19-6158; Rev 0; 12/11
备有评估板

MAX2691

L2波段GPS低噪声放大器

概述

MAX2691低噪声放大器(LNA)设计用于GPS L2波段产品。采用Maxim先进的SiGe工艺设计，在提供高增益和低噪声系数的同时，获得最高的输入参考1dB压缩点和3阶截点。MAX2691具有17.5dB高增益以及不到1dB的噪声系数。

器件采用+1.6V至+3.6V单电源供电，可选择关断功能使器件的电源电流降至4µA (典型值)。器件采用超小尺寸、无铅并符合RoHS标准的0.86mm x 0.86mm x 0.65mm晶片级封装(WLP)。

应用

精密导航系统

远程信息处理(资产跟踪与管理)

航空设备

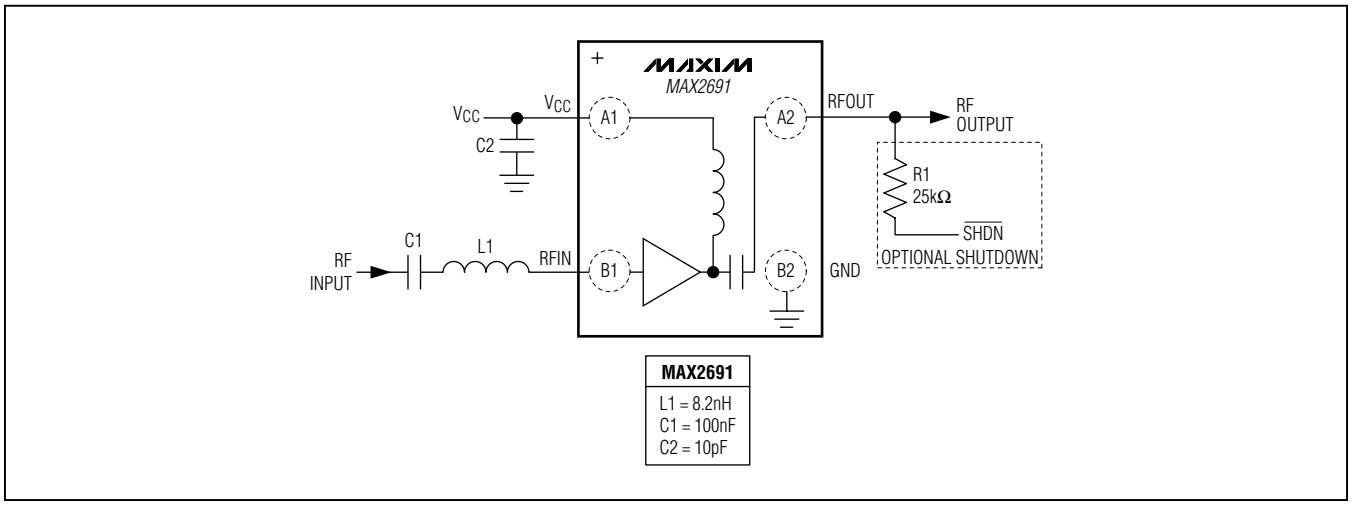
特性

- ♦ 高功率增益：17.5dB
- ♦ 低噪声系数：0.93dB
- ♦ 集成50Ω输出匹配电路
- ♦ 低电源电流：4.3mA
- ♦ 宽电源电压范围：1.6V至3.6V
- ♦ 较少的材料清单：一个电感、两个电容
- ♦ 小尺寸封装：0.86mm x 0.86mm
- ♦ 超薄外形：0.65mm
- ♦ 0.4mm间距晶片级封装(WLP)

定购信息在数据资料的最后给出。

相关型号以及配合该器件使用的推荐产品，请参见： ***china.maxim-ic.com/MAX2691.related****。*

典型应用电路



ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND.....-0.3V to +3.6V
Other Pins to GND
(except RFIN).....-0.3V to (+ Operating V_{CC} + 0.3V)
Maximum Current into RF Input.....10mA
Maximum RF Input Power.....+5dBm
Continuous Power Dissipation (T_A = +70°C)
4-Bump WLP (derates 9.7mW/°C above +70°C).....776mW
Operating Temperature Range.....-40°C to +85°C
Junction Temperature.....+150°C
Storage Temperature Range.....-65°C to +160°C
Lead Temperature (soldering, 10s).....Reflow Profile (Note 1)
Soldering Temperature (reflow).....+260°C

Note 1: Refer to Application Note 1891: *Wafer-Level Packaging (WLP) and Its Applications*.

CAUTION! ESD SENSITIVE DEVICE

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

(MAX2691 EV kit, V_{CC} = 1.6V to 3.6V, T_A = -40°C to +85°C, no RF signals are applied. Typical values are at V_{CC} = 2.85V and T_A = +25°C, unless otherwise noted.) (Note 2)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage		1.6	2.85	3.6	V
Supply Current	$\overline{SHDN}$ = high		4.3		mA
	Shutdown mode, $\overline{SHDN}$ = low		4.0	20	µA
Digital Input Logic-High	(Note 3)	1.2			V
Digital Input Logic-Low	(Note 3)			0.45	V

AC ELECTRICAL CHARACTERISTICS

(MAX2691 EV kit, V_{CC} = 1.6V to 3.6V, T_A = -40°C to +85°C, f_{RFIN} = 1227MHz. Typical values are at V_{CC} = 2.85V and T_A = +25°C, unless otherwise noted.) (Note 2)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
RF Frequency	L2 band		1227		MHz
Power Gain (Note 4)	V_{CC} = 2.85V	13.3	17.5		dB
	V_{CC} = 1.6V	13.1	17.4		
Noise Figure	V_{CC} = 1.6V to 3.3V		0.93		dB
In-Band 3rd-Order Input Intercept Point	(Note 5)		-3.0		dBm
Input 1dB Compression Point	(Note 6)		-8.5		dBm
Input Return Loss			10.9		dB

AC ELECTRICAL CHARACTERISTICS (continued)

(MAX2691 EV kit, V_{CC} = 1.6V to 3.6V, T_A = -40°C to +85°C, f_{RFIN} = 1227MHz. Typical values are at V_{CC} = 2.85V and T_A = +25°C, unless otherwise noted.) (Note 2)

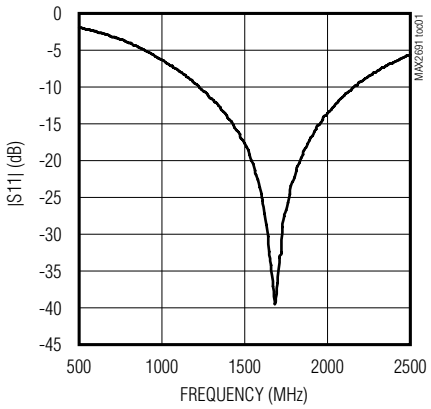
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Return Loss			15.6		dB
Reverse Isolation			45		dB

Note 2: Min and max limits guaranteed by test at T_A = +25°C and guaranteed by design and characterization at T_A = -40°C and T_A = +85°C, unless otherwise noted.
Note 3: Min and max limits guaranteed by test at T_A = +25°C.
Note 4: Min limit guaranteed by design and characterization.
Note 5: Measured with the two tones located at 1MHz and 2MHz offset from the center of the GPS band with -30dBm/tone.
Note 6: Measured with a tone located at 5MHz offset from the center of the GPS band.

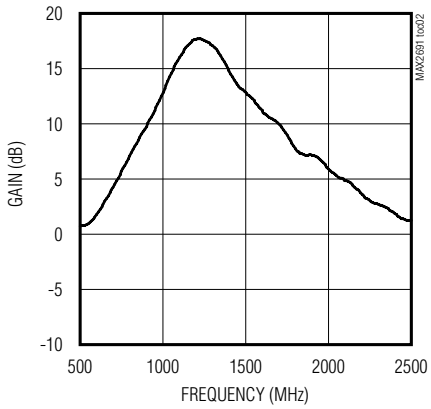
典型工作特性

(MAX2691 EV kit. Typical values are at V_{CC} = 2.85V, T_A = +25°C, and f_{RFIN} = 1227MHz, unless otherwise noted.)

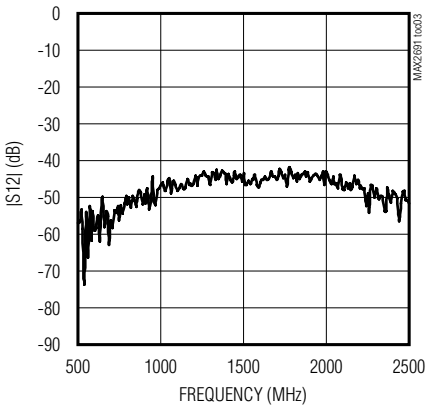
INPUT RETURN LOSS vs. FREQUENCY



GAIN vs. FREQUENCY



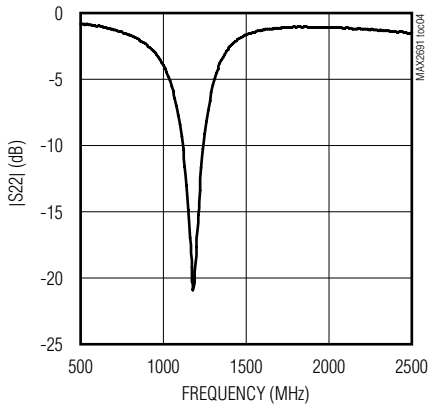
REVERSE ISOLATION vs. FREQUENCY



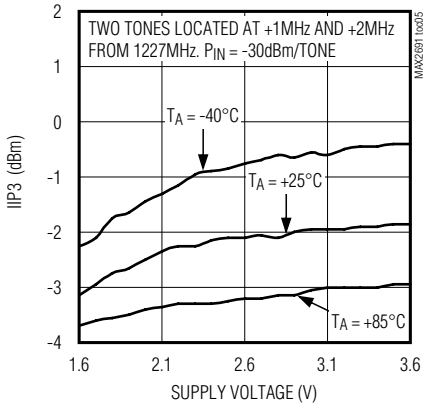
典型工作特性(续)

(MAX2691 EV kit. Typical values are at V_{CC} = 2.85V, T_A = +25°C, and f_{RFIN} = 1227MHz, unless otherwise noted.)

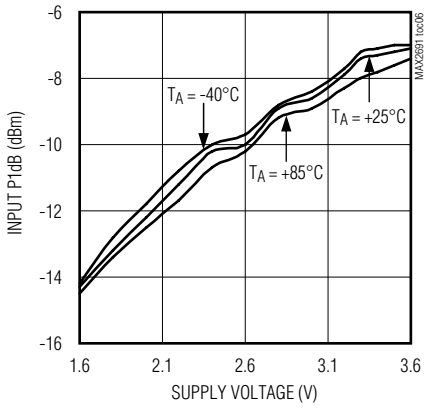
OUTPUT RETURN LOSS vs. FREQUENCY



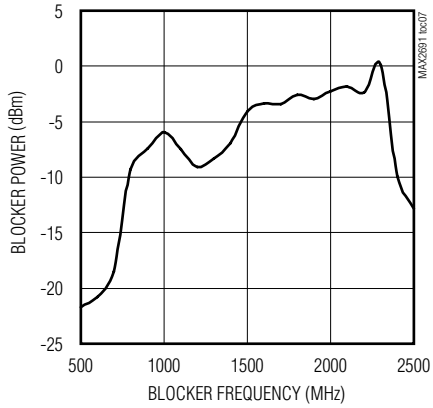
INBAND IIP3 vs. SUPPLY VOLTAGE AND TEMPERATURE



INPUT P1dB COMPRESSION vs. SUPPLY VOLTAGE AND TEMPERATURE

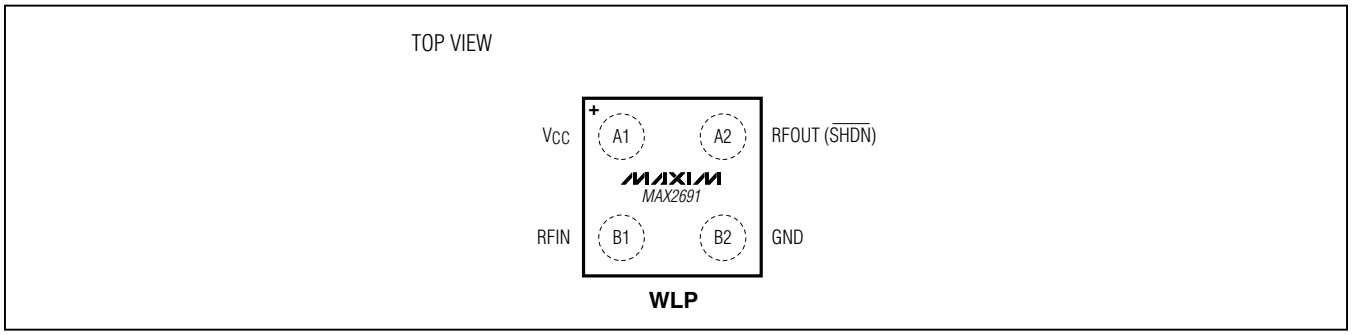


1dB GAIN DESENSE vs. BLOCKER FREQUENCY



L2波段GPS低噪声放大器

焊球配置



焊球说明

焊球	名称	功能
A1	V_{CC}	电源电压，通过10pF电容旁路到地，电容应尽可能靠近IC放置。
A2	RFOUT ($\overline{SHDN}$)	RF输出/$\overline{SHDN}$输入，RFOUT内部匹配至50Ω，通过1MΩ电阻上拉到V_{CC}。$\overline{SHDN}$与RFOUT共用一个焊球，一旦V_{CC}上电，器件将进入默认的有效工作模式；通过25kΩ电阻将RFOUT ($\overline{SHDN}$)下拉至低电平，将关断IC。
B1	RFIN	RF输入，需要隔直流电容和外部匹配元件。
B2	GND	地，连接到PCB的接地平面。

详细说明

MAX2691 LNA设计用于L2波段的GPS系统，器件具有关断控制模式，无需外部电源开关。提供高增益、低噪声系数以及出色的线性指标。

输入和输出匹配

MAX2691需要外部输入匹配电路，只需一个电感串联隔直流电容即可构成输入匹配电路，*典型应用电路*给出了推荐的输入匹配网络。元件参数针对最佳增益、噪声系数、回波损耗特性进行优化。减小输入耦合电容会降低IIP3。器件集成了50Ω输出匹配电路，从而省去了外部匹配元件。表1列出了器件的S参数和K_f值，典型噪声指标如表2所示。

关断

MAX2691提供关断控制功能，可关闭整个器件的工作。由于RFOUT焊球(与$\overline{SHDN}$共用一个焊球)通过电阻上拉到V_{CC}，所以器件在V_{CC}上电时置于默认的有效工作模式。通过一个适当的外部电阻(例如，25kΩ，以便在有效工作模式下不会增大RF输出负荷)将RFOUT下拉至低电平，将关断器件。

应用信息

合理设计PCB是确保RF微波电路正确工作的基础，所有高频输入和输出应采用阻抗受控引线。通过去耦电容旁路V_{CC}，电容应尽可能靠近器件放置。V_{CC}连线较长时，可能需要增加去耦电容，这些新增电容可适当远离器件安装。合理的GND布线是电路正确工作的保障，如果PCB顶层作为RF地平面的话，将其直接连接到GND引脚。电路板地层不在元件层时，则通过靠近封装的多个过孔将地层连接到GND引脚。

有关MAX2691评估板的原理图、Gerber数据、PADS布局文件、BOM信息，请访问：**china.maxim-ic.com**。

表1. S参数和K系数典型值

FREQ. (MHz)	S11 MAG (dB)	S11 PHASE (DEGREES)	S21 MAG (dB)	S21 PHASE (DEGREES)	S12 MAG (dB)	S12 PHASE (DEGREES)	S22 MAG (dB)	S22 PHASE (DEGREES)	K_f
700	-2.1	-78.1	3.5	-175.7	-54.0	113.3	-1.3	-124.9	16.75126
800	-2.5	-87.1	6.0	175.7	-47.7	112.0	-1.6	-143.3	8.847551
900	-2.8	-96.2	8.8	163.0	-55.5	85.4	-2.4	-162.8	22.33037
1000	-3.1	-104.3	11.7	146.2	-53.8	54.0	-3.9	175.0	19.54059
1100	-3.4	-112.3	14.4	119.2	-46.3	33.8	-8.3	149.5	9.366309
1200	-3.7	-119.4	16.0	83.5	-46.9	15.3	-19.1	-126.9	9.788318
1220	-3.7	-120.7	16.1	75.6	-47.6	-1.0	-14.2	-114.7	10.25069
1240	-3.7	-122.4	16.0	67.9	-49.4	20.3	-10.9	-114.4	12.09861
1260	-3.8	-123.7	15.9	60.1	-49.7	14.9	-8.7	-118.5	12.1323
1280	-3.8	-125.0	15.6	52.8	-47.3	-6.0	-6.9	-124.3	8.793041
1300	-3.8	-126.6	15.2	46.0	-43.5	19.6	-5.7	-130.2	5.277003
1400	-4.0	-133.5	13.4	18.4	-44.9	-22.8	-2.6	-157.6	4.94144
1500	-4.1	-140.3	11.3	-0.5	-48.5	-21.4	-1.6	-179.3	6.656188
1600	-4.1	-147.6	9.4	-15.6	-47.7	-23.6	-1.3	163.8	5.983826
1700	-4.1	-154.6	7.8	-28.5	-44.8	-16.5	-1.0	148.8	4.18904

表2. 典型噪声参数(V_{CC} = 2.85V、T_A = +25℃)

FREQUENCY (MHz)	FMIN (dB)	$\lvert\Gamma_{OPT}\rvert$	$\lvert\Gamma_{OPT}\rvert$ ANGLE	R_N (I)
1200	0.66	0.45	47	8.37
1210	0.66	0.45	48	8.35
1220	0.66	0.45	48	8.33
1230	0.66	0.45	48	8.30
1240	0.66	0.45	49	8.28
1250	0.66	0.45	49	8.26
1260	0.66	0.45	50	8.24
1270	0.67	0.45	50	8.22
1280	0.67	0.44	50	8.20
1290	0.67	0.44	51	8.18
1300	0.67	0.44	51	8.17

定购信息

PART	TEMP RANGE	PIN-PACKAGE
MAX2691EWS+T	-40°C to +85°C	4 WLP

+表示无铅(Pb)/符合RoHS标准。
T = 卷带包装。

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(占位面积)，请查询china.maxim-ic.com/packages。请注意，封装编码中的“+”、“#”或“–”仅表示RoHS状态。封装图中可能包含不同的尾缀字符，但封装图只与封装有关，与RoHS状态无关。

封装类型	封装编码	外形编号	焊盘布局编号
4 WLP	W40A0+1	21-0480	参见应用笔记1891

L2波段GPS低噪声放大器

修订历史

修订号	修订日期	说明	修改页
0	12/11	最初版本。	—

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