

# CGH55030F2 / CGH55030P2

## 25 W, C-band, Unmatched, GaN HEMT

Cree's CGH55030F2/CGH55030P2 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH55030F2/CGH55030P2 ideal for C-band pulsed or CW saturated amplifiers. The transistor is available in both screw-down, flange and solder-down, pill packages. Based on appropriate external match adjustment, the CGH55030F2/CGH55030P2 is suitable for applications up to 6 GHz.



Package Type: 440196 & 440166  
PN: CGH55030P2 & CGH55030F2

### FEATURES

- 4.5 to 6.0 GHz Operation
- 12 dB Small Signal Gain at 5.65 GHz
- 30 W typical  $P_{SAT}$
- 60 % Efficiency at  $P_{SAT}$
- 28 V Operation

### APPLICATIONS

- 2-Way Private Radio
- Broadband Amplifiers
- Cellular Infrastructure
- Test Instrumentation
- Class A, AB Amplifiers for Drivers and Gain Blocks





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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	$V_{DS}$	84	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	$I_{GMAX}$	7.0	mA	25 °C
Maximum Drain Current <sup>1</sup>	$I_{MAX}$	3	A	25 °C
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	60	in-oz	
Thermal Resistance, Junction to Case <sup>3</sup>	$R_{\theta JC}$	4.8	°C/W	85 °C
Case Operating Temperature <sup>3,4</sup>	$T_C$	-40, +150	°C	30 seconds

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/products/wireless\\_appnotes.asp](http://www.cree.com/products/wireless_appnotes.asp)

<sup>3</sup> Measured for the CGH55030 at  $P_{DISS} = 28$  W.

<sup>4</sup> See also, the Power Dissipation De-rating Curve on Page 5.

## Electrical Characteristics ( $T_C = 25$ °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, $I_D = 7.2$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-3.0	-	$V_{DC}$	$V_{DS} = 28$ V, $I_D = 250$ mA
Saturated Drain Current	$I_{DS}$	5.8	7.0	-	A	$V_{DS} = 6.0$ V, $V_{GS} = 2$ V
Drain-Source Breakdown Voltage	$V_{BR}$	120	-	-	$V_{DC}$	$V_{GS} = -8$ V, $I_D = 7.2$ mA
<b>RF Characteristics<sup>2</sup> (<math>T_C = 25</math> °C, <math>F_0 = 5.65</math> GHz unless otherwise noted)</b>						
Small Signal Gain	$G_{SS}$	9.0	11.0	-	dB	$V_{DD} = 28$ V, $I_{DQ} = 250$ mA
Power Output <sup>3</sup>	$P_{SAT}$	20	30	-	W	$V_{DD} = 28$ V, $I_{DQ} = 250$ mA
Drain Efficiency <sup>4</sup>	$\eta$	50	60	-	%	$V_{DD} = 28$ V, $I_{DQ} = 250$ mA, $P_{SAT}$
Output Mismatch Stress	VSWR	-	-	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 250$ mA, $P_{SAT}$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	-	9.0	-	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance	$C_{DS}$	-	2.6	-	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Feedback Capacitance	$C_{GD}$	-	0.4	-	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz

Notes:

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

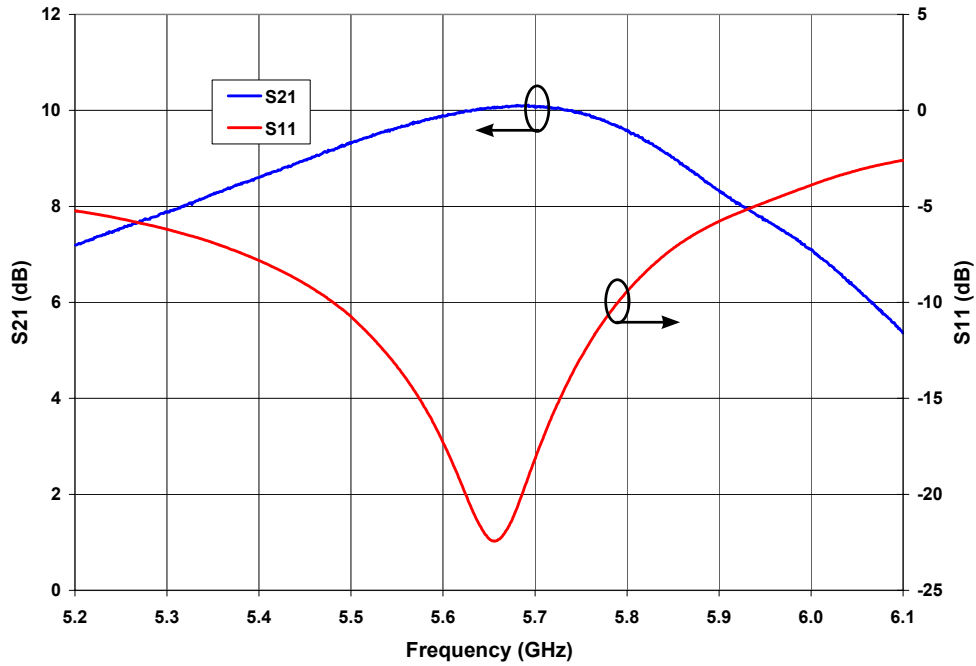
<sup>2</sup> Measured in CGH55030-TB.

<sup>3</sup>  $P_{SAT}$  is defined as  $I_G = 0.72$  mA.

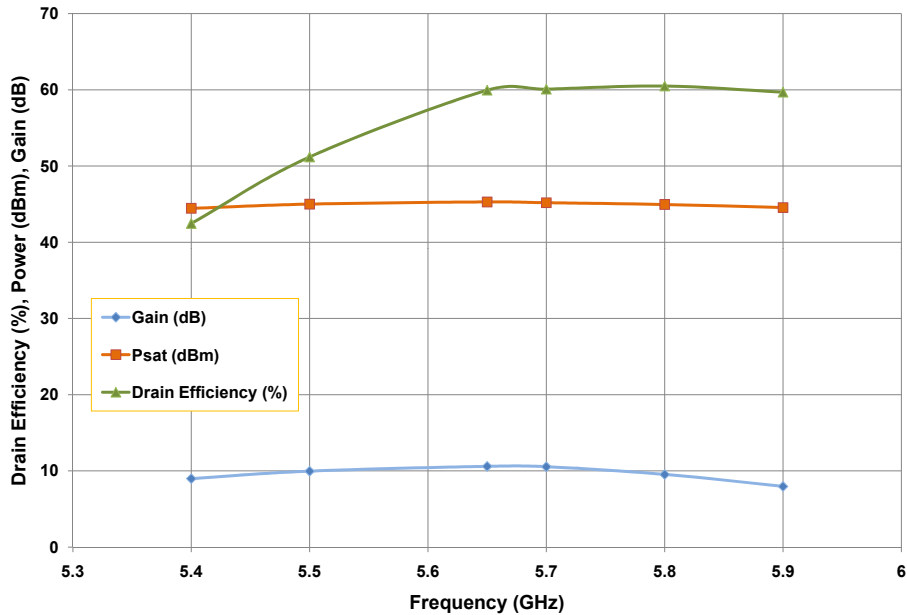
<sup>4</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$

## Typical Performance

**Small Signal S-Parameters vs Frequency of  
CGH55030F2 and CGH55030P2 in the CGH55030-TB**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$

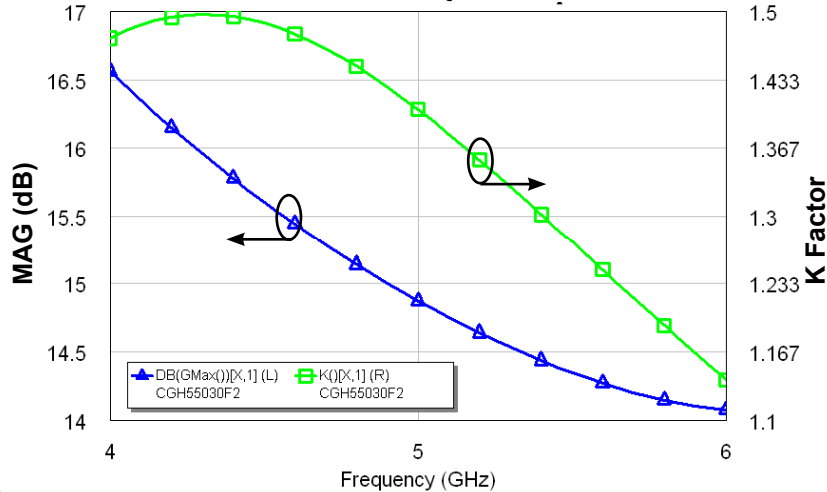


**Drain Efficiency, Power and Gain vs Frequency of the  
CGH55030F2 and CGH55030P2 in the CGH55030-TB**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$



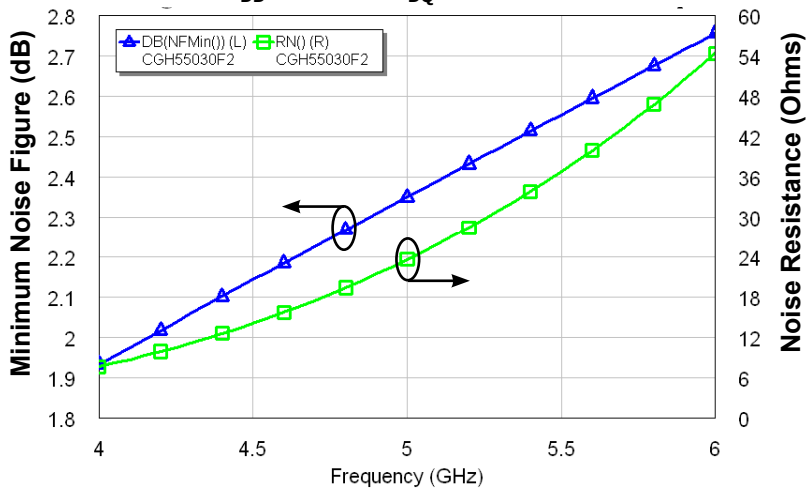
## Typical Performance

**Simulated Maximum Available Gain and K Factor of the CGH55030F2/CGH55030P2**  
 $V_{DD} = 28\text{ V}, I_{DQ} = 250\text{ mA}$



## Typical Noise Performance

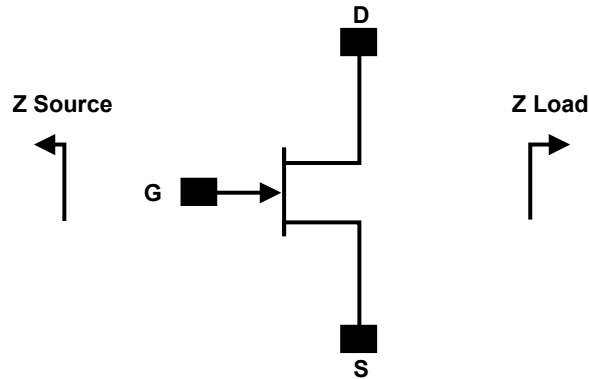
**Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH55030F2/CGH55030P2**  
 $V_{DD} = 28\text{ V}, I_{DQ} = 250\text{ mA}$



## Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (200 < 500 V)	JEDEC JESD22 C101-C

## Source and Load Impedances

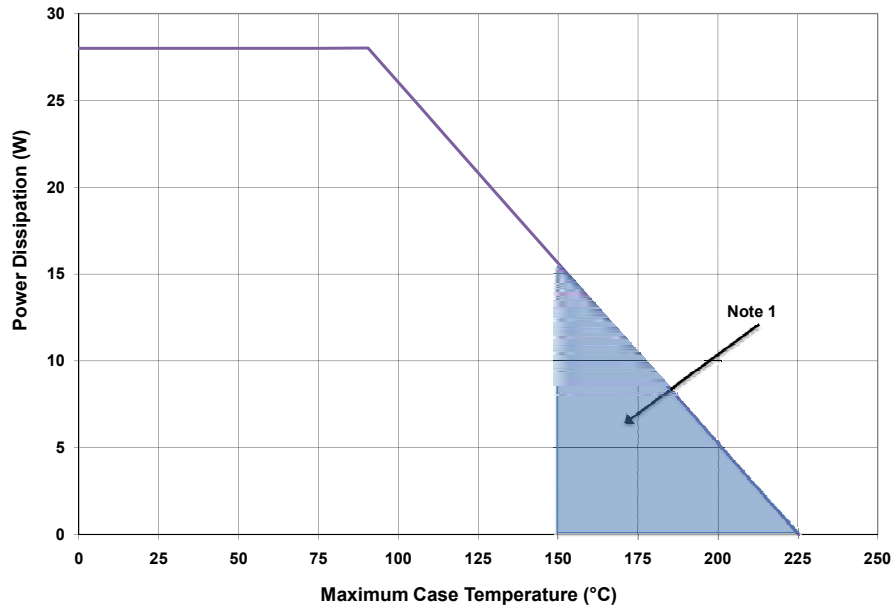


Frequency (MHz)	Z Source	Z Load
5500	8.0 - j12.4	14.1 - j12.6
5650	8.7 - j13.1	14.7 - j11.7
5800	8.4 - j14.0	15.4 - j11.0

Note 1.  $V_{DD} = 28V$ ,  $I_{DQ} = 250$  mA in the 440166 package.

Note 2. Impedances are extracted from the CGH55030-TB demonstration amplifier and are not source and load pull data derived from the transistor.

## CGH55030F2 and CGH55030P2 Power Dissipation De-rating Curve

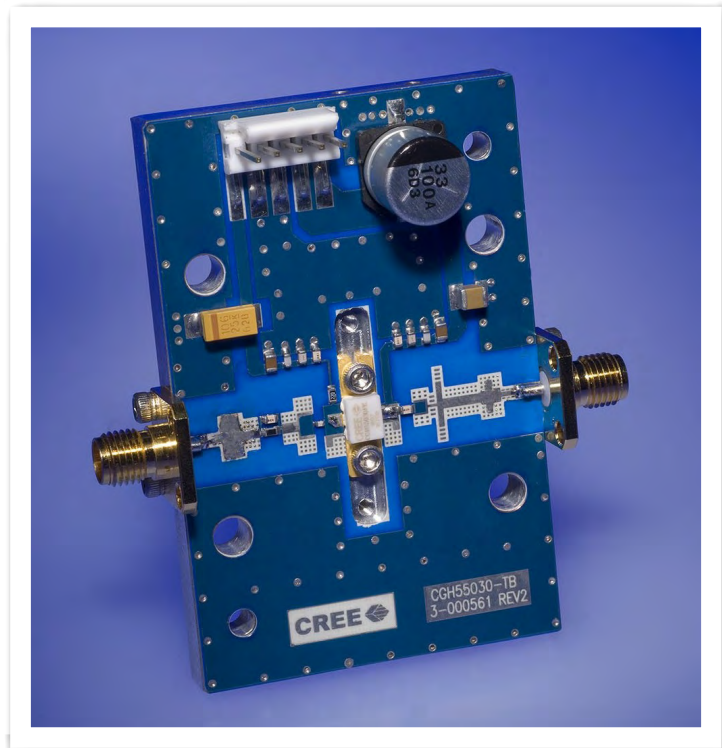


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

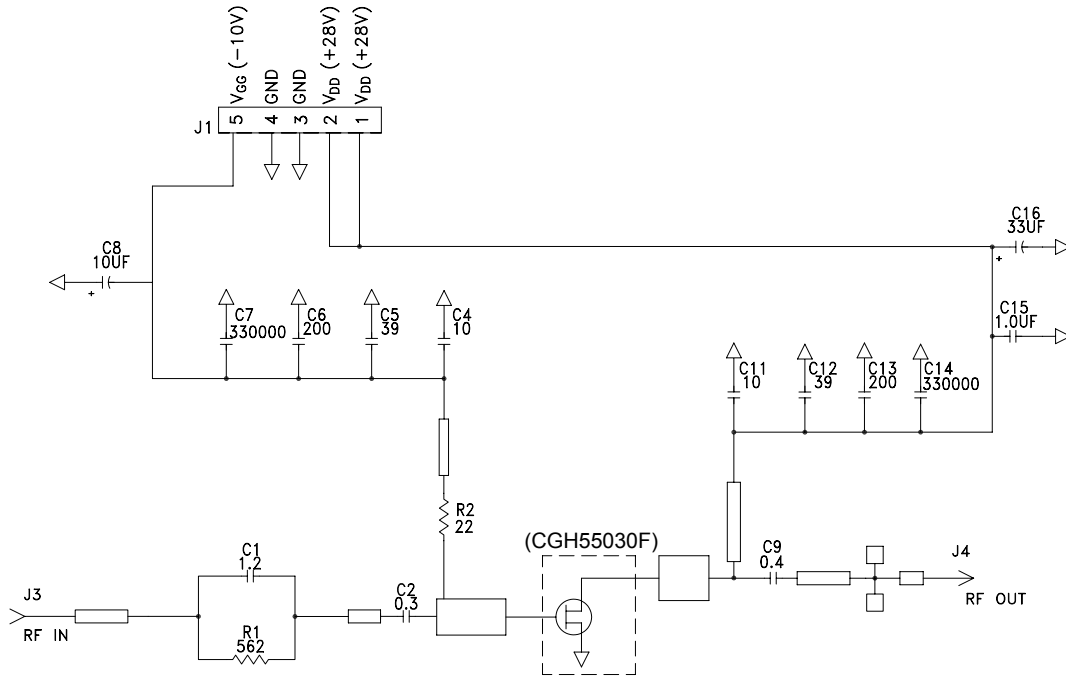
## CGH55030-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16W, 0603, 1%, 562 OHMS	1
R2	RES, 1/16W, 0603, 1%, 22.6 OHMS	1
C2	CAP, 0.3pF, +/-0.05pF, 0402, ATC600L	1
C16	CAP, 33 UF, 20%, G CASE	1
C15	CAP, 1.0UF, 100V, 10%, X7R, 1210	1
C8	CAP 10UF 16V TANTALUM	1
C9	CAP, 0.4pF, +/-0.05pF, 0603, ATC600S	1
C1	CAP, 1.2pF, +/-0.1pF, 0603, ATC600S	1
C6,C13	CAP,200 PF,0603 PKG, 100 V	2
C4,C11	CAP, 10.0pF,+/-5%, 0603, ATC600S	2
C5,C12	CAP, 39pF, +/-5%, 0603, ATC600S	2
C7,C14	CAP, 330000PF, 0805, 100V, TEMP STABILIZ	2
J3,J4	CONN, SMA, PANEL MOUNT JACK, FLANGE	2
J1	HEADER RT>PLZ .1CEN LK 5POS	1
-	PCB, RO4350B, Er = 3.48, h = 20 mil	1
-	CGH55030	1

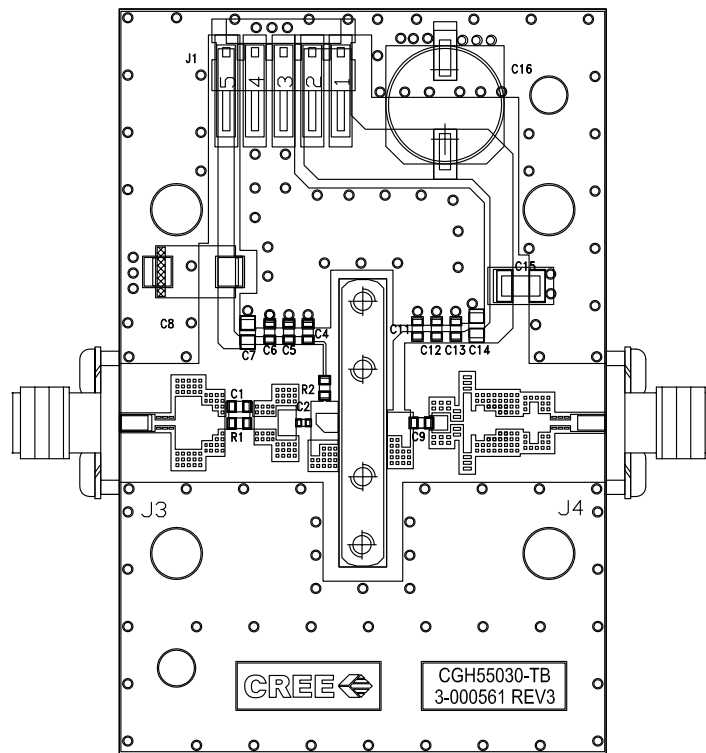
## CGH55030-TB Demonstration Amplifier Circuit



## CGH55030-TB Demonstration Amplifier Circuit Schematic



## CGH55030-TB Demonstration Amplifier Circuit Outline





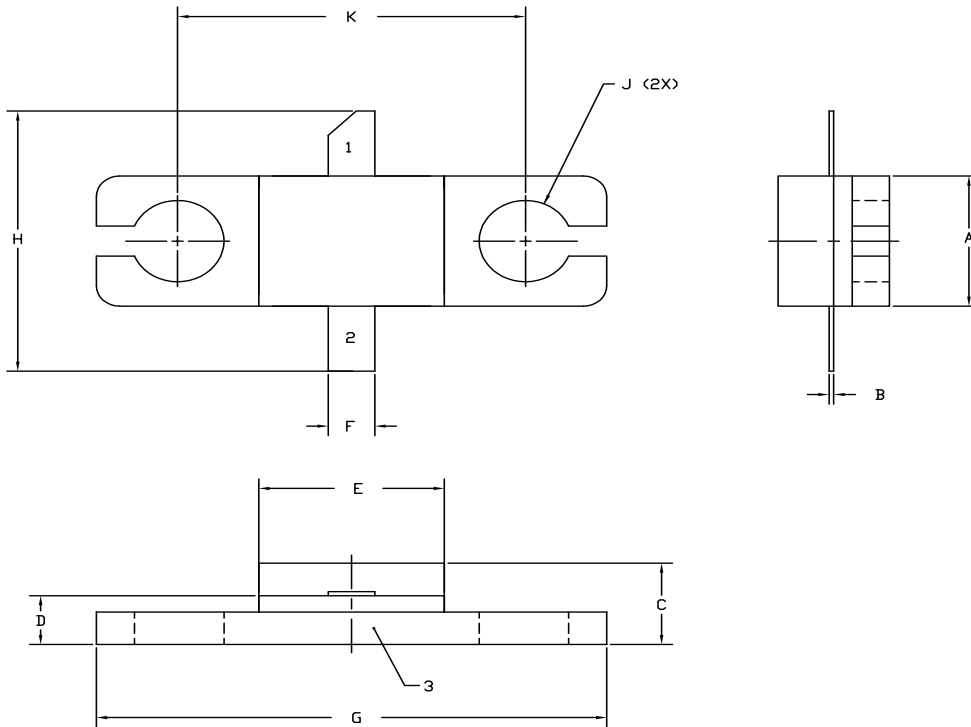
**Typical Package S-Parameters for CGH55030**  
**(Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$ , angle in degrees)**

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.917	-157.22	12.62	91.45	0.018	7.56	0.458	-158.97
600 MHz	0.916	-161.92	10.57	87.33	0.018	4.70	0.465	-160.93
700 MHz	0.916	-165.46	9.07	83.78	0.018	2.41	0.472	-162.19
800 MHz	0.916	-168.28	7.94	80.58	0.018	0.51	0.478	-163.04
900 MHz	0.916	-170.61	7.05	77.64	0.017	-1.12	0.485	-163.64
1.0 GHz	0.916	-172.60	6.33	74.88	0.017	-2.55	0.493	-164.09
1.1 GHz	0.917	-174.33	5.74	72.25	0.017	-3.82	0.500	-164.45
1.2 GHz	0.917	-175.88	5.24	69.73	0.017	-4.94	0.508	-164.77
1.3 GHz	0.918	-177.28	4.82	67.30	0.017	-5.95	0.516	-165.06
1.4 GHz	0.918	-178.57	4.46	64.94	0.017	-6.84	0.525	-165.36
1.5 GHz	0.919	-179.78	4.14	62.65	0.016	-7.63	0.533	-165.67
1.6 GHz	0.919	179.09	3.87	60.41	0.016	-8.31	0.542	-165.99
1.7 GHz	0.920	178.01	3.62	58.22	0.016	-8.90	0.550	-166.35
1.8 GHz	0.921	176.98	3.40	56.07	0.016	-9.39	0.559	-166.73
1.9 GHz	0.921	175.99	3.21	53.97	0.015	-9.77	0.568	-167.14
2.0 GHz	0.922	175.03	3.03	51.90	0.015	-10.06	0.577	-167.59
2.1 GHz	0.923	174.09	2.87	49.87	0.015	-10.24	0.585	-168.07
2.2 GHz	0.924	173.17	2.73	47.87	0.014	-10.31	0.594	-168.57
2.3 GHz	0.924	172.27	2.60	45.91	0.014	-10.27	0.602	-169.11
2.4 GHz	0.925	171.39	2.47	43.97	0.014	-10.12	0.610	-169.67
2.5 GHz	0.926	170.51	2.36	42.07	0.014	-9.85	0.619	-170.26
2.6 GHz	0.926	169.65	2.26	40.19	0.013	-9.46	0.626	-170.88
2.7 GHz	0.927	168.79	2.16	38.34	0.013	-8.95	0.634	-171.52
2.8 GHz	0.928	167.93	2.08	36.52	0.013	-8.31	0.642	-172.17
2.9 GHz	0.928	167.08	1.99	34.72	0.013	-7.54	0.649	-172.85
3.0 GHz	0.929	166.24	1.92	32.94	0.013	-6.65	0.656	-173.55
3.2 GHz	0.930	164.54	1.78	29.45	0.012	-4.49	0.670	-175.00
3.4 GHz	0.931	162.85	1.66	26.05	0.012	-1.85	0.683	-176.50
3.6 GHz	0.932	161.14	1.55	22.72	0.012	1.19	0.695	-178.06
3.8 GHz	0.933	159.42	1.46	19.46	0.012	4.55	0.706	-179.66
4.0 GHz	0.933	157.68	1.38	16.27	0.012	8.08	0.716	178.70
4.2 GHz	0.934	155.91	1.31	13.12	0.012	11.64	0.726	177.02
4.4 GHz	0.934	154.11	1.24	10.03	0.013	15.08	0.735	175.30
4.6 GHz	0.935	152.28	1.18	6.97	0.013	18.26	0.743	173.56
4.8 GHz	0.935	150.41	1.13	3.95	0.014	21.09	0.750	171.78
5.0 GHz	0.935	148.49	1.08	0.96	0.015	23.50	0.756	169.97
5.2 GHz	0.935	146.53	1.04	-2.00	0.016	25.48	0.762	168.12
5.4 GHz	0.935	144.52	1.00	-4.96	0.017	27.02	0.768	166.24
5.6 GHz	0.935	142.45	0.97	-7.90	0.018	28.12	0.773	164.32
5.8 GHz	0.934	140.31	0.94	-10.84	0.020	28.83	0.777	162.36
6.0 GHz	0.934	138.12	0.91	-13.79	0.021	29.18	0.781	160.36

Download this s-parameter file in ".s2p" format at [http://www.cree.com/products/wireless\\_s-parameters.asp](http://www.cree.com/products/wireless_s-parameters.asp)



## Product Dimensions CGH55030F (Package Type – 440166)



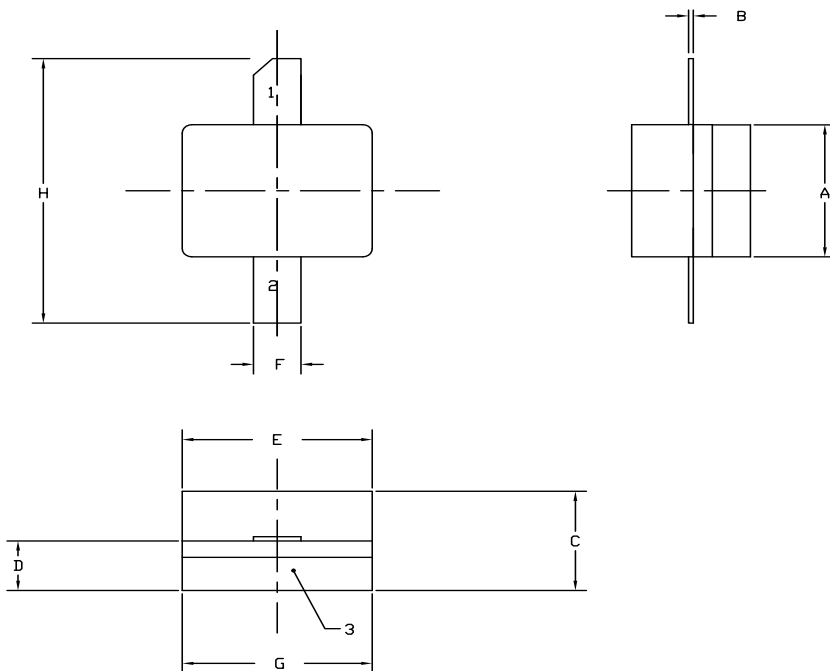
**NOTES:**

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	0.155	0.165	3.94	4.19
B	0.004	0.006	0.10	0.15
C	0.115	0.135	2.92	3.43
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.545	0.555	13.84	14.09
H	0.280	0.360	7.11	9.14
J	∅ .100		2.54	
K	0.375		9.53	

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

## Product Dimensions CGH55030P (Package Type – 440196)



**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	0.155	0.165	3.94	4.19
B	0.003	0.006	0.10	0.15
C	0.115	0.135	2.92	3.17
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.195	0.205	4.95	5.21
H	0.280	0.360	7.11	9.14

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



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