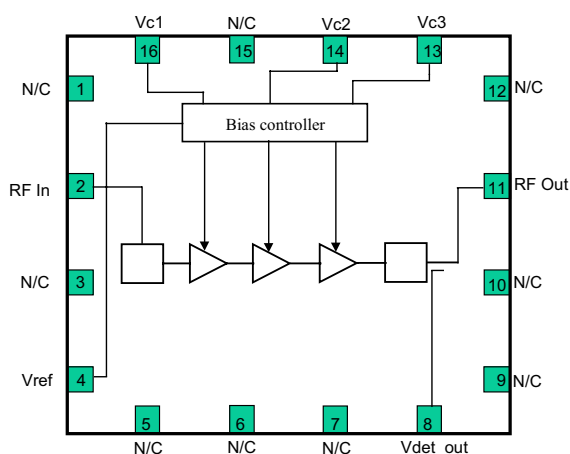


## 2.4GHz ISM Band InGaP HBT Matched Power Amplifier

### Functional Block Diagram



### Product Description

The TQP777002 is a high performance, high linearity, medium-power amplifier designed for 802.11b/g WLAN and other applications in the 2.4GHz ISM band. The device exhibits industry-leading power added efficiency under 802.11b and 802.11g modulated signals. The RF input match and output matches are integrated on chip as are the second and third stage bias chokes. The power amplifier is manufactured using TriQuint's InGaP HBT process and is packaged in an industry standard 3mm x 3mm VQFN-16 Pb-Free package.

### Electrical Specifications

Parameter	Min	typ	max	units
Frequency Range	2400	-	2500	MHz
Power Gain	28.5	30.0		dB
Error Vector Magnitude (Pout = +18.5dBm, 54Mbps OFDM Signal)		<3.0		%
Linear Output Power (guaranteed ACP under 802.11b modulation)	21	22		dBm
802.11b ACP; +22.0 dBm Output; 1 <sup>st</sup> Side Lobe, 11 Mbps		-37		dBc
802.11b ACP; +22.0 dBm Output; 2 <sup>nd</sup> Side Lobe, 11Mbps		-55		dBc

Test Conditions: Ta=25°C; Vc1=Vc2=Vc3=3.3V Vref=2.90V

### Features

- High Linearity, 2.4 GHz ISM Band PA for 802.11b/g WLAN Systems
- Integrated Output Power Detector
- Leadless 3.0 x 3.0 mm SMT Pb-Free Package
- Temperature Compensated Bias Network with Bias Shutdown Mode
- EVM < 3.0% @ +18.5 dBm Linear Output Power 802.11g modulation
- +22 dBm Linear Output Power 802.11b modulation
- Integrated input and output match
- Integrated bias chokes
- Single 3.3V supply

## 2.4GHz ISM Band InGaP HBT Matched Power Amplifier

### Absolute Maximum Ratings

Parameter	Symbol	Value		Unit
		min	max	
Power Supply Voltage (no RF applied)	Vc1, Vc2, Vc3		6.0	V
Power Supply Voltage (RF applied)	Vc1, Vc2, Vc3		4.5	V
Bias Voltage	Vref		5.0	V
Case Temperature, Survival	Tc	-40	100	°C
Storage Temperature	Ta	-40	150	°C
Operating Temperature Range	Toper	-40	85	°C
RF Input Power	Pin		+10	dBm

### General Electrical Characteristics

Parameter	min	typ	max	Unit
Frequency Range	2400	-	2500	Mhz
Power Gain	28.5	30.5		dB
Linear Output Power (802.11g 54Mbps OFDM) – 3.0% EVM		18.5		dBm
Linear Output Power (guaranteed ACP under 802.11b modulation) , 11Mbps	21	22		dBm
Gain Variation vs. Frequency		+/-0.2		dB
802.11b Adjacent Channel Power @ +22.0 dBm Output power – 1 <sup>st</sup> Side Lobe, 11 Mbps		-37		dBc
802.11b Adjacent Channel Power @+22.0 dBm Output power – 2 <sup>nd</sup> Side Lobe, 11Mbps		-55		dBc
802.11b Adjacent Channel Power @ +22 dBm Output power – 1 <sup>st</sup> Side Lobe, 1 Mbps		-37		
802.11b Adjacent Channel Power @+22 dBm Output power – 2 <sup>nd</sup> Side Lobe, 1Mbps		-52		
2 <sup>nd</sup> Harmonic @ +22.0 dBm Output power		-35		dBc
3 <sup>rd</sup> Harmonic @ +22.0 dBm Output power		-47		dBc
S21 off-state, (2400-2500MHz)		-40		dB
S12		-47		dB
Input Return Loss		-16		dB
Power detector voltage range	0.5		1.5	V
Power detector slope		8mV/dB at +0dBm 66mV/dB @ +23dBm		

**Data Sheet: Subject to change without notice**

For additional information and latest specifications, see our website: [www.triquint.com](http://www.triquint.com)

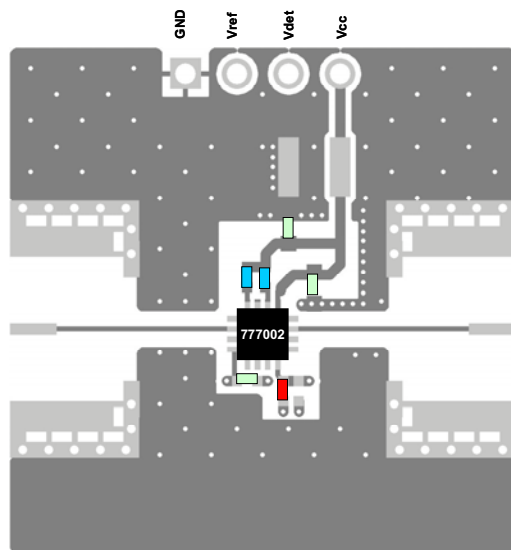
Revision A, July 22, 2004

## 2.4GHz ISM Band InGaP HBT Matched Power Amplifier

### DC Electrical Performance

Parameter	min	typ	max	Unit
Operating Voltage Supply Range	3.0	3.3	3.6	V
Total Current (No RF Applied)		50		mA
Supply Current: $T_a = 25^{\circ}\text{C}$ , $V_{c1} = V_{c2} = V_{c3} = 3.3\text{V}$ , $V_{ref} = 2.90\text{V}$ Linear Output Power = 19dBm, with 802.11g 54Mbps modulation		145	165	mA
Supply Current: $T_a = 25^{\circ}\text{C}$ , $V_{ref} = 2.90$ , $V_{c1} = V_{c2} = V_{c3} = 3.3\text{V}$ Linear Output Power = 22dBm, with 802.11b CCK modulation		200	240	mA
Vref Voltage Range	2.7	2.90	3.6	V
$I_{ref}$		12		mA
Collector current in shutdown mode		0.5		$\mu\text{A}$

### Layout and BOM of TQP777002 Evaluation board



### BOM- TQP777002 Ev

Evaluation Board				777002				
Integrated Circuit ID				TQP777002				
Part #	Quantity	Component ID	Size	Value	Units	Manufacturer	P/N	Comments
1	1	L1	0402	10.0	nH	Toko	LL1005-FH10NJ	
2	1	L2	0402	22.0	nH	Toko	LL1005-FH22NJ	
3	2	C1, C2	0402	1.0	uF	Mitsubishi	CA105Z1NV-T1	
4	1	C4	0402	100.0	pF	MuRata	GRP1555C1H101JD01E	
5	1	R1	0402	10000.0	Ohms	Rohm	MCR01J103	
6	1	Q1	MLF		N/A	Triquint	TQP777002	
7	2	J1, J2				Johnson	142-0711-881	
8	2	J3, J4						DC Connector

**Data Sheet: Subject to change without notice**

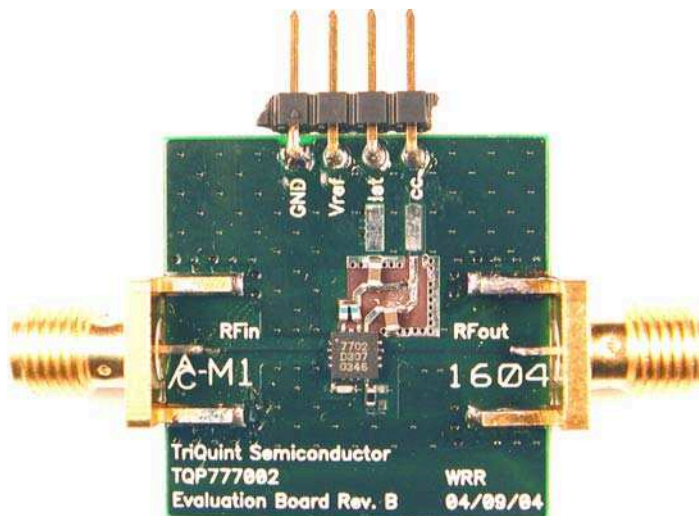
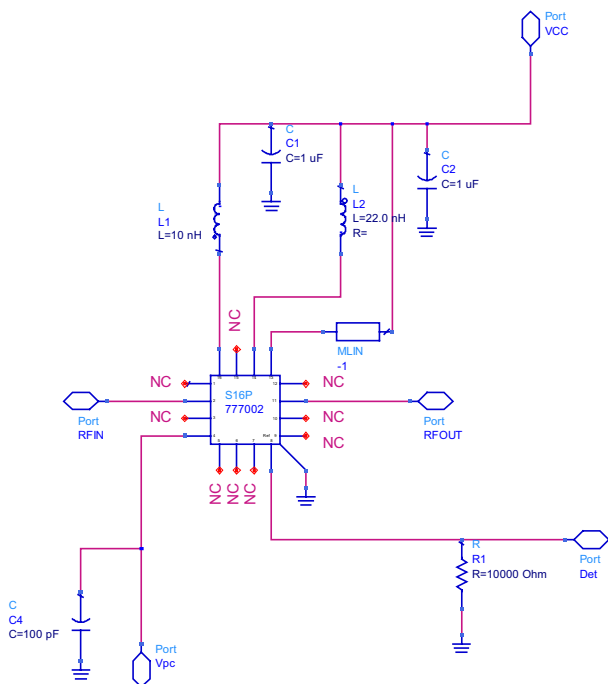
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Revision A, July 22, 2004

## 2.4GHz ISM Band InGaP HBT Matched Power Amplifier

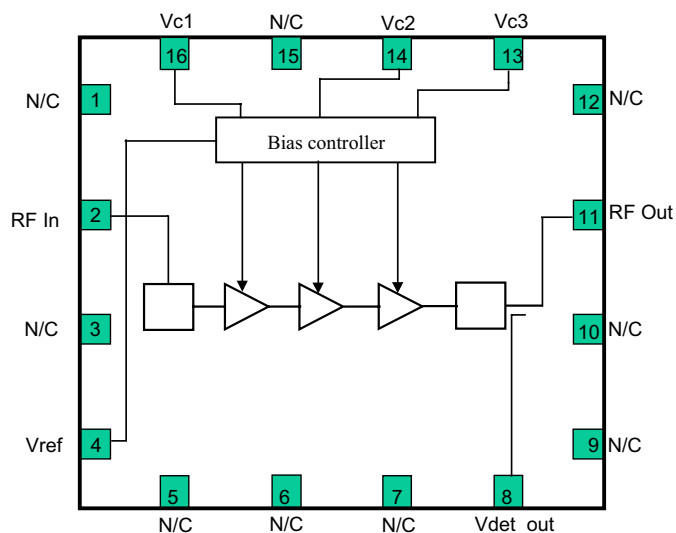
Schematic- TQP777002 Evaluation board

Photograph of TQP777002 Evaluation board



### Pin Assignments

PIN	Symbol	Description
1	N/C	No Connect
2	RF_in	Input
3	N/C	No Connect
4	Vref	Reference Voltage
5	N/C	No Connect
6	N/C	No Connect
7	N/C	No Connect
8	Vdet_out	Detector output voltage
9	N/C	No Connect
10	N/C	No Connect
11	RF_Out	Output
12	N/C	No Connect
13	Vc3	Stage 3 collector supply
14	Vc2	Stage 2 collector supply
15	N/C	No Connect
16	Vc1	Stage 1 collector supply
	Paddle	Ground



Data Sheet: Subject to change without notice

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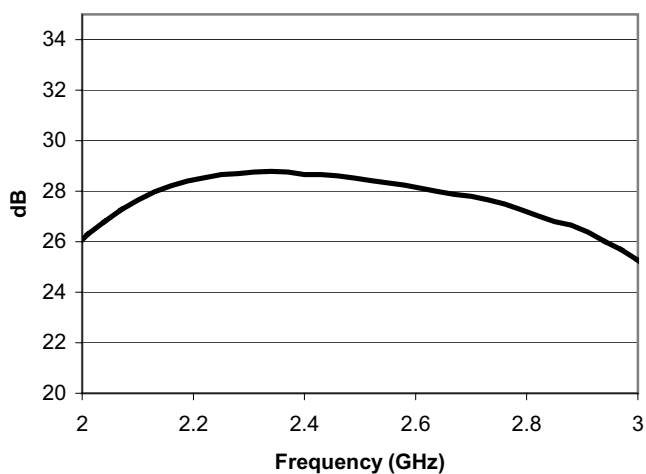
Revision A, July 22, 2004

## 2.4GHz ISM Band InGaP HBT Matched Power Amplifier

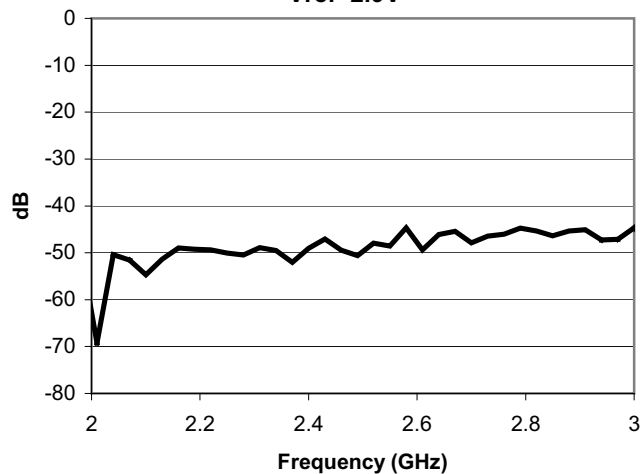
*TQP777002 measured Small Signal performance; in TriQuint WLAN777002 Evaluation Board*

*Measurement Conditions:  $T_a = 25^\circ\text{C}$ ,  $V_{\text{ref}} = 2.90\text{V}$   $V_{c1} = V_{c2} = V_{c3} = 3.3\text{V}$*

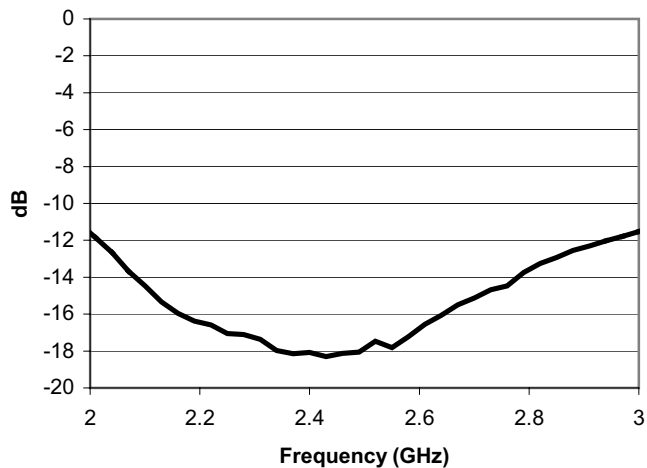
**s21**  
**TQP777002**  
**Vref=2.9V**



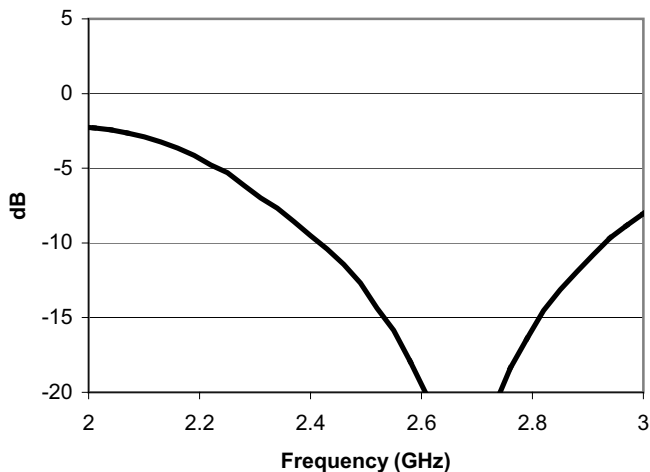
**s12**  
**TQP777002**  
**Vref=2.9V**



**s11**  
**TQP777002**  
**Vref=2.9V**



**s22**  
**TQP777002**  
**Vref=2.9V**



## 2.4GHz ISM Band InGaP HBT Matched Power Amplifier

**TQP777002 measured 802.11g performance; in TriQuint WLAN777002 Evaluation Board**

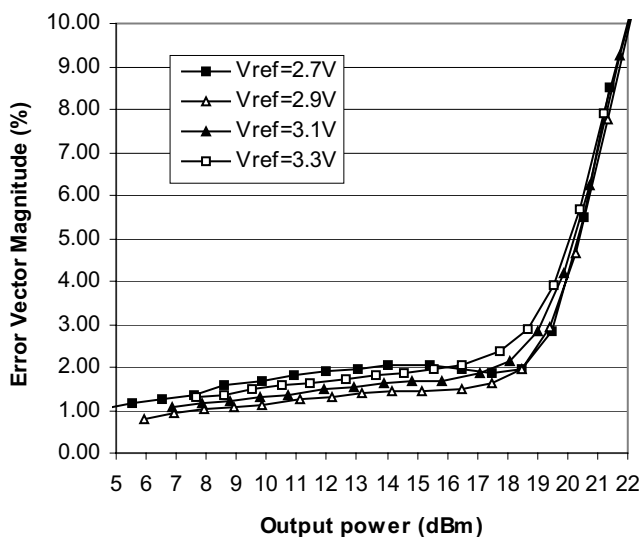
Measurement conditions:  $T_a = 25^\circ\text{C}$ ,  $V_{\text{ref}} = \text{variable}$ ,  $V_{c1} = V_{c2} = V_{c3} = 3.3\text{V}$ , 802.11g OFDM modulation-54Mbps

**EVM and Gain vs Output power**

777002

Freq=2.45GHz

Variable Vref

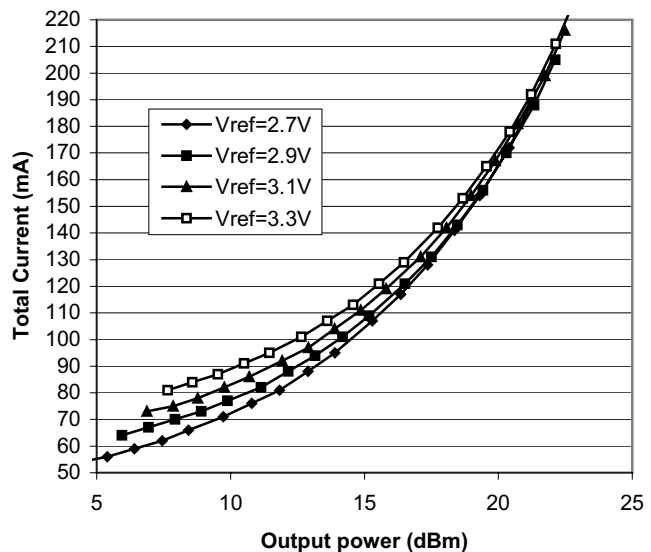


**Total Current vs Output power**

777002

Freq=2.45 GHz

Variable Vref



**TQP777002 Measured ACP performance; in TriQuint WLAN777002 Evaluation Board- 5Samples**

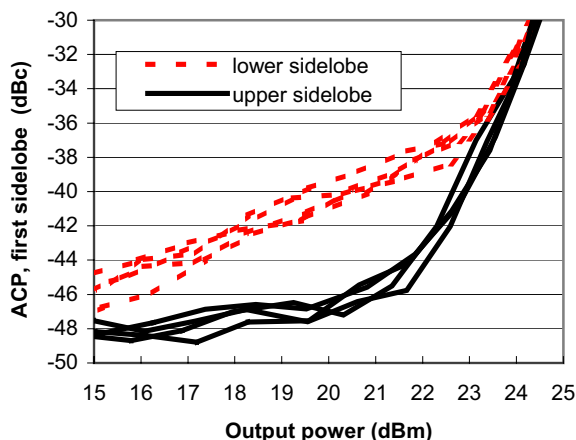
Measurement conditions:  $T_a = 25^\circ\text{C}$ ,  $V_{\text{ref}} = 2.9\text{V}$ ,  $V_{c1} = V_{c2} = V_{c3} = 3.3\text{V}$ ,  $f = 2450\text{MHz}$ , 802.11b 1Mbps modulation

**ACP vs. Output power**

TQP777002

$V_{\text{ref}} = 2.90\text{V}$

$f = 2450\text{MHz}$

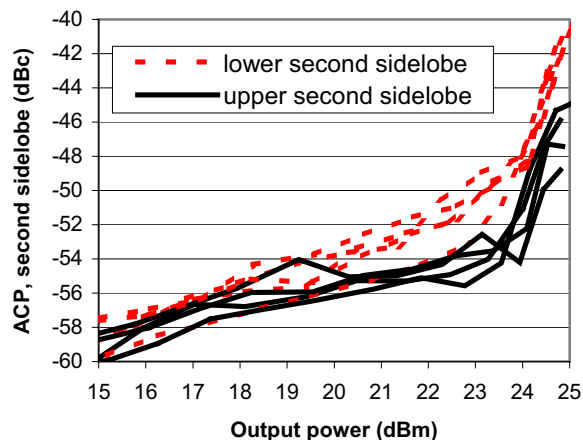


**ACP vs. Output power**

TQP777002

$V_{\text{ref}} = 2.90\text{V}$

$f = 2450\text{MHz}$



**Data Sheet: Subject to change without notice**

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Revision A, July 22, 2004

## 2.4GHz ISM Band InGaP HBT Matched Power Amplifier

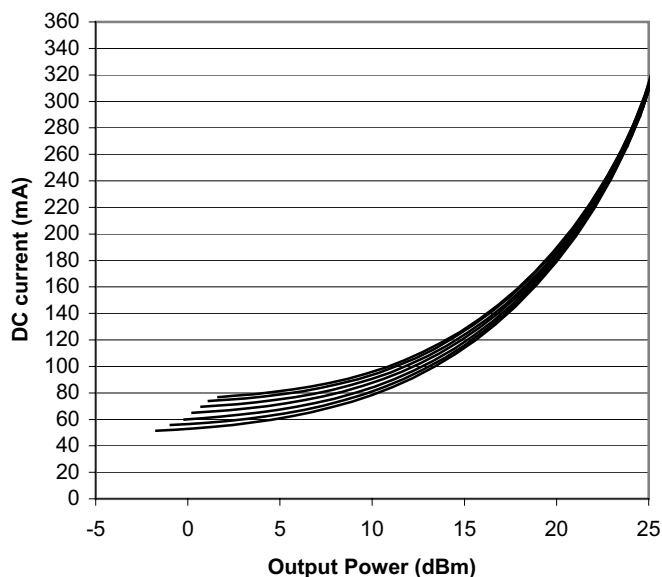
### TQP777002 Measured 802.11b in TriQuint WLAN777002 Evaluation Board

Measurement conditions:  $T_a = 25^\circ\text{C}$ ,  $V_{\text{ref}} = \text{variable}$ ,  $V_{c1} = V_{c2} = V_{c3} = 3.3\text{V}$ ,  $f = 2450\text{MHz}$ , 802.11b CCK modulation

**Total Current vs Output power**

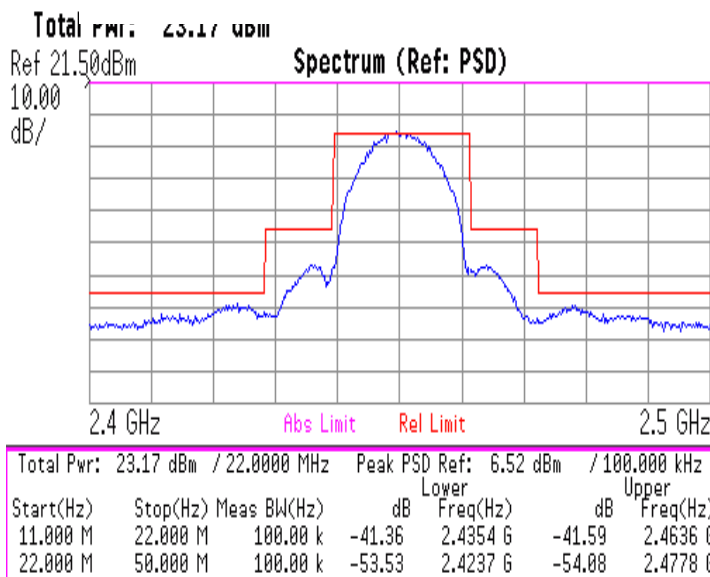
777002

varying reference voltage  
CCK Modulation



**Transmit Spectral Mask-777002**

CCK Modulation



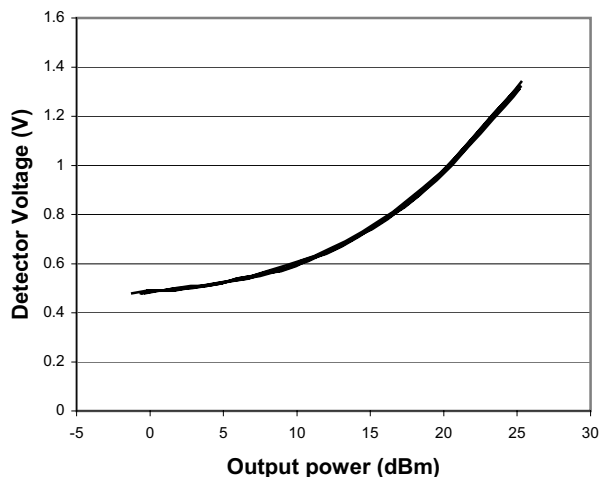
### TQP777002 Measured 802.11b DC Current in TriQuint WLAN777002 Evaluation Board

Measurement conditions:  $T_a = 25^\circ\text{C}$ ,  $V_{\text{ref}} = 2.90\text{V}$ ,  $V_{c1} = V_{c2} = V_{c3} = 3.3\text{V}$  802.11b CCK modulation

**Detector Voltage vs Output power**

777002

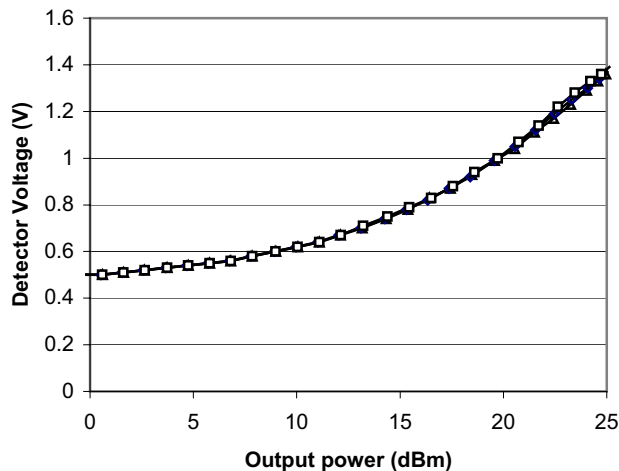
5 Samples  
 $f = 2.45\text{GHz}$



**Detector Voltage vs Output power**

777002

2400, 2450, 2500 MHz





## 2.4GHz ISM Band InGaP HBT Matched Power Amplifier

**TQP777002 Measured Temperature Performance in TriQuint WLAN777002 Evaluation Board**

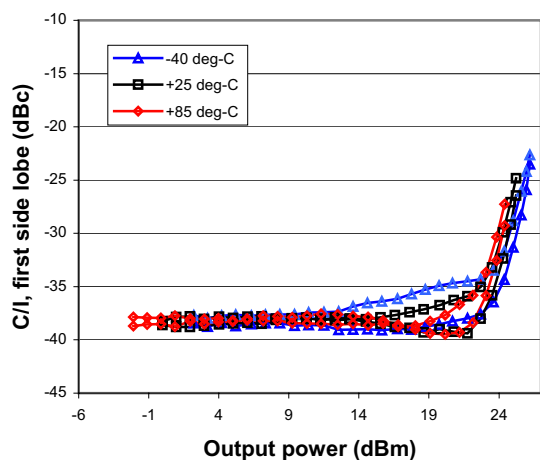
Measurement conditions:  $T_a = 25^\circ\text{C}$ ,  $V_{ref}=2.90\text{V}$ ,  $V_{c1}=V_{c2}=V_{c3}= 3.3\text{V}$ ,  $f=2450\text{MHz}$ , 802.11b CCK modulation

**ACP vs Output Power**

777002

-40 to +85 deg-C

$f=2450\text{ MHz}$

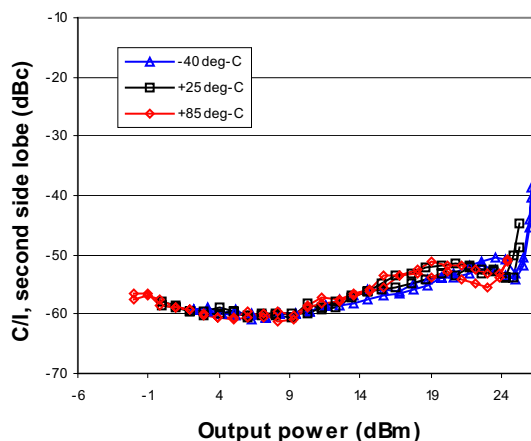


**ACP vs Output Power**

777002

-40 to +85 deg-C

$f=2450\text{ MHz}$



**TQP777002 Measured Temperature Performance in TriQuint WLAN777002 Evaluation Board**

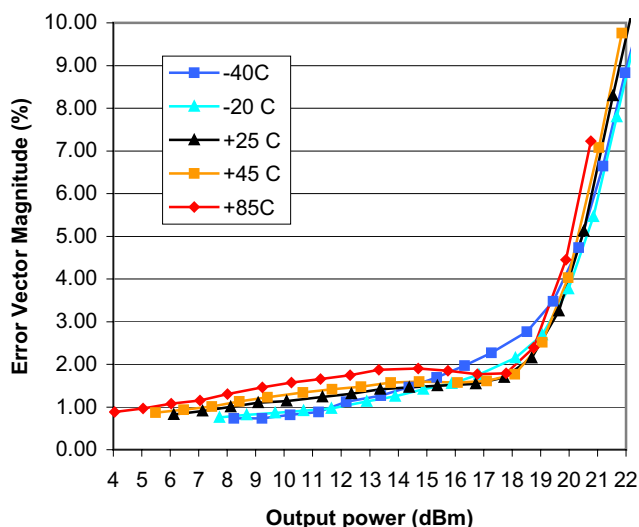
Measurement conditions:  $T_a = 25^\circ\text{C}$ ,  $V_{ref}=2.90\text{V}$ ,  $V_{c1}=V_{c2}=V_{c3}= 3.3\text{V}$ ,  $f=2450\text{MHz}$ , 802.11g OFDM modulation-54Mbps

**EVM vs Output power**

777002

Freq=2.45GHz

-40 to +85 deg-C

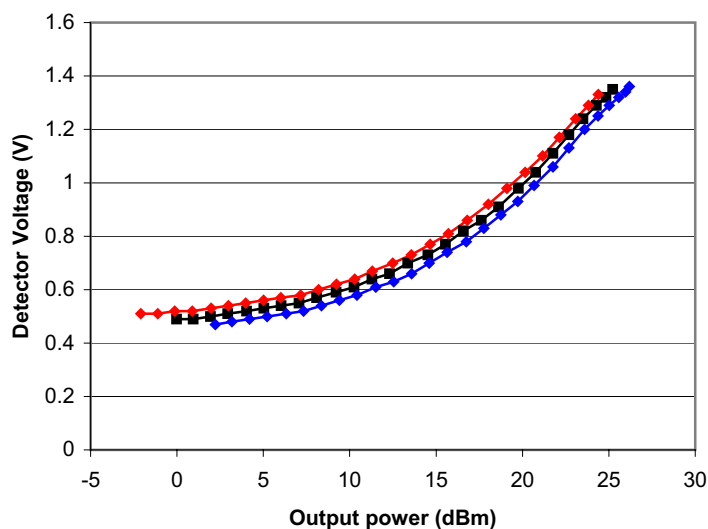


**Detector Voltage vs Output power**

777002

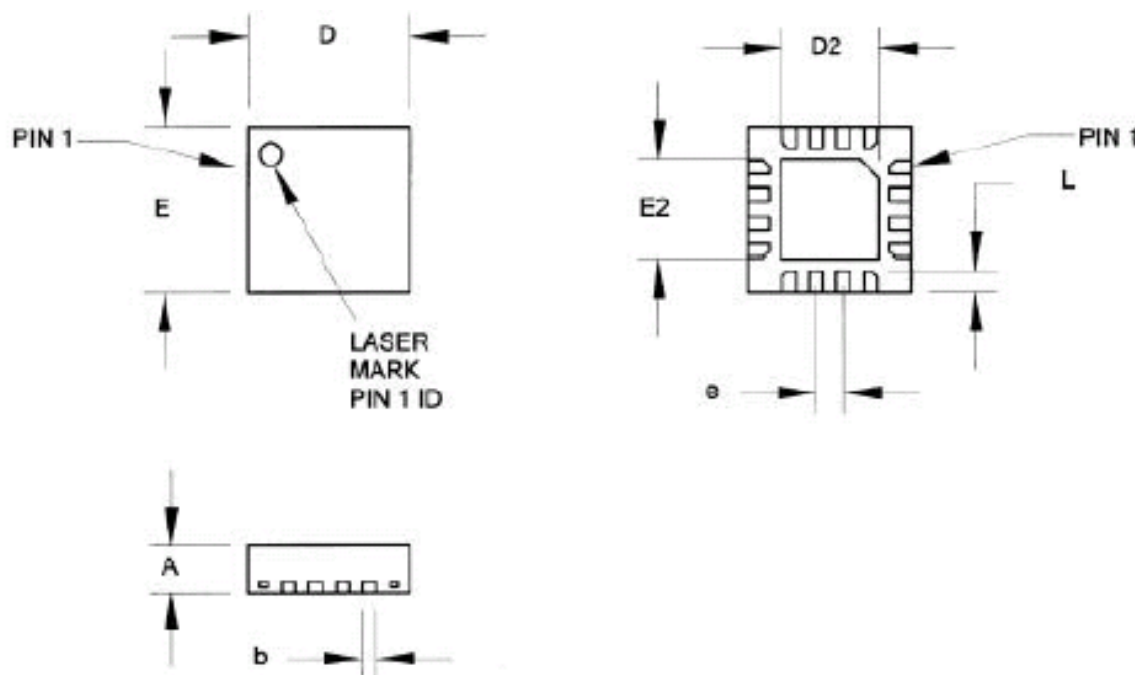
-40 to +85 deg-C

$f=2.45\text{ GHz}$





**2.4GHz ISM Band InGaP HBT Matched Power Amplifier**



JEDEC DESIGNATION	DESCRIPTION	METRIC	ENGLISH	Notes
A	OVERALL HEIGHT	0.90 +/- .10 mm	.035 +/- .004 in	1
b	TERMINAL WIDTH	.250 +/- .025 mm	.010 +/- .001 in	1
D	PACKAGE LENGTH	3.00 mm BSC	.118 in	1
D2	EXPOSED PAD LENGTH	1.80 +/- .15 mm	.071 +/- .006 in	1
e	TERMINAL PITCH	.50 mm BSC	.020 in	1
E	PACKAGE WIDTH	3.00 mm BSC	.118 in	1
E2	EXPOSED PAD WIDTH	1.80 +/- .05 mm	.071 +/- .002 in	1
L	TERMINAL LENGTH	.40 +/- .05 mm	.016 +/- .002 in	1

**2.4GHz ISM Band InGaP HBT Matched Power Amplifier**

**Package Marking**

Pin 1



Line 1: 7002  
Line 2: XXXX TriQuint Assembly Lot Number  
Line 3: Manufacturing year and work week

**Ordering Information:**

Type	Marking	Package
<b>TQP777002</b>	<b>7002</b>	<b>VQFN-16</b>

**Caution:** Electrostatic discharge sensitive. Observe handling Precautions!

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

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Tel: (503) 615-9000

Email: [info\\_wireless@tqs.com](mailto:info_wireless@tqs.com)

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