# $\mu$PC8236T6N

## SiGe:C LOW NOISE AMPLIFIER FOR GPS

### DESCRIPTION

The $\mu$PC8236T6N is a silicon germanium carbon (SiGe:C) monolithic integrated circuit designed as low noise amplifier for GPS. This device exhibits low noise figure and high power gain characteristics, so this IC can improve the sensitivity of GPS receiver. In addition, the $\mu$PC8236T6N which is included output matching circuit contributes to reduce external components and system size.

The package is a 6-pin plastic TSON (Thin Small Out-line Non-leaded) (T6N) suitable for surface mount.

This IC is manufactured using our UHS4 (Ultra High Speed Process) SiGe:C bipolar process.

### FEATURES

- Supply voltage : $V_{CC}$ = 1.6 to 3.3 V (2.7 V TYP.)
- Low noise : NF = 0.8 dB TYP. @ $V_{CC}$ = 2.7 V, $f_{in}$ = 1 575 MHz
  : NF = 0.8 dB TYP. @ $V_{CC}$ = 1.8 V, $f_{in}$ = 1 575 MHz
- High gain : $G_P$ = 19.5 dB TYP. @ $V_{CC}$ = 2.7 V, $f_{in}$ = 1 575 MHz
  : $G_P$ = 19.1 dB TYP. @ $V_{CC}$ = 1.8 V, $f_{in}$ = 1 575 MHz
- Low current consumption : $I_{CC}$ = 6.5 mA TYP. @ $V_{CC}$ = 2.7 V
- Built-in power-saving function : $V_{PSon}$ = 1.0 V to $V_{CC}$, $V_{PSoff}$ = 0 to 0.4 V
- High-density surface mounting : 6-pin plastic TSON (T6N) package (1.5 × 1.5 × 0.37 mm)
- Included output matching circuit
- Included very robust bandgap regulator (Small $V_{CC}$ and $T_A$ dependence)
- Included protection circuits for ESD

### APPLICATION

- Low noise amplifier for GPS

### ORDERING INFORMATION

| Part Number | Order Number | Package | Marking | Supplying Form |
|---|---|---|---|---|
| $\mu$PC8236T6N-E2 | $\mu$PC8236T6N-E2-A | 6-pin plastic TSON (T6N) (Pb-Free) | 6S | • 8 mm wide embossed taping<br>• Pin 1, 6 face the perforation side of the tape<br>• Qty 3 kpcs/reel |

**Remark** To order evaluation samples, contact your nearby sales office.
Part number for sample order: $\mu$PC8236T6N-A

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



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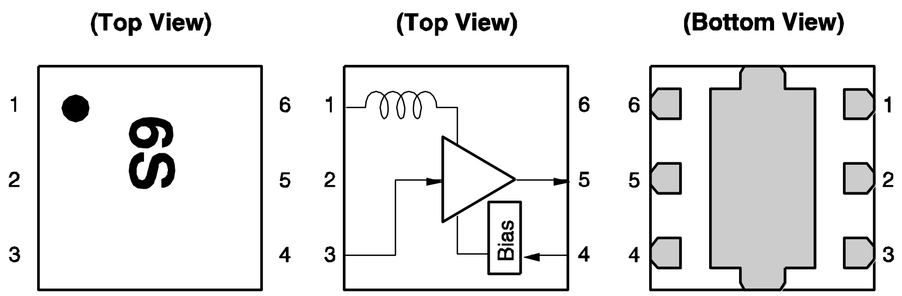
## PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM




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

**Remark** Exposed pad : GND

## ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Test Conditions | Ratings | Unit |
| --- | --- | --- | --- | --- |
| Supply Voltage | $V_{CC}$ | $T_A$ = +25°C | 4.0 | V |
| Power-Saving Voltage | $V_{PS}$ | $T_A$ = +25°C | 4.0 | V |
| Total Power Dissipation | $P_{tot}$ | | 150 | mW |
| Operating Ambient Temperature | $T_A$ | | –40 to +85 | °C |
| Storage Temperature | $T_{stg}$ | | –55 to +150 | °C |
| Input Power | $P_{in}$ | | +10 | dBm |

## RECOMMENDED OPERATING RANGE

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
| --- | --- | --- | --- | --- | --- |
| Supply Voltage | $V_{CC}$ | 1.6 | 2.7 | 3.3 | V |
| Operating Ambient Temperature | $T_A$ | –40 | +25 | +85 | °C |
| Power Save Turn-on Voltage | $V_{PSon}$ | 1.0 | – | $V_{CC}$ | V |
| Power Save Turn-off Voltage | $V_{PSoff}$ | 0 | – | 0.4 | V |

## ELECTRICAL CHARACTERISTICS

**($T_A$ = +25°C, $V_{CC}$ = $V_{PS}$ = 2.7 V, $f_{in}$ = 1 575 MHz, unless otherwise specified)**

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
| --- | --- | --- | --- | --- | --- | --- |
| Circuit Current | $I_{CC}$ | No Signal ($V_{PS}$ = 2.7 V) | 5.0 | 6.5 | 8.0 | mA |
| | | At Power-Saving Mode ($V_{PS}$ = 0 V) | – | – | 1 | μA |
| Power Gain | $G_P$ | $P_{in}$ = –35 dBm | 17 | 19.5 | 22 | dB |
| Noise Figure | NF | | – | 0.8 | 1.1 | dB |
| Input Return Loss | $RL_{in}$ | | 7.5 | 11 | – | dB |
| Output Return Loss | $RL_{out}$ | | 11 | 14 | – | dB |

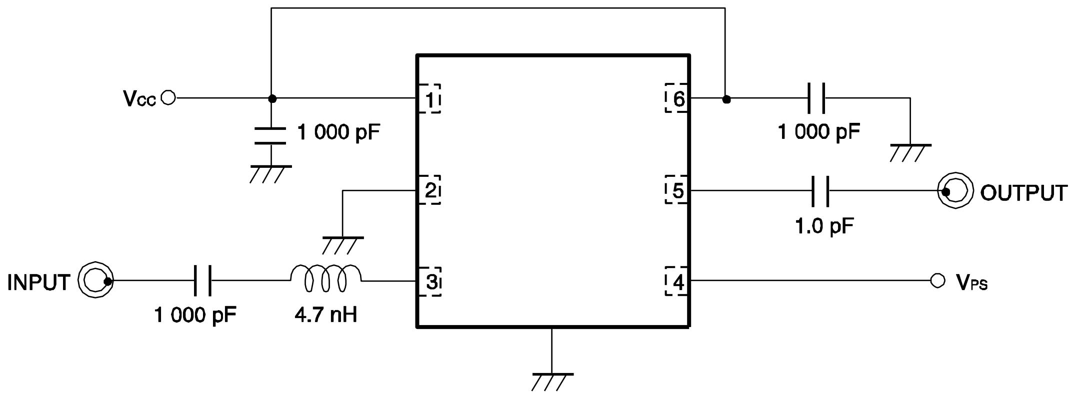
## STANDARD CHARACTERISTICS FOR REFERENCE 1
**($T_A$ = +25°C, $V_{CC}$ = $V_{PS}$ = 2.7 V, $f_{in}$ = 1 575 MHz, unless otherwise specified)**

| Parameter | Symbol | Test Conditions | Reference | Unit |
|---|---|---|---|---|
| Input 3rd Order Intercept Point | $IIP_3$ | $f_{in}1$ = 1 575 MHz, $f_{in}2$ = 1 574 MHz | −3 | dBm |
| Isolation | ISL | | 39 | dB |
| Gain 1 dB Compression Input Power | $P_{in\ (1\ dB)}$ | | −18 | dBm |

## STANDARD CHARACTERISTICS FOR REFERENCE 2
**($T_A$ = +25°C, $V_{CC}$ = $V_{PS}$ = 1.8 V, $f_{in}$ = 1 575 MHz, unless otherwise specified)**

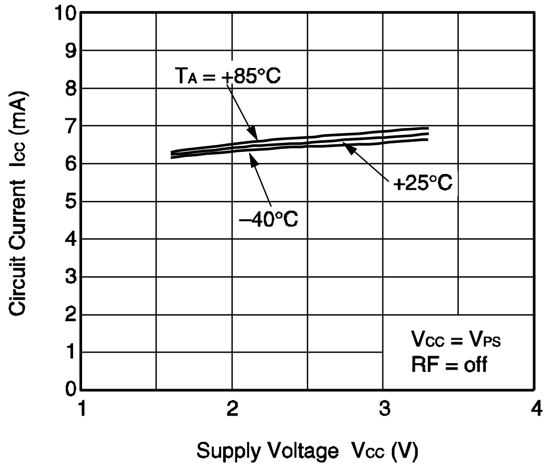
| Parameter | Symbol | Test Conditions | Reference | Unit |
|---|---|---|---|---|
| Circuit Current | $I_{CC}$ | No Signal ($V_{PS}$ = 1.8 V) | 6.2 | mA |
| Power Gain | $G_P$ | $P_{in}$ = −35 dBm | 19.1 | dB |
| Noise Figure | NF | | 0.8 | dB |
| Input 3rd Order Intercept Point | $IIP_3$ | $f_{in}1$ = 1 575 MHz, $f_{in}2$ = 1 574 MHz | −5 | dBm |
| Input Return Loss | $RL_{in}$ | | 11 | dB |
| Output Return Loss | $RL_{out}$ | | 14 | dB |
| Isolation | ISL | | 39 | dB |
| Gain 1 dB Compression Input Power | $P_{in\ (1\ dB)}$ | | −19 | dBm |

## TEST CIRCUIT

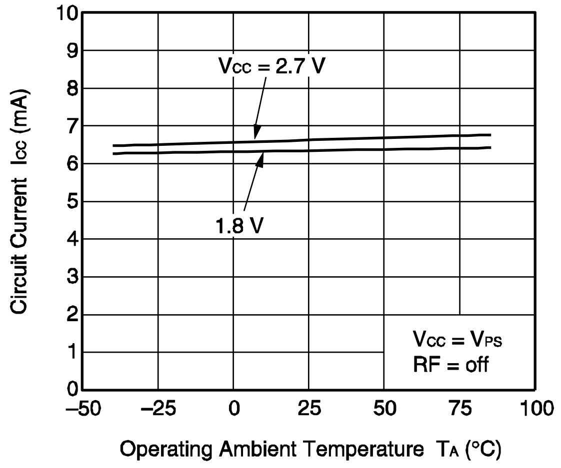


**TYPICAL CHARACTERISTICS ($T_A$ = +25°C, unless otherwise specified)**

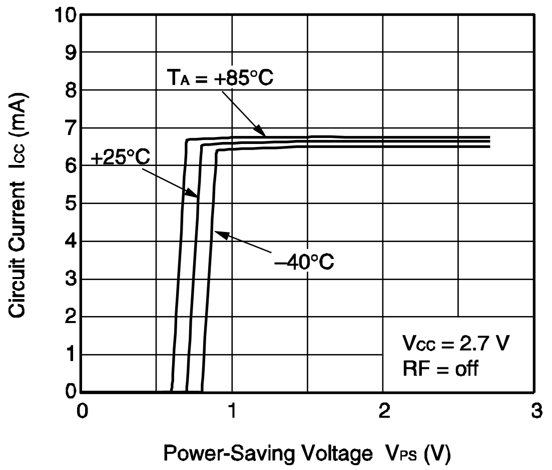
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



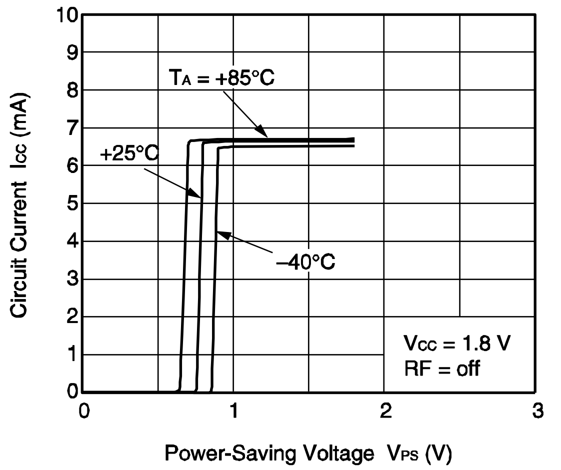

CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



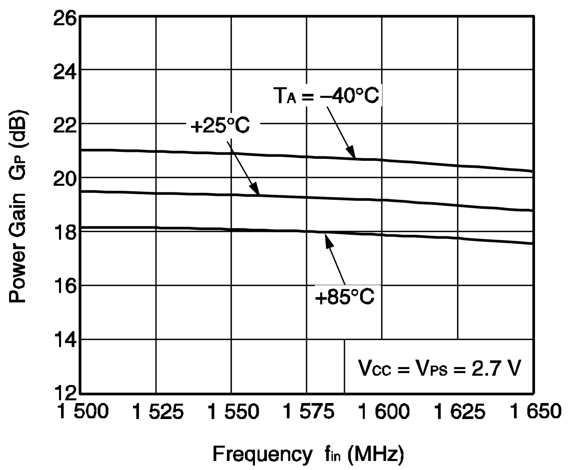

CIRCUIT CURRENT vs. POWER-SAVING VOLTAGE



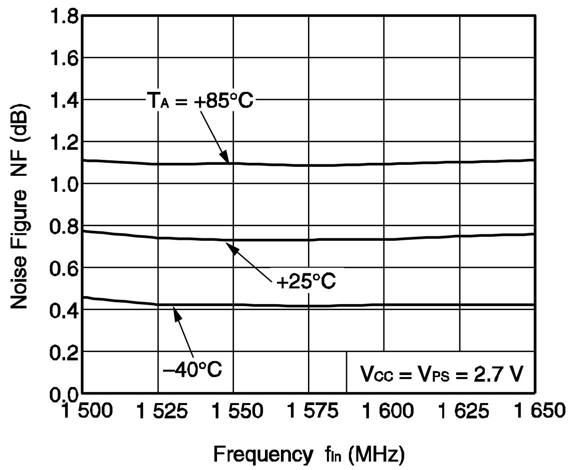

CIRCUIT CURRENT vs. POWER-SAVING VOLTAGE




POWER GAIN vs. FREQUENCY

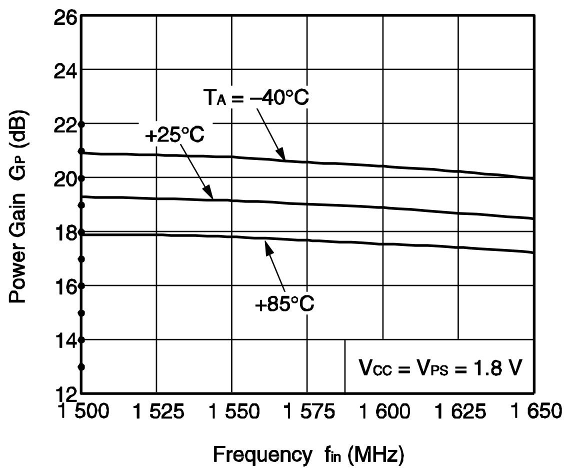



NOISE FIGURE vs. FREQUENCY

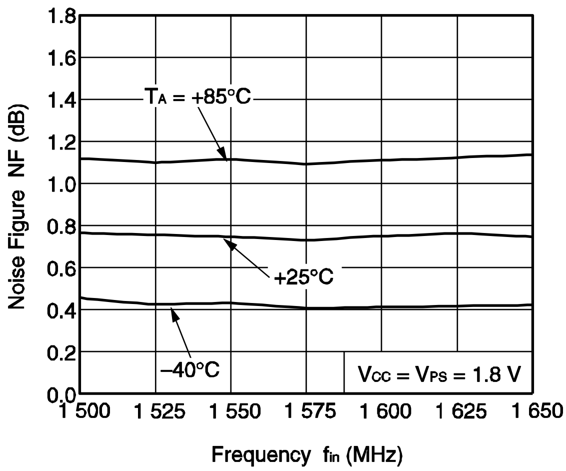



**Remark** The graphs indicate nominal characteristics.

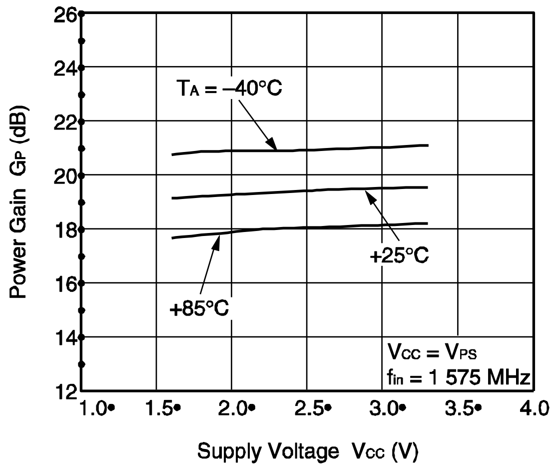
POWER GAIN vs. FREQUENCY



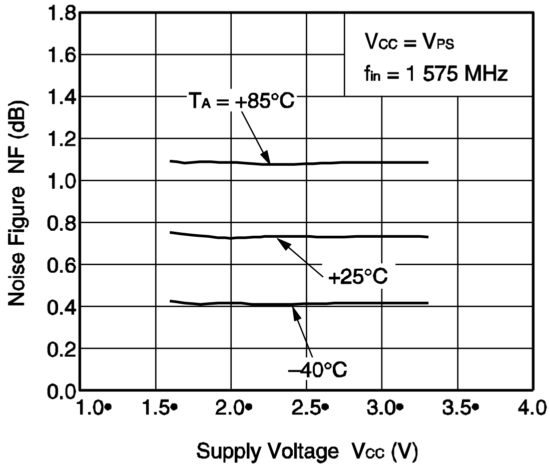

NOISE FIGURE vs. FREQUENCY



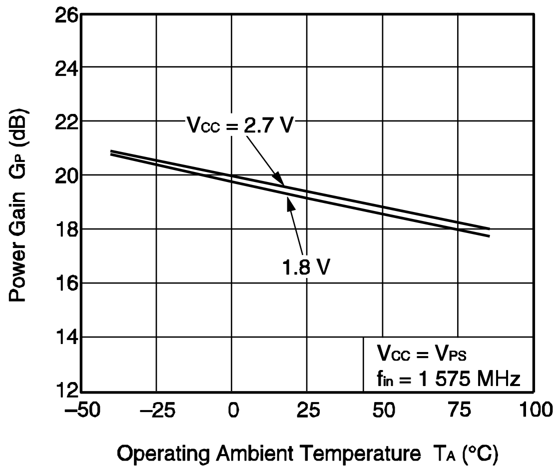

POWER GAIN vs. SUPPLY VOLTAGE



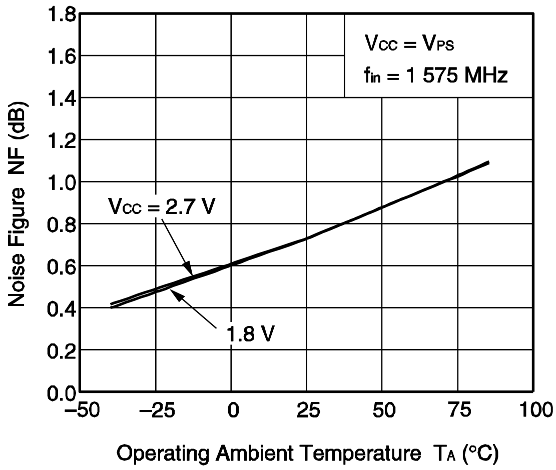

NOISE FIGURE vs. SUPPLY VOLTAGE




POWER GAIN vs. OPERATING AMBIENT TEMPERATURE

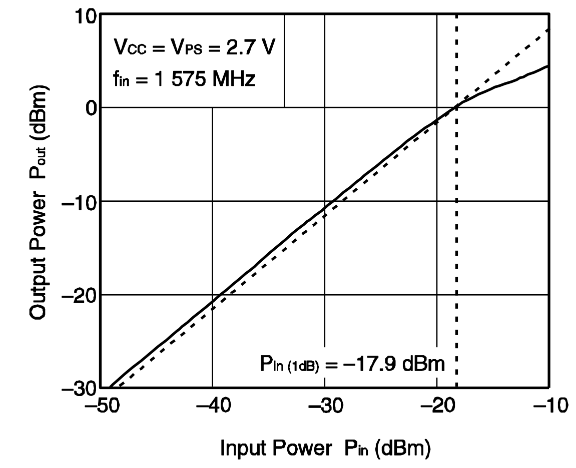



NOISE FIGURE vs. OPERATING AMBIENT TEMPERATURE

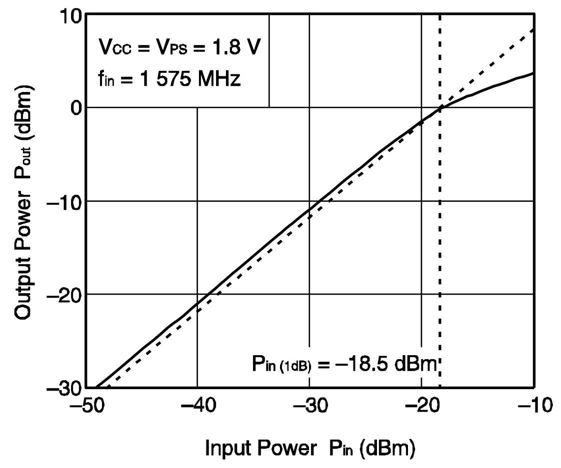



**Remark** The graphs indicate nominal characteristics.

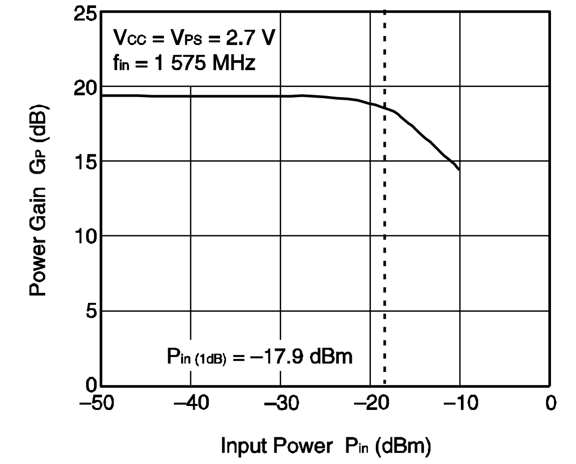
OUTPUT POWER vs. INPUT POWER



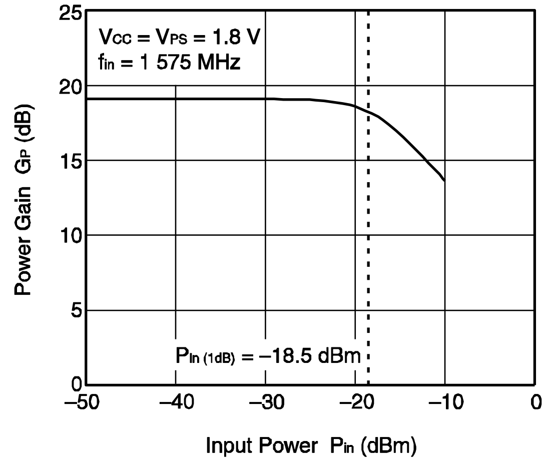

OUTPUT POWER vs. INPUT POWER



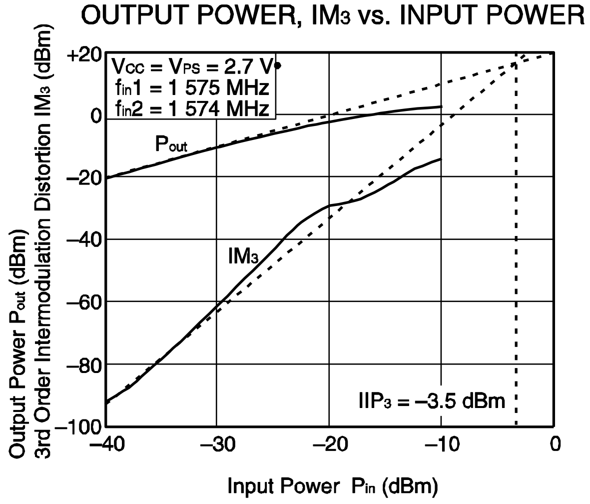

POWER GAIN vs. INPUT POWER



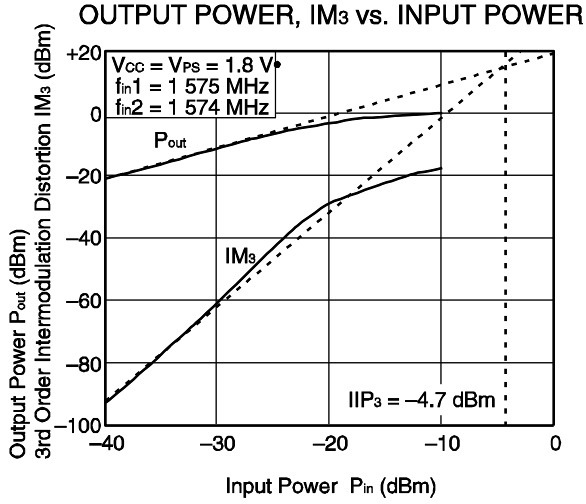

POWER GAIN vs. INPUT POWER




OUTPUT POWER, IM3 vs. INPUT POWER

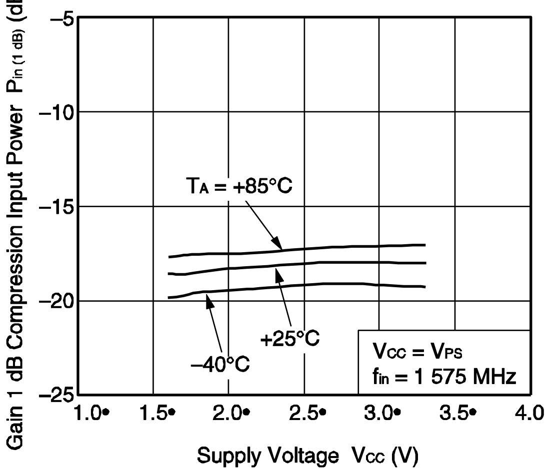



OUTPUT POWER, IM3 vs. INPUT POWER

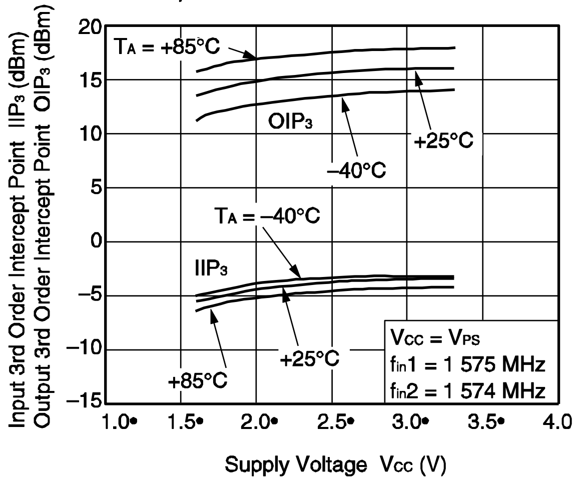



**Remark** The graphs indicate nominal characteristics.

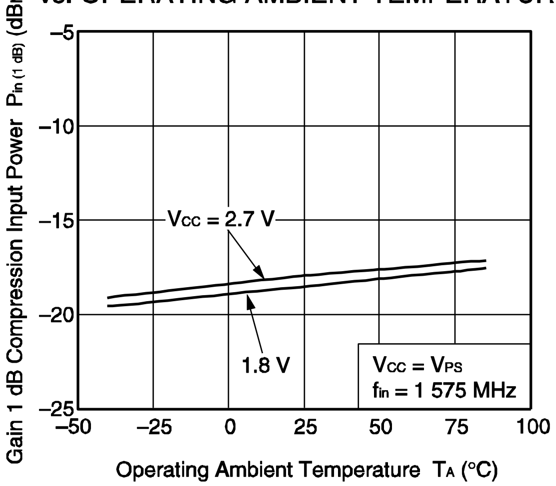
GAIN 1 dB COMPRESSION INPUT POWER vs. SUPPLY VOLTAGE



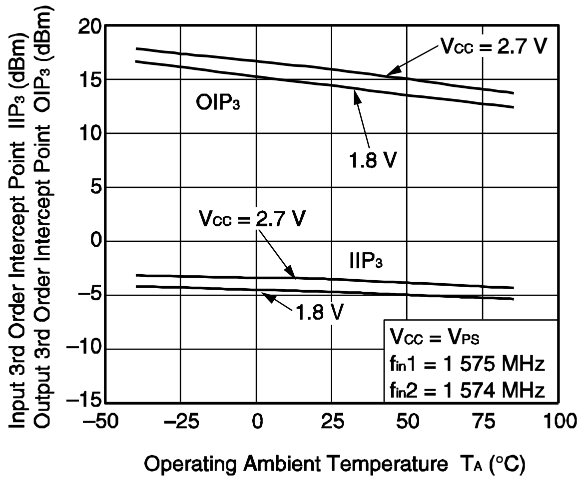

IIP3, OIP3 vs. SUPPLY VOLTAGE



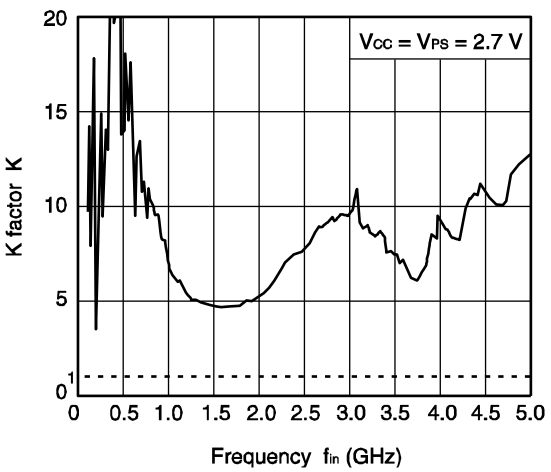

GAIN 1 dB COMPRESSION INPUT POWER vs. OPERATING AMBIENT TEMPERATURE



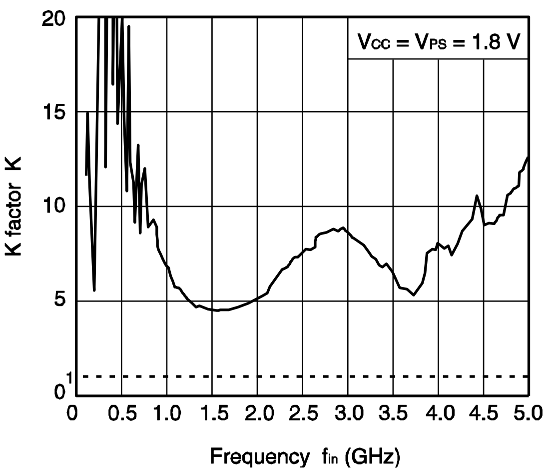

IIP3, OIP3 vs. OPERATING AMBIENT TEMPERATURE




K FACTOR vs. FREQUENCY



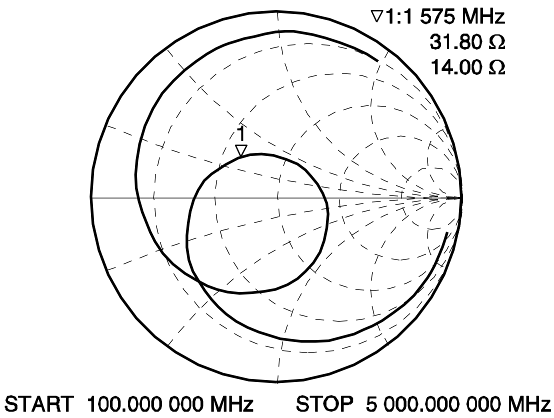

K FACTOR vs. FREQUENCY



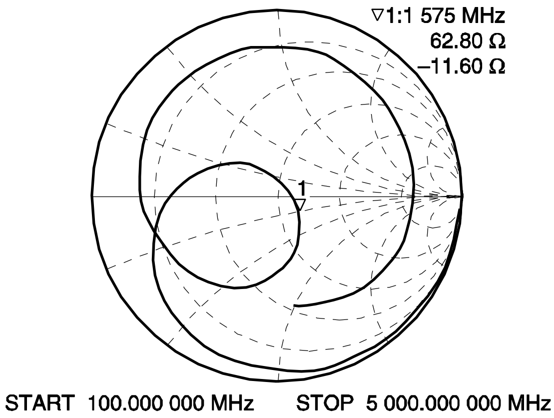

**Remark** The graphs indicate nominal characteristics.

**S-PARAMETERS ($T_A$ = +25°C, $V_{CC}$ = $V_{PS}$ = 2.7 V, monitored at connector on board)**

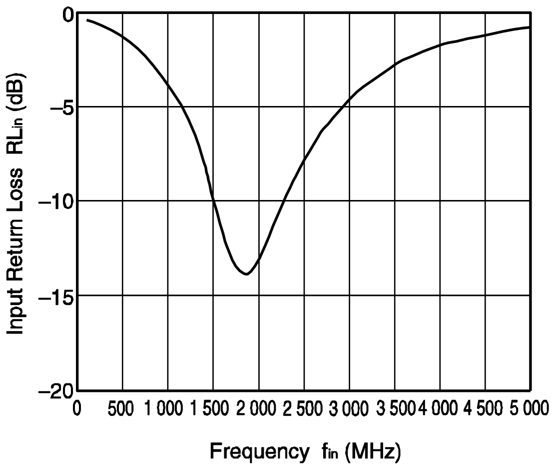
S11–FREQUENCY



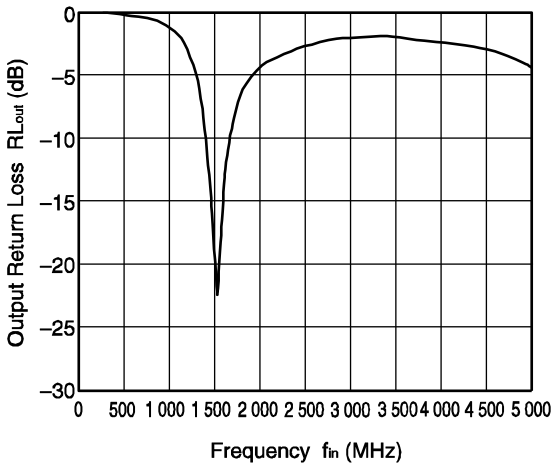

S22–FREQUENCY



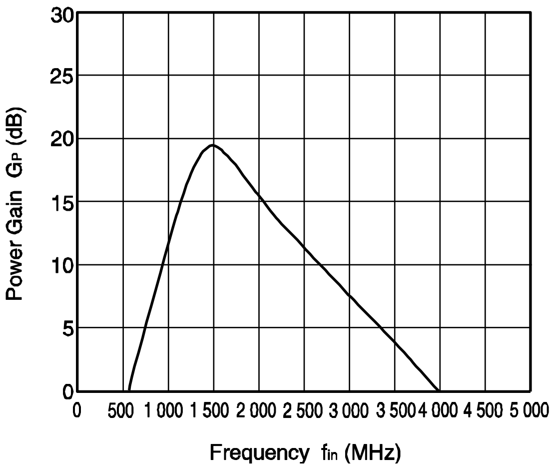

INPUT RETURN LOSS vs. FREQUENCY



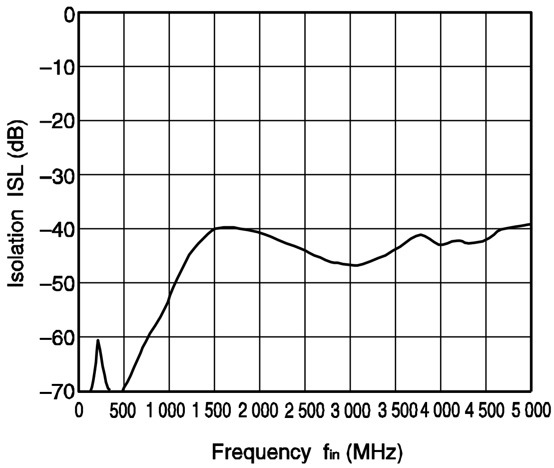

OUTPUT RETURN LOSS vs. FREQUENCY




POWER GAIN vs. FREQUENCY

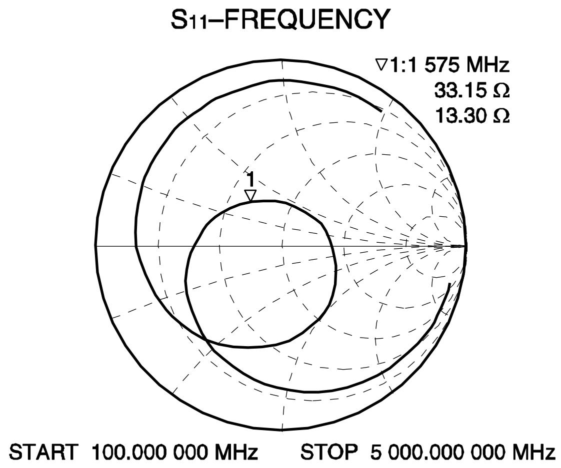


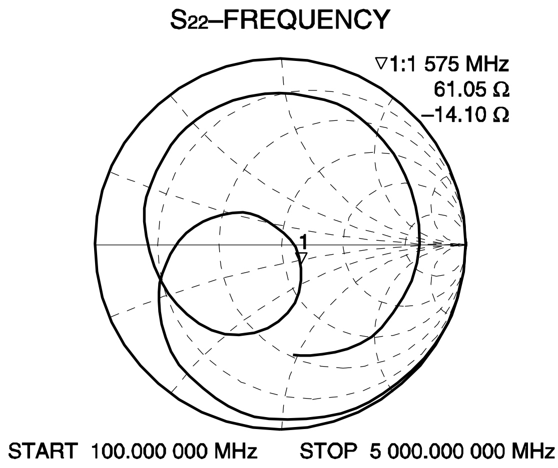

ISOLATION vs. FREQUENCY

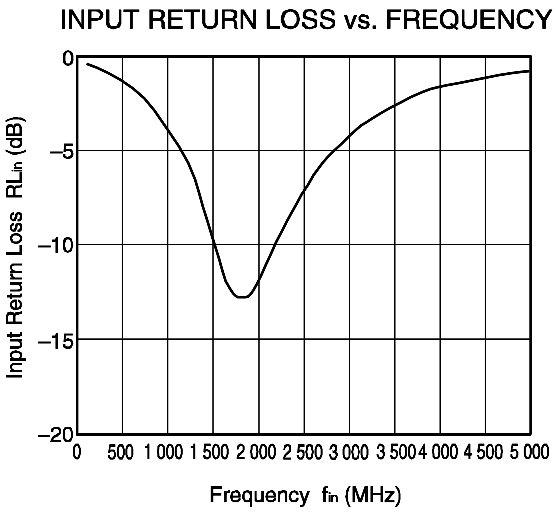


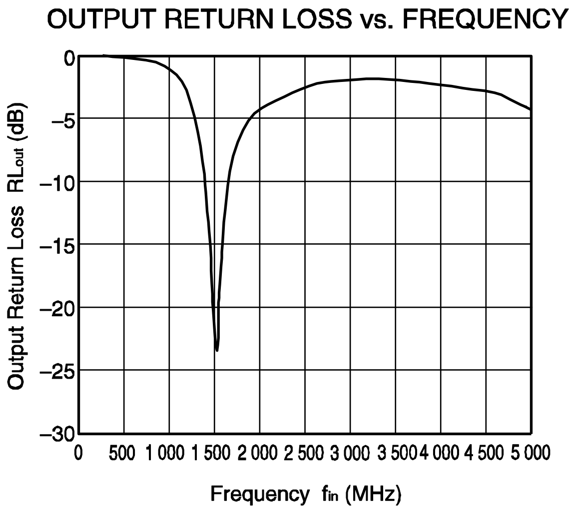

**Remark** The graphs indicate nominal characteristics.

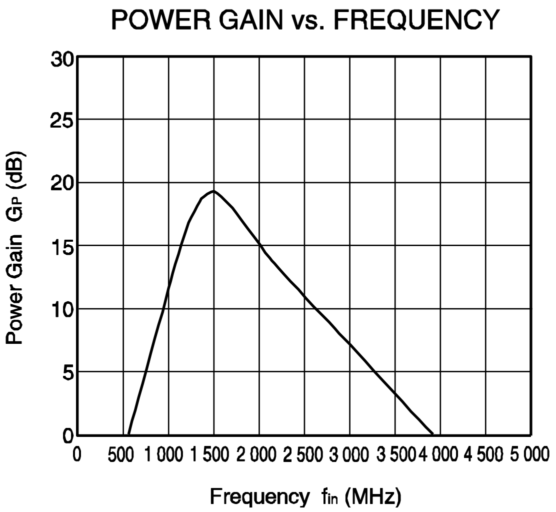
**S-PARAMETERS ($T_A$ = +25°C, $V_{CC}$ = $V_{PS}$ = 1.8 V, monitored at connector on board)**

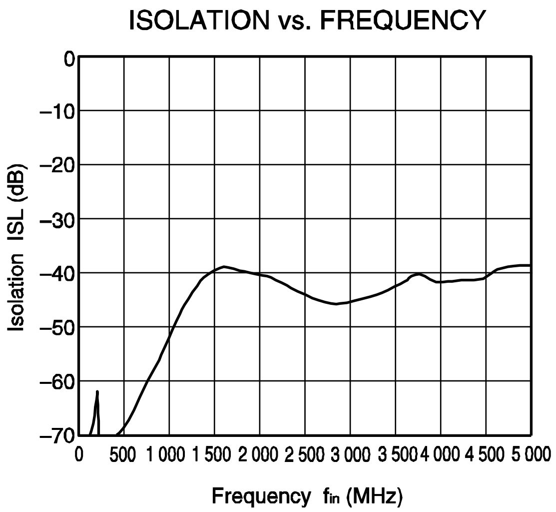


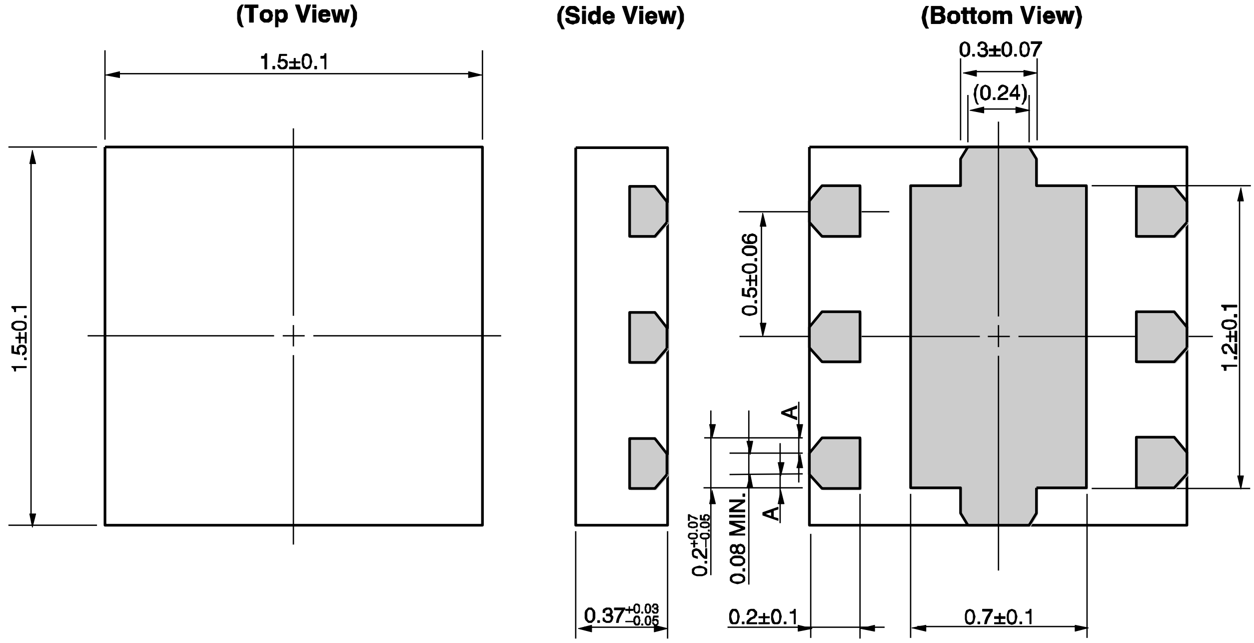




**Remark** The graphs indicate nominal characteristics.

## PACKAGE DIMENSIONS

### 6-PIN PLASTIC TSON (T6N) (UNIT: mm)




**Remark** A>0

( ) : Reference value

## 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 $V_{CC}$ line.
(4) Do not supply DC voltage to INPUT pin.

## 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).**