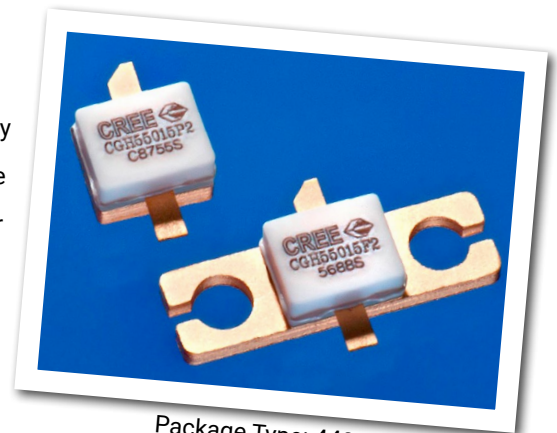


# CGH55015F2 / CGH55015P2

10 W, C-band, Unmatched, GaN HEMT

Cree's CGH55015F2/CGH55015P2 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH55015F2/CGH55015P2 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 CGH55015F2/CGH55015P2 is suitable for applications up to 6 GHz.



Package Type: 440196 & 440166  
PN: CGH55015P2 & CGH55015F2

## FEATURES

- 4.5 to 6.0 GHz Operation
- 12 dB Small Signal Gain at 5.65 GHz
- 13 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



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	$V_{DS}$	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	$I_{GMAX}$	4.0	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	1.5	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>	$R_{\theta JC}$	8.0	°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/RF/Document-Library](http://www.cree.com/RF/Document-Library)

<sup>3</sup> Measured for the CGH55015 at  $P_{DISS} = 14W$ .

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

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

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	$V_{DC}$	$V_{DS} = 10 V, I_D = 3.6 mA$
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	$V_{DC}$	$V_{DS} = 28 V, I_D = 200 mA$
Saturated Drain Current	$I_{DS}$	2.9	3.5	-	A	$V_{DS} = 6.0 V, V_{GS} = 2.0 V$
Drain-Source Breakdown Voltage	$V_{BR}$	120	-	-	$V_{DC}$	$V_{GS} = -8 V, I_D = 3.6 mA$
<b>RF Characteristics<sup>2</sup> (<math>T_C = 25^\circ C, F_0 = 5.65 GHz</math> unless otherwise noted)</b>						
Small Signal Gain	$G_{SS}$	10	12	-	dB	$V_{DD} = 28 V, I_{DQ} = 200 mA$
Power Output <sup>3</sup>	$P_{SAT}$	10	12.5	-	W	$V_{DD} = 28 V, I_{DQ} = 200 mA$
Drain Efficiency <sup>4</sup>	$\eta$	50	60	-	%	$V_{DD} = 28 V, I_{DQ} = 200 mA, P_{OUT} = 10 W$
Output Mismatch Stress	VSWR	-	-	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 28 V, I_{DQ} = 200 mA,$ $P_{OUT} = 10 W CW$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	-	4.5	-	pF	$V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz$
Output Capacitance	$C_{DS}$	-	1.3	-	pF	$V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz$
Feedback Capacitance	$C_{GD}$	-	0.2	-	pF	$V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz$

Notes:

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

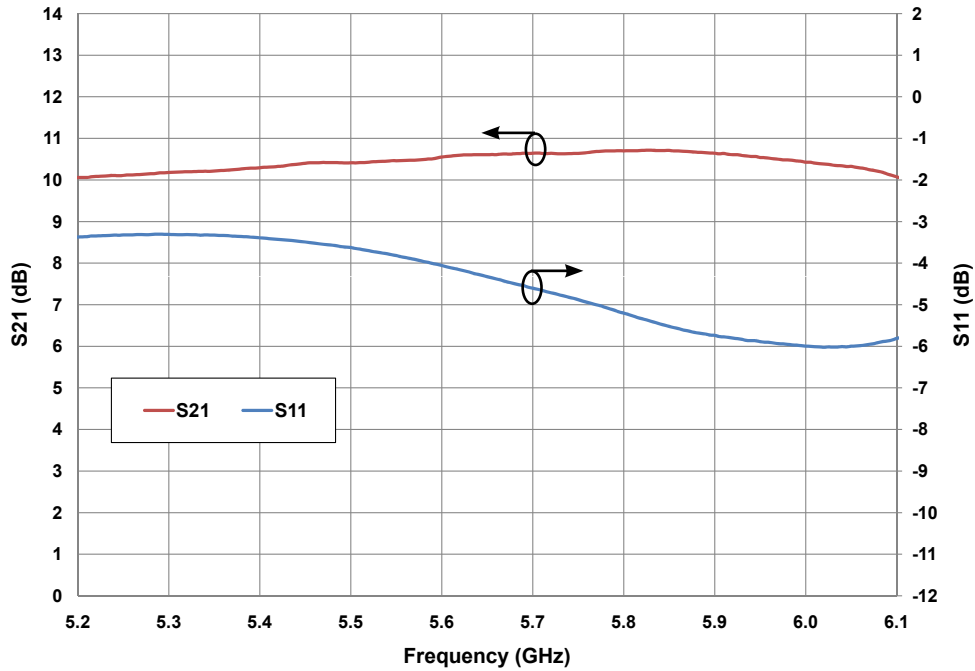
<sup>2</sup> Measured in CGH55015-AMP

<sup>3</sup>  $P_{SAT}$  is defined as  $I_G = 0.36 mA$ .

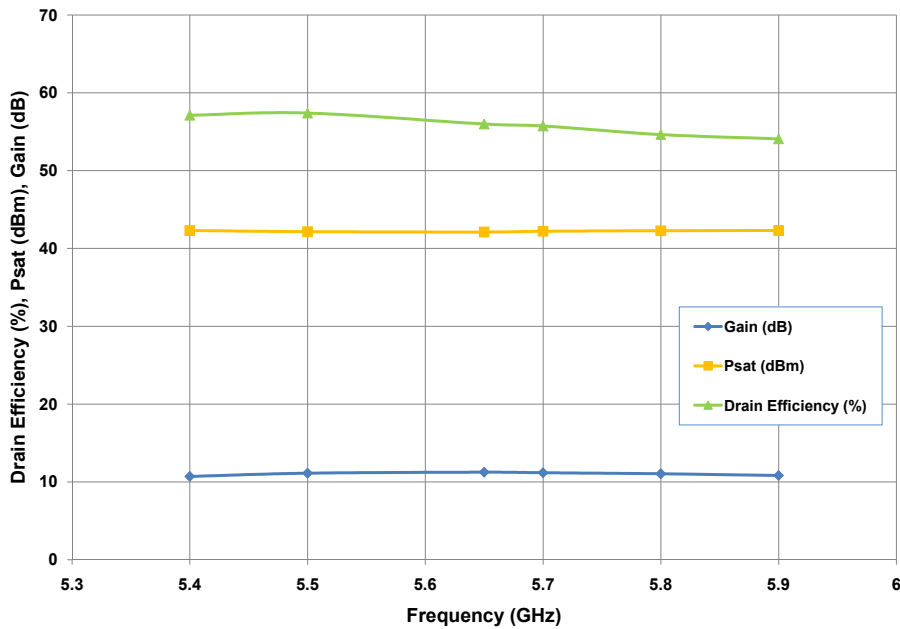
<sup>4</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$

## Typical Performance

**Small Signal S-Parameters vs Frequency of  
CGH55015F2 and CGH55015P2 in the CGH55015-AMP**  
 $V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}$

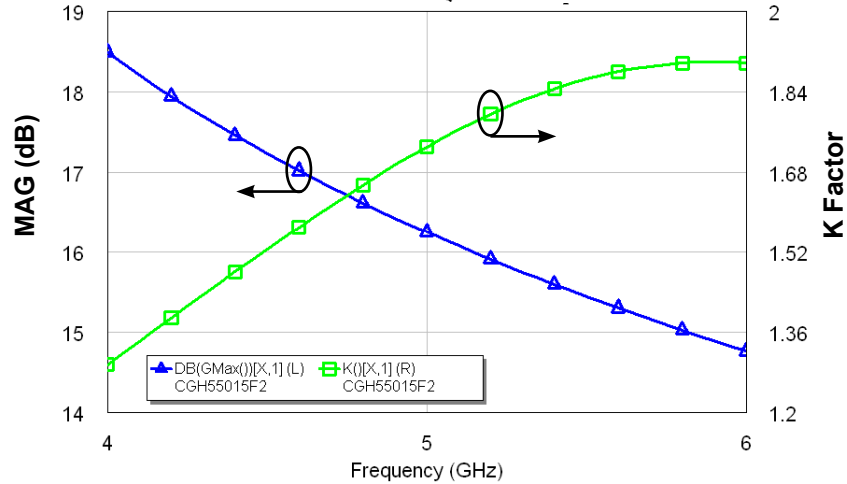


**Drain Efficiency, Power and Gain vs Frequency of the  
CGH55015F2 and CGH55015P2 in the CGH55015-AMP**  
 $V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}$



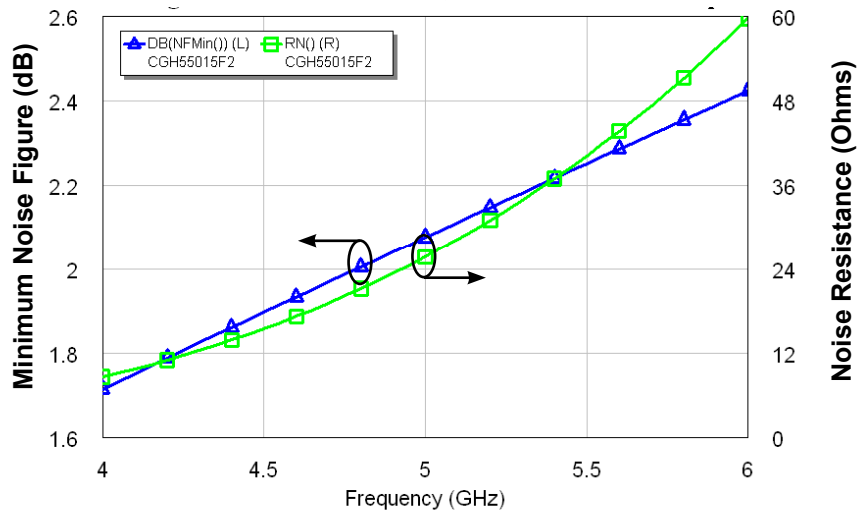
## Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH55015F2/CGH55015P2  
 $V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}$



## Typical Noise Performance

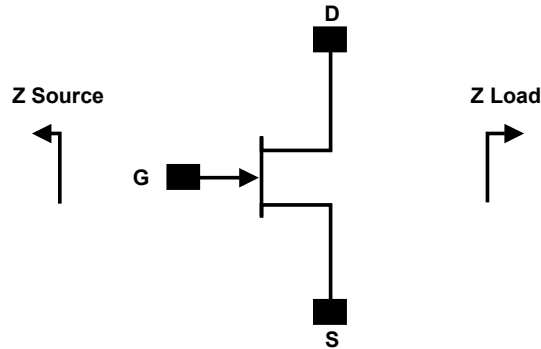
Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH55015F2/CGH55015P2  
 $V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}$



## Electrostatic Discharge (ESD) Classifications

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

## Source and Load Impedances

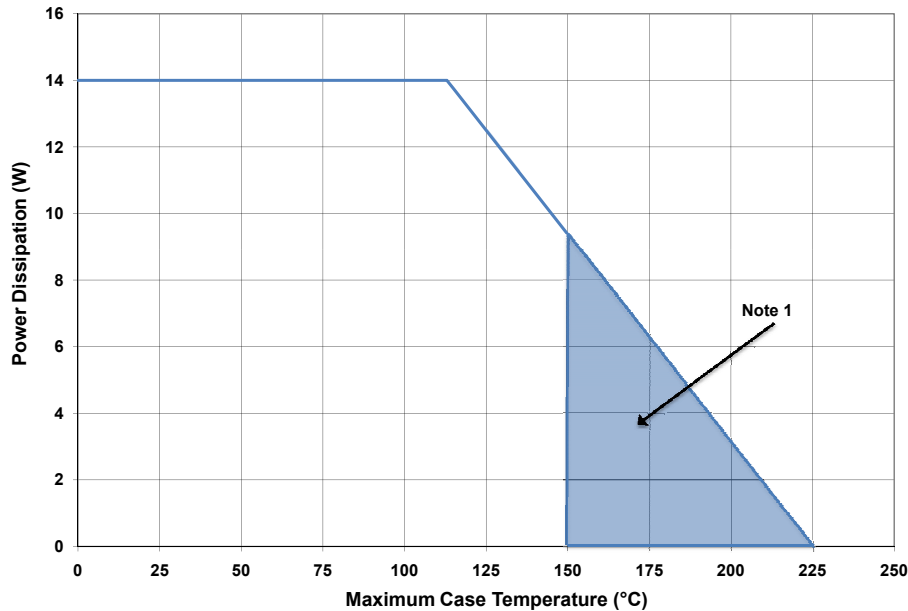


Frequency (MHz)	Z Source	Z Load
5500	8.7 - j30.2	21.6 - j4.7
5650	10.2 - j26.9	24.2 - j5.5
5800	12.3 - j24.3	26.5 - j7.5

Note 1.  $V_{DD} = 28V$ ,  $I_{DQ} = 200\text{ mA}$  in the 440166 package.

Note 2. Impedances are extracted from the CGH55015-AMP demonstration amplifier and are not source and load pull data derived from the transistor.

## CGH55015F2 and CGH55015P2 Power Dissipation De-rating Curve

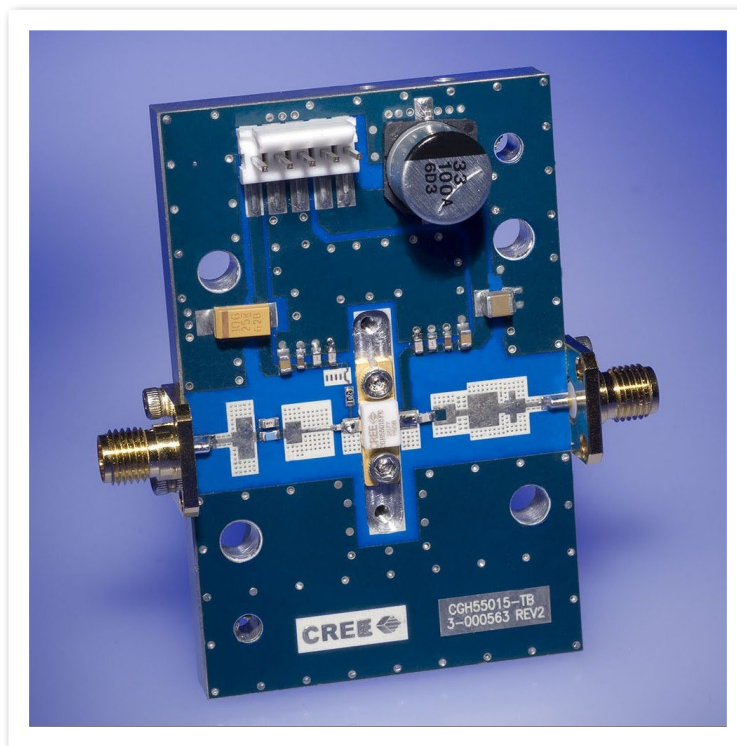


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

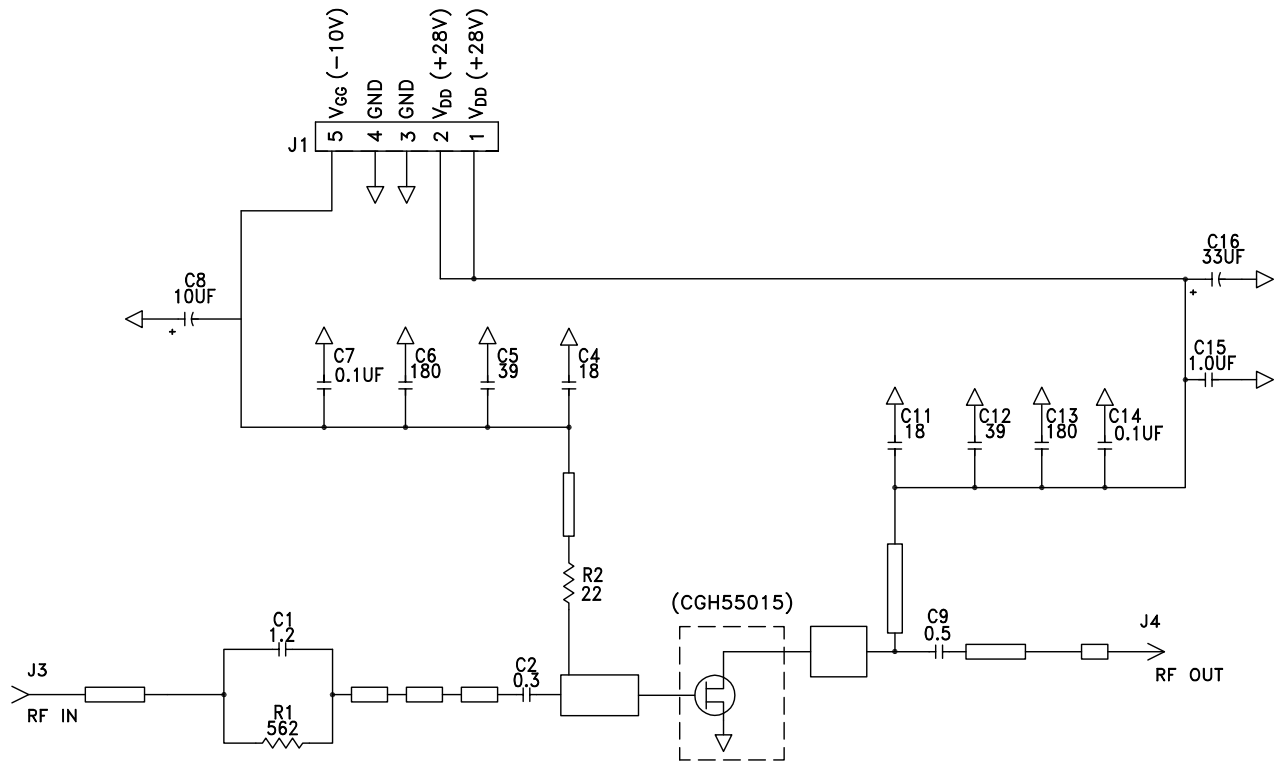
## CGH55015-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1	CAP, 1.2pF, +/-0.1 pF, 0603, ATC 600S	1
C2	CAP, 0.3pF, +/-0.05 pF, 0402, ATC 600L	1
C9	CAP, 0.5pF,+/-0.05pF, 0603, ATC 600S	1
C4,C11	CAP, 18pF, +/-5%, 0603, ATC 600S	2
C5,C12	CAP, 39pF +/-5%, 0603, ATC 600S	2
C6,C13	CAP, CER, 180pF, 50V, +/-5%, C0G, 0603	2
C7,C14	CAP, CER, 0.1UF, 50V, +/-10%, X7R, 0805	2
C8	CAP, 10UF, 16V, SMT, TANTALUM	1
C15	CAP, 1.0UF ±10%, 100V, 1210, X7R	1
C16	CAP, 33UF, 100V, ELECT, FK, SMD	1
R1	RES, 1/16W, 0603, 1%, 562 OHMS	1
R2	RES, 1/16W, 0603, 1%, 22 OHMS	1
J1	HEADER RT> PLZ .1 CEN LK 5 POS	1
J3,J4	CONN, SMA, FLANGE	2
-	PCB, RO4350B, Er = 3.48, h = 20 mil	1
-	CGH55015	1

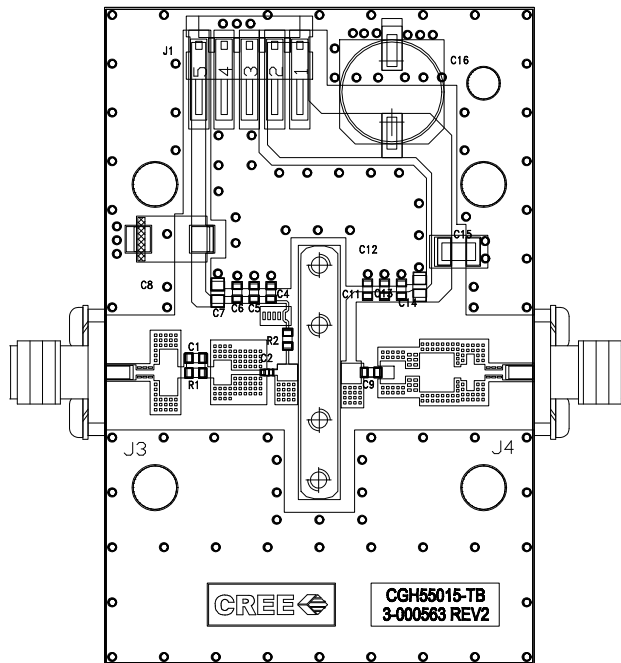
## CGH55015-AMP Demonstration Amplifier Circuit



## CGH55015-AMP Demonstration Amplifier Circuit Schematic



## CGH55015-AMP Demonstration Amplifier Circuit Outline



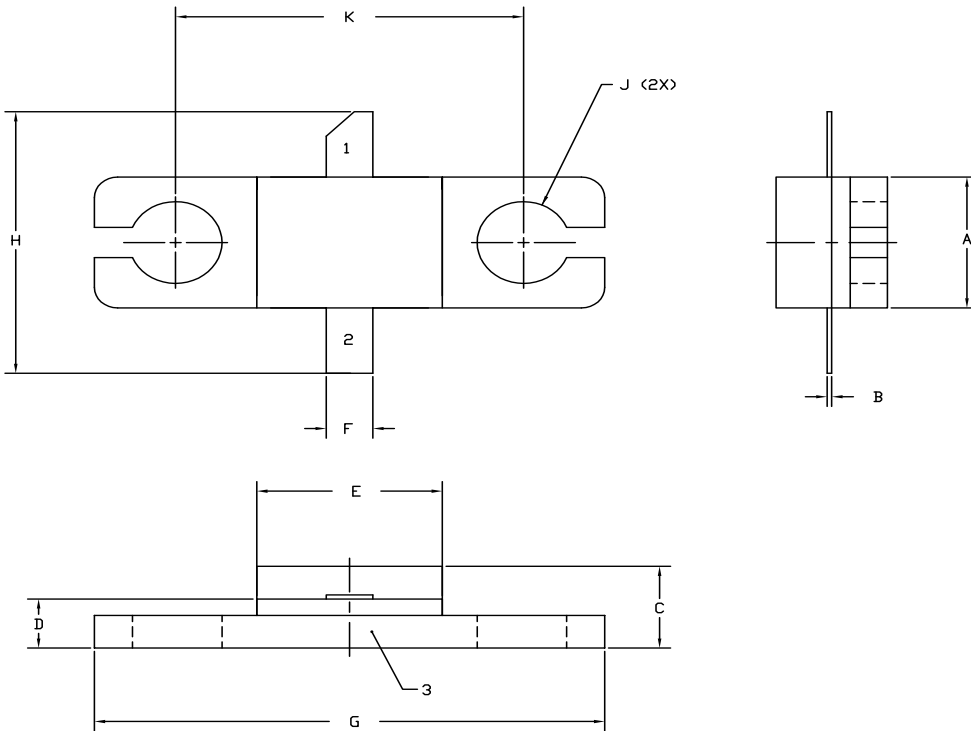
**Typical Package S-Parameters for CGH55015F2 / CGH55015P2**  
 (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$ , angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.911	-130.86	18.44	105.32	0.022	19.38	0.302	-113.00
600 MHz	0.906	-139.86	15.82	99.40	0.023	14.28	0.299	-120.56
700 MHz	0.902	-146.89	13.81	94.44	0.023	10.15	0.298	-126.20
800 MHz	0.900	-152.58	12.23	90.14	0.023	6.68	0.299	-130.51
900 MHz	0.898	-157.33	10.97	86.29	0.023	3.69	0.302	-133.91
1.0 GHz	0.897	-161.38	9.93	82.79	0.023	1.03	0.305	-136.65
1.1 GHz	0.896	-164.92	9.06	79.53	0.023	-1.36	0.309	-138.93
1.2 GHz	0.895	-168.07	8.33	76.47	0.023	-3.55	0.314	-140.86
1.3 GHz	0.895	-170.92	7.71	73.56	0.023	-5.58	0.320	-142.55
1.4 GHz	0.895	-173.52	7.17	70.77	0.023	-7.47	0.326	-144.06
1.5 GHz	0.894	-175.93	6.70	68.08	0.023	-9.25	0.332	-145.44
1.6 GHz	0.894	-178.19	6.29	65.47	0.023	-10.93	0.338	-146.73
1.7 GHz	0.894	179.68	5.92	62.93	0.023	-12.52	0.345	-147.96
1.8 GHz	0.894	177.66	5.60	60.44	0.023	-14.04	0.351	-149.13
1.9 GHz	0.894	175.72	5.31	58.01	0.022	-15.49	0.358	-150.28
2.0 GHz	0.894	173.85	5.04	55.62	0.022	-16.88	0.365	-151.42
2.1 GHz	0.895	172.04	4.80	53.26	0.022	-18.21	0.372	-152.54
2.2 GHz	0.895	170.28	4.59	50.93	0.022	-19.48	0.379	-153.66
2.3 GHz	0.895	168.57	4.39	48.64	0.022	-20.69	0.386	-154.78
2.4 GHz	0.895	166.88	4.21	46.37	0.021	-21.85	0.393	-155.92
2.5 GHz	0.895	165.22	4.04	44.11	0.021	-22.96	0.400	-157.06
2.6 GHz	0.895	163.58	3.88	41.88	0.021	-24.02	0.407	-158.21
2.7 GHz	0.895	161.97	3.74	39.67	0.021	-25.02	0.413	-159.37
2.8 GHz	0.896	160.36	3.61	37.47	0.020	-25.97	0.420	-160.55
2.9 GHz	0.896	158.76	3.49	35.28	0.020	-26.87	0.426	-161.75
3.0 GHz	0.896	157.17	3.37	33.11	0.020	-27.72	0.433	-162.96
3.2 GHz	0.896	153.99	3.17	28.79	0.019	-29.24	0.445	-165.43
3.4 GHz	0.896	150.81	2.99	24.49	0.019	-30.53	0.456	-167.97
3.6 GHz	0.897	147.59	2.83	20.21	0.018	-31.57	0.467	-170.58
3.8 GHz	0.897	144.34	2.69	15.94	0.018	-32.35	0.477	-173.26
4.0 GHz	0.897	141.03	2.56	11.67	0.017	-32.86	0.487	-176.01
4.2 GHz	0.897	137.66	2.45	7.39	0.017	-33.08	0.496	-178.84
4.4 GHz	0.897	134.20	2.35	3.09	0.017	-33.02	0.504	178.25
4.6 GHz	0.897	130.65	2.26	-1.24	0.016	-32.67	0.511	175.25
4.8 GHz	0.897	127.01	2.18	-5.61	0.016	-32.06	0.517	172.16
5.0 GHz	0.896	123.25	2.11	-10.03	0.016	-31.23	0.523	168.97
5.2 GHz	0.896	119.37	2.04	-14.50	0.016	-30.22	0.528	165.68
5.4 GHz	0.896	115.36	1.98	-19.04	0.016	-29.11	0.532	162.26
5.6 GHz	0.896	111.21	1.92	-23.65	0.016	-27.99	0.536	158.72
5.8 GHz	0.895	106.92	1.87	-28.34	0.017	-26.98	0.539	155.04
6.0 GHz	0.895	102.47	1.83	-33.12	0.017	-26.15	0.541	151.21

To download the s-parameters in s2p format, go to the [CGH55015F2/P2 Product Page](#), click on the documentation tab.



## Product Dimensions CGH55015F2 (Package Type – 440166)



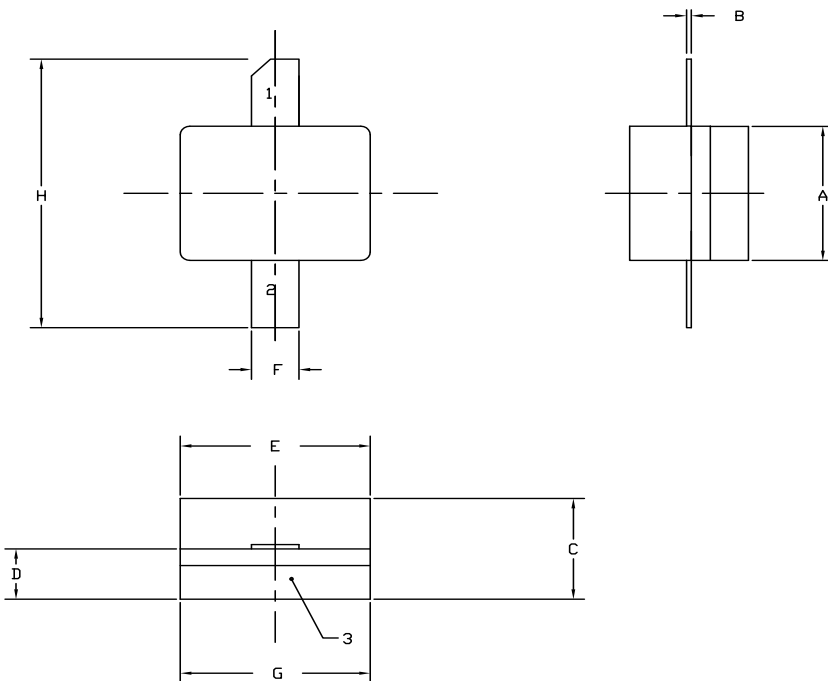
**NOTES:**

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 CGH55015P2 (Package Type – 440196)



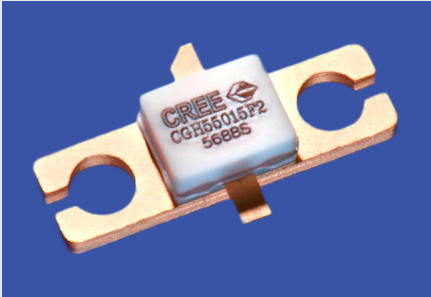

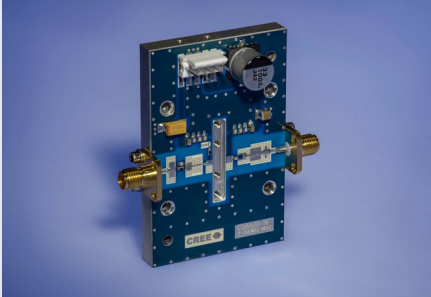
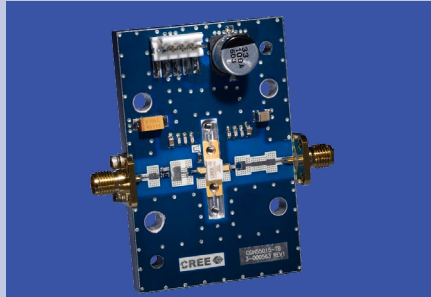
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DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.155	0.165	3.94	4.19
B	0.003	0.006	0.10	0.15
C	0.115	0.135	2.92	3.17
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.195	0.205	4.95	5.21
H	0.280	0.360	7.11	9.14

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

## Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH55015F2	GaN HEMT	Each	
CGH55015P2	GaN HEMT	Each	
CGH55015-TB	Test board without GaN HEMT	Each	
CGH55015-AMP	Test board with GaN HEMT installed	Each	



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