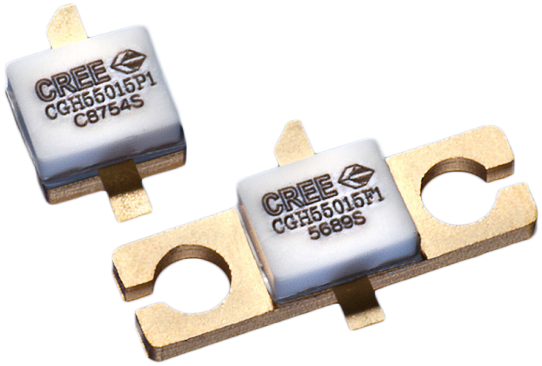
CGH55015F1 / CGH55015P1

15 W, 5.5 - 5.8 GHz, GaN HEMT for WiMAX



Package Types: 440196 & 440166
PNs: CGH55015P1 & CGH55015F1

Description

Cree's CGH55015F1/CGH55015P1 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH55015F1/CGH55015P1 ideal for 5.5-5.8 GHz WiMAX and linear amplifier applications. The transistor is available in both screw-down, flange and solder-down, pill packages. Based on appropriate external match adjustment, the CGH55015F1/ CGH55015P1 is suitable for 4.9 - 5.5 GHz applications as well.

Typical Performance 5.5 - 5.8 GHz (T_C = 25˚C)

Parameter	5.50 GHz	5.65 GHz	5.80 GHz	Units
Small Signal Gain	10.7	11.0	10.7	dB
EVM at P_{AVE} = 23 dBm	1.9	1.8	2.0	%
EVM at P_{AVE} = 33 dBm	1.5	1.5	1.7	%
Drain Efficiency at P_{AVE} = 33 dBm	25	25	25	%
Input Return Loss	11.5	14.5	10.5	dB

Note: Measured in the CGH55015-AMP amplifier circuit, 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.

Features

- 5.5 - 5.8 GHz Operation
- 15 W Peak Power Capability
- >10.5 dB Small Signal Gain
- 2 W P_{AVE} < 2.0 % EVM
- 25% Efficiency at 2 W Average Power
- Designed for WiMAX Fixed Access 802.16-2004 OFDM Applications
- Designed for Multi-carrier DOCSIS Applications

Large Signal Models Available for ADS and MWO

RoHS COMPLIANT

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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	120	Volts	25˚C
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts	25˚C
Power Dissipation	P_{DISS}	7	Watts	
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	4.0	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	1.5	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	8.0	˚C/W	85˚C
Case Operating Temperature[3]	T_C	-40, +150	˚C	

Notes:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering at wolfspeed.com/rf/document-library
[3] Measured for the CGH55015 at P_{DISS} = 7 W

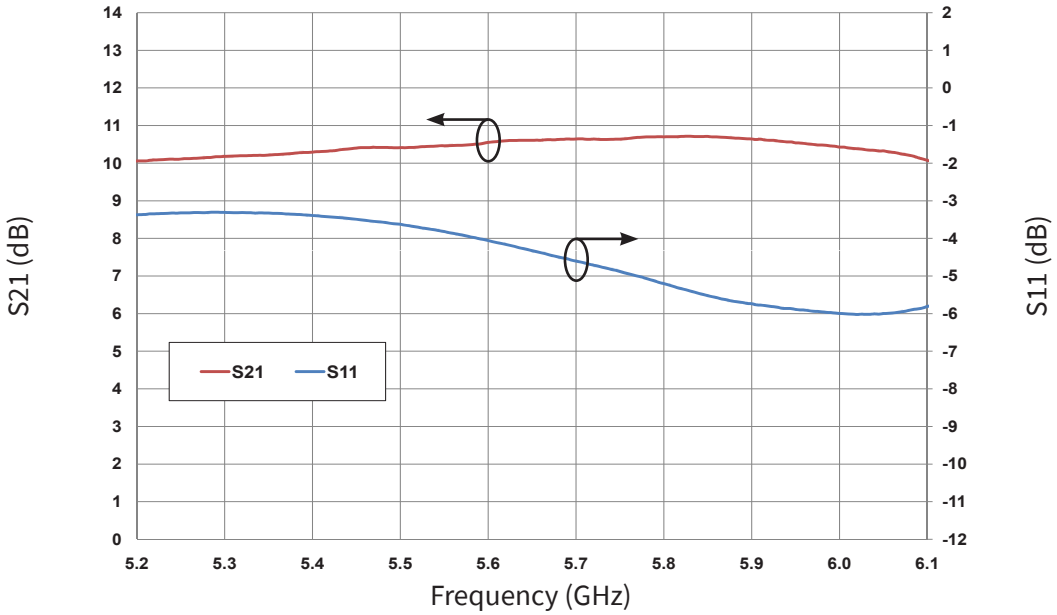
Electrical Characteristics (T_C = 25˚C)

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 = 3.6 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 28 V, I_D = 115 mA
Saturated Drain Current	I_{DS}	2.9	3.5	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	84	–	–	V_{DC}	V_{GS} = -8 V, I_D = 3.6 mA
RF Characteristics[2,3] (T_C = 25˚C, F_0 = 5.65 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	8.5	11.0	–	dB	V_{DD} = 28 V, I_{DQ} = 115 mA
Drain Efficiency[4]	η	20.6	25	–	%	V_{DD} = 28 V, I_{DQ} = 115 mA, P_{AVE} = 2.0 W
Error Vector Magnitude	EVM	-	2.0	2.5	%	V_{DD} = 28 V, I_{DQ} = 115 mA, P_{AVE} = 2.0 W
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 115 mA, P_{AVE} = 2.0 W
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	4.5	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	1.3	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.2	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

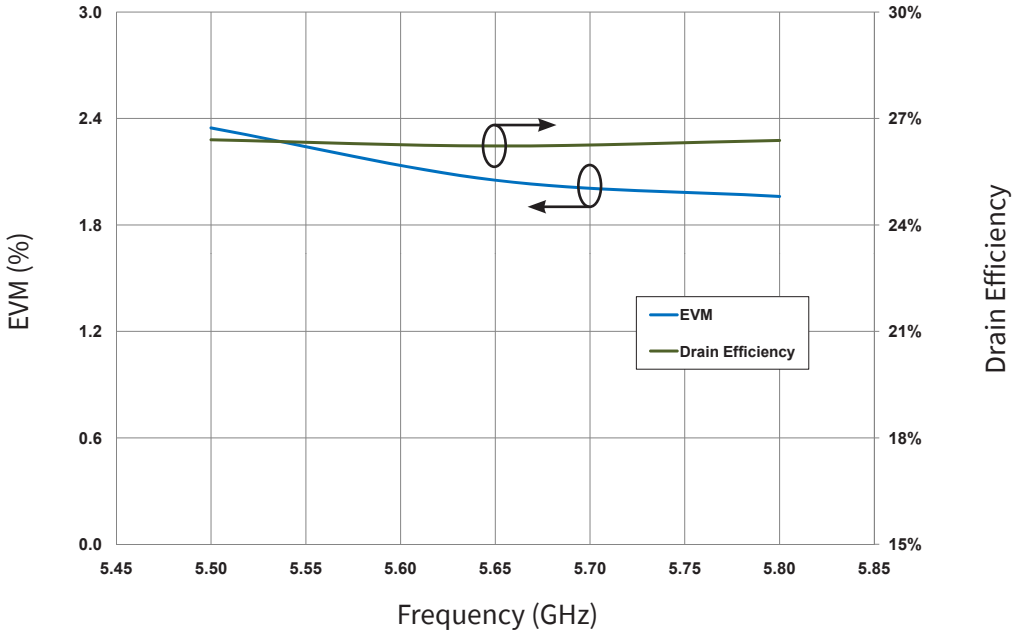
Notes:
[1] Measured on wafer prior to packaging
[2] Measured in the CGH55015-AMP test fixture
[3] Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, 5 ms Burst, Symbol Length of 59, Coding Type RS-CC, Coding RateType 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF
[4] Drain Efficiency = P_{OUT} / P_{DC}

Typical WiMAX Performance

Small Signal S-Parameters vs Frequency measured in the CGH55015-AMP
V_{DD} = 28 V, I_{DQ} = 115 mA



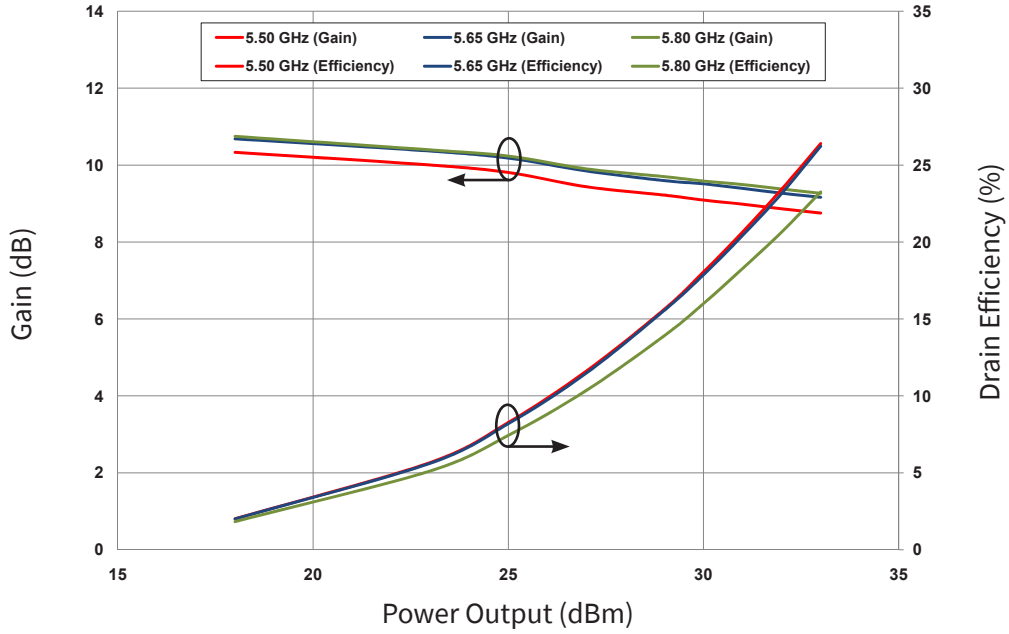
EVM and Efficiency vs. Frequency measured in the CGH55015-AMP
V_{DD} = 28 V, I_{DQ} = 115 mA, P_{OUT} = 2.5 W



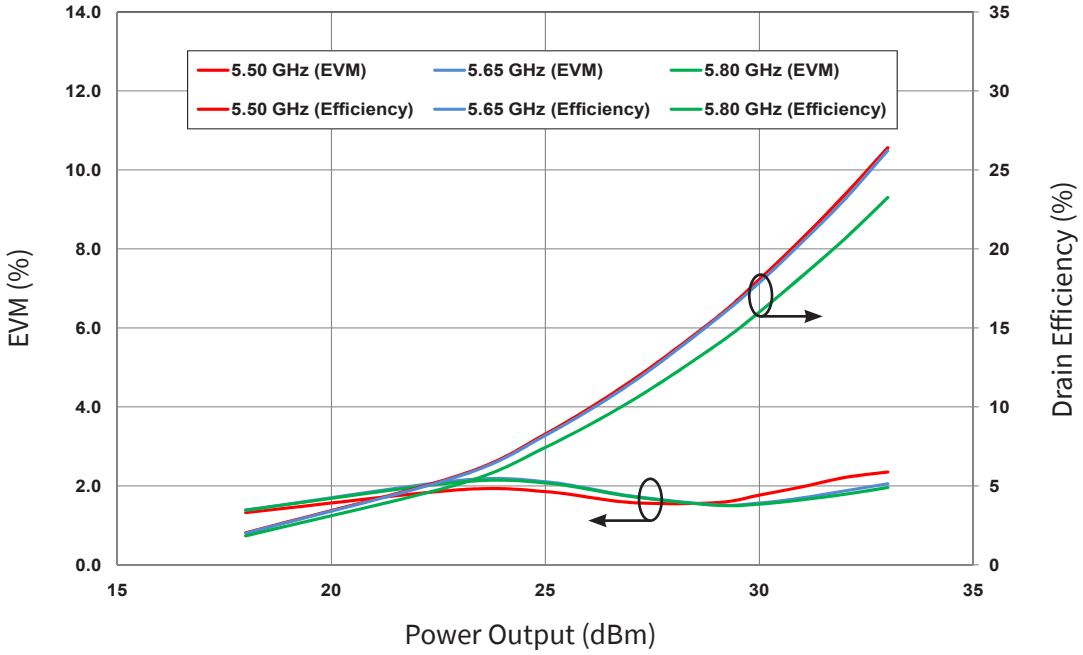
Note: Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF

Typical WiMAX Performance

Drain Efficiency and Gain vs Power Output measured in the CGH55015-AMP
V_{DD} = 28 V, I_{DQ} = 115 mA, 802.16-2004 OFDM, PAR = 9.8 dB



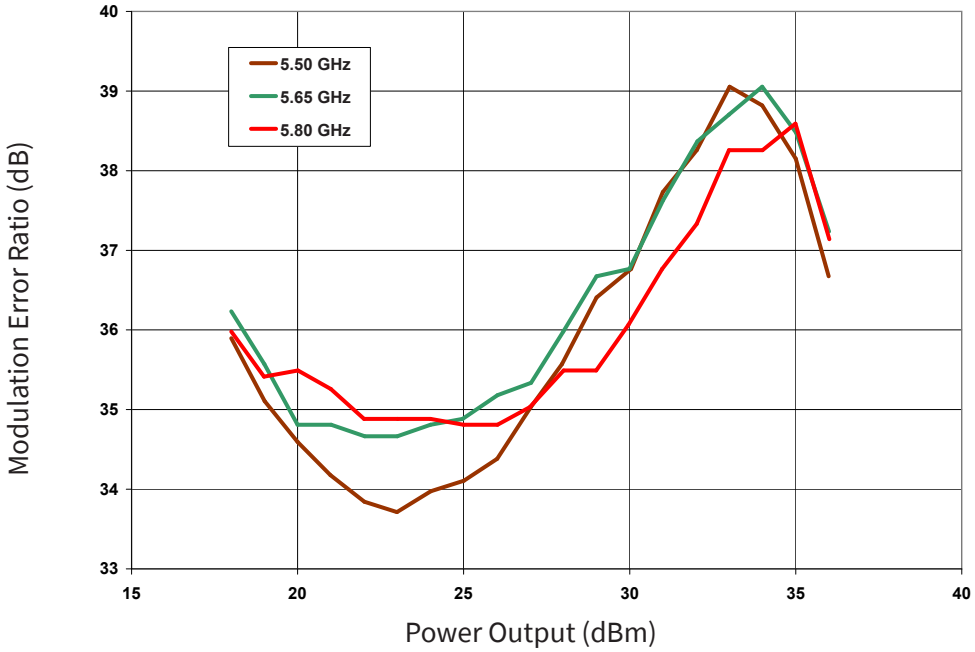
Typical EVM and Drain Efficiency vs Output Power measured in the CGH55015-AMP at 5.50 GHz, 5.65 GHz, 5.80 GHz, 802.16-2004 OFDM, PAR = 9.8 dB



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.

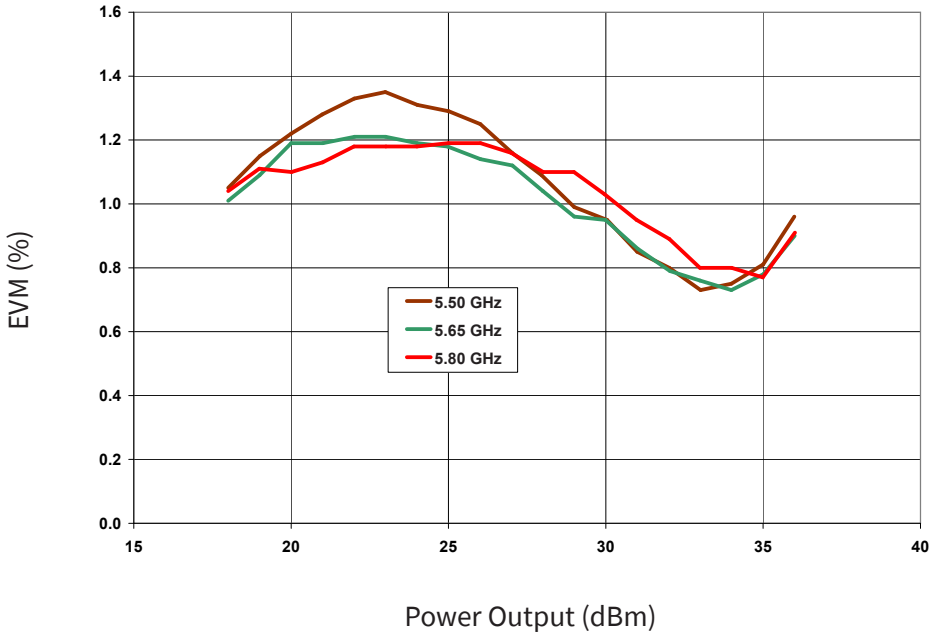
Typical DOCSIS Performance

DOCSIS Modulation Error Ratio vs Output Power of CGH55015



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

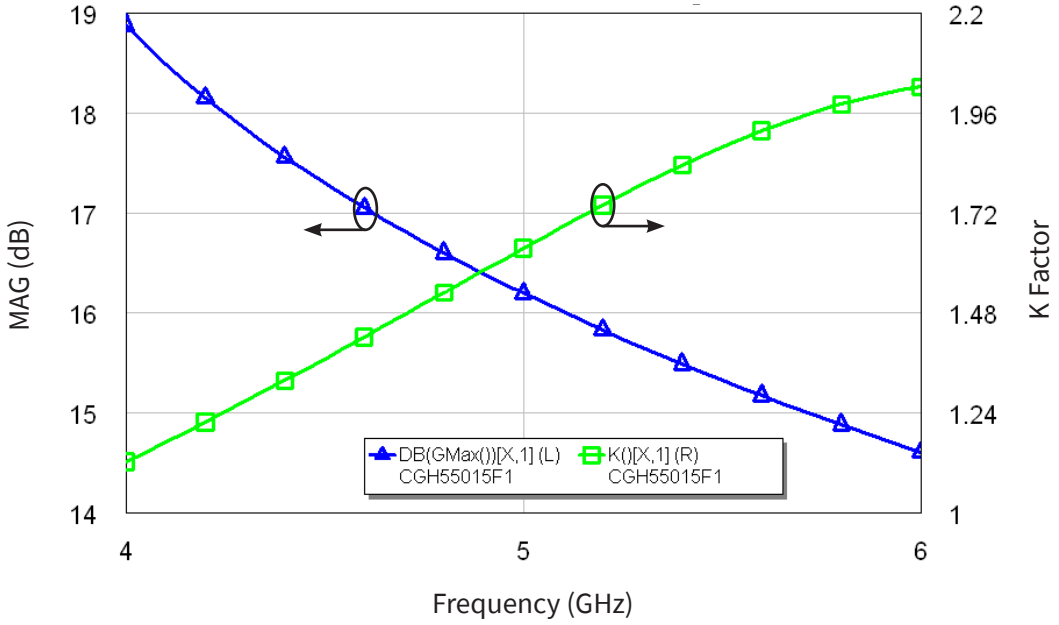
DOCSIS EVM vs Output Power of CGH55015 in Broadband Amplifier Circuit



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

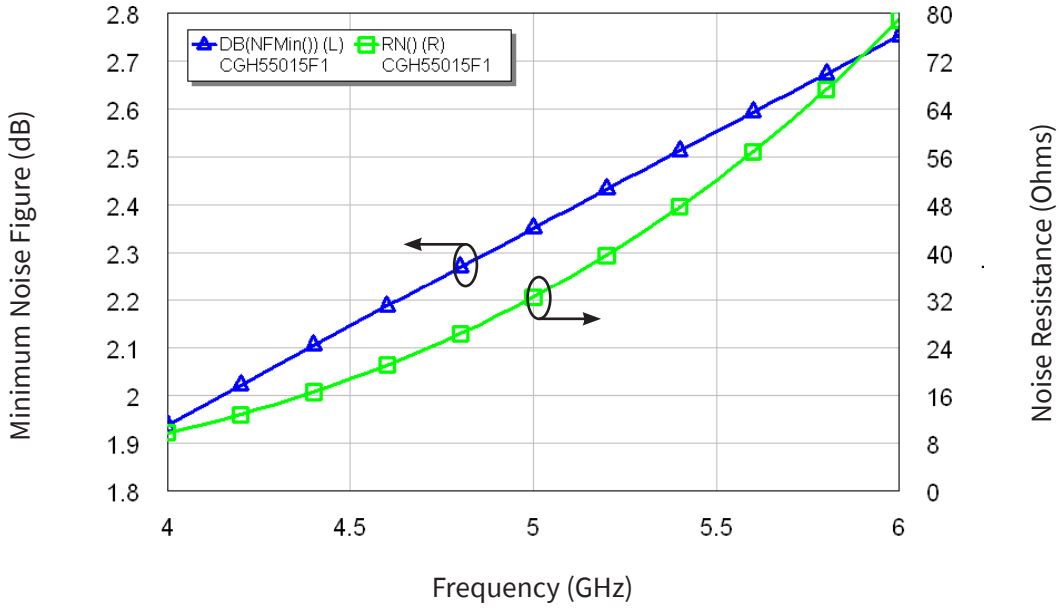
Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH55015F1/P1
V_{DD} = 28 V, I_{DQ} = 115 mA

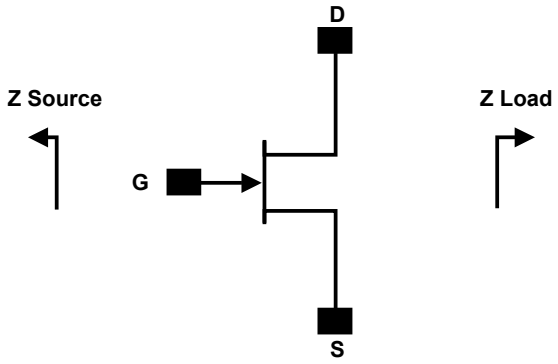


Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH55015F1/P1
V_{DD} = 28 V, I_{DQ} = 115 mA



Source and Load Impedances



Frequency	Z Source	Z Load
5500	8.7 – j30.2	21.6 – j4.7
5650	10.2 – j26.9	24.2 - j5.5
5800	12.3 – j24.3	26.5 - j7.5

Note 1. V_{DD} = 28V, I_{DQ} = 115 mA in the 440166 package.
Note 2. Impedances are extracted from the CGH55015-AMP demonstration amplifierand are not source and load pull data derived from the transistor.

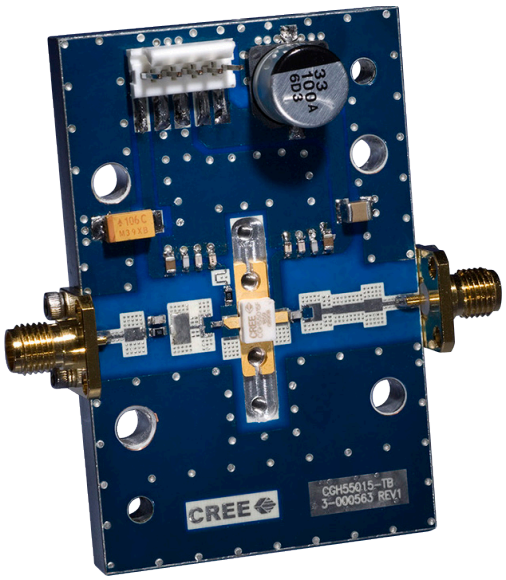
Electrostatic Discharge (ESD) Classifications

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

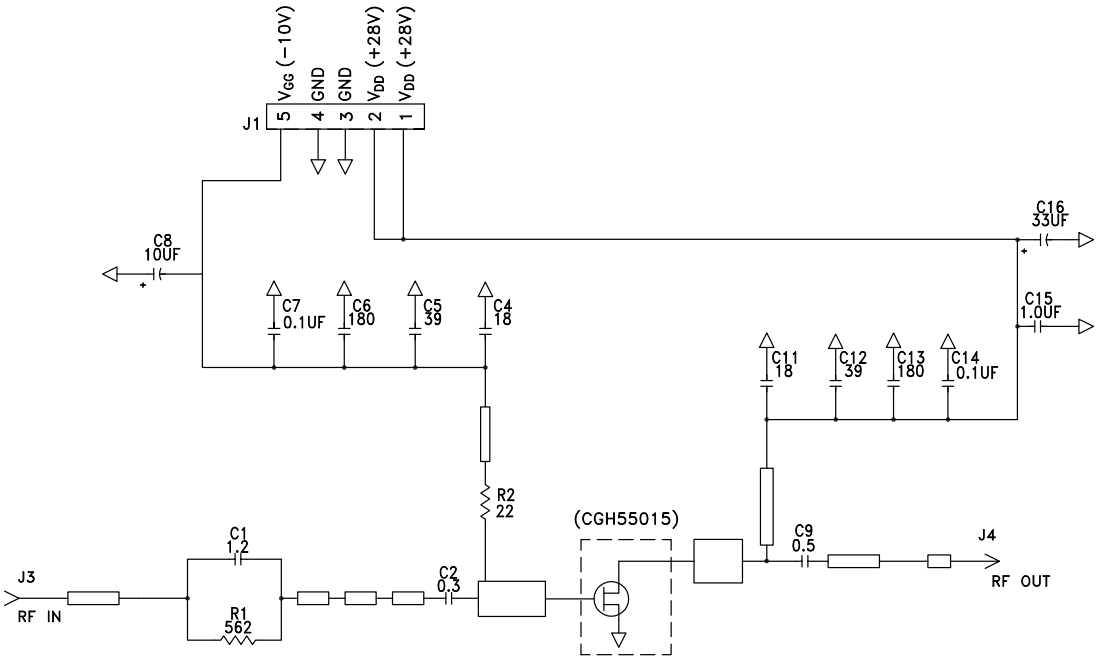
CGH55015-AMP1 Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1	CAP, 1.2pF, +/-0.1 pF, 0603, ATC 600S	1
C2	CAP, 0.3pF, +/-0.05 pF, 0402, ATC 600L	1
C9	CAP, 0.5pF,+/-0.05pF, 0603, ATC 600S	1
C4, C11	CAP, 18pF, +/-5%, 0603, ATC 600S	2
C5, C12	CAP, 39pF +/-5%, 0603, ATC 600S	2
C6, C13	CAP, CER, 180pF, 50V, +/-5%, C0G, 0603	2
C7, C14	CAP, CER, 0.1UF, 50V, +/-10%, X7R, 0805	2
C8	CAP, 10UF, 16V, SMT, TANTALUM	1
C15	CAP, 1.0UF ±10%, 100V, 1210, X7R	1
C16	CAP, 33UF, 100V, ELECT, FK, SMD	1
R1	RES, 1/16W, 0603, 1%, 562 OHMS	1
R2	RES, 1/16W, 0603, 1%, 22 OHMS	1
J1	HEADER RT> PLZ .1 CEN LK 5 POS	1
J3, J4	CONN, SMA, FLANGE	2
-	PCB, RO4350B, Er = 3.48, h = 20 mil	1
-	CGH55015	1

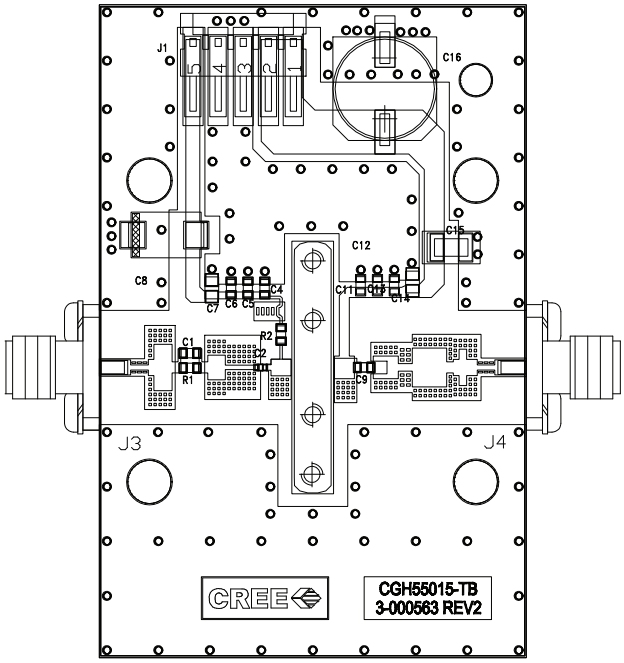
CGH55015-AMP Demonstration Amplifier Circuit



CGH55015-AMP Demonstration Amplifier Circuit Schematic



CGH55015-AMP Demonstration Amplifier Circuit Outline

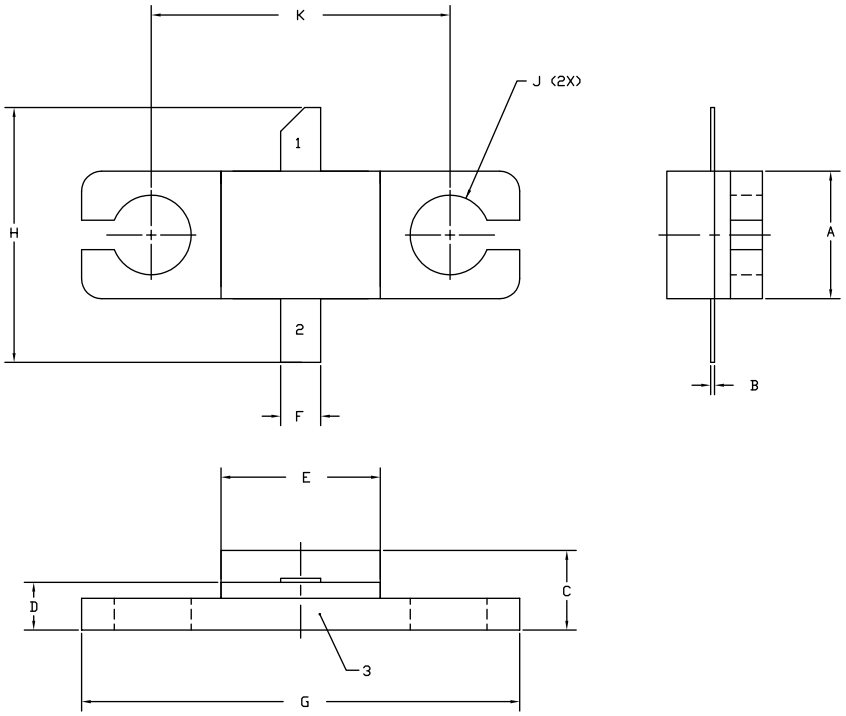


Typical Package S-Parameters for CGH55015 (Small Signal, V_{DS} = 28 V, I_{DQ} = 115 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.909	-125.16	17.56	107.52	0.026	20.86	0.330	-95.81
600 MHz	0.903	-134.72	15.15	101.24	0.027	15.25	0.318	-103.71
700 MHz	0.898	-142.24	13.28	95.96	0.027	10.66	0.312	-109.87
800 MHz	0.895	-148.34	11.79	91.38	0.027	6.76	0.309	-114.77
900 MHz	0.893	-153.43	10.58	87.30	0.028	3.37	0.310	-118.75
1.0 GHz	0.891	-157.78	9.59	83.58	0.028	0.34	0.312	-122.07
1.2 GHz	0.889	-164.93	8.06	76.89	0.028	-4.92	0.320	-127.35
1.4 GHz	0.888	-170.72	6.94	70.90	0.027	-9.46	0.332	-131.53
1.6 GHz	0.888	-175.64	6.08	65.34	0.027	-13.51	0.347	-135.09
1.8 GHz	0.888	-179.99	5.41	60.10	0.027	-17.20	0.362	-138.30
2.0 GHz	0.889	176.04	4.86	55.09	0.026	-20.60	0.378	-141.33
2.2 GHz	0.889	172.35	4.42	50.24	0.025	-23.76	0.394	-144.27
2.4 GHz	0.890	168.84	4.05	45.53	0.025	-26.70	0.410	-147.16
2.6 GHz	0.891	165.46	3.73	40.93	0.024	-29.44	0.426	-150.04
2.8 GHz	0.891	162.16	3.46	36.41	0.024	-31.97	0.441	-152.92
3.0 GHz	0.892	158.90	3.23	31.95	0.023	-34.32	0.455	-155.81
3.2 GHz	0.893	155.67	3.03	27.55	0.022	-36.45	0.469	-158.73
3.4 GHz	0.893	152.43	2.85	23.19	0.021	-38.38	0.482	-161.68
3.6 GHz	0.894	149.18	2.70	18.85	0.021	-40.07	0.494	-164.66
3.8 GHz	0.894	145.89	2.56	14.53	0.020	-41.52	0.506	-167.68
4.0 GHz	0.894	142.54	2.44	10.22	0.019	-42.71	0.516	-170.74
4.1 GHz	0.895	140.85	2.38	8.07	0.019	-43.19	0.521	-172.29
4.2 GHz	0.895	139.14	2.33	5.91	0.019	-43.59	0.526	-173.85
4.3 GHz	0.895	137.40	2.28	3.75	0.018	-43.92	0.530	-175.43
4.4 GHz	0.895	135.65	2.23	1.58	0.018	-44.16	0.535	-177.02
4.5 GHz	0.895	133.88	2.18	-0.59	0.018	-44.32	0.539	-178.62
4.6 GHz	0.895	132.08	2.14	-2.77	0.017	-44.38	0.543	179.75
4.7 GHz	0.895	130.26	2.10	-4.96	0.017	-44.35	0.546	178.11
4.8 GHz	0.895	128.41	2.06	-7.15	0.017	-44.23	0.550	176.45
4.9 GHz	0.895	126.53	2.03	-9.36	0.017	-44.02	0.553	174.77
5.0 GHz	0.895	124.63	1.99	-11.58	0.016	-43.71	0.556	173.07
5.1 GHz	0.895	122.69	1.96	-13.81	0.016	-43.30	0.559	171.35
5.2 GHz	0.895	120.72	1.93	-16.05	0.016	-42.81	0.561	169.60
5.3 GHz	0.895	118.73	1.90	-18.31	0.016	-42.22	0.564	167.83
5.4 GHz	0.895	116.70	1.87	-20.59	0.016	-41.56	0.566	166.04
5.5 GHz	0.895	114.63	1.84	-22.89	0.016	-40.83	0.568	164.21
5.6 GHz	0.895	112.53	1.81	-25.20	0.016	-40.05	0.570	162.36
5.7 GHz	0.895	110.39	1.79	-27.53	0.016	-39.22	0.572	160.47
5.8 GHz	0.895	108.22	1.77	-29.89	0.016	-38.35	0.574	158.55
5.9 GHz	0.895	106.00	1.74	-32.27	0.016	-37.48	0.575	156.60
6.0 GHz	0.895	103.75	1.72	-34.67	0.016	-36.62	0.576	154.61

To download the s-parameters in s2p format, go to the CGH55015F1/P1 Product page and click on the documentation tab.

Product Dimensions CGH55015F1 (Package Type — 440166)



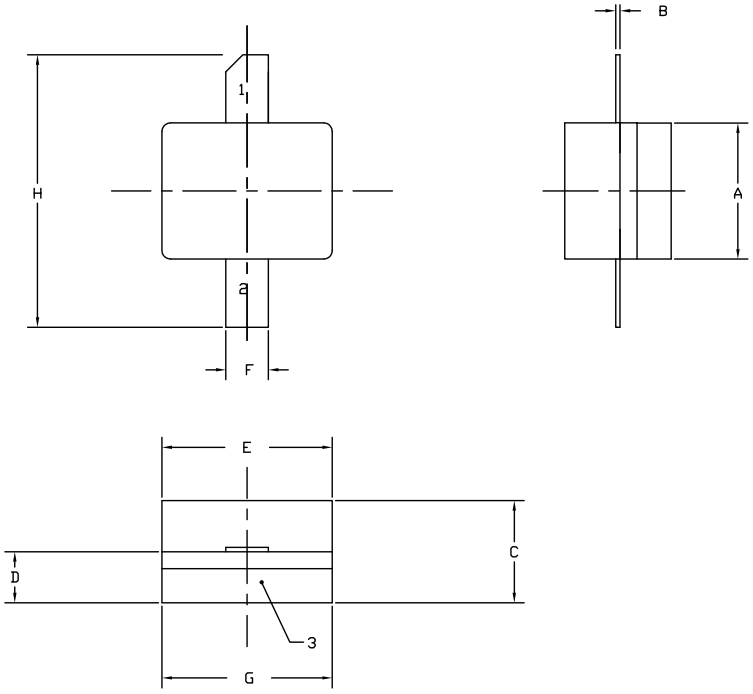
NOTES:

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 CGH55015P1 (Package Type — 440196)



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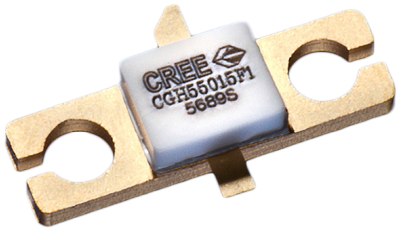
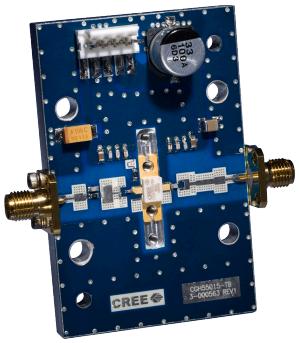
5. ALL PLATED SURFACES ARE NI/AU

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
CGH55015F1	GaN HEMT	Each	
CGH55015P1	GaN HEMT	Each	
CGH55015F1-AMP	Test board with GaN HEMT installed	Each	

For more information, please contact:

4600 Silicon Drive
Durham, North Carolina, USA 27703
www.wolfspeed.com/RF

Sales Contact
RFSales@cree.com

Notes

Disclaimer

Specifications are subject to change without notice. “Typical” parameters are the average values expected by Cree in large quantities and are provided for information purposes only. Cree products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death. No responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from use of the information contained herein. No license is granted by implication or otherwise under any patent or patent rights of Cree.

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