DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC3236TK

5 V, SILICON GERMANIUM MMIC MEDIUM OUTPUT POWER AMPLIFIER

DESCRIPTION

The μPC3236TK is a silicon germanium carbon (SiGe:C) monolithic integrated circuit designed as IF amplifier for DBS LNB.

This device exhibits low noise figure and high power gain characteristics.

This IC is manufactured using our UHS4 (Ultra High Speed Process) SiGe:C bipolar process.

FEATURES

- Low current : I_{CC} = 24.0 mA TYP.
- Medium output power : $P_{O\ (sat)}$ = +15.5 dBm TYP. @ f = 1.0 GHz
  : $P_{O\ (sat)}$ = +10.5 dBm TYP. @ f = 2.2 GHz
- High linearity : $P_{O\ (1dB)}$ = +11 dBm TYP. @ f = 1.0 GHz
  : $P_{O\ (1dB)}$ = +7.5 dBm TYP. @ f = 2.2 GHz
- Power gain : G_P = 38 dB TYP. @ f = 1.0 GHz
  : G_P = 38 dB TYP. @ f = 2.2 GHz
- Gain flatness : ΔG_P = 1.0 dB TYP. @ f = 1.0 to 2.2 GHz
- Noise Figure : NF = 2.6 dB TYP. @ f = 1.0 GHz
  : NF = 2.6 dB TYP. @ f = 2.2 GHz
- Supply voltage : V_{CC} = 4.5 to 5.5 V
- Port impedance : input/output 50 Ω

APPLICATIONS

- IF amplifiers in DBS LNB, other L-band amplifiers, etc.

ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPC3236TK-E2	μPC3236TK-E2-A	6-pin lead-less minimold (1511 PKG) (Pb-Free)	6U	• Embossed tape 8 mm wide • Pin 1, 6 face the perforation side of the tape • Qty 5 kpcs/reel

Remark To order evaluation samples, please contact your nearby sales office
Part number for sample order: μPC3236TK

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

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.

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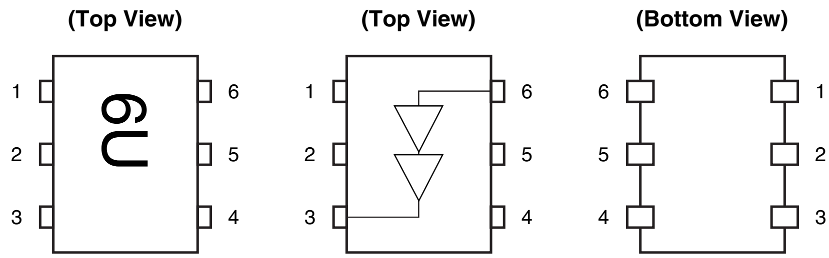
PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM



Pin No.	Pin Name
1	V_{CC}
2	GND
3	OUTPUT
4	GND
5	GND
6	INPUT

PRODUCT LINE-UP OF 5 V-BIAS SILICON MMIC MEDIUM OUTPUT POWER AMPLIFIER (T$_A$ = +25°C, f = 1 GHz, V_{CC} = V_{out} = 5.0 V, Z_S = Z_L = 50 Ω)

Part No.	I_{CC} (mA)	G_P (dB)	NF (dB)	$P_{O\ (1dB)}$ (dBm)	$P_{O\ (sat)}$ (dBm)	Package	Marking
μPC2708TB	26	15.0	6.5	–	+10.0	6-pin super minimold	C1D
μPC2709TB	25	23.0	5.0	–	+11.5		C1E
μPC2710TB	22	33.0	3.5	–	+13.5		C1F
μPC2776TB	25	23.0	6.0	–	+8.5		C2L
μPC3223TB	19	23.0	4.5	+6.5	+12.0		C3J
μPC3225TB	24.5	32.5 Note	3.7 Note	+9 Note	+15.5 Note		C3M
μPC3226TB	15.5	25.0	5.3	+7.5	+13.0		C3N
μPC3232TB	26	32.8	4.0	+11	+15.5		C3S
μPC3236TK	24	38	2.6	+11	+15.5	6-pin lead-less minimold (1511 PKG)	6U

Note μPC3225TB is f = 0.95 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°C, pin 1 and 3	6.0	V
Power Dissipation	P_D	T_A = +85°C **Note**	232	mW
Operating Ambient Temperature	T_A		–40 to +85	°C
Storage Temperature	T_{stg}		–55 to +150	°C
Input Power	P_{in}	T_A = +25°C	0	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 1 and 3.	4.5	5.0	5.5	V
Operating Ambient Temperature	T_A		–40	+25	+85	°C

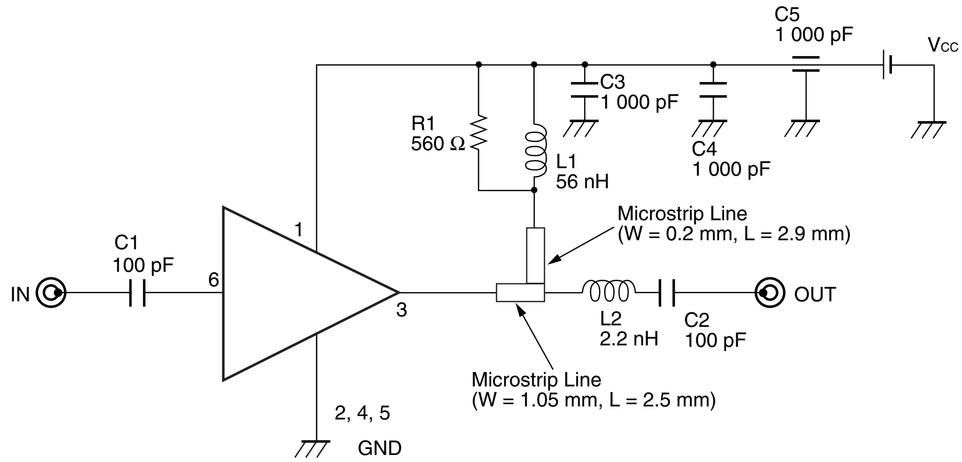
ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_{CC} = V_{out} = 5.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I_{CC}	No input signal	19	24	31	mA
Power Gain 1	G_P1	f = 0.25 GHz, P_{in} = –40 dBm	34	37	39	dB
Power Gain 2	G_P2	f = 1.0 GHz, P_{in} = –40 dBm	35.5	38	40.5	
Power Gain 3	G_P3	f = 1.8 GHz, P_{in} = –40 dBm	36	39	42	
Power Gain 4	G_P4	f = 2.2 GHz, P_{in} = –40 dBm	35	38	41	
Saturated Output Power 1	$P_{O\,(sat)}$ 1	f = 1.0 GHz, P_{in} = 0 dBm	+13.5	+15.5	–	dBm
Saturated Output Power 2	$P_{O\,(sat)}$ 2	f = 2.2 GHz, P_{in} = –5 dBm	+8.5	+10.5	–	
Gain 1 dB Compression Output Power 1	$P_{O\,(1\,dB)}$ 1	f = 1.0 GHz	+8	+11	–	dBm
Gain 1 dB Compression Output Power 2	$P_{O\,(1\,dB)}$ 2	f = 2.2 GHz	+5	+7.5	–	
Noise Figure 1	NF1	f = 1.0 GHz	–	2.6	3.5	dB
Noise Figure 2	NF2	f = 2.2 GHz	–	2.6	3.5	
Isolation 1	ISL1	f = 1.0 GHz, P_{in} = –40 dBm	43	50	–	dB
Isolation 2	ISL2	f = 2.2 GHz, P_{in} = –40 dBm	43	50	–	
Input Return Loss 1	$RL_{in}1$	f = 1.0 GHz, P_{in} = –40 dBm	6	9	–	dB
Input Return Loss 2	$RL_{in}2$	f = 2.2 GHz, P_{in} = –40 dBm	6.5	9.5	–	
Output Return Loss 1	$RL_{out}1$	f = 1.0 GHz, P_{in} = –40 dBm	8	11	–	dB
Output Return Loss 2	$RL_{out}2$	f = 2.2 GHz, P_{in} = –40 dBm	7	10	–	

STANDARD CHARACTERISTICS FOR REFERENCE
(T_A = +25°C, V_{CC} = V_{out} = 5.0 V, Z_S = Z_L = 50 Ω, unless otherwise specified)

Parameter	Symbol	Test Conditions	Reference Value	Unit
Power Gain 5	G_P5	f = 2.6 GHz, P_{in} = –40 dBm	36	dB
Power Gain 6	G_P6	f = 3.0 GHz, P_{in} = –40 dBm	32.5	
Gain Flatness	ΔG_P	f = 1.0 to 2.2 GHz, P_{in} = –40 dBm	1.0	dB
K factor 1	K1	f = 1.0 GHz, P_{in} = –40 dBm	1.6	–
K factor 2	K2	f = 2.2 GHz, P_{in} = –40 dBm	1.6	–
Output 3rd Order Intercept Point 1	$OIP_3 1$	f1 = 1 000 MHz, f2 = 1 001 MHz	23	dBm
Output 3rd Order Intercept Point 2	$OIP_3 2$	f1 = 2 200 MHz, f2 = 2 201 MHz	16.5	
2nd Order Intermodulation Distortion	IM_2	f1 = 1 000 MHz, f2 = 1 001 MHz, P_{out} = –5 dBm/tone	45	dBc
2nd Harmonic	2f0	f0 = 1.0 GHz, P_{out} = –15 dBm	58	dBc

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
R1	Chip Resistance	560 Ω
L1	Chip Inductor	56 nH
L2	Chip Inductor	2.2 nH
C1, C2	Chip Capacitor	100 pF
C3, C4	Chip Capacitor	1 000 pF
C5	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 1) and output pin (pin 3). 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

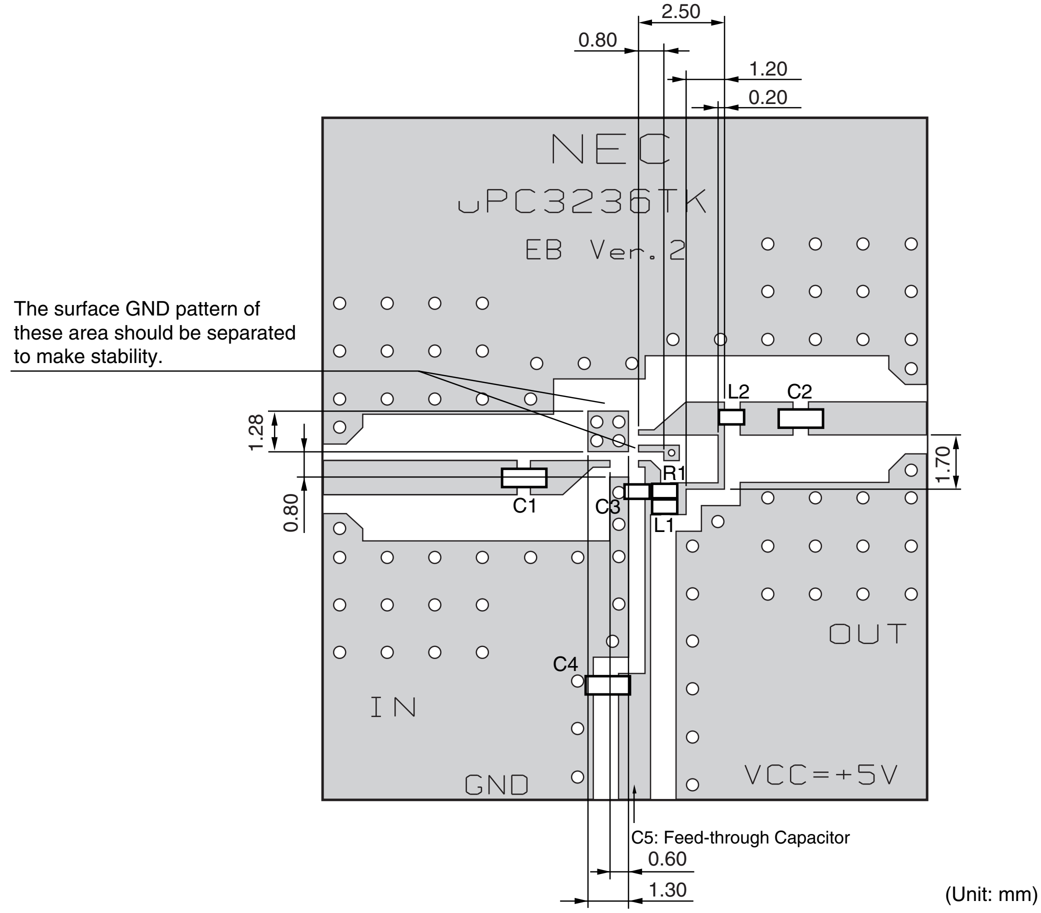
Capacitors of 1 000 pF are recommendable as the bypass capacitor for the V_{CC} pin and the coupling capacitors for the input and output pins.

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.

To obtain a flat gain from 100 MHz upwards, 1 000 pF capacitors are used in the test circuit. In the case of under 10 MHz operation, increase the value of coupling capacitor such as 10 000 pF. Because the coupling capacitors are determined by equation, $C = 1/(2\pi Rfc)$.

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



(Unit: mm)

COMPONENT LIST

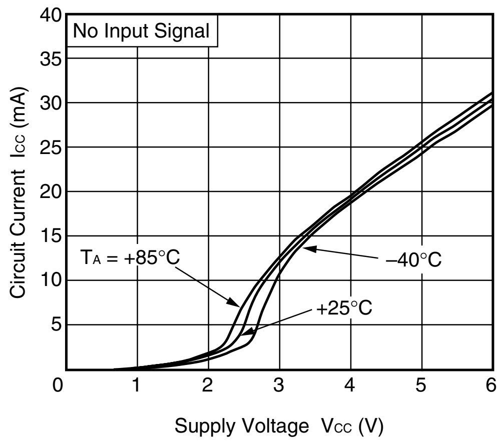
	Value	Size
R1	560 Ω	1005
L1	56 nH	1005
L2	2.2 nH	1005
C1, C2	100 pF	1608
C3	1 000 pF	1005
C4	1 000 pF	1608
C5	1 000 pF	Feed-through Capacitor

Notes

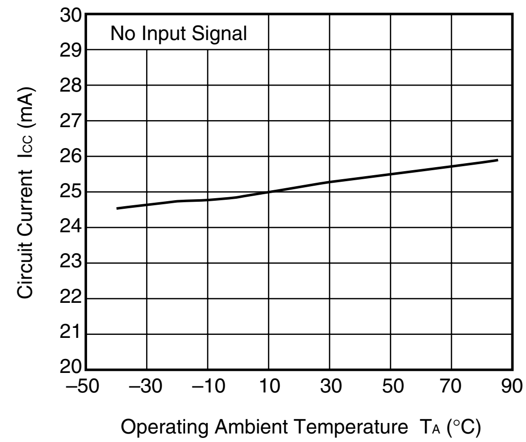
1. 19 × 21.46 × 0.51 mm double sided 18 μm copper clad RO4003C (Rogers) board.
2. Back side: GND pattern
3. Au plated on pattern
4. ○○ : Through holes (φ0.40, φ0.30)
5. L1, L2: FDK's products

TYPICAL CHARACTERISTICS (T_A = +25°C, V_{CC} = V_{out} = 5.0 V, Z_S = Z_L = 50 Ω, unless otherwise specified)

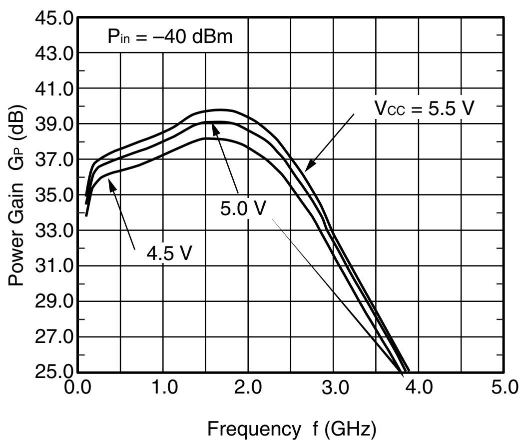
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



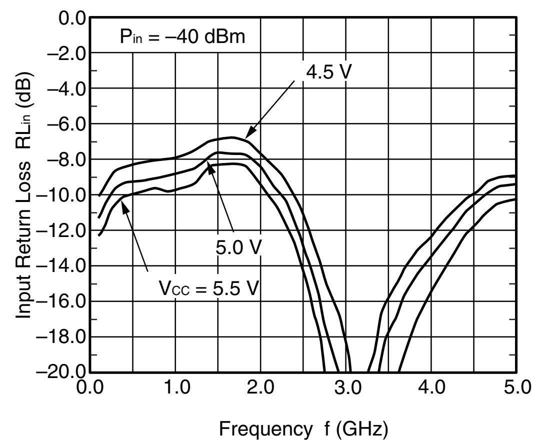
CURCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



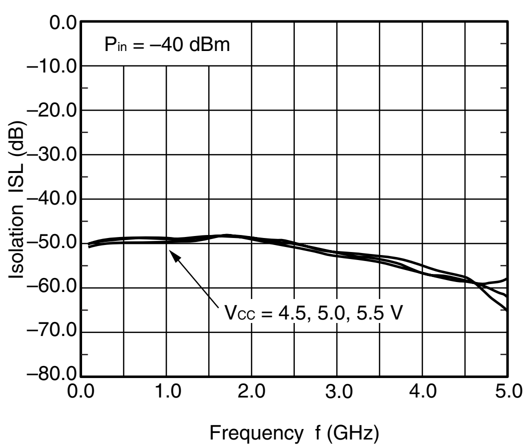
POWER GAIN vs. FREQUENCY



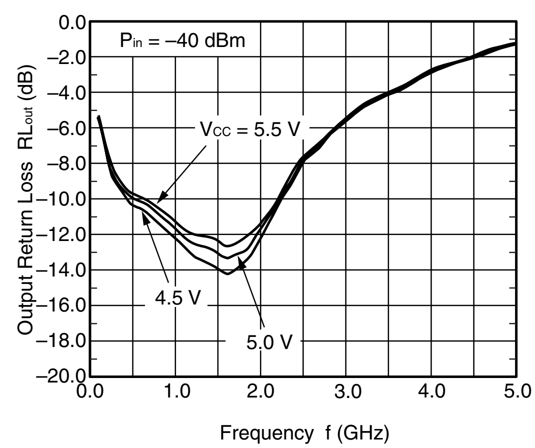
INPUT RETURN LOSS vs. FREQUENCY



ISOLATION vs. FREQUENCY

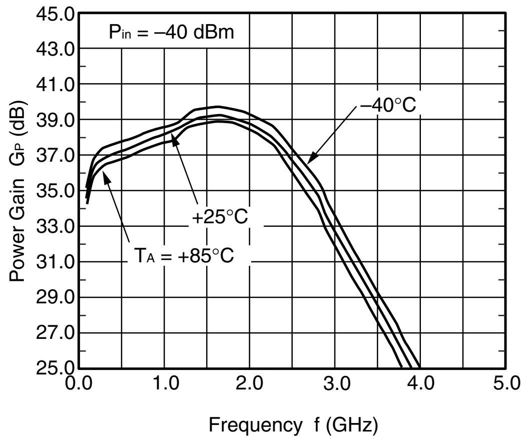


OUTPUT RETURN LOSS vs. FREQUENCY

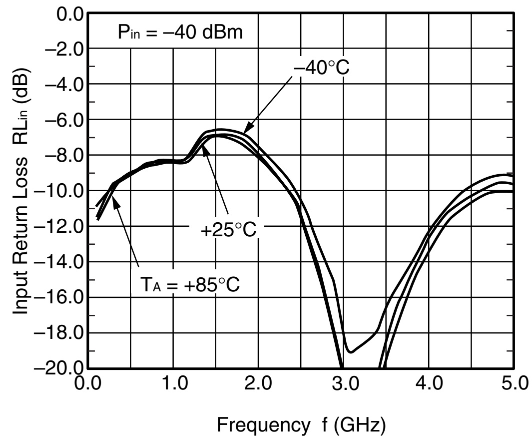


Remark The graphs indicate nominal characteristics.

POWER GAIN vs. FREQUENCY



INPUT RETURN LOSS vs. FREQUENCY



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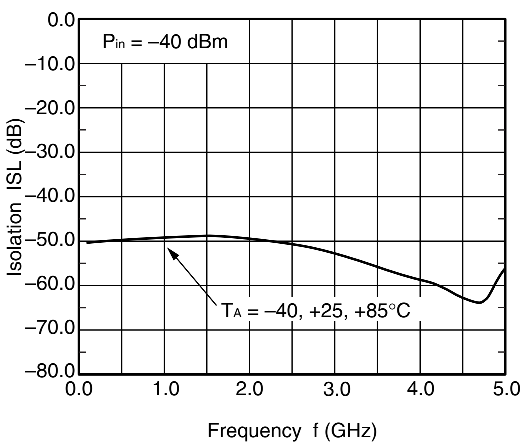
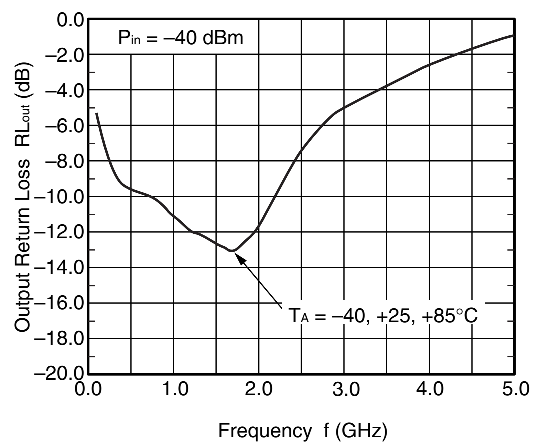
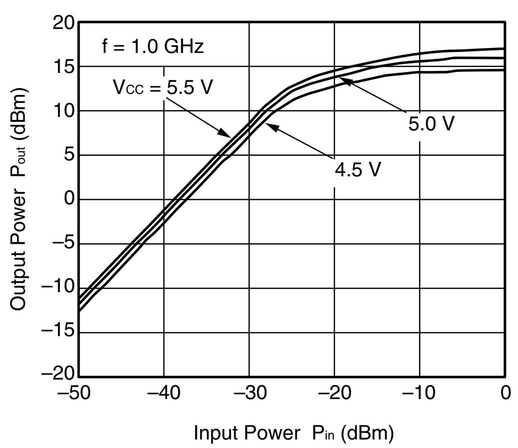


OUTPUT RETURN LOSS vs. FREQUENCY



OUTPUT POWER vs. INPUT POWER



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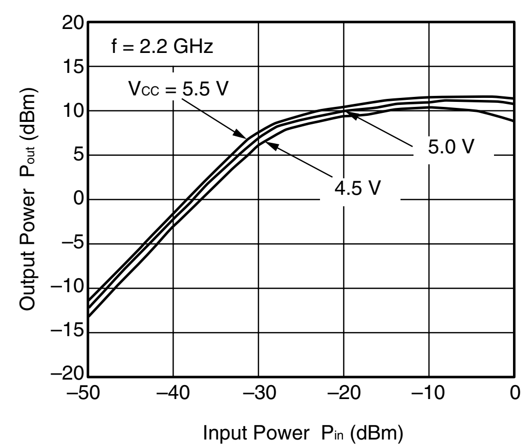

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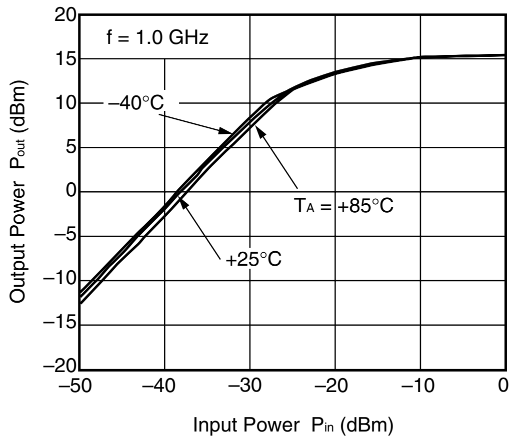
OUTPUT POWER vs. INPUT POWER



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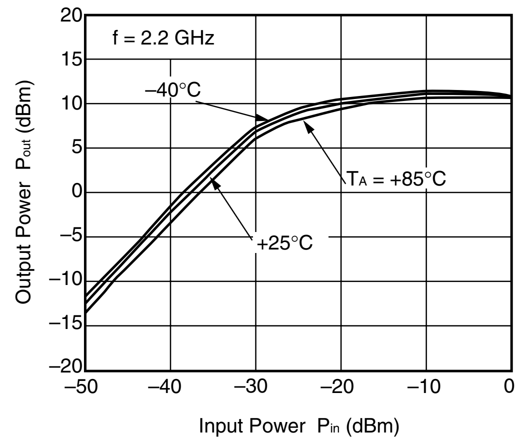
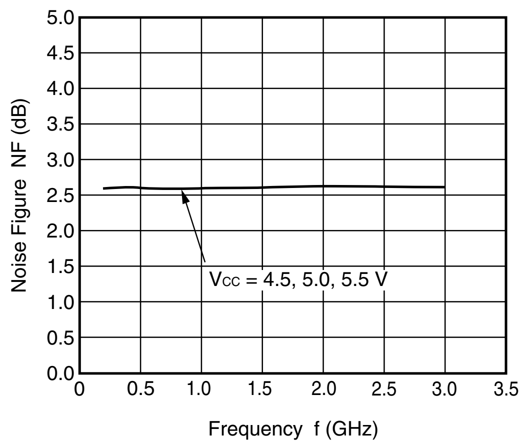
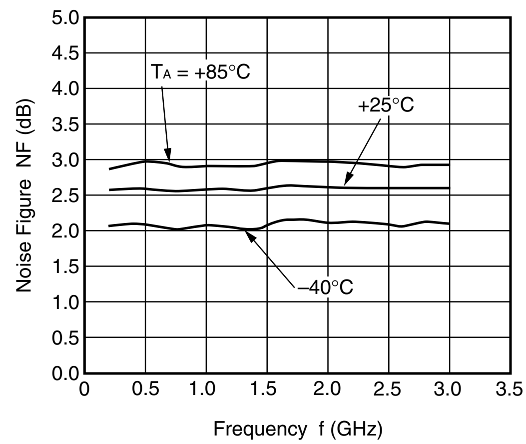


NOISE FIGURE vs. FREQUENCY



NOISE FIGURE vs. FREQUENCY



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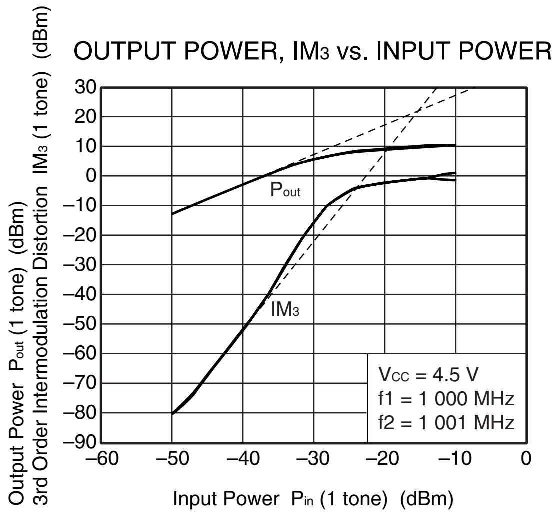

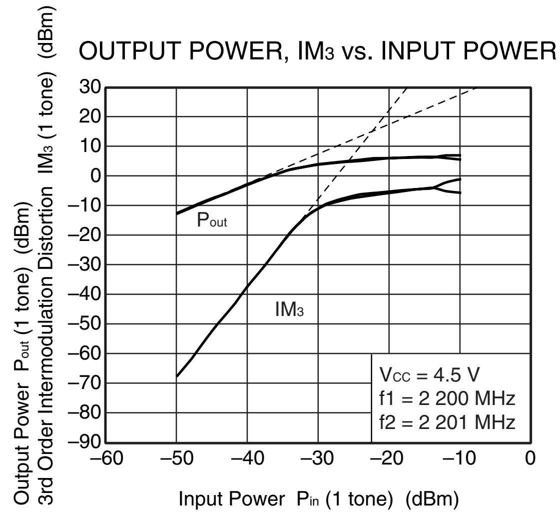

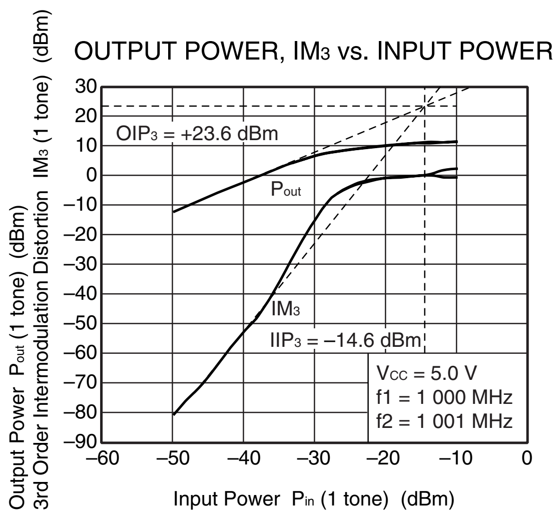

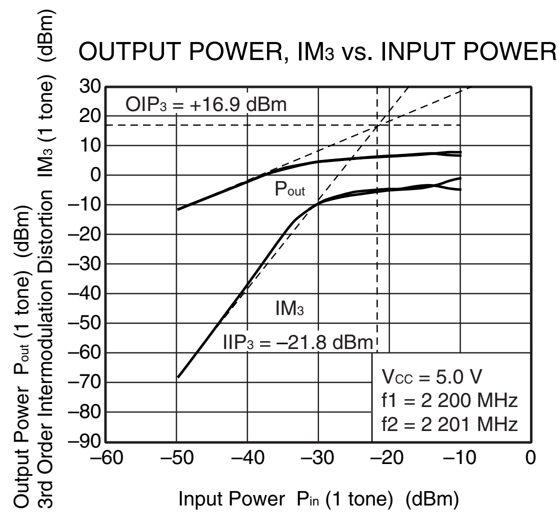

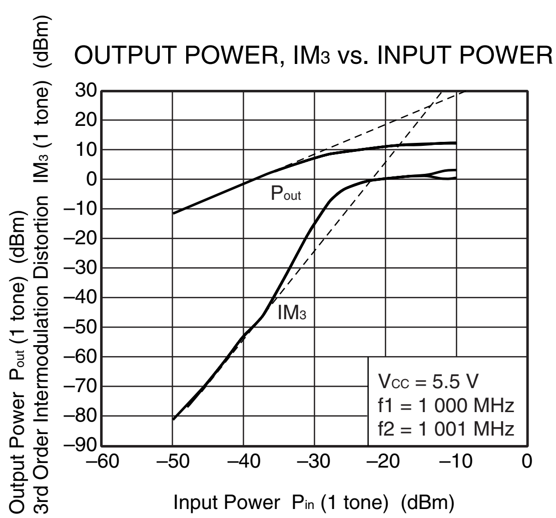

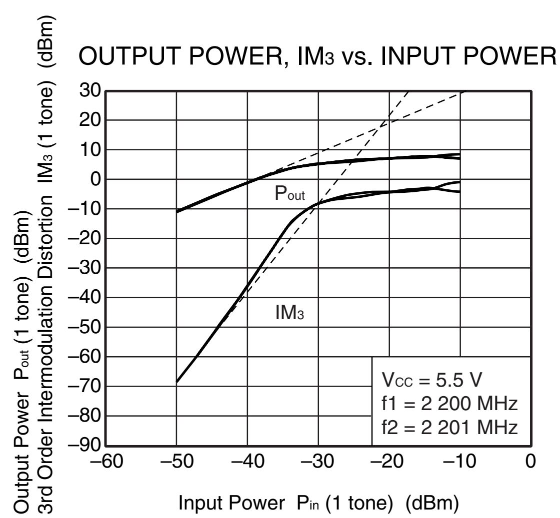

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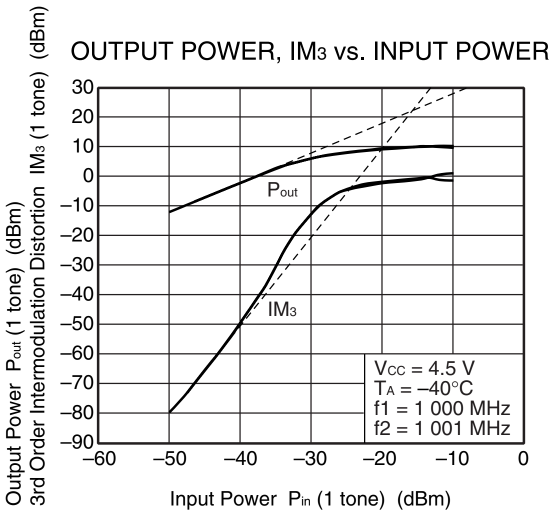
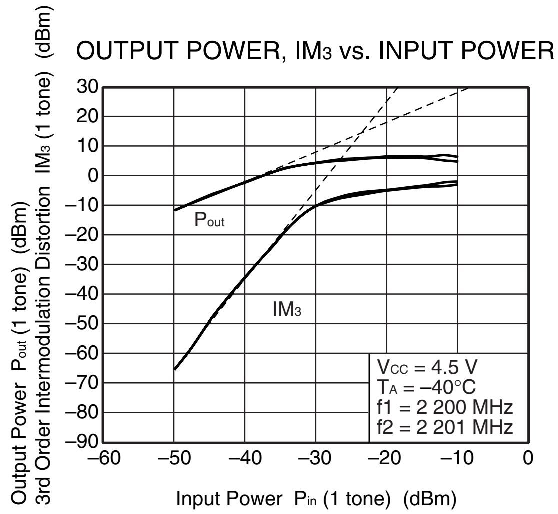
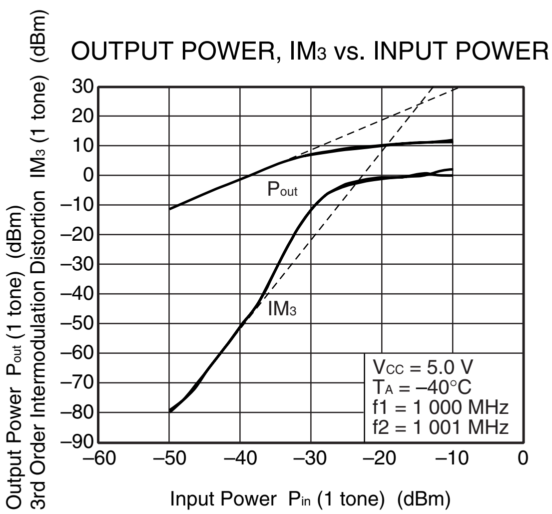
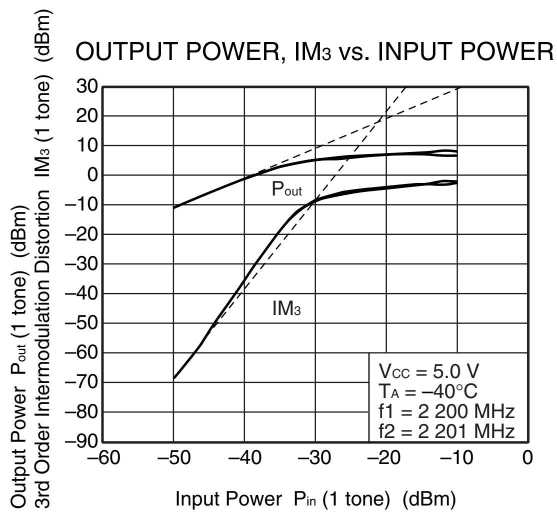
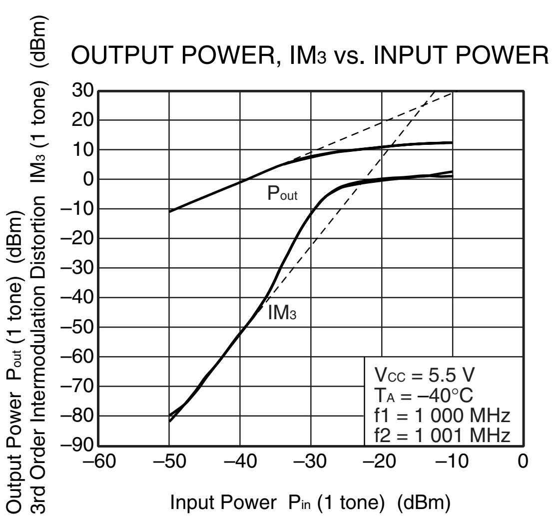
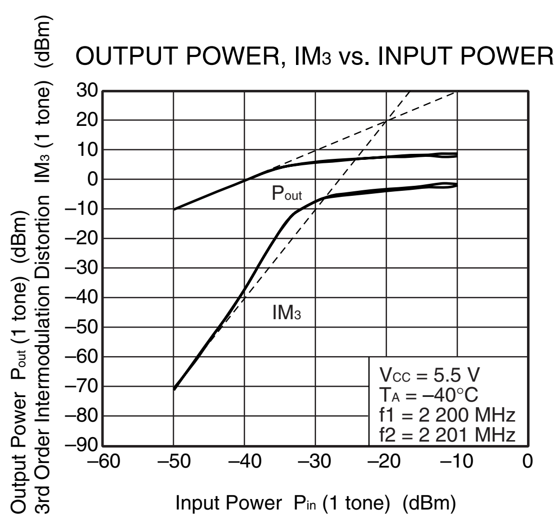






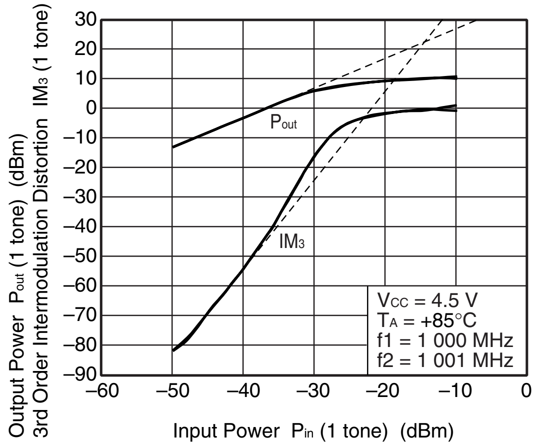




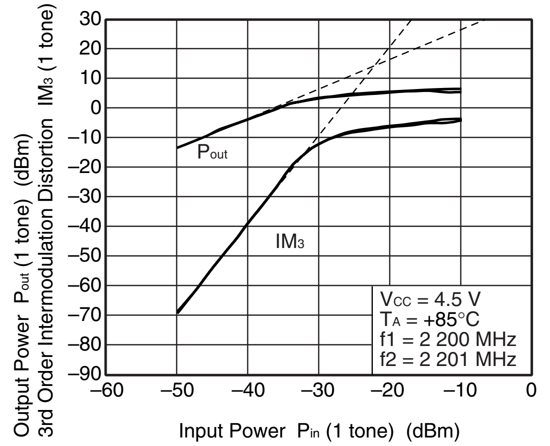


Remark The graphs indicate nominal characteristics.

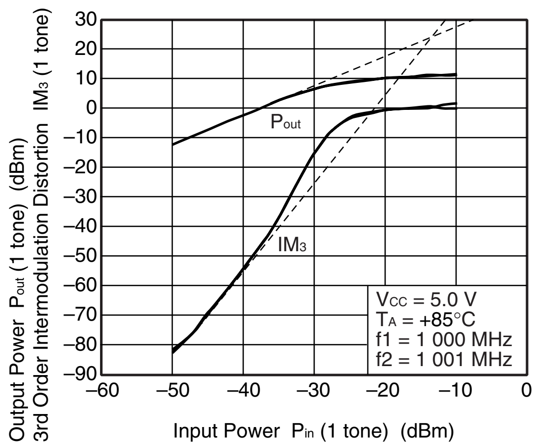
OUTPUT POWER, IM3 vs. INPUT POWER



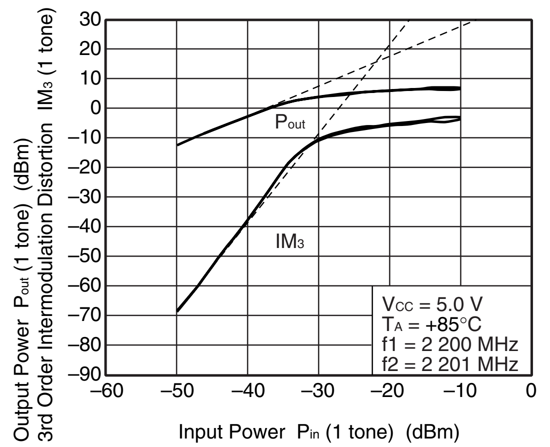
OUTPUT POWER, IM3 vs. INPUT POWER



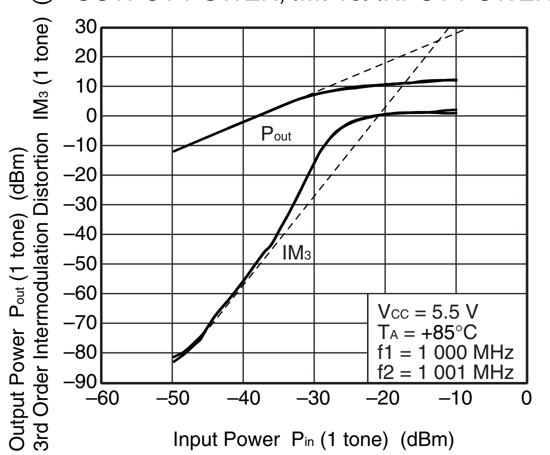
OUTPUT POWER, IM3 vs. INPUT POWER



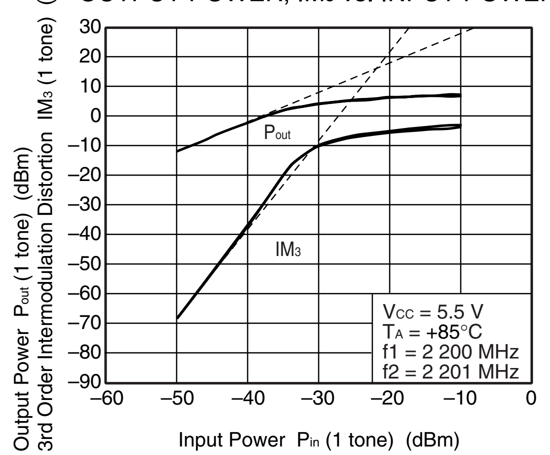
OUTPUT POWER, IM3 vs. INPUT POWER



OUTPUT POWER, IM3 vs. INPUT POWER

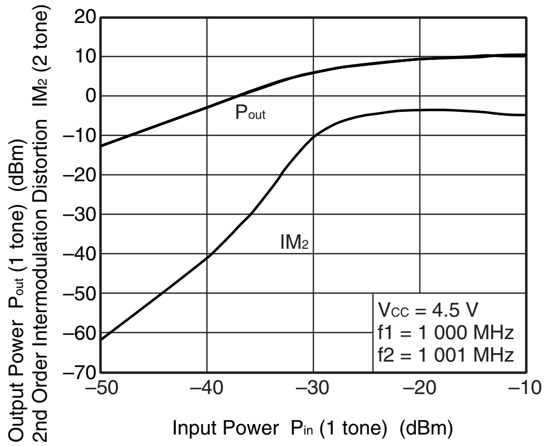


OUTPUT POWER, IM3 vs. INPUT POWER

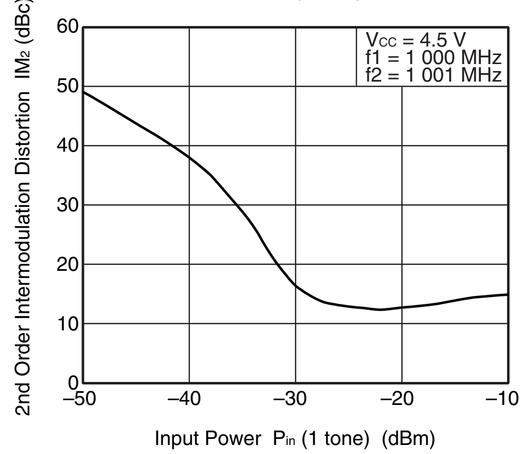


Remark The graphs indicate nominal characteristics.

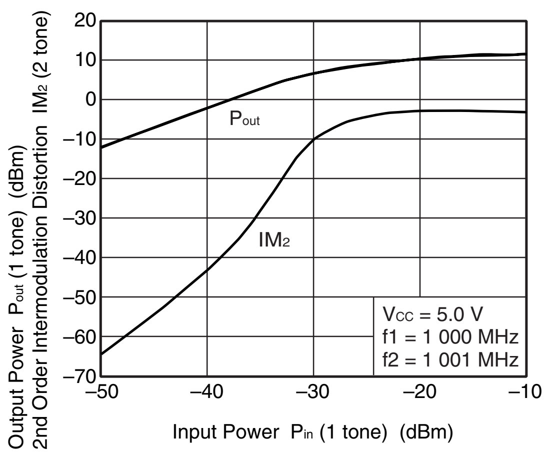
OUTPUT POWER, IM2 vs. INPUT POWER



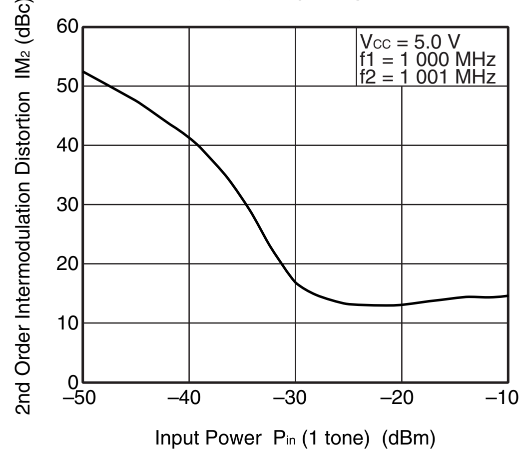
IM2 vs. INPUT POWER



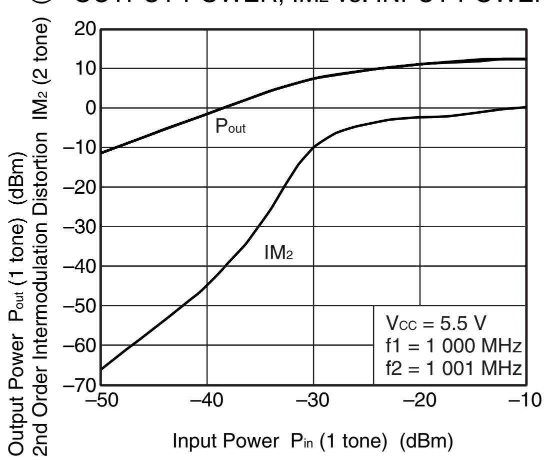
OUTPUT POWER, IM2 vs. INPUT POWER



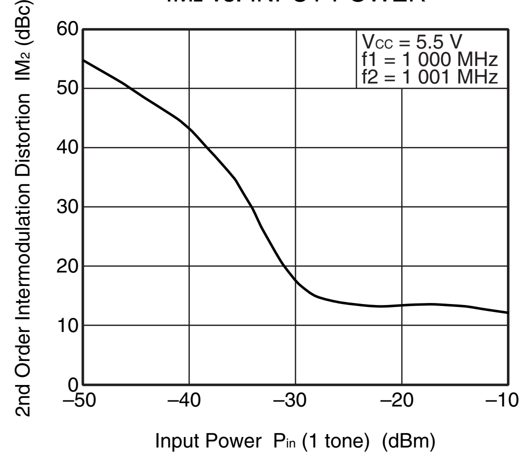
IM2 vs. INPUT POWER



OUTPUT POWER, IM2 vs. INPUT POWER

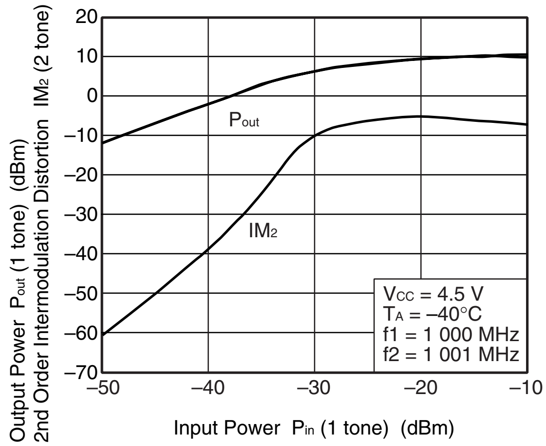


IM2 vs. INPUT POWER

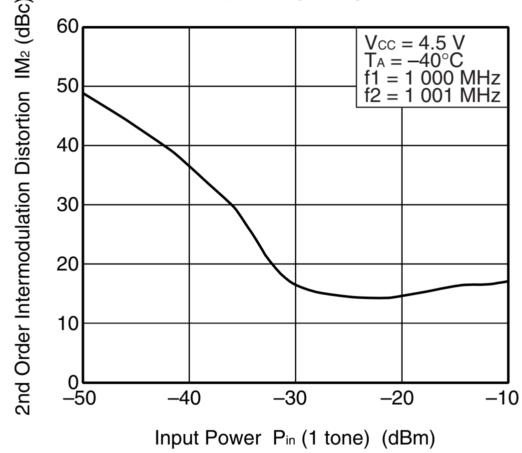


Remark The graphs indicate nominal characteristics.

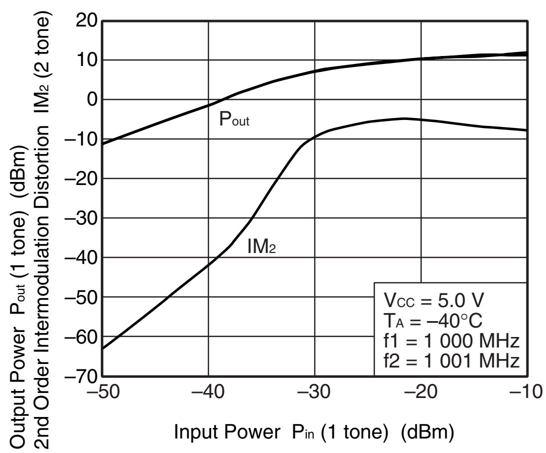
OUTPUT POWER, IM2 vs. INPUT POWER



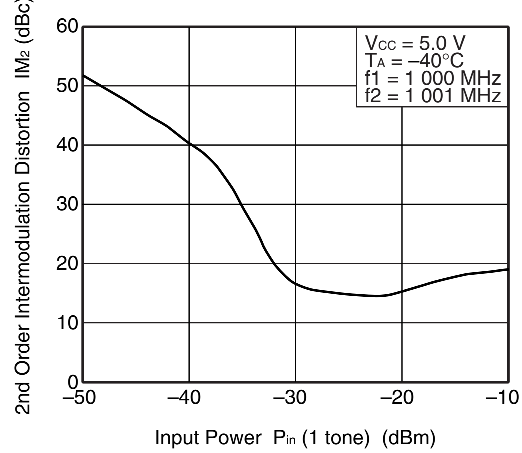
IM2 vs. INPUT POWER



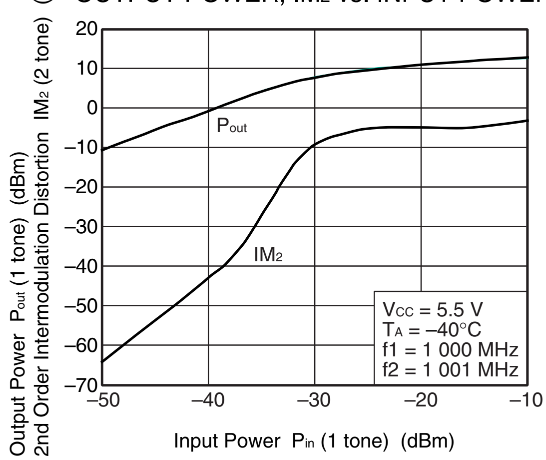
OUTPUT POWER, IM2 vs. INPUT POWER



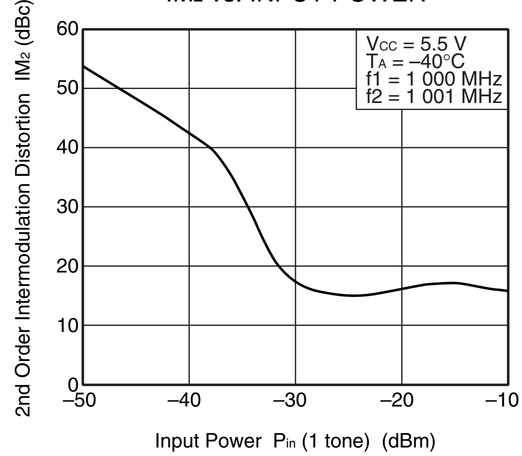
IM2 vs. INPUT POWER



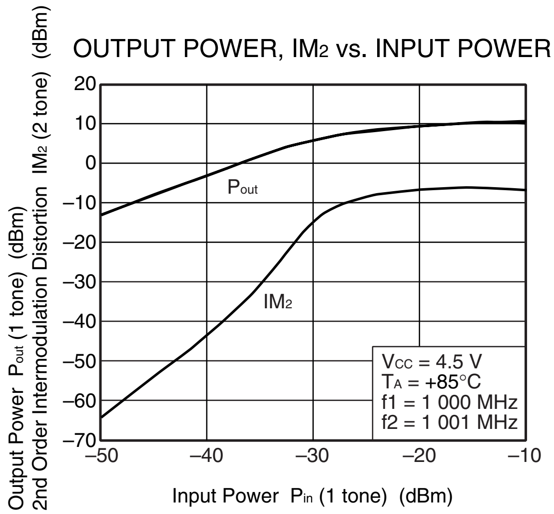
OUTPUT POWER, IM2 vs. INPUT POWER

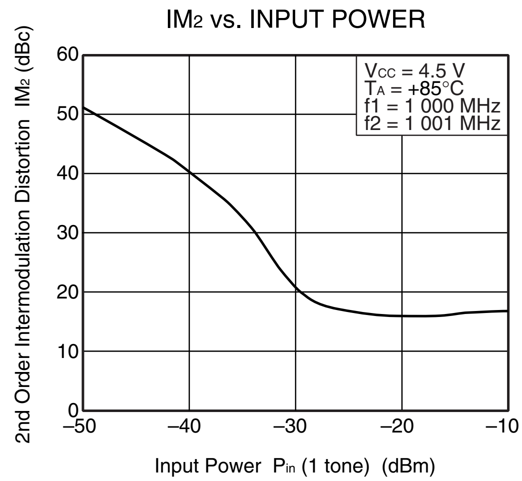


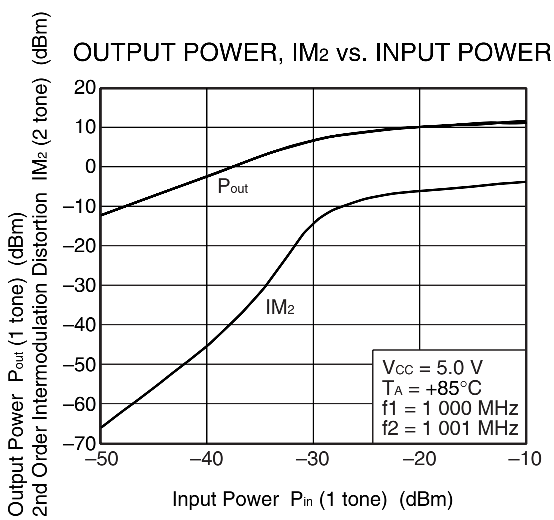
IM2 vs. INPUT POWER

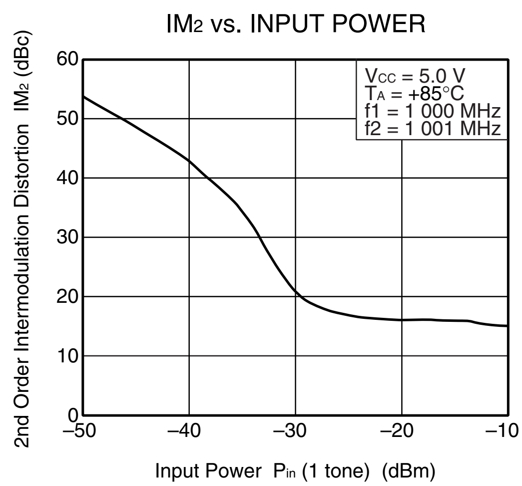


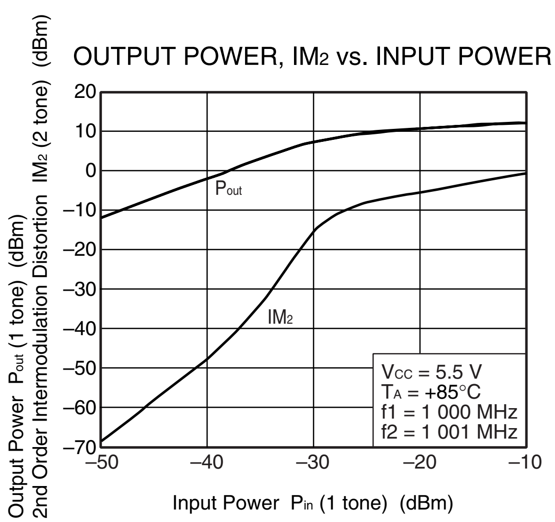
Remark The graphs indicate nominal characteristics.

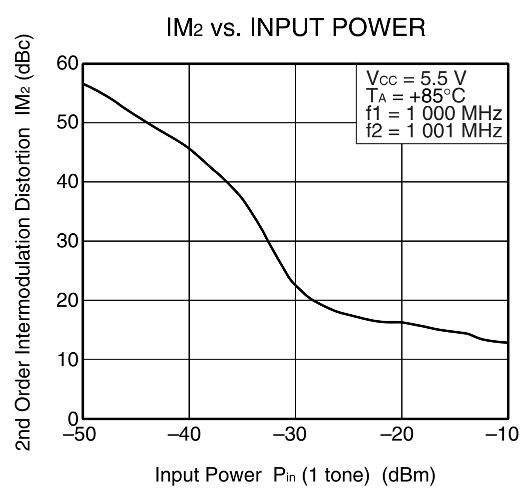






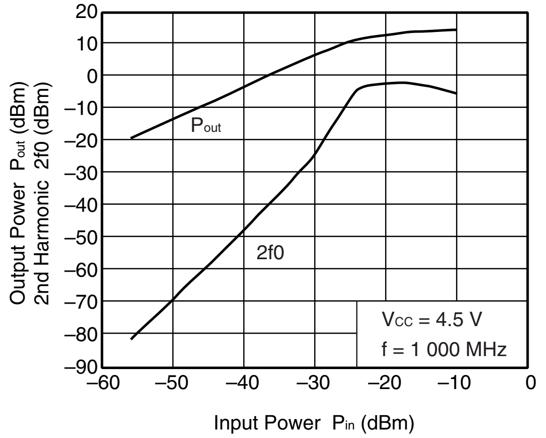




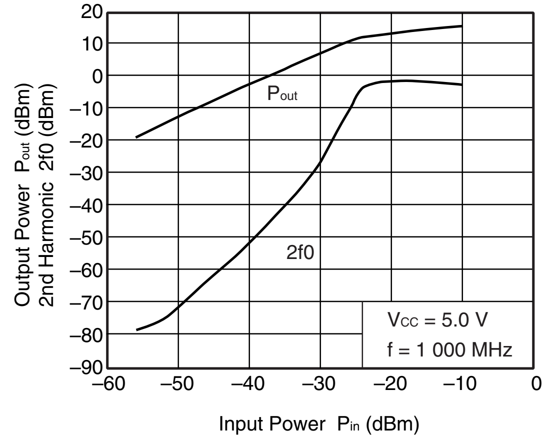


Remark The graphs indicate nominal characteristics.

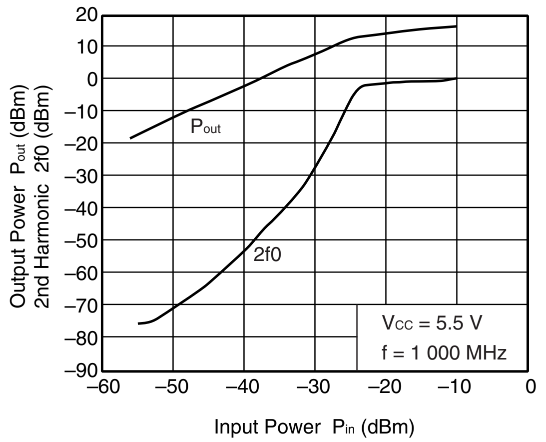
OUTPUT POWER, 2f0 vs. INPUT POWER



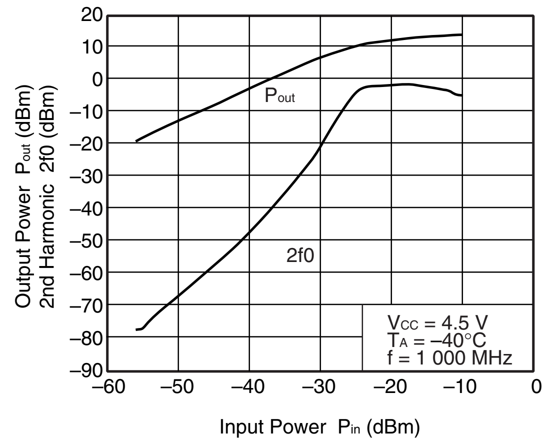
OUTPUT POWER, 2f0 vs. INPUT POWER



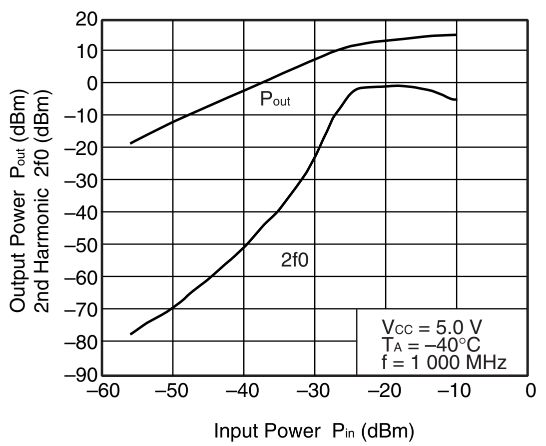
OUTPUT POWER, 2f0 vs. INPUT POWER



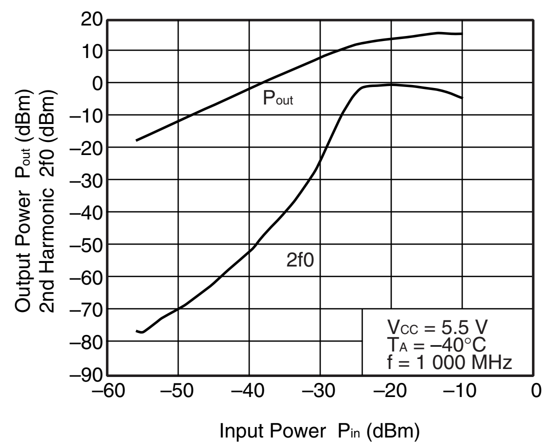
OUTPUT POWER, 2f0 vs. INPUT POWER



OUTPUT POWER, 2f0 vs. INPUT POWER

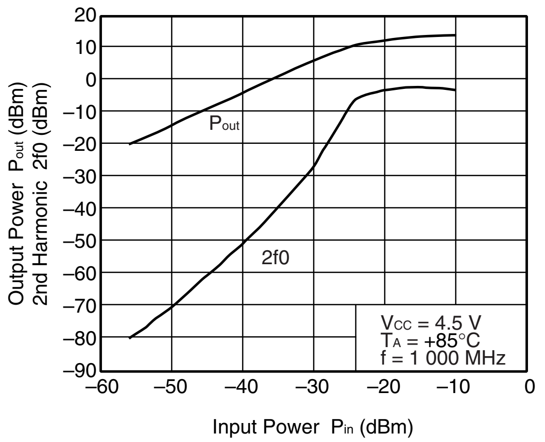


OUTPUT POWER, 2f0 vs. INPUT POWER

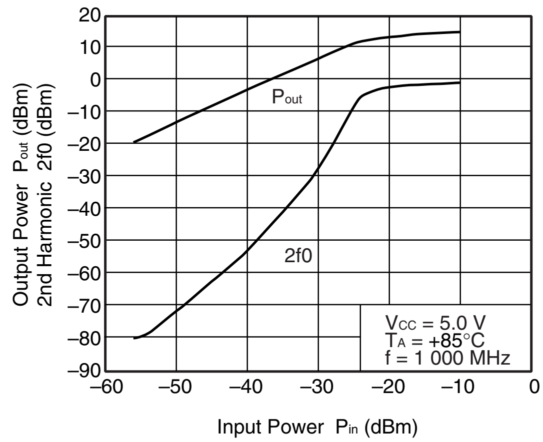


Remark The graphs indicate nominal characteristics.

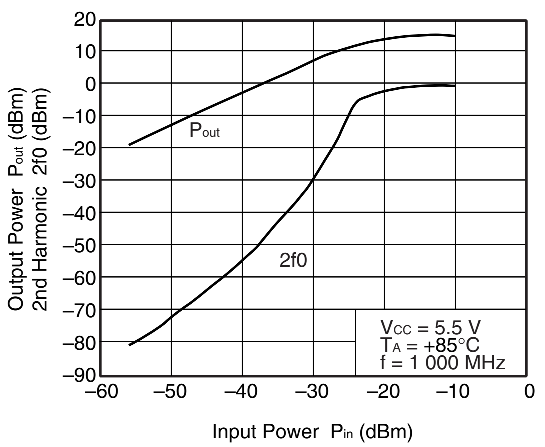
OUTPUT POWER, 2f0 vs. INPUT POWER



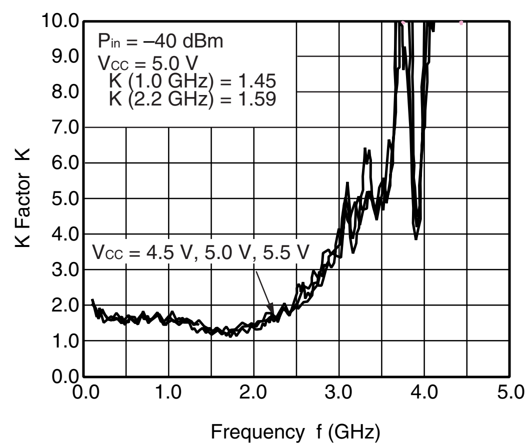
OUTPUT POWER, 2f0 vs. INPUT POWER



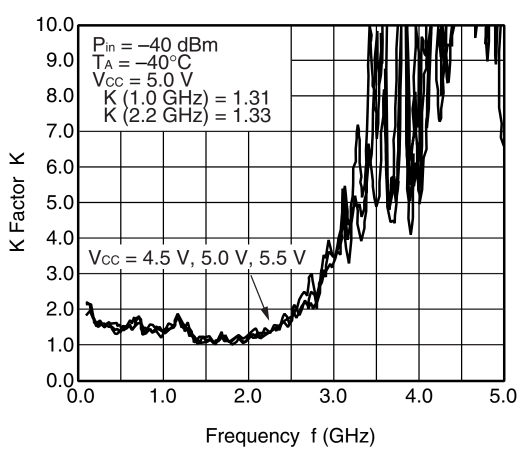
OUTPUT POWER, 2f0 vs. INPUT POWER



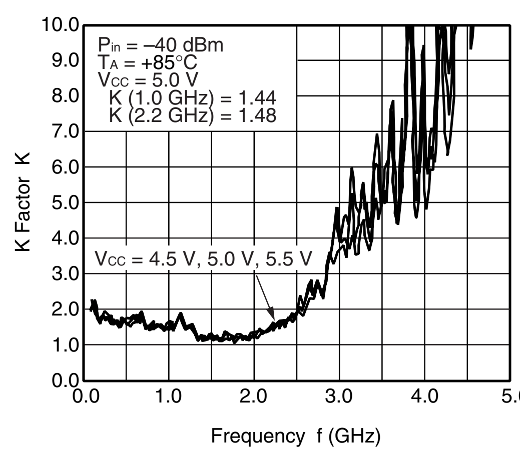
K FACTOR vs. FREQUENCY



K FACTOR vs. FREQUENCY



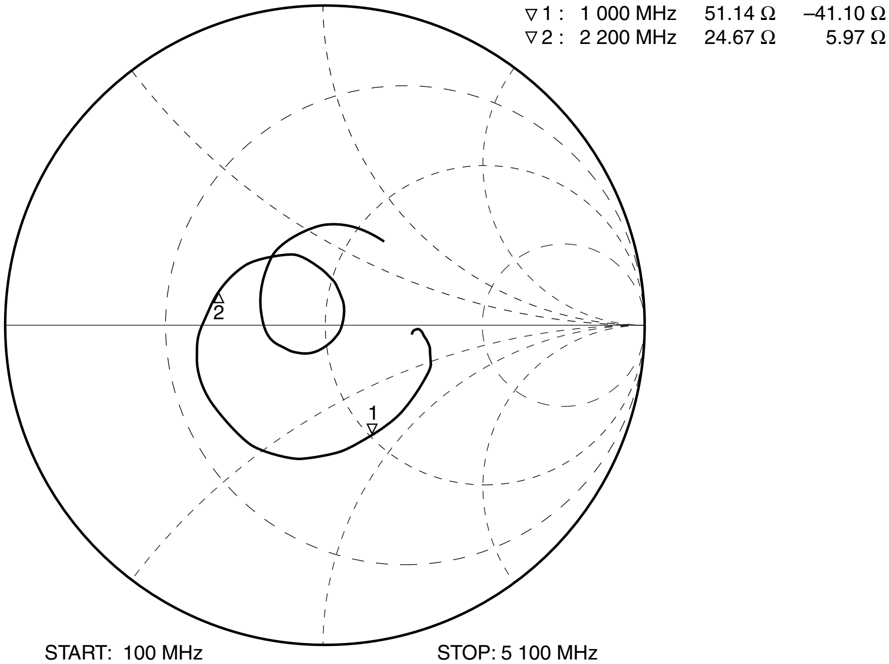
K FACTOR vs. FREQUENCY



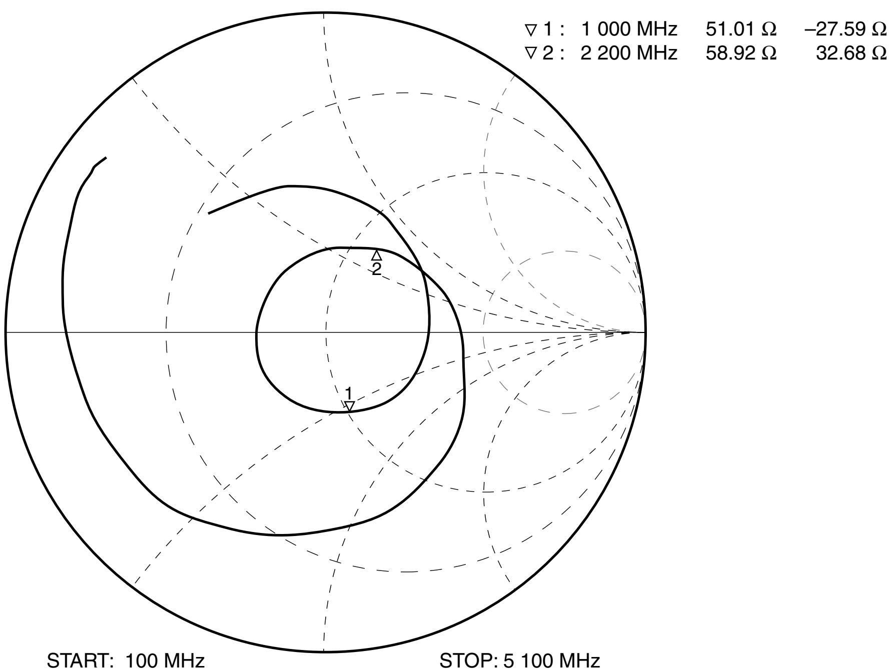
Remark The graphs indicate nominal characteristics.

S-PARAMETERS (T_A = +25°C, V_{CC} = V_{out} = 5.0 V, P_{in} = –40 dBm)

S_{11}–FREQUENCY



S_{22}–FREQUENCY



Remarks 1. Measured on the test circuit of evaluation board.

2. 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.

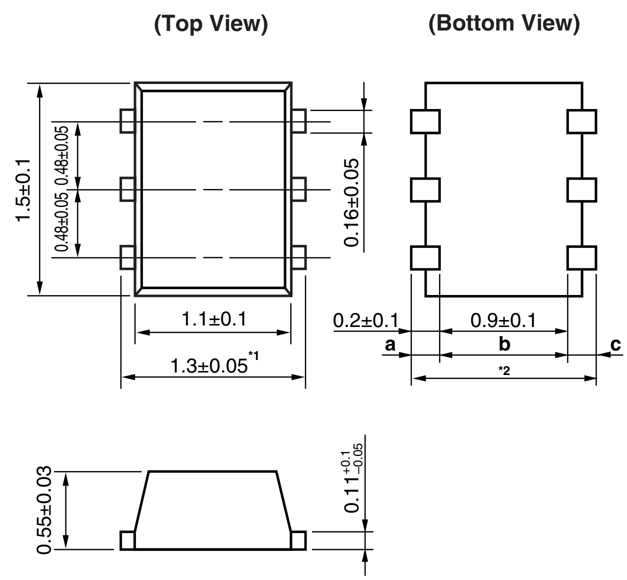
Click here to download S-parameters.

[RF and Microwave] → [Device Parameters]

URL http://www.necel.com/microwave/en/

PACKAGE DIMENSIONS

6-PIN LEAD-LESS MINIMOLD (1511 PKG) (UNIT: mm)



Remark Dimension*1 is bigger than dimension*2 (dimension*2= **a** + **b** + **c**).

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). There are the surface GND pattern area that must be separated to make stability.

(3) The bypass capacitor should be attached to the V_{CC} line.

(4) The inductor (L) must be attached between V_{CC} 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	IR260
	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	
Wave Soldering	Peak temperature (molten solder temperature)	: 260°C or below	WS260
	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	
Partial Heating	Peak temperature (terminal temperature)	: 350°C or below	HS350
	Soldering time (per side of device)	: 3 seconds or less	
	Maximum chlorine content of rosin flux (% mass)	: 0.2%(Wt.) or below	

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