DATA SHEET

NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2782GR

L BAND DOWN CONVERTER IC

DESCRIPTION

The μPC2782GR 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
μPC2782GR-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: μPC2782GR)

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.**

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The mark ★ shows major revised points

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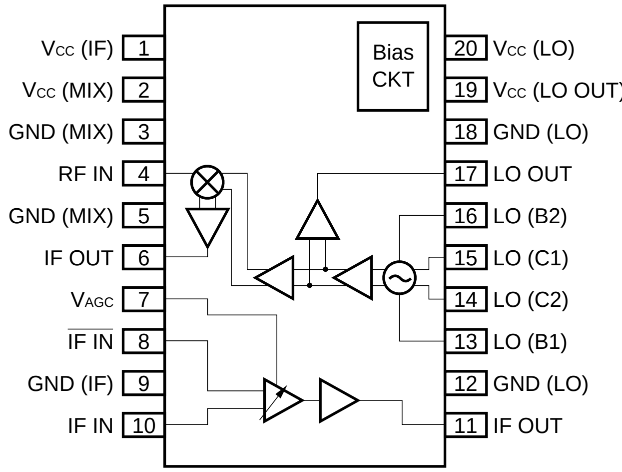
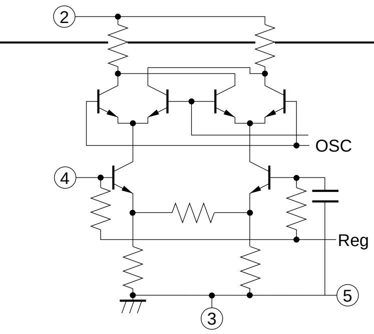
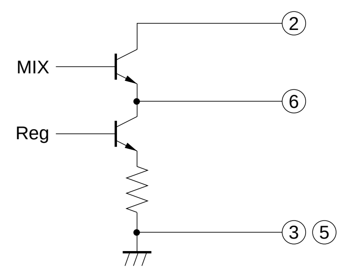
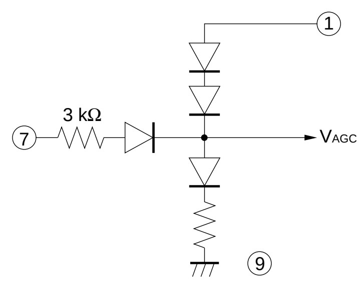
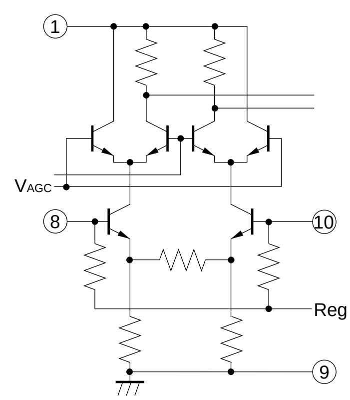
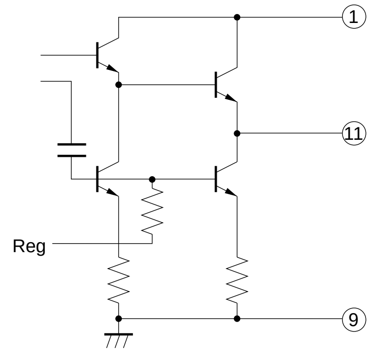
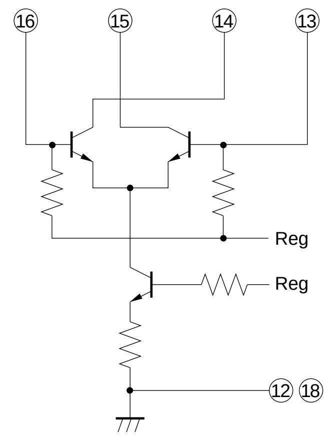
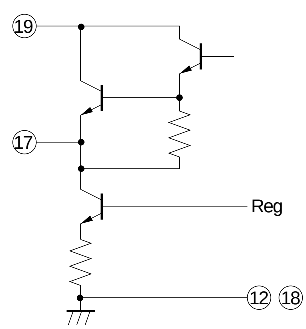
INTERNAL BLOCK DIAGRAM



Pin No.	Symbol	Pin Volt TYP.(V)	Functions and Explanation	Equivalent Circuit
1	V_{CC} (IF)	5.00	Power supply pin of IF AGC Amp.	
2	V_{CC} (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_{AGC}	0 to 5	Gain control pin. This pin's bias govern the AGC output level. Maximum gain at V_{AGC} = 0 V Minimum gain at V_{AGC} = 5 V	
8	$\overline{\text{IF IN}}$	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_{CC} 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_{CC} 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 (T_A = 25 °C unless otherwise specified)

Parameter	Symbol	Test Conditions	Rating	Unit
Supply Votage	V_{CC}		6.0	V
Power dissipation	P_D	T_A = 85 °C[*1]	430	mW
Operation temperature range	T_A		–40 to +85	°C
Storage temperature range	T_{stg}		–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_{CC}	4.5	5.0	5.5	V
Operating temperature range	T_A	–40	+25	+85	°C

Electrical Characteristics (T_A = 25 °C, V_{CC} = 5 V)

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

***2** by measurement circuit 1
***3** by measurement circuit 2
***4** by measurement circuit 4
***5** by measurement circuit 5

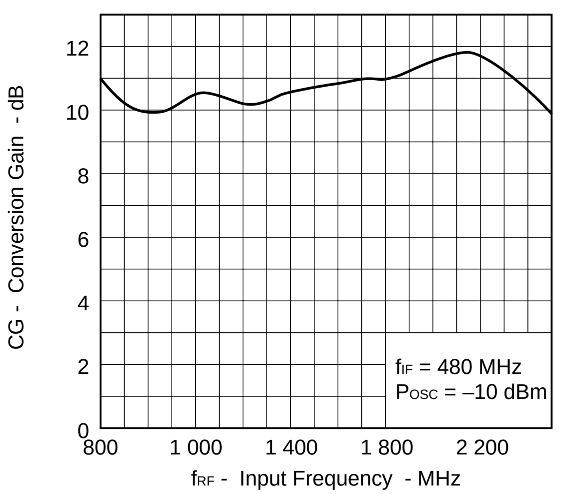
Standard Characteristics (T_A = 25 °C, V_{CC} = 5 V)

Parameter	Symbol	Reference Value			UNIT	Test Conditions
		MIN.	TYP.	MAX.		
Mixer Section						
Input Intercept Point 1	IIP_31	–	0	–	dBm	f_{RF} = 900, 930 MHz, f_{OSC} = 1 380 MHz P_{OSC} = –10 dBm ***6**
Input Intercept Point 2	IIP_32	–	+4.5	–	dBm	f_{RF} = 2.1, 2.13 GHz, f_{OSC} = 2.58 GHz P_{OSC} = –10 dBm ***6**
Third Intermodulation Distortion 1	IM_31	–	50	–	dBc	f_{RF} = 900, 930 MHz, P_{RF} = –25 dBm each f_{OSC} = 1 380 MHz, P_{OSC} = –10 dBm ***6**
Third Intermodulation Distortion 2	IM_32	–	59	–	dBc	f_{RF} = 2.1, 1.13 GHz, P_{RF} = –25 dBm each f_{OSC} = 2.58 GHz, P_{OSC} = –10 dBm ***6**
Oscillator Output Power	P_{OSC}	–	–15	–	dBm	***7**
Oscillator Frequency Range	f_{OSC}	1.3	–	2.6	GHz	***7**
IF Amp. Section						
Output Intercept Point	OIP_3	–	+15.5	–	dBm	f_{IF} = 480, 510 MHz ***8**

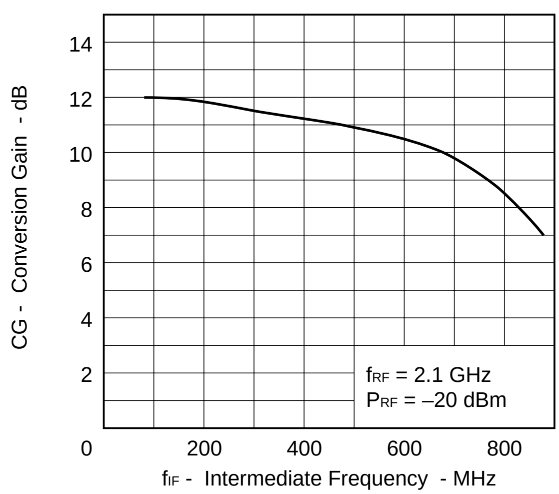
***6** by measurement circuit 3
***7** by application circuit example
***8** by measurement circuit 6

Typical Characteristics (V_{CC} = 5 V, T_A = 25 °C)

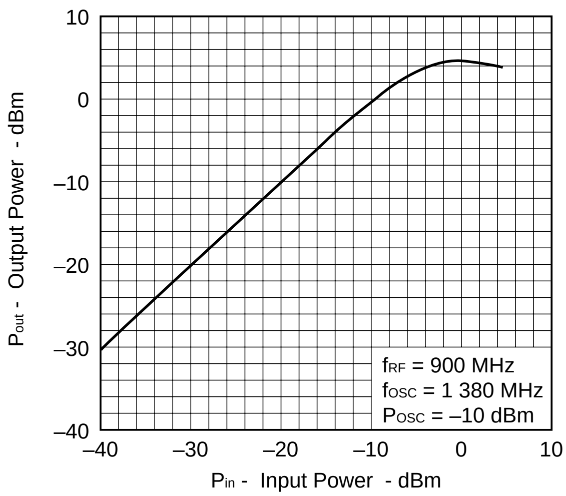
f_{RF} vs. CG (MIXER)



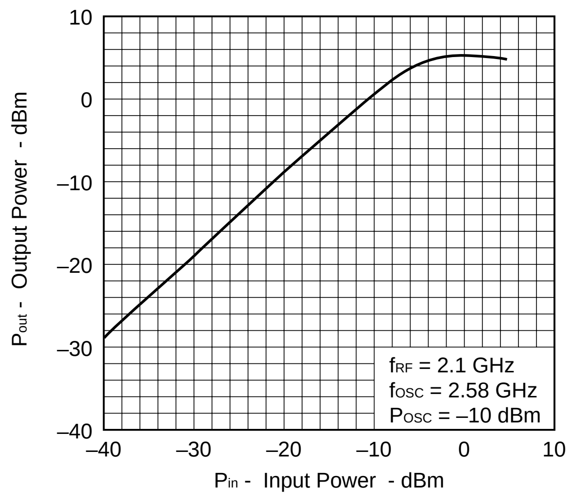
f_{IF} vs. CG (MIXER)



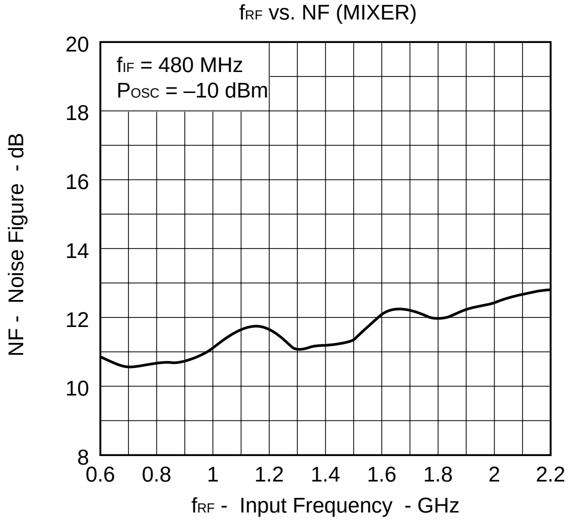
P_{in} vs. P_{out} (MIXER)



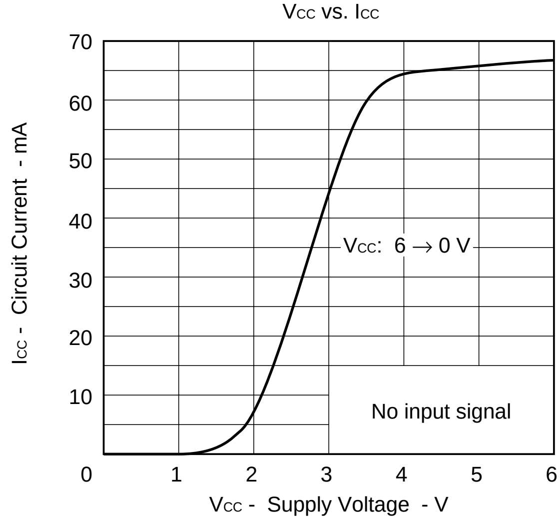
P_{in} vs. P_{out} (MIXER)

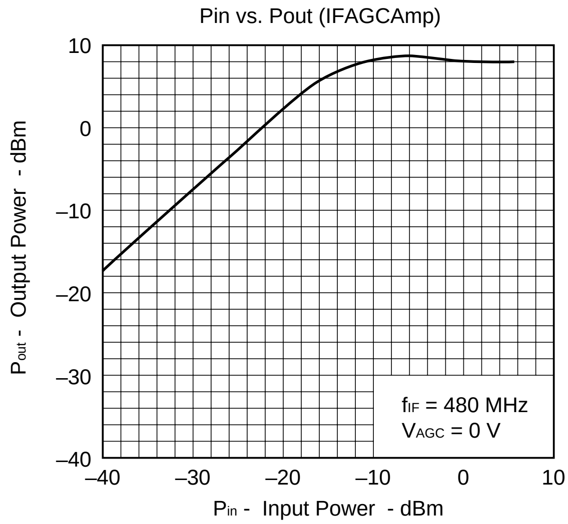


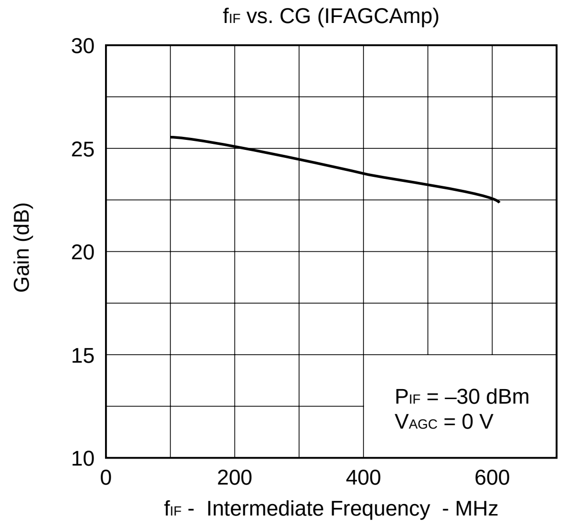
f_{RF} vs. NF (MIXER)

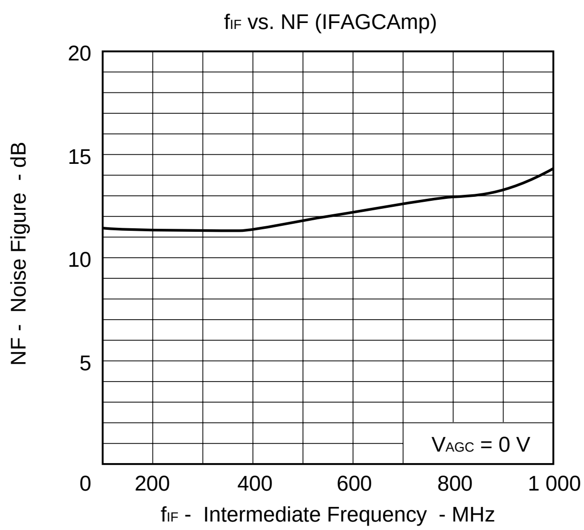


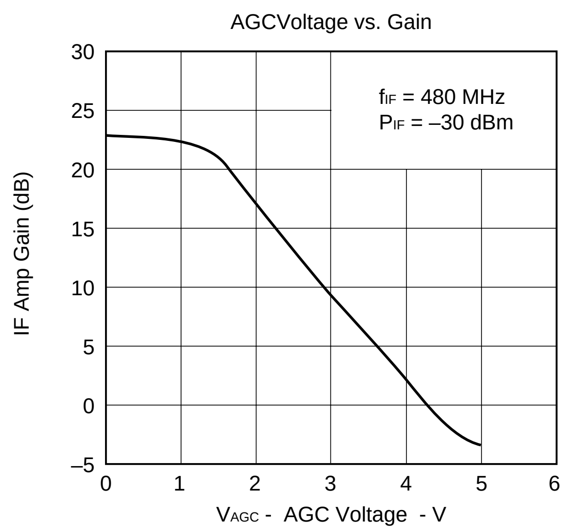
V_{CC} vs. I_{CC}



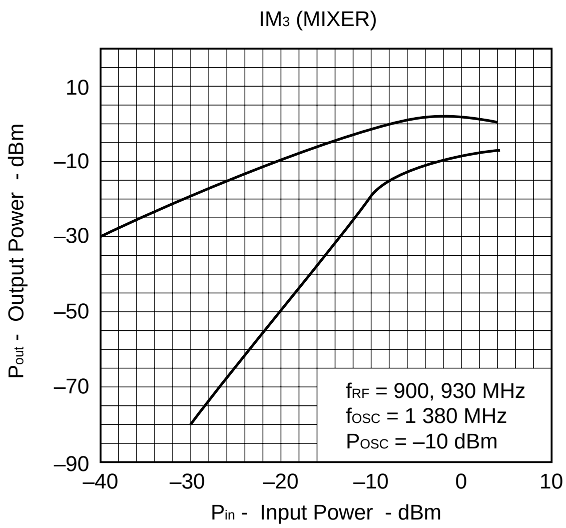

Pin vs. Pout (IFAGCAmp)
10
0
–10
–20
–30
–40
–40
–30
–20
–10
0
10
Pout - Output Power - dBm
Pin - Input Power - dBm
fIF = 480 MHz
VAGC = 0 V

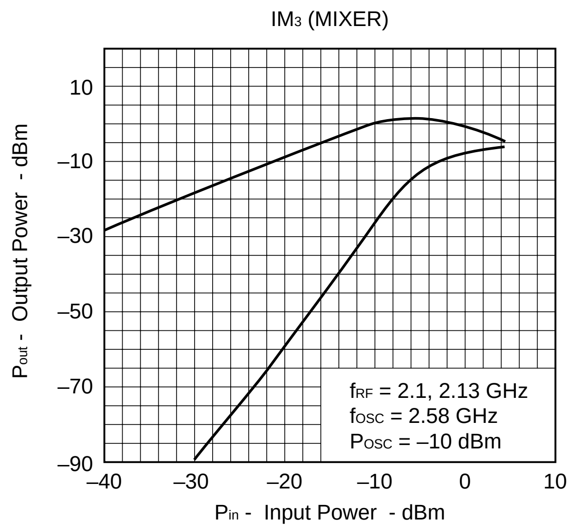

fIF vs. CG (IFAGCAmp)
30
25
20
15
10
0
200
400
600
Gain (dB)
fIF - Intermediate Frequency - MHz
PIF = –30 dBm
VAGC = 0 V

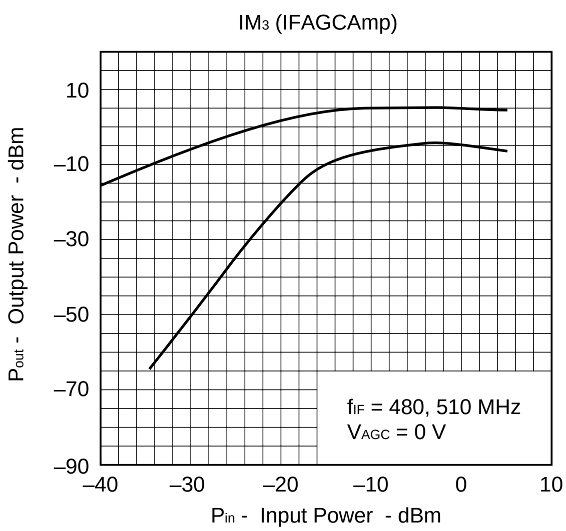

fIF vs. NF (IFAGCAmp)
20
15
10
5
0
200
400
600
800
1 000
NF - Noise Figure - dB
fIF - Intermediate Frequency - MHz
VAGC = 0 V

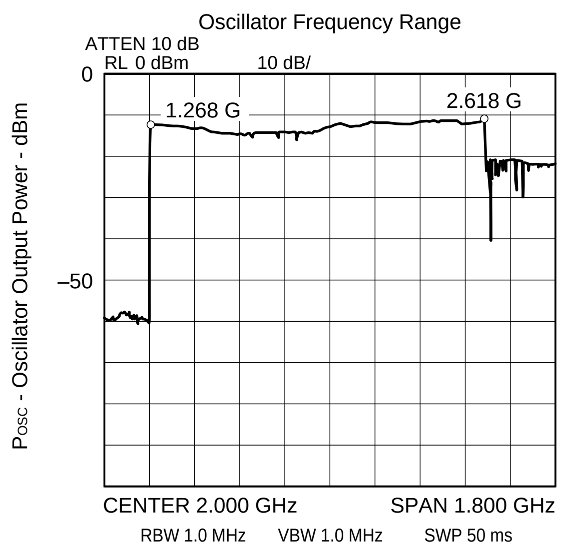

AGCVoltage vs. Gain
30
25
20
15
10
5
0
–5
0
1
2
3
4
5
6
IF Amp Gain (dB)
VAGC - AGC Voltage - V
fIF = 480 MHz
PIF = –30 dBm

Standard Characteristics (V_{CC} = 5 V, T_A = 25 °C)



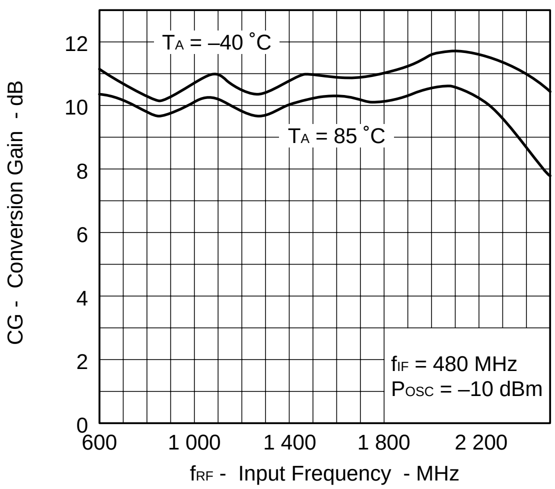




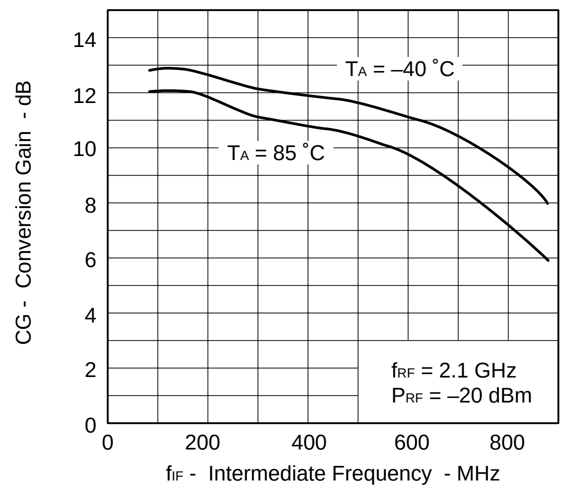


Standard Characteristics (V_{CC} = 5 V, T_A = –40 °C, 85 °C)

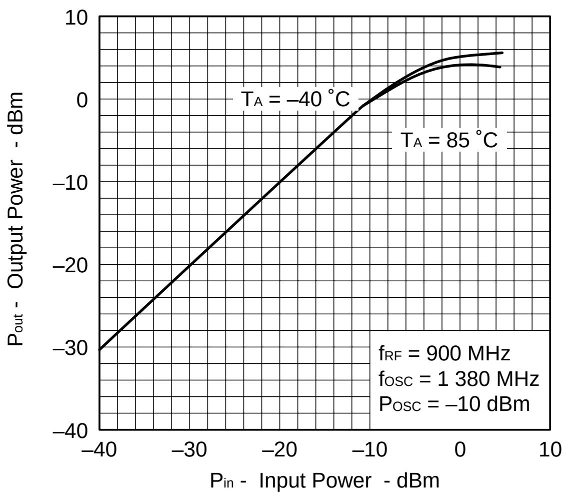
f_{RF} vs. CG (MIXER)



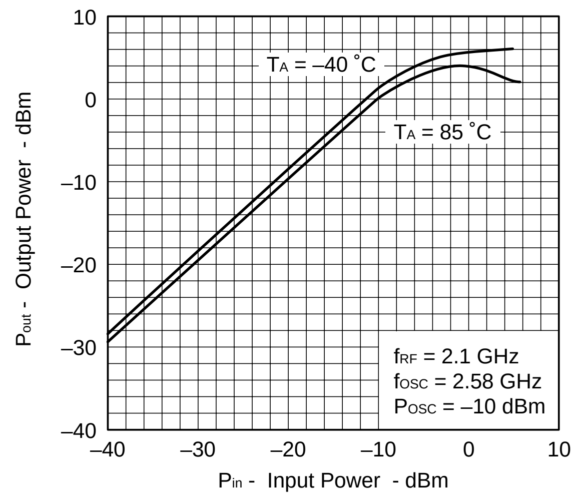
f_{IF} vs. CG (MIXER)



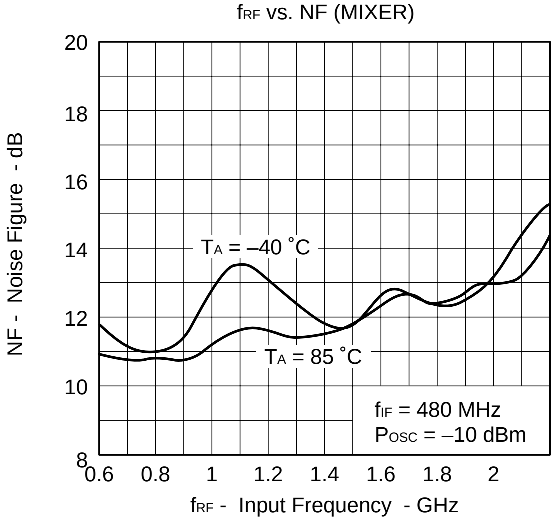
P_{in} vs. P_{out} (MIXER)



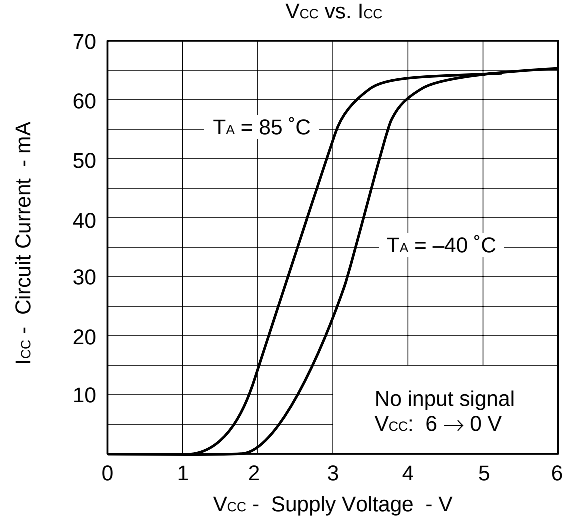
P_{in} vs. P_{out} (MIXER)

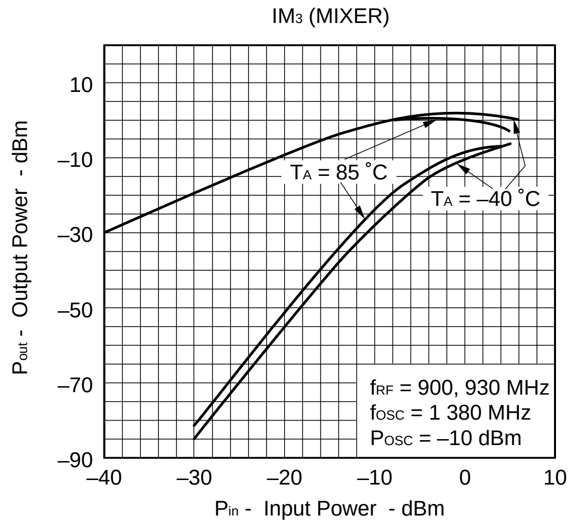


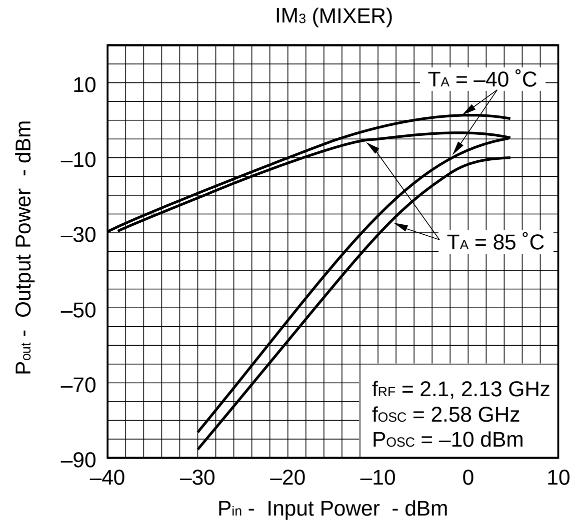
f_{RF} vs. NF (MIXER)

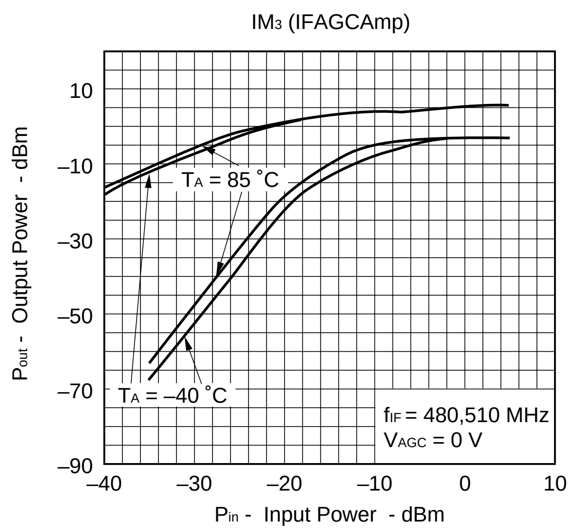


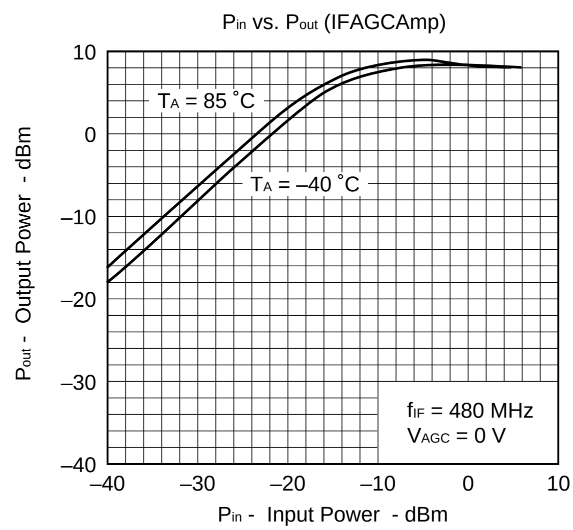
V_{CC} vs. I_{CC}

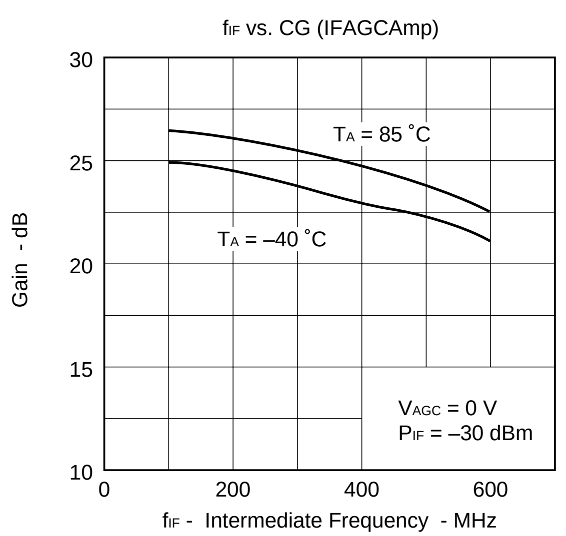


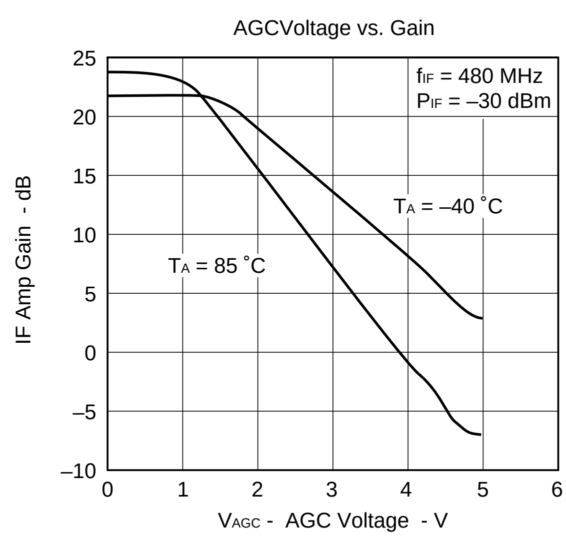

IM3 (MIXER)
TA = 85 °C
TA = –40 °C
fRF = 900, 930 MHz
fOSC = 1 380 MHz
POSC = –10 dBm
Pout - Output Power - dBm
Pin - Input Power - dBm
10
–10
–30
–50
–70
–90
–40
–30
–20
–10
0
10


IM3 (MIXER)
TA = –40 °C
TA = 85 °C
fRF = 2.1, 2.13 GHz
fOSC = 2.58 GHz
POSC = –10 dBm
Pout - Output Power - dBm
Pin - Input Power - dBm

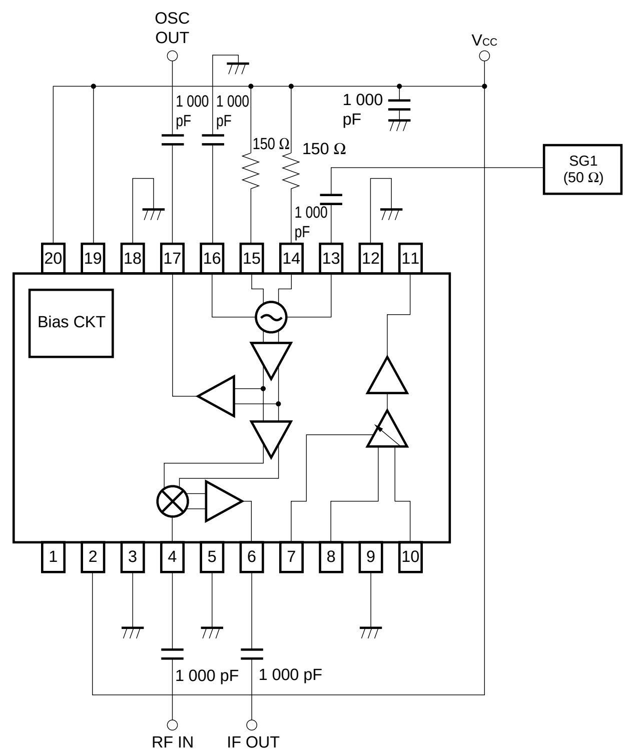

IM3 (IFAGCAmp)
TA = 85 °C
TA = –40 °C
fIF = 480,510 MHz
VAGC = 0 V
Pout - Output Power - dBm
Pin - Input Power - dBm


Pin vs. Pout (IFAGCAmp)
TA = 85 °C
TA = –40 °C
fIF = 480 MHz
VAGC = 0 V
Pout - Output Power - dBm
Pin - Input Power - dBm

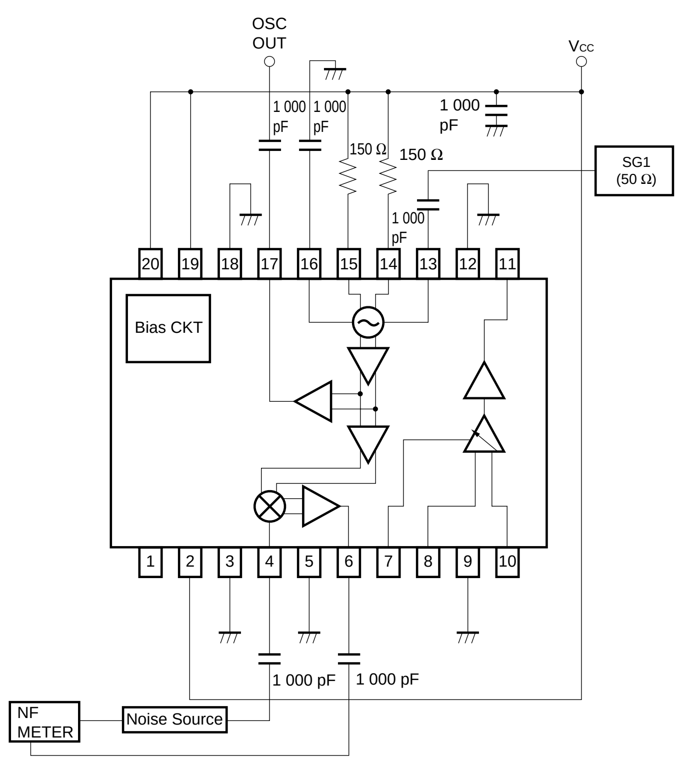

fIF vs. CG (IFAGCAmp)
TA = 85 °C
TA = –40 °C
VAGC = 0 V
PIF = –30 dBm
Gain - dB
fIF - Intermediate Frequency - MHz


AGCVoltage vs. Gain
fIF = 480 MHz
PIF = –30 dBm
TA = –40 °C
TA = 85 °C
IF Amp Gain - dB
VAGC - AGC Voltage - V

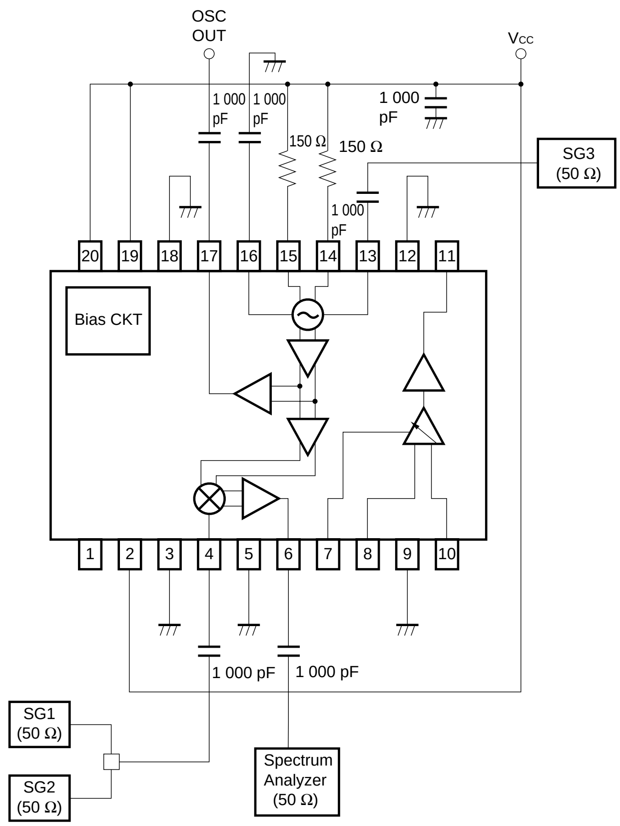
Measurement Circuit 1



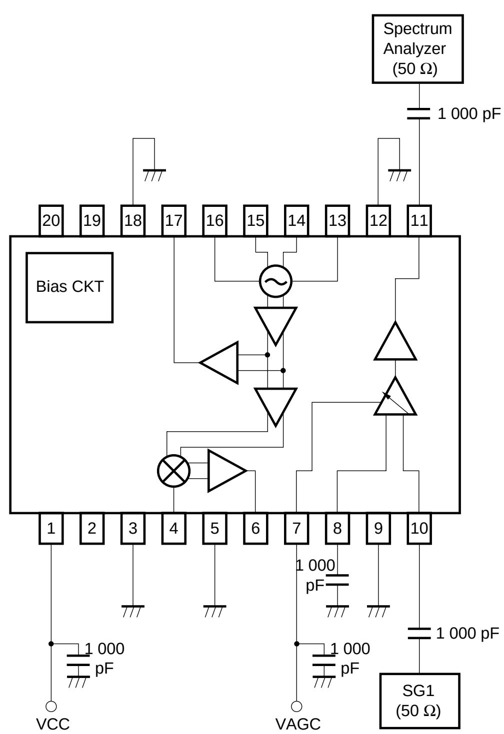
Measurement Circuit 2



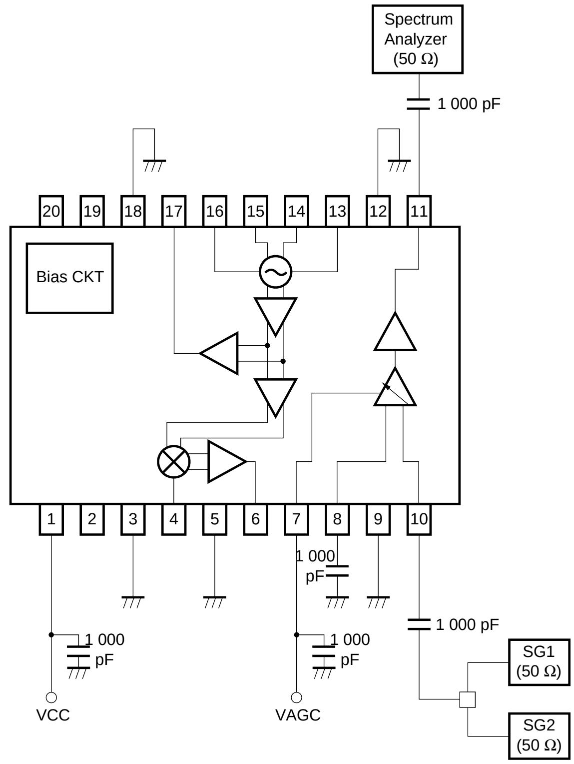
Measurement Circuit 3



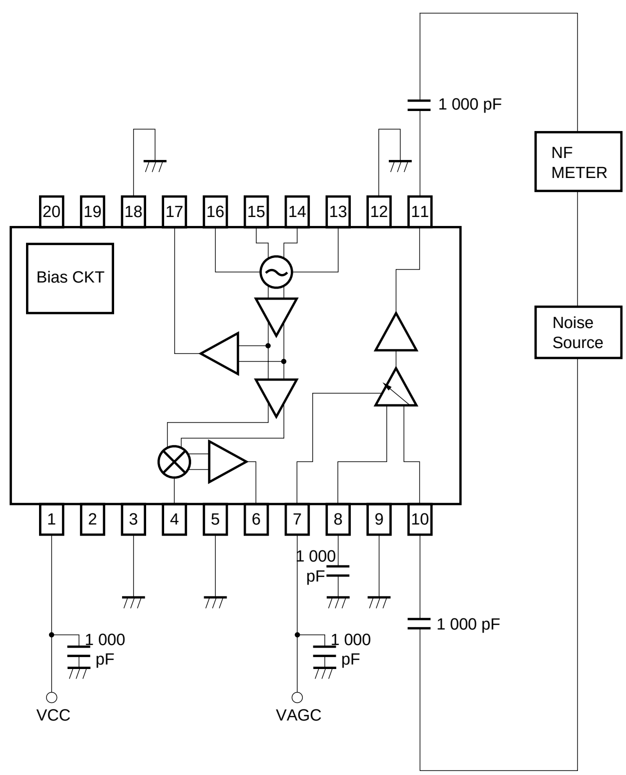
Measurement Circuit 4



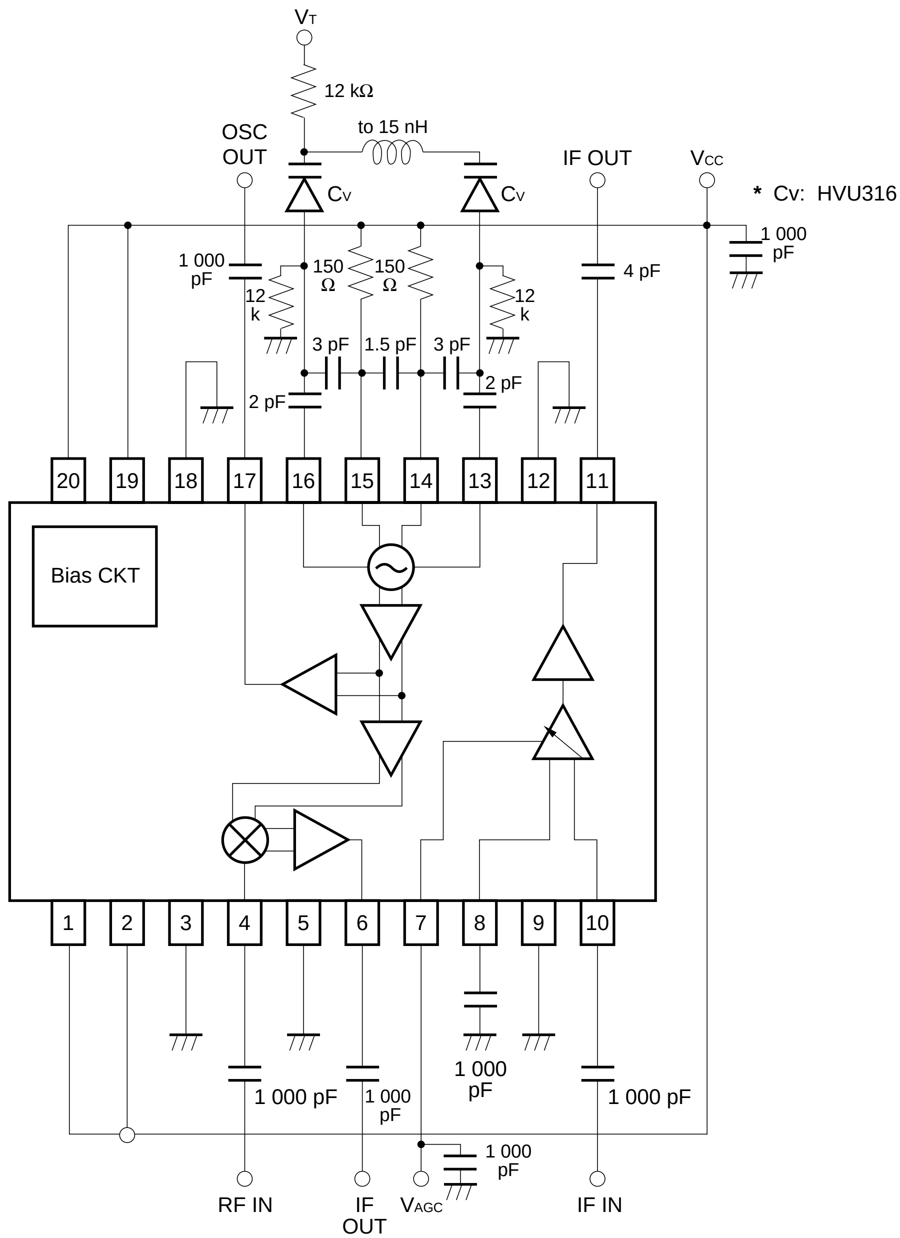
Measurement Circuit 5



Measurement Circuit 6

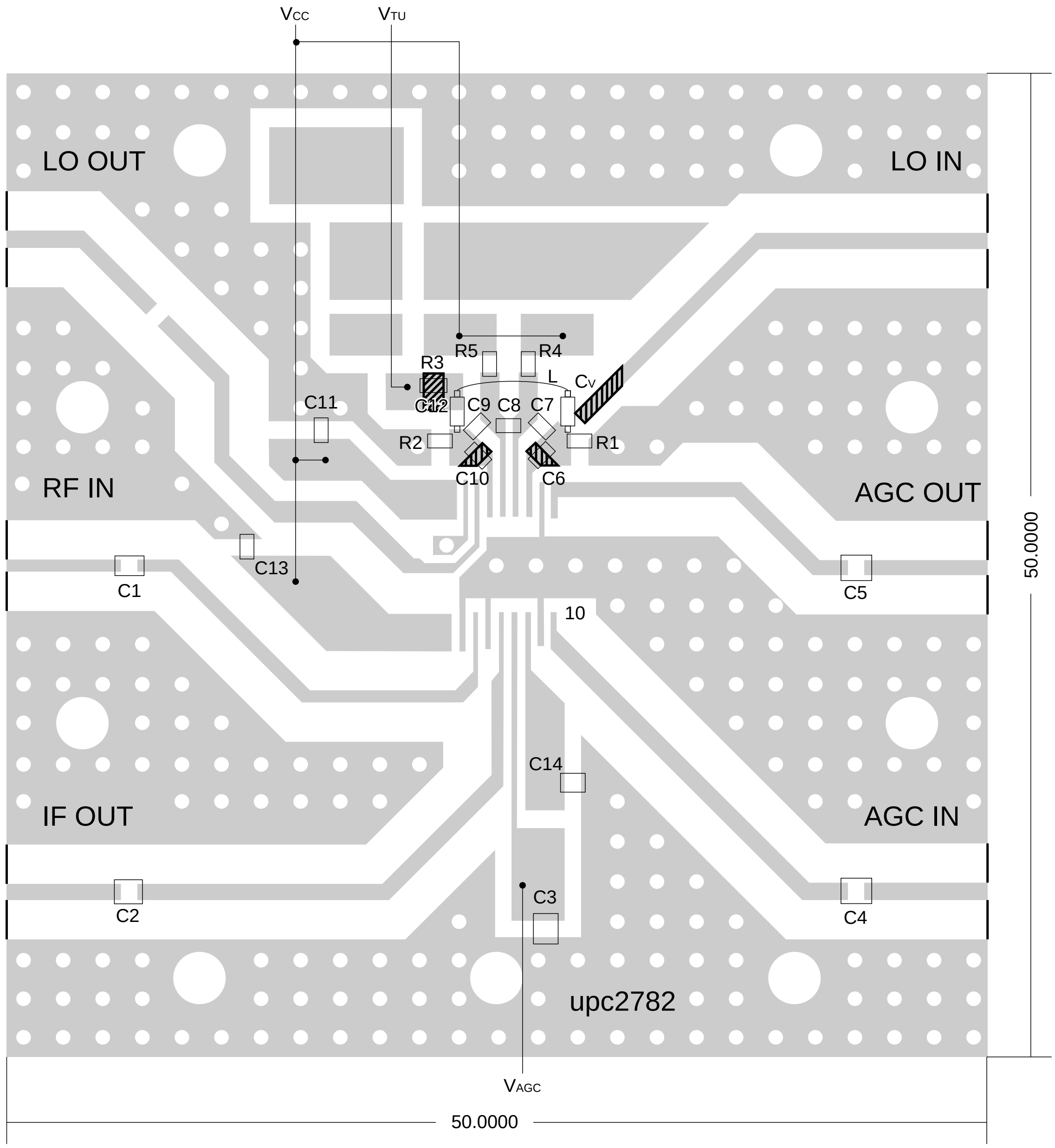


Application Circuit Example

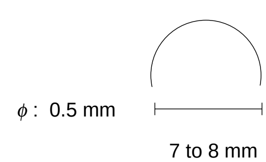


The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

Illustration of The Application Circuit Assembled on Evaluation Board



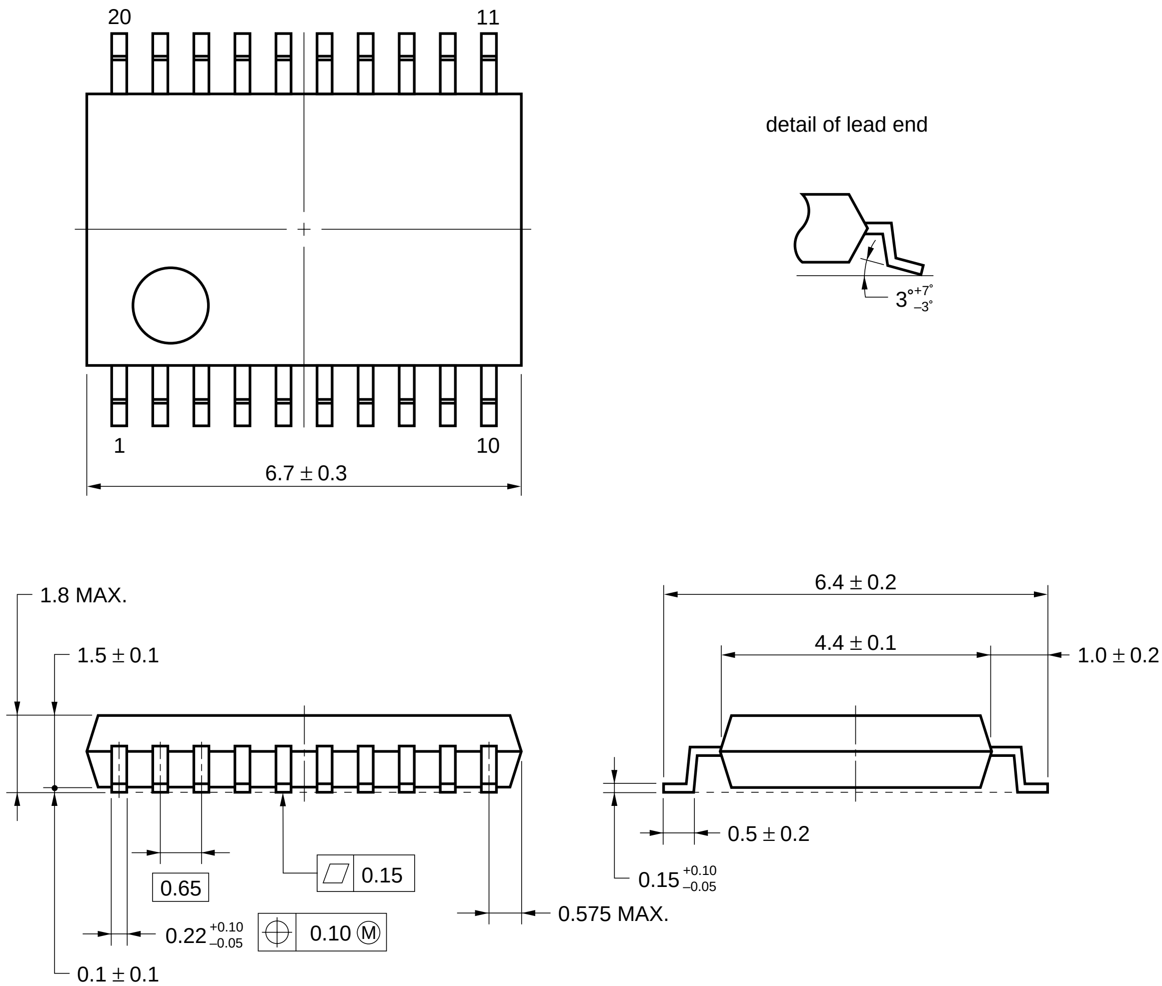
C1 to C5	:	1 000 pF
C6, C10	:	2 pF
C7, C9	:	3 pF
C8	:	1.5 pF
C11 to C14	:	1 000 pF
R1 to R3	:	12 kΩ
R4, R5	:	150 Ω
C_V	:	HVU316
L	:	to 15 nH



* [hatched box] pattern should be removed on this application

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.

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).

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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[Note]: 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[Note]: 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[Note] : None	WS60-00-1
Partial heating method	Terminal temperature: 300 °C or below, Flow time: 3 seconds or below, Exposure limit[Note]: 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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  "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.

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