DATA SHEET

NEC

# BIPOLAR ANALOG INTEGRATED CIRCUIT

# μPC3237TK

## LOW NOISE WIDE BAND SILICON GERMANIUM MMIC AMPLIFIER FOR MOBILE COMMUNICATIONS

### DESCRIPTION

The μPC3237TK is a silicon germanium (SiGe) monolithic integrated circuit designed as low noise amplifier for the mobile digital TV etc. This device exhibits low noise figure and high power gain characteristics.

This package is 6-pin lead-less minimold, suitable for surface mount.

This IC is manufactured using our 50 GHz $f_{max}$ UHS2 (Ultra High Speed Process) SiGe bipolar process.

### FEATURES

- Supply voltage : $V_{CC}$ = 2.4 to 3.3 V (2.8 V TYP.)
- Low current consumption : $I_{CC}$ = 5 mA TYP. @ $V_{CC}$ = 2.8 V
- Low Noise : NF = 1.4 dB TYP. @ f = 470 MHz
  : NF = 1.5 dB TYP. @ f = 770 MHz
- Power gain : $G_P$ = 15.3 dB TYP. @ f = 470 MHz
  : $G_P$ = 13.5 dB TYP. @ f = 770 MHz
- High-density surface mounting : 6-pin lead-less minimold package (1.5 × 1.1 × 0.55 mm)

### APPLICATIONS

- Low noise amplifier for the mobile digital TV etc.

### ORDERING INFORMATION

| Part Number | Order Number | Package | Marking | Supplying Form |
|---|---|---|---|---|
| μPC3237TK-E2 | μPC3237TK-E2-A | 6-pin lead-less minimold (1511 PKG) (Pb-Free) | 6N | • Embossed tape 8 mm wide<br>• Pin 1, 6 face the perforation side of the tape<br>• Qty 5 kpcs/reel |

**Remark** To order evaluation samples, please contact your nearby sales office
Part number for sample order: μPC3237TK

**Caution Observe precautions when handling because these devices are sensitive to electrostatic discharge.**



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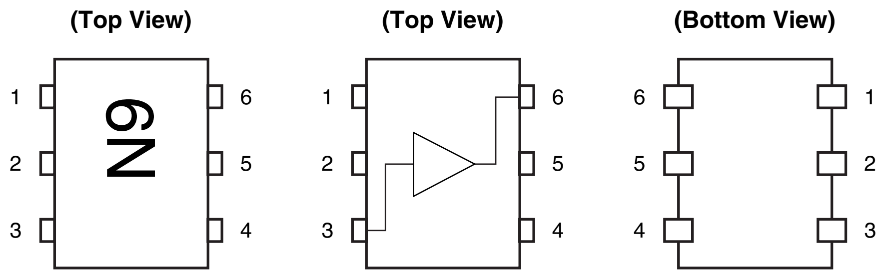
## PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM




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

## ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | $T_A$ = +25°C | 3.6 | V |
| Circuit Current | $I_{CC}$ | $T_A$ = +25°C | 10 | mA |
| Power Dissipation | $P_D$ | $T_A$ = +85°C **Note** | 203 | 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 | +8 | dBm |

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

## RECOMMENDED OPERATING RANGE

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 2.4 | 2.8 | 3.3 | V |
| Operating Ambient Temperature | $T_A$ | –40 | +25 | +85 | °C |

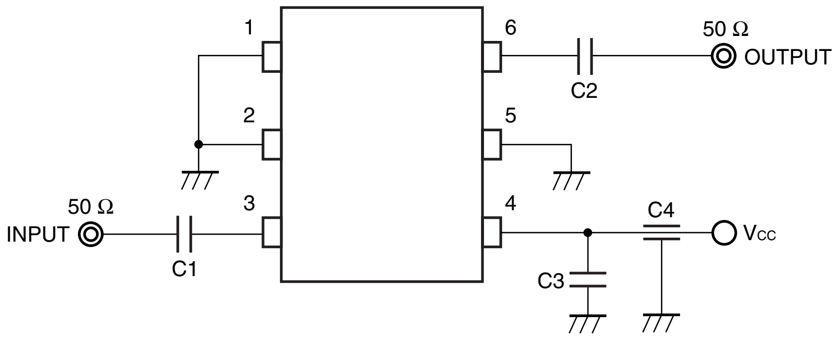
## ELECTRICAL CHARACTERISTICS ($T_A$ = +25°C, $V_{CC}$ = 2.8 V, $Z_S$ = $Z_L$ = 50 Ω, unless otherwise specified)

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Circuit Current | $I_{CC}$ | No input signal | 3.5 | 5 | 7 | mA |
| Power Gain 1 | $G_P1$ | f = 470 MHz, $P_{in}$ = –30 dBm | 13.0 | 15.3 | 17.5 | dB |
| Power Gain 2 | $G_P2$ | f = 770 MHz, $P_{in}$ = –30 dBm | 11.0 | 13.5 | 16.0 | dB |
| Noise Figure 1 | NF1 | f = 470 MHz | – | 1.4 | 1.9 | dB |
| Noise Figure 2 | NF2 | f = 770 MHz | – | 1.5 | 2.0 | dB |
| Input Return Loss 1 | $RL_{in}1$ | f = 470 MHz, $P_{in}$ = –30 dBm | 6.5 | 9.5 | – | dB |
| Input Return Loss 2 | $RL_{in}2$ | f = 770 MHz, $P_{in}$ = –30 dBm | 5.5 | 8.5 | – | dB |
| Output Return Loss 1 | $RL_{out}1$ | f = 470 MHz, $P_{in}$ = –30 dBm | 9 | 14 | – | dB |
| Output Return Loss 2 | $RL_{out}2$ | f = 770 MHz, $P_{in}$ = –30 dBm | 10 | 15 | – | dB |
| Isolation 1 | ISL1 | f = 470 MHz, $P_{in}$ = –30 dBm | 17 | 22 | – | dB |
| Isolation 2 | ISL2 | f = 770 MHz, $P_{in}$ = –30 dBm | 16 | 21 | – | dB |
| Gain 1 dB Compression Output Power 1 | $P_{O\,(1\,dB)}\,1$ | f = 470 MHz | –8 | –5.5 | – | dBm |
| Gain 1 dB Compression Output Power 2 | $P_{O\,(1\,dB)}\,2$ | f = 770 MHz | –8 | –5.5 | – | dBm |

## STANDARD CHARACTERISTICS FOR REFERENCE
## ($T_A$ = +25°C, $V_{CC}$ = 2.8 V, $Z_S$ = $Z_L$ = 50 Ω, unless otherwise specified)

| Parameter | Symbol | Test Conditions | Reference Value | Unit |
|---|---|---|---|---|
| Saturated Output Power 1 | $P_{O\,(sat)}\,1$ | f = 470 MHz, $P_{in}$ = +2 dBm | +1.3 | dBm |
| Saturated Output Power 2 | $P_{O\,(sat)}\,2$ | f = 770 MHz, $P_{in}$ = +2 dBm | +1.3 | dBm |
| Input 3rd Order Distortion Intercept Point 1 | $IIP_31$ | f1 = 470 MHz, f2 = 471 MHz | –10.5 | dBm |
| Input 3rd Order Distortion Intercept Point 2 | $IIP_32$ | f1 = 770 MHz, f2 = 771 MHz | –9.5 | dBm |
| Output 3rd Order Distortion Intercept Point 1 | $OIP_31$ | f1 = 470 MHz, f2 = 471 MHz | +4.8 | dBm |
| Output 3rd Order Distortion Intercept Point 2 | $OIP_32$ | f1 = 770 MHz, f2 = 771 MHz | +4.0 | dBm |
| K factor 1 | K1 | f = 470 MHz | 1.15 | – |
| K factor 2 | K2 | f = 770 MHz | 1.20 | – |

## TEST CIRCUIT

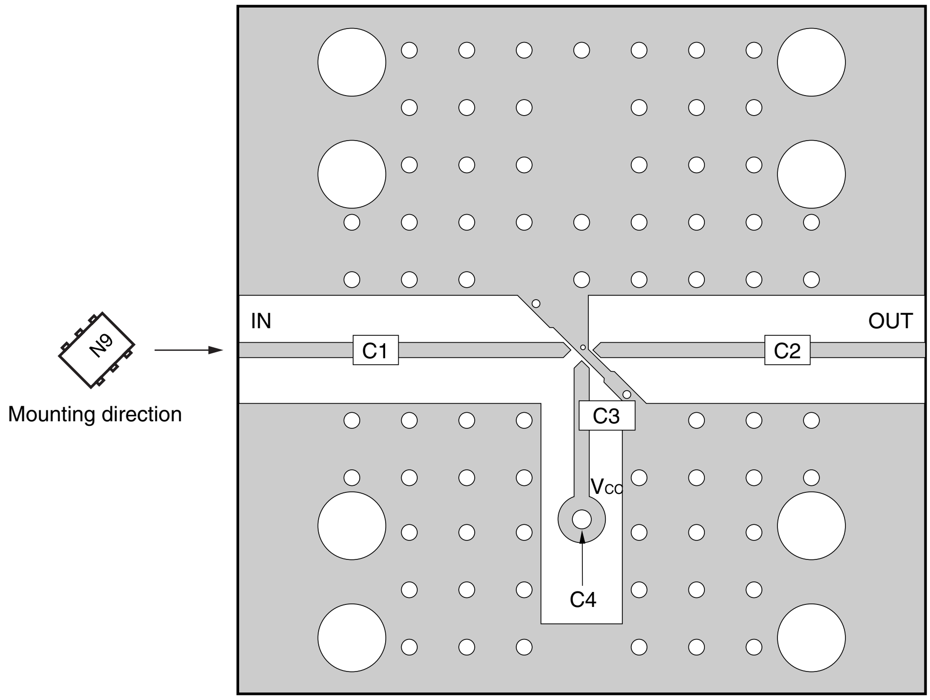



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

## COMPONENTS OF TEST CIRCUIT FOR MEASURING ELECTRICAL CHARACTERISTICS

| | Type | Value |
|---|---|---|
| C1, C2 | Chip Capacitor | 100 pF |
| C3 | Chip Capacitor | 1 000 pF |
| C4 | Feed-through Capacitor | 1 000 pF |

## ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD

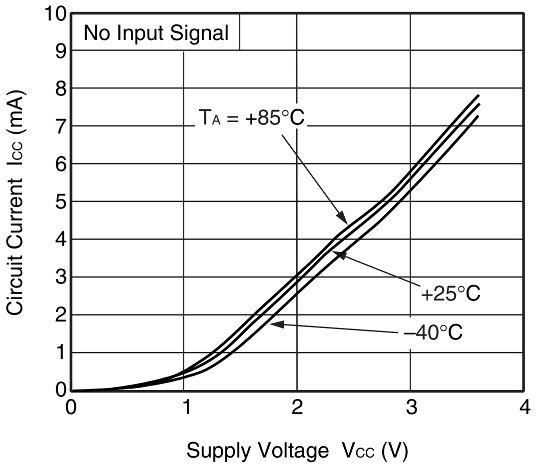



**Notes**

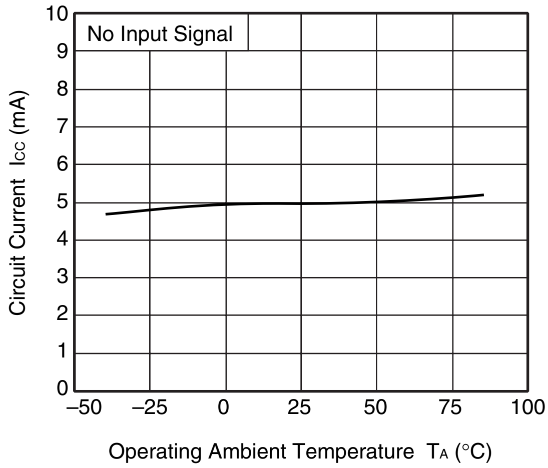
1. 30 × 30 × 0.4 mm double sided copper clad FR-4 board.
2. Back side: GND pattern
3. Au plated on pattern
4. ○◯: Through holes

**TYPICAL CHARACTERISTICS ($T_A$ = +25°C, $V_{CC}$ = 2.8 V, $Z_S$ = $Z_L$ = 50 Ω, unless otherwise specified)**

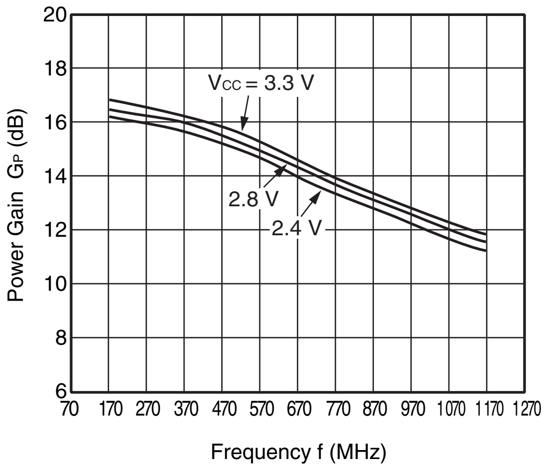
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



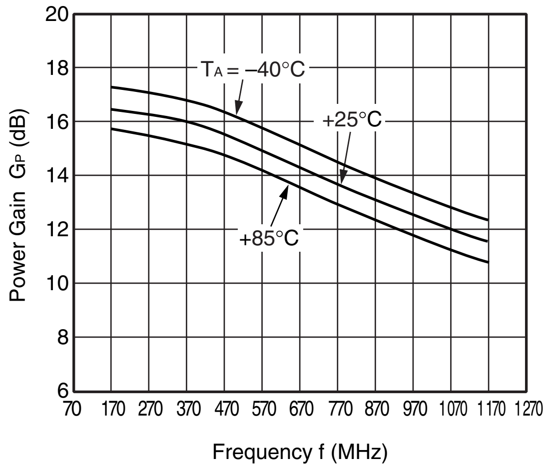

CURCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



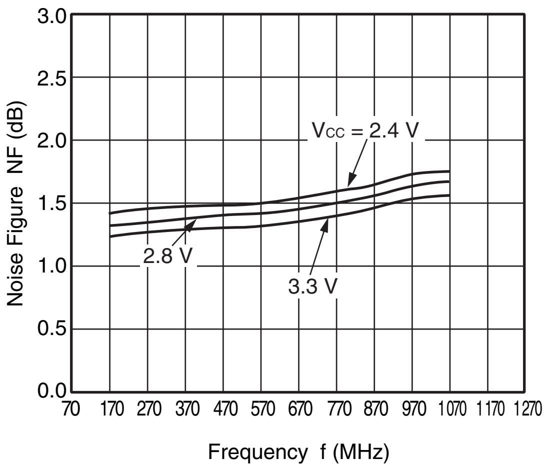

POWER GAIN vs. FREQUENCY



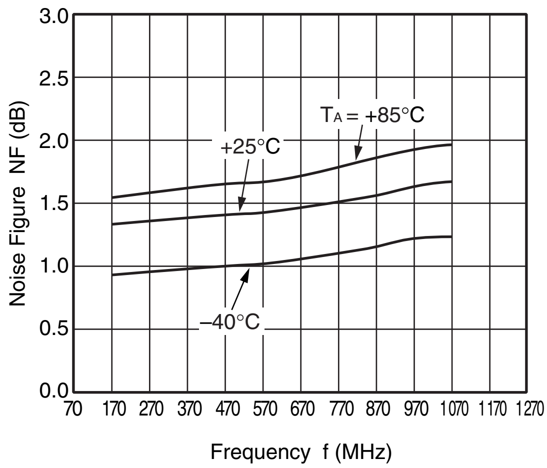

POWER GAIN vs. FREQUENCY




NOISE FIGURE vs. FREQUENCY

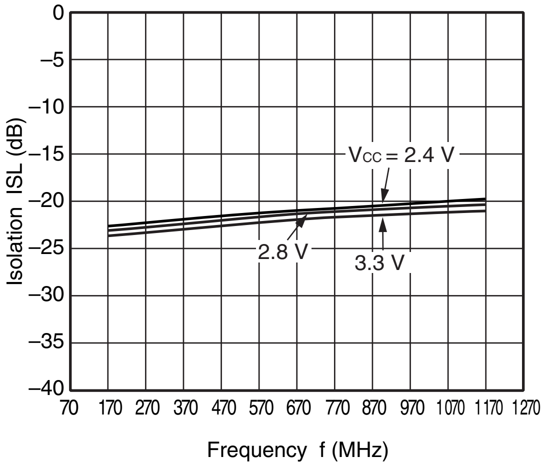



NOISE FIGURE vs. FREQUENCY

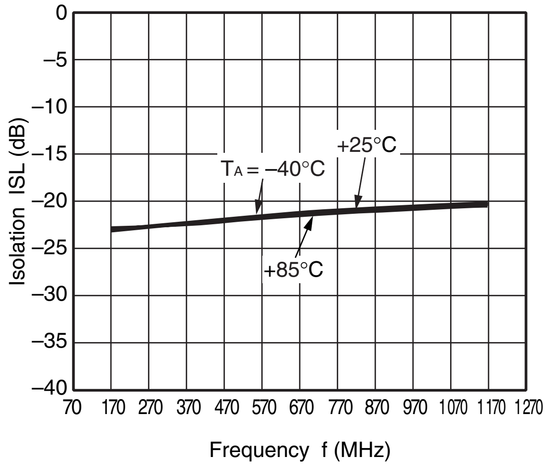



**Remark** The graphs indicate nominal characteristics.

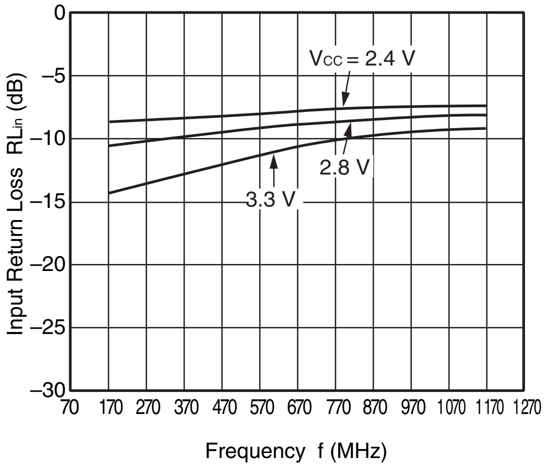
ISOLATION vs. FREQUENCY



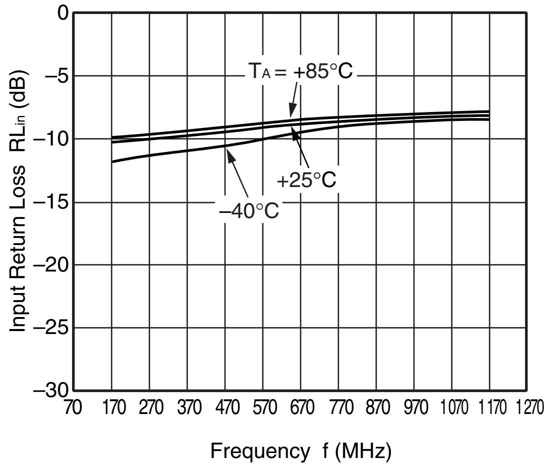

ISOLATION vs. FREQUENCY



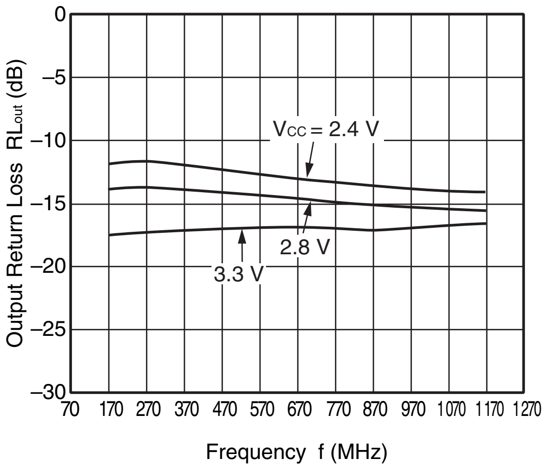

INPUT RETURN LOSS vs. FREQUENCY



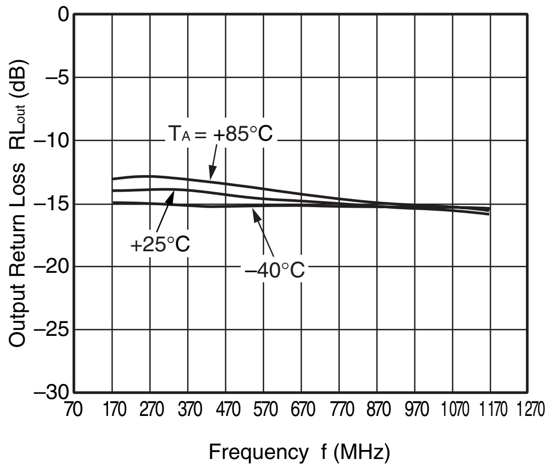

INPUT RETURN LOSS vs. FREQUENCY




OUTPUT RETURN LOSS vs. FREQUENCY

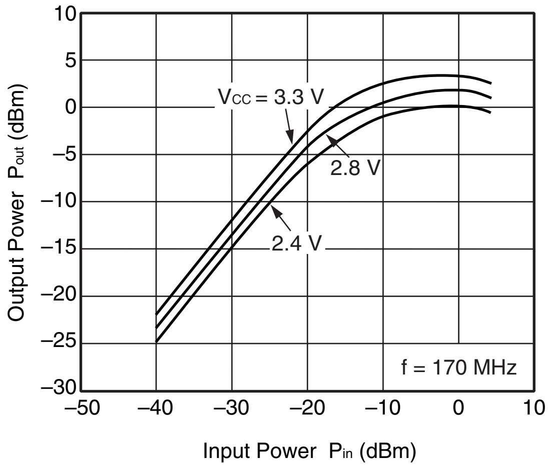



OUTPUT RETURN LOSS vs. FREQUENCY

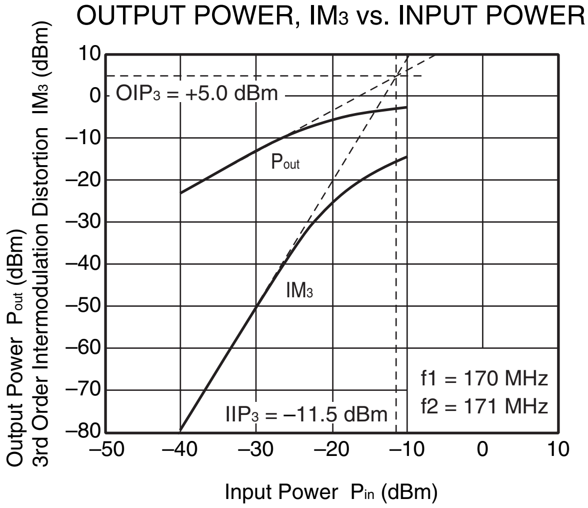



**Remark** The graphs indicate nominal characteristics.

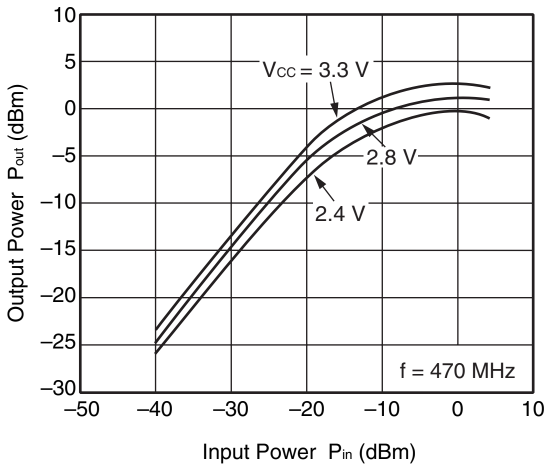
OUTPUT POWER vs. INPUT POWER



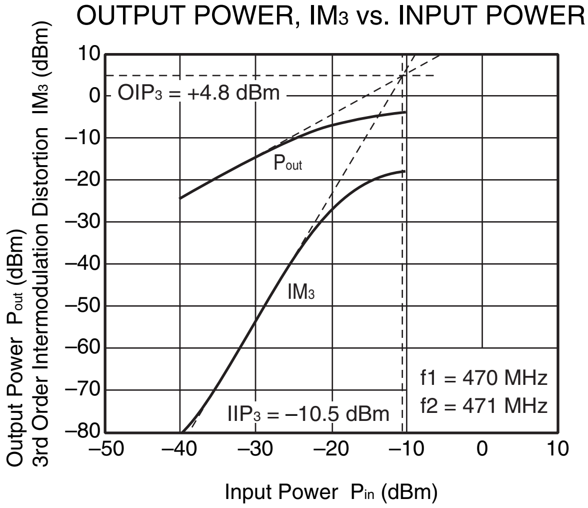

OUTPUT POWER, IM3 vs. INPUT POWER



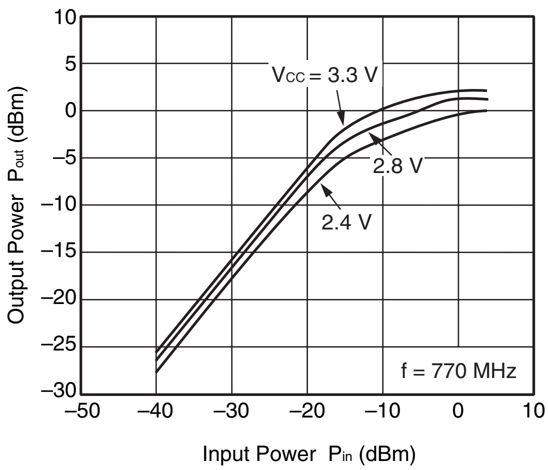

OUTPUT POWER vs. INPUT POWER



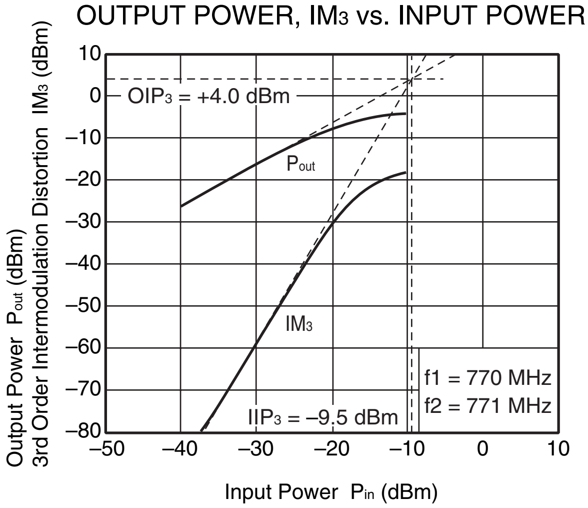

OUTPUT POWER, IM3 vs. INPUT POWER




OUTPUT POWER vs. INPUT POWER




OUTPUT POWER, IM3 vs. INPUT POWER

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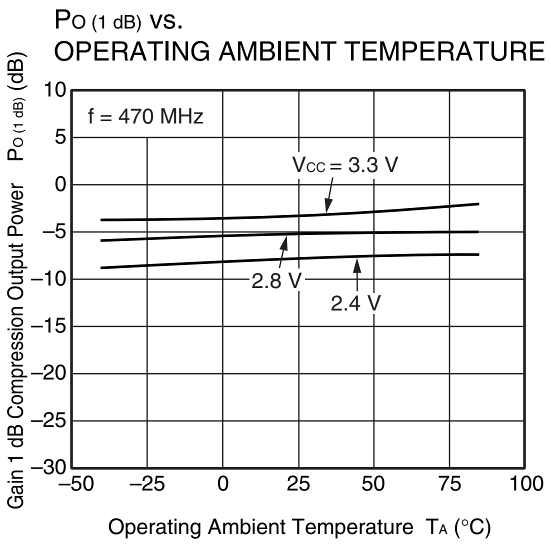
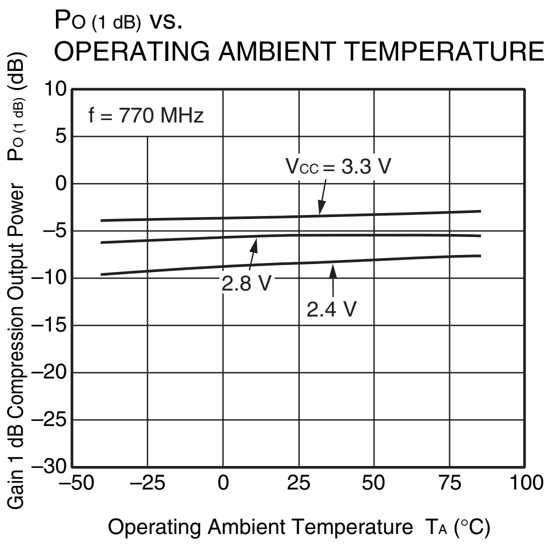
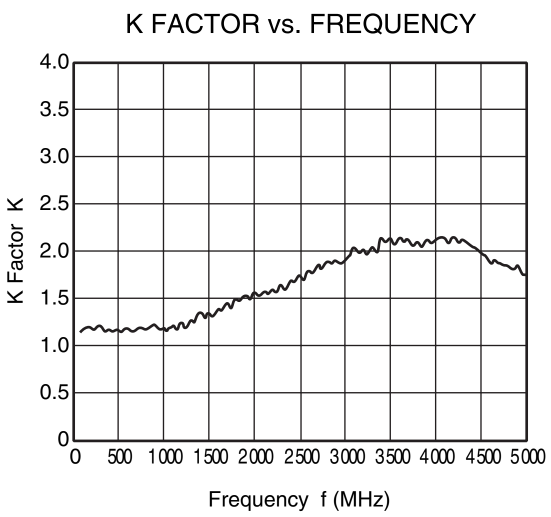


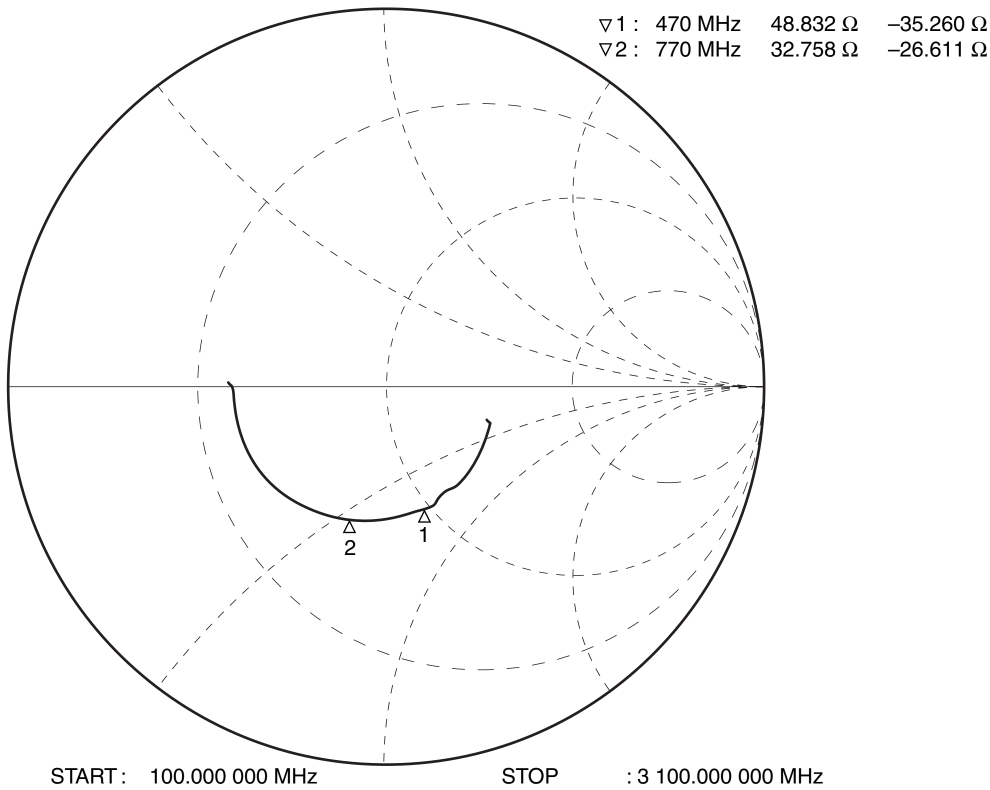



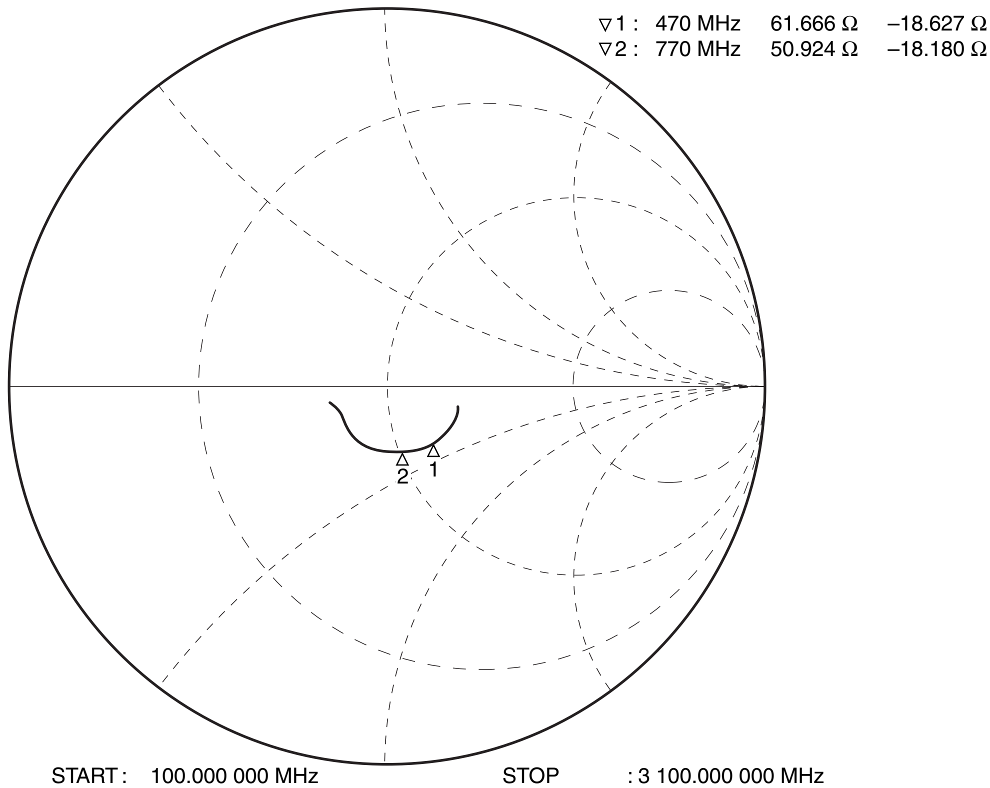

**Remark** The graphs indicate nominal characteristics.

## S-PARAMETERS ($T_A$ = +25°C, $V_{CC}$ = 2.8 V, monitored at connector on board)

### $S_{11}$–FREQUENCY

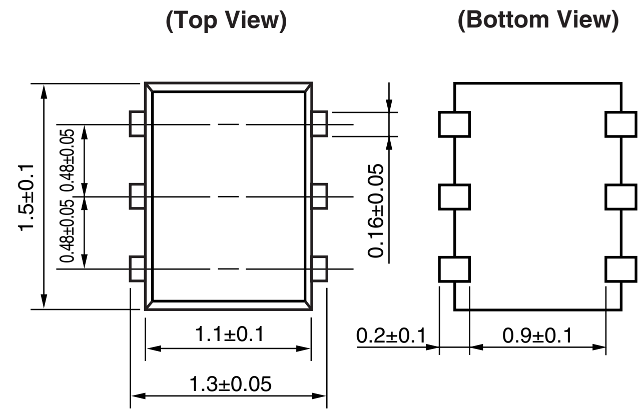


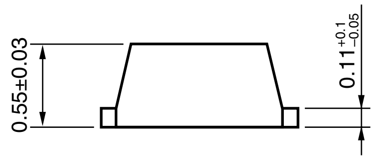

### $S_{22}$–FREQUENCY



**PACKAGE DIMENSIONS**

**6-PIN LEAD-LESS MINIMOLD (1511 PKG) (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 DC cut capacitor should be attached to Input and Output pin.
(5) Pin 1 (NC) should be connected to the ground pattern.

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

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