

BIPOLAR ANALOG INTEGRATED CIRCUITS

μ PC2757TB, μ PC2758TB

SILICON MMIC 1st FREQUENCY DOWN-CONVERTER FOR CELLULAR/CORDLESS TELEPHONE

DESCRIPTION

The μ PC2757TB and μ PC2758TB are silicon monolithic integrated circuit designed as 1st frequency down-converter for cellular/cordless telephone receiver stage. The ICs consist of mixer and local amplifier. The μ PC2757TB features low current consumption and the μ PC2758TB features improved intermodulation. From these two version, you can chose either IC corresponding to your system design. These TB suffix ICs which are smaller package than conventional T suffix ICs contribute to reduce your system size.

The μ PC2757TB and μ PC2758TB are manufactured using NEC's 20 GHz fr NESAT™||| silicon bipolar process. This process uses silicon nitride passivation film and gold electrodes. These materials can protect chip surface from external pollution and prevent corrosion/migration. Thus, this IC has excellent performance, uniformity and reliability.

FEATURES

- Wideband operation : $f_{RFin} = 0.1$ to 2.0 GHz, $f_{Fin} = 20$ to 300 MHz
- High-density surface mounting : 6-pin super minimold package
- Low current consumption : $I_{CC} = 5.6$ mA TYP. @ μ PC2757TB
 $I_{CC} = 11$ mA TYP. @ μ PC2758TB
- Supply voltage : $V_{CC} = 2.7$ to 3.3 V
- Minimized carrier leakage : Due to double balanced mixer
- Equable output impedance : Single-end push-pull IF amplifier
- Built-in power save function

APPLICATIONS

- Cellular/cordless telephone up to 2.0 GHz MAX. (example: GSM, PDC800M, PDC1.5G and so on): μ PC2758TB
- Cellular/cordless telephone up to 2.0 GHz MAX. (example: CT1, CT2 and so on): μ PC2757TB

ORDERING INFORMATION

Part Number	Package	Markings	Supplying Form	Product Type
μ PC2757TB-E3	6-pin super minimold	C1X	Embossed tape 8 mm wide. Pin 1, 2, 3 face the tape perforation side. Qty 3kpcs/reel.	Low current consumption
μ PC2758TB-E3		C1Y		High OIP ₃

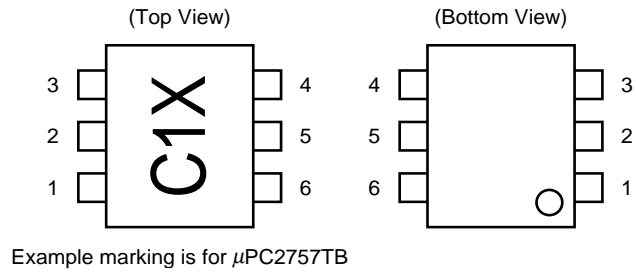
Remark To order evaluation samples, please contact your local NEC sales office.
(Part number for sample order: μ PC2757TB, μ PC2758TB)

Caution Electro-static sensitive devices

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

PIN CONNECTIONS

μ PC2757TB, μ PC2758TB in common



Pin No.	Pin Name
1	RFinput
2	GND
3	LOinput
4	PS
5	Vcc
6	IFoutput

PRODUCT LINE-UP (T_A = +25°C, V_{CC} = 3.0 V, Z_S = Z_L = 50 Ω)

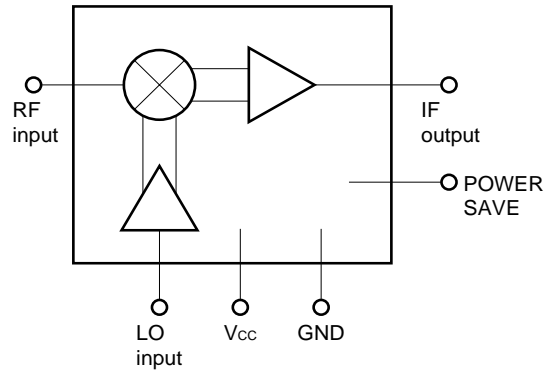
Part No.	Items	No RF I _{cc} (mA)	900 MHz SSB · NF (dB)	1.5 GHz SSB · NF (dB)	1.9 GHz SSB · NF (dB)	900 MHz CG (dB)	1.5 GHz CG (dB)	1.9 GHz CG (dB)	900 MHz IIP ₃ (dBm)	1.5 GHz IIP ₃ (dBm)	1.9 GHz IIP ₃ (dBm)
μ PC2757T		5.6	10	10	13	15	15	13	-14	-14	-12
μ PC2757TB											
μ PC2758T		11	9	10	13	19	18	17	-13	-12	-11
μ PC2758TB											
μ PC8112T		8.5	9	11	11	15	13	13	-10	-9	-7
μ PC8112TB											

Part No.	Items	900 MHz P _{O(sat)} (dBm)	1.5 GHz P _{O(sat)} (dBm)	1.9 GHz P _{O(sat)} (dBm)	900 MHz RF _{Lo} (dB)	1.5 GHz RF _{Lo} (dB)	1.9 GHz RF _{Lo} (dB)	IF Output Configuration	Packages
μ PC2757T		-3	-	-8	-	-	-	Emitter follower	6-pin minimold
μ PC2757TB									6-pin super minimold
μ PC2758T	+1	-	-4	-	-	-	6-pin minimold		
μ PC2758TB							6-pin super minimold		
μ PC8112T		-2.5	-3	-3	-80	-57	-55	Open collector	6-pin minimold
μ PC8112TB									6-pin super minimold

Remark Typical performance. Please refer to ELECTRICAL CHARACTERISTICS in detail.
To know the associated product, please refer to each latest data sheet.

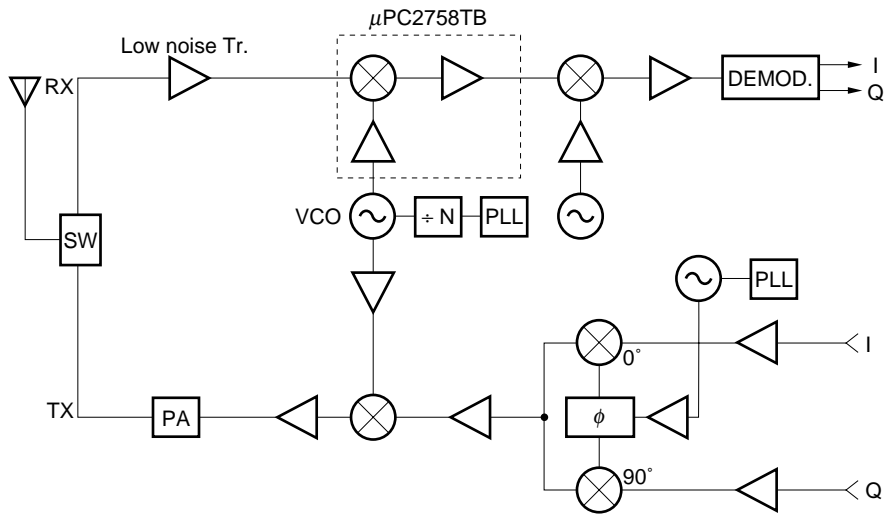
Caution The μ PC2757 and μ PC2758's IIP₃ are calculated with Δ IM₃ = 3 which is the same IM₃ inclination as μ PC8112. On the other hand, OIP₃ of Standard characteristics in page 6 is cross point IP.

INTERNAL BLOCK DIAGRAM (μ PC2757TB, μ PC2758TB in common)



SYSTEM APPLICATION EXAMPLE

DIGITAL CELLULAR TELEPHONE



To know the associated products, please refer to each latest data sheet.

PIN EXPLANATION (Both μ PC2757TB, 2758TB)

Pin No.	Pin Name	Applied Voltage (V)	Pin Voltage (V) ^{Note}	Function and Application	Internal Equivalent Circuit								
1	RFinput	–	1.2	This pin is RF input for mixer designed as double balance type. This circuit contributes to suppress spurious signal with minimum LO and bias power consumption. Also this symmetrical circuit can keep specified performance insensitive to process-condition distribution.									
2	GND	GND	–	This pin is ground of IC. Must be connected to the system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible. (Track length should be kept as short as possible.)	–								
3	LOinput	–	1.3	This pin is LO input for local buffer designed as differential amplifier. Recommendable input level is –15 to 0 dBm. Also this symmetrical circuit can keep specified performance insensitive to process-condition distribution.									
4	PS	V _{cc} or GND	–	This pin is for power-save function. This pin can control ON/OFF operation with bias as follows; <table border="1" style="margin: 10px auto;"> <thead> <tr> <th></th> <th>Bias: V</th> <th>Operation</th> </tr> </thead> <tbody> <tr> <td rowspan="2">V_{PS}</td> <td>≥ 2.5</td> <td>ON</td> </tr> <tr> <td>0 to 0.5</td> <td>OFF</td> </tr> </tbody> </table> Rise time/fall time using this pin are approximately 10 μ s.		Bias: V	Operation	V _{PS}	≥ 2.5	ON	0 to 0.5	OFF	
	Bias: V	Operation											
V _{PS}	≥ 2.5	ON											
	0 to 0.5	OFF											
5	V _{cc}	2.7 to 3.3	–	Supply voltage 3.0 \pm 0.3 V for operation. Must be connected bypass capacitor. (example: 1 000 pF) to minimize ground impedance.	–								
6	IFOutput	–	1.7	This pin is output from IF buffer amplifier designed as single-ended push-pull type. This pin is assigned for emitter follower output with low-impedance. In the case of connecting to high-impedance stage, please attach external matching circuit.									

Note Each pin voltage is measured with V_{cc} = 3.0 V

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V _{CC}	T _A = +25°C	5.5	V
Power Dissipation of Package Allowance	P _D	Mounted on 50 × 50 × 1.6 mm double sided copper clad epoxy glass board at T _A = +85°C	200	mW
Operating Ambient Temperature	T _A		-40 to +85	°C
Storage Temperature	T _{stg}		-55 to +150	°C
PS Pin Voltage	V _{PS}	T _A = +25°C	5.5	V

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V _{CC}	2.7	3.0	3.3	V
Operating Ambient Temperature	T _A	-40	+25	+85	°C
LO Input Level	P _{LOin}	-15	-10	0	dBm

ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_{CC} = V_{PS} = 3.0 V, P_{LOin} = -10 dBm, Z_s = Z_L = 50 Ω)

Parameter	Symbol	Conditions	μ PC2757TB			μ PC2758TB			Unit
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Circuit Current	I _{CC}	No input signal	3.7	5.6	7.7	6.6	11	14.8	mA
RF Frequency Response	f _{RF}	CG ≥ (CG1 -3 dB) f _{fOut} = 130 MHz constant	0.1	-	2.0	0.1	-	2.0	GHz
IF Frequency Response	f _{IF}	CG ≥ (CG1 -3 dB) f _{RFIn} = 0.8 GHz constant	20	-	300	20	-	300	MHz
Conversion Gain 1	CG1	f _{RFIn} = 0.8 GHz, f _{fOut} = 130 MHz P _{RFIn} = -40 dBm, Upper local	12	15	18	16	19	22	dB
Conversion Gain 2	CG2	f _{RFIn} = 2.0 GHz, f _{fOut} = 250 MHz P _{RFIn} = -40 dBm, Lower local	10	13	16	14	17	20	dB
Single Sideband Noise Figure 1	SSB • NF1	f _{RFIn} = 0.8 GHz, f _{fOut} = 130 MHz, SSB mode, Upper local	-	10	13	-	9	12	dB
Single Sideband Noise Figure 2	SSB • NF2	f _{RFIn} = 2.0 GHz, f _{fOut} = 250 MHz, SSB mode, Lower local	-	13	16	-	13	15	dB
Saturated Output Power 1	P _{O(sat) 1}	f _{RFIn} = 0.8 GHz, f _{fOut} = 130 MHz P _{RFIn} = -10 dBm, Upper local	-11	-3	-	-7	+1	-	dBm
Saturated Output Power 2	P _{O(sat) 2}	f _{RFIn} = 2.0 GHz, f _{fOut} = 250 MHz P _{RFIn} = -10 dBm, Lower local	-11	-8	-	-7	-4	-	dBm

STANDARD CHARACTERISTICS FOR REFERENCE

(Unless otherwise specified: $T_A = +25^\circ\text{C}$, $V_{CC} = V_{PS} = 3.0\text{ V}$, $P_{LOin} = -10\text{ dBm}$, $Z_s = Z_L = 50\ \Omega$)

Parameter	Symbol	Conditions	Reference Value		Unit
			μ PC2757TB	μ PC2758TB	
Output 3rd Intercept Point	OIP ₃	f _{RFIn} = 0.8 to 2.0 GHz, f _{IFout} = 0.1 GHz, Cross point IP	+5	+11	dBm
LO Leakage at RF pin	LO _{rf}	f _{LOin} = 0.8 to 2.0 GHz	-35	-30	dBm
LO Leakage at IF pin	LO _{if}	f _{LOin} = 0.8 to 2.0 GHz	-23	-15	dBm
Power-saving Current	I _{CC(PS)}	V _{PS} = 0.5 V	0.1	0.1	μ A

TEST CIRCUIT

μPC2757TB, μPC2758TB

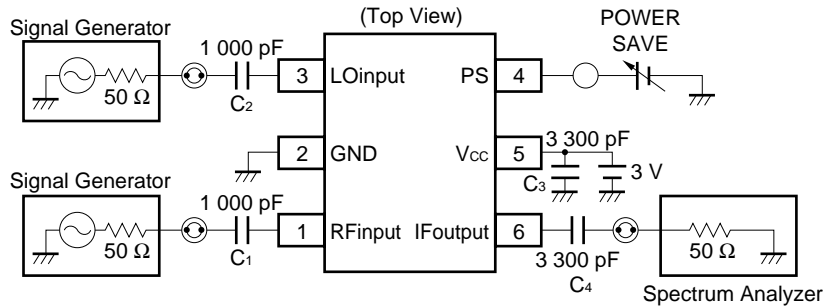
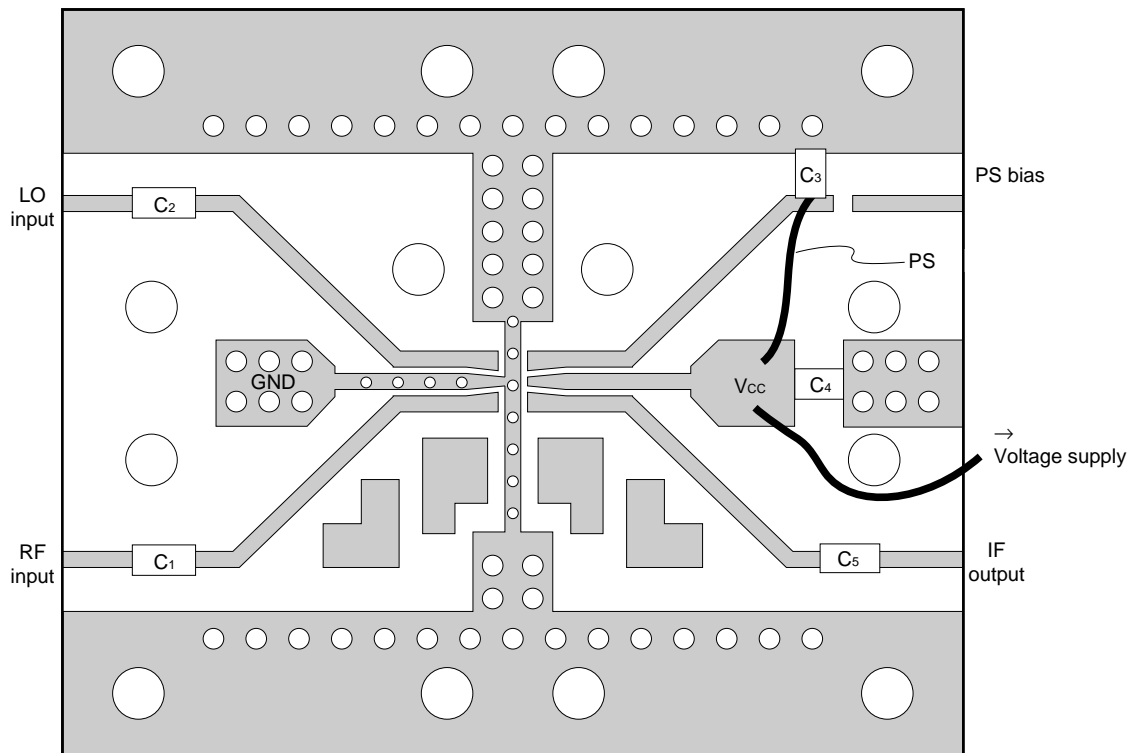


ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



Component List

No.	Value
C _{1 to 2}	1 000 pF
C _{3 to 5}	3 300 pF

Notes 1. 35 × 42 × 0.4 mm double sided copper clad polyimide board.

- 2. Back side: GND pattern
- 3. Solder plated on pattern
- 4. °O: Through holes

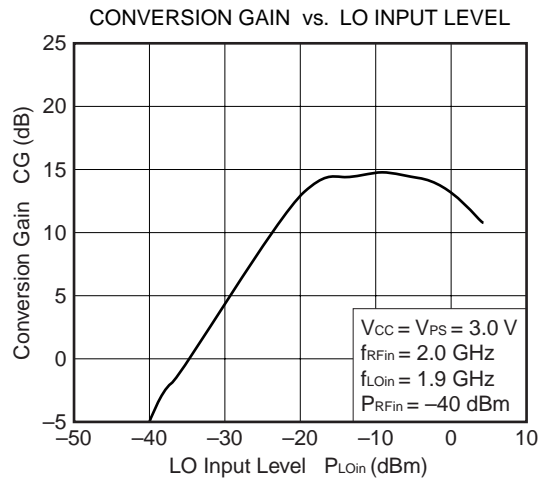
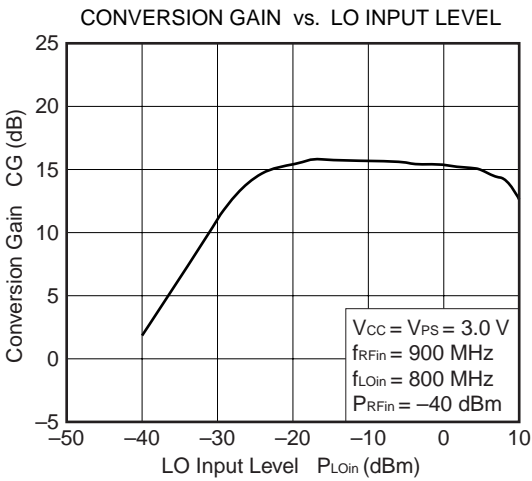
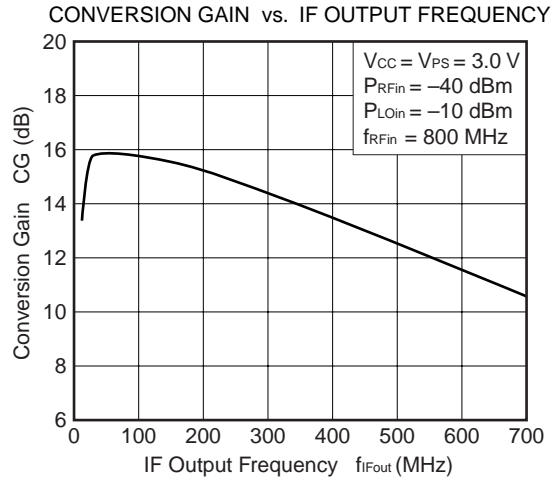
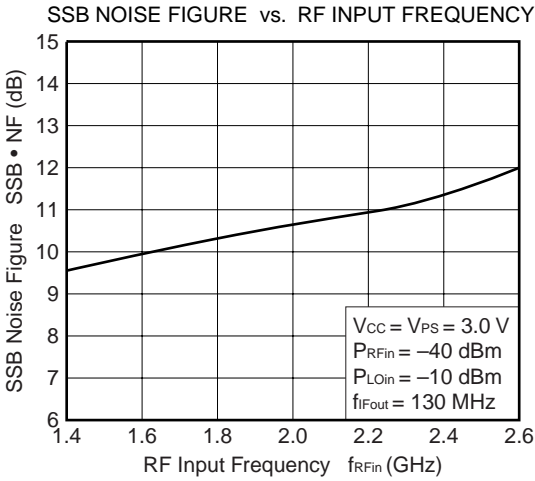
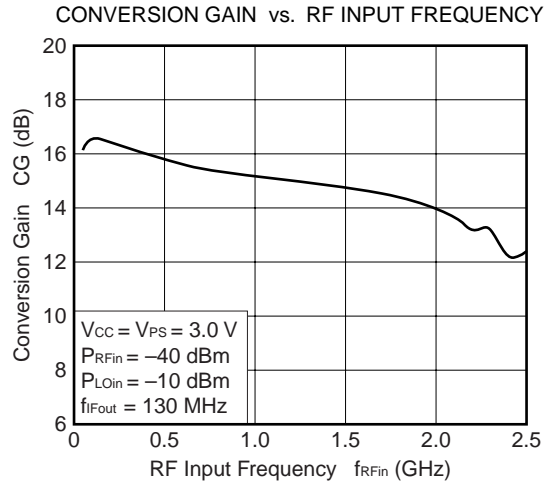
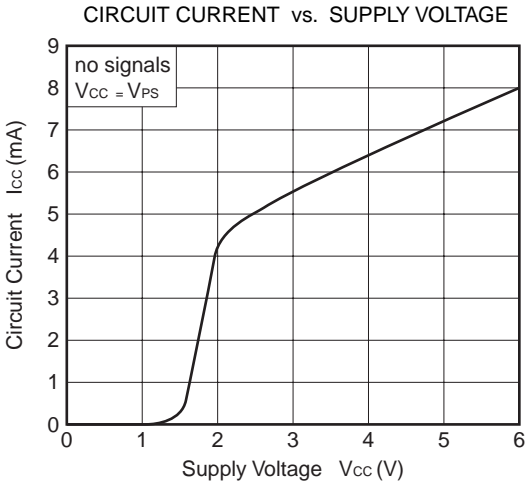
APPLICATION

This IC is guaranteed on the test circuit constructed with 50 Ω equipment and transmission line.

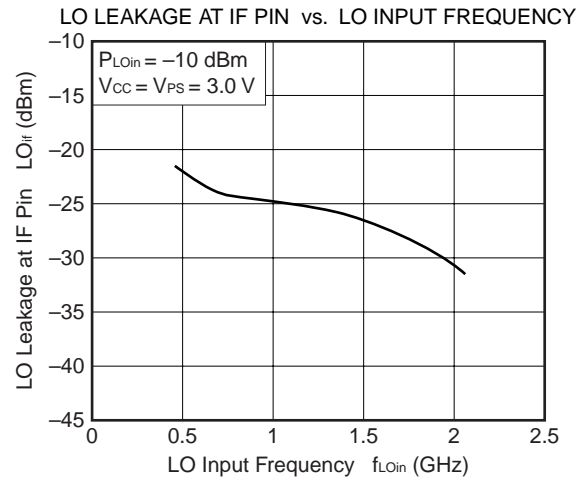
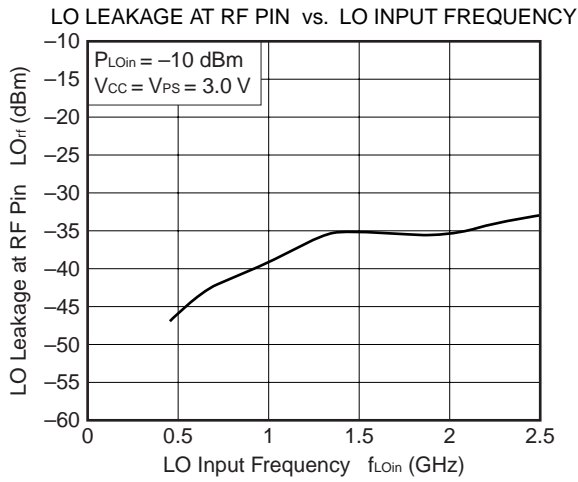
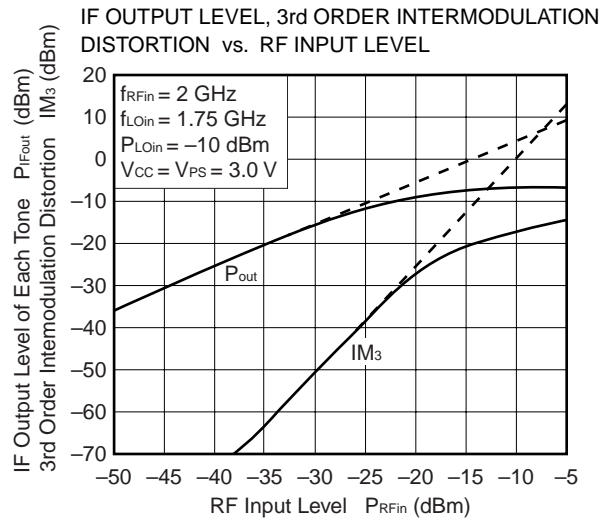
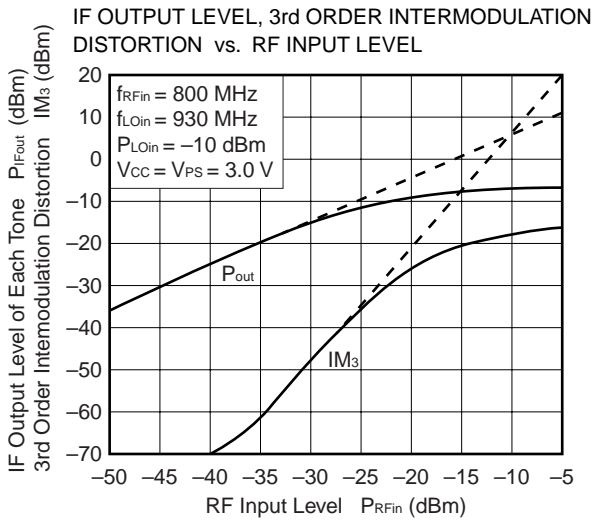
This IC, however, does not have 50 Ω input/output impedance, but electrical characteristics such as conversion gain and intermodulation distortion are described herein on these conditions without impedance matching. So, you should understand that conversion gain and intermodulation distortion at input level will vary when you improve VS of RF input with external circuit (50 Ω termination or impedance matching.)

★ TYPICAL CHARACTERISTICS (TA = +25°C, on Measurement Circuit)

– μ PC2757TB –



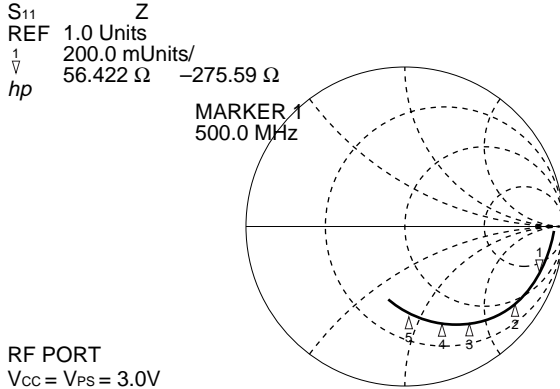
- μ PC2757TB -



Remark The graphs indicate nominal characteristics.

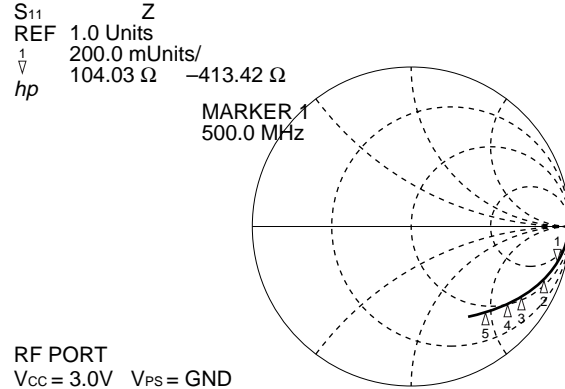
★ S-PARAMETERS

– μ PC2757TB –
 Calibrated on pin of DUT



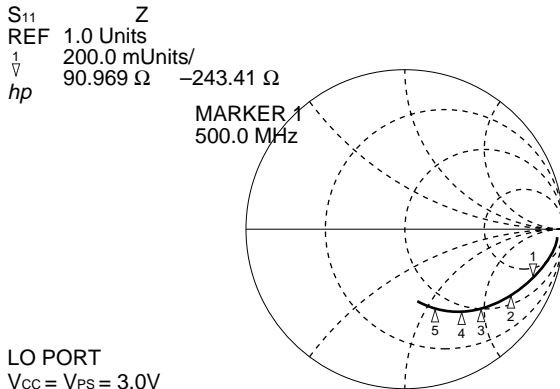
RF PORT
 V_{CC} = V_{PS} = 3.0V

1:500 MHz	56.422 Ω -j275.59 Ω	START 0.050000000 GHz
2:900 MHz	38.68 Ω -j152.71 Ω	STOP 3.000000000 GHz
3:1 500 MHz	31.699 Ω -j88.102 Ω	
4:1 900 MHz	29.209 Ω -j65.926 Ω	
5:2 500 MHz	29.209 Ω -j44.758 Ω	



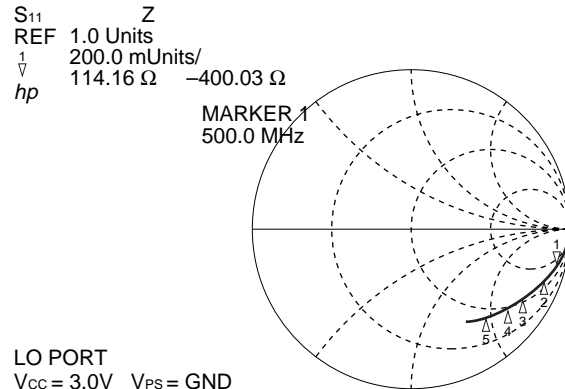
RF PORT
 V_{CC} = 3.0V V_{PS} = GND

1:500 MHz	104.03 Ω -j413.42 Ω	START 0.050000000 GHz
2:900 MHz	74.82 Ω -j243.06 Ω	STOP 3.000000000 GHz
3:1 500 MHz	59.266 Ω -j154.98 Ω	
4:1 900 MHz	51.227 Ω -j124.55 Ω	
5:2 500 MHz	43.996 Ω -j95.117 Ω	



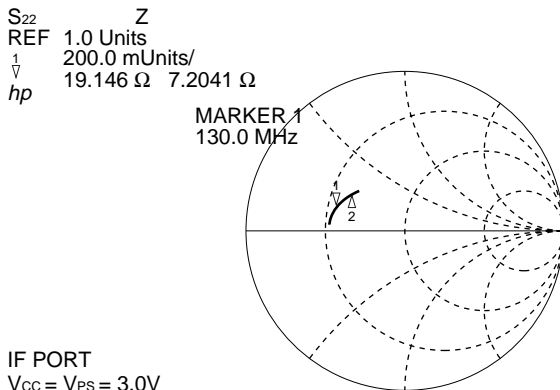
LO PORT
 V_{CC} = V_{PS} = 3.0V

1:500 MHz	90.969 Ω -j243.41 Ω	START 0.050000000 GHz
2:900 MHz	67.828 Ω -j150.32 Ω	STOP 3.000000000 GHz
3:1 500 MHz	51.488 Ω -j97.273 Ω	
4:1 900 MHz	44.621 Ω -j77.352 Ω	
5:2 500 MHz	39.627 Ω -j56.738 Ω	



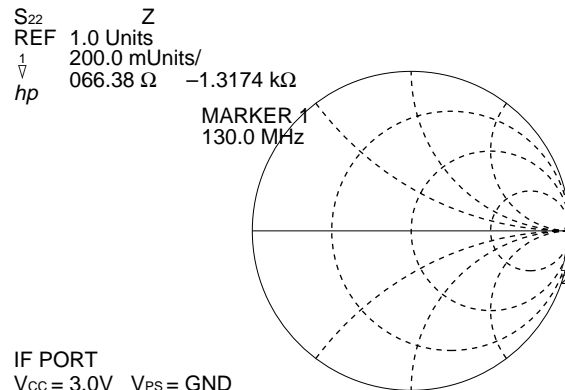
LO PORT
 V_{CC} = 3.0V V_{PS} = GND

1:500 MHz	114.16 Ω -j400.03 Ω	START 0.050000000 GHz
2:900 MHz	75.133 Ω -j242.73 Ω	STOP 3.000000000 GHz
3:1 500 MHz	53.516 Ω -j154.21 Ω	
4:1 900 MHz	44.789 Ω -j124.74 Ω	
5:2 500 MHz	37.004 Ω -j93.828 Ω	



IF PORT
 V_{CC} = V_{PS} = 3.0V

1:130 MHz	19.146 Ω -j7.2041 Ω	START 0.050000000 GHz
2:250 MHz	22.73 Ω -j12.909 Ω	STOP 3.000000000 GHz

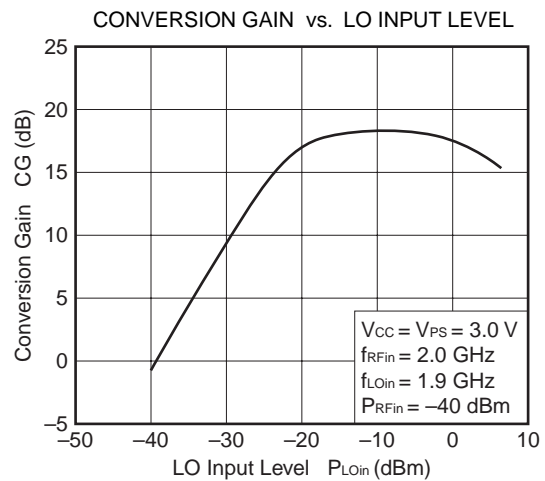
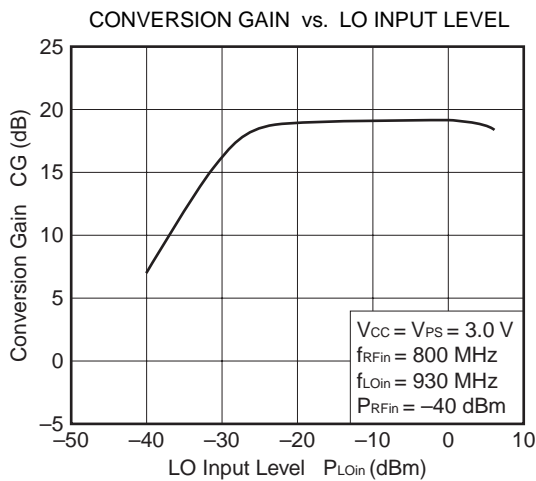
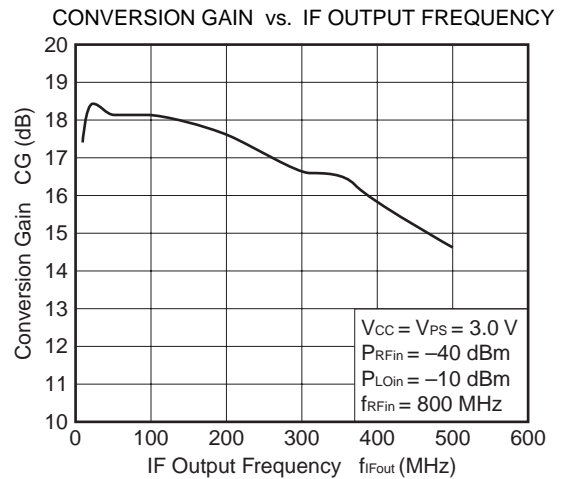
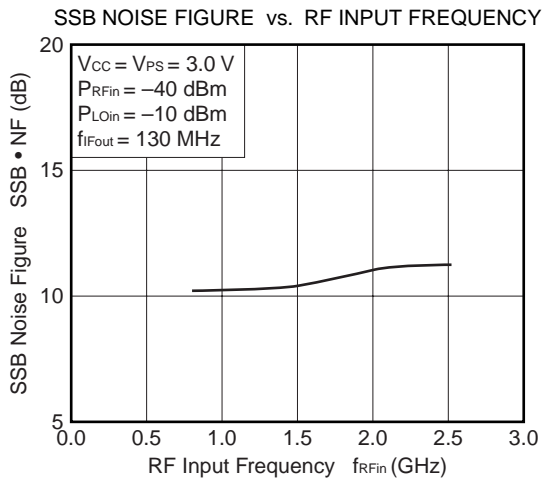
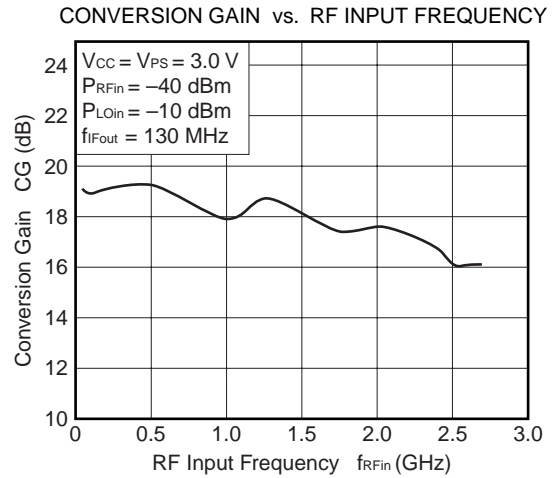
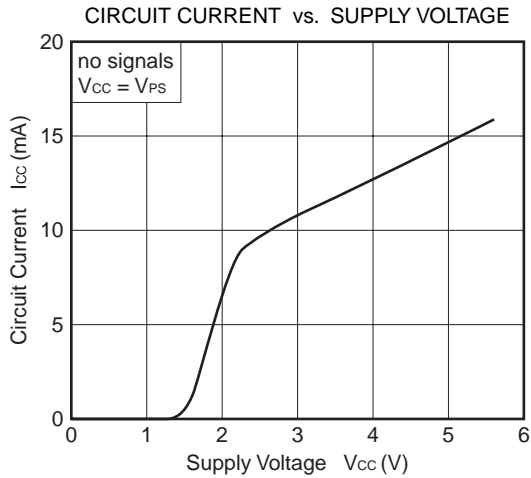


IF PORT
 V_{CC} = 3.0V V_{PS} = GND

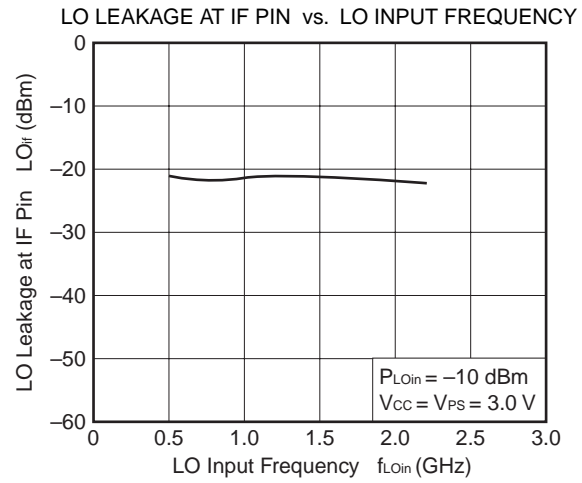
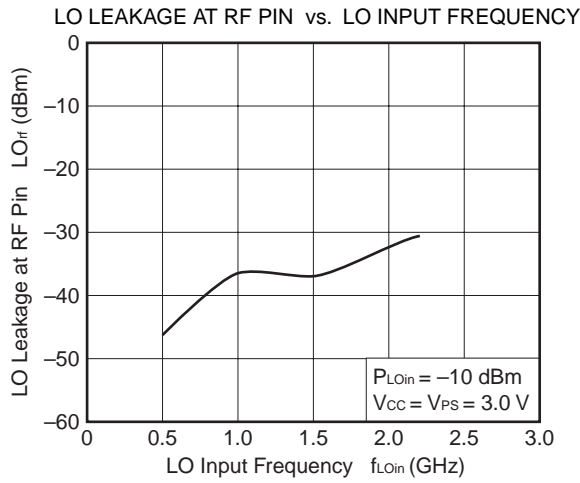
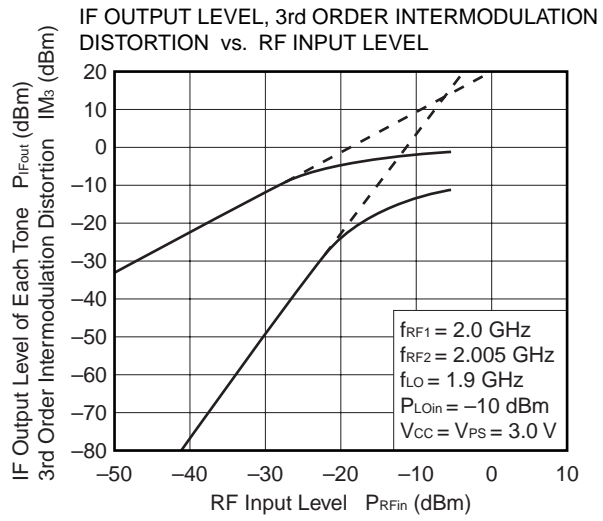
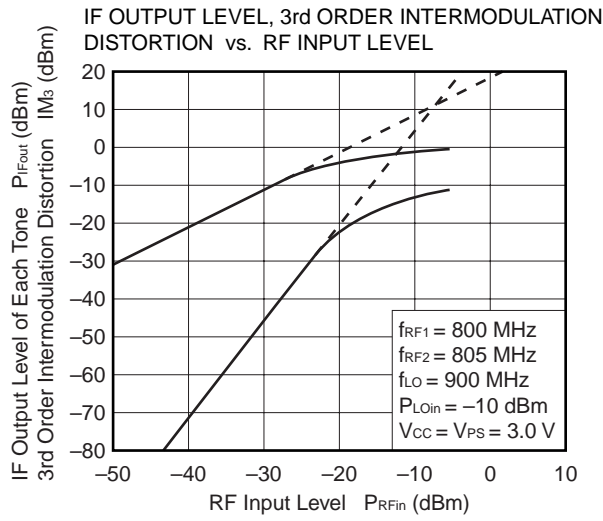
1:130 MHz	66.38 Ω -j1.3174 k Ω	START 0.050000000 GHz
2:250 MHz	88.281 Ω -j725.41 Ω	STOP 3.000000000 GHz

★ TYPICAL CHARACTERISTICS (T_A = +25°C, on Measurement Circuit)

– μ PC2758TB –



– μ PC2758TB –

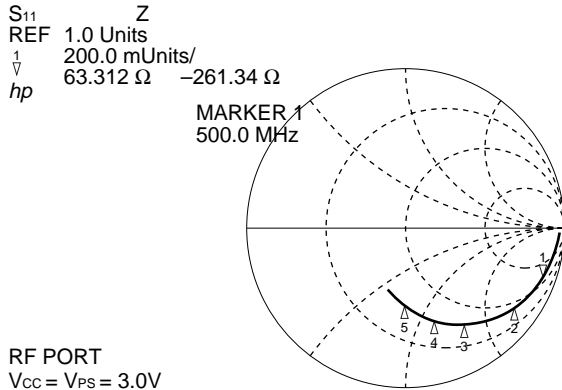


Remark The graphs indicate nominal characteristics.

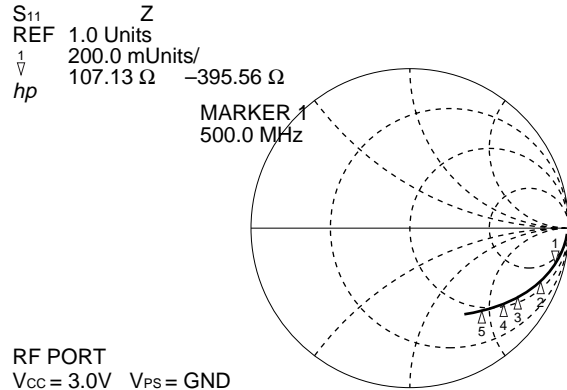
★ S-PARAMETERS

– μ PC2758TB –

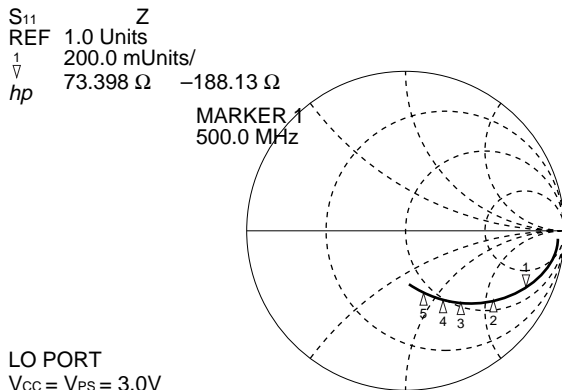
Calibrated on pin of DUT



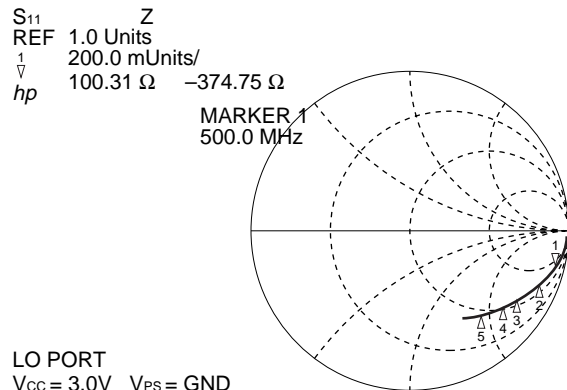
RF PORT
V_{CC} = V_{PS} = 3.0V
1:500 MHz 63.312 Ω -j261.34 Ω START 0.050000000 GHz
2:900 MHz 40.227 Ω -j142.36 Ω STOP 3.000000000 GHz
3:1 500 MHz 32.441 Ω -j79.68 Ω
4:1 900 MHz 31.107 Ω -j58.273 Ω
5:2 500 MHz 30.871 Ω -j39.08 Ω



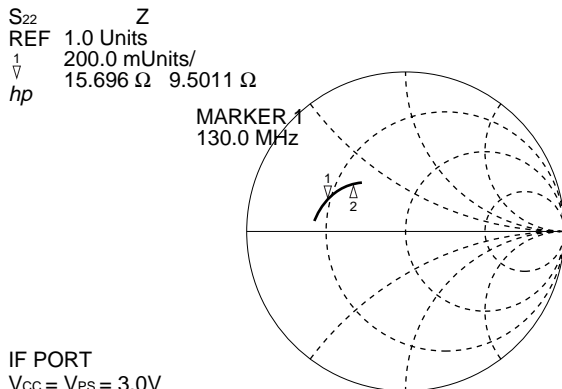
RF PORT
V_{CC} = 3.0V V_{PS} = GND
1:500 MHz 107.13 Ω -j395.56 Ω START 0.050000000 GHz
2:900 MHz 78.711 Ω -j234.41 Ω STOP 3.000000000 GHz
3:1 500 MHz 61.922 Ω -j148.82 Ω
4:1 900 MHz 52.629 Ω -j119.55 Ω
5:2 500 MHz 44.766 Ω -j90.578 Ω



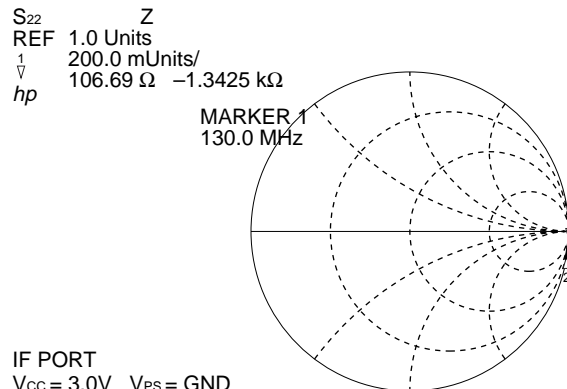
LO PORT
V_{CC} = V_{PS} = 3.0V
1:500 MHz 73.398 Ω -j188.13 Ω START 0.050000000 GHz
2:900 MHz 64.551 Ω -j112.66 Ω STOP 3.000000000 GHz
3:1 500 MHz 53.133 Ω -j72.941 Ω
4:1 900 MHz 48.111 Ω -j57.307 Ω
5:2 500 MHz 44.541 Ω -j41.564 Ω



LO PORT
V_{CC} = 3.0V V_{PS} = GND
1:500 MHz 100.31 Ω -j374.75 Ω START 0.050000000 GHz
2:900 MHz 73.148 Ω -j223.07 Ω STOP 3.000000000 GHz
3:1 500 MHz 57.719 Ω -j144.02 Ω
4:1 900 MHz 50.738 Ω -j119.52 Ω
5:2 500 MHz 41.836 Ω -j90.25 Ω



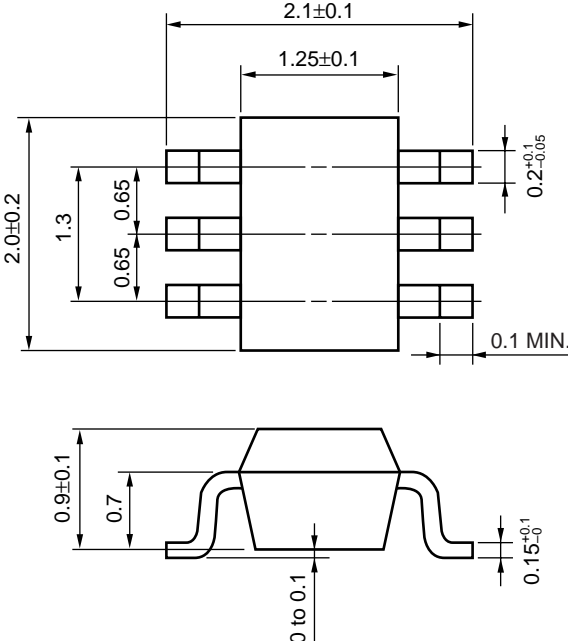
IF PORT
V_{CC} = V_{PS} = 3.0V
1:130 MHz 15.696 Ω -j9.5811 Ω START 0.050000000 GHz
2:250 MHz 21.4 Ω -j16.331 Ω STOP 3.000000000 GHz



IF PORT
V_{CC} = 3.0V V_{PS} = GND
1:130 MHz 106.69 Ω -j1.3425 k Ω START 0.050000000 GHz
2:250 MHz 83.75 Ω -j711.47 Ω STOP 3.000000000 GHz

PACKAGE DIMENSIONS

6-pin super minimold (Unit: mm)



NOTE ON CORRECT USE

- (1) Observe precautions for handling because of electrostatic sensitive devices.
- (2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation).
Keep the track length of the ground pins as short as possible.
- (3) Connect a bypass capacitor (e.g. 1 000 pF) to the Vcc pin.
- (4) The DC cut capacitor must be attached to input pin.

RECOMMENDED SOLDERING CONDITIONS

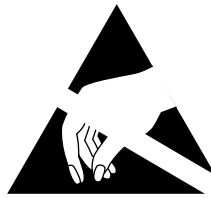
This product should be soldered under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared Reflow	Package peak temperature: 235°C or below Time: 30 seconds or less (at 210°C) Count: 3, Exposure limit: None ^{Note}	IR35-00-3
VPS	Package peak temperature: 215°C or below Time: 40 seconds or less (at 200°C) Count: 3, Exposure limit: None ^{Note}	VP15-00-3
Wave Soldering	Soldering bath temperature: 260°C or below Time: 10 seconds or less Count: 1, Exposure limit: None ^{Note}	WS60-00-1
Partial Heating	Pin temperature: 300°C Time: 3 seconds or less (per side of device) Exposure limit: None ^{Note}	–

Note After opening the dry pack, keep it in a place below 25°C and 65% RH for the allowable storage period.

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

For details of recommended soldering conditions for surface mounting, refer to information document SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E).



ATTENTION

OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES

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(Note)

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