CGH40006P

6 W, RF Power GaN HEMT

Package Type: 440109
PN: CGH40006P

Description

The 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.

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

Large Signal Models Available for ADS and MWO

RoHS compliant

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}	2.1	mA	25°C
Maximum Drain Current[1]	I_{DMAX}	0.75	A	
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
[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_{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 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	
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	–		
Feedback Capacitance	C_{GD}	–	0.1	–		

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

Typical Performance

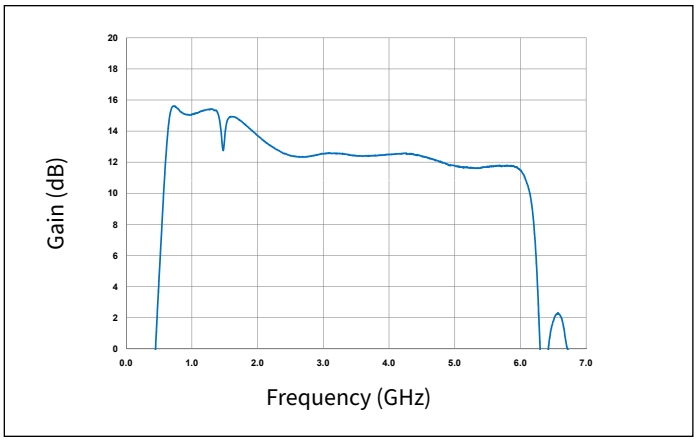


Figure 1. Small Signal Gain vs Frequency at 28 V of the CGH40006P in the CGH40006P-AMP

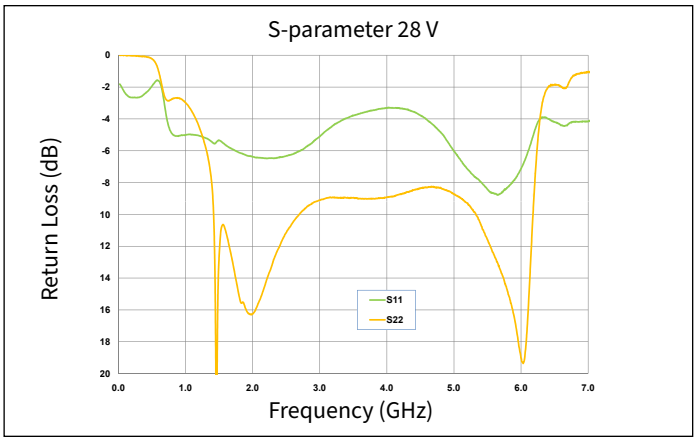


Figure 2. Input & Output Return Losses vs Frequency at 28 V of the CGH40006P in the CGH40006P-AMP

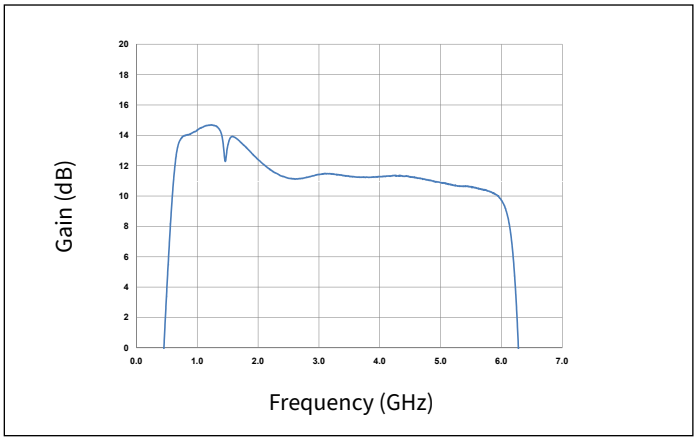


Figure 3. Small Signal Gain vs Frequency at 20 V of the CGH40006P in the CGH40006P-AMP

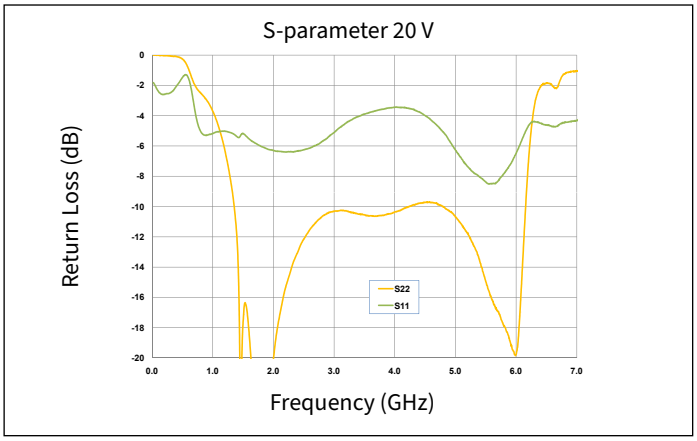


Figure 4. Input & Output Return Losses vs Frequency at 20 V of the CGH40006P in the CGH40006P-AMP

Typical Performance

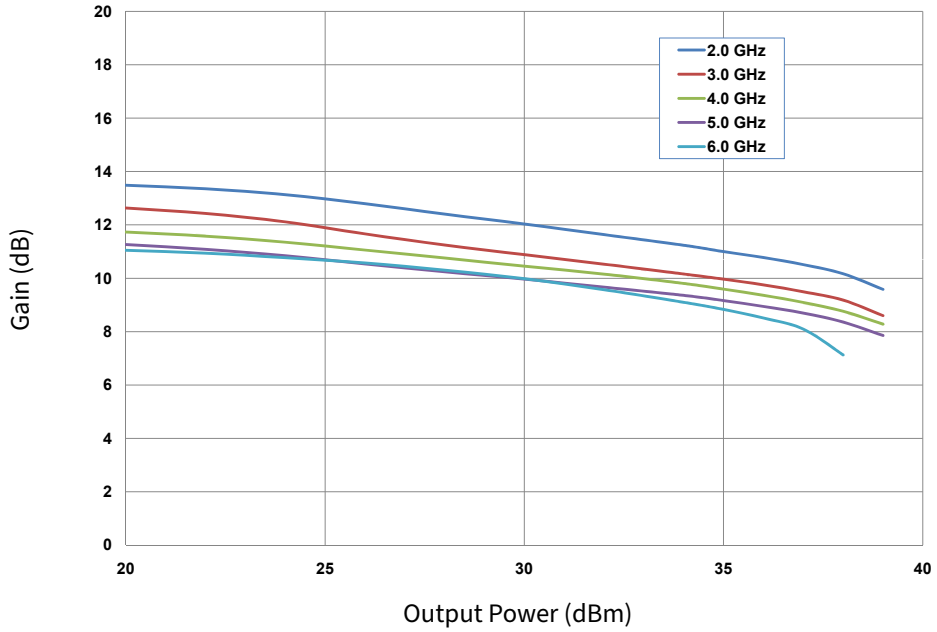


Figure 5. Power Gain vs Output Power as a Function of Frequency of the CGH40006P in the CGH40006P-AMP
V_{DD} = 28 V, I_{DQ} = 100 mA

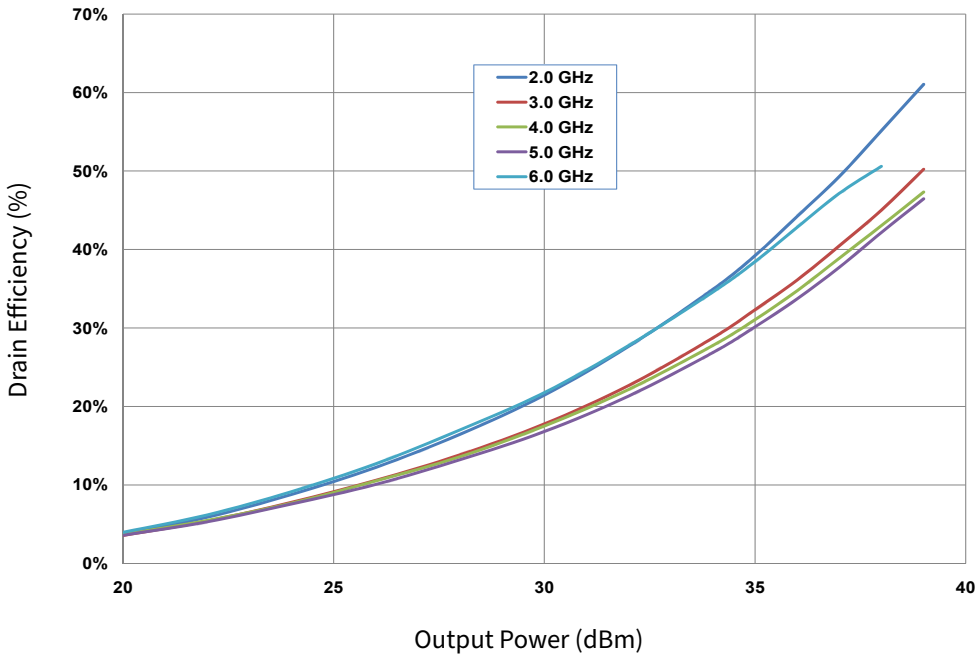


Figure 6. Drain Efficiency vs Output Power as a Function of Frequency of the CGH40006P in the CGH40006P-AMP
V_{DD} = 28 V, I_{DQ} = 100 mA

Typical Performance

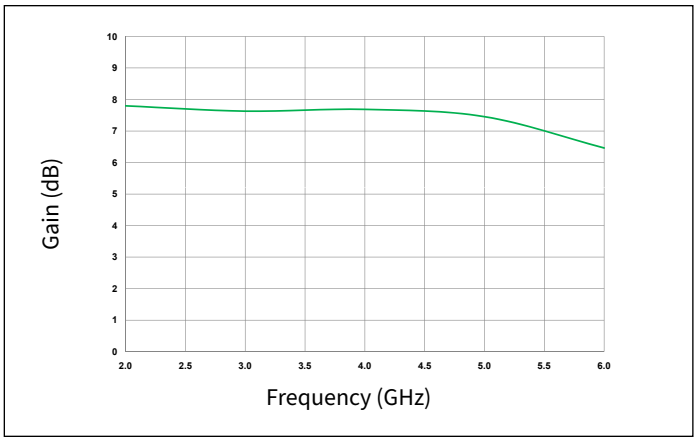


Figure 7. Small Signal Gain vs Frequency at 28 V in the CGH40006P-AMP
P_{IN} = 32 dBm, V_{DD} = 28 V

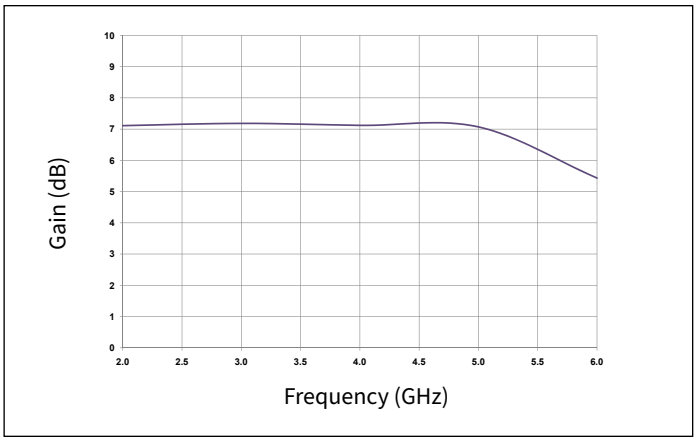


Figure 8. Power Gain vs Frequency of the CGH40006P in the CGH40006P-AMP
P_{IN} = 30 dBm, V_{DD} = 20 V

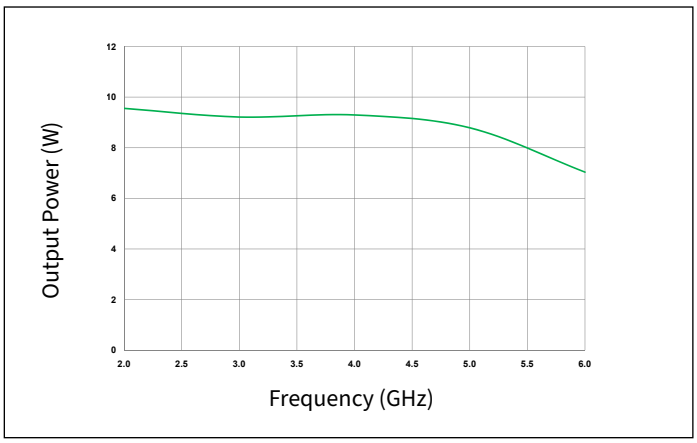


Figure 9. Output Power vs Frequency of the CGH40006P in the CGH40006P-AMP
P_{IN} = 32 dBm, V_{DD} = 28 V

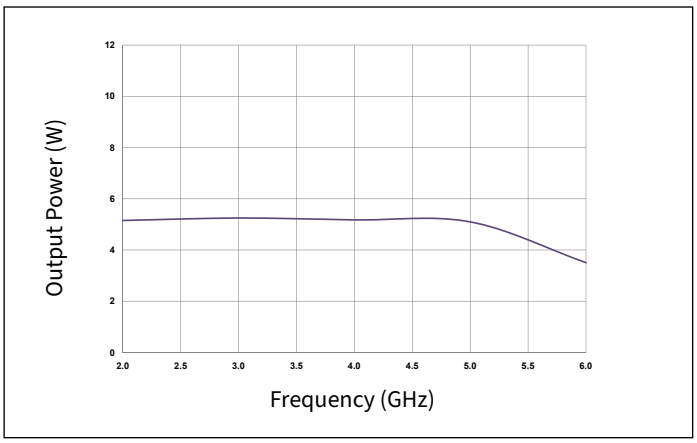


Figure 10. Output Power vs Frequency of the CGH40006P in the CGH40006P-AMP
P_{IN} = 30 dBm, V_{DD} = 20 V

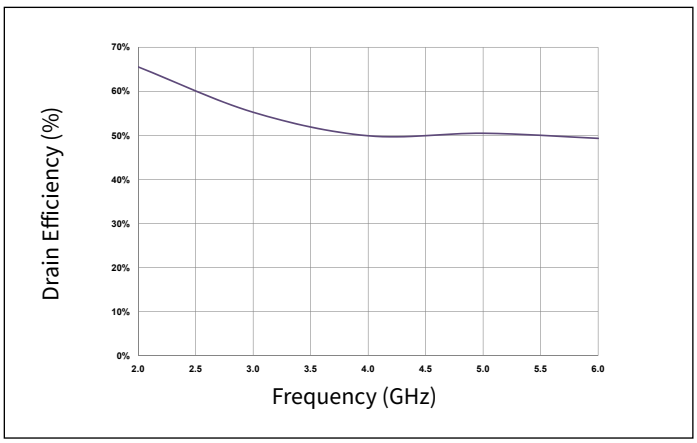


Figure 11. Drain Efficiency vs Frequency of the CGH40006P in the CGH40006P-AMP
P_{IN} = 32 dBm, V_{DD} = 28 V

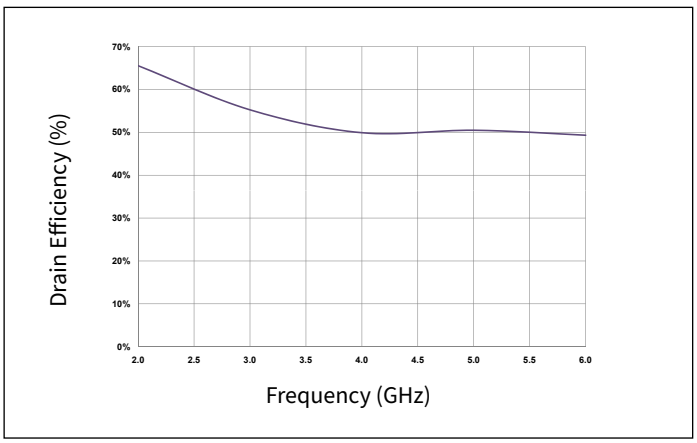


Figure 12. Drain Efficiency vs Frequency of the CGH40006P in the CGH40006P-AMP
P_{IN} = 30 dBm, V_{DD} = 20 V

Typical Performance

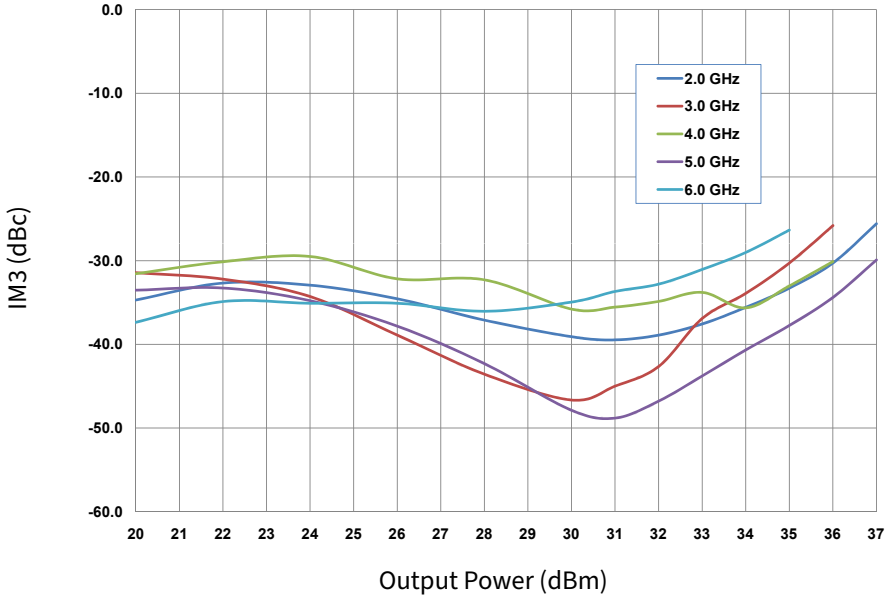


Figure 13. Third Order Intermodulation Distortion vs Average Output Power as a Function of Frequency of the CGH40006P in the CGH40006P-AMP
V_{DD} = 28 V, I_{DQ} = 60 mA

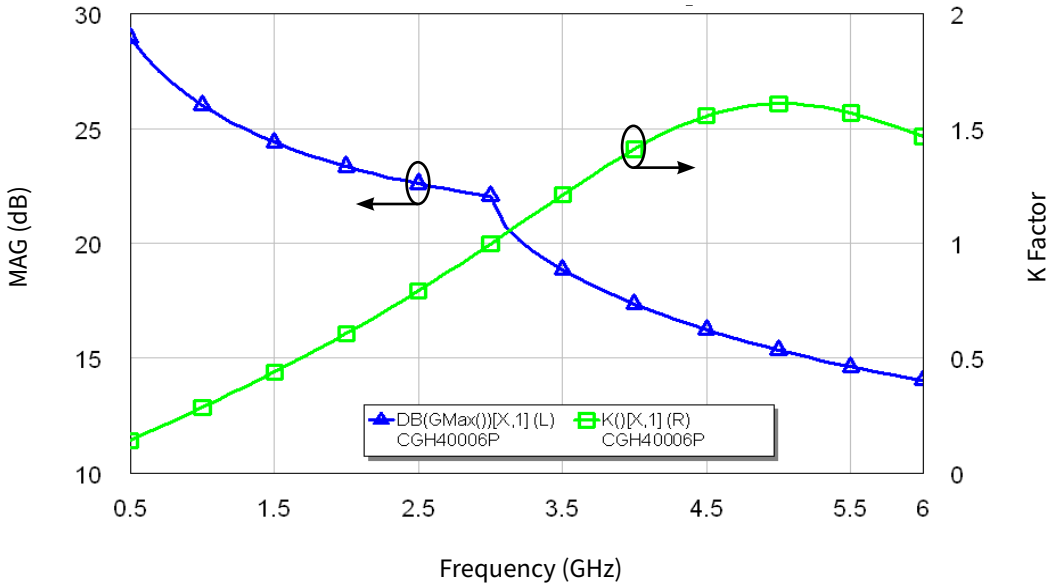


Figure 14. Simulated Maximum Available Gain and K Factor of the CGH40006P
V_{DD} = 28 V, I_{DQ} = 100 mA

Typical Noise Performance

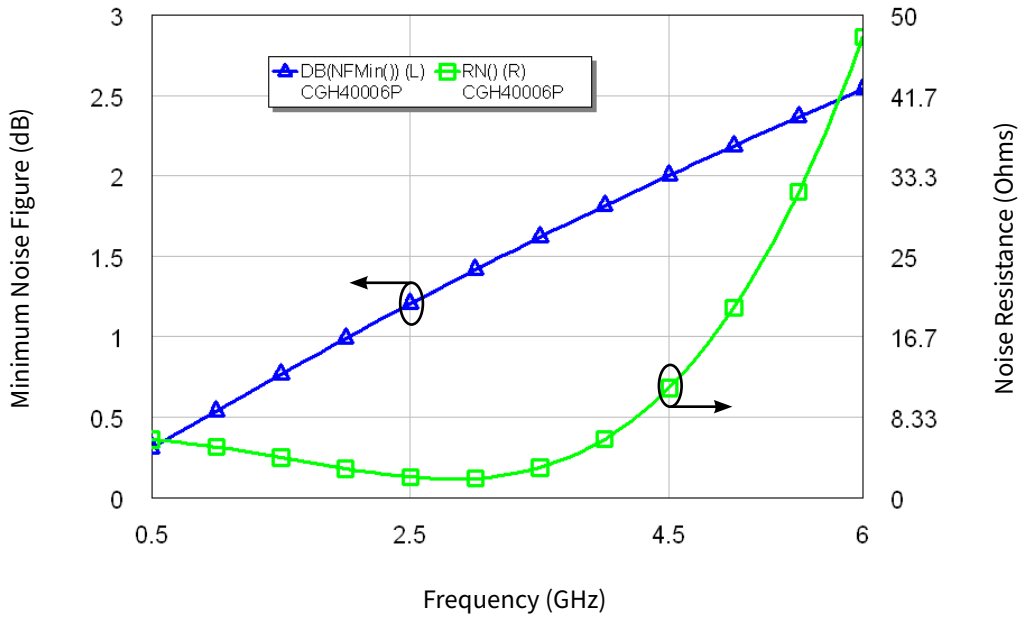
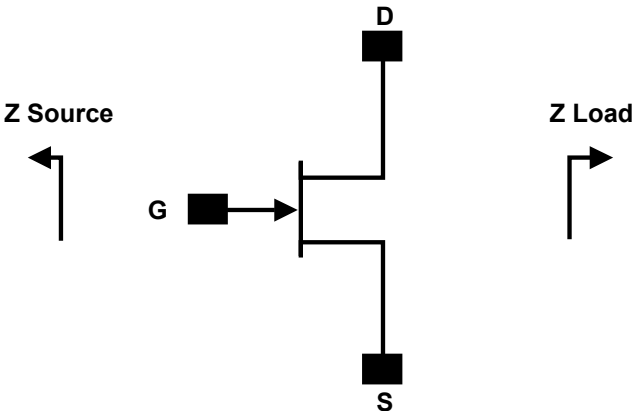


Figure 15. Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH40006P
V_{DD} = 28 V, I_{DQ} = 100 mA

Electrostatic Discharge (ESD) Classifications

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

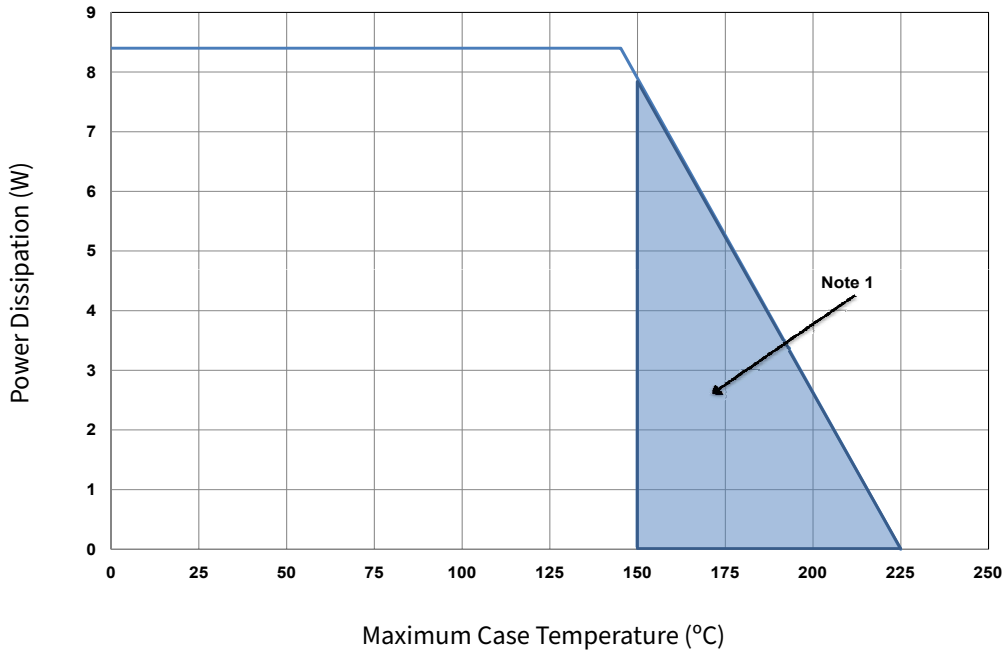
Source and Load Impedances



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

Notes:
[1] V_{DD} = 28V, I_{DQ} = 100mA in the 440109 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

CGH40006P Power Dissipation De-rating Curve

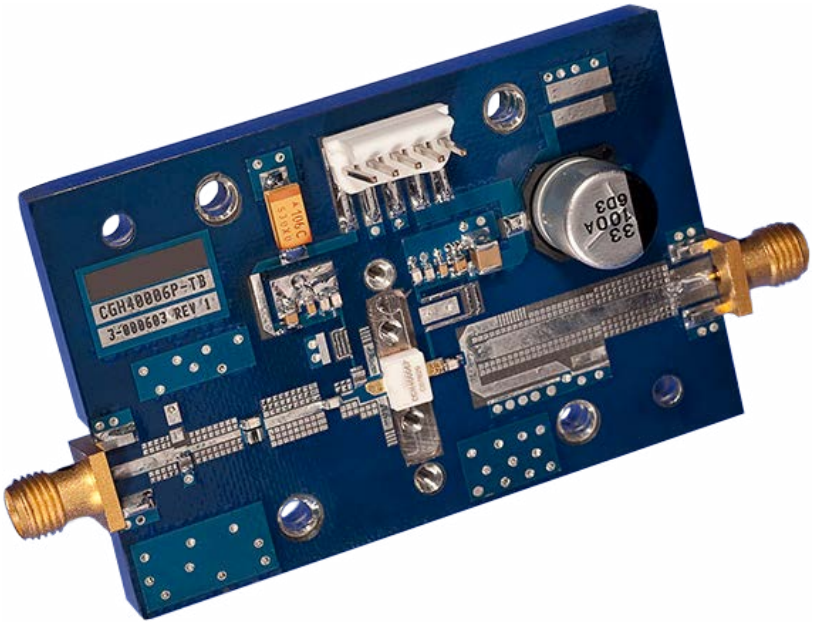


Note:
[1] Area exceeds Maximum Case Operating Temperature (See Page 2).

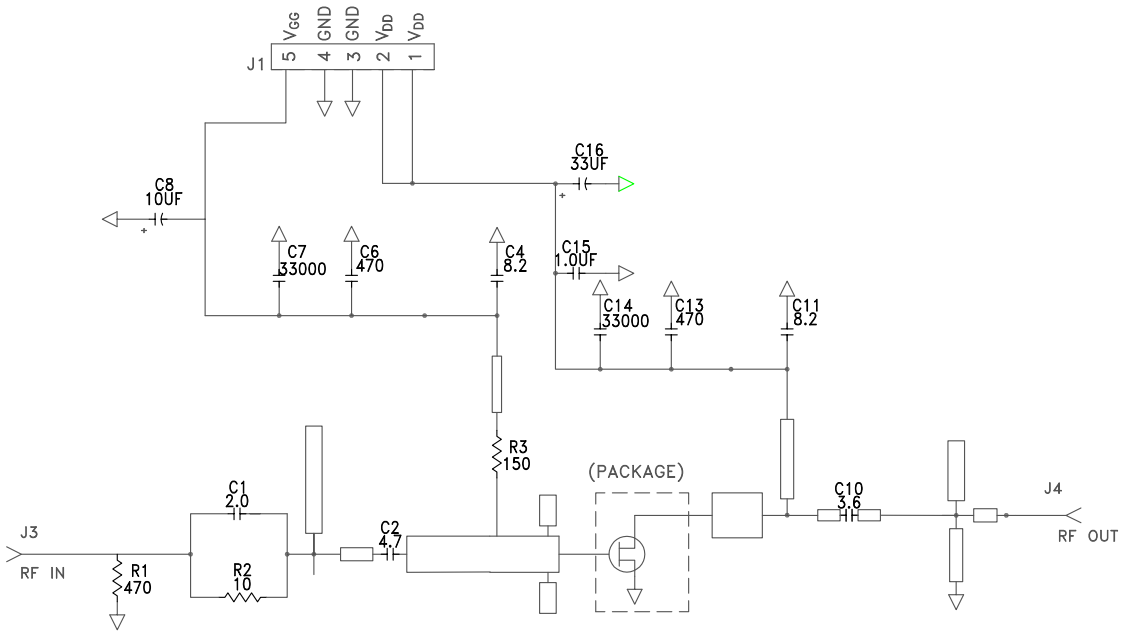
CGH40006P-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, AIN, 0505, 470 Ohms (≤5% tolerance)	1
R2	RES, AIN, 0505, 10 Ohms (≤5% tolerance)	1
R3	RES, AIN, 0505, 150 Ohms (≤5% tolerance)	1
C1	CAP, 2.0pF +/-0.1pF, 0603, ATC 600S	1
C2	CAP, 4.7pF +/-0.1pF, 0603, ATC 600S	1
C10	CAP, 3.6pF +/-0.1pF, 0603, ATC 600S	1
C4, C11	CAP, 8.2pF +/-0.25, 0603, ATC 600S	2
C6, C13	CAP, 470pF +/-5%, 0603, 100 V	2
C7, C14	CAP, 33000pF, CER, 100V, X7R, 0805	2
C8	CAP, 10µF, 16V, SMT, TANTALUM	1
C15	CAP, 1.0µF +/-10%, CER, 100V, X7R, 1210	1
C16	CAP, 33µF, 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

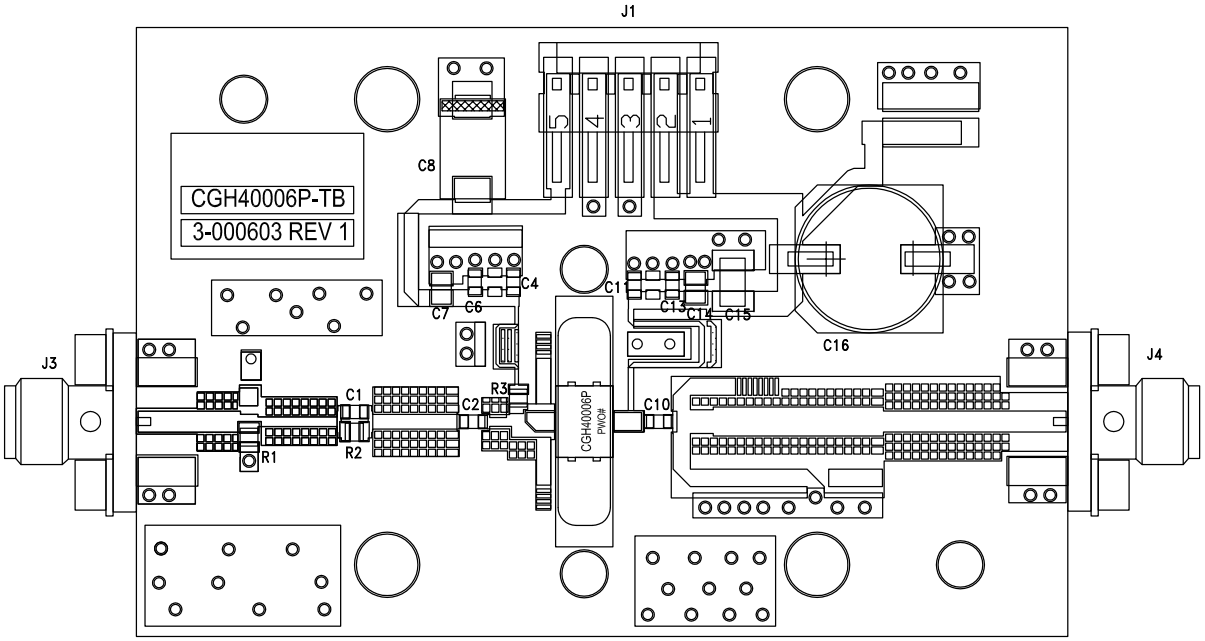
CGH40006P-AMP Demonstration Amplifier Circuit



CGH40006P-AMP Demonstration Amplifier Circuit Schematic



CGH40006P-AMP Demonstration Amplifier Circuit Outline

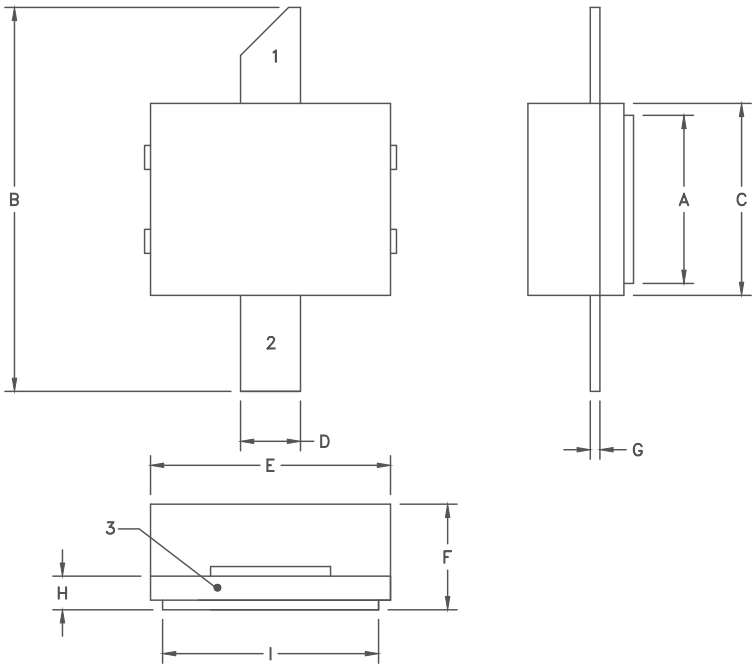


Typical Package S-Parameters for CGH40006P (Small Signal, V_{DS} = 28 V, I_{DQ} = 100 mA, angle in degrees)

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

To download the s-parameters in s2p format, go to the CGH40006P Product Page.

Product Dimensions CGH40006P (Package Type — 440109)



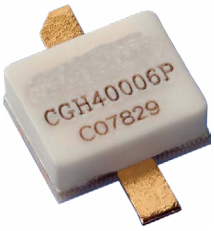
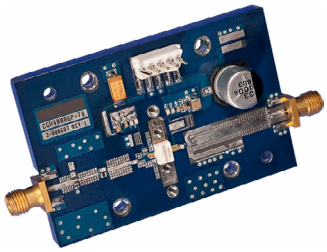
NOTES: (UNLESS OTHERWISE SPECIFIED)

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

	INCHES		MILLIMETERS	
DIM	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	
CGH40006P-AMP	Test board with GaN HEMT installed	Each	

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