

# BIPOLAR ANALOG INTEGRATED CIRCUIT

# $\mu$ PC3200GS

## FREQUENCY DOWN CONVERTER FOR VHF TO UHF BAND TV/VCR TUNER

### DESCRIPTION

The  $\mu$ PC3200GS is a Silicon monolithic IC designed for TV/VCR tuner applications. This IC consists of a double balanced mixer (DBM), local oscillator, preamplifier for prescaler operation, IF amplifier, regulator, UHF/VHF switching circuit, and so on. This one-chip IC covers a wide frequency band from VHF to UHF bands. This IC is packaged in 20-pin SOP (Small Outline Package) suitable for surface mounting.

### FEATURES

- VHF to UHF band operation.
- Low distortion  
CM: VHF (@ $f_{RF}$  = 470 MHz) 96 dB $\mu$   
UHF (@ $f_{RF}$  = 890 MHz) 92 dB $\mu$
- Supply voltage: 9 V
- Packaged in 20-pin SOP suitable for surface mounting

### ORDERING INFORMATION

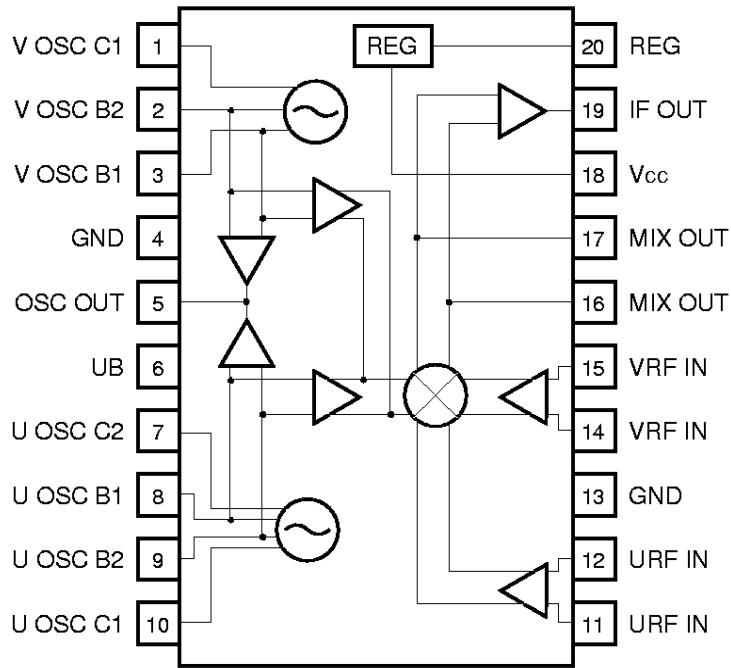
Part Number	Package	Package Style
$\mu$ PC3200GS-E1	20-pin plastic SOP (300 mil)	Embossed tape 24 mm wide. 2.5 k/REEL. Pin 1 indicates pull-out direction of tape.

For evaluation sample order, please contact your local NEC office. (Part number for sample order:  $\mu$ PC3200GS)

**Caution** electro-static sensitive device

The information in this document is subject to change without notice.

INTERNAL BLOCK DIAGRAM AND PIN CONFIGURATION (Top View)



PIN EXPLANATION

Pin No.	Symbol	Pin Voltage TYP. above: VHF mode below: UHF mode	Function and Explanation	Equivalent Circuit	
1	VOSC collector (Tr. 1)	6.20	Collector pin of VHF oscillator. Connected to LC resonator through feedback capacitor $\approx 3$ pF.		
		6.90			
2	VOSC base (Tr. 2)	3.50	Base pin of VHF oscillator. Assemble LC resonator with 1 pin to oscillate with active feedback loop.		
		5.90			
3	VOSC base (Tr. 1)	3.50	Base pin of VHF oscillator. Grounded through capacitor $\approx 10$ pF.		
		5.90			
4	GND	0.0	VHF and UHF oscillator's GND pin.		
		0.0			
5	OSC output	5.85	UHF and VHF oscillator output pin. In case of F/S tuner application, connected PLL synthesizer IC's input pin. Grounded through 1.5 kΩ resistor.		
		5.85			
6	UB	-	Switching pin for VHF or UHF operation. VHF operation = open UHF operation = 9.0 V		
		9.0			
7	UOSC collector (Tr. 2)	6.90	Collector pin of UHF oscillator with balance amplifier. Assemble LC resonator with 8 pin through capacitor $\approx 1$ pF to oscillate with active feedback loop. Double balanced oscillator with transistor 1 and transistor 2.		
		6.25			
8	UOSC base (Tr. 1)	6.00	Base pin of UHF oscillator with balance amplifier. Connected to LC resonator through feedback capacitor $\approx 360$ pF.		
		3.90			
9	UOSC base (Tr. 2)	6.00	Base pin of UHF oscillator with balance amplifier. Connected to LC resonator through feedback capacitor $\approx 360$ pF.		
		3.90			
10	UOSC collector (Tr. 1)	6.90	Collector pin of UHF oscillator. Assemble LC resonator with 9 pin through capacitor $\approx 1$ pF to oscillate with active feedback loop.		
		6.25			

Pin No.	Symbol	Pin Voltage TYP. above: VHF mode below: UHF mode	Function and Explanation	Equivalent Circuit
11	URF input	3.10	URF signal input pin from antenna.	
		3.10		
12	URF input (bypass)	3.10	Bypass pin for UHF MIX input. Grounded through capacitor.	
		3.10		
13	GND	0.0	GND pin of MIX, IF amplifier and regulator.	
		0.0		
14	VRF input	3.10	VRF signal input pin from antenna.	
		3.10		
15	VRF input (bypass)	3.10	Bypass pin for VHF MIX input. Grounded through capacitor.	
		3.10		
16	MIX output 2	7.10	VHF and UHF MIX output pin. These pins should be equipped with tank circuit to adjust intermediate frequency.	
		7.05		
17	MIX output 1	7.10		
		7.05		
18	Vcc	9.0		Power supply pin for VHF-UHF band functions.
		9.0		
19	IF output	2.80	IF output pin of VHF-UHF band functions.	
		2.80		
20	REG	6.90	Monitor pin of regulator output voltage.	
		6.90		

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

Parameter	Symbol	Condition	Rating	Unit
Supply Voltage 1	V <sub>CC</sub>		11.0	V
Supply Voltage 2	UB		11.0	V
Power Dissipation	P <sub>D</sub>	T <sub>A</sub> = 80 °C <sup>Note</sup>	700	mW
Operating Ambient Temperature	T <sub>A</sub>		-40 to +80	°C
Storage Temperature	T <sub>stg</sub>		-60 to +150	°C

**Note** Mounted on 50 × 50 × 1.6 mm double copper epoxy glass board.

**RECOMMENDED OPERATION RANGE**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage 1	V <sub>CC</sub>	8.0	9.0	10.0	V
Supply Voltage 2	UB	8.0	9.0	10.0	V
Operating Ambient Temperature	T <sub>A</sub>	-20	+25	+80	°C

**ELECTRICAL CHARACTERISTICS** ( $T_A = +25\text{ }^\circ\text{C}$ ,  $V_{CC} = 9\text{V}$ ,  $f_{IF} = 45\text{ MHz}$ ,  $P_{osc} = -10\text{ dBm}$ )

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current 1	$I_{CC1}$	@VHF, no input signal <b>Note 1</b>	31.0	38.0	45.0	mA
Circuit Current 2	$I_{CC2}$	@UHF, no input signal <b>Note 1</b>	31.0	38.0	45.0	mA
Conversion Gain 1	CG1	$f_{RF} = 55\text{ MHz}$ , $P_{RF} = -30\text{ dBm}$ <b>Note 2</b>	18.5	22.0	25.5	dB
Conversion Gain 2	CG2	$f_{RF} = 200\text{ MHz}$ , $P_{RF} = -30\text{ dBm}$ <b>Note 2</b>	18.5	22.0	25.5	dB
Conversion Gain 3	CG3	$f_{RF} = 470\text{ MHz}$ , $P_{RF} = -30\text{ dBm}$ <b>Note 2</b>	18.5	22.0	25.5	dB
Conversion Gain 4	CG4	$f_{RF} = 470\text{ MHz}$ , $P_{RF} = -30\text{ dBm}$ <b>Note 2</b>	24.5	28.0	31.5	dB
Conversion Gain 5	CG5	$f_{RF} = 890\text{ MHz}$ , $P_{RF} = -30\text{ dBm}$ <b>Note 2</b>	24.5	28.0	31.5	dB
Noise Figure 1	NF1	$f_{RF} = 55\text{ MHz}$ <b>Note 3</b>	–	11.0	14.0	dB
Noise Figure 2	NF2	$f_{RF} = 200\text{ MHz}$ <b>Note 3</b>	–	11.0	14.0	dB
Noise Figure 3	NF3	$f_{RF} = 470\text{ MHz}$ <b>Note 3</b>	–	11.0	14.0	dB
Noise Figure 4	NF4	$f_{RF} = 470\text{ MHz}$ <b>Note 3</b>	–	9.5	12.5	dB
Noise Figure 5	NF5	$f_{RF} = 890\text{ MHz}$ <b>Note 3</b>	–	10.0	13.0	dB
Maximum Output Power 1	$P_{O(SAT)1}$	$f_{RF} = 55\text{ MHz}$ , $P_{RF} = 0\text{ dBm}$ <b>Note 2</b>	7.0	10.0	–	dBm
Maximum Output Power 2	$P_{O(SAT)2}$	$f_{RF} = 200\text{ MHz}$ , $P_{RF} = 0\text{ dBm}$ <b>Note 2</b>	7.0	10.0	–	dBm
Maximum Output Power 3	$P_{O(SAT)3}$	$f_{RF} = 470\text{ MHz}$ , $P_{RF} = 0\text{ dBm}$ <b>Note 2</b>	7.0	10.0	–	dBm
Maximum Output Power 4	$P_{O(SAT)4}$	$f_{RF} = 470\text{ MHz}$ , $P_{RF} = 0\text{ dBm}$ <b>Note 2</b>	7.0	10.0	–	dBm
Maximum Output Power 5	$P_{O(SAT)5}$	$f_{RF} = 890\text{ MHz}$ , $P_{RF} = 0\text{ dBm}$ <b>Note 2</b>	7.0	10.0	–	dBm

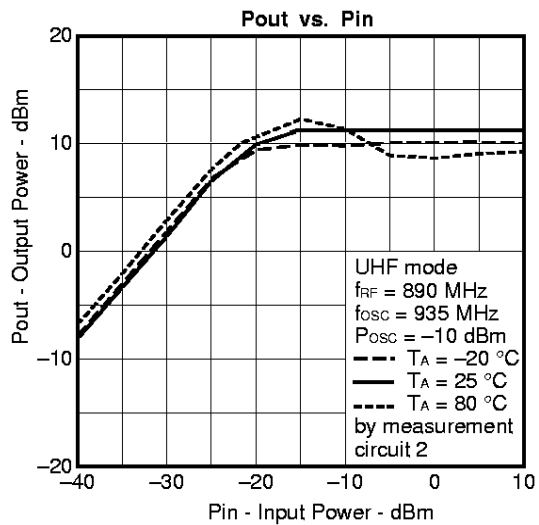
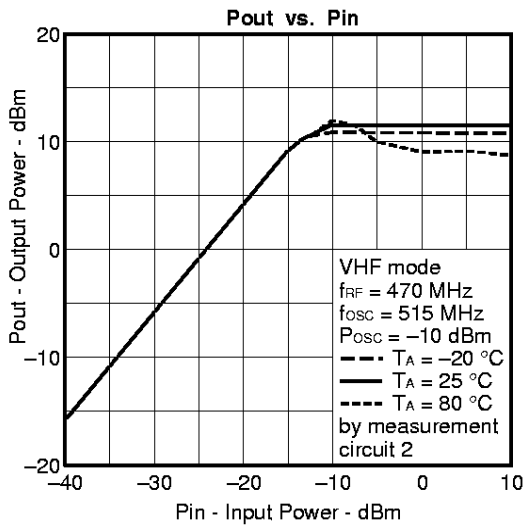
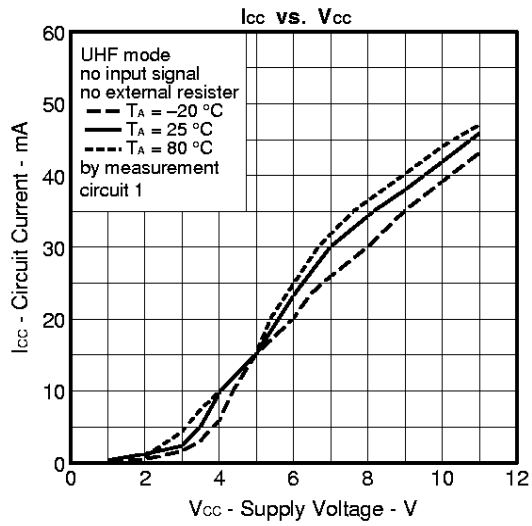
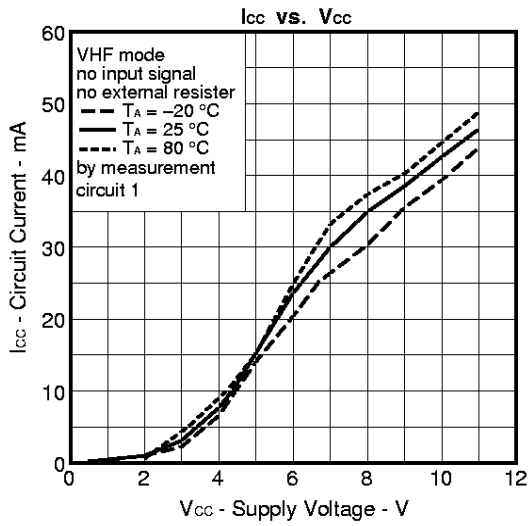
- Notes**
1. By measurement circuit 1
  2. By measurement circuit 2
  3. By measurement circuit 3

**STANDARD CHARACTERISTICS (Reference Values) (T<sub>A</sub> = 25 °C, V<sub>CC</sub> = 9 V<sup>Note</sup>)**

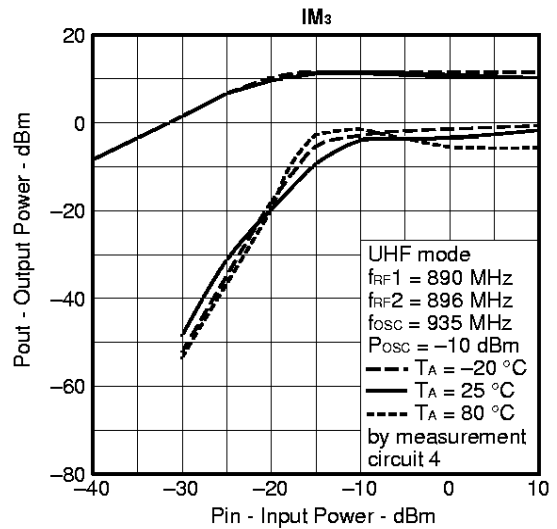
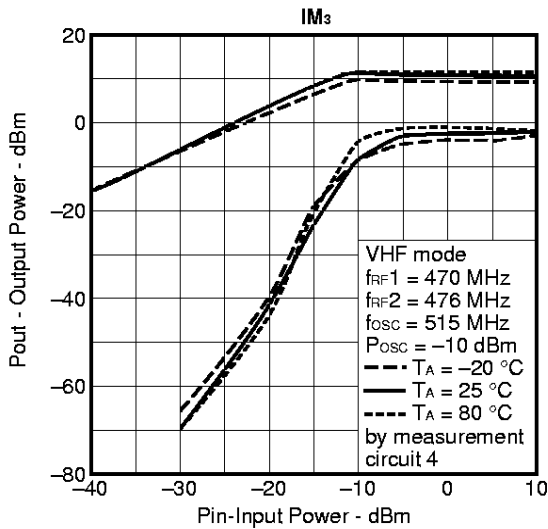
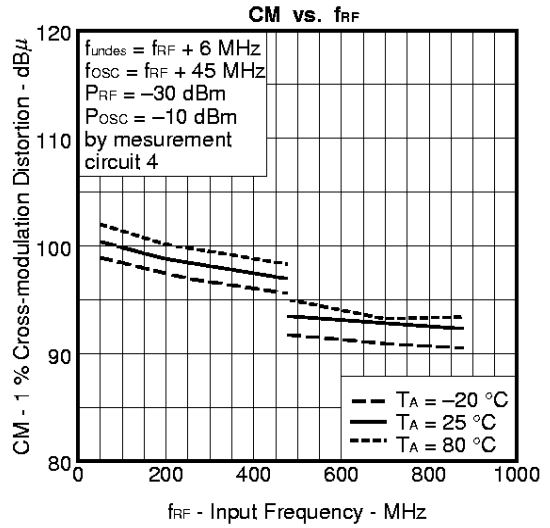
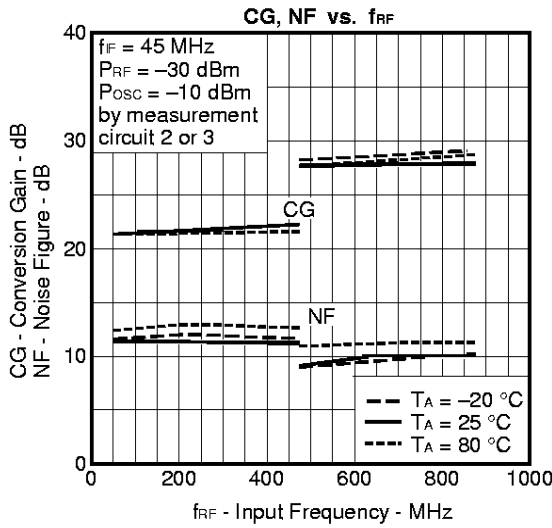
Parameter	Symbol	Test Conditions	Value for Reference	Unit
1 % cross-modulation distortion 1	CM1	f <sub>des</sub> = 55 MHz, f <sub>undes</sub> = f <sub>des</sub> + 6 MHz, P <sub>des</sub> = -30 dBm, f <sub>IF</sub> = 45 MHz, P <sub>OSC</sub> = -10 dBm AM 100 kHz, 30 % modulation, DES/CM = 46 dBc	100	dBμ
1 % cross-modulation distortion 2	CM2	f <sub>des</sub> = 200 MHz, f <sub>undes</sub> = f <sub>des</sub> + 6 MHz, P <sub>des</sub> = -30 dBm, f <sub>IF</sub> = 45 MHz, P <sub>OSC</sub> = -10 dBm AM 100 kHz, 30 % modulation, DES/CM = 46 dBc	100	dBμ
1 % cross-modulation distortion 3	CM3	f <sub>des</sub> = 470 MHz, f <sub>undes</sub> = f <sub>des</sub> + 6 MHz, P <sub>des</sub> = -30 dBm, f <sub>IF</sub> = 45 MHz, P <sub>OSC</sub> = -10 dBm AM 100 kHz, 30 % modulation, DES/CM = 46 dBc	96	dBμ
1 % cross-modulation distortion 4	CM4	f <sub>des</sub> = 470 MHz, f <sub>undes</sub> = f <sub>des</sub> + 6 MHz, P <sub>des</sub> = -30 dBm, f <sub>IF</sub> = 45 MHz, P <sub>OSC</sub> = -10 dBm AM 100 kHz, 30 % modulation, DES/CM = 46 dBc	94	dBμ
1 % cross-modulation distortion 5	CM5	f <sub>des</sub> = 890 MHz, f <sub>undes</sub> = f <sub>des</sub> + 6 MHz, P <sub>des</sub> = -30 dBm, f <sub>IF</sub> = 45 MHz, P <sub>OSC</sub> = -10 dBm AM 100 kHz, 30 % modulation, DES/CM = 46 dBc	92	dBμ

**Note** By measurement circuit 4

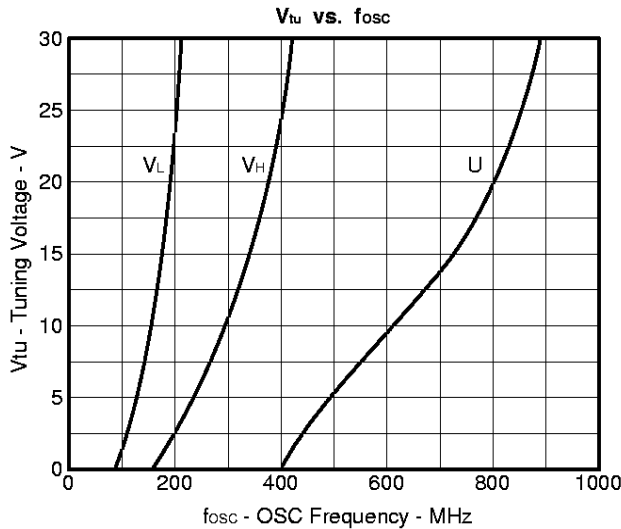
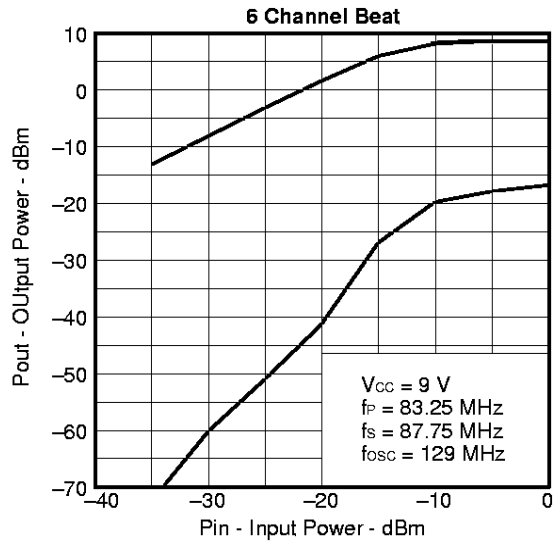
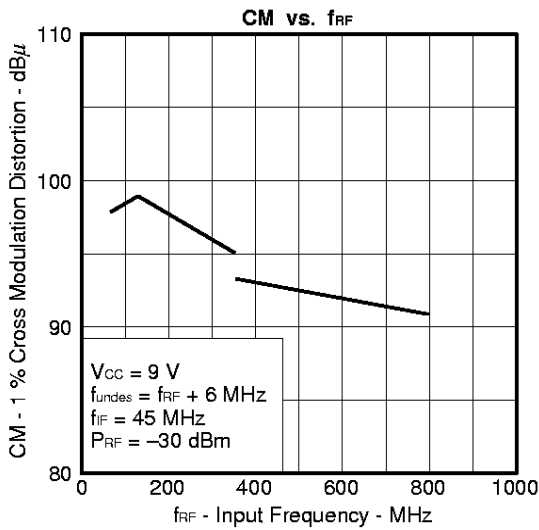
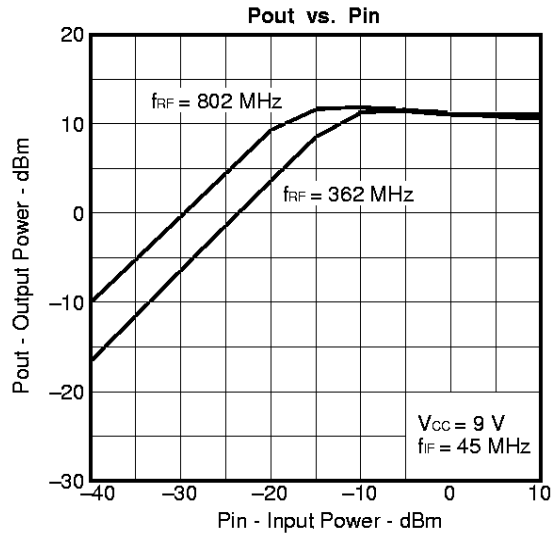
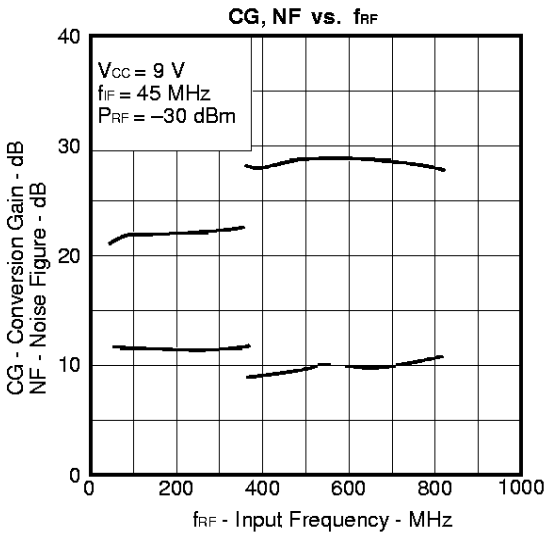
TYPICAL CHARACTERISTICS (V<sub>CC</sub> = 9 V)



TYPICAL CHARACTERISTICS (V<sub>CC</sub> = 9 V)

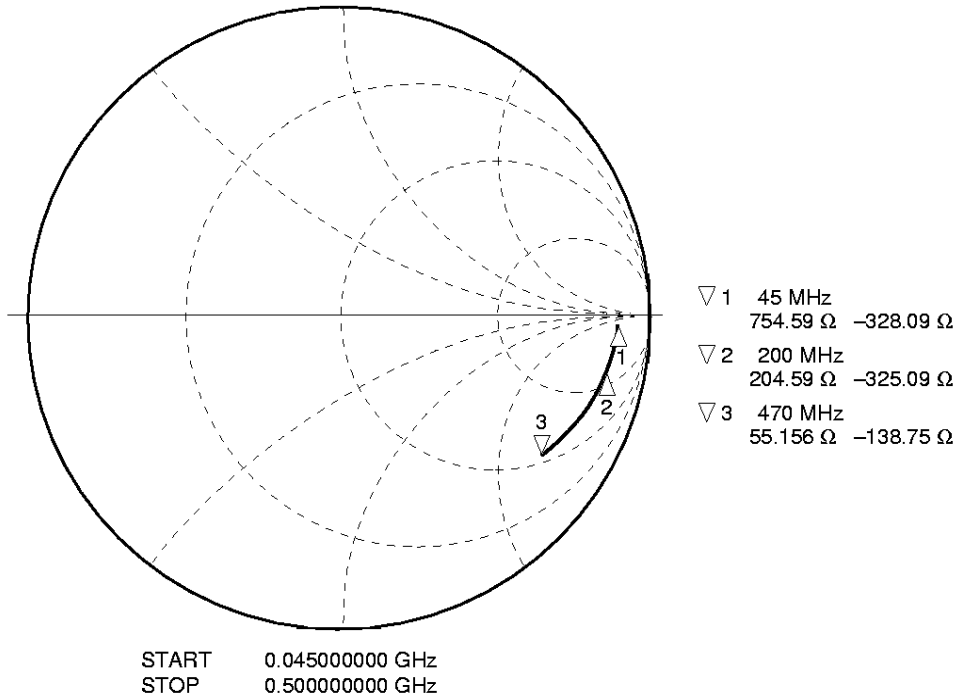


STANDARD CHARACTERISTICS (by application circuit example)

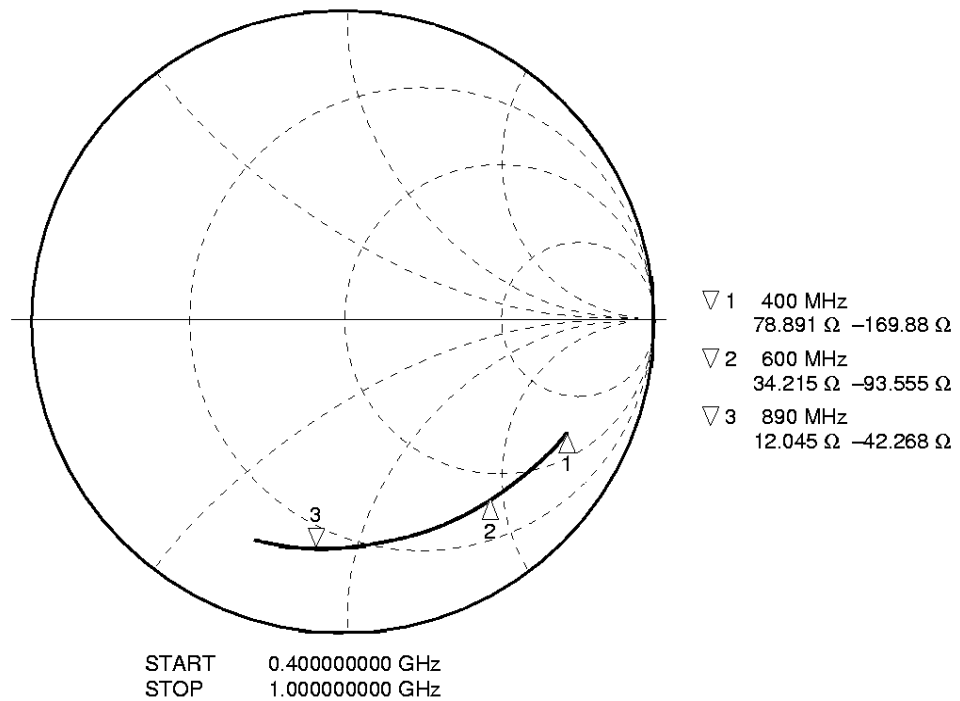


★ INPUT IMPEDANCE (by measurement circuit 5)

<VRF INPUT: 14 PIN>

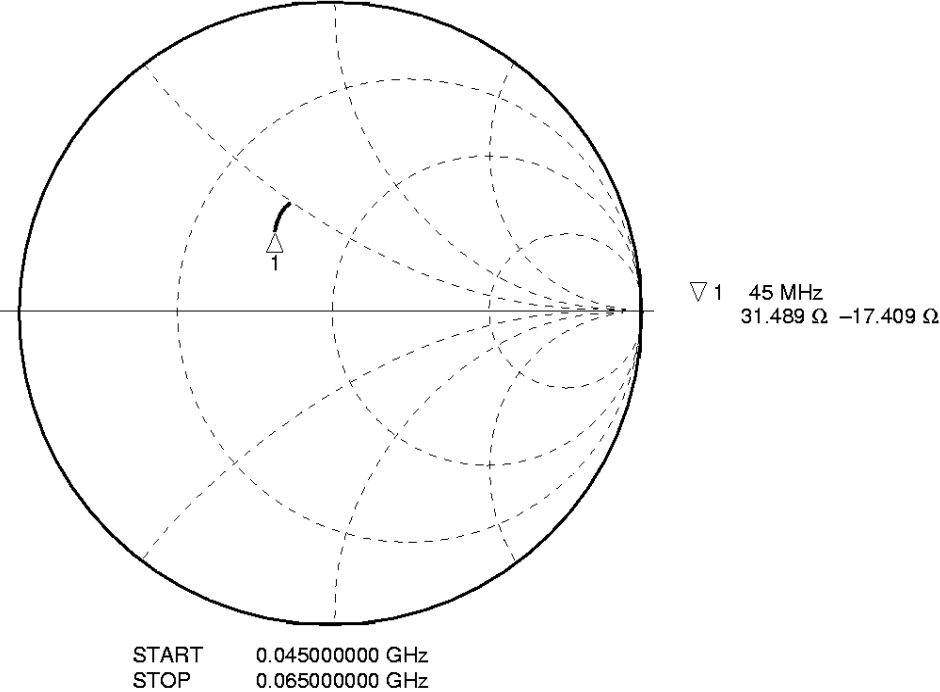


<URF INPUT: 11 PIN>

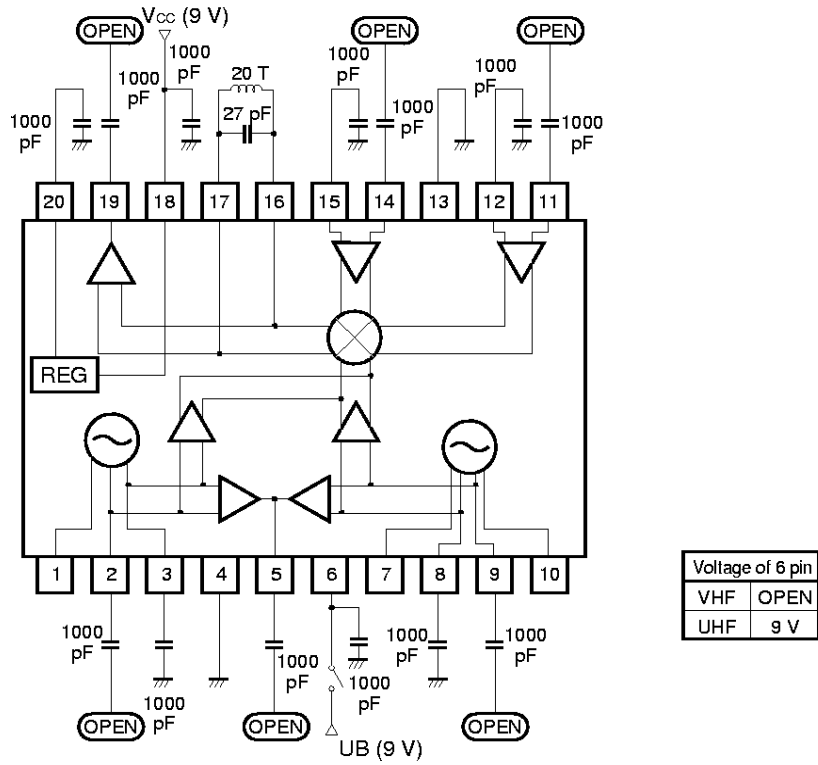


★ OUTPUT IMPEDANCE (by measurement circuit 5)

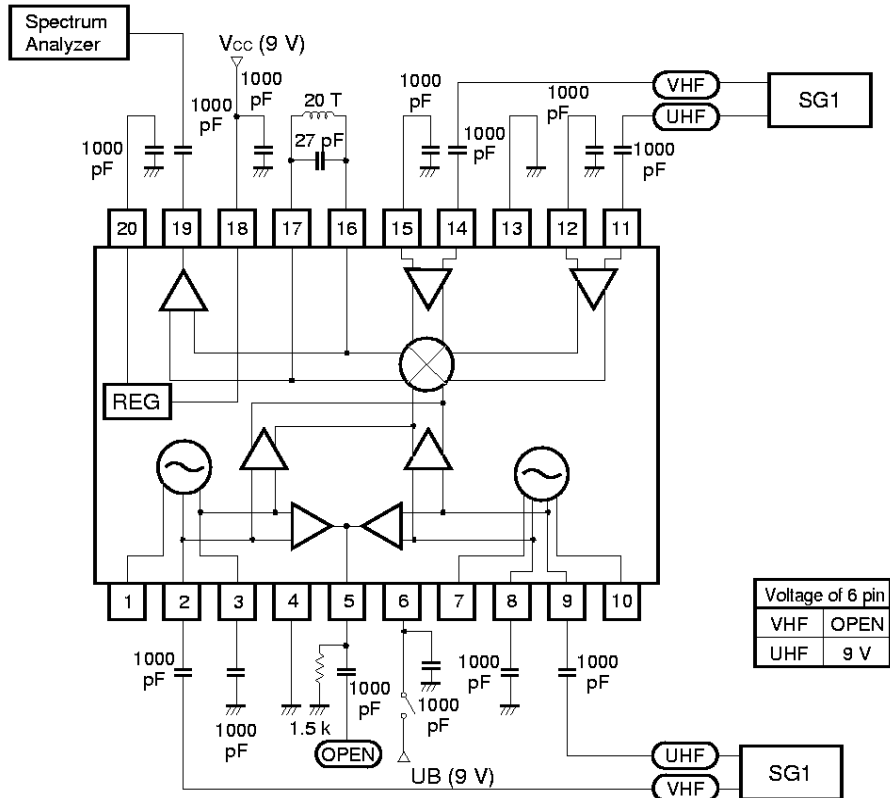
<IF OUTPUT: 19 PIN>



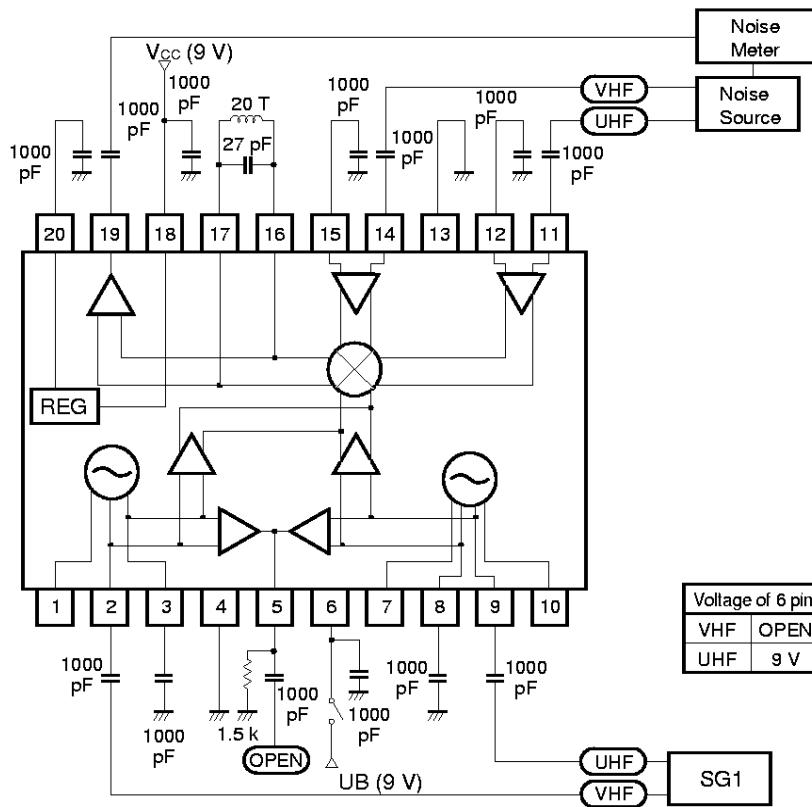
MEASUREMENT CIRCUIT 1



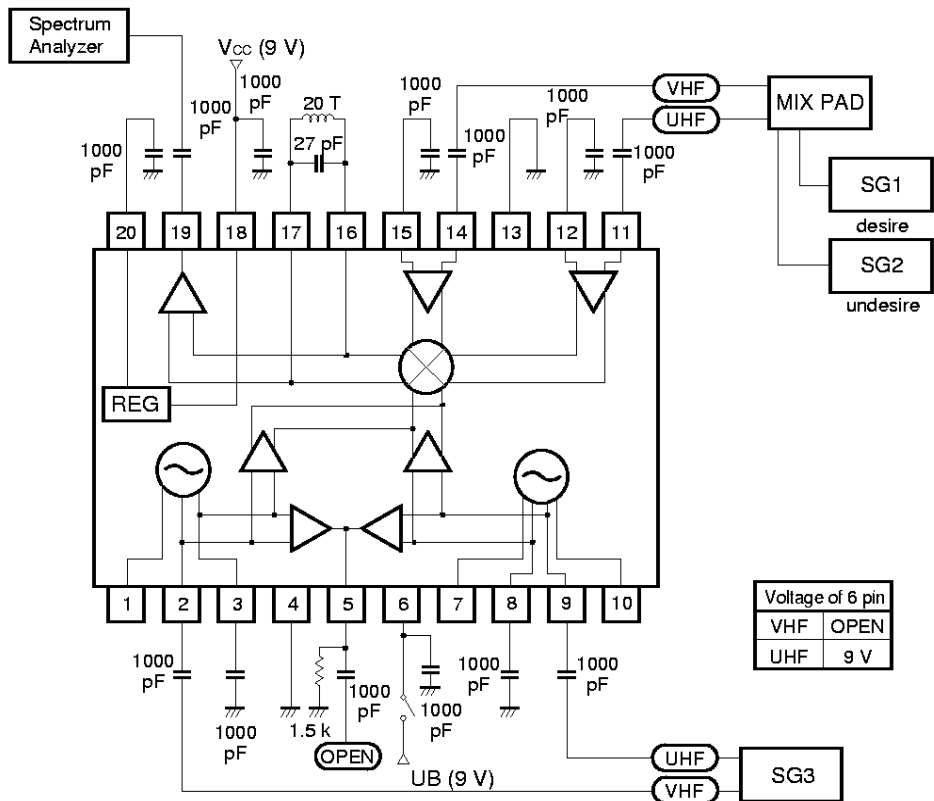
MEASUREMENT CIRCUIT 2



MEASUREMENT CIRCUIT 3

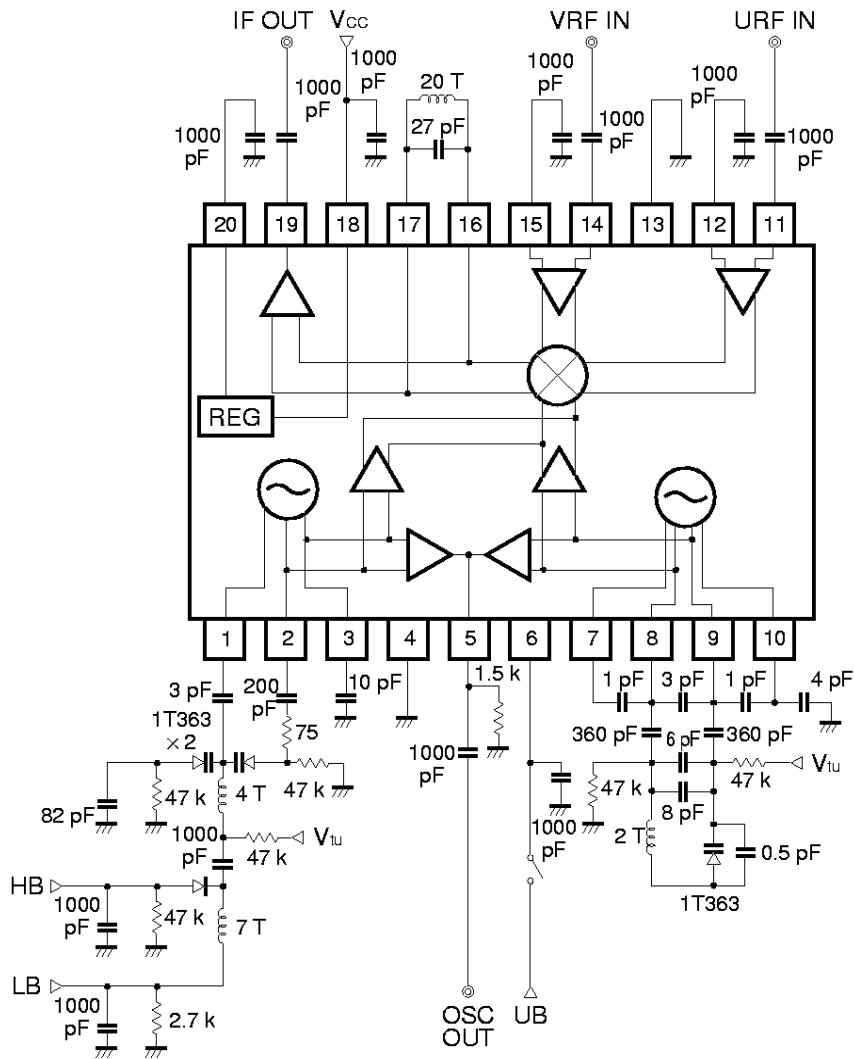


MEASUREMENT CIRCUIT 4



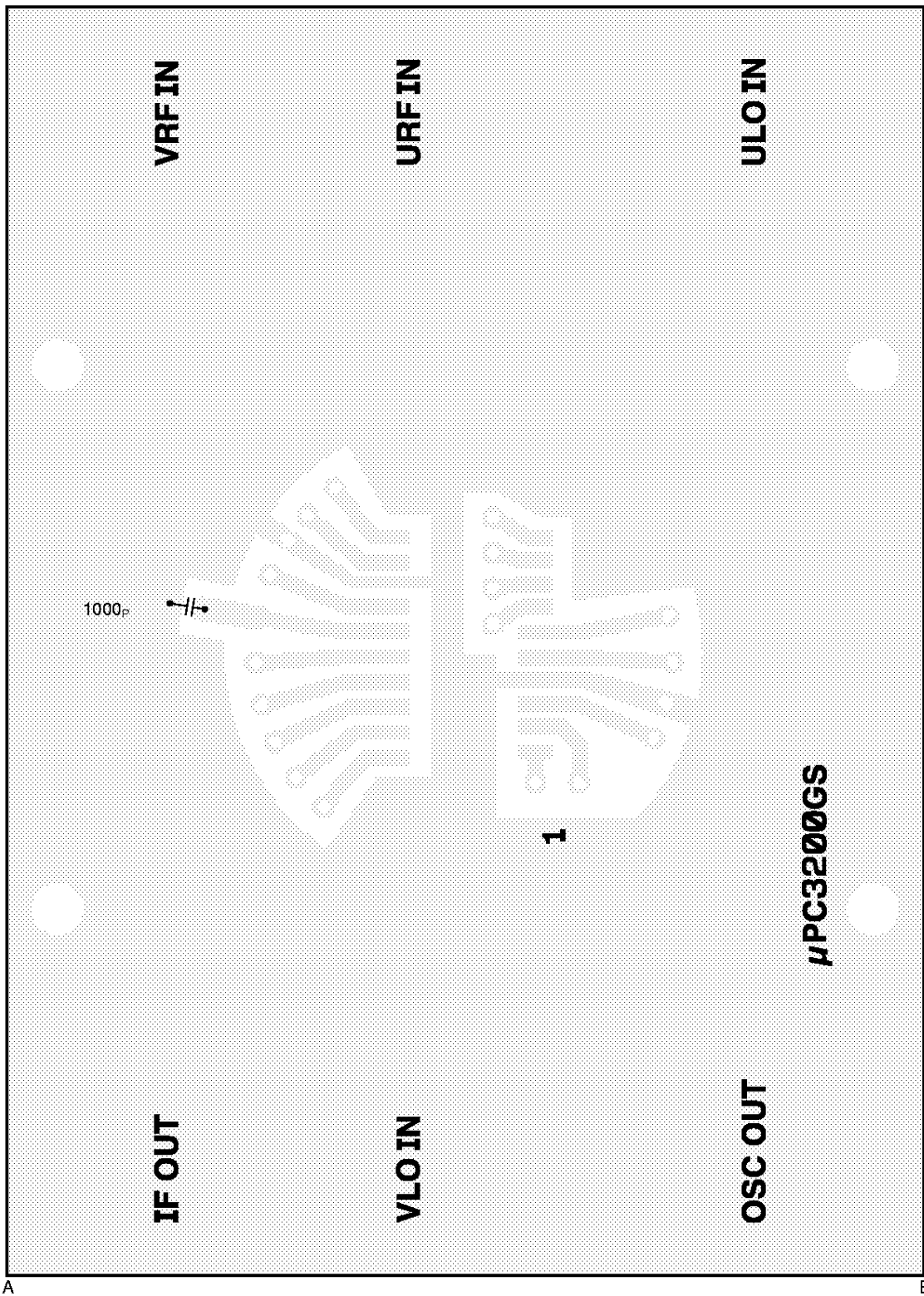


APPLICATION CIRCUIT EXAPLE



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

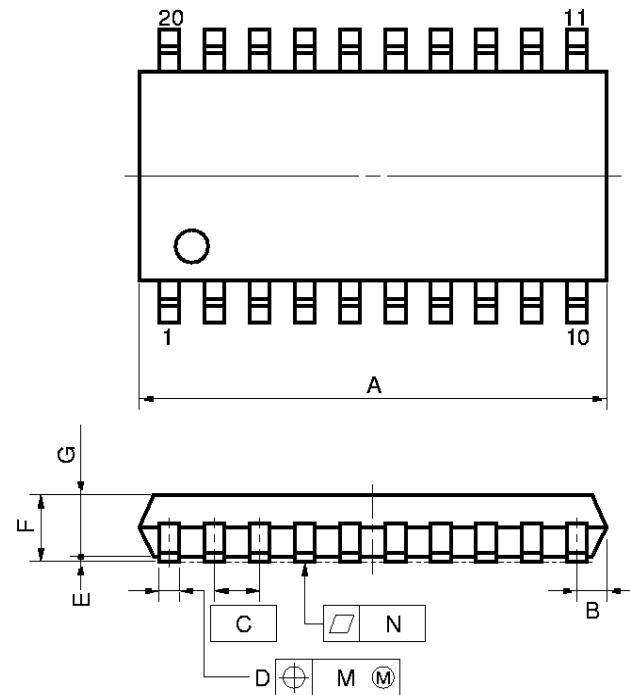
★ ILLUSTRATION OF THE EVALUATION BOARD FOR APPLICATION CIRCUIT EXAMPLE (Surface)



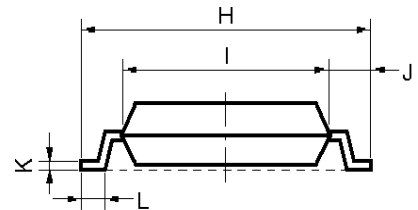
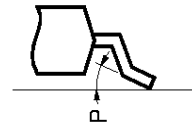


PACKAGE DIMENSIONS

20 PIN PLASTIC SOP (300 mil)



detail of lead end



NOTE

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	13.00 MAX.	0.512 MAX.
B	0.78 MAX.	0.031 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	0.40 <sup>+0.10</sup> <sub>-0.05</sub>	0.016 <sup>+0.004</sup> <sub>-0.003</sub>
E	0.1±0.1	0.004±0.004
F	1.8 MAX.	0.071 MAX.
G	1.55	0.061
H	7.7±0.3	0.303±0.012
I	5.6	0.220
J	1.1	0.043
K	0.20 <sup>+0.10</sup> <sub>-0.05</sub>	0.008 <sup>+0.004</sup> <sub>-0.002</sub>
L	0.6±0.2	0.024 <sup>+0.008</sup> <sub>-0.009</sub>
M	0.12	0.005
N	0.10	0.004
P	3° <sup>+7°</sup> <sub>-3°</sub>	3° <sup>+7°</sup> <sub>-3°</sub>

P20GM-50-300B, C-4

**NOTE 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 undesires oscillation).
- (3) Keep the track length of the ground pins as short as possible.
- (4) A low pass filter must be attached to Vcc line.
- (5) A matching circuit must be externally attached to output port.

**RECOMMENDED SOLDERING CONDITIONS**

The following conditions (see table below) must be met when soldering this product.

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

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

**μPC3200GS**

Soldering Process	Soldering Conditions	Symbol
Infrared Ray Reflow	Peak package's surface temperature: 235 °C or below, Reflow time: 30 seconds or below (at 210 °C), Number of reflow process: 3, Exposure limit <sup>Note</sup> : None	IR35-00-3
VPS	Peak package's surface temperature: 215 °C or below, Reflow time: 40 seconds or below (at 200 °C), Number of reflow process: 3, Exposure limit <sup>Note</sup> : None	VP15-00-3
Partial Heating Method	Terminal temperature: 300 °C or below, Flow time: 3 seconds or below (per one pin), Exposure limit <sup>Note</sup> : None	

**Note** Exposure limit before soldering after dry-pack package is opened.

Storage conditions: 25 °C and relative humidity at 65% or less.

**Caution** Do not apply more than single process at once, except for "Partial heating method".

[MEMO]

[MEMO]

[MEMO]

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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: Aircrafts, 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.

Anti-radioactive design is not implemented in this product.