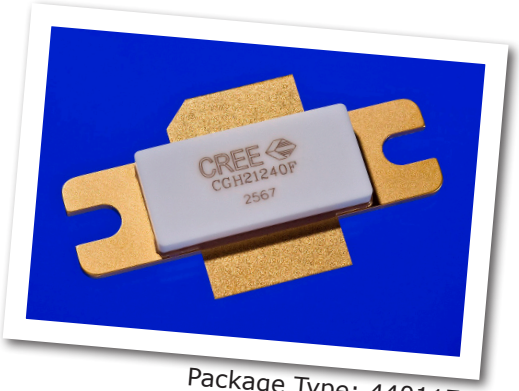
PRELIMINARY

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}	-55, +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, +105	˚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	VDC	V_{DS} = 10 V, I_D = 57.6 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}	46.4	56.0	–	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 = 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
Dynamic Characteristics						
Input Capacitance[7]	C_{GS}	–	159	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance[7]	C_{DS}	–	17	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	4.8	–	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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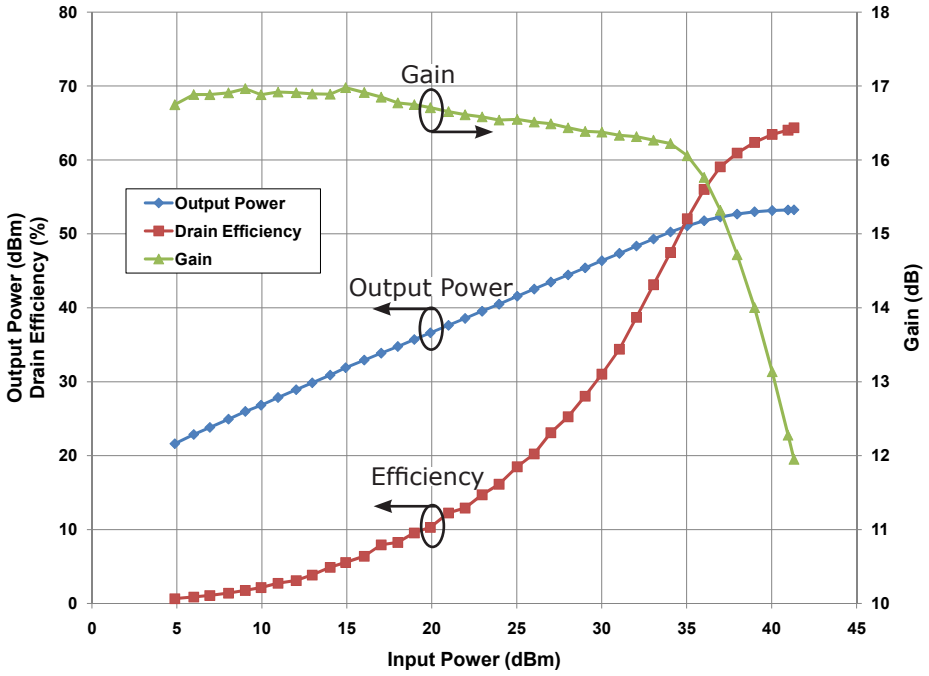
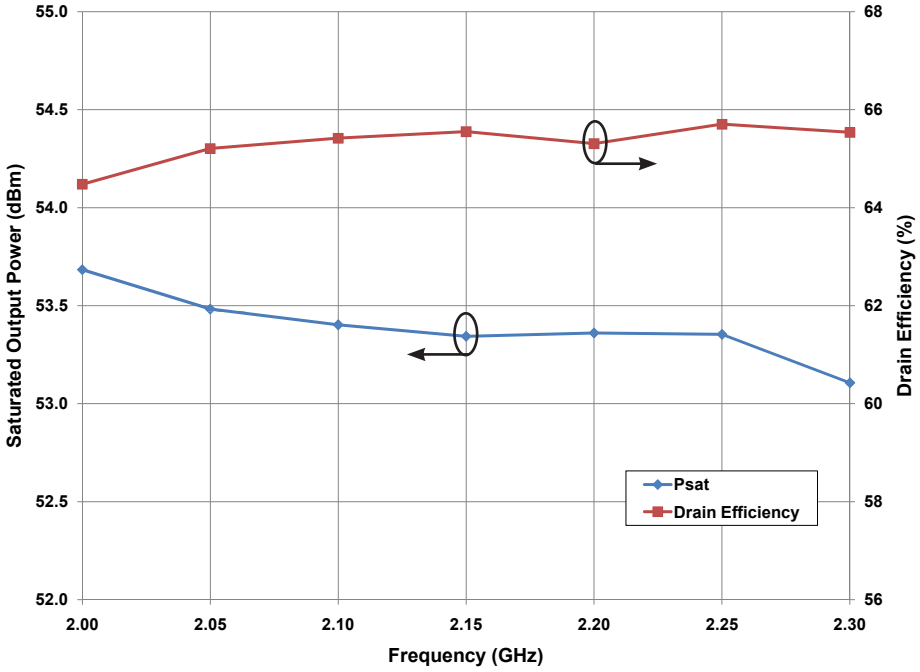
Typical Pulse Performance

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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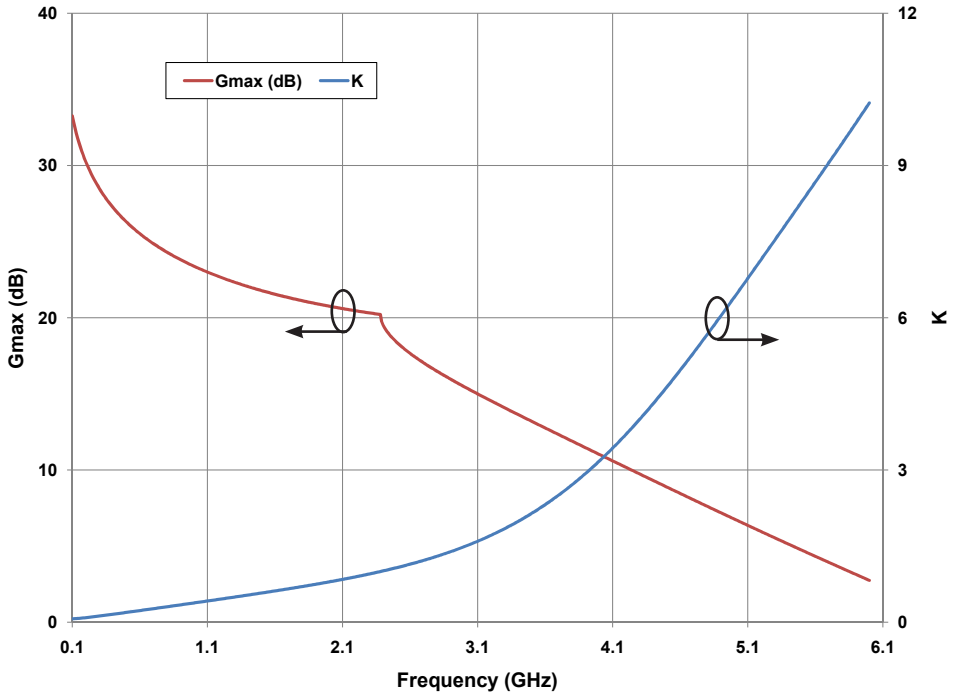
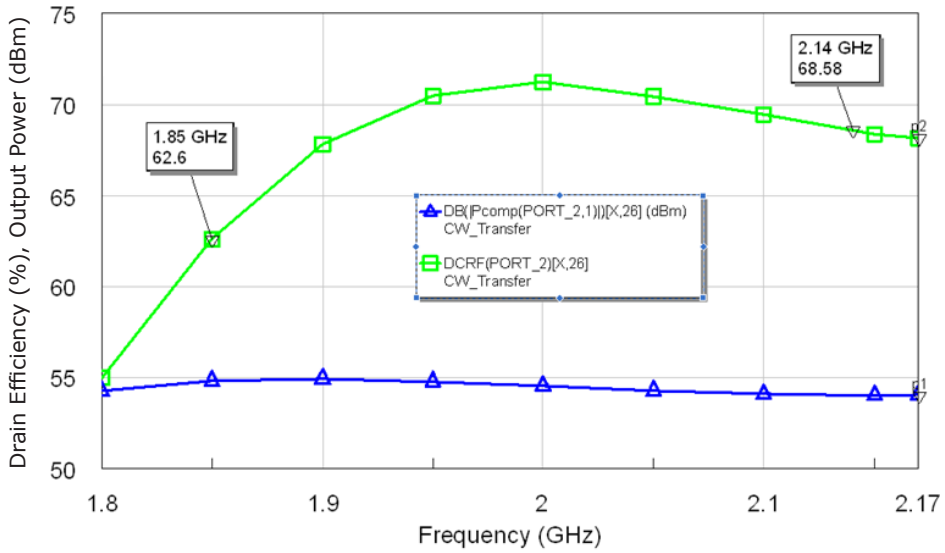
Typical Performance

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



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



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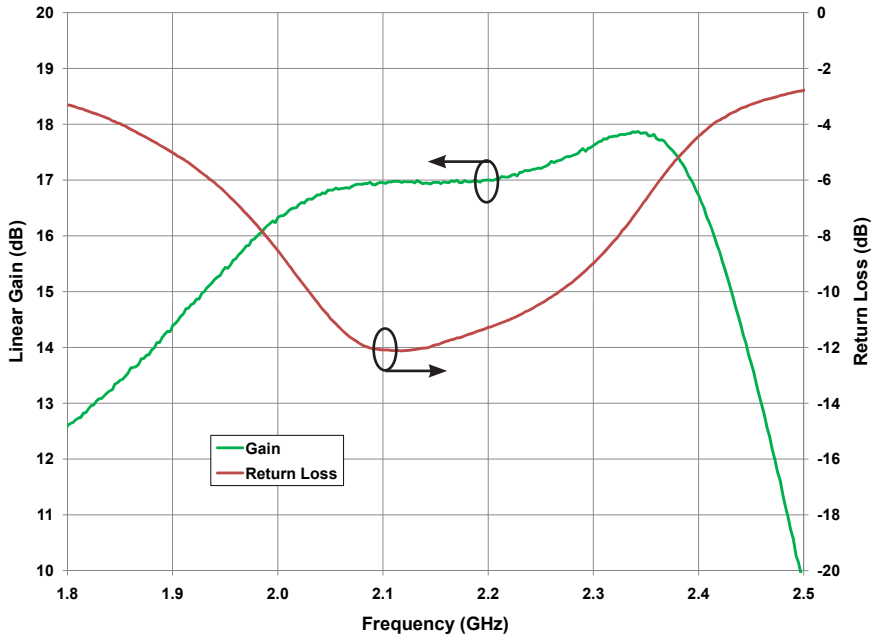
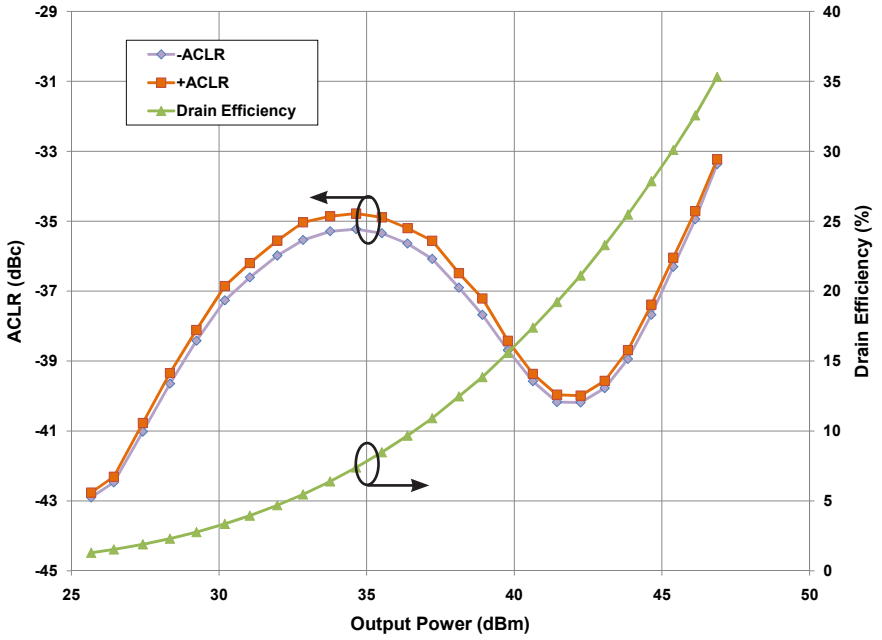
Typical Linear Performance

Typical Small Signal Gain and Return Loss vs Frequency of the 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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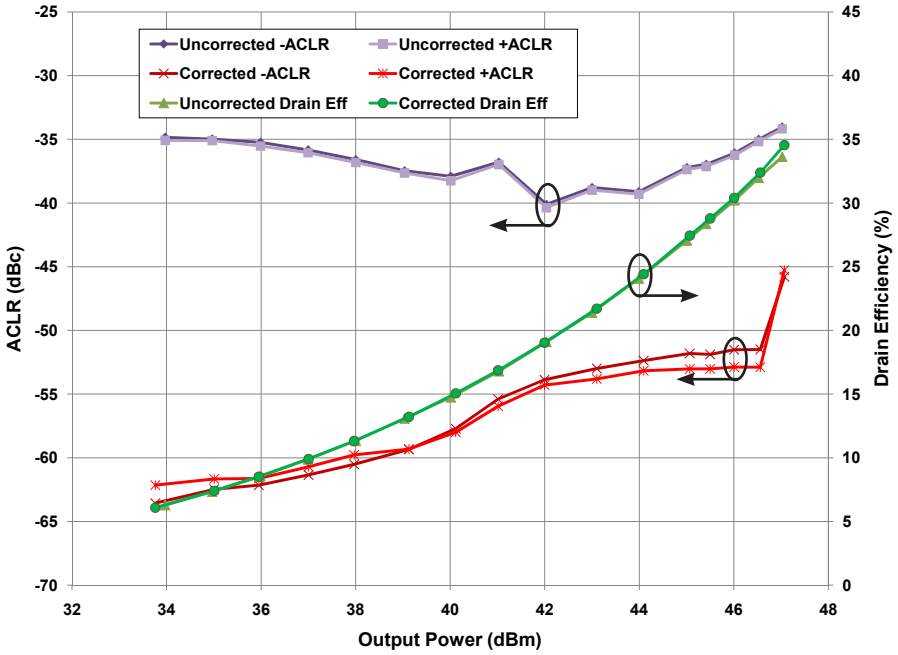
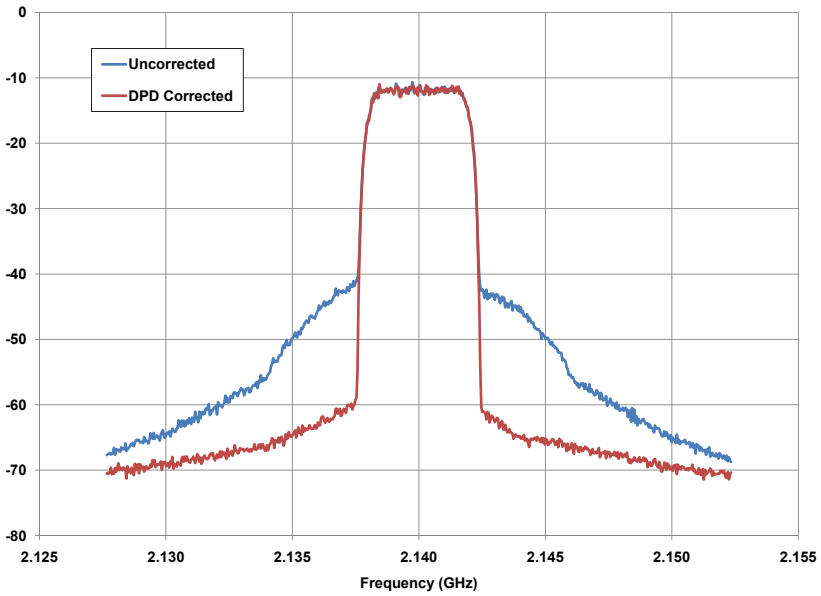
Typical WCDMA Digital Pre-Distortion (DPD) Performance

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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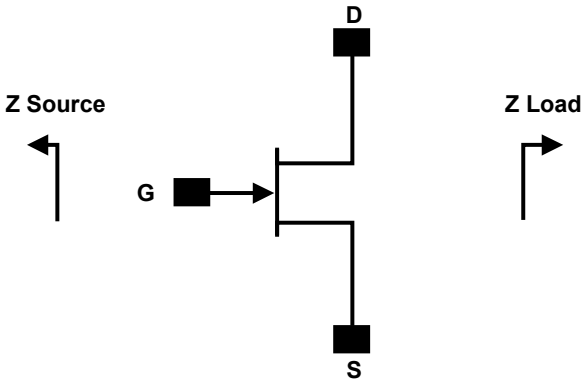
Source and Load Impedances



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.

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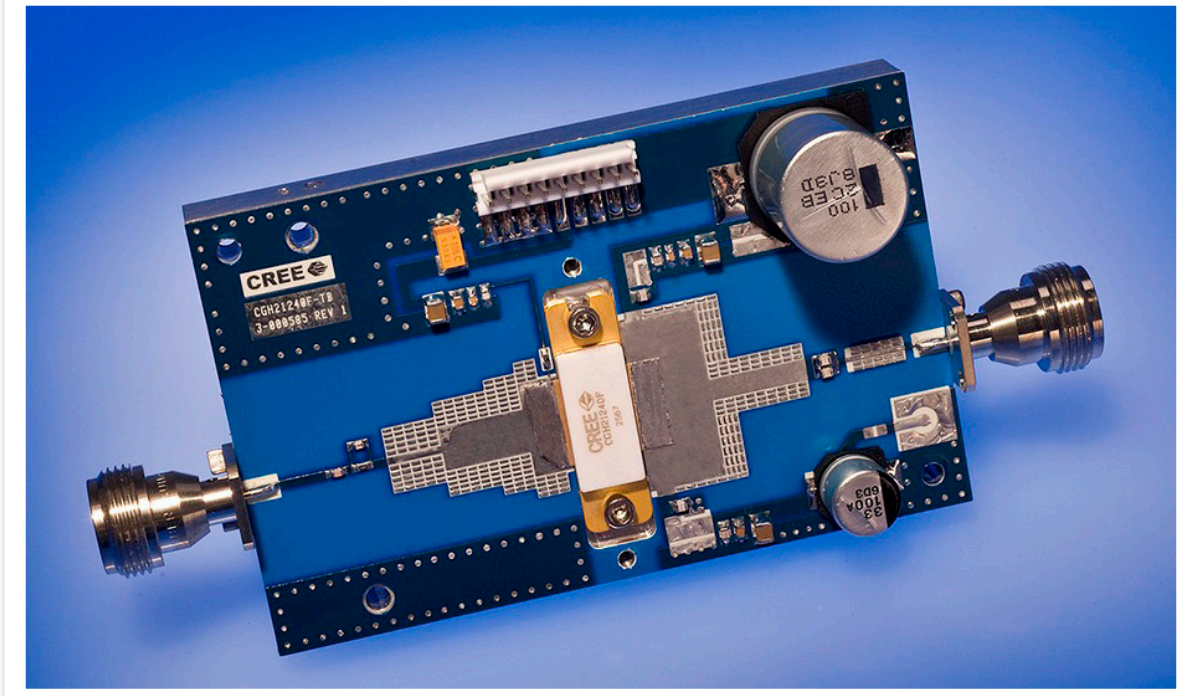
CGH21240F-TB Demonstration Amplifier Circuit Bill of Materials

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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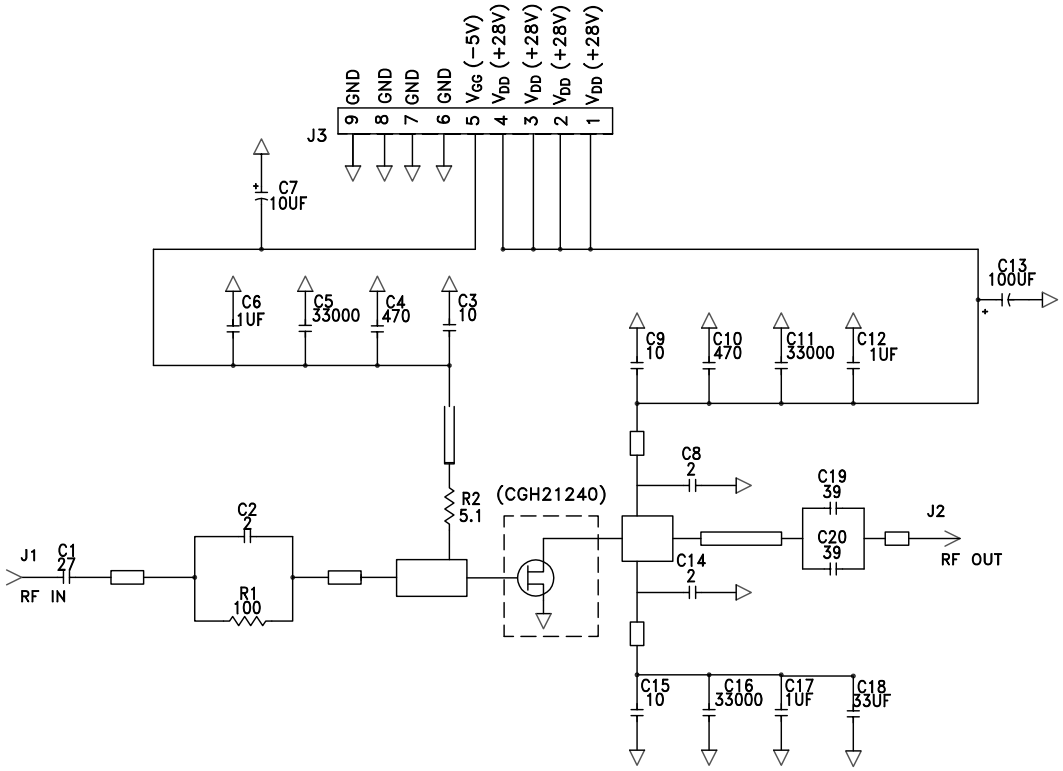
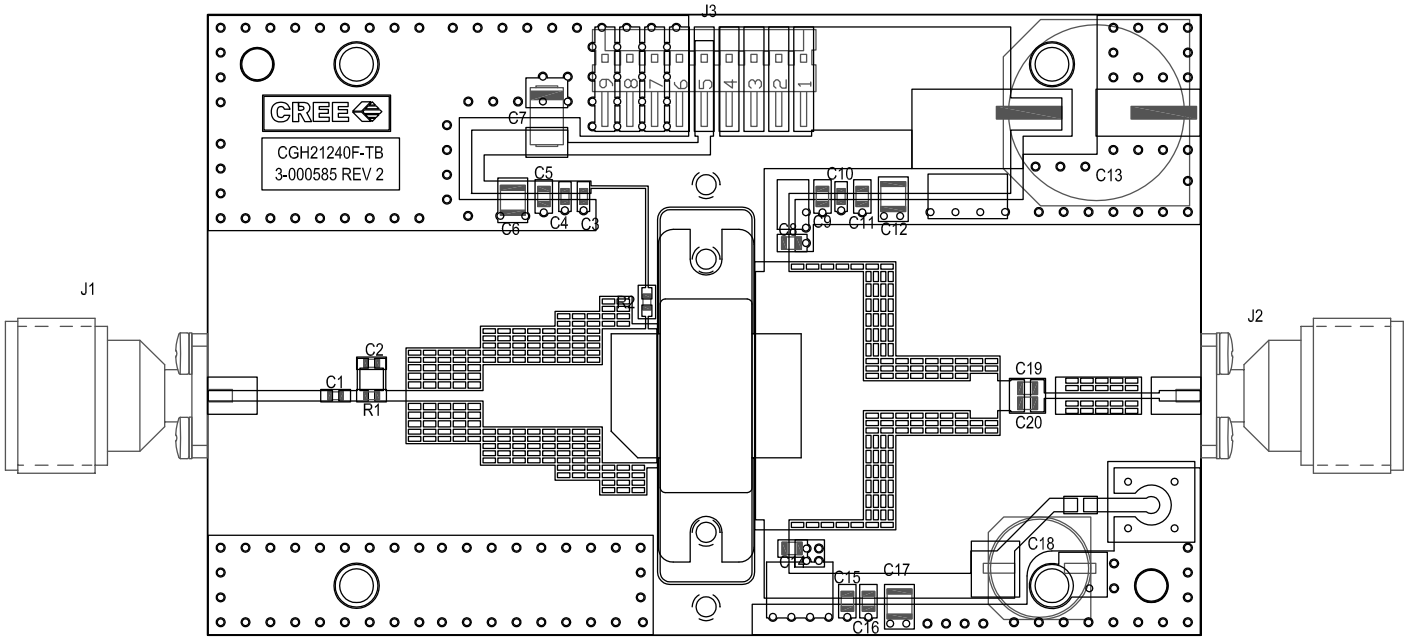
CGH21240F-TB Demonstration Amplifier Circuit Schematic



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	0.980	179.34	1.82	68.41	0.004	-16.83	0.843	-177.47
600 MHz	0.980	178.76	1.54	63.70	0.004	-20.56	0.847	-177.15
700 MHz	0.979	178.24	1.35	58.96	0.004	-24.32	0.852	-176.83
800 MHz	0.978	177.74	1.21	54.12	0.004	-28.15	0.858	-176.53
900 MHz	0.977	177.27	1.11	49.17	0.005	-32.09	0.864	-176.25
1.0 GHz	0.975	176.81	1.03	44.03	0.005	-36.21	0.871	-176.00
1.1 GHz	0.973	176.35	0.98	38.65	0.005	-40.55	0.879	-175.77
1.2 GHz	0.970	175.91	0.94	32.94	0.005	-45.20	0.888	-175.57
1.3 GHz	0.967	175.48	0.91	26.80	0.005	-50.26	0.898	-175.42
1.4 GHz	0.964	175.08	0.89	20.11	0.006	-55.85	0.910	-175.32
1.5 GHz	0.959	174.71	0.88	12.71	0.006	-62.12	0.923	-175.31
1.6 GHz	0.954	174.41	0.87	4.43	0.006	-69.25	0.938	-175.44
1.7 GHz	0.949	174.21	0.87	-4.88	0.006	-77.37	0.954	-175.76
1.8 GHz	0.944	174.12	0.86	-15.32	0.007	-86.60	0.971	-176.34
1.9 GHz	0.941	174.17	0.84	-26.83	0.007	-96.86	0.987	-177.22
2.0 GHz	0.941	174.29	0.80	-39.09	0.007	-107.83	0.998	-178.36
2.1 GHz	0.944	174.38	0.74	-51.56	0.006	-118.97	1.003	-179.62
2.2 GHz	0.950	174.33	0.67	-63.59	0.006	-129.62	1.002	179.17
2.3 GHz	0.958	174.09	0.59	-74.66	0.005	-139.26	0.996	178.15
2.4 GHz	0.965	173.66	0.51	-84.50	0.005	-147.63	0.988	177.38
2.5 GHz	0.972	173.10	0.45	-93.11	0.004	-154.70	0.980	176.82
2.6 GHz	0.977	172.44	0.39	-100.57	0.004	-160.58	0.973	176.43
2.7 GHz	0.981	171.72	0.34	-107.08	0.003	-165.42	0.966	176.14
2.8 GHz	0.984	170.96	0.29	-112.78	0.003	-169.40	0.961	175.91
2.9 GHz	0.987	170.16	0.26	-117.83	0.003	-172.65	0.957	175.72
3.0 GHz	0.989	169.33	0.23	-122.36	0.003	-175.30	0.954	175.54
3.2 GHz	0.992	167.55	0.19	-130.23	0.002	-179.15	0.950	175.17
3.4 GHz	0.993	165.57	0.16	-136.97	0.002	178.49	0.947	174.78
3.6 GHz	0.994	163.32	0.13	-142.99	0.002	177.26	0.946	174.33
3.8 GHz	0.995	160.69	0.12	-148.57	0.001	176.89	0.944	173.82
4.0 GHz	0.995	157.54	0.11	-153.94	0.001	177.14	0.943	173.26
4.2 GHz	0.995	153.65	0.10	-159.32	0.001	177.75	0.942	172.63
4.4 GHz	0.995	148.67	0.10	-164.98	0.001	178.40	0.941	171.94
4.6 GHz	0.994	142.05	0.10	-171.25	0.001	178.65	0.939	171.18
4.8 GHz	0.992	132.78	0.10	-178.69	0.002	177.81	0.937	170.34
5.0 GHz	0.989	118.99	0.11	171.73	0.002	174.76	0.935	169.41
5.2 GHz	0.985	97.01	0.12	158.15	0.002	167.51	0.932	168.38
5.4 GHz	0.977	60.47	0.14	137.44	0.003	152.80	0.928	167.23
5.6 GHz	0.973	5.73	0.14	107.87	0.003	128.82	0.923	165.93
5.8 GHz	0.980	-50.47	0.12	77.49	0.003	103.59	0.917	164.44
6.0 GHz	0.989	-89.10	0.08	55.55	0.002	86.33	0.909	162.74

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

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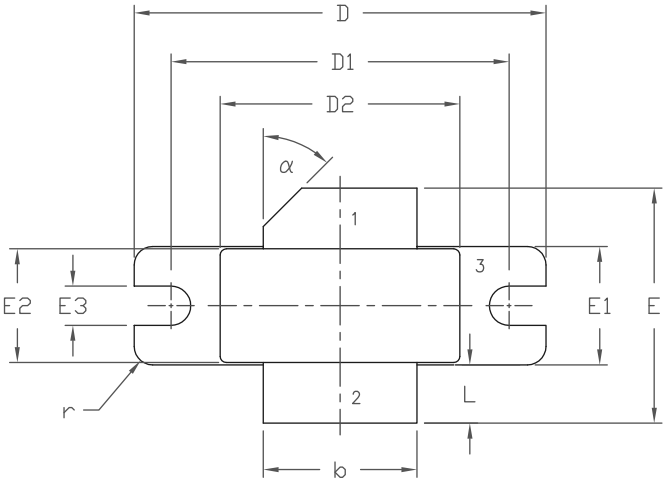
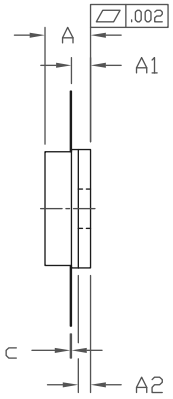
Product Dimensions CGH21240F (Package Type — 440117)





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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