19-4582; Rev 0; 4/09

MAXIM

SiGe、高线性度、850MHz至1550MHz上/下变频混频器，带有LO缓冲器

概述

MAX2051高线性度、上/下变频混频器可为850MHz至1550MHz无线基础设施和多载波电缆前端下行视频、视频点播(VOD)以及电缆调制解调器终端系统(CMTS)应用提供+35dBm输入IP3、7.8dB噪声系数(NF)和7.4dB转换损耗。MAX2051还提供优异的互调杂散抑制性能(RF电平为-14dBm时大于77dBc)，非常适合在DOCSIS® 3.0和欧洲DOCSIS电缆前端系统中用作下变频器。MAX2051带有调谐在1200MHz至2250MHz频率范围的LO电路，理想用于50MHz至1000MHz IF频率范围的高端LO注入架构。

除具有优异的线性度和噪声指标外，MAX2051还具有非常高的元件集成度。该器件在RF和LO端口集成了非平衡变压器，允许单端RF输入和单端LO输入。MAX2051需要一个典型值为0dBm的LO驱动，电源电流保证小于130mA。

MAX2051采用紧凑的5mm x 5mm、20引脚薄型QFN封装，带有裸焊盘。在T_C = -40°C至+85°C扩展级温度范围内保证其电气性能。

特性

- 850MHz至1550MHz RF频率范围
- 1200MHz至2250MHz LO频率范围
- 50MHz至1000MHz IF频率范围
- 符合DOCSIS 3.0和欧洲DOCSIS标准
- 转换损耗典型值为7.4dB
- 噪声系数典型值为7.8dB
- 输入1dB压缩点典型值为+24dBm
- 输入IP3典型值为+35dBm
- P_{RF} = -14dBm时，2RF-LO抑制典型值为88dBc
- 内置LO缓冲器
- 内置RF和LO非平衡变压器，允许单端输入
- 低LO驱动(0dBm标称值)
- 外部电流设置电阻允许折衷选择混频器的低功耗/低性能工作模式

应用

视频点播和DOCSIS兼容边沿QAM调制

电缆调制解调器终端系统

微波和固定带宽无线接入设备

微波链路

军用系统

预修正接收机

个人移动无线通信装置

集成数字增强网络(iDEN®)基站

WiMAX™基站及用户端设备

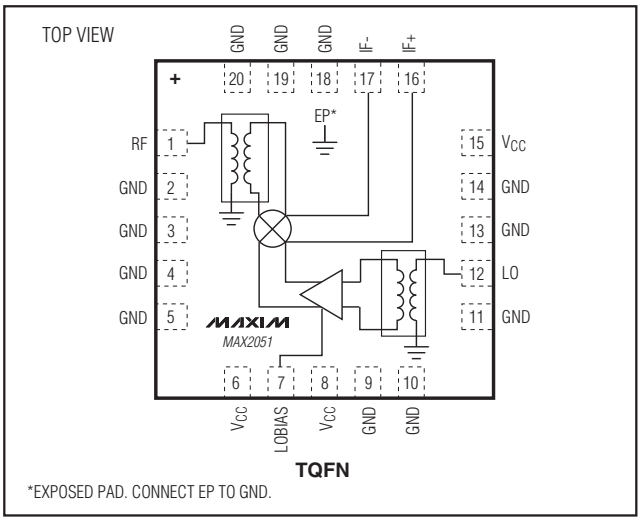
无线本地环路

定购信息

PART	TEMP RANGE	PIN-PACKAGE
MAX2051ETP+	-40°C to +85°C	20 Thin QFN-EP*
MAX2051ETP+T	-40°C to +85°C	20 Thin QFN-EP*

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

引脚配置/功能框图



DOCSIS和CableLabs是Cable Television Laboratories, Inc. (CableLabs®)的注册商标。
iDEN是Motorola, Inc.的注册商标。
WiMAX是WiMAX论坛的商标。

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +5.5V
RF, LO to GND .....-0.3V to 0.3V
IF+, IF-, LOBIAS to GND .....-0.3V to (V_{CC} + 0.3V)
RF, LO Input Power .....+20dBm
RF, LO Current (RF and LO is DC shorted to GND through balun).....50mA
Continuous Power Dissipation (Note 1) 2100mW
θ_{JA} (Notes 2, 3).....+33°C/W
θ_{JC} (Note 3).....8°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.

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, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{CC}		4.75	5	5.25	V
Supply Current	I_{CC}	Total supply current		105	130	mA

RECOMMENDED AC OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RF Frequency	f_{RF}	(Notes 5, 6)	850		1550	MHz
LO Frequency	f_{LO}	(Note 5)	1200		2250	MHz
IF Frequency	f_{IF}	Meeting RF and LO frequency ranges; IF matching components affect the IF frequency range (Note 5)	50		1000	MHz
LO Drive Level	P_{LO}		-3		+9	dBm

AC ELECTRICAL CHARACTERISTICS (DOWNCONVERTER OPERATION)

(*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} = 0dBm, f_{RF} = 1000MHz to 1250MHz, f_{LO} = 1200MHz to 2250MHz, f_{IF} = 50MHz to 1000MHz, $f_{RF} < f_{LO}$, T_C = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, P_{RF} = 0dBm, P_{LO} = 0dBm, f_{RF} =1200MHz, f_{LO} = 1700MHz, f_{IF} = 500MHz, T_C = +25°C, unless otherwise noted.) (Note 7)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Conversion Power Loss	L_C	f_{RF} = 1200MHz, f_{LO} = 1700MHz, f_{IF} = 500MHz, T_C = +25°C (Notes 8, 9)			7.4	9	dB
Conversion Power Loss Temperature Coefficient	TC_L	T_C = -40°C to +85°C			0.01		dB/°C
Conversion Power Loss Variation vs. Frequency	ΔL_C	f_{LO} = 1200MHz to 2250MHz			± 0.5		dB
Noise Figure	NF_{SSB}	Single sideband			7.8		dB
Input 1dB Compression Point	IP_{1dB}				24		dBm
Third-Order Input Intercept Point	IIP3	V_{CC} = +5.0V, f_{RF1} = 1200MHz, f_{RF2} = 1201MHz, P_{RF} = 0dBm tone, f_{LO} = 1562MHz, P_{LO} = 0dBm, T_C = +25°C, f_{IF} = 362MHz (Notes 8, 9)		33	35		dBm
2RF-LO Spurious Rejection	2 x 1	Single tone, f_{RF} =1200MHz, f_{IF} = 192.5MHz to 857.5MHz, f_{LO} = 1392.5MHz to 2057.5MHz, P_{LO} = +3dBm, resultant f_{SPUR} = 1007.5MHz to 342.5MHz (Notes 8, 9, 10)	P_{RF} = -14dBm	73	88		dBc
			P_{RF} = -10dBm	69	84		
			P_{RF} = 0dBm	59	74		
		Single tone, f_{RF} =1200MHz, f_{IF} = 857.5MHz to 1000MHz, f_{LO} = 2057.5MHz to 2200MHz, P_{LO} = +3dBm, resultant f_{SPUR} = 342.5MHz to 200MHz (Notes 8, 9, 10)	P_{RF} = -14dBm	74	78		
			P_{RF} = -10dBm	70	74		
			P_{RF} = 0dBm	60	64		
2LO-2RF Spurious Rejection	2 x 2	Single tone, f_{RF} =1200MHz, f_{IF} = 97.5MHz to 430MHz, f_{LO} = 1297.5MHz to 1630MHz, P_{LO} = +3dBm, resultant f_{SPUR} = 195MHz to 860MHz (Notes 8, 9, 10)	P_{RF} = -14dBm	68	79		dBc
			P_{RF} = -10dBm	64	75		
			P_{RF} = 0dBm	54	65		
		Single tone, f_{RF} =1200MHz, f_{IF} = 430MHz to 525MHz, f_{LO} = 1630MHz to 1725MHz, P_{LO} = +3dBm, resultant f_{SPUR} = 860MHz to 1050MHz (Notes 8, 9, 10)	P_{RF} = -14dBm	71.5	77.4		
			P_{RF} = -10dBm	67.5	73.4		
			P_{RF} = 0dBm	57.5	63.4		

AC ELECTRICAL CHARACTERISTICS (DOWNCONVERTER OPERATION) (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} = 0dBm, f_{RF} = 1000MHz to 1250MHz, f_{LO} = 1200MHz to 2250MHz, f_{IF} = 50MHz to 1000MHz, $f_{RF} < f_{LO}$, T_C = -40°C to +85°C. Typical values are at V_{CC} = +5.0V, P_{RF} = 0dBm, P_{LO} = 0dBm, f_{RF} =1200MHz, f_{LO} = 1700MHz, f_{IF} = 500MHz, T_C = +25°C, unless otherwise noted.) (Note 7)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
3LO-3RF Spurious Rejection	3 x 3	Single tone, f_{RF} = 1200MHz, 50MHz < f_{IF} < 1000MHz, 1250MHz < f_{LO} < 2200MHz (Notes 8, 9)	P_{RF} = -14dBm	87.5	101		dBc
			P_{RF} = -10dBm	79.5	93		
			P_{RF} = 0dBm	59.5	73		
LO Leakage at RF Port		P_{LO} = +3dBm (Notes 6, 8)			-33.5	-27.5	dBm
LO Leakage at IF Port		P_{LO} = +3dBm (Notes 8, 9)			-26.3	-22.9	dBm
RF-to-IF Isolation		f_{RF} = 1200MHz, P_{LO} = +3dBm (Notes 8, 9)		24	51		dB
RF Input Impedance	Z_{RF}				50		Ω
RF Input Return Loss		LO on and IF terminated with a matched impedance			12		dB
LO Input Impedance	Z_{LO}				50		Ω
LO Input Return Loss		RF and IF terminated with a matched impedance (Note 11)			11		dB
IF Output Impedance	Z_{IF}	Nominal differential impedance at the IC's IF outputs			50		Ω
IF Output Return Loss		RF terminated into 50Ω, LO driven by 50Ω source, IF transformed to 50Ω single-ended using external components shown in the *Typical Application Circuit*			15		dB

AC ELECTRICAL CHARACTERISTICS (UPCONVERTER OPERATION)

(*Typical Application Circuit*, RF and LO ports are driven from 50Ω sources, $f_{RF} < f_{LO}$. Typical values are at V_{CC} = +5.0V, P_{IF} = 0dBm, P_{LO} = 0dBm, f_{RF} = 1250MHz, f_{LO} = 1600MHz, f_{IF} = 350MHz, T_C = +25°C, unless otherwise noted.) (Note 7)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Conversion Power Loss	L_C			7.5		dB
Third-Order Input Intercept Point	IIP3	f_{IF1} = 350MHz, f_{IF2} = 351MHz, P_{IF} = 0dBm/tone		33.4		dBm
LO-2IF Spurious Rejection				61		dBc
LO+2IF Spurious Rejection				63.3		dBc
LO-3IF Spurious Rejection				78		dBc
LO+3IF Spurious Rejection				79		dBc
LO Leakage at RF Port		P_{LO} = +3dBm		-35.7		dBm
IF Leakage at RF Port				-52		dBm
RF Return Loss				12.3		dB
IF Input Return Loss		f_{LO} = 1200MHz		18		dB

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

Note 6: Not production tested.

Note 7: All values reflect losses of external components, including a 0.6dB loss at f_{IF} = 350MHz and a 0.8dB loss at f_{IF} = 1000MHz due to the 1:1 transformer. Output measurements were taken at IF outputs of the *Typical Application Circuit*.

Note 8: Guaranteed by design and characterization.

Note 9: 100% production tested for functionality.

Note 10: Additional improvements (of up to 4dB to 6dB) in spurious responses can be made by increasing the LO drive to +6dBm.

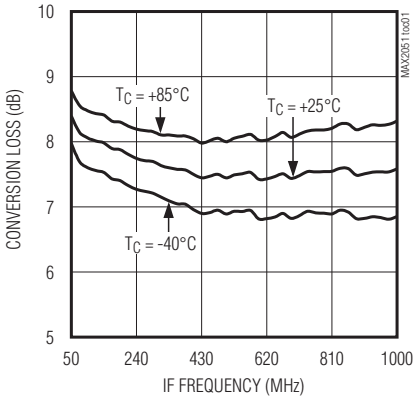
Note 11: The LO return loss can be improved by tuning C9 to offset any parasitics within the specific application circuit. Typical range of C9 is 10pF to 50pF.

SiGe、高线性度、850MHz至1550MHz上/下变频混频器，带有LO缓冲器

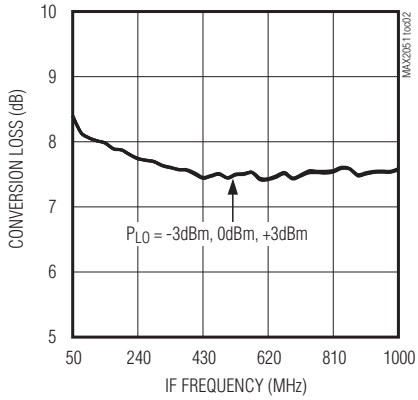
典型工作特性

(*Typical Application Circuit*, **Downconversion mode**, V_{CC} = +5.0V, P_{LO} = 0dBm, P_{RF} = 0dBm, f_{RF} = 1200MHz, LO is high-side injected, T_C = +25°C, unless otherwise noted.)

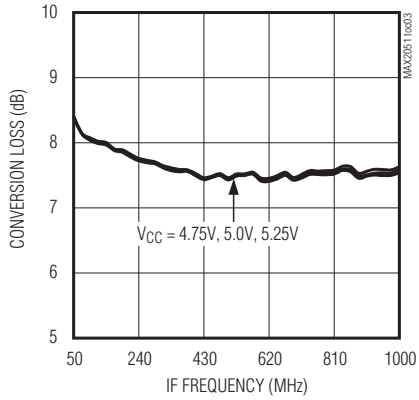
CONVERSION LOSS vs. IF FREQUENCY (DOWNCONVERSION MODE)



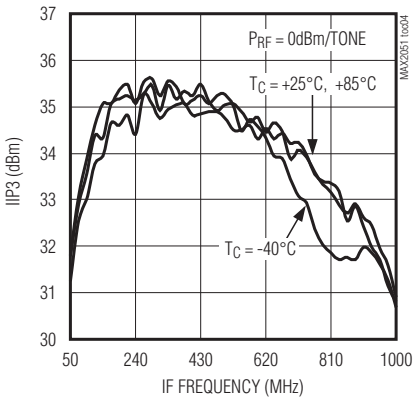
CONVERSION LOSS vs. IF FREQUENCY (DOWNCONVERSION MODE)



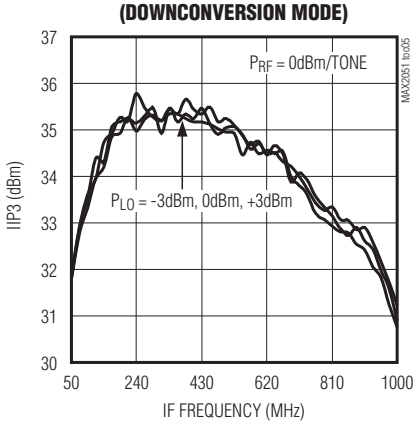
CONVERSION LOSS vs. IF FREQUENCY (DOWNCONVERSION MODE)



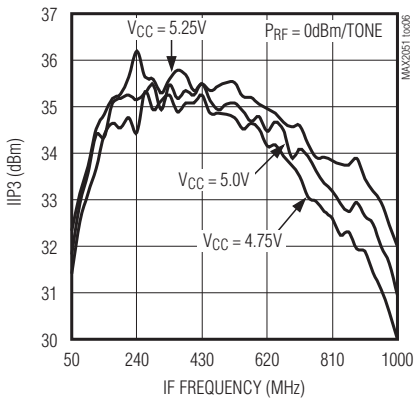
IIP3 vs. IF FREQUENCY (DOWNCONVERSION MODE)



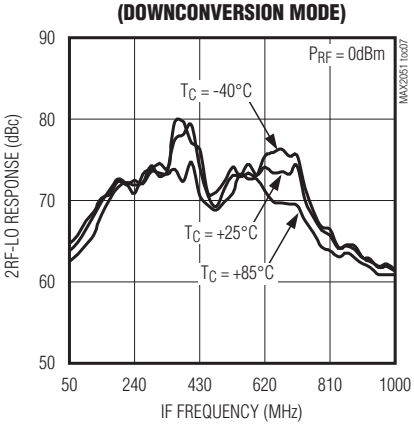
IIP3 vs. IF FREQUENCY (DOWNCONVERSION MODE)



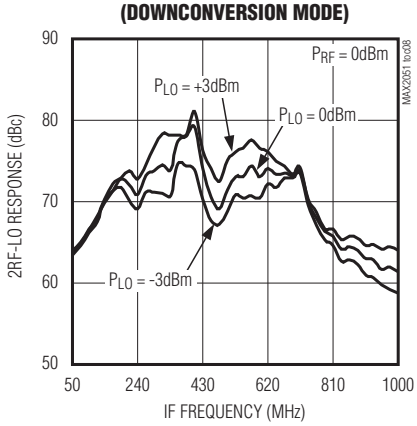
IIP3 vs. IF FREQUENCY (DOWNCONVERSION MODE)



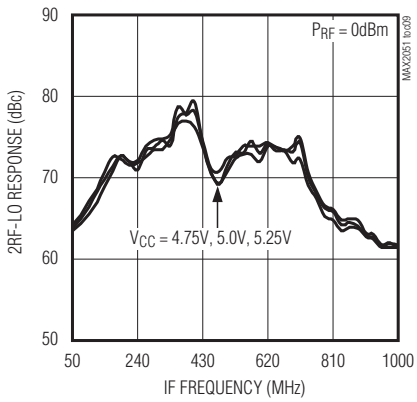
2RF-LO RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



2RF-LO RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



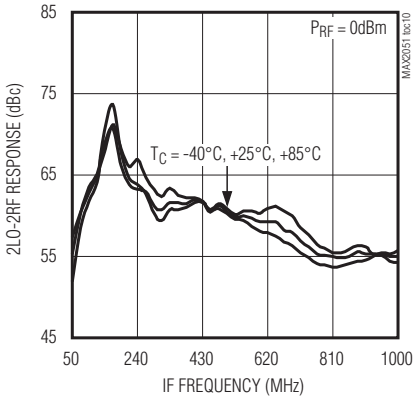
2RF-LO RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



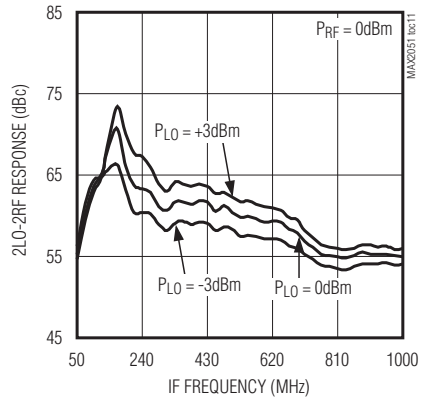
典型工作特性(续)

(*Typical Application Circuit*, **Downconversion mode**, V_{CC} = +5.0V, P_{LO} = 0dBm, P_{RF} = 0dBm, f_{RF} = 1200MHz, LO is high-side injected, T_C = +25°C, unless otherwise noted.)

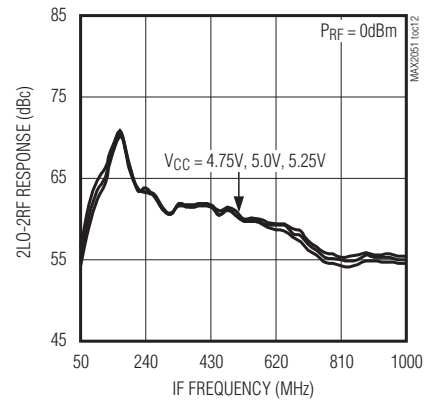
2LO-2RF RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



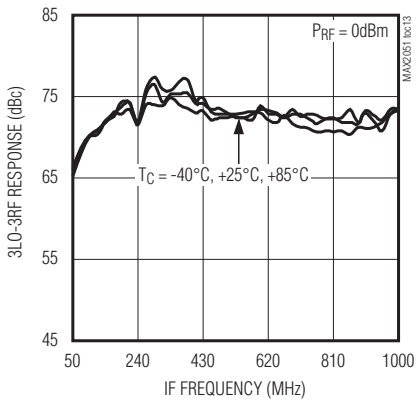
2LO-2RF RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



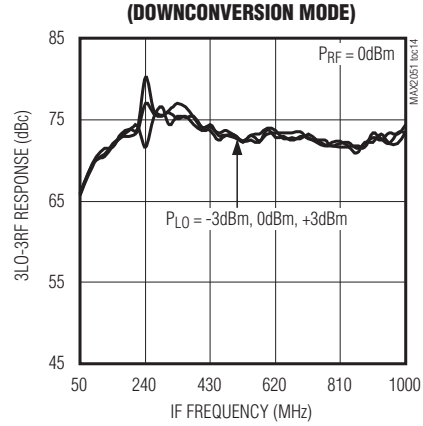
2LO-2RF RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



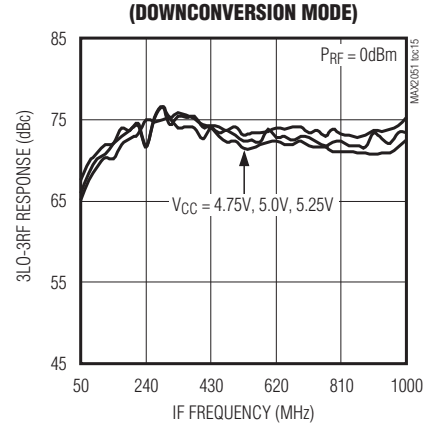
3LO-3RF RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



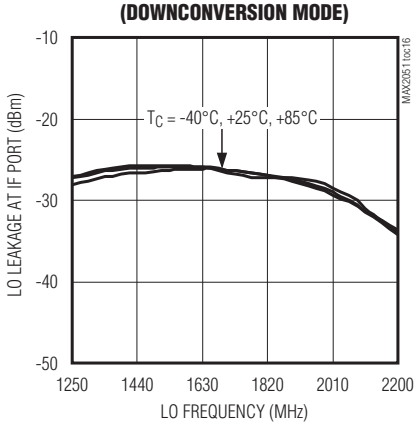
3LO-3RF RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



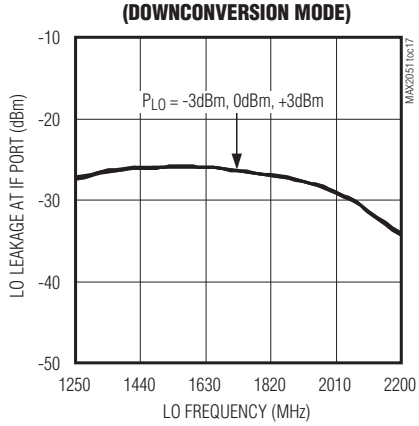
3LO-3RF RESPONSE vs. IF FREQUENCY (DOWNCONVERSION MODE)



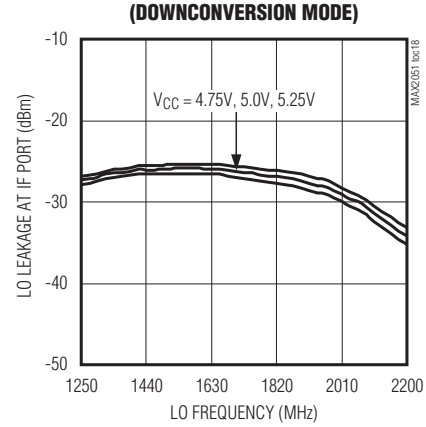
LO LEAKAGE AT IF PORT vs. LO FREQUENCY (DOWNCONVERSION MODE)



LO LEAKAGE AT IF PORT vs. LO FREQUENCY (DOWNCONVERSION MODE)



LO LEAKAGE AT IF PORT vs. LO FREQUENCY (DOWNCONVERSION MODE)

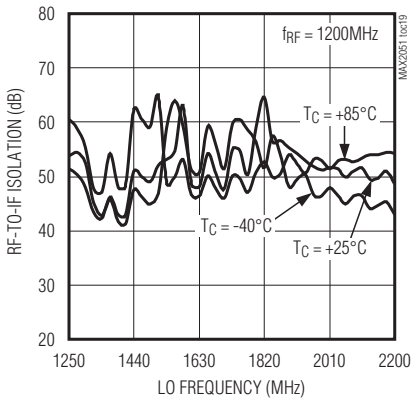


SiGe、高线性度、850MHz至1550MHz上/下变频混频器，带有LO缓冲器

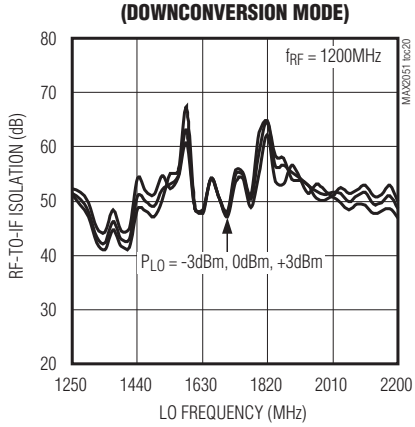
典型工作特性(续)

(*Typical Application Circuit*, **Downconversion mode**, V_{CC} = +5.0V, P_{LO} = 0dBm, P_{RF} = 0dBm, f_{RF} = 1200MHz, LO is high-side injected, T_C = +25°C, unless otherwise noted.)

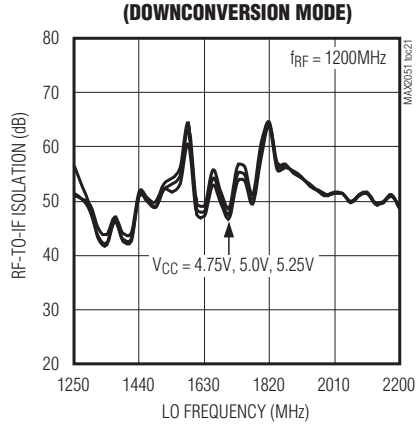
RF-TO-IF ISOLATION vs. LO FREQUENCY (DOWNCONVERSION MODE)



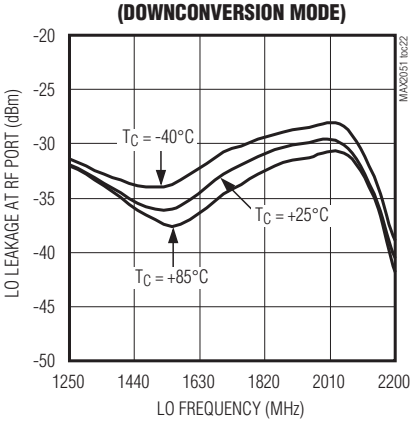
RF-TO-IF ISOLATION vs. LO FREQUENCY (DOWNCONVERSION MODE)



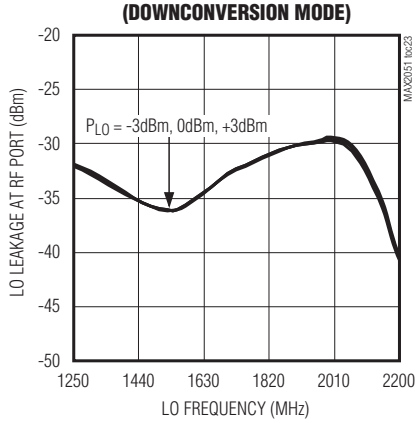
RF-TO-IF ISOLATION vs. LO FREQUENCY (DOWNCONVERSION MODE)



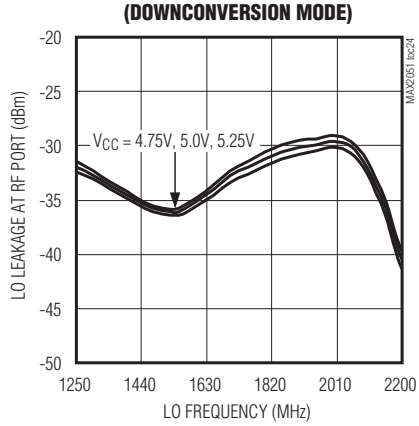
LO LEAKAGE AT RF PORT vs. LO FREQUENCY (DOWNCONVERSION MODE)



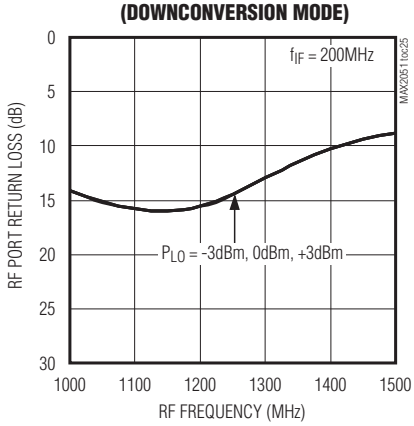
LO LEAKAGE AT RF PORT vs. LO FREQUENCY (DOWNCONVERSION MODE)



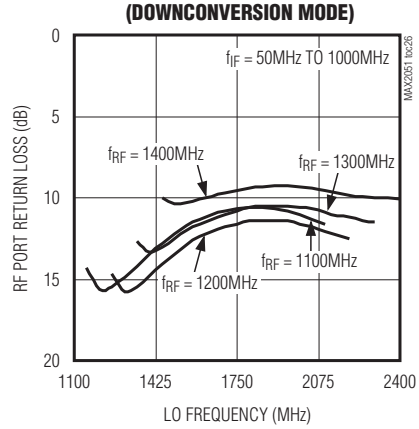
LO LEAKAGE AT RF PORT vs. LO FREQUENCY (DOWNCONVERSION MODE)



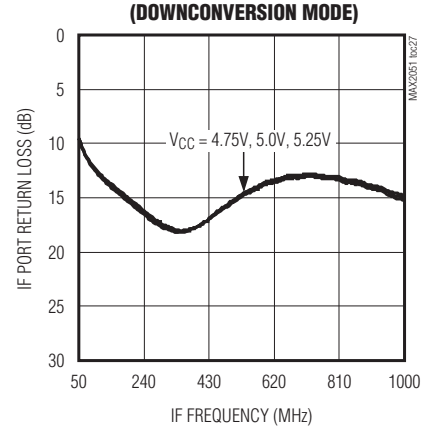
RF PORT RETURN LOSS vs. RF FREQUENCY (DOWNCONVERSION MODE)



RF PORT RETURN LOSS vs. LO FREQUENCY (DOWNCONVERSION MODE)



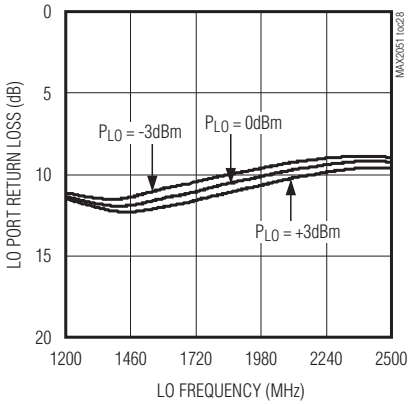
IF PORT RETURN LOSS vs. IF FREQUENCY (DOWNCONVERSION MODE)



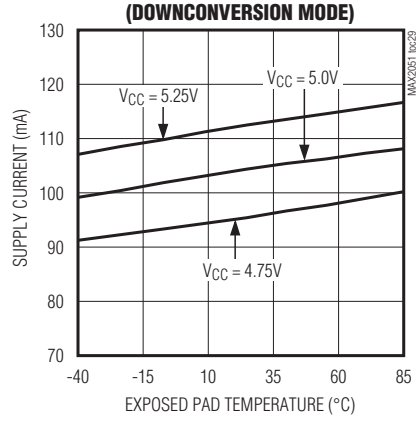
典型工作特性(续)

(*Typical Application Circuit*, **Downconversion mode**, V_{CC} = +5.0V, P_{LO} = 0dBm, P_{RF} = 0dBm, f_{RF} = 1200MHz, LO is high-side injected, T_C = +25°C, unless otherwise noted.)

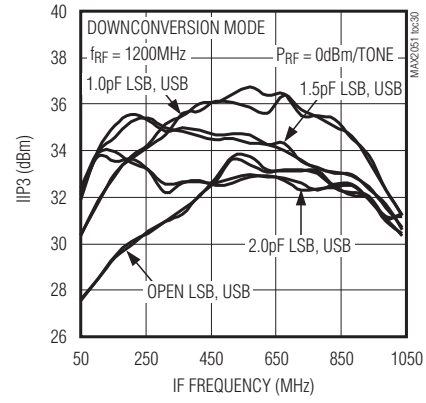
LO PORT RETURN LOSS vs. LO FREQUENCY (DOWNCONVERSION MODE)



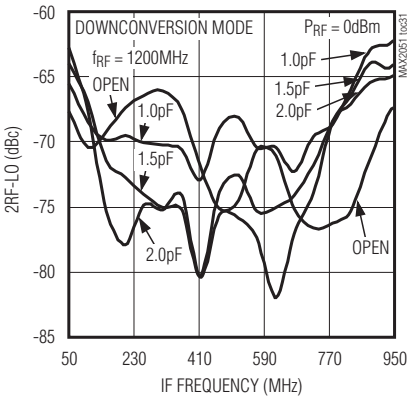
SUPPLY CURRENT vs. EXPOSED PAD TEMPERATURE (T_C) (DOWNCONVERSION MODE)



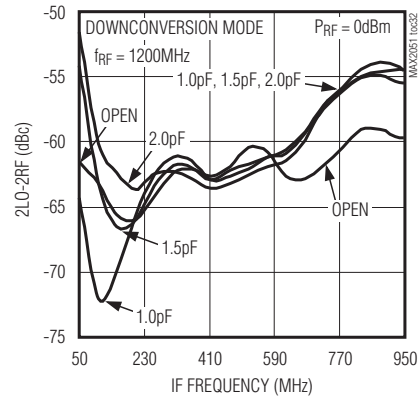
IIP3 vs. IF FREQUENCY (ALTERNATIVE VALUES OF C2)



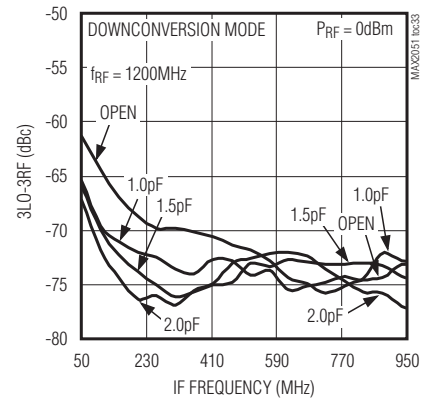
2RF-LO vs. IF FREQUENCY (ALTERNATIVE VALUES OF C2)



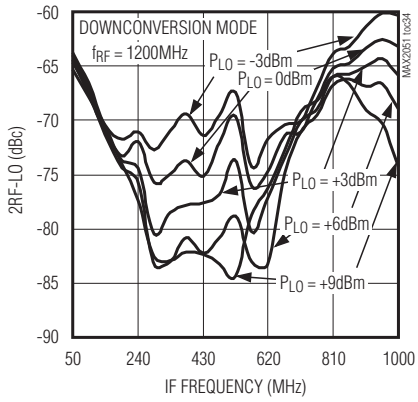
2LO-2RF vs. IF FREQUENCY (ALTERNATIVE VALUES OF C2)



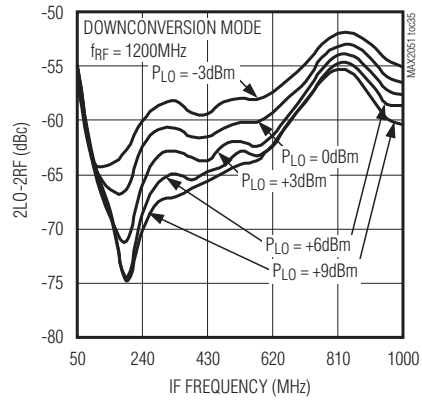
3LO-3RF vs. IF FREQUENCY (ALTERNATIVE VALUES OF C2)



2RF-LO vs. IF FREQUENCY (VARIOUS LO DRIVE LEVELS)



2LO-2RF vs. IF FREQUENCY (VARIOUS LO DRIVE LEVELS)

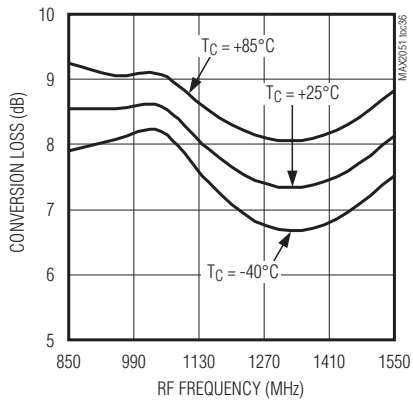


SiGe、高线性度、850MHz至1550MHz上/下变频混频器，带有LO缓冲器

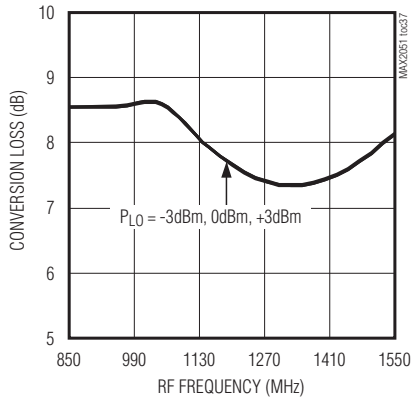
典型工作特性(续)

(*Typical Application Circuit*, **Upconversion mode**, V_{CC} = +5.0V, P_{LO} = 0dBm, P_{IF} = 0dBm, f_{IF} = 350MHz, LO is high-side injected, T_C = +25°C, unless otherwise noted.)

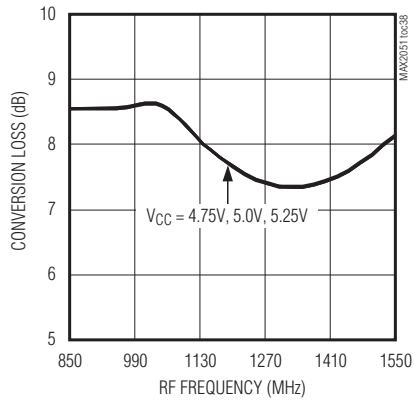
CONVERSION LOSS vs. RF FREQUENCY (UPCONVERSION MODE)



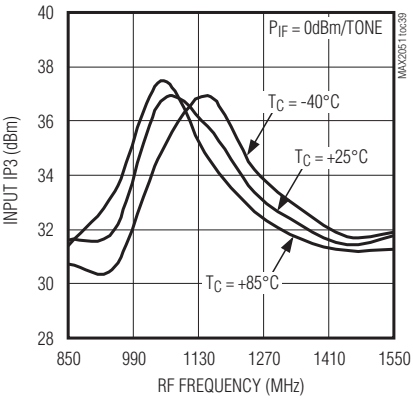
CONVERSION LOSS vs. RF FREQUENCY (UPCONVERSION MODE)



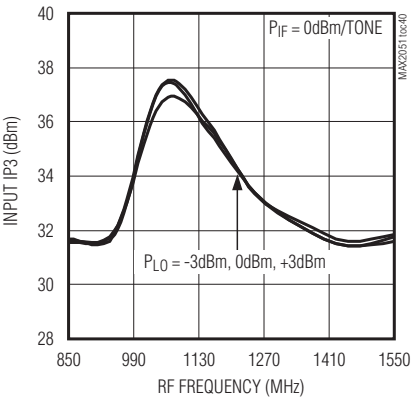
CONVERSION LOSS vs. RF FREQUENCY (UPCONVERSION MODE)



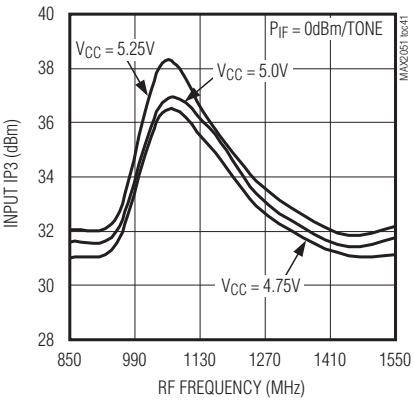
INPUT IP3 vs. RF FREQUENCY (UPCONVERSION MODE)



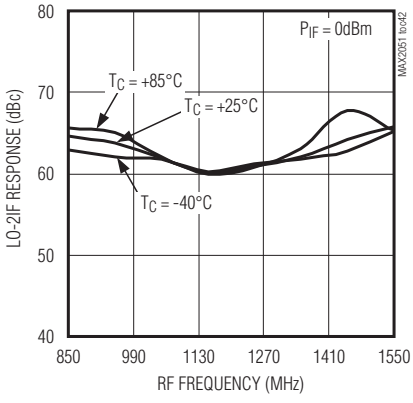
INPUT IP3 vs. RF FREQUENCY (UPCONVERSION MODE)



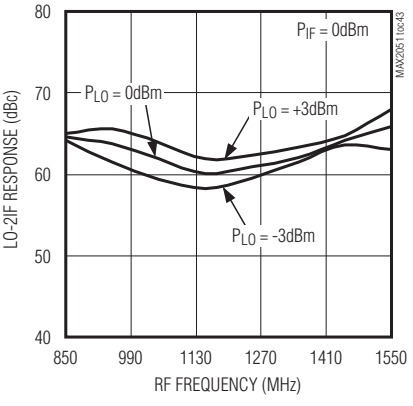
INPUT IP3 vs. RF FREQUENCY (UPCONVERSION MODE)



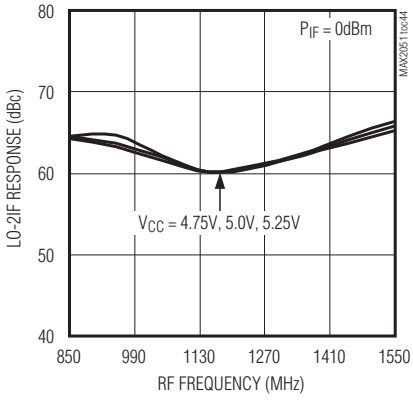
LO-2IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



LO-2IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



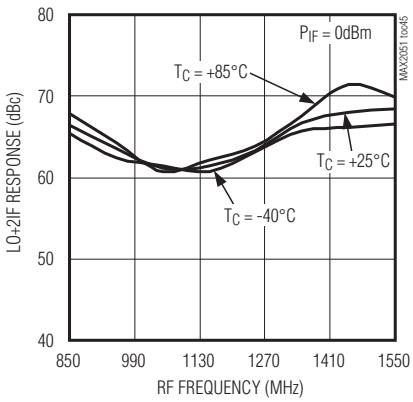
LO-2IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



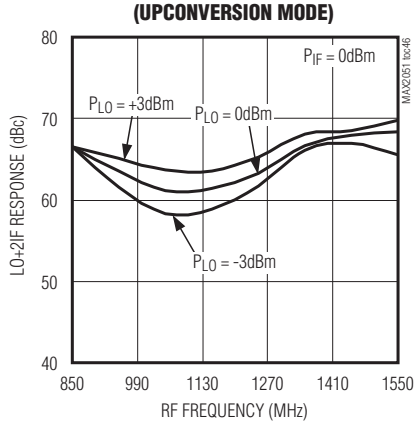
典型工作特性(续)

(*Typical Application Circuit*, **Upconversion mode**, V_{CC} = +5.0V, P_{LO} = 0dBm, P_{IF} = 0dBm, f_{IF} = 350MHz, LO is high-side injected, T_C = +25°C, unless otherwise noted.)

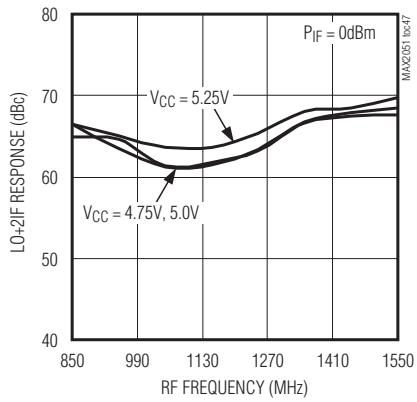
LO+2IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



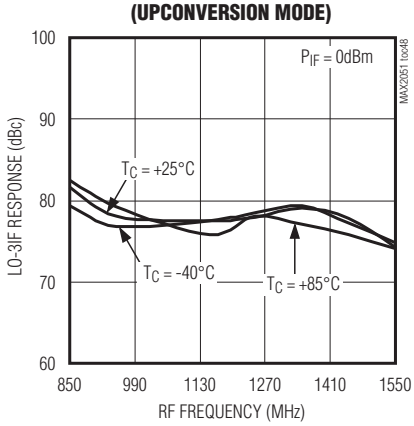
LO+2IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



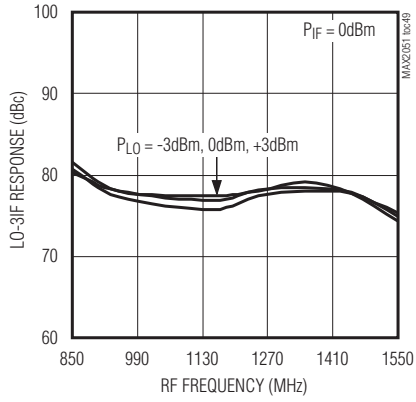
LO+2IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



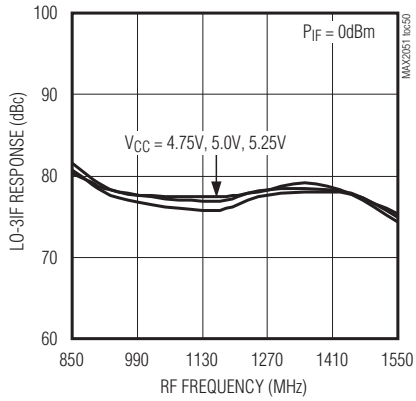
LO-3IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



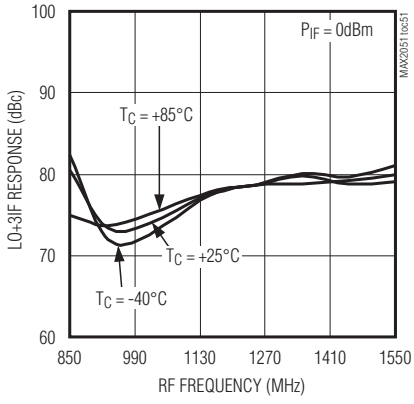
LO-3IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



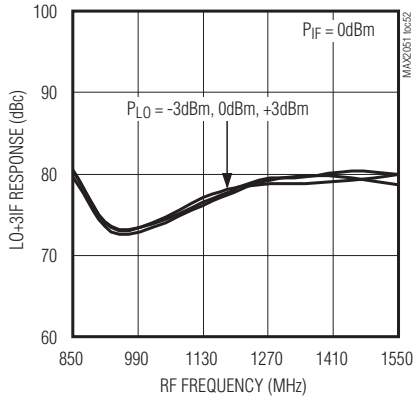
LO-3IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



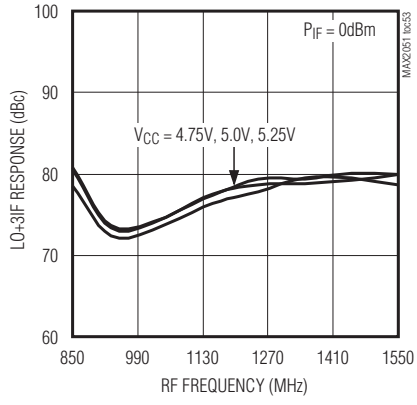
LO+3IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



LO+3IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)



LO+3IF RESPONSE vs. RF FREQUENCY (UPCONVERSION MODE)

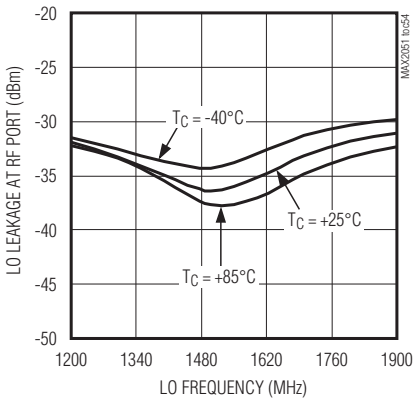


SiGe、高线性度、850MHz至1550MHz上/下变频混频器，带有LO缓冲器

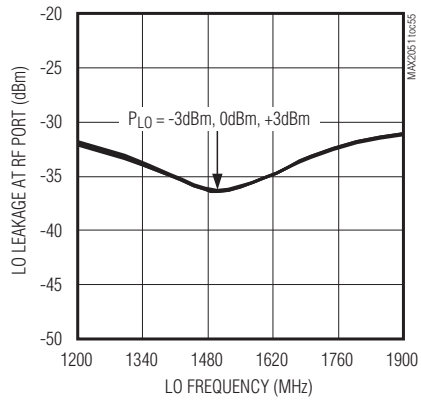
典型工作特性(续)

(*Typical Application Circuit*, **Upconversion mode**, V_{CC} = +5.0V, P_{LO} = 0dBm, P_{IF} = 0dBm, f_{IF} = 350MHz, LO is high-side injected, T_C = +25°C, unless otherwise noted.)

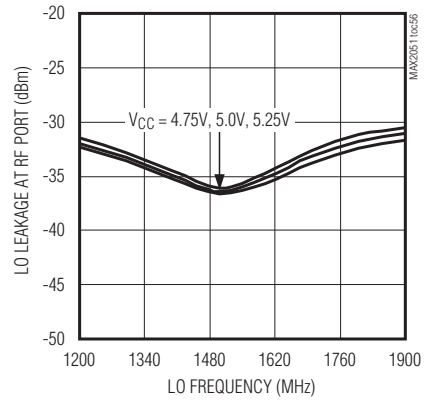
LO LEAKAGE AT RF PORT vs. LO FREQUENCY (UPCONVERSION MODE)



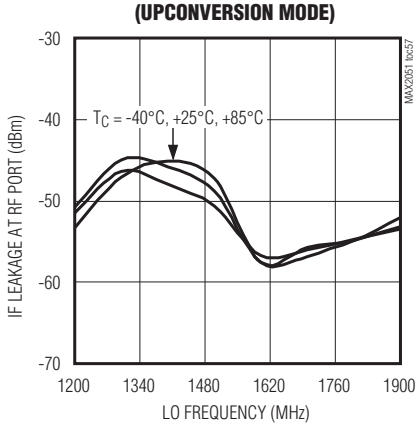
LO LEAKAGE AT RF PORT vs. LO FREQUENCY (UPCONVERSION MODE)



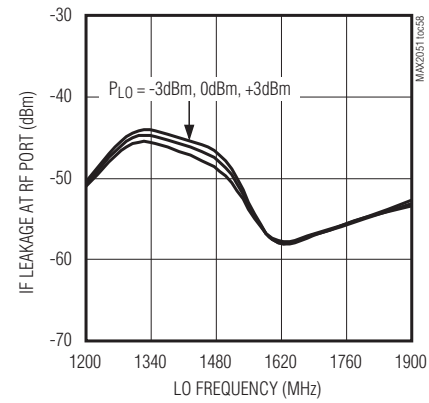
LO LEAKAGE AT RF PORT vs. LO FREQUENCY (UPCONVERSION MODE)



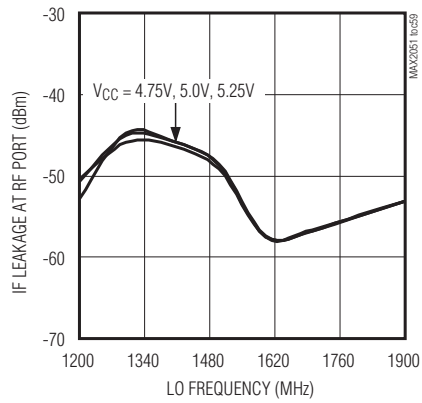
IF LEAKAGE AT RF PORT vs. LO FREQUENCY (UPCONVERSION MODE)



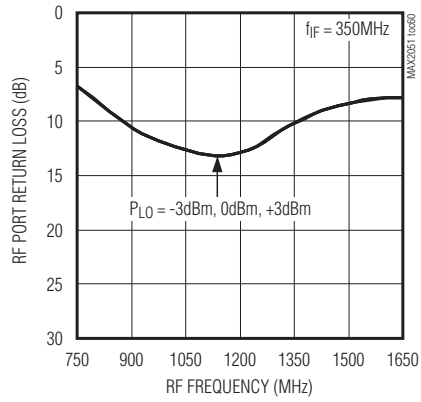
IF LEAKAGE AT RF PORT vs. LO FREQUENCY (UPCONVERSION MODE)



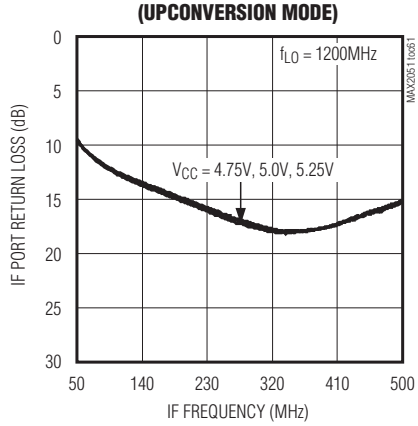
IF LEAKAGE AT RF PORT vs. LO FREQUENCY (UPCONVERSION MODE)



RF PORT RETURN LOSS vs. RF FREQUENCY (UPCONVERSION MODE)



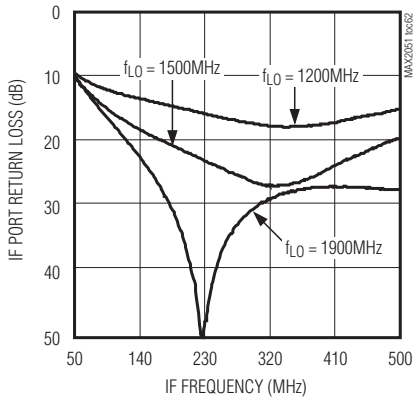
IF PORT RETURN LOSS vs. IF FREQUENCY (UPCONVERSION MODE)



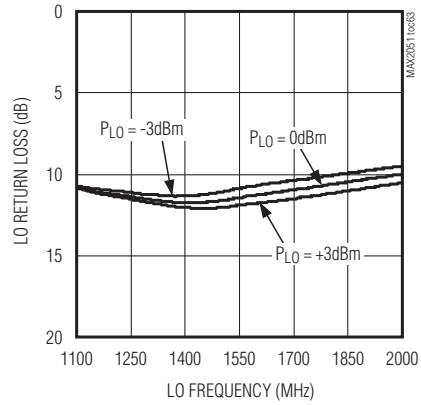
典型工作特性(续)

(*Typical Application Circuit*, **Upconversion mode**, V_{CC} = +5.0V, P_{LO} = 0dBm, P_{IF} = 0dBm, f_{IF} = 350MHz, LO is high-side injected, T_C = +25°C, unless otherwise noted.)

IF PORT RETURN LOSS vs. IF FREQUENCY (UPCONVERSION MODE)



LO RETURN LOSS vs. LO FREQUENCY (UPCONVERSION MODE)



引脚说明

引脚	名称	功能
1	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路至GND，输入需要一个隔直流电容。
2–5, 9, 10, 11, 13, 14	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。
6, 8, 15	V_{CC}	电源，通过电容旁路至GND，电容应尽可能靠近该引脚放置(请参考*典型应用电路*)。
7	LOBIAS	LO放大器偏置控制。LO缓冲器的输出偏置电阻连接端。在LOBIAS与V_{CC}之间连接一个61.9Ω ±1%电阻，设置LO主放大器的偏置电流。
12	LO	本振输入。该输入端内部匹配在50Ω，输入需要一个隔直流电容。
16, 17	IF+, IF-	差分IF输出。
18, 19, 20	GND	地，没有内部连接，所有这些引脚接地或悬空。
—	EP	裸焊盘。内部连接至GND，通过多个接地过孔将裸焊盘焊接到PCB焊盘，有助于器件通过PCB的地层散热。多个接地过孔还有助于改善RF性能。

SiGe、高线性度、850MHz至1550MHz上/下变频混频器，带有LO缓冲器

详细说明

MAX2051高线性度上/下变频混频器可提供+35dBm的IIP3和典型值为7.8dB的噪声系数(NF)以及7.4dB的转换损耗。集成的非平衡变压器和匹配电路允许与RF端口和LO端口之间的50Ω单端连接。集成LO缓冲器能够为混频器核提供较强的驱动能力，使MAX2051输入端所需的LO驱动降低到-3dBm至+3dBm范围。IF端口配合差分输出，有效改善了2RF-LO性能和2LO-2RF性能。在-14dBm RF驱动下，2RF-LO抑制典型值为88dB、2LO-2RF抑制典型值为79dB。

该器件能够在较宽的频率范围内保证性能，适用于VOD、DOCSIS兼容的边沿QAM调制以及CMTS系统。MAX2051规定工作在850MHz至1550MHz RF输入范围、1200MHz至2250MHz LO范围以及50MHz至1000MHz IF范围。

RF端口和非平衡变压器

MAX2051的RF输入端与47pF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，因此需要隔直流电容。在1000MHz至1250MHz的RF频率范围内，RF端口输入回波损耗的典型值为12dB。

LO输入、缓冲器和非平衡变压器

MAX2051针对LO频率范围为1200MHz至2250MHz的高端LO注入架构进行优化。LO输入在内部匹配为50Ω，只需一个47pF隔直流电容。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内。

高线性度混频器

MAX2051的核心是一个双平衡、高性能无源混频器。片上LO缓冲器提供较大的LO摆幅，具有优异的线性指标。IIP3、2RF-LO抑制和噪声系数的典型值分别为+35dBm、88dBc和7.8dB。

差分IF输出

MAX2051具有50MHz至1000MHz的IF频率范围。器件的差分端口有效改善了2RF-LO性能。单端IF应用需要一个1:1(阻抗比)的非平衡变压器，将50Ω差分IF电阻转换成50Ω单端系统输出。

应用信息

输入和输出匹配

RF和LO端口设计工作在50Ω系统。RF和LO输入需要隔直流，将这些端口与外部直流相隔离并提供一定的谐振电抗。IF输出阻抗为50Ω (差分)。为方便评估，通过外部低损耗1:1非平衡变压器将该阻抗转换成50Ω单端输出(请参*考典型应用电路*)。

外部可调偏置

LO缓冲器的偏置电流可通过微调电阻R1进行优化，表1列出了R1的标称阻值，能够优化线性度/系统性能。采用较大阻值(高达125Ω)有助于降低功耗，但线性度有所下降；采用较小阻值(低至0Ω)有助于提高线性度，但功耗增大。如果系统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。

表1. 元件值

DESIGNATION	QTY	DESCRIPTION	SUPPLIER
C1, C9	2	47pF microwave capacitors (0402)	Murata Electronics North America, Inc.
C2	1	1.3pF microwave capacitor (0402)	Murata Electronics North America, Inc.
C3, C4	2	150pF microwave capacitors (0402)	Murata Electronics North America, Inc.
C5, C7, C10	3	100pF microwave capacitors (0402)	Murata Electronics North America, Inc.
C6, C8, C11	3	0.01µF microwave capacitors (0402)	Murata Electronics North America, Inc.
R1	1	61.9Ω ±1% resistor (0402)	Digi-Key Corp.
T1	1	1:1 transformer (50:50) MABACT0060	M/A-Com, Inc.
U1	1	MAX2051 IC (20 TQFN-EP)	Maxim Integrated Products, Inc.

通过外部IF调谐优化IIP3和杂散性能

通过调整IF端口的容性负载可进一步优化IIP3线性度和杂散性能。选择C2默认值为1.3pF (表1所示)，可在50MHz至1000MHz频带内提供最佳的IIP3线性度。也可以选择其它电容值以提高器件的2RF-LO、2LO-2RF以及3LO-3RF杂散响应，代价是会牺牲整体IIP3性能，请参考*典型工作特性*部分的相关曲线，对IIP3和杂散性能进行评估和折衷选择。

通过提高LO驱动优化杂散性能

通过提高器件的LO驱动电平也可以改善MAX2051的2RF-LO、2LO-2RF以及3LO-3RF杂散性能。*典型应用电路*中标称LO驱动为0dBm。但是，也可以增大驱动电平使其最高达到+9dBm，这种情况下能够改善器件的杂散性能，请参考*典型工作特性*部分的相关曲线，对杂散性能和LO驱动能力进行评估和折衷选择。

布局考虑

合理的PCB布局对于任何RF/微波电路设计都很重要。RF信号线应尽可能短，以降低损耗、辐射和电感。混频器的负载阻抗必须保证IF-、IF+与地之间的电容最小。为获得最佳性能，接地引脚必须直接与封装底部的裸焊盘连接。PCB的裸焊盘**必须**连接至PCB的地平面。建议采用多个过孔将该焊盘连接至地平面。这种方式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到PCB。MAX2051评估板提供了一个电路板布局参考，Gerber文件可从www.maxim-ic.com.cn申请。

电源旁路

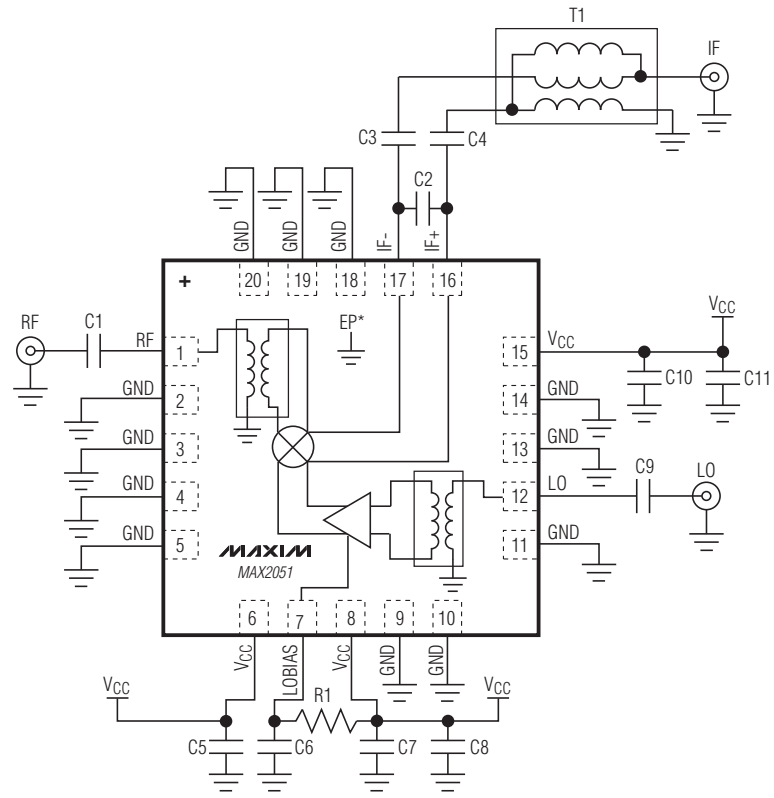
合理的电源旁路对高频电路的稳定性至关重要，按照*典型应用电路*和表1所示对各个V_{CC}引脚采用电容进行旁路。

裸焊盘的RF/散热考虑

MAX2051 20引脚、薄型QFN封装的裸焊盘(EP)提供了一个与管芯之间的低热阻通路。安装MAX2051的PCB与EP之间保持良好的导热通道非常重要。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在PCB的地平面。

SiGe、高线性度、850MHz至1550MHz上/下变频混频器，带有LO缓冲器

典型应用电路



*EXPOSED PAD. CONNECT EP TO GND.

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**

Maxim北京办事处

北京 8328信箱 邮政编码 100083
免费电话：800 810 0310
电话：010-6211 5199
传真：010-6211 5299