



## DATA SHEET

# BIPOLAR ANALOG INTEGRATED CIRCUIT $\mu$ PC8231TK

### SiGe:C LOW NOISE AMPLIFIER FOR GPS/MOBILE COMMUNICATIONS

#### DESCRIPTION

The  $\mu$ PC8231TK is a silicon germanium carbon (SiGe:C) monolithic integrated circuit designed as low noise amplifier for GPS and mobile communications. This device exhibits low noise figure and high power gain characteristics. This device is enabled in the frequency range from 1.5 to 2.4 GHz by modifying the external matching circuit.

The package is 6-pin lead-less minimold, suitable for surface mount.

This IC is manufactured using our UHS4 (Ultra High Speed Process) SiGe:C bipolar process.

#### FEATURES

- Low noise : NF = 0.8 dB TYP. @  $f_{in} = 1.575$  MHz
- High gain : GP = 20 dB TYP. @  $f_{in} = 1.575$  MHz
- Low current consumption :  $I_{CC} = 3.8$  mA TYP. @  $V_{CC} = 3.0$  V
- Built-in power-saving function
- High-density surface mounting : 6-pin lead-less minimold package (1.5 × 1.1 × 0.55 mm)
- Included very robust bandgap regulator (Small  $V_{CC}$  and  $T_A$  dependence)
- Included protection circuits for ESD

#### APPLICATION

- Low noise amplifier for GPS and mobile communications

#### ORDERING INFORMATION

Part Number	Order Number	Package	Marking	Supplying Form
$\mu$ PC8231TK-E2	$\mu$ PC8231TK-E2-A	6-pin lead-less minimold (1511 PKG) (Pb-Free)	6K	<ul style="list-style-type: none"><li>• 8 mm wide embossed taping</li><li>• Pin 1, 6 face the perforation side of the tape</li><li>• Qty 5 kpcs/reel</li></ul>

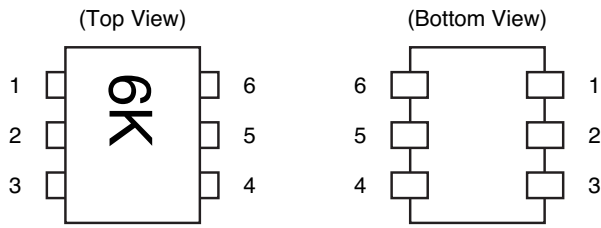
**Remark** To order evaluation samples, contact your nearby sales office.

Part number for sample order:  $\mu$ PC8231TK

**Caution** Observe precautions when handling because these devices are sensitive to electrostatic discharge.

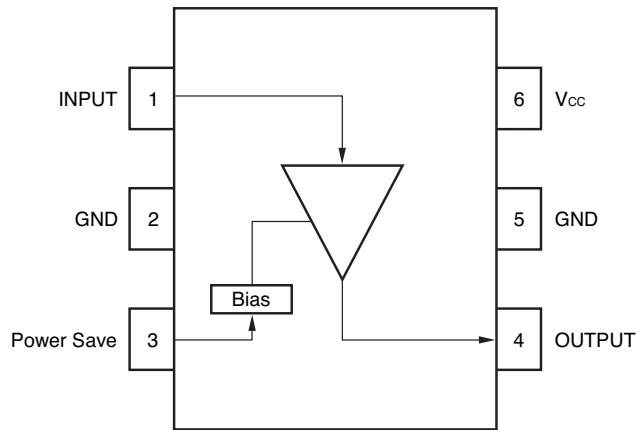
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**PIN CONNECTIONS**



Pin No.	Pin Name
1	INPUT
2	GND
3	Power Save
4	OUTPUT
5	GND
6	V <sub>cc</sub>

**INTERNAL BLOCK DIAGRAM**



**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Test Conditions	Ratings	Unit
Supply Voltage	V <sub>CC</sub>	T <sub>A</sub> = +25°C	4.0	V
Power-Saving Voltage	V <sub>PS</sub>	T <sub>A</sub> = +25°C	4.0	V
Power Dissipation	P <sub>D</sub>	T <sub>A</sub> = +85°C <b>Note</b>	232	mW
Operating Ambient Temperature	T <sub>A</sub>		-40 to +85	°C
Storage Temperature	T <sub>stg</sub>		-55 to +150	°C
Input Power	P <sub>in</sub>		+10	dBm

**Note** Mounted on double-side copper-clad 50 × 50 × 1.6 mm epoxy glass PWB

**RECOMMENDED OPERATING RANGE**

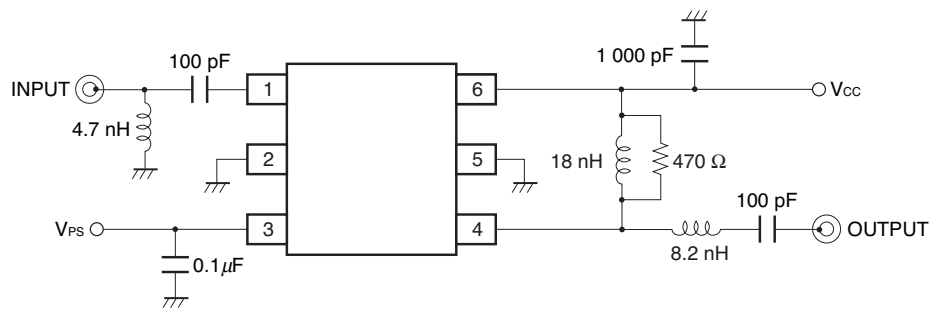
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V <sub>CC</sub>	2.7	3.0	3.3	V
Operating Ambient Temperature	T <sub>A</sub>	-40	+25	+85	°C
Power Save Turn-on Voltage	V <sub>PSon</sub>	1.6	-	V <sub>CC</sub>	V
Power Save Turn-off Voltage	V <sub>PSoff</sub>	0	-	0.4	V

**ELECTRICAL CHARACTERISTICS**

( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = V_{PS} = 3.0\text{ V}$ ,  $f_{in} = 1\ 575\text{ MHz}$ , unless otherwise specified)

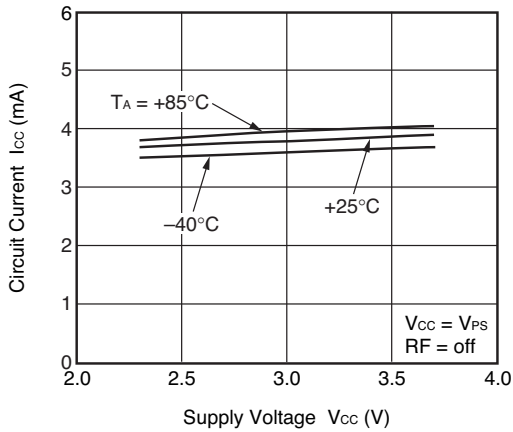
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	$I_{CC}$	No Signal ( $V_{PS} = 3.0\text{ V}$ )	2.8	3.8	5.1	mA
		At Power-Saving Mode ( $V_{PS} = 0\text{ V}$ )	–	–	1	$\mu\text{A}$
Power Gain	$G_P$	$P_{in} = -35\text{ dBm}$	17.5	20	22.5	dB
Noise Figure	NF		–	0.8	1.1	dB
Input 3rd Order Distortion Intercept Point	$IIP_3$	$f_{in1} = 1\ 574\text{ MHz}$ , $f_{in2} = 1\ 575\text{ MHz}$	–	-10	–	dBm
Input Return Loss	$RL_{in}$		7	10	–	dB
Output Return Loss	$RL_{out}$		10	18	–	dB
Isolation	ISL		–	35	–	dB
Gain 1 dB Compression Input Power	$P_{in(1\text{ dB})}$		–	-22	–	dBm

**TEST CIRCUIT**

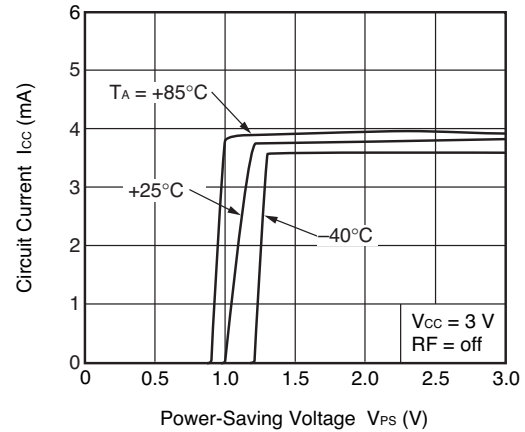


**TYPICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ , unless otherwise specified)**

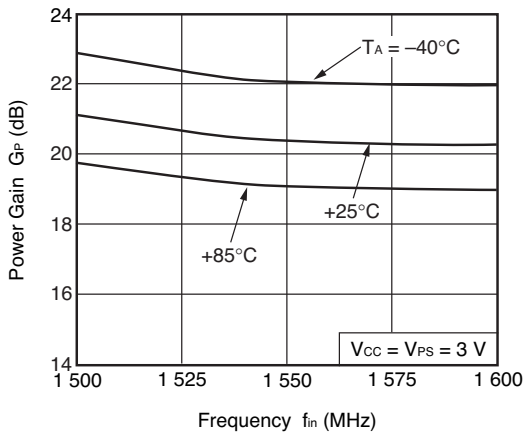
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



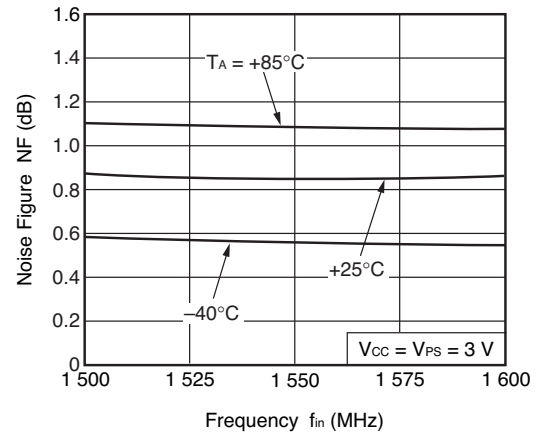
CIRCUIT CURRENT vs. POWER-SAVING VOLTAGE



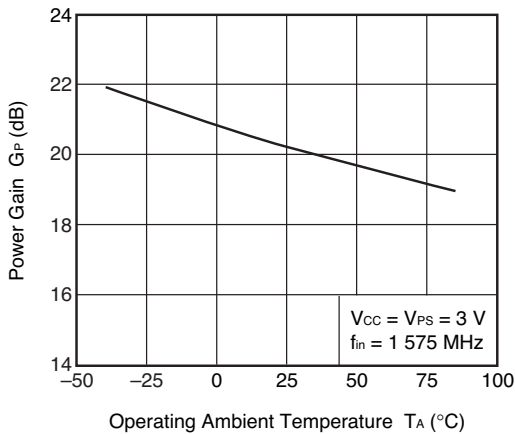
POWER GAIN vs. FREQUENCY



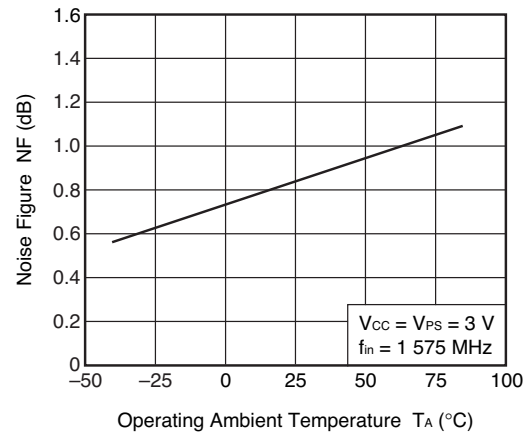
NOISE FIGURE vs. FREQUENCY



POWER GAIN vs. OPERATING AMBIENT TEMPERATURE

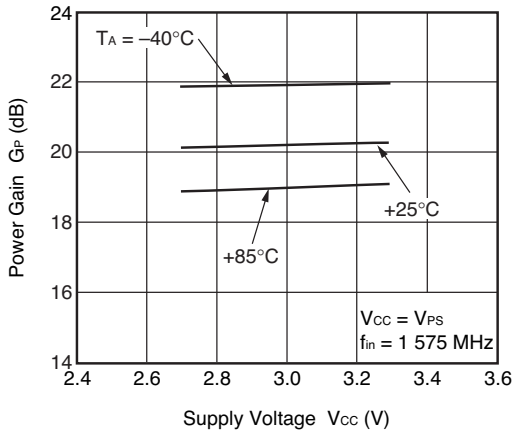


NOISE FIGURE vs. OPERATING AMBIENT TEMPERATURE

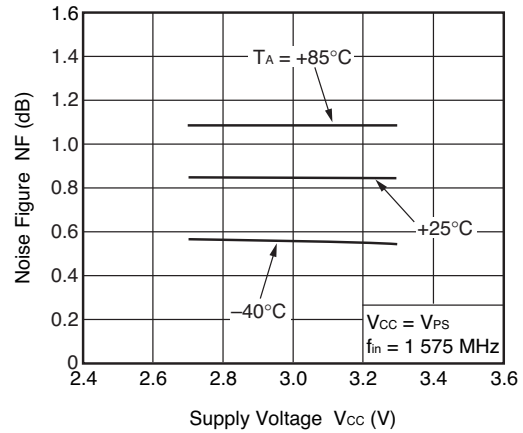


**Remark** The graphs indicate nominal characteristics.

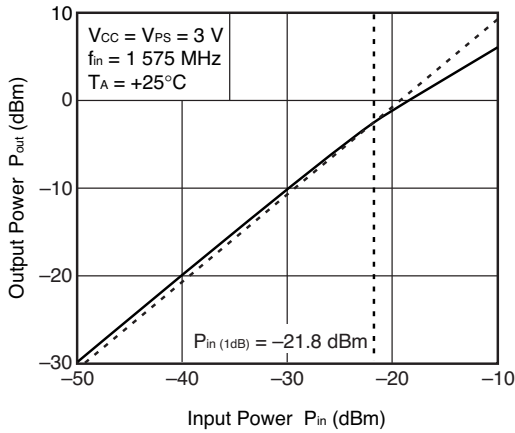
POWER GAIN vs. SUPPLY VOLTAGE



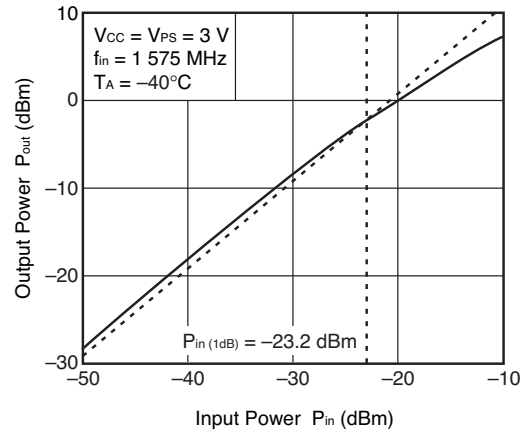
NOISE FIGURE vs. SUPPLY VOLTAGE



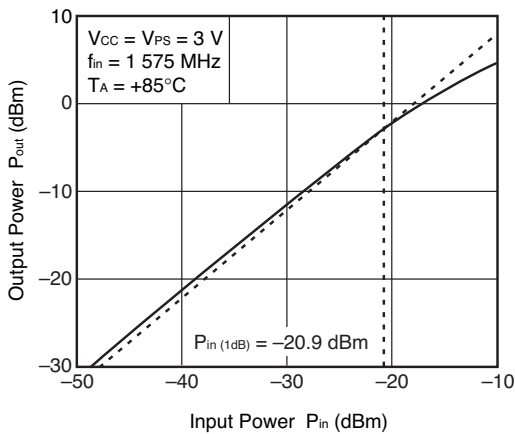
OUTPUT POWER vs. INPUT POWER



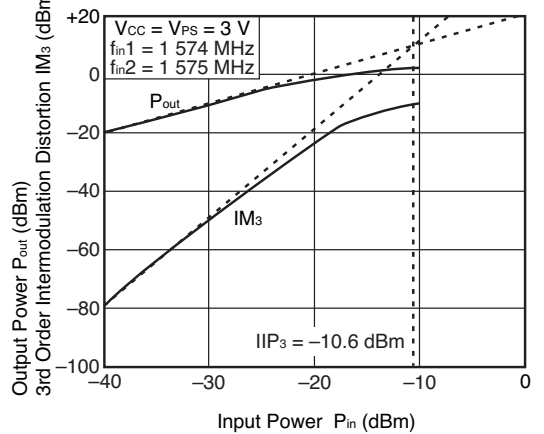
OUTPUT POWER vs. INPUT POWER



OUTPUT POWER vs. INPUT POWER



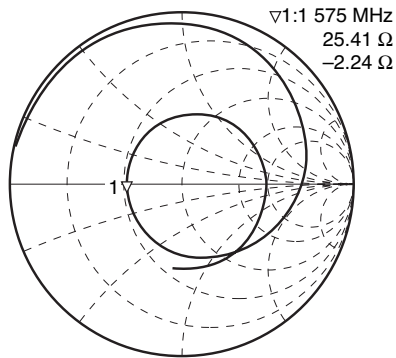
OUTPUT POWER, IM3 vs. INPUT POWER



**Remark** The graphs indicate nominal characteristics.

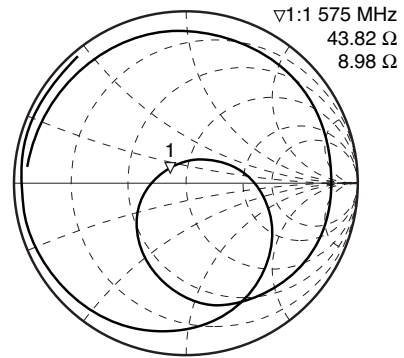
**S-PARAMETERS (T<sub>A</sub> = +25°C, V<sub>CC</sub> = V<sub>PS</sub> = 3.0 V, monitored at connector on board)**

S<sub>11</sub>-FREQUENCY



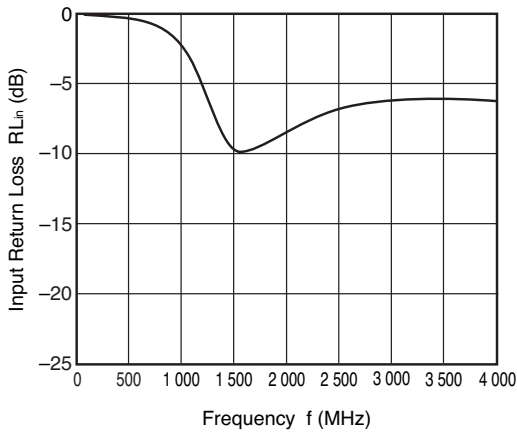
START 100.000 000 MHz STOP 4 000.000 000 MHz

S<sub>22</sub>-FREQUENCY

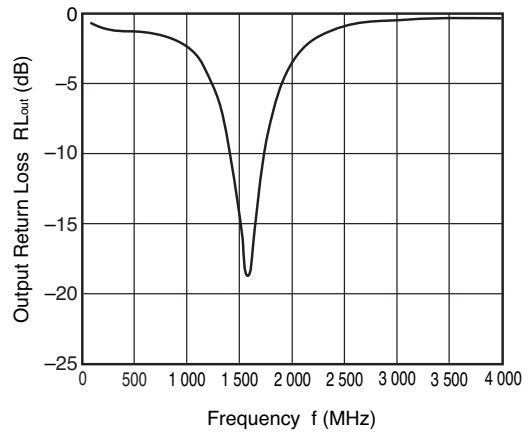


START 100.000 000 MHz STOP 4 000.000 000 MHz

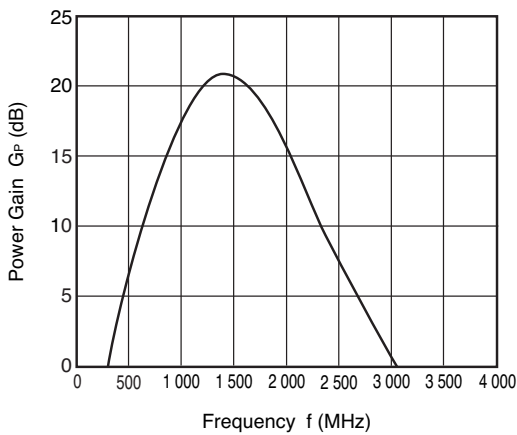
INPUT RETURN LOSS vs. FREQUENCY



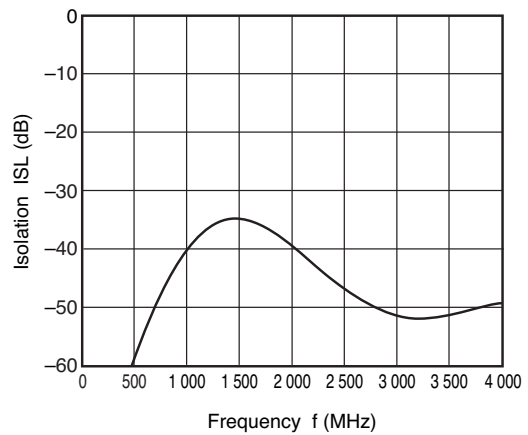
OUTPUT RETURN LOSS vs. FREQUENCY



POWER GAIN vs. FREQUENCY

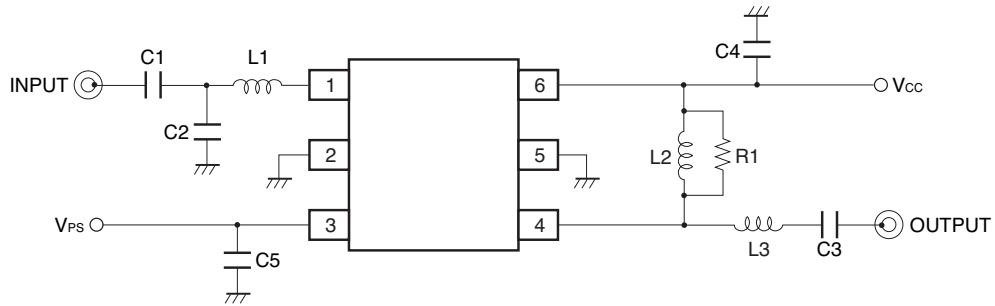


ISOLATION vs. FREQUENCY



**Remark** The graphs indicate nominal characteristics.

**APPLIED CIRCUIT EXAMPLE**



**EXTERNAL PARTS CHART**

Symbol	Parts	Value				Unit
		1.575 GHz Band	1.9 GHz Band	2.14 GHz Band	2.4 GHz Band	
L1	Chip Inductor	5.6	3.9	3.3	2.7	nH
L2	Chip Inductor	18	12	8.2	6.8	nH
L3	Chip Inductor	10	8.2	6.8	5.6	nH
C1	Chip Capacitor	120	5.0	2.0	2.0	pF
C2	Chip Capacitor	1.3	0.7	0.5	0.3	pF
C3	Chip Capacitor	120	5.0	5.0	5.0	pF
C4	Chip Capacitor	1 000	1 000	1 000	1 000	pF
C5	Chip Capacitor	1 000	1 000	1 000	1 000	pF
R1	Chip Resistor	470	470	470	470	$\Omega$

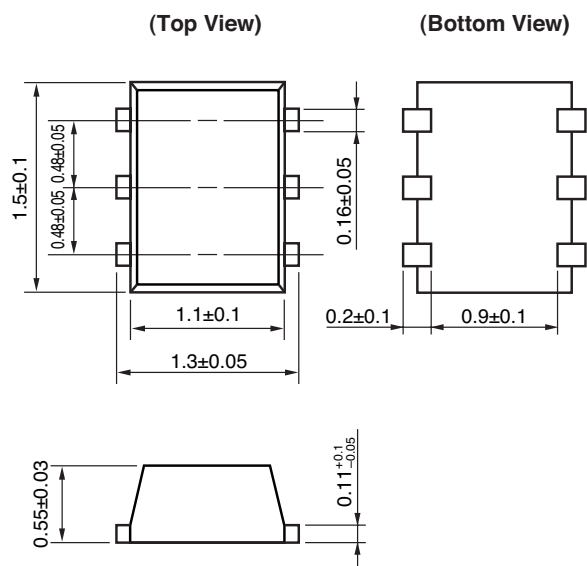
**TYPICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = V_{PS} = 3.0\text{ V}$ , unless otherwise specified)**

Parameter	Symbol	Reference Value				Unit
		1.575 GHz	1.9 GHz	2.14 GHz	2.4 GHz	
Power Gain	$G_P$	20.0	19.0	18.0	17.0	dB
Noise Figure	NF	0.78	0.95	1.10	1.27	dB
Input Return Loss	$RL_{in}$	10.4	10.2	10.2	10.5	dB
Output Return Loss	$RL_{out}$	21.0	30.0	32.2	23.0	dB



**PACKAGE DIMENSIONS**

**6-PIN LEAD-LESS MINIMOLD (1511 PKG) (UNIT: mm)**



**NOTES 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 undesired oscillation).  
All the ground terminals must be connected together with wide ground pattern to decrease impedance difference.
- (3) The bypass capacitor should be attached to Vcc line.
- (4) Do not supply DC voltage to INPUT pin.

**RECOMMENDED SOLDERING CONDITIONS**

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

Soldering Method	Soldering Conditions	Condition Symbol
Infrared Reflow	Peak temperature (package surface temperature) : 260°C or below Time at peak temperature : 10 seconds or less Time at temperature of 220°C or higher : 60 seconds or less Preheating time at 120 to 180°C : 120±30 seconds Maximum number of reflow processes : 3 times Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	IR260
Wave Soldering	Peak temperature (molten solder temperature) : 260°C or below Time at peak temperature : 10 seconds or less Preheating temperature (package surface temperature) : 120°C or below Maximum number of flow processes : 1 time Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	WS260
Partial Heating	Peak temperature (terminal temperature) : 350°C or below Soldering time (per side of device) : 3 seconds or less Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	HS350

**Caution Do not use different soldering methods together (except for partial heating).**

Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL’s understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
		-A	-AZ
Lead (Pb)	< 1000 PPM	Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

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