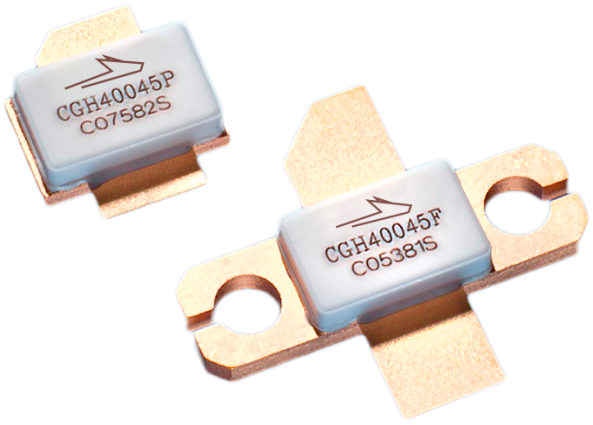
CGH40045

45 W, DC - 4 GHz RF Power GaN HEMT



Package Types: 440193 & 440206
PN's: CGH40045F & CGH40045P

Description

Wolfspeed's CGH40045 is an unmatched, gallium nitride (GaN) highelectron mobility transistor (HEMT). The CGH40045, operating from a 28 volt rail, offers a general purpose, broadband solution to a variety of RF and microwave applications. GaN HEMT soffer high efficiency, high gain and wide bandwidth capabilities making the CGH40045 ideal for linear and compressed amplifier circuits. The transistor is available in a flange and pill package.

Features

- Up to 4 GHz Operation
- 16 dB Small Signal Gain at 2.0 GHz
- 12 dB Small Signal Gain at 4.0 GHz
- 55 W Typical P_{SAT}
- 55% Efficiency at P_{SAT}
- 28 V Operation

Applications

- 2-Way Private Radio
- Broadband Amplifiers
- Cellular Infrastructure
- Test Instrumentation
- Class A, AB, Linear amplifiers suitable for OFDM, W-CDMA, EDGE, CDMA waveforms

Large Signal Models Available for ADS and MWO

RoHS compliant

4600 Silicon Drive | Durham, NC 27703 | Tel: +1.919.313.5300

Absolute Maximum Ratings (not simultaneous) at 25˚C Case Temperature

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	120	V	25˚C
Gate-to-Source Voltage	V_{GS}	-10, +2		
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225		
Maximum Forward Gate Current	I_{GMAX}	15	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	6	A	
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	2.8	˚C/W	85˚C
Case Operating Temperature[3,4]	T_C	-40, +150	˚C	

Notes:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering at wolfspeed.com/rf/document-library
[3] Measured for the CGH40045F at P_{DISS} = 56 W
[4] See also, the Power Dissipation De-rating Curve on Page 8

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_{DS} = 28 V, I_D = 400 mA
Saturated Drain Current[2]	I_{DS}	11.6	14.0	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	84	–	–	V_{DC}	V_{GS} = -8 V, I_D = 14.4 mA
RF Characteristics[3] (T_C = 25˚C, F_0 = 2.5 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	12.5	14	–	dB	V_{DD} = 28 V, I_{DQ} = 400 mA
Power Output[4]	P_{SAT}	40	55	–	W	
Drain Efficiency[5]	η	45		–	%	V_{DD} = 28 V, I_{DQ} = 400 mA, P_{OUT} = P_{SAT}
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 400 mA, P_{OUT} = 45 W CW
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	–		
Feedback Capacitance	C_{GD}	–	0.8	–		

Notes:
[1] Measured on wafer prior to packaging
[2] Scaled from PCM data
[3] Measured in CGH40045F-AMP
[4] P_{SAT} is defined as I_G = 1.08 mA
[5] Drain Efficiency = P_{OUT} / P_{DC}

Typical Performance

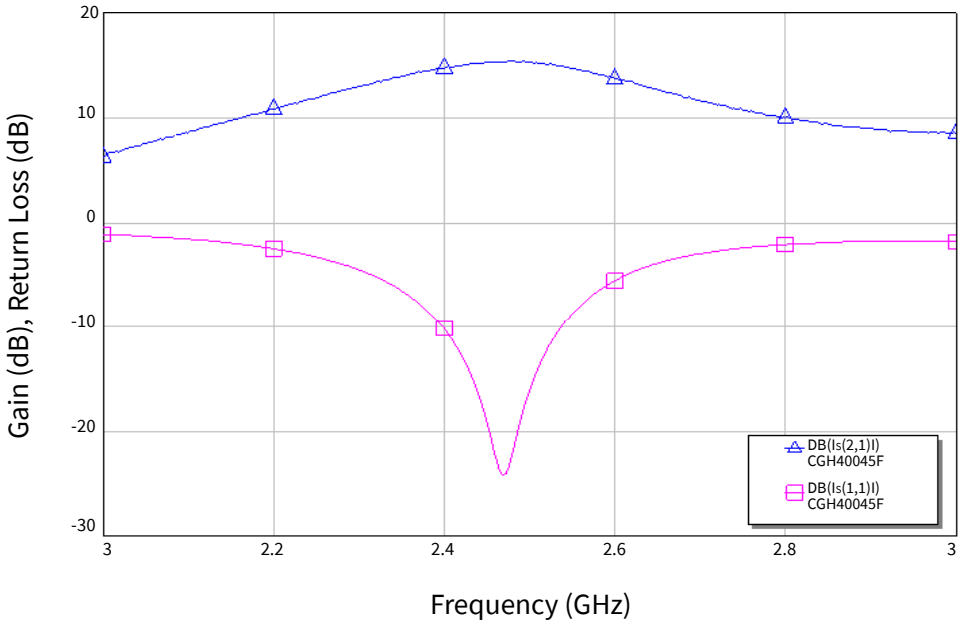


Figure 1. Simulated Small Signal Gain and Input Return Loss of the CGH40045F-AMP vs Frequency
V_{DD} = 28 V, I_{DQ} = 400 mA

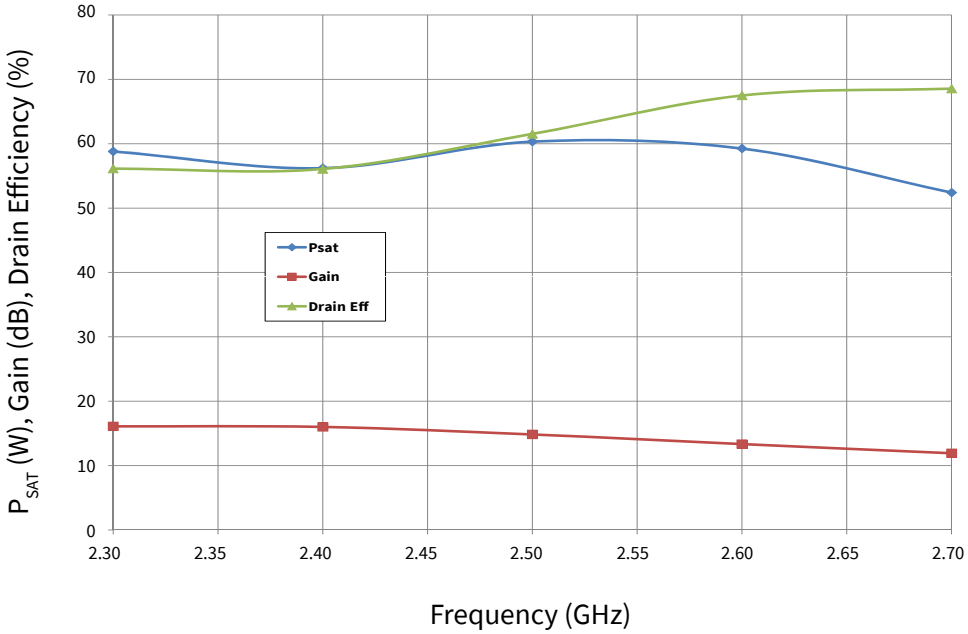


Figure 2. Gain, Efficiency, and Output Power vs Frequency measured in Amplifier Circuit CGH40045F-AMP
V_{DD} = 28 V, I_{DQ} = 400 mA

Typical Performance

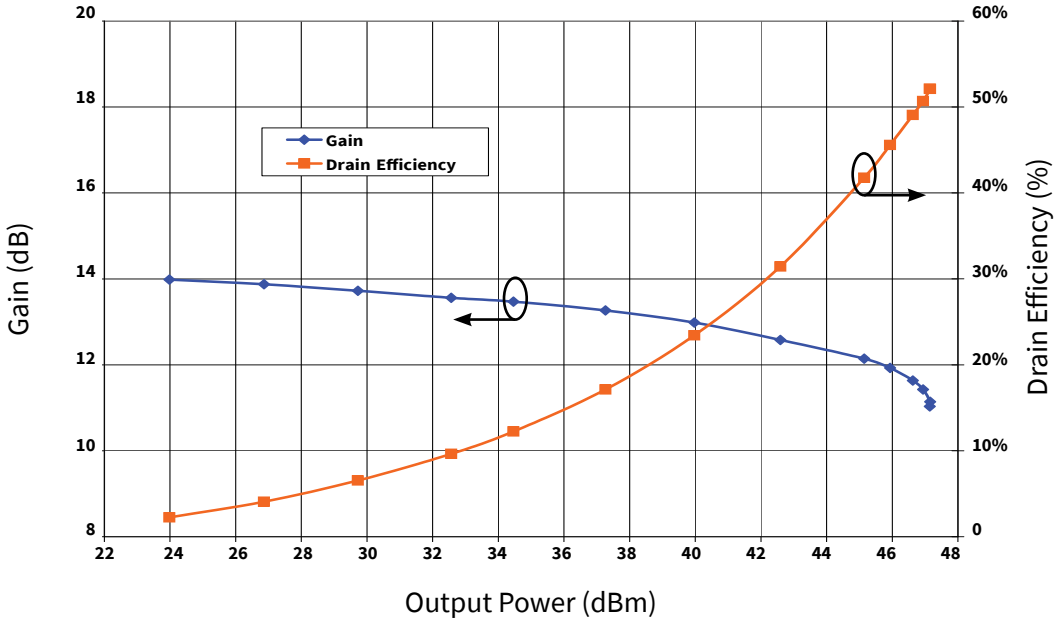


Figure 3. Gain and Efficiency vs Output Power measured in Amplifier Circuit CGH40045F-AMP
V_{DD} = 28 V, I_{DQ} = 400 mA, Freq = 2.5 GHz

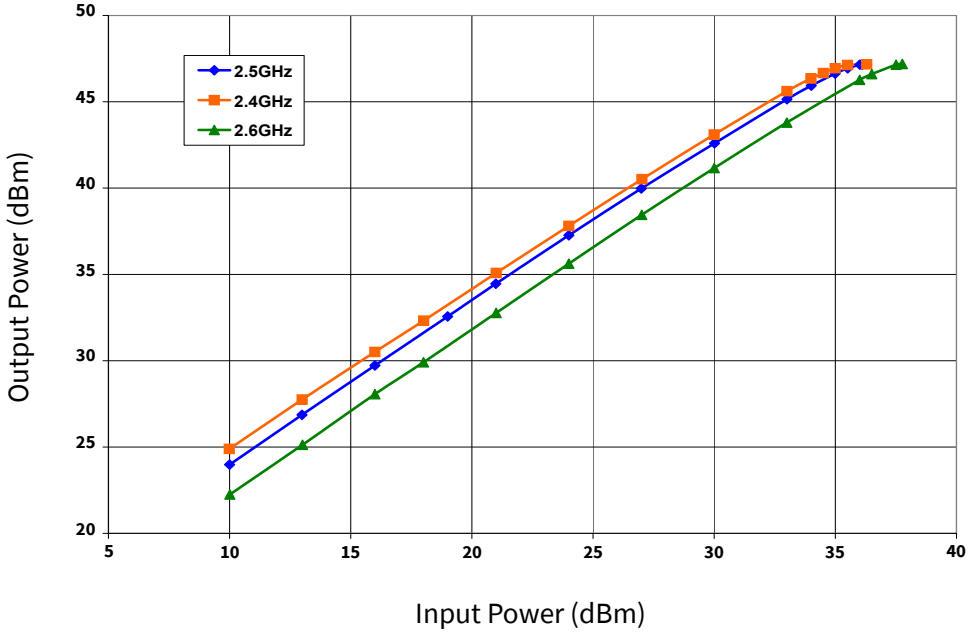


Figure 4. Single Tone CW Output Power vs Input Power measured in Amplifier Circuit CGH40045F-AMP
V_{DD} = 28 V, I_{DQ} = 400 mA

Typical Performance

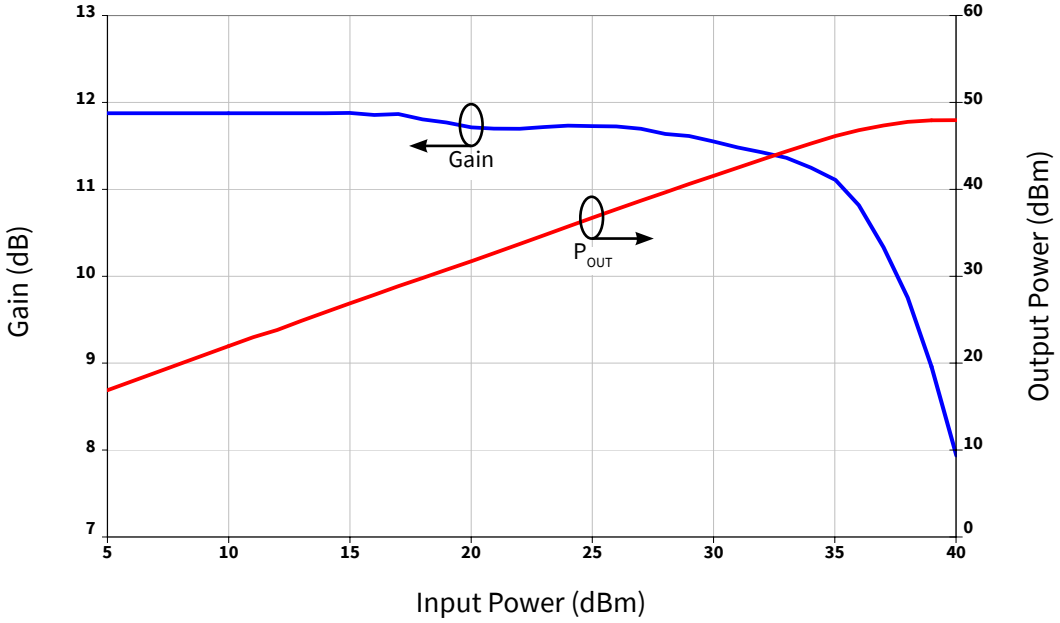


Figure 5. Pulsed Gain and Output Power vs Input Power measured in Amplifier Circuit CGH40045F-AMP
V_{DD} = 28 V, I_{DQ} = 800 mA, Freq = 3.6 GHz, Pulse Width = 200µS, 10% Duty Cycle

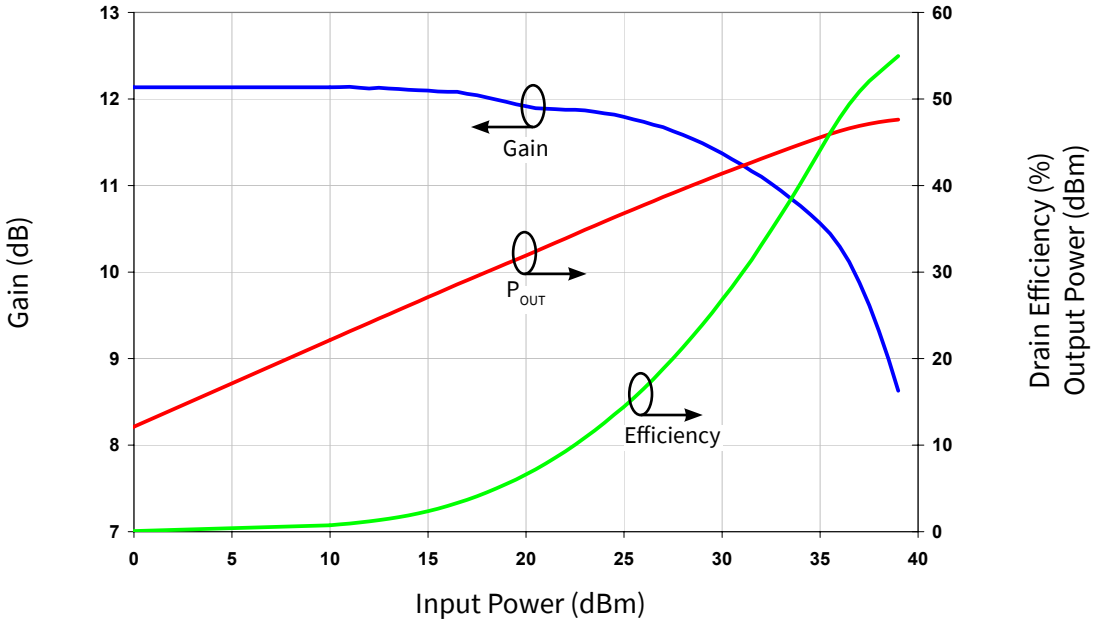


Figure 6. Single Tone CW Gain, Efficiency, and Output Power vs Input Power measured in Amplifier Circuit CGH40045F-AMP
V_{DD} = 28 V, I_{DQ} = 800 mA, Freq = 3.6 GHz

Typical Performance

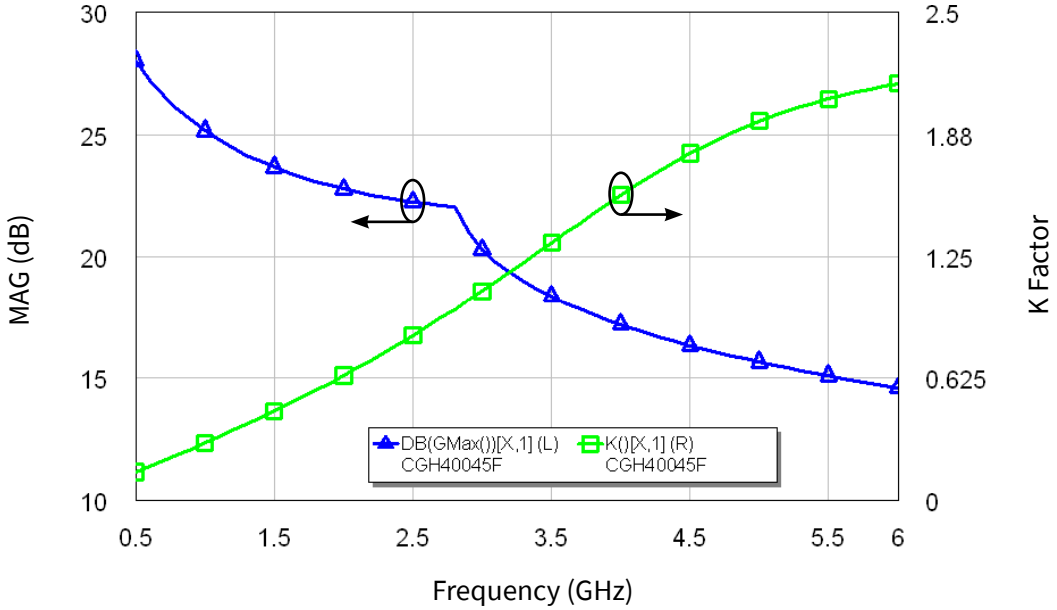


Figure 7. Simulated Maximum Available Gain and K Factor of the CGH40045
V_{DD} = 28 V, I_{DQ} = 400 mA

Typical Performance

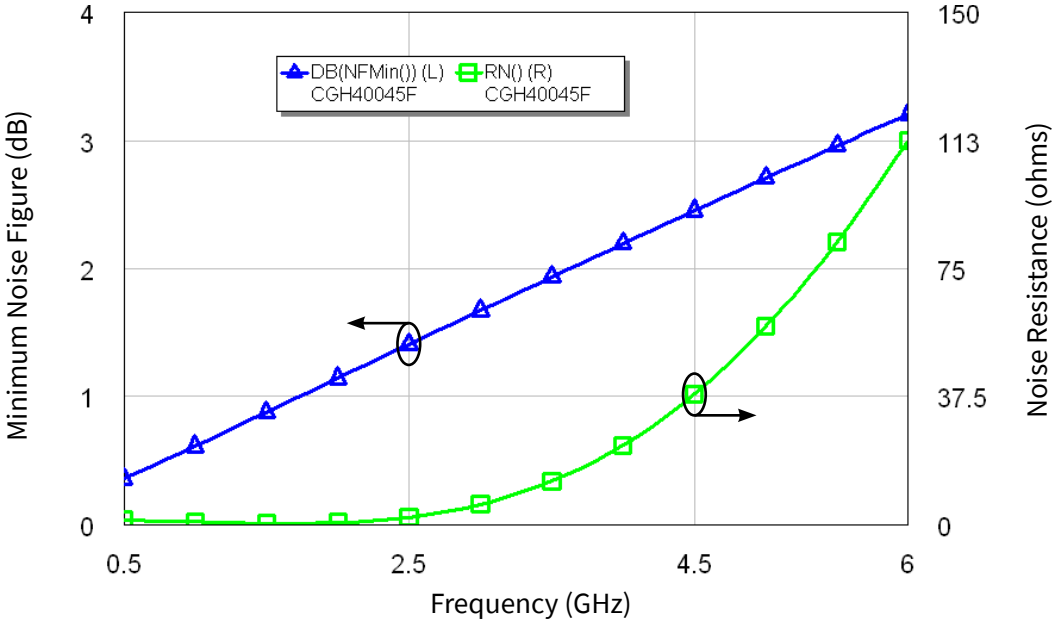
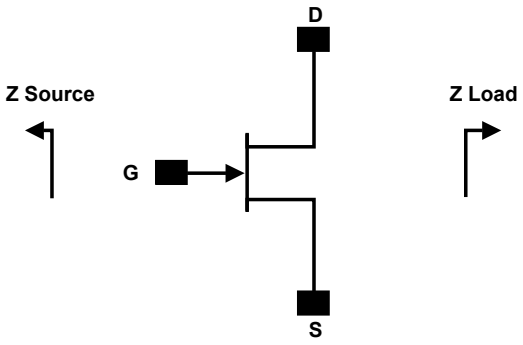


Figure 8. Simulated Minimum Noise Figure and Noise Resistance vsFrequency of the CGH40045
V_{DD} = 28 V, I_{DQ} = 400 mA

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Levels	Test Methodology
Human Body Model	HBM	1A	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	C3	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C

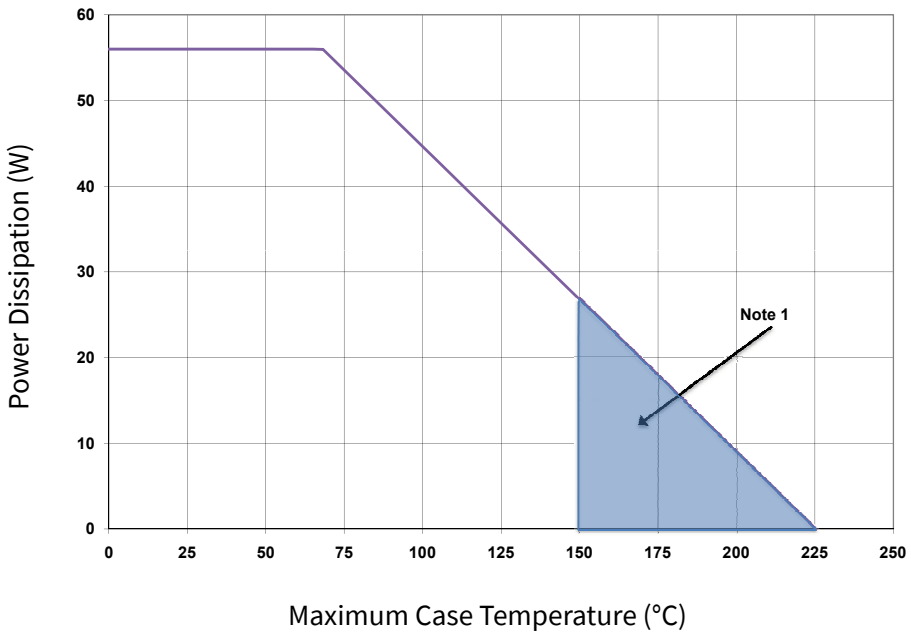
Simulated Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
500	4.1 + j5.27	14.73 + j6.91
750	2.9 + j4.1	12.3 + j7.6
1000	2.48 + j0.06	8.13 + j6.85
1100	1.9 + j3.1	9.2 + j6.2
1500	2.1 - j2.5	6.0 + j4.3
1700	1.05 - j2.48	5.07 + j2.29
1800	2.1 - j1.9	5.8 + j4.1
1900	0.89 - j2.62	4.81 + j2.17
2000	0.69 - j3.75	4.93 + j0.16
2100	1.5 - j4.4	5.1 + j2.8
3000	1.06 - j8.92	4.04 - j2.98
4000	1.67 - j18.1	4.97 - j8.25

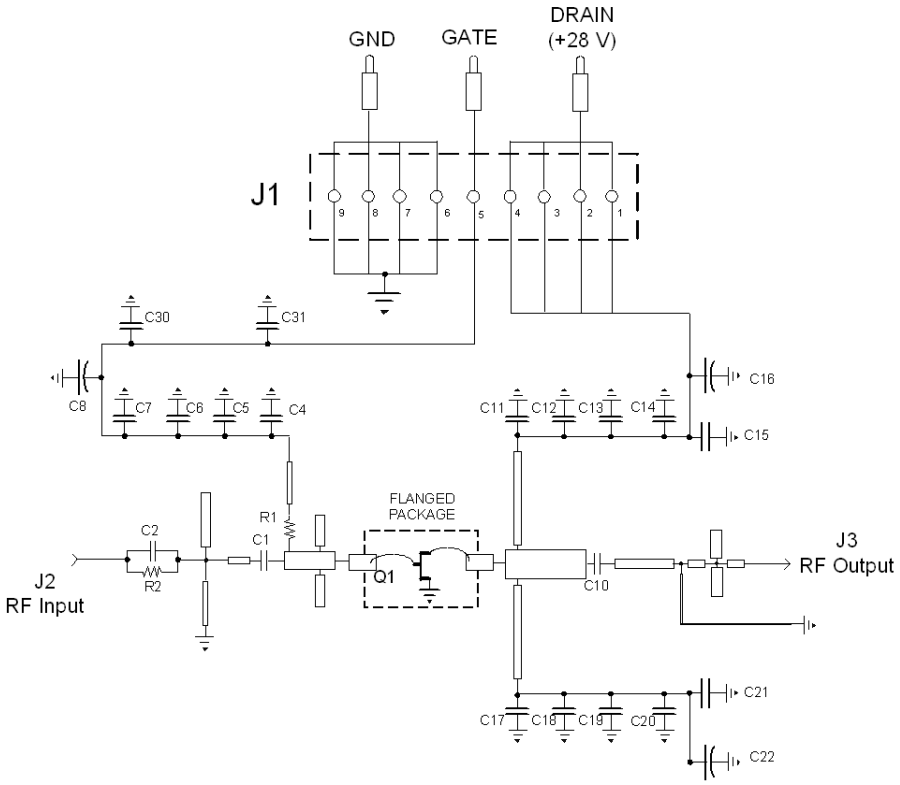
Notes:
[1] V_{DD} = 28V, I_{DQ} = 800 mA in the 440193 package.
[2] Optimized for power gain, P_{SAT} and PAE.
[3] When using this device at low frequency, series resistors should be used to maintain amplifier stability

CGH40045 Power Dissipation De-rating Curve

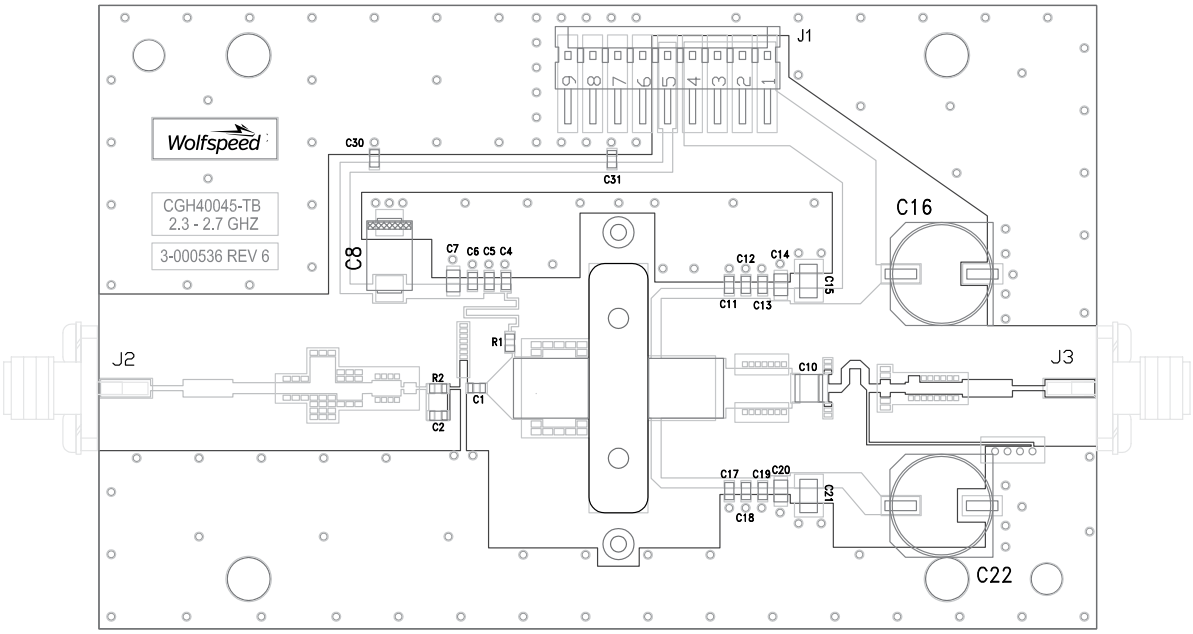


Note:
[1] Area exceeds Maximum Case Operating Temperature (See Page 2).

CGH40045-AMP Demonstration Amplifier Circuit Schematic



CGH40045-AMP Demonstration Amplifier Circuit Outline

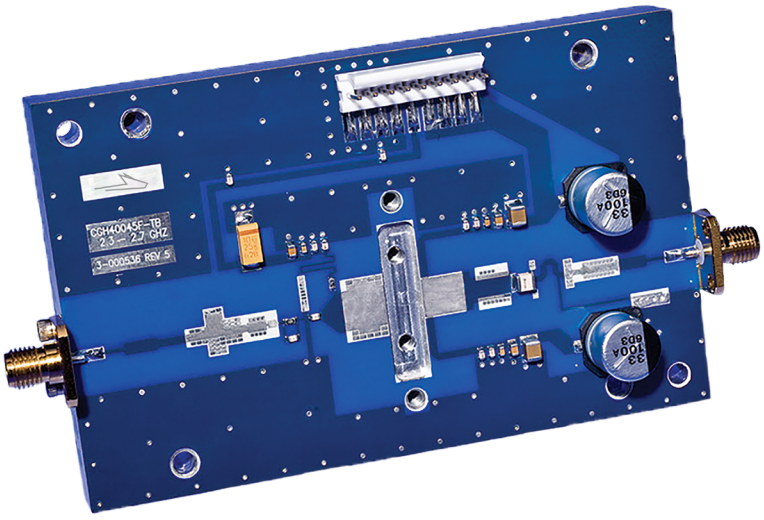


Note: The device slot is machined to different depths to support either pill or flanged versions

CGH40045-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1	CAP, 0.8pF, ± 0.1 pF, 0603	1
C2	CAP, 2.2pF, ± 0.1 pF, 0603	1
C4, C11, C17	CAP, 10.0pF, +/-5%, 0603, ATC	3
C6, C13, C19	CAP, 470pF ±5%, 100V, 0603, X7R	3
C7, C14, C20	CAP, 33000pF, 0805, 100V, X7R	3
C8	CAP, 10µF, 16V, SMT, TANTALUM	1
C10	CAP, 8.2pF ±5%, ATC100B	1
C15, C21	CAP, 1.0µF ±10%, 100V, 1210, X7R	2
C5, C12, C18, C30, C31	CAP, 82.0pF, ±5%, 0603	5
C16, C22	CAP, 33µF, 20%, G CASE	2
R2	RES, 1/16W, 0603, 100 ohms 1%	1
R1	RES, 1/16W, 0603, 5.1 ohms 1%	1
J2, J3	CONN, SMA, PANEL MOUNT JACK, FLANGE	2
J1	CONN, HEADER, RT>PLZ .1CEN LK 9POS	1
-	PCB, RO4350B, Er = 3.48, h = 20 mil	1
Q1	CGH40045	1

CGH40045-AMP Demonstration Amplifier Circuit



Typical Package S-Parameters for CGH40045
(Small Signal, V_{DS} = 28 V, I_{DQ} = 400 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.941	-171.75	7.34	80.91	0.012	-3.58	0.650	-173.39
600 MHz	0.941	-174.07	6.12	77.22	0.012	-6.14	0.655	-173.73
700 MHz	0.941	-175.88	5.24	73.81	0.012	-8.41	0.660	-173.93
800 MHz	0.942	-177.39	4.59	70.58	0.012	-10.49	0.665	-174.05
900 MHz	0.942	-178.70	4.07	67.49	0.012	-12.42	0.671	-174.15
1.0 GHz	0.942	-179.88	3.66	64.51	0.011	-14.23	0.677	-174.24
1.1 GHz	0.943	179.05	3.33	61.61	0.011	-15.93	0.683	-174.35
1.2 GHz	0.943	178.03	3.05	58.78	0.011	-17.54	0.689	-174.49
1.3 GHz	0.944	177.07	2.82	56.03	0.011	-19.06	0.695	-174.66
1.4 GHz	0.944	176.13	2.62	53.33	0.011	-20.50	0.701	-174.86
1.5 GHz	0.945	175.21	2.45	50.69	0.011	-21.86	0.707	-175.10
1.6 GHz	0.945	174.30	2.30	48.10	0.011	-23.14	0.713	-175.37
1.7 GHz	0.945	173.40	2.17	45.56	0.011	-24.34	0.718	-175.68
1.8 GHz	0.946	172.49	2.06	43.05	0.010	-25.47	0.724	-176.02
1.9 GHz	0.946	171.58	1.96	40.59	0.010	-26.53	0.729	-176.40
2.0 GHz	0.946	170.65	1.87	38.16	0.010	-27.51	0.734	-176.81
2.1 GHz	0.946	169.70	1.80	35.76	0.010	-28.43	0.739	-177.25
2.2 GHz	0.946	168.73	1.73	33.39	0.010	-29.28	0.743	-177.72
2.3 GHz	0.946	167.73	1.67	31.03	0.010	-30.06	0.747	-178.21
2.4 GHz	0.945	166.70	1.62	28.70	0.010	-30.78	0.751	-178.74
2.5 GHz	0.945	165.63	1.57	26.37	0.010	-31.44	0.754	-179.28
2.6 GHz	0.945	164.53	1.54	24.06	0.010	-32.05	0.757	-179.85
2.7 GHz	0.944	163.38	1.50	21.74	0.009	-32.60	0.759	179.55
2.8 GHz	0.943	162.17	1.47	19.42	0.009	-33.10	0.761	178.93
2.9 GHz	0.942	160.91	1.45	17.09	0.009	-33.56	0.763	178.28
3.0 GHz	0.941	159.57	1.43	14.74	0.009	-33.99	0.764	177.61
3.2 GHz	0.938	156.68	1.41	9.95	0.009	-34.75	0.766	176.20
3.4 GHz	0.935	153.41	1.41	5.00	0.009	-35.46	0.765	174.68
3.6 GHz	0.930	149.66	1.42	-0.20	0.010	-36.21	0.763	173.05
3.8 GHz	0.923	145.28	1.46	-5.76	0.010	-37.13	0.758	171.27
4.0 GHz	0.914	140.09	1.52	-11.80	0.011	-38.39	0.751	169.35
4.2 GHz	0.903	133.82	1.60	-18.50	0.011	-40.21	0.742	167.23
4.4 GHz	0.888	126.08	1.71	-26.07	0.012	-42.86	0.729	164.90
4.6 GHz	0.868	116.32	1.86	-34.83	0.013	-46.72	0.712	162.27
4.8 GHz	0.842	103.74	2.05	-45.14	0.015	-52.24	0.690	159.29
5.0 GHz	0.811	87.25	2.27	-57.50	0.017	-59.93	0.663	155.80
5.2 GHz	0.777	65.61	2.51	-72.38	0.019	-70.34	0.628	151.60
5.4 GHz	0.752	38.13	2.72	-90.03	0.021	-83.73	0.581	146.39
5.6 GHz	0.753	6.31	2.83	-110.07	0.023	-99.76	0.516	139.81
5.8 GHz	0.785	-25.54	2.78	-131.39	0.023	-117.31	0.427	131.59
6.0 GHz	0.835	-53.19	2.58	-152.64	0.022	-135.03	0.311	121.26

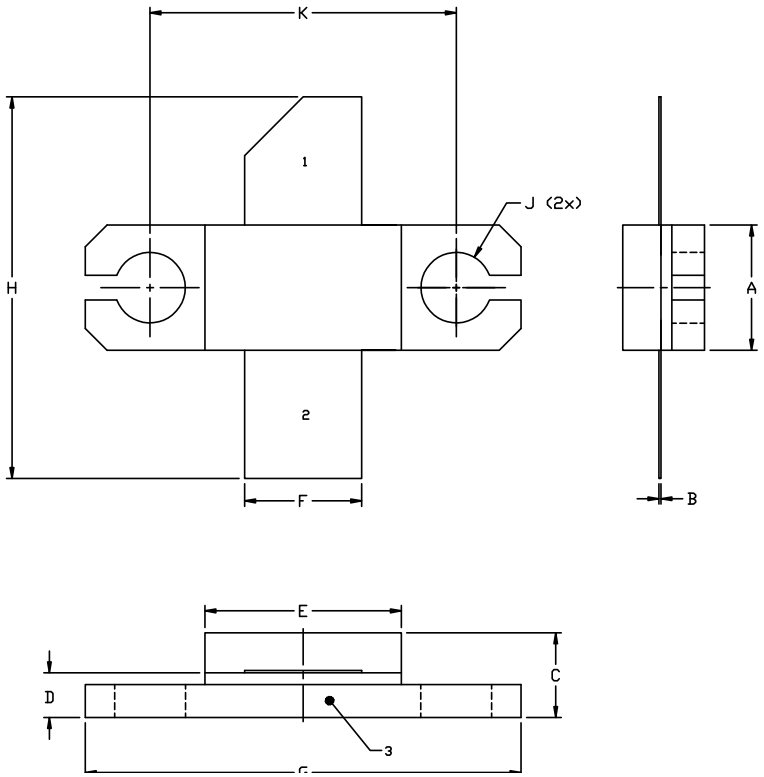
To download the s-parameters in s2p format, go to the CGH40045 Product page and click on the documentation tab.

Typical Package S-Parameters for CGH40045
(Small Signal, V_{DS} = 28 V, I_{DQ} = 800 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.952	-172.90	7.23	81.83	0.009	-1.13	0.688	-176.19
600 MHz	0.952	-175.11	6.03	78.47	0.009	-3.05	0.691	-176.58
700 MHz	0.952	-176.85	5.18	75.35	0.009	-4.72	0.694	-176.86
800 MHz	0.952	-178.32	4.54	72.38	0.009	-6.21	0.696	-177.07
900 MHz	0.952	-179.59	4.05	69.53	0.009	-7.58	0.699	-177.25
1.0 GHz	0.952	179.25	3.65	66.76	0.009	-8.84	0.702	-177.42
1.1 GHz	0.952	178.19	3.33	64.06	0.009	-10.01	0.706	-177.59
1.2 GHz	0.952	177.18	3.06	61.42	0.009	-11.09	0.709	-177.77
1.3 GHz	0.952	176.22	2.83	58.82	0.009	-12.11	0.712	-177.96
1.4 GHz	0.952	175.28	2.64	56.27	0.009	-13.05	0.716	-178.17
1.5 GHz	0.952	174.37	2.48	53.75	0.009	-13.92	0.719	-178.41
1.6 GHz	0.952	173.46	2.34	51.27	0.009	-14.72	0.722	-178.67
1.7 GHz	0.952	172.55	2.21	48.82	0.009	-15.46	0.725	-178.95
1.8 GHz	0.952	171.64	2.11	46.39	0.009	-16.14	0.728	-179.26
1.9 GHz	0.952	170.72	2.01	43.99	0.009	-16.75	0.731	-179.59
2.0 GHz	0.951	169.78	1.93	41.60	0.009	-17.29	0.734	-179.94
2.1 GHz	0.951	168.83	1.86	39.23	0.009	-17.78	0.737	179.67
2.2 GHz	0.951	167.85	1.80	36.88	0.008	-18.21	0.739	179.27
2.3 GHz	0.950	166.84	1.74	34.53	0.008	-18.58	0.741	178.83
2.4 GHz	0.949	165.80	1.69	32.19	0.008	-18.90	0.743	178.38
2.5 GHz	0.949	164.73	1.65	29.85	0.008	-19.17	0.744	177.90
2.6 GHz	0.948	163.61	1.61	27.51	0.008	-19.40	0.746	177.39
2.7 GHz	0.947	162.44	1.58	25.15	0.008	-19.59	0.747	176.86
2.8 GHz	0.946	161.22	1.56	22.79	0.008	-19.74	0.747	176.31
2.9 GHz	0.945	159.94	1.54	20.40	0.009	-19.87	0.748	175.73
3.0 GHz	0.943	158.58	1.53	17.98	0.009	-19.99	0.747	175.12
3.2 GHz	0.940	155.64	1.51	13.04	0.009	-20.21	0.746	173.83
3.4 GHz	0.935	152.30	1.51	7.90	0.009	-20.51	0.743	172.44
3.6 GHz	0.930	148.47	1.54	2.47	0.010	-21.01	0.738	170.92
3.8 GHz	0.922	143.99	1.58	-3.34	0.010	-21.86	0.730	169.27
4.0 GHz	0.913	138.66	1.65	-9.68	0.011	-23.25	0.721	167.47
4.2 GHz	0.900	132.21	1.75	-16.72	0.012	-25.41	0.708	165.49
4.4 GHz	0.884	124.23	1.87	-24.68	0.013	-28.63	0.691	163.32
4.6 GHz	0.863	114.16	2.04	-33.86	0.015	-33.25	0.671	160.90
4.8 GHz	0.835	101.18	2.24	-44.66	0.017	-39.70	0.646	158.17
5.0 GHz	0.802	84.20	2.47	-57.54	0.020	-48.45	0.616	155.00
5.2 GHz	0.768	62.03	2.72	-72.91	0.022	-59.96	0.577	151.18
5.4 GHz	0.745	34.19	2.91	-90.96	0.025	-74.38	0.527	146.39
5.6 GHz	0.750	2.50	2.99	-111.20	0.026	-91.25	0.459	140.32
5.8 GHz	0.785	-28.66	2.91	-132.50	0.027	-109.41	0.366	132.93
6.0 GHz	0.837	-55.46	2.67	-153.57	0.025	-127.56	0.245	124.60

To download the s-parameters in s2p format, go to the CGH40045 Product page and click on the documentation tab.

Product Dimensions CGH40045F (Package Type — 440193)



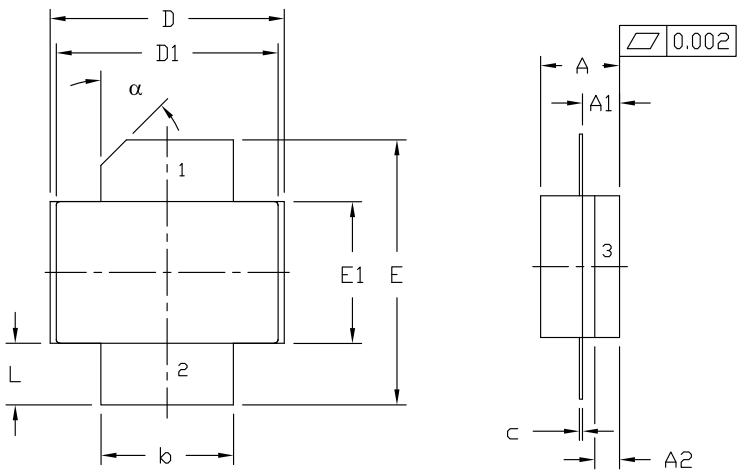
NOTES:

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

	INCHES		MILLIMETERS	
DIM	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	3.18	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 CGH40045P (Package Type — 440206)



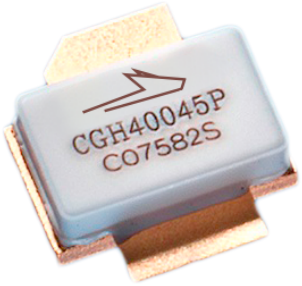
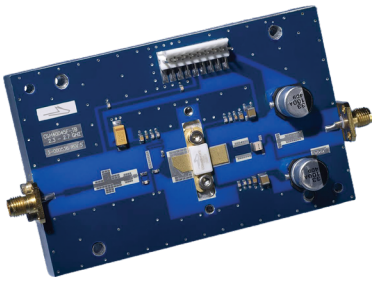
NOTES:

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.

	INCHES		MILLIMETERS		NOTES
DIM	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
CGH40045F	GaN HEMT	Each	
CGH40045P	GaN HEMT	Each	
CGH40045F-AMP	Test board with GaN HEMT installed	Each	
CGH40045P-AMP	Test board with GaN HEMT installed	Each	

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Notes & Disclaimer

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