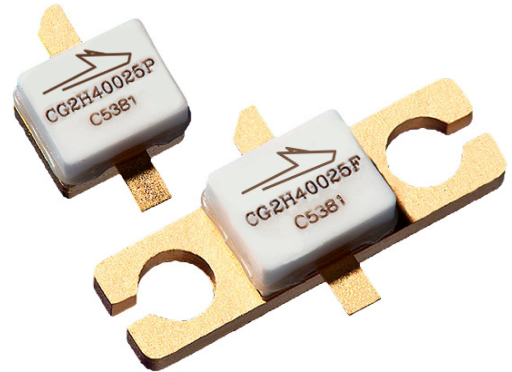


# CG2H40025

25 W, 28 V RF Power GaN HEMT

## Description

WolfSpeed's CG2H40025 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CG2H40025, 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 CG2H40025 ideal for linear and compressed amplifier circuits. The transistor is available in a screw-down, flange package and solder-down, pill package.



PNs: CG2H40025P and CG2H40025F  
Package Types: 440196 and 440166

## Features

- Up to 6 GHz Operation
- 17 dB Small Signal Gain at 2.0 GHz
- 15 dB Small Signal Gain at 4.0 GHz
- 30 W typical  $P_{SAT}$
- 70% Efficiency at  $P_{SAT}$
- 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



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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	$V_{DS}$	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	$I_{GMAX}$	7.0	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	3	A	
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
Thermal Resistance, Junction to Case <sup>3</sup>	$R_{\theta JC}$	3.8	°C/W	85°C
Case Operating Temperature <sup>3, 4</sup>	$T_C$	-40, +150	°C	

Notes:

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

<sup>2</sup> Refer to the Application Note on soldering at [wolfspeed.com/rf/document-library](http://wolfspeed.com/rf/document-library)

<sup>3</sup> Measured for the CG2H40025F at  $P_{DISS} = 28.8$  W

<sup>4</sup> See also, the Power Dissipation De-rating Curve on page 6

## 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	$V_{DC}$	$V_{DS} = 10$ V, $I_D = 7.2$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	—	-2.7	—		$V_{DS} = 28$ V, $I_D = 250$ mA
Saturated Drain Current	$I_{DS}$	5.2	7.2	—	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	$V_{BR}$	84	—	—	$V_{DC}$	$V_{GS} = -8$ V, $I_D = 7.2$ mA
<b>RF Characteristics<sup>2</sup> (<math>T_C = 25^\circ\text{C}</math>, <math>F_0 = 3.7</math> GHz unless otherwise noted)</b>						
Small Signal Gain	$G_{SS}$	13.0	14.8	—	dB	$V_{DD} = 28$ V, $I_{DQ} = 250$ mA
Output Power <sup>3</sup>	$P_{SAT}$	25	34	—	—	
Drain Efficiency <sup>4</sup>	$\eta$	57	71	—	%	$V_{DD} = 28$ V, $I_{DQ} = 250$ mA, $P_{SAT}$
Output Mismatch Stress	VSWR	—	—	10 : 1	Y	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 250$ mA, $P_{OUT} = 25$ W CW
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	—	7.5	—	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance	$C_{DS}$	—	2.4	—		
Feedback Capacitance	$C_{GD}$	—	0.4	—		

Notes:

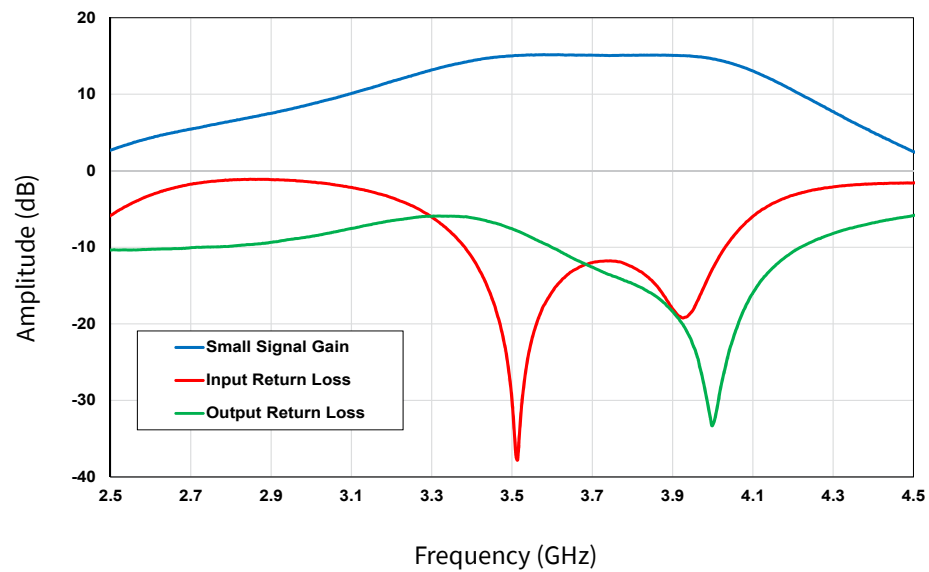
<sup>1</sup> Measured on wafer prior to packaging

<sup>2</sup> Measured in CG2H40025-AMP

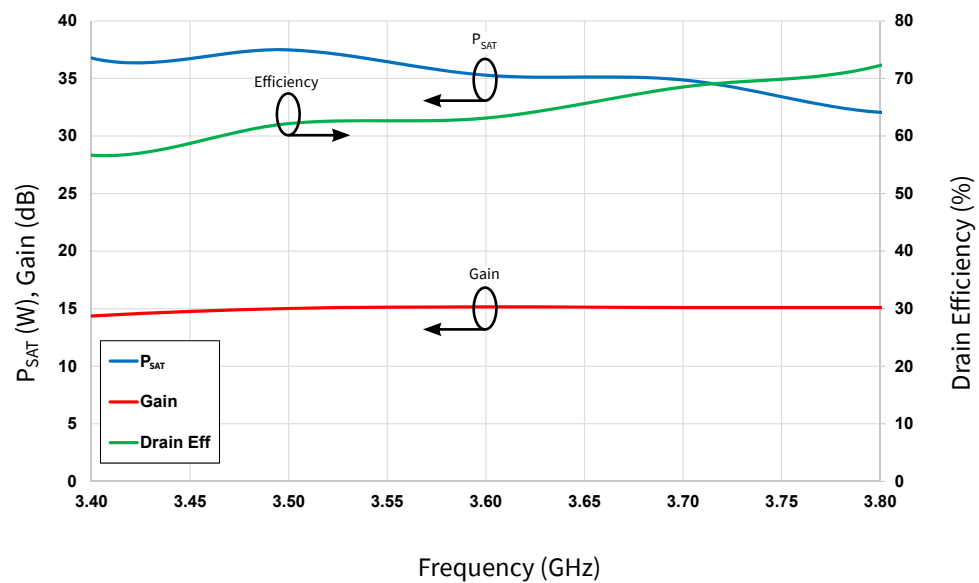
<sup>3</sup>  $P_{SAT}$  is defined as  $I_G = 0.72$  mA

<sup>4</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$

## Typical Performance



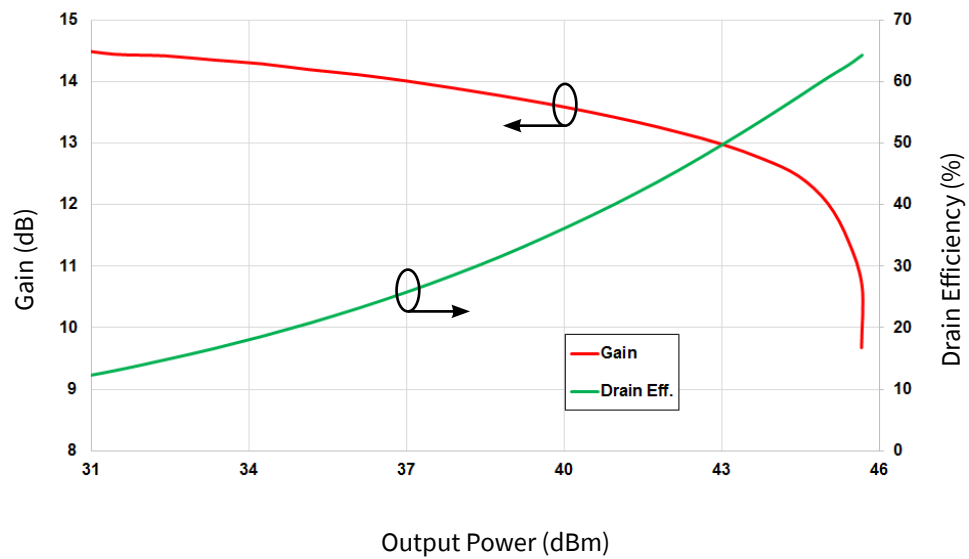
**Figure 1.** Small Signal Gain and Return Loss vs Frequency of the CG2H40025F in the CG2H40025-AMP



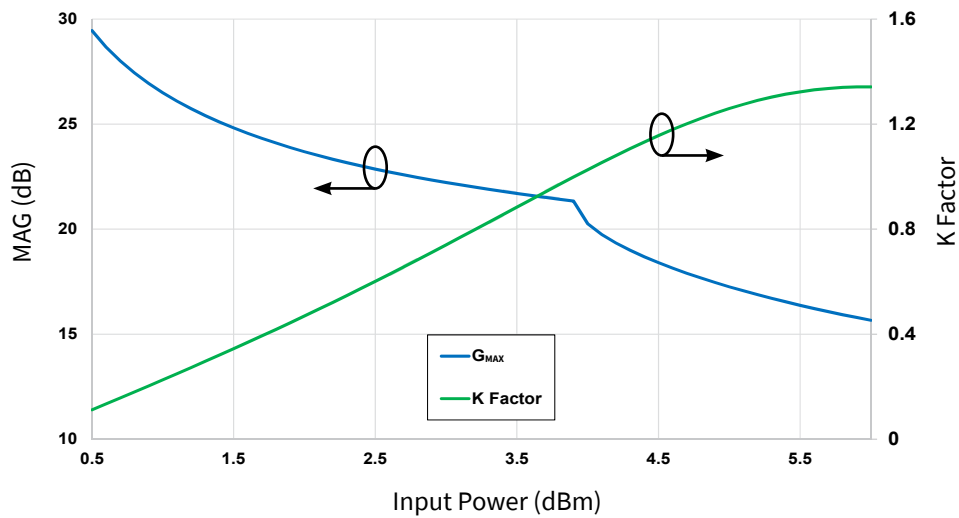
**Figure 2.**  $P_{SAT}$ , Gain, and Drain Efficiency vs Frequency of the CG2H40025F in the CG2H40025-AMP  
 $V_{DD} = 28 \text{ V}$ ,  $I_{DQ} = 250 \text{ mA}$



### CG2H40025F Typical Performance



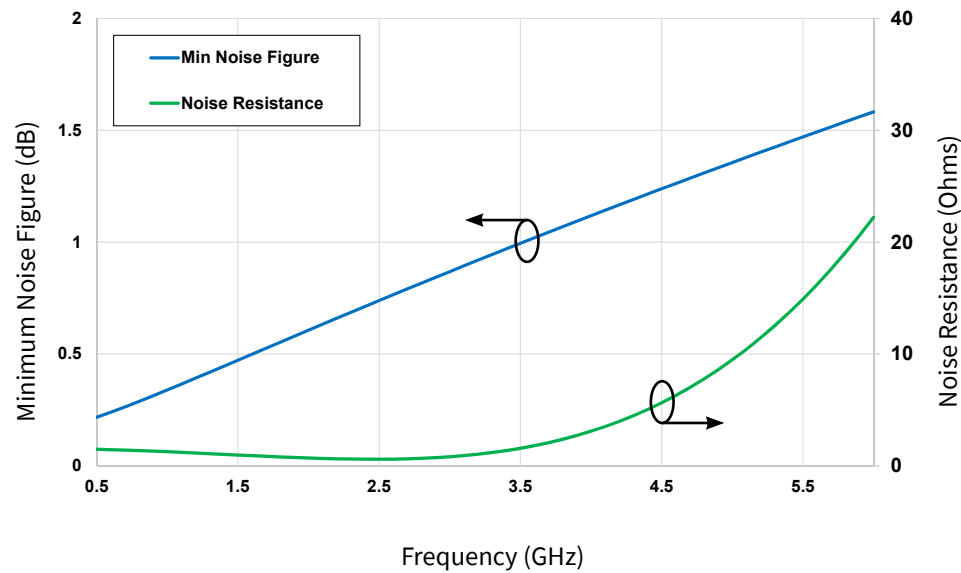
**Figure 3.** Swept CW Data of CG2H40025 vs. Output Power in CG2H40025-AMP  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$ , Freq = 3.6 GHz



**Figure 4.** Maximum Available Gain and K Factor of the CG2H40025  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$



Typical Noise Performance



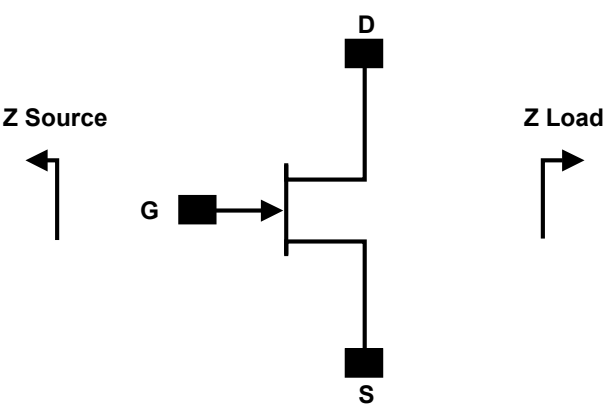
**Figure 5.** Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CG2H40025F  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	1A	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	C2B	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C



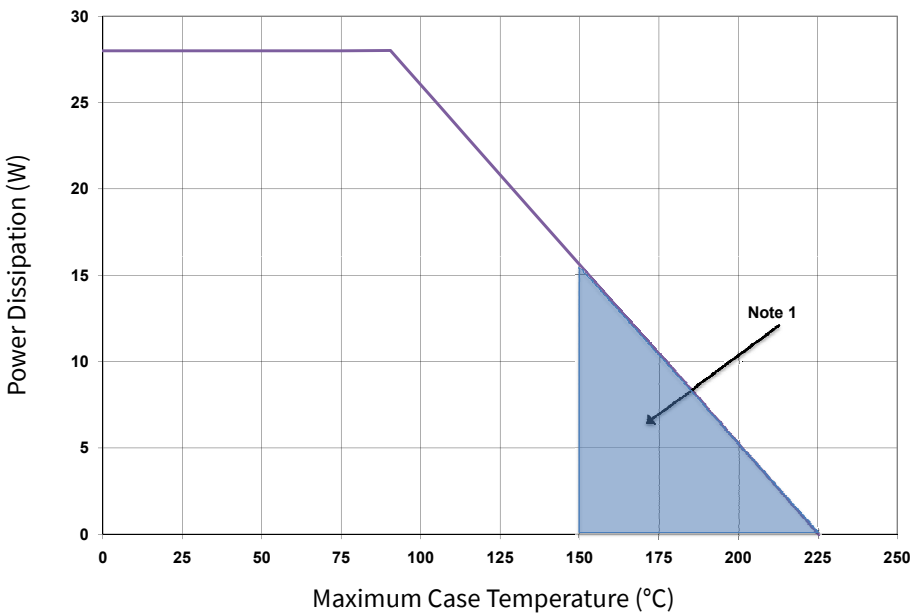
Source and Load Impedances



Frequency ĩMHz	Z Source	Z Load
500	7.75 + ĵ15.5	20 + ĵ5.2
1000	3.11 + ĵ5.72	17 + ĵ6.66
1500	2.86 + ĵ1.63	16.8 + ĵ3.2
2500	2.4 - ĵ3.52	8.02 + ĵ4.32
3500	1.31 - ĵ7.3	5.85 - ĵ0.51

- Notes:
- <sup>1</sup> V<sub>DD</sub> = 28 V, I<sub>DQ</sub> = 250mA in the 440166 package
  - <sup>2</sup> Optimized for P<sub>SAT</sub> and PAE
  - <sup>3</sup> When using this device at low frequency, series resistors should be used to maintain amplifier stability

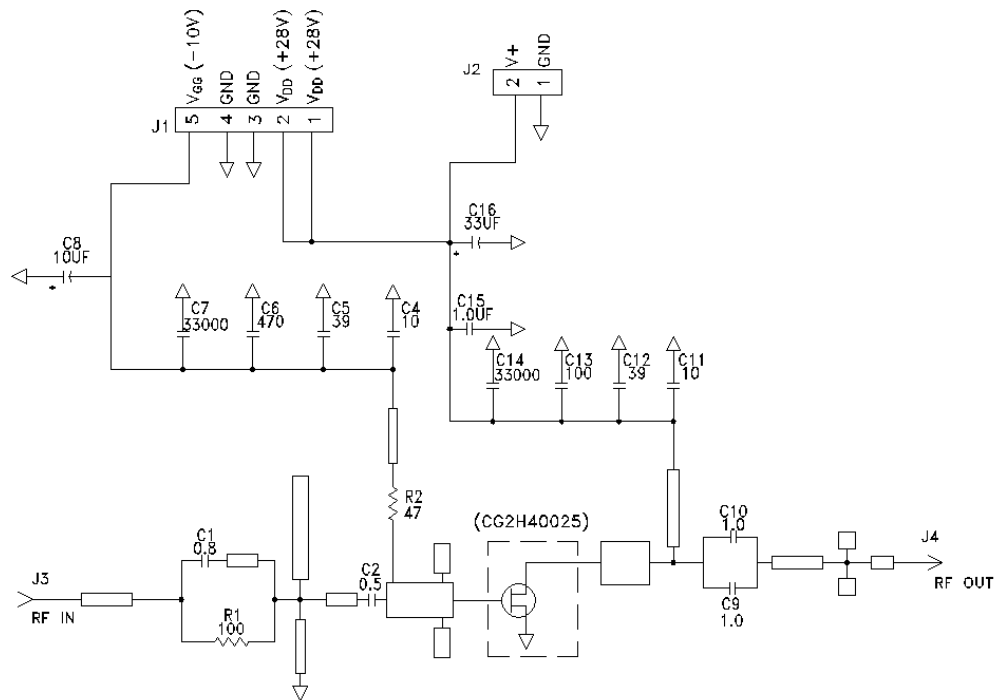
CG2H40025 Power Dissipation De-rating Curve



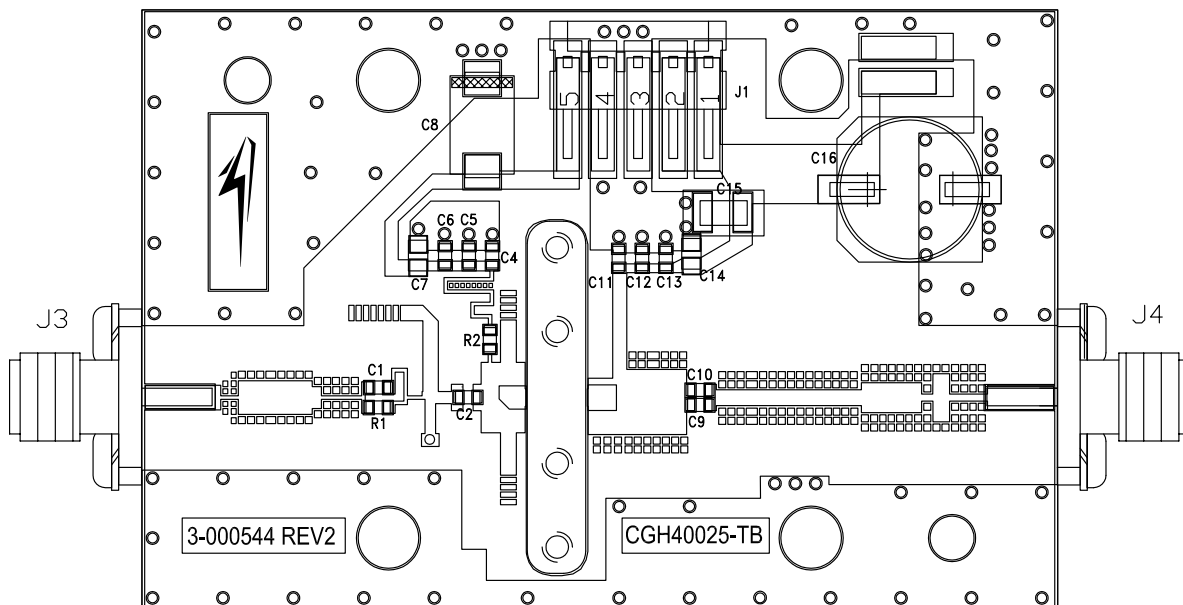
- Note:
- <sup>1</sup> Area exceeds Maximum Case Operating Temperature (See Page 2)



## CG2H40025-AMP Demonstration Amplifier Circuit Schematic



## CG2H40025-AMP Demonstration Amplifier Circuit Outline

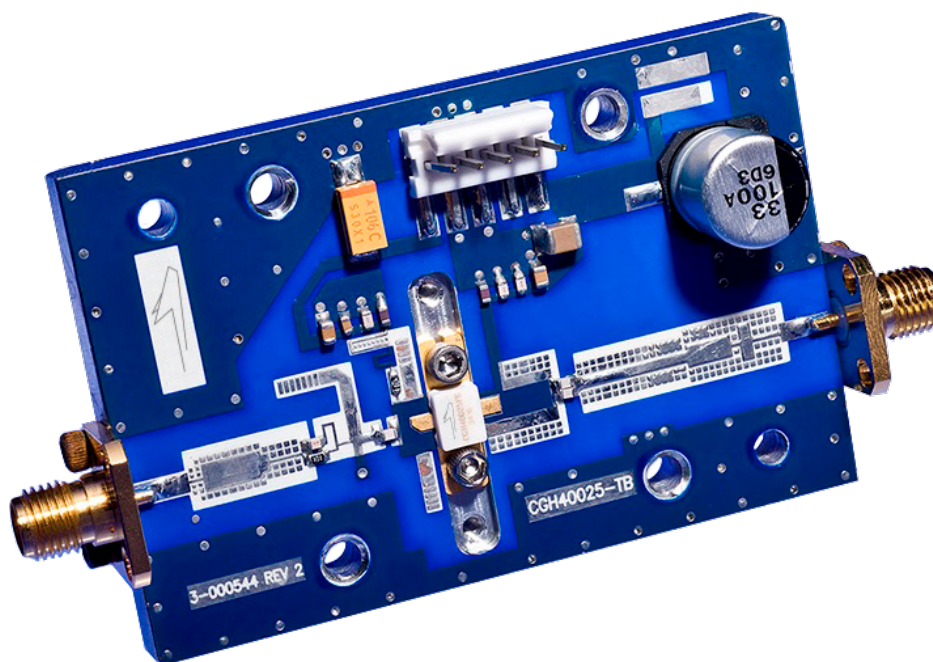




## CG2H40025-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R2	RES, 1/16W, 0603, 1%, 47 OHMS	1
R1	RES, 1/16W, 0603, 1%, 100 OHMS	1
C6	CAP, 470pF, 5%, 100V, 0603	1
C16	CAP, 33μF, 20%, G CASE	1
C15	CAP, 1.0μF, 100V, 10%, X7R, 1210	1
C8	CAP 10μF 16V TANTALUM	1
C13	CAP, 100.0pF, +/-5%, 0603	1
C1	CAP, 0.8pF, +/-0.1pF, 0603	1
C2	CAP, 0.5pF, +/-0.05pF, 0603	1
C9, C10	CAP, 1.0pF, +/-0.1pF, 0603	2
C4, C11	CAP, 10.0pF, +/-5%, 0603	2
C5, C12	CAP, 39pF, +/-5%, 0603	2
C7, C14	CAP, 33000pF, 0805, 100V, X7R	2
J3, J4	CONN SMA STR PANEL JACK RECP	2
J1	HEADER RT>PLZ .1CEN LK 5POS	1
—	PCB, RO4350B, Er = 3.48, h = 20 mil	1
—	CG2H40025F or CG2H40025P	1

## CG2H40025F-AMP Demonstration Amplifier Circuit







**Typical Package S-Parameters for CG2H40025**  
**(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
0.5	0.869	-144.08	16.82	95.26	0.024	10.68	0.425	-137.01
0.6	0.864	-151.15	14.18	89.71	0.024	6.25	0.431	-142.15
0.7	0.861	-156.57	12.22	84.97	0.024	2.64	0.438	-145.82
0.8	0.859	-160.90	10.70	80.75	0.025	-0.43	0.446	-148.58
0.9	0.858	-164.50	9.49	76.90	0.025	-3.10	0.454	-150.76
1	0.857	-167.56	8.51	73.32	0.025	-5.46	0.463	-152.56
1.1	0.856	-170.23	7.70	69.96	0.025	-7.59	0.472	-154.11
1.2	0.856	-172.60	7.02	66.75	0.025	-9.52	0.482	-155.49
1.3	0.855	-174.74	6.43	63.69	0.025	-11.28	0.492	-156.77
1.4	0.855	-176.71	5.93	60.74	0.025	-12.87	0.502	-157.98
1.5	0.854	-178.52	5.49	57.88	0.025	-14.32	0.513	-159.15
1.6	0.854	179.77	5.10	55.12	0.025	-15.64	0.523	-160.30
1.7	0.854	178.17	4.76	52.43	0.025	-16.82	0.533	-161.43
1.8	0.854	176.64	4.45	49.81	0.025	-17.86	0.543	-162.56
1.9	0.853	175.18	4.18	47.25	0.025	-18.78	0.553	-163.69
2	0.853	173.78	3.93	44.76	0.025	-19.56	0.562	-164.83
2.1	0.853	172.43	3.70	42.32	0.025	-20.21	0.572	-165.97
2.2	0.853	171.11	3.50	39.93	0.025	-20.73	0.581	-167.12
2.3	0.852	169.83	3.31	37.59	0.025	-21.10	0.590	-168.28
2.4	0.852	168.58	3.14	35.30	0.025	-21.33	0.599	-169.44
2.5	0.852	167.35	2.98	33.06	0.025	-21.41	0.607	-170.61
2.6	0.851	166.15	2.84	30.85	0.025	-21.34	0.615	-171.78
2.7	0.851	164.96	2.70	28.69	0.025	-21.12	0.623	-172.96
2.8	0.851	163.79	2.58	26.56	0.025	-20.73	0.630	-174.14
2.9	0.850	162.64	2.47	24.48	0.025	-20.18	0.637	-175.32
3	0.850	161.49	2.36	22.42	0.025	-19.47	0.644	-176.51
3.2	0.849	159.23	2.17	18.42	0.025	-17.56	0.657	-178.89
3.4	0.848	157.00	2.00	14.55	0.026	-15.02	0.669	178.72
3.6	0.847	154.78	1.85	10.79	0.027	-11.92	0.679	176.34
3.8	0.845	152.58	1.73	7.14	0.028	-8.41	0.689	173.95
4	0.844	150.37	1.61	3.60	0.029	-4.65	0.697	171.56
4.2	0.843	148.16	1.51	0.16	0.031	-0.86	0.705	169.18
4.4	0.841	145.94	1.42	-3.19	0.034	2.77	0.712	166.79
4.6	0.839	143.71	1.34	-6.44	0.037	6.05	0.718	164.40
4.8	0.837	141.46	1.27	-9.61	0.041	8.89	0.723	162.00
5	0.835	139.18	1.21	-12.69	0.046	11.21	0.728	159.60
5.2	0.833	136.87	1.15	-15.69	0.051	13.00	0.732	157.18
5.4	0.830	134.54	1.10	-18.61	0.057	14.29	0.735	154.75
5.6	0.828	132.16	1.05	-21.45	0.064	15.09	0.738	152.31
5.8	0.825	129.75	1.01	-24.21	0.072	15.47	0.740	149.84
6	0.822	127.30	0.97	-26.89	0.080	15.46	0.742	147.35

To download the s-parameters in s2p format, go to the [CG2H40025](#) Product page and click on the documentation tab.

**Typical Package S-Parameters for CG2H40025**  
**(Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$ , angle in degrees)**

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
0.5	0.881	-151.40	18.76	93.94	0.017	12.31	0.488	-157.38
0.6	0.878	-157.62	15.77	89.14	0.018	9.22	0.495	-160.94
0.7	0.876	-162.40	13.57	85.03	0.018	6.84	0.501	-163.55
0.8	0.874	-166.25	11.89	81.37	0.018	4.92	0.505	-165.55
0.9	0.872	-169.47	10.56	78.02	0.018	3.33	0.510	-167.15
1	0.871	-172.24	9.49	74.89	0.018	1.99	0.515	-168.49
1.1	0.870	-174.67	8.60	71.93	0.019	0.84	0.519	-169.64
1.2	0.869	-176.86	7.86	69.10	0.019	-0.14	0.524	-170.66
1.3	0.867	-178.85	7.22	66.37	0.019	-0.99	0.529	-171.60
1.4	0.866	-179.31	6.68	63.73	0.019	-1.72	0.534	-172.47
1.5	0.865	-177.59	6.20	61.17	0.020	-2.33	0.539	-173.30
1.6	0.863	-175.98	5.78	58.67	0.020	-2.84	0.544	-174.11
1.7	0.862	-174.44	5.41	56.22	0.020	-3.26	0.549	-174.89
1.8	0.861	-172.98	5.08	53.83	0.020	-3.58	0.554	-175.67
1.9	0.859	-171.57	4.78	51.48	0.021	-3.81	0.559	-176.45
2	0.858	-170.22	4.51	49.18	0.021	-3.95	0.564	-177.23
2.1	0.856	-168.91	4.27	46.91	0.021	-4.00	0.569	-178.01
2.2	0.855	-167.63	4.05	44.68	0.022	-3.97	0.574	-178.80
2.3	0.854	-166.38	3.85	42.48	0.022	-3.86	0.579	-179.60
2.4	0.852	-165.17	3.66	40.32	0.023	-3.67	0.584	-179.58
2.5	0.850	-163.97	3.49	38.19	0.023	-3.40	0.589	-178.76
2.6	0.849	-162.80	3.33	36.08	0.024	-3.06	0.593	-177.93
2.7	0.847	-161.64	3.19	34.01	0.024	-2.65	0.598	-177.09
2.8	0.846	-160.50	3.05	31.96	0.025	-2.18	0.602	-176.23
2.9	0.844	-159.38	2.93	29.94	0.025	-1.64	0.607	-175.36
3	0.842	-158.26	2.81	27.95	0.026	-1.05	0.611	-174.48
3.2	0.839	-156.06	2.60	24.03	0.027	0.26	0.619	-172.70
3.4	0.836	-153.89	2.41	20.21	0.029	1.71	0.627	-170.87
3.6	0.832	-151.74	2.25	16.47	0.031	3.23	0.634	-169.01
3.8	0.829	-149.60	2.10	12.82	0.033	4.77	0.640	-167.11
4	0.825	-147.46	1.97	9.25	0.036	6.24	0.646	-165.18
4.2	0.821	-145.33	1.86	5.75	0.039	7.61	0.651	-163.22
4.4	0.817	-143.19	1.76	2.33	0.043	8.82	0.656	-161.23
4.6	0.814	-141.03	1.66	-1.02	0.047	9.85	0.660	-159.21
4.8	0.810	-138.86	1.58	-4.31	0.051	10.66	0.664	-157.17
5	0.806	-136.67	1.51	-7.52	0.057	11.24	0.667	-155.10
5.2	0.801	-134.46	1.44	-10.68	0.062	11.59	0.669	-153.00
5.4	0.797	-132.22	1.38	-13.77	0.069	11.71	0.671	-150.87
5.6	0.793	-129.95	1.32	-16.80	0.076	11.60	0.673	-148.72
5.8	0.788	-127.64	1.27	-19.78	0.083	11.28	0.674	-146.53
6	0.783	-125.29	1.23	-22.69	0.092	10.74	0.675	-144.31

To download the s-parameters in s2p format, go to the [CG2H40025](#) Product page and click on the documentation tab.

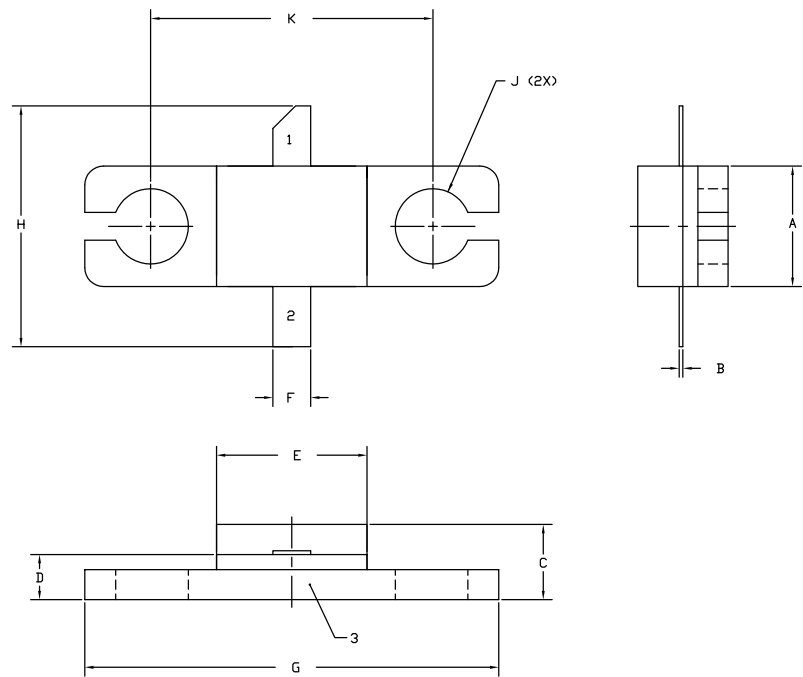
**Typical Package S-Parameters for CG2H40025**  
**(Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 400\text{ mA}$ , angle in degrees)**

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
0.5	0.891	-154.59	18.81	93.00	0.015	13.05	0.509	-162.83
0.6	0.888	-160.39	15.79	88.47	0.015	10.57	0.515	-165.80
0.7	0.886	-164.86	13.57	84.59	0.015	8.73	0.519	-168.00
0.8	0.885	-168.47	11.89	81.12	0.016	7.31	0.524	-169.72
0.9	0.883	-171.51	10.56	77.93	0.016	6.19	0.527	-171.12
1	0.882	-174.13	9.49	74.94	0.016	5.28	0.531	-172.30
1.1	0.881	-176.46	8.61	72.11	0.016	4.55	0.535	-173.34
1.2	0.879	-178.55	7.87	69.39	0.017	3.95	0.538	-174.27
1.3	0.878	-179.53	7.23	66.77	0.017	3.47	0.542	-175.12
1.4	0.876	-177.75	6.69	64.23	0.017	3.08	0.546	-175.93
1.5	0.875	-176.09	6.22	61.76	0.017	2.79	0.550	-176.70
1.6	0.873	-174.52	5.80	59.34	0.018	2.57	0.554	-177.44
1.7	0.872	-173.02	5.43	56.97	0.018	2.43	0.558	-178.17
1.8	0.870	-171.58	5.11	54.65	0.019	2.36	0.562	-178.90
1.9	0.869	-170.20	4.81	52.36	0.019	2.35	0.566	-179.62
2	0.867	-168.87	4.55	50.12	0.019	2.41	0.570	-179.65
2.1	0.865	-167.57	4.30	47.91	0.020	2.52	0.574	-178.93
2.2	0.864	-166.31	4.08	45.73	0.020	2.69	0.578	-178.19
2.3	0.862	-165.08	3.88	43.58	0.021	2.91	0.582	-177.45
2.4	0.860	-163.87	3.70	41.46	0.021	3.18	0.586	-176.69
2.5	0.858	-162.68	3.53	39.36	0.022	3.50	0.590	-175.93
2.6	0.856	-161.52	3.37	37.30	0.023	3.86	0.594	-175.15
2.7	0.854	-160.37	3.23	35.26	0.023	4.25	0.597	-174.37
2.8	0.852	-159.23	3.09	33.24	0.024	4.68	0.601	-173.57
2.9	0.850	-158.11	2.97	31.25	0.025	5.14	0.605	-172.76
3	0.848	-157.00	2.85	29.28	0.026	5.62	0.608	-171.94
3.2	0.844	-154.81	2.64	25.40	0.028	6.63	0.615	-170.27
3.4	0.840	-152.64	2.46	21.61	0.030	7.66	0.621	-168.56
3.6	0.836	-150.50	2.29	17.90	0.032	8.69	0.627	-166.80
3.8	0.832	-148.36	2.15	14.26	0.035	9.67	0.632	-165.01
4	0.828	-146.23	2.02	10.70	0.038	10.55	0.637	-163.18
4.2	0.823	-144.10	1.91	7.20	0.041	11.32	0.641	-161.32
4.4	0.819	-141.97	1.80	3.78	0.045	11.94	0.645	-159.43
4.6	0.814	-139.82	1.71	0.41	0.050	12.40	0.649	-157.50
4.8	0.810	-137.66	1.63	-2.89	0.055	12.68	0.652	-155.54
5	0.805	-135.48	1.55	-6.13	0.060	12.79	0.654	-153.56
5.2	0.800	-133.27	1.48	-9.30	0.066	12.71	0.656	-151.54
5.4	0.795	-131.04	1.42	-12.43	0.073	12.45	0.658	-149.49
5.6	0.790	-128.78	1.37	-15.49	0.080	12.01	0.659	-147.40
5.8	0.785	-126.49	1.32	-18.50	0.088	11.40	0.660	-145.28
6	0.779	-124.15	1.27	-21.45	0.096	10.62	0.660	-143.13

To download the s-parameters in s2p format, go to the [CG2H40025](#) Product page and click on the documentation tab.



Product Dimensions CG2H40025F (Package Type — 440166)

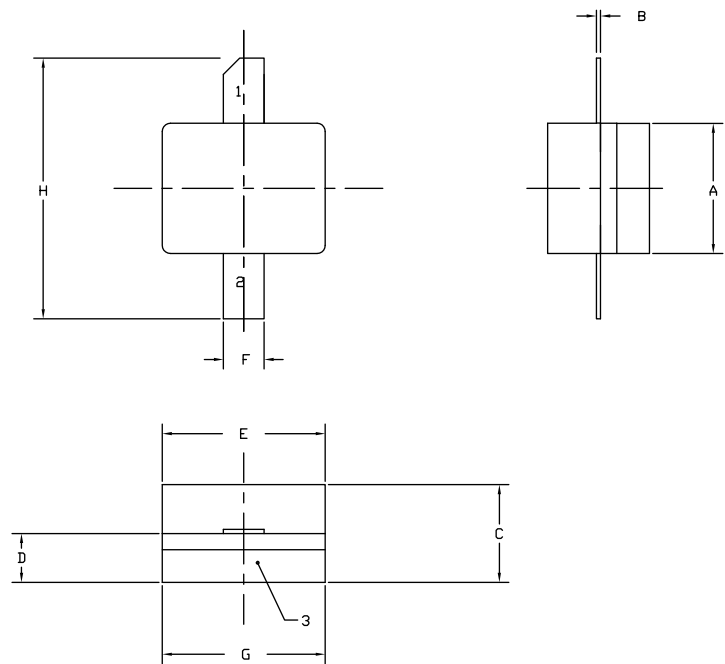


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
  4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
  5. ALL PLATED SURFACES ARE NI/AU.

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 CG2H40025P (Package Type — 440196)

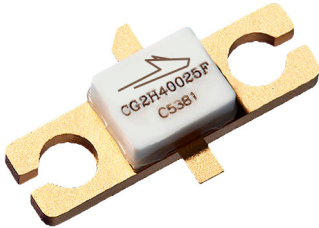



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
  4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
  5. ALL PLATED SURFACES ARE NI/AU.

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

Product Ordering Information

Order Number	Description	Unit of Measure	Image
CG2H40025F	GaN HEMT	Each	
CG2H40025P	GaN HEMT	Each	
CG2H40025F-AMP	Test board with GaN HEMT installed	Each	