CGH40006P

6 W, RF Power GaN HEMT

Cree's CGH40006P is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGH40006P, operating from a 28 volt rail, offers a general purpose, broadband solution to a variety of RF and microwave applications. GaN HEMTs offer high efficiency, high gain and wide bandwidth capabilities making the CGH40006P ideal for linear and compressed amplifier circuits. The transistor is available in a solder-down, pill package.

Package Types: 440109
PN's: CGH40006P

FEATURES

- Up to 6 GHz Operation
- 13 dB Small Signal Gain at 2.0 GHz
- 11 dB Small Signal Gain at 6.0 GHz
- 8 W typical at P_{IN} = 32 dBm
- 65 % Efficiency at P_{IN} = 32 dBm
- 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

RoHS COMPLIANT

PRELIMINARY
Rev 2.1 – April 2012

Large Signal Models Available for SiC & GaN

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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	84	Volts	25˚C
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts	25˚C
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	2.1	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	0.75	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	9.5	˚C/W	85˚C
Case Operating Temperature[3]	T_C	-40, +150	˚C	30 seconds

Note:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering at www.cree.com/products/wireless_appnotes.asp
[3] Measured for the CGH40006P at P_{DISS} = 8 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 = 2.1 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 28 V, I_D = 100 mA
Saturated Drain Current	I_{DS}	1.7	2.1	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	120	–	–	V_{DC}	V_{GS} = -8 V, I_D = 2.1 mA
RF Characteristics[2] (T_C = 25˚C, F_0 = 2.0 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	11.5	13	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Power Output at P_{IN} = 32 dBm	P_{OUT}	7.0	9	–	W	V_{DD} = 28 V, I_{DQ} = 100 mA
Drain Efficiency[3]	η	53	65	–	%	V_{DD} = 28 V, I_{DQ} = 100 mA, P_{IN} = 32 dBm
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 100 mA, P_{IN} = 32 dBm
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	3.0	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	1.1	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.1	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging.
[2] Measured in CGH40006P-TB.
[3] Drain Efficiency = P_{OUT} / P_{DC}

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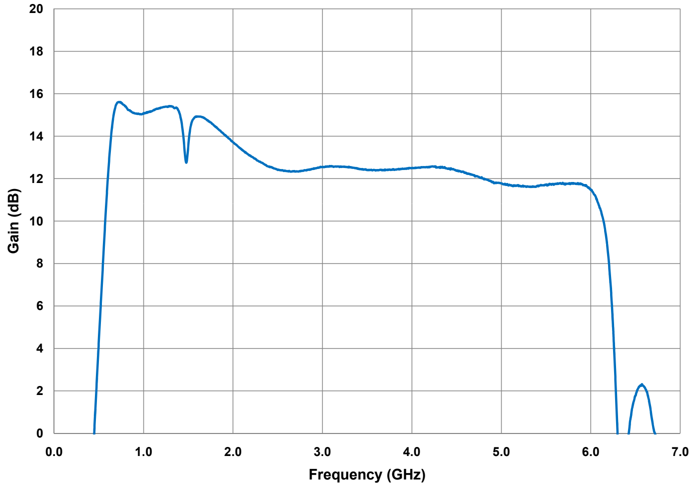
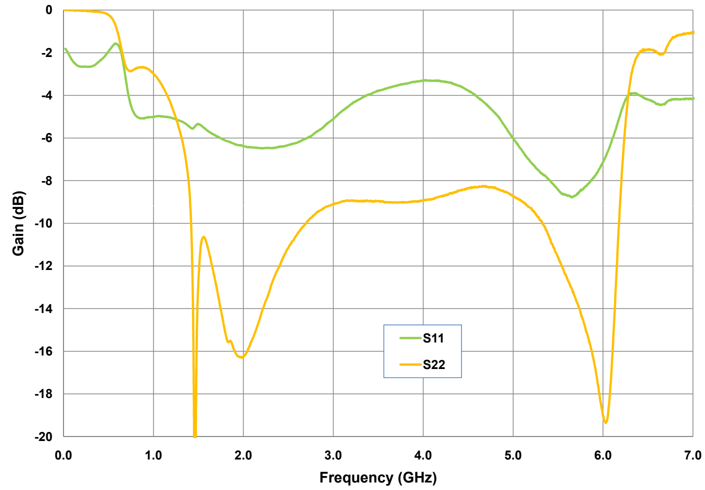
Typical Performance

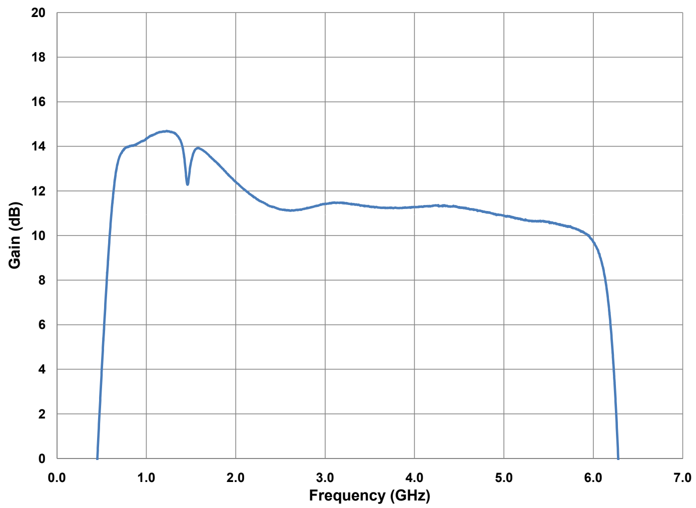
Small Signal Gain vs Frequency at 28 V of the CGH40006P in the CGH40006P-TB



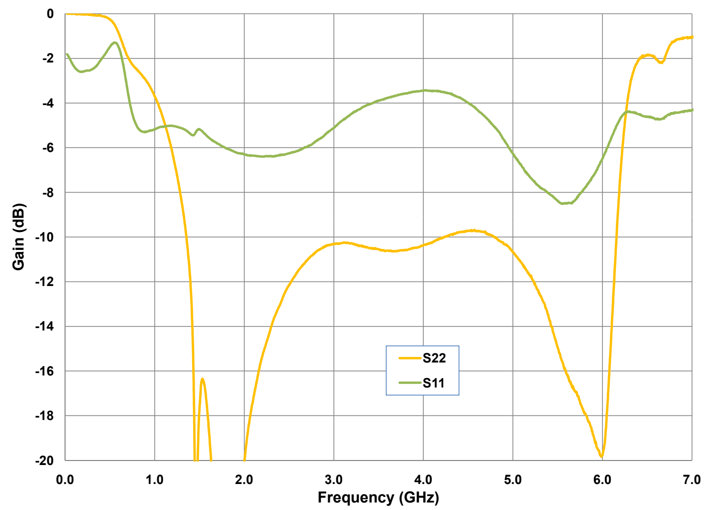
Input & Output Return Losses vs Frequency at 28 V of the CGH40006P in the CGH40006P-TB



Small Signal Gain vs Frequency at 20 V of the CGH40006P in the CGH40006P-TB



Input & Output Return Losses vs Frequency at 20 V of the CGH40006P in the CGH40006P-TB



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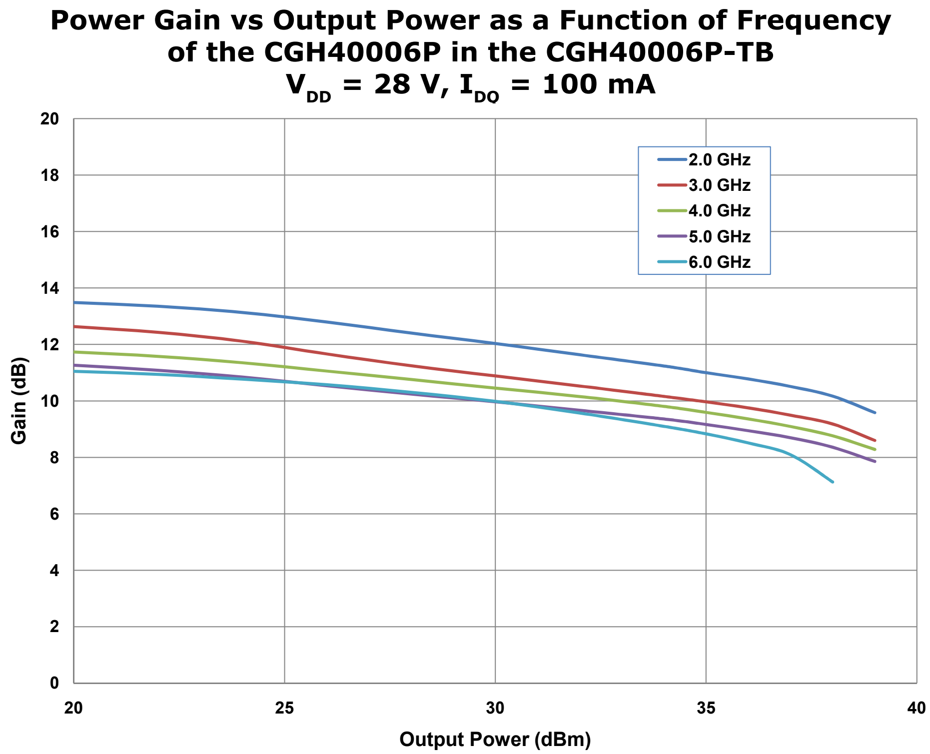
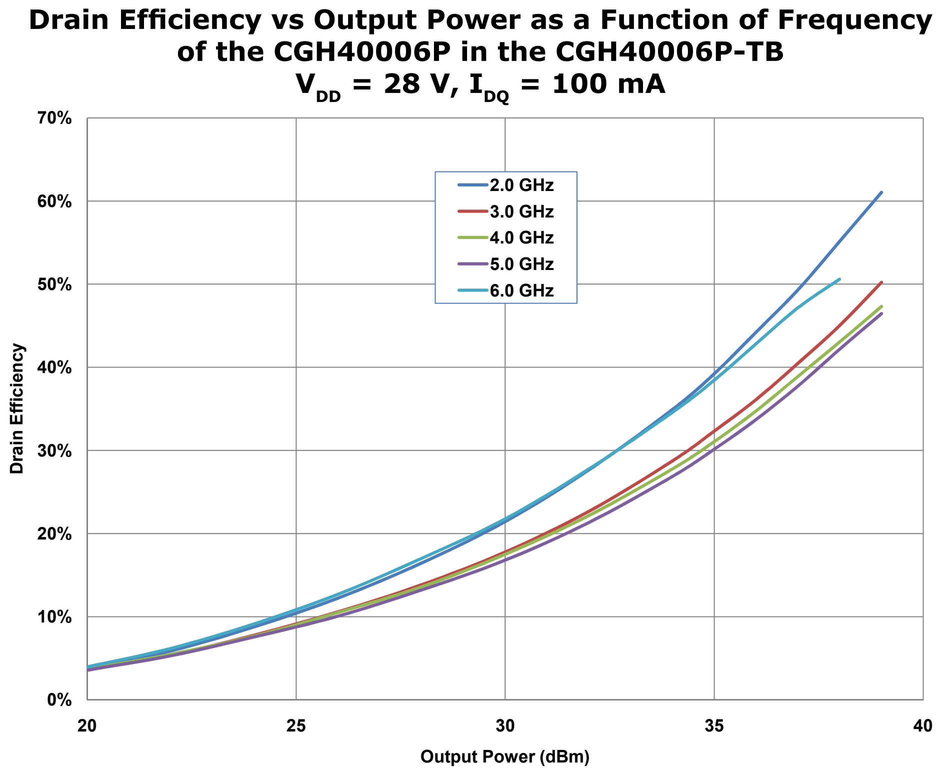
Typical Performance





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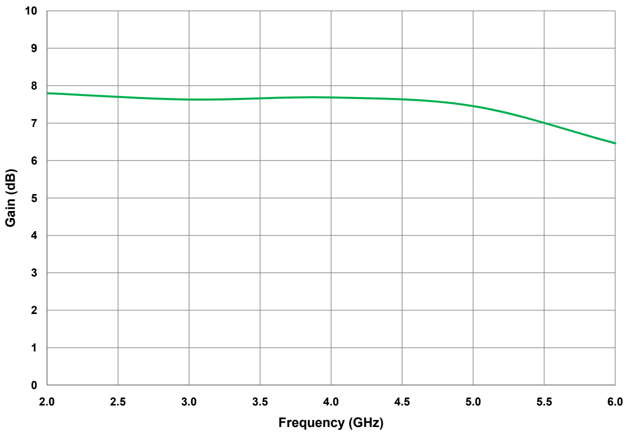
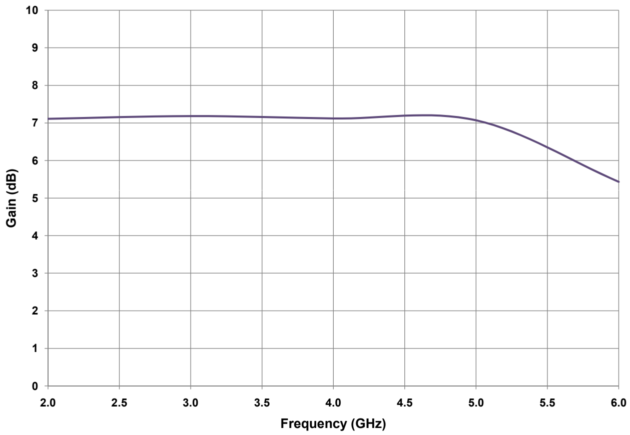
Typical Performance

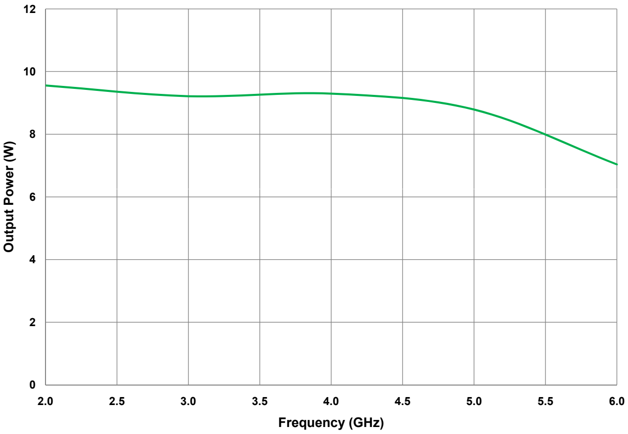
Power Gain vs Frequency of the CGH40006P in the CGH40006P-TB at P_{IN} = 32 dBm, V_{DD} = 28 V



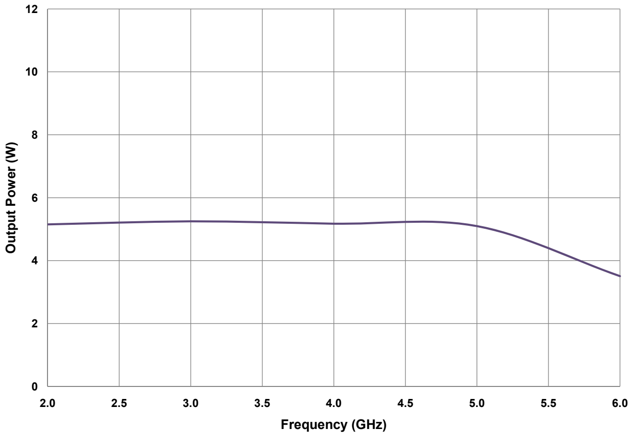
Power Gain vs Frequency of the CGH40006P in the CGH40006P-TB at P_{IN} = 30 dBm, V_{DD} = 20 V



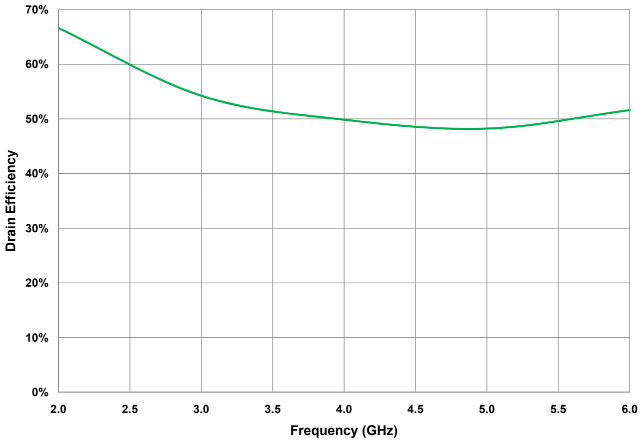
Output Power vs Frequency of the CGH40006P in the CGH40006P-TB at P_{IN} = 32 dBm, V_{DD} = 28 V



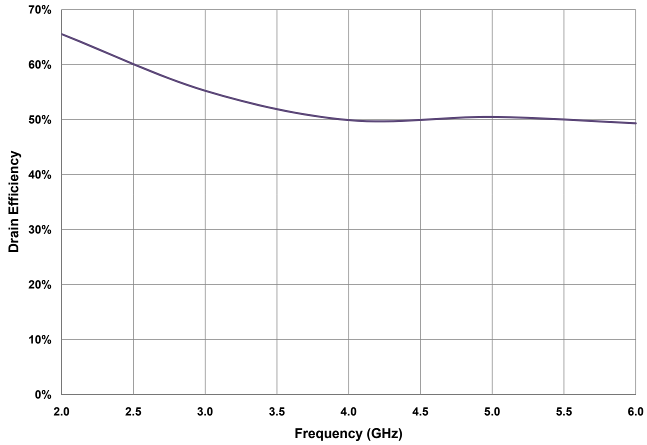
Output Power vs Frequency of the CGH40006P in the CGH40006P-TB at P_{IN} = 30 dBm, V_{DD} = 20 V



Drain Efficiency vs Frequency of the CGH40006P in the CGH40006P-TB at P_{IN} = 32 dBm, V_{DD} = 28 V



Drain Efficiency vs Frequency of the CGH40006P in the CGH40006P-TB at P_{IN} = 30 dBm, V_{DD} = 20 V



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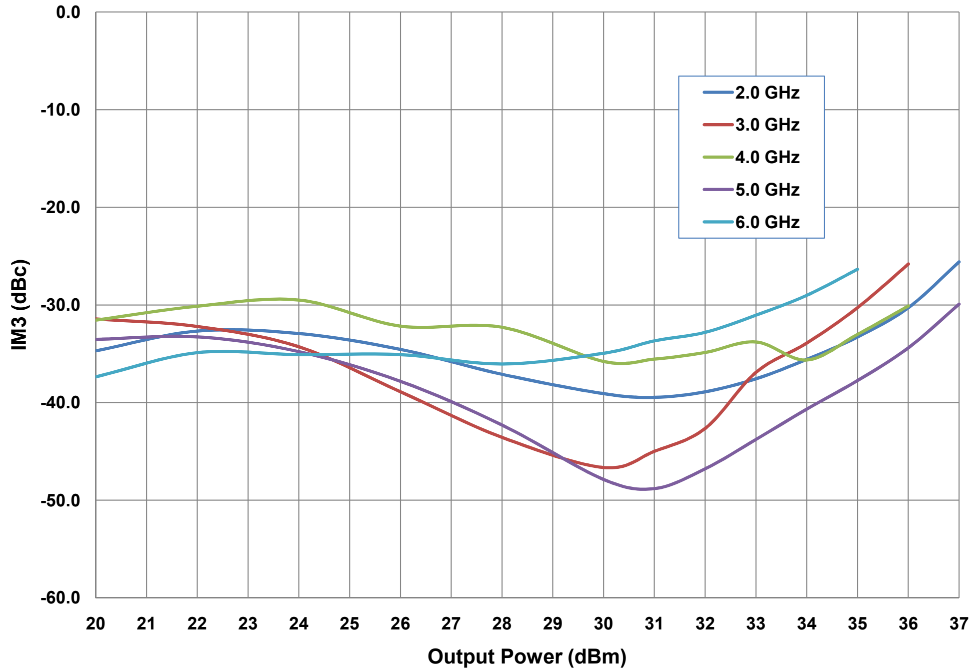
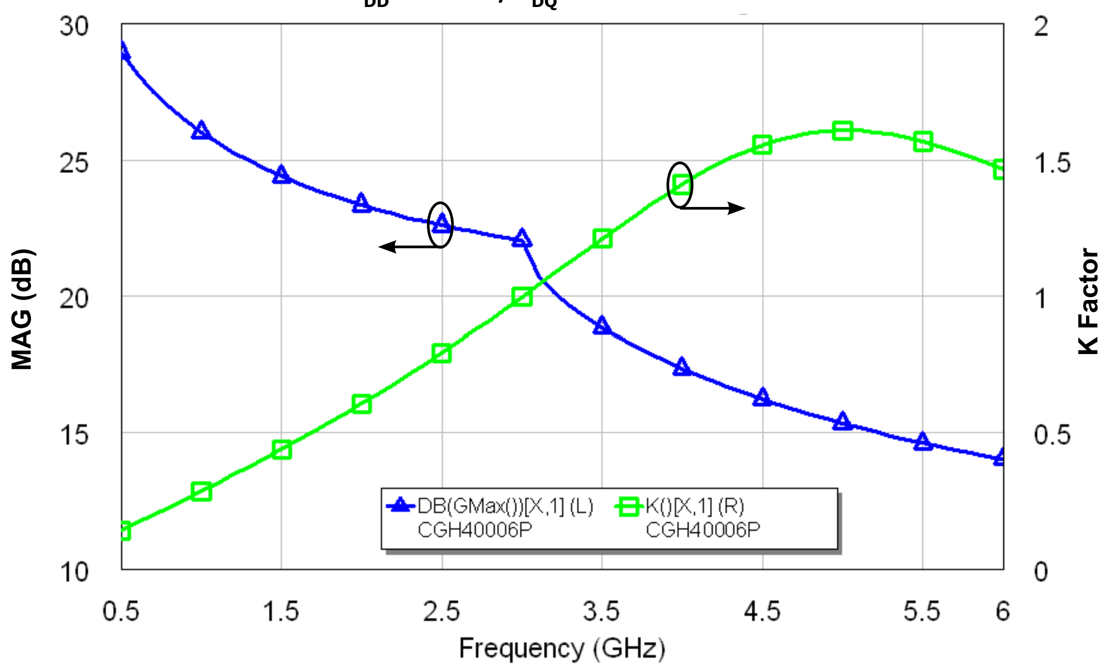
Typical Performance

Third Order Intermodulation Distortion vs Average Output Power as a Function of Frequency of the CGH40006P in the CGH40006P-TB
V_{DD} = 28 V, I_{DQ} = 60 mA



Simulated Maximum Available Gain and K Factor of the CGH40006P
V_{DD} = 28 V, I_{DQ} = 100 mA



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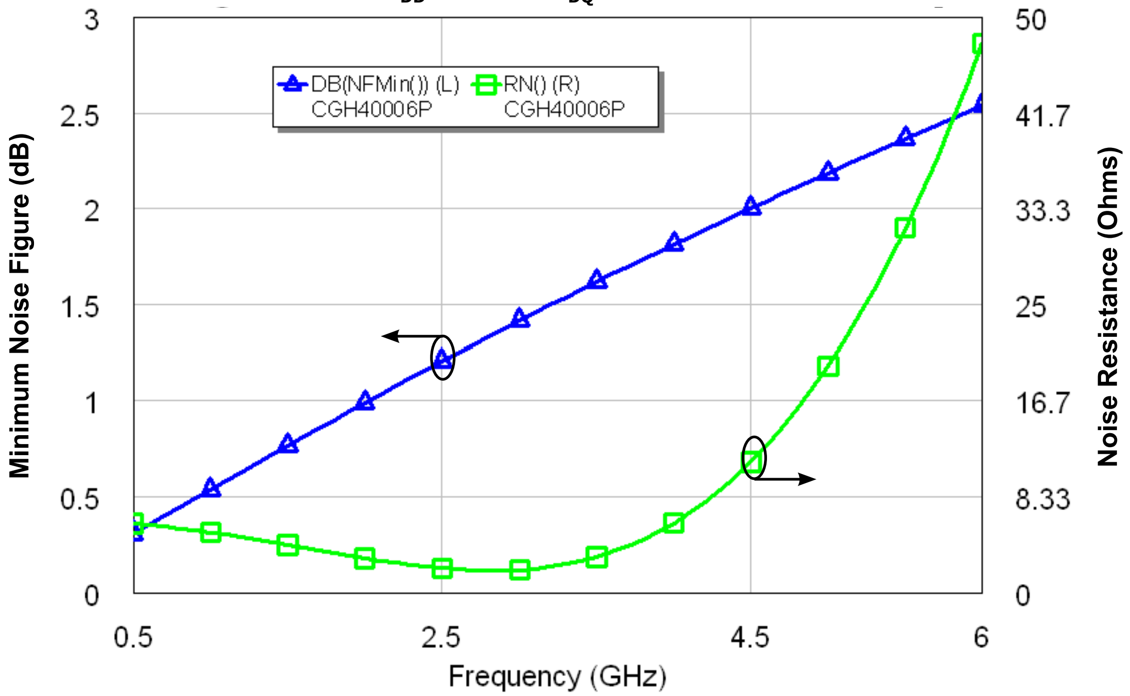
Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH40006P
V_{DD} = 28 V, I_{DQ} = 100 mA



Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A > 250 V	JEDEC JESD22 A114-D
Charge Device Model	CDM	1 < 200 V	JEDEC JESD22 C101-C

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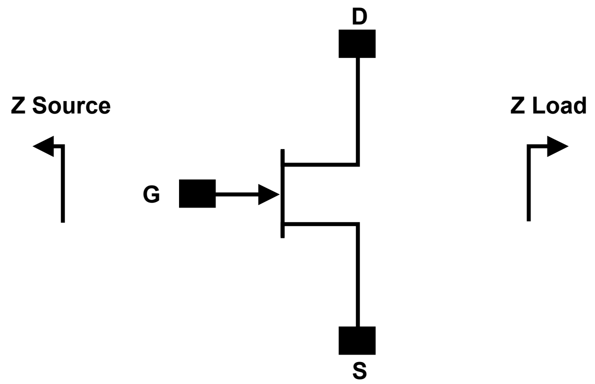
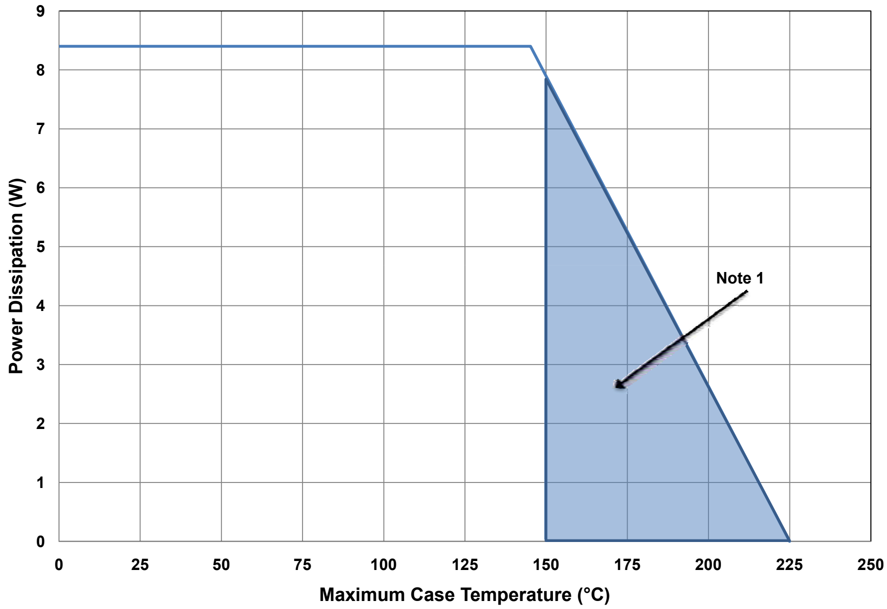
Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
1000	13.78 + j6.9	61.5 + j47.4
2000	4.78 + j1.78	19.4 + j39.9
3000	2.57 - j6.94	12.57 + j23.1
4000	3.54 - j14.86	9.44 + j11.68
5000	4.42 - j25.8	9.78 + j4.85
6000	7.1 - j42.7	9.96 - j4.38

Note 1. V_{DD} = 28V, I_{DQ} = 100mA in the 440109 package.
Note 2. Optimized for power gain, P_{SAT} and PAE.
Note 3. When using this device at low frequency, series resistors should be used to maintain amplifier stability.

CGH40006P Power Dissipation De-rating Curve



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

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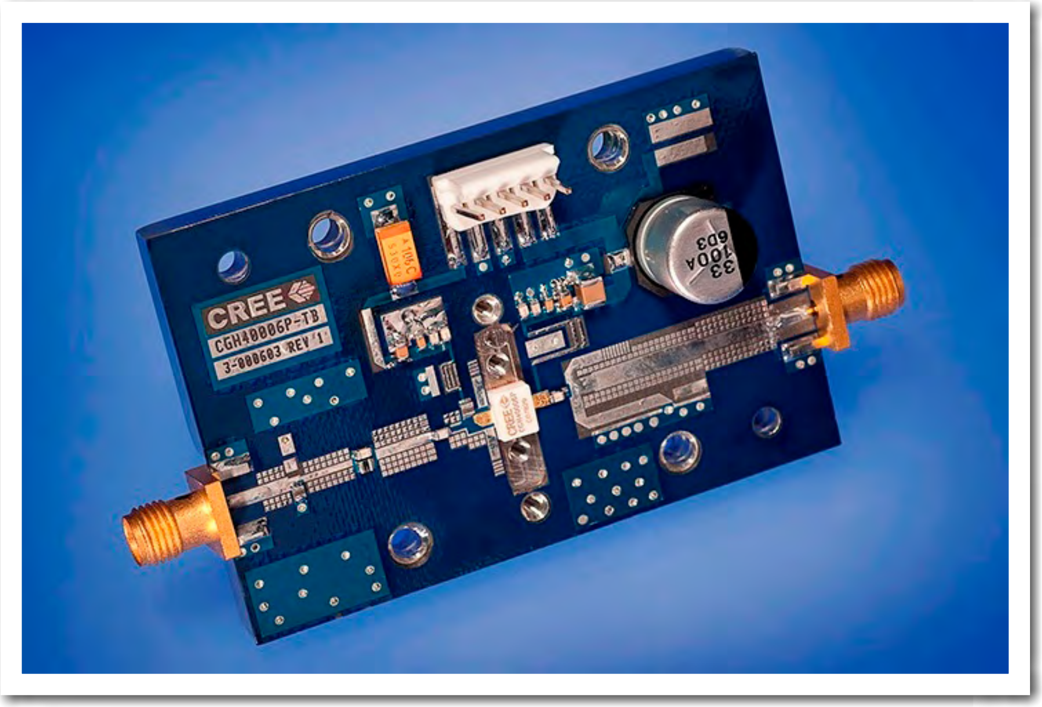
CGH40006P-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, AIN, 0505, 470 Ohms (≤5% tolerance)	1
R2	RES, AIN, 0505, 10 Ohms (≤5% tolerance)	1
R3	RES, AIN, 0505, 150 Ohms (≤5% tolerance)	1
C1	CAP, 2.0 pF +/-0.1 pF, 0603, ATC 600S	1
C2	CAP, 4.7 pF +/-0.1 pF, 0603, ATC 600S	1
C10	CAP, 3.6 pF +/-0.1 pF, 0603, ATC 600S	1
C4,C11	CAP, 8.2 pF +/-0.25, 0603, ATC 600S	2
C6,C13	CAP, 470 pF +/-5%, 0603, 100 V	2
C7,C14	CAP, 33000 pF, CER, 100V, X7R, 0805	2
C8	CAP, 10 uf, 16V, SMT, TANTALUM	1
C15	CAP, 1.0 uF +/-10%, CER, 100V, X7R, 1210	1
C16	CAP, 33 uF, 100V, ELECT, FK, SMD	1
J3,J4	CONN, SMA, STR, PANEL, JACK, RECP	2
J1	HEADER RT>PLZ .1CEN LK 5POS	1
-	PCB, RO5880, 20 MIL	1
Q1	CGH40006P	1

CGH40006P-TB Demonstration Amplifier Circuit



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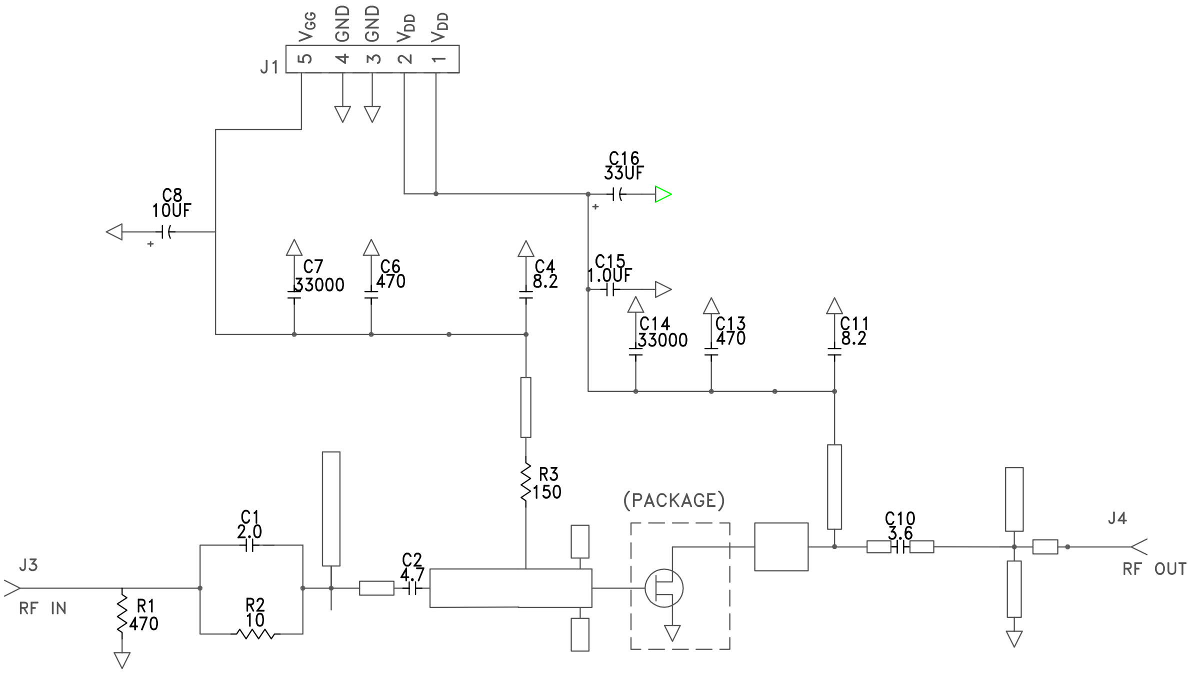
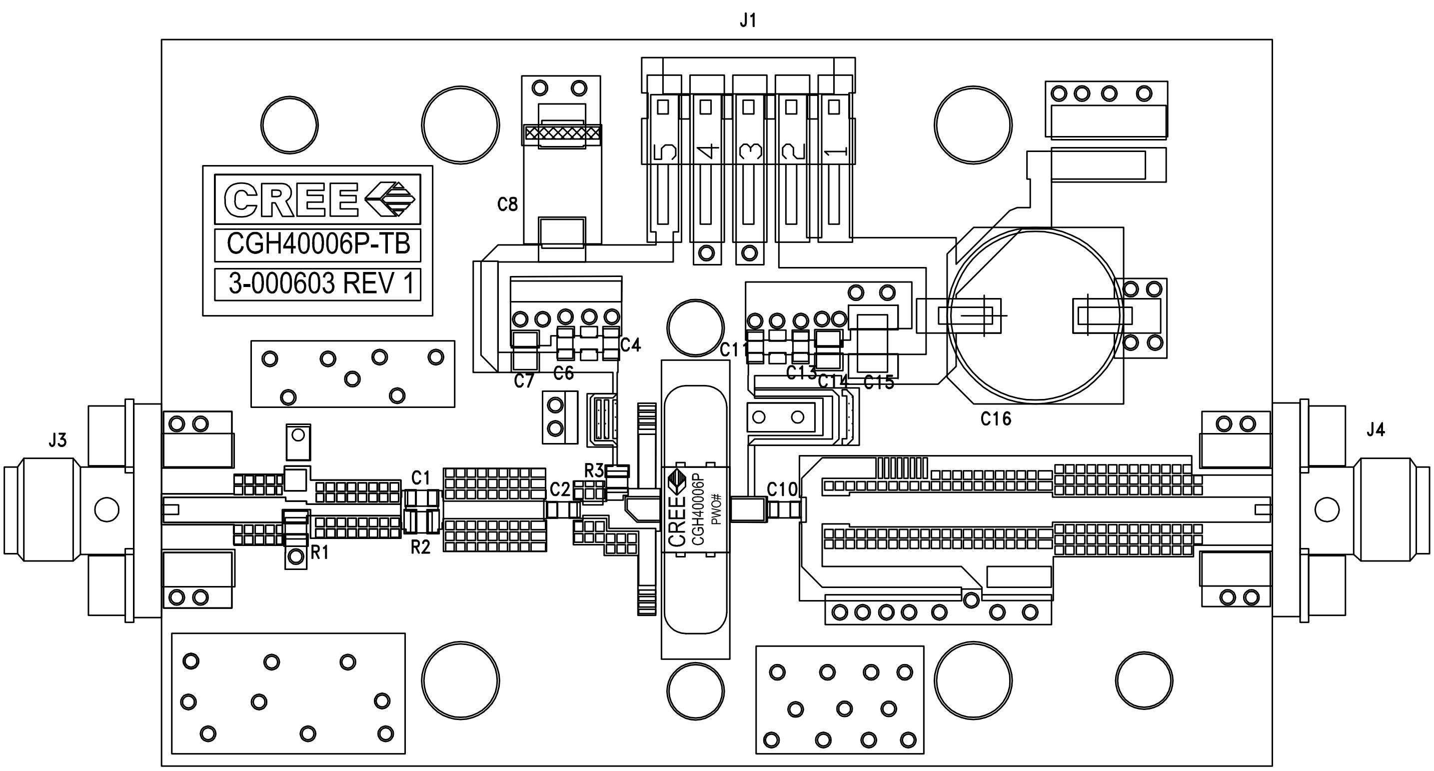
CGH40006P-TB Demonstration Amplifier Circuit Schematic



CGH40006P-TB Demonstration Amplifier Circuit Outline



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Typical Package S-Parameters for CGH40006P
(Small Signal, V_{DS} = 28 V, I_{DQ} = 100 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.905	-96.56	18.30	120.62	0.023	35.87	0.456	-52.76
600 MHz	0.889	-107.98	16.39	113.31	0.025	29.63	0.429	-58.98
700 MHz	0.877	-117.55	14.76	106.99	0.026	24.39	0.408	-64.31
800 MHz	0.867	-125.66	13.37	101.43	0.027	19.92	0.393	-68.96
900 MHz	0.860	-132.61	12.19	96.46	0.028	16.05	0.381	-73.11
1.0 GHz	0.854	-138.66	11.18	91.94	0.028	12.66	0.374	-76.87
1.1 GHz	0.849	-143.98	10.31	87.79	0.028	9.64	0.368	-80.34
1.2 GHz	0.845	-148.73	9.56	83.92	0.028	6.92	0.366	-83.57
1.3 GHz	0.842	-153.01	8.90	80.29	0.028	4.46	0.365	-86.61
1.4 GHz	0.839	-156.90	8.33	76.84	0.028	2.22	0.365	-89.49
1.5 GHz	0.837	-160.49	7.82	73.56	0.028	0.15	0.367	-92.24
1.6 GHz	0.835	-163.81	7.37	70.40	0.028	-1.75	0.369	-94.88
1.7 GHz	0.833	-166.92	6.96	67.36	0.028	-3.51	0.373	-97.43
1.8 GHz	0.832	-169.85	6.60	64.41	0.028	-5.15	0.376	-99.88
1.9 GHz	0.830	-172.62	6.27	61.54	0.028	-6.67	0.381	-102.27
2.0 GHz	0.829	-175.27	5.98	58.74	0.028	-8.08	0.386	-104.58
2.1 GHz	0.828	-177.81	5.71	56.00	0.028	-9.40	0.391	-106.84
2.2 GHz	0.827	179.75	5.46	53.32	0.027	-10.61	0.396	-109.04
2.3 GHz	0.826	177.38	5.24	50.68	0.027	-11.73	0.401	-111.19
2.4 GHz	0.825	175.07	5.03	48.09	0.027	-12.77	0.407	-113.29
2.5 GHz	0.824	172.82	4.84	45.53	0.027	-13.71	0.412	-115.36
2.6 GHz	0.823	170.61	4.67	43.00	0.026	-14.57	0.418	-117.38
2.7 GHz	0.821	168.44	4.51	40.50	0.026	-15.34	0.423	-119.36
2.8 GHz	0.820	166.30	4.36	38.02	0.026	-16.02	0.428	-121.32
2.9 GHz	0.819	164.18	4.22	35.57	0.026	-16.62	0.434	-123.24
3.0 GHz	0.818	162.08	4.09	33.13	0.026	-17.13	0.439	-125.13
3.2 GHz	0.816	157.91	3.85	28.31	0.025	-17.89	0.449	-128.84
3.4 GHz	0.813	153.76	3.65	23.53	0.025	-18.30	0.458	-132.46
3.6 GHz	0.810	149.58	3.47	18.78	0.025	-18.38	0.467	-136.00
3.8 GHz	0.807	145.35	3.31	14.05	0.024	-18.13	0.474	-139.48
4.0 GHz	0.804	141.05	3.18	9.32	0.024	-17.60	0.481	-142.91
4.2 GHz	0.801	136.66	3.05	4.57	0.024	-16.82	0.488	-146.30
4.4 GHz	0.797	132.15	2.94	-0.20	0.025	-15.89	0.493	-149.67
4.6 GHz	0.793	127.50	2.85	-5.01	0.025	-14.87	0.497	-153.02
4.8 GHz	0.789	122.70	2.76	-9.86	0.026	-13.89	0.500	-156.37
5.0 GHz	0.785	117.72	2.68	-14.79	0.027	-13.04	0.503	-159.74
5.2 GHz	0.780	112.55	2.62	-19.78	0.029	-12.42	0.504	-163.14
5.4 GHz	0.776	107.17	2.55	-24.86	0.030	-12.13	0.505	-166.59
5.6 GHz	0.772	101.58	2.50	-30.03	0.032	-12.22	0.504	-170.10
5.8 GHz	0.768	95.76	2.44	-35.30	0.035	-12.75	0.503	-173.70
6.0 GHz	0.764	89.70	2.40	-40.69	0.037	-13.73	0.501	-177.41

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

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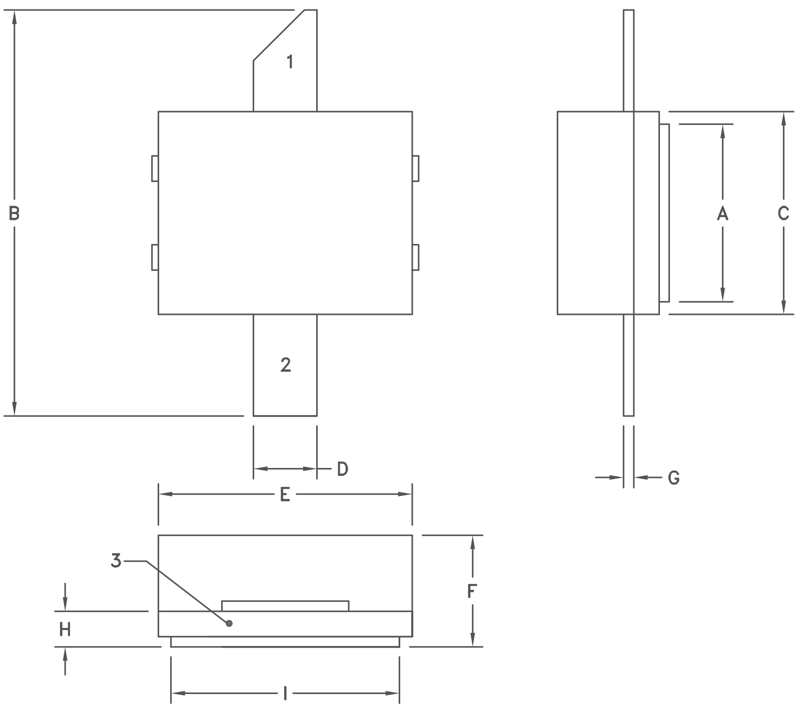
Product Dimensions CGH40006P (Package Type — 440109)



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M—1982 DIMENSIONING AND TOLERANCING.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.135	.145	3.43	3.68
B	.315	.325	8.00	8.26
C	.155	.165	3.94	4.19
D	.045	.055	1.14	1.40
E	.195	.205	4.95	5.21
F	.090	.110	2.29	2.79
G	.007	.009	.178	0.23
H	.026	.030	.660	.762
I	.175	.185	4.45	4.70

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

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