μPG2413T6M

SP3T SWITCH FOR Bluetooth™ AND 802.11b/g

DESCRIPTION

The μPG2413T6M is a GaAs MMIC SP3T switch which was developed for Bluetooth, wireless LAN.

This device can operate frequencies from 0.5 to 3.0 GHz, with low insertion loss.

This device is housed in a 12-pin plastic TSQFN (Thin Small Quad Flat Non-leaded) (T6M) 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} = 0.35 dB TYP. @ f = 1.0 GHz
  : L_{ins} = 0.45 dB TYP. @ f = 2.0 GHz
  : L_{ins} = 0.50 dB TYP. @ f = 2.5 GHz
- High isolation : ISL = 26 dB TYP. @ f = 1.0 GHz
  : ISL = 20 dB TYP. @ f = 2.0 GHz
  : ISL = 18 dB TYP. @ f = 2.5 GHz
- Handling power : $P_{in\ (0.1\ dB)}$ = +28.0 dBm TYP. @ f = 2.5 GHz, $V_{cont\ (H)}$ = 3.0 V, $V_{cont\ (L)}$ = 0 V
- High-density surface mounting : 12-pin plastic TSQFN (T6M) package (2.0 × 2.0 × 0.37 mm)

APPLICATIONS

- Bluetooth and IEEE802.11b/g etc.

ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPG2413T6M-E2	μPG2413T6M-E2-A	12-pin plastic TSQFN (T6M) (Pb-Free)	2413	• Embossed tape 8 mm wide • Pin 10, 11, 12 face the perforation side of the tape • Qty 3 kpcs/reel

Remark To order evaluation samples, please contact your nearby sales office.
Part number for sample order: μPG2413T6M-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.

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

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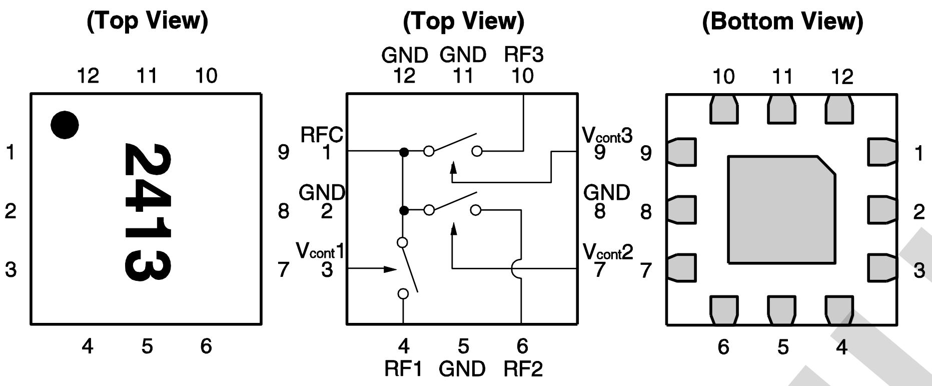
PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM



Pin No.	Pin Name
1	RFC
2	GND
3	$V_{cont}1$
4	RF1
5	GND
6	RF2
7	$V_{cont}2$
8	GND
9	$V_{cont}3$
10	RF3
11	GND
12	GND

Remark Exposed pad : GND

TRUTH TABLE

$V_{cont}1$	$V_{cont}2$	$V_{cont}3$	RFC–RF1	RFC–RF2	RFC–RF3
High	Low	Low	ON	OFF	OFF
Low	High	Low	OFF	ON	OFF
Low	Low	High	OFF	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 ($V_{cont\,(H)}$ = 1.8 V)	P_{in}	+26	dBm
Input Power ($V_{cont\,(H)}$ = 2.3 V)	P_{in}	+28	dBm
Input Power ($V_{cont\,(H)}$ = 3.0 V)	P_{in}	+32	dBm
Input Power ($V_{cont\,(H)}$ = 3.6 V)	P_{in}	+34	dBm
Operating Ambient Temperature	T_A	–45 to +85	°C
Storage Temperature	T_{stg}	–55 to +150	°C

Note $|V_{cont\,(H)} - V_{cont\,(L)}| \leq 6.0$ V

RECOMMENDED OPERATING RANGE (T_A = +25°C)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Operating Frequency	f	0.5	–	3.0	GHz
Switch Control Voltage (H)	$V_{cont\,(H)}$	1.8	3.0	3.6	V
Switch Control Voltage (L)	$V_{cont\,(L)}$	–0.2	0	0.2	V
Control Voltage Difference (H)	$\Delta V_{cont\,(H)}$ **Note1**	–0.1	0	0.1	V
Control Voltage Difference (L)	$\Delta V_{cont\,(L)}$ **Note2**	–0.1	0	0.1	V

Notes 1. $\Delta V_{cont\,(H)}$ is a difference between the maximum and the minimum control voltages among $V_{cont}1_{(H)}$, $V_{cont}2_{(H)}$ and $V_{cont}3_{(H)}$.

2. $\Delta V_{cont\,(L)}$ is a difference between the maximum and the minimum control voltages among $V_{cont}1_{(L)}$, $V_{cont}2_{(L)}$ and $V_{cont}3_{(L)}$.

ELECTRICAL CHARACTERISTICS 1

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

Parameter	Symbol	Pass	Test Conditions	MIN.	TYP.	MAX.	Unit
Insertion Loss	L_{ins}	RFC to RF1, 2, 3	f = 0.5 to 1.0 GHz	–	0.35	0.60	dB
			f = 1.0 to 2.0 GHz	–	0.45	0.70	dB
			f = 2.0 to 2.5 GHz	–	0.50	0.75	dB
			f = 2.5 to 3.0 GHz	–	0.60	–	dB
Isolation	ISL	RFC to RF1, 2, 3 (OFF)	f = 0.5 to 1.0 GHz	23	26	–	dB
			f = 1.0 to 2.0 GHz	17	20	–	dB
			f = 2.0 to 2.5 GHz	15	18	–	dB
			f = 2.5 to 3.0 GHz	–	16	–	dB
Return Loss (RFC)	RL_C		f = 0.5 to 3.0 GHz	15	20	–	dB
Return Loss (RF1, 2, 3)	RL1, 2, 3		f = 0.5 to 3.0 GHz	15	20	–	dB
0.1 dB Loss Compression Input Power Note 1	$P_{in\ (0.1\ dB)}$	RFC to RF1, 2, 3	f = 2.5 GHz	+25.0	+28.0	–	dBm
1 dB Loss Compression Input Power Note 2	$P_{in\ (1\ dB)}$	RFC to RF1, 2, 3	f = 2.5 GHz, $V_{cont\ (H)}$ = 2.3 V	–	+27.0	–	dBm
			f = 2.5 GHz, $V_{cont\ (H)}$ = 3.0 V	–	+31.0	–	dBm
			f = 2.5 GHz, $V_{cont\ (H)}$ = 3.6 V	–	+33.0	–	dBm
2nd Harmonics	2f0		f = 2.5 GHz, P_{in} = 23 dBm	–	75	–	dBc
3rd Harmonics	3f0		f = 2.5 GHz, P_{in} = 23 dBm	–	75	–	dBc
Switch Control Current	I_{cont}		No RF input	–	0.1	5.0	μA
Switch Control Speed	t_{SW}		50% CTL to 90/10% RF	–	50	–	ns

Notes 1. $P_{in\ (0.1\ dB)}$ is the measured input power level when the insertion loss increases 0.1 dB more than that of the linear range.

2. $P_{in\ (1\ dB)}$ 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.

ELECTRICAL CHARACTERISTICS 2

(T_A = +25°C, $V_{cont\ (H)}$ = 1.8 V, $V_{cont\ (L)}$ = 0 V, Z_O = 50 Ω, DC blocking capacitors = 56 pF, unless otherwise specified)

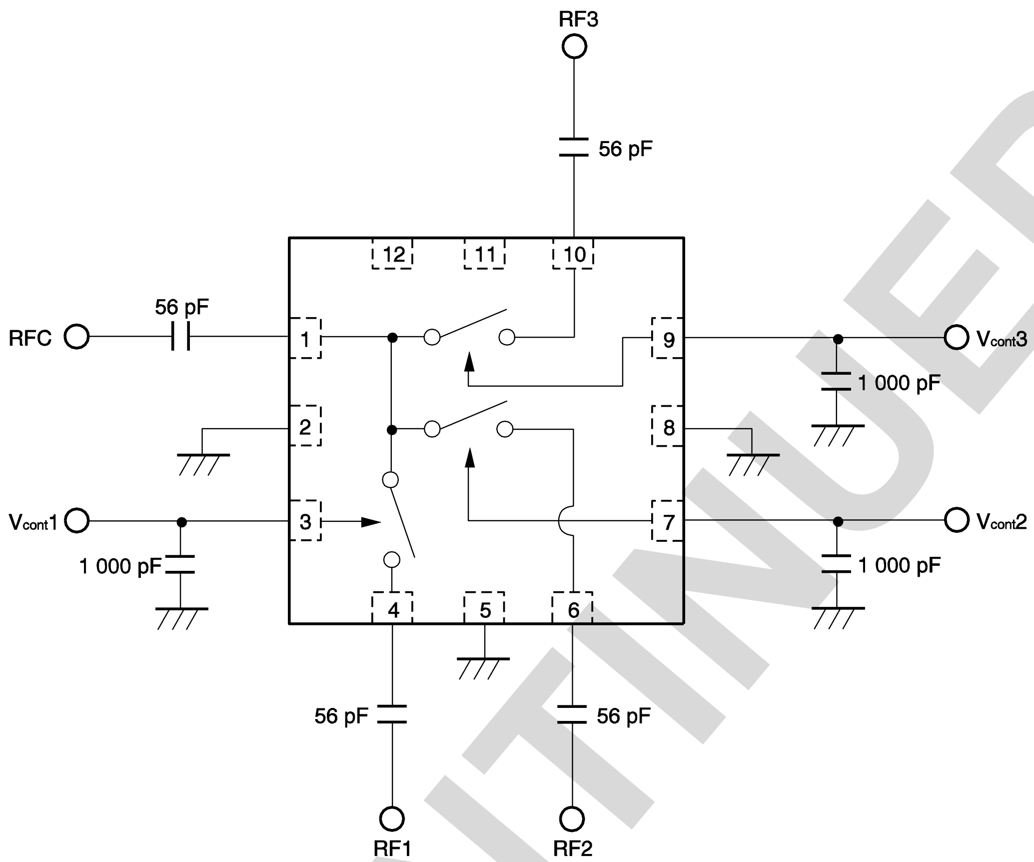
Parameter	Symbol	Pass	Test Conditions	MIN.	TYP.	MAX.	Unit
Insertion Loss	L_{ins}	RFC to RF1, 2, 3	f = 0.5 to 1.0 GHz	–	0.35	0.65	dB
			f = 1.0 to 2.0 GHz	–	0.45	0.75	dB
			f = 2.0 to 2.5 GHz	–	0.50	0.80	dB
			f = 2.5 to 3.0 GHz	–	0.65	–	dB
Isolation	ISL	RFC to RF1, 2, 3 (OFF)	f = 0.5 to 1.0 GHz	22.5	25.5	–	dB
			f = 1.0 to 2.0 GHz	16.5	19.5	–	dB
			f = 2.0 to 2.5 GHz	14.5	17.5	–	dB
			f = 2.5 to 3.0 GHz	–	15.5	–	dB
Return Loss (RFC)	RL_C		f = 0.5 to 3.0 GHz	15	20	–	dB
Return Loss (RF1, 2, 3)	RL1, 2, 3		f = 0.5 to 3.0 GHz	15	20	–	dB
0.1 dB Loss Compression Input Power Note 1	$P_{in\ (0.1\ dB)}$	RFC to RF1, 2, 3	f = 2.5 GHz	+19.0	+22.0	–	dBm
1 dB Loss Compression Input Power Note 2	$P_{in\ (1\ dB)}$	RFC to RF1, 2, 3	f = 2.5 GHz	+21.0	+25.0	–	dBm
2nd Harmonics	2f0		f = 2.5 GHz, P_{in} = 17 dBm	–	75	–	dBc
3rd Harmonics	3f0		f = 2.5 GHz, P_{in} = 17 dBm	–	75	–	dBc
Switch Control Current	I_{cont}		No RF input	–	0.1	5.0	μA
Switch Control Speed	t_{SW}		50% CTL to 90/10% RF	–	50	–	ns

Notes 1. $P_{in\ (0.1\ dB)}$ is the measured input power level when the insertion loss increases 0.1 dB more than that of the linear range.

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

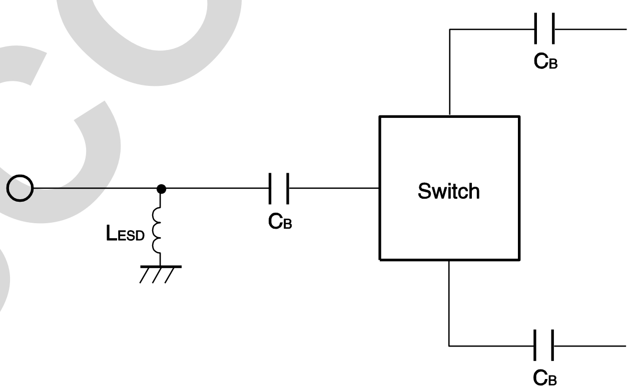
Caution It is necessary to use DC blocking capacitors with this device.

EVALUATION CIRCUIT



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

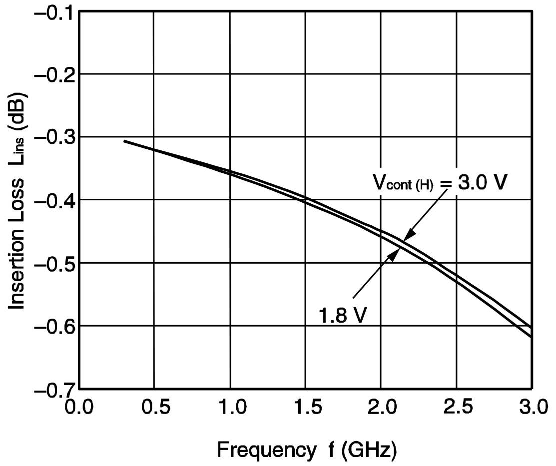
APPLICATION INFORMATION



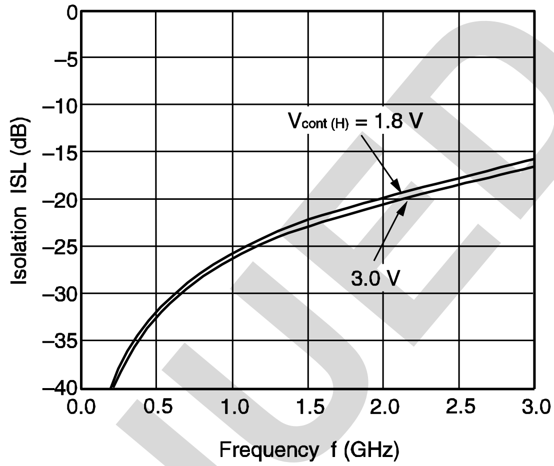
- C_B are DC blocking capacitors external to the device.
  A value of 56 pF is sufficient for operation from 500 MHz to 2.5 GHz bands.
  The value may be tailored to provide specific electrical responses.
- The RF ground connections should be kept as short as possible and connected to directly to a good RF ground for best performance.
- L_{ESD} 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, DC blocking capacitors = 56 pF, unless otherwise specified)

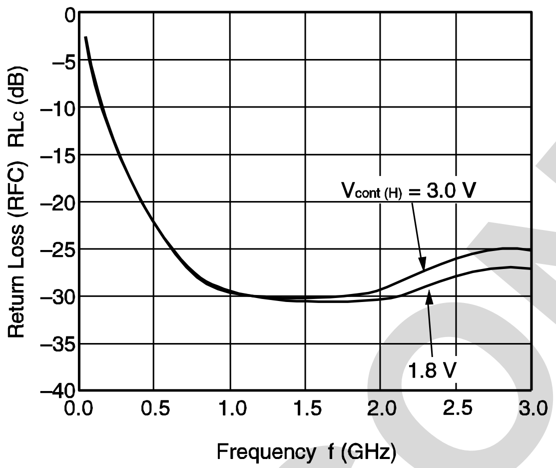
RFC-RF1/RF2/RF3
INSERTION LOSS vs. FREQUENCY



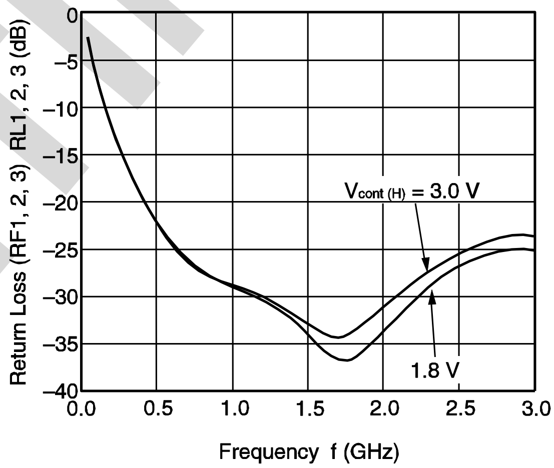
RFC-RF1/RF2/RF3
ISOLATION vs. FREQUENCY



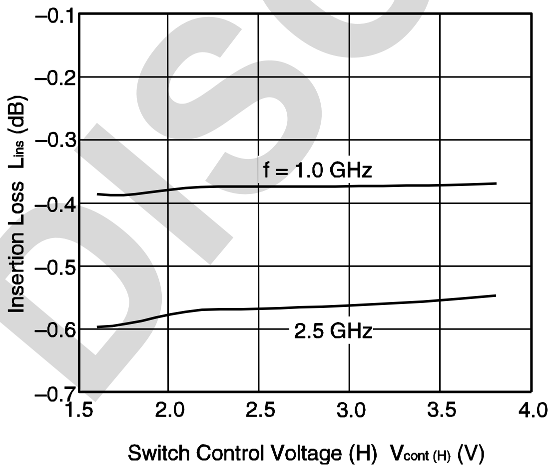
RETURN LOSS (RFC) vs. FREQUENCY



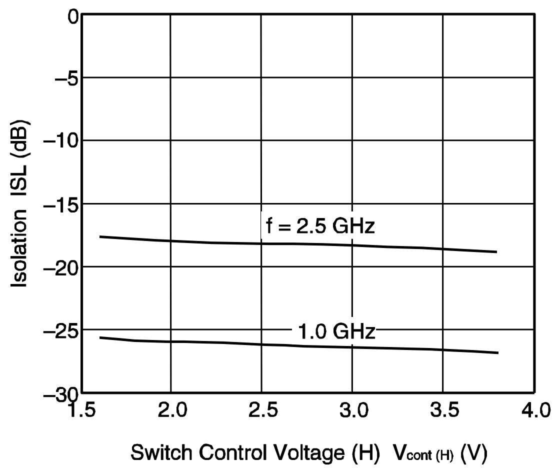
RETURN LOSS (RF1, 2, 3) vs. FREQUENCY



RFC-RF1/RF2/RF3 INSERTION LOSS
vs. SWITCH CONTROL VOLTAGE (H)

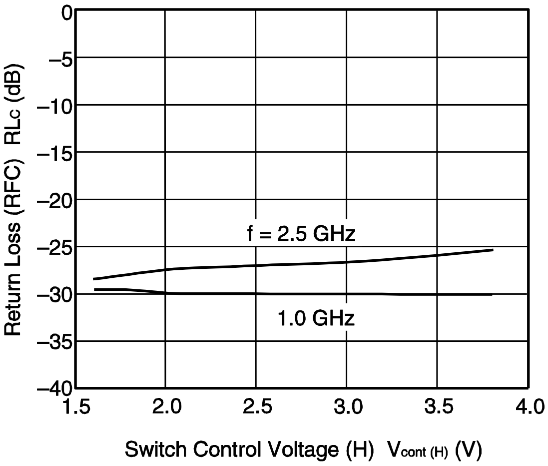


RFC-RF1/RF2/RF3 ISOLATION vs.
SWITCH CONTROL VOLTAGE (H)

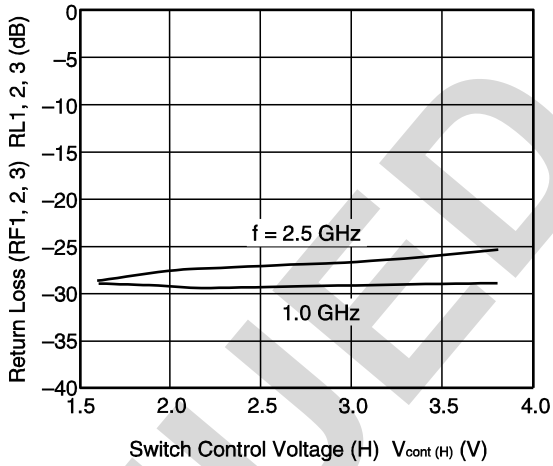


Remark The graphs indicate nominal characteristics.

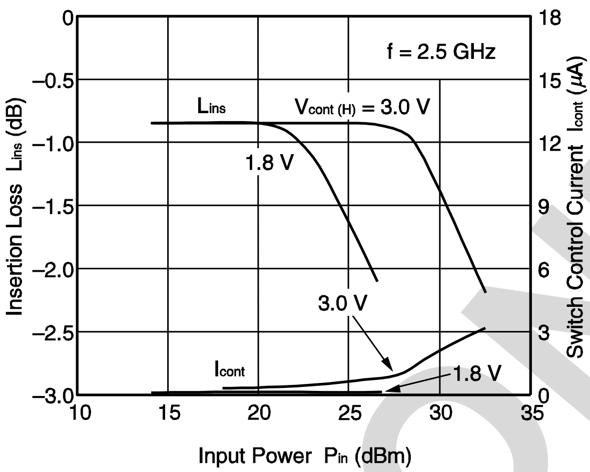
RETURN LOSS (RFC)
vs. SWITCH CONTROL VOLTAGE (H)



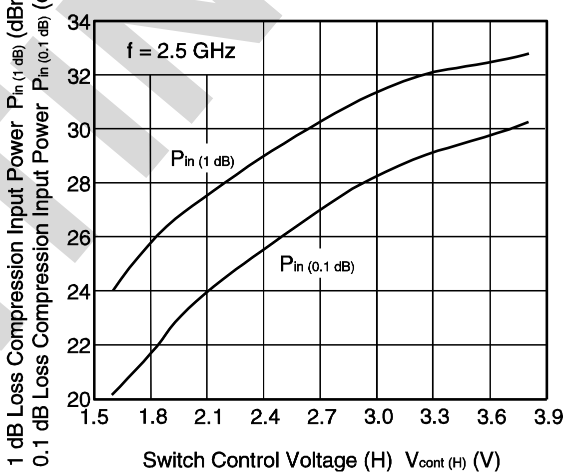
RETURN LOSS (RF1, 2, 3)
vs. SWITCH CONTROL VOLTAGE (H)



RFC-RF1/RF2/RF3 INSERTION LOSS,
I_{cont} vs. INPUT POWER



RFC-RF1/RF2/RF3 $P_{in\ (1\ dB)}$, $P_{in\ (0.1\ dB)}$ vs.
SWITCH CONTROL VOLTAGE (H)

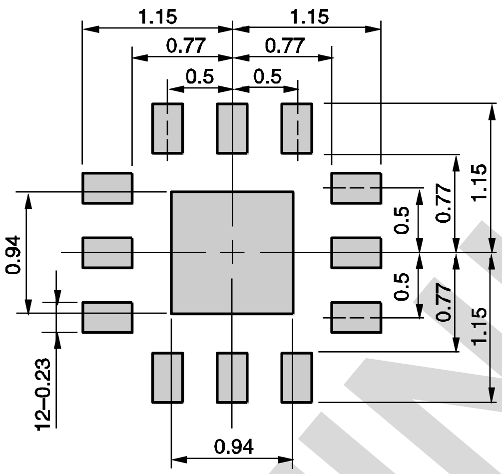


Remark The graphs indicate nominal characteristics.

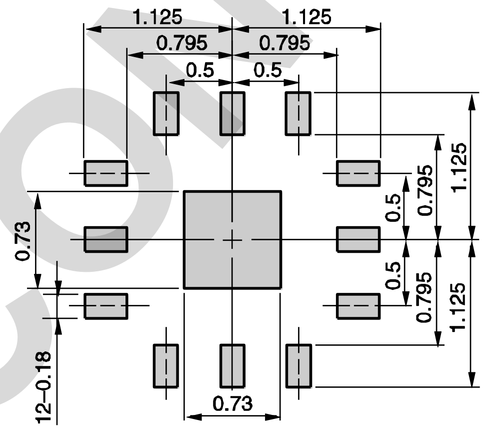
MOUNTING PAD AND SOLDER MASK LAYOUT DIMENSIONS

12-PIN PLASTIC TSQFN (T6M) (UNIT: mm)

MOUNTING PAD



SOLDER MASK

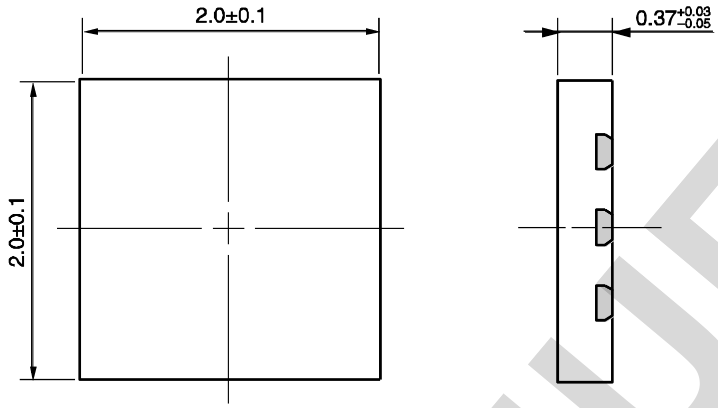


Solder thickness : 0.1 mm

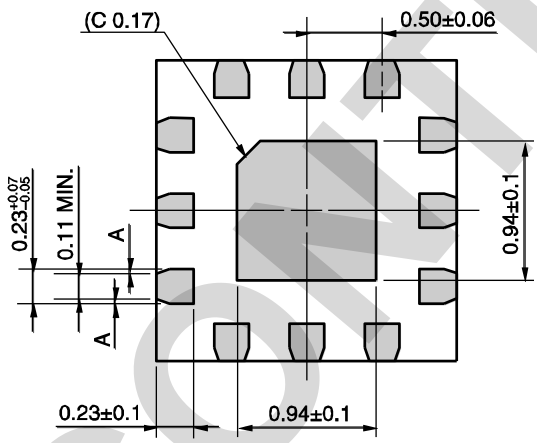
Remark The mounting pad and solder mask layouts in this document are for reference only.
When designing PCB, please consider workability of mounting, solder joint reliability, prevention of solder bridge and so on, in order to optimize the design.

PACKAGE DIMENSIONS

12-PIN PLASTIC TSQFN (T6M) (UNIT: mm)



(Bottom View)



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) Time at peak temperature Time at temperature of 220°C or higher Preheating time at 120 to 180°C Maximum number of reflow processes Maximum chlorine content of rosin flux (% mass)	: 260°C or below : 10 seconds or less : 60 seconds or less : 120±30 seconds : 3 times : 0.2%(Wt.) or below	IR260
Partial Heating	Peak temperature (terminal temperature) Soldering time (per side of device) Maximum chlorine content of rosin flux (% mass)	: 350°C or below : 3 seconds or less : 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). GaAs vapor and powder are hazardous to human health if inhaled or ingested, so please observe the following points. • 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. 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. 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. • Do not burn, destroy, cut, crush, or chemically dissolve the product. • Do not lick the product or in any way allow it to enter the mouth.