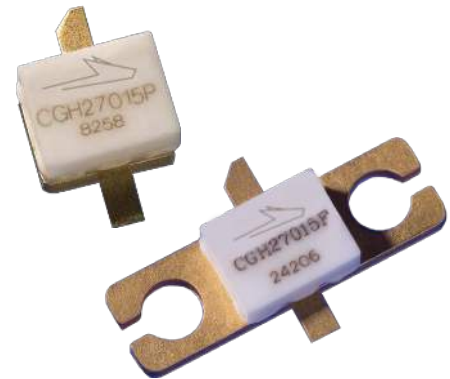


# CGH27015

15 W, 28 V, GaN HEMT for Linear Communications ranging from VHF to 3 GHz

## Description

WolfSpeed's CGH27015 is a gallium nitride (GaN) high electron mobility transistor designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH27015 ideal for VHF, Comms, 3G, 4G, LTE, 2.3-2.9 GHz WiMAX and BWA amplifier applications. The unmatched transistor is available in both screw-down, flange and solder-down, pill packages.



Package Types: 440166 and 440196  
PNs: CGH27015F and CGH27015P

## Typical Performance Over 2.3-2.7 GHz ( $T_c = 25^\circ\text{C}$ )

Parameter	2.3 GHz	2.4 GHz	2.5 GHz	2.6 GHz	2.7 GHz	Unit
Small Signal Gain	16.9	16.0	15.1	14.6	14.3	dB
EVM at $P_{AVE} = 33$ dBm	1.69	1.51	1.50	1.66	1.93	%
Drain Efficiency at $P_{AVE} = 33$ dBm	27.1	27.8	28.4	28.0	28.0	dB

### Notes:

<sup>1</sup> Measured in the CGH27015F-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

- VHF - 3.0 GHz Operation
- 15 W Peak Power Capability
- 14.5 dB Small Signal Gain
- 2 W  $P_{AVE} < 2.0\%$  EVM
- 28% Efficiency at 2 W Average Power
- Designed for WiMAX Fixed Access 802.16-2004 OFDM Applications
- Designed for WiMAX Mobile Access 802.16e OFDMA Applications







## 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		
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 <sup>1</sup>	$I_{DMAX}$	1.5	A	
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
Thermal Resistance, Junction to Case <sup>3</sup>	$R_{\theta JC}$	8.0	°C/W	85°C
Case Operating Temperature <sup>3</sup>	$T_C$	-40, +150	°C	

### Notes:

<sup>1</sup> Current limit for long term, reliable operation

<sup>2</sup> Refer to the Application Note on soldering at [wolfspeed.com/rf/document-library](http://wolfspeed.com/rf/document-library)

<sup>3</sup> Measured for the CGH27015F at  $P_{DISS} = 14$  W

## Electrical Characteristics ( $T_C = 25^\circ\text{C}$ )

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics<sup>1</sup></b>						
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, $I_{DQ} = 100$ 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
<b>RF Characteristics<sup>2,3</sup> (<math>T_C = 25^\circ\text{C}</math>, <math>F_0 = 2.5</math> GHz unless otherwise noted)</b>						
Small Signal Gain	$G_{SS}$	13	15	—	dB	$V_{DD} = 28$ V, $I_{DQ} = 100$ mA
Drain Efficiency <sup>4</sup>	$\eta$	20	28	—	%	$V_{DD} = 28$ V, $I_{DQ} = 100$ mA, $P_{AVE} = 33$ dBm
Error Vector Magnitude	EVM	—	2.0	—		
Output Mismatch Stress	VSWR	—	—	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 100$ mA, $P_{AVE} = 33$ dBm OFDM $P_{AVE}$
<b>Dynamic Characteristics</b>						
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:

<sup>1</sup> Measured in the CGH27015F-AMP test fixture

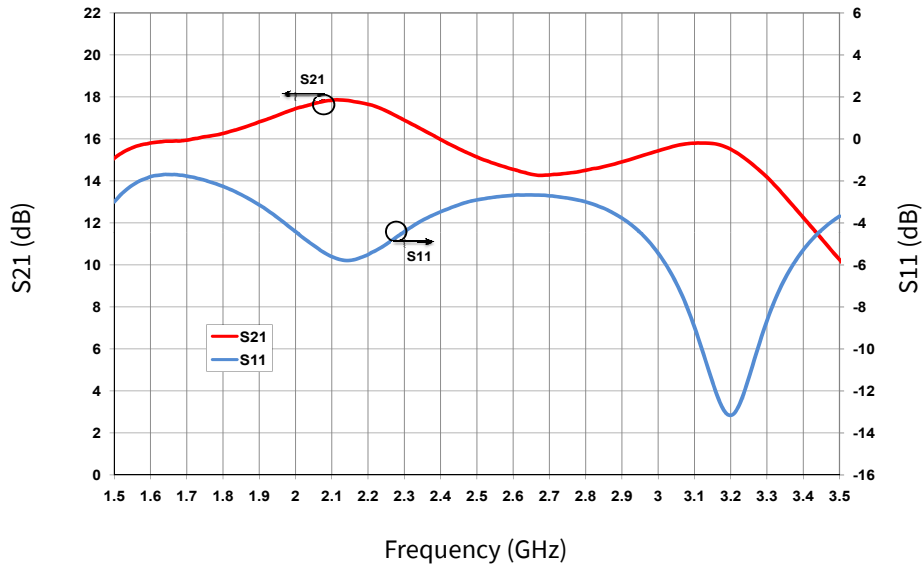
<sup>2</sup> Scaled from PCM data

<sup>3</sup> 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

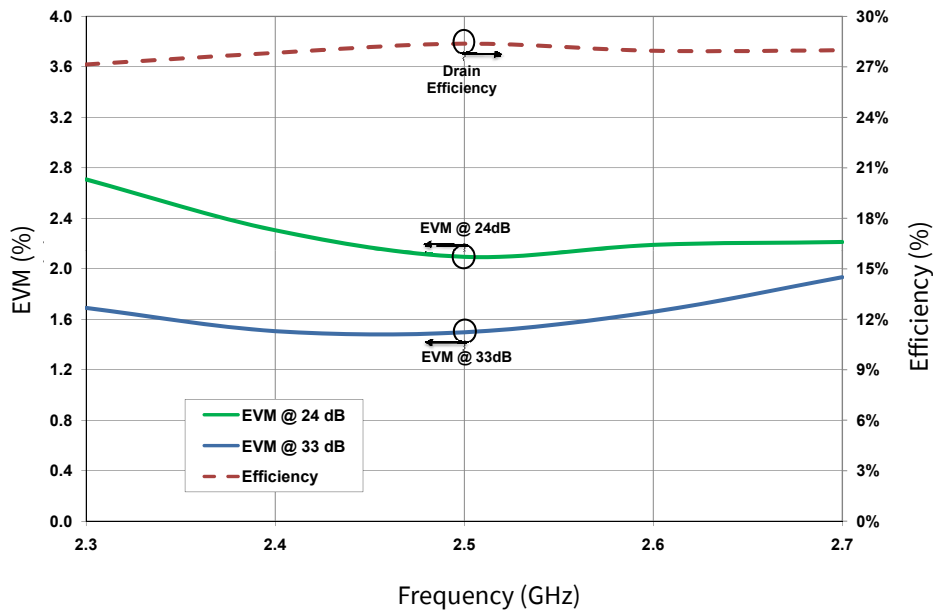
<sup>4</sup> Drain Efficiency =  $P_{OUT}/P_{DC}$



**Typical Performance Data**



**Figure 1.** Performance of CGH27015 in Broadband Amplifier Circuit  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 100\text{ mA}$



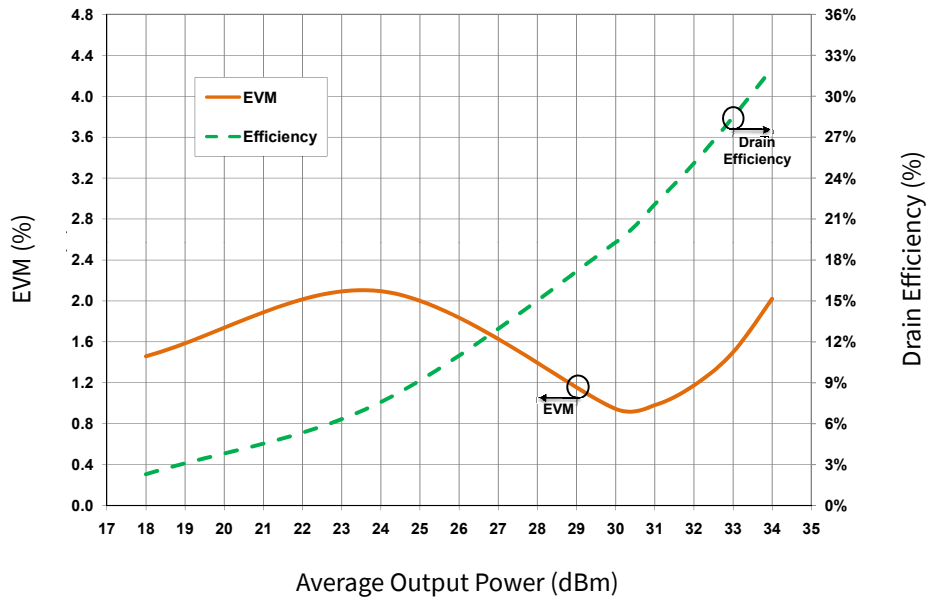
**Figure 2.** Typical EVM and Efficiency at 24 dBm and 33 dBm vs Frequency of CGH27015 in Broadband Amplifier Circuit

Note:

<sup>1</sup> 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.

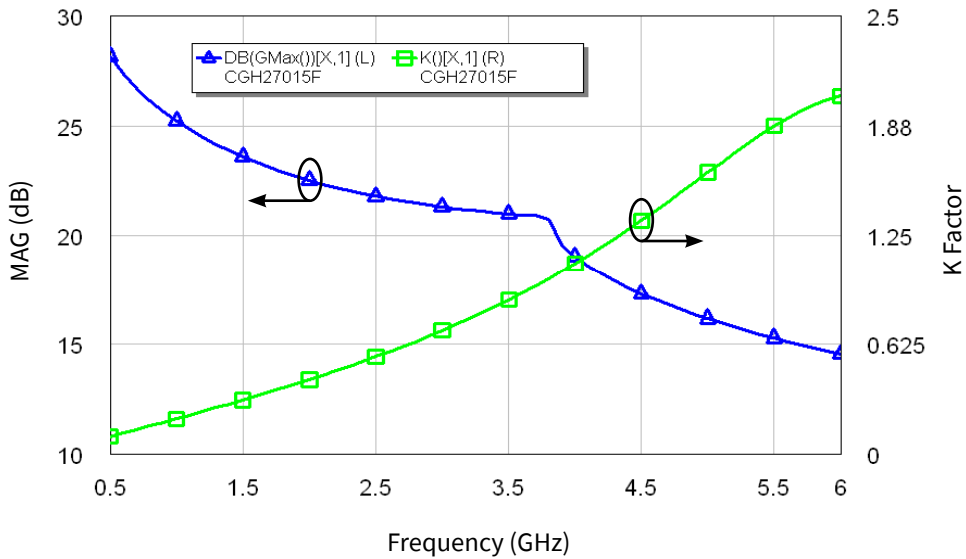


Typical Performance Data



**Figure 3.** Typical EVM and Efficiency of CGH27015 in Broadband Amplifier Circuit at 2.5 GHz  
 $f = 2.5 \text{ GHz}$ , 802.16-2004 OFDM, P/A = 9.8 dB

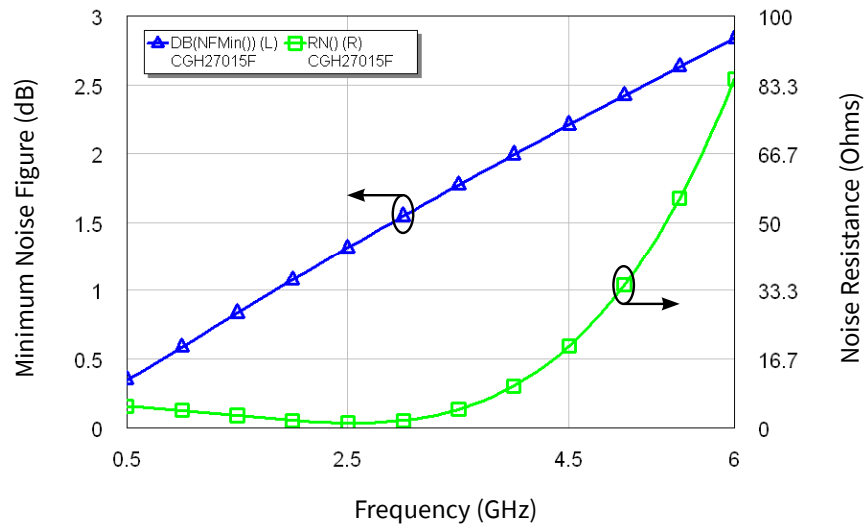
Note:  
<sup>1</sup> Under 802.16-2004 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3.



**Figure 4.** Simulated Maximum Available Gain and K Factor of the CGH27015F  
 $V_{DD} = 28 \text{ V}$ ,  $I_{DQ} = 100 \text{ mA}$



### Typical Noise Performance

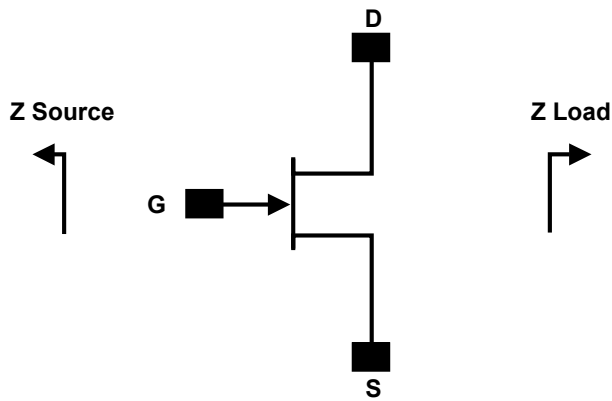


**Figure 5.** Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH27015  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 100\text{ mA}$

### 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

### Source and Load Impedances



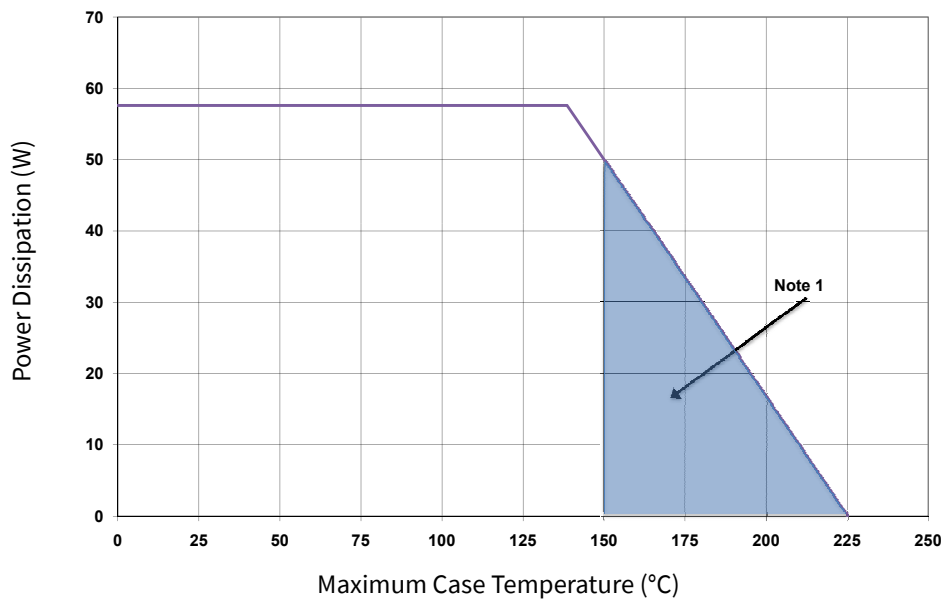
Frequency (MHz)	Z Source	Z Load
2300	17.8 - j1.5	16.8 - j1.7
2400	20.3 - j4.0	16.9 - j0.8
2500	20.6 - j7.9	17.2 + j0.2
2600	18.2 - j11.3	17.7 + j1.3
2700	14.6 - j12.6	19.1 + j2.4

Notes:

<sup>1</sup>  $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$ . In the 440166 package

<sup>2</sup> Impedances are extracted from CGH27015-AMP demonstration circuit and are not source and load pull data derived from the transistor

### CGH27015 Power Dissipation De-rating Curve



Note:

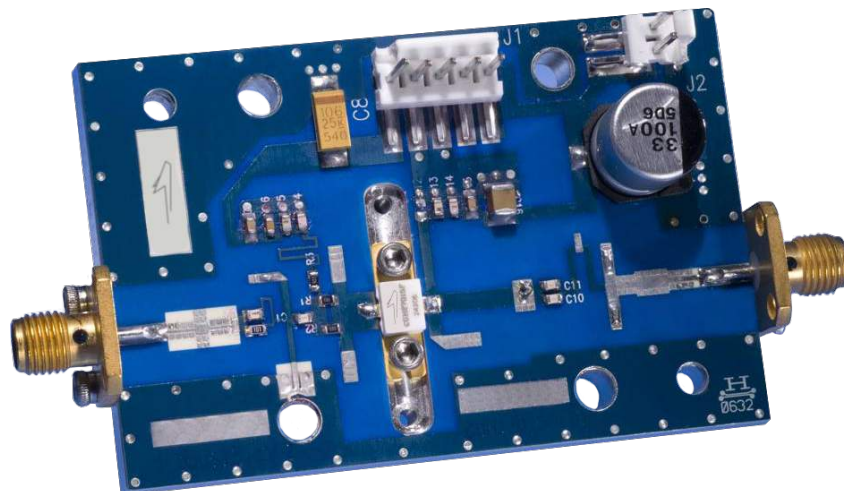
<sup>1</sup> Area exceeds Maximum Case Operating Temperature (See Page 2)



## CGH27015-AMP Demonstration Amplifier Circuit Bill of Materials

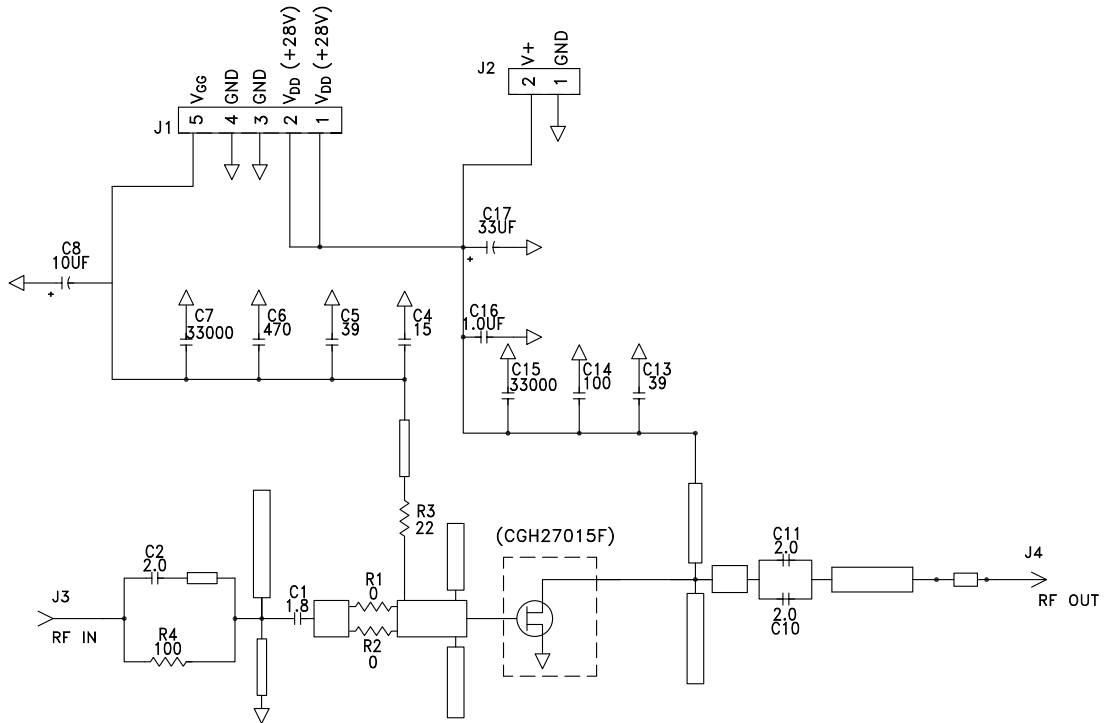
Designator	Description	Qty
R1, R2	RES, 1/16W, 0603, 1%, 0 OHMS	2
R4	RES, 1/16W, 0603, 1%, 100 OHMS	1
R3	RES, 1/16W, 0603, 1%, 22.6 OHMS	1
C6	CAP, 470pF, 5%, 100V, 0603	1
C17	CAP, 33 $\mu$ F, 20%, G CASE	1
C16	CAP, 1.0 $\mu$ F, 100V, 10%, X7R, 1210	1
C8	CAP, 10 $\mu$ F, 16V TANTALUM	1
C14	CAP, 100.0pF, +/-5%, 0603	1
C4	CAP, 15pF, +/-5%, 0603	1
C1	CAP, 1.8pF, +/-0.1pF, 0603	1
C2, C10, C11	CAP, 2.0pF, +/-0.1pF, 0603	3
C5, C13	CAP, 39pF, +/-5%, 0603	2
C7, C15	CAP, 33000pF, 0805, 100V, X7R	2
J3, J4	CONN SMA STR PANEL JACK RECP	1
J2	HEADER RT>PLZ.1CEN LK 2 POS	1
J1	HEADER RT>PLZ .1CEN LK 5POS	1
—	PCB, RO4350B, Er = 3.48, h = 20 mil	1
—	CGH27015F or CGH27015P	1

## CGH27015-AMP Demonstration Amplifier Circuit

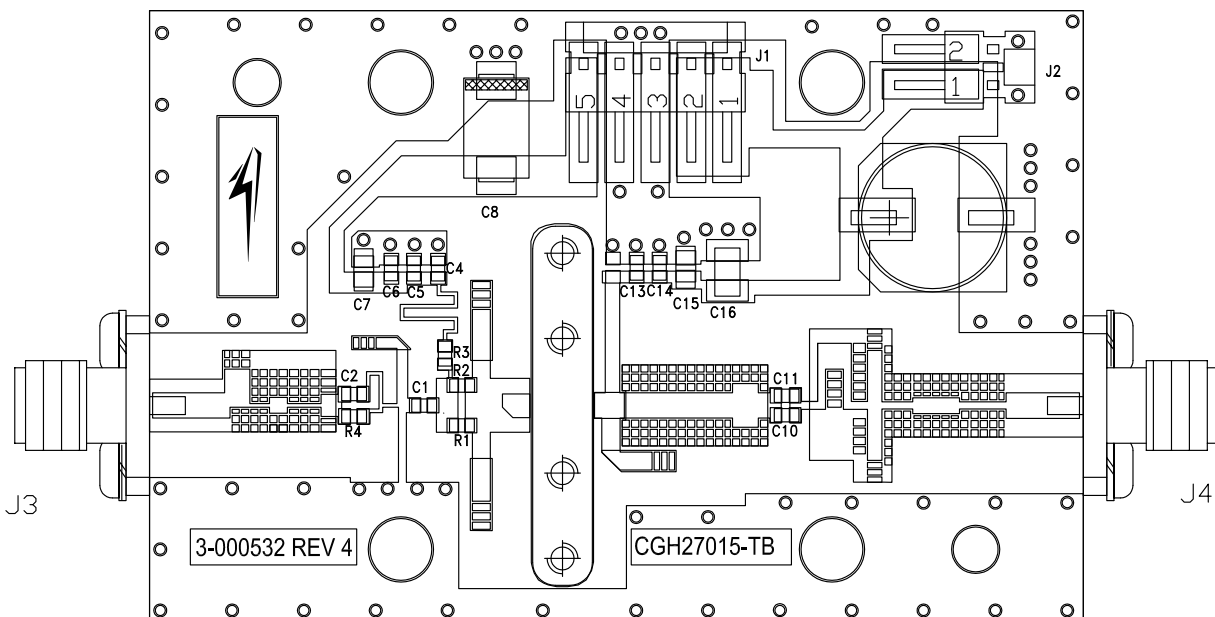




### CGH27015-AMP Demonstration Amplifier Circuit Schematic



### CGH27015-AMP Demonstration Amplifier Circuit Outline







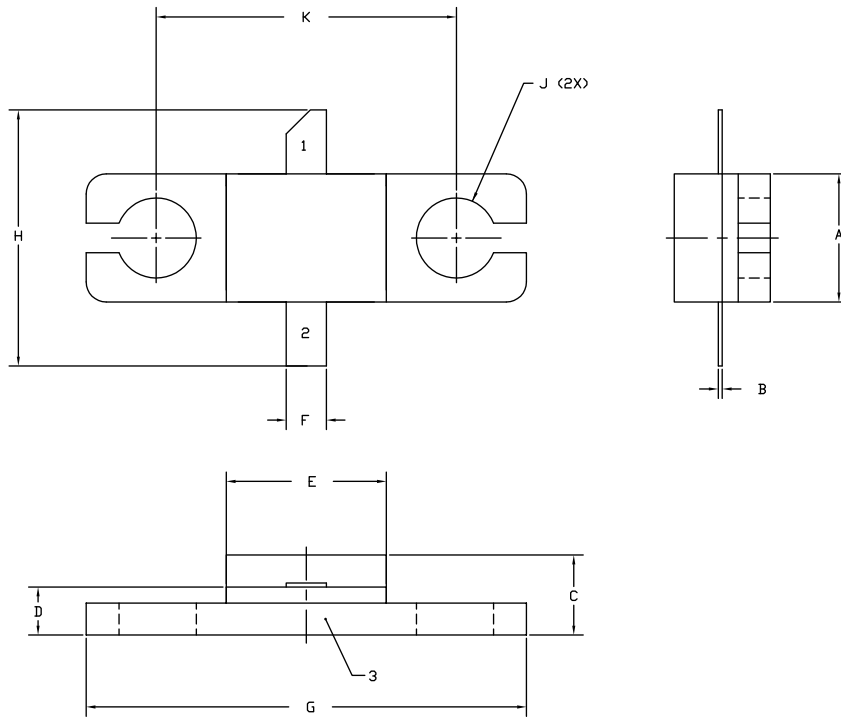
**Typical Package S-Parameters for CGH27015**  
 (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 100\text{ mA}$ , angle in degrees)

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 [CGH27015 Product page](#) and click on the documentation tab.



**Product Dimensions CGH27015F (Package Type — 440166)**



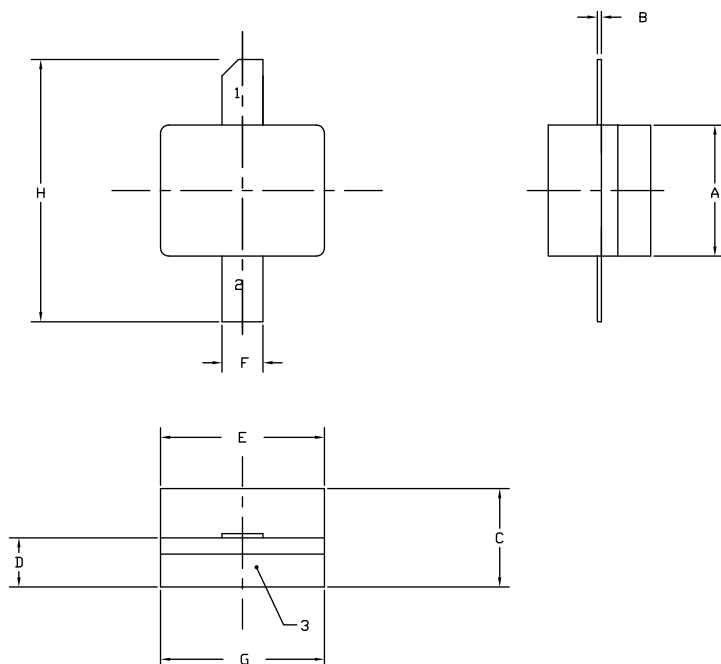
NOTES:

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 CGH27015P (Package Type — 440196)**



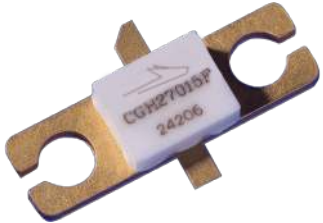

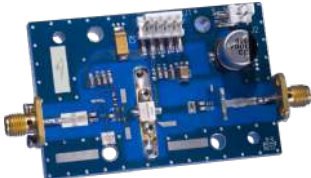
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DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.155	0.165	3.94	4.19
B	0.003	0.006	0.10	0.15
C	0.115	0.135	2.92	3.17
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.195	0.205	4.95	5.21
H	0.280	0.360	7.11	9.14

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

**Product Ordering Information**

Order Number	Description	Unit of Measure	Image
CGH27015F	GaN HEMT	Each	
CGH27015P	GaN HEMT	Each	
CGH27015F-AMP	Test board with GaN HEMT installed	Each	

**For more information, please contact:**

4600 Silicon Drive  
Durham, NC 27703 USA  
Tel: +1.919.313.5300  
[www.wolfspeed.com/RF](http://www.wolfspeed.com/RF)

Sales Contact  
[RFSales@wolfspeed.com](mailto:RFSales@wolfspeed.com)

RF Product Marketing Contact  
[RFMarketing@wolfspeed.com](mailto:RFMarketing@wolfspeed.com)

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