TQP9224

High Linearity 0.25 W Small Cell PA

General Description

The TQP9224 is a high-linearity three-stage power amplifier in a low-cost surface-mount package with on-chip bias control and temperature control circuits, suitable for small cell or enterprise Femto cell base station applications.

The TQP9224 provides 36.7 dB high gain and −50 dBc ACLR at +24 dBm linear power using a 20 MHz LTE signal over the 2.3 – 2.4 GHz frequency range covering 3GPP Bands 30, 40.

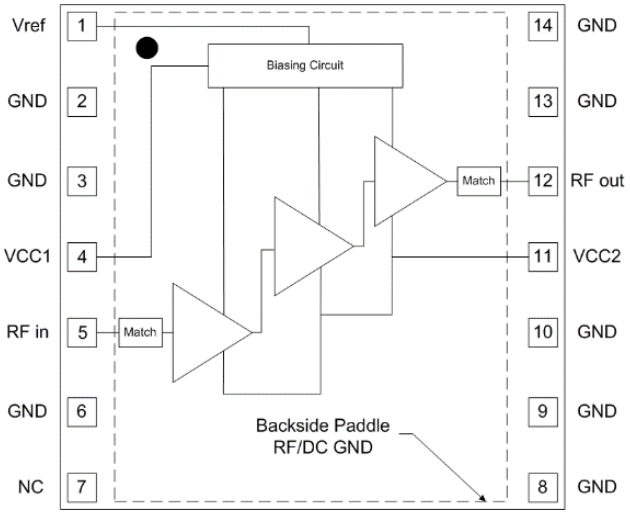
The TQP9224 integrates three high performance amplifier stages to allow for a compact system design and requires very few external components for operation. The amplifier is bias adjustable allowing the amplifier's power consumption to be optimized for specific performance requirements. The TQP9224 is available in a lead-free/RoHS-compliant 7 x 7 mm surface mount package.

14 Pin 7 x 7 mm Leadless SMT Package

Product Features

- 2.3 – 2.4 GHz Frequency Range
- Fully integrated, 3-Stage Power Amplifier
- Internally Matched 50 Ω Input/Output
- −50 dBc ACLR at Pavg = +24 dBm
- 36.7 dB Gain
- 14% PAE at +24 dBm
- 204 mA Quiescent Current
- On-chip Control Bias and Temp. Comp Circuit
- RoHS compliant
- Covers Band 30, 40

Functional Block Diagram



Top View

Applications

- Small Cell / Picocell
- Enterprise Femtocell
- Customer Premises Equipment (CPE)
- Data Cards and Terminals
- Distributed Antenna Systems (DAS)
- Booster Amps, Repeaters

Ordering Information

Part No.	Description
TQP9224TR13	2,500 pieces on a 13" reel (standard)
TQP9224PCB401	2.3−2.4 GHz Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	−55 to +150 °C
RF Input Power, CW, 50Ω, T=+25 °C	+9 dBm
Supply Voltage (V_{CC})	6 V
V_{REF}	+3.5 V

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
V_{CC1}, V_{cc2}	+3.6	+4.5	+5.25	V
V_{ref}	+2.75	+2.85	+2.95	V
T_{CASE}	−40		+85	°C
Tj at T_{CASE} max			+156	°C

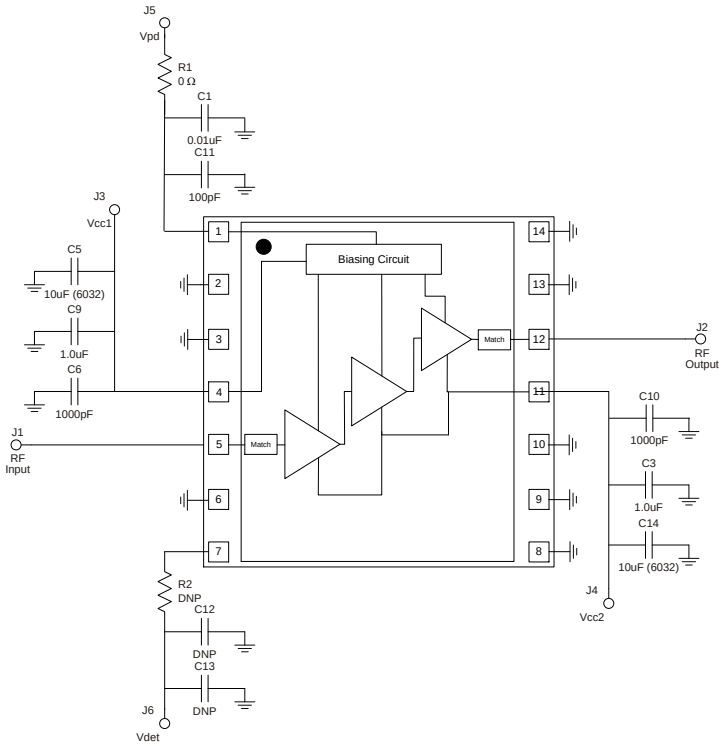
Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

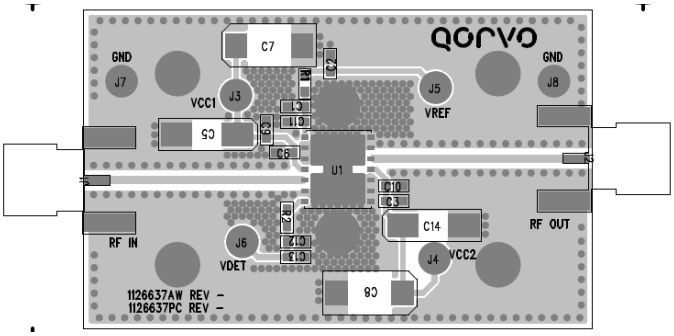
Electrical Specifications

Parameter	Conditions[1]	Min	Typ	Max	Units
Frequency Range		2300		2400	MHz
Test Frequency			2350		MHz
Gain		34	36.7	40	dB
Input Return Loss			16		dB
Output Return Loss			8		dB
Output P1dB			+33.6		dBm
ACLR	P_{OUT} = +24 dBm, 20 MHz LTE E-TM1.1, 9.5 dB PAR		−50	-45	dBc
Power Added Efficiency	P_{OUT} = +24 dBm, 20 MHz LTE E-TM1.1, 9.5 dB PAR	13	14		%
Spurious Output Level	P_{OUT} = +24 dBm, 10:1 VSWR		<60		dBc
VSWR survivability	No permanent degradation or failure	10:1			-
Quiescent Current, I_{CQ}	V_{CC1} + V_{CC2}	160	204	250	mA
Reference Current , I_{ref}	Temp = −40°C to +85°C, V_{REF} = +2.85V		8.7		mA
Leakage Current	V_{CC} = +4.5 V, V_{REF} = 0 V		1.5	8	µA
Operational Current, I_{CC}	P_{OUT} = +24 dBm		390	430	mA
Switching Speed	0% Vref to 90% RF Rise time		1.7	2.5	µs
	100% Vref to 10% RF Fall time		0.87	1	µs
Harmonics	$2F_0$ at +24dBm, CW signal		-40	-35	dBc
	$3F_0$ at +24dBm, CW signal		-54	-49	dBc
	$4F_0$ at +24dBm, CW signal		-61	-56	dBc
Thermal Resistance, θ_{jc}	Module (junction to case)			35.4	°C/W

Notes:
1. Test conditions unless otherwise noted: V_{CC1} = V_{cc2} = +4.5 V, V_{REF} = +2.85V, Temp = +25 °C, 50 Ω system.

Evaluation Board (TQP9224−PCB)



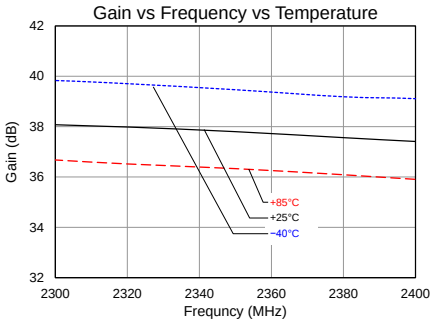


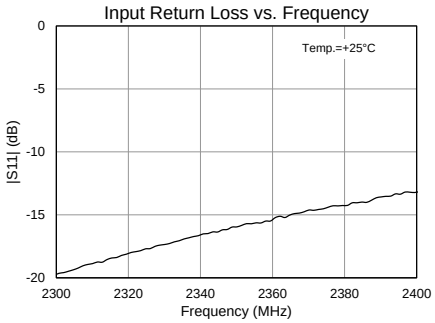
Bill of Material – TQP9224−PCB

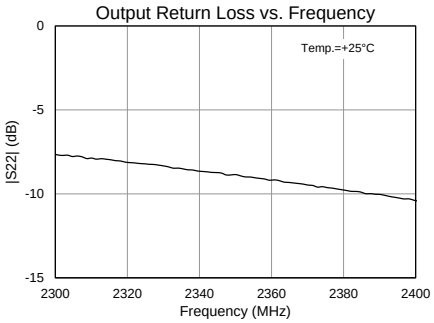
Reference Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board		
U1	n/a	High Linearity 0.25 W Power Amplifier	Qorvo	TQP9224
R1	0 Ω	Resistor, Chip, 0603, 5%	various	
C1	0.01 uF	Capacitor, Chip, 0603, 5%	various	
C11	100 pF	Capacitor, Chip, 0603, 5%	various	
C3, C9	0.1 uF	Capacitor, Chip, 0603, 5%	various	
C5, C14	10 uF	Capacitor , Chip, 6032, 10%, Tantalum	various	
C6, C10	1000 pF	Capacitor , Chip, 0603, NPO/COG, 5%	various	

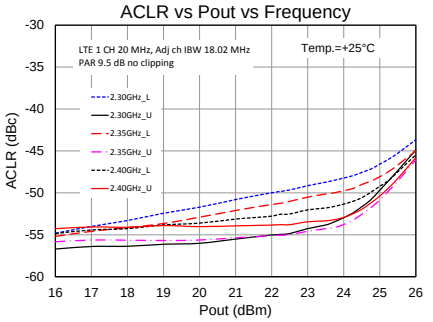
Performance Plots

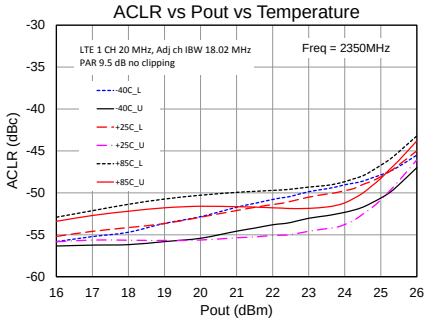
Test conditions unless otherwise noted: V_{CC1} = V_{CC2} = +4.5V, V_{REF} = +2.85 V, I_{CQ} = 204mA, I_{REF} = 8.7mA, Temp.= +25 °C

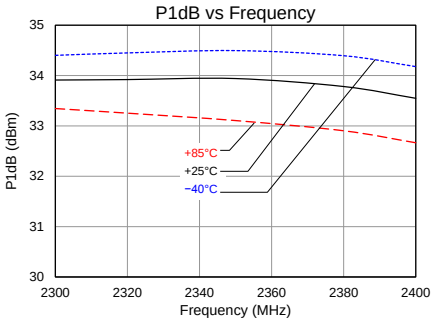


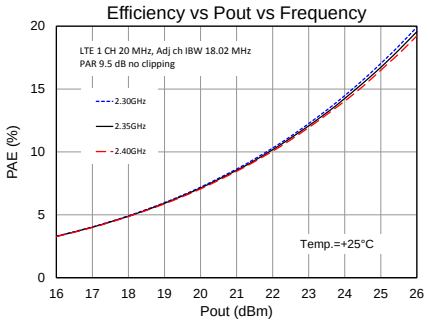


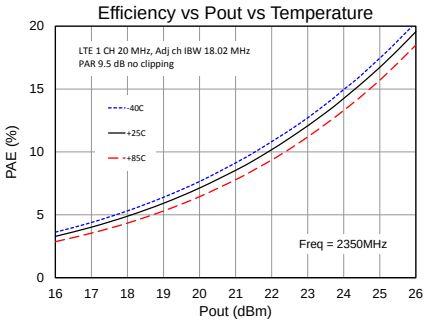




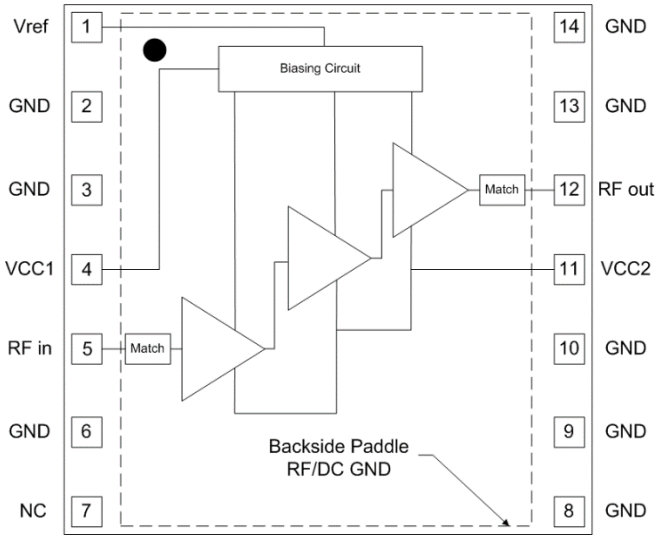








Pin Configuration and Description

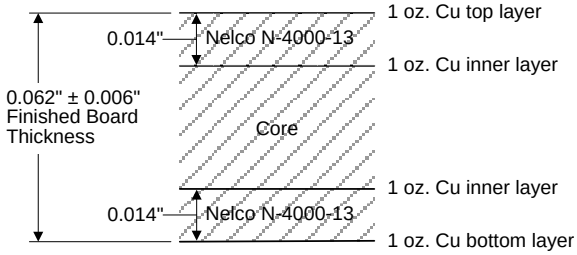


Top View

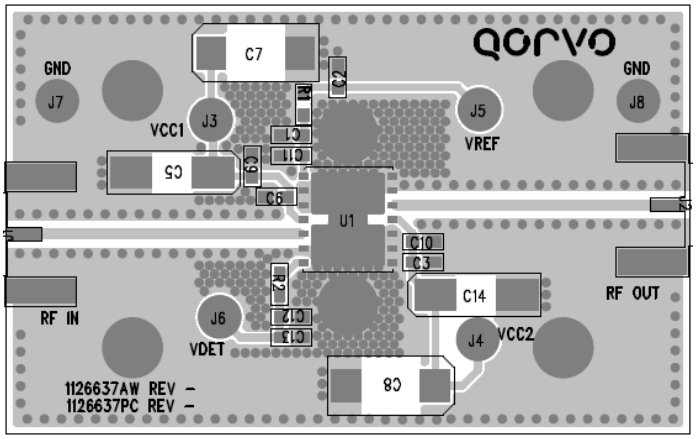
Pad No.	Label	Description
1	V_{REF}	Sets the bias current for the amplifiers. It can also be used to power down the device.
2, 3, 6, 8, 9, 10, 13, 14	GND	RF and DC ground.
4	$V_{CC}1$	Voltage supply for the active bias circuitry.
5	RFin	RF input pin. The DC is internally blocked at this pin.
7	NC	No internal connection.
11	$V_{CC}2$	DC voltage supply connection for AMP1, 2, 3.
12	RFout	RF output pin. The DC is internally blocked at this pin.
Backside Paddle	RF/DC GND	RF/DC ground. See PCB Mounting Pattern for suggested footprint.

Evaluation Board PCB Information

Qorvo PCB 1126637 Material and Stack-up

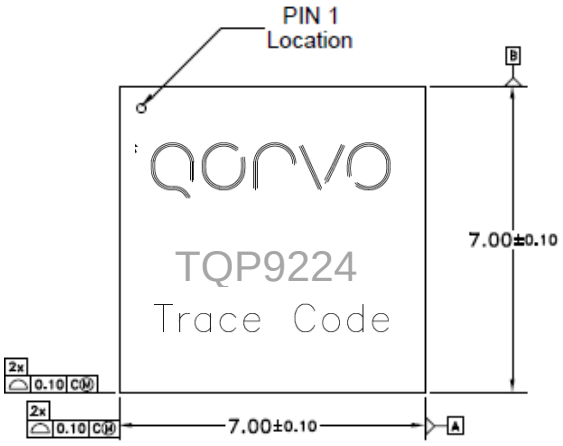


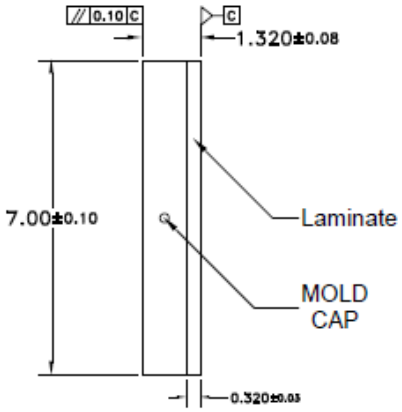
50 ohm line dimensions: width = .028”
spacing = .028”.

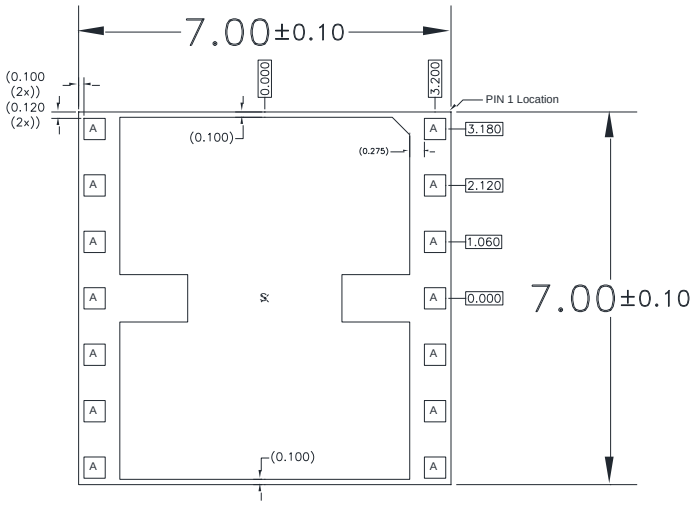


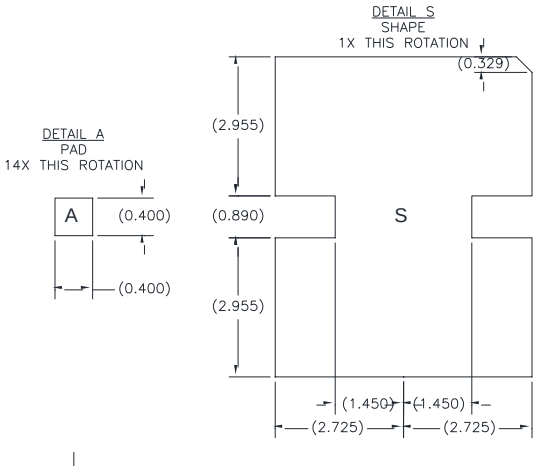
Package Marking and Dimensions

Marking: Part Number – TQP9224
Trace Code





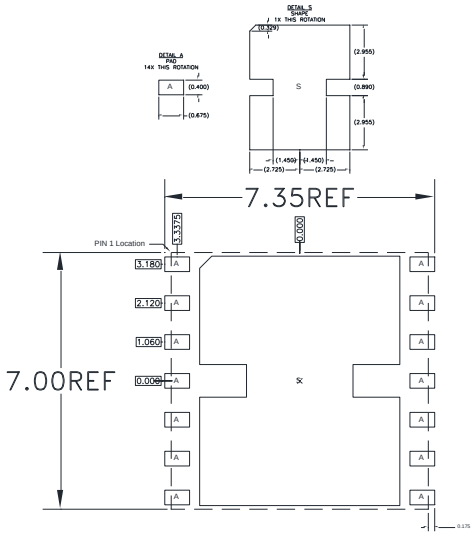




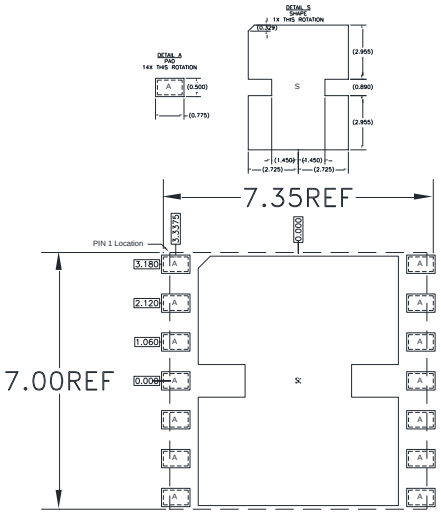
Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

PCB Mounting Pattern



RECOMMENDED
LAND PATTERN



RECOMMENDED
LAND PATTERN MASK

Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Vias are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.10”).
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.