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# CGHV22200

200 W, 1800-2200 MHz, GaN HEMT for LTE

Cree's CGHV22200 is a gallium nitride (GaN) high electron mobility transistor (HEMT) is designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGHV22200F ideal for 1.8 - 2.2 GHz LTE, 4G Telecom and BWA amplifier applications. The transistor is input matched and supplied in a ceramic/metal flange package.



Package Type: 440162 and 440161  
PN: CGHV22200F and CGHV22200P

## Typical Performance Over 1.8 - 2.2 GHz ( $T_c = 25^\circ\text{C}$ ) of Demonstration Amplifier

Parameter	1.8 GHz	2.0 GHz	2.2 GHz	Units
Gain @ 47 dBm	16.6	19.2	18.1	dB
ACLR @ 47 dBm	-37.4	-37.4	-35.6	dBc
Drain Efficiency @ 47 dBm	31.5	31.9	34.8	%

**Note:**

Measured in the CGHV22200-AMP amplifier circuit, under WCDMA 3GPP test model 1, 64 DPCH, 45% clipping, PAR = 7.5 dB @ 0.01% Probability on CCDF.  $I_{DS} = 1.0\text{ A}$

## Features



- 1.8 - 2.2 GHz Operation
- 18 dB Gain
- -35 dBc ACLR at 50 W  $P_{AVE}$
- 31-35 % Efficiency at 50 W  $P_{AVE}$
- High Degree of DPD Correction Can be Applied

Large Signal Models Available for ADS and MWO



## Absolute Maximum Ratings (not simultaneous) at 25°C Case Temperature

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	$V_{DSS}$	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 <sup>3</sup>	$T_J$	225	°C	
Maximum Forward Gate Current	$I_{GMAX}$	32	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	12	A	25°C
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	80	in-oz	
Thermal Resistance, Junction to Case <sup>3</sup>	$R_{\theta JC}$	1.22	°C/W	85°C, $P_{DISS} = 96$ W
Thermal Resistance, Junction to Case <sup>4</sup>	$R_{\theta JC}$	1.54	°C/W	85°C, $P_{DISS} = 96$ W
Case Operating Temperature <sup>5</sup>	$T_C$	-40, +150	°C	

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 CGHV22200P

<sup>4</sup> Measured for the CGHV22200F

<sup>5</sup> See also, the Power Dissipation De-rating Curve on Page 6.

## Electrical Characteristics ( $T_C = 25^\circ\text{C}$ )

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics<sup>1</sup></b>						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	-2.3	$V_{DC}$	$V_{DS} = 10$ V, $I_D = 32$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	$V_{DC}$	$V_{DS} = 50$ V, $I_D = 1.0$ A
Saturated Drain Current <sup>2</sup>	$I_{DS}$	24	28.8	-	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	$V_{BR}$	150	-	-	$V_{DC}$	$V_{GS} = -8$ V, $I_D = 32$ mA
<b>RF Characteristics<sup>3</sup> (<math>T_C = 25^\circ\text{C}</math>, <math>F_0 = 2.17</math> GHz unless otherwise noted)</b>						
Saturated Output Power <sup>3,4</sup>	$P_{SAT}$	-	240	-	W	$V_{DD} = 50$ V, $I_{DQ} = 1.0$ A
Pulsed Drain Efficiency <sup>3</sup>	$\eta$	-	65	-	%	$V_{DD} = 50$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = P_{SAT}$
Gain <sup>6</sup>	G	-	18.0	-	dB	$V_{DD} = 50$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = 47$ dBm
WCDMA Linearity <sup>6</sup>	ACLR	-	-36.7	-	dBc	$V_{DD} = 50$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = 47$ dBm
Drain Efficiency <sup>6</sup>	$\eta$	-	34.5	-	%	$V_{DD} = 50$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = 47$ dBm
Output Mismatch Stress <sup>3</sup>	VSWR	-	-	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 50$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = 200$ W Pulsed
<b>Dynamic Characteristics</b>						
Input Capacitance <sup>7</sup>	$C_{GS}$	-	97	-	pF	$V_{DS} = 50$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance <sup>7</sup>	$C_{DS}$	-	13.4	-	pF	$V_{DS} = 50$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Feedback Capacitance	$C_{GD}$	-	0.94	-	pF	$V_{DS} = 50$ V, $V_{GS} = -8$ V, $f = 1$ MHz

Notes:

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

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

<sup>3</sup> Pulse Width = 100  $\mu$ S, Duty Cycle = 10%

<sup>4</sup>  $P_{SAT}$  is defined as  $I_G = 3$  mA peak.

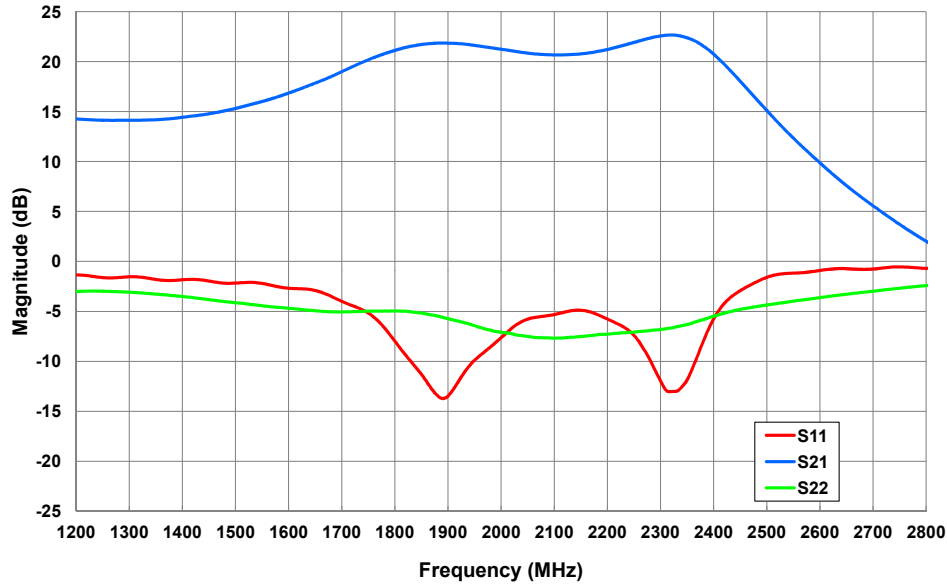
<sup>5</sup> Measured in CGHV22200-AMP

<sup>6</sup> Single Carrier WCDMA, 3GPP Test Model 1, 64 DPCH, 45% Clipping, PAR = 7.5 dB @ 0.01% Probability on CCDF.

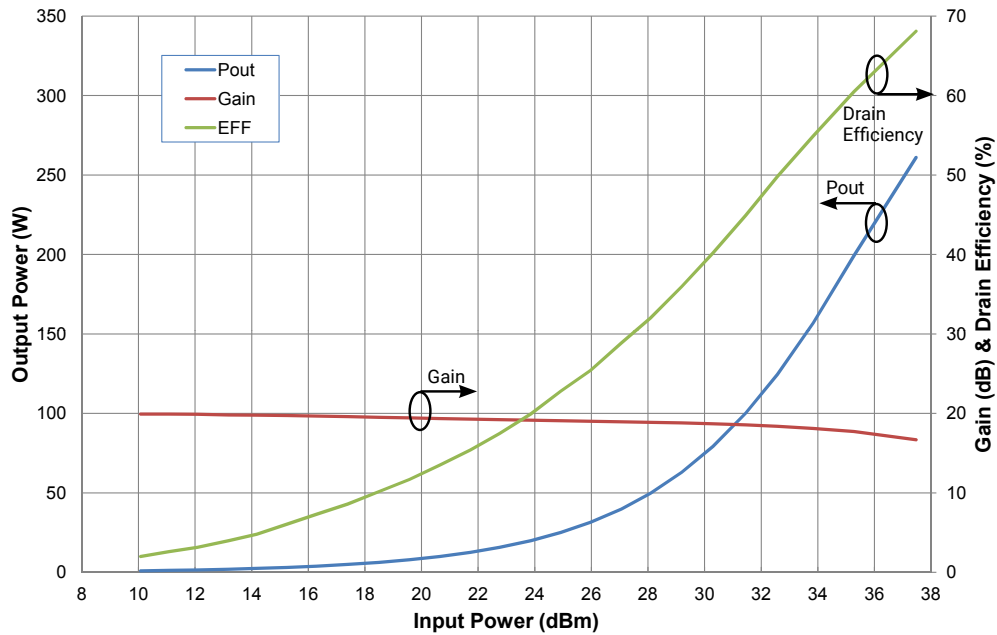
<sup>7</sup> Includes package and internal matching components.

## Typical Performance

**Figure 1. - Small Signal Gain and Return Losses vs Frequency for the CGHV22200 measured in CGHV22200-AMP Amplifier Circuit**  
 $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 1.0\text{ A}$

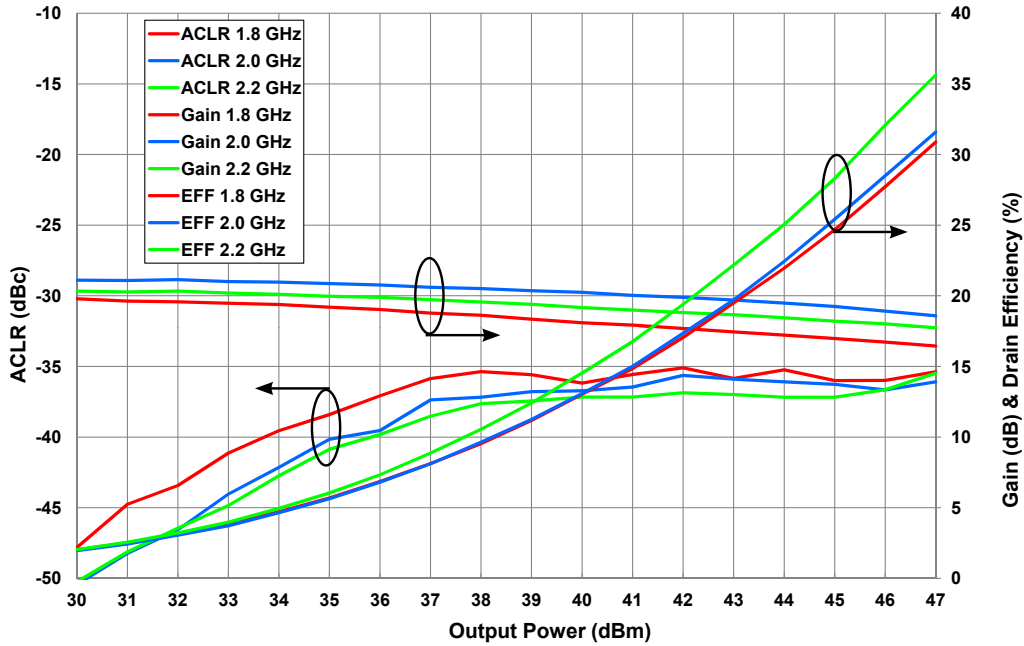


**Figure 2. - Typical Gain and Drain Efficiency vs Input Power of the CGHV22200 measured in CGHV22200-AMP Amplifier Circuit.**  
 $V_{DS} = 50\text{ V}$ ,  $I_{DQ} = 1.0\text{ A}$ , Freq = 2.1 GHz, Pulse Width = 100  $\mu\text{s}$ , Duty Cycle = 10 %

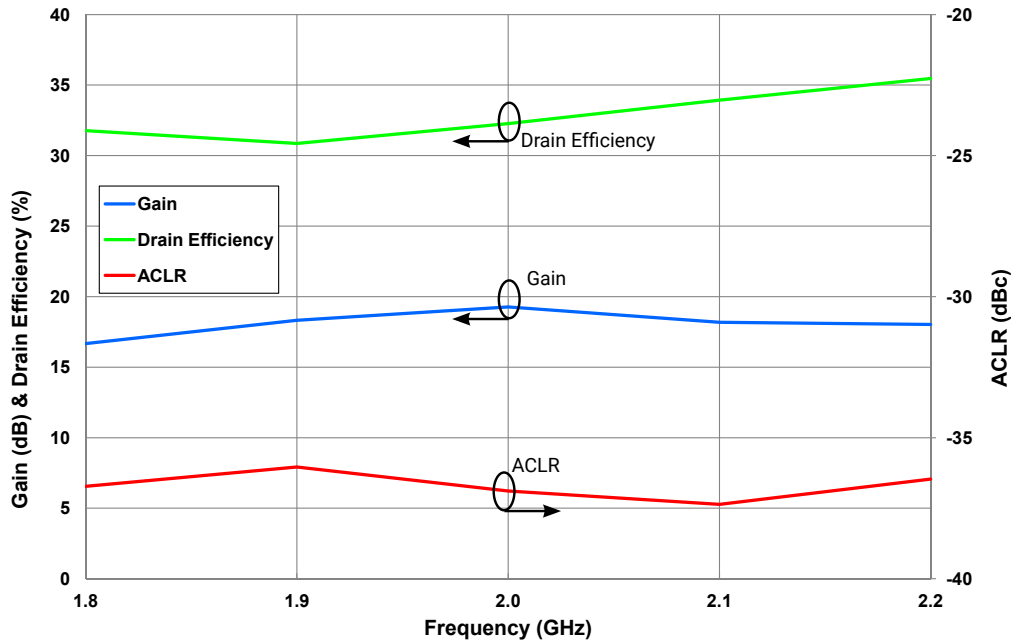


## Typical Performance

**Figure 3. - Typical WCDMA Transfer Characteristics**  
 $V_{DD} = 50\text{ V}$ ,  $I_{DS} = 1.0\text{ A}$ , 1c WCDMA, PAR = 7.5 dB

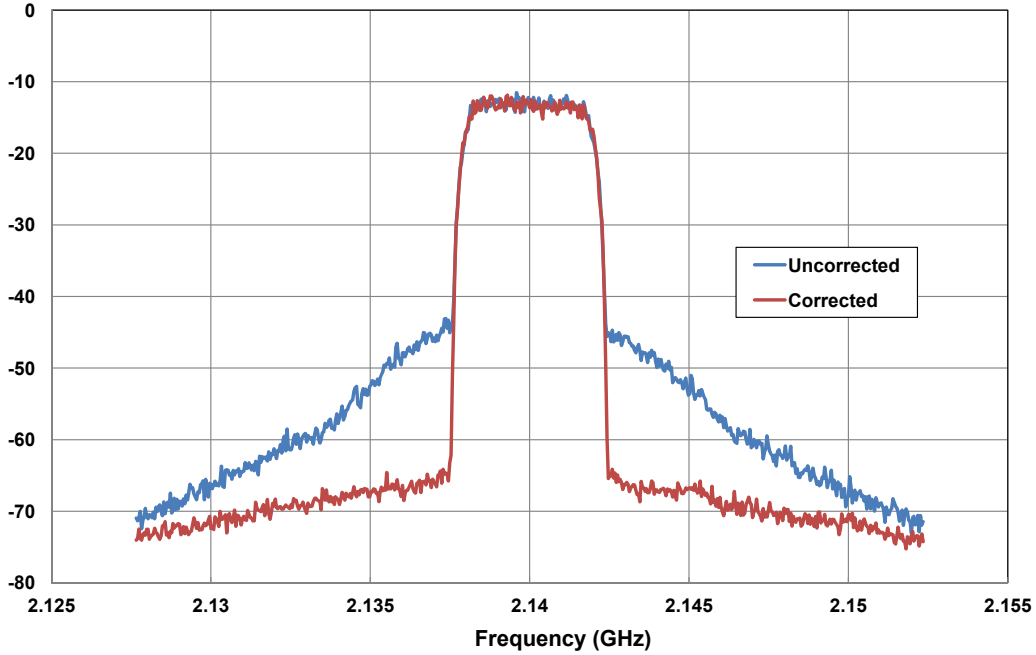


**Figure 4. - Typical Gain, Drain Efficiency and ACLR vs Frequency**  
of the CGHV22200 measured in CGHV22200-AMP Amplifier Circuit  
 $V_{DD} = 50\text{ V}$ ,  $I_{DS} = 1.0\text{ A}$ ,  $P_{AVE} = 50\text{ W}$ , 1c WCDMA, PAR = 7.5 dB

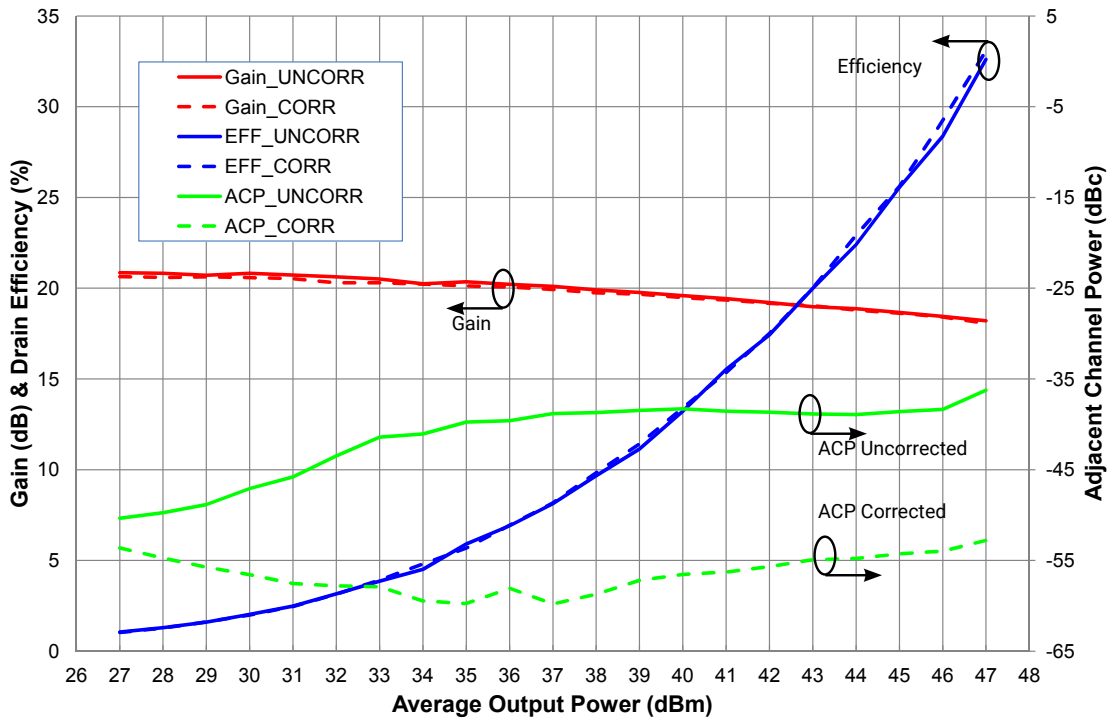


## Typical Performance

**Figure 5. - CGHV22200 Spectral Mask at  $P_{AVE} = 47$  dBm with and without DPD**  
 $V_{DD} = 50$ ,  $I_{DQ} = 1.0$  A, Freq=2.14 GHz, 1 C WCDMA 7.5 PAR

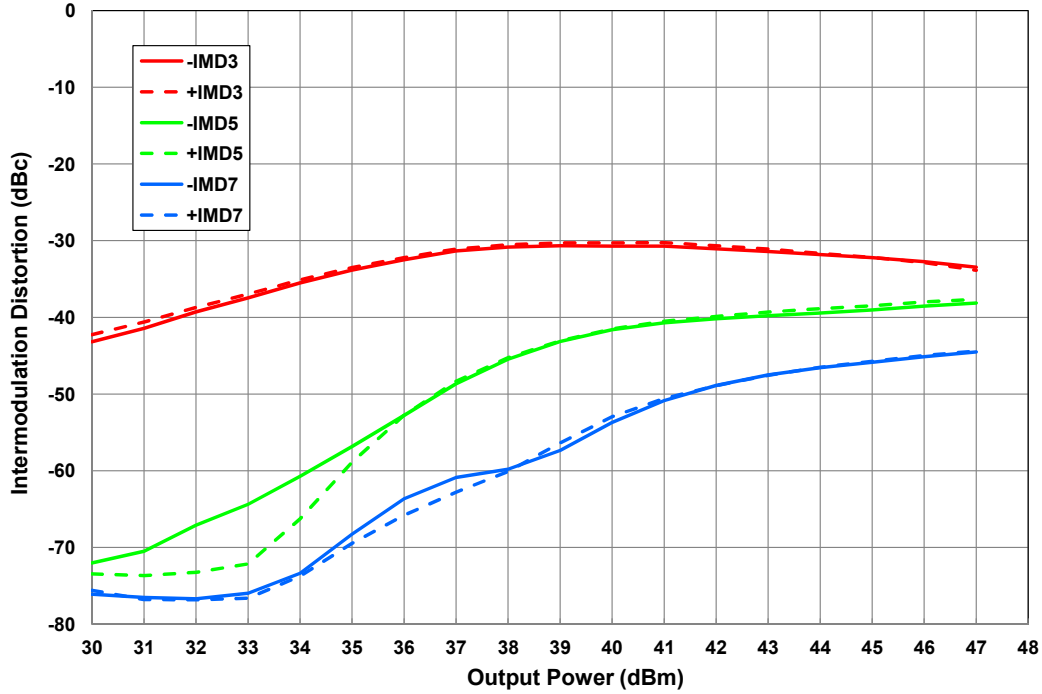


**Figure 6. - CGHV22200 Typical Linearity under DPD vs. Output Power**  
 $V_{DD} = 50$ ,  $I_{DQ} = 1.0$  A, Freq=2.14 GHz, 1 C WCDMA 7.5 PAR

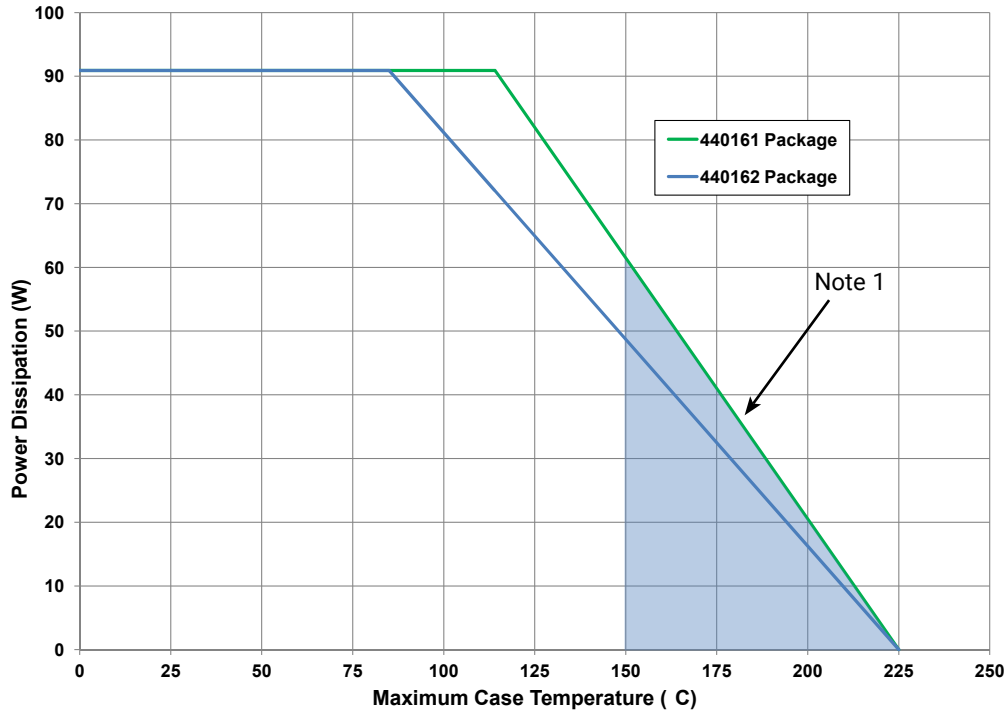


## Typical Performance

**Figure 7. - Intermodulation Distortion Products vs Output Power**  
 Freq. = 2.1 GHz, VDD = 50 V, IDQ = 1.0 A, Tone Spacing = 100 kHz.

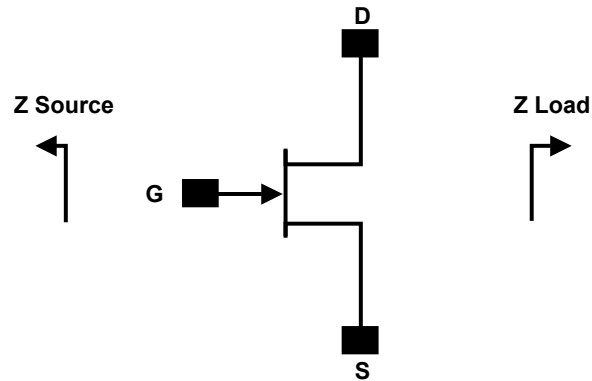


**Figure 8. - Power Dissipation Derating Curve**



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

## Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
1800	10.6 - j7.3	2.7 + j0.6
1900	8.1 - j7.4	2.8 + j0.7
2000	6.1 - j6.6	2.9 + j0.8
2100	4.7 - j5.5	2.8 + j0.8
2200	3.7 - j4.3	2.6 + j0.8

Note<sup>1</sup>:  $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 1.0\text{ A}$ . In the 440162 package.

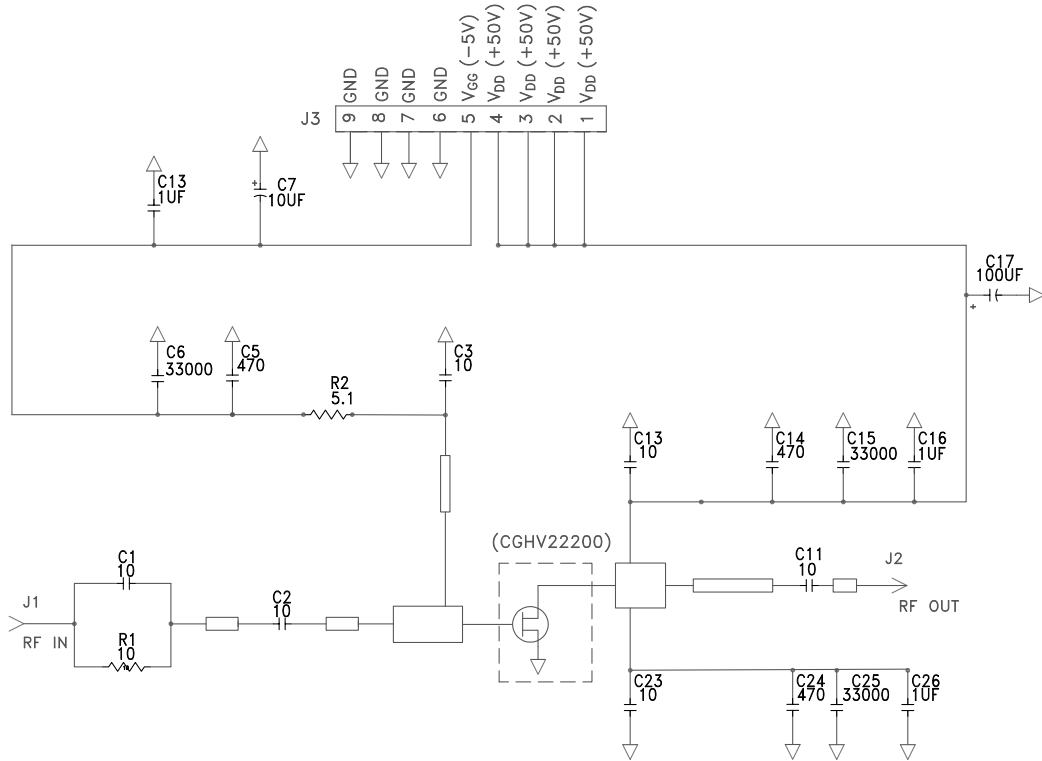
Note<sup>2</sup>: Impedances are extracted from CGHV22200-AMP demonstration circuit and are not source and load pull data derived from transistor.



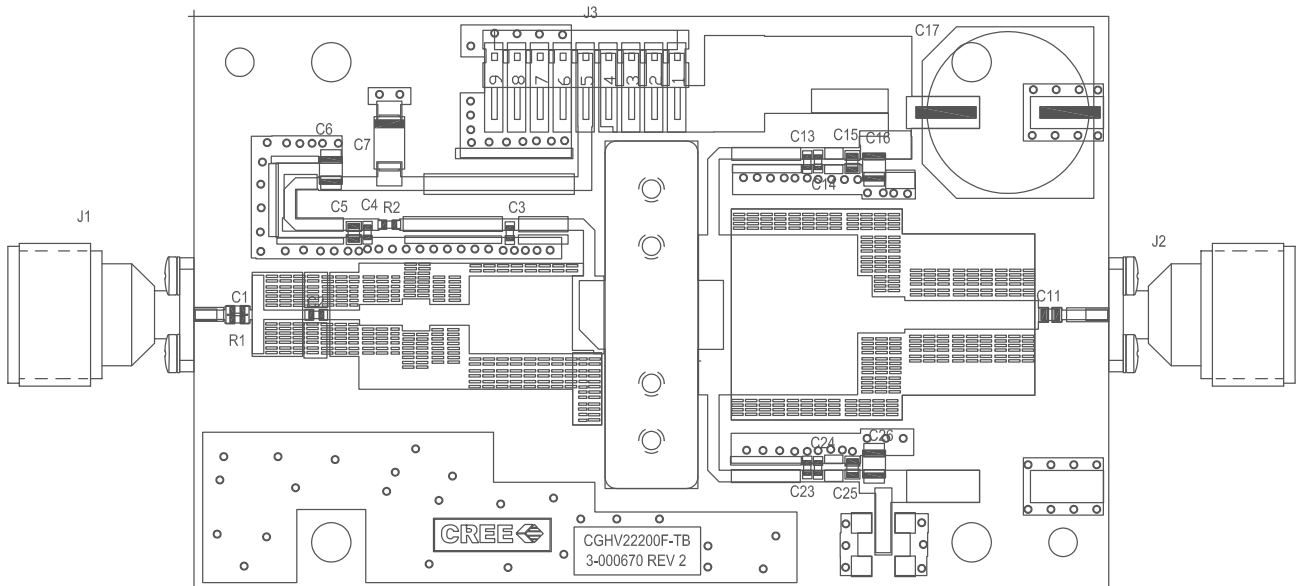
## CGHV22200-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16 W, 0603, 1%, 10.0 OHMS	1
R2	RES, 1/16 W, 0603, 1%, 5.1 OHMS	1
C4, C14, C24	CAP, 470 pF, 5%, 100 V, 0603, X	3
C6, C16, C26	CAP, 1.0 uF, 100 V, 10%, x7R, 121	3
C17, C27	CAP, 100 uF, 20%, 160 V, ELEC	2
C7	CAP, 10 uF, 16 V, TANTALUM, 2312	1
C1, C2, C3, C13, C23	CAP, 10.0 pF, 5%, 0603, ATC	5
C5, C15, C25	CAP, 33000 pF, 0805, 100 V, X7R	3
C11	CAP, 10 pF, 5%, 250 V, 0805, A	1
J1, J2	CONN, N, FEM, W/.500 SMA FLNG	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
	PCB, CGHV22200F, R04350, 0.020" THK	1
	2-56 SOC HD SCREW 1/4 SS	4
	#2 SPLIT LOCKWASHER SS	4
	CGHV22200	1

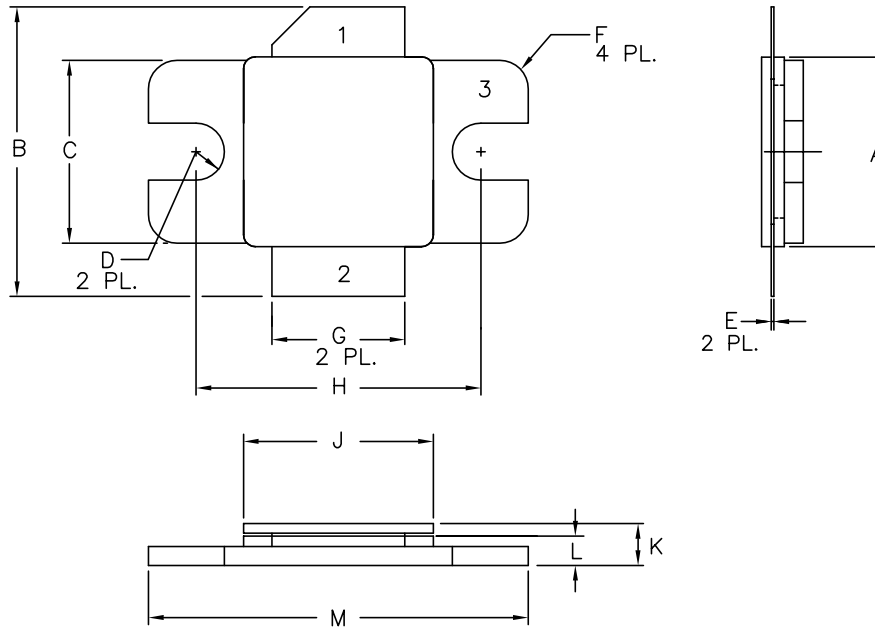
## CGHV22200-AMP Demonstration Amplifier Circuit Schematic



## CGHV22200-AMP Demonstration Amplifier Circuit Outline



## Product Dimensions CGHV22200F (Package Type – 440162)



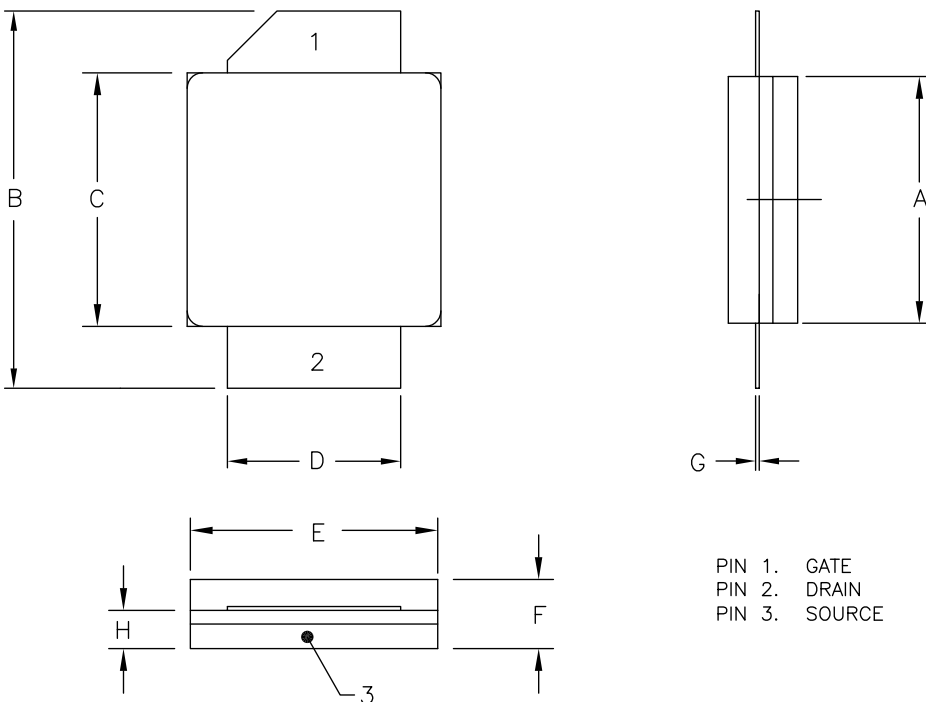
**NOTES:**

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 CGHV22200P (Package Type – 440161)



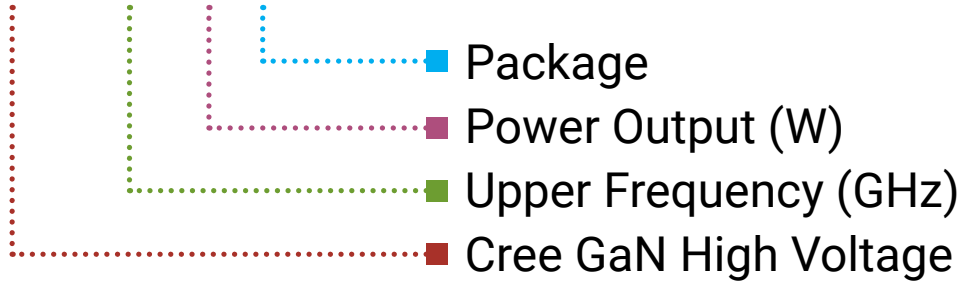
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
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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

### CGHV22200F



Parameter	Value	Units
Upper Frequency <sup>1</sup>	2.2	GHz
Power Output	200	W
Package	Flange	-

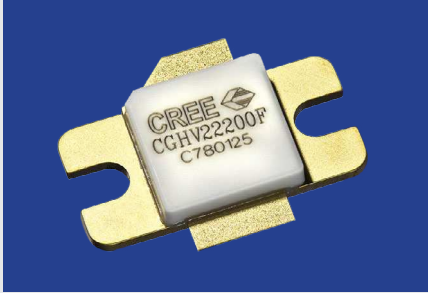
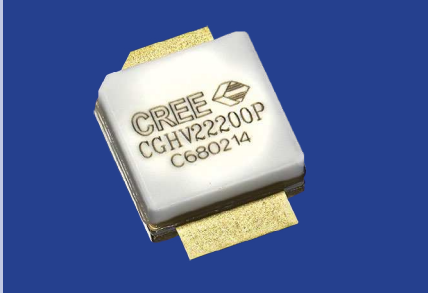
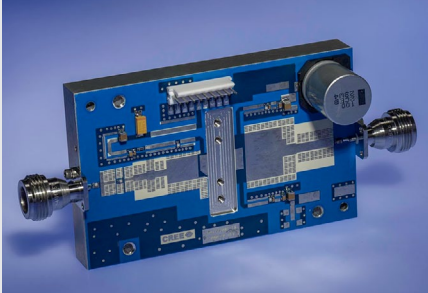
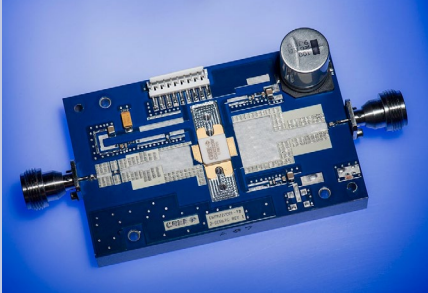
**Table 1.**

**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
CGHV22200F	GaN HEMT	Each	
CGHV22200P	GaN HEMT	Each	
CGHV22200-TB	Test board without GaN HEMT	Each	
CGHV22200F-AMP	Test board with GaN HEMT installed	Each	



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