

To our customers,

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## Old Company Name in Catalogs and Other Documents

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On April 1<sup>st</sup>, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: <http://www.renesas.com>

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

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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CMOS INTEGRATED CIRCUIT  
 **$\mu$ PD5716GR**

CMOS MMIC 4 x 2 IF SWITCH MATRIX

**FEATURES**

- 4 independent IF channels, integral switching to channel input to either channel output
- Integrated 4 bit decoder
- Frequency range :  $f = 250$  to  $2\ 150$  MHz
- High isolation D/U ratio : ISL = 29 dB TYP.
- Insertion loss :  $L_{INS} = 6.7$  dB TYP. @  $Z_0 = 50\ \Omega$
- Insertion loss flatness :  $\Delta L_{INS} = 0.7$  dB TYP.
- Control voltage :  $V_{CONT} = 0\ V/+5.0\ V$
- 16-pin plastic HTSSOP package

**APPLICATIONS**

- DBS IF switching
- Switch box
- $4 \times 2$  switching application for microwave signal

**ORDERING INFORMATION**

Part Number	Order Number	Package	Marking	Supplying Form
$\mu$ PD5716GR-E1	$\mu$ PD5716GR-E1-A	16-pin plastic HTSSOP (Pb-Free)	D5716	<ul style="list-style-type: none"> <li>• Embossed tape 12 mm wide</li> <li>• Pin 8, 9 face the perforation side of the tape</li> <li>• Qty 3 kpcs/reel</li> </ul>

**Remark** To order evaluation samples, contact your nearby sales office.  
 Part number for sample order:  $\mu$ PD5716GR

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

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

Parameter	Symbol	Ratings	Unit
Supply Voltage	V <sub>DD</sub>	+6.0	V
Switch Control Voltage 1 to 4	V <sub>CONT1 to4</sub>	+6.0	V
Total Power Dissipation	P <sub>tot</sub>	2 <sup>Note</sup>	W
Input Power	P <sub>in</sub>	+15	dBm
Operating Ambient Temperature	T <sub>A</sub>	-40 to +85	°C
Storage Temperature	T <sub>stg</sub>	-65 to +150	°C

**Note** Mounted on double-sided copper-clad 50 × 50 × 1.6 mm epoxy glass PWB, T<sub>A</sub> = +85°C

**RECOMMENDED OPERATING CONDITIONS (T<sub>A</sub> = +25°C)**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V <sub>DD</sub>	+4.0	+5.0	+5.5	V
Control Voltage (H) <sup>Note</sup>	V <sub>CONT (H)</sub>	+4.0	+5.0	+5.5	V
Control Voltage (L)	V <sub>CONT (L)</sub>	-0.2	0	+0.4	V

**Note** V<sub>DD</sub>-0.4 V ≤ V<sub>CONT (H)</sub> ≤ V<sub>DD</sub>+0.2 V

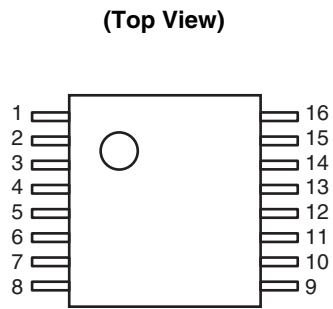
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = +25°C, V<sub>DD</sub> = +5.0 V, V<sub>CONT</sub> = 0 V/+5.0 V, P<sub>in</sub> = 0 dBm, Z<sub>o</sub> = 50 Ω, each port, unless otherwise specified)**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Insertion Loss	L <sub>INS</sub>	f = 0.25 to 2.15 GHz	-	6.7	9.0	dB
Insertion Loss Flatness	ΔL <sub>INS</sub>	L <sub>INS</sub> (0.95 GHz) - L <sub>INS</sub> (2.15 GHz)	-	0.7	3.0	dB
Isolation D/U-ratio1 <sup>Note 1</sup>	ISL1	f = 0.25 to 0.95 GHz	28	35	-	dB
Isolation D/U-ratio2 <sup>Note 1</sup>	ISL2	f = 0.95 to 2.15 GHz	25	29	-	dB
Output Return Loss	RL <sub>out</sub>	f = 0.25 to 2.15 GHz	10	13	-	dB
Control Current <sup>Note 2</sup>	I <sub>CONT</sub>	V <sub>DD</sub> = +5.0 V, V <sub>CONT</sub> = +5.0 V/0 V, non-RF	-	50	100	μA
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> = +5.0 V, V <sub>CONT</sub> = +5.0 V/0 V, non-RF	-	50	100	μA

**Notes 1.** Isolation Desire Un-desire (D/U)-ratio = |(Signal leakage (off-state)) - (Insertion loss (on-state))|

**2.** Per 1 control pin

PIN CONNECTIONS



Pin No.	Pin Name	Pin No.	Pin Name
1	IN-C	16	IN-B
2	GND	15	GND
3	IN-D	14	IN-A
4	GND	13	GND
5	GND	12	V <sub>DD</sub>
6	OUT2	11	OUT1
7	V <sub>CONT3</sub>	10	V <sub>CONT1</sub>
8	V <sub>CONT4</sub>	9	V <sub>CONT2</sub>

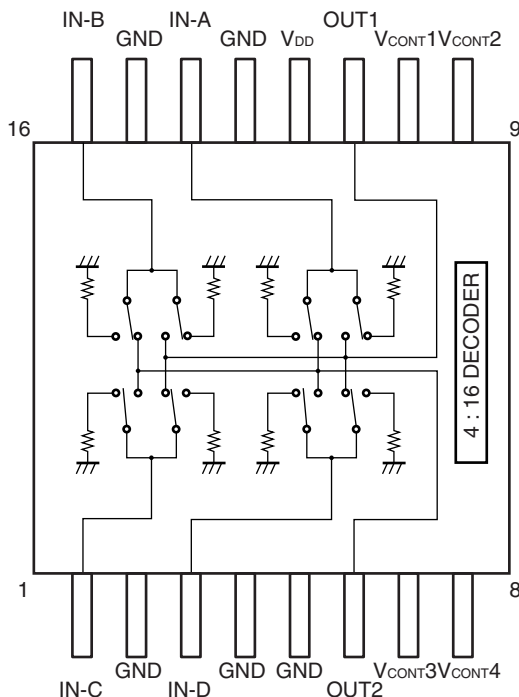
**Remark** Back side. : GND

TRUTH TABLE

State		Output Signal		Control Pins			
No.	Mode	OUT1	OUT2	V <sub>CONT1</sub>	V <sub>CONT2</sub>	V <sub>CONT3</sub>	V <sub>CONT4</sub>
1	AA	IN-A	IN-A	Low	Low	Low	Low
2	AB		IN-B	Low	Low	Low	High
3	AC		IN-C	Low	Low	High	Low
4	AD		IN-D	Low	Low	High	High
5	BA	IN-B	IN-A	Low	High	Low	Low
6	BB		IN-B	Low	High	Low	High
7	BC		IN-C	Low	High	High	Low
8	BD		IN-D	Low	High	High	High
9	CA	IN-C	IN-A	High	Low	Low	Low
10	CB		IN-B	High	Low	Low	High
11	CC		IN-C	High	Low	High	Low
12	CD		IN-D	High	Low	High	High
13	DA	IN-D	IN-A	High	High	Low	Low
14	DB		IN-B	High	High	Low	High
15	DC		IN-C	High	High	High	Low
16	DD		IN-D	High	High	High	High

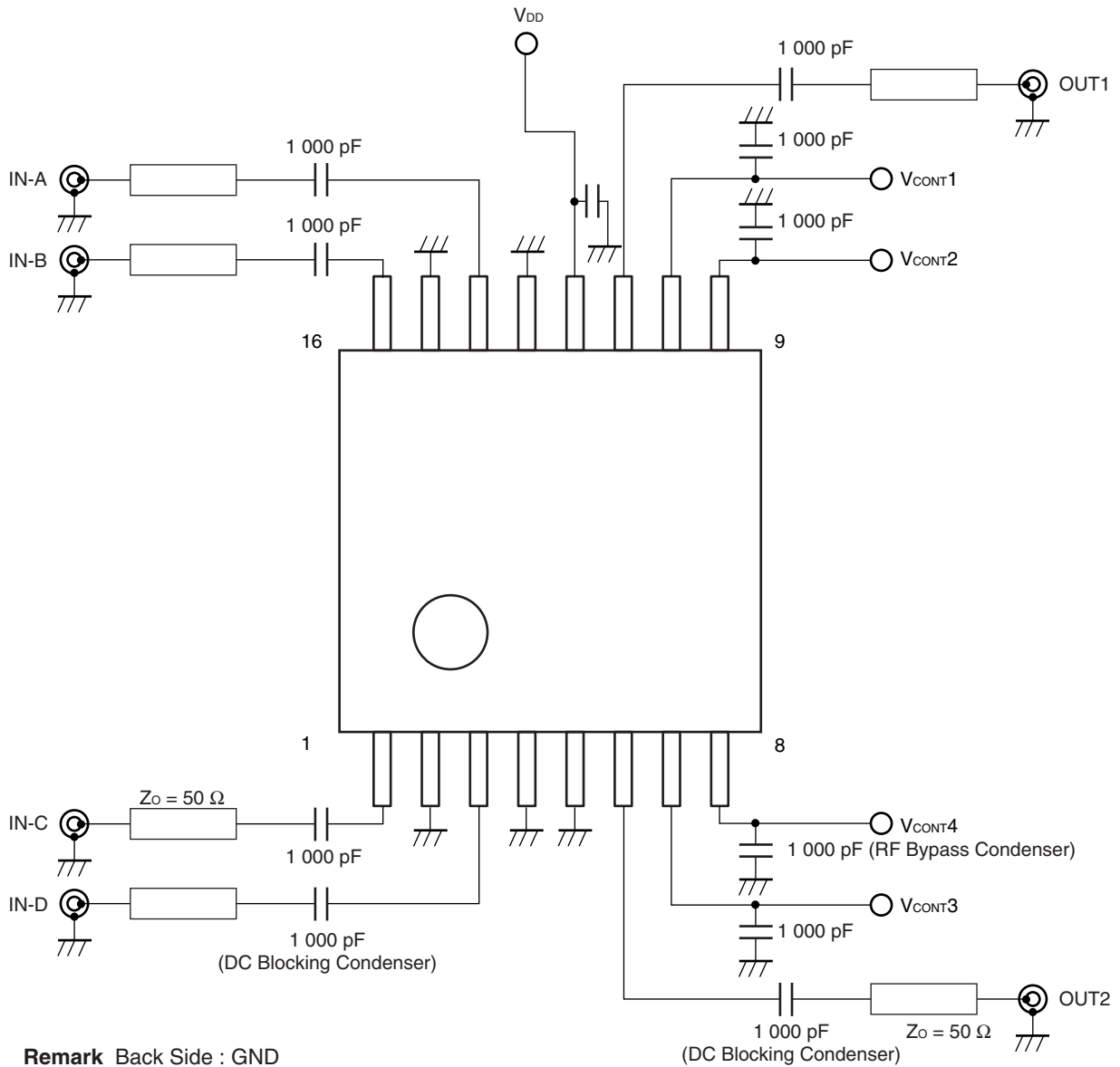
Remark High : +5.0 Vdc, Low : 0 Vdc

FUNCTIONAL DIAGRAM



Remark Back Side : GND

**EVALUATION CIRCUIT** ( $V_{DD} = +5.0\text{ V}$ ,  $V_{CONT1}$  to  $V_{CONT4} = 0\text{ V}/+5.0\text{ V}$ ,  $P_{in} = 0\text{ dBm}$ ,  $Z_o = 50\ \Omega$ , DC Blocking Capacitor =  $1\ 000\ \text{pF}$ )

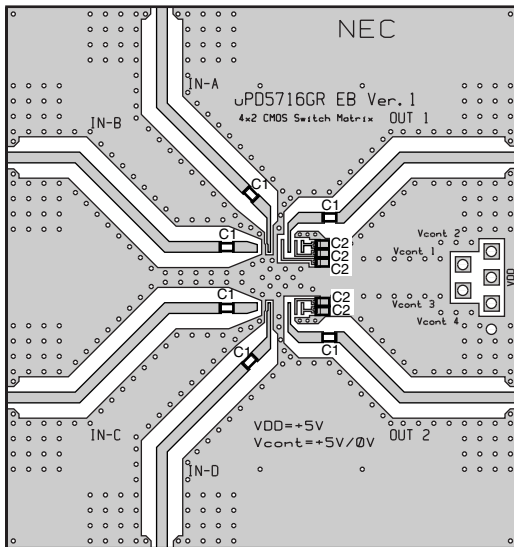


**Remark** Back Side : GND

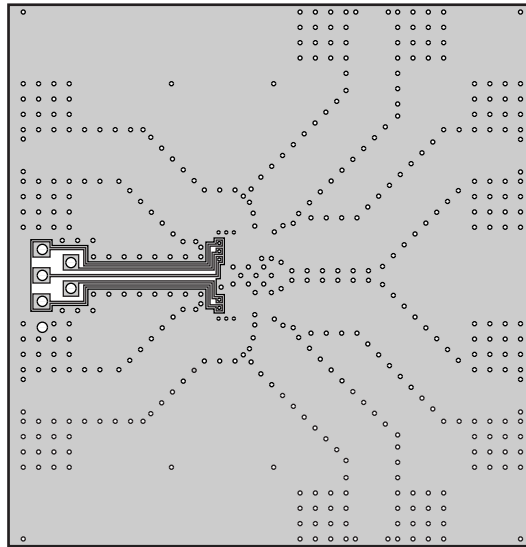
The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD

(Top View)



(Bottom View)



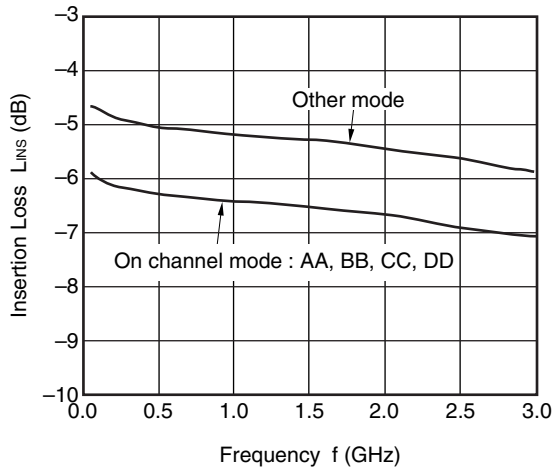
**Notes**

1. 50 × 53 × 0.51 mm double sided copper clad RO4003 (Rogers) board ( $\epsilon_r = 3.38$ ).
2. Au plated on pattern
3.  $\circ$ : Through holes
4. C1, C2: 1 000 pF

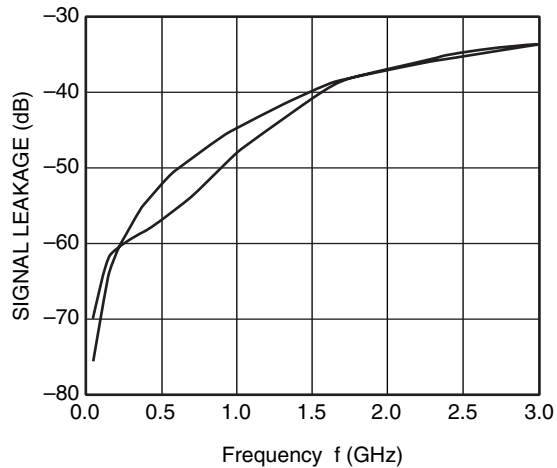
**TYPICAL CHARACTERISTICS**

( $T_A = +25^\circ\text{C}$ ,  $V_{DD} = +5.0\text{ V}$ ,  $V_{CONT} = 0\text{ V}/+5.0\text{ V}$ ,  $P_{in} = 0\text{ dBm}$ ,  $Z_o = 50\ \Omega$ , unless otherwise specified)

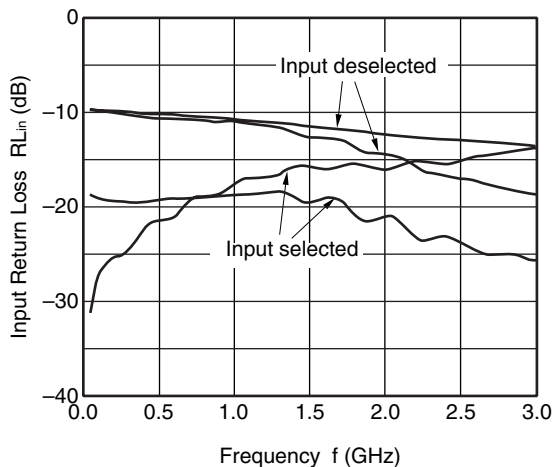
INSERTION LOSS vs. FREQUENCY  
(INx-OUT, all states)



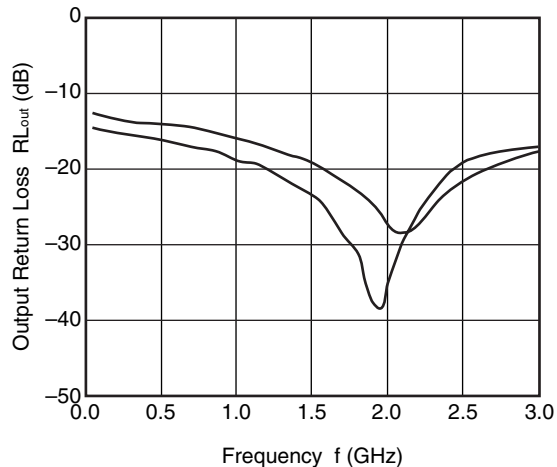
SIGNAL LEAKAGE vs. FREQUENCY  
(INx-OUT, all states)



INPUT RETURN LOSS vs. FREQUENCY

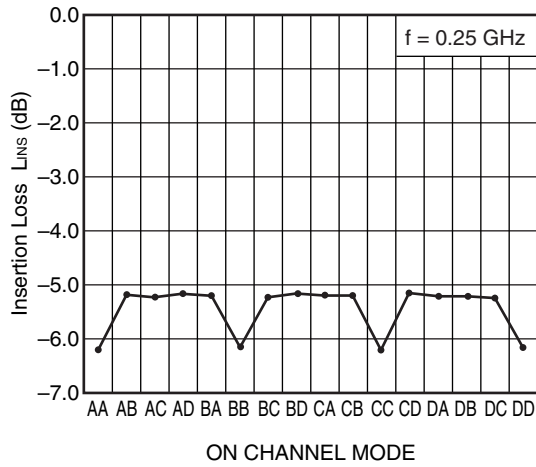


OUTPUT RETURN LOSS vs. FREQUENCY

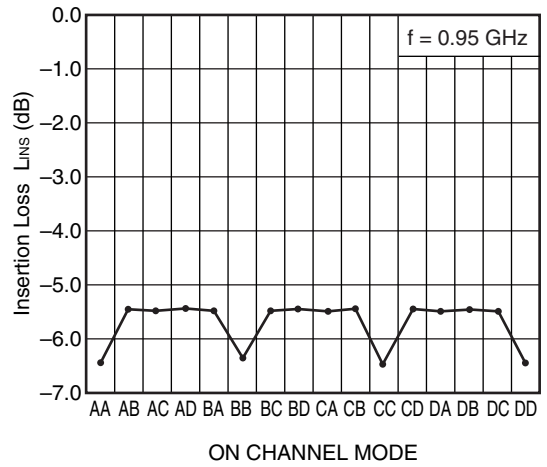


**Remark** The graphs indicate nominal characteristics.

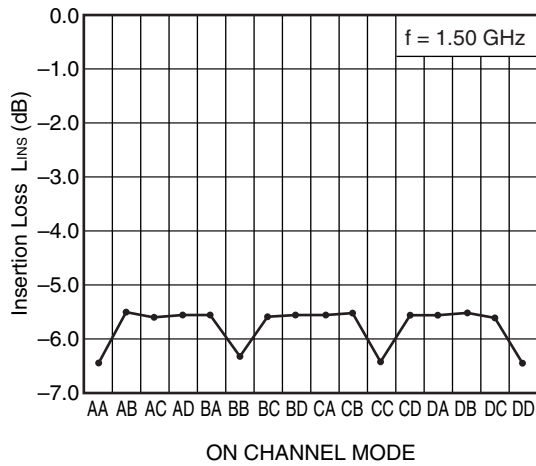
INSERTION LOSS vs.  
ON CHANNEL MODE



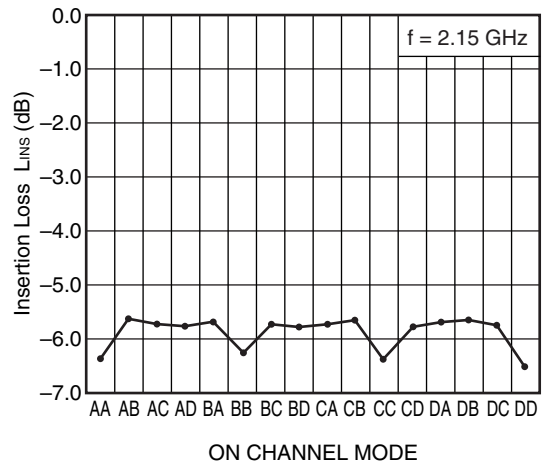
INSERTION LOSS vs.  
ON CHANNEL MODE



INSERTION LOSS vs.  
ON CHANNEL MODE

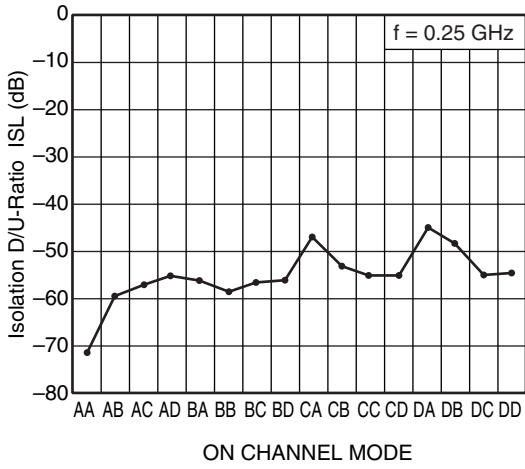


INSERTION LOSS vs.  
ON CHANNEL MODE

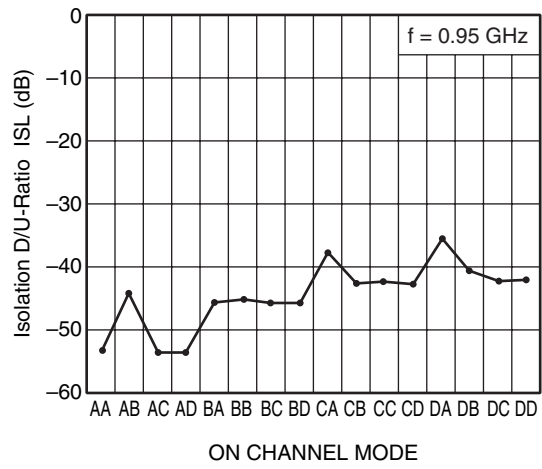


**Remark** The graphs indicate nominal characteristics.

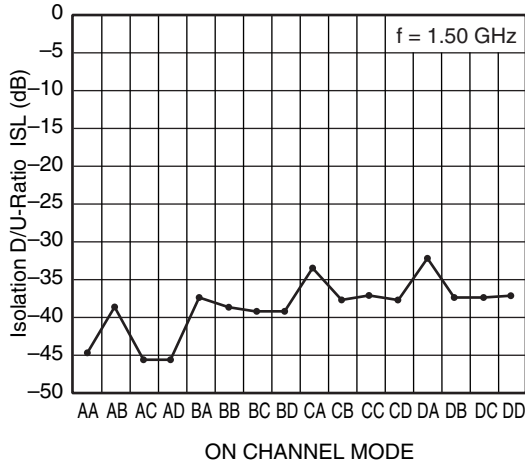
ISOLATION D/U-RATIO  
vs. ON CHANNEL MODE



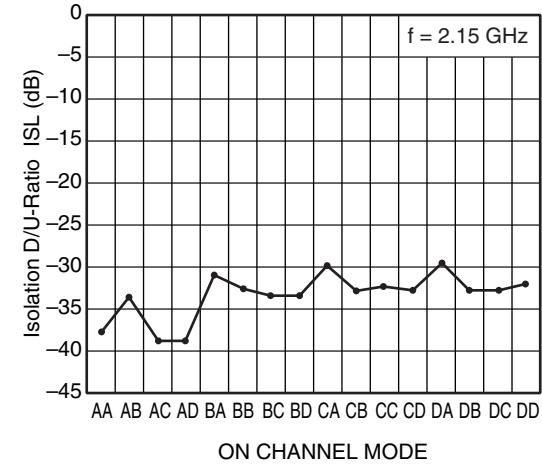
ISOLATION D/U-RATIO  
vs. ON CHANNEL MODE



ISOLATION D/U-RATIO  
vs. ON CHANNEL MODE

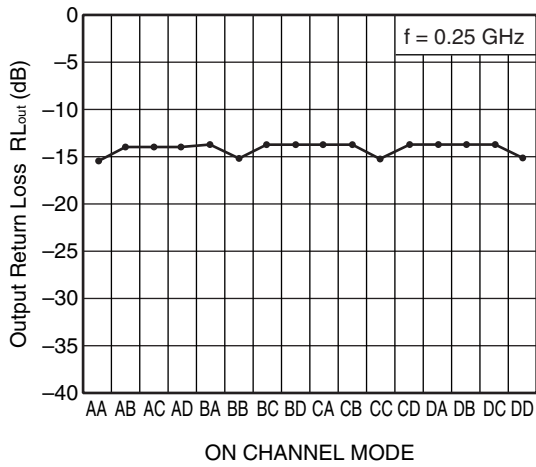


ISOLATION D/U-RATIO  
vs. ON CHANNEL MODE

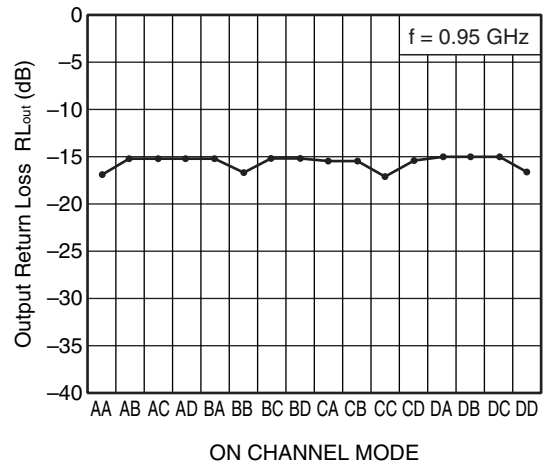


**Remark** The graphs indicate nominal characteristics.

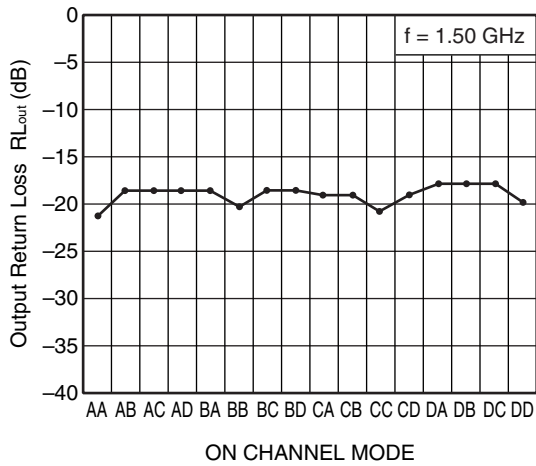
OUTPUT RETURN LOSS  
vs. ON CHANNEL MODE



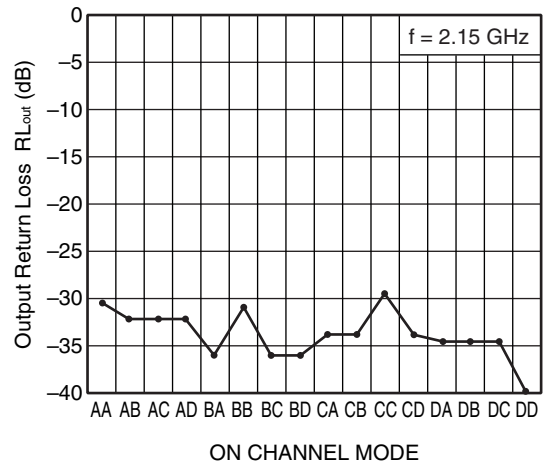
OUTPUT RETURN LOSS  
vs. ON CHANNEL MODE



OUTPUT RETURN LOSS  
vs. ON CHANNEL MODE



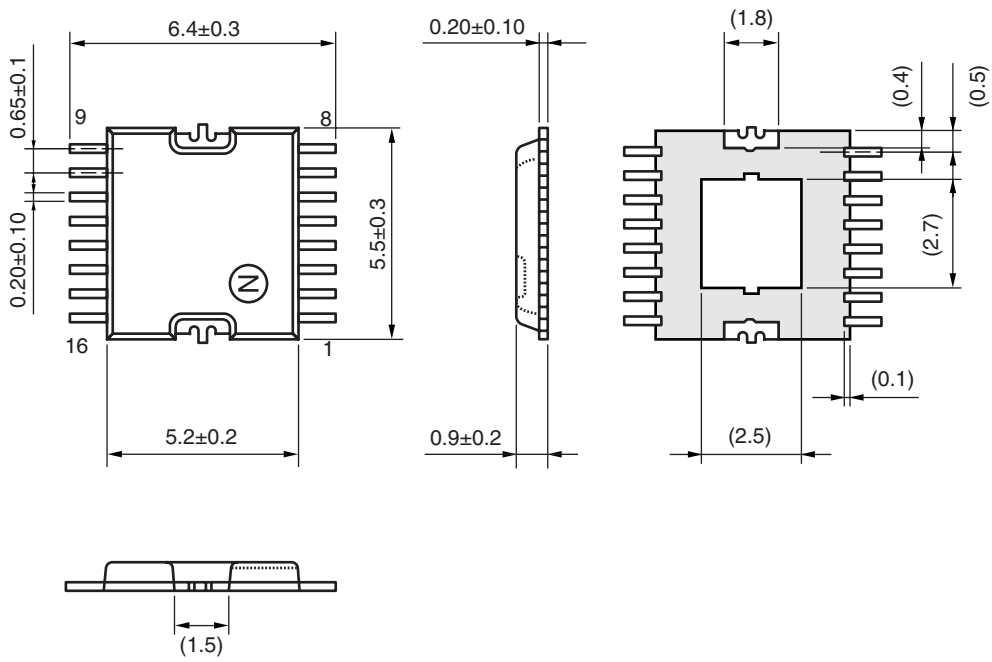
OUTPUT RETURN LOSS  
vs. ON CHANNEL MODE



**Remark** The graphs indicate nominal characteristics.

PACKAGE DIMENSIONS

16-PIN PLASTIC HTSSOP (UNIT: mm)



Remark ( ): 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	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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