NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2753GR

IF DOWN-CONVERTER IC FOR 3 V GPS RECEIVER

The μPC2753GR 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 μPC27×× series is manufactured using NEC original silicon bipolar process technology called "NESAT™ 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
μPC2753GR-E1	20-pin plastic Shrink SOP (225 mil)	Embossed tape 12-mm wide. No. 1 pin is in pull-out direction. 2500 pieces/reel
μPC2753GR-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 "μPC2753GR."

Caution electro-static sensitive device

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Printed in Japan

The mark ★ shows major revised points.

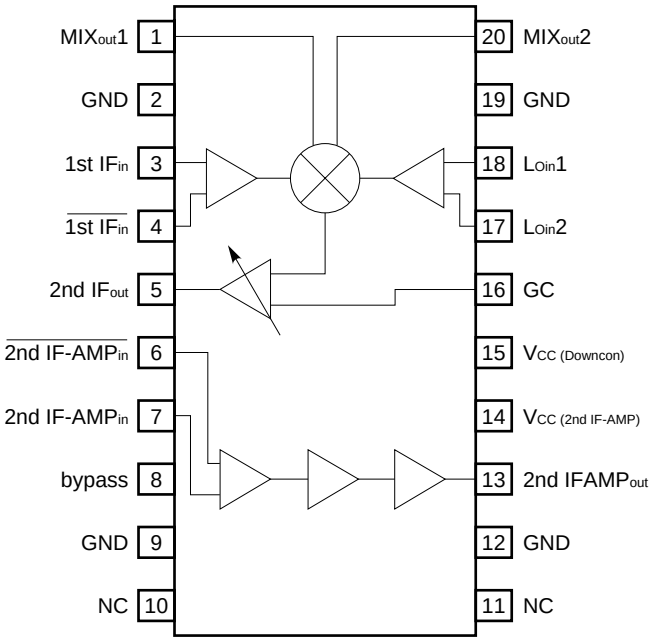
PRODUCT LINE-UP (T_A =+ 25 °C, V_{CC} = 3.0 V)

Type	Part Number	I_{CC} (mA)	Gain (dB)	SSB NF (dB)	f_{in} (GHz)
RF Down-converter	μPC2756T	6	14	12	0.1 - 2.0
IF Down-converter	μPC2753GR	6.5	60 to 79[Note]	12	DC - 0.4

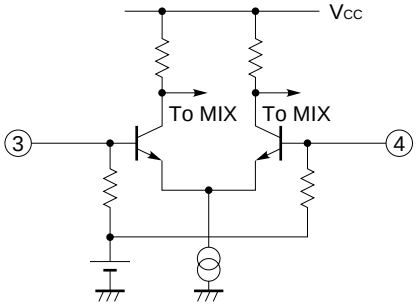
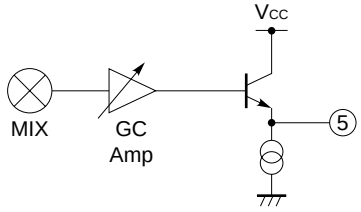
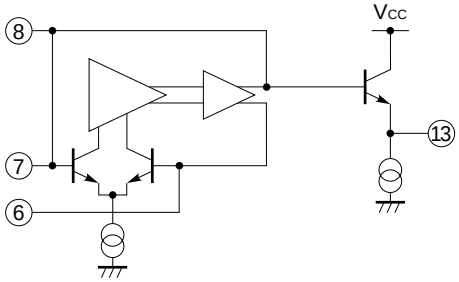
Remark Typical values of major parameters. For test conditions, refer to Electrical Characteristics Tables.

Note V_{GC} = 0 to 2.4 V

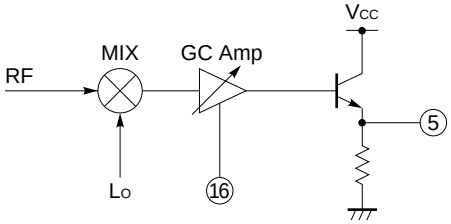
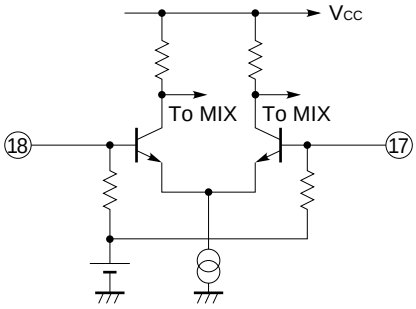
PIN CONFIGURATION AND BLOCK DIAGRAM (Top View)



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	$\overline{\text{1st IF}_{in}}$	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	$\overline{\text{2ndIF-AMP}_{in}}$	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	Vcc (Downcon)	–	No. 15 pin is the Vcc supply pin for the IF down-converter block. This pin is independent of the Vcc pin for the IF amplifier. Apply 3 V to the No. 15 pin.	–
14	Vcc (2nd IF-AMP)	–	No. 14 pin is the Vcc supply pin for the 2nd IF amplifier. This pin is independent of the Vcc 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	$MIX_{out}1$	–	No. 1 and 20 pins are the output pins of the mixer block. These pin 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	$MIX_{out}2$			

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Rating	Unit
Supply Voltage	V_{CC}	T_A = +25 °C	4.0	V
Gain control Voltage	V_{GC}	T_A = +25 °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 °C	34	mW
Operating Ambient Temperature	T_{opt}		–40 to +85	°C
Storage Temperature	T_{stg}		–55 to +150	°C

Recommended Operating Conditions

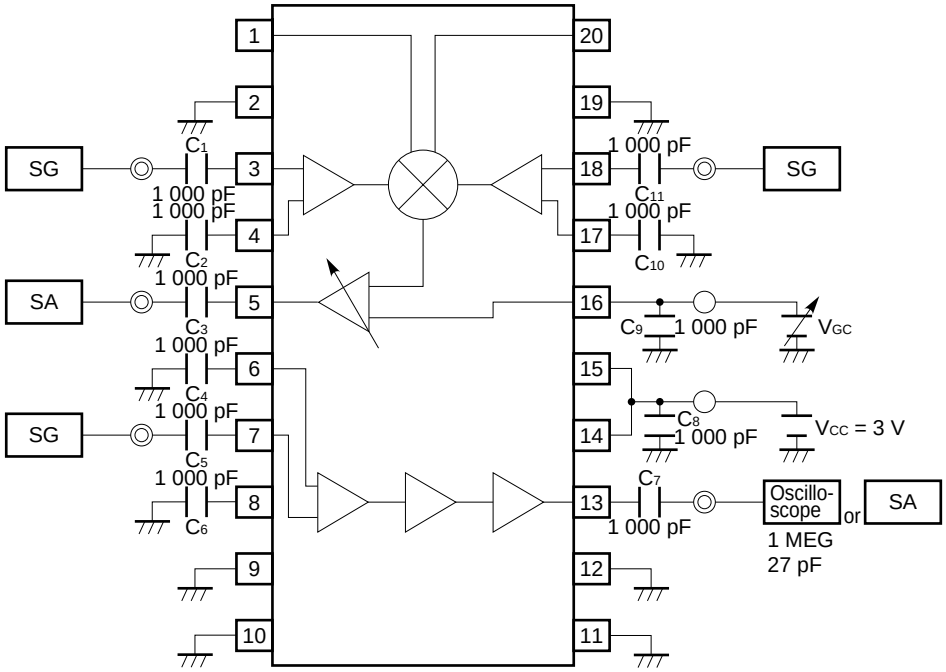
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}	2.7	3.0	3.3	V
Operating Ambient Temperature	T_{opt}	–40	+25	+85	°C
Lo Input Level	P_{Loin}	–20	–	0	dBm

Electrical Characteristics (Unless otherwise specified, T_A = +25 °C, V_{CC} = 3.0 V, Z_s = Zo = 50 Ω)

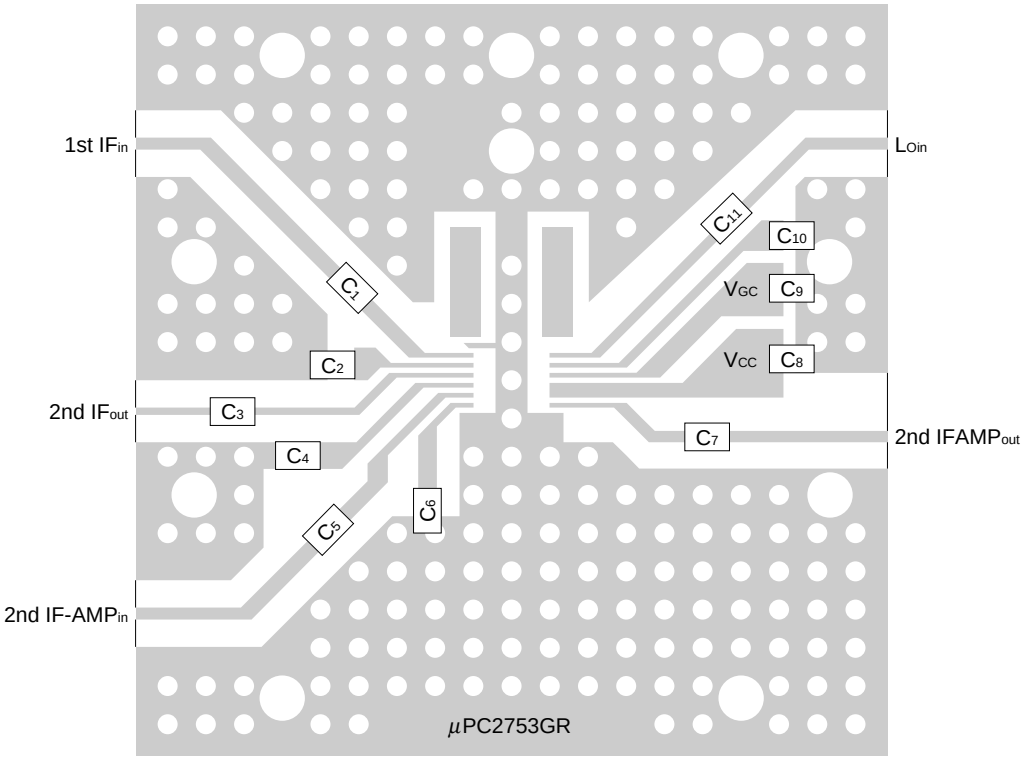
	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
	Circuit Current	$I_{CC\ TOTAL}$	No signal, V_{GC} = GND	4.7	6.9	8.5	mA
	(1) IF Down-converter Block						
	1st IF Input Frequency	$f_{1st\ IFin}$	Within –3 dB from CG at $f_{1st\ IFin}$ = 50 MHz $f_{1st\ IFout}$ = 4 MHz, V_{GC} = GND	DC		400	MHz
	2nd IF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

* For reference only

Test Circuit



Footprint of Test Circuit



Parts

Number	Value
C1 to C11	1 000 pF

Legends

(*1) Double-sided patterning with 35-μm-thick copper on polyhimid board sizing 50 × 50 × 0.4 mm

(*2) GND pattern on backside

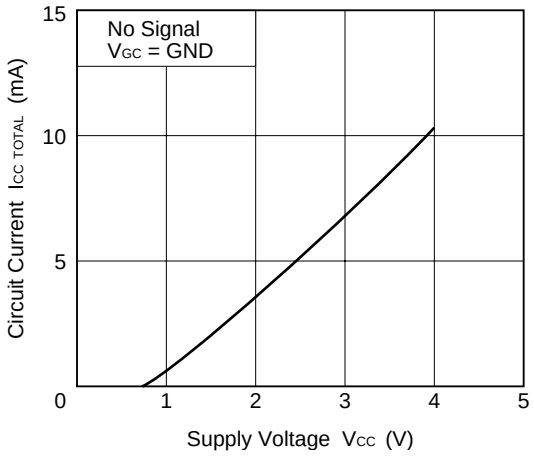
(*3) Solder coating over patterns

(*4) ○○ indicate through-holes

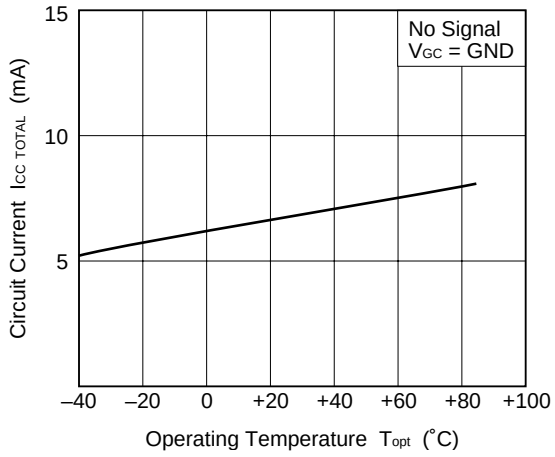
Characteristic Curves (Unless otherwise specified, T_A = +25 °C, V_{CC} = 3 V)

– Entire IC –

CIRCUIT CURRENT vs. SUPPLY VOLTAGE

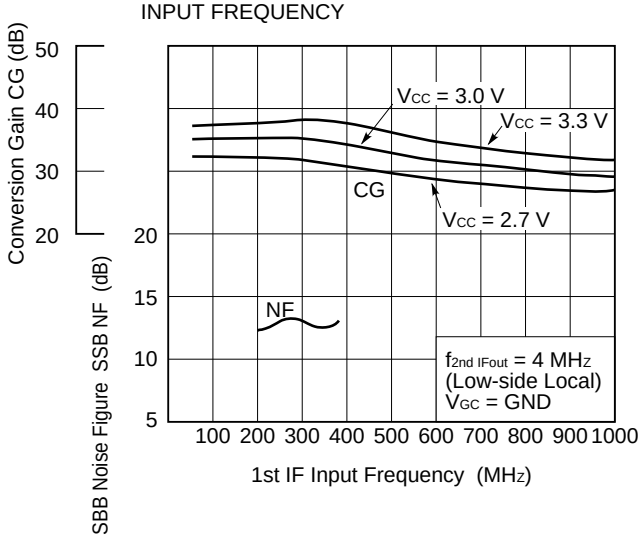


CIRCUIT CURRENT vs. TEMPERATURE

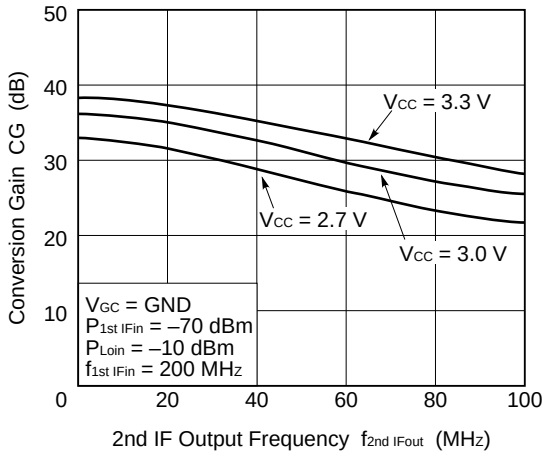


– IF Down-Converter Block –

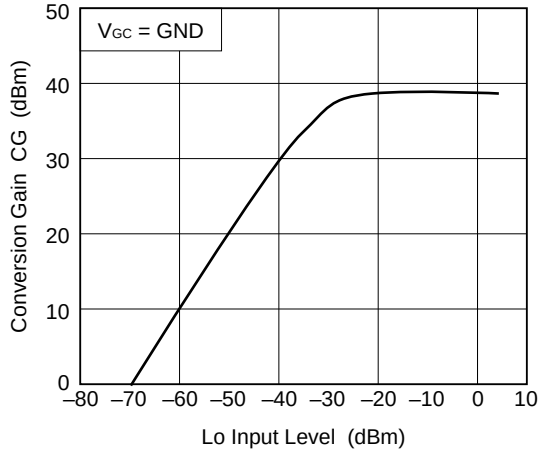
CONVERSION GAIN AND SSB NOISE FIGURE vs. INPUT FREQUENCY



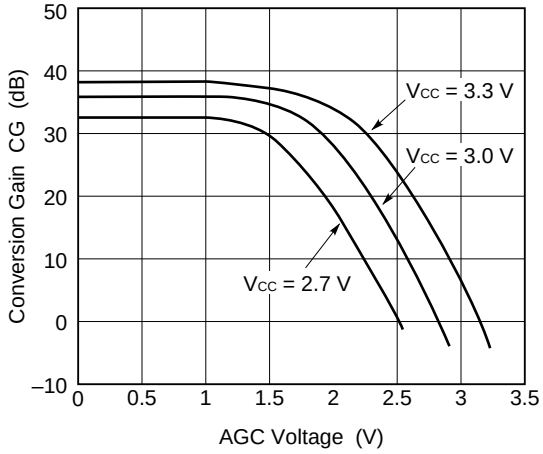
CONVERSION GAIN vs. 2nd IF OUTPUT FREQUENCY



CONVERSION GAIN vs. Lo INPUT POWER

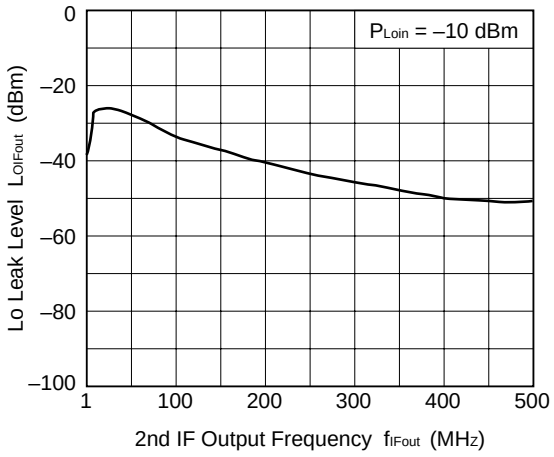


CONVERSION GAIN vs. AGC VOLTAGE

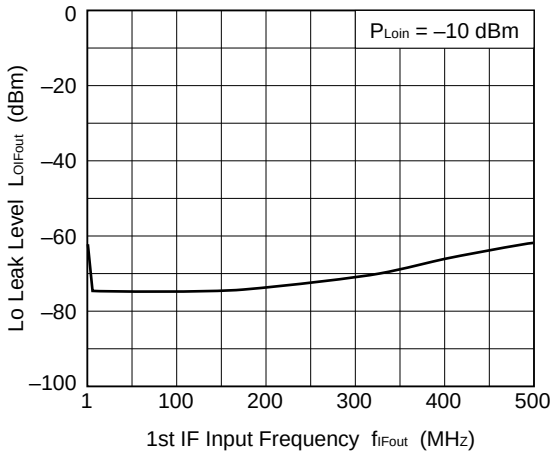


– IF Down-Converter Block –

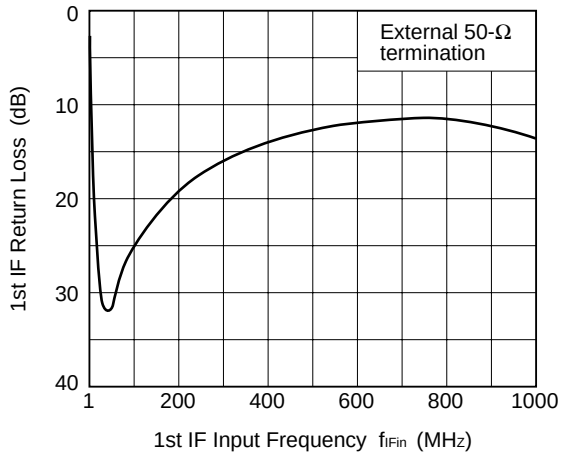
Lo LEAKAGE AT 2nd IF OUTPUT PIN



Lo LEAKAGE AT 1st IF OUTPUT PIN

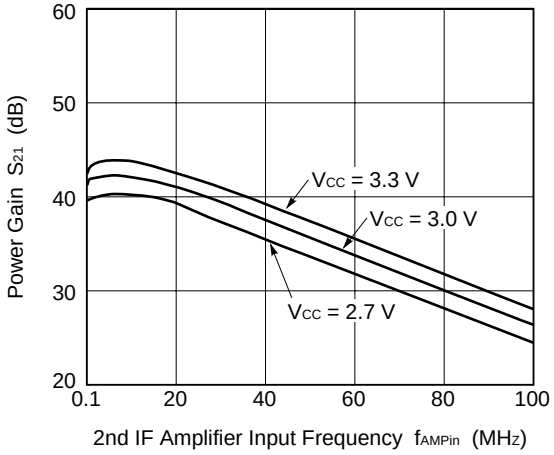


1st IF INPUT RETURN LOSS vs. FREQUENCY

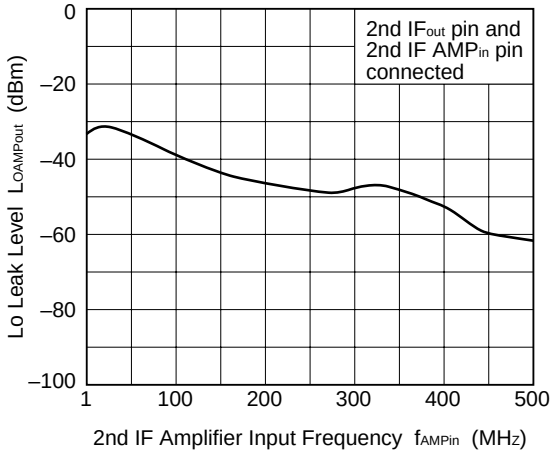


– 2nd IF Amplifier Block –

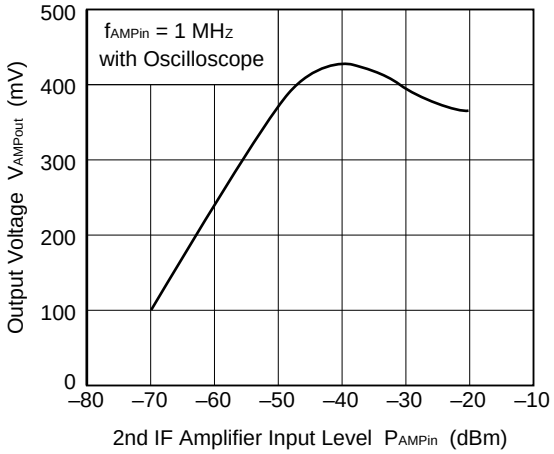
GAIN vs. RESPONCE FREQUENCY



Lo LEAKAGE AT 2nd IF AMPLIFIER OUTPUT PIN

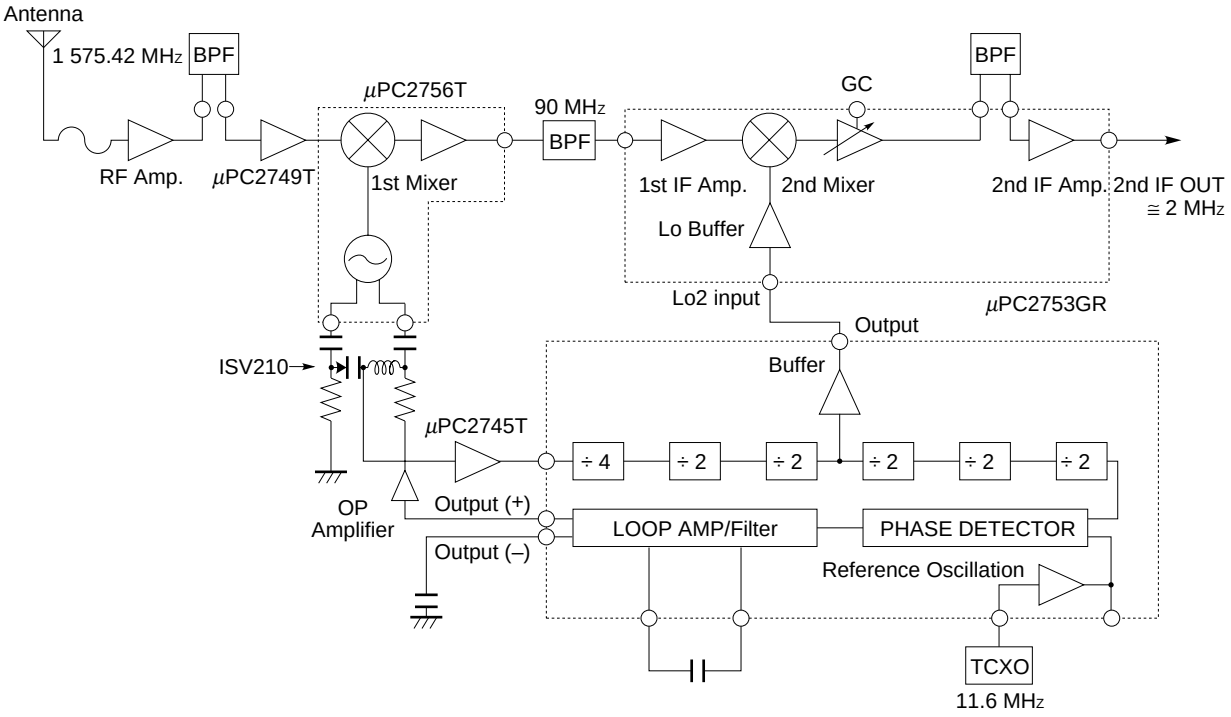


OUTPUT VOLTAGE vs. INPUT POWER



SYSTEM APPLICATION EXAMPLES: GPS Receiver Schematic

GPS RECEIVER CHIP SET

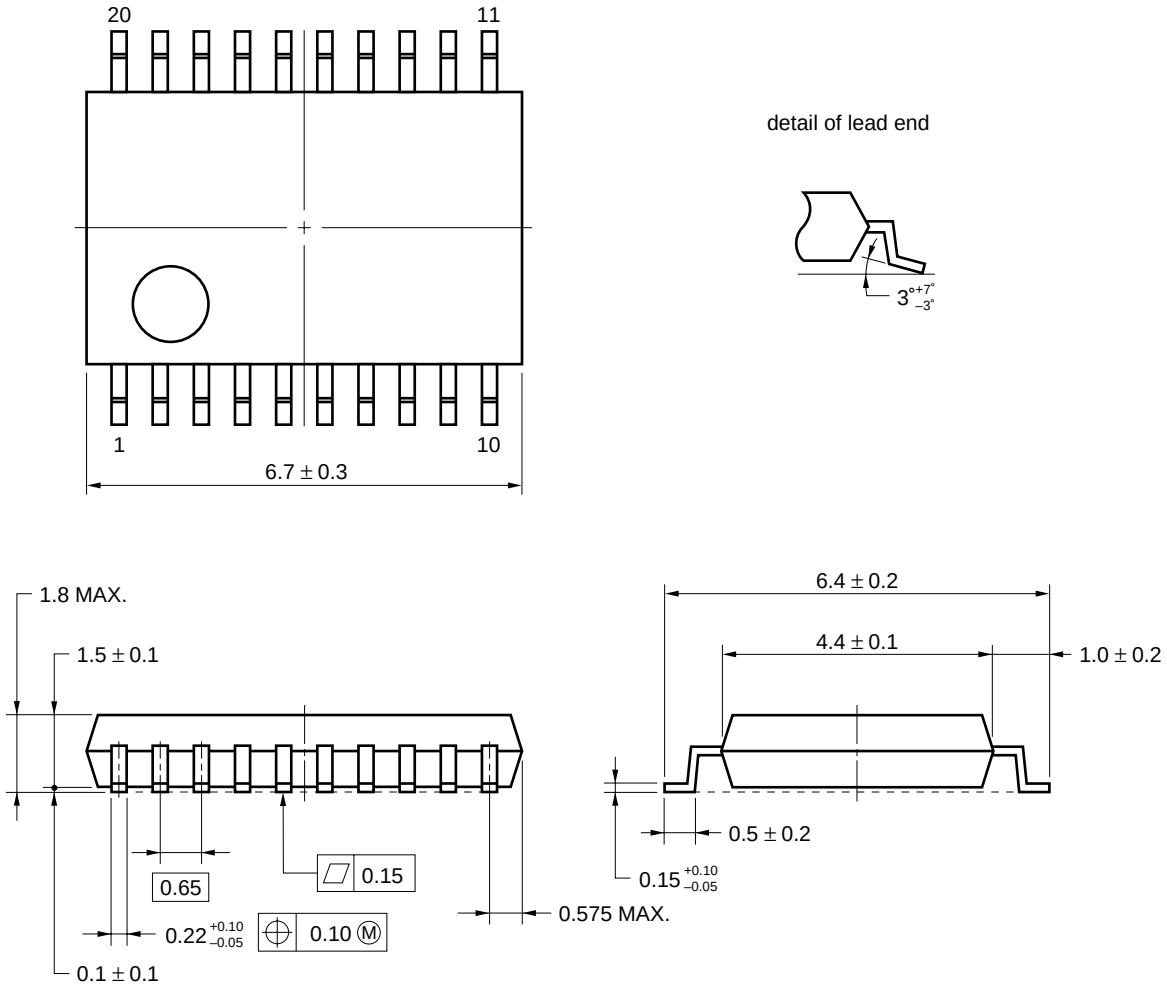


Caution This block diagram schematically represents the chip set product line-up only, and does not imply a detailed application circuit.

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.

μPC2753GR

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]	

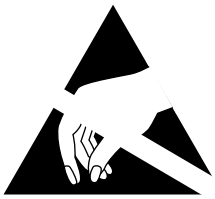
Note Exposure limit before soldering after dry-pack package is opened.
Storage conditions : 25 °C and relative humidity of 65 % or less.

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

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  - 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.

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