μPD5904T7K

Data Sheet
R09DS0045EJ0200
Rev.2.00
Dec 11, 2012

CMOS Integrated Circuits High Power SP4T Switch

DESCRIPTION

The μPD5904T7K is a CMOS MMIC SP4T (Single Pole Four Throw) switch for GSM and UMTS/LTE main Antenna switching and other High Power RF switching applications up to +35 dBm.

This device can operate frequency from 0.05 to 6.0 GHz, having low insertion loss and high isolation.

This device is housed in a 12-pin plastic QFN (Quad Flat Non-Leaded) (T7K) package.

FEATURES

- Low control voltage : V_{cont} = 1.3 V MIN., V_{DD} = 2.3 V MIN.
- Low insertion loss : L_{ins} = 0.4 dB TYP. @ f = 1 GHz
  : L_{ins} = 0.5 dB TYP. @ f = 2 GHz
- High isolation : ISL = 35 dB TYP. @ f = 1 GHz
  : ISL = 30 dB TYP. @ f = 2 GHz
- High Handling power : $P_{in\ (0.1dB)}$ = +38 dBm TYP. @f = 0.9/2 GHz
- High-density surface mounting : 12-pin plastic QFN (T7K) package (2.0 × 2.0 × 0.6 mm)
- No DC blocking capacitors required.

APPLICATIONS

- GSM and UMTS/LTE main Antenna switching
- Diversity Antenna switching
- Antenna tuning Application

ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPD5904T7K-E2	μPD5904T7K-E2-A	12-pin plastic QFN (T7K) (Pb-Free)	5904	• Embossed tape 8 mm wide • Pin 10, 11 and 12 face the perforation side of the tape • Qty 3 kpcs/reel

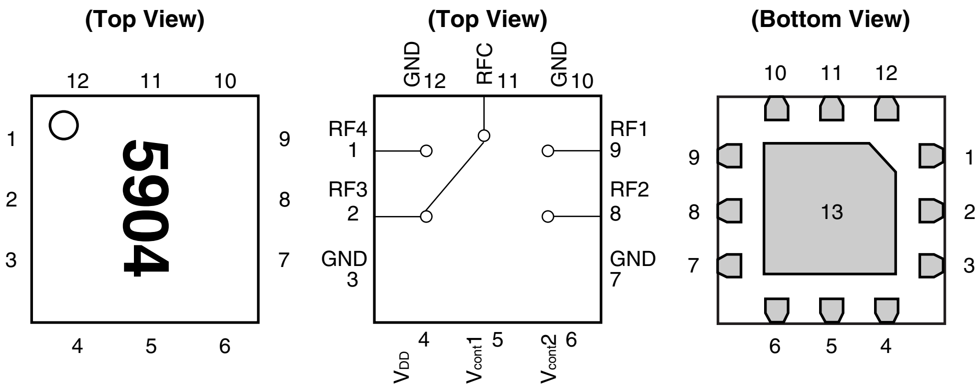
Remark To order evaluation samples, please contact your nearby sales office.
Part number for sample order: μPD5904T7K-A

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.

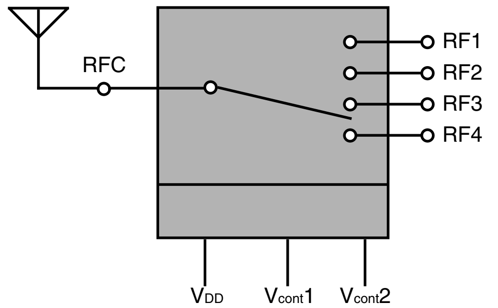
The mark <R> shows major revised points.
The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.

<R> PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM



Pin No.	Pin Name
1	RF4
2	RF3
3	GND
4	V_{DD}
5	$V_{cont}1$
6	$V_{cont}2$
7	GND
8	RF2
9	RF1
10	GND
11	RFC
12	GND
13	GND

BLOCK DIAGRAM



SW TRUTH TABLE

$V_{cont}1$	$V_{cont}2$	RFC–RF1	RFC–RF2	RFC–RF3	RFC–RF4
High	High	ON	OFF	OFF	OFF
High	Low	OFF	ON	OFF	OFF
Low	High	OFF	OFF	ON	OFF
Low	Low	OFF	OFF	OFF	ON

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

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{DD}	3.6	V
Control Voltage	V_{cont}	3.6	V
Input Power	P_{in}	+38	dBm
Operating Ambient Temperature	T_A	–40 to +85	°C
Storage Temperature	T_{stg}	–55 to +125	°C

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

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Operating Frequency	f	0.05	–	6.0	GHz
Supply Voltage	V_{DD}	2.3	–	3.3	V
Control Voltage (High)	$V_{cont (H)}$ Note	1.3	–	V_{DD}	V
Control Voltage (Low)	$V_{cont (L)}$	0	–	0.4	V

Note: $V_{cont} \leq V_{DD}$

ELECTRICAL CHARACTERISTICS
(T_A = +25°C, V_{DD} = 2.5 V, $V_{cont\ (H)}$ = 1.8 V, $V_{cont\ (L)}$ = 0 V, Z_O = 50 Ω, unless otherwise specified)

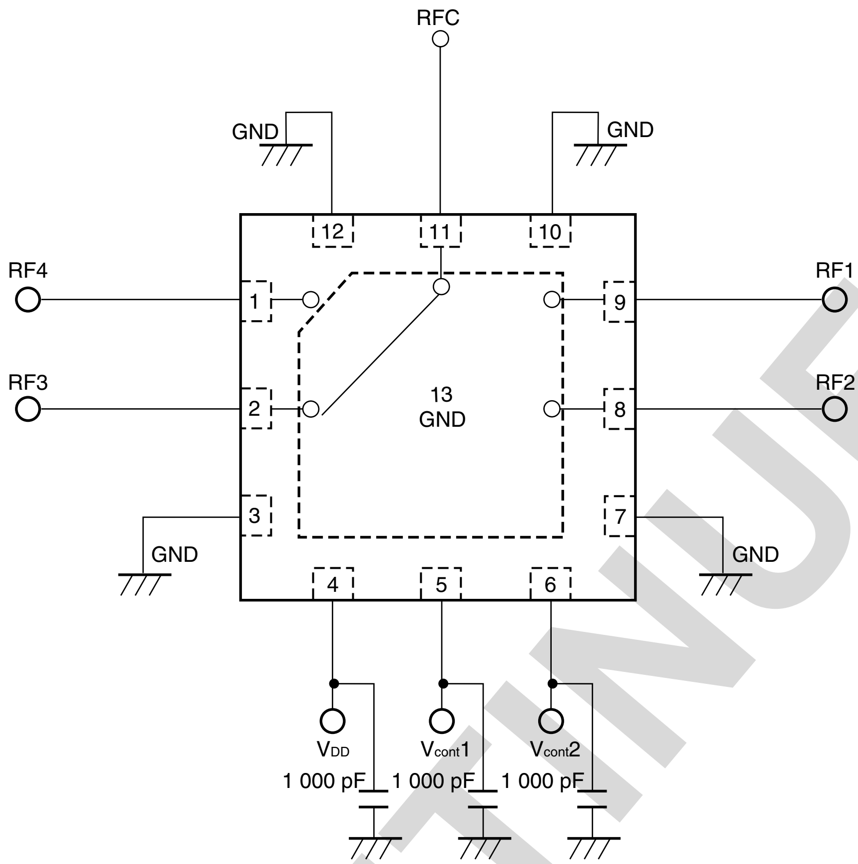
Parameter	Symbol	Path	Test Conditions	MIN.	TYP.	MAX.	Unit
Insertion Loss	$L_{ins}1$	RFC – RF1, 2, 3, 4	f = 0.05 to 0.5 GHz	–	0.35	0.50	dB
	$L_{ins}2$		f = 0.5 to 1.0 GHz	–	0.40	0.55	dB
	$L_{ins}3$		f = 1.0 to 2.0 GHz	–	0.50	0.65	dB
	$L_{ins}4$		f = 2.0 to 2.7 GHz	–	0.55	0.75	dB
	$L_{ins}5$		f = 2.7 to 3.8 GHz	–	0.60	0.80	dB
	$L_{ins}6$		f = 3.8 to 6.0 GHz	–	0.75	0.95	dB
Isolation	ISL1	RFC – RF1, 2, 3, 4	f = 0.05 to 0.5 GHz	30	40	–	dB
	ISL2		f = 0.5 to 1.0 GHz	25	35	–	dB
	ISL3		f = 1.0 to 2.0 GHz	20	30	–	dB
	ISL4		f = 2.0 to 2.7 GHz	15	25	–	dB
	ISL5		f = 2.7 to 3.8 GHz	15	25	–	dB
	ISL6		f = 3.8 to 6.0 GHz	10	20	–	dB
Return Loss (RFC)	$RL_{(C)}1$	RFC – RF1, 2, 3, 4	f = 0.05 to 3.8 GHz	15	25	–	dB
	$RL_{(C)}2$		f = 3.8 to 6.0 GHz	10	17	–	dB
Return Loss (RF1,2,3,4)	$RL_{(RF)}1$		f = 0.05 to 3.8 GHz	15	25	–	dB
	$RL_{(RF)}2$		f = 3.8 to 6.0 GHz	10	17	–	dB
0.1 dB Loss Compression Input Power	$P_{in\ (0.1\ dB)}1$	RFC – RF1, 2, 3, 4	f = 0.9 GHz	+36.0	+38.0 Note	–	dBm
	$P_{in\ (0.1\ dB)}2$		f = 2.0 GHz	+36.0	+38.0 Note	–	dBm
Harmonics	2f0 (L)	RFC – RF1, 2, 3, 4	f = 0.9 GHz, P_{in} = +35 dBm CW	75	80	–	dBc
	3f0 (L)			70	75	–	
	2f0 (H)	RFC – RF1, 2, 3, 4	f = 2.0 GHz, P_{in} = +33 dBm CW	75	85	–	dBc
	3f0 (H)			70	80	–	
2nd Order Inter Modulation Distortion	IMD2(L)	RFC – RF1, 2, 3, 4	f = 835 MHz, P_{in} = +20 dBm f = 45 MHz, P_{in} = –15 dBm	–	–98	–93	dBc
	IMD2(H)		f = 1 950 MHz, P_{in} = +20 dBm f = 190MHz, P_{in} = –15 dBm	–	–105	–100	
3rd Order Inter Modulation Distortion	IMD3(L)	RFC – RF1, 2, 3, 4	f = 835 MHz, P_{in} = +20 dBm f = 790 MHz, P_{in} = –15 dBm	–	–110	–105	dBc
	IMD3(H)		f = 1 950 MHz, P_{in} = +20 dBm f = 1 760 MHz, P_{in} = –15 dBm	–	–110	–105	
Triple Beat Ratio	TBR(L)	RFC – RF1, 2, 3, 4	f = 836±0.5 MHz, P_{in} = +21.5 dBm f = 881.5 MHz, P_{in} = –30 dBm	75	80	–	dBc
	TBR(H)		f = 1 880.5±0.5 MHz, P_{in} = +21.5 dBm f = 1 960 MHz, P_{in} = –30 dBm	75	80	–	
Input 2nd order Intercept Point	$IIP_{2(Cel)}$	RFC – RF1, 2, 3, 4	f = 836.6 MHz, P_{in} = +24 dBm f = 1718 MHz, P_{in} = –20 dBm	105	110	–	dBm
	$IIP_{2(PCS)}$		f = 1 885 MHz, P_{in} = +24 dBm f = 3 850 MHz, P_{in} = –20 dBm	105	110	–	

Note: Absolute Maximum Ratings

ELECTRICAL CHARACTERISTICS
(T_A = +25°C, V_{DD} = 2.5 V, $V_{cont\ (H)}$ = 1.8 V, $V_{cont\ (L)}$ = 0 V, Z_O = 50 Ω, unless otherwise specified)

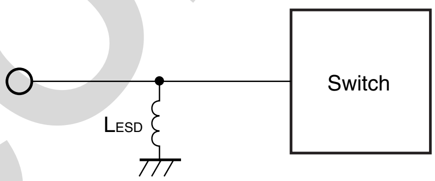
Parameter	Symbol	Path	Test Conditions	MIN.	TYP.	MAX.	Unit
Switch Control Speed	t_{sw}	RFC – RF1, 2, 3, 4	50% CTL to 90/10%	–	1.5	3	μs
Supply Current	I_{DD}	–	No RF	–	130	250	μA
Control Current 1	$I_{cont}1(H)$	–	$V_{cont}1$: High No RF	–	–	1	
	$I_{cont}1(L)$	–	$V_{cont}1$: Low No RF	–	–	1	
Control Current 2	$I_{cont}2(H)$	–	$V_{cont}2$: High No RF	–	–	1	
	$I_{cont}2(L)$	–	$V_{cont}2$: Low No RF	–	–	1	

<R> **EVALUATION CIRCUIT**



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

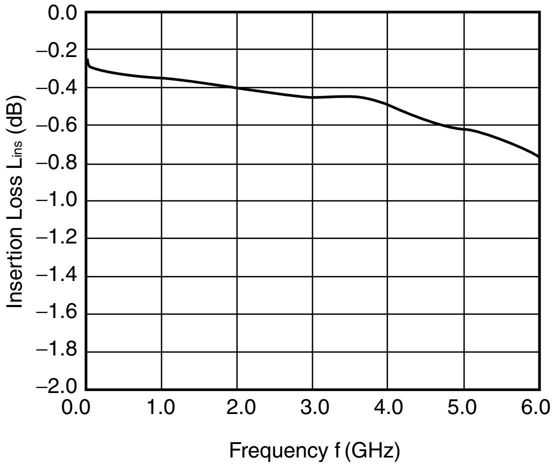
APPLICATION INFORMATION



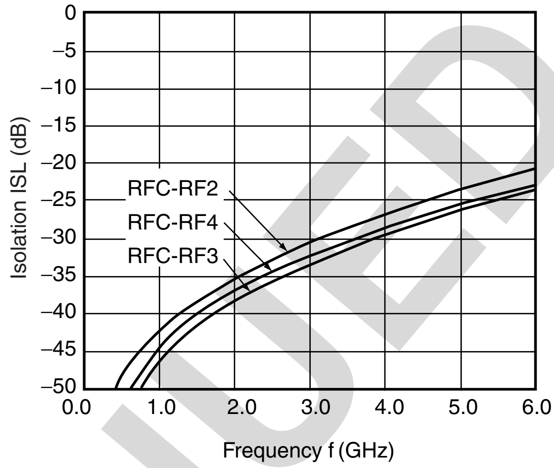
- L_{ESD} provides a means to increase the ESD protection on a specific RF port, typically the port attached to the antenna.

TYPICAL CHARACTERISTICS
(T_A = +25°C, V_{DD} = 2.5 V, $V_{cont\ (H)}$ = 1.8 V, $V_{cont\ (L)}$ = 0 V, Z_O = 50 Ω, unless otherwise specified)

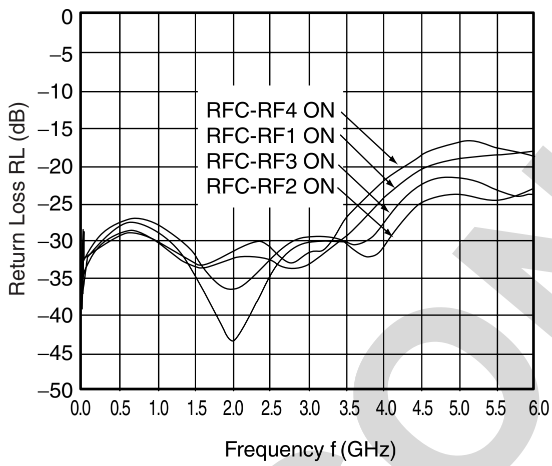
RFC-RF1/RF2/RF3/RF4
INSERTION LOSS vs. FREQUENCY



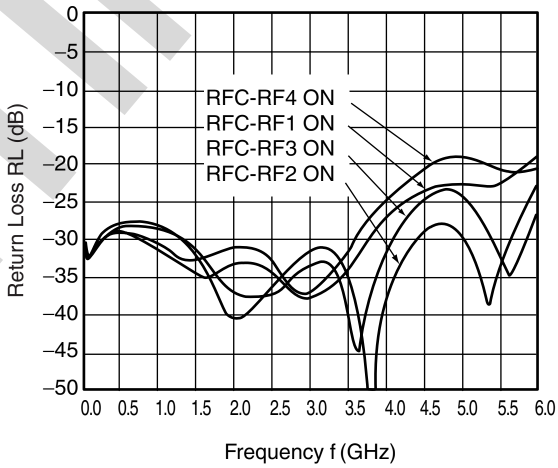
RFC-RF2/RF3/RF4 (RFC-RF1 ON)
ISOLATION vs. FREQUENCY



RFC RETURN LOSS vs. FREQUENCY

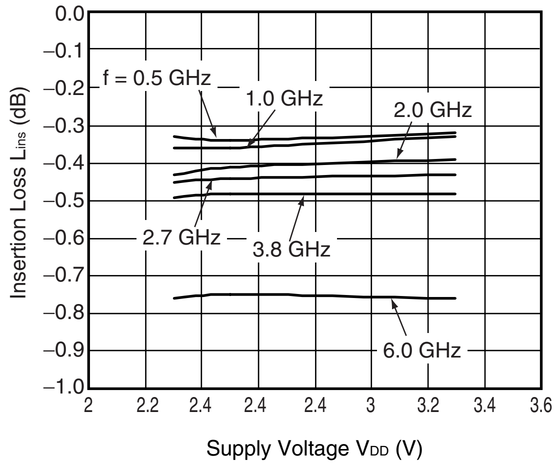


RF1/RF2/RF3/RF4 RETURN LOSS vs.
FREQUENCY

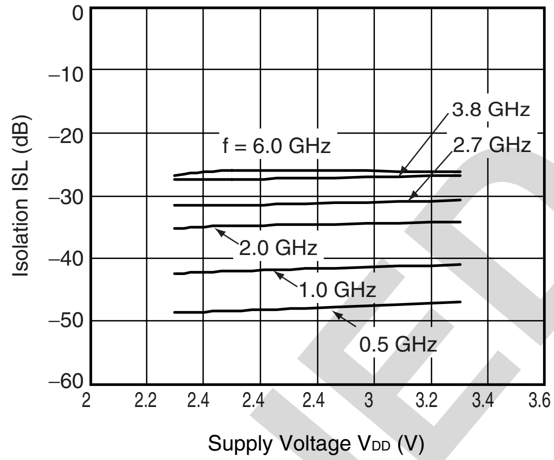


Remark The graphs indicate nominal characteristics.

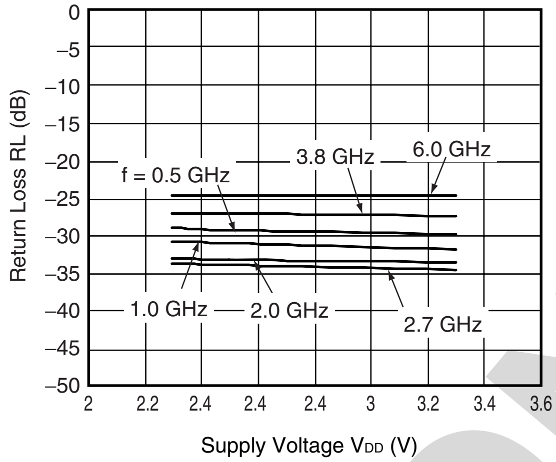
RFC-RF1/RF2/RF3/RF4 INSERTION LOSS vs. SUPPLY VOLTAGE



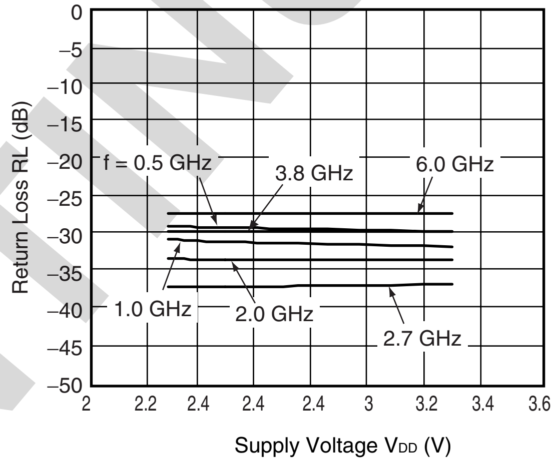
RFC-RF1/RF2/RF3/RF4 ISOLATION vs. SUPPLY VOLTAGE



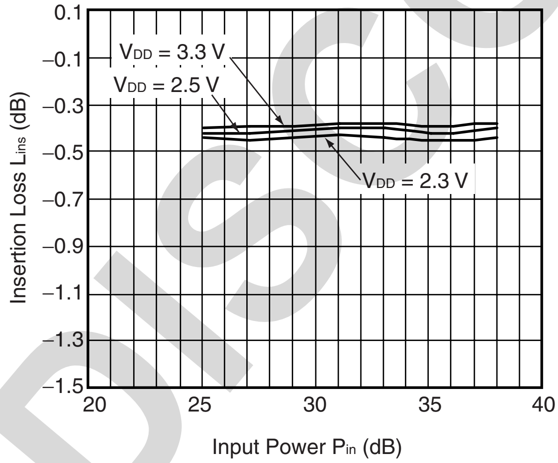
RFC-RF1/RF2/RF3/RF4 RETURN LOSS vs. SUPPLY VOLTAGE



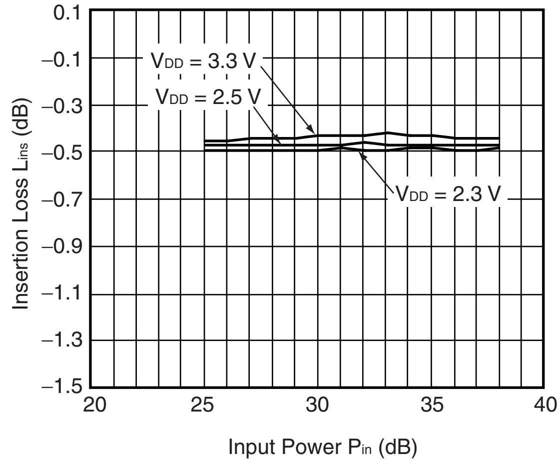
RF1/RF2/RF3/RF4-RFC RETURN LOSS vs. SUPPLY VOLTAGE



RFC-RF1/RF2/RF3/RF4 INSERTION LOSS vs. INPUT POWER f = 0.9 GHz

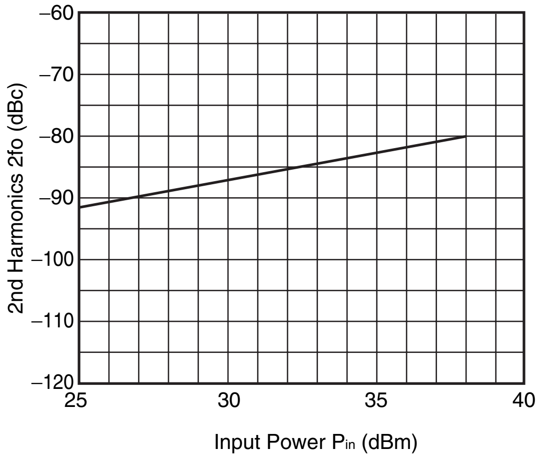


RFC-RF1/RF2/RF3/RF4 INSERTION LOSS vs. INPUT POWER f = 2 GHz

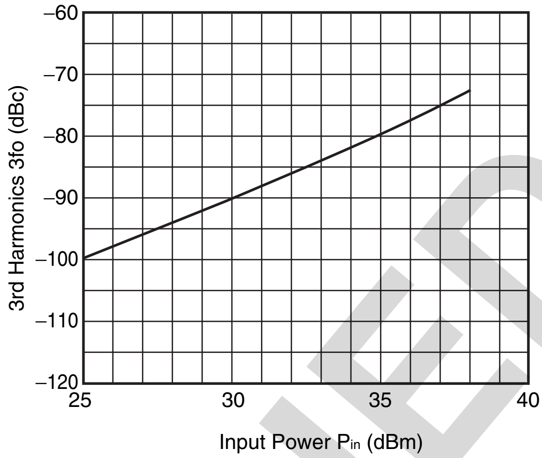


Remark The graphs indicate nominal characteristics.

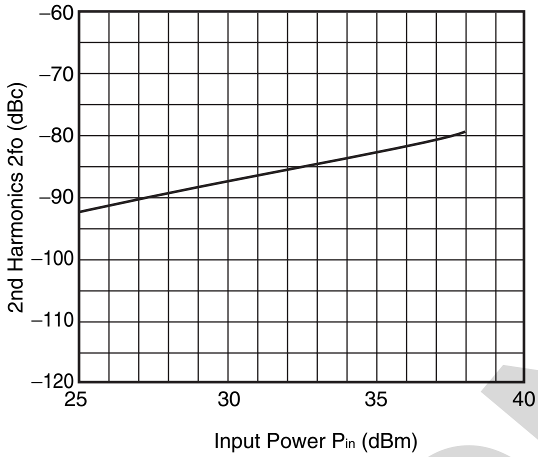
RFC-RF1/RF2/RF3/RF4 2nd HARMONICS vs. INPUT POWER f = 0.9 GHz



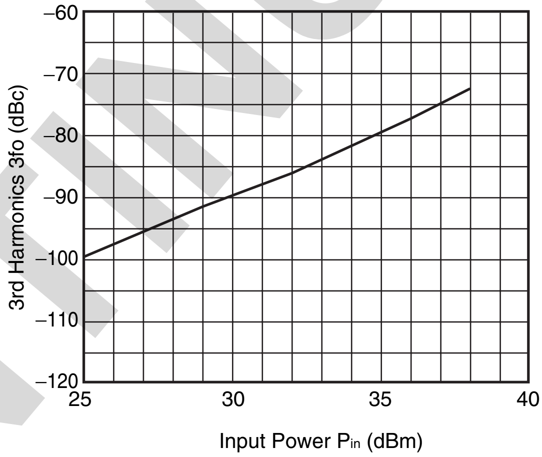
RFC-RF1/RF2/RF3/RF4 3rd HARMONICS 3fo vs. INPUT POWER f = 0.9 GHz



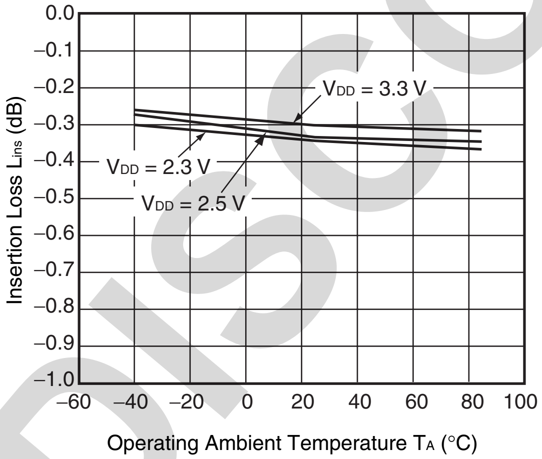
RFC-RF1/RF2/RF3/RF4 2nd HARMONICS vs. INPUT POWER f = 2 GHz



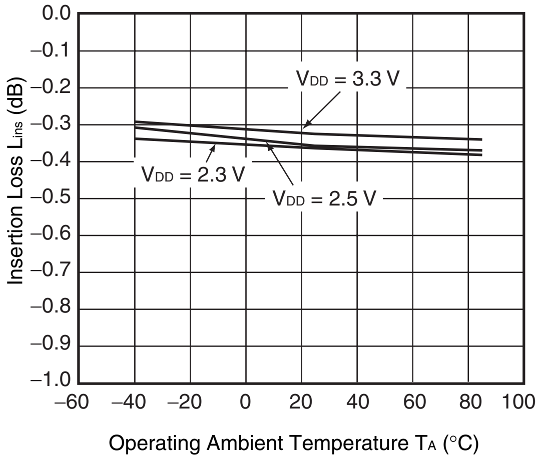
RFC-RF1/RF2/RF3/RF4 3rd HARMONICS 3fo vs. INPUT POWER f = 2 GHz



RFC-RF1/RF2/RF3/RF4 INSERTION LOSS vs. OPERATING AMBIENT TEMPERATURE f = 0.5 GHz

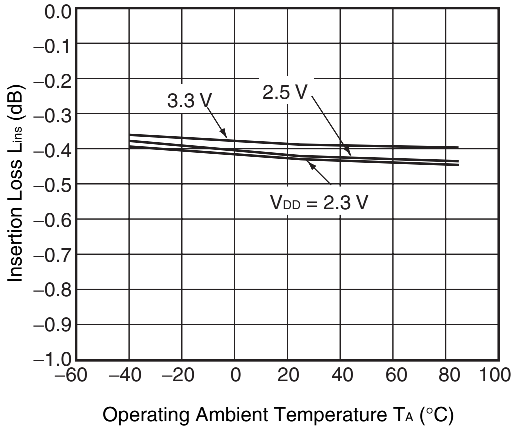


RFC-RF1/RF2/RF3/RF4 INSERTION LOSS vs. OPERATING AMBIENT TEMPERATURE f = 1 GHz

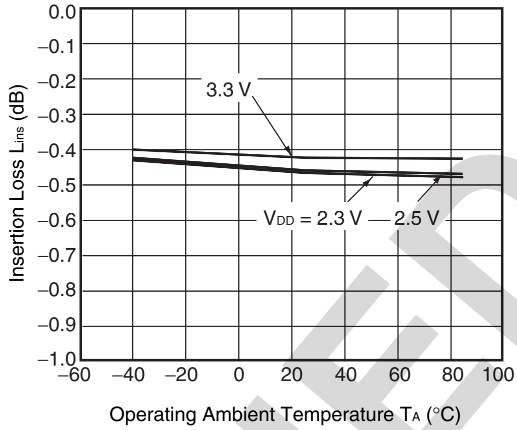


Remark The graphs indicate nominal characteristics.

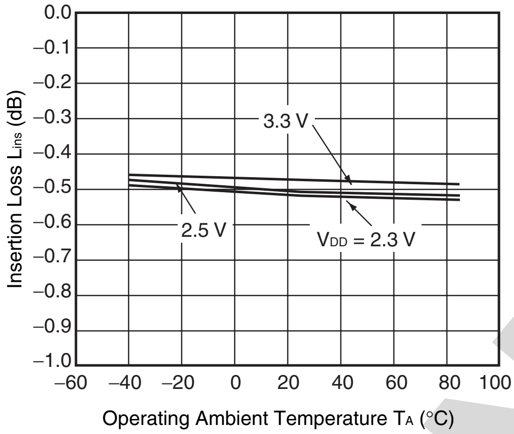
RFC-RF1/RF2/RF3/RF4 INSERTION LOSS vs.
OPERATING AMBIENT TEMPERATURE f = 2 GHz



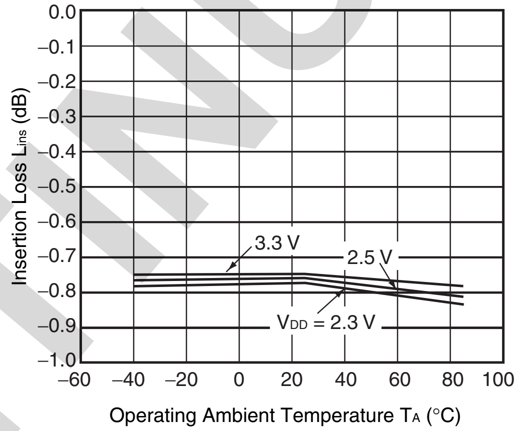
RFC-RF1/RF2/RF3/RF4 INSERTION LOSS vs.
OPERATING AMBIENT TEMPERATURE f = 2.7 GHz



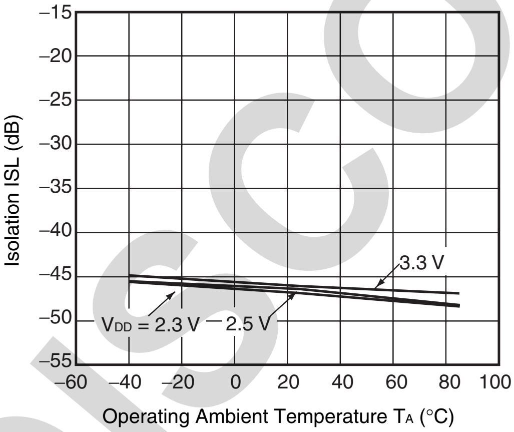
RFC-RF1/RF2/RF3/RF4 INSERTION LOSS vs.
OPERATING AMBIENT TEMPERATURE f = 3.8 GHz



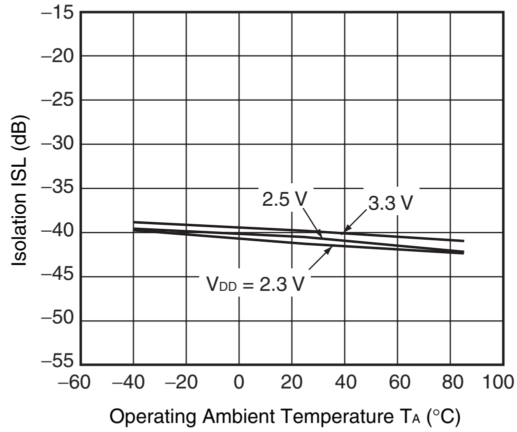
RFC-RF1 INSERTION LOSS vs.
OPERATING AMBIENT TEMPERATURE f = 6 GHz



RFC-RF1/RF2/RF3/RF4 ISOLATION vs.
OPERATING AMBIENT TEMPERATURE f = 0.5 Hz

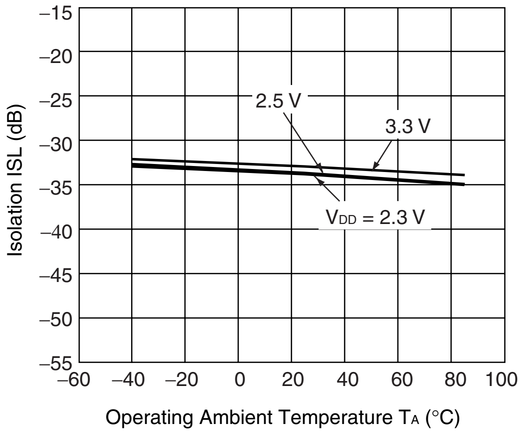


RFC-RF1/RF2/RF3/RF4 ISOLATION vs.
OPERATING AMBIENT TEMPERATURE f = 1 GHz

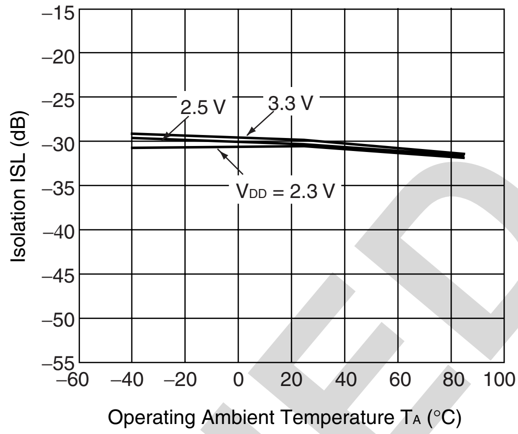


Remark The graphs indicate nominal characteristics.

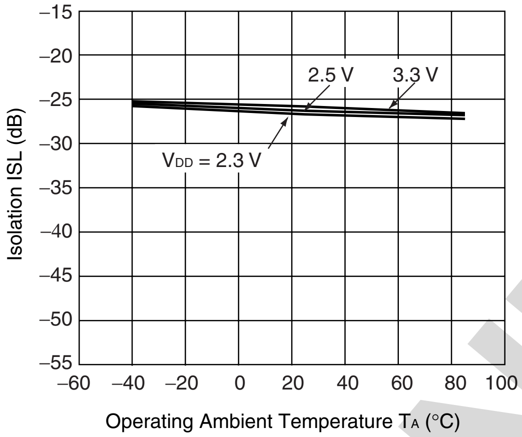
RFC-RF1/RF2/RF3/RF4 ISOLATION vs.
OPERATING AMBIENT TEMPERATURE f = 2 GHz



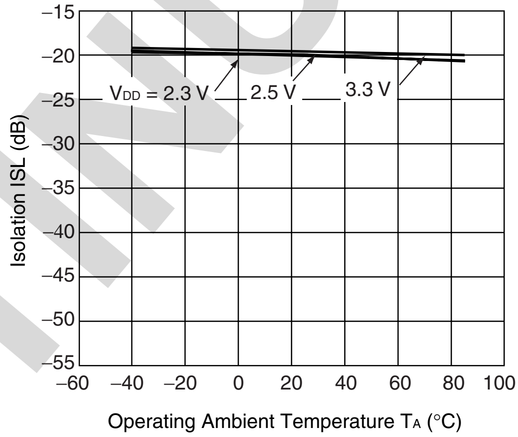
RFC-RF1/RF2/RF3/RF4 ISOLATION vs.
OPERATING AMBIENT TEMPERATURE f = 2.7 GHz



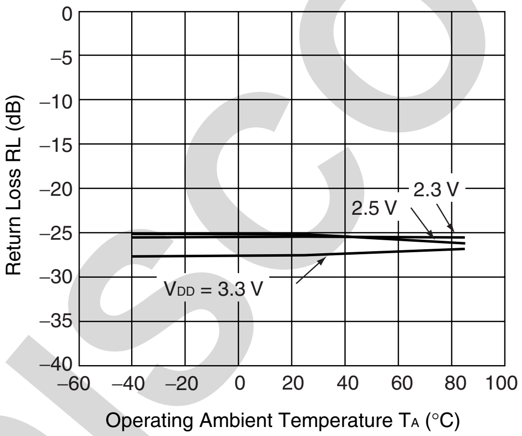
RFC-RF1/RF2/RF3/RF4 ISOLATION vs.
OPERATING AMBIENT TEMPERATURE f = 3.8 GHz



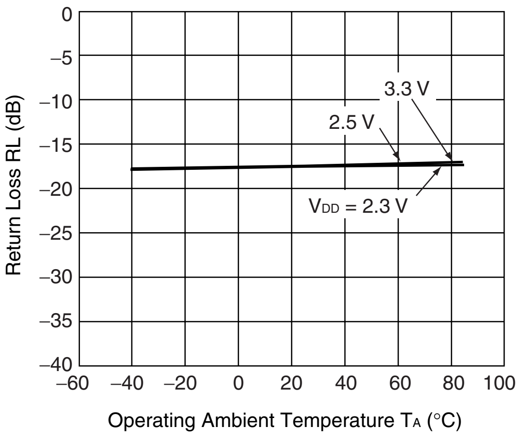
RFC-RF1/RF2/RF3/RF4 ISOLATION vs.
OPERATING AMBIENT TEMPERATURE f = 6 GHz



RFC RETURN LOSS vs. OPERATING AMBIENT
TEMPERATURE f = 3.8 GHz

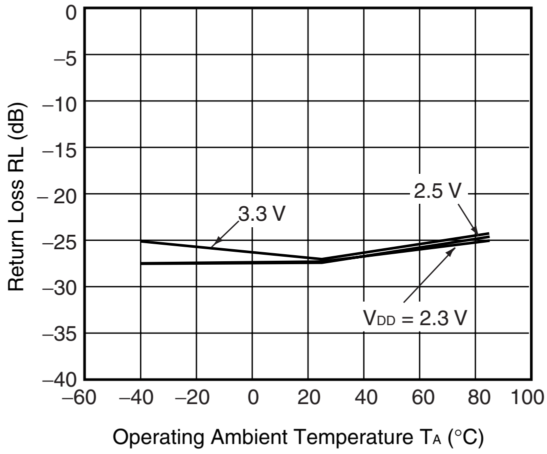


RFC RETURN LOSS vs. OPERATING AMBIENT
TEMPERATURE f = 6.0 GHz

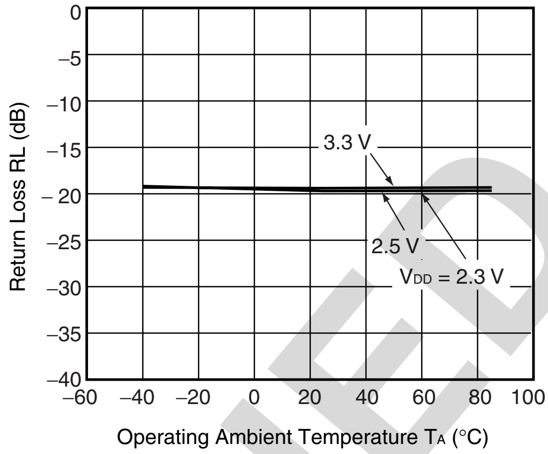


Remark The graphs indicate nominal characteristics.

RF 1/RF2/RF3/RF4 RETURN LOSS vs.
OPERATING AMBIENT TEMPERATURE f = 3.8 GHz



RRF1/RF2/RF3/RF4 RETURN LOSS vs.
OPERATING AMBIENT TEMPERATURE f = 6 GHz

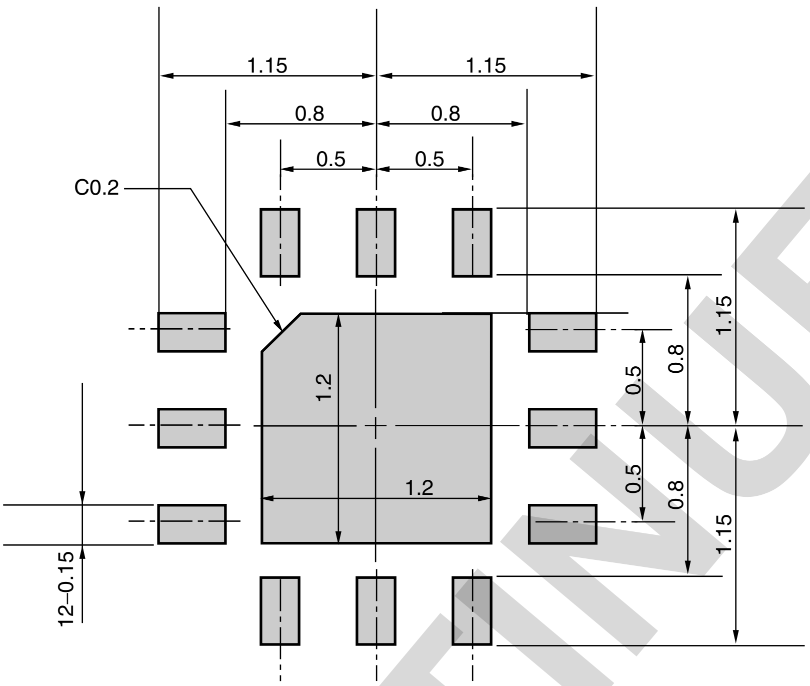


Remark The graphs indicate nominal characteristics.

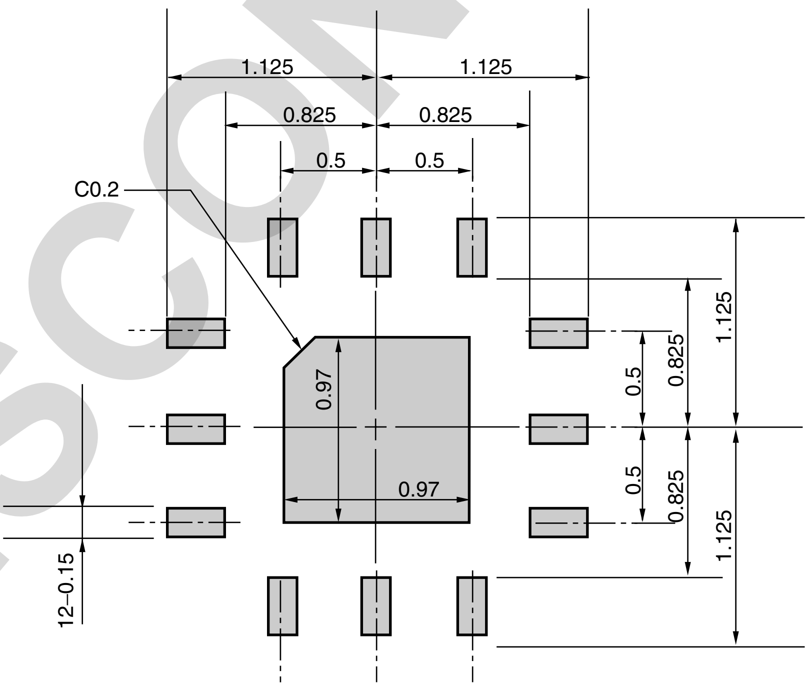
MOUNTING PAD LAYOUT DIMENSIONS

12-PIN PLASTIC QFN (T7K) (UNIT: mm)

MOUNTING PAD



SOLDER MASK

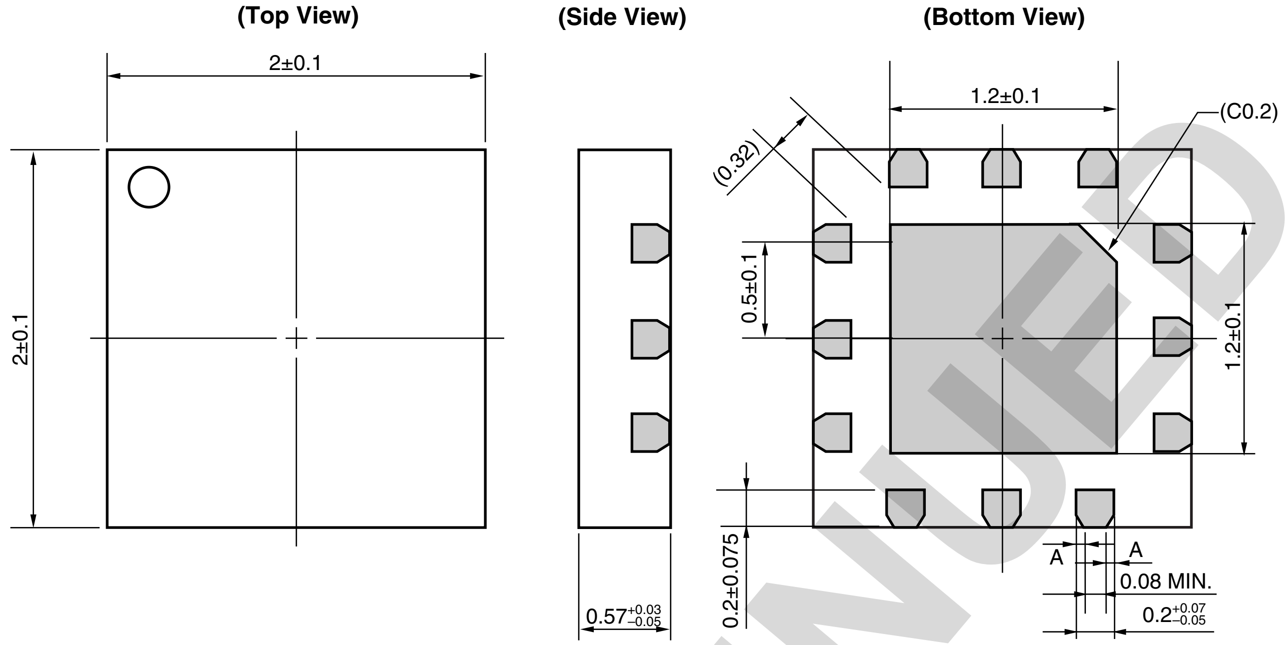


Solder thickness : 0.1 mm

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

12-PIN PLASTIC QFN (T7K) (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) 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).

Revision History	μPD5904T7K Data Sheet

Rev.	Date	Description	
		Page	Summary
1.00	Jul 24, 2012	–	First edition issued
2.00	Dec 11, 2012	p.2	GND is added as Pin No.13 in PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM.
		p.5	GND is added in EVALUATION CIRCUIT.