

### Applications

- Quad-Band GSM850 / GSM900 / DCS / PCS
- GSM / EDGE / WEDGE Handsets
- GSM / EDGE / WEDGE Wireless Cards

### Product Features

- Digital Control Interface
- Low Current At Backed-Off Power Levels
- Input Power Controlled – GMSK & 8PSK
- LB Has 4 modes – HP, MP, LP, & ULP
- HB Has 3 modes – HP, LP, & ULP
- HBT/PHEMT High Efficiency Technology
- High–Power Linearity
- Standard LB & HB Paths
- 50  $\Omega$  Input & Output Impedance
- Halogen-Free
- 11 Pin Package

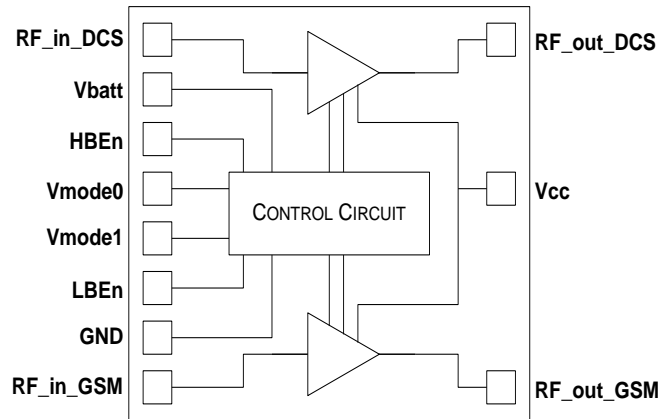
### General Description

The TQM7M5013 is an input power controlled, multiple gain state, quad band, GSM/EDGE PAM designed for use with the Qualcomm QTR/RTR8600 WEDGE solutions. This highly efficient PAM significantly improves talk-time while still providing an easy to use solution in a small form factor. The PA output power is controlled by the input power coming from the transceiver in both GMSK and 8PSK modes and so does not require a Vramp input. Additionally, the small 5 mm x 5 mm package requires minimum board space and allows for high levels of phone integration.

### GSMK Electrical Specifications

Parameter	Typical Value				Units
	GSM850	GSM900	DCS	PCS	
HPM P <sub>out</sub>	35.3	35	33.3	33	dBm
MPM P <sub>out</sub>	31.8	32.2			
LPM P <sub>out</sub>	22	22	22.8	22	
ULPM P <sub>out</sub>	20.5	21	21.5	20	
HPM PAE	52	55	55	52	%
MPM PAE	43	45			
LPM PAE	27	31	25	19	
ULPM PAE	29	32	23	16	

### Functional Block Diagram



### Pin Configuration

Pin No.	Label	Pin No.	Label
1	RF_in_DCS	7	GND
2	Vbatt	8	RF_in_GSM
3	HBEn	9	RF_out_GSM
4	Vmode0	10	Vcc
5	Vmode1	11	RF_out_DCS
6	LBEn	Backside Pad	GND

### 8PSK Electrical Specifications

Parameter	Typical Value				Units
	GSM850	GSM900	DCS	PCS	
RMS Power	29	29	28	28	dBm

### Ordering Information

Part No.	Description
TQM7M5013	Quad-Band EDGE PAM

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

## Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Positive Supply Voltage	V <sub>Batt</sub> , V <sub>CC</sub>	-0.5 to +5.5	V
Control Voltages (Enable, V <sub>MODE0</sub> , V <sub>MODE1</sub> )	LB_EN, HB_EN, V <sub>MODE0</sub> , V <sub>MODE1</sub>	-0.5 to +5.5	V
Input RF Power	P <sub>IN</sub>	+15	dBm
Positive Supply Voltage	V <sub>CC</sub> , connects to 2 <sup>nd</sup> stage collectors	-0.5 to +5.5	V
Storage Temperature	T <sub>storage</sub>	-40 to +150	°C
Operating Case Temperature (Ambient)	T <sub>case</sub>	-25 to +90	°C
Output Load		10:1	VSWR
Maximum Input Power	P <sub>in</sub>	+15	dBm
Peak Reflow Temperature	T <sub>max</sub>	260	°C
Duty Cycle At Maximum Power	δ	50	%

**Notes:**

1. Stresses greater than the listed absolute maximum ratings may cause permanent and functional damage to the device.
2. Exposure exceeding absolute maximum rating conditions for extended periods may affect device reliability.

## Recommended Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Battery voltage (V <sub>BATT</sub> )		+3.0	+3.5	+4.8	V
V <sub>MODE0</sub> , V <sub>MODE1</sub> (digital control) LB_EN, HB_EN	Low	+0		+0.5	V
	High	+1.35		+3.1	V
	Logic Line Current			+0.1	mA
Rise Time	From P <sub>out</sub> = -30 dBm to P <sub>out</sub> = P <sub>max</sub>		0.5		µs
Fall Time	From P <sub>out</sub> = -30 dBm to P <sub>out</sub> = P <sub>max</sub>		0.5		µs
Operating Case Temperature		-25		+90	°C
LB TX Frequency Range GSM850		824		849	MHz
LB TX Frequency Range GSM900		880		915	MHz
HB TX Frequency Range GSM1800		1710		1785	MHz
HB TX Frequency Range GSM1900		1850		1910	MHz

### Control Truth Table

Mode of Operation	LB_EN	HB_EN	VMode0	Vmode1
Powerdown	Low	Low	Low	Low
Low Band – High-power mode (HPM)	High	Low	Low	Low
Low Band – Medium Power mode (MPM)	High	Low	Low	High
Low Band – Low-power mode (LPM)	High	Low	High	Low
Low Band – Ultra-Low-power mode (ULPM)	High	Low	High	High
High Band – High-power mode (HPM)	Low	High	Low	Low
High Band – Low-power mode (LPM)	Low	High	High	Low
High Band – Ultra-Low-power mode (ULPM)	Low	High	High	High

Notes:

- RF functionality will be disabled for LB or HB when the respective EN pin is low. This is true regardless of the voltages applied to Vmode0 and Vmode1. However, leakage current will be minimized when Vmode voltages are low.

### Recommended GSM Power Levels for Each Mode of Operation <sup>(1)</sup>

GMSK Mode	PCL	Output Power Range
Low Band – High-power mode (HPM)	5 – 6	30.5 dBm < Pout ≤ Psat
Low Band – Medium Power mode (MPM)	7 – 13	18.5 dBm < Pout ≤ 30.5 dBm
Low Band – Low-power mode (LPM)	14 – 15	12.5 dBm < Pout ≤ 18.5 dBm
Low Band – Ultra-Low-power mode (ULPM)	16 – 19	Pout ≤ 12.5 dBm
High Band – High-power mode (HPM)	0 – 6	18.5 dBm ≤ Pout ≤ Psat
High Band – Low-power mode (LPM)	7 – 9	12.5 dBm ≤ Pout ≤ 18.5 dBm
High Band – Ultra-Low-power mode (ULPM)	10 – 15	Pout ≤ 12.5 dBm

Notes:

- Use of ULPM mode is optional. LPM can support the ULPM PCLs.

### Recommended EDGE Power Levels for Each Mode of Operation <sup>(1)</sup>

8PSK Mode	PCL	Output Power Range
Low Band – High-power mode (HPM)	8 – 9	23 dBm < Pout ≤ 29 dBm
Low Band – Medium Power mode (MPM)	10 – 14	13 dBm < Pout ≤ 23 dBm
Low Band – Low-power mode (LPM)	15 – 19	Pout ≤ 13 dBm
High Band – High-power mode (HPM)	2 – 8	14 dBm ≤ Pout ≤ 28 dBm
High Band – Low-power mode (LPM)	9 – 15	Pout ≤ 14 dBm

Notes:

- Battery voltage operating range for EDGE operation is +3.2 V to +4.2 V.

### Electrical Specifications: GSM 850 / GSM 900 Low-Band

Test conditions unless otherwise noted: Temp.=+25 °C, V<sub>CC</sub>=V<sub>BATT</sub>= +3.8 V, Pulse Width= 1145 μs, Duty Cycle= 25 %, LB\_EN= High & Z<sub>in</sub>/Z<sub>out</sub>= 50 Ω

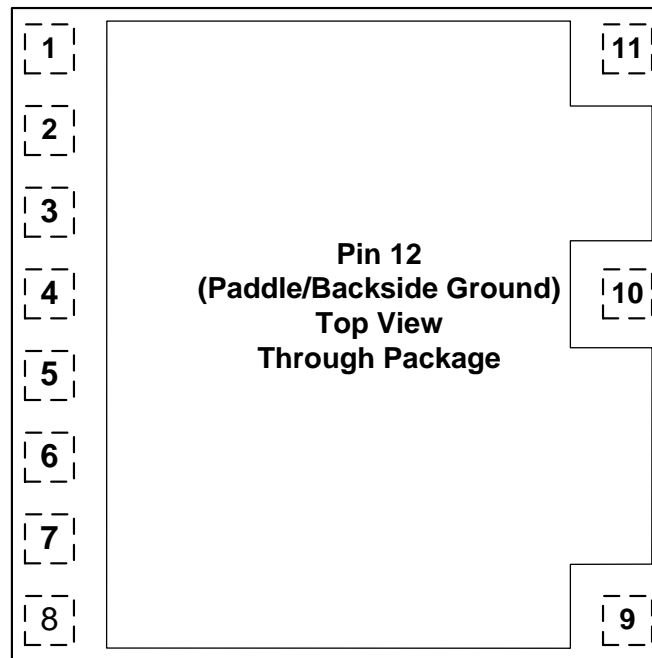
Parameter	Conditions	Min	Typ	Max	Units		
Operating Frequency Range	GSM 850	824		849	MHz		
	GSM 900	880		915			
Maximum Output Power	GMSK HPM	+34.2	+35		dBm		
	GMSK HPM (degraded power)	+32.2					
	GMSK MPM	+30.5	+32				
	8PSK (RMS power)	+29					
	GMSK LPM	+20	+22				
	GMSK ULPM	+16	+21				
Power Added Efficiency (PAE)	GMSK HPM, Po = Psat_HPM	44	53		%		
	GMSK MPM, Po = Psat_MPM	36	44				
	GMSK LPM, Po = Psat_LPM	19	29				
	GMSK ULPM, Po = Psat_ULPM	21	29				
	8PSK HPM, Po = +29dBm	20	28				
Gain	High-power mode Po = +34.2 dBm	25.5	29	33	dB		
	Medium Power mode Po = +30.5 dBm	22.5	26	30			
	Low-power mode Po = +16 dBm	13	17	20			
	Ultra Low Power mode Po = +8 dBm	10	13	17			
Gain Variations – Tc	-25 ≤ Tc ≤ 90 °C (all modes)			±1.5	dB		
Gain Variations – Vbatt	+3.2 ≤ Vbatt ≤ +4.2 V (all modes)			±1	dB		
EDGE ACPR	MPM; Po ≤ +23 dBm LPM; Po ≤ +16 dBm	±400 kHz		-60	-58	dBc/ 30 kHz	
		±600 kHz		-70	-65		
		±400 kHz		-45	-40	dBm/ 30 kHz	
		±600 kHz		-60	-55		
EDGE EVM	All modes			1.7	3	%	
Rx Band noise	Rx=869-894 MHz			-90	-86	dBm/ 100 kHz	
	Rx=925-935 MHz			-89	-79		
	Rx=935-960 MHz			-90	-86		
Harmonics	Po ≤ +34.2 dBm	2fo		-23	-10	dBm	
		3fo-5fo		-30	-15		
Forward Isolation	LB_EN = low, pin = -10 dBm			-34	-30	dBm	
Cross Isolation	LB_EN = high	Spurious at HB output			-27	-20	dBm
		LB fundamental on HB output			-10	+2	
Stability	Load VSWR ≤ 8:1 in band, all phases				-36	dBm	
Ruggedness	Pout ≤ +32.0 dBm, +3.0 V ≤ Vbatt ≤ +4.8 V, all phases		10:1			VSWR	
Input Impedance				1.5:1	2.5:1	VSWR	

## Electrical Specifications: GSM 1800/GSM 1900 High – Band

Test conditions unless otherwise noted: Temp.=+25 °C, V<sub>CC</sub>=V<sub>BATT</sub>= +3.8 V, Pulse Width= 1145 μs, Duty Cycle= 25 %, HB\_EN= High & Z<sub>in</sub>/Z<sub>out</sub>= 50 Ω

Parameter	Conditions	Min	Typ	Max	Units	
Operating Frequency Range	DCS 1800	1710		1785	MHz	
	PCS 1900	1850		1910		
Maximum Output Power	GMSK High Power Mode	+32.2	+33		dBm	
	GMSK HPM (degraded power)	+30.0				
	8PSK (RMS power)	+28				
	Low Power Mode	+19	+22.5			
	Ultra Low Power Mode	+16	+20			
Power Added Efficiency (PAE)	GMSK HPM, Po = Psat_HPM	44	53		%	
	GMSK LPM, Po = Psat_LPM	8	23			
	GMSK ULPM, Po = Psat_ULPM	5	20			
	8PSK HPM, Po = 28 dBm	22	28			
Gain	High Power Mode Po = +32.0 dBm	26.5	29	32	dB	
	Low Power Mode Po = +16 dBm	13	17	21		
	Ultra Low Power mode, Po = +8 dBm	10	13	18		
Gain variations – Tc	-25 ≤ Tc ≤ 90 °C		±1.5		dB	
Gain variations – Vbatt	+3.2 ≤ Vbatt ≤ +4.2 V		±1		dB	
EDGE ACPR	MPM; Po ≤ +22 dBm LPM; Po ≤ +16 dBm	±400 kHz		-60	-58	dBc/ 30 kHz
		±600 kHz		-73	-65	
		±400 kHz		-45	-40	dBm/ 30 kHz
		±600 kHz		-65	-60	
EDGE EVM	All modes		1.7	3	%	
Rx band Noise	Rx=1805 – 1880 MHz		-85	-83	dBm/ 100 kHz	
	Rx=1930 – 1990 MHz		-85	-83		
Harmonics	Po ≤ 32.0 dBm	2fo		-30	-10	dBm
		3fo – 5fo		-30	-15	
Forward Isolation	HB_EN = low, pin = -10 dBm		-43	-30	dBm	
Cross Isolation	HB_EN = high	Spurious at HB output		-36	-20	dBm
		HB fundamental on LB output		-12	+5	
Stability	Load VSWR ≤ 8:1 in band, all phases			-36	dBm	
Ruggedness	Pout ≤ +32.0 dBm, +3.0 V ≤ Vbatt ≤ +4.8 V, all phases	10:1			VSWR	
Input Impedance			1.5:1	2.5:1	VSWR	

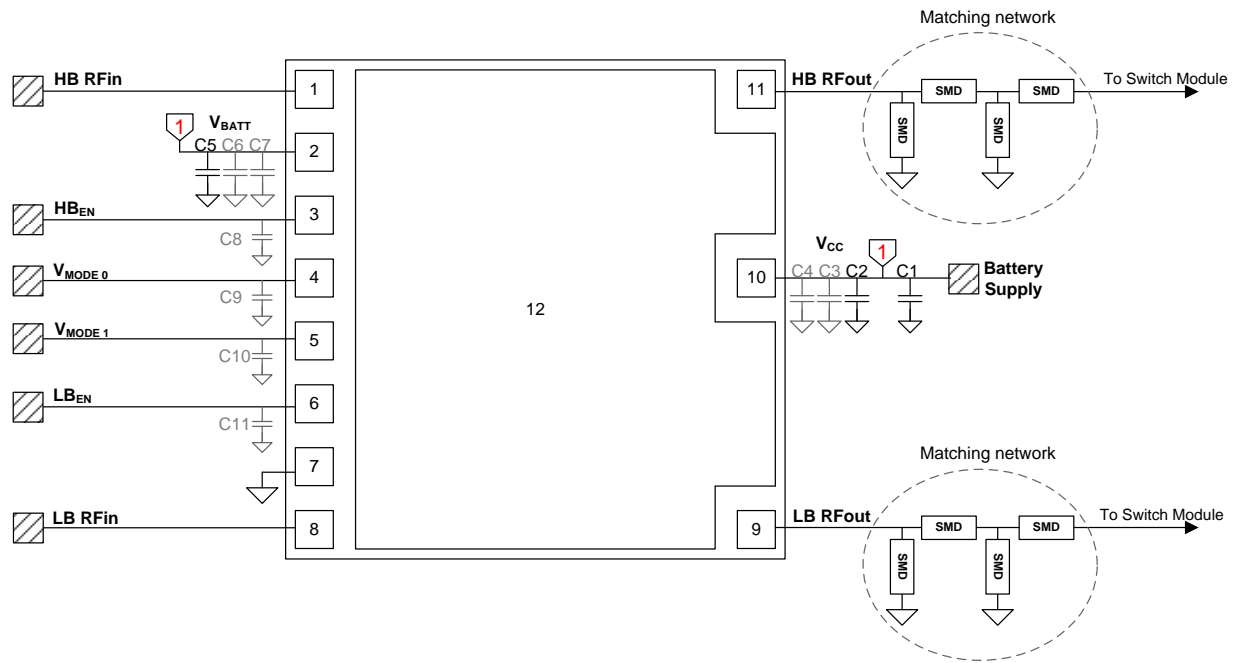
## Pin Configuration and Description



TOP VIEW

Pin No.	Label	Description
1	RF_IN_DCS	RF input for DCS/PCS amplifier
2	Vbatt	Battery Voltage supply to module and Vcc1
3	HB_EN	Enables HB (DCS/PCS) amplifier
4	Vmode0	Logic input to set amplifier mode
5	Vmode1	Logic input to set amplifier mode
6	LB_EN	Enables LB (GSM) amplifier
7	GND	GND pin
8	RF_IN_GSM	RF input for GSM850/900 amplifier
9	RF_OUT_GSM	RF output for GSM850/900 amplifier
10	VCC	Voltage supply to Vcc2 (QCOM refers to this as pin 13)
11	RF_OUT_DCS	RF output for DCS/PCS amplifier (QCOM refers to this as pin 16)
12	GND	Ground Paddle (See application note pages 7-10)

### Application Circuit Diagram



TOP VIEW

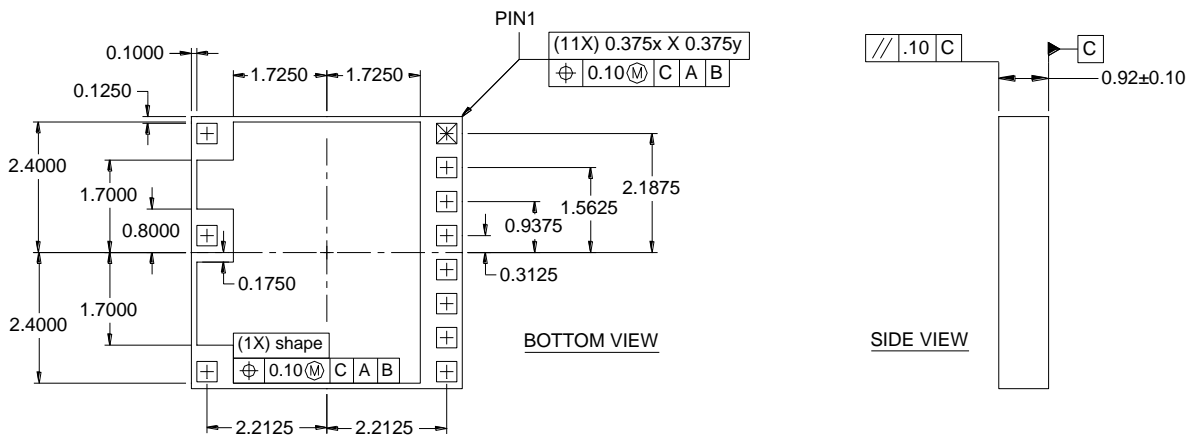
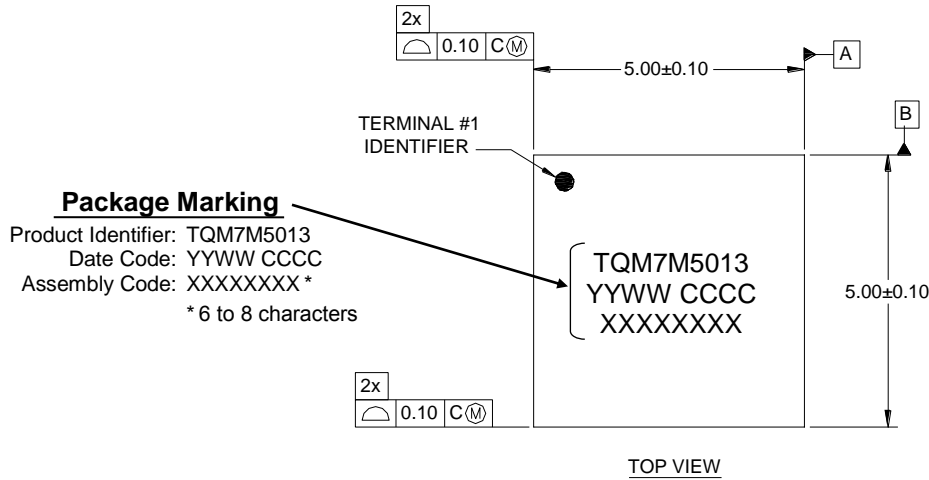
### Bill of Material – TQM7M5013 Application Circuit

Component	Reference Designator	Value	Recommended Size	Notes
Capacitor	C1	22 uF <sup>(1, 4)</sup>	>= 0603	V <sub>CC</sub> , V <sub>BATT</sub> voltage drop regulation.
Capacitor	C2, C5	0.01 uF <sup>(2)</sup>	0402	V <sub>CC</sub> , V <sub>BATT</sub> bypass.
Capacitor	C3, C6	15 pF <sup>(2, 3)</sup>	0402	V <sub>CC</sub> , V <sub>BATT</sub> RF bypass for DCS/PCS
Capacitor	C4, C7	56 pF <sup>(2, 3)</sup>	0402	V <sub>CC</sub> , V <sub>BATT</sub> RF bypass for GSM850/900
Capacitor	C8-C11	1 nF <sup>(2, 3)</sup>	0402 or 0201	Logic line bypassing
Matching Network SMD	SMD	Application Specific <sup>(5)</sup>	0402 or 0201	Please make provisions for all four components as shown

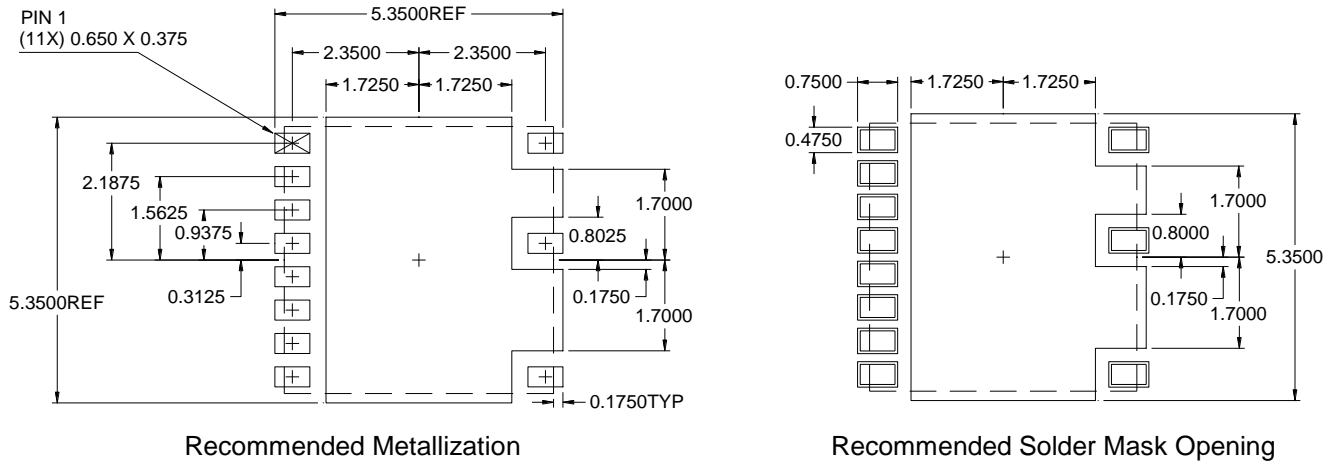
Notes:

1. Please refer to your transceiver vendor's documentation for additional phone level bypassing recommendations.
2. The effectiveness of an RF bypassing capacitor is determined by the frequency at which it is resonant. Because a component's resonance is a function of its size, value, location, and grounding, the recommended values may need to be adjusted. Please place bypass caps as close to their respective PA pins as possible.
3. Please place all bypass caps as shown for initial builds.
4. V<sub>batt</sub> line supplies driver amplifier stage. V<sub>cc</sub> line supplies PA stage. V<sub>cc</sub> current is ~ 10x V<sub>batt</sub> current. Please place 22uF cap close to V<sub>cc</sub>.
5. Component values will vary depending on performance requirements, switch module, and layout. TriQuint Field and Factory Application Engineers are available to assist.
6. GND pin 7 should be a good RF ground. Use a via to ground under pin 7.

## Package Marking and Dimensions



## Recommended Land Pattern

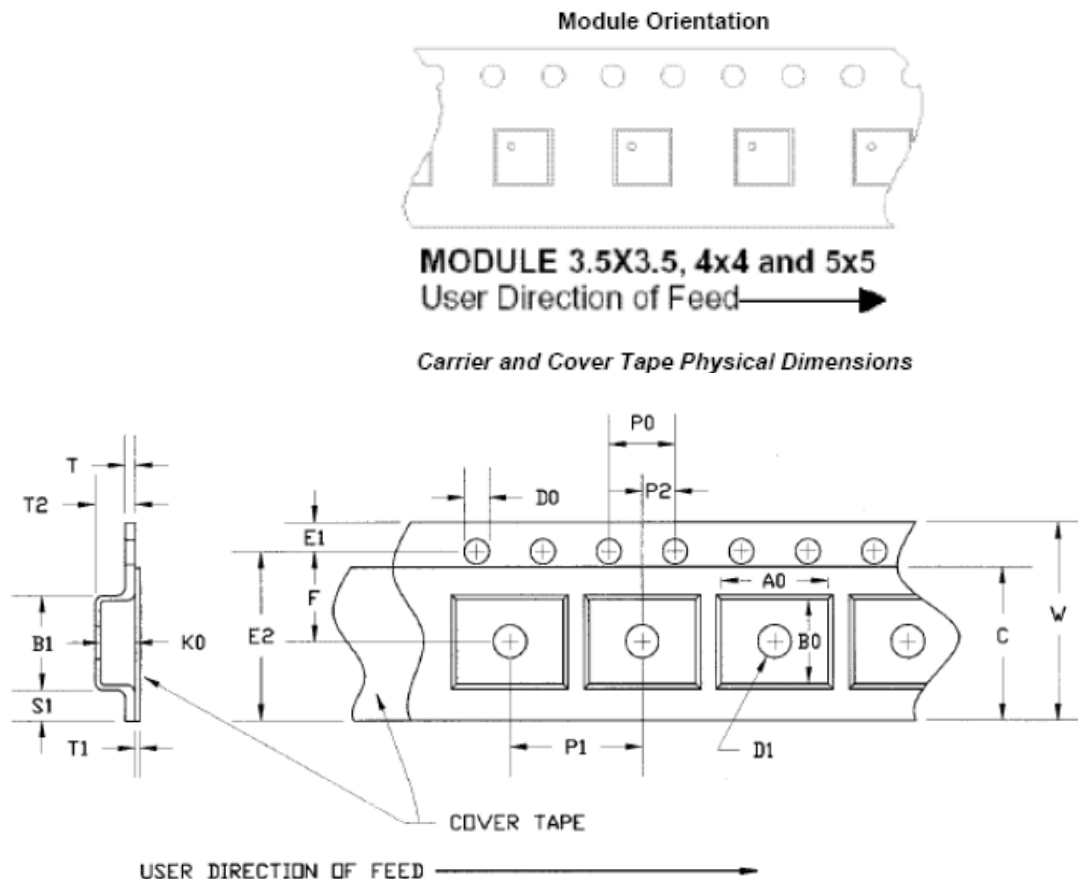




### Tape and Reel Information – Carrier Tape

Tape and reel specifications for this part are also available on the TriQuint website.  
 Standard T/R size = 2500 pieces on a 13" reel.

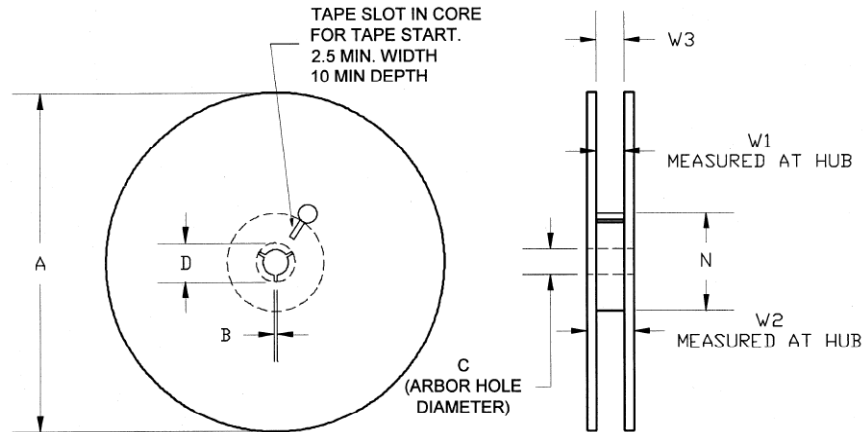
\*Provided as informational only. Please request TriQuint PKG.075 for controlling documentation.



Feature	Feature	Symbol	Size (in)	Size (mm)
Cavity	Bottom Hole Diameter	D1	0.059	1.50
	Diameter	D0	0.059	1.50
Perforation	Pitch	P0	1.57	4.00
	Position	E1	0.069	1.75
Carrier Tape	Thickness	T	0.012	0.30
Cover Tape	Thickness	T1	0.002	0.056

## Tape and Reel Information – Reel Dimensions

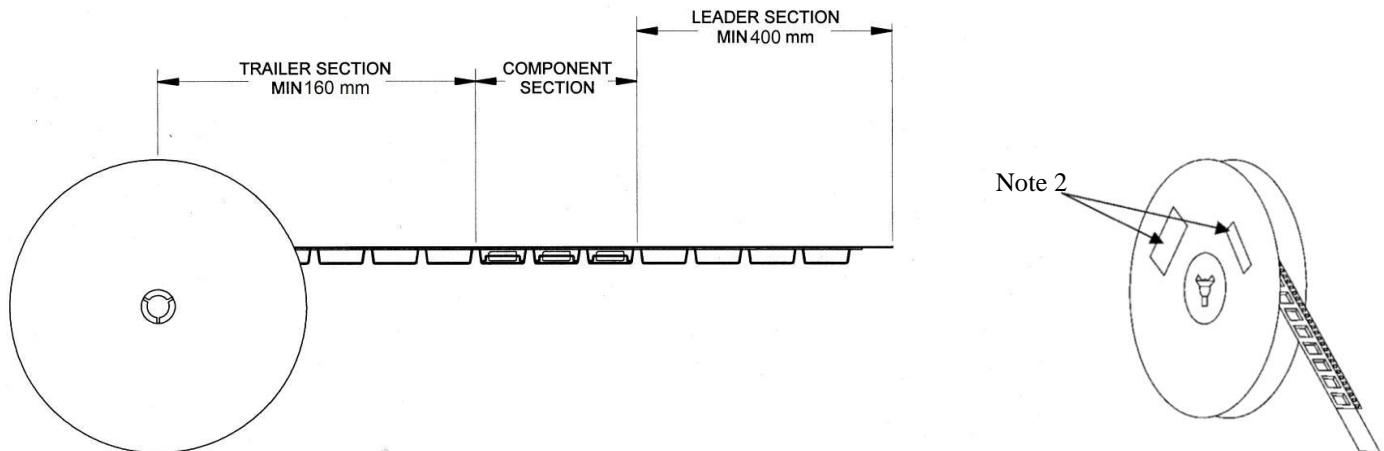
Packaging reels are used to prevent damage to devices during shipping and storage, loaded carrier tape is typically wound onto a plastic take-up reel. The reel size is 13" diameter. The reels are made from high-impact injection-molded polystyrene (HIPS), which offers mechanical and ESD protection to packaged devices.



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	12.992	330.0
	Thickness	W2	0.717	18.2
	Space Between Flange	W1	0.504	12.8
Hub	Outer Diameter	N	4.016	102.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	0.795	20.2

## Tape and Reel Information – Tape Length and Label Placement

Tape and reel specifications for this part are also available on the TriQuint website. Standard T/R size = 2500 pieces on a 13" reel.



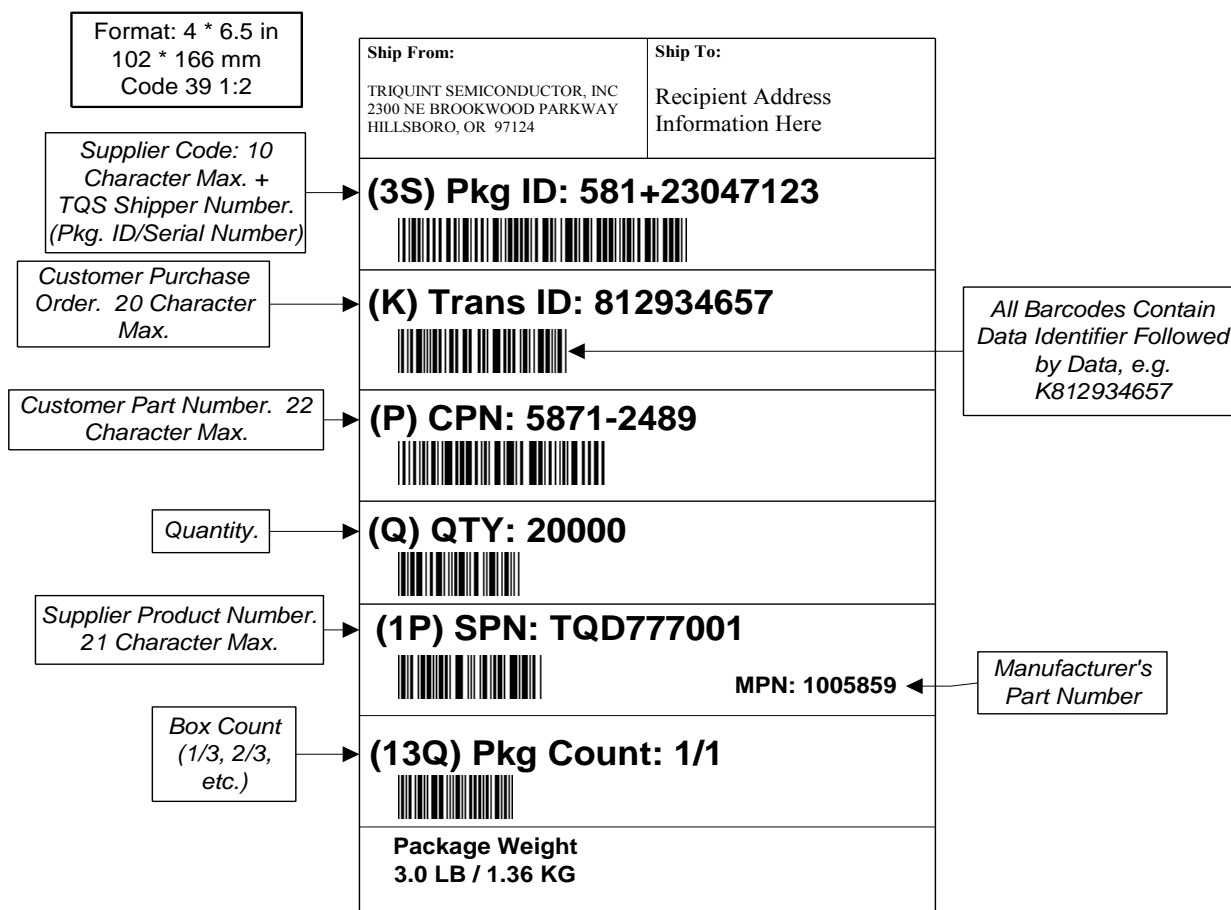
**Notes:**

1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
2. Labels are placed on the flange opposite the sprockets in the carrier tape.

### Shipment Box & Label Description

Tape & Reels will be packaged in a dry-pack bag and then in a shipment box. The box dimensions will depend on the number of reels shipped in each box and are noted in the table below. The box label and a description of each item on the label are also shown below.

13 Inch x 16 mm – Drypack		
Box Size	Reel Qty/Box	Empty Box Wt w/ Packing
15 x 15 x 7	3	2
18 x 15 x 11	5	2.36
17 x 16 x 17	9	2.76



## Product Compliance Information

### ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: Class 2  
Value:  $\geq 2000$  V to  $< 4000$  V  
Test: Human Body Model (HBM)  
Standard: ESDA/JEDEC Standard JS-001-2012

### MSL Rating

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

### Solderability

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

### 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<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) 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](http://www.triquint.com)  
Email: [info-sales@triquint.com](mailto:info-sales@triquint.com)

Tel: +1.503.615.9000  
Fax: +1.503.615.8902

## Important Notice

The information contained herein is believed to be reliable. TriQuint makes no warranties regarding the information contained herein. TriQuint assumes no responsibility or liability whatsoever for any of the information contained herein. TriQuint 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 TriQuint 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.

TriQuint 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.