

BIPOLAR ANALOG INTEGRATED CIRCUIT

μ PC2753GR

IF DOWN-CONVERTER IC FOR 3 V GPS RECEIVER

The μ PC2753GR is a monolithic IC designed as IF down-converter for GPS receivers. This IF down-converter IC features high gain and the GC (gain control) function, and operates on 3 volts typ. Therefore, this IC is suitable for enhancing the performance and reducing the power consumption of user's application sets.

This IC is packaged in a 20-pin shrink SOP that enables high-density surface mounting.

The μ PC27 $\times\times$ series is manufactured using NEC original silicon bipolar process technology called "NESATTM III" ($f_T = 20$ GHz). This process technology includes direct silicon nitride film and gold electrode structure. Semiconductor chips produced with this technology have excellent moisture resistivity, anticorrosion, current characteristics, and high-frequency performance. As a result, this IC features excellent reliability and electrical characteristics.

FEATURES

- Low power operation: power supply $V_{CC} = 3.0$ V typ.
- Low power consumption: $I_{CCTOTAL} = 6.5$ mA typ.
- High gain of 79 dB in total: 38 dB typ. in down-converter block ($V_{GC} \leq 12$ V), and 41 dB typ. in 2nd IF amplifier block
- GC function: GC dynamic range (D_{GC}) = 19 dB typ.
- Available in 20-pin shrink SOP : enabling high-density surface mount

ORDERING INFORMATION

Part Number	Package	Packing Style
μ PC2753GR-E1	20-pin plastic Shrink SOP (225 mil)	Embossed tape 12-mm wide. No. 1 pin is in pull-out direction. 2500 pieces/reel
μ PC2753GR-E2	20-pin plastic Shrink SOP (225 mil)	embossed tape 12-mm wide. No. 1 pin is in roll-in direction. 2500 pieces/reel

Remark To order evaluation samples, please contact local NEC sales representative, mentioning " μ PC2753GR."

Caution electro-static sensitive device

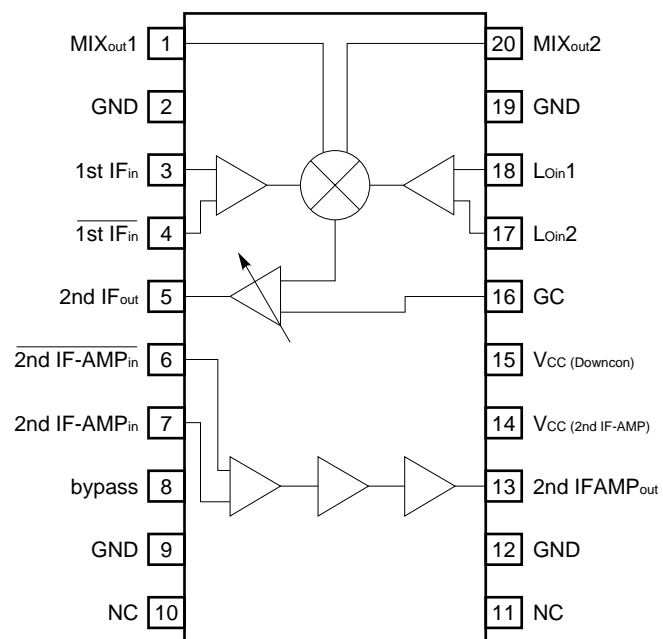
The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

PRODUCT LINE-UP ($T_A = +25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.0\text{ V}$)

Type	Part Number	I_{CC} (mA)	Gain (dB)	SSB NF (dB)	f_{in} (GHz)
RF Down-converter	μ PC2756T	6	14	12	0.1 - 2.0
IF Down-converter	μ PC2753GR	6.5	60 to 79 ^{Note}	12	DC - 0.4

Remark Typical values of major parameters. For test conditions, refer to Electrical Characteristics Tables.

Note $V_{GC} = 0$ to 2.4 V

PIN CONFIGURATION AND BLOCK DIAGRAM (Top View)

PIN FUNCTION

Pin No.	Symbol	Pin Voltage (V)	Description	Equivalent Circuit
3	1st IF _{in}	2.5	No. 3 pin is the input pin of the 1st IF amplifier. No. 4 pin should be connected to GND via a bypass capacitor.	
4	1st IF _{in}	2.5		
5	2nd IF _{out}	1.1	No. 5 pin is the output pin of the 2nd IF. The output signal comes from the mixer unit via the GC amplifier. This output pin features low impedance because of its emitter-follower output port.	
6	2ndIF-AMP _{in}	2.1	No. 6 and 7 pins are the input pins of the 2nd IF amplifier. These two inputs are internally connected to each base of the pair transistors of the differential amplifier. No.6 pin should be connected to GND via a bypass capacitor.	
7	2ndIF-AMP _{in}	2.1		
8	bypass	2.1	No. 8 pin is connected to the feedback loop of the 2nd IF amplifier. This pin should be connected to GND via a bypass capacitor to stabilize the DC bias.	
13	2ndIF-AMP _{out}	1.4	No. 13 pin is the output pin of the 2nd IF amplifier. This output pin features low impedance because of its emitter-follower output port.	

PIN FUNCTION

Pin No.	Symbol	Pin Voltage (V)	Description	Equivalent Circuit
16	GC	0 to 2.4 (Supply voltage)	No. 16 pin is the gain control pin for the GC amplifier. The gain of the GC amplifier is controlled by the applied voltage of this pin. This GC amplifier functions as a reverse GC.	
17	Lo2	2.5	No. 17 and 18 pins are the local input pins of the mixer. The Lo2 pin should be connected to GND via a bypass capacitor.	
18	Lo1	2.5		
15	V _{CC} (Downcon)	—	No. 15 pin is the V _{CC} supply pin for the IF down-converter block. This pin is independent of the V _{CC} pin for the IF amplifier. Apply 3 V to the No. 15 pin.	—
14	V _{CC} (2nd IF-AMP)	—	No. 14 pin is the V _{CC} supply pin for the 2nd IF amplifier. This pin is independent of the V _{CC} pin for the IF down-converter unit. Apply 3 V to the No. 16 pin.	—
2 9 12 19	GND	—	This pin is the ground pin for the entire chip. Therefore the ground of the IF down-converter and 2nd IF amplifier blocks are not separated. The ground pattern to be connected to this pin should be formed as wide as possible to minimize its impedance.	—
10 11	NC	—	No. 10 and 11 pins are not connected to the internal circuits. Connecting these pins to GND is recommended, though these pins may be left unconnected.	—
1	MIX _{out1}	—	No. 1 and 20 pins are the output pins of the mixer block. These pins are used to monitor the signal output from the 2nd IF amplifier and to be input to the GC amplifier. When this IC is actually used, these pins should be left opened.	—
20	MIX _{out2}			

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage	V_{CC}	$T_A = +25\text{ }^{\circ}\text{C}$	4.0	V
Gain control Voltage	V_{GC}	$T_A = +25\text{ }^{\circ}\text{C}$	4.0	V
Power Dissipation	P_D	When mounted on double-sided copper clad epoxy glass board of 50 x 50 x 1.6 mm, $T_A = +85\text{ }^{\circ}\text{C}$	34	mW
Operating Ambient Temperature	T_{opt}		-40 to +85	$^{\circ}\text{C}$
Storage Temperature	T_{stg}		-55 to +150	$^{\circ}\text{C}$

Recommended Operating Conditions

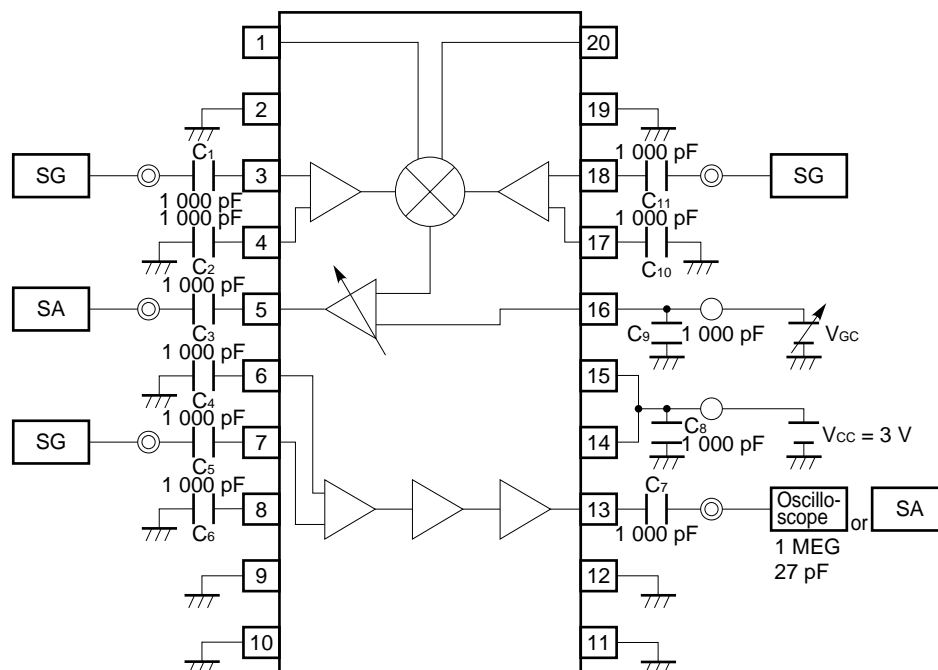
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}	2.7	3.0	3.3	V
Operating Ambient Temperature	T_{opt}	-40	+25	+85	$^{\circ}\text{C}$
Lo Input Level	P_{LoIn}	-20	-	0	dBm

Electrical Characteristics (Unless otherwise specified, $T_A = +25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.0\text{ V}$, $Z_s = Z_o = 50\text{ }\Omega$)

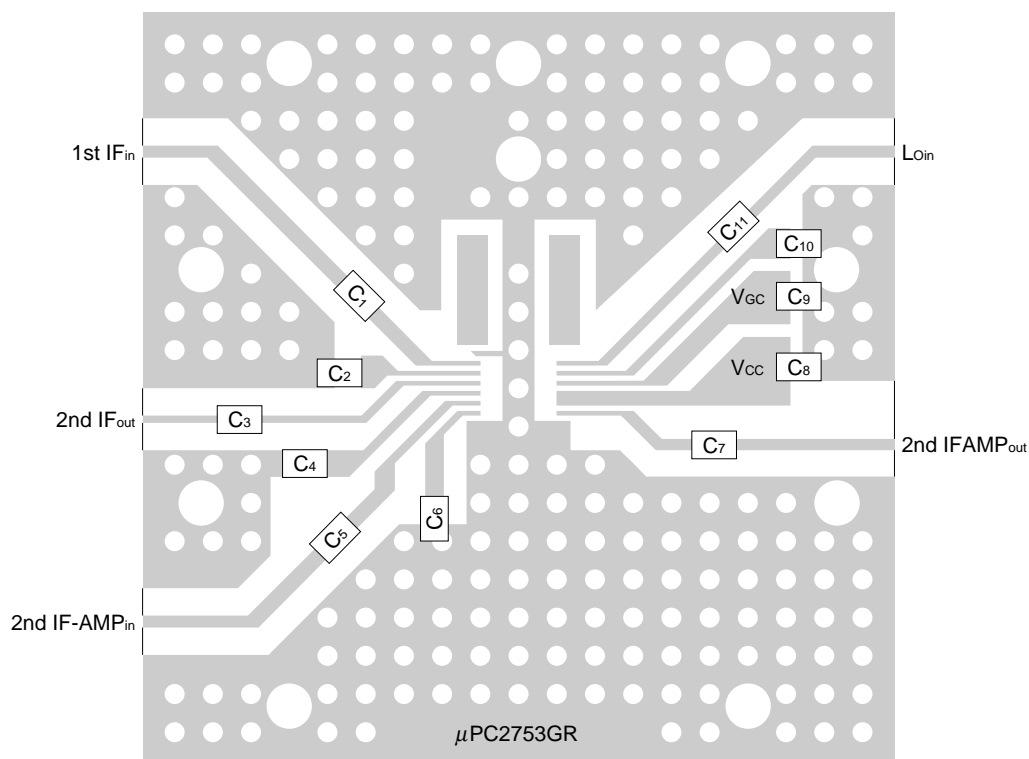
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	$I_{CC\text{ TOTAL}}$	No signal, $V_{GC} = \text{GND}$	4.7	6.9	8.5	mA
(1) IF Down-converter Block						
1st IF Input Frequency	$f_{1st\text{ IFIn}}$	Within -3 dB from CG at $f_{1st\text{ IFIn}} = 50\text{ MHz}$ $f_{1st\text{ IFout}} = 4\text{ MHz}$, $V_{GC} = \text{GND}$	DC		400	MHz
2nd IF Output Frequency	$f_{2nd\text{ IFout}}$	Within -3 dB from CG at $f_{1st\text{ IFIn}} = 200\text{ MHz}$ $f_{1st\text{ IFIn}} = 200\text{ MHz}$, $V_{GC} = \text{GND}$	DC		20	MHz
Conversion Gain	C.G	$f_{1st\text{ IFIn}} = 200\text{ MHz}$, $f_{2nd\text{ IFout}} = 4\text{ MHz}$ $V_{GC} = \text{GND}$	35	38	42	dB
Noise Figure	SSB NF	$f_{1st\text{ IFIn}} = 200\text{ MHz}$, $f_{2nd\text{ IFout}} = 20\text{ MHz}$ $V_{GC} = \text{GND}$	-	12	15	dB
* Input VSWR	VSWR1	$f_{1st\text{ IF}} \leq 400\text{ MHz}$		1.5 : 1		
* Lo Leak to 2nd IF output pin	$LO\ 2nd\text{ IFout}$	$f_{LO} = 1\text{ to }400\text{ MHz}$		-62		dBm
* Lo Leak to 1st IF input pin	$LO\ 1st\text{ IFIn}$	$f_{LO} = 1\text{ to }500\text{ MHz}$		-25		dBm
Gain control Voltage	V_{GC}	Voltage at CG = max.			1.2	V
Gain control Dynamic Range	D_{GC}	$f_{1st\text{ IFIn}} = 200\text{ MHz}$, $f_{2nd\text{ IFout}} = 4\text{ MHz}$ $V_{GC} = 1.2\text{ V to }2.4\text{ V}$	15	19		dB
(2) 2nd IF Amplifier Block						
Input Frequency	f_{AMPIn}	Within -3 dB from the gain at $f = 4\text{ MHz}$	DC		20	MHz
Output Voltage	V_{AMPout}	$f = 4\text{ MHz}$, $Z_o = 1\text{ M}\Omega/27\text{ pF}$	350	450	550	mV _{P-P}
Gain	S_{21}	$f = 4\text{ MHz}$	38	41	45	dB

* For reference only

Test Circuit



Footprint of Test Circuit



Legends

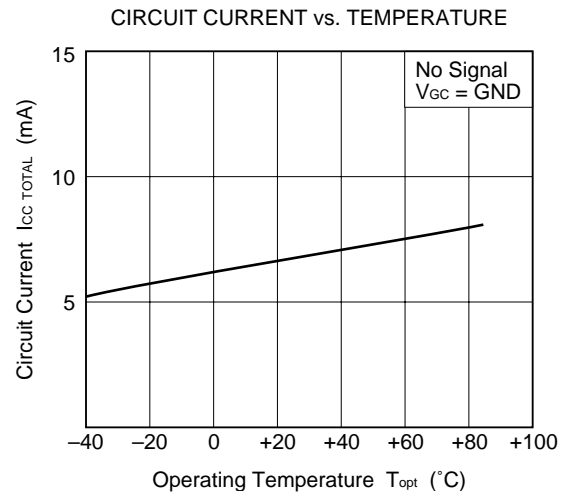
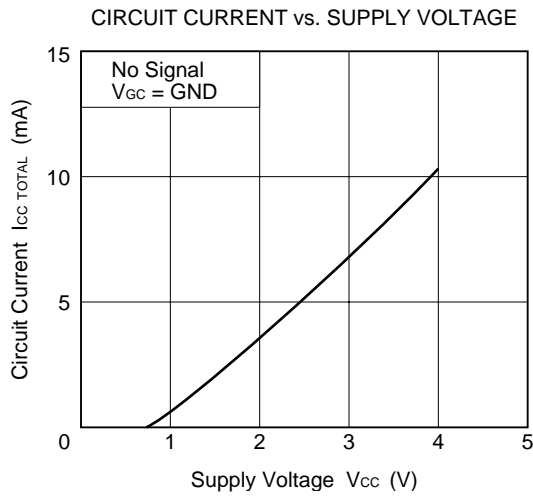
- (*1) Double-sided patterning with 35- μ m-thick copper on polyimide board sizing 50 × 50 × 0.4 mm
- (*2) GND pattern on backside
- (*3) Solder coating over patterns
- (*4) ○○ indicate through-holes

Parts

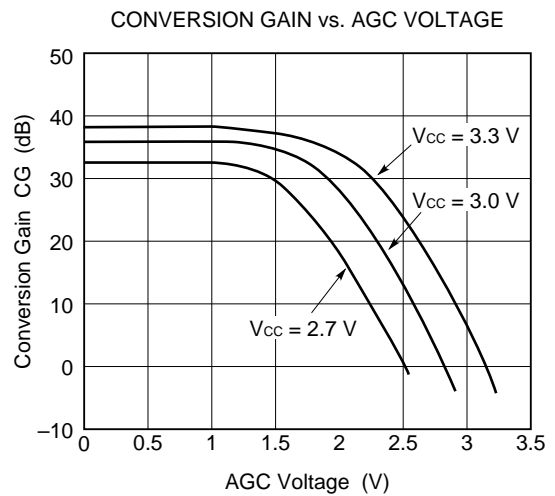
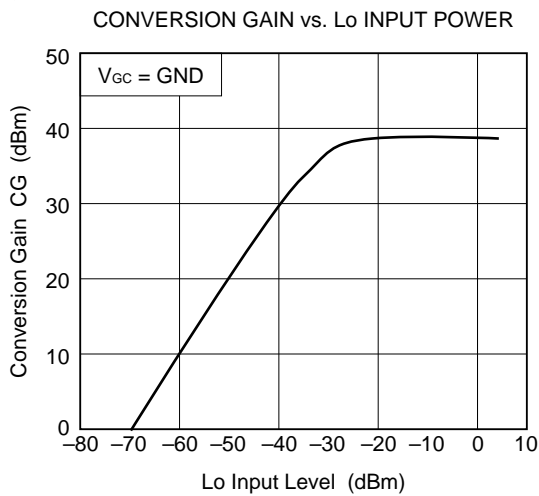
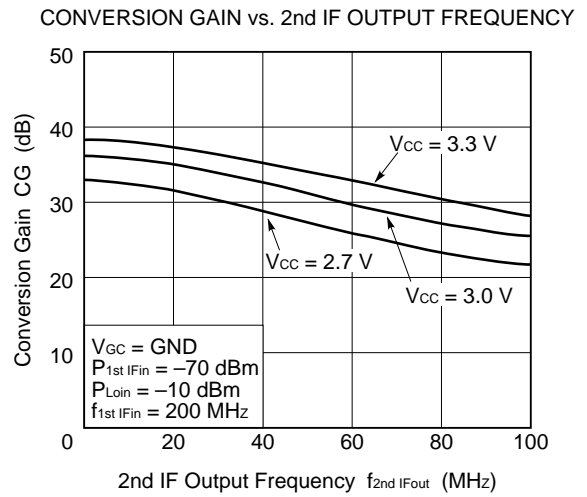
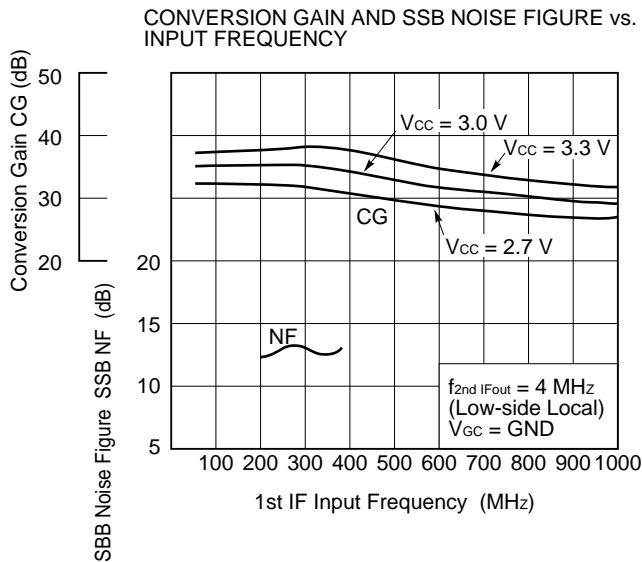
Number	Value
C1 to C11	1 000 pF

Characteristic Curves (Unless otherwise specified, $T_A = +25^\circ\text{C}$, $V_{CC} = 3\text{ V}$)

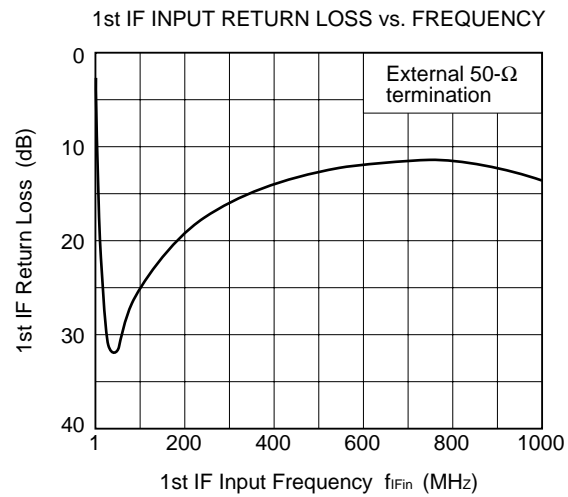
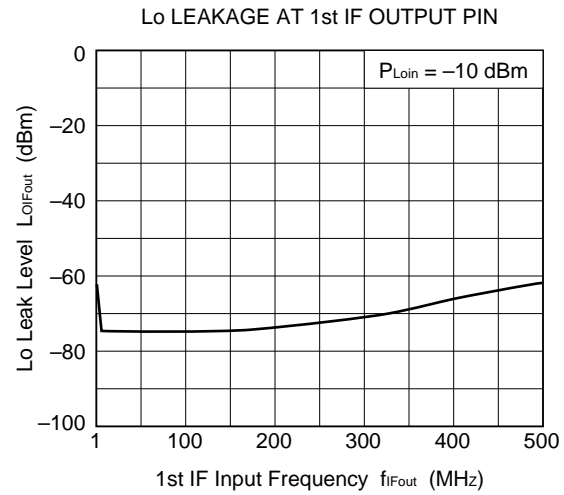
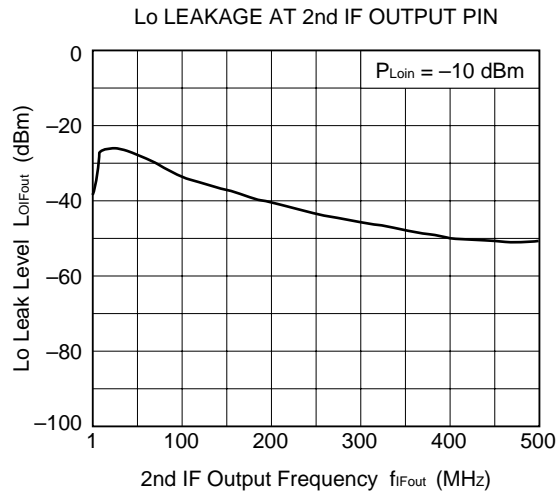
– Entire IC –



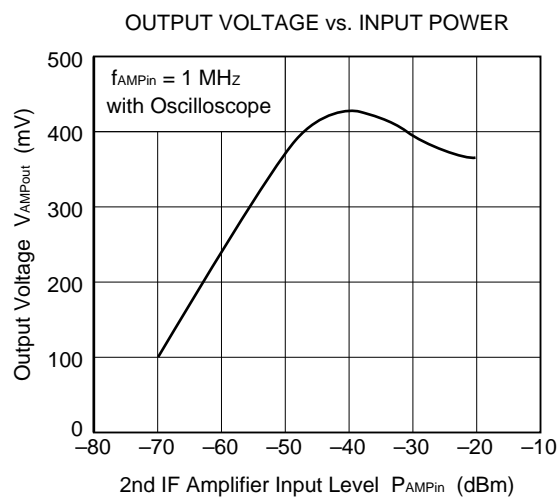
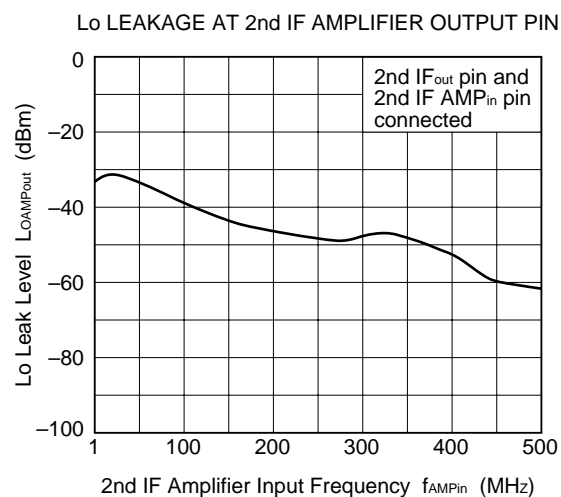
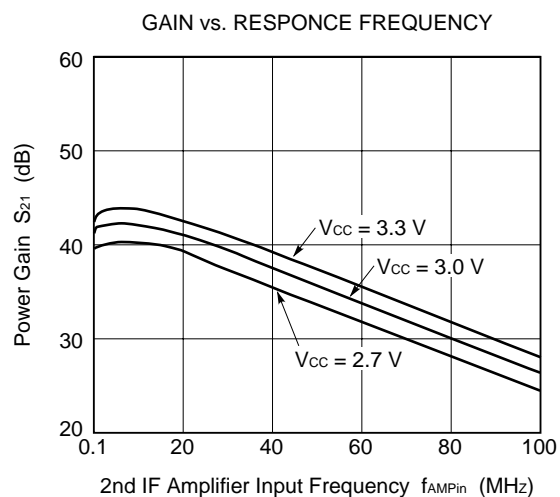
– IF Down-Converter Block –



– IF Down-Converter Block –

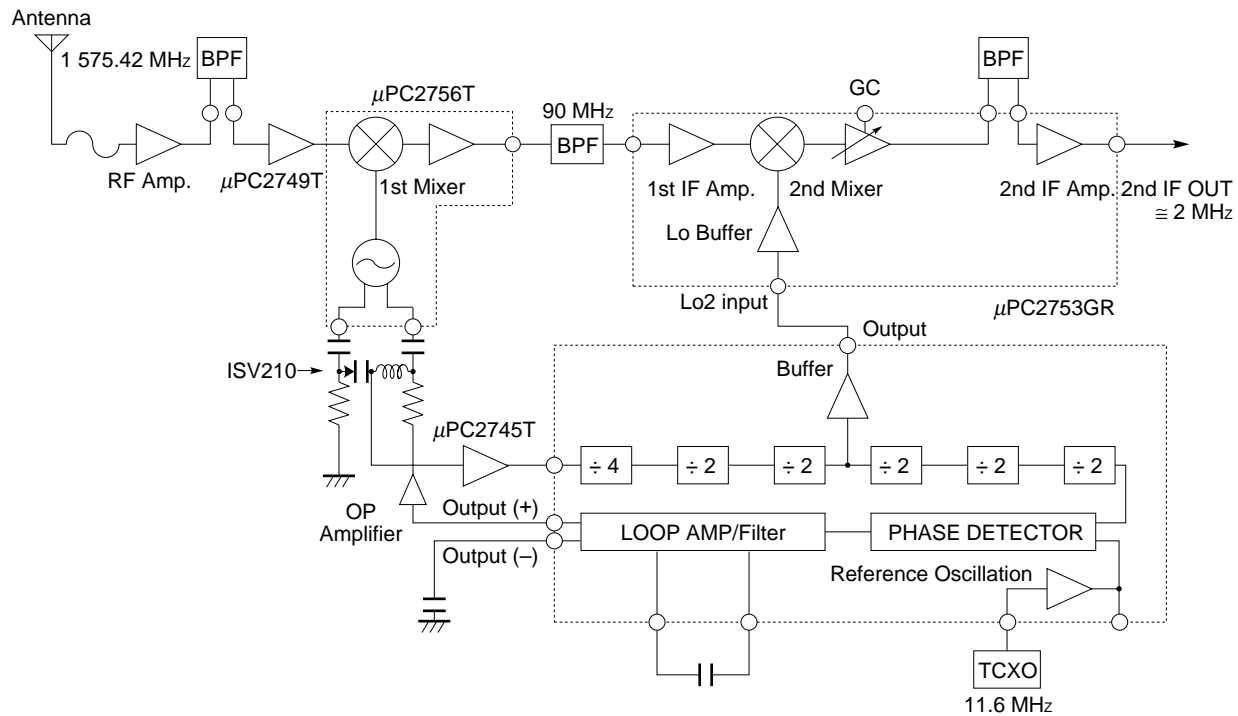


– 2nd IF Amplifier Block –



SYSTEM APPLICATION EXAMPLES: GPS Receiver Schematic

GPS RECEIVER CHIP SET

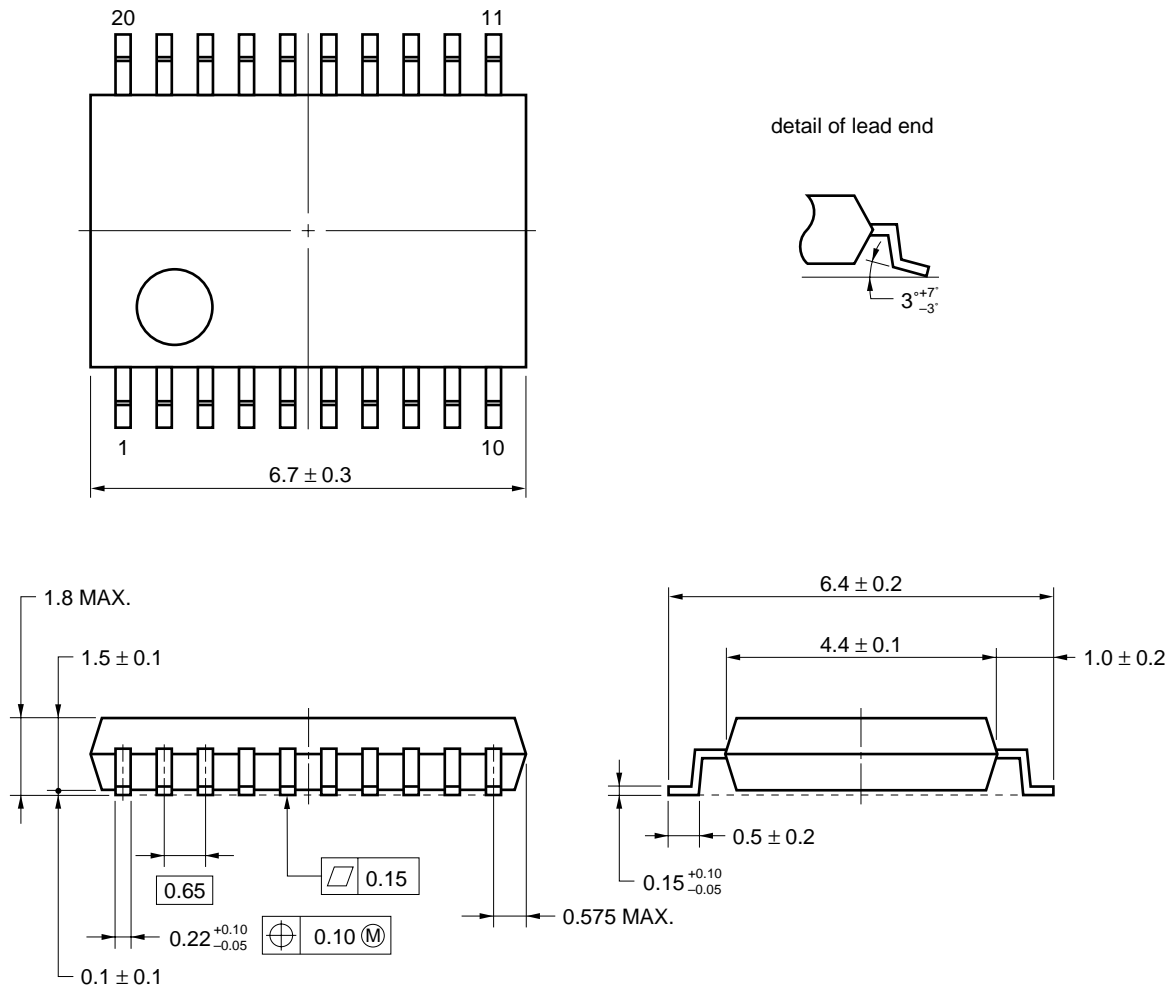


Caution This block diagram schematically represents the chip set product line-up only, and does not imply a detailed application circuit.

For details on the related devices, refer to the latest data sheet of each device.

PACKAGE DIMENSIONS

★ 20 PIN PLASTIC SSOP (225 mil) (UNIT: mm)



NOTE Each lead centerline is located within 0.10 mm of its true position (T.P.) at maximum material condition.

ATTENTION ON USING THIS IC

- (1) Observe precautions for handling because of electrostatic sensitive devices.
- (2) The ground pattern should be designed as wide as possible to minimize its ground impedance. Otherwise, undesired oscillation may occur.
- (3) The track length of the ground pins should be as short as possible.
- (4) A bypass capacitor should be inserted between the V_{cc} pin and the V_{cc} line.

RECOMMENDED SOLDERING CONDITIONS

The following conditions must be met when soldering this product.

Please consult with our sales offices in case other soldering process is used, or in case soldering is done under different conditions.

 μ PC2753GR

Soldering Process	Soldering Conditions	Symbols
Infrared Ray Reflow	Peak temperature of package surface : 235 °C, Reflow time : 30 seconds or less (210 °C or higher), Number of reflow processes : 2, Exposure limit : none ^{Note}	IR35-00-2
VPS	Peak temperature of package surface : 215 °C, Reflow time : 40 seconds or less (200 °C or higher), Number of reflow processes : 2, Exposure limit : none ^{Note}	VP15-00-2
Wave Soldering	Solder temperature : 260 °C or lower, Flow time : 10 seconds or less, Number of reflow processes : 1, Exposure limit : none ^{Note}	WS60-00-1
Partial Heating Method	Pin temperature : 300 °C or lower, Time : 10 seconds or less for each pin, Exposure limit : none ^{Note}	

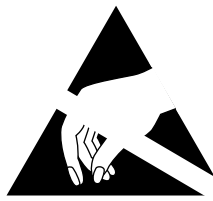
Note Exposure limit before soldering after dry-pack package is opened.
Storage conditions : 25 °C and relative humidity of 65 % or less.

Caution Do not apply more than one soldering method at any one time, except for the partial heating method.

[MEMO]

[MEMO]

[MEMO]

**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 subject to change without notice. Before using this document, please confirm that this is the latest version.**
 - No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.
 - NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation 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 the customer's equipment shall be done under the full responsibility of the customer. NEC Corporation assumes no responsibility for any losses incurred by the customer or third parties arising from the use of these circuits, software, and information.
 - While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.
 - NEC devices are classified into the following three quality grades:
"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device 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 or medical equipment for life support, etc.
- The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.