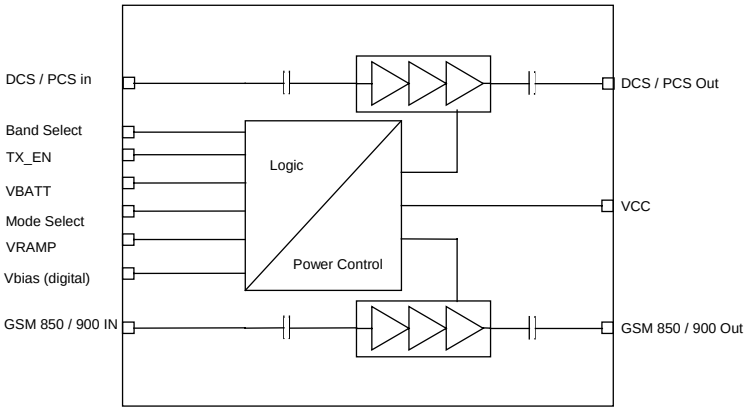
TQM 7M5001

Advance Data Sheet

GSM/EDGE Multi-mode Power Amplifier Module

Functional Block Diagram



Product Description

The TQM 7M5001 is an extremely small (7x7x1.1mm^3) multi-mode power amplifier module for GSM/EDGE applications. This module has been optimized for high EDGE efficiency and EDGE power class E2 operation while maintaining high GSM/GPRS efficiency. Two EDGE quiescent current states are provided to minimize current consumption during backed-off power settings. During EDGE mode V_{RAMP} is disabled eliminating the need to apply a constant voltage for proper operation.

The module incorporates two highly-integrated InGaP power amplifier die with a CMOS controller. The CMOS controller implements a fully integrated closed-loop power control within the module for GSM Operation. This eliminates the need for any external couplers, power detectors, current sensing etc., to assure the output power level. The latter is set directly from the V_{ramp} input from the DAC. The module has Tx enable, band select, mode (EDGE or GSM) inputs. Module construction is a low-profile over-molded land-grid array on laminate.

Electrical Specifications

Parameter	850 Band			900 Band			DCS / PCS			Units
	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
GSM Pout	34.5	35.5		34.5	35.5		32.0	33		dBm
Efficiency	43	48		46	52		43/46	48/52		%
Pin	2	5	8	2	5	8	2	5	8	dBm
EDGE Pout	28.5	29		28.5	29		28	28.5		dBm
Efficiency	20	23		20	23		20	25		%
Gain	27.5	29.0	30.5	27.5	29.0	30.5	34	35.5	37	dB
ACPR (400KHz)		62	58		62	58		62	58	dBc

Features

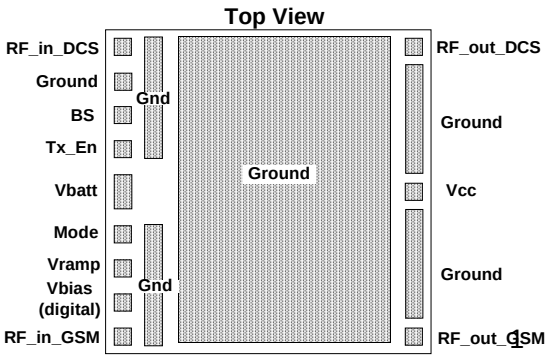
- Very compact size – 7×7×1.1 mm^3.
- High GSM efficiency – GSM 850 48%, GSM900 52%, DCS 48%, PCS 52%.
- High EDGE efficiency – GSM 850 23%, GSM 900 23%, DCS 25%, PCS 25%
- Low Quiescent Current Mode for EDGE Pout <= 18.5dBm (low-band) & <= 18dBm (high-band)
- V_{RAMP} input is “don’t care” during 8PSK mode
- Positive supply voltage – 3.0 to 4.5 V
- 50 Ω input and output impedances
- GPRS class 12.
- CMOS band select and internal closed-loop power control for GSM Operation.
- High-reliability InGaP technology.
- Ruggedness 10:1
- No external Vref Required

Applications

- *GSM/EDGE handsets*
- *GSM/EDGE wireless cards & data links*

Package Style

Package Size: LGA 7 x 7 x 1.1 mm



Advance Data Sheet: Subject to change without notice

For additional information and latest specifications, see our website: www.triquint.com

Revision C, June 8, 2005

GSM/EDGE Multi-mode Power Amplifier Module

Absolute Maximum Ratings

Symbol	Parameter	Absolute Maximum Value	Units
V_{BATT}	Supply Voltage	-0.5 to 6.0	VDC
I_{BATT}	DC Supply Current	2.5	A
V_{RAMP}	Power Control Voltage	-0.5 to 3.0	VDC
V_{MODE}	Mode Select Voltage	-0.5 to 3.0	VDC
V_{TX_EN}	TX Enable Voltage	-0.5 to 3.0	VDC
V_{BS}	Band Select Voltage	-0.5 to 3.0	VDC
V_{BIAS}	Low-Power Mode (Low quiescent current) Voltage	-0.5 to 3.0	VDC
δ	Duty Cycle at Max. Power	50	%
VSWR	Output Load	20:1	
T_C	Case Temperature, Operating	-30 to +85	°C
T_{STG}	Storage Temperature	-55 to +150	°C
P_{IN}	Input Power	12	dBm

Note: The part may not survive all maximums applied simultaneously; The amplifier will survive over the full range specified for any individual input, while other parameters are nominal and with no RF input.

GSM/EDGE Multi-mode Power Amplifier Module

Operating Parameters

Parameter		Conditions	Min.	Typ/Nom	Max.	Units
Supply Voltage- V_{BATT}			3	3.5	4.5	V
Supply Current- I_{BATT}				2	5.0	A
Band Select Voltage	850/900 MHz	V_{BS}- L	0		0.5	Vdc
		I_{BS}- L			1	µA
	DCS/PCS	V_{BS}- H	1.25		3.0	Vdc
		I_{BS}- H	0		10	µA
TX Enable Input	Disenabled	V_{TX_EN}- L	0		0.5	Vdc
		I_{TX_EN}- L			1	µA
	Enabled	V_{TX_EN}- H	1.25		3.0	Vdc
		I_{TX_EN}- H	0		10	µA
Mode Select Input	GSM	V_{MODE}- L	0		0.5	Vdc
		I_{MODE}- L			1	µA
	EDGE	V_{MODE}- H	1.25		3.0	Vdc
		I_{MODE}- H	0		10	µA
Bias Control	High Power	V_{BIAS}- L	0		0.5	Vdc
(EDGE Mode Only)		I_{BIAS}- L			1	µA
	Lower Power Mode	V_{BIAS}- H	1.25		3.0	Vdc
		I_{BIAS}- H	0		10	µA
V_{ramp} Input Range		$V_{BAT\_MIN} \le V_{BAT} \le V_{BAT\_MAX}$, $T_{C\text{-}MIN} \le Tc \le T_{C\text{-}MAX}$	0.2		1.6	Vdc
V_{ramp} Input Current					1	µA
Vbatt Leakage Current		TX_EN = L		1	10	µA
Input and Output Impedance				50		Ω

GSM/EDGE Multi-mode Power Amplifier Module

GSM850/900 General Characteristics (Applies to GMSK and 8PSK Modes)

Standard Conditions: V_{BATT}=3.5V, TX_EN = H, BS = L, Mode = L or H, T_C = 25°C, Duty Cycle = 25%.

Parameter	Conditions	Min.	Typ/Nom	Max.	Units
Input VSWR	Pin_min ≤ Pin ≤ Pin_max			2.5:1	
Forward Isolation- Iso	V_{TX_EN}- L, $P_{in} \le P_{in\_max}$, $V_{RAMP} \le V_{RAMP\_MIN}$			-30	dBm
Cross Isolation	2f, 3f at high band output			-20	dBm
RF Power turn-on time- RF_{TON}	V_{TX_EN} = Logic Low to Logic High			1	µS
RF Power turn-off time- RF_{TOFF}	V_{TX_EN} = Logic High to Logic Low			1	µS
Mode Select Transition Time	Mode = Logic High to Logic Low / Logic Low to Logic High			1	µS
Vbias Transition Time	Vbias = Logic High to Logic Low / Logic High to Logic Low			1	µS
Stability	Spurious < -36 dBm. $V_{RAMP} \le 2.2$ V	8:1			
Ruggedness	No permanent degradation. $V_{RAMP} \le 2.2$ V	10:1			

GSM850/GSM900 GMSK Mode Characteristics

Standard Conditions: V_{BATT}=3.5V, P_{in}=5 dBm, TX_EN = H, BS = L, Mode = L, T_C = 25°C, Duty Cycle = 25%, V_{RAMP}=1.6V

Parameter		Conditions	Min.	Typ/Nom	Max.	Units
Frequency Range – f	GSM850		824		849	MHz
	GSM900		880		915	MHz
Input Power for Pout max.- P_{in}			2	5	8	dBm
Output Power- P_{out}			34.5	35.5		dBm
Output Power Degradation		V_{batt}=3.0V, $P_{in}=P_{in\ min}$, $T_{min} \le T_C \le T_{max}$	32.0			dBm
PAE – η	GSM 850	V_{RAMP} = 1.6 VDC	43	48		%
	GSM 900	V_{RAMP} = 1.6 VDC	46	52		%
Power Control Voltage- V_{RAMP}		$V_{BAT\_MIN} \le V_{BAT} \le V_{BAT\_MAX}$	0.2		1.6	V
Power Control Range		$V_{RAMP\_MIN} \le V_{RAMP} \le V_{RAMP\_MAX}$	52			dB
RX Noise Power:	RBW = 100 kHz	Pout ≤ 34.5 dBm, V_{BAT} = 3.5V, T_C = 25°C, Pin = +5 dBm				
	869 to 894 MHz	fo=849MHz		-87	-85	dBm
	925 to 935MHz	fo=915MHz		-80	-76	dBm
	935 to 960MHz	fo=915MHz		-87	-85	dBm
RX Noise Power:	RBW = 100 kHz	Pout ≤ Pout_max, $V_{BAT\_MIN} \le V_{BAT} \le V_{BAT\_MAX}$, $T_{min} \le T_C \le T_{max}$				
	869 to 894 MHz	fo=849MHz		-85	-83	dBm
	925 to 935MHz	fo=915MHz		-79	-74	dBm
	935 to 960MHz	fo=915MHz		-85	-83	dBm
Harmonics	$2f_0$	Pout ≤ Pout_max, $V_{BAT\_MIN} \le V_{BAT} \le V_{BAT\_MAX}$, $T_{min} \le T_C \le T_{max}$			-10	dBm
	$3f_0$				-15	dBm
	$>3f_0$				-20	dBm

GSM/EDGE Multi-mode Power Amplifier Module

GSM850 / GSM900 8PSK Mode Characteristics

Standard Conditions: V_{BATT}=3.5V, V_{ramp}=Don't Care, TX_EN = H, BS = L, Mode = H, T_C = 25°C, Duty Cycle = 25%.

Parameter		Conditions	Min.	Typ/Nom	Max.	Units
Frequency Range- f	GSM850		824		849	MHz
	GSM900		880		915	MHz
Output Power	High Power Mode	Vbias = Logic Low	28.5	29		dBm
-Pout	Low Power Mode	Vbias = Logic High	18.5			dBm
Gain	High Power Mode	Vbias = Logic Low, over f	27.5	29	30.5	dB
	Low Power Mode	Vbias = Logic High, over f	24.5	26	27.5	dB
Gain Variation- V_{BAT}		$V_{BAT\_MIN} \le V_{BAT} \le V_{BAT\_MAX}$	-0.5		+0.5	dB
Gain Variation- T_C		$T_{min} \le T_C \le T_{max}$	-1.5		+0.5	dB
Gain Variation- Pout		Pout ≤ 28.5	-1.0		+0.5	dB
Power Added Efficiency- η		P_{out} = 29dBm (High Power Mode)	20	23		%
Quiescent Current	I_{CQ_High}	Vbias = Logic Low (High Power Mode)		600		mA
	I_{CQ_Low}	Vbias = Logic High (Low Power Mode)		200		mA
ACPR (BW = 30 kHz)		Standard conditions				
±200 kHz – ACPR1		P_{OUT} ≤ 28.5 dBm (High Power Mode) and		-36	-34	dBc
±250 kHz – ACPR2		P_{OUT} ≤ 18.5 dBm (Low Power Mode)		-39	-37	dBc
±400 kHz – ACPR3				-62	-58	dBc
±600 kHz – ACPR4				-66	-64	dBc
EVM (RMS)				2	5	%
ACPR (BW = 30 kHz)		$V_{BAT\_MIN} \le V_{BAT} \le V_{BAT\_MAX}$, $T_{min} \le T_C \le T_{max}$				
±200 kHz – ACPR1		P_{OUT} ≤ 28.0 dBm (High Power Mode) and		-36	-33	dBc
±250 kHz – ACPR2		P_{OUT} ≤ 18.0 dBm (Low Power Mode)		-39	-36	dBc
±400 kHz – ACPR3				-62	-57	dBc
±600 kHz – ACPR4				-66	-63	dBc
EVM (RMS)				2	5	%
Harmonics	$2f_0$	$V_{BAT\_MIN} \le V_{BAT} \le V_{BAT\_MAX}$, $T_{min} \le T_C \le T_{max}$			-10	dBm
	$3f_0$	P_{OUT} ≤ 28.5 dBm (High Power Mode) and			-15	dBm
	>$3f_0$	P_{OUT} ≤ 18.5 dBm (Low Power Mode)			-20	dBm
RX Noise Power:		RBW = 100 kHz; Pout ≤ 28.5dBm (High Power Mode) and Pout ≤ 18.5 dBm (Low Power Mode)				
	869 to 894 MHz	fo=849MHz		-86	-84	dBm
	925 to 935MHz	fo=915MHz		-79	-76	dBm
	935 to 960MHz	fo=915MHz		-86	-84	dBm

GSM/EDGE Multi-mode Power Amplifier Module

DCS/PCS General Characteristics

Standard Conditions: V_{BATT}=3.5V, TX_EN = H, BS = H, Mode = L or H, T_C = 25°C, Duty Cycle = 25%.

Parameter	Conditions	Min.	Typ/Nom	Max.	Units
Input VSWR	Pin_min ≤ Pin ≤ Pin_max			2.5:1	
Forward Isolation- Iso	V_{TX_EN}- L, $P_{in} \leq P_{in\_max}$			-30	dBm
RF Power turn-on time- RF_{TON}	V_{TX_EN} = Logic Low to Logic High			1	µS
RF Power turn-off time- RF_{TOFF}	V_{TX_EN} = Logic High to Logic Low			1	µS
Mode Select Transition Time	Mode = Logic High to Logic Low / Logic Low to Logic High			1	µS
Vbias Transition Time	Vbias = Logic High to Logic Low / Logic High to Logic Low			1	µS
Stability	Spurious < -36 dBm	8:1			
Ruggedness		10:1			

DCS/PCS GMSK Mode Characteristics

Standard Conditions: V_{BATT}=3.5V, P_{in}=5 dBm, TX_EN = H, BS = H, Mode = L, T_C = 25°C, Duty Cycle = 25%, V_{RAMP}=1.6V

Parameter		Conditions	Min.	Typ/Nom	Max.	Units
Frequency Range – f	DCS		1710		1785	MHz
	PCS		1850		1910	MHz
Input Power for Pout max.- P_{in}			2	5	8	dBm
Output Power- P_{out}			32.0	33		dBm
Output Power Degradation		V_{batt}=3.0V, $P_{in}=P_{in\ min}$, $T_{min} \leq T_C \leq T_{max}$	30.0			dBm
PAE – η	DCS	V_{RAMP} = 1.6 VDC	43	48		%
	PCS	V_{RAMP} = 1.6 VDC	46	52		%
Power Control Voltage- V_{RAMP}		$V_{BATT\_MIN} \leq V_{BATT} \leq V_{BATT\_MAX}$	0.2		1.6	V
Power Control Range		$V_{RAMP\_MIN} \leq V_{RAMP} \leq V_{RAMP\_MAX}$	52			dB
RX Noise Power:		RBW = 100 kHz; Pout ≤ Pout_max				
	1805 to 1880 MHz	fo=1785MHz			-76	dBm
	1930 to 1990 MHz	fo=1910MHz			-76	dBm
Harmonics	$2f_0$				-10	dBm
	$3f_0$				-15	dBm
	$>3f_0$				-20	dBm

GSM/EDGE Multi-mode Power Amplifier Module

DCS/PCS 8PSK Mode Characteristics

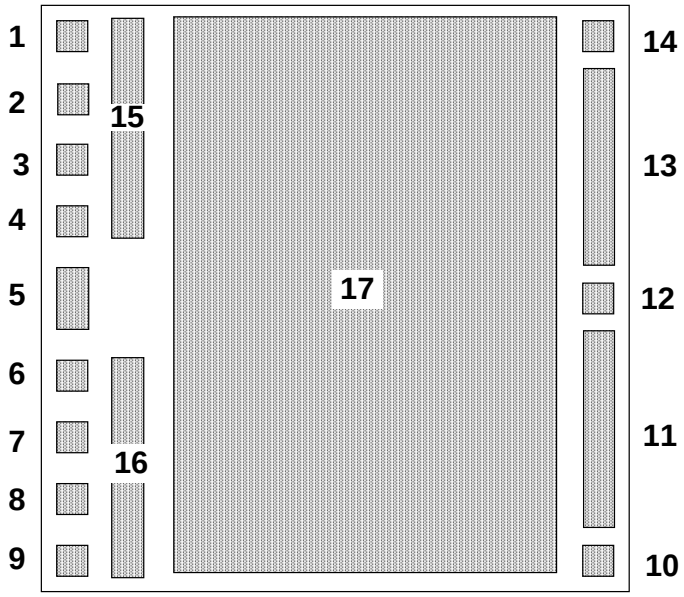
Standard Conditions: V_{BATT}=3.5V, V_{ramp}=Don't Care, TX_EN = H, BS = H, Mode = H, T_C = 25°C, Duty Cycle = 25%.

Parameter		Conditions	Min.	Typ/Nom	Max.	Units
Frequency Range- f	DCS		1710		1785	MHz
	PCS		1850		1910	MHz
Output Power	High Power Mode	Vbias = Logic Low	28	28.5		dBm
-Pout	Low Power Mode	Vbias = Logic High	18	18.5		dBm
Gain	High Power Mode	Vbias = Logic Low	34	35.5	37	dB
	Low Power Mode	Vbias = Logic High	32	33.5	35.5	dB
Gain Variation- V_{BATT}		$V_{BATT\_MIN} \le V_{BATT} \le V_{BATT\_MAX}$	-0.5		+0.5	dB
Gain Variation- T_C		$T_{min} \le T_C \le T_{max}$	-1.5		+0.5	dB
Gain Variation- Pout		Pout ≤ 28.0	-1.0		+0.5	dB
Power Added Efficiency- η		P_{out} = 28.5dBm (High Power Mode)	20	25		%
Quiescent Current –	I_{CQ_High}	Vbias = Logic Low (High Power Mode)		600		mA
	I_{CQ_Low}	Vbias = Logic High (Low Power Mode)		300		mA
ACPR (BW = 30 kHz)		Standard conditions				
±200 kHz – ACPR1		$P_{OUT} \le$ 28.0 dBm (High Power Mode) and		-36	-34	dBc
±250 kHz – ACPR2		$P_{OUT} \le$ 18.0 dBm (Low Power Mode)		-39	-37	dBc
±400 kHz – ACPR3				-62	-58	dBc
±600 kHz – ACPR4				-66	-64	dBc
EVM (RMS)				2	5	%
ACPR (BW = 30 kHz)		$3.2 \le V_{BAT} \le 4.5V$, $T_{min} \le T_C \le T_{max}$				
±200 kHz – ACPR1		$P_{OUT} \le$ 27.5 dBm (High Power Mode) and			-33	dBc
±250 kHz – ACPR2		$P_{OUT} \le$ 17.5 dBm (Low Power Mode)			-36	dBc
±400 kHz – ACPR3					-57	dBc
±600 kHz – ACPR4					-63	dBc
EVM (RMS)				2	5	%
Harmonics	$2f_0$	$T_{min} \le T_C \le T_{max}$, $3.2 \le V_{BAT} \le 4.5V$			-10	dBm
	$3f_0$	$P_{OUT} \le$ 28 dBm (High Power Mode) &			-15	dBm
	$>3f_0$	$P_{OUT} \le$ 18 (Low Power Mode)			-20	dBm
RX Noise Power:		RBW = 100 kHz; Pout ≤ 28 dBm (High Power Mode) & Pout ≤ 18 dBm (Low Power Mode)				
	1805 to 1880 MHz	fo=1785MHz		-82	-76	dBm
	1930 to 1990 MHz	fo=1910MHz		-82	-76	dBm

GSM/EDGE Multi-mode Power Amplifier Module

Pin-Out Diagram

TQM7M5001 Footprint
Top View



Pin #	Description	Function
1	DCS / PCS in	DCS/PCS RF input
3	Band Select	Band Select Pin (Low -> Low-Band active; High -> High-Band active)
4	TX Enable	Digital Transmit Enable Signal. When activated (TX_EN = high), all bands of the PA will be enabled for operation.
5	VBATT	Battery supply voltage, typ. 3.0 – 4.5 V, nom. 1.6A.
6	MODE	Digital Interface Signal. When activated (MODE=high) the PAM operates in EDGE mode.. When Low (MODE=low) the PAM operates in GMSK mode.
7	VRAMP	DAC Control Signal for output power setting, nominal 0.2 .. 1.6 V (Operational during GMSK mode only)
8	Vbias (digital)	V bias (Operational during EDGE mode only) Logic High enables low-power, low quiescent current mode. Logic Low enables high-power high quiescent current mode.
9	GSM850 / 900 in	GSM850 / GSM900 RF input
10	GSM850 / 900 out	GSM850 / GSM900 RF output
12	VCC	Internal Voltage
14	DCS / PCS out	DCS / PCS RF output
2, 11, 13, 15, 16, 17	GND	Ground

GSM/EDGE Multi-mode Power Amplifier Module

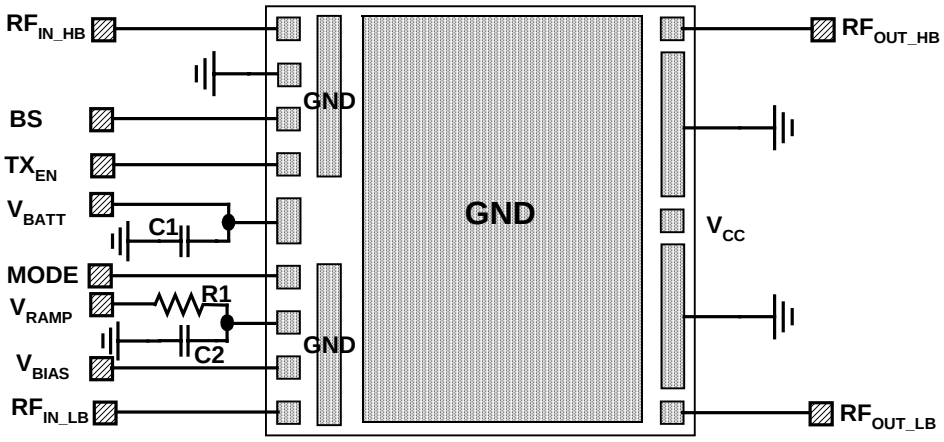
Logic Table:

Operating Mode	Mode	Band Select	Vbias	Tx Enable	Vramp
GMSK, Low Band	Low	Low	X	High - Enabled Low - Disabled	0.2 to 1.6 VDC
GMSK, High Band	Low	High	X	High - Enabled Low - Disabled	0.2 to 1.6 VDC
EDGE, Low Band, High Pout/Icq	High	Low	Low	High - Enabled Low - Disabled	X
EDGE, Low Band, Low Pout/Icq	High	Low	High	High - Enabled Low - Disabled	X
EDGE, High Band, High Pout/Icq	High	High	Low	High - Enabled Low - Disabled	X
EDGE, High Band, Low Pout/Icq	High	High	High	High - Enabled Low - Disabled	X
PA Off	X	X	X	Low	X

X- Don't Care

GSM/EDGE Multi-mode Power Amplifier Module

Typical Application/Test Circuit:



Bill of Material for TQM7M5001 Power Amplifier Module Application/Test Circuit[1]

Component	Reference Designator	Part Number	Value	Size
Power Amplifier Module		TQM7M5001		17pin/7mm square
Capacitor	C1		TBD	TBD
Capacitor (See note 2)	C2		TBD	TBD
Resistor (See note 2)	R1		TBD	TBD

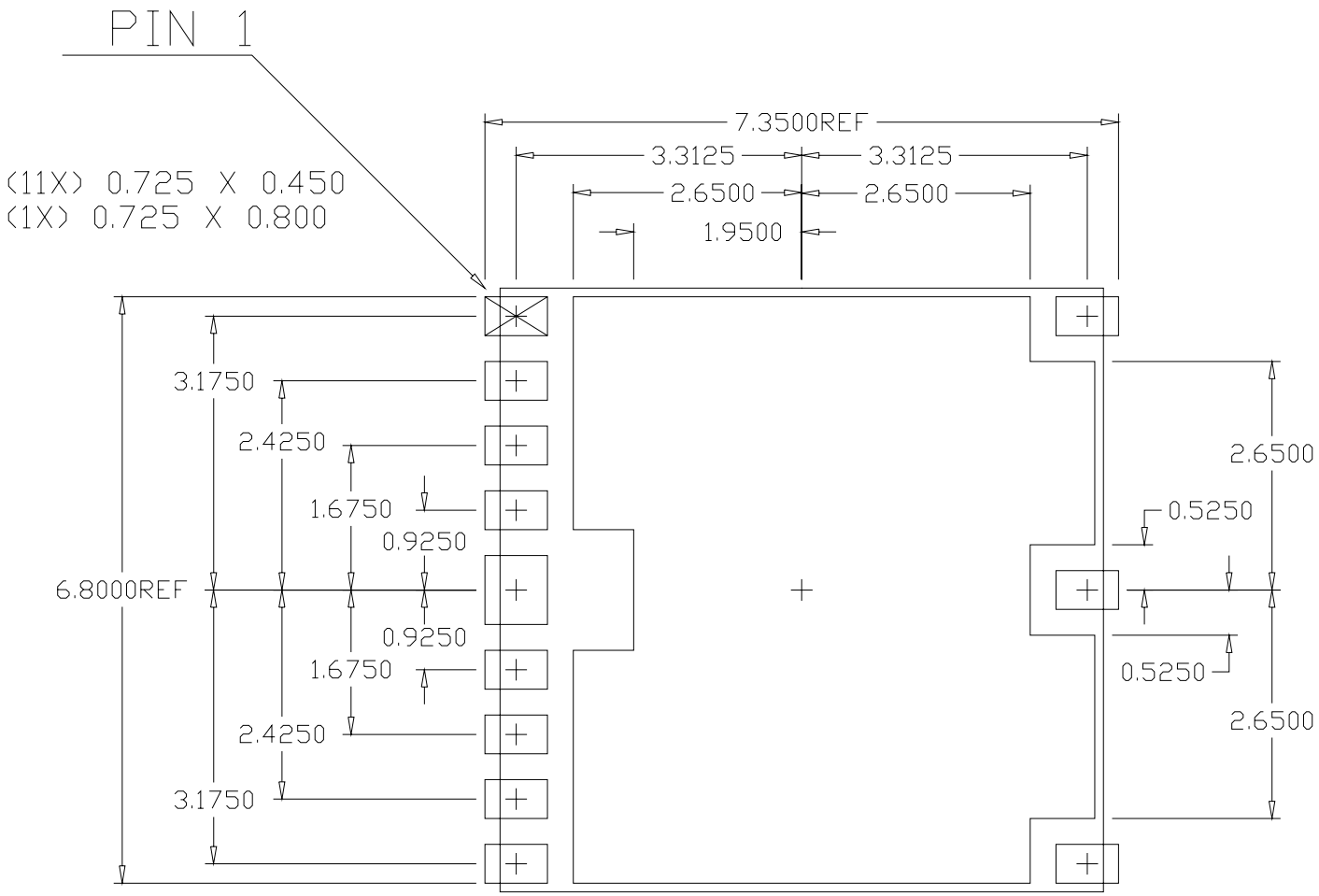
Note 1: May vary due to printed circuit board layout and material

Note 2: Value of R1 and C2 vary based on base-band. Please see application note for further information.

GSM/EDGE Multi-mode Power Amplifier Module

PC Board Layout Recommendations:

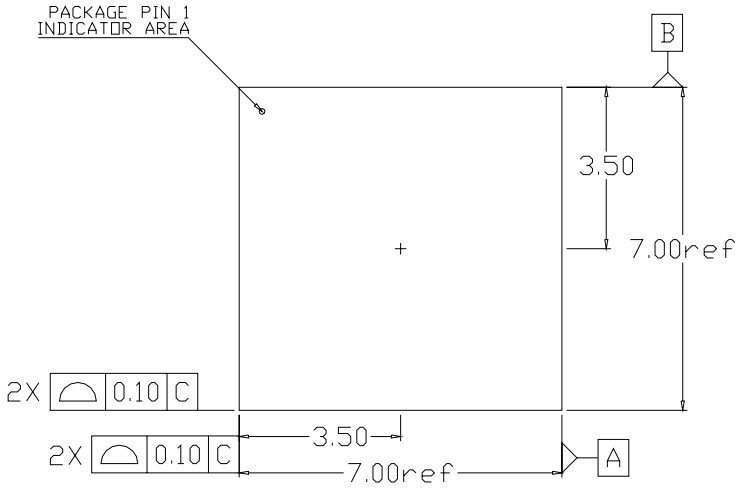
TOP VIEW LOOKING THROUGH MODULE



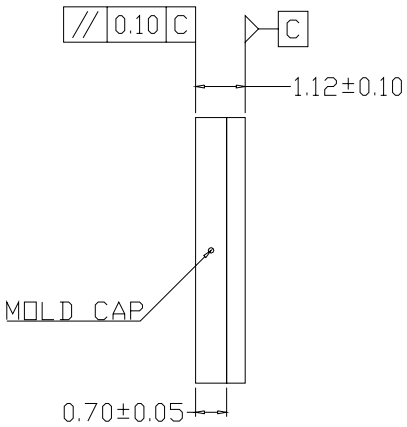
GSM/EDGE Multi-mode Power Amplifier Module

Package Dimensional Drawings:

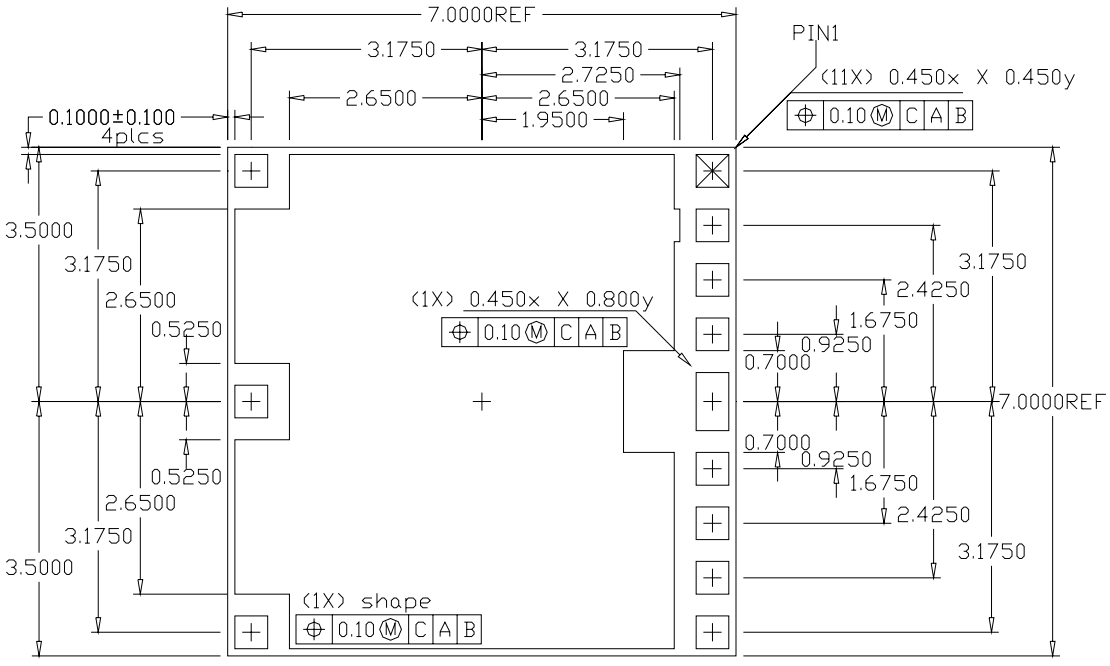
TOP VIEW



SIDE VIEW



BOTTOM VIEW

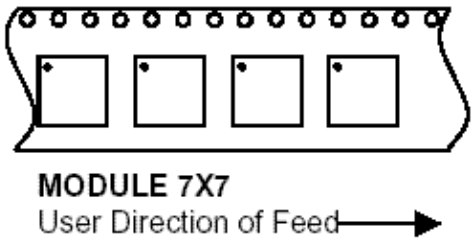


GSM/EDGE Multi-mode Power Amplifier Module

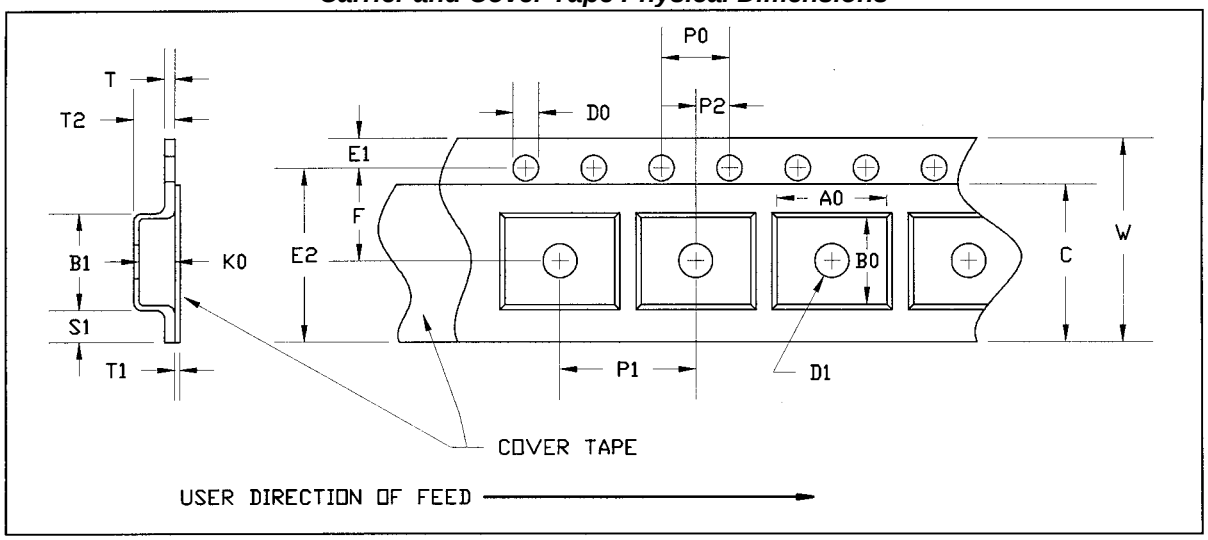
Tape and Reel:*

*Information provided as informational only. Please request TriQuint PKG.075 for controlling documentation.

Module Orientation



Carrier and Cover Tape Physical Dimensions



FIXED CARRIER AND COVER TAPE DIMENSIONS

PART	FEATURE	SYMBOL	SIZE (in)	SIZE (mm)
CAVITY	BOTTOM HOLE DIAMETER	D1	0.059	1.50
PERFORATION	DIAMETER	D0	0.059	1.50
	PITCH	P0	0.157	4.00
	POSITION	E1	0.069	1.75
CARRIER TAPE	THICKNESS	T	0.012	0.30
COVER TAPE	THICKNESS	T1	0.002	0.056

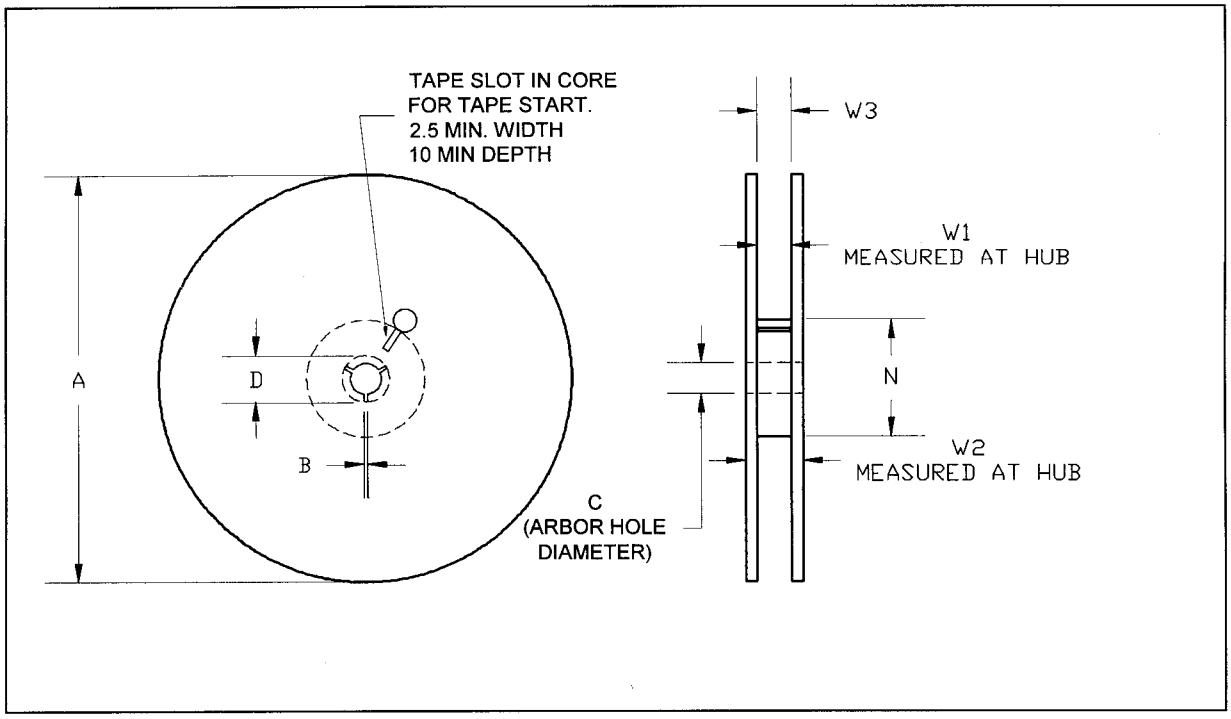
GSM/EDGE Multi-mode Power Amplifier Module

Tape and Reel (continued):

MODULE –7X7 CARRIER AND COVER TAPE DIMENSIONS

PART	FEATURE	SYMBOL	SIZE (in)	SIZE (mm)
CAVITY	LENGTH	A0	0.291	7.4
	WIDTH	B0	0.291	7.4
	DEPTH	K0	0.079	2.0
	PITCH	P1	0.472	12.00
DISTANCE BETWEEN CENTERLINE	CAVITY TO PERFORATION LENGTH DIRECTION	P2	0.079	2.00
	CAVITY TO PERFORATION WIDTH DIRECTION	F	0.295	7.50
COVER TAPE	WIDTH	C	0.524	13.30
CARRIER TAPE	WIDTH	W	0.630	16.00

Reel Physical Dimensions



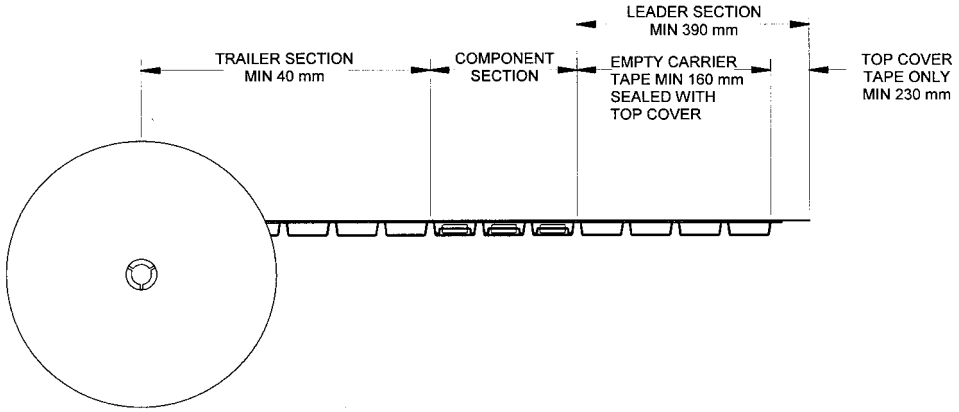
GSM/EDGE Multi-mode Power Amplifier Module

Tape and Reel (continued):

Reel Dimensions for 16mm Carrier Tape

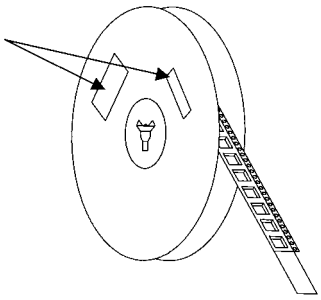
SOIC-14, SOIC-16 BATWING, QSOP 24, SSOP-24, TSSOP-20, TSSOP-28 and HP VFQFP-N 7x7 and SOT 223. Modules 6X6,7X7, 8X8, 7X10, 5X9 and 9.55X8.75			13" REEL	
PART	FEATURE	SYMBOL	SIZE (in)	SIZE (mm)
FLANGE	DIAMETER	A	12.992	330.0
	THICKNESS	W2	0.874	22.2
	SPACE BETWEEN FLANGE	W1	0.661	16.8
HUB	OUTER DIAMETER	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	0.787	20.0

Tape Length



Label Placement

Product label, Mfg Label and ESD label are placed on the flange opposite to the sprockets in the carrier tape

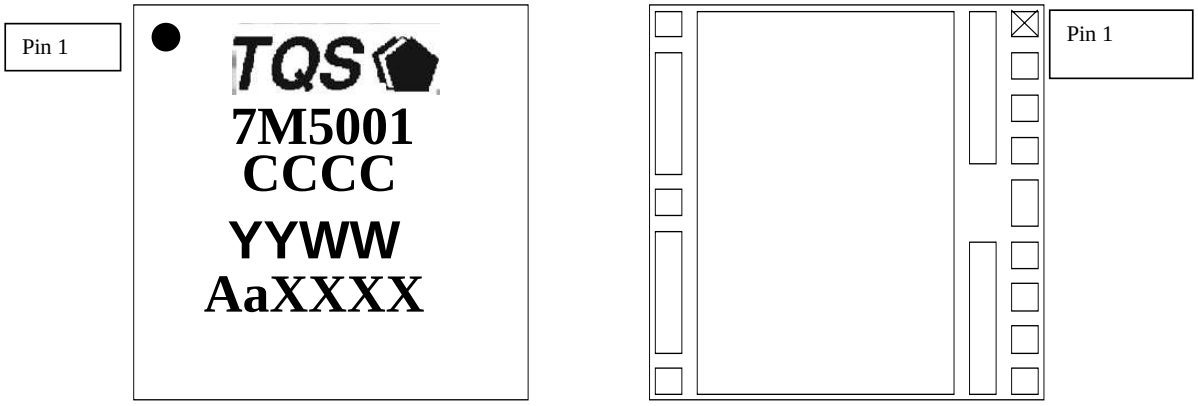


Quantity Per Reel: 2500

GSM/EDGE Multi-mode Power Amplifier Module

Marking Diagram:*

**Information provided as informational only. Please request TriQuint MRK.TQM7M5001 for controlling documentation.*



WHITE INK OR LASER MARK

Line 1: TriQuint logo
Line 2: 7M5001
Line 3: CCCC = Country Code (example: Philippines = PHIL)
Line 4: YYWW = Year and Work Week
Line 5: XXXX = Aa (2 letter vendor code)+Last 4 digits of TriQuint assembly lot number

Additional Information [1]T

1 For latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

Web: Hwww.triquint.comH Tel: (503) 615-9000

Email: info_wireless@tqs.com Fax: (503) 615-8902

For technical questions and additional information on specific applications:

Email: info_wireless@tqs.com