330mA at V_{CC} = 5.0V, or 264mA at V_{CC} = 3.3V.

The MAX19994A is pin compatible with the MAX9985/MAX9995/MAX19985A/MAX19993/MAX19995/MAX19995A series of 700MHz to 2500MHz mixers and pin similar with the MAX19997A/MAX19999 series of 1850MHz to 4000MHz mixers, making this entire family of downconverters ideal for applications where a common PCB layout is used across multiple frequency bands.

The device is available in a 6mm x 6mm, 36-pin thin QFN package with an exposed pad. Electrical performance is guaranteed over the extended temperature range, from T_C = -40°C to +85°C.

Applications

WCDMA/LTE Base Stations

TD-SCDMA Base Stations

GSM/EDGE Base Stations

cdma2000® Base Stations

Wireless Local Loop

Fixed Broadband Wireless Access

Private Mobile Radios

Military Systems

Features

- ♦ **1200MHz to 2000MHz RF Frequency Range**
- ♦ **1450MHz to 2050MHz LO Frequency Range**
- ♦ **50MHz to 500MHz IF Frequency Range**
- ♦ **8.4dB Typical Conversion Gain**
- ♦ **9.8dB Typical Noise Figure**
- ♦ **+25dBm Typical Input IP3**
- ♦ **+14dBm Typical Input 1dB Compression Point**
- ♦ **68dBc Typical 2LO - 2RF Spurious Rejection at P_{RF} = -10dBm**
- ♦ **Dual Channels Ideal for Diversity Receiver Applications**
- ♦ **47dB Typical Channel-to-Channel Isolation**
- ♦ **Low -6dBm to +3dBm LO Drive**
- ♦ **Integrated LO Buffer**
- ♦ **Internal RF and LO Baluns for Single-Ended Inputs**
- ♦ **Built-In SPDT LO Switch with 48dB LO-to-LO Isolation and 50ns Switching Time**
- ♦ **Pin Compatible with the MAX9985/MAX9995/MAX19985A/MAX19993/MAX19995/MAX19995A Series of 700MHz to 2200MHz Mixers**
- ♦ **Pin Similar to the MAX19997A/MAX19999 Series of 1850MHz to 4000MHz Mixers**
- ♦ **Single 5.0V or 3.3V Supply**
- ♦ **External Current-Setting Resistors Provide Option for Operating Device in Reduced-Power/Reduced-Performance Mode**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX19994AETX+	-40°C to +85°C	36 Thin QFN-EP*
MAX19994AETX+T	-40°C to +85°C	36 Thin QFN-EP*

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

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Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND..........-0.3V to +5.5V
LO1, LO2 to GND..........-0.3V to +0.3V
LOSEL to GND..........-0.3V to (V_{CC} + 0.3V)
RFMAIN, RFDIV, and LO_ Input Power..........+15dBm
RFMAIN, RFDIV Current
(RF is DC shorted to GND through a balun)..........50mA
Continuous Power Dissipation (Note 1)..........8.7W
θ_{JA} (Notes 1, 3)..........+38°C/W
θ_{JC} (Notes 2, 3)..........7.4°C/W
Operating Case Temperature
Range (Note 4)..........-40°C to +85°C
Junction Temperature..........+150°C
Storage Temperature Range..........-65°C to +150°C
Lead Temperature (soldering, 10s)..........+300°C
Soldering Temperature (reflow)..........+260°C

Note 1: 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 2: 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 3: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to **www.maxim-ic.com/thermal-tutorial**.
Note 4: T_C is the temperature on the exposed pad of the package. T_A is the ambient temperature of the device and PCB.

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

5.0V SUPPLY DC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit*, V_{CC} = 4.75V to 5.25V, no input AC signals. T_C = -40°C to +85°C, R1 = R4 = 681Ω, R2 = R5 = 1.82kΩ. Typical values are at V_{CC} = 5.0V, T_C = +25°C, unless otherwise noted. All parameters are production tested.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{CC}		4.75	5	5.25	V
Supply Current	I_{CC}	Total supply current		330	420	mA
LOSEL Input High Voltage	V_{IH}		2			V
LOSEL Input Low Voltage	V_{IL}				0.8	V
LOSEL Input Current	I_{IH} and I_{IL}		-10		+10	µA

3.3V SUPPLY DC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit*, V_{CC} = 3.0V to 3.6V, no input AC signals. T_C = -40°C to +85°C, R1 = R4 = 681Ω, R2 = R5 = 1.43kΩ. Typical values are at V_{CC} = 3.3V, T_C = +25°C, 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		264		mA
LOSEL Input High Voltage	V_{IH}			2		V
LOSEL Input Low Voltage	V_{IL}			0.8		V

RECOMMENDED AC OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RF Frequency	f_{RF}	C1 = C8 = 39pF (Note 5)	1200		1700	MHz
		C1 = C8 = 1.8pF, L7 = L8 = 4.7nH (Note 5)	1700		2000	
LO Frequency	f_{LO}	(Note 5)	1450		2050	MHz

RECOMMENDED AC OPERATING CONDITIONS (continued)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
IF Frequency	f_{IF}	Using Mini-Circuits TC4-1W-17 4:1 transformer as defined in the *Typical Application Circuit*, IF matching components affect the IF frequency range (Note 5)	100		500	MHz
		Using alternative Mini-Circuits TC4-1W-7A 4:1 transformer as defined in the *Typical Application Circuit*, IF matching components affect the IF frequency range (Note 5)	50		250	
LO Drive Level	P_{LO}	(Note 5)	-6		+3	dBm

5.0V SUPPLY, HIGH-SIDE INJECTION AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit* optimized for the **Standard RF Band (see Table 1)**. R1 = R4 = 681Ω, R2 = R5 = 1.82kΩ, V_{CC} = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources, P_{LO} = -6dBm to +3dBm, P_{RF} = -5dBm, f_{RF} = 1200MHz to 1700MHz, f_{LO} = 1550MHz to 2050MHz, 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} = 1450MHz, f_{LO} = 1800MHz, f_{IF} = 350MHz, T_C = +25°C. All parameters are guaranteed by design and characterization, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Gain	G_C		6.2	8.4	9.8	dB
		T_C = +25°C (Note 7)	7.0	8.4	9.0	
		T_C = +25°C, f_{RF} = 1427MHz to 1463MHz (Note 7)	7.9	8.4	8.9	
Conversion Gain Flatness	ΔG_C	f_{RF} = 1427MHz to 1463MHz		±0.05		dB
Gain Variation Over Temperature	TC_{CG}	T_C = -40°C to +85°C		-0.01		dB/°C
Input Compression Point	IP_{1dB}	f_{RF} = 1450MHz (Notes 7, 8)	12.6	14.0		dBm
Input Third-Order Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone	21.5	25.0		dBm
		f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone, f_{RF} = 1427MHz to 1463MHz, T_C = +25°C (Note 7)	23.0	25.0		
		f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone, f_{RF} = 1427MHz to 1463MHz	22	25.0		
Input Third-Order Intercept Point Variation Over Temperature	TC_{IIP3}	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone, T_C = -40°C to +85°C		±0.75		dBm
Noise Figure (Note 9)	NF_{SSB}	Single sideband, no blockers present		9.8	13	dB
		f_{RF} = 1427MHz to 1463MHz, T_C = +25°C, P_{LO} = 0dBm, single sideband, no blockers present		9.8	11	
		f_{RF} = 1427MHz to 1463MHz, P_{LO} = 0dBm, single sideband, no blockers present		9.8	12.5	
Noise Figure Temperature Coefficient	TC_{NF}	Single sideband, no blockers present, T_C = -40°C to +85°C		0.016		dB/°C
Noise Figure with Blocker	NF_B	$P_{BLOCKER}$ = +8dBm, f_{RF} = 1450MHz, f_{LO} = 1800MHz, $f_{BLOCKER}$ = 1350MHz, P_{LO} = 0dBm, V_{CC} = 5.0V, T_C = +25°C (Notes 9, 10)		20.2	22	dB

Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

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

(*Typical Application Circuit* optimized for the **Standard RF Band (see Table 1)**. R1 = R4 = 681Ω, R2 = R5 = 1.82kΩ, V_{CC} = 4.75V to 5.25V, RF and LO ports are driven from 50Ω sources, P_{LO} = -6dBm to +3dBm, P_{RF} = -5dBm, f_{RF} = 1200MHz to 1700MHz, f_{LO} = 1550MHz to 2050MHz, 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} = 1450MHz, f_{LO} = 1800MHz, f_{IF} = 350MHz, T_C = +25°C. All parameters are guaranteed by design and characterization, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
2LO - 2RF Spur Rejection (Note 9)	2 x 2	f_{RF} = 1450MHz, f_{LO} = 1800MHz, f_{SPUR} = 1625MHz	P_{RF} = -10dBm	57	68		dBc
			P_{RF} = -5dBm	52	63		
		f_{RF} = 1450MHz, f_{LO} = 1800MHz, f_{SPUR} = 1625MHz, P_{LO} = 0dBm, V_{CC} = 5.0V, T_C = +25°C	P_{RF} = -10dBm	58	68		
			P_{RF} = -5dBm	53	63		
3LO - 3RF Spur Rejection (Note 9)	3 x 3	f_{RF} = 1450MHz, f_{LO} = 1800MHz, f_{SPUR} = 1683.33MHz	P_{RF} = -10dBm	68	84		dBc
			P_{RF} = -5dBm	58	74		
		f_{RF} = 1450MHz, f_{LO} = 1800MHz, f_{SPUR} = 1683.33MHz, P_{LO} = 0dBm, V_{CC} = 5.0V, T_C = +25°C	P_{RF} = -10dBm	70	84		
			P_{RF} = -5dBm	60	74		
RF Input Return Loss		LO and IF terminated into matched impedance, LO "on"			17		dB
LO Input Return Loss		LO port selected, RF and IF terminated into matched impedance			16		dB
		LO port unselected, RF and IF terminated into matched impedance			20		
IF Output Impedance	Z_{IF}	Nominal differential impedance of the 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*			13.0		dB
RF-to-IF Isolation		(Note 7)		19	30		dB
LO Leakage at RF Port		(Note 7)			-42		dBm
2LO Leakage at RF Port		(Note 7)			-30		dBm
LO Leakage at IF Port		(Note 7)			-35		dBm
Channel Isolation (Note 7)		RFMAIN converted power measured at IFDIV relative to IFMAIN, all unused ports terminated to 50Ω		43	47		dB
		RFDIV converted power measured at IFMAIN relative to IFDIV, all unused ports terminated to 50Ω		43	47		
LO-to-LO Isolation		P_{LO1} = +3dBm, P_{LO2} = +3dBm, f_{LO1} = 1800MHz, f_{LO2} = 1801MHz (Note 7)		42	48		dB
LO Switching Time		50% of LOSEL to IF settled within 2 degrees			50		ns

3.3V SUPPLY, HIGH-SIDE INJECTION AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1)**. R1 = R4 = 681Ω, R2 = R5 = 1.43kΩ. Typical values are at V_{CC} = 3.3V, P_{RF} = -5dBm, P_{LO} = 0dBm, f_{RF} = 1450MHz, f_{LO} = 1800MHz, f_{IF} = 350MHz, T_C = +25°C, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Gain	G_C	(Note 7)		8.2		dB
Conversion Gain Flatness	ΔG_C	f_{RF} = 1427MHz to 1463MHz		±0.05		dB
Gain Variation Over Temperature	TC_{CG}	T_C = -40°C to +85°C		-0.01		dB/°C
Input Compression Point	IP_{1dB}	(Note 8)		10.6		dBm
Input Third-Order Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz		23.6		dBm
Input Third-Order Intercept Point Variation Over Temperature	TC_{IIP3}	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone, T_C = -40°C to +85°C		±0.5		dBm
Noise Figure	NF_{SSB}	Single sideband, no blockers present		9.8		dB
Noise Figure Temperature Coefficient	TC_{NF}	Single sideband, no blockers present, T_C = -40°C to +85°C		0.016		dB/°C
2LO - 2RF Spur Rejection	2 x 2	P_{RF} = -10dBm		68		dBc
		P_{RF} = -5dBm		63		
3LO - 3RF Spur Rejection	3 x 3	P_{RF} = -10dBm		77		dBc
		P_{RF} = -5dBm		67		
RF Input Return Loss		LO and IF terminated into matched impedance, LO "on"		15		dB
LO Input Return Loss		LO port selected, RF and IF terminated into matched impedance		18		dB
		LO port unselected, RF and IF terminated into matched impedance		21		
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*		12.5		dB
RF-to-IF Isolation				31		dB
LO Leakage at RF Port				-49		dBm
2LO Leakage at RF Port				-40		dBm
LO Leakage at IF Port				-35		dBm
Channel Isolation		RFMAIN converted power measured at IFDIV relative to IFMAIN, all unused ports terminated to 50Ω		48		dB
		RFDIV converted power measured at IFMAIN relative to IFDIV, all unused ports terminated to 50Ω		48		
LO-to-LO Isolation		P_{LO1} = +3dBm, P_{LO2} = +3dBm, f_{LO1} = 1800MHz, f_{LO2} = 1801MHz		50		dB
LO Switching Time		50% of LOSEL to IF settled within 2 degrees		50		ns

Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

5.0V SUPPLY, LOW-SIDE INJECTION AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit* **optimized for the Extended RF Band (see Table 1)**, R1 = R4 = 681Ω, R2 = R5 = 1.82kΩ. Typical values are at V_{CC} = 5.0V, P_{RF} = -5dBm, P_{LO} = 0dBm, f_{RF} = 1850MHz, f_{LO} = 1500MHz, f_{IF} = 350MHz, T_C = +25°C, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Gain	G_C			7.9		dB
Conversion Gain Flatness	ΔG_C	f_{RF} = 1700MHz to 2000MHz, over any 100MHz band		±0.06		dB
Gain Variation Over Temperature	TC_{CG}	T_C = -40°C to +85°C		-0.007		dB/°C
Input Compression Point	IP_{1dB}	(Note 8)		13.9		dBm
Input Third-Order Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz		24.9		dBm
Input Third-Order Intercept Point Variation Over Temperature	TC_{IIP3}	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone, T_C = -40°C to +85°C		±0.6		dBm
Noise Figure	NF_{SSB}	Single sideband, no blockers present		10.2		dB
Noise Figure Temperature Coefficient	TC_{NF}	Single sideband, no blockers present, T_C = -40°C to +85°C		0.017		dB/°C
2RF - 2LO Spur Rejection	2 x 2	P_{RF} = -10dBm		68		dBc
		P_{RF} = -5dBm		63		
3RF - 3LO Spur Rejection	3 x 3	P_{RF} = -10dBm		87		dBc
		P_{RF} = -5dBm		77		
RF Input Return Loss		LO and IF terminated into matched impedance, LO “on”		14		dB
LO Input Return Loss		LO port selected, RF and IF terminated into matched impedance		29		dB
		LO port unselected, RF and IF terminated into matched impedance		28		
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*		14.5		dB
RF-to-IF Isolation				37		dB
LO Leakage at RF Port				-52		dBm
2LO Leakage at RF Port				-29		dBm
LO Leakage at IF Port				-19.4		dBm
Channel Isolation		RFMAIN converted power measured at IFDIV relative to IFMAIN, all unused ports terminated to 50Ω		43		dB
		RFDIV converted power measured at IFMAIN relative to IFDIV, all unused ports terminated to 50Ω		43		
LO-to-LO Isolation		P_{LO1} = +3dBm, P_{LO2} = +3dBm, f_{LO1} = 1500MHz, f_{LO2} = 1501MHz		54		dB
LO Switching Time		50% of LOSEL to IF settled within 2 degrees		50		ns

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

Note 6: All limits reflect losses of external components, including a 0.8dB loss at f_{IF} = 350MHz due to the 4:1 transformer. Output measurements were taken at IF outputs of the *Typical Application Circuit*.

Note 7: 100% production tested for functionality.

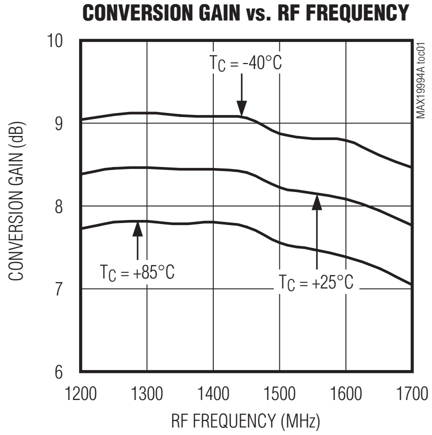
Note 8: Maximum reliable continuous input power applied to the RF or IF port of this device is +12dBm from a 50Ω source.

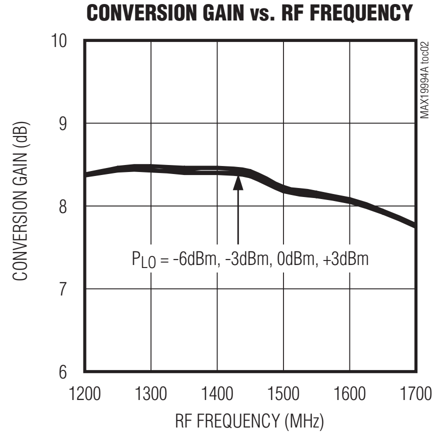
Note 9: Not production tested.

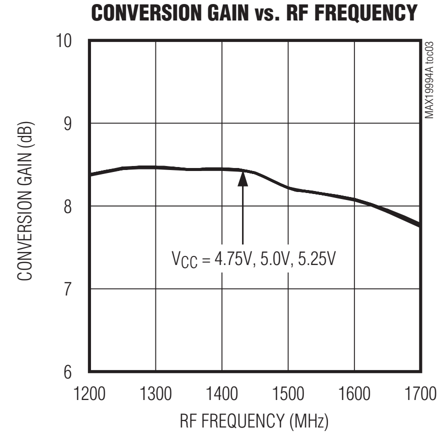
Note 10: Measured with external LO source noise filtered so the noise floor is -174dBm/Hz. This specification reflects the effects of all SNR degradations in the mixer, including the LO noise, as defined in Application Note 2021: *Specifications and Measurement of Local Oscillator Noise in Integrated Circuit Base Station Mixers*.

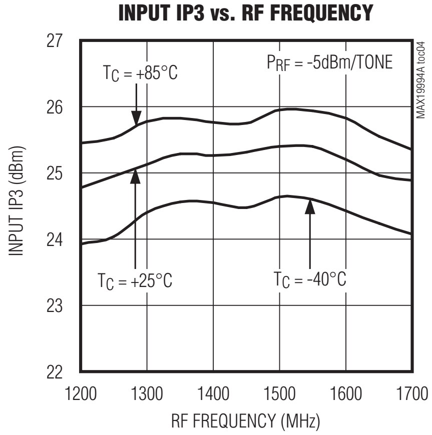
Typical Operating Characteristics

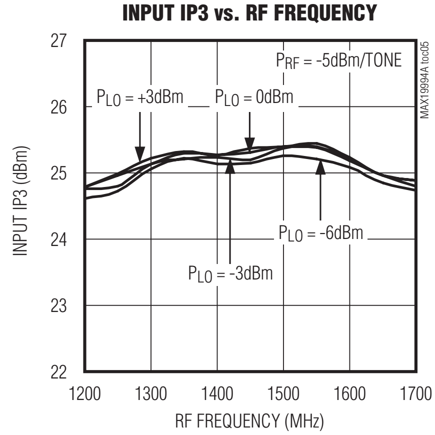
(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1). V_{CC} = 5.0V, f_{RF} = 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

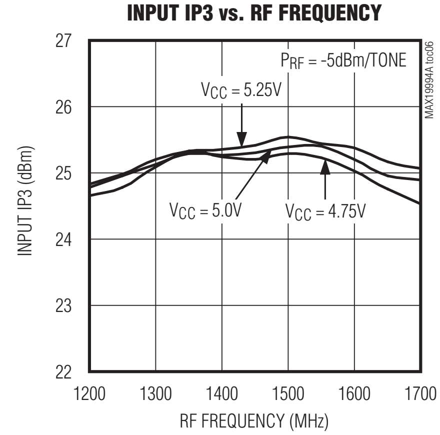










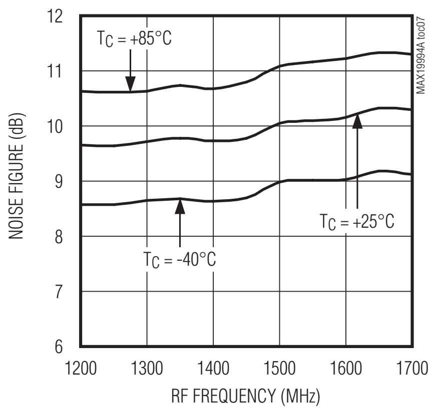


Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

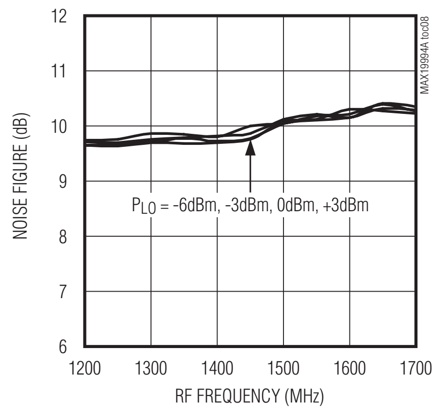
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** **V_{CC} = 5.0V, f_{RF} = 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

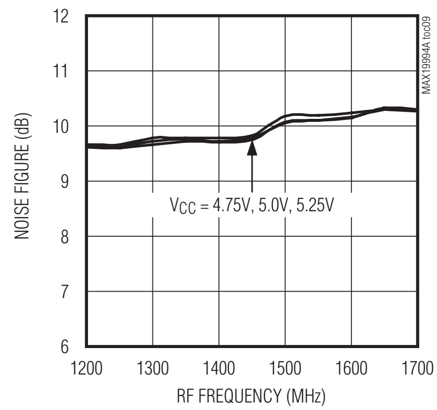
NOISE FIGURE vs. RF FREQUENCY



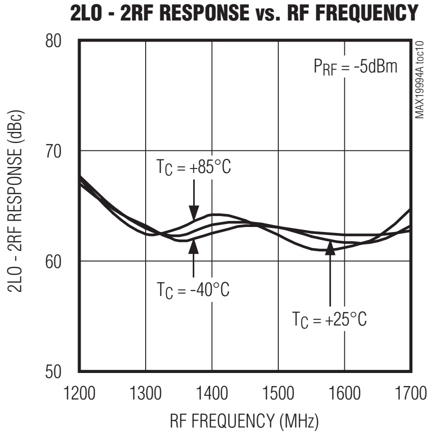
NOISE FIGURE vs. RF FREQUENCY



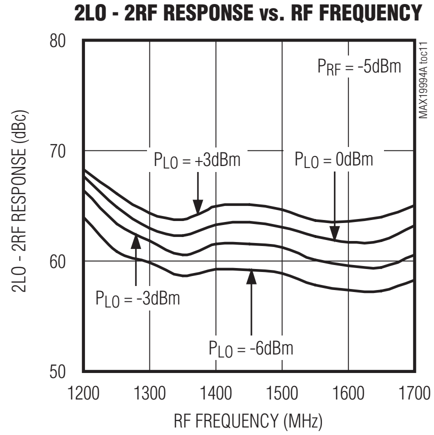
NOISE FIGURE vs. RF FREQUENCY



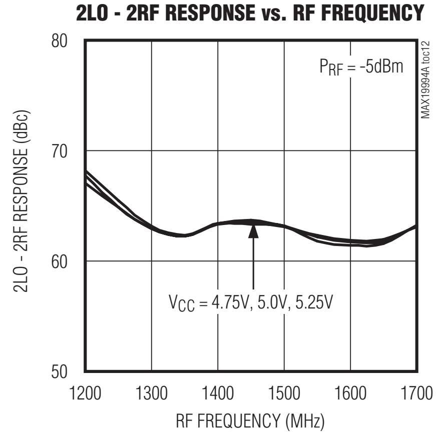
2LO - 2RF RESPONSE vs. RF FREQUENCY



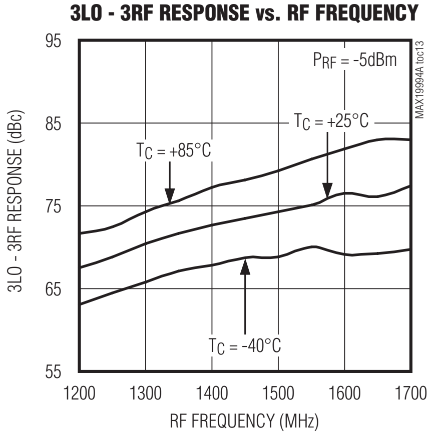
2LO - 2RF RESPONSE vs. RF FREQUENCY



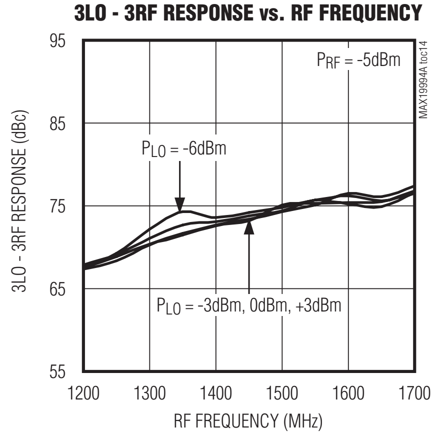
2LO - 2RF RESPONSE vs. RF FREQUENCY



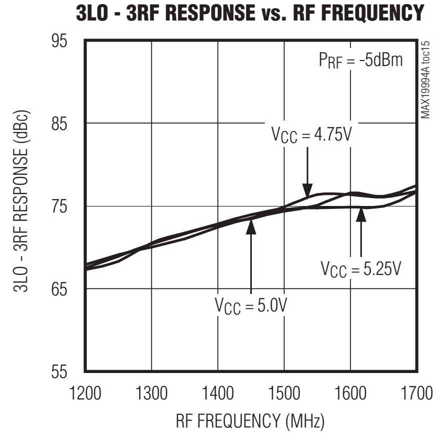
3LO - 3RF RESPONSE vs. RF FREQUENCY



3LO - 3RF RESPONSE vs. RF FREQUENCY



3LO - 3RF RESPONSE vs. RF FREQUENCY

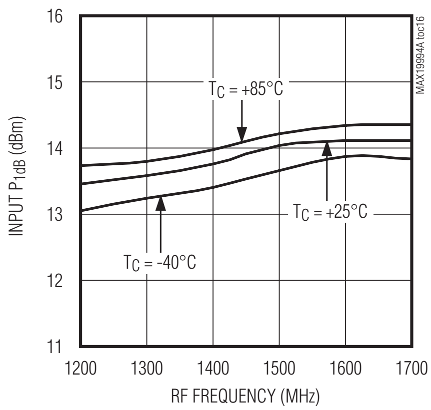


Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

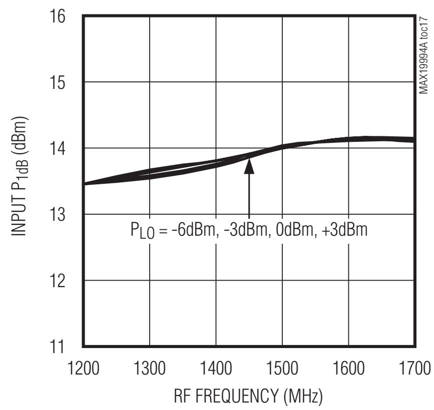
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** V_{CC} **= 5.0V,** f_{RF} **= 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

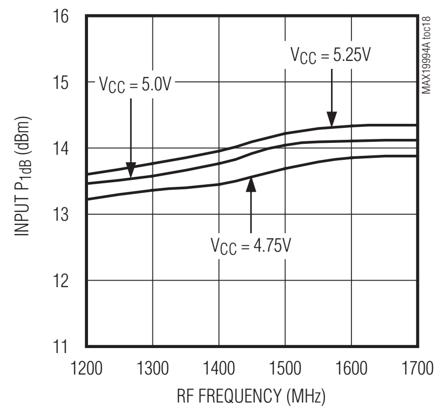
INPUT P_{1dB} vs. RF FREQUENCY



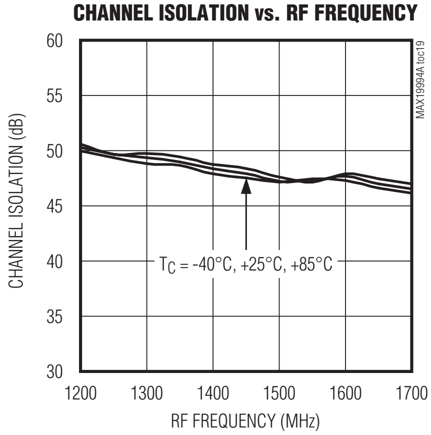
INPUT P_{1dB} vs. RF FREQUENCY



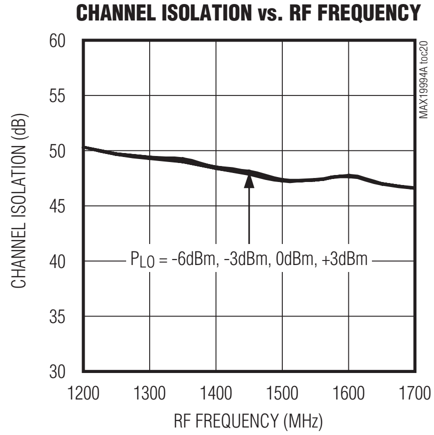
INPUT P_{1dB} vs. RF FREQUENCY



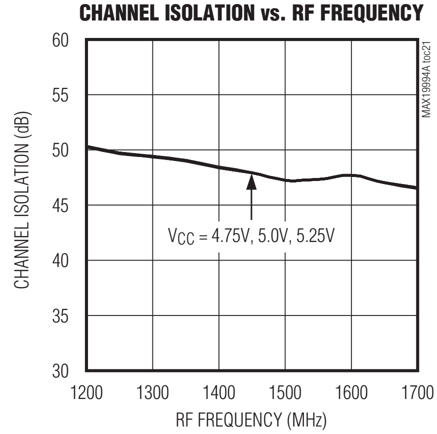
CHANNEL ISOLATION vs. RF FREQUENCY



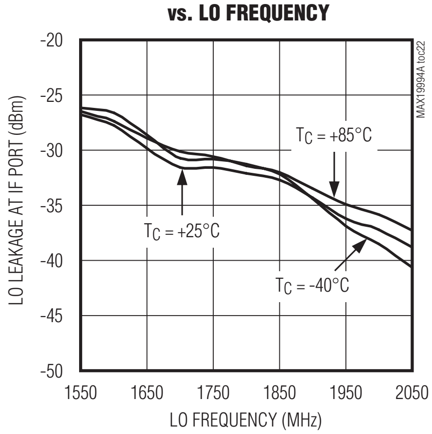
CHANNEL ISOLATION vs. RF FREQUENCY



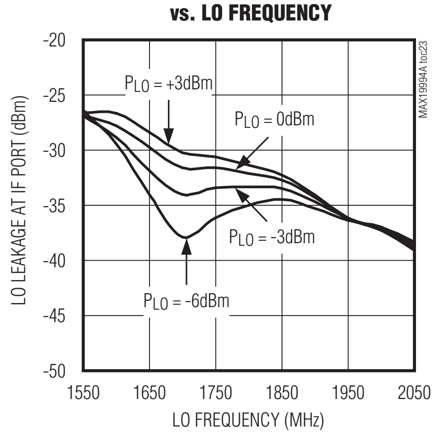
CHANNEL ISOLATION vs. RF FREQUENCY



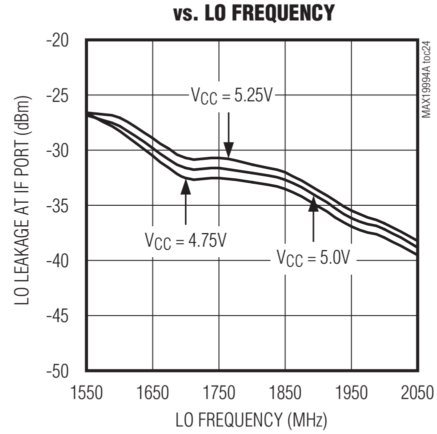
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



LO LEAKAGE AT IF PORT vs. LO FREQUENCY



LO LEAKAGE AT IF PORT vs. LO FREQUENCY

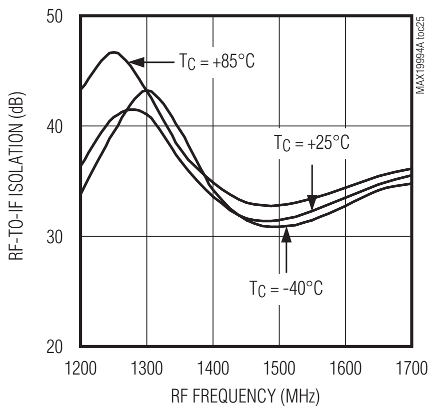


Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

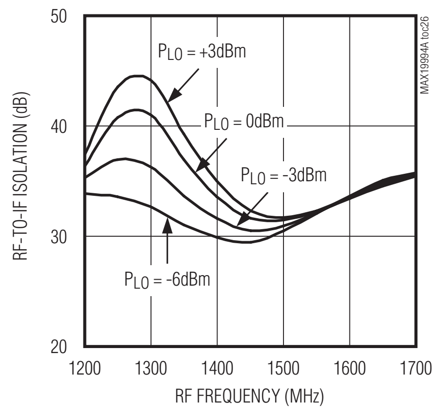
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** V_{CC} **= 5.0V,** f_{RF} **= 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

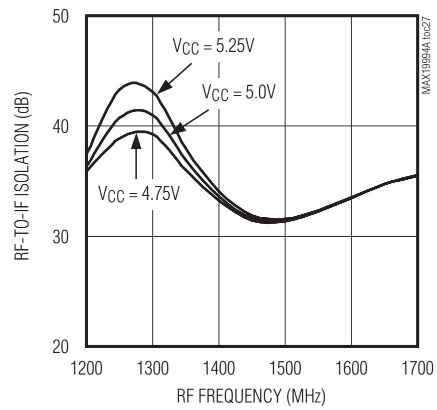
RF-TO-IF ISOLATION vs. RF FREQUENCY



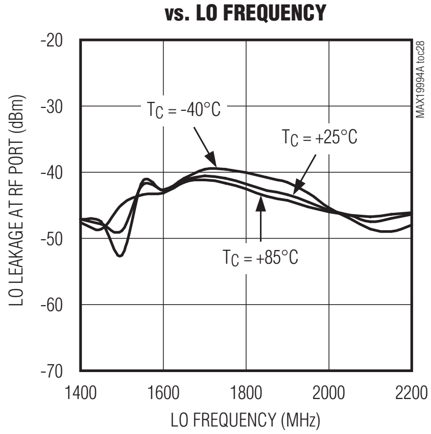
RF-TO-IF ISOLATION vs. RF FREQUENCY



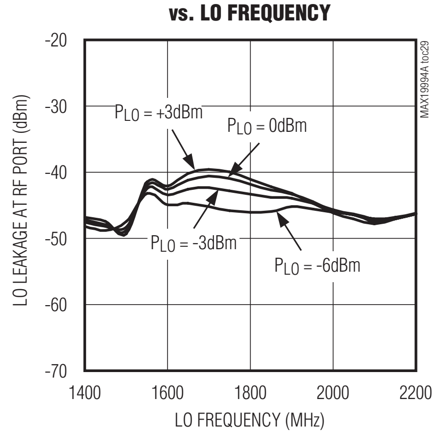
RF-TO-IF ISOLATION vs. RF FREQUENCY



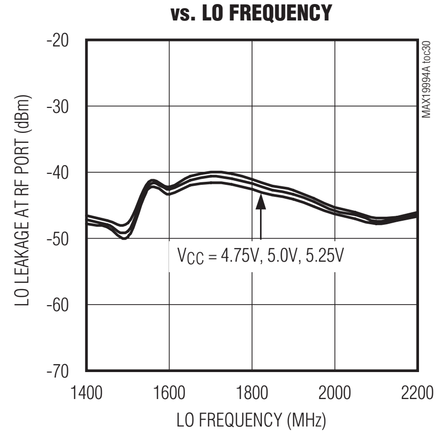
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



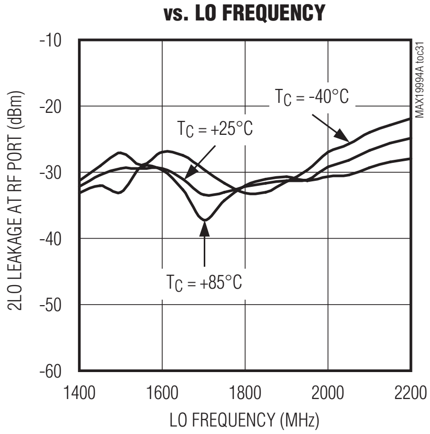
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



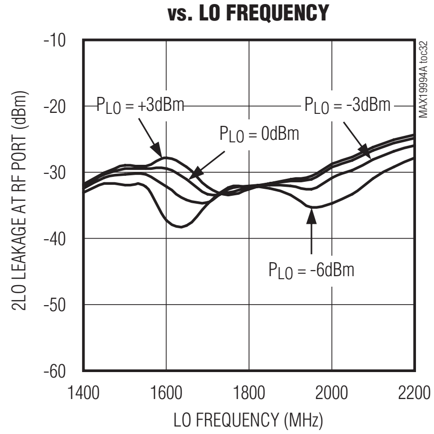
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



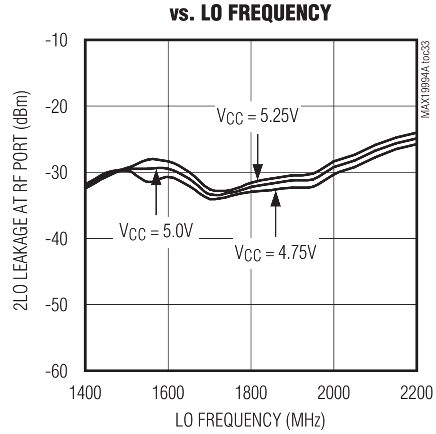
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



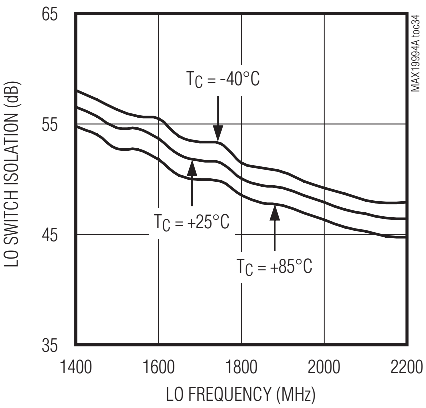
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



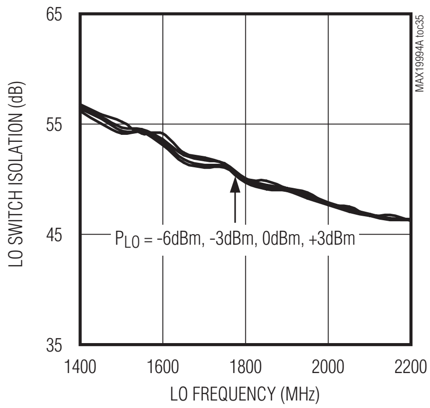
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** V_{CC} **= 5.0V,** f_{RF} **= 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

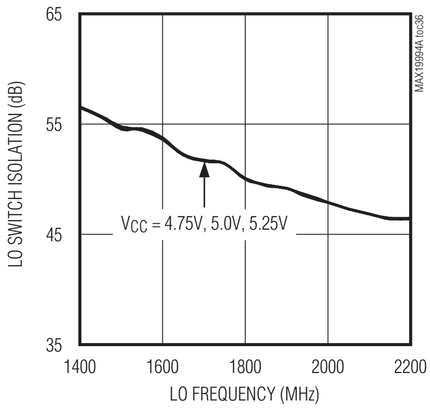
LO SWITCH ISOLATION vs. LO FREQUENCY



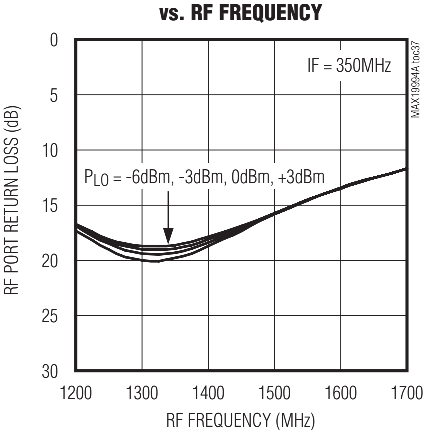
LO SWITCH ISOLATION vs. LO FREQUENCY



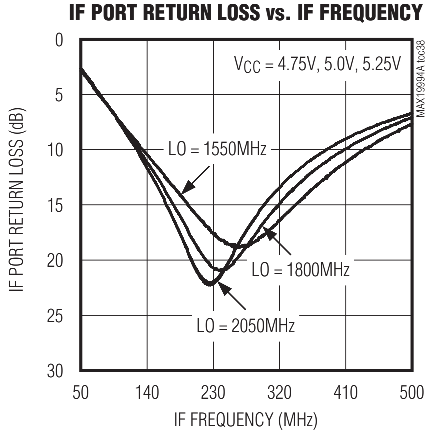
LO SWITCH ISOLATION vs. LO FREQUENCY



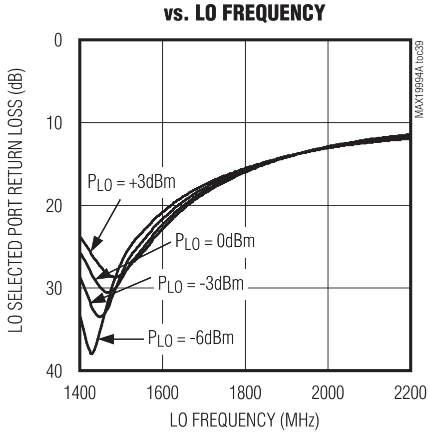
RF PORT RETURN LOSS vs. RF FREQUENCY



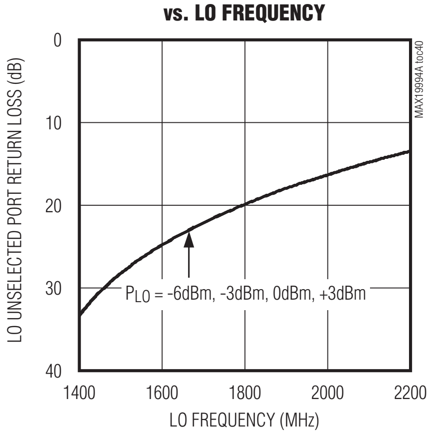
IF PORT RETURN LOSS vs. IF FREQUENCY



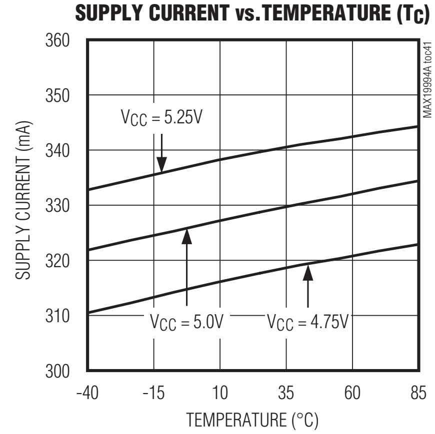
LO SELECTED PORT RETURN LOSS vs. LO FREQUENCY



LO UNSELECTED PORT RETURN LOSS vs. LO FREQUENCY



SUPPLY CURRENT vs.TEMPERATURE (T_C)

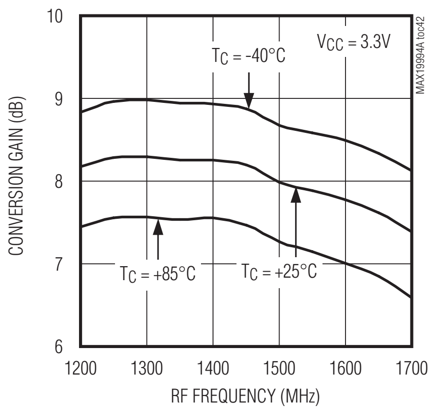


Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

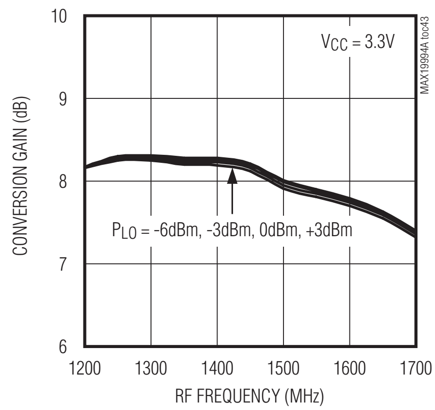
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** V_{CC} **= 3.3V,** f_{RF} **= 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

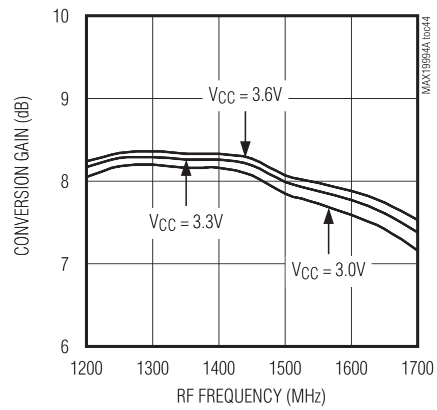
CONVERSION GAIN vs. RF FREQUENCY



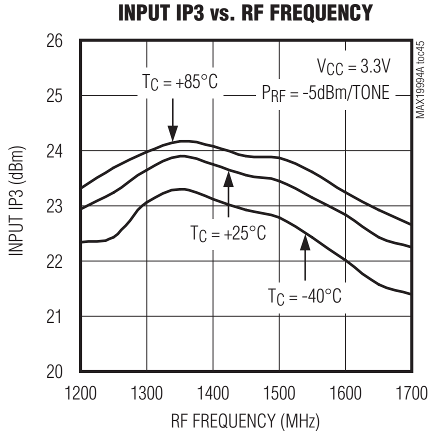
CONVERSION GAIN vs. RF FREQUENCY



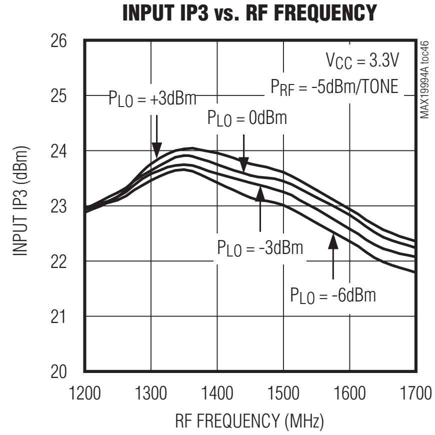
CONVERSION GAIN vs. RF FREQUENCY



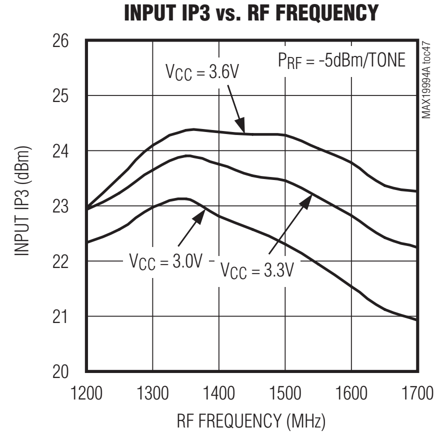
INPUT IP3 vs. RF FREQUENCY



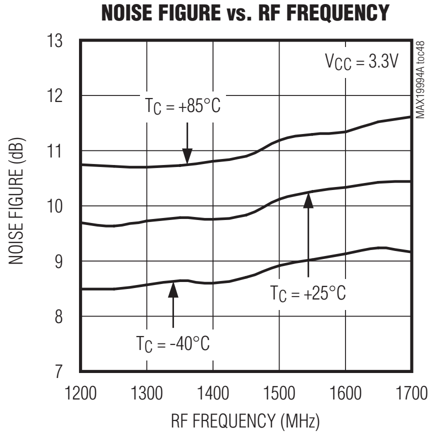
INPUT IP3 vs. RF FREQUENCY



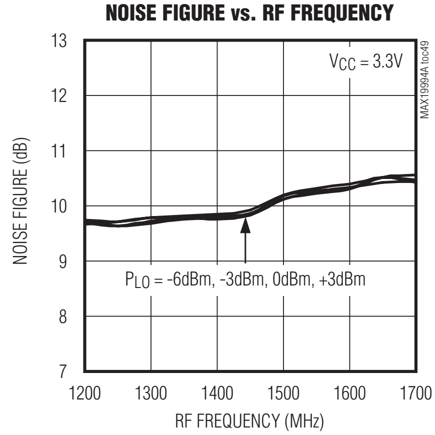
INPUT IP3 vs. RF FREQUENCY



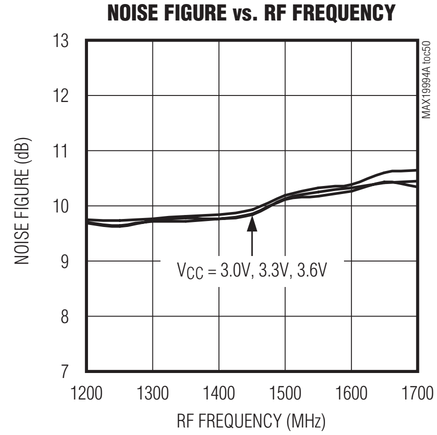
NOISE FIGURE vs. RF FREQUENCY



NOISE FIGURE vs. RF FREQUENCY

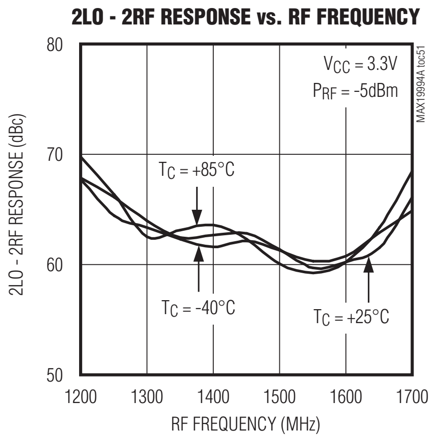


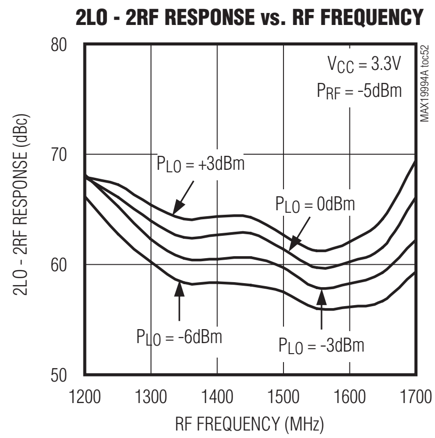
NOISE FIGURE vs. RF FREQUENCY

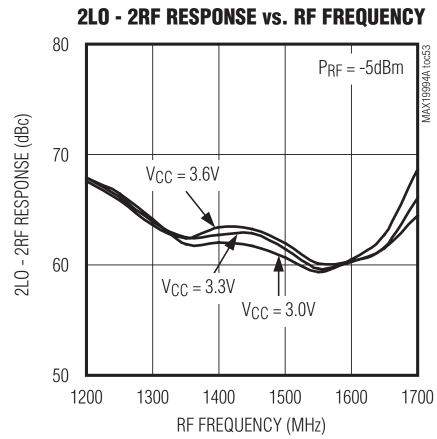


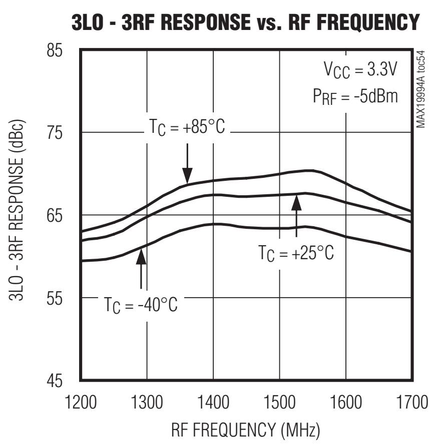
Typical Operating Characteristics (continued)

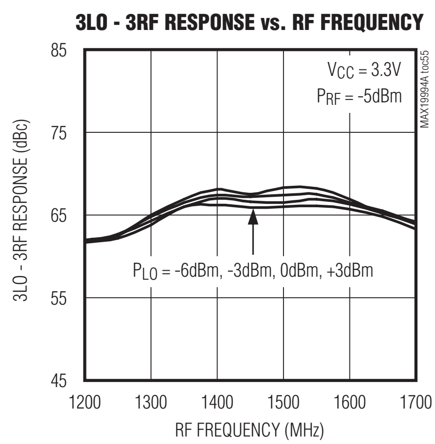
(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** V_{CC} **= 3.3V,** f_{RF} **= 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

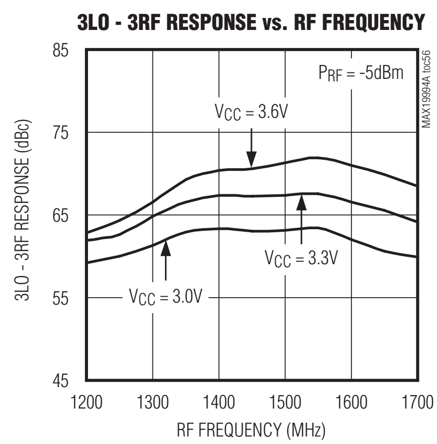


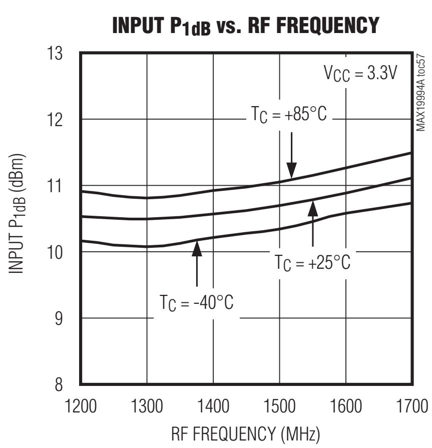


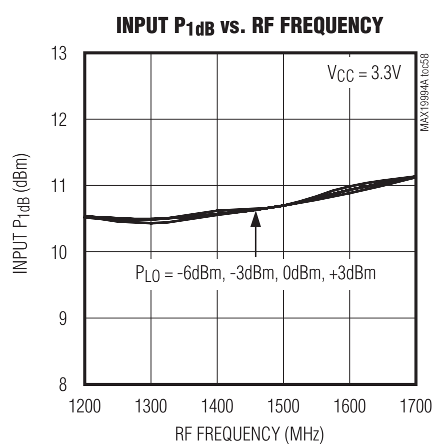


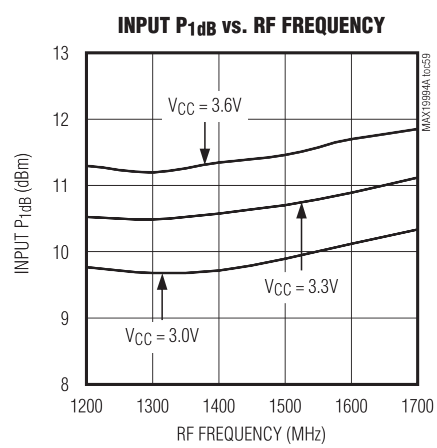










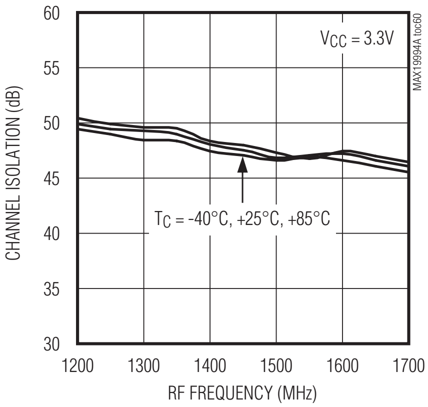


Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

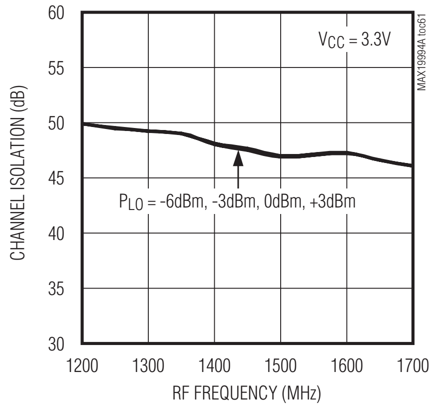
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** **V_{CC} = 3.3V, f_{RF} = 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

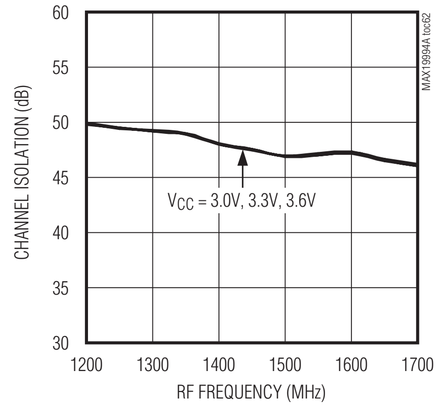
CHANNEL ISOLATION vs. RF FREQUENCY



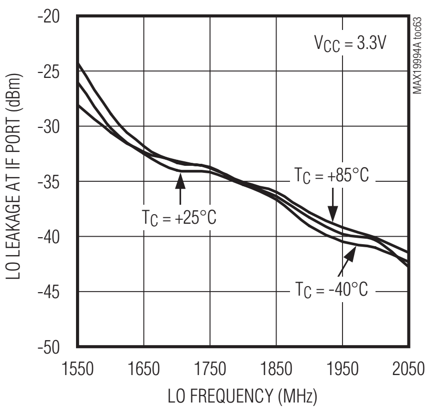
CHANNEL ISOLATION vs. RF FREQUENCY



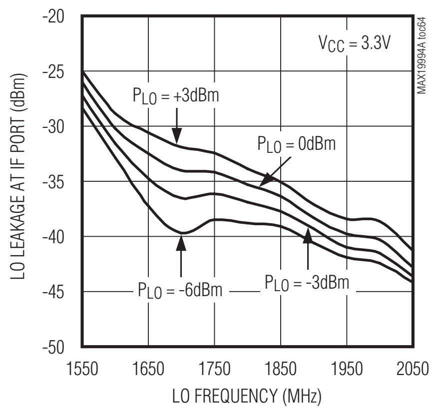
CHANNEL ISOLATION vs. RF FREQUENCY



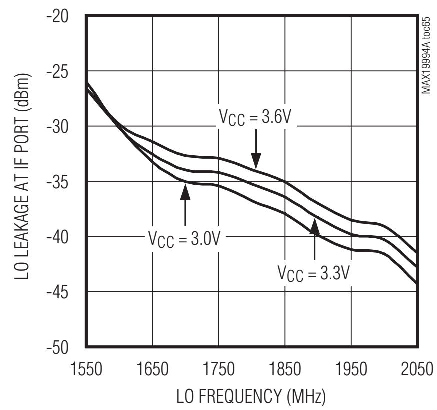
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



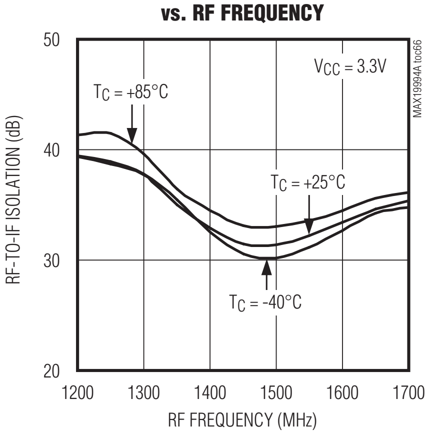
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



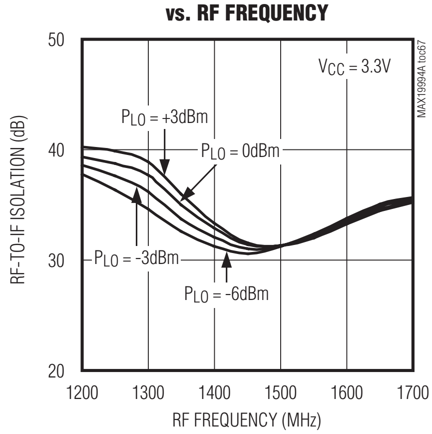
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



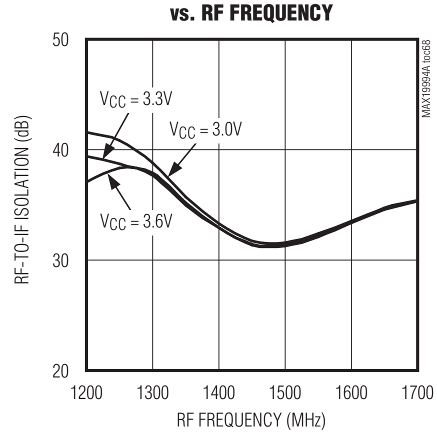
RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



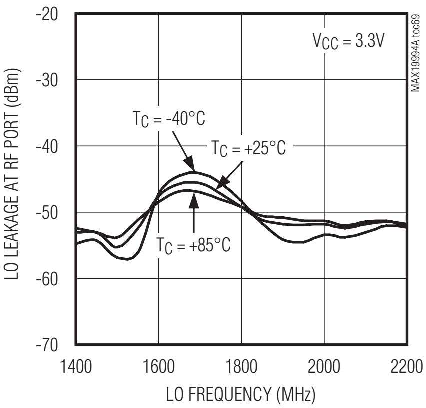
RF-TO-IF ISOLATION vs. RF FREQUENCY



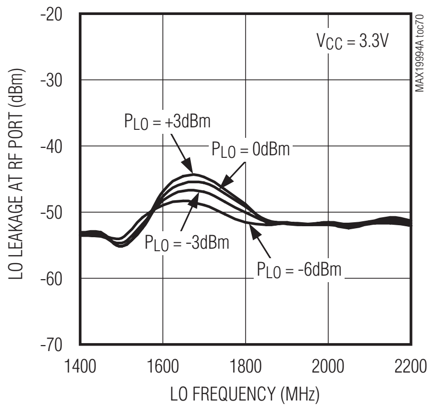
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** V_{CC} **= 3.3V,** f_{RF} **= 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

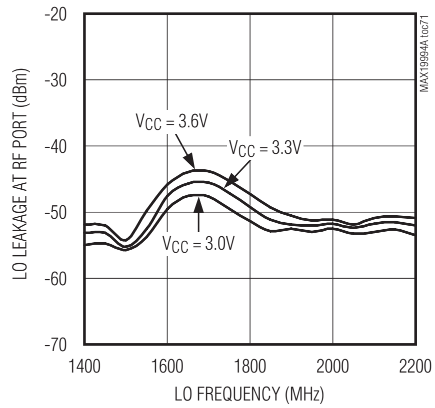
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



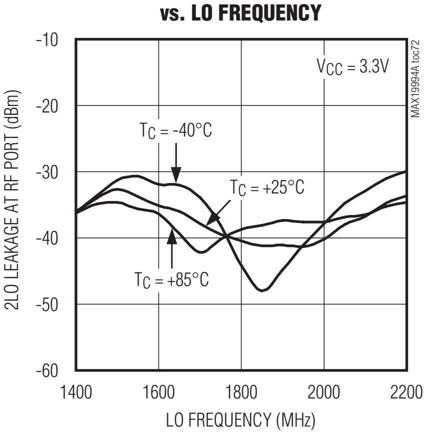
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



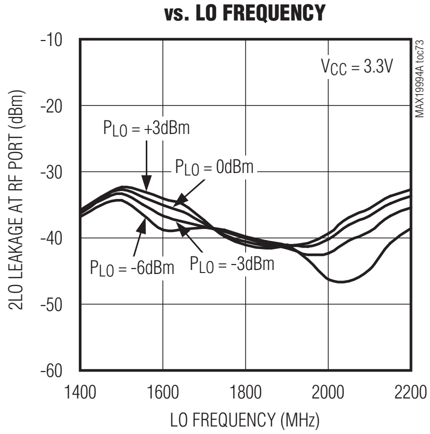
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



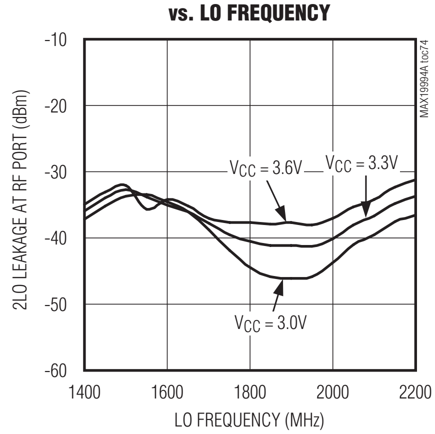
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



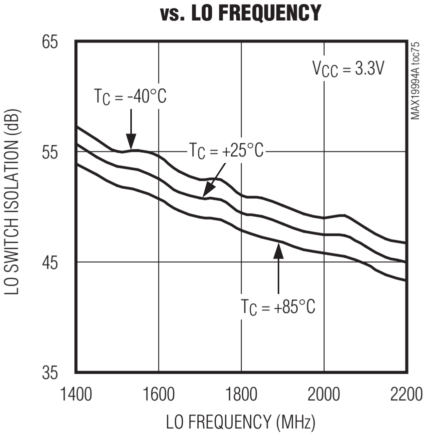
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



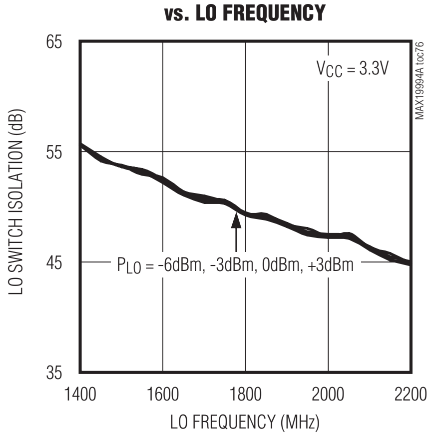
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



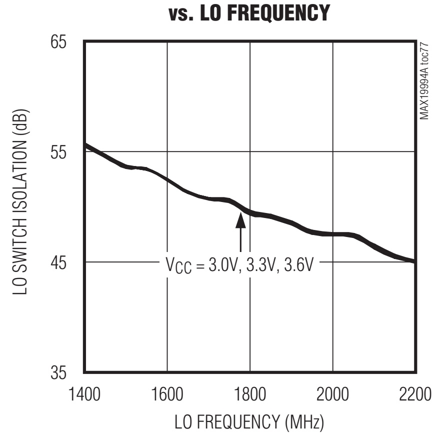
LO SWITCH ISOLATION vs. LO FREQUENCY



LO SWITCH ISOLATION vs. LO FREQUENCY



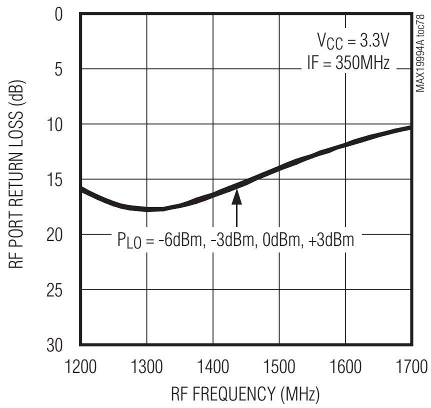
LO SWITCH ISOLATION vs. LO FREQUENCY



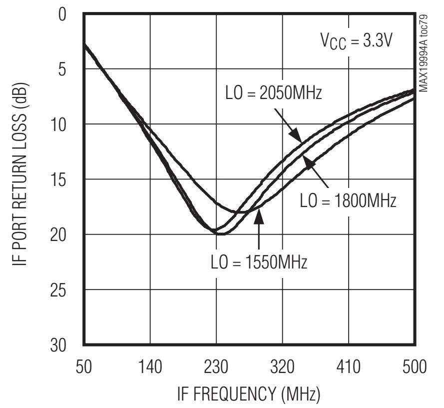
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Standard RF Band (see Table 1).** V_{CC} **= 3.3V,** f_{RF} **= 1200MHz to 1700MHz, LO is high-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

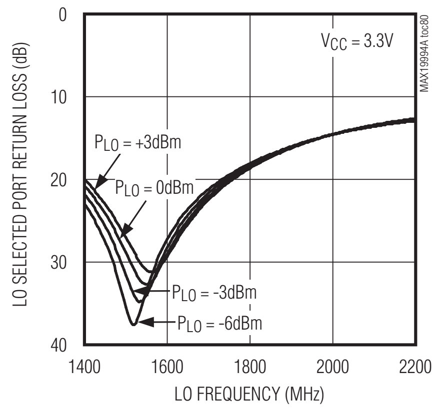
RF PORT RETURN LOSS vs. RF FREQUENCY



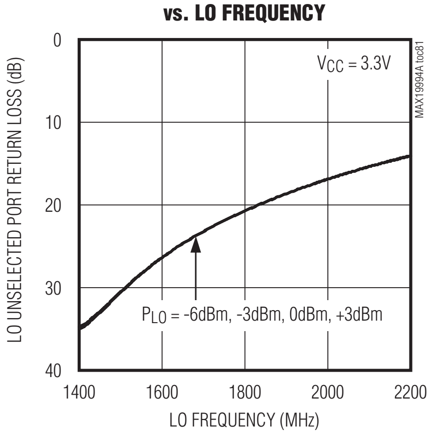
IF PORT RETURN LOSS vs. IF FREQUENCY



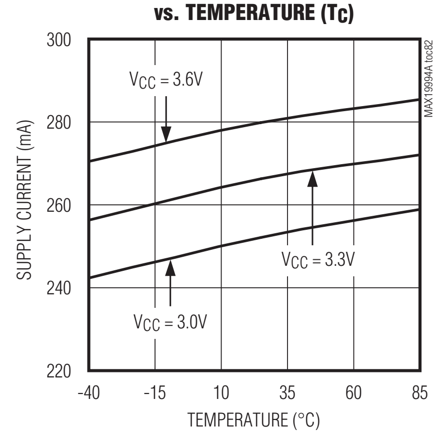
LO SELECTED PORT RETURN LOSS vs. LO FREQUENCY



LO UNSELECTED PORT RETURN LOSS vs. LO FREQUENCY



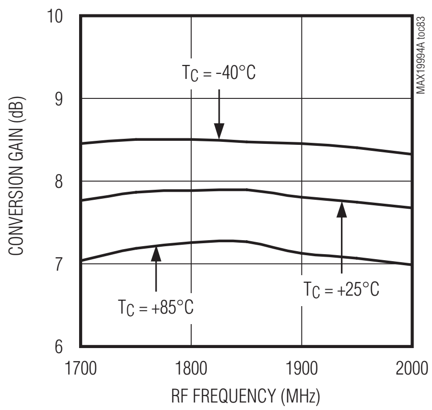
SUPPLY CURRENT vs. TEMPERATURE (T_C)



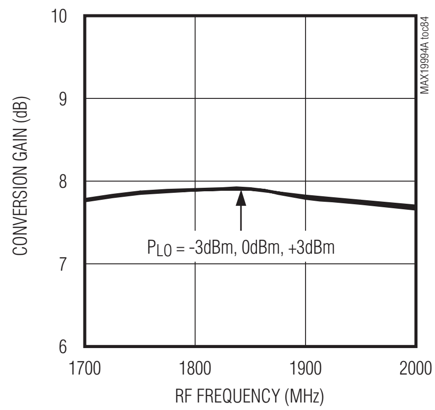
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Extended RF Band (see Table 1). V_{CC} = 5.0V, f_{RF} = 1700MHz to 2000MHz, LO is low-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

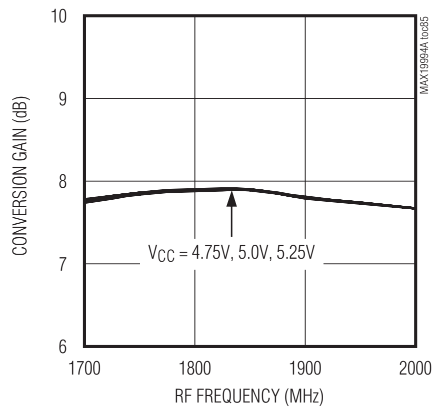
CONVERSION GAIN vs. RF FREQUENCY



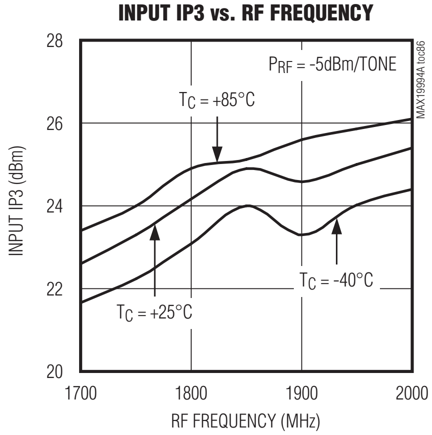
CONVERSION GAIN vs. RF FREQUENCY



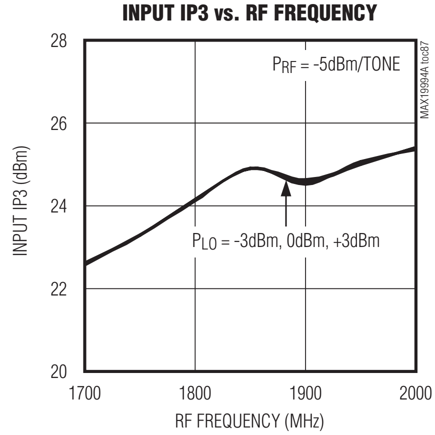
CONVERSION GAIN vs. RF FREQUENCY



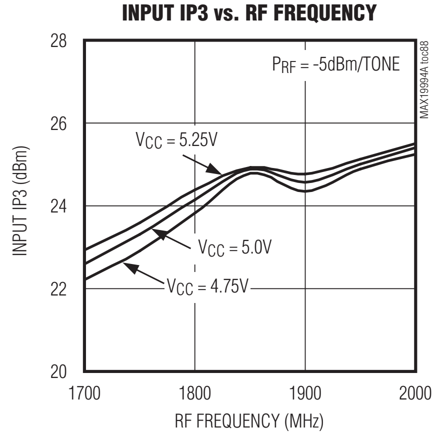
INPUT IP3 vs. RF FREQUENCY



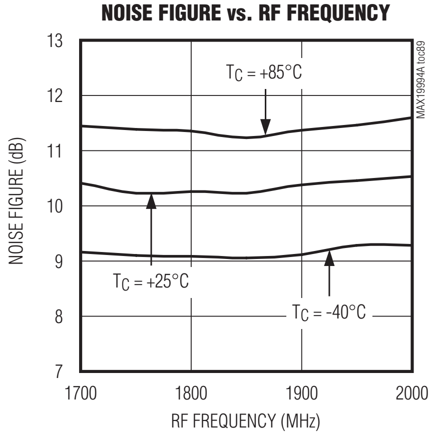
INPUT IP3 vs. RF FREQUENCY



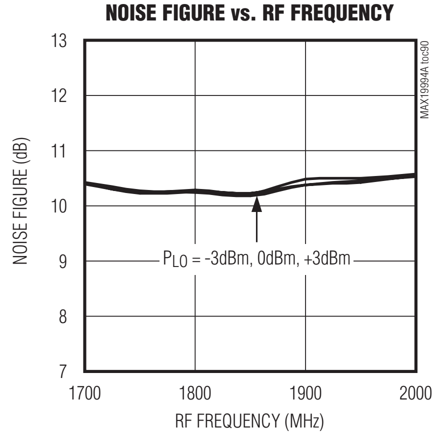
INPUT IP3 vs. RF FREQUENCY



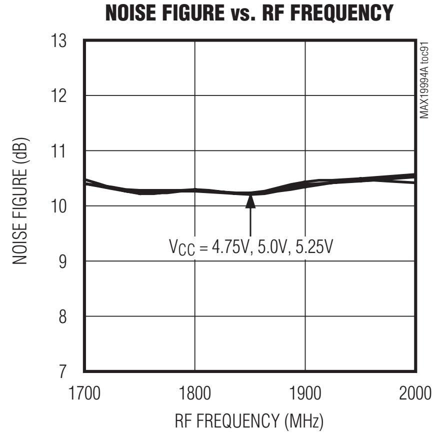
NOISE FIGURE vs. RF FREQUENCY



NOISE FIGURE vs. RF FREQUENCY



NOISE FIGURE vs. RF FREQUENCY

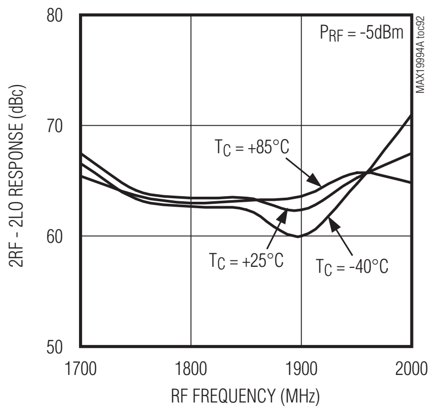


Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

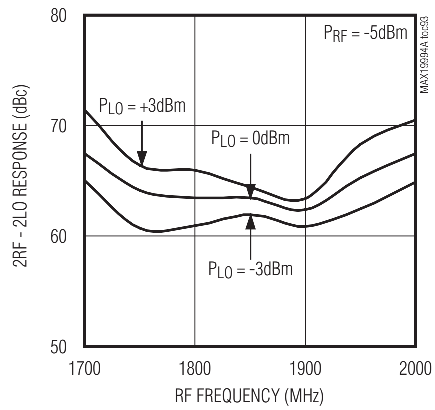
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Extended RF Band (see Table 1).** V_{CC} **= 5.0V,** f_{RF} **= 1700MHz to 2000MHz, LO is low-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

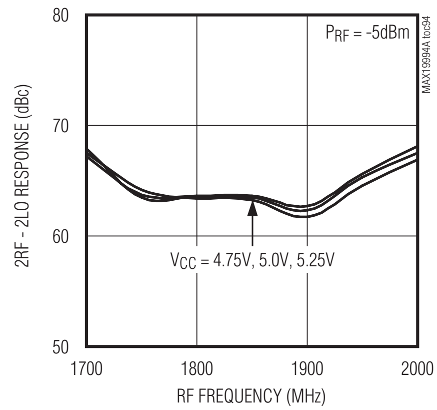
2RF - 2LO RESPONSE vs. RF FREQUENCY



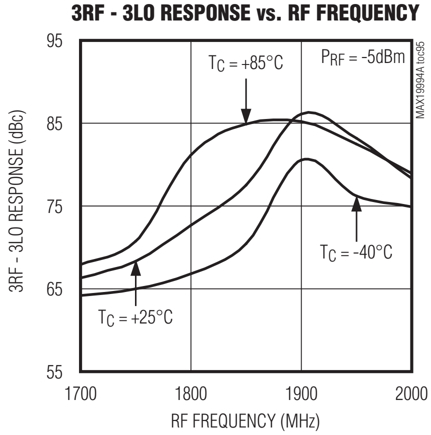
2RF - 2LO RESPONSE vs. RF FREQUENCY



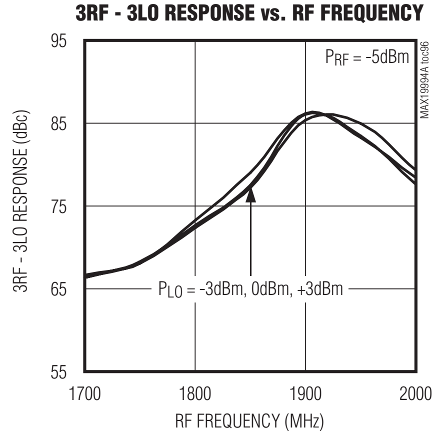
2RF - 2LO RESPONSE vs. RF FREQUENCY



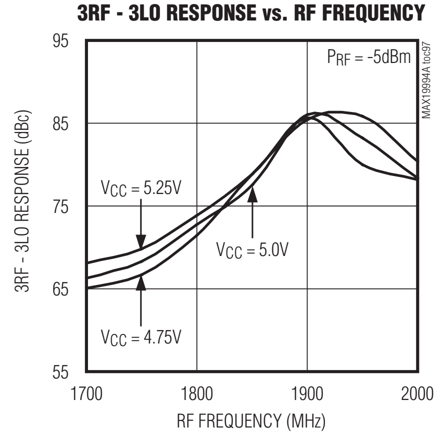
3RF - 3LO RESPONSE vs. RF FREQUENCY



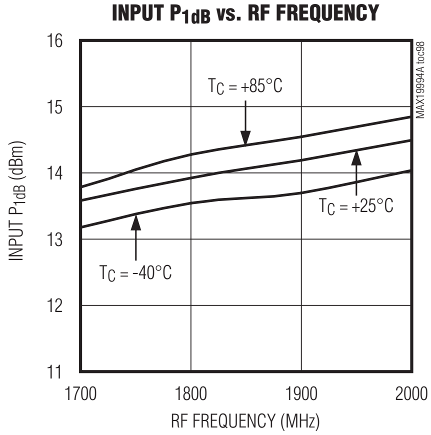
3RF - 3LO RESPONSE vs. RF FREQUENCY



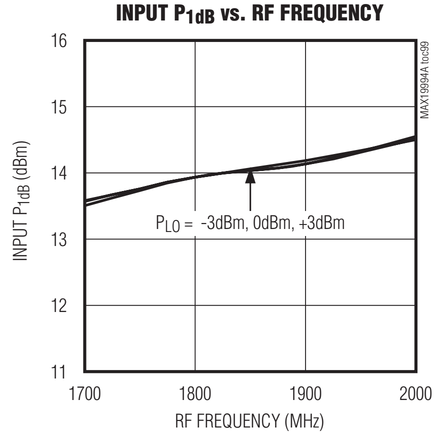
3RF - 3LO RESPONSE vs. RF FREQUENCY



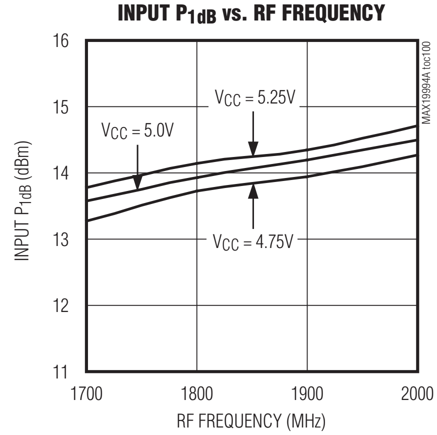
INPUT P_{1dB} vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY



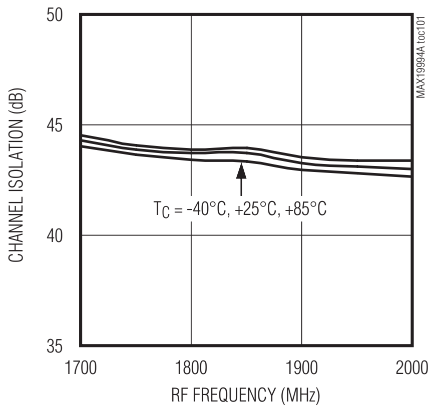
INPUT P_{1dB} vs. RF FREQUENCY



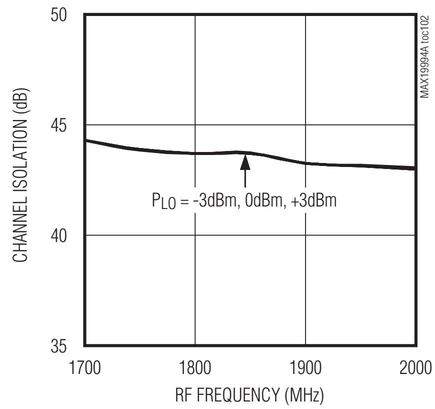
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Extended RF Band (see Table 1).** $\mathbf{V_{CC} = 5.0V}$**,** $\mathbf{f_{RF} =}$ **1700MHz to 2000MHz, LO is low-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

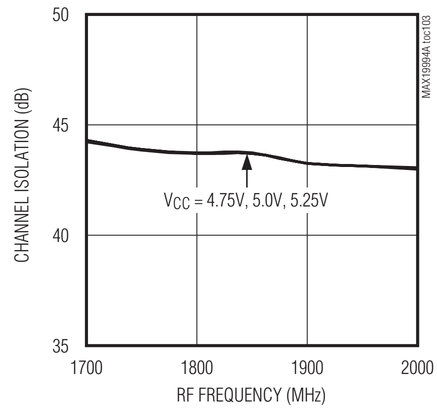
CHANNEL ISOLATION vs. RF FREQUENCY



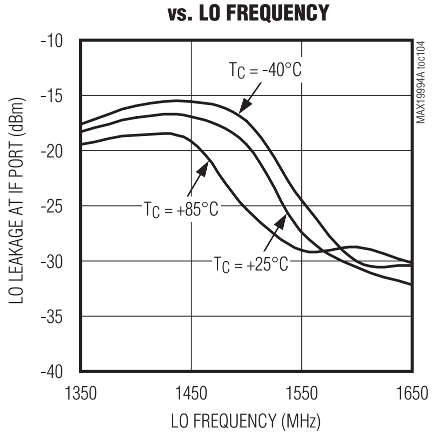
CHANNEL ISOLATION vs. RF FREQUENCY



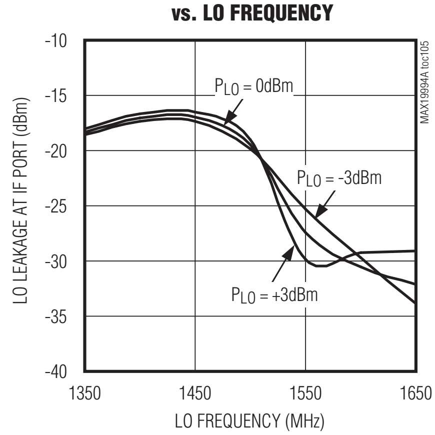
CHANNEL ISOLATION vs. RF FREQUENCY



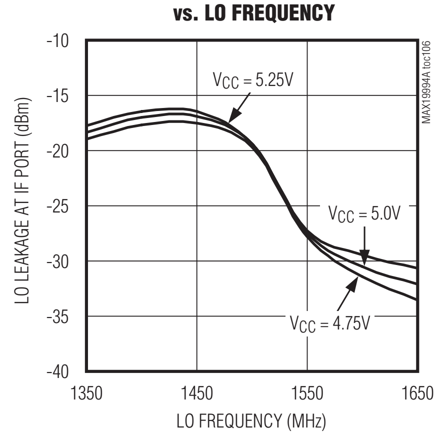
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



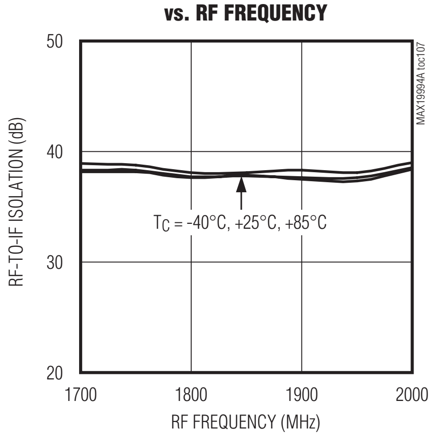
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



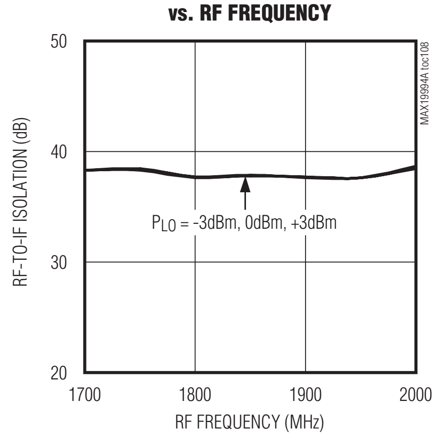
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



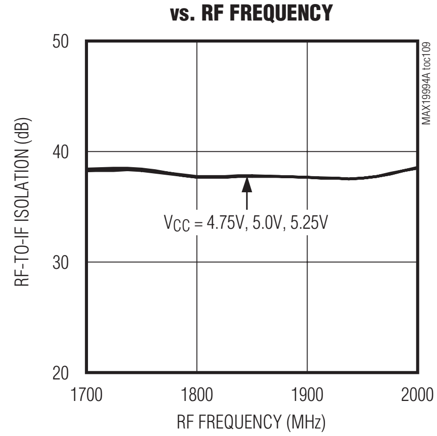
RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY

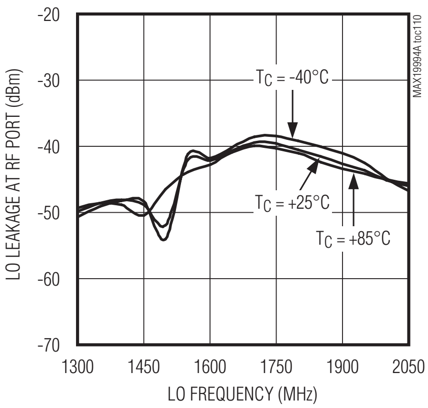


Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

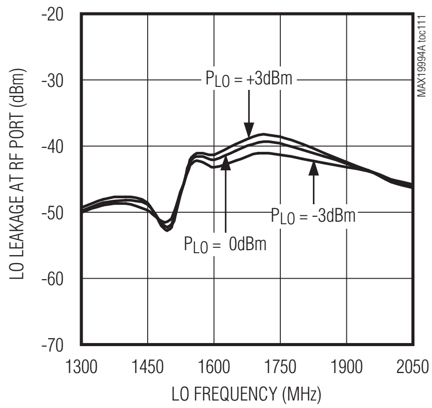
Typical Operating Characteristics (continued)

(*Typical Application Circuit* **optimized for the Extended RF Band (see Table 1).** V_{CC} **= 5.0V,** f_{RF} **= 1700MHz to 2000MHz, LO is low-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)

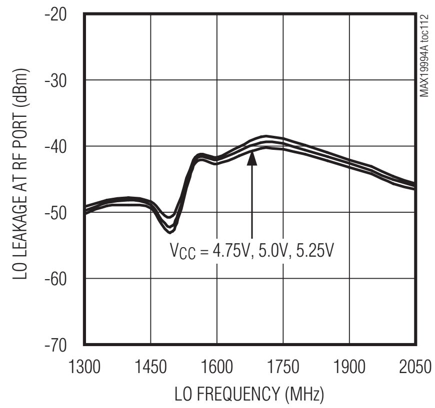
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



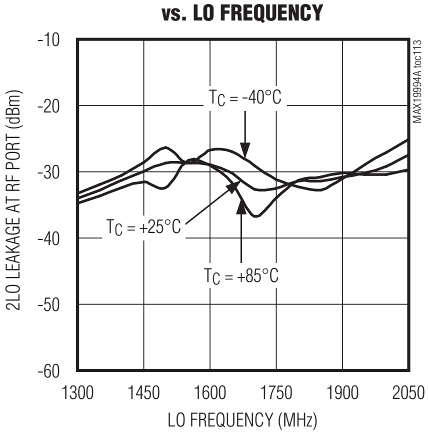
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



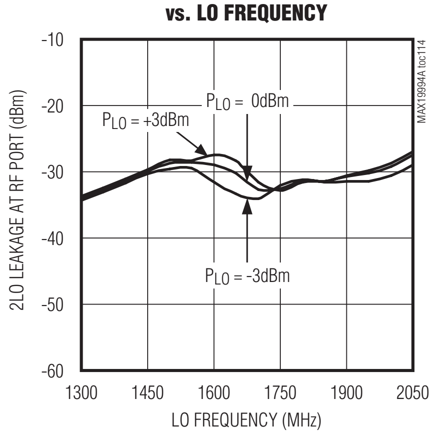
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



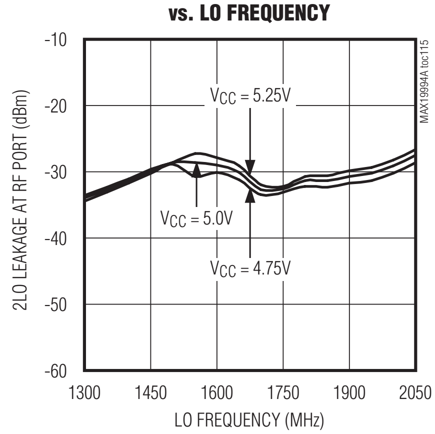
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



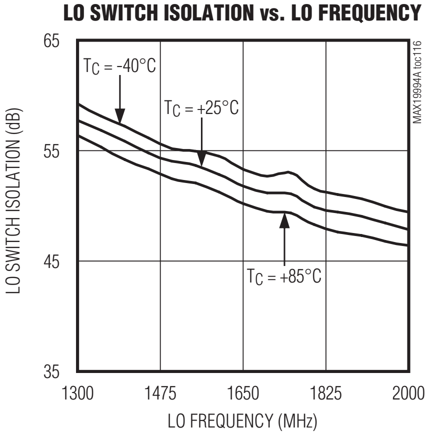
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



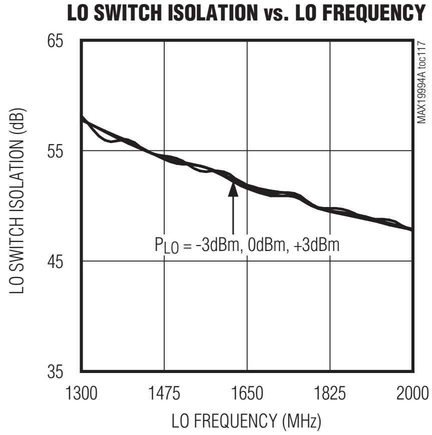
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



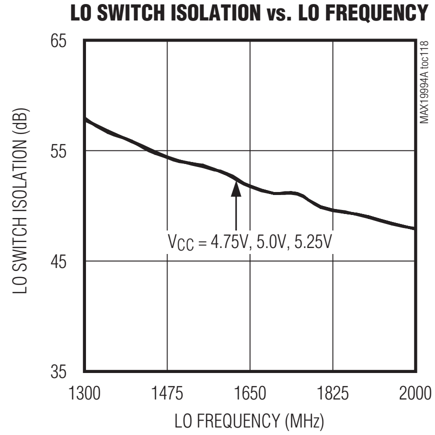
LO SWITCH ISOLATION vs. LO FREQUENCY



LO SWITCH ISOLATION vs. LO FREQUENCY

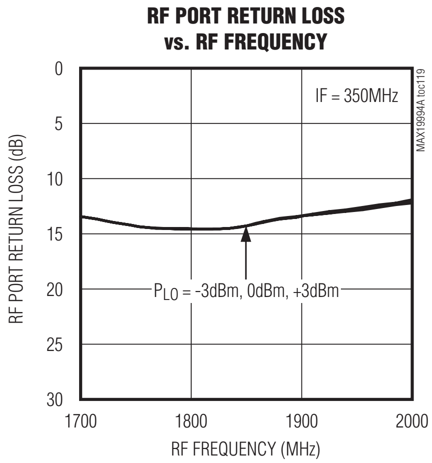


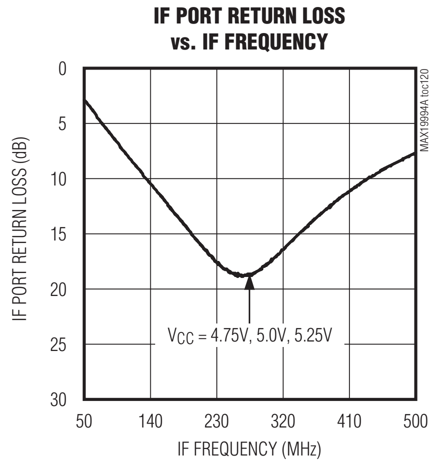
LO SWITCH ISOLATION vs. LO FREQUENCY

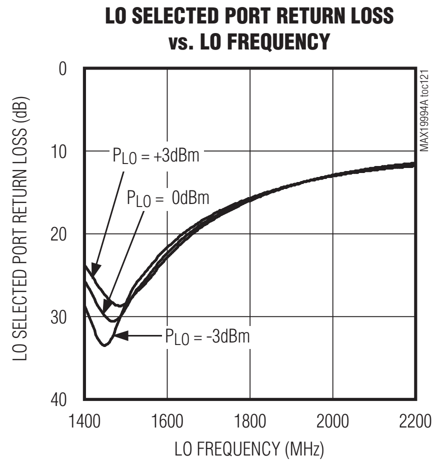


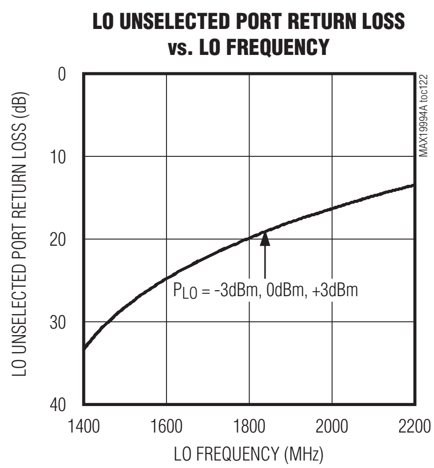
Typical Operating Characteristics (continued)

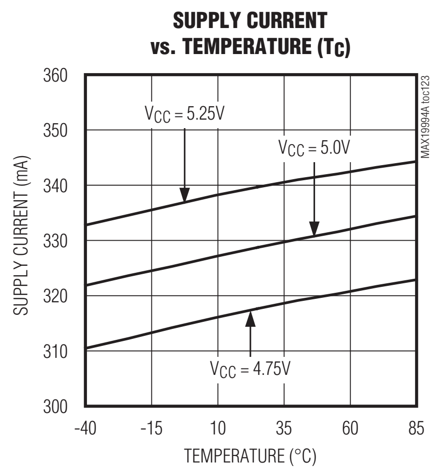
(*Typical Application Circuit* **optimized for the Extended RF Band (see Table 1). V_{CC} = 5.0V, f_{RF} = 1700MHz to 2000MHz, LO is low-side injected** for a 350MHz IF, P_{RF} = -5dBm, P_{LO} = 0dBm, T_C = +25°C, unless otherwise noted.)





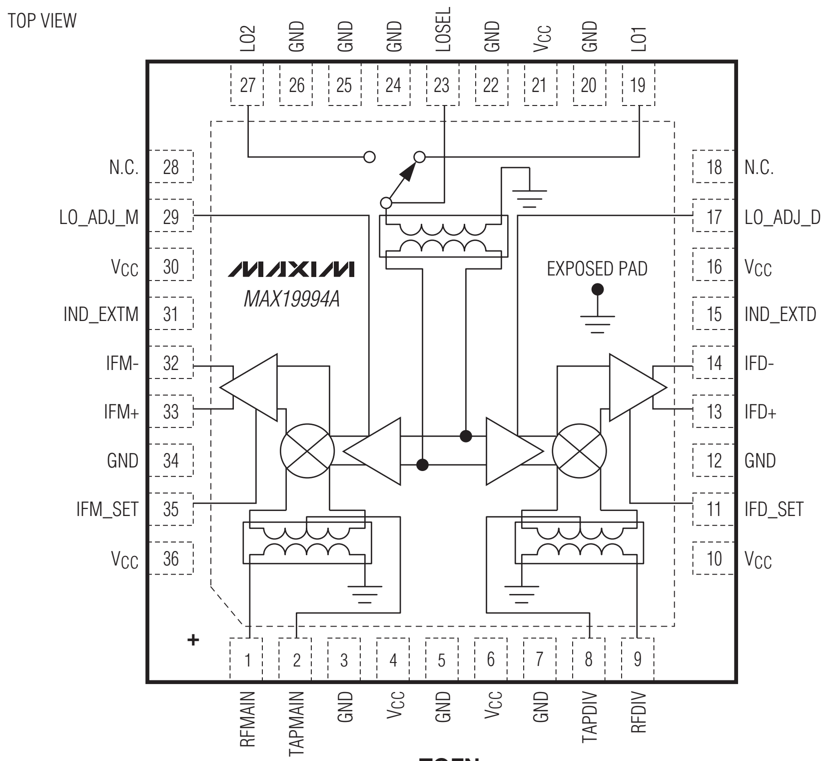






Dual, SiGe, High-Linearity, 1200MHz to 2000MHz Downconversion Mixer with LO Buffer/Switch

Pin Configuration/Functional Block Diagram



TQFN
(6mm × 6mm)

EXPOSED PAD ON THE BOTTOM OF THE PACKAGE

Pin Description

PIN	NAME	FUNCTION
1	RFMAIN	Main Channel RF input. Internally matched to 50Ω. Requires an input DC-blocking capacitor.
2	TAPMAIN	Main Channel Balun Center Tap. Bypass to GND with 39pF and 0.033µF capacitors as close as possible to the pin with the smaller value capacitor closer to the part.
3, 5, 7, 12, 20, 22, 24, 25, 26, 34	GND	Ground
4, 6, 10, 16, 21, 30, 36	V_{CC}	Power Supply. Bypass to GND with capacitors as close as possible to the pin, as shown in the *Typical Application Circuit*.
8	TAPDIV	Diversity Channel Balun Center Tap. Bypass to GND with 39pF and 0.033µF capacitors as close as possible to the pin with the smaller value capacitor closer to the part.

Pin Description (continued)

PIN	NAME	FUNCTION
9	RFDIV	Diversity Channel RF input. Internally matched to 50Ω. Requires an input DC-blocking capacitor.
11	IFD_SET	IF Diversity Amplifier Bias Control. Connect a resistor from this pin to ground to set the bias current for the diversity IF amplifier (see the *Typical Application Circuit*).
13, 14	IFD+, IFD-	Diversity Mixer Differential IF Output +/-. Connect pullup inductors from each of these pins to V_{CC} (see the *Typical Application Circuit*).
15	IND_EXTD	Diversity External Inductor Connection. Connect this pin to ground. For improved RF-to-IF and LO-to-IF isolation, connect a low-ESR 10nH inductor from this pin to ground (see the *Typical Application Circuit*).
17	LO_ADJ_D	LO Diversity Amplifier Bias Control. Connect a resistor from this pin to ground to set the bias current for the diversity LO amplifier (see the *Typical Application Circuit*).
18, 28	N.C.	No Connection. Not internally connected.
19	LO1	Local Oscillator 1 Input. This input is internally matched to 50Ω. Requires an input DC-blocking capacitor.
23	LOSEL	Local Oscillator Select. Set this pin to high to select LO1. Set to low to select LO2.
27	LO2	Local Oscillator 2 Input. This input is internally matched to 50Ω. Requires an input DC-blocking capacitor.
29	LO_ADJ_M	LO Main Amplifier Bias Control. Connect a resistor from this pin to ground to set the bias current for the main LO amplifier (see the *Typical Application Circuit*).
31	IND_EXTM	Main External Inductor Connection. Connect this pin to ground. For improved RF-to-IF and LO-to-IF isolation, connect a low-ESR 10nH inductor from this pin to ground (see the *Typical Application Circuit*).
32, 33	IFM-, IFM+	Main Mixer Differential IF Output -/+. Connect pullup inductors from each of these pins to V_{CC} (see the *Typical Application Circuit*).
35	IFM_SET	IF Main Amplifier Bias Control. Connect a resistor from this pin to ground to set the bias current for the main IF amplifier (see the *Typical Application Circuit*).
—	EP	Exposed Pad. Internally connected to GND. Solder this exposed pad to a PCB pad that uses multiple ground vias to provide heat transfer out of the device into the PCB ground planes. These multiple ground vias are also required to achieve the noted RF performance.

Detailed Description

The MAX19994A is a dual-channel downconverter designed to provide up to 8.4dB of conversion gain, +25dBm input IP3, +14dBm 1dB input compression point, and a noise figure of 9.8dB.

In addition to its high-linearity performance, the device achieves a high level of component integration. The device integrates two double-balanced mixers for two-channel downconversion. Both the main and diversity channels include a balun and matching circuitry to allow 50Ω single-ended interfaces to the RF ports and the two LO ports. An integrated single-pole/double-throw (SPDT) switch provides 50ns switching time between the two LO inputs, with 48dB of LO-to-LO isolation and -42dBm of LO leakage at the RF port. Furthermore, the integrated LO buffers provide a high drive level to each mixer core, reducing the LO drive required at the device's inputs to a range of -6dBm to +3dBm. The IF ports for both channels incorporate differential outputs for downconversion, which is ideal for providing enhanced 2LO - 2RF performance.

With an optimized 1450MHz to 2050MHz LO frequency range, this mixer supports both high- and low-side LO injection architectures for the 1200MHz to 1700MHz and 1700MHz to 2000MHz RF bands, respectively. The device also supports an IF range of 50MHz to 500MHz. The external IF components set the lower frequency range (see the *Typical Operating Characteristics* for details). Operation beyond these ranges is possible; see the *Typical Operating Characteristics* for additional information.

Although this device is optimized for a 1450MHz to 2050MHz LO frequency range, it can operate with even lower LO frequencies to support 1200MHz to 1700MHz low-side LO injection architectures. However, performance degrades as f_{LO} continues to decrease. Contact the factory for a variant with increased low-side LO performance.

RF Port and Balun

The RF input ports for both the main and diversity channels are internally matched to 50Ω, requiring no external matching components when operating the device over a 1200MHz to 1700MHz RF frequency range. A DC-blocking capacitor is required as the input is internally DC shorted to ground through the on-chip balun. The RF port input return loss is typically better than 15dB over the 1200MHz to 1700MHz RF frequency range.

The RF inputs of the device can also be matched to operate over an extended 1700MHz to 2000MHz RF frequency range of with the addition of two shunt 4.7nH inductors. See Table 1 for details.

LO Inputs, Buffer, and Balun

The device is optimized for a 1450MHz to 2050MHz LO frequency range. As an added feature, the device includes an internal LO SPDT switch for use in frequency-hopping applications. The switch selects one of the two single-ended LO ports, allowing the external oscillator to settle on a particular frequency before it is switched in. LO switching time is typically 50ns, which is more than adequate for typical GSM applications. If frequency hopping is not employed, simply set the switch to either of the LO inputs. The switch is controlled by a digital input (LOSEL), where logic-high selects LO1 and logic-low selects LO2. LO1 and LO2 inputs are internally matched to 50Ω, requiring only 39pF DC-blocking capacitors.

If LOSEL is connected directly to a logic source, then voltage **MUST** be applied to V_{CC} before digital logic is applied to LOSEL to avoid damaging the part. Alternatively, a 1kΩ resistor can be placed in series at the LOSEL to limit the input current in applications where LOSEL is applied before V_{CC}.

The main and diversity channels incorporate a two-stage LO buffer that allows for a wide-input power range for the LO drive. The on-chip low-loss baluns, along with LO buffers, drive the double-balanced mixers. All interfacing and matching components from the LO inputs to the IF outputs are integrated on-chip.

High-Linearity Mixer

The core of the MAX19994A dual-channel downconverter consists of two double-balanced, high-performance passive mixers. Exceptional linearity is provided by the large LO swing from the on-chip LO buffers. When combined with the integrated IF amplifiers, the cascaded IIP3, 2LO - 2RF rejection, and noise-figure performance are typically +25dBm, 68dBc, and 9.8dB, respectively.

Differential IF

The device has a 50MHz to 500MHz IF frequency range, where the low-end frequency depends on the frequency response of the external IF components. Note that these differential ports are ideal for providing enhanced IIP2 performance. Single-ended IF applications require a 4:1 (impedance ratio) balun to transform the 200Ω differential IF impedance to a 50Ω single-ended system. After the balun, the return loss is typically 13dB. The user can use a differential IF amplifier on the mixer IF ports, but a DC block is required on both IFD+/IFD- and IFM+/IFM- ports to keep external DC from entering the IF ports of the mixer.

Applications Information

Input and Output Matching

The RF and LO inputs are internally matched to 50Ω when operating over 1200MHz to 1700MHz and 1450MHz to 2050MHz frequency ranges, respectively. No matching components are required for operation within these bands. The RF port input return loss is typically better than 15dB over the 1200MHz to 1700MHz RF frequency range and return loss at the LO ports is typically better than 15dB over the entire LO range. RF and LO inputs require only DC-blocking capacitors for interfacing.

If operating the device over the Extended RF Band of 1700MHz to 2000MHz, simply change the DC-blocking capacitors to 1.8pF and add a shunt 4.7nH inductor to each RF port. See Table 1 for details. When matched with this alternative set of elements, the RF port input return loss is typically better than 14dB over the 1700MHz to 2000MHz band.

The IF output impedance is 200Ω (differential). For evaluation, an external low-loss 4:1 (impedance ratio) balun transforms this impedance to a 50Ω single-ended output (see the *Typical Application Circuit*).

Reduced-Power Mode

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

Significant reductions in power consumption can also be realized by operating the mixer with an optional 3.3V supply voltage. Doing so reduces the overall power consumption by approximately 47%. See the *3.3V Supply AC Electrical Characteristics* table and the relevant 3.3V curves in the *Typical Operating Characteristics* section.

IND_EXT_ Inductors

For applications requiring optimum RF-to-IF and LO-to-IF isolation, connect low-ESR inductors from IND_EXT_ (pins 15 and 31) to ground. When improved isolation is not required, connect IND_EXT_ to ground using 0Ω resistance.

Layout Considerations

A properly designed PCB is an essential part of any RF/microwave circuit. Keep RF signal lines as short as possible to reduce losses, radiation, and inductance. The load impedance presented to the mixer must be such that any capacitance from both IF_- and IF_+ to ground does not exceed several picofarads. For the best performance, route the ground pin traces directly to the exposed pad under the package. The PCB exposed pad **MUST** be connected to the ground plane of the PCB. Use multiple vias to connect this pad to the lower-level ground planes. This method provides a good RF/thermal-conduction path for the device. Solder the exposed pad on the bottom of the device package to the PCB. The MAX19994A evaluation kit can be used as a reference for board layout. Gerber files are available upon request at **www.maxim-ic.com**.

Power-Supply Bypassing

Proper voltage-supply bypassing is essential for high-frequency circuit stability. Bypass each V_{CC} pin and TAPMAIN/TAPDIV with the capacitors shown in the *Typical Application Circuit* (see Table 1 for component values). Place the TAPMAIN/TAPDIV bypass capacitors to ground within 100 mils of the pin.

Exposed Pad RF/Thermal Considerations

The exposed pad (EP) of the MAX19994A's 36-pin thin QFN-EP package provides a low thermal-resistance path to the die. It is important that the PCB on which the device is mounted be designed to conduct heat from the EP. In addition, provide the EP with a low-inductance path to electrical ground. The EP **MUST** be soldered to a ground plane on the PCB, either directly or through an array of plated via holes.

Table 1. Component Values

DESIGNATION	QTY	DESCRIPTION	COMPONENT SUPPLIER
C1, C8	2	39pF microwave capacitors (0402) 1.8pF for Extended RF Band applications (f_{RF} = 1.7GHz to 2GHz)	Murata Electronics North America, Inc.
C2, C7, C14, C16	4	39pF microwave capacitors (0402)	Murata Electronics North America, Inc.
C3, C6	2	0.033µF microwave capacitors (0603)	Murata Electronics North America, Inc.
C4, C5	2	Not used	—
C9, C13, C15, C17, C18	5	0.01µF microwave capacitors (0402)	Murata Electronics North America, Inc.
C10, C11, C12, C19, C20, C21	6	150pF microwave capacitors (0603)	Murata Electronics North America, Inc.
L1, L2, L4, L5	4	120nH wire-wound, high-Q inductors (0805)	Coilcraft, Inc.
L3, L6	2	10nH wire-wound, high-Q inductors (0603). Smaller values or a 0Ω resistor can be used at the expense of some LO leakage at the IF port and RF-to-IF isolation performance loss.	Coilcraft, Inc.
L7, L8	2	4.7nH inductor (0603). Installed for Extended RF Band applications only (1.7GHz to 2GHz).	TOKO America, Inc.