DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC3232TB

5 V, SILICON GERMANIUM MMIC MEDIUM OUTPUT POWER AMPLIFIER

DESCRIPTION

The μPC3232TB is a silicon germanium (SiGe) monolithic integrated circuit designed as IF amplifier for DBS tuners. This IC is manufactured using our 50 GHz f_{max} UHS2 (Ultra High Speed Process) SiGe bipolar process.

FEATURES

- Low current : I_{CC} = 26.0 mA TYP.
- Medium output power : $P_{O\,(sat)}$ = +15.5 dBm TYP. @ f = 1.0 GHz
  : $P_{O\,(sat)}$ = +12.0 dBm TYP. @ f = 2.2 GHz
- High linearity : $P_{O\,(1\,dB)}$ = +11.0 dBm TYP. @ f = 1.0 GHz
  : $P_{O\,(1\,dB)}$ = +8.5 dBm TYP. @ f = 2.2 GHz
- Power gain : G_P = 32.8 dB MIN. @ f = 1.0 GHz
  : G_P = 33.5 dB MIN. @ f = 2.2 GHz
- Gain flatness : ΔG_P = 1.0 dB TYP. @ f = 1.0 to 2.2 GHz
- Noise figure : NF = 4 dB TYP. @ f = 1.0 GHz
  : NF = 4.1 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 LNB for DBS converters etc.

ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPC3232TB-E3	μPC3232TB-E3-A	6-pin super minimold (Pb-Free)	C3S	• Embossed tape 8 mm wide • Pin 1, 2, 3 face the perforation side of the tape • Qty 3 kpcs/reel

Remark To order evaluation samples, please contact your nearby sales office
Part number for sample order: μPC3232TB

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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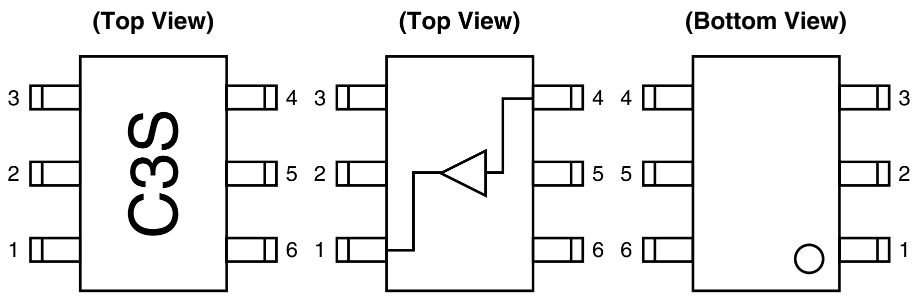
PIN CONNECTIONS



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

PRODUCT LINE-UP OF 5 V-BIAS SILICON MMIC MEDIUM OUTPUT POWER AMPLIFIER (TA = +25°C, f = 1 GHz, VCC = Vout = 5.0 V, ZS = ZL = 50 Ω)

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

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	6.0	V
Total Circuit Current	I_{CC}	T_A = +25°C	45	mA
Power Dissipation	P_D	T_A = +85°C **Note**	270	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

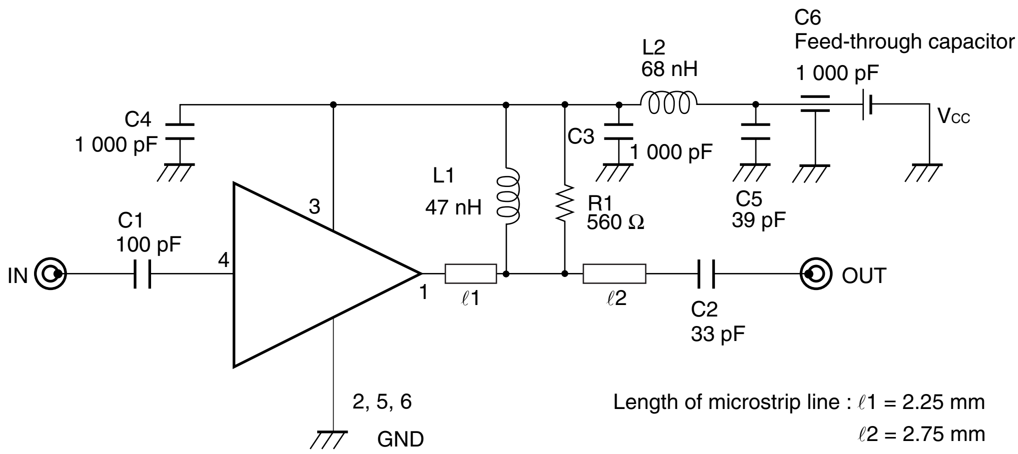
RECOMMENDED OPERATING RANGE

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}		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	20	26	32	mA
Power Gain 1	G_P1	f = 0.25 GHz, P_{in} = –35 dBm	29	31.5	34	dB
Power Gain 2	G_P2	f = 1.0 GHz, P_{in} = –35 dBm	30	32.8	35.5	
Power Gain 3	G_P3	f = 1.8 GHz, P_{in} = –35 dBm	31	33.8	37	
Power Gain 4	G_P4	f = 2.2 GHz, P_{in} = –35 dBm	30.5	33.5	36.5	
Power Gain 5	G_P5	f = 2.6 GHz, P_{in} = –35 dBm	29	32.2	35.5	
Power Gain 6	G_P6	f = 3.0 GHz, P_{in} = –35 dBm	27	30.7	34	
Gain Flatness	ΔG_P	f = 1.0 to 2.2 GHz, P_{in} = –35 dBm	–	1.0	–	dB
K factor 1	K1	f = 1.0 GHz, P_{in} = –35 dBm	–	1.3	–	–
K factor 2	K2	f = 2.2 GHz, P_{in} = –35 dBm	–	1.9	–	–
Saturated Output Power 1	$P_{O(sat)}1$	f = 1.0 GHz, P_{in} = 0 dBm	+13	+15.5	–	dBm
Saturated Output Power 2	$P_{O(sat)}2$	f = 2.2 GHz, P_{in} = –5 dBm	+9.5	+12	–	
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	+6	+8.5	–	
Noise Figure 1	NF1	f = 1.0 GHz	–	4	4.8	dB
Noise Figure 2	NF2	f = 2.2 GHz	–	4.1	4.9	
Isolation 1	ISL1	f = 1.0 GHz, P_{in} = –35 dBm	36	41	–	dB
Isolation 2	ISL2	f = 2.2 GHz, P_{in} = –35 dBm	38	45	–	
Input Return Loss 1	$RL_{in}1$	f = 1.0 GHz, P_{in} = –35 dBm	9.5	13	–	dB
Input Return Loss 2	$RL_{in}2$	f = 2.2 GHz, P_{in} = –35 dBm	10	14.5	–	
Output Return Loss 1	$RL_{out}1$	f = 1.0 GHz, P_{in} = –35 dBm	12	15.5	–	dB
Output Return Loss 2	$RL_{out}2$	f = 2.2 GHz, P_{in} = –35 dBm	12	15	–	
Input 3rd Order Distortion Intercept Point 1	IIP_31	f1 = 1 000 MHz, f2 = 1 001 MHz	–	–9	–	dBm
Input 3rd Order Distortion Intercept Point 2	IIP_32	f1 = 2 200 MHz, f2 = 2 201 MHz	–	–15.5	–	
Output 3rd Order Distortion Intercept Point 1	OIP_31	f1 = 1 000 MHz, f2 = 1 001 MHz	–	+23.5	–	dBm
Output 3rd Order Distortion Intercept Point 2	OIP_32	f1 = 2 200 MHz, f2 = 2 201 MHz	–	+18	–	
2nd Order Intermodulation Distortion	IM_2	f1 = 1 000 MHz, f2 = 1 001 MHz, P_{out} = –5 dBm/tone	–	50	–	dBc
2nd Harmonic	2f0	f0 = 1.0 GHz, P_{out} = –15 dBm	–	70	–	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	47 nH
L2	Chip Inductor	68 nH
C1	Chip Capacitor	100 pF
C2	Chip Capacitor	33 pF
C3, C4	Chip Capacitor	1 000 pF
C5	Chip Capacitor	39 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 Vcc 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 Vcc, INPUT AND OUTPUT PINS

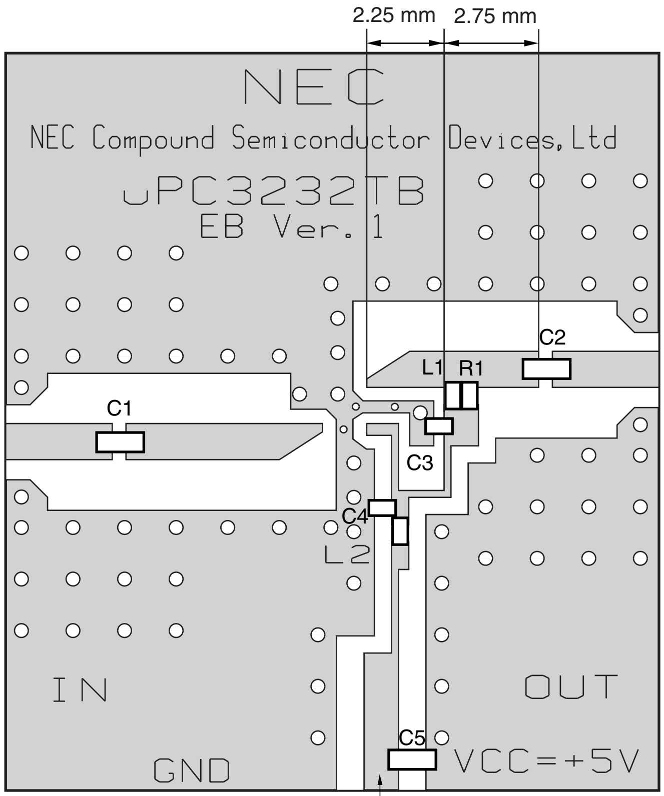
Capacitors of 1 000 pF are recommendable as the bypass capacitor for the Vcc pin and the coupling capacitors for the input and output pins.

The bypass capacitor connected to the Vcc pin is used to minimize ground impedance of Vcc pin. So, stable bias can be supplied against Vcc 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



C6: Feed-through Capacitor

COMPONENT LIST

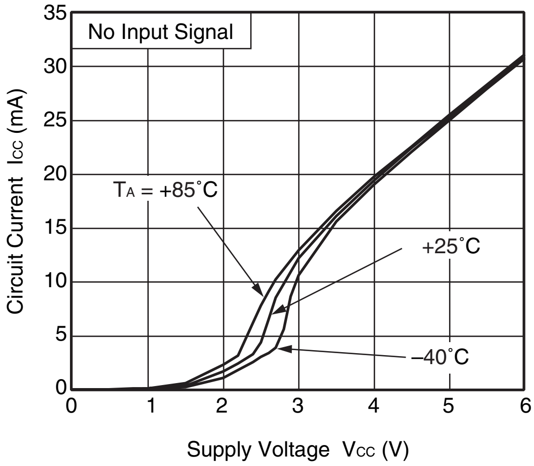
	Value	Size
R1	560 Ω	1005
L1	47 nH	1005
L2	68 nH	1005
C1	100 pF	1608
C2	33 pF	1608
C3, C4	1 000 pF	1005
C5	39 pF	1608
C6	1 000 pF	Feed-through Capacitor

Notes

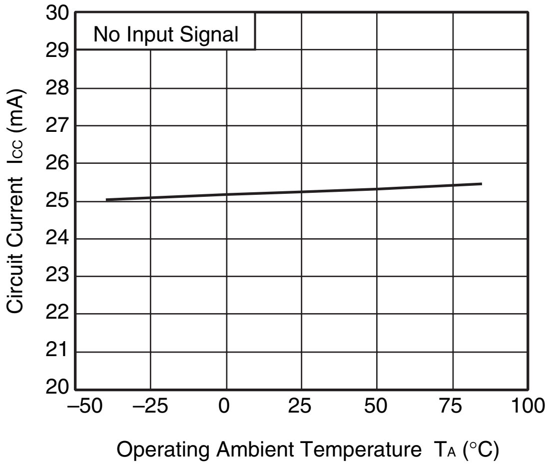
1. 19 × 21.46 × 0.51 mm double sided copper clad RO4003C (Rogers) board.
2. Back side: GND pattern
3. Au plated on pattern
4. o O: Through holes
5. L1, L2: FDK’s products

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

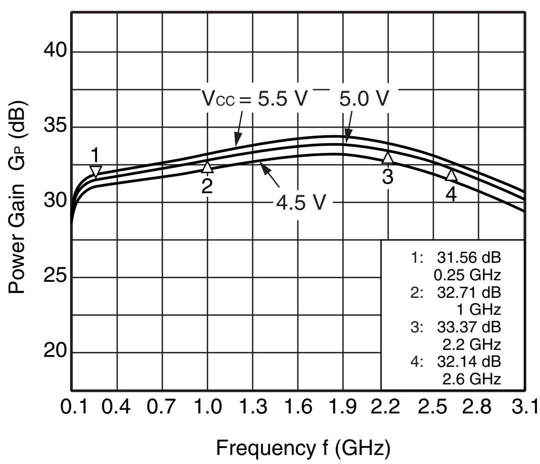
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



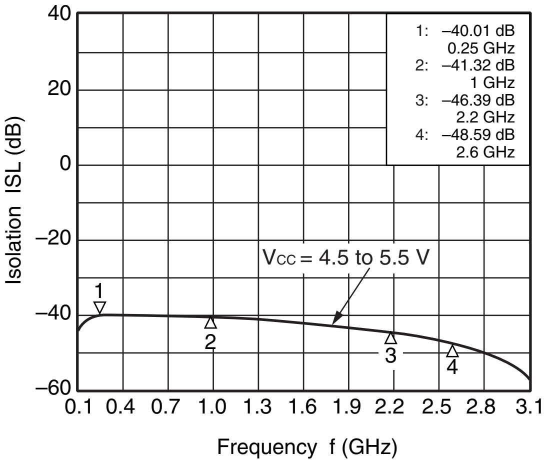
CURCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



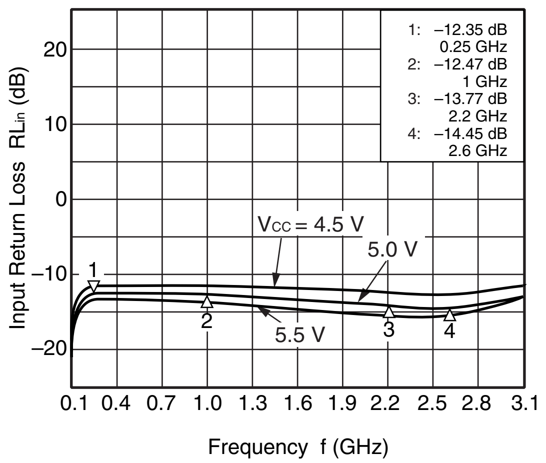
POWER GAIN vs. FREQUENCY



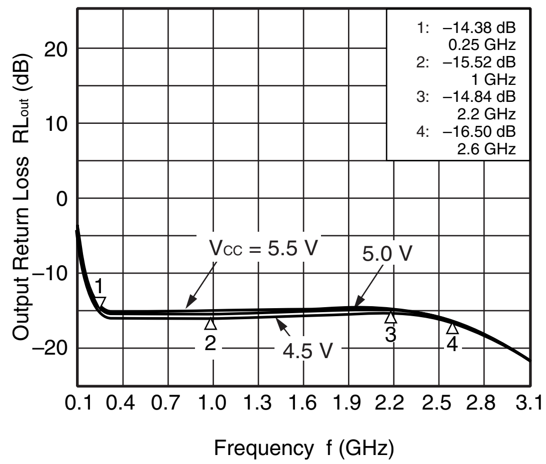
ISOLATION vs. FREQUENCY



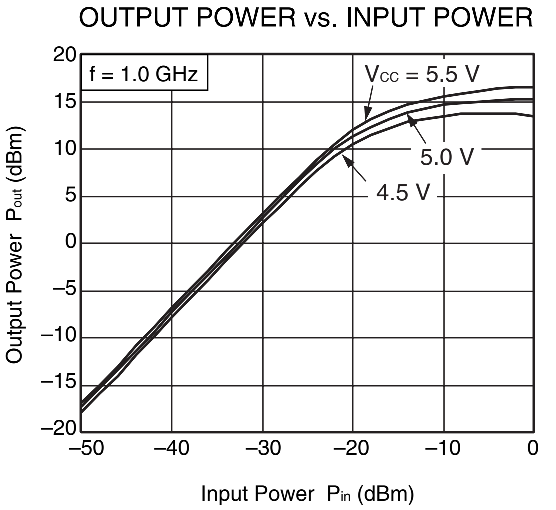
INPUT RETURN LOSS vs. FREQUENCY

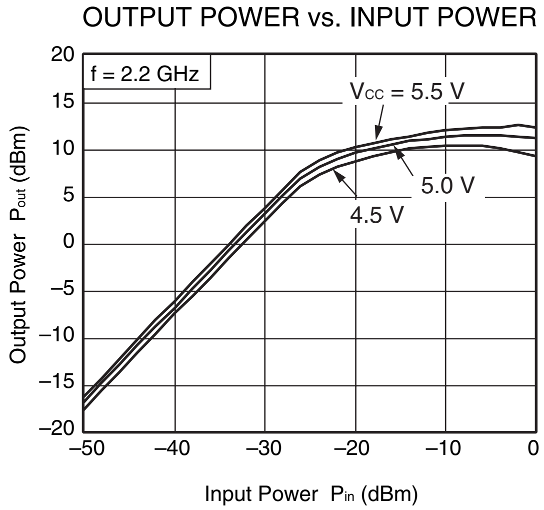


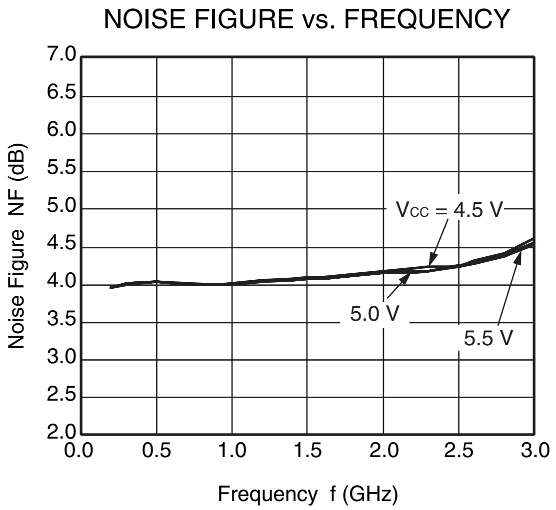
OUTPUT RETURN LOSS vs. FREQUENCY

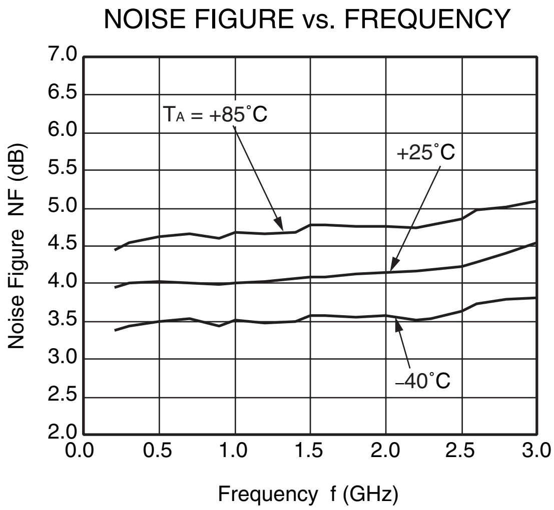


Remark The graphs indicate nominal characteristics.



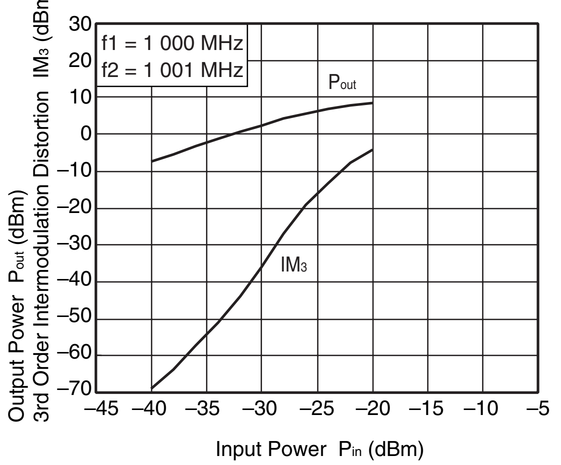




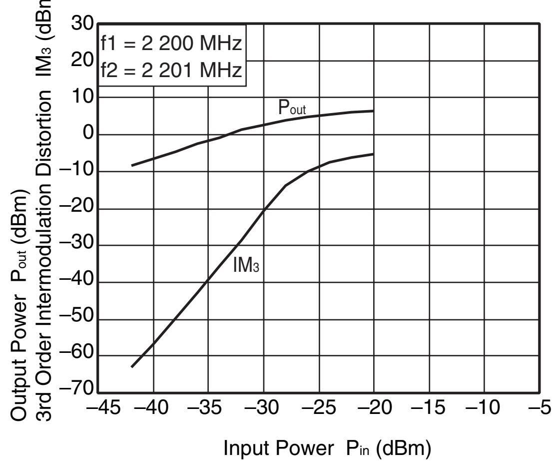


Remark The graphs indicate nominal characteristics.

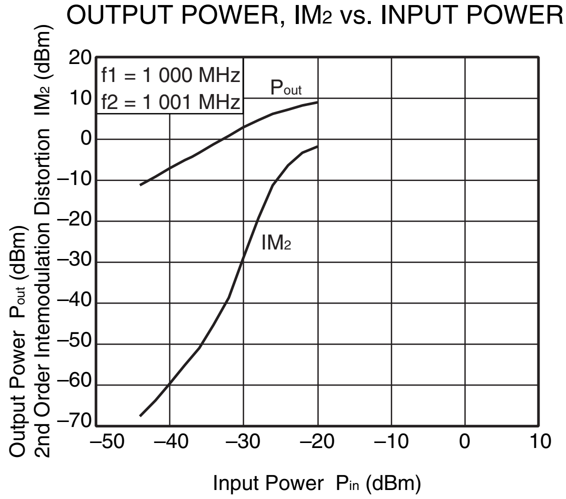
OUTPUT POWER, IM3 vs. INPUT POWER



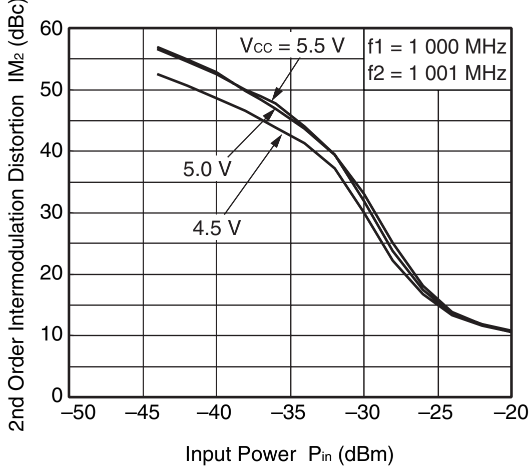
OUTPUT POWER, IM3 vs. INPUT POWER



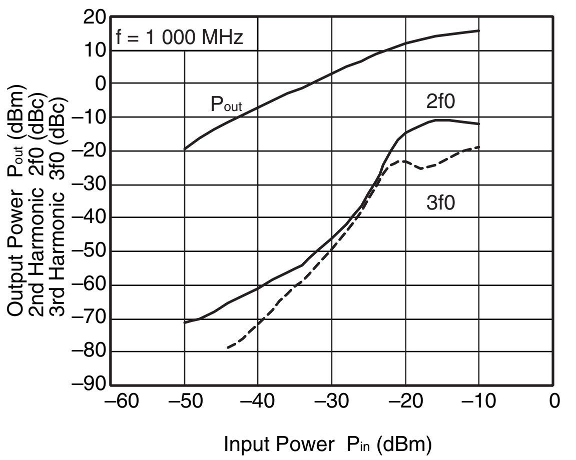
OUTPUT POWER, IM2 vs. INPUT POWER



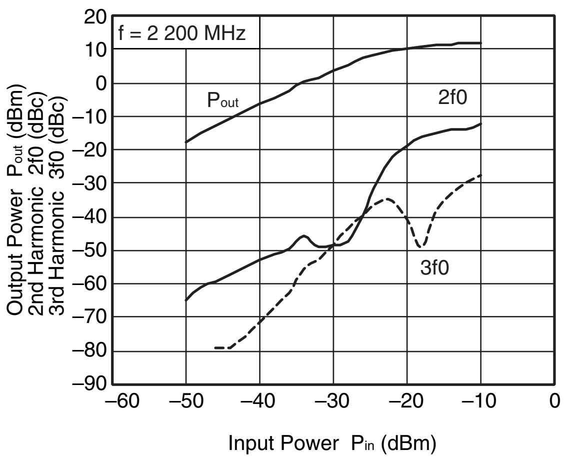
IM2 vs. INPUT POWER



OUTPUT POWER, 2ND HARMONIC,
3RD HARMONIC vs. INPUT POWER



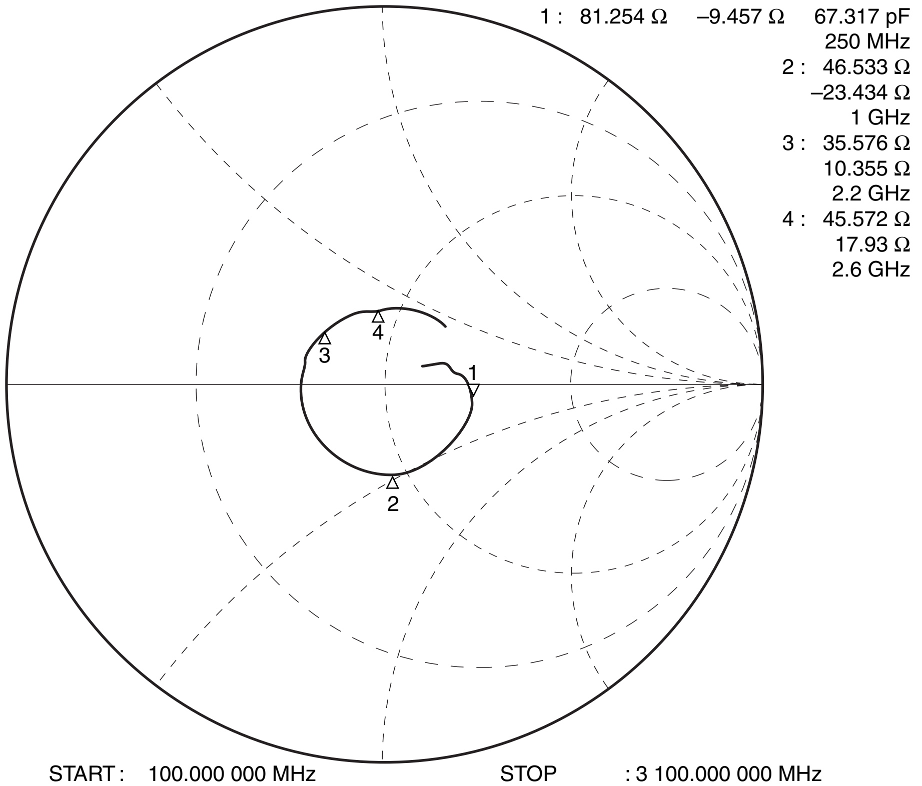
OUTPUT POWER, 2ND HARMONIC,
3RD HARMONIC vs. INPUT POWER



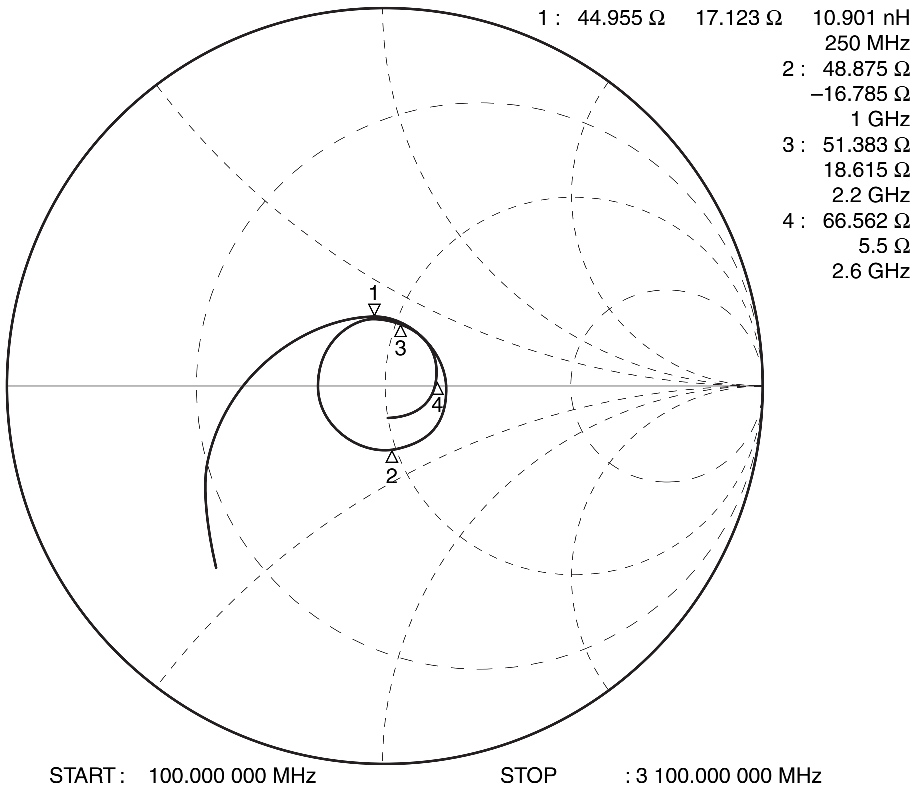
Remark The graphs indicate nominal characteristics.

S-PARAMETERS (T_A = +25°C, V_{DD} = V_{CC} = 5.0 V, P_{in} = –35 dBm)

S_{11}–FREQUENCY



S_{22}–FREQUENCY



S-PARAMETERS

S-parameters/Noise parameters are provided on our web site in a form (S2P) that enables direct import to a microwave circuit simulator without keyboard input.

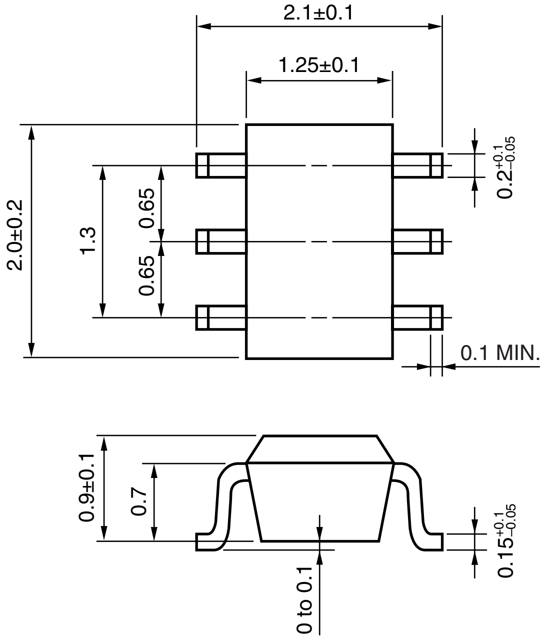
Click here to download S-parameters.

[RF and Microwave] → [Device Parameters]

URL http://www.ncsd.necel.com/microwave/index.html

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

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

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