VG111

PCS/UMTS-band Variable Gain Amplifier

Product Features

- 1700 – 2200 MHz bandwidth
- 26.6 dB Attenuation Range
- +39.5 dBm Output IP3
- +22 dBm P1dB
- Constant IP3 & P1dB over attenuation range
- Single voltage supply
- Pb-free 6mm 28-pin QFN package
- MTTF > 1000 years

Applications

- Xmit & Rcv AGC circuitry for mobile infrastructure

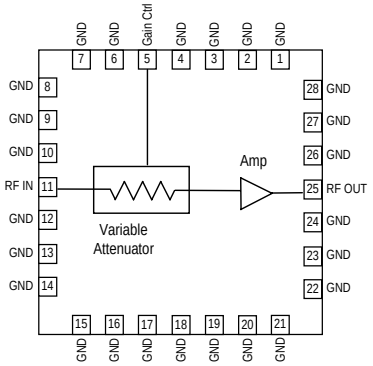
Product Description

The VG111 is a PCS / UMTS-band high dynamic range variable gain amplifier (VGA) packaged in a low profile Pb-free / RoHS-compliant surface-mount leadless package that measures 6 x 6 mm square.

The +22 dBm output compression point and +39.5 dBm output intercept point of the amplifier are maintained over the entire attenuation range, making the VG111 ideal for use in transmitter and receiver AGC circuits and as a variable gain stage following an LNA in high dynamic range receiver front ends.

Superior thermal design allows the product to have a minimum MTTF rating of 1000 years at a mounting temperature of +85º C. All devices are 100% RF & DC tested and packaged on tape and reel for automated surface-mount assembly.

Functional Diagram



Specifications (1)

Parameter	Units	Min	Typ	Max	Conditions
Operational Bandwidth	MHz	1700		2200	
Test Frequency	MHz		1900		See note 1
Gain at min. attenuation	dB	12	14		
Input Return Loss	dB		12		
Output Return Loss	dB		11		
Output P1dB	dBm		+22		
Output IP3	dBm	+37	+39.5		See note 2
Noise Figure at min. attenuation	dB		4.3		V_{CTRL} = 0 V
Test Frequency	MHz		2140		See note 1
Gain at min. attenuation	dB		13.3		
Input Return Loss	dB		14		
Output Return Loss	dB		14		
Output P1dB	dBm		+22		
Output IP3	dBm		+39.5		See note 2
Noise Figure at min. attenuation	dB		4.5		V_{CTRL} = 0 V
Gain Variation Range	dB	23.5	26.6	32.5	See note 3
Gain Variation Control Voltage, V_{CTRL}	V	0		4.5	See note 1
Group Delay	ns		0.6		
Supply Voltage	V		+5		
Operating Amplifier Current Range	mA	120	150	180	Pin 25
Gain Control Pin Current	mA			20	V_{CTRL} = 4.5 V. See note 1.

1. Test conditions unless otherwise noted: 25ºC, Vdd = +5 V in a tuned application circuit. Vctrl is the control voltage through a BJT transistor and a 100 Ω dropping resistor as shown in the same application circuit.
2. 3OIP measured with two tones at an output power of +5 dBm/tone separated by 10 MHz. The suppression on the largest IM3 product is used to calculate the 3OIP using a 2:1 rule.
3. The gain variation range is measured as the difference in gain with Vctrl = 0V and Vctrl = 4.5V at 1.9 GHz.

Absolute Maximum Rating

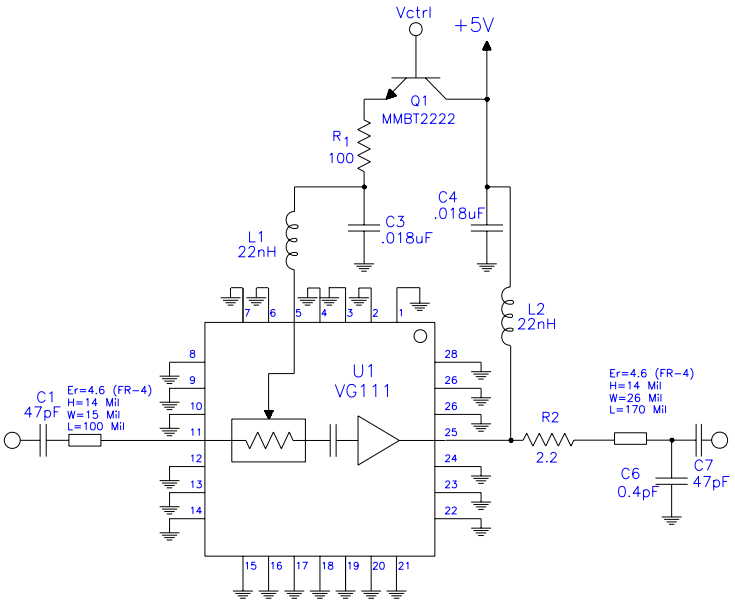
Parameter	Rating
Operating Case Temperature	-40 to +85 °C
Storage Temperature	-55 to +125 °C
Amplifier Supply Voltage (pin 25)	+6 V
Pin 5 (Gain Control) Current	30 mA
RF Input Power (continuous)	+12 dBm
Junction Temperature	+220° C

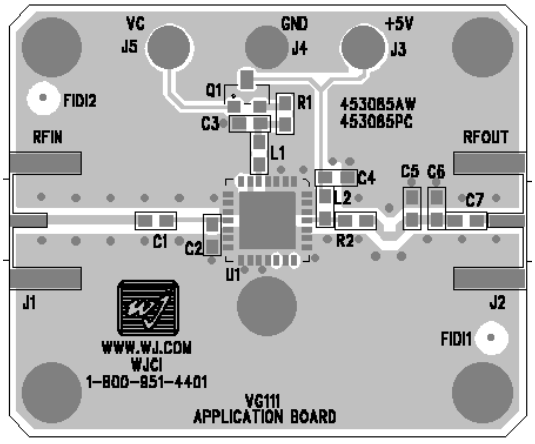
Operation of this device above any of these parameters may cause permanent damage.

Ordering Information

Part No.	Description
VG111-F	PCS/UMTS-band Variable Gain Amplifier (lead-free/RoHS-compliant QFN package)
VG111-PCB1900	1.8 – 2.0 GHz Fully Assembled Application Board
VG111-PCB2100	2.0 – 2.2 GHz Fully Assembled Application Board

Application Circuit: 1.8 – 2.0 GHz (VG111-PCB1900)



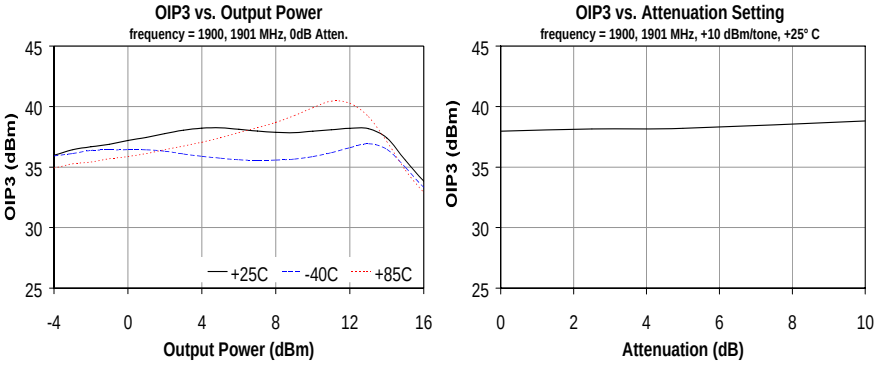


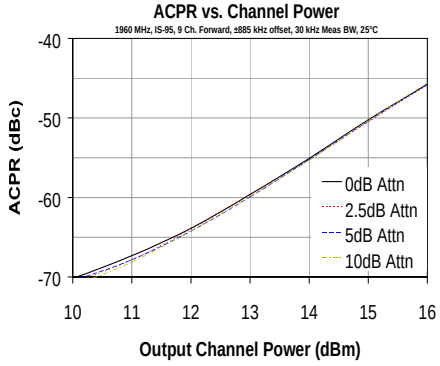
Circuit Board Material: .014" FR-4, 4 layers, .062" total thickness

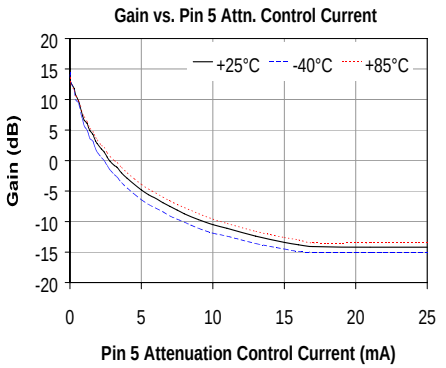
- The amplifier is biased through Pin 25 and should be connected directly into a voltage regulator.
- Components shown in the silkscreen but not on the schematic are not used for this circuit.
- Distances are shown from the edge-to-edge for the land pattern.

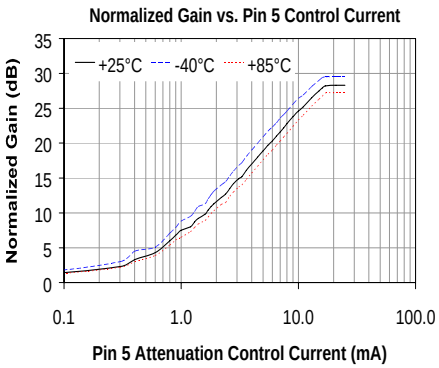
Bill of Materials

Ref. Des.	Description	Size
C1, C7	47 pF Chip Capacitor	0603
C2, C5	Do Not Place	
C3, C4	0.01 µF Chip Capacitor	0603
C6	0.4 pF Chip Capacitor	0603
L1, L2	22 nH Chip Inductor	0603
R1	100 Ω Chip Resistor	0603
R2	2.2 Ω Chip Resistor	0603
Q1	MMBT2222 Motorola Transistor	SOT-23
U1	VG111 Variable Gain Amplifier	QFN 6x6

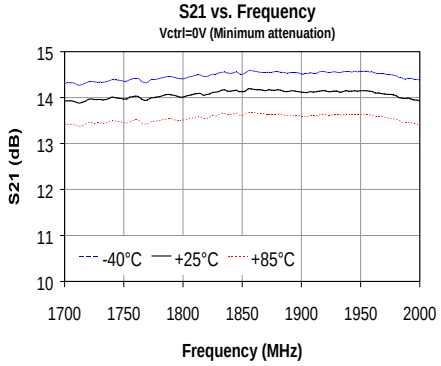


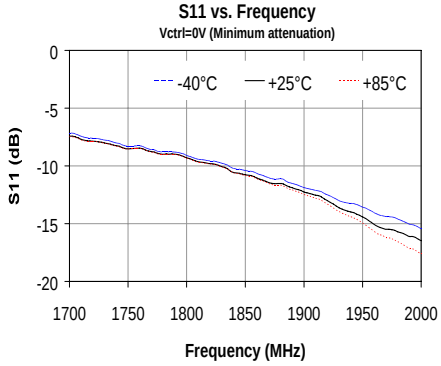


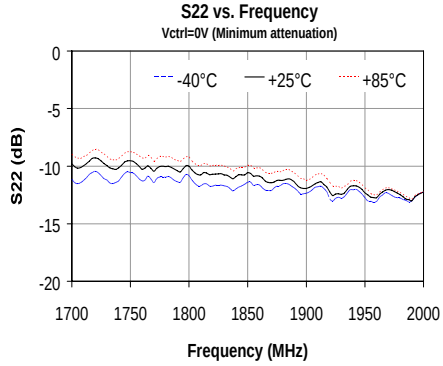


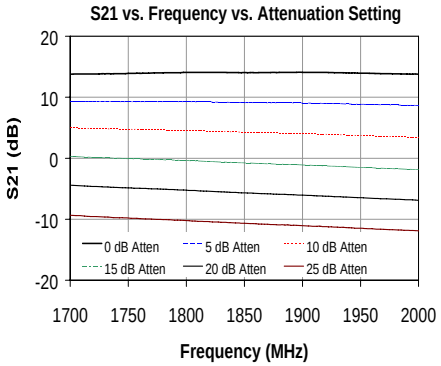


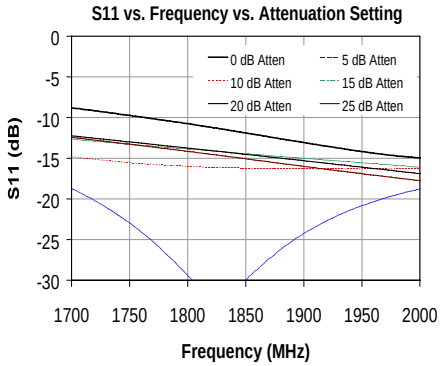
VG111-PCB1900 Application Circuit Performance (cont'd)

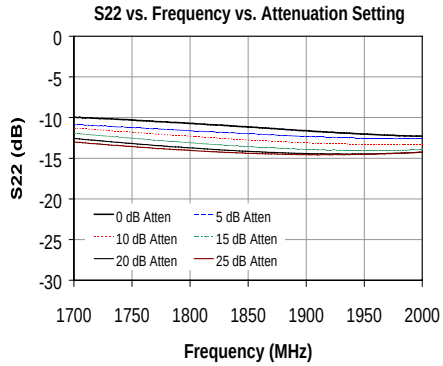


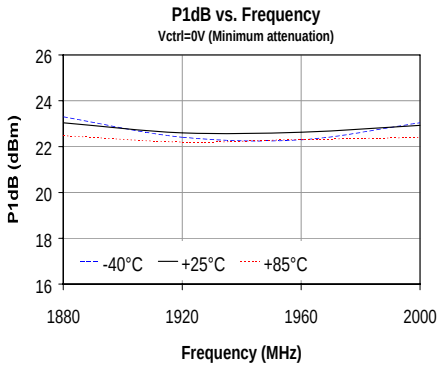


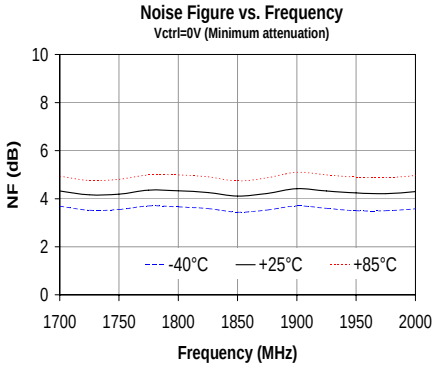




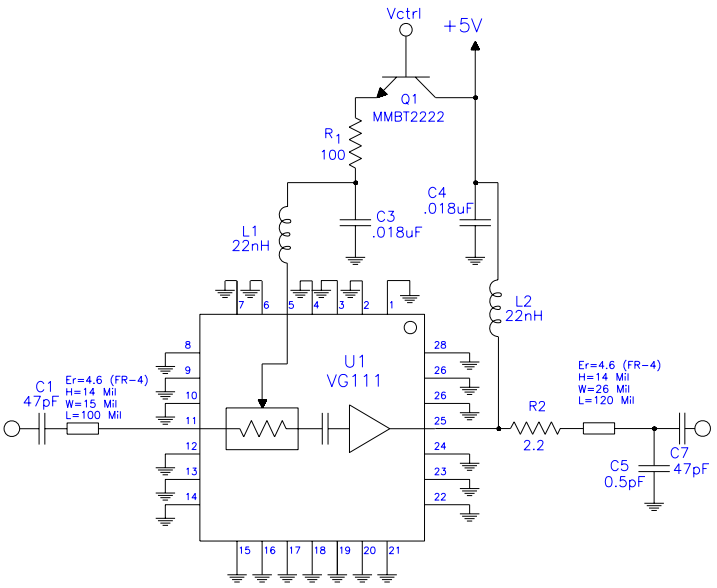


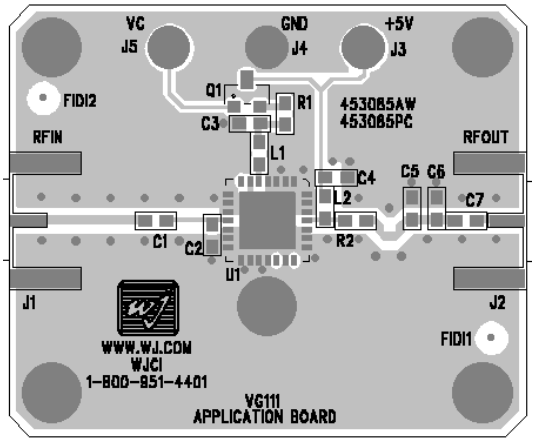






Application Circuit: 2.0 – 2.2 GHz (VG111-PCB2100)





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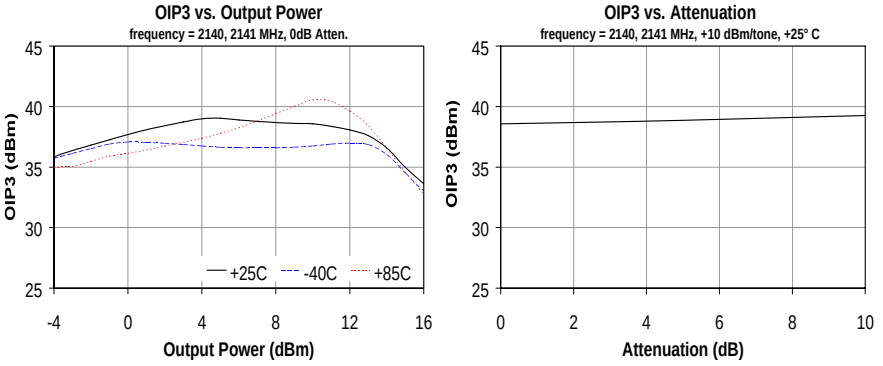
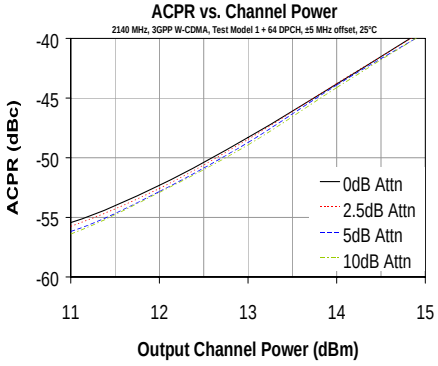
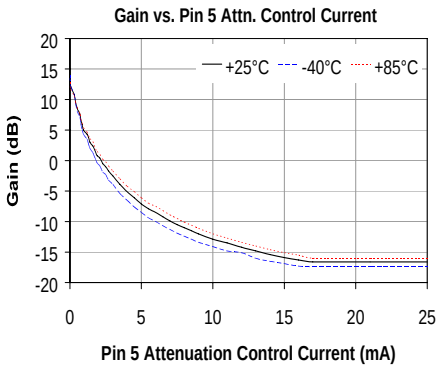
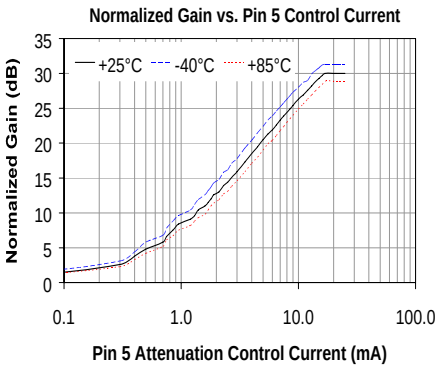
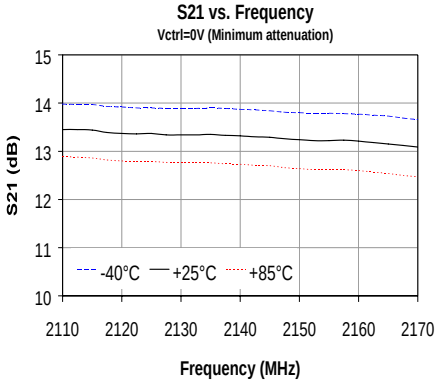


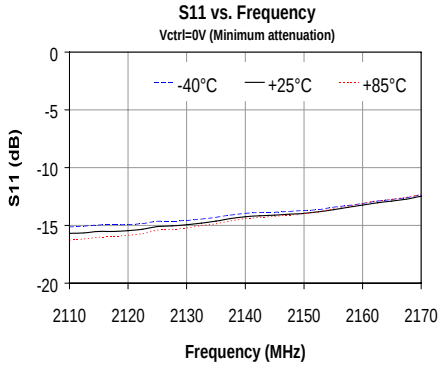


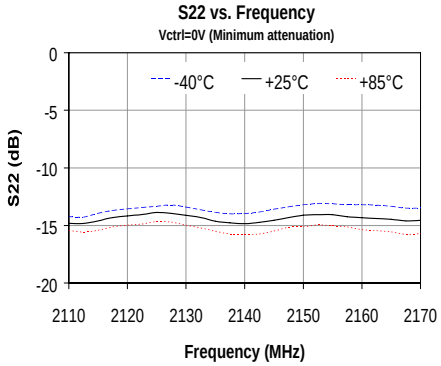


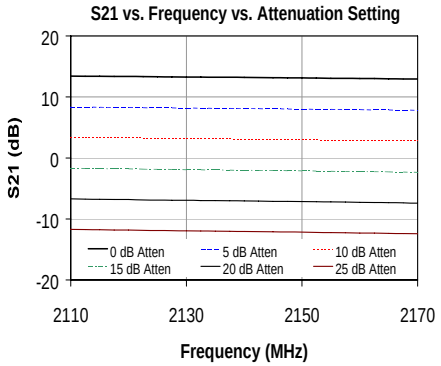


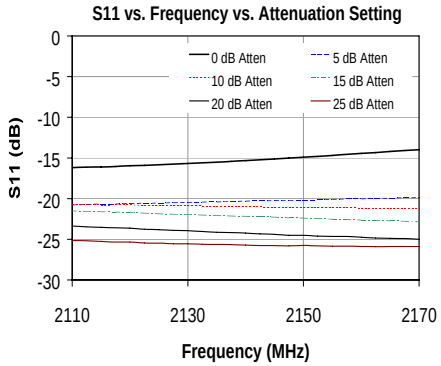
VG111-PCB2100 Application Circuit Performance (cont'd)

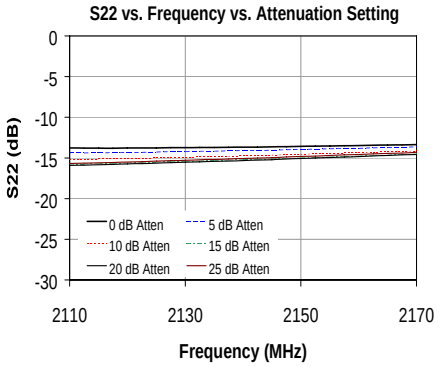


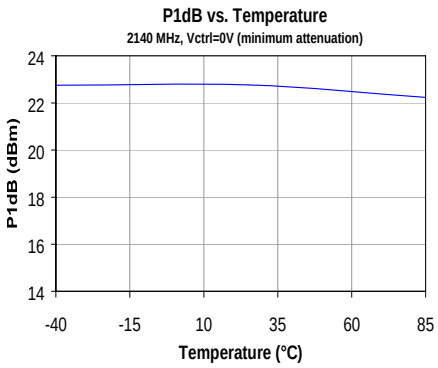


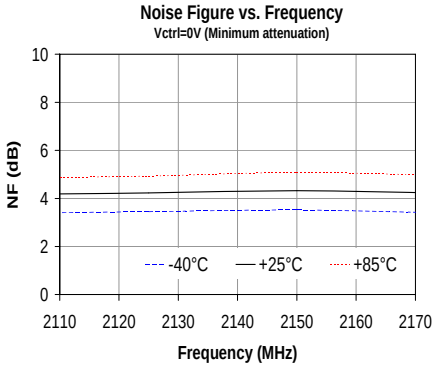








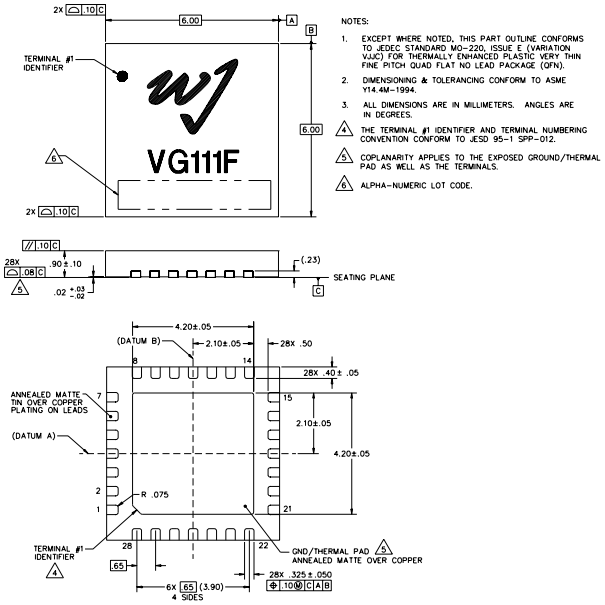




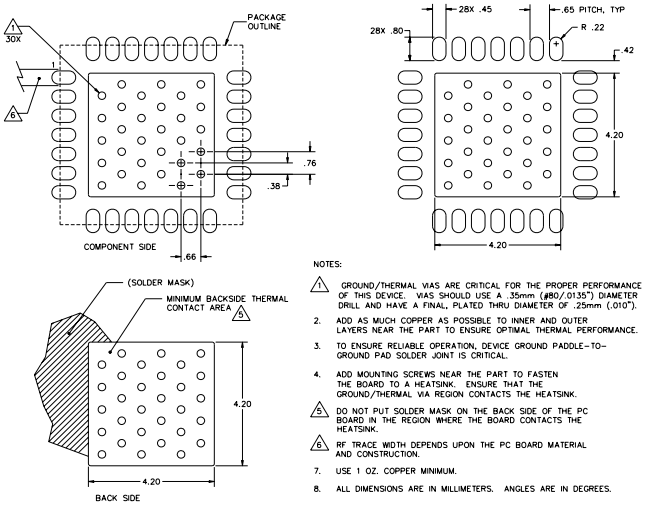
VG111-F Mechanical Information

This package is lead-free/RoHS-compliant. The plating material on the pins is annealed matte tin over copper. It is compatible with both lead-free (maximum 260 °C reflow temperature) and leaded (maximum 245 °C reflow temperature) soldering processes.

Outline Drawing



Mounting Configuration / Land Pattern



Product Marking

The component will be lasermarked with a "VG111F" designator with an alphanumeric lot code on the top surface of the package. The obsolete tin-lead package is marked with an "VG111" designator followed by an alphanumeric lot code.

Tape and reel specifications for this part will be located on the website in the "Application Notes" section.

ESD / MSL Information

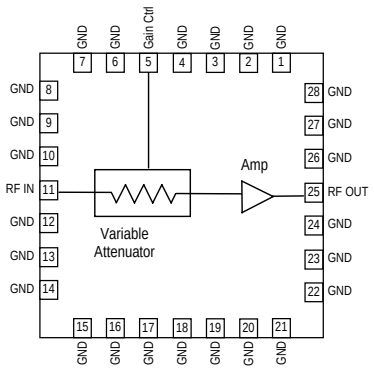
Caution! ESD sensitive device.

ESD Rating: Class 1B
Value: Passes ⩾500V to <1000V
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

ESD Rating: Class IV
Value: Passes ⩾1000V to <2000V
Test: Charged Device Model (CDM)
Standard: JEDEC Standard JESD22-C101

MSL Rating: Level 2 at +260°C convection reflow
Standard: JEDEC Standard J-STD-020

Functional Pin Layout



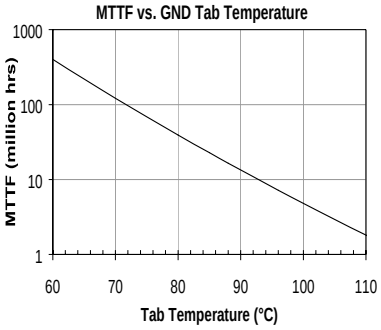
Function	Pin No
Gain Control	5
RF Input	11
RF Output / DC bias	25
No Connect or GND	All other pins
Ground	Backside copp

The even numbered pins are hard grounded to the backside paddle internally.

Thermal Specifications

Parameter	Rating
Operating Case Temperature	-40 to +85 °C
Thermal Resistance, Rth (1)	59 °C / W
Junction Temperature, Tj (2)	129 °C

1. The thermal resistance is referenced from the hottest part of the junction to the backside ground paddle.
2. This corresponds to the typical biasing condition of +5V, 150 mA at an 85 °C case temperature. A minimum MTTF of 1 million hours is achieved for junction temperatures below 160 °C.



Specifications and information are subject to change without notice