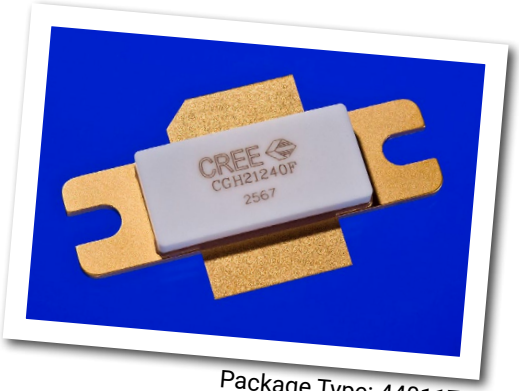
CGH21240F

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

Cree's CGH21240F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically with high efficiency, high gain and wide bandwidth capabilities, which makes the CGH21240F ideal for 1.8-2.3GHz WCDMA and LTE amplifier applications. The transistor is supplied in a ceramic/metal flange package.



Package Type: 440117
PN: CGH21240F

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 @ 46 dBm	13.1	14.6	15.1	15.7	dB
ACLR @ 46 dBm	-36.5	-34.5	-34.2	-32.0	dBc
Drain Efficiency @ 46 dBm	30.5	32.7	32.9	33.8	%

Note:
Measured in the CGH21240F-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 40 W P_{AVE}
- 33 % Efficiency at 40 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}	115	Watts	
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	60	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	24	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	80	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	0.75	˚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 CGH21240F at P_{DISS} = 115 W.

Electrical Characteristics (T_C = 25˚C)

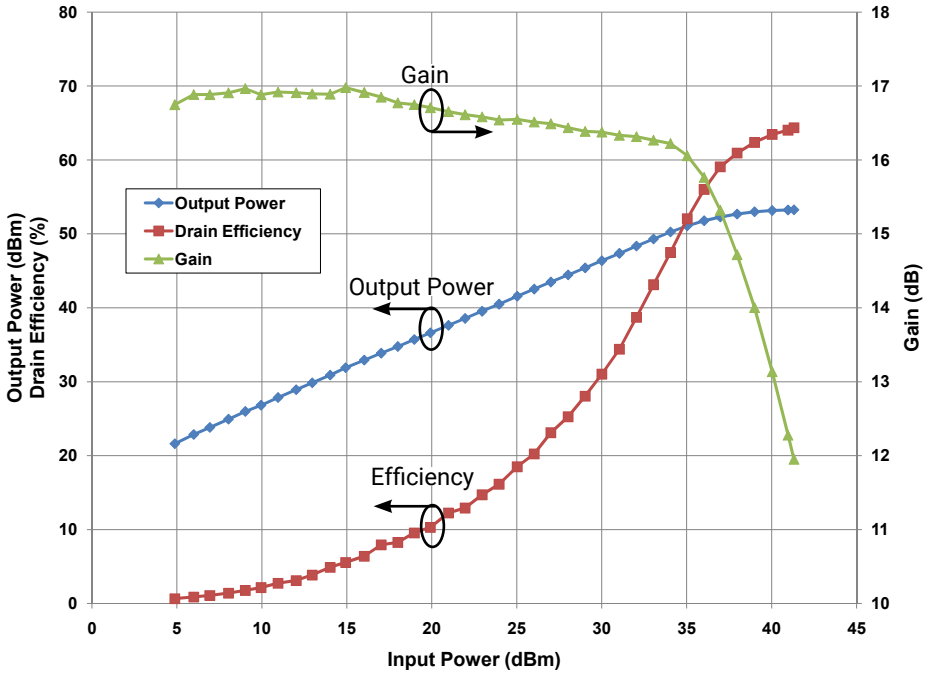
Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	-2.3	V_{DC}	V_{DS} = 10 V, I_D = 57.6 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 28 V, I_D = 1.0 A
Saturated Drain Current[2]	I_{DS}	46.4	56.0	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	120	–	–	V_{DC}	V_{GS} = -8 V, I_D = 57.6 mA
RF Characteristics[5] (T_C = 25˚C, F_0 = 2.14 GHz unless otherwise noted)						
Saturated Output Power[3,4]	P_{SAT}	–	215	–	W	V_{DD} = 28 V, I_{DQ} = 1.0 A
Pulsed Drain Efficiency[3]	η	–	65	–	%	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = P_{SAT}
Modulated Gain[6]	G_{SS}	13.5	15	–	dB	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 46 dBm
WCDMA Linearity[6]	ACLR	–	-35	-30	dBc	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 46 dBm
Modulated Drain Efficiency[6]	η	27	33	–	%	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 46 dBm
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 40 W CW
Dynamic Characteristics						
Input Capacitance[7]	C_{GS}	–	172	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance[7]	C_{DS}	–	19.5	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	3.2	–	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 = 20 mA peak.
[5] Measured in CGH21240F-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.

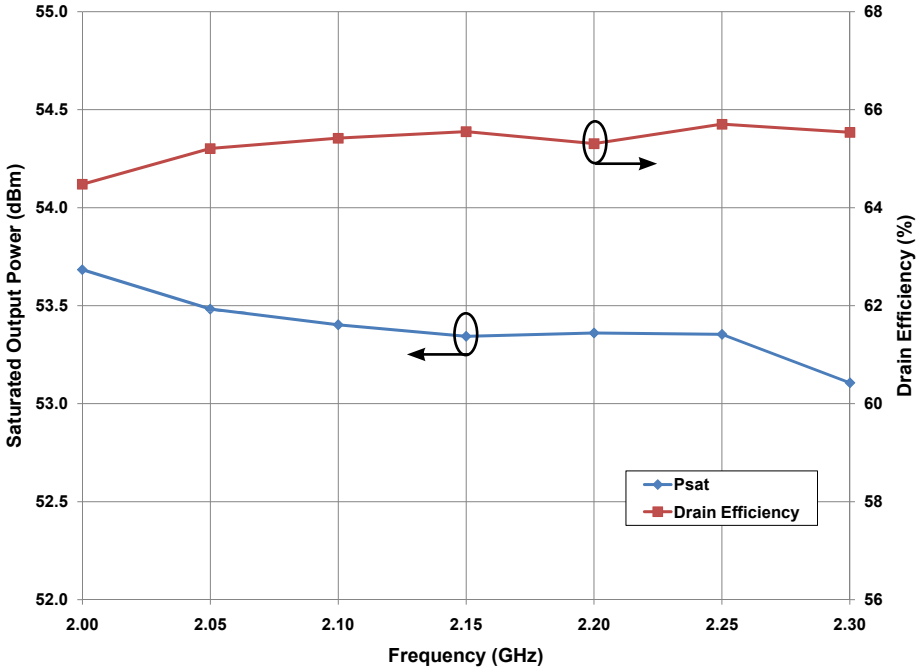
Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Typical Pulse Performance

Typical Pulsed Output Power, Drain Efficiency, and Gain vs Input Power of the CGH21240F measured in CGH21240F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 1.0 A, Freq = 2.14 GHz, Pulse Width = 40 µS, Duty Cycle = 5 %



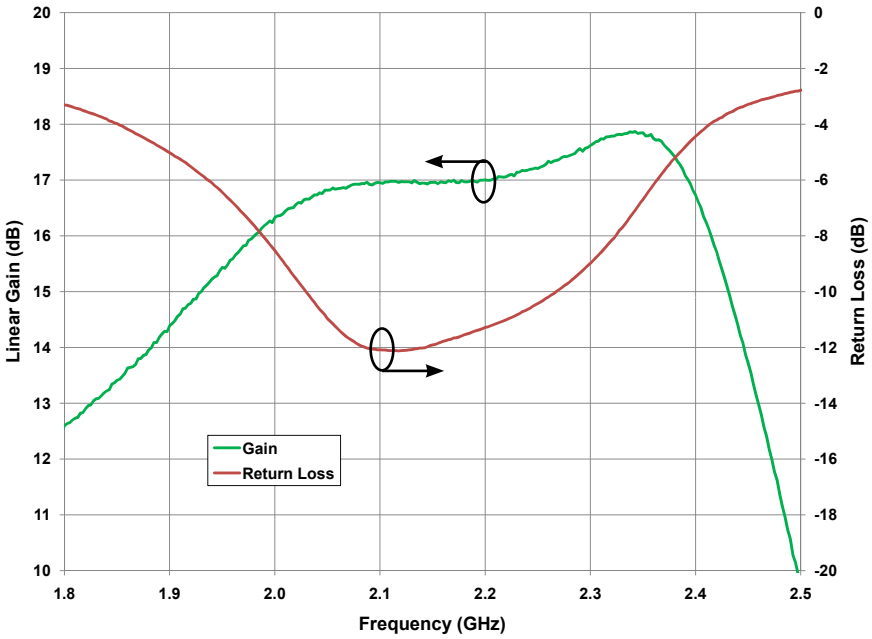
Typical Pulsed Saturated Power and Drain Efficiency vs Frequency of the CGH21240F measured in CGH21240F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 1.0 A, P_{SAT} = 20 mA I_{GS} Peak, Pulse Width = 40 µS, Duty Cycle = 5 %



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

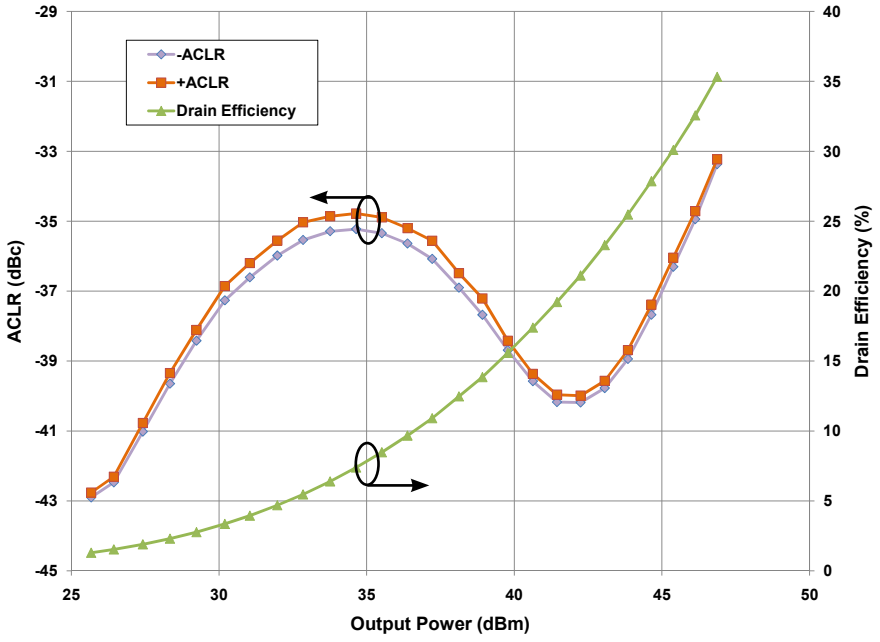
Typical Linear Performance

Typical Small Signal Gain and Return Loss vs Frequency of the CGH21240F measured in CGH21240F-AMP Amplifier Circuit. V_{DS} = 28 V, I_{DS} = 1.0 A



Typical WCDMA Performance

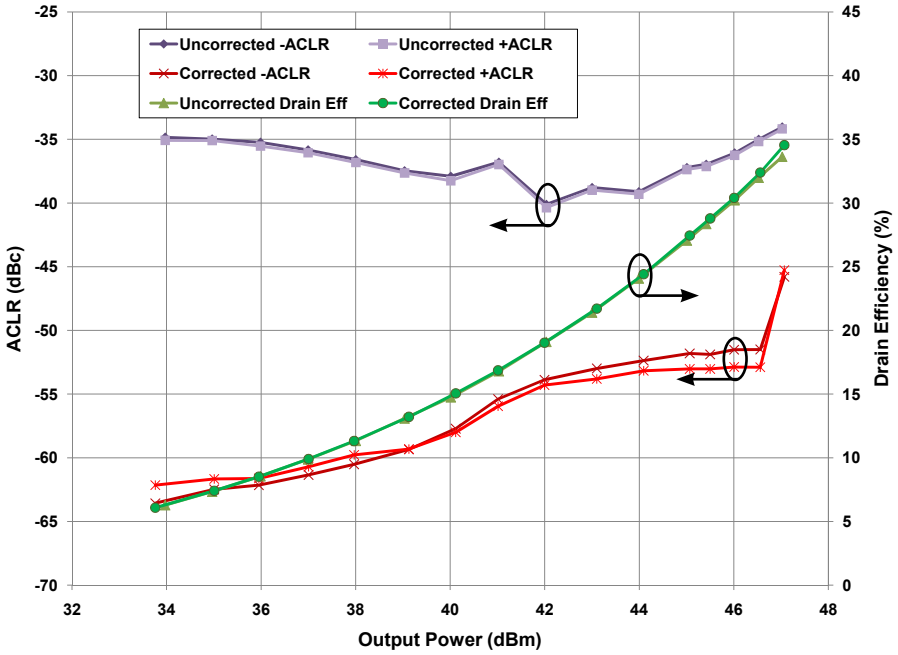
Typical WCDMA Characteristics ACLR and Drain Efficiency vs Output Power of the CGH21240F measured in CGH21240F-AMP Amplifier Circuit. 3GPP Test Model 1, 64 DPCH 67 % Clipping, 8.81 dB PAR @ 0.01 % V_{DS} = 28 V, I_{DS} = 1.0 A, Frequency = 2.14 GHz



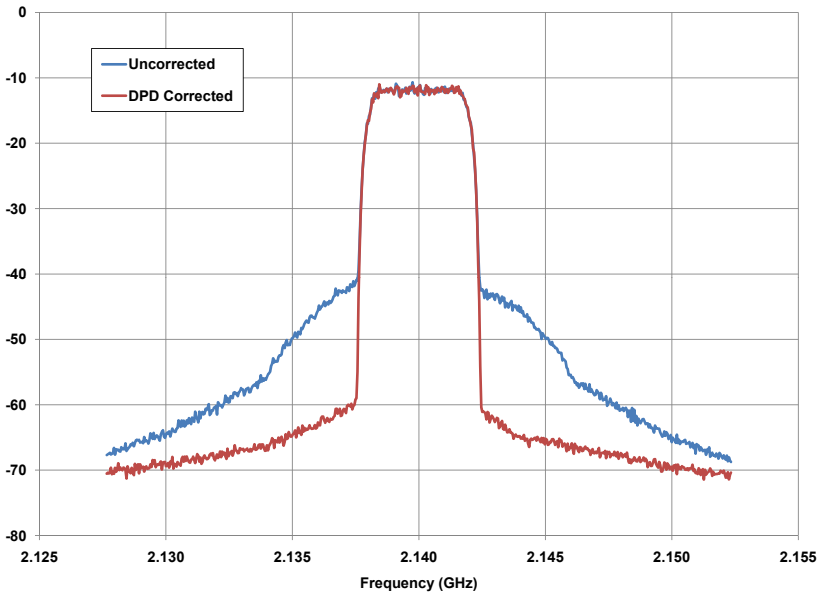
Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Typical WCDMA Digital Pre-Distortion (DPD) Performance

WCDMA Characteristics with and without DPD Correction
ACLR and Drain Efficiency vs Output Power
of the CGH21240F measured in CGH21240F-AMP Amplifier Circuit.
Single Channel WCDMA 6.5dB PAR with CFR
V_{DS} = 28 V, I_{DS} = 1.0 A, Frequency = 2.14 GHz



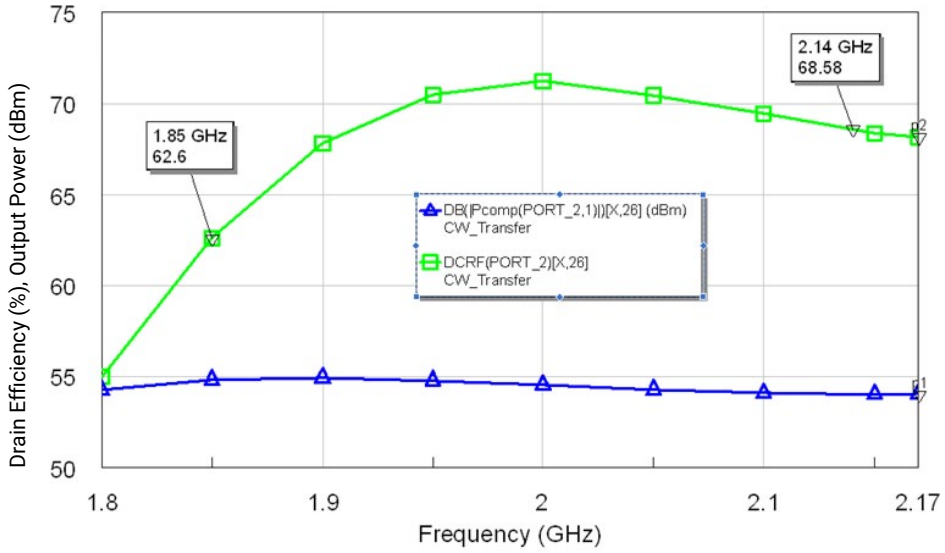
WCDMA Linearity with DPD Linearizer
of the CGH21240F measured in CGH21240F-AMP Amplifier Circuit.
Single Channel WCDMA 6.5dB PAR with CFR
V_{DS} = 28 V, I_{DS} = 1.0 A, P_{AVE} = 46 dBm, Efficiency = 30 %



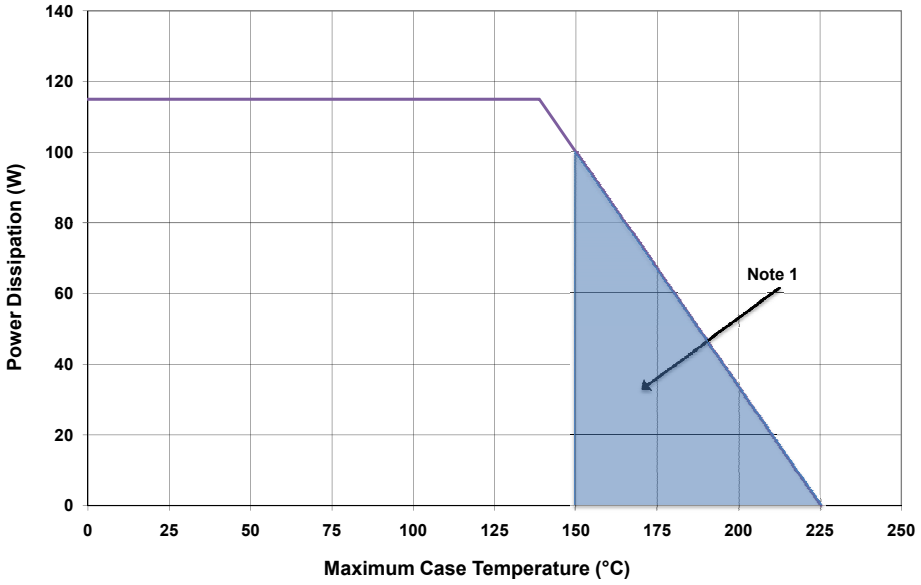
Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Typical Performance

Simulated Performance of the CGH21240F from 1.8 - 2.17 GHz
V_{DD} = 28 V, I_{DQ} = 1.0 A



CGH21240F Power Dissipation De-rating Curve

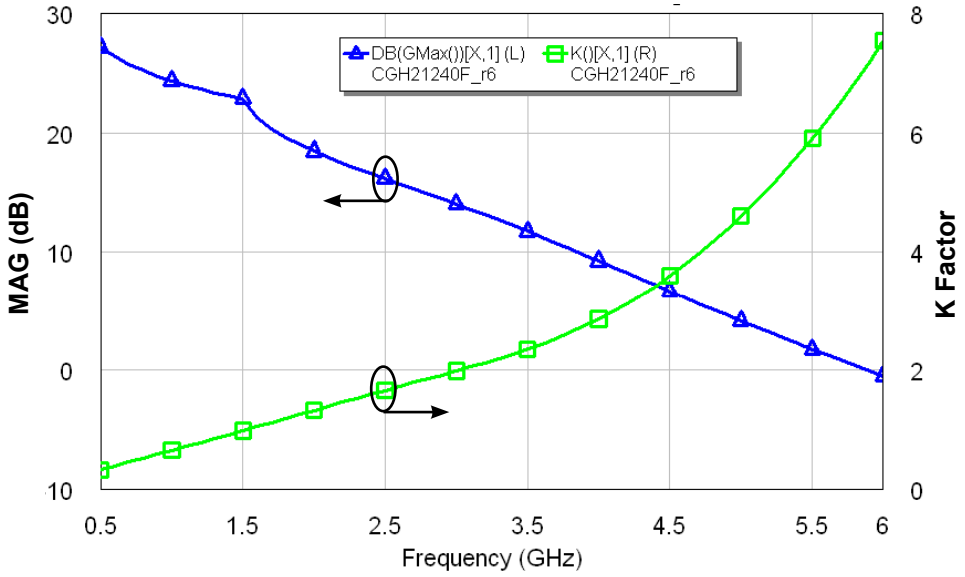


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

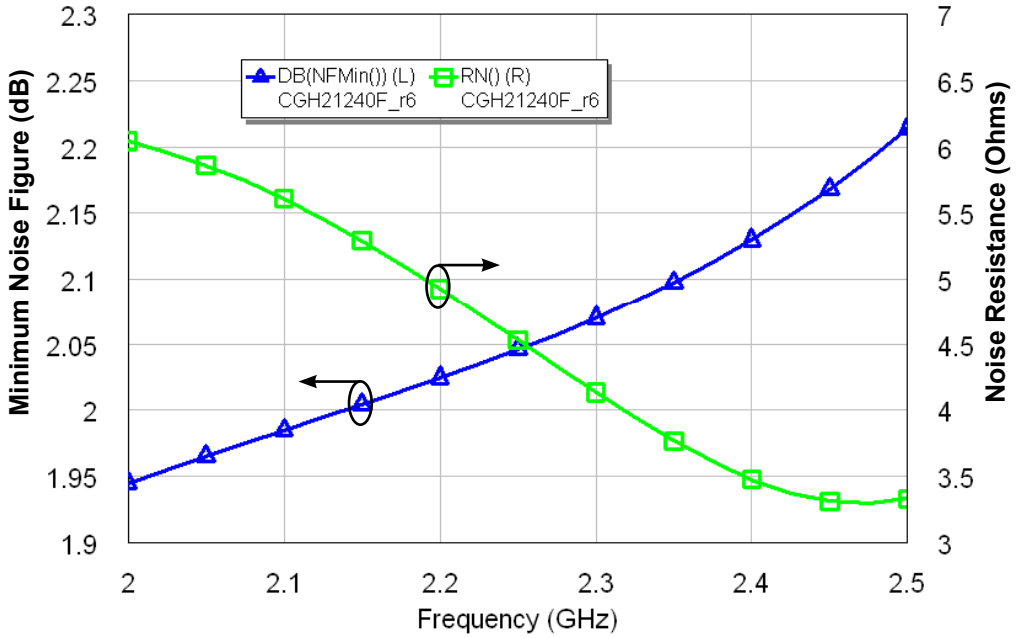
Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH21240F
V_{DD} = 28 V, I_{DQ} = 1.0 A



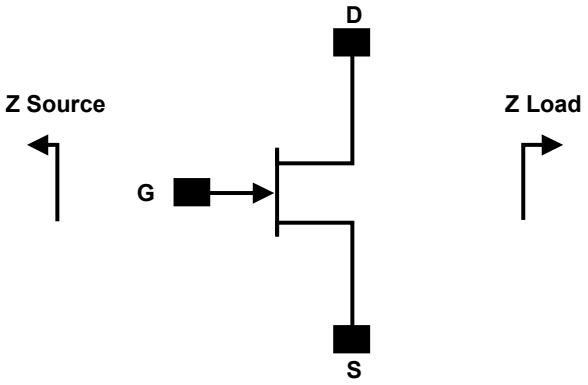
Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH21240F
V_{DD} = 28 V, I_{DQ} = 1.0 A



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
1900	4.50 - j 4.36	2.98 - j 0.69
1950	4.28 - j 4.23	3.17 - j 0.88
2000	4.05 - j 4.04	3.20 - j 1.22
2050	3.86 - j 3.82	2.98 - j 1.60
2100	3.69 - j 3.58	2.52 - j 1.85
2150	3.55 - j 3.32	1.95 - j 1.85
2200	3.44 - j 3.04	1.42 - j 1.63
2250	3.36 - j 2.76	1.00 - j 1.28
2300	3.30 - j 2.47	0.70 - j 0.86

Note[1] V_{DD} = 28V, I_{DQ} = 1.0 A in the 440117 package.
Note[2] Impedances are extracted from CGH21240F-AMP demonstration circuit and are not source and load pull data derived from transistor.

Electrostatic Discharge (ESD) Classifications

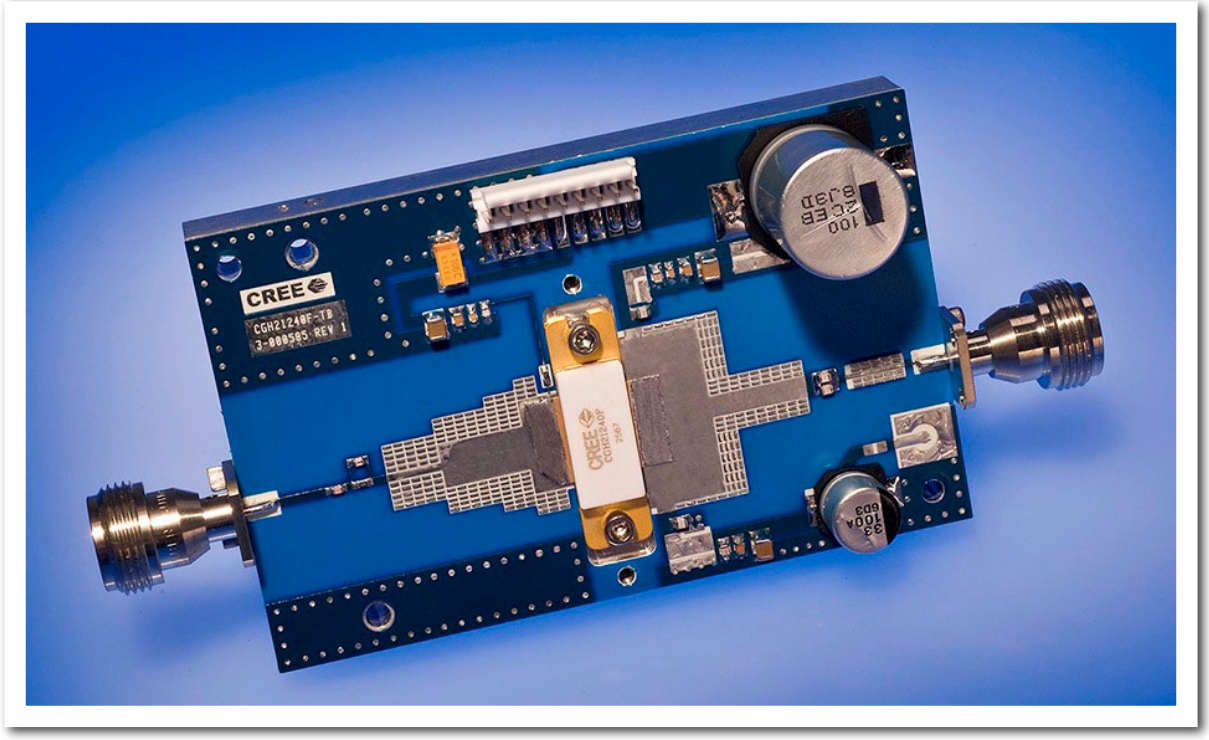
Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (200 < 500 V)	JEDEC JESD22 C101-C

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

CGH21240F-AMP Demonstration Amplifier Circuit Bill of Materials

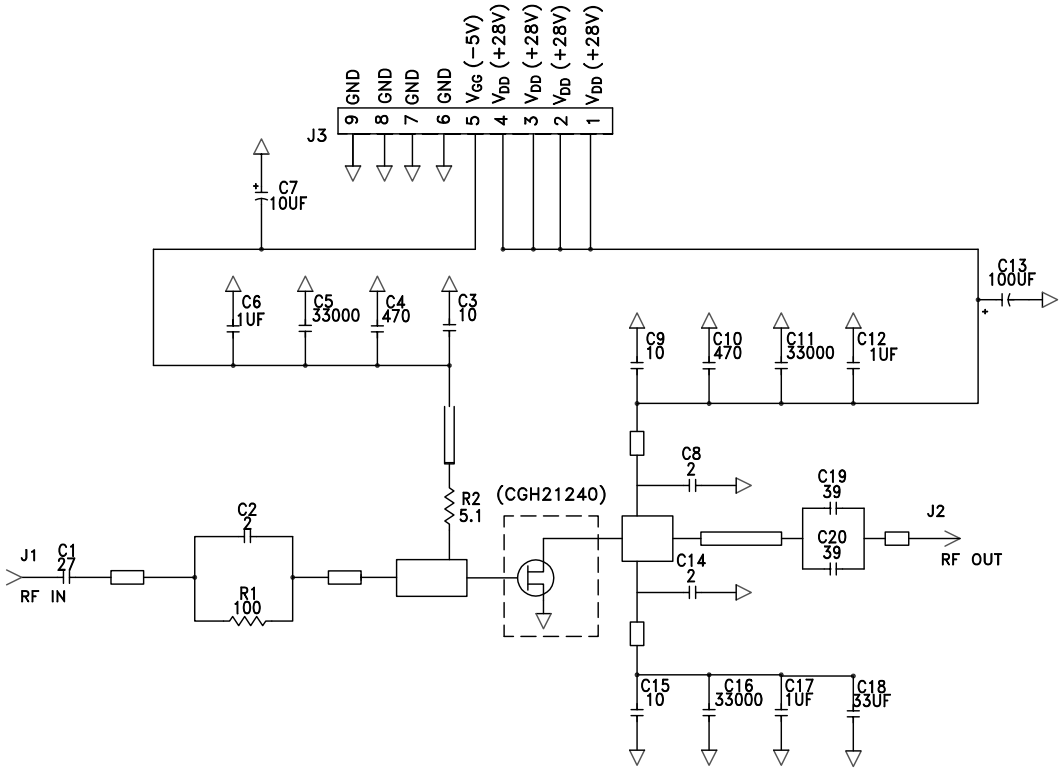
Designator	Description	Qty
R1	RES, 1/16W, 0603, 1%, 100 OHMS	1
R2	RES, 1/16W, 0603, 1%, 5.1 OHMS	1
C1	CAP, 27 pF, +/-5%, ATC600S	1
C2	CAP, 2.0 pF, +/-0.1pF, ATC600S	1
C3	CAP, 10 pF, +/-5%, ATC600S	1
C4, C10	CAP, 470 pF, +/-5%, 100V, 0603	2
C5, C11, C16	CAP, 33000 pF, 0805, 100V, X7R	3
C6, C12, C17	CAP, 1.0 uF, +/-10%, 1210, 100V, X7R	3
C7	CAP, 10 uF, 16V, TANTALUM	1
C8, C14	CAP, 2.0pF, +/-0.1pF, 250V, 0805, ATC600F	2
C9, C15	CAP, 10pF, +/-0.1pF, 250V, 0805, ATC600F	2
C13	CAP 100 uF, 160V, ELECTROLYTIC	1
C18	CAP, 33 uF, +/-20%, G CASE	1
C19, C20	CAP, 39pF, +/-5%, 250V, 0805, ATC600F	2
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
-	CGH21240F	1

CGH21240F-AMP Demonstration Amplifier Circuit

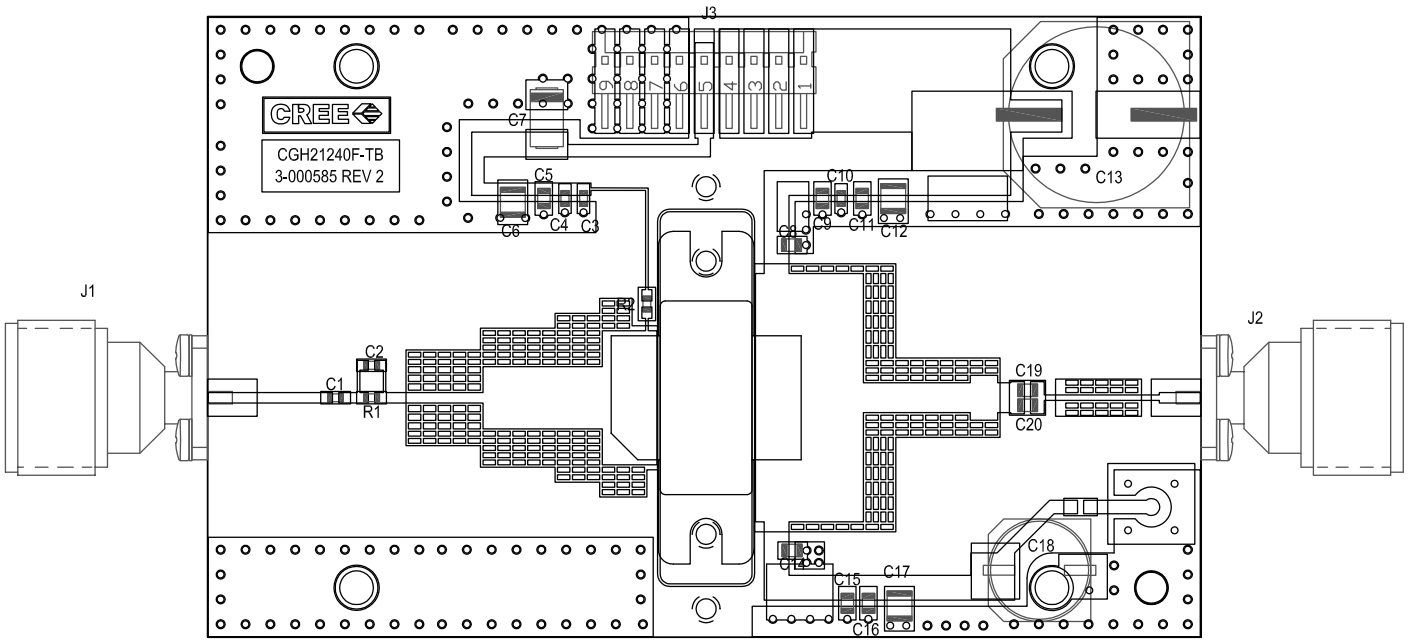


Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

CGH21240F-AMP Demonstration Amplifier Circuit Schematic



CGH21240F-AMP Demonstration Amplifier Circuit Outline



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Typical Package S-Parameters for CGH21240F
(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	0.983	179.25	1.84	66.59	0.004	-13.75	0.823	-177.25
600 MHz	0.983	178.45	1.56	61.58	0.004	-16.73	0.828	-176.89
700 MHz	0.982	177.73	1.36	56.57	0.004	-19.66	0.834	-176.58
800 MHz	0.981	177.04	1.22	51.54	0.004	-22.56	0.841	-176.31
900 MHz	0.980	176.38	1.12	46.42	0.004	-25.48	0.848	-176.07
1.0 GHz	0.978	175.72	1.04	41.17	0.004	-28.46	0.855	-175.87
1.1 GHz	0.976	175.07	0.99	35.70	0.004	-31.57	0.862	-175.71
1.2 GHz	0.974	174.42	0.95	29.94	0.004	-34.88	0.870	-175.56
1.3 GHz	0.970	173.77	0.93	23.76	0.004	-38.51	0.879	-175.44
1.4 GHz	0.966	173.13	0.92	16.98	0.005	-42.62	0.888	-175.35
1.5 GHz	0.961	172.51	0.92	9.40	0.005	-47.40	0.898	-175.28
1.6 GHz	0.954	171.95	0.93	0.77	0.005	-53.11	0.910	-175.28
1.7 GHz	0.947	171.50	0.94	-9.23	0.005	-60.04	0.925	-175.39
1.8 GHz	0.939	171.24	0.95	-20.82	0.006	-68.42	0.941	-175.71
1.9 GHz	0.933	171.20	0.94	-34.02	0.006	-78.25	0.957	-176.32
2.0 GHz	0.931	171.32	0.90	-48.37	0.006	-89.09	0.971	-177.25
2.1 GHz	0.935	171.39	0.83	-62.95	0.006	-100.00	0.979	-178.39
2.2 GHz	0.944	171.20	0.74	-76.66	0.005	-109.90	0.981	-179.50
2.3 GHz	0.954	170.68	0.64	-88.79	0.005	-118.09	0.979	179.57
2.4 GHz	0.963	169.89	0.54	-99.14	0.004	-124.40	0.974	178.85
2.5 GHz	0.971	168.91	0.46	-107.87	0.004	-128.98	0.970	178.30
2.6 GHz	0.976	167.81	0.40	-115.25	0.003	-132.17	0.966	177.87
2.7 GHz	0.981	166.63	0.34	-121.56	0.003	-134.27	0.963	177.52
2.8 GHz	0.984	165.35	0.30	-127.07	0.003	-135.56	0.960	177.20
2.9 GHz	0.986	164.00	0.26	-131.94	0.003	-136.27	0.959	176.90
3.0 GHz	0.988	162.54	0.24	-136.34	0.003	-136.57	0.957	176.61
3.2 GHz	0.990	159.26	0.19	-144.13	0.002	-136.53	0.956	176.02
3.4 GHz	0.991	155.29	0.17	-151.15	0.002	-136.31	0.955	175.41
3.6 GHz	0.991	150.30	0.15	-157.91	0.002	-136.53	0.955	174.76
3.8 GHz	0.990	143.73	0.14	-164.89	0.003	-137.70	0.954	174.06
4.0 GHz	0.988	134.60	0.13	-172.75	0.003	-140.42	0.954	173.32
4.2 GHz	0.985	121.09	0.14	177.52	0.003	-145.66	0.953	172.52
4.4 GHz	0.978	99.57	0.15	164.06	0.004	-155.19	0.952	171.66
4.6 GHz	0.968	63.52	0.16	143.65	0.005	-172.15	0.951	170.72
4.8 GHz	0.961	8.37	0.16	114.18	0.006	161.39	0.949	169.70
5.0 GHz	0.971	-49.39	0.13	83.48	0.005	133.32	0.947	168.55
5.2 GHz	0.984	-89.09	0.09	61.46	0.004	113.61	0.943	167.26
5.4 GHz	0.991	-112.76	0.06	47.31	0.003	101.50	0.939	165.81
5.6 GHz	0.995	-127.38	0.04	37.64	0.003	93.61	0.933	164.16
5.8 GHz	0.996	-137.07	0.03	30.34	0.002	87.89	0.926	162.23
6.0 GHz	0.998	-143.91	0.03	24.30	0.002	83.22	0.916	159.94

To download the s-parameters in s2p format, go to the CGH21240F Product Page and click on the documentation tab.

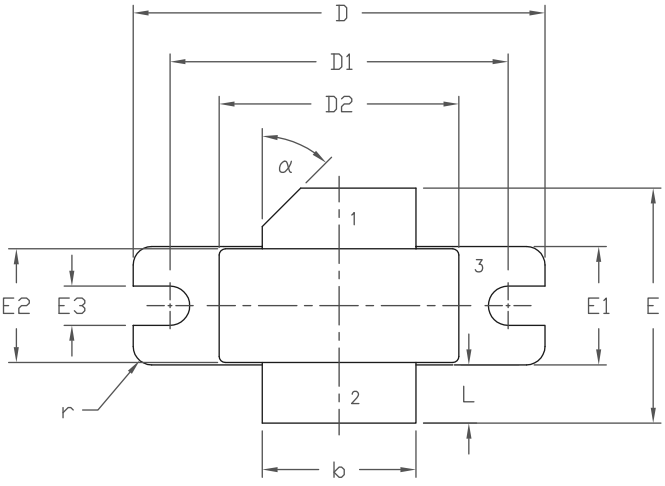
Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

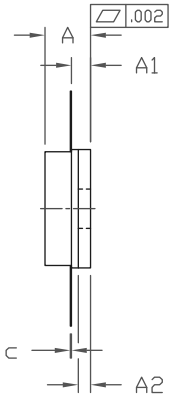
Product Ordering Information

Order Number	Description	Unit of Measure
CGH21240F	GaN HEMT	Each
CGH21240F-AMP	Test board without GaN HEMT	Each
CGH21240F-AMP1	Test board with GaN HEMT installed	Each

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Product Dimensions CGH21240F (Package Type — 440117)





PIN 1. GATE
2. DRAIN
3. SOURCE

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M – 1994.

2. CONTROLLING DIMENSION: INCH.

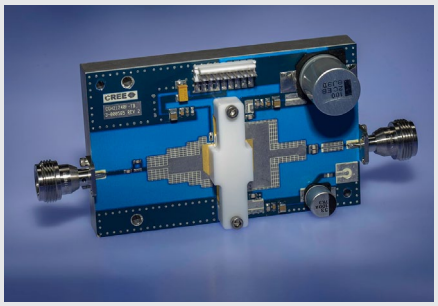
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.

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	0.138	0.158	3.51	4.01	
A1	0.057	0.067	1.45	1.70	
A2	0.035	0.045	0.89	1.14	
b	0.495	0.505	12.57	12.83	2x
c	0.003	0.006	0.08	0.15	
D	1.335	1.345	33.91	34.16	
D1	1.095	1.105	27.81	28.07	
D2	0.773	0.787	19.63	20.00	
E	0.745	0.785	18.92	19.94	
E1	0.380	0.390	9.65	9.91	
E2	0.365	0.375	9.72	9.53	
E3	0.123	0.133	3.12	3.38	
L	0.170	0.210	4.32	5.33	2x
r	0.06 TYP		0.06 TYP		4x
α	45° REF		45° REF		

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH21240F	GaN HEMT	Each	
CGH21240F-TB	Test board without GaN HEMT	Each	
CGH21240F-AMP	Test board with GaN HEMT installed	Each	

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

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

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

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf