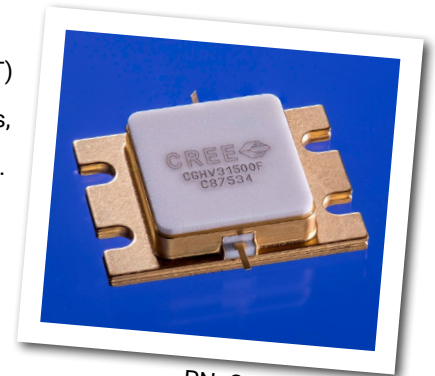


# CGHV31500F

**500 W, 2700 - 3100 MHz, 50-Ohm Input/Output Matched, GaN HEMT for S-Band Radar Systems**

Cree's CGHV31500F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically with high efficiency, high gain and wide bandwidth capabilities, which makes the CGHV31500F ideal for 2.7 - 3.1 GHz S-Band radar amplifier applications. The transistor is supplied in a ceramic/metal flange package, type 440217.



PN: CGHV31500F  
Package Type: 440217

## Typical Performance Over 2.7-3.1 GHz ( $T_c = 25^\circ\text{C}$ ) of Demonstration Amplifier

Parameter	2.7 GHz	2.9 GHz	3.1 GHz	Units
Output Power	665	705	645	W
Gain	13.2	13.5	13.1	dB
Drain Efficiency	66	68	62	%

**Note:**

Measured in the CGHV31500F-AMP application circuit, under 500  $\mu\text{s}$  pulse width, 10% duty cycle,  $P_{IN} = 45 \text{ dBm}$ .

## Features

- 2.7 - 3.1 GHz Operation
- 675 W Typical Output Power
- 13.3 dB Power Gain
- 66% Typical Drain Efficiency
- 50 Ohm Internally Matched
- <0.3 dB Pulsed Amplitude Droop

## Absolute Maximum Ratings (not simultaneous)

Parameter	Symbol	Rating	Units	Conditions
Pulse Width	PW	500	μs	
Duty Cycle	DC	10	%	
Drain-Source Voltage	$V_{DS}$	125	Volts	25°C
Gate-to-Source Voltage	$V_{GS}$	-10, +2	Volts	25°C
Storage Temperature	$T_{STG}$	-65, +150	°C	
Operating Junction Temperature	$T_J$	225	°C	
Maximum Forward Gate Current	$I_{GMAX}$	80	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	24	A	25°C
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
Pulsed Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.22	°C/W	100 μsec, 10%, 85°C, $P_{DISS} = 376$ W
Pulsed Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.30	°C/W	500 μsec, 10%, 85°C, $P_{DISS} = 376$ W
Case Operating Temperature	$T_C$	-40, +85	°C	

### Notes:

<sup>1</sup> Current limit for long term, reliable operation

<sup>2</sup> Refer to the Application Note on soldering at <http://www.cree.com/rf/document-library>

## Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics<sup>1</sup> (<math>T_C = 25^\circ\text{C}</math>)</b>						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	-2.3	$V_{DC}$	$V_{DS} = 10$ V, $I_D = 83.6$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	$V_{DC}$	$V_{DS} = 50$ V, $I_D = 0.5$ A
Saturated Drain Current <sup>2</sup>	$I_{DS}$	62.7	75.5	-	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	$V_{BR}$	150	-	-	$V_{DC}$	$V_{GS} = -8$ V, $I_D = 83.6$ mA

### Notes:

<sup>1</sup> Measured on wafer prior to packaging.

<sup>2</sup> Scaled from PCM data.

## Electrical Characteristics Continued...

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>RF Characteristics<sup>3</sup> (T<sub>c</sub> = 25 °C, F<sub>0</sub> = 2.7 - 3.1 GHz unless otherwise noted)</b>						
Output Power at 2.7 GHz	P <sub>OUT1</sub>	–	665	–	W	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Output Power at 2.9 GHz	P <sub>OUT2</sub>	–	705	–	W	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Output Power at 3.1 GHz	P <sub>OUT3</sub>	–	645	–	W	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Gain at 2.7 GHz	G <sub>P1</sub>	–	13.2	–	dB	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Gain at 2.9 GHz	G <sub>P2</sub>	–	13.5	–	dB	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Gain at 3.1 GHz	G <sub>P3</sub>	–	13.1	–	dB	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Drain Efficiency at 2.7 GHz	D <sub>E1</sub>	–	66	–	%	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Drain Efficiency at 2.9 GHz	D <sub>E2</sub>	–	68	–	%	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Drain Efficiency at 3.1 GHz	D <sub>E3</sub>	–	62	–	%	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Small Signal Gain	S21	–	14.5	–	dB	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = -10 dBm
Input Return Loss	S11	–	-15	–	dB	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = -10 dBm
Output Return Loss	S22	–	-6	–	dB	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = -10 dBm
Amplitude Droop	D	–	-0.3	–	dB	V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm
Output Stress Match	VSWR	–	5:1	–	Ψ	No damage at all phase angles, V <sub>DD</sub> = 50 V, I <sub>DQ</sub> = 500 mA, P <sub>IN</sub> = 45 dBm Pulsed

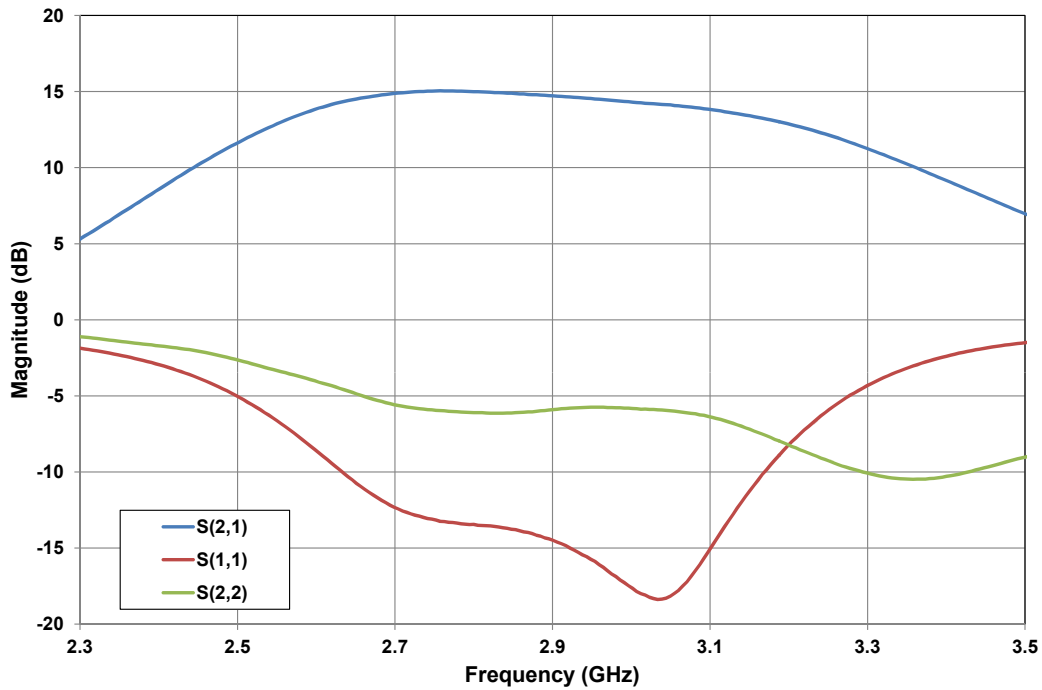
**Notes:**

<sup>3</sup> Measured in CGHV31500F-AMP. Pulse Width = 500 μs, Duty Cycle = 10%.

## Typical Performance

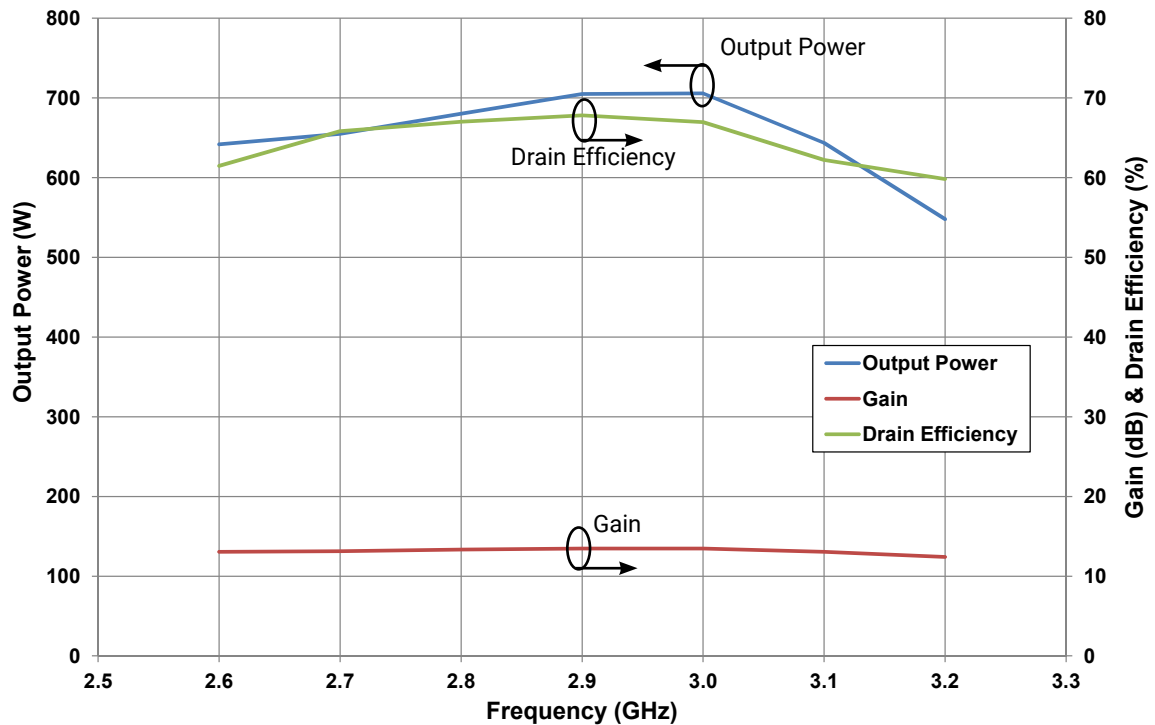
**Figure 1. - CGHV31500F S-Parameters**

$V_{DD} = 50\text{ V}, I_{DQ} = 0.5\text{ A}$



**Figure 2. - CGHV31500F Output Power and Drain Efficiency vs Frequency**

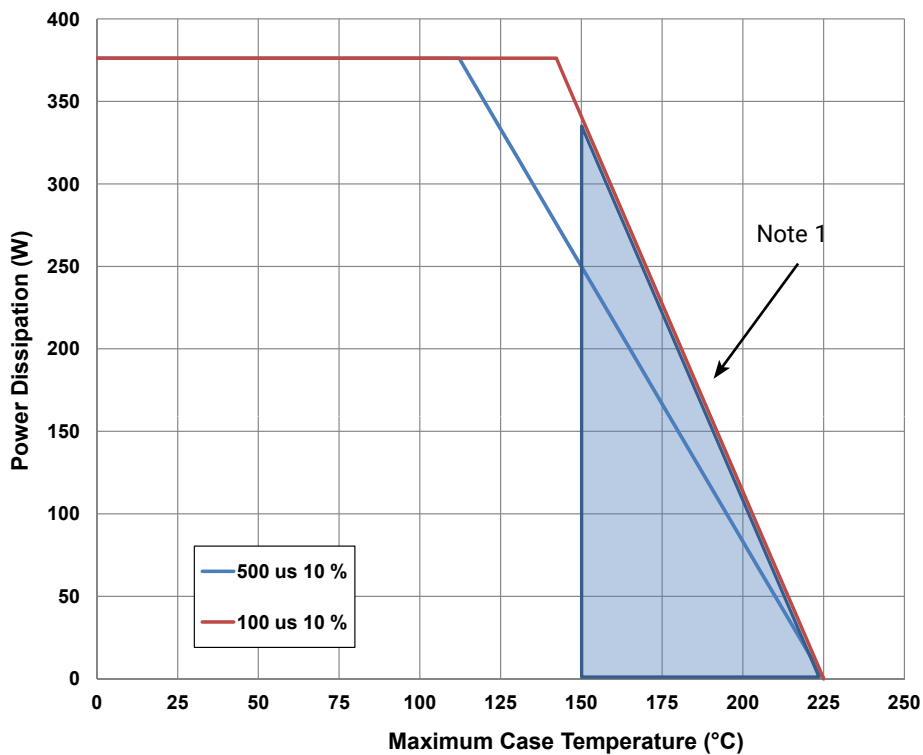
$V_{DD} = 50\text{ V}, I_{DQ} = 0.5\text{ A}, P_{IN} = 45\text{ dBm}, \text{Pulse Width} = 500\mu\text{s}, \text{Duty Cycle} = 10\%, T_{CASE} = 25^\circ\text{C}$



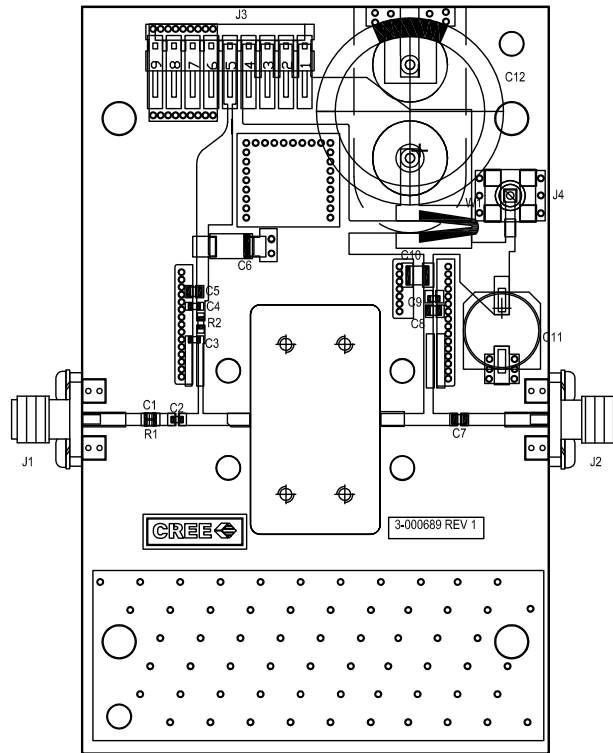
## CGHV31500F-AMP Application Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 511, OHM, +/- 1%, 1/16W, 0603	1
R2	RES, 5.1, OHM, +/- 1%, 1/16W, 0603	1
C1	CAP, 6.8pF, +/-0.25%, 250V, 0603	1
C2, C7, C8	CAP, 10.0pF, +/-1%, 250V, 0805	3
C3	CAP, 10.0pF, +/-5%, 250V, 0603	1
C4, C9	CAP, 470pF, 5%, 100V, 0603, X	2
C5	CAP, 33000 pF, 0805, 100V, X7R	1
C6	CAP, 10uF 16V TANTALUM	1
C10	CAP, 1.0uF, 100V, 10%, X7R, 1210	1
C11	CAP, 33uF, 20%, G CASE	1
C12	CAP, 3300uF, +/-20%, 100V, ELECTROLYTIC	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FL	2
J3	HEADER, RT>PLZ, 0.1CEN LK 9POS	1
J4	CONNECTOR; SMB, Straight, JACK, SMD	1
W1	CABLE, 18 AWG, 4.2	1
-	PCB, RO4350, 2.5 X 4.0 X 0.030	1
Q1	CGHV31500F	1

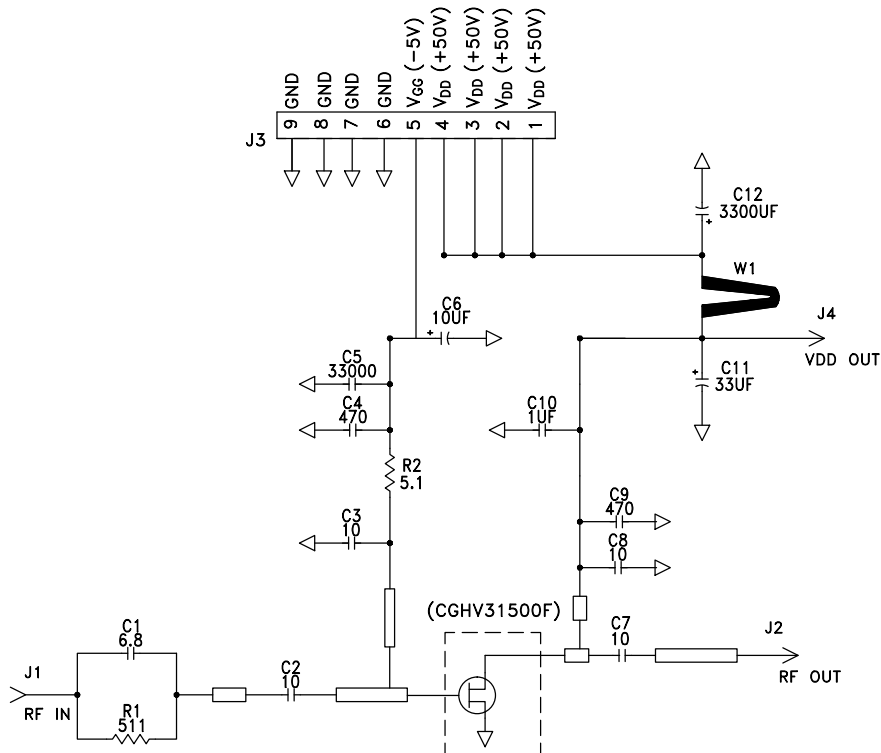
## CGHV31500F Power Dissipation De-rating Curve



## CGHV31500F-AMP Application Circuit Outline



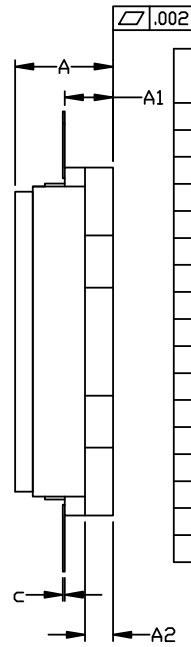
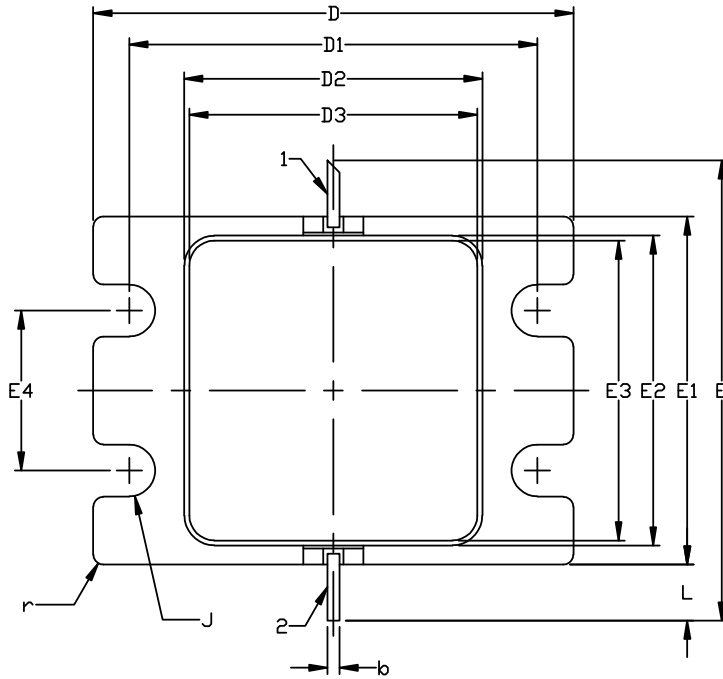
## CGHV31500F-AMP Application Circuit Schematic



## Product Dimensions CGHV31500F (Package Type – 440217)

NOTES: (UNLESS OTHERWISE SPECIFIED)

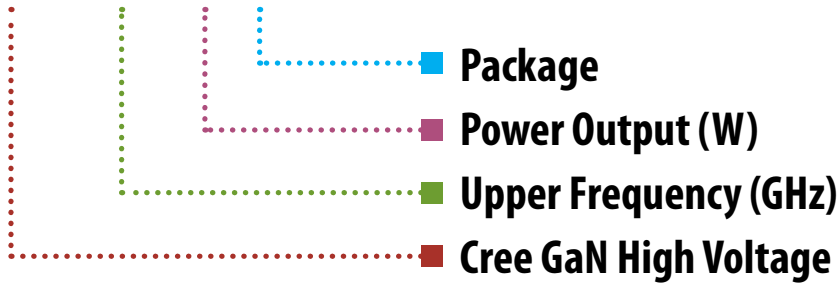
1. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M-2009
2. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF .020 BEYOND EDGE OF LID
3. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF .008 IN ANY DIRECTION
4. ALL PLATED SURFACES ARE GOLD OVER NICKEL



1. GATE  
2. DRAIN

DIM	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.188	0.198	4.78	5.03	
A1	0.088	0.100	2.24	2.54	2x
A2	0.049	0.061	1.24	1.55	
b	0.022	0.026	0.56	0.66	2x
c	0.002	0.006	0.05	0.15	
D	0.935	0.955	23.75	24.26	
D1	0.797	0.809	20.24	20.55	2x
D2	0.581	0.593	14.76	15.06	
D3	0.563	0.571	14.30	14.50	
E	0.906		23.01		REF
E1	0.679	0.691	17.25	17.55	
E2	0.604	0.616	15.34	15.65	
E3	0.586	0.594	14.88	15.09	
E4	0.309	0.321	7.85	8.15	2x
J	Ø0.097	Ø0.107	Ø2.46	Ø2.72	4x
L	0.090	0.130	2.29	3.30	2x
r	0.02	TYP	0.51	TYP	12x

### CGHV31500F



Parameter	Value	Units
Upper Frequency <sup>1</sup>	3.1	GHz
Power Output	500	W
Package	Flange	-

**Table 1.**

**Note<sup>1</sup>:** Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

Character Code	Code Value
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
J	8
K	9
Examples:	1A = 10.0 GHz 2H = 27.0 GHz

**Table 2.**



## Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGHV31500F	GaN HEMT	Each	
CGHV31500F-TB	Test board without GaN HEMT	Each	
CGHV31500F-AMP	Test board with GaN HEMT installed	Each	



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