

CGH40006P

6 W, RF Power GaN HEMT

Description

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 Type: 440109
PN: 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
- 28 V Operation

Applications

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



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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DS}	120	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	

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 CGH40006P at $P_{DISS} = 8W$

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

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics¹						
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}	1.5	2.1	-	A	$V_{DS} = 6.0 V, V_{GS} = 2.0 V$
Drain-Source Breakdown Voltage	V_{BR}	84	-	-	V_{DC}	$V_{GS} = -8 V, I_D = 2.1 mA$
RF Characteristics² ($T_C = 25^\circ C, F_0 = 2.0 GHz$ 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	Y	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

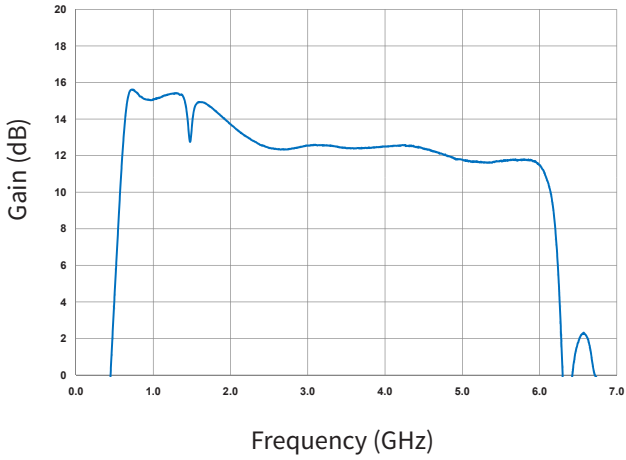
² Measured in the CGH40006P-AMP

³ Drain Efficiency = P_{OUT} / P_{DC}

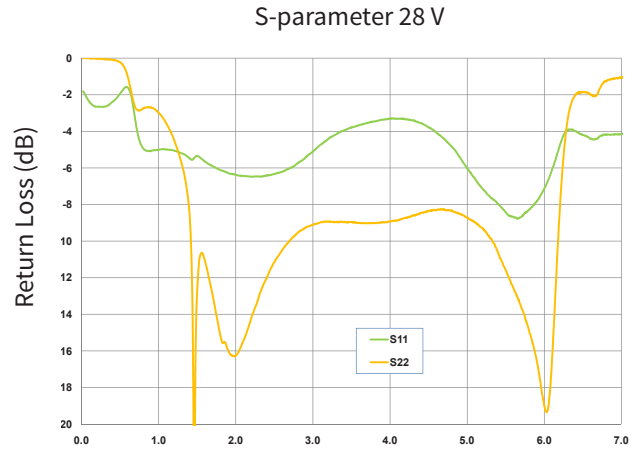


Typical Performance

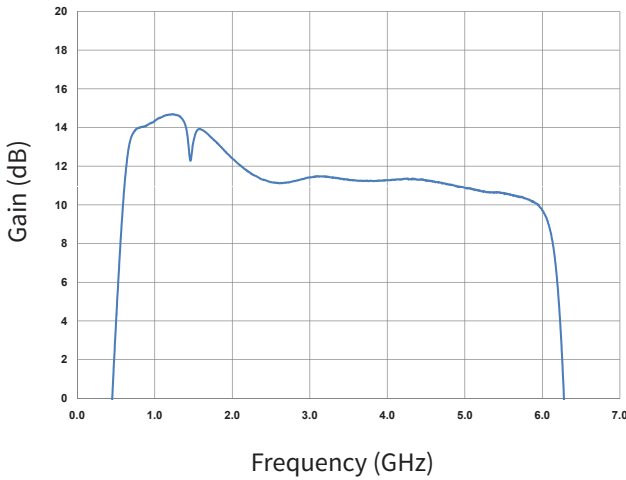
Small Signal Gain vs Frequency at 28 V of the CGH40006P in the CGH40006P-AMP



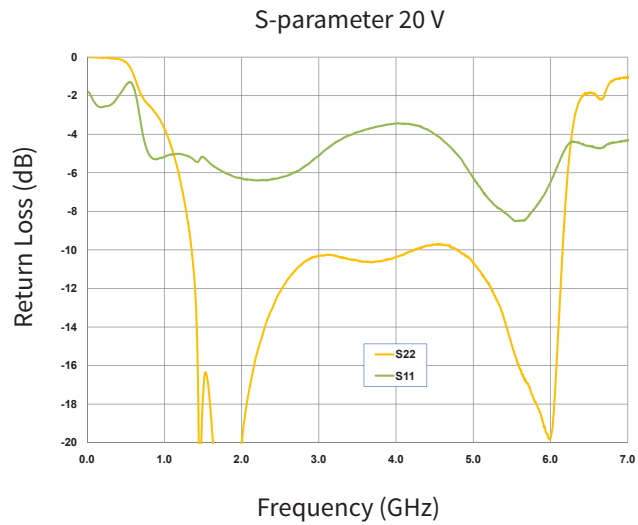
Input & Output Return Losses vs Frequency 28 V of the CGH40006P in the CGH40006P-AMP



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



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

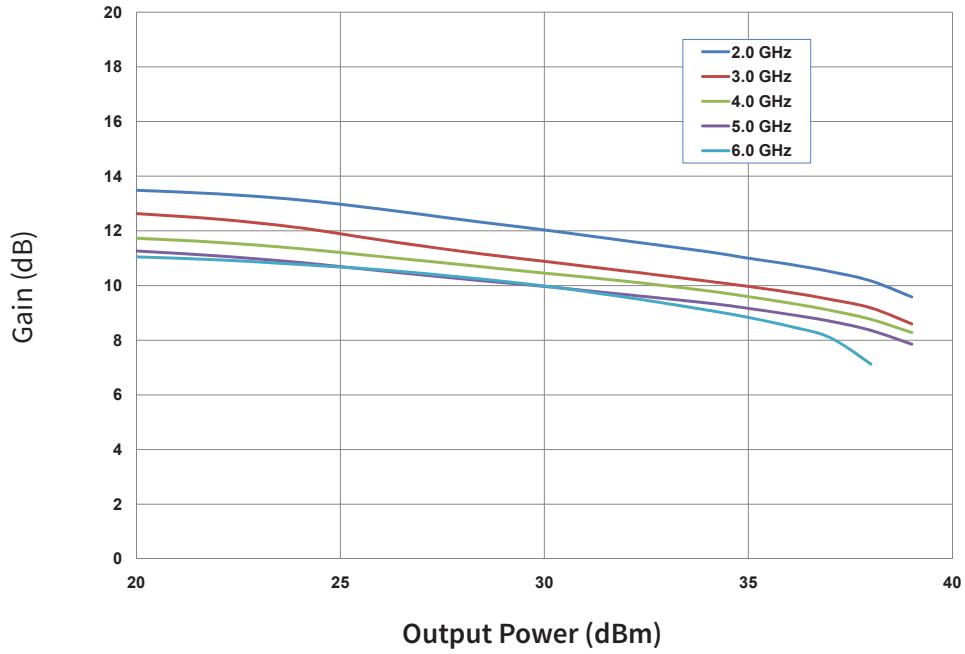




Typical Performance

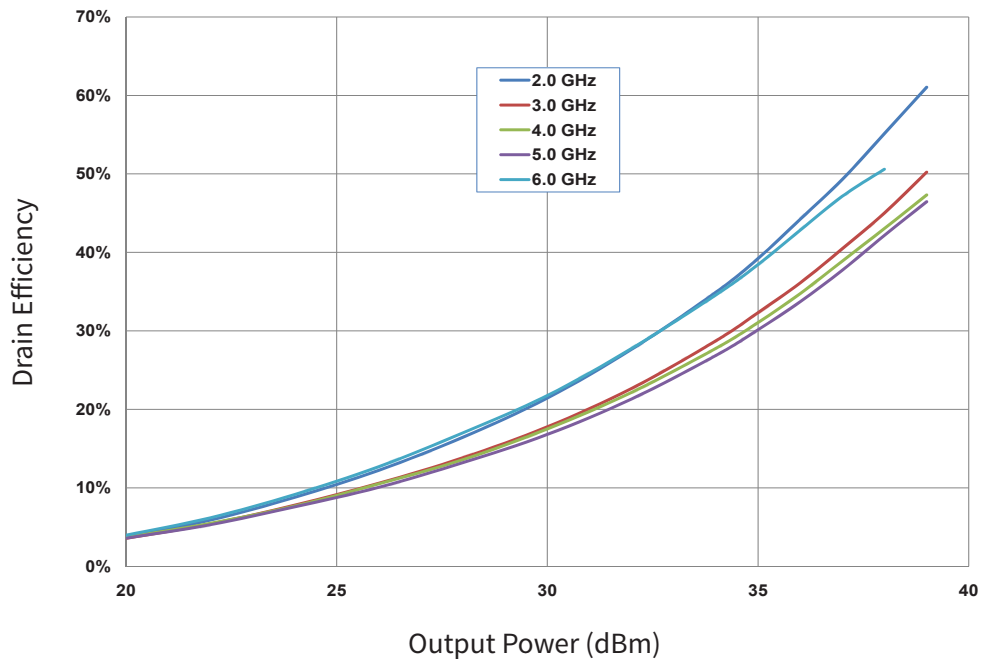
Power Gain vs Output Power as a Function of Frequency of the CGH40006P in the CGH40006P-AMP

$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}$



Drain Efficiency vs Output Power as a Function of Frequency of the CGH40006P in the CGH40006P-AMP

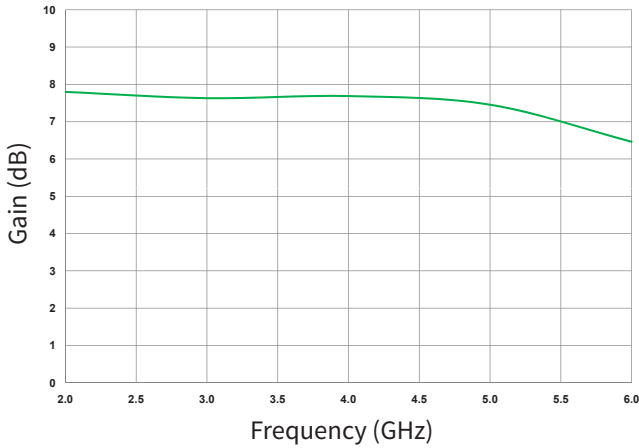
$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}$



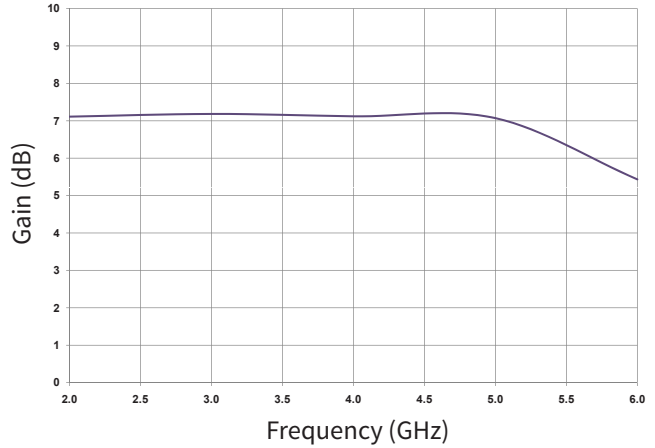


Typical Performance

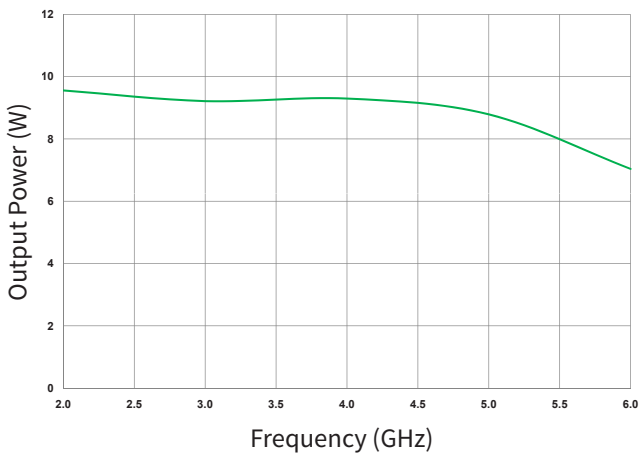
Small Signal Gain vs Frequency at 28 V
in the CGH40006P-AMP at $P_{IN} = 32 \text{ dBm}$, $V_{DD} = 28 \text{ V}$



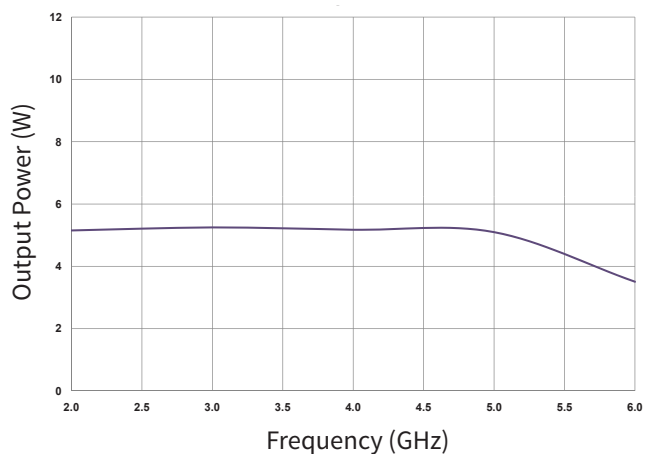
Power Gain vs Frequency of the CGH40006P
in the CGH40006P-AMP at $P_{IN} = 30 \text{ dBm}$, $V_{DD} = 20 \text{ V}$



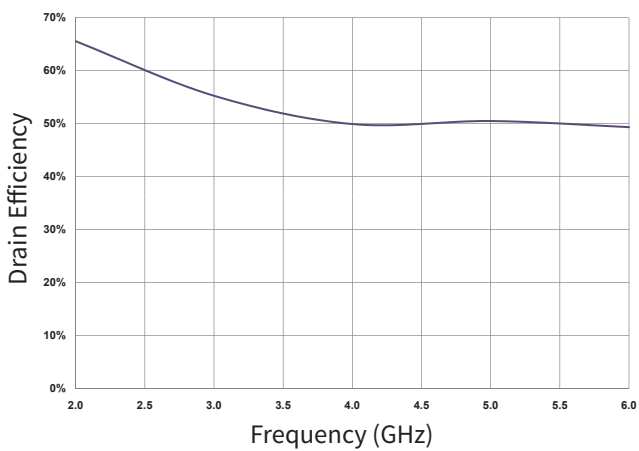
Output Power vs Frequency of the CGH40006P
in the CGH40006P-AMP at $P_{IN} = 32 \text{ dBm}$, $V_{DD} = 28 \text{ V}$



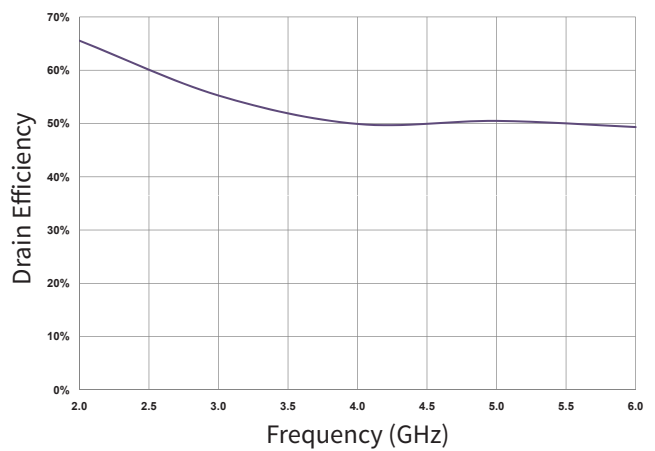
Output Power vs Frequency of the CGH40006P
in the CGH40006P-AMP at $P_{IN} = 30 \text{ dBm}$, $V_{DD} = 20 \text{ V}$



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



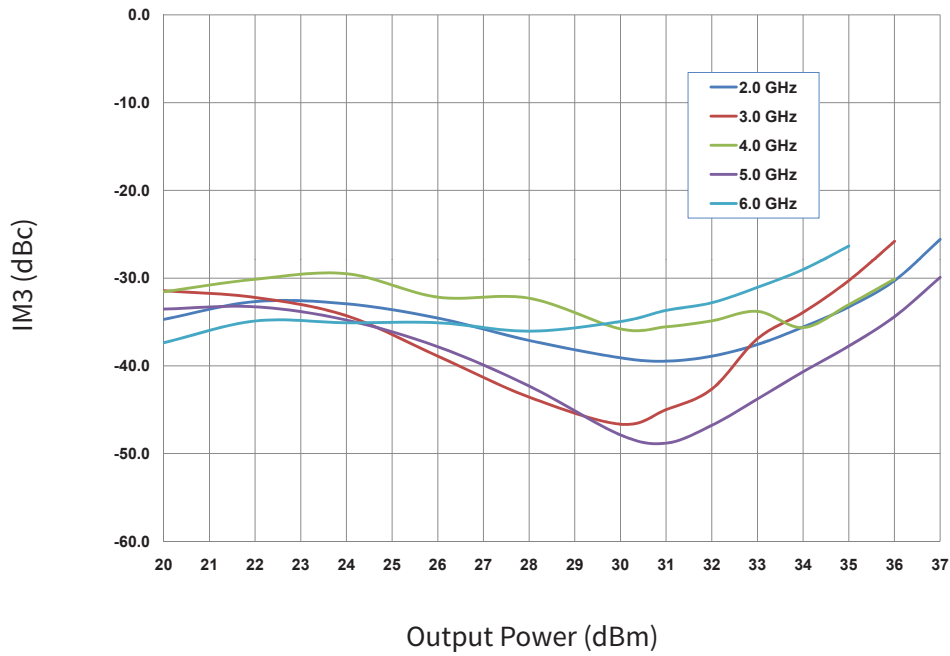
Drain Efficiency vs Frequency of the CGH40006P
in the CGH40006P-AMP at $P_{IN} = 30 \text{ dBm}$, $V_{DD} = 20 \text{ V}$



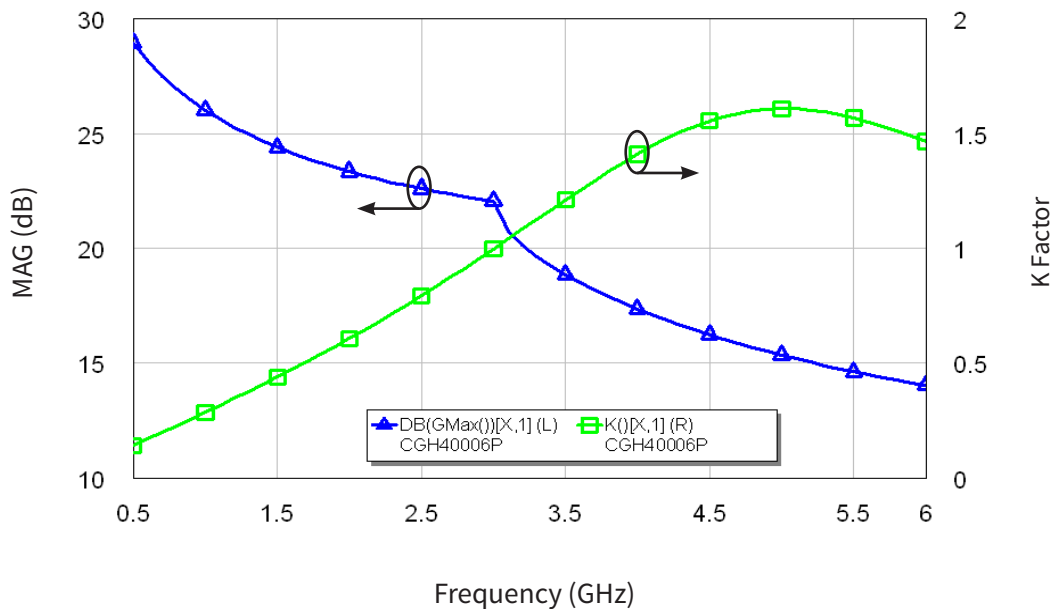


Typical Performance

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



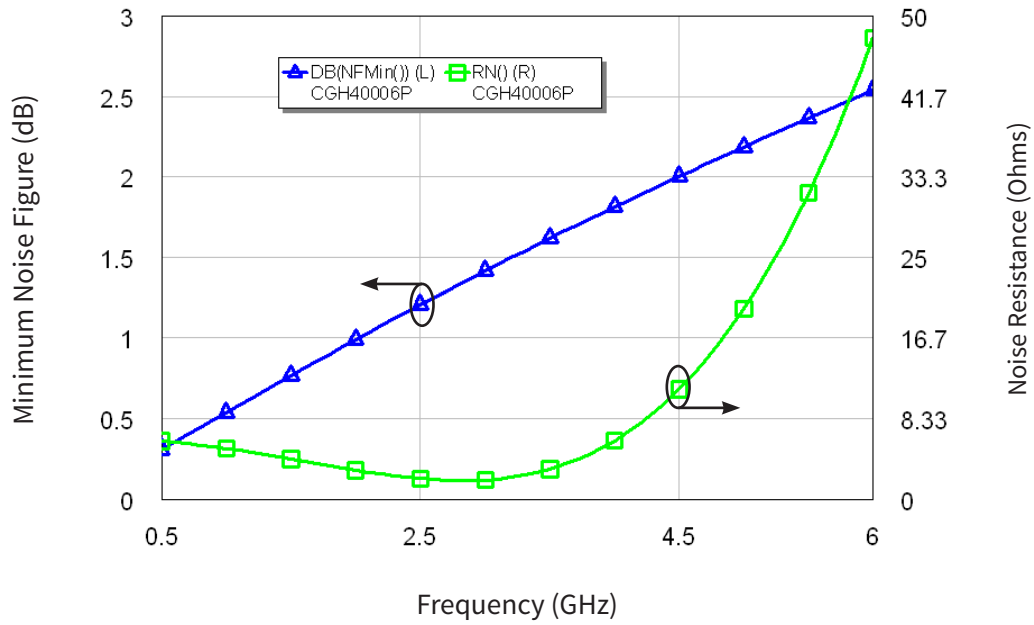
Simulated Maximum Available Gain and K Factor of the CGH40006P
 $V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}$





Typical Noise Performance

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

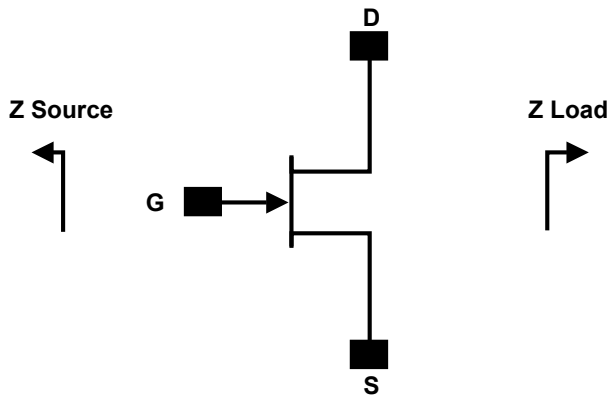


Electrostatic Discharge (ESD) Classifications

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



Source and Load Impedances



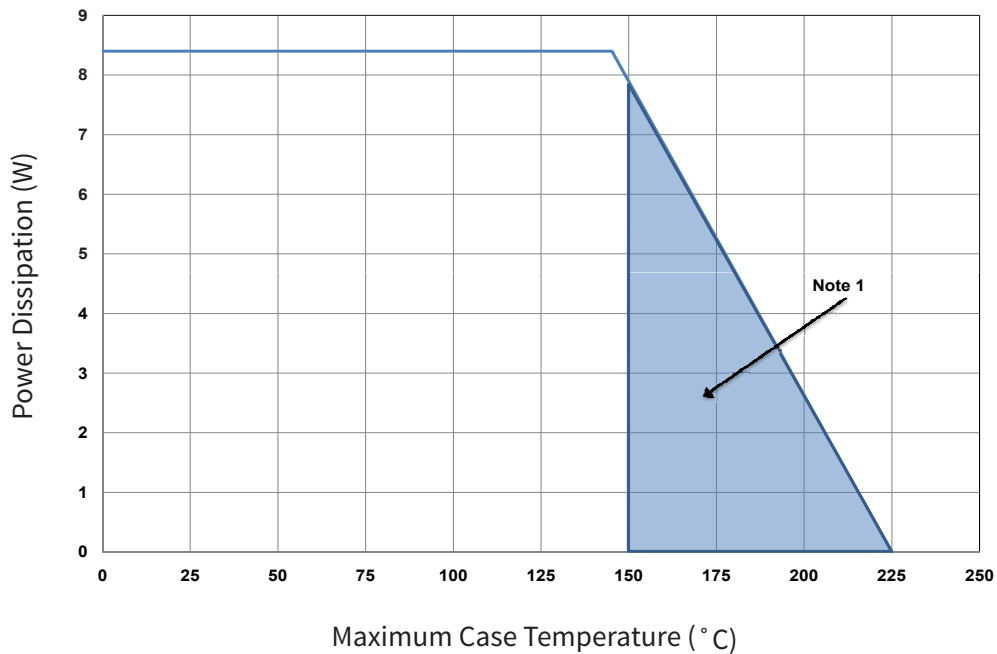
Frequency (MHz)	Z Source	Z Load
1000	13.78 + j6.9	61.5 + j47.4
2000	4.78 + j1.78	19.4 + j39.9
3000	2.57 - j6.94	12.57 + j23.1
4000	3.54 - j14.86	9.44 + j11.68
5000	4.42 - j25.8	9.78 + j4.85
6000	7.1 - j42.7	9.96 - j4.38

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

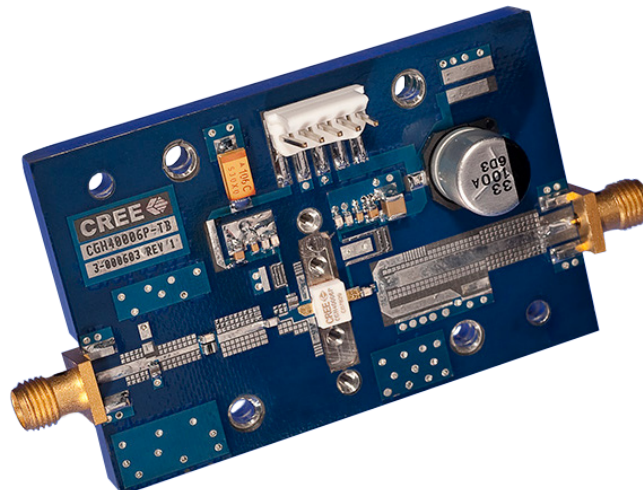


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

CGH40006P-AMP Demonstration Amplifier Circuit Bill of Materials

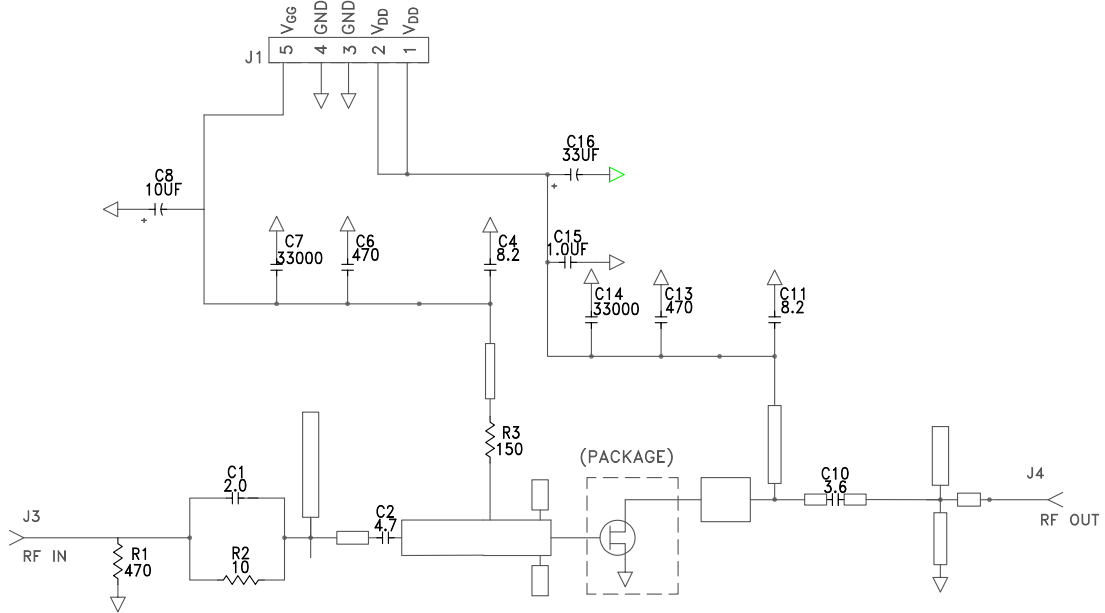
Designator	Description	Qty
R1	RES, AIN, 0505, 470 Ohms ($\leq 5\%$ tolerance)	1
R2	RES, AIN, 0505, 10 Ohms ($\leq 5\%$ tolerance)	1
R3	RES, AIN, 0505, 150 Ohms ($\leq 5\%$ tolerance)	1
C1	CAP, 2.0 pF +/-0.1 pF, 0603, ATC 600S	1
C2	CAP, 4.7 pF +/-0.1 pF, 0603, ATC 600S	1
C10	CAP, 3.6 pF +/-0.1 pF, 0603, 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-AMP Demonstration Amplifier Circuit

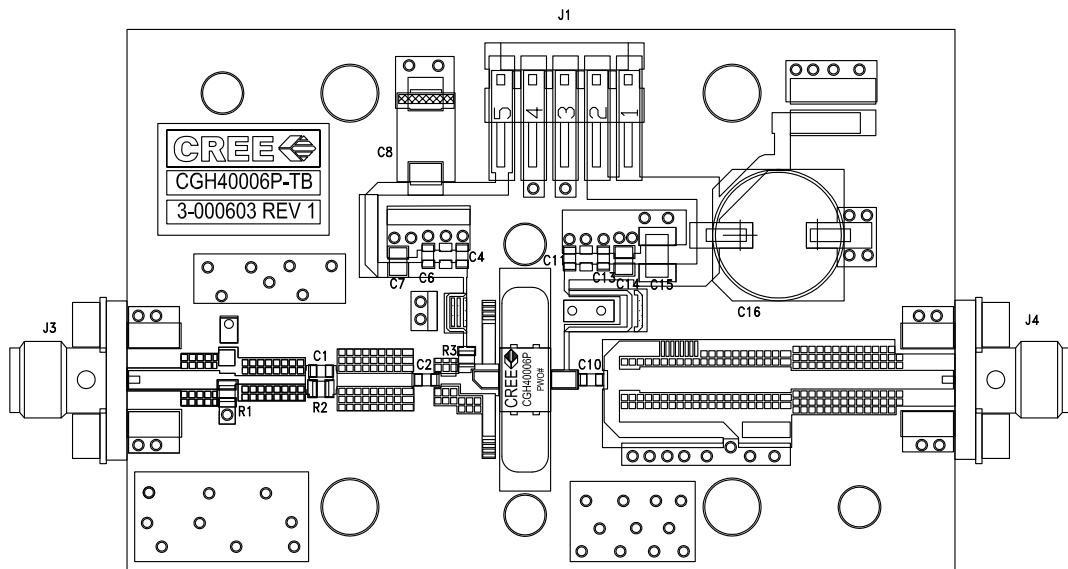




CGH40006P-AMP Demonstration Amplifier Circuit Schematic



CGH40006P-AMP Demonstration Amplifier Circuit Outline

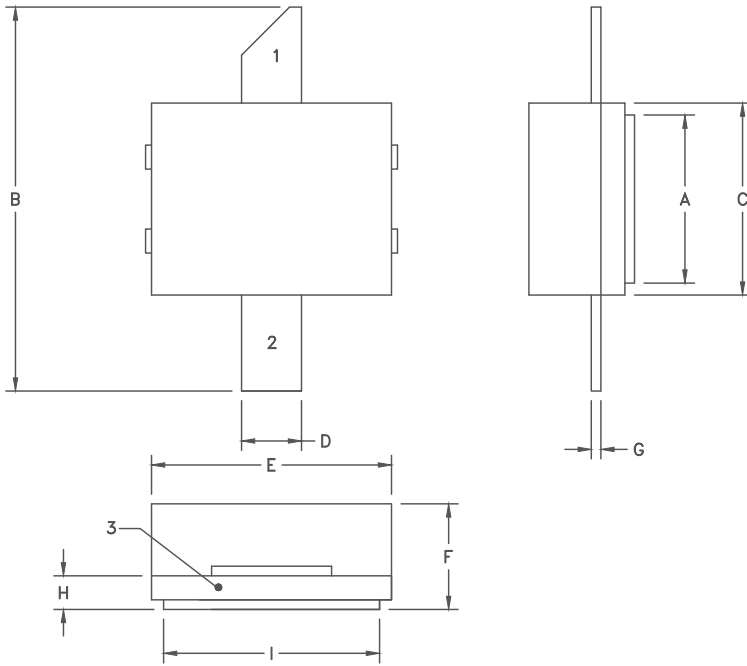


Typical Package S-Parameters for CGH40006P
(Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 100\text{ mA}$, angle in degrees)

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

To download the s-parameters in s2p format, go to the [CGH40006P](#) Product page and click on the documentation tab.

Product Dimensions CGH40006P (Package Type – 440109)



NOTES: (UNLESS OTHERWISE SPECIFIED)


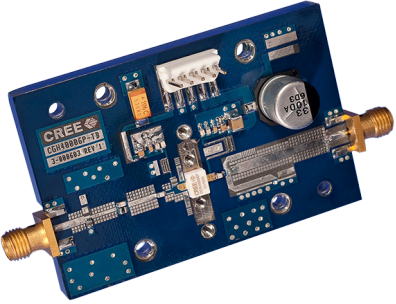
1. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M-1982 DIMENSIONING AND TOLERANCING.
2. CONTROLLING DIMENSION: INCH.
3. ALL PLATED SURFACES ARE Ni/Au

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	.085	.104	2.15	2.65
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



Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH40006P	GaN HEMT	Each	 A white, rectangular GaN HEMT device with two gold-colored leads extending from the top and bottom. The device is marked with "CREE", "CGH40006P", and "C07829".
CGH40006P-AMP	Test board with GaN HEMT installed	Each	 A blue printed circuit board (PCB) test board with various electronic components, including a GaN HEMT device, capacitors, and connectors. It features two gold-colored SMA connectors on the left and right sides. The board is marked with "CREE" and "CGH40006P".



For more information, please contact:

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RFSales@cree.com

Notes

Disclaimer

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