

CG2H40035

35 W, DC - 6 GHz, RF Power GaN HEMT

Cree's CG2H40035 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CG2H40035, 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 CG2H40035 ideal for linear and compressed amplifier circuits. The transistor is available in both a screw-down, flange package and solder-down, pill packages.



Package Type: 440166 & 440196
PN: CG2H40035F & CG2H40035P

FEATURES

- Up to 6 GHz Operation
- 40 W Typical P_{SAT}
- 64% Efficiency at P_{SAT}
- 14 dB Small Signal Gain at 3.5 GHz
- 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_{DC}	25°C
Gate-to-Source Voltage	V_{GS}	-10, +2	V_{DC}	25°C
Storage Temperature	T_{STG}	-65, +150	°C	
Operating Junction Temperature	T_J	225	°C	
Maximum Forward Gate Current	I_{GMAX}	12	mA	25°C
Maximum Drain Current ¹	I_{DMAX}	4.5	A	25°C
Soldering Temperature ²	T_S	245	°C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case (packaged) ³	$R_{\theta JC}$	3.4	°C/W	85°C
Case Operating Temperature ^{3,4}	T_C	-40, +85	°C	

Note:

¹ Current limit for long term, reliable operation

² Eutectic die attach using 80/20 AuSn mounted to a 60 mil thick CuMoCu carrier

³ Measured for the CG2H40035F at $P_{DISS} = 42$ W

⁴ 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
DC Characteristics¹						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.1	-2.3	V	$V_{DS} = 10$ V, $I_D = 10.8$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	—	-2.7	—	V	$V_{DS} = 28$ V, $I_D = 500$ mA
Saturated Drain Current	I_{DS}	7.8	10.8	—	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	V_{BR}	84	—	—	V	$V_{GS} = -8$ V, $I_D = 10.8$ mA
RF Characteristics² ($T_C = 25^\circ\text{C}$, $F_0 = 3.5$ GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	—	14.3	—	dB	$V_{DD} = 28$ V, $I_{DQ} = 500$ mA
Power Output ³	P_{SAT}	—	40	—	W	$V_{DD} = 28$ V, $I_{DQ} = 500$ mA
Drain Efficiency ⁴	η	—	64	—	%	$V_{DD} = 28$ V, $I_{DQ} = 500$ mA, $P_{SAT} = 40$ W
Output Mismatch Stress	VSWR	—	—	10 : 1	Ψ	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 500$ mA, $P_{OUT} = 40$ W CW
Dynamic Characteristics						
Input Capacitance	C_{GS}	—	15.4	—	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance	C_{DS}	—	3.0	—	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Feedback Capacitance	C_{GD}	—	0.7	—	pF	$V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz

Notes:

¹ Measured on wafer prior to packaging

² Measured in CG2H40035F-AMP

³ P_{SAT} is defined as $I_G > 0.1$ mA

⁴ Drain Efficiency = P_{OUT} / P_{DC}

Typical Performance

Figure 1. - Small Signal Gain and Return Loss vs. Frequency of the CG2H40035F in the CG2H40035F-AMP

$V_{DD} = 28\text{ V}$, $I_{DQ} = 500\text{ mA}$

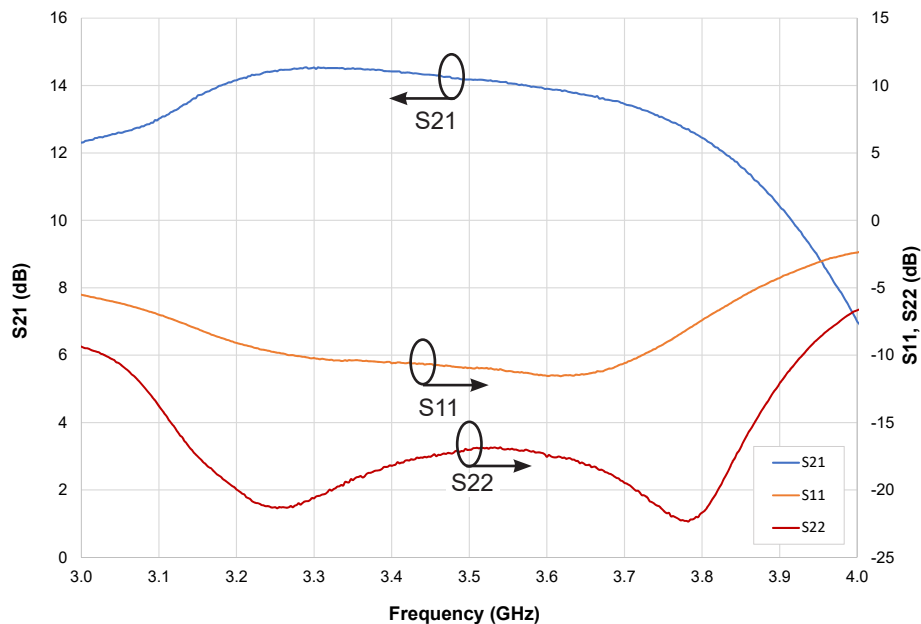
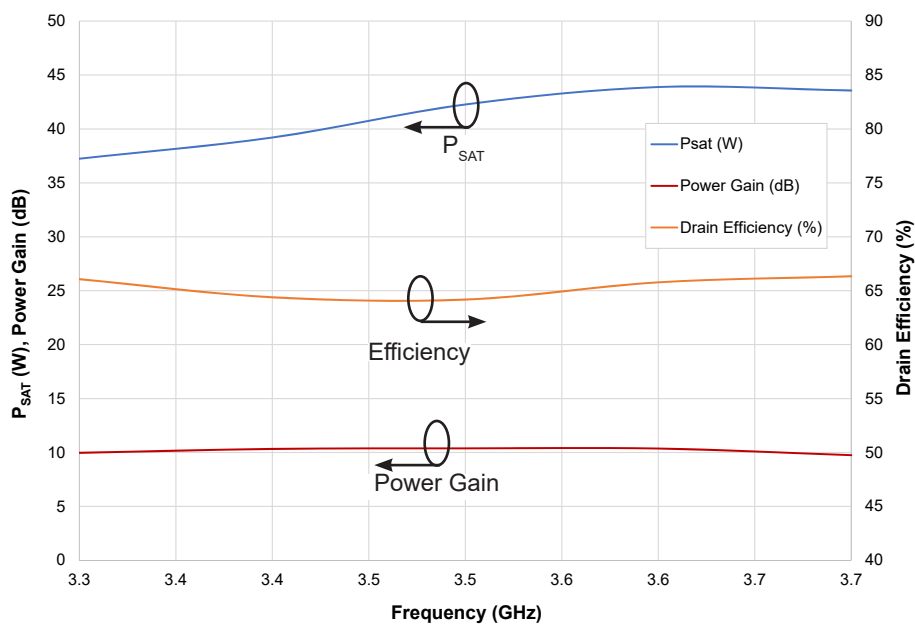


Figure 2. - P_{SAT} Power Gain, and Drain Efficiency vs Frequency of the CG2H40035 in the CG2H40035F-AMP

$V_{DD} = 28\text{ V}$, $I_{DQ} = 500\text{ mA}$



Typical Performance

Figure 3. - Swept Data vs. Output Power of the CG2H40035F-AMP
 $V_{DD} = 28\text{ V}$, $I_{DQ} = 500\text{ mA}$, Freq = 3.5 GHz

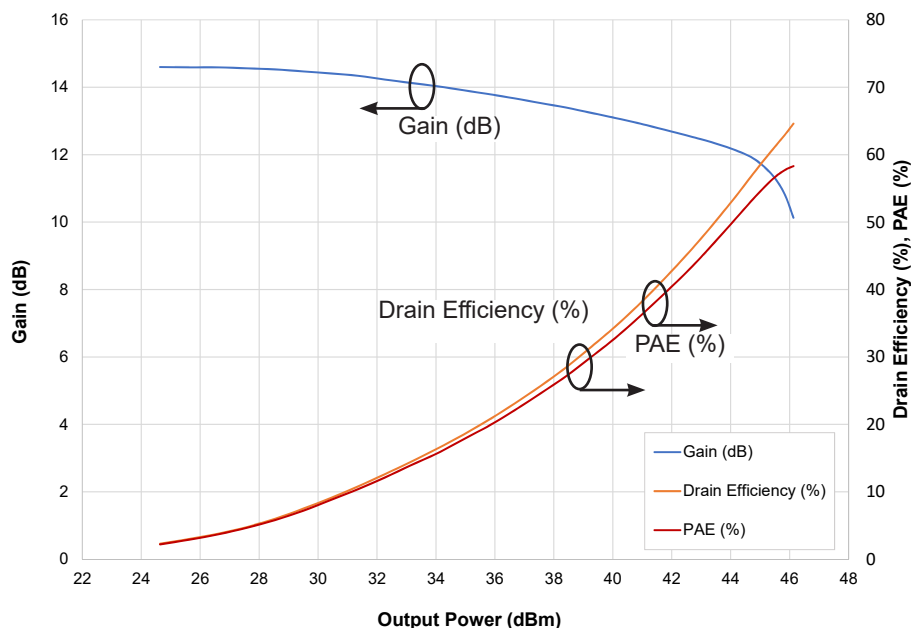
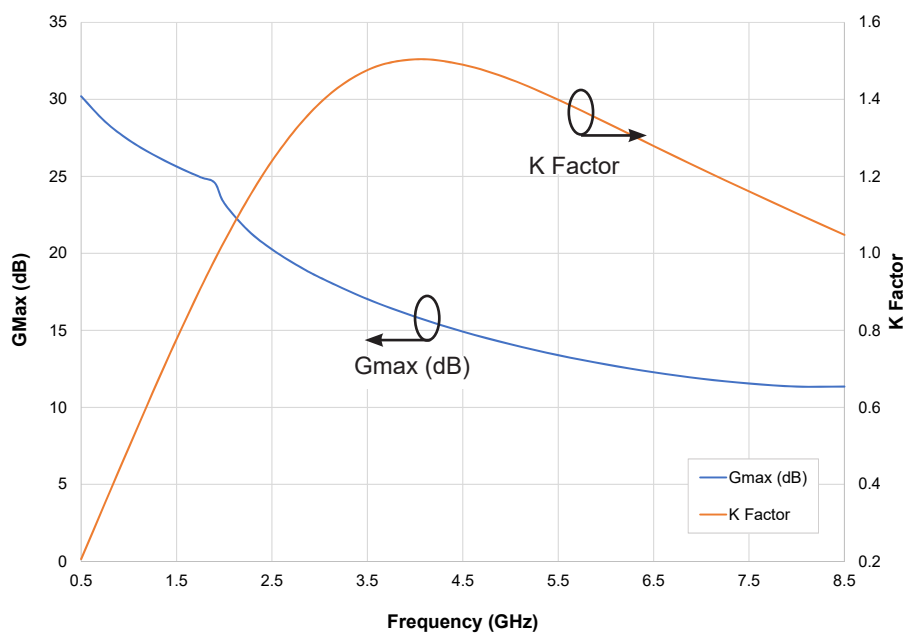
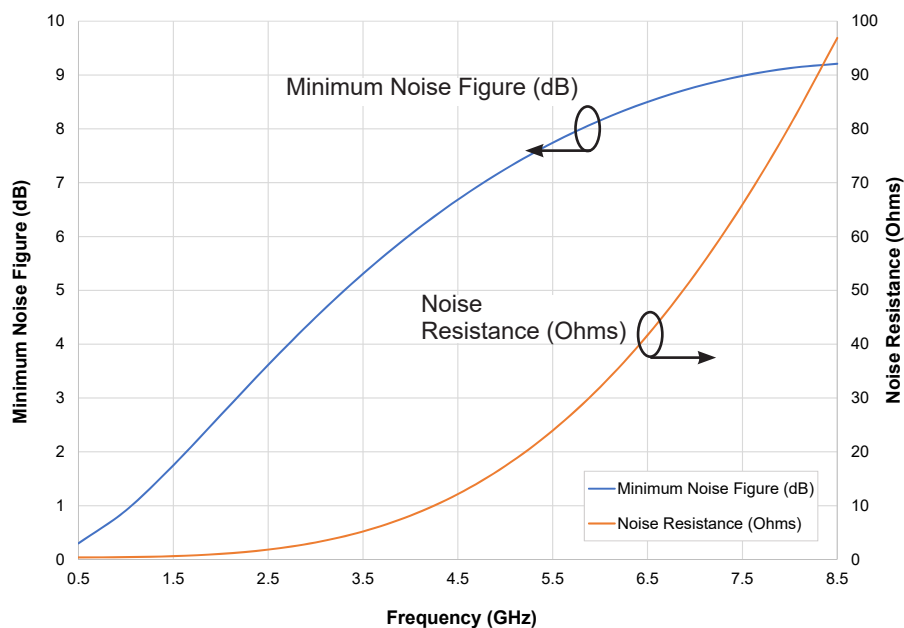


Figure 4. Simulated Maximum Available Gain and K Factor of the CG2H40035
 $V_{DD} = 28\text{ V}$, $I_{DQ} = 500\text{ mA}$



Typical Noise Performance

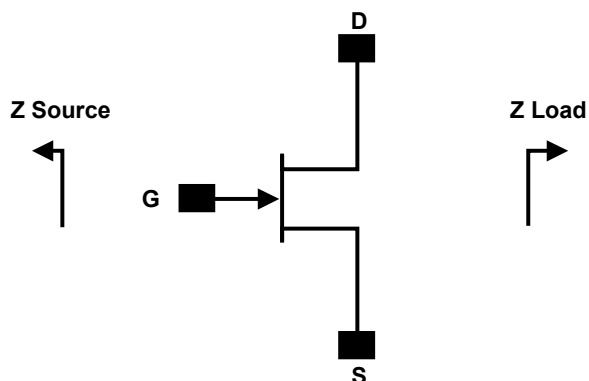
Figure 5. - Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CG2H40035
 $V_{DD} = 28\text{ V}$, $I_{DQ} = 500\text{ mA}$



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



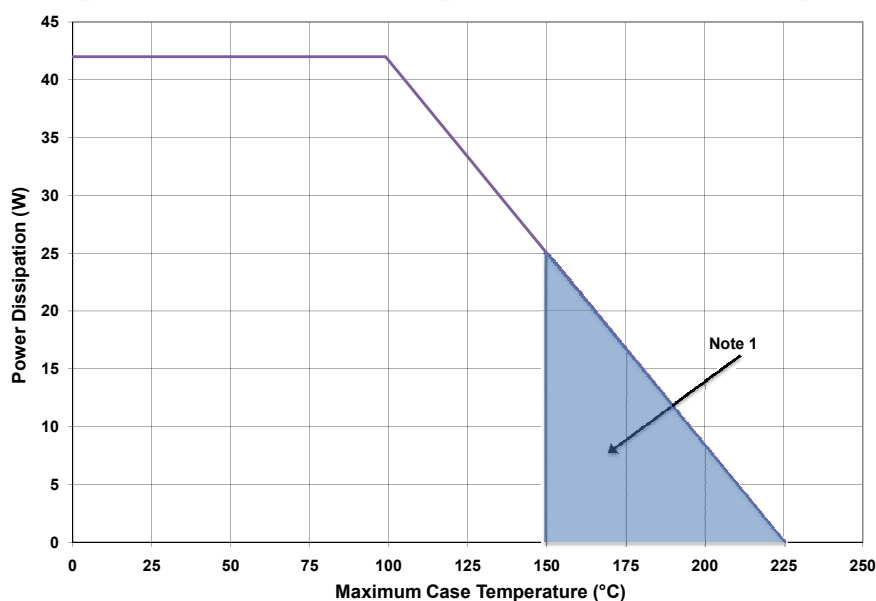
Frequency (MHz)	Z Source	Z Load
500	$4.212 + j5.822$	$10.547 + j3.155$
1000	$3.536 + j2.811$	$7.281 + j2.996$
1500	$1.468 + j1.554$	$5.530 + j0.839$
2500	$1.326 - j3.115$	$5.221 - j3.508$
3500	$1.648 - j6.926$	$4.309 - j7.717$

Note 1. $V_{DD} = 28V$, $I_{DQ} = 500mA$, in the 440166/440196 package.

Note 2. Optimized for P_{SAT} and PAE

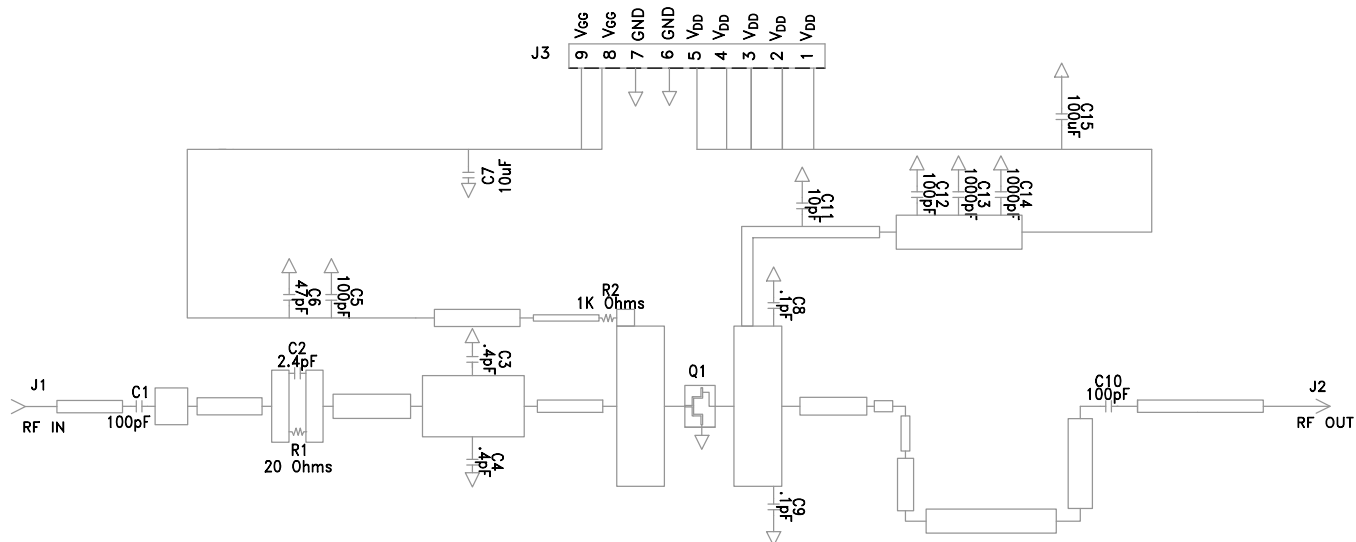
Note 3. When using this device at low frequency, series resistors should be used to maintain amplifier stability.

CG2H40035 Power Dissipation De-rating Curve

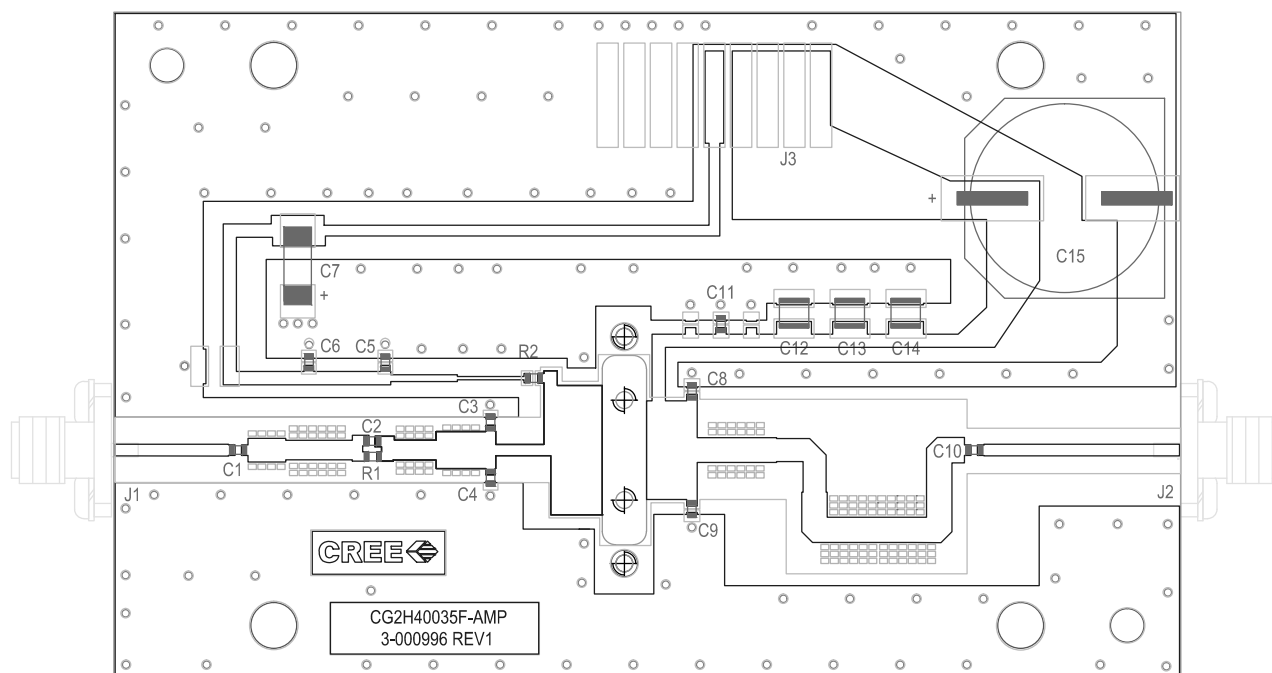


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

CG2H40035F-AMP Demonstration Amplifier Circuit Schematic



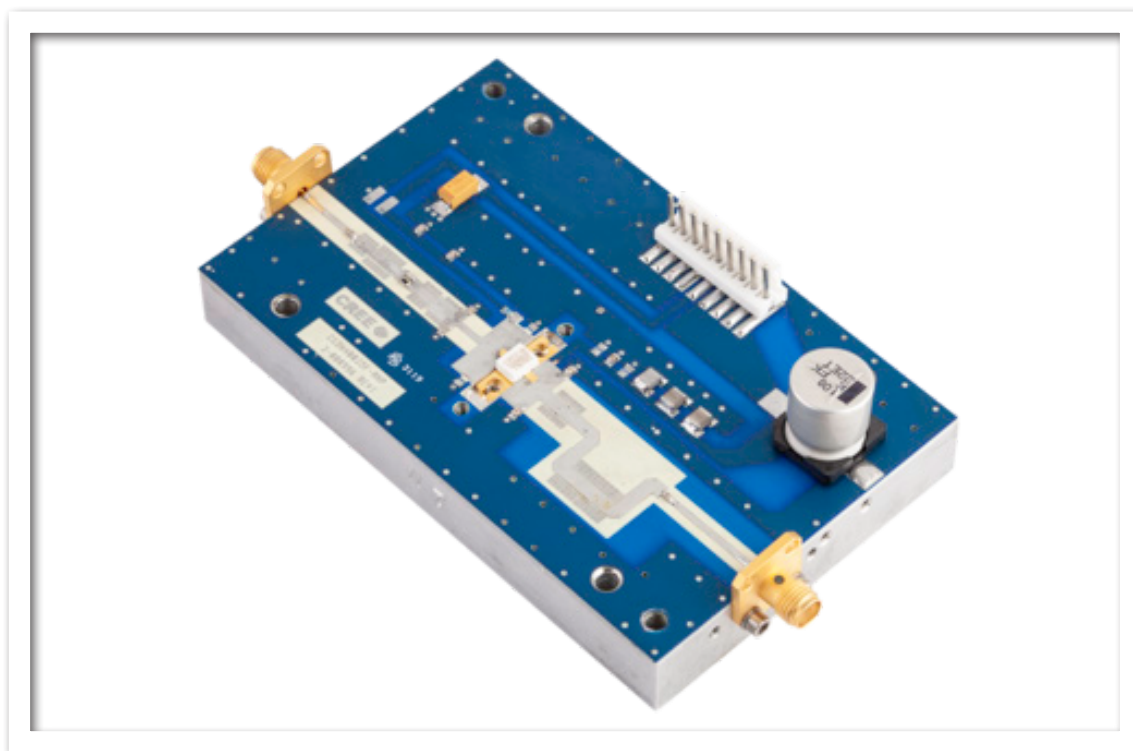
CG2H40035F-AMP Demonstration Amplifier Circuit Outline



CG2H40035F-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1, C5, C10	CAP, 100 PF, +/-5%, ATC600s SERIES	2
C2	CAP, 2.4pF, +/-0.1pF, 0603, ATC	1
C3, C4	CAP, 0.4pF,+/-0.05pF, 0603, ATC	2
C6	CAP, 47pF,+/-5%pF, 0603, ATC	1
C15	CAP, 100UF, 80V, ELECTROLYTIC, CAN	1
C8, C9	CAP, .1pF, +/-0.05pF, 0603, ATC	2
C11	CAP, 10.0pF, +/-5%, 0603, ATC	1
C12	CAP, 100pF,800B, ATC	1
C13, C14	CAP, 1000pF, ATC800B	2
C7	CAP, 10UF, 16V, TANTALUM	1
R1	RES, 1/16W, 0603, 1%, 20 Ohms	1
R2	RES 1K OHM 1% 1/8W 0603	1
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
Q1	CG2H40035F	1

CG2H40035F-AMP Demonstration Amplifier Circuit



Typical Package S-Parameters for CG2H40035F
 (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	0.921	-166.78	10.837	87.47	0.013	4.98	0.679	-174.42
0.6	0.921	-169.95	9.042	84.19	0.013	3.64	0.683	-175.85
0.7	0.921	-172.39	7.749	81.28	0.012	2.72	0.687	-176.98
0.8	0.921	-174.36	6.775	78.60	0.012	2.07	0.690	-177.94
0.9	0.921	-176.02	6.013	76.09	0.012	1.60	0.693	-178.78
1.0	0.921	-177.46	5.403	73.72	0.012	1.32	0.695	-179.45
1.1	0.922	-178.73	4.901	71.37	0.012	1.07	0.698	-179.74
1.2	0.922	-179.89	4.482	69.12	0.012	0.96	0.701	-179.07
1.3	0.923	-179.05	4.127	66.94	0.012	0.94	0.704	-178.42
1.4	0.923	-178.05	3.821	64.80	0.012	1.00	0.707	-177.78
1.5	0.923	-177.11	3.556	62.71	0.012	1.15	0.710	-177.16
1.6	0.924	-176.22	3.323	60.65	0.011	1.37	0.714	-176.54
1.7	0.924	-175.36	3.117	58.62	0.011	1.68	0.717	-175.92
1.8	0.925	-174.54	2.934	56.62	0.011	2.06	0.720	-175.30
1.9	0.926	-173.74	2.770	54.65	0.011	2.52	0.724	-174.68
2.0	0.926	-172.96	2.622	52.71	0.011	3.06	0.727	-174.06
2.1	0.927	-172.20	2.488	50.79	0.011	3.68	0.730	-173.43
2.2	0.927	-171.46	2.366	48.90	0.011	4.38	0.734	-172.79
2.3	0.928	-170.73	2.255	47.03	0.011	5.15	0.737	-172.14
2.4	0.928	-170.01	2.153	45.18	0.011	6.01	0.740	-171.48
2.5	0.929	-169.30	2.059	43.35	0.011	6.93	0.744	-170.81
2.6	0.929	-168.60	1.972	41.55	0.011	7.92	0.747	-170.14
2.7	0.930	-167.91	1.892	39.76	0.010	8.98	0.750	-169.45
2.8	0.930	-167.22	1.818	38.00	0.010	10.09	0.754	-168.75
2.9	0.931	-166.54	1.749	36.25	0.010	11.26	0.757	-168.05
3.0	0.931	-165.86	1.685	34.53	0.010	12.46	0.760	-167.33
3.1	0.932	-165.19	1.625	32.82	0.010	13.70	0.763	-166.60
3.2	0.932	-164.52	1.570	31.13	0.011	14.97	0.766	-165.87
3.4	0.933	-163.19	1.468	27.81	0.011	17.53	0.772	-164.36
3.6	0.934	-161.86	1.379	24.55	0.011	20.07	0.777	-162.81
3.8	0.934	-160.55	1.301	21.35	0.011	22.51	0.782	-161.23
4.0	0.935	-159.23	1.231	18.21	0.012	24.78	0.787	-159.60
4.2	0.935	-157.91	1.169	15.13	0.012	26.83	0.791	-157.93
4.4	0.936	-156.60	1.114	12.09	0.013	28.62	0.795	-156.21
4.6	0.936	-155.27	1.065	9.09	0.013	30.13	0.798	-154.45
4.8	0.936	-153.94	1.021	6.13	0.014	31.35	0.801	-152.64
5.0	0.936	-152.60	0.981	3.19	0.015	32.28	0.803	-150.78
5.2	0.936	-151.25	0.946	0.29	0.016	32.92	0.805	-148.86
5.4	0.936	-149.88	0.915	-2.60	0.017	33.28	0.807	-146.89
5.6	0.936	-148.50	0.888	-5.48	0.018	33.39	0.808	-144.85
5.8	0.935	-147.09	0.863	-8.35	0.019	33.24	0.809	-142.73
6.0	0.935	-145.66	0.842	-11.23	0.020	32.87	0.809	-140.54

To download the s-parameters in s2p format, go to the [CG2H40035F Product Page](#) and click on the documentation tab.

Typical Package S-Parameters for CG2H40035F
 (Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 500\text{ mA}$, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
0.5	0.929	-168.26	10.923	87.49	0.010	5.60	0.715	-176.01
0.6	0.929	-171.23	9.110	84.51	0.010	5.08	0.719	-177.40
0.7	0.929	-173.52	7.809	81.86	0.010	5.00	0.722	-178.56
0.8	0.930	-175.39	6.829	79.43	0.010	5.18	0.725	-179.58
0.9	0.930	-176.97	6.065	77.13	0.010	5.52	0.727	-179.51
1.0	0.930	-178.36	5.454	74.97	0.010	6.03	0.729	-178.77
1.1	0.930	-179.59	4.952	72.82	0.010	6.53	0.731	-177.88
1.2	0.930	-179.29	4.534	70.77	0.010	7.14	0.733	-177.12
1.3	0.931	-178.24	4.180	68.76	0.010	7.81	0.735	-176.39
1.4	0.931	-177.27	3.876	66.80	0.010	8.53	0.737	-175.68
1.5	0.931	-176.34	3.612	64.87	0.010	9.29	0.739	-174.98
1.6	0.932	-175.46	3.381	62.97	0.010	10.09	0.741	-174.30
1.7	0.932	-174.61	3.177	61.09	0.010	10.93	0.743	-173.62
1.8	0.932	-173.80	2.995	59.23	0.010	11.79	0.745	-172.95
1.9	0.932	-173.00	2.832	57.40	0.010	12.69	0.747	-172.29
2.0	0.933	-172.23	2.686	55.58	0.010	13.61	0.749	-171.62
2.1	0.933	-171.48	2.554	53.79	0.010	14.56	0.751	-170.96
2.2	0.933	-170.74	2.433	52.01	0.010	15.53	0.753	-170.29
2.3	0.934	-170.01	2.323	50.24	0.010	16.52	0.755	-169.62
2.4	0.934	-169.30	2.223	48.50	0.010	17.51	0.757	-168.94
2.5	0.934	-168.59	2.130	46.77	0.010	18.52	0.759	-168.26
2.6	0.934	-167.89	2.045	45.05	0.010	19.53	0.761	-167.58
2.7	0.935	-167.20	1.966	43.35	0.010	20.54	0.763	-166.89
2.8	0.935	-166.52	1.893	41.66	0.010	21.54	0.765	-166.20
2.9	0.935	-165.84	1.825	39.99	0.011	22.54	0.767	-165.49
3.0	0.935	-165.17	1.762	38.33	0.011	23.51	0.769	-164.79
3.1	0.935	-164.50	1.703	36.69	0.011	24.47	0.771	-164.07
3.2	0.936	-163.84	1.648	35.06	0.011	25.40	0.772	-163.35
3.4	0.936	-162.51	1.548	31.83	0.011	27.16	0.776	-161.88
3.6	0.936	-161.20	1.460	28.65	0.012	28.78	0.779	-160.38
3.8	0.936	-159.89	1.382	25.51	0.012	30.22	0.782	-158.84
4.0	0.937	-158.59	1.313	22.42	0.013	31.47	0.785	-157.26
4.2	0.937	-157.28	1.252	19.36	0.013	32.52	0.788	-155.65
4.4	0.937	-155.97	1.197	16.34	0.014	33.35	0.790	-153.99
4.6	0.936	-154.66	1.148	13.35	0.015	33.98	0.792	-152.28
4.8	0.936	-153.34	1.104	10.38	0.016	34.40	0.793	-150.53
5.0	0.936	-152.01	1.065	7.43	0.017	34.61	0.794	-148.73
5.2	0.936	-150.67	1.031	4.50	0.017	34.63	0.795	-146.86
5.4	0.935	-149.31	1.000	1.57	0.018	34.45	0.796	-144.94
5.6	0.934	-147.94	0.972	-1.35	0.020	34.08	0.796	-142.95
5.8	0.934	-146.55	0.948	-4.27	0.021	33.54	0.795	-140.88
6.0	0.933	-145.13	0.927	-7.21	0.022	32.82	0.795	-138.73

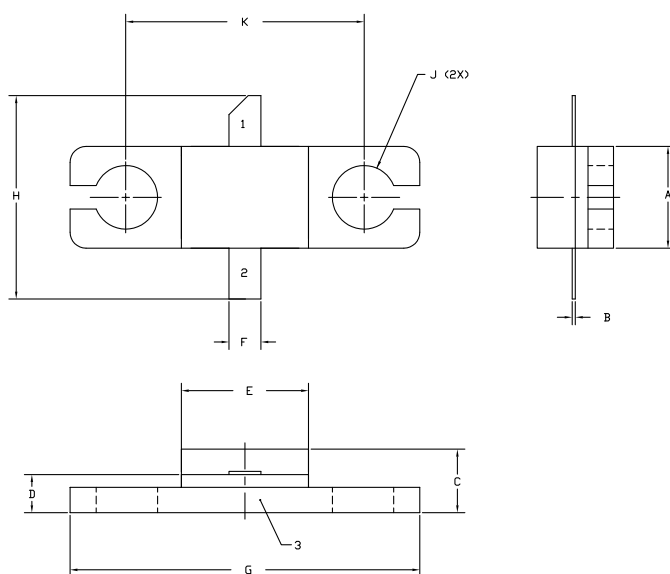
To download the s-parameters in s2p format, go to the [CG2H40035F Product Page](#) and click on the documentation tab.

Typical Package S-Parameters for CG2H40035F
 (Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 750\text{ mA}$, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
0.5	0.929	-168.69	10.902	87.14	0.010	4.35	0.723	-175.78
0.6	0.929	-171.57	9.084	84.27	0.010	4.14	0.728	-177.24
0.7	0.930	-173.80	7.781	81.72	0.010	4.39	0.732	-178.46
0.8	0.931	-175.63	6.802	79.37	0.010	4.91	0.735	-179.54
0.9	0.931	-177.19	6.040	77.17	0.010	5.60	0.737	-179.49
1.0	0.932	-178.57	5.432	75.09	0.009	6.44	0.739	-178.69
1.1	0.932	-179.78	4.932	73.01	0.009	7.25	0.742	-177.75
1.2	0.932	-179.10	4.516	71.03	0.009	8.16	0.743	-176.94
1.3	0.933	-178.07	4.164	69.09	0.009	9.11	0.745	-176.16
1.4	0.933	-177.09	3.862	67.18	0.009	10.08	0.747	-175.41
1.5	0.933	-176.17	3.600	65.31	0.009	11.08	0.749	-174.67
1.6	0.933	-175.29	3.371	63.46	0.009	12.09	0.750	-173.95
1.7	0.934	-174.44	3.168	61.64	0.009	13.12	0.752	-173.25
1.8	0.934	-173.63	2.988	59.83	0.009	14.15	0.754	-172.54
1.9	0.934	-172.84	2.827	58.05	0.010	15.20	0.755	-171.85
2.0	0.935	-172.06	2.682	56.28	0.010	16.25	0.757	-171.16
2.1	0.935	-171.31	2.551	54.52	0.010	17.30	0.759	-170.47
2.2	0.935	-170.57	2.432	52.78	0.010	18.35	0.761	-169.78
2.3	0.935	-169.84	2.323	51.06	0.010	19.39	0.762	-169.09
2.4	0.936	-169.13	2.224	49.35	0.010	20.43	0.764	-168.39
2.5	0.936	-168.42	2.132	47.65	0.010	21.45	0.766	-167.70
2.6	0.936	-167.72	2.048	45.97	0.010	22.46	0.767	-167.00
2.7	0.936	-167.03	1.970	44.30	0.010	23.45	0.769	-166.30
2.8	0.936	-166.35	1.898	42.64	0.010	24.42	0.770	-165.59
2.9	0.936	-165.67	1.831	41.00	0.011	25.36	0.772	-164.88
3.0	0.937	-165.00	1.768	39.37	0.011	26.27	0.774	-164.16
3.1	0.937	-164.33	1.710	37.75	0.011	27.15	0.775	-163.44
3.2	0.937	-163.66	1.656	36.14	0.011	27.99	0.777	-162.71
3.4	0.937	-162.34	1.557	32.95	0.012	29.55	0.780	-161.23
3.6	0.937	-161.03	1.471	29.80	0.012	30.95	0.782	-159.73
3.8	0.937	-159.72	1.394	26.70	0.013	32.15	0.785	-158.18
4.0	0.937	-158.42	1.326	23.63	0.013	33.17	0.787	-156.61
4.2	0.937	-157.11	1.265	20.59	0.014	33.98	0.789	-155.00
4.4	0.937	-155.81	1.211	17.58	0.015	34.60	0.791	-153.34
4.6	0.937	-154.50	1.163	14.60	0.015	35.02	0.792	-151.64
4.8	0.937	-153.18	1.120	11.64	0.016	35.25	0.793	-149.90
5.0	0.936	-151.85	1.081	8.69	0.017	35.29	0.794	-148.10
5.2	0.936	-150.51	1.047	5.76	0.018	35.15	0.794	-146.24
5.4	0.935	-149.15	1.017	2.83	0.019	34.83	0.794	-144.32
5.6	0.934	-147.78	0.990	-0.09	0.020	34.35	0.794	-142.34
5.8	0.934	-146.39	0.966	-3.02	0.021	33.69	0.793	-140.28
6.0	0.933	-144.97	0.945	-5.97	0.022	32.88	0.792	-138.14

To download the s-parameters in s2p format, go to the [CG2H40035F Product Page](#) and click on the documentation tab.

Product Dimensions CG2H40035F (Package Type – 440166)

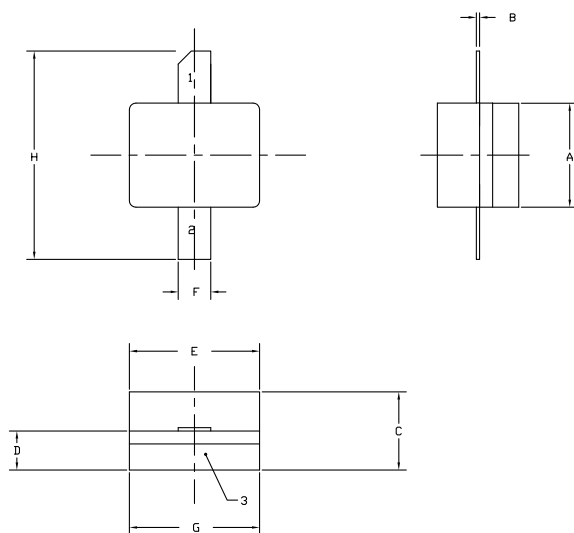


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
 4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
 5. ALL PLATED SURFACES ARE Ni/AU.

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 CG2H40035P (Package Type – 440196)

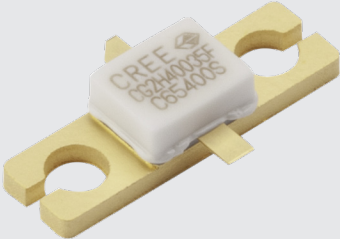
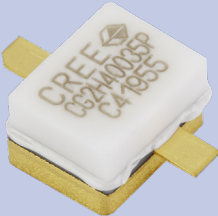


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
 4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
 5. ALL PLATED SURFACES ARE Ni/AU.

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
CG2H40035F	GaN HEMT	Each	
CG2H40035P	GaN HEMT	Each	
CG2H40035F-AMP	Test board with GaN HEMT installed	Each	

Disclaimer

Specifications are subject to change without notice. Cree, Inc. believes the information contained within this data sheet to be accurate and reliable. However, no responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Cree. Cree makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose. "Typical" parameters are the average values expected by Cree in large quantities and are provided for information purposes only. These values can and do vary in different applications and actual performance can vary over time. All operating parameters should be validated by customer's technical experts for each application. Cree products are not designed, intended or authorized for use as components in applications intended for surgical implant into the body or to support or sustain life, in applications in which the failure of the Cree product could result in personal injury or death or in applications for planning, construction, maintenance or direct operation of a nuclear facility.

For more information, please contact:

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
rfsales@cree.com
www.cree.com/RF