

# μPC3244TB

Bipolar Analog Integrated Circuit

3.3 V, Silicon Germanium MMIC Medium Output Power Amplifier

R09DS0015EJ0100

Rev.1.00

Mar 28, 2011

## DESCRIPTION

The μPC3244TB is a silicon germanium monolithic IC designed as IF amplifier for DBS tuners.

This IC is manufactured using our 50 GHz  $f_{MAX}$  UHSK3 (Ultra High Speed Process) silicon germanium bipolar process.

## FEATURES

- Low current :  $I_{CC} = 18$  mA TYP.
- Power gain :  $G_p = 30$  dB TYP. @  $f = 1.0$  GHz  
 $G_p = 31$  dB TYP. @  $f = 2.2$  GHz
- Noise figure :  $NF = 3.1$  dB TYP. @  $f = 1.0$  GHz  
 $NF = 3.1$  dB TYP. @  $f = 2.2$  GHz
- High linearity :  $P_{O(1\text{ dB})} = +8$  dBm TYP. @  $f = 1.0$  GHz  
 $P_{O(1\text{ dB})} = +6$  dBm TYP. @  $f = 2.2$  GHz
- Supply voltage :  $V_{CC} = 3.0$  to  $3.6$  V
- Port impedance : input/output  $50 \Omega$

## APPLICATIONS

- IF amplifier in DBS LNB, other L-band Amplifier, etc.

## ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPC3244TB-E3	μPC3244TB-E3-A	6-pin super minimold (Pb-Free)	C4B	<ul style="list-style-type: none"> <li>• Embossed tape 8 mm wide</li> <li>• Pin 1, 2, 3 face the perforation side of the tape</li> <li>• Qty 3 kpcs/reel</li> </ul>

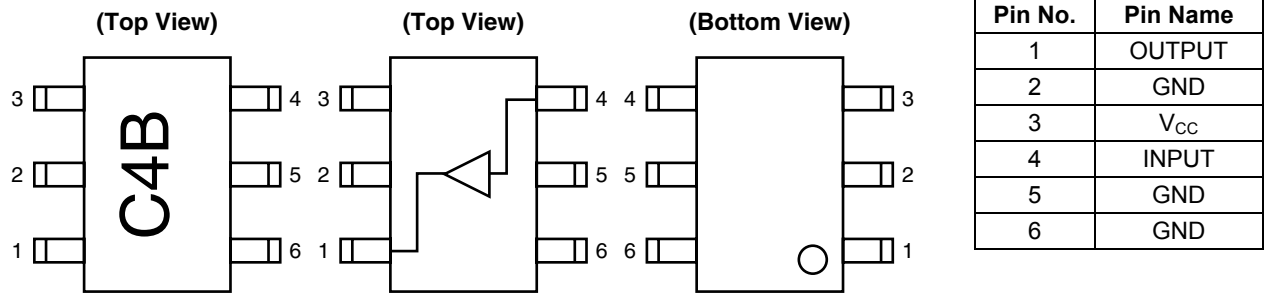
**Remark** To order evaluation samples, please contact your nearby sales office.

Part number for sample order: μPC3244TB

### CAUTION

Observe precautions when handling because these devices are sensitive to electrostatic discharge.

**PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM**



**PRODUCT LINE-UP OF 3 V or 3.3 V BIAS SILICON MMIC MEDIUM OUTPUT POWER AMPLIFIER**  
 (T<sub>A</sub> = +25°C, V<sub>CC</sub> = +5.0 V or +3.3 V, Z<sub>S</sub> = Z<sub>L</sub> = 50 Ω)

Part No.	V <sub>CC</sub> (V)	I <sub>CC</sub> (mA)	G <sub>P</sub> (dB)	NF (dB)	P <sub>O</sub> (1 dB) (dBm)	P <sub>O</sub> (sat) (dBm)	Package	Marking
μPC2762TB	3.0	26.5	13.0 (0.9 GHz)	6.5 (0.9 GHz)	+8.0 (0.9 GHz)	+9.0 (0.9 GHz)	6-pin super minimold	C1Z
			15.5 (1.9 GHz)	7.0 (1.9 GHz)	+7.0 (1.9 GHz)	+8.5 (1.9 GHz)		C2A
μPC2763TB		27.0	20.0 (0.9 GHz)	5.5 (0.9 GHz)	+9.5 (0.9 GHz)	+11.0 (0.9 GHz)		C2H
			21.0 (1.9 GHz)	5.5 (1.9 GHz)	+6.5 (1.9 GHz)	+8.0 (1.9 GHz)		C3E
μPC2771TB		36.0	21.0 (0.9 GHz)	6.0 (0.9 GHz)	+11.5 (0.9 GHz)	+12.5 (0.9 GHz)		C3F
			21.0 (1.5 GHz)	6.0 (1.5 GHz)	+9.5 (1.5 GHz)	+11.0 (1.5 GHz)		
μPC8181TB	23.0	19.0	19.0 (0.9 GHz)	4.5 (0.9 GHz)	+8.0 (0.9 GHz)	+9.5 (0.9 GHz)	C3Y	
			21.0 (1.9 GHz)	4.5 (1.9 GHz)	+7.0 (1.9 GHz)	+9.0 (1.9 GHz)		C4B
			22.0 (2.4 GHz)	4.5 (2.4 GHz)	+7.0 (2.4 GHz)	+9.0 (2.4 GHz)		
μPC8182TB	30.0	20.5	21.5 (0.9 GHz)	4.5 (0.9 GHz)	+9.5 (0.9 GHz)	+11.0 (0.9 GHz)		
			20.5 (1.9 GHz)	4.5 (1.9 GHz)	+9.0 (1.9 GHz)	+10.5 (1.9 GHz)		
			20.5 (2.4 GHz)	5.0 (2.4 GHz)	+8.0 (2.4 GHz)	+10.0 (2.4 GHz)		
μPC3239TB	3.3	29.0	25.0 (1.0 GHz)	4.0 (1.0 GHz)	+10.0 (1.0 GHz)	+12.5 (1.0 GHz)		
			25.5 (2.2 GHz)	4.3 (2.2 GHz)	+8.0 (2.2 GHz)	+10.0 (2.2 GHz)		
μPC3241TB		19.8	23.5 (1.0 GHz)	4.0 (1.0 GHz)	+7.5 (1.0 GHz)	–		
	24.0 (2.2 GHz)		4.3 (2.2 GHz)	+6.0 (2.2 GHz)				
μPC3244TB	18.0	30.0 (1.0 GHz)	3.1 (1.0 GHz)	+8.0 (1.0 GHz)	+13.0 (1.0 GHz)			
		31.0 (2.2 GHz)	3.1 (2.2 GHz)	+6.0 (2.2 GHz)	+9.0 (2.2 GHz)			

**Remark** Typical performance. Please refer to **ELECTRICAL CHARACTERISTICS** in detail.

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	$V_{CC}$	$T_A = +25^\circ\text{C}$ , pin 3 and 1	4.0	V
Total Circuit Current	$I_{CC}$	$T_A = +25^\circ\text{C}$ , pin 3 and 1	35	mA
Power Dissipation	$P_D$	$T_A = +85^\circ\text{C}$ <b>Note</b>	166	mW
Operating Ambient Temperature	$T_A$		-40 to +85	$^\circ\text{C}$
Storage Temperature	$T_{stg}$		-55 to +150	$^\circ\text{C}$
Input Power	$P_{in}$	$T_A = +25^\circ\text{C}$	-5	dBm

Note: Mounted on double-sided copper-clad 50 × 50 × 1.6 mm epoxy glass PWB

## RECOMMENDED OPERATING RANGE

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply Voltage	$V_{CC}$	The same voltage should be applied to pin 3 and 1.	3.0	3.3	3.6	V
Operating Ambient Temperature	$T_A$		-40	+25	+85	$^\circ\text{C}$

## ELECTRICAL CHARACTERISTICS

( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = V_{out} = 3.3\text{ V}$ ,  $Z_S = Z_L = 50\ \Omega$ , unless otherwise specified)

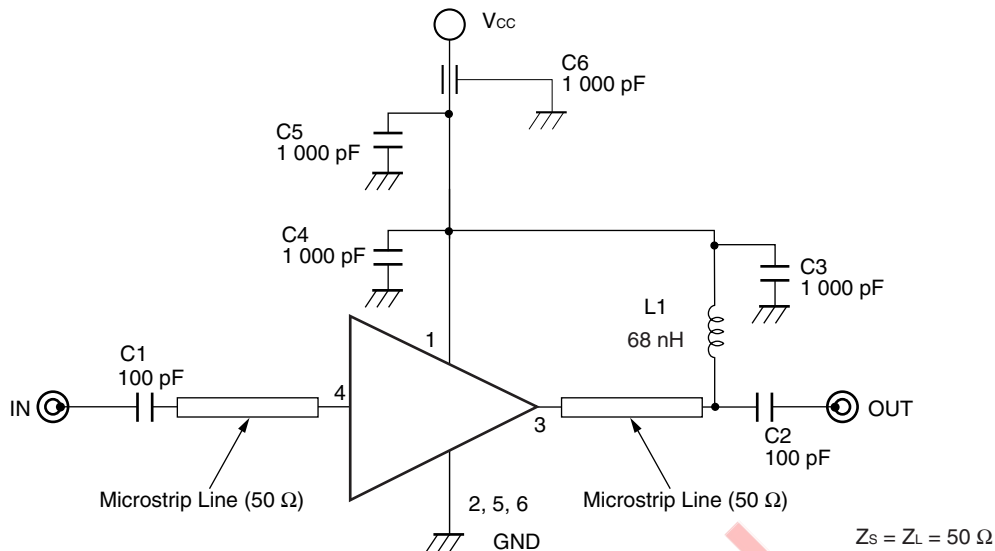
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	$I_{CC}$	No input signal	14.5	18	22	mA
Power Gain 1	$G_{p1}$	$f = 0.25\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	26.5	29.5	32.5	dB
Power Gain 2	$G_{p2}$	$f = 1.0\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	27	30	33	dB
Power Gain 3	$G_{p3}$	$f = 1.8\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	28	31	34	dB
Power Gain 4	$G_{p4}$	$f = 2.2\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	28	31	34	dB
Gain 1 dB Compression Output Power 1	$P_{O(1dB)1}$	$f = 1.0\text{ GHz}$	+5.0	+8.0	-	dBm
Gain 1dB Compression Output Power 2	$P_{O(1dB)2}$	$f = 2.2\text{ GHz}$	+3.0	+6.0	-	dBm
Noise Figure 1	NF1	$f = 1.0\text{ GHz}$	-	3.1	3.9	dB
Noise Figure 2	NF2	$f = 2.2\text{ GHz}$	-	3.1	3.9	dB
Isolation 1	ISL1	$f = 1.0\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	36	41	-	dB
Isolation 2	ISL2	$f = 2.2\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	34	39	-	dB
Input Return Loss 1	$RL_{in1}$	$f = 1.0\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	8.0	11	-	dB
Input Return Loss 2	$RL_{in2}$	$f = 2.2\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	8.5	12	-	dB
Output Return Loss 1	$RL_{out1}$	$f = 1.0\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	9.0	12	-	dB
Output Return Loss 2	$RL_{out2}$	$f = 2.2\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	8.5	12	-	dB

**STANDARD CHARACTERISTICS FOR REFERENCE**  
( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = V_{out} = 3.3\text{ V}$ ,  $Z_S = Z_L = 50\ \Omega$ )

Parameter	Symbol	Test Conditions	Reference Value	Unit
Power Gain 5	$G_{p5}$	$f = 2.6\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	29.5	dB
Power Gain 6	$G_{p6}$	$f = 3.0\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	27.5	dB
Gain Flatness	$\Delta G_p$	$f = 1.0\text{ GHz to } 2.2\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	1.0	dB
K factor 1	K1	$f = 1.0\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	1.6	–
K factor 2	K2	$f = 2.2\text{ GHz}$ , $P_{in} = -35\text{ dBm}$	1.2	–
Output 3rd Order Distortion Intercept Point 1	$OIP_3\ 1$	$f_1 = 1\ 000\text{ MHz}$ , $f_2 = 1\ 001\text{ MHz}$	18.5	dBm
Output 3rd Order Distortion Intercept Point 2	$OIP_3\ 2$	$f_1 = 2\ 200\text{ MHz}$ , $f_2 = 2\ 201\text{ MHz}$	15.5	dBm
Input 3rd Order Distortion Intercept Point 1	$IIP_3\ 1$	$f_1 = 1\ 000\text{ MHz}$ , $f_2 = 1\ 001\text{ MHz}$	-11.5	dBm
Input 3rd Order Distortion Intercept Point 2	$IIP_3\ 2$	$f_1 = 2\ 200\text{ MHz}$ , $f_2 = 2\ 201\text{ MHz}$	-15.5	dBm
2nd Order Intermodulation Distortion	$IM_2$	$f_1 = 1\ 000\text{ MHz}$ , $f_2 = 1\ 001\text{ MHz}$ , $P_{out} = -5\text{ dBm/ tone}$	40	dBc
2nd Harmonic	$2f_0$	$f_0 = 1.0\text{ GHz}$ , $P_{out} = -15\text{ dBm}$	55	dBc
Saturated Output Power 1	$P_{O(sat)\ 1}$	$f = 1.0\text{ GHz}$ , $P_{in} = -10\text{ dBm}$	+13.0	dBm
Saturated Output Power 2	$P_{O(sat)\ 2}$	$f = 2.2\text{ GHz}$ , $P_{in} = -10\text{ dBm}$	+9.0	dBm

Not recommended for new design

## TEST CIRCUIT



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

### COMPONENTS OF TEST CIRCUIT FOR MEASURING ELECTRICAL CHARACTERISTICS

	Type	Value
L1	Chip Inductor	68 nH
C1, C2	Chip Capacitor	100 pF
C3, C4, C5	Chip Capacitor	1 000 pF
C6	Feed-through Capacitor	1 000 pF

### INDUCTOR FOR THE OUTPUT PIN

The internal output transistor of this IC, to output medium power. To supply current for output transistor, connect an inductor between the  $V_{CC}$  pin (pin 3) and output pin (pin 1).

Select inductance, as the value listed above. The inductor has both DC and AC effects.

In terms of DC, the inductor biases the output transistor with minimum voltage drop to output enable high level. In terms of AC, the inductor makes output-port impedance higher to get enough gain. In this case, large inductance and Q is suitable (Refer to the following page).

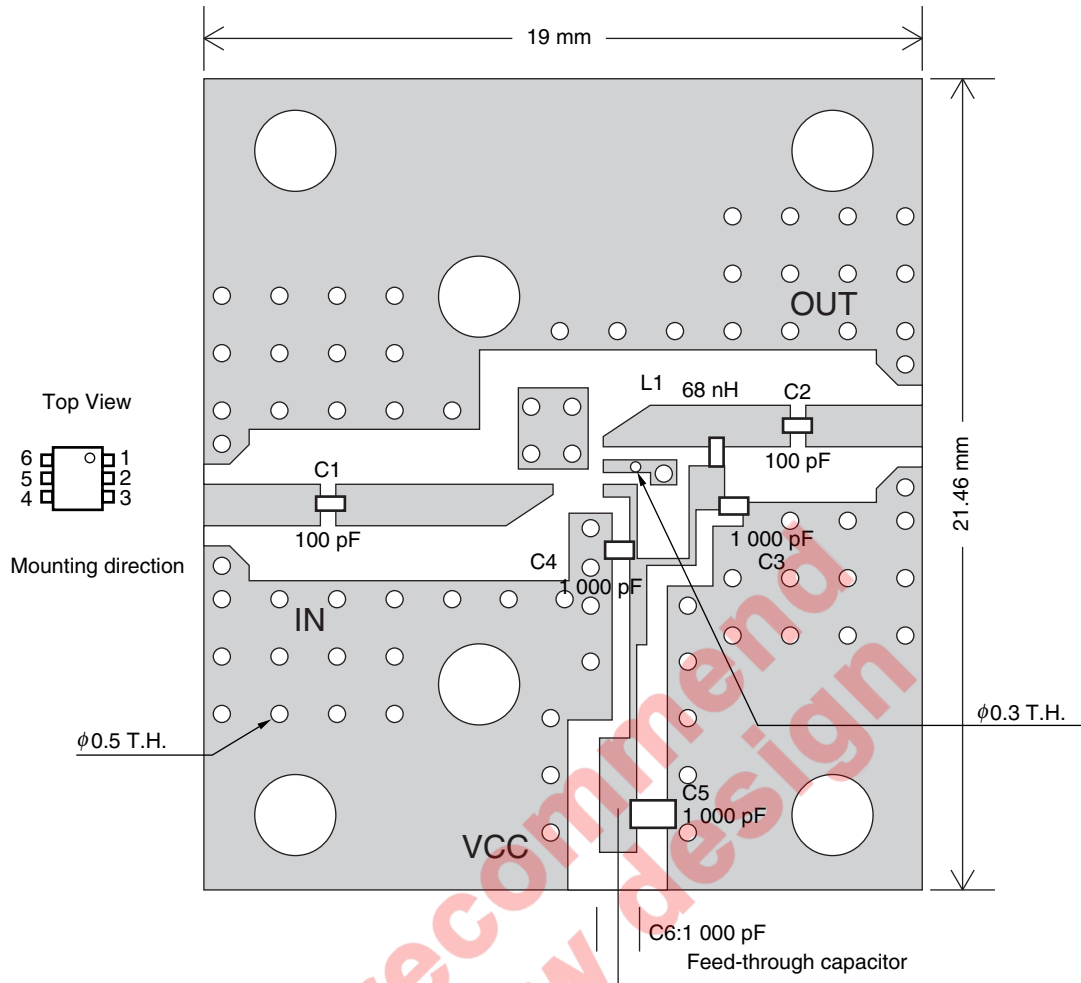
### CAPACITORS FOR THE $V_{CC}$ , INPUT AND OUTPUT PINS

Capacitors of 1 000 pF are recommendable as the bypass capacitor for the  $V_{CC}$  pin. And the coupling capacitors of 100 pF are recommendable for the input and output pins.

The bypass capacitor connected to the  $V_{CC}$  pin is used to minimize ground impedance of  $V_{CC}$  pin. So, stable bias can be supplied against  $V_{CC}$  fluctuation.

The coupling capacitors, connected to the input and output pins, are used to cut the DC and minimize RF serial impedance. Their capacitances are therefore selected as lower impedance against a 50 Ω load. The capacitors thus perform as high pass filters, suppressing low frequencies to DC.

EVALUATION CIRCUIT



C6: 1 000 pF  
Feed-through capacitor

RO4003C/ROGERS  
t = 0.508 mm  
ε r = 3.55  
tan delta = 0.0027 @10 GHz  
Cu/Ni/Au-flash plate

COMPONENT LIST

	Type	Value	size
L1	Chip Inductor	68 nH	1005
C1, C2	Chip Capacitor	100 pF	1005
C3, C4	Chip Capacitor	1 000 pF	1005
C5	Chip Capacitor	1 000 pF	1608
C6	Feed-through Capacitor	1 000 pF	-

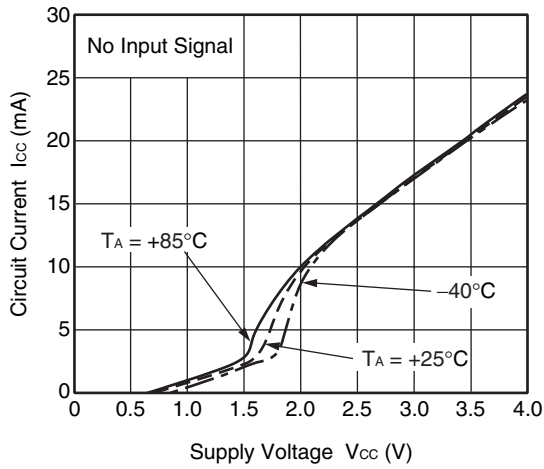
Notes:

1. 21.46 × 19 × 0.508 mm double sided 18μm copper clad polyimide board.
2. Back side: GND pattern.
3. Solder plated on pattern.
4. ○: Through holes

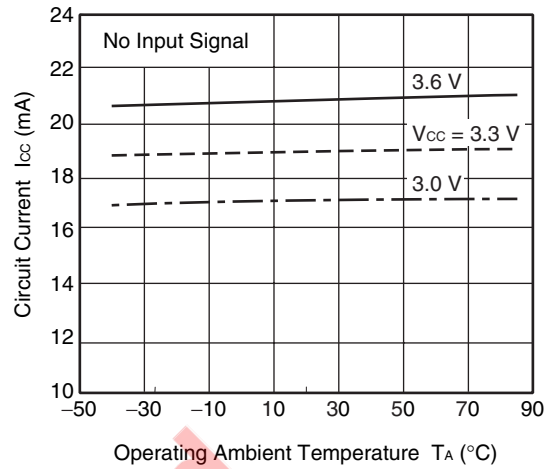
**TYPICAL CHARACTERISTICS**

( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = V_{out} = 3.3\text{ V}$ ,  $Z_S = Z_L = 50\ \Omega$ , unless otherwise specified)

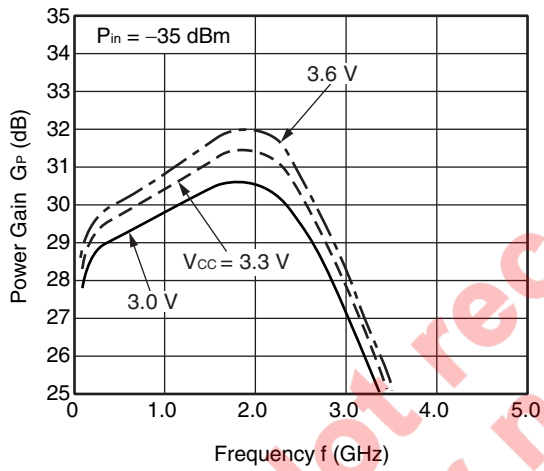
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



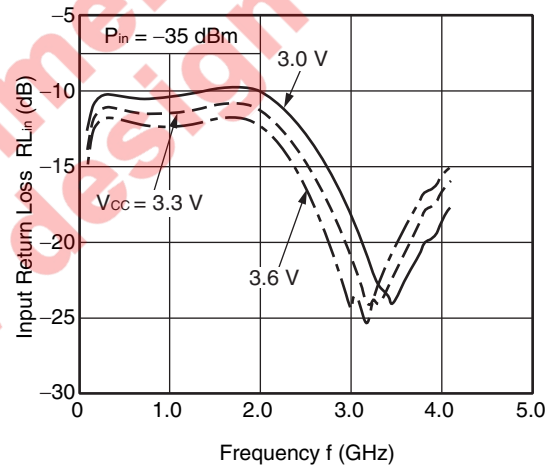
CURCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



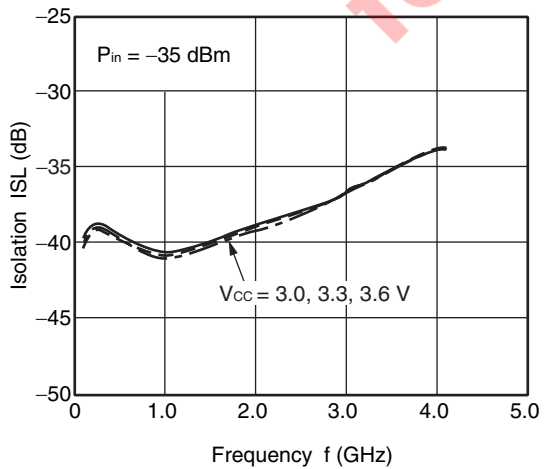
POWER GAIN vs. FREQUENCY



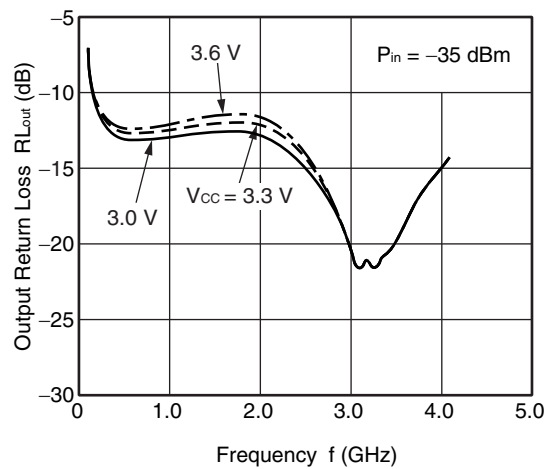
INPUT RETURN LOSS vs. FREQUENCY



ISOLATION vs. FREQUENCY

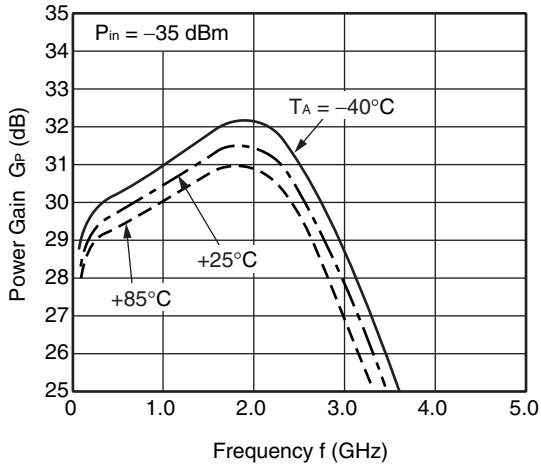


OUTPUT RETURN LOSS vs. FREQUENCY

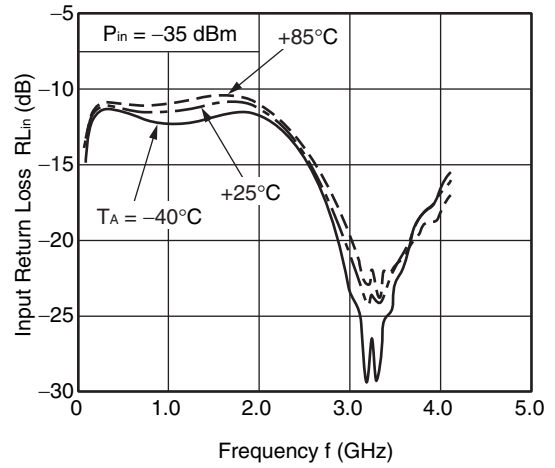


**Remark** The graphs indicate nominal characteristics.

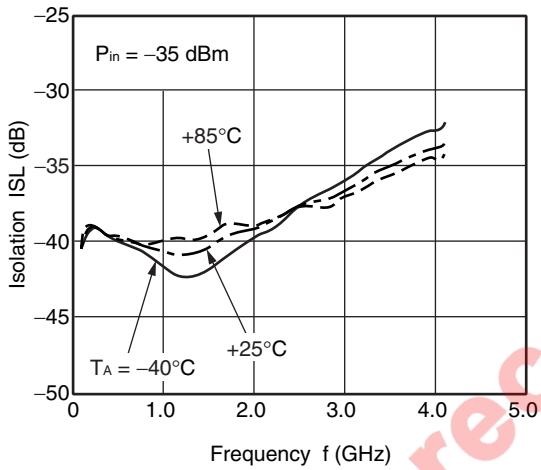
POWER GAIN vs. FREQUENCY



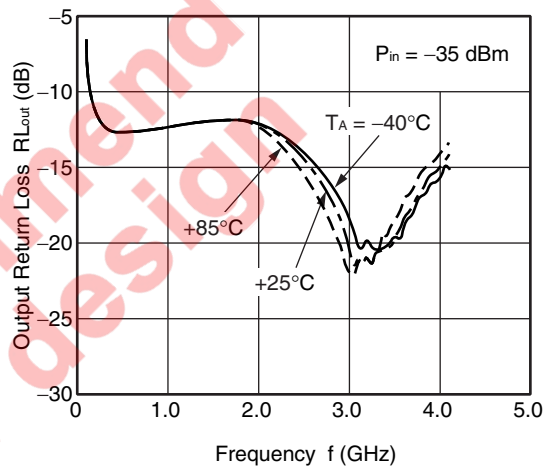
INPUT RETURN LOSS vs. FREQUENCY



ISOLATION vs. FREQUENCY



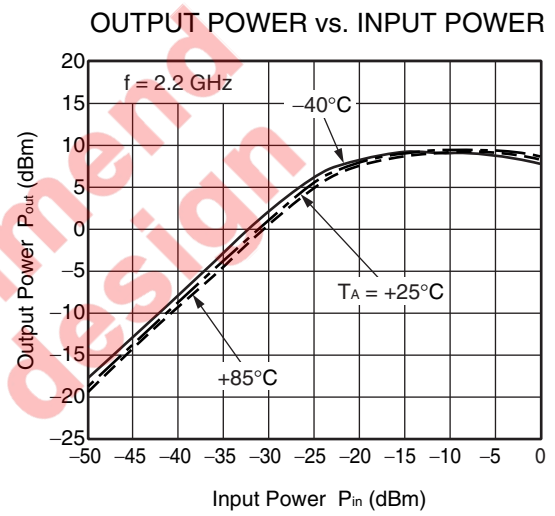
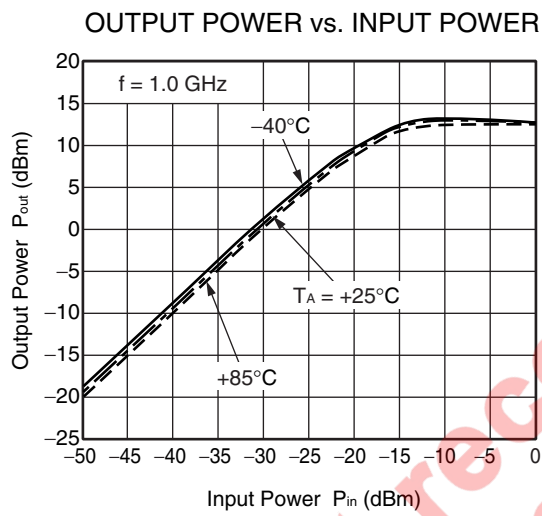
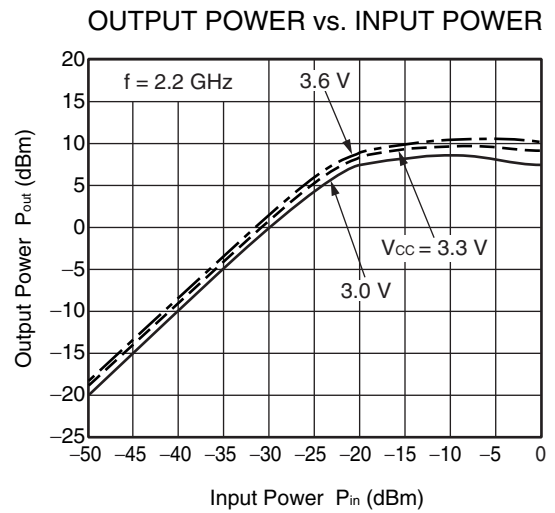
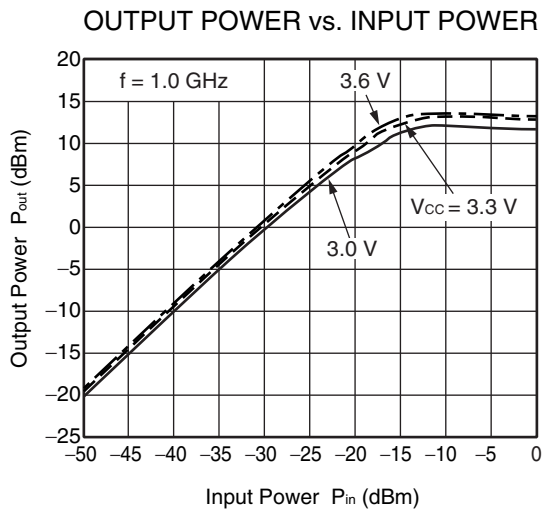
OUTPUT RETURN LOSS vs. FREQUENCY



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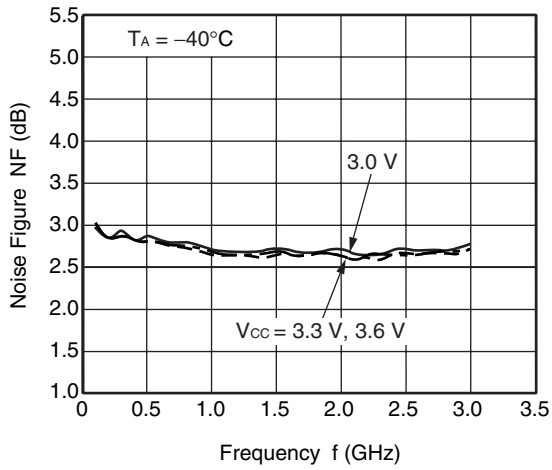
Not recommended for new designs



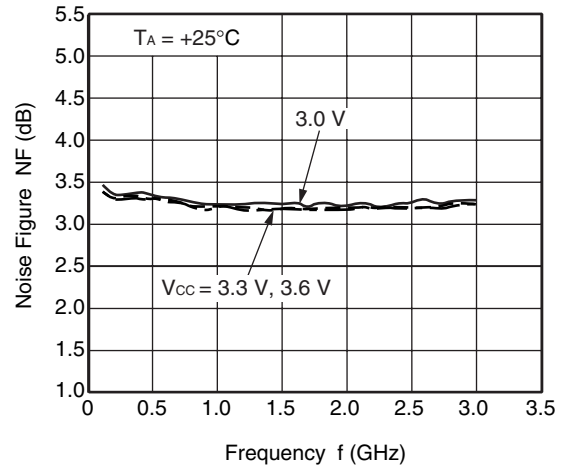


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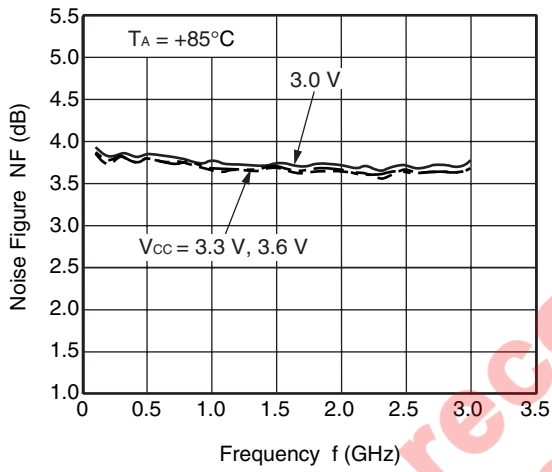
NOISE FIGURE vs. FREQUENCY



NOISE FIGURE vs. FREQUENCY

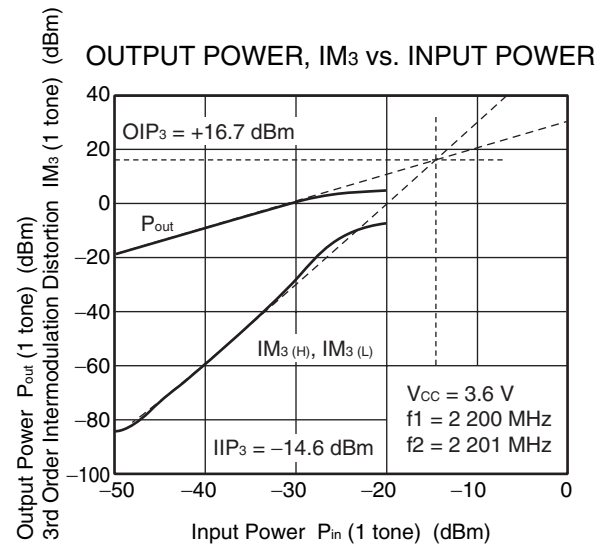
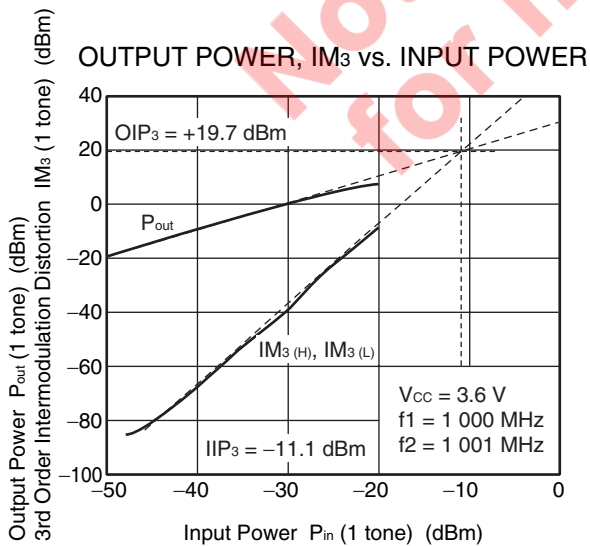
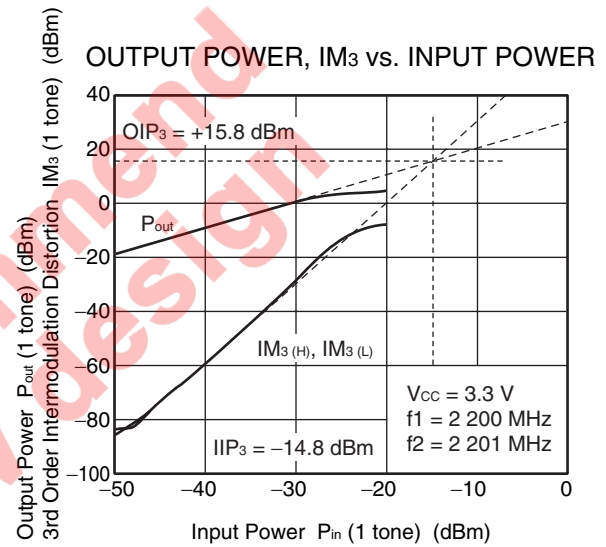
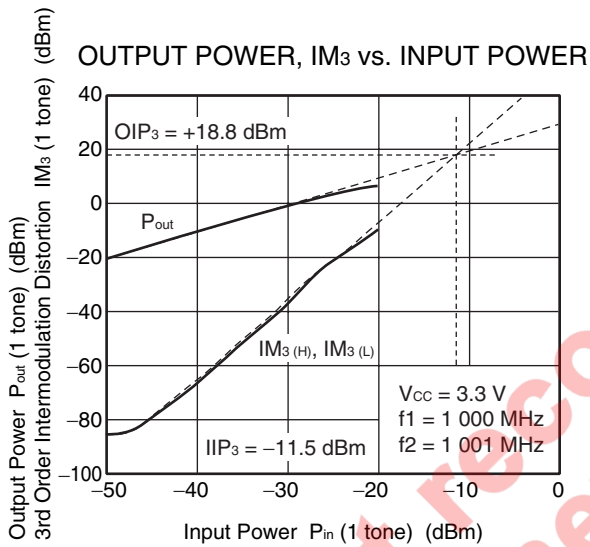
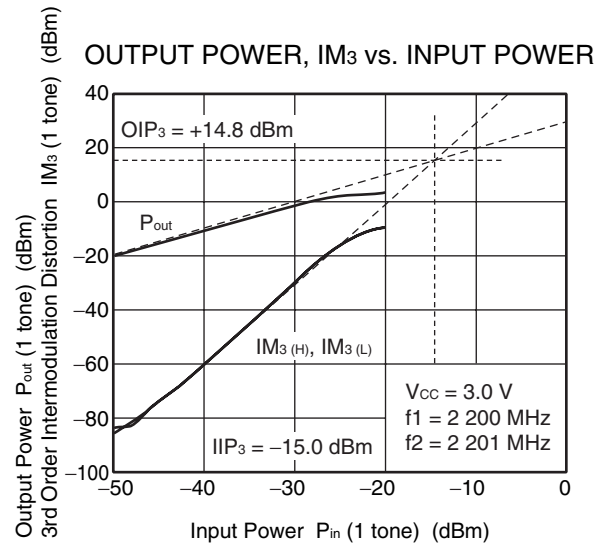
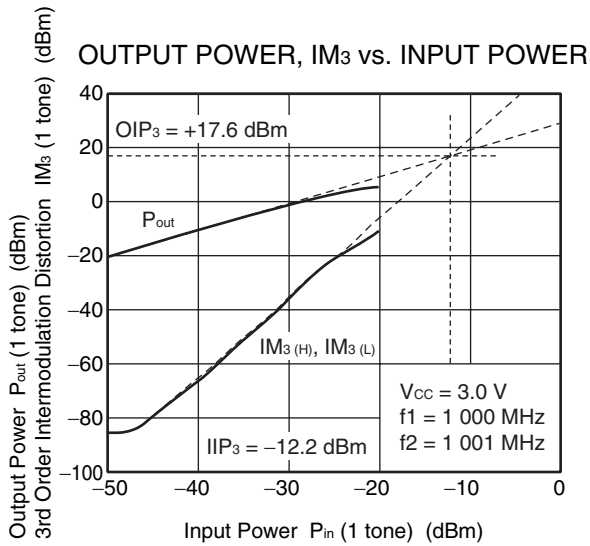


NOISE FIGURE vs. FREQUENCY

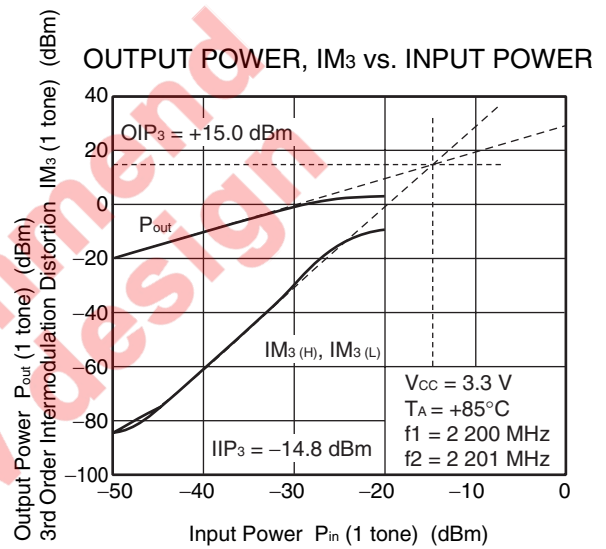
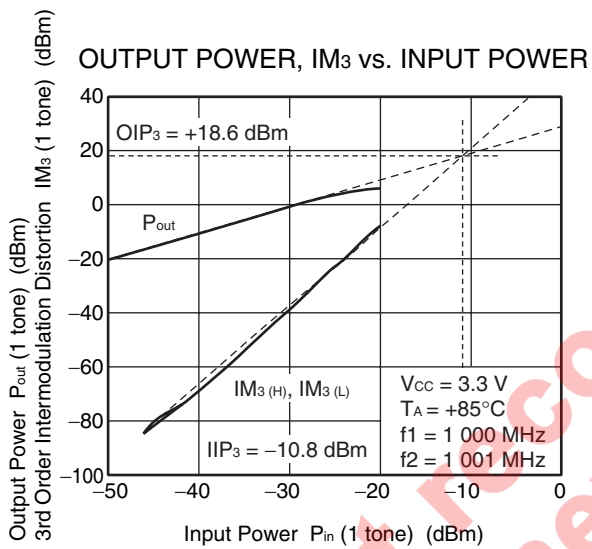
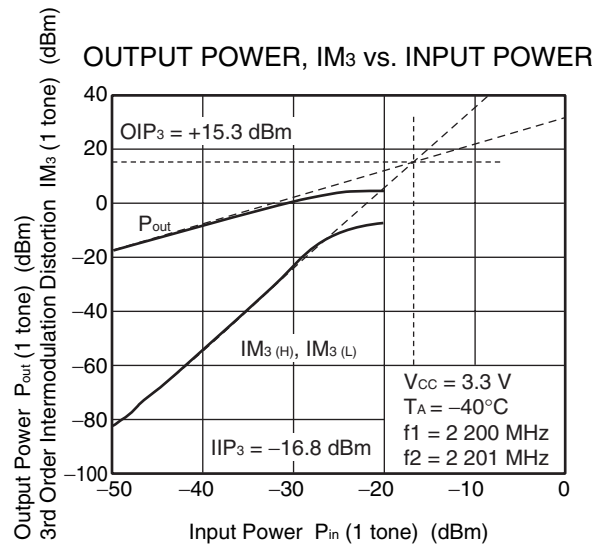
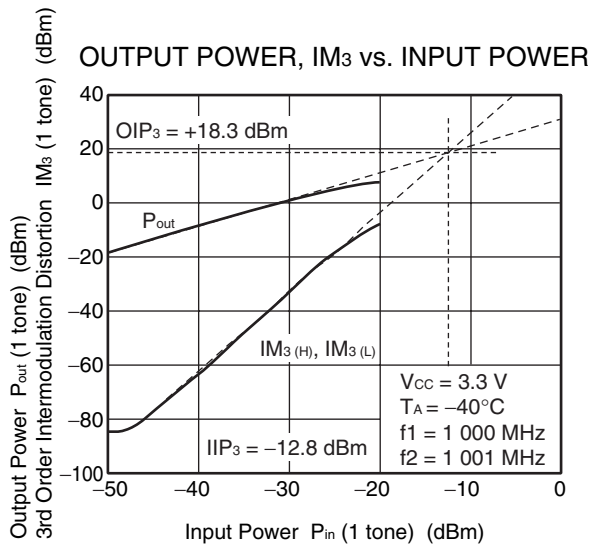


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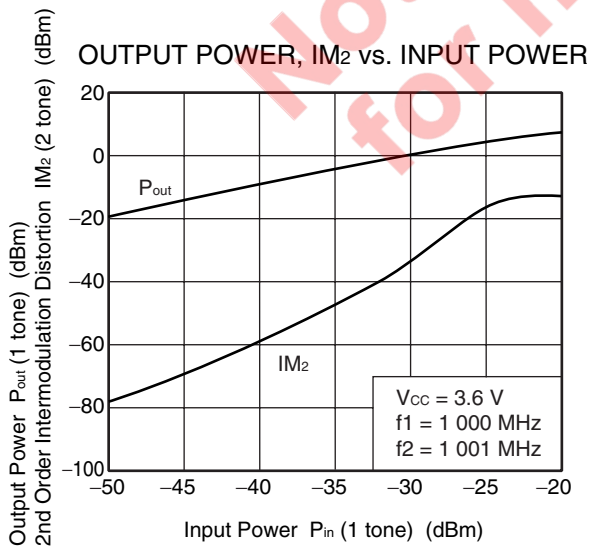
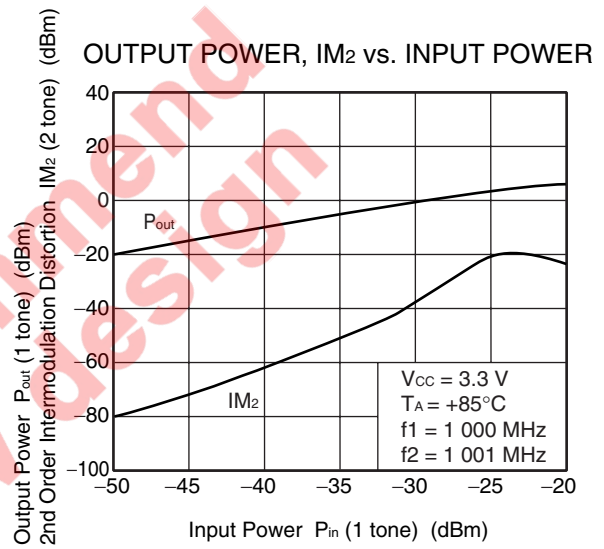
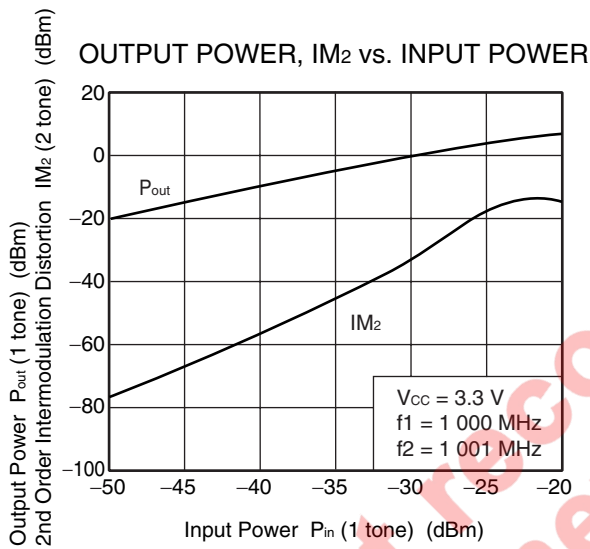
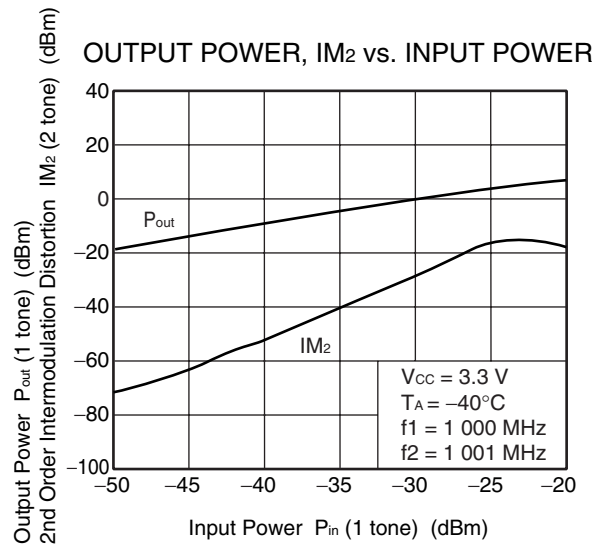
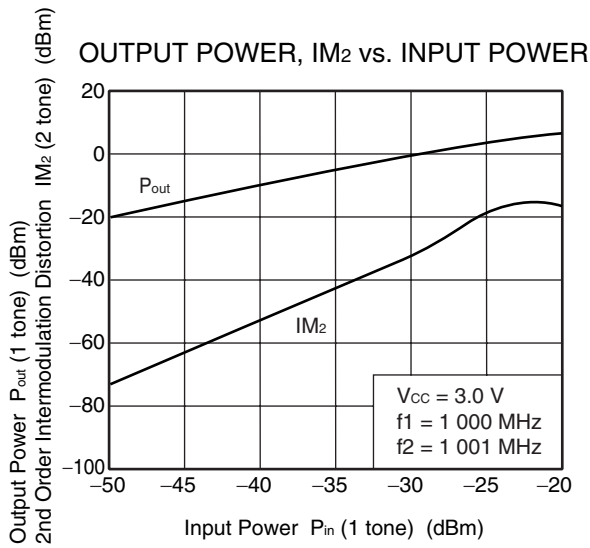
Not recommend  
for new design



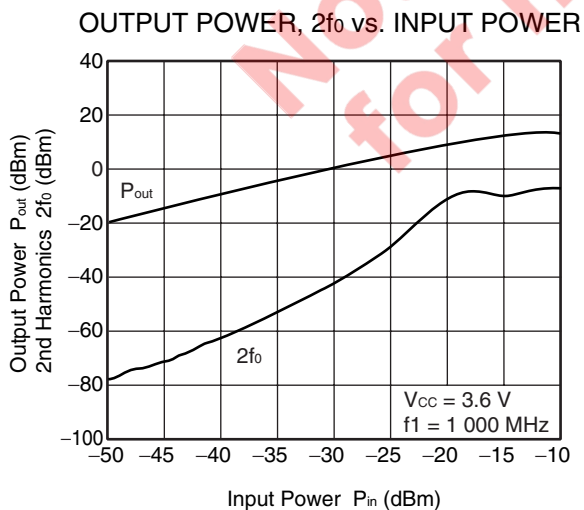
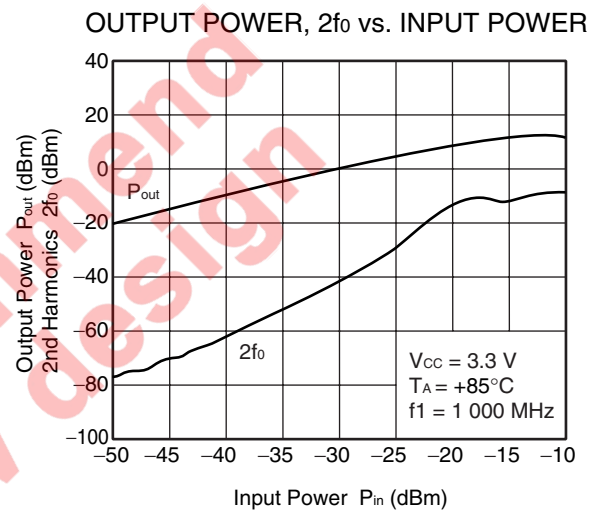
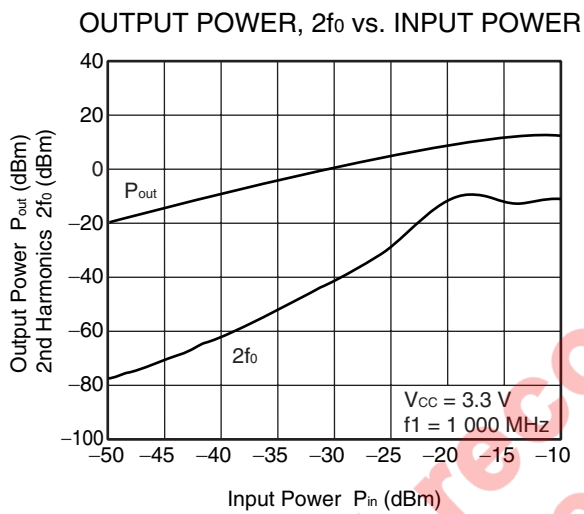
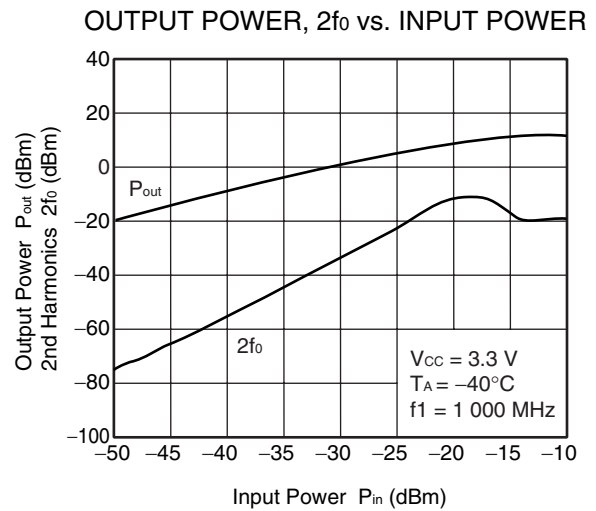
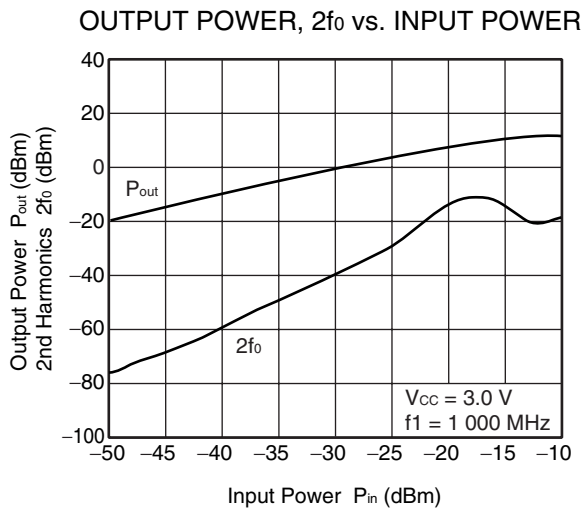
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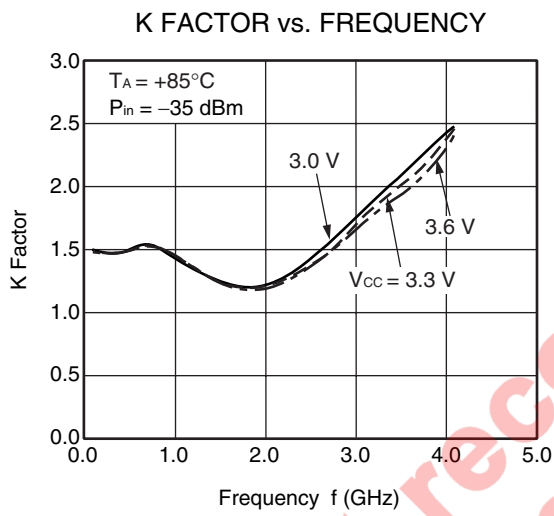
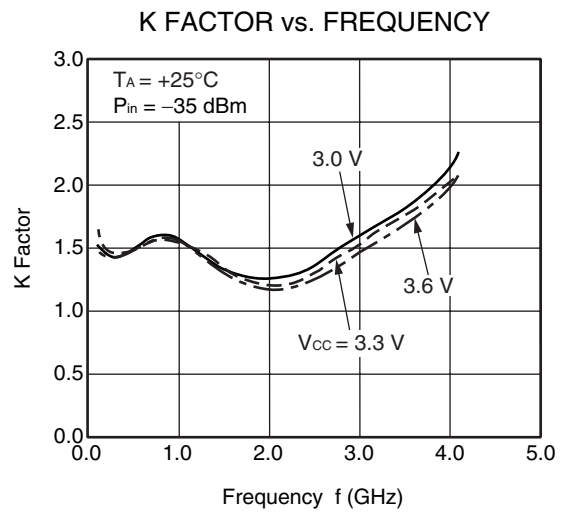
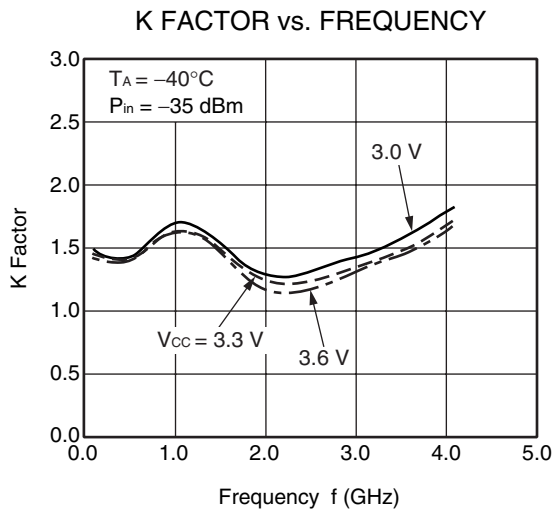
**Remark** The graphs indicate nominal characteristics.



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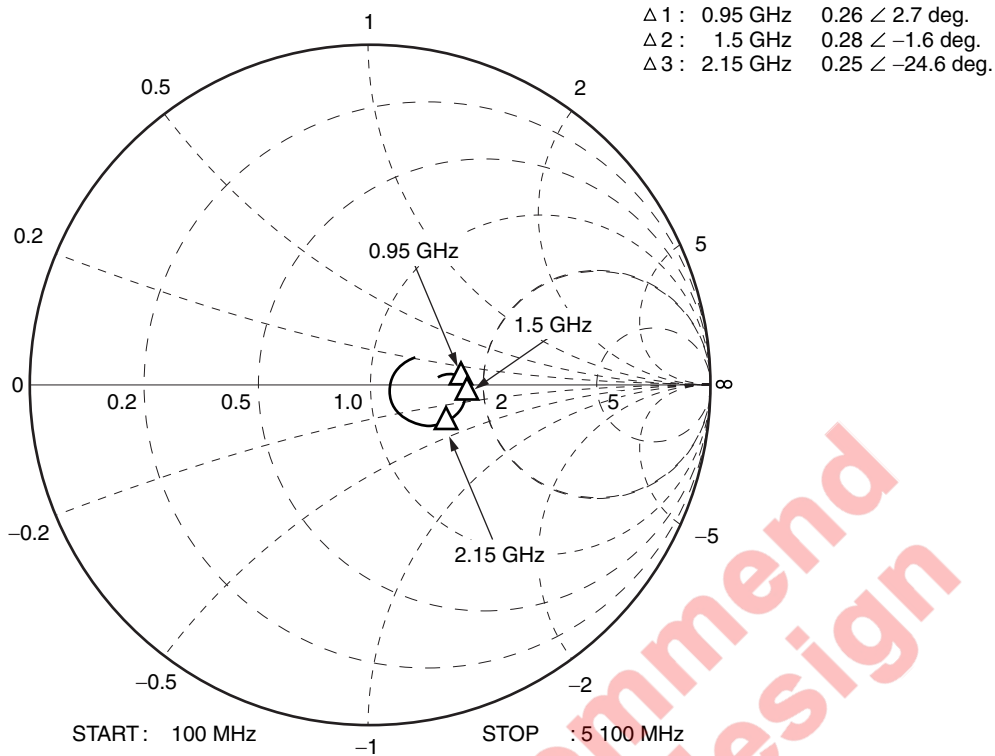


**Remark** The graphs indicate nominal characteristics.

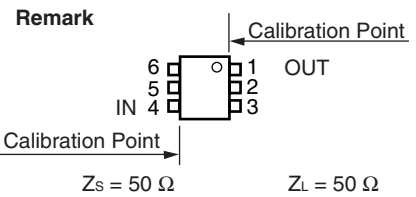
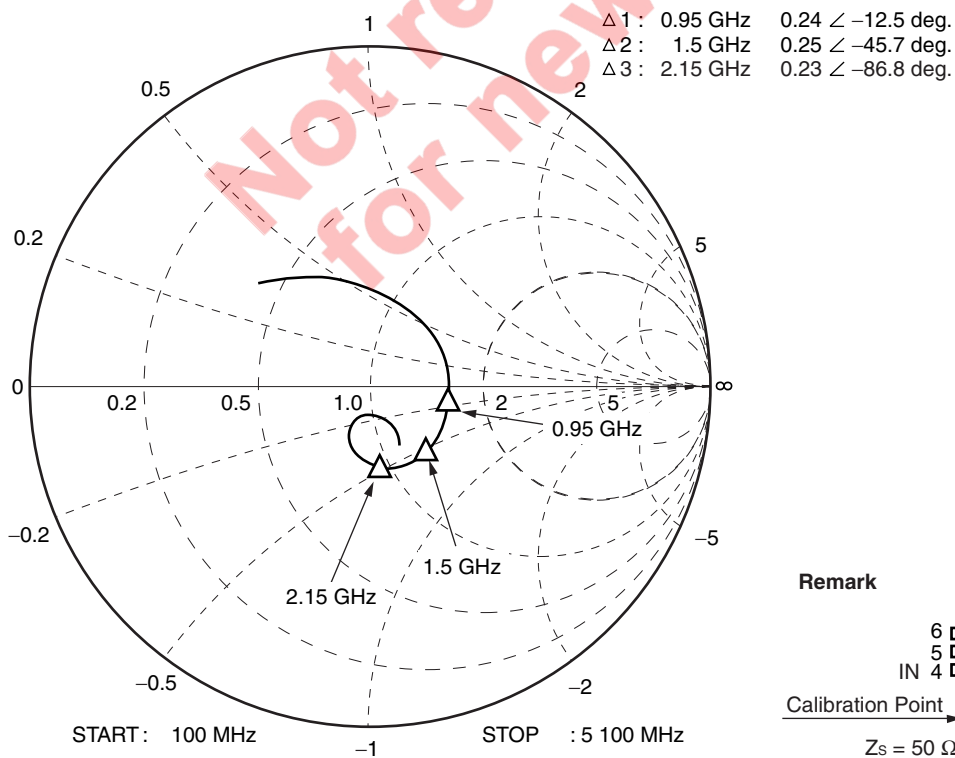
Not recommend  
for new design

**S-PARAMETERS** ( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = V_{out} = 3.3\text{ V}$ ,  $P_{in} = -35\text{ dBm}$ ,  $Z_O = 50\ \Omega$ )

**S<sub>11</sub>-FREQUENCY**



**S<sub>22</sub>-FREQUENCY**



**Remark** The graphs indicate nominal characteristics.



## **S-Parameters**

S-parameters and noise parameters are provided on our Web site in a format (S2P) that enables the direct import of the parameters to microwave circuit simulators without the need for keyboard inputs.

Click here to download S-parameters.

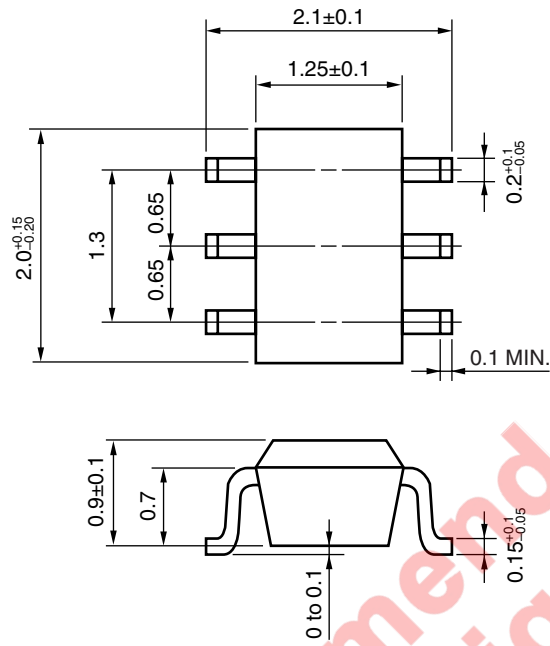
[RF and Microwave] → [Device Parameters]

URL <http://www2.renesas.com/microwave/en/download.html>

**Not recommend  
for new design**

## PACKAGE DIMENSIONS

6-PIN SUPER MINIMOLD (UNIT: mm)



### NOTES ON CORRECT USE

- (1) Observe precautions for handling because of electro-static sensitive devices.
- (2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation).  
All the ground terminals must be connected together with wide ground pattern to decrease impedance difference.
- (3) The bypass capacitor should be attached to the V<sub>CC</sub> line.
- (4) The inductor (L) must be attached between V<sub>CC</sub> and output pins. The inductance value should be determined in accordance with desired frequency.
- (5) The DC cut capacitor must be attached to input and output pin.

### RECOMMENDED SOLDERING CONDITIONS

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

Soldering Method	Soldering Conditions	Condition Symbol
Infrared Reflow	Peak temperature (package surface temperature) : 260°C or below Time at peak temperature : 10 seconds or less Time at temperature of 220°C or higher : 60 seconds or less Preheating time at 120 to 180°C : 120±30 seconds Maximum number of reflow processes : 3 times Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	IR260
Wave Soldering	Peak temperature (molten solder temperature) : 260°C or below Time at peak temperature : 10 seconds or less Preheating temperature (package surface temperature) : 120°C or below Maximum number of flow processes : 1 time Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	WS260
Partial Heating	Peak temperature (package surface temperature) : 350°C or below Soldering time (per side of device) : 3 seconds or less Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	HS350

#### CAUTION

Do not use different soldering methods together (except for partial heating).

<b>Revision History</b>	<b>μPC3244TB Data Sheet</b>
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Rev.	Date	Description	
		Page	Summary
1.00	Mar 28, 2011	–	First edition issued

**Not recommend  
for new design**

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