

# μPD5750T7D

## SiGe BiCMOS Integrated Circuit Wide Band LNA IC with Through Function

R09DS0009EJ0100

Rev.1.00

Feb 24, 2011

### DESCRIPTION

The μPD5750T7D is a low noise wideband amplifier IC mainly designed for the portable digital TV application. This IC exhibits low noise figure and high power gain characteristics. The μPD5750T7D has an LNA pass-through function (bypass function) to prevent the degradation of the received signal quality at the strong electric field, and achieve the high reception sensitivity and low power consumption.

The package is a 6-pin WLBGA (Wafer Level Ball Grid Array) (T7D) suitable for surface mount.

This IC is manufactured using our latest SiGe BiCMOS process that shows superior high frequency characteristics.

### FEATURES

- Low voltage operation :  $V_{CC} = 1.8 \text{ V TYP.}$
- Low mode control voltage :  $V_{\text{cont(H)}} = 1.0 \text{ V to } V_{CC}, V_{\text{cont(L)}} = 0 \text{ to } 0.4 \text{ V}$
- Low current consumption :  $I_{CC} = 3.1 \text{ mA TYP. @ } V_{CC} = 1.8 \text{ V (LNA-mode)}$   
:  $I_{CC} = 1 \mu\text{A MAX. @ } V_{CC} = 1.8 \text{ V (Bypass-mode)}$
- Low noise :  $\text{NF} = 1.5 \text{ dB TYP. @ } V_{CC} = 1.8 \text{ V, } f = 470 \text{ MHz}$   
(LNA-mode) :  $\text{NF} = 1.4 \text{ dB TYP. @ } V_{CC} = 1.8 \text{ V, } f = 770 \text{ MHz}$
- High gain :  $G_p = 13.5 \text{ dB TYP. @ } V_{CC} = 1.8 \text{ V, } f = 470 \text{ MHz}$   
(LNA-mode) :  $G_p = 12.5 \text{ dB TYP. @ } V_{CC} = 1.8 \text{ V, } f = 770 \text{ MHz}$
- Low insertion loss :  $L_{\text{ins}} = 1.2 \text{ dB TYP. @ } V_{CC} = 1.8 \text{ V, } f = 470 \text{ MHz}$   
(Bypass-mode) :  $L_{\text{ins}} = 1.4 \text{ dB TYP. @ } V_{CC} = 1.8 \text{ V, } f = 770 \text{ MHz}$
- High-density surface mounting : 6-pin WLBGA (0.73 × 0.48 × 0.26 mm)
- Included protection circuit for ESD

### APPLICATIONS

- Low noise amplifier for the portable and mobile digital TV system, etc.

### ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
μPD5750T7D-E4A	μPD5750T7D-E4A-A	6-pin WLBGA (T7D) (Pb-Free)	A	<ul style="list-style-type: none"> <li>• Embossed tape 8 mm wide</li> <li>• Pin A3, B3 face the perforation side of the tape</li> <li>• Qty 10 kpcs/reel</li> </ul>

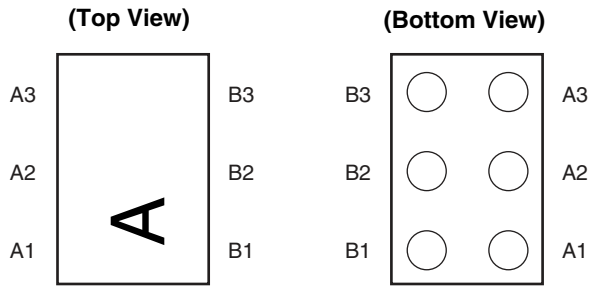
**Remark** To order evaluation samples, please contact your nearby sales office.

Part number for sample order: μPD5750T7D

### CAUTION

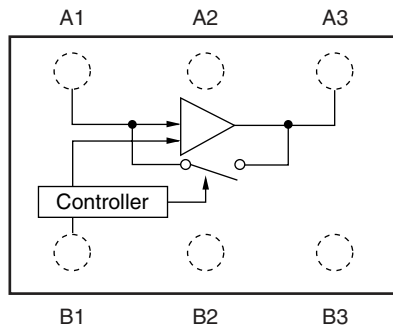
Observe precautions when handling because these devices are sensitive to electrostatic discharge.

## PIN CONNECTIONS AND MARKING



Pin No	Pin Name
A1	INPUT
A2	GND1
A3	OUTPUT
B1	V <sub>cont</sub>
B2	GND2
B3	V <sub>CC</sub>

## INTERNAL BLOCK DIAGRAM



## TRUTH TABLE

V <sub>cont</sub>	Gain	Mode
H	High	LNA-mode
L	Low	Bypass-mode

Remark "H" = V<sub>cont</sub> (H), "L" = V<sub>cont</sub> (L)

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

Parameter	Symbol	Ratings	Unit
Supply Voltage	V <sub>CC</sub>	3.6	V
Mode Control Voltage	V <sub>cont</sub>	3.6	V
Operating Ambient Temperature	T <sub>A</sub>	-40 to +85	°C
Storage Temperature	T <sub>stg</sub>	-55 to +150	°C
Input Power	P <sub>in</sub>	+30	dBm

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

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V <sub>CC</sub>	1.6	1.8	2.0	V
Mode Control Voltage (H)	V <sub>cont</sub> (H)	1.0	—	V <sub>CC</sub>	V
Mode Control Voltage (L)	V <sub>cont</sub> (L)	0	—	0.4	V
Operating Frequency	f	50	—	1 800	MHz
Operating Ambient Temperature	T <sub>A</sub>	-40	—	+85	°C
Input Power (LNA-mode)	P <sub>in</sub>	—	—	+7	dBm
Input Power (Bypass-mode)	P <sub>in</sub>	—	—	+15	dBm

**ELECTRICAL CHARACTERISTICS 1 (DC Characteristics)**  
( $T_A = +25^{\circ}\text{C}$ ,  $V_{CC} = 1.8\text{ V}$ , unless otherwise specified)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current 1	$I_{CC1}$	$V_{cont} = 1.8\text{ V}$ , No Signal (LNA-mode)	1.6	3.1	4.5	mA
Circuit Current 2	$I_{CC2}$	$V_{cont} = 0\text{ V}$ , No Signal (Bypass-mode)	–	–	1	μA
Mode Control Current 1	$I_{cont1}$	$V_{cont} = 1.8\text{ V}$ , No Signal (LNA-mode)	–	20	30	μA
Mode Control Current 2	$I_{cont2}$	$V_{cont} = 0\text{ V}$ , No Signal (Bypass-mode)	–	–	1	μA

**ELECTRICAL CHARACTERISTICS 2 (LNA-mode)**  
( $T_A = +25^{\circ}\text{C}$ ,  $V_{CC} = V_{cont} = 1.8\text{ V}$ ,  $Z_S = Z_L = 50\ \Omega$ , unless otherwise specified)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Power Gain 1	$G_{P1}$	$f = 470\text{ MHz}$ , $P_{in} = -30\text{ dBm}$ , excluded PCB and connector losses <b>Note 1</b>	10.5	13.5	16.5	dB
Power Gain 2	$G_{P2}$	$f = 770\text{ MHz}$ , $P_{in} = -30\text{ dBm}$ , excluded PCB and connector losses <b>Note 1</b>	9.5	12.5	15.5	dB
Noise Figure 1	NF1	$f = 470\text{ MHz}$ , excluded PCB and connector losses <b>Note 2</b>	–	1.5	2.0	dB
Noise Figure 2	NF2	$f = 770\text{ MHz}$ , excluded PCB and connector losses <b>Note 2</b>	–	1.4	2.0	dB
Output Return Loss 1	$RL_{out1}$	$f = 470\text{ MHz}$ , $P_{in} = -30\text{ dBm}$	6.5	8.5	–	dB
Output Return Loss 2	$RL_{out2}$	$f = 770\text{ MHz}$ , $P_{in} = -30\text{ dBm}$	6.0	8.0	–	dB
Input 3rd Order Intercept Point 1	$IIP_{31}$	$f1 = 470\text{ MHz}$ , $f2 = 471\text{ MHz}$ , $P_{in} = -30\text{ dBm}$	–15	–11	–	dBm
Input 3rd Order Intercept Point 2	$IIP_{32}$	$f1 = 770\text{ MHz}$ , $f2 = 771\text{ MHz}$ , $P_{in} = -30\text{ dBm}$	–12	–8	–	dBm

Notes: 1. Input-output PCB and connector losses : 0.20 dB (at 470 MHz), 0.27 dB (at 770 MHz)  
 2. Input PCB and connector losses : 0.10 dB (at 470 MHz), 0.14 dB (at 770 MHz)

**ELECTRICAL CHARACTERISTICS 3 (Bypass-mode)**  
( $T_A = +25^{\circ}\text{C}$ ,  $V_{CC} = 1.8\text{ V}$ ,  $V_{cont} = 0\text{ V}$ ,  $Z_S = Z_L = 50\ \Omega$ , unless otherwise specified)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Insertion Loss 1	$L_{ins1}$	$f = 470\text{ MHz}$ , $P_{in} = -10\text{ dBm}$ , excluded PCB and connector losses <b>Note</b>	–	1.2	2.0	dB
Insertion Loss 2	$L_{ins2}$	$f = 770\text{ MHz}$ , $P_{in} = -10\text{ dBm}$ , excluded PCB and connector losses <b>Note</b>	–	1.4	2.0	dB
Input Return Loss 1	$RL_{in1}$	$f = 470\text{ MHz}$ , $P_{in} = -10\text{ dBm}$	10	17	–	dB
Input Return Loss 2	$RL_{in2}$	$f = 770\text{ MHz}$ , $P_{in} = -10\text{ dBm}$	10	14	–	dB
Output Return Loss 1	$RL_{out1}$	$f = 470\text{ MHz}$ , $P_{in} = -10\text{ dBm}$	10	17	–	dB
Output Return Loss 2	$RL_{out2}$	$f = 770\text{ MHz}$ , $P_{in} = -10\text{ dBm}$	10	14	–	dB
Input 3rd Order Intercept Point	$IIP_3$	$f1 = 770\text{ MHz}$ , $f2 = 771\text{ MHz}$ , $P_{in} = -2.5\text{ dBm}$	+25	+32	–	dBm

Note: Input-output PCB and connector losses : 0.20 dB (at 470 MHz), 0.27 dB (at 770 MHz)

**STANDARD CHARACTERISTICS FOR REFERENCE 1 (LNA-mode)**  
 (T<sub>A</sub> = +25°C, V<sub>CC</sub> = V<sub>cont</sub> = 1.8 V, Z<sub>S</sub> = Z<sub>L</sub> = 50 Ω, unless otherwise specified)

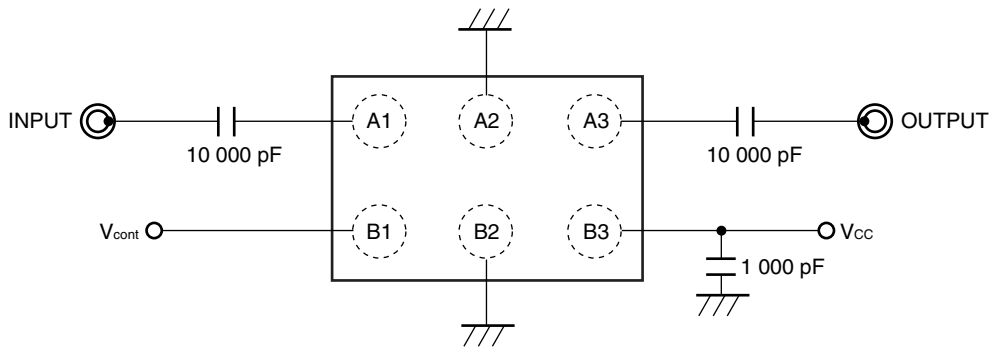
Parameter	Symbol	Test Conditions	Reference Value	Unit
Isolation 1	ISL1	f = 470 MHz, P <sub>in</sub> = -30 dBm	-30	dB
Isolation 2	ISL2	f = 770 MHz, P <sub>in</sub> = -30 dBm	-25	dB
Input Return Loss 1	RL <sub>in1</sub>	f = 470 MHz, P <sub>in</sub> = -30 dBm	1.7	dB
Input Return Loss 2	RL <sub>in2</sub>	f = 770 MHz, P <sub>in</sub> = -30 dBm	2.5	dB
Input Impedance 1	Z <sub>in1</sub>	f = 470 MHz, P <sub>in</sub> = -30 dBm <b>Note</b>	0.50 - j 2.01	Ω
Input Impedance 2	Z <sub>in2</sub>	f = 770 MHz, P <sub>in</sub> = -30 dBm <b>Note</b>	0.36 - j 1.21	Ω
Gain 1 dB Compression Output Power 1	P <sub>O(1 dB)1</sub>	f = 470 MHz	-12	dBm
Gain 1 dB Compression Output Power 2	P <sub>O(1 dB)2</sub>	f = 770 MHz	-12	dBm

Note: Calibration reference plane : Device edge side

**STANDARD CHARACTERISTICS FOR REFERENCE 2 (Bypass-mode)**  
 (T<sub>A</sub> = +25°C, V<sub>CC</sub> = 1.8 V, V<sub>cont</sub> = 0 V, Z<sub>S</sub> = Z<sub>L</sub> = 50 Ω, unless otherwise specified)

Parameter	Symbol	Test Conditions	Reference Value	Unit
Gain 1 dB Compression Output Power	P <sub>O(1 dB)</sub>	f = 770 MHz	+6	dBm

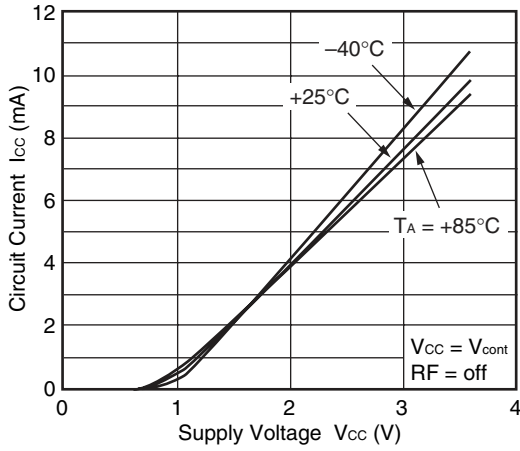
**TEST CIRCUIT**



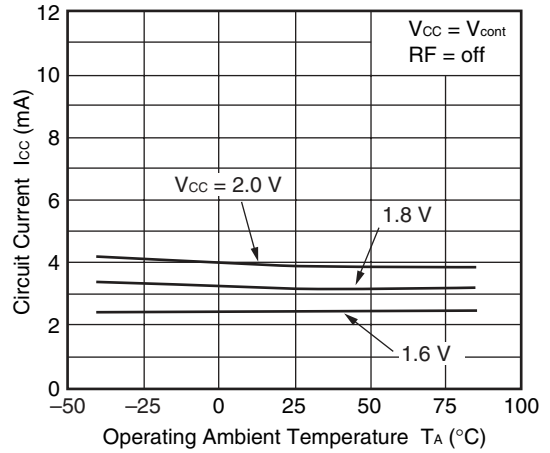
**TYPICAL CHARACTERISTICS 1 (DC Characteristics)**

( $T_A = +25^\circ\text{C}$ , unless otherwise specified)

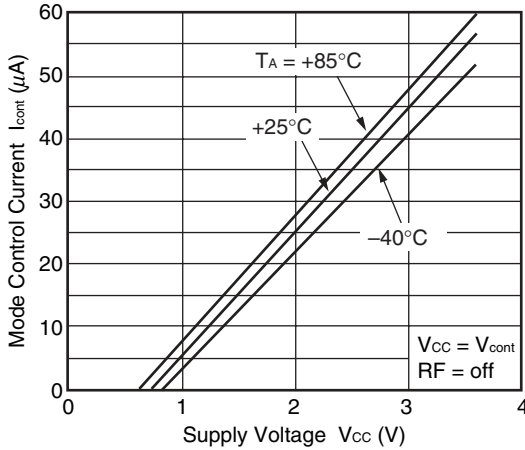
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



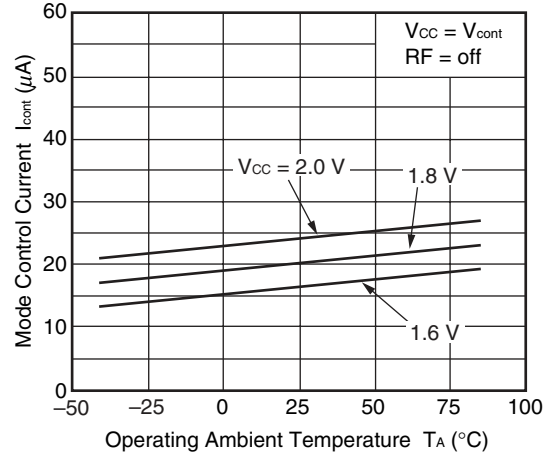
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



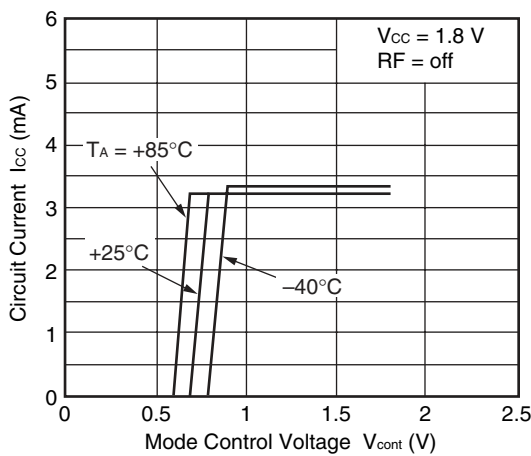
MODE CONTROL CURRENT vs. SUPPLY VOLTAGE



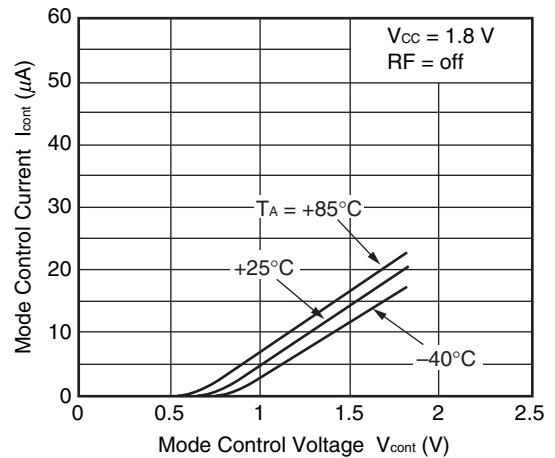
MODE CONTROL CURRENT vs. OPERATING AMBIENT TEMPERATURE



CIRCUIT CURRENT vs. MODE CONTROL VOLTAGE

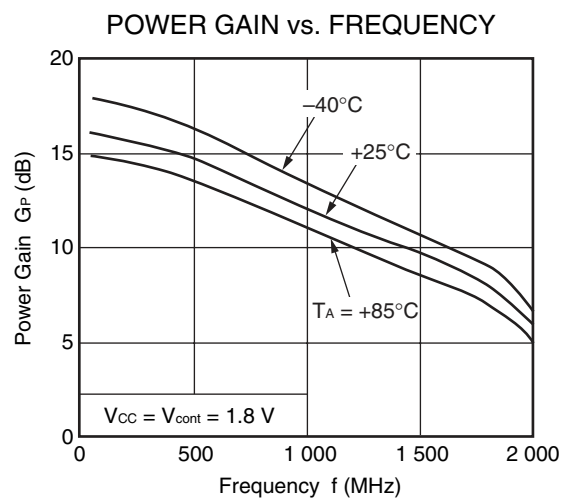
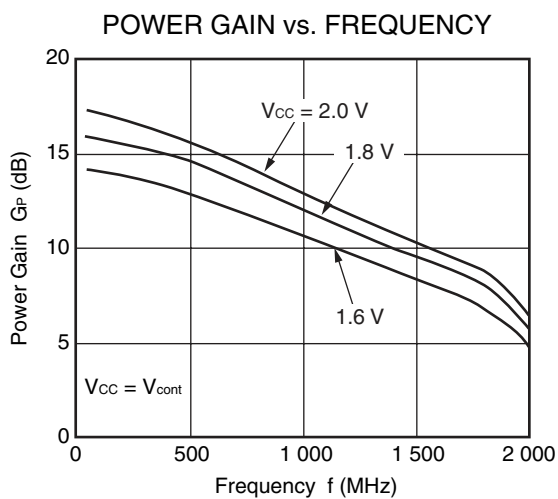
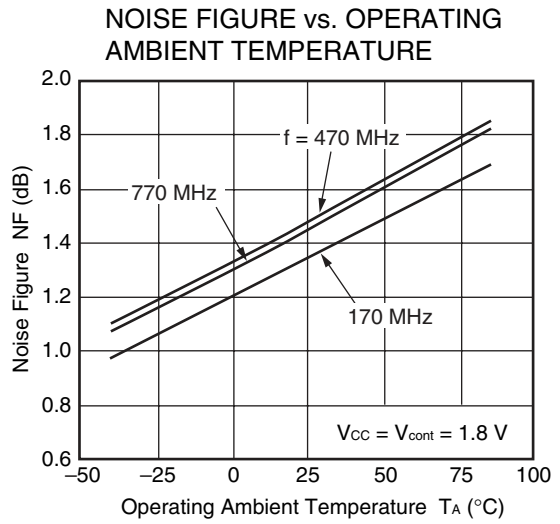
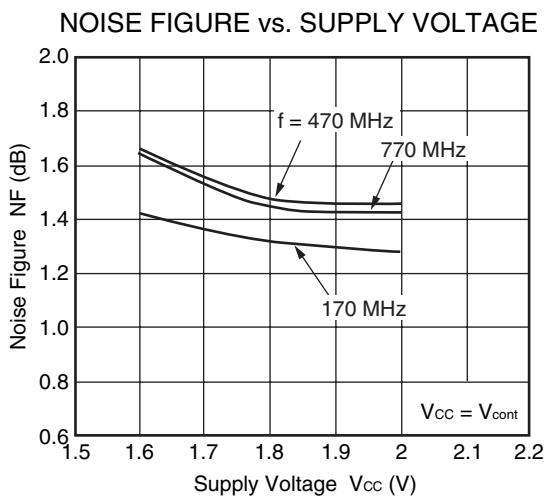
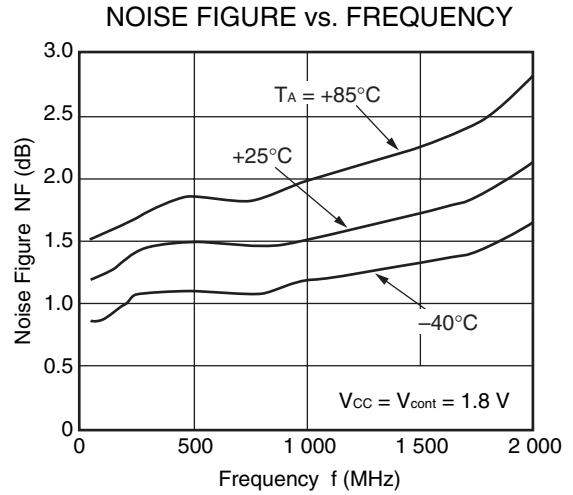
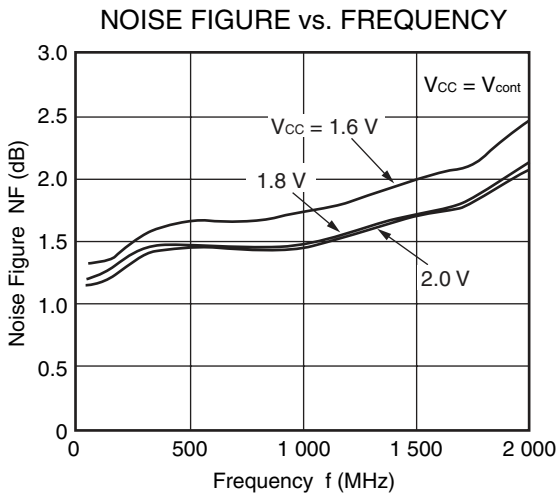


MODE CONTROL CURRENT vs. MODE CONTROL VOLTAGE

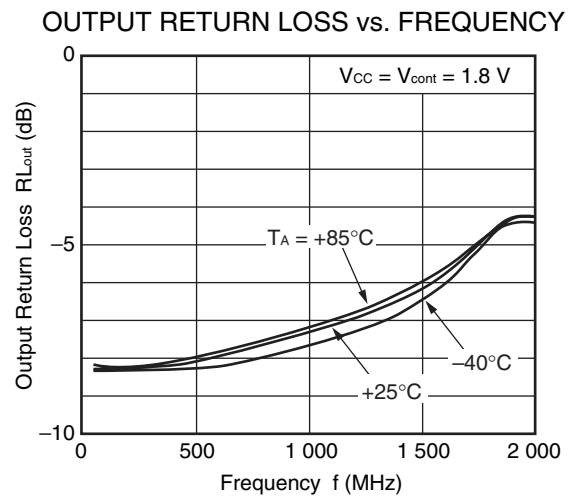
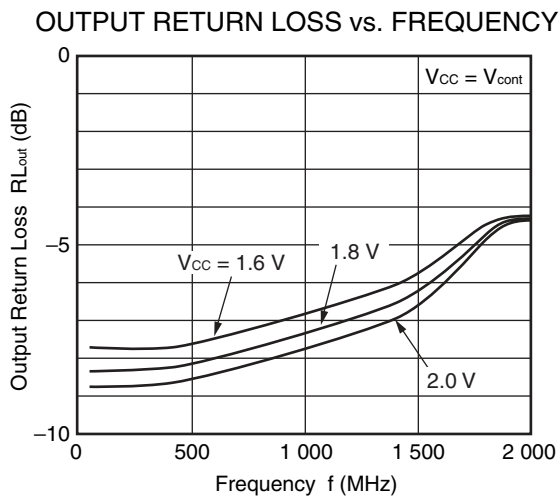
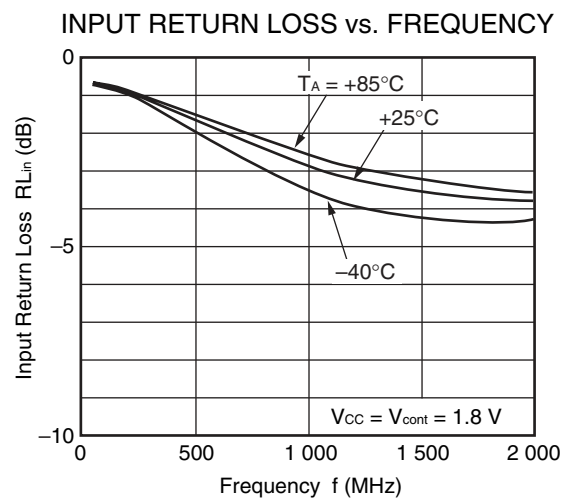
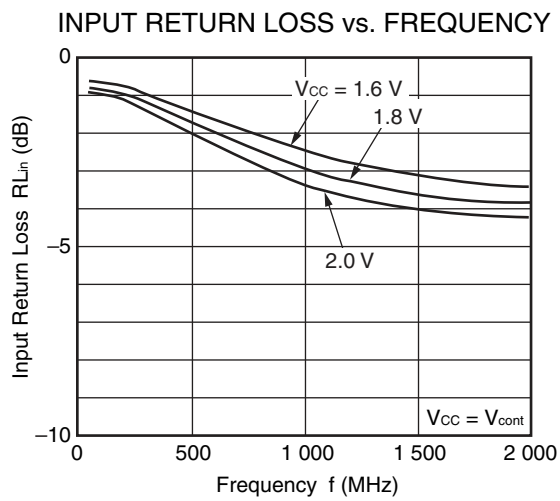
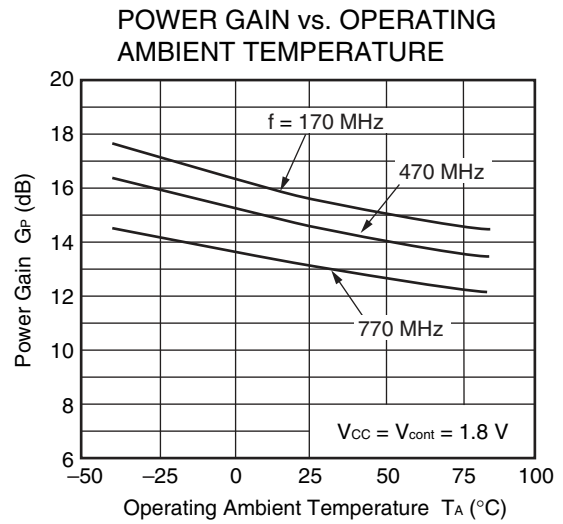
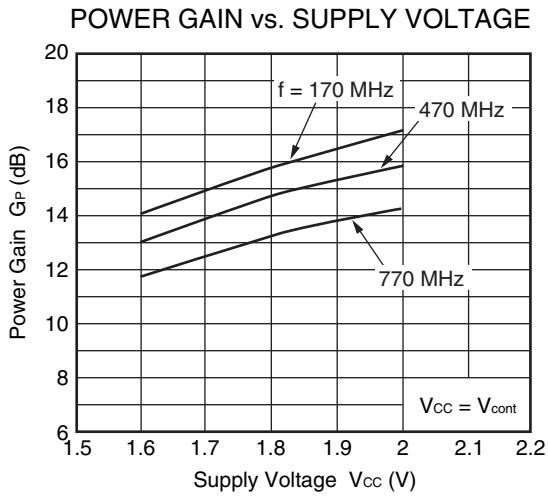


**Remark** The graphs indicate nominal characteristics.

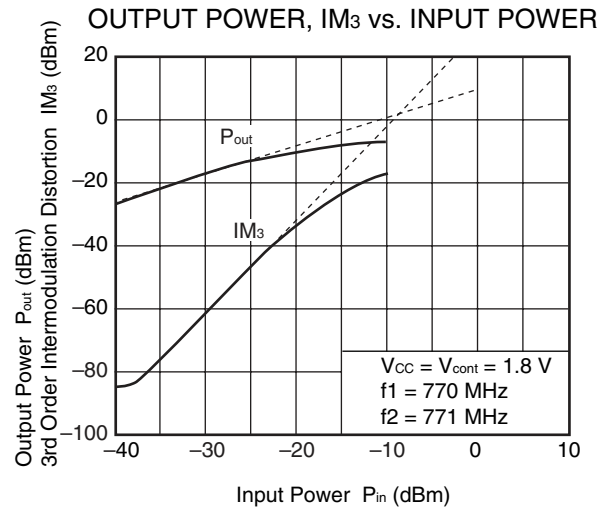
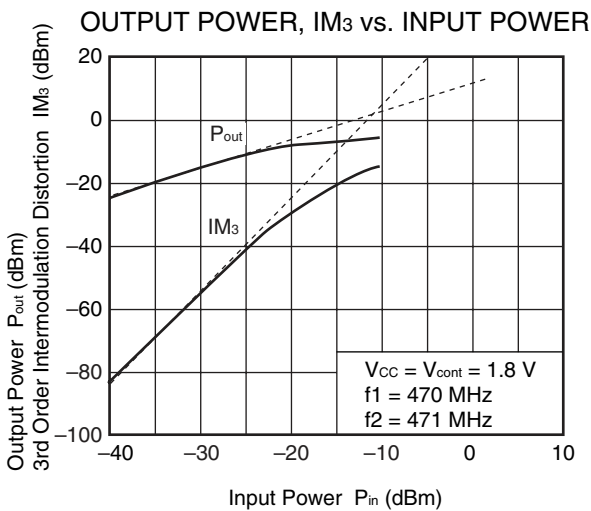
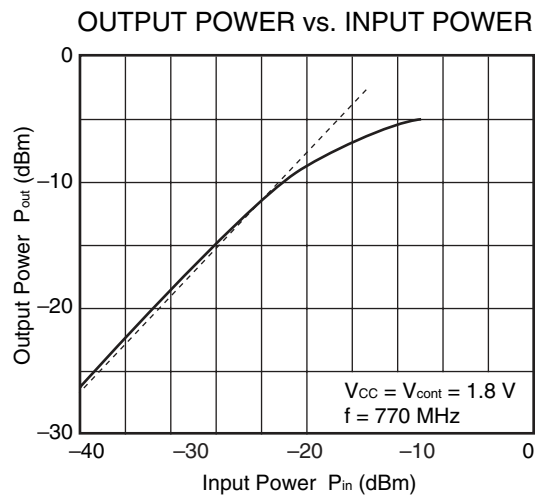
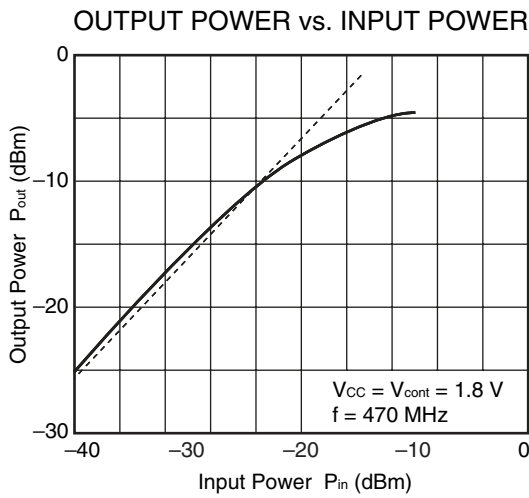
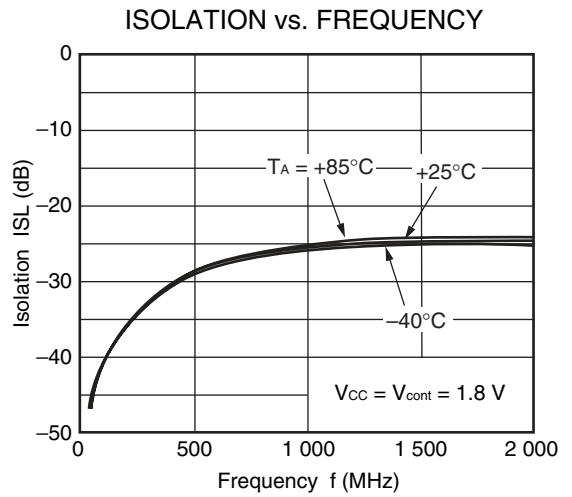
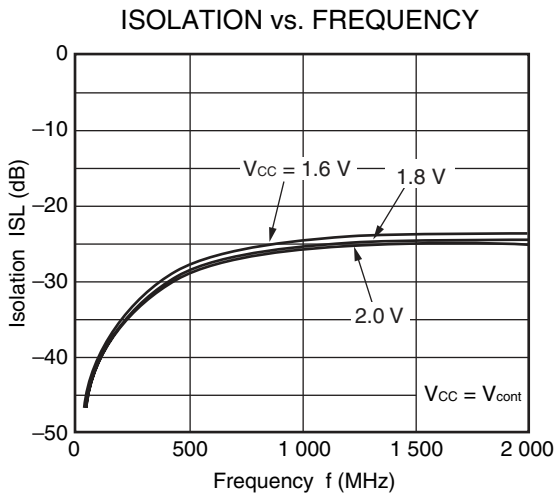
**TYPICAL CHARACTERISTICS 2 (LNA-mode)**  
 (T<sub>A</sub> = +25°C, unless otherwise specified)



**Remark** The graphs indicate nominal characteristics.



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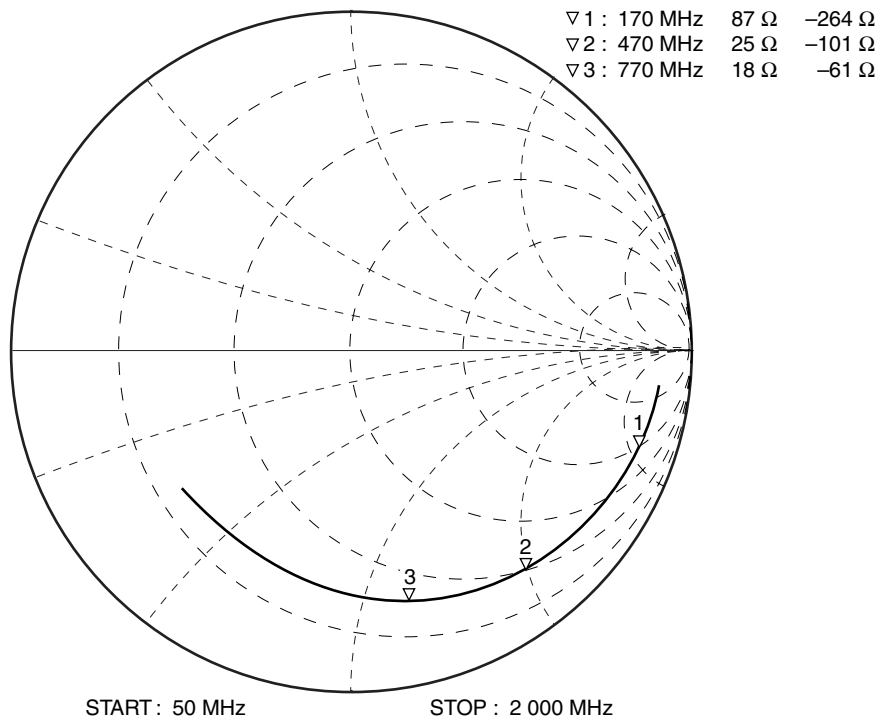
**Remark** The graphs indicate nominal characteristics.



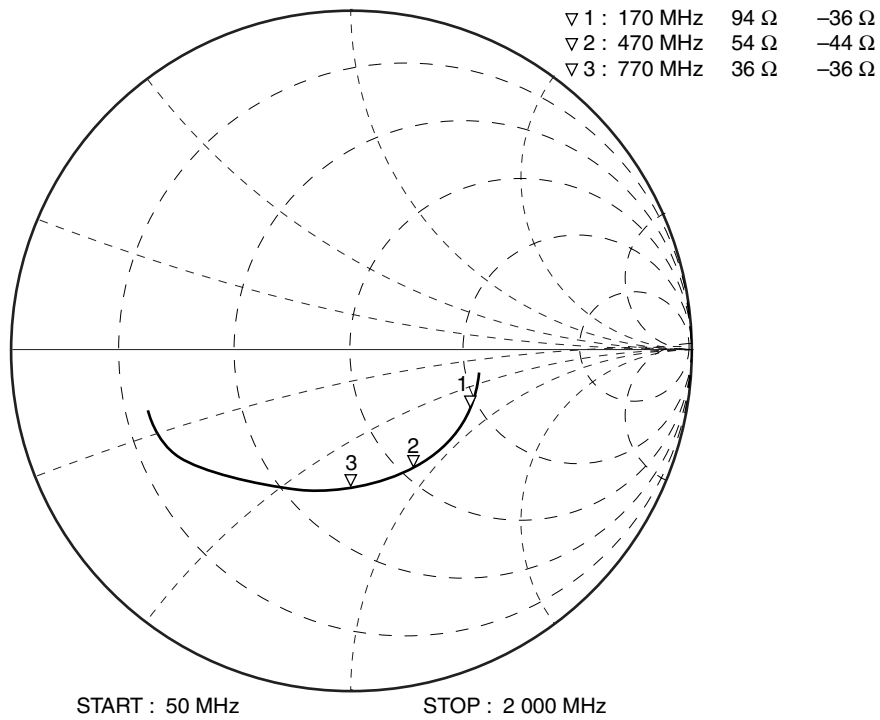
### S-PARAMETERS 1 (LNA-mode)

( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = V_{cont} = 1.8\text{ V}$ , Calibration reference plane: Device edge side)

#### S<sub>11</sub>-FREQUENCY

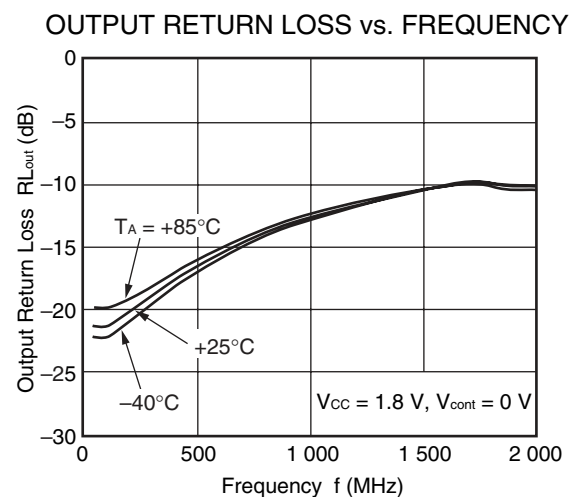
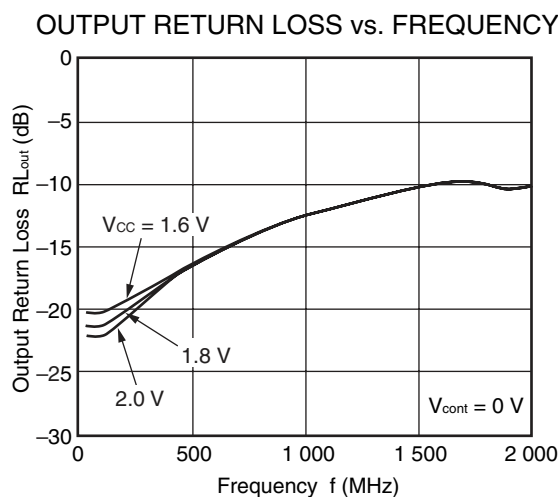
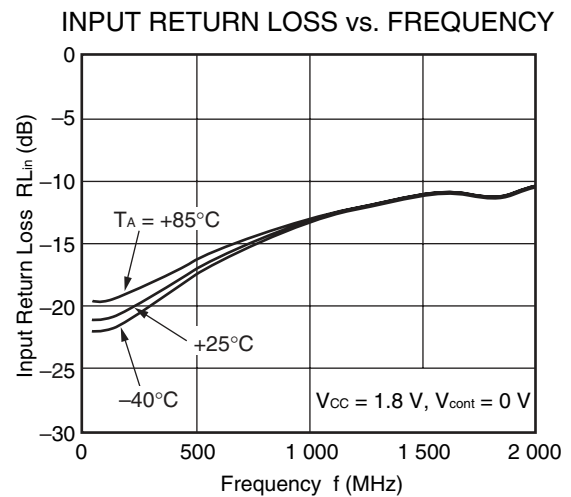
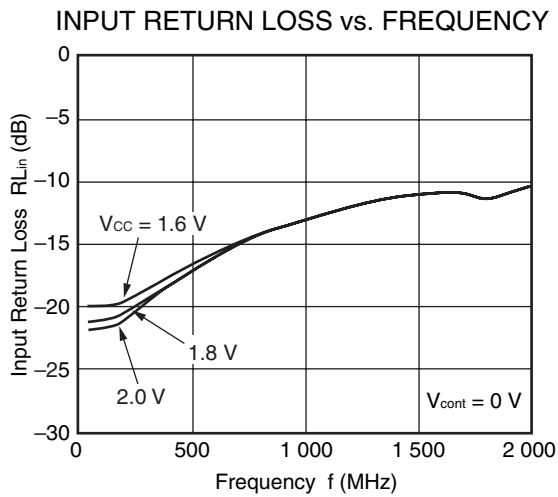
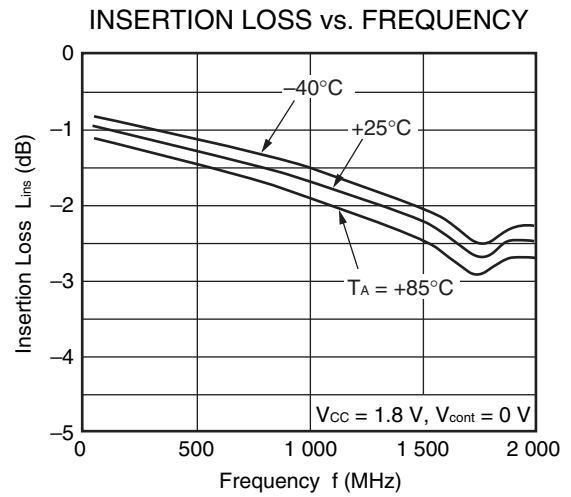
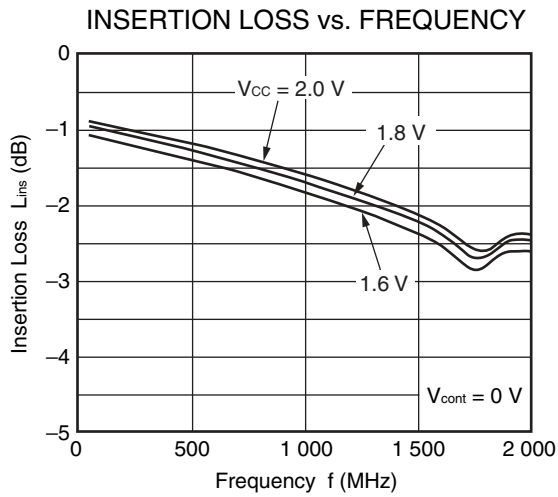


#### S<sub>22</sub>-FREQUENCY

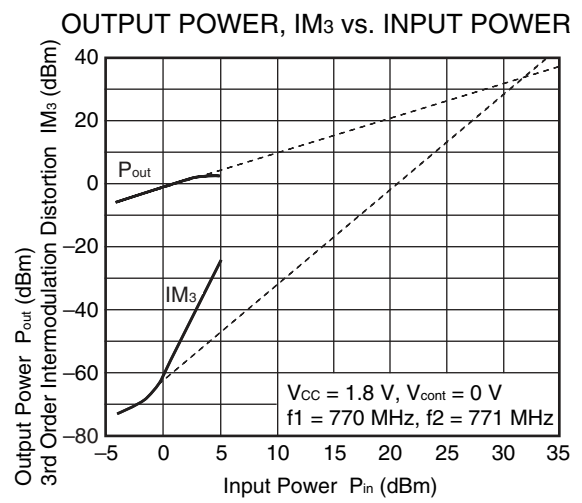
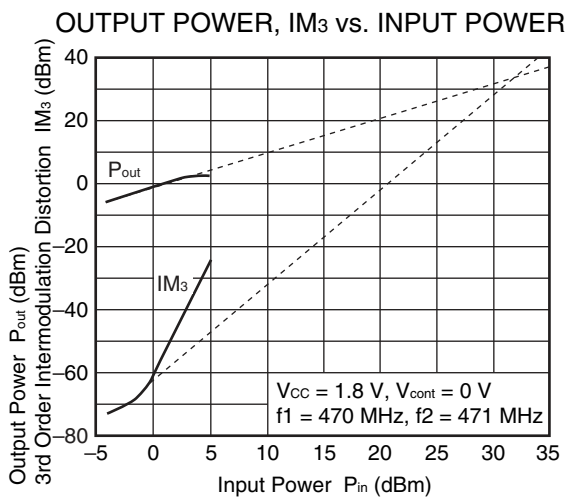
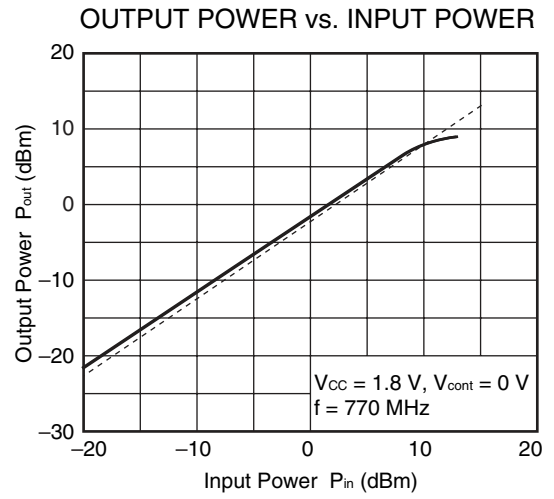
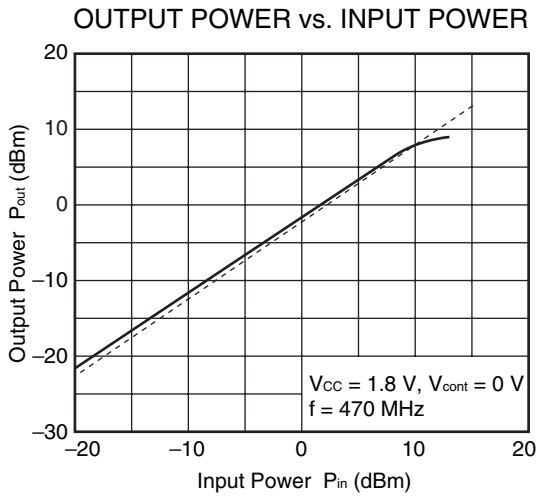


**Remark** The graphs indicate nominal characteristics.

### TYPICAL CHARACTERISTICS 3 (Bypass-mode) ( $T_A = +25^\circ\text{C}$ , unless otherwise specified)



**Remark** The graphs indicate nominal characteristics.

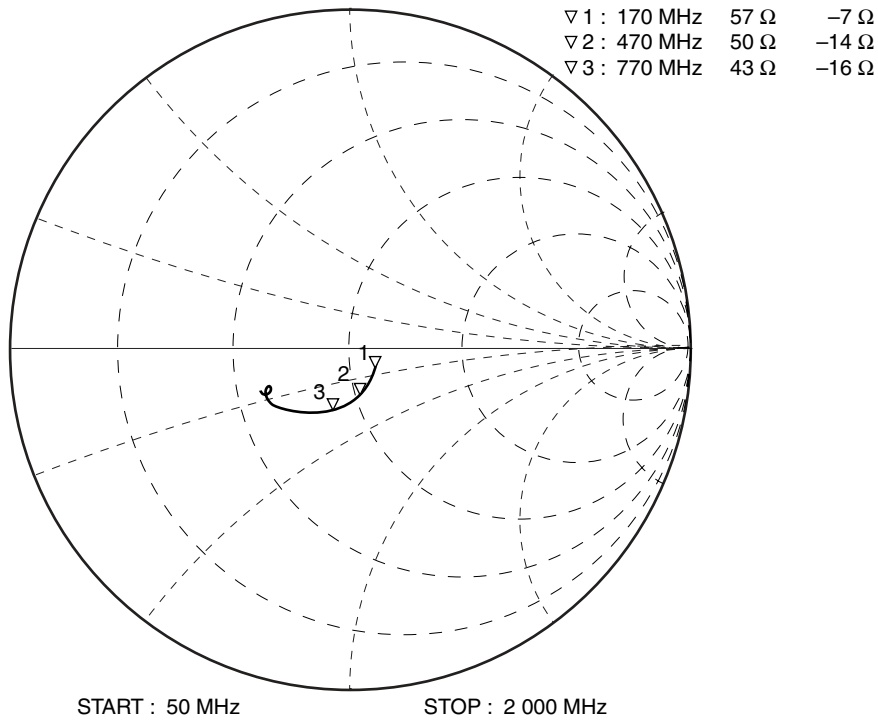


**Remark** The graphs indicate nominal characteristics.

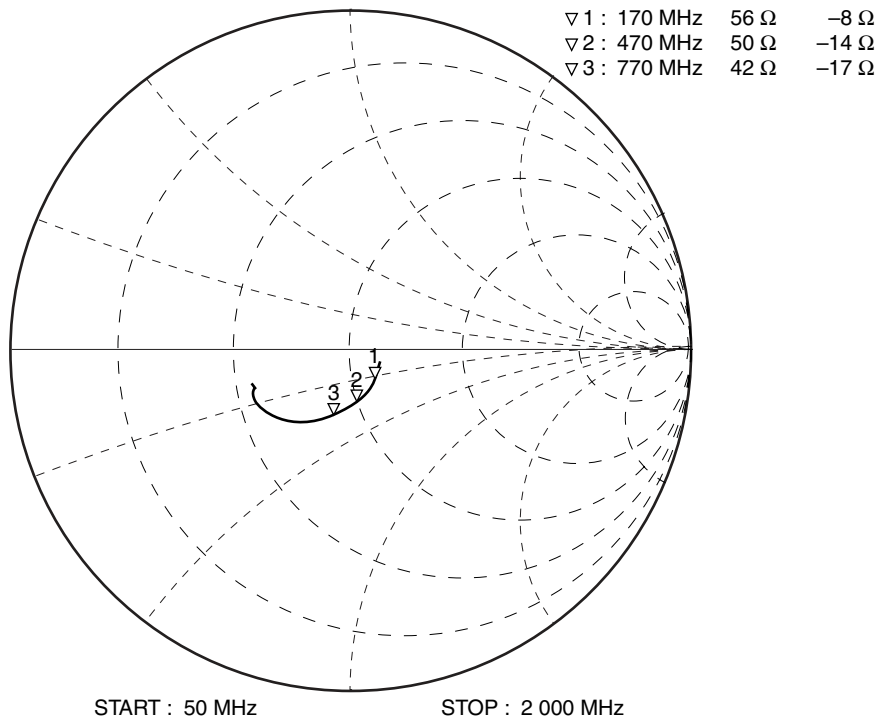
### S-PARAMETERS 2 (Bypass-mode)

( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = 1.8\text{ V}$ ,  $V_{cont} = 0\text{ V}$ , Calibration reference plane: Device edge side)

#### S<sub>11</sub>-FREQUENCY



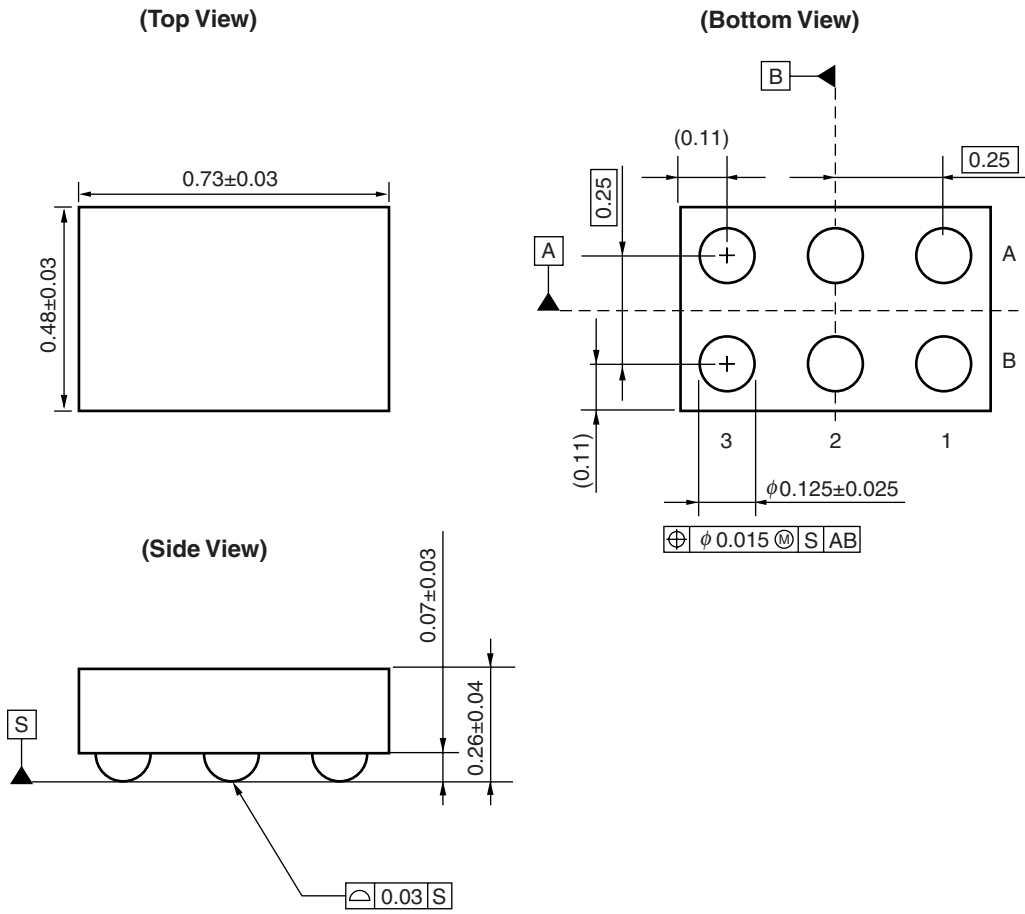
#### S<sub>22</sub>-FREQUENCY



**Remark** The graphs indicate nominal characteristics.

# PACKAGE DIMENSIONS

6-PIN WLBGA (T7D) (UNIT: mm)



Remark ( ): Reference value

### NOTES ON CORRECT USE

- (1) Observe precautions for handling because of electro-static sensitive devices.
- (2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation).  
All the ground terminals must be connected together with wide ground pattern to decrease impedance difference.
- (3) The bypass capacitor should be attached to V<sub>CC</sub> line.
- (4) Do not supply DC voltage to INPUT pin.

### 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

#### CAUTION

Do not use different soldering methods together.

<b>Revision History</b>	<b><math>\mu</math>PD5750T7D Data Sheet</b>
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<b>Rev.</b>	<b>Date</b>	<b>Description</b>	
		<b>Page</b>	<b>Summary</b>
1.00	Feb 24, 2011	—	First edition issued

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