

BIPOLAR ANALOG INTEGRATED CIRCUIT

μ PC3215TB

5 V, SUPER MINIMOLD SILICON MMIC WIDEBAND AMPLIFIER

DESCRIPTION

The μ PC3215TB is a silicon monolithic IC designed as wideband amplifier. The μ PC3215TB is suitable to systems required wideband operation from HF to L band.

This IC is manufactured using NEC's 30 GHz f_{max} UHS0 (Ultra High Speed Process) silicon bipolar process. The package is 6-pin super minimold suitable for surface mount.

FEATURES

- Wideband response : $f_u = 2.9$ GHz TYP. @3 dB bandwidth
- Noise figure : NF = 2.3 dB TYP. @f = 1.5 GHz
- Power gain : $G_P = 20.5$ dB TYP. @f = 1.5 GHz
- Supply voltage : $V_{CC} = 4.5$ to 5.5 V
- High-density surface mounting: 6-pin super minimold package

APPLICATION

- Systems required wideband operation from HF to L band

ORDERING INFORMATION

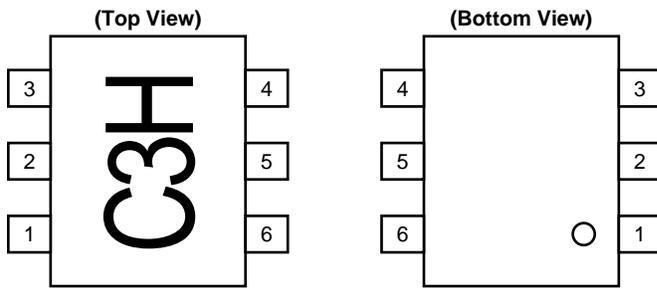
Part Number	Package	Marking	Supplying Form
μ PC3215TB-E3	6-pin super minimold	C3H	Embossed tape 8 mm wide. 1, 2, 3 pins face the perforation side of the tape. Qty 3 kpcs/reel.

Remark To order evaluation samples, please contact your local NEC sales office. (Part number for sample order: μ PC3215TB)

Caution Electro-static sensitive devices

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 devices/types available in every country. Please check with local NEC representative for availability and additional information.

PIN CONNECTIONS



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

PRODUCT LINE-UP OF 5V-BIAS SILICON MMIC WIDEBAND AMPLIFIERS

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

Part No.	f _u (GHz)	P _{O (sat)} (dBm)	G _P (dB)	NF (dB)	I _{CC} (mA)	Package	Marking
μ PC2711T	2.9	+1.0	13	5.0 @f = 1 GHz	12	6-pin minimold	C1G
μ PC2711TB						6-pin super minimold	
μ PC2712T	2.6	+3.0	20	4.5 @f = 1 GHz	12	6-pin minimold	C1H
μ PC2712TB						6-pin super minimold	
μ PC3210TB	2.3	+3.5	20	3.4 @f = 1.5 GHz	15	6-pin super minimold	C2X
μ PC3215TB	2.9	+3.5	20.5	2.3 @f = 1.5 GHz	14	6-pin super minimold	C3H

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

Caution The package size distinguishes between minimold and super minimold.

PIN EXPLANATION

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V) ^{Note}	Function and Applications	Internal Equivalent Circuit
1	INPUT	—	0.82	Signal input pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wideband. A multi-feedback circuit is designed to cancel the deviations of h_{FE} and resistance. This pin must be coupled to signal source with capacitor for DC cut.	
2 3 5	GND	0	—	Ground pin. This pin should be connected to system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible. All the ground pins must be connected together with wide ground pattern to decrease impedance difference.	
4	OUTPUT	—	3.8	Signal output pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wideband. This pin must be coupled to next stage with capacitor for DC cut.	
6	V _{CC}	4.5 to 5.5	—	Power supply pin. This pin should be externally equipped with bypass capacitor to minimize ground impedance.	

Note Pin voltage is measured at V_{CC} = 5.0 V

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V _{CC}	T _A = +25°C	6.0	V
Circuit Current	I _{CC}	T _A = +25°C	30	mA
Input Power	P _{in}	T _A = +25°C	+10	dBm
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

Note Mounted on 50 × 50 × 1.6-mm epoxy glass PWB, with copper patterning on both sides.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V _{CC}	4.5	5.0	5.5	V
Operating Ambient Temperature	T _A	-40	+25	+85	°C
Input Power	P _{in}	-	-	0	dBm
Input Frequency	f _{in}	0.1	-	2.9	GHz

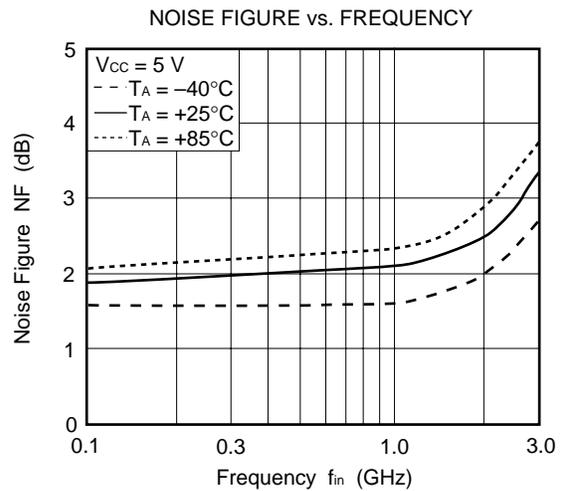
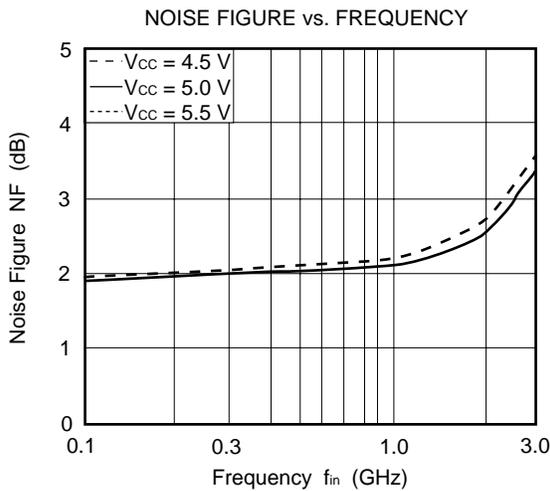
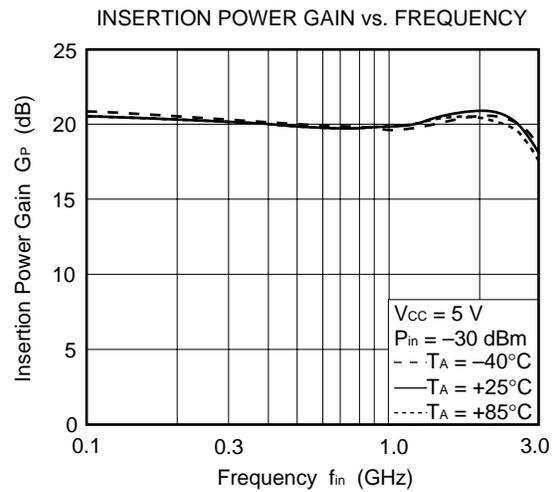
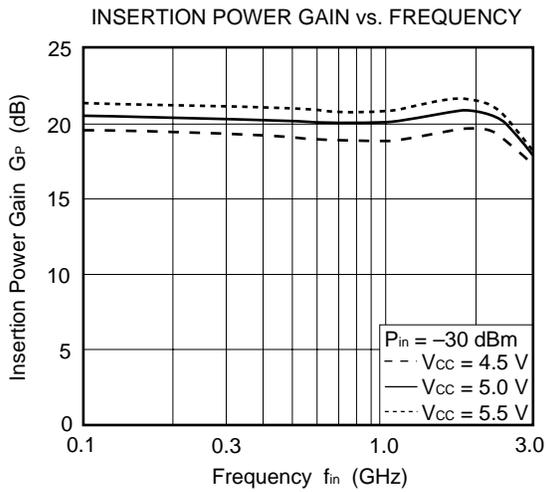
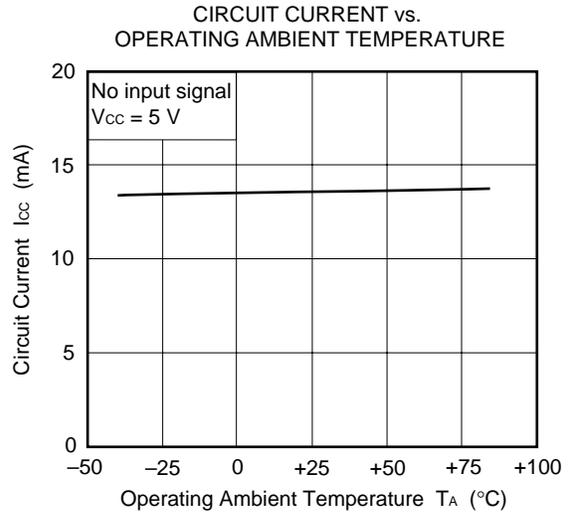
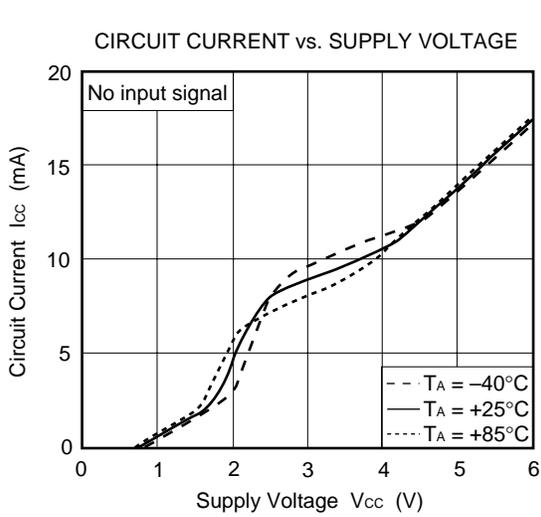
ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_{CC} = 5.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I _{CC}	No input signals	10.5	14.0	17.5	mA
Power Gain	G _P	f = 1.5 GHz, P _{in} = -30 dBm	18.5	20.5	-	dB
Noise Figure	NF	f = 1.5 GHz	-	2.3	3.0	dB
Upper Limit Operating Frequency	f _u	3 dB down below from gain at f = 0.1 GHz	2.5	2.9	-	GHz
Isolation	ISL	f = 1.5 GHz, P _{in} = -30 dBm	39	44	-	dB
Input Return Loss	RL _{in}	f = 1.5 GHz, P _{in} = -30 dBm	10	15	-	dB
Output Return Loss	RL _{out}	f = 1.5 GHz, P _{in} = -30 dBm	6.5	9.5	-	dB
1 dB Compression Point	P-1		-4	-1.5	-	dBm

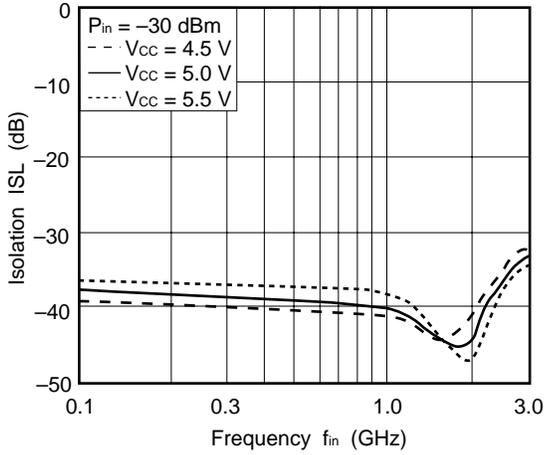
STANDARD CHARACTERISTICS (T_A = +25°C, V_{CC} = 5.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Test Conditions	Reference Values	Unit
Saturated Output Power	P _{O(sat)}	P _{in} = 0 dBm	+3.5	dBm
Output Intercept Point	OIP ₃	f ₁ = 1.5 GHz, f ₂ = 1.501 GHz	+10	dBm
Gain Flatness	ΔG _P	f = 0.1 to 2.15 GHz	1.0	dB

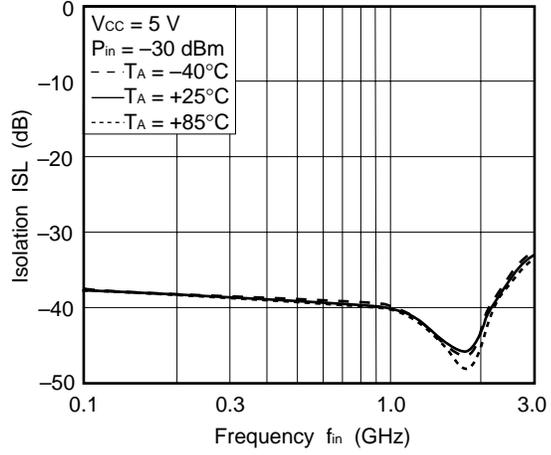
★ TYPICAL CHARACTERISTICS (Unless otherwise specified, $T_A = +25^\circ\text{C}$)



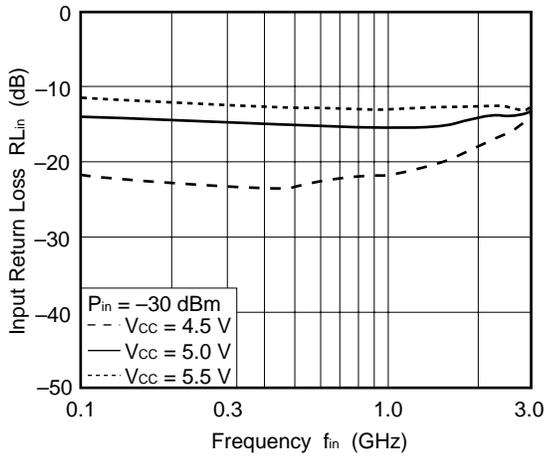
ISOLATION vs. FREQUENCY



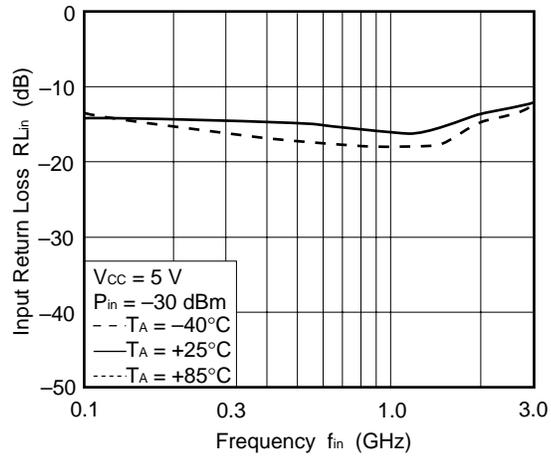
ISOLATION vs. FREQUENCY



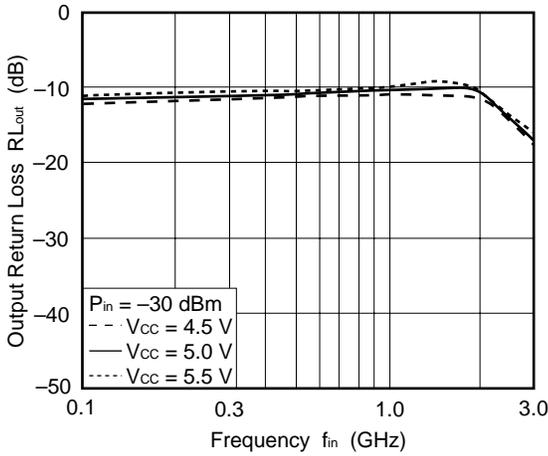
INPUT RETURN LOSS vs. FREQUENCY



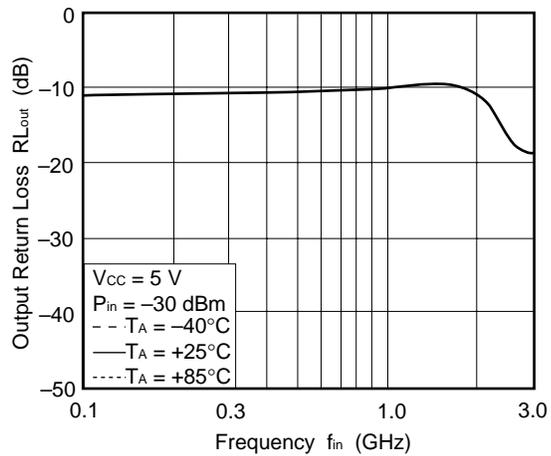
INPUT RETURN LOSS vs. FREQUENCY

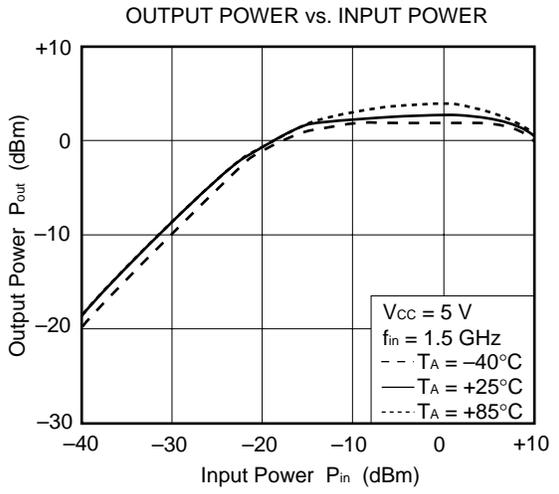
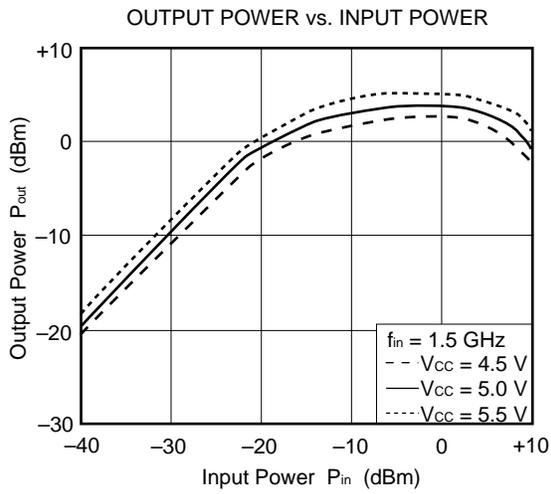
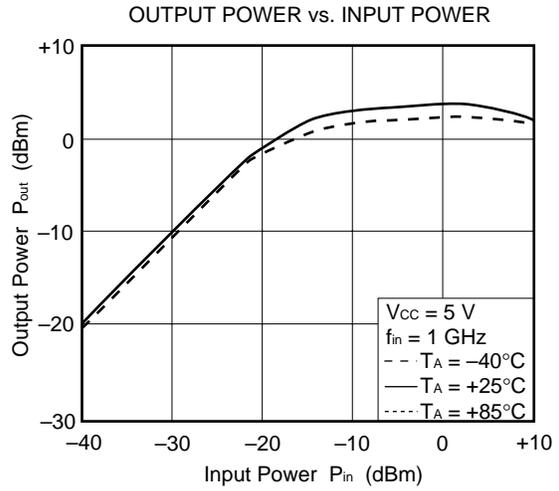
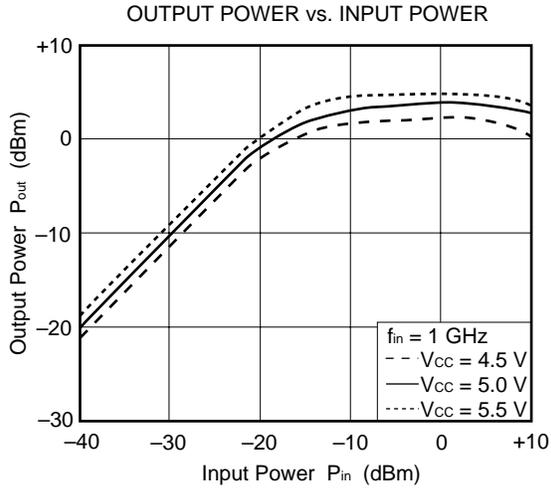


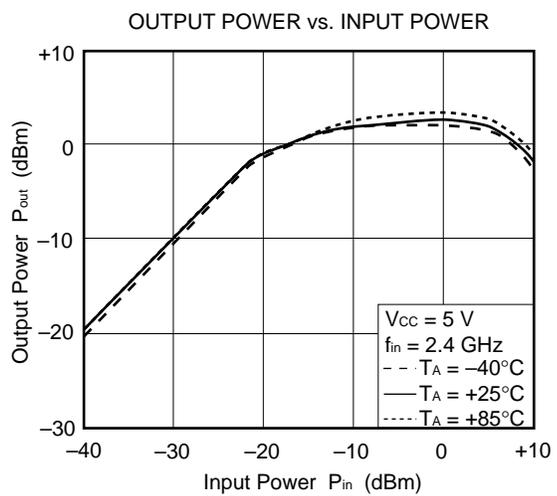
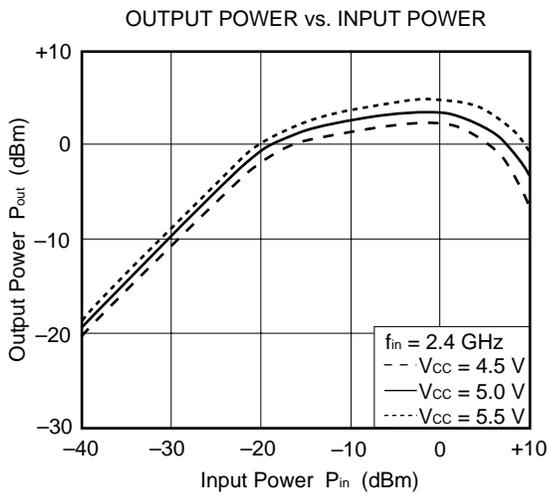
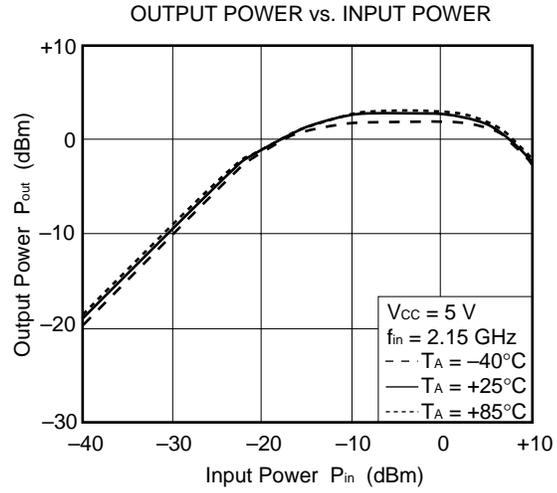
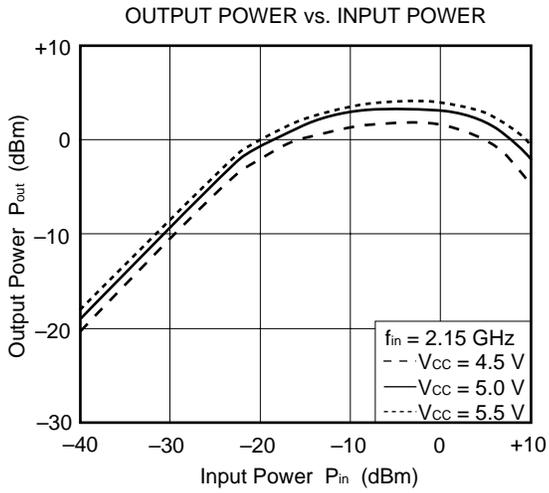
OUTPUT RETURN LOSS vs. FREQUENCY



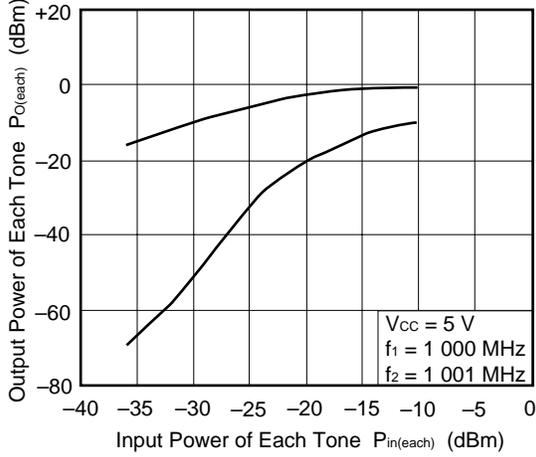
OUTPUT RETURN LOSS vs. FREQUENCY



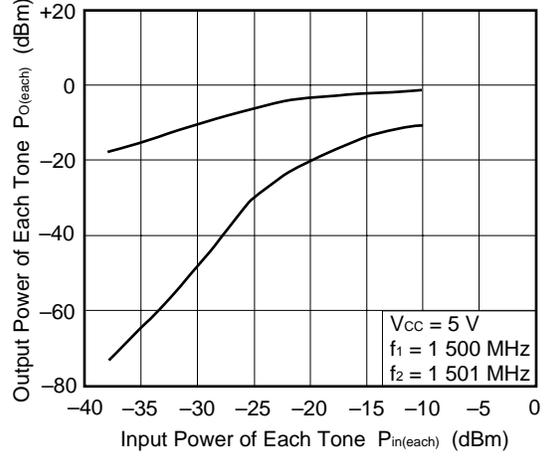




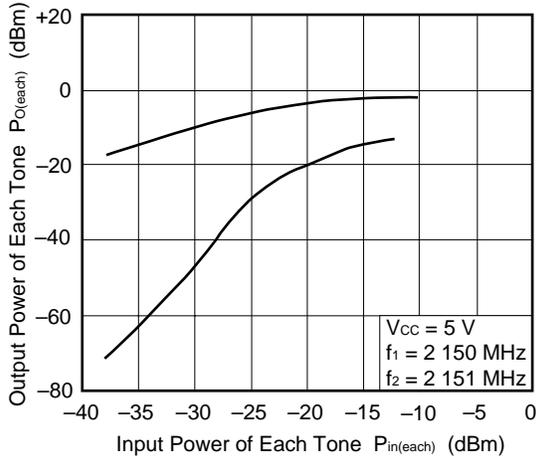
OUTPUT POWER OF EACH TONE vs.
INPUT POWER OF EACH TONE



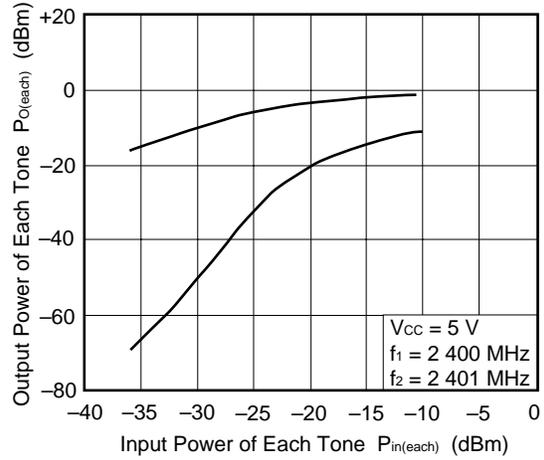
OUTPUT POWER OF EACH TONE vs.
INPUT POWER OF EACH TONE



OUTPUT POWER OF EACH TONE vs.
INPUT POWER OF EACH TONE



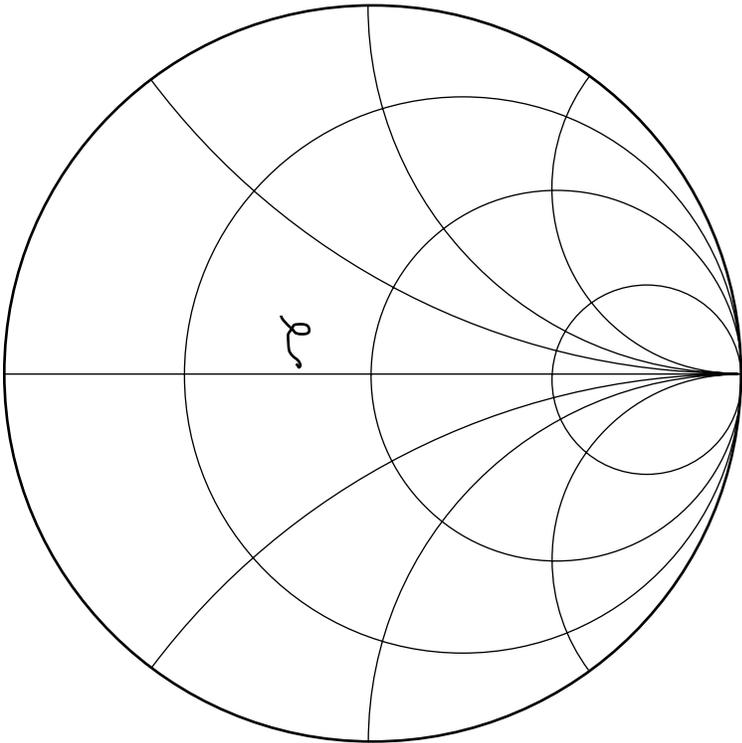
OUTPUT POWER OF EACH TONE vs.
INPUT POWER OF EACH TONE



Remark The graphs indicate nominal characteristics.

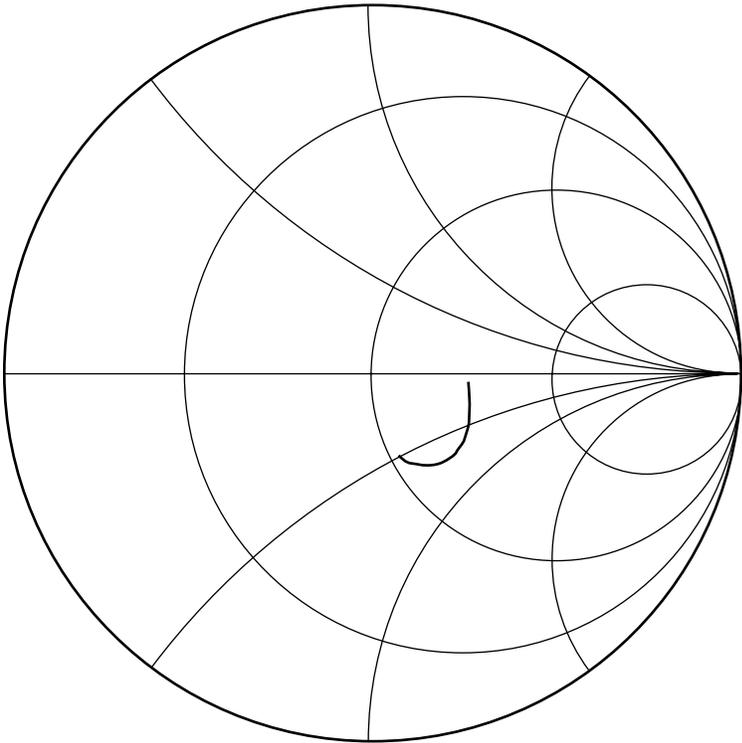
★ S-PARAMETERS ($T_A = +25^\circ\text{C}$, $V_{CC} = 5\text{ V}$)

S₁₁-FREQUENCY



START 0.10000000 GHz
STOP 3.10000000 GHz

S₂₂-FREQUENCY



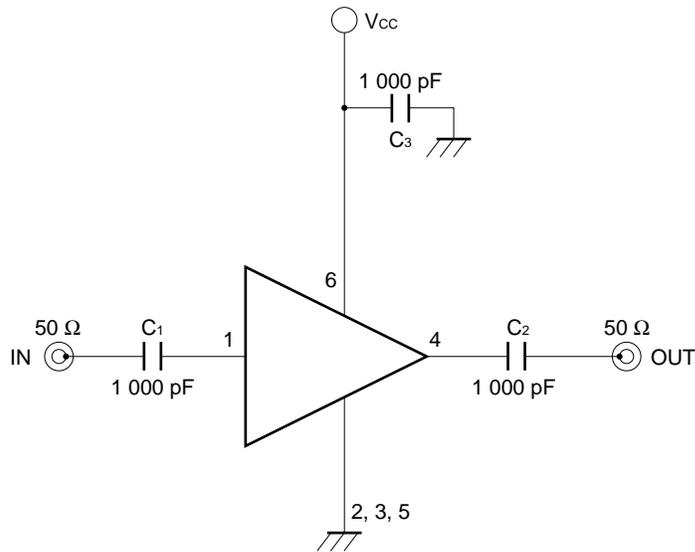
START 0.10000000 GHz
STOP 3.10000000 GHz

★ TYPICAL S-PARAMETER VALUES (T_A = +25°C)

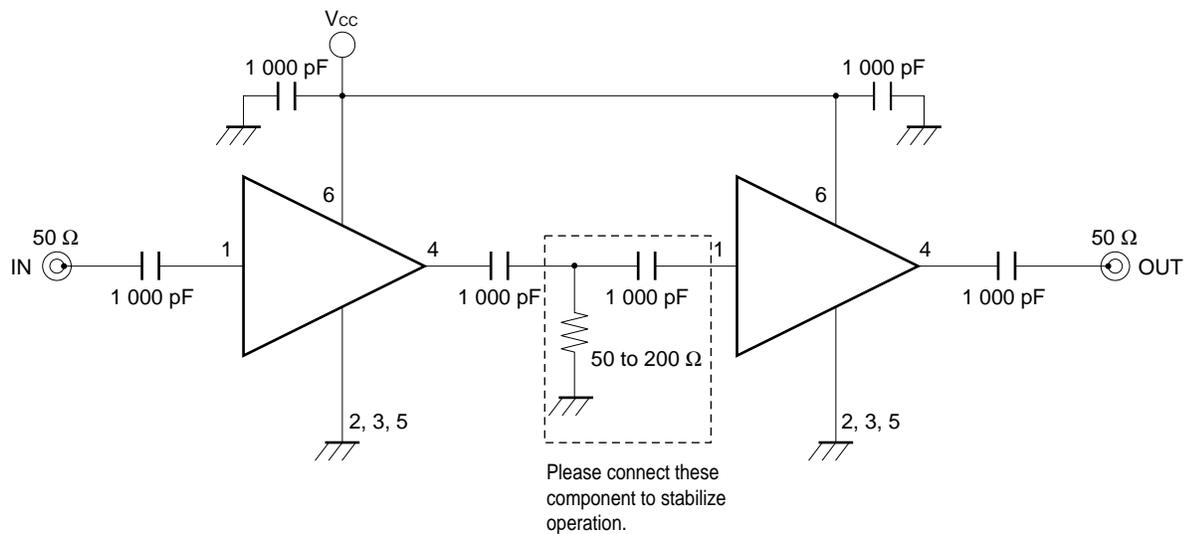
V_{CC} = 5.0 V, I_{CC} = 16 mA

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	
100.0000	0.207	174.1	10.788	-4.6	0.013	6.3	0.285	-3.3	3.38
200.0000	0.190	173.1	10.714	-9.8	0.013	-0.5	0.282	-3.7	3.39
300.0000	0.186	174.3	10.565	-14.3	0.013	2.7	0.283	-4.6	3.37
400.0000	0.192	173.8	10.359	-18.3	0.014	4.7	0.285	-6.2	3.92
500.0000	0.200	174.5	10.225	-21.7	0.013	5.3	0.286	-7.6	3.96
600.0000	0.201	173.0	10.116	-24.9	0.013	2.1	0.286	-8.8	3.69
700.0000	0.204	173.0	10.116	-28.0	0.011	1.6	0.288	-10.4	3.91
800.0000	0.206	172.4	10.122	-31.1	0.011	12.9	0.289	-11.7	4.17
900.0000	0.210	172.7	10.186	-34.5	0.011	5.1	0.290	-13.5	3.99
1000.0000	0.212	171.4	10.182	-37.7	0.009	4.1	0.295	-14.9	4.28
1100.0000	0.218	169.4	10.208	-41.6	0.011	4.9	0.299	-16.8	4.19
1200.0000	0.217	168.4	10.296	-45.6	0.009	11.0	0.300	-18.0	4.65
1300.0000	0.221	165.9	10.248	-49.7	0.006	20.5	0.299	-20.2	5.78
1400.0000	0.228	164.7	10.438	-53.9	0.008	1.6	0.307	-23.1	6.97
1500.0000	0.233	162.3	10.369	-58.0	0.006	25.7	0.310	-24.8	6.80
1600.0000	0.238	159.5	10.554	-62.7	0.005	31.6	0.316	-27.5	11.54
1700.0000	0.244	157.2	10.492	-67.2	0.004	48.5	0.317	-30.5	11.75
1800.0000	0.246	153.9	10.483	-72.2	0.003	87.2	0.318	-33.3	13.52
1900.0000	0.248	150.6	10.408	-76.9	0.004	93.4	0.323	-36.9	8.46
2000.0000	0.246	147.4	10.405	-82.2	0.007	114.5	0.323	-40.6	7.46
2100.0000	0.241	144.9	10.267	-87.2	0.008	115.4	0.319	-44.9	6.20
2200.0000	0.236	142.2	10.039	-92.7	0.011	124.0	0.312	-48.9	4.50
2300.0000	0.229	142.2	9.896	-97.7	0.012	121.6	0.306	-52.6	4.12
2400.0000	0.219	143.5	9.684	-102.4	0.014	124.9	0.292	-56.3	3.40
2500.0000	0.215	145.7	9.348	-107.5	0.015	117.8	0.279	-59.3	3.42
2600.0000	0.213	149.3	9.068	-112.0	0.018	117.3	0.270	-61.7	3.02
2700.0000	0.221	150.1	8.673	-116.6	0.017	114.4	0.256	-63.7	3.17
2800.0000	0.234	151.3	8.437	-121.1	0.020	114.0	0.248	-65.1	2.85
2900.0000	0.253	152.1	8.080	-124.9	0.021	111.6	0.237	-67.3	2.98
3000.0000	0.264	150.7	7.791	-129.4	0.020	112.5	0.232	-68.0	2.90
3100.0000	0.283	148.7	7.458	-132.7	0.022	113.7	0.229	-70.2	3.02

TEST CIRCUIT



EXAMPLE OF APPLICATION CIRCUIT



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

Capacitors for Vcc, input and output pins

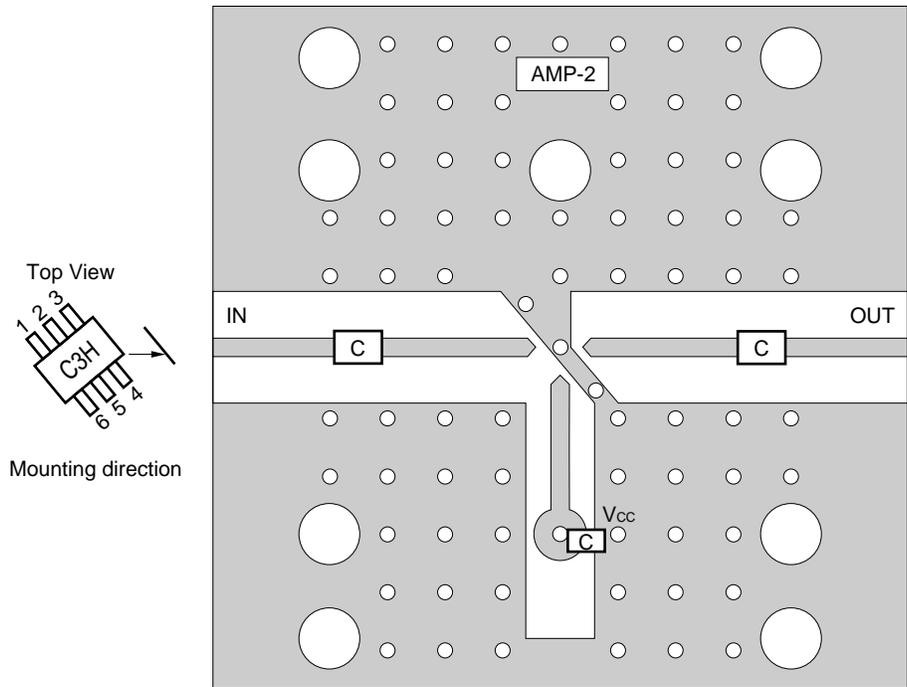
1 000 pF capacitors are recommendable as bypass capacitor for Vcc pin and coupling capacitors for input/output pins.

Bypass capacitor for Vcc pin is intended to minimize Vcc pin's ground impedance. Therefore, stable bias can be supplied against Vcc fluctuation.

Coupling capacitors for input/output pins are intended to minimize RF serial impedance and cut DC.

To get flat gain from 100 MHz up, 1 000 pF capacitors are assembled on the test circuit. [Actually, 1 000 pF capacitors give flat gain at least 10 MHz. In the case of under 10 MHz operation, increase the value of coupling capacitor such as 2 200 pF. Because the coupling capacitors are determined by the equation of $C = 1/(2 \pi fZs)$.]

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

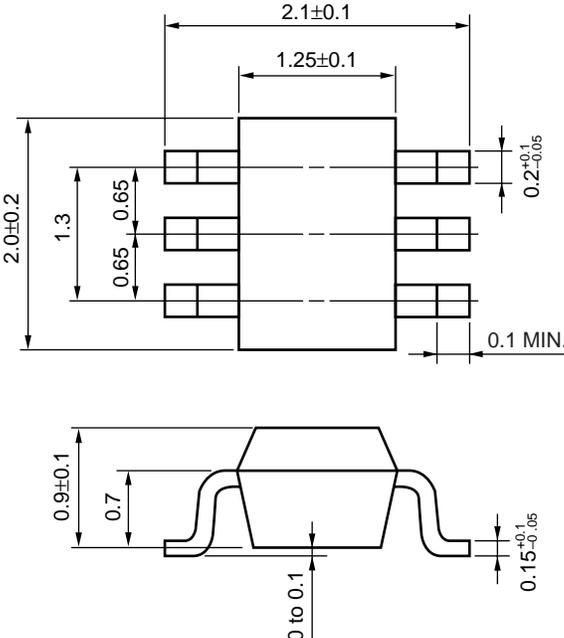
	Value
C	1 000 pF

Notes

1. 30 × 30 × 0.4 mm double sided copper clad polyimide board.
2. Back side: GND pattern
3. Solder plated on pattern
4. ○ ○ : Through holes

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).
- (3) Keep the track length of the ground pins as short as possible.
- (4) A low pass filter must be attached to Vcc line.

RECOMMENDED SOLDERING CONDITIONS

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

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared Reflow	Package peak temperature: 235°C or below Time: 30 seconds or less (at 210°C) Count: 3, Exposure limit: None ^{Note}	IR35-00-3
VPS	Package peak temperature: 215°C or below Time: 40 seconds or less (at 200°C) Count: 3, Exposure limit: None ^{Note}	VP15-00-3
Wave Soldering	Soldering bath temperature: 260°C or below Time: 10 seconds or less Count: 1, Exposure limit: None ^{Note}	WS60-00-1
Partial Heating	Pin temperature: 300°C Time: 3 seconds or less (per side of device) Exposure limit: None ^{Note}	—

Note After opening the dry pack, keep it in a place below 25°C and 65% RH for the allowable storage period.

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

For details of recommended soldering conditions for surface mounting, refer to information document SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E).

- **The information in this document is current as of August, 2000. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.**
 - No part of this document may be copied or reproduced in any form or by any means without prior written consent of NEC. NEC assumes no responsibility for any errors that may appear in this document.
 - NEC does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from the use of NEC semiconductor products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC or others.
 - Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of customer's equipment shall be done under the full responsibility of customer. NEC assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
 - While NEC endeavours to enhance the quality, reliability and safety of NEC semiconductor products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC semiconductor products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment, and anti-failure features.
 - NEC semiconductor products are classified into the following three quality grades:
"Standard", "Special" and "Specific". The "Specific" quality grade applies only to semiconductor products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of a semiconductor product depend on its quality grade, as indicated below. Customers must check the quality grade of each semiconductor product before using it in a particular application.
 - "Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots
 - "Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)
 - "Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.
- The quality grade of NEC semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.
- (Note)
- (1) "NEC" as used in this statement means NEC Corporation and also includes its majority-owned subsidiaries.
 - (2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).