

### 3V-BIAS, 2.7 GHz/2.9 GHz WIDE-BAND SiMMIC AMPLIFIER FOR MOBILE COMMUNICATIONS

#### DESCRIPTION

$\mu$ PC2745T and  $\mu$ PC2749T are silicon monolithic integrated circuits designed as buffer amplifiers for mobile communications. These ICs feature 3V bias supply and 2.7 or 2.9 GHz wide band operation. 3 V supply operation is suitable for low voltage systems. 2.7 GHz or 2.9 GHz wide band operation is applicable for not only cellular/cordless telephones but also wireless LAN and so on. Due to the 50  $\Omega$  cascable and mini-mold package, these ICs are suitable for high-density surface mounting.

These ICs are manufactured using NEC's 20 GHz fr NESAT™ III silicon bipolar process. This process uses silicon nitride passivation film and gold electrodes. These materials can protect chip surface from external pollution and prevent corrosion/migration. Thus, this series have excellent performance, uniformity and reliability.

#### FEATURES

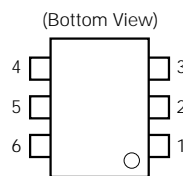
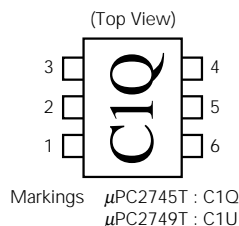
- Recommended supply voltage :  $V_{CC} = 3.0 \text{ V} \pm 0.3 \text{ V}$   
(minimum operation voltage :  $\mu$ PC2745T -  $V_{CC} = 1.8 \text{ V}$ ,  $\mu$ PC2749T -  $V_{CC} = 2.7 \text{ V}$ )
- Wide band operation :  $\mu$ PC2745T -  $G_P = 12 \text{ dB}$ ,  $f_u = 2.7 \text{ GHz}$   
 $\mu$ PC2749T -  $G_P = 16 \text{ dB}$ ,  $f_u = 2.9 \text{ GHz}$
- Noise Figure :  $\mu$ PC2745T -  $NF = 6.0 \text{ dB @ } 0.5 \text{ GHz}$ ,  $NF = 5.5 \text{ dB @ } 1.0 \text{ GHz}$   
 $\mu$ PC2749T -  $NF = 3.2 \text{ dB @ } 0.9 \text{ GHz}$ ,  $NF = 4.0 \text{ dB @ } 1.9 \text{ GHz}$
- Isolation :  $\mu$ PC2745T -  $ISL = 38 \text{ dB @ } 0.5 \text{ GHz}$   
 $\mu$ PC2749T -  $ISL = 30 \text{ dB @ } 1.9 \text{ GHz}$
- 50  $\Omega$  cascable : 50  $\Omega$  input/output impedance
- High-density surface mounting : 6 pin mini mold package

#### ORDERING INFORMATION

| PART NUMBER                          | PACKAGE         | SUPPLYING FORM   |
|--------------------------------------|-----------------|--|
| $\mu$ PC2745T-E3<br>$\mu$ PC2749T-E3 | 6 pin mini mold | Embossed tape 8 mm wide. Pin 1, 2, 3 face to perforation side of the tape.<br>QTY 3 kp/reel. |

**Caution** To order evaluation samples, please contact your local NEC sales office. (Part number:  $\mu$ PC2745T,  $\mu$ PC2749T)

#### PIN CONNECTION



| Pin No | Pin name |
|--------|----------|
| 1      | Input    |
| 2      | GND      |
| 3      | GND      |
| 4      | Output   |
| 5      | GND      |
| 6      | $V_{CC}$ |

**Caution** Electro-static sensitive devices

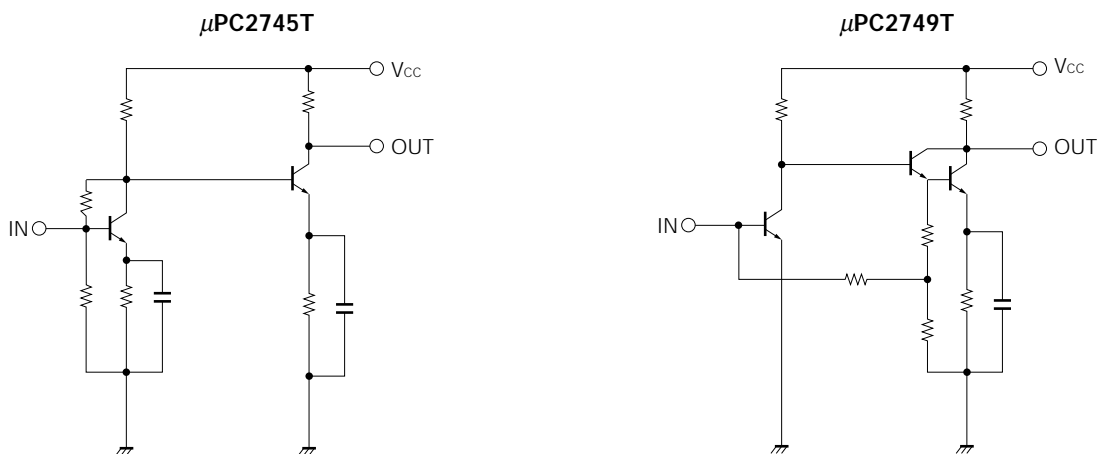
The information in this document is subject to change without notice.

**Selector Guide ( $T_A = +25\text{ }^\circ\text{C}$ ,  $Z_L = Z_s = 50\ \Omega$ )**

| TYPE            | PART NUMBER   | $V_{CC}$ (V)         | $I_{CC}$ (mA) | $G_P$ (dB) | $f_u$ (GHz) | NF (dB) | ISL (dB) | $P_{O(sat)}$ (dBm) |
|-----------------|---------------|----------------------|---------------|------------|-------------|---------|----------|--------------------|
| 5 V, 13 dB gain | $\mu$ PC2711T | 4.5 - 5.5            | 12            | 13         | 2.9         | 5.0     | 30       | +1                 |
| 5 V, 20 dB gain | $\mu$ PC2712T | 4.5 - 5.5            | 12            | 20         | 2.6         | 4.5     | 33       | +3                 |
| 3 V, 13 dB gain | $\mu$ PC2745T | (1.8 -)<br>2.7 - 3.3 | 7.5           | 12         | 2.7         | 6.0     | 38       | -1                 |
| 3 V, 16 dB gain | $\mu$ PC2749T | 2.7 - 3.3            | 6             | 16         | 2.9         | 4.0     | 30       | -6                 |

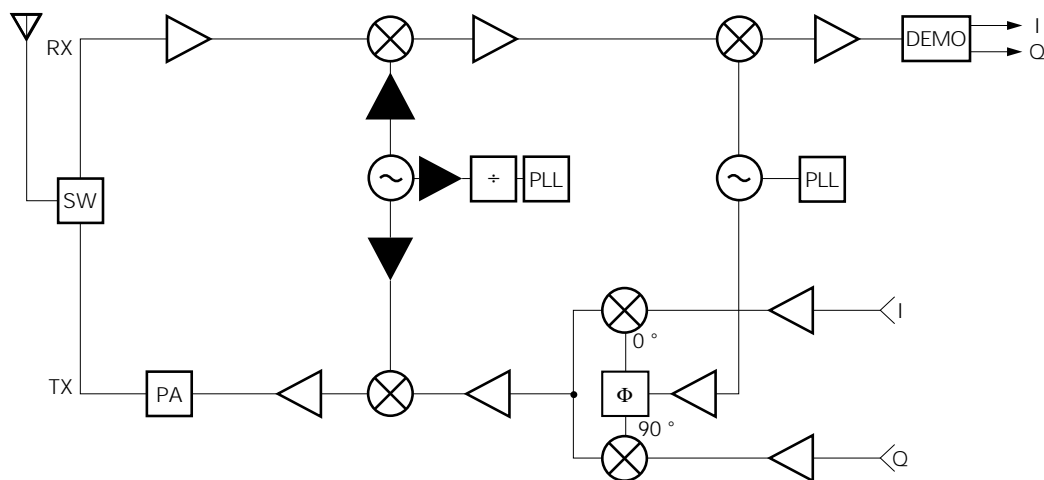
**Note 1** Typical performance. Please refer to ELECTRICAL CHARACTERISTICS in detail.

**EQUIVALENT CIRCUITS**



**SYSTEM APPLICATION EXAMPLE**

**Digital cellular telephone**



► :  $\mu$ PC2745T,  $\mu$ PC2749T

This system diagram presents schematic application only of these ICs. Suitable IC and block can be chosen in accordance with required RF performance on customer's systems.

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER             | SYMBOL    | RATING           | UNIT               | CONDITIONS  |
|-----------------------|-----------|------------------|--------------------|---|
| Supply Voltage        | $V_{CC}$  | 4.0              | V                  | $T_A = +25\text{ }^{\circ}\text{C}$   |
| Circuit Current       | $I_{CC}$  | 15 <b>Note 2</b> | mA                 | $T_A = +25\text{ }^{\circ}\text{C}$   |
| Power Dissipation     | $P_D$     | 280              | mW                 | Mounted on $50 \times 50 \times 1.6$ mm double side copper clad epoxy glass PWD $T_A = +85\text{ }^{\circ}\text{C}$ |
| Operating Temperature | $T_A$     | $-40$ to $+85$   | $^{\circ}\text{C}$ |   |
| Storage Temperature   | $T_{stg}$ | $-55$ to $+150$  | $^{\circ}\text{C}$ |   |
| Input Power           | $P_{in}$  | 0                | dBm                | $T_A = +25\text{ }^{\circ}\text{C}$   |

**Note 2**  $\mu$ PC2745T: 16 mA

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER             | SYMBOL   | MN.   | TYP.  | MAX.  | UNIT               |
|-----------------------|----------|-------|-------|-------|--------------------|
| Supply Voltage        | $V_{CC}$ | 2.7   | 3.0   | 3.3   | V                  |
| Operating Temperature | $T_A$    | $-40$ | $+25$ | $+85$ | $^{\circ}\text{C}$ |

ELECTRICAL CHARACTERISTICS ( $T_A = +25\text{ }^{\circ}\text{C}$ ,  $V_{CC} = 3.0\text{ V}$ ,  $Z_L = Z_S = 50\text{ }\Omega$ )

| PARAMETER                       | SYMBOL       | $\mu$ PC2745T |      |      | $\mu$ PC2749T |      |      | UNIT | CONDITION                              |
|---------------------------------|--------------|---------------|------|------|---------------|------|------|------|--|
|                                 |              | MIN.          | TYP. | MAX. | MIN.          | TYP. | MAX. |      |  |
| Circuit Current                 | $I_{CC}$     | 5.0           | 7.5  | 10.0 | 4             | 6    | 8    | mA   | No input signals                       |
| Power Gain                      | $G_P$        | 9.0           | 12   | 14   | 13            | 16   | 18.5 | dB   | <b>Note 3</b>                          |
| Noise Figure                    | NF           |               | 6    | 7.5  |               | 4.0  | 5.5  | dB   | <b>Note 3</b>                          |
| Upper Limit Operating Frequency | $f_u$        | 2.3           | 2.7  |      | 2.5           | 2.9  |      | GHz  | 3 dB less than the gain at 0.1 GHz     |
| Isolation                       | ISL          | 33            | 38   |      | 25            | 30   |      | dB   | <b>Note 3</b>                          |
| Input Return Loss               | $RL_{in}$    | 8             | 11   |      | 7             | 10   |      | dB   | <b>Note 3</b>                          |
| Output Return Loss              | $RL_{out}$   | 2.5           | 5.5  |      | 9.5           | 12.5 |      | dB   | <b>Note 3</b>                          |
| Saturated output power          | $PO_{(sat)}$ | $-4$          | $-1$ |      | $-9$          | $-6$ |      | dBm  | <b>Note 3</b> $P_{in} = -6\text{ dBm}$ |

**Note 3** Specified frequency condition:  $\mu$ PC2745T –  $f = 500\text{ MHz}$ ,  $\mu$ PC2749T –  $f = 1.9\text{ GHz}$

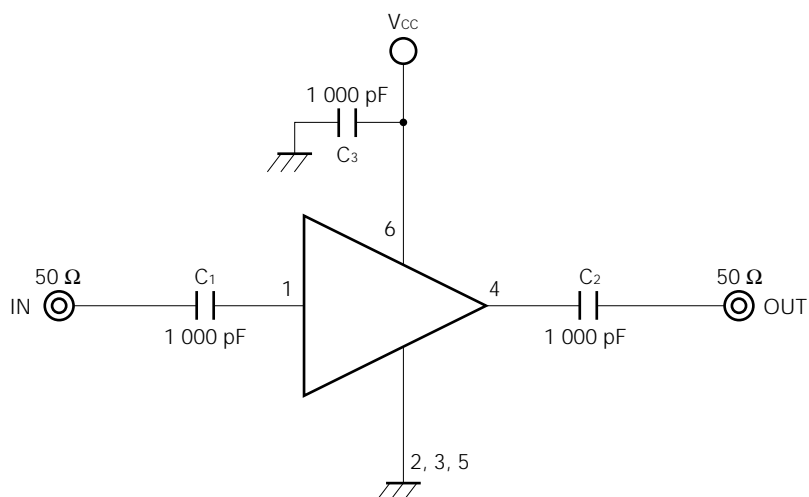
STANDARD CHARACTERISTICS FOR REFERENCE ( $T_A = +25\text{ }^{\circ}\text{C}$ ,  $Z_L = Z_S = 50\ \Omega$ )

| PARAMETER                            | SYMBOL          | CONDITION  | $\mu$ PC2745T   | UNIT |
|--------------------------------------|-----------------|--|-----------------|------|
|                                      |                 |  | REFERENCE VALUE |      |
| Circuit Current                      | $I_{CC}$        | $V_{CC} = 1.8\text{ V}$ , No input signals   | 4.5             | mA   |
| Power Gain                           | $G_P$           | $V_{CC} = 3.0\text{ V}$ , $f = 1\text{ GHz}$   | 12              | dB   |
|                                      |                 | $V_{CC} = 3.0\text{ V}$ , $f = 2\text{ GHz}$   | 11              |      |
|                                      |                 | $V_{CC} = 1.8\text{ V}$ , $f = 500\text{ MHz}$   | 7               |      |
| Noise Figure                         | NF              | $V_{CC} = 3.0\text{ V}$ , $f = 1\text{ GHz}$   | 5.5             | dB   |
|                                      |                 | $V_{CC} = 3.0\text{ V}$ , $f = 2\text{ GHz}$   | 5.7             |      |
|                                      |                 | $V_{CC} = 1.8\text{ V}$ , $f = 500\text{ MHz}$   | 8.0             |      |
| Upper Limit Operating Frequency      | $f_u$           | $V_{CC} = 1.8\text{ V}$ , 3 dB less than the gain at 0.1 GHz   | 1.8             | GHz  |
| Isolation                            | ISL             | $V_{CC} = 3.0\text{ V}$ , $f = 1\text{ GHz}$   | 33              | dB   |
|                                      |                 | $V_{CC} = 3.0\text{ V}$ , $f = 2\text{ GHz}$   | 30              |      |
|                                      |                 | $V_{CC} = 1.8\text{ V}$ , $f = 500\text{ MHz}$   | 35              |      |
| Input Return Loss                    | $RL_{in}$       | $V_{CC} = 3.0\text{ V}$ , $f = 1\text{ GHz}$   | 13              | dB   |
|                                      |                 | $V_{CC} = 3.0\text{ V}$ , $f = 2\text{ GHz}$   | 14              |      |
|                                      |                 | $V_{CC} = 1.8\text{ V}$ , $f = 500\text{ MHz}$   | 6.5             |      |
| Output Return Loss                   | $RL_{out}$      | $V_{CC} = 3.0\text{ V}$ , $f = 1\text{ GHz}$   | 6.5             | dB   |
|                                      |                 | $V_{CC} = 3.0\text{ V}$ , $f = 2\text{ GHz}$   | 8.5             |      |
|                                      |                 | $V_{CC} = 1.8\text{ V}$ , $f = 500\text{ MHz}$   | 6.0             |      |
| Saturated Output Power               | $PO_{(sat)}$    | $V_{CC} = 3.0\text{ V}$ , $f = 1\text{ GHz}$ , $P_{in} = -6\text{ dBm}$                                  | -2.5            | dBm  |
|                                      |                 | $V_{CC} = 3.0\text{ V}$ , $f = 2\text{ GHz}$ , $P_{in} = -6\text{ dBm}$                                  | -3.5            |      |
|                                      |                 | $V_{CC} = 1.8\text{ V}$ , $f = 500\text{ MHz}$ , $P_{in} = -10\text{ dBm}$                               | -11             |      |
| 3rd Order Intermodulation Distortion | IM <sub>3</sub> | $V_{CC} = 3.0\text{ V}$ , $P_{out} = -20\text{ dBm}$ , $f_1 = 500\text{ MHz}$ , $f_2 = 502\text{ MHz}$   | -54             | dBc  |
|                                      |                 | $V_{CC} = 3.0\text{ V}$ , $P_{out} = -20\text{ dBm}$ , $f_1 = 1000\text{ MHz}$ , $f_2 = 1002\text{ MHz}$ | -50             |      |
|                                      |                 | $V_{CC} = 1.8\text{ V}$ , $P_{out} = -20\text{ dBm}$ , $f_1 = 500\text{ MHz}$ , $f_2 = 502\text{ MHz}$   | -31             |      |

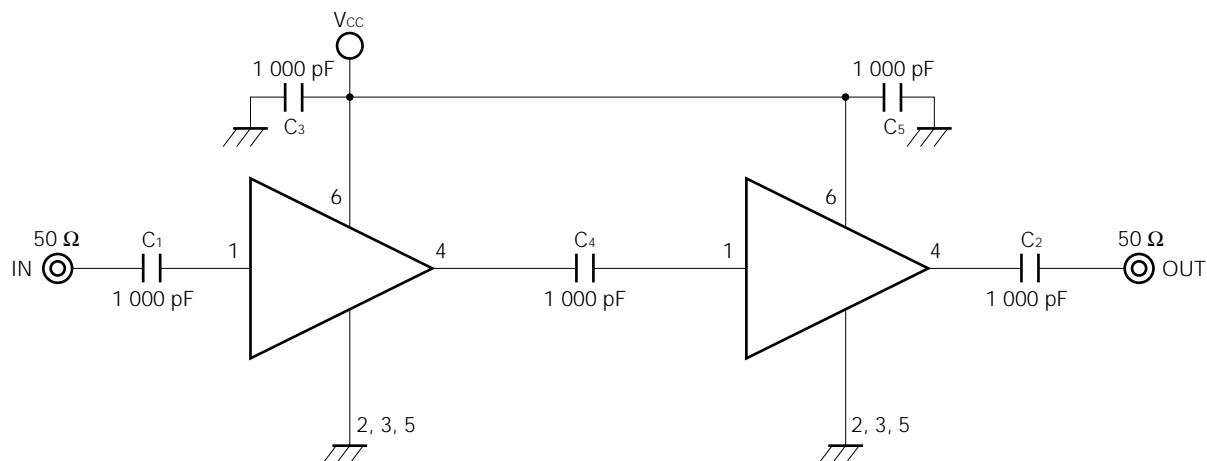
STANDARD CHARACTERISTICS FOR REFERENCE ( $T_A = +25\text{ }^{\circ}\text{C}$ ,  $V_{CC} = 3.0\text{ V}$ ,  $Z_L = Z_S = 50\ \Omega$ )

| PARAMETER                            | SYMBOL          | CONDITION  | $\mu$ PC2749T   | UNIT |
|--------------------------------------|-----------------|--|-----------------|------|
|                                      |                 |  | REFERENCE VALUE |      |
| 1 dB compression output              | $PO_{(1dB)}$    | $f = 1.9\text{ GHz}$   | -12.5           | dBm  |
| 3rd Order Intermodulation Distortion | IM <sub>3</sub> | $P_{out} = -25\text{ dBm}$ , $f_1 = 1.9\text{ GHz}$ , $f_2 = 1.902\text{ GHz}$ | -43             | dBc  |
| Power Gain                           | $G_P$           | $f = 0.9\text{ GHz}$   | 14.5            | dB   |
| Noise Figure                         | NF              | $f = 0.9\text{ GHz}$   | 3.2             | dB   |

## TEST CIRCUIT



## EXAMPLE OF APPLICATION CIRCUIT



The application circuit and their parameters are for references only and are not intended for use in actual design-in's

**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.

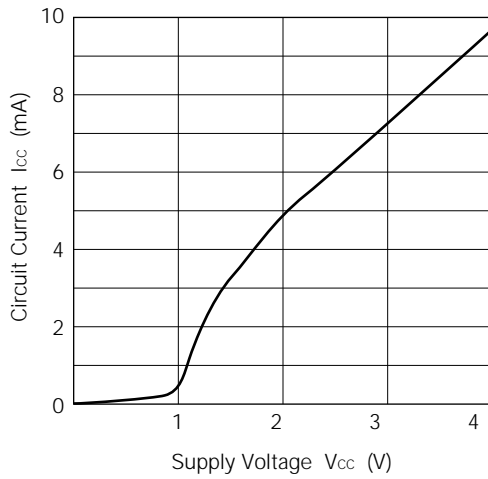
To get flat gain from 100 MHz up, 1 000 pF capacitors are assembled on the test circuit. [Actually, 1000 pF capacitors give flat gain at least 10 MHz. In the case of under 10 MHz operation, increase the value of coupling capacitor such as 2 200 pF. Because the coupling capacitors are determined by the equation of

$$C = 1/(2 \pi f Z_s).]$$

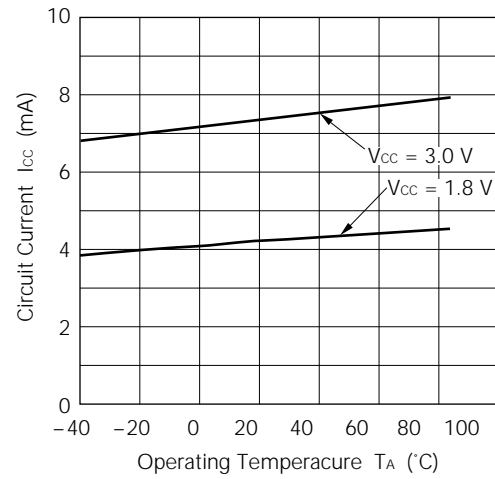
TYPICAL CHARACTERISTICS —  $\mu$ PC2745T —

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

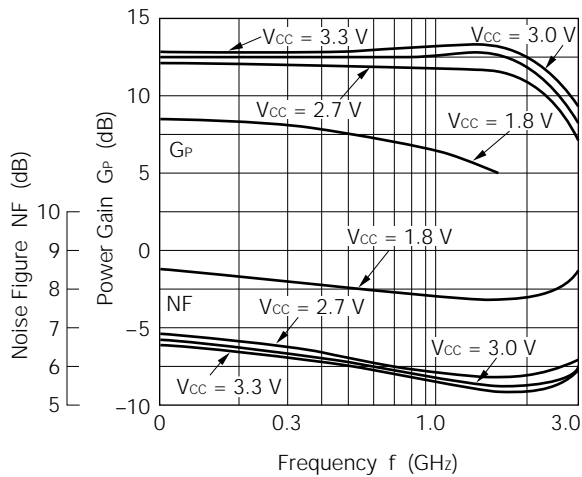
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



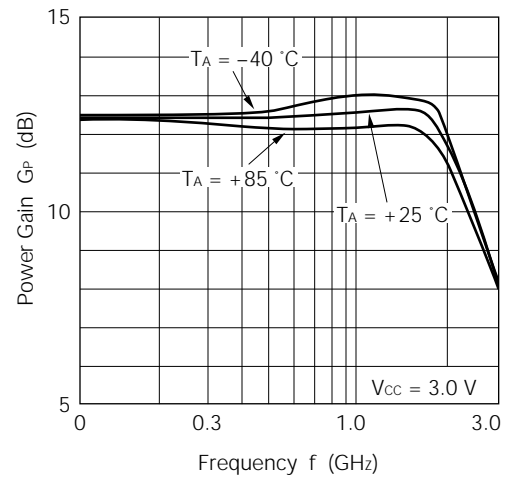
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



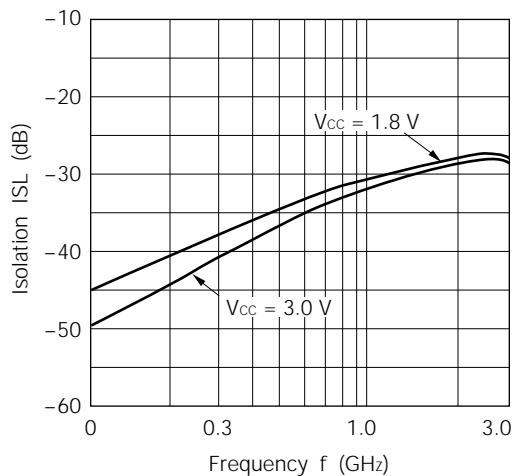
NOISE FIGURE POWER GAIN vs. FREQUENCY



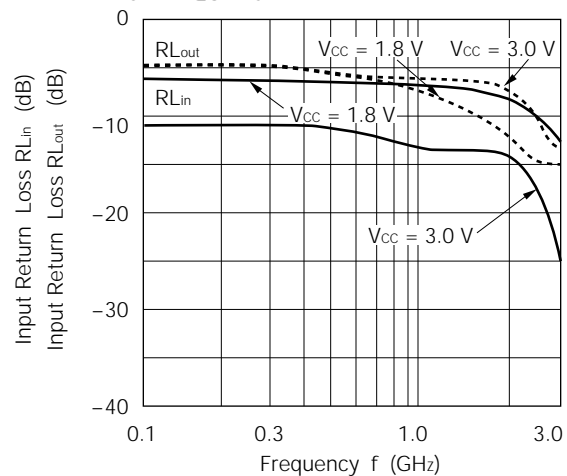
POWER GAIN vs. FREQUENCY



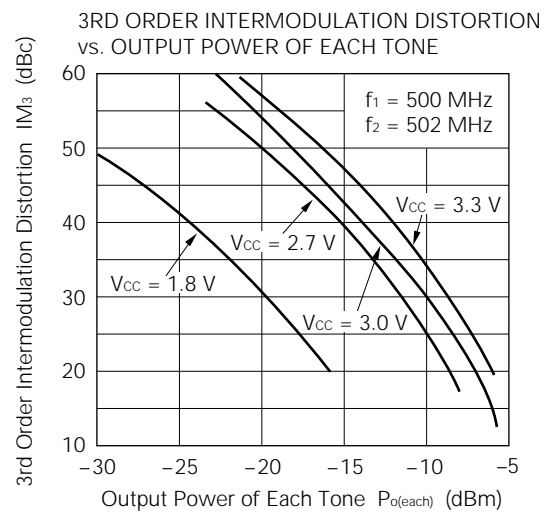
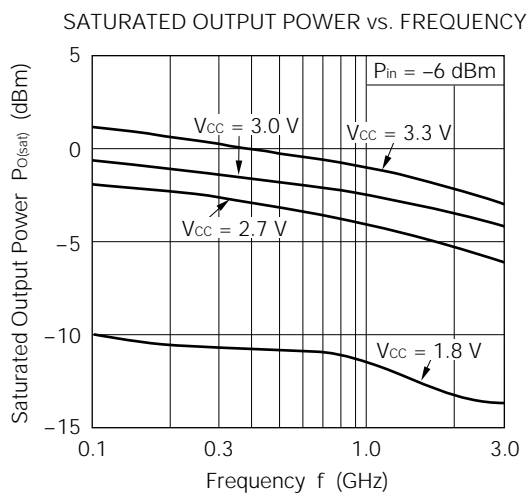
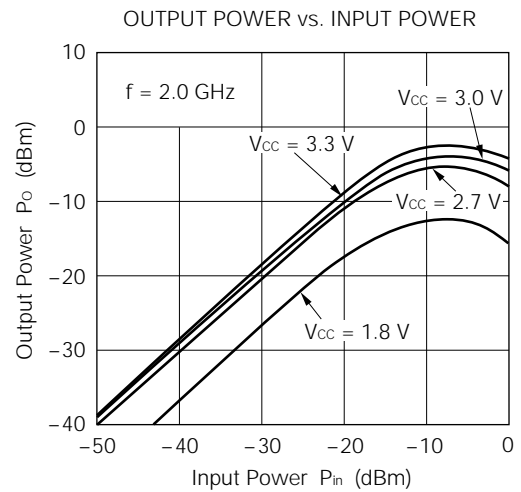
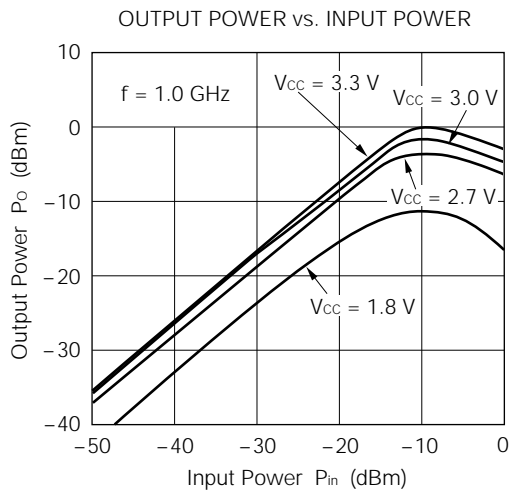
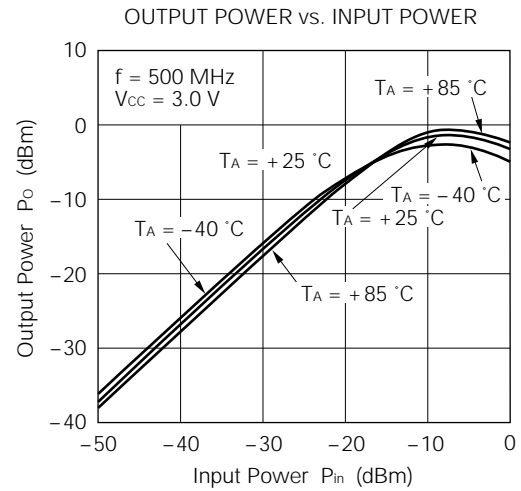
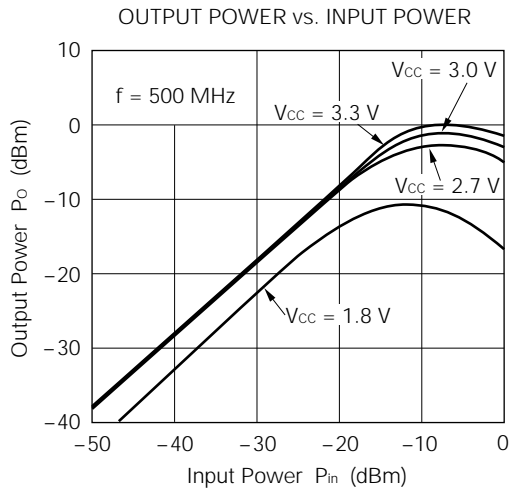
ISOLATION vs. FREQUENCY



INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



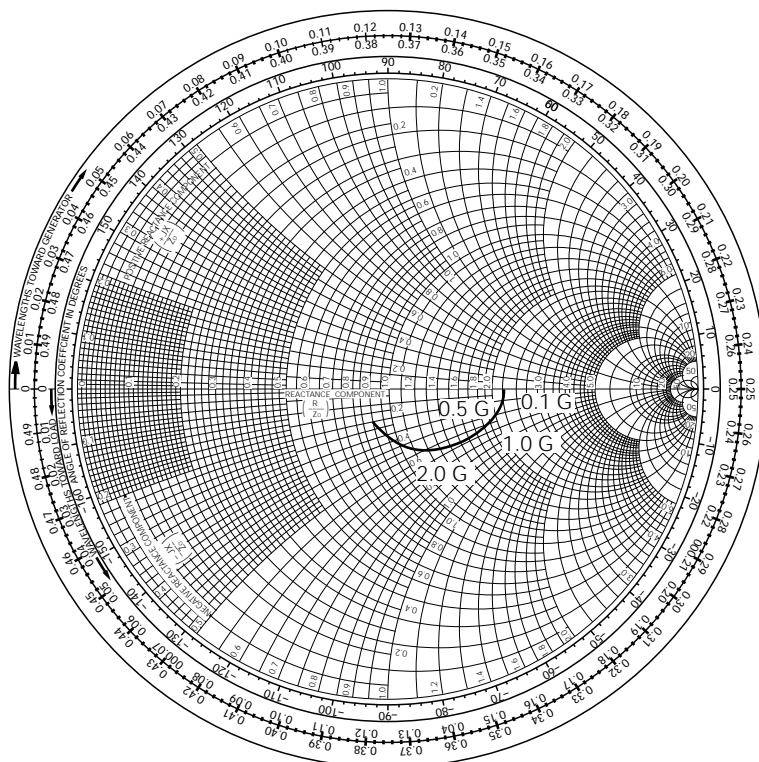
—  $\mu$ PC2745T —



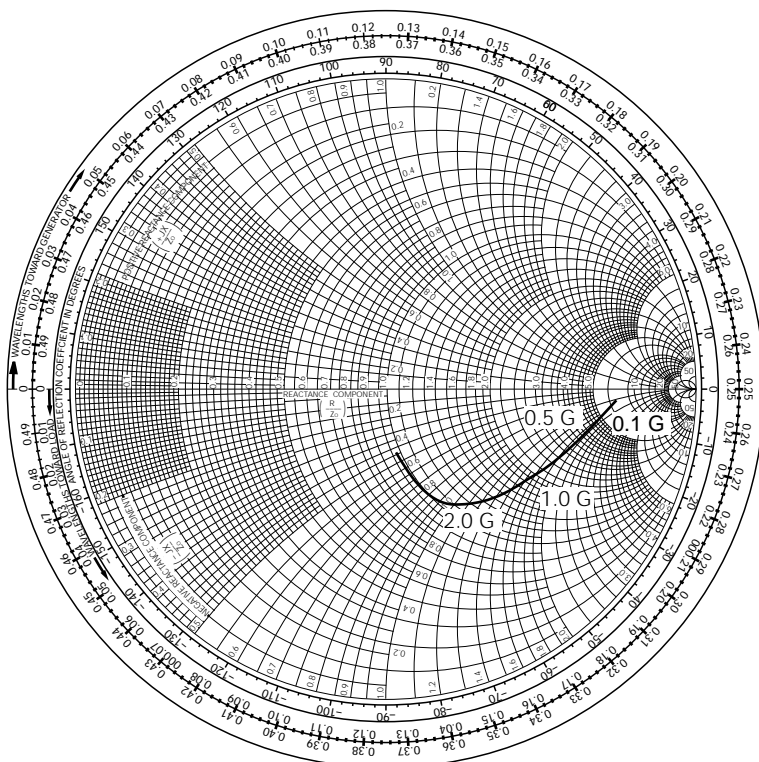
—  $\mu$ PC2745T —

S Parameter ( $V_{CC} = 3.0\text{ V}$ )

$S_{11}$ -FREQUENCY



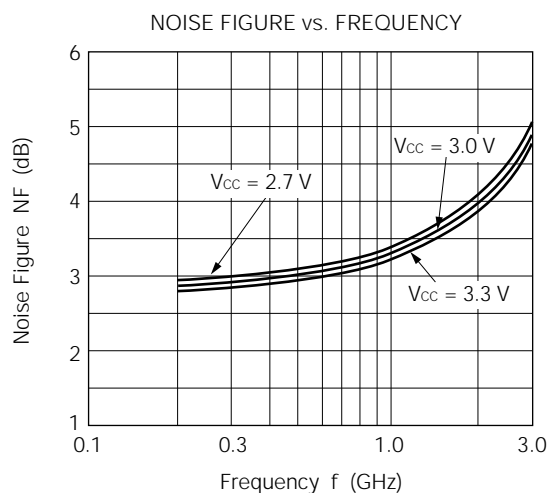
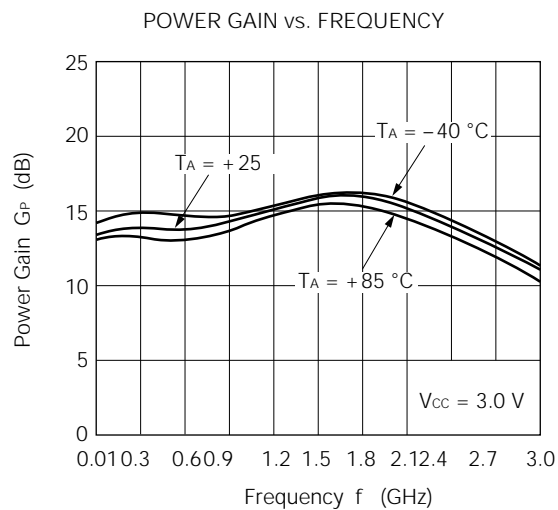
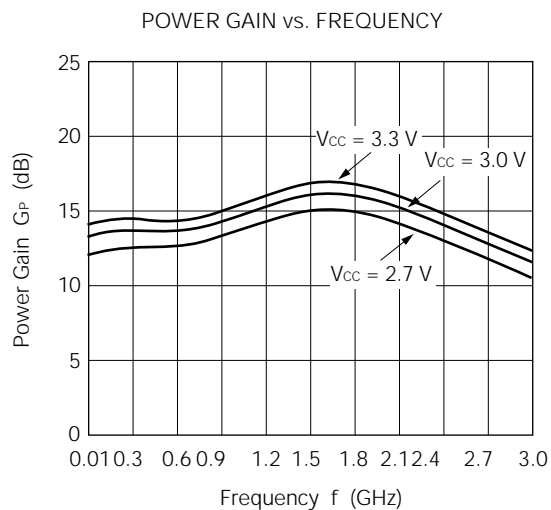
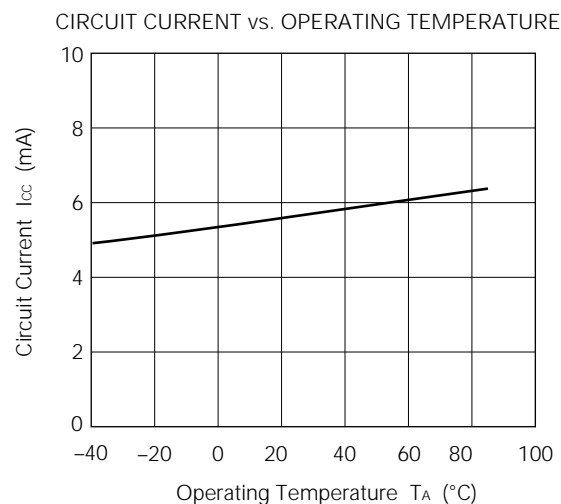
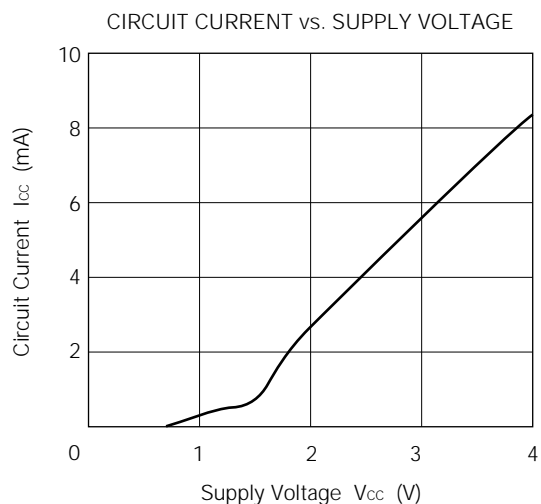
$S_{22}$ -FREQUENCY





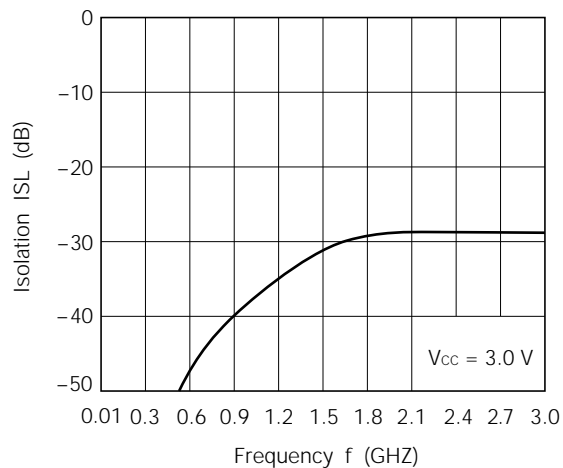
TYPICAL CHARACTERISTICS —  $\mu$ PC2749T —

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

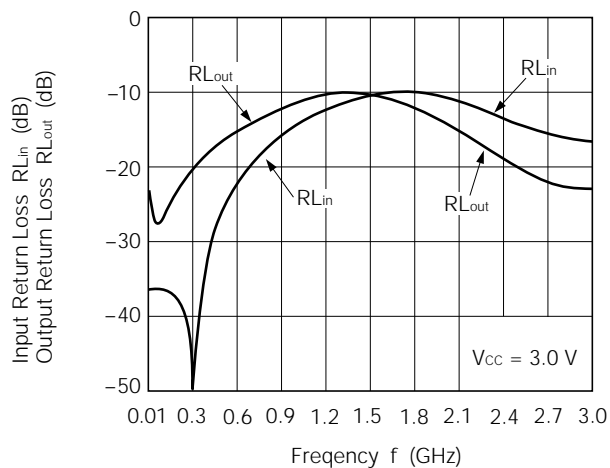


—  $\mu$ PC2749T —

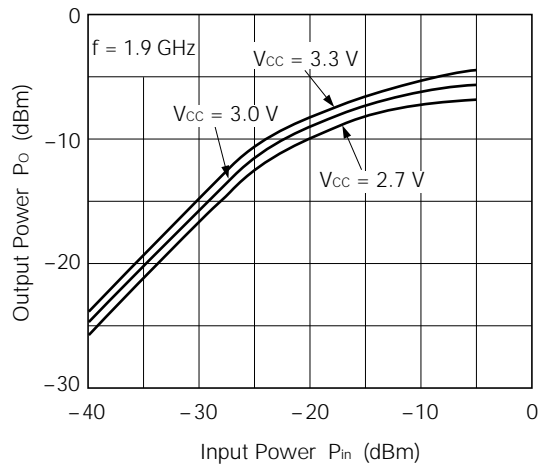
ISOLATION vs. FREQUENCY



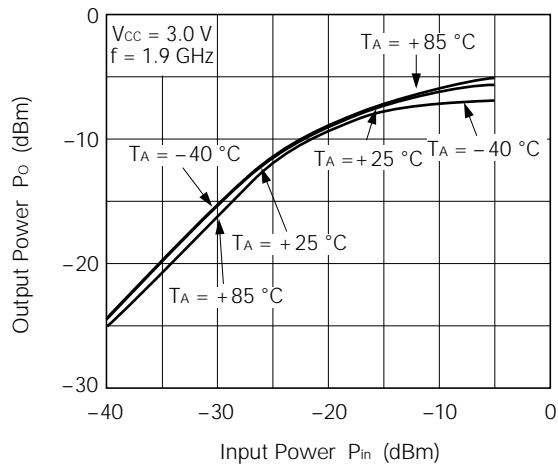
INPUT RETURN LOSS, OUTPUT RETURN LOSS vs. FREQUENCY



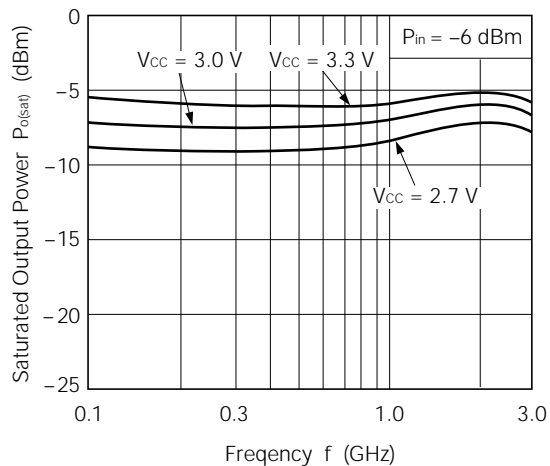
OUTPUT POWER vs. INPUT POWER



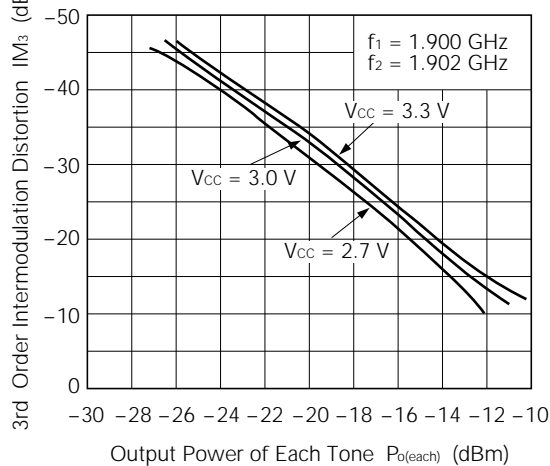
OUTPUT POWER vs. INPUT POWER



SATURATED OUTPUT POWER vs. FREQUENCY



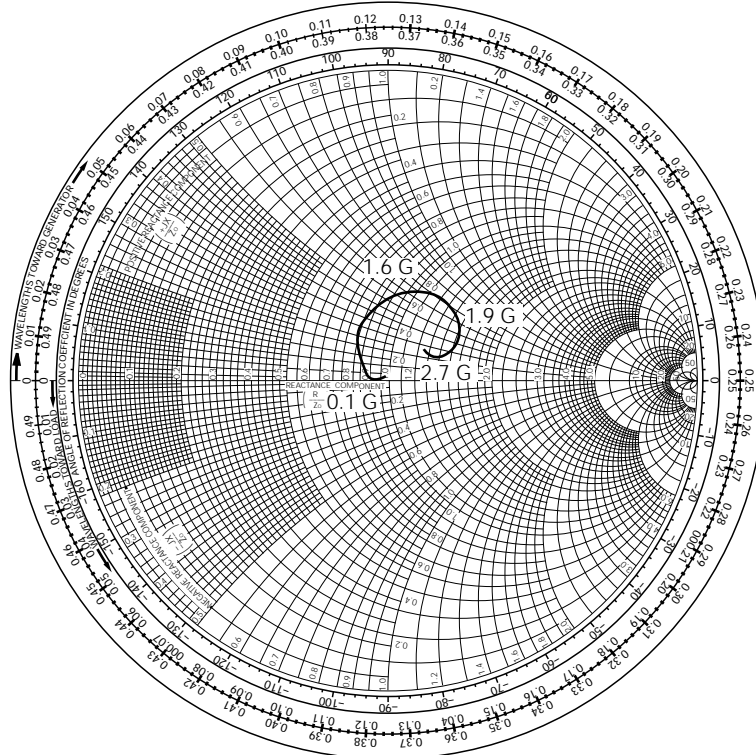
3RD ORDER INTERMODULATION DISTORTION vs. OUTPUT POWER OF EACH TONE



—  $\mu$ PC2749T —

S Parameter

$S_{11}$ -FREQUENCY ( $V_{CC} = 3.0$  V)



$S_{22}$ -FREQUENCY ( $V_{CC} = 3.0$  V)

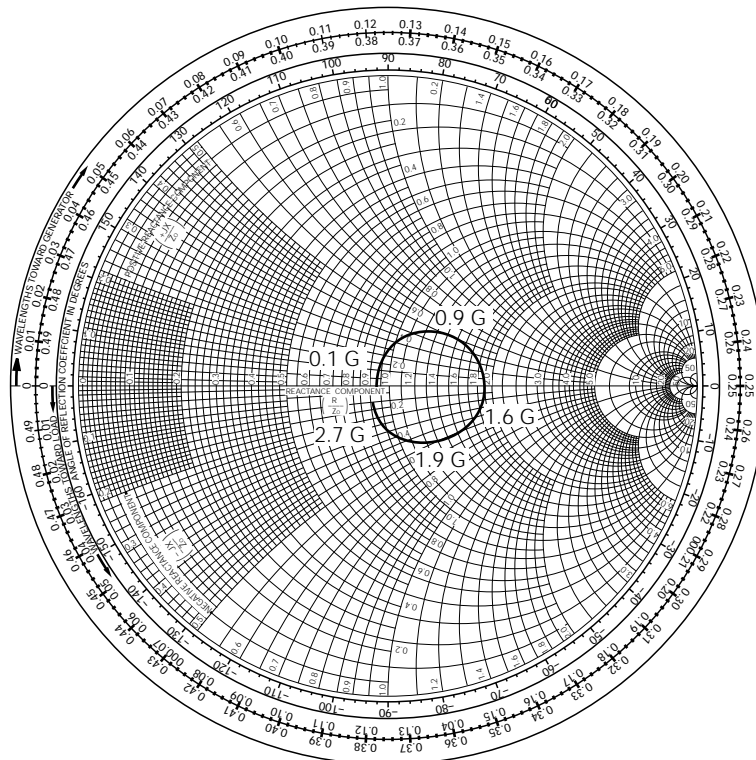
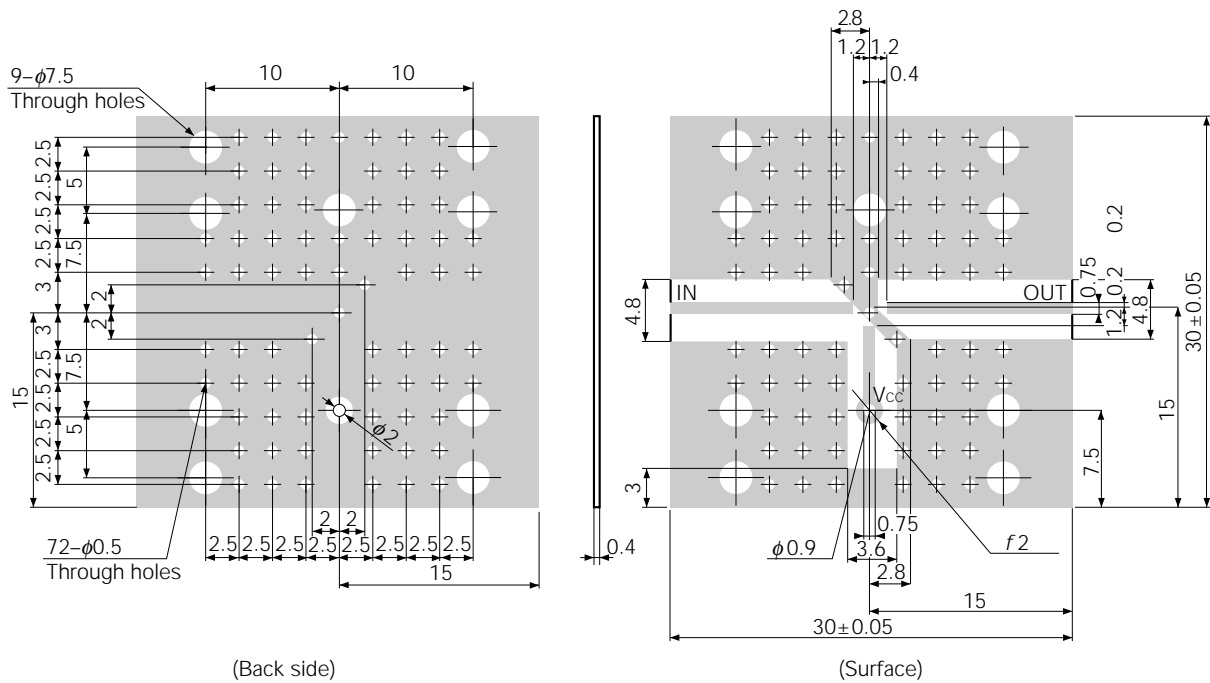


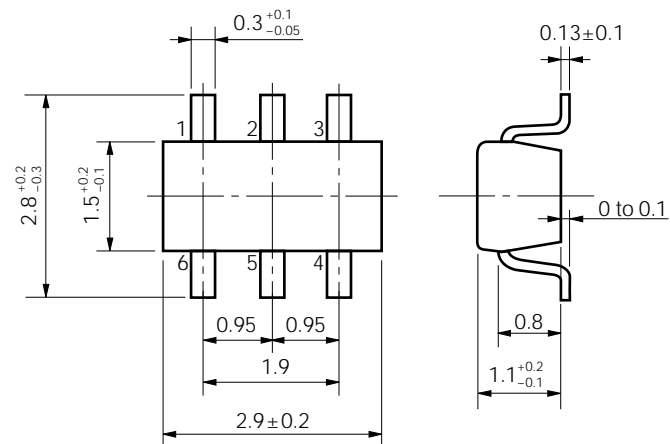
Illustration of evaluation board for the test circuit



Note

- (1) 30 × 30 × 0.4 mm double sided copper clad polyimide board.
- (2) Back side: GND pattern
- (3) Solder plated on pattern
- (4)  $\oplus\oplus\oplus$  : Through holes

6 PIN MINI MOLD PACKAGE DIMENSIONS (Unit: mm)



**NOTE ON CORRECT USE**

- (1) Observe precautions for handling because of electro-static sensitive devices.
- (2) Form a ground pattern as wide as possible to keep minimum ground impedance (to prevent undesired oscillation).
- (3) Keep the track length of the ground pins as short as possible.
- (4) Connect a bypass capacitor (e.g. 1 000 pF) to the V<sub>cc</sub> Pin.

**RECOMMENDED SOLDERING CONDITIONS**

This product should be soldered in the following recommended conditions. Other soldering methods and conditions than the recommended conditions are to be consulted with our sales representatives.

 **$\mu$ PC2745T,  $\mu$ PC2749T**

| Soldering method    | Soldering conditions   | Recommended condition symbol |
|---------------------|--|------------------------------|
| Infrared ray reflow | Package peak temperature: 235 °C, Hour: within 30 s.<br>(more than 210 °C), Time: 2 times, Limited days: no. <b>Note</b> | IR30-00-2                    |
| VPS                 | Package peak temperature: 215 °C, Hour: within 40 s.<br>(more than 200 °C), Time: 2 times, Limited days: no. <b>Note</b> | VP15-00-2                    |
| Wave soldering      | Soldering tub temperature: less than 260 °C, Hour: within 10 s.<br>Time: 1 time, Limited days: no.                       | WS60-00-1                    |
| Pin part heating    | Pin area temperature: less than 300 °C, Hour: within 10s.<br>Limited days: no. <b>Note</b>                               |                              |

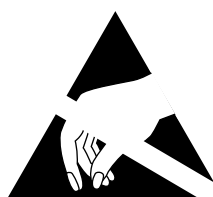
**Note** It is the storage days after opening a dry pack, the storage conditions are 25 °C, less than 65 % RH.

**Caution** The combined use of soldering method is to be avoided (However, except the pin area heating method).

For details of recommended soldering conditions for surface mounting, refer to information document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (IEI-1207)**.

[MEMO]

[MEMO]

**ATTENTION**

OBSERVE PRECAUTIONS  
FOR HANDLING  
ELECTROSTATIC  
SENSITIVE  
DEVICES

**The application circuit and circuit constants shown in this document are for reference only and may not be employed for mass production of the application system.**

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While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customer must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device 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: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices in "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact NEC Sales Representative in advance.

Anti-radioactive design is not implemented in this product.

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