GaAs INTEGRATED CIRCUIT

# μPG2183T6C

## 4 W HIGH POWER SP4T SWITCH

### DESCRIPTION

The μPG2183T6C is a GaAs MMIC SP4T (Single Pole Four Throw) switch which was designed for digital cellular phone application.

This device can operate frequency from 0.5 to 2.5 GHz, having the low insertion loss and high isolation.

This device is housed in a 16-pin plastic QFN (Quad Flat Non-leaded) (T6C) package. And this package is able to high-density surface mounting.

### FEATURES

- Supply voltage : $V_{bat}$ = 2.9 to 3.2 V (3.0 V TYP.)
- Standby mode voltage : $V_{DD\,(H)}$ = 1.7 to $V_{bat}$ V (2.65 V TYP.)
  : $V_{DD\,(L)}$ = 0 to +0.05 V (0 V TYP.)
- Switch control voltage : $V_{cont\,(H)}$ = 1.7 to $V_{bat}$ V (2.65 V TYP.)
  : $V_{cont\,(L)}$ = 0 to +0.05 V (0 V TYP.)
- Operating Frequency : f = 0.5 to 2.5 GHz
- Low insertion loss : $L_{ins}1$ = 0.4 dB TYP. @ f = 0.5 to 1.0 GHz, $V_{bat}$ = 3.0 V, $V_{DD}$ = $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V
  : $L_{ins}2$ = 0.55 dB TYP. @ f = 1.0 to 2.0 GHz, $V_{bat}$ = 3.0 V, $V_{DD}$ = $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V
  : $L_{ins}3$ = 0.7 dB TYP. @ f = 2.0 to 2.5 GHz, $V_{bat}$ = 3.0 V, $V_{DD}$ = $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V
- High isolation : ISL1 = 24 dB TYP. @ f = 0.5 to 1.0 GHz, $V_{bat}$ = 3.0 V, $V_{DD}$ = $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V
  : ISL2 = 19 dB TYP. @ f = 1.0 to 2.0 GHz, $V_{bat}$ = 3.0 V, $V_{DD}$ = $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V
  : ISL3 = 17 dB TYP. @ f = 2.0 to 2.5 GHz, $V_{bat}$ = 3.0 V, $V_{DD}$ = $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V
- Handling power : $P_{in\,(0.1\,dB)}$ = +37.5 dBm TYP. @ f = 0.9 GHz, $V_{bat}$ = 3.0 V, $V_{DD}$ = $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V
  : $P_{in\,(0.1\,dB)}$ = +35.0 dBm TYP. @ f = 1.8 GHz, $V_{bat}$ = 3.0 V, $V_{DD}$ = $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V
- High-density surface mounting : 16-pin plastic QFN (T6C) package (3.0 × 3.0 × 0.75 mm)

### APPLICATIONS

- Digital cellular phone etc.

### ORDERING INFORMATION

| Part Number | Order Number | Package | Marking | Supplying Form |
|---|---|---|---|---|
| μPG2183T6C-E2 | μPG2183T6C-E2-A | 16-pin plastic QFN (T6C) (Pb-Free) | 2183 | • Embossed tape 12 mm wide<br>• Pin 13, 14, 15 and 16 face the perforation side of the tape<br>• Qty 3 kpcs/reel |

**Remark** To order evaluation samples, please contact your nearby sales office.
Part number for sample order: μPG2183T6C-A

**Caution Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions must be employed at all times.**





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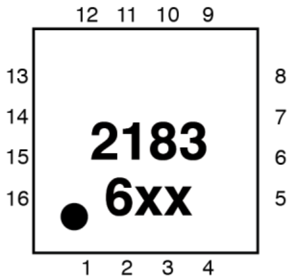
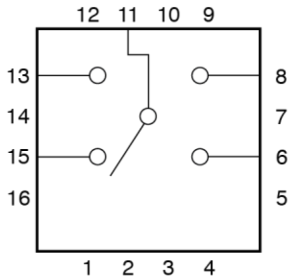
## PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM

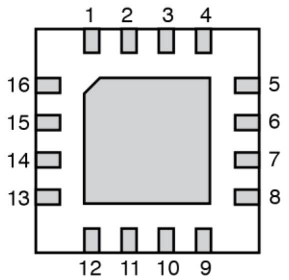
(Top View)




(Top View)




(Bottom View)




| Pin No. | Pin Name |
|---|---|
| 1 | GND (N.C.) |
| 2 | $V_{DD}$ |
| 3 | $V_{cont}2$ |
| 4 | $V_{cont}1$ |
| 5 | GND |
| 6 | RF4 |
| 7 | GND (N.C.) |
| 8 | RF3 |
| 9 | GND (N.C.) |
| 10 | GND (N.C.) |
| 11 | ANT |
| 12 | GND (N.C.) |
| 13 | RF1 |
| 14 | GND (N.C.) |
| 15 | RF2 |
| 16 | $V_{bat}$ |

**Remark** Exposed pad : GND

## SW TRUTH TABLE

| $V_{bat}$ | $V_{DD}$ | $V_{cont}1$ | $V_{cont}2$ | RF Path | Mode |
|---|---|---|---|---|---|
| High | High | Low | Low | ANT-RF1 | Active mode |
| High | High | Low | High | ANT-RF2 | Active mode |
| High | High | High | Low | ANT-RF3 | Active mode |
| High | High | High | High | ANT-RF4 | Active mode |
| High | Low | Low | Low | ANT-RF1 | Standby mode |
| High | Low | Low | High | ANT-RF2 | Standby mode |
| High | Low | High | Low | ANT-RF3 | Standby mode |
| High | Low | High | High | ANT-RF4 | Standby mode |

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = +25°C, unless otherwise specified)

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| Battery Voltage | $V_{bat}$ | +4.2 | V |
| Standby Mode Voltage | $V_{DD}$ | +4.2 | V |
| Switch Control Voltage | $V_{cont}$ | +4.2 | V |
| Input Power | $P_{in}$ | +38 | dBm |
| Operating Ambient Temperature | $T_A$ | −45 to +85 | °C |
| Storage Temperature | $T_{stg}$ | −55 to +150 | °C |

## RECOMMENDED OPERATING RANGE ($T_A$ = +25°C, unless otherwise specified)

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|
| Battery Voltage | $V_{bat}$ | 2.9 | 3.0 | 3.2 | V |
| Standby Mode Voltage (H) | $V_{DD\ (H)}$ | 1.7 | 2.65 | $V_{bat}$ | V |
| Standby Mode Voltage (L) | $V_{DD\ (L)}$ | 0 | 0 | 0.05 | V |
| Switch Control Voltage (H) | $V_{cont\ (H)}$ | 1.7 | 2.65 | $V_{bat}$ | V |
| Switch Control Voltage (L) | $V_{cont\ (L)}$ | 0 | 0 | 0.05 | V |

## ELECTRICAL CHARACTERISTICS

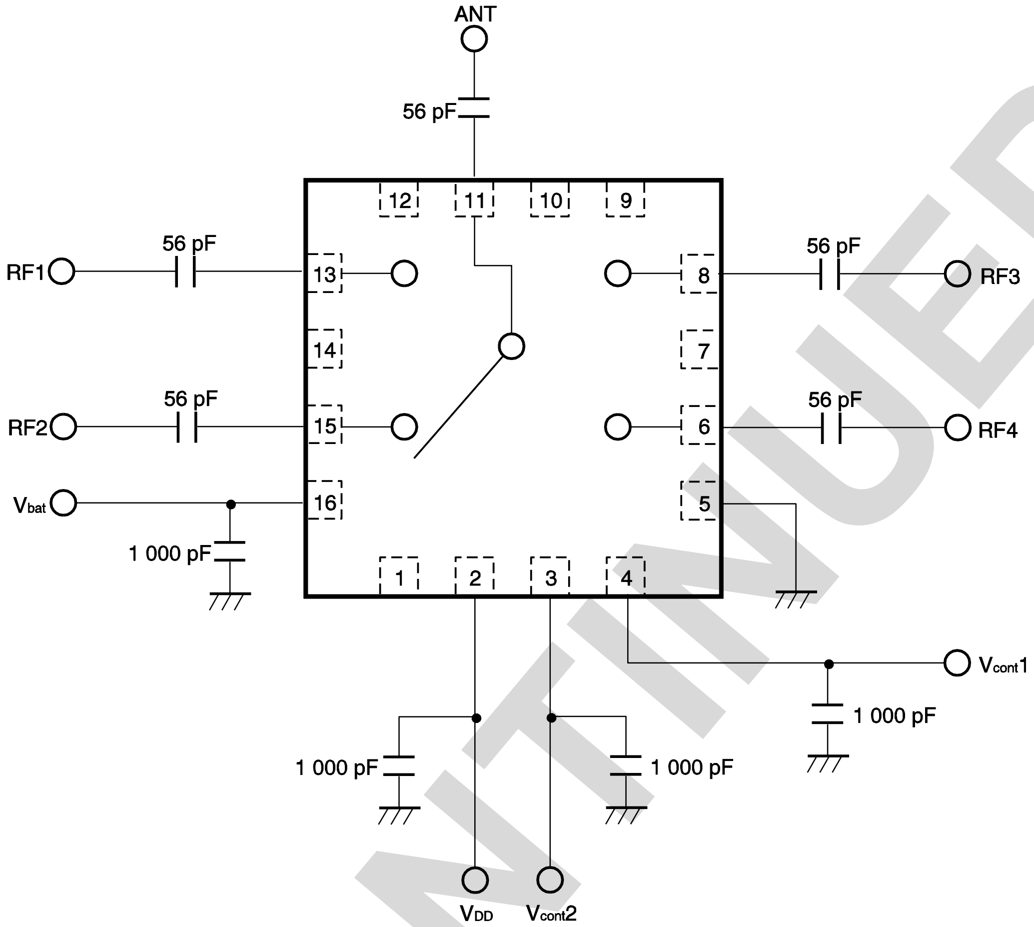
**($T_A$ = +25°C, $V_{bat}$ = 3.0 V, $V_{DD}$ = 2.65 V, $V_{cont (H)}$ = 2.65 V, $V_{cont (L)}$ = 0 V, Zo = 50 Ω, DC blocking capacitors = 56 pF, unless otherwise specified)**

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Insertion Loss 1 | $L_{ins}1$ | f = 0.5 to 1.0 GHz | – | 0.4 | 0.55 | dB |
| Insertion Loss 2 | $L_{ins}2$ | f = 1.0 to 2.0 GHz | – | 0.55 | 0.8 | dB |
| Insertion Loss 3 | $L_{ins}3$ | f = 2.0 to 2.5 GHz | – | 0.7 | 0.95 | dB |
| Isolation 1 | ISL1 | f = 0.5 to 1.0 GHz | 22 | 24 | – | dB |
| Isolation 2 | ISL2 | f = 1.0 to 2.0 GHz | 17 | 19 | – | dB |
| Isolation 3 | ISL3 | f = 2.0 to 2.5 GHz | 15 | 17 | – | dB |
| Input Return Loss | $RL_{in}$ | f = 0.5 to 2.5 GHz | 15 | 19 | – | dB |
| Output Return Loss | $RL_{out}$ | f = 0.5 to 2.5 GHz | 15 | 19 | – | dB |
| 0.1 dB Loss Compression Input Power 1 Note | $P_{in (0.1 dB)}1$ | f = 0.9 GHz | +37.0 | +37.5 | – | dBm |
| 0.1 dB Loss Compression Input Power 2 Note | $P_{in (0.1 dB)}2$ | f = 1.8 GHz | +34.0 | +35.0 | – | dBm |
| Harmonics 1 | 2f0 | f = 0.9 GHz, $P_{in}$ = 34.5 dBm | – | –75 | –65 | dBc |
| | 3f0 | | – | –75 | –65 | dBc |
| Harmonics 2 | 2f0 | f = 1.8 GHz, $P_{in}$ = 31.5 dBm | – | –72 | –62 | dBc |
| | 3f0 | | – | –75 | –62 | dBc |
| Battery Current 1 | $I_{bat}1$ | Active Mode, No RF | – | 0.55 | 1.5 | mA |
| Battery Current 2 | $I_{bat}2$ | Standby Mode, No RF | – | – | 10 | μA |
| Switched Supply Current 1 | $I_{DD}1$ | $V_{DD}$ : High, No RF | – | 0 | 0.1 | mA |
| Switched Supply Current 2 | $I_{DD}2$ | $V_{DD}$ :Low, No RF | – | 0 | 0.1 | mA |
| Control Current 1-1 | $I_{cont 1-1}$ | $V_{cont}1$ : High, No RF | –100 | 0 | 100 | μA |
| Control Current 1-2 | $I_{cont 1-2}$ | $V_{cont}1$ : Low, No RF | –100 | 0 | 100 | μA |
| Control Current 2-1 | $I_{cont 2-1}$ | $V_{cont}2$ : High, No RF | –100 | 0 | 100 | μA |
| Control Current 2-2 | $I_{cont 2-2}$ | $V_{cont}2$ : Low, No RF | –100 | 0 | 100 | μA |
| Switch Control Speed | $t_{SW}$ | 50% CTL to 90/10% | – | 0.5 | 5.0 | μs |
| Startup Time | – | Time for the switch to be operational from that the switched supply voltage ($V_{DD}$) goes high. | – | – | 100 | μs |

**Note** $P_{in (0.1 dB)}$ is measured the input power level when the insertion loss increases more 0.1 dB than that of linear range.

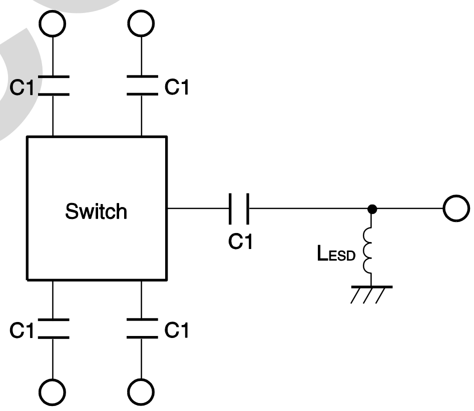
**Caution This device is used it is necessary to use DC blocking capacitors.**
**The value of DC blocking capacitors should be chosen to accommodate the frequency of operation, bandwidth, switching speed and the condition with actual board of your system. The range of recommended DC blocking capacitor value is less than 56 pF.**

## EVALUATION CIRCUIT




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

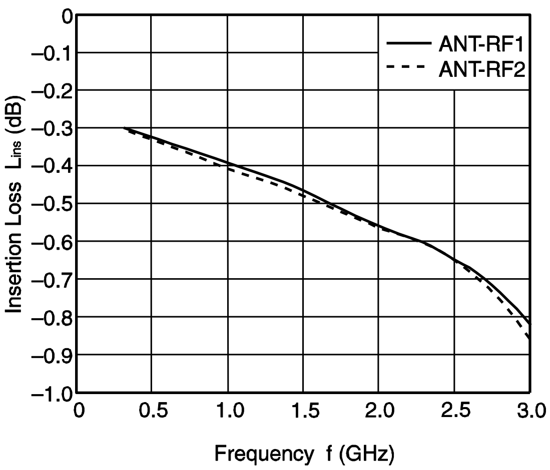
## APPLICATION INFORMATION



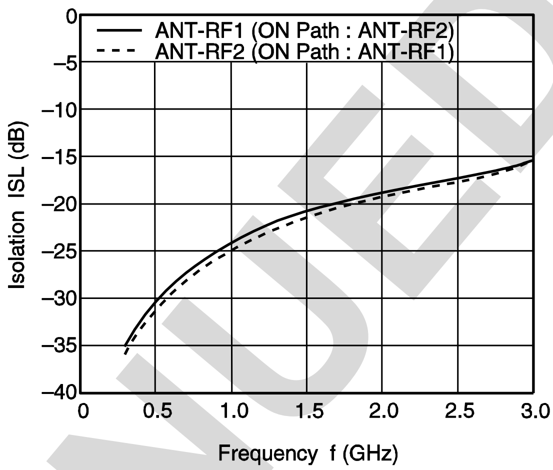

- $L_{ESD}$ provides a means to increase the ESD protection on a specific RF port, typically the port attached to the antenna.
- The value may be tailored to provide specific electrical responses.
- The RF ground connections should be kept as short as possible and connected to directly to a good RF ground for best performance.

**PERFORMANCE DATA**
**($T_A$ = +25°C, $V_{bat}$ = 3.0 V, $V_{DD}$ = 2.65 V, $V_{cont\,(H)}$ = 2.65 V, $V_{cont\,(L)}$ = 0 V, DC blocking capacitors = 56 pF, unless otherwise specified)**

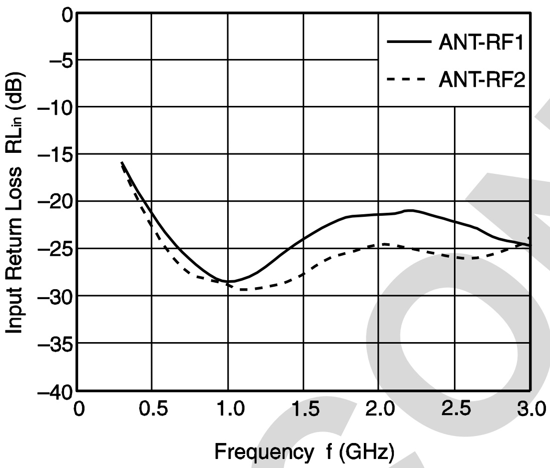
INSERTION LOSS vs. FREQUENCY



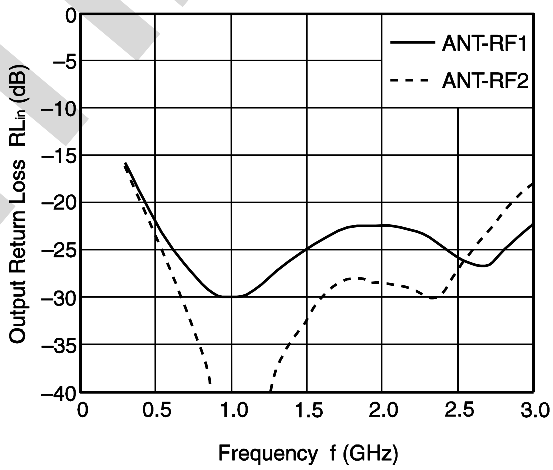

ISOLATION vs. FREQUENCY




INPUT RETURN LOSS vs. FREQUENCY

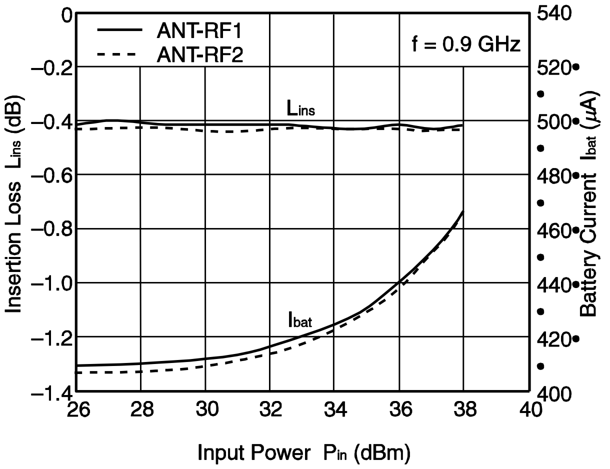



OUTPUT RETURN LOSS vs. FREQUENCY

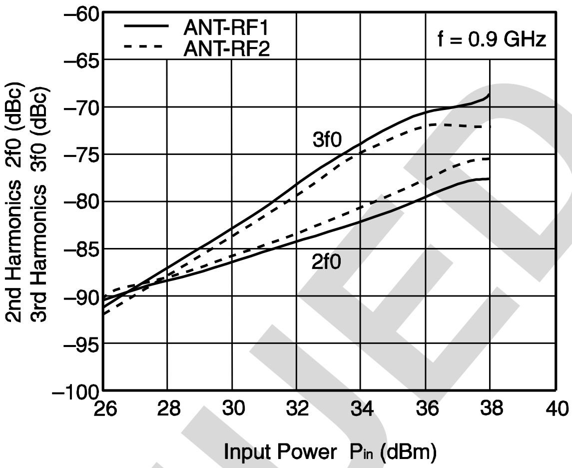



**Remark** The graphs indicate nominal characteristics.

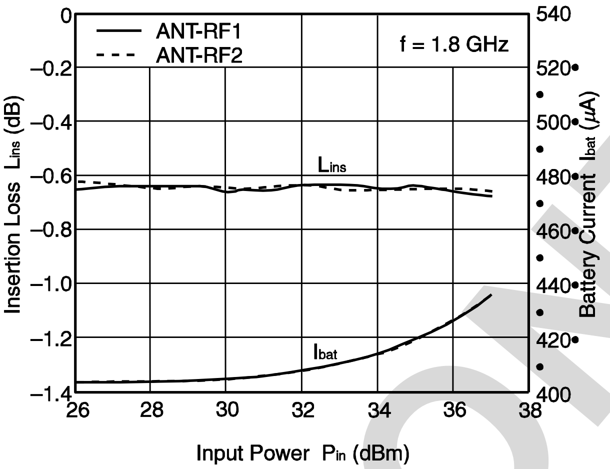
INSERTION LOSS, BATTERY CURRENT
vs. INPUT POWER



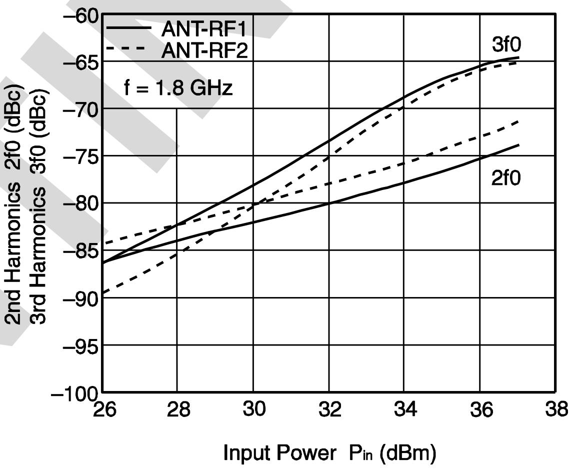

2ND HARMONICS, 3RD HARMONICS
vs. INPUT POWER




INSERTION LOSS, BATTERY CURRENT
vs. INPUT POWER



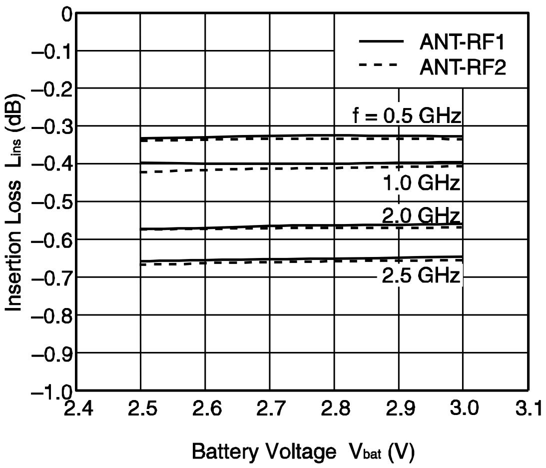

2ND HARMONICS, 3RD HARMONICS
vs. INPUT POWER



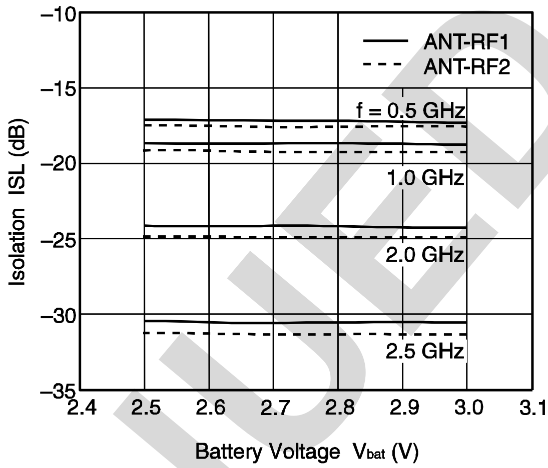

**Remark** The graphs indicate nominal characteristics.

**REFERENCE DATA ($T_A$ = +25°C, $V_{DD}$ = 1.8 V, $V_{cont (H)}$ = 1.8 V, $V_{cont (L)}$ = 0 V, DC blocking capacitors = 56 pF, unless otherwise specified)**

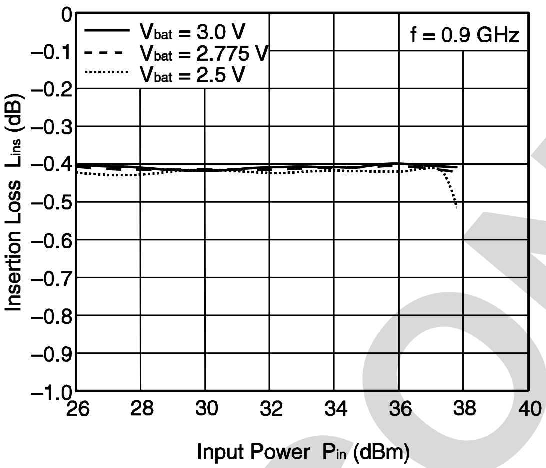
INSERTION LOSS vs. BATTERY VOLTAGE



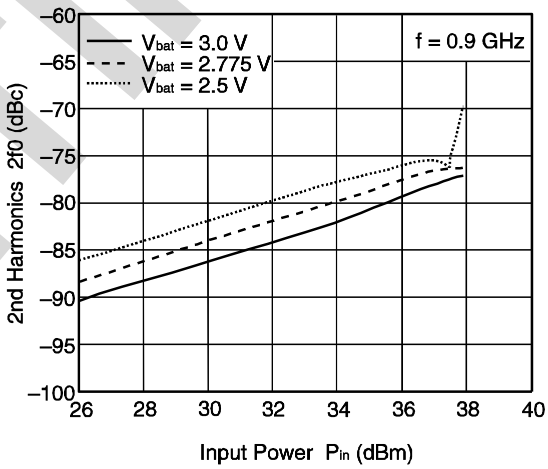

ISOLATION vs. BATTERY VOLTAGE



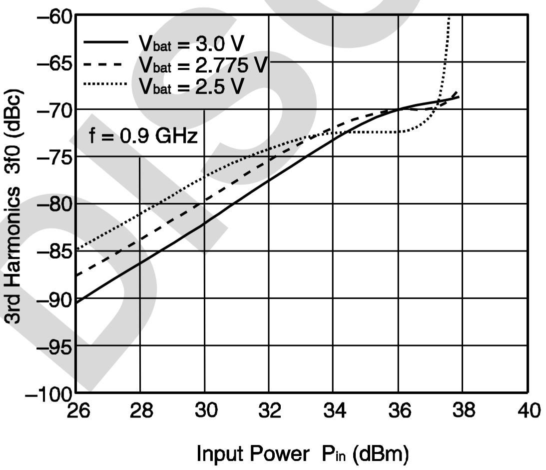

INSERTION LOSS vs. INPUT POWER



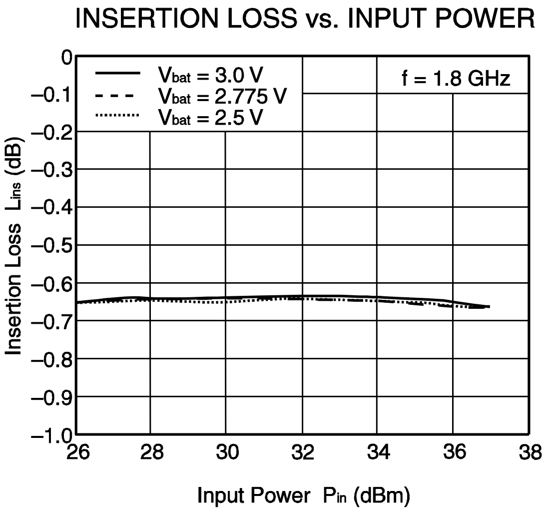

2ND HARMONICS vs. INPUT POWER

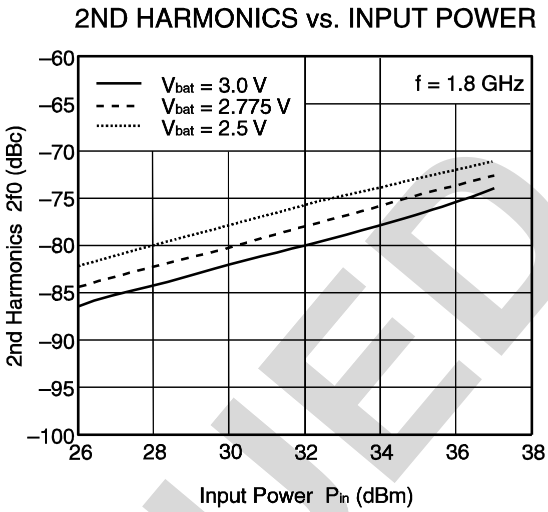


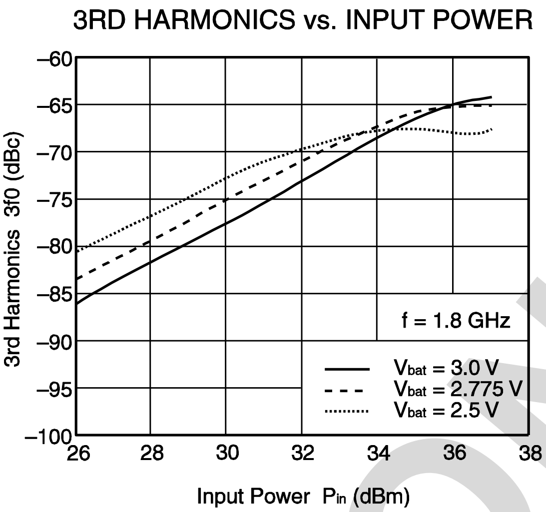

3RD HARMONICS vs. INPUT POWER




**Remark** The graphs indicate nominal characteristics.



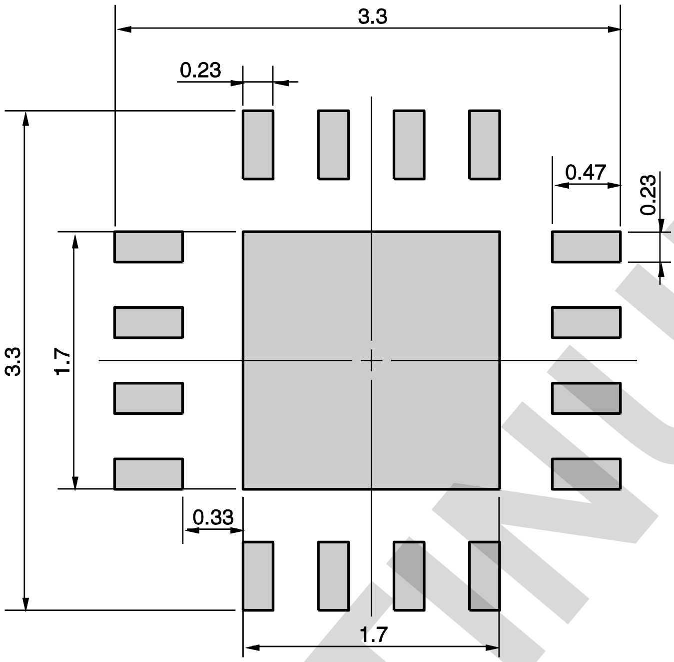




**Remark** The graphs indicate nominal characteristics.

**MOUNTING PAD LAYOUT DIMENSIONS**

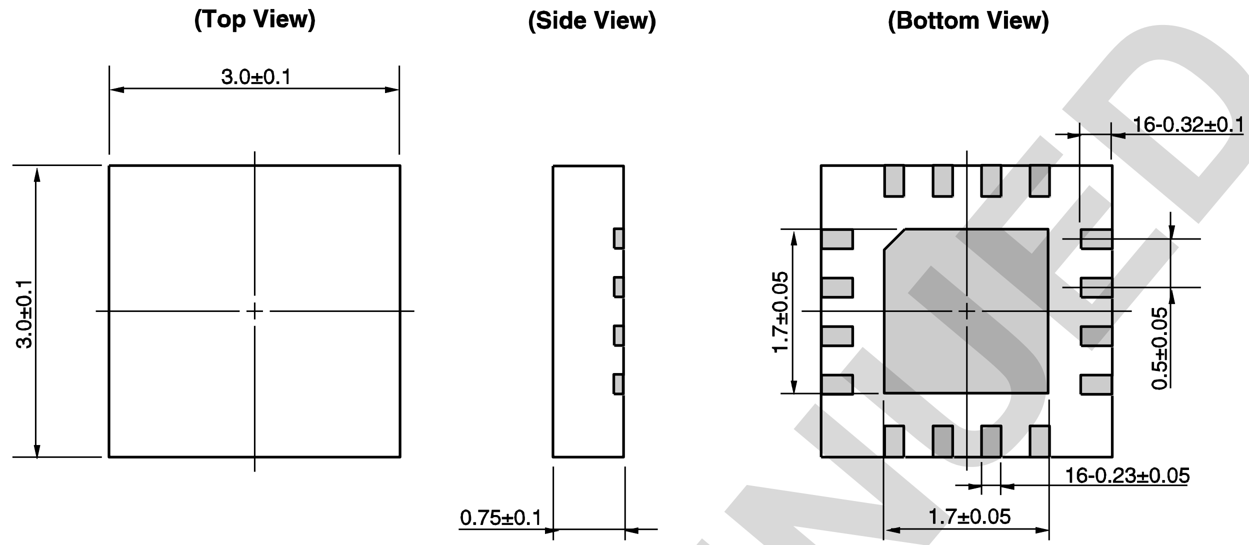
**16-PIN PLASTIC QFN (T6C) (UNIT: mm)**




**Remark** The mounting pad layout in this document is for reference only.
When designing PCB, please consider workability of mounting, solder joint reliability, prevention of solder bridge and so on, in order to optimize the design.

**PACKAGE DIMENSIONS**

**16-PIN PLASTIC QFN (T6C) (UNIT: mm)**



## 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 |
| Partial Heating | Peak temperature (pin 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).**

| Caution GaAs Products | This product uses gallium arsenide (GaAs).<br>GaAs vapor and powder are hazardous to human health if inhaled or ingested, so please observe the following points.<br>• Follow related laws and ordinances when disposing of the product. If there are no applicable laws and/or ordinances, dispose of the product as recommended below.<br>1. Commission a disposal company able to (with a license to) collect, transport and dispose of materials that contain arsenic and other such industrial waste materials.<br>2. Exclude the product from general industrial waste and household garbage, and ensure that the product is controlled (as industrial waste subject to special control) up until final disposal.<br>• Do not burn, destroy, cut, crush, or chemically dissolve the product.<br>• Do not lick the product or in any way allow it to enter the mouth. |
|---|---|