19-0797; Rev 0; 4/07

EVALUATION KIT AVAILABLE

GPS/GNSS Low-Noise Amplifier

MAX2659

General Description

The MAX2659 high-gain, low-noise amplifier (LNA) is designed for GPS, Galileo, and GLONASS applications. Designed in Maxim's advanced SiGe process, the device achieves a 20.5dB gain and an ultra-low-noise figure of 0.8dB while maximizing the input-referred 1dB compression point and the 3rd-order intercept point at -12dBm and -5dBm, respectively.

The MAX2659 operates from a +1.6V to +3.3V single supply and consumes only 4.1mA. The shutdown feature in the device reduces the supply current to be less than 1µA. The MAX2659 is available in a very small, lead-free, RoHS-compliant, 1.5mm x 1.0mm x 0.75mm, 6-pin µDFN package.

Applications

Automotive Navigation

Location-Enabled Mobile Devices

Telematics (Asset Tracking and Management)

Personal Navigation Device (PND)

Cellular Phones with GPS

Notebook PC/Ultra-Mobile PC

Recreational, Marine Navigation

Avionics

Features

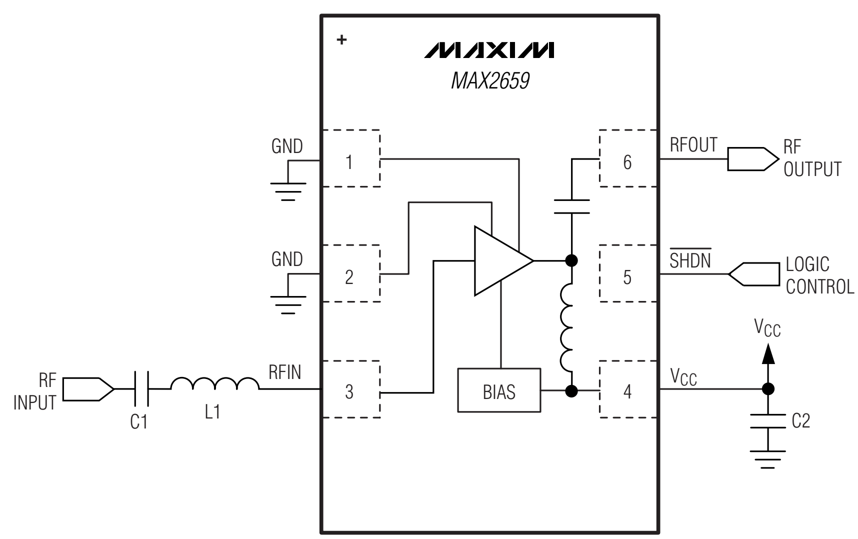
- ♦ High-Power Gain: 20.5dB
- ♦ Ultra-Low-Noise Figure: 0.8dB
- ♦ Integrated 50Ω Output Matching Circuit
- ♦ Low Supply Current: 4.1mA
- ♦ Wide Supply Voltage Range: 1.6V to 3.3V
- ♦ Low Bill of Materials
- ♦ Small Footprint: 1.5mm x 1.0mm
- ♦ Thin Profile: 0.75mm
- ♦ Lead-Free and RoHS-Compliant Package

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	PKG CODE
MAX2659ELT+	-40°C to +85°C	6 µDFN	L611-2

+Denotes a lead-free package.

Pin Diagram/Functional Diagram/Typical Application Circuit



L1 = 6.8nH
C1 = 470pF
C2 = 33nF

GPS/GNSS Low-Noise Amplifier

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND ....-0.3V to +4.2V
Other Pins to GND....................-0.3V to + Operating V_{CC} + 0.3V
Maximum RF Input Power ....+10dBm
Continuous Power Dissipation (T_A = +70°C)
6-Pin µDFN (derates 2.1mW/°C above +70°C)............167mW

Operating Temperature Range ....-40°C to +85°C
Junction Temperature..+150°C
Storage Temperature Range ....-65°C to +160°C
Lead Temperature (soldering, 10s) ....+260°C

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

(MAX2659 EV kit; V_{CC} = 1.6V to 3.3V, 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 1)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage		1.6	2.85	3.3	V
Supply Current	$\overline{SHDN}$ = high		4.1	5.6	mA
	Shutdown mode, $\overline{SHDN}$ = low			1	µA
Digital Input-Logic High		1.4			V
Digital Input-Logic Low				0.4	V
Digital Input Current				1	µA

AC ELECTRICAL CHARACTERISTICS

(MAX2659 EV kit; V_{CC} = 1.6V to 3.3V, T_A = -40°C to +85°C, f_{RFIN} = 1575.42MHz. Typical values are at V_{CC} = 2.85V and T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
RF Frequency	L1 band		1575.42		MHz
Power Gain	V_{CC} = 2.85V	17	20.5		dB
	V_{CC} = 1.6V	16.5	20.5		
Noise Figure	(Note 2)		0.8		dB
3rd-Order Input Intercept Point	(Note 3)		-5		dBm
Input 1dB Compression point	(Note 4)		-12		dBm
Input Return Loss	(Note 2)	10	15		dB
Output Return Loss	(Note 2)	10	25		dB
Reverse Isolation	(Note 2)		32		dB

Note 1: 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.

Note 2: Guaranteed by design and characterization.

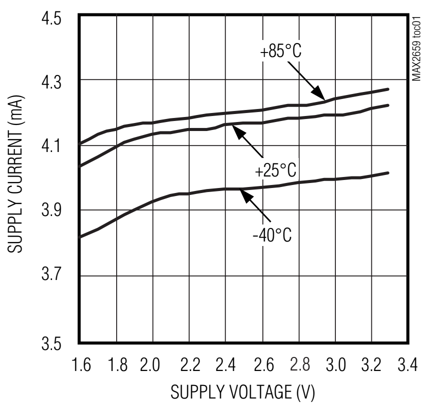
Note 3: Measured with the two tones located at 5MHz and 10MHz offset from the center of the GPS band with -40dBm/tone.

Note 4: Measured with a tone located at 5MHz offset from the center of the GPS band.

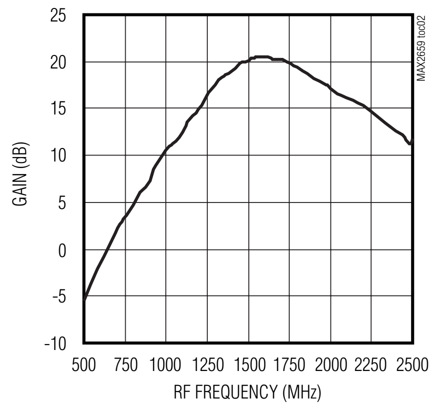
Typical Operating Characteristics

(MAX2659 EV kit; Typical values are at V_{CC} = 2.85V, T_A = +25°C, and f_{RFIN} = 1575.42MHz, unless otherwise noted.)

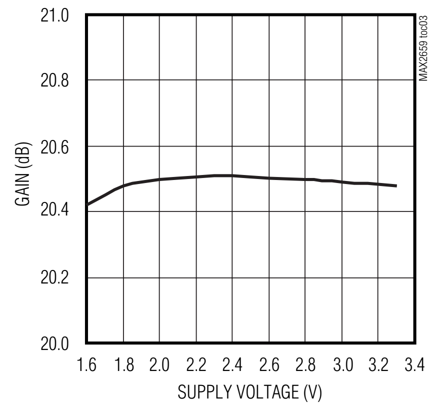
SUPPLY CURRENT vs. SUPPLY VOLTAGE



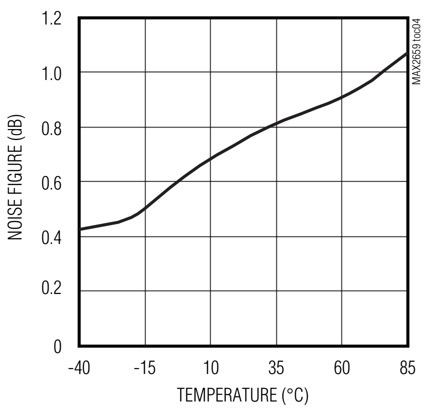
GAIN vs. RF FREQUENCY



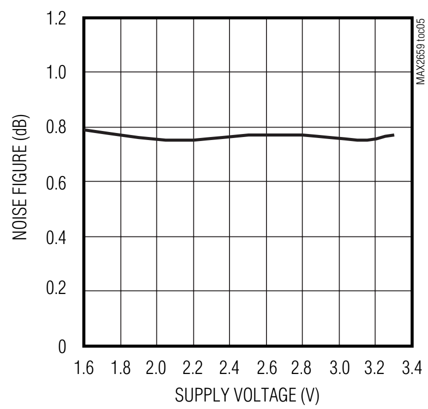
GAIN vs. SUPPLY VOLTAGE



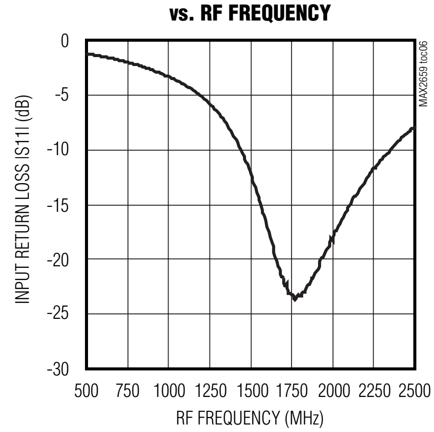
NOISE FIGURE vs. TEMPERATURE



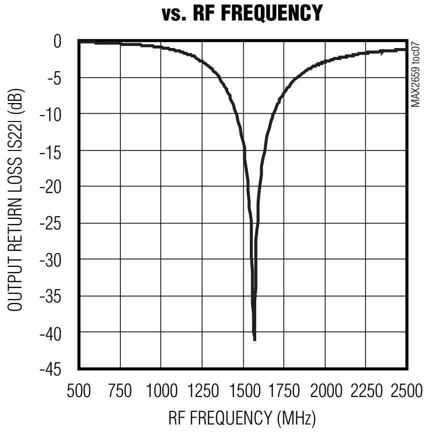
NOISE FIGURE vs. SUPPLY VOLTAGE



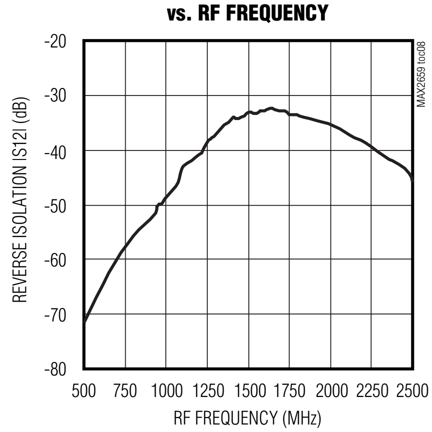
INPUT RETURN LOSS vs. RF FREQUENCY



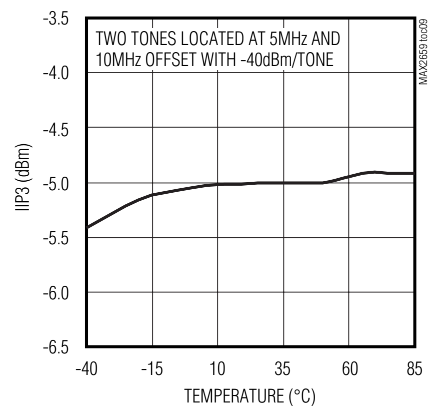
OUTPUT RETURN LOSS vs. RF FREQUENCY



REVERSE ISOLATION vs. RF FREQUENCY

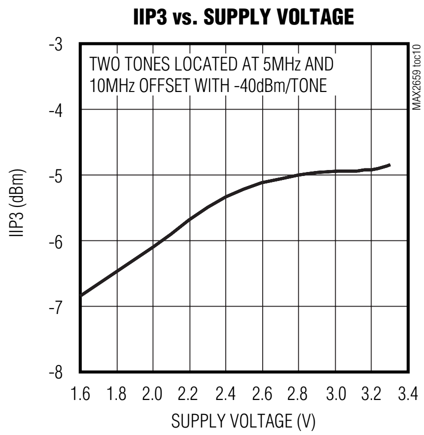


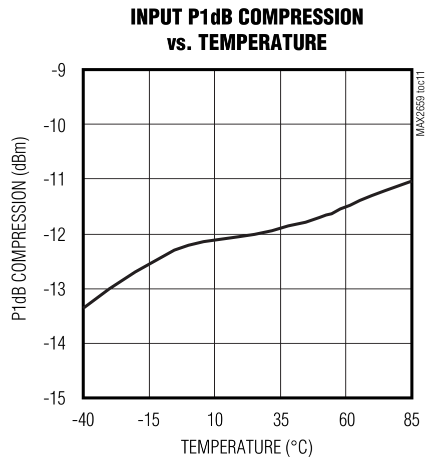
IIP3 vs. TEMPERATURE

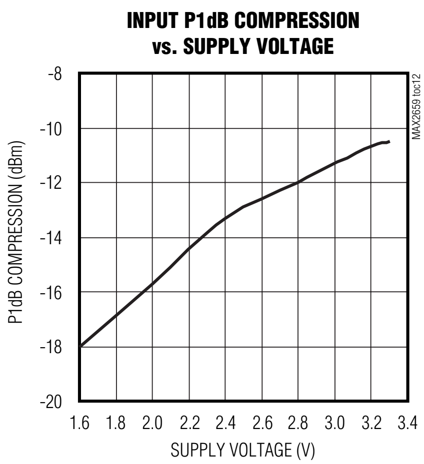


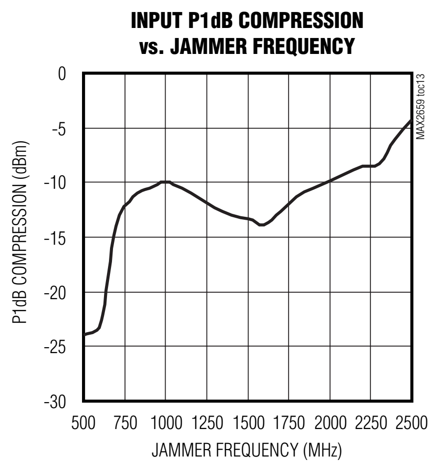
Typical Operating Characteristics (continued)

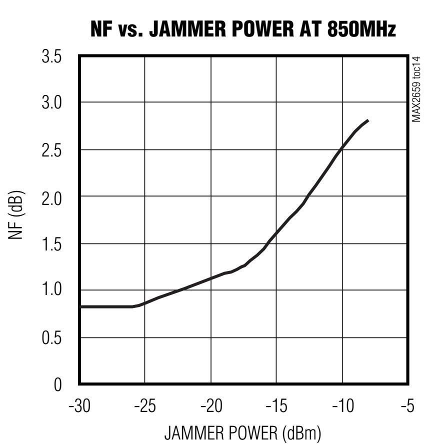
(MAX2659 EV kit; Typical values are at V_{CC} = 2.85V, T_A = +25°C, and f_{RFIN} = 1575.42MHz, unless otherwise noted.)

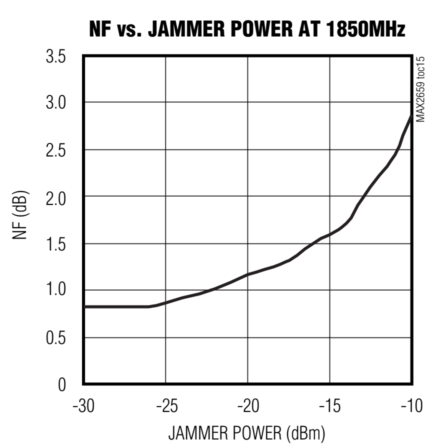












Pin Description

PIN	NAME	FUNCTION
1, 2	GND	Ground. Connect to the PCB ground plane.
3	RFIN	RF Input. Requires a DC-blocking capacitor and external matching components.
4	V_{CC}	Supply Voltage. Bypass to ground with a 33nF capacitor as close as possible to the IC.
5	$\overline{SHDN}$	Shutdown Input. A logic-low disables the device.
6	RFOUT	RF Output. RFOUT is internally matched to 50Ω and incorporates an internal DC-blocking capacitor.

Detailed Description

The MAX2659 is an LNA designed for GPS L1, GALILEO, and GLONASS applications. The device features a power-shutdown control mode to eliminate the need for an external supply switch. The device achieves a 20.5dB gain and an ultra-low-noise figure of 0.8dB. The MAX2659 consumes approximately 4.1mA while providing a IP_{1dB} of -12dBm and an IIP3 of -5dBm.

Input and Output Matching

The MAX2659 requires an off-chip input matching. Only a 6.8nH inductor in series with a DC-blocking capacitor is needed to form the input matching circuit. The *Typical Application Circuit* diagram shows the recommended input-matching network. These values are optimized for the best simultaneous gain, noise figure, and return loss performance. Table 1 lists typical device S11 values. The MAX2659 integrates an on-chip output matching to 50Ω at the output, eliminating the need for external matching components.

Table 1. Typical S11 Values

FREQUENCY (MHz)	REAL S11	IMAGINARY S11
1000	-0.58	-j0.52
1100	-0.68	-j0.356
1200	-0.74	-j0.16
1300	-0.74	j0.036
1400	-0.676	j0.22
1500	-0.56	j0.36
1575	-0.47	j0.415
1600	-0.44	j0.43
1700	-0.36	j0.467
1800	-0.3	j0.51
1900	-0.228	j0.567
2000	-0.14	j0.622

Shutdown

The MAX2659 includes a shutdown feature to turn off the entire chip. Apply a logic high to $\overline{SHDN}$ pin to place the part in the active mode and a logic low to place the part in the shutdown mode.

Applications Information

A properly designed PC board (PCB) is essential to any RF microwave circuit. Use controlled-impedance lines on all high-frequency inputs and outputs. Bypass V_{CC} with decoupling capacitors located close to the device. For long V_{CC} lines, it may be necessary to add decoupling capacitors. Locate these additional capacitors further away from the device package. Proper grounding of the GND pins is essential. If the PCB uses a top-side RF ground, connect it directly to the GND pins. For a board where the ground is not on the component layer, connect the GND pins to the board with multiple vias close to the package.

Chip Information

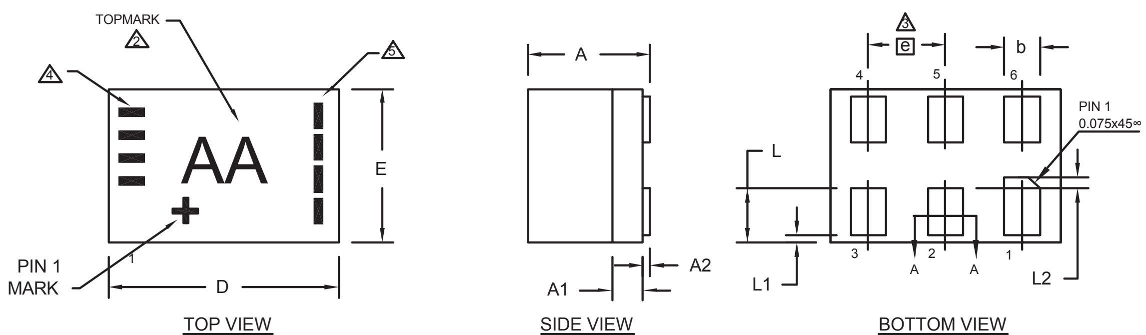
PROCESS: SiGe BiCMOS

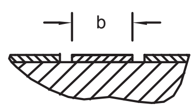
GPS/GNSS Low-Noise Amplifier

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

6L UDFN.EPS





SECTION A-A

SYMBOL	COMMON DIMENSIONS		
	MIN.	NOM.	MAX.
A	0.65	0.72	0.80
A1	--	0.20	--
A2	0.00	--	0.05
D	1.45	1.50	1.55
E	0.95	1.00	1.05
L	0.30	0.35	0.40
L1	0.00	--	0.08
L2	0.05	--	0.10
b	0.17	0.20	0.23
e	0.50 BSC.		
Pkg. Code	L611-1, L611-2		

NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY. PACKAGE USES 2 CHARACTER PRODUCT CODE.
3. LEAD CENTERLINES TO BE AT TRUE POSITION AS DEFINED BY BASIC DIMENSION "e", ±0.05.
4. CALENDAR YEAR BINARY DATE CODE (REFER TO PG. 2 TABLE 1 FOR TRANSLATION).
5. 6 WEEKLY DATE BINARY CODE (REFER TO PG. 2 TABLE 2 FOR TRANSLATION).
6. MATERIAL MUST COMPLY WITH BANNED AND RESTRICTED SUBSTANCES SPEC # 10-0131.
7. MEETS JEDEC MO-252 VARIATION WAAD.

-DRAWING NOT TO SCALE-

DALLAS SEMICONDUCTOR MAXIM

TITLE: PACKAGE OUTLINE, 6L uDFN, 1.5x1.0x0.8mm

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0147	E	1/2

Package Information (continued)

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