

#### FEATURES

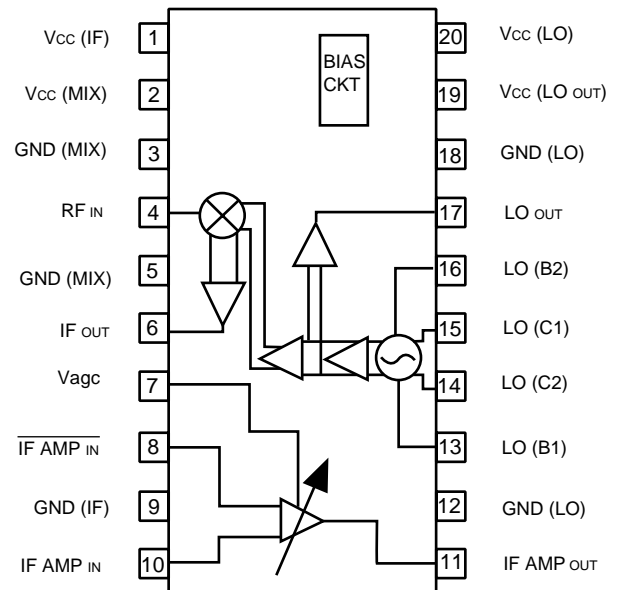
- **WIDEBAND OPERATION:** 900 - 2100 MHz
- **HIGH DYNAMIC RANGE:** +4.5 dBm IIP<sub>3</sub>
- **HIGH LO-RF ISOLATION:** -40 dBm Leakage
- **VARIABLE GAIN IF AMP:** 25 dB Control Range
- **INTERNAL LO**
- **SMALL 20 PIN SSOP PACKAGE**
- **TAPE AND REEL PACKAGING OPTION AVAILABLE**

#### DESCRIPTION

The UPC2782GR is a Silicon Monolithic Microwave Integrated Circuit manufactured using the NESAT III process. This process produces transistors with  $f_T$  of 20 GHz. This device consists of a Gilbert cell mixer, two stages of LO buffering, local oscillator, external filter port, a high output variable gain IF amp, and a temperature compensation circuit. The device was specifically designed for digital satellite receivers, WLAN's, and other digital receiver applications.

NEC's stringent quality assurance and test procedures assure the highest reliability and performance.

#### INTERNAL BLOCK DIAGRAM



#### ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, V<sub>CC</sub> = 5V, P<sub>LO</sub> = -10 dBm, Z<sub>L</sub> = Z<sub>s</sub> = 50 Ω unless otherwise specified)

PART NUMBER PACKAGE OUTLINE			UPC2782GR S20			
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	
I <sub>CC</sub>	Circuit Current	mA	46	66	78	
f <sub>rFin</sub>	RF Frequency Response, P <sub>rFin</sub> = -20dBm, f <sub>iF</sub> = 480 MHz, -3 dB down	GHz	0.9		2.1	
f <sub>iFout</sub>	IF Frequency Response, P <sub>rFin</sub> = -20 dBm, f <sub>rF</sub> = 2.1 GHz, -3 dB down	MHz	150		500	
Mixer Section	CG	Conversion Gain <sup>1</sup> , f <sub>rF</sub> = 900 MHz, f <sub>LO</sub> = 1380 MHz	dB	7	10	13
		f <sub>rF</sub> = 2.1 GHz, f <sub>LO</sub> = 2.58 GHz	dB	8	11	14
	P <sub>SAT</sub>	Saturated Output Power <sup>2</sup> , f <sub>rF</sub> = 900 MHz, f <sub>LO</sub> = 1380 MHz	dBm	+2	+5	
		f <sub>rF</sub> = 2.1 GHz, f <sub>LO</sub> = 2.58 GHz	dBm	+2	+5	
	NF	Noise Figure, f <sub>rF</sub> = 900 MHz	dB		11	14
		f <sub>rF</sub> = 2.1 GHz	dB		13.5	16.5
	IIP <sub>3</sub>	Input 3rd Order Intercept Point, f <sub>rF</sub> = 900, 930 MHz, f <sub>LO</sub> = 1380 MHz	dBm		0	
		f <sub>rF</sub> = 2.1, 2.13 GHz, f <sub>LO</sub> = 2.58 GHz	dBm		+4.5	
	IM <sub>3</sub>	Two-Tone 3rd Order Intermod Level,	dBc		50	
		f <sub>rF</sub> = 900, 930 MHz, P <sub>rF</sub> = -25 dBm each, f <sub>LO</sub> = 1380 MHz	dBc		59	
	f <sub>rF</sub> = 2.1, 2.13 GHz, P <sub>rF</sub> = -25 dBm each, f <sub>LO</sub> = 2.58 GHz	dBc				
PL <sub>Out</sub>	Internal LO Output Power (pin 17), f <sub>LO</sub> = 1.9 GHz	dBm		-15		
LO <sub>LRF</sub>	LO Leakage to RF Pin, f <sub>LO</sub> = 1.0 ~ 2.6 GHz	dBm		-40		
LO <sub>LIF</sub>	LO Leakage to IF Pin, f <sub>LO</sub> = 1.0 ~ 2.6 GHz	dBm		-20		
PN	SSB Phase Noise, 10 KHz Offset	dBc/Hz		-75		
f <sub>OSC</sub>	Oscillator Frequency Range	GHz	1.3		2.6	

**ELECTRICAL CHARACTERISTICS (con't)** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{V}$ ,  $P_{LO} = -10\text{ dBm}$ ,  $Z_L = Z_S = 50\ \Omega$  unless otherwise specified)

PART NUMBER PACKAGE OUTLINE			UPC2782GR S20			
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	
IF AGC Section	GIF	Gain, $f_{IF} = 480\text{ MHz}$ , $P_{IF} = -30\text{ dBm}$ , $V_{AGC} = 0\text{ V}$	dB	20	23	26
	PSAT, IF	Saturated Output Power, $f_{IF} = 480\text{ MHz}$ , $P_{IF} = 0\text{ dBm}$ , $V_{AGC} = 0\text{ V}$	dBm	+5	+8	
	$\Delta G_{AGC}$	Gain Control Range, $f_{IF} = 480\text{ MHz}$ , $P_{IF} = -30\text{ dBm}$ , $V_{AGC} = 0\text{--}5\text{ V}$	dB	20	25	
	NF <sub>IF</sub>	Noise Figure, $f_{IF} = 480\text{ MHz}$ , $V_{AGC} = 0\text{ V}$	dB		12	15
	RL <sub>IFin</sub>	IF Input Return Loss	dB		12	
	RL <sub>IFout</sub>	IF Output Return Loss	dB		12	
	OIP <sub>3</sub>	IF Output 3rd Order Intercept Point, $f_{IF} = 480, 510\text{ MHz}$ , $P_{OUT} = -5\text{ dBm}$ , $V_{AGC} = 0\text{ V}$	dBm		+15.5	

Notes:

1.  $P_{RFin} = -30\text{ dBm}$
2.  $P_{RFin} = 0\text{ dBm}$

**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** ( $T_A = 25^\circ\text{C}$ )

SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>CC</sub>	Supply Voltage	V	6.0
P <sub>D</sub>	Power Dissipation <sup>2</sup>	mW	430
T <sub>OP</sub>	Operating Temperature	°C	-40 to +85
T <sub>STG</sub>	Storage Temperature	°C	-55 to +150

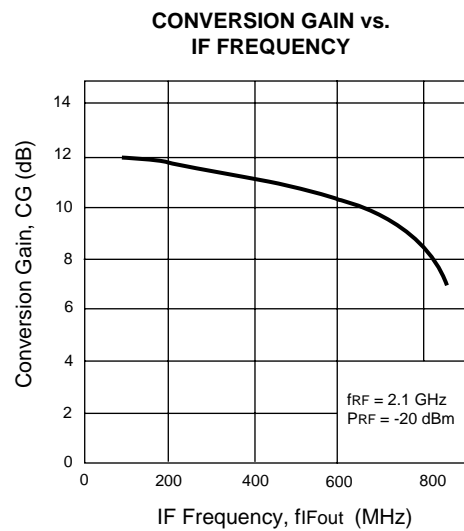
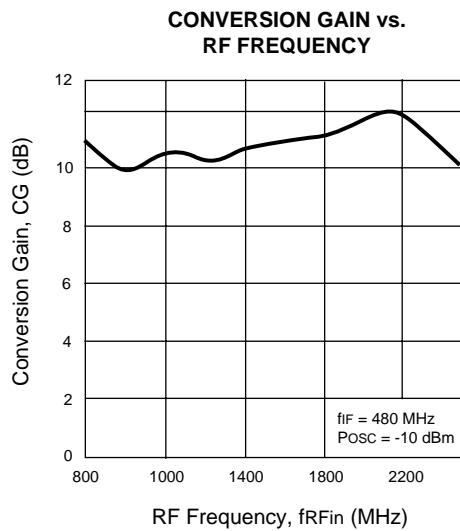
Notes:

1. Operation in excess of any one of these parameters may result in permanent damage.
2. Mounted on a 50 x 50 x 1.6 mm epoxy glass PWB ( $T_A = +85^\circ\text{C}$ ).

**RECOMMENDED  
OPERATING CONDITIONS**

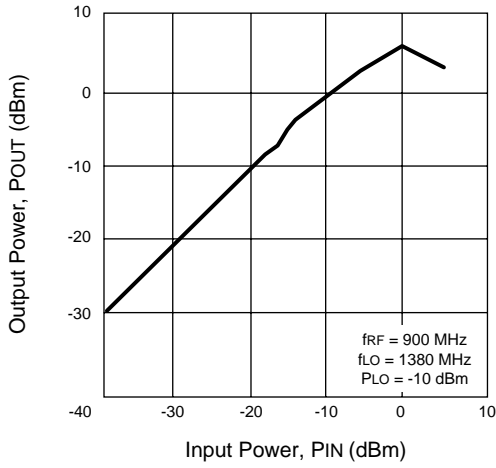
SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
V <sub>CC</sub>	Supply Voltage	V	4.5	5.0	5.5
T <sub>OP</sub>	Operating Temperature	°C	-40	+25	+85
P <sub>LOin</sub>	LO Input Level	dBm	-15	-10	0
f <sub>RFin</sub>	RF Input Frequency	GHz	0.9		2.5
f <sub>IFout</sub>	IF Output Frequency	MHz	150		500

**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{ V}$ )

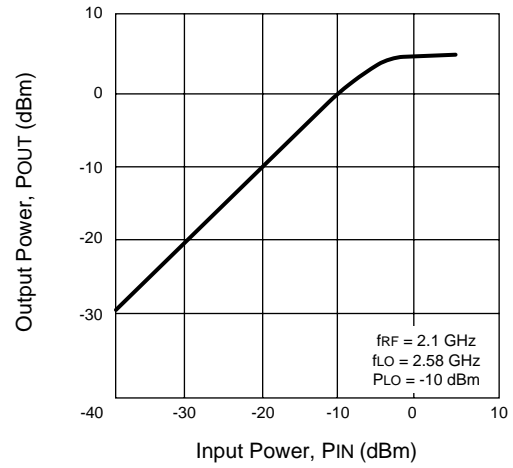


**TYPICAL PERFORMANCE CURVES** (TA = 25°C, VCC = 5 V)

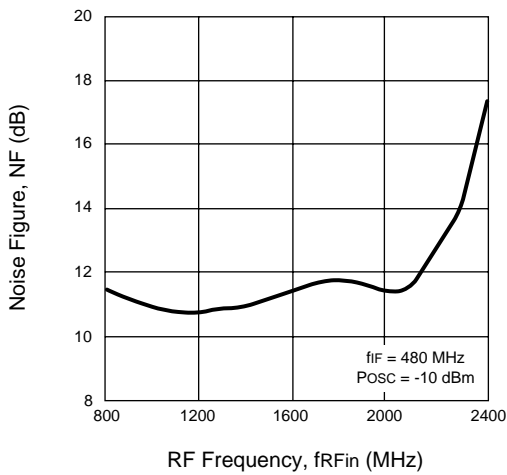
**OUTPUT POWER vs. INPUT POWER (MIXER)**



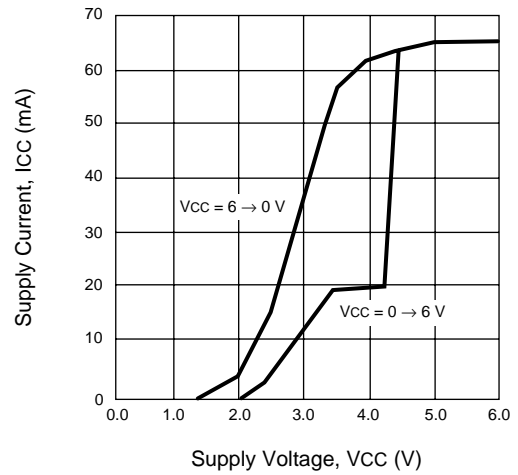
**OUTPUT POWER vs. INPUT POWER (MIXER)**



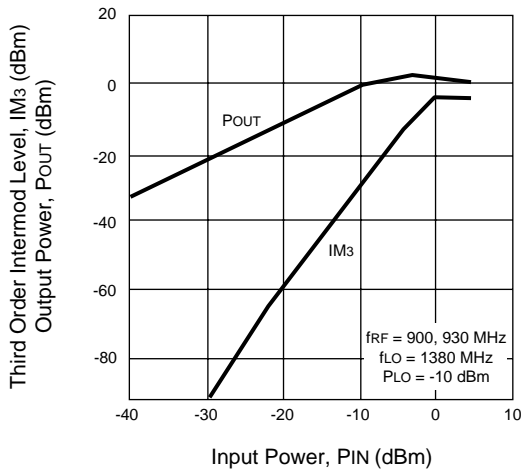
**NOISE FIGURE vs. RF FREQUENCY (MIXER)**



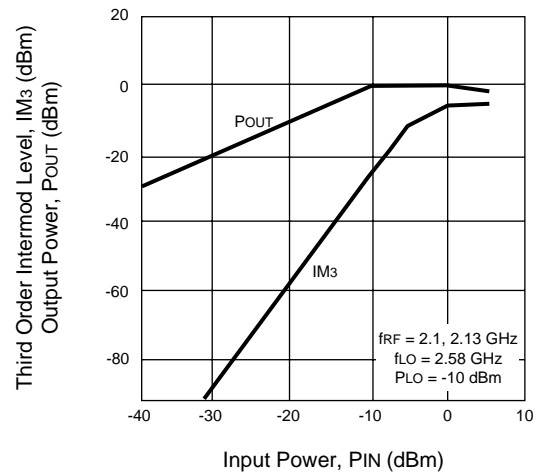
**SUPPLY CURRENT vs. SUPPLY VOLTAGE**



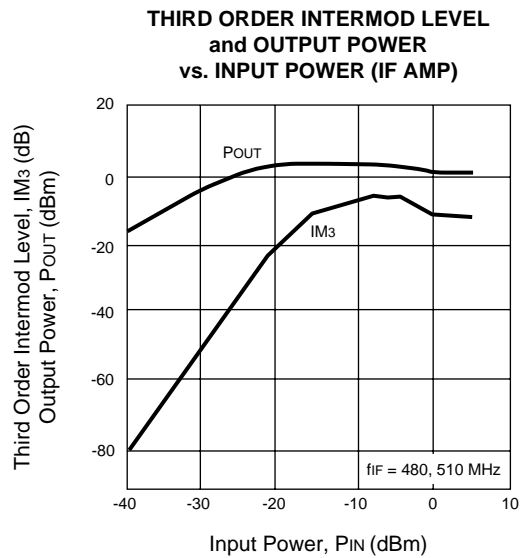
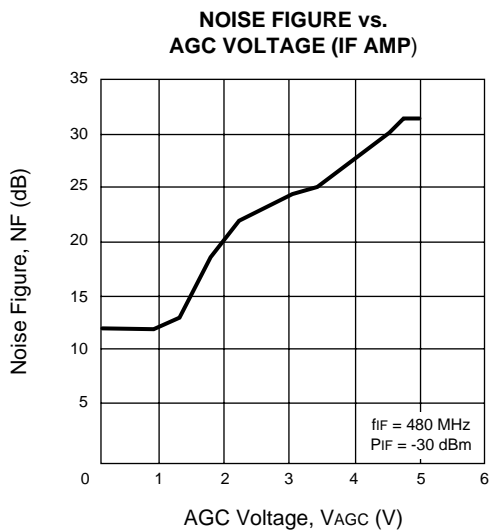
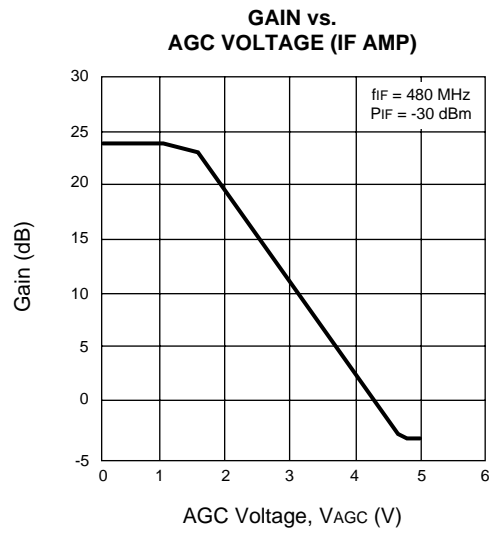
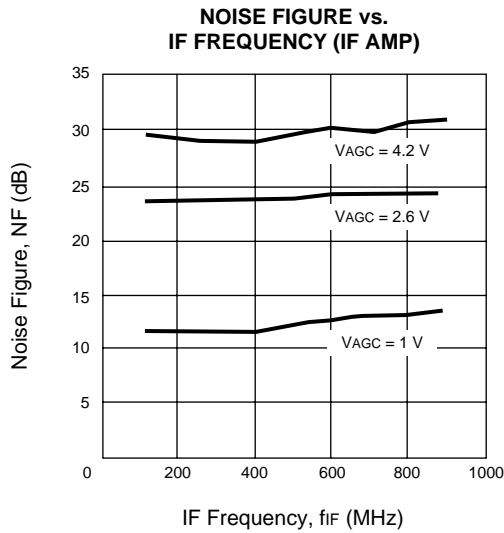
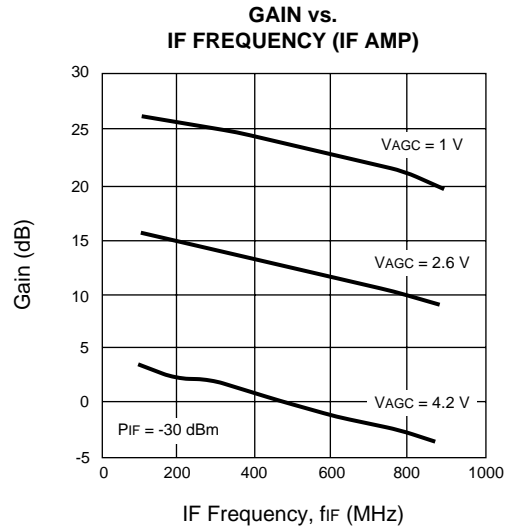
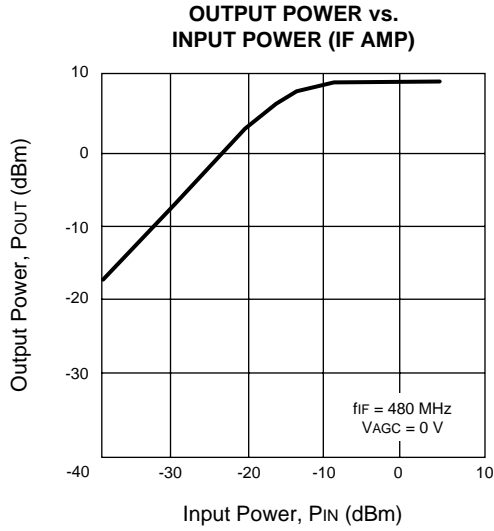
**THIRD ORDER INTERMOD LEVEL and OUTPUT POWER vs. INPUT POWER (MIXER)**



**THIRD ORDER INTERMOD LEVEL and OUTPUT POWER vs. INPUT POWER (MIXER)**



TYPICAL PERFORMANCE CURVES (TA = 25°C, VCC = 5 V)



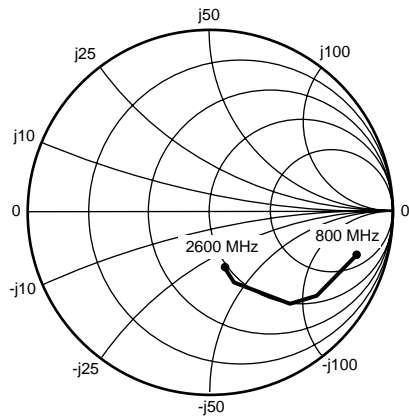
## PIN CONNECTIONS

PIN NO.	SYMBOL	PIN VOLT TYP (V)	FUNCTIONS AND EXPLANATION	EQUIVALENT CIRCUIT
1	Vcc (IF)	5.00	Power supply pin of IF AGC Amp.	
2	Vcc (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	VAGC	0 to 5	Gain control pin. This pin's bias governs the AGC output level. Maximum gain at VAGC = 0 V Minimum gain at VAGC = 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 a 1000 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 CONNECTIONS

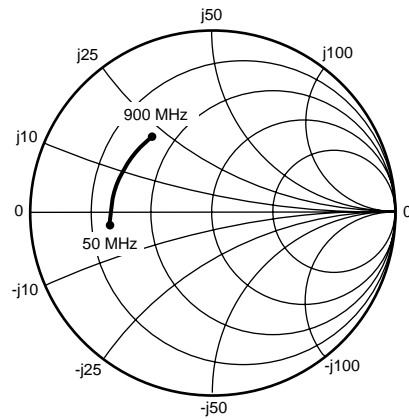
PIN NO.	SYMBOL	PIN VOLT TYP (V)	FUNCTIONS AND EXPLANATION	EQUIVALENT CIRCUIT
11	IF OUT	2.55	Output pin of IF AGC Amp. This pin is assigned for emitter follower push-pull output.	
12	GND (LO)	0.00	Ground pin of oscillator amplifier. Buffer amplifier, oscillator output.	
13	LO (B1)	2.30	Base Pin of oscillator. Connected to 14 pin through a capacitor.	
14	LO (C2)	5.00	Collector pin of oscillator. Connected to 15 pin through capacitor. Oscillator frequency bandwidth is dependent on this capacitor. This pin should be connected to Vcc through a 150 Ω resistor.	
15	LO (C1)	5.00	Collector pin of oscillator. Connected to 14 pin through capacitor. This pin should be connected to Vcc through a 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.	

**PORT IMPEDANCES**



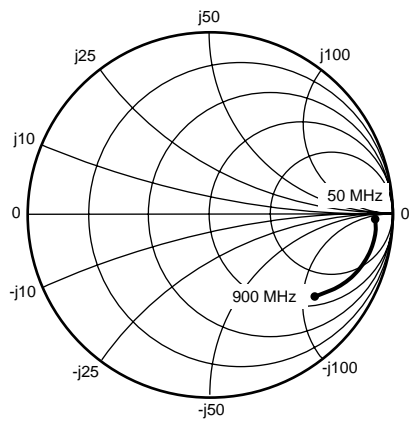
**RFin (PIN 4)**

<u>f (MHz)</u>	<u>MAG</u>	<u>ANG</u>
800	0.849	-13.9
1000	0.820	-18.4
1200	0.791	-24.0
1400	0.767	-30.2
1600	0.718	-38.9
1800	0.635	-45.9
2000	0.567	-53.0
2200	0.485	-58.6
2400	0.402	-66.3
2600	0.290	-76.2



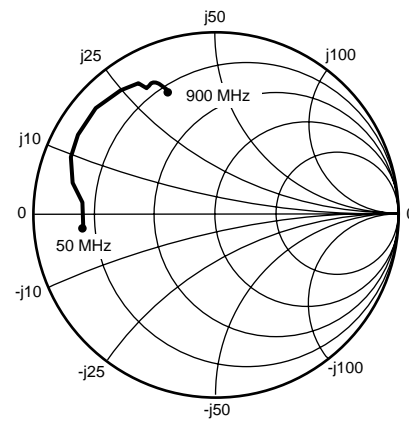
**IFout (PIN 6)**

<u>f (MHz)</u>	<u>MAG</u>	<u>ANG</u>
50	0.586	-175.3
100	0.562	174.9
200	0.571	165.0
300	0.566	156.4
400	0.559	149.6
500	0.560	144.1
600	0.550	139.5
700	0.548	135.8
800	0.540	132.9
900	0.538	130.6



**IF AMPin (PIN 10)**

<u>f (MHz)</u>	<u>MAG</u>	<u>ANG</u>
50	0.894	-1.7
100	0.890	-3.6
200	0.891	-5.9
300	0.890	-9.6
400	0.884	-13.6
500	0.868	-17.9
600	0.839	-22.2
700	0.805	-26.2
800	0.769	-29.8
900	0.737	-33.0

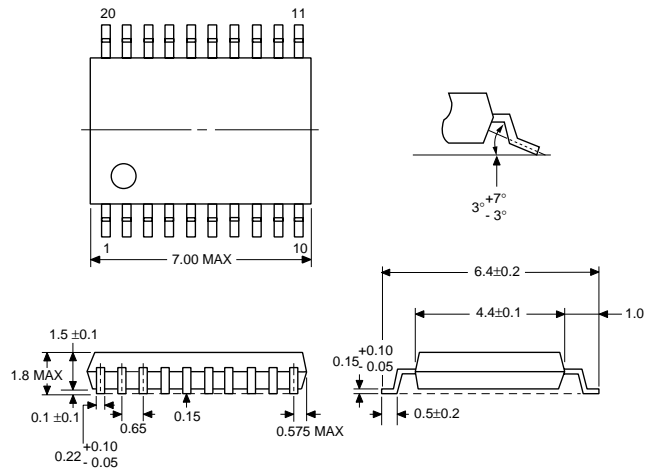


**IF AMPout (PIN 11)**

<u>f (MHz)</u>	<u>MAG</u>	<u>ANG</u>
50	0.750	-173.7
100	0.755	178.5
200	0.802	171.0
300	0.847	161.2
400	0.865	151.4
500	0.875	142.7
600	0.864	134.0
700	0.830	128.2
800	0.799	121.1
900	0.791	115.4

**OUTLINE DIMENSIONS** (Units in mm)

**PACKAGE OUTLINE S20**

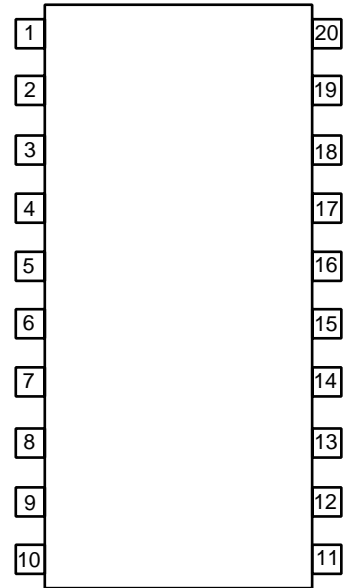


Lead Material: Alloy 42  
Lead Plating: Lead Tin Alloy

**ORDERING INFORMATION**

PART NUMBER	QTY
UPC2782GR-E1	2,500/Reel

**PIN CONNECTIONS**



**PIN CONNECTIONS:**

- |              |                 |
|--------------|-----------------|
| 1. Vcc (IF)  | 20. Vcc (LO)    |
| 2. Vcc (MIX) | 19. Vcc (LOOUT) |
| 3. GND (MIX) | 18. GND (LO)    |
| 4. RFIN      | 17. LOOUT       |
| 5. GND (MIX) | 16. LO (B2)     |
| 6. IFOUT     | 15. LO (C1)     |
| 7. VAGC      | 14. LO (C2)     |
| 8. IF AMPIN  | 13. LO (B1)     |
| 9. GND (IF)  | 12. GND (LO)    |
| 10. IF AMPIN | 11. IF AMPOUT   |

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06/21/2000