TQL9092

Ultra Low Noise, Flat Gain LNA

Applications

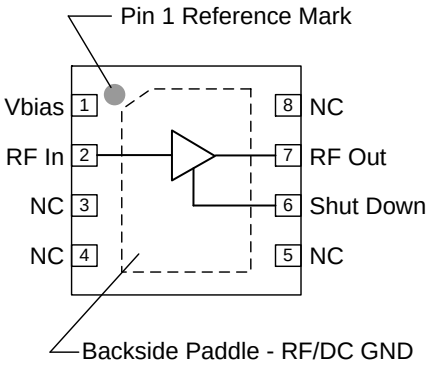
- Repeaters / DAS
- Mobile Infrastructure
- LTE / WCDMA / CDMA / GSM
- General Purpose Wireless
- TDD or FDD systems

8 pin 2x2 mm DFN Package

Product Features

- 0.6-4.2 GHz Operational Bandwidth
- Ultra low noise figure, 0.6 dB NF @ 2.6 GHz
- >20 dB gain across 1.5 to 3.8 GHz
- Flat 2 dB gain variation across 1.5 to 3.6GHz
- Bias adjustable for linearity optimization
- 37 dBm OIP3 at 65mA I_{DD}
- Shut-down mode pin with 1.8V TTL logic
- Unconditionally stable
- Integrated shutdown control pin
- Maintains OFF state with high Pin drive
- +3V to +5V supply; does not require -Vgg

Functional Block Diagram



General Description

The TQL9092 is a flat-gain, high-linearity, ultra-low noise amplifier in a small 2 x 2 mm surface-mount package. The LNA provides a gain flatness of 2 dB (peak-to-peak) over a wide bandwidth from 1.5 to 3.6GHz. At 2.6 GHz, the amplifier typically provides 22.6 dB gain, +39.5 dBm OIP3 at a 65 mA bias setting, and 0.6 dB noise figure. The LNA can be biased from a single positive supply ranging from 3.3 to 5 volts. The device is housed in a green/RoHS-compliant industry-standard 2x2 mm package.

The TQL9092 is internally matched using a high performance E-pHEMT process and only requires five external components for operation from a single positive supply: an external RF choke and blocking/bypass capacitors and a bias resistor going to pin 1. This LNA integrates a shut-down biasing capability to allow for operation in TDD applications.

The TQL9092 is optimized for linear performance across the 1.5 to 4.2 GHz frequency band but can operate down to 600 MHz.

Pin Configuration

Pin No.	Label
1	Vbias
3, 4, 5, 8	No Connect or GND
2	RF In
6	Shut Down
7	RF Out
Backside Paddle	RF/DC GND

Ordering Information

Part No.	Description
TQL9092	Ultra low noise, Flat Gain LNA
TQL9092-PCB	0.6-4.2 GHz Evaluation Board

Standard T/R size = 2500 pieces on a 7” reel

© 2015 TriQuint Semiconductor, Inc

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	−65 to 150°C
Supply Voltage (V_{DD})	+7 V
RF Input Power, CW, 50Ω, T=25°C	+33 dBm
RF Input Power, WCDMA, 10dB PAR	+27 dBm
RF Input Power, CW, OFF State	+33 dBm

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_{DD})	3.3	5.0	5.25	V
T_{CASE}	−40		+105	°C
Tj for >10^6 hours MTTF			+190	°C

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

Electrical Specifications

Test conditions unless otherwise noted: V_{DD} =+5V, Temp=+25°C, 50 Ω system.

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		600		4200	MHz
Test Frequency			2600		MHz
Gain		21	22.6	24.5	dB
Gain Flatness	1500-3600MHz		2.0		dB
Input Return Loss			11		dB
Output Return Loss			17		dB
Noise Figure(1)			0.65	0.95	dB
Output P1dB			+19		dBm
Output IP3	Pout=+5 dBm/tone, Δf=1 MHz	+33	+37		dBm
Power Shutdown Control (pin 6)	On state	0		0.63	V
	Off state (Power down)	1.17		V_{DD}	V
Current, I_{DD}	On state	45	65	85	mA
	Off state (Power down)		3		mA
Shutdown pin current, I_{SD}	V_{PD} ≥ 1.17 V		140		µA
Switching Speed	LNA ON to OFF		583		ns
	LNA OFF to ON		216		ns
Thermal Resistance, θ_{jc}	channel to case		48		°C/W

Note: 1) Noise figure data has input trace loss de-embedded.

© 2015 TriQuint Semiconductor, Inc

S-Parameters

Test Conditions: V_{DD}=+5 V, I_{DD}=65 mA (typ.), T=+25°C, unmatched 50 ohm system, calibrated to device leads

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
0.6	-11.76	-50.69	23.21	75.64	-32.67	3.34	-17.78	-82.70
0.7	-12.71	-50.64	22.61	64.33	-32.32	-0.10	-19.37	-95.95
0.8	-13.48	-49.70	22.07	53.89	-32.07	-3.77	-21.01	-111.25
0.9	-13.97	-47.94	21.62	44.25	-31.88	-7.51	-22.57	-127.54
1	-14.17	-46.01	21.24	35.23	-31.74	-11.34	-24.09	-146.47
1.1	-14.12	-44.61	20.95	26.72	-31.66	-15.27	-25.21	-170.38
1.2	-13.85	-44.30	20.72	18.67	-31.60	-19.21	-25.32	163.93
1.3	-13.51	-45.93	20.57	10.97	-31.58	-23.13	-24.42	142.26
1.4	-13.22	-48.66	20.45	3.55	-31.58	-27.21	-23.14	125.62
1.5	-13.03	-52.44	20.40	-3.55	-31.60	-31.21	-22.30	112.36
1.6	-12.87	-56.00	20.40	-10.53	-31.66	-35.36	-21.21	99.97
1.7	-12.74	-60.59	20.44	-17.40	-31.73	-39.63	-20.45	90.85
1.8	-12.57	-64.83	20.53	-24.24	-31.81	-44.05	-19.74	80.82
1.9	-12.32	-70.61	20.65	-31.05	-31.91	-48.65	-19.19	74.07
2	-12.15	-77.39	20.82	-37.89	-32.00	-53.53	-18.89	65.49
2.1	-11.91	-85.11	21.01	-44.83	-32.11	-58.82	-18.73	57.48
2.2	-11.84	-94.45	21.26	-51.96	-32.22	-64.28	-18.88	49.58
2.3	-11.71	-103.32	21.48	-59.27	-32.33	-70.14	-19.01	40.16
2.4	-11.58	-114.41	21.77	-66.85	-32.45	-76.66	-19.75	31.25
2.5	-11.36	-125.29	22.03	-74.82	-32.56	-83.41	-20.68	19.64
2.6	-10.75	-137.87	22.35	-83.11	-32.51	-92.09	-22.11	1.63
2.7	-10.51	-152.17	22.54	-92.23	-32.96	-100.23	-25.45	-16.73
2.8	-9.95	-166.24	22.71	-101.40	-33.19	-109.01	-29.13	-56.17
2.9	-9.36	179.27	22.86	-111.02	-33.45	-118.56	-27.48	-118.31
3	-8.79	164.95	22.88	-121.01	-33.76	-128.78	-22.59	-154.88
3.1	-8.27	150.82	22.83	-131.17	-34.10	-139.39	-19.03	-173.88
3.2	-7.79	137.73	22.61	-141.31	-34.47	-150.14	-16.31	170.67
3.3	-7.41	124.99	22.32	-151.26	-34.84	-160.90	-14.19	158.49
3.4	-7.15	113.98	21.90	-160.90	-35.23	-171.42	-12.59	146.44
3.5	-6.96	103.20	21.40	-169.96	-35.60	178.70	-11.16	137.22
3.6	-6.82	94.04	20.87	-178.58	-35.91	169.44	-10.25	128.56
3.7	-6.79	85.65	20.27	173.50	-36.16	161.01	-9.49	120.64
3.8	-6.81	77.65	19.67	166.05	-36.31	153.47	-8.97	113.48
3.9	-6.92	70.51	19.02	159.20	-36.36	146.55	-8.48	106.15
4	-7.10	63.84	18.40	152.87	-36.34	140.32	-8.08	99.85

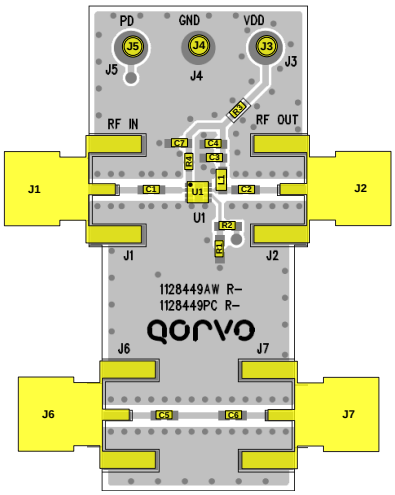
Noise Parameters

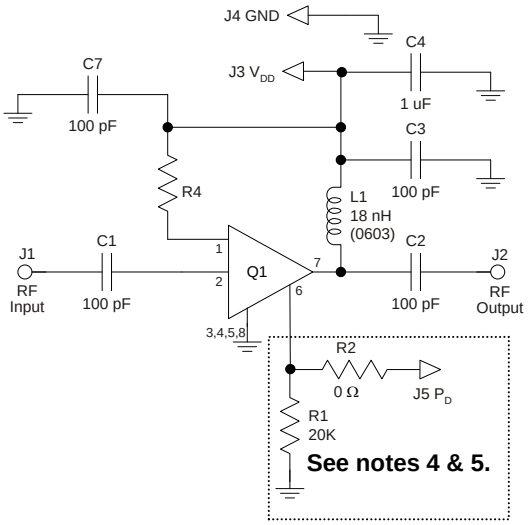
Test conditions unless otherwise noted: V_{DD}=+5 V, I_{DD}=65 mA (typ.), Temp=+25°C, 50 Ohm system

Freq (GHz)	NF_{min} (dB)	GammaOpt (mag)	GammaOpt (deg)	Rn (Ω)
1.7	0.44	0.21	41.22	3.91
1.8	0.43	0.21	43.79	3.97
1.9	0.44	0.17	52.37	3.64
2	0.46	0.16	52.59	3.65
2.1	0.46	0.16	52.28	3.80
2.2	0.47	0.14	65.48	3.57
2.3	0.48	0.16	64.17	3.46
2.4	0.51	0.15	69.57	3.54
2.5	0.54	0.12	87.09	3.25
2.6	0.56	0.11	97.35	3.14
2.7	0.58	0.06	103.92	3.45

© 2015 TriQuint Semiconductor, Inc

TQL9092-PCB Evaluation Board





Notes:

1. See Evaluation Board PCB Information section for material and stack-up.
2. R3 (0 Ω jumper) is not shown on the schematic and may be replaced with copper trace in the target application layout.
3. All components are of 0402 size unless stated on the schematic.
4. For TDD Applications: R1 = 20K & R2 = 0Ω
5. For FDD Applications: R1 = 20K 'OR' Pin 6 tied to ground. R2 = DNP/Omitted
6. A through line is included on the evaluation board to de-embed the board losses.
7. R4 sets the current draw. Can be changed for the desired bias point. See table below.

Bill of Material – TQL9092-PCB

Reference Des.	Value	Description	Manuf.	Part Number
N/A	N/A	Printed Circuit Board	Qorvo	
U1	n/a	Ultra Low Noise, Flat Gain LNA	Qorvo	TQL9092
R4	5.1K	Resistor, Chip, 0402, 5%, 1/16W	various	
R1	20K	Resistor, chip, 0402, 5%, 1/16W	various	
R2, 3	0 Ω	Resistor, Chip, 0402, 5%, 1/16W	various	
L1	18 nH	Inductor, 0603, 5%, Ceramic	various	
C4	1.0 uF	Cap., Chip, 0402, 10%, 10V, X5R	various	
C1, C2, C3, C5, C6	100 pF	Cap., Chip, 0402, 5%, 50V, NPO/COG	various	

R4 Resistor Values for Various I_{CQ} settings

I_{CQ} (mA)	45	55	65	75	85	95	105	115
R4	9.2K	6.5K	5.1K	3.9K	3.1K	2.6K	2.2K	1.8K

Disclaimer: Subject to change without notice
© 2015 TriQuint Semiconductor, Inc
www.triquint.com \ www.qorvo.com

Typical Performance – TQL9092-PCB

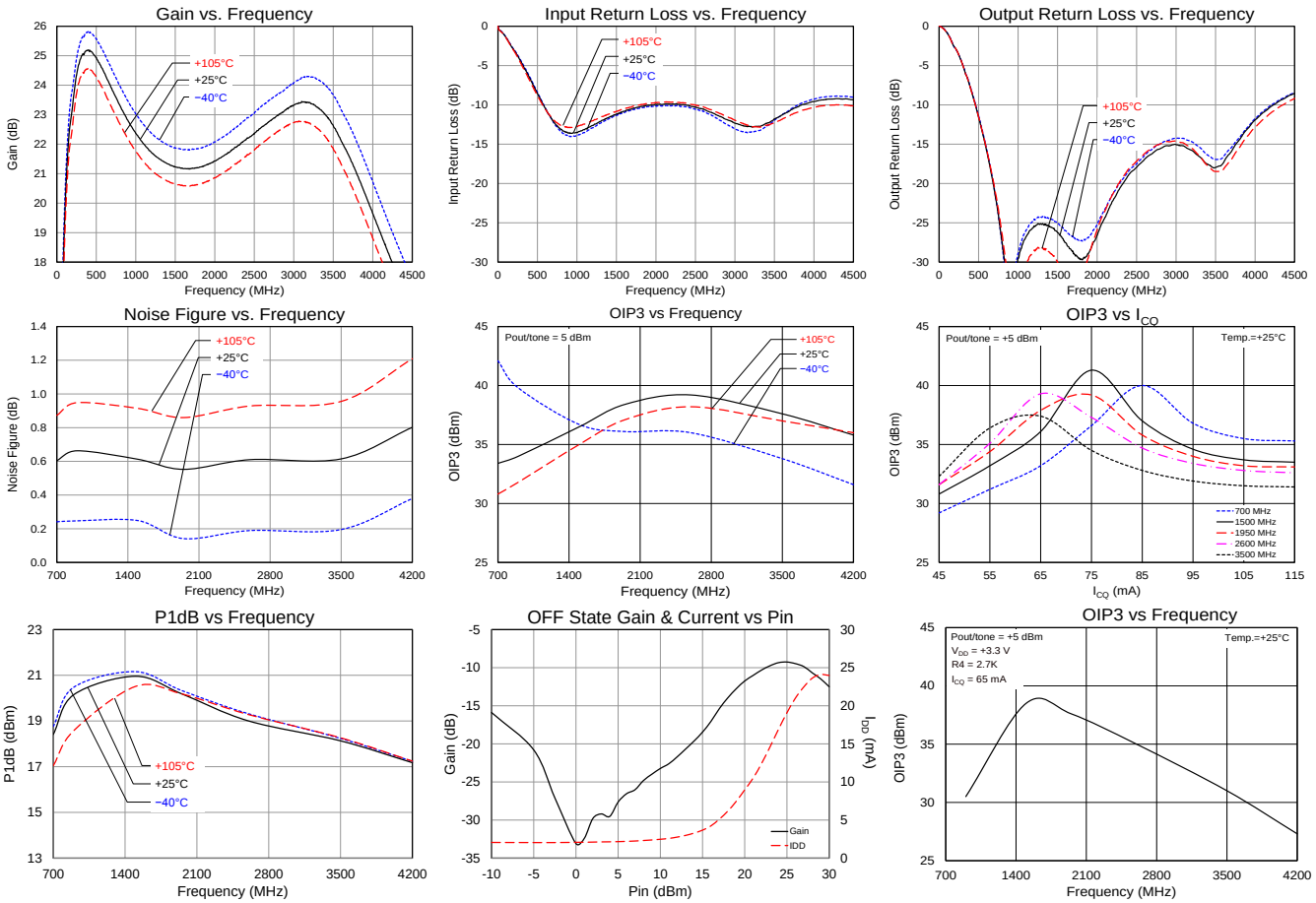
Test conditions unless otherwise noted: V_{DD}=+5 V, I_{DD}=65 mA (typ.), Temp=+25°C

Parameter	Conditions	Typical Values					Units
Frequency		900	1950	2600	3500	4200	MHz
Gain		22.8	21.3	22.6	22.6	18.3	dB
Input Return Loss		13.5	10	10.5	11.8	9.2	dB
Output Return Loss		33	27	17	18	10.2	dB
Output P1dB		+20.1	+20.2	+19	+18.3	+17.2	dBm
OIP3	Pout=+5 dBm/tone, Δf=1 MHz	+34	+38.4	+39.2	+37.6	+35.8	dBm
OIP3	Pout=+5 dBm/tone, Δf=1 MHz I_{DD} = 80 mA	+40	+35.7	+34.7	+32.8		dBm
Noise figure (1)		0.66	0.55	0.6	0.6	0.8	dB

Note: 1) Noise figure data has input trace loss de-embedded.

Performance Plots – TQL9092-PCB

Test conditions unless otherwise noted: V_{DD}=+5 V, I_{DD} = 65mA, Temp=+25°C. Noise figure data has input trace loss de-embedded.



© 2015 TriQuint Semiconductor, Inc

Disclaimer: Subject to change without notice

TQL9092 3.3V V_{DD} Operation

This page provides performance data when operating at 3.3V V_{DD} with 65mA and 80mA I_{DD}. The current level was adjusted with the following resistor setting on the evaluation board. Please refer to pg. 4 for PCB schematic and layout.

R4 = 2.4K for I_{DD} = 65mA

R4 = 1.6K for I_{DD} = 80mA

Typical Performance – VDD = 3.3V

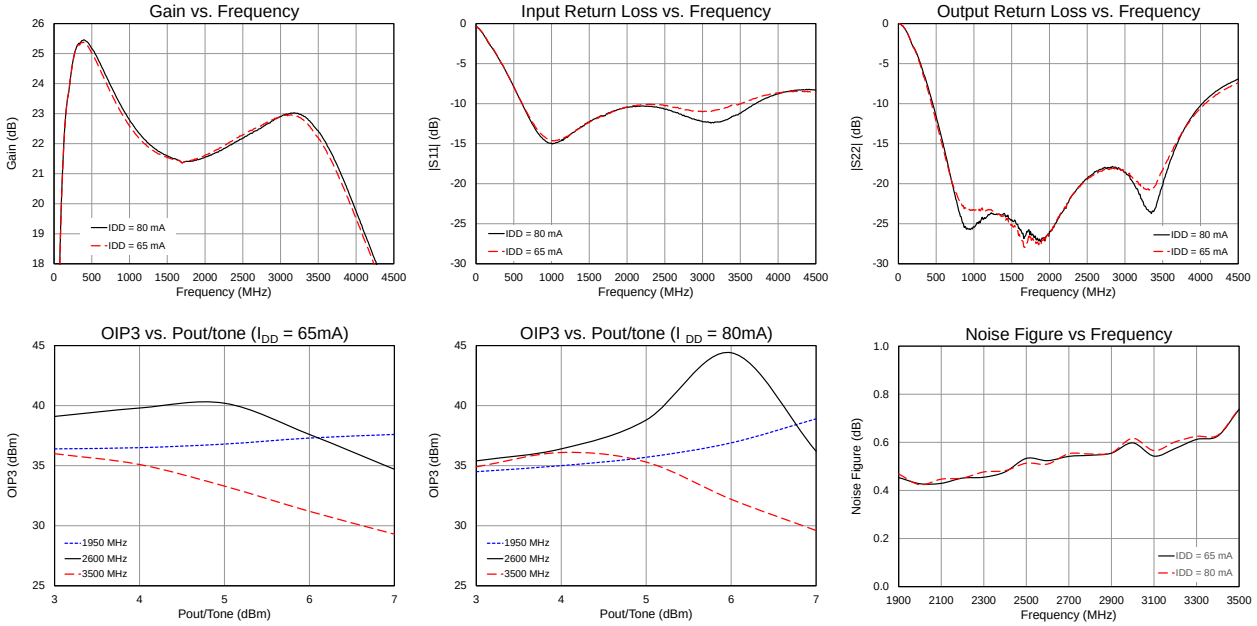
Test conditions unless otherwise noted: V_{DD}=+3.3 V, Temp=+25°C

Parameter	Conditions	Typical Values						Units
Frequency		1950		2600		3500		MHz
I_{DD}		65	80	65	80	65	80	mA
Gain		21.5	21.5	22.4	22.3	22.2	22.4	dB
Input Return Loss		10.5	10.5	10.5	11	10	11	dB
Output Return Loss		26	26	18	18	18	20	dB
Output P1dB		+18.5	+18.7	+17.4	+17.6	+16	+15.8	dBm
OIP3	Pout=+5 dBm/tone, Δf=1 MHz	+36.8	+35.7	+40.2	+38.8	+33.3	+35.3	dBm
Noise figure (1)		0.43	0.42	0.52	0.51	0.74	0.74	dB

Note: 1) Noise figure data has input trace loss de-embedded.

Performance Plots – TQL9092-PCB at V_{DD} = 3.3V

Test conditions unless otherwise noted: V_{DD}=+3.3 V, Temp=+25°C. Noise figure data has input trace loss de-embedded.

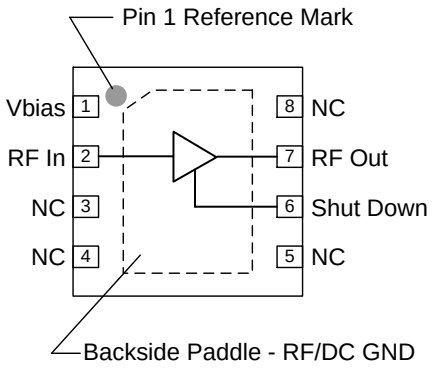


© 2015 TriQuint Semiconductor, Inc

Disclaimer: Subject to change without notice

www.triquint.com \ www.qorvo.com

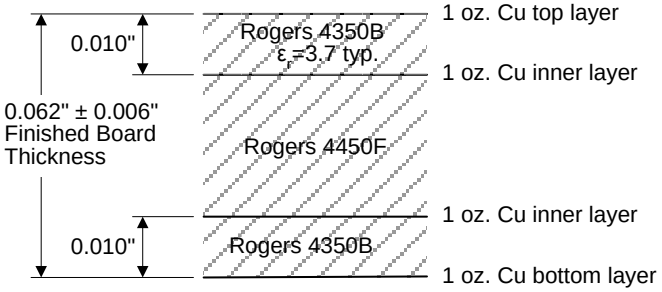
Pin Configuration and Description



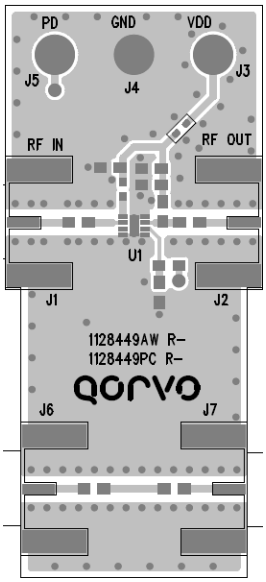
Pin No.	Label	Description
1	Vbias	Sets the Icq bias point for the device.
2	RF In	RF Input pin. A DC Block is required.
6	Shut Down	A high voltage(>1.17V) turns off the device. If the pin is pulled to ground or driven with a voltage less than 0.63V, then the device will operate under LNA ON state.
7	RF Out / DCBias	RF Output pin. DC bias will also need to be injected through a RF bias choke/inductor for operation.
3, 4, 5, 8	NC	No electrical connection. Provide grounded land pads for PCB mounting integrity.
Backside Paddle	RF/DC GND	RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance; see PCB Mounting Pattern for suggested footprint.

Evaluation Board PCB Information

Qorvo PCB 1128449 Material and Stack-up



50 ohm line dimensions: width = 0.020”, spacing = 0.032”

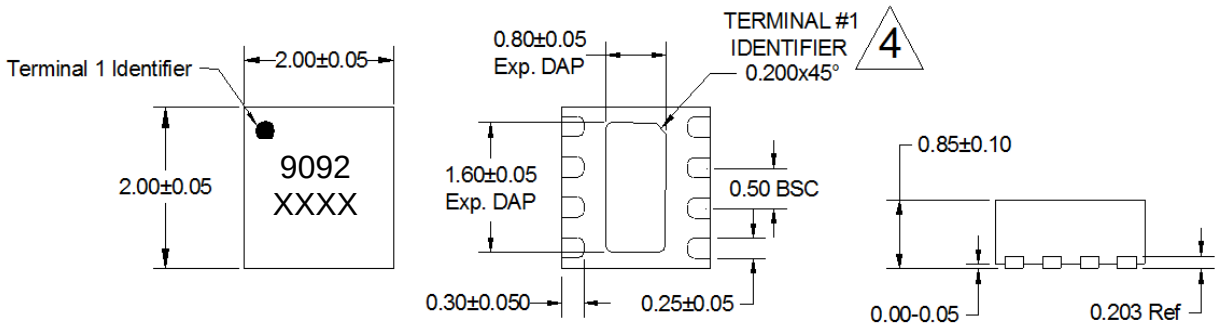


© 2015 TriQuint Semiconductor, Inc

Mechanical Information

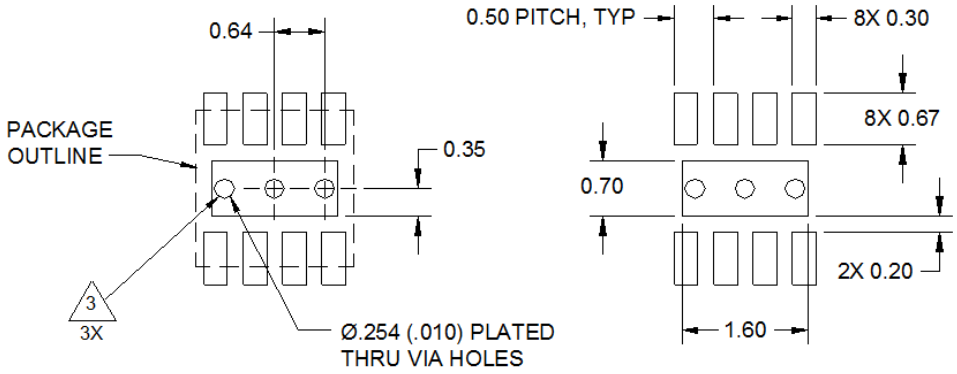
Package Marking and Dimensions

Marking: Part number – 9092
Lot code – XXXX



Notes:
1. All dimensions are in millimeters. Angles are in degrees.
2. Except where noted, this part outline conforms to JEDEC standard MO-220, Issue E (Variation VGGC) for thermally enhanced plastic very thin fine pitch quad flat no lead package (QFN).
3. Dimension and tolerance formats conform to ASME Y14.4M-1994.
4. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

PCB Mounting Pattern



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.

© 2015 TriQuint Semiconductor, Inc

Product Compliance Information

ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating: Class 1B
Value: 500V to <1000V
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

ESD Rating: Class C3
Value: >1000V
Test: Charged Device Model (CDM)
Standard: JEDEC Standard JESD22-C101

MSL Rating

MSL Rating: Level 1
Test: 260°C convection reflow
Standard: JEDEC Standard IPC/JEDEC J-STD-020

Solderability

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

Contact plating: NiPdAu

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

Important Notice

The information contained herein is believed to be reliable. Qorvo makes no warranties regarding the information contained herein. Qorvo assumes no responsibility or liability whatsoever for any of the information contained herein. Qorvo assumes no responsibility or liability whatsoever for the use of the information contained herein. The information contained herein is provided "AS IS, WHERE IS" and with all faults, and the entire risk associated with such information is entirely with the user. All information contained herein is subject to change without notice. Customers should obtain and verify the latest relevant information before placing orders for Qorvo products. The information contained herein or any use of such information does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other intellectual property rights, whether with regard to such information itself or anything described by such information.

Qorvo products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.

© 2015 TriQuint Semiconductor, Inc

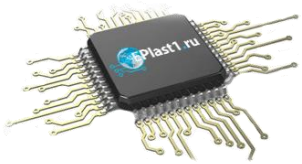
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.