DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUITS

μPC2757TB, μPC2758TB

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

DESCRIPTION

The μPC2757TB and μPC2758TB 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 μPC2757TB features low current consumption and the μPC2758TB 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 μPC2757TB and μPC2758TB are manufactured using NEC's 20 GHz f_T 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_{IFin} = 20 to 300 MHz
- High-density surface mounting : 6-pin super minimold package
- Low current consumption : I_{CC} = 5.6 mA TYP. @ μPC2757TB
  I_{CC} = 11 mA TYP. @ μPC2758TB
- 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): μPC2758TB
- Cellular/cordless telephone up to 2.0 GHz MAX. (example: CT1, CT2 and so on): μPC2757TB

ORDERING INFORMATION

Part Number	Package	Markings	Supplying Form	Product Type
μPC2757TB-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
μPC2758TB-E3		C1Y		High OIP_3

Remark To order evaluation samples, please contact your local NEC sales office.
(Part number for sample order: μPC2757TB, μPC2758TB)

Caution Electro-static sensitive devices

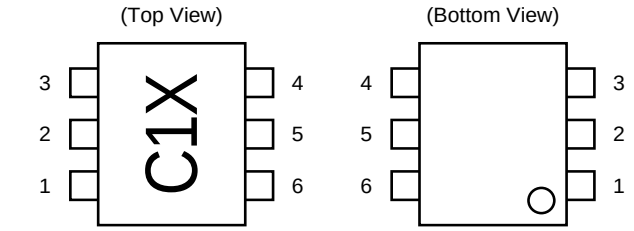
The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

Document No. P12771EJ2V0DS00 (2nd edition)
Date Published June 2000 N CP(K)
Printed in Japan

The mark ★ shows major revised points.

PIN CONNECTIONS

μPC2757TB, μPC2758TB in common



Example marking is for μPC2757TB

Pin No.	Pin Name
1	RFinput
2	GND
3	LOinput
4	PS
5	V_{CC}
6	IFoutput

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

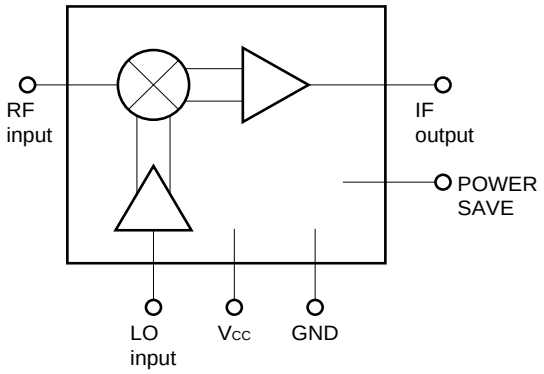
Items / Part No.	No RF I_{CC} (mA)	900 MHz SSB · NF (dB)	1.5 GHz SSB · NF (dB)	1.9 GHz SSB · NF (dB)	900 MHz CG (dB)	1.5 GHz CG (dB)	1.9 GHz CG (dB)	900 MHz IIP_3 (dBm)	1.5 GHz IIP_3 (dBm)	1.9 GHz IIP_3 (dBm)
μPC2757T	5.6	10	10	13	15	15	13	–14	–14	–12
μPC2757TB										
μPC2758T	11	9	10	13	19	18	17	–13	–12	–11
μPC2758TB										
μPC8112T	8.5	9	11	11	15	13	13	–10	–9	–7
μPC8112TB										

Items / Part No.	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
μPC2757T	–3	–	–8	–	–	–	Emitter follower	6-pin minimold
μPC2757TB								6-pin super minimold
μPC2758T	+1	–	–4	–	–	–		6-pin minimold
μPC2758TB								6-pin super minimold
μPC8112T	–2.5	–3	–3	–80	–57	–55	Open collector	6-pin minimold
μPC8112TB								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.

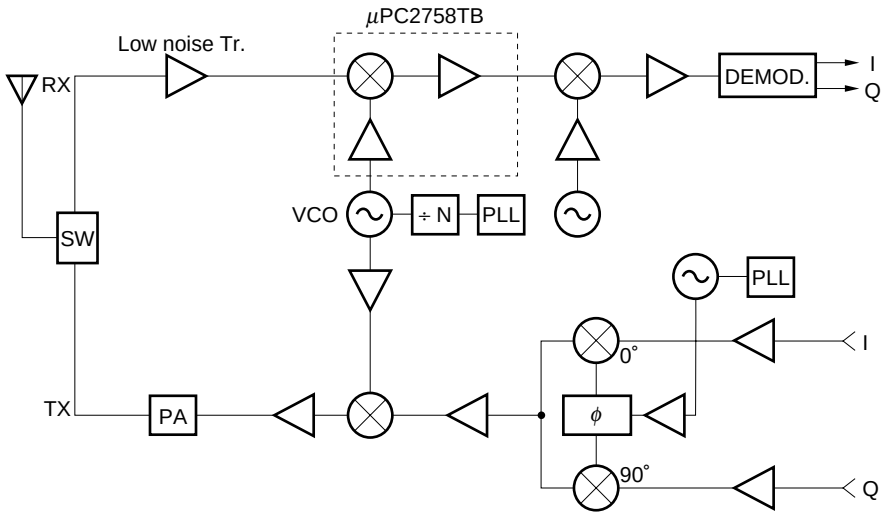
Caution The μPC2757 and μPC2758's IIP_3 are calculated with ΔIM_3 = 3 which is the same IM_3 inclination as μPC8112. On the other hand, OIP_3 of Standard characteristics in page 6 is cross point IP.

INTERNAL BLOCK DIAGRAM (μPC2757TB, μPC2758TB in common)



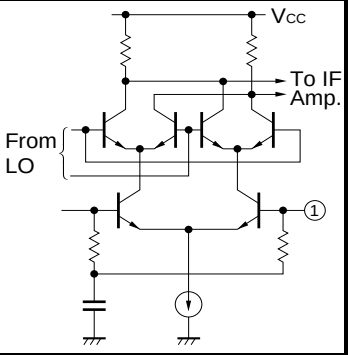
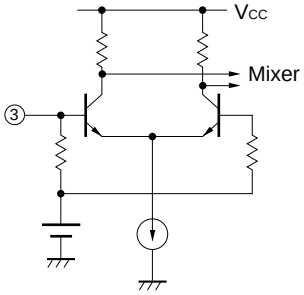
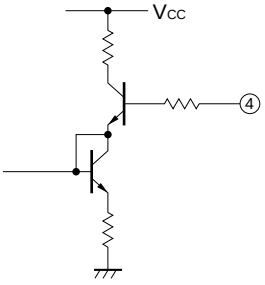
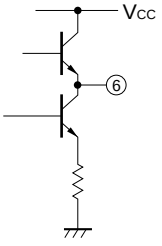
SYSTEM APPLICATION EXAMPLE

DIGITAL CELLULAR TELEPHONE



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

PIN EXPLANATION (Both μPC2757TB, 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	VCC or GND	–	This pin is for power-save function. This pin can control ON/OFF operation with bias as follows; VPS: ≥ 2.5 → ON; 0 to 0.5 → OFF Rise time/fall time using this pin are approximately 10 μs.	
5	VCC	2.7 to 3.3	–	Supply voltage 3.0 ±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 VCC = 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	μPC2757TB			μPC2758TB			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_{IFout} = 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_{IFout} = 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_{IFout} = 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_{IFout} = 130 MHz, SSB mode, Upper local	–	10	13	–	9	12	dB
Single Sideband Noise Figure 2	SSB • NF2	f_{RFin} = 2.0 GHz, f_{IFout} = 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_{IFout} = 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_{IFout} = 250 MHz P_{RFin} = –10 dBm, Lower local	–11	–8	–	–7	–4	–	dBm

STANDARD CHARACTERISTICS FOR REFERENCE
(Unless otherwise specified: T_A = +25°C, V_{CC} = V_{PS} = 3.0 V, P_{LOin} = –10 dBm, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Conditions	Reference Value		Unit
			μPC2757TB	μPC2758TB	
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	μA

TEST CIRCUIT

μPC2757TB, μPC2758TB

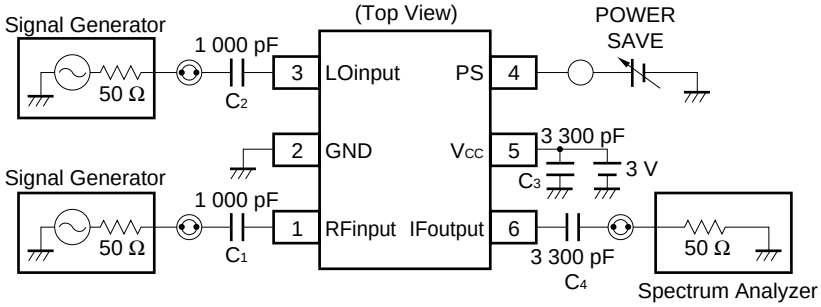
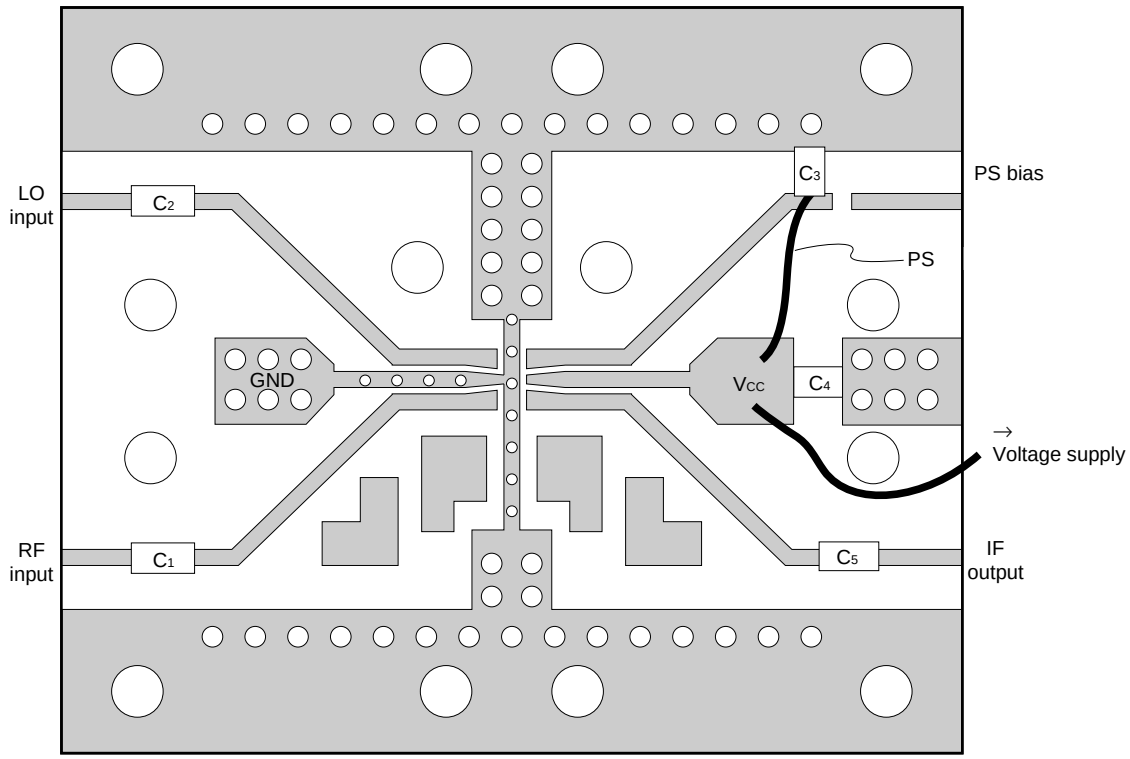


ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



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. °○: Through holes

APPLICATION

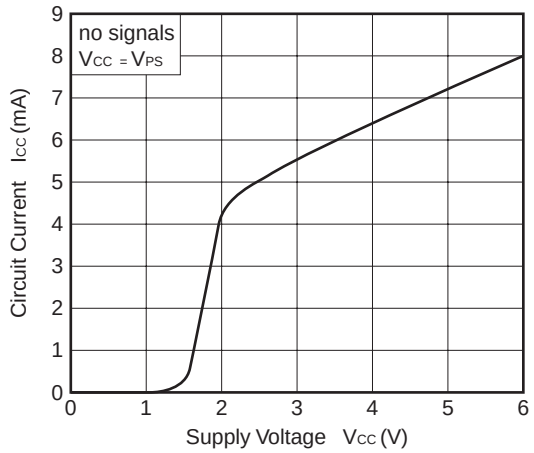
This IC is guaranteed on the test circuit constructed with 50 Ω equipment and transmission line.

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.)

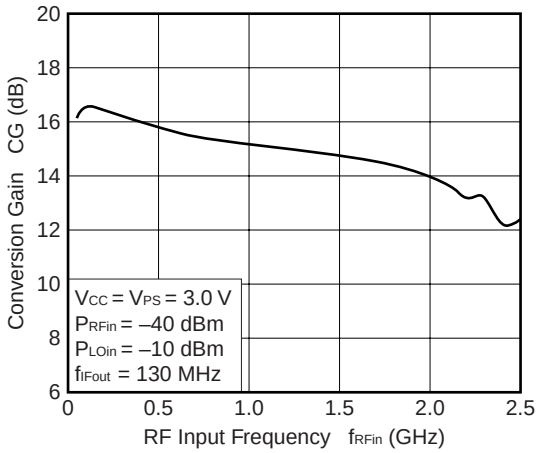
★ TYPICAL CHARACTERISTICS (T_A = +25°C, on Measurement Circuit)

– μPC2757TB –

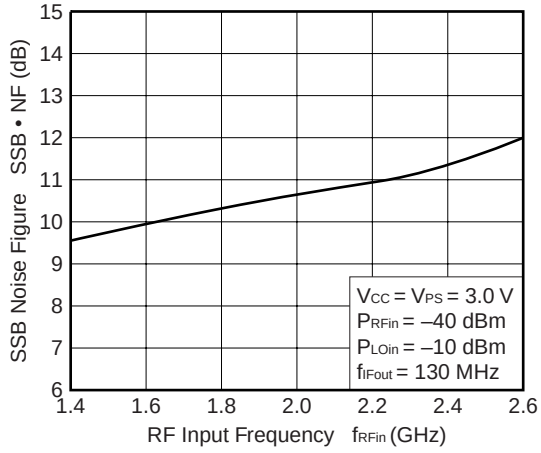
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



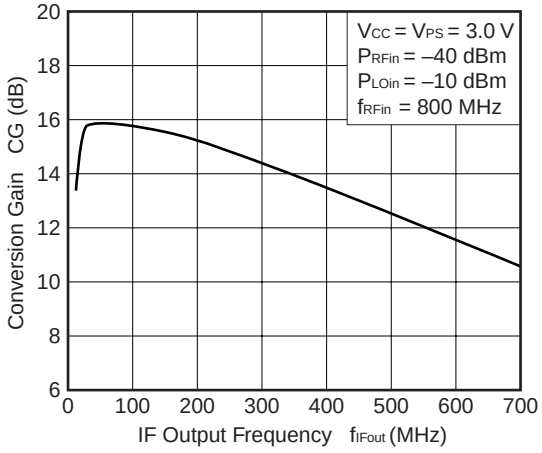
CONVERSION GAIN vs. RF INPUT FREQUENCY



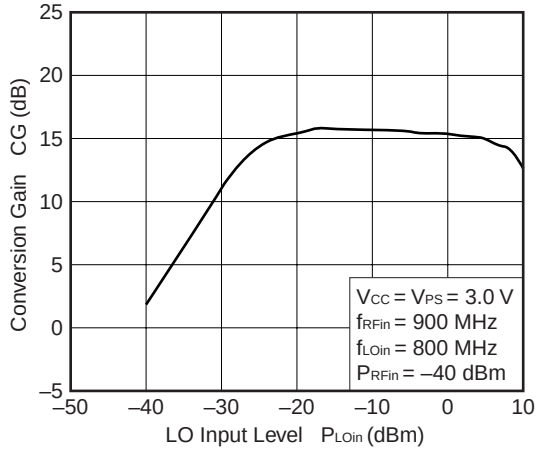
SSB NOISE FIGURE vs. RF INPUT FREQUENCY



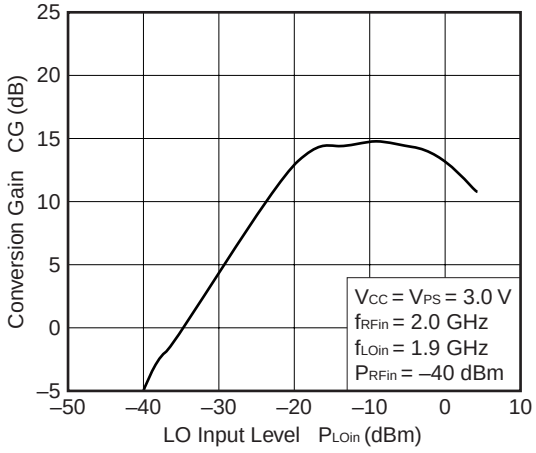
CONVERSION GAIN vs. IF OUTPUT FREQUENCY



CONVERSION GAIN vs. LO INPUT LEVEL

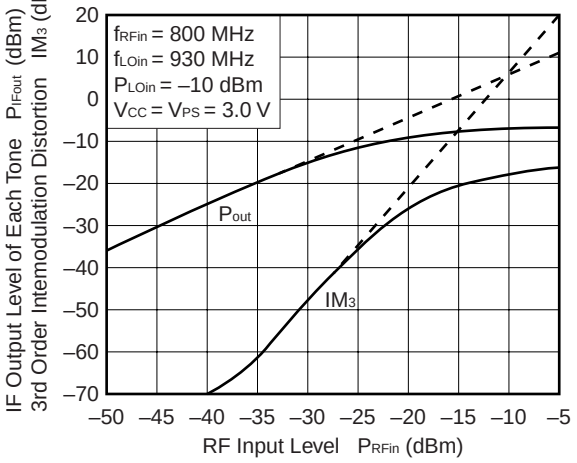


CONVERSION GAIN vs. LO INPUT LEVEL

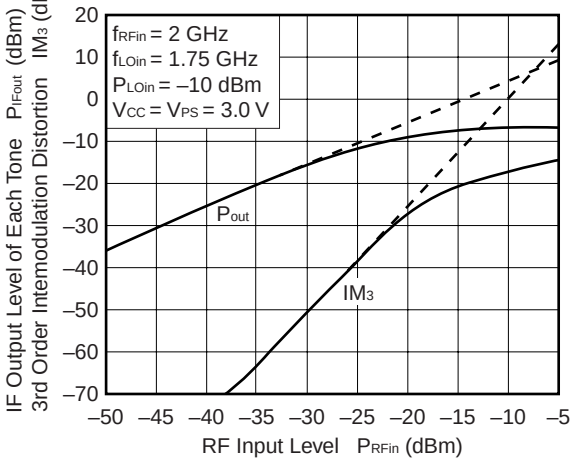


– μPC2757TB –

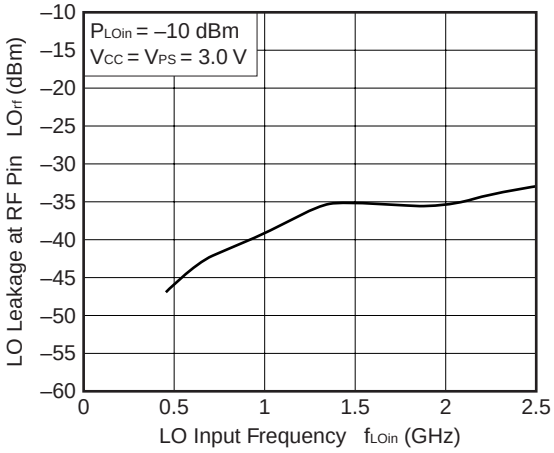
IF OUTPUT LEVEL, 3rd ORDER INTERMODULATION DISTORTION vs. RF INPUT LEVEL



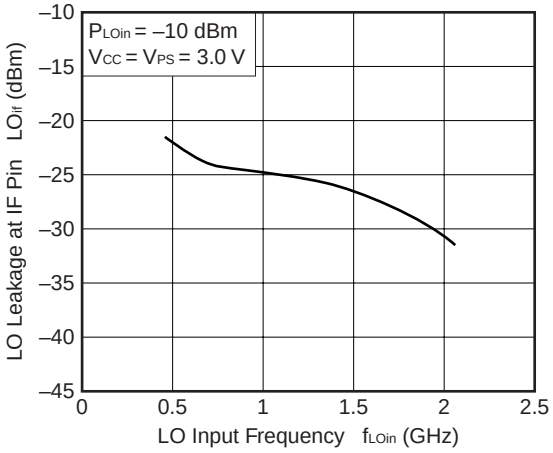
IF OUTPUT LEVEL, 3rd ORDER INTERMODULATION DISTORTION vs. RF INPUT LEVEL



LO LEAKAGE AT RF PIN vs. LO INPUT FREQUENCY



LO LEAKAGE AT IF PIN vs. LO INPUT FREQUENCY



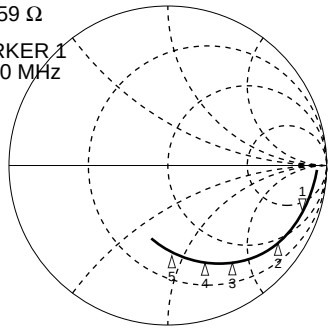
Remark The graphs indicate nominal characteristics.

★ S-PARAMETERS

– μPC2757TB –

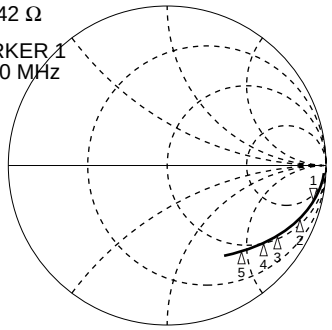
Calibrated on pin of DUT

S11 Z
REF 1.0 Units
1 200.0 mUnits/
56.422 Ω –275.59 Ω
hp
MARKER 1
500.0 MHz



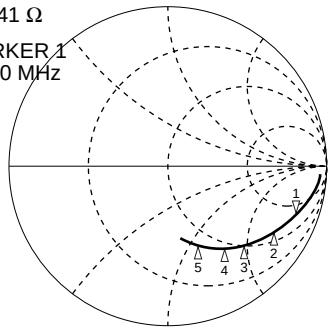
RF PORT
VCC = VPS = 3.0V
1:500 MHz 56.422 Ω -j275.59 Ω
2:900 MHz 38.68 Ω -j152.71 Ω
3:1 500 MHz 31.699 Ω -j88.102 Ω
4:1 900 MHz 29.209 Ω -j65.926 Ω
5:2 500 MHz 29.209 Ω -j44.758 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S11 Z
REF 1.0 Units
1 200.0 mUnits/
104.03 Ω –413.42 Ω
hp
MARKER 1
500.0 MHz



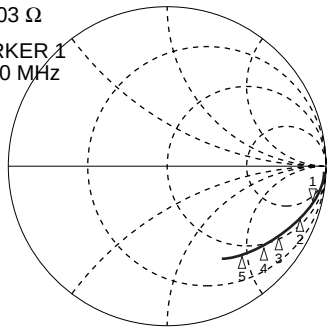
RF PORT
VCC = 3.0V VPS = GND
1:500 MHz 104.03 Ω -j413.42 Ω
2:900 MHz 74.82 Ω -j243.06 Ω
3:1 500 MHz 59.266 Ω -j154.98 Ω
4:1 900 MHz 51.227 Ω -j124.55 Ω
5:2 500 MHz 43.996 Ω -j95.117 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S11 Z
REF 1.0 Units
1 200.0 mUnits/
90.969 Ω –243.41 Ω
hp
MARKER 1
500.0 MHz



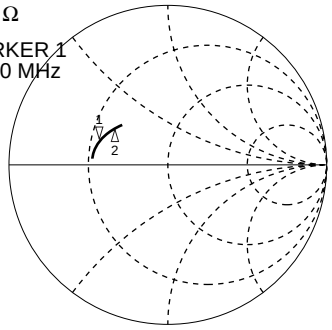
LO PORT
VCC = VPS = 3.0V
1:500 MHz 90.969 Ω -j243.41 Ω
2:900 MHz 67.828 Ω -j150.32 Ω
3:1 500 MHz 51.488 Ω -j97.273 Ω
4:1 900 MHz 44.621 Ω -j77.352 Ω
5:2 500 MHz 39.627 Ω -j56.738 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S11 Z
REF 1.0 Units
1 200.0 mUnits/
114.16 Ω –400.03 Ω
hp
MARKER 1
500.0 MHz



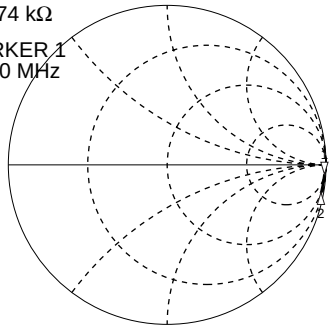
LO PORT
VCC = 3.0V VPS = GND
1:500 MHz 114.16 Ω -j400.03 Ω
2:900 MHz 75.133 Ω -j242.73 Ω
3:1 500 MHz 53.516 Ω -j154.21 Ω
4:1 900 MHz 44.789 Ω -j124.74 Ω
5:2 500 MHz 37.004 Ω -j93.828 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S22 Z
REF 1.0 Units
1 200.0 mUnits/
19.146 Ω 7.2041 Ω
hp
MARKER 1
130.0 MHz



IF PORT
VCC = VPS = 3.0V
1:130 MHz 19.146 Ω -j7.2041 Ω
2:250 MHz 22.73 Ω -j12.909 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S22 Z
REF 1.0 Units
1 200.0 mUnits/
066.38 Ω –1.3174 kΩ
hp
MARKER 1
130.0 MHz

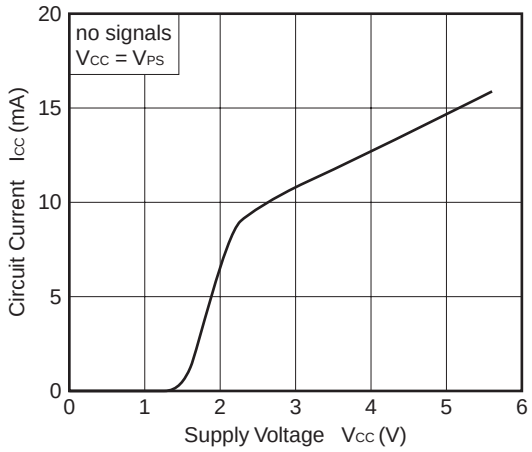


IF PORT
VCC = 3.0V VPS = GND
1:130 MHz 66.38 Ω -j1.3174 kΩ
2:250 MHz 88.281 Ω -j725.41 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

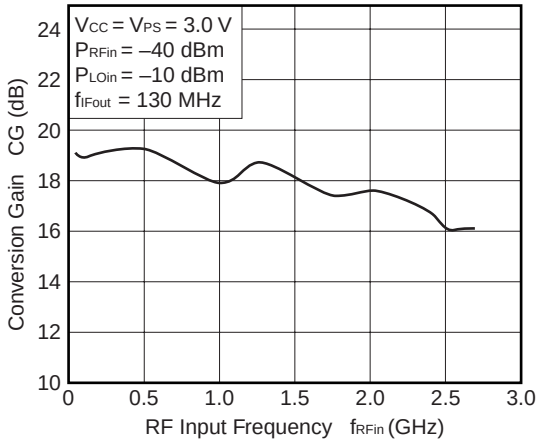
★ TYPICAL CHARACTERISTICS (T_A = +25°C, on Measurement Circuit)

– μPC2758TB –

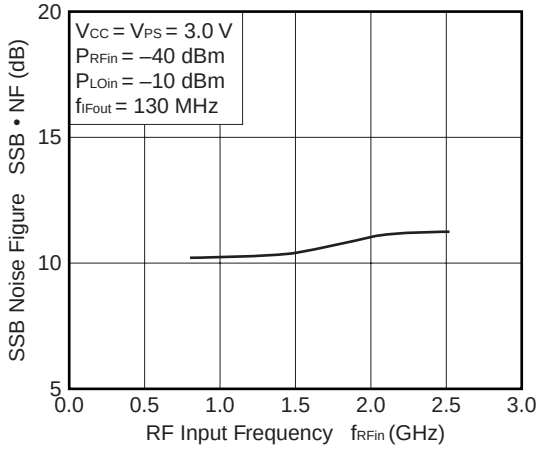
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



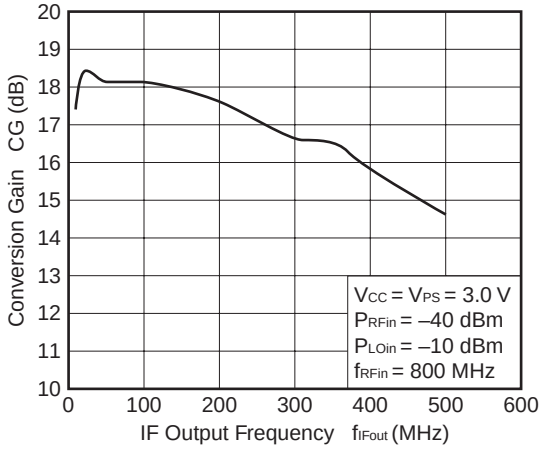
CONVERSION GAIN vs. RF INPUT FREQUENCY



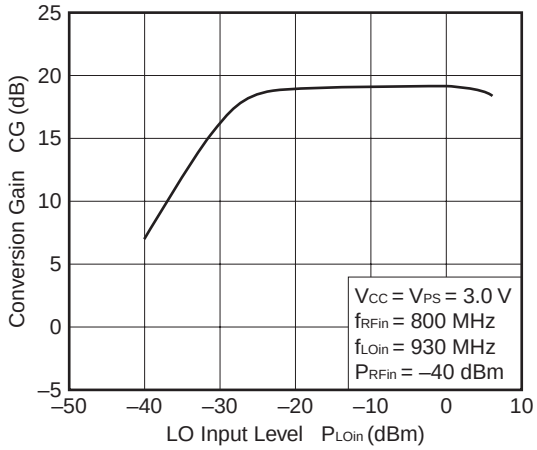
SSB NOISE FIGURE vs. RF INPUT FREQUENCY



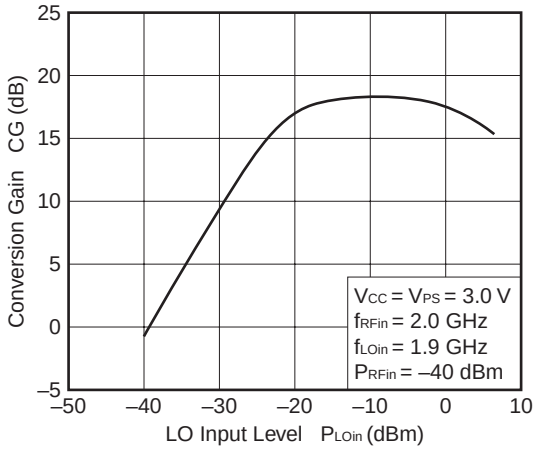
CONVERSION GAIN vs. IF OUTPUT FREQUENCY



CONVERSION GAIN vs. LO INPUT LEVEL

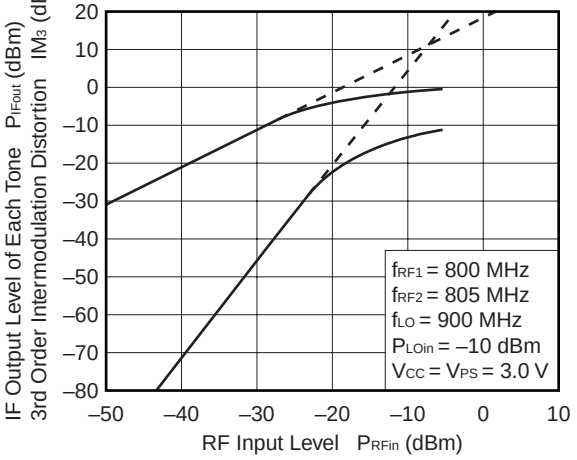


CONVERSION GAIN vs. LO INPUT LEVEL

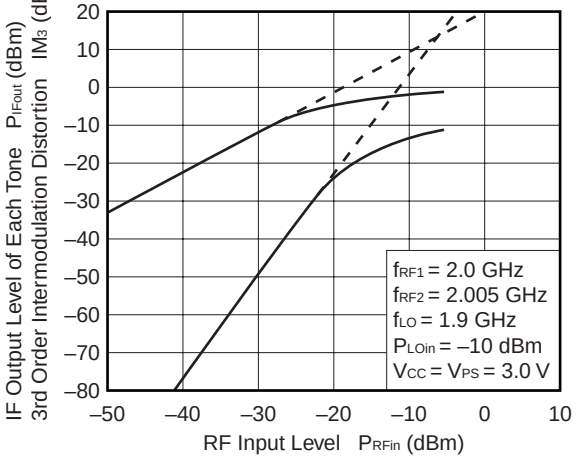


– μPC2758TB –

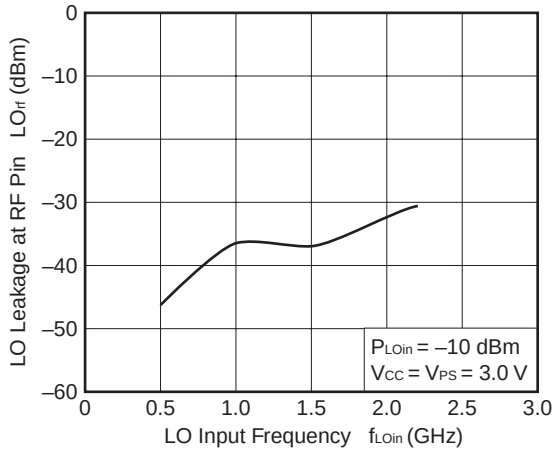
IF OUTPUT LEVEL, 3rd ORDER INTERMODULATION DISTORTION vs. RF INPUT LEVEL



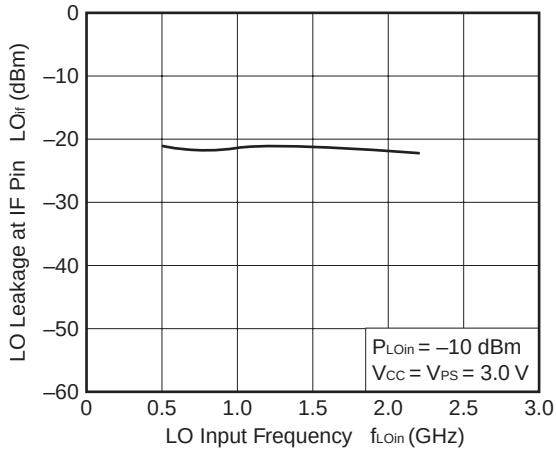
IF OUTPUT LEVEL, 3rd ORDER INTERMODULATION DISTORTION vs. RF INPUT LEVEL



LO LEAKAGE AT RF PIN vs. LO INPUT FREQUENCY



LO LEAKAGE AT IF PIN vs. LO INPUT FREQUENCY



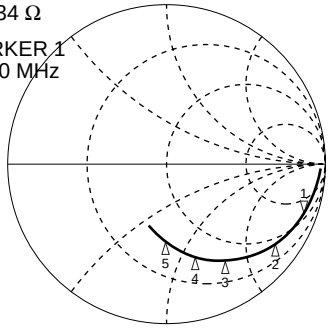
Remark The graphs indicate nominal characteristics.

★ S-PARAMETERS

– μPC2758TB –

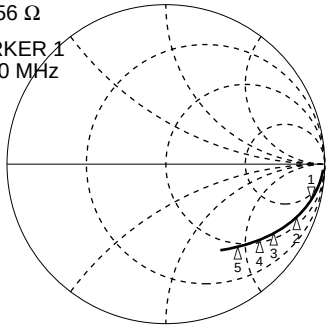
Calibrated on pin of DUT

S11 Z
REF 1.0 Units
1 200.0 mUnits/
hp 63.312 Ω –261.34 Ω
MARKER 1
500.0 MHz



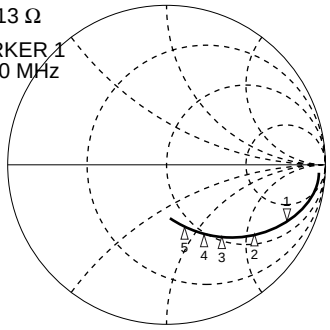
RF PORT
V_{CC} = V_{PS} = 3.0V
1:500 MHz 63.312 Ω -j261.34 Ω
2:900 MHz 40.227 Ω -j142.36 Ω
3:1 500 MHz 32.441 Ω -j79.68 Ω
4:1 900 MHz 31.107 Ω -j58.273 Ω
5:2 500 MHz 30.871 Ω -j39.08 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S11 Z
REF 1.0 Units
1 200.0 mUnits/
hp 107.13 Ω –395.56 Ω
MARKER 1
500.0 MHz



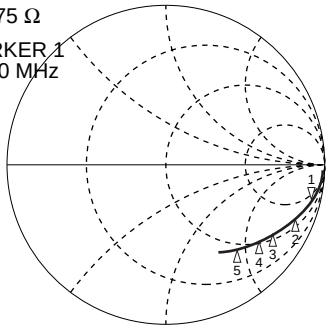
RF PORT
V_{CC} = 3.0V V_{PS} = GND
1:500 MHz 107.13 Ω -j395.56 Ω
2:900 MHz 78.711 Ω -j234.41 Ω
3:1 500 MHz 61.922 Ω -j148.82 Ω
4:1 900 MHz 52.629 Ω -j119.55 Ω
5:2 500 MHz 44.766 Ω -j90.578 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S11 Z
REF 1.0 Units
1 200.0 mUnits/
hp 73.398 Ω –188.13 Ω
MARKER 1
500.0 MHz



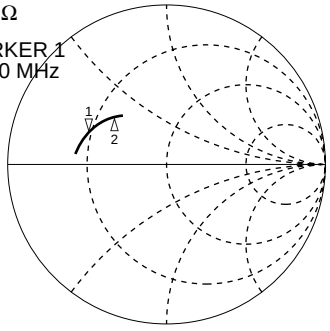
LO PORT
V_{CC} = V_{PS} = 3.0V
1:500 MHz 73.398 Ω -j188.13 Ω
2:900 MHz 64.551 Ω -j112.66 Ω
3:1 500 MHz 53.133 Ω -j72.941 Ω
4:1 900 MHz 48.111 Ω -j57.307 Ω
5:2 500 MHz 44.541 Ω -j41.564 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S11 Z
REF 1.0 Units
1 200.0 mUnits/
hp 100.31 Ω –374.75 Ω
MARKER 1
500.0 MHz



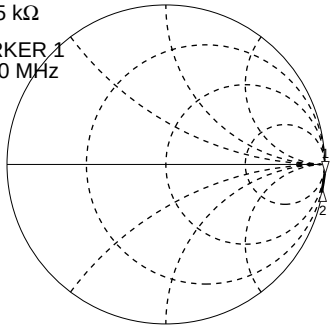
LO PORT
V_{CC} = 3.0V V_{PS} = GND
1:500 MHz 100.31 Ω -j374.75 Ω
2:900 MHz 73.148 Ω -j223.07 Ω
3:1 500 MHz 57.719 Ω -j144.02 Ω
4:1 900 MHz 50.738 Ω -j119.52 Ω
5:2 500 MHz 41.836 Ω -j90.25 Ω
START 0.050000000 GHz
STOP 3.000000000 GHz

S22 Z
REF 1.0 Units
1 200.0 mUnits/
hp 15.696 Ω 9.5011 Ω
MARKER 1
130.0 MHz



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

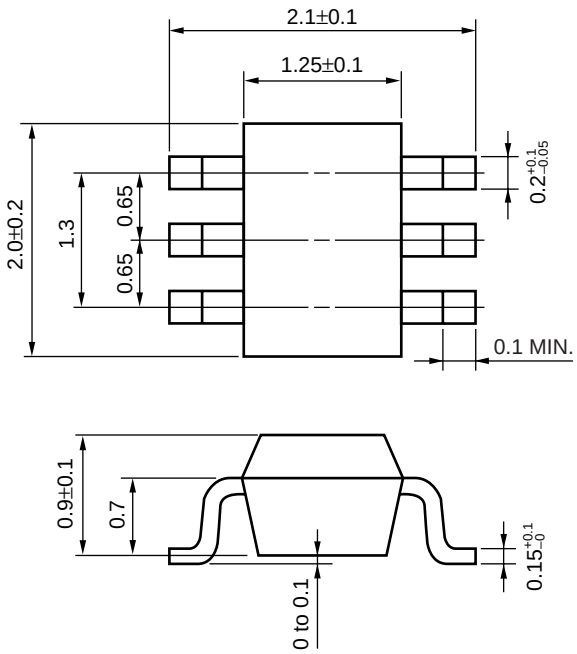
S22 Z
REF 1.0 Units
1 200.0 mUnits/
hp 106.69 Ω –1.3425 kΩ
MARKER 1
130.0 MHz



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

NESAT (NEC Silicon Advanced Technology) is a trademark of NEC Corporation.

- **The information in this document is current as of June, 2000. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.**
- No part of this document may be copied or reproduced in any form or by any means without prior written consent of NEC. NEC assumes no responsibility for any errors that may appear in this document.
- NEC does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from the use of NEC semiconductor products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of customer's equipment shall be done under the full responsibility of customer. NEC assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC endeavours to enhance the quality, reliability and safety of NEC semiconductor products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC semiconductor products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment, and anti-failure features.
- NEC semiconductor products are classified into the following three quality grades:
  "Standard", "Special" and "Specific". The "Specific" quality grade applies only to semiconductor products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of a semiconductor product depend on its quality grade, as indicated below. Customers must check the quality grade of each semiconductor product before using it in a particular application.

  "Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

  "Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

  "Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.

  The quality grade of NEC semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.

  (Note)

  (1) "NEC" as used in this statement means NEC Corporation and also includes its majority-owned subsidiaries.

  (2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).

M8E 00.4