CGH25120F

120 W, 2300-2700 MHz, GaN HEMT for WiMAX and LTE

Cree's CGH25120F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH25120F ideal for 2.3-2.7GHz WiMAX, LTE and BWA amplifier applications. The transistor is supplied in a ceramic/metal flange package.

Package Type: 440162
PN: CGH25120F

Typical Performance Over 2.3-2.7GHz (T_c = 25°C) of Demonstration Amplifier

Parameter	2.3 GHz	2.4 GHz	2.5 GHz	2.6 GHz	2.7 GHz	Units
Gain @ 43 dBm	12.5	12.8	13.1	13.5	13.6	dB
ACLR @ 43 dBm	-32.7	-34.0	-32.5	-29.5	-25.8	dBc
Drain Efficiency @ 43 dBm	26.5	28.0	30.0	32.5	34.5	%

Note:
Measured in the CGH25120F-AMP amplifier circuit, under equivalent 802.16e WiMAX signal, 10 MHz Bandwidth, PAR = 9.6 dB @ 0.01 % Probability on CCDF.

Features

RoHS COMPLIANT

- 2.3 - 2.7 GHz Operation
- 13 dB Gain
- -32 dBc ACLR at 20 W P_{AVE}
- 30 % Efficiency at 20 W P_{AVE}
- High Degree of DPD Correction Can be Applied

Large Signal Models Available for ADS and MWO

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

Parameter	Symbol	Rating	Units	Units
Drain-Source Voltage	V_{DSS}	84	Volts	25˚C
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts	25˚C
Power Dissipation	P_{DISS}	56	Watts	
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	30	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	12	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	80	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	1.5	˚C/W	85˚C
Case Operating Temperature[3]	T_C	-40, +150	˚C	

Note:
[1] Current limit for long term, reliable operation.
[2] Refer to the Application Note on soldering at www.cree.com/RF/Document-Library
[3] Measured for the CGH25120F at P_{DISS} = 56 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	-3.0	-2.3	V_{DC}	V_{DS} = 10 V, I_D = 28.8 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 28 V, I_D = 0.5 A
Saturated Drain Current[2]	I_{DS}	23.2	28.0	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	120	–	–	V_{DC}	V_{GS} = -8 V, I_D = 28.8 mA
RF Characteristics (T_C = 25˚C, F_0 = 2.5 GHz unless otherwise noted)						
Saturated Output Power[3,4,5]	P_{SAT}	–	130	–	W	V_{DD} = 28 V, I_{DQ} = 0.5 A,
Pulsed Drain Efficiency[3,5]	η	–	60	–	%	V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = P_{SAT}
Gain[6]	G	10.5	12.5	–	dB	V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = 43 dBm
WiMAX Linearity[6,7]	ACLR	–	-31	-27	dBc	V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = 43 dBm
Drain Efficiency[6]	η	27	32	–	%	V_{DD} = 28 V, I_{DQ} = 0.5 A, P_{OUT} = 43 dBm
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 1.0 A, P_{OUT} = 20 W CW
Dynamic Characteristics						
Input Capacitance[8]	C_{GS}	–	88	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance[8]	C_{DS}	–	12	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	1.6	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging.
[2] Scaled from PCM data.
[3] Pulse Width = 40 µS, Duty Cycle = 5 %.
[4] P_{SAT} is defined as I_G = 10 mA peak.
[5] Measured in CGH25120F-AMP
[6] Equivalent 802.16e WiMAX signal, 10 MHz Bandwidth, PAR = 9.6 dB @ 0.01% Probability on CCDF.
[7] Measured over 10 MHz bandwidth at 10 MHz offset from carrier edge.
[8] Includes package and internal matching components.

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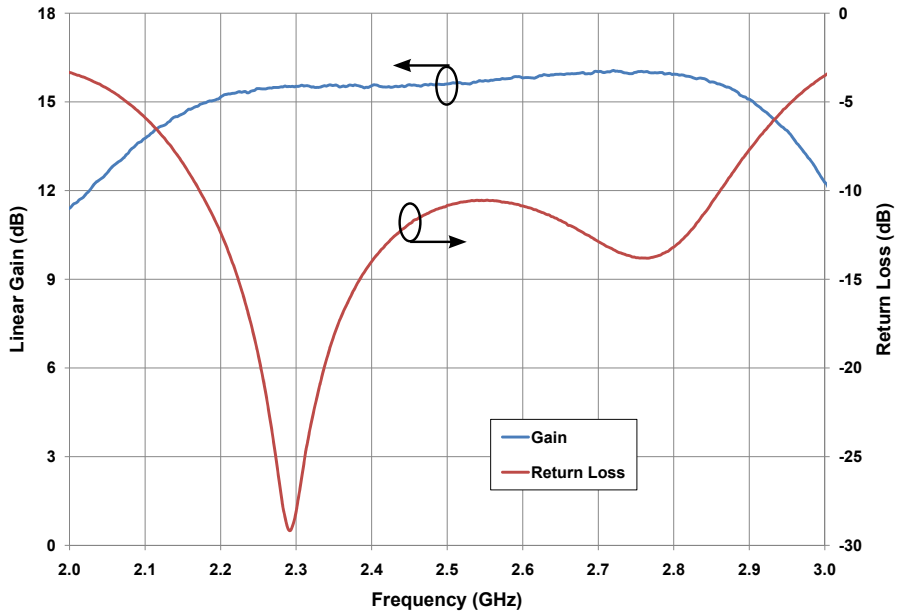
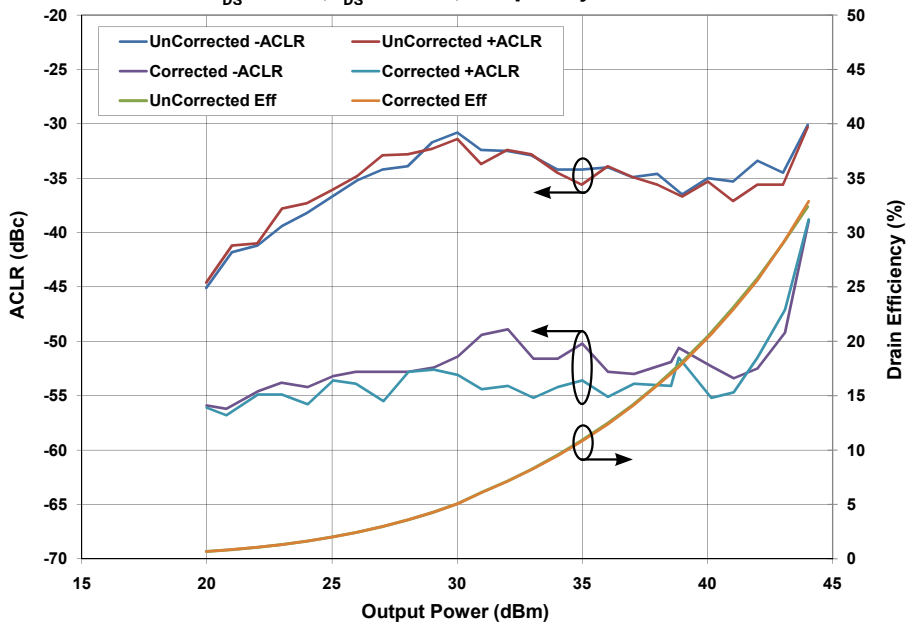
Typical Performance

Gain and Input Return Loss vs Frequency of CGH25120F in Broadband Amplifier Circuit
V_{DD} = 28 V, I_{DQ} = 0.5 A



Typical Mobile WiMAX Digital Pre-Distortion (DPD) Performance

WiMAX Characteristics with and without DPD Correction
ACLR and Drain Efficiency vs Output Power
measured in CGH25120F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 0.5 A, Frequency = 2.5 GHz



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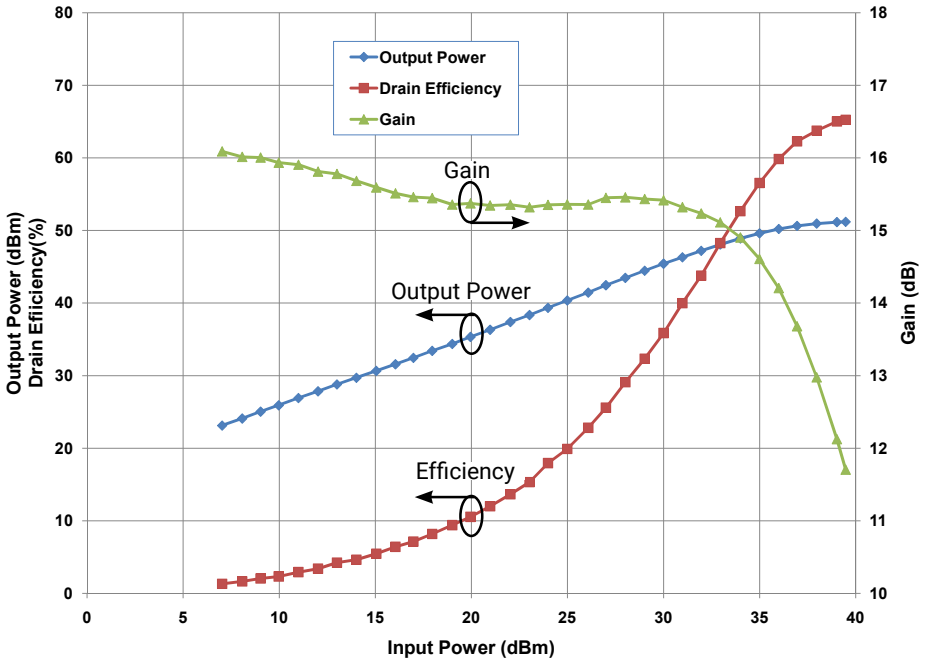
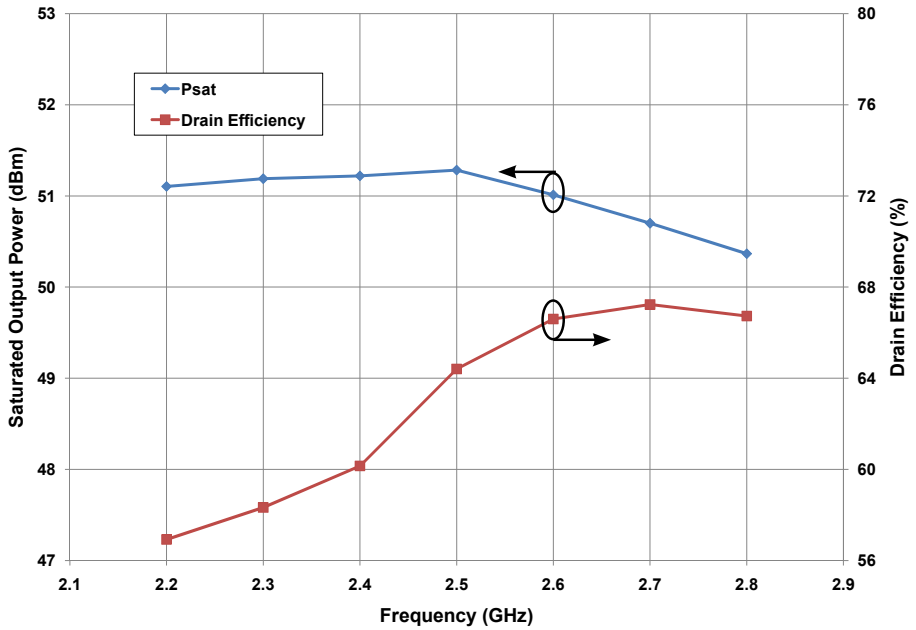
Typical Pulse Performance

Typical Pulse Characteristics Output Power, Drain Efficiency, and Gain vs Input Power measured in CGH25120F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 0.5 A, Freq = 2.5 GHz, Pulse Width = 40 µS, Duty Cycle = 5 %



Typical Pulsed Saturated Power vs Frequency measured in CGH25120F-AMP Amplifier Circuit.
V_{DS} = 28 V, I_{DS} = 0.5 A, P_{SAT} = 10 mA I_{GS} Peak, Pulse Width = 40 µS, Duty Cycle = 5 %



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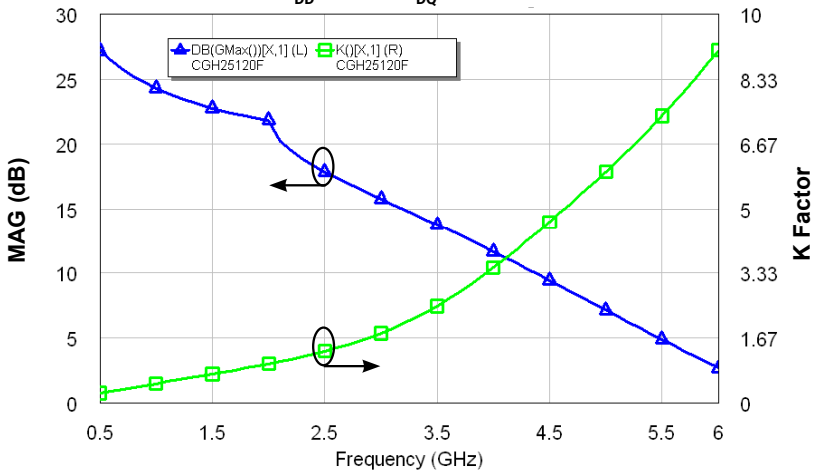
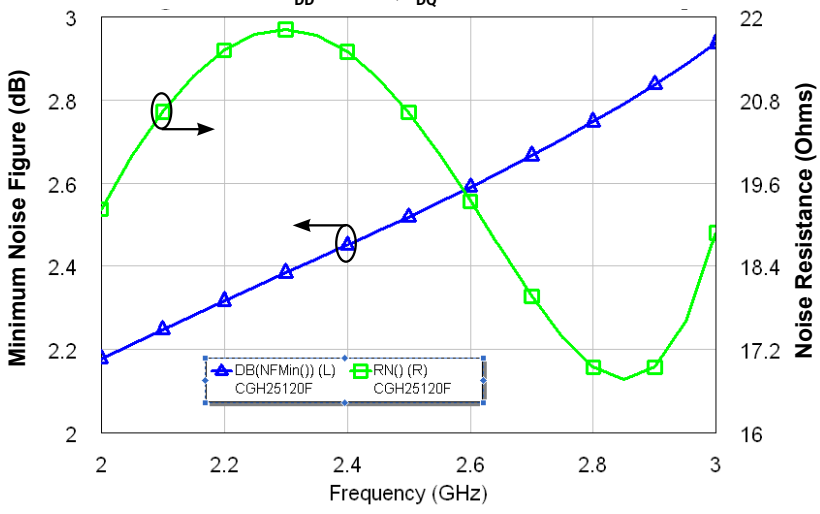
Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH25120F
V_{DD} = 28 V, I_{DQ} = 500 mA



Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH25120F
V_{DD} = 28 V, I_{DQ} = 500 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	II (200 < 500 V)	JEDEC JESD22 C101-C

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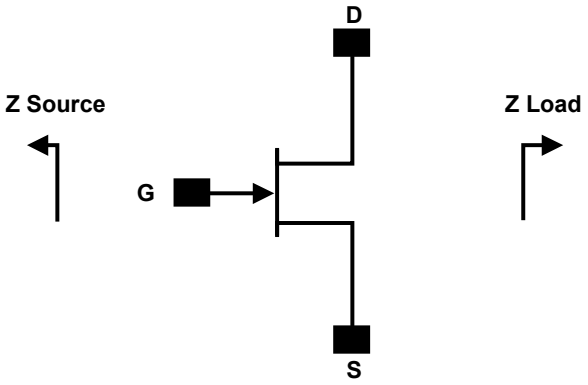
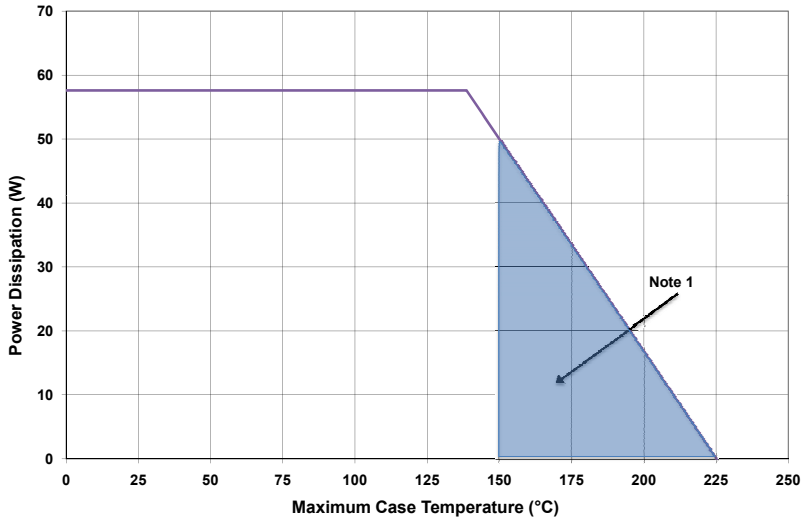
Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
2300	6.80 - j12.19	4.38 - j1.42
2350	6.42 - j11.89	4.39 - j1.36
2400	6.05 - j11.61	4.39 - j1.33
2450	5.71 - j11.34	4.36 - j1.32
2500	5.37 - j11.08	4.31 - j1.33
2550	5.04 - j10.83	4.23 - j1.34
2600	4.71 - j10.57	4.11 - j1.36
2650	4.39 - j10.31	3.98 - j1.37
2700	4.07 - j10.04	3.80 - j1.36

Note[1]: V_{DD} = 28V, I_{DQ} = 500mA. In the 440162 package.
Note[2]: Impedances are extracted from CGH25120F-AMP demonstration circuit and are not source and load pull data derived from transistor.

CGH25120F Power Dissipation De-rating Curve



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

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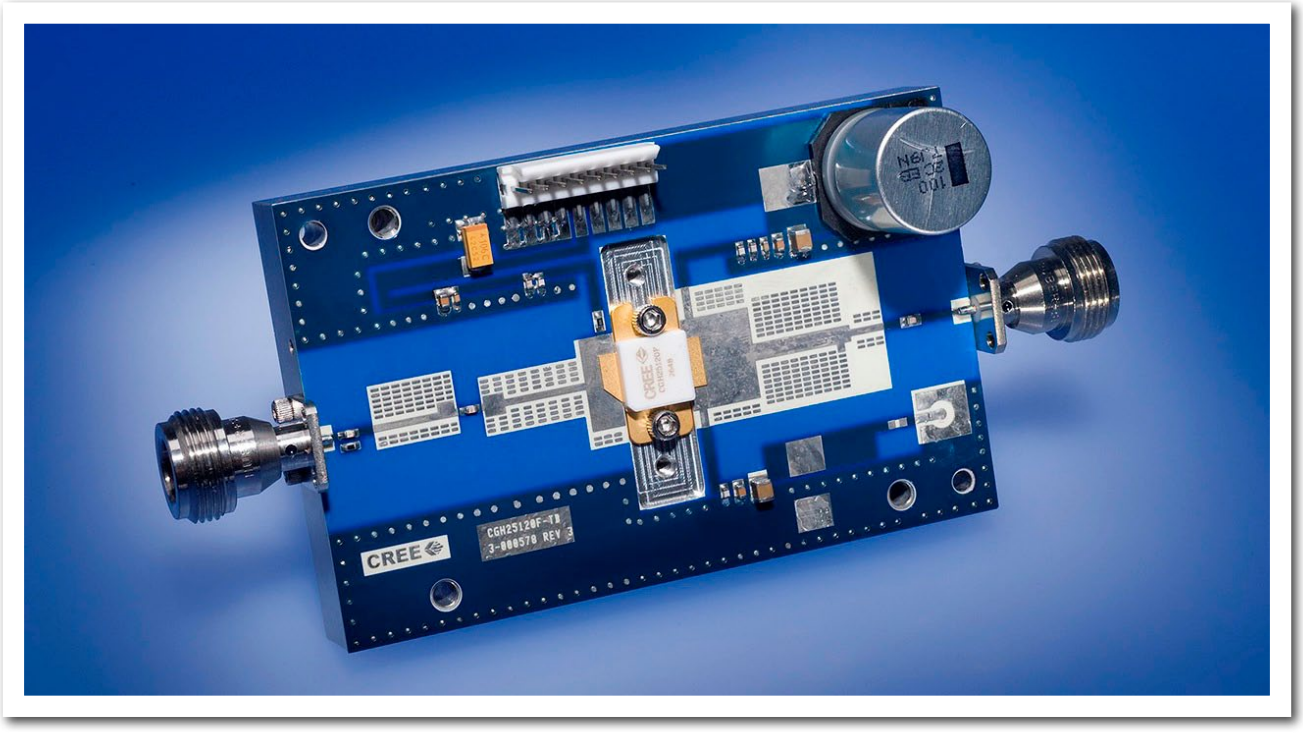
CGH25120F-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 1/16 W, 0603, 1%, 150 OHMS	1
R2	RES, 1/16 W, 0603, 1%, 5.1 OHMS	1
C1	CAP, 6.8 pF, +/-0.25 pF, 0603, ATC600S	1
C2	CAP, 27 pF, +/-5%, 0603, ATC600S	1
C3,C9,C15	CAP, 8.2 pF, +/-0.25 pF, 0603, ATC600S	3
C4,C10	CAP, 82.0 pF, +/-5%, 0603, ATC600S	2
C5,C11	CAP, 470 pF, 5%, 100V, 0603, X7R	2
C6,C12,C16	CAP, 33000 pF, 0805, 100V, X7R	3
C7	CAP, 10 UF, 16V, TANTALUM	1
C8	CAP, 24 pF, +/-5%, 0603, ATC600S	1
C13,C17	CAP, 1.0 UF, 100V, 10%, X7R, 1210	2
C14	CAP, 100 UF, +/-20%, 160V, ELECTROLYTIC	1
J1,J2	CONN, N-Type, Female, 0.500 SMA Flange	2
J3	CONN, Header, RT> PLZ, 0.1 CEN, LK, 9 POS	1
-	PCB, RO4350, Er = 3.48, h = 20 mil	1
-	CGH25120F	1

CGH25120F-AMP Demonstration Amplifier Circuit



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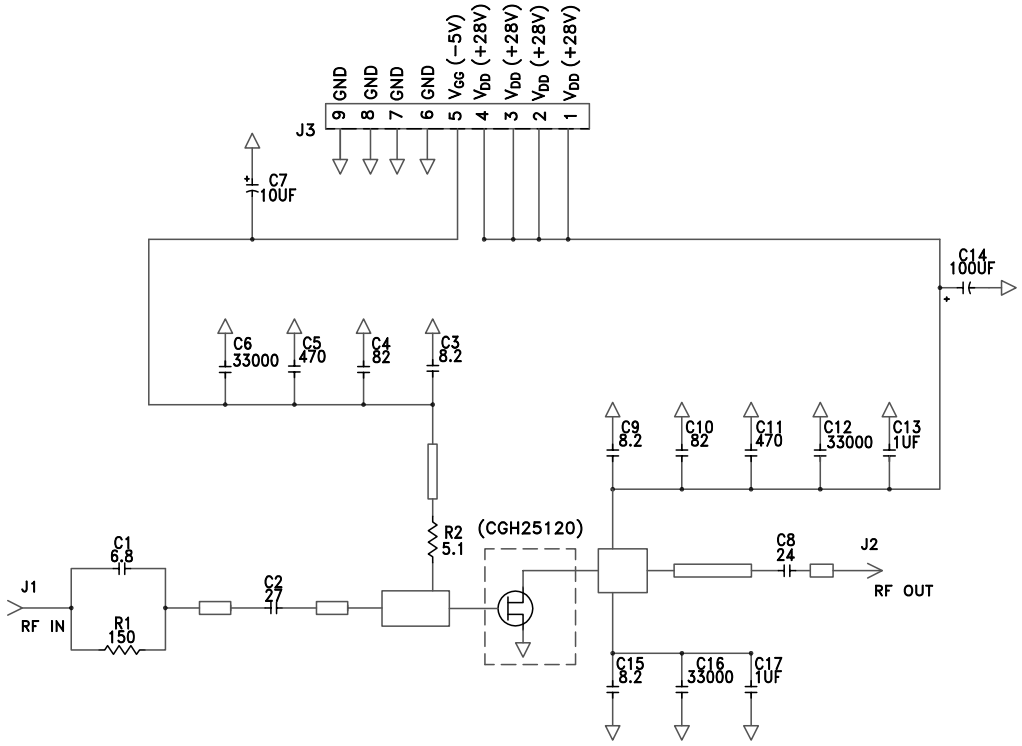
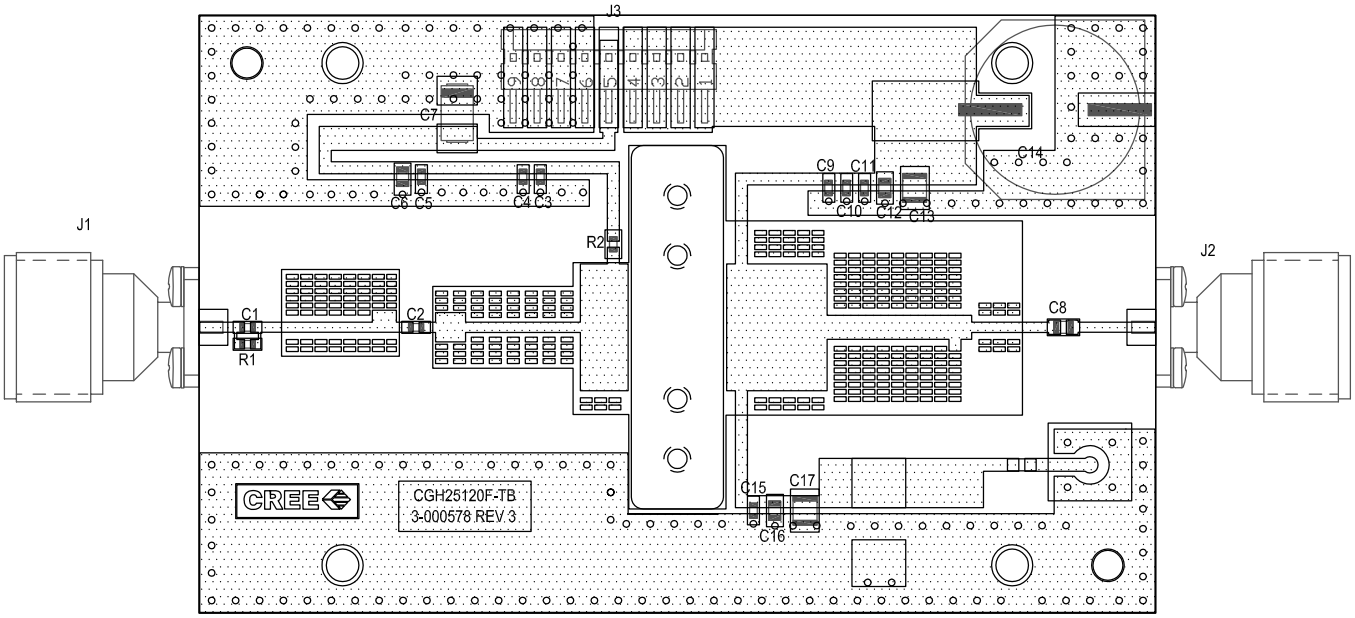
CGH25120F-AMP Demonstration Amplifier Circuit Schematic



CGH25120F-AMP Demonstration Amplifier Circuit Outline



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Typical Package S-Parameters for CGH25120
(Small Signal, V_{DS} = 28 V, I_{DQ} = 500 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.970	179.55	3.23	65.19	0.006	-19.55	0.697	-171.85
600 MHz	0.969	178.04	2.71	59.73	0.006	-23.92	0.712	-171.11
700 MHz	0.969	176.68	2.35	54.43	0.006	-28.13	0.728	-170.54
800 MHz	0.968	175.39	2.08	49.24	0.006	-32.20	0.744	-170.15
900 MHz	0.967	174.12	1.88	44.13	0.006	-36.17	0.760	-169.90
1.0 GHz	0.965	172.86	1.73	39.07	0.006	-40.07	0.776	-169.80
1.1 GHz	0.963	171.57	1.62	34.02	0.007	-43.93	0.792	-169.82
1.2 GHz	0.961	170.24	1.53	28.94	0.007	-47.79	0.808	-169.93
1.3 GHz	0.957	168.86	1.47	23.78	0.007	-51.71	0.823	-170.13
1.4 GHz	0.953	167.39	1.43	18.47	0.007	-55.72	0.838	-170.41
1.5 GHz	0.948	165.84	1.41	12.95	0.007	-59.92	0.853	-170.74
1.6 GHz	0.941	164.19	1.40	7.11	0.008	-64.38	0.868	-171.14
1.7 GHz	0.932	162.42	1.41	0.85	0.008	-69.21	0.882	-171.61
1.8 GHz	0.921	160.54	1.44	-5.98	0.009	-74.56	0.897	-172.16
1.9 GHz	0.906	158.55	1.49	-13.54	0.009	-80.57	0.912	-172.82
2.0 GHz	0.887	156.51	1.54	-22.02	0.010	-87.43	0.928	-173.62
2.1 GHz	0.863	154.51	1.61	-31.62	0.011	-95.34	0.943	-174.61
2.2 GHz	0.836	152.72	1.68	-42.48	0.012	-104.43	0.956	-175.83
2.3 GHz	0.807	151.32	1.73	-54.61	0.012	-114.71	0.966	-177.27
2.4 GHz	0.782	150.41	1.76	-67.78	0.013	-125.92	0.970	-178.85
2.5 GHz	0.767	149.70	1.74	-81.50	0.013	-137.58	0.968	179.58
2.6 GHz	0.765	148.57	1.69	-95.15	0.013	-149.05	0.960	178.22
2.7 GHz	0.772	146.34	1.61	-108.22	0.012	-159.82	0.948	177.17
2.8 GHz	0.784	142.57	1.52	-120.49	0.012	-169.67	0.937	176.41
2.9 GHz	0.795	137.00	1.43	-132.07	0.012	-178.68	0.926	175.88
3.0 GHz	0.802	129.35	1.37	-143.26	0.011	172.84	0.918	175.48
3.2 GHz	0.800	105.38	1.29	-166.46	0.011	155.52	0.907	174.80
3.4 GHz	0.786	62.35	1.25	164.88	0.011	133.38	0.901	174.02
3.6 GHz	0.824	-2.68	1.08	128.15	0.010	103.76	0.897	172.96
3.8 GHz	0.913	-61.31	0.73	93.46	0.007	76.68	0.890	171.72
4.0 GHz	0.963	-96.70	0.45	69.63	0.005	60.78	0.881	170.41
4.2 GHz	0.983	-116.99	0.29	53.87	0.003	53.02	0.872	168.93
4.4 GHz	0.992	-129.53	0.19	42.45	0.002	49.41	0.860	167.19
4.6 GHz	0.995	-137.94	0.14	33.27	0.002	47.62	0.844	165.11
4.8 GHz	0.997	-143.97	0.10	25.19	0.002	46.36	0.823	162.61
5.0 GHz	0.998	-148.50	0.08	17.50	0.001	44.82	0.793	159.54
5.2 GHz	0.999	-152.04	0.07	9.61	0.001	42.41	0.751	155.74
5.4 GHz	0.999	-154.90	0.06	0.93	0.001	38.57	0.688	150.96
5.6 GHz	0.999	-157.26	0.05	-9.20	0.001	32.67	0.594	145.02
5.8 GHz	0.999	-159.26	0.04	-21.62	0.001	23.98	0.453	138.33
6.0 GHz	1.000	-160.97	0.04	-36.99	0.001	11.87	0.251	136.18

To download the s-parameters in s2p format, go to the CGH25120F Product Page and click on the documentation tab.

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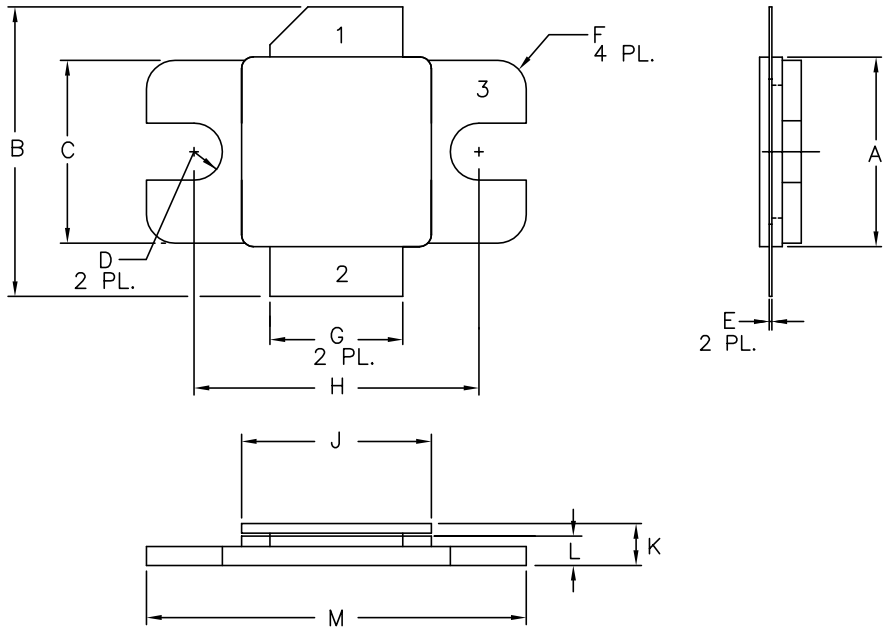
Product Dimensions CGH25120F (Package Type — 440162)



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.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.395	.405	10.03	10.29
B	.580	.620	14.73	15.75
C	.380	.390	9.65	9.91
D	.055	.065	1.40	1.65
E	.004	.006	0.10	0.15
F	.055	.065	1.40	1.65
G	.275	.285	6.99	7.24
H	.595	.605	15.11	15.37
J	.395	.405	10.03	10.29
K	.129	.149	3.28	3.78
L	.053	.067	1.35	1.70
M	.795	.805	20.19	20.45

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

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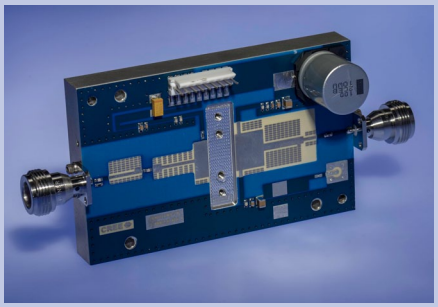
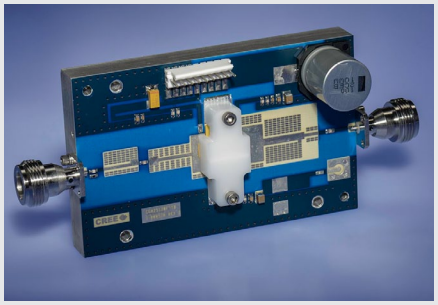
Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH25120F	GaN HEMT	Each	
CGH25120F-TB	Test board without GaN HEMT	Each	
CGH25120F-AMP	Test board with GaN HEMT installed	Each	

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