CGH09120F

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

Description

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˚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	%

Notes:
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

RoHS COMPLIANT

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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	120	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[1]	I_{DMAX}	12	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	1.7	˚C/W	85˚C
Case Operating Temperature[3]	T_C	-40, +150	˚C	

Notes:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering at wolfspeed.com/RF/Document-Library
[3] Measured for the CGH09120F at P_{DISS} = 56 W

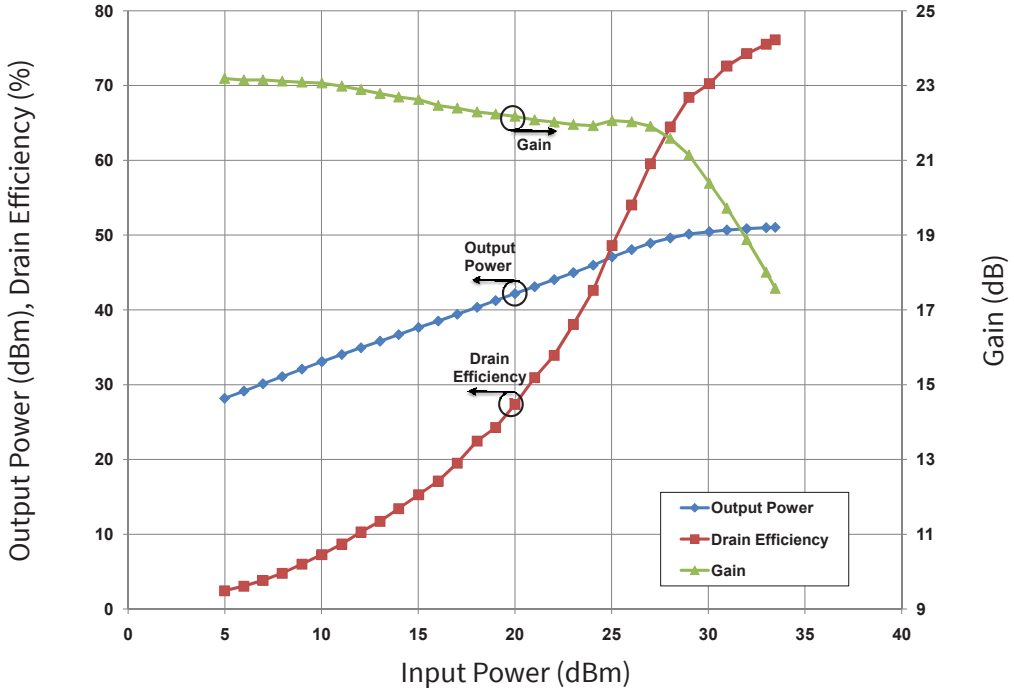
Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
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[2]	I_{DS}	23.2	28.0	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	84	–	–	V_{DC}	V_{GS} = -8 V, I_D = 28.8 mA
RF Characteristics[3] (T_C = 25˚C, F_0 = 2.5 GHz unless otherwise noted)						
Saturated Output Power[3,4]	P_{SAT}	–	120	–	W	V_{DD} = 28 V, I_{DQ} = 1.2 A
Pulsed Drain Efficiency[3]	η	–	75	–	%	V_{DD} = 28 V, I_{DQ} = 1.2 A, P_{OUT} = P_{SAT}
Modulated Gain[6]	G_{SS}	20	21.5	–	dB	V_{DD} = 28 V, I_{DQ} = 1.2 A, P_{OUT} = 43 dBm
WCDMA Linearity[6]	ACLR	–	-38	-34	dBc	V_{DD} = 28 V, I_{DQ} = 1.2 A, P_{OUT} = 43 dBm
Modulated Drain Efficiency[6]	η	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
Dynamic Characteristics						
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

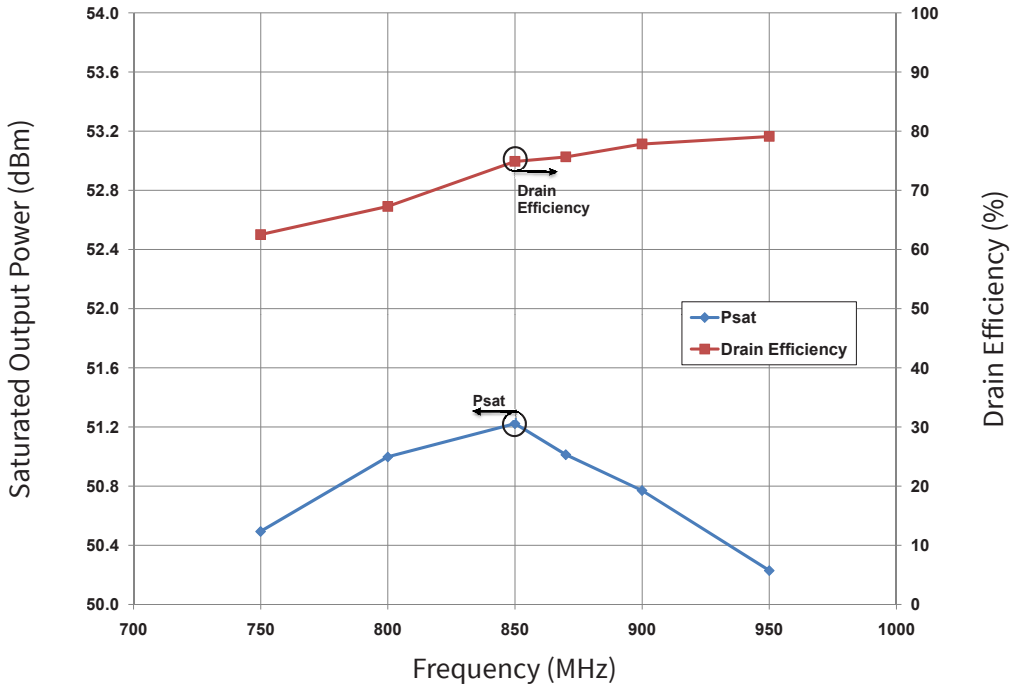
Notes:
[1] Measured on wafer prior to packaging
[2] Scaled from PCM data
[3] Pulse Width = 40 μS, Duty Cycle = 5%
[4] P_{SAT} is defined as I_G = 10 mA peak
[5] Measured in CGH09120F-AMP
[6] Single Carrier WCDMA, 3GPP Test Model 1, 64 DPCH, 67 % Clipping, PAR = 8.81 dB @ 0.01 % Probability on CCDF

Typical Pulse Performance

Typical Pulsed Output Power, Drain Efficiency, and Gain vs Input Power measured in CGH09120F-AMP Amplifier Circuit
V_{DS} = 28 V, I_{DS} = 1.2 A, Freq = 870 MHz, Pulse Width = 40 μS, Duty Cycle = 5%

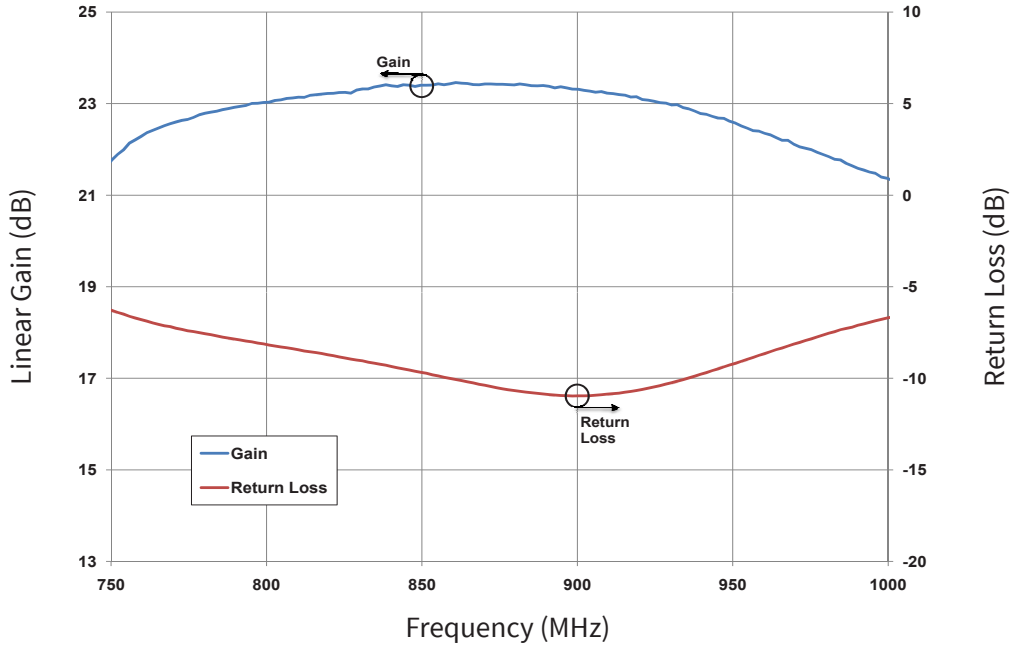


Typical Pulsed Saturated Power vs Frequency measured in CGH09120F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 1.2 A, P_{SAT} = 10 mA I_{GS} Peak, Pulse Width = 40 μS, Duty Cycle = 5 %



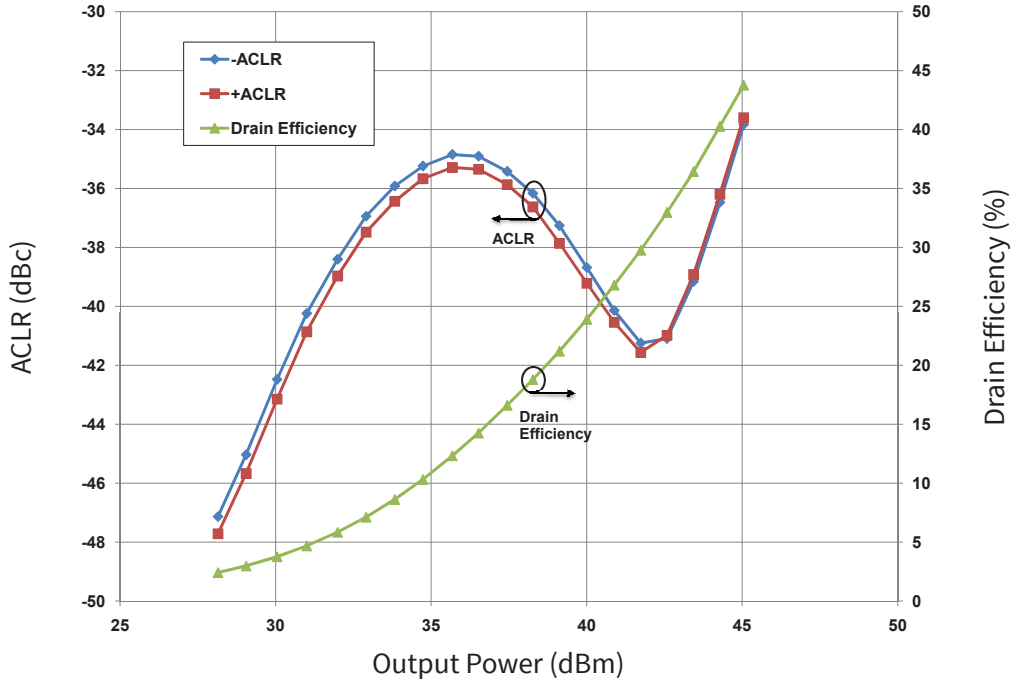
Typical Linear Performance

Typical Small Signal Gain and Return Loss vs Frequency measured in CGH09120F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 1.2 A



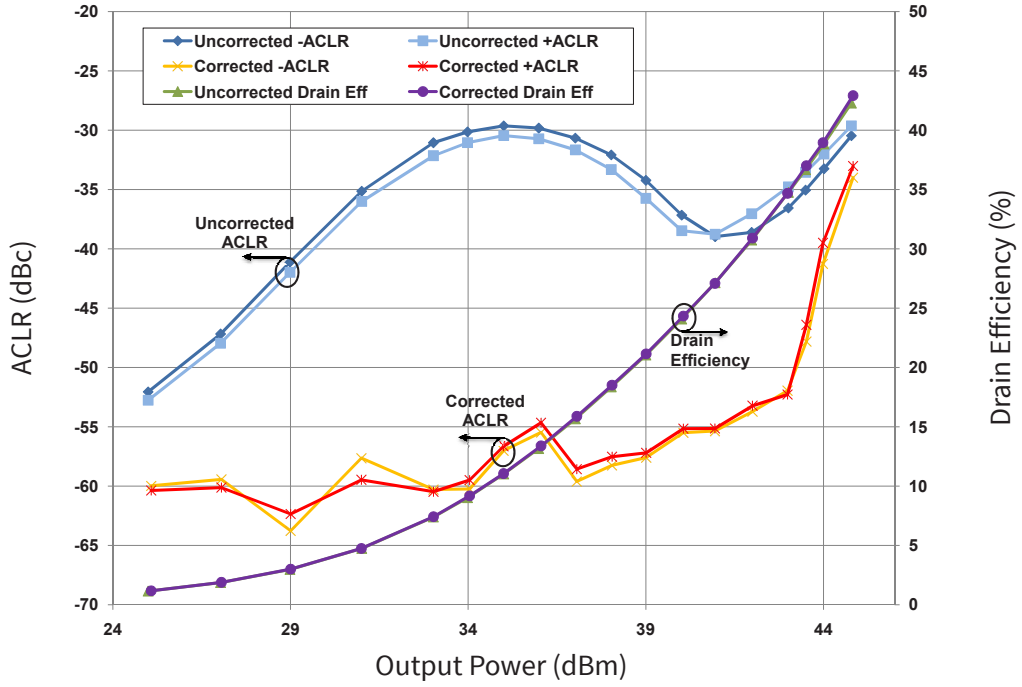
Typical WCDMA Performance

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 V, I_{DS} = 1.2 A, Frequency = 870 MHz

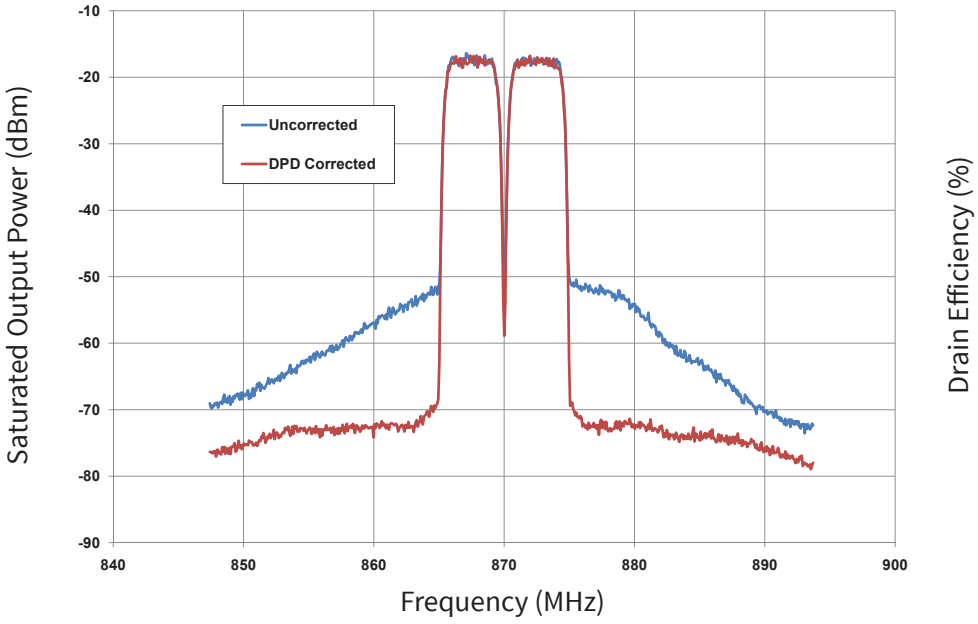


Typical WCDMA Digital Pre-Distortion (DPD) Performance

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 V, I_{DS} = 1.2 A, Frequency = 870 MHz

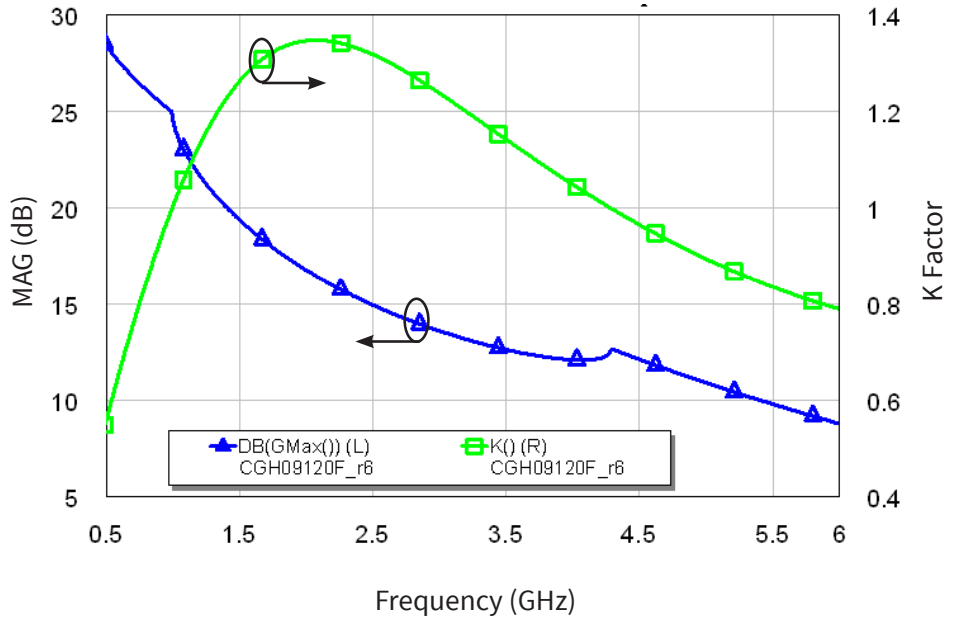


WCDMA Linearity with DPD Linearizer
measured in CGH09120F-AMP Amplifier Circuit.
Two Channel WCDMA 7.5dB PAR with CFR
V_{DS} = 28 V, I_{DS} = 1.2 A, P_{OUT} = 43 dBm, Efficiency = 35%



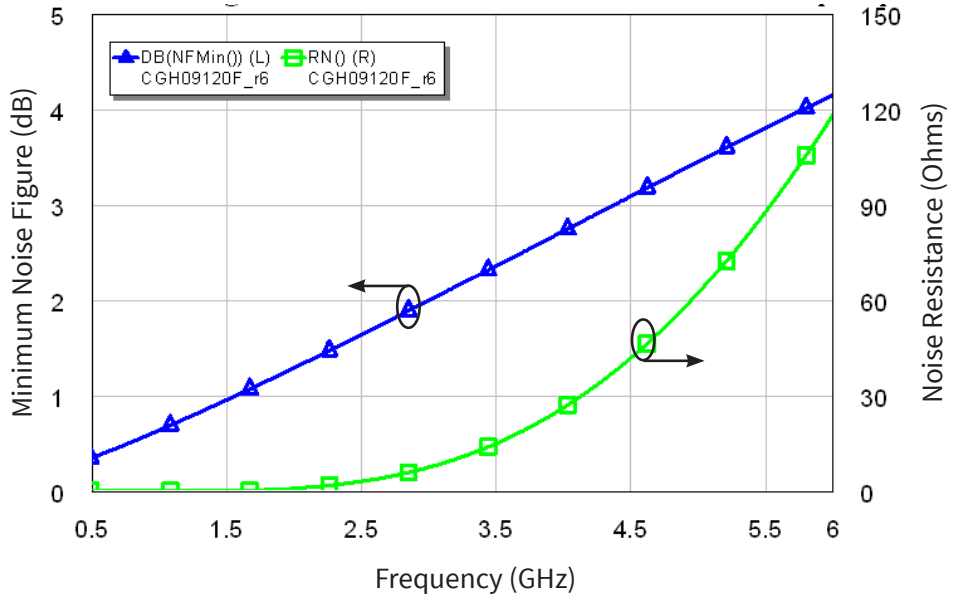
Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH09120F
V_{DD} = 28 V, I_{DQ} = 1.2 A



Typical Noise Performance

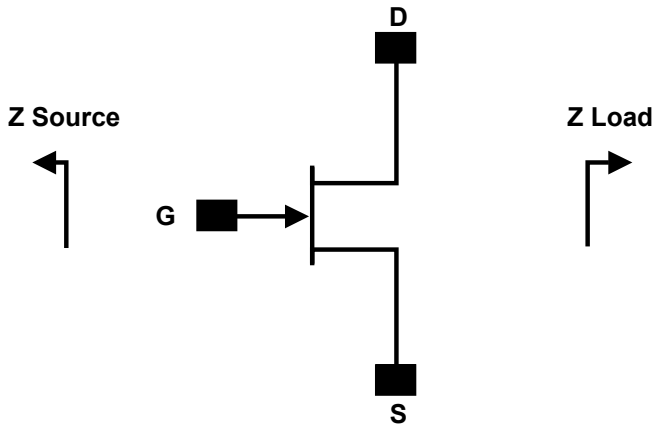
Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH09120F
V_{DD} = 28 V, I_{DQ} = 1.2 A



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

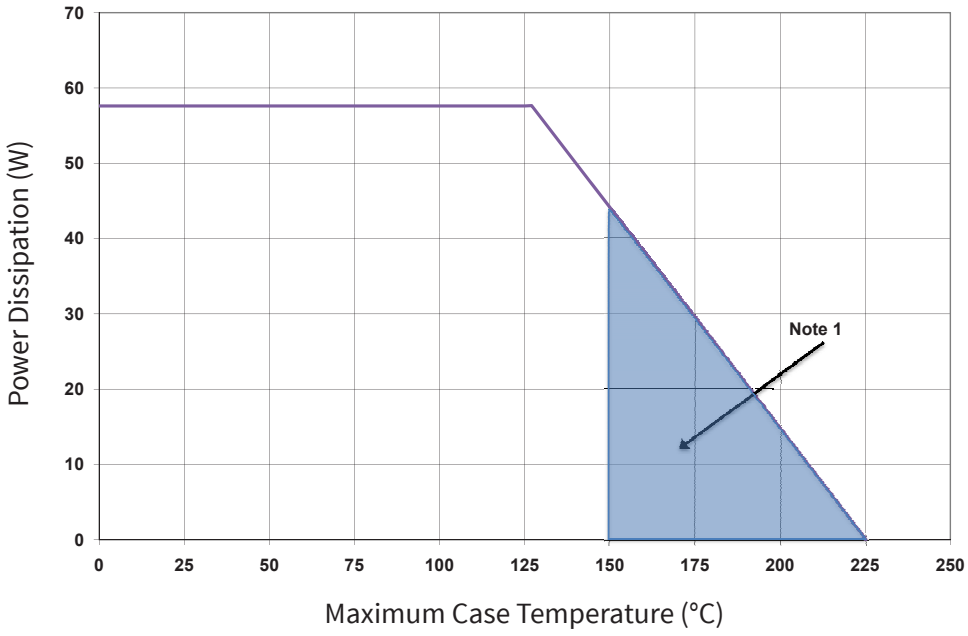
Simulated Source and Load Impedances



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 1. V_{DD} = 28V, I_{DQ} = 1.2 A in the 440095 package
Note 2. 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

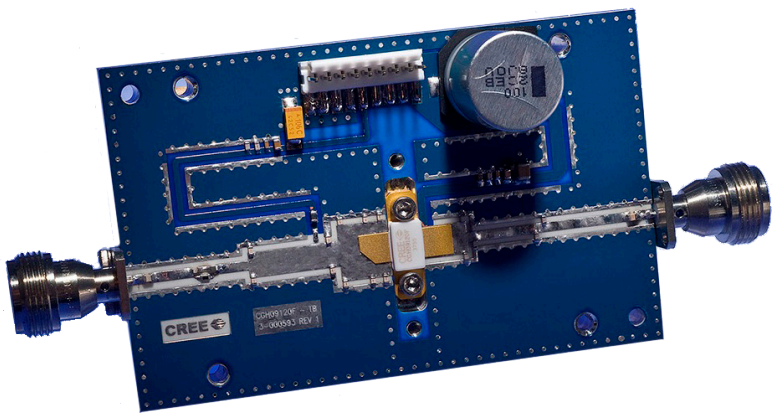


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

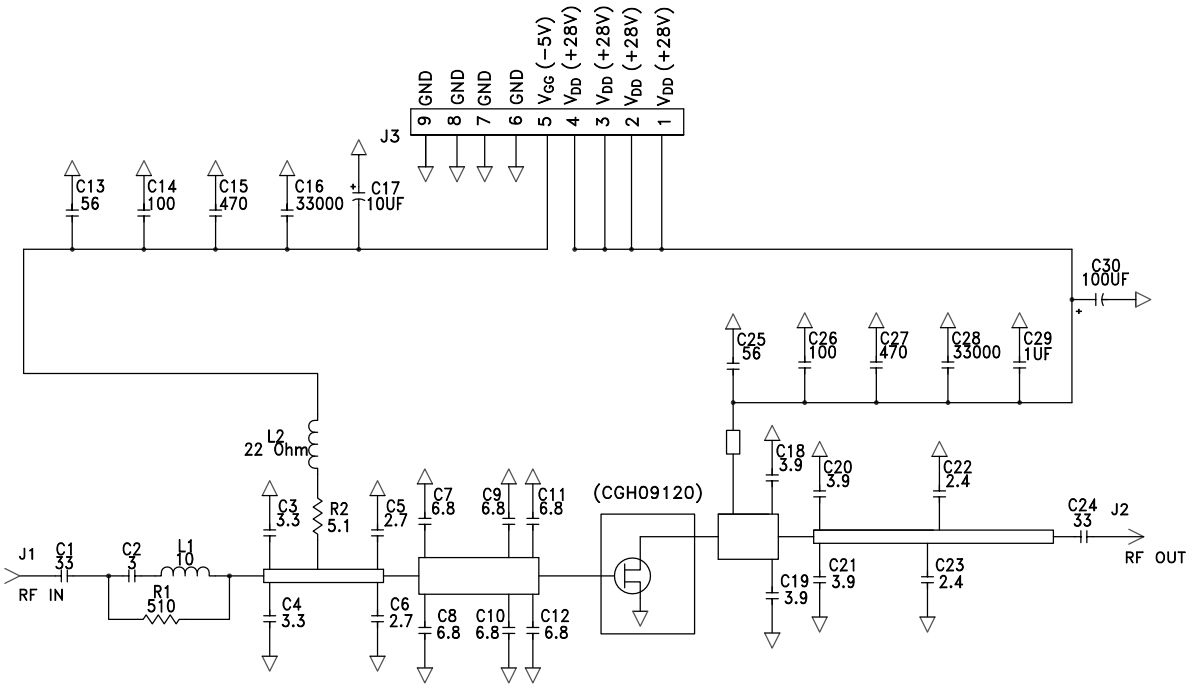
CGH09120F-AMP Demonstration Amplifier Circuit Bill of Materials

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

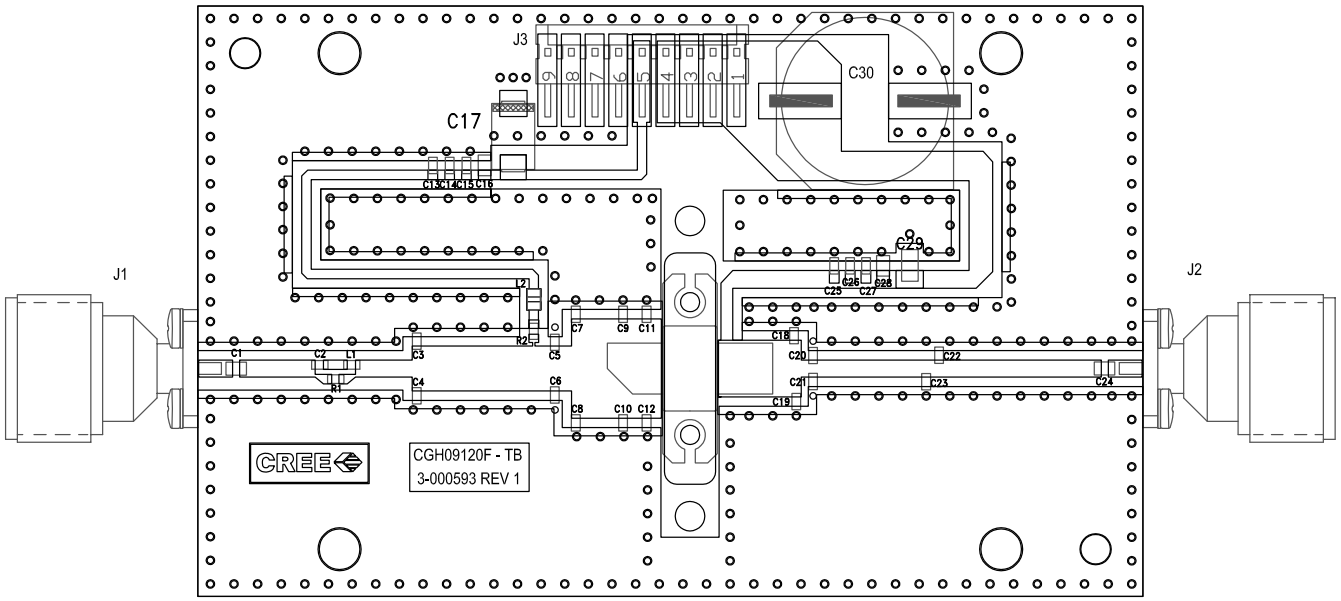
CGH09120F-AMP Demonstration Amplifier Circuit



CGH09120F-AMP Demonstration Amplifier Circuit Schematic



CGH09120F-AMP Demonstration Amplifier Circuit Outline

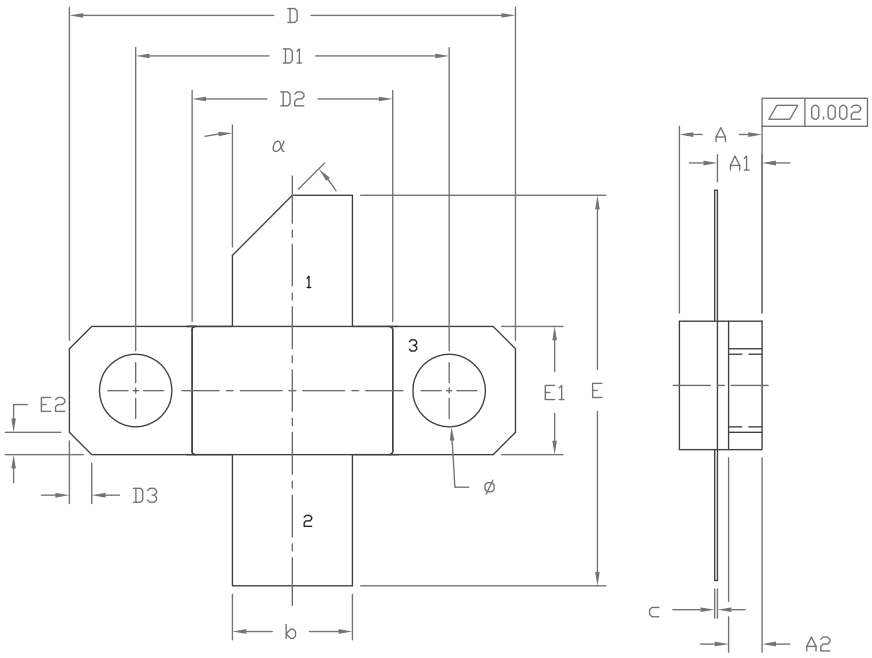


Typical Package S-Parameters for CGH09120F (Small Signal, V_{DS} = 28 V, I_{DQ} = 1.2 A, angle in degrees)

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)



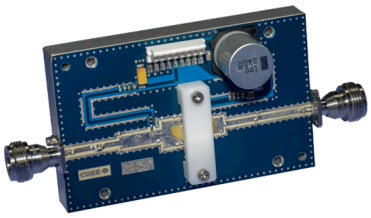
NOTES:

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.

	INCHES		MILLIMETERS		NOTES
DIM	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
ø	0.130 TYP		3.30 TYP		2x
α	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-AMP	Test board with GaN HEMT installed	Each	

For more information, please contact:

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RFSales@cree.com

Notes

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