

CGH31240F

240 W, 2700-3100 MHz, GaN HEMT for S-Band Radar Systems

Cree's CGH31240F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically with high efficiency, high gain and wide bandwidth capabilities, which makes the CGH31240F ideal for 2.7-3.1GHz S-Band radar amplifier applications. The transistor is supplied in a ceramic/metal flange package.



Package Type: 440117
PN: CGH31240F

Typical Performance Over 2.7-3.1GHz ($T_c = 25^\circ\text{C}$) of Demonstration Amplifier

Parameter	2.7 GHz	2.8 GHz	2.9 GHz	3.0 GHz	3.1 GHz	Units
Saturated Output Power	235	240	230	225	220	W
Gain @ P_{SAT}	10.1	10.6	10.6	10.7	10.3	dB
Power Added Efficiency	43	50	53	53	51	%

Note:

Measured in the CGH31240F-TB amplifier circuit, under 300 μs pulse width, 10% duty cycle, where $I_G = 20$ mA peak.

Features

- 2.7 - 3.1 GHz Operation
- 10 dB Gain at Saturated Output Power
- 50 % Power Added Efficiency at Saturated Output Power
- < 0.4 dB Pulsed Amplitude Droop at Saturated Output Power



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_{DS}	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
CW Thermal Resistance, Junction to Case ²	$R_{\theta JC}$	0.75	°C/W
Pulsed Thermal Resistance, Junction to Case ^{2,3}	$R_{\theta JC}$	0.57	°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 CGH31240F at $P_{DISS} = 115$ W

³ Pulse Width = 300 μ S, Duty Cycle = 10%.

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

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics¹						
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^{3,5} ($T_C = 25^\circ\text{C}$, $F_0 = 2.9$ GHz unless otherwise noted)						
Saturated Output Power ⁴	P_{SAT}	-	230	-	W	$V_{DD} = 28$ V, $I_{DQ} = 1.0$ A
Power Added Efficiency	PAE	-	52	-	%	$V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = P_{SAT}$
Gain	G	-	10.5	-	dB	$V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = P_{SAT}$
Pulsed Amplitude Droop	D	-	0.4	-	dB	$V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = P_{SAT}$
Dynamic Characteristics						
Input Capacitance ⁶	C_{GS}	-	99	-	pF	$V_{DS} = 28$ V, $V_{gs} = -8$ V, $f = 1$ MHz
Output Capacitance ⁶	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 = 300 μ S, Duty Cycle = 10%.

⁴ P_{SAT} is defined as $I_G = 20$ mA peak.

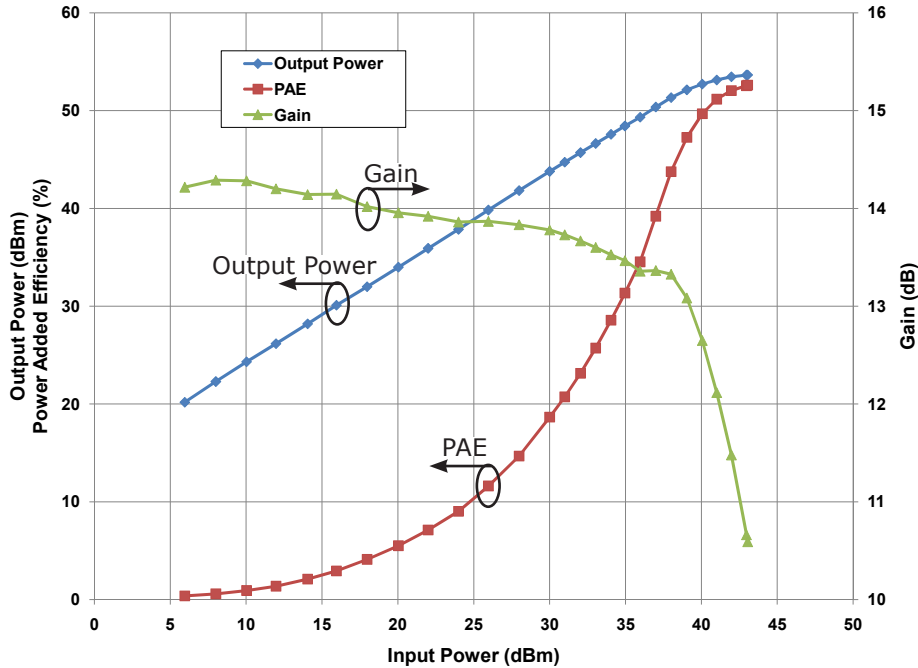
⁵ Measured in CGH31240F-TB.

⁶ Includes package and internal matching components.

Typical Performance

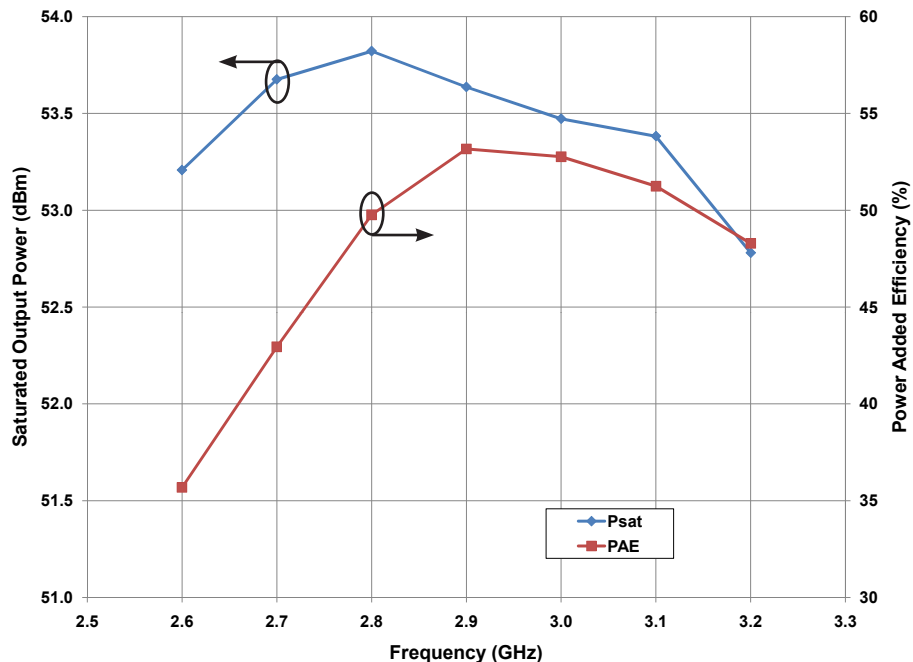
Typical Pulse Characteristics Output Power, PAE, and Gain vs Input Power of the CGH31240F Measured in CGH31240-TB Amplifier Circuit.

$V_{DS} = 28\text{ V}$, $I_{DS} = 1\text{ A}$, Freq = 2.9 GHz, Pulse Width = 300 μs , Duty Cycle = 10%



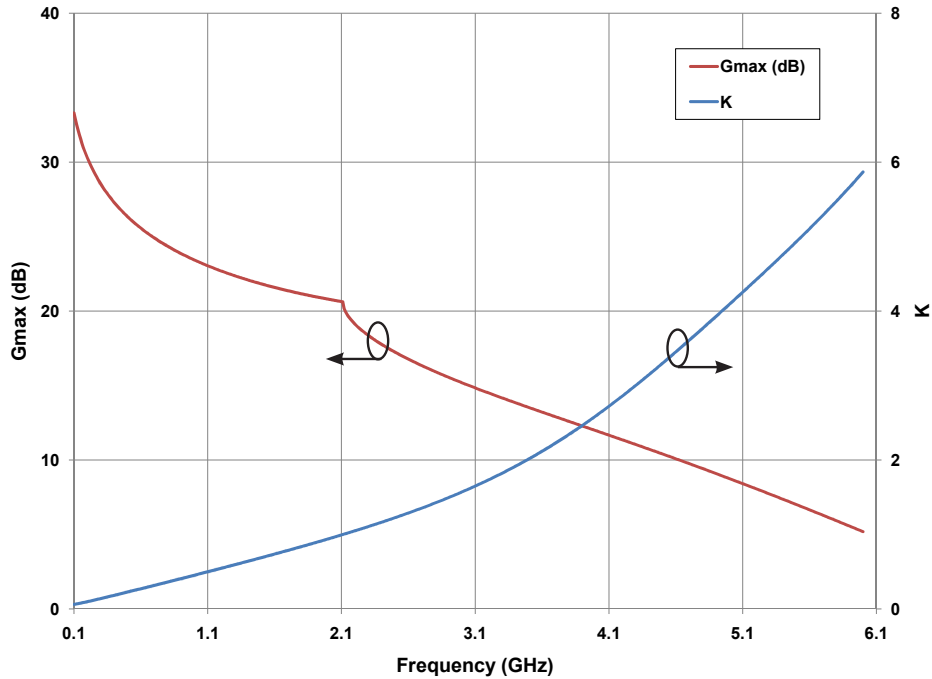
Typical Pulsed Saturated Power and PAE vs Frequency of the CGH31240F Measured in CGH31240-TB Amplifier Circuit.

$V_{DS} = 28\text{ V}$, $I_{DS} = 1\text{ A}$, I_{GS} (at P_{SAT}) = 20 mA Peak, Pulse Width = 300 μs , Duty Cycle = 10%

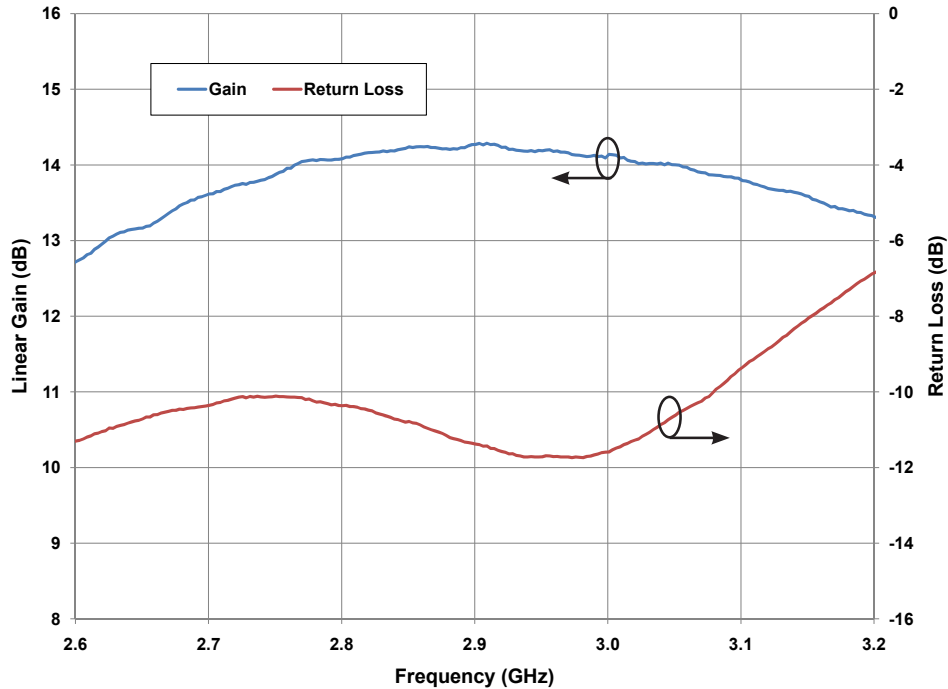


Typical Performance

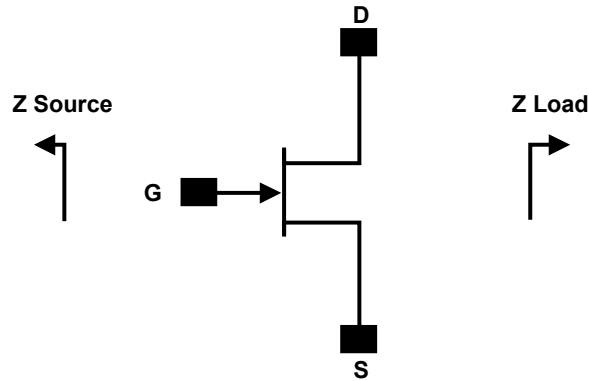
Simulated Maximum Available Gain and K Factor of the CGH31240F
 $V_{DD} = 28\text{ V}, I_{DQ} = 1.0\text{ A}$



Typical Small Signal Gain and Return Loss vs Frequency of the CGH31240F Measured in CGH31240-TB Amplifier Circuit.
 $V_{DS} = 28\text{ V}, I_{DS} = 1\text{ A}$



Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
2700	5.53 - j 4.54	1.37 - j 2.61
2800	5.31 - j 4.20	1.39 - j 2.37
2900	5.18 - j 3.92	1.40 - j 2.19
3000	5.11 - j 3.71	1.37 - j 2.06
3100	5.06 - j 3.59	1.27 - j 1.94

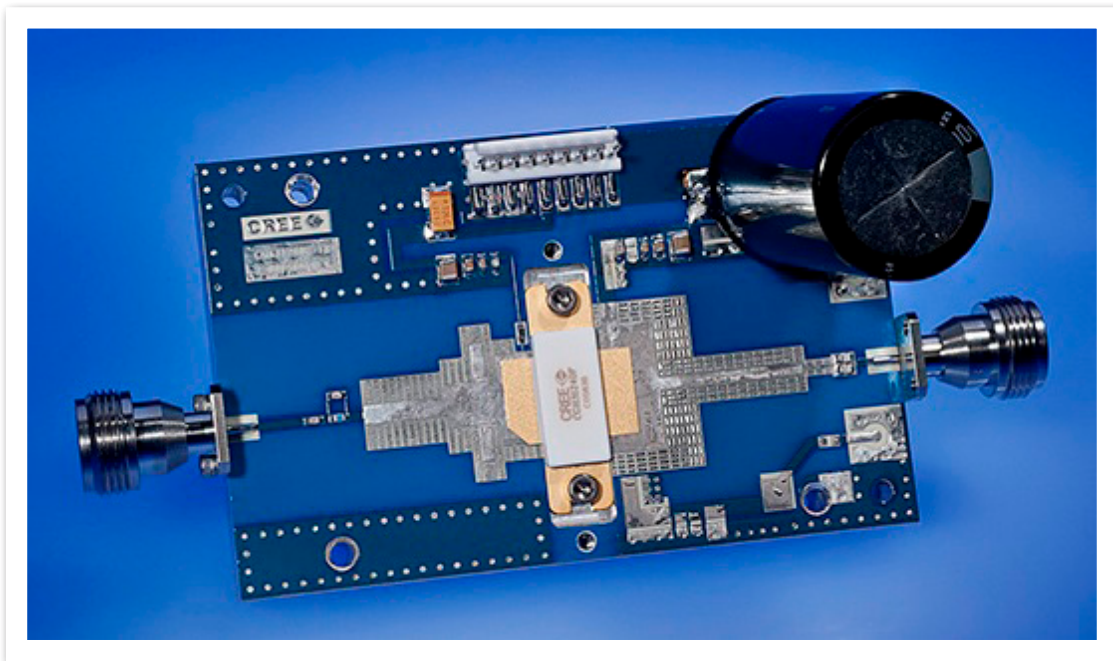
Note¹ $V_{DD} = 28 \text{ V}$, $I_{DQ} = 1.0 \text{ A}$ in the 440117 package.

Note² Impedances are extracted from CGH31240F-TB demonstration circuit and are not source and load pull data derived from transistor.

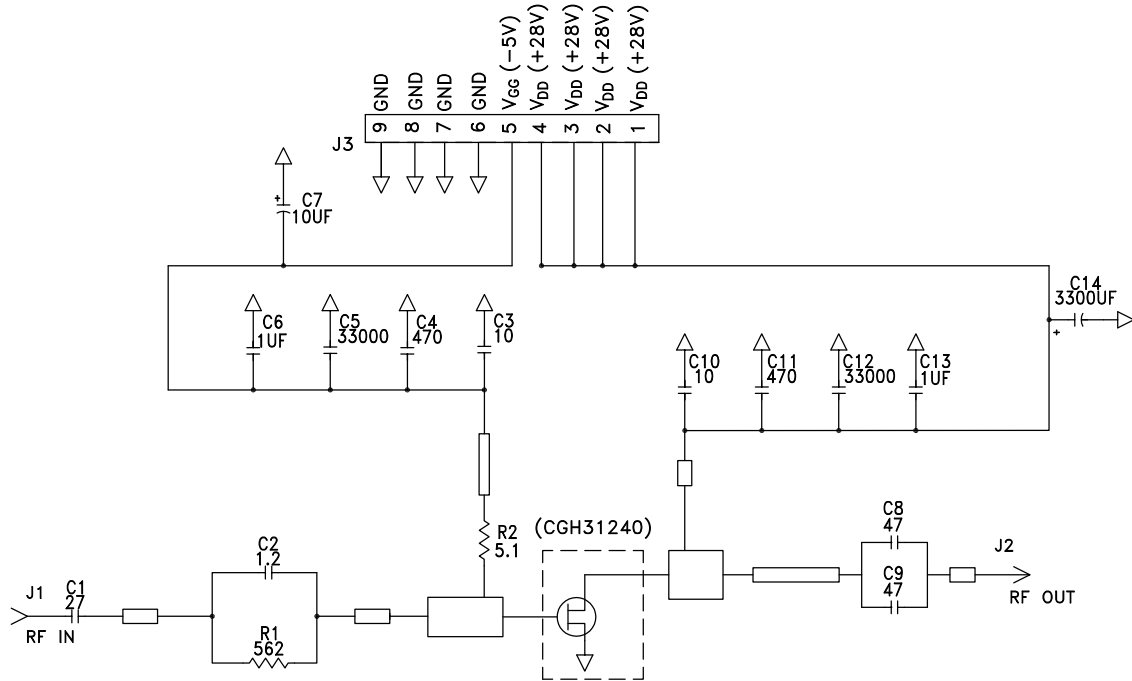
CGH31240F-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16W, 0603, 1%, 562 OHMS	1
R2	RES, 1/16W, 0603, 1%, 5.1 OHMS	1
C1	CAP, 27pF, +/-5%, 0603, ATC600S	1
C2	CAP, 1.2pF, +/-0.1pF, 0603, ATC600S	1
C3	CAP, 10.0pF, +/-5%, 0603, ATC600S	1
C4,C11	CAP, 470pF, 5%, 100V, 0603, X7R	2
C5,C12	CAP, 33000pF, 0805,100V, X7R	2
C6,C13	CAP, 1.0UF, 100V, 10%, X7R, 1210	2
C7	CAP, 10UF, 16V, TANTALUM	1
C8,C9	CAP, 47pF, +/- 5%, 250V, 0805, ATC600F	2
C10	CAP, 10pF, +/- 1%, 250V, 0805, ATC600F	1
C14	CAP, 3300 UF, +/-20%, 100V, ELECTROLYTIC, VR, RADIAL	1
J1,J2	CONN, N, FEM, W/.500", SMA, FLANGE	1
J3	HEADER, RT>PLZ, 0.1 CEN, LK, 9 POS	1
-	PCB, RO4350, 0.020 THK	1
-	CGH31240	1

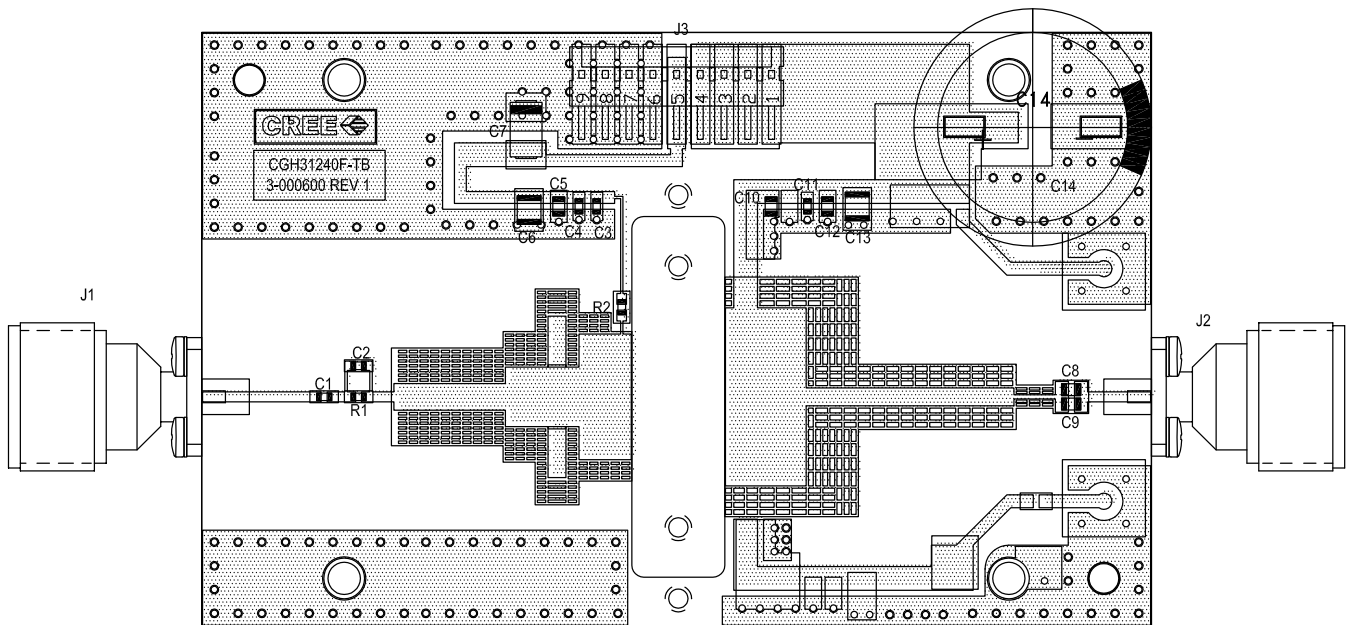
CGH31240F-TB Demonstration Amplifier Circuit



CGH31240F-TB Demonstration Amplifier Circuit Schematic



CGH31240F-TB-TB Demonstration Amplifier Circuit Outline



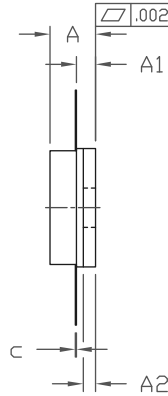
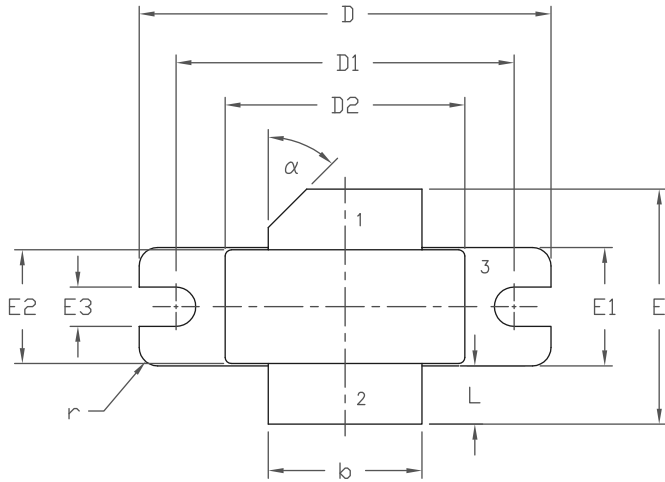


Typical Package S-Parameters for CGH31240F
(Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 1.0\text{ A}$, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.976	178.73	1.98	73.16	0.005	-12.05	0.871	-178.95
600 MHz	0.976	177.98	1.66	69.54	0.005	-14.67	0.873	-178.90
700 MHz	0.975	177.28	1.44	65.97	0.005	-17.24	0.876	-178.85
800 MHz	0.974	176.59	1.28	62.43	0.005	-19.77	0.878	-178.81
900 MHz	0.973	175.92	1.16	58.92	0.005	-22.26	0.881	-178.78
1.0 GHz	0.972	175.24	1.07	55.41	0.005	-24.73	0.884	-178.77
1.1 GHz	0.971	174.55	0.99	51.91	0.005	-27.19	0.887	-178.77
1.2 GHz	0.969	173.84	0.94	48.39	0.005	-29.64	0.890	-178.78
1.3 GHz	0.967	173.11	0.89	44.84	0.005	-32.10	0.893	-178.81
1.4 GHz	0.965	172.34	0.86	41.24	0.005	-34.59	0.897	-178.86
1.5 GHz	0.962	171.54	0.84	37.57	0.005	-37.13	0.900	-178.91
1.6 GHz	0.958	170.68	0.82	33.79	0.006	-39.74	0.904	-178.98
1.7 GHz	0.954	169.78	0.81	29.87	0.006	-42.47	0.907	-179.05
1.8 GHz	0.948	168.80	0.82	25.75	0.006	-45.36	0.911	-179.14
1.9 GHz	0.941	167.76	0.82	21.38	0.007	-48.47	0.915	-179.23
2.0 GHz	0.932	166.64	0.84	16.66	0.007	-51.89	0.919	-179.33
2.1 GHz	0.920	165.45	0.87	11.50	0.007	-55.71	0.924	-179.44
2.2 GHz	0.905	164.18	0.91	5.75	0.008	-60.08	0.929	-179.57
2.3 GHz	0.885	162.89	0.95	-0.78	0.009	-65.17	0.935	-179.72
2.4 GHz	0.858	161.68	1.01	-8.31	0.010	-71.22	0.941	-179.92
2.5 GHz	0.824	160.74	1.07	-17.12	0.010	-78.49	0.949	179.80
2.6 GHz	0.783	160.50	1.14	-27.46	0.011	-87.22	0.958	179.38
2.7 GHz	0.739	161.55	1.19	-39.44	0.012	-97.53	0.967	178.77
2.8 GHz	0.705	164.31	1.22	-52.81	0.013	-109.17	0.973	177.96
2.9 GHz	0.696	168.23	1.19	-66.87	0.013	-121.42	0.976	177.03
3.0 GHz	0.716	171.64	1.13	-80.59	0.012	-133.25	0.974	176.13
3.2 GHz	0.794	173.35	0.93	-104.03	0.010	-152.66	0.962	174.82
3.4 GHz	0.857	170.42	0.75	-121.38	0.009	-165.62	0.952	174.05
3.6 GHz	0.894	165.74	0.62	-134.48	0.007	-173.93	0.944	173.47
3.8 GHz	0.913	159.94	0.54	-145.27	0.007	-179.53	0.940	172.89
4.0 GHz	0.920	152.55	0.49	-155.17	0.006	176.16	0.936	172.26
4.2 GHz	0.917	142.36	0.48	-165.45	0.006	171.85	0.933	171.56
4.4 GHz	0.903	126.79	0.50	-177.71	0.007	165.85	0.930	170.78
4.6 GHz	0.871	100.10	0.55	165.21	0.008	155.23	0.927	169.90
4.8 GHz	0.826	51.01	0.60	138.60	0.009	135.14	0.923	168.90
5.0 GHz	0.846	-20.47	0.55	102.53	0.009	105.53	0.919	167.70
5.2 GHz	0.922	-76.76	0.38	71.81	0.007	81.07	0.913	166.34
5.4 GHz	0.964	-107.87	0.25	52.40	0.005	67.60	0.904	164.85
5.6 GHz	0.982	-125.32	0.17	39.82	0.004	60.56	0.893	163.16
5.8 GHz	0.990	-136.11	0.13	30.63	0.003	56.47	0.880	161.21
6.0 GHz	0.994	-143.37	0.10	23.10	0.003	53.59	0.863	158.92

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

Product Dimensions CGH31240F (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.

DIM	INCHES		MILLIMETERS		NOTES
	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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