CEL

CMOS INTEGRATED CIRCUIT

μPD5731T6M

WIDEBAND SP4T CMOS SWITCH IC

DESCRIPTION

The μPD5731T6M is a CMOS MMIC SP4T switch which was developed for mobile communications, wireless communications and other RF switching applications.

<R> This device can operate from 0.01 to 2.0 GHz, with low insertion loss and high isolation.

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

- Supply voltage : V_{DD} = 1.5 to 3.6 V (2.8 V TYP.)
- Switch control voltage : $V_{cont\ (H)}$ = 1.5 to 3.6 V (2.8 V TYP.)
  : $V_{cont\ (L)}$ = −0.2 to +0.4 V (0 V TYP.)
- Low insertion loss : $L_{ins}1$ = 0.7dB TYP. @ f = 0.01 to 0.05 GHz, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V
  : $L_{ins}2$ = 1.0 dB TYP. @ f = 0.05 to 1.0 GHz, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V
  <R> : $L_{ins}3$ = 1.4 dB TYP. @ f = 1.0 to 2.0 GHz, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V
- High isolation : ISL1 = 60 dB TYP. @ f = 0.01 to 0.05 GHz, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V
  : ISL2 = 35 dB TYP. @ f = 0.05 to 1.0 GHz, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V
  : ISL3 = 26 dB TYP. @ f = 1.0 to 2.0 GHz, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V
- Power Handling : $P_{in\ (1\ dB)}$ = +20 dBm TYP. @ f = 1.0 GHz, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V
  : $P_{in\ (0.1\ dB)}$ = +17 dBm TYP. @ f = 1.0 GHz, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V
- High-density surface mounting : 12-pin plastic TSQFN (T6M) package (2.0 × 2.0 × 0.37 mm)

APPLICATIONS

- Mobile communications
- Wireless communications
- Other RF switching applications

ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPD5731T6M-E2	μPD5731T6M-E2-A	12-pin plastic TSQFN (T6M) (Pb-Free)	5731	• 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, contact your nearby sales office.
Part number for sample order: μPD5731T6M-A

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

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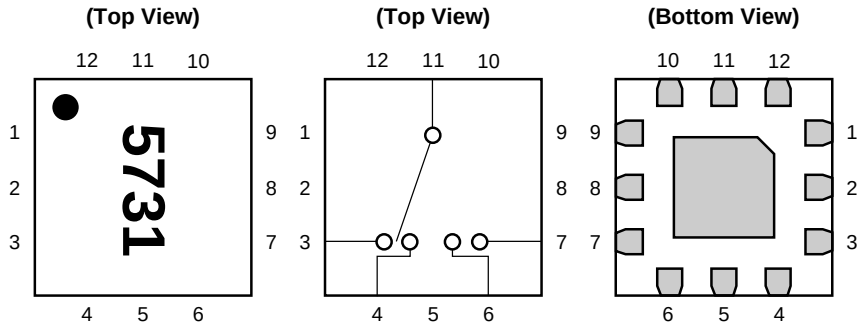
The mark <R> shows major revised points.

The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM



Pin No.	Pin Name
1	NC
2	GND
3	OUTPUT1
4	OUTPUT2
5	GND
6	OUTPUT3
7	OUTPUT4
8	GND
9	$V_{cont}1$
10	$V_{cont}2$
11	INPUT
12	V_{DD}

TRUTH TABLE

ON-state	$V_{cont}1$	$V_{cont}2$
INPUT–OUTPUT1	Low	Low
INPUT–OUTPUT2	Low	High
INPUT–OUTPUT3	High	Low
INPUT–OUTPUT4	High	High

Remark High: +2.8 V, Low: 0 V

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

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{DD}	–0.5 to +4.6	V
Switch Control Voltage	V_{cont}	–0.5 to +4.6	V
Voltage Difference	$V_{cont (H)} - V_{DD}$	+0.5	V
Input Power	P_{in}	+23	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
Supply Voltage	V_{DD}	+1.5	+2.8	+3.6	V
Switch Control Voltage (H)	$V_{cont (H)}$	+1.5	+2.8	+3.6	V
Switch Control Voltage (L)	$V_{cont (L)}$	–0.2	0	+0.4	V

Remark $V_{DD} - 0.4\ V \leq V_{cont (H)} \leq V_{DD} + 0.2\ V$

ELECTRICAL CHARACTERISTICS

(T_A = +25°C, V_{DD} = 2.8 V, $V_{cont\,(H)}$ = 2.8 V, $V_{cont\,(L)}$ = 0 V, P_{in} = 0 dBm, DC blocking capacitors = 10 000 pF, unless otherwise specified)

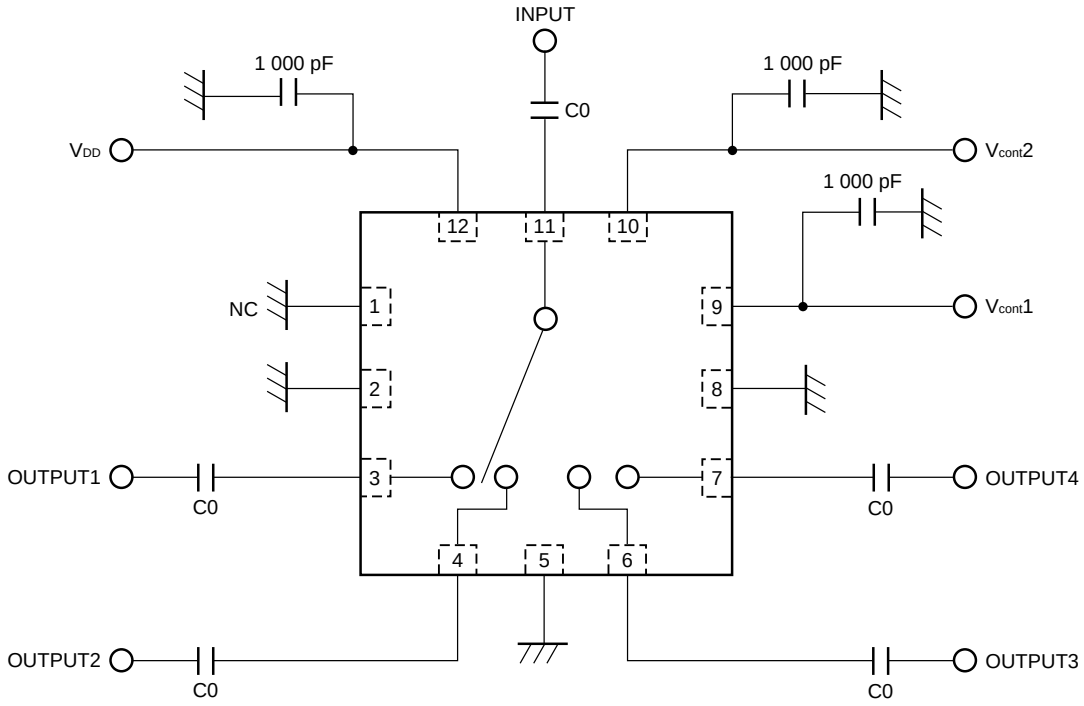
	Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
	Insertion Loss 1	$L_{ins}1$	f = 0.01 to 0.05 GHz	–	0.7	1.1	dB
	Insertion Loss 2	$L_{ins}2$	f = 0.05 to 1.0 GHz	–	1.0	1.4	dB
<R>	Insertion Loss 3	$L_{ins}3$	f = 1.0 to 2.0 GHz	–	1.4	1.8	dB
	Isolation 1	ISL1	f = 0.01 to 0.05 GHz	50	60	–	dB
	Isolation 2	ISL2	f = 0.05 to 1.0 GHz	31	35	–	dB
	Isolation 3	ISL3	f = 1.0 to 2.0 GHz	23	26	–	dB
<R>	Input Return Loss 1	$RL_{in}1$	f = 0.01 to 1.0 GHz	12	15	–	dB
<R>	Input Return Loss 2	$RL_{in}2$	f = 1.0 to 2.0 GHz	10	12	–	dB
<R>	Output Return Loss 1	$RL_{out}1$	f = 0.01 to 1.0 GHz	12	16	–	dB
<R>	Output Return Loss 2	$RL_{out}2$	f = 1.0 to 2.0 GHz	10	14	–	dB
	0.1 dB Loss Compression Input Power Note 1	$P_{in\,(0.1\,dB)}$	f = 1.0 GHz	+13	+17	–	dBm
	1 dB Loss Compression Input Power Note 2	$P_{in\,(1\,dB)}$	f = 1.0 GHz	–	+20	–	dBm
	Supply Current	I_{DD}	V_{DD} = V_{cont} = 2.8 V, RF off	–	0.01	1.0	μA
	Switch Control Current	I_{cont}	V_{DD} = V_{cont} = 2.8 V, RF off	–	0.01	1.0	μA
	Switch Control Speed	t_{SW}	f = 1.0 GHz	–	30	100	ns

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

2. $P_{in\,(1\,dB)}$ is the measured input power level when the insertion loss increases more 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.

EVALUATION CIRCUIT

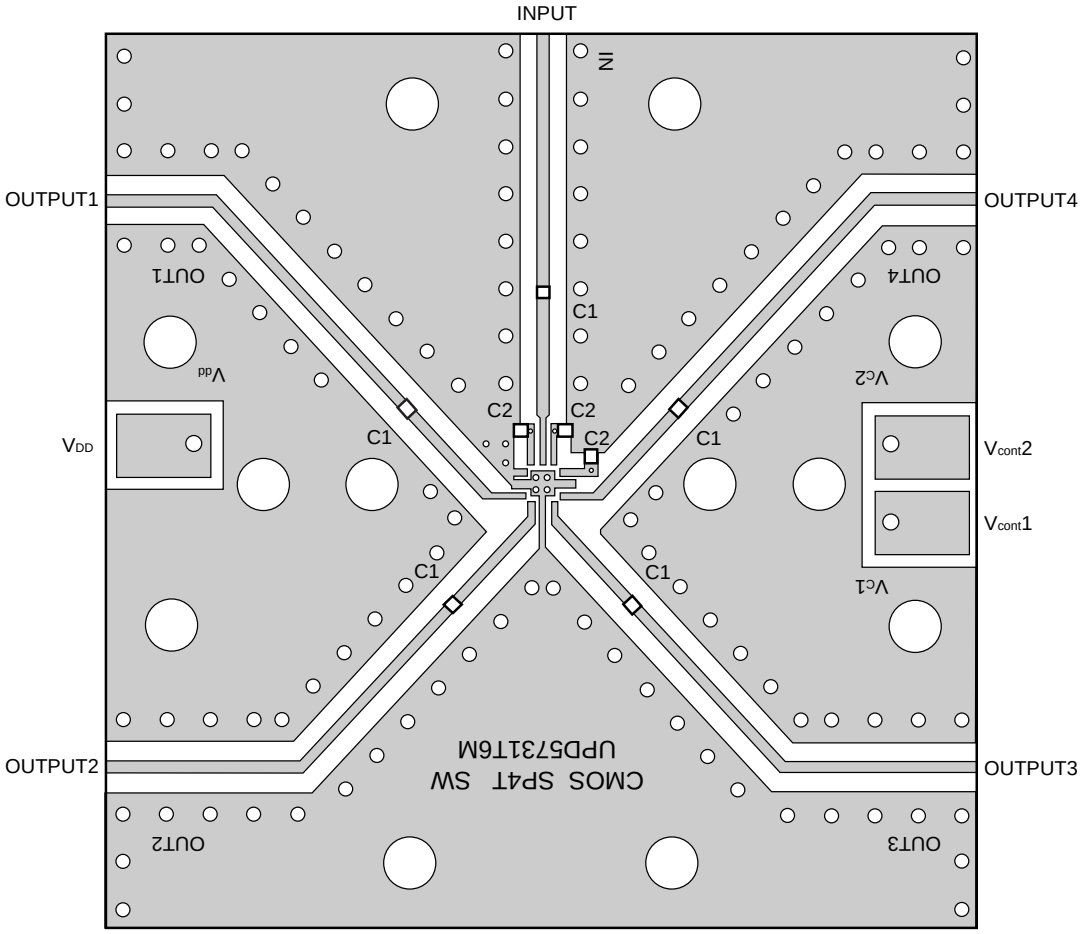


Remark C0 = 10 000 pF

Caution This IC has pull down resistance between RF line and GND, which fixes the electrical potential of RF line to 0 V, therefore the IC cannot be used for DC switching.

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

<R> **ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD**

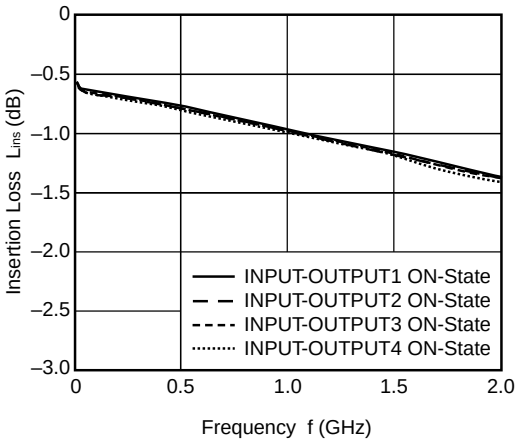


<R> **USING THE NEC EVALUATION BOARD**

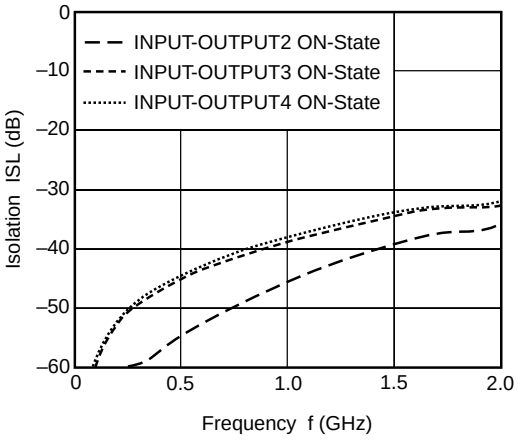
Symbol	Values
C2	1 000 pF
C1	10 000 pF

<R> **TYPICAL CHARACTERISTICS**
(T_A = +25°C, V_{DD} = 2.8 V, $V_{cont\ (H)}$ = 2.8 V, $V_{cont\ (L)}$ = 0 V, P_{in} = 0 dBm, DC blocking capacitors = 10 000 pF, unless otherwise specified)

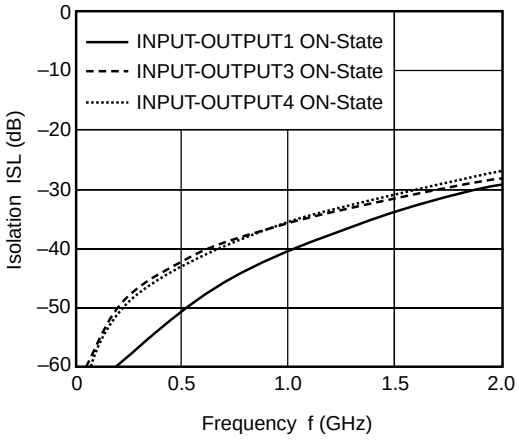
INSERTION LOSS vs. FREQUENCY



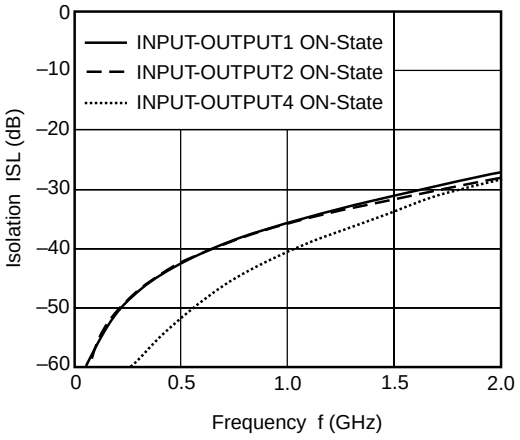
INPUT–OUTPUT1
ISOLATION vs. FREQUENCY



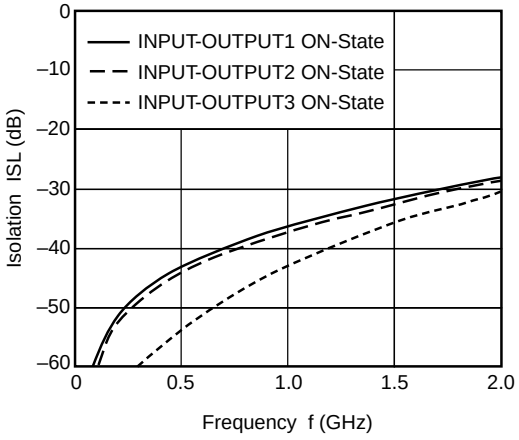
INPUT–OUTPUT2
ISOLATION vs. FREQUENCY



INPUT–OUTPUT3
ISOLATION vs. FREQUENCY

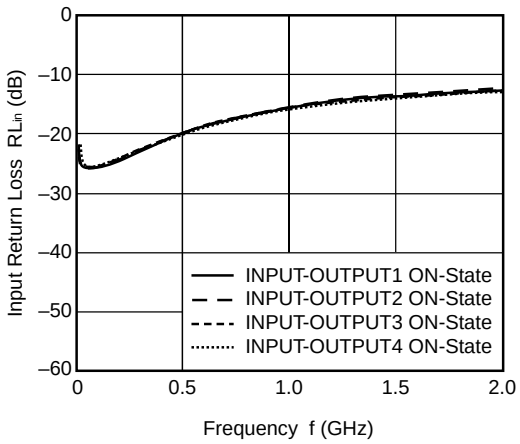


INPUT–OUTPUT4
ISOLATION vs. FREQUENCY

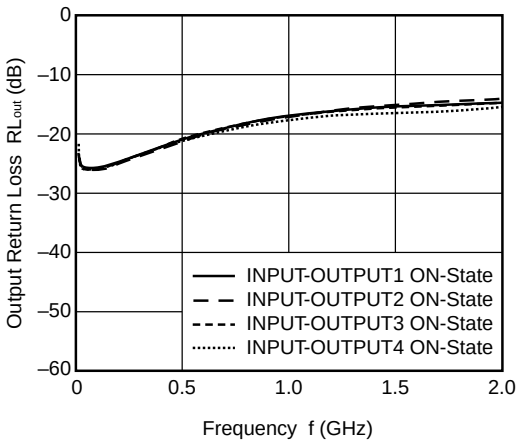


Remark The graphs indicate nominal characteristics.

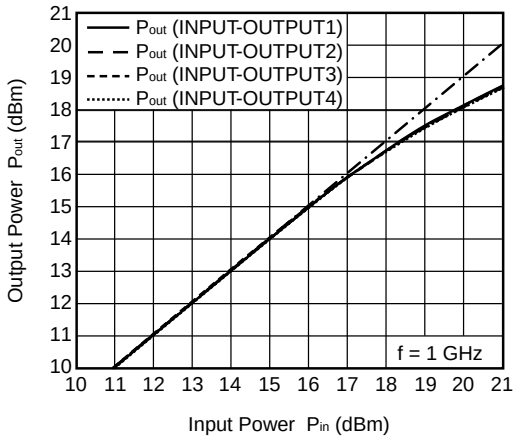
INPUT RETURN LOSS vs. FREQUENCY



OUTPUT RETURN LOSS vs. FREQUENCY



OUTPUT POWER vs. INPUT POWER

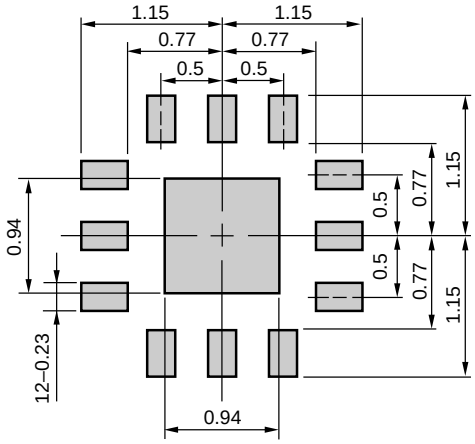


Remark The graphs indicate nominal characteristics.

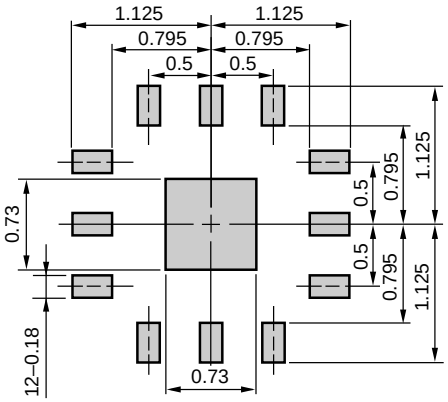
MOUNTING PAD AND SOLDER MASK LAYOUT DIMENSIONS

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

MOUNTING PAD



SOLDER MASK

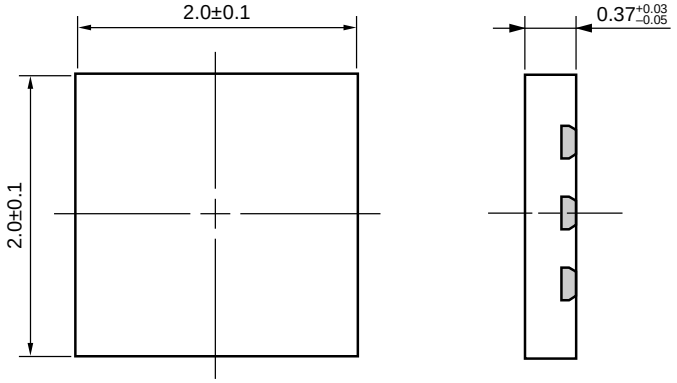


Solder thickness : 0.1 mm

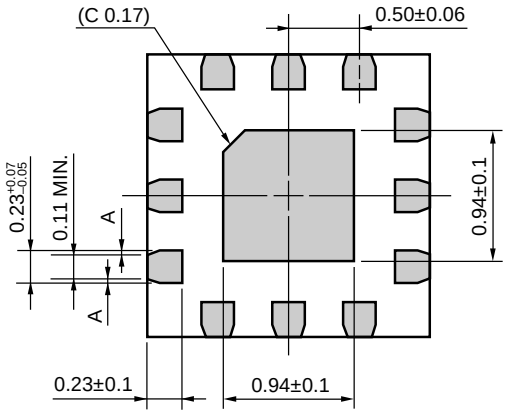
Remark The mounting pad and solder mask layouts in this document are for reference only.

PACKAGE DIMENSIONS

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



(Bottom View)



Remark A > 0

( ): Reference value

<R> 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	IR260
	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	
Partial Heating	Peak temperature (terminal temperature)	: 350°C or below	HS350
	Soldering time (per side of device)	: 3 seconds or less	
	Maximum chlorine content of rosin flux (% mass)	: 0.2%(Wt.) or below	

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

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