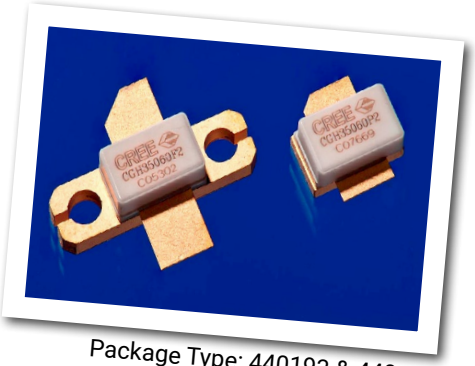
CGH35060F2 / CGH35060P2

60 W, 3100-3500 MHz, 28V, GaN HEMT

Cree's CGH35060F2/P2 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH35060F2 / P2 ideal for 3.1-3.5 GHz S-band pulsed amplifier applications. The transistor is supplied in a ceramic/metal flange and pill package.



Package Type: 440193 & 440206
PN: CGH35060F2 & CGH35060P2

Typical Performance Over 3.1-3.5 GHz (T_C = 25°C) of Demonstration Amplifier

Parameter	3.1 GHz	3.3 GHz	3.5 GHz	Units
Small Signal Gain	12.0	13.2	11.5	dB
P_{OUT} @ P_{IN} = 36.5 dBm	47.0	47.6	46.7	dBm
P_{OUT} @ P_{IN} = 36.5 dBm	10.4	11.06	10.1	dBm
Drain Efficiency @ P_{IN} = 36.5 dBm	55.0	62.0	62.0	%
Input Return Loss	-7.3	-17.0	-4.3	dB

Note:
Measured in the CGH35060F2-AMP1 amplifier circuit, under 100 µsec Pulse Width, 20% Duty Cycle and 28 V.

Features

RoHS COMPLIANT

- 3.1 - 3.5 GHz Operation
- 60 W Peak Power Capability
- 12 dB Small Signal Gain
- 60 % Drain Efficiency

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}	125	Volts	25˚C
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts	25˚C
Power Dissipation	P_{DISS}	57.6	Watts	
Storage Temperature	T_{STG}	-55, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	14.4	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	6	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	80	in-oz	
Thermal Resistance, Junction to Case, Pulsed[3]	$R_{\theta JC}$	1.67	˚C/W	85˚C, Pulse Width = 300%, Duty Cycle = 10%
Thermal Resistance, Junction to Case, CW[3]	$R_{\theta JC}$	2.45	˚C/W	85˚C, Pulse Width = 300%, Duty Cycle = 10%
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 http://www.cree.com/rf/document-library
[3] Measured for the CGH35060F2 at P_{DISS} = 57.6 W

Electrical Characteristics (T_C = 25˚C)

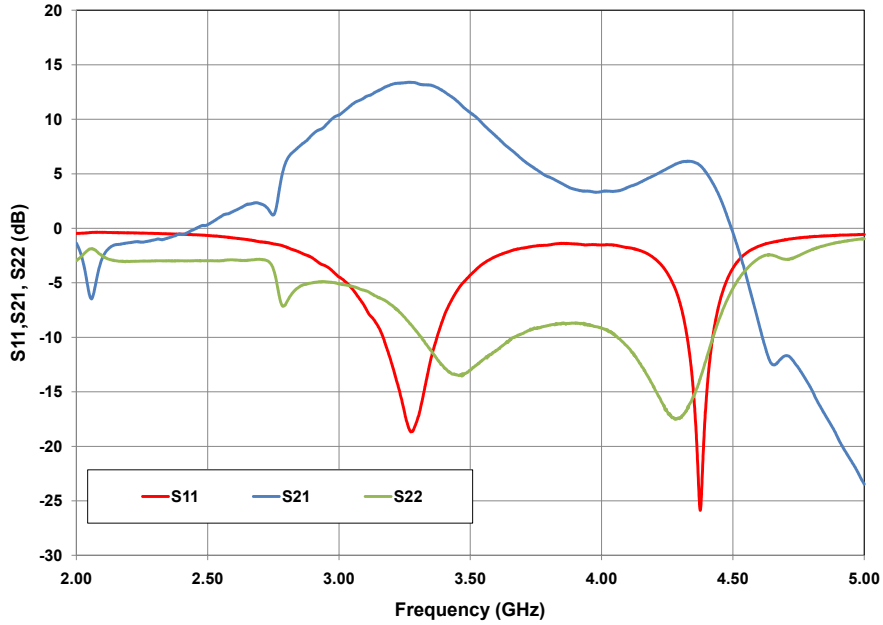
Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	–2.3	V_{DC}	V_{DS} = 10 V, I_D = 14.4 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 28 V, I_D = 200 mA
Saturated Drain Current	I_{DS}	11.6	14.0	-	A	V_{DS} = 6.0 V, V_{GS} = 2 V
Drain-Source Breakdown Voltage	V_{BR}	120	–	–	V_{DC}	V_{GS} = -8 V, I_D = 14.4 mA
RF Characteristics[2,3] (T_C = 25˚C, F_0 = 3.3 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	10.0	13.0	–	dB	V_{DD} = 28 V, I_{DQ} = 200 mA
Drain Efficiency[4]	η	40	62	–	%	V_{DD} = 28 V, I_{DQ} = 200 mA, P_{IN} = 36.5 dBm
Power Output[4]	P_{OUT}	45.4	47.6	–	dBm	V_{DD} = 28 V, I_{DQ} = 200 mA, P_{IN} = 36.5 dBm
Output Mismatch Stress	VSWR	–	–	10:1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 200 mA, P_{OUT} = 60 W Pulsed
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	19.0	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	5.9	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.8	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging.
[2] Measured in the CGH35060F2-AMP1 test fixture.
[3] 100 µS Pulse Width at 20% Duty Cycle.
[4] Drain Efficiency = P_{OUT} / P_{DC}.

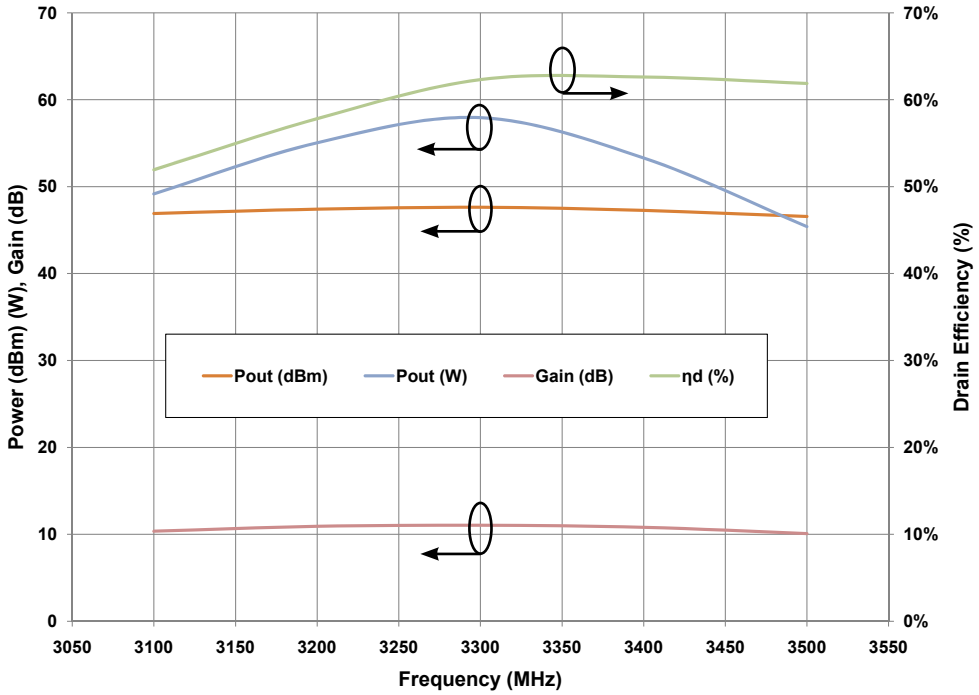
Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
www.cree.com/rf

Typical Performance

Small Signal Gain and Return Losses vs Frequency of the CGH35060F2 and CGH35060P2
V_{DD} = 28 V, I_{DQ} = 200 mA

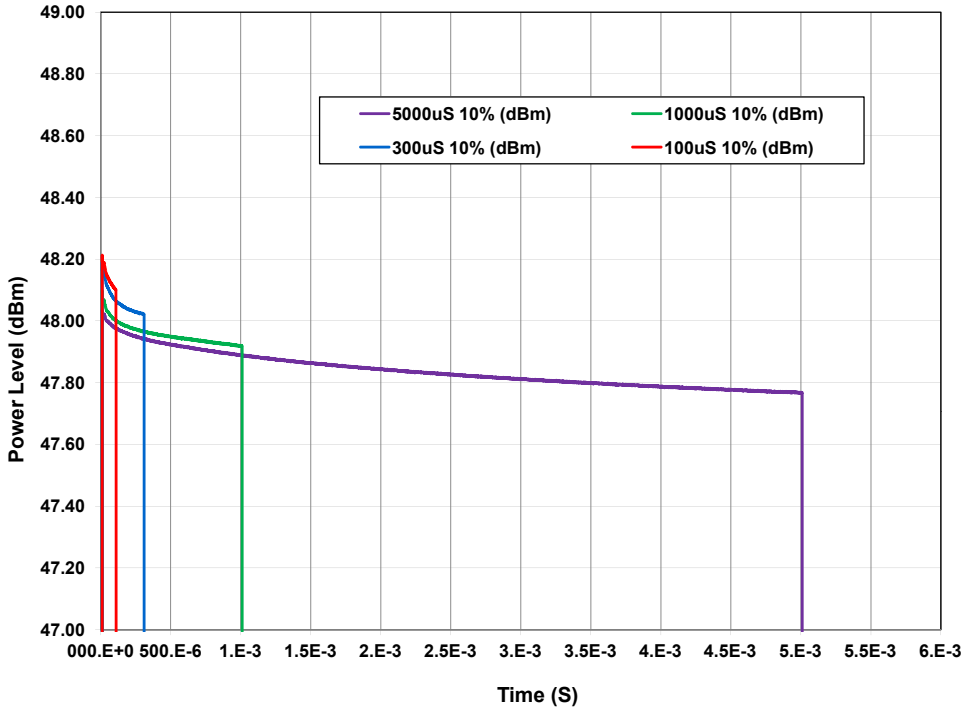


Output Power, Gain and Drain Efficiency vs Frequency of the CGH35060F2 and CGH35060P2
V_{DD} = 28 V, I_{DQ} = 200 mA, Pulse Width = 100 µsec, Duty Cycle = 20%



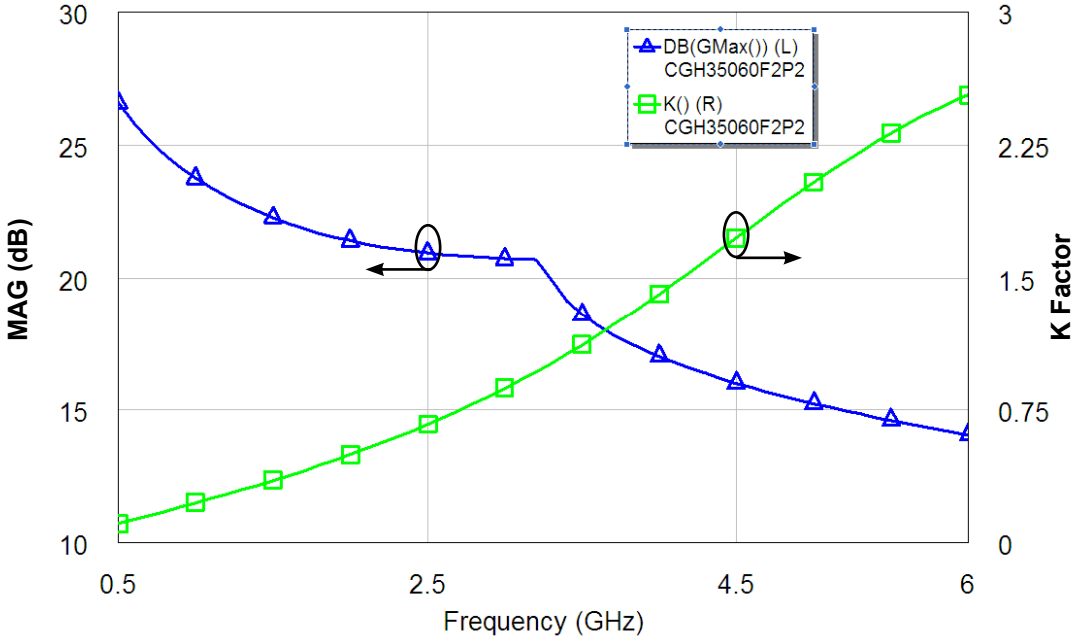
Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
www.cree.com/rf

Typical Pulse Droop Performance



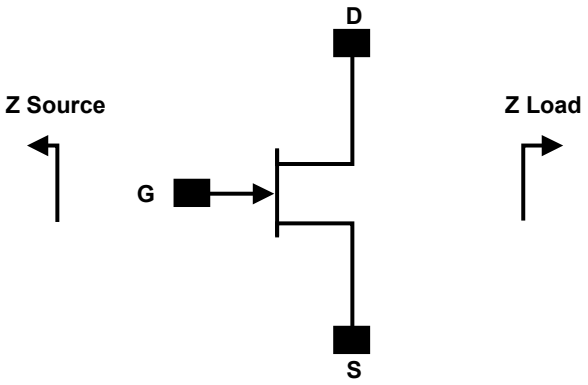
Typical Performance Data

Simulated Maximum Available Gain and K Factor of the CGH35060F2 and CGH35060P2
V_{DD} = 28 V, I_{DQ} = 200 mA



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
www.cree.com/rf

Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
3100	3.6 -j13.5	8.0 -j8.5
3200	3.6 -j12.8	7.1 -j7.7
3300	3.5 -j12.1	6.5 -j6.8
3400	3.5 -j11.4	6.0 -j5.9
3500	3.3 -j10.7	5.6 -j5.1

Note[1]: V_{DD} = 28V, I_{DQ} = 200mA. In the 440193 package.
Note[2]: Impedances are extracted from the CGH35060F2-AMP1 demonstration circuit and are not source and load pull data derived from the 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

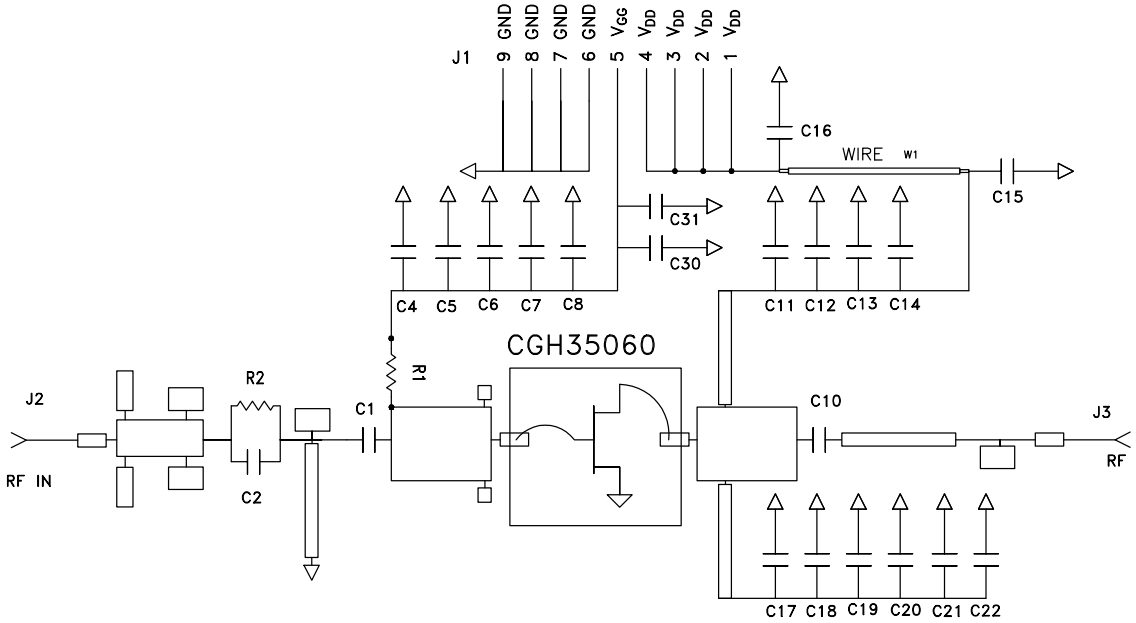
Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
www.cree.com/rf

CGH35060F2-AMP1 Demonstration Amplifier Circuit Bill of Materials

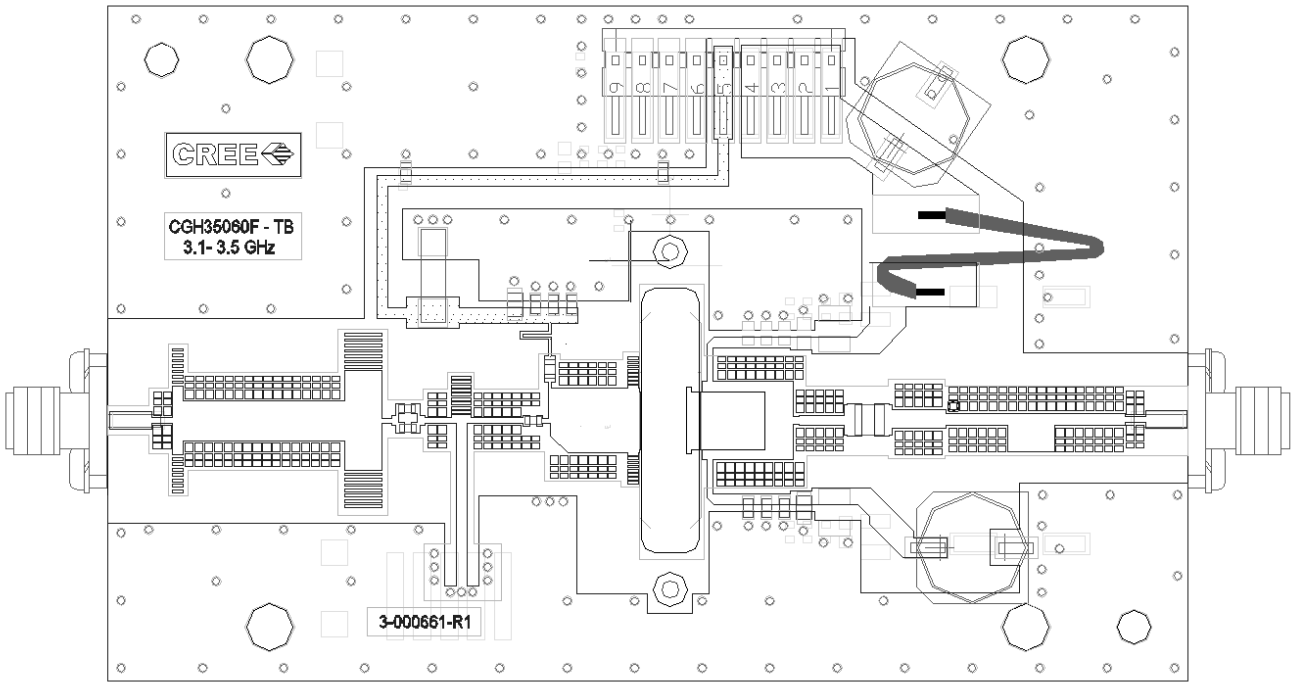
Designator	Description	Qty
R1	RES, 1/16 W, 0603, 1%, 5.1 OHMS	1
R2	RES, 1/16 W, 0603, 1%, 100 OHMS	1
C6,C13,C19	CAP, 470 pF, +/-5%, 100 V, 0603	3
C16,C22	CAP, 33 UF 100 V ELECT FK SMD	2
C15,C21	CAP CER 1.0 UF, 100 V, 10%, X7R 1210	2
C8	CAP 10 UF 16V SMT TANTALUM	1
C10	CAP, 20.0 pF, +/-5%, 0603, ATC 100B	1
C1	CAP, 5.1 pF, +/-5%, 0603, ATC 600S	1
C2	CAP, 3.0 pF, +/-0.1 pF, 0603, ATC 600S	1
C5,C12,C18,C30,C31	CAP, 4.7 pF, 5% pF, 0603, ATC	5
C4,C11,C17	CAP, 7.5 pF, 0.1 pF, 0603, ATC	3
C7,C14,C20	CAP CER 33000 pF, 0805, 100V, X7R	3
	PCB	1
	BASEPLATE	1
	PRESSPLATE	1
J2,J3	CONN, SMA, PANEL MOUNT JACK	2
J1	HEADER RT>PLZ .1CEN LK 9POS	1
	2-56 SOC HD SCREW 1/4 SS	4
	#2 SPLIT LOCKWASHER SS	4
W1	WIRE, BLACK, 22 AWG ~ 2.0”	1

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
www.cree.com/rf

CGH35060F2-AMP1 Demonstration Amplifier Circuit Schematic



CGH35060F2-AMP1 Demonstration Amplifier Circuit Outline



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
www.cree.com/rf

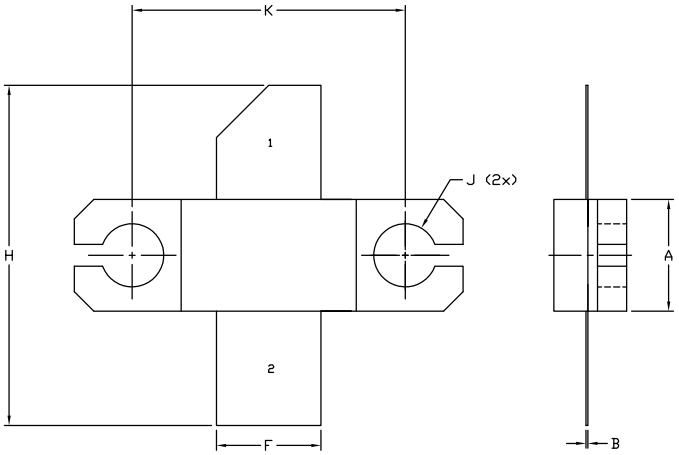
Typical Package S-Parameters for CGH35060F2/P2
(Small Signal, V_{DS} = 28 V, I_{DQ} = 200 mA, angle in degrees)

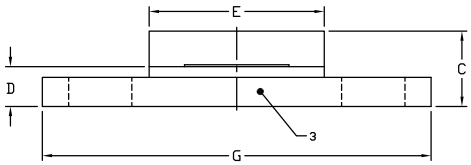
Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.927	-170.09	7.16	79.27	0.016	-6.59	0.596	-168.07
600 MHz	0.928	-172.55	5.95	75.10	0.016	-9.91	0.605	-168.34
700 MHz	0.929	-174.46	5.08	71.25	0.015	-12.90	0.615	-168.44
800 MHz	0.930	-176.04	4.42	67.64	0.015	-15.66	0.626	-168.49
900 MHz	0.931	-177.39	3.91	64.20	0.015	-18.24	0.637	-168.54
1.0 GHz	0.932	-178.59	3.50	60.90	0.015	-20.65	0.648	-168.63
1.1 GHz	0.933	-179.70	3.16	57.72	0.015	-22.94	0.659	-168.78
1.2 GHz	0.935	179.27	2.88	54.66	0.014	-25.10	0.670	-168.99
1.3 GHz	0.936	178.29	2.65	51.70	0.014	-27.14	0.681	-169.25
1.4 GHz	0.937	177.34	2.45	48.83	0.014	-29.08	0.692	-169.58
1.5 GHz	0.938	176.41	2.28	46.04	0.013	-30.91	0.702	-169.96
1.6 GHz	0.939	175.49	2.13	43.33	0.013	-32.65	0.712	-170.40
1.7 GHz	0.940	174.57	2.00	40.70	0.013	-34.29	0.721	-170.87
1.8 GHz	0.941	173.65	1.88	38.13	0.013	-35.85	0.730	-171.39
1.9 GHz	0.942	172.73	1.78	35.62	0.012	-37.32	0.738	-171.94
2.0 GHz	0.943	171.79	1.69	33.16	0.012	-38.70	0.746	-172.53
2.1 GHz	0.943	170.83	1.62	30.76	0.012	-40.01	0.753	-173.14
2.2 GHz	0.944	169.85	1.55	28.40	0.012	-41.25	0.760	-173.78
2.3 GHz	0.944	168.85	1.49	26.07	0.012	-42.41	0.766	-174.44
2.4 GHz	0.944	167.82	1.44	23.78	0.011	-43.51	0.772	-175.12
2.5 GHz	0.945	166.75	1.39	21.52	0.011	-44.55	0.777	-175.82
2.6 GHz	0.944	165.64	1.35	19.27	0.011	-45.52	0.781	-176.54
2.7 GHz	0.944	164.49	1.32	17.03	0.011	-46.44	0.785	-177.27
2.8 GHz	0.944	163.29	1.29	14.80	0.011	-47.31	0.789	-178.03
2.9 GHz	0.943	162.03	1.26	12.57	0.011	-48.13	0.792	-178.80
3.0 GHz	0.943	160.71	1.24	10.34	0.010	-48.92	0.795	-179.59
3.2 GHz	0.941	157.85	1.22	5.80	0.010	-50.38	0.798	178.78
3.4 GHz	0.938	154.62	1.21	1.13	0.010	-51.75	0.800	177.06
3.6 GHz	0.934	150.94	1.21	-3.76	0.010	-53.09	0.800	175.23
3.8 GHz	0.928	146.65	1.24	-8.97	0.010	-54.51	0.798	173.28
4.0 GHz	0.921	141.58	1.28	-14.63	0.011	-56.12	0.794	171.18
4.2 GHz	0.911	135.46	1.35	-20.90	0.011	-58.11	0.787	168.89
4.4 GHz	0.897	127.93	1.45	-28.01	0.012	-60.71	0.777	166.35
4.6 GHz	0.880	118.44	1.57	-36.26	0.012	-64.27	0.764	163.51
4.8 GHz	0.857	106.23	1.73	-46.04	0.014	-69.22	0.746	160.26
5.0 GHz	0.828	90.20	1.93	-57.83	0.015	-76.13	0.723	156.46
5.2 GHz	0.796	69.08	2.15	-72.17	0.017	-85.57	0.692	151.91
5.4 GHz	0.770	42.01	2.35	-89.39	0.018	-97.96	0.649	146.29
5.6 GHz	0.766	10.14	2.48	-109.22	0.019	-113.08	0.590	139.24
5.8 GHz	0.793	-22.34	2.47	-130.55	0.020	-129.85	0.509	130.26
6.0 GHz	0.839	-50.86	2.33	-152.01	0.019	-146.93	0.401	118.41

To download the s-parameters in s2p format, go to the CGH35060F2/P2 Product Page, 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.CREE
www.cree.com/rf

Product Dimensions CGH35060F2 (Package Type — 440193)





NOTES:

1. DIMENSIONING AND TOLERANICING PER ANSI Y14.5M, 1982.

2. CONTROLLING DIMENSION: INCH.

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

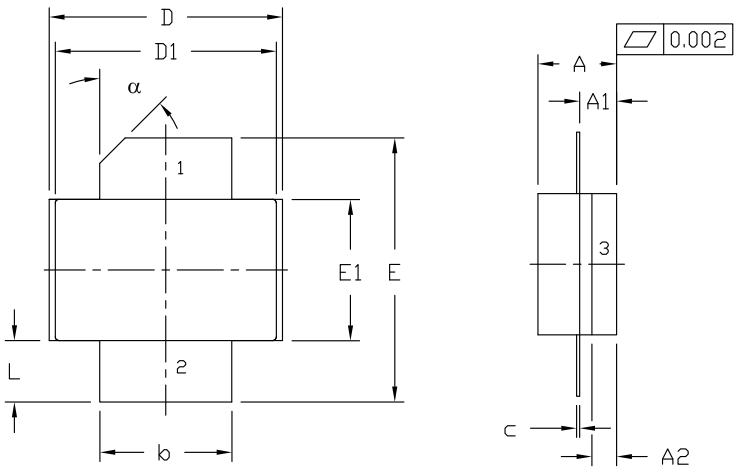
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

5. ALL PLATED SURFACES ARE NI/AU

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.225	0.235	5.72	5.97
B	0.004	0.006	0.10	0.15
C	0.145	0.165	3.68	4.19
D	0.077	0.087	1.96	2.21
E	0.355	0.365	9.02	9.27
F	0.210	0.220	5.33	5.59
G	0.795	0.805	20.19	20.45
H	0.670	0.730	17.02	18.54
J	ø .130		3.30	
k	0.562		14.28	

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

Product Dimensions CGH35060P2 (Package Type — 440206)



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.

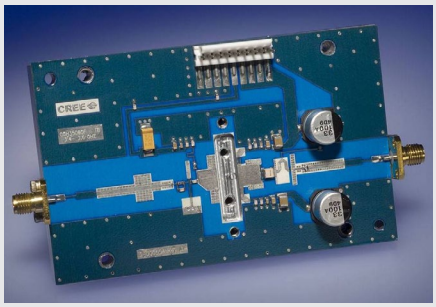
4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

DIM	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.125	0.145	3.18	3.68	
A1	0.057	0.067	1.45	1.70	
A2	0.035	0.045	0.89	1.14	
b	0.210	0.220	5.33	5.59	2x
c	0.004	0.006	0.10	0.15	2x
D	0.375	0.385	9.53	9.78	
D1	0.355	0.365	9.02	9.27	
E	0.400	0.460	10.16	11.68	
E1	0.225	0.235	5.72	5.97	
L	0.085	0.115	2.16	2.92	2x
α	45° REF		45° REF		

PIN 1. GATE
2. DRAIN
3. SOURCE

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
www.cree.com/rf

Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH35060F2	GaN HEMT (Flanged)	Each	
CGH35060P1	GaN HEMT (Pill)	Each	
CGH35060-TB	Test board without GaN HEMT	Each	
CGH35060F2-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.CREE
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 & Export
Cree, RF Components
919.407.5302

Ryan Baker
Marketing
Cree, RF Components
919.407.7816

Tom Dekker
Sales Director
Cree, RF Components
919.407.5639

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
www.cree.com/rf