



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

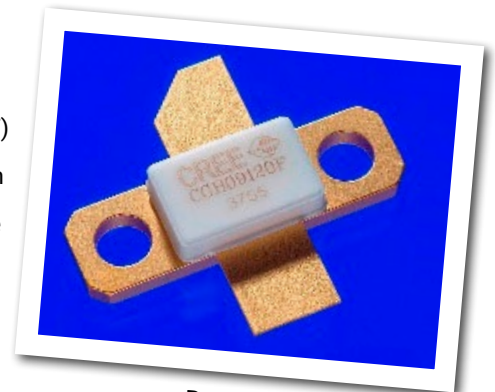
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



# CGH09120F

120 W, UHF - 2.5 GHz, GaN HEMT for WCDMA, LTE, MC-GSM

Cree's CGH09120F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH09120F ideal for MC-GSM, WCDMA and LTE amplifier applications. The transistor is supplied in a ceramic/metal flange package.



Package Type: 440095  
PN: CGH09120F

## Typical Performance Over 800-950 MHz ( $T_c = 25^\circ\text{C}$ ) of Demonstration Amplifier

Parameter	800 MHz	850 MHz	900 MHz	950 MHz	Units
Gain @ 43 dBm	19.2	21.0	21.6	21.6	dB
ACLR @ 43 dBm	-40.5	-40.5	-39.0	-36.5	dBc
Drain Efficiency @ 43 dBm	31.0	33.7	36.6	39.3	%

**Note:**

Measured in the CGH09120F-AMP amplifier circuit, under WCDMA 3GPP test model 1, 64 DPCH, 67% clipping, PAR = 8.81 dB @ 0.01 % Probability on CCDF.

## Features



- UHF - 2.5 GHz Operation
- 21 dB Gain
- -38 dBc ACLR at 20 W  $P_{AVE}$
- 35 % Efficiency at 20 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	$V_{DSS}$	84	Volts	25°C
Gate-to-Source Voltage	$V_{GS}$	-10, +2	Volts	25°C
Power Dissipation	$P_{DISS}$	56	Watts	
Storage Temperature	$T_{STG}$	-65, +150	°C	
Operating Junction Temperature	$T_J$	225	°C	
Maximum Forward Gate Current	$I_{GMAX}$	30	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>	$R_{\theta JC}$	1.7	°C/W	85°C
Case Operating Temperature <sup>3</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 CGH09120F at  $P_{DISS} = 56$  W

## 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, $I_D = 28.8$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	$V_{DC}$	$V_{DS} = 28$ V, $I_D = 1.2$ A
Saturated Drain Current <sup>2</sup>	$I_{DS}$	23.2	28.0	-	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	$V_{BR}$	120	-	-	$V_{DC}$	$V_{GS} = -8$ V, $I_D = 28.8$ mA
<b>RF Characteristics<sup>5</sup> (<math>T_C = 25^\circ\text{C}</math>, <math>F_c = 870</math> MHz unless otherwise noted)</b>						
Saturated Output Power <sup>3,4</sup>	$P_{SAT}$	-	120	-	W	$V_{DD} = 28$ V, $I_{DQ} = 1.2$ A,
Pulsed Drain Efficiency <sup>3</sup>	$\eta$	-	75	-	%	$V_{DD} = 28$ V, $I_{DQ} = 1.2$ A, $P_{OUT} = P_{SAT}$
Modulated Gain <sup>6</sup>	$G_{SS}$	20	21.5	-	dB	$V_{DD} = 28$ V, $I_{DQ} = 1.2$ A, $P_{OUT} = 43$ dBm
WCDMA Linearity <sup>6</sup>	ACLR	-	-38	-34	dBc	$V_{DD} = 28$ V, $I_{DQ} = 1.2$ A, $P_{OUT} = 43$ dBm
Modulated Drain Efficiency <sup>6</sup>	$\eta$	31	35	-	%	$V_{DD} = 28$ V, $I_{DQ} = 1.2$ A, $P_{OUT} = 43$ dBm
Output Mismatch Stress	VSWR	-	-	10 : 1	Y	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 1.2$ A, $P_{OUT} = 20$ W CW
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	-	35.3	-	pF	$V_{DS} = 28$ V, $V_{gs} = -8$ V, $f = 1$ MHz
Output Capacitance	$C_{DS}$	-	9.1	-	pF	$V_{DS} = 28$ V, $V_{gs} = -8$ V, $f = 1$ MHz
Feedback Capacitance	$C_{GD}$	-	1.6	-	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> Scaled from PCM data.

<sup>3</sup> Pulse Width = 40  $\mu$ S, Duty Cycle = 5 %.

<sup>4</sup>  $P_{SAT}$  is defined as  $I_G = 10$  mA peak.

<sup>5</sup> Measured in CGH09120F-AMP

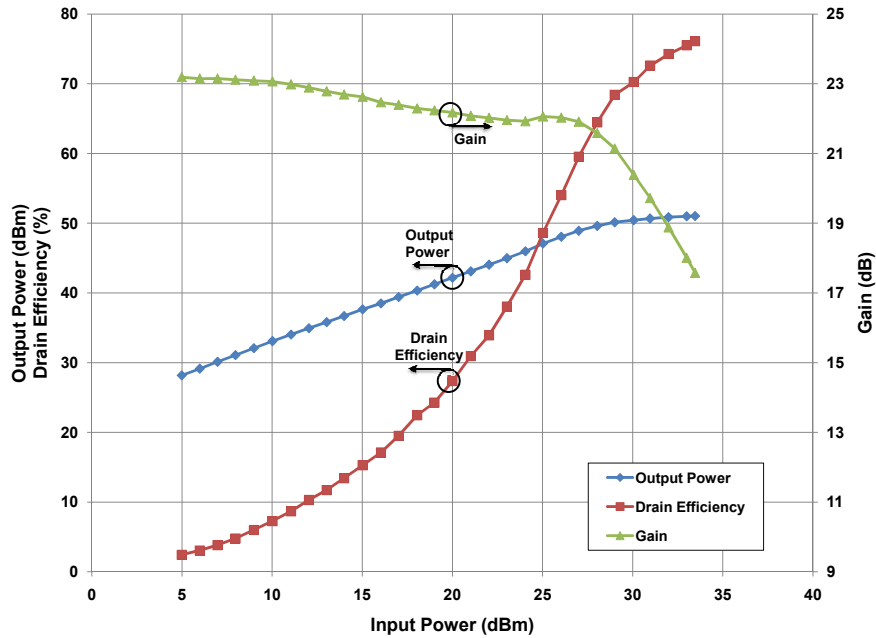
<sup>6</sup> Single Carrier WCDMA, 3GPP Test Model 1, 64 DPCH, 67 % Clipping, PAR = 8.81 dB @ 0.01 % Probability on CCDF.



## Typical Pulse Performance

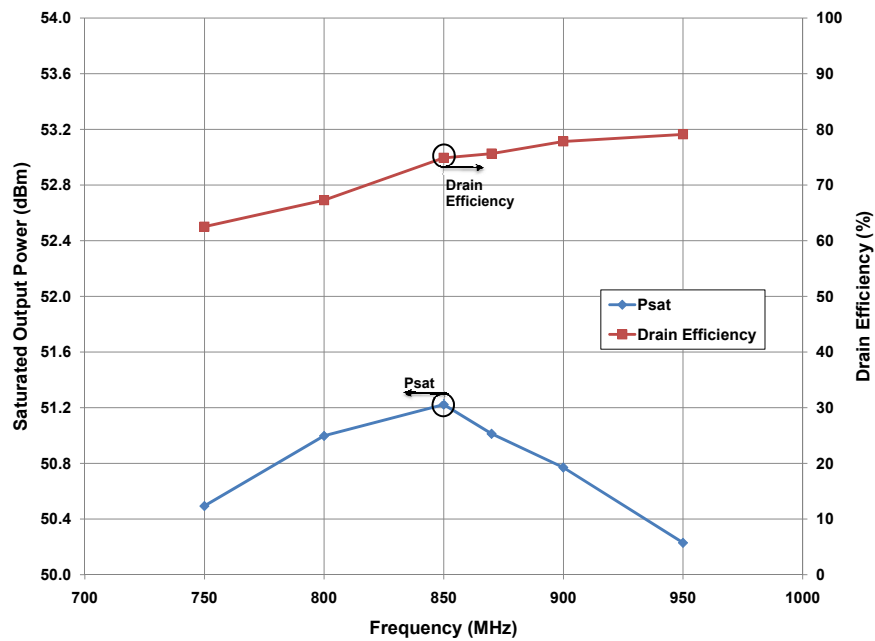
**Typical Pulsed Output Power, Drain Efficiency, and Gain vs Input Power**  
measured in CGH09120F-AMP Amplifier Circuit.

$V_{DS} = 28\text{ V}$ ,  $I_{DS} = 1.2\text{ A}$ , Freq = 870 MHz, Pulse Width = 40  $\mu\text{S}$ , Duty Cycle = 5 %



**Typical Pulsed Saturated Power vs Frequency**  
measured in CGH09120F-AMP Amplifier Circuit.

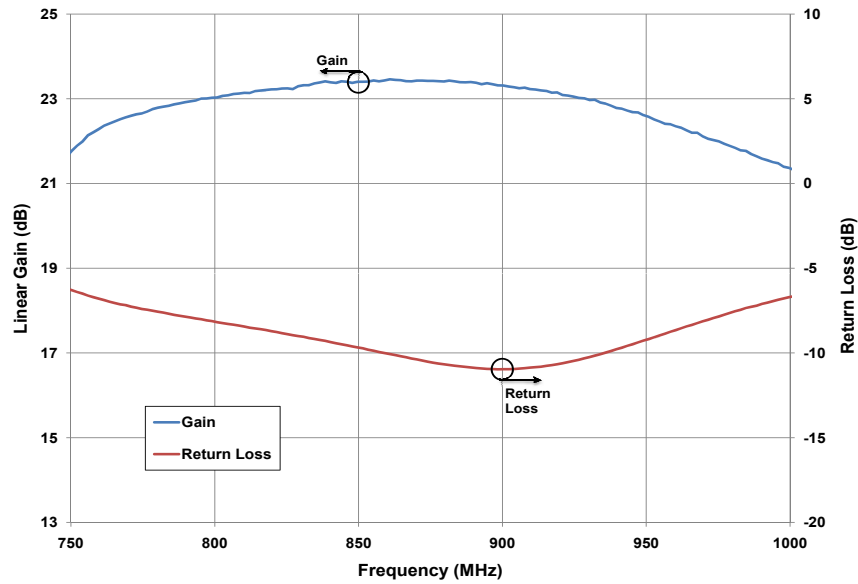
$V_{DS} = 28\text{ V}$ ,  $I_{DS} = 1.2\text{ A}$ ,  $P_{SAT} = 10\text{ mA}$   $I_{GS}$  Peak, Pulse Width = 40  $\mu\text{S}$ , Duty Cycle = 5 %



## Typical Linear Performance

**Typical Small Signal Gain and Return Loss vs Frequency**  
measured in CGH09120F-AMP Amplifier Circuit.

$V_{DS} = 28\text{ V}$ ,  $I_{DS} = 1.2\text{ A}$

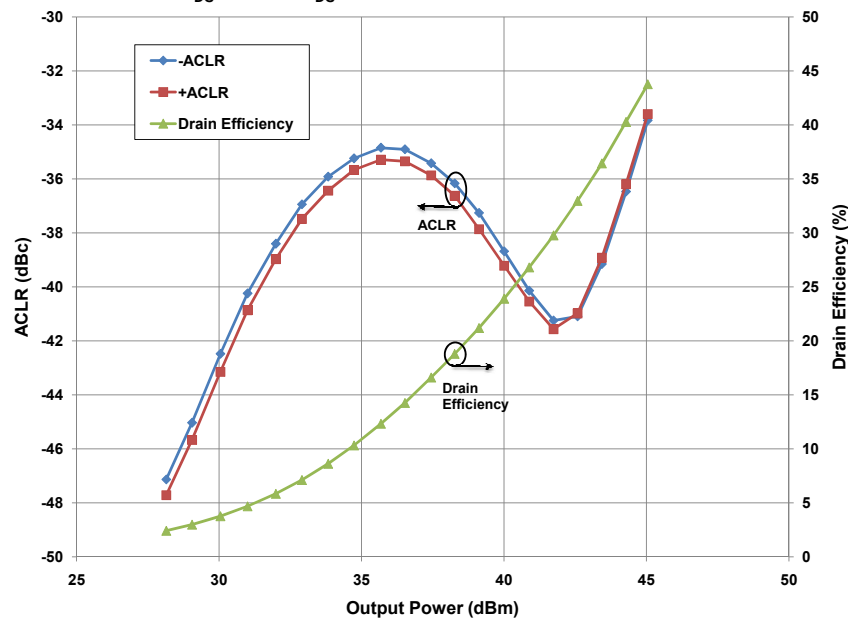


## Typical WCDMA Performance

**Typical WCDMA Characteristics ACLR and Drain Efficiency vs Output Power**  
measured in CGH09120F-AMP Amplifier Circuit.

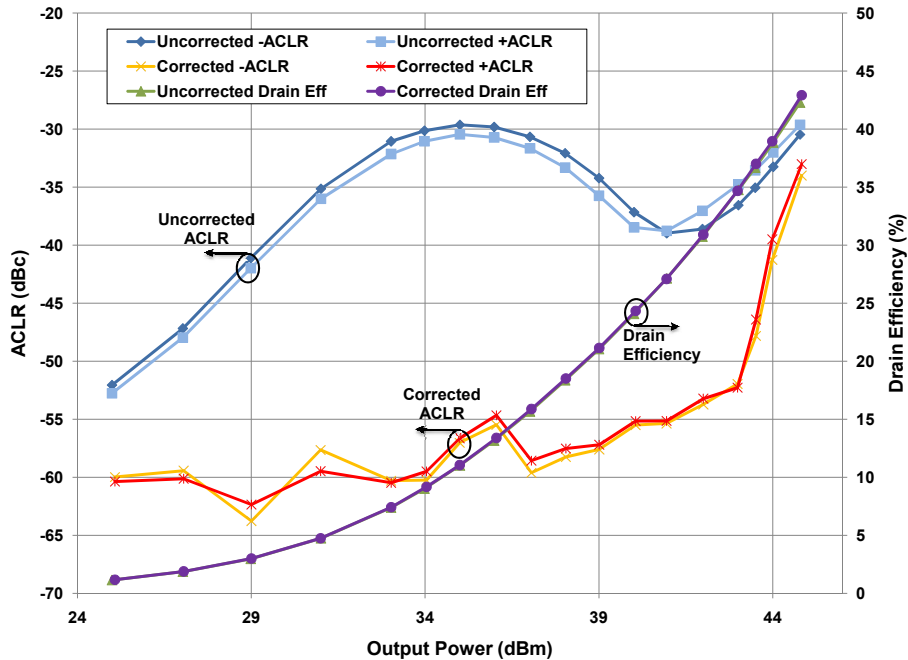
3GPP Test Model 1, 64 DPCH 67 % Clipping, 8.81 dB PAR @ 0.01 %

$V_{DS} = 28\text{ V}$ ,  $I_{DS} = 1.2\text{ A}$ , Frequency = 870 MHz

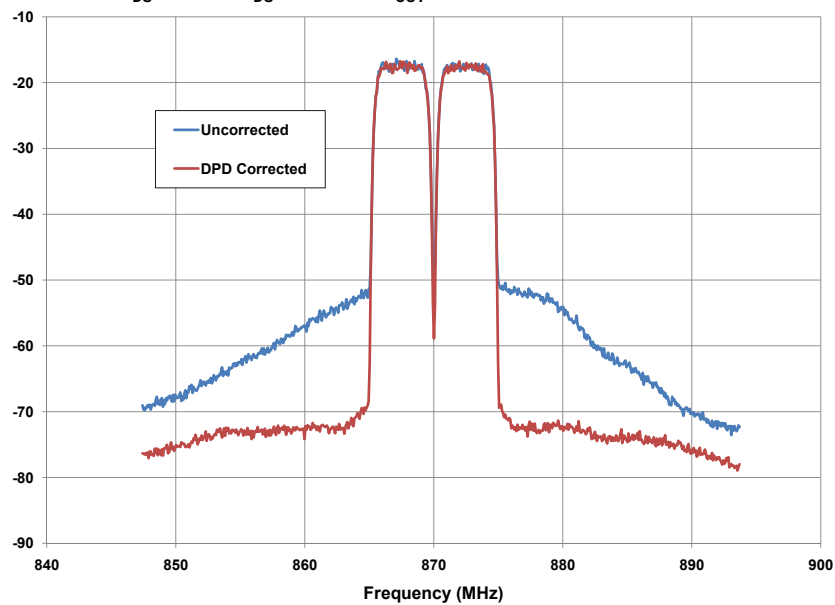


## Typical WCDMA Digital Pre-Distortion (DPD) Performance

**WCDMA Characteristics with and without DPD Correction**  
**ACLR and Drain Efficiency vs Output Power**  
 measured in CGH09120F-AMP Amplifier Circuit.  
 Two Channel WCDMA 7.5dB PAR with CFR  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 1.2\text{ A}$ , Frequency = 870 MHz



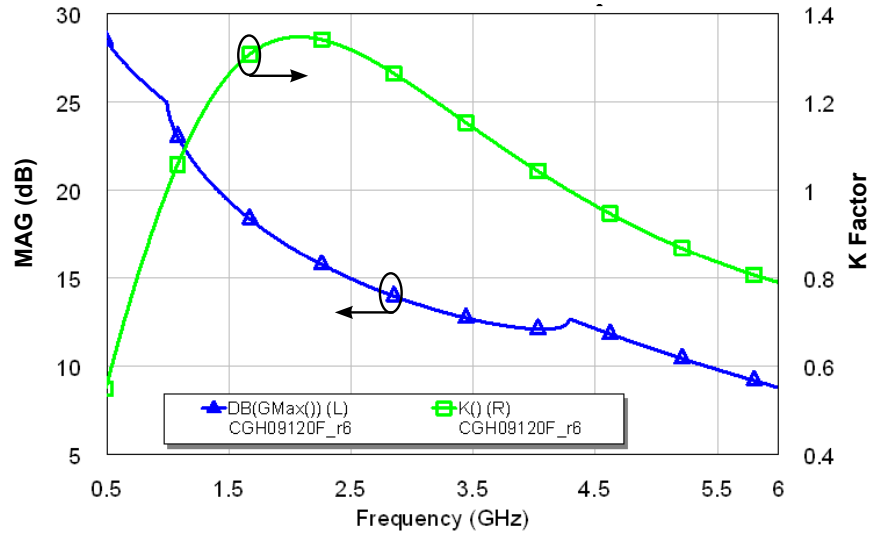
**WCDMA Linearity with DPD Linearizer**  
 measured in CGH09120F-AMP Amplifier Circuit.  
 Two Channel WCDMA 7.5dB PAR with CFR  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 1.2\text{ A}$ ,  $P_{OUT} = 43\text{ dBm}$ , Efficiency = 35 %



## Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH09120F

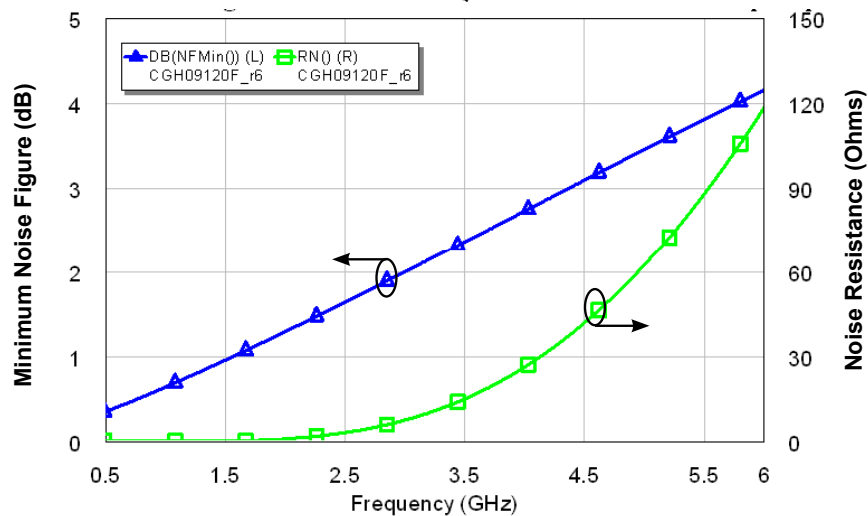
$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 1.2\text{ A}$



## Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH09120F

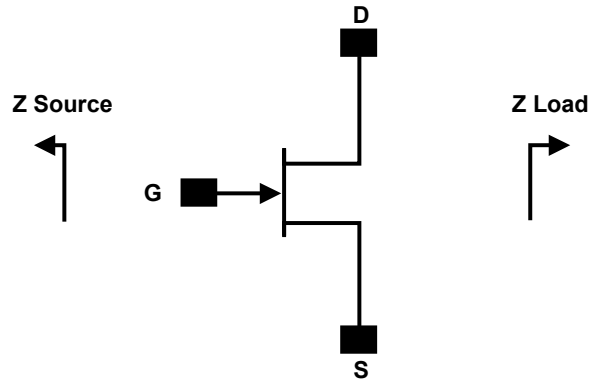
$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 1.2\text{ A}$



## 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

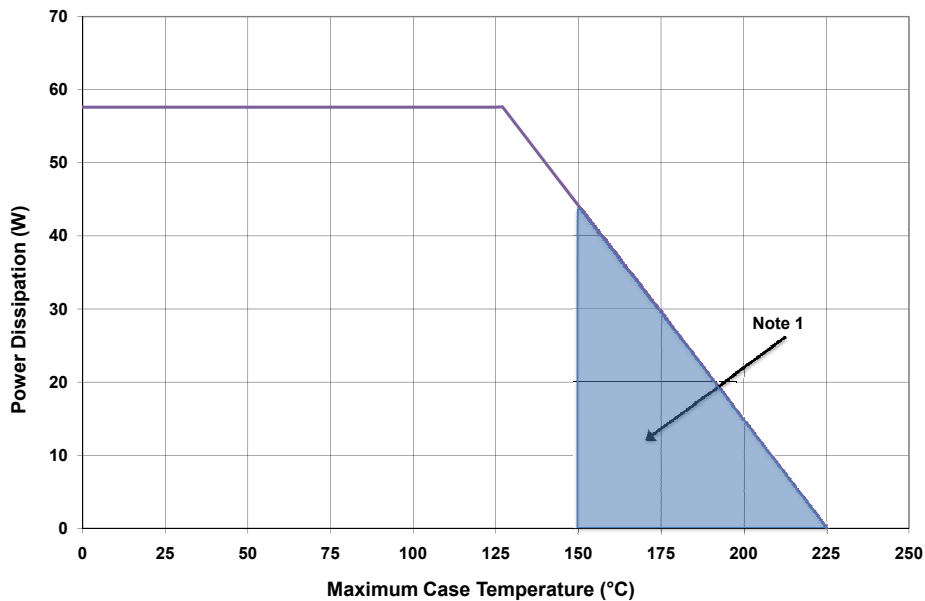


Frequency (MHz)	Z Source	Z Load
700	0.75 - j 0.58	5.59 - j 2.12
750	0.84 - j 0.18	4.97 - j 1.25
800	0.90 + j 0.19	4.68 - j 0.37
850	0.95 + j 0.59	4.59 + j 0.45
900	1.02 + j 1.03	4.67 + j 1.19
950	1.17 + j 1.53	4.90 + j 1.82
1000	1.53 + j 2.10	5.28 + j 2.31

Note<sup>1</sup>  $V_{DD} = 28V$ ,  $I_{DQ} = 1.2 A$  in the 440095 package.

Note<sup>2</sup> Impedances are extracted from CGH09120F-AMP demonstration circuit and are not source and load pull data derived from transistor.

## CGH09120F Power Dissipation De-rating Curve



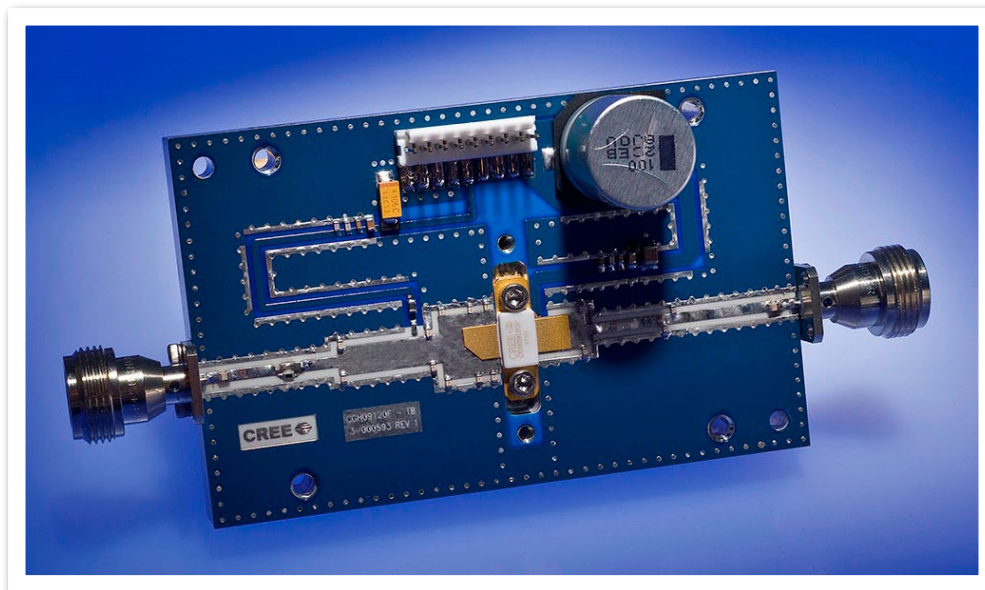
Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).



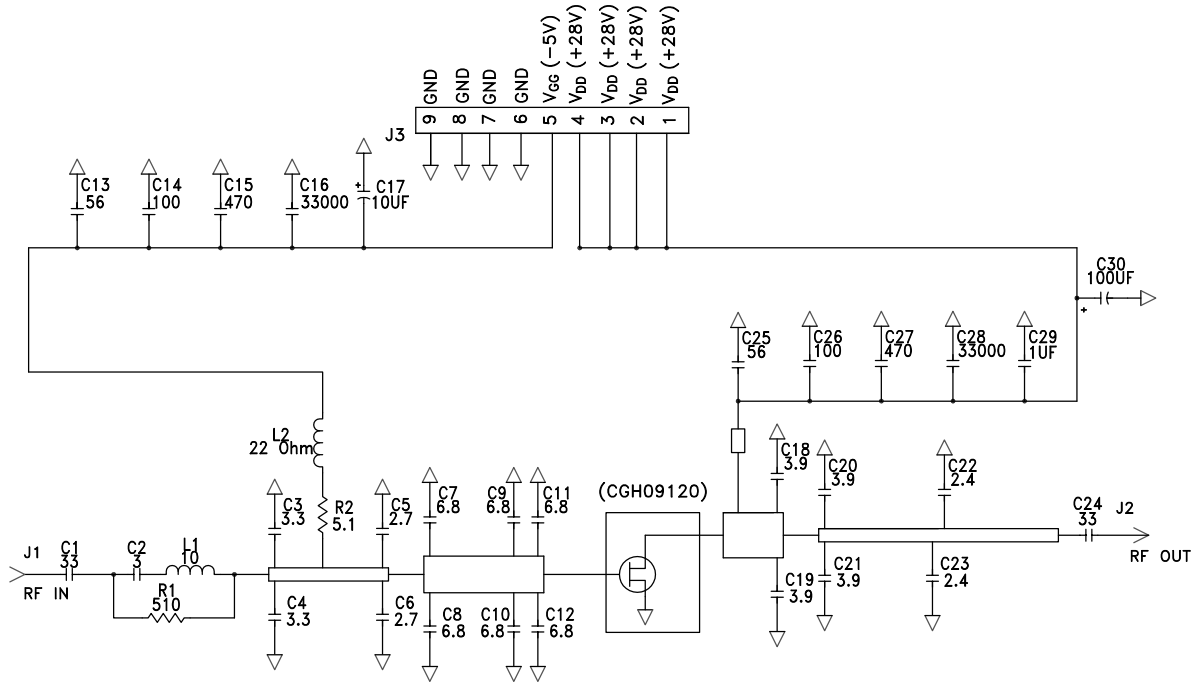
## CGH09120F-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16W, 0603, 1%, 511 OHMS	1
R2	RES, 1/16W, 0603, 1%, 5.1 OHMS	1
C1, C24	CAP, 33 pF +/- 5%, 250V, 0805, ATC 600F	2
C2	CAP, 3.0 pF, +/- 0.1pF, 0603, ATC600S	1
C3, C4	CAP, 3.3 pF, +/- 0.1pF, 0603, ATC600S	2
C5, C6	CAP, 2.7 pF, +/- 0.1pF, 0603, ATC600S	2
C7, C8, C9, C10, C11, C12	CAP, 6.8pF, +/- 0.25 pF, 0603, ATC600S	6
C13, C25	CAP, 56 pF +/- 5%, 0603 , ATC600S	2
C14, C26	CAP, 100 pF, +/-5%, 0603, ATC600S	2
C15, C27	CAP, 470 pF, 5%, 100V, 0603, X7R	2
C16, C28	CAP, 33000 pF, 0805, 100V, X7R	2
C17	CAP, 10 uF, 16V, TANTALUM	1
C18, C19, C20, C21	CAP, 3.9 pF, +/- 0.1pF, 0603, ATC600S	4
C22, C23	CAP, 2.4PF, +/-0.1 pF, 0603, ATC600S	2
C29	CAP, 1.0 uF, +/-10%, 1210, 100V, X7R	1
C30	CAP 100 uF, 160V, ELECTROLYTIC	1
L1	INDUCTOR, CHIP, 10nH, 0603, SMT	1
L2	FERRITE, 22 OHM, 0805, BLM21PG220SN1	1
J1, J2	CONN, N-Type, Female, 0.500 SMA Flange	2
J3	CONN, Header, RT> PLZ, 0.1 CEN, LK, 9 POS	1
-	PCB, RO4003, Er = 3.38, h = 32 mil	1
-	CGH09120F	1

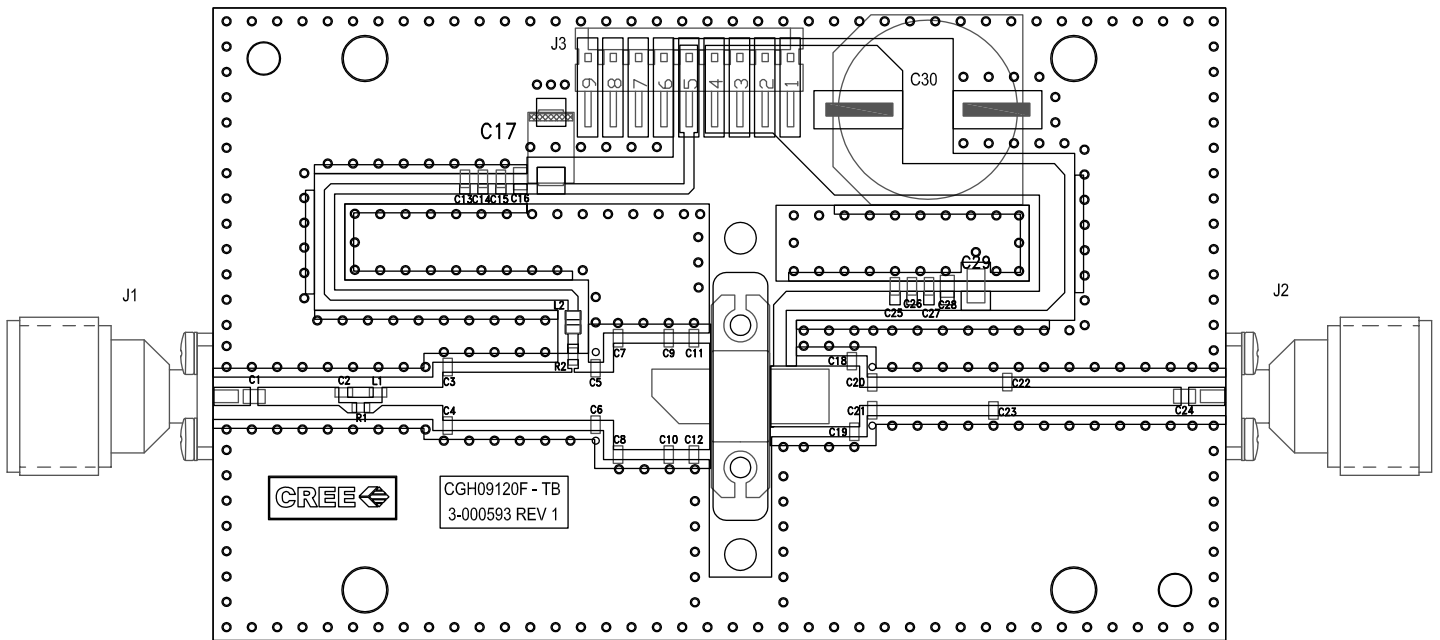
## CGH09120F-AMP Demonstration Amplifier Circuit



## CGH09120F-AMP Demonstration Amplifier Circuit Schematic



## CGH09120F-AMP Demonstration Amplifier Circuit Outline

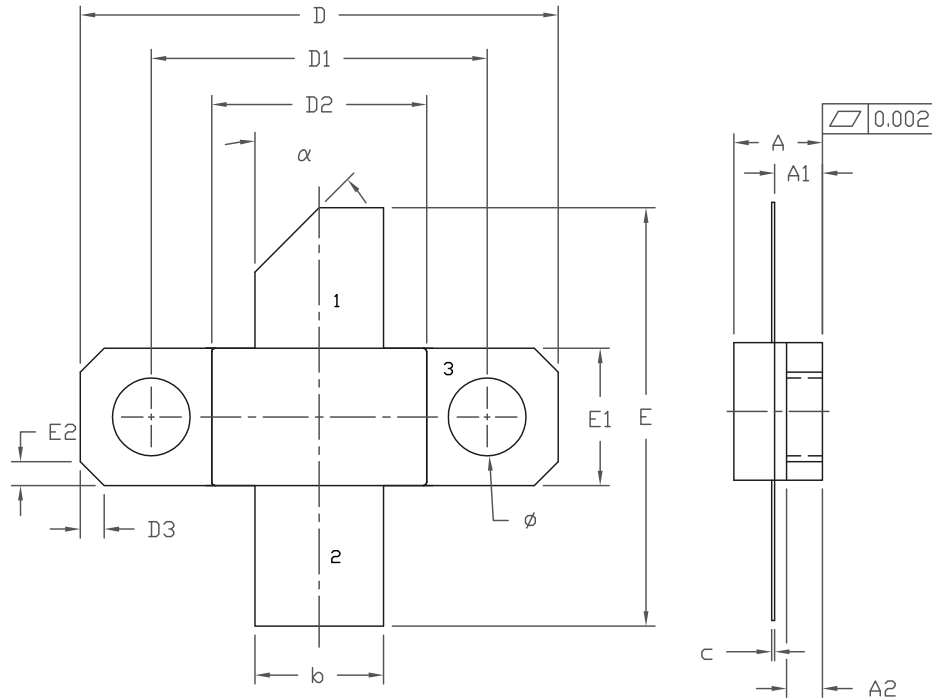


**Typical Package S-Parameters for CGH09120F**  
 (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 1.2\text{ A}$ , angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.962	-177.69	4.16	80.41	0.006	15.01	0.812	-179.78
600 MHz	0.962	-178.94	3.46	77.69	0.006	17.16	0.814	179.92
700 MHz	0.962	-179.97	2.97	75.09	0.006	19.38	0.815	179.65
800 MHz	0.962	179.14	2.59	72.58	0.006	21.64	0.816	179.40
900 MHz	0.962	178.33	2.30	70.14	0.006	23.89	0.818	179.15
1.0 GHz	0.962	177.59	2.07	67.74	0.007	26.12	0.820	178.90
1.1 GHz	0.962	176.88	1.88	65.40	0.007	28.30	0.821	178.64
1.2 GHz	0.962	176.21	1.73	63.09	0.007	30.42	0.823	178.37
1.3 GHz	0.961	175.55	1.59	60.83	0.007	32.47	0.825	178.09
1.4 GHz	0.961	174.91	1.48	58.60	0.008	34.43	0.827	177.80
1.5 GHz	0.961	174.28	1.38	56.40	0.008	36.30	0.829	177.50
1.6 GHz	0.961	173.65	1.29	54.24	0.008	38.06	0.831	177.18
1.7 GHz	0.961	173.02	1.22	52.12	0.008	39.70	0.833	176.84
1.8 GHz	0.960	172.40	1.15	50.02	0.009	41.24	0.835	176.49
1.9 GHz	0.960	171.77	1.09	47.96	0.009	42.65	0.836	176.13
2.0 GHz	0.960	171.14	1.04	45.93	0.010	43.95	0.838	175.75
2.1 GHz	0.959	170.50	1.00	43.92	0.010	45.13	0.840	175.35
2.2 GHz	0.959	169.86	0.95	41.94	0.011	46.19	0.841	174.93
2.3 GHz	0.958	169.20	0.92	39.99	0.011	47.13	0.843	174.50
2.4 GHz	0.958	168.54	0.88	38.07	0.012	47.96	0.844	174.05
2.5 GHz	0.957	167.86	0.85	36.16	0.013	48.68	0.846	173.59
2.6 GHz	0.956	167.17	0.82	34.28	0.013	49.30	0.847	173.11
2.7 GHz	0.956	166.46	0.80	32.42	0.014	49.81	0.848	172.61
2.8 GHz	0.955	165.74	0.78	30.58	0.015	50.22	0.849	172.10
2.9 GHz	0.954	165.00	0.76	28.75	0.015	50.54	0.850	171.56
3.0 GHz	0.953	164.24	0.74	26.94	0.016	50.76	0.850	171.01
3.2 GHz	0.951	162.65	0.71	23.34	0.018	50.94	0.851	169.86
3.4 GHz	0.948	160.96	0.68	19.78	0.021	50.78	0.851	168.62
3.6 GHz	0.945	159.15	0.67	16.22	0.023	50.30	0.850	167.31
3.8 GHz	0.941	157.21	0.65	12.64	0.026	49.50	0.848	165.90
4.0 GHz	0.936	155.11	0.65	9.02	0.029	48.38	0.846	164.39
4.2 GHz	0.931	152.81	0.64	5.33	0.033	46.95	0.842	162.78
4.4 GHz	0.924	150.30	0.65	1.52	0.038	45.18	0.837	161.04
4.6 GHz	0.916	147.52	0.66	-2.44	0.043	43.05	0.831	159.17
4.8 GHz	0.907	144.44	0.67	-6.59	0.049	40.54	0.823	157.14
5.0 GHz	0.896	140.98	0.69	-11.01	0.056	37.59	0.813	154.94
5.2 GHz	0.882	137.08	0.72	-15.75	0.065	34.17	0.801	152.55
5.4 GHz	0.865	132.66	0.75	-20.88	0.075	30.19	0.786	149.94
5.6 GHz	0.844	127.59	0.79	-26.51	0.087	25.59	0.769	147.10
5.8 GHz	0.818	121.74	0.84	-32.73	0.102	20.26	0.749	143.99
6.0 GHz	0.787	114.95	0.90	-39.65	0.119	14.11	0.725	140.60

To download the s-parameters in s2p format, go to the [CGH09120F Product Page](#) and click on the documentation tab.

## Product Dimensions CGH09120F (Package Type – 440095)



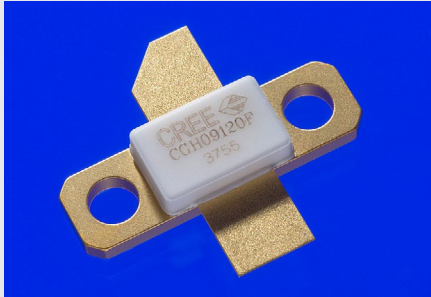
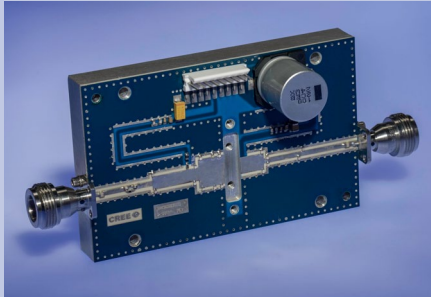
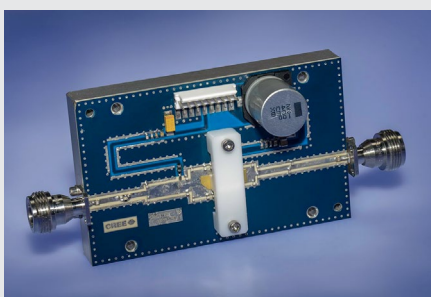
### NOTES:

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	0.145	0.165	3.68	4.19	
A1	0.077	0.087	1.96	2.21	
A2	0.055	0.065	1.40	1.65	
b	0.210	0.220	5.33	5.59	2x
c	0.004	0.006	0.10	0.15	
D	0.795	0.805	20.19	20.45	
D1	0.557	0.567	14.15	14.40	
D2	0.355	0.365	9.02	9.27	
D3	0.040	TYP	1.02	TYP	4x
E	0.670	0.730	17.02	18.54	
E1	0.225	0.235	5.72	5.97	
E2	0.040	TYP	1.02	TYP	4x
$\phi$	0.130	TYP	3.30	TYP	2x
$\alpha$	45° REF		45° REF		

- PIN 1. GATE  
 2. DRAIN  
 3. SOURCE

## Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH09120F	GaN HEMT	Each	
CGH09120F-TB	Test board without GaN HEMT	Each	
CGH09120F-AMP	Test board with GaN HEMT installed	Each	



## Disclaimer

Specifications are subject to change without notice. Cree, Inc. believes the information contained within this data sheet to be accurate and reliable. However, no responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Cree. Cree makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose. "Typical" parameters are the average values expected by Cree in large quantities and are provided for information purposes only. These values can and do vary in different applications and actual performance can vary over time. All operating parameters should be validated by customer's technical experts for each application. Cree products are not designed, intended or authorized for use as components in applications intended for surgical implant into the body or to support or sustain life, in applications in which the failure of the Cree product could result in personal injury or death or in applications for planning, construction, maintenance or direct operation of a nuclear facility.

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