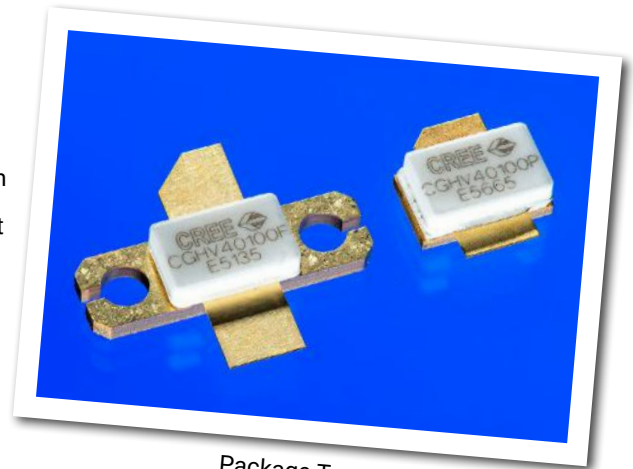


# CGHV40100

100 W, DC - 3.0 GHz, 50 V, GaN HEMT

Cree's CGHV40100 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGHV40100, operating from a 50 volt rail, offers a general purpose, broadband solution to a variety of RF and microwave applications. GaN HEMTs offer high efficiency, high gain and wide bandwidth capabilities making the CGHV40100 ideal for linear and compressed amplifier circuits. The transistor is available in a 2-lead flange and pill package.



Package Types: 440193 & 440206  
PN: CGHV40100F & CGHV40100P

## Typical Performance Over 500 MHz - 2.5 GHz ( $T_c = 25^\circ\text{C}$ ), 50 V

Parameter	500 MHz	1.0 GHz	1.5 GHz	2.0 GHz	2.5 GHz	Units
Small Signal Gain	17.6	16.9	17.7	17.5	14.8	dB
Saturated Output Power	147	100	141	116	112	W
Drain Efficiency @ $P_{SAT}$	68	56	58	54	54	%
Input Return Loss	6	5.1	10.5	5.5	8.8	dB

Note:  
Measured CW in the CGHV40100F-AMP application circuit.

## Features

- Up to 3 GHz Operation
- 100 W Typical Output Power
- 17.5 dB Small Signal Gain at 2.0 GHz
- Application Circuit for 0.5 - 2.5 GHz
- 55 % Efficiency at  $P_{SAT}$
- 50 V Operation



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	$V_{DS}$	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	$I_{GMAX}$	20.8	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	8.7	A	25°C
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
Thermal Resistance, Junction to Case <sup>3</sup>	$R_{\theta JC}$	1.62	°C/W	85°C
Thermal Resistance, Junction to Case <sup>4</sup>	$R_{\theta JC}$	1.72	°C/W	85°C
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 [www.cree.com/RF/Document-Library](http://www.cree.com/RF/Document-Library)

<sup>3</sup> Measured for the CGHV40100P at  $P_{DISS} = 83$  W.

<sup>4</sup> Measured for the CGHV40100F at  $P_{DISS} = 83$  W.

<sup>5</sup> See also, Power Derating Curve on Page 5.

## 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, $I_D = 20.8$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	$V_{DC}$	$V_{DS} = 50$ V, $I_D = 0.6$ A
Saturated Drain Current <sup>2</sup>	$I_{DS}$	15.6	18.7	-	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	$V_{BR}$	150	-	-	$V_{DC}$	$V_{GS} = -8$ V, $I_D = 20.8$ mA
<b>RF Characteristics<sup>3</sup> (<math>T_C = 25^\circ\text{C}</math>, <math>F_0 = 2.0</math> GHz unless otherwise noted)</b>						
Small Signal Gain	$G_{SS}$	-	17.5	-	dB	$V_{DD} = 50$ V, $I_{DQ} = 0.6$ A
Power Gain	$G_P$	-	11.0	-	dB	$V_{DD} = 50$ V, $I_{DQ} = 0.6$ A, $P_{OUT} = P_{SAT}$
Power Output at Saturation <sup>4</sup>	$P_{SAT}$	-	116	-	W	$V_{DD} = 50$ V, $I_{DQ} = 0.6$ A
Drain Efficiency	$\eta$	-	54	-	%	$V_{DD} = 50$ V, $I_{DQ} = 0.6$ A, $P_{OUT} = P_{SAT}$
Output Mismatch Stress	VSWR	-	-	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 50$ V, $I_{DQ} = 0.6$ A, $P_{OUT} = 100$ W CW
<b>Dynamic Characteristics<sup>5</sup></b>						
Input Capacitance	$C_{GS}$	-	29.3	-	pF	$V_{DS} = 50$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance	$C_{DS}$	-	7.3	-	pF	$V_{DS} = 50$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Feedback Capacitance	$C_{GD}$	-	0.61	-	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> Measured in CGHV40100-AMP

<sup>4</sup>  $P_{SAT}$  is defined as  $I_G = 0.208$  mA.

<sup>5</sup> Includes package

## CGHV40100 Typical Performance

Figure 1. - Small Signal Gain and Return Losses versus Frequency measured in application circuit CGHV40100-AMP  
 $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 600\text{ mA}$ ,  $T_{case} = 25^\circ\text{C}$

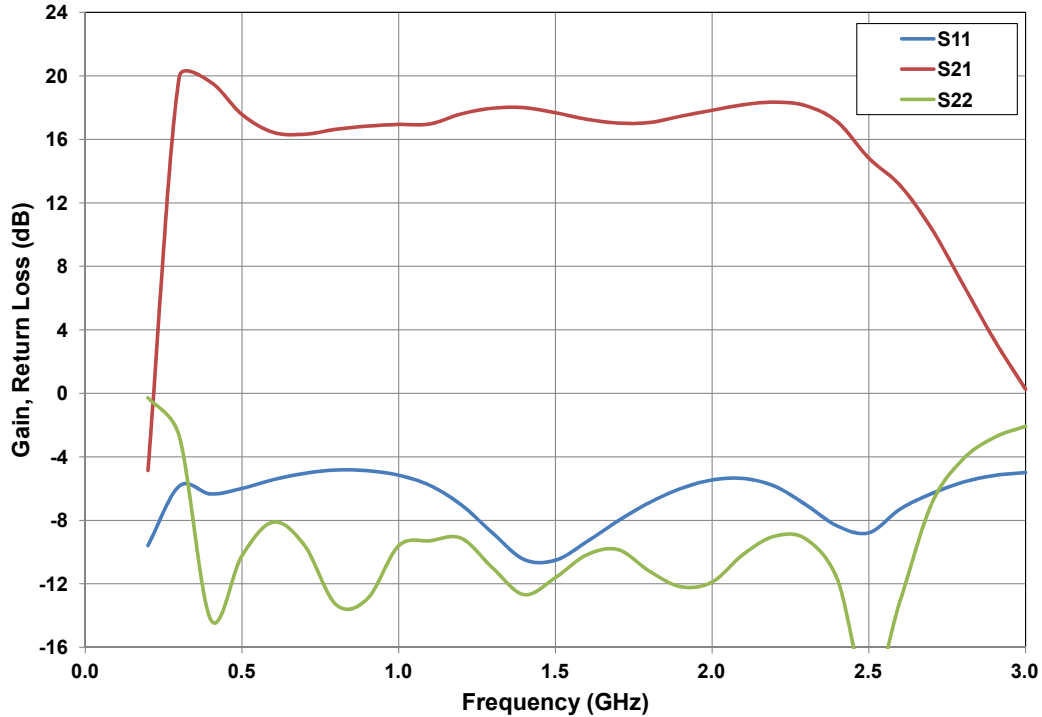
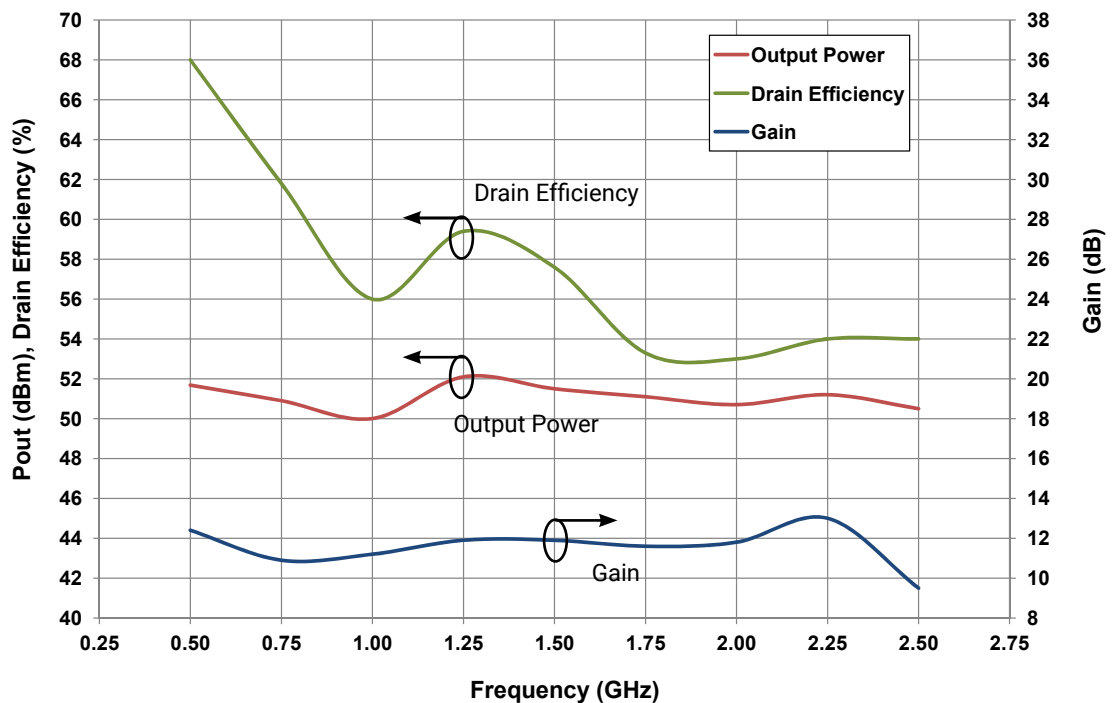
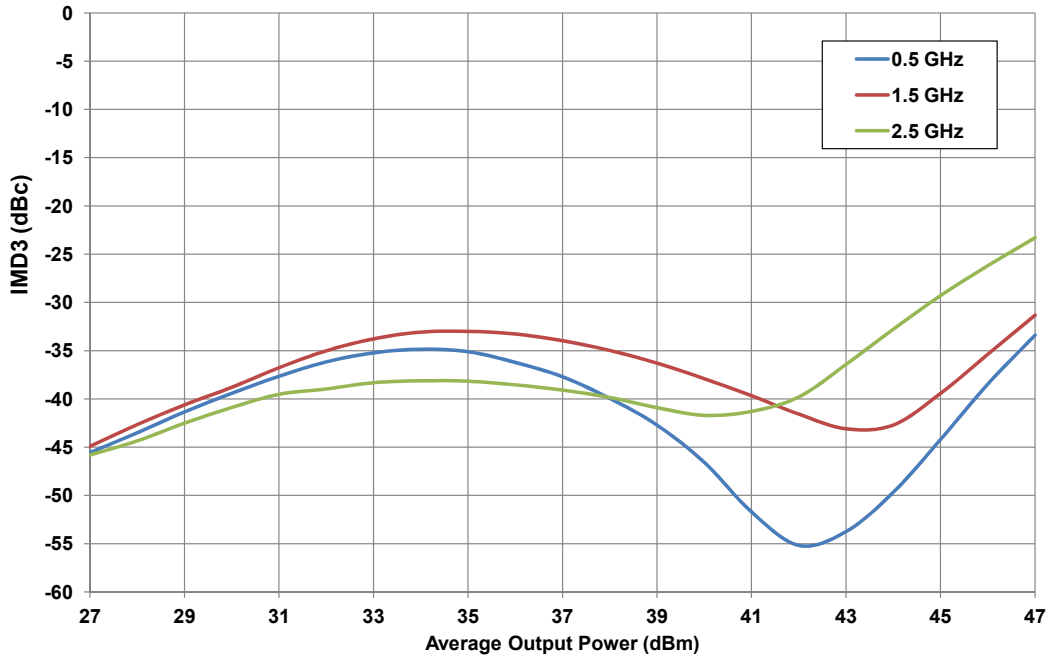


Figure 2. - Output Power and Drain Efficiency vs Frequency  
 $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 600\text{ mA}$

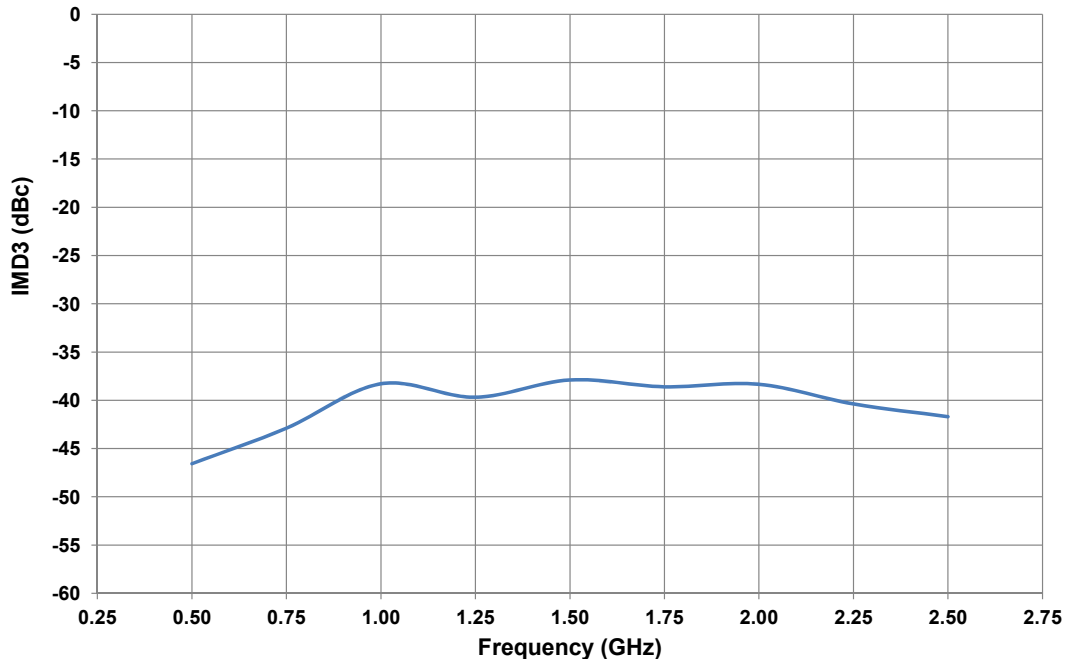


## CGHV40100 Typical Performance

**Figure 3. - Third Order Intermodulation Distortion vs Average Output Power measured in Broadband Amplifier Circuit CGHV40100-AMP**  
 Spacing = 1 MHz,  $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 600\text{ mA}$ ,  $T_{case} = 25^\circ\text{C}$

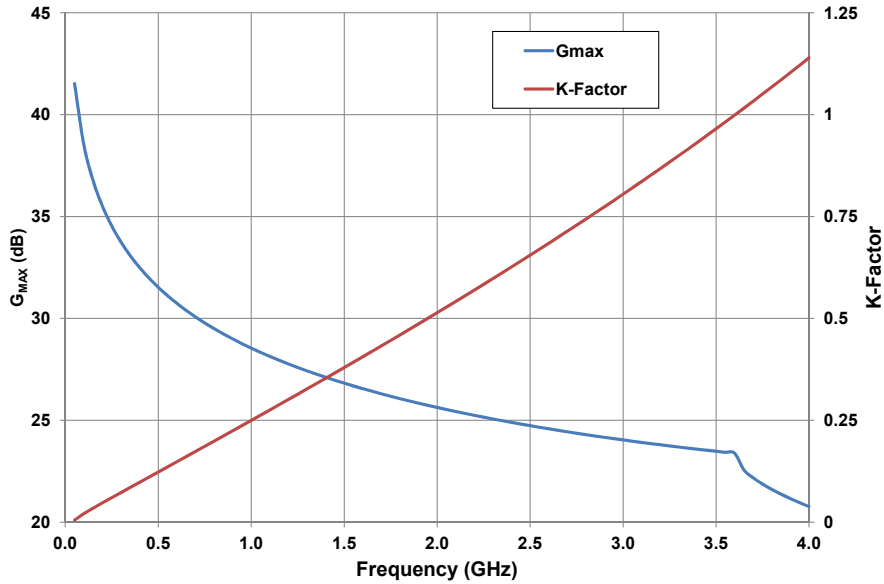


**Figure 4. - Third Order Intermodulation Distortion vs Frequency measured in Broadband Amplifier Circuit CGHV40100-AMP**  
 Spacing = 1 MHz,  $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 600\text{ mA}$ ,  $T_{case} = 25^\circ\text{C}$



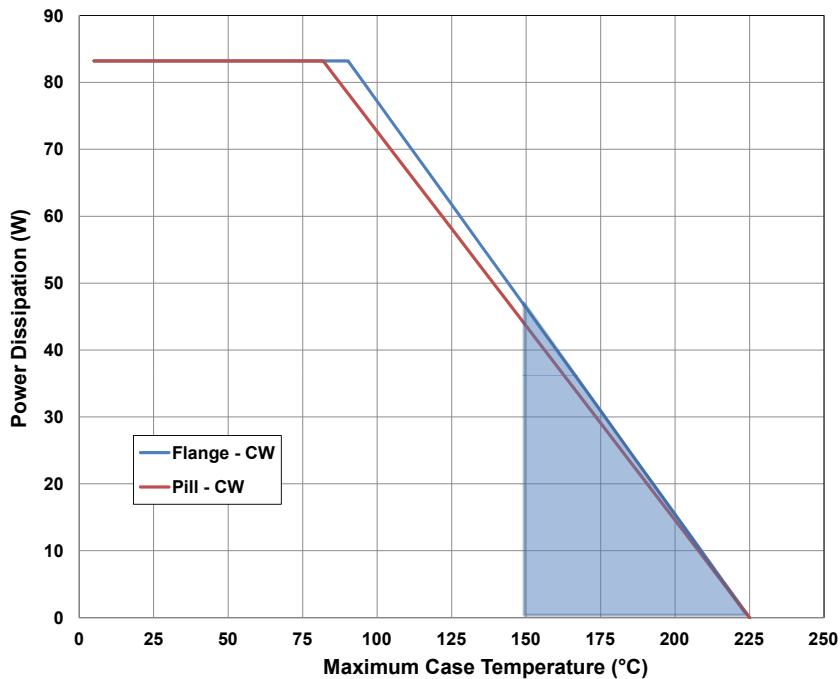
## CGHV40100 Typical Performance

**Figure 5. -  $G_{MAX}$  and K-Factor vs Frequency**  
 $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 600\text{ mA}$ ,  $T_{case} = 25^\circ\text{C}$



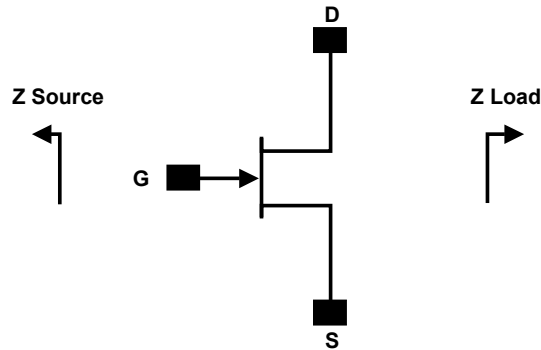
## CGHV40100 Power Dissipation De-rating Curve

**Figure 6. - Transient Power Dissipation De-Rating Curve**



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

## Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
500	0.43 + j5.25	8.83 + j0.85
750	0.40 + j2.62	10.78 + j2.50
1000	0.30 + j1.31	9.06 + 4.23
1250	0.30 + j0.44	7.40 + j3.85
1500	0.30 - j0.44	6.39 + j3.44
1750	0.25 - j0.87	4.41 + j3.03
2000	0.25 - j1.31	3.68 + j2.17
2250	0.25 - j2.18	3.42 + j2.17
2500	0.26 - j2.62	2.65 + j1.74

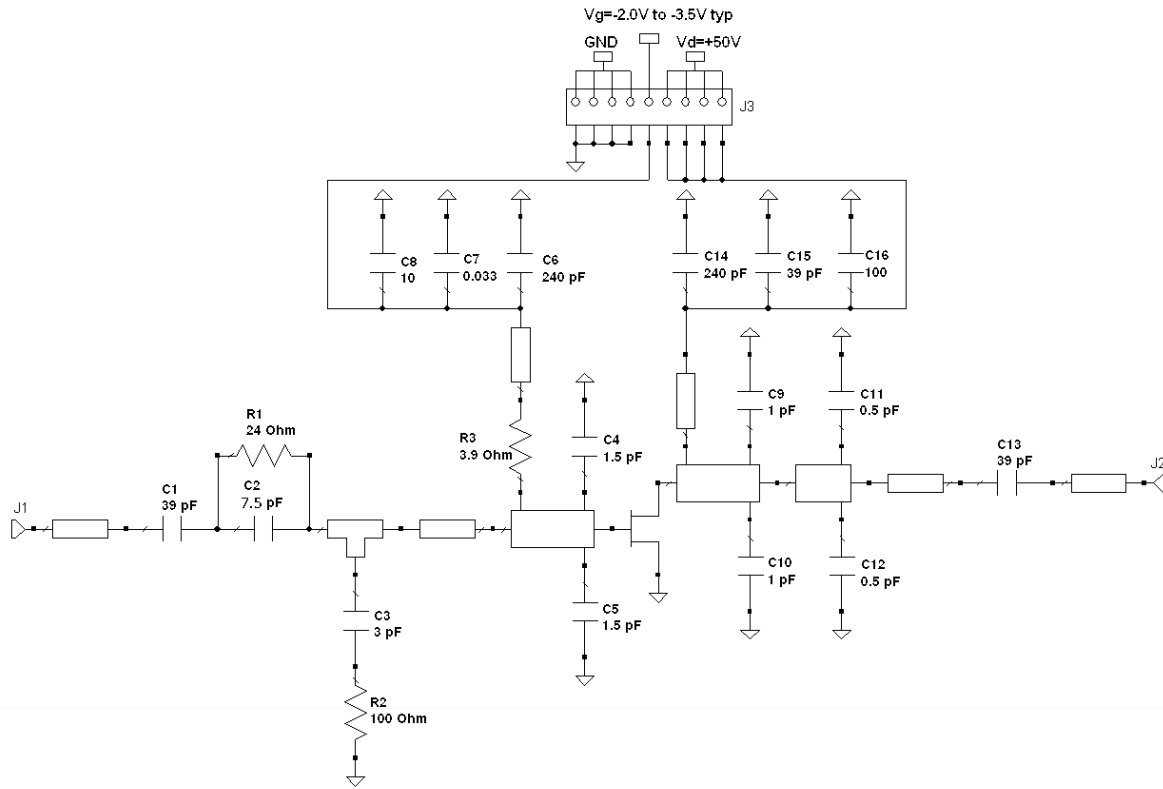
Note 1.  $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 600\text{ mA}$  in the 440193 package.

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

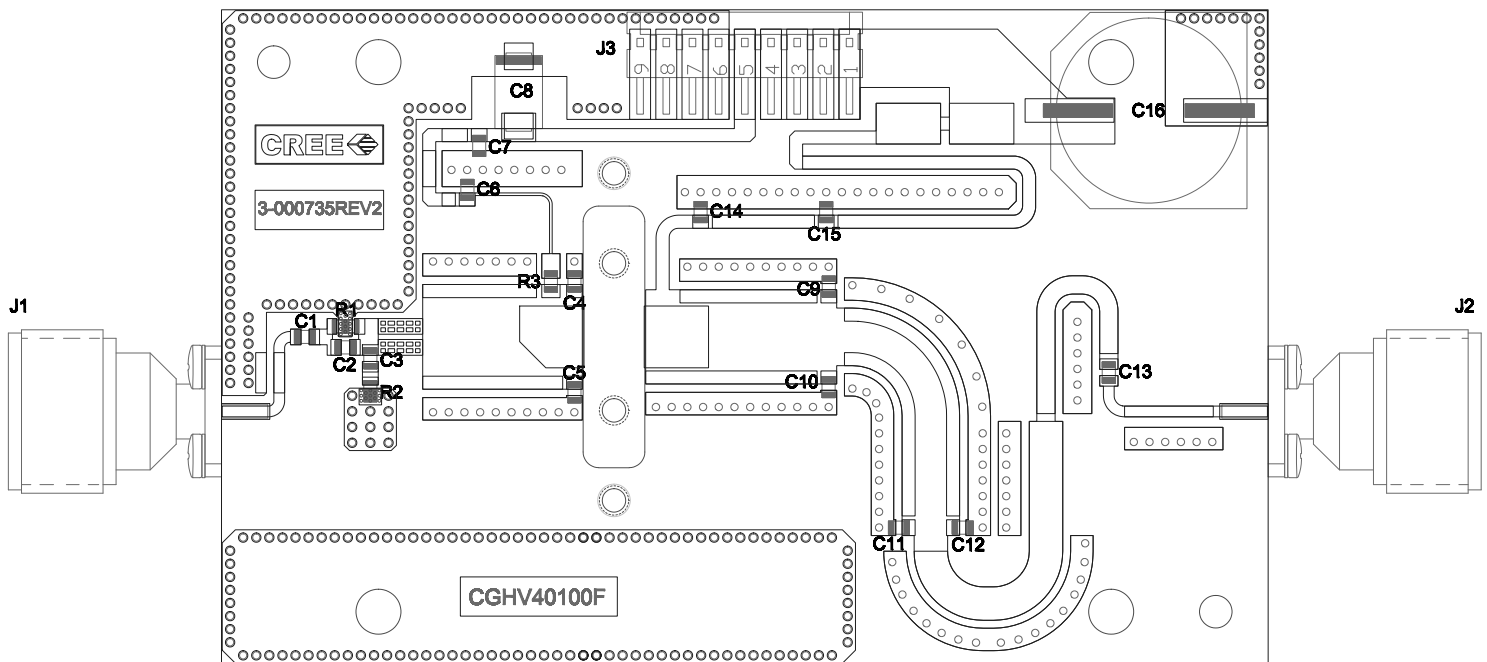
## Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	2 (125 V to 250 V)	JEDEC JESD22 C101-C

## CGHV40100-AMP Application Circuit Schematic



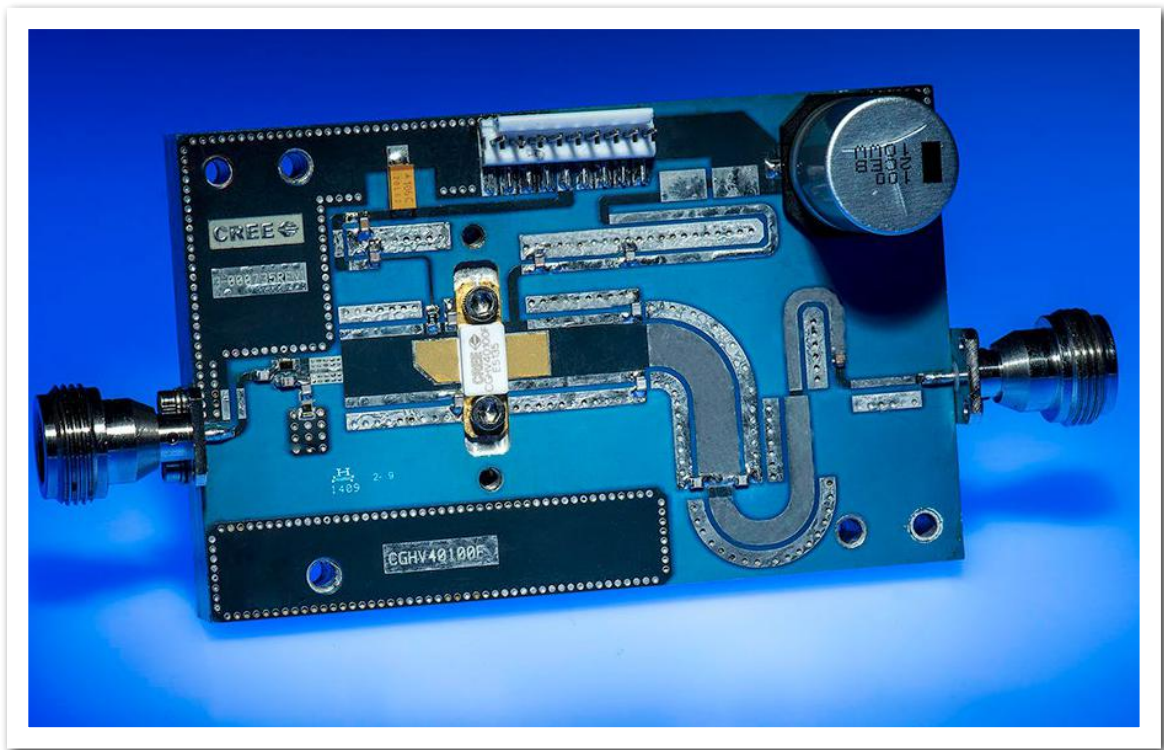
## CGHV40100-AMP Application Circuit



## CGHV40100-AMP Application Circuit Bill of Materials

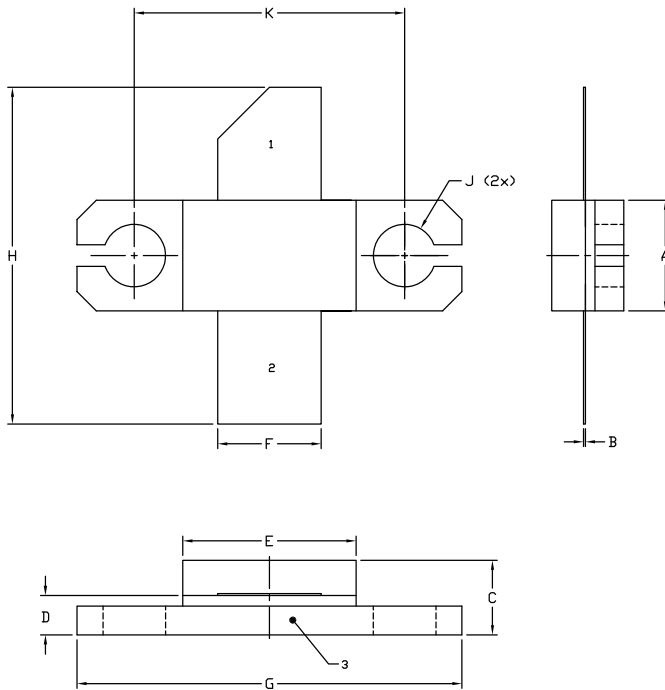
Designator	Description	Qty
C1, C13, C15	CAP, 39 pF, $\pm 0.1$ pF, 250V, 0805, ATC600F	3
C2	CAP, 7.5 pF, $\pm 0.1$ pF, 250 V, 0806, ATC600F	1
C3	CAP, 3 pF $\pm 0.1$ pF, 250 V, 0805, ATC600F	1
C4, C5	CAP, 1.5 pF, $\pm 0.1$ pF, 250 V, 0805, ATC600F	2
C7	CAP, 33000 pF, 0805 100V, X7R	1
C6, C14	CAP, 240 pF, $\pm 0.5$ pF, 250 V, 0805, ATC600F	2
C8	CAP, 10 UF, 16V TANTALUM, 2312	1
C9, C10	CAP, 1 pF, $\pm 0.1$ pF, 250 V, 0805, ATC600F	2
C11, C12	CAP, 0.5 pF, $\pm 0.1$ pF, 250 V, 0805, ATC600F	2
C16	CAP, 100 UF, 20%, 160 V, ELEC	1
R1	RES, 24 OHMS, IMS ND3-1005CS24R0G	1
R2	RED, 100 OHMS, IMS ND3-0805EW1000G	1
R3	RES, 3.9 OHMS, 0805	1
J1, J2	CONN, SMA, PANEL MOUNT JACK	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
	BASEPLATE, CGH35120	1
	PCB, RO4350B, 2.5" X 4" X 0.020", CGHV40100F	1

## CGHV40100-AMP Demonstration Amplifier Circuit





## Product Dimensions CGHV40100F (Package Type – 440193)

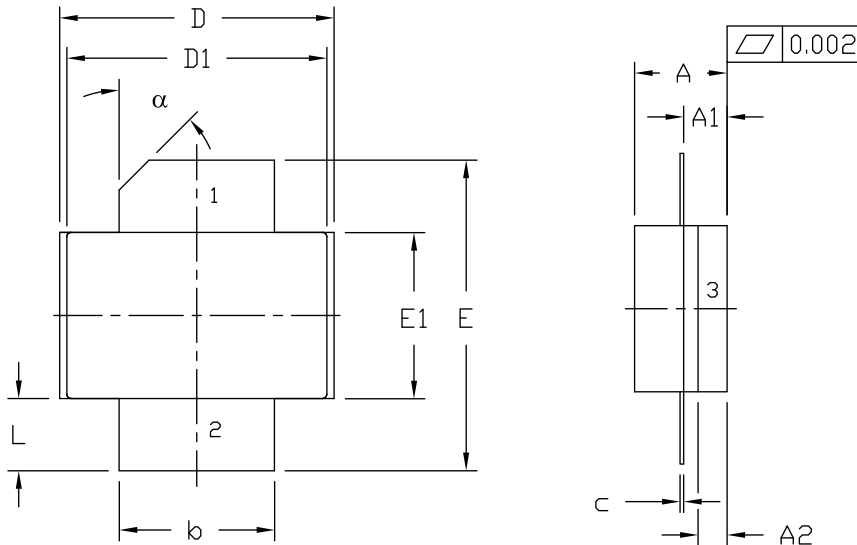


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
  4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
  5. ALL PLATED SURFACES ARE Ni/AU

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.225	0.235	5.72	5.97
B	0.004	0.006	0.10	0.15
C	0.145	0.165	3.68	4.19
D	0.077	0.087	1.96	2.21
E	0.355	0.365	9.02	9.27
F	0.210	0.220	5.33	5.59
G	0.795	0.805	20.19	20.45
H	0.670	0.730	17.02	18.54
J	∅ .130		3.30	
k	0.562		14.28	

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

## Product Dimensions CGHV40100P (Package Type – 440206)



NOTES:

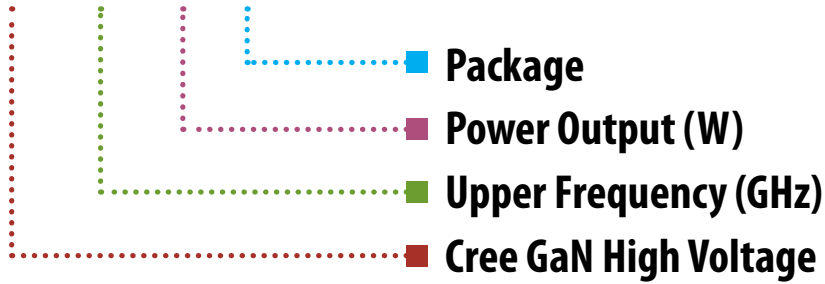
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M - 1994.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

DIM	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.125	0.145	3.18	3.68	
A1	0.057	0.067	1.45	1.70	
A2	0.035	0.045	0.89	1.14	
b	0.210	0.220	5.33	5.59	2x
c	0.004	0.006	0.10	0.15	2x
D	0.375	0.385	9.53	9.78	
D1	0.355	0.365	9.02	9.27	
E	0.400	0.460	10.16	11.68	
E1	0.225	0.235	5.72	5.97	
L	0.085	0.115	2.16	2.92	2x
α	45° REF		45° REF		

- PIN 1. GATE  
 2. DRAIN  
 3. SOURCE

## Part Number System

### CGHV40100F



Parameter	Value	Units
Upper Frequency <sup>1</sup>	4.0	GHz
Power Output	100	W
Package	Flange	-

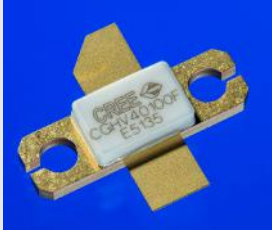



**Table 1.**

**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
CGHV40100F	GaN HEMT	Each	
CGHV40100P	GaN HEMT	Each	
CGHV40100-TB	Test board without GaN HEMT	Each	
CGHV40100F-AMP	Test board with GaN HEMT (flanged) installed	Each	
CGHV40100P-AMP	Test board with GaN HEMT (pill) installed	Each	Photo TBD



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For more information, please contact:

Cree, Inc.  
4600 Silicon Drive  
Durham, North Carolina, USA 27703  
[www.cree.com/RF](http://www.cree.com/RF)

Sarah Miller  
Marketing  
Cree, RF Components  
1.919.407.5302

Ryan Baker  
Marketing & Sales  
Cree, RF Components  
1.919.407.7816

Tom Dekker  
Sales Director  
Cree, RF Components  
1.919.407.5639