



# CGB241

Data Sheet

## 2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier

### Description:

The CGB241 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, or IEEE 802.11b). Its high power added efficiency (typically 50%) and single positive supply operation makes the device ideally suited to handheld applications. The device delivers 22.5 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.

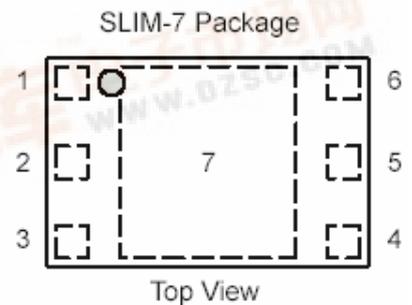
### Features:

- 2-stage Bluetooth InGaP HBT power amplifier
- Single voltage supply
- Wide operating voltage range 2.0 - 5.5 V
- $P_{OUT} = 22.5$  dBm at  $V_C = 3.2$  V
- Overall power added efficiency ( *PAE* ) typically 50%
- Analog power control with four power steps
- High *PAE* at low-power mode
- High harmonic suppression typ. 35 dBc
- Easy external matching concept
- Thin Small Leadless Package ( $A = 2.6\text{mm}^2$ )

### Applications:

- Bluetooth Class 1
- Home RF
- Cordless Phones
- IEEE 802.11b
- ISM-band Spread Spectrum

### Package Outline:



### Pin Configuration:

- |             |              |
|-------------|--------------|
| 1:          | $V_{c1}$     |
| 2:          | RFin         |
| 3:          | NC           |
| 4:          | $V_{cntrl1}$ |
| 5:          | $V_{cntrl2}$ |
| 6:          | $V_{c2}$     |
| 7 (paddle): | GND          |



**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

**Absolute Maximum Ratings**

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Max. Supply Voltage	$V_{CC,MAX}$	0	5.5	V
Max. Control Voltage	$V_{CTR,MAX}$	0	3.2	V
Max. Current Stage 1	$I_{C1,MAX}$	0	40	mA
Max. Current Stage 2	$I_{C2,MAX}$	0	160	mA
Max. Total Power Dissipation <sup>1)</sup>	$P_{TOT}$		0.5	W
Max. RF Input Power <sup>2)</sup>	$P_{IN,MAX}$		+10	dBm
Channel Temperature <sup>1)</sup>	$T_{Ch}$		150	°C
Storage Temperature	$T_{Stg}$	- 55	150	°C

<sup>1)</sup> Thermal resistance between junction and pad 7 (= heatsink ):  $R_{THCH} = 100$  K/W.

<sup>2)</sup> No RF input signal should be applied at turn on of DC Power. An output VSWR of 1:1 is assumed.

**Typical Electrical Characteristics in CGB241 Reference Design**

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

Parameter	Symbol	Limit Values			Unit	Test Conditions
		min	typ	max		
Supply Current Small-Signal Operation	$I_{CC,SS}$		120	150	mA	$P_{IN} = -10$ dBm $V_{CTR} = 2.5$ V
Power Gain Small-Signal Operation	$G_{SS}$	24	26		dB	$P_{IN} = -10$ dBm $V_{CTR} = 2.5$ V
Output Power Power Step 1	$P_{OUT,1}$		3		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	$PAE_1$		7		%	$P_{IN} = +3$ dBm $V_{CTR} = 1.15$ V
Output Power Power Step 2	$P_{OUT,2}$		12		dBm	$P_{IN} = +3$ dBm $V_{CTR} = 1.3$ V
Supply Current Power Step 2	$I_{CC,2}$		30		mA	$P_{IN} = +3$ dBm $V_{CTR} = 1.3$ V
Power Added Efficiency Power Step 2	$PAE_2$		15		%	$P_{IN} = +3$ dBm $V_{CTR} = 1.3$ V

**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

**Electrical Characteristics in CGB241 Reference Design (cont.)**

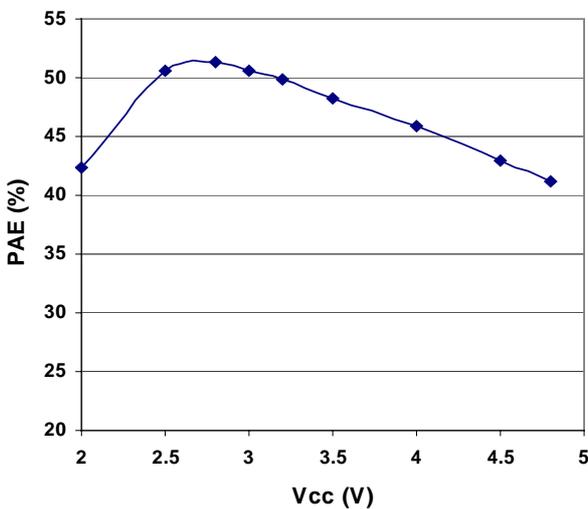
Parameter	Symbol	Limit Values			Unit	Test Conditions
		Min	typ	max		
Output Power Power Step 3	$P_{OUT,3}$		17		dBm	$P_{IN} = +3 \text{ dBm}$ $V_{CTR} = 1.5 \text{ V}$
Supply Current Power Step 3	$I_{CC,3}$		52		mA	$P_{IN} = +3 \text{ dBm}$ $V_{CTR} = 1.5 \text{ V}$
Power Added Efficiency Power Step 3	$PAE_3$		30		%	$P_{IN} = +3 \text{ dBm}$ $V_{CTR} = 1.5 \text{ V}$
Output Power Power Step 4	$P_{OUT,4}$	22.0	22.5		dBm	$P_{IN} = +3 \text{ dBm}$ $V_{CTR} = 2.5 \text{ V}$
Supply Current Power Step 4	$I_{CC,4}$		130	170	mA	$P_{IN} = +3 \text{ dBm}$ $V_{CTR} = 2.5 \text{ V}$
Power Added Efficiency Power Step 4	$PAE_4$	40	50	-	%	$P_{IN} = +3 \text{ dBm}$ $V_{CTR} = 2.5 \text{ V}$
2 <sup>nd</sup> Harm. Suppression Power Step 4	$h_2$		-35	-10	dBc	$P_{IN} = +3 \text{ dBm}$ $V_{CTR} = 2.5 \text{ V}$
Turn-Off Current	$I_{CC,OFF}$		0.5		uA	$V_{CC} = n/c$ $V_{CTR} < -2.0 \text{ V}$ No RF Input
Off-State Isolation	$S_{21,0}$		26		dB	$P_{IN} = +3 \text{ dBm}$ $V_{CTR} = 0 \text{ V}$
Stable Load VSWR (no oscillation for any phase of load)	VSWR			6		$P_{IN} = +3 \text{ dBm}$ $V_{CC} = 3.2 \text{ V}$ $V_{CTR} = 2.5 \text{ V}$ $Z_{IN} = 50 \text{ Ohms}$
Maximum Load VSWR (no damage to device) allowed for 10s RF must not be applied before DC is turned on !	VSWR			6		$P_{IN} = +5 \text{ dBm}$ $V_{CC} = 4.8 \text{ V}$ $V_{CTR} = 2.5 \text{ V}$ $Z_{IN} = 50 \text{ Ohms}$

**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

**Typical Device Performance**

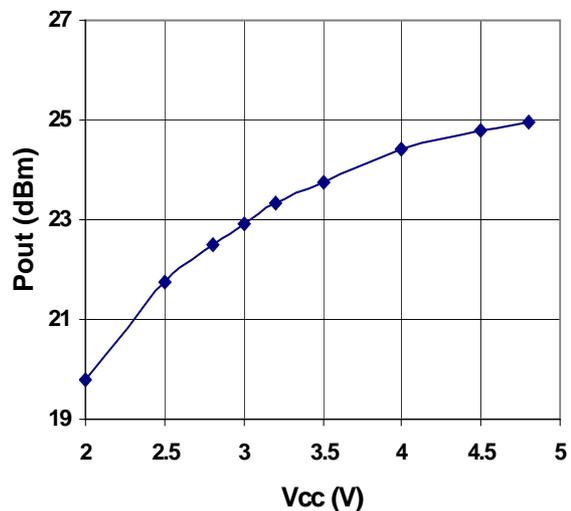
**PAE versus Vcc**

Vctrl: 2.5V; Pin: +3 dBm @ 2.45 GHz



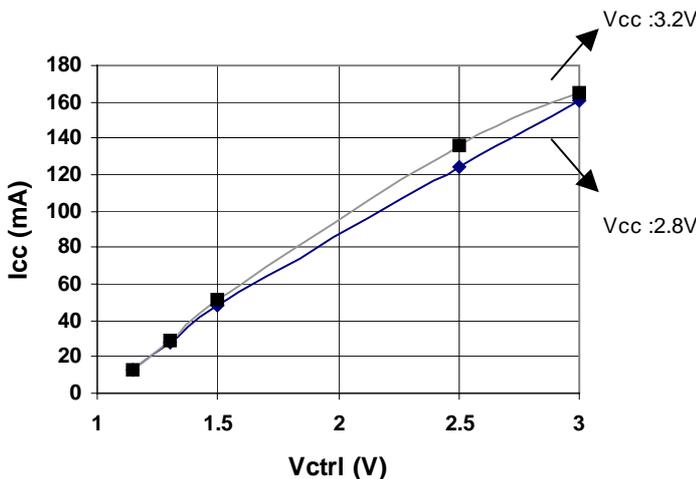
**Pout versus Vcc**

Vctrl: 2.5V; Pin: +3 dBm @ 2.45 GHz



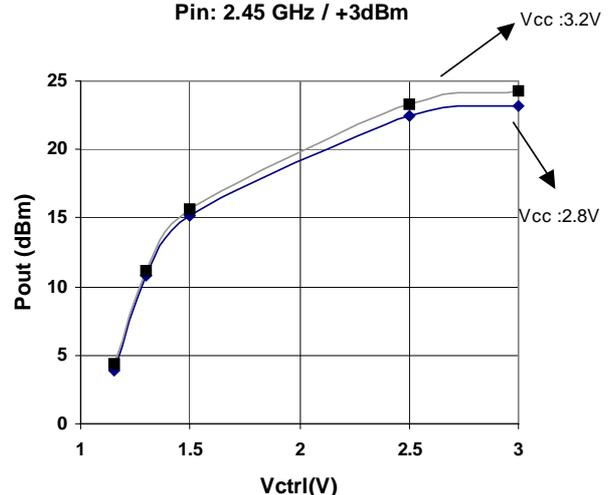
**Supply Current  $I_{CC} = f(V_{CTR})$**

**Icc vs Vctrl**  
Pin: 2.45GHz / +3dBm



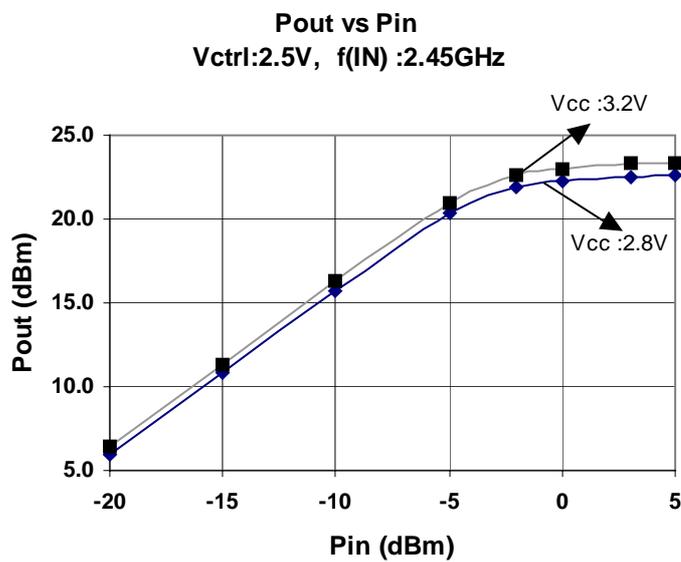
**Output Power  $P_{OUT} = f(V_{CTR})$**

**Pout vs Vctrl**  
Pin: 2.45 GHz / +3dBm



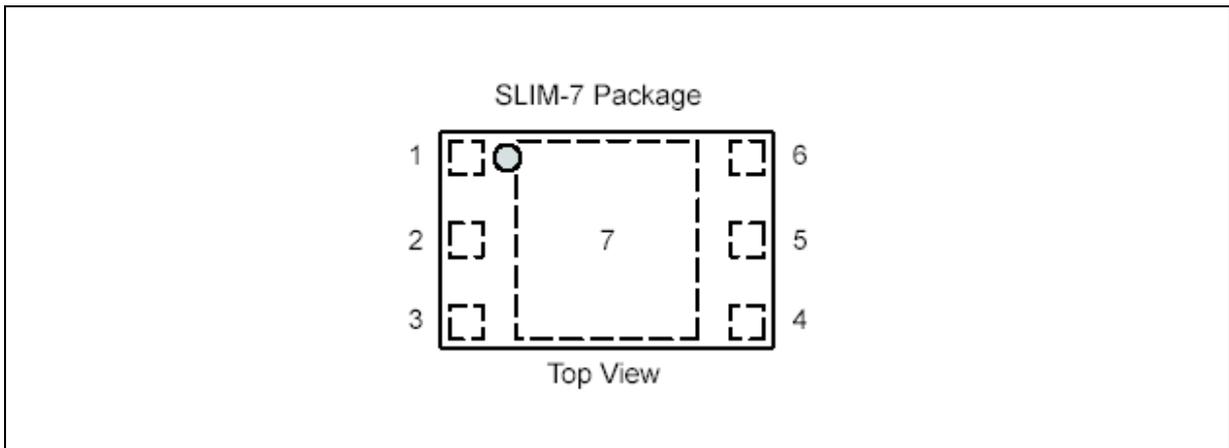
**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

Output Power Compression  $P_{OUT} = f(P_{IN})$



**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

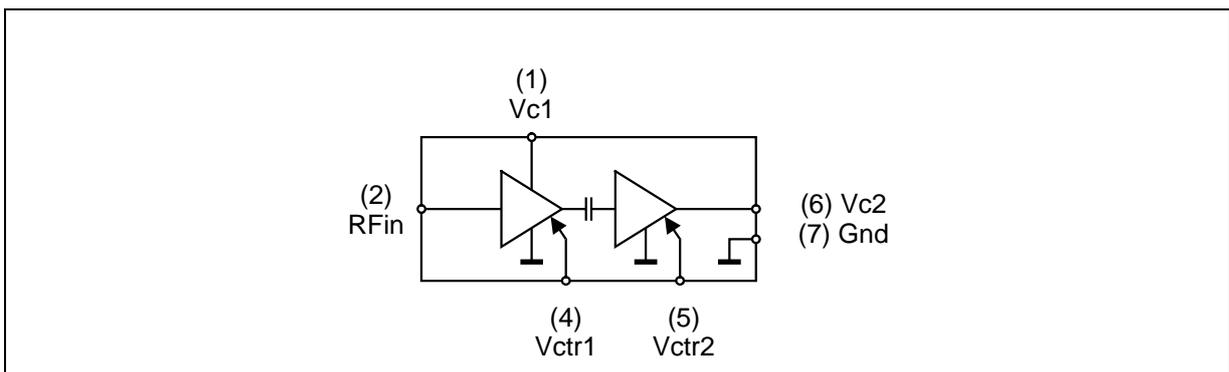
**Pinning**



**Figure 1 CGB241 Outline: SLIM-7 Package**

Pad	Symbol	Function
1	$V_{C1}$	Supply voltage of 1 <sup>st</sup> stage / interstage match
2	$RF_{IN}$	RF input
3	NC	No connection; It is recommended to ground this pad as short as possible e.g. by a via under the pad.
4	$V_{CTR1}$	Control voltage 1 <sup>st</sup> stage
5	$V_{CTR2}$	Control voltage 2 <sup>nd</sup> stage
6	$V_{C2}$	Supply voltage of 2 <sup>nd</sup> stage / RF output
7	GND	RF and DC ground (pad located on backside of package) Heatsink. Thermal resistance between junction – pad 7: $R_{THCH} = 100$ K/W.

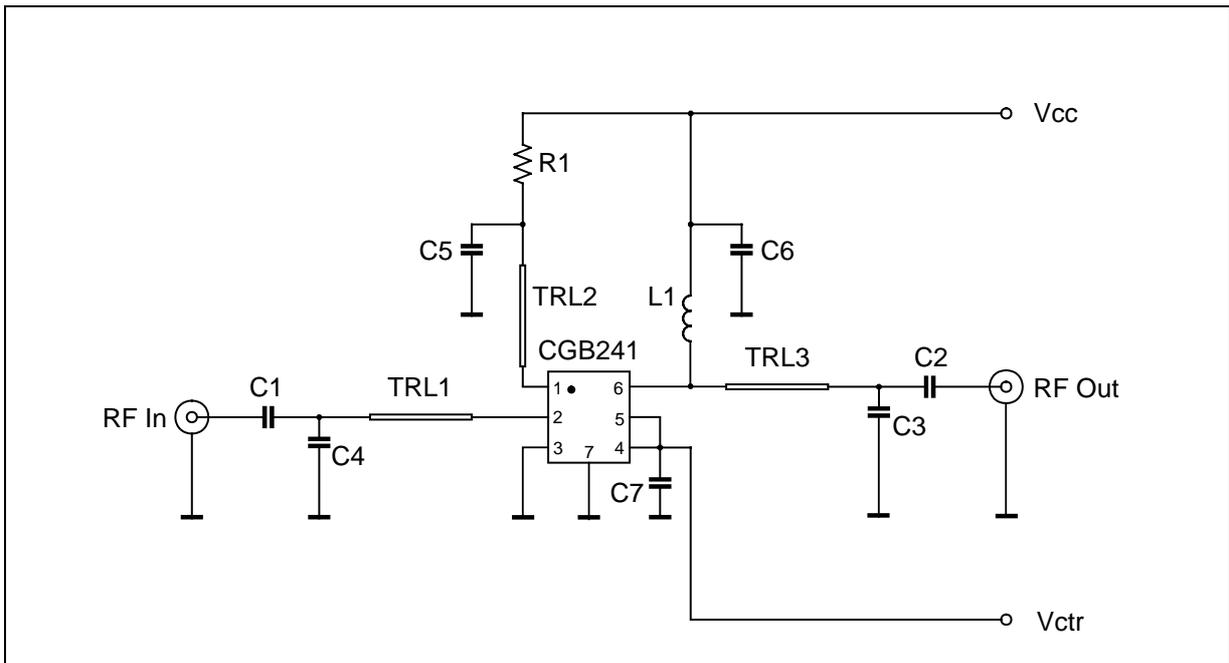
**Functional Diagram**



**Figure 2 CGB241 Functional Diagram**

**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

**Application Note 1: CGB241 Reference Design**

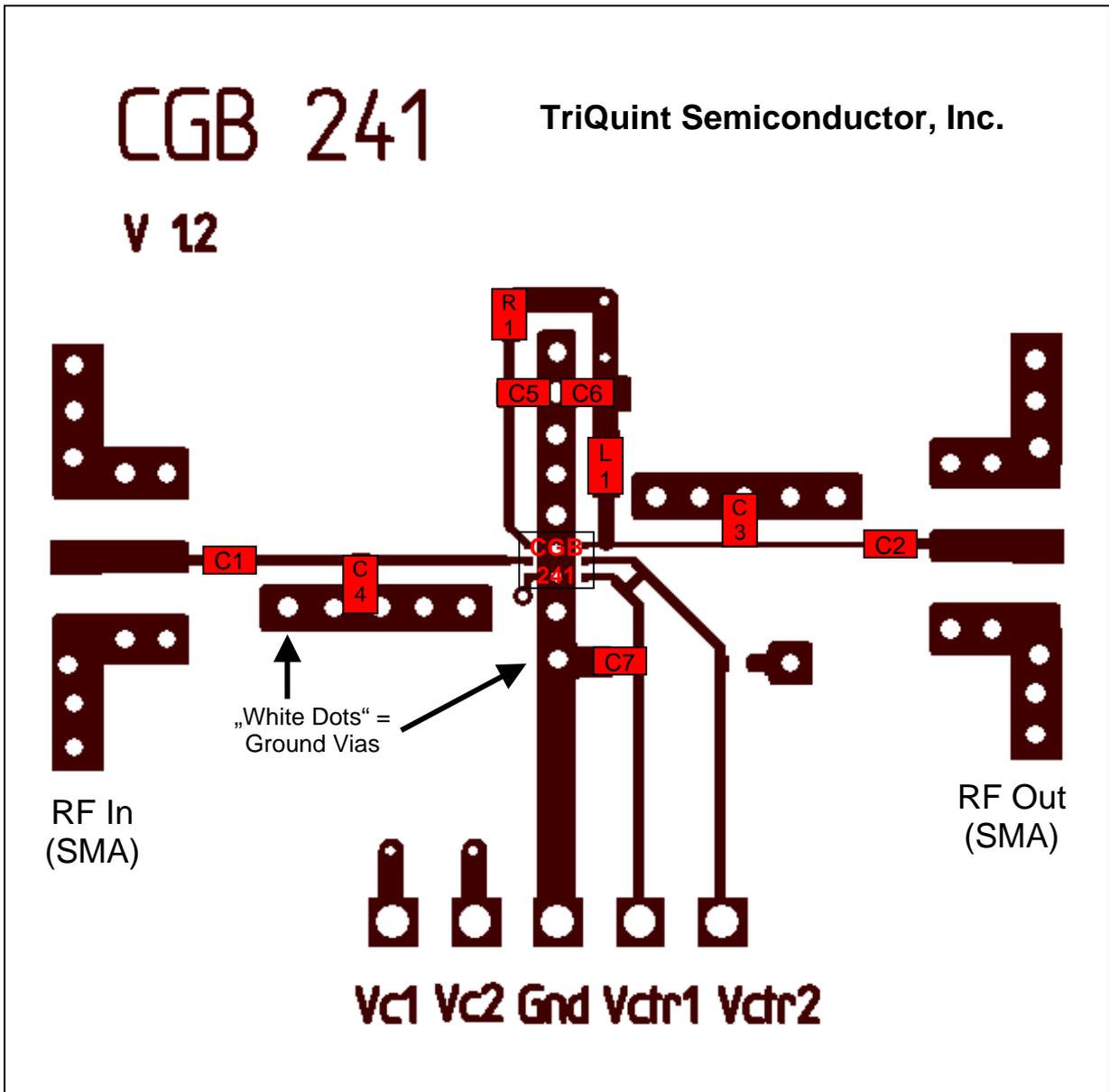


**Figure 3 Schematic of CGB241 reference design.**

Part	Type	Value	Outline	Source	Part No.
C1	Cer. Capacitor	22 pF	0402	Murata COG	
C2	Cer. Capacitor	22 pF	0402	Murata COG	
C3 <sup>4)</sup>	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	FR4 substrate; $h = 0,2$ mm; $w = 0,32$ mm			
TRL2	Microstrip Line	FR4 substrate; $h = 0,2$ mm; $w = 0,32$ mm			
TRL3	Microstrip Line	FR4 substrate; $h = 0,2$ mm; $w = 0,32$ mm			

<sup>4)</sup> 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. Line length  $l$  is the total distance from the corner of tuning capacitor to the corner of MMIC's package. Length of bend structures measured in the middle of the corresponding conductor.

**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**



**Figure 4** Layout of CGB241 reference design.

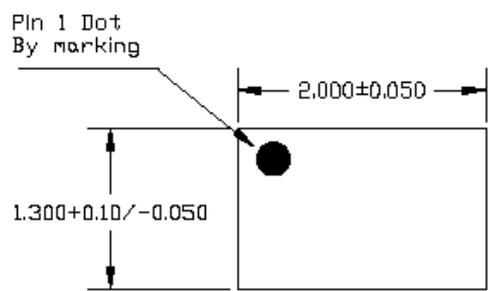
Notes:

Vc1 and Vc2 are connected together on the PCB.

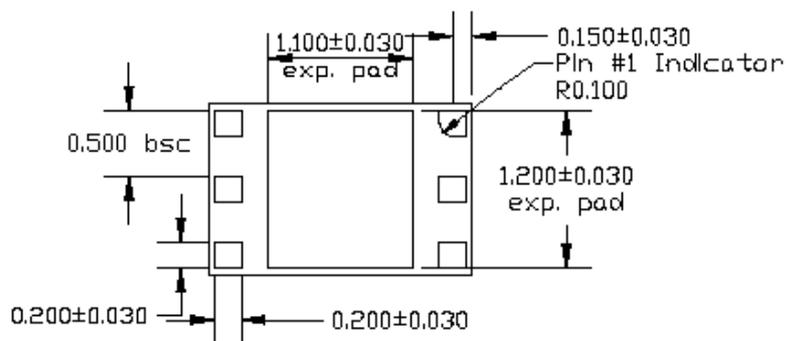
Vctr1 and Vctr2 are connected together on the PCB.

**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

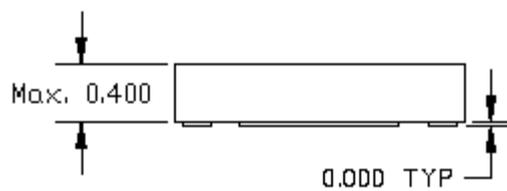
**Package Outline of SLIM-7 Package**



Top View



Bottom View



Side View

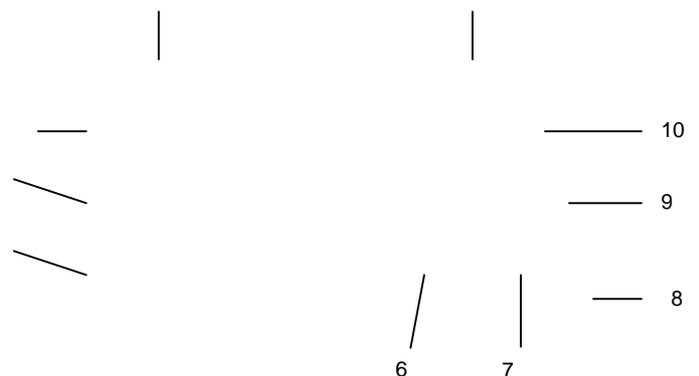
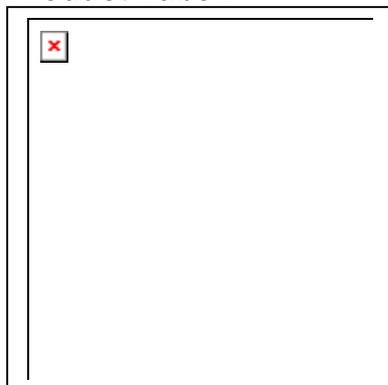
**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

**Part Marking:**



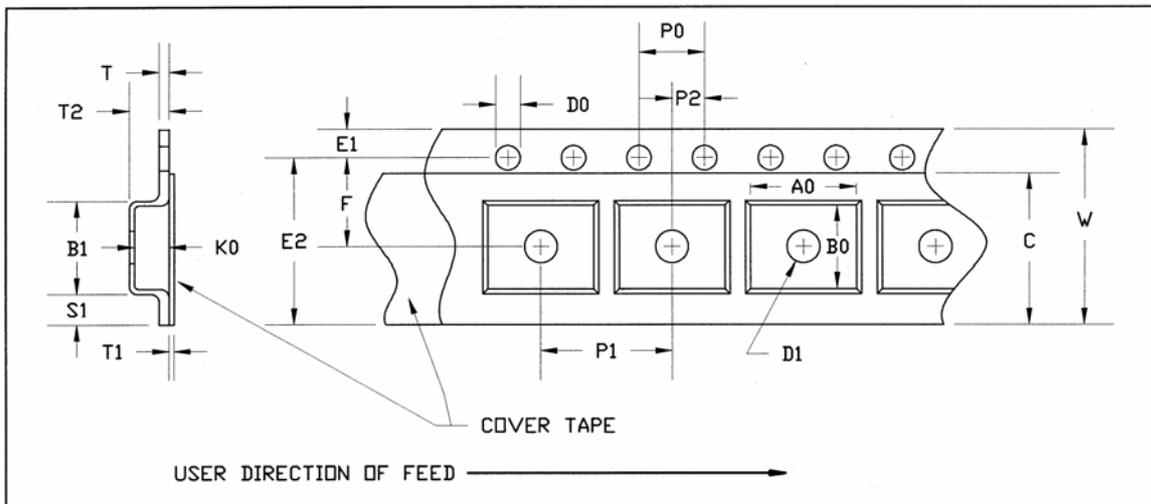
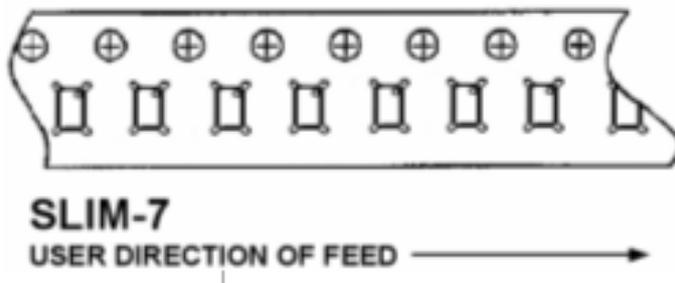
White Ink or Laser Mark; XXXX = last 4 digits of lot code.

**Product Label:**



**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

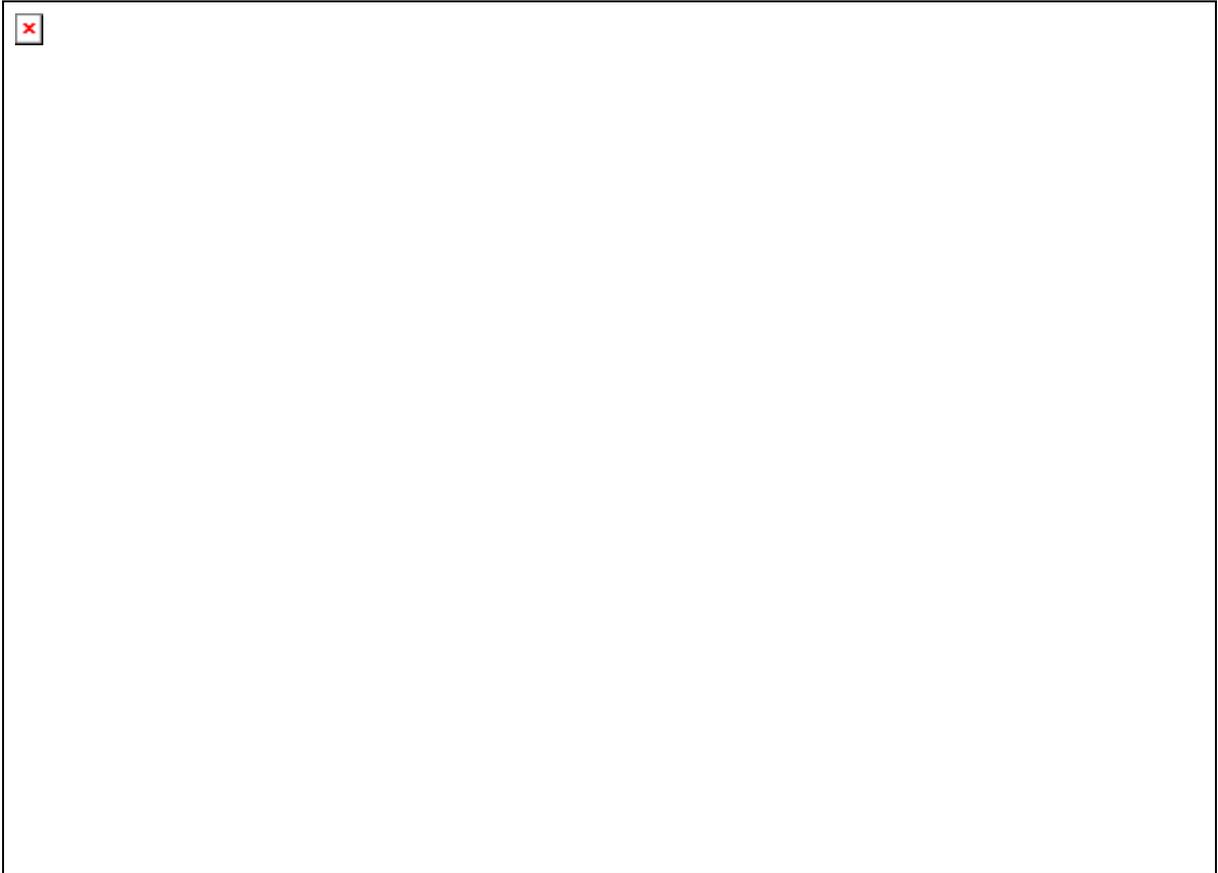
**Tape and Reel Information:**



PART	FEATURE	SYMBOL	SIZE (in)	SIZE (mm)
CAVITY	LENGTH	A0	0.062	1.57
	WIDTH	B0	0.087	2.21
	DEPTH	K0	0.023	0.59
	PITCH	P1	0.157	4.00
DISTANCE BETWEEN CENTERLINE	CAVITY TO PERFORATION LENGTH DIRECTION	P2	0.079	2.00
	CAVITY TO PERFORATION WIDTH DIRECTION	F	0.138	3.50
COVER TAPE	WIDTH	C	0.213	5.40
CARRIER TAPE	WIDTH	W	0.315	8.00

**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

Carton Label:



**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

**Packing List Label:**



**2-Stage Bluetooth & WLAN InGaP HBT Power Amplifier**

**Ordering Information:**

Type	Marking	Package
CGB241	XXXX	SLIM-7

**ESD:** Electrostatic discharge sensitive device  
Observe handling precautions!

**Moisture:** The CGB241 is rated Moisture Sensitivity Level 1 at 260°C per JEDEC Standard IPC/JEDEC J-STD-020.

**RoHS:** The CGB241 is compliant with RoHS Directive (Restrictions on the use of certain Hazardous Substances in Electrical and Electronic Equipment).

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**Additional Information**

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