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# CGHV14250

## 250 W, 1200 - 1400 MHz, GaN HEMT for L-Band Radar Systems

Cree's CGHV14250 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically with high efficiency, high gain and wide bandwidth capabilities, which makes the CGHV14250 ideal for 1.2 - 1.4 GHz L-Band radar amplifier applications. The transistor could be utilized for band specific applications ranging from 900 through 1800 MHz. The package options are ceramic/metal flange and pill package.



Package Type: 440162, 440161  
PN: CGHV14250F, CGHV14250P

### Typical Performance Over 1.2-1.4 GHz ( $T_c = 25^\circ\text{C}$ ) of Demonstration Amplifier

Parameter	1.2 GHz	1.25 GHz	1.3 GHz	1.35 GHz	1.4 GHz	Units
Output Power	365	365	350	310	330	W
Gain	18.6	18.6	18.4	17.9	18.2	dB
Drain Efficiency	80	80	77	74	76	%

**Note:**

Measured in the CGHV14250-AMP amplifier circuit, under 500  $\mu\text{s}$  pulse width, 10% duty cycle,  $P_{IN} = 37 \text{ dBm}$ .

### Features

- Reference design amplifier 1.2 - 1.4 GHz Operation
- FET Tuning range UHF through 1800 MHz
- 330 W Typical Output Power
- 18 dB Power Gain
- 77% Typical Drain Efficiency
- <0.3 dB Pulsed Amplitude Droop
- Internally pre-matched on input, unmatched output

Large Signal Models Available for ADS and MWO

## Absolute Maximum Ratings (not simultaneous)

Parameter	Symbol	Rating	Units	Conditions
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	$I_{GMAX}$	42	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	18	A	25°C
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
CW Thermal Resistance, Junction to Case <sup>3</sup>	$R_{\theta JC}$	0.95	°C/W	$P_{DISS} = 167 \text{ W}, 65^\circ\text{C}$
Pulsed Thermal Resistance, Junction to Case <sup>3</sup>	$R_{\theta JC}$	0.57	°C/W	$P_{DISS} = 167 \text{ W}, 500 \mu\text{sec}, 10\%, 85^\circ\text{C}$
Pulsed Thermal Resistance, Junction to Case <sup>4</sup>	$R_{\theta JC}$	0.63	°C/W	$P_{DISS} = 167 \text{ W}, 500 \mu\text{sec}, 10\%, 85^\circ\text{C}$
Case Operating Temperature <sup>5</sup>	$T_C$	-40, +130	°C	$P_{DISS} = 167 \text{ W}, 500 \mu\text{sec}, 10\%$

### Note:

<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>

<sup>3</sup> Measured for the CGHV14250P

<sup>4</sup> Measured for the CGHV14250F

<sup>5</sup> See also, the Power Dissipation De-rating Curve on Page 5

## 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	$V_{DC}$	$V_{DS} = 10 \text{ V}, I_D = 41.8 \text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	$V_{DC}$	$V_{DS} = 50 \text{ V}, I_D = 500 \text{ mA}$
Saturated Drain Current <sup>2</sup>	$I_{DS}$	31.4	37.6	-	A	$V_{DS} = 6.0 \text{ V}, V_{GS} = 2.0 \text{ V}$
Drain-Source Breakdown Voltage	$V_{BR}$	150	-	-	$V_{DC}$	$V_{GS} = -8 \text{ V}, I_D = 41.8 \text{ mA}$
<b>RF Characteristics<sup>3</sup> (<math>T_C = 25^\circ\text{C}, F_0 = 1.3 \text{ GHz}</math> unless otherwise noted)</b>						
Output Power	$P_{OUT}$	275	330	-	W	$V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 37 \text{ dBm}$
Drain Efficiency	$D_E$	63	77	-	%	$V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 37 \text{ dBm}$
Power Gain	$G_p$	-	18.2	-	dB	$V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 37 \text{ dBm}$
Pulsed Amplitude Droop	$D$	-	-0.3	-	dB	$V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}$
Output Mismatch Stress	VSWR	-	5 : 1	-	$\Psi$	No damage at all phase angles, $V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 37 \text{ dBm}$ Pulsed
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	-	150	-	pF	$V_{DS} = 50 \text{ V}, V_{GS} = -8 \text{ V}, f = 1 \text{ MHz}$
Output Capacitance	$C_{DS}$	-	16	-	pF	$V_{DS} = 50 \text{ V}, V_{GS} = -8 \text{ V}, f = 1 \text{ MHz}$
Feedback Capacitance	$C_{GD}$	-	1.35	-	pF	$V_{DS} = 50 \text{ V}, V_{GS} = -8 \text{ V}, f = 1 \text{ MHz}$

### Notes:

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

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

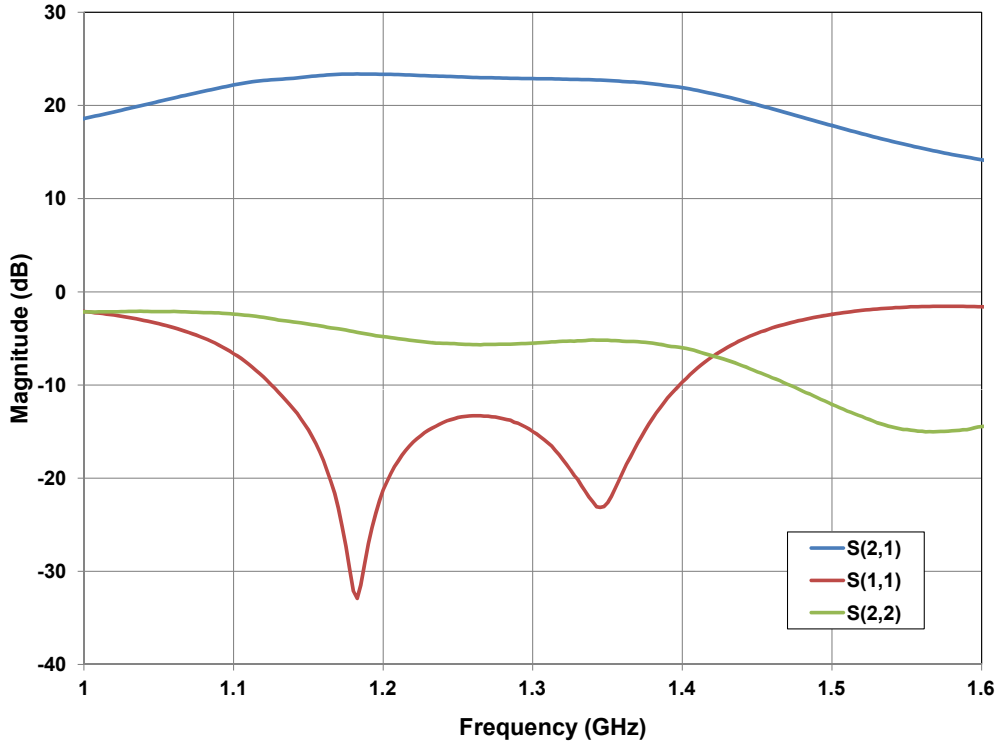
<sup>3</sup> Measured in CGHV14250-AMP. Pulse Width = 500  $\mu\text{s}$ , Duty Cycle = 10%.



## Typical Performance

**Figure 1. - CGHV14250 Typical Sparameters**

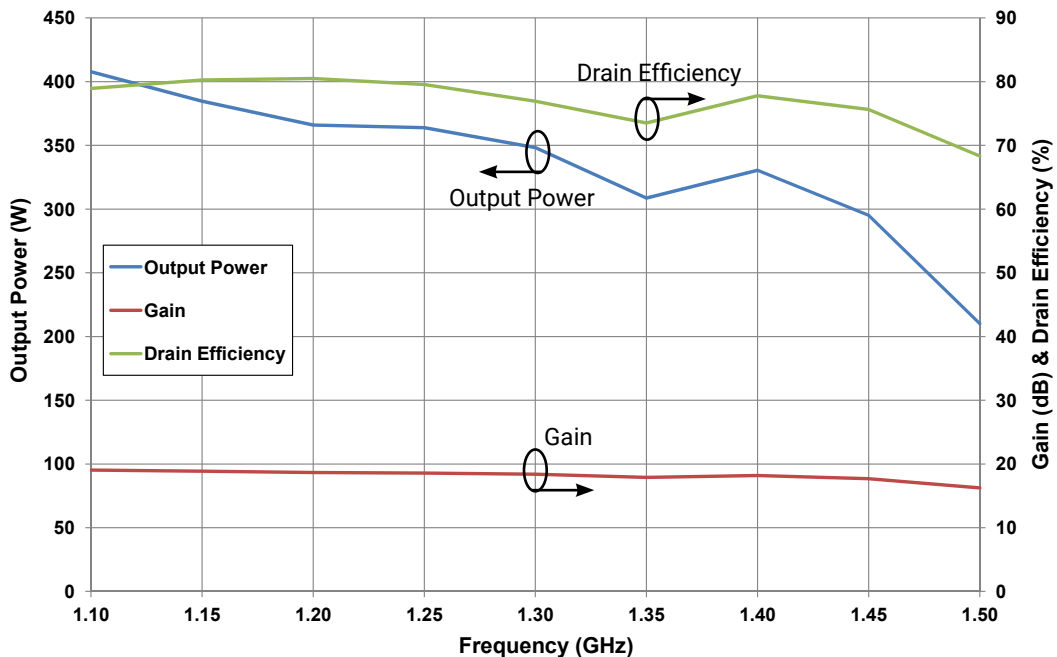
$T_{case} = 25^{\circ}C$   $V_{DD} = 50 V$ ,  $I_{DQ} = 500 mA$



**Figure 2. - CGHV14250 Typical RF Results**

$V_{DD} = 50 V$ ,  $I_{DQ} = 500 mA$ ,  $P_{IN} = 37 dBm$

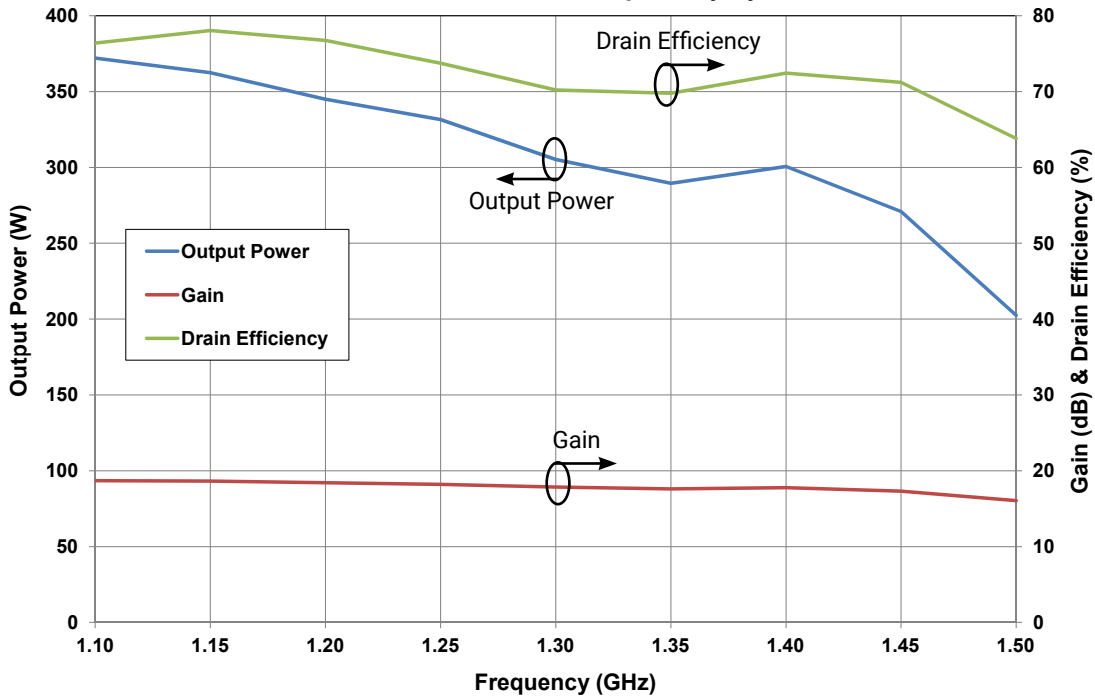
$T_{case} = 25^{\circ}C$ , Pulse Width = 500  $\mu s$ , Duty Cycle = 10 %



## Typical Performance

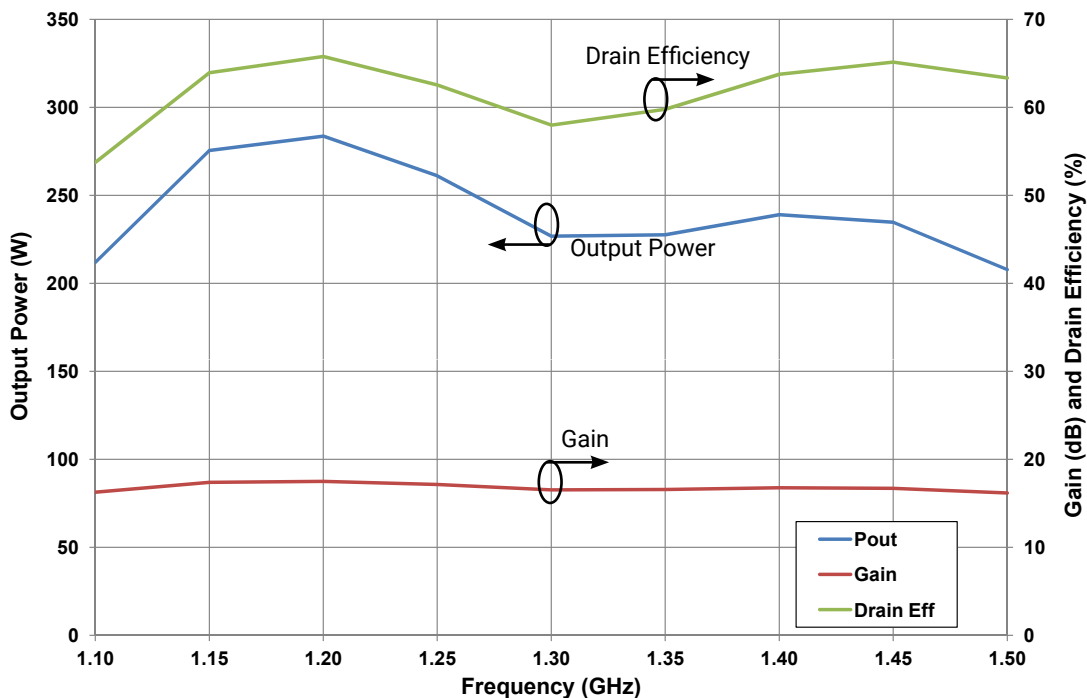
**Figure 3. - CGHV14250 Typical RF Results**

$V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ ,  $P_{IN} = 37\text{ dBm}$   
 $T_{case} = 85^\circ\text{C}$ , Pulse Width =  $500\ \mu\text{s}$ , Duty Cycle = 10 %

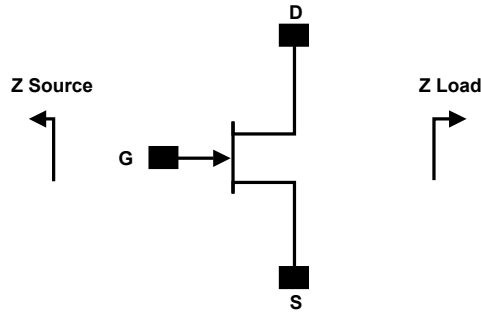


**Figure 4. - CGHV14250 CW RF Results**

$V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ ,  $P_{IN} = 37\text{ dBm}$ ,  $T_{case} = 65^\circ\text{C}$



## Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
900	0.6 - j0.3	5.3 + j0.1
1000	0.7 - j0.8	4.3 + j0.8
1100	1.3 - j1.1	3.3 + j0.8
1200	1.8 - j1.1	3.0 + j0.4
1300	2.5 - j0.7	2.5 + j0.4
1400	3.4 - j0.7	2.3 + j0.1
1500	1.8 - j0.9	2.3 + j0

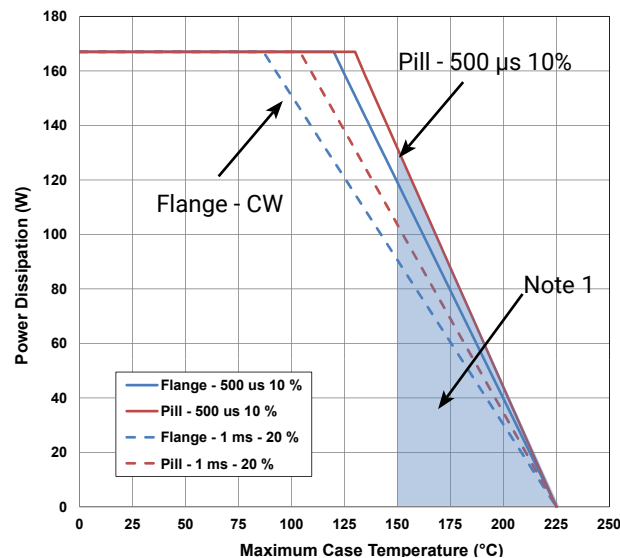
Note 1.  $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$  in the 440162 package

Note 2. Optimized for power gain,  $P_{SAT}$  and Drain Efficiency

Note 3. When using this device at low frequency, series resistors should be used to maintain amplifier stability

## CGHV14250F Power Dissipation De-rating Curve

Figure 4. - CGHV14250 Transient Power Dissipation De-Rating Curve

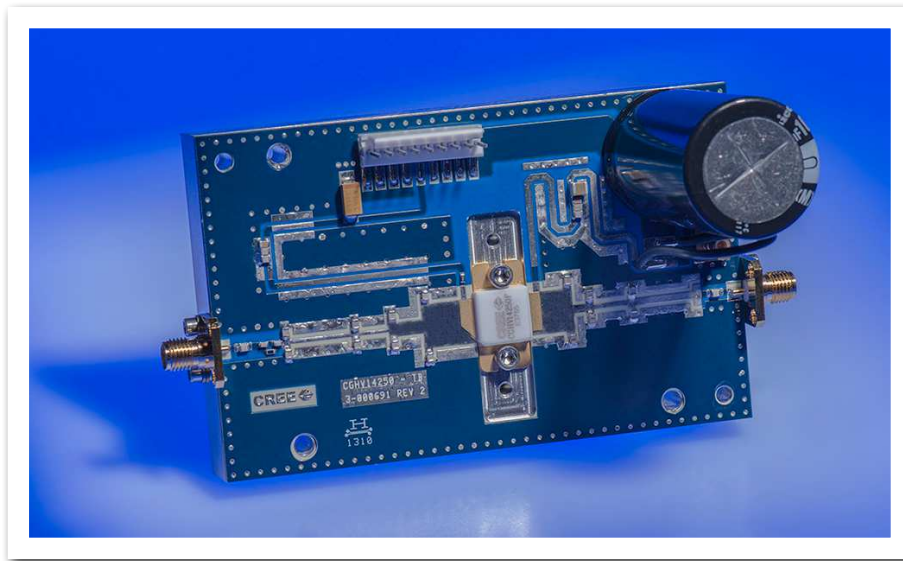


Note 1. Area exceeds Maximum Case Temperature (See Page 2).

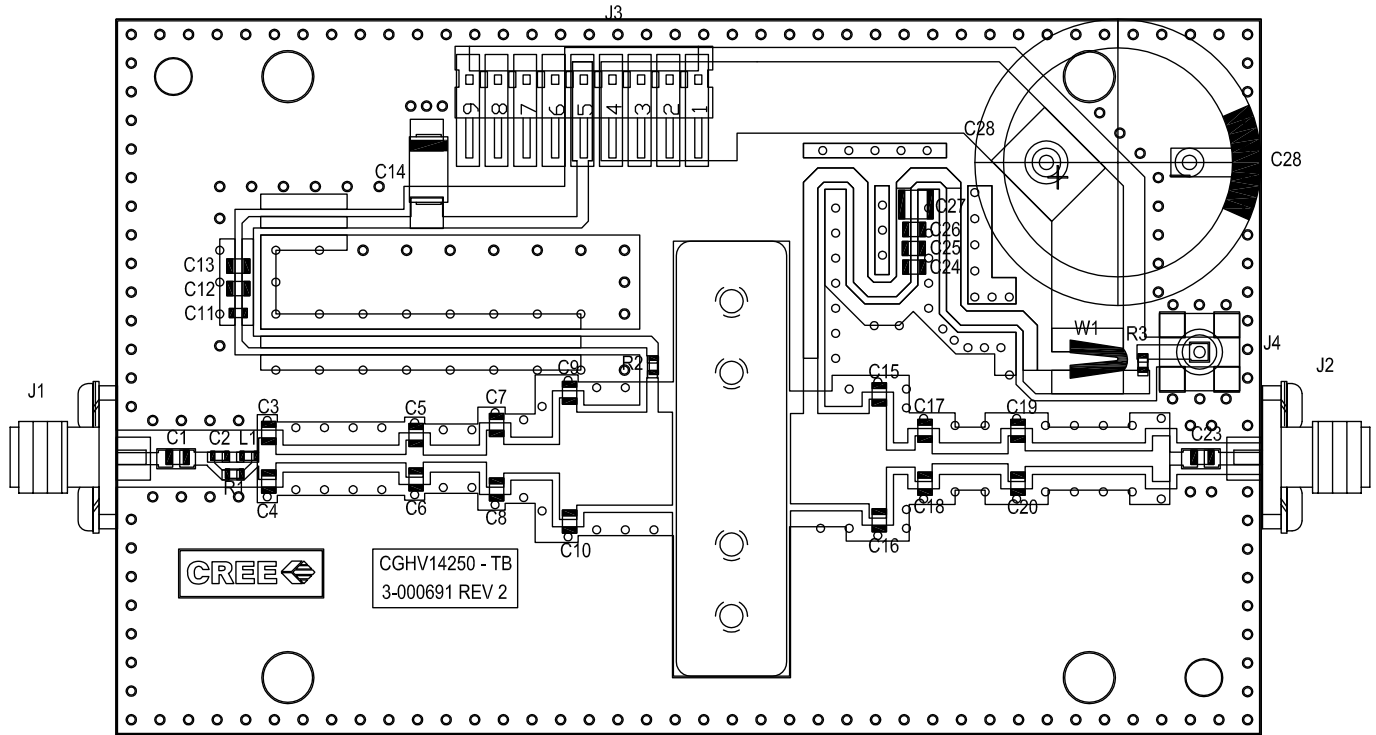
## CGHV14250-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16W, 0603, 1%, 562 OHMS	1
R2	RES, 5.1 OHM, +/-1%, 1/16W, 0603	1
R3	RES, 1/16W, 0603, 1%, 4700 OHMS	1
L1	INDUCTOR, CHIP, 6.8 nH, 0603 SMT	1
C1, C23	CAP, 27pF, +/- 5%, 250V, 0805, ATC 600F	2
C2	CAP, 2.0pF, +/- 0.1pF, 0603, ATC	1
C3, C4	CAP, 0.5pF, +/-0.05pF, 0805, ATC 600F	2
C5,C6	CAP, 1.0pF, +/-0.05 pF, 0805, ATC 600F	2
C7,C8,C9,C10	CAP, 3.0pF, +/-0.1pF, 250V, 0805, ATC 600F	4
C11,C24	CAP, 47pF,+/-5%, 250V, 0805, ATC 600F	2
C12,C25	CAP, 100pF, +/-5%, 250V, 0805, ATC 600F	2
C13,C26	CAP, 33000PF, 0805,100V, X7R	2
C14	CAP 10uF 16V TANTALUM	1
C15,C16,C17,C18	CAP, 3.9pF, +/-0.1pF, 250V, 0805, ATC 600F	4
C19,C20	CAP, 1.2pF, +/-0.05pF, 0805, ATC 600F	2
C27	CAP, 1.0UF, 100V, 10%, X7R, 1210	1
C28	CAP, 3300 UF, +/-20%, 100V, ELECTROLYTIC	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FL	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
J4	CONNECTOR ; SMB, Straight, JACK,SMD	1
W1	CABLE ,18 AWG, 4.2	1
	PCB, RO4350, 0.020 MIL THK, CGHV14250, 1.2-1.4GHZ	1
Q1	CGHV14250	1

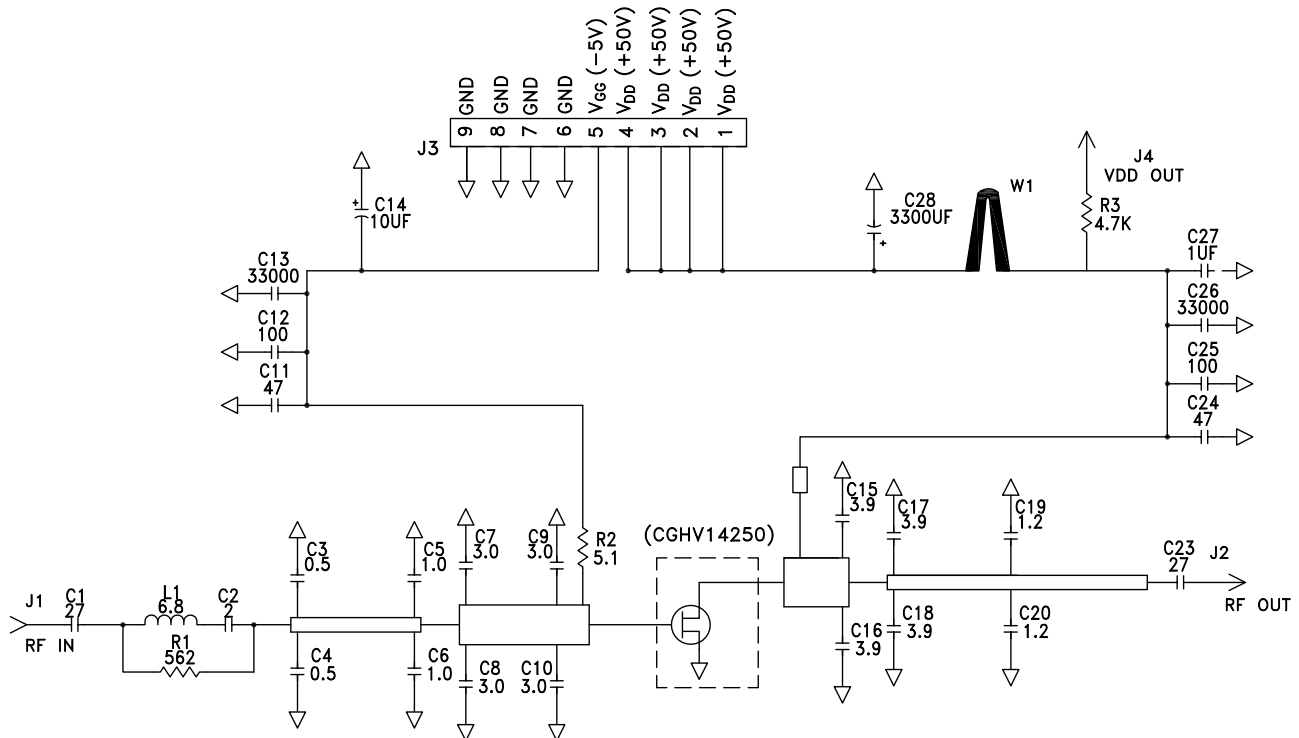
## CGHV14250-AMP Demonstration Amplifier Circuit



## CGHV14250-AMP Demonstration Amplifier Circuit Outline

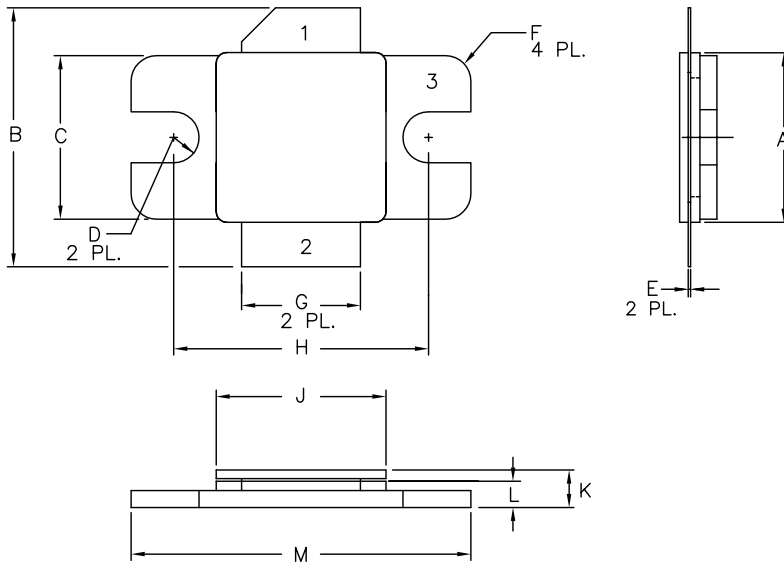


## CGHV14250-AMP Demonstration Amplifier Circuit Schematic





## Product Dimensions CGHV14250F (Package Type – 440162)



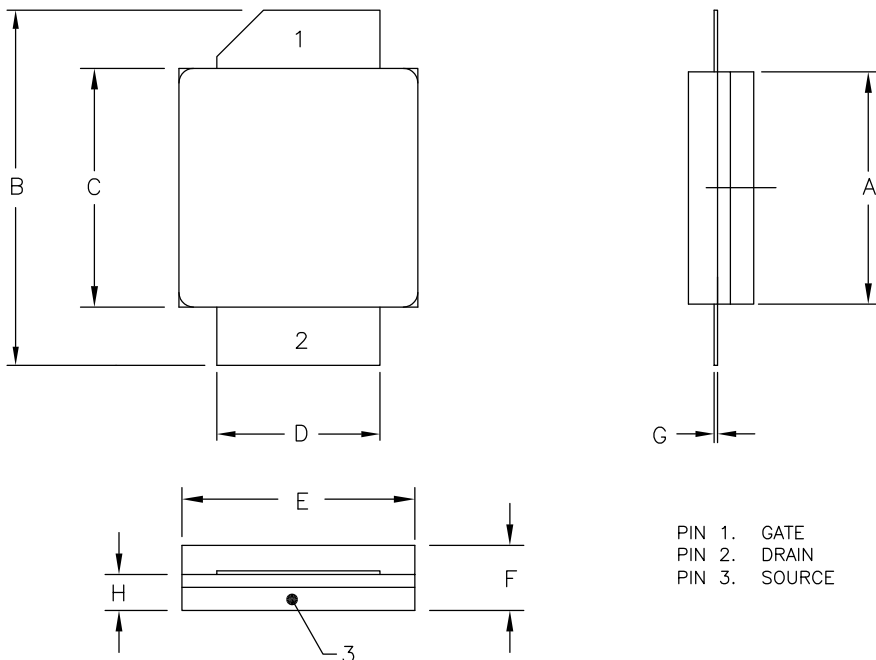
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.395	.405	10.03	10.29
B	.580	.620	14.73	15.75
C	.380	.390	9.65	9.91
D	.055	.065	1.40	1.65
E	.004	.006	0.10	0.15
F	.055	.065	1.40	1.65
G	.275	.285	6.99	7.24
H	.595	.605	15.11	15.37
J	.395	.405	10.03	10.29
K	.129	.149	3.28	3.78
L	.053	.067	1.35	1.70
M	.795	.805	20.19	20.45

- PIN 1. GATE  
 PIN 2. DRAIN  
 PIN 3. SOURCE

## Product Dimensions CGHV14250P (Package Type – 440161)



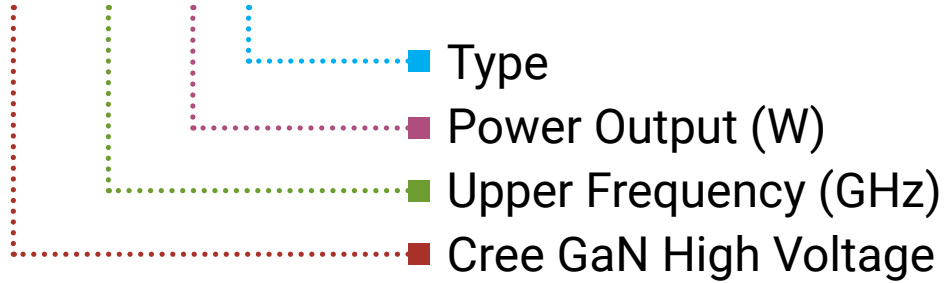
**NOTES:**

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2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.395	.407	10.03	10.34
B	.594	.634	15.09	16.10
C	.395	.407	10.03	10.34
D	.275	.285	6.99	7.24
E	.395	.407	10.03	10.34
F	.129	.149	3.28	3.78
G	.004	.006	0.10	0.15
H	.057	.067	1.45	1.70

- PIN 1. GATE  
 PIN 2. DRAIN  
 PIN 3. SOURCE

### CGHV14250F



Parameter	Value	Units
Upper Frequency <sup>1</sup>	1.4	GHz
Power Output	250	W
Type	F = Flanged P = Package	-

**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
CGHV14250F	GaN HEMT	Each	
CGHV14250P	GaN HEMT	Each	
CGHV14250-TB	Test board without GaN HEMT	Each	
CGHV14250P-AMP	Test board with GaN HEMT installed	Each	
CGHV14250F-AMP	Test board with GaN HEMT installed	Each	



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