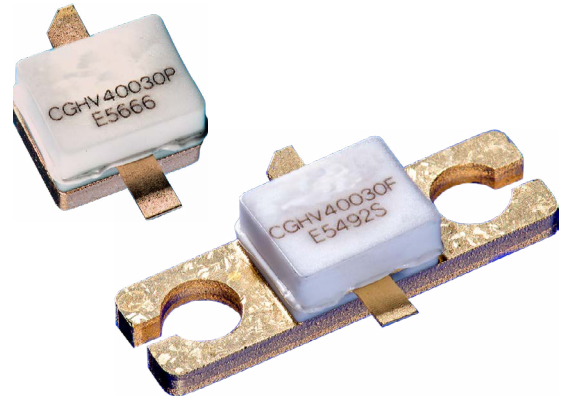


# CGHV40030

30 W, DC - 6 GHz, 50 V, GaN HEMT

## Description

The CGHV40030 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities. The device can be deployed for L-, S- and C-Band amplifier applications. The datasheet specifications are based on a 0.96 - 1.4 GHz amplifier. The CGHV40030 operates on a 50 volt rail circuit while housed in a 2-lead flange or pill package.



Package Types: 440166 and 440196  
PN: CGHV40030

## Typical Performance 0.96 - 1.4 GHz ( $T_c = 25^\circ\text{C}$ ), 50 V

Parameter	0.96 GHz	1.1 GHz	1.25 GHz	1.4 GHz	Units
Gain @ $P_{SAT}$	15.6	15.8	16.6	15.8	dB
Saturated Output Power	29	30	36	31	W
Drain Efficiency @ $P_{SAT}$	62	74	64	67	%

Note: Measured CW in the CGHV40030-AMP application circuit.

## Features

- Up to 6 GHz Operation
- 30 W Typical Output Power
- 16 dB Gain
- Application circuit for 0.96 - 1.4 GHz
- 70% Efficiency at  $P_{SAT}$
- 50 V Operation

## Listing of Available Hardware Application Circuits / Demonstration Circuits

Application Circuit	Operating Frequency	Operating Voltage
CGHV40030F-AMP	0.96 - 1.4 GHz	50 V
CGHV40030F-AMP2	0.5 - 2.7 GHz	50 V

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	$V_{DS}$	150	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	$I_{GMAX}$	5.2	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	4.2	A	
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
Case Operating Temperature <sup>3</sup>	$T_C$	-40, +85	°C	
Thermal Resistance, Junction to Case <sup>4</sup>	$R_{\theta JC}$	5.9	°C/W	85°C

Notes:

<sup>1</sup> Current limit for long term, reliable operation

<sup>2</sup> Refer to the Application Note on soldering

<sup>3</sup>  $P_{DISS} = 23.4 \text{ W}$

<sup>4</sup> CW

## Electrical Characteristics ( $T_C = 25^\circ\text{C}$ )

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics<sup>1</sup></b>						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	-2.3	$V_{DC}$	$V_{DS} = 10 \text{ V}, I_D = 5.2 \text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	—	-2.6	—		$V_{DS} = 50 \text{ V}, I_D = 150 \text{ mA}$
Saturated Drain Current <sup>2</sup>	$I_{DS}$	3.4	4.8	—	A	$V_{DS} = 6.0 \text{ V}, V_{GS} = 2.0 \text{ V}$
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	125	—	—	$V_{DC}$	$V_{GS} = -8 \text{ V}, I_D = 5.2 \text{ mA}$
<b>RF Characteristics<sup>3</sup> (<math>T_C = 25^\circ\text{C}</math>, <math>F_0 = 1.2 \text{ GHz}</math> unless otherwise noted)</b>						
Power Gain <sup>4</sup>	$G_{SS}$	15	16	—	dB	$V_{DD} = 50 \text{ V}, I_{DQ} = 150 \text{ mA}, P_{OUT} = P_{SAT}$
Output Power <sup>4</sup>	$P_{OUT}$	30	35	—	W	
Drain Efficiency <sup>4</sup>	$\eta$	62	65	—	%	
Output Mismatch Stress <sup>4</sup>	VSWR	—	—	10:1	$\Psi$	No damage at all phase angles, $V_{DD} = 50 \text{ V}, I_{DQ} = 150 \text{ mA}, P_{OUT} = 30 \text{ W CW}$
<b>Dynamic Characteristics</b>						
Input Capacitance <sup>5</sup>	$C_{GS}$	—	7.4	—	pF	$V_{DS} = 50 \text{ V}, V_{GS} = -8 \text{ V}, f = 1 \text{ MHz}$
Output Capacitance <sup>5</sup>	$C_{DS}$	—	2	—		
Feedback Capacitance	$C_{GD}$	—	0.15	—		

Notes:

<sup>1</sup> Measured on wafer prior to packaging

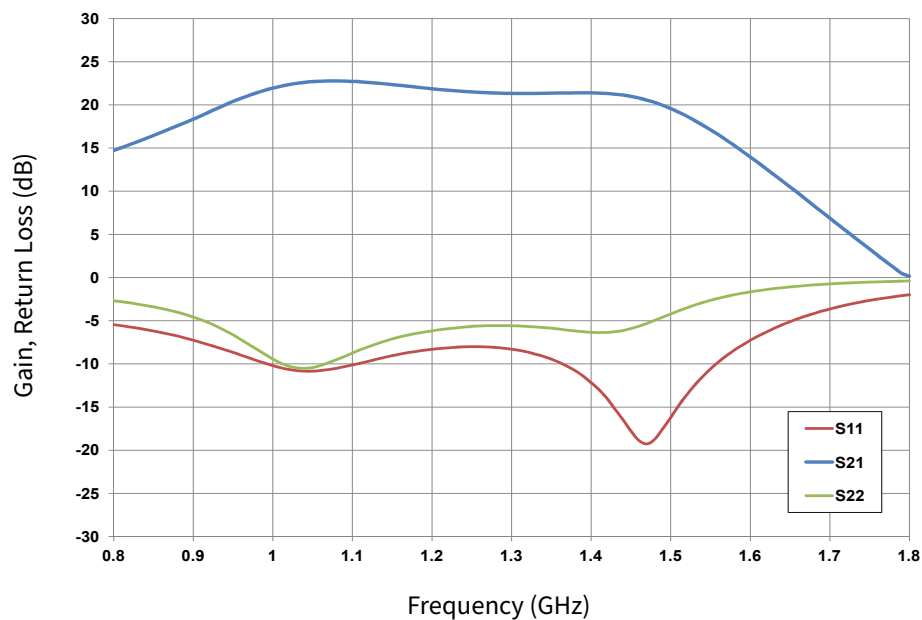
<sup>2</sup> Scaled from PCM data

<sup>3</sup> Measured in CGHV40030-AMP

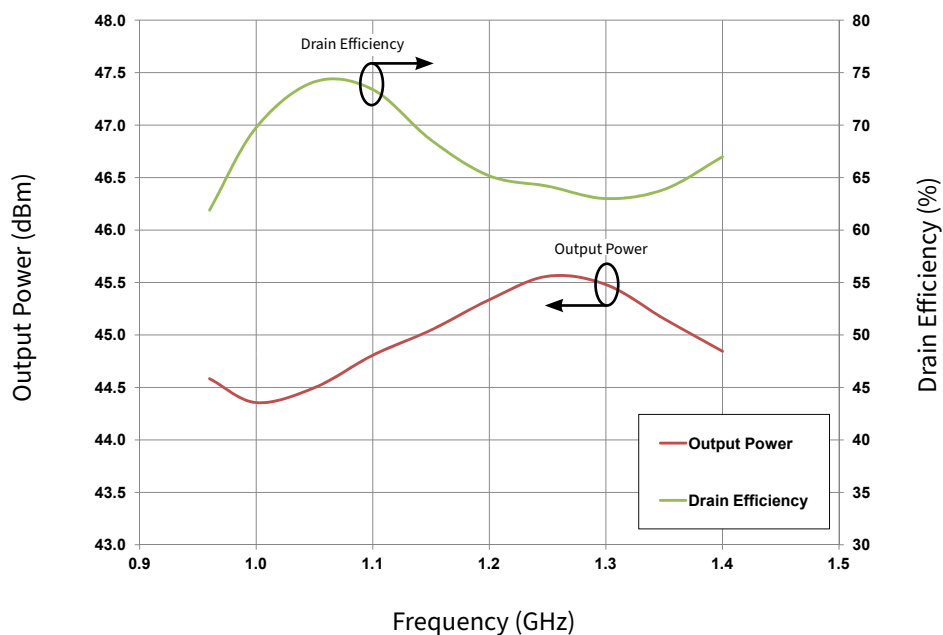
<sup>4</sup>  $P_{SAT}$  is defined as  $I_G = 0.52 \text{ mA}$

<sup>5</sup> Includes package

## Typical Performance



**Figure 1.** Typical Small Signal Response of CGHV40030-AMP Application Circuit  
 $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 150\text{ mA}$

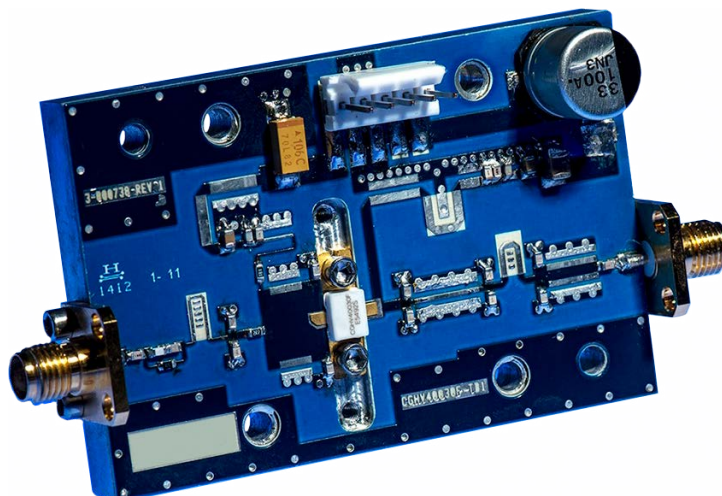


**Figure 2.** Typical Large Signal Response of CGHV40030-AMP Application Circuit  
 $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 150\text{ mA}$ ,  $P_{IN} = 29\text{ dBm}$ ,  $T_{CASE} = 25^\circ\text{C}$ , CW

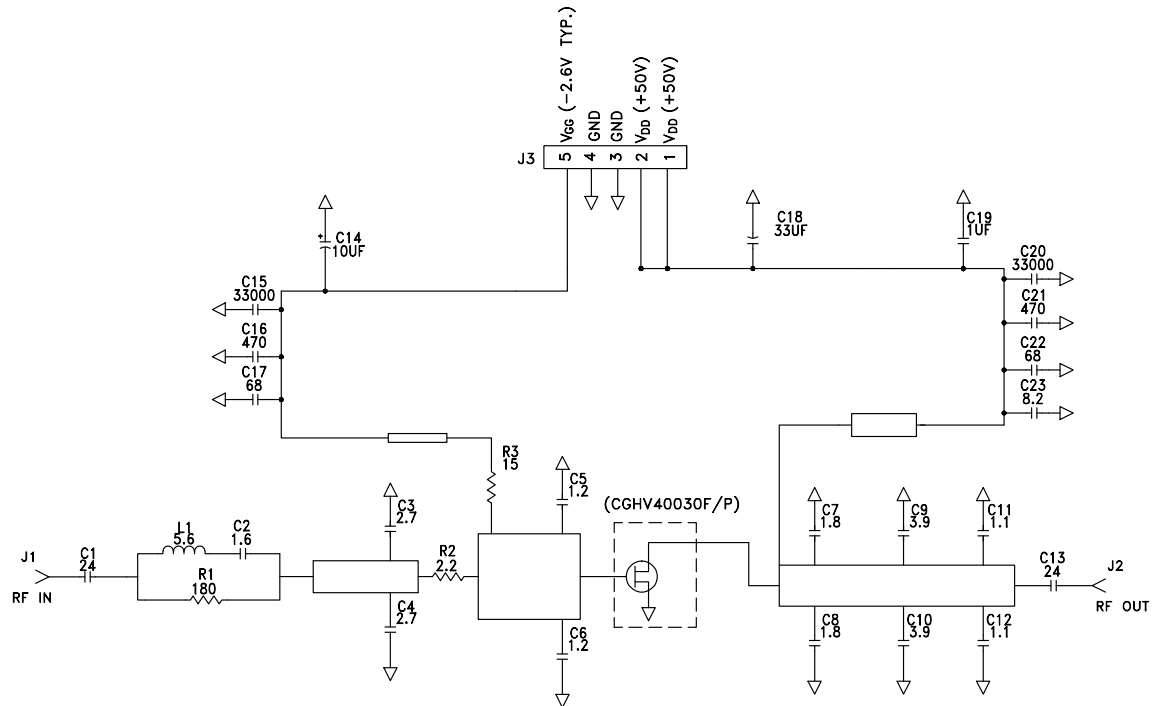
## CGH40030-AMP Application Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16W, 0603, 1%, 187 OHMS	1
R2	RES, 2.2 OHMS, +/- 1%, 1/16W, 0603	1
R3	RES, 1/16W, 0603, 1%, 15.4 OHMS	1
L1	IND, 5.6nH, 0603	1
C3, C4	CAP, 2.7pF, +/-0.1pF, 0603, ATC	2
C11, C12	CAP, 1.2pF, +/-0.1pF, 0603, ATC	2
C5, C6	CAP, 0.8pF, +/-0.1pF, 0603, ATC	2
C2, C7, C8	CAP 1.8pF, +/-0.05pF 0603, ATC	3
C9, C10	CAP, 3.9pF, +/-0.1pF 0603, ATC	2
C1, C13	CAP, 24pF, +/-5% 0603, ATC	2
C14	CAP 10μF 16V TANTALUM	1
C15, C20	CAP, 33000pF, 0805, ATC	2
C16,C21	CAP, 470pF, 5%, 100V, 0603,	2
C17	CAP, 68pF, +/-0.1pF 0603, ATC	1
C22	CAP, 56pF +/- 5%, 0603 , ATC600S	1
C18	CAP, 33μF, 20%, G CASE	1
C19	CAP, 1.0μF, 100V, 10%, X7R, 1210	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST	2
J3	HEADER RT>PLZ .1CEN LK 5POS	1
-	BASEPLATE, CGH35015, 2.60 X 1.7	1
-	CGHV40030F/P PCB, RO4350, 0.020" THK	1
-	2-56 SOC HD SCREW 1/4 SS	4
-	#2 SPLIT LOCKWASHER SS	4

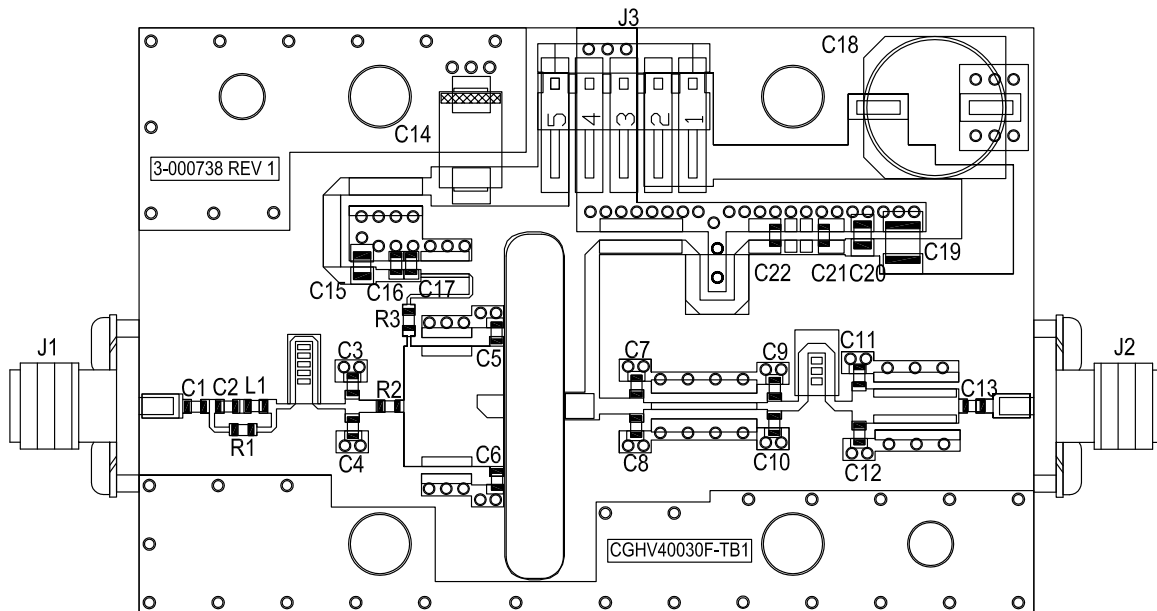
## CGHV40030-AMP Application Circuit



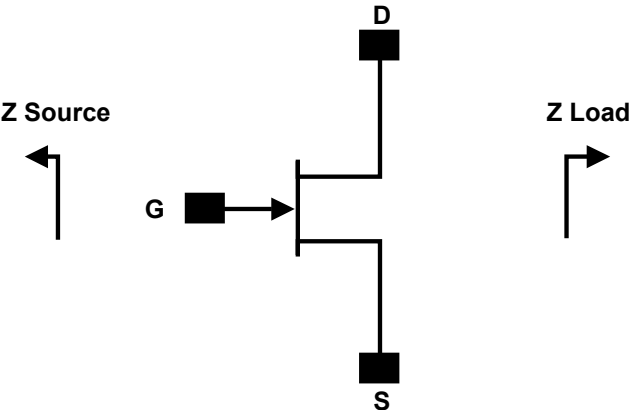
## CGHV40030-AMP Application Circuit Schematic



## CGHV40030-AMP Application Circuit Outline



Source and Load Impedances for Application Circuit CGHV40030-AMP



Frequency (MHz)	Z Source	Z Load
500	5.5 + j0.9	43 + j20.8
1000	2.6 - j1.3	25.5 + j29.1
2000	3.8 - j0.9	11.5 + j17.3
3000	2.7 - j7.0	6.7 + j7.8
4000	2.8 - j13.4	6.5 + j1.7

Notes:  
<sup>1</sup> V<sub>DD</sub> = 50 V, I<sub>DQ</sub> = 150 mA  
<sup>2</sup> Impedances are extracted from source and load pull data derived from the transistor.

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-002 Table 3	JEDEC JESD22 C101-C

## Electrical Characteristics When Tested in CGHV40030-AMP2, 50 V, 0.5 - 2.7 GHz

Parameter <sup>1,2,3</sup>	0.5 GHz	1.1 GHz	2.7 GHz	Units
Gain	13.7	15.0	12.5	dB
Output Power	29.8	40.0	22.8	W
Drain Efficiency	62.0	58.7	48.6	%

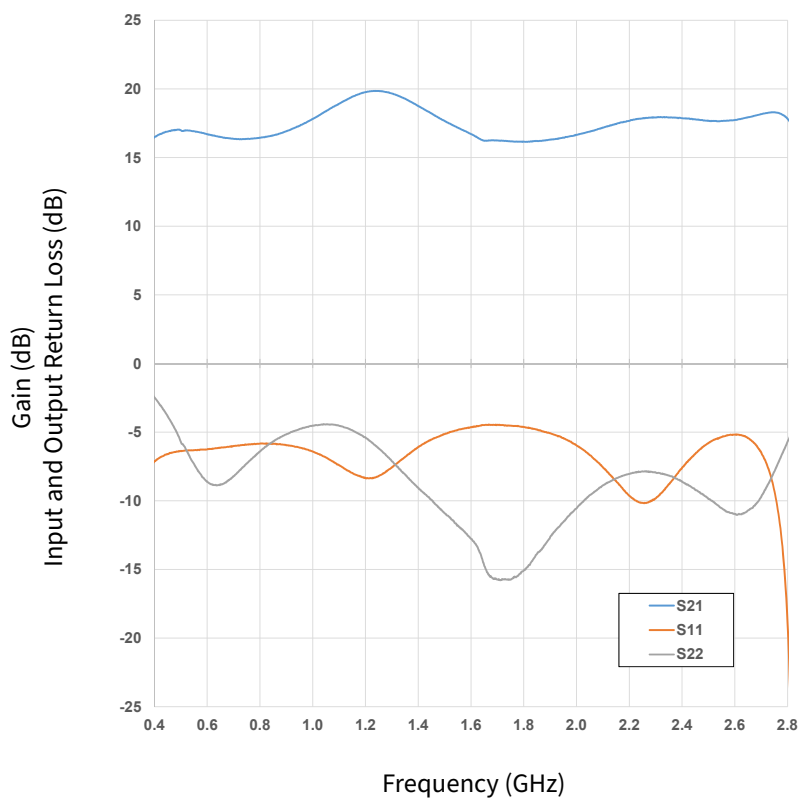
Notes:

<sup>1</sup> Measured CW in the CGHV40030F-AMP2 application circuit

<sup>2</sup>  $P_{IN} = 31$  dBm

<sup>3</sup> Typical performance values

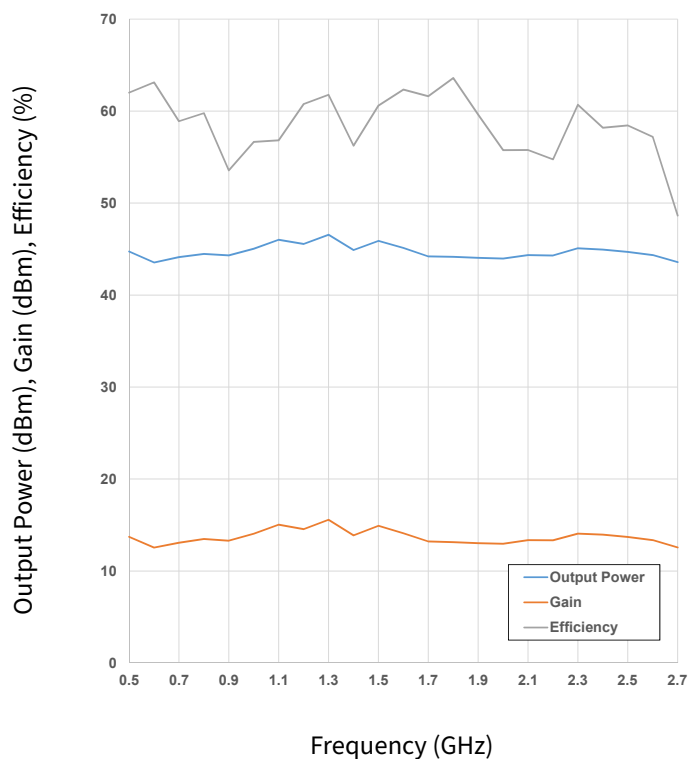
## CGHV40030F-AMP2 Typical Performance



**Figure 3.** Typical Small Signal Response of CGHV40030F-AMP2

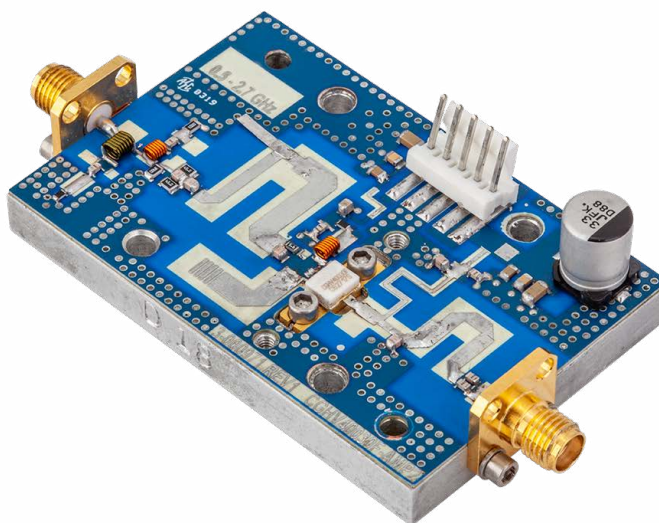
$V_{DD} = 50$  V,  $I_{DQ} = 90$  mA

## CGHV40030F-AMP2 Typical Performance



**Figure 4.** Typical Large Signal Response of CGHV40030F-AMP2 Application Circuit  
 $V_{DD} = 50\text{ V}$ ,  $I_{DQ} = 90\text{ mA}$ ,  $P_{IN} = 31\text{ dBm}$

## CGHV40030F-AMP2 Application Circuit

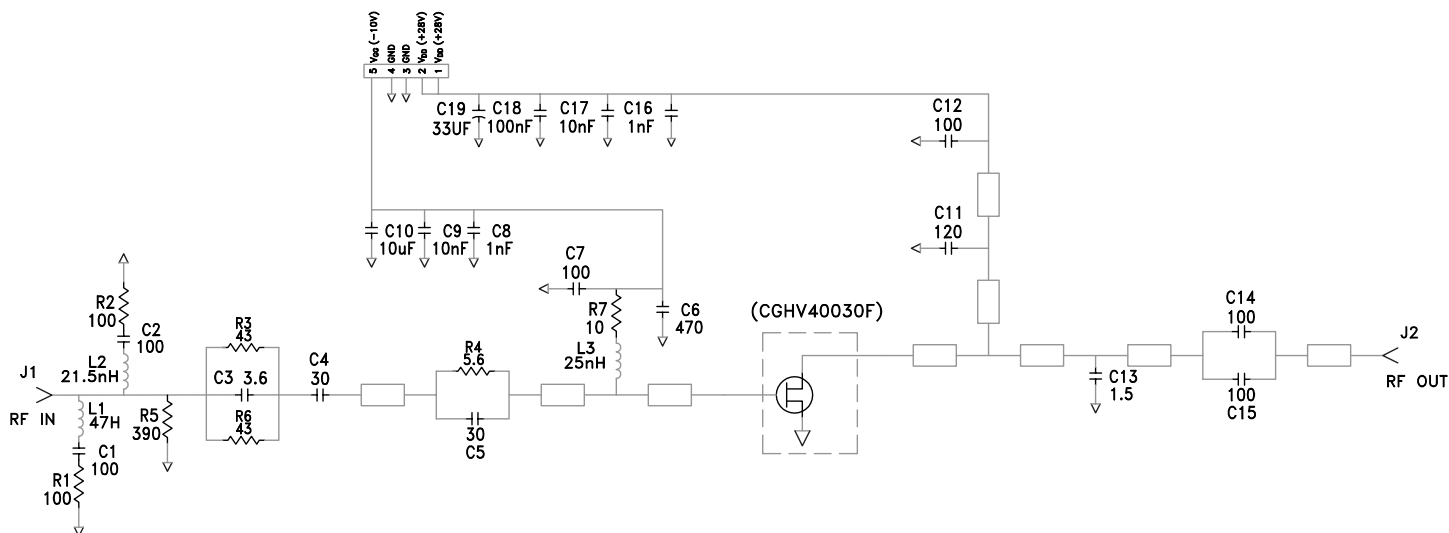




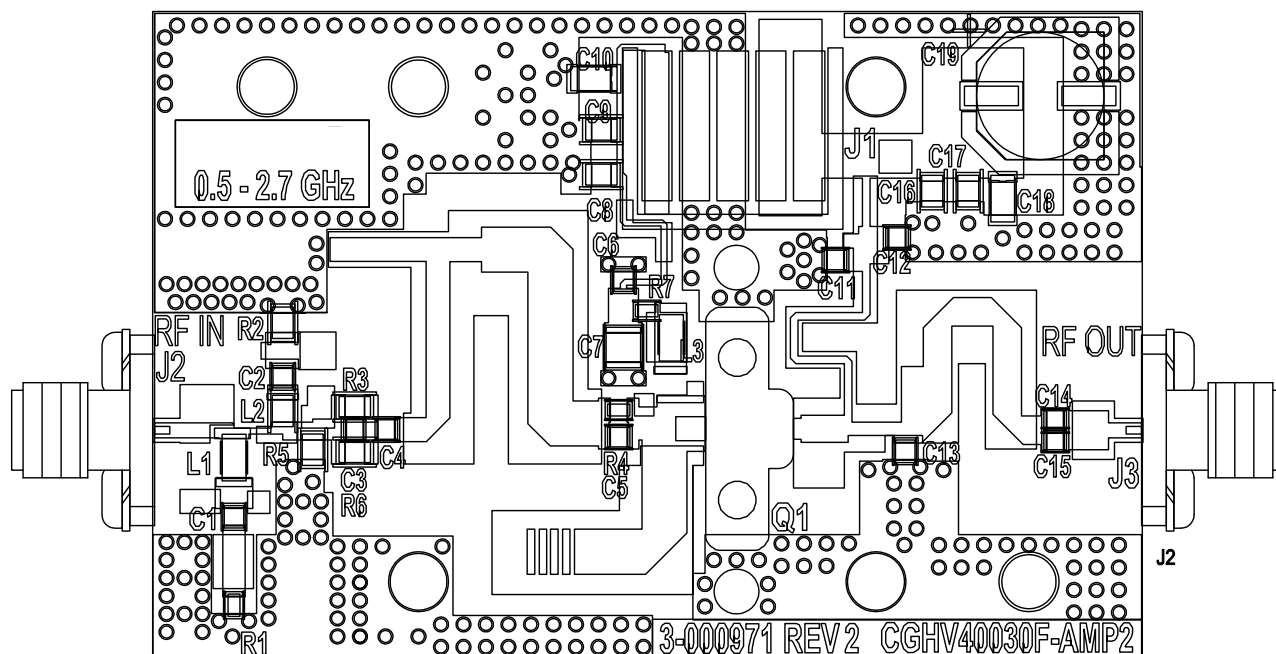
## CGH40030-AMP2 Application Circuit Bill of Materials

Designator	Description	Qty
R4	RES, 0.25W, 0603, 1%, 5.6 OHMS	1
R7	RES, 0.25W, 0603, 1%, 10 OHMS	1
R3,6	RES, 0.5W, 0805, 1% 43 OHMS	2
R1	RES, 0.25W, 0603, 5%, 100 OHMS	1
R2	RES, 0.5W, 0805, 1% 100 OHMS	1
R5	RES, 0.5W, 0805, 1% 390 OHMS	1
C13	CAP, 1.5pF, +/-0.1pF, 0505C, 150V, PPI	1
C3	CAP, 3.6pF, +/-0.1pF, 0505C, 150V, PPI	1
C11 (on side)	CAP, 120pF, +/-5%, 0805, 250V, ATC	1
C4, 5	CAP, 30pF, +/-2%, 0505C, 150V, PPI	2
C1,2,7,12,14,15	CAP, 100pF, +/-5%, 0603, 250V, ATC	6
C6	CAP, 470pF, +/-5%, 0505C, 150V, PPI	1
C8,16	CAP, 1nF, 0805, 100V, X7R	2
C9,17	CAP,10nF, 0805,100V, X7R	2
C18	CAP, 100nF, 0805, 100V, X7R	1
C10	CAP, 10μF, 10%, 1206, 16V, X5R	1
C19	CAP, 33μF, 20%, F CASE, 63V	1
L2	IND, 21.5nH, 2% Air Core, Coilcraft	1
L3	IND, 25nH, 2% Air Core, Coilcraft	1
L1	IND, 47nH, 5% Air Core, Coilcraft	1
J2,J3	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST	2
-	PCB, Rogers RO4350B, 20mils, 2oz. Cu, 66x44mm	1
-	BASEPLATE, 2.60 X 1.70 X .25" modified	1
J1	HEADER RT>PLZ .1CEN LK 5POS	1
-	2-56 SOC HD SCREW 1/4 SS	2
-	#2 SPLIT LOCKWASHER SS	2
-	Lead Clamp 440166	1
Q1	Transistor CGHV40030F	1

## CGHV40030F-AMP2 Application Circuit Schematic



## CGHV40030F-AMP2 Application Circuit Outline



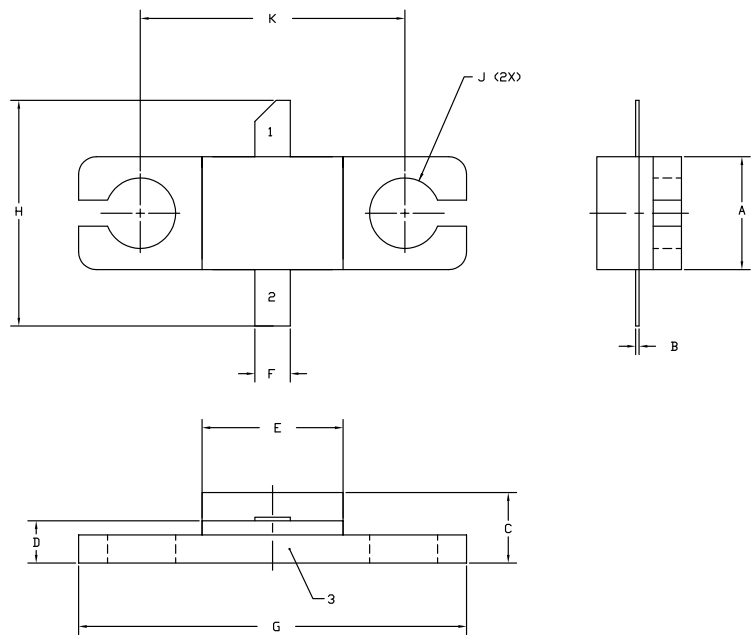
### Typical Package S-Parameters for CGHV40030

(Small Signal,  $V_{DS} = 50\text{ V}$ ,  $I_{DQ} = 150\text{ mA}$ , angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.92	-135.45	21.23	101.31	0.01	16.50	0.32	-74.10
600 MHz	0.92	-143.51	18.06	95.44	0.01	11.72	0.32	-79.66
700 MHz	0.91	-149.71	15.66	90.50	0.01	7.89	0.31	-84.44
800 MHz	0.91	-154.67	13.78	86.16	0.01	4.69	0.32	-88.69
900 MHz	0.91	-158.75	12.27	82.26	0.01	1.97	0.33	-92.58
1.0 GHz	0.91	-162.21	11.04	78.67	0.01	-0.41	0.34	-96.19
1.1 GHz	0.91	-165.20	10.02	75.32	0.01	-2.50	0.35	-99.57
1.2 GHz	0.91	-167.83	9.15	72.16	0.01	-4.34	0.36	-102.79
1.3 GHz	0.91	-170.19	8.41	69.14	0.01	-5.98	0.37	-105.86
1.4 GHz	0.92	-172.34	7.76	66.24	0.01	-7.43	0.39	-108.80
1.5 GHz	0.92	-174.30	7.20	63.45	0.01	-8.69	0.40	-111.64
1.6 GHz	0.92	-176.13	6.70	60.74	0.01	-9.77	0.42	-114.39
1.7 GHz	0.92	-177.83	6.26	58.11	0.01	-10.67	0.43	-117.06
1.8 GHz	0.92	-179.44	5.86	55.54	0.01	-11.39	0.45	-119.65
1.9 GHz	0.92	-179.04	5.50	53.03	0.01	-11.90	0.46	-122.18
2.0 GHz	0.92	-177.58	5.18	50.58	0.01	-12.20	0.48	-124.64
2.1 GHz	0.92	-176.19	4.89	48.17	0.01	-12.26	0.49	-127.05
2.2 GHz	0.92	-174.84	4.62	45.81	0.01	-12.07	0.51	-129.41
2.3 GHz	0.93	-173.54	4.37	43.50	0.01	-11.60	0.52	-131.72
2.4 GHz	0.93	-172.28	4.14	41.22	0.01	-10.82	0.53	-133.98
2.5 GHz	0.93	-171.06	3.93	38.98	0.01	-9.70	0.55	-136.21
2.6 GHz	0.93	-169.86	3.73	36.78	0.01	-8.20	0.56	-138.39
2.7 GHz	0.93	-168.70	3.55	34.62	0.01	-6.30	0.57	-140.53
2.8 GHz	0.93	-167.55	3.38	32.49	0.01	-3.97	0.59	-142.63
2.9 GHz	0.93	-166.43	3.23	30.39	0.01	-1.18	0.60	-144.70
3.0 GHz	0.94	-165.33	3.08	28.33	0.01	2.04	0.61	-146.73
3.2 GHz	0.94	-163.18	2.81	24.29	0.01	9.69	0.64	-150.70
3.4 GHz	0.94	-161.08	2.57	20.36	0.01	18.36	0.66	-154.54
3.6 GHz	0.94	-159.05	2.36	16.55	0.01	27.05	0.68	-158.26
3.8 GHz	0.95	-157.05	2.17	12.85	0.01	34.79	0.70	-161.87
4.0 GHz	0.95	-155.10	2.00	9.25	0.01	41.04	0.72	-165.37
4.2 GHz	0.95	-153.19	1.85	5.75	0.01	45.73	0.73	-168.77
4.4 GHz	0.95	-151.31	1.72	2.35	0.01	49.02	0.75	-172.07
4.6 GHz	0.96	-149.46	1.59	-0.96	0.01	51.19	0.76	-175.28
4.8 GHz	0.96	-147.65	1.48	-4.18	0.01	52.48	0.78	-178.39
5.0 GHz	0.96	-145.86	1.37	-7.31	0.01	53.11	0.79	-178.58
5.2 GHz	0.96	-144.11	1.28	-10.36	0.01	53.24	0.80	-175.63
5.4 GHz	0.96	-142.38	1.19	-13.33	0.01	52.98	0.82	-172.76
5.6 GHz	0.96	-140.68	1.11	-16.22	0.02	52.43	0.83	-169.97
5.8 GHz	0.97	-139.00	1.04	-19.03	0.02	51.65	0.84	-167.25
6.0 GHz	0.97	-137.35	0.98	-21.76	0.02	50.70	0.85	-164.60

To download the s-parameters in s2p format, go to the CGHV40030 product page.

Product Dimensions CGHV40030F (Package Type - 440166 )

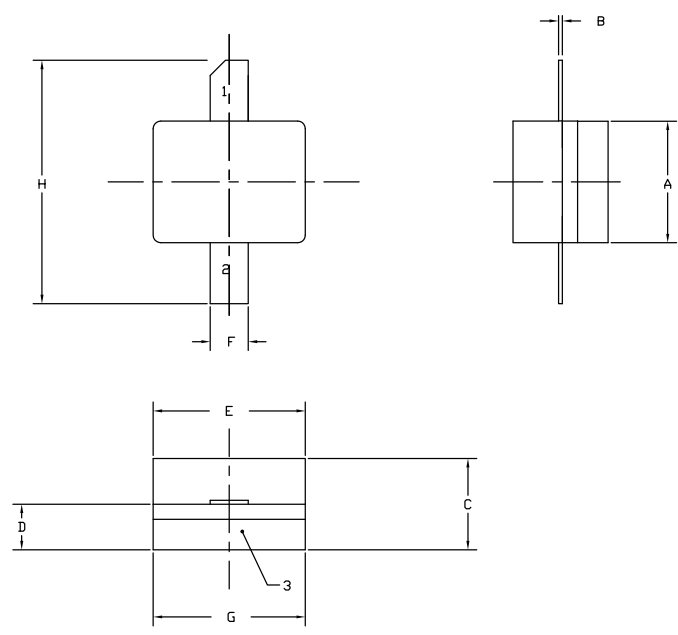


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
  4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
  5. ALL PLATED SURFACES ARE NI/AU

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.155	0.165	3.94	4.19
B	0.004	0.006	0.10	0.15
C	0.115	0.135	2.92	3.43
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.545	0.555	13.84	14.09
H	0.280	0.360	7.11	9.14
J	Ø .100		2.54	
K	0.375		9.53	

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

Product Dimensions CGHV40030P (Package Type - 440196)



- NOTES:
1. DIMENSIONING AND TOLERANCING 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	0.155	0.165	3.94	4.19
B	0.003	0.006	0.10	0.15
C	0.115	0.135	2.92	3.17
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.195	0.205	4.95	5.21
H	0.280	0.360	7.11	9.14

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

Part Number System

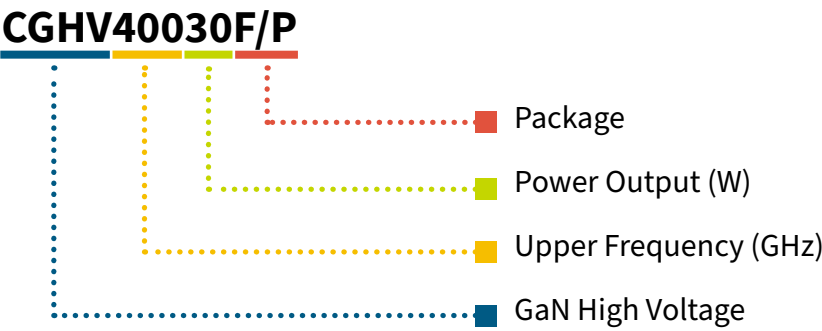


Table 1.



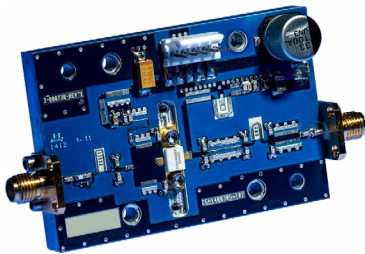
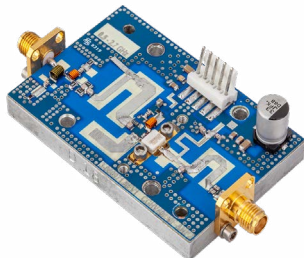
Parameter	Value	Units
Upper Frequency <sup>1</sup>	6	GHz
Power Output	30	W
Package	Flanged/Pill	—

Note:  
<sup>1</sup> Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

Table 2.

Character Code	Code Value
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
J	8
K	9
Examples	1A = 10.0 GHz 2H = 27.0 GHz

## Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGHV40030F	GaN HEMT	Each	
CGHV40030P	GaN HEMT	Each	
CGHV40030F-AMP	Test board with GaN HEMT installed	Each	
CGHV40030F-AMP2	Test board with GaN HEMT installed	Each	

## Notes & Disclaimer

---

MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.