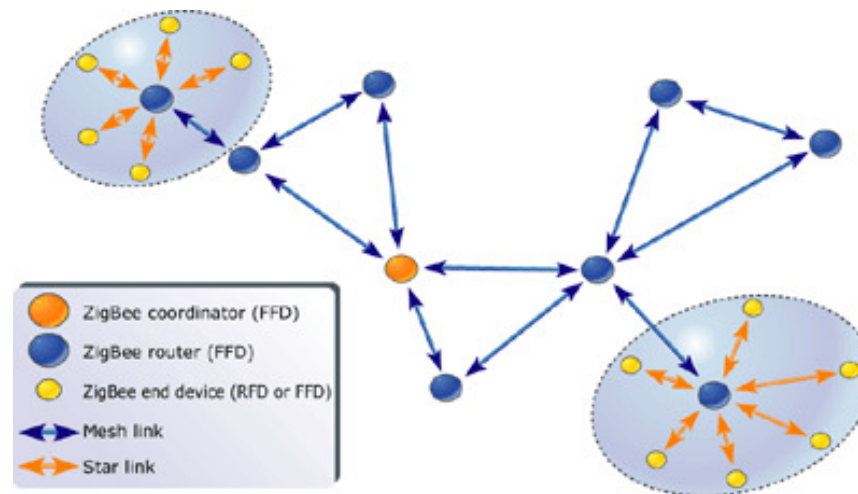


NEC / CEL Components

For

2.4GHz ZigBee and ISM Band Applications



Components for 2.4 GHz Designs

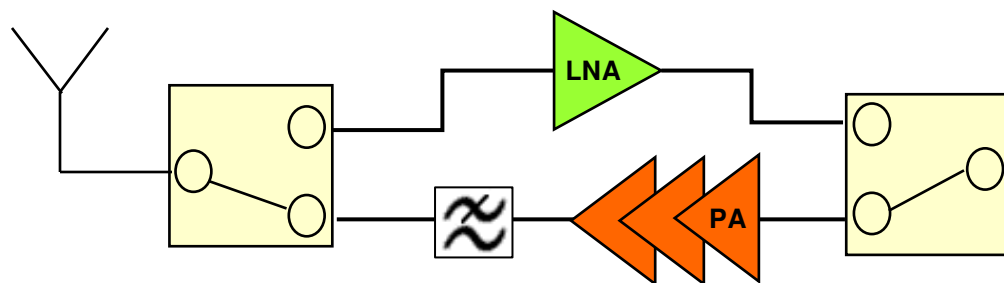
Bluetooth, ZigBee, ISM Band Transmitters

SPDT Switches*:

uPG2214TB/TK
uPG2030TK
uPG2179TB
uPG2158T5K
uPG2012TK
uPG2015TB

LNA Devices:

NESG3031M05/M14
NE662M04
NE3508M04
uPC8233TK



SP3T Switch:

uPG2150T5L

PA ICs:

uPG2314T5N
uPG2301TQ
uPG2250T5N

RF Transceiver

*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 1.8V
uPG2250T5N:	+25 dBm at 3V

uPG2314T5N

In
Mass Production**Features**

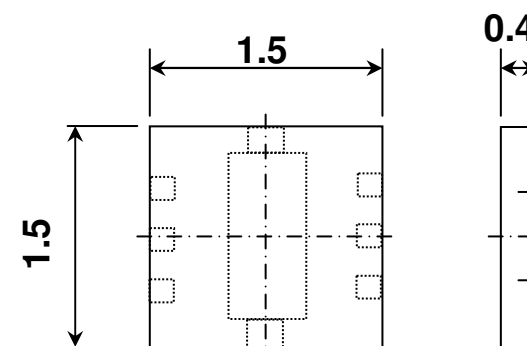
- **Low Current Consumption**
- 20dB Variable Gain Control
- Shut Down Function
- **Smaller & Lower Height Package**

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.** @ $P_{in} = +0dBm$, $V_{cont} = 3V$

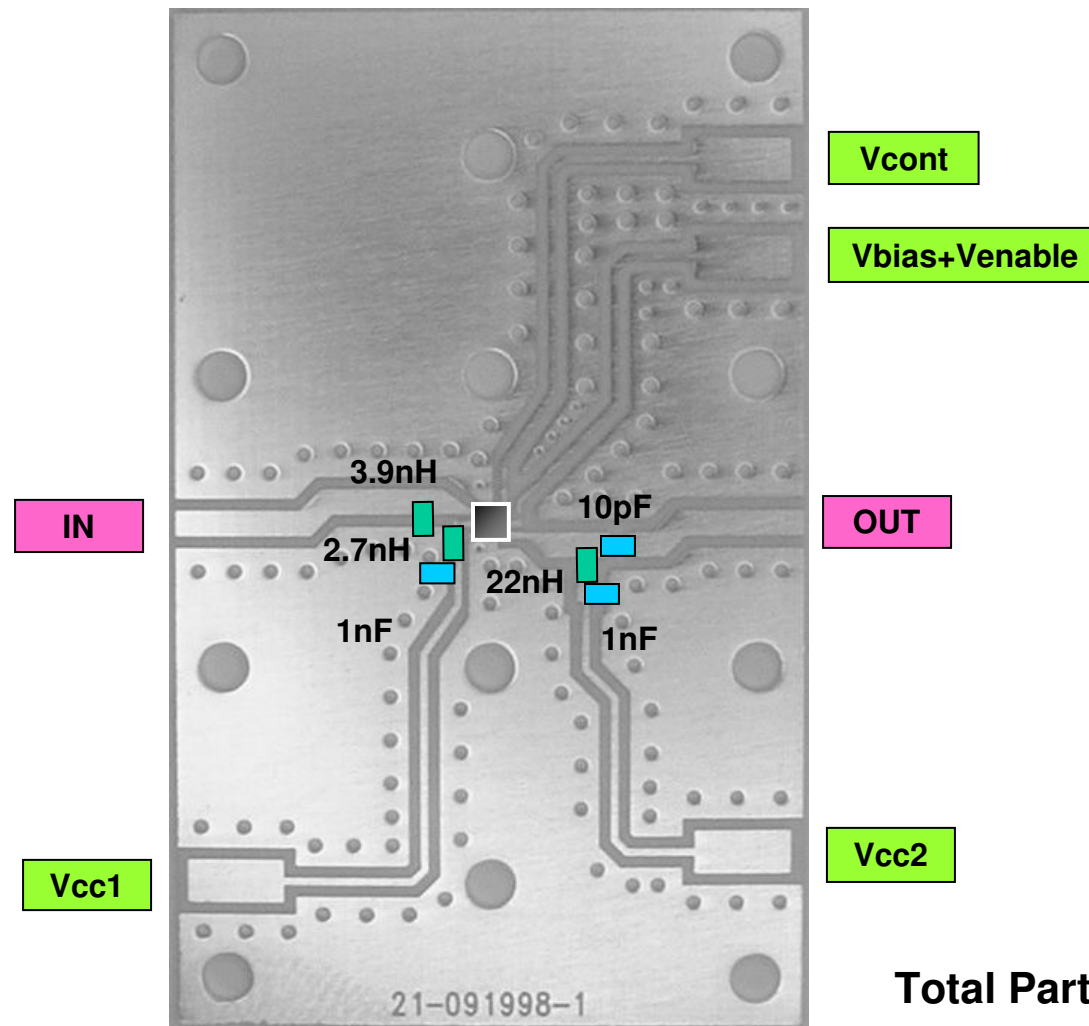


6-pinTSON PKG

Thickness: 0.4mm max.



uPG2314T5N Evaluation Board Layout

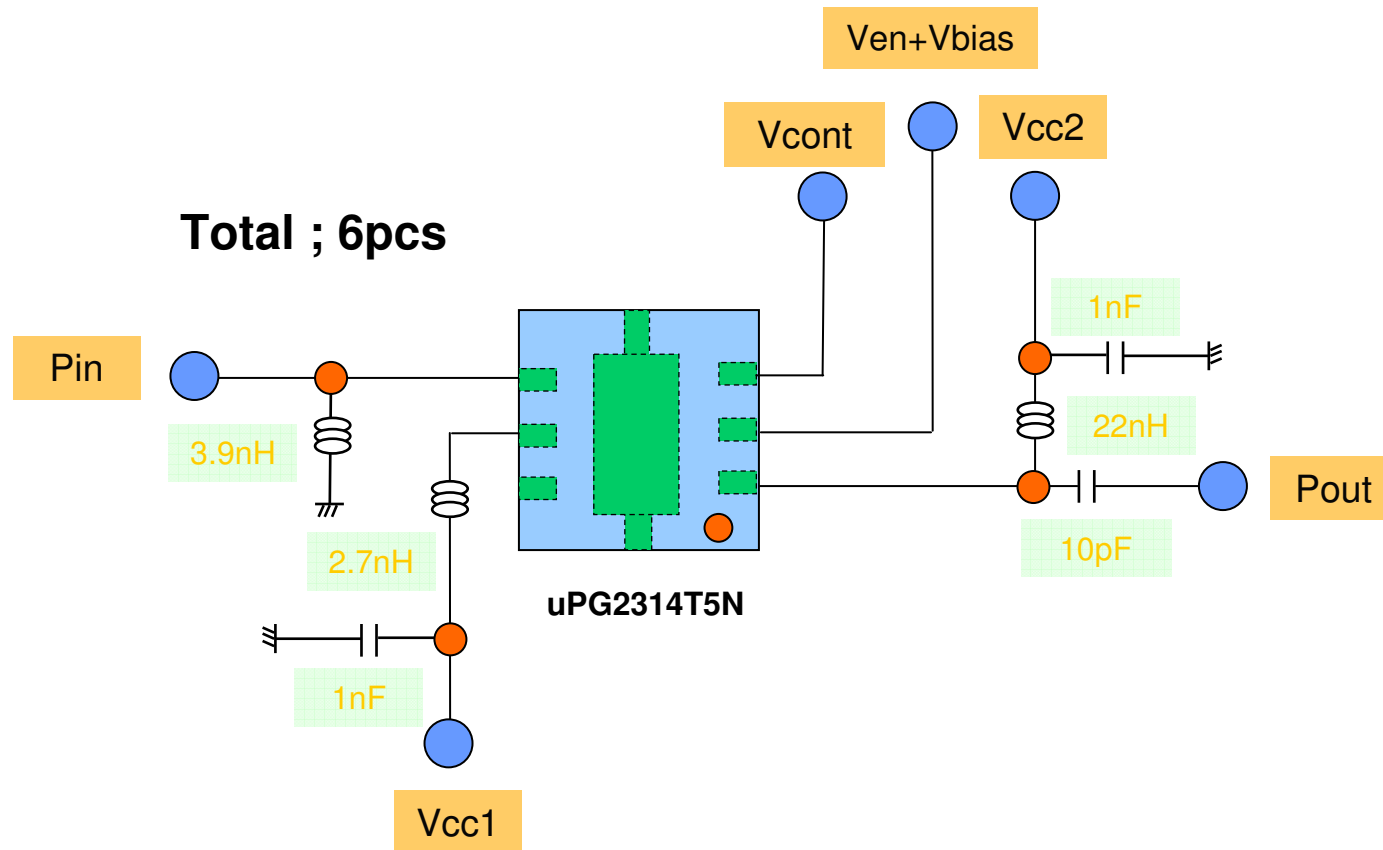


Total Parts : 6pcs

NEC

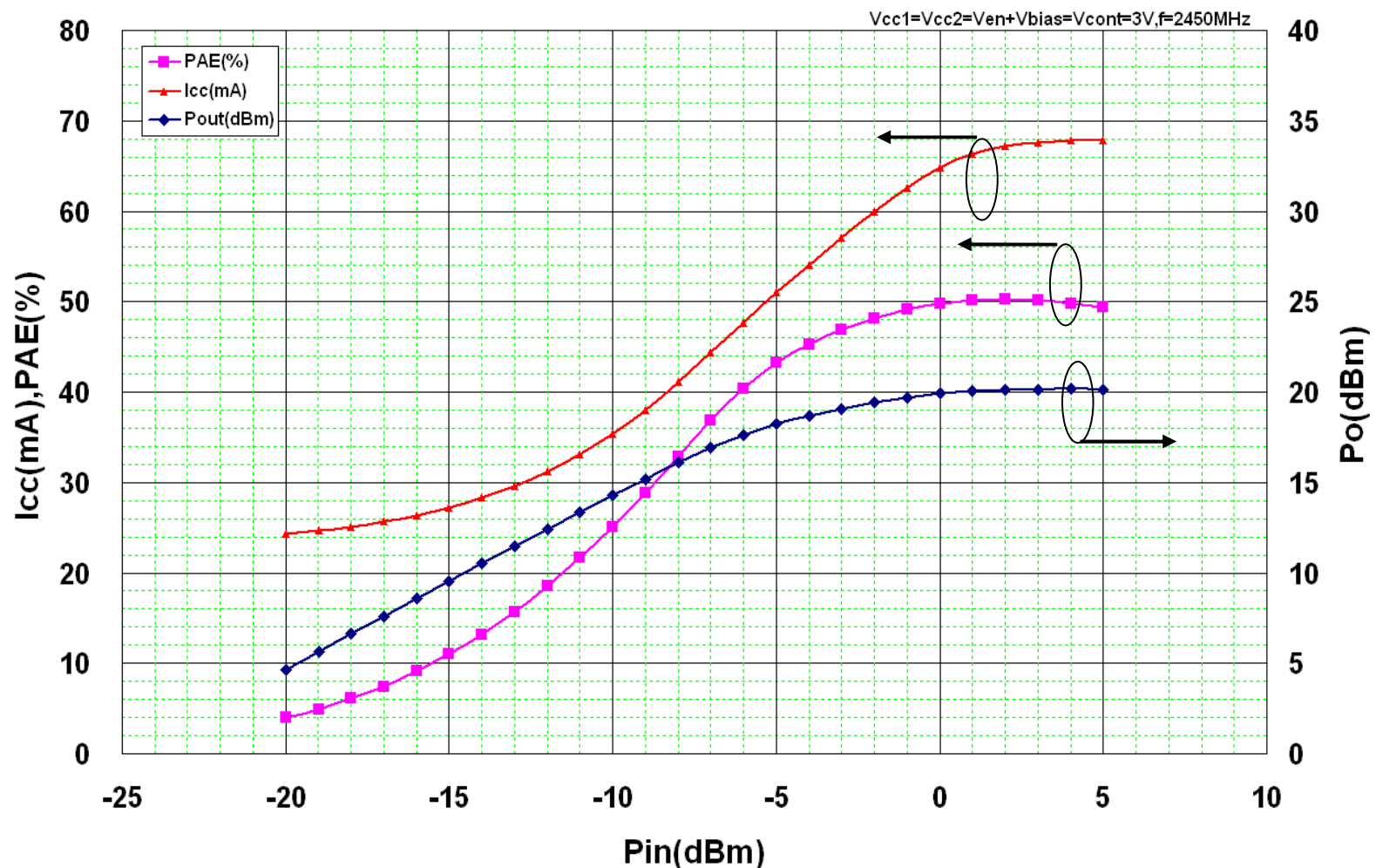
A Business Partner of NEC Electronics Corporation.

CEL uPG2314T5N Evaluation Board Schematic

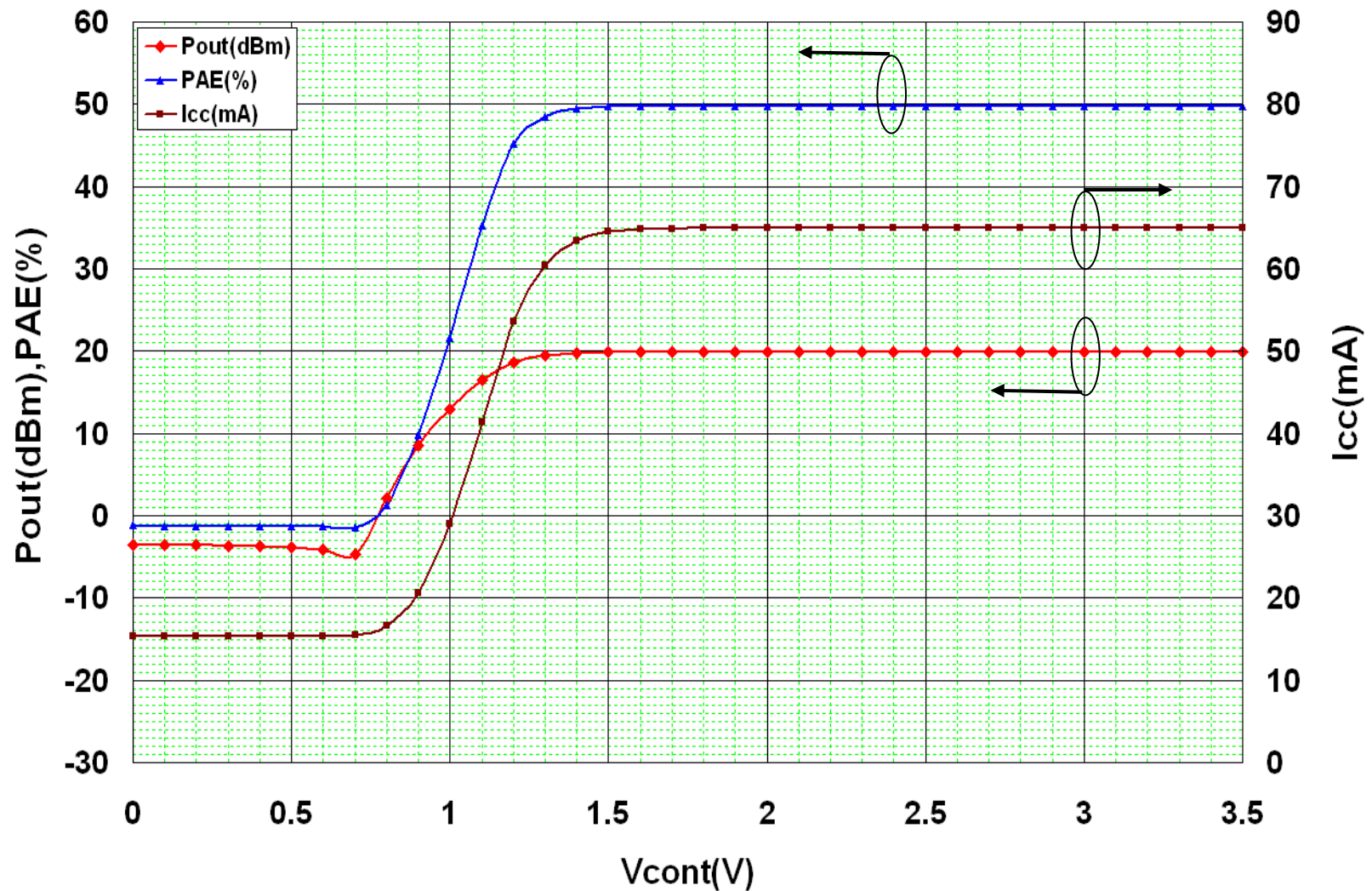


uPG2314T5N Pin vs. Pout, PAE, Icc

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

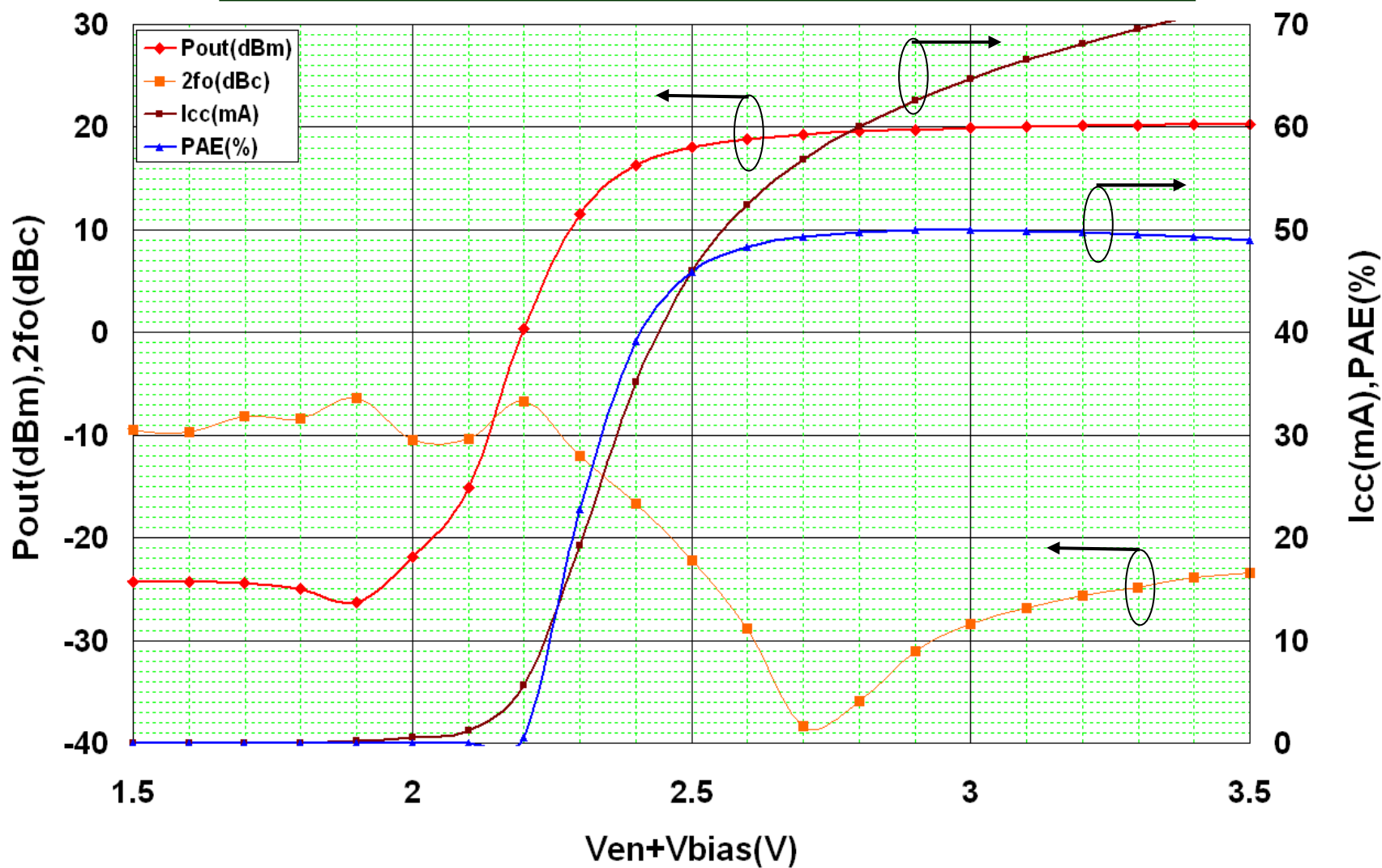


Test Conditions : $f = 2450\text{MHz}$, $V_{cc1}=V_{cc2}=V_{bias}+V_{enable}=3.0\text{V}$,
 $P_{in}=+0\text{dBm}$, with external input & output matching circuits



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

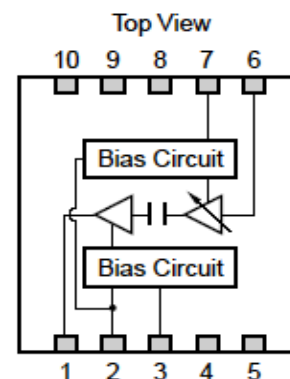
Applications

- Bluetooth, ZigBee, ISM Band

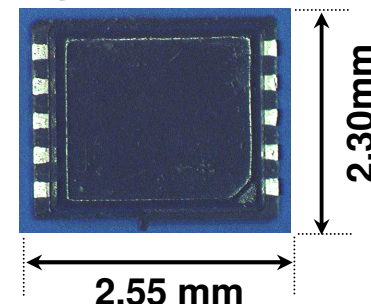
RF Performance (typical)

- 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



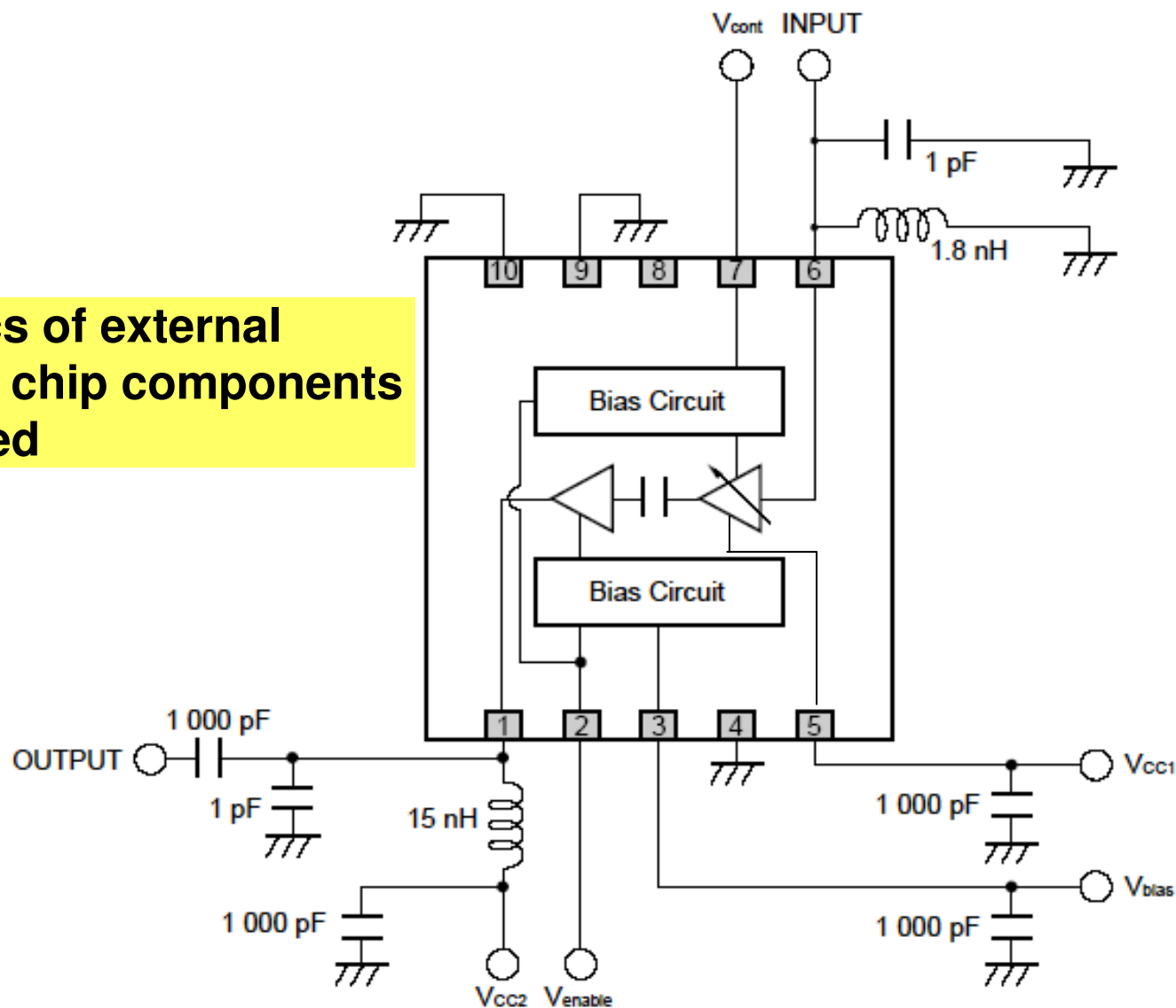
10pin TSON PKG



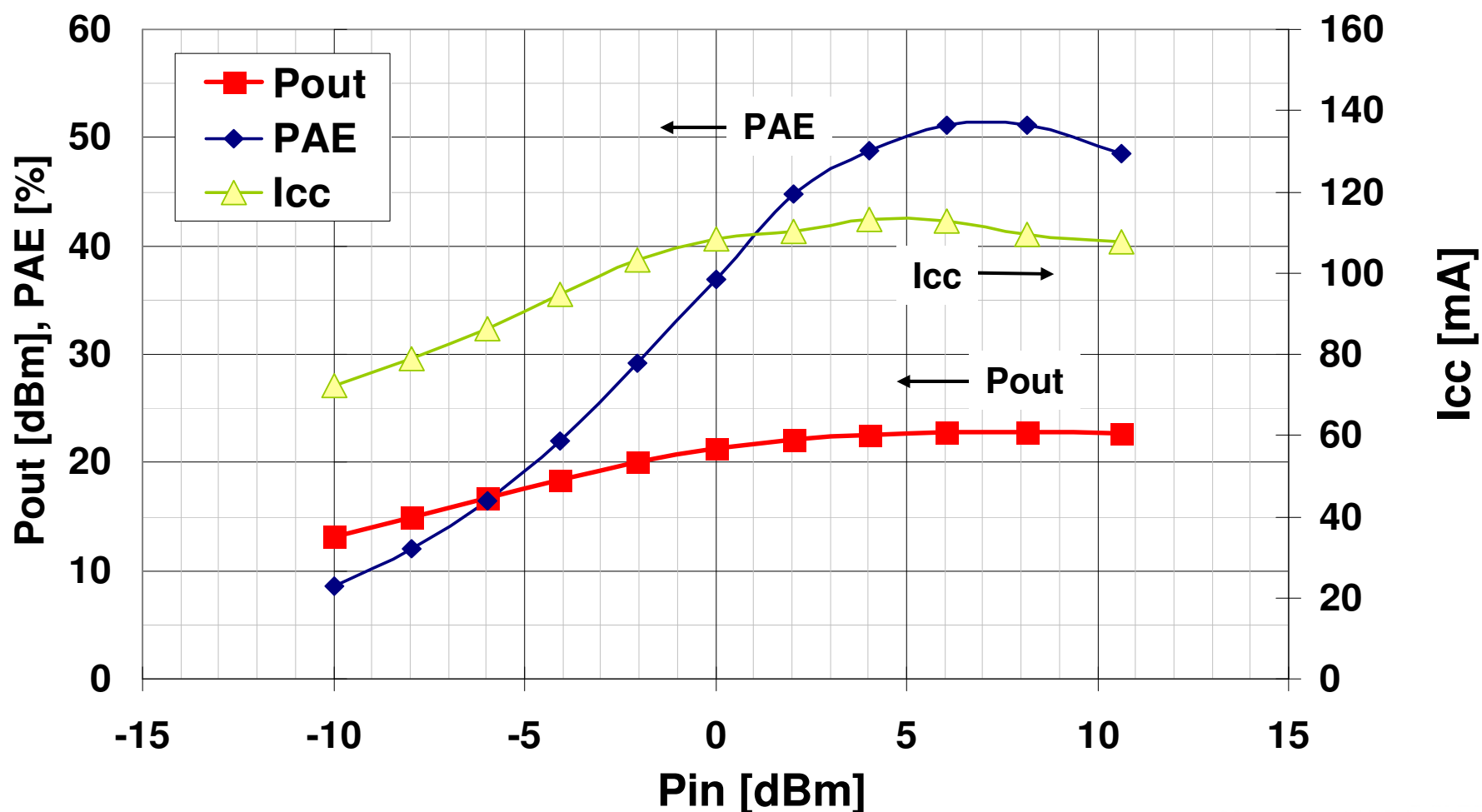
Thickness: 0.6mm MAX
Lead Pitch: 0.4mm

uPG2301TQ Evaluation Circuit

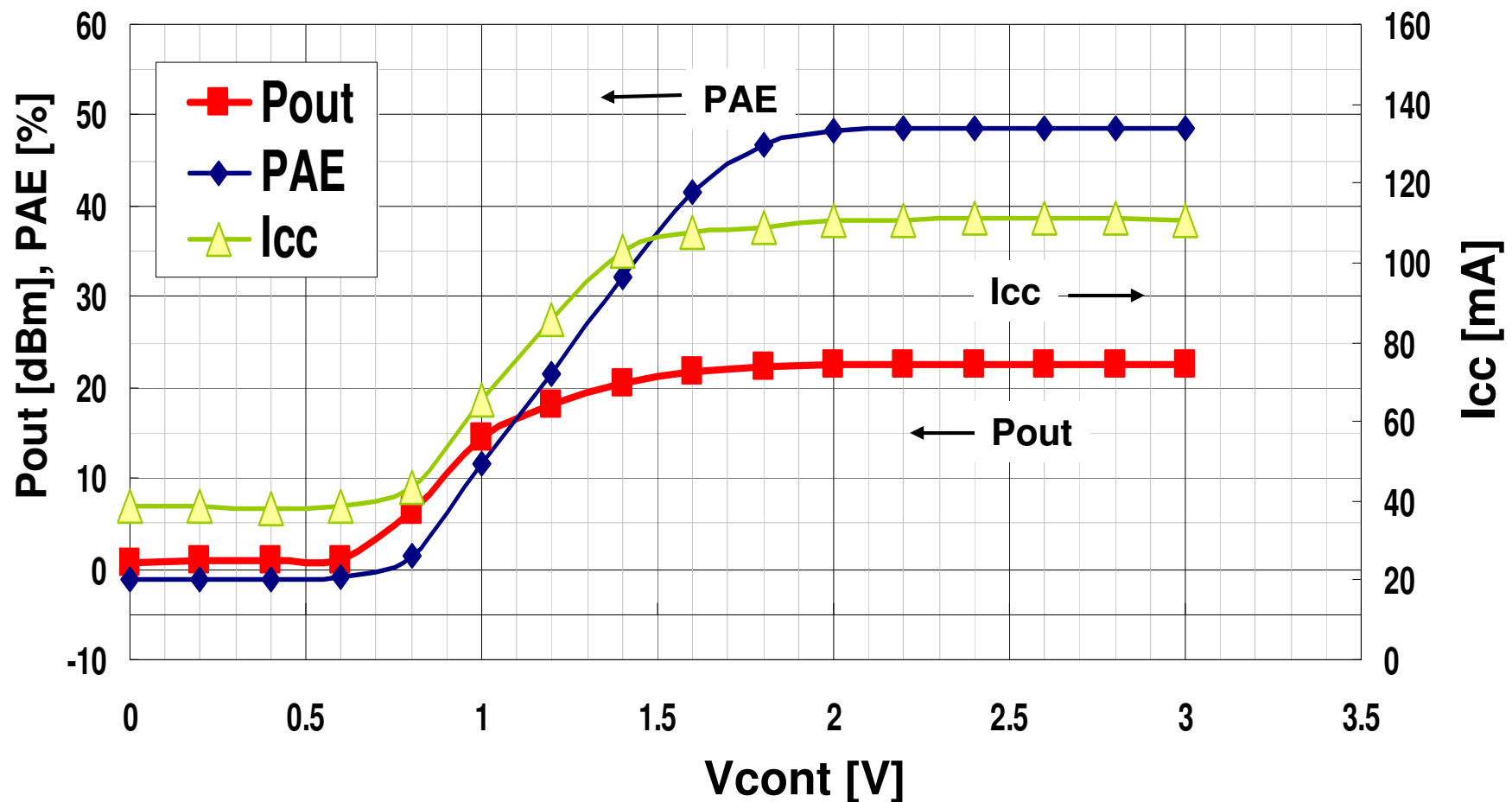
Only 8 pcs of external
0603 size chip components
are needed



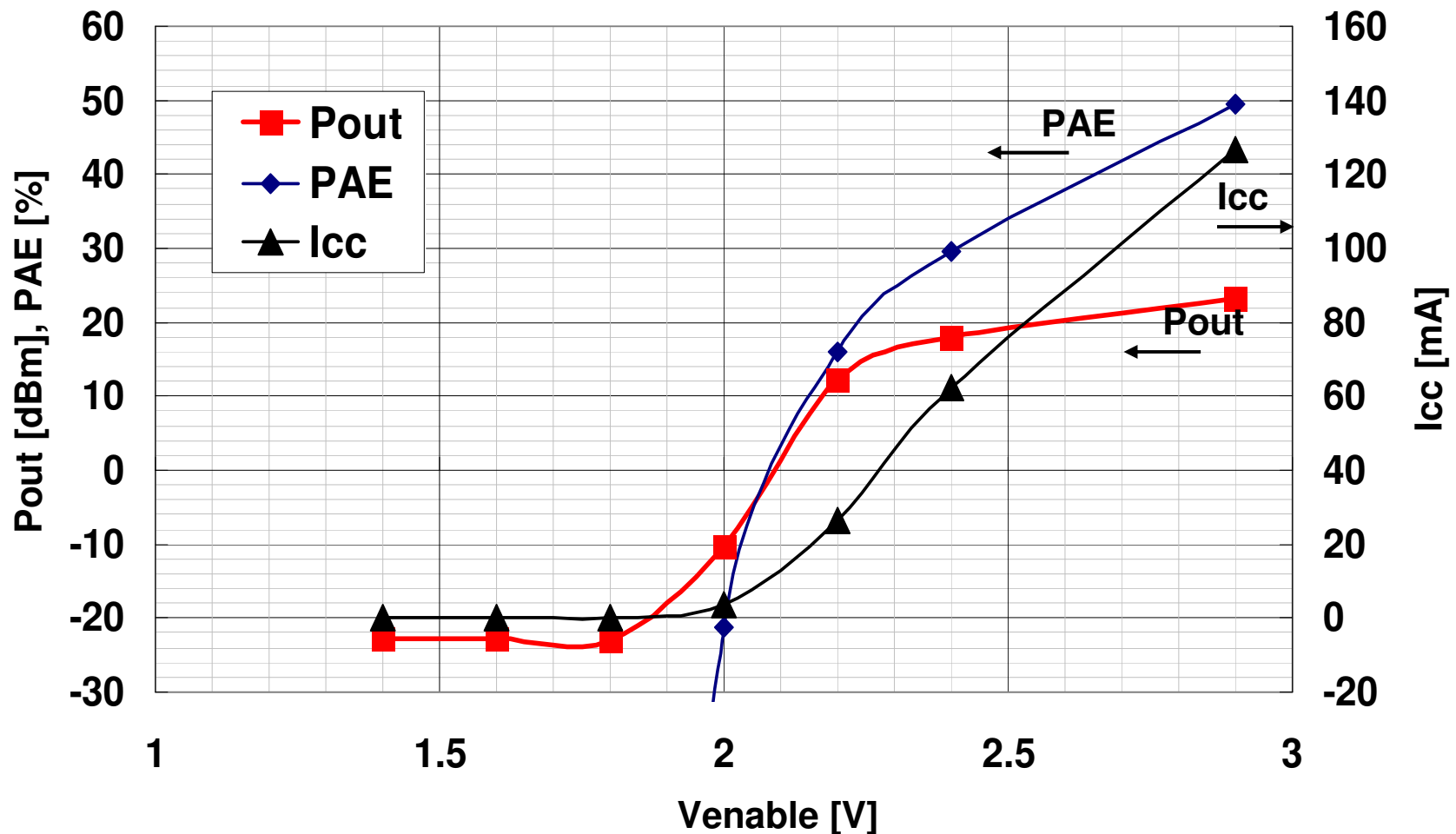
Test Conditions : $f = 2450\text{MHz}$, $V_{cc1}=V_{cc2}=V_{bias}=3.3\text{V}$, $V_{enable}=2.9\text{V}$,
 $V_{cont}=2.5\text{V}$, with external input & output matching circuits



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



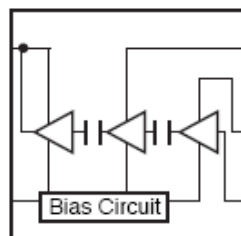
Test Conditions : $f = 2450\text{MHz}$, $V_{cc1}=V_{cc2}=V_{bias}=3.3\text{V}$, $V_{cont}=2.5\text{V}$, $P_{in}=+4\text{dBm}$,
With external input & output matching circuits



uPG2250T5N

Features

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



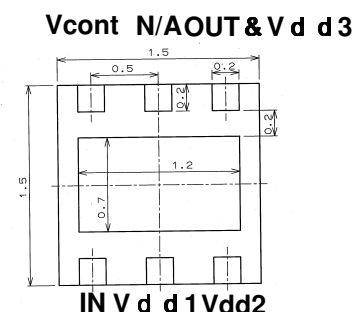
In
Mass Production

Applications

- Bluetooth Class 1 EDR, ZigBee, ISM Band

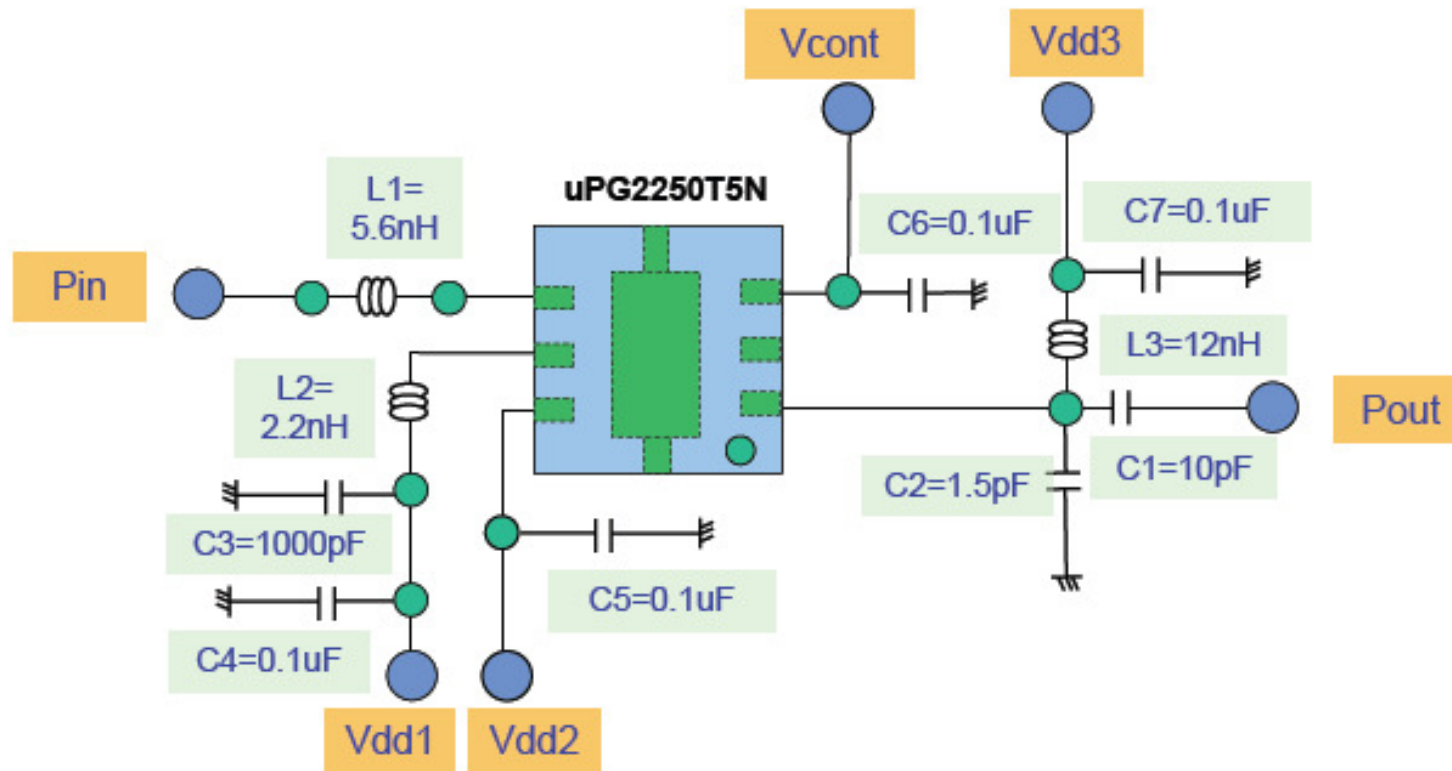
Preliminary Performance (Typical)

- Frequency Range: 2.4 to 2.5GHz
- Supply voltage: $V_{dd} = 3.0V$ or $1.8V$, $V_{cont} = 1.8V$
- Output Power: **+25dBm**, $V_{dd} = 3.0V$
+20dBm, $V_{dd} = 1.8V$
@ $V_{cont} = 1.8V$, $P_{in} = -2dBm$
- Current: 190mA @ **$P_{out} = +25dBm$** , $V_{dd} = 3.0V$
110mA @ **$P_{out} = +20dBm$** , $V_{dd} = 1.8V$

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)

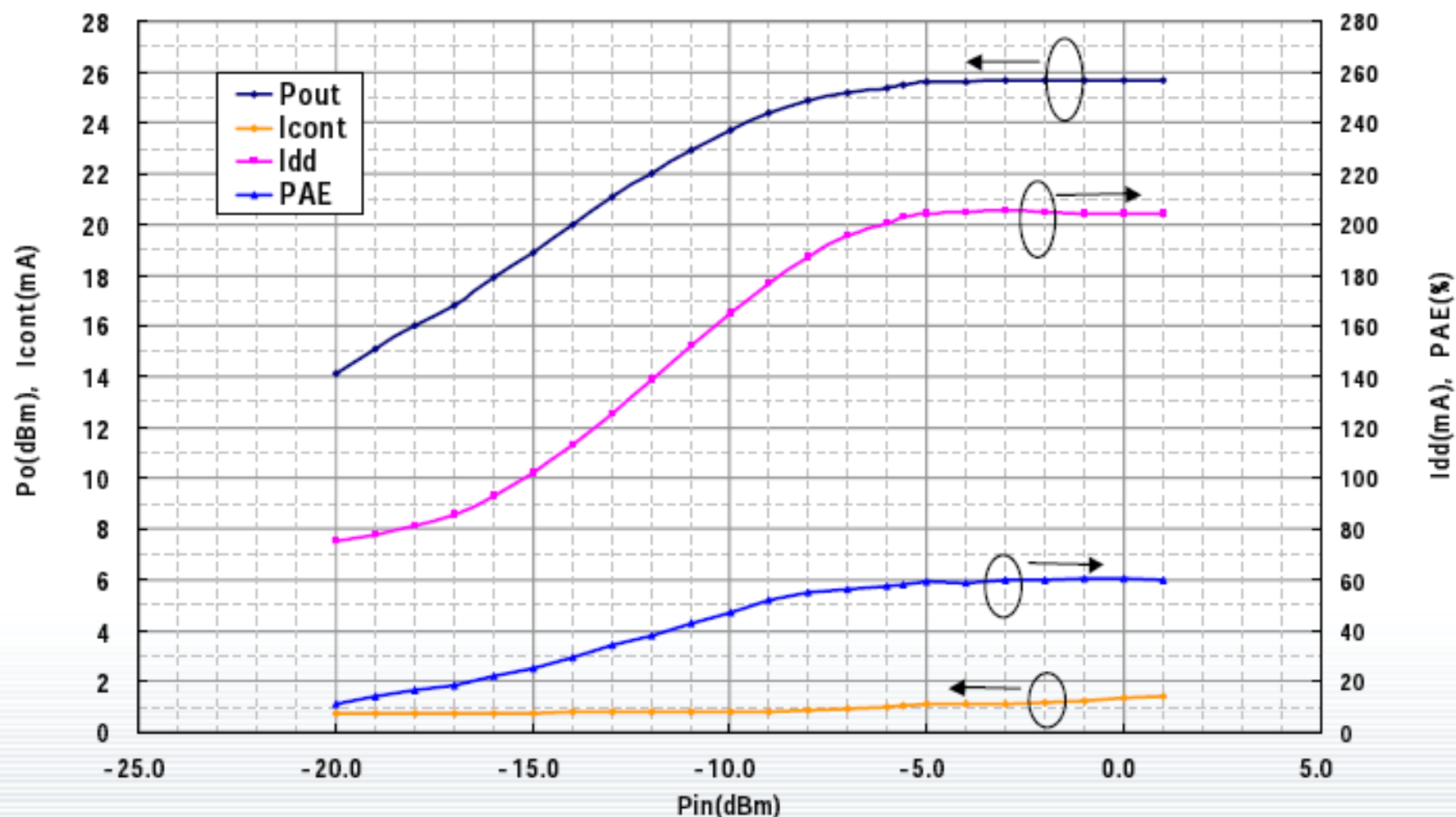
CEL

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

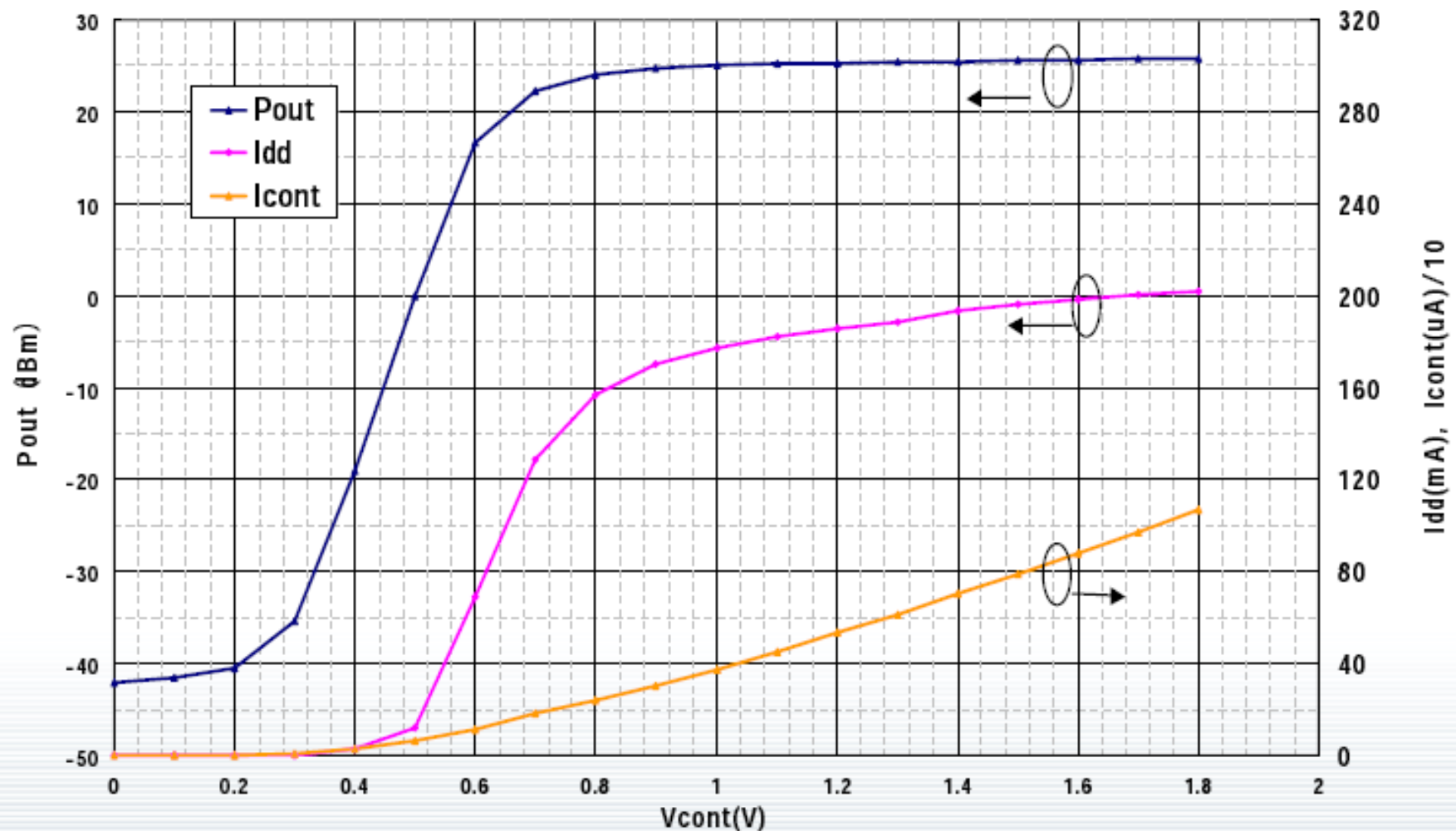
(Reference Only)

Vdd = 3V

Vdd = 3V

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

(Reference Only)

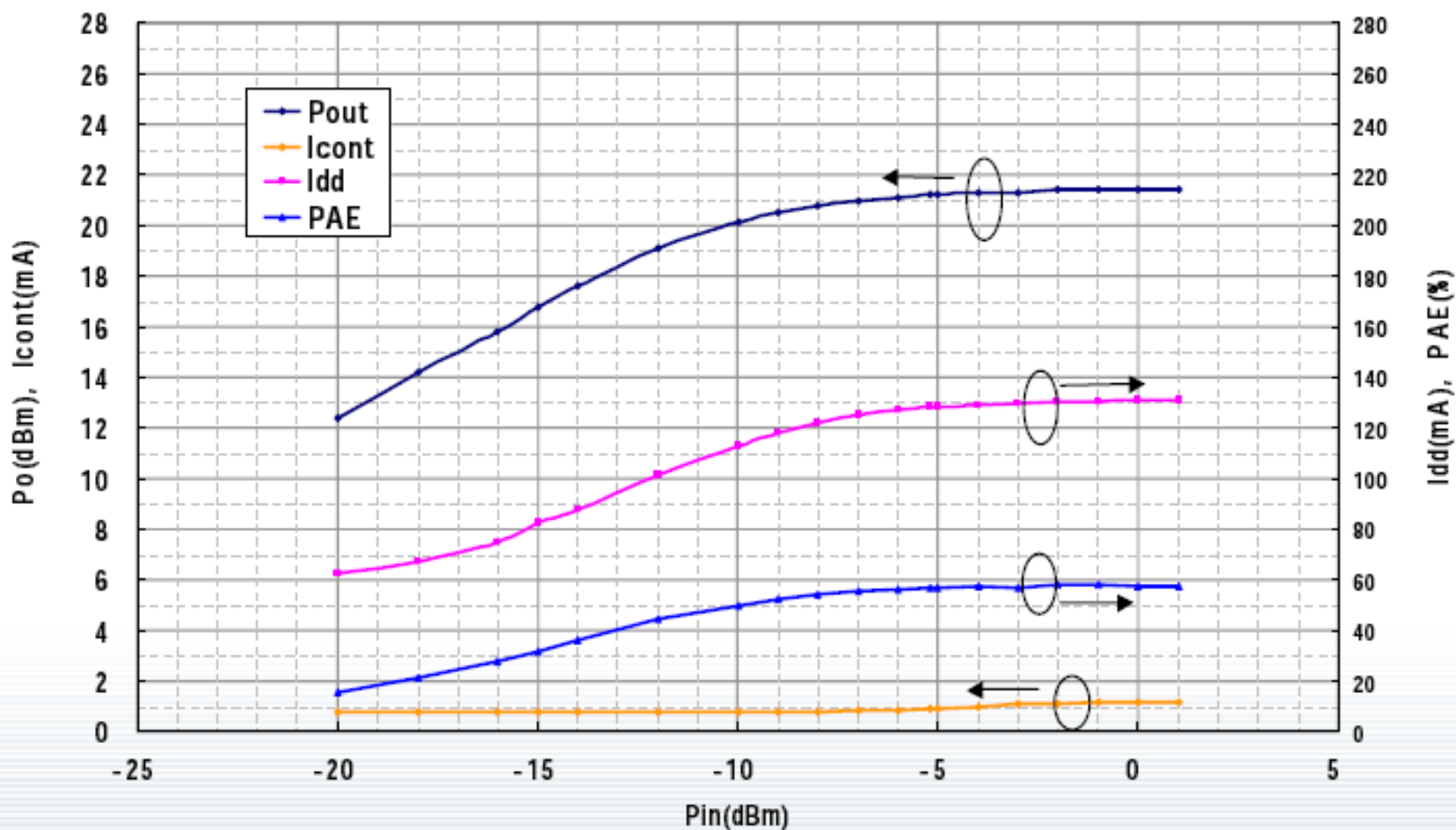


Vdd = 1.8V

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)

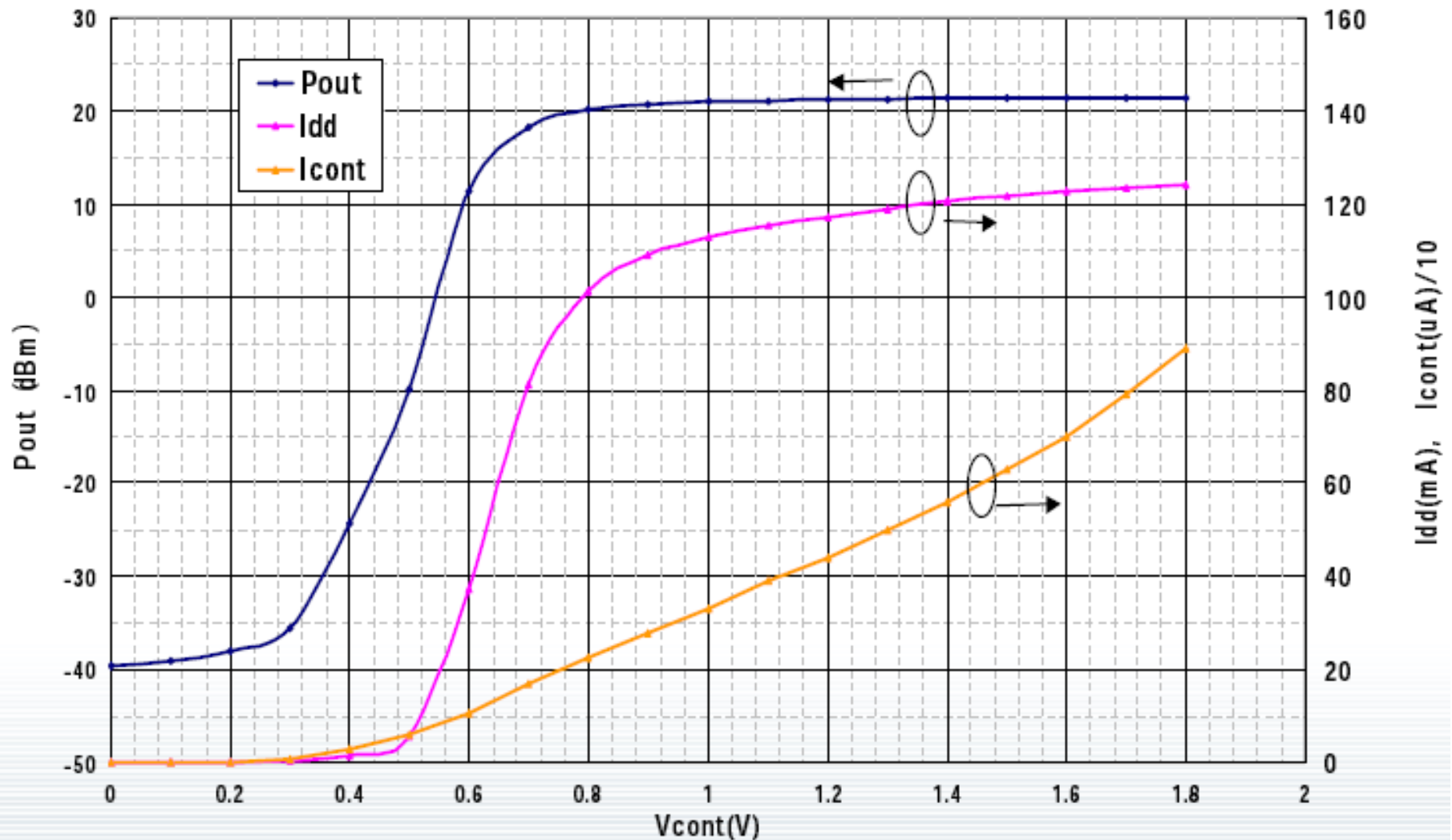
Vdd = 1.8V



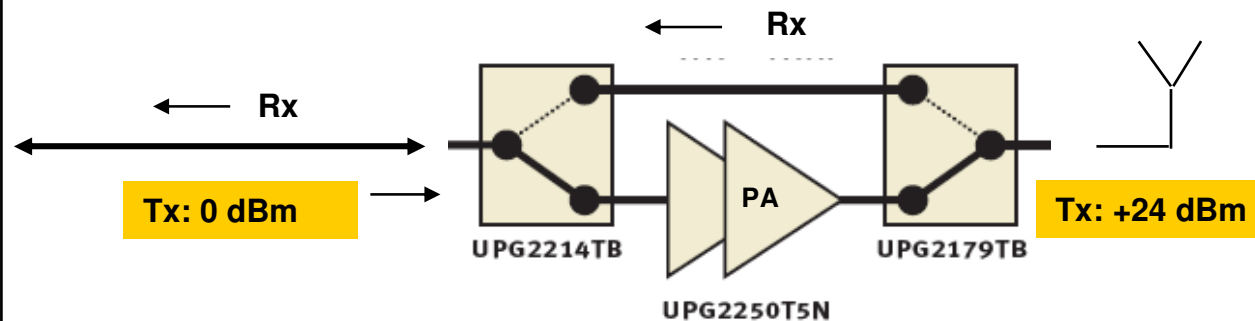
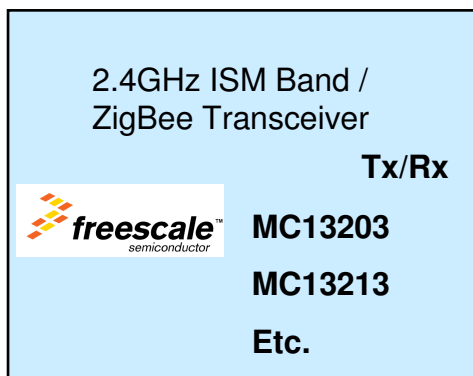
Vdd = 1.8V

Test Conditions : $f = 2450\text{MHz}$, $V_{dd1}=V_{dd2}=V_{dd3}=1.8\text{V}$, $\text{Pin}=-5\text{dBm}$
with external input & output matching circuits

(Reference Only)

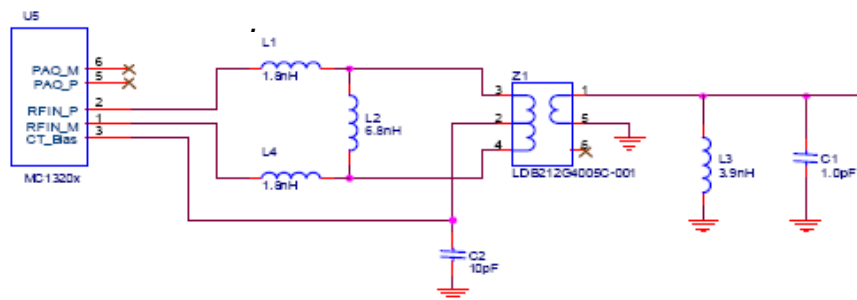


2.4GHz Application Example



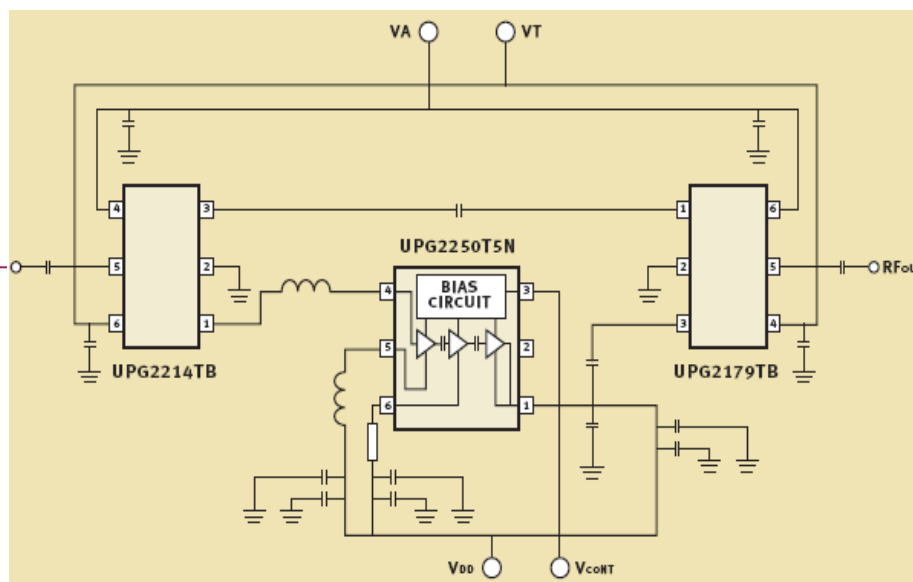
Also

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



Transceiver

Single Ended
Matching Network



CEL Range Extension Solution

NEC

A Business Partner of NEC Electronics Corporation.

CEL

+25dBm GaAs PA IC

uPG2251T6M

NEW**DS: Oct'08****MP: Feb'09**

Features

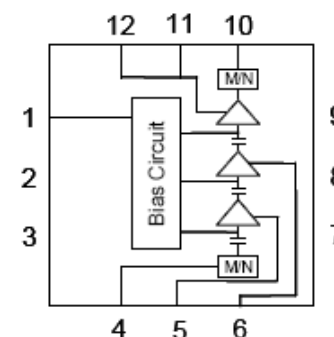
- 2.4 – 2.5GHz, **Internally Matched**
- 6 External Components
- 2.5V to 3.6V Operation with $V_{cont} = 1.8V$
- Shut Down Function

Applications

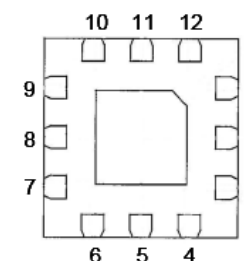
- Bluetooth Class 1 EDR, ZigBee, ISM Band

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

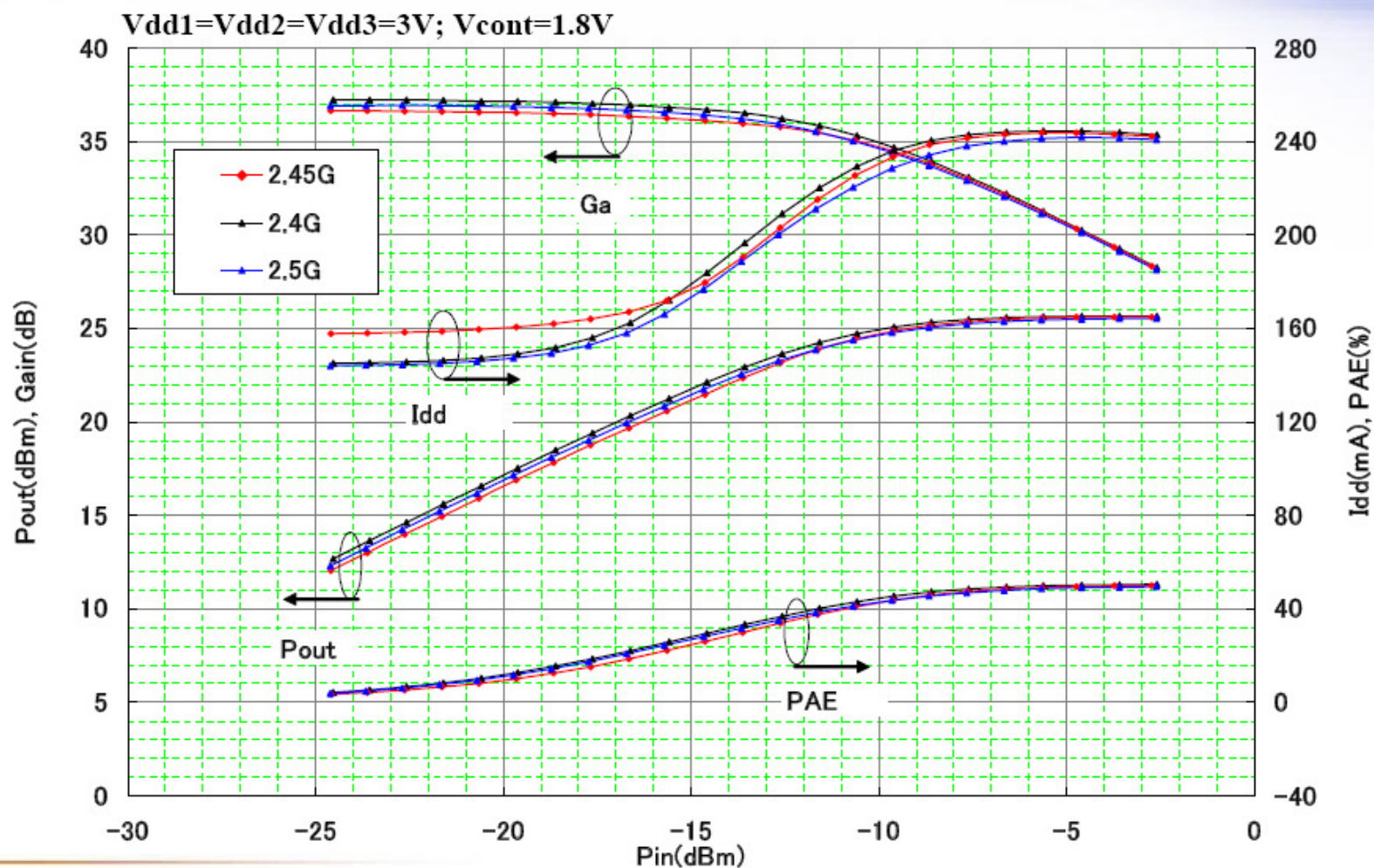
2.0 x 2.0 x 0.37 mm

NEC

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Pout vs. Ga, PAE, Idd Characteristics

NEC



Measured Data

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

Switches

Power Considerations for Switches

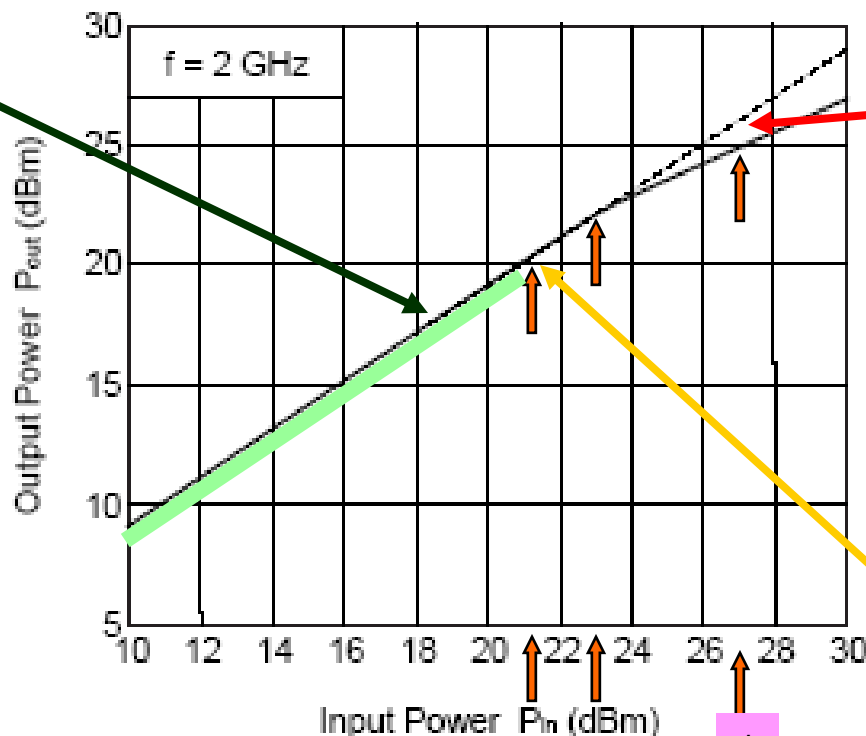
3 Min Typ 2

0.1 dB Loss Compression	$P_{in(0.1\text{ dB})}$	$f = 2.0/2.5\text{ GHz}$	+21.0	+23.0	–	dBm
Input Power ^{Note 2}		$f = 0.5\text{ to }3.0\text{ GHz}$	–	+23.0	–	dBm
1 dB Loss Compression	$P_{in(1\text{ dB})}$	$f = 0.5\text{ to }3.0\text{ GHz}$	–	+27.0	–	dBm
Input Power ^{Note 3}				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 P_{1dB} , switch loss will be $\sim 1.4\text{ dB}$, 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) Minimum	Pin (0.1dB) (dBm) Typical	Voltage for P(0.1dB) Spec
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 uPG2030TK	+29 dBm (Typ) +25.5 dBm (Min) +27 dBm (Typ) +25.5 dBm (Min)
uPG2250T5N	+25 dBm		uPG2179TB uPG2030TK	+29 dBm (Typ) +25.5 dBm (Min) +27 dBm (Typ) +25.5 dBm (Min)

uPG2214TB is recommended as the lowest cost input switch.

Features

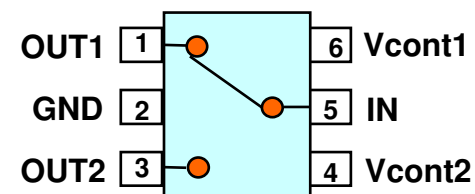
- Low insertion loss, high isolation
- Specified at **1.8V** (as well as 3V)
- Two Package Choices

Applications

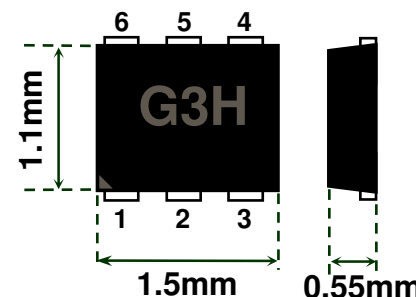
- Mobile Comm., 802.11b/g, Bluetooth, ZigBee

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

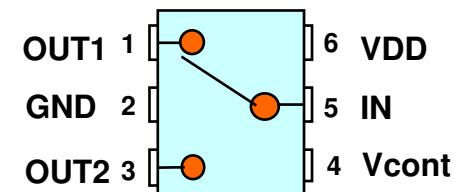
Applications

- Mobilecomm., Bluetooth, ZigBee

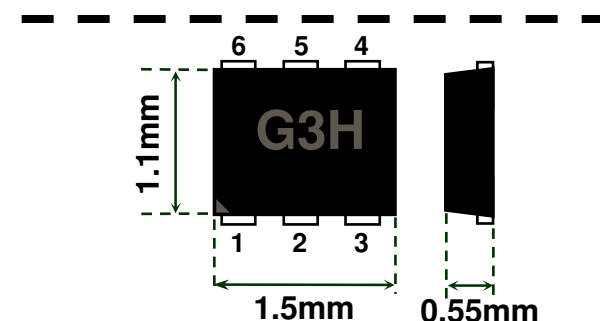
RF Performance (typical)

- 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

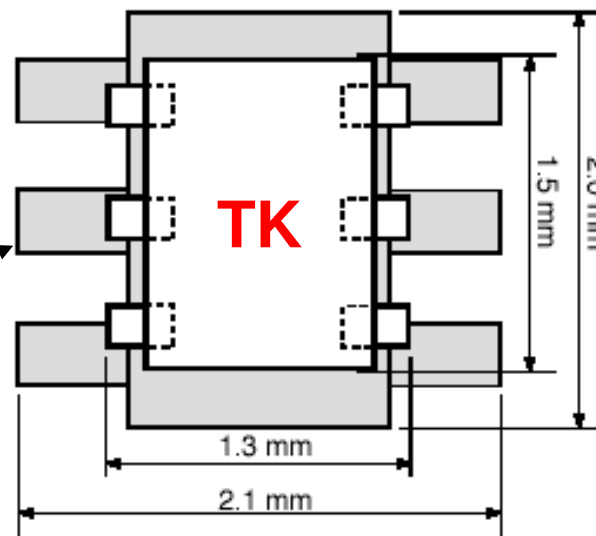


Comparison of TK and TB Packages

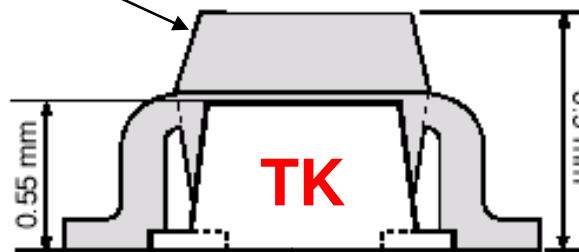
uPG2012 and uPG2214 are available in both TB and TK packages

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)

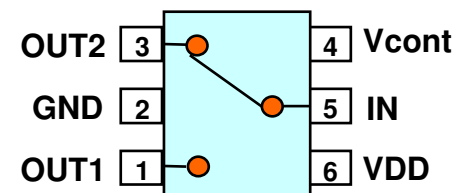
In Mass Production

Application

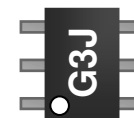
- 800MHz to 2.5GHz band Mobile Comm., Bluetooth, ZigBee, ISM Band Transceivers

RF Performance

- Frequency : $f = 500\text{M}$ to 2.5GHz
- 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. @ $f = 2.5\text{GHz}$
- $\text{Pin}(0.1\text{dB}) : +27.0\text{dBm}$ typ. @ $V_{\text{CONT}} = +2.8\text{V} / 0\text{V}$
- $\text{Pin}(0.1\text{dB}) : +25.5\text{dBm}$ **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

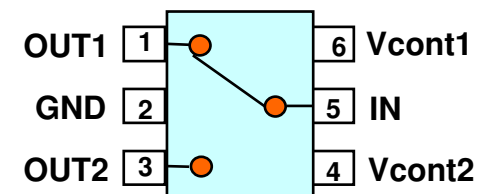
Applications

- 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: **27**dB typ @ 2.5 GHz

- P(1.0 dB): +32 dBm typ
- P(**0.1**dB): +**29** dBm typ
- P(**0.1**dB): +**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

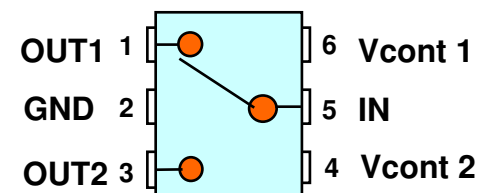
■ Applications

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

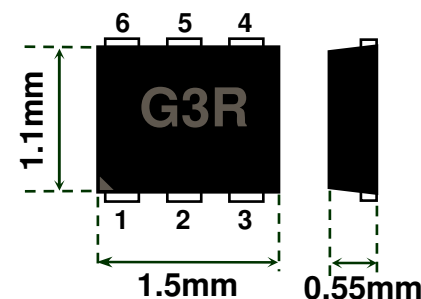
■ Performance (typical)

- 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
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uPG2158T5K

■ Features

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

**In Mass
Production**

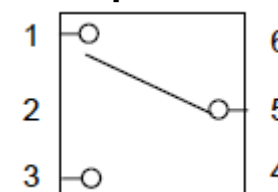
■ Applications

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

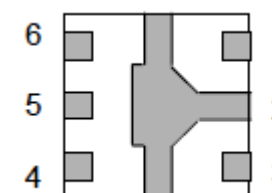
■ Performance (typical)

- 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

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

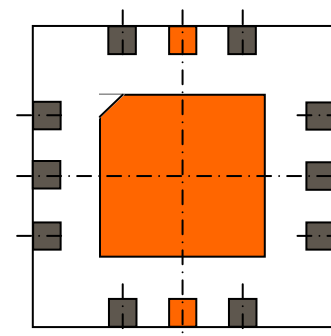
- **High Isolation between WiFi Tx and BT port**
- Low Height Small Package

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)

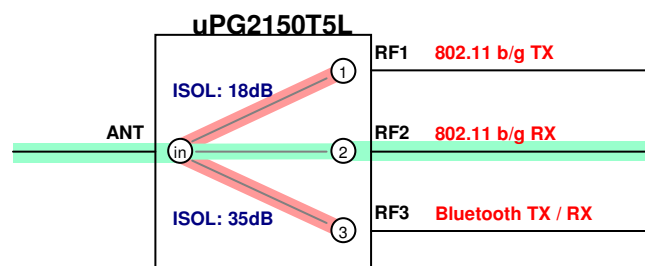
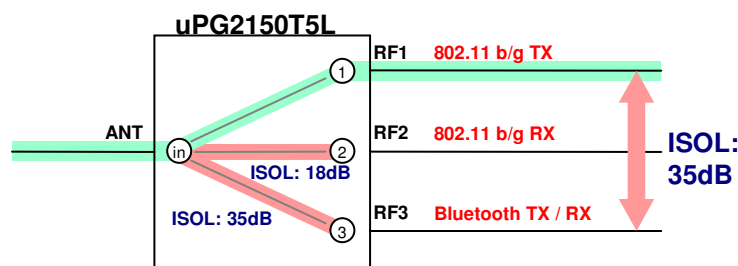
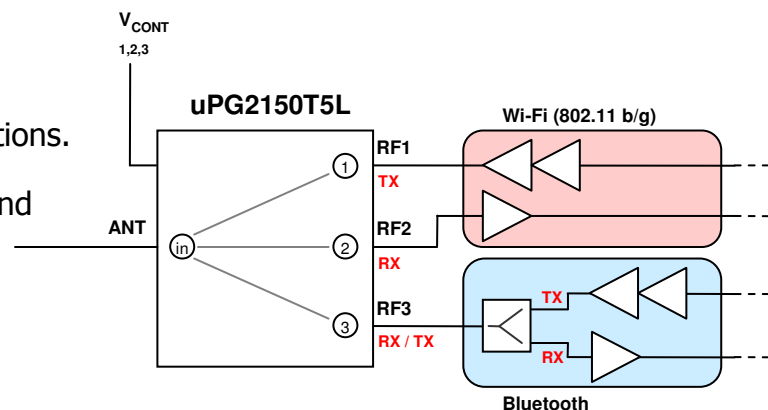
Explanation of typical application for this switch:

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:

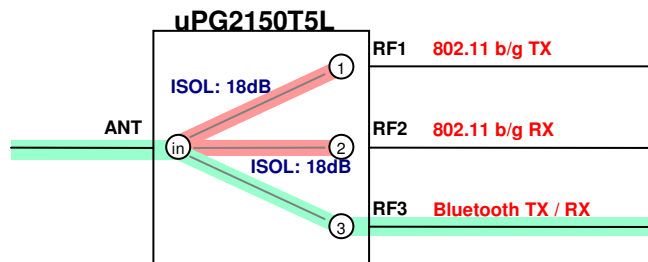
The first two outputs (RF1 and RF2) are used for the transmit and receive sides (respectively) of the Wi-Fi RF solution. And the third output handles the Bluetooth communications, with another T/R switch to handle the Bluetooth transmit and receive functions.

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

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

Measured Data from CEL Eval Boards

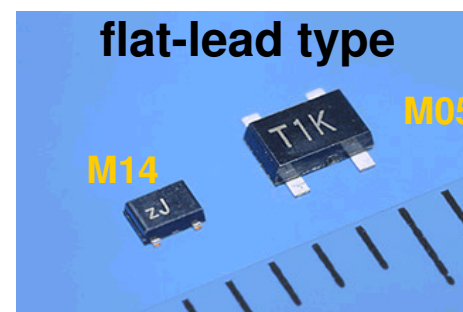
= Low Noise SiGe HBT =

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

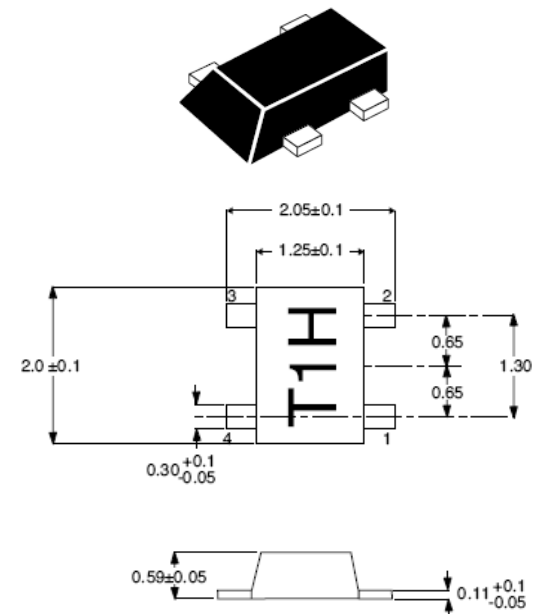
- Low Noise Amplifier for Mobile Communications, etc.
- ISM Band LNA or Medium Power Stage

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:
 - +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)

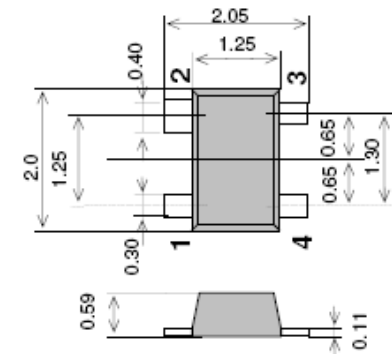
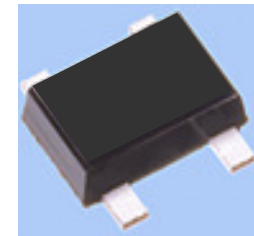
- Low Noise Figure:
(2V, 5mA)

1.0dB, 21dB Ga @ 1.0GHz
1.1dB, 16dB Ga @ 2.0GHz
1.2dB, 14dB Ga @ 2.5GHz
- High Output P_{1dB} :
(2V, 20mA I_{CQ})

+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

Pb-Free Product

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- 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

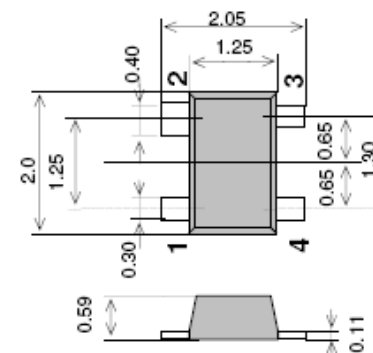
Evaluation Board Test Results

(V_{DD} = 3.0 V, I_D = 29.1 mA, f = 2.4 GHz)

Item	Symbol	Data	Unit
Noise Figure	NF ^{Note 1}	0.74	dB
Associated Gain	G _a	14.8	dB
Return Loss (in)	RL _{in}	11.5	dB
Return Loss (out)	RL _{out}	18.8	dB
Output Power at 1 dB Compression Point	P _{out} (1 dB)	15.9	dB
Output 3rd Order Distortion Intercept Point	OIP ₃ ^{Note 2}	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

1.8V Operation

Process technology

- SiGe:C HBT Process (UHS4)

Application

- ZigBee, Bluetooth, GPS

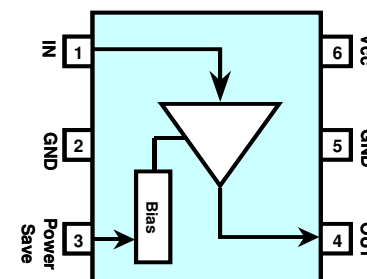
Performance (Typ) @ 2.4GHz, 1.8V Vcc

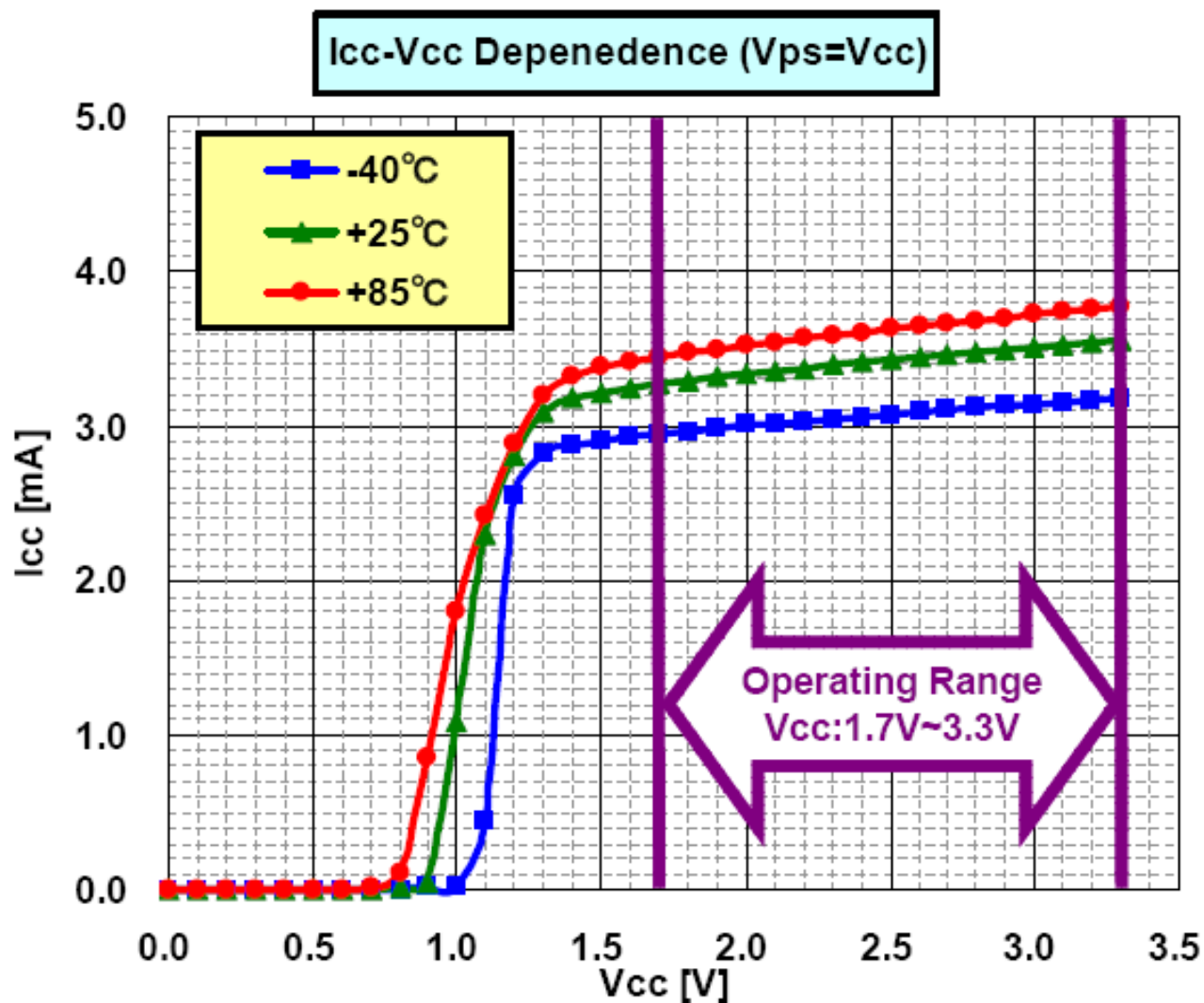
- Low Supply Voltage, Low Noise, Low Current
 - Supply Voltage : 1.7V ~ 3.3V
 - NF : 1.3dB, • Gain : 16.6dB
 - Input Return Loss(S11) : 12dB
 - Output Return Loss(S22) : 12dB
 - $I_{cc} = 3.3\text{mA}$ (@Vcc=1.8V, f=2.4GHz)
- Built-in Power Save function
(V_{PSon} : 1.0V ~ VCC, V_{PSoff} : 0 ~ 0.4V)
- 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**



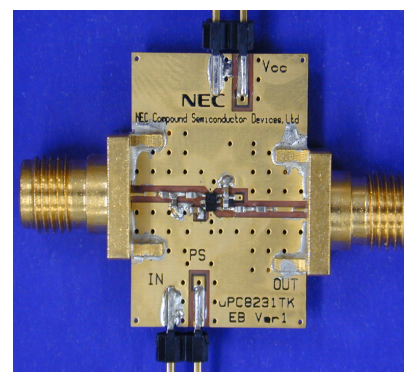
LNA for 0.9, 1.5 & 2.4GHz

(Reference Only)

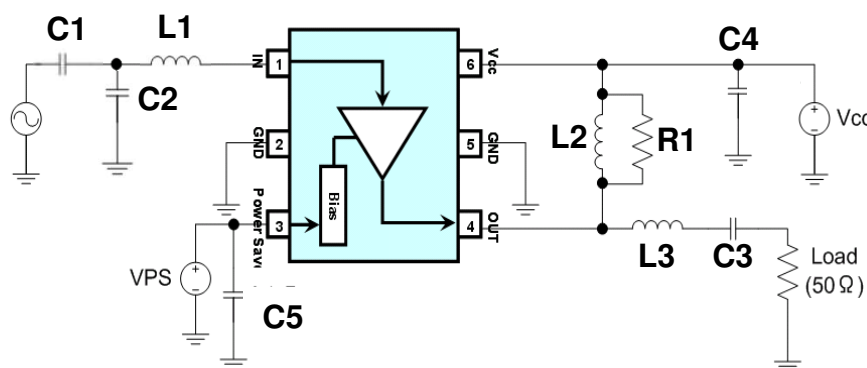
Narrow Band Tuned Performance

<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



Thank You !

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



Tel: (408) 919-2500

Fax: (408) 988-0279

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