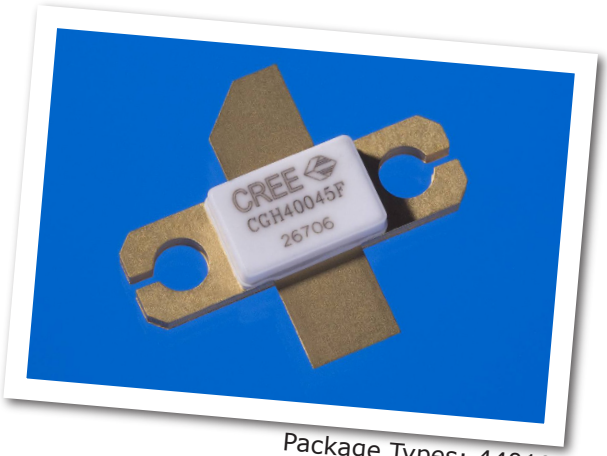
CGH40045

45 W, RF Power GaN HEMT

Cree's CGH40045 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGH40045, 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 CGH40045 ideal for linear and compressed amplifier circuits. The transistor is available in a flange package.



Package Types: 440193
PN: CGH40045F

FEATURES

- Up to 4 GHz Operation
- >16 dB Small Signal Gain at 2.0 GHz
- 12 dB Small Signal Gain at 4.0 GHz
- 55 W Typical P_{3dB}
- 55 % Efficiency at P3dB
- 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

RoHS COMPLIANT

Rev 1.1 – March 2007

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

Parameter	Symbol	Rating	Units
Drain-Source Voltage	V_{DSS}	84	Volts
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts
Storage Temperature	T_{STG}	-55, +150	˚C
Operating Junction Temperature	T_J	175	˚C
Maximum Forward Gate Current	I_{GMAX}	15	mA
Soldering Temperature	T_S	245	˚C
Thermal Resistance, Junction to Case [1]	$R_{\theta JC}$	2.7	˚C/W

Note:

[1] Measured for the CGH40045F at 43W P_{DISS}.

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[2]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.0	-2.5	-1.8	VDC	V_{DS} = 10 V, I_D = 14.4 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.3	–	VDC	V_{DS} = 28 V, I_D = 800 mA
Saturated Drain Current[3]	I_{DS}	9.6	10.8	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	84	100	–	VDC	V_{GS} = -8 V, I_D = 14.4 mA
Case Operating Temperature[4]	T_C	-10	–	+60	˚C	P_{DISS} = 43 W
Screw Torque	T	–	–	80	in-oz	Reference 440193 Rev 1
RF Characteristics (T_C = 25˚C, F_0 = 3.6 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	11.0	12.0	–	dB	V_{DD} = 28 V, I_{DQ} = 800 mA
Power Output at 3 dB Compression	P_{3dB}	45	55	–	W	V_{DD} = 28 V, I_{DQ} = 800 mA
Drain Efficiency[1]	η	50	55	–	%	V_{DD} = 28 V, I_{DQ} = 800 mA, P_{OUT} = P_{3dB}
Output Mismatch Stress	VSWR	–	TBD	–	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 800 mA, P_{OUT} = 45 W CW
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	19.3	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	4.6	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	1.7	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

Notes:

[1] Drain Efficiency = P_{OUT} / P_{DC}

[2] Measured on wafer prior to packaging.

[3] Scaled from PCM data.

[4] See also, the Power Dissipation De-rating Curve on Page 5.

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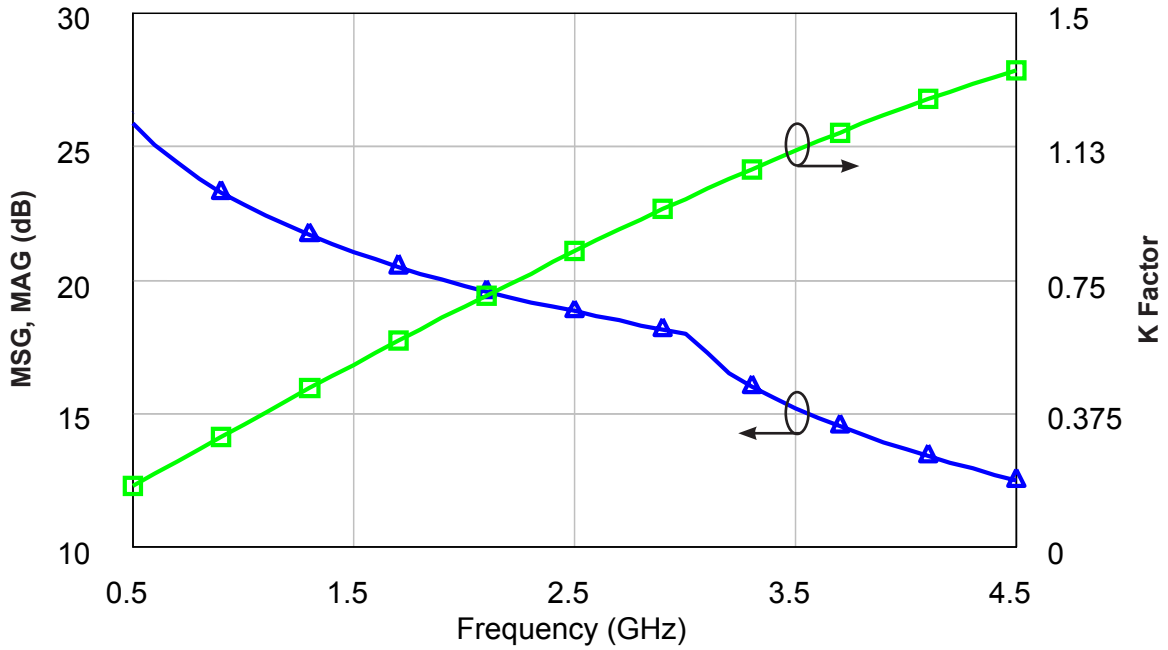
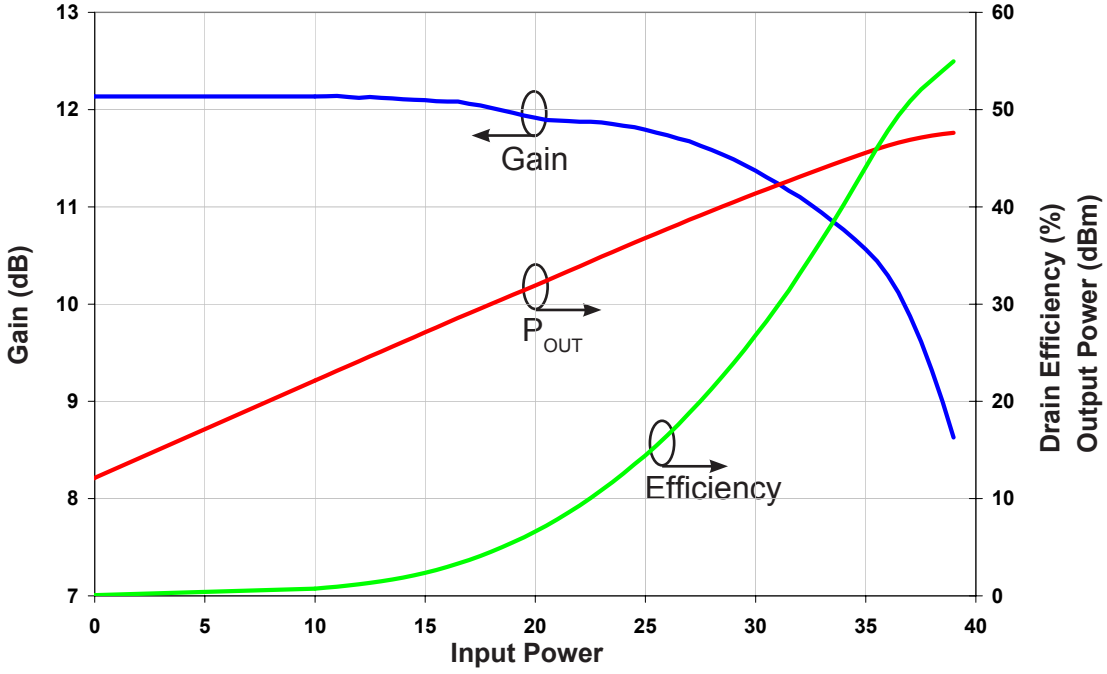
Typical Performance

Simulated Maximum Stable Gain, Maximum Available Gain and K Factor of the CGH40045F
V_{DD} = 28 V, I_{DQ} = 800 mA



Single Tone CW Gain, Efficiency, and Output Power vs Input Power of the CGH40045F measured in Amplifier Circuit CGH40045F-TB
V_{DD} = 28 V, I_{DQ} = 800 mA, Freq = 3.6 GHz



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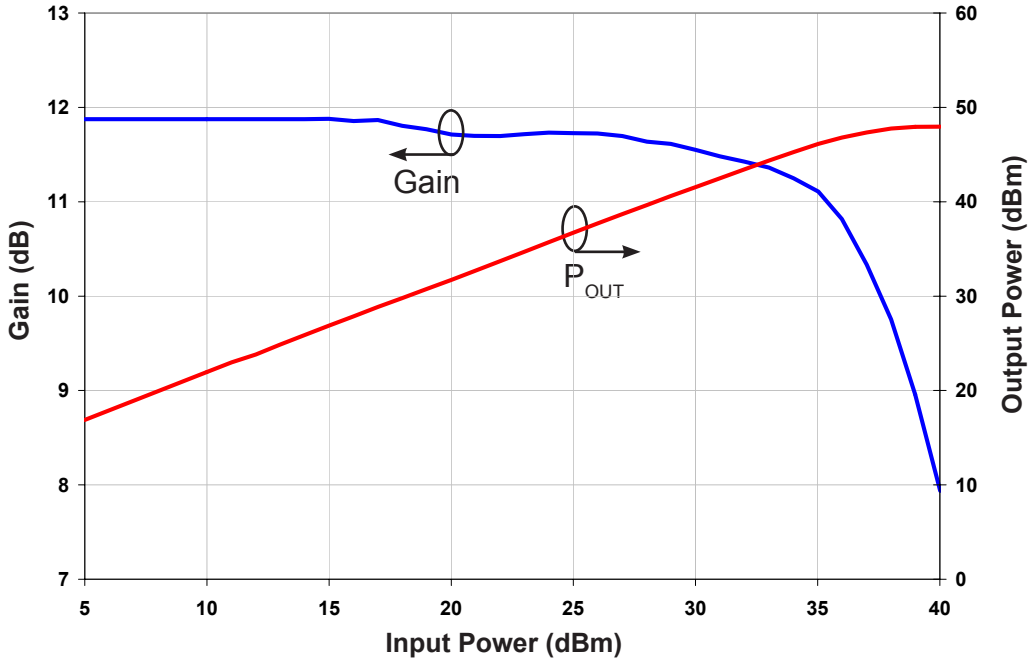
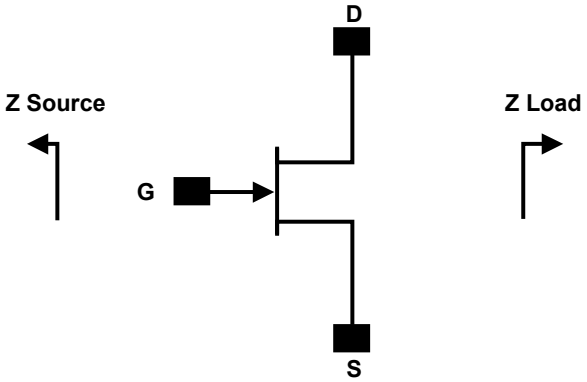
Typical Performance

Pulsed Gain and Output Power vs Input Power of the CGH40045F measured in Amplifier Circuit CGH40045F-TB
V_{DD} = 28 V, I_{DQ} = 800 mA, Freq = 3.6 GHz, Pulse Width=200µS, 10% Duty Cycle



Simulated Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
500	3.34 + j4.56	10.8 + j8.24
1000	2.07 + j0.05	6.18 + j4.17
2000	1.3 – j3.37	4.65 + j0.05
3000	1.64 – j8.15	4.75 – j3.4
4000	1.9 – j10.8	4.56 – j7.9

Note 1. V_{DD} = 28V, I_{DQ} = 800mA in the 440193 package.
Note 2. Optimized for P_{3dB} and Drain Efficiency

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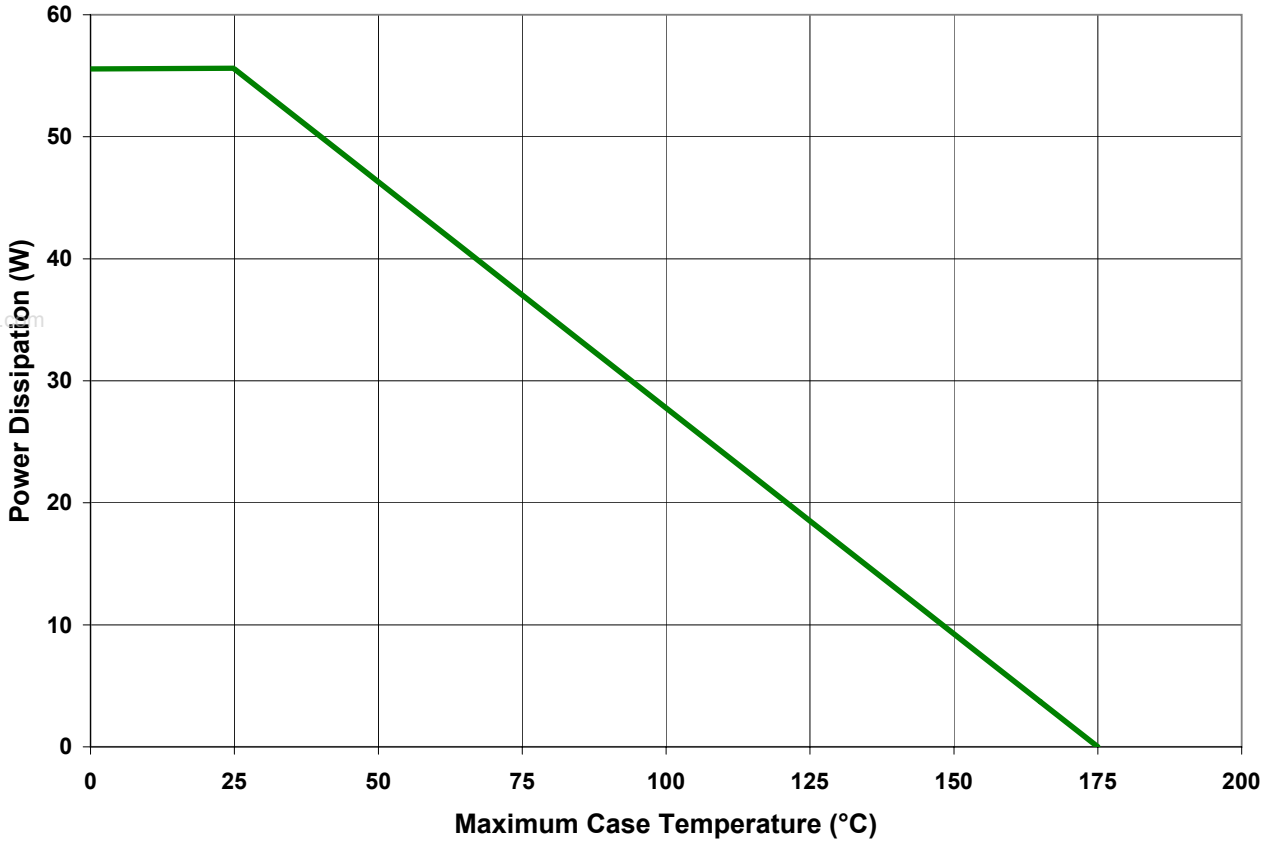
CGH40045F Power Dissipation De-rating Curve



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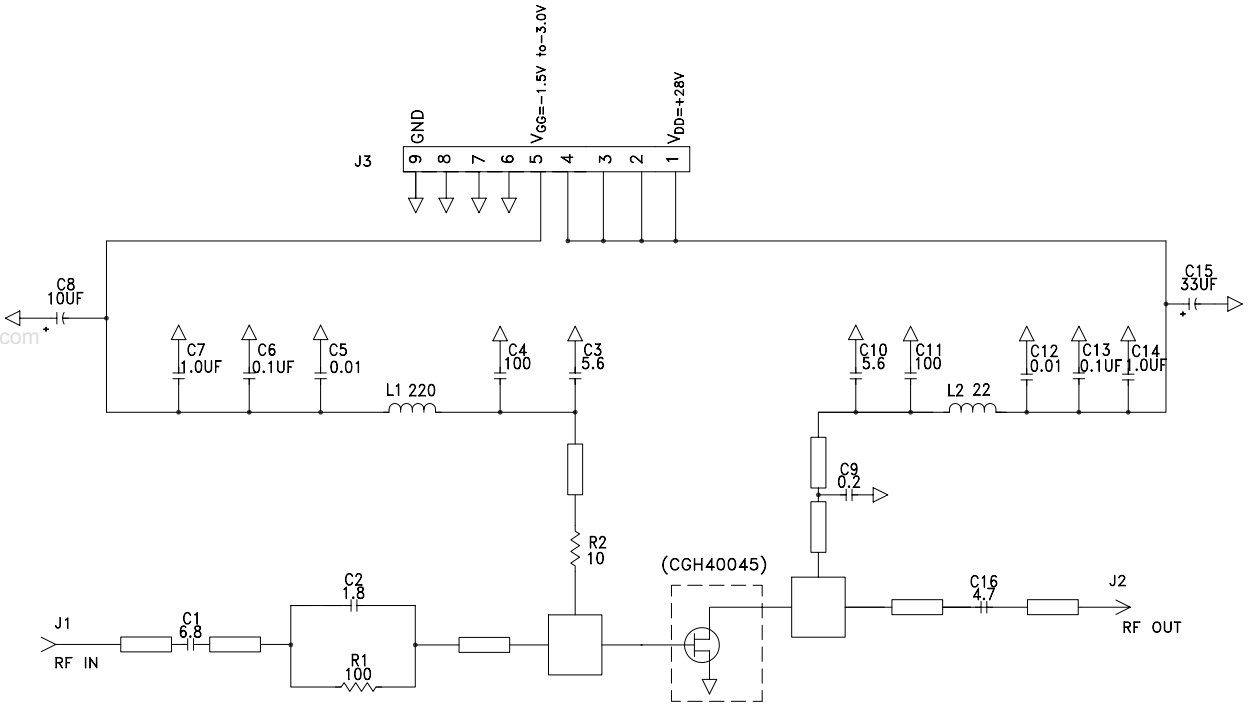
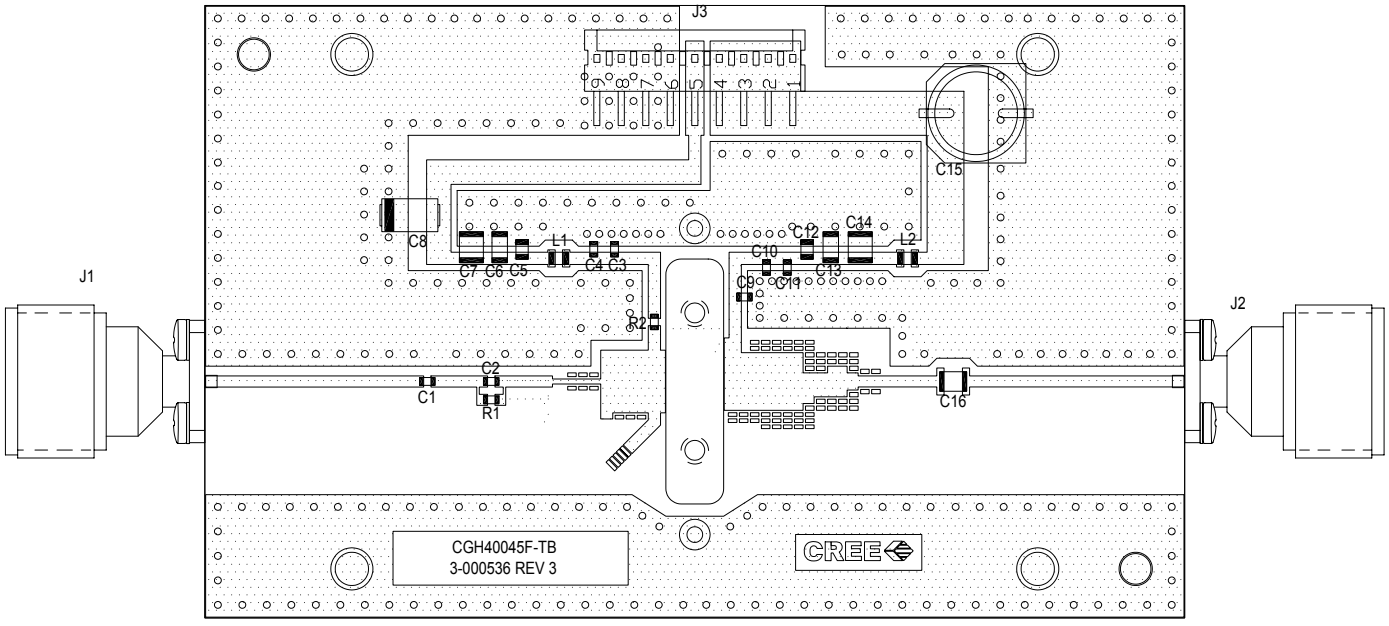
CGH40045F-TB Demonstration Amplifier Circuit Schematic



CGH40045F-TB Demonstration Amplifier Circuit Outline



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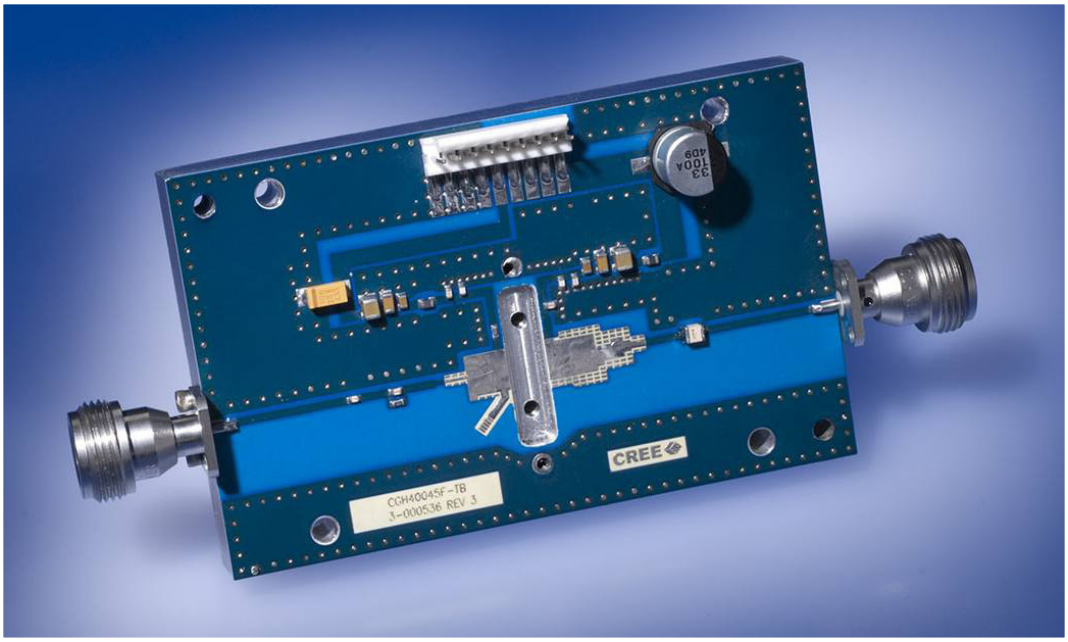
CGH40045F-TB Demonstration Amplifier Circuit



CGH40045F-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1	CAP, 6.8pF, ± -0.25 pF, 0603	1
C2	CAP, 1.8pF, ± -0.1 pF, 0603	1
C3,C10	CAP, 5.6pF, ± -0.1pF, 0603	2
C5,C12	CAP, 10000pF, 100V, TEMP STBL, 0805	2
C6,C13	CAP, 0.1uF ±10%, 100 V, 1206, X7R	2
C4,C11	CAP, 100pF±5%, 0603	2
C8	CAP, 10UF, 16V, SMT, TANTALUM	1
C9	CAP, 0.2pF, ± -0.05pF, 0603	1
C7,C14	CAP, 1.0UF ±10%, 100V, 1210, X7R	2
C15	CAP, 33UF, 20%, 100V, ELECT, FK, SMD	1
C16	CAP, 4.7pF, ± 0.25pF, 0603	1
R1	RES, 1/16W, 0603, 100 Ohms 1%	1
R2	RES, 1/16W, 0603, 10 Ohms 1%	1
L1	FERRITE, 220 OHM, 0805	1
L2	FERRITE, 22 OHM, 0805	1
J1,J2	CONN, N-TYPE, FEMALE , W/ 0.500 FLANGE	2
J3	CONN, HEADER, RT>PLZ .1CEN LK 9POS	1
Q1	CGH40045	1

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Typical Package S-Parameters for CGH40045F
(Small Signal, V_{DS} = 28 V, I_{DQ} = 400 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.93509	-177.40	4.4285	84.624	0.01475	-0.3152	0.85207	179.93
600 MHz	0.93482	-178.88	3.7059	82.583	0.01480	-1.3398	0.85193	179.09
700 MHz	0.93453	179.90	3.1916	80.663	0.01486	-2.2414	0.85161	178.36
800 MHz	0.93420	178.84	2.8078	78.817	0.01492	-3.0667	0.85115	177.69
900 MHz	0.93384	177.88	2.5112	77.018	0.01500	-3.8419	0.85058	177.05
1.0 GHz	0.93343	176.98	2.2755	75.250	0.01508	-4.5830	0.84991	176.45
1.1 GHz	0.93298	176.13	2.0844	73.502	0.01518	-5.3001	0.84914	175.86
1.2 GHz	0.93248	175.32	1.9266	71.768	0.01528	-6.0003	0.84828	175.28
1.3 GHz	0.93194	174.53	1.7946	70.041	0.01540	-6.6885	0.84731	174.71
1.4 GHz	0.93133	173.75	1.6829	68.317	0.01553	-7.3686	0.84625	174.14
1.5 GHz	0.93068	172.98	1.5875	66.594	0.01567	-8.0434	0.84508	173.57
1.6 GHz	0.92996	172.21	1.5054	64.869	0.01582	-8.7154	0.84381	173.00
1.7 GHz	0.92919	171.45	1.4343	63.138	0.01598	-9.3866	0.84242	172.42
1.8 GHz	0.92834	170.68	1.3725	61.401	0.01616	-10.059	0.84092	171.84
1.9 GHz	0.92743	169.90	1.3186	59.654	0.01636	-10.734	0.83930	171.26
2.0 GHz	0.92644	169.12	1.2714	57.896	0.01657	-11.413	0.83755	170.66
2.1 GHz	0.92538	168.32	1.2300	56.126	0.01679	-12.098	0.83566	170.06
2.2 GHz	0.92423	167.51	1.1939	54.341	0.01704	-12.791	0.83363	169.44
2.3 GHz	0.92299	166.68	1.1622	52.538	0.01730	-13.493	0.83144	168.82
2.4 GHz	0.92165	165.84	1.1347	50.718	0.01758	-14.206	0.82910	168.18
2.5 GHz	0.92020	164.97	1.1108	48.876	0.01789	-14.931	0.82658	167.52
2.6 GHz	0.91865	164.08	1.0902	47.011	0.01821	-15.671	0.82388	166.85
2.7 GHz	0.91697	163.16	1.0728	45.120	0.01857	-16.428	0.82098	166.16
2.8 GHz	0.91516	162.21	1.0582	43.201	0.01894	-17.204	0.81788	165.45
2.9 GHz	0.91321	161.22	1.0463	41.251	0.01935	-18.002	0.81455	164.72
3.0 GHz	0.91110	160.21	1.0369	39.268	0.01979	-18.824	0.81099	163.97
3.1 GHz	0.90882	159.15	1.0299	37.247	0.02026	-19.673	0.80716	163.19
3.2 GHz	0.90636	158.05	1.0252	35.186	0.02077	-20.553	0.80307	162.39
3.3 GHz	0.90370	156.90	1.0229	33.081	0.02132	-21.467	0.79867	161.56
3.4 GHz	0.90081	155.70	1.0227	30.927	0.02191	-22.420	0.79396	160.71
3.5 GHz	0.89769	154.45	1.0247	28.721	0.02255	-23.414	0.78891	159.81
3.6 GHz	0.89430	153.13	1.0290	26.457	0.02324	-24.456	0.78349	158.89
3.7 GHz	0.89062	151.74	1.0354	24.130	0.02398	-25.551	0.77767	157.93
3.8 GHz	0.88662	150.28	1.0441	21.734	0.02479	-26.703	0.77142	156.92
3.9 GHz	0.88226	148.74	1.0551	19.263	0.02566	-27.921	0.76470	155.88
4.0 GHz	0.87752	147.10	1.0684	16.710	0.02660	-29.210	0.75749	154.78
4.1 GHz	0.87234	145.37	1.0842	14.066	0.02763	-30.579	0.74973	153.64
4.2 GHz	0.86669	143.52	1.1025	11.324	0.02873	-32.036	0.74139	152.44
4.3 GHz	0.86051	141.55	1.1234	8.475	0.02994	-33.590	0.73241	151.18
4.4 GHz	0.85375	139.44	1.1471	5.507	0.03124	-35.253	0.72275	149.86
4.5 GHz	0.84634	137.18	1.1737	2.410	0.03266	-37.035	0.71236	148.46

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(Small Signal, V_{DS} = 28 V, I_{DQ} = 800 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.94423	-177.75	4.3872	85.323	0.01135	1.7836	0.87623	179.08
600 MHz	0.94397	-179.19	3.6730	83.462	0.01141	1.2165	0.87598	178.28
700 MHz	0.94368	179.60	3.1651	81.715	0.01147	0.76453	0.87556	177.57
800 MHz	0.94335	178.54	2.7864	80.038	0.01154	0.38259	0.87501	176.89
900 MHz	0.94298	177.58	2.4938	78.403	0.01163	0.04514	0.87433	176.25
1.0 GHz	0.94256	176.68	2.2618	76.797	0.01172	-0.26343	0.87355	175.62
1.1 GHz	0.94210	175.83	2.0737	75.208	0.01183	-0.55339	0.87265	175.00
1.2 GHz	0.94159	175.10	1.9187	73.628	0.01194	-0.83188	0.87165	174.39
1.3 GHz	0.94103	174.21	1.7892	72.054	0.01207	-1.1042	0.87054	173.78
1.4 GHz	0.94042	173.42	1.6799	70.480	0.01221	-1.3743	0.86931	173.18
1.5 GHz	0.93975	172.64	1.5867	68.903	0.01237	-1.6456	0.86797	172.56
1.6 GHz	0.93901	171.86	1.5067	67.320	0.01253	-1.9209	0.86651	171.95
1.7 GHz	0.93822	171.08	1.4376	65.729	0.01272	-2.2027	0.86492	171.32
1.8 GHz	0.93736	170.29	1.3778	64.127	0.01291	-2.4932	0.86320	170.69
1.9 GHz	0.93642	169.50	1.3258	62.513	0.01313	-2.7946	0.86134	170.05
2.0 GHz	0.93541	168.70	1.2805	60.884	0.01336	-3.1091	0.85933	169.40
2.1 GHz	0.93431	167.88	1.2410	59.238	0.01361	-3.4387	0.85718	168.74
2.2 GHz	0.93313	167.05	1.2068	57.572	0.01388	-3.7856	0.85485	168.07
2.3 GHz	0.93185	166.20	1.1770	55.886	0.01418	-4.1520	0.85236	167.38
2.4 GHz	0.93047	165.33	1.1514	54.176	0.01449	-4.5402	0.84968	166.67
2.5 GHz	0.92898	164.44	1.1295	52.440	0.01483	-4.9527	0.84680	165.95
2.6 GHz	0.92738	163.52	1.1110	50.676	0.01519	-5.3920	0.84372	165.20
2.7 GHz	0.92564	162.57	1.0956	48.880	0.01559	-5.8609	0.84041	164.44
2.8 GHz	0.92377	161.59	1.0832	47.051	0.01601	-6.3624	0.83686	163.65
2.9 GHz	0.92174	160.58	1.0735	45.185	0.01647	-6.8995	0.83305	162.84
3.0 GHz	0.91955	159.53	1.0664	43.279	0.01696	-7.4759	0.82896	162.01
3.1 GHz	0.91718	158.44	1.0619	41.329	0.01749	-8.0951	0.82458	161.14
3.2 GHz	0.91461	157.31	1.0598	39.332	0.01806	-8.7612	0.81988	160.25
3.3 GHz	0.91183	156.12	1.0601	37.283	0.01868	-9.4786	0.81483	159.32
3.4 GHz	0.90881	154.88	1.0627	35.178	0.01935	-10.252	0.80940	158.36
3.5 GHz	0.90553	153.58	1.0677	33.012	0.02007	-11.087	0.80358	157.36
3.6 GHz	0.90196	152.22	1.0751	30.780	0.02085	-11.988	0.79731	156.32
3.7 GHz	0.89808	150.78	1.0848	28.475	0.02169	-12.962	0.79057	155.24
3.8 GHz	0.89384	149.27	1.0970	26.092	0.02261	-14.016	0.78332	154.11
3.9 GHz	0.88922	147.67	1.1117	23.623	0.02360	-15.157	0.77551	152.93
4.0 GHz	0.88417	145.98	1.1290	21.061	0.02468	-16.393	0.76710	151.70
4.1 GHz	0.87865	144.18	1.1490	18.398	0.02585	-17.732	0.75803	150.40
4.2 GHz	0.87260	142.26	1.1718	15.624	0.02712	-19.185	0.74826	149.05
4.3 GHz	0.86597	140.22	1.1975	12.729	0.02850	-20.761	0.73772	147.62
4.4 GHz	0.85869	138.03	1.2262	9.7017	0.03000	-22.473	0.72635	146.12
4.5 GHz	0.85070	135.68	1.2581	6.5310	0.03163	-24.332	0.71408	144.54

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Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.9509	-177.89	4.307	86.11	0.0089	4.281	0.9126	178.45
600 MHz	0.9506	-179.33	3.608	84.41	0.0090	4.216	0.9010	177.68
700 MHz	0.9503	179.46	3.110	82.83	0.0091	4.258	0.9006	176.98
800 MHz	0.9500	178.40	2.740	81.32	0.0091	4.363	0.9000	176.30
900 MHz	0.9497	177.43	2.454	79.85	0.0092	4.504	0.8993	175.64
1.0 GHz	0.9493	176.53	2.227	78.40	0.0093	4.664	0.8986	174.99
1.1 GHz	0.9488	175.67	2.043	76.97	0.0095	4.834	0.8977	174.35
1.2 GHz	0.9483	174.84	1.892	75.55	0.0096	5.005	0.8967	173.71
1.3 GHz	0.9478	174.03	1.766	74.13	0.0097	5.170	0.8956	173.07
1.4 GHz	0.9472	173.23	1.660	72.71	0.0099	5.326	0.8944	172.42
1.5 GHz	0.9465	172.43	1.570	71.29	0.0101	5.468	0.8931	171.77
1.6 GHz	0.9458	171.64	1.492	69.86	0.0103	5.593	0.8916	171.11
1.7 GHz	0.9450	170.85	1.426	68.41	0.0105	5.698	0.8900	170.44
1.8 GHz	0.9442	170.05	1.368	66.96	0.0107	5.779	0.8883	169.76
1.9 GHz	0.9433	169.25	1.318	65.49	0.0109	5.834	0.8865	169.07
2.0 GHz	0.9423	168.43	1.275	64.00	0.0112	5.860	0.8845	168.37
2.1 GHz	0.9412	167.60	1.238	62.49	0.0115	5.855	0.8823	167.65
2.2 GHz	0.9400	166.75	1.206	60.96	0.0118	5.815	0.8800	166.92
2.3 GHz	0.9388	165.88	1.178	59.40	0.0121	5.739	0.8775	166.16
2.4 GHz	0.9374	164.99	1.155	57.82	0.0125	5.623	0.8748	165.39
2.5 GHz	0.9359	164.08	1.135	56.21	0.0129	5.465	0.8719	164.60
2.6 GHz	0.9343	163.14	1.119	54.57	0.0133	5.262	0.8688	163.78
2.7 GHz	0.9326	162.17	1.105	52.89	0.0137	5.009	0.8655	162.94
2.8 GHz	0.9307	161.17	1.095	51.17	0.0142	4.705	0.8619	162.07
2.9 GHz	0.9287	160.13	1.088	49.41	0.0147	4.346	0.8580	161.17
3.0 GHz	0.9265	159.06	1.083	47.61	0.0153	3.927	0.8538	160.24
3.1 GHz	0.9241	157.94	1.081	45.76	0.0159	3.445	0.8493	159.28
3.2 GHz	0.9215	156.77	1.082	43.85	0.0166	2.895	0.8444	158.28
3.3 GHz	0.9186	155.55	1.085	41.88	0.0173	2.274	0.8392	157.24
3.4 GHz	0.9155	154.28	1.090	39.86	0.0181	1.575	0.8335	156.16
3.5 GHz	0.9122	152.94	1.099	37.76	0.0189	0.793	0.8274	155.30
3.6 GHz	0.9085	151.54	1.109	35.59	0.0198	-0.078	0.8208	153.86
3.7 GHz	0.9045	150.06	1.123	33.34	0.0208	-1.044	0.8137	152.62
3.8 GHz	0.9001	148.50	1.139	31.00	0.0218	-2.113	0.8060	151.34
3.9 GHz	0.8953	146.84	1.157	28.56	0.0230	-3.292	0.7976	149.98
4.0 GHz	0.8900	145.09	1.179	26.02	0.0242	-4.590	0.7886	148.56
4.1 GHz	0.8842	143.24	1.204	23.37	0.0256	-6.015	0.7787	147.07
4.2 GHz	0.8778	141.26	1.232	20.59	0.0271	-7.579	0.7681	145.50
4.3 GHz	0.8707	139.14	1.263	17.68	0.0287	-9.292	0.7565	143.84
4.4 GHz	0.8630	136.88	1.297	14.62	0.0305	-11.167	0.7440	142.09
4.5 GHz	0.8544	134.46	1.335	11.40	0.0324	-13.215	0.7303	140.23

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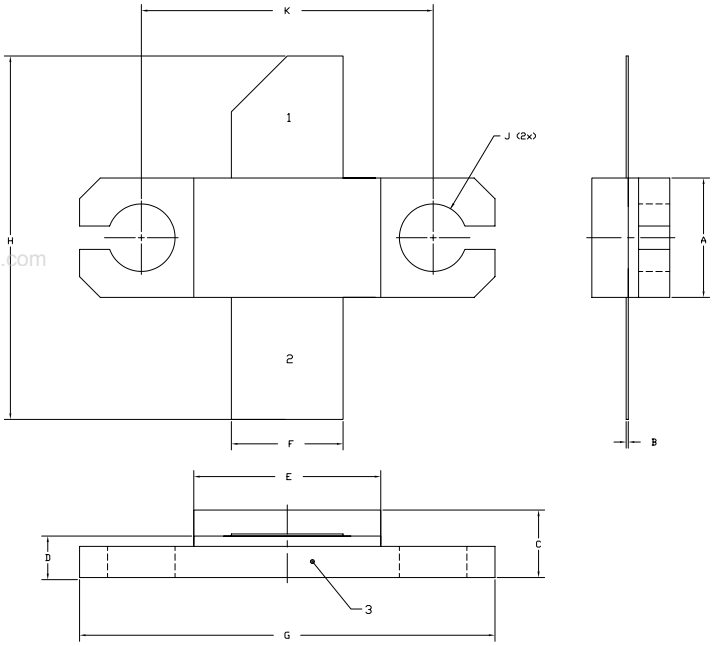
Product Dimensions CGH40045F (Package Type — 440193)



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

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.225	0.235	5.72	5.97
B	0.004	0.006	0.10	0.15
C	0.125	0.135	3.18	3.43
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

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