NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2713T

5 V, SILICON MMIC VHF-UHF WIDEBAND AMPLIFIER

DESCRIPTION

The μPC2713T is a silicon monolithic integrated circuit designed as 2nd IF buffer amplifier for DBS tuners.

This IC is manufactured using NEC's 20 GHz f_T NESAT™ III silicon bipolar process. This process uses silicon nitride passivation film and gold electrodes. The material can protect chip surface from external pollution and prevent corrosion/migration. Thus, this IC has excellent performance, uniformity and reliability.

FEATURES

- Supply voltage : V_{CC} = 4.5 to 5.5 V
- Circuit current : I_{CC} = 12 mA TYP. @ V_{CC} = 5.0 V
- High power gain : G_P = 29 dB TYP. @ f = 500 MHz
- Saturated output power : $P_{O(sat)}$ = +7 dBm TYP. @ f = 500 MHz
- Noise figure : NF = 3.2 dB TYP. @ f = 500 MHz
- Upper limit operating frequency : f_u = 1.2 GHz TYP. @ 3 dB bandwidth
- Port impedance : input/output 50 Ω

★ APPLICATION

- 400 MHz band 2nd IF buffer amplifiers in DBS tuners (2nd IF frequency converter block), etc.

ORDERING INFORMATION

Part Number	Package	Marking	Supplying Form
μPC2713T-E3	6-pin minimold	C1J	• Embossed tape 8 mm wide • 1, 2, 3 pins face the perforation side of the tape • Qty 3 kpcs/reel

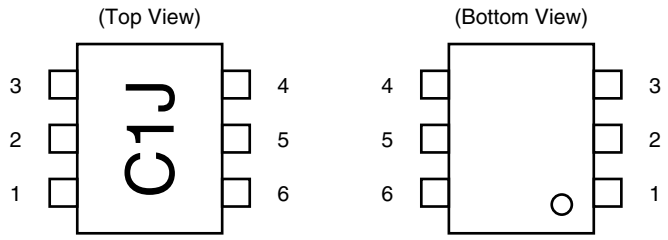
Remark To order evaluation samples, please contact your local NEC sales office.
Prt number of sample order: μPC2713T

Caution Electro-static sensitive devices

Document No. P12430EJ3V0DS00 (3rd edition)
Date Published April 2001 N CP(K)
Printed in Japan

The mark ★ shows major revised points.

★ PIN CONNECTIONS



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

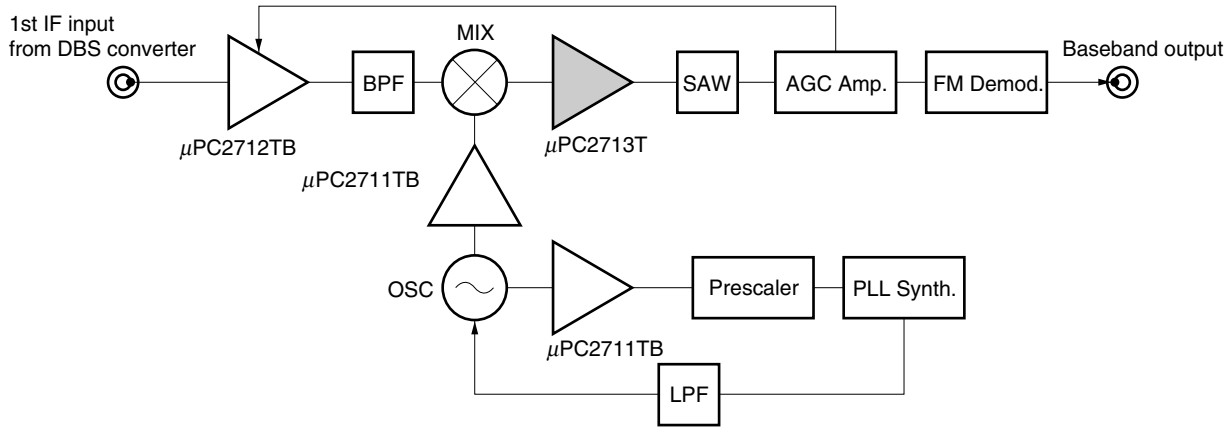
★ PRODUCT LINE-UP (T_A = +25°C, V_{CC} = 5.0 V, Z_S = Z_L = 50 Ω)

Part Number	f_u (GHz)	$P_{O(sat)}$ (dBm)	G_P (dB)	NF (dB)	I_{CC} (mA)	Package	Marking
μPC2713T	1.2	+7.0	29	3.2	12	6-pin minimold	C1J
μPC1675G	1.9	+4.0	12	5.5	17	4-pin minimold	C1A
μPC2791TB						6-pin super minimold	C2S
μPC1688G	1.1	+4.0	21	4.0	19	4-pin minimold	C1C
μPC1676G	1.2	+5.5	22	4.5	19	4-pin minimold	C1B
μPC2792TB		+5.0	20	3.5		6-pin super minimold	C2T
μPC2711T	2.9	+1.0	13	5.0	12	6-pin minimold	C1G
μPC2711TB						6-pin super minimold	
μPC2712T	2.6	+3.0	20	4.5	12	6-pin minimold	C1H
μPC2712TB						6-pin super minimold	
μPC3215TB	2.9	+3.5	20.5	2.3	14	6-pin super minimold	C3H

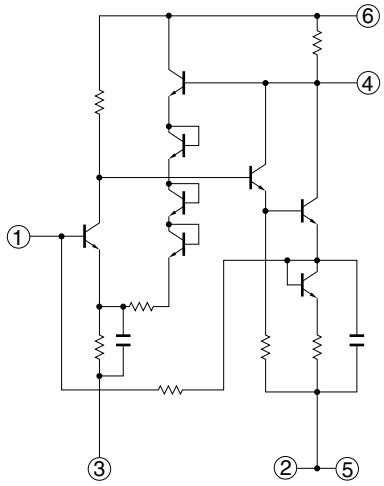
Remark Typical performance. Please refer to ELECTRICAL CHARACTERISTICS in detail.

★ SYSTEM APPLICATION EXAMPLE

EXAMPLE OF DBS TUNERS (2ND FREQUENCY CONVERTER BLOCK)



★ PIN EXPLANATION

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V)[Note]	Function and Applications	Internal Equivalent Circuit
1	INPUT	–	0.86	Signal input pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wide band. A multi-feedback circuit is designed to cancel the deviations of h_{FE} and resistance. This pin must be coupled to front stage 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	–	4.26	Signal output pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wide band. A multi-feedback circuit is designed to cancel the deviations of h_{FE} and resistance. This pin must be coupled to front 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	V
Circuit Current	I_{CC}	T_A = +25°C	30	mA
Power Dissipation	P_D	T_A = +85°C **Note**	280	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	+10	dBm

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

RECOMMENDED OPERATING RANGE

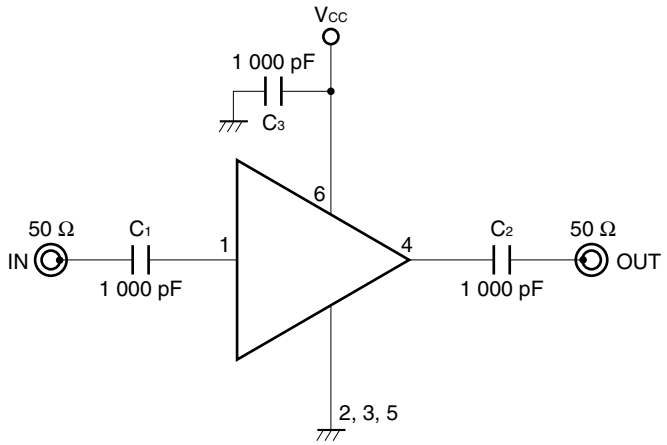
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V

ELECTRICAL CHARACTERISTICS

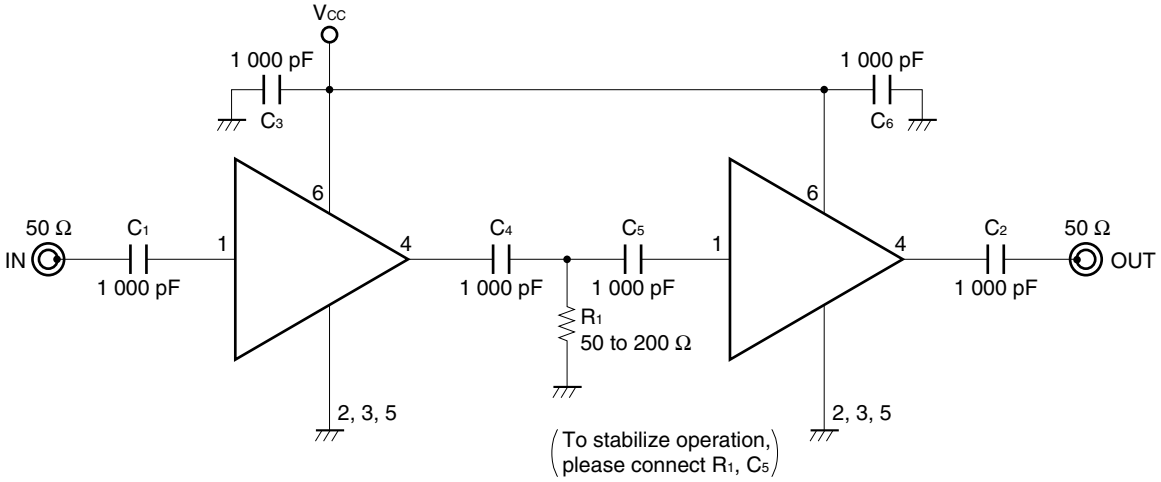
(Unless otherwise specified, T_A = +25°C, V_{CC} = 5.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I_{CC}	No signal	9.0	12.0	15.0	mA
Power Gain	G_P	f = 500 MHz	26.0	29.0	33.0	dB
Saturated Output Power	$P_{O(sat)}$	f = 500 MHz, P_{in} = 0 dBm	+4.0	+7.0	–	dBm
Noise Figure	NF	f = 500 MHz	–	3.2	4.5	dB
Upper Limit Operating Frequency	f_u	3 dB down from gain at f = 0.1 GHz	0.9	1.2	–	GHz
Isolation	ISL	f = 500 MHz	35	40	–	dB
Input Return Loss	RL_{in}	f = 500 MHz	10	13	–	dB
Output Return Loss	RL_{out}	f = 500 MHz	6	9	–	dB
Gain Flatness	ΔG_P	f = 0.1 to 0.8 GHz	–	±0.8	–	dB

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 V_{CC}, input and output pins

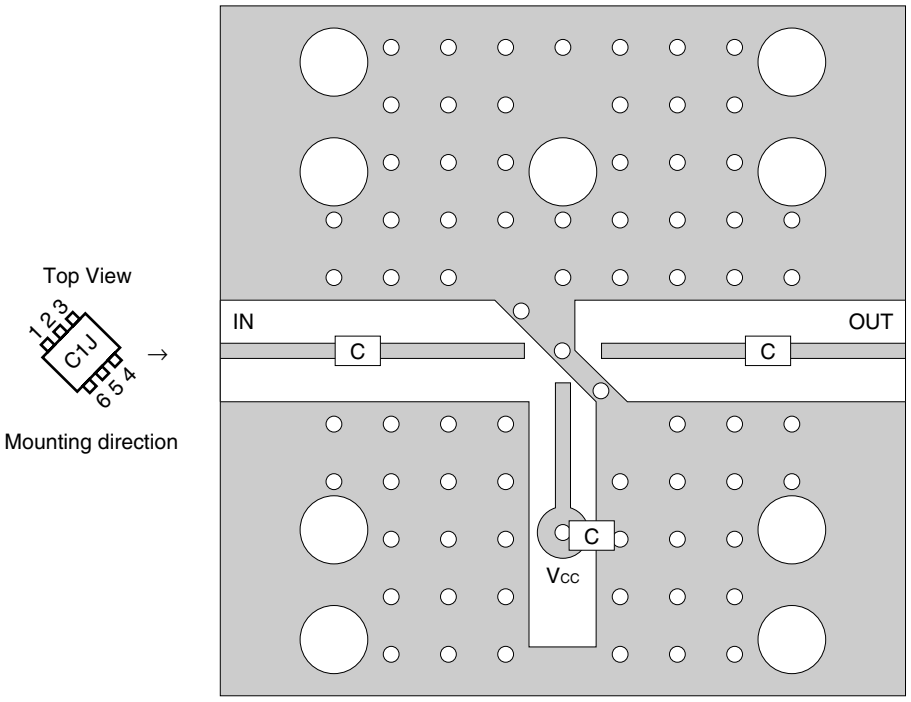
1 000 pF capacitors are recommendable as bypass capacitor for V_{CC} pin and coupling capacitors for input/output pins.

Bypass capacitor for V_{CC} pin is intended to minimize V_{CC} pin's ground impedance. Therefore, stable bias can be supplied against V_{CC} 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

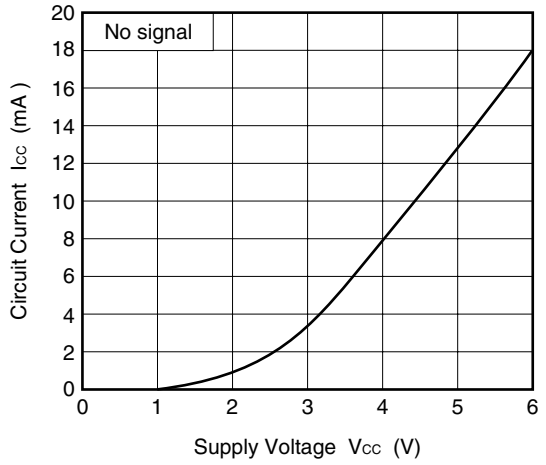
	Value
C	1 000 pF

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

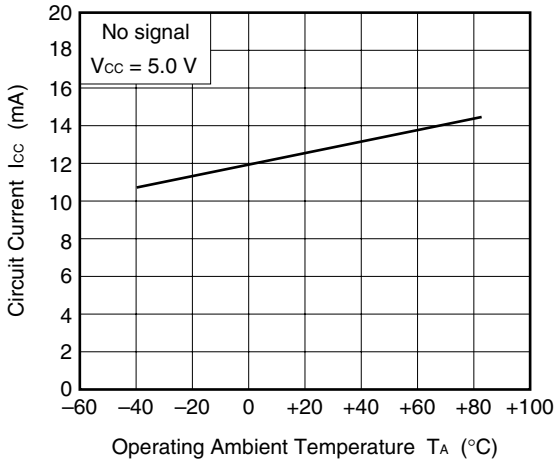
For more information on the use of this IC, refer to the following application note: **USAGE AND APPLICATIONS OF 6-PIN MINI-MOLD, 6-PIN SUPER MINI-MOLD SILICON HIGH-FREQUENCY WIDEBAND AMPLIFIER MMIC (P11976E)**.

TYPICAL CHARACTERISTICS (Unless otherwise specified, T_A = +25°C)

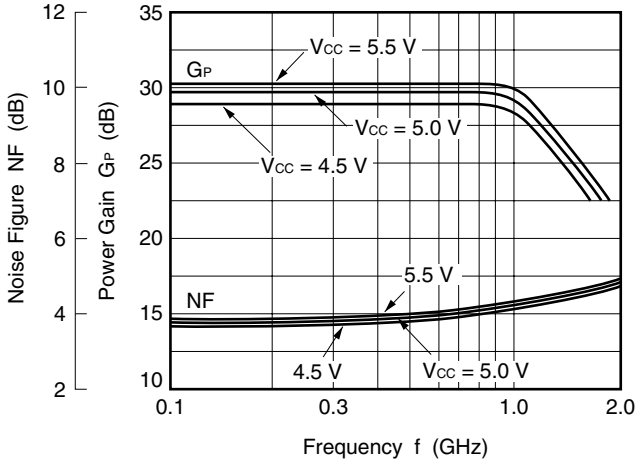
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



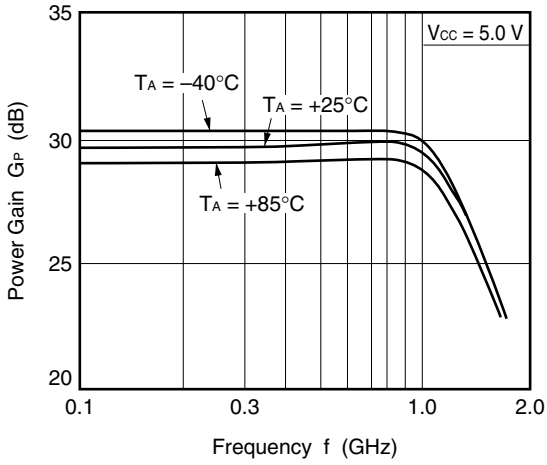
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



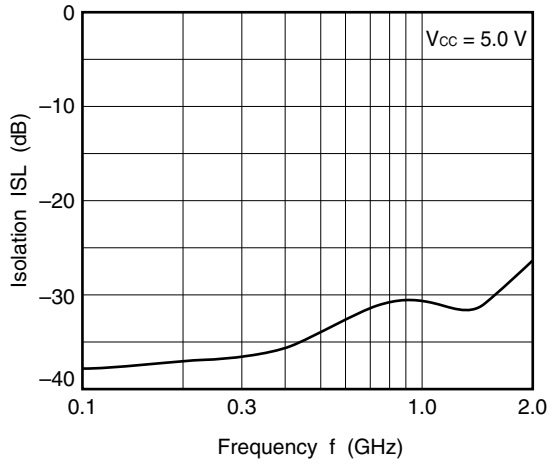
NOISE FIGURE, POWER GAIN vs. FREQUENCY



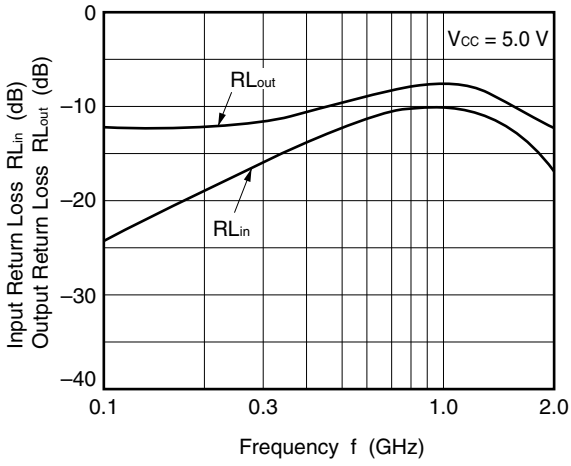
POWER GAIN vs. FREQUENCY



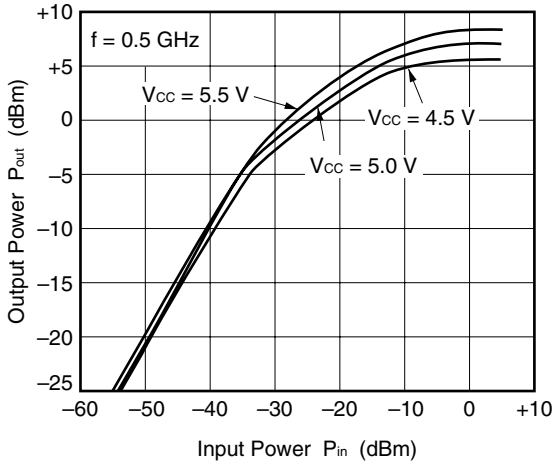
ISOLATION vs. FREQUENCY



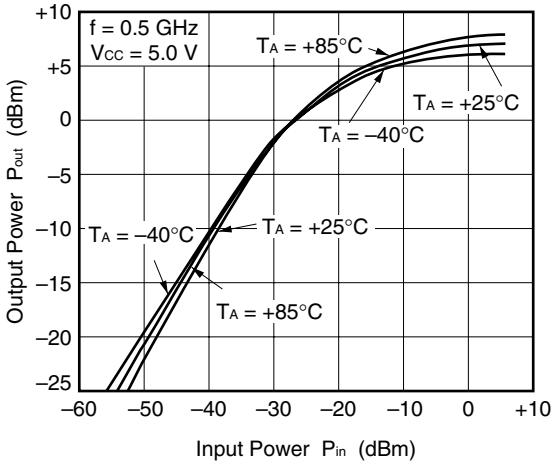
INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



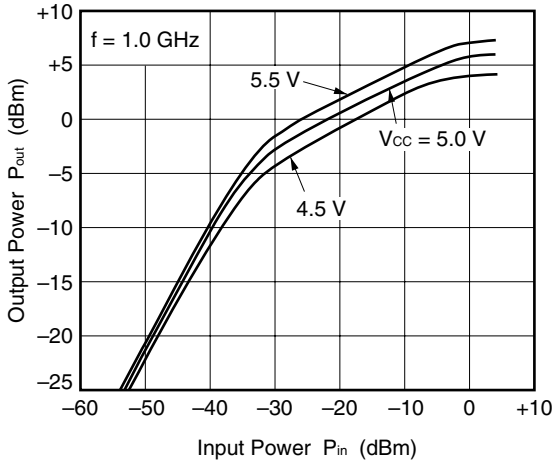
OUTPUT POWER vs. INPUT POWER



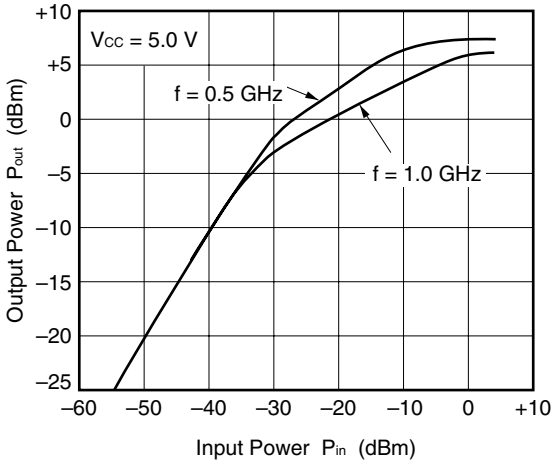
OUTPUT POWER vs. INPUT POWER



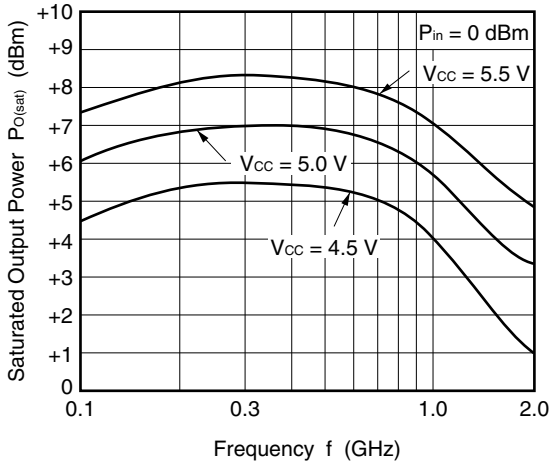
OUTPUT POWER vs. INPUT POWER



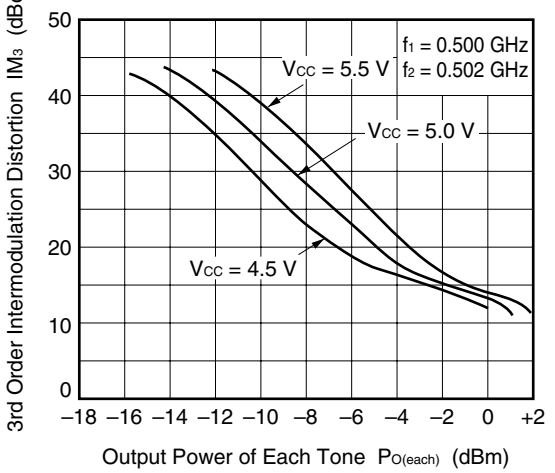
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY



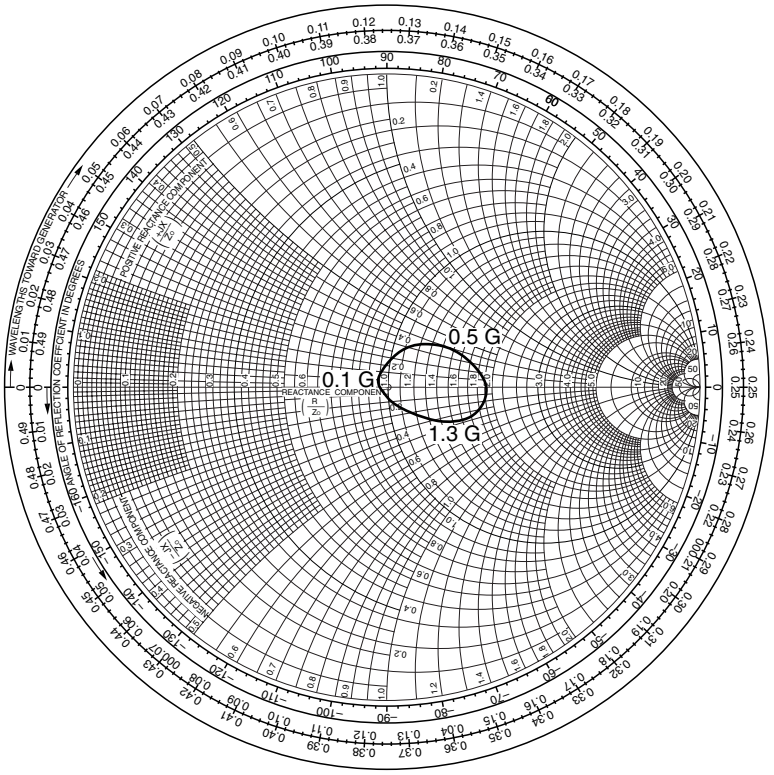
3RD ORDER INTERMODULATION DISTORTION vs. OUTPUT POWER OF EACH TONE



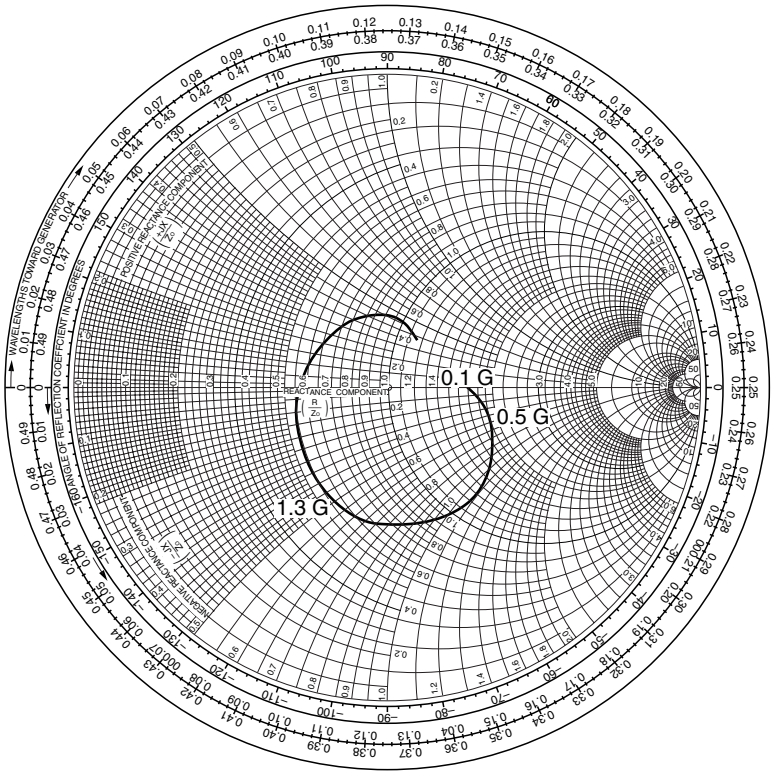
Remark The graphs indicate nominal characteristics.

S-PARAMETERS (T_A = +25°C, V_{CC} = 5.0 V)

S_{11}-FREQUENCY



S_{22}-FREQUENCY



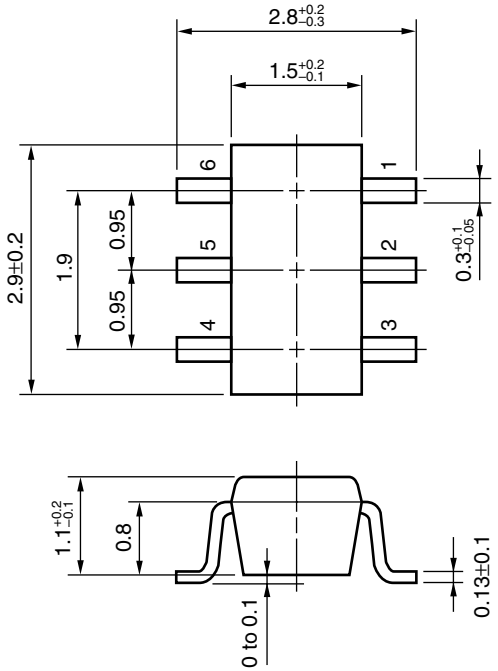
★ TYPICAL S-PARAMETER VALUES (T_A = +25°C)

V_{CC} = 5.0 V, I_{CC} = 12 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	
100.0000	0.350	–21.8	21.9	–8.1	0.006	25.6	0.286	–10.3	3.07
200.0000	0.290	–33.1	22.0	–25.3	0.006	24.9	0.298	–16.1	3.17
300.0000	0.243	–41.7	22.1	–37.3	0.007	23.7	0.313	–25.6	2.77
400.0000	0.207	–47.3	22.3	–48.6	0.007	22.4	0.327	–35.2	2.78
500.0000	0.185	–50.5	22.4	–60.0	0.007	21.6	0.336	–45.4	2.78
600.0000	0.176	–54.0	22.6	–72.7	0.008	20.1	0.348	–56.9	2.41
700.0000	0.161	–57.5	22.8	–85.7	0.008	19.0	0.359	–69.0	2.39
800.0000	0.148	–60.2	22.9	–100.7	0.009	18.3	0.366	–82.9	2.13
900.0000	0.127	–63.9	22.8	–114.8	0.009	17.2	0.366	–96.8	2.15
1000.0000	0.111	–62.9	22.3	–132.0	0.009	16.4	0.359	–111.8	2.23
1100.0000	0.097	–56.5	21.6	–147.6	0.010	15.7	0.343	–126.8	2.12
1200.0000	0.095	–48.2	20.6	–163.1	0.010	14.4	0.320	–142.3	2.24
1300.0000	0.098	–40.1	18.9	–177.8	0.010	13.1	0.291	–156.6	2.47
1400.0000	0.110	–35.7	17.6	168.3	0.010	12.0	0.263	–171.7	2.68
1500.0000	0.129	–34.6	15.6	154.8	0.011	11.8	0.234	174.3	2.77
1600.0000	0.145	–36.2	14.2	142.7	0.012	11.2	0.208	160.8	2.81
1700.0000	0.161	–40.0	12.6	130.5	0.013	10.8	0.185	147.1	2.92
1800.0000	0.179	–44.7	11.4	120.9	0.014	9.8	0.164	132.6	3.02
1900.0000	0.191	–50.3	10.2	110.1	0.015	7.5	0.148	119.5	3.15
2000.0000	0.197	–56.1	9.3	100.8	0.016	5.5	0.137	107.4	3.23

★ **PACKAGE DIMENSIONS**

6-PIN MINIMOLD (UNIT: mm)



★ NOTES ON CORRECT USE

(1) Observe precautions for handiling 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 pins must be connected together with wide ground pattern to decrease impedance difference.

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

(4) The DC cut capacitor must be each attached to input pin and output pin.

★ 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 or below 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)**.

[MEMO]

[MEMO]

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