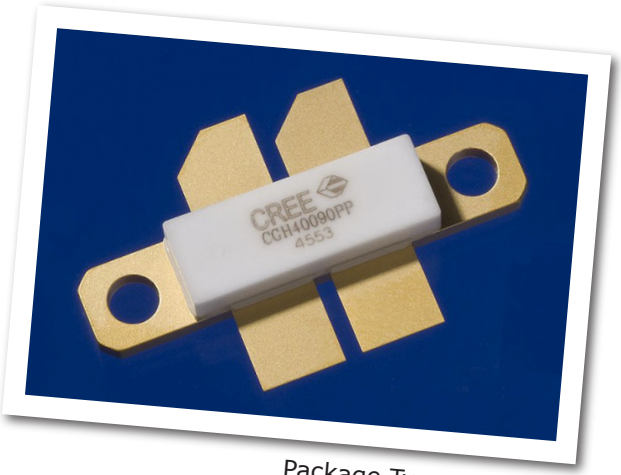
CGH40090PP

90 W, RF Power GaN HEMT

Cree's CGH40090PP is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGH40090PP, 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 CGH40090PP ideal for linear and compressed amplifier circuits. The transistor is available in a 4-lead flange package.



Package Types: 440199
PN: CGH40090PP

Typical Performance Over 500 MHz - 2.5 GHz (T_c = 25°C) of Demonstration Amplifier

Parameter	500 MHz	1.0 GHz	1.5 GHz	2.0 GHz	2.5 GHz	Units
Small Signal Gain	17.6	15.6	14.1	12.4	12.4	dB
Gain at P_{SAT}	13.7	11.7	9.2	7.0	10.4	dB
Saturated Power	66.8	102.7	91.4	101.7	57.0	W
Drain Efficiency at P_{SAT}	48.5	57.0	56.6	59.2	37.3	%
Input Return Loss	7.3	23.0	14.9	14.3	11.3	dB

Features

- Up to 4 GHz Operation
- 16 dB Small Signal Gain at 2.0 GHz
- 12 dB Small Signal Gain at 4.0 GHz
- 90 W Typical P_{SAT}
- 55 % Efficiency at P_{SAT}
- 28 V Operation
- Use as a Pair of 45 W Transistors

Rev 1.0 – June 2008

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}	28	mA
Soldering Temperature[2]	T_S	245	˚C
Screw Torque	T	80	in-oz
Thermal Resistance, Junction to Case [1]	$R_{\theta JC}$	1.45	˚C/W

Note:
[1] Measured for the CGH40090PP at P_{DISS} = 86W.

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[2]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.6	-2.5	-1.8	VDC	V_{DS} = 10 V, I_D = 28.8 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.3	–	VDC	V_{DS} = 28 V, I_D = 1.0 A
Saturated Drain Current[4]	I_{DS}	19.2	21.6	–	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 = 28.8 mA
Case Operating Temperature[5]	T_C	-10	–	+50	˚C	P_{DISS} = 86 W
RF Characteristics[3,7] (T_C = 25˚C, F_0 = 2.0 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	–	12.5	–	dB	V_{DD} = 28 V, I_{DQ} = 1.0 A
Power Output at Saturation[6]	P_{SAT}	–	100	–	W	V_{DD} = 28 V, I_{DQ} = 1.0 A
Drain Efficiency[1]	η	–	55	–	%	V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = P_{SAT}
Output Mismatch Stress	VSWR	–	TBD	–	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 90 W CW
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	32.5	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	8.9	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	1.2	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Drain Efficiency = P_{SAT} / P_{DC}
[2] Measured on wafer prior to packaging.
[3] Measured in broadband circuit CGH40090PP-TB
[4] Scaled from PCM data.
[5] Also see the Power Dissipation De-rating Curve on Page 5.
[6] P_{SAT} is defined as: Q1 or Q2 = I_G = 14 mA
[7] I_{DQ} of 1.0 A is by biasing each device at 0.5 A.

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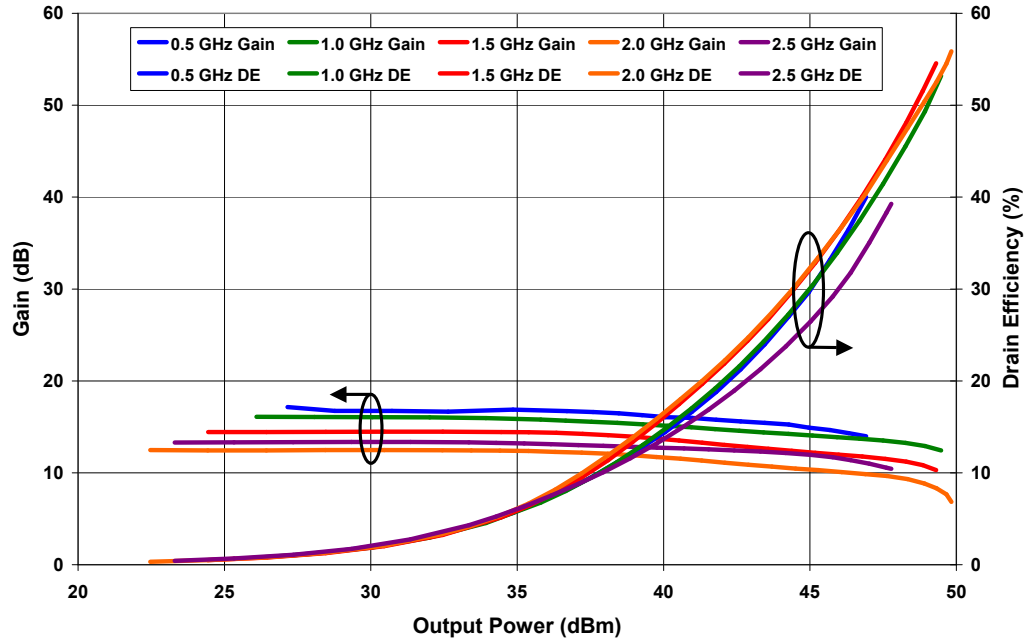
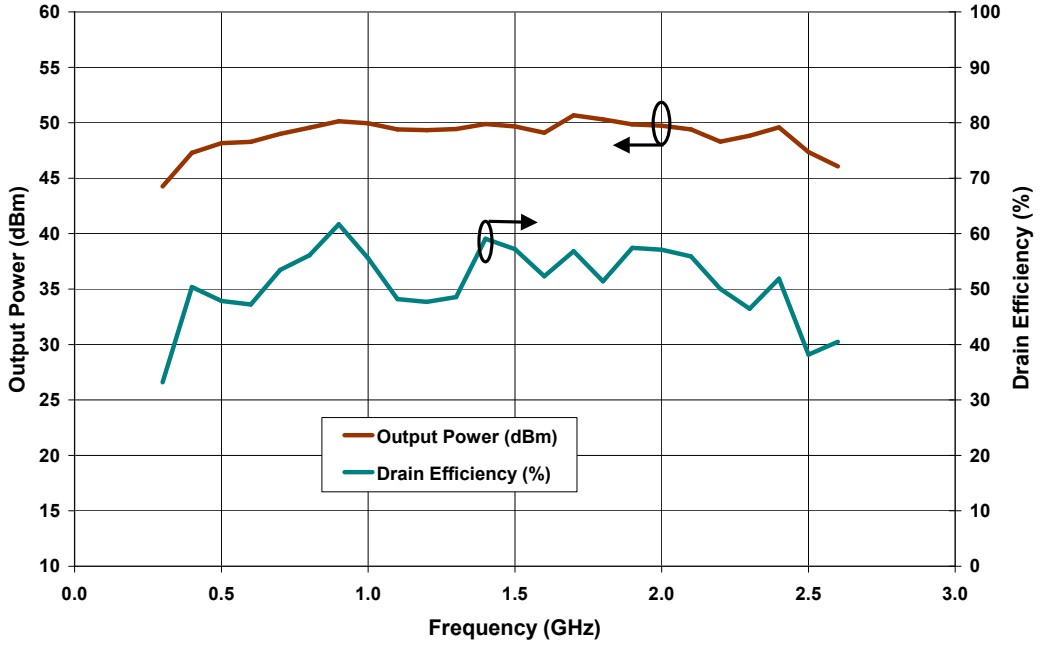
Typical Performance

Gain and Efficiency vs Output Power of the CGH40090PP measured in Broadband Amplifier Circuit CGH40090PP-TB
V_{DD} = 28 V, I_{DQ} = 1.0 A, Freq = 0.5 - 2.5 GHz



Output Power and Drain Efficiency vs Frequency of the CGH40090PP measured in Broadband Amplifier Circuit CGH40090PP-TB
V_{DD} = 28 V, I_{DQ} = 1.0 A



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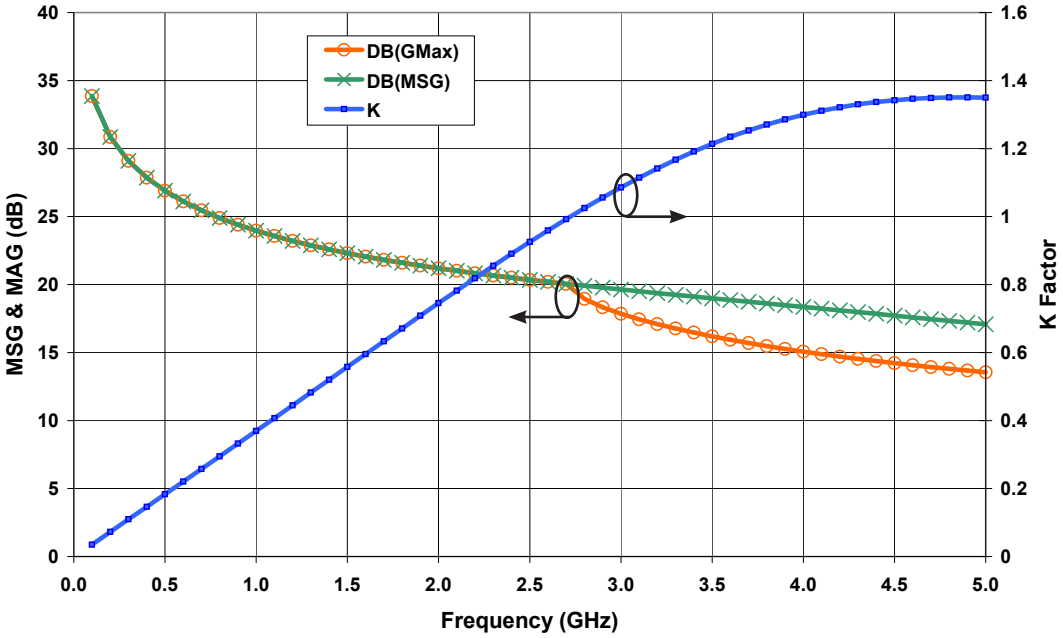
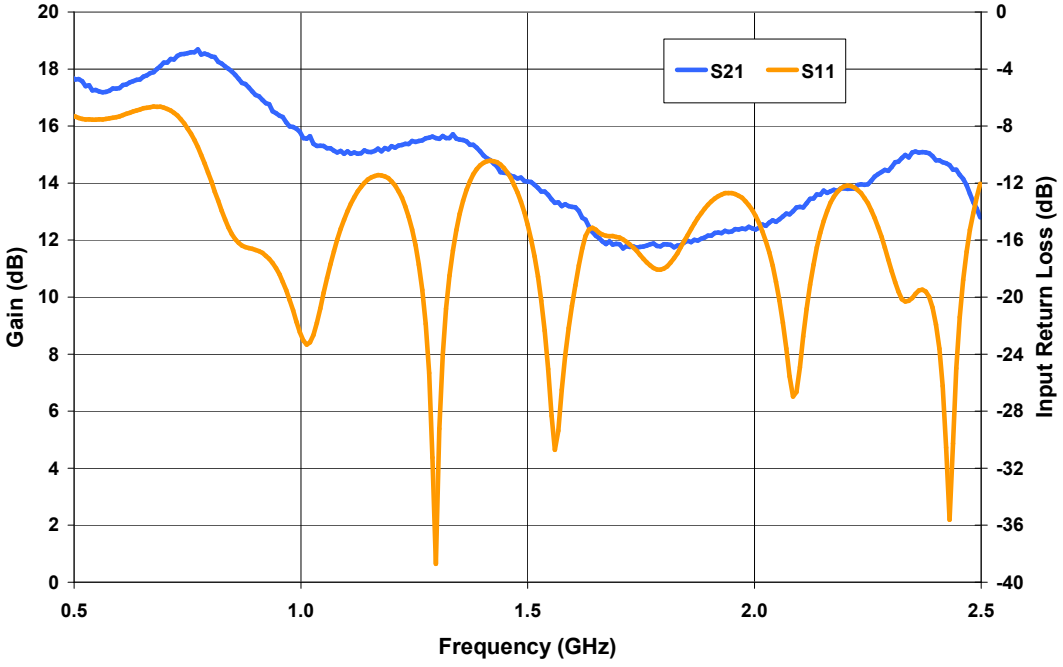
Typical Performance

Simulated Maximum Stable Gain, Maximum Available Gain and K Factor of the CGH40090PP
Vdd = 28 V, Idq = 1.0 A



Gain and Input Return Loss vs Frequency from 0.5 GHz to 2.5 GHz in Broadband Amplifier Circuit CGH40090PP-TB
V_{DD} = 28 V, I_{DQ} = 1.0 A



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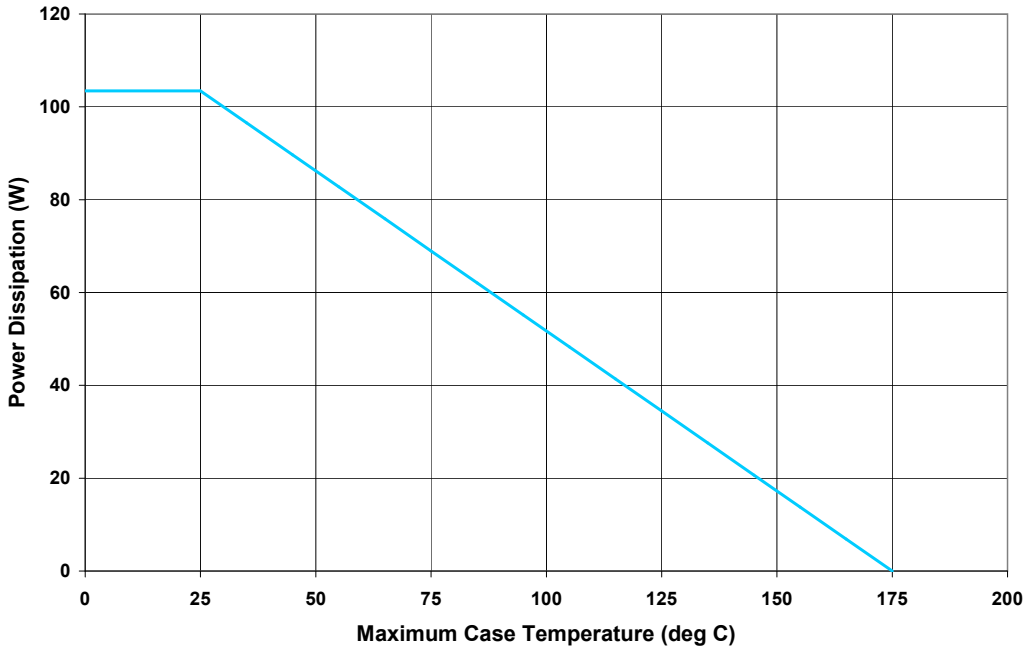
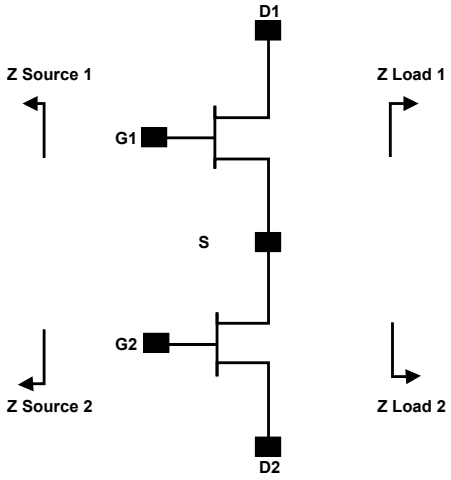
CGH40090PP Power Dissipation De-rating Curve



Simulated Source and Load Impedances



Frequency (MHz)	Z Source (1,2)	Z Load (1,2)
500	8.4 + j5.2	8.8 + j1.7
1500	1.2 - j1.3	3.9 + j2.9
2500	2.1 - j5.5	2.6 + j0

Note 1. V_{DD} = 28V, I_{DQ} = 1.0A in the 440199 package.
Note 2. Optimized for P_{SAT} and Drain Efficiency
Note 3. When using this device at low frequency, series resistors should be used to maintain amplifier stability.

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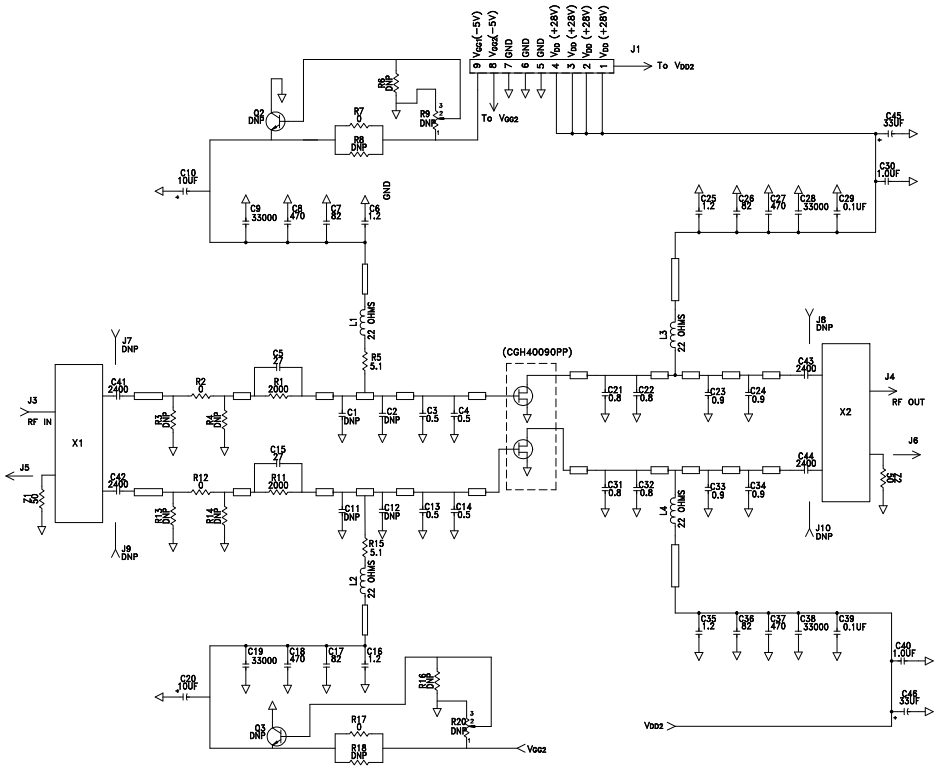
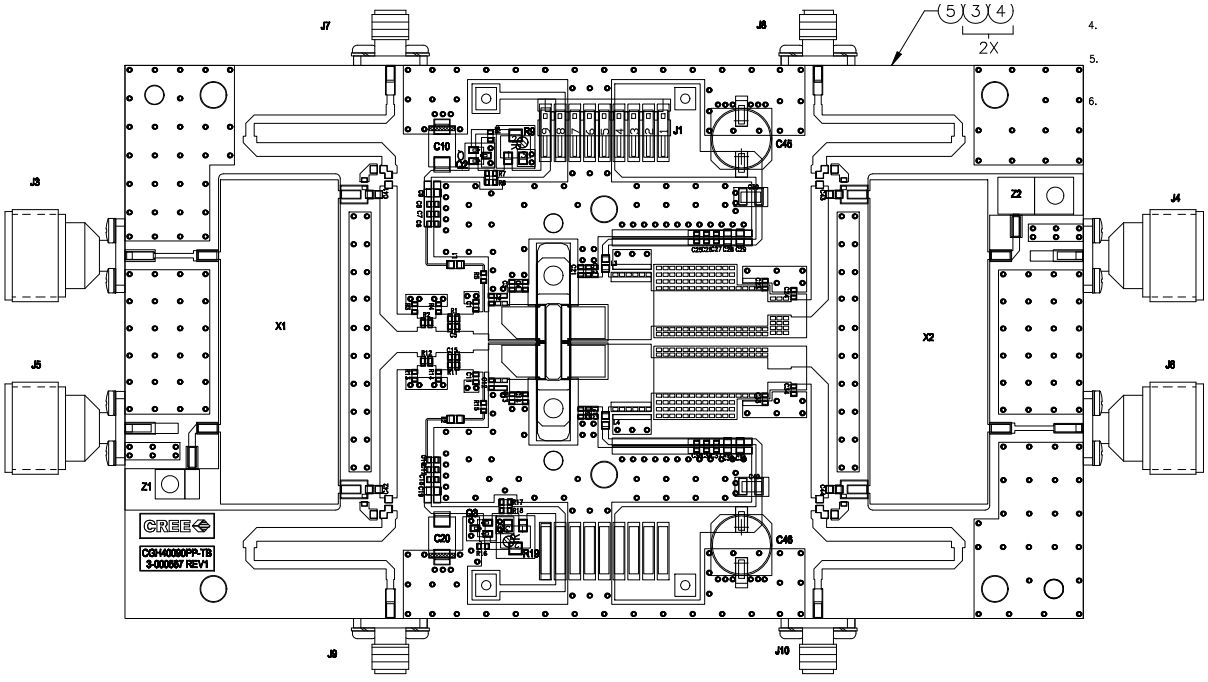
CGH40090PP-TB Demonstration Amplifier Circuit Schematic



CGH40090PP-TB Demonstration Amplifier Circuit Outline



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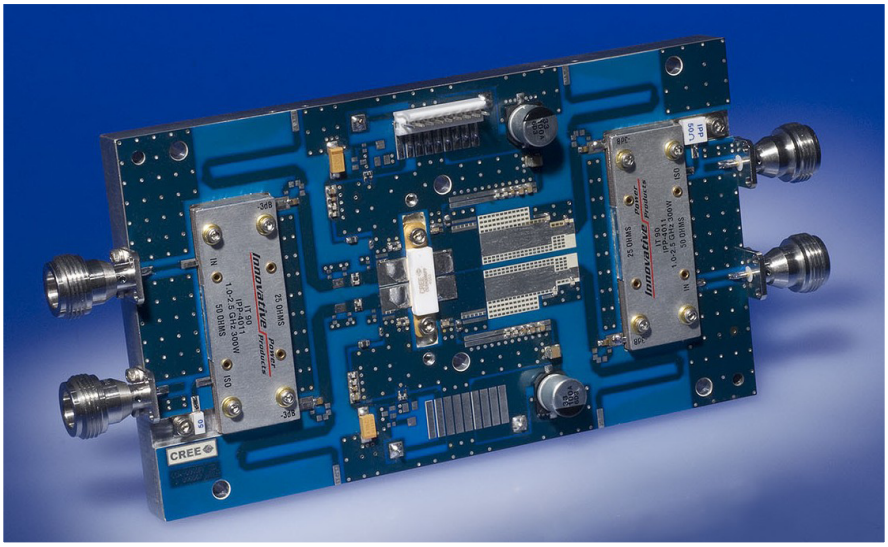
CGH40090PP-TB Demonstration Amplifier Circuit



CGH40090PP-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C3, C4, C13, C14	CAP, 0.5 pF, ± 0.05 pF, 0603, ATC 600S	4
C5,C15	CAP, 27 pF, ± 5%, 0603, ATC 600S	2
C6,C16,C25,C35	CAP, 1.2 PF ± 0.10 pF, 0603, ATC 600S	4
C7,C17,C26,C36	CAP, 82 pF, ± 5%, 0603, ATC 600S	4
C8, C18, C27, C37	CAP, CER, 470 pF, 100V, 10%, X7R, 0603	4
C9,C19,C28,C38	CAP, CER, 33000 pF, 100V, X7R, 0805	4
C10,C20	CAP, TANTALUM, 10UF, 25V, 10%, SMD	2
C21, C22, C31, C32	CAP, 0.8 pF, ± 0.05 pF, 0603, ATC 600S	4
C23,C24,C33,C34	CAP, 0.9 pF, ± 0.05 pF, 0603, ATC 600S	4
C29,C39	CAP, CER, 0.1UF, 50V, 10%, X7R, 0805	2
C30,C40	CAP, 1.0 UF, 100V, 10%, X7R, 1210	2
C41,C42,C43,C44	CAP, DC BLOCK, MULTI-LAYER, 0805, 2400 pF	4
C45, C46	CAP, 33 UF, 100V, ELECT, FK, SMD	2
R1,R11	RES, 1/16W, 0603, 1%, 2.00K OHMS	2
R2,R7,R12,R17	RES, 0 OHMS, 0603	4
R5,R15	RES, 1/16W, 0603, 1%, 5.1 OHMS	2
L1,L2,L3,L4	FERRITE, 22 OHM, 0805	4
Z1	50 OHM, TERMINATION, 30 WATT, HALF FLNG	1
Z2	50 OHM, TERMINATION, 50 WATT, FLANGE	1
X1,X2	1.0 - 2.5 GHZ 50 TO 25 OHM COUPLER, IPP 4011	2
J1	CONN, HEADER, RT>PLZ .1CEN LK 9POS	1
J2	HEADER RT>PLZ.1CEN LK 2 POS	1
J3,J4	CONN,N,FEM,W/.500 SMA FLNG	2
Q1	CGH40090PP	1

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Typical Package S-Parameters for CGH40090PP, Single Side (Small Signal, V_{DS} = 28 V, I_{DQ} = 0.5 A, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
100 MHz	0.954	-147.83	27.65	103.75	0.011	15.35	0.722	-167.04
200 MHz	0.951	-164.35	14.24	93.73	0.012	7.08	0.742	-173.53
300 MHz	0.951	-170.38	9.55	88.84	0.012	3.90	0.747	-175.86
400 MHz	0.951	-173.68	7.18	85.29	0.012	2.07	0.748	-177.10
500 MHz	0.951	-175.87	5.76	82.28	0.012	0.78	0.750	-177.90
600 MHz	0.950	-177.51	4.81	79.55	0.012	-0.22	0.751	-178.48
700 MHz	0.950	-178.84	4.13	76.98	0.012	-1.05	0.752	-178.94
800 MHz	0.950	-179.98	3.62	74.51	0.012	-1.76	0.753	-179.33
900 MHz	0.950	179.01	3.23	72.12	0.012	-2.39	0.754	-179.68
1.0 GHz	0.950	178.09	2.91	69.78	0.012	-2.95	0.755	179.99
1.1 GHz	0.950	177.23	2.66	67.48	0.012	-3.45	0.756	179.68
1.2 GHz	0.950	176.40	2.45	65.22	0.012	-3.89	0.757	179.38
1.3 GHz	0.950	175.61	2.27	62.98	0.012	-4.29	0.758	179.08
1.4 GHz	0.950	174.84	2.12	60.77	0.012	-4.64	0.760	178.77
1.5 GHz	0.950	174.08	1.98	58.58	0.012	-4.94	0.761	178.46
1.6 GHz	0.949	173.32	1.87	56.41	0.012	-5.20	0.762	178.14
1.7 GHz	0.949	172.57	1.77	54.26	0.012	-5.42	0.763	177.82
1.8 GHz	0.949	171.82	1.69	52.12	0.012	-5.60	0.764	177.48
1.9 GHz	0.949	171.06	1.61	49.99	0.012	-5.74	0.765	177.12
2.0 GHz	0.948	170.29	1.54	47.88	0.012	-5.84	0.766	176.76
2.1 GHz	0.948	169.52	1.48	45.77	0.012	-5.91	0.767	176.38
2.2 GHz	0.947	168.72	1.43	43.68	0.012	-5.94	0.768	175.98
2.3 GHz	0.947	167.92	1.38	41.59	0.012	-5.93	0.769	175.57
2.4 GHz	0.946	167.09	1.34	39.50	0.012	-5.90	0.769	175.14
2.5 GHz	0.946	166.24	1.30	37.42	0.012	-5.85	0.769	174.69
2.6 GHz	0.945	165.36	1.27	35.33	0.012	-5.77	0.770	174.23
2.7 GHz	0.944	164.46	1.24	33.24	0.012	-5.67	0.770	173.75
2.8 GHz	0.943	163.53	1.21	31.15	0.012	-5.56	0.770	173.24
2.9 GHz	0.942	162.57	1.19	29.05	0.013	-5.44	0.769	172.72
3.0 GHz	0.941	161.57	1.17	26.94	0.013	-5.33	0.769	172.18
3.1 GHz	0.940	160.52	1.16	24.81	0.013	-5.21	0.768	171.62
3.2 GHz	0.939	159.44	1.14	22.67	0.013	-5.11	0.767	171.03
3.3 GHz	0.937	158.30	1.13	20.50	0.013	-5.03	0.766	170.42
3.4 GHz	0.935	157.11	1.13	18.31	0.014	-4.98	0.764	169.79
3.5 GHz	0.934	155.87	1.12	16.09	0.014	-4.96	0.762	169.13
3.6 GHz	0.931	154.55	1.12	13.83	0.015	-4.99	0.760	168.44
3.7 GHz	0.929	153.17	1.12	11.52	0.015	-5.08	0.758	167.73
3.8 GHz	0.927	151.70	1.12	9.17	0.015	-5.23	0.755	166.99
3.9 GHz	0.924	150.15	1.13	6.77	0.016	-5.46	0.752	166.21
4.0 GHz	0.921	148.50	1.13	4.30	0.017	-5.77	0.748	165.41

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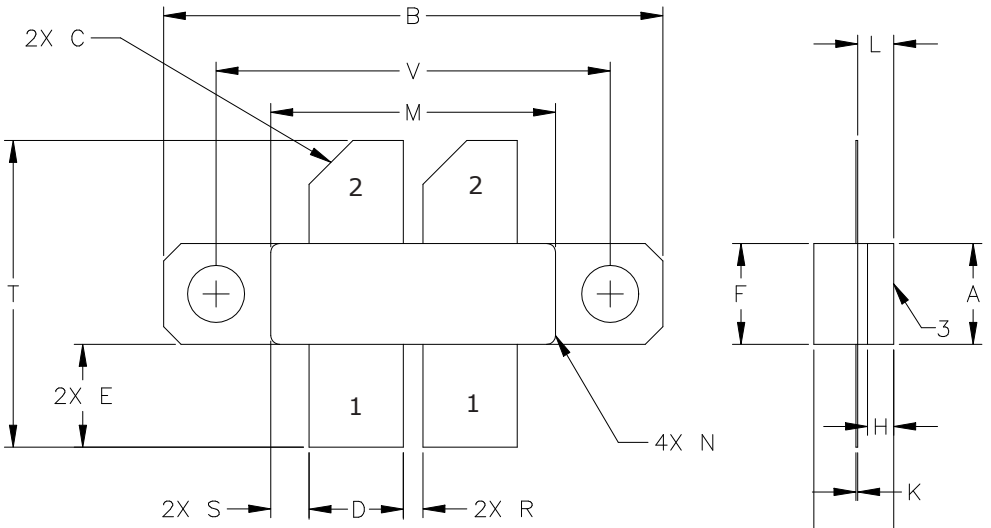
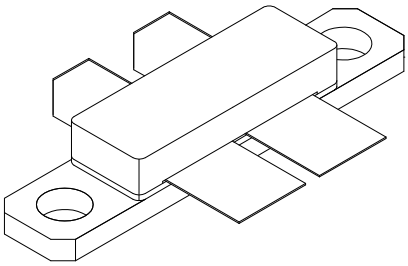
Product Dimensions CGH40090PP (Package Type — 440199)





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

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 PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.225	0.235	5.715	5.970
B	1.135	1.145	28.83	29.00
C	.10 45° REF		.10 45° REF	
D	0.210	0.220	5.330	5.590
E	0.230	0.240	5.840	6.000
F	0.225	0.235	5.715	5.970
H	0.055	0.065	1.400	1.650
J	0.183	0.193	4.650	4.900
K	0.003	0.006	0.076	0.150
L	0.077	0.087	1.950	2.200
M	0.643	0.657	16.30	16.70
N	R.020 REF			
R	0.040	0.050	1.000	1.270
S	0.083	0.093	2.100	2.360
T	0.680	0.720	17.30	18.30
V	0.895	0.905	22.70	22.98

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