ML501

1.9-2.7 GHz High IP3 Mixer with Integrated LO Amp

Applications

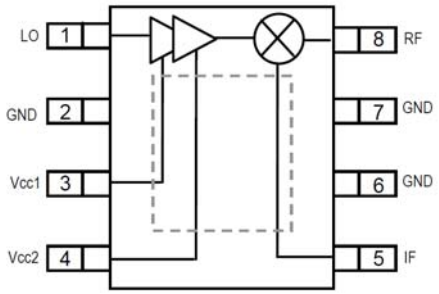
- 2.5/3G GSM/CDMA/WCDMA
- PCS/UMTS-band Mobile Infrastructure
- WiBro / WiLAN / WiMAX

SOIC-8 Package

Product Features

- High dynamic range mixer with integrated LO driver
- +30 dBm Input IP3
- 8 dB Conversion Loss
- RF: 1900 – 2700 MHz
- LO: 1600 – 2500 MHz
- IF: 50 – 500 MHz
- 0 dBm Drive Level
- RoHS-compliant SOIC-8 pkg

Functional Block Diagram



General Description

The ML501 high linearity upconverter or downconverter combines a passive GaAs MESFET mixer with an integrated HBT LO driver in a low-cost lead-free/green/RoHS-compliant SOIC-8 package. The ML501 uses patented techniques to realize +30 dBm Input IP3 with 8 dB conversion loss using an LO drive level of 0 dBm in a downconverting application. The on-chip diplexer in the mixers allows for good matching on the RF and IF ports. The dual-stage LO driver provides a stable input power level into the mixer to allow for consistent performance over a wide range of LO power levels.

Typical applications include frequency up/down conversion, modulation and demodulation for receivers and transmitters used in 2.5G and 3G GSM/CDMA/WCDMA systems in the PCS, or UMTS frequency bands. They can also be used for WiBro/WiLAN/WiMAX infrastructure requiring high linearity frequency conversion.

Pin Configuration

Pin #	Symbol
1	LO
2, 6, 7	GND
3	Vcc1
4	Vcc2
5	IF
8	RF
Backside Paddle	GND

Ordering Information

Part No.	Description
ML501-G	High IP3 Mixer w/ Integrated LO Amp
ML501-PCB	Full Assembled Evaluation Board

Standard T/R size = 500 pieces on a 7” reel.

Specifications

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	-55 to +150 °C
DC Voltage	+5.5 V
Input IF / RF Power, +25°C	+20 dBm
LO Power	+10 dBm
Thermal Resistance	104 °C/W

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

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
V_{cc}		+5		V
Operating Case Temp	-40		+85	°C

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

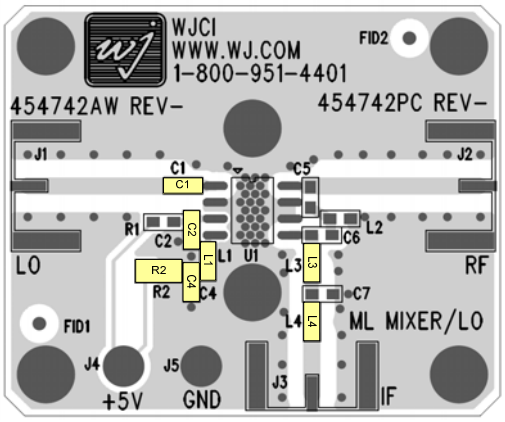
Electrical Specifications

Test conditions unless otherwise noted: Min / max limits are tested for the mixer in downconverting application with a low-side LO at 0 dBm at 25 °C with RF/IF = 2200/50 MHz.

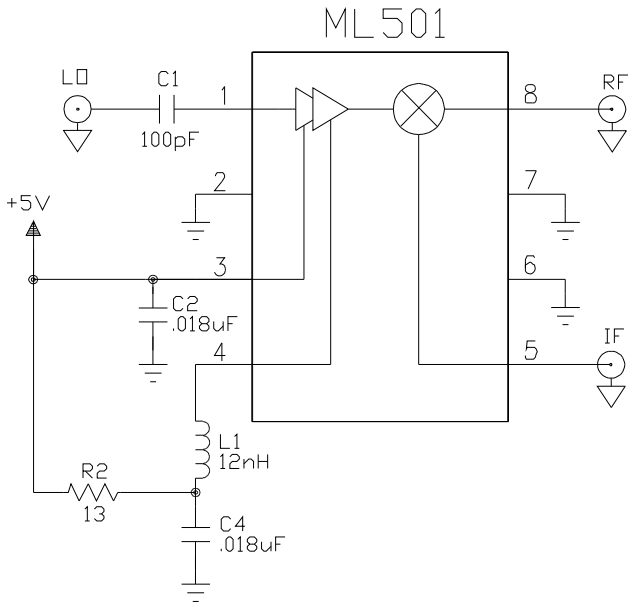
Parameter	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit
RF Freq Range		1900-2200			2200-2400			2400-2700		MHz
LO Freq Range		1600-2150			1900-2350			1900-2500		MHz
IF Freq Range		50-300			50-300			200-500		MHz
SSB Conversion		8			8.1	9		8.4		dB
Input IP3 (2)		+30		+28	+30			+28		dBm
Input P1dB		+21			+20			+20		dBm
LO – RF Isolation (3)		9			8			7		dBm
LO - IF Isolation (3)		27			27			25		dB
RF - IF Isolation		20			21			21		dB
RF Return Loss		16			17			17		dB
IF Return Loss		20			20			20		dB
LO Return Loss		15			12			11		dBm
LO Drive Level	-2.5	0	2.5	-2.5	0	2.5	-2.5	0	2.5	dBm
Supply Voltage					+5					V
Supply Current(4)	85	110	135		120			130		mA

Notes:
1. IIP3 is measured with Δf = 1 MHz with RFin = 0 dBm / tone.
2. LO is injected with 0 dBm.
3. This refers to the operating current under LO drive. The current can be reduced by increasing the value of the R2 resistor slightly.

Downconversion Application Circuit : ML501-PCB



Note:
1. R1 is shown in the silkscreen but is not required for the ML501. A 0Ω jumper is placed in this spot on the PCB.

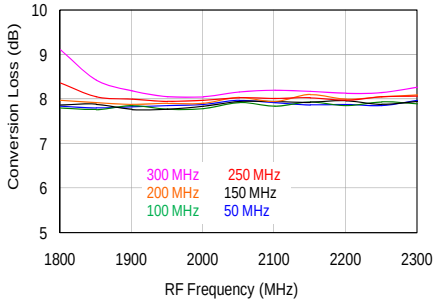


Bill of Material

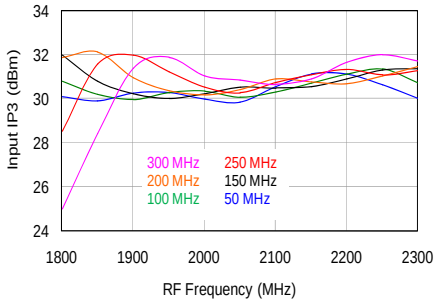
Ref Des	Value	Description	Manufacturer	Part Number
U1		High IP3 Mixer with Integrated LO Amp	TriQuint	ML501-G
C1	100 pF	Cap, Chip, 0603, 5%, 50 V, COG	various	
C2, C4	0.018 uF	Cap, Chip, 0603, 5%, 50 V, X7R	various	
L1	12 nH	Ind, Chip, 0603, 5%	various	
L3, L4, R1	0 Ω	Res, Chip, 0603, 5%, 1/16W	various	
R2	13 Ω	Res, Chip, 0603, 5%, 1/10W	various	

Typical Performance Plots

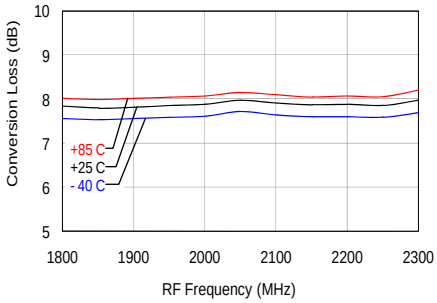
Conversion Loss vs RF Frequency vs IF
+25 C, LO = 0 dBm, low-side LO



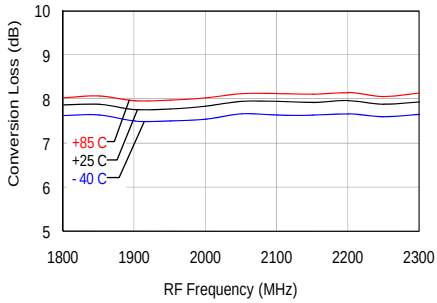
Input IP3 vs RF Frequency vs IF Frequency
+25 C, LO = 0 dBm, low-side LO



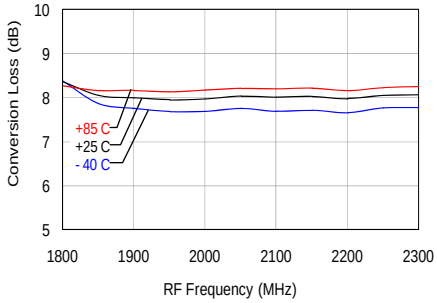
Conversion Loss vs RF Frequency vs Temp
LO = 0 dBm, IF = 50 MHz, low-side LO



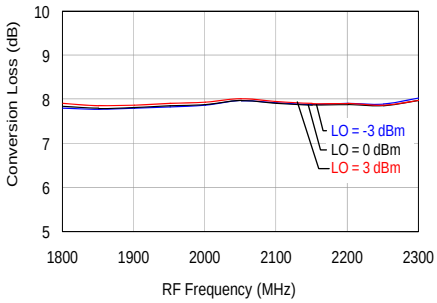
Conversion Loss vs RF Frequency vs Temp
LO = 0 dBm, IF = 150 MHz, low-side LO



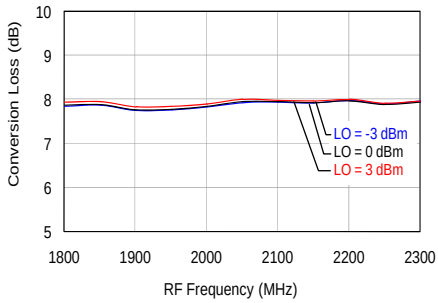
Conversion Loss vs RF Frequency vs Temp
LO = 0 dBm, IF = 250 MHz, low-side LO



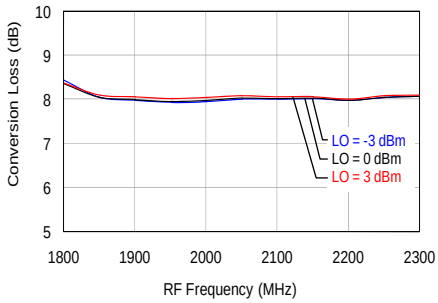
Conversion Loss vs RF Freq vs LO Power
+25 C, IF = 50 MHz, low-side LO



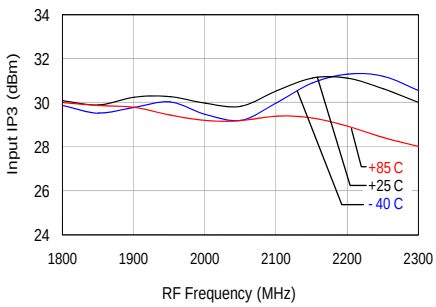
Conversion Loss vs RF Freq vs LO Power
+25 C, IF = 150 MHz, low-side LO



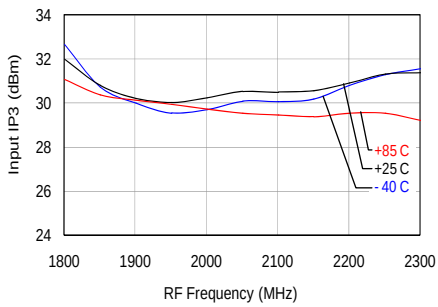
Conversion Loss vs RF Freq vs LO Power
+25 C, IF = 250 MHz, low-side LO



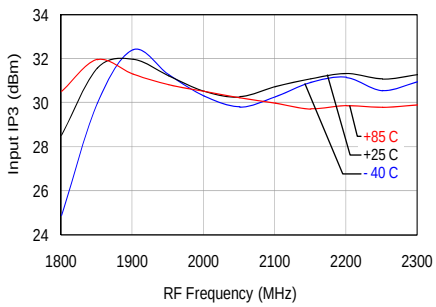
Input IP3 vs RF Frequency vs Temperature
LO = 0 dBm, IF = 50 MHz, low-side LO



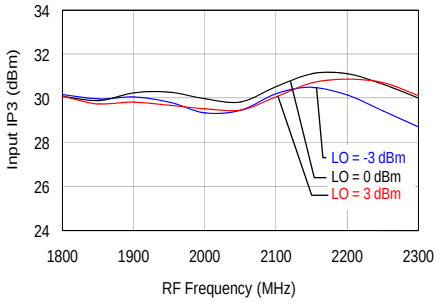
Input IP3 vs RF Frequency vs Temperature
LO = 0 dBm, IF = 150 MHz, low-side LO



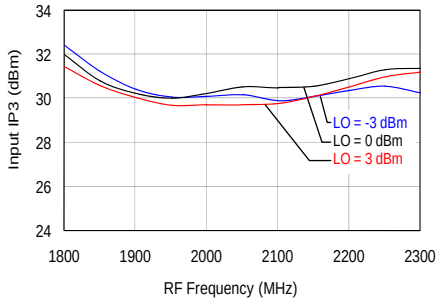
Input IP3 vs RF Frequency vs Temperature
LO = 0 dBm, IF = 250 MHz, low-side LO



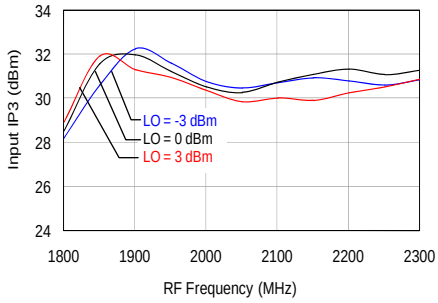
Input IP3 vs RF Freq vs LO Power
+25 C, IF = 50 MHz, low-side LO



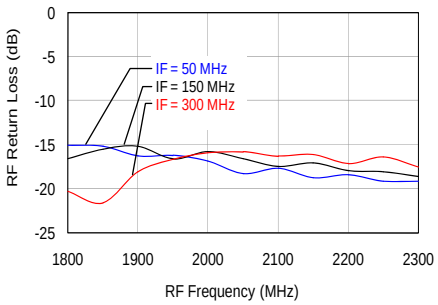
Input IP3 vs RF Freq vs LO Power
+25 C, IF = 150 MHz, low-side LO



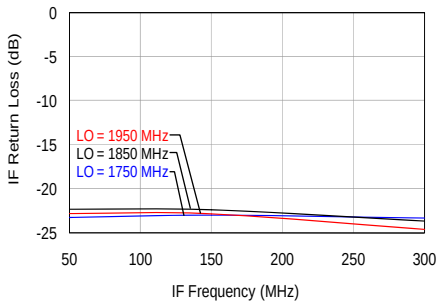
Input IP3 vs RF Freq vs LO Power
+25 C, IF = 250 MHz, low-side LO



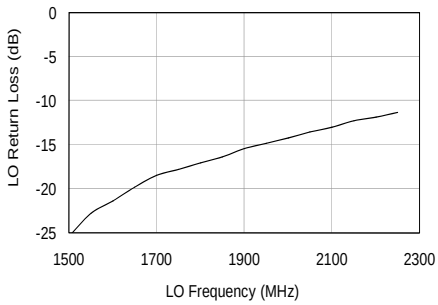
RF Return Loss vs LO Frequency
+25 C, LO = 0 dBm



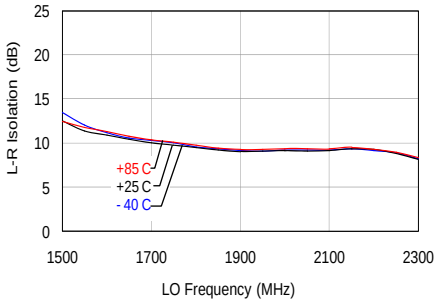
IF Return Loss vs IF Frequency
+25 C, LO = 0 dBm



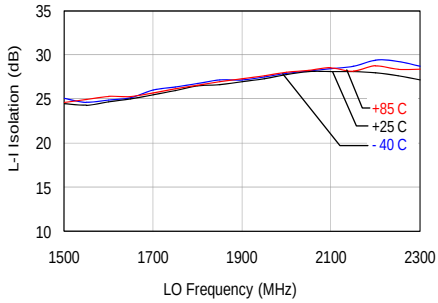
LO Return Loss vs LO Frequency



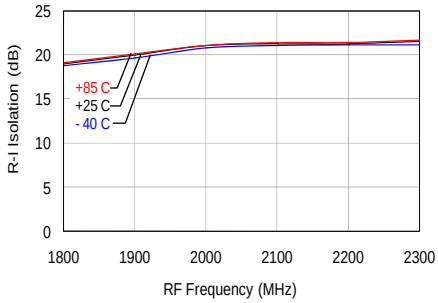
L-R Isolation vs LO Frequency
Referenced with LO = 0 dBm



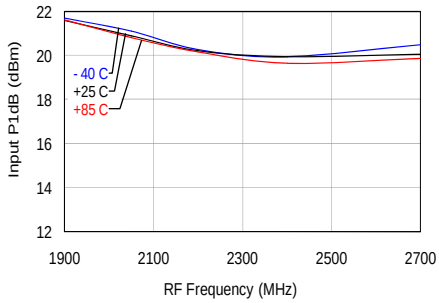
L-I Isolation vs LO Frequency
Referenced with LO = 0 dBm



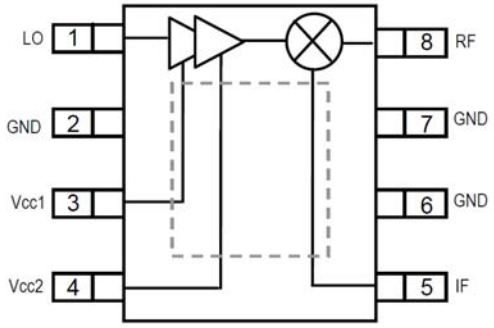
R-I Isolation vs RF Frequency



Input P1dB vs RF Frequency
IF = 100 MHz, low-side LO at 0 dBm



Pin Description



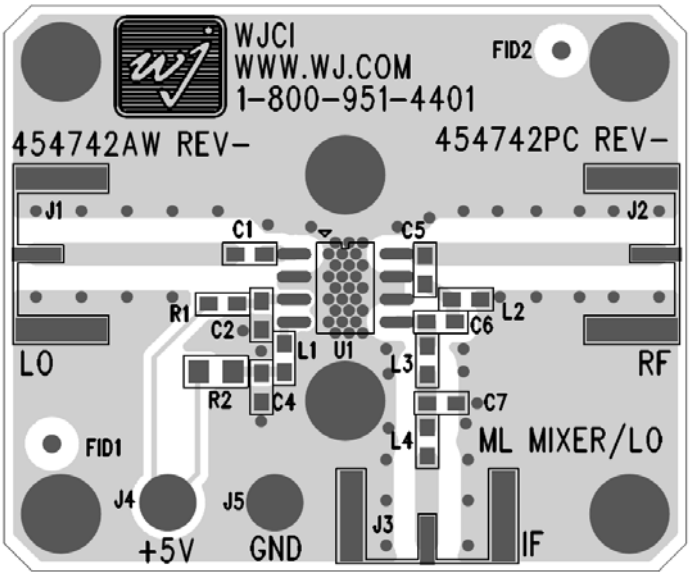
Pin	Symbol	Description
1	LO	Local Oscillator Frequency
2, 6, 7	GND	No internal connection. Provide an isolated or grounded solder pad for mounting integrity.
3	Vcc1	Supply voltage. An external bypass capacitor should be used at this pin and then connected to the 5V supply.
4	Vcc2	Supply voltage. An external bypass capacitor should be used at this pin and then connected to the 5V supply.
5	IF	Intermediate Frequency
8	RF	Radio Frequency
Backside Paddle	GND	Provides the ground path for the DC and RF for the integrated LO amplifier in the device. It also supplies the thermal path for the heat generated by the component. Ground / thermal vias are critical for device performance , see section on Mounting Configuration

Applications Information

PC Board Layout

Circuit Board Material: .028" FR4, 2 layers, 1 oz copper.

The pad pattern shown has been developed and tested for optimized assembly at TriQuint Semiconductor. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.



For further technical information, Refer to http://www.triquint.com/prodserv/more_info/default.aspx?prod_id=ML501

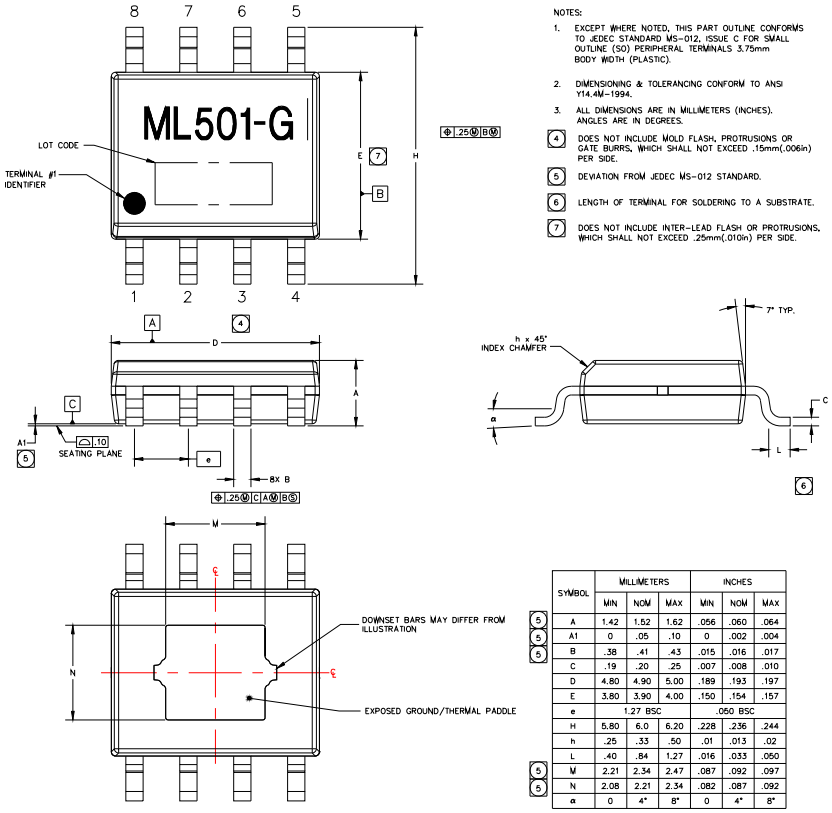
Mechanical Information

Package Information and Dimensions

This package is lead-free/green/RoHS-compliant. The plating material on the leads is NiPdAu. It is compatible with both lead-free (maximum 260 °C reflow temperature) and lead (maximum 245 °C reflow temperature) soldering processes.

The component will be lasermarked with a "ML501-G" product label with an alphanumeric lot code on the top surface of the package.

Tape and reel specifications for this part will be located on the website in the "Application Notes" section.



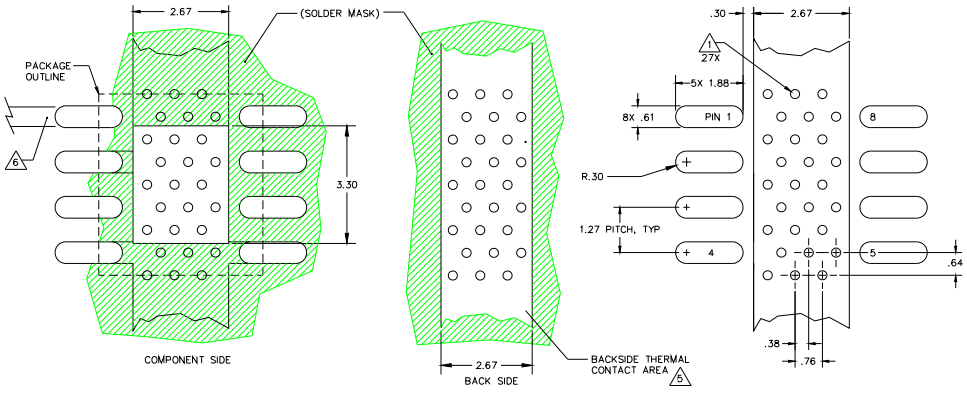
NOTES:

1. EXCEPT WHERE NOTED, THIS PART OUTLINE CONFORMS TO JEDEC STANDARD MS-012, ISSUE C FOR SMALL OUTLINE (SO) PERIPHERAL TERMINALS 3.75mm BODY WIDTH (PLASTIC).
2. DIMENSIONING & TOLERANCING CONFORM TO ANSI Y14.4M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES). ANGLES ARE IN DEGREES.
4. DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS, WHICH SHALL NOT EXCEED .15mm(.006in) PER SIDE.
5. DEVIATION FROM JEDEC MS-012 STANDARD.
6. LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
7. DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSIONS, WHICH SHALL NOT EXCEED .25mm(.010in) PER SIDE.

SYMBOL	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.42	1.52	1.62	.056	.060	.064
A1	0	.05	.10	0	.002	.004
B	.38	.41	.43	.015	.016	.017
C	.19	.20	.25	.007	.008	.010
D	4.80	4.90	5.00	.189	.193	.197
E	3.80	3.90	4.00	.150	.154	.157
e	1.27 BSC			.050 BSC		
H	5.80	6.0	6.20	.228	.236	.244
h	.25	.33	.50	.01	.013	.02
L	.40	.84	1.27	.016	.033	.050
M	2.21	2.34	2.47	.087	.092	.097
N	2.08	2.21	2.34	.082	.087	.092
α	0	4°	8°	0	4°	8°

Mounting Configuration

All dimensions are in millimeters (inches). Angles are in degrees.



1. 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").
2. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
3. Mounting screws can be added near the part to fasten the board to a heatsink. Ensure that the ground / thermal via region contacts the heatsink.
4. All dimensions are in millimeters (inches). Angles are in degrees.
5. Do not put solder mask on the backside of the PC board in the region where the board contacts the heatsink.
6. RF trace width depends upon the PC board material and construction.
7. Use 1 oz. Copper minimum.

Product Compliance Information

ESD Information

Caution! ESD-Sensitive Device

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

ESD Rating:	Class IV
Value:	Passes /1000V
Test:	Charged Device Model (CDM)
Standard:	JEDEC Standard JESD22-C101

MSL Rating

Level 2 at +260 °C convection reflow
JEDEC Standard J-STD-020

Solderability

Compatible with the latest version of J-STD-020, Lead free solder, 260°

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, and information about TriQuint:

Web: www.triquint.com **Tel:** +1.503.615.9000
Email: info-sales@tqs.com **Fax:** +1.503.615.8902

For technical questions and application information:

Email: sjcapplications.engineering@tqs.com

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