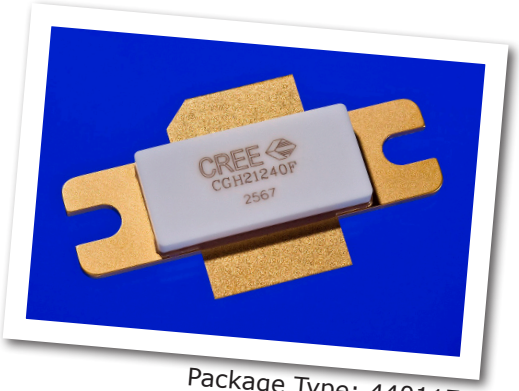
PRELIMINARY

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-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

- 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 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}	115	Watts
Storage Temperature	T_{STG}	-65, +150	˚C
Operating Junction Temperature	T_J	225	˚C
Maximum Forward Gate Current	I_{GMAX}	60	mA
Soldering Temperature[1]	T_S	245	˚C
Screw Torque	τ	80	in-oz
Thermal Resistance, Junction to Case[2]	$R_{\theta JC}$	0.75	˚C/W
Case Operating Temperature[2]	T_C	-40, +150	˚C

Note:
[1] Refer to the Application Note on soldering at www.cree.com/products/wireless_appnotes.asp
[2] 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	-3.3	-2.3	V_{DC}	V_{DS} = 10 V, I_D = 57.6 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-3.0	–	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-TB.
[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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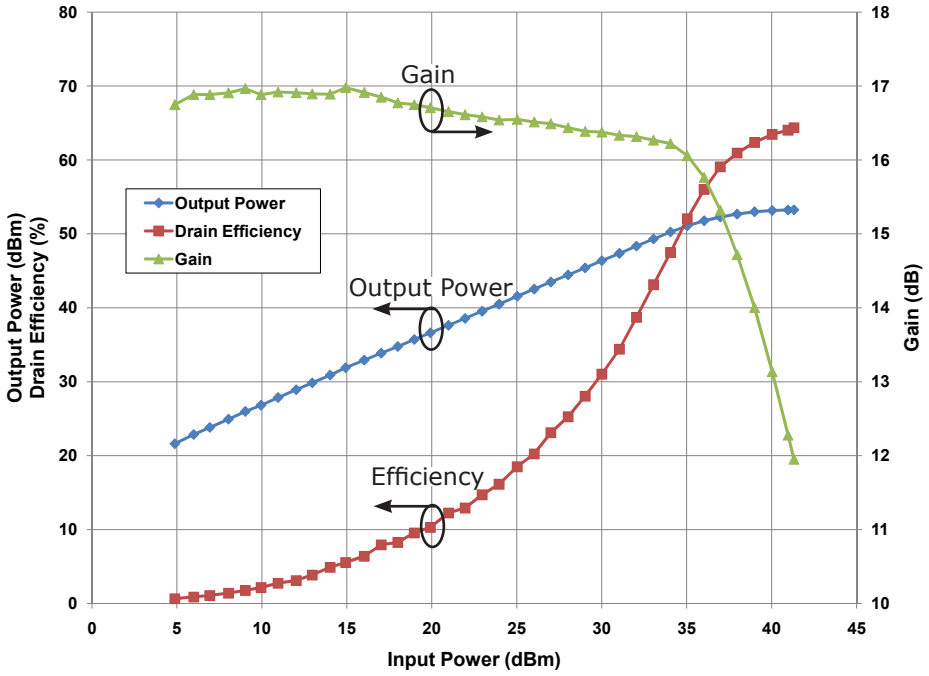
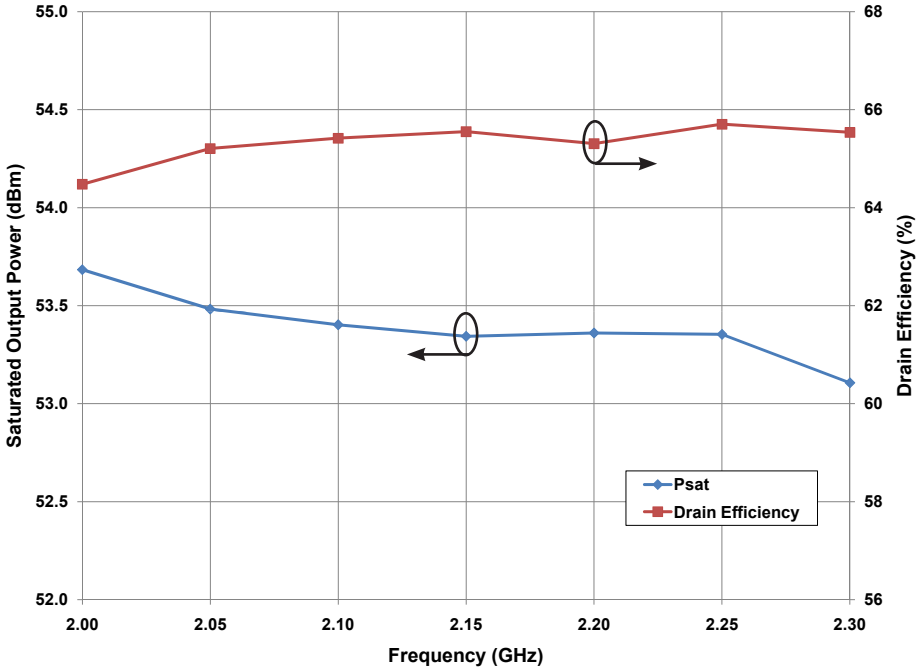
Typical Pulse Performance

Typical Pulsed Output Power, Drain Efficiency, and Gain vs Input Power of the CGH21240F measured in CGH21240F-TB 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-TB 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 %



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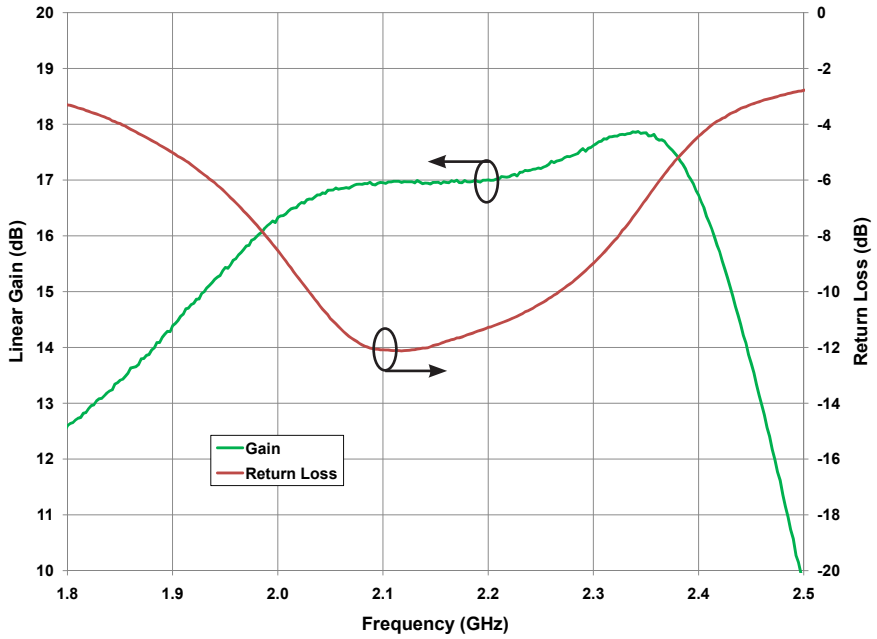
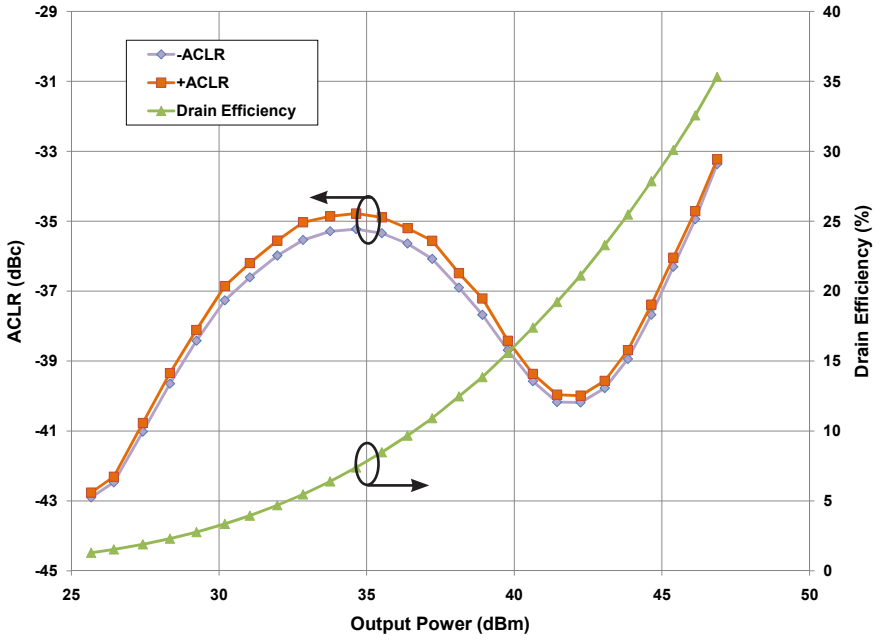
Typical Linear Performance

Typical Small Signal Gain and Return Loss vs Frequency of the CGH21240F measured in CGH21240F-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 CGH21240F measured in CGH21240F-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 = 2.14 GHz



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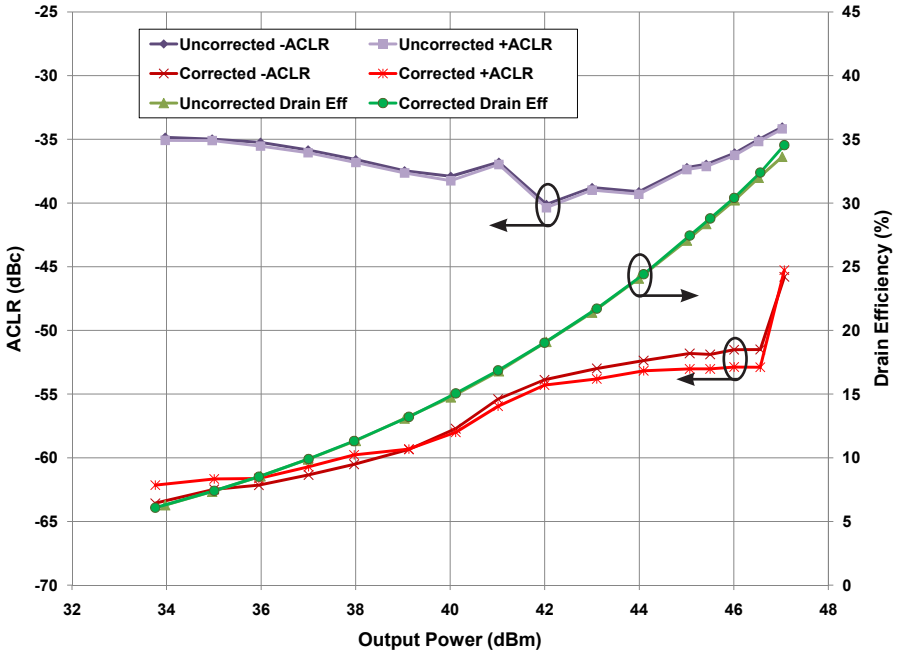
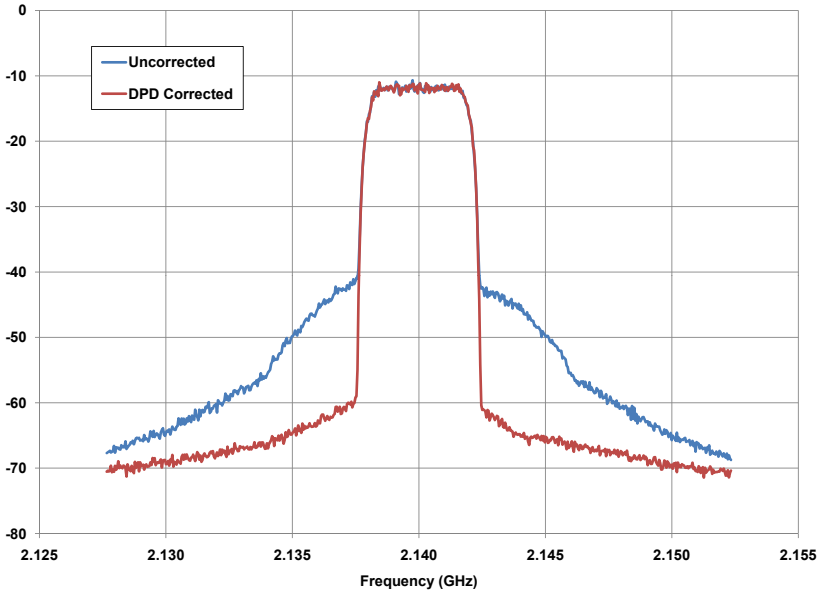
Typical WCDMA Digital Pre-Distortion (DPD) Performance

WCDMA Characteristics with and without DPD Correction
ACLR and Drain Efficiency vs Output Power
of the CGH21240F measured in CGH21240F-TB 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-TB 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 %



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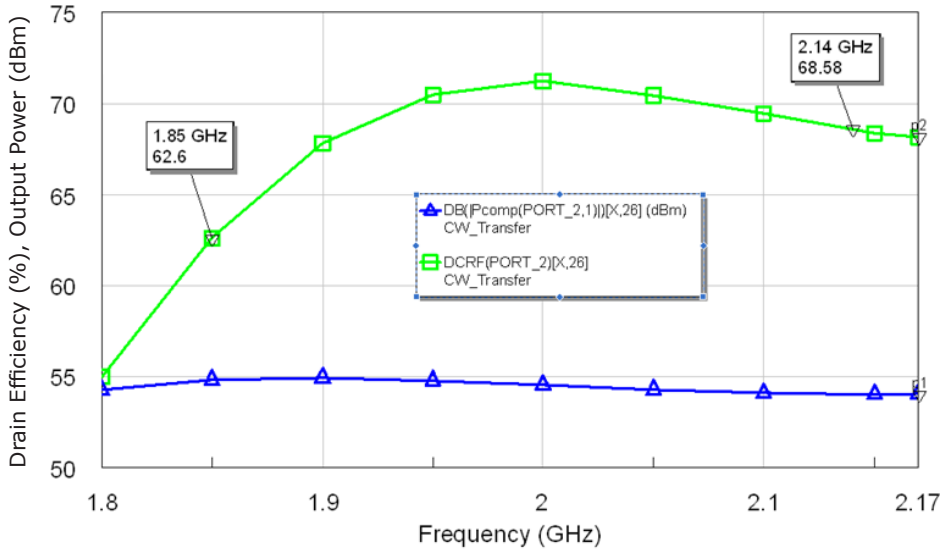
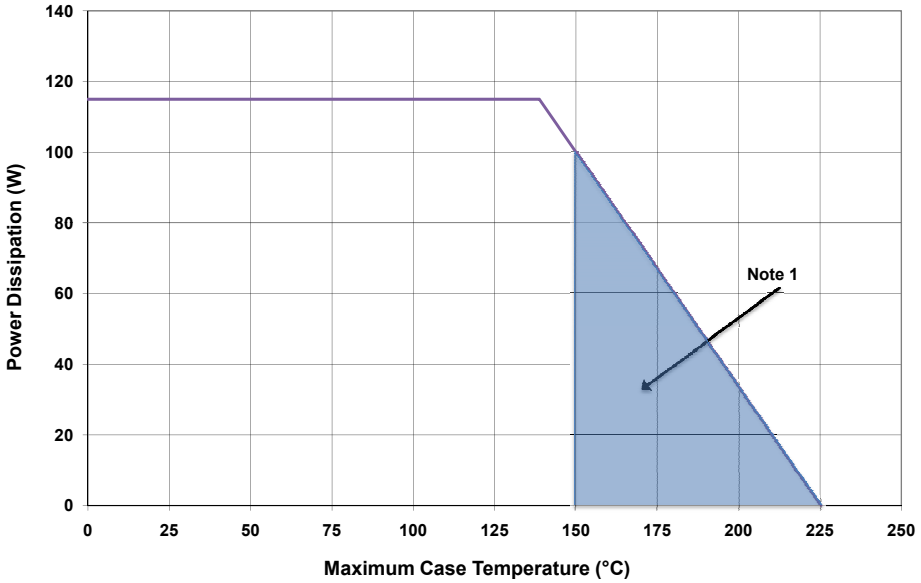
Typical Performance

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).

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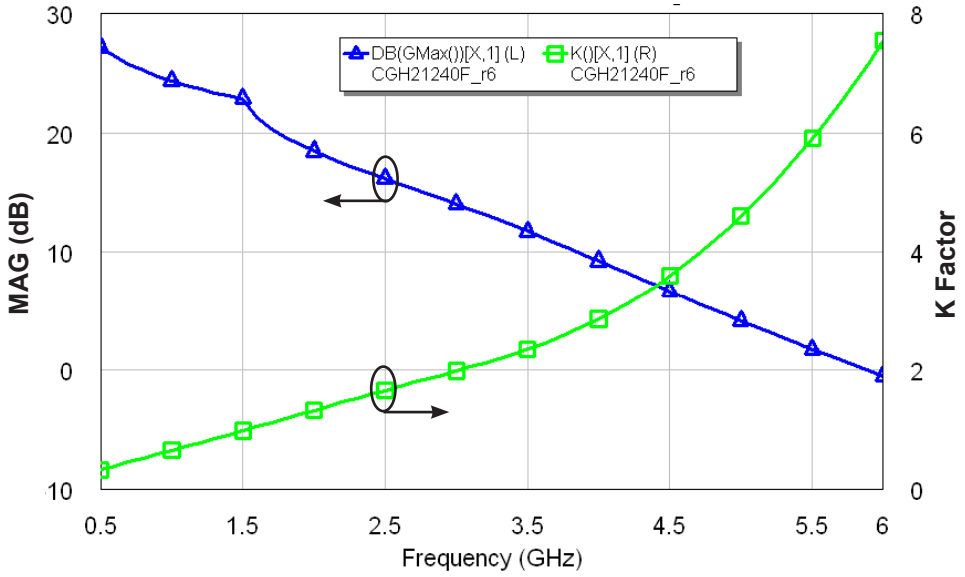
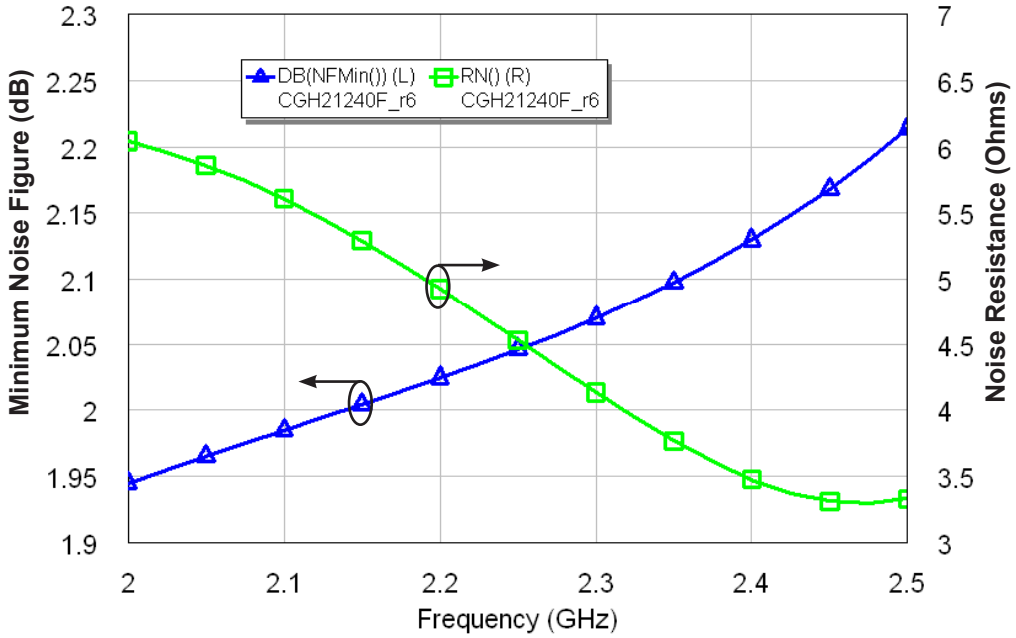
Typical Performance

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



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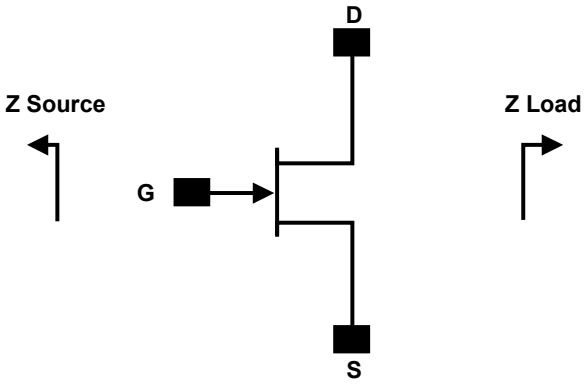
Source and Load Impedances



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-TB 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	1 < 200 V	JEDEC JESD22 C101-C

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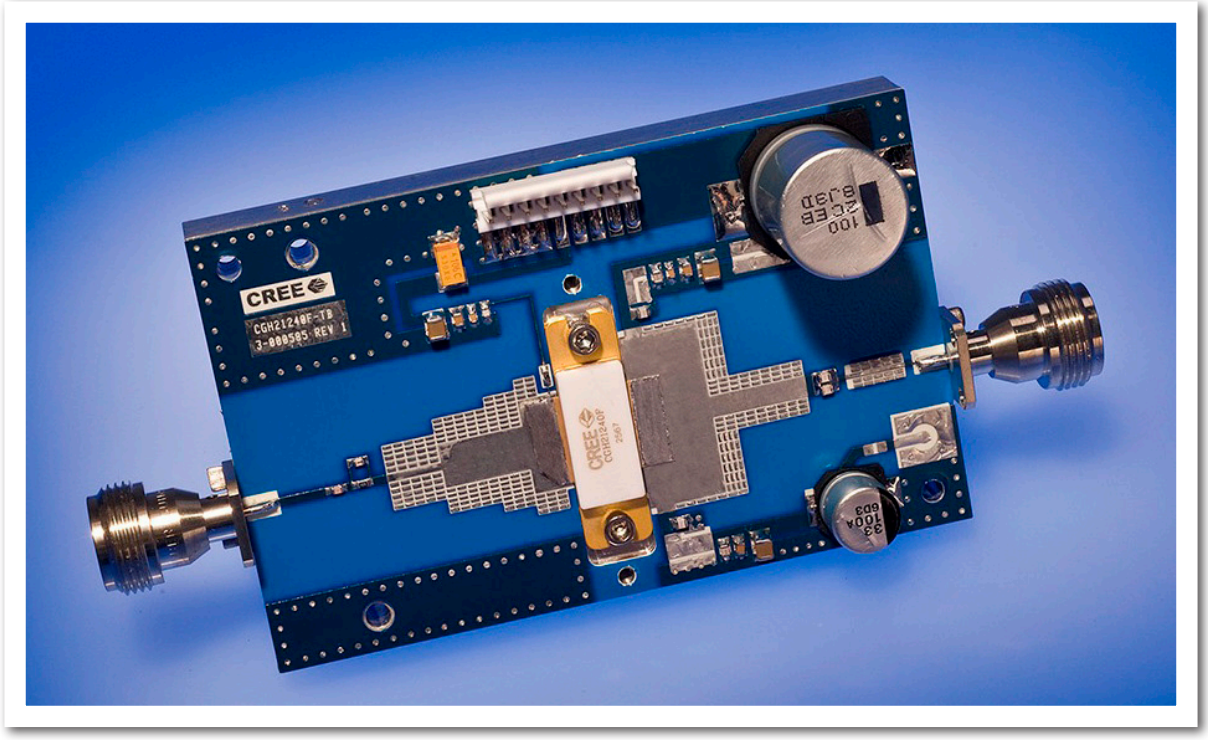
CGH21240F-TB Demonstration Amplifier Circuit Bill of Materials

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-TB Demonstration Amplifier Circuit



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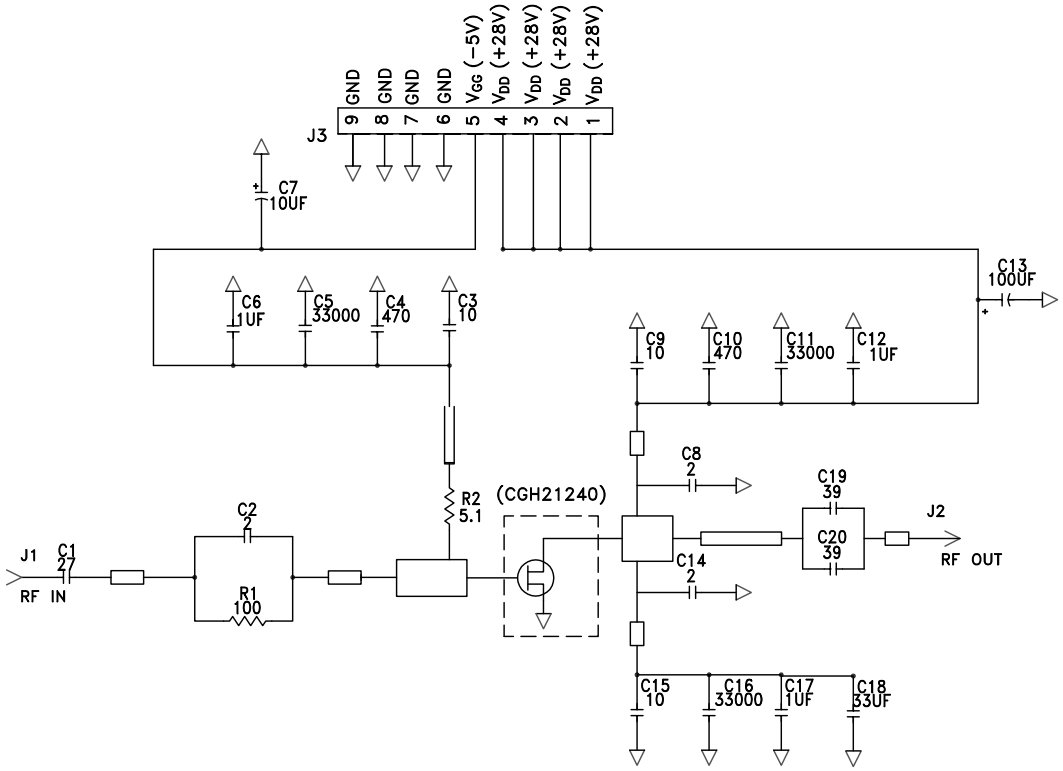
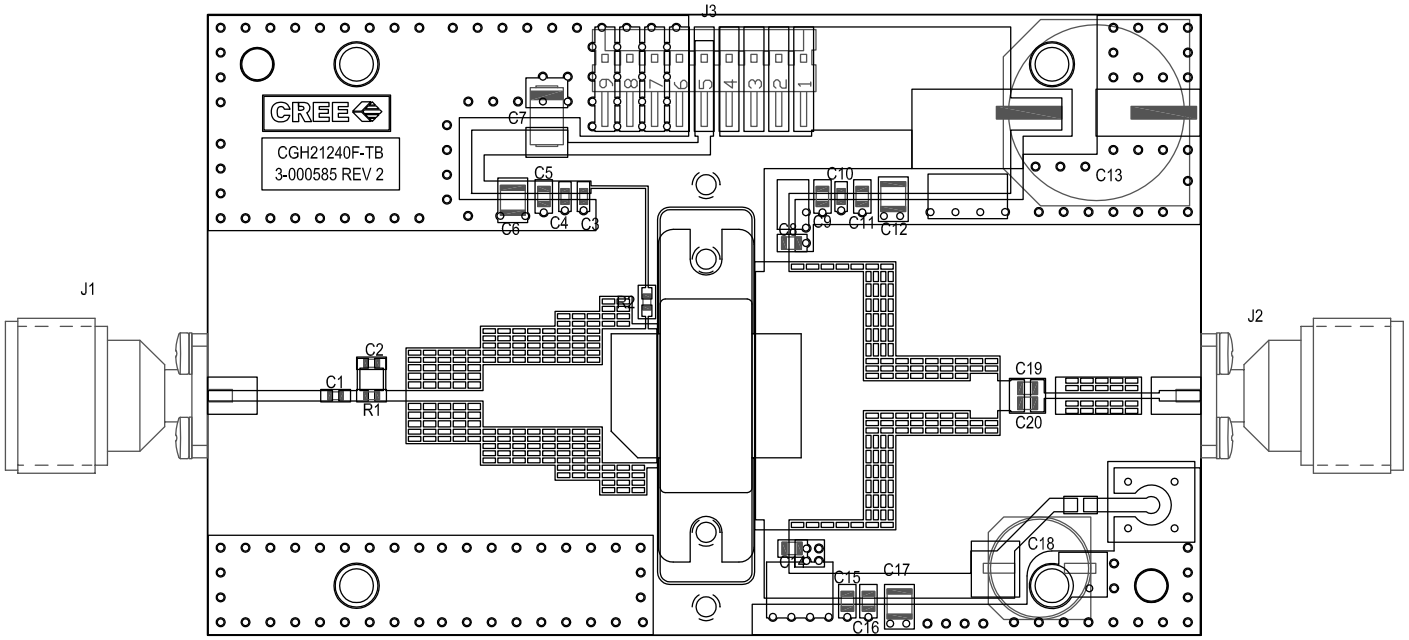
CGH21240F-TB Demonstration Amplifier Circuit Schematic



CGH21240F-TB Demonstration Amplifier Circuit Outline



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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

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

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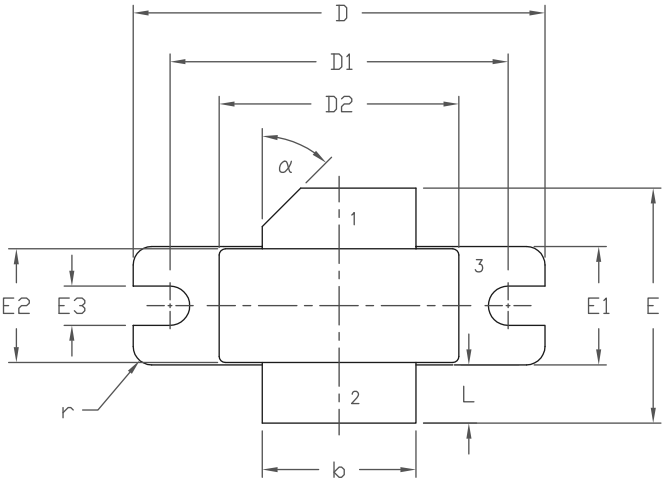
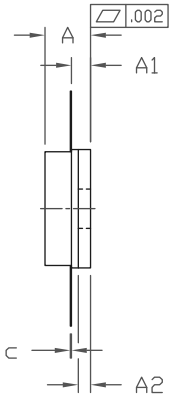
Product Dimensions CGH21240F (Package Type — 440117)





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		

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