CGH21120F

120 W, 1800-2300 MHz, GaN HEMT for WCDMA, LTE, WiMAX

Cree's CGH21120F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH21120F ideal for 1.8-2.3 GHz WCDMA and LTE amplifier applications. The transistor is supplied in a ceramic/metal flange package.

Package Type: 440162
PN: CGH21120F

Typical Performance Over 2.0-2.3GHz (T_c = 25˚C) of Demonstration Amplifier

Parameter	2.0 GHz	2.1 GHz	2.2 GHz	2.3 GHz	Units
Gain @ 43 dBm	14.0	15.0	15.0	14.5	dB
ACLR @ 43 dBm	-36.5	-36.0	-34.0	-33.5	dBc
Drain Efficiency @ 43 dBm	33.5	34.5	36.5	40.0	%

Note:
Measured in the CGH21120F-AMP amplifier circuit, under WCDMA 3GPP test model 1, 64 DPCH, 67% clipping, PAR = 8.81 dB @ 0.01 % Probability on CCDF.

Features

RoHS COMPLIANT

- 1.8 - 2.3 GHz Operation
- 15 dB Gain
- -35 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

Rev 3.1 – June 2015

CREE

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[1]	I_{DMAX}	12	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	80	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	1.5	˚C/W	85˚C
Case Operating Temperature[3]	T_C	-40, +150	˚C	

Note:
[1] Current limit for long term, reliable operation.
[2] Refer to the Application Note on soldering at www.cree.com/RF/Document-Library
[3] Measured for the CGH21120F 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 = 0.5 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}	120	–	–	V_{DC}	V_{GS} = -8 V, I_D = 28.8 mA
RF Characteristics (T_C = 25˚C, F_0 = 2.15 GHz unless otherwise noted)						
Saturated Output Power[3,4,5]	P_{SAT}	–	110	–	W	V_{DD} = 28 V, I_{DQ} = 0.5 A,
Pulsed Drain Efficiency[3,5]	η	–	70	–	%	V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = P_{SAT}
Modulated Gain[6]	G_{SS}	13.5	15	–	dB	V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = 43 dBm
WCDMA Linearity[6]	ACLR	–	-35	-30	dBc	V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = 43 dBm
Modulated Drain Efficiency[6]	η	29	35	–	%	V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = 43 dBm
Output Mismatch Stress	VSWR	–	–	10 : 1	Y	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = 20 W CW
Dynamic Characteristics						
Input Capacitance[7]	C_{GS}	–	66	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance[7]	C_{DS}	–	12	–	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 CGH21120F-AMP.
[6] Single Carrier WCDMA, 3GPP Test Model 1, 64 DPCH, 67 % Clipping, PAR = 8.81 dB @ 0.01 % Probability on CCDF.
[7] Includes package and internal matching components.

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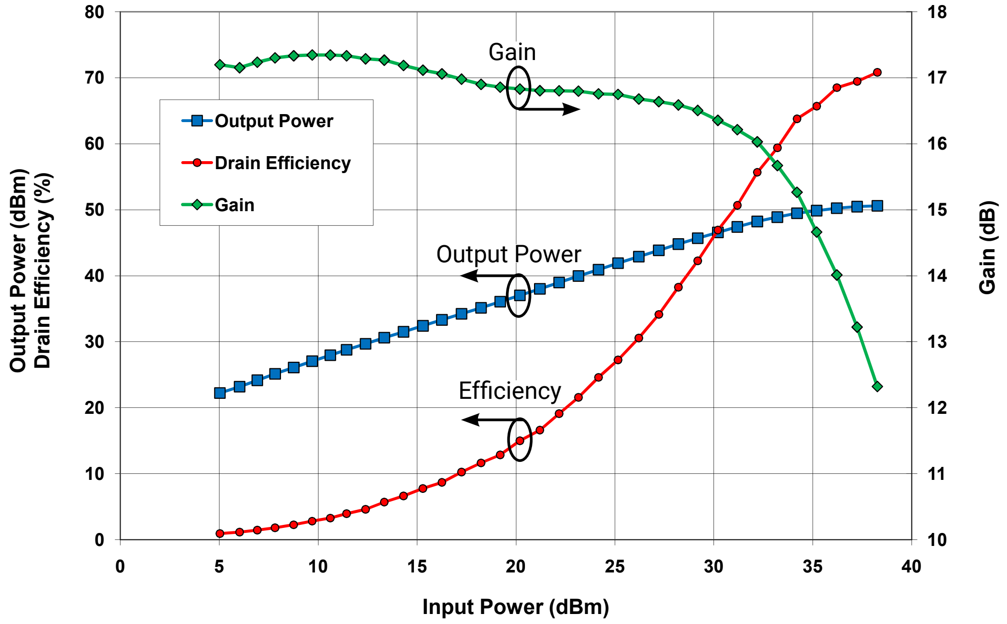
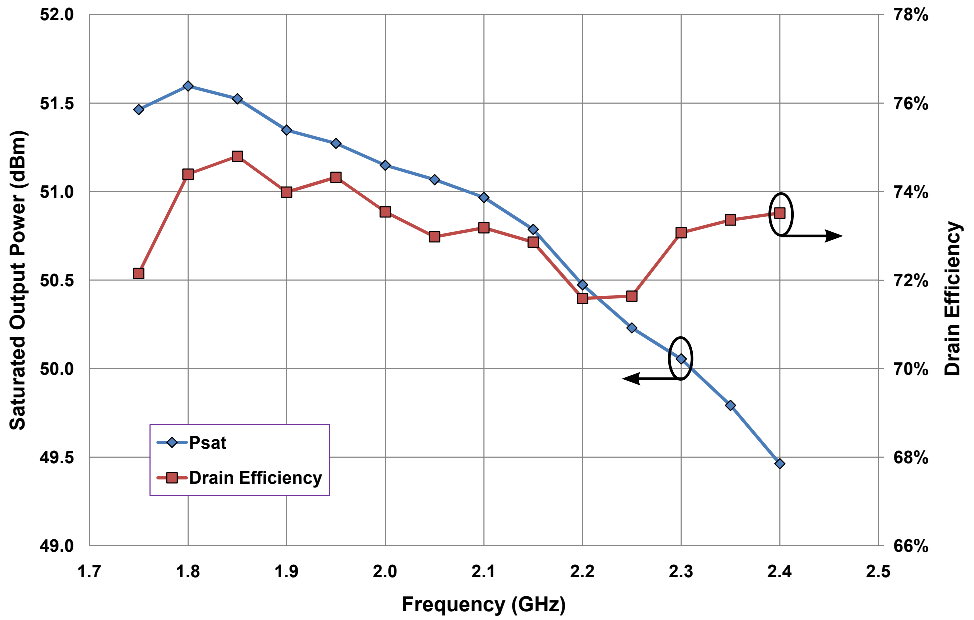
Typical Pulse Performance

Typical Pulse Characteristics Output Power, Drain Efficiency, and Gain vs Input Power measured in CGH21120F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 0.5 A, Freq = 2.15 GHz, Pulse Width = 40 µS, Duty Cycle = 5 %



Typical Pulsed Saturated Power vs Frequency measured in CGH21120F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 0.5 A, P_{SAT} = 10 mA I_{GS} Peak, Pulse Width = 40 µS, Duty Cycle = 5 %



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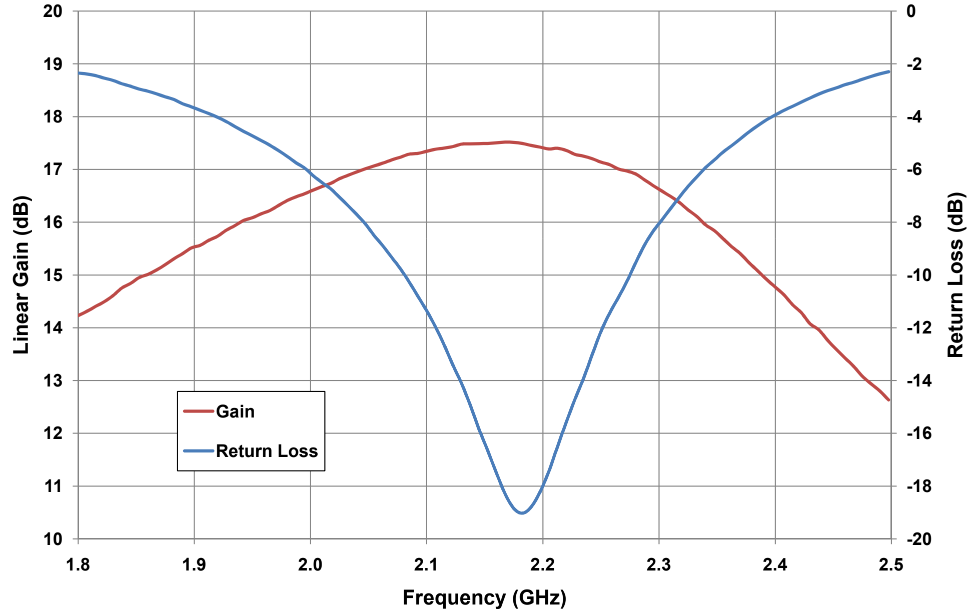
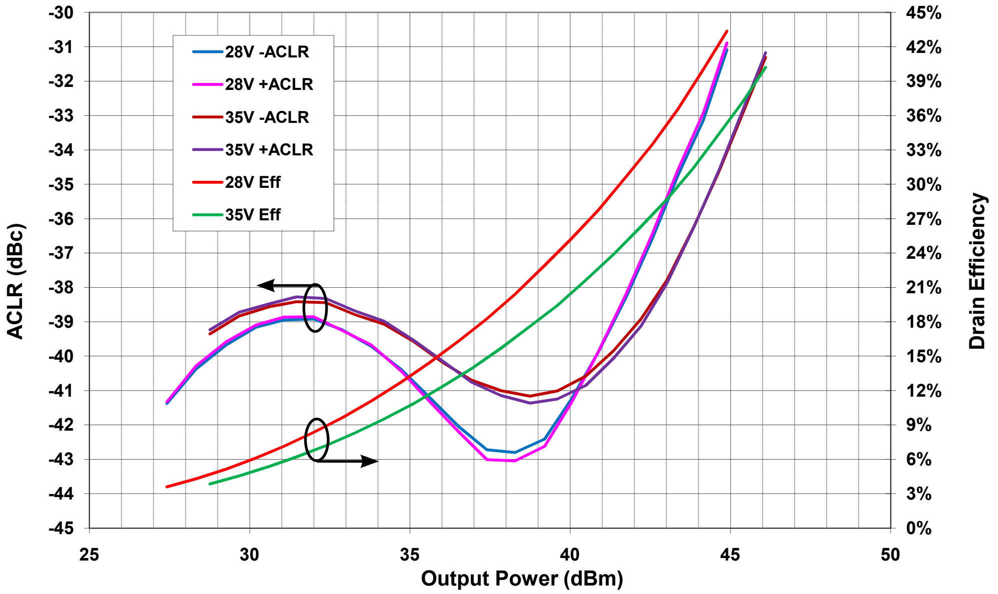
Typical Linear Performance

Typical Small Signal Gain and Return Loss vs Frequency measured in CGH21120F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 0.5 A



Typical WCDMA Performance

Typical WCDMA Characteristics ACLR and Drain Efficiency vs Output Power measured in CGH21120F-AMP Amplifier Circuit.
3GPP Test Model 1, 64 DPCH 67 % Clipping, 8.81 dB PAR @ 0.01 %
V_{DS} = 28 V and 35 V, I_{DS} = 0.5 A, Frequency = 2.15 GHz



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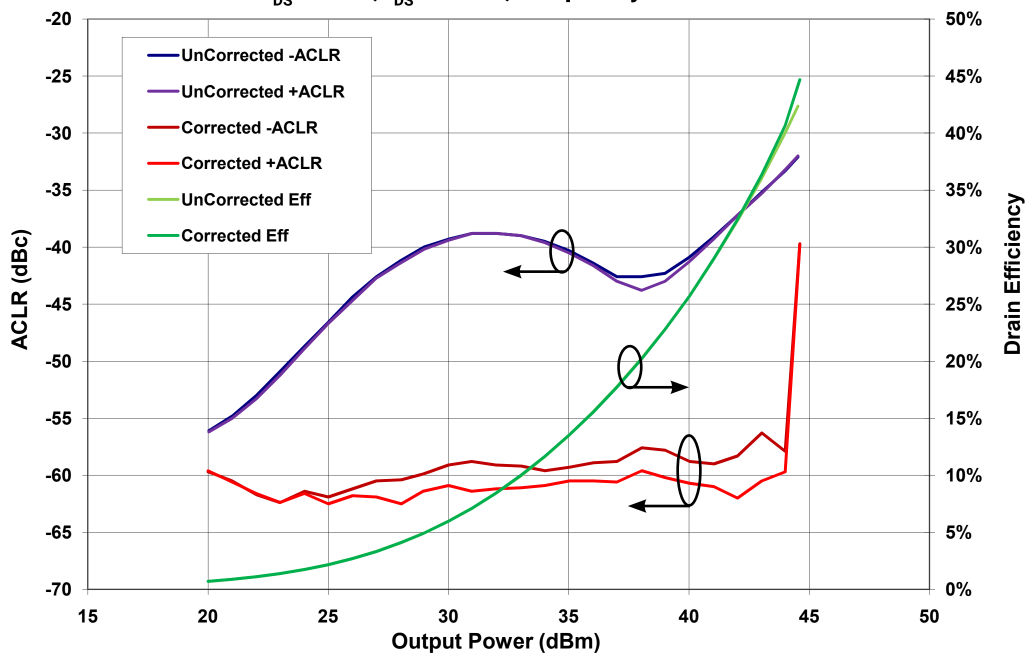
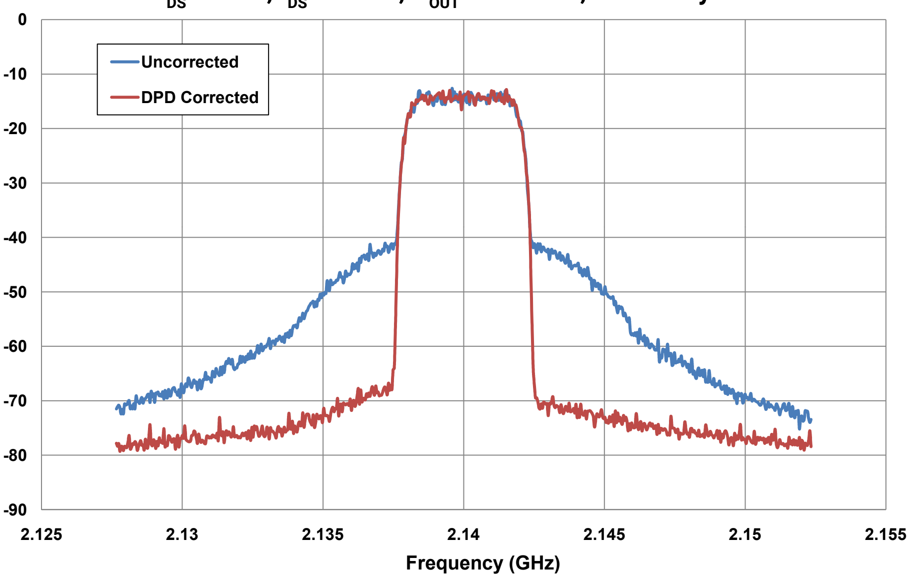
Typical WCDMA Digital Pre-Distortion (DPD) Performance

WCDMA Characteristics with and without DPD Correction
ACLR and Drain Efficiency vs Output Power
measured in CGH21120F-AMP Amplifier Circuit.
Single Channel WCDMA 6.5dB PAR with CFR
V_{DS} = 28 V, I_{DS} = 0.5 A, Frequency = 2.14 GHz



WCDMA Linearity with DPD Linearizer
measured in CGH21120F-AMP Amplifier Circuit.
Single Channel WCDMA 6.5dB PAR with CFR
V_{DS} = 28 V, I_{DS} = 0.5 A, P_{OUT} = 44 dBm, Efficiency = 40 %



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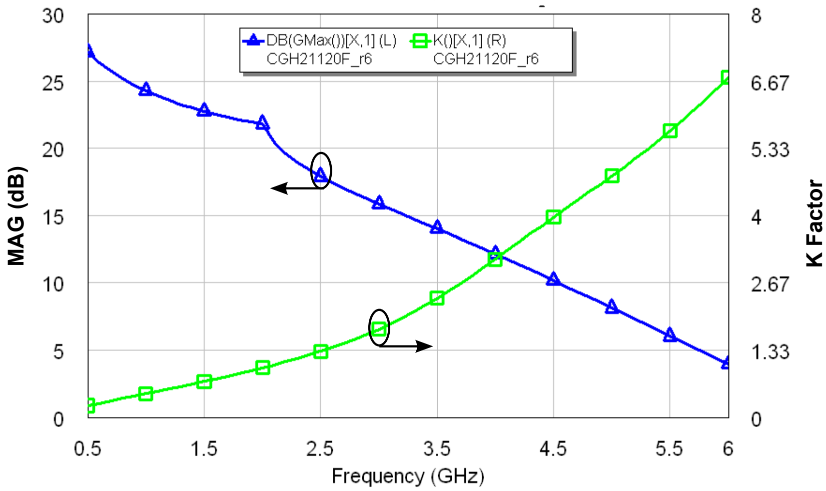
Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH21120F

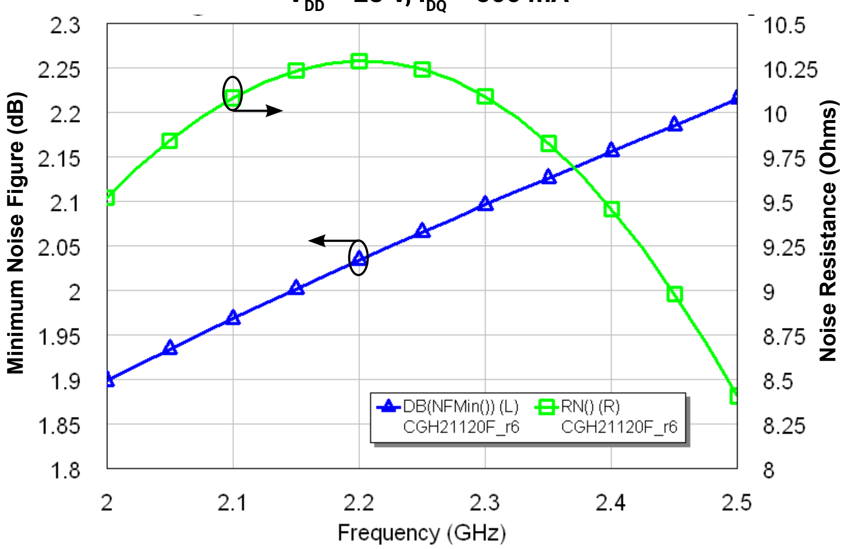
V_{DD} = 28 V, I_{DQ} = 500 mA



Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH21120F

V_{DD} = 28 V, I_{DQ} = 500 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

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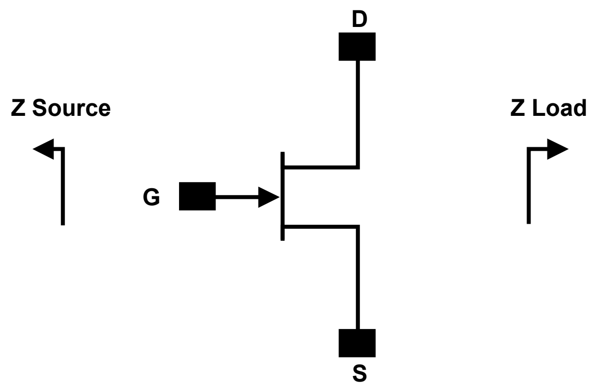
Source and Load Impedances

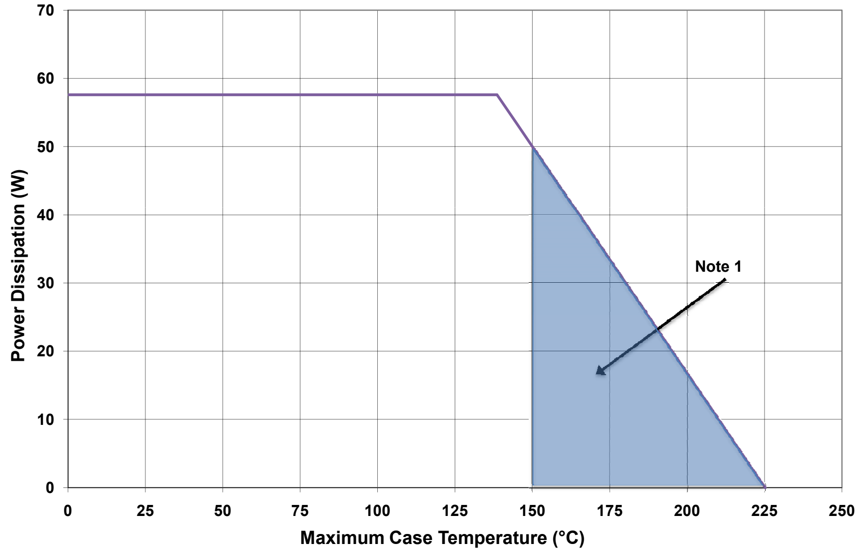


Frequency (MHz)	Z Source	Z Load
2000	18.17 - j15.4	3.43 - j0.24
2050	16.88 - j16.5	3.44 - j0.18
2100	15.31 - j17.44	3.43 - j0.15
2150	13.53 - j18.07	3.42 - j0.12
2200	11.63 - j18.35	3.37 - j0.10
2250	9.76 - j18.23	3.31 - j0.08
2300	8.00 - j17.78	3.22 - j0.06

Note[1] V_{DD} = 28V, I_{DQ} = 0.5 A in the 440162 package.

Note[2] Impedances are extracted from CGH21120F-AMP demonstration circuit and are not source and load pull data derived from transistor.

CGH21120F Power Dissipation De-rating Curve



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

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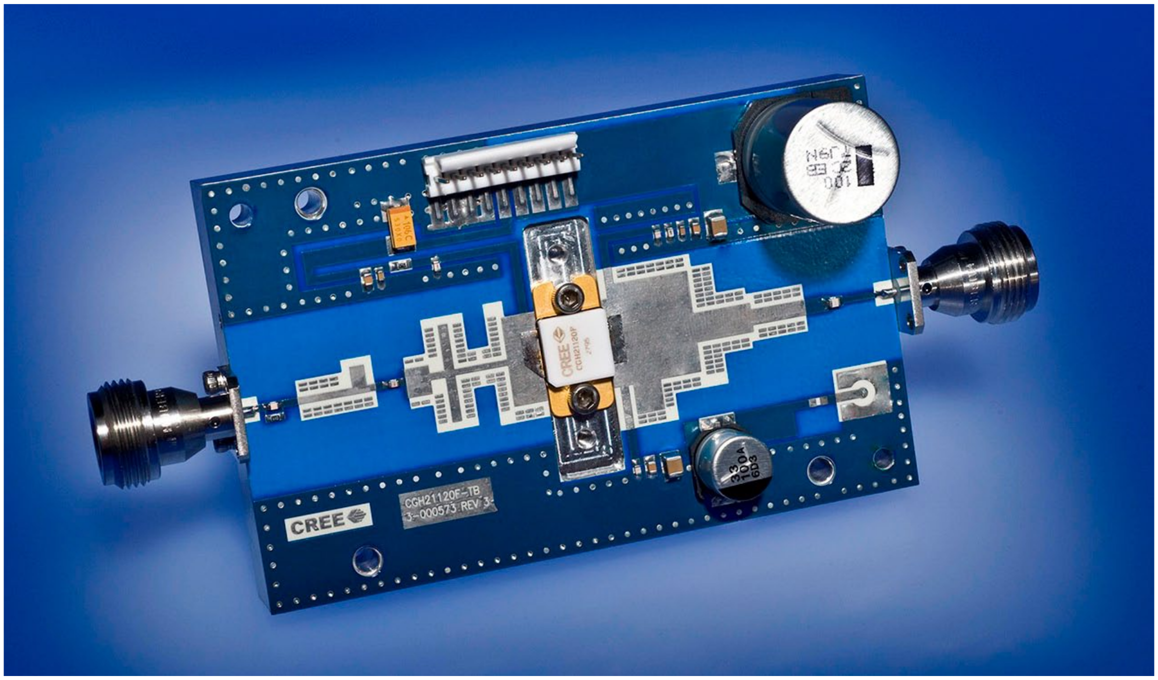
CGH21120F-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16W, 0603, 1%, 10 OHMS	1
R2	RES, 1/16W, 0603, 1%, 5.1 OHMS	1
C1, C3, C8	CAP, 10 pF, +/-5%, ATC600S	3
C2	CAP, 27 pF, +/-5%, ATC600S	1
C5, C10	CAP, 470 pF, +/-5%, 100V, 0603	2
C6, C11, C18	CAP, 33000 pF, 0805, 100V, X7R	3
C7	CAP, 10 uF, 16V, TANTALUM	1
C9	CAP, 82 pF, +/-5%, ATC600S	1
C12	CAP 100 uF, 160V, ELECTROLYTIC	1
C13	CAP, 24 pF, +/-5%, ATC600F	1
C14	CAP 8.2pF, +/-0.25 ATC600S	1
C15, C19	CAP, 1.0 uF, +/-10%, 1210, 100V, X7R	2
C20	CAP, 33 uF, +/-20%, G CASE	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, RO4350, Er = 3.48, h = 20 mil	1
-	CGH21120F	1

CGH21120F-AMP Demonstration Amplifier Circuit



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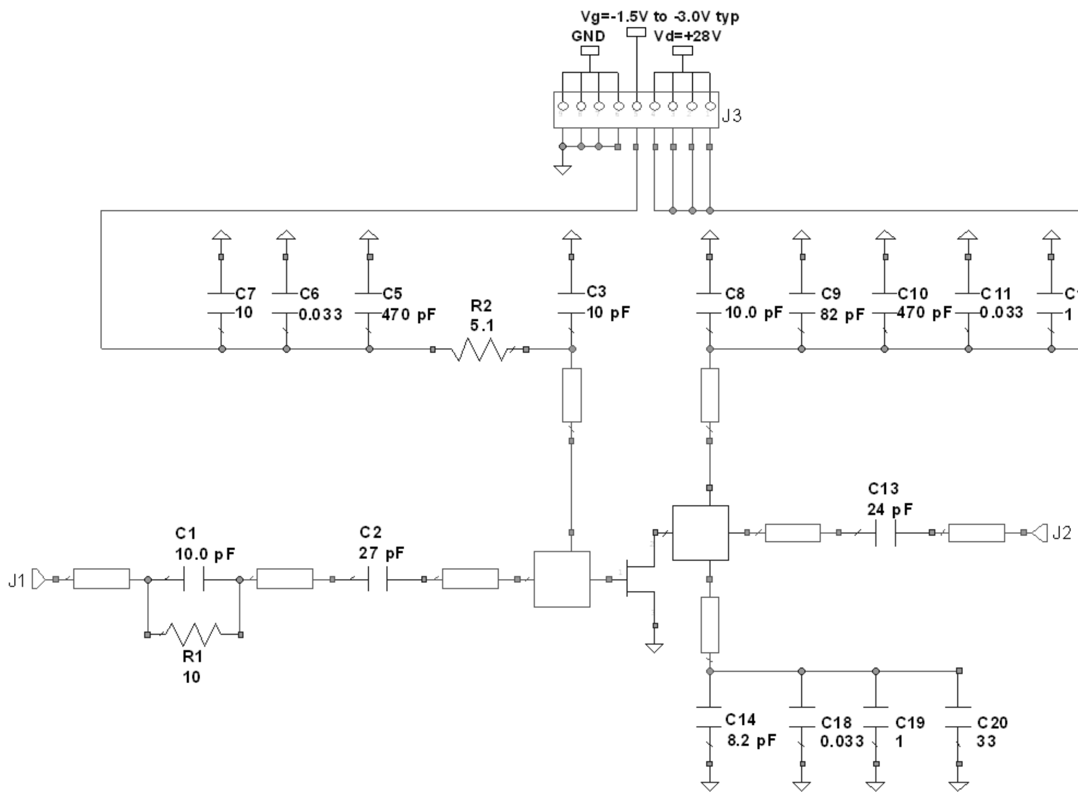
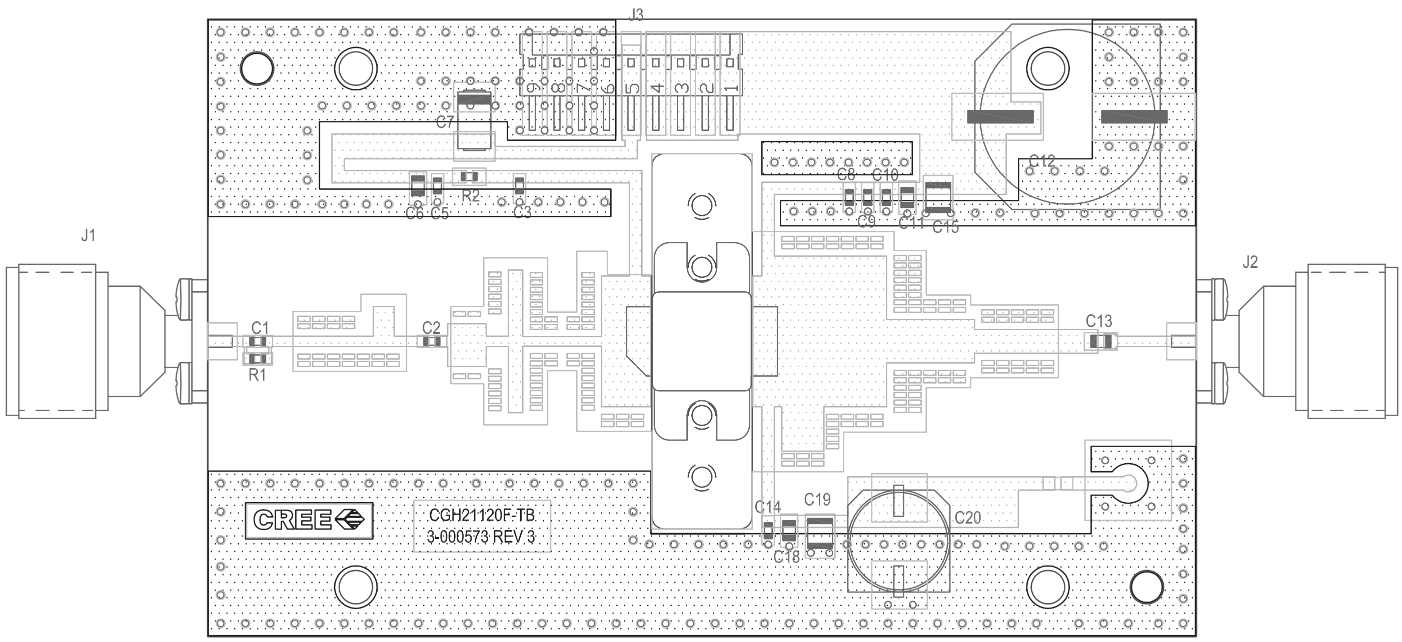
CGH21120F-AMP Demonstration Amplifier Circuit Schematic



CGH21120F-AMP Demonstration Amplifier Circuit Outline



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Typical Package S-Parameters for CGH21120F
(Small Signal, V_{DS} = 28 V, I_{DQ} = 0.5 A, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.961	179.86	3.67	68.26	0.007	-16.54	0.722	-173.72
600 MHz	0.960	178.22	3.09	63.27	0.007	-20.46	0.732	-173.18
700 MHz	0.959	176.75	2.69	58.41	0.007	-24.23	0.744	-172.73
800 MHz	0.957	175.36	2.40	53.65	0.007	-27.89	0.755	-172.37
900 MHz	0.955	173.99	2.19	48.94	0.007	-31.47	0.768	-172.12
1.0 GHz	0.952	172.61	2.03	44.26	0.008	-35.01	0.780	-171.96
1.1 GHz	0.949	171.20	1.91	39.56	0.008	-38.53	0.792	-171.88
1.2 GHz	0.944	169.72	1.82	34.81	0.008	-42.08	0.805	-171.88
1.3 GHz	0.938	168.15	1.77	29.95	0.008	-45.70	0.817	-171.94
1.4 GHz	0.930	166.46	1.74	24.91	0.009	-49.47	0.829	-172.06
1.5 GHz	0.920	164.63	1.73	19.59	0.009	-53.47	0.842	-172.23
1.6 GHz	0.907	162.63	1.75	13.89	0.010	-57.82	0.854	-172.45
1.7 GHz	0.889	160.43	1.80	7.63	0.011	-62.66	0.868	-172.72
1.8 GHz	0.863	158.03	1.87	0.61	0.011	-68.22	0.882	-173.07
1.9 GHz	0.828	155.48	1.97	-7.46	0.013	-74.76	0.897	-173.54
2.0 GHz	0.780	153.01	2.10	-16.94	0.014	-82.64	0.914	-174.18
2.1 GHz	0.715	151.22	2.24	-28.22	0.015	-92.25	0.932	-175.11
2.2 GHz	0.637	151.48	2.36	-41.58	0.017	-103.85	0.948	-176.42
2.3 GHz	0.566	155.82	2.42	-56.84	0.017	-117.27	0.958	-178.09
2.4 GHz	0.541	164.16	2.38	-73.11	0.017	-131.60	0.958	-179.89
2.5 GHz	0.577	171.39	2.22	-88.96	0.017	-145.40	0.949	178.57
2.6 GHz	0.643	173.87	2.01	-103.24	0.015	-157.52	0.935	177.50
2.7 GHz	0.708	172.59	1.79	-115.54	0.014	-167.55	0.922	176.84
2.8 GHz	0.760	169.28	1.60	-126.07	0.013	-175.66	0.912	176.44
2.9 GHz	0.796	164.87	1.44	-135.23	0.012	177.73	0.905	176.14
3.0 GHz	0.821	159.63	1.32	-143.50	0.011	172.16	0.900	175.88
3.2 GHz	0.843	146.16	1.17	-158.98	0.010	162.55	0.894	175.28
3.4 GHz	0.835	125.42	1.13	-175.91	0.010	152.13	0.891	174.54
3.6 GHz	0.799	88.32	1.17	161.01	0.011	136.18	0.888	173.59
3.8 GHz	0.786	21.79	1.15	126.34	0.011	109.17	0.886	172.34
4.0 GHz	0.879	-50.56	0.84	87.99	0.008	78.81	0.879	170.82
4.2 GHz	0.951	-93.77	0.52	61.47	0.006	60.37	0.869	169.25
4.4 GHz	0.979	-116.72	0.33	44.97	0.004	51.78	0.856	167.49
4.6 GHz	0.990	-130.14	0.22	33.45	0.003	47.74	0.840	165.43
4.8 GHz	0.994	-138.83	0.16	24.22	0.002	45.41	0.819	162.96
5.0 GHz	0.997	-144.91	0.12	15.93	0.002	43.34	0.789	159.95
5.2 GHz	0.998	-149.42	0.10	7.73	0.002	40.67	0.746	156.25
5.4 GHz	0.998	-152.92	0.08	-1.09	0.002	36.72	0.683	151.66
5.6 GHz	0.999	-155.72	0.07	-11.28	0.002	30.81	0.589	146.08
5.8 GHz	0.999	-158.03	0.06	-23.63	0.002	22.20	0.449	140.15
6.0 GHz	0.999	-159.97	0.05	-38.80	0.002	10.30	0.254	139.99

To download the s-parameters in s2p format, go to the CGH21120F Product Page and click on the documentation tab.

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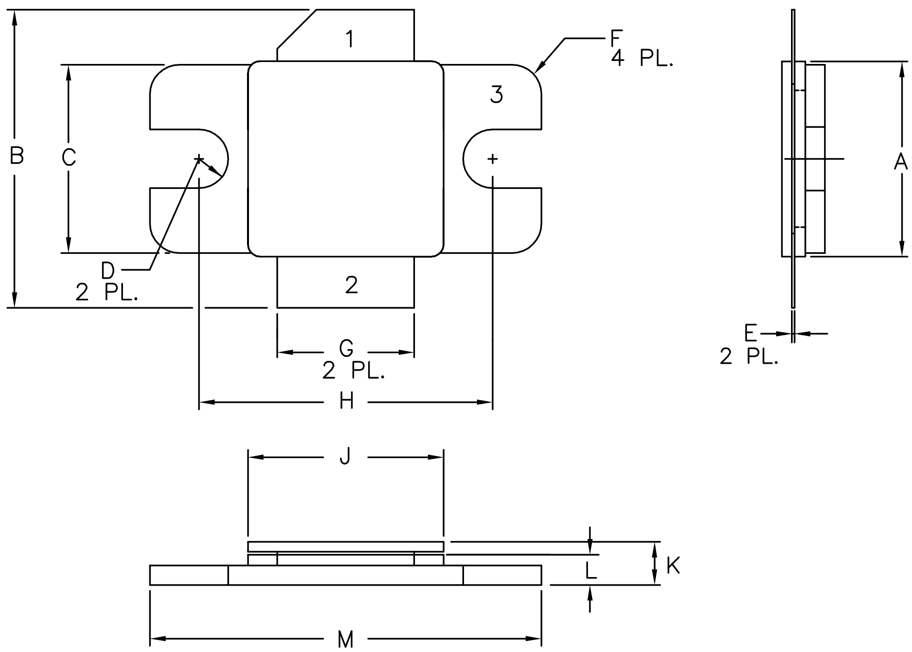
Product Dimensions CGH21120F (Package Type — 440162)



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.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.395	.405	10.03	10.29
B	.580	.620	14.73	15.75
C	.380	.390	9.65	9.91
D	.055	.065	1.40	1.65
E	.004	.006	0.10	0.15
F	.055	.065	1.40	1.65
G	.275	.285	6.99	7.24
H	.595	.605	15.11	15.37
J	.395	.405	10.03	10.29
K	.129	.149	3.28	3.78
L	.053	.067	1.35	1.70
M	.795	.805	20.19	20.45

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

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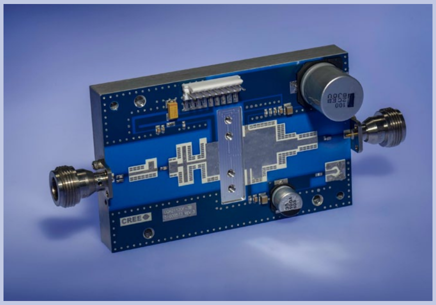
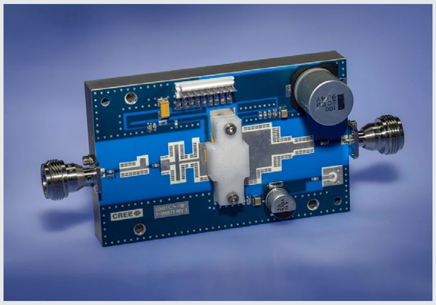
Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH21120F	GaN HEMT	Each	
CGH21120F-TB	Test board without GaN HEMT	Each	
CGH21120F-AMP	Test board with GaN HEMT installed	Each	

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