PRELIMINARY

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°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-TB amplifier circuit, under WCDMA 3GPP test model 1, 64 DPCH, 67% clipping, PAR = 8.81 dB @ 0.01 % Probability on CCDF.

Features

RoHS COMPLIANT

- 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 SiC & GaN

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

Parameter	Symbol	Rating	Units
Drain-Source Voltage	V_{DSS}	84	Volts
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts
Power Dissipation	P_{DISS}	56	Watts
Storage Temperature	T_{STG}	-55, +150	˚C
Operating Junction Temperature	T_J	225	˚C
Maximum Forward Gate Current	I_{GMAX}	30	mA
Soldering Temperature[1]	T_S	245	˚C
Screw Torque	τ	80	in-oz
Thermal Resistance, Junction to Case[2]	$R_{\theta JC}$	1.7	˚C/W
Case Operating Temperature[2]	T_C	-40, +105	˚C

Note:
[1] Refer to the Application Note on soldering at www.cree.com/products/wireless_appnotes.asp
[2] 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	-3.3	-2.3	VDC	V_{DS} = 10 V, I_D = 28.8 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-3.0	–	VDC	V_{DS} = 28 V, I_D = 1.0 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	100	–	VDC	V_{GS} = -8 V, I_D = 28.8 mA
RF Characteristics[5] (T_C = 25˚C, F_0 = 870 MHz unless otherwise noted)						
Saturated Output Power[3,4]	P_{SAT}	–	120	–	W	V_{DD} = 28 V, I_{DQ} = 1.0 A,
Pulsed Drain Efficiency[3]	η	–	75	–	%	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = P_{SAT}
Modulated Gain[6]	G_{SS}	–	21	–	dB	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 43 dBm
WCDMA Linearity[6]	ACLR	–	-38	–	dBc	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 43 dBm
Modulated Drain Efficiency[6]	η	–	35	–	%	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 43 dBm
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	33	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	10	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	3.0	–	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-TB.
[6] Single Carrier WCDMA, 3GPP Test Model 1, 64 DPCH, 67 % Clipping, PAR = 8.81 dB @ 0.01 % Probability on CCDF.

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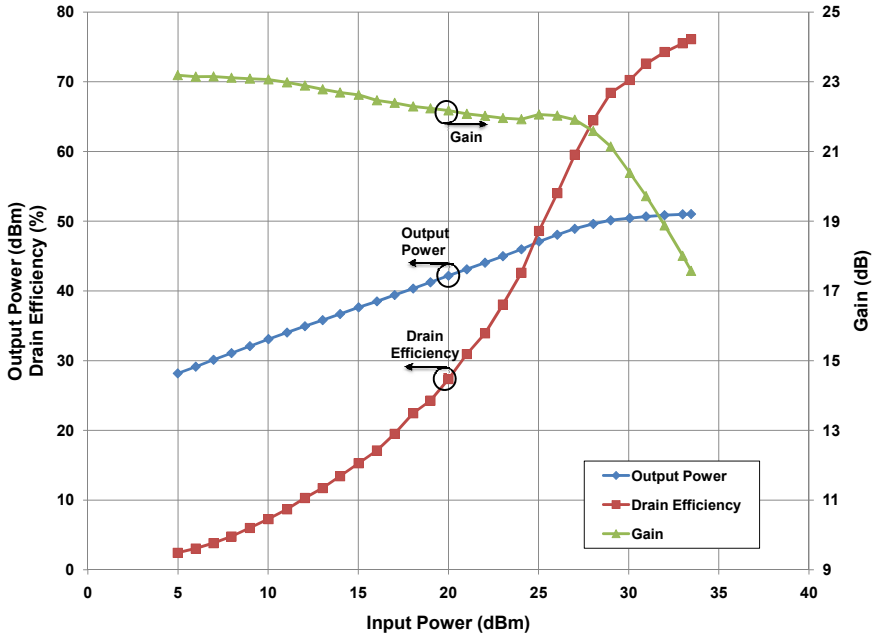
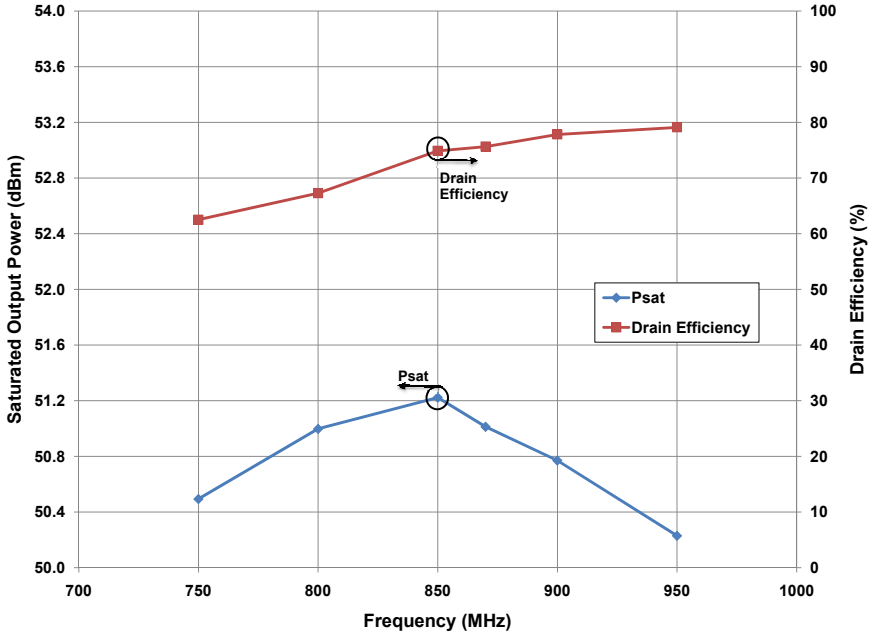
Typical Pulse Performance

Typical Pulsed Output Power, Drain Efficiency, and Gain vs Input Power of the CGH09120F measured in CGH09120F-TB Amplifier Circuit. V_{DS} = 28 V, I_{DS} = 1.0 A, Freq = 870 MHz, Pulse Width = 40 µS, Duty Cycle = 5 %



Typical Pulsed Saturated Power vs Frequency of the CGH09120F measured in CGH09120F-TB Amplifier Circuit. V_{DS} = 28 V, I_{DS} = 1.0 A, P_{SAT} = 10 mA I_{GS} Peak, Pulse Width = 40 µS, Duty Cycle = 5 %



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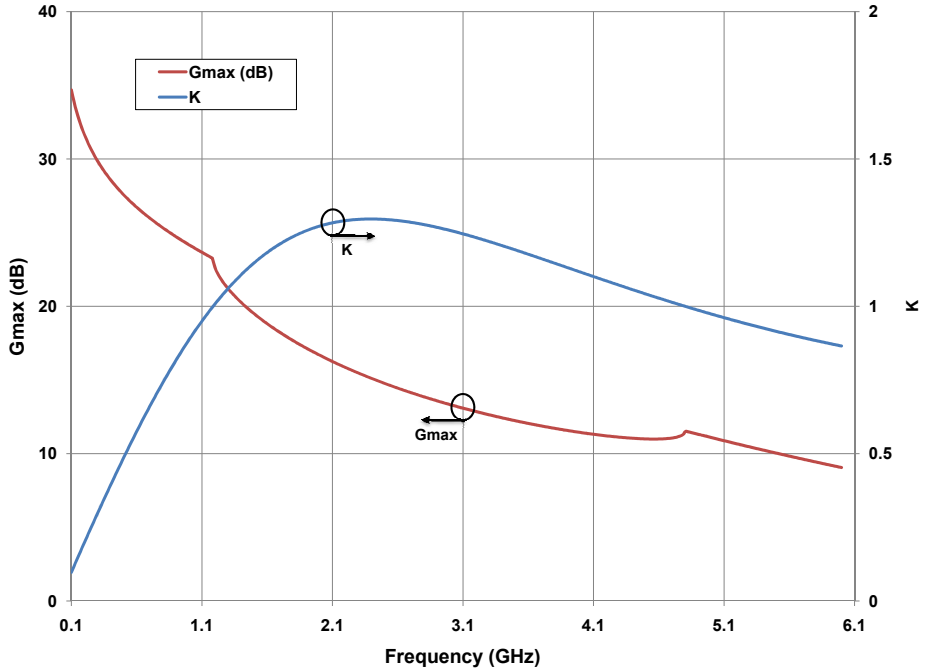
Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH09120F
V_{DD} = 28 V, I_{DQ} = 1.0 A



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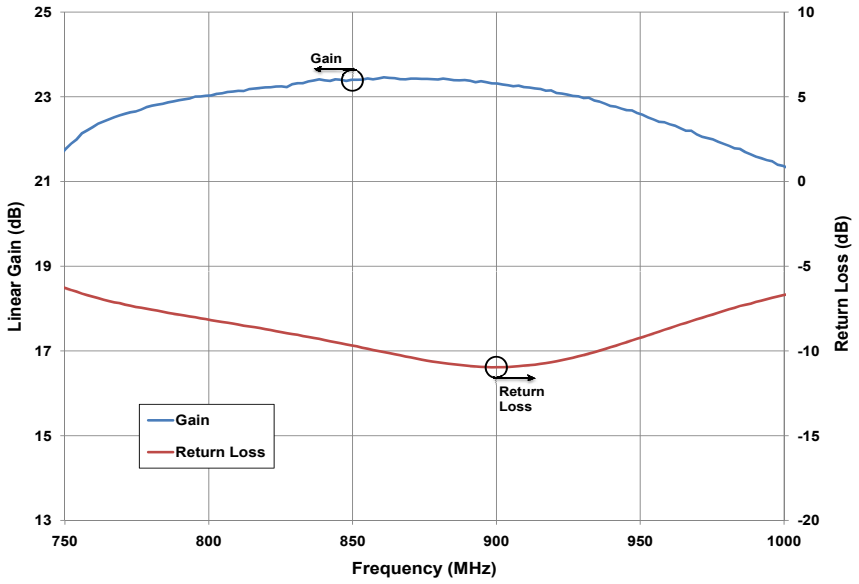
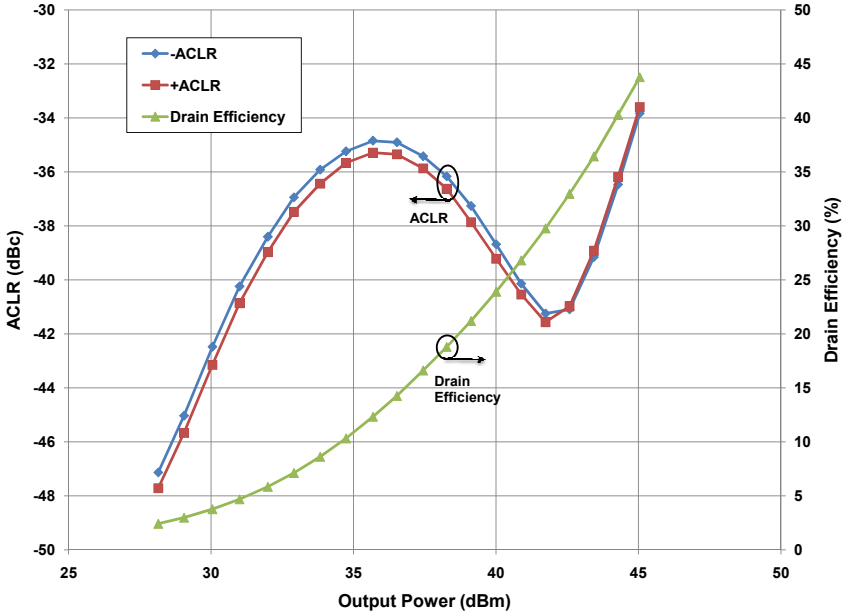
Typical Linear Performance

Typical Small Signal Gain and Return Loss vs Frequency of the CGH09120F measured in CGH09120F-TB Amplifier Circuit. V_{DS} = 28 V, I_{DS} = 1.0 A



Typical WCDMA Performance

Typical WCDMA Characteristics ACLR and Drain Efficiency vs Output Power of the CGH09120F measured in CGH09120F-TB Amplifier Circuit. 3GPP Test Model 1, 64 DPCH 67 % Clipping, 8.81 dB PAR @ 0.01 % V_{DS} = 28 V, I_{DS} = 1.0 A, Frequency = 870 MHz



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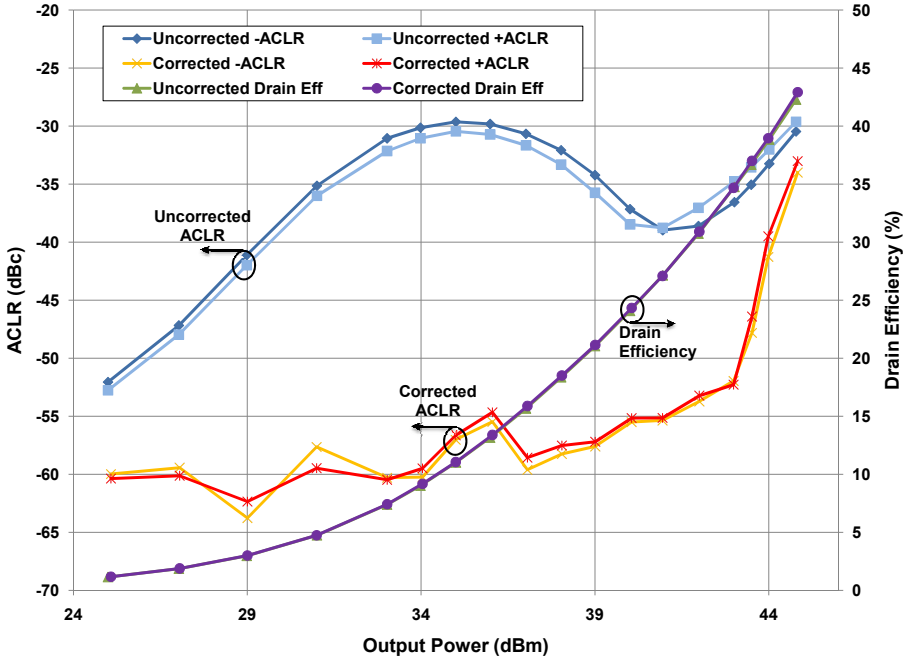
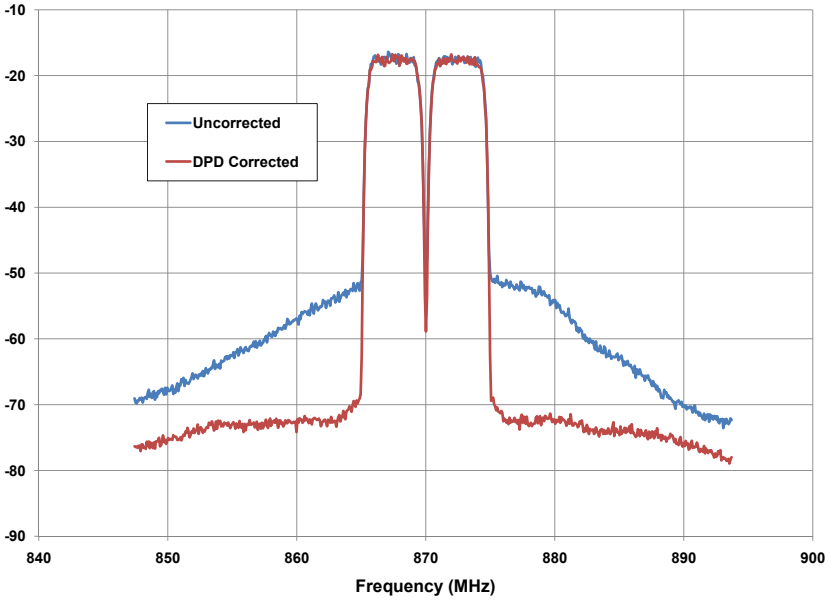
Typical WCDMA Digital Pre-Distortion (DPD) Performance

WCDMA Characteristics with and without DPD Correction
ACLR and Drain Efficiency vs Output Power
of the CGH09120F measured in CGH09120F-TB Amplifier Circuit.
Two Channel WCDMA 7.5dB PAR with CFR
V_{DS} = 28 V, I_{DS} = 1.0 A, Frequency = 870 MHz



WCDMA Linearity with DPD Linearizer
of the CGH09120F measured in CGH09120F-TB Amplifier Circuit.
Two Channel WCDMA 7.5dB PAR with CFR
V_{DS} = 28 V, I_{DS} = 1.0 A, P_{OUT} = 43 dBm, Efficiency = 35 %



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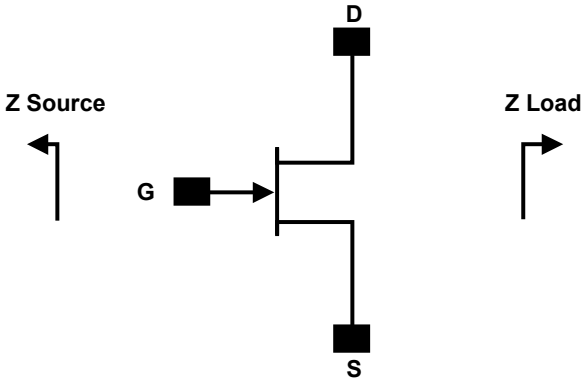
Source and Load Impedances



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} = 1.0 A in the 440095 package.
Note[2] Impedances are extracted from CGH09120F-TB demonstration circuit and are not source and load pull data derived from transistor.

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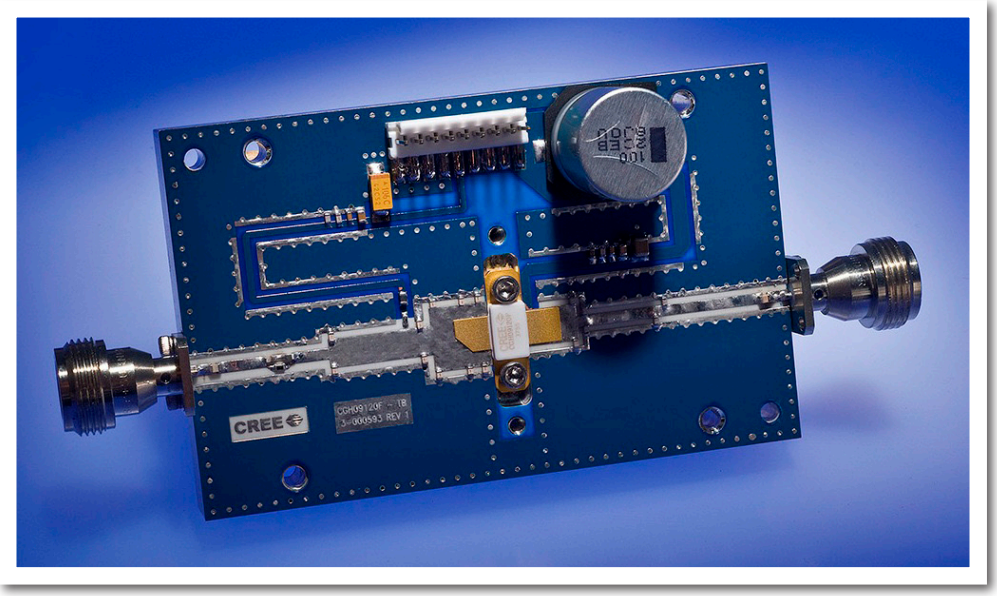
CGH09120F-TB Demonstration Amplifier Circuit Bill of Materials

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	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-TB Demonstration Amplifier Circuit



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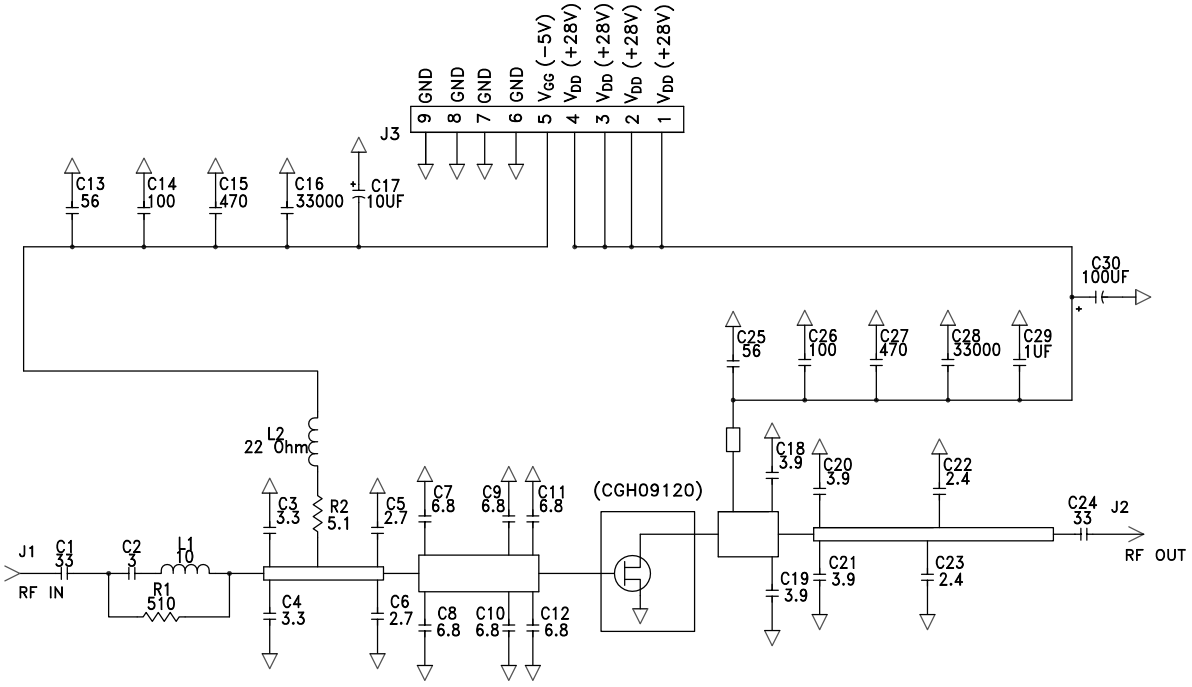
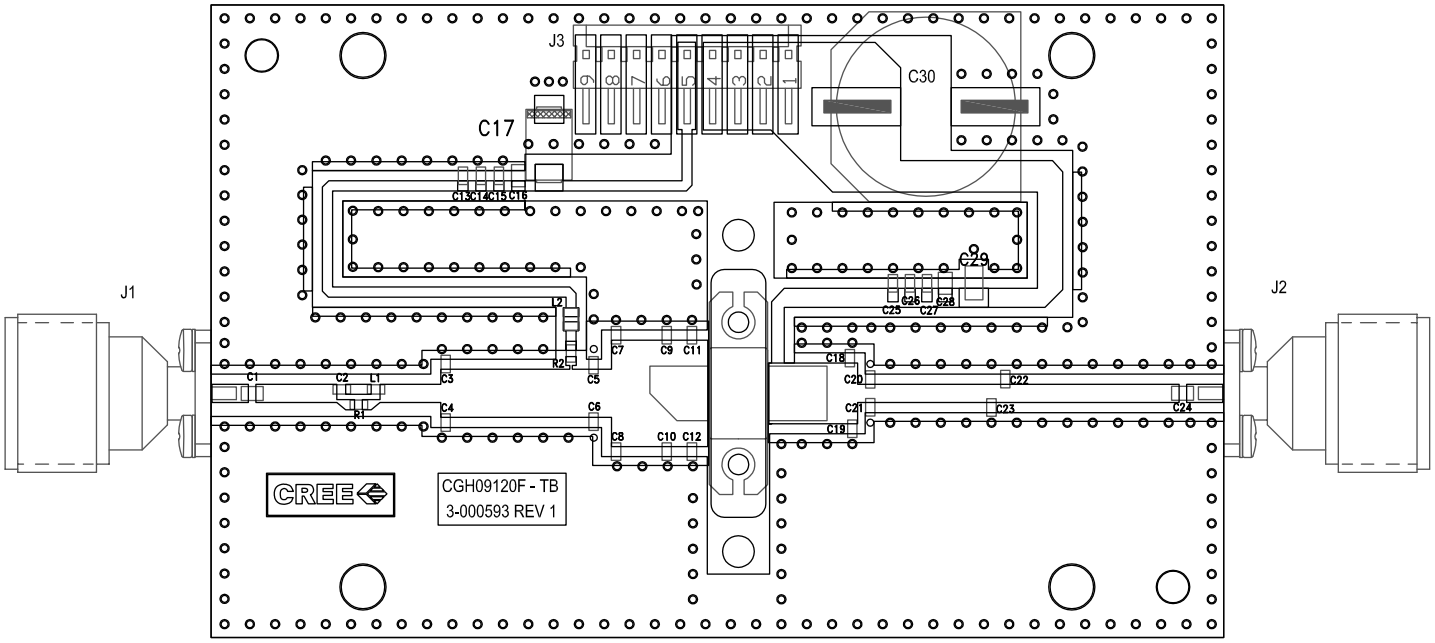
CGH09120F-TB Demonstration Amplifier Circuit Schematic



CGH09120F-TB Demonstration Amplifier Circuit Outline



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Typical Package S-Parameters for CGH09120F
(Small Signal, V_{DS} = 28 V, I_{DQ} = 1.0 A, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.9597	-179.25	3.86	80.29	0.0069	11.86	0.841	179.79
600 MHz	0.9599	179.78	3.22	77.99	0.0070	13.83	0.842	179.39
700 MHz	0.9600	178.96	2.76	75.78	0.0071	15.85	0.842	179.03
800 MHz	0.9601	178.22	2.42	73.61	0.0073	17.89	0.843	178.69
900 MHz	0.9601	177.54	2.15	71.49	0.0074	19.91	0.844	178.36
1.0 GHz	0.9600	176.90	1.94	69.41	0.0076	21.92	0.845	178.03
1.1 GHz	0.9600	176.28	1.77	67.35	0.0077	23.89	0.846	177.71
1.2 GHz	0.9598	175.68	1.62	65.31	0.0079	25.81	0.846	177.38
1.3 GHz	0.9597	175.10	1.50	63.30	0.0082	27.68	0.847	177.06
1.4 GHz	0.9595	174.52	1.40	61.31	0.0084	29.49	0.848	176.72
1.5 GHz	0.9593	173.95	1.31	59.35	0.0087	31.23	0.849	176.38
1.6 GHz	0.9591	173.37	1.23	57.40	0.0090	32.89	0.850	176.02
1.7 GHz	0.9589	172.81	1.16	55.48	0.0093	34.47	0.851	175.67
1.8 GHz	0.9586	172.23	1.10	53.57	0.0097	35.97	0.852	175.30
1.9 GHz	0.9582	171.65	1.05	51.68	0.0101	37.37	0.852	174.92
2.0 GHz	0.9579	171.07	1.00	49.81	0.0105	38.69	0.853	174.53
2.1 GHz	0.9575	170.47	0.96	47.95	0.0109	39.91	0.854	174.13
2.2 GHz	0.9570	169.87	0.92	46.12	0.0114	41.03	0.854	173.71
2.3 GHz	0.9565	169.26	0.88	44.30	0.0119	42.06	0.855	173.29
2.4 GHz	0.9559	168.64	0.85	42.49	0.0125	42.99	0.855	172.85
2.5 GHz	0.9553	168.01	0.83	40.70	0.0131	43.84	0.856	172.40
2.6 GHz	0.9546	167.36	0.80	38.92	0.0137	44.58	0.856	171.93
2.7 GHz	0.9539	166.70	0.78	37.16	0.0144	45.24	0.856	171.45
2.8 GHz	0.9531	166.03	0.76	35.40	0.0151	45.80	0.856	170.96
2.9 GHz	0.9522	165.33	0.74	33.65	0.0159	46.27	0.856	170.45
3.0 GHz	0.9513	164.63	0.72	31.92	0.0167	46.66	0.856	169.93
3.2 GHz	0.9491	163.15	0.70	28.46	0.0185	47.19	0.856	168.83
3.4 GHz	0.9465	161.57	0.67	25.01	0.0206	47.38	0.854	167.66
3.6 GHz	0.9435	159.89	0.66	21.55	0.0230	47.25	0.853	166.41
3.8 GHz	0.9399	158.10	0.65	18.07	0.0257	46.81	0.850	165.09
4.0 GHz	0.9357	156.15	0.64	14.54	0.0288	46.06	0.847	163.66
4.2 GHz	0.9306	154.04	0.64	10.94	0.0324	44.99	0.842	162.14
4.4 GHz	0.9246	151.74	0.64	7.24	0.0365	43.59	0.837	160.49
4.6 GHz	0.9175	149.22	0.65	3.40	0.0413	41.85	0.830	158.73
4.8 GHz	0.9090	146.42	0.66	-0.62	0.0469	39.74	0.822	156.80
5.0 GHz	0.8986	143.31	0.68	-4.86	0.0535	37.23	0.811	154.73
5.2 GHz	0.8862	139.83	0.70	-9.38	0.0612	34.27	0.799	152.46
5.4 GHz	0.8710	135.91	0.73	-14.24	0.0704	30.82	0.785	150.01
5.6 GHz	0.8527	131.45	0.77	-19.52	0.0812	26.80	0.768	147.32
5.8 GHz	0.8302	126.36	0.81	-25.31	0.0941	22.14	0.748	144.39
6.0 GHz	0.8030	120.50	0.86	-31.69	0.1094	16.75	0.724	141.20

Download this s-parameter file in ".s2p" format at http://www.cree.com/products/wireless_s-parameters.asp

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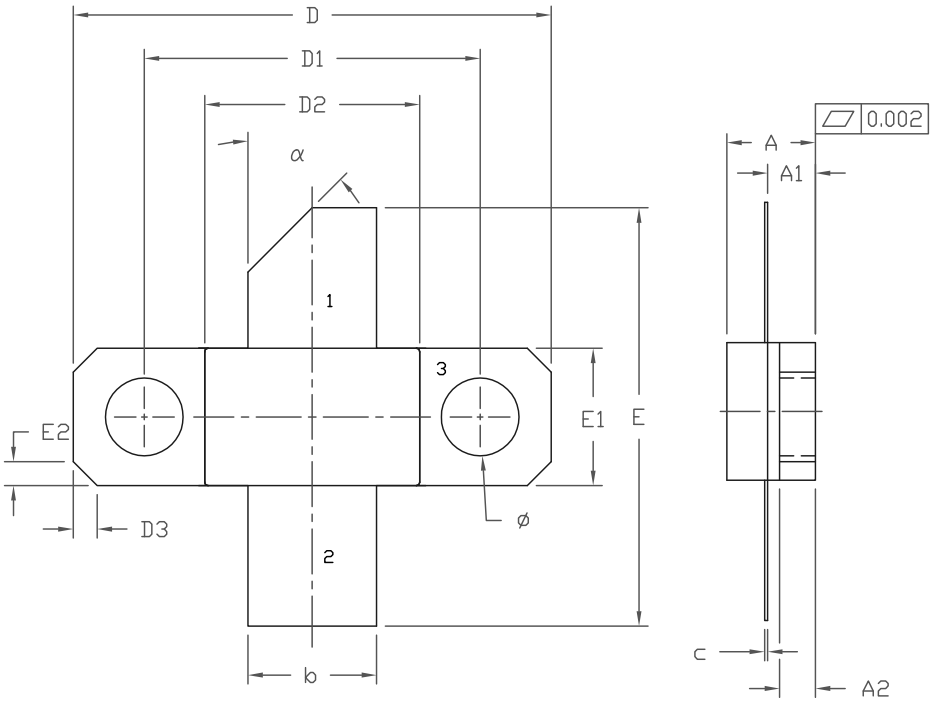
Product Dimensions CGH09120F (Package Type — 440095)



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

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