

### 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 :  $V_{\text{cont (H)}} = 3.0 \text{ V TYP.}$   
:  $V_{\text{cont (L)}} = 0 \text{ V TYP.}$
- Low insertion loss :  $L_{\text{ins}} = 0.45 \text{ dB TYP. @ } f = 2.5 \text{ GHz}$   
:  $L_{\text{ins}} = 0.55 \text{ dB TYP. @ } f = 6.0 \text{ GHz}$
- High isolation :  $ISL = 28 \text{ dB TYP. @ } f = 2.5 \text{ GHz}$   
:  $ISL = 26 \text{ dB TYP. @ } f = 6.0 \text{ GHz}$
- Handling power :  $P_{\text{in (0.1 dB)}} = +31.0 \text{ dBm TYP. @ } f = 2.0 \text{ to } 6.0 \text{ GHz}$
- 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

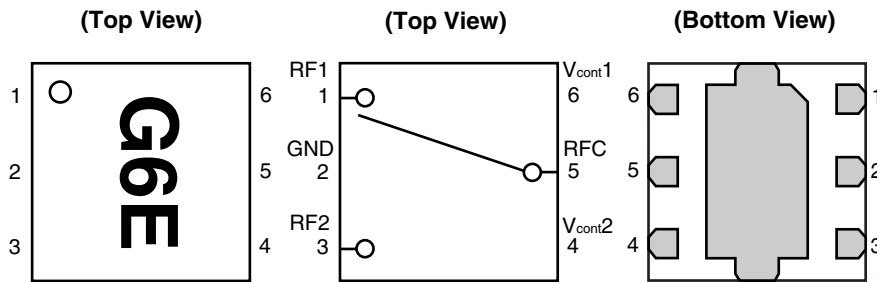
Part Number	Order Number	Package	Marking	Supplying Form
μPG2415T6X-E2	μPG2415T6X-E2-A	6-pin plastic TSON (T6X) (Pb-Free)	G6E	<ul style="list-style-type: none"> <li>• Embossed tape 8 mm wide</li> <li>• Pin 1, 6 face the perforation side of the tape</li> <li>• Qty 3 kpcs/reel</li> </ul>

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

**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



Pin No.	Pin Name
1	RF1
2	GND
3	RF2
4	V <sub>cont2</sub>
5	RFC
6	V <sub>cont1</sub>

Remark Exposed pad : GND

SW TRUTH TABLE

V <sub>cont1</sub>	V <sub>cont2</sub>	RFC-RF1	RFC-RF2
High	Low	ON	OFF
Low	High	OFF	ON

ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = +25°C, unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Switch Control Voltage	V <sub>cont</sub>	+6.0 <sup>Note</sup>	V
Input Power	P <sub>in</sub>	+36	dBm
Operating Ambient Temperature	T <sub>A</sub>	-45 to +85	°C
Storage Temperature	T <sub>stg</sub>	-55 to +150	°C

Note |V<sub>cont1</sub> - V<sub>cont2</sub>| ≤ 6.0 V

RECOMMENDED OPERATING RANGE (T<sub>A</sub> = +25°C, unless otherwise specified)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Operating Frequency	f	0.05	-	6.0	GHz
Switch Control Voltage (H)	V <sub>cont (H)</sub>	2.7	3.0	3.3	V
Switch Control Voltage (L)	V <sub>cont (L)</sub>	-0.2	0	0.2	V
Control Voltage Difference	ΔV <sub>cont (H)</sub> , ΔV <sub>cont (L)</sub> <sup>Note</sup>	-0.1	0	0.1	V

Note ΔV<sub>cont (H)</sub> = V<sub>cont1 (H)</sub> - V<sub>cont2 (H)</sub>  
 ΔV<sub>cont (L)</sub> = V<sub>cont1 (L)</sub> - V<sub>cont2 (L)</sub>

**ELECTRICAL CHARACTERISTICS**

(T<sub>A</sub> = +25°C, V<sub>cont</sub> (H) = 3.0 V, V<sub>cont</sub> (L) = 0 V, Z<sub>o</sub> = 50 Ω, DC blocking capacitors = 8 pF, unless otherwise specified)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Insertion Loss 1	L <sub>ins1</sub>	f = 0.05 to 0.5 GHz <sup>Note 1</sup>	–	0.35	–	dB
Insertion Loss 2	L <sub>ins2</sub>	f = 0.5 to 2.0 GHz <sup>Note 2</sup>	–	0.40	0.65	dB
Insertion Loss 3	L <sub>ins3</sub>	f = 2.0 to 2.5 GHz	–	0.45	0.70	dB
Insertion Loss 4	L <sub>ins4</sub>	f = 2.5 to 3.8 GHz	–	0.55	0.80	dB
Insertion Loss 5	L <sub>ins5</sub>	f = 3.8 to 6.0 GHz	–	0.55	0.80	dB
Isolation 1	ISL1	f = 0.05 to 0.5 GHz <sup>Note 1</sup>	–	30	–	dB
Isolation 2	ISL2	f = 0.5 to 2.0 GHz <sup>Note 2</sup>	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 <sup>Note 1</sup>	–	20	–	dB
Return Loss 2	RL2	f = 0.5 to 2.0 GHz <sup>Note 2</sup>	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 <sup>Note 3</sup>	P <sub>in (0.1 dB)</sub>	f = 0.5 to 2.0 GHz <sup>Note 2</sup>	–	+32.0	–	dBm
		f = 2.0 to 6.0 GHz	–	+31.0	–	dBm
1 dB Loss Compression Input Power <sup>Note 4</sup>	P <sub>in (1 dB)</sub>	f = 0.5 to 2.0 GHz <sup>Note 2</sup>	–	+36.0	–	dBm
		f = 2.0 to 6.0 GHz	–	+35.0	–	dBm
2nd Harmonics	2f <sub>o</sub>	f = 2.5 GHz, P <sub>in</sub> = +20 dBm	–	80	–	dBc
3rd Harmonics	3f <sub>o</sub>	f = 2.5 GHz, P <sub>in</sub> = +20 dBm	–	80	–	dBc
Input 3rd Order Intercept Point	IIP <sub>3</sub>	f = 2.5 GHz, P <sub>in</sub> = +20 dBm	–	+60	–	dBm
Switch Control Current	I <sub>cont</sub>	No RF input	–	0.1	10	μA
Switch Control Speed	t <sub>sw</sub>	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

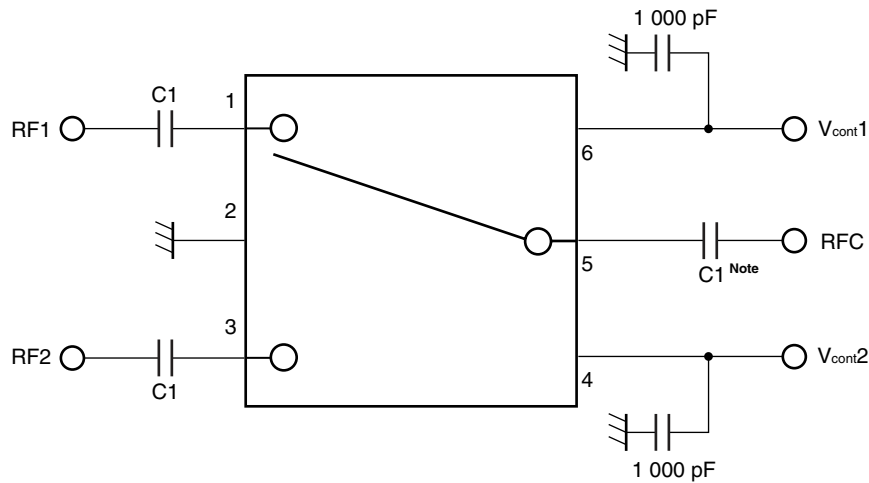
**3.** P<sub>in (0.1 dB)</sub> is the measured input power level when the insertion loss increases 0.1 dB more than that of the linear range.

**4.** P<sub>in (1 dB)</sub> 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.

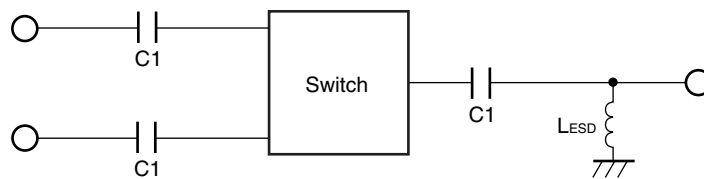
EVALUATION CIRCUIT



**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

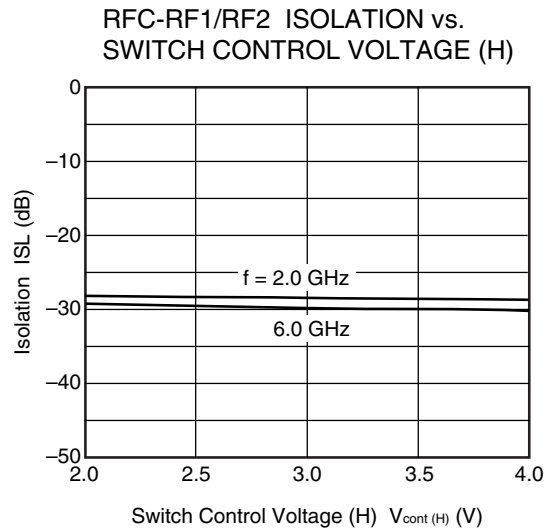
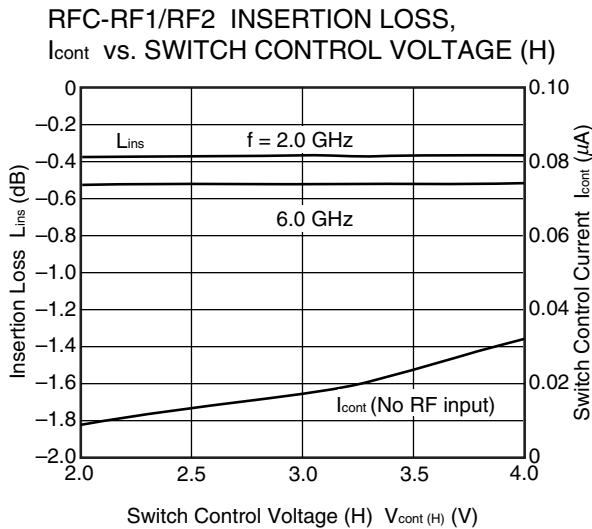
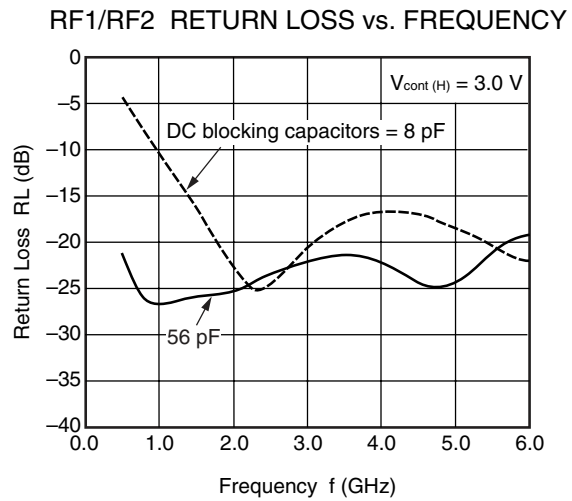
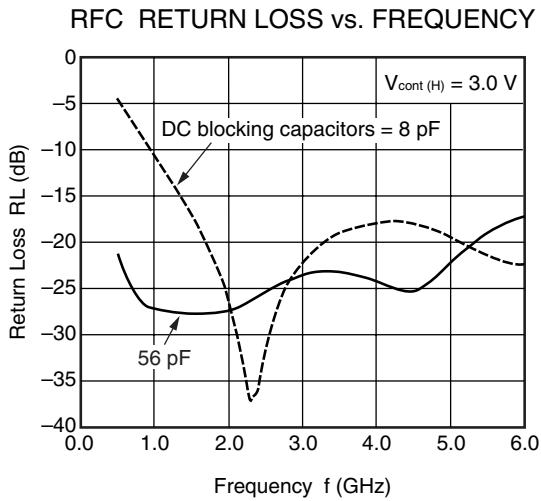
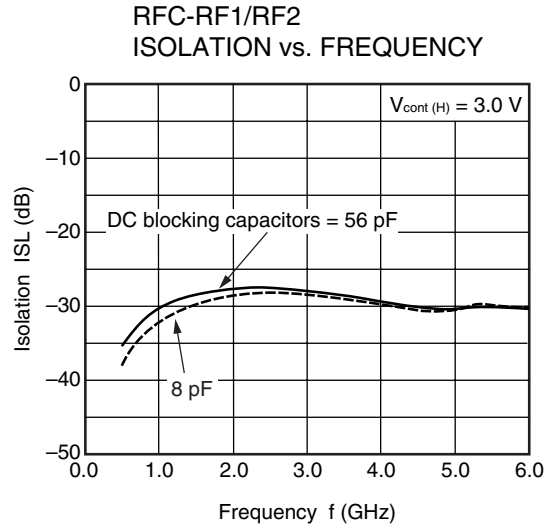
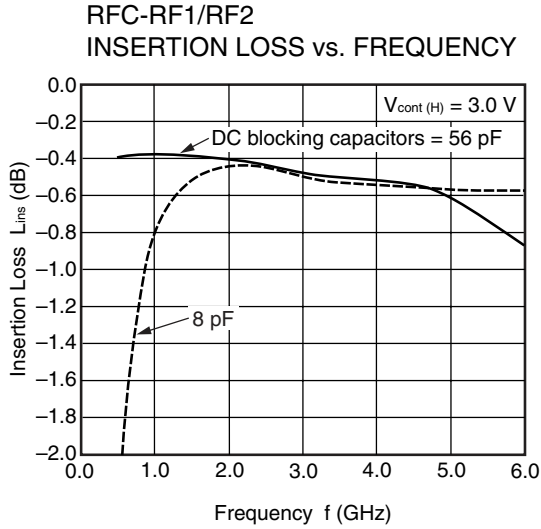
The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

APPLICATION INFORMATION



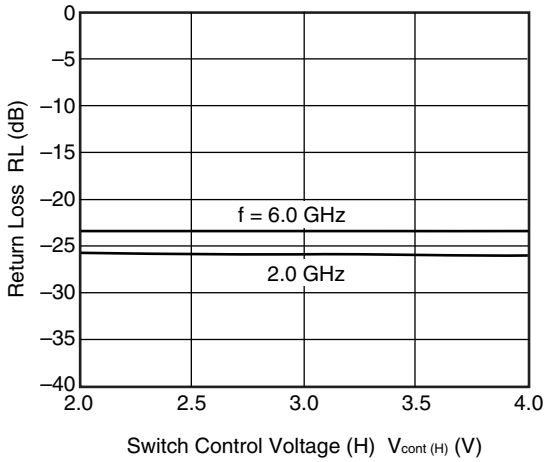
- C1 are DC blocking capacitors external to the device.  
 The value may be tailored to provide specific electrical responses.
- The RF ground connections should be kept as short as possible and connected to directly to a good RF ground for best performance.
- L<sub>ESD</sub> provides a means to increase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

**TYPICAL CHARACTERISTICS** ( $T_A = +25^\circ\text{C}$ ,  $V_{\text{cont}}(\text{H}) = 3.0\text{ V}$ ,  $V_{\text{cont}}(\text{L}) = 0\text{ V}$ ,  $Z_0 = 50\ \Omega$ , DC blocking capacitors = 8 pF, unless otherwise specified)

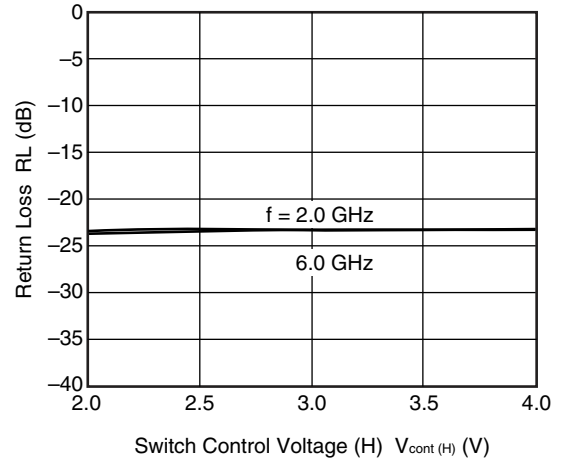


**Remark** The graphs indicate nominal characteristics.

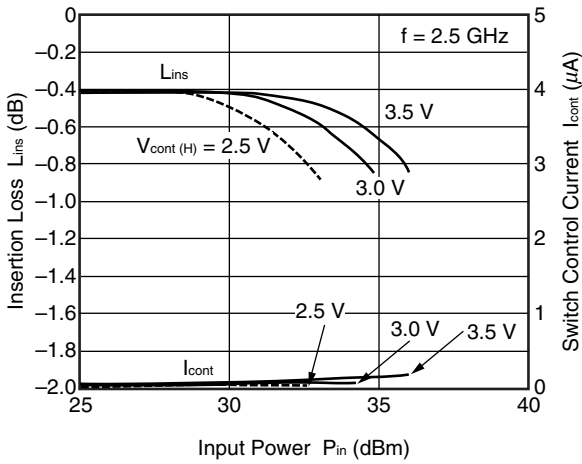
RFC RETURN LOSS vs. SWITCH CONTROL VOLTAGE (H)



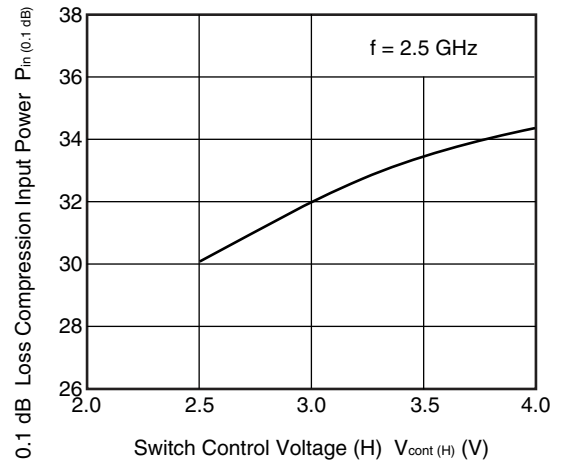
RF1/RF2 RETURN LOSS vs. SWITCH CONTROL VOLTAGE (H)



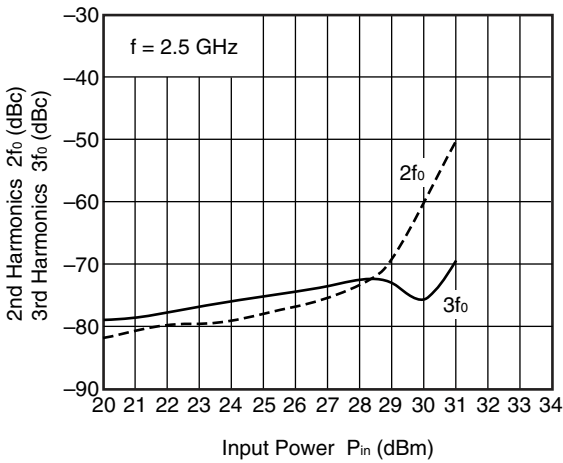
RFC-RF1/RF2 INSERTION LOSS, Icont vs. INPUT POWER



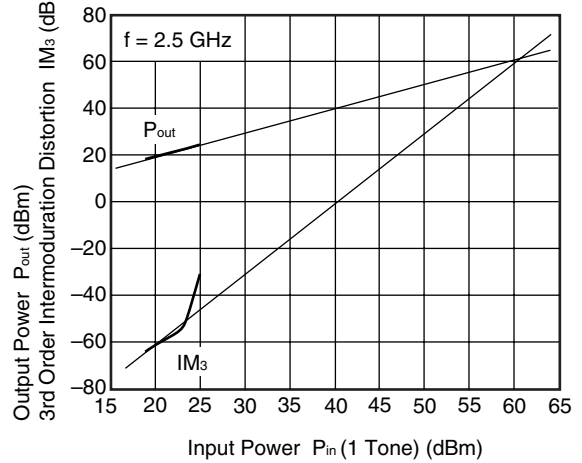
RFC-RF1/RF2 Pin (0.1 dB) vs. SWITCH CONTROL VOLTAGE (H)



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



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

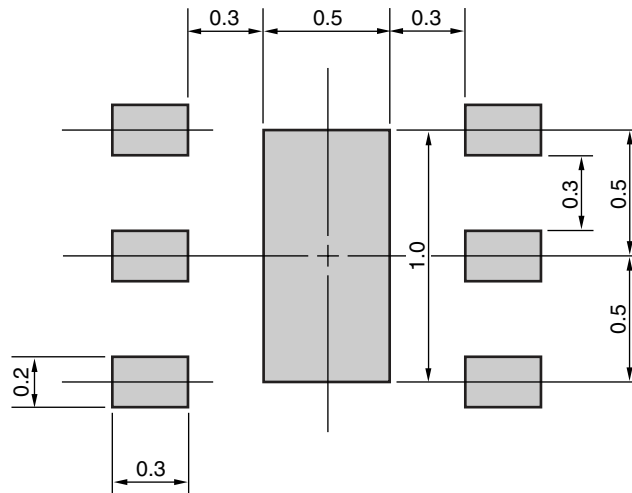


**Remark** The graphs indicate nominal characteristics.

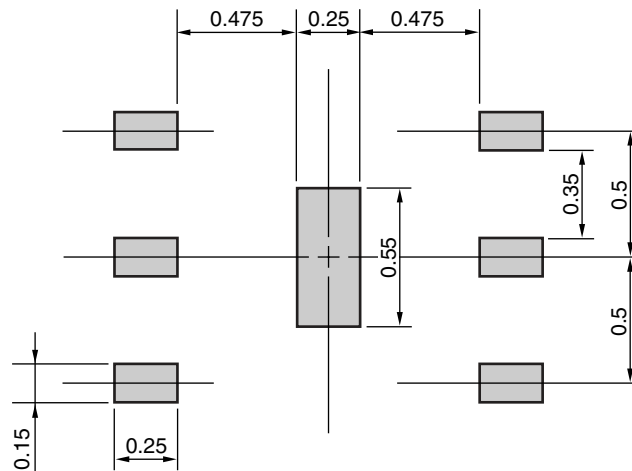
MOUNTING PAD AND SOLDER MASK LAYOUT DIMENSIONS

6-PIN PLASTIC TSON (UNIT: mm)

MOUNTING PAD



SOLDER MASK

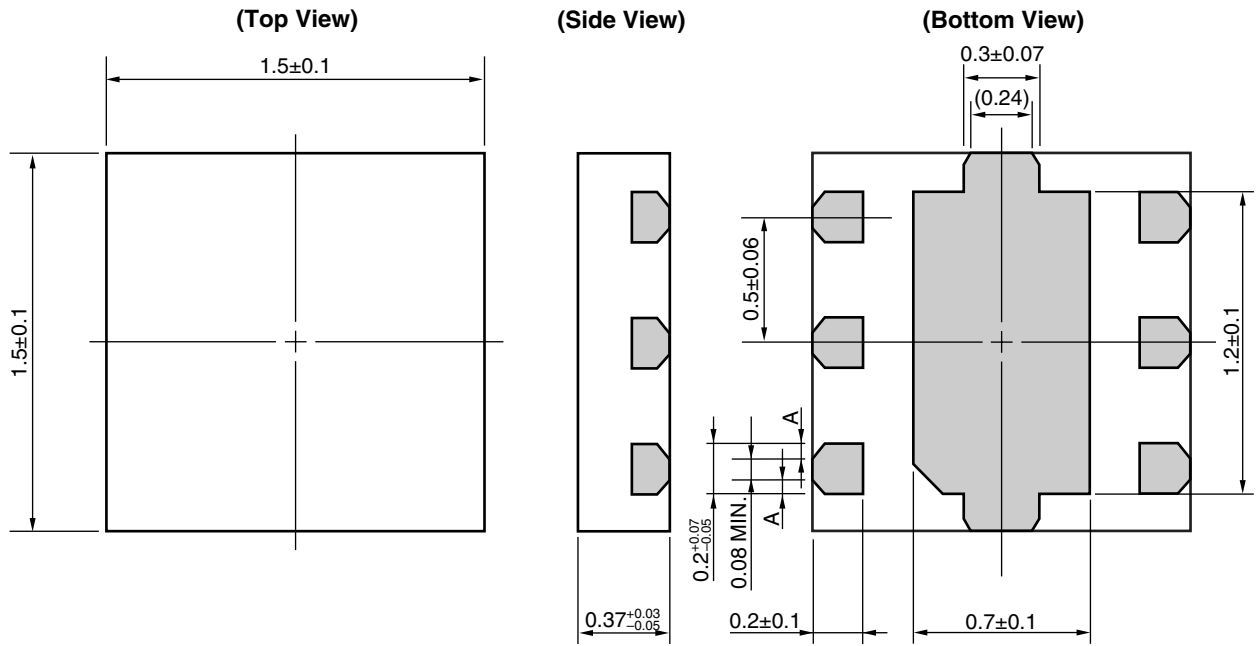


Solder thickness : 0.08 mm

**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) : 260°C or below Time at peak temperature : 10 seconds or less Time at temperature of 220°C or higher : 60 seconds or less Preheating time at 120 to 180°C : 120±30 seconds Maximum number of reflow processes : 3 times Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	IR260
Partial Heating	Peak temperature (terminal temperature) : 350°C or below Soldering time (per side of device) : 3 seconds or less 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).**

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M8E0904E

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To our customers,

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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