



# BIPOLAR ANALOG INTEGRATED CIRCUIT

## UPC3227TB

### 5 V, SILICON GERMANIUM MMIC WIDEBAND AMPLIFIER

#### DESCRIPTION

The  $\mu$ PC3227TB is a silicon germanium (SiGe) monolithic integrated circuit designed as IF amplifier for DBS tuners. This IC is manufactured using our 50 GHz  $f_{\max}$  UHS2 (Ultra High Speed Process) SiGe bipolar process.

#### FEATURES

- Low current :  $I_{CC} = 4.8$  mA TYP. @  $V_{CC} = 5.0$  V
- Output power :  $P_{O(sat)} = -1.0$  dBm TYP. @  $f = 1.0$  GHz  
:  $P_{O(sat)} = -3.5$  dBm TYP. @  $f = 2.2$  GHz
- High linearity :  $P_{O(1dB)} = -6.5$  dBm TYP. @  $f = 1.0$  GHz  
:  $P_{O(1dB)} = -8.0$  dBm TYP. @  $f = 2.2$  GHz
- Power gain :  $G_P = 22.0$  dB TYP. @  $f = 1.0$  GHz  
:  $G_P = 22.0$  dB TYP. @  $f = 2.2$  GHz
- Noise Figure :  $NF = 4.7$  dB TYP. @  $f = 1.0$  GHz  
:  $NF = 4.6$  dB TYP. @  $f = 2.2$  GHz
- Supply voltage :  $V_{CC} = 4.5$  to  $5.5$  V
- Port impedance : input/output  $50\ \Omega$

#### APPLICATIONS

- IF amplifiers in LNB for DBS converters etc.

#### ORDERING INFORMATION

| Part Number       | Order Number        | Package   | Marking | Supplying Form  |
|-------------------|---------------------|---|---------|---|
| $\mu$ PC3227TB-E3 | $\mu$ PC3227TB-E3-A | 6-pin super minimold<br>(Pb-Free) <sup>Note</sup> | C3P     | Embossed tape 8 mm wide.<br>1, 2, 3 pins face the perforation side of the tape.<br>Qty 3 kpcs/reel. |

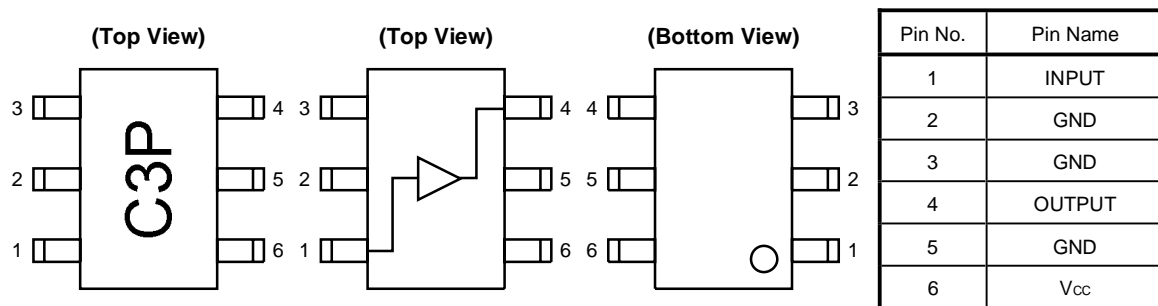
**Note** With regards to terminal solder (the solder contains lead) plated products (conventionally plated), contact your nearby sales office.

**Remark** To order evaluation samples, please contact your nearby sales office.  
Part number for sample order:  $\mu$ PC3227TB

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

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

## PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM



## PRODUCT LINE-UP OF 5 V-BIAS SILICON MMIC WIDEBAND AMPLIFIER

(T<sub>A</sub> = +25°C, f = 1 GHz, V<sub>cc</sub> = 5.0 V, Z<sub>s</sub> = Z<sub>L</sub> = 50 Ω)

| Part No.                  | f <sub>u</sub><br>(GHz) | P <sub>O</sub> (sat)<br>(dBm) | G <sub>P</sub><br>(dB) | NF<br>(dB) | I <sub>cc</sub><br>(mA) | Package              | Marking |
|---------------------------|-------------------------|-------------------------------|------------------------|------------|-------------------------|----------------------|---------|
| μPC2711TB                 | 2.9                     | +1.0                          | 13                     | 5.0        | 12                      | 6-pin super minimold | C1G     |
| μPC2712TB                 | 2.6                     | +3.0                          | 20                     | 4.5        | 12                      |                      | C1H     |
| μPC3215TB <sup>Note</sup> | 2.9                     | +3.5                          | 20.5                   | 2.3        | 14                      |                      | C3H     |
| μPC3224TB                 | 3.2                     | +4.0                          | 21.5                   | 4.3        | 9.0                     |                      | C3K     |
| μPC3227TB                 | 3.2                     | -1.0                          | 22                     | 4.7        | 4.8                     |                      | C3P     |

**Note** μPC3215TB is f = 1.5 GHz**Remark** Typical performance. Please refer to **ELECTRICAL CHARACTERISTICS** in detail.

**ABSOLUTE MAXIMUM RATINGS**

| Parameter                     | Symbol           | Conditions                         | Ratings     | Unit |
|-------------------------------|------------------|------------------------------------|-------------|------|
| Supply Voltage                | V <sub>CC</sub>  | T <sub>A</sub> = +25°C             | 6.0         | V    |
| Total Circuit Current         | I <sub>CC</sub>  | T <sub>A</sub> = +25°C             | 15          | mA   |
| Power Dissipation             | P <sub>D</sub>   | T <sub>A</sub> = +85°C <b>Note</b> | 270         | mW   |
| Operating Ambient Temperature | T <sub>A</sub>   |                                    | −40 to +85  | °C   |
| Storage Temperature           | T <sub>stg</sub> |                                    | −55 to +150 | °C   |
| Input Power                   | P <sub>in</sub>  | T <sub>A</sub> = +25°C             | +10         | dBm  |

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

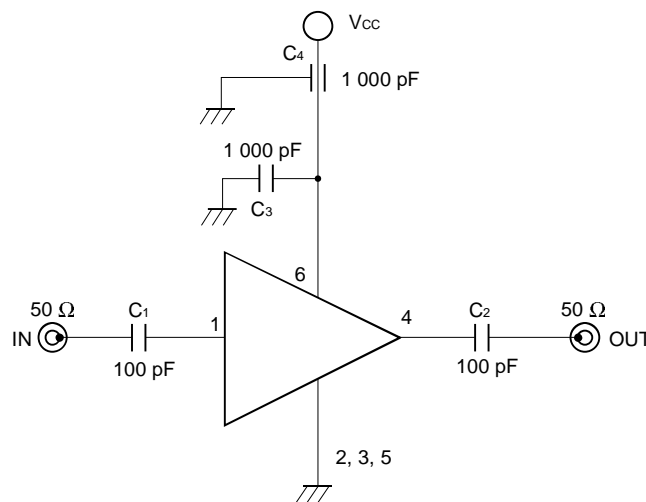
**RECOMMENDED OPERATING RANGE**

| Parameter                     | Symbol          | Conditions | MIN. | TYP. | MAX. | Unit |
|-------------------------------|-----------------|------------|------|------|------|------|
| Supply Voltage                | V <sub>CC</sub> |            | 4.5  | 5.0  | 5.5  | V    |
| Operating Ambient Temperature | T <sub>A</sub>  |            | −40  | +25  | +85  | °C   |

**ELECTRICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V}$ ,  $Z_S = Z_L = 50\ \Omega$ )**

| Parameter                                     | Symbol               | Test Conditions   | MIN.  | TYP.  | MAX. | Unit |
|---|----------------------|---|-------|-------|------|------|
| Circuit Current                               | I <sub>CC</sub>      | No input signal   | 4.0   | 4.8   | 6.0  | mA   |
| Power Gain 1                                  | G <sub>P1</sub>      | f = 0.1 GHz, P <sub>in</sub> = -40 dBm  | 20.5  | 22.5  | 24.5 | dB   |
| Power Gain 2                                  | G <sub>P2</sub>      | f = 1.0 GHz, P <sub>in</sub> = -40 dBm  | 19.5  | 22.0  | 24.5 |      |
| Power Gain 3                                  | G <sub>P3</sub>      | f = 1.8 GHz, P <sub>in</sub> = -40 dBm  | 19.0  | 22.0  | 25.0 |      |
| Power Gain 4                                  | G <sub>P4</sub>      | f = 2.2 GHz, P <sub>in</sub> = -40 dBm  | 19.0  | 22.0  | 25.0 |      |
| Power Gain 5                                  | G <sub>P5</sub>      | f = 2.6 GHz, P <sub>in</sub> = -40 dBm  | 19.0  | 22.0  | 25.0 |      |
| Power Gain 6                                  | G <sub>P6</sub>      | f = 3.0 GHz, P <sub>in</sub> = -40 dBm  | 18.0  | 21.0  | 24.5 |      |
| Saturated Output Power 1                      | P <sub>O(sat)1</sub> | f = 1.0 GHz, P <sub>in</sub> = -12 dBm  | -3.5  | -1.0  | —    | dBm  |
| Saturated Output Power 2                      | P <sub>O(sat)2</sub> | f = 2.2 GHz, P <sub>in</sub> = -12 dBm  | -6.0  | -3.5  | —    |      |
| Gain 1 dB Compression Output Power 1          | P <sub>O(1dB)1</sub> | f = 1.0 GHz   | -9.0  | -6.5  | —    | dBm  |
| Gain 1 dB Compression Output Power 2          | P <sub>O(1dB)2</sub> | f = 2.2 GHz   | -11.0 | -8.0  | —    |      |
| Noise Figure 1                                | NF1                  | f = 1.0 GHz   | —     | 4.7   | 5.5  | dB   |
| Noise Figure 2                                | NF2                  | f = 2.2 GHz   | —     | 4.6   | 5.5  |      |
| Isolation 1                                   | ISL1                 | f = 1.0 GHz, P <sub>in</sub> = -40 dBm  | 35    | 40    | —    | dB   |
| Isolation 2                                   | ISL2                 | f = 2.2 GHz, P <sub>in</sub> = -40 dBm  | 35    | 43    | —    |      |
| Input Return Loss 1                           | RL <sub>in1</sub>    | f = 1.0 GHz, P <sub>in</sub> = -40 dBm  | 7.5   | 10.5  | —    | dB   |
| Input Return Loss 2                           | RL <sub>in2</sub>    | f = 2.2 GHz, P <sub>in</sub> = -40 dBm  | 7.5   | 10.5  | —    |      |
| Output Return Loss 1                          | RL <sub>out1</sub>   | f = 1.0 GHz, P <sub>in</sub> = -40 dBm  | 10.0  | 13.5  | —    | dB   |
| Output Return Loss 2                          | RL <sub>out2</sub>   | f = 2.2 GHz, P <sub>in</sub> = -40 dBm  | 7.5   | 9.5   | —    |      |
| Input 3rd Order Distortion Intercept Point 1  | IIP <sub>31</sub>    | f <sub>1</sub> = 1 000 MHz, f <sub>2</sub> = 1 001 MHz, P <sub>in</sub> = -40 dBm | —     | -18.0 | —    | dBm  |
| Input 3rd Order Distortion Intercept Point 2  | IIP <sub>32</sub>    | f <sub>1</sub> = 2 200 MHz, f <sub>2</sub> = 2 201 MHz, P <sub>in</sub> = -40 dBm | —     | -20.5 | —    |      |
| Output 3rd Order Distortion Intercept Point 1 | OIP <sub>31</sub>    | f <sub>1</sub> = 1 000 MHz, f <sub>2</sub> = 1 001 MHz, P <sub>in</sub> = -40 dBm | —     | +4.0  | —    | dBm  |
| Output 3rd Order Distortion Intercept Point 2 | OIP <sub>32</sub>    | f <sub>1</sub> = 2 200 MHz, f <sub>2</sub> = 2 201 MHz, P <sub>in</sub> = -40 dBm | —     | +1.5  | —    |      |
| 2nd Order Intermodulation Distortion          | IM <sub>2</sub>      | f <sub>1</sub> = 1 000 MHz, f <sub>2</sub> = 1 001 MHz, P <sub>in</sub> = -40 dBm | —     | 30.5  | —    | dBc  |
| K factor 1                                    | K1                   | f = 1.0 GHz   | —     | 3.8   | —    | —    |
| K factor 2                                    | K2                   | f = 2.2 GHz   | —     | 3.9   | —    | —    |

## 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

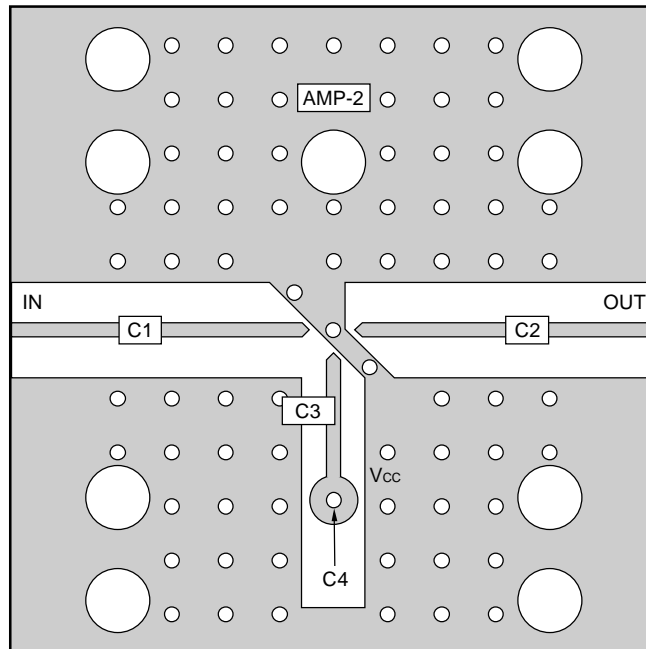
|        | Type                   | Value    |
|--------|------------------------|----------|
| C1, C2 | Chip Capacitor         | 100 pF   |
| C3     | Chip Capacitor         | 1 000 pF |
| C4     | Feed-through Capacitor | 1 000 pF |

### CAPACITORS FOR V<sub>CC</sub> AND INPUT PINS

Bypass capacitor for V<sub>CC</sub> pin is intended to minimize V<sub>CC</sub> pin's ground impedance. Therefore, stable bias can be supplied against V<sub>CC</sub> fluctuation.

Coupling capacitors for input/output pins are intended to minimize RF serial impedance and cut DC.

**ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD**



**COMPONENT LIST**

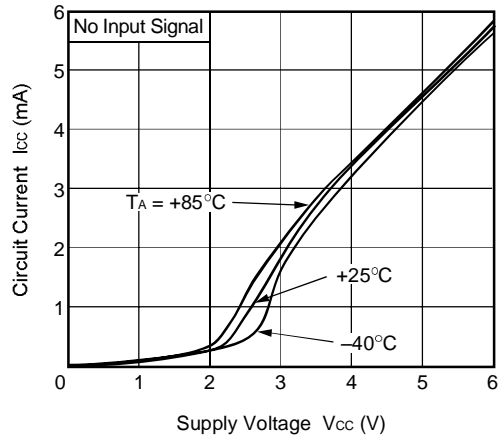
|        | Value    |
|--------|----------|
| C1, C2 | 100 pF   |
| C3, C4 | 1 000 pF |

**Notes**

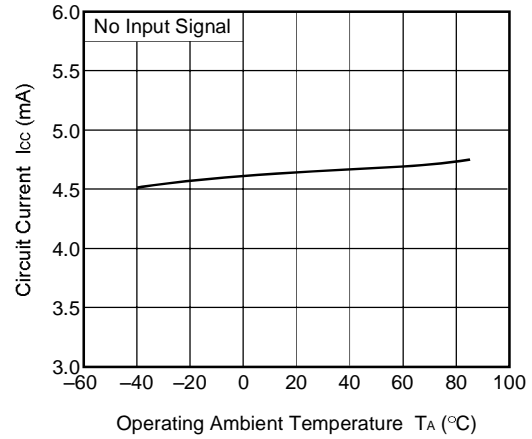
1. 30 x 30 x 0.4 mm double sided copper clad polyimide board.
2. Back side: GND pattern
3. Solder plated on pattern
4. oO: Through holes

**TYPICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V}$ ,  $Z_S = Z_L = 50\ \Omega$ , unless otherwise specified)**

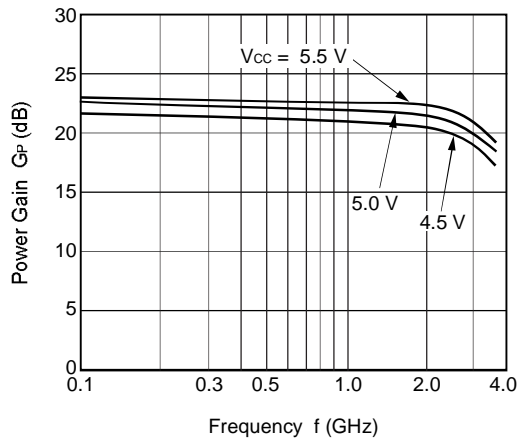
**CIRCUIT CURRENT vs. SUPPLY VOLTAGE**



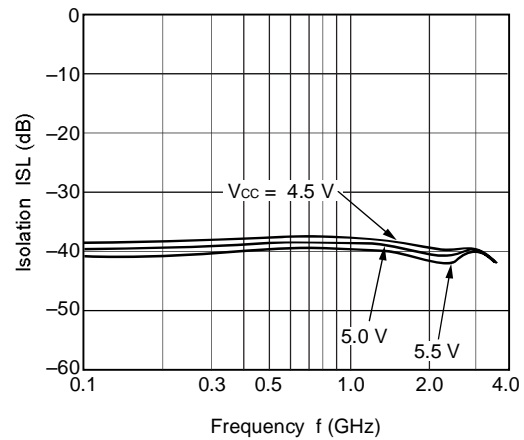
**CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE**



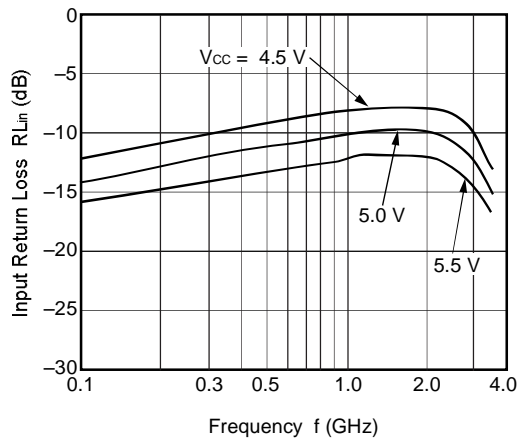
**POWER GAIN vs. FREQUENCY**



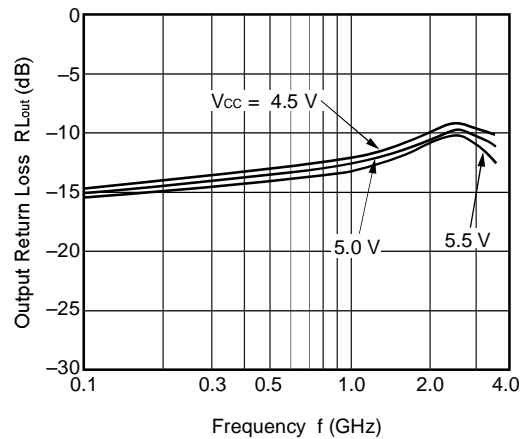
**ISOLATION vs. FREQUENCY**



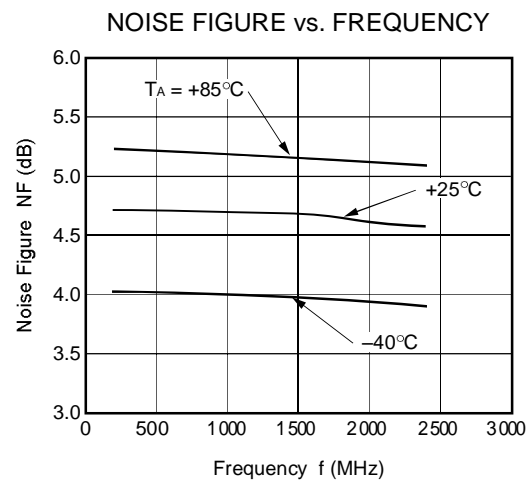
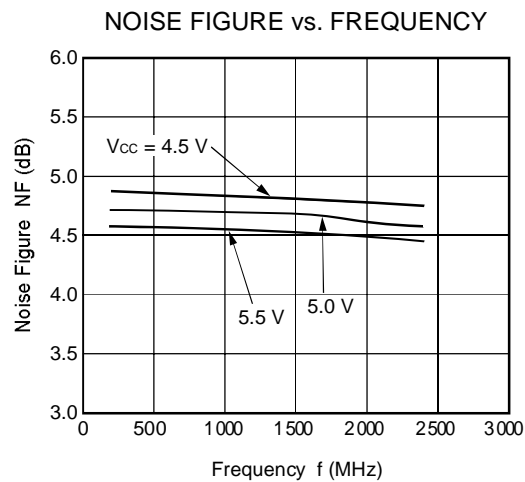
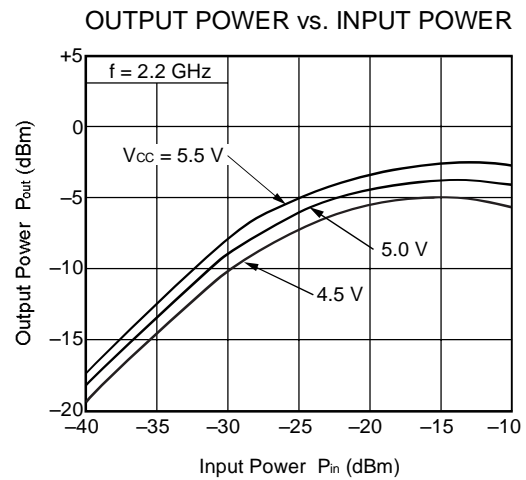
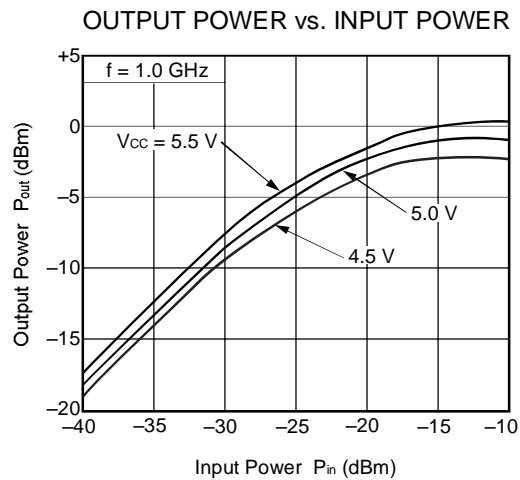
**INPUT RETURN LOSS vs. FREQUENCY**



**OUTPUT RETURN LOSS vs. FREQUENCY**

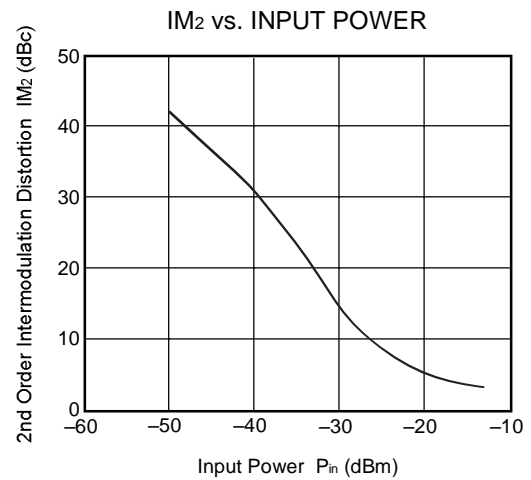
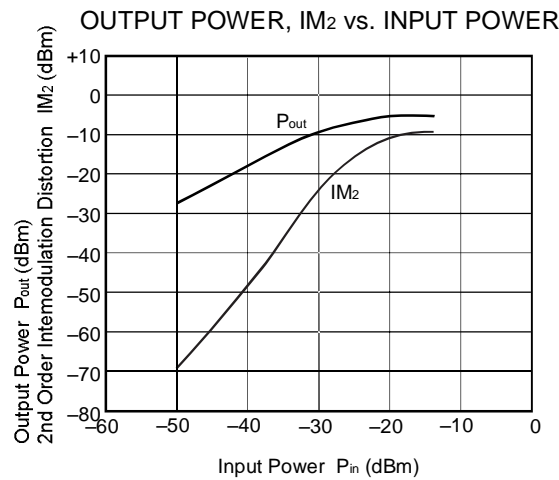
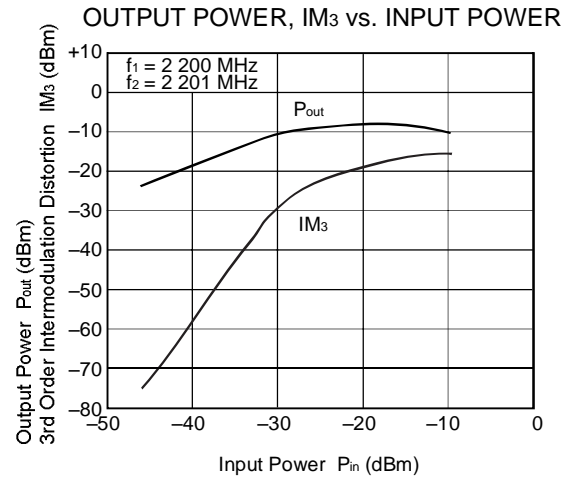
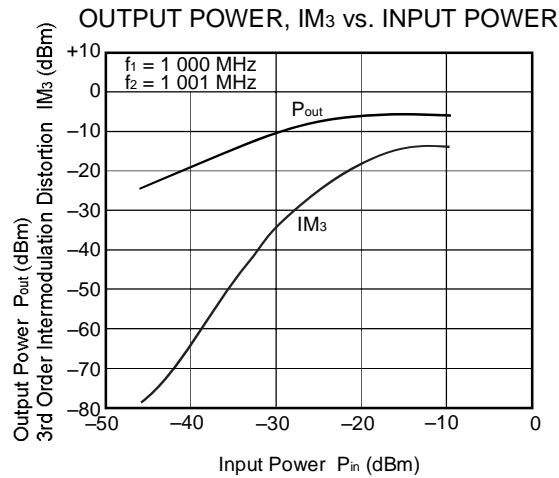


**Remark** The graphs indicate nominal characteristics.



**Remark** The graphs indicate nominal characteristics.

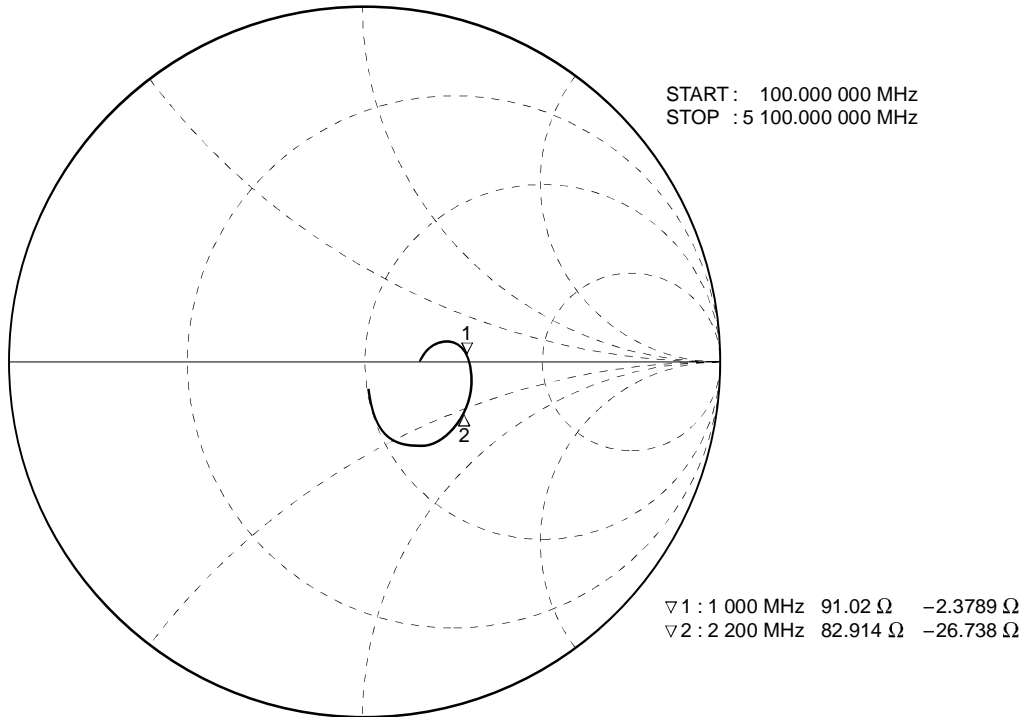




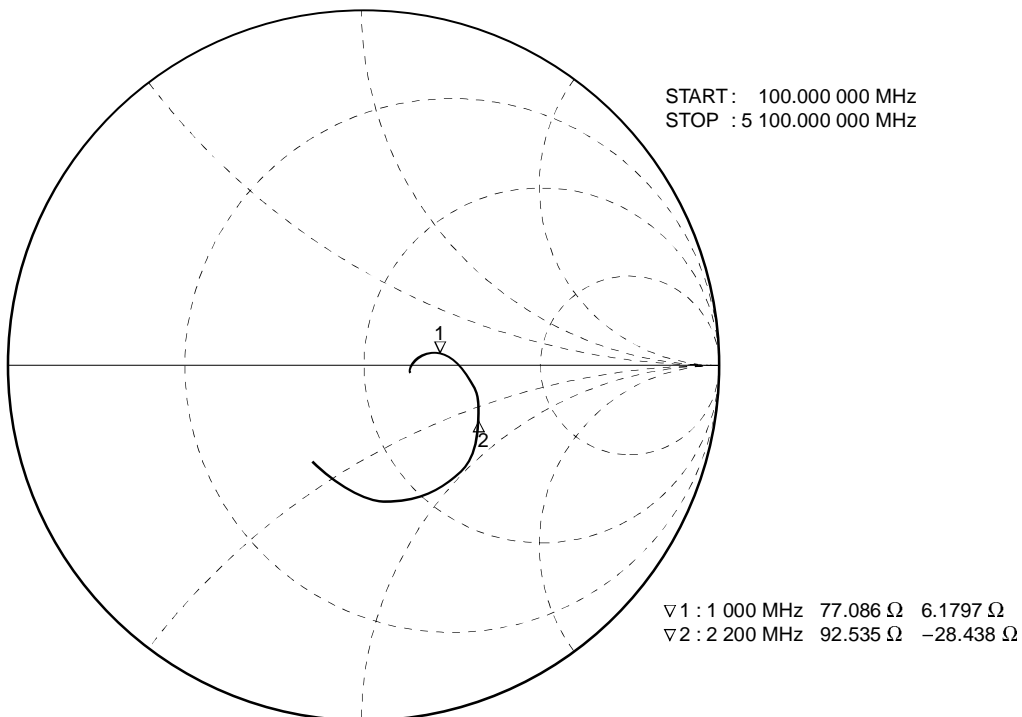
**Remark** The graphs indicate nominal characteristics.

**S-PARAMETERS** ( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V}$ ,  $P_{in} = -40\text{ dBm}$ )

**S<sub>11</sub>-FREQUENCY**

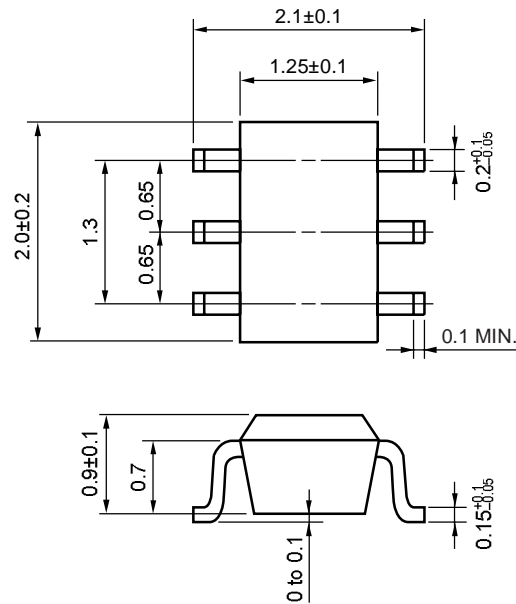


**S<sub>22</sub>-FREQUENCY**



**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 terminals must be connected together with wide ground pattern to decrease impedance difference.
- (3) The bypass capacitor should be attached to the V<sub>CC</sub> line.
- (4) The DC cut capacitor must be attached to input and output 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) : 260°C or below<br>Time at peak temperature : 10 seconds or less<br>Time at temperature of 220°C or higher : 60 seconds or less<br>Preheating time at 120 to 180°C : 120±30 seconds<br>Maximum number of reflow processes : 3 times<br>Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below | IR260            |
| Wave Soldering   | Peak temperature (molten solder temperature) : 260°C or below<br>Time at peak temperature : 10 seconds or less<br>Preheating temperature (package surface temperature) : 120°C or below<br>Maximum number of flow processes : 1 time<br>Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below  | WS260            |
| Partial Heating  | Peak temperature (terminal temperature) : 350°C or below<br>Soldering time (per side of device) : 3 seconds or less<br>Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below   | HS350            |

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

Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

| Restricted Substance<br>per RoHS | Concentration Limit per RoHS<br>(values are not yet fixed) | Concentration contained<br>in CEL devices |     |
|----------------------------------|--|---|-----|
|                                  |  | -A  | -AZ |
| Lead (Pb)                        | < 1000 PPM   | Not Detected                              | (*) |
| Mercury                          | < 1000 PPM   | Not Detected                              |     |
| Cadmium                          | < 100 PPM  | Not Detected                              |     |
| Hexavalent Chromium              | < 1000 PPM   | Not Detected                              |     |
| PBB                              | < 1000 PPM   | Not Detected                              |     |
| PBDE                             | < 1000 PPM   | Not Detected                              |     |

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

Important Information and Disclaimer: Information provided by CEL on its website or in other communications concerning the substance content of its products represents knowledge and belief as of the date that it is provided. CEL bases its knowledge and belief on information provided by third parties and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. CEL has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. CEL and CEL suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall CEL's liability arising out of such information exceed the total purchase price of the CEL part(s) at issue sold by CEL to customer on an annual basis.

See CEL Terms and Conditions for additional clarification of warranties and liability.