InGaP HBT 2.4GHz 802.11b/g/n Power Amplifier

Description

The LX5602 is a power amplifier optimized for 802.11b/g/n applications in the 2.4-2.5 GHz frequency range. The LX5602 includes a three-stage PA, active bias, and input/output matching.

The power amplifier operates with a single positive voltage supply of 5V. It provides power gain of 30 dB and output powers of 26dBm for 11n HT40 MCS7 at -30dB EVM and 26.5dBm for 11n HT20 MCS0 across the frequency band. It is fully matched to 50 Ohms on the input and is easily matched on the output port.

The LX5602 also features an on-chip power detector to help reduce BOM cost and PCB space for implementation of power control in a typical wireless system.

The LX5602 is available in a 16-pin 3mm x 3mm quad flat no lead package (QFN 3×3-16L). The compact footprint and excellent thermal capability make the LX5602 an ideal solution for 802.11b/g/n applications.

Features

- 2.41-2.48GHz Operation
- Single-Polarity 5V Supply
- Power Gain ~ 30dB
- 26dBm @ -30dB DEVM for 802.11n
- 26.5dBm @ 802.11n, HT20, MCS0 Spectral Mask
- Complete Input and Simple Output Match
- On-Chip Output Power Detector
- Small Footprint: 3x3mm²
- RoHS2 Compliant & Halogen Free

Applications

- Tablets
- Access Points
- Mobile Devices
- Notebooks
- Gaming

Block Diagram

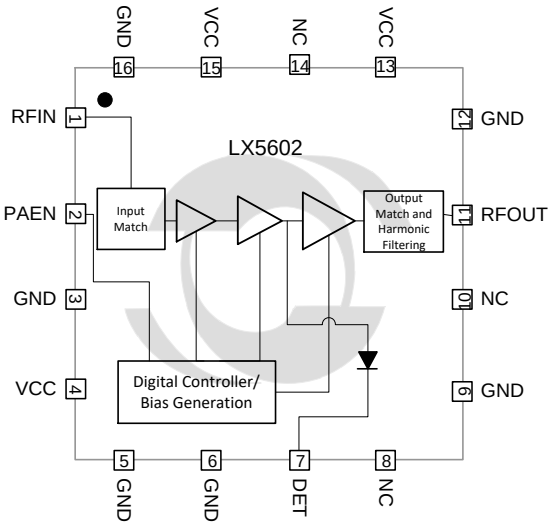


Figure 1 · Functional Block Diagram

Pin Configuration

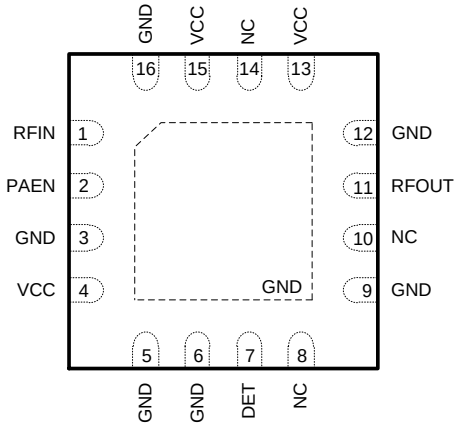


Figure 2 · Pinout (Top View)

Top mark •MSC
5602
YNNN = Trace code

Ordering Information

Case Temperature	Type	Package	Ordering Part Number	Packaging Type
-40°C to +85°C	RoHS2 compliant, Pb-free	QFN 3x3 16L	LX5602LQ-TR	Tape and Reel

Pin Description

Pin Number	Pin Designator	Description
1	RFIN	50 Ohm input to PA (needs external DC blocking)
2	PAEN	Digital enable for PA
3	GND	Ground
4	VCC	Supply voltage
5	GND	Ground
6	GND	Ground
7	DET	Detector output
8	NC	Non connected or grounded pin
9	GND	Ground

10	NC	Non connected or grounded pin
11	RFOUT	RF output from PA (needs external DC blocking)
12	GND	Ground
13	VCC	Supply voltage
14	NC	Non connected or grounded pin
15	VCC	Supply voltage
16	GND	Ground

Absolute Maximum Ratings

Parameter	Value	Units
DC Supply Voltage, RF off	-0.3 to 6	V
Collector Current	900	mA
Total Power Dissipation	5.5	W
Enable voltage	+3.6	V
CW or OFDM RF Input Power (With 50 Ohm Load at Output)	+10	dBm
Maximum Junction Temperature ($T_{J\ MAX}$)	+150	°C
Operation Ambient Temperature (T_C)	-40 to +85	°C
Storage Temperature	-40 to +150	°C
Peak Package Temp. for Solder Reflow (30 seconds max exposure)	+260°C (+0,-5)	°C
Electrostatic Discharge Human Body Model(HBM), Class 2	+2000	V

Note: Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.

Exceeding any Absolute Maximum ratings could cause damage to the device. All voltages are with respect to GND. Currents are positive into, negative out of specified terminal. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” are not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

Thermal Properties

Thermal Resistance	Typ	Units
θ_{JP} Junction to exposed pad	9.2	°C/W

Note: The θ_{JX} numbers assume no forced airflow. Junction Temperature is calculated using $T_J = T_C +$ (Power dissipation x θ_{JP}). The stated number above is calculated with a four-layer board in accordance with JESD-51 (JEDEC). Note that an external heat sink will be required at elevated temperatures and at high output powers to ensure that the maximum junction temperature of 150°C is not exceeded.

Electrical Characteristics

Parameter	Sym	Conditions	Min	Typ	Max	Units
Frequency Range	F_{RFhi}		2.41		2.48	GHz
Channel bandwidth	CHBW			40		MHz
Supply voltage	Vcc		4.75	5	5.25	V
Enable Voltage	V_{HI} V_{LOW}	High Low	1.8 -0.3	3.3 0	3.6 0.2	V V
PAEN Control pin current	I_{EN}			10		µA
Switching time	Δt_{onPA} Δt_{offPA}	Difference between edge of PAEn and time when Tx output has settled to within 90% of its final power		400		ns
Ruggedness	Ru	802.11n,Pin=5 dBm, VSWR=10:1	No damage			
Case Temperature Range	T_{Spec}	QFN ground slug temperature	-40		+85	ºC

Power Amplifier Characteristics

Unless otherwise noted: Typical conditions are at 2.442GHz, TA = 25°C, VCC =5V.
Performance is guaranteed only under the conditions listed in following table.

Parameter	Sym	Conditions	Min	Typ	Max	Units
Input return loss	S_{11}	RFIN port with PA enabled		-10		dB
Output return loss	S_{22}	RFOUT port with PA enabled		-10		dB
Power gain	S_{21}	At Pout =26 dBm		30		dB
Gain variation	ΔS_{21}	Over operating frequency		1		dB
Output power	Pout	802.11n, HT20, MCS0, Mask Compliant 802.11n, HT40, MCS7, -30dB DEVM 802.11ac, VHT40, MCS9, -35dB DEVM	25 24	26.5 26 18		dBm
2nd Harmonic	2fo	Pout=27 dBm, 802.11b, 1 Mbps, Root Cosine		-25		dBm/MHz
3rd Harmonic	3fo	Pout=27 dBm, 802.11b, 1 Mbps, Root Cosine		-35		dBm/MHz
Operating Current	I_{cc}	802.11b, 1 Mbps, Pout=27 dBm		490		mA

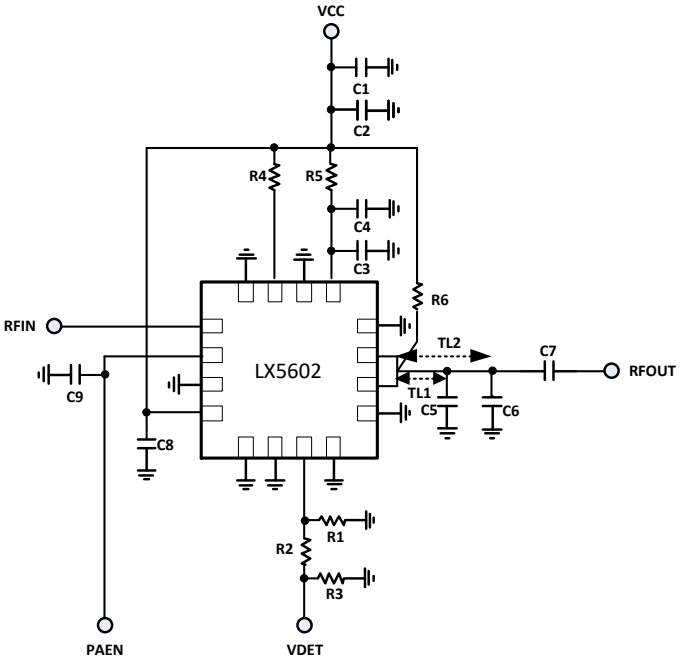
Detector Characteristics

Unless otherwise noted: Typical conditions are at 2.442GHz, TA = 25°C, VCC =5V.

Performance is guaranteed only under the conditions listed in following table.

Parameter	Sym	Conditions	Min	Typ	Max	Units
Power detector range	PD_{range}	Power range over which Vdet-rms sensitivity needs to be met in high band	5		29	dBm
Power detector voltage	VDET	No RF Pout=27 dBm, 802.11b, 1Mbps		150 850		mV

Evaluation Board Schematic



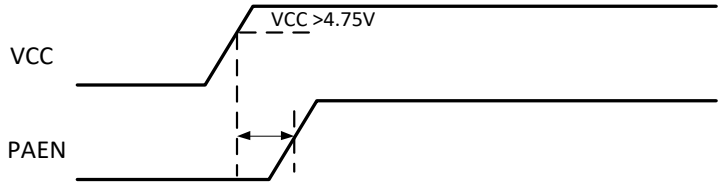
R1 = 49.9 KOhm (0402)
R2 = 20 Ohm (0402)
R3 = 26.1 KOhm (0402)
R4 = 0 Ohm (0402)
R5 = 10 Ohm (0402)
R6 = 0 Ohm (0603)

C1 = 10 uF (0603)
C2 = 1 uF (0402)
C3= 18 pF (0402)
C4= 0.1uF (0402)
C5= 2.2 pF (0402) @45mil
C6= 1.5 pF (0402) @83mil
C7= 10 pF (0402)
C8 = 1uF (0201)
C9 = DNI (0201)

TL1= 45mil (50Ohm TL)
TL2= 83mil (50Ohm TL)

Figure 3 · Evaluation Board Schematic

PAEN timing diagram



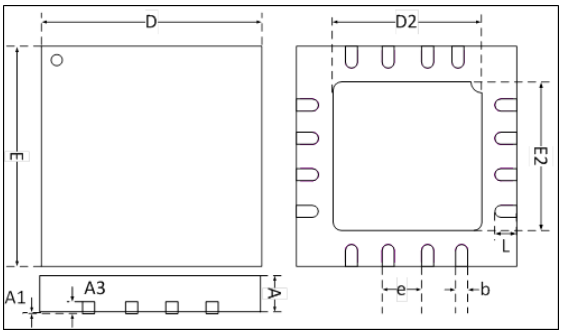
VCC should be higher than 4.75V before PAEN turn on in order to turn on PA correctly.

Figure 4 · PAEN Timing Diagram

Package Outline Dimensions

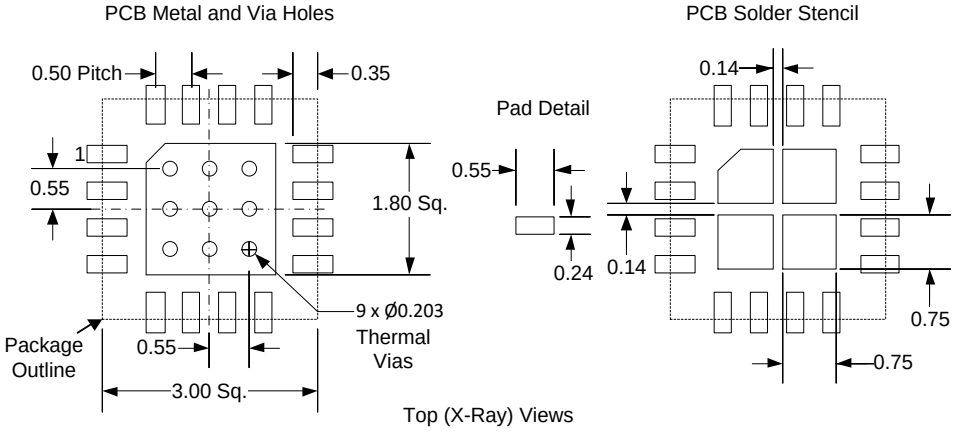
The package is halogen free and meets RoHS2 and REACH standards.

(MSL1, 260°C per JEDEC J-STD-020)



DIMENSION	MILLIMETERS	
	MIN	MAX
A	0.80	1.00
A1	0	0.05
A3	0.20 REF	
b	0.18	0.30
D	3.00 BSC	
E	3.00 BSC	
e	0.50 BSC	
D2	1.65	1.75
E2	1.65	1.75
L	0.20	0.40

Figure 5. 16L Plastic QFN 3x3mm^2 Exposed Pad Package Dimensions



Notes:
1. All dimensions are in millimeters.
2. Unless specified dimensions are symmetrical about center lines.
3. OSP or NiAu planar surface finish recommended.
4. Non-Solder Mask Defined (NSMD) pads recommended for terminal pads.
5. Recommended tented thermal vias as shown with vias filled with solder.
6. Stencil thickness < 0.15mm.
7. Aperture design for thermal pads using multiple openings with 60 to 80% solder paste coverage.

Figure 6. PCB Layout Footprint (Top View)

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