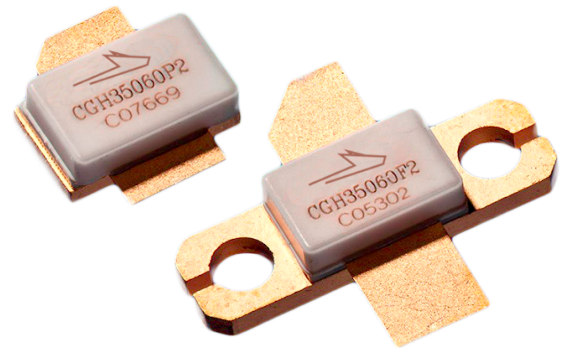


# CGH35060F2/P2

60 W, 3.1 - 3.5 GHz, 28 V, GaN HEMT



## Description

WolfSpeed'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 Types: 440193 & 440206  
PNs: CGH35060F2 & CGH35060P2

## Typical Performance Over 3.1-3.5 GHz ( $T_c = 25^\circ\text{C}$ ) 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
Gain @ $P_{IN} = 36.5$ dBm	10.4	11.06	10.1	dB
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-AMP amplifier circuit, under 100 $\mu$ s Pulse Width, 20% Duty Cycle and 28 V.

## Features

- 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	$V_{DS}$	120	V	25°C
Gate-to-Source Voltage	$V_{GS}$	-10, +2		
Storage Temperature	$T_{STG}$	-55, +150	°C	
Operating Junction Temperature	$T_J$	225		
Maximum Forward Gate Current	$I_{GMAX}$	14.4	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	6	A	
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
Thermal Resistance, Junction to Case, Pulsed <sup>3</sup>	$R_{\theta JC}$	1.67	°C/W	85°C, Pulse Width = 300%, Duty Cycle = 10%
Case Operating Temperature <sup>3</sup>	$T_C$	-40, +150	°C	

### Notes:

<sup>1</sup> Current limit for long term, reliable operation

<sup>2</sup> Refer to the Application Note on soldering at [wolfspeed.com/rf/document-library](http://wolfspeed.com/rf/document-library)

<sup>3</sup> Measured for the CGH35060F2 at  $P_{DISS} = 57.6$  W.

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

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics<sup>1</sup></b>						
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	—		$V_{DS} = 28$ V, $I_D = 200$ mA
Saturated Drain Current	$I_{DS}$	10.1	14.0	—	A	$V_{DS} = 6.0$ V, $V_{GS} = 2$ V
Drain-Source Breakdown Voltage	$V_{BR}$	84	—	—	$V_{DC}$	$V_{GS} = -8$ V, $I_D = 14.4$ mA
<b>RF Characteristics<sup>2,3</sup> (<math>T_C = 25^\circ\text{C}</math>, <math>F_0 = 3.3</math> GHz unless otherwise noted)</b>						
Small Signal Gain	$G_{SS}$	11.0	13.0	—	dB	$V_{DD} = 28$ V, $I_{DQ} = 200$ mA
Drain Efficiency <sup>4</sup>	$\eta$	40	62	—	%	$V_{DD} = 28$ V, $I_{DQ} = 200$ mA, $P_{IN} = 36.5$ W
Power Output <sup>4</sup>	$P_{OUT}$	45.6	47.6	—	dBm	
Output Mismatch Stress	VSWR	—	—	10:1	$\Psi$	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 200$ mA, $P_{OUT} = 60$ W Pulse
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	—	19.0	—	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance	$C_{DS}$	—	5.9	—		
Feedback Capacitance	$C_{GD}$	—	0.8	—		

### Notes:

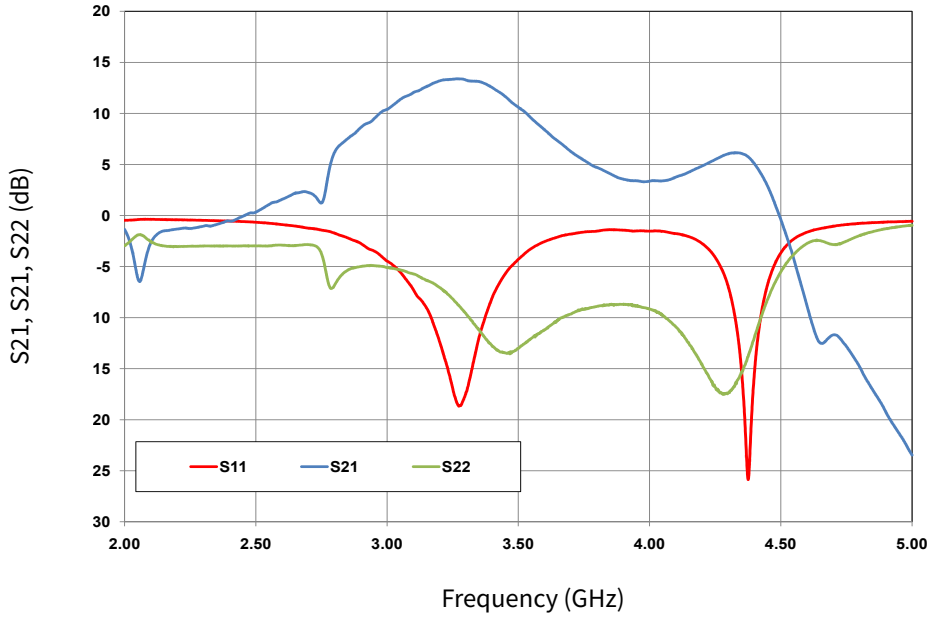
<sup>1</sup> Measured on wafer prior to packaging.

<sup>2</sup> Measured in the CGH35060F2-AMP test fixture

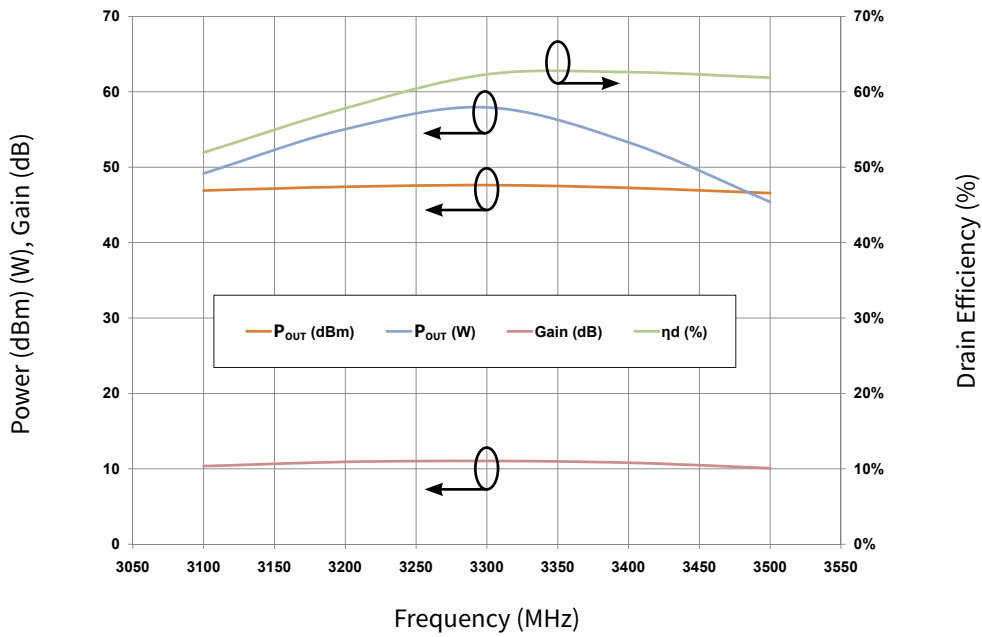
<sup>3</sup> 100 $\mu$ s Pulse Width at 20% Duty Cycle

<sup>4</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$

Typical Performance



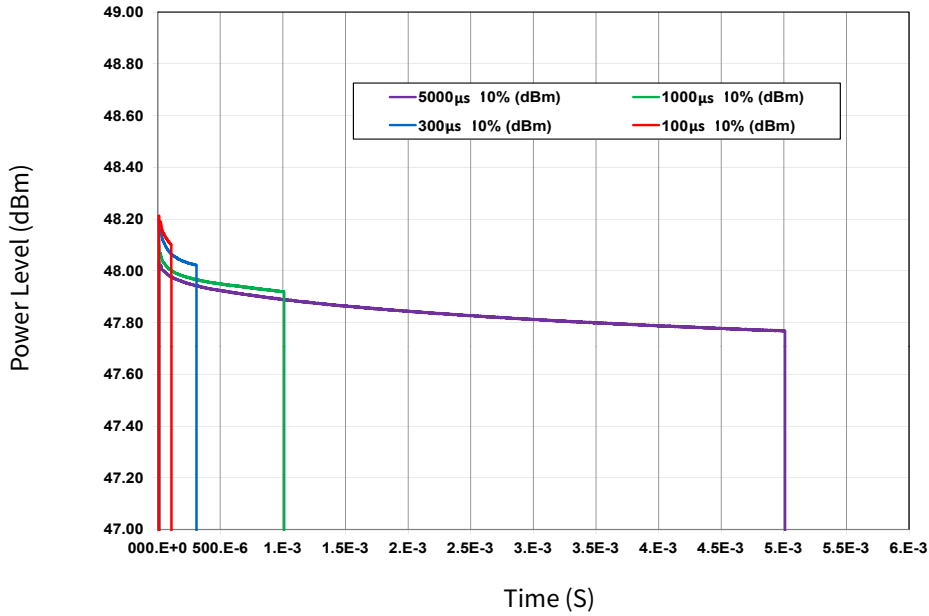
**Figure 1.** Small Signal Gain and Return Losses vs Frequency of the CGH35060F2 and CGH35060P2  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$



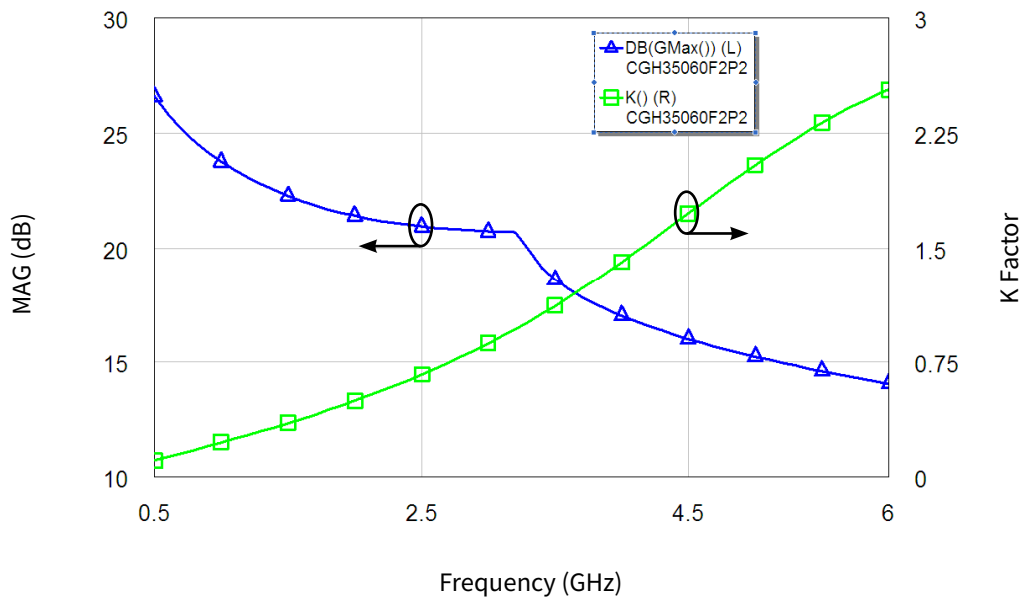
**Figure 2.** Output Power, Gain and Drain Efficiency vs Frequency of the CGH35060F2 and CGH35060P2  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$ , Pulse Width = 100 $\mu$ sec, Duty Cycle = 20%



### Typical Pulse Droop Performance



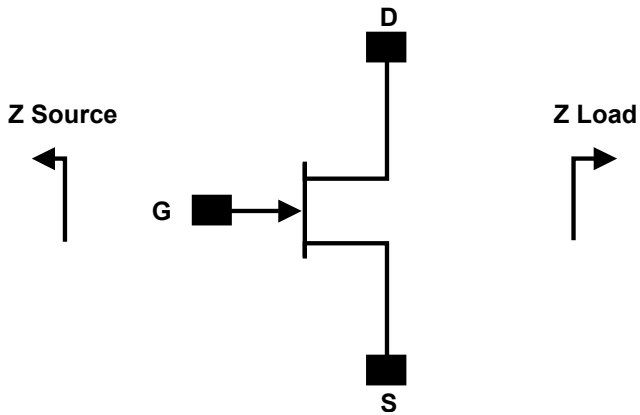
### Typical Performance



**Figure 3.** Simulated Maximum Available Gain and K Factor of the CGH35060F2 and CGH35060P2  
 $V_{DD} = 28 \text{ V}$ ,  $I_{DQ} = 200 \text{ mA}$



## 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

### Notes:

<sup>1</sup>  $V_{DD} = 28V$ ,  $I_{DQ} = 200mA$  in the 440193 package

<sup>2</sup> Impedances are extracted from the CGH35060F2-AMP demonstration amplifier and are not source and load pull data derived from the transistor

## Electrostatic Discharge (ESD) Classifications

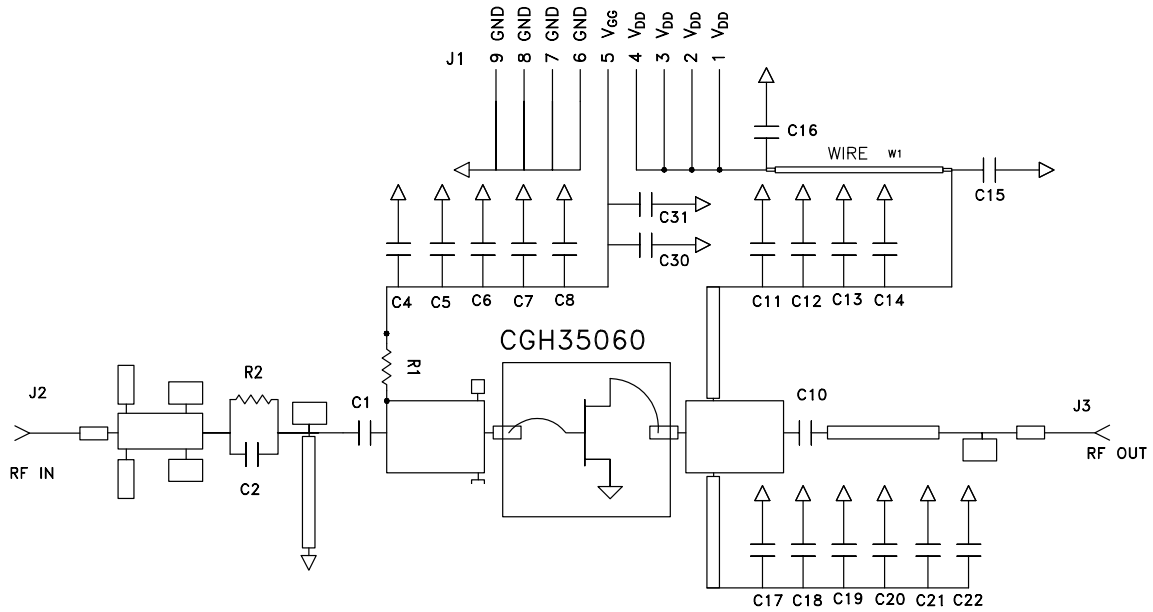
Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	TBD	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	TBD	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 C101-C



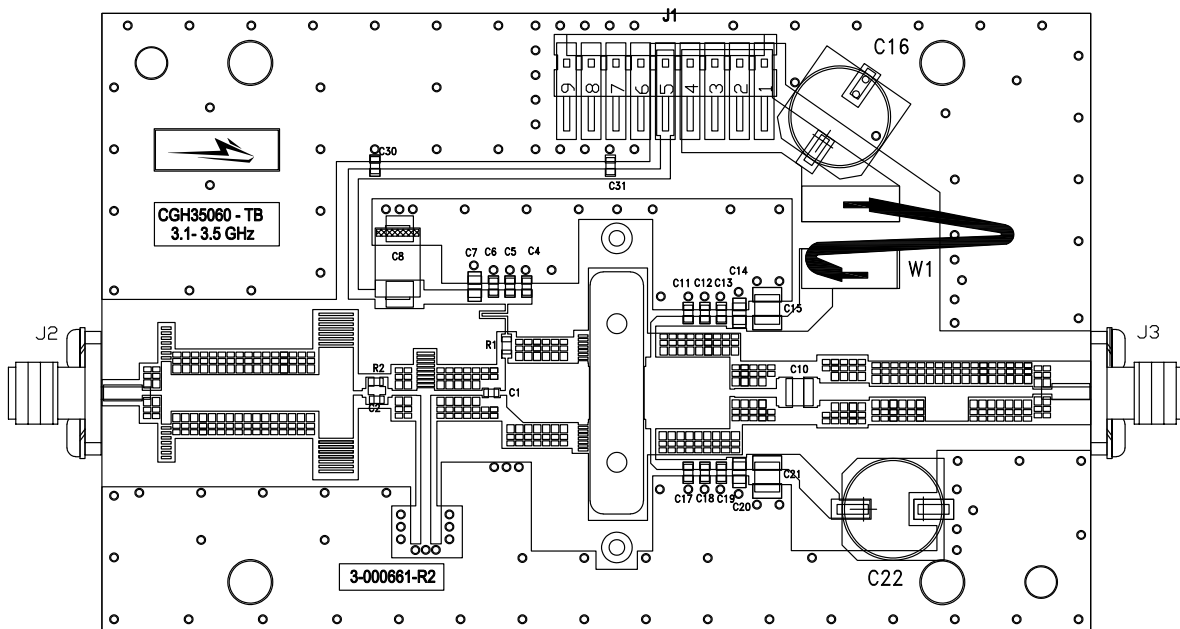
## CGH35060F2-AMP Demonstration Amplifier Circuit Bill of Materials

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, 470pF, +/-5%, 100 V, 0603	3
C16, C22	CAP, 33μF 100 V ELECT FK SMD	2
C15, C21	CAP, CER 1.0μF, 100 V, 10%, X7R 1210	2
C8	CAP, 10μF 16V SMT TANTALUM	1
C10	CAP, 20.0pF, +/-5%, 0603, ATC 100B	1
C1	CAP, 5.1pF, +/-5%, 0603, ATC 600S	1
C2	CAP, 3.0pF, +/-0.1pF, 0603, ATC 600S	1
C5, C12, C18, C30, C31	CAP, 4.7pF, 5%pF, 0603, ATC	5
C4, C11, C17	CAP, 7.5pF, 0.1pF, 0603, ATC	3
C7, C14, C20	CAP CER 33000pF, 0805, 100V, X7R	3
	PCB	1
	BASEPLATE	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
Q1	CGH35060F2	1

### CGH35060F2-AMP Demonstration Amplifier Circuit Schematic



### CGH35060F2-AMP Demonstration Amplifier Circuit Outline





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

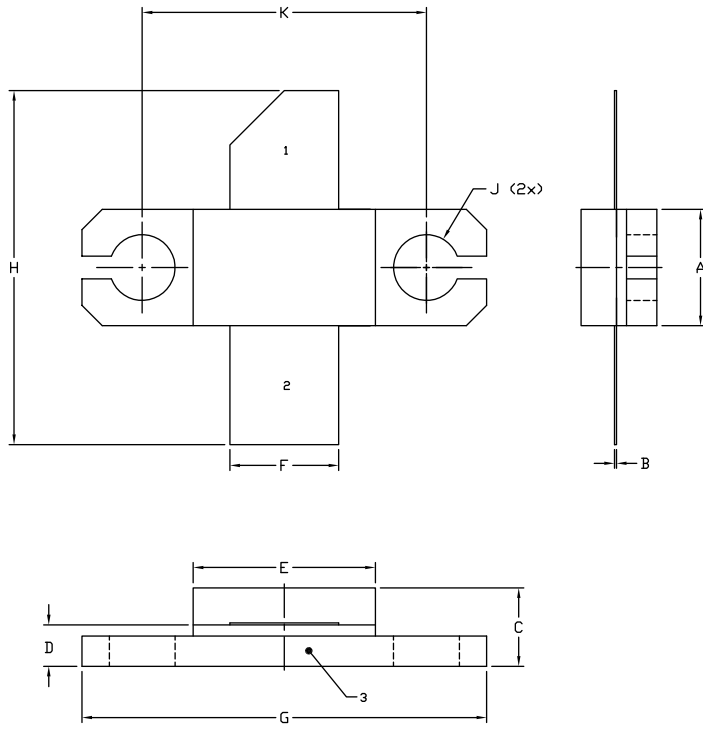
Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.927	-170.09	7.16	79.27	0.016	-6.59	0.596	-168.07
600 MHz	0.928	-172.55	5.95	75.10	0.016	-9.91	0.605	-168.34
700 MHz	0.929	-174.46	5.08	71.25	0.015	-12.90	0.615	-168.44
800 MHz	0.930	-176.04	4.42	67.64	0.015	-15.66	0.626	-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](#) and click on the documentation tab.





**Product Dimensions CGH35060F2 (Package Type — 440193)**

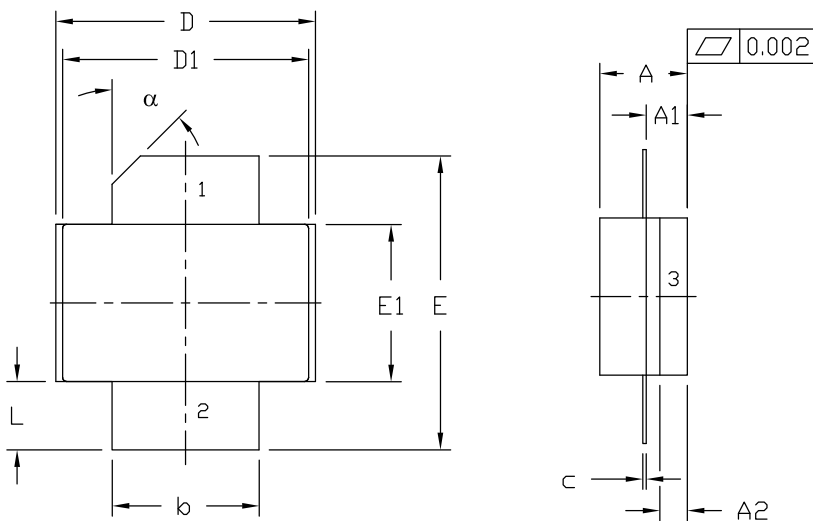


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
  4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
  5. ALL PLATED SURFACES ARE Ni/AU

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	∅ .130		3.30	
k		0.562		14.28

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

**Product Dimensions CGH35060P2 (Package Type — 440206)**



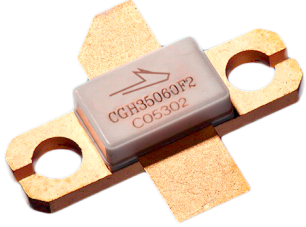

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M - 1994.
  2. CONTROLLING DIMENSION: INCH.
  3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
  4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

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



## Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH35060F2	GaN HEMT (Flanged)	Each	
CGH35060P2	GaN HEMT (Pill)	Each	
CGH35060F2-AMP	Test board with GaN HEMT installed	Each	

**For more information, please contact:**

4600 Silicon Drive  
Durham, NC 27703 USA  
Tel: +1.919.313.5300  
[www.wolfspeed.com/RF](http://www.wolfspeed.com/RF)

Sales Contact  
[RFSales@wolfspeed.com](mailto:RFSales@wolfspeed.com)

RF Product Marketing Contact  
[RFMarketing@wolfspeed.com](mailto:RFMarketing@wolfspeed.com)

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