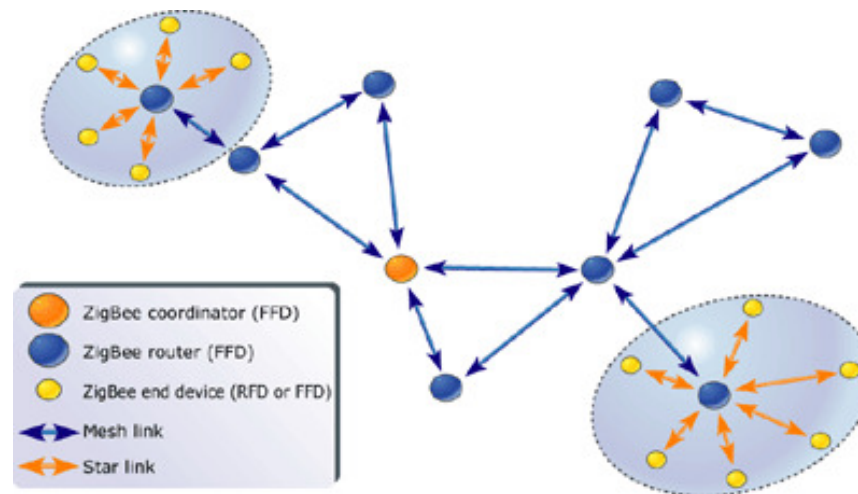


## NEC / CEL Components

For

## 2.4GHz ZigBee and ISM Band Applications



# Components for 2.4 GHz Designs

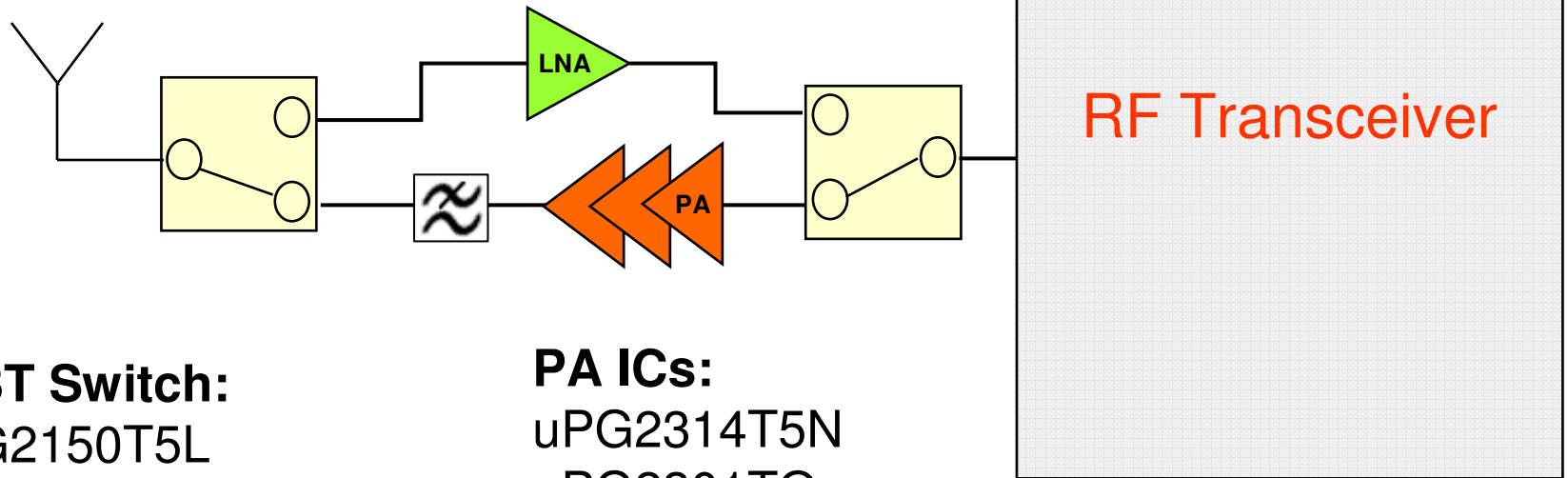
## Bluetooth, ZigBee, ISM Band Transmitters

**SPDT Switches\*:**

- uPG2214TB/TK
- uPG2030TK
- uPG2179TB
- uPG2158T5K
- uPG2012TK
- uPG2015TB

**LNA Devices:**

- NESG3031M05/M14
- NE662M04
- NE3508M04
- uPC8233TK



**SP3T Switch:**

- uPG2150T5L

**PA ICs:**

- uPG2314T5N
- uPG2301TQ
- uPG2250T5N

\*See page on power considerations for switches

## Quick Guide:

P/N	Pout (typical, at T=25C)
uPG2314T5N:	+20 dBm at 3V
uPG2301TQ:	+23 dBm at 3.3V
uPG2250T5N:	+20 dBm at <b>1.8V</b>
uPG2250T5N:	+25 dBm at 3V

## uPG2314T5N

In  
Mass Production**Features**

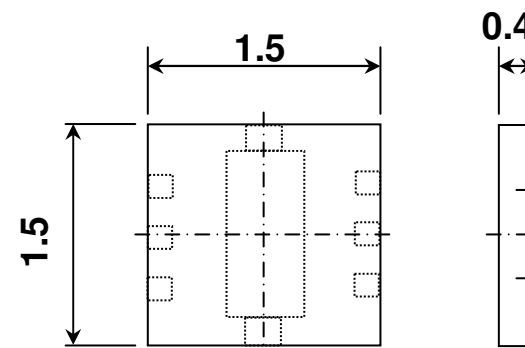
- **Low Current Consumption**
- 20dB Variable Gain Control
- Shut Down Function
- **Smaller & Lower Height Package**

**Applications**

- Bluetooth Class 1, ZigBee, ISM Band

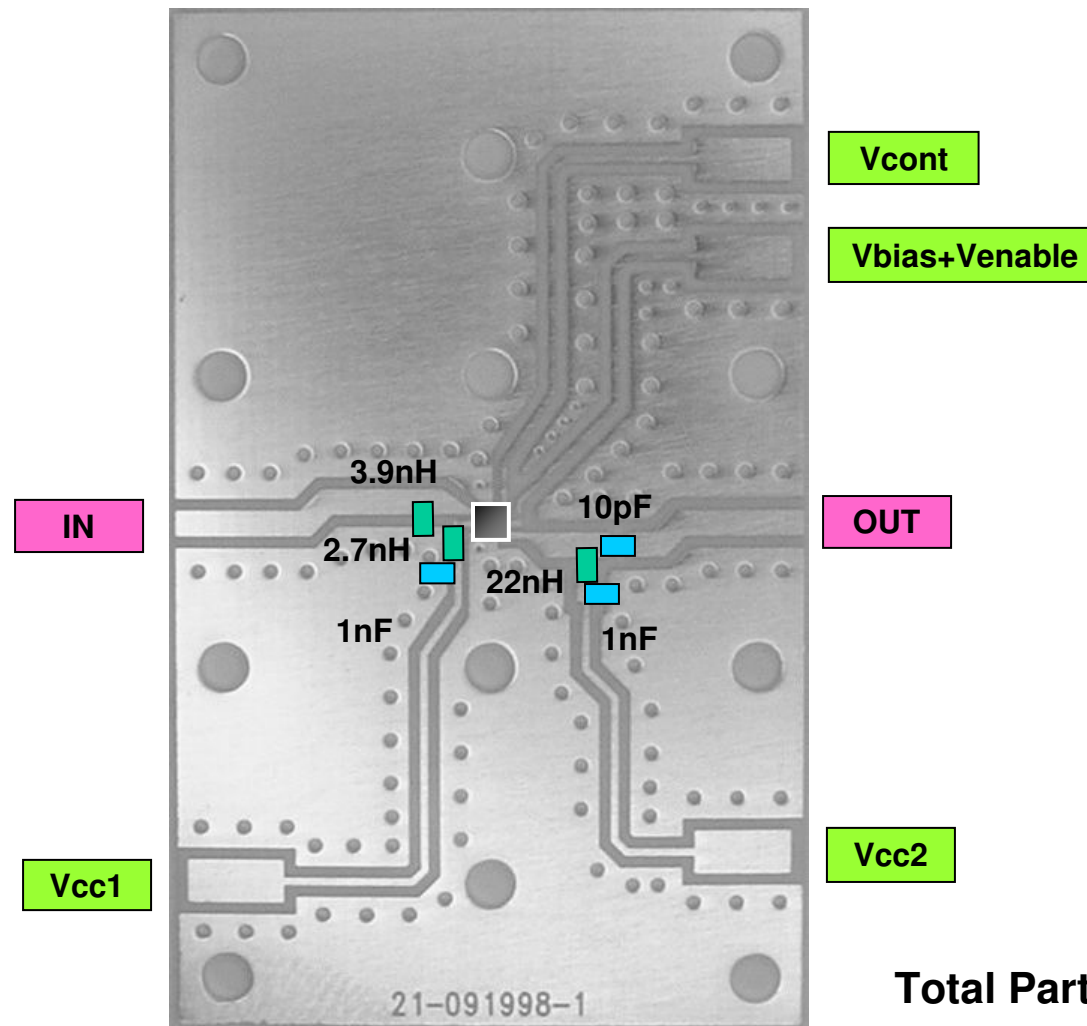
**Performance (typical )**

- Frequency: 2.4 to 2.5GHz
- Supply voltage:  $V_{CC1,2} = V_{bias} = V_{enable} = 3V$
- Output Power: +20dBm @  $V_{cont} = 3V$ ,  $P_{in} = +0dBm$
- Gain Control Range:  $\Delta G = 20dB$  @  $V_{cont} = 0$  to 3.0V,  $P_{in} = +0dBm$
- Operating Current: **65 mA typ.** @  $P_{in} = +0dBm$ ,  $V_{cont} = 3V$



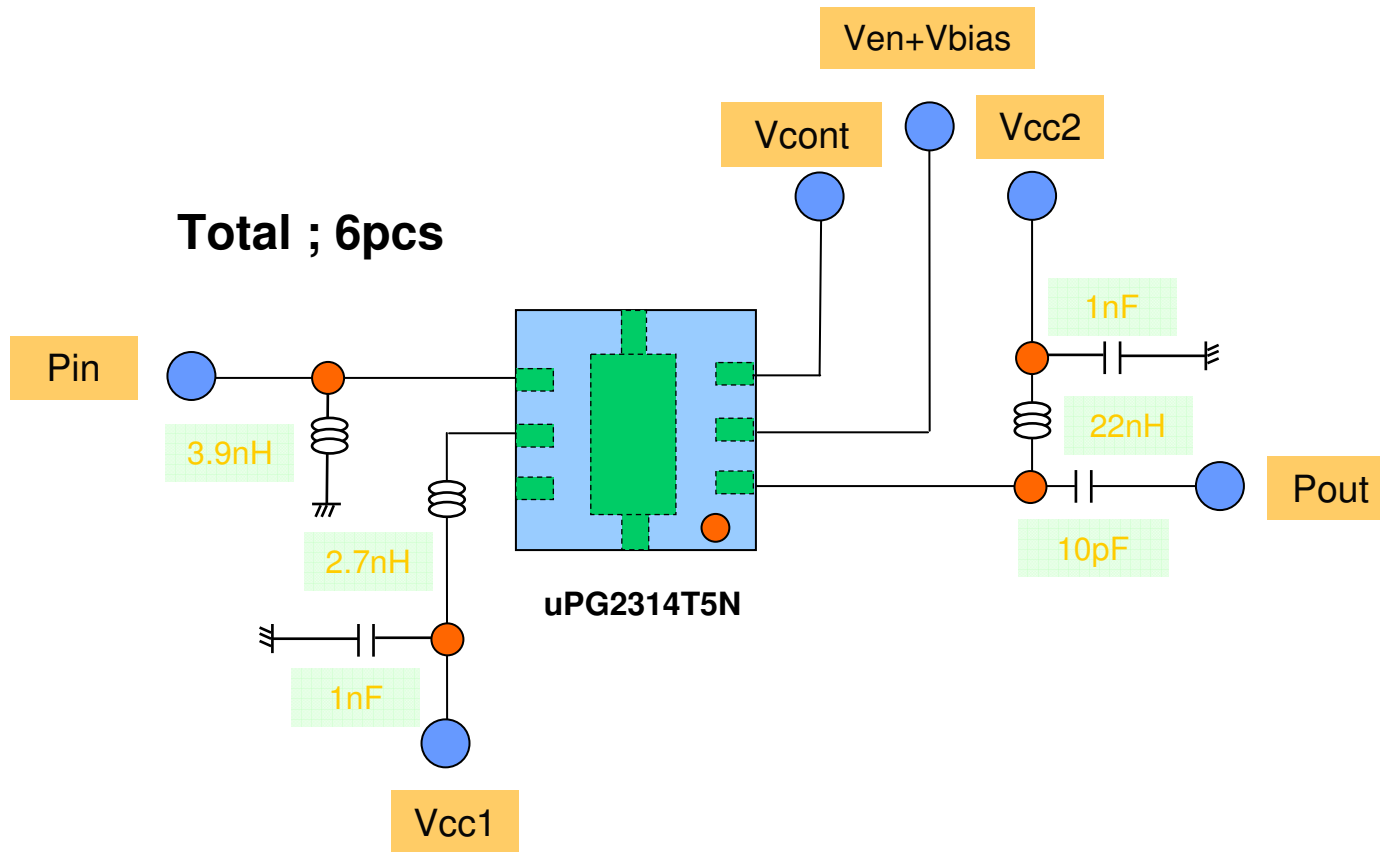
6-pinTSON PKG

Thickness: 0.4mm max.



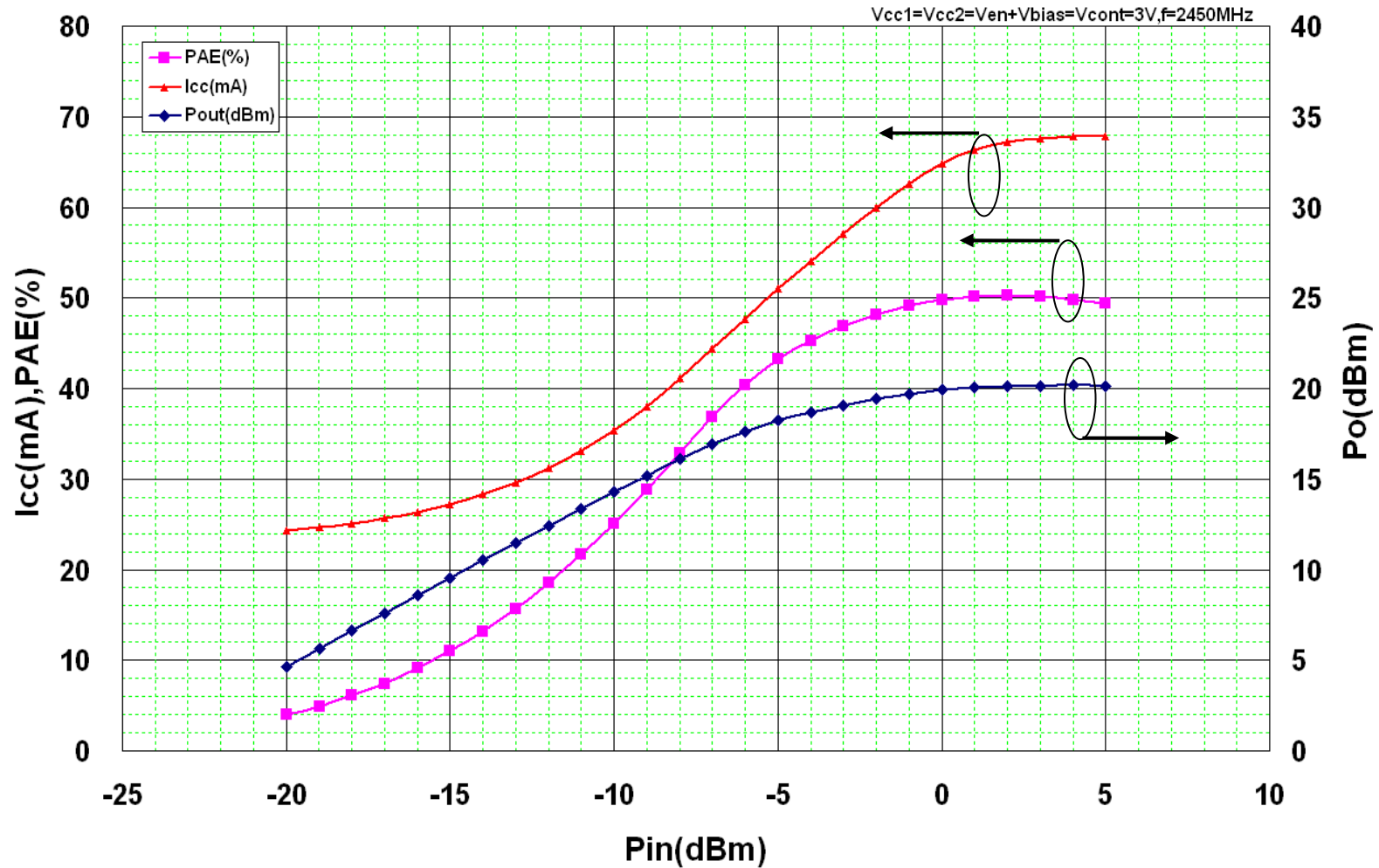
**Total Parts : 6pcs**

# CEL uPG2314T5N Evaluation Board Schematic



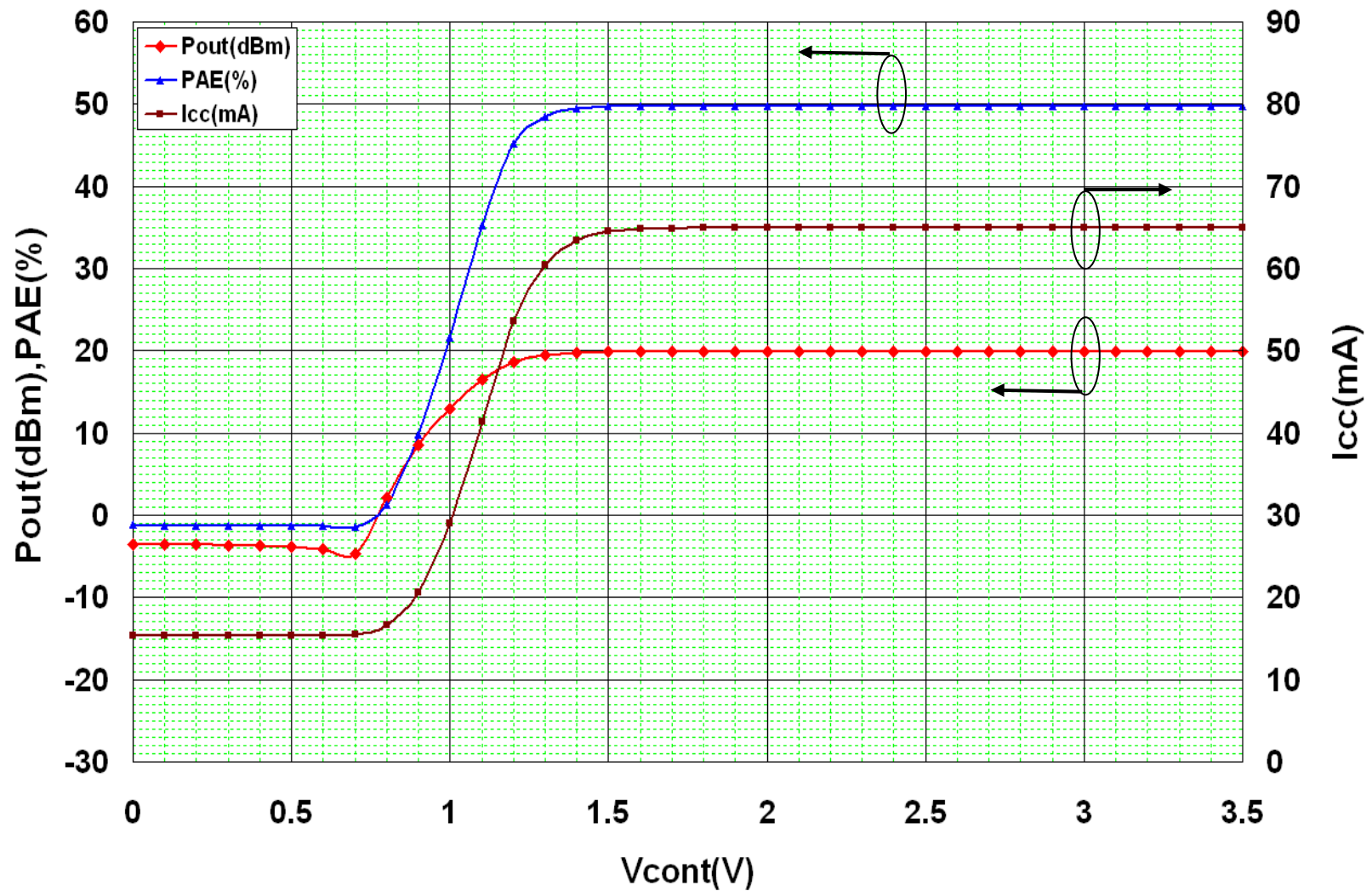
# uPG2314T5N Pin vs. Pout, PAE, Icc

**Test Conditions** :  $f = 2450\text{MHz}$ ,  $V_{cc1}=V_{cc2}=V_{bias}+V_{enable}=V_{cont}=3.0\text{V}$ ,  
with external input & output matching circuits



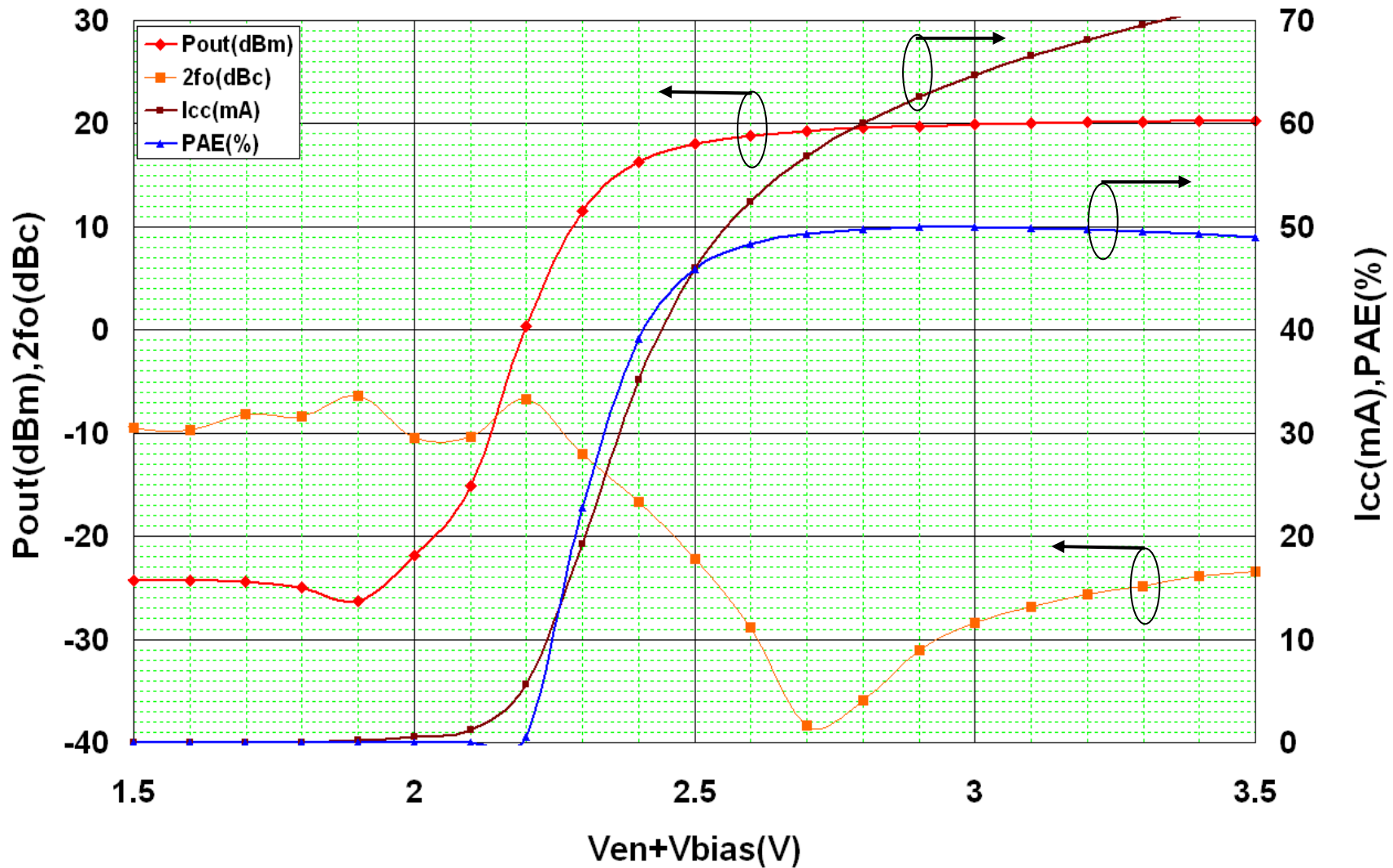
# uPG2314T5N Vcont vs. Pout, PAE, Icc

Test Conditions :  $f = 2450\text{MHz}$ ,  $V_{cc1}=V_{cc2}=V_{bias}+V_{enable}=3.0\text{V}$ ,  
 $P_{in}=+0\text{dBm}$ , with external input & output matching circuits





Test Conditions :  $f = 2450\text{MHz}$ ,  $V_{cc1}=V_{cc2}=V_{cont}=3.0\text{V}$ ,  
 $P_{in}=+0\text{dBm}$ , with external input & output matching circuits



## uPG2301TQ

In  
Mass Production

### Features

- Low Current Consumption
- 20dB Variable Gain Control
- Shut Down Function

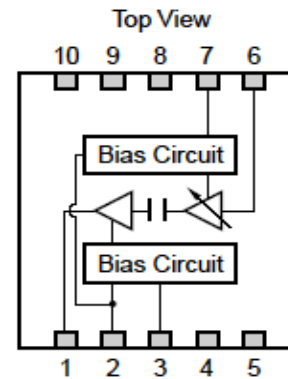
### Applications

- Bluetooth, ZigBee, ISM Band

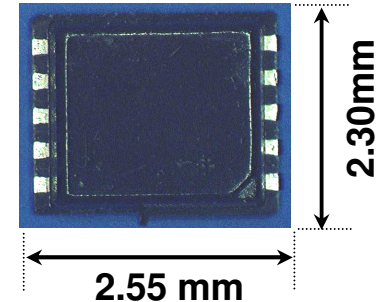
### RF Performance (typical)

- Frequency: 2.4 to 2.5GHz
- Supply voltage:  $V_{CC1,2} = V_{bias} = 3.3V, V_{enable} = 2.9V$
- Output Power: **+23dBm** @  $V_{cont} = 2.5V, P_{in} = +4dBm$
- Gain Control Range: 23dB @  $V_{cont} = 0$  to 2.5V,  $P_{in} = +4dBm$
- Operating Current: 120mA typ. @  $P_{in} = +4dBm, V_{cont} = 2.5V$
- Harmonics @ +20dBm Output,  $V_{cc} = 3.3V, I_{cc} = 100mA$

$2f_0$	49 dBc
$3f_0$	40 dBc
$4f_0$	54 dBc
$5f_0$	60 dBc



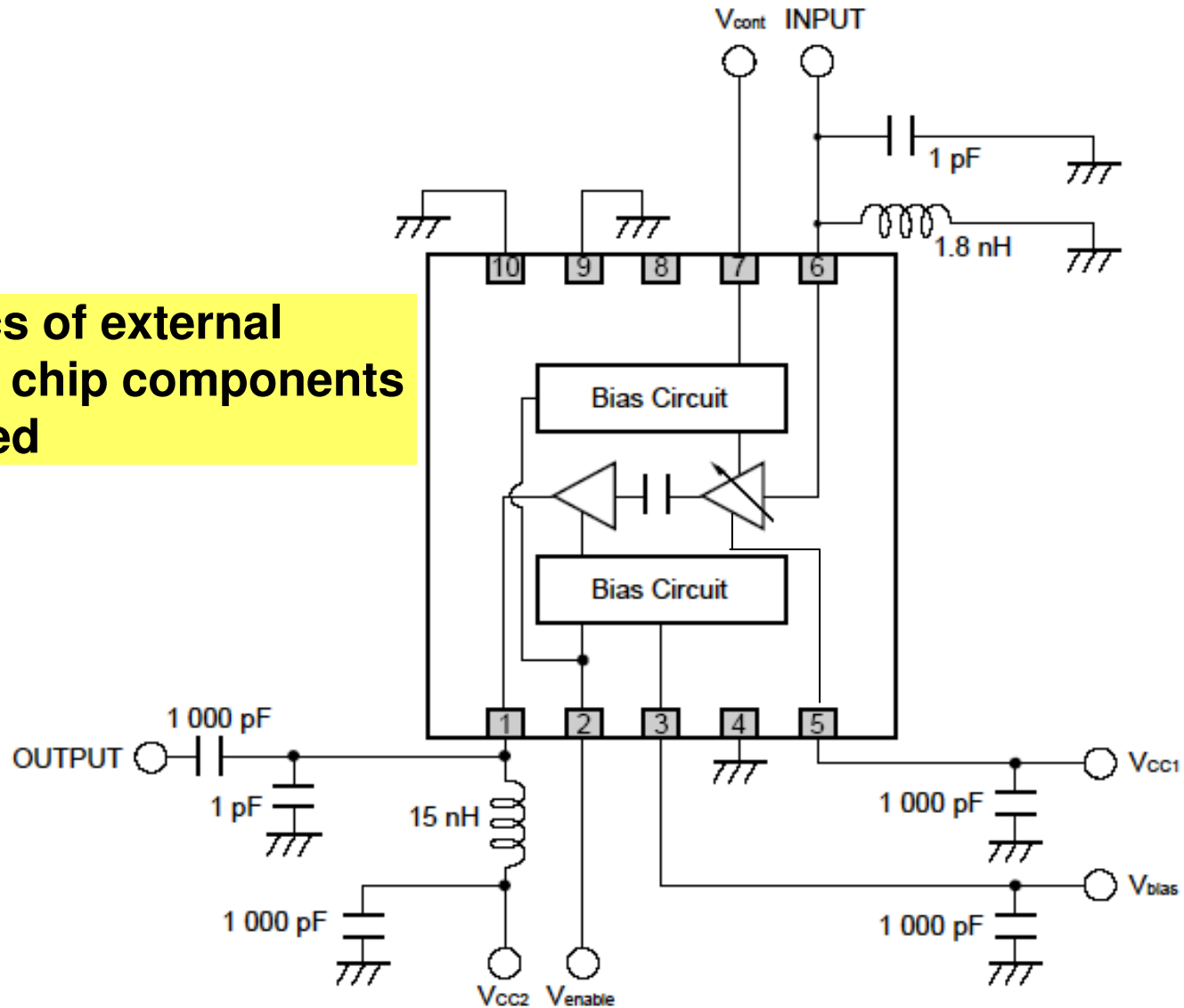
10pin TSON PKG



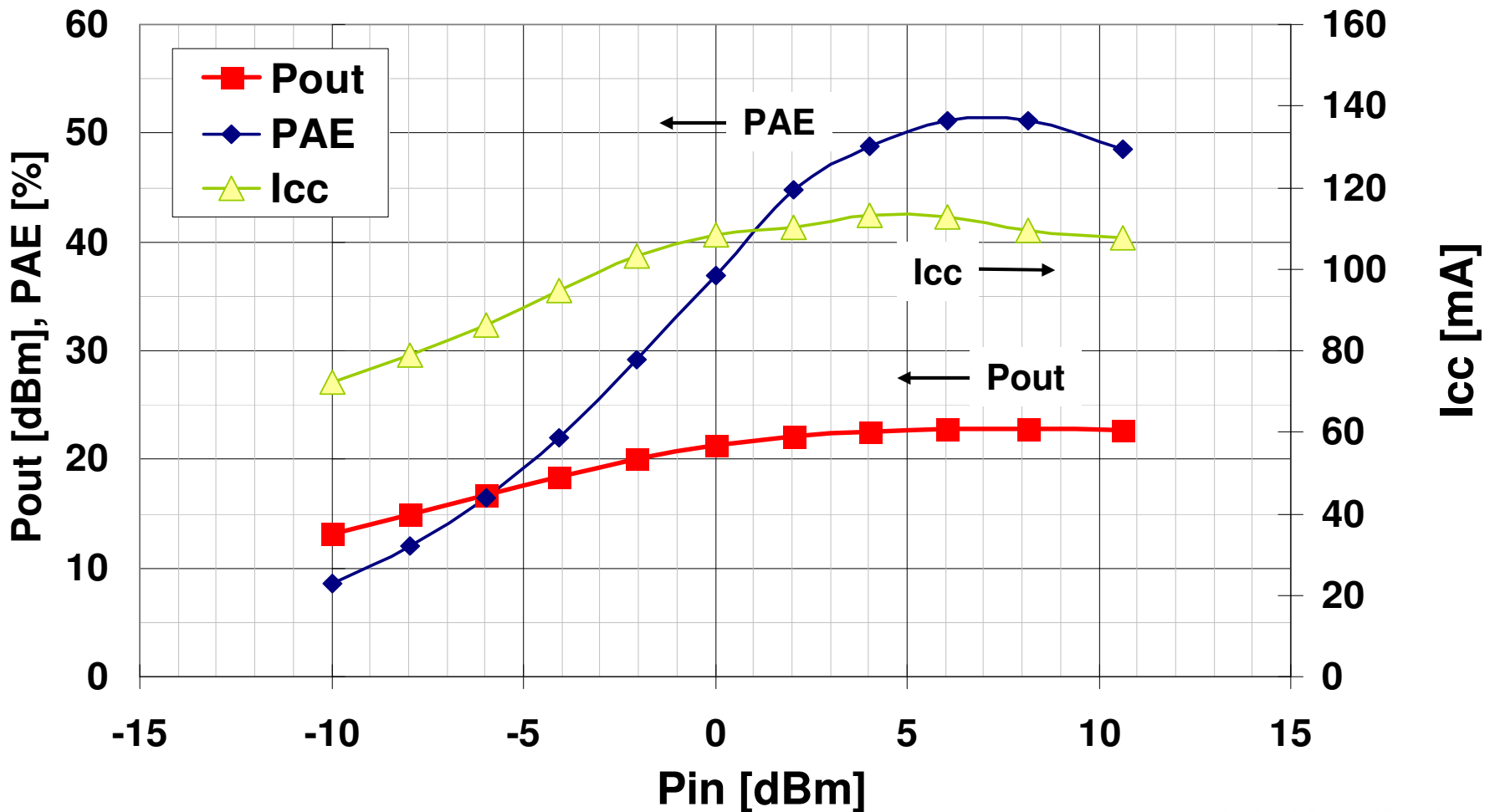
Thickness: 0.6mm MAX  
Lead Pitch: 0.4mm

# uPG2301TQ Evaluation Circuit

Only 8 pcs of external  
0603 size chip components  
are needed

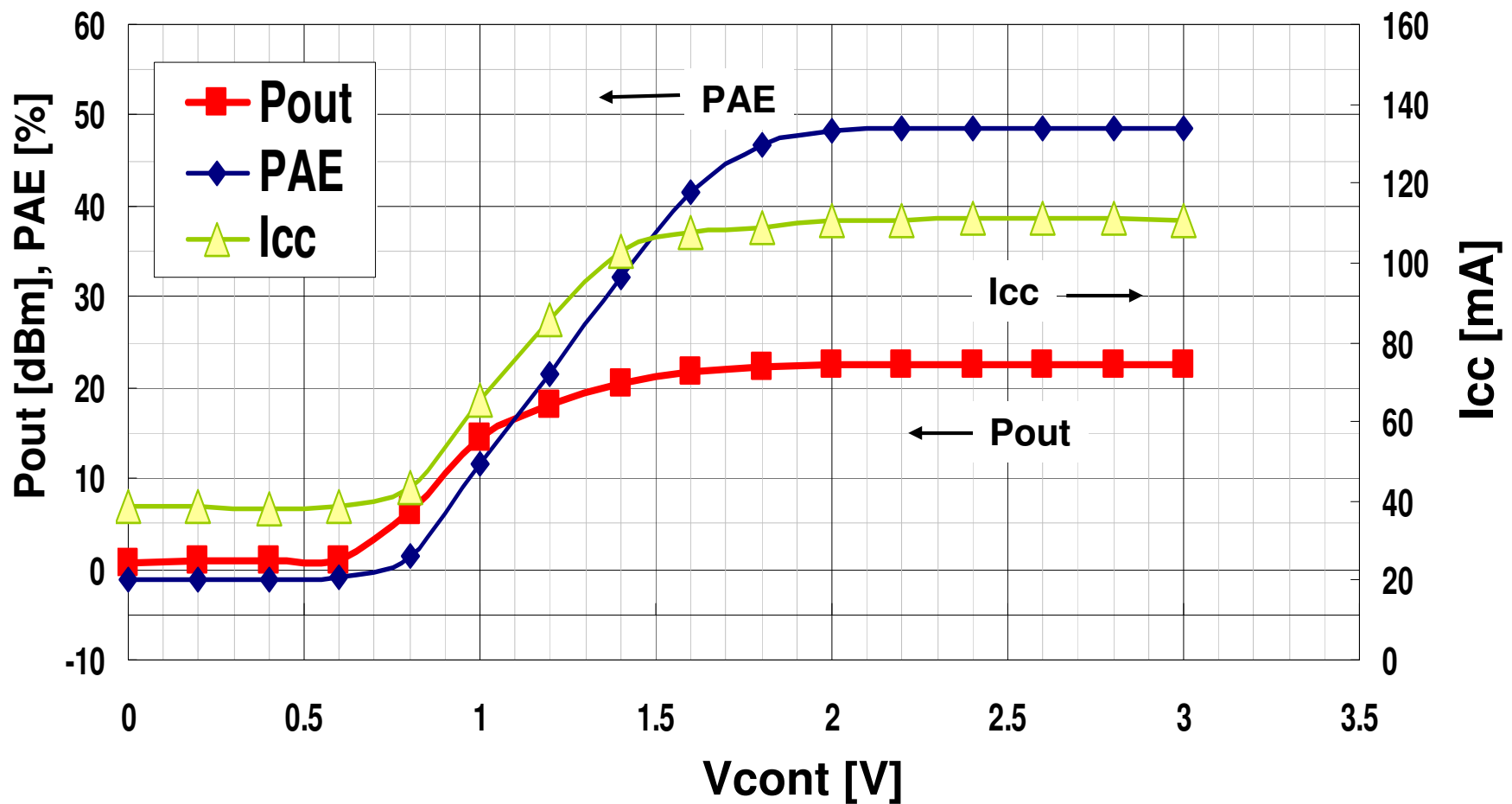


**Test Conditions** :  $f = 2450\text{MHz}$ ,  $V_{cc1}=V_{cc2}=V_{bias}=3.3\text{V}$ ,  $V_{enable}=2.9\text{V}$ ,  
 $V_{cont}=2.5\text{V}$ , with external input & output matching circuits



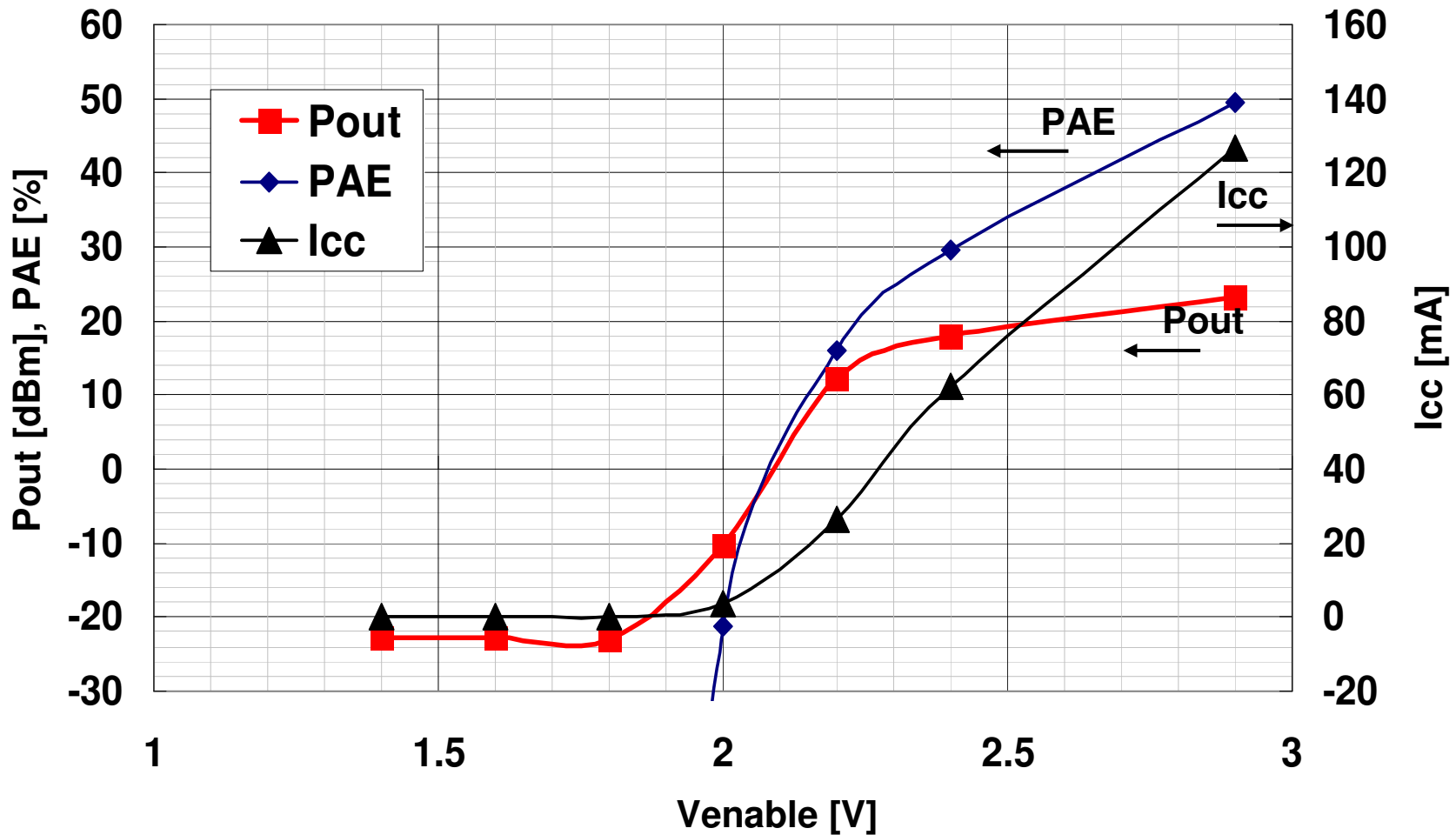
# uPG2301TQ Vcont vs. Pout, PAE, Icc

**Test Conditions** :  $f = 2450\text{MHz}$ ,  $V_{cc1}=V_{cc2}=V_{bias}=3.3\text{V}$ ,  $V_{enable}=2.9\text{V}$ ,  
 $P_{in}=+4\text{dBm}$ , with external input & output matching circuits



# uPG2301TQ Venable vs. Pout, PAE, Icc

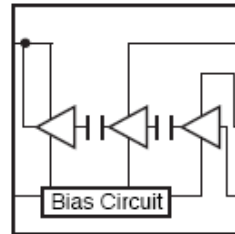
**Test Conditions :  $f = 2450\text{MHz}$ ,  $V_{cc1}=V_{cc2}=V_{bias}=3.3\text{V}$ ,  $V_{cont}=2.5\text{V}$ ,  $P_{in}=+4\text{dBm}$ ,  
With external input & output matching circuits**



## uPG2250T5N

### Features

- **1.8V to 3.0V Operation**
- Shut Down Function
- 0.4mm Lower Height Package



**In  
Mass Production**

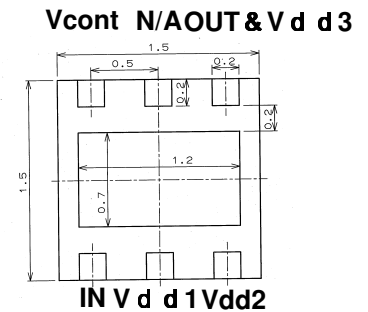
### Applications

- Bluetooth Class 1 EDR, ZigBee, ISM Band

### Preliminary Performance (Typical)

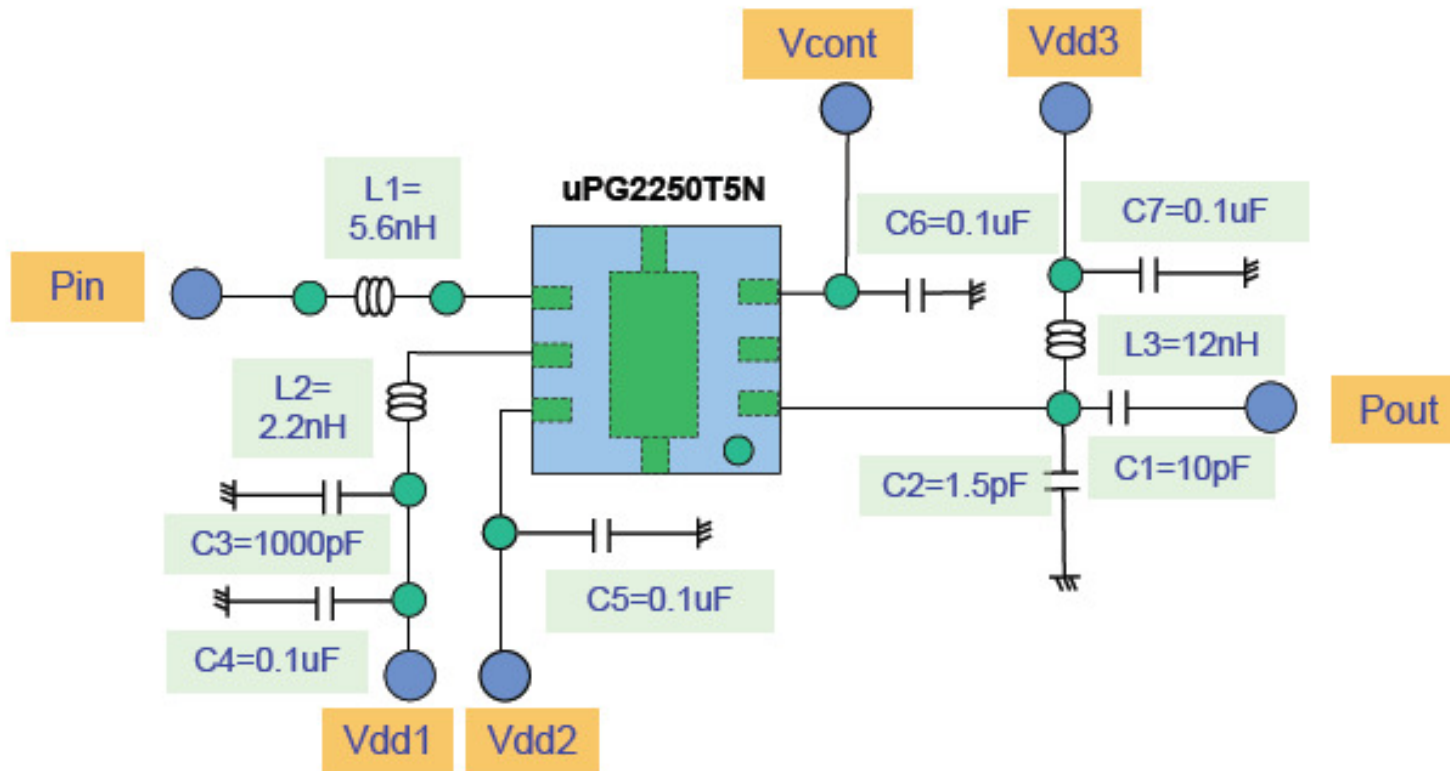
- Frequency Range: 2.4 to 2.5GHz
- Supply voltage: **Vdd = 3.0V or 1.8V, Vcont = 1.8V**
- Output Power: **+25dBm, Vdd=3.0V**  
**+20dBm, Vdd = 1.8V**  
**@Vcont = 1.8V, Pin = -2dBm**
- Current: **190mA @ Pout=+25dBm, Vdd=3.0V**  
**110mA @ Pout=+20dBm, Vdd=1.8V**

**6pin TSON PKG**



**1.5x1.5x0.4 mm  
(0.5mm pitch)**

# CEL uPG2250T5N Evaluation Board Schematic



## COMPONENTS OF TEST CIRCUIT

Parts	Part Number	Maker	Symbol	Value
Chip Capacitor	GRM1552C1H100JZ01	Murata	C1	10pF
Chip Capacitor	GRM1554C1H1R5CZ01	Murata	C2	1.5pF
Chip Capacitor	GRM1552C1H102JA01	Murata	C3	1000pF
Chip Capacitor	GRM155B31C104KA87	Murata	C4~C7	0.1uF
Chip Inductor	LL1005-FHL5N6S	TOKO	L1	5.6nH
Chip Inductor	LL1005-FHL2N2S	TOKO	L2	2.2nH
Chip Inductor	LL1005-FHL12NJ	TOKO	L3	12nH
RF Connector	01K2266-00	WAKA		

Total ;10pcs (005size)



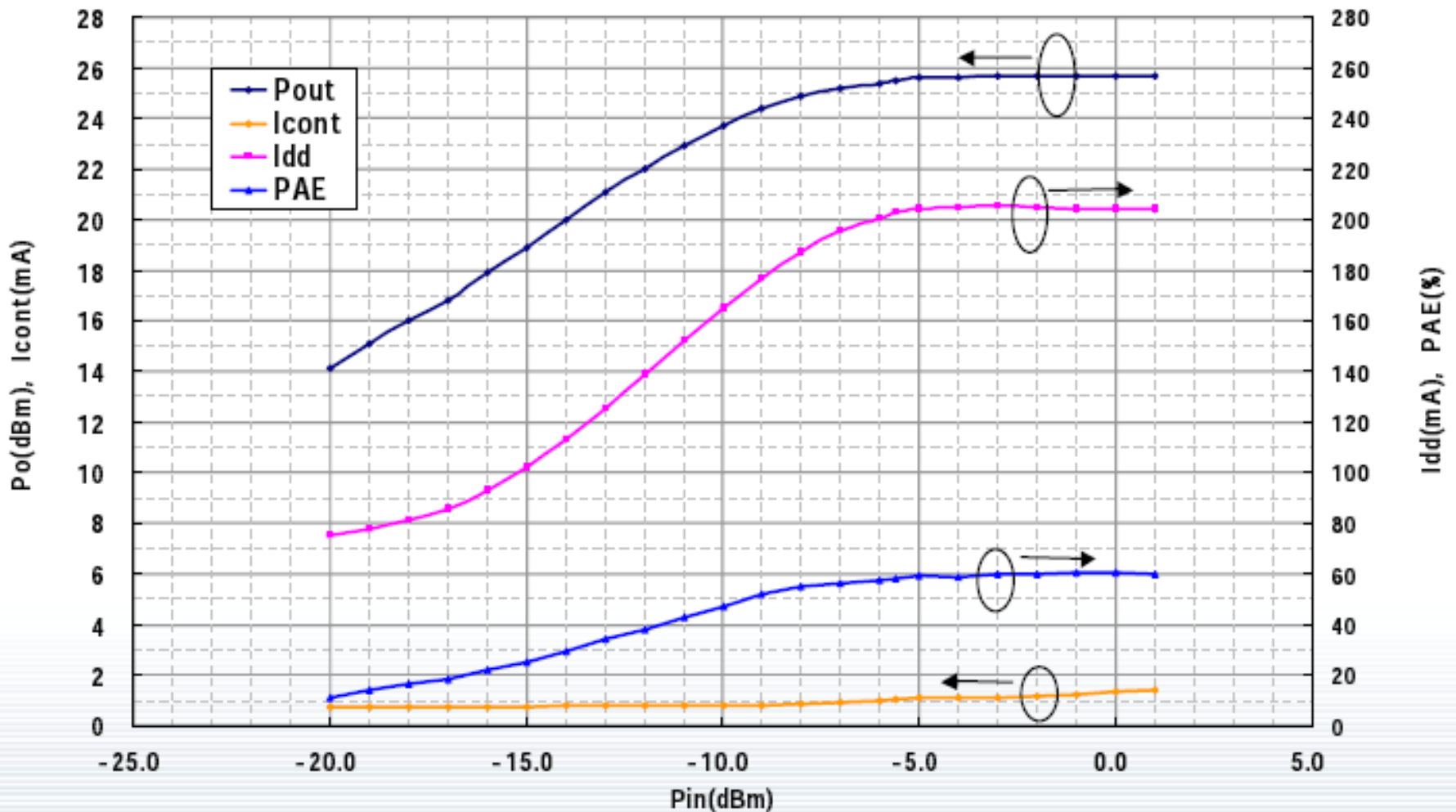
# uPG2250T5N Pin vs. Pout, PAE, Icc

**Vdd = 3V**

**Test Conditions** :  $f = 2450\text{MHz}$ ,  $V_{dd1}=V_{dd2}=V_{dd3}=3.0\text{V}$ ,  $V_{cont}=1.8\text{V}$   
with external input & output matching circuits

(Reference Only)

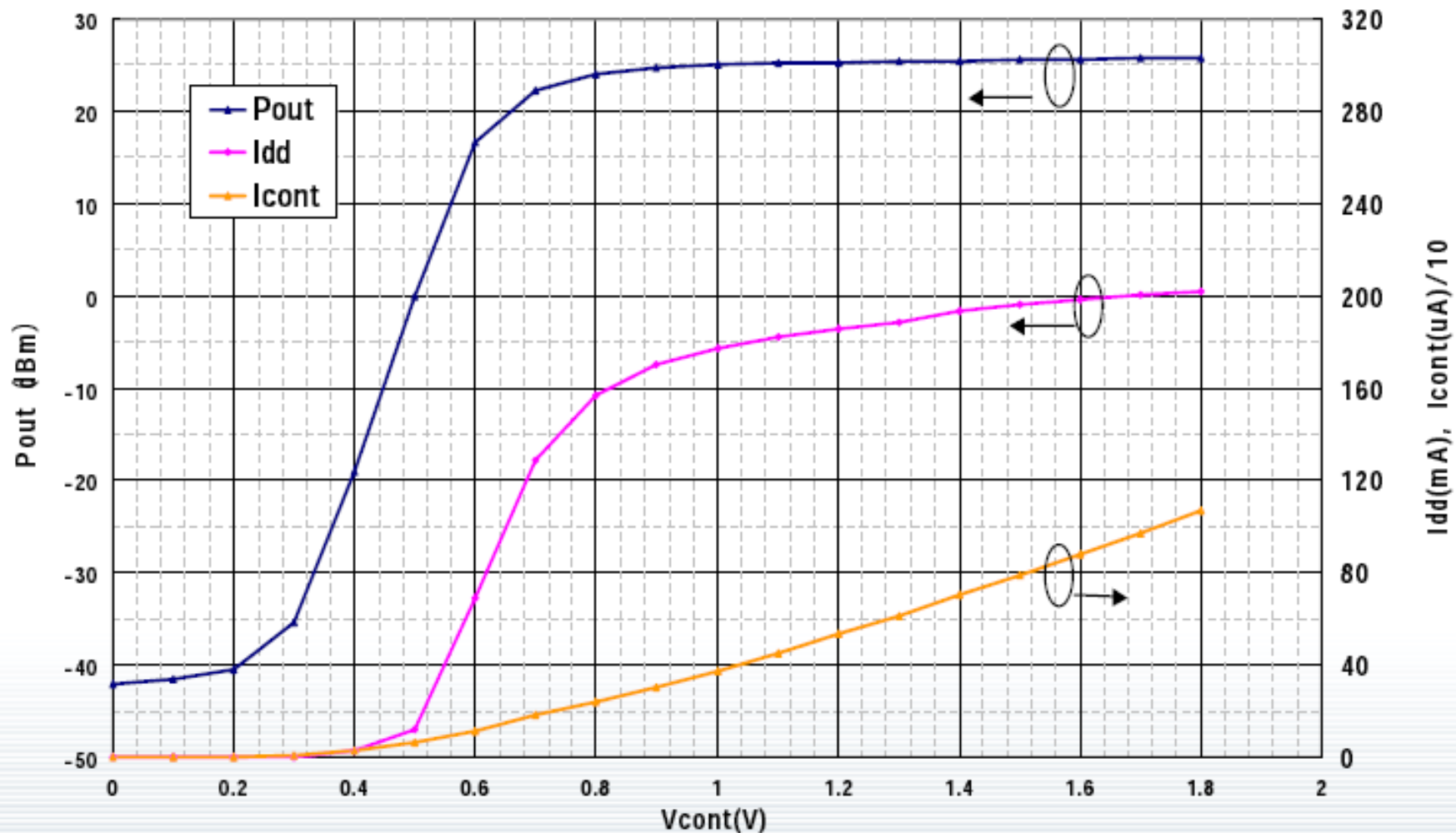
**Vdd = 3V**



**Vdd = 3V**

**Test Conditions** :  $f = 2450\text{MHz}$ ,  $V_{dd1}=V_{dd2}=V_{dd3}=3.0\text{V}$ ,  $P_{in}=-5\text{dBm}$   
with external input & output matching circuits

(Reference Only)

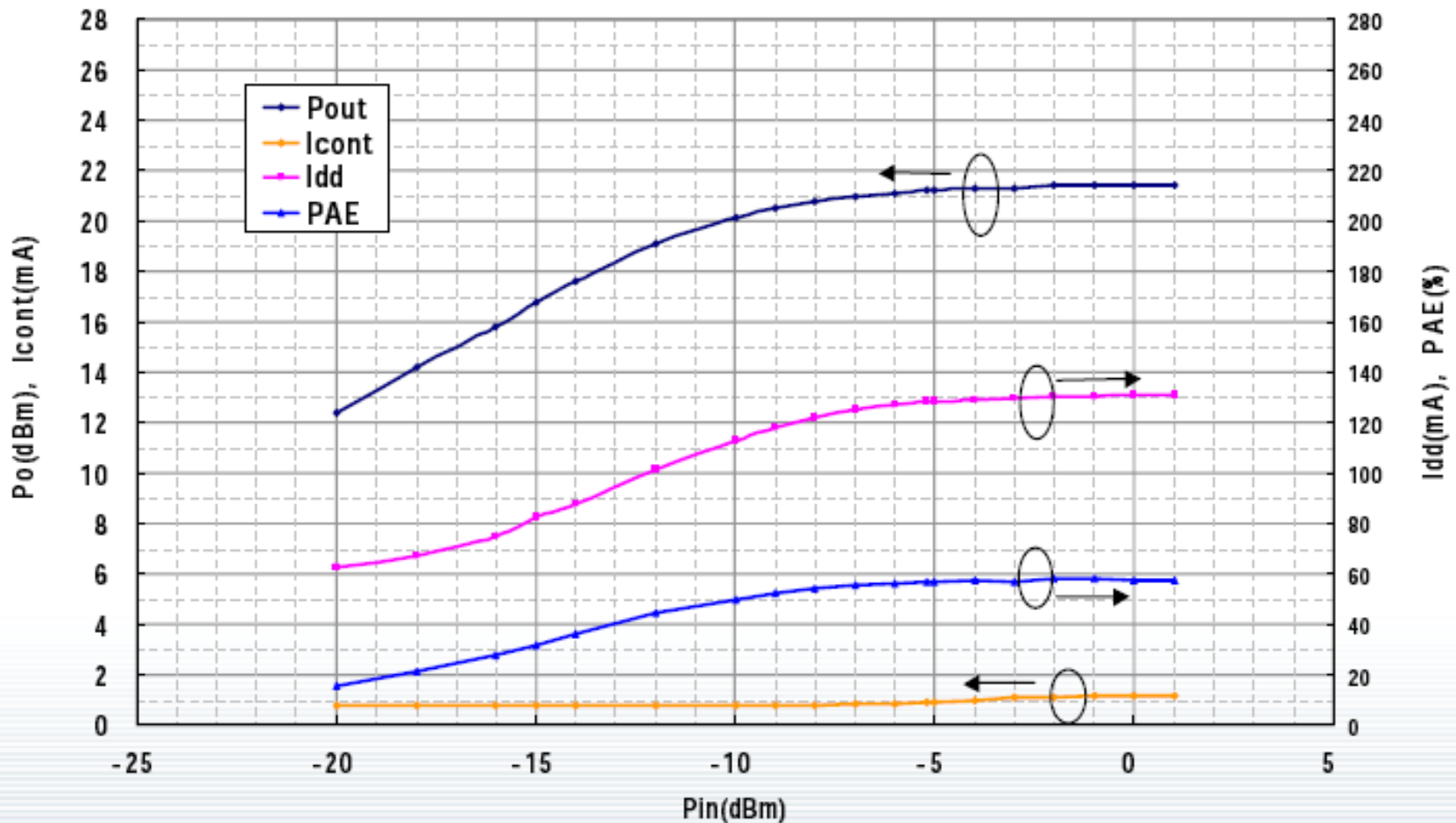


**Vdd = 1.8V**

**Test Conditions** :  $f = 2450\text{MHz}$ ,  $V_{dd1}=V_{dd2}=V_{dd3}=1.8\text{V}$ ,  $V_{cont}=1.8\text{V}$   
with external input & output matching circuits

(Reference Only)

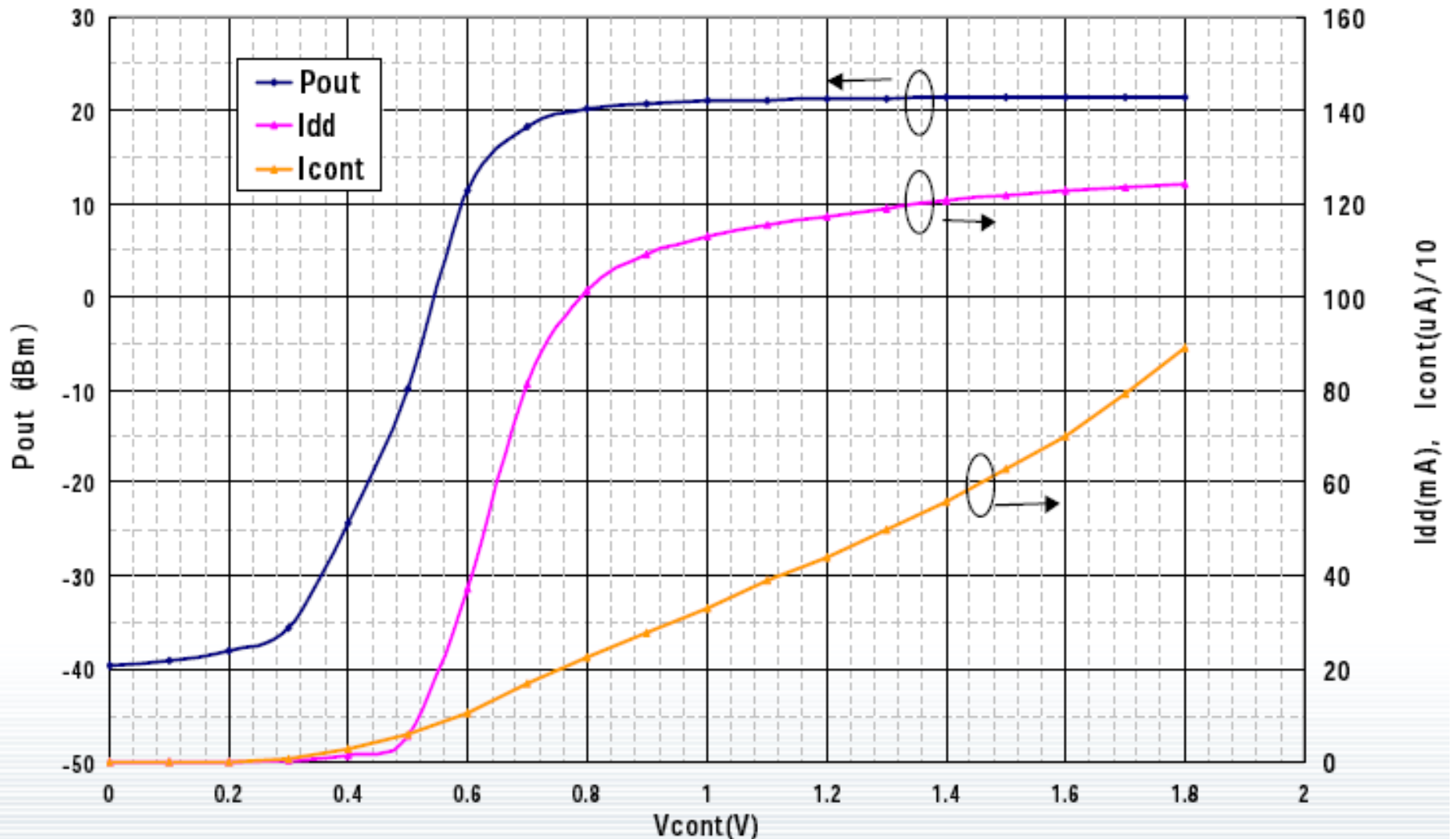
**Vdd = 1.8V**



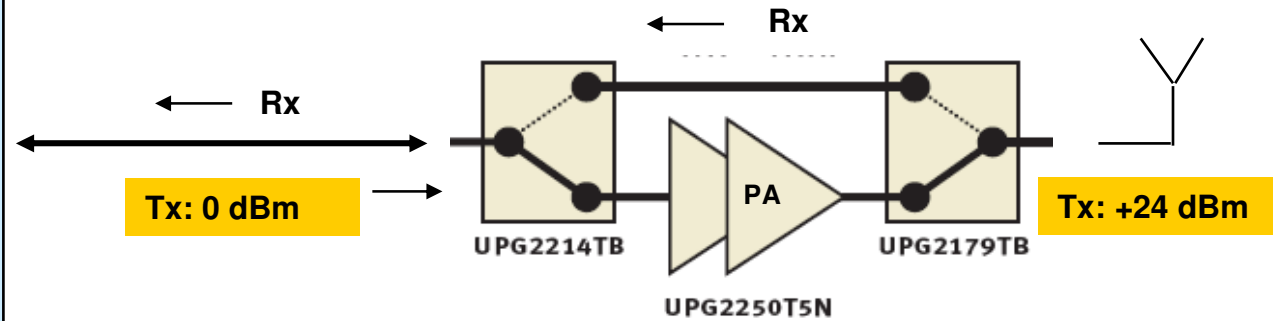
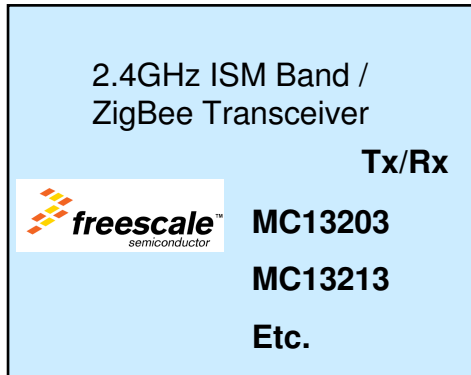
**Vdd = 1.8V**

Test Conditions : f = 2450MHz, Vdd1=Vdd2=Vdd3=1.8V, Pin=-5dBm  
with external input & output matching circuits

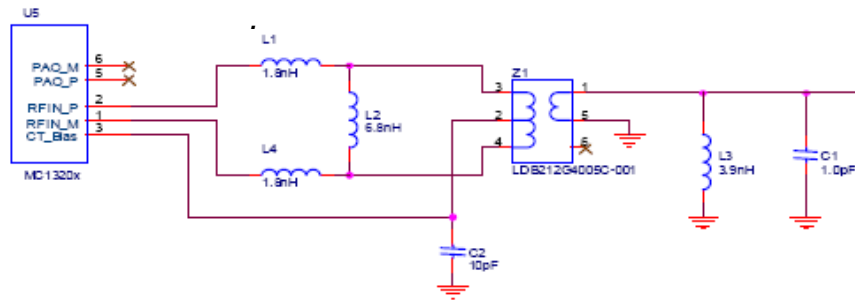
(Reference Only)



# 2.4GHz Application Example

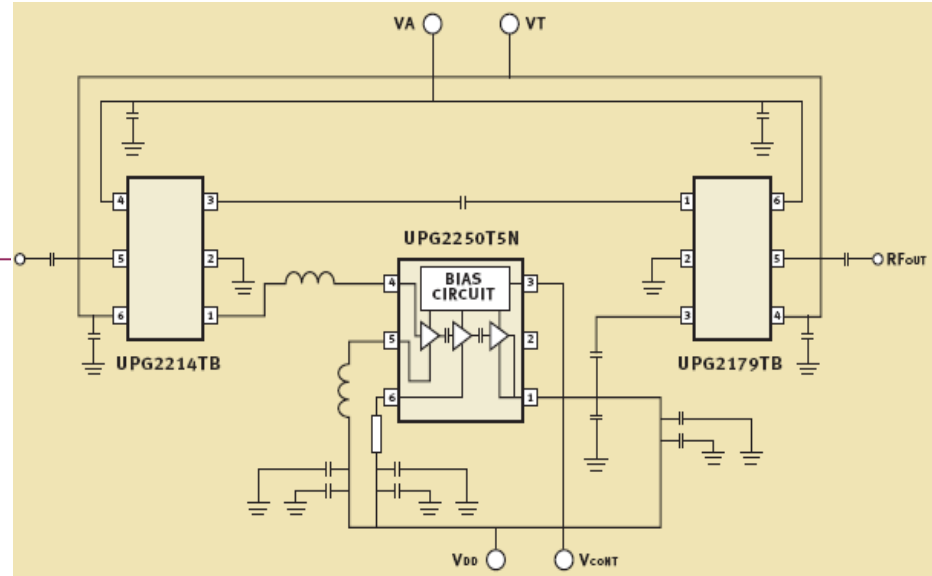


- Also*
- Ember EM250/260
  - ATMEL AT86RF230
  - TI Chipcon cc2430/2500
  - ST Micro SN250
  - Nordic nRF2401A



Transceiver

Single Ended  
Matching Network



CEL Range Extension Solution



A Business Partner of NEC Electronics Corporation.

**CEL**

# +25dBm GaAs PA IC

## uPG2251T6M

**NEW**

DS: Oct'08

MP: Feb'09

### Features

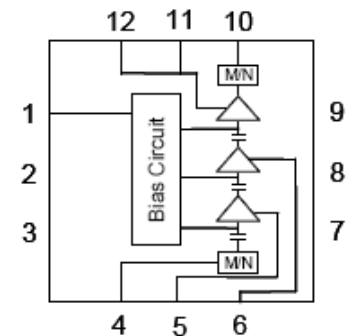
- 2.4 – 2.5GHz, **Internally Matched**
  - 6 External Components
- 2.5V to 3.6V Operation with  $V_{cont} = 1.8V$
- Shut Down Function

### Applications

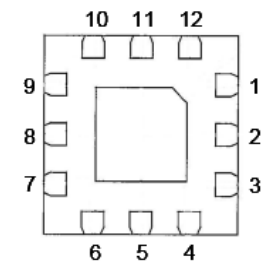
- Bluetooth Class 1 EDR, ZigBee, ISM Band

### Preliminary Performance (Typical)

- Frequency Range: 2.4 to 2.5GHz
- Supply voltage:  $V_{dd} = 3.0V$ ,  $V_{cont} = 1.8V$
- Output Power: **+25dBm**,  $P_{in} = -5dBm$
- Harmonics:  $2f_0$  -35dBc  
@+25dBm out  $3f_0$  -27dBc
- Current: 240mA @  $P_{out} = +25dBm$ ,  $V_{dd} = 3.0V$   
@ $V_{cont} = 1.8V$ ,  $P_{in} = -5dBm$



(Bottom View)



12-pin TSQFN

2.0 x 2.0 x 0.37 mm

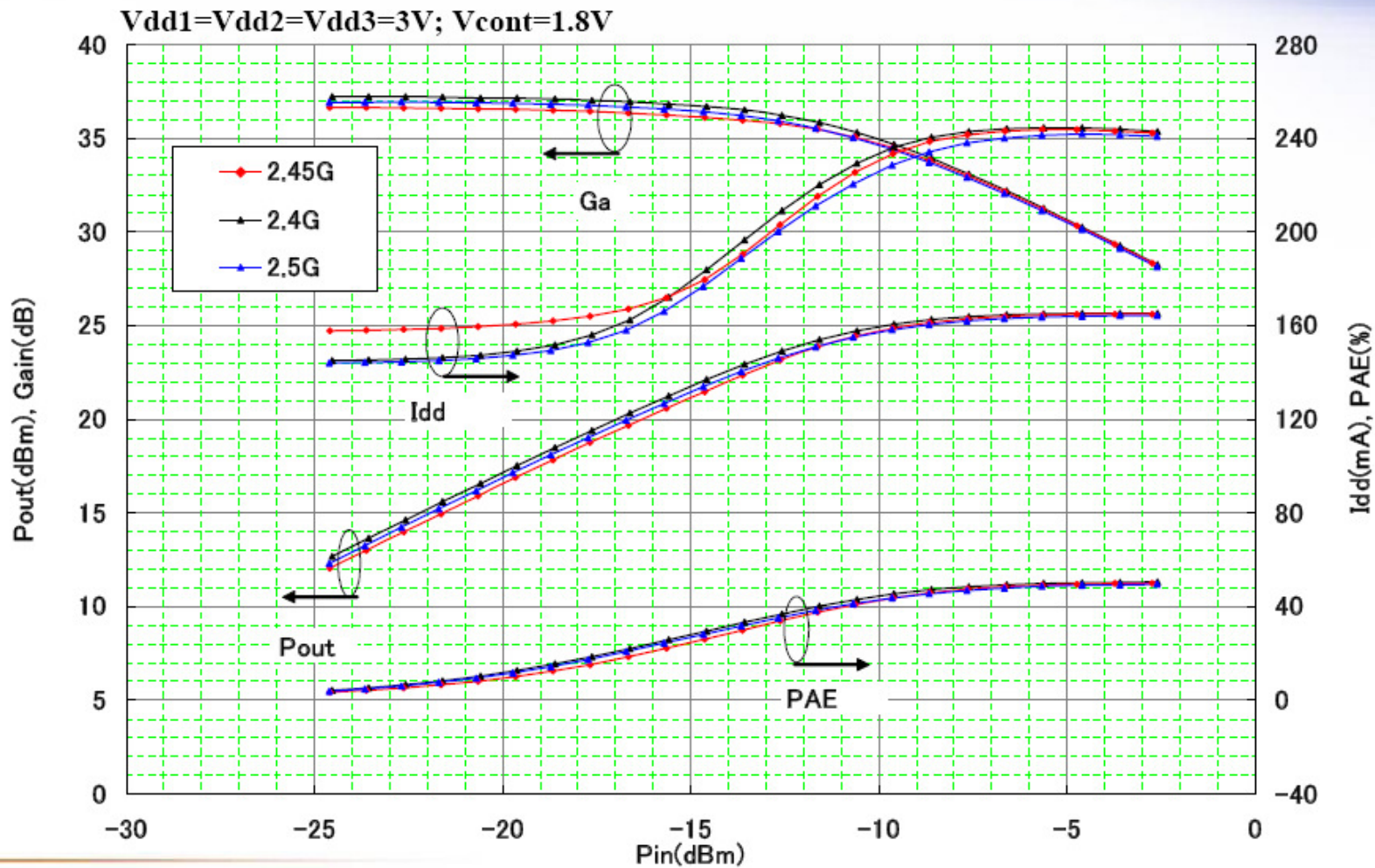
**NEC**

A Business Partner of NEC Electronics Corporation.



## Pout vs. Ga, PAE, Idd Characteristics

NEC



## Measured Data

Device	Frequency	Bias	P <sub>SAT</sub>	Eval Boards In Stock	Range Extender Boards (SW-PA-SW)
<b>uPG2314T5N</b>	915 MHz	3.0 V	+20 dBm		
	2.4 GHz	3.0 V	+19.5 dBm	✓	✓
<b>uPG2301TQ</b>	915 MHz	3.3 V	+22.8 dBm		
	2.4 GHz	3.3 V	+22.8 dBm	✓	✓
<b>uPG2250T5N</b>	915 MHz	3.0 V	+25.5 dBm	✓	
	2.4 GHz	3.0 V	+25.0 dBm	✓	✓
<b>uPG2118K</b>	915 MHz	3.2 V	+31.5 dBm	✓	
	2.4 GHz	3.2 V	+30.5 dBm	✓	



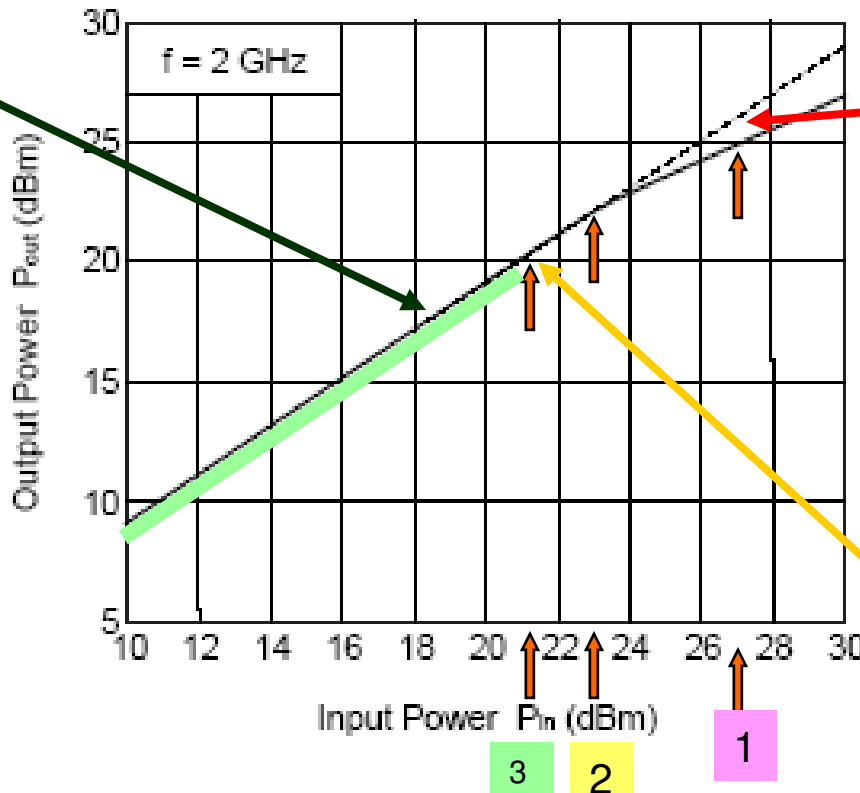
# Switches

3 Min Typ 2

0.1 dB Loss Compression Input Power <sup>Note 2</sup>	$P_{In(0.1dB)}$	$f = 2.0/2.5$ GHz	+21.0	+23.0	-	dBm
1 dB Loss Compression Input Power <sup>Note 3</sup>	$P_{In(1dB)}$	$f = 0.5$ to 3.0 GHz	-	+23.0	-	dBm
						1

Better to operate below the min P(0.1) dB point to assure the switch will not contribute excess loss

OUTPUT POWER vs. INPUT POWER



Never want to operate at P1dB, switch loss will be ~1.4 dB, high power / heat dissipation in the pkg, highly non-linear, possible reliability risk

Just starting to compress by 0.1 dB



# P(0.1dB) Points of NEC-CEL SPDT Switches

Part No.	# of Controls	Package Size (mm)	Pin (0.1dB) (dBm)		Voltage for P(0.1dB) Spec
			Minimum	Typical	
uPD5713TK	1	1.5 x 1.3 x 0.55	+13.0	+17.0	2.8V
uPG2012TK	1	1.5 x 1.3 x 0.55	+17.5	+20.5	2.8V
uPG2012TB	1	2.0 x 2.1 x 0.90	+17.5	+20.5	2.8V
uPG2160T5K	1	1.0 x 1.0 x 0.37	+18.0	+21.0	2.6V
uPG2015TB	1	2.0 x 2.1 x 0.90	+25.5	+27.0	2.8V
uPG2010TB	1	2.0 x 2.1 x 0.90	+31.5	+33.0	2.8V
uPG2159T6R	2	1.0 x 1.0 x 0.37	+20.0	+22.0	2.7V
uPG2214TK	2	1.5 x 1.3 x 0.55	+21.0	+23.0	3.0V
uPG2214TB	2	2.0 x 2.1 x 0.90	+21.0	+23.0	3.0V
uPG2163T5N	2	1.5 x 1.5 x 0.37	No Spec	Approx +28	3.0V
uPG2185T6R	2	1.0 x 1.0 x 0.37	No Spec	Approx +28	3.0V
uPG2030TK	2	1.5 x 1.3 x 0.55	+25.5	+27.0	2.8V
uPG2179TB	2	2.0 x 2.1 x 0.90	+25.5	+29.0	3.0V
uPG2158T5K	2	1.0 x 1.0 x 0.37	+26.0	+29.0	2.7V
uPG2009TB	2	2.0 x 2.1 x 0.90	+32.5	+34.0	2.8V
uPG2157T5F	2	3.0 x 3.0 x 0.75	No Spec	Approx +34	3.0V
uPG2176T5N	2	1.5 x 1.5 x 0.37	No Spec	Approx +34	3.0V
uPG2155TB	2	2.0 x 2.1 x 0.90	No Spec	+37.5	2.6V

These switches can be used at various voltages. P(0.1 dB) is highly dependent on the applied voltage



# Recommended PA – Switch Pairs

PA operated at or near saturation

PA	$P_{SAT}$		Output Switch IC	$P_{0.1dB}$
uPG2314T5N	+20 dBm		uPG2214TB/TK	+23dBm (Typ) +21dBm (Min)
uPG2301TQ	+23 dBm		uPG2179TB	+29 dBm (Typ) +25.5 dBm (Min)
			uPG2030TK	+27 dBm (Typ) +25.5 dBm (Min)
uPG2250T5N	+25 dBm		uPG2179TB	+29 dBm (Typ) +25.5 dBm (Min)
			uPG2030TK	+27 dBm (Typ) +25.5 dBm (Min)

uPG2214TB is recommended as the lowest cost input switch.



A Business Partner of NEC Electronics Corporation.

## uPG2214TB / TK

**In Mass Production**

### Features

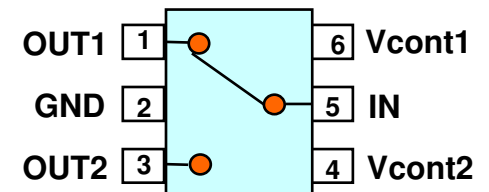
- Low insertion loss, high isolation
- Specified at **1.8V** (as well as 3V)
- Two Package Choices

### Applications

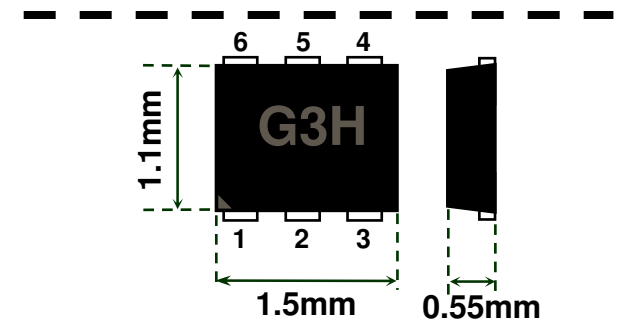
- Mobile Comm., 802.11b/g, Bluetooth, ZigBee

### Performance ( typical )

- Frequency: **50 MHz to 3.0 GHz**
- Control Voltage: **+1.8 to 5.3 / 0V (3.0V typ)**
- Insertion Loss: **0.35dB @ 2.5GHz**
- Isolation: **26dB @ 2.5GHz**
- Pin(**0.1dB**): **+23dBm typ. @ +3.0V / 0V**
- Pin(**0.1dB**): **+21dBm Min. @ +3.0V / 0V**
- Pin(**0.1 dB**): **+16 dBm typ @ +1.8V / 0V**



**TB Package**  
(SC-70 / SOT-363)  
2.0 x 2.1 x 0.9 mm



**TK Package**  
1.5 x 1.3 x 0.55 mm

**Low Cost Switch for Bluetooth & ZigBee**

## uPG2012TK

## uPG2012TB

### Features

- 2.8V **Single Control** Voltage
- Two package choices

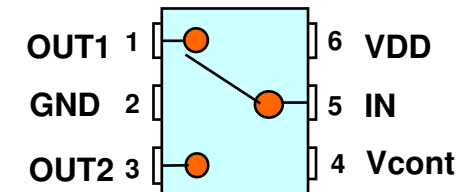
### Applications

- Mobilecomm., Bluetooth, ZigBee

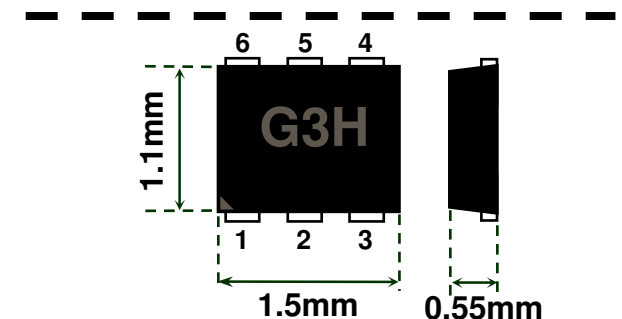
### RF Performance (typical)

- Frequency: 500 MHz to 2.5 GHz
- Control Voltage: +2.8V / 0V, VDD=+2.8V
- Insertion Loss: **0.30dB @ 2.5GHz**
- Isolation: 25dB @ 2.5GHz (TB)  
**30dB @ 2.5GHz (TK)**
- Pin(**0.1dB**): +20.5dBm Typ @ +2.8V / 0V
- Pin(**0.1dB**): +17.5dBm **Min** @ +2.8V / 0V
- Pin(**1 dB**): +24.0dBm @ +2.8V / 0V
- Switching Speed: 300nS typ.

### In Mass Production



**TB Package**  
(SC-70 / SOT-363)  
2.0 x 2.1 x 0.9 mm



**TK Package**  
1.5 x 1.3 x 0.55 mm

Designed into ZigBee reference designs

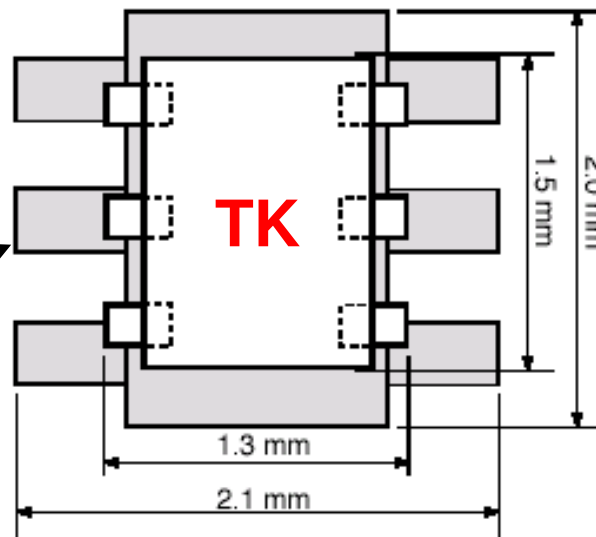


# Comparison of TK and TB Packages

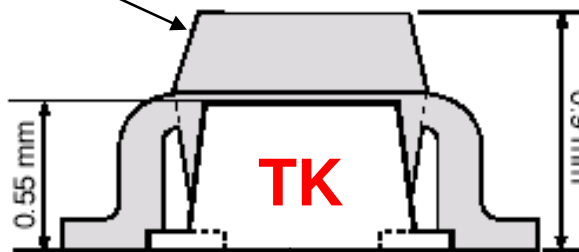
uPG2012 and uPG2214 are available in both TB and TK packages

TB vs. TK  
(SOT-363)

TOP VIEW



END VIEW



Industry Standard  
SOT-363 / SC-70  
and  
NEC's "TB" package

NEC's  
"TK" package

**CEL**

# Medium Power, Single Control SPDT

## uPG2015TB

### Concept

-2.8V **Single Control** Voltage (2.7-3.0V)

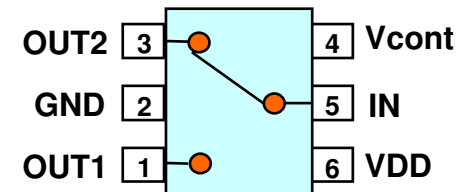
**In Mass Production**

### Application

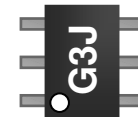
- 800MHz to 2.5GHz band Mobile Comm., Bluetooth, ZigBee, ISM Band Transceivers

### RF Performance

- Frequency :  $f = 500\text{M}$  to  $2.5\text{GHz}$
- Supply Voltage :  $V_{\text{CONT}} = +2.8\text{V} / 0\text{V}$ ,  $V_{\text{DD}} = +2.8\text{V}$
- Insertion Loss :  $L_{\text{INS}} = 0.35\text{dB}$  typ. @  $f = 2.5\text{GHz}$
- Isolation :  $\text{ISL} = 25\text{dB}$  typ. @  $f = 2.5\text{GHz}$
- Pin(0.1dB) :  $+27.0\text{dBm}$  typ. @  $V_{\text{CONT}} = +2.8\text{V} / 0\text{V}$
- Pin(0.1dB) :  $+25.5\text{dBm}$  **Min.** @  $V_{\text{CONT}} = +2.8\text{V} / 0\text{V}$
- Switching Speed :  $t_{\text{sw}} = 300\text{nS}$  typ.
- 6pin Super Mini Mold Package (SOT-363 style)



Block Diagram



6pin super MM  
( 2.0X1.25mm )

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## uPG2179TB

In Mass  
Production■ Features

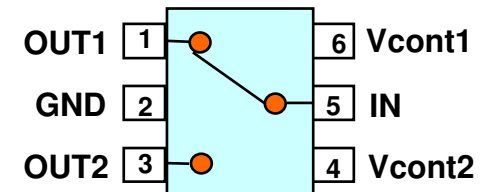
- Low insertion loss and high isolation

■ Applications

- 802.11b/g, Bluetooth, ZigBee
- Mobilecomm

■ Performance ( typical )

- Frequency Range: 500 MHz to 3.0 GHz
- Control Voltage: +2.5V to +5.3V, 0V
- Insertion Loss: 0.35dB typ @ 2.5GHz
- Isolation: **27dB typ @ 2.5 GHz**
- P(1.0 dB): +32 dBm typ
- P(0.1dB): +**29** dBm typ
- P(0.1dB): +**25.5** dBm **min**



**TB** Package  
(SC-70 / SOT-363)  
2.0 x 2.1 x 0.9 mm

Industry Best 1-1.5W SPDT

# Compact Medium Power SPDT

in a **Smaller** Package

## uPG2030TK

### Features

- Low insertion loss and high isolation

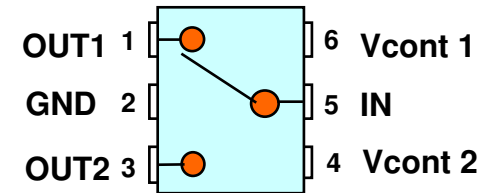
### Applications

- WLAN 802.11b/g, Mobilecomm
- Bluetooth, ZigBee

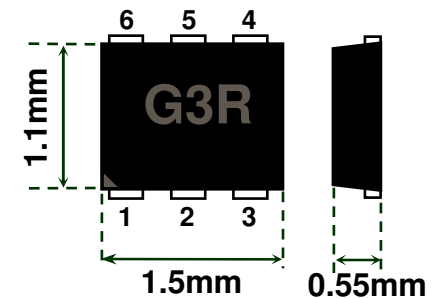
### Performance ( typical )

- Frequency: 500 MHz to 2.5 GHz
- Control Voltage: +2.8V / 0V
- Insertion Loss: 0.35 dB @ 2.5GHz
- Isolation : 25 dB @ 2.5GHz
- Pin( 0.1 dB): +27dBm @ +2.8V
- Switching Speed: 50nS typ.

**In Mass Production**



**Block Diagram & Package Dimensions**



PKG Height : **0.6mm MAX**

## uPG2158T5K

### ■ Features

- **Smaller, thin Package**
- **Alternative to chips for thin modules**

### ■ Applications

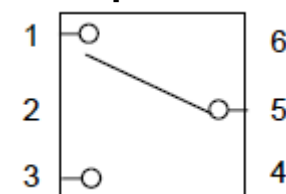
- Mobilecomm, 802.11b,g, Bluetooth, ZigBee  
Antenna diversity, LO and BPF switching

### ■ Performance ( typical )

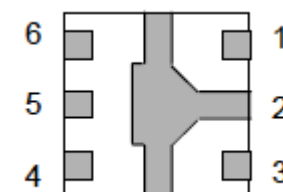
- Frequency: 0.05 to 3.0GHz
- Supply Voltage: +1.8 to 5.3 / 0V (2.7V typ)
- Insertion Loss: 0.47 dB @ 2.5 GHz
- Isolation: 17 dB @ 2.5 GHz
- Pin(0.1dB): +29.0dBm @ +2.7V / 0V
- Small Package: 1.0 x 1.0 x 0.37mm

**In Mass  
Production**

Top View



Bottom View



**1.0x1.0x0.37mm**

**Also specified at 1.8V**

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# High Isolation SP3T Switch

for Bluetooth + 802.11b,g

## uPG2150T5L

In Mass  
Production

### Features

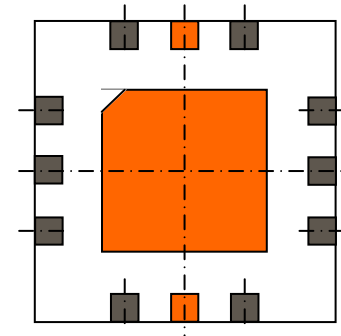
- High Isolation between WiFi Tx and BT port
- Low Height Small Package

### Applications

- 802.11b/g + Bluetooth
- 2.4GHz-Band Communications

### Performance ( Typical, at $V_c=2.85V$ )

- Frequency: 2.4 to 2.5GHz
- Control voltage: +2.85V / 0V
- Insertion Loss: 0.50dB @ 2.5GHz (RF1,RF2)
- Insertion Loss: 0.60 dB @ 2.5 GHz (RF3)
- Isolation: **35 dB @ 2.5 GHz WiFi Tx- BT**
- Pin (1dB): TX, BT : +31 dBm
- Package: 10pin 2.0 x 2.0 x 0.4mm



New 10-pin Package  
0.5mm pitch  
**(2.0 x 2.0 x 0.4 mm)**

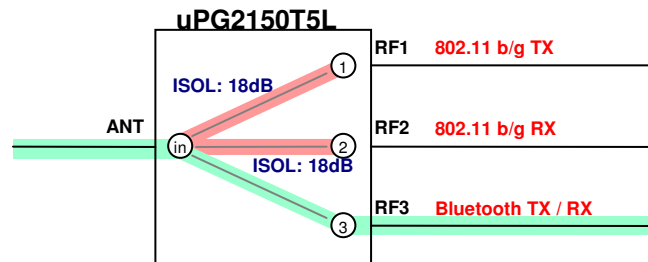
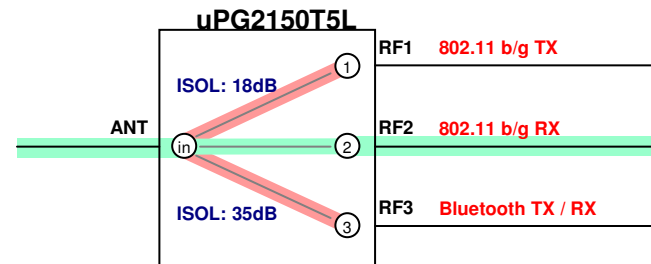
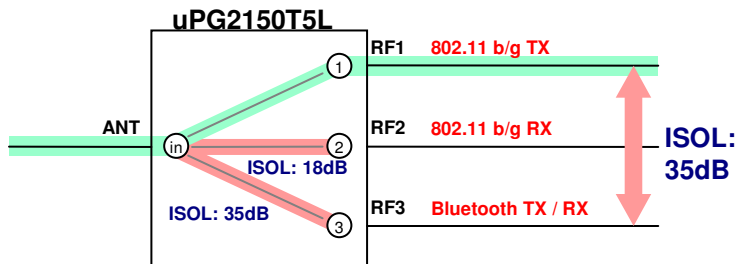
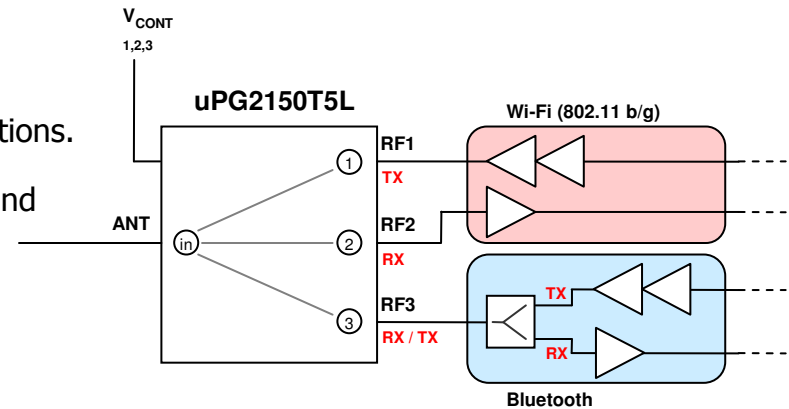
## Explanation of typical application for this switch:

The **uPG2150T5L** SP3T switch has been designed specifically for devices that enable both Wi-Fi (802.11 b/g) and Bluetooth connectivity. A typical application diagram would look like the one on the right:

The first two outputs (RF1 and RF2) are used for the transmit and receive sides (respectively) of the Wi-Fi RF solution. And the third output handles the Bluetooth communications, with another T/R switch to handle the Bluetooth transmit and receive functions.

The performance of the **uPG2150T5L** has been specified with this kind of application in mind, with extra isolation (35dB) provided for the RF3 port in particular.

The three diagrams below summarize the different possible cases with the corresponding isolation values for each path.



On Path  
Off Paths

# 2.4GHz LNA Devices

# 2.4GHz LNAs

	<b>NE662M04</b> Si XSTR	<b>NESG3031M05</b> SiGe XSTR	<b>NE3508M04</b> GaAs FET	<b>uPC8233TK</b> SiGe:C IC
Gain	<b>12.4 dB</b>	<b>12.6 dB</b>	<b>13 dB</b>	<b>16.6 dB</b>
NF	<b>1.5 dB</b>	<b>0.9 dB</b>	<b>0.8 dB</b>	<b>1.3 dB</b>
Input P <sub>1dB</sub>	<b>-11 dBm</b> (-7 dBm)	<b>-7 dBm</b> (-5 dBm)	<b>+1 dBm</b>	<b>-20 dBm</b>
Bias	<b>2V / 5mA</b> (2V / 20mA)	<b>2V / 5mA</b> (3V / 20mA)	<b>2V / 18mA</b>	<b>1.8V / 3.3mA</b>
Features			<b>Constant Gain, NF: 1.5V – 3.0V</b>	<b>Voltage Regulator (1.7V ~ 3.3V) Enable / Shutdown ESD Protection</b>
Cost	<b>Lowest</b>	<b>Lower</b>	<b>Low</b>	<b>Low</b>

Measured Data from CEL Eval Boards

# NESG3031M05 / M14

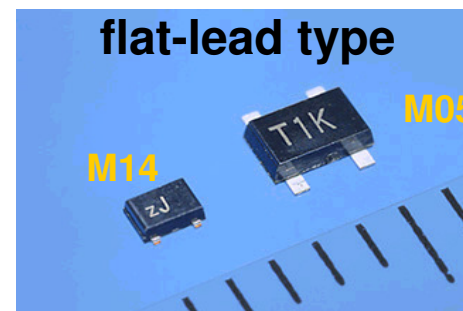
**= Low Noise SiGe HBT =**

## 2.4GHz Performance

- **Excellent Low Noise Figure**  
 0.6dB, Ga=16dB (2V, 6mA)  
 0.7dB, Ga=17dB (2V, 10mA)
- **High Linearity, Output P1dB**  
 +12.5dBm (3V, 20mA)
- **UHS3 SiGe HBT**  
 fmax : 110GHz process  
 technology
- **High Break down voltage**  
 Vceo: 4.3V min  
 (absolute maximum ratings)

2.4GHz	Vce=2V, Ic=6mA
NF	0.6 dB
Ga	16 dB

Parts Number	Feature	PKG SIZE
NESG3031M05	NF: 1.1dB Ga: 9.5dB	2 x 1.25mm ( 0.59mm)
NESG3031M14	@ 5.8GHz (Ic=6mA)	1.2 x 0.8mm ( 0.5mm )





## NESG2031M05

**In Mass Production**

- Concept**
  - Advanced SiGe transistor with NEC's High Voltage UHS2-HV process
  - Low Noise, High Linearity @ 2GHz

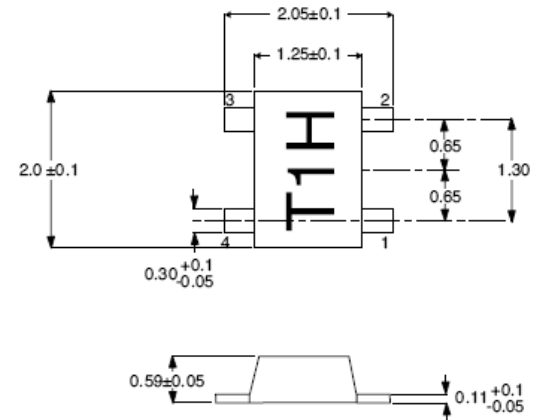
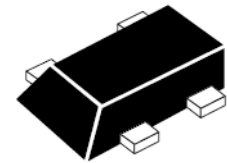
- Applications**
  - Low Noise Amplifier for Mobile Communications, etc.
  - ISM Band LNA or Medium Power Stage

- Performance ( typical)**
  - Low Noise Figure:
 

(2V, 5mA)	0.7dB, 23dB Ga @ 1.0GHz
	0.8dB, 17dB Ga @ 2.0GHz
	1.3dB, 10dB Ga @ 5.2GHz
  - High Linearity, P1dB:
 

(3V, 20mA)	+14dBm @ 1.0GHz
	+13dBm @ 2.0GHz
	+12dBm @ 5.2GHz

- Package M05**
  - Low Profile SOT-343 footprint: 2.0 x 2.1 x 0.59mm



PIN CONNECTIONS  
 1. Base  
 2. Emitter  
 3. Collector  
 4. Emitter

## NE662M04

In Mass Production

### Concept

- Low Noise, Low Current Si transistor made with NEC's UHSO 25 GHz  $f_t$  process
- High Gain at Low Voltage, Low Current

### Applications

- Low Noise Amplifier for ISM Band, ZigBee, Mobile Communications, etc.
- Oscillator Applications for Communications

### Performance ( typical)

- Low Noise Figure:
 

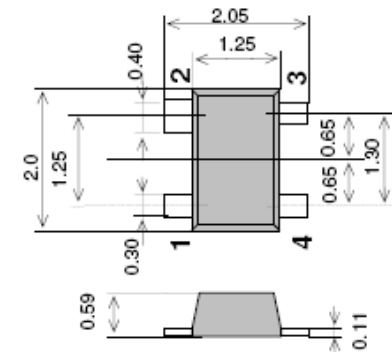
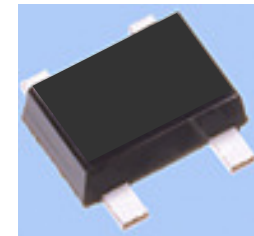
1.0dB, 21dB Ga @ 1.0GHz
1.1dB, 16dB Ga @ 2.0GHz
1.2dB, 14dB Ga @ 2.5GHz

- High Output  $P_{1dB}$ :
 

+12dBm @ 1.0GHz
+11dBm @ 2.0GHz

### Package M04

- Low Profile SOT-343 footprint: 2.0 x 2.1 x 0.59mm



PIN CONNECTIONS

1. Emitter
2. Collector
3. Emitter
4. Base

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## NE3508M04

**In Mass Production**

- Discrete GaAs FET Device
- LNA for 2.4GHz Applications
  - ZigBee, ISM Band, SDARS Antennas
- Operates from a Single Bias (Self-Bias Mode)
- Constant Gain with Voltage Bias 1.5V – 3.0V

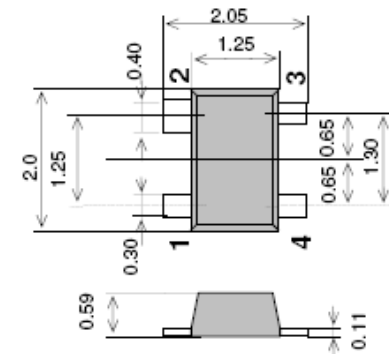
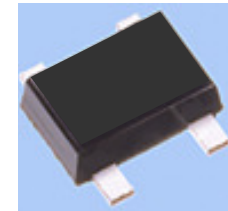
### Evaluation Board Test Results

(V<sub>DD</sub> = 3.0 V, I<sub>D</sub> = 29.1 mA, f = 2.4 GHz)

Item	Symbol	Data	Unit
Noise Figure	NF <sup>Note 1</sup>	0.74	dB
Associated Gain	G <sub>a</sub>	14.8	dB
Return Loss (in)	RL <sub>in</sub>	11.5	dB
Return Loss (out)	RL <sub>out</sub>	18.8	dB
Output Power at 1 dB Compression Point	P <sub>out</sub> (1 dB)	15.9	dB
Output 3rd Order Distortion Intercept Point	OIP <sub>3</sub> <sup>Note 2</sup>	33.0	dBm

**Notes 1.** A substrate loss 0.11 dB is including in value of NF.

**2.** f = 2.4 GHz, 1 MHz offset



### PIN CONNECTIONS

1. Source
2. Drain
3. Source
4. Gate

CEL

SiGe:C LNA IC

uPC8233TK

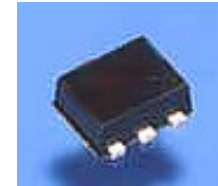
New!!

Now in MP

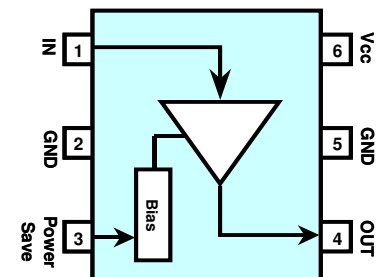
→ 1.8V Operation ←

- Process technology
  - SiGe:C HBT Process (UHS4)
- Application
  - ZigBee, Bluetooth, GPS
- Performance (Typ) @ 2.4GHz, 1.8V Vcc
  - **Low Supply Voltage, Low Noise, Low Current**
    - Supply Voltage : 1.7V ~ 3.3V
    - NF : 1.3dB, • **Gain : 16.6dB**
    - Input Return Loss(S11) : 12dB
    - Output Return Loss(S22) : 12dB
    - $I_{cc} = 3.3\text{mA}$  (@Vcc=1.8V, f=2.4GHz)
  - **Built-in Power Save function**  
( $V_{PSon}: 1.0\text{V} \sim V_{CC}$ ,  $V_{PSoff}: 0 \sim 0.4\text{V}$ )
  - **Very robust Bandgap Regulator on chip**  
(Small Vcc & Ta dependence)
  - **Included protection circuits for ESD**
    - Sample tested to 1.4kV (HBM)

Package: 6pin L2MM  
(1.5\*1.1\*0.55mm)



Pin Connections and  
Internal Block Diagram

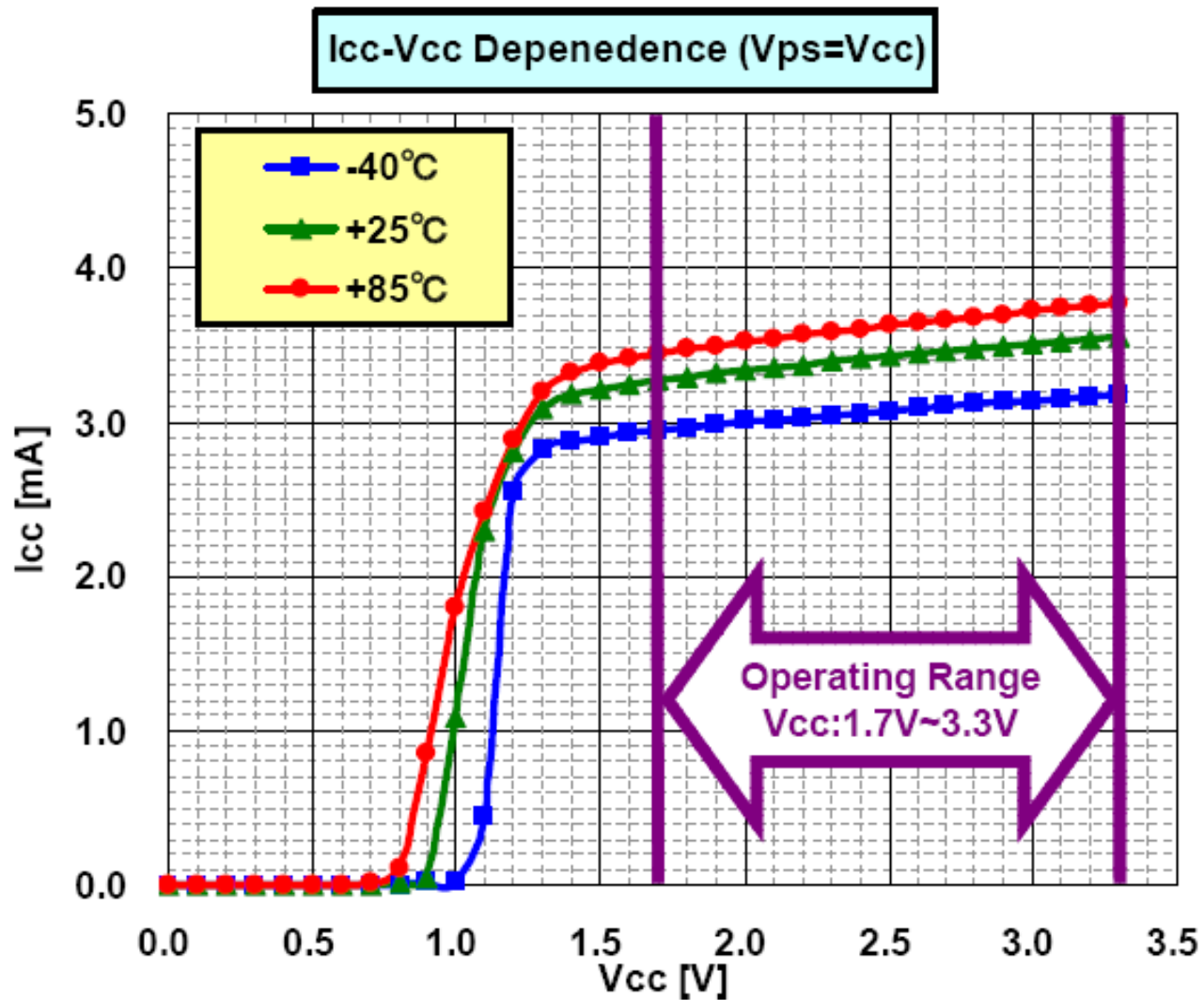


Pb-Free Product

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# uPC8233TK Low Voltage Operation



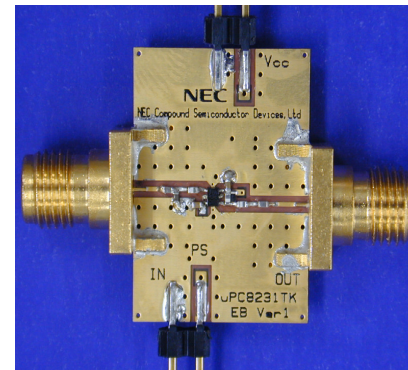
## LNA for 0.9, 1.5 & 2.4GHz

(Reference Only)

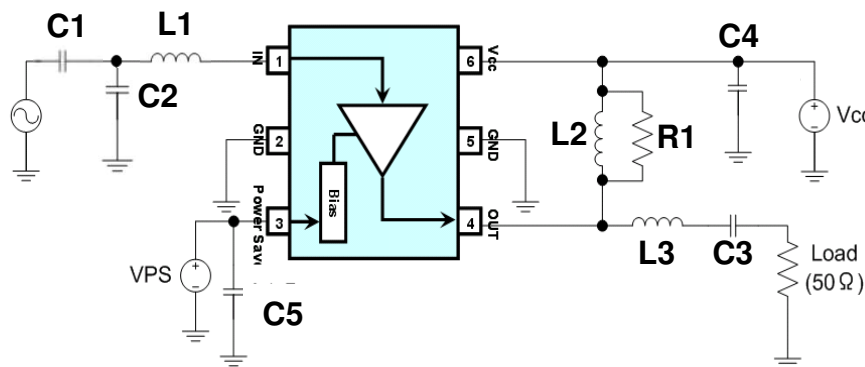
### Narrow Band Tuned Performance

<u>Vcc = 1.8V</u>	915 MHz	1.575GHz	2.4GHz
NF (dB)	1.2	0.9	1.3
Gain (dB)	24.5	20.5	16.6
InR.L. (dB)	12	13	12
OutR.L.(dB)	14	16	12

### Evaluation Board



### uPC8233TK Reference Circuit for L-S band



	915 MHz	1.575GHz	2.4GHz
L1 (nH)	24	10	4.7
C1 (pF)	33	22	56
C2 (pF)	2.0	1.0	1.0
L2 (nH)	68	18	18
L3 (nH)	15	6.8	6.8
C3 (pF)	22	18	0.5
C4 (pF)	1000	1000	1000
C5 (pF)	1000	1000	1000
R1 (ohm)	360	360	360

The logo for CEL, consisting of the letters 'CEL' in white, bold, sans-serif font, set against a red rectangular background with a slight shadow effect.

# Thank You !

**For Additional Information, Technical Support or Product Availability,  
Contact:**

 **California Eastern Laboratories**

**Tel: (408) 919-2500**

**Fax: (408) 988-0279**

**[www.cel.com](http://www.cel.com)**

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