

BIPOLAR ANALOG INTEGRATED CIRCUIT

μ PC3210TB

5 V, SUPER MINIMOLD SILICON MMIC WIDEBAND AMPLIFIER

DESCRIPTION

The μ PC3210TB is a silicon monolithic integrated circuits designed as wideband amplifier. The μ PC3210TB is suitable to systems required wideband operation from HF to L band.

This IC is 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 IC has excellent performance, uniformity and reliability.

FEATURES

- High-density surface mounting: 6-pin super minimold package (2.0 × 1.25 × 0.9 mm)
- Wideband response : $f_u = 2.3$ GHz TYP. @3 dB bandwidth
- Supply voltage : $V_{CC} = 4.5$ to 5.5 V
- Power gain : $G_P = 20$ dB TYP. @ $f = 1.5$ GHz
- Noise figure : $NF = 3.4$ dB TYP. @ $f = 1.5$ GHz

APPLICATION

- Systems required wideband operation from HF to 2.0 GHz

ORDERING INFORMATION

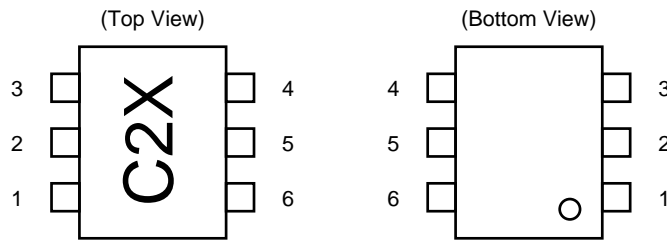
| Part Number | Package | Marking | Supplying Form |
|-------------------|----------------------|---------|---|
| μ PC3210TB-E3 | 6-pin super minimold | C2X | Embossed tape 8 mm wide. 1, 2, 3 pins face the perforation side of the tape. Qty 3 kpcs/reel. |

Remark To order evaluation samples, please contact your local NEC sales office. (Part number for sample order: μ PC3210TB)

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 |
|-----------|-------------------------|-------------------------------|------------------------|---------------------|-------------------------|----------------------|---------|
| μPC2711T | 2.9 | +1.0 | 13 | 5.0 @f = 1.0 GHz | 12 | 6-pin minimold | C1G |
| μPC2711TB | | | | | | 6-pin super minimold | |
| μPC2712T | 2.6 | +3.0 | 20 | 4.5 @f = 1.0 GHz | 12 | 6-pin minimold | C1H |
| μPC2712TB | | | | | | 6-pin super minimold | |
| μPC2713T | 1.2 | +7.0 | 29 | 3.2 @f = 0.5 GHz | 12 | 6-pin minimold | C1J |
| μPC2791TB | 1.9 | +4.0 | 12 | 5.5 @f = 0.5 GHz | 17 | 6-pin super minimold | C2S |
| μPC2792TB | 1.2 | +5.0 | 20 | 3.5 @f = 0.5 GHz | 19 | | C2T |
| μPC3210TB | 2.3 | +3.5 | 20 | 3.4 @f = 1.5 GHz | 15 | | C2X |
| μPC3215TB | 2.9 | +3.5 | 20.5 | 2.3 @f = 1.5 GHz | 14 | | 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 wide band. 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. | |
| 4 | OUTPUT | — | 4.0 | Signal output pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wide band. 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. | |
| 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. | |

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 |
| ★ Power Dissipation | P _D | Mounted on double sided copper clad 50 × 50 × 1.6 mm epoxy glass PWB (T _A = +85°C) | 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 | +10 | dBm |

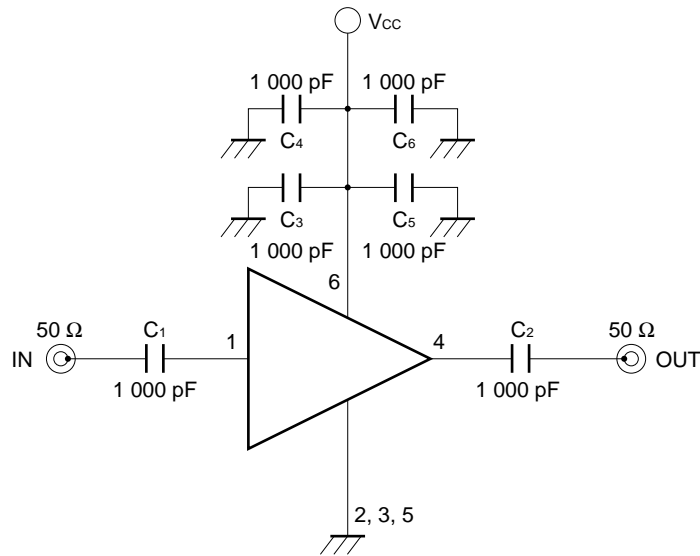
RECOMMENDED OPERATING RANGE

| 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 |

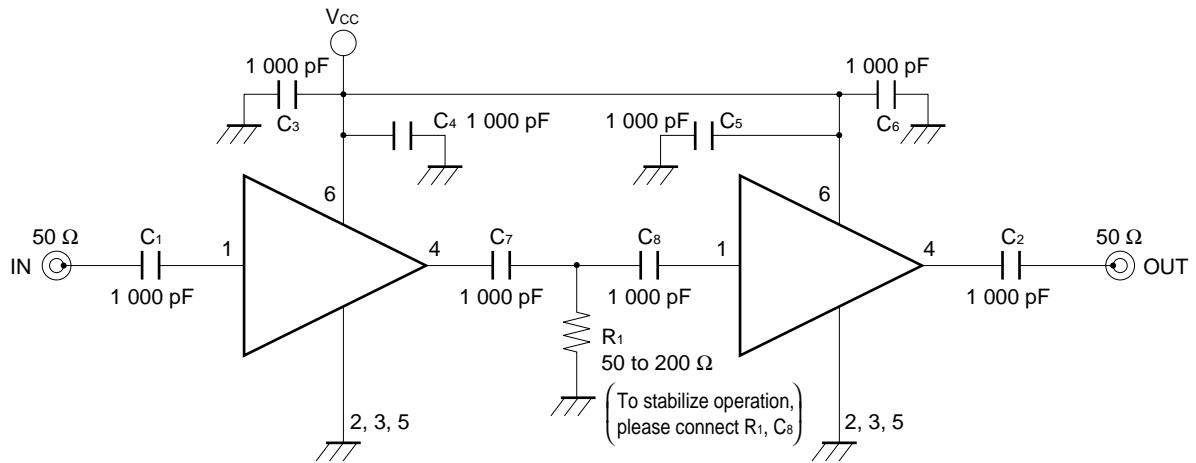
ELECTRICAL OPERATING CONDITIONS (T_A = +25°C, V_{CC} = 5.0 V, Z_S = Z_L = 50 Ω)

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---------------------------------|---------------------|---|------|------|------|------|
| Circuit Current | I _{CC} | No signals | 11.5 | 15.0 | 19.5 | mA |
| Power Gain | G _P | f = 1.5 GHz | 18 | 20 | - | dB |
| Noise Figure | NF | f = 1.5 GHz | - | 3.4 | 4.4 | dB |
| Upper Limit Operating Frequency | f _u | 3 dB down below from gain at f = 0.1 GHz | 2.05 | 2.3 | - | GHz |
| Isolation | ISL | f = 1.5 GHz | 29 | 34 | - | dB |
| Input Return Loss | RL _{in} | f = 1.5 GHz | 10 | 14.5 | - | dB |
| Output Return Loss | RL _{out} | f = 1.5 GHz | 7 | 11 | - | dB |
| Saturated Output Level | P _{O(sat)} | f = 1.5 GHz, P _{in} = 0 dBm | +0.5 | +3.5 | - | dBm |
| Gain Flatness | ΔG _P | f = 0.1 to 2.05 GHz | - | ±1.0 | - | 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 Vcc, input and output pins

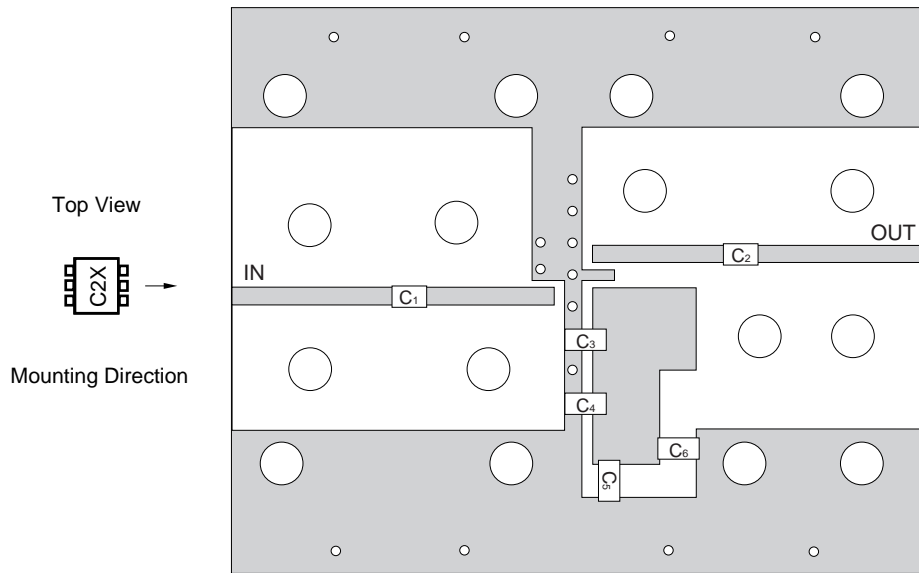
1 000 pF capacitors are recommendable as bypass capacitor for Vcc pin and coupling capacitors for input/output pins.

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 to C ₆ | 1 000 pF |

Notes

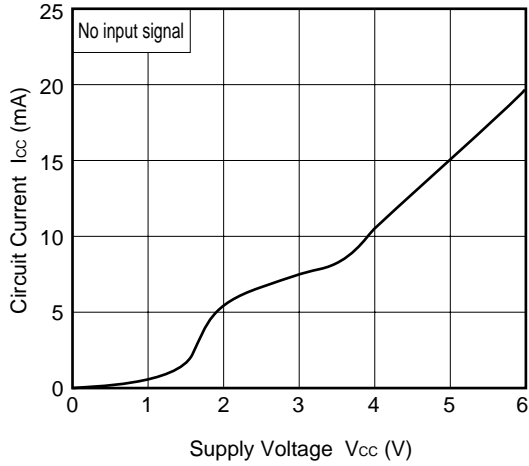
1. 42 × 35 × 0.4 mm double sided copper clad polyimide board.
2. Solder plated on pattern
3. Back side: GND pattern
4. ○: Through holes

For more information on the use of this IC, refer to the following application note:

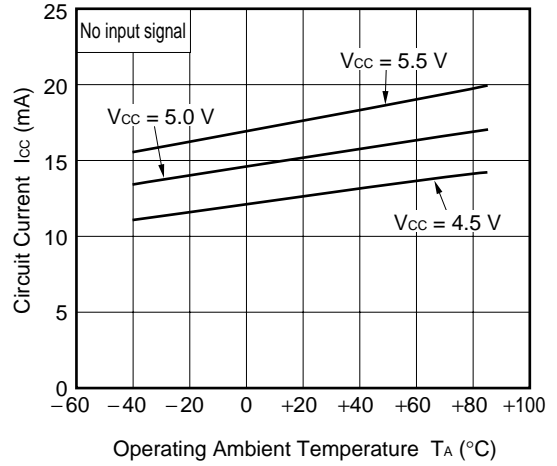
USAGE AND APPLICATIONS OF 6-PIN MINI-MOLD, 6-PIN SUPER MINI-MOLD SILICON HIGH-FREQUENCY WIDEBAND AMPLIFIER MMIC (P11976E).

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

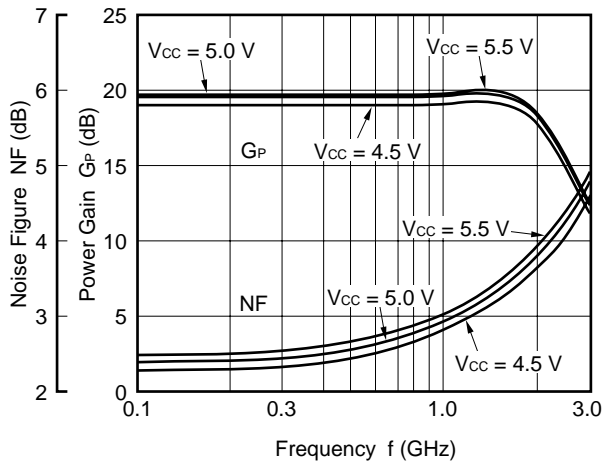
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



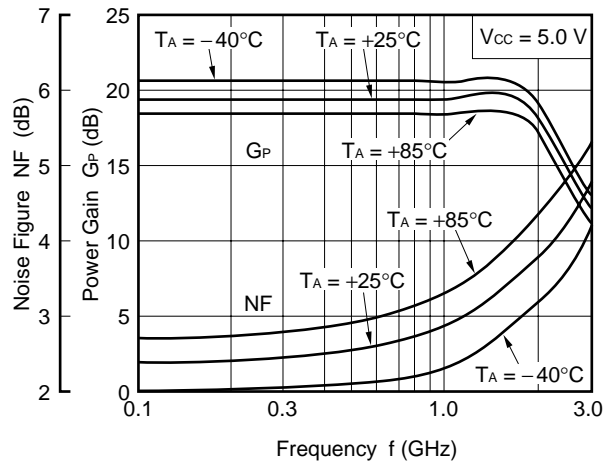
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



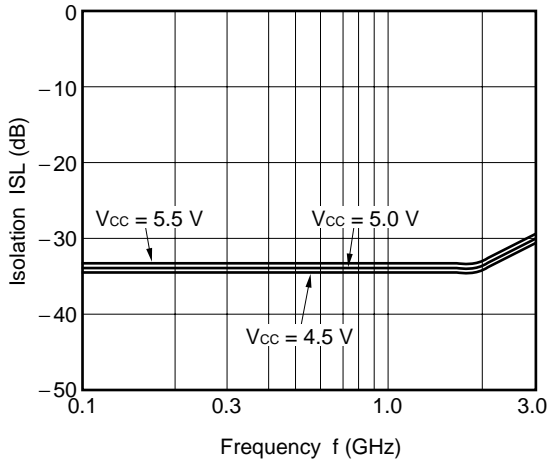
NOISE FIGURE, POWER GAIN vs. FREQUENCY



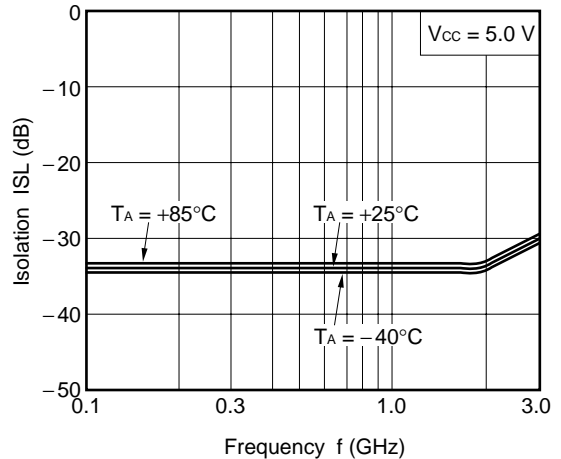
NOISE FIGURE, POWER GAIN vs. FREQUENCY



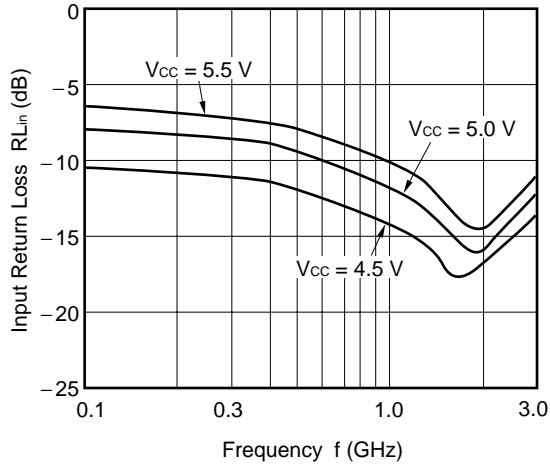
ISOLATION vs. FREQUENCY



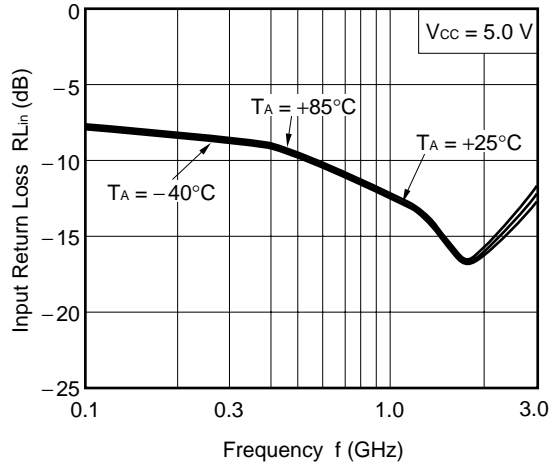
ISOLATION vs. FREQUENCY



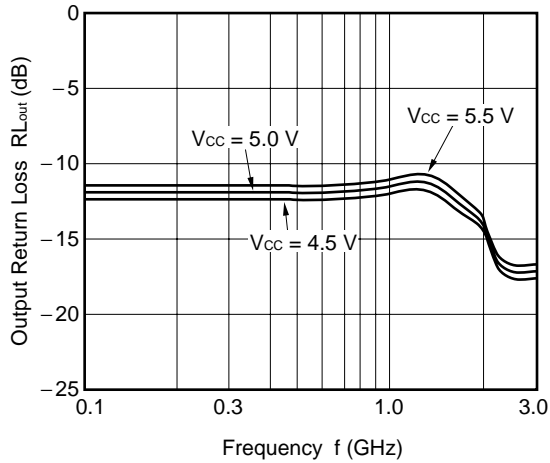
INPUT RETURN LOSS vs. FREQUENCY



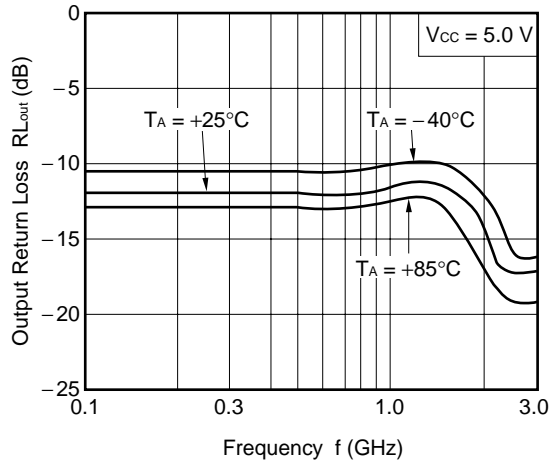
INPUT RETURN LOSS vs. FREQUENCY



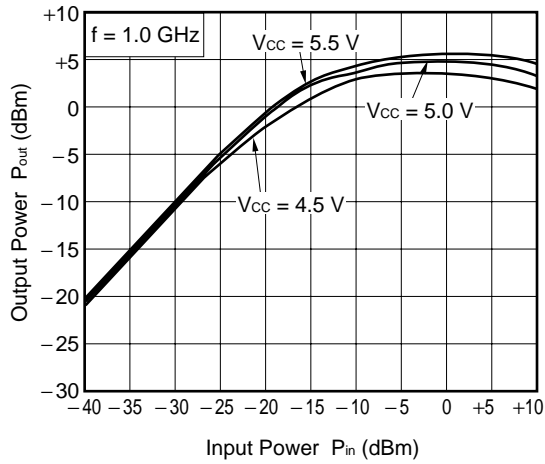
OUTPUT RETURN LOSS vs. FREQUENCY



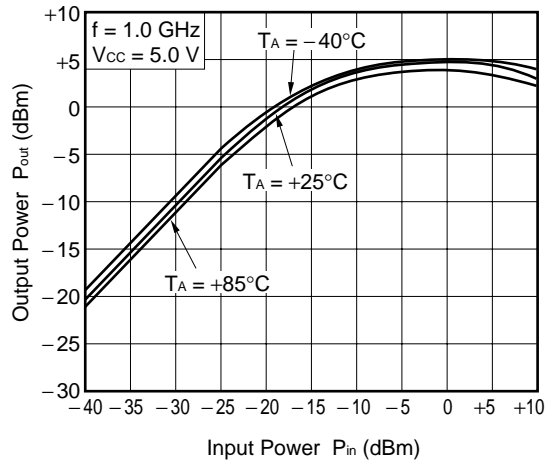
OUTPUT RETURN LOSS vs. FREQUENCY



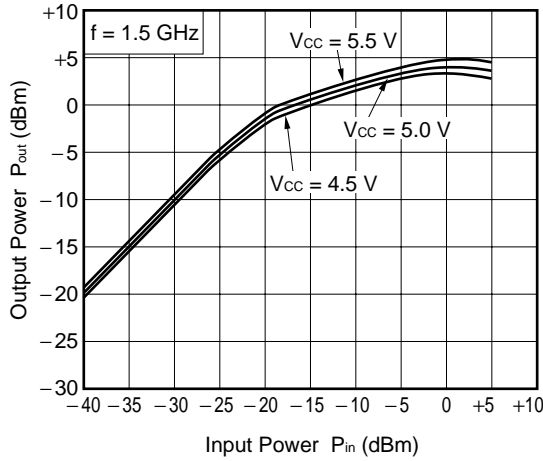
OUTPUT POWER vs. INPUT POWER



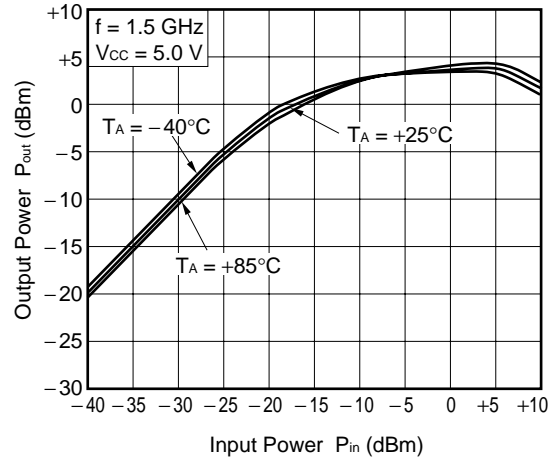
OUTPUT POWER vs. INPUT POWER



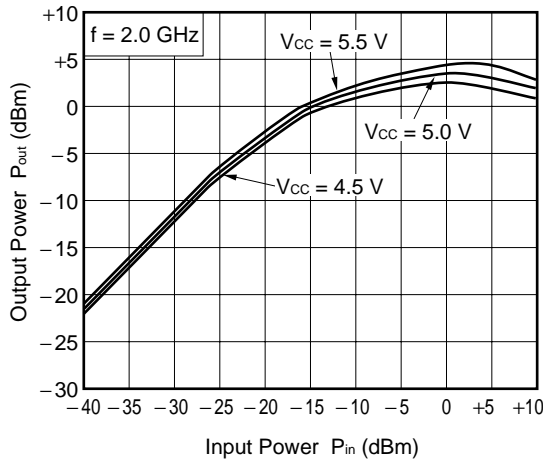
OUTPUT POWER vs. INPUT POWER



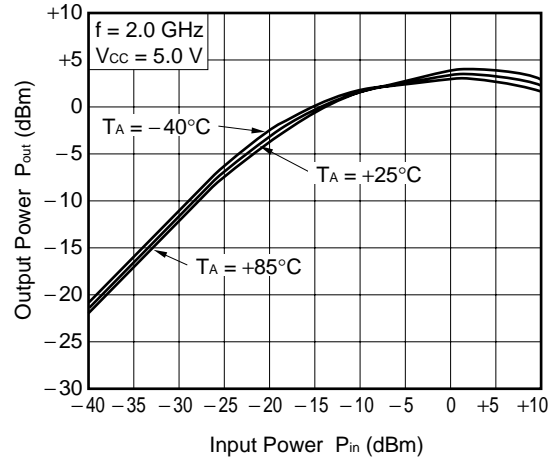
OUTPUT POWER vs. INPUT POWER



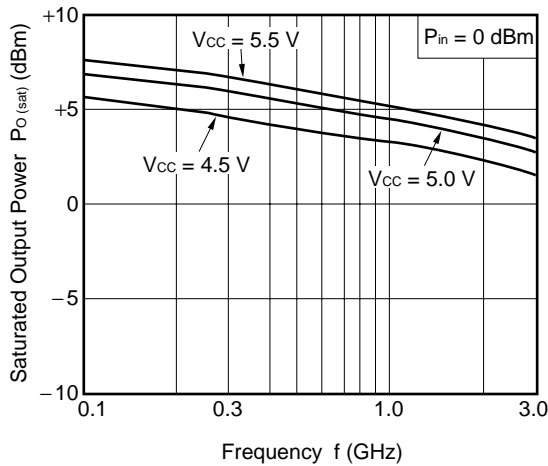
OUTPUT POWER vs. INPUT POWER



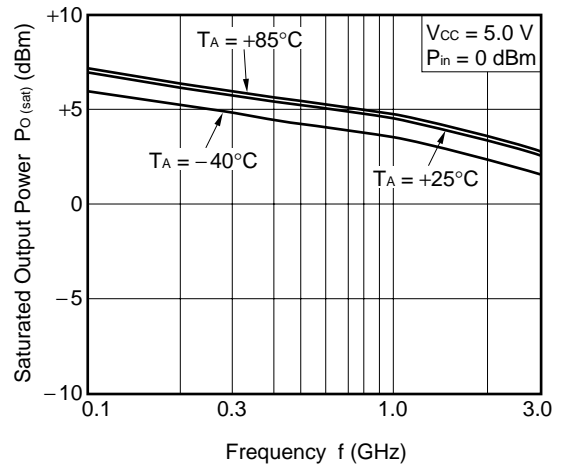
OUTPUT POWER vs. INPUT POWER

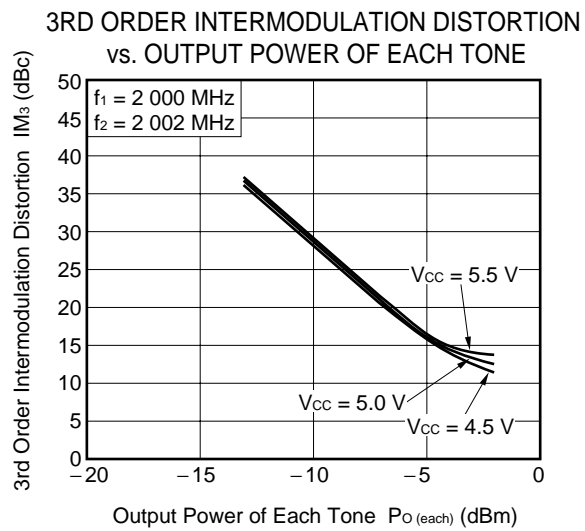
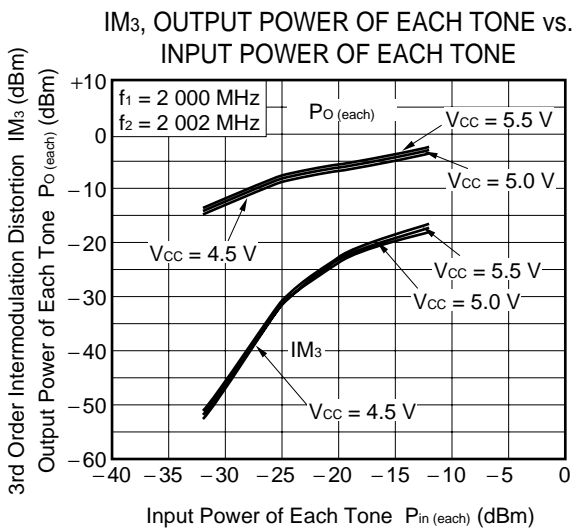
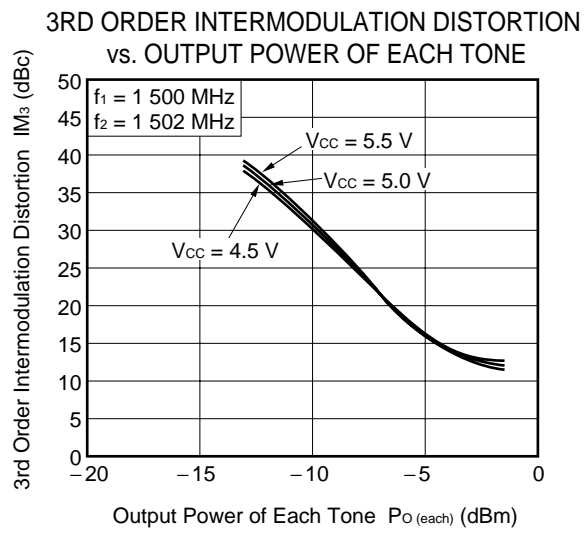
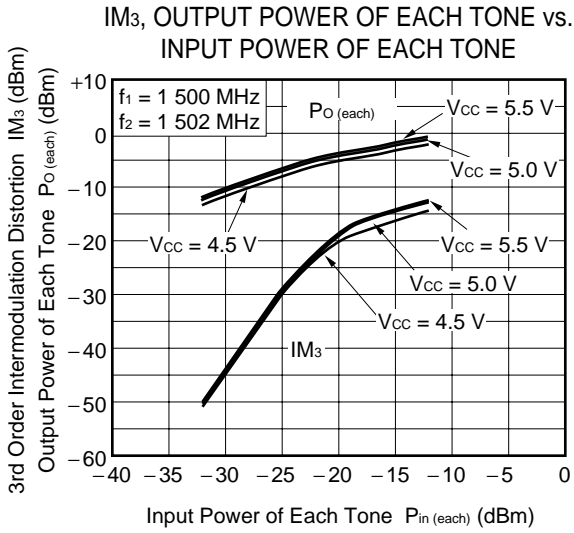
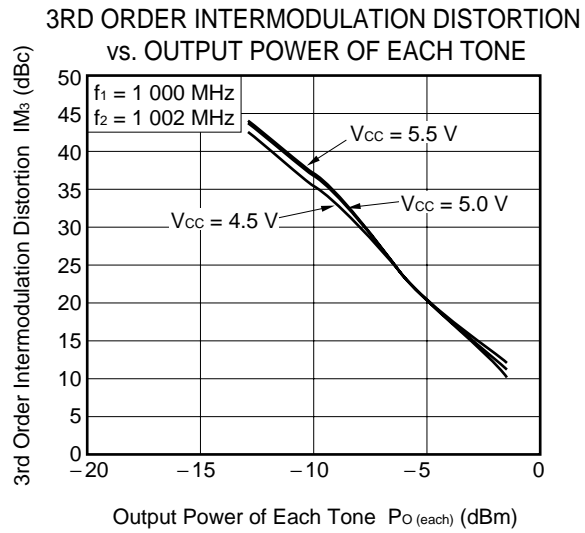
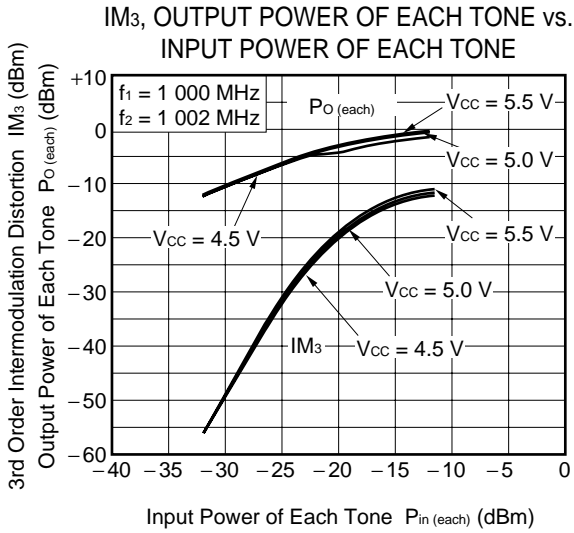


SATURATED OUTPUT POWER vs. FREQUENCY



SATURATED OUTPUT POWER vs. FREQUENCY

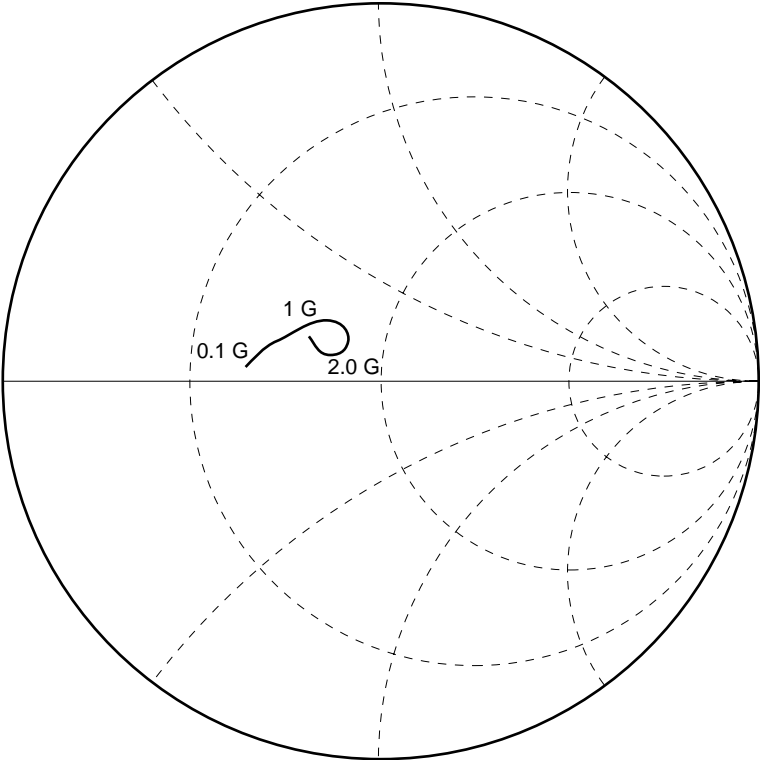




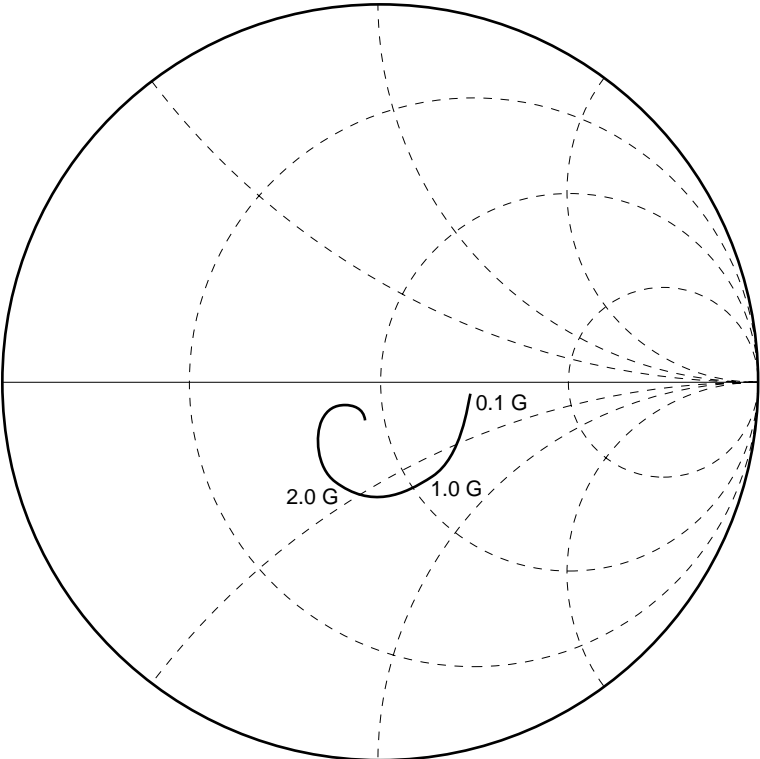
Remark The graphs indicate nominal characteristics.

S-PARAMETERS ($T_A = +25^\circ\text{C}$, $V_{CC} = 5.0\text{ V}$)

S₁₁-FREQUENCY



S₂₂-FREQUENCY



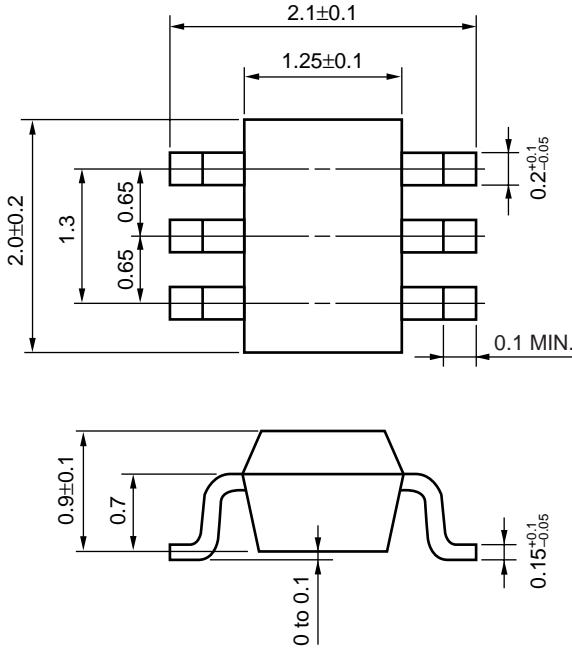
TYPICAL S-PARAMETER VALUES (T_A = +25°C)

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 | 0.358 | 171.9 | 8.688 | -4.4 | 0.019 | -1.4 | 0.233 | -6.8 | 2.63 |
| 200.0000 | 0.335 | 166.6 | 8.807 | -10.6 | 0.019 | 3.3 | 0.237 | -12.0 | 2.71 |
| 300.0000 | 0.321 | 160.7 | 8.821 | -17.1 | 0.019 | 6.3 | 0.233 | -15.1 | 2.68 |
| 400.0000 | 0.306 | 158.3 | 8.841 | -23.3 | 0.019 | 9.9 | 0.233 | -20.6 | 2.68 |
| 500.0000 | 0.294 | 154.4 | 8.908 | -29.2 | 0.019 | 13.6 | 0.241 | -25.6 | 2.67 |
| 600.0000 | 0.283 | 151.8 | 8.990 | -35.1 | 0.019 | 15.8 | 0.246 | -30.8 | 2.74 |
| 700.0000 | 0.273 | 148.6 | 9.160 | -41.0 | 0.019 | 19.5 | 0.250 | -35.8 | 2.67 |
| 800.0000 | 0.267 | 146.0 | 9.342 | -47.3 | 0.018 | 24.3 | 0.256 | -41.2 | 2.65 |
| 900.0000 | 0.260 | 144.2 | 9.541 | -53.9 | 0.018 | 29.8 | 0.263 | -47.9 | 2.69 |
| 1000.0000 | 0.252 | 141.5 | 9.741 | -60.8 | 0.019 | 28.9 | 0.274 | -53.1 | 2.46 |
| 1100.0000 | 0.246 | 138.4 | 10.071 | -68.6 | 0.019 | 29.4 | 0.283 | -59.0 | 2.37 |
| 1200.0000 | 0.239 | 135.9 | 10.393 | -76.3 | 0.018 | 36.7 | 0.291 | -65.7 | 2.38 |
| 1300.0000 | 0.229 | 133.3 | 10.513 | -85.4 | 0.019 | 38.1 | 0.299 | -71.9 | 2.25 |
| 1400.0000 | 0.224 | 131.1 | 10.763 | -94.5 | 0.019 | 45.6 | 0.303 | -79.7 | 2.20 |
| 1500.0000 | 0.215 | 127.4 | 10.708 | -104.0 | 0.021 | 48.2 | 0.311 | -87.6 | 2.05 |
| 1600.0000 | 0.203 | 125.8 | 10.720 | -114.2 | 0.021 | 48.9 | 0.316 | -94.9 | 2.07 |
| 1700.0000 | 0.191 | 123.1 | 10.388 | -124.1 | 0.023 | 55.7 | 0.308 | -103.4 | 1.98 |
| 1800.0000 | 0.179 | 122.1 | 9.993 | -133.7 | 0.023 | 59.5 | 0.303 | -111.5 | 2.02 |
| 1900.0000 | 0.163 | 121.0 | 9.507 | -142.8 | 0.025 | 61.9 | 0.291 | -119.5 | 2.01 |
| 2000.0000 | 0.155 | 123.4 | 8.983 | -151.2 | 0.024 | 65.9 | 0.275 | -128.4 | 2.17 |
| 2100.0000 | 0.140 | 126.1 | 8.384 | -158.9 | 0.027 | 69.0 | 0.255 | -135.0 | 2.14 |
| 2200.0000 | 0.133 | 129.1 | 7.905 | -166.0 | 0.029 | 70.7 | 0.230 | -140.5 | 2.12 |
| 2300.0000 | 0.130 | 135.3 | 7.412 | -172.3 | 0.032 | 71.8 | 0.207 | -145.9 | 2.10 |
| 2400.0000 | 0.133 | 139.0 | 6.976 | -178.6 | 0.034 | 74.3 | 0.182 | -150.3 | 2.12 |
| 2500.0000 | 0.137 | 144.0 | 6.582 | 176.1 | 0.038 | 73.2 | 0.157 | -151.8 | 2.06 |
| 2600.0000 | 0.149 | 148.5 | 6.202 | 170.4 | 0.039 | 71.4 | 0.136 | -152.1 | 2.13 |
| 2700.0000 | 0.157 | 150.2 | 5.942 | 164.9 | 0.043 | 73.7 | 0.116 | -147.1 | 2.03 |
| 2800.0000 | 0.170 | 152.2 | 5.567 | 159.7 | 0.045 | 72.2 | 0.102 | -137.8 | 2.04 |
| 2900.0000 | 0.181 | 150.3 | 5.360 | 153.9 | 0.047 | 72.5 | 0.099 | -132.3 | 2.03 |
| 3000.0000 | 0.203 | 149.0 | 5.013 | 149.0 | 0.048 | 69.6 | 0.104 | -122.3 | 2.10 |
| 3100.0000 | 0.209 | 147.9 | 4.810 | 142.9 | 0.051 | 71.0 | 0.117 | -114.4 | 2.08 |

★ 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 pins must be connected together with wide ground pattern to decrease impedance difference.
- (3) The bypass capacitor should be attached to Vcc line.
- (4) The DC cut capacitor must be each attached to input and output 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.

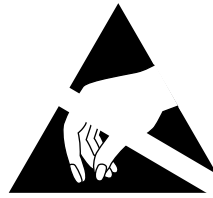
| Soldering Method | Soldering Conditions | Recommended Condition Symbol |
|------------------|--|------------------------------|
| Infrared Reflow | Package peak temperature: 235°C or below Time: 30 seconds or less (at 210°C) Count: 3, Exposure limit ^{Note} : None | IR35-00-3 |
| VPS | Package peak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

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]



ATTENTION
 OBSERVE PRECAUTIONS
 FOR HANDLING
 ELECTROSTATIC
 SENSITIVE
 DEVICES

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- NEC semiconductor products are classified into the following three quality grades:
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 "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).