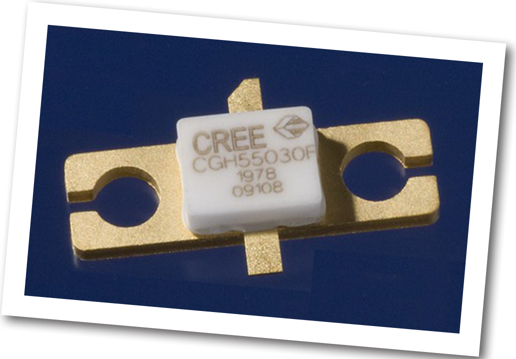
CGH55030F

30 W, 5500-5800 MHz, 28V, GaN HEMT for WiMAX

Cree's CGH55030F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH55030F ideal for 5.5-5.8 GHz WiMAX and BWA amplifier applications. The transistor is supplied in a ceramic/metal flange package. Based on appropriate external match adjustment, the CGH55030F is suitable for 4.9 - 5.5 GHz applications as well.



Package Type: 440166
PN: CGH55030F

Typical Performance Over 5.5-5.8GHz (T_c = 25˚C) of Demonstration Amplifier

Parameter	5.50 GHz	5.65 GHz	5.80 GHz	Units
Small Signal Gain	9.5	10.0	9.5	dB
EVM at P_{AVE} = 29 dBm	1.1	0.9	0.9	%
EVM at P_{AVE} = 36 dBm	2.2	1.4	1.4	%
Drain Efficiency at P_{AVE} = 4 W	23	24	25	%
Input Return Loss	10.8	22	9.3	dB

Note:
Measured in the CGH55030F-TB amplifier circuit, under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF.

Features

RoHS COMPLIANT

- 300 MHz Instantaneous Bandwidth
- 30 W Peak Power Capability
- 10 dB Small Signal Gain
- 4 W P_{AVE} < 2.0 % EVM
- 25 % Efficiency at 4 W Average Power
- Designed for WiMAX Fixed Access 802.16-2004 OFDM Applications
- Designed for Multi-carrier DOCSIS Applications

Large Signal Models Available for SiC & GaN

PRELIMINARY
Rev 2.0 – March 2009

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
Power Dissipation	P_{DISS}	14	Watts
Storage Temperature	T_{STG}	-55, +150	˚C
Operating Junction Temperature	T_J	225	˚C
Maximum Forward Gate Current	I_{GMAX}	7.0	mA
Soldering Temperature[1]	T_S	245	˚C
Screw Torque	τ	60	in-oz
Thermal Resistance, Junction to Case[2]	$R_{\theta JC}$	4.8	˚C/W
Case Operating Temperature[2]	T_C	-40, +105	˚C

Note:
[1] Refer to the Application Note on soldering at www.cree.com/products/wireless_appnotes.asp
[2] Measured for the CGH55030F at P_{DISS} = 14 W

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.3	–2.3	VDC	V_{DS} = 10 V, I_D = 7.2 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-3.0	–	VDC	V_{DS} = 28 V, I_D = 250 mA
Saturated Drain Current	I_{DS}	5.8	7.0	-	A	V_{DS} = 6.0 V, V_{GS} = 2 V
Drain-Source Breakdown Voltage	V_{BR}	84	100	–	VDC	V_{GS} = -8 V, I_D = 7.2 mA
RF Characteristics[2,3] (T_C = 25˚C, F_0 = 5.65 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	8.5	10.0	-	dB	V_{DD} = 28 V, I_{DQ} = 250 mA
Drain Efficiency[4]	η	19	24	–	%	V_{DD} = 28 V, I_{DQ} = 250 mA, P_{AVE} = 4 W
Back-Off Error Vector Magnitude	EVM_1	–	2.5	–	%	V_{DD} = 28 V, I_{DQ} = 250 mA, P_{AVE} = 29 dBm
Error Vector Magnitude	EVM_2	–	2.0	–		V_{DD} = 28 V, I_{DQ} = 250 mA, P_{AVE} = 4 W
Output Mismatch Stress	VSWR	-	10:1	-	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 250 mA, P_{AVE} = 4 W
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	9.3	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	2.0	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.9	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging.
[2] Measured in the CGH55030F-TB test fixture.
[3] Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, 5 ms Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF.
[4] Drain Efficiency = P_{OUT} / P_{DC}.

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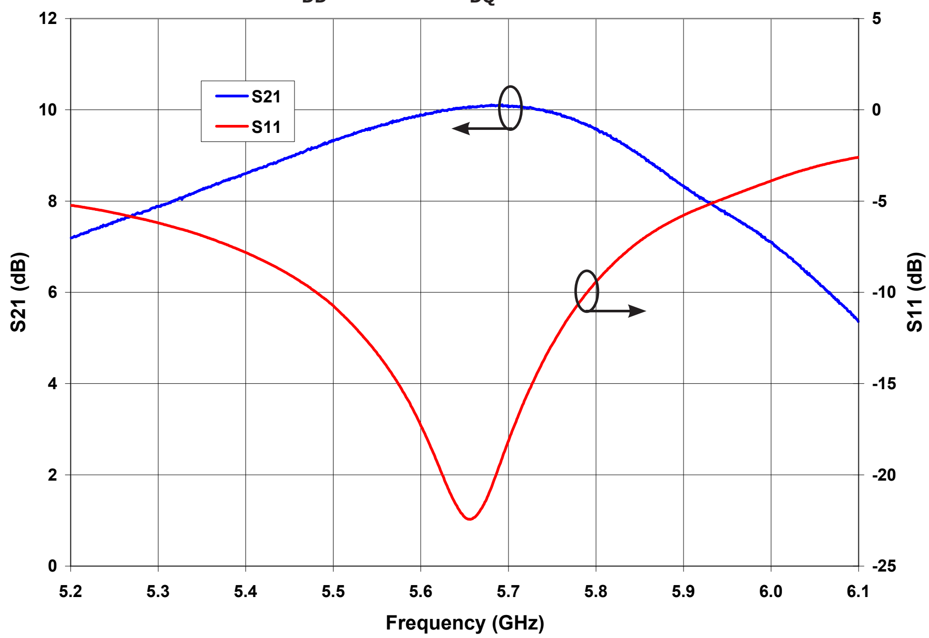
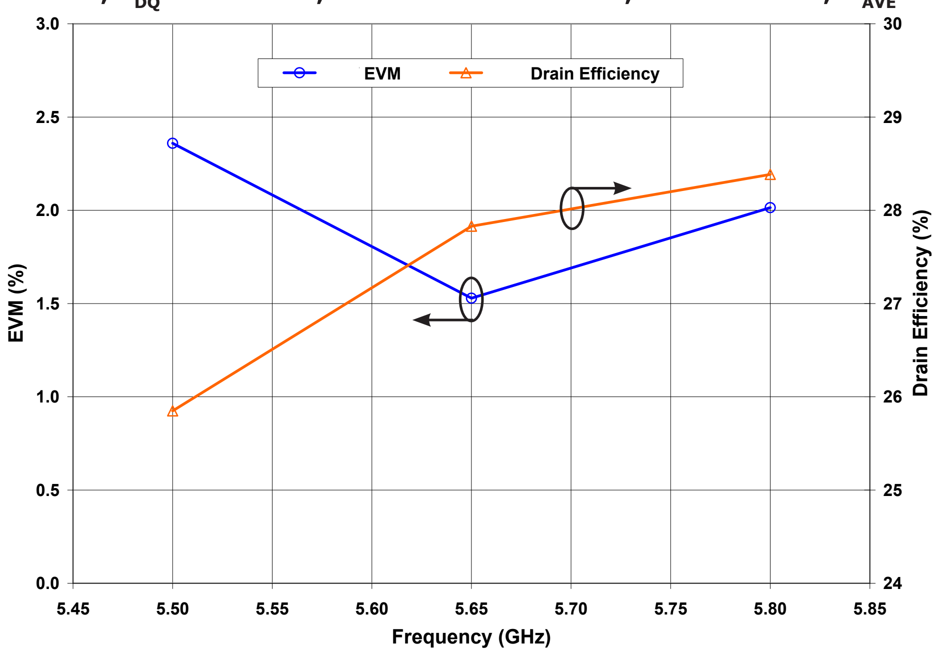
Typical WiMAX Performance

Small Signal S-Parameters vs Frequency of CGH55030F in the CGH55030F-TB
V_{DD} = 28 V, I_{DQ} = 250 mA



Typical EVM and Efficiency versus Frequency of CGH55030F in the CGH55030F-TB
V_{DD} = 28 V, I_{DQ} = 250 mA, 802.16-2004 OFDM, PAR=9.8 dB, P_{AVE} = 5 W



Note:
Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF.

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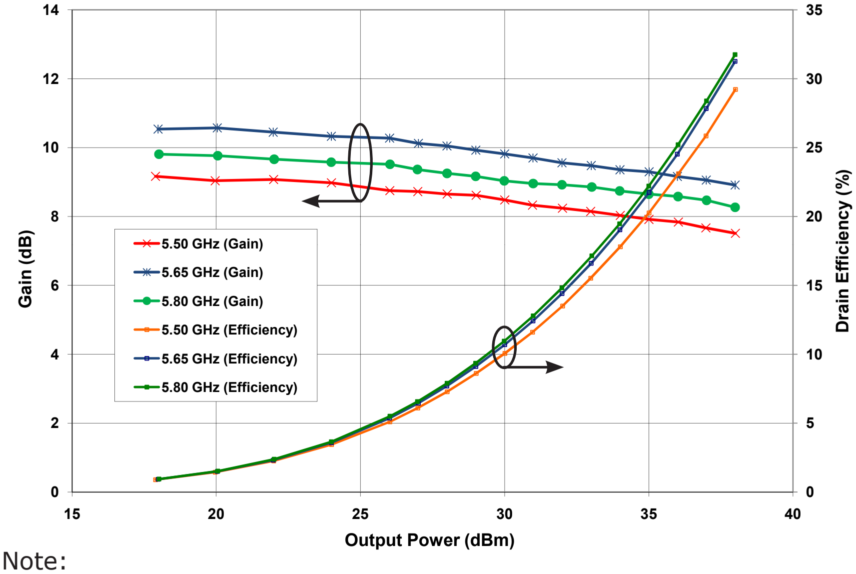
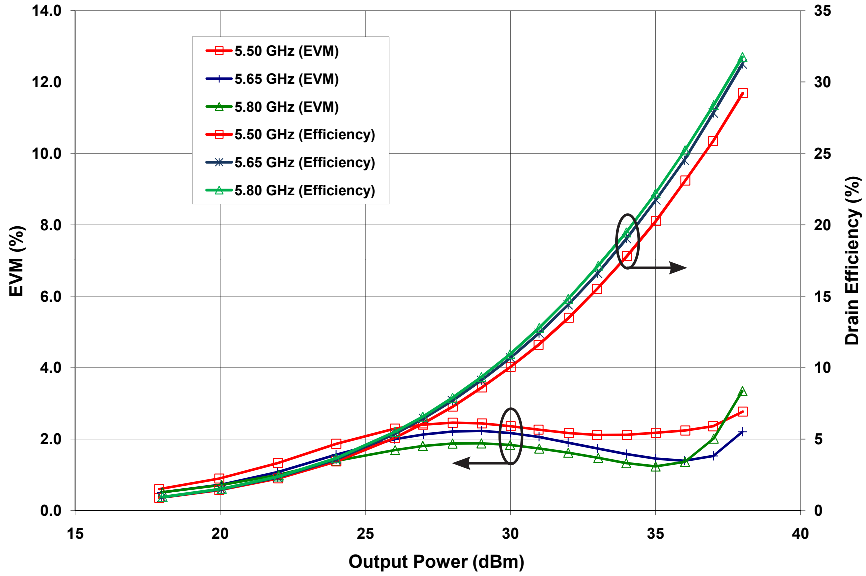
Typical WiMAX Performance

Drain Efficiency and Gain vs Output Power of CGH55030F in CGH55030F-TB
V_{DD} = 28 V, I_{DQ} = 250 mA, 802.16-2004 OFDM, PAR=9.8 dB



Note:
Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF.

Typical EVM and Drain Efficiency vs Output Power of CGH55030F in CGH55030F-TB at 5.50GHz, 5.65 GHz, 5.80GHz, 802.16-2004 OFDM, PAR=9.8 dB



Note:
Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF.

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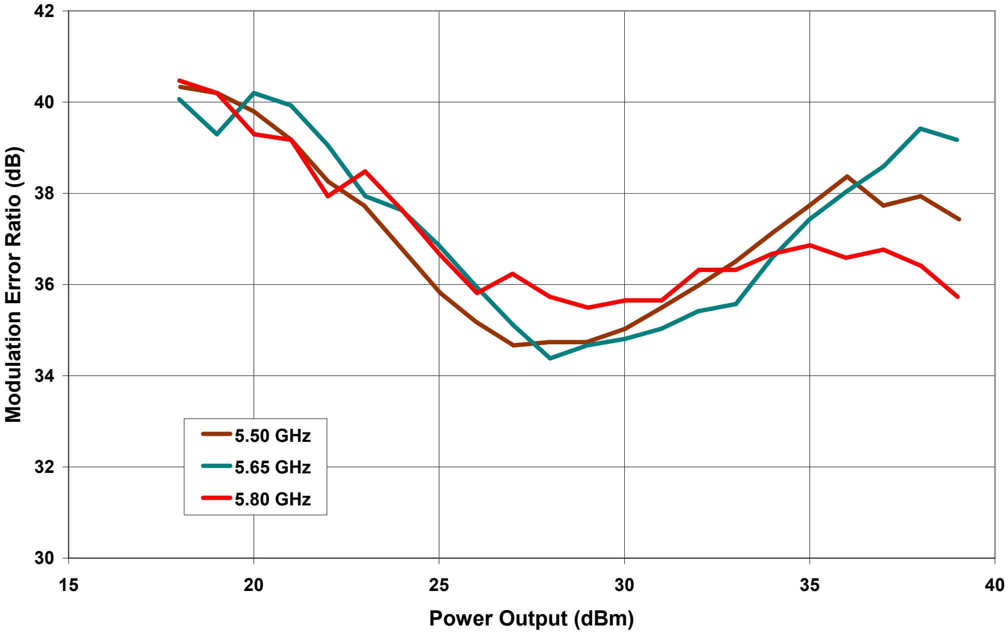
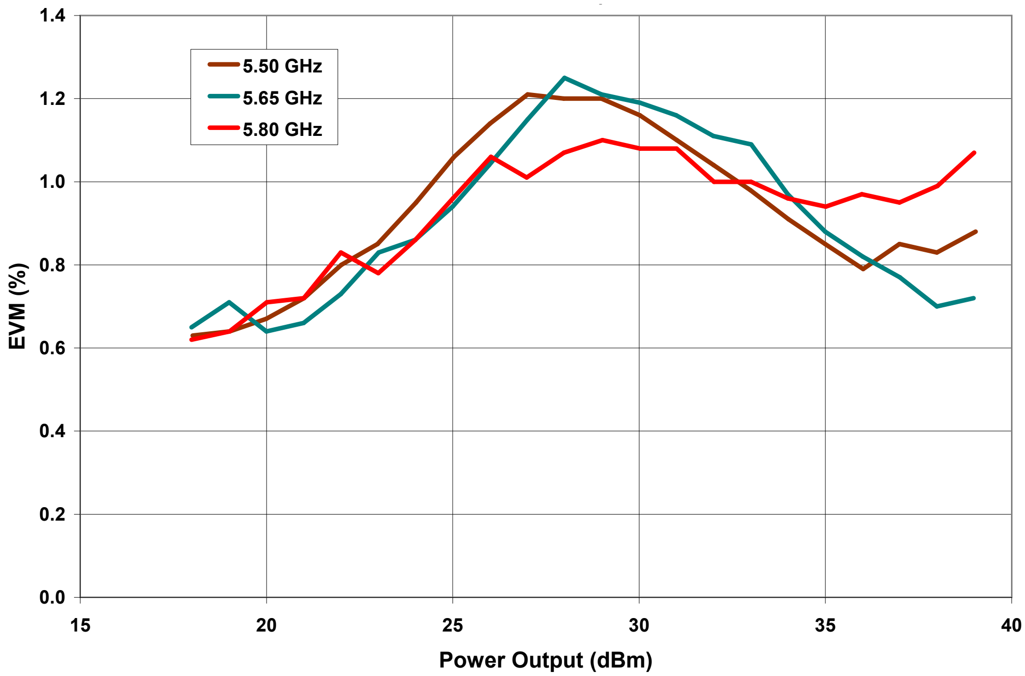
Typical DOCSIS Performance

Modulation Error Ratio vs Power Output of CGH55030F in Broadband Amplifier Circuit



Note:
MER is the metric of choice for cable systems and can be related to EVM by the following equation: EVM(%) = 100 x 10 ^ -((MERdB + MTAdB)/20). MTA is the "maximum-to-average constellation power ratio" which varies with the modulation type: MTA = 0 for BPSK and QPSK; 2.55 for 16QAM and 8QAM-DS; 3.68 for 64QAM and 32QAM-DS; 4.23 for 256QAM and 128QAM-DS

EVM vs Output Power of CGH55030F in Broadband Amplifier Circuit



Note:
Under DOCSIS, 6.0 MHz Channel BW, 64 QAM, PN23, Filter Alpha 0.18, PAR = 6.7dB.

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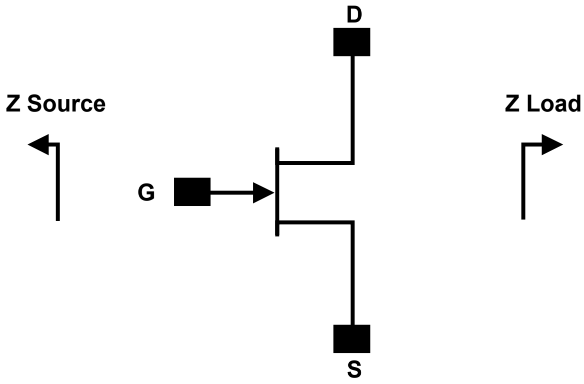
Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
5500	8.0 - j12.4	13.2 - j12.2
5650	8.7 - j13.1	13.8 - j11.4
5800	8.4 - j14.0	14.4 - j10.7

Note 1. V_{DD} = 28V, I_{DQ} = 250 mA in the 440166 package.
Note 2. Impedences are extracted from the CGH55030F-TB demonstration amplifier and are not source and load pull date derived from the transistor.

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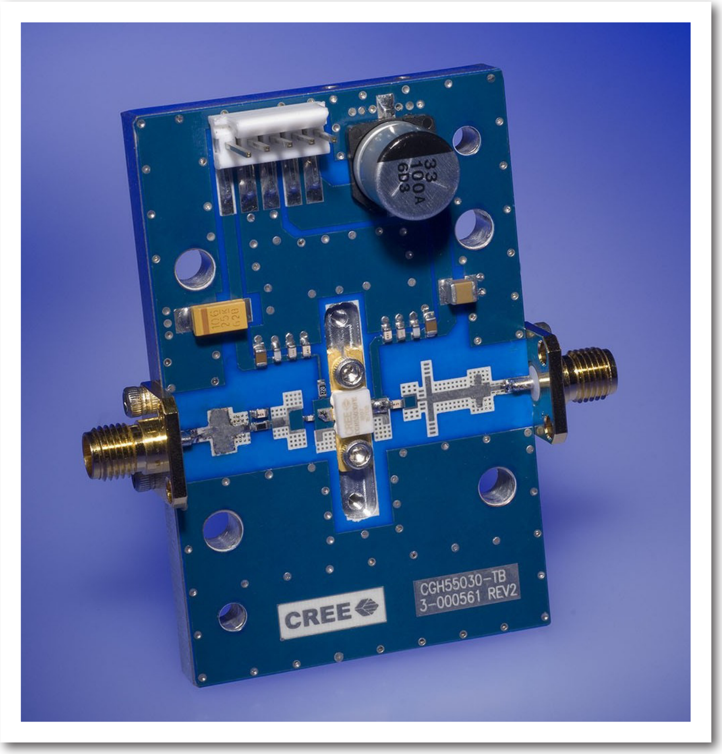
CGH55030F-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16W, 0603, 1%, 562 OHMS	1
R2	RES, 1/16W, 0603, 1%, 22.6 OHMS	1
C2	CAP, 0.3pF, +/-0.05pF, 0402, ATC600L	1
C16	CAP, 33 UF, 20%, G CASE	1
C15	CAP, 1.0UF, 100V, 10%, X7R, 1210	1
C8	CAP 10UF 16V TANTALUM	1
C9	CAP, 0.4pF, +/-0.05pF, 0603, ATC600S	1
C1	CAP, 1.2pF, +/-0.1pF, 0603, ATC600S	1
C6,C13	CAP,200 PF,0603 PKG, 100 V	2
C4,C11	CAP, 10.0pF,+/-5%, 0603, ATC600S	2
C5,C12	CAP, 39pF, +/-5%, 0603, ATC600S	2
C7,C14	CAP, 330000PF, 0805, 100V, TEMP STABILIZ	2
J3,J4	CONN, SMA, PANEL MOUNT JACK, FLANGE	2
J1	HEADER RT>PLZ .1CEN LK 5POS	1
-	PCB, RO4350B, Er = 3.48, h = 20 mil	1
-	CGH55030F	1

CGH55030F-TB Demonstration Amplifier Circuit



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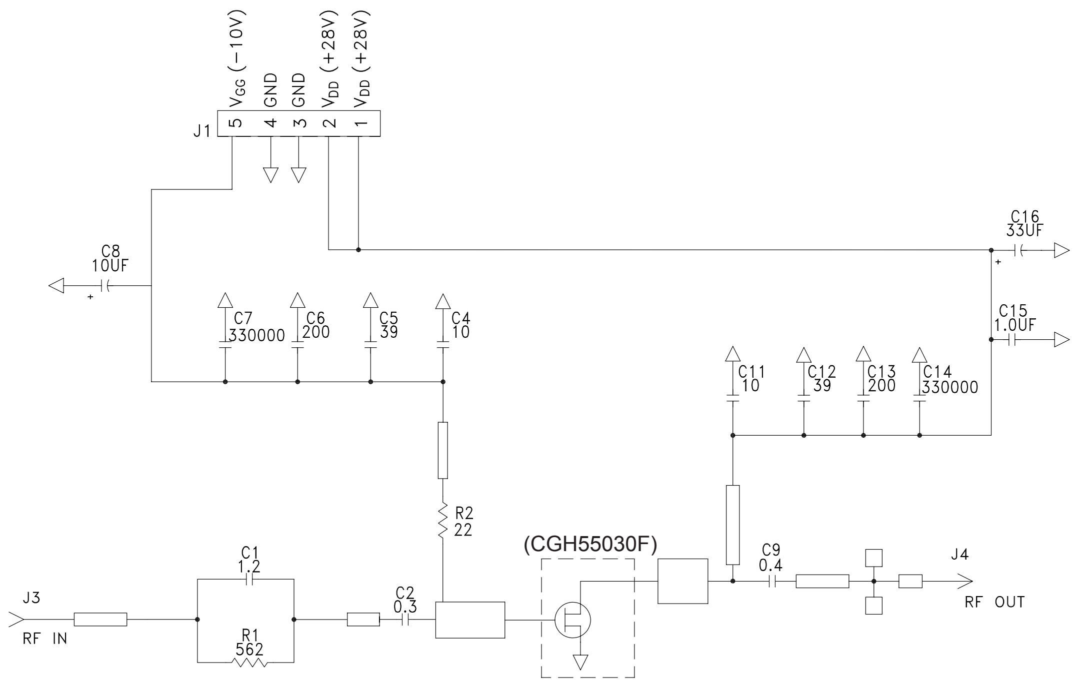
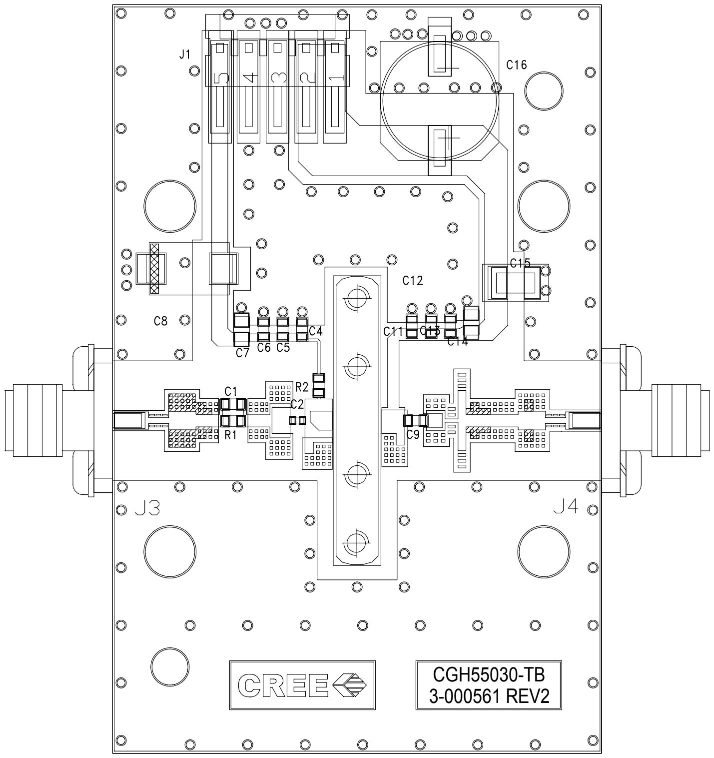
CGH55030F-TB Demonstration Amplifier Circuit Schematic



CGH55030F-TB Demonstration Amplifier Circuit Outline



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Typical Package S-Parameters for CGH55030F
(Small Signal, V_{DS} = 28 V, I_{DQ} = 250 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.914	-163.42	12.17	89.92	0.021	5.48	0.528	-163.71
600 MHz	0.914	-167.32	10.17	86.47	0.021	3.15	0.531	-166.13
700 MHz	0.914	-170.31	8.73	83.46	0.021	1.28	0.534	-167.86
800 MHz	0.913	-172.73	7.65	80.72	0.021	-0.30	0.537	-169.14
900 MHz	0.913	-174.76	6.80	78.18	0.021	-1.68	0.540	-170.15
1.0 GHz	0.914	-176.53	6.11	75.78	0.021	-2.91	0.544	-170.97
1.1 GHz	0.914	-178.09	5.55	73.47	0.021	-4.03	0.547	-171.66
1.2 GHz	0.914	-179.52	5.08	71.24	0.021	-5.04	0.551	-172.26
1.3 GHz	0.914	179.17	4.69	69.08	0.020	-5.98	0.555	-172.80
1.4 GHz	0.915	177.95	4.35	66.96	0.020	-6.84	0.559	-173.30
1.5 GHz	0.915	176.79	4.05	64.89	0.020	-7.63	0.563	-173.77
1.6 GHz	0.915	175.68	3.79	62.86	0.020	-8.37	0.567	-174.23
1.7 GHz	0.916	174.62	3.56	60.85	0.020	-9.04	0.571	-174.68
1.8 GHz	0.916	173.60	3.36	58.88	0.020	-9.66	0.576	-175.13
1.9 GHz	0.916	172.60	3.18	56.93	0.019	-10.22	0.580	-175.59
2.0 GHz	0.917	171.62	3.01	55.00	0.019	-10.72	0.585	-176.05
2.1 GHz	0.917	170.67	2.86	53.09	0.019	-11.16	0.590	-176.52
2.2 GHz	0.918	169.72	2.73	51.21	0.019	-11.54	0.595	-177.01
2.3 GHz	0.918	168.79	2.60	49.34	0.019	-11.87	0.599	-177.51
2.4 GHz	0.919	167.87	2.49	47.49	0.018	-12.13	0.604	-178.03
2.5 GHz	0.919	166.95	2.39	45.66	0.018	-12.33	0.609	-178.56
2.6 GHz	0.919	166.04	2.29	43.84	0.018	-12.46	0.614	-179.11
2.7 GHz	0.920	165.13	2.20	42.03	0.018	-12.53	0.619	-179.68
2.8 GHz	0.920	164.22	2.12	40.24	0.017	-12.53	0.623	179.74
2.9 GHz	0.921	163.31	2.04	38.47	0.017	-12.46	0.628	179.13
3.0 GHz	0.921	162.41	1.97	36.70	0.017	-12.32	0.633	178.51
3.2 GHz	0.922	160.58	1.85	33.21	0.017	-11.83	0.642	177.22
3.4 GHz	0.923	158.73	1.73	29.76	0.016	-11.04	0.650	175.85
3.6 GHz	0.923	156.87	1.63	26.34	0.016	-9.97	0.659	174.42
3.8 GHz	0.924	154.97	1.55	22.96	0.016	-8.61	0.666	172.93
4.0 GHz	0.924	153.04	1.47	19.61	0.016	-7.01	0.674	171.37
4.2 GHz	0.925	151.06	1.40	16.29	0.016	-5.19	0.681	169.74
4.4 GHz	0.925	149.04	1.34	12.98	0.016	-3.21	0.688	168.06
4.6 GHz	0.925	146.97	1.28	9.68	0.016	-1.14	0.694	166.32
4.8 GHz	0.926	144.85	1.23	6.39	0.016	0.95	0.699	164.51
5.0 GHz	0.926	142.66	1.19	3.11	0.017	2.98	0.705	162.64
5.2 GHz	0.926	140.41	1.15	-0.18	0.018	4.88	0.709	160.70
5.4 GHz	0.926	138.08	1.11	-3.48	0.018	6.58	0.714	158.70
5.6 GHz	0.925	135.68	1.08	-6.79	0.019	8.03	0.717	156.63
5.8 GHz	0.925	133.19	1.05	-10.13	0.020	9.19	0.721	154.49
6.0 GHz	0.925	130.62	1.02	-13.50	0.022	10.03	0.724	152.27

Download this s-parameter file in ".s2p" format at http://www.cree.com/products/wireless_s-parameters.asp

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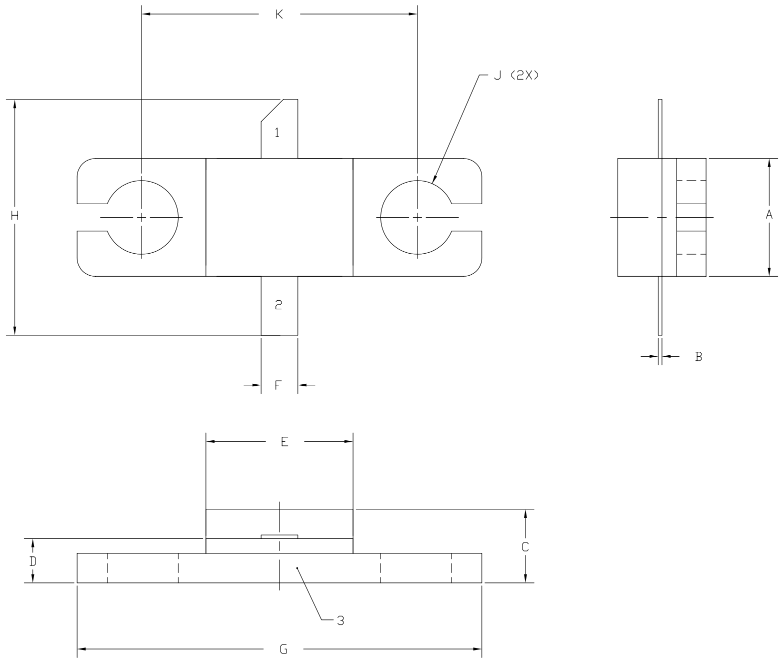
Product Dimensions CGH55030F (Package Type — 440166)



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	0.155	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	7.87	8.38
J	ø .100		2.54	
K	0.375		9.53	

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

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