NEC

500 MHz AM/ASK RECEIVER IC | UPC8116GR

FEATURES

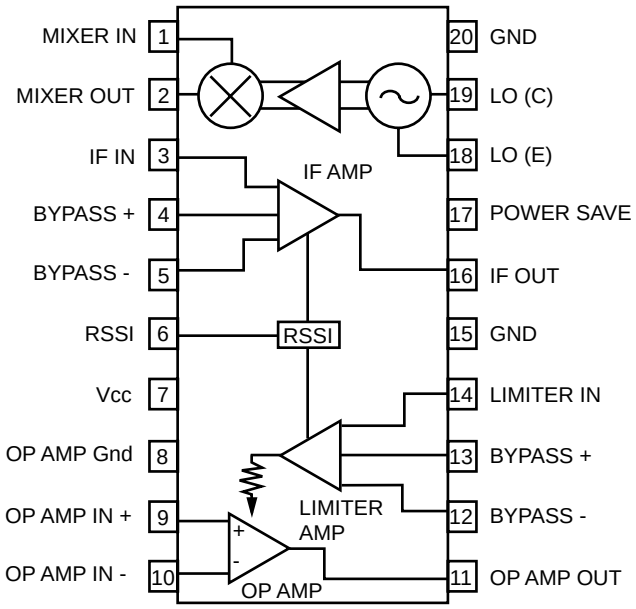
- **WIDEBAND RF & LO BANDWITH: 100~500 MHz**
- **HIGH GAIN: 118 dB Typical**
- **RSSI DYNAMIC RANGE: 70 dB**
- **LOW POWER DISSIPATION: 12 mW @ 3 V**
- **POWER SAVE FUNCTION**
- **SMALL PACKAGE: 20 pin SSOP**
- **AVAILABLE IN TAPE AND REEL**

DESCRIPTION AND APPLICATIONS

The UPC8116GR is a Si MMIC Wideband IF Receiver IC manufactured with the NESAT III silicon bipolar process. The IC consists of a mixer, on-chip oscillator, IF amplifier, limiter amplifier, OP amp, and built-in RSSI and power save functions. The device operates over a wide 2.7 to 5.5 V supply voltage range while drawing only 4 mA at 3 V. It is housed in a small 20 pin SSOP package. The device was specifically designed for use in low cost automotive keyless entry receivers, wireless security systems, UHF remote control, and other low power Part 15 applications.

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

INTERNAL BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS (T_A = 25°C, Vcc = Vps = 3 V, unless otherwise specified)

PART NUMBER PACKAGE OUTLINE			UPC8116GR S20		
SYMBOLS	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**
I_{CC}	Circuit Current, No Input Signal	mA	2.6	4.1	5.7
I_{PS}	Current in Power Save Mode, P_{IN} 17 grounded	μA			1.0
MIXER SECTION					
f_{RF}	RF Input Frequency Range, f_{IF} = 10.7 MHz, $f_{RF} > f_{LO}$	MHz	100		500
f_{LO}	LO Input Frequency Range, f_{IF} = 10.7 MHz, $f_{RF} > f_{LO}$	MHz	100		500
f_{IF}	IF Output Frequency Range, P_{in} = -80 dBm, -3 dB Down	MHz	0.3		15
CG	Mixer Conversion Gain, P_{RF} = -50 dBm, P_{LO} = -10 dBM f_{IF} = 10.7 MHz, Zs = 50 Ω	dB	3.5	6.5	11.2
$ISOL_{(LO-RF)}$	LO to RF Isolation, f_{LO} = 304.3 MHz, -10 dBm	dBc		40	
$ISOL_{(RF-LO)}$	RF to LO Isolation, f_{RF} = 315 MHz, -30 dBm	dBc		50	
NF	Noise Figure	dB		15	
IF SECTION					
G_{IF}	IF Amplifier Gain, f_{in} = 10.7 MHz, P_{in} = -80 dBm	dB	62	65	
RSSI	RSSI Sensitivity, f_{RF} = 315 MHz, f_{LO} = 304.3 MHz, P_{in} = -10 dBm	dBm		-100	-85
D_{RSSI}	RSSI Dynamic Range	dB		70	
$\Delta RSSI/\Delta P_{RF}$	RSSI Linearity, f_{RF} = 315 MHz, f_{LO} = 304.3 MHz, P_{in} = -10 dBm	dB		±2	
OP AMP					
f_{OP}	OP Amp Input Frequency Range, P_{in} = -50 dBm	KHz	200	500	800
G_{OP}	OP Amp Gain, f_{IN} = 200 KHz, P_{in} = -50 dBm	dB	50	57	

ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

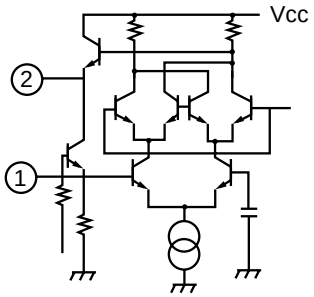
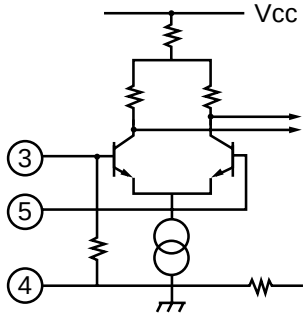
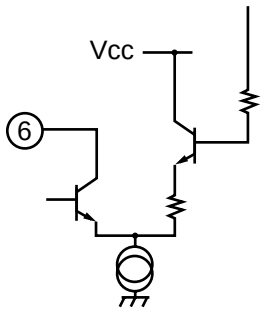
SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CC}	Supply Voltage	V	6.0
P_D	Power Dissipation[2]	mW	433
T_A	Operation Temperature	°C	-40 to +85
T_{STG}	Storage Temperature	°C	-55 to +150

Note:
1. Operation in excess of any one of these parameters may result in permanent damage.
2. Mounted on double-sided copper clad 50 x 50 x 1.6 mm epoxy glass PWB (T_A = +85°C).

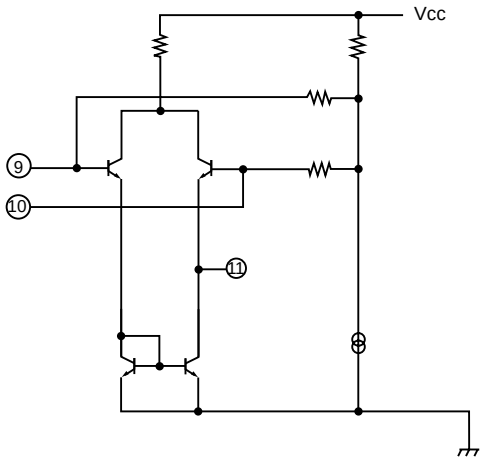
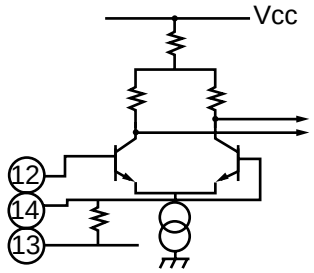
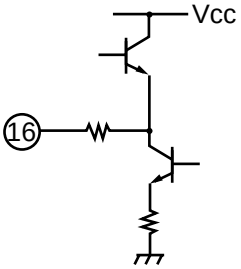
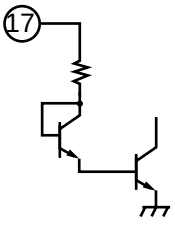
RECOMMENDED OPERATING CONDITIONS

SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
V_{CC}	Supply Voltage	V	2.7	3.0	5.5
T_A	Operating Temperature	°C	-40	+25	+85

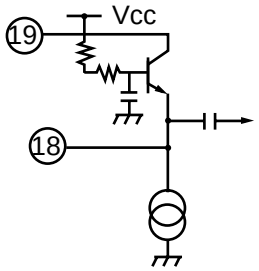
PIN DESCRIPTIONS

PIN NO.	SYMBOL	PIN VOLTAGE TYP (V)	DESCRIPTION	EQUIVALENT CIRCUIT
1	MIX IN	1.95	RF signal input pin.	
2	MIX OUT	2.1	Output pin of Mixer. This pin is an emitter follower output with low impedance.	
3	IF IN	2.38	IF signal input pin.	
4	BYPASS + (IF)	2.38	Bypass pin for IF Amplifier. Capacitor for filter should be connected between pin 4 and pin 5.	
5	BYPASS - (IF)	2.38		
6	RSSI OUT	0.9	RSSI signal output pin.	
7	Vcc	3.0	Power supply pin.	
8	GND	0.0	Ground pin for OP Amp.	

PIN DESCRIPTIONS (Continued)

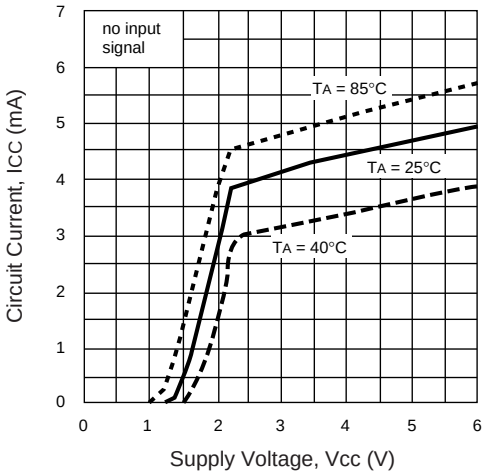
<table>
<tr><th>PIN NO.</th><th>SYMBOL</th><th>PIN VOLT TYP (V)</th><th>DESCRIPTION</th><th>EQUIVALENT CIRCUIT</th></tr>
<tr><td>9</td><td>OP Amp+</td><td>2.1</td><td rowspan="2">Input pin of OP Amp.
In case of single ended input, pin 9 or pin 10 should be grounded through a capacitor.</td><td rowspan="3">
</td></tr>
<tr><td>10</td><td>OP Amp-</td><td>2.1</td></tr>
<tr><td>11</td><td>OP Amp OUT</td><td>0.77</td><td>Output pin of OP Amp.
This pin is an emitter follower output.</td></tr>
<tr><td>12</td><td>BYPASS -</td><td>2.38</td><td rowspan="2">Bypass pin for OP Amp
Capacitor for filter should be connected between pin 12 and pin 13.</td><td rowspan="3">
</td></tr>
<tr><td>13</td><td>BYPASS +</td><td>2.38</td></tr>
<tr><td>14</td><td>LIM IN</td><td>2.38</td><td>Input pin of Limiter Amplifier.</td></tr>
<tr><td>15</td><td>GND</td><td>0.0</td><td>Ground pin for Limiter Amp., RSSI, and regulator.</td><td></td></tr>
<tr><td>16</td><td>IF OUT</td><td>1.55</td><td>IF signal output pin. If a crystal filter is used, it should be connected between pin 16 and pin 14.</td><td>
</td></tr>
<tr><td>17</td><td>Power Save</td><td>0 ~ 3</td><td>Power Save control pin.
The ON/SLEEP state bias voltage is:
<table><tr><td>PS (V)</td><td>STATE</td></tr><tr><td>Vcc</td><td>ON</td></tr><tr><td>GND</td><td>SLEEP</td></tr></table></td><td>
</td></tr>
</table>

PIN DESCRIPTIONS (Continued)

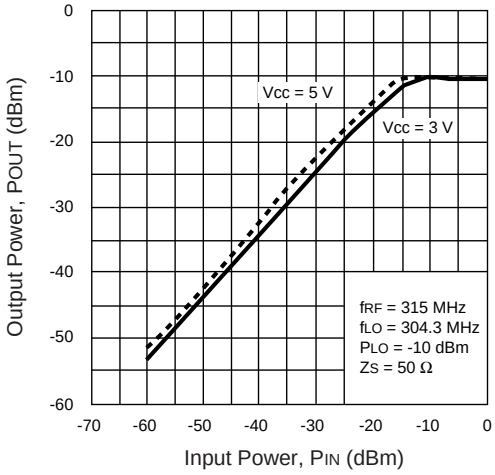
PIN NO.	SYMBOL	PIN VOLT TYP (V)	DESCRIPTION	EQUIVALENT CIRCUIT
18	LO (E)	1.31	Oscillator signal input pins. Oscillator circuit should be connected between pin 18 and pin 19.	
19	LO (C)	3.0		
20	GND	0.0	Ground pin for MIXER, IF Amplifier, and Oscillator.	

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

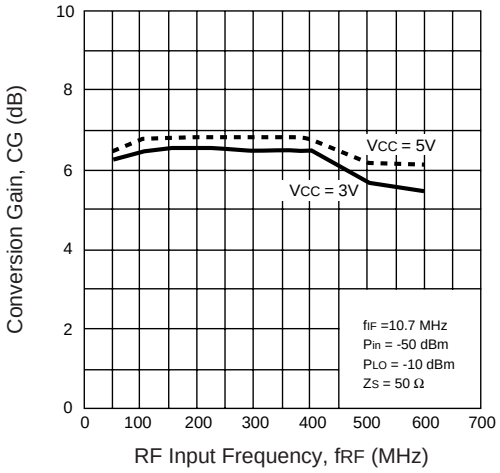
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



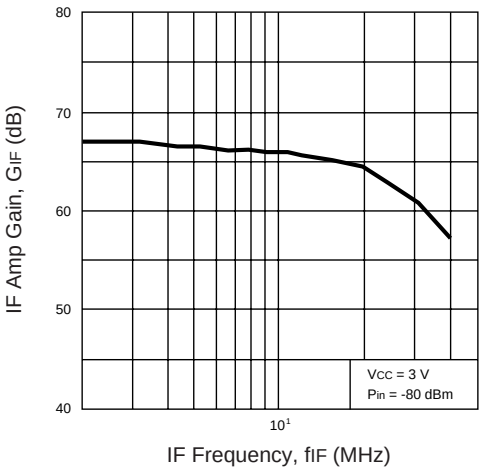
OUTPUT POWER vs. INPUT POWER



CONVERSION GAIN (MIXER) vs. RF FREQUENCY

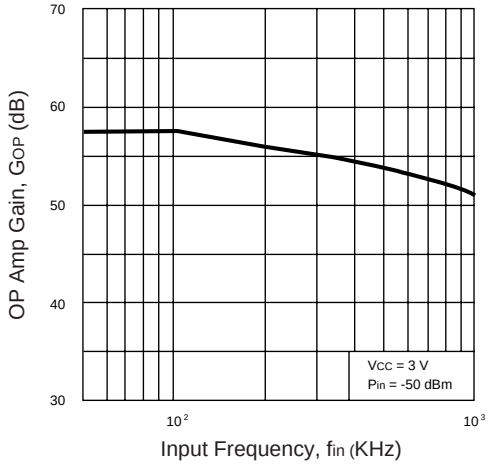


Gain (IF Amp.) vs. IF FREQUENCY

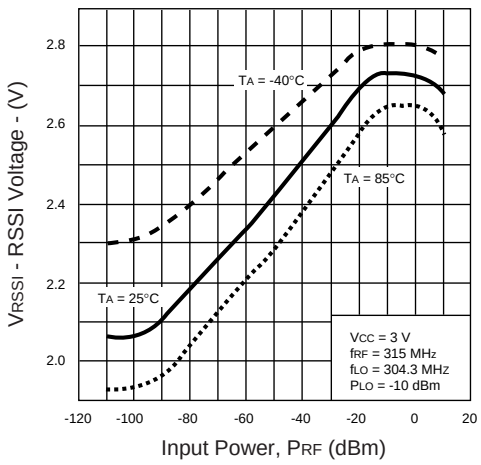


TYPICAL PERFORMANCE CURVES (T_A = 25°C)

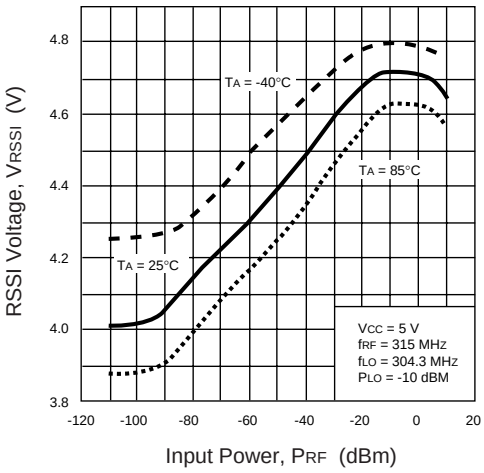
Gain (OP Amp) vs. INPUT FREQUENCY



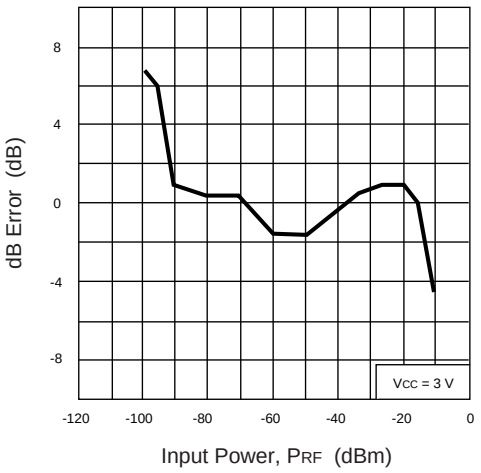
RSSI VOLTAGE vs. RF INPUT POWER



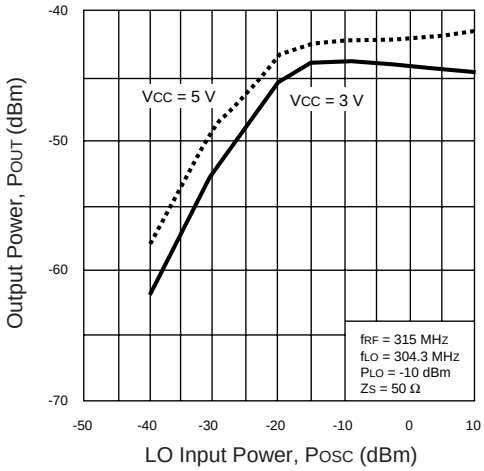
RSSI VOLTAGE vs. RF INPUT POWER



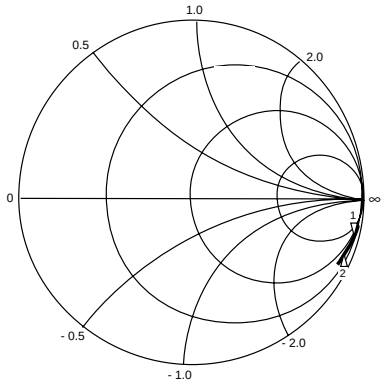
RSSI Linearity vs. RF Input Power



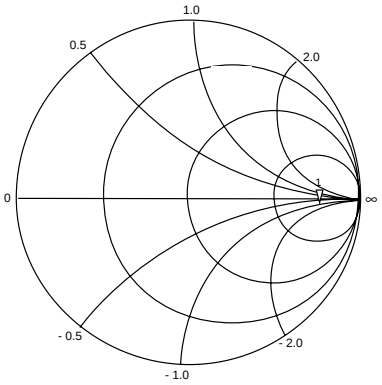
OUTPUT POWER vs. LO INPUT POWER



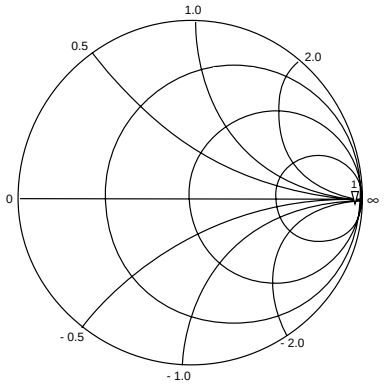
UPC8116GR PORT IMPEDANCE



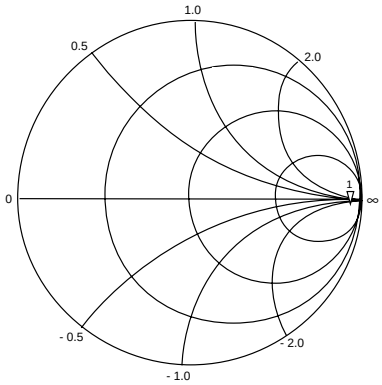
Mixer Input Impedance (Pin 1)
1. 315 MHz: 59.3 - j413.3
2. 433 MHz: 49.1-j305.6



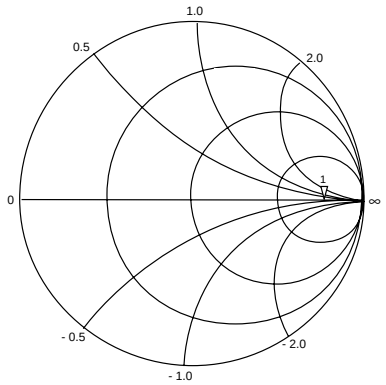
Mixer Output Impedance (Pin 2)
1. 10.7 MHz: 346.5-j31.7



IF Amp Input Impedance (Pin 3)
1. 10.7MHz: 2.2k-j740.8

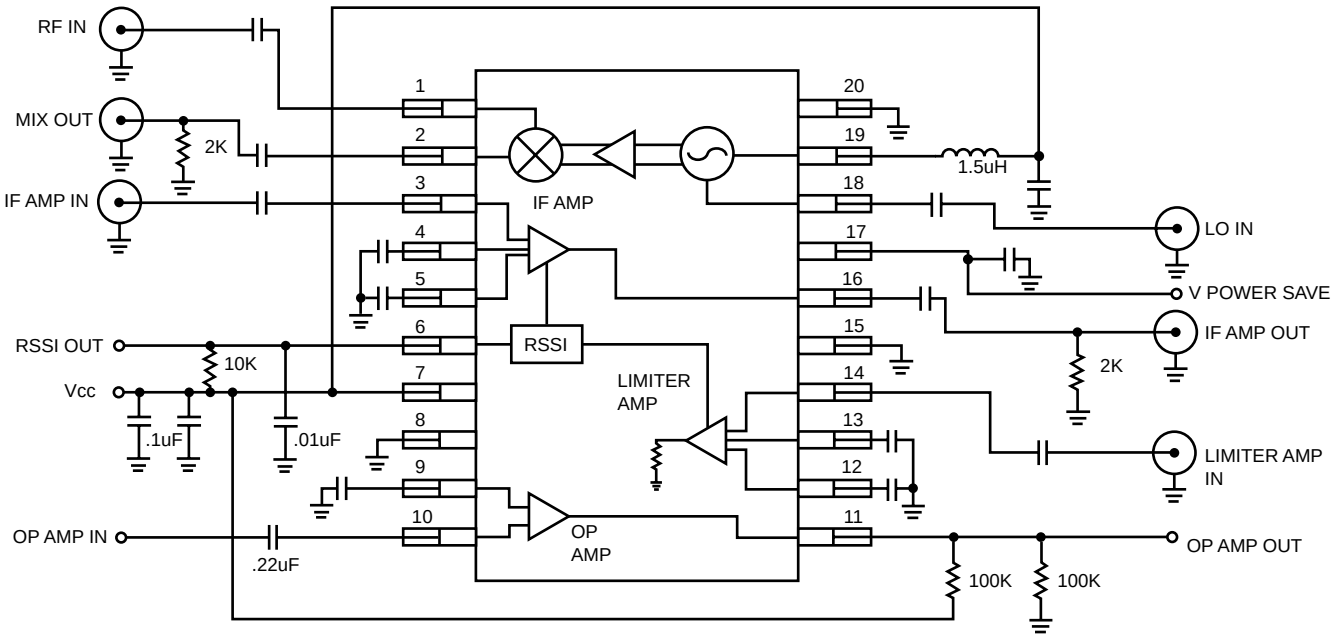


Limiter Amp Input Impedance (Pin 14)
1. 10.7 MHz: 1.3k+j246.8



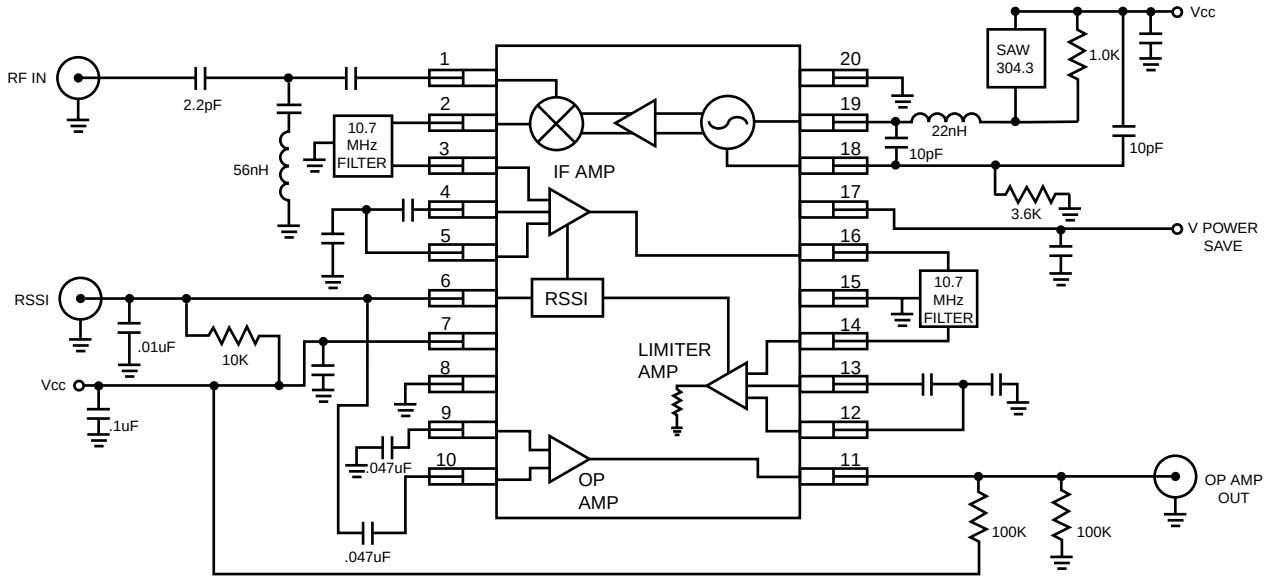
IF Amp Output Impedance (Pin 16)
1. 10.7MHz: 386.2+j26.8

TEST CIRCUITS



Note: Unless noted all capacitors are 1000pF.

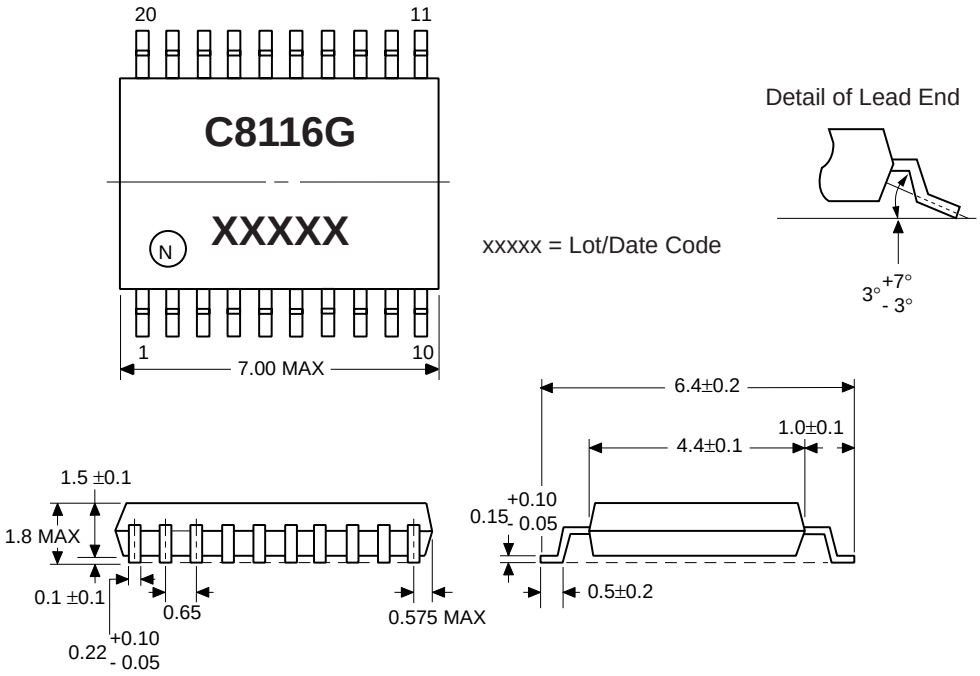
KEYLESS ENTRY APPLICATION CIRCUIT



Note: Unless noted all capacitors are 1000pF.

OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE S20



Lead Material: Alloy 42
Lead Plating: Lead Tin Alloy

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

ORDERING INFORMATION

PART NUMBER	QUANTITY
UPC8116GR-E1	2500/Reel