TriQuint SEMICONDUCTOR

CGB 240 Datasheet

2-Stage Bluetooth InGaP HBT Power Amplifier

Description:

The CGB240 GaAs Power Amplifier MMIC has been especially developed for wireless applications in the 2.4 - 2.5 GHz ISM band (e.g. Bluetooth class 1). Its high power added efficiency and single positive supply operation makes the device ideally suited to handheld applications. The device delivers 23 dBm output power at a supply voltage of 3.2 V, with an overall *PAE* of 50%. The output power can be adjusted using an analog control voltage (V_{CTR}). Simple external input-, interstage-, and output matching circuits are used to adapt to the different requirements of linearity and harmonic suppression in various applications.

For WLAN applications (IEEE802.11b) or applications serving both WLAN and Bluetooth, we recommend to use the CGB240B device.

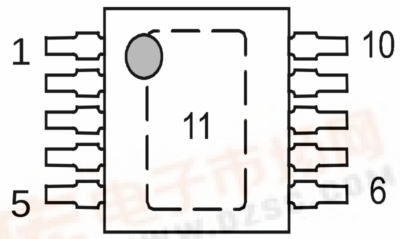
Features:

- Single voltage supply.
- Wide operating voltage range 2.0 - 5.5 V.
- P_{OUT} = 23 dBm at V_C = 3.2 V.
- Overall power added efficiency (PAE) typically 50%.
- High *PAE* at low–power mode.
- Analog power control with four power steps.
- Straight-Forward Matching; Few external components.

Applications:

- Bluetooth Class 1
- Cordless Phones
- Home RF

Package Outline:



MSOP-10

Pin Configuration:

1 & 2:	**Vc1**
3:	**RF In**
4, 5, & 10:	**NC**
6:	**Vcntrl1**
7:	**Vcntrl2**
8 & 9:	**Vc2**
11 (Paddle):	**GND**

Absolute Maximum Ratings:

Parameter	Symbol	Min.	Max.	Units
Supply voltage- CW	V_{cc}	0	5.5	V_{dc}
Supply voltage- Pulsed	V_{cc}	0	5.0	V_{dc}
Power control voltage	V_{apc}	0	3.2	V
DC supply current- Stage 1	I_{cc}	0	40.0	mA
DC supply current- Stage 2	I_{cc}	0	160.0	mA
Total Power Dissipation[1]	P_{TOT}		0.5	W
RF Input Power[2]	$P_{IN, MAX}$		+10	dBm
RF Output Power[2]	$P_{OUT, MAX}$		+25	dBm
Operating case temperature	T_a	-20	85	ºC
Storage temperature	T_s	-55	150	ºC

[1] Thermal resistance between junction and pad 11 (= heatsink): R_{THCH} = 100 K/W.
[2] No RF input signal should be applied before turn-on of DC Power. An output VSWR of 1:1 is assumed.

Electrical Characteristics of CGB240 Device used in Bluetooth PA Reference Design (See Application Note 1)

T_A = 25 °C; V_{CC} = 3.2 V; f = 2.4 ... 2.5 GHz; Z_{IN} = Z_{OUT} = 50 Ohms

Parameter	Symbol	Limit Values			Unit	Test Conditions
		min	typ	max		
Supply Current Small-Signal Operation	$I_{CC,SS}$		125	150	mA	P_{IN} = - 10 dBm V_{CTR} = 2.5 V
Power Gain Small-Signal Operation	G_{SS}	23	26		dB	P_{IN} = - 10 dBm V_{CTR} = 2.5 V
Output Power Power Step 1	$P_{OUT,1}$		7		dBm	P_{IN} = + 3 dBm V_{CTR} = 1.15 V
Supply Current Power Step 1	$I_{CC,1}$		15		mA	P_{IN} = + 3 dBm V_{CTR} = 1.15 V
Power Added Efficiency Power Step 1	PAE_1		10		%	P_{IN} = + 3 dBm V_{CTR} = 1.15 V

Electrical Characteristics of CGB240 used in PA Reference Design (cont.)

Parameter	Symbol	Limit Values			Unit	Test Conditions
		Min	Typ	Max		
Output Power Power Step 2	$P_{OUT,2}$		12		dBm	P_{IN} = + 3 dBm V_{CTR} = 1.3 V
Supply Current Power Step 2	$I_{CC,2}$		25		mA	P_{IN} = + 3 dBm V_{CTR} = 1.3 V
Power Added Efficiency Power Step 2	PAE_2		20		%	P_{IN} = + 3 dBm V_{CTR} = 1.3 V
Output Power Power Step 3	$P_{OUT,3}$		17		dBm	P_{IN} = + 3 dBm V_{CTR} = 1.5 V
Supply Current Power Step 3	$I_{CC,3}$		52		mA	P_{IN} = + 3 dBm V_{CTR} = 1.5 V
Power Added Efficiency Power Step 3	PAE_3		32		%	P_{IN} = + 3 dBm V_{CTR} = 1.5 V
Output Power Power Step 4	$P_{OUT,4}$	22	23	24	dBm	P_{IN} = + 3 dBm V_{CTR} = 2.5 V
Supply Current Power Step 4	$I_{CC,4}$		125		mA	P_{IN} = + 3 dBm V_{CTR} = 2.5 V
Power Added Efficiency Power Step 4	PAE_4	40	50	-	%	P_{IN} = + 3 dBm V_{CTR} = 2.5 V
2nd Harm. Suppression Power Step 4	h_2		- 35		dBc	P_{IN} = + 3 dBm V_{CTR} = 2.5 V
3rd Harm. Suppression Power Step 4	h_3		- 50		dBc	P_{IN} = + 3 dBm V_{CTR} = 2.5 V
Turn-Off Current	$I_{CC,OFF}$		1		uA	V_{CC} = 3.2 V; V_{CTR} < 0.4 V; No RF Input
Off-State Isolation	$S_{21,0}$		26		dB	P_{IN} = + 3 dBm V_{CTR} = 0 V
Rise Time 1)	T_{R1}			1	µs	V_{CC} = 5.0 V V_{CTR} = 0 to 1V Step
Rise Time 2 [1)]	T_{R2}			1	µs	V_{CC} = 5.0 V V_{CTR} = 0 to 3V Step
Fall Time 1 [1)]	T_{F1}			1	µs	V_{CC} = 5.0 V V_{CTR} = 1 to 0V Step
Fall Time 2 [1)]	T_{F2}			1	µs	V_{CC} = 5.0 V V_{CTR} = 3 to 0V Step
Maximum Load VSWR (no damage to device) allowed for 10s	$VSWR$			6		P_{IN} = + 5 dBm; V_{CC} = 4.8 V; V_{CTR} = 2.5 V Z_{IN} = 50 Ohms

1) Rise time $T_{R:}$ time between turn-on of V_{CTR} voltage until reach of 90% of full output power level.
Fall time $T_{F:}$ as time between turn-off of V_{CTR} voltage until reach of 10% of full output power level.
Please note: Reduced Vccp,max for pulsed operation applies (see "absolute maximum ratings").

S–Parameters for Linear Small-Signal Operation

T_A = 25 °C; V_{CC} = 2.8 to 3.2 V; V_{CTR} = 2.5 to 2.8 V; f = 2.4 ... 2.5 GHz

P_{IN} < - 4 dBm; Interstage match pin terminated with (1 + j 12.5) Ohms.

Parameter (Target Data)	Symbol	Typ. Value	Unit
Magnitude Input Reflection	MAG (S_{11})	0.67	
Phase Input Reflection	ANG (S_{11})	+ 180	Degrees
Magnitude Forward Power Gain [2)]	MAG (S_{21})	20	dB
Magnitude Reverse Power Gain [2])	MAG (S_{12})	– 47	dB
Magnitude Output Reflection)	MAG (S_{22})	0.59	
Phase Output Reflection [2])	ANG (S_{22})	+ 147	Degrees

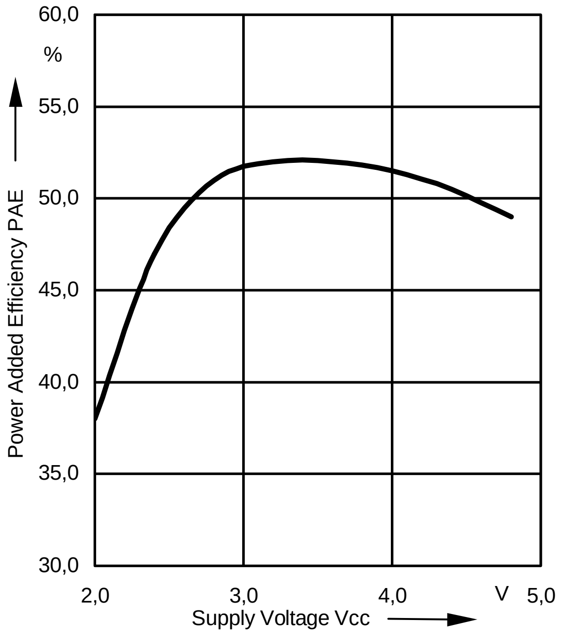
[2]) Measured for small signal conditions in pure 50 Ohm environment.

Typical Device Performance for Reference Design (see Application Note 1)

Valid for all plots: T_A = 25 °C; V_{CC} = 3.2 V; V_{CTR} = 2.5 V; f = 2.4 ... 2.5 GHz;
Z_{IN} = Z_{OUT} = 50 Ohms. Changes from these values noted.

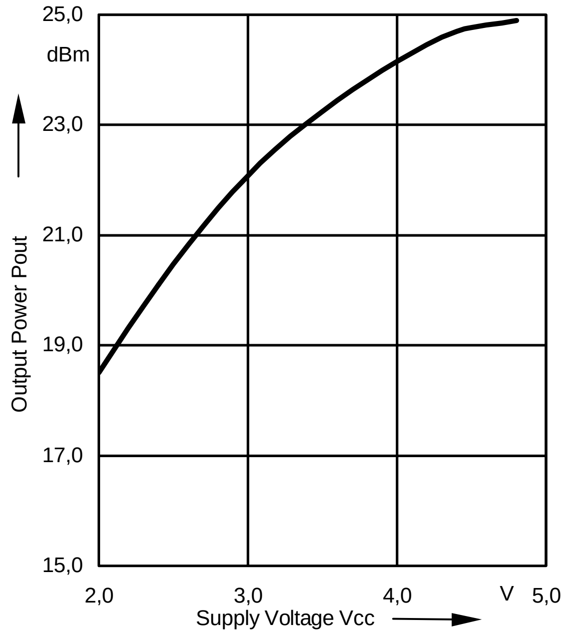
Efficiency $PAE = f(V_{CC})$

P_{IN} = +3dBm



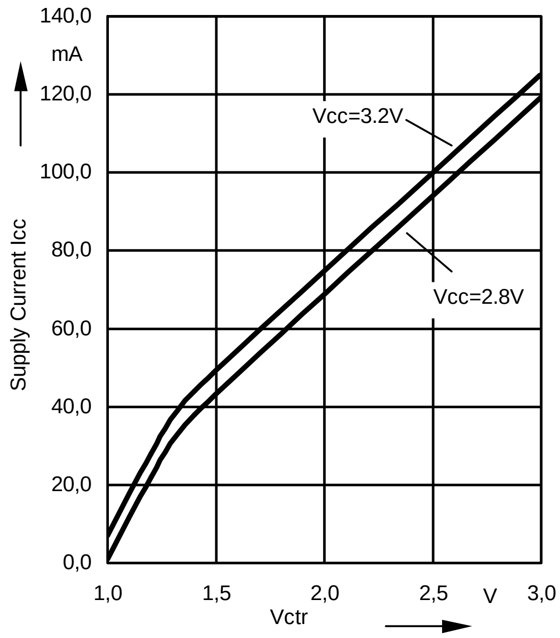
Output Power $P_{OUT} = f(V_{CC})$

P_{IN} = +3dBm



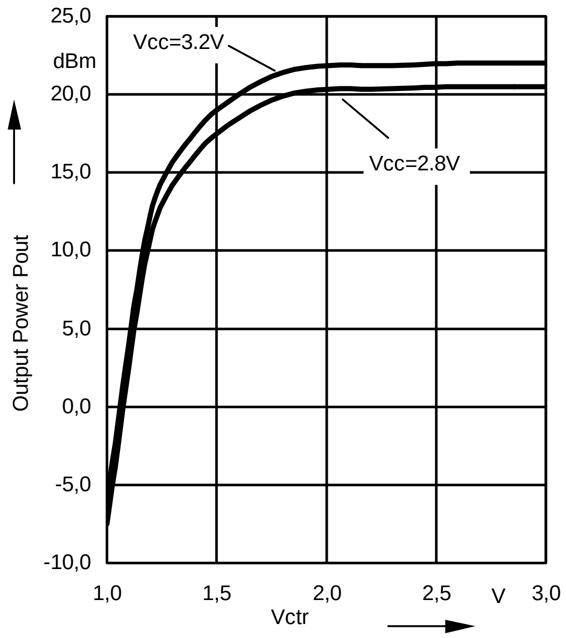
Supply Current $I_{CC} = f(V_{CTR})$

P_{IN} = +3dBm

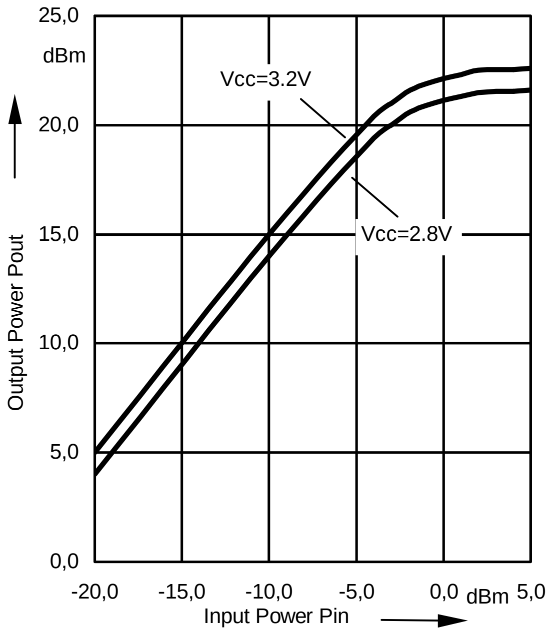


Output Power $P_{OUT} = f(V_{CTR})$

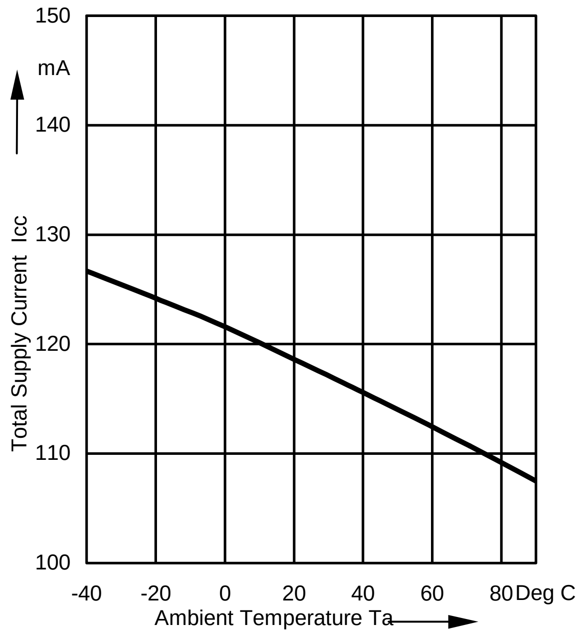
P_{IN} = +3dBm



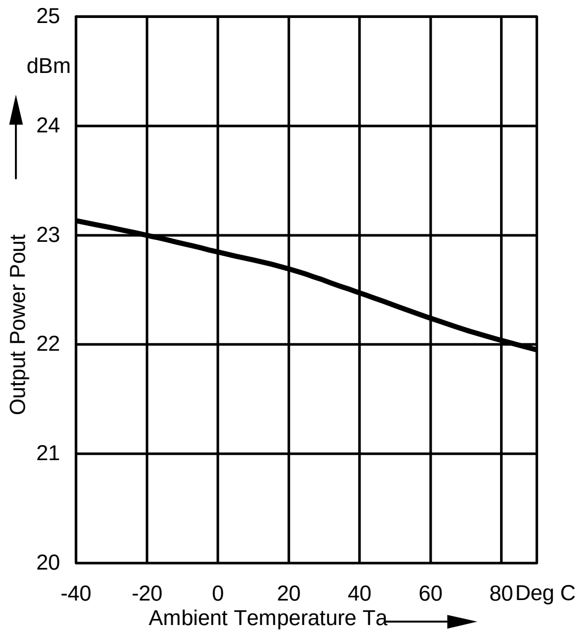
Output Power Compression $P_{OUT} = f(P_{CIN})$
P_{IN} = +3dBm



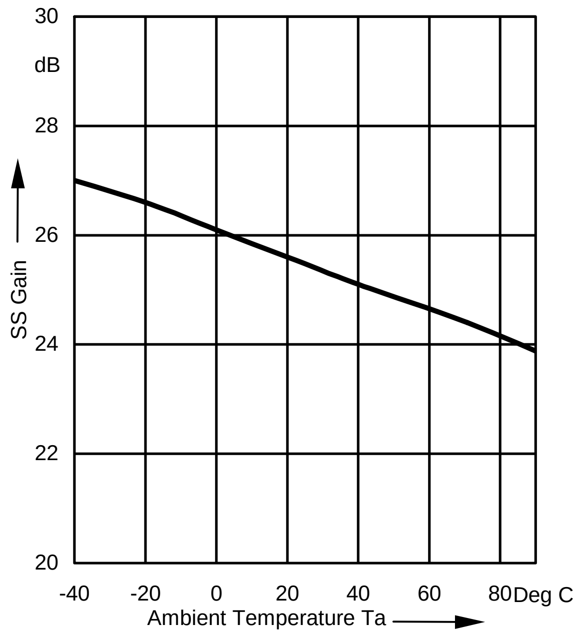
Supply Current $I_{CC} = f(T_A)$
P_{IN} = +3dBm, Vcc = 3.2V



Output Power $P_{OUT} = f(T_A)$
P_{IN} = +3dBm



Small-Signal Gain $S_{21} = f(T_A)$
P_{IN} = -10 dBm, Vcc = 3.2V



Pinning

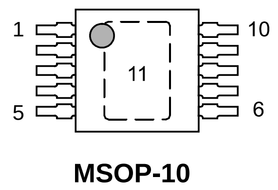


Figure 1 CGB240 Outline

Pad	Symbol	Function
1	V_{C1}	Supply voltage of 1st stage / interstage match
2	V_{C1}	Supply voltage of 1st stage / interstage match
3	RF_{IN}	RF input
4	N.C.	
5	N.C.	
6	V_{CTR1}	Control voltage 1st stage
7	V_{CTR2}	Control voltage 2nd stage
8	V_{C2}	Supply voltage of 2nd stage / RF output
9	V_{C2}	Supply voltage of 2nd stage / RF output
10	N.C.	
11	GND	RF and DC ground (pad located on backside of package) Heatsink. Thermal resistance between junction – pad 11: R_{THCH} = 100 K/W.

Functional Diagram

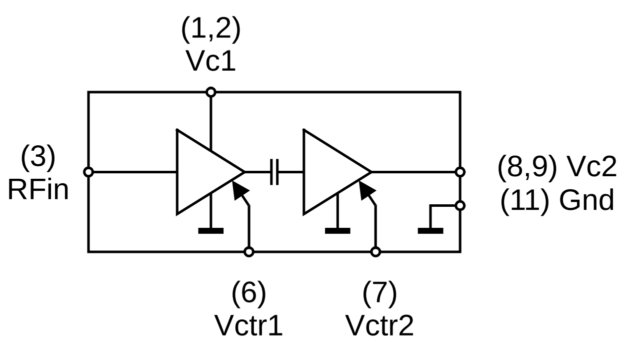


Figure 2 CGB240 Functional Diagram

Application Note 1: Bluetooth CGB240 PA Reference Design (TRL matching)

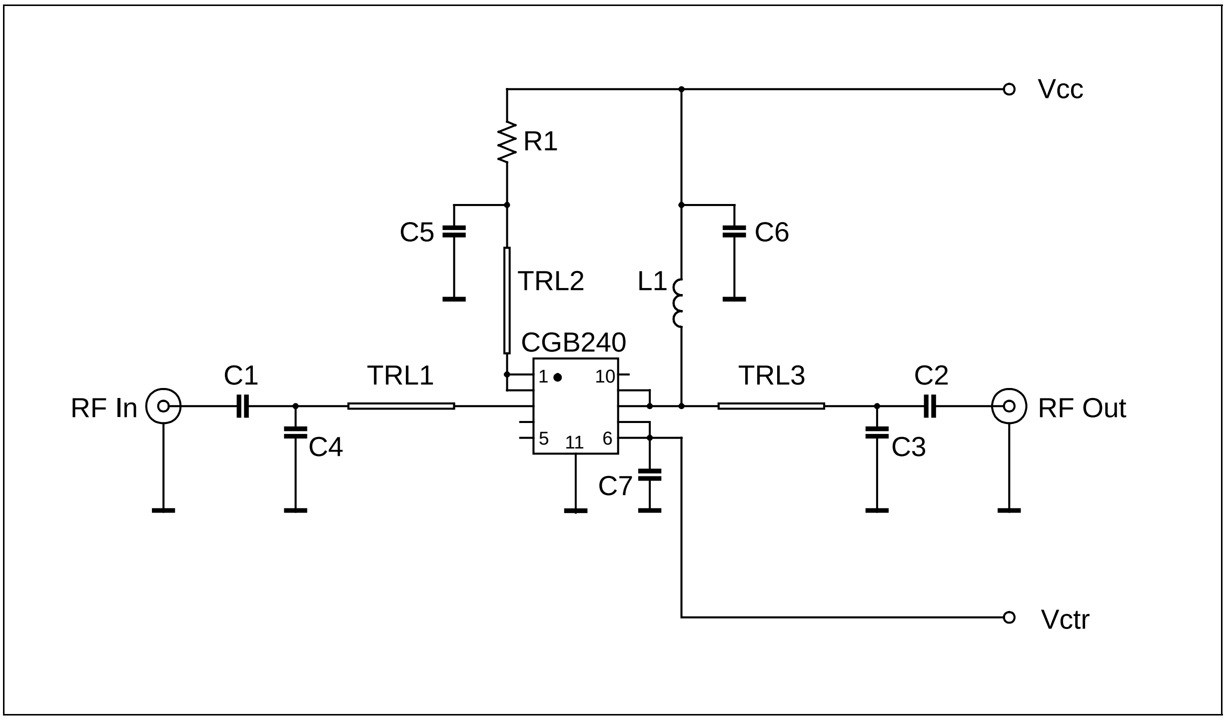


Figure 3 **Schematic of Bluetooth CGB240 PA reference design.**

Part	Type	Value	Outline	Source	Part No.
C1	Cer. Capacitor	22 pF	0402	Murata COG	
C2	Cer. Capacitor	22 pF	0402	Murata COG	
C3)	Cer. Capacitor	1.5 pF	0603	AVX ACCU-P	06035J1R5BBT
C4	Cer. Capacitor	2.2 pF	0402	Murata COG	
C5	Cer. Capacitor	10 pF	0402	Murata COG	
C6	Cer. Capacitor	1 µF	0603	Murata X7R	
C7	Cer. Capacitor	1 nF	0402	Murata X7R	
L1	Inductor	22 nH	0603	Toko	LL1608–FS
R1	Resistor	10 R	0402	Mira	
TRL1)	Microstrip Line	l = 2,5 mm; FR4 substrate; h = 0,2 mm; w = 0,32 mm			
TRL2 [4)]	Microstrip Line	l = 1,8 mm; FR4 substrate; h = 0,2 mm; w = 0,32 mm			
TRL3 [4)]	Microstrip Line	l = 4,0 mm; FR4 substrate; h = 0,2 mm; w = 0,32 mm			

[3]) Cost optimization might take place by using lower-Q AVX-CU capacitors instead of the AccuP version. This will lead to better h_2 performance, however resulting in a loss of about 2% PAE.

[4]) Line length measured from corner of capacitor to end of MMIC's lead.

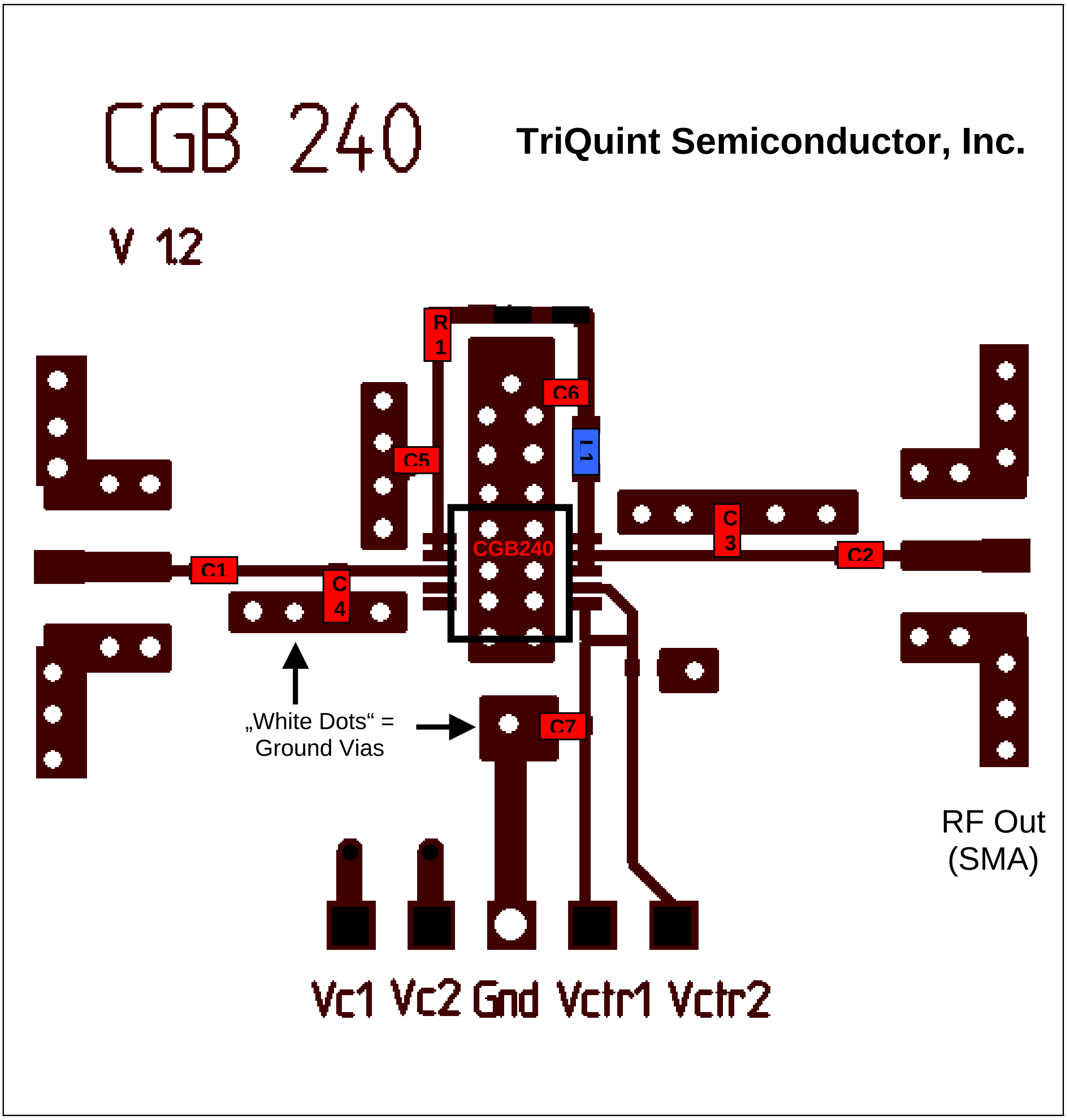


Figure 4 Layout of Bluetooth CGB240 PA reference design using TRL matching (see application note 1).

Vc1 and Vc2 are connected together on the PCB.

Vctr1 and Vctr2 are connected together on the PCB.

Application Note 2: Bluetooth Power Amplifier using Discrete Matching

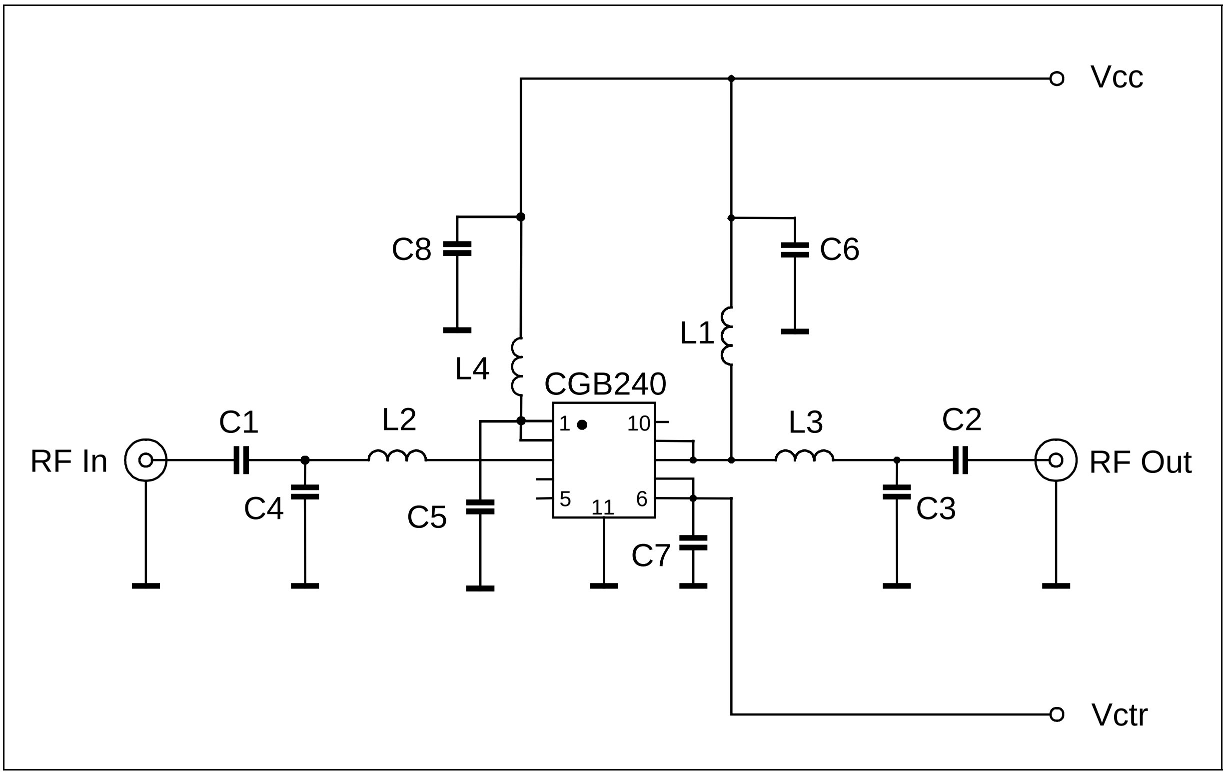


Figure 5 **Bluetooth Amplifier using discrete matching.**

Part	Type	Value	Outline	Source	Part No.
C1	Cer. Capacitor	22 pF	0402	Murata COG	
C2	Cer. Capacitor	22 pF	0402	Murata COG	
C3	Cer. Capacitor	1.5 pF	0603	AVX ACCU-P	06035J1R5BBT
C4	Cer. Capacitor	2.0 pF	0402	Murata COG	
C5	Cer. Capacitor	82 pF	0402	Murata COG	
C6	Cer. Capacitor	0.1 µF	0603	Murata X7R	
C7	Cer. Capacitor	1 nF	0402	Murata X7R	
C8	Cer. Capacitor	0.1 µF	0603	Murata X7R	
L1	Inductor	22 nH	0603	Toko	LL1005–FH22NJ
L2	Inductor	1.0 nH	0402	Coilcraft	0402CS-1N0X_BG
L3	Inductor	1.0 nH	0402	Coilcraft	0402CS-1N0X_BG
L4	Inductor	22 nH	0603	Toko	LL1005–FH22NJ

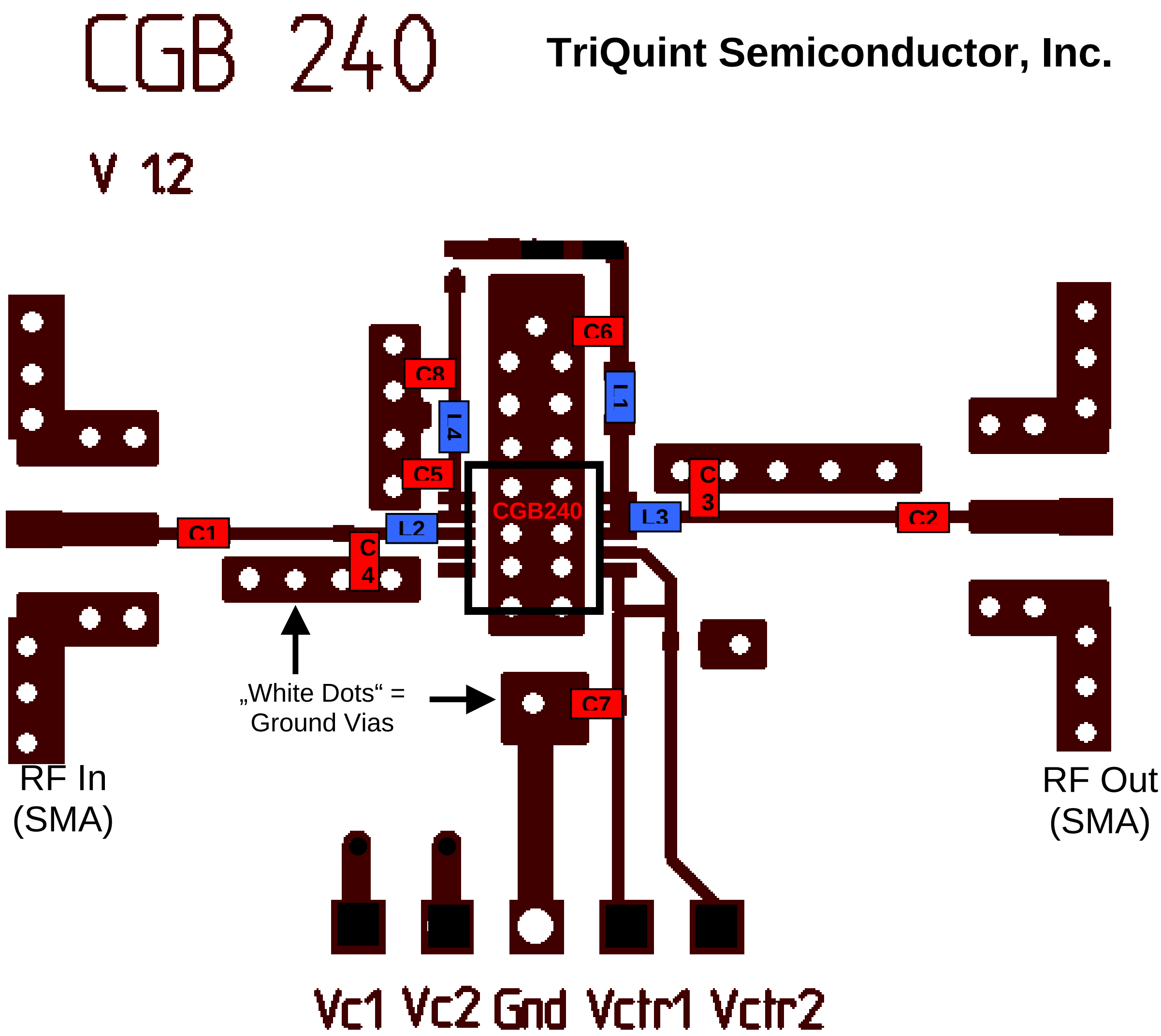
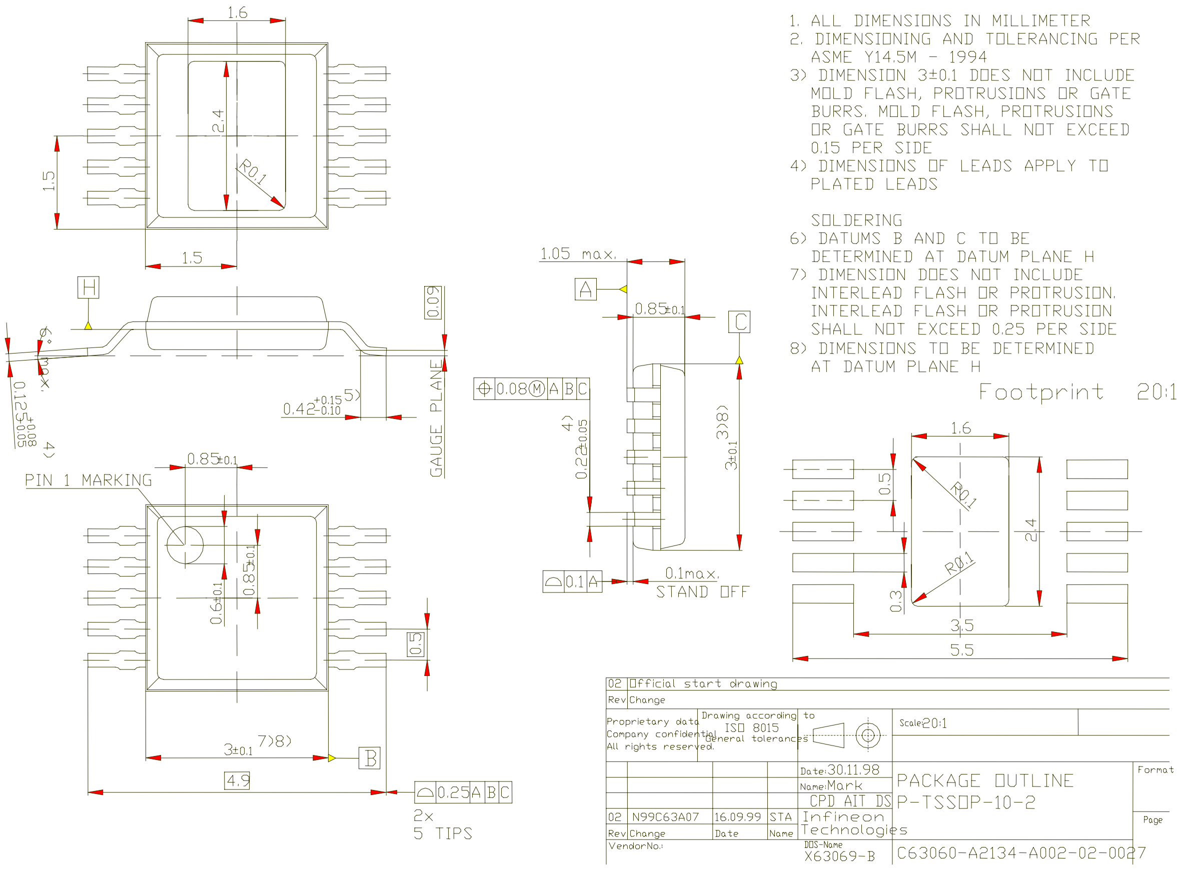


Figure 6 **Layout of CGB240 Bluetooth evaluation board used in application note 2.**

For a discrete matching concept, the same evaluation board (V1.2) as shown in figure 5 might be used. However, to insert the series elements (L2, L3, L4), the pcb lines have to be cut mechanically.

The use of a discrete matching concept saves pcb space but will lead to a lower output power (typ. 0.3dB lower) and higher BOM cost.

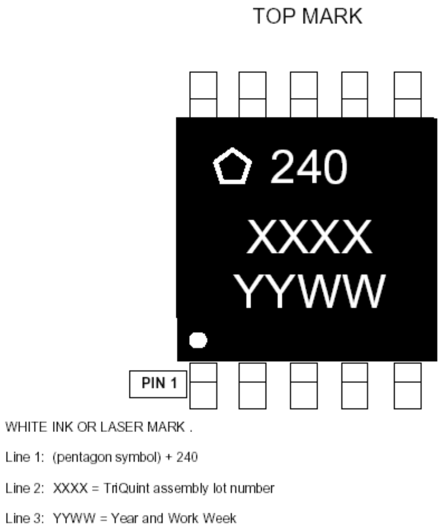
Description of MSOP-10 Package



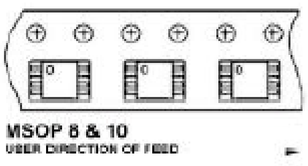
In order to ensure maximum mounting yield and optimal reliability, special soldering conditions apply in volume production. Please ask for our information brochure on details or download the related document (TSSOP10_Soldering_Version01.pdf) from our website.

The TSSOP-10-2 is a level 1 package. International standards for handling this type of package are described in the JEDEC standard J-STD-033 „STANDARD FOR HANDLING, PACKING, SHIPPING AND USE OF MOISTURE/REFLOW SENSITIVE SURFACE-MOUNT DEVICES“, published May-1999. The original document is available from the JEDEC website www.jedec.org .

Part Marking:



Part Orientation on Reel:



Ordering Information:

Type	Marking	Package
CGB240	CGB240	MSOP-10

ESD: **E**lectro**s**tatic **d**ischarge sensitive device
Observe handling precautions !

Additional Information

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

Web: www.triquint.com 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

Revision 1.5-December 16, 2003

Additional Information

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

Web: www.triquint.com   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

Revision 1.5-December 16, 2003