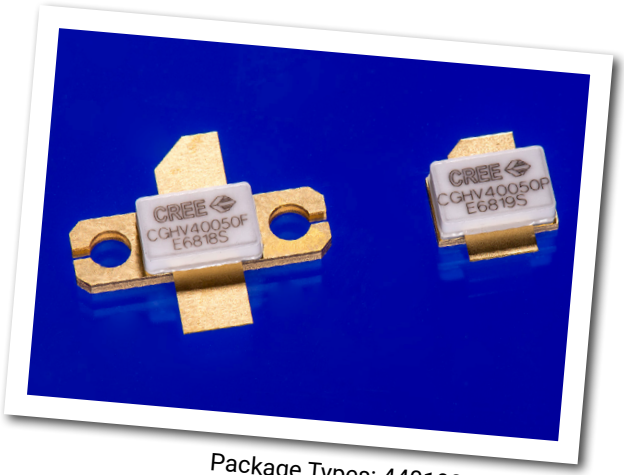
CGHV40050

50 W, DC - 4.0 GHz, 50 V, GaN HEMT



Package Types: 440193 & 440206
PN: CGHV40050F & CGHV40050P

Cree's CGHV40050 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGHV40050, operating from a 50 volt rail, offers a general purpose, broadband solution to a variety of RF and microwave applications up to 4 GHz. The reference HPA design in the datasheet operates from 800 MHz to 2 GHz operation instantaneously. It is a demonstration amplifier to showcase the CGHV40050's high efficiency, high gain and wide bandwidth capabilities. The device can be used for a range of applications from narrow band UHF, L and S Band as well as multi-octave bandwidth amplifiers up to 4 GHz. The transistor is available in a 2-lead flange and pill package.

Typical Performance Over 800 MHz - 2.5 GHz (T_c = 25°C), 50 V

Parameter	800 MHz	1.2 GHz	1.4 GHz	1.8 GHz	2.0 GHz	Units
Small Signal Gain	17.6	16.9	17.7	17.5	14.8	dB
Saturated Output Power	65	70	63	77	60	W
Drain Efficiency @ P_{SAT}	63	63	60	53	52	%
Input Return Loss	5	5.5	4.2	8	5	dB

Note:
Measured CW in the CGHV40050F-AMP application circuit.

Features

RoHS COMPLIANT

- Up to 4 GHz Operation
- 77 W Typical Output Power
- 17.5 dB Small Signal Gain at 1.8 GHz
- Application Circuit for 0.8 - 2.0 GHz
- 53 % Efficiency at P_{SAT}
- 50 V Operation

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_{DSS}	150	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}	10.4	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	6.3	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	3.04	˚C/W	85˚C
Thermal Resistance, Junction to Case[4]	$R_{\theta JC}$	3.11	˚C/W	85˚C
Case Operating Temperature[5]	T_C	-40, +80	˚C	30 seconds

Note:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering at www.cree.com/RF/Document-Library
[3] Measured for the CGHV40050P at P_{DISS} = 41.6 W.
[4] Measured for the CGHV40050F at P_{DISS} = 41.6 W.
[5] See also, Power Derating Curve on Page 7.

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 = 10.4 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 50 V, I_D = 0.3 A
Saturated Drain Current[2]	I_{DS}	7.8	10.4	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	150	–	–	V_{DC}	V_{GS} = -8 V, I_D = 10.4 mA
RF Characteristics[3] (T_C = 25˚C, F_0 = 1.8 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	17.5	19	–	dB	V_{DD} = 50 V, I_{DQ} = 0.3 A
Power Gain	G_P	–	15.5	–	dB	V_{DD} = 50 V, I_{DQ} = 0.3 A, P_{OUT} = P_{SAT}
Power Output at Saturation[4]	P_{SAT}	70	77	–	W	V_{DD} = 50 V, I_{DQ} = 0.3 A
Drain Efficiency	η	48	53	–	%	V_{DD} = 50 V, I_{DQ} = 0.3 A, P_{OUT} = P_{SAT}
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 50 V, I_{DQ} = 0.3 A, P_{OUT} = 50 W CW
Dynamic Characteristics[5]						
Input Capacitance	C_{GS}	–	16	–	pF	V_{DS} = 50 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	5	–	pF	V_{DS} = 50 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.3	–	pF	V_{DS} = 50 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging.
[2] Scaled from PCM data.
[3] Measured in CGHV40050-AMP
[4] P_{SAT} is defined as I_G = 1 mA.
[5] Includes package

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CGHV40050 Typical Performance

Figure 1. - Small Signal Gain and Return Losses versus Frequency of the CGHV40050 in the application circuit CGHV40050-AMP
V_{DD} = 50 V, I_{DQ} = 300 mA, Tcase = 25°C

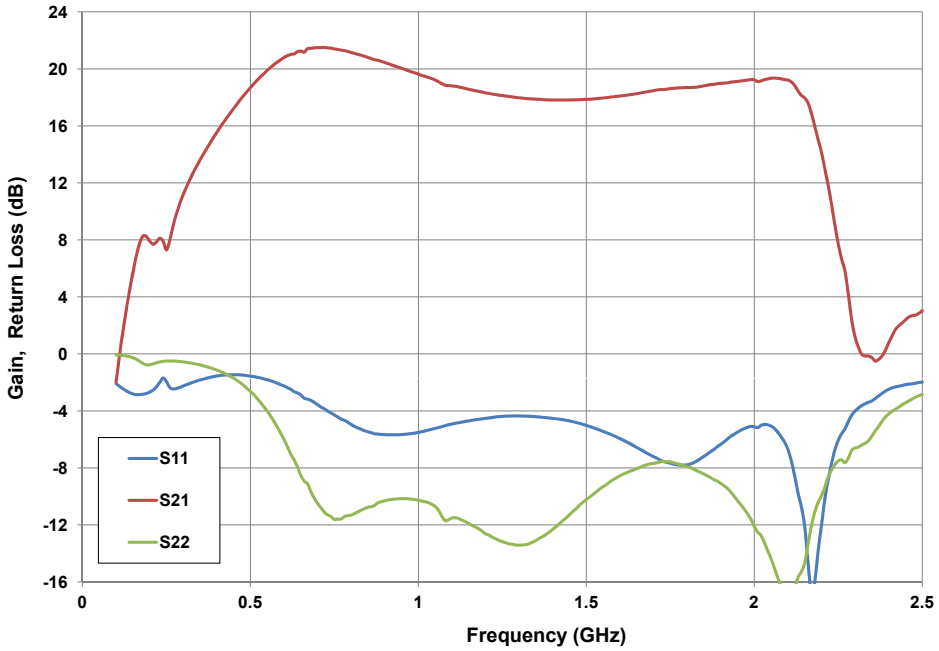
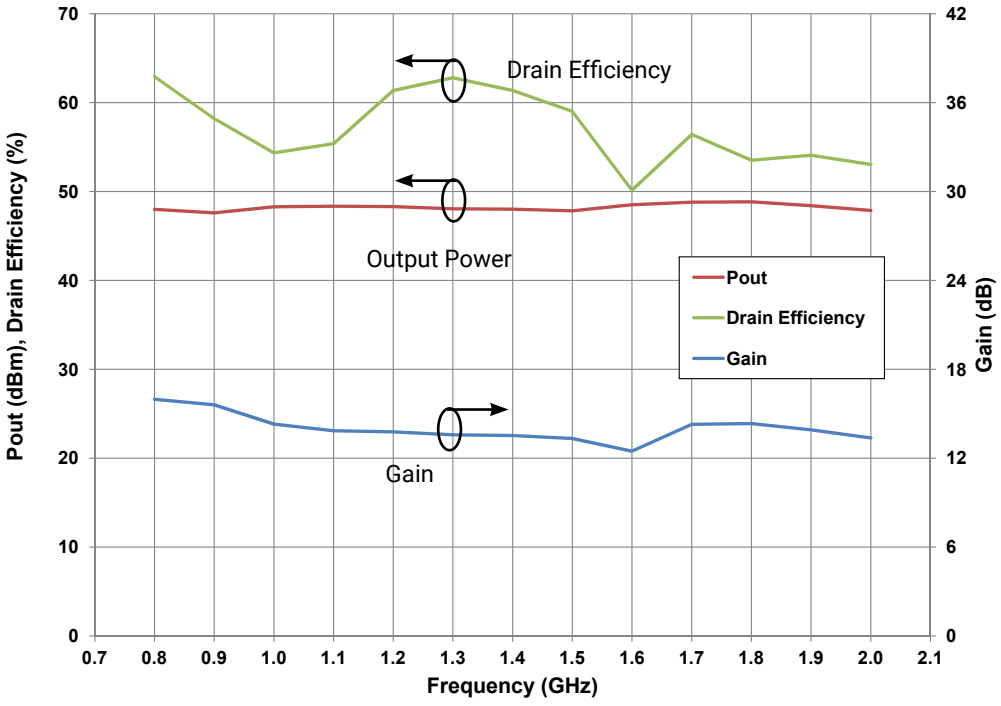


Figure 2. - Gain, Output Power and Drain Efficiency vs Frequency of the CGHV40050 measured in Broadband Amplifier Circuit CGHV40050-AMP
V_{DD} = 50 V, I_{DQ} = 300 mA, Tcase = 25°C



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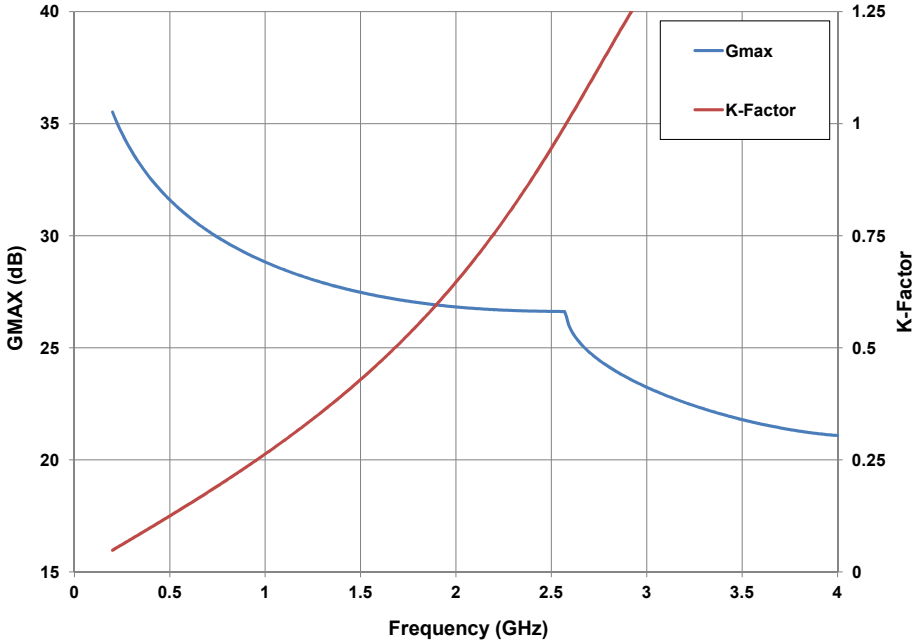
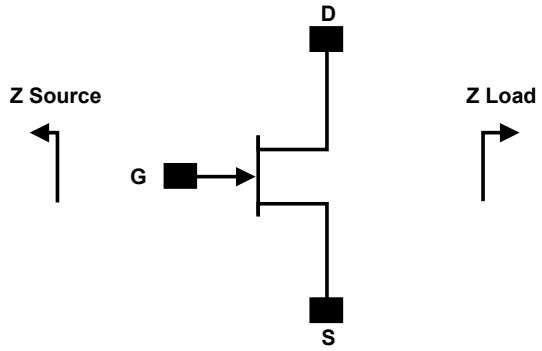
CGHV40050 Typical Performance

Figure 3. - G_{MAX} and K-Factor vs Frequency
V_{DD} = 50V, I_{DQ} = 300 mA, Tcase = 25°C



Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
500	5.69+j7.82	21.47+j10.28
1000	3.21+j3.48	11.72+j10.50
2000	3.2-j1.74	3.84+j7.07
3000	3.23-j5.23	5.58+j3.02
4000	2.75-j10.6	4.65-j0.74

Note[1]: V_{DD} = 50 V, I_{DQ} = 300 mA. In the 440193 package.

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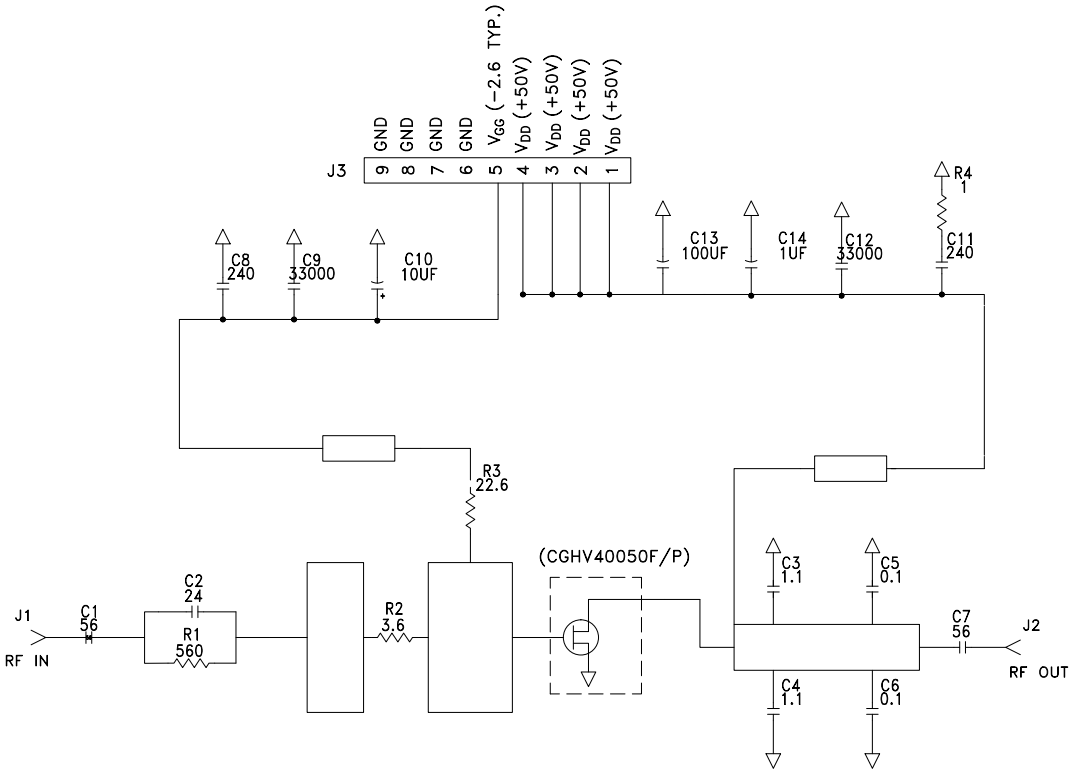
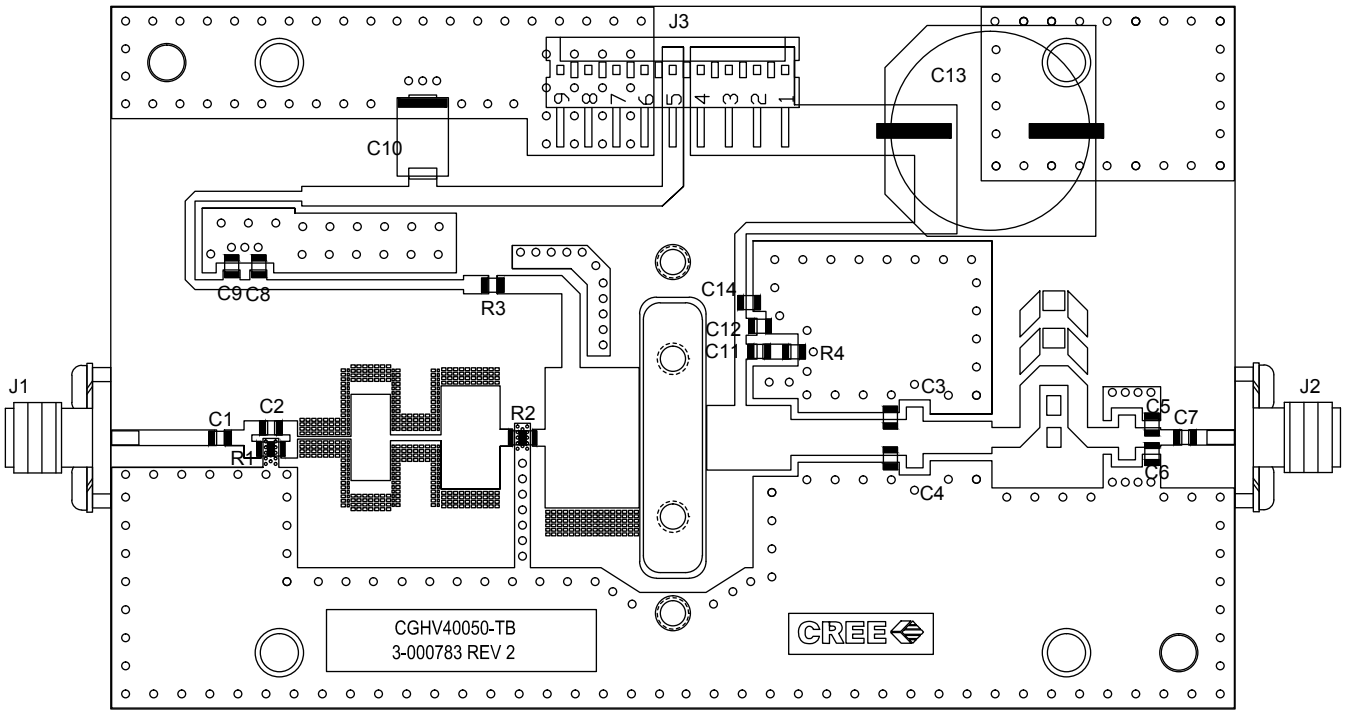
CGHV40050-AMP Application Circuit Schematic



CGHV40050-AMP Application Circuit



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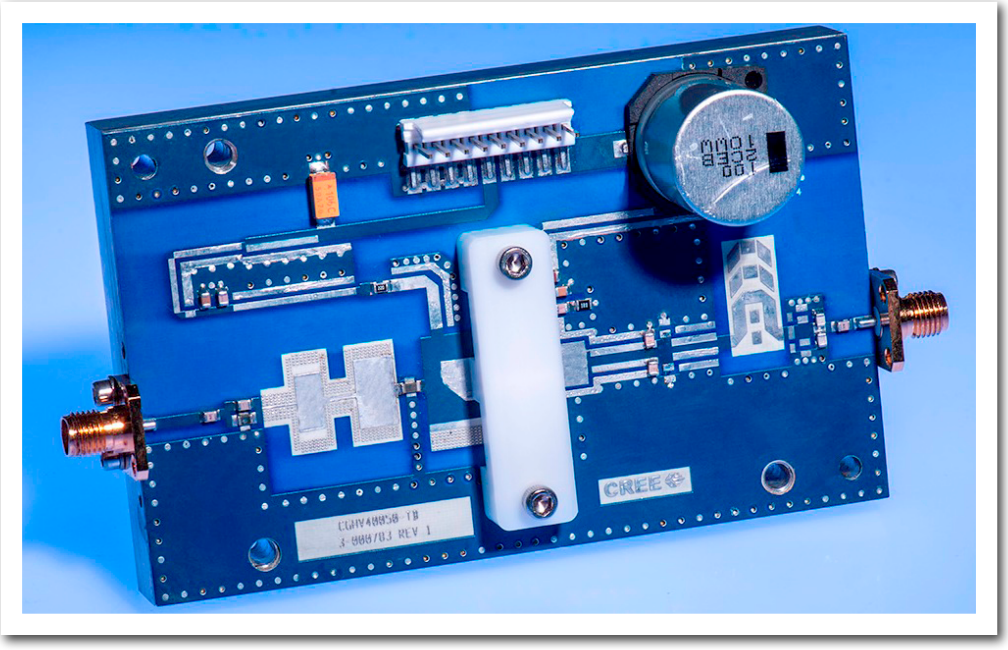
CGHV40050-AMP Application Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 560Ohms, 0805, HIGH POWER SMT	1
R2	RES, 3.6Ohms, 1005, HIGH POWER SMT	1
R3	RES, SMT, 0805, 22 OHM	1
R4	RES, SMT, 0805, 1OHM	1
C1, C7	CAP, 56 PF +/- 5%,, 250V, 0805, ATC 600F	3
C2	CAP, 24 pF +/- 5%, 250V, 0805, ATC 600F	1
C3, C4	CAP, 1.1pF, +/-0.1pF, 250V, 0805, ATC600F	2
C5, C6	CAP, 0.1 PF +/- 0.05 pF, 0805, ATC 600F	2
C8, C11	CAP, 240pF, +/-5%, 0805, ATC600F	2
C9, C12	CAP, 33000pF, 0805, 100V, X7R	2
C10	CAP, 10UF, 16V, TANTALUM	1
C13	CAP, 100UF, 80V, ELECTROLYTIC, CAN	1
C14	CAP, 1UF, 0805, 100V, X7S	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
	BASEPLATE, CGH35120	1
	PCB, RO4350B, 2.5"x4"x0.020", CGHV40050F	1

CGHV40050-AMP Demonstration Amplifier Circuit



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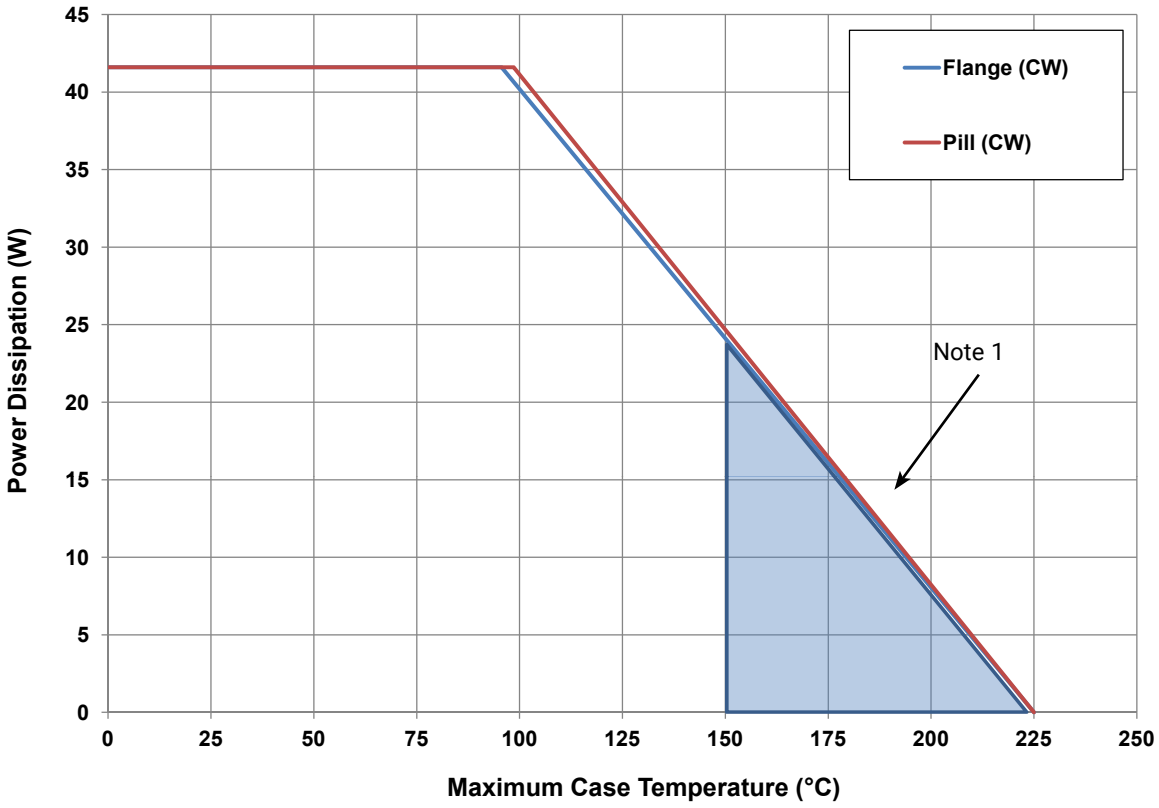
CGHV40050 Power Dissipation De-rating Curve

Figure 4. - Transient Power Dissipation De-Rating Curve



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

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (200 < 500 V)	JEDEC JESD22 C101-C

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Typical S-Parameters (Small Signal, V_{DS} = 50 V, I_{DQ} = 300 mA, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.92	-161.97	13.79	79.27	0.01	-5.56	0.44	-142.42
600 MHz	0.92	-165.42	11.38	74.02	0.01	-9.73	0.46	-143.34
700 MHz	0.92	-168.02	9.62	69.31	0.01	-13.32	0.49	-144.16
800 MHz	0.93	-170.08	8.29	64.99	0.01	-16.49	0.52	-145.04
900 MHz	0.93	-171.8	7.24	60.98	0.009	-19.32	0.55	-146.01
1.0 GHz	0.93	-173.27	6.4	57.23	0.009	-21.83	0.58	-147.07
1.1 GHz	0.93	-174.58	5.7	53.71	0.009	-24.07	0.61	-148.21
1.2 GHz	0.94	-175.77	5.13	50.38	0.008	-26.05	0.63	-149.4
1.3 GHz	0.94	-176.86	4.64	47.24	0.008	-27.77	0.65	-150.62
1.4 GHz	0.94	-177.89	4.23	44.25	0.007	-29.25	0.67	-151.85
1.5 GHz	0.94	-178.87	3.87	41.42	0.007	-30.48	0.69	-153.09
1.6 GHz	0.94	-179.81	3.56	38.72	0.007	-31.46	0.71	-154.33
1.7 GHz	0.95	179.28	3.3	36.14	0.006	-32.19	0.73	-155.54
1.8 GHz	0.95	178.4	3.06	33.68	0.006	-32.66	0.74	-156.74
1.9 GHz	0.95	177.53	2.85	31.32	0.006	-32.85	0.76	-157.91
2.0 GHz	0.95	176.67	2.67	29.06	0.005	-32.75	0.77	-159.06
2.1 GHz	0.95	175.82	2.51	26.88	0.005	-32.33	0.78	-160.18
2.2 GHz	0.95	174.97	2.37	24.78	0.005	-31.57	0.79	-161.28
2.3 GHz	0.95	174.13	2.24	22.75	0.005	-30.43	0.8	-162.34
2.4 GHz	0.96	173.28	2.12	20.78	0.004	-28.87	0.81	-163.39
2.5 GHz	0.96	172.43	2.02	18.87	0.004	-26.86	0.82	-164.4
2.6 GHz	0.96	171.57	1.93	17.02	0.004	-24.35	0.82	-165.4
2.7 GHz	0.96	170.7	1.85	15.2	0.004	-21.31	0.83	-166.37
2.8 GHz	0.96	169.82	1.77	13.43	0.003	-17.72	0.84	-167.32
2.9 GHz	0.96	168.92	1.71	11.69	0.003	-13.6	0.84	-168.25
3.0 GHz	0.96	168.01	1.65	9.98	0.003	-8.98	0.85	-169.17
3.2 GHz	0.96	166.12	1.55	6.62	0.003	1.31	0.86	-170.95
3.4 GHz	0.96	164.13	1.47	3.33	0.003	11.88	0.86	-172.69
3.6 GHz	0.96	162	1.41	0.06	0.004	21.35	0.87	-174.4
3.8 GHz	0.95	159.72	1.36	-3.22	0.004	28.89	0.87	-176.09
4.0 GHz	0.95	157.25	1.33	-6.55	0.005	34.35	0.88	-177.76

To download the s-parameters in s2p format, go to the CGHV40050 Product Page and click on the documentation tab.

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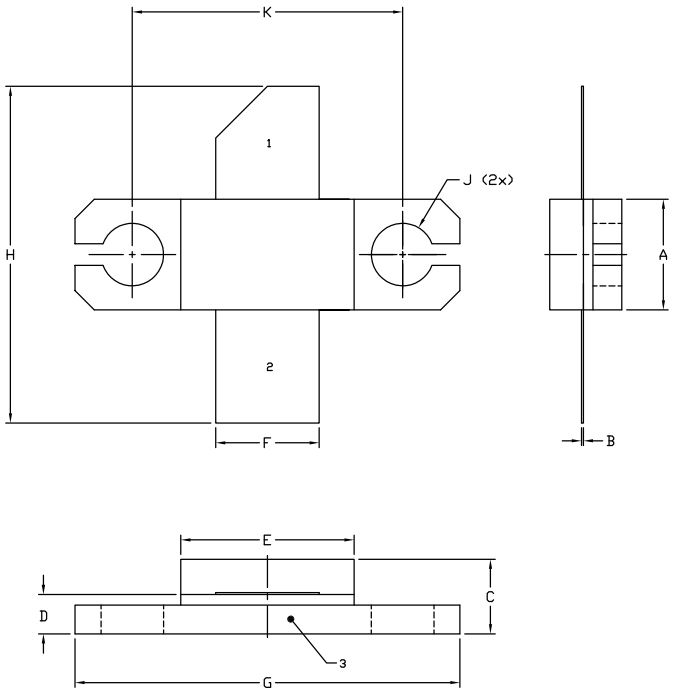
Product Dimensions CGHV40050F (Package Type — 440193)



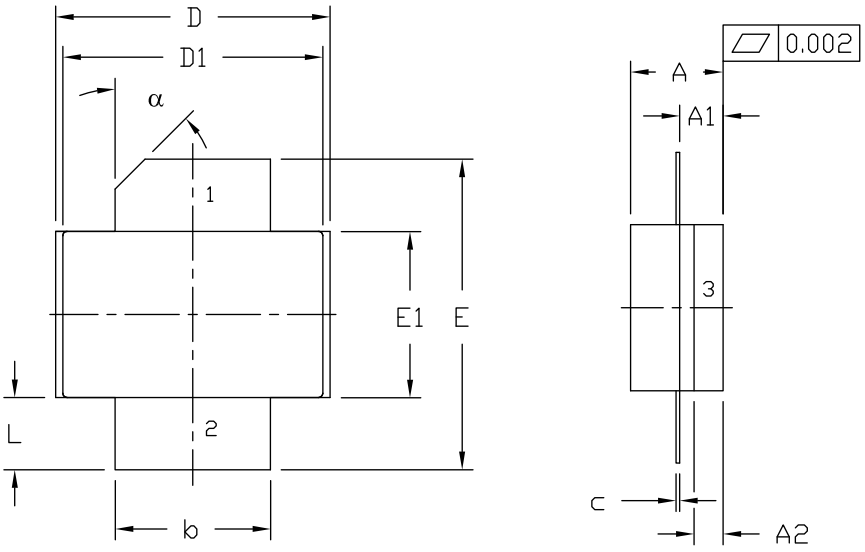
NOTES:

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

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	ø .130		3.30	
k	0.562		14.28	

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

Product Dimensions CGHV40050P (Package Type — 440206)



NOTES:

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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

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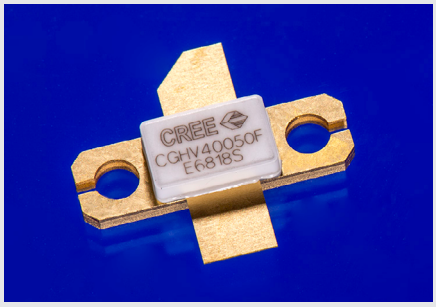
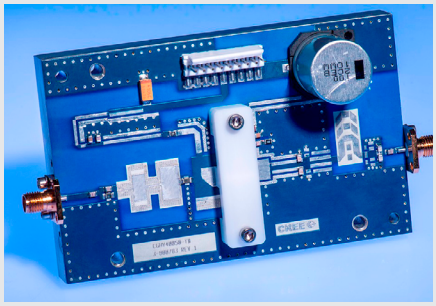
Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGHV40050F	GaN HEMT	Each	
CGHV40050P	GaN HEMT	Each	
CGHV40050-TB	Test board without GaN HEMT	Each	
CGHV40050-AMP	Test board with GaN HEMT installed	Each	

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