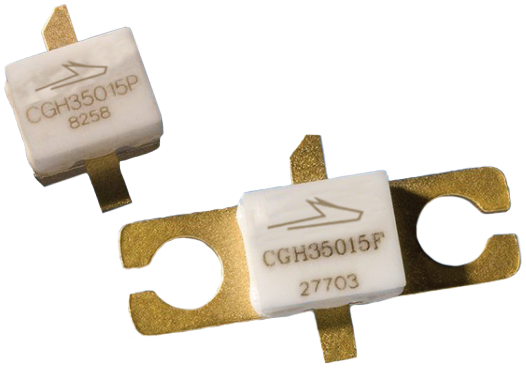
CGH35015

15 W, 3.3-3.9 GHz, 28V, GaN HEMT for WiMAX



Package Types: 440166 and 440196
PNs: CGH35015F and CGH35015P

Description

Wolfspeed's CGH35015 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for 802.16-2004 WiMAX Fixed Access applications. GaN HEMTs offer high efficiency, high gain and wide bandwidth capabilities, which makes the CGH35015 ideal for 3.3-3.9 GHz WiMAX and BWA amplifier applications. The transistor is available in both screw-down, flange and solder-down, pill packages.

Typical Performance Over 3.3-3.8 GHz (T_C = 25°C) of Demonstration Amplifier

Parameter	3.3 GHz	3.4 GHz	3.5 GHz	3.6 GHz	3.7 GHz	3.8 GHz	Units
Small Signal Gain	13.6	12.8	12.3	12.2	12.3	12.8	dB
EVM at P_{AVE} = 24 dBm	2.71	2.31	2.1	2.12	2.54	3.04	%
EVM at P_{AVE} = 33 dBm	2.63	2.29	1.93	1.70	1.70	2.14	%
Drain Efficiency at P_{AVE} = 33 dBm	24.0	25.5	26.1	25.6	23.8	2.38	%

Note:
Measured in the CGH35015F-AMP amplifier circuit, under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, 5ms Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01% Probability on CCDF.

Features

- 3.3 - 3.9 GHz Operation
- 15 W Peak Power Capability
- 12 dB Small Signal Gain
- 2.0 W P_{AVE} at < 2.0% EVM
- 26% Efficiency at 2 W Average Power
- WiMAX Fixed Access 802.16-2004 OFDM
- WiMAX Mobile Access 802.16e OFDMA

Large Signal Models Available for ADS and MWO

RoHS compliant

4600 Silicon Drive | Durham, NC 27703 | Tel: +1.919.313.5300

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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	120	V	25°C
Gate-to-Source Voltage	V_{GS}	-10, +2		
Power Dissipation	P_{DISS}	7	W	
Storage Temperature	T_{STG}	-65, +150	°C	
Operating Junction Temperature	T_J	225		
Maximum Forward Gate Current	I_{GMAX}	4.0	mA	25°C
Maximum Drain Current[1]	I_{DMAX}	1.5	A	
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 CGH35015 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_{DS} = 28 V, I_D = 60 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	$V_{(BR)DSS}$	84	–	–	V_{DC}	V_{GS} = -8 V, I_D = 3.6 mA
RF Characteristics[2, 3] (T_C = 25°C, F_0 = 3.5 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	10.5	12	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Drain Efficiency[4]	η	22	26	–	%	V_{DD} = 28 V, I_{DQ} = 100 mA, P_{AVE} = 2.0 W
Back-Off Error Vector Magnitude	EVM	–	2.5	–		V_{DD} = 28 V, I_{DQ} = 100 mA, P_{AVE} = 18 dBm
Error Vector Magnitude		–		–		V_{DD} = 28 V, I_{DQ} = 100 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} = 100 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	–		
Feedback Capacitance	C_{GD}	–	0.2	–		

Notes:
[1] Measured on wafer prior to packaging
[2] Measured in the CGH35015F-AMP test fixture
[3] Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, 5ms 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}

Typical WiMAX Performance

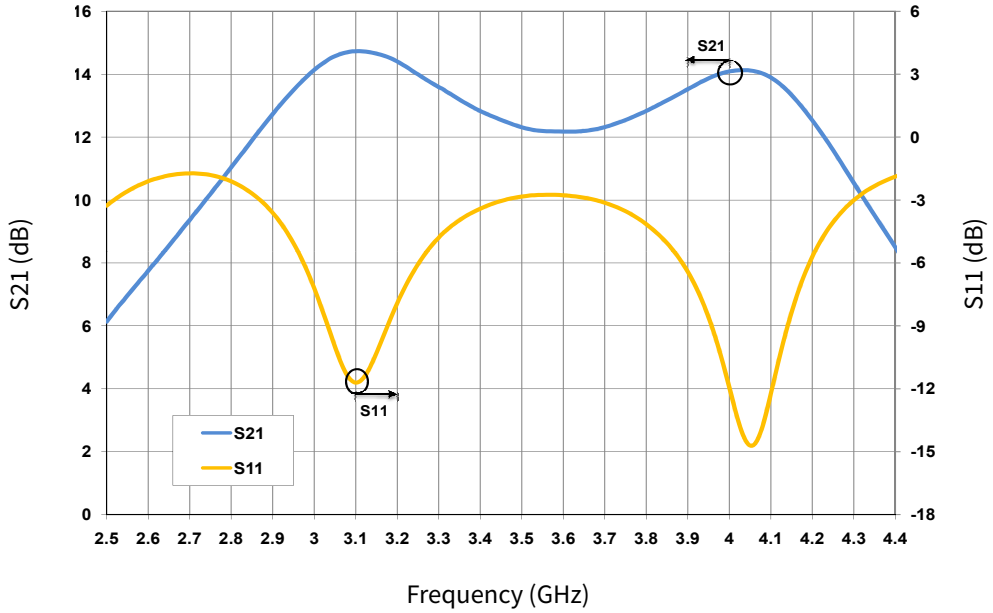


Figure 1. Small Signal S-Parameters vs Frequency measured in the CGH35015F-AMP
V_{DD} = 28 V, I_{DQ} = 100 mA

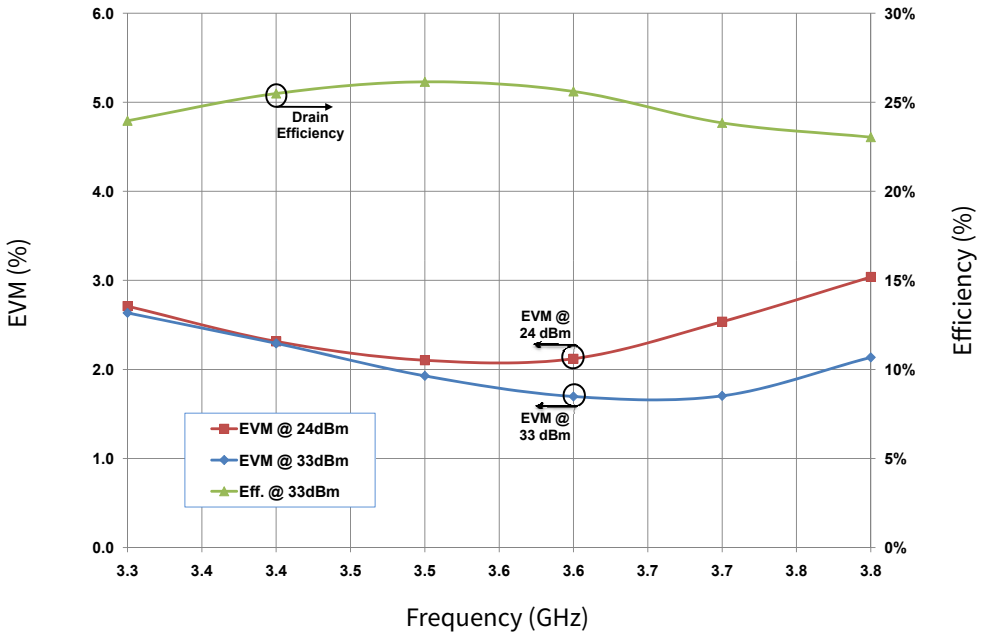


Figure 2. Typical EVM and Efficiency versus Frequency measured in the CGH35015F-AMP
V_{DD} = 28 V, I_{DQ} = 100 mA, 802.16-2004 OFDM, PAR = 9.8 dB

Note:
[1] 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

Typical WiMAX Performance

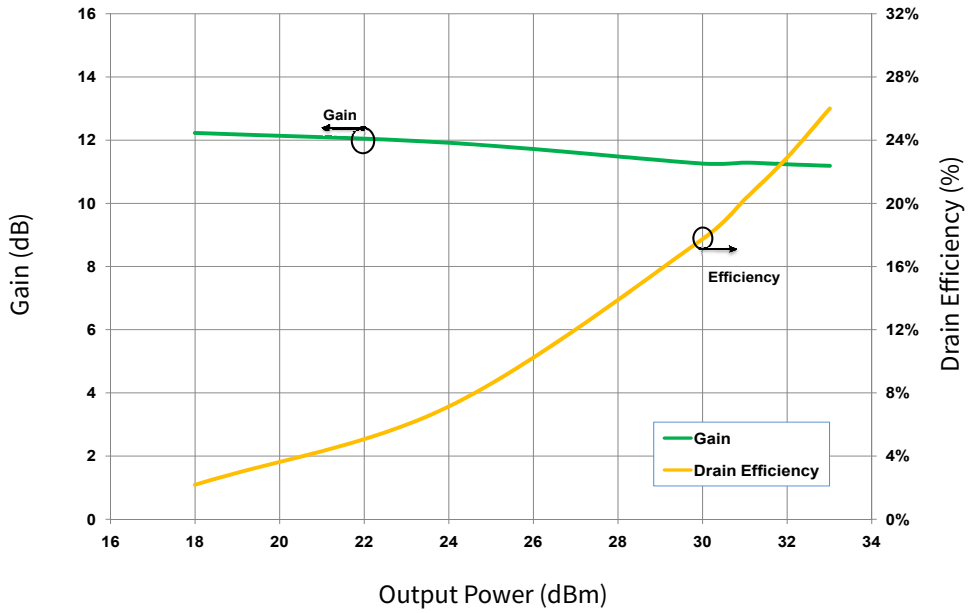


Figure 3. Drain Efficiency and Gain vs Output Power measured in the CGH35015F-AMP
V_{DD} = 28 V, I_{DQ} = 100 mA, 802.16-2004 OFDM, PAR = 9.8 dB

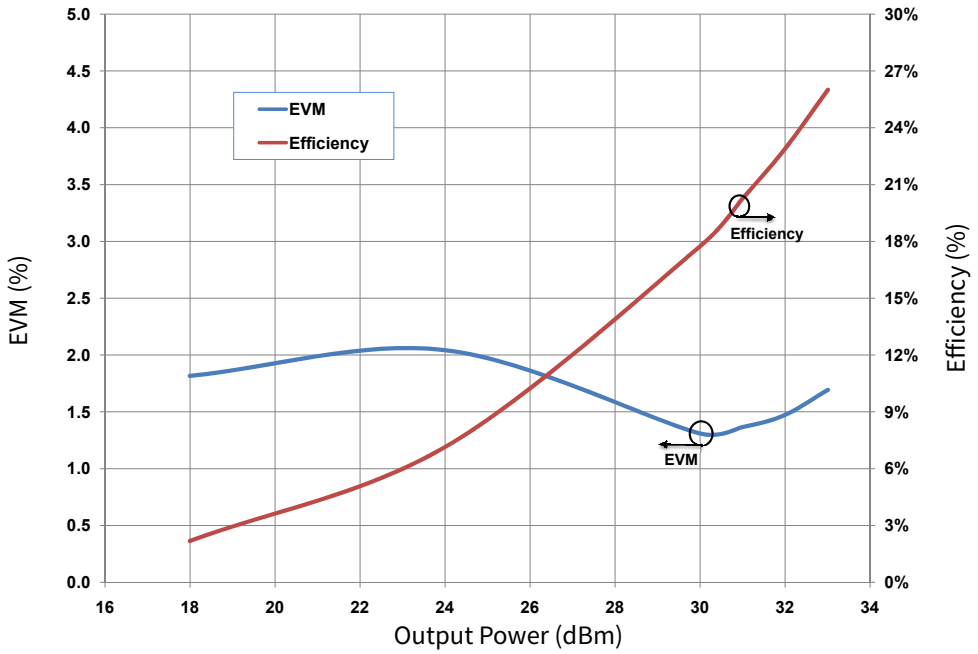


Figure 4. Typical EVM and Efficiency vs Output Power measured in the CGH35015F-AMP
V_{DD} = 28 V, I_{DQ} = 100 mA, 802.16-2004 OFDM, PAR = 9.8 dB

Note:
[1] 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

Typical Performance

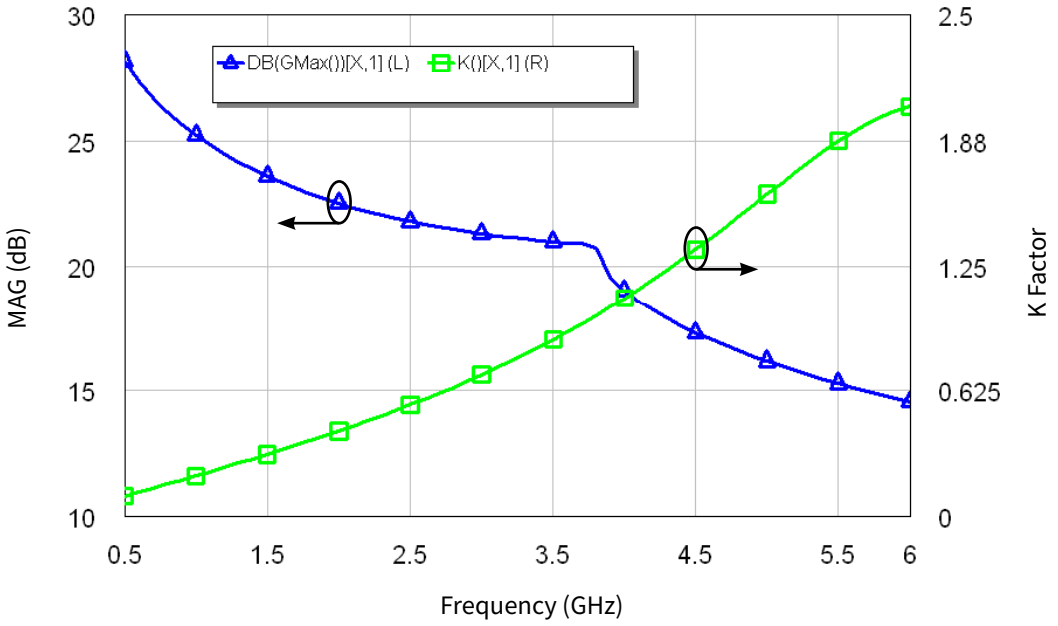


Figure 5. Simulated Maximum Available Gain and K Factor of the CGH35015
V_{DD} = 28 V, I_{DQ} = 100 mA

Typical Noise Performance

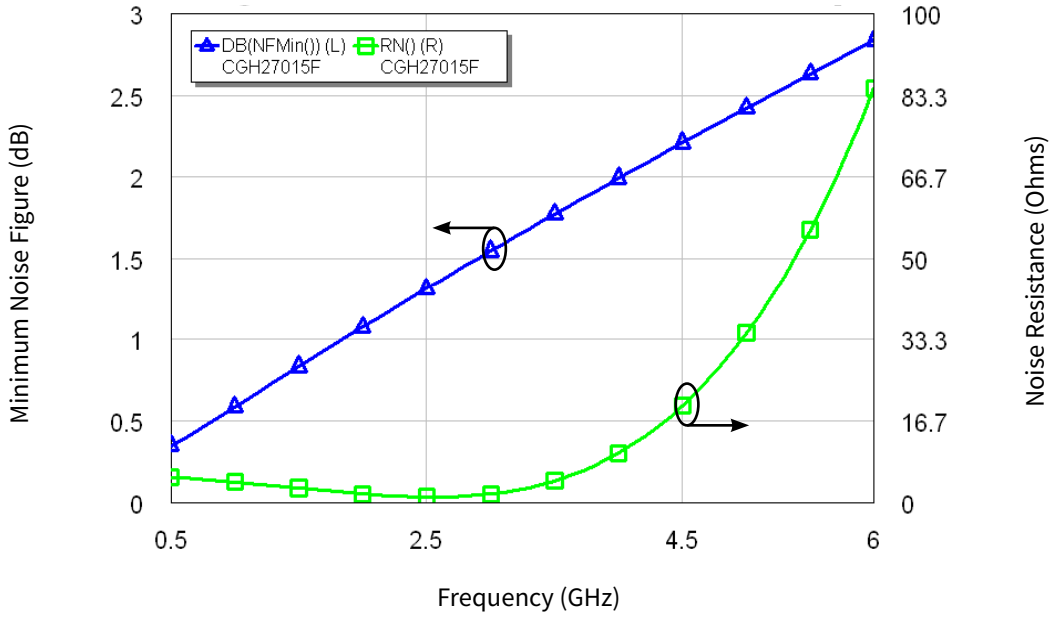
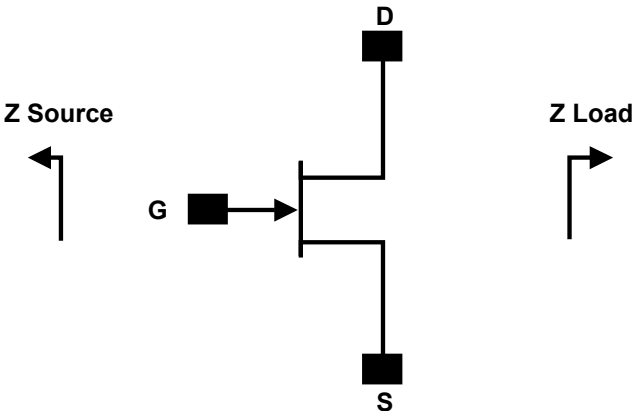


Figure 6. Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH35015
V_{DD} = 28 V, I_{DQ} = 100 mA

Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
3300	13.0 - j5.6	13.2 - j2.8
3400	17.2 - j6.0	13.2 - j2.8
3500	20.8 - j9.9	13.1 - j2.9
3600	20.1 - j15.8	13.1 - j3.3
3700	15.7 - j19.0	12.3 - j3.8

Notes:
[1] V_{DD} = 28V, I_{DQ} = 115 mA in the 440166 package
[2] Impedances are extracted from the CGH35015F-AMP demonstration amplifier and are not source and load pull data derived from the transistor

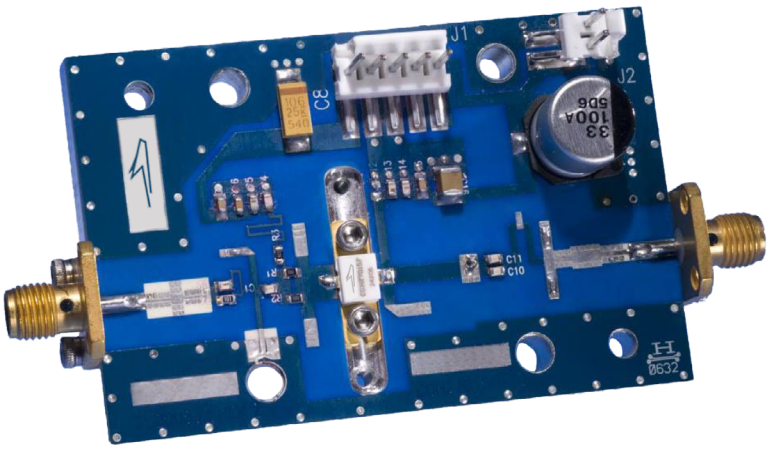
Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	TBD	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	TBD	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C

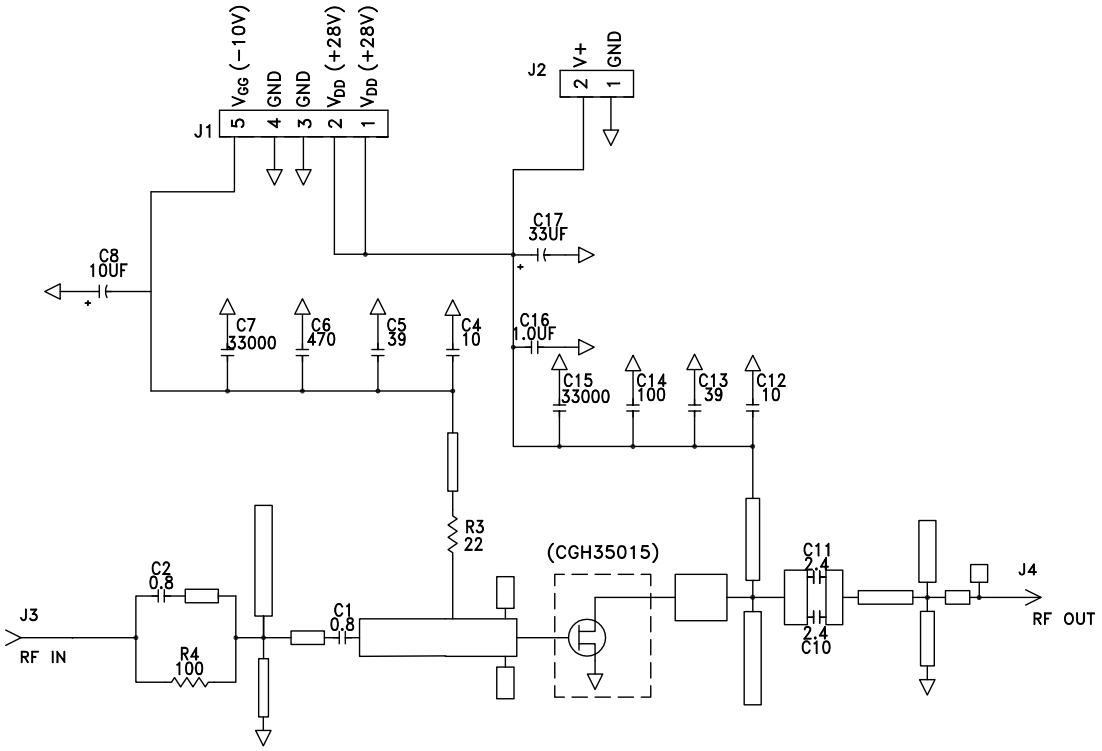
CGH35015F-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1, C2	CAP, 0.8pF, +/-0.1pF, 0603, ATC 600S	2
C10, C11	CAP, 2.4pF,+/-0.1pF, 0603, ATC 600S	2
C4, C12	CAP, 10.0pF, +/-5%, 0603, ATC 600S	1
C5, C13	CAP, 39pF ±5%, 0603, ATC 600S	2
C14	CAP, 100pF ±5%, 0603, ATC 600S	1
C6	CAP, 470pF ±10%, 100V, 0603	1
C7, C15	CAP, 33000pF, 100V, 0805, X7R	2
C8	CAP, 10µF, 16V, SMT, TANTALUM (240096)	1
C16	CAP, 1.0µF ±10%, 100V, 1210, X7R	1
C17	CAP, 33µF, 100V, ELECT, FK, SMD	1
R3	RES, 1/16W, 0603, 22 Ohms ≤5%	1
R4	RES, 1/16W, 0603, 100 Ohms ≤5%	1
J1	5-PIN, MOLEX, MALE, CONNECTOR	1
J2	2-PIN, MOLEX, MALE, CONNECTOR	1
J3, J4	SMA, FEMALE, CONNECTOR	2
-	PCB, RO4350B, Er = 3.48, h = 20 mil	1
-	CGH35015F or CGH35015P	1

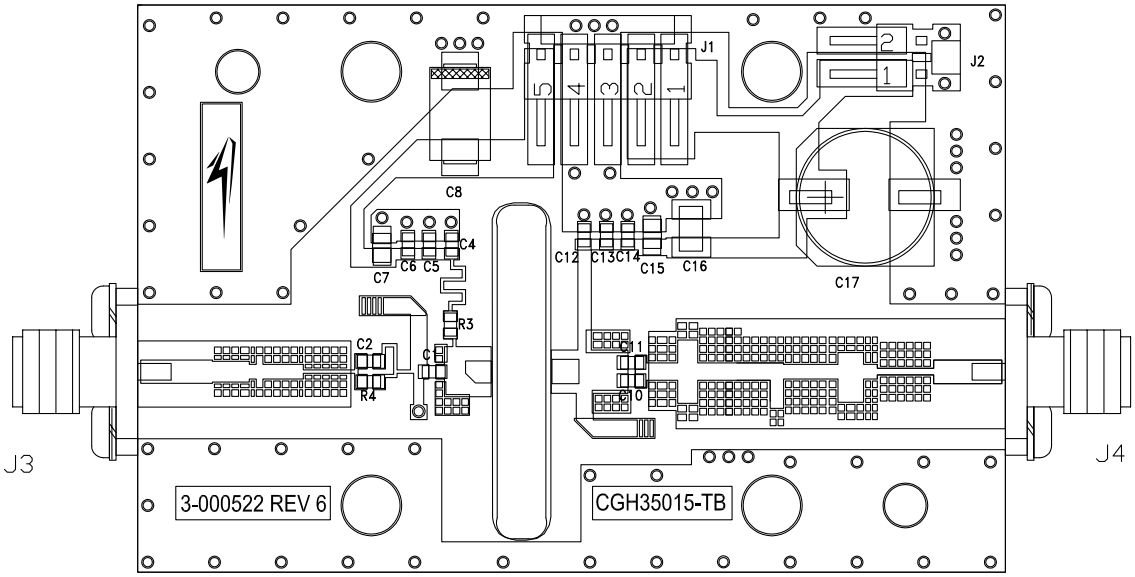
CGH35015F-AMP Demonstration Amplifier Circuit



CGH35015-AMP Demonstration Amplifier Circuit Schematic



CGH35015-AMP Demonstration Amplifier Circuit Outline

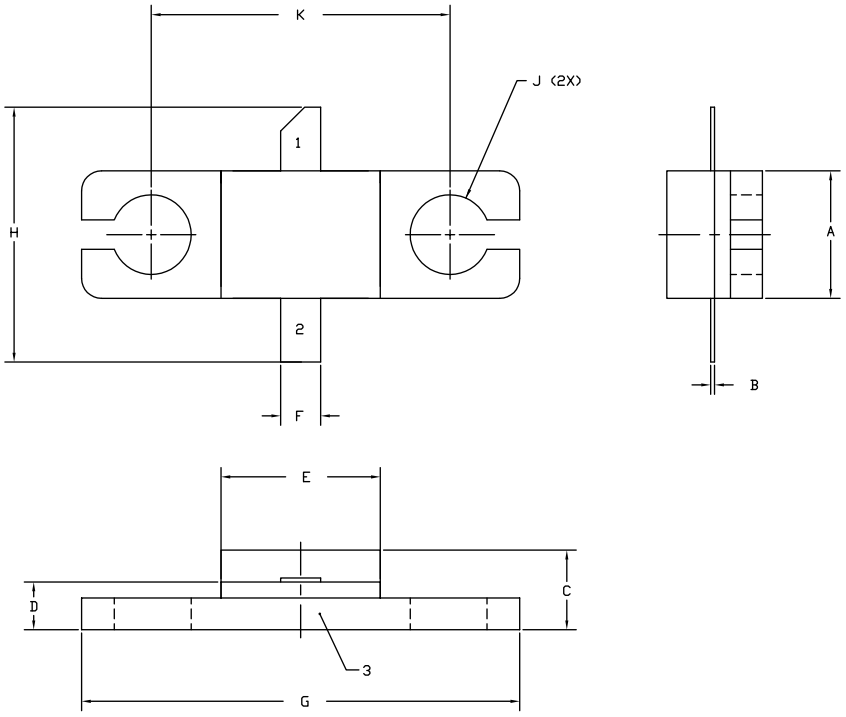


Typical Package S-Parameters for CGH35015
(Small Signal, V_{DS} = 28 V, I_{DQ} = 100 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.909	-124.41	17.41	107.81	0.026	21.06	0.335	-93.73
600 MHz	0.902	-134.04	15.04	101.48	0.027	15.39	0.322	-101.61
700 MHz	0.898	-141.62	13.18	96.16	0.028	10.74	0.315	-107.78
800 MHz	0.894	-147.78	11.71	91.54	0.028	6.79	0.312	-112.73
900 MHz	0.892	-152.91	10.51	87.43	0.028	3.35	0.312	-116.77
1.0 GHz	0.890	-157.30	9.53	83.68	0.028	0.28	0.314	-120.15
1.1 GHz	0.889	-161.12	8.71	80.20	0.028	-2.51	0.318	-123.04
1.2 GHz	0.889	-164.51	8.01	76.95	0.028	-5.07	0.322	-125.57
1.3 GHz	0.888	-167.56	7.41	73.86	0.028	-7.45	0.328	-127.82
1.4 GHz	0.888	-170.34	6.89	70.91	0.028	-9.69	0.335	-129.87
1.5 GHz	0.888	-172.91	6.44	68.07	0.028	-11.81	0.342	-131.77
1.6 GHz	0.888	-175.30	6.04	65.32	0.028	-13.82	0.349	-133.56
1.7 GHz	0.888	-177.55	5.69	62.65	0.027	-15.74	0.357	-135.25
1.8 GHz	0.888	-179.68	5.37	60.05	0.027	-17.58	0.364	-136.89
1.9 GHz	0.888	178.29	5.09	57.50	0.027	-19.34	0.373	-138.48
2.0 GHz	0.888	176.34	4.83	55.01	0.027	-21.04	0.381	-140.03
2.1 GHz	0.889	174.45	4.60	52.56	0.026	-22.69	0.389	-141.55
2.2 GHz	0.889	172.63	4.39	50.14	0.026	-24.27	0.397	-143.06
2.3 GHz	0.889	170.84	4.20	47.76	0.026	-25.80	0.405	-144.56
2.4 GHz	0.889	169.10	4.02	45.41	0.025	-27.28	0.413	-146.04
2.5 GHz	0.890	167.39	3.86	43.09	0.025	-28.70	0.421	-147.52
2.6 GHz	0.890	165.71	3.71	40.79	0.025	-30.08	0.429	-149.00
2.7 GHz	0.891	164.04	3.57	38.51	0.024	-31.41	0.437	-150.48
2.8 GHz	0.891	162.39	3.44	36.26	0.024	-32.69	0.445	-151.95
2.9 GHz	0.891	160.76	3.32	34.01	0.024	-33.92	0.452	-153.43
3.0 GHz	0.892	159.13	3.21	31.79	0.023	-35.10	0.459	-154.92
3.2 GHz	0.892	155.89	3.00	27.38	0.023	-37.31	0.473	-157.90
3.4 GHz	0.893	152.65	2.83	23.00	0.022	-39.32	0.486	-160.90
3.6 GHz	0.893	149.39	2.67	18.66	0.021	-41.09	0.499	-163.93
3.8 GHz	0.894	146.09	2.54	14.34	0.020	-42.63	0.510	-166.99
4.0 GHz	0.894	142.74	2.41	10.02	0.020	-43.90	0.521	-170.10
4.2 GHz	0.895	139.33	2.31	5.70	0.019	-44.88	0.530	-173.24
4.4 GHz	0.895	135.84	2.21	1.37	0.018	-45.53	0.539	-176.45
4.6 GHz	0.895	132.26	2.12	-2.98	0.018	-45.84	0.547	-179.71
4.8 GHz	0.895	128.59	2.04	-7.36	0.017	-45.78	0.554	176.97
5.0 GHz	0.895	124.80	1.97	-11.79	0.016	-45.32	0.561	173.56
5.2 GHz	0.895	120.90	1.91	-16.27	0.016	-44.47	0.566	170.07
5.4 GHz	0.895	116.87	1.85	-20.81	0.016	-43.25	0.571	166.48
5.6 GHz	0.895	112.70	1.80	-25.41	0.015	-41.72	0.575	162.78
5.8 GHz	0.895	108.38	1.75	-30.10	0.015	-39.97	0.579	158.96
6.0 GHz	0.895	103.92	1.70	-34.88	0.016	-38.13	0.581	155.00

To download the s-parameters in s2p format, go to the CGH35015 Product Page and click on the documentation tab.

Product Dimensions CGH35015F (Package Type — 440166)



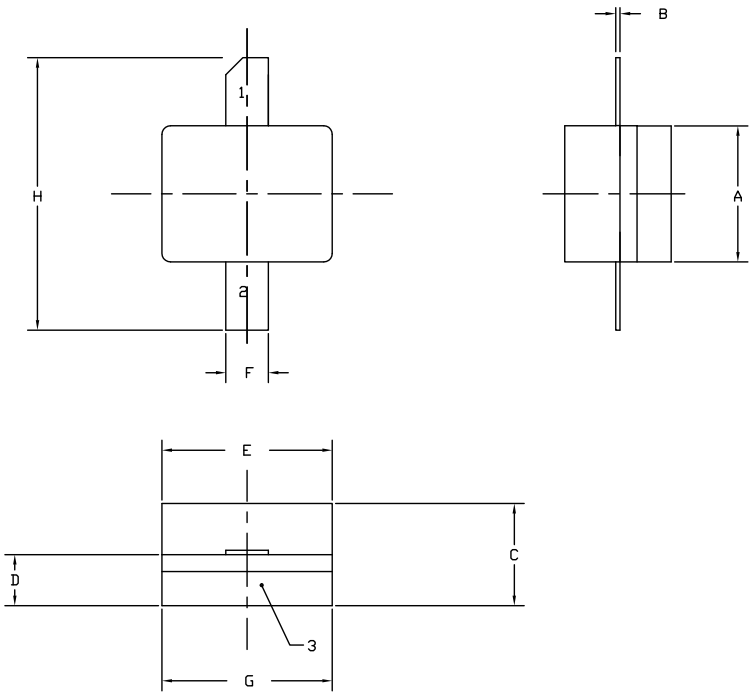
NOTES:

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 CGH35015P (Package Type — 440196)



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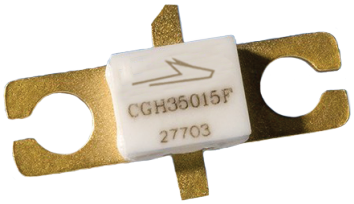
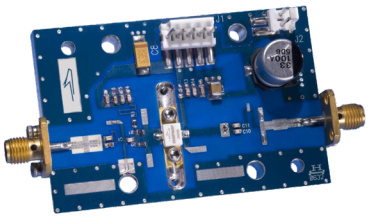
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.155	0.165	3.94	4.19
B	0.003	0.006	0.10	0.15
C	0.115	0.135	2.92	3.17
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.195	0.205	4.95	5.21
H	0.280	0.360	7.11	9.14

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

Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGH35015F	GaN HEMT	Each	
CGH35015P	GaN HEMT	Each	
CGH35015-AMP	Test board with GaN HEMT installed	Each	

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