19-4177; Rev 0; 7/08

MAXIM

SiGe、高线性度、2000MHz至3000MHz下变频混频器，带有LO缓冲器

概述

MAX19996单路、高线性度下变频混频器可为2000MHz至3000MHz的WCS、LTE、WiMAX™以及MMDS无线基础设施应用提供8.7dB转换增益、+24.5dBm IIP3和9.6dB噪声系数。该混频器具有1800MHz至2550MHz LO频率范围，理想用于低端LO注入接收器结构。MAX19996A支持高端LO注入，与MAX19996引脚、功能兼容。

除具有优异的线性度和噪声性能外，MAX19996还具有非常高的元件集成度。该器件包括一个双平衡无源混频器核、一个IF放大器以及一个LO缓冲器。片内集成的非平衡变压器使器件能够接收单端RF和LO输入。MAX19996需要一个标称0dBm的LO驱动，电源电流在V_{CC} = +5.0V时的典型值为230mA、在V_{CC} = +3.3V时为149.5mA。

MAX19996与MAX19996A 2300MHz至3900MHz混频器引脚兼容，并与MAX9984/MAX9986 400MHz至1000MHz混频器以及MAX9993/MAX9994/MAX9996 1700MHz至2200MHz混频器引脚相似。这使得该系列下变频混频器非常适合多个频段采用相同PCB布局的应用。

MAX19996采用紧凑的、5mm x 5mm、20引脚、薄型QFN无铅封装，带有裸焊盘。在-40°C至+85°C扩展级温度范围内，可保证电气性能。

应用

2.3GHz WCS基站

2.5GHz WiMAX和LTE基站

2.7GHz MMDS基站

固定宽带无线接入

无线本地环路

个人移动无线装置

军用系统

WiMAX是WiMAX论坛的商标。

特性

- 2000MHz至3000MHz RF频率范围
- 1800MHz至2550MHz LO频率范围
- 50MHz至500MHz IF频率范围
- 8.7dB (典型值)转换增益
- 9.6dB (典型值)噪声系数
- +24.5dBm (典型值)输入IP3
- +11dBm (典型值)输入1dB压缩点
- P_{RF} = -10dBm时，具有69dBc (典型值)的2RF-2LO杂散抑制
- 集成LO缓冲器
- 内部RF和LO非平衡变压器支持单端输入
- -3dBm至+3dBm的低LO驱动
- 引脚兼容于MAX19996A 2300MHz至3900MHz混频器
- 引脚相似于MAX9993/MAX9994/MAX9996 1700MHz至2200MHz混频器以及MAX9984/MAX9986 400MHz至1000MHz混频器
- 采用+5.0V或+3.3V单电源供电
- 外部电流设置电阻允许折中选择混频器的低功耗/低性能工作模式

定购信息

PART	TEMP RANGE	PIN-PACKAGE
MAX19996ETP+	-40°C to +85°C	20 Thin QFN-EP*
MAX19996ETP+T	-40°C to +85°C	20 Thin QFN-EP*

+表示无铅/符合RoHS标准的封装。

**EP = 裸焊盘。*

T = 卷带包装。

引脚配置在数据资料的最后给出。

SiGe、高线性度、2000MHz至3000MHz下变频混频器，带有LO缓冲器

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +5.5V
IF+, IF-, LOBIAS, LO, IFBIAS, LEXT to GND .....-0.3V to (V_{CC} + 0.3V)
RF, LO Input Power .....+12dBm
RF, LO Current (RF and LO is DC shorted to GND through a balun).....50mA
Continuous Power Dissipation (Note 1) 5.0W
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.cn/thermal-tutorial**.

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

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

+5.0V SUPPLY DC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit*, V_{CC} = +4.75V to +5.25V, no input AC signals. T_C = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +5.0V, T_C = +25°C, all parameters are production tested.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{CC}		4.75	5	5.25	V
Supply Current	I_{CC}			230	245	mA

+3.3V SUPPLY DC ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{CC}		3.0	3.3	3.6	V
Supply Current	I_{CC}	Total supply current, V_{CC} = +3.3V		149.5		mA

RECOMMENDED AC OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RF Frequency	f_{RF}	(Note 7)	2000		3000	MHz
LO Frequency	f_{LO}	(Note 7)	1800		2550	MHz
IF Frequency	f_{IF}	Using Mini-Circuits TC4-1W-17 4:1 transformer as defined in the *Typical Application Circuit*, IF matching components affect the IF frequency range (Note 7)	100		500	MHz
		Using alternative Mini-Circuits TC4-1W-7A 4:1 transformer, IF matching components affect the IF frequency range (Note 7)	50		250	
LO Drive Level	P_{LO}		-3		+3	dBm

+5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit*, V_{CC} = +4.75V to +5.25V, RF and LO ports are driven from 50Ω sources, P_{LO} = -3dBm to +3dBm, P_{RF} = -5dBm, f_{RF} = 2300MHz to 2800MHz, f_{LO} = 2000MHz to 2500MHz, f_{IF} = 300MHz, $f_{RF} > f_{LO}$, T_C = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, P_{RF} = -5dBm, P_{LO} = 0dBm, f_{RF} = 2500MHz, f_{LO} = 2200MHz, f_{IF} = 300MHz, 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 Power Gain	G_C	T_C = +25°C (Note 5)		8.1	8.7	9.3	dB
Conversion Power Gain Variation vs. Frequency	ΔG_C	f_{RF} = 2300MHz to 2800MHz for any 100MHz band			0.1		dB
Conversion Power Gain Temperature Coefficient	TC_G	T_C = -40°C to +85°C			-0.012		dB/°C
Input 1dB Compression Point	IP_{1dB}	T_C = +25°C (Note 8)		10	11		dBm
		f_{RF} = 2500MHz, T_C = +25°C (Note 8)		10.4	11		dBm
Third-Order Input Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz, P_{RF1} = P_{RF2} = -5dBm, T_C = +25°C (Note 5)		22	24.5		dBm
Third-Order Input Intercept Point Variation Over Temperature		f_{RF} = 2300MHz to 2800MHz, f_{IF} = 300MHz, f_{RF1} - f_{RF2} = 1MHz, P_{RF1} = P_{RF2} = -5dBm, T_C = -40°C to +85°C			±0.5		dB
Noise Figure	NF_{SSB}	f_{RF} = 2300MHz to 2700MHz, f_{IF} = 300MHz, single sideband, no blockers present (Note 9)			9.6	12	dB
		f_{RF} = 2500MHz, f_{IF} = 300MHz, P_{LO} = 0dBm, V_{CC} = +5.0V, T_C = +25°C, single sideband, no blockers present (Note 9)			9.6	10.5	
Noise Figure Temperature Coefficient	TC_{NF}	f_{RF} = 2000MHz to 3000MHz, single sideband, no blockers present, T_C = -40°C to +85°C (Note 9)			0.0183		dB/°C
Noise Figure Under Blocking Condition	NF_B	+8dBm blocker tone applied to RF port, f_{RF} = 2300MHz, f_{LO} = 2110MHz, $f_{BLOCKER}$ = 2400MHz, P_{LO} = -3dBm, V_{CC} = +5.0V, T_C = +25°C (Note 9)			20.8	25	dB
2RF-2LO Spur Rejection	2 x 2	f_{RF} = 2300MHz to 2700MHz, f_{LO} = 2000MHz to 2400MHz, f_{SPUR} = f_{LO} + 150MHz	P_{RF} = -10dBm	60	69		dBc
			P_{RF} = -5dBm (Note 5)	55	64		
3RF-3LO Spur Rejection	3 x 3	f_{RF} = 2300MHz to 2700MHz, f_{LO} = 2000MHz to 2400MHz, f_{SPUR} = f_{LO} + 100MHz	P_{RF} = -10dBm	70	78		dBc
			P_{RF} = -5dBm (Note 5)	60	68		
RF Input Return Loss		LO on and IF terminated into a matched impedance			18		dB
LO Input Return Loss		RF and IF terminated into a matched impedance			20		dB

+5.0V SUPPLY AC ELECTRICAL CHARACTERISTICS (continued)

(*Typical Application Circuit*, V_{CC} = +4.75V to +5.25V, RF and LO ports are driven from 50Ω sources, P_{LO} = -3dBm to +3dBm, P_{RF} = -5dBm, f_{RF} = 2300MHz to 2800MHz, f_{LO} = 2000MHz to 2500MHz, f_{IF} = 300MHz, $f_{RF} > f_{LO}$, T_C = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, P_{RF} = -5dBm, P_{LO} = 0dBm, f_{RF} = 2500MHz, f_{LO} = 2200MHz, f_{IF} = 300MHz, T_C = +25°C, all parameters are guaranteed by design and characterization, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
IF Output Impedance	Z_{IF}	Nominal differential impedance at the IC's IF outputs			200		Ω
IF Output Return Loss		RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*. See the *IF Port Return Loss vs. IF Frequency* graph in the *Typical Operating Characteristics* for performance vs. inductor values	f_{IF} = 450MHz, L1 = L2 = 120nH		25		dB
			f_{IF} = 350MHz, L1 = L2 = 270nH		25		
			f_{IF} = 300MHz, L1 = L2 = 470nH		25		
Minimum RF-to-IF Isolation		f_{RF} = 2300MHz to 2700MHz, P_{LO} = +3dBm (Note 5)			34		dB
Maximum LO Leakage at RF Port		f_{LO} = 1900MHz to 2500MHz, P_{LO} = +3dBm			-22.7		dBm
Maximum 2LO Leakage at RF Port		f_{LO} = 1900MHz to 2500MHz, P_{LO} = +3dBm			-21		dBm
Maximum LO Leakage at IF Port		f_{LO} = 1900MHz to 2500MHz, P_{LO} = +3dBm (Note 5)			-27.5		dBm

+3.3V SUPPLY AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit*, RF and LO ports are driven from 50Ω sources, Typical values are at V_{CC} = +3.3V, P_{RF} = -5dBm, P_{LO} = 0dBm, f_{RF} = 2500MHz, f_{LO} = 2200MHz, f_{IF} = 300MHz, T_C = +25°C, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Power Gain	G_C			8.6		dB
Conversion Power Gain Variation vs. Frequency	ΔG_C	f_{RF} = 2300MHz to 2800MHz for any 100MHz band		0.1		dB
Gain Variation Over Temperature	TC_G	T_C = -40°C to +85°C		-0.012		dB/°C
Input 1dB Compression Point	IP_{1dB}	(Note 8)		7.5		dBm
Third-Order Input Intercept Point	IIP3	f_{RF1} = 2500MHz, f_{RF2} = 2501MHz, f_{LO} = 2200MHz, P_{RF1} = P_{RF2} = -5dBm		19.8		dBm
Third-Order Input Intercept Variation Over Temperature		f_{RF1} = 2500MHz, f_{RF2} = 2501MHz, f_{LO} = 2200MHz, P_{RF1} = P_{RF2} = -5dBm, T_C = +25°C		±0.5		dB
Noise Figure	NF_{SSB}	Single sideband, no blockers present (Note 9)		9.6		dB
Noise Figure Temperature Coefficient	TC_{NF}	Single sideband, no blockers present, T_C = -40°C to +85°C (Note 9)		0.017		dB/°C
2RF-2LO Spur Rejection	2 x 2	P_{RF} = -10dBm		65.9		dBc
		P_{RF} = -5dBm		60.9		

+3.3V SUPPLY AC ELECTRICAL CHARACTERISTICS (continued)

(*Typical Application Circuit*, RF and LO ports are driven from 50Ω sources, Typical values are at V_{CC} = +3.3V, P_{RF} = -5dBm, P_{LO} = 0dBm, f_{RF} = 2500MHz, f_{LO} = 2200MHz, f_{IF} = 300MHz, T_C = +25°C, unless otherwise noted.) (Note 6)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
3RF-3LO Spur Rejection	3 x 3	P_{RF} = -10dBm			67.9		dBc
		P_{RF} = -5dBm			57.9		
RF Input Return Loss		LO on and IF terminated into a matched impedance			16		dB
LO Input Return Loss		RF and IF terminated into a matched impedance			16.7		dB
IF Output Impedance	Z_{IF}	Nominal differential impedance at the IC's IF outputs			200		Ω
IF Output Return Loss		RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*. See the *IF Port Return Loss vs. IF Frequency* graph in the *Typical Operating Characteristics* for performance vs. inductor values.	f_{IF} = 450MHz, L1 = L2 = 120nH		23		dB
			f_{IF} = 350MHz, L1 = L2 = 270nH		23		
			f_{IF} = 300MHz, L1 = L2 = 470nH		23		
Minimum RF-to-IF Isolation		f_{RF} = 2300MHz to 2700MHz, P_{LO} = +3dBm			33		dB
Maximum LO Leakage at RF Port		f_{LO} = 1900MHz to 2500MHz, P_{LO} = +3dBm			-26.6		dBm
Maximum 2LO Leakage at RF Port		f_{LO} = 1900MHz to 2500MHz, P_{LO} = +3dBm			-28.8		dBm
Maximum LO Leakage at IF Port		f_{LO} = 1900MHz to 2500MHz, P_{LO} = +3dBm			-21.9		dBm

Note 5: 100% production tested for functional performance.

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

Note 7: Not production tested. Operation outside this range is possible, but with degraded performance of some parameters. See the *Typical Operating Characteristics*.

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

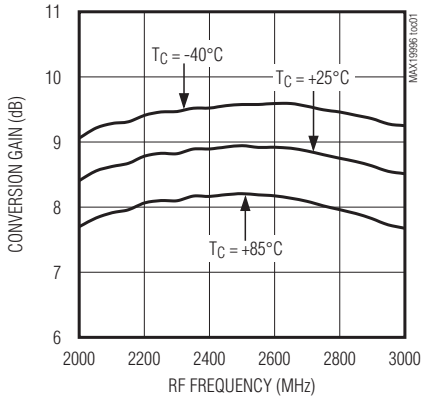
Note 9: Measured with external LO source noise filtered so that the noise floor is -174dBm/Hz. This specification reflects the effects of all SNR degradations in the mixer including the LO noise, as defined in Application Note 2021: *Specifications and Measurement of Local Oscillator Noise in Integrated Circuit Base Station Mixers*.

SiGe、高线性度、2000MHz至3000MHz下变频混频器，带有LO缓冲器

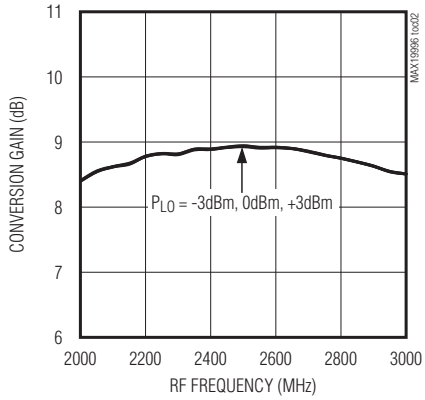
典型工作特性

(*Typical Application Circuit*, **V_{CC} = +5.0V**, P_{LO} = 0dBm, P_{RF} = -5dBm, LO is low-side injected for a 300MHz IF, T_C = +25°C, unless otherwise noted.)

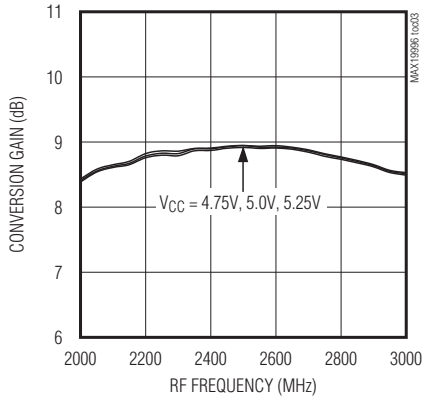
CONVERSION GAIN vs. RF FREQUENCY



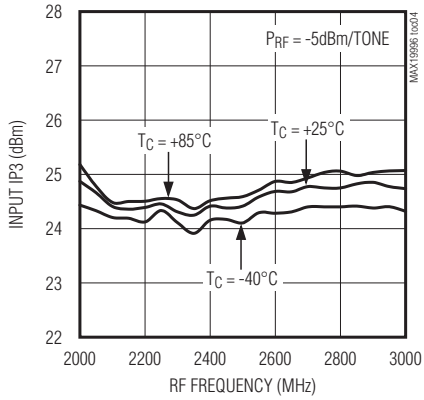
CONVERSION GAIN vs. RF FREQUENCY



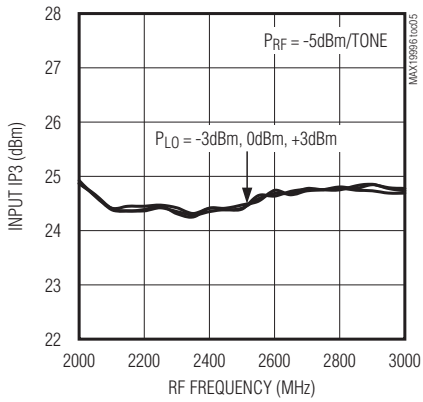
CONVERSION GAIN vs. RF FREQUENCY



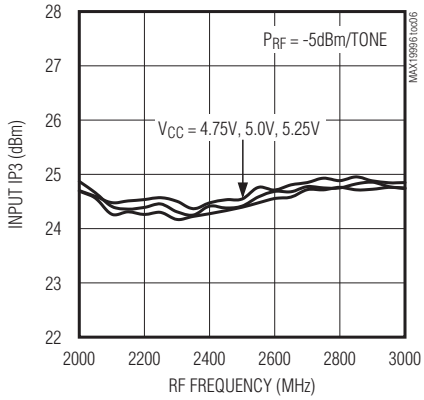
INPUT IP3 vs. RF FREQUENCY



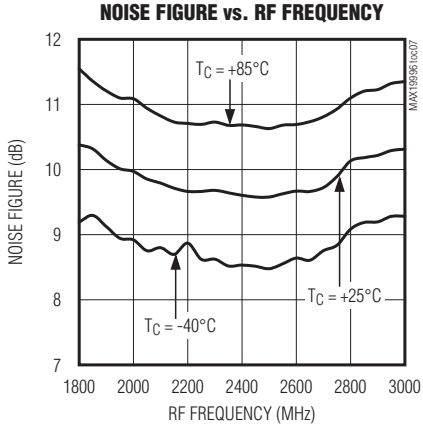
INPUT IP3 vs. RF FREQUENCY



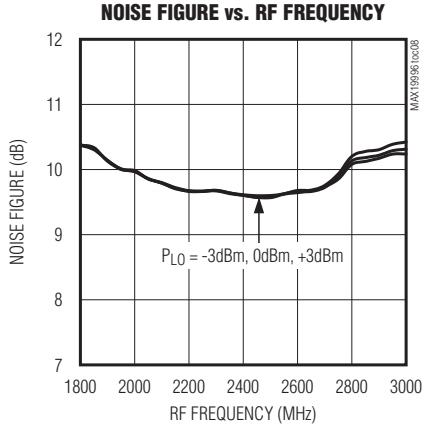
INPUT IP3 vs. RF FREQUENCY



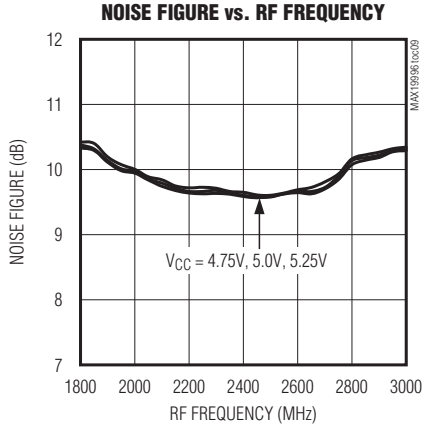
NOISE FIGURE vs. RF FREQUENCY



NOISE FIGURE vs. RF FREQUENCY



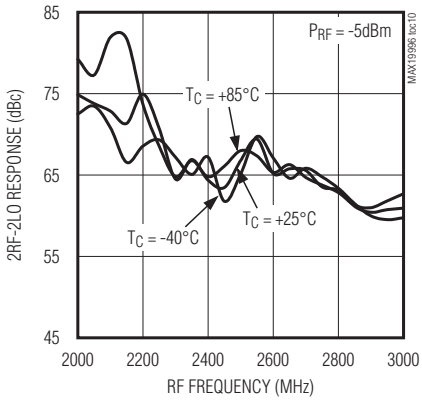
NOISE FIGURE vs. RF FREQUENCY



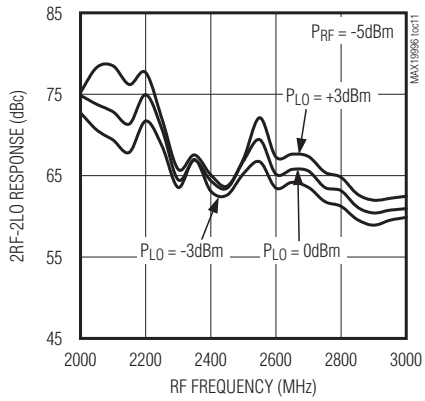
典型工作特性(续)

(*Typical Application Circuit*, **V_{CC} = +5.0V**, P_{LO} = 0dBm, P_{RF} = -5dBm, LO is low-side injected for a 300MHz IF, T_C = +25°C, unless otherwise noted.)

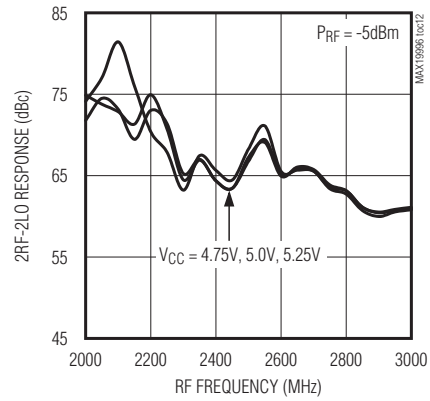
2RF-2LO RESPONSE vs. RF FREQUENCY



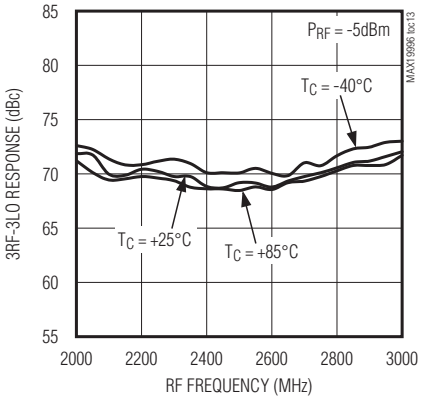
2RF-2LO RESPONSE vs. RF FREQUENCY



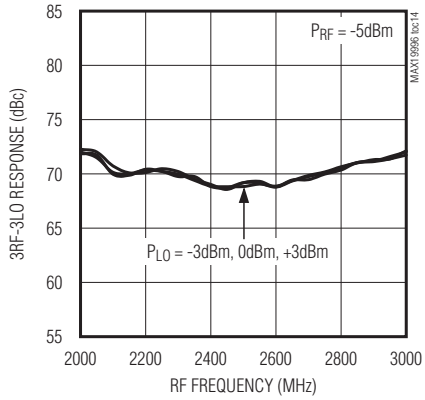
2RF-2LO RESPONSE vs. RF FREQUENCY



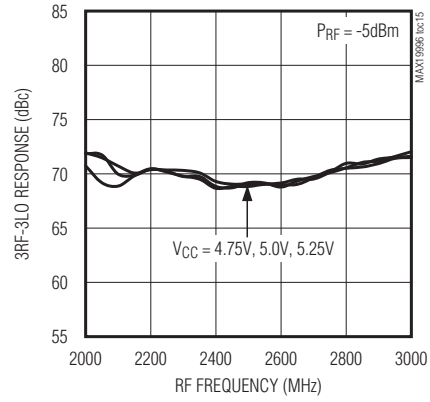
3RF-3LO RESPONSE vs. RF FREQUENCY



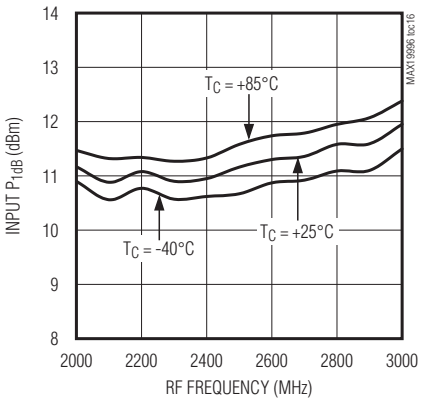
3RF-3LO RESPONSE vs. RF FREQUENCY



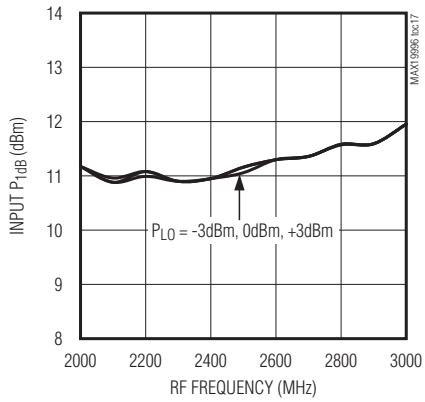
3RF-3LO RESPONSE vs. RF FREQUENCY



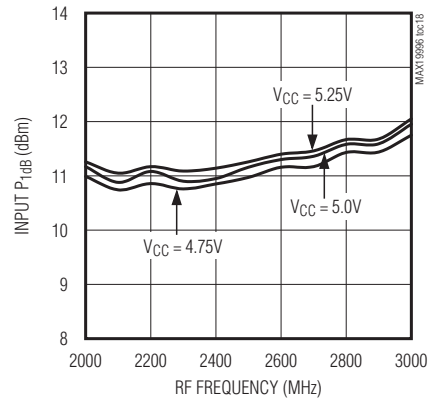
INPUT P_{1dB} vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY

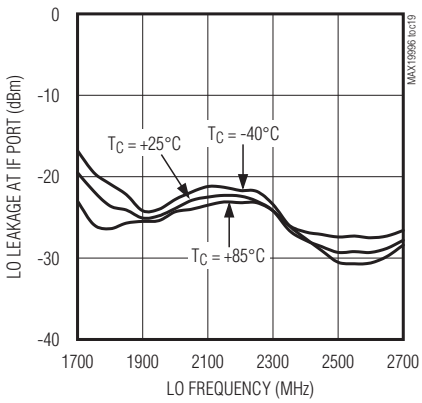


SiGe、高线性度、2000MHz至3000MHz下变频混频器，带有LO缓冲器

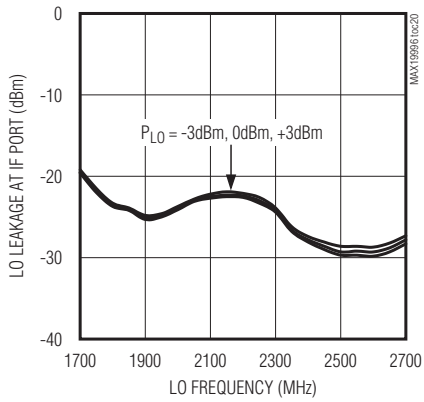
典型工作特性(续)

(*Typical Application Circuit*, **V_{CC} = +5.0V**, P_{LO} = 0dBm, P_{RF} = -5dBm, LO is low-side injected for a 300MHz IF, T_C = +25°C, unless otherwise noted.)

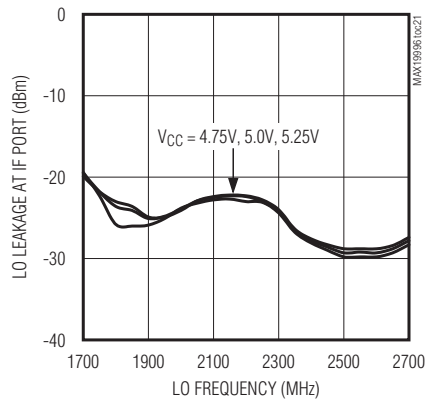
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



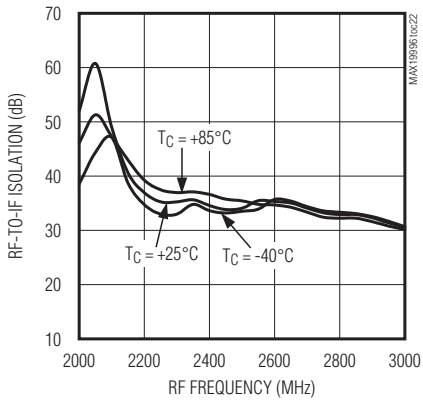
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



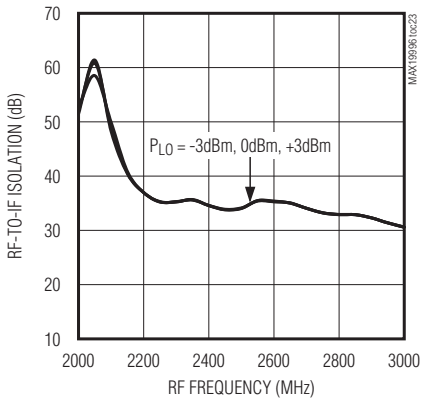
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



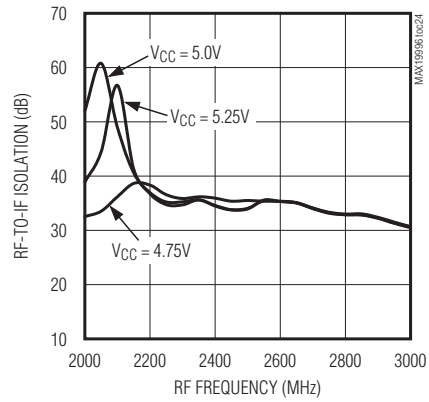
RF-TO-IF ISOLATION vs. RF FREQUENCY



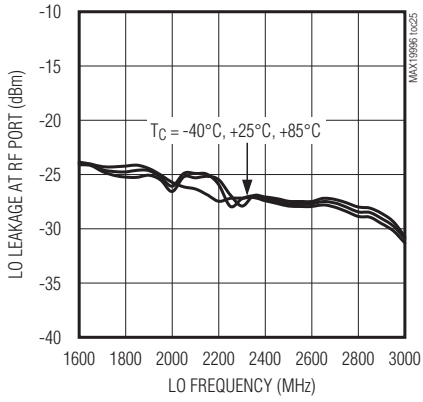
RF-TO-IF ISOLATION vs. RF FREQUENCY



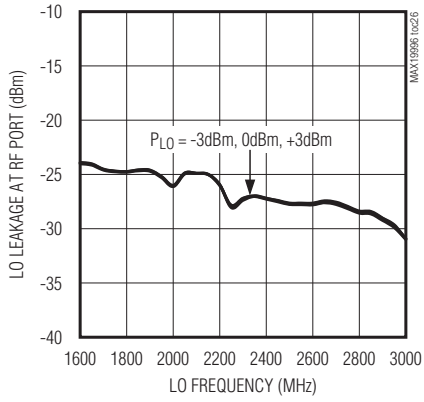
RF-TO-IF ISOLATION vs. RF FREQUENCY



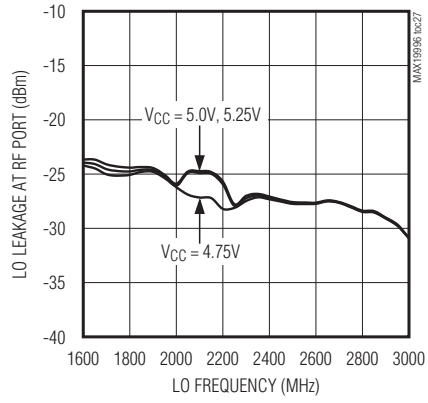
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



LO LEAKAGE AT RF PORT vs. LO FREQUENCY



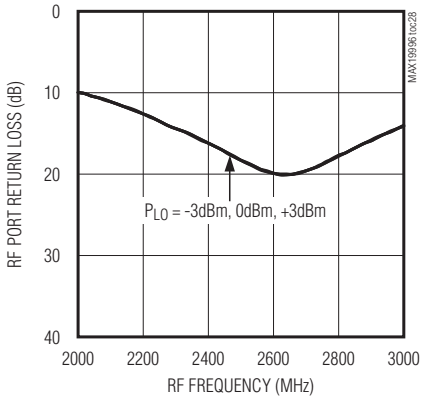
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



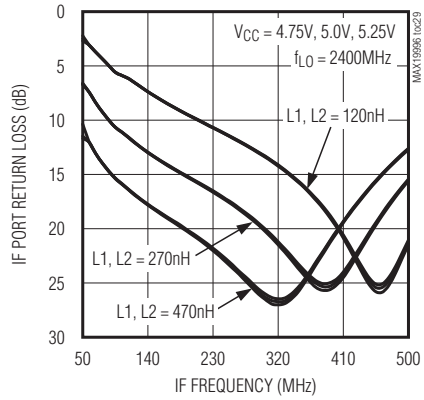
典型工作特性(续)

(*Typical Application Circuit*, **V_{CC} = +5.0V**, P_{LO} = 0dBm, P_{RF} = -5dBm, LO is low-side injected for a 300MHz IF, T_C = +25°C, unless otherwise noted.)

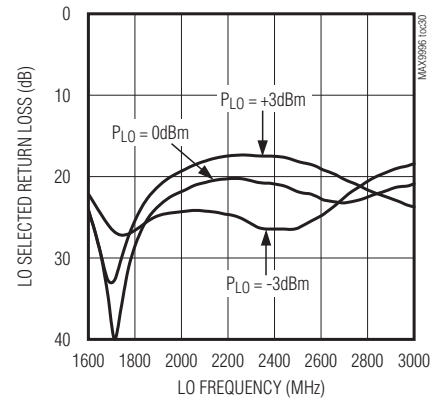
RF PORT RETURN LOSS vs. RF FREQUENCY



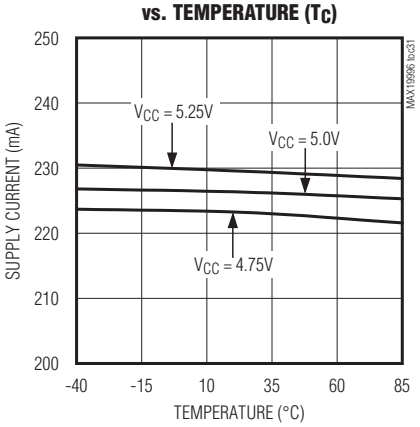
IF PORT RETURN LOSS vs. IF FREQUENCY



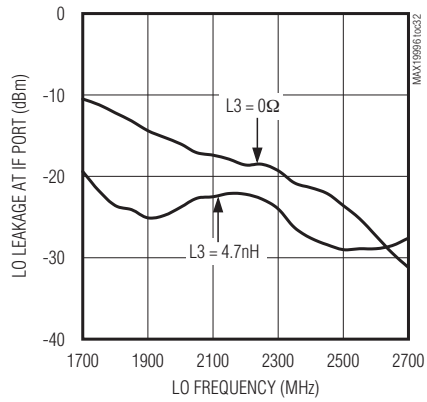
LO SELECTED RETURN LOSS vs. LO FREQUENCY



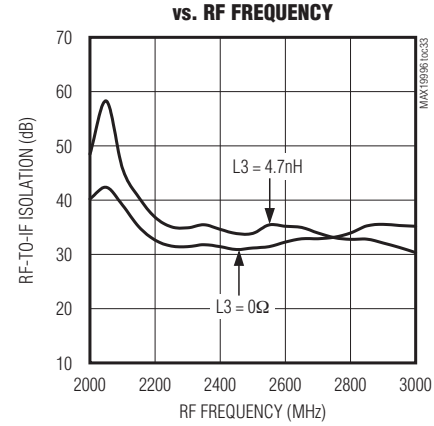
SUPPLY CURRENT vs. TEMPERATURE (T_C)



LO LEAKAGE AT IF PORT vs. LO FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



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典型工作特性(续)

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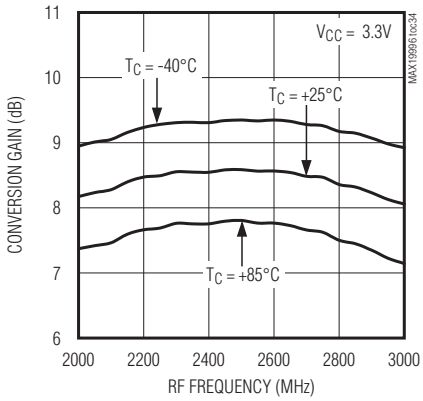
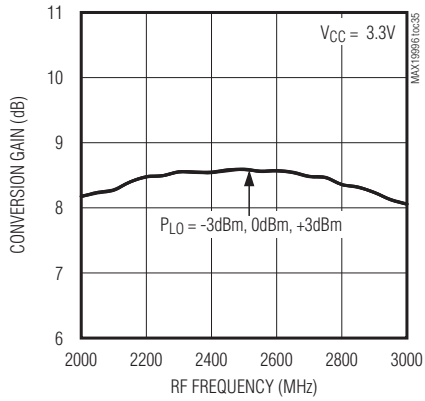
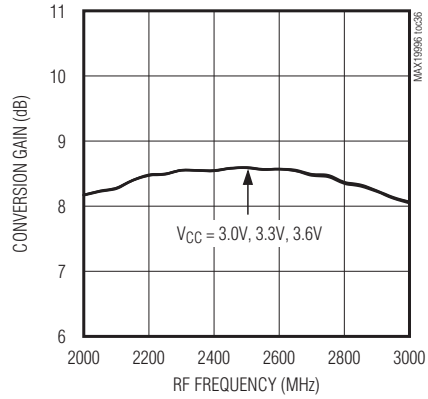
CONVERSION GAIN vs. RF FREQUENCY



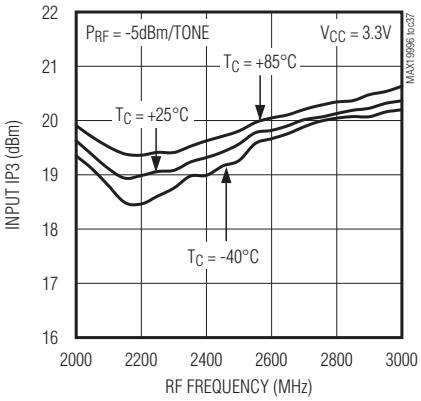
CONVERSION GAIN vs. RF FREQUENCY



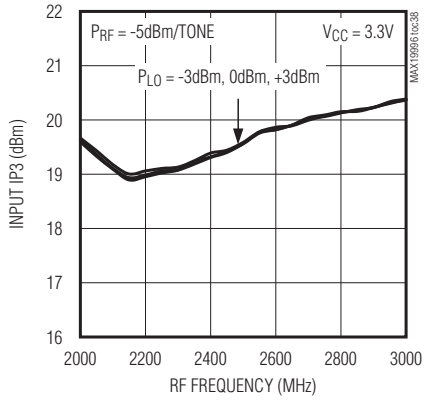
CONVERSION GAIN vs. RF FREQUENCY



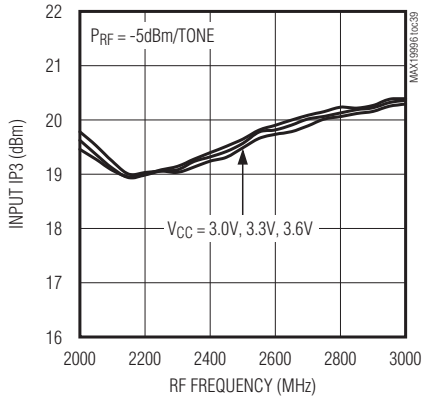
INPUT IP3 vs. RF FREQUENCY



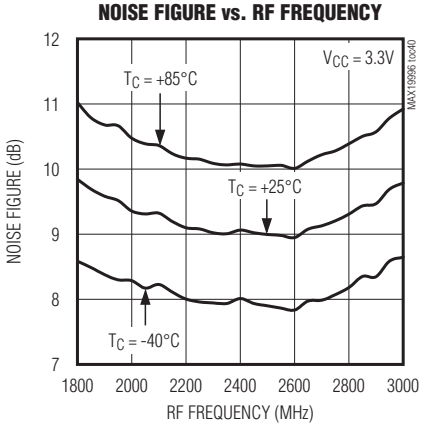
INPUT IP3 vs. RF FREQUENCY



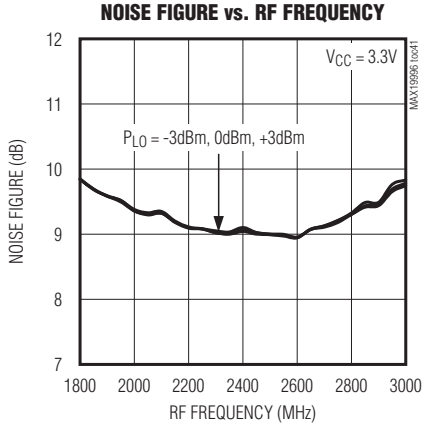
INPUT IP3 vs. RF FREQUENCY



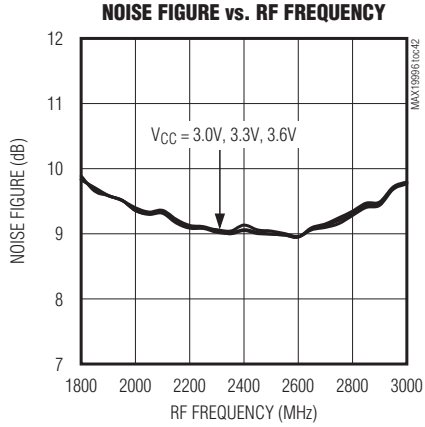
NOISE FIGURE vs. RF FREQUENCY



NOISE FIGURE vs. RF FREQUENCY



NOISE FIGURE vs. RF FREQUENCY



典型工作特性(续)

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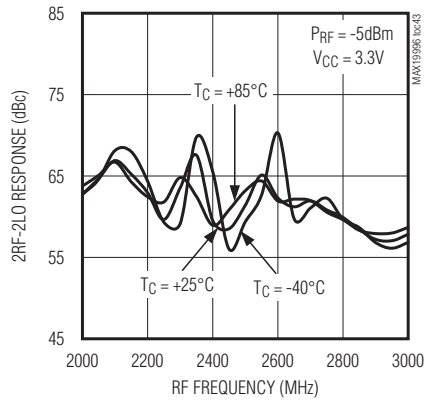
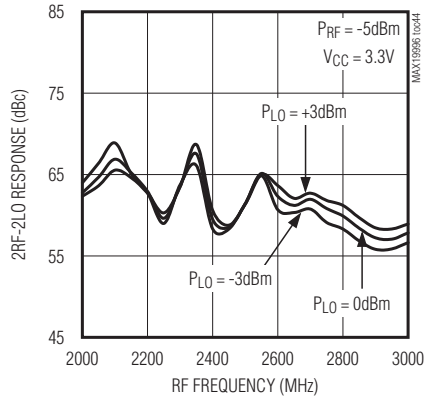
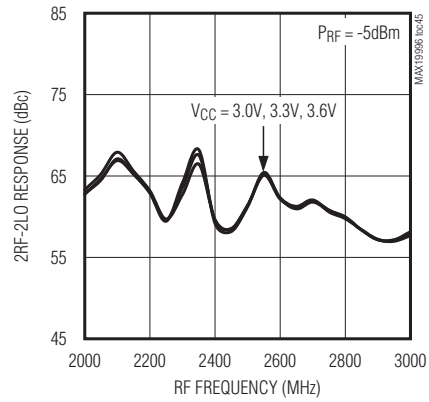
2RF-2LO RESPONSE vs. RF FREQUENCY



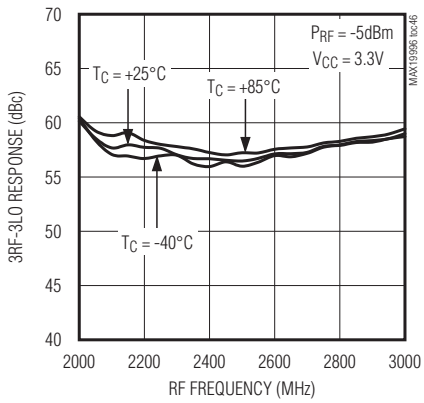
2RF-2LO RESPONSE vs. RF FREQUENCY



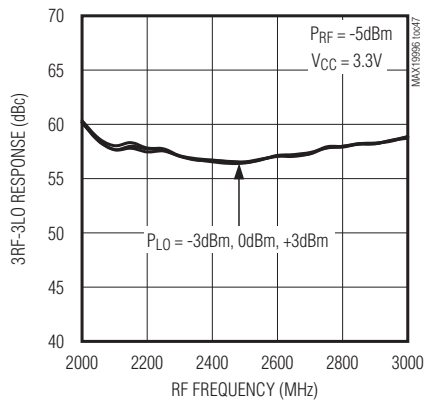
2RF-2LO RESPONSE vs. RF FREQUENCY



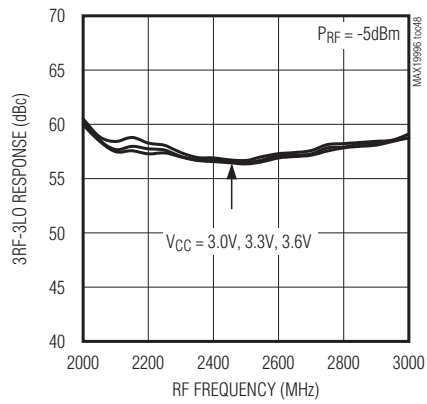
3RF-3LO RESPONSE vs. RF FREQUENCY



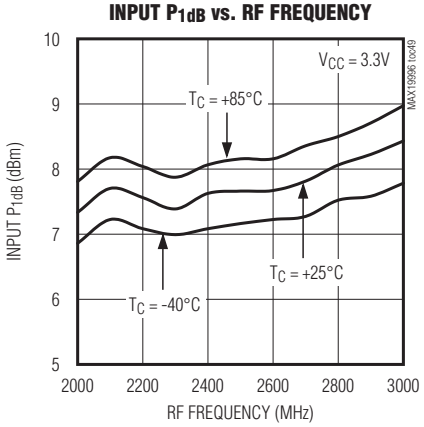
3RF-3LO RESPONSE vs. RF FREQUENCY



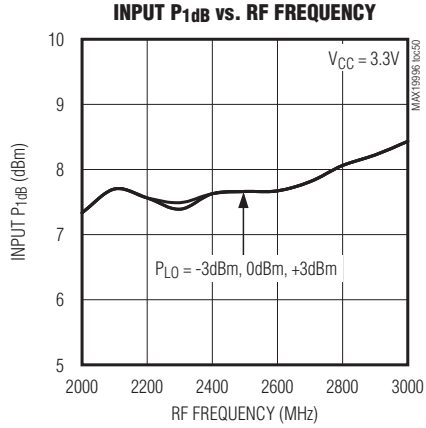
3RF-3LO RESPONSE vs. RF FREQUENCY



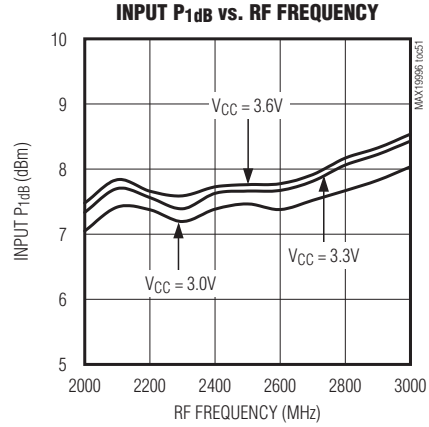
INPUT P_{1dB} vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY



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典型工作特性(续)

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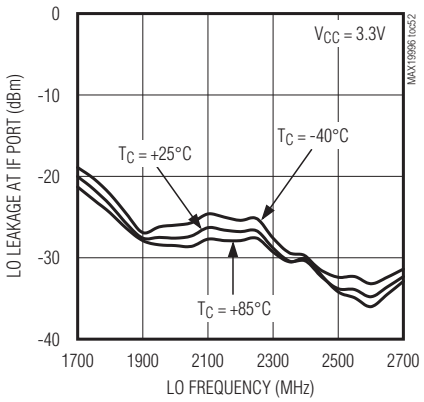
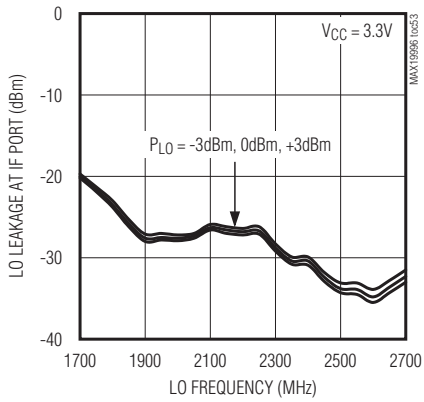
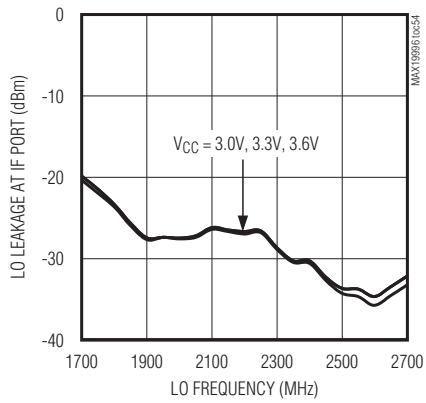
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



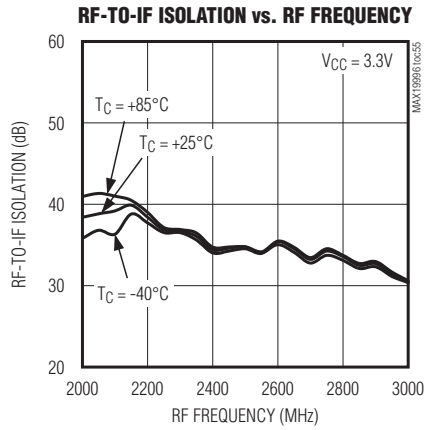
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



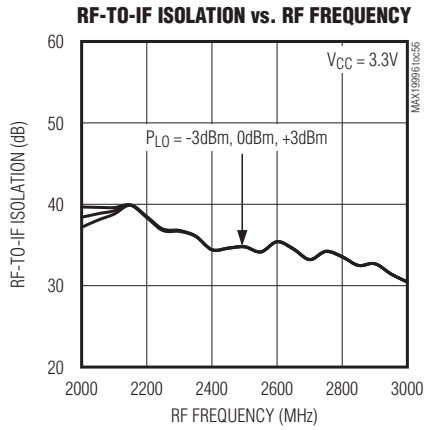
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



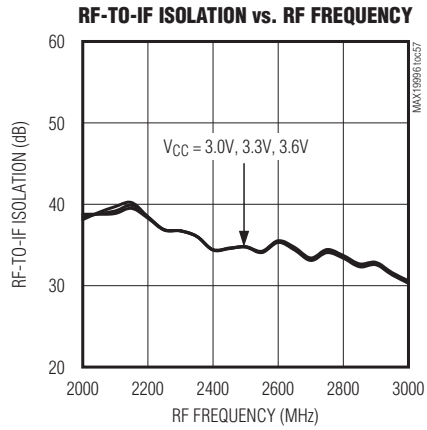
RF-TO-IF ISOLATION vs. RF FREQUENCY



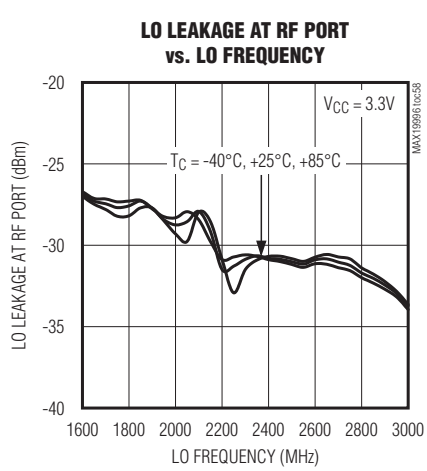
RF-TO-IF ISOLATION vs. RF FREQUENCY



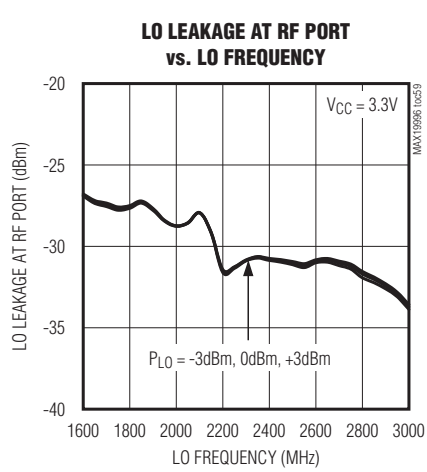
RF-TO-IF ISOLATION vs. RF FREQUENCY



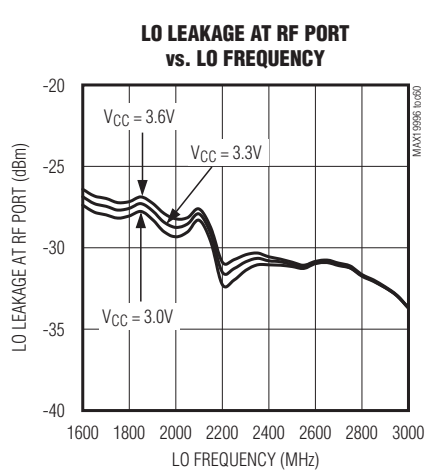
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



LO LEAKAGE AT RF PORT vs. LO FREQUENCY



LO LEAKAGE AT RF PORT vs. LO FREQUENCY



典型工作特性(续)

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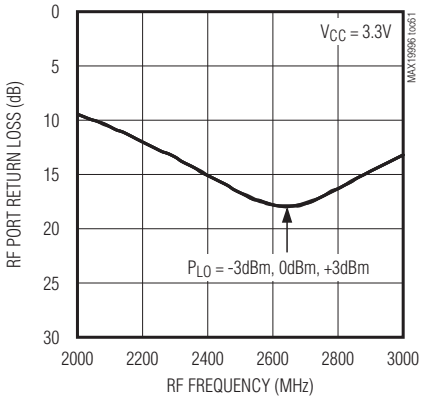
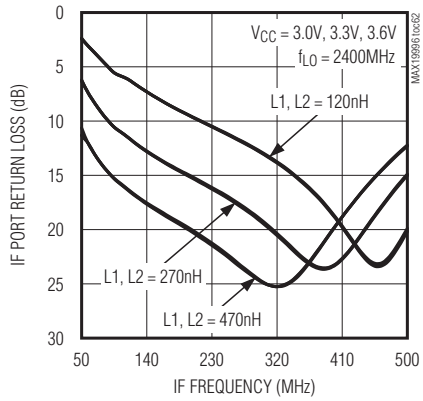
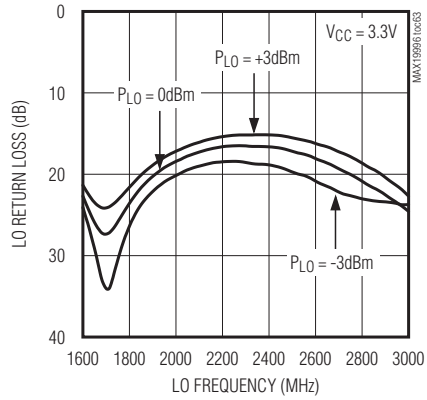
RF PORT RETURN LOSS vs. RF FREQUENCY



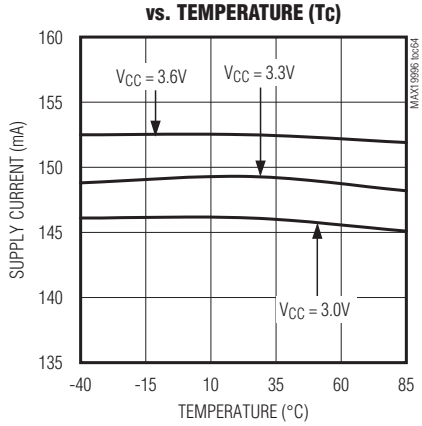
IF PORT RETURN LOSS vs. IF FREQUENCY



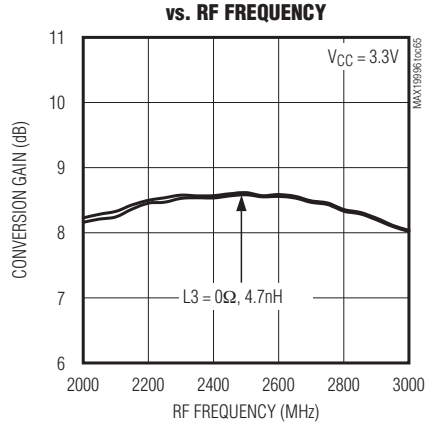
LO RETURN LOSS vs. LO FREQUENCY



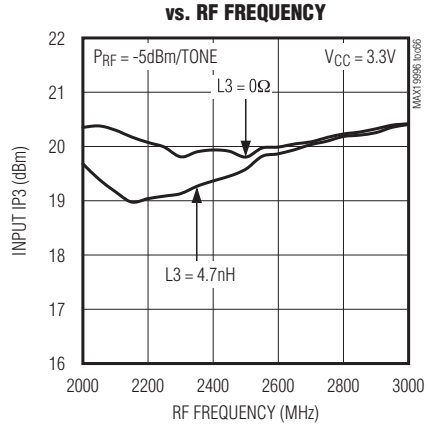
SUPPLY CURRENT vs. TEMPERATURE (Tc)



CONVERSION GAIN vs. RF FREQUENCY



INPUT IP3 vs. RF FREQUENCY



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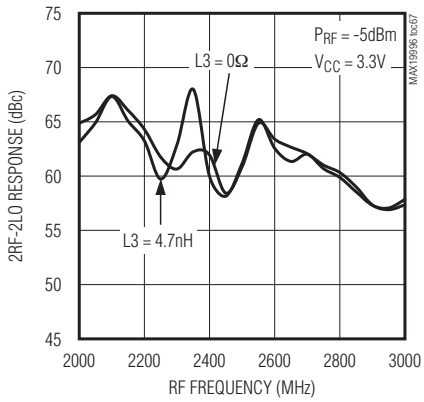
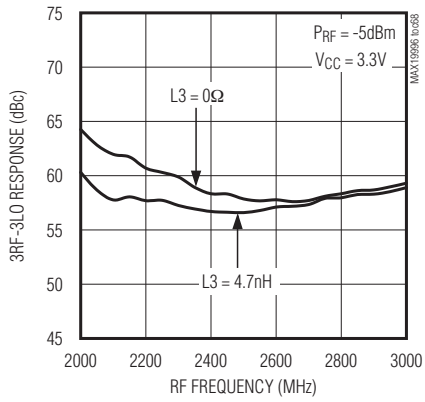
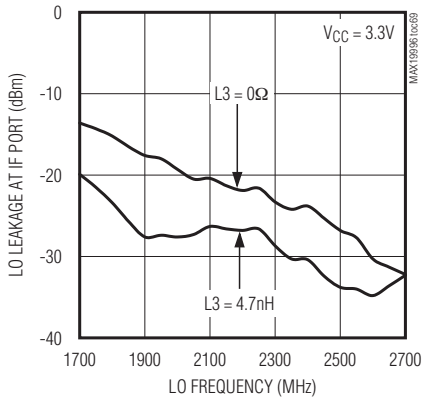


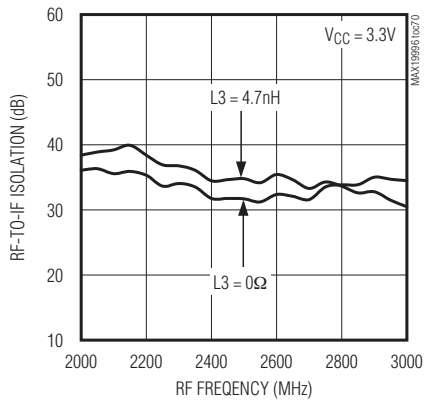
3RF-3LO RESPONSE vs. RF FREQUENCY



LO LEAKAGE AT IF PORT vs. LO FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



引脚说明

引脚	名称	功能
1, 6, 8, 14	V_{CC}	电源。使用0.01µF电容旁路至GND，电容应尽可能靠近引脚放置。
2	RF	单端50Ω RF输入。该端口由内部匹配，并通过非平衡变压器直流短接到GND，需要一个输入隔直电容。
3, 4, 5, 10, 12, 13, 17	GND	地。内部连接至裸焊盘，将所有地引脚与裸焊盘(EP)连接在一起。
7	LOBIAS	LO放大器的偏置控制。LO缓冲器的输出偏置电阻连接端，在LOBIAS与地之间连接一个604Ω 1%的电阻(偏置电流设置为230mA)。
9, 15	N.C.	无内部连接。引脚可以接地。
11	LO	本振输入。该输入端在内部匹配为50Ω，需要一个输入隔直电容。
16	LEXT	外部电感连接端。在该引脚和地之间连接一个电感，以提高RF与IF之间和LO与IF之间的隔离度(典型性能与电感值的对应关系请参考*典型工作特性*)。
18, 19	IF-, IF+	混频器差分IF输出端。各引脚均需通过上拉电感连接至V_{CC} (参见*典型应用电路*)。
20	IFBIAS	IF放大器的偏置控制。IF放大器的IF偏置电阻连接端，在IFBIAS与GND之间连接一个698Ω 1%的电阻(偏置电流设置为230mA)。
—	EP	裸焊盘。内部连接至GND，使用多个过孔将其连接至大面积地层，以改善散热和RF性能。

SiGe、高线性度、2000MHz至3000MHz下变频混频器，带有LO缓冲器

详细说明

MAX19996高线性度下变频混频器可提供8.7dB的转换增益、+24.5dBm的IIP3和典型值为9.6dB的噪声系数。集成的非平衡变压器和匹配电路允许50Ω单端连接至RF端口和LO端口。集成LO缓冲器可以为混频器核提供较强的驱动能力，将MAX19996输入端所需的LO驱动减小到-3dBm至+3dBm。IF端口配合差分输出端，有效改善了2RF-2LO性能。

该器件可在较宽的频率范围内保证性能，适用于WCS、LTE、WiMAX和MMDS基站。MAX19996能够工作在2000MHz至3000MHz RF输入范围、1800MHz至2550MHz LO范围以及50MHz至500MHz IF范围。外部IF器件可设置在更低的频率范围(详细信息请参见*典型工作特性*)。允许工作在上述范围以外(更多信息请参见*典型工作特性*)。尽管该器件针对低端LO注入架构进行了优化，但其同样可用于高端LO注入模式。然而，随着f_{LO}频率的提高，性能会下降。如需获得改善高端LO性能的相关信息，请参考MAX19996A数据资料。

RF端口和非平衡变压器

MAX19996的RF输入端与8.2pF隔直电容串联时，具有50Ω的匹配。输入端通过片上非平衡变压器内部直流短路到地，因此需要隔直电容。在整个2300MHz至2800MHz的RF频率范围内，RF端口的输入回波损耗典型值为15dB。

LO输入、缓冲器和非平衡变压器

MAX19996针对LO频率范围为1800MHz至2550MHz的低端LO注入架构进行了优化。LO输入在内部匹配为50Ω，只需一个2pF的隔直电容。两级内部LO缓冲器允许-3dBm至+3dBm的LO输入功率范围。片上低损耗非平衡变压器和LO缓冲器配合使用，驱动双平衡混频器。LO输入端与IF输出端之间的所有接口和匹配元件均已集成在芯片上。

高线性度混频器

MAX19996的核心是一个双平衡、高性能无源混频器。片上LO缓冲器具有较大的LO摆幅，可提供优异的线性度指标。与集成IF放大器配合使用时，IIP3、2RF-2LO抑制和噪声系数的典型值分别为+24.5dBm、69dBc和9.6dB。

差分IF输出放大器

MAX19996具有50MHz至500MHz的IF频率范围，其低端频率取决于外部IF元件的频率响应。MAX19996通过外部120nH的上拉偏置电感调谐至450MHz IF。对于350MHz和300MHz的较低IF，则分别需要270nH和470nH电感。集电极开路、差分IF输出端口需要通过这些电感上拉至V_{CC}。

注意：这些差分端口具有较强的2RF-2LO抑制能力，单端IF应用需要一个4:1 (阻抗比)的非平衡变压器，将200Ω的差分IF电阻转换成50Ω单端输出。IF频率高于200MHz时采用TC4-1W-17 4:1变压器；IF频率低于200MHz时采用TC4-1W-7A 4:1变压器。用户可以在混频器的IF端口使用差分IF放大器或SAW滤波器，但IF+/IF-端口需要隔直，以防止外部直流进入混频器的IF端口。

应用信息

输入和输出匹配

RF和LO端口设计工作在50Ω系统。需对RF和LO输入进行隔直，将这些端口与外部直流隔离开，同时还可提供一定的调谐容抗。IF输出阻抗为200Ω (差分)。为方便评估，通过外部低损耗4:1 (阻抗比)非平衡变压器将该阻抗转化成50Ω单端输出(参见*典型应用电路*)。

外部可调偏置

LO缓冲器和IF放大器的偏置电流可通过微调电阻R1和R2进行优化。表1列出了能够提供最高线性指标的R1和R2标称值。增大电阻值可降低功耗，但性能会有所下降。如果允许以牺牲性能为代价来降低功耗，请与厂商联系。如果没有±1%精度的电阻，可以采用±5%的电阻替代。

混频器采用可选的+3.3V电源供电时，能够显著降低功耗，可使整体功耗降低57%，参见*+3.3V Supply AC Electrical Characteristics*表和*典型工作特性*中与工作在+3.3V相关的曲线，在功率和性能之间进行权衡。

表1. 元件值

DESIGNATION	QTY	DESCRIPTION	COMPONENT SUPPLIER
C1	1	8.2pF microwave capacitor (0402)	Murata Electronics North America, Inc.
C2, C6, C8, C11	4	0.01µF microwave capacitors (0402)	Murata Electronics North America, Inc.
C3, C9	0	Not installed, capacitors	—
C10	1	2pF microwave capacitor (0402)	Murata Electronics North America, Inc.
C13, C14	2	1000pF microwave capacitors (0402)	Murata Electronics North America, Inc.
C15	1	82pF microwave capacitor (0402)	Murata Electronics North America, Inc.
L1, L2	2	120nH wire-wound high-Q inductors* (0805) (see the *Typical Operating Characteristics*)	Coilcraft, Inc.
L3	1	4.7nH wire-wound high-Q inductor (0603)	Coilcraft, Inc.
R1	1	698Ω ±1% resistor (0402). Use for **V_{CC} = +5.0V** applications.	Digi-Key Corp.
		1.1kΩ ±1% resistor (0402). Use for **V_{CC} = +3.3V** applications.	
R2	1	604Ω ±1% resistor (0402). Use for **V_{CC} = +5.0V** applications.	Digi-Key Corp.
		845Ω ±1% resistor (0402). Use for **V_{CC} = +3.3V** applications.	
R3	1	0Ω resistor (1206)	Digi-Key Corp.
T1	1	4:1 IF balun TC4-1W-17*	Mini-Circuits
U1	1	MAX19996 IC (20 TQFN)	Maxim Integrated Products, Inc.

**IF频率低于200MHz时，使用470nH电感和TC4-1W-7A 4:1非平衡变压器。*

LEXT电感

用一个0Ω电阻将LEXT短接至地。在需要改善RF与IF之间和LO与IF之间隔离度的应用中，可以在LEXT与GND之间连接一个4.7nH的低ESR电感。混频器的负载阻抗必须保证IF-、IF+与地之间的电容不会超出几个皮法(pF)，以保证稳定工作。由于流过LEXT的电流大约为120mA，因此需要选择一个低DCR的绕线电感。

布局考虑

合理的PCB设计是任何RF/微波电路的一个重要部分。RF信号线应尽可能短，以减小损耗、辐射和电感。混频器的负载阻抗必须保证IF-、IF+与地之间的电容不会超出几个皮法。为获得最佳性能，接地引脚须直接与封装底部的裸焊盘连接。PCB上的裸焊盘**必须**连接至PCB的地层。建议采用多个过孔将该焊盘连接至地层。这种方法能为器件提供一个良好的RF/散热路径。将器件封装底部的裸焊盘焊接至PCB。电路板布局请参考MAX19996评估板，Gerber文件可从www.maxim-ic.com.cn申请。

电源旁路

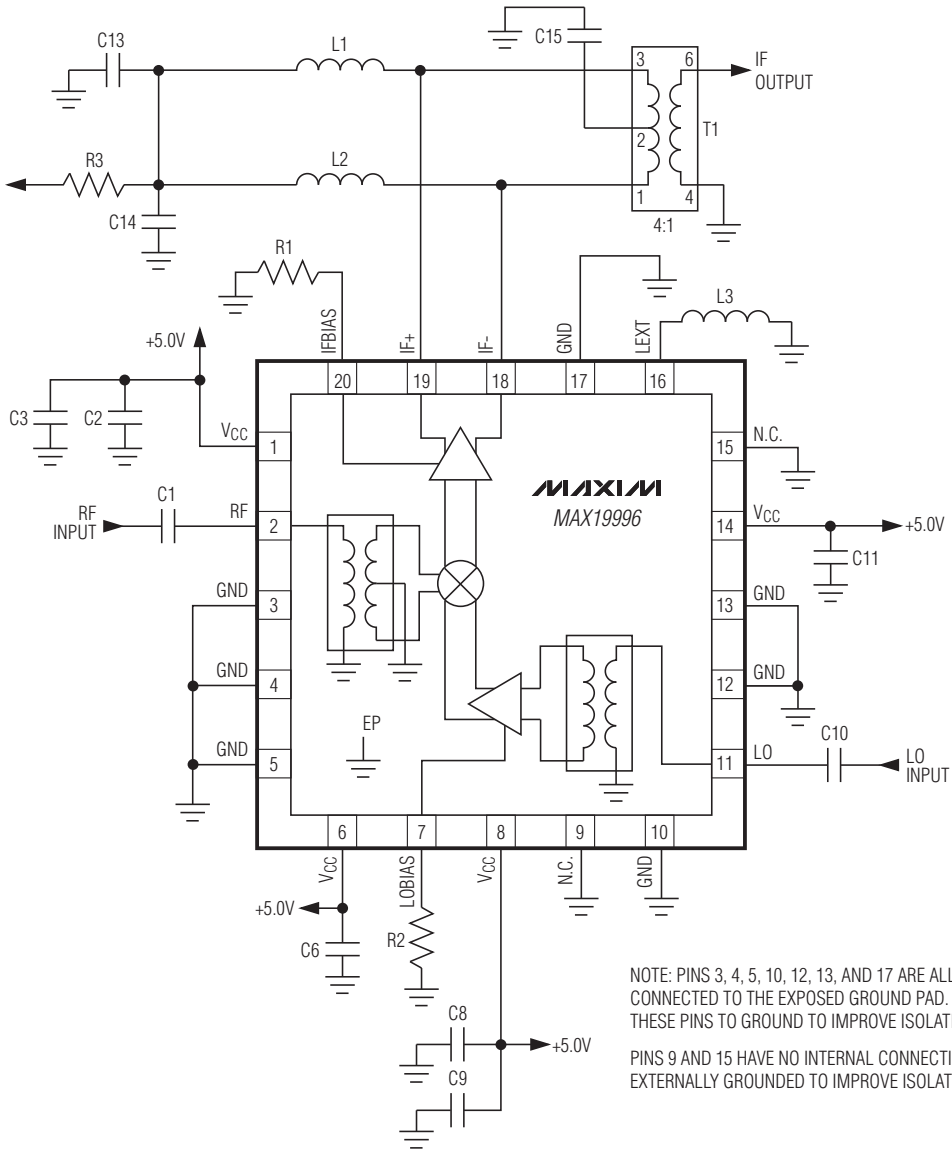
合理的电源旁路对高频电路的稳定性至关重要。如*典型应用电路*所示，对各V_{CC}引脚使用电容旁路，并参见表1。

裸焊盘的RF/散热考虑

MAX19996采用20引脚、薄型QFN封装，其裸焊盘(EP)提供了一个与管芯之间的低热阻通路。在安装MAX19996的PCB与EP之间保持良好的热传递通道非常重要。此外，EP应通过一个低电感路径接地。EP**必须**直接或通过一系列电镀过孔焊接至PCB的地层。

SiGe、高线性度、2000MHz至3000MHz下变频混频器，带有LO缓冲器

典型应用电路

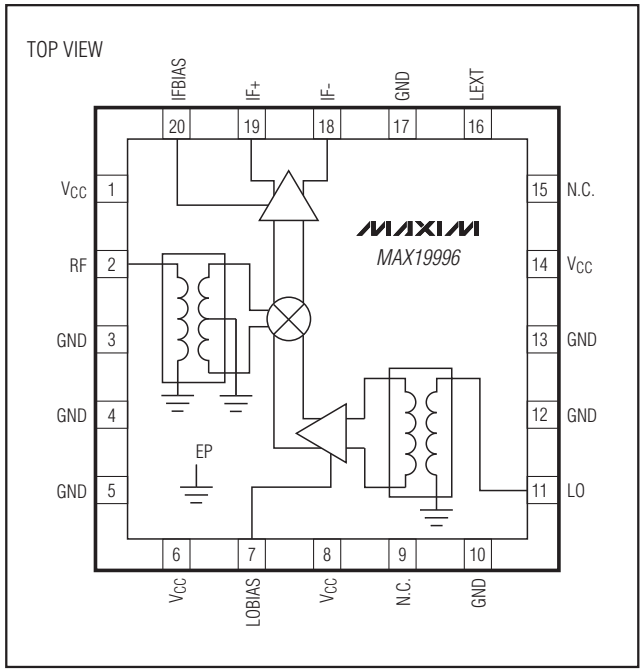


NOTE: PINS 3, 4, 5, 10, 12, 13, AND 17 ARE ALL INTERNALLY CONNECTED TO THE EXPOSED GROUND PAD. CONNECT THESE PINS TO GROUND TO IMPROVE ISOLATION.

PINS 9 AND 15 HAVE NO INTERNAL CONNECTION BUT CAN BE EXTERNALLY GROUNDED TO IMPROVE ISOLATION.

SiGe、高线性度、2000MHz至3000MHz下变频混频器，带有LO缓冲器

引脚配置



芯片信息

PROCESS: SiGe BiCMOS

封装信息

如需最近的封装外形信息和焊盘布局，请查询 **www.maxim-ic.com.cn/packages**。

封装类型	封装编码	文档编号
20引脚薄型QFN-EP	T2055-3	**21-0140**

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