

# BIPOLAR ANALOG INTEGRATED CIRCUIT

# $\mu$ PC2782GR

## L BAND DOWN CONVERTER IC

### DESCRIPTION

The  $\mu$ PC2782GR is a Silicon monolithic IC designed for use as L band downconverter. This IC consists of a Gilbert cell mixer, two stages of LO buffering, local oscillator, external filter port, or a high output IF AGC amplifier and IF output buffer amplifier.

The package is 20 pins SSOP (shrink small outline package) suitable for high-density surface mount.

### FEATURES

- Broad band operation  $f_{RF} = 0.9$  to 2.1 GHz
- 25 dB variable gain IF AGC amplifier
- Low distortion  $IIP_3 = +4.5$  dBm ( $f_{RF} = 2.1$  GHz)
- Supply Voltage 5 V
- Packaged in 20 pins SSOP suitable for high-density surface mount

### ORDERING INFORMATION

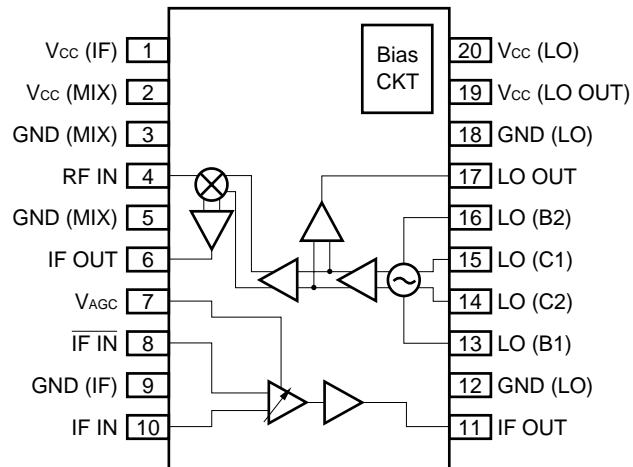
Part Number	Package	Package Style
$\mu$ PC2782GR-E1	20 pin plastic SSOP (225 mil)	Embossed tape 12 mm wide. 2.5 k/REEL. Pin 1 indicates pull-out direction of tape

For evaluation sample order, please contact your local NEC sales office. (Part number for sample order:  $\mu$ PC2782GR)

**Caution** electro-static sensitive devices.

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

INTERNAL BLOCK DIAGRAM



Pin No.	Symbol	Pin Volt TYP.(V)	Functions and Explanation	Equivalent Circuit
1	V <sub>CC</sub> (IF)	5.00	Power supply pin of IF AGC Amp.	
2	V <sub>CC</sub> (MIX)	5.00	Power supply pin of Mixer	
3	GND (MIX)	0.00	Ground pin of Mixer.	
4	RF IN	2.00	RF signal input pin.	
5	GND (MIX)	0.00	Ground pin of Mixer.	
6	IF OUT	1.85	Output pin of Mixer. This pin is assigned for the emitter follower output.	
7	V <sub>AGC</sub>	0 to 5	Gain control pin. This pin's bias govern the AGC output level. Maximum gain at V <sub>AGC</sub> = 0 V Minimum gain at V <sub>AGC</sub> = 5 V	
8	IF IN	2.36	IF signal input pin of IF AGC Amp. In case of single input, this pin should be grounded through 1 000 pF capacitor.	
9	GND (IF)	0.00	Ground pin of IF AGC Amp.	
10	IF IN	2.36	IF signal input pin of IF AGC Amp.	

Pin No.	Symbol	Pin Volt TYP.(V)	Functions and Explanation	Equivalent Circuit
11	IF OUT	2.55	Output pin of IF AGC Amp. This pin is assigned for emitter follower push-pull output.	
12	GND (LO)	0.00	Ground pin of Oscillator amplifier, Buffer amplifier, Oscillator output.	
13	LO (B1)	2.30	Base pin of oscillator. Connected to 14 pin through capacitor.	
14	LO (C2)	5.00	Collector pin of oscillator. Connected to 15 pin through capacitor. Oscillator frequency bandwidth is depended on this capacitor. This pin should be connected to V <sub>CC</sub> through 150 Ω resistor.	
15	LO (C1)	5.00	Collector pin of oscillator. Connected to 14 pin through capacitor. This pin should be connected to V <sub>CC</sub> through 150 Ω resistor.	
16	LO (B2)	2.30	Base pin of oscillator. Connected to 15 pin through capacitor. Assemble LC resonator between 13 pin and 16 pin through 2 pF capacitor to oscillate.	
17	LO OUT	3.15	Output pin of Oscillator. This pin is assigned for emitter follower output.	
18	GND (LO)	0.00	Ground pin of Oscillator amplifier, Buffer amplifier, Oscillator output.	
19	VCC (LO)	5.00	Power supply pin of Oscillator output.	
20	VCC (LO)	5.00	Power supply pin of Oscillator amplifier, Buffer amplifier.	

**Absolute Maximum Ratings (TA = 25 °C unless otherwise specified)**

Parameter	Symbol	Test Conditions	Rating	Unit
Supply Voltage	V <sub>CC</sub>		6.0	V
Power dissipation	P <sub>D</sub>	T <sub>A</sub> = 85 °C <sup>*1</sup>	430	mW
Operation temperature range	T <sub>A</sub>		-40 to +85	°C
Storage temperature range	T <sub>stg</sub>		-55 to +150	°C

\*1 Mounted on 50 × 50 × 1.6 mm double copper epoxy glass board.

**Recommended Operating Range**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
Operating temperature range	T <sub>A</sub>	-40	+25	+85	°C

**Electrical Characteristics (T<sub>A</sub> = 25 °C, V<sub>CC</sub> = 5 V)**

Parameter	Symbol	MIN.	TYP.	MAX.	UNIT	Test Conditions
Circuit Current	I <sub>CC</sub>	46	66	78	mA	No input signal *2
RF Input Frequency Range	RF BW	0.9		2.1	GHz	P <sub>RF</sub> = -20 dBm, P <sub>OSC</sub> = -10 dBm f <sub>IF</sub> = 480 MHz, -3 dB down *2
IF Output Frequency Range	IF BW	150		500	MHz	f <sub>RF</sub> = 2.1 GHz, P <sub>RF</sub> = -20 dBm P <sub>OSC</sub> = -10 dBm, -3 dB down *2
<b>Mixer Section</b>						
Conversion Gain	CG1	7	10	13	dB	f <sub>RF</sub> = 900 MHz, P <sub>RF</sub> = -30 dBm f <sub>OSC</sub> = 1 380 MHz, P <sub>OSC</sub> = -10 dBm *2
Conversion Gain 2	CG2	8	11	14	dB	f <sub>RF</sub> = 2.1 GHz, P <sub>RF</sub> = -30 dBm f <sub>OSC</sub> = 2.58 GHz, P <sub>OSC</sub> = -10 dBm *2
Maximum Output Power 1	P <sub>O (sat)1</sub>	+2	+5	-	dBm	f <sub>RF</sub> = 900 MHz, P <sub>RF</sub> = 0 dBm f <sub>OSC</sub> = 1 380 MHz, P <sub>OSC</sub> = -10 dBm *2
Maximum Output Power 2	P <sub>O (sat)2</sub>	+2	+5	-	dBm	f <sub>RF</sub> = 2.1 GHz, P <sub>RF</sub> = 0 dBm f <sub>OSC</sub> = 2.58 GHz, P <sub>OSC</sub> = -10 dBm *2
Noise Figure 1	NF1	-	11.0	14.0	dB	f <sub>RF</sub> = 900 MHz, P <sub>OSC</sub> = -10 dBm *3
Noise Figure 2	NF2	-	13.5	16.5	dB	f <sub>RF</sub> = 2.1 GHz, P <sub>OSC</sub> = -10 dBm *3
<b>IF Amp. Section</b>						
IF Input Frequency Range	IFinBW	150	-	500	MHz	P <sub>IF</sub> = -30 dBm, V <sub>AGC</sub> = 0 V -3 dB down *4
IF Power Gain	G <sub>IF</sub>	20	23	26	dB	f <sub>IF</sub> = 480 MHz, P <sub>IF</sub> = -30 dBm V <sub>AGC</sub> = 0 *4
Maximum Output Power 3	P <sub>O (sat)3</sub>	+5	+8	-	dBm	f <sub>IF</sub> = 480 MHz, P <sub>IF</sub> = 0 dBm V <sub>AGC</sub> = 0 V *4
AGC Dynamic range	ΔG <sub>AGC</sub>	20	25	-	dB	f <sub>IF</sub> = 480 MHz, P <sub>IF</sub> = -30 dBm V <sub>AGC</sub> = 0 to 5 V *4
Noise Figure 3	NF3	-	12.0	15.0	dB	f <sub>IF</sub> = 480 MHz, V <sub>AGC</sub> = 0 V *5

\*2 by measurement circuit 1

\*3 by measurement circuit 2

\*4 by measurement circuit 4

\*5 by measurement circuit 5

Standard Characteristics (T<sub>A</sub> = 25 °C, V<sub>CC</sub> = 5 V)

Parameter	Symbol	Reference Value			UNIT	Test Conditions
		MIN.	TYP.	MAX.		
Mixer Section						
Input Intercept Point 1	IIP <sub>31</sub>	–	0	–	dBm	f <sub>RF</sub> = 900, 930 MHz, f <sub>OSC</sub> = 1 380 MHz P <sub>OSC</sub> = –10 dBm *6
Input Intercept Point 2	IIP <sub>32</sub>	–	+4.5	–	dBm	f <sub>RF</sub> = 2.1, 2.13 GHz, f <sub>OSC</sub> = 2.58 GHz P <sub>OSC</sub> = –10 dBm *6
Third Intermodulation Distortion 1	IM <sub>31</sub>	–	50	–	dBc	f <sub>RF</sub> = 900, 930 MHz, P <sub>RF</sub> = –25 dBm each f <sub>OSC</sub> = 1 380 MHz, P <sub>OSC</sub> = –10 dBm *6
Third Intermodulation Distortion 2	IM <sub>32</sub>	–	59	–	dBc	f <sub>RF</sub> = 2.1, 1.13 GHz, P <sub>RF</sub> = –25 dBm each f <sub>OSC</sub> = 2.58 GHz, P <sub>OSC</sub> = –10 dBm *6
Oscillator Output Power	P <sub>OSC</sub>	–	–15	–	dBm	*7
Oscillator Frequency Range	f <sub>OSC</sub>	1.3	–	2.6	GHz	*7
IF Amp. Section						
Output Intercept Point	OIP <sub>3</sub>	–	+15.5	–	dBm	f <sub>IF</sub> = 480, 510 MHz *8

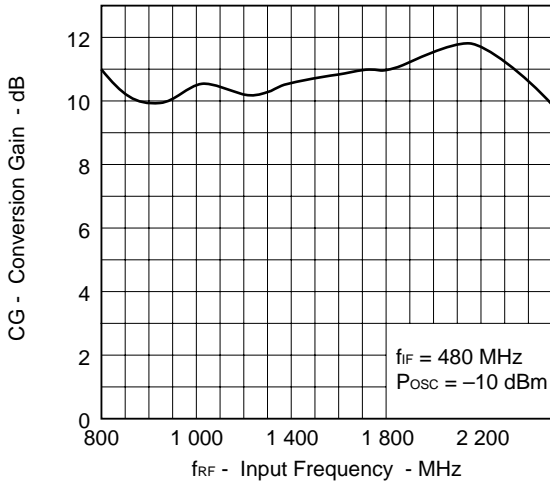
\*6 by measurement circuit 3

\*7 by application circuit example

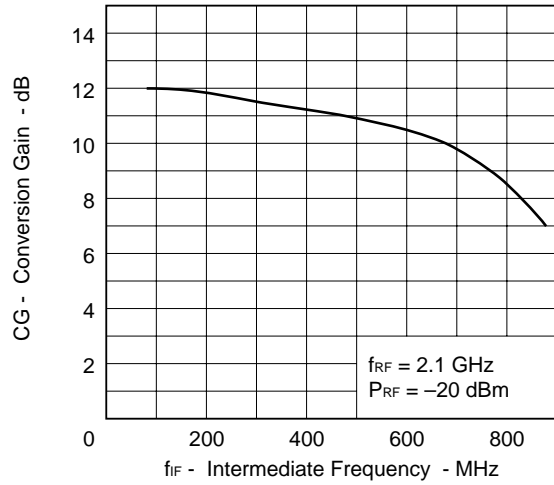
\*8 by measurement circuit 6

Typical Characteristics ( $V_{CC} = 5\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$ )

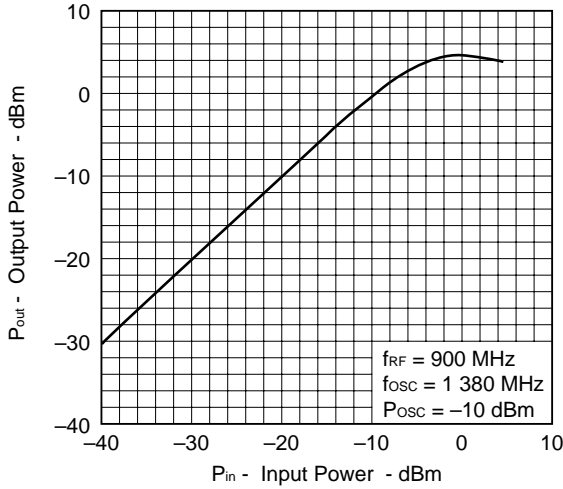
$f_{RF}$  vs. CG (MIXER)



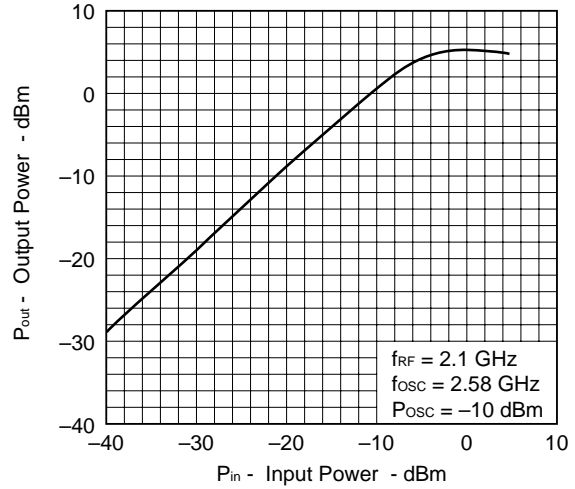
$f_{IF}$  vs. CG (MIXER)



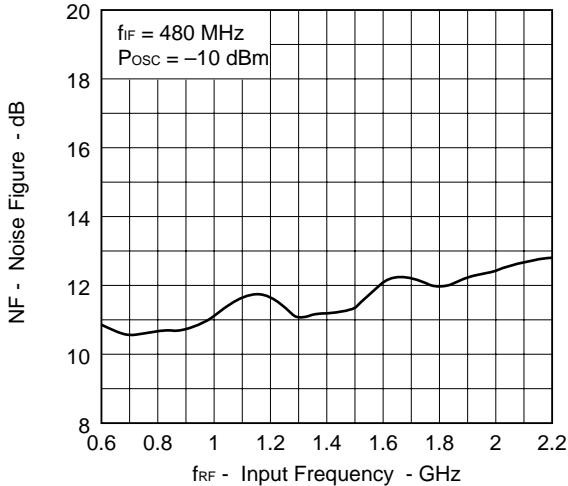
$P_{in}$  vs.  $P_{out}$  (MIXER)



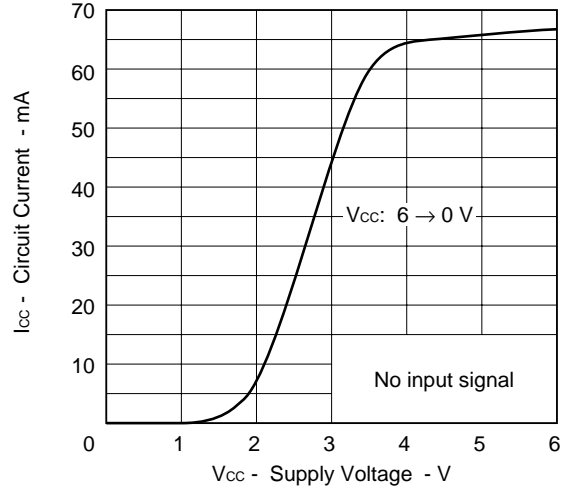
$P_{in}$  vs.  $P_{out}$  (MIXER)



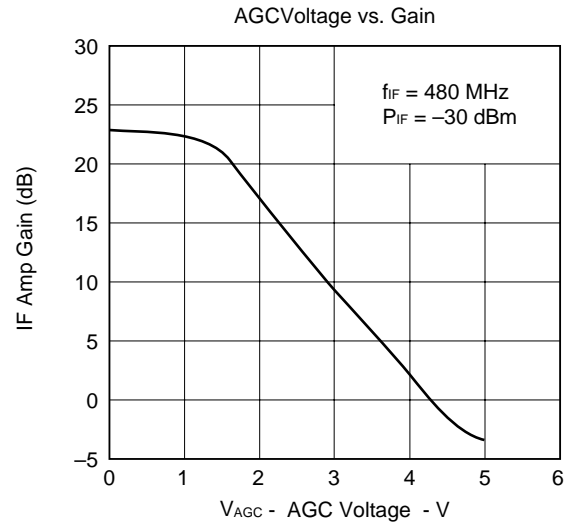
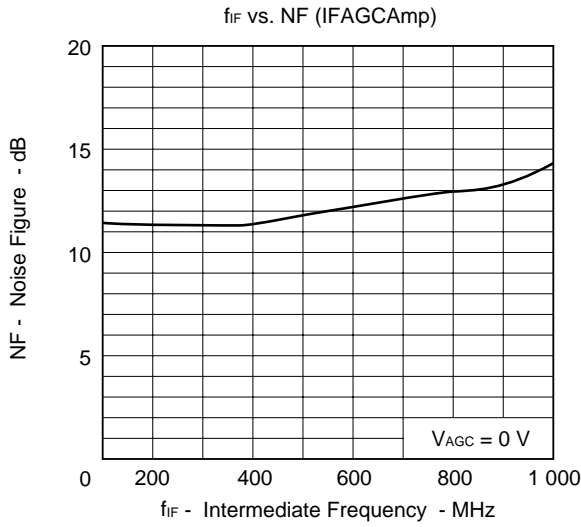
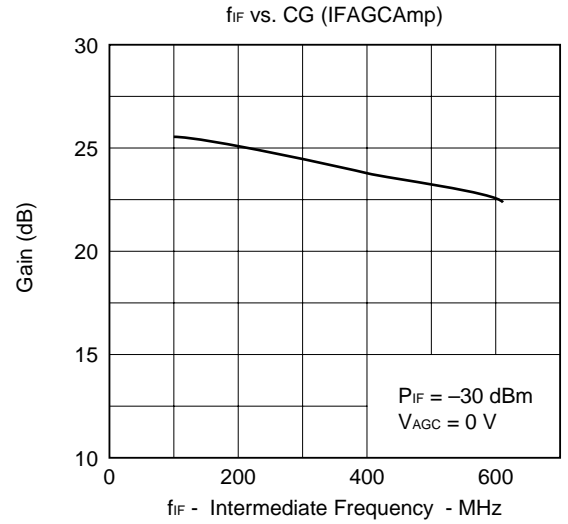
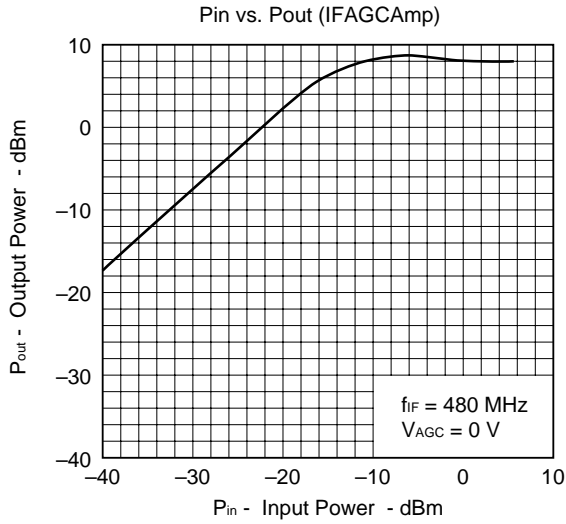
$f_{RF}$  vs. NF (MIXER)



$V_{CC}$  vs.  $I_{CC}$

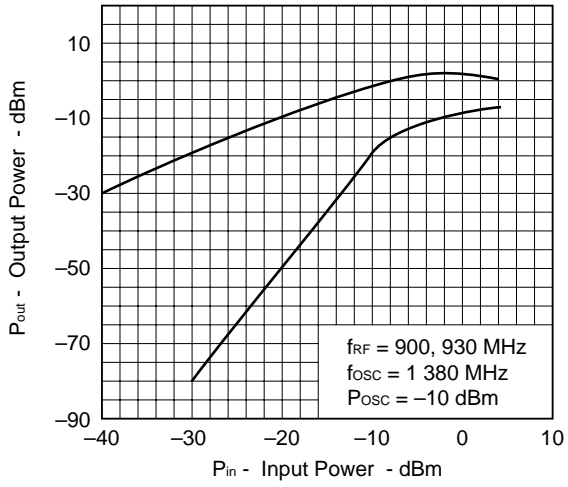




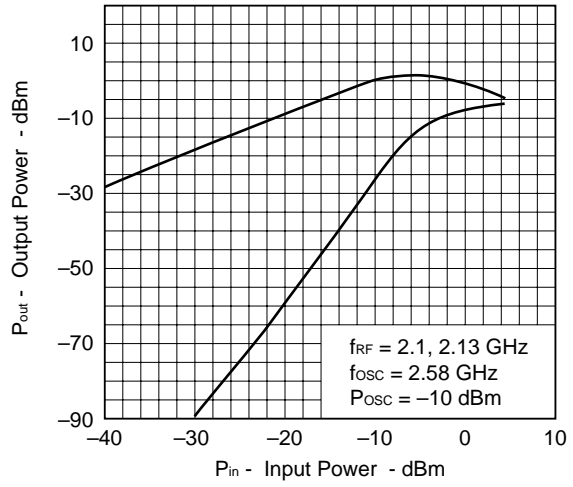


Standard Characteristics ( $V_{CC} = 5\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$ )

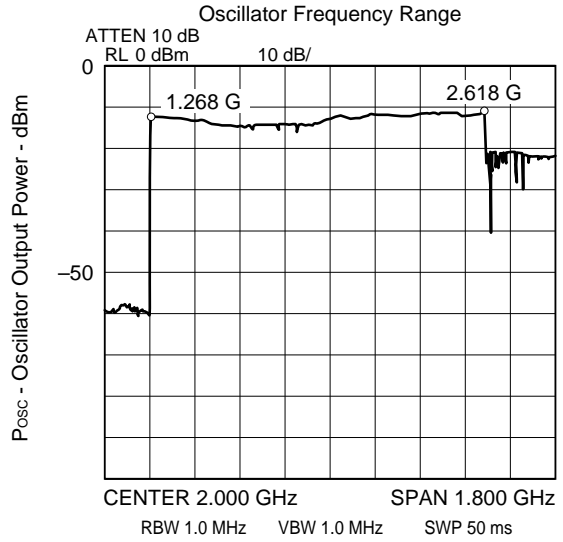
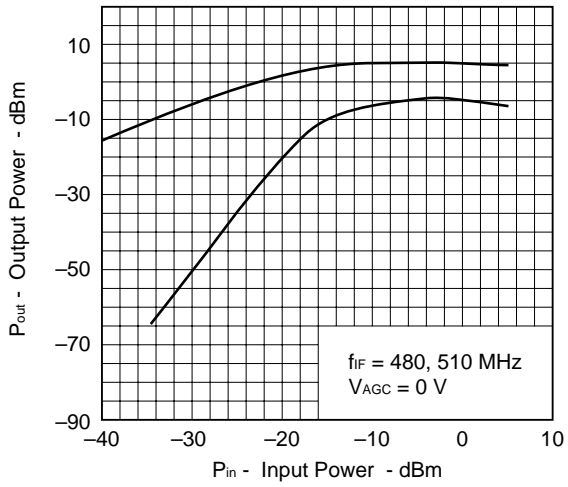
IM<sub>3</sub> (MIXER)



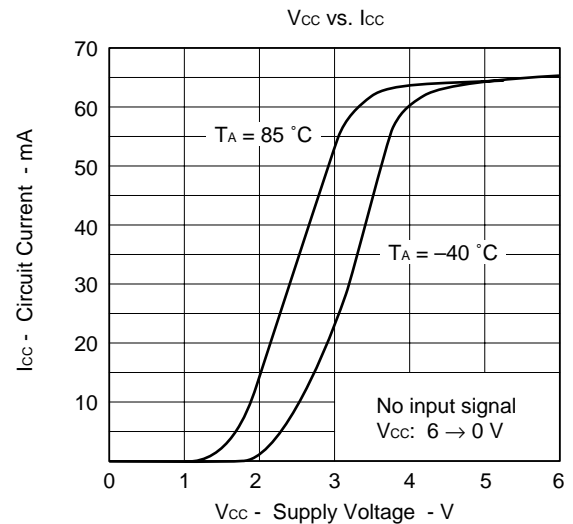
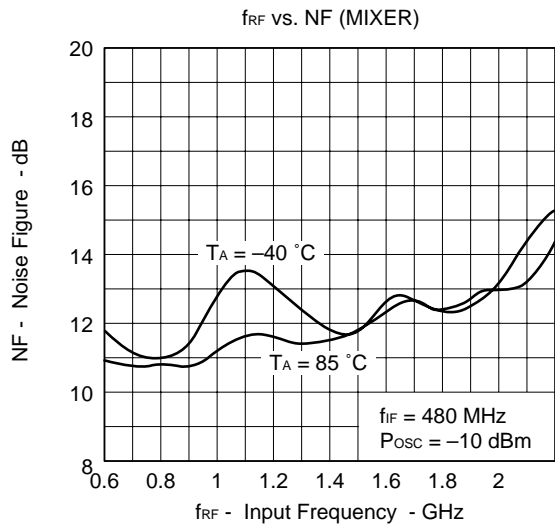
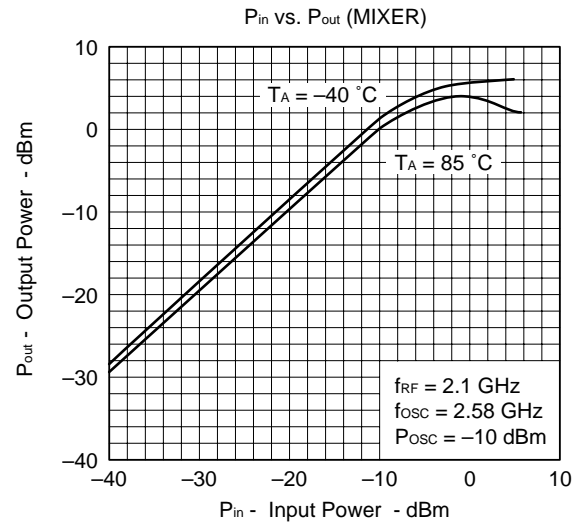
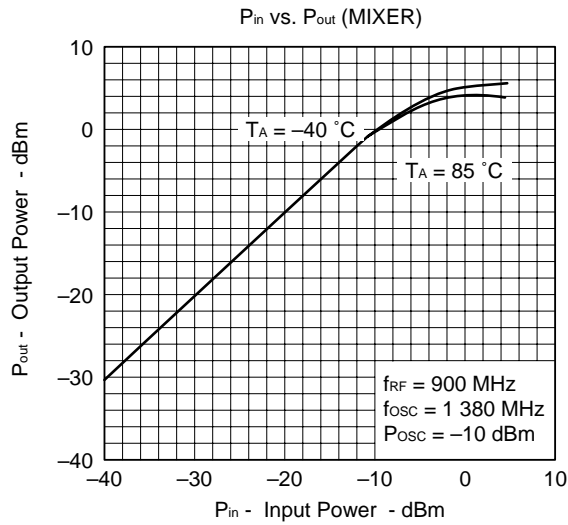
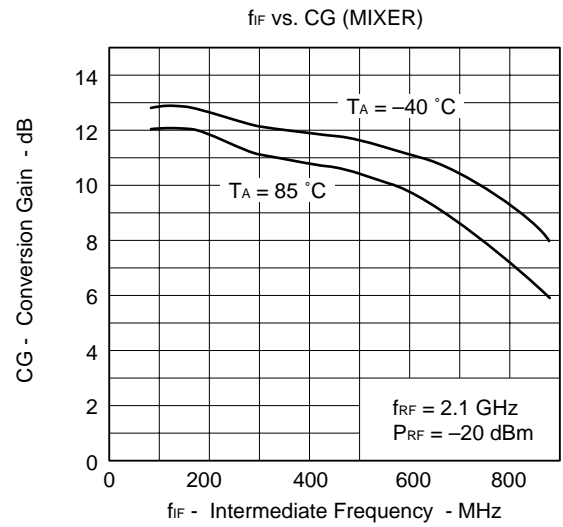
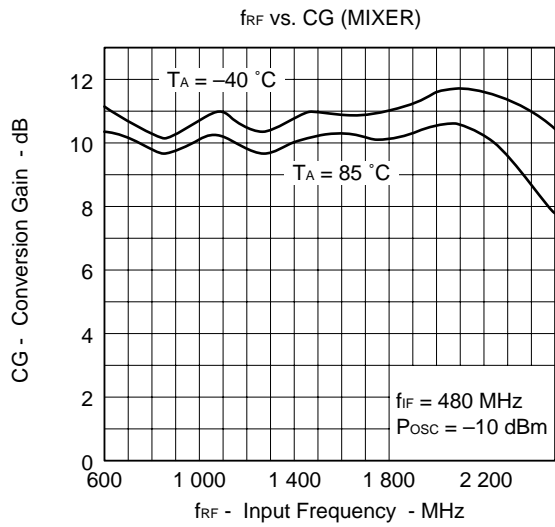
IM<sub>3</sub> (MIXER)

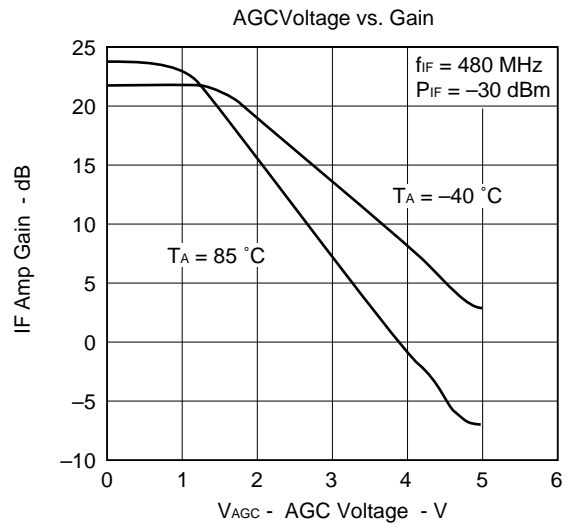
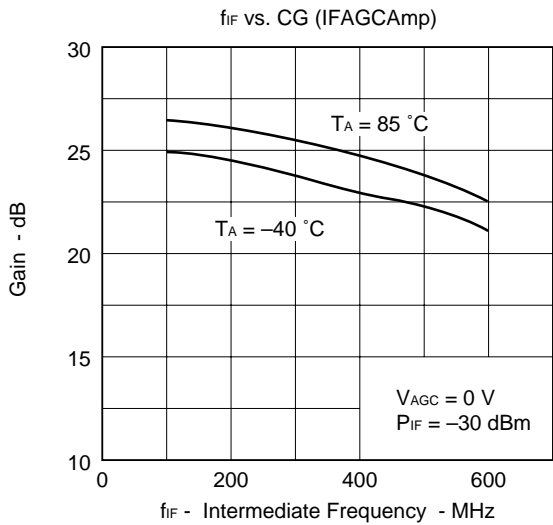
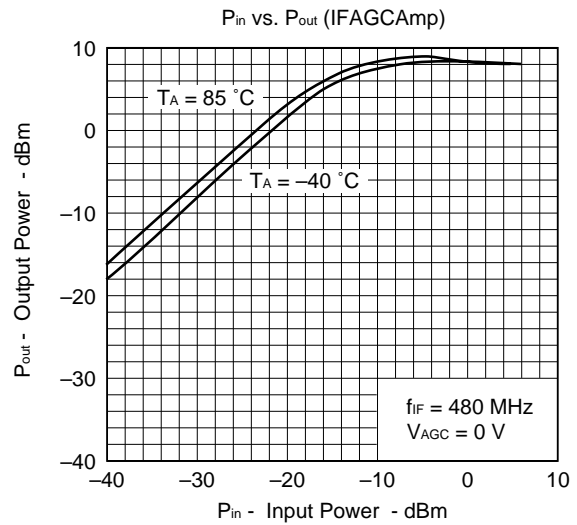
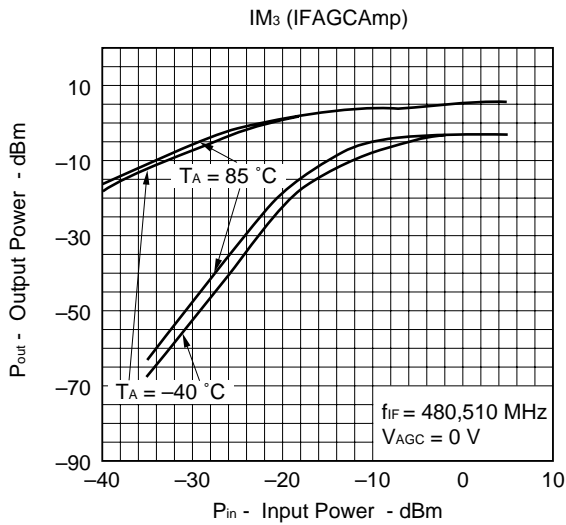
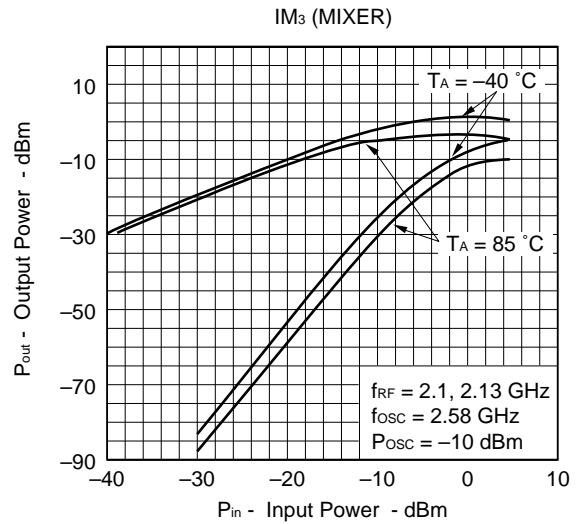
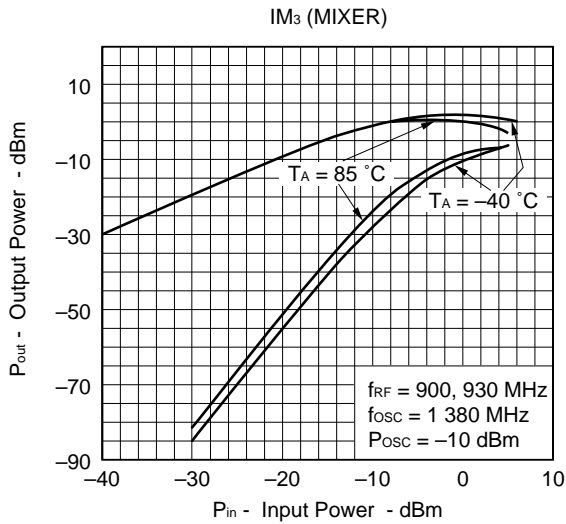


IM<sub>3</sub> (IFAGCAmp)

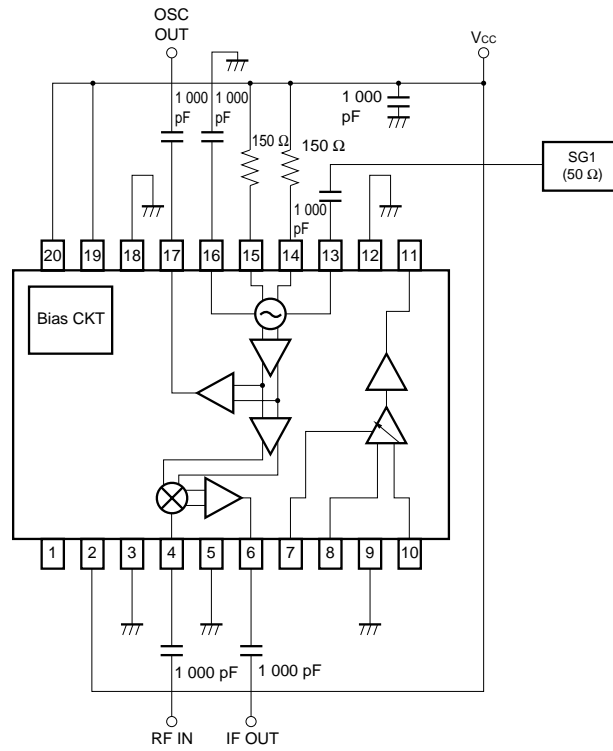


Standard Characteristics (V<sub>CC</sub> = 5 V, T<sub>A</sub> = -40 °C, 85 °C)

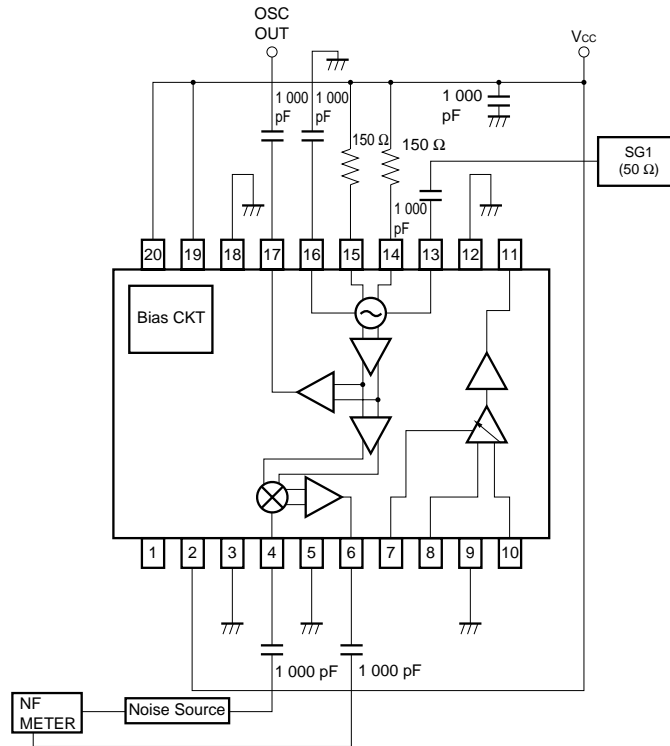




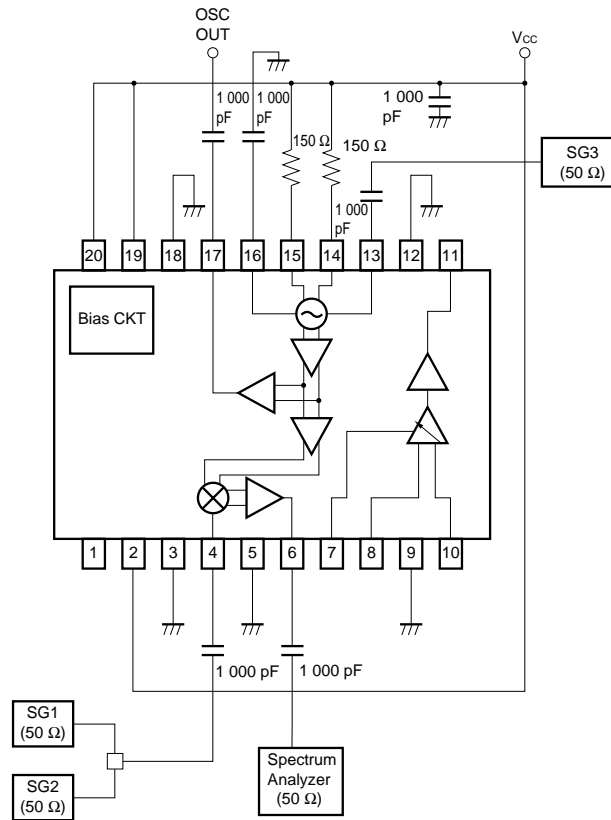
Measurement Circuit 1



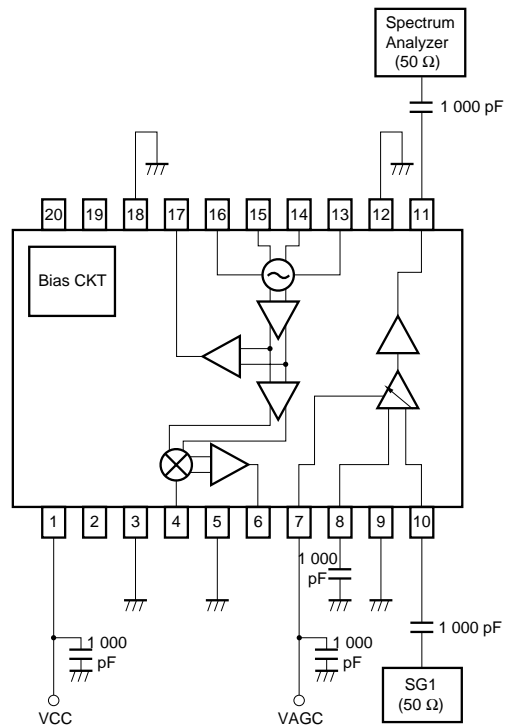
Measurement Circuit 2



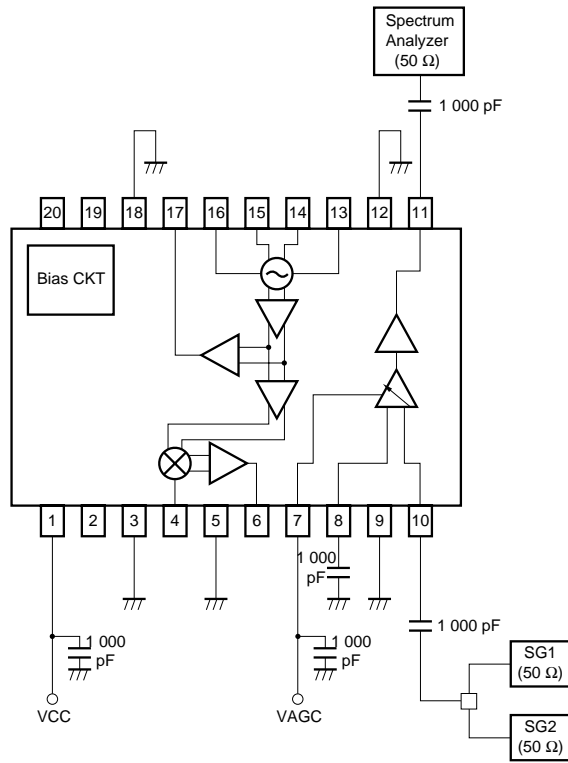
Measurement Circuit 3



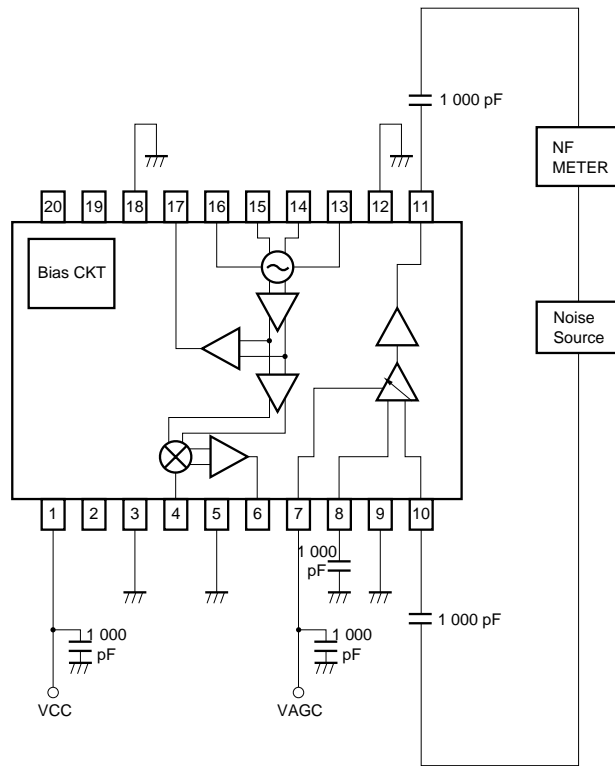
Measurement Circuit 4



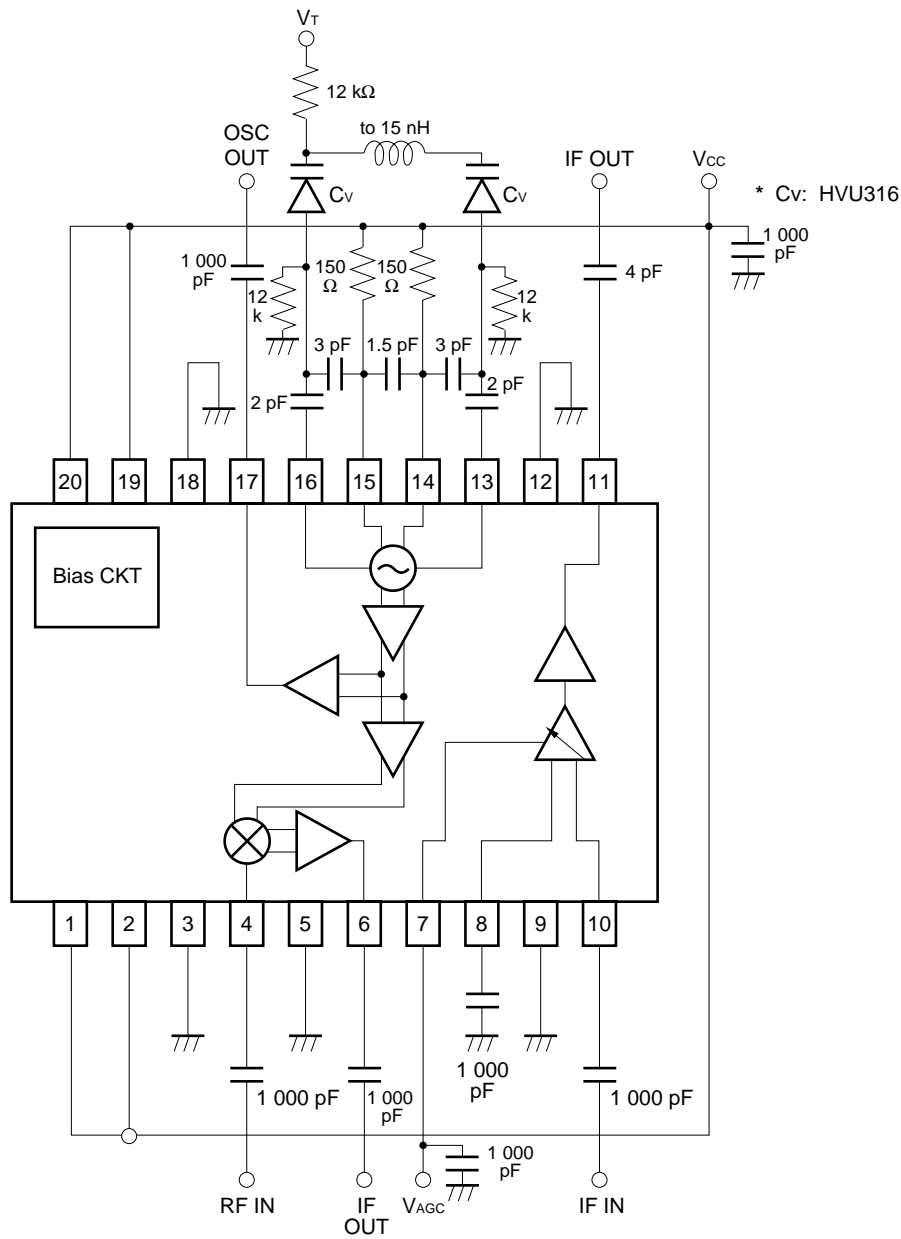
Measurement Circuit 5



Measurement Circuit 6



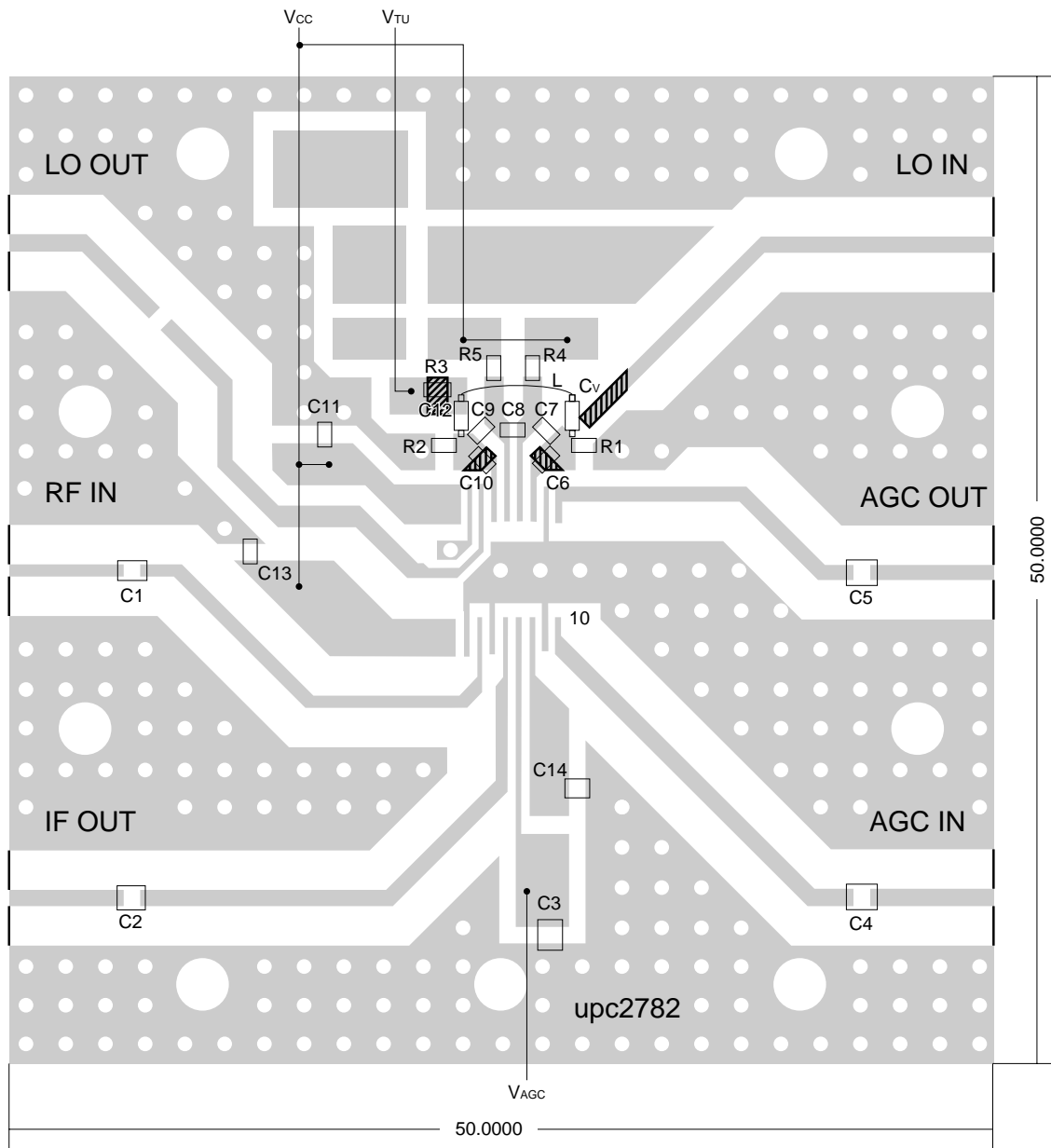
Application Circuit Example



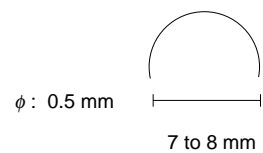
The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.



Illustration of The Application Circuit Assembled on Evaluation Board



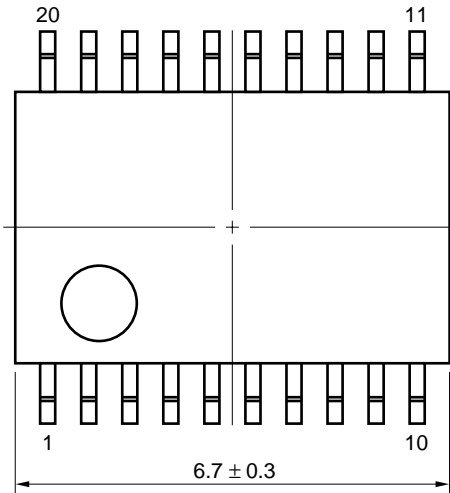
- C1 to C5 : 1 000 pF
- C6, C10 : 2 pF
- C7, C9 : 3 pF
- C8 : 1.5 pF
- C11 to C14 : 1 000 pF
- R1 to R3 : 12 k $\Omega$
- R4, R5 : 150  $\Omega$
- Cv : HVU316
- L : to 15 nH



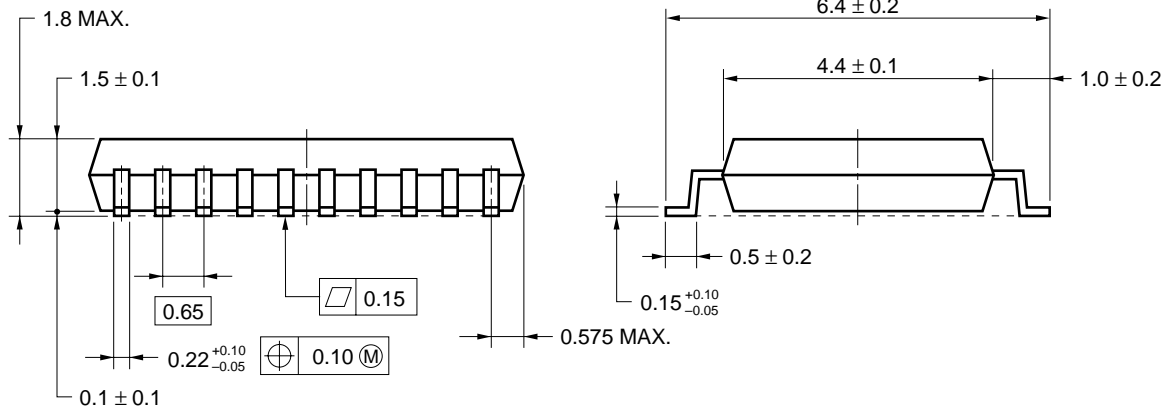
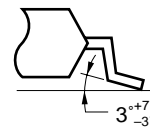
\* pattern should be removed on this application

PACKAGE DIMENSIONS

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



detail of lead end



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

**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 SEMI CONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E).

**μPC2782GR**

Soldering process	Soldering conditions	Symbol
Infrared ray reflow	Peak package's surface temperature: 235 °C or below, Reflow time: 30 seconds or below (210 °C or higher), 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 (200 °C or higher), Number of reflow process: 3, Exposure limit <sup>Note</sup> : None	VP15-00-3
Wave soldering	Solder temperature: 260 °C or below, Reflow time: 10 seconds or below, Number of reflow process: 1, Exposure limit <sup>Note</sup> : None	WS60-00-1
Partial heating method	Terminal temperature: 300 °C or below, Flow time: 3 seconds or below, 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".

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    - 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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