TQP9221

High Linearity 0.25 W Small Cell PA

Applications

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

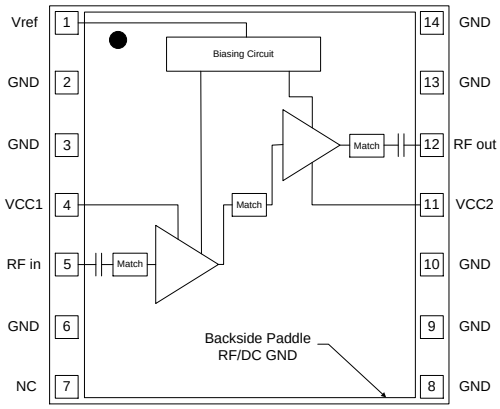


14 Pin 7x7 mm leadless SMT Package

Product Features

- 2010 – 2200 MHz
- Bands 1, 4, 10, 23, 34, 66
- Fully integrated, 2 Stage Power Amplifier
- Internally Matched 50 Ω Input/Output
- −49 dBc ACLR at Pavg =+24 dBm
- 30.5 dB Gain
- 15% PAE at +24 dBm
- 220 mA Quiescent Current
- On-chip Control Bias and Temp. Comp Circuit
- Lead-free / RoHS Compliant

Functional Block Diagram



Top View

General Description

The TQP9221 is a high-linearity two-stage power amplifier in a low-cost surface-mount package with on-chip bias control and temperature compensation circuits. The amplifier provides 30.5 dB gain over the 2010 – 2200 MHz frequency range and be utilized without the need of linearization circuitry such as DPD It is able to achieve −49 dBc ACLR at +24 dBm output power using 20 MHz LTE signal (9.5 dB PAR).

The TQP9221 integrates two high performance amplifier stages onto a module to allow for a compact system design and requires very few external components for operation. The product is bias adjustable allowing the amplifier's power consumption to be optimized and is available in a lead-free/RoHS-compliant 7 x 7 mm surface mount package.

The TQP9221 is targeted for small cell or enterprise Femtocell basestation applications, distributed antenna systems (DAS), repeaters, and/or booster amplifiers.

Pin Configuration

Pin No.	Label
1	V_{REF}
2, 3, 6, 8, 9, 10, 13, 14	GND
4	V_{CC1}
5	RF in
7	NC
11	V_{CC2}
12	RFout
Backside Paddle	RF/DC Ground

Ordering Information

Part No.	Description
TQP9221	High Linearity 0.25 W Small Cell PA
TQP9221-PCB	2.11 – 2.17 GHz Evaluation Board

Standard T/R size: 2500 pieces on a 13" reel

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Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	−55 to +150 °C
RF Input Power, CW, 50Ω, T=25°C	+13 dBm
Supply Voltage (V_{CC})	+6 V
V_{REF}	+3.5 V

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Supply Voltage (V_{CC})	+3.6	+4.5	+5.25	V
V_{REF}	+2.75	+2.85	+2.95	V
T_{CASE}	−40		+85	°C
Tj for >10^5 hours MTTF			+200	°C

Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications

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

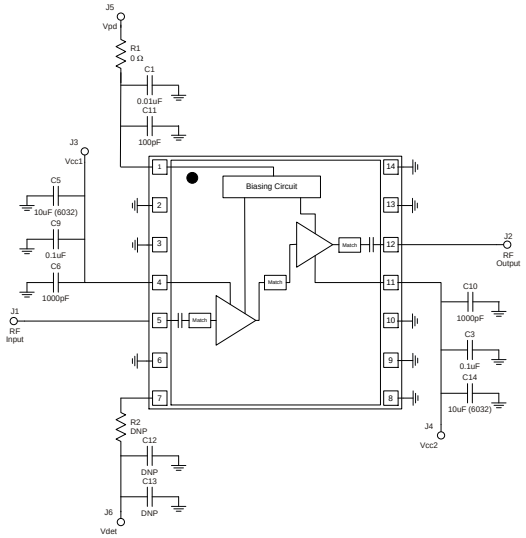
Parameter	Conditions	Min	Typ	Max	Units
Frequency Range		2010		2200	MHz
Test Frequency			2140		MHz
Gain		27.5	30.5	34.5	dB
Input Return Loss		7	10		dB
Output Return Loss		9	12		dB
Output P1dB			+33		dBm
ACLR	P_{out} = +24 dBm, 20 MHz LTE E-TM1.1, 9.5 dB PAR		-49	-45	dBc
ACLR	P_{out} = +24 dBm, 2X20 MHz LTE E-TM1.1, 9.5 dB PAR		-43		dBc
ACLR	P_{out} = +24 dBm, 15 MHz LTE E-TM1.1, 9.5 dB PAR		-51		dBc
ACLR	P_{out} = +24 dBm, 10 MHz LTE E-TM1.1, 9.5 dB PAR		-51		dBc
ACLR	P_{out} = +24 dBm, 5 MHz LTE E-TM1.1, 9.5 dB PAR		-51		dBc
Power Added Efficiency	P_{out} = +24 dBm, 20 MHz LTE E-TM1.1, 9.5 dB PAR	12	15.2		%
Spurious Output Level	P_{out} = +24 dBm, 10:1 VSWR		<60		dBc
VSWR Survivability	No degradation or failure	10:1			VSWR
Quiescent Current	V_{CC1} + V_{CC2}	160	220	280	mA
Reference Current	Temp = −40°C to +85°C, V_{REF} = +2.85V		6.5	10	mA
Leakage current	VCC = +4.5V, Vref = 0V		1.5	5	µA
Operational Current	Pout = +24 dBm		365	460	mA
Switching Speed	10% to 90% Rise time		620		nSec
	90% to 10% Fall time		840		nSec
Harmonics	$2F_0$ at +24dBm		-37	-32	dBc
	$3F_0$ at +24dBm		-52	-47	dBc
	$4F_0$ at +24dBm		-60	-55	dBc
Thermal Resistance, θ_{jc}	Module (junction to case)			37	°C/W

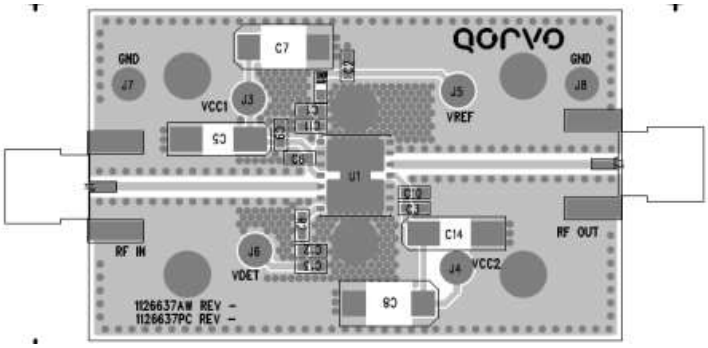
Parameter	Conditions	-40°C	+25°C	+85°C	Units
Gain	Small Signal	32	30.5	29.0	dB
ACLR	P_{OUT} = +24 dBm, 20 MHz LTE E-TM1.1, 9.5dB PAR	-51	-49	-47	dBc
PAE	P_{OUT} = +24 dBm, 20 MHz LTE E-TM1.1, 9.5dB PAR	16	15	14	%

Test Frequency = 2140MHz

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TQP9221-PCB Application Circuit Schematic and Layout





Bill of Material - TQP9221-PCB

Ref Des	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board		
U1	n/a	High Linearity 0.25 W Power Amplifier	TriQuint	TQP9221
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	

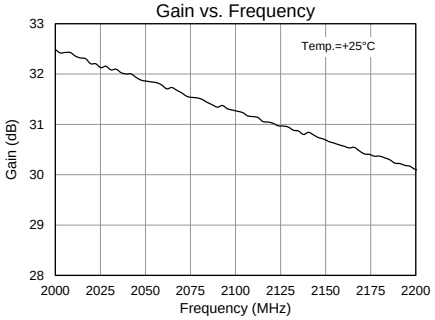
Vcc1=Vcc2=4.5V, Pout=24.5dBm, Signal PAR=9.5dB, F = 2140MHz					
LTE signal BW	5MHz	10MHz	15MHz	20MHz	Units
ACLR1-Low	-50.0	-50.5	-50.5	-50.0	dBc
ACLR1-high	-50.0	-50.0	-50.0	-50.0	dBc

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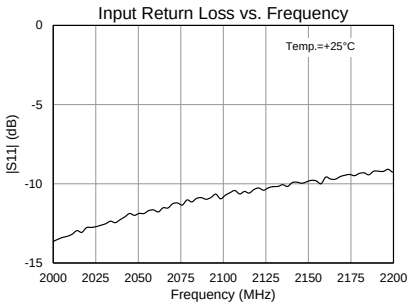
Performance Plots

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

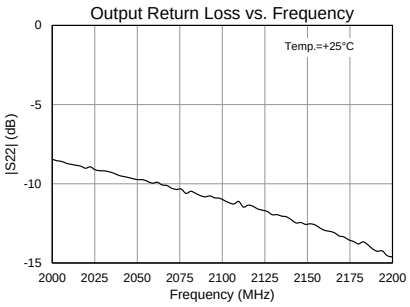
Gain vs. Frequency



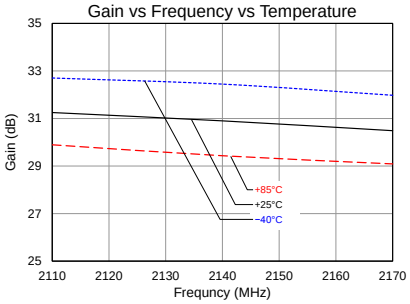
Input Return Loss vs. Frequency



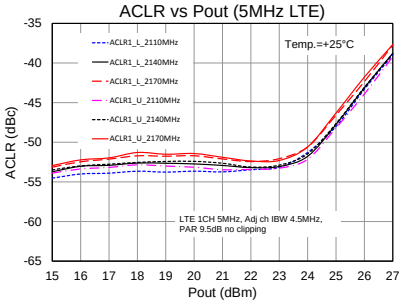
Output Return Loss vs. Frequency



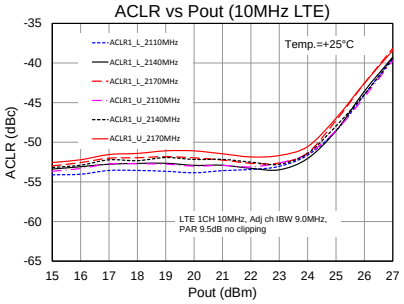
Gain vs Frequency vs Temperature



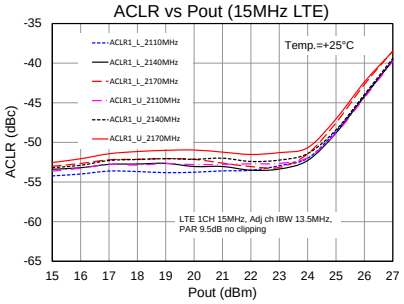
ACLR vs Pout (5MHz LTE)



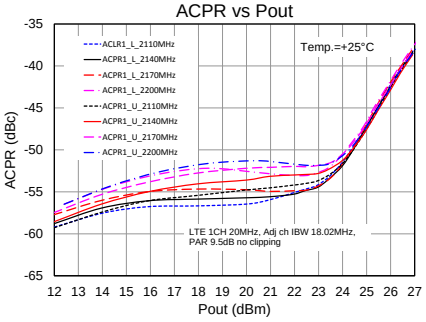
ACLR vs Pout (10MHz LTE)



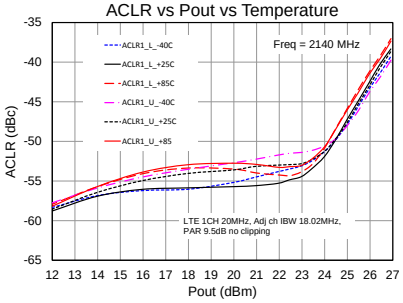
ACLR vs Pout (15MHz LTE)



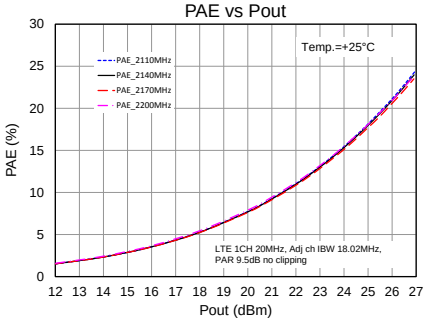
ACPR vs Pout



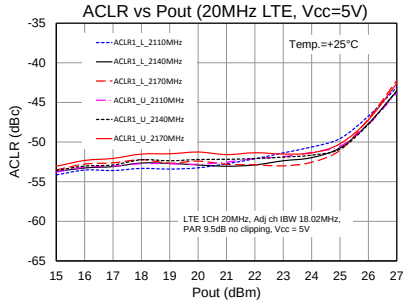
ACLR vs Pout vs Temperature



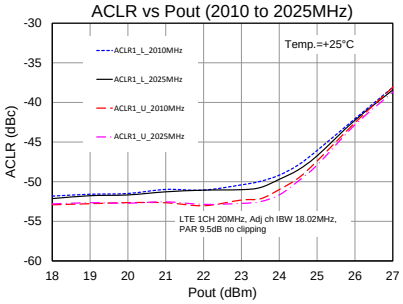
PAE vs Pout



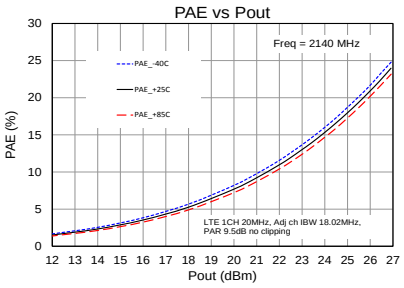
ACLR vs Pout (20MHz LTE, Vcc=5V)



ACLR vs Pout (2010 to 2025MHz)



PAE vs Pout



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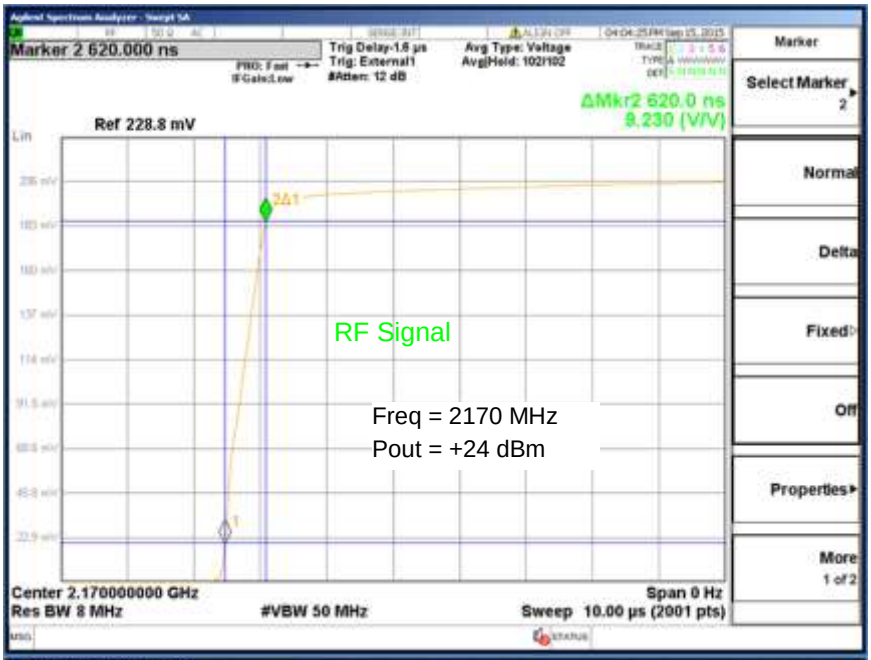
Switching Speed

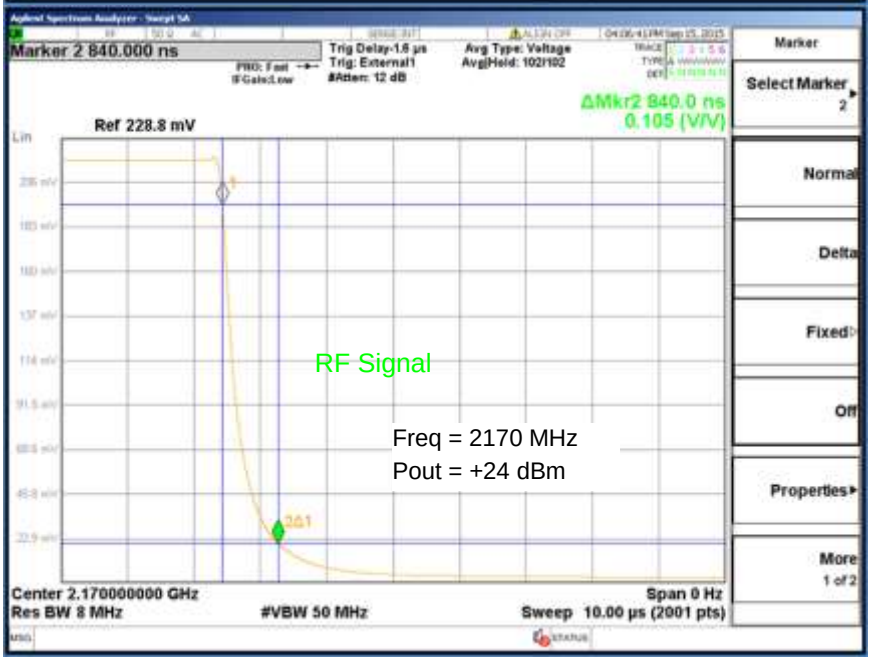
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Switching Speed Measurement based on TQP9221 Application Board

Using Shutdown Circuit: V_{REF}=2.85V, Vcc=4.5V, C1=NL

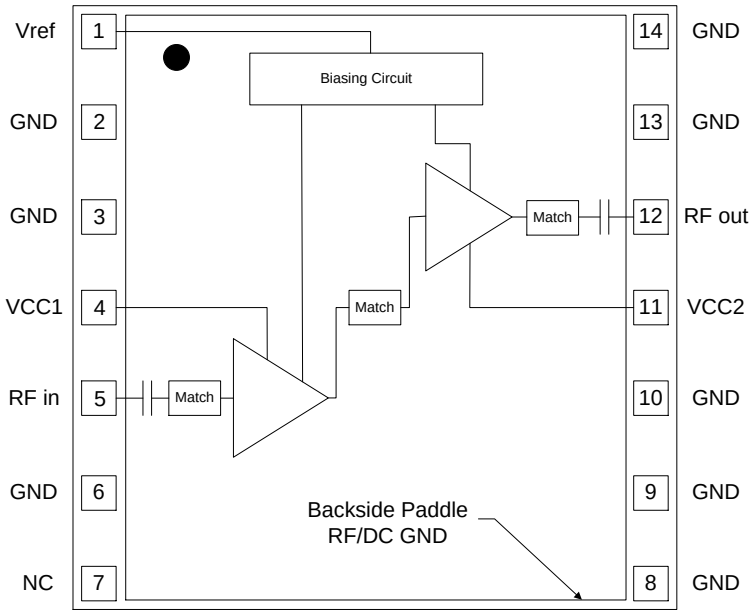
Parameter	
Turn-on Transition (10% RF – 90% RF)	620nS
Turn-off Transition (90% RF – 10% RF)	840nS





Pin Configuration and Description

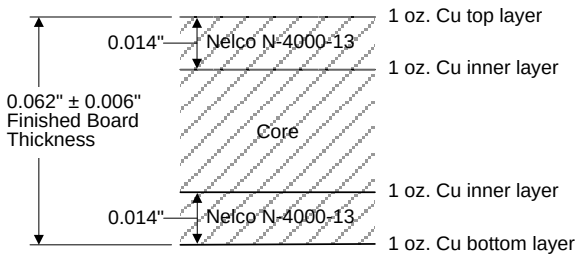
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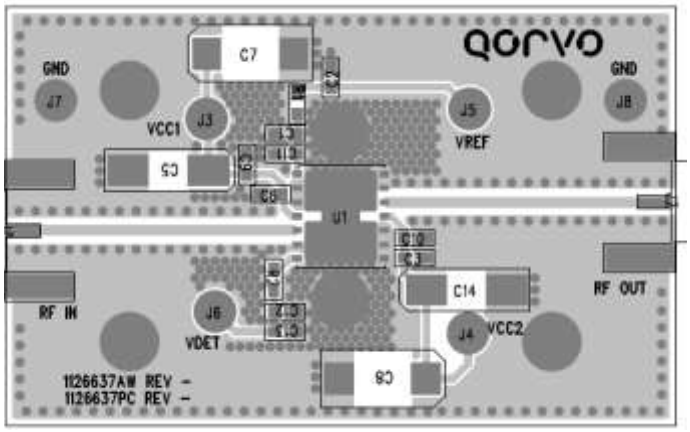
Pin No.	Label	Description
1	V_{REF}	Power down for AMP. This voltage adjusts for the current draw in Amp. Provides reference voltage for internal active biasing circuit
2, 3, 6, 8, 9, 10, 13, 14	GND	RF and DC ground.
4	V_{cc1}	DC voltage supply connection for AMP1.
5	RF in	RF input pin. The DC is internally blocked at this pin.
7	NC	No internal connection.
11	V_{cc2}	DC voltage supply connection for AMP2.
12	RFout	RF output pin. The DC is internally blocked at this pin.
Backside PaCCle	RF/DC GND	RF/DC ground. See PCB Mounting Pattern for suggested footprint.

Evaluation Board PCB Information

TriQuint PCB 1126637 Material and Stack-up



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

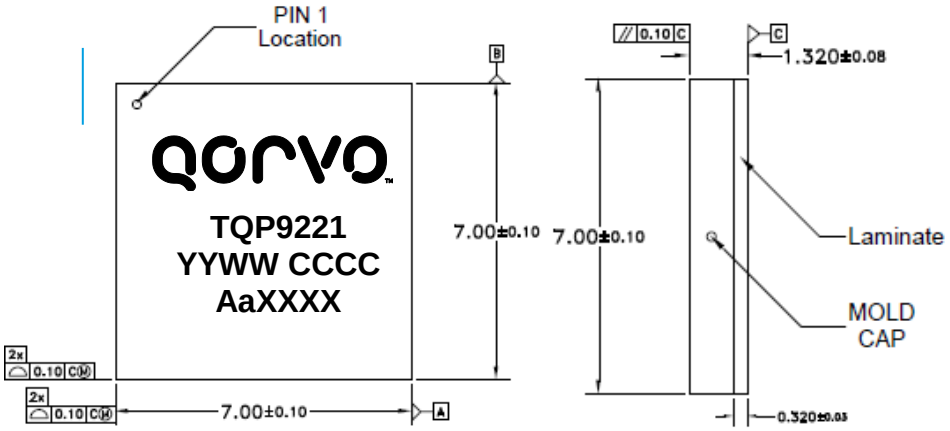


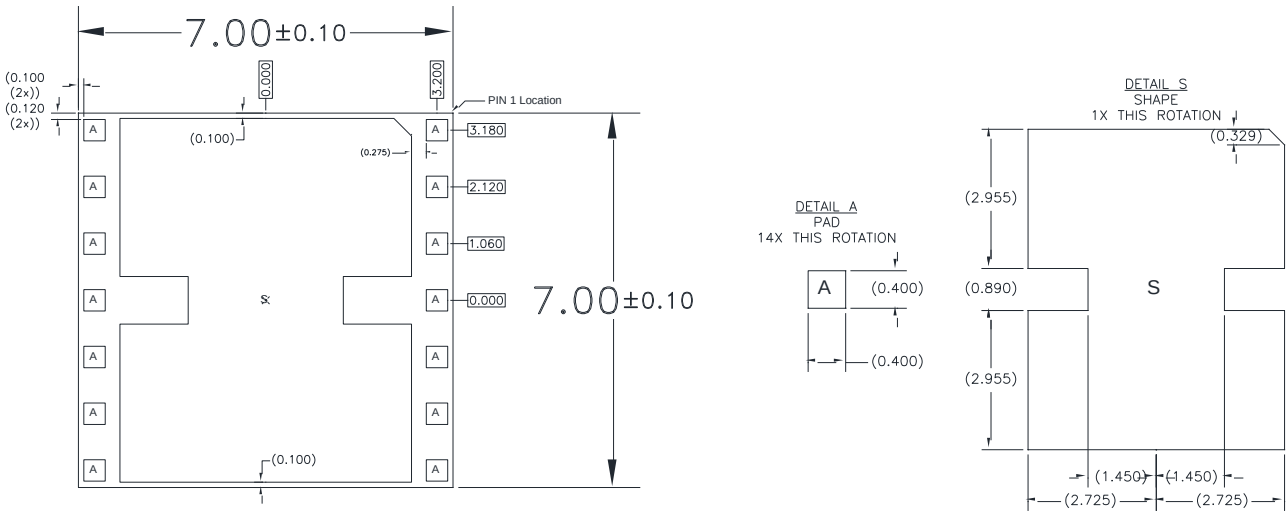
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Mechanical Information

Package Marking and Dimensions

Marking: Part number – TQP9221
Assembly Code – YYWW
Country Code - CCCC
Lot code –AaXXXX





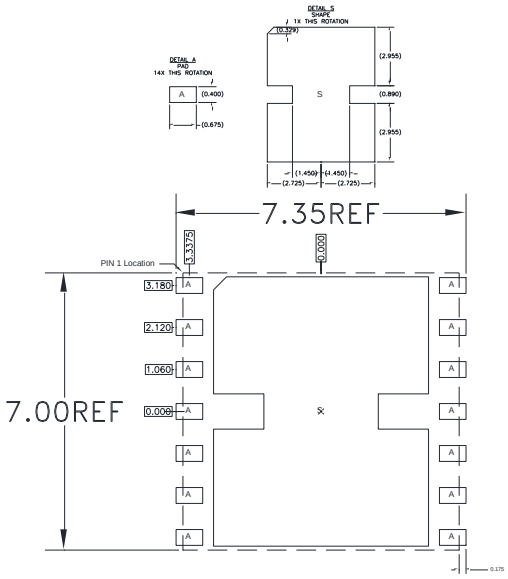
Notes:

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.

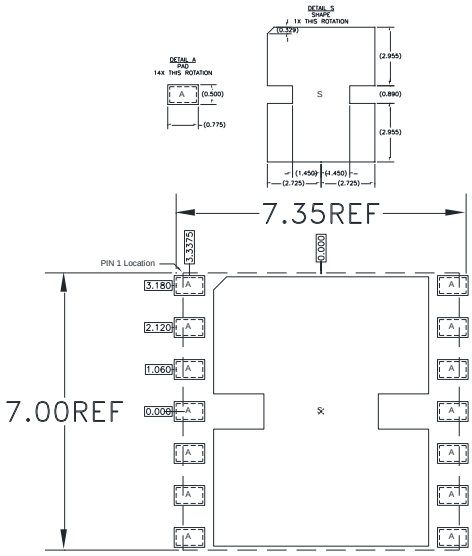
PCB Mounting Pattern

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Recommend PCB land-pad pattern metallization (Top View)



RECOMMENDED
LAND PATTERN



RECOMMENDED
LAND PATTERN MASK

Notes:

1. A heat sink underneath the area of the PCB for the mounted device is strictly required for proper thermal operation. Damage to the device can occur without the use of one.
2. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm (#80 / .0135") diameter drill and have a final plated thru diameter of .25 mm (.010").
3. ACC as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.

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Product Compliance Information

ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating:	Class 2
Volt. Range:	≥ 2000 V to < 4000 V
Test:	Human Body Model (HBM)
Standard:	ESDA / JEDEC Standard JS-001-2012

ESD Class:	Class C3
Volt. Range:	≥ 1000 V
Test:	Charged Device Model (CDM)
Standard:	JEDEC Standard JESD22-C101F

MSL Rating

MSL Rating:	Level 3
Test:	260°C convection reflow
Standard:	JEDEC Standard IPC/JEDEC J-STD-020

Solderability

Compatible with both lead-free (260°C maximum reflow temperature) and tin/lead (245°C maximum reflow temperature) soldering processes.

Contact plating: Electrolytic plated Au over Ni

RoHs Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Web: www.triquint.com **Tel: 877-800-8584**
Email: customer.support@qorvo.com

For information about the merger of RFMD and TriQuint as Qorvo:

Web: www.qorvo.com

For technical questions and application information:

Email: sjcapplications.engineering@qorvo.com

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