

## CGH40045

### 45 W, RF Power GaN HEMT

Cree's CGH40045 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGH40045, operating from a 28 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 CGH40045 ideal for linear and compressed amplifier circuits. The transistor is available in a flange package.



Package Types: 440193  
PN: CGH40045F

#### FEATURES

- Up to 4 GHz Operation
- >16 dB Small Signal Gain at 2.0 GHz
- 12 dB Small Signal Gain at 4.0 GHz
- 55 W Typical  $P_{3dB}$
- 55 % Efficiency at  $P_{3dB}$
- 28 V Operation

#### APPLICATIONS

- 2-Way Private Radio
- Broadband Amplifiers
- Cellular Infrastructure
- Test Instrumentation
- Class A, AB, Linear amplifiers suitable for OFDM, W-CDMA, EDGE, CDMA waveforms



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

Parameter	Symbol	Rating	Units
Drain-Source Voltage	$V_{DS}$	84	Volts
Gate-to-Source Voltage	$V_{GS}$	-10, +2	Volts
Storage Temperature	$T_{STG}$	-55, +150	°C
Operating Junction Temperature	$T_J$	175	°C
Maximum Forward Gate Current	$I_{GMAX}$	15	mA
Soldering Temperature	$T_S$	225	°C
Screw Torque	T	80	in-oz
Thermal Resistance, Junction to Case <sup>1</sup>	$R_{\theta JC}$	2.7	°C/W

Note:

<sup>1</sup> Measured for the CGH40045F at 43W  $P_{DISS}$ .

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

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics<sup>2</sup></b>						
Gate Threshold Voltage	$V_{GS(th)}$	-3.0	-2.5	-1.8	VDC	$V_{DS} = 10\text{ V}, I_D = 14.4\text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.3	-	VDC	$V_{DS} = 28\text{ V}, I_D = 400\text{ mA}$
Saturated Drain Current <sup>3</sup>	$I_{DS}$	9.6	10.8	-	A	$V_{DS} = 6.0\text{ V}, V_{GS} = 2.0\text{ V}$
Drain-Source Breakdown Voltage	$V_{BR}$	84	100	-	VDC	$V_{GS} = -8\text{ V}, I_D = 14.4\text{ mA}$
Case Operating Temperature <sup>4</sup>	$T_c$	-10	-	+60	°C	$P_{DISS} = 43\text{ W}$
<b>RF Characteristics (<math>T_c = 25^\circ\text{C}</math>, <math>F_o = 2.5\text{ GHz}</math> unless otherwise noted)</b>						
Small Signal Gain	$G_{SS}$	12.5	14	-	dB	$V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}$
Power Output at 3 dB Compression	$P_{3dB}$	45	55	-	W	$V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}$
Drain Efficiency <sup>1</sup>	$\eta$	45	55	-	%	$V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}, P_{OUT} = P_{3dB}$
Output Mismatch Stress	VSWR	-	TBD	-	$\Psi$	No damage at all phase angles, $V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA},$ $P_{OUT} = 45\text{ W CW}$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	-	19.3	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$
Output Capacitance	$C_{DS}$	-	4.6	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$
Feedback Capacitance	$C_{GD}$	-	1.7	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$

Notes:

<sup>1</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$

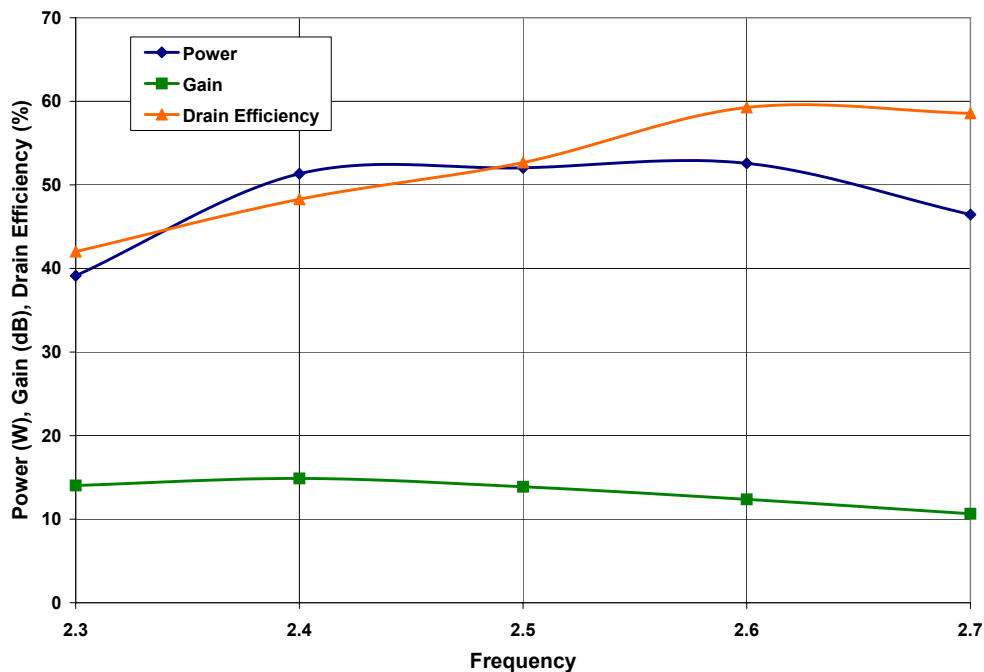
<sup>2</sup> Measured on wafer prior to packaging.

<sup>3</sup> Scaled from PCM data.

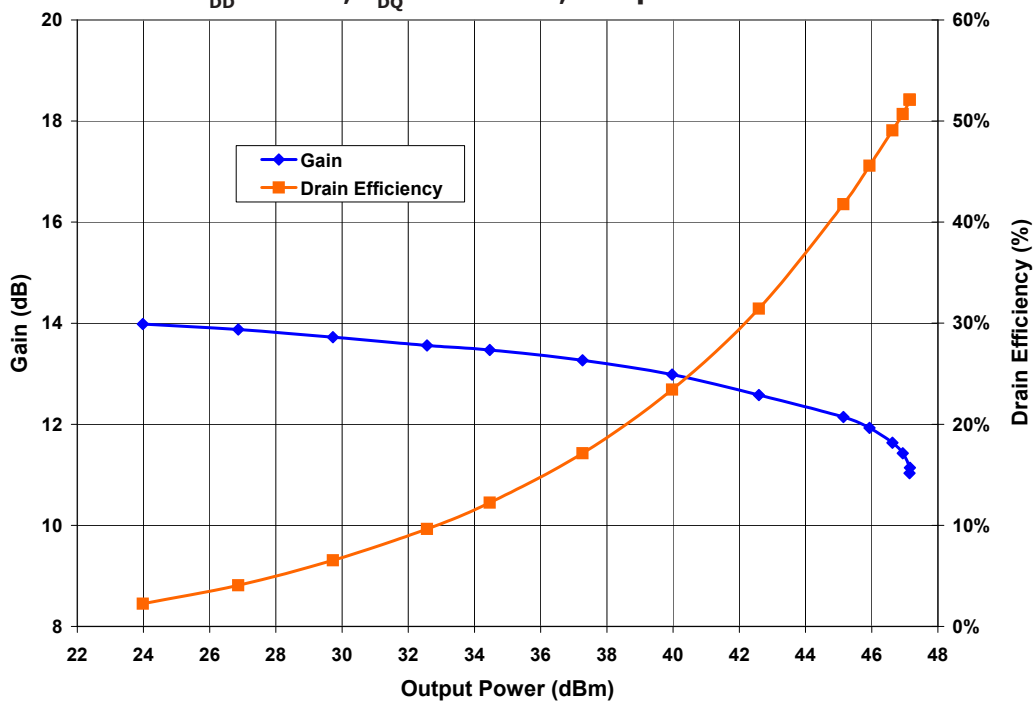
<sup>4</sup> See also, the Power Dissipation De-rating Curve on Page 4.

## Typical Performance

**Gain, Efficiency, and Output Power vs Frequency of the CGH40045F measured in Amplifier Circuit CGH40045F-TB**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 400\text{ mA}$ , Freq = 2.3 - 2.7 GHz



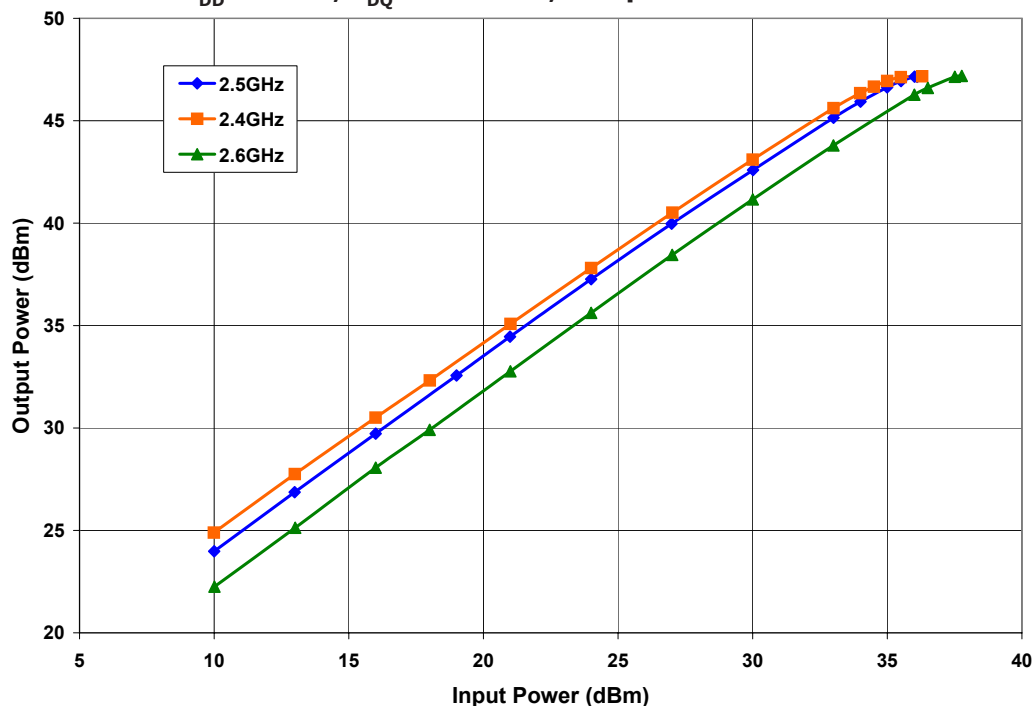
**Gain and Efficiency vs Output Power of the CGH40045F measured in Amplifier Circuit CGH40045F-TB**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 400\text{ mA}$ , Freq = 2.5 GHz



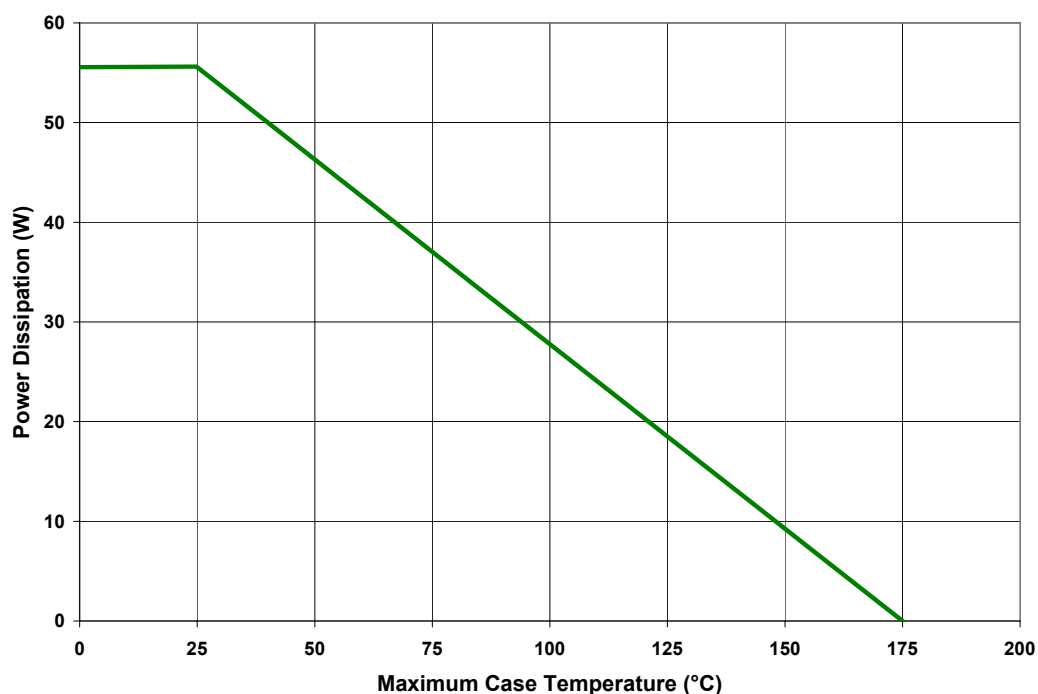
## Typical Performance

### Single Tone CW Gain, Efficiency, and Output Power vs Input Power of the CGH40045F measured in an Amplifier Circuit

$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 400\text{ mA}$ , Freq = 2.3 - 2.7 GHz

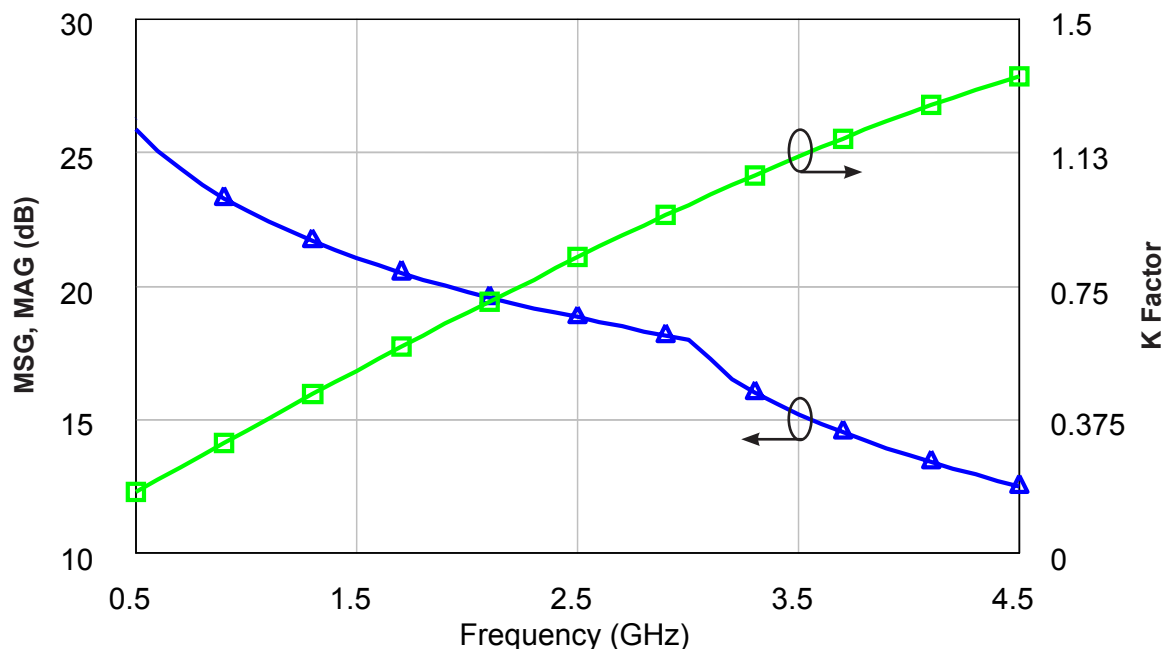


### CGH40045F Power Dissipation De-rating Curve

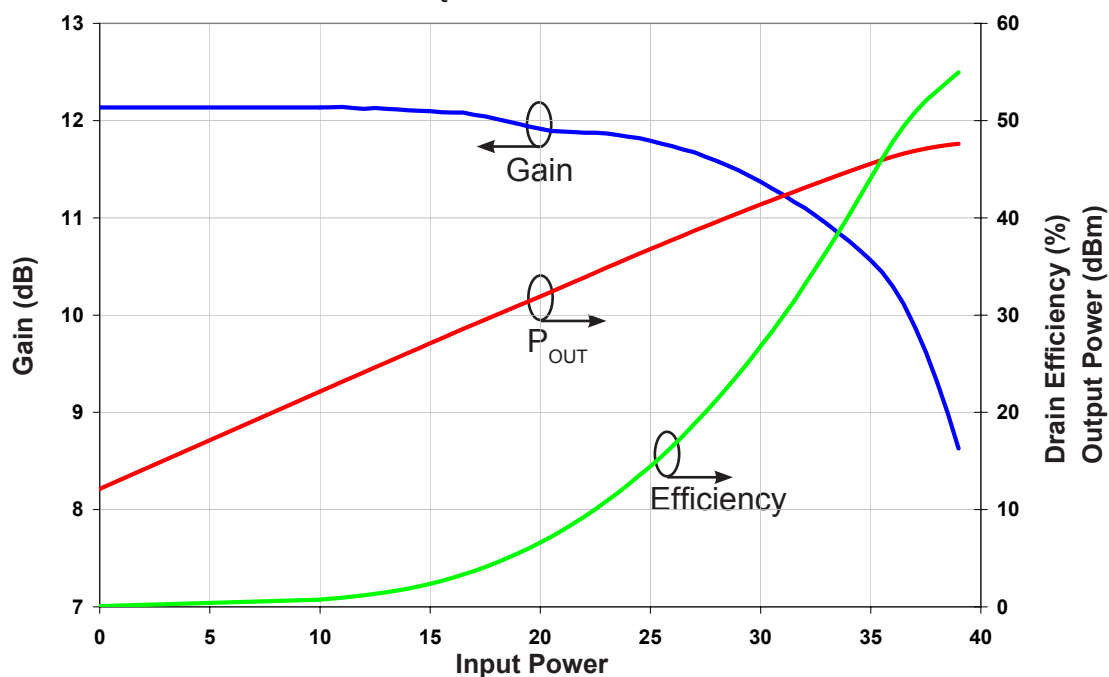


## Typical Performance

**Simulated Maximum Stable Gain, Maximum Available Gain and K Factor of the CGH40045F**  
 $V_{DD} = 28 \text{ V}$ ,  $I_{DQ} = 800 \text{ mA}$



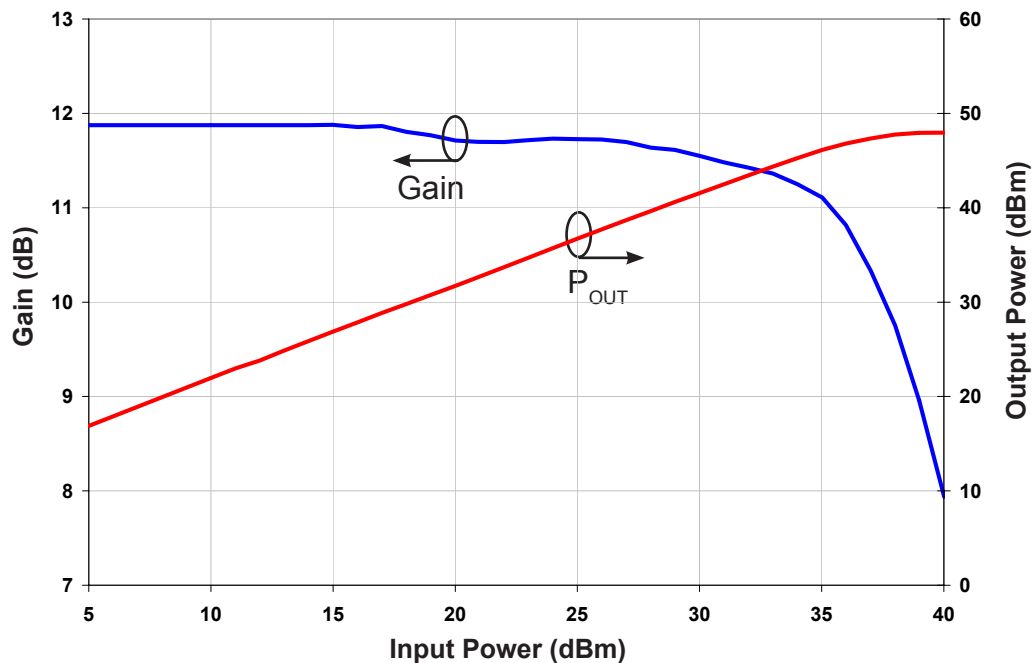
**Single Tone CW Gain, Efficiency, and Output Power vs Input Power of the CGH40045F measured in an Amplifier Circuit**  
 $V_{DD} = 28 \text{ V}$ ,  $I_{DQ} = 800 \text{ mA}$ , Freq = 3.6 GHz



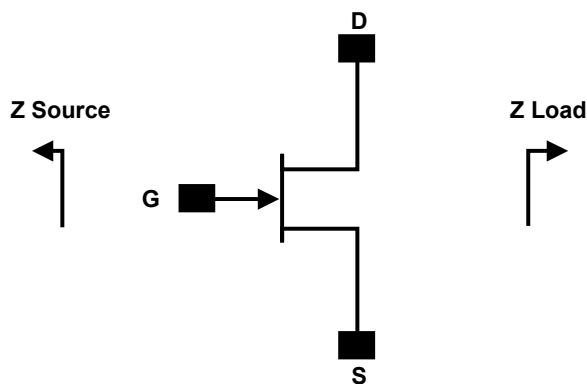
## Typical Performance

### Pulsed Gain and Output Power vs Input Power of the CGH40045F measured in an Amplifier Circuit

$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 800\text{ mA}$ , Freq = 3.6 GHz, Pulse Width=200 $\mu$ S, 10% Duty Cycle



## Simulated Source and Load Impedances

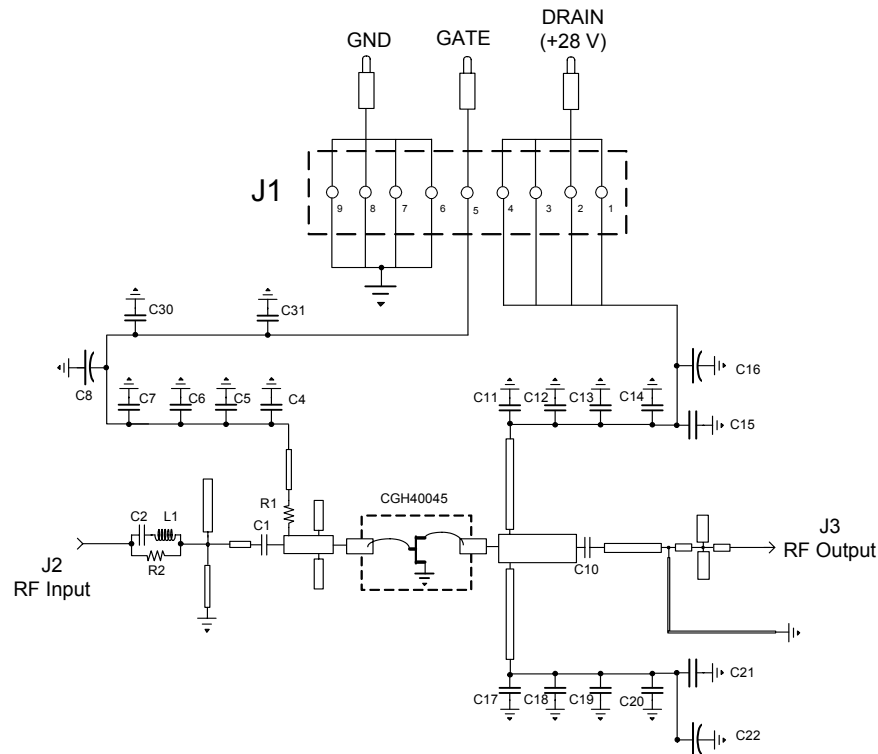


Frequency (MHz)	Z Source	Z Load
500	$3.34 + j4.56$	$10.8 + j8.24$
1000	$2.07 + j0.05$	$6.18 + j4.17$
2000	$1.3 - j3.37$	$4.65 + j0.05$
3000	$1.64 - j8.15$	$4.75 - j3.4$
4000	$1.9 - j10.8$	$4.56 - j7.9$

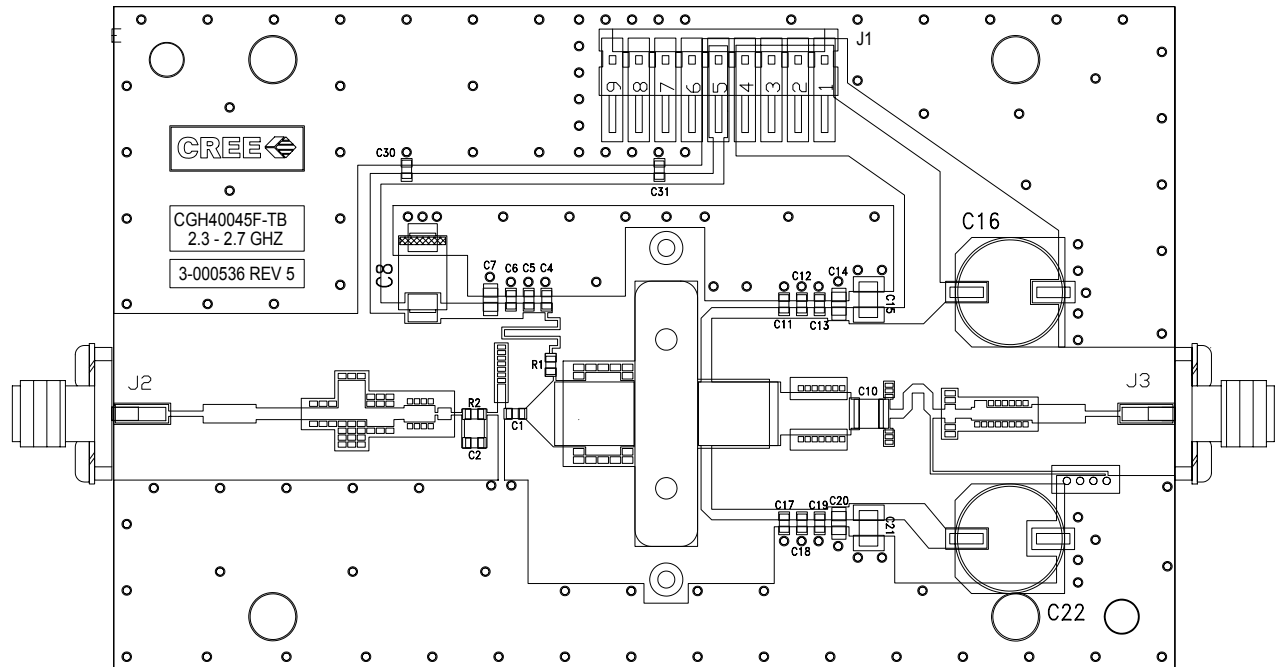
Note 1.  $V_{DD} = 28\text{V}$ ,  $I_{DQ} = 800\text{mA}$  in the 440193 package.

Note 2. Optimized for  $P_{3dB}$  and Drain Efficiency

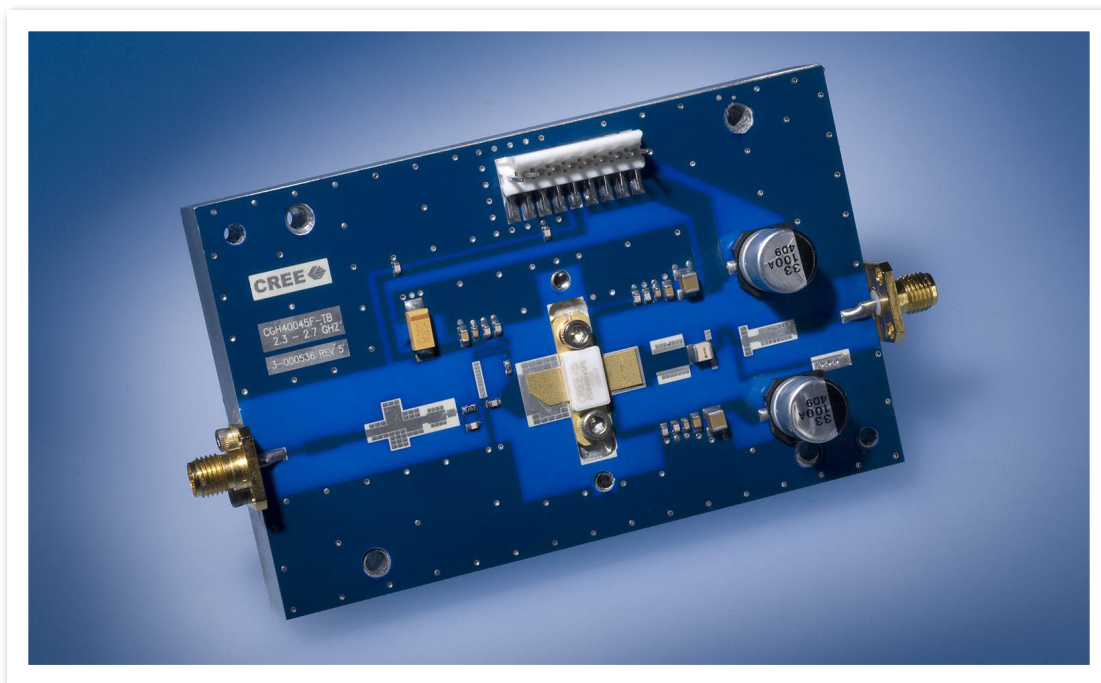
## CGH40045F-TB Demonstration Amplifier Circuit Schematic



## CGH40045F-TB Demonstration Amplifier Circuit Outline



## CGH40045F-TB Demonstration Amplifier Circuit

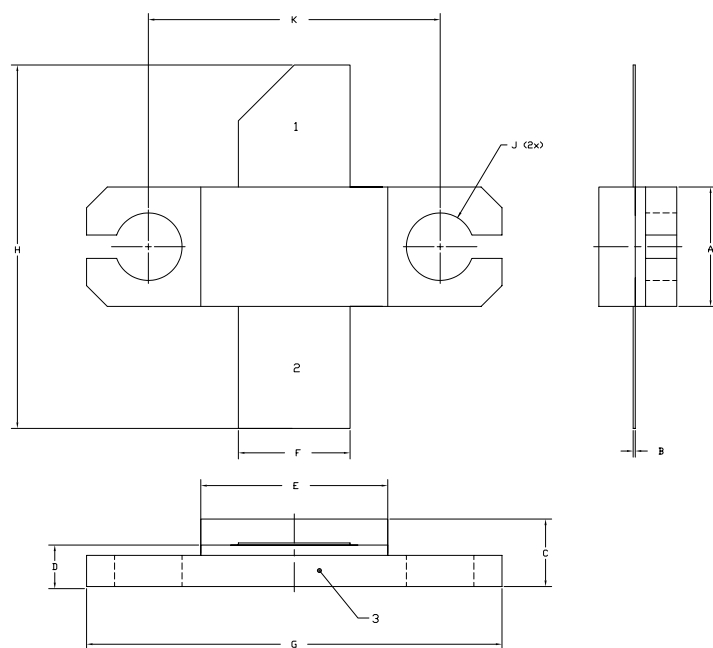


## CGH40045F-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1	CAP, 6.8pF, $\pm -0.25$ pF, 0603	1
C2	CAP, 1.8pF, $\pm -0.1$ pF, 0603	1
C3,C10	CAP, 5.6pF, $\pm -0.1$ pF, 0603	2
C12	CAP, 10000pF, 100V, TEMP STBL, 0805	1
C6,C13	CAP, 0.1uF $\pm 10\%$ , 100 V, 1206, X7R	2
C4,C11	CAP, 100pF $\pm 5\%$ , 0603	2
C8	CAP, 10UF, 16V, SMT, TANTALUM	1
C9	CAP, 0.2pF, $\pm -0.05$ pF, 0603	1
C7,C14	CAP, 1.0UF $\pm 10\%$ , 100V, 1210, X7R	2
C5,C15,C18,C30,C31	CAP, 82.0pF, $\pm 5\%$ , 0603	5
C16	CAP, 4.7pF, $\pm 0.25$ pF, 0603	1
R2	RES, 1/16W, 0603, 100 Ohms 1%	1
R1	RES, 1/16W, 0603, 5.1 Ohms 1%	1
L1	FERRITE, 220 OHM, 0805	1
L2	FERRITE, 22 OHM, 0805	1
J2,J3	CONN, SMA, PANEL MOUNT JACK, FLANGE	2
J1	CONN, HEADER, RT>PLZ .1CEN LK 9POS	1
Q1	CGH40045	1



## Product Dimensions CGH40045F (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	0.125	0.135	3.18	3.43
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	Ø .130		3.30	
k	0.562		14.28	

PIN 1: GATE  
PIN 2: DRAIN  
PIN 3: SOURCE



## Disclaimer

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