19-4293; Rev 0; 10/08

MAXIM

双通道、SiGe、高线性度、3000MHz至4000MHz下变频混频器，带有LO缓冲器

概述

MAX19999双通道下变频混频器可为3000MHz至4000MHz的WiMAX™和LTE分集接收器应用提供8.3dB转换增益、+24dBm输入IP3、+11.4dBm输入1dB压缩点和10.5dB噪声系数。该混频器专门针对2650MHz至3700MHz LO频率范围进行优化，理想用于低端LO注入架构。

除具有优异的线性度和噪声性能外，MAX19999还具有非常高的元件集成度。该器件包括两个双平衡无源混频器核、两个LO缓冲器和一对差分IF输出放大器。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。

MAX19999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388mA、在V_{CC} = +3.3V时的典型值为279mA。

MAX19999与MAX19997A 1800MHz至2900MHz混频器引脚兼容，并与MAX19985/MAX19985A和MAX19995/MAX19995A系列700MHz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。

MAX19999采用紧凑的6mm x 6mm、36引脚、薄型QFN封装，带有裸焊盘。在T_C = -40°C至+85°C的扩展级温度范围内，可保证电气性能。

应用

3.5GHz WiMAX和LTE基站

固定宽带无线接入

微波链路

无线本地环路

个人移动无线装置

军用系统

引脚配置/功能框图和典型应用电路在数据资料的最后给出。

特性

- 3000MHz至4000MHz RF频率范围
- 2650MHz至3700MHz LO频率范围
- 50MHz至500MHz IF频率范围
- 8.3dB转换增益
- +24dBm输入IP3
- 10.5dB噪声系数
- +11.4dBm输入1dB压缩点
- P_{RF} = -10dBm时，具有74dBc (典型值)的2 x 2杂散抑制
- 双通道理想用于分集接收机应用
- 集成LO缓冲器
- 内部LO和RF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MAX19997A 1800MHz至2900MHz混频器
- 引脚相似于MAX9995/MAX9995A和MAX19995/MAX19995A 1700MHz至2200MHz混频器以及MAX9985/MAX9985A和MAX19985/MAX19985A 700MHz至1000MHz混频器
- 39dB通道间隔离
- 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
MAX19999ETX+	-40°C to +85°C	36 Thin QFN-EP*
MAX19999ETX+T	-40°C to +85°C	36 Thin QFN-EP*

+表示无铅/符合RoHS标准的封装。
**EP = 裸焊盘。*
T = 卷带包装。

WiMAX是WiMAX论坛的商标。

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ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +5.5V
RF_, LO to GND.....-0.3V to +0.3V
IFM_, IFD_, IFM_SET, IFD_SET, LO_ADJ_M, LO_ADJ_D to GND.....-0.3V to (V_{CC} + 0.3V)
RF_, LO Input Power .....+15dBm
RF_, LO Current (RF and LO are DC shorted to GND through balun).....50mA
Continuous Power Dissipation (Note 1) 8.7W
θ_{JA} (Notes 2, 3).....+38°C/W
θ_{JC} (Note 3).....7.4°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*, no input RF or LO signals applied, V_{CC} = +4.75V to +5.25V, T_C = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, T_C = +25°C, unless otherwise noted. R1 = R4 = 750Ω, R2 = R5 = 698Ω.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{CC}		4.75	5	5.25	V
Supply Current	I_{CC}	Total supply current		388	420	mA

+3.3V SUPPLY DC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit*, no input RF or LO signals applied, T_C = -40°C to +85°C. Typical values are at V_{CC} = +3.3V, T_C = +25°C, unless otherwise noted. R1 = R4 = 1.1kΩ; R2 = R5 = 845Ω.) (Note 5)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{CC}	(Note 6)	3	3.3	3.6	V
Supply Current	I_{CC}	Total supply current		279		mA

RECOMMENDED AC OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RF Frequency	f_{RF}	(Notes 5, 7)	3000		4000	MHz
LO Frequency	f_{LO}	(Notes 5, 7)	2650		3700	MHz
IF Frequency	f_{IF}	Using Mini-Circuits TC4-1W-17 4:1 transformer as defined in the *Typical Application Circuit*, IF matching components affect the IF frequency range (Notes 5, 7)	100		500	MHz
		Using alternative Mini-Circuits TC4-1W-7A 4:1 transformer, IF matching components affect the IF frequency range (Notes 5, 7)	50		250	
LO Drive Level	P_{LO}	(Note 7)	-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} = 3200MHz to 3900MHz, f_{LO} = 2800MHz to 3600MHz, 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} = 3550MHz, f_{LO} = 3200MHz, f_{IF} = 350MHz, T_C = +25°C, unless otherwise noted.) (Note 8)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Conversion Gain	G_C	T_C = +25°C (Notes 6, 9)		7.3	8.3	9.3	dB
Conversion Gain Flatness		f_{RF} = 3200MHz to 3900MHz, over any 100MHz band			0.15		dB
Gain Variation Over Temperature	TC_{CG}	f_{RF} = 3200MHz to 3900MHz, T_C = -40°C to +85°C			-0.01		dB/°C
Input Compression Point	IP_{1dB}	(Notes 6, 9, 10)		9.8	11.4		dBm
Third-Order Input Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone (Notes 6, 9)		21.6	24.3		dBm
		f_{RF} = 3550MHz, f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone, T_C = +25°C (Notes 6, 9)		22	24.3		
Third-Order Input Intercept Point Variation Over Temperature		f_{RF1} - f_{RF2} = 1MHz, T_C = -40°C to +85°C			±0.3		dBm
Noise Figure	NF_{SSB}	Single sideband, no blockers present (Notes 5, 6)			10.5	13	dB
		Single sideband, no blockers present, f_{RF} = 3500MHz, T_C = +25°C (Notes 5, 6)			10.5	11.5	
Noise Figure Temperature Coefficient	TC_{NF}	Single sideband, no blockers present, T_C = -40°C to +85°C			0.018		dB/°C
Noise Figure Under Blocking Conditions	NF_B	$f_{BLOCKER}$ = 3700MHz, $P_{BLOCKER}$ = 8dBm, f_{RF} = 3450MHz, f_{LO} = 3100MHz, P_{LO} = 0dBm, V_{CC} = 5.0V, T_C = +25°C (Notes 5, 6, 11)			21	25	dB
2RF-2LO Spurious Rejection	2 x 2	f_{RF} = 3500MHz, f_{LO} = 3150MHz, f_{SPUR} = f_{LO} + 175MHz, T_C = +25°C	P_{RF} = -10dBm, (Notes 5, 6)	68	74		dBc
			P_{RF} = -5dBm, (Notes 6, 9)	63	69		
3RF-3LO Spurious Rejection	3 x 3	f_{RF} = 3500MHz, f_{LO} = 3150MHz, f_{SPUR} = f_{LO} + 116.67MHz, T_C = +25°C	P_{RF} = -10dBm, (Notes 5, 6)	77	86		dBc
			P_{RF} = -5dBm, (Notes 6, 9)	67	76		
RF Input Return Loss		LO on and IF terminated into a matched impedance			15.4		dB
LO Input Return Loss		RF and IF terminated into a matched impedance			14		dB
IF Output Impedance	Z_{IF}	Nominal differential impedance at the IC's IF outputs			200		Ω

双通道、SiGe、高线性度、3000MHz至4000MHz下变频混频器，带有LO缓冲器

+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} = 3200MHz to 3900MHz, f_{LO} = 2800MHz to 3600MHz, 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} = 3550MHz, f_{LO} = 3200MHz, f_{IF} = 350MHz, T_C = +25°C, unless otherwise noted.) (Note 8)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
IF Output Return Loss		RF terminated into 50Ω, LO driven by a 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*		18		dB
RF-to-IF Isolation				28		dB
LO Leakage at RF Port		(Notes 6, 9)		-31	-24	dBm
2LO Leakage at RF Port				-30		dBm
LO Leakage at IF Port				-23		dBm
Channel Isolation		RFMAIN (RFDIV) converted power measured at IFDIV (IFMAIN), relative to IFMAIN (IFDIV), all unused ports terminated to 50Ω (Notes 6, 9)	36	39		dB

+3.3V SUPPLY AC ELECTRICAL CHARACTERISTICS

(*Typical Application Circuit,* typical values are at V_{CC} = +3.3V, P_{RF} = -5dBm, P_{LO} = 0dBm, f_{RF} = 3550MHz, f_{LO} = 3200MHz, f_{IF} = 350MHz, T_C = +25°C, unless otherwise noted.) (Note 8)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Conversion Gain	G_C				8.0		dB
Conversion Gain Flatness		f_{RF} = 3200MHz to 3900MHz, over any 100MHz band			0.15		dB
Gain Variation Over Temperature	TC_{CG}	f_{RF} = 3200MHz to 3900MHz, T_C = -40°C to +85°C			-0.01		dB/°C
Input Compression Point	IP_{1dB}				8.4		dBm
Third-Order Input Intercept Point	IIP3	f_{RF1} - f_{RF2} = 1MHz, P_{RF} = -5dBm per tone			20.3		dBm
Third-Order Input Intercept Variation Over Temperature		f_{RF1} - f_{RF2} = 1MHz, T_C = -40°C to +85°C			±0.3		dBm
Noise Figure	NF_{SSB}	Single sideband, no blockers present			10.5		dB
Noise Figure Temperature Coefficient	TC_{NF}	Single sideband, no blockers present, T_C = -40°C to +85°C			0.018		dB/°C
2RF-2LO Spurious Rejection	2 x 2	$f_{SPUR} = f_{LO}$ + 175MHz	P_{RF} = -10dBm		74		dBc
			P_{RF} = -5dBm		69		
3RF-3LO Spurious Rejection	3 x 3	$f_{SPUR} = f_{LO}$ + 116.67MHz	P_{RF} = -10dBm		75		dBc
			P_{RF} = -5dBm		65		
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			15.5		dB

+3.3V SUPPLY AC ELECTRICAL CHARACTERISTICS (continued)

(*Typical Application Circuit,* typical values are at V_{CC} = +3.3V, P_{RF} = -5dBm, P_{LO} = 0dBm, f_{RF} = 3550MHz, f_{LO} = 3200MHz, f_{IF} = 350MHz, T_C = +25°C, unless otherwise noted.) (Note 8)

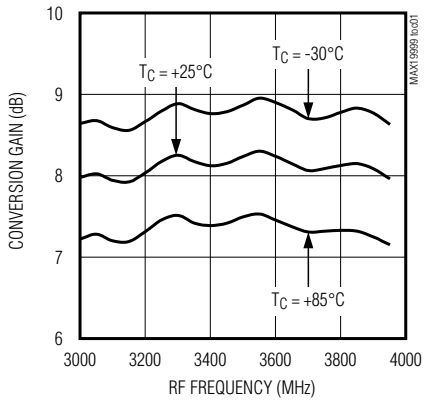
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
IF Output Impedance	Z_{IF}	Nominal differential impedance at the IC's IF outputs		200		Ω
IF Output Return Loss		RF terminated into 50Ω, LO driven by a 50Ω source, IF transformed to 50Ω using external components shown in the *Typical Application Circuit*		19		dB
RF-to-IF Isolation				28		dB
LO Leakage at RF Port				-36		dBm
2LO Leakage at RF Port				-34		dBm
LO Leakage at IF Port				-27		dBm
Channel Isolation		RFMAIN (RFDIV) converted power measured at IFDIV (IFMAIN), relative to IFMAIN (IFDIV), all unused ports terminated to 50Ω		38.5		dB

Note 5: Not production tested.
Note 6: Guaranteed by design and characterization.
Note 7: Operation outside this range is possible, but with degraded performance of some parameters. See the *Typical Operating Characteristics* section.
Note 8: All limits reflect losses of external components, including a 0.9dB loss at f_{IF} = 350MHz due to the 4:1 impedance transformer. Output measurements were taken at IF outputs of the *Typical Application Circuit*.
Note 9: 100% production tested for functional performance.
Note 10: Maximum reliable continuous input power applied to the RF or IF port of this device is +12dBm from a 50Ω source.
Note 11: Measured with external LO source noise filtered so the noise floor is -174dBm/Hz. This specification reflects the effects of all SNR degradations in the mixer, including the LO noise as defined in Application Note 2021: *Specifications and Measurement of Local Oscillator Noise in Integrated Circuit Base Station Mixers*.

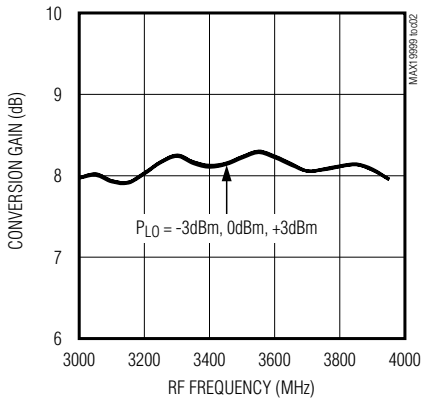
典型工作特性

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

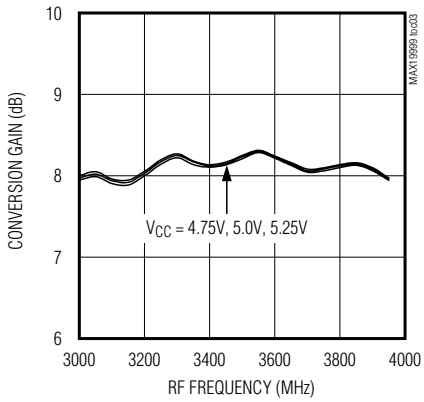
CONVERSION GAIN vs. RF FREQUENCY



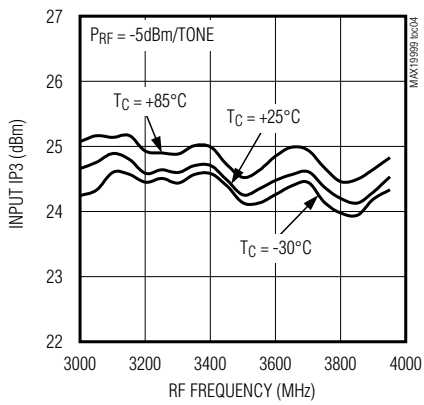
CONVERSION GAIN vs. RF FREQUENCY



CONVERSION GAIN vs. RF FREQUENCY



INPUT IP3 vs. RF FREQUENCY



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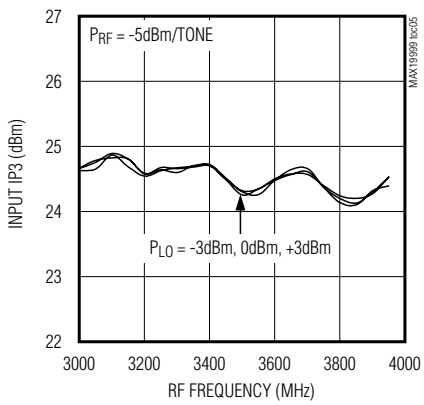
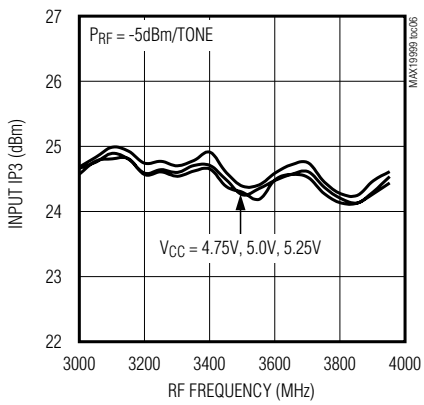
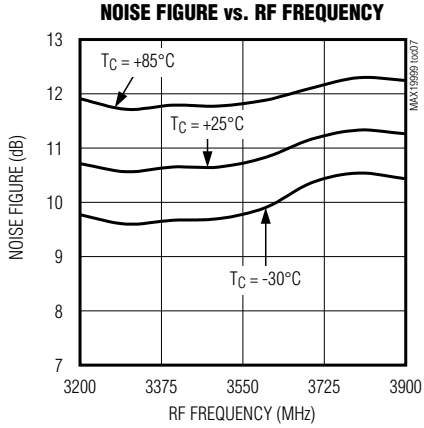


INPUT IP3 vs. RF FREQUENCY



NOISE FIGURE vs. RF FREQUENCY



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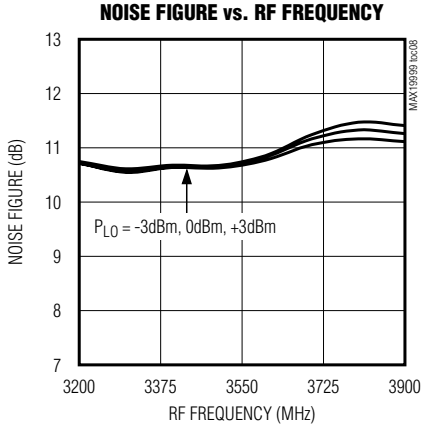
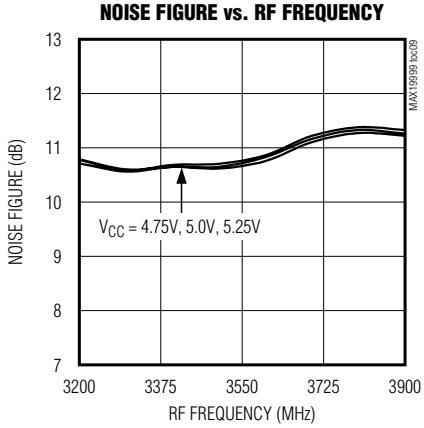


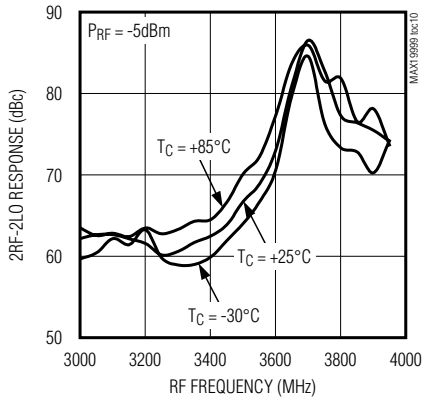
NOISE FIGURE vs. RF FREQUENCY



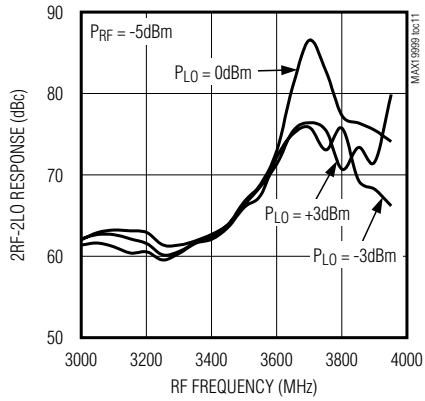
典型工作特性(续)

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

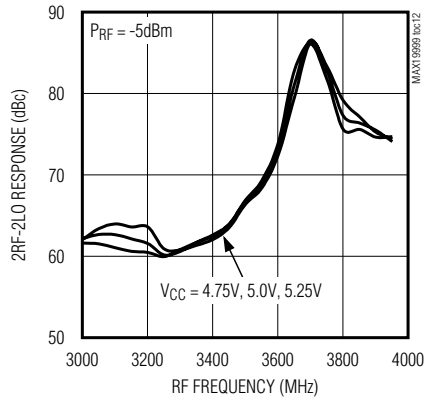
2RF-2LO RESPONSE vs. RF FREQUENCY



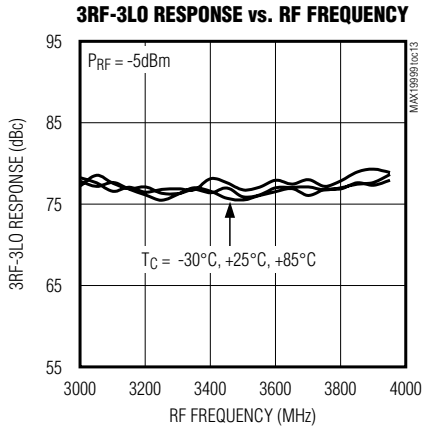
2RF-2LO RESPONSE vs. RF FREQUENCY



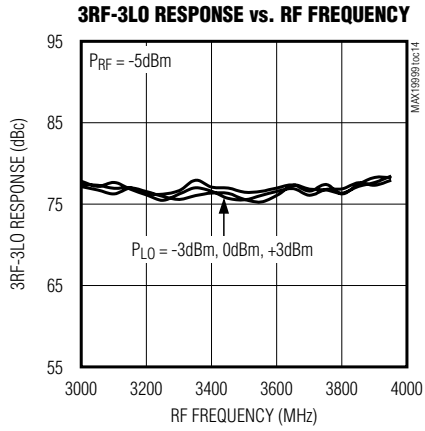
2RF-2LO RESPONSE vs. RF FREQUENCY



3RF-3LO RESPONSE vs. RF FREQUENCY



3RF-3LO RESPONSE vs. RF FREQUENCY



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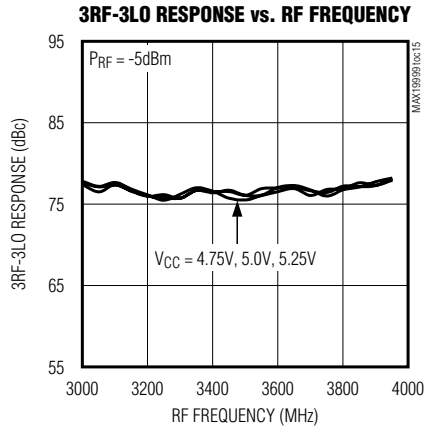
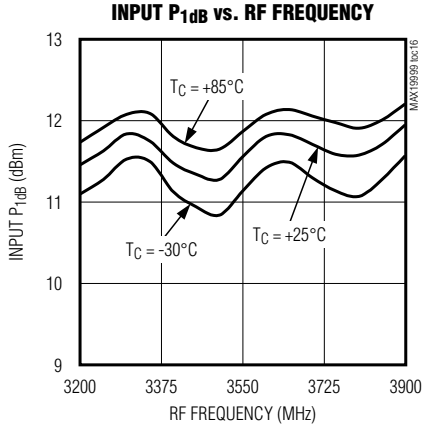


INPUT P_{1dB} vs. RF FREQUENCY



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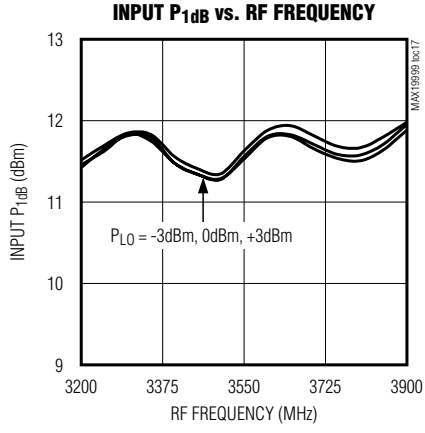

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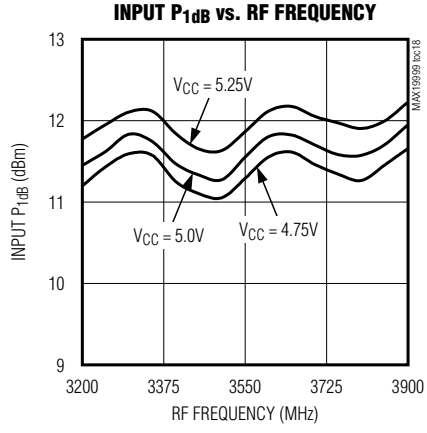
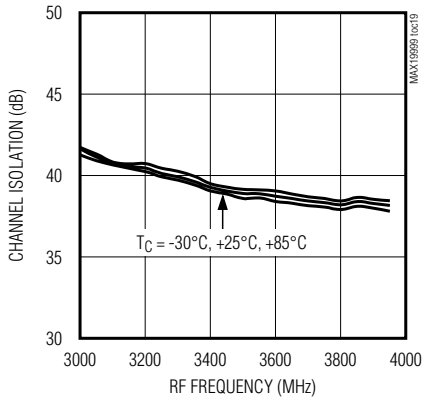


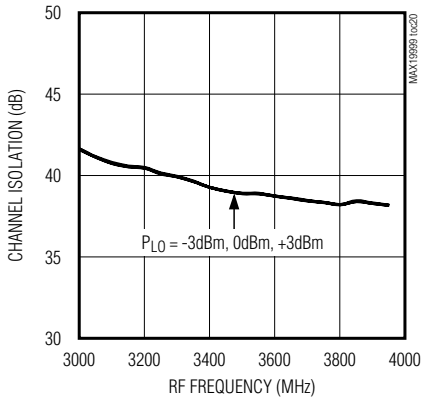
典型工作特性(续)

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

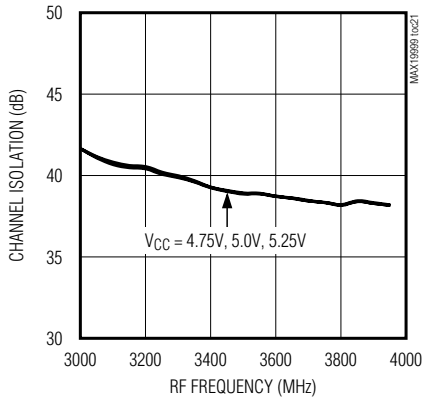
CHANNEL ISOLATION vs. RF FREQUENCY



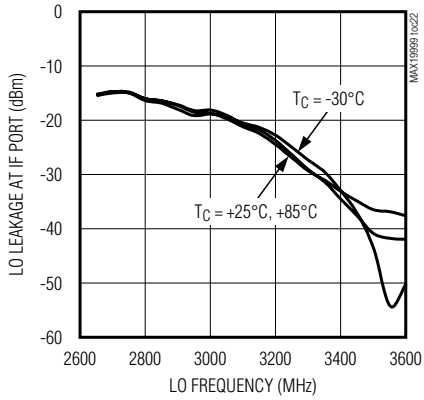
CHANNEL ISOLATION vs. RF FREQUENCY



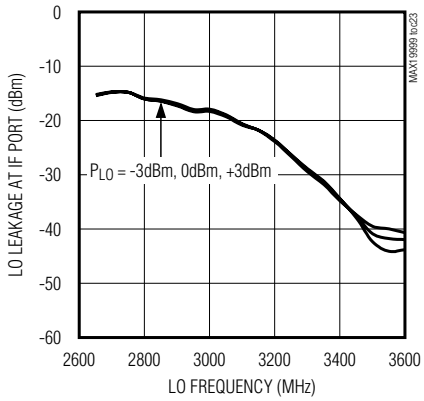
CHANNEL ISOLATION vs. RF FREQUENCY



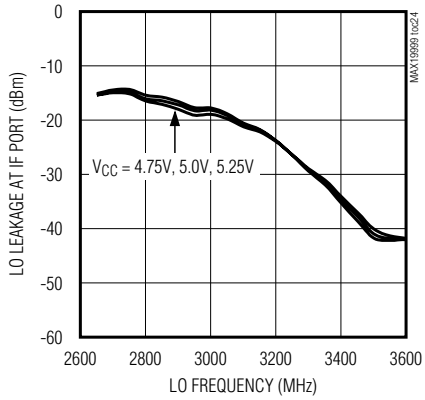
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



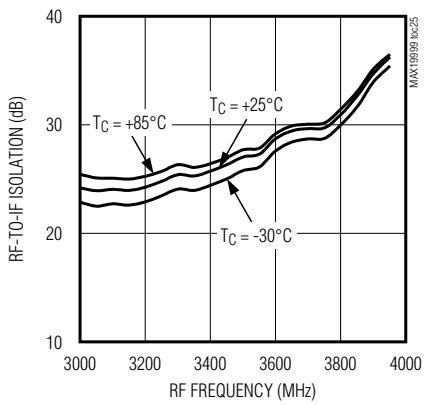
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



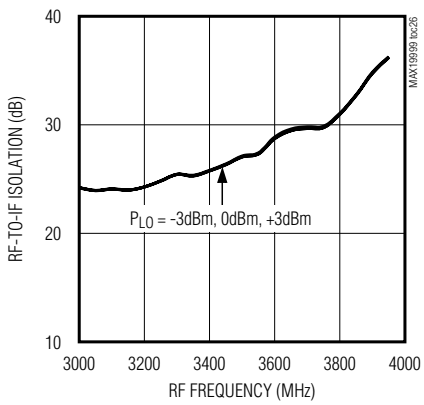
LO LEAKAGE AT IF PORT vs. LO FREQUENCY



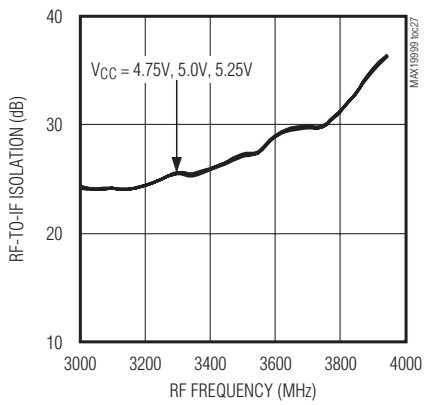
RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



典型工作特性(续)

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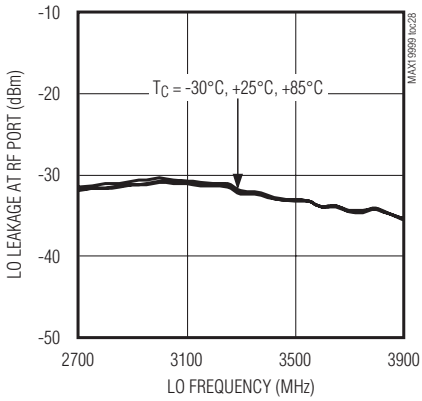
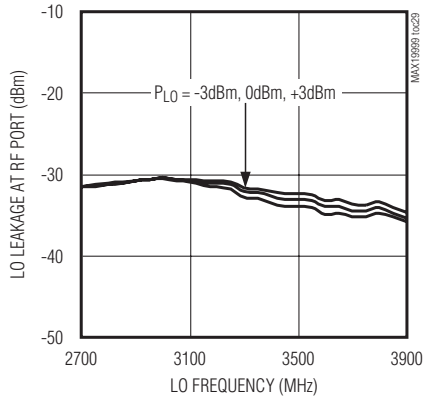
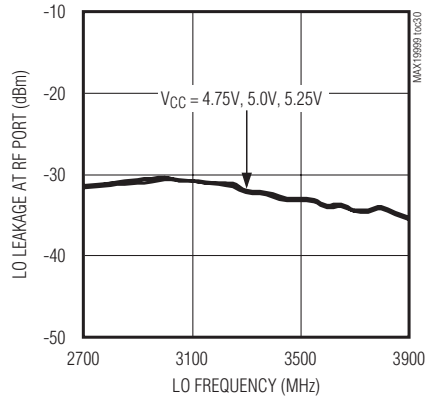
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



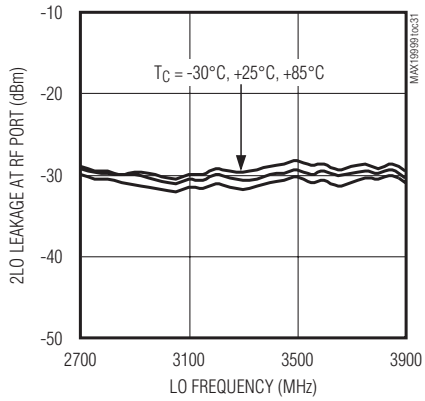
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



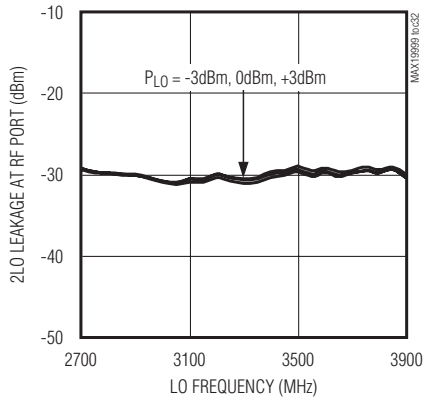
LO LEAKAGE AT RF PORT vs. LO FREQUENCY



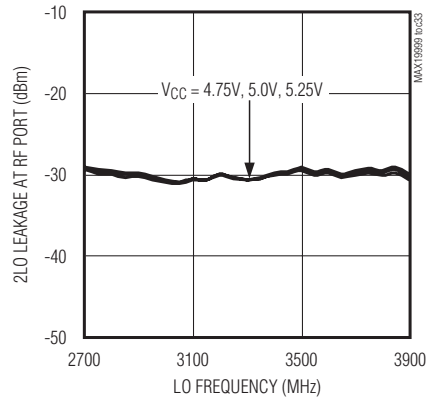
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



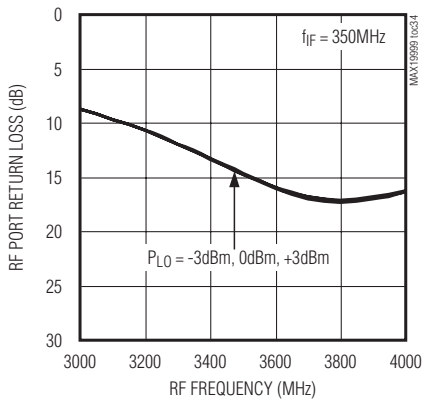
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



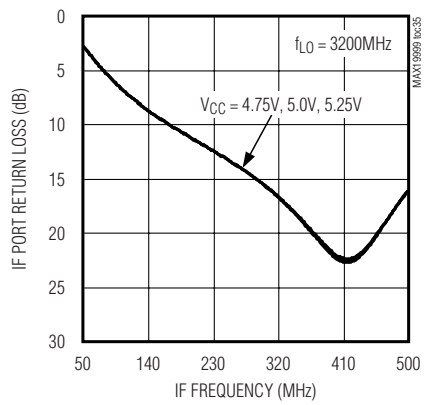
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



RF PORT RETURN LOSS vs. RF FREQUENCY



IF PORT RETURN LOSS vs. IF FREQUENCY



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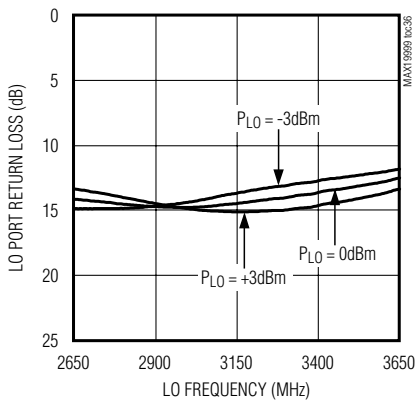
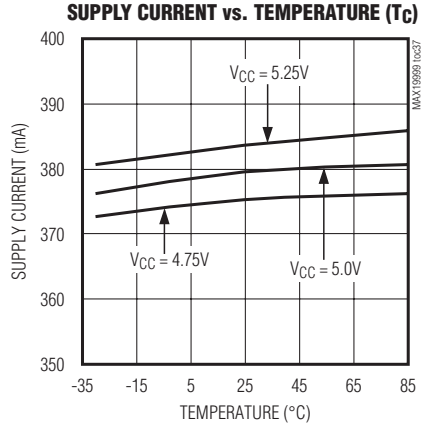
LO PORT RETURN LOSS vs. LO FREQUENCY



SUPPLY CURRENT vs. TEMPERATURE (T_C)



典型工作特性(续)

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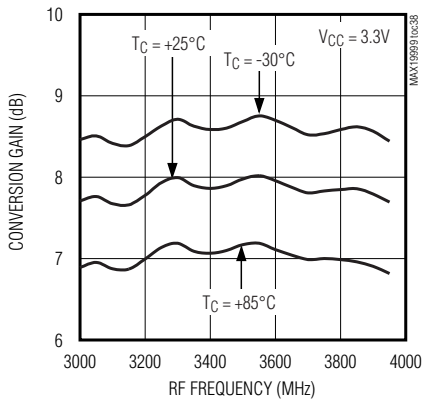
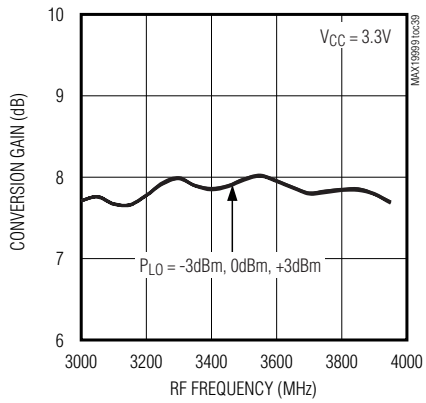
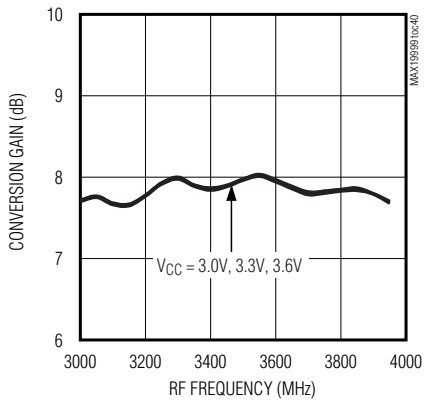
CONVERSION GAIN vs. RF FREQUENCY



CONVERSION GAIN vs. RF FREQUENCY



CONVERSION GAIN vs. RF FREQUENCY



典型工作特性(续)

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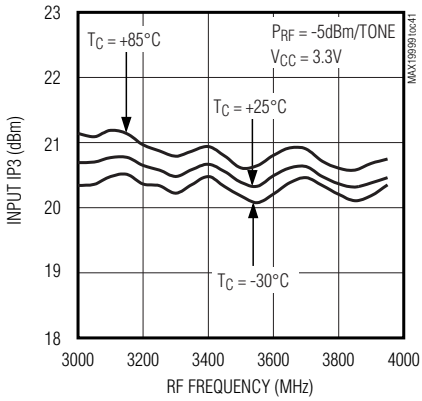
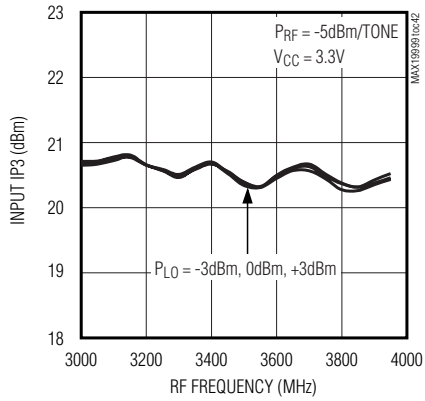
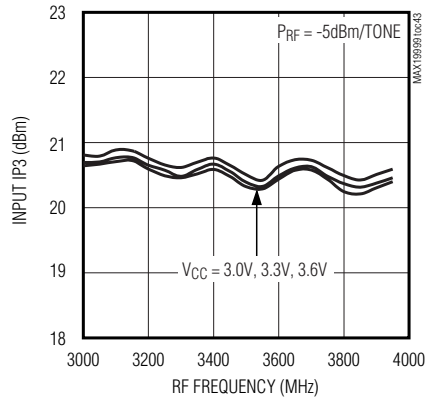
INPUT IP3 vs. RF FREQUENCY



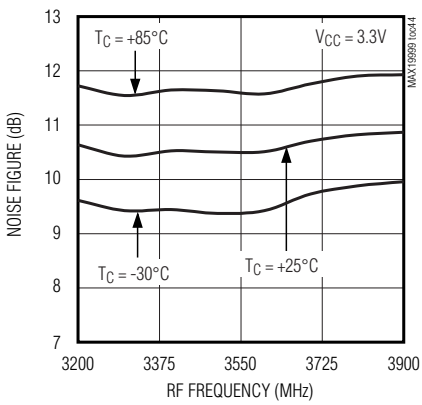
INPUT IP3 vs. RF FREQUENCY



INPUT IP3 vs. RF FREQUENCY



NOISE FIGURE vs. RF FREQUENCY



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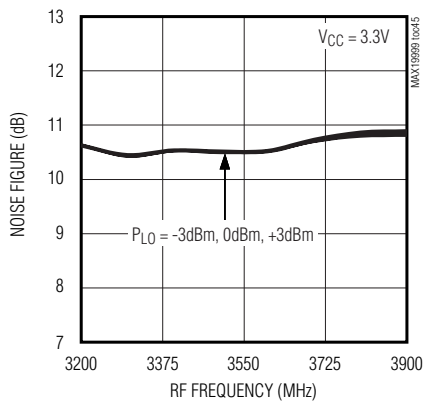
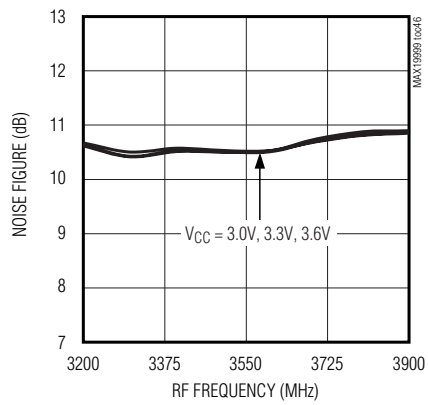
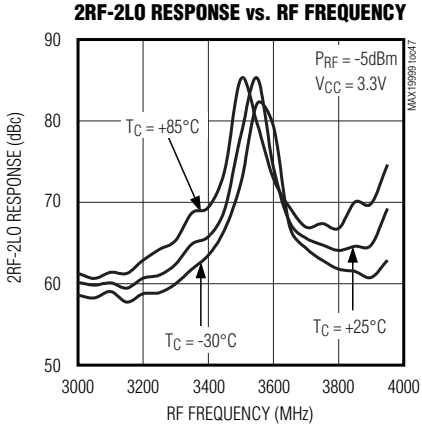


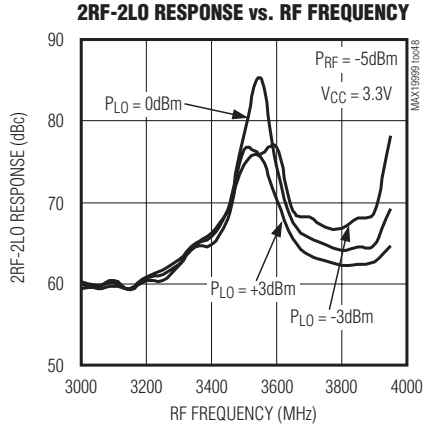
NOISE FIGURE vs. RF FREQUENCY



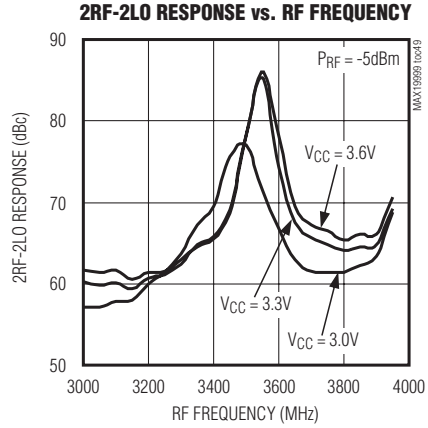
2RF-2LO RESPONSE vs. RF FREQUENCY



2RF-2LO RESPONSE vs. RF FREQUENCY



2RF-2LO RESPONSE vs. RF FREQUENCY



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典型工作特性(续)

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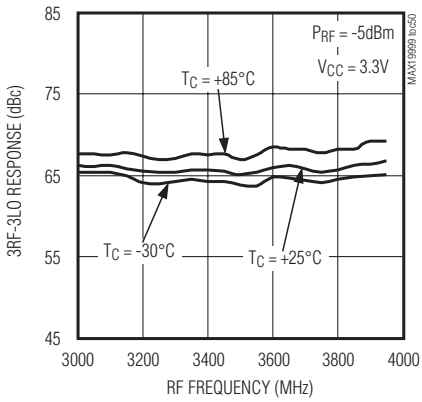
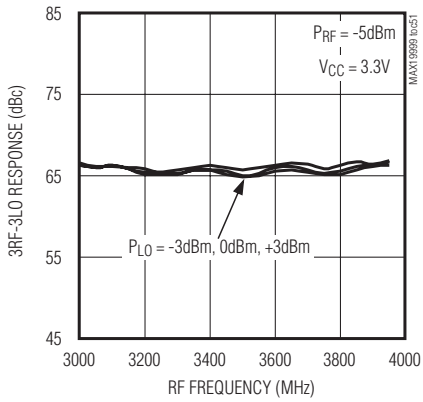
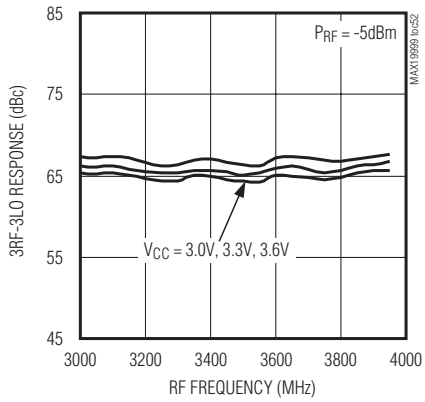
3RF-3LO RESPONSE vs. RF FREQUENCY



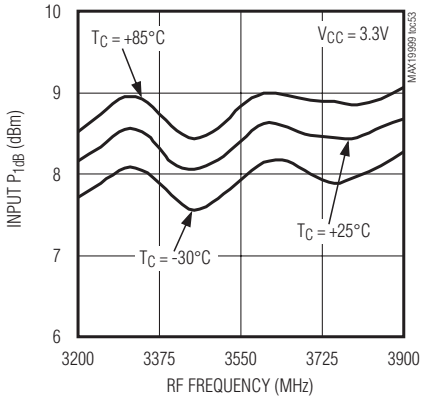
3RF-3LO RESPONSE vs. RF FREQUENCY



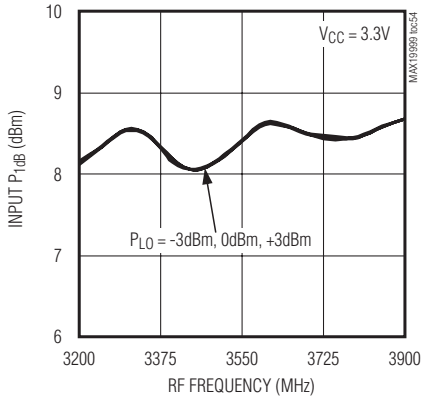
3RF-3LO RESPONSE vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY



INPUT P_{1dB} vs. RF FREQUENCY



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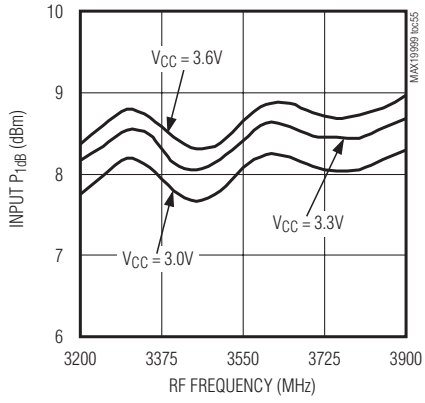
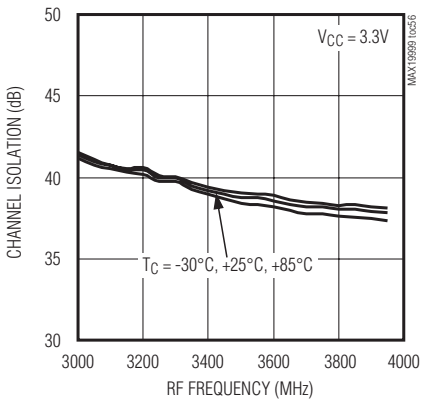
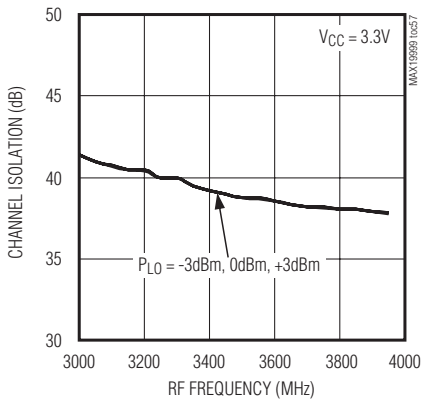


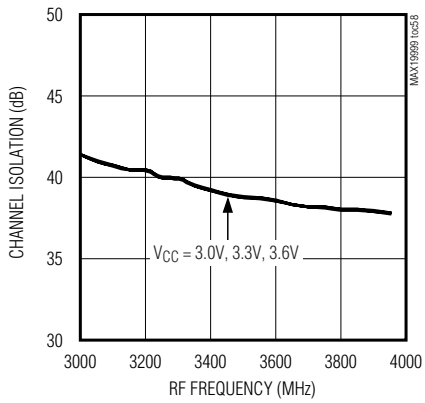
CHANNEL ISOLATION vs. RF FREQUENCY



CHANNEL ISOLATION vs. RF FREQUENCY



CHANNEL ISOLATION vs. RF FREQUENCY



典型工作特性(续)

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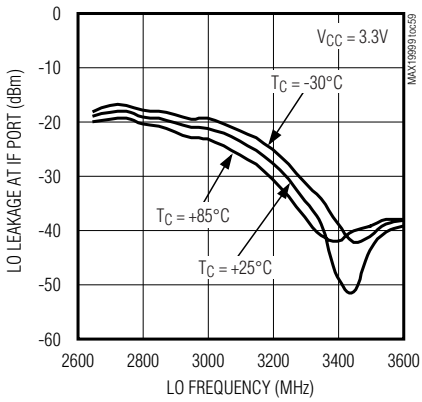

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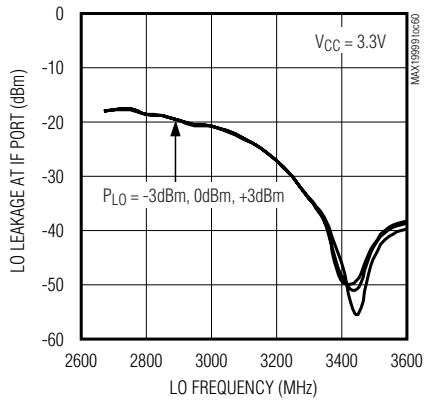

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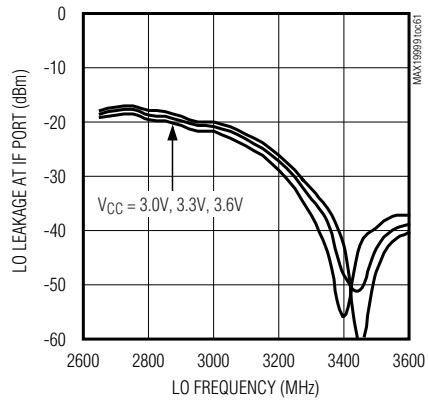
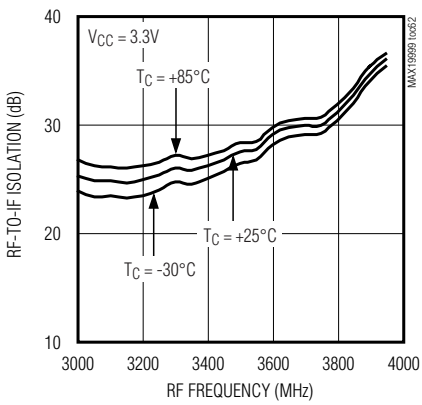
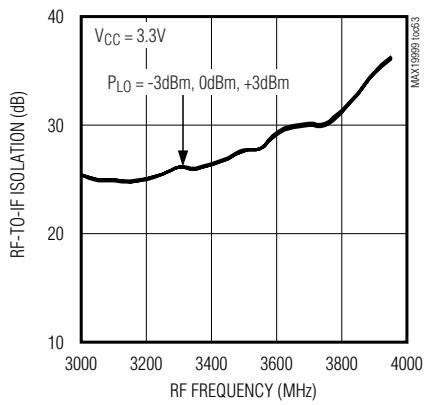


RF-TO-IF ISOLATION vs. RF FREQUENCY



RF-TO-IF ISOLATION vs. RF FREQUENCY



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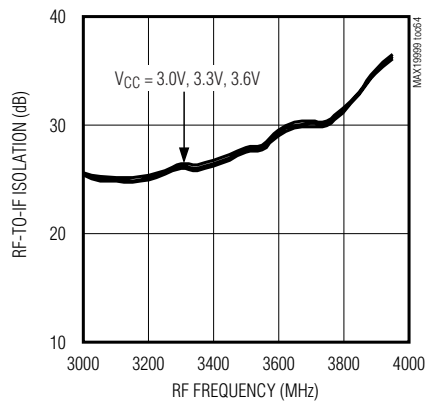
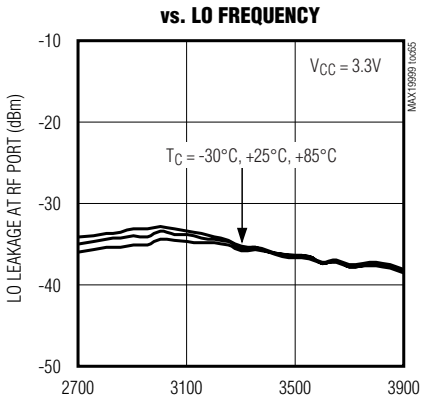
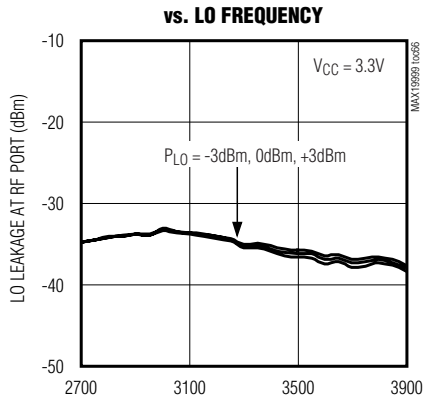


LO LEAKAGE AT RF PORT vs. LO FREQUENCY



LO LEAKAGE AT RF PORT vs. LO FREQUENCY



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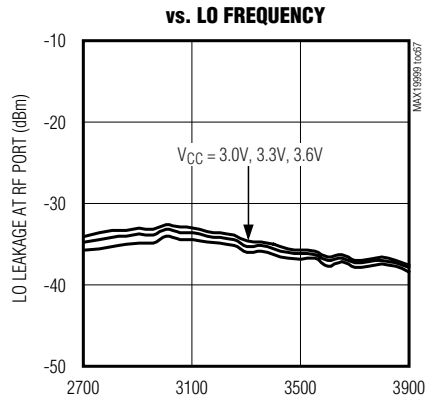

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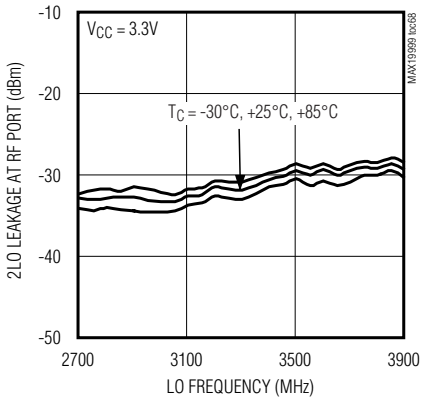

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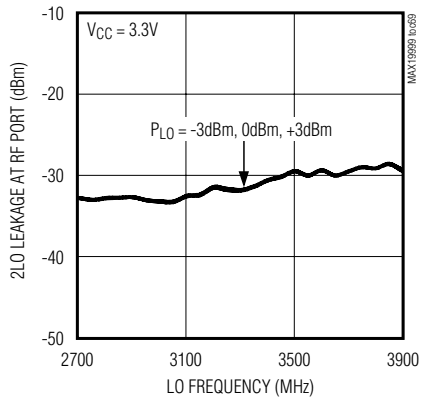
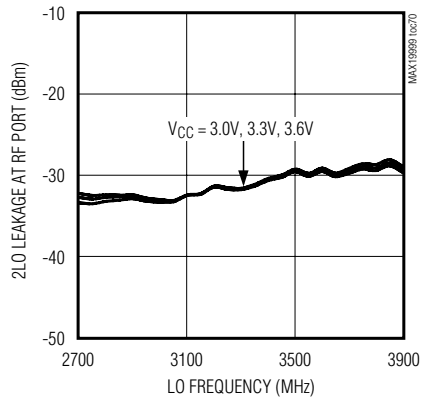
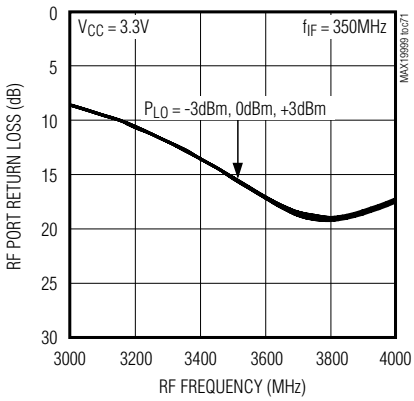


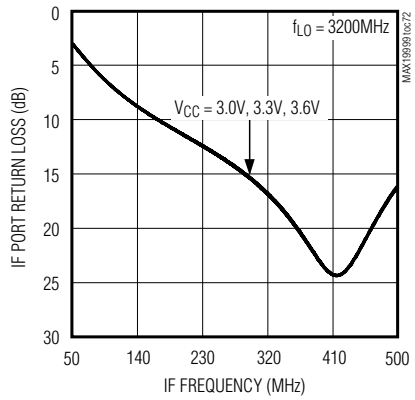
2LO LEAKAGE AT RF PORT vs. LO FREQUENCY



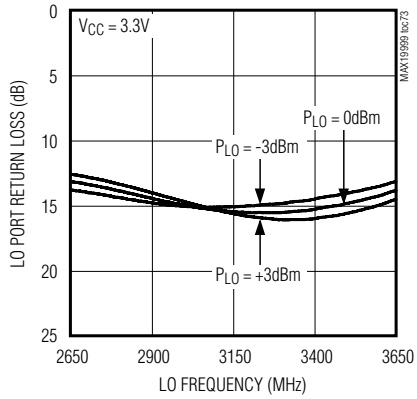
RF PORT RETURN LOSS vs. RF FREQUENCY



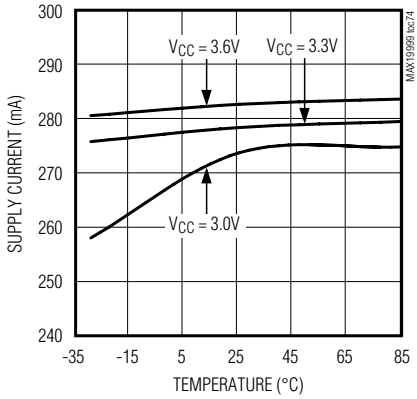
IF PORT RETURN LOSS vs. IF FREQUENCY



LO PORT RETURN LOSS vs. LO FREQUENCY



SUPPLY CURRENT vs. TEMPERATURE (T_C)



引脚说明

引脚	名称	功能
1	RFMAIN	主通道RF输入。内部匹配为50Ω，需要一个输入隔直电容。
2, 5, 6, 8, 12, 15, 18, 23, 28, 31, 34	GND	地，内部没有连接，可以将这些引脚接地或浮空。
3, 7, 20, 22, 24, 25, 26, 27	GND	地，内部连接至裸焊盘(EP)，将所有地引脚与裸焊盘连接在一起。
4, 10, 16, 21, 30, 36	V_{CC}	电源，旁路电容应尽可能靠近该引脚放置(参见*典型应用电路*)。
9	RFDIV	分集通道RF输入。内部匹配为50Ω，需要一个输入隔直电容。
11	IFD_SET	IF分集放大器的偏置控制。在该引脚与地之间连接一个电阻来设置分集IF放大器的偏置电流。
13, 14	IFD+, IFD-	分集混频器差分IF输出。各引脚均需通过上拉电感连接至V_{CC} (参见*典型应用电路*)。
17	LO_ADJ_D	LO分集放大器的偏置控制。在该引脚与地之间连接一个电阻设置分集LO放大器的偏置电流。
19	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。
29	LO_ADJ_M	LO主放大器的偏置控制。在该引脚与地之间连接一个电阻来设置LO主放大器的偏置电流。
32, 33	IFM-, IFM+	主混频器差分IF输出。各引脚均需通过上拉电感连接至V_{CC} (参见*典型应用电路*)。
35	IFM_SET	IF主放大器的偏置控制。在该引脚与地之间连接一个电阻设置IF主放大器的偏置电流。
—	EP	裸焊盘，内部连接至GND，使用多个接地过孔将该焊盘焊接到一个PCB盘，为器件与PCB地层之间提供好的散热通道。多个接地过孔还有助于改善RF性能。

详细说明

MAX19999能够为3000MHz至4000MHz WiMAX和LTE基站应用提供高线性度和低噪声系数。器件工作在2650MHz至3700MHz LO范围以及50MHz至500MHz IF范围。集成非平衡变压器和匹配电路允许50Ω单端接口与RF和LO端口连接。集成LO缓冲器可以为混频器核提供较强的驱动能力，将MAX19999输入端所需的LO驱动减小到-3dBm至+3dBm。IF端口配合差分输出，有效改善了2RF-2LO性能。

RF输入和非平衡变压器

MAX19999的两个RF输入(RFMAIN和RFDIV)结合串联隔直流电容，均匹配在50Ω。输入端通过每个通道的片上非平衡变压器内部直流短接到地，因此需要隔直电容。使用1.5pF隔直流电容时，在整个3200MHz至3900MHz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

两级内部LO缓冲器允许较宽范围的输入功率驱动LO。在-3dBm至+3dBm LO信号功率范围内，确保各项指标在规定的范围内。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

MAX19999的核心电路由两个双平衡、高性能无源混频器组成。片上LO缓冲器具有较大的LO摆幅，可提供优异的

双通道、SiGe、高线性度、3000MHz至4000MHz下变频混频器，带有LO缓冲器

线性度指标。对于覆盖3000MHz至4000MHz频段的低端LO注入架构，与集成IF放大器配合使用时，级联后的IIP3、2RF-2LO抑制和NF的典型值分别为+24dBm、74dBc和10.5dB。

差分IF输出放大器

MAX19999混频器具有50MHz至500MHz的IF频率范围，差分、集电极开路IF输出端口需要通过外部电感上拉至V_{CC}。这些电感与IC的并联电容、PCB上的元件以及PCB本身的寄生电容产生谐振，使IF匹配电路优化在所要求的频率。值得注意的是：这些差分IF输出能够改善2RF-2LO抑制指标，单端IF应用需要一个4:1的非平衡变压器，将200Ω的差分电阻转换成50Ω单端输出。在非平衡变压器之后，IF回波损耗的典型值为18dB。

应用信息

输入和输出匹配

RF和LO输入端在内部匹配为50Ω，在3000MHz至4000MHz的RF频率范围内无需匹配元件。RF和LO输入端只需通过隔直电容连接。

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*)。

降低功耗模式

MAX19999的每个通道均具有两个引脚(LO_ADJ_ _，IF_ _SET)，允许通过外部电阻设置内部偏置电流。电阻的标称值如表1所示。增大电阻值可降低功耗，但代价是性能有所下降。如果没有±1%精度的电阻，可以采用±5%的电阻替代。

选择3.3V为混频器供电也可以显著降低功耗，这种方式可以将整体功耗降低53%。参见*+3.3V Supply AC Electrical Characteristics*和*典型工作特性*中与+3.3V供电相关的特性曲线，以评估功耗与性能的关系。

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。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MAX19999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。

裸焊盘的RF/散热考虑

MAX19999采用36引脚、薄型QFN-EP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MAX19999的PCB与裸焊盘之间保持良好的热传递通道非常重要。此外，裸焊盘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。

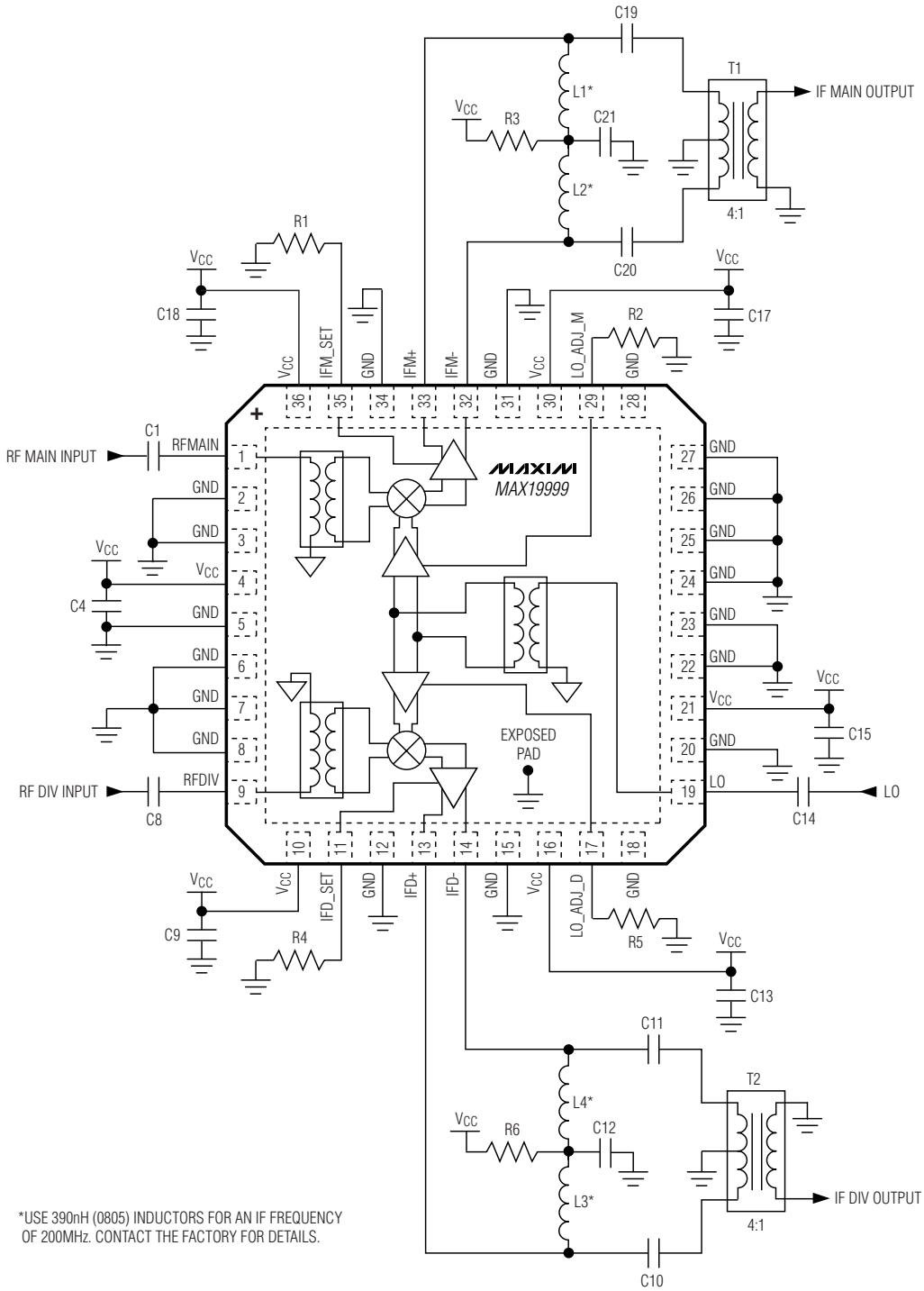
表1. 应用电路元件值

DESIGNATION	QTY	DESCRIPTION	SUPPLIER
C1, C8, C14	3	1.5pF microwave capacitors (0402)	Murata Electronics North America, Inc.
C4, C9, C13, C15, C17, C18	6	0.01µF microwave capacitors (0402)	Murata Electronics North America, Inc.
C10, C11, C12, C19, C20, C21	6	82pF microwave capacitors (0603)	Murata Electronics North America, Inc.
L1–L4	4	120nH wire-wound high-Q inductors* (0805)	Coilcraft, Inc.
R1, R4	2	750Ω ±1% resistor (0402). Use for **V_{CC} = +5.0V** applications. Larger values can be used to reduce power at the expense of some performance loss. See the *Typical Operating Characteristics.*	Digi-Key Corp.
		1.1kΩ ±1% resistor (0402). Use for **V_{CC} = +3.3V** applications. Larger values can be used to reduce power at the expense of some performance loss. See the *Typical Operating Characteristics.*	Digi-Key Corp.
R2, R5	2	698Ω ±1% resistor (0402). Use for **V_{CC} = +5.0V** applications. Larger values can be used to reduce power at the expense of some performance loss. See the *Typical Operating Characteristics.*	Digi-Key Corp.
		845Ω ±1% resistor (0402). Use for **V_{CC} = +3.3V** applications. Larger values can be used to reduce power at the expense of some performance loss. See the *Typical Operating Characteristics.*	Digi-Key Corp.
R3, R6	2	0Ω resistors (1206). These resistors can be increased in value to reduce power dissipation in the device but will reduce the compression point. Full P_{1dB} performance achieved using 0Ω.	Digi-Key Corp.
T1, T2	2	4:1 IF balun TC4-1W-17+	Mini-Circuits
U1	1	MAX19999 IC (36 TQFN-EP)	Maxim Integrated Products, Inc.

**对于200MHz IF频率，使用390nH (0805)电感。详细信息请与工厂联系。*

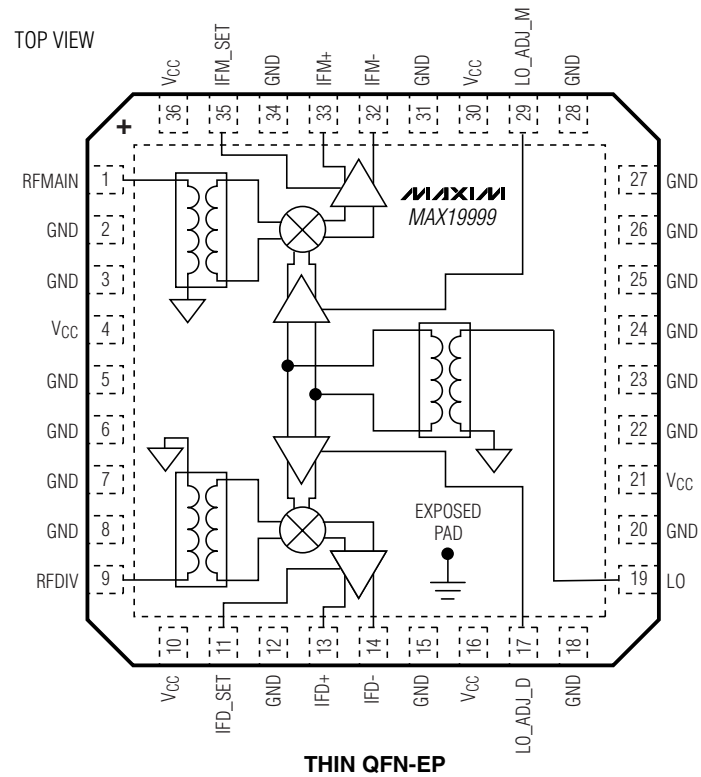
双通道、SiGe、高线性度、3000MHz至4000MHz下变频混频器，带有LO缓冲器

典型应用电路



双通道、SiGe、高线性度、3000MHz至4000MHz下变频混频器，带有LO缓冲器

引脚配置/功能框图



THIN QFN-EP
(6mm x 6mm)

EXPOSED PAD ON THE BOTTOM OF THE PACKAGE.

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
36引脚薄型QFN-EP	T3666+2	**21-0141**

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