CEL

GaAs INTEGRATED CIRCUIT

# μPG2415T6X

## 0.05 to 6.0 GHz SPDT SWITCH



### DESCRIPTION

The μPG2415T6X is a GaAs MMIC SPDT (Single Pole Double Throw) switch for 0.05 to 6.0 GHz applications, including dual-band wireless LAN.

This device operates with dual control switching voltages of 2.7 to 3.3 V. This device can operate at frequencies from 0.05 to 6.0 GHz, with low insertion loss and high isolation.

This device is housed in a 6-pin plastic TSON (Thin Small Out-line Non-leaded) (T6X) package and is suitable for high-density surface mounting.

### FEATURES

- Switch control voltage : $V_{cont\ (H)}$ = 3.0 V TYP.
  : $V_{cont\ (L)}$ = 0 V TYP.
- Low insertion loss : $L_{ins}$ = 0.45 dB TYP. @ f = 2.5 GHz
  : $L_{ins}$ = 0.55 dB TYP. @ f = 6.0 GHz
- High isolation : ISL = 28 dB TYP. @ f = 2.5 GHz
  : ISL = 26 dB TYP. @ f = 6.0 GHz
- Handling power : $P_{in\ (0.1\ dB)}$ = +31.0 dBm TYP. @ f = 2.0 to 6.0 GHz
- High-density surface mounting : 6-pin plastic TSON (T6X) package (1.5 × 1.5 × 0.37 mm)

### APPLICATIONS

- Dual-band wireless LAN etc.

### ORDERING INFORMATION

| Part Number | Order Number | Package | Marking | Supplying Form |
|---|---|---|---|---|
| μPG2415T6X-E2 | μPG2415T6X-E2-A | 6-pin plastic TSON (T6X) (Pb-Free) | G6E | • Embossed tape 8 mm wide<br>• Pin 1, 6 face the perforation side of the tape<br>• Qty 3 kpcs/reel |

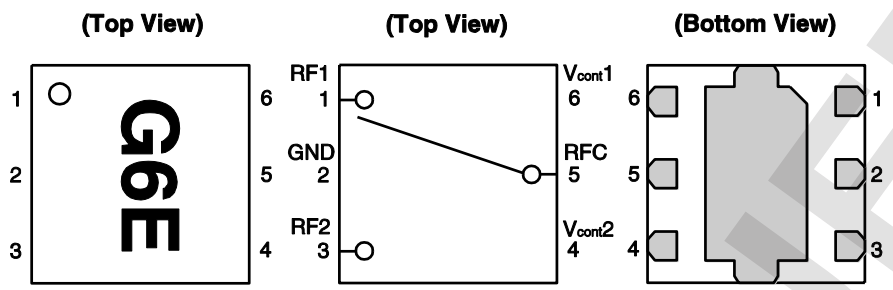
**Remark** To order evaluation samples, please contact your nearby sales office.
Part number for sample order: μPG2415T6X-A

**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.**



Document No. PG10797EJ01V0DS (1st edition)
Date Published March 2010 NS

## PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM




| Pin No. | Pin Name |
|---|---|
| 1 | RF1 |
| 2 | GND |
| 3 | RF2 |
| 4 | $V_{cont}2$ |
| 5 | RFC |
| 6 | $V_{cont}1$ |

**Remark** Exposed pad : GND

## SW TRUTH TABLE

| $V_{cont}1$ | $V_{cont}2$ | RFC-RF1 | RFC-RF2 |
|---|---|---|---|
| High | Low | ON | OFF |
| Low | High | OFF | ON |

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

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| Switch Control Voltage | $V_{cont}$ | +6.0 Note | V |
| Input Power | $P_{in}$ | +36 | dBm |
| Operating Ambient Temperature | $T_A$ | −45 to +85 | °C |
| Storage Temperature | $T_{stg}$ | −55 to +150 | °C |

**Note** $|V_{cont}1 - V_{cont}2| \leq 6.0$ V

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

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|
| Operating Frequency | f | 0.05 | – | 6.0 | GHz |
| Switch Control Voltage (H) | $V_{cont\ (H)}$ | 2.7 | 3.0 | 3.3 | V |
| Switch Control Voltage (L) | $V_{cont\ (L)}$ | −0.2 | 0 | 0.2 | V |
| Control Voltage Difference | $\Delta V_{cont\ (H)}$, $\Delta V_{cont\ (L)}$ Note | −0.1 | 0 | 0.1 | V |

**Note** $\Delta V_{cont\ (H)} = V_{cont}1_{\ (H)} - V_{cont}2_{\ (H)}$

$\Delta V_{cont\ (L)} = V_{cont}1_{\ (L)} - V_{cont}2_{\ (L)}$

## ELECTRICAL CHARACTERISTICS

**($T_A$ = +25°C, $V_{cont\ (H)}$ = 3.0 V, $V_{cont\ (L)}$ = 0 V, $Z_O$ = 50 Ω, DC blocking capacitors = 8 pF, unless otherwise specified)**

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Insertion Loss 1 | $L_{ins}1$ | f = 0.05 to 0.5 GHz Note 1 | – | 0.35 | – | dB |
| Insertion Loss 2 | $L_{ins}2$ | f = 0.5 to 2.0 GHz Note 2 | – | 0.40 | 0.65 | dB |
| Insertion Loss 3 | $L_{ins}3$ | f = 2.0 to 2.5 GHz | – | 0.45 | 0.70 | dB |
| Insertion Loss 4 | $L_{ins}4$ | f = 2.5 to 3.8 GHz | – | 0.55 | 0.80 | dB |
| Insertion Loss 5 | $L_{ins}5$ | f = 3.8 to 6.0 GHz | – | 0.55 | 0.80 | dB |
| Isolation 1 | ISL1 | f = 0.05 to 0.5 GHz Note 1 | – | 30 | – | dB |
| Isolation 2 | ISL2 | f = 0.5 to 2.0 GHz Note 2 | 25 | 28 | – | dB |
| Isolation 3 | ISL3 | f = 2.0 to 2.5 GHz | 25 | 28 | – | dB |
| Isolation 4 | ISL4 | f = 2.5 to 3.8 GHz | 25 | 28 | – | dB |
| Isolation 5 | ISL5 | f = 3.8 to 6.0 GHz | 22 | 26 | – | dB |
| Return Loss 1 | RL1 | f = 0.05 to 0.5 GHz Note 1 | – | 20 | – | dB |
| Return Loss 2 | RL2 | f = 0.5 to 2.0 GHz Note 2 | 15 | 20 | – | dB |
| Return Loss 3 | RL3 | f = 2.0 to 2.5 GHz | 15 | 20 | – | dB |
| Return Loss 4 | RL4 | f = 2.5 to 6.0 GHz | 10 | 15 | – | dB |
| 0.1 dB Loss Compression Input Power Note 3 | $P_{in\ (0.1\ dB)}$ | f = 0.5 to 2.0 GHz Note 2 | – | +32.0 | – | dBm |
| | | f = 2.0 to 6.0 GHz | – | +31.0 | – | dBm |
| 1 dB Loss Compression Input Power Note 4 | $P_{in\ (1\ dB)}$ | f = 0.5 to 2.0 GHz Note 2 | – | +36.0 | – | dBm |
| | | f = 2.0 to 6.0 GHz | – | +35.0 | – | dBm |
| 2nd Harmonics | $2f_0$ | f = 2.5 GHz, $P_{in}$ = +20 dBm | – | 80 | – | dBc |
| 3rd Harmonics | $3f_0$ | f = 2.5 GHz, $P_{in}$ = +20 dBm | – | 80 | – | dBc |
| Input 3rd Order Intercept Point | $IIP_3$ | f = 2.5 GHz, $P_{in}$ = +20 dBm | – | +60 | – | dBm |
| Switch Control Current | $I_{cont}$ | No RF input | – | 0.1 | 10 | μA |
| Switch Control Speed | $t_{SW}$ | 50% CTL to 90/10% RF | – | 50 | 250 | ns |

**Notes 1.** DC blocking capacitors = 1 000 pF at f = 0.05 to 0.5 GHz

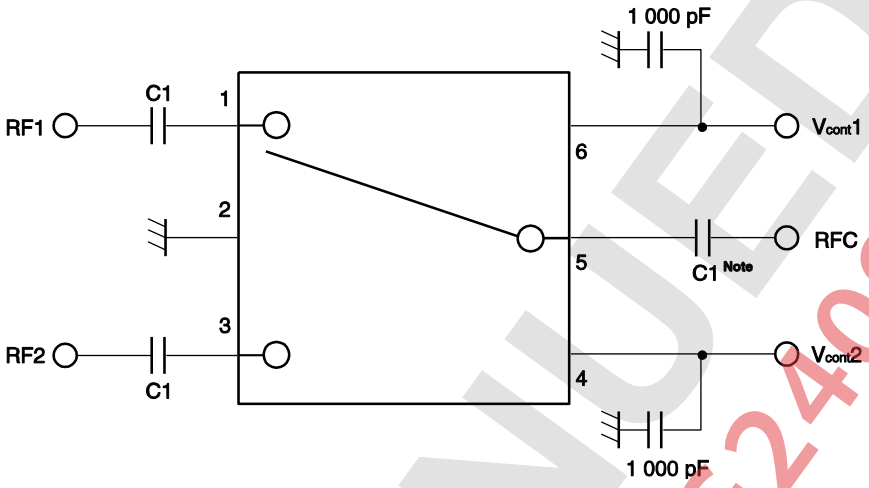
**2.** DC blocking capacitors = 56 pF at f = 0.5 to 2.0 GHz

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

**4.** $P_{in\ (1\ dB)}$ is the measured input power level when the insertion loss increases 1 dB more than that of the linear range.

**Caution It is necessary to use DC blocking capacitors with this device.**
**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.**

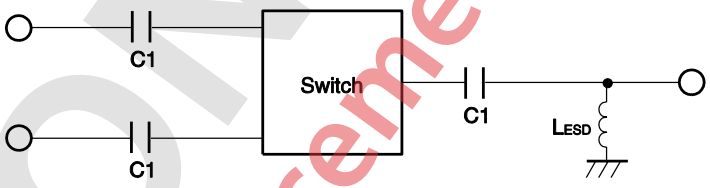
## EVALUATION CIRCUIT




**Note** C1 : 0.05 to 0.5 GHz 1 000 pF
: 0.5 to 2.0 GHz 56 pF
: 2.0 to 6.0 GHz 8 pF

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

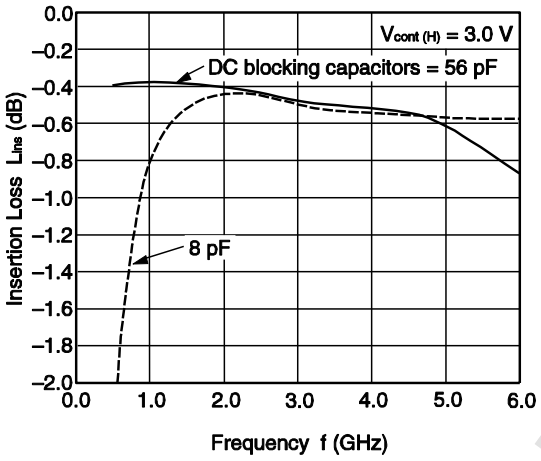
## APPLICATION INFORMATION



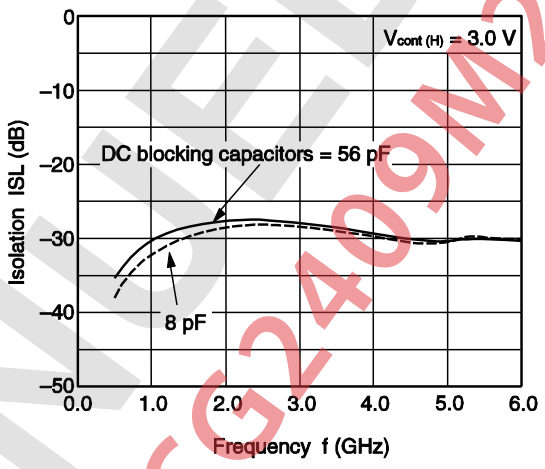

- C1 are DC blocking capacitors external to the device.
  The value may be tailored to provide specific electrical responses.
- The RF ground connections should be kept as short as possible and connected to directly to a good RF ground for best performance.
- LESD provides a means to increase the ESD protection on a specific RF port, typically the port attached to the antenna.

**TYPICAL CHARACTERISTICS ($T_A$ = +25°C, $V_{cont\ (H)}$ = 3.0 V, $V_{cont\ (L)}$ = 0 V, $Z_O$ = 50 Ω, DC blocking capacitors = 8 pF, unless otherwise specified)**

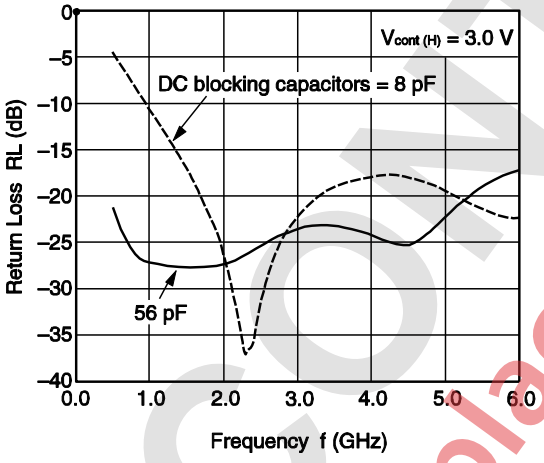
RFC-RF1/RF2
INSERTION LOSS vs. FREQUENCY



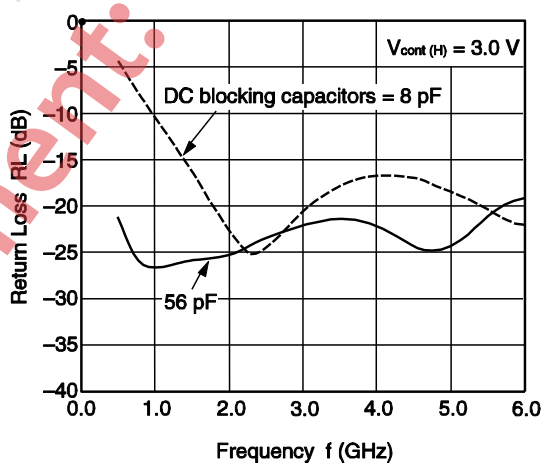

RFC-RF1/RF2
ISOLATION vs. FREQUENCY



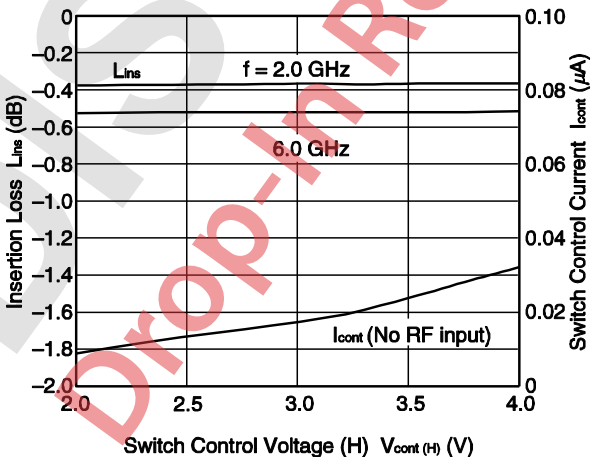

RFC RETURN LOSS vs. FREQUENCY



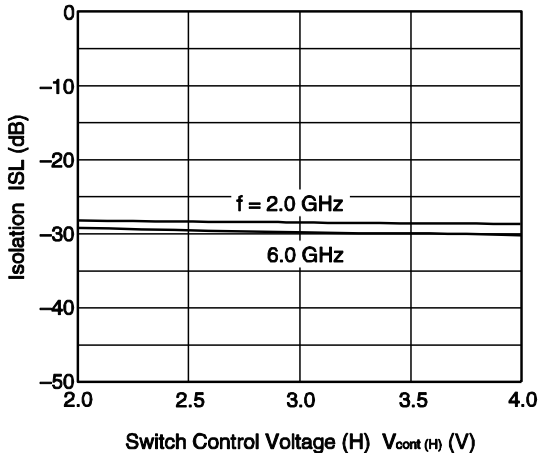

RF1/RF2 RETURN LOSS vs. FREQUENCY




RFC-RF1/RF2 INSERTION LOSS,
$I_{cont}$ vs. SWITCH CONTROL VOLTAGE (H)

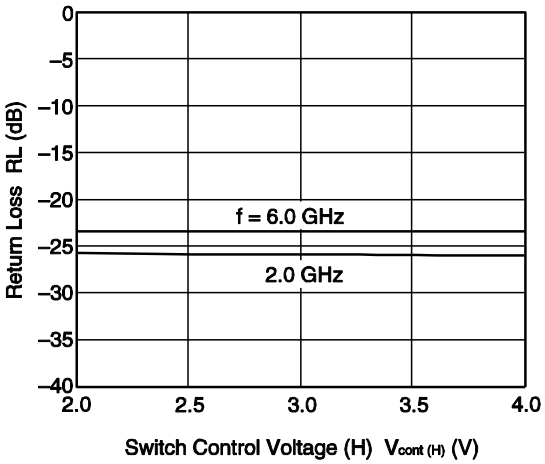



RFC-RF1/RF2 ISOLATION vs.
SWITCH CONTROL VOLTAGE (H)

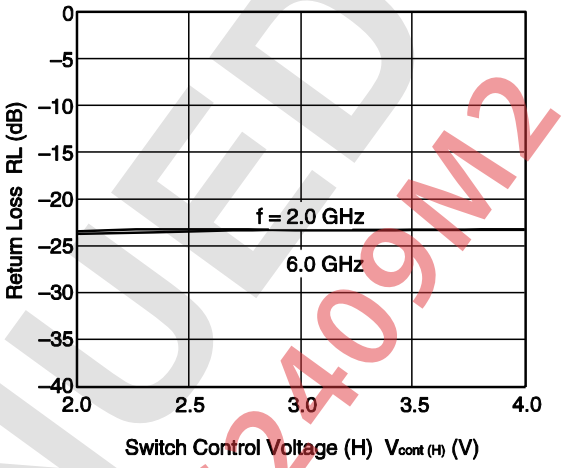



**Remark** The graphs indicate nominal characteristics.

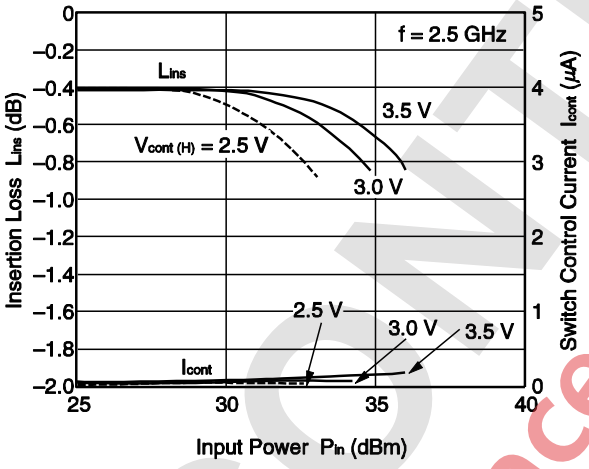
RFC RETURN LOSS vs.
SWITCH CONTROL VOLTAGE (H)



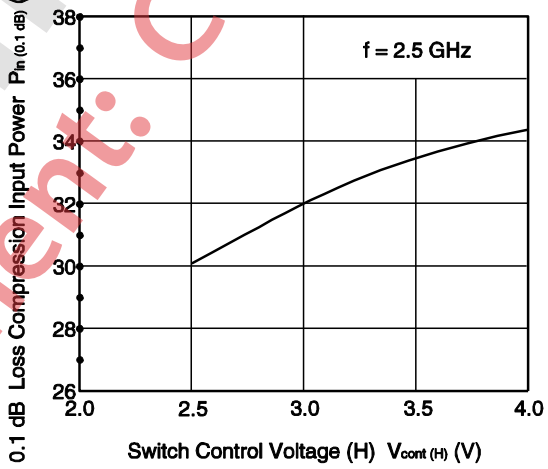

RF1/RF2 RETURN LOSS vs.
SWITCH CONTROL VOLTAGE (H)



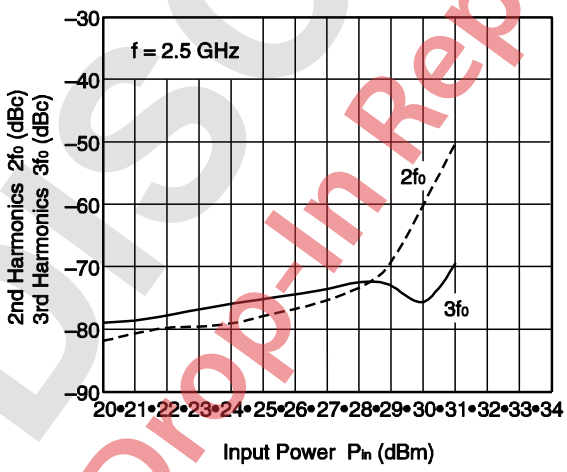

RFC-RF1/RF2 INSERTION LOSS,
Icont vs. INPUT POWER



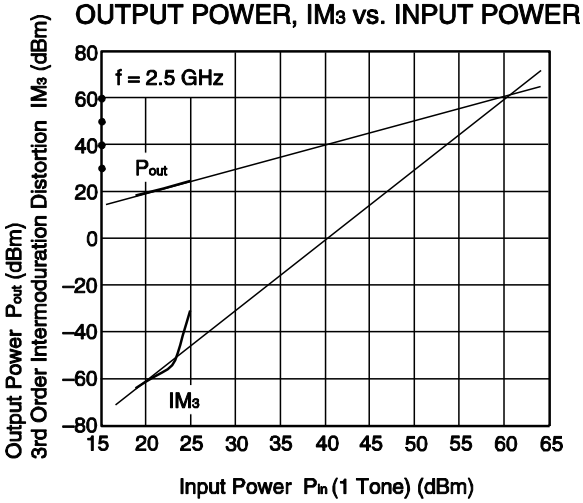

RFC-RF1/RF2 Pin (0.1 dB) vs.
SWITCH CONTROL VOLTAGE (H)




RFC-RF1/RF2 •
2f0, 3f0 vs. INPUT POWER




RFC-RF1/RF2
OUTPUT POWER, IM3 vs. INPUT POWER

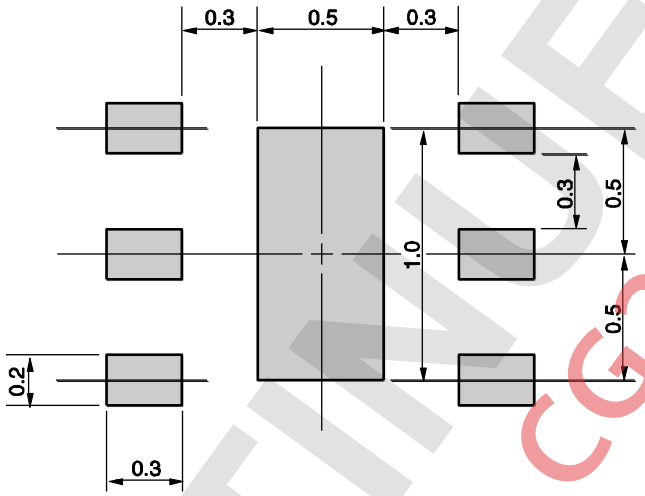



**Remark** The graphs indicate nominal characteristics.

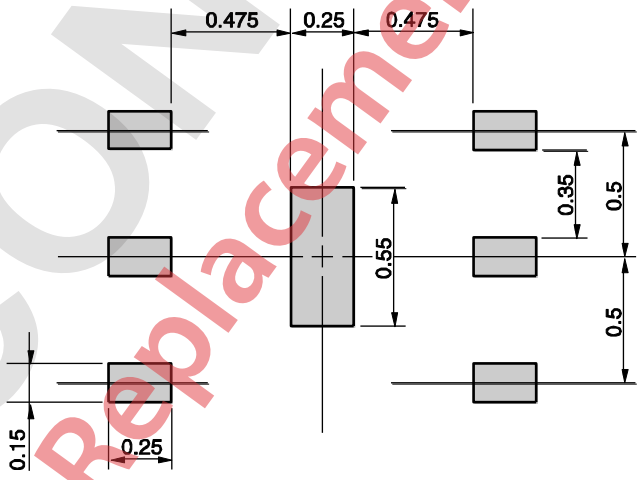
## MOUNTING PAD AND SOLDER MASK LAYOUT DIMENSIONS

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

**MOUNTING PAD**




**SOLDER MASK**

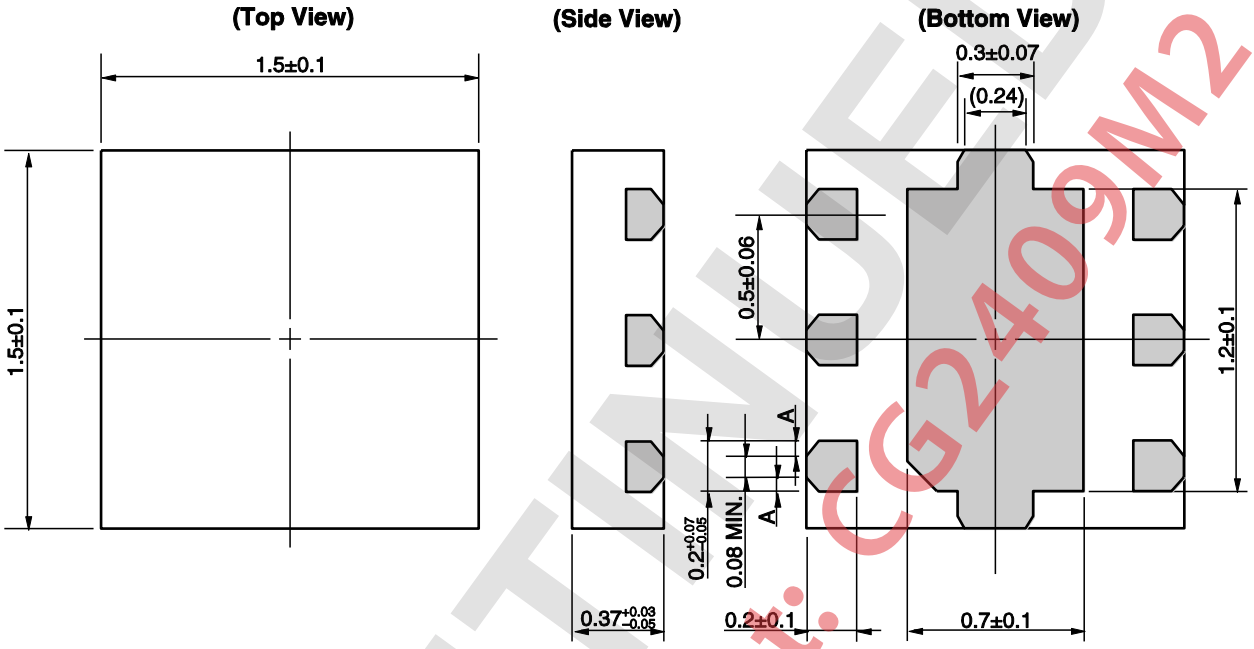



Solder thickness : 0.08 mm

**Remark** The mounting pad and solder mask layouts in this document are 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

### 6-PIN PLASTIC TSON (T6X) (UNIT: mm)




**Remark** A>0

( ) : Reference value

## 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 (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).**

| | |
|---|---|
| **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. |

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