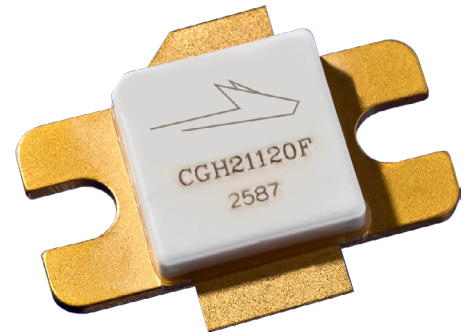


# CGH21120F

120 W, 1.8 - 2.3 GHz, GaN HEMT  
for WCDMA, LTE, WiMAX

## Description

WolfSpeed'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 2.0-2.3 GHz ( $T_c = 25^\circ\text{C}$ ) of Demonstration Amplifier

Parameter	2.0 GHz	2.1 GHz	2.2 GHz	2.3 GHz	Unit
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	%

Notes:

<sup>1</sup> 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

- 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





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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	$V_{DSS}$	120	V	25°C
Gate-to-Source Voltage	$V_{GS}$	-10, +2		
Power Dissipation	$P_{DISS}$	56	W	
Storage Temperature	$T_{STG}$	-65, +150	°C	
Operating Junction Temperature	$T_J$	225		
Maximum Forward Gate Current	$I_{GMAX}$	30	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	12	A	
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
Thermal Resistance, Junction to Case <sup>3</sup>	$R_{\theta JC}$	1.5	°C/W	85°C
Case Operating Temperature <sup>3</sup>	$T_C$	-40, +150	°C	

### Notes:

<sup>1</sup> Current limit for long term, reliable operation

<sup>2</sup> Refer to the Application Note on soldering at [wolfspeed.com/rf/document-library](http://wolfspeed.com/rf/document-library)

<sup>3</sup> Measured for the CGH21120F at  $P_{DISS} = 56$  W

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

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics</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	—		$V_{DS} = 28$ V, $I_D = 0.5$ A
Saturated Drain Current	$I_{DS}$	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
<b>RF Characteristics (<math>T_C = 25^\circ\text{C}</math>, <math>F_0 = 2.15</math> GHz unless otherwise noted)</b>						
Saturated Output Power <sup>2, 3, 4</sup>	$P_{SAT}$	—	110	—	W	$V_{DD} = 28$ V, $I_{DQ} = 0.5$ A
Pulsed Drain Efficiency <sup>2</sup>	$\eta$	—	70	—	%	$V_{DD} = 28$ V, $I_{DQ} = 0.5$ A, $P_{OUT} = P_{SAT}$
Modulated Gain <sup>5</sup>	$G_{SS}$	13.5	15	—	dB	$V_{DD} = 28$ V, $I_{DQ} = 0.5$ A, $P_{OUT} = 43$ dBm
WCDMA Linearity <sup>5</sup>	ACLR	—	-35	-30	dBc	
Modulated Drain Efficiency <sup>5</sup>	$\eta$	29	35	—	%	
Output Mismatch Stress	VSWR	—	—	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 0.5$ A, $P_{OUT} = 20$ W CW
<b>Dynamic Characteristics</b>						
Input Capacitance <sup>6</sup>	$C_{GS}$	—	66	—	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance <sup>6</sup>	$C_{DS}$	—	12	—		
Feedback Capacitance	$C_{GD}$	—	1.6	—		

### Notes:

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

<sup>2</sup> Pulse Width = 40 $\mu$ s, Duty Cycle = 5%

<sup>3</sup>  $P_{SAT}$  is defined as  $I_G = 10$  mA peak

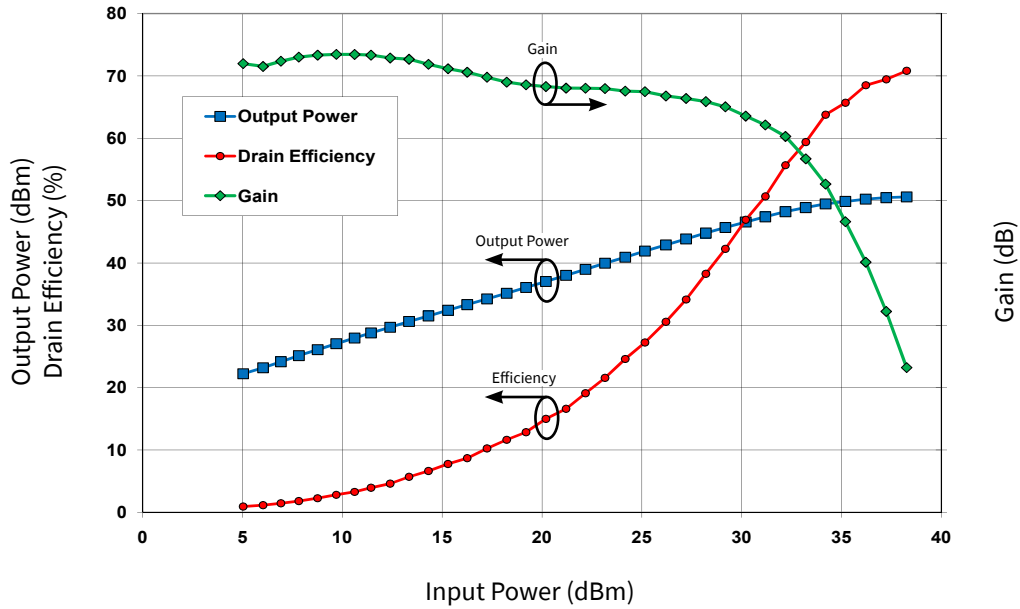
<sup>4</sup> Measured in CGH21120F-AMP

<sup>5</sup> Single Carrier WCDMA, 3GPP Test Model 1, 64 DPCH, 67 % Clipping, PAR = 8.81 dB @ 0.01 % Probability on CCDF

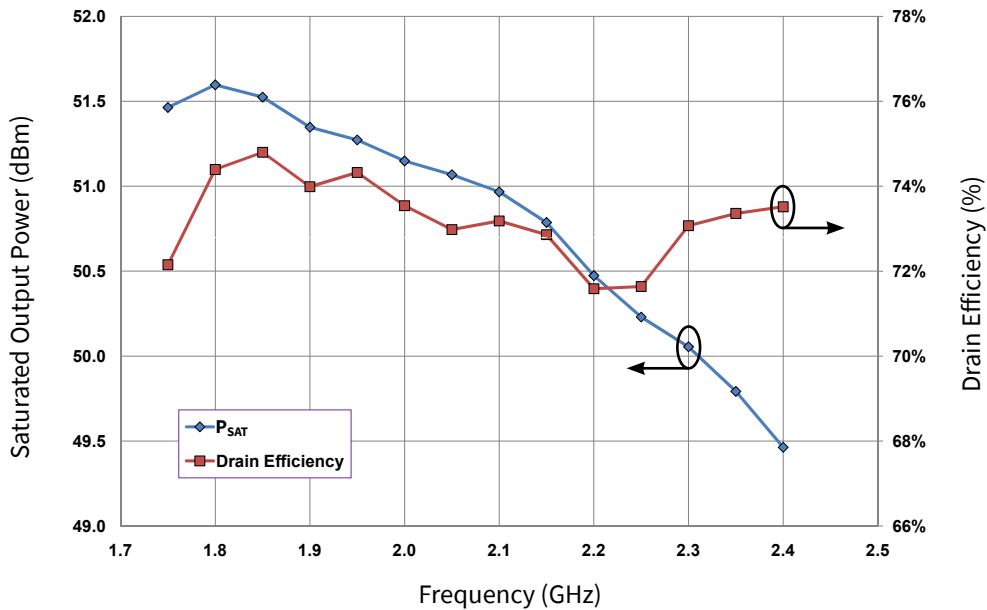
<sup>6</sup> Includes package and internal matching components



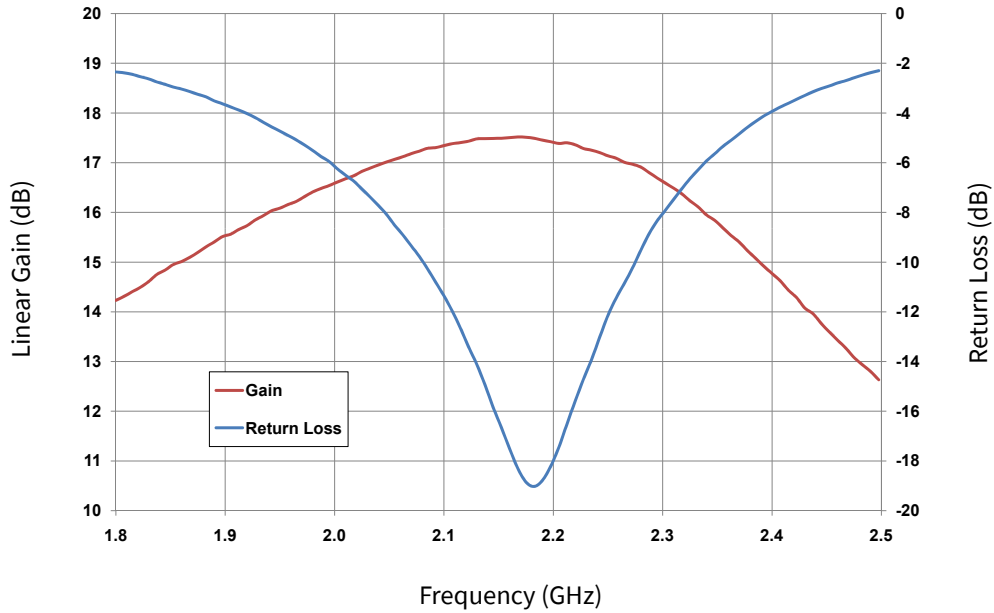
Typical Performance



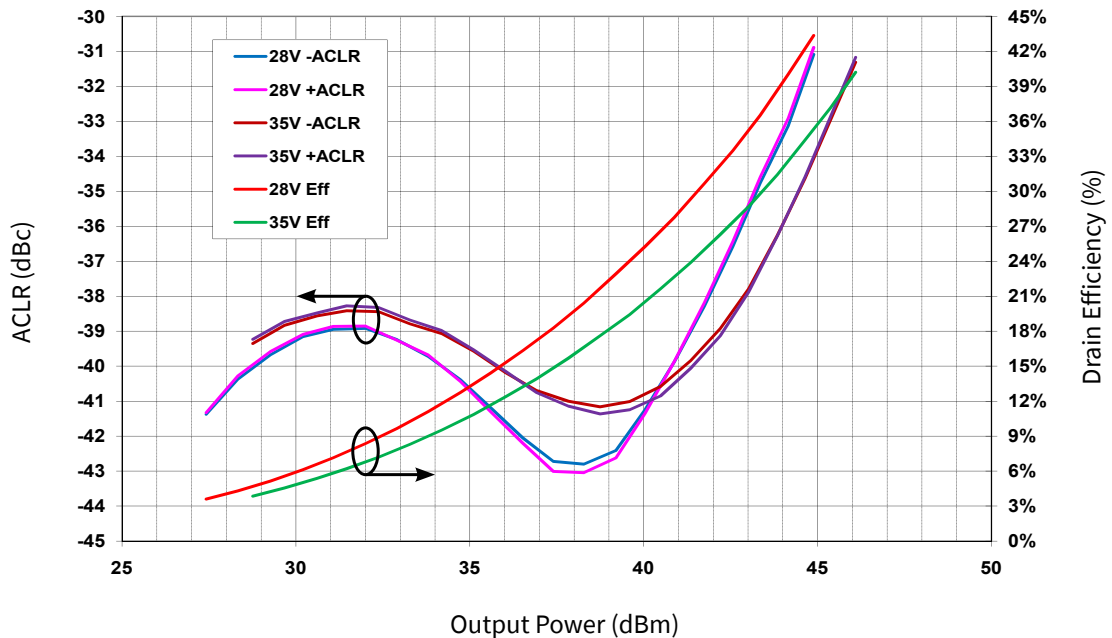
**Figure 1.** Typical Pulsed Characteristics Output Power, Drain Efficiency, and Gain vs Input Power measured in CGH21120F-AMP Amplifier Circuit  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 0.5\text{ A}$ , Freq = 2.15 MHz, Pulse Width = 40 $\mu\text{s}$ , Duty Cycle = 5%



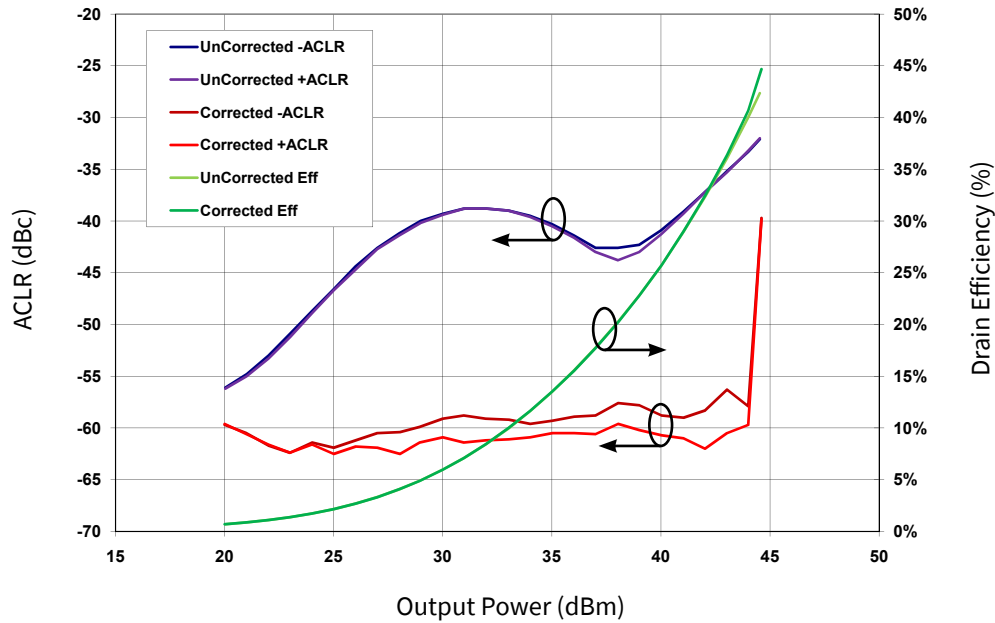
**Figure 2.** Typical Pulsed Saturated Power vs Frequency measured in CGH21120F-AMP Amplifier Circuit  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 0.5\text{ A}$ ,  $P_{SAT} = 10\text{ mA}$   $I_{GS}$  Peak, Pulse Width = 40 $\mu\text{s}$ , Duty Cycle = 5 %



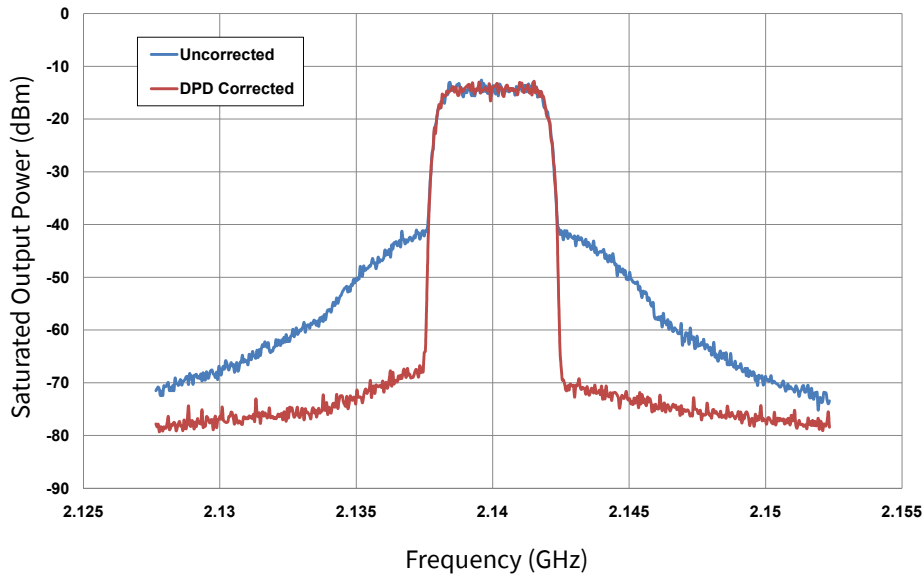
**Figure 3.** Typical Small Signal Gain and Return Loss vs Frequency measured in CGH21120F-AMP Amplifier Circuit  
 $V_{DS} = 28\text{ V}, I_{DS} = 0.5\text{ A}$



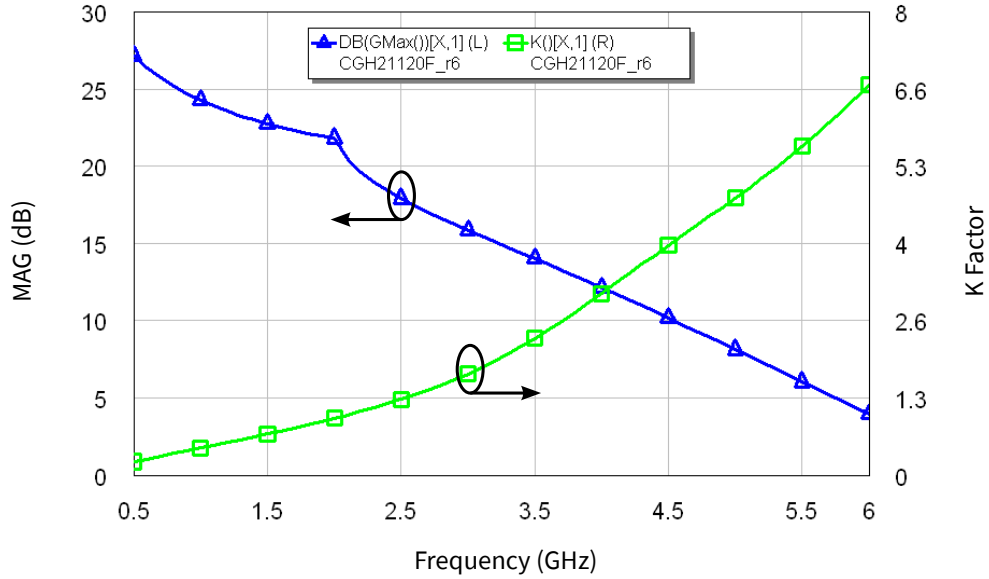
**Figure 4.** Typical WCDMA Characteristics ACLR and Drain Efficiency vs Output Power measured in CGH21120F-AMP Amplifier Circuit  
 3GPP Test Model 1, 64 DPCH, 67% Clipping, 8.81 dB PAR @ 0.01%  
 $V_{DS} = 28\text{ V}$  and  $35\text{ V}, I_{DS} = 0.5\text{ A}, \text{Frequency} = 2.15\text{ GHz}$



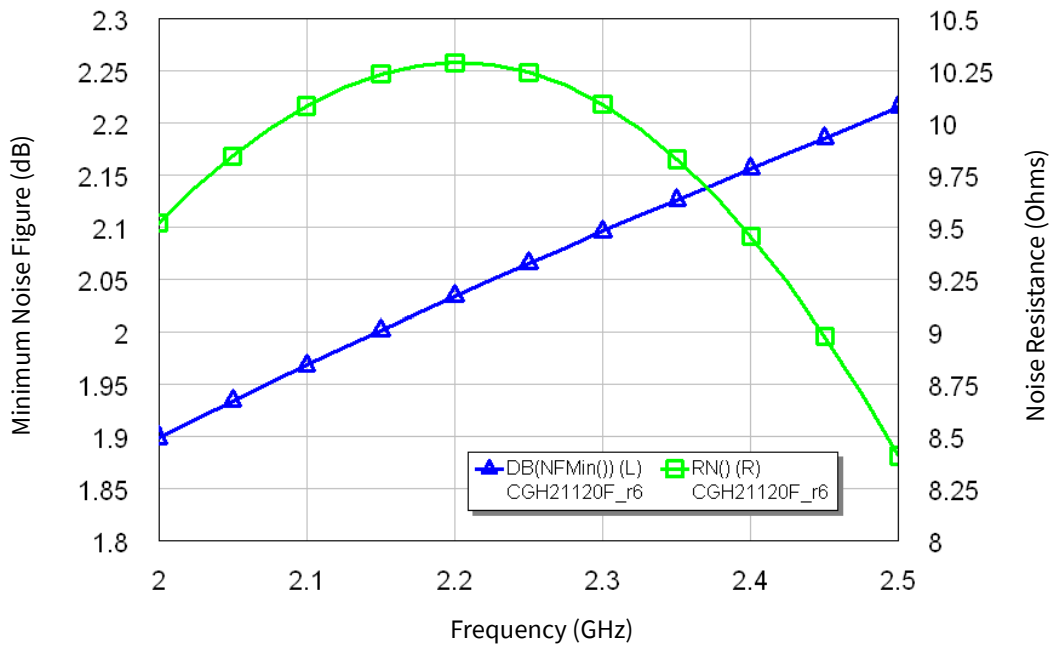
**Figure 5.** WCDMA Characteristics with and without DPD Correction ACLR and Drain Efficiency vs Output Power measured in CGH21120F-AMP Amplifier Circuit Single Channel WCDMA 6.5 dB PAR with CFR  $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 0.5\text{ A}$ , Frequency = 2.14 GHz



**Figure 6.** WCDMA Linearity with DPD Linearizer measured in CGH21120F-AMP Amplifier Circuit Single Channel WCDMA 6.5 dB PAR with CFR  $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 0.5\text{ A}$ ,  $P_{OUT} = 44\text{ dBm}$ , Efficiency = 40%



**Figure 7.** Simulated Maximum Available Gain and K Factor of the CGH21120F  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$

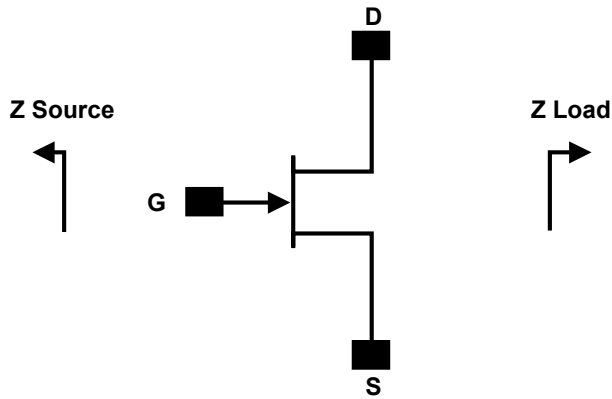


**Figure 8.** Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH21120F  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$

### Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (200 < 500 V)	JEDEC JESD22 C101-C

### Source and Load Impedances



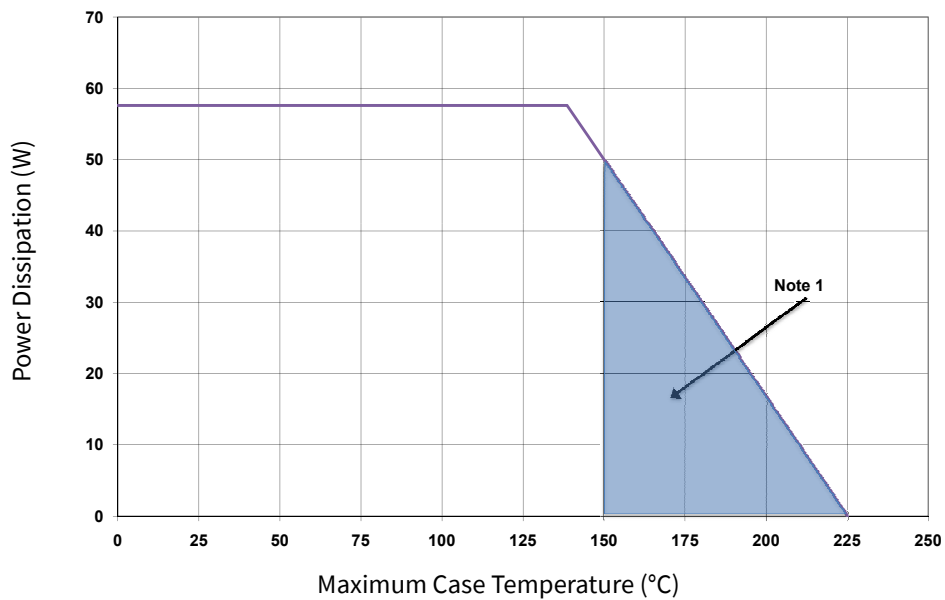
Frequency (MHz)	Z Source	Z Load
2000	18.17 - j15.4	3.43 - j0.24
2050	16.88 - j16.5	3.44 - j0.18
2100	15.31 - j17.44	3.43 - j0.15
2150	13.53 - j18.07	3.42 - j0.12
2200	11.63 - j18.35	3.37 - j0.10
2250	9.76 - j18.23	3.31 - j0.08
2300	8.00 - j17.78	3.22 - j0.06

Notes:

<sup>1</sup>  $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 0.5\text{ A}$  in the 440162 package

<sup>2</sup> 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:

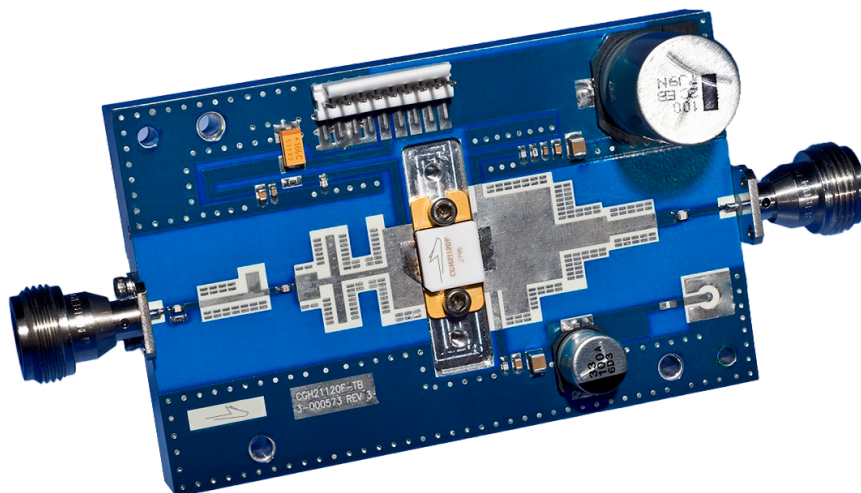
<sup>1</sup> Area exceeds Maximum Case Operating Temperature (See Page 2)



## 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, 10pF, +/-5%, ATC600S	3
C2	CAP, 27pF, +/-5%, ATC600S	1
C5, C10	CAP, 470pF, +/-5%, 100V, 0603	2
C6, C11, C18	CAP, 33000pF, 0805, 100V, X7R	3
C7	CAP, 10μF, 16V, TANTALUM	1
C9	CAP, 82pF, +/-5%, ATC600S	1
C12	CAP 100μF, 160V, ELECTROLYTIC	1
C13	CAP, 24pF, +/-5%, ATC600F	1
C14	CAP 8.2pF, +/-0.25 ATC600S	1
C15, C19	CAP, 1.0μF, +/-10%, 1210, 100V, X7R	2
C20	CAP, 33μF, +/-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

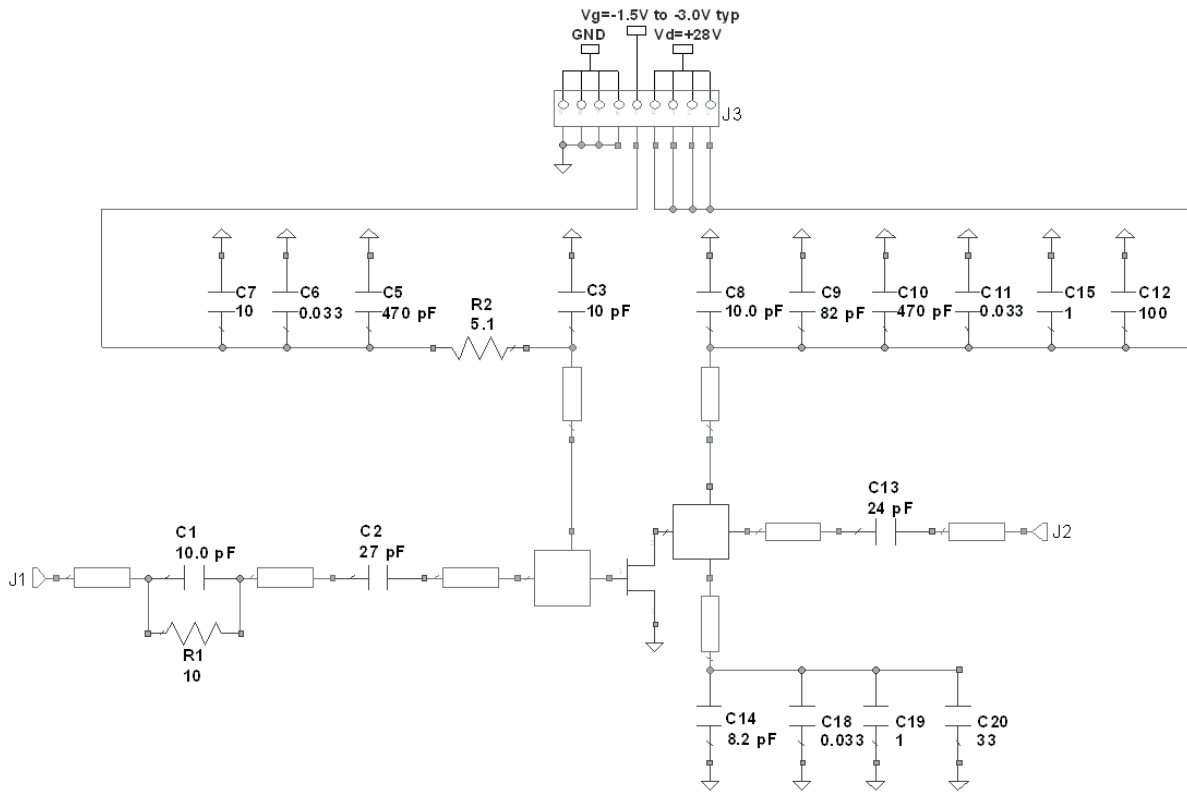
## CGH21120F-AMP Demonstration Amplifier Circuit



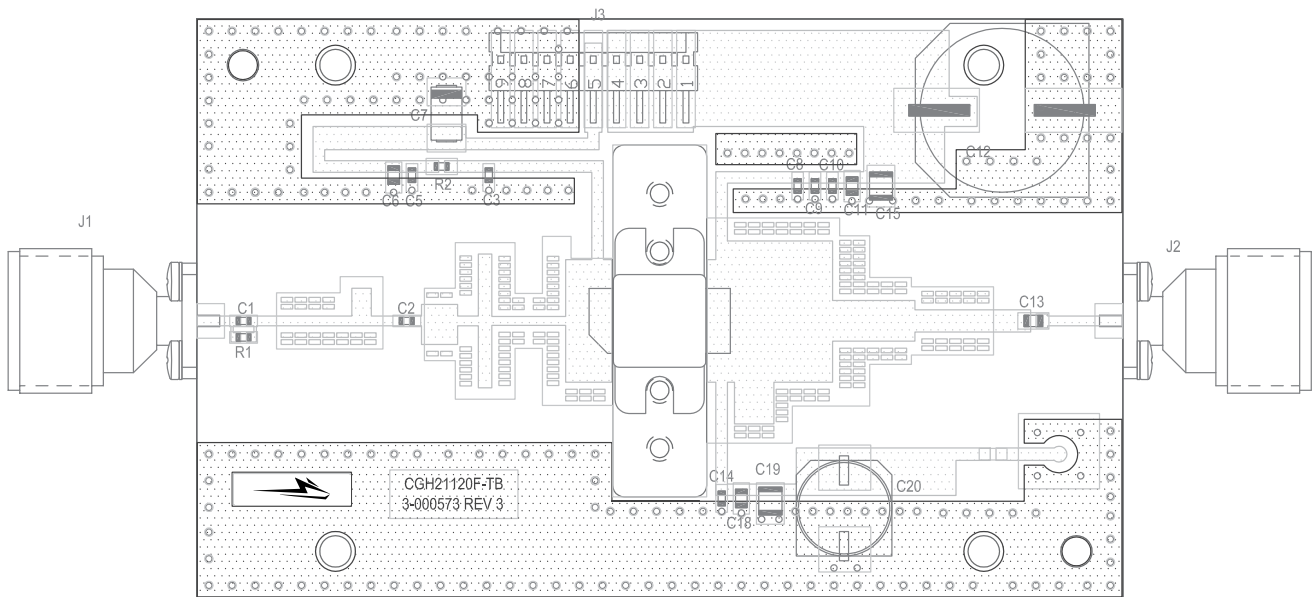




### CGH21120F-AMP Demonstration Amplifier Circuit Schematic



### CGH21120F-AMP Demonstration Amplifier Circuit Outline





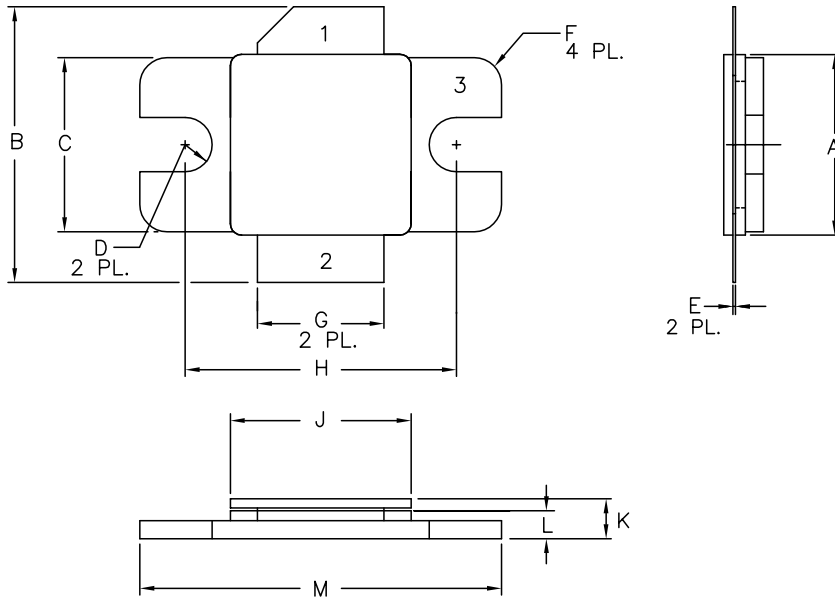
**Typical Package S-Parameters for CGH21120F**  
 (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 0.5\text{ A}$ , angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.961	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.



**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.

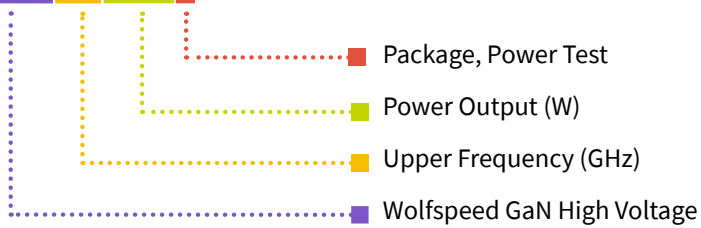
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.395	.405	10.03	10.29
B	.580	.620	14.73	15.75
C	.380	.390	9.65	9.91
D	.055	.065	1.40	1.65
E	.004	.006	0.10	0.15
F	.055	.065	1.40	1.65
G	.275	.285	6.99	7.24
H	.595	.605	15.11	15.37
J	.395	.405	10.03	10.29
K	.129	.149	3.28	3.78
L	.053	.067	1.35	1.70
M	.795	.805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

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



## Part Number System

### CGH21120F



**Table 1.**

Parameter	Value	Units
Upper Frequency <sup>1</sup>	2.3	GHz
Power Output	120	W
Package	Flanged	—

Note:

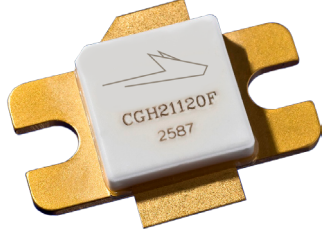
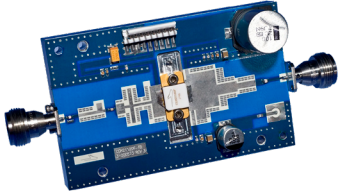
<sup>1</sup> Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

**Table 2.**

Character Code	Code Value
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
J	8
K	9
Examples:	1A = 10.0 GHz 2H = 27.0 GHz



## Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH21120F	GaN HEMT	Each	
CGH21120F-AMP	Test board with GaN HEMT installed	Each	

**For more information, please contact:**

4600 Silicon Drive  
Durham, NC 27703 USA  
Tel: +1.919.313.5300  
[www.wolfspeed.com/RF](http://www.wolfspeed.com/RF)

Sales Contact  
[RFSales@wolfspeed.com](mailto:RFSales@wolfspeed.com)

RF Product Marketing Contact  
[RFMarketing@wolfspeed.com](mailto:RFMarketing@wolfspeed.com)

## Notes & Disclaimer

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