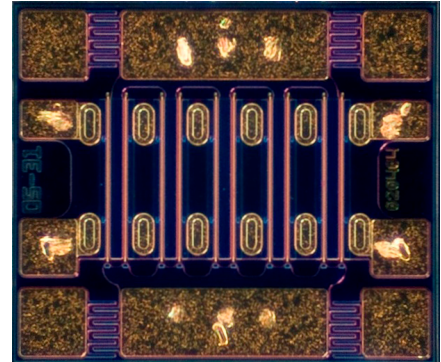


# CGH60015D

15 W, 6.0 GHz, GaN HEMT Die

## Description

WolfSpeed's CGH60015D is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT). GaN has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity, and higher thermal conductivity. GaN HEMTs offer greater power density and wider bandwidths compared to Si and GaAs transistors.



PN: CGH60015D

## Features

- 15 dB Typical Small Signal Gain at 4 GHz
- 12 dB Typical Small Signal Gain at 6 GHz
- 15 W Typical  $P_{SAT}$
- 28 V Operation
- High Breakdown Voltage
- High Temperature Operation
- Up to 6 GHz Operation
- High Efficiency

## Applications

- 2-Way Private Radio
- Broadband Amplifiers
- Cellular Infrastructure
- Test Instrumentation
- Class A, AB, Linear amplifiers suitable for OFDM, W-CDMA, EDGE, CDMA waveforms

## Packaging Information



- Bare die are shipped in Gel-Pak® containers
- Non-adhesive tacky membrane immobilizes die during shipment

 Large Signal Models Available for ADS and MWO





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

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	$V_{DS}$	120	$V_{DC}$	25°C
Gate-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	
Thermal Resistance, Junction to Case (packaged) <sup>2</sup>	$R_{\theta JC}$	8.0	°C/W	85°C
Thermal Resistance, Junction to Case (die only)		5.1		
Mounting Temperature (30 seconds)	$T_s$	320	°C	30 seconds

Notes:

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

<sup>2</sup> Eutectic die attach using 80/20 AuSn mounted to a 40 mil thick CuMoCu carrier

## Electrical Characteristics (Frequency = 4 GHz unless otherwise stated; $T_c = 25^\circ\text{C}$ )

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics</b>						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	-2.3	V	$V_{DS} = 10\text{ V}, I_D = 3.6\text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	—	-2.7	—	$V_{DC}$	$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}$
Drain Current	$I_{DS}$	2.9	3.5	—	A	$V_{DS} = 6.0\text{ V}, V_{GS} = 2.0\text{ V}$
Drain-Source Breakdown Voltage	$V_{BD}$	84	—	—	V	$V_{GS} = -8\text{ V}, I_D = 3.6\text{ mA}$
On Resistance	$R_{ON}$	—	1.0	—	$\Omega$	$V_{DS} = 0.1\text{ V}$
Gate Forward Voltage	$V_{G-ON}$	—	1.9	—	V	$I_{GS} = 3.6\text{ mA}$
<b>RF Characteristics</b>						
Small Signal Gain	$G_{SS}$	—	15	—	dB	$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}$
Saturated Power Output <sup>1</sup>	$P_{SAT}$	—		—	W	
Drain Efficiency <sup>2</sup>	$\eta$	—	65	—	%	$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}, P_{SAT} = 15\text{ W}$
Intermodulation Distortion	IM3	—	-30	—	dBc	$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}, P_{OUT} = 15\text{ W PEP}$
Output Mismatch Stress	VSWR	—	—	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}, P_{OUT} = 15\text{ W CW}$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	—	4.1	—	pF	$V_{DS} = 28\text{ V}, V_{GS} = -8\text{ V}, f = 1\text{ MHz}$
Output Capacitance	$C_{DS}$	—	0.9	—		
Feedback Capacitance	$C_{GD}$	—	0.2	—		

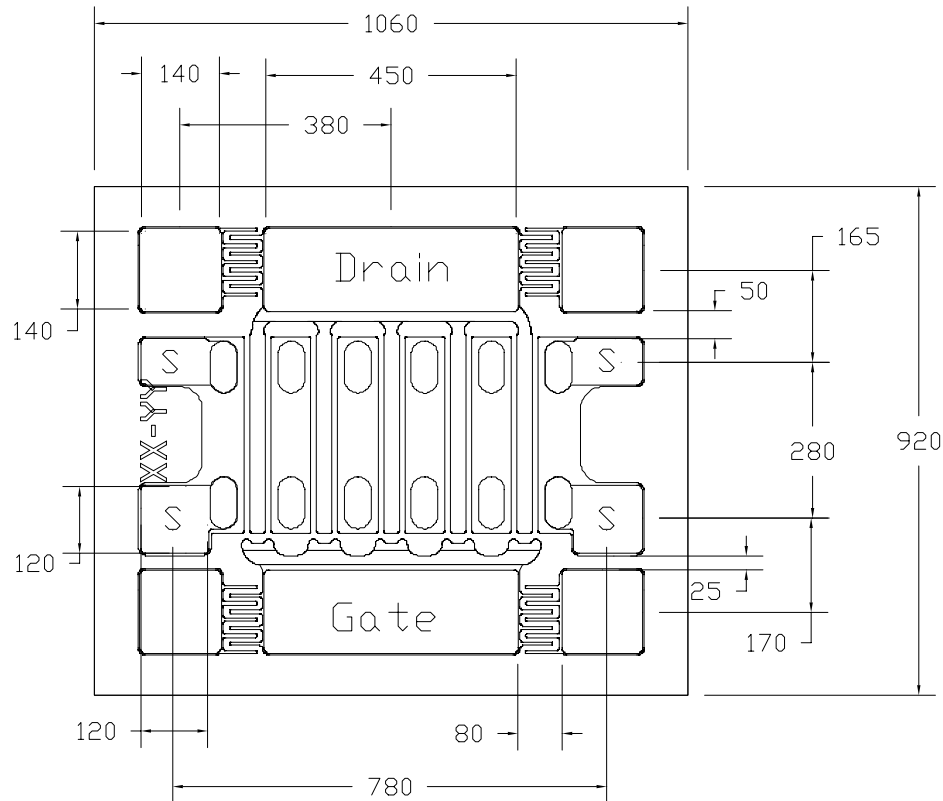
Notes:

<sup>1</sup>  $P_{SAT}$  is defined as  $I_G = 0.4\text{ mA}$

<sup>2</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$



## DIE Dimensions (units in microns)



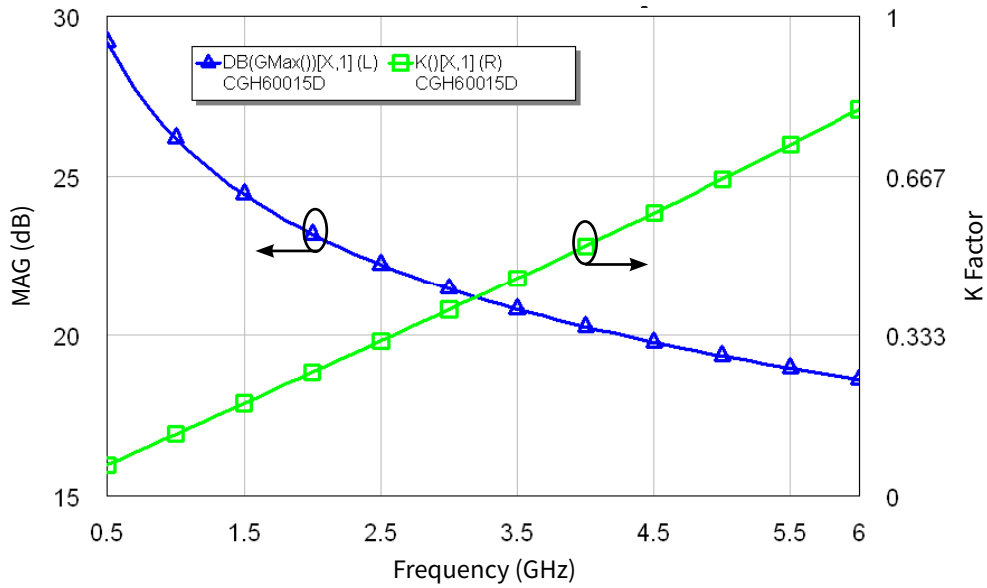
Overall die size 1060 x 920 (+0/-50) microns, die thickness 100 (+/- 10) microns.  
All Gate and Drain pads must be wire bonded for electrical connection.

### Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to Wolfstreak's website for the Eutectic Die Bond Procedure application note at <https://www.wolfstreak.com/rf/document-library>
- Vacuum collet is the preferred method of pick-up.
- The backside of the die is the Source (ground) contact.
- Die back side gold plating is 5 microns thick minimum.
- Thermosonic ball or wedge bonding are the preferred connection methods.
- Gold wire must be used for connections.
- Use the die label (XX-YY) for correct orientation.



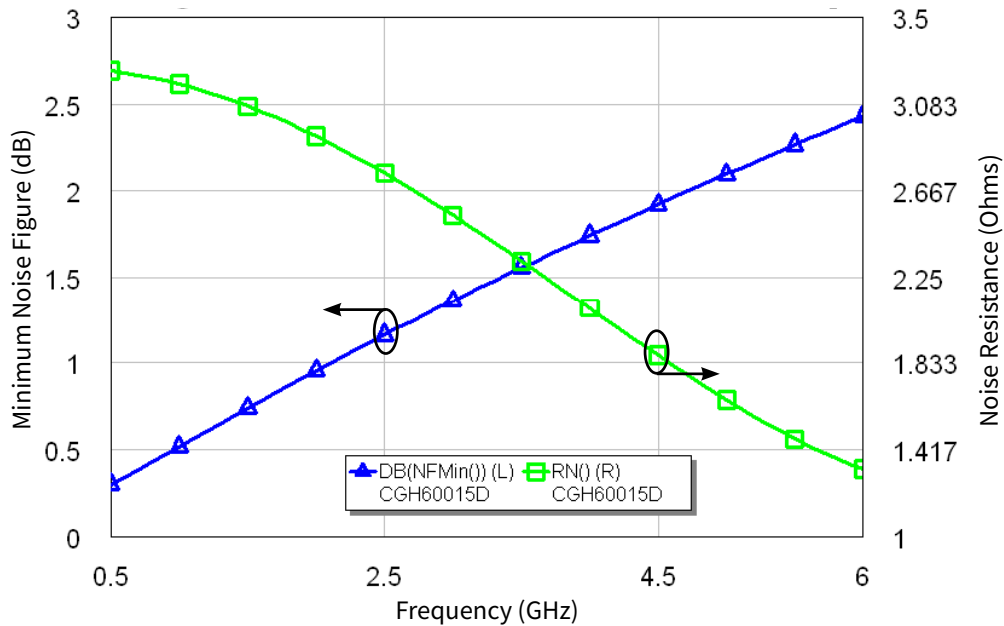
**Typical Performance**



**Figure 1.** Simulated Maximum Available Gain and K Factor of the CGH60015D  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$

Intrinsic die parameters - reference planes at centers of gate and drain bonding pads. No wire bonds assumed.

**Typical Noise Performance**



**Figure 2.** Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH60015D  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$



## Typical Die S-Parameters (Small Signal, $V_{DS} = 28\text{ V}$ , $I_{DQ} = 100\text{ mA}$ , magnitude/angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.934	-119.01	17.60	114.24	0.027	25.07	0.332	-87.18
600 MHz	0.929	-127.83	15.22	108.93	0.028	19.92	0.316	-94.45
700 MHz	0.925	-134.59	13.36	104.63	0.029	15.79	0.307	-100.05
800 MHz	0.923	-139.91	11.87	101.05	0.029	12.37	0.302	-104.41
900 MHz	0.921	-144.20	10.66	97.98	0.029	9.46	0.300	-107.86
1.0 GHz	0.920	-147.72	9.66	95.28	0.030	6.93	0.300	-110.62
1.1 GHz	0.919	-150.66	8.82	92.86	0.030	4.68	0.302	-112.85
1.2 GHz	0.918	-153.16	8.11	90.66	0.030	2.64	0.305	-114.69
1.3 GHz	0.918	-155.31	7.50	88.64	0.030	0.78	0.309	-116.23
1.4 GHz	0.918	-157.17	6.96	86.75	0.030	-0.94	0.315	-117.53
1.5 GHz	0.917	-158.81	6.50	84.98	0.030	-2.54	0.320	-118.66
1.6 GHz	0.917	-160.27	6.09	83.30	0.030	-4.05	0.327	-119.65
1.7 GHz	0.918	-161.56	5.72	81.70	0.030	-5.49	0.334	-120.54
1.8 GHz	0.918	-162.73	5.39	80.17	0.030	-6.85	0.341	-121.35
1.9 GHz	0.918	-163.79	5.10	78.70	0.030	-8.16	0.349	-122.09
2.0 GHz	0.918	-164.75	4.83	77.28	0.029	-9.42	0.357	-122.79
2.1 GHz	0.918	-165.64	4.59	75.90	0.029	-10.63	0.365	-123.45
2.2 GHz	0.919	-166.45	4.37	74.56	0.029	-11.80	0.373	-124.09
2.3 GHz	0.919	-167.20	4.16	73.26	0.029	-12.94	0.381	-124.71
2.4 GHz	0.919	-167.90	3.98	71.99	0.029	-14.04	0.390	-125.30
2.5 GHz	0.920	-168.56	3.80	70.74	0.029	-15.12	0.398	-125.89
2.6 GHz	0.920	-169.17	3.64	69.53	0.029	-16.17	0.407	-126.47
2.7 GHz	0.921	-169.75	3.49	68.34	0.029	-17.20	0.415	-127.05
2.8 GHz	0.921	-170.29	3.35	67.17	0.028	-18.20	0.424	-127.62
2.9 GHz	0.921	-170.80	3.22	66.02	0.028	-19.18	0.433	-128.18
3.0 GHz	0.922	-171.29	3.10	64.89	0.028	-20.14	0.441	-128.75
3.2 GHz	0.923	-172.20	2.88	62.69	0.028	-22.01	0.458	-129.87
3.4 GHz	0.924	-173.02	2.68	60.56	0.028	-23.81	0.475	-130.99
3.6 GHz	0.925	-173.79	2.51	58.49	0.027	-25.56	0.492	-132.10
3.8 GHz	0.926	-174.50	2.35	56.47	0.027	-27.24	0.508	-133.22
4.0 GHz	0.927	-175.16	2.21	54.51	0.027	-28.87	0.524	-134.33
4.2 GHz	0.928	-175.79	2.08	52.59	0.026	-30.45	0.539	-135.44
4.4 GHz	0.929	-176.39	1.96	50.72	0.026	-31.99	0.554	-136.54
4.6 GHz	0.930	-176.95	1.85	48.90	0.025	-33.48	0.568	-137.63
4.8 GHz	0.931	-177.50	1.75	47.12	0.025	-34.93	0.582	-138.71
5.0 GHz	0.933	-178.02	1.66	45.37	0.025	-36.34	0.596	-139.78
5.2 GHz	0.934	-178.52	1.57	43.67	0.024	-37.71	0.609	-140.85
5.4 GHz	0.935	-179.01	1.50	42.01	0.024	-39.04	0.622	-141.90
5.6 GHz	0.936	-179.48	1.42	40.38	0.023	-40.33	0.634	-142.93
5.8 GHz	0.937	-179.94	1.36	38.78	0.023	-41.59	0.646	-143.96
6.0 GHz	0.938	-179.61	1.29	37.22	0.023	-42.82	0.657	-144.97

To download the s-parameters in s2p format, go to the [CGH60015D Product page](#) and click on the documentation tab.



## Typical Die S-Parameters (Small Signal, $V_{DS} = 28\text{ V}$ , $I_{DQ} = 200\text{ mA}$ , magnitude/angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.938	-125.92	18.76	111.46	0.022	22.32	0.300	-109.34
600 MHz	0.933	-134.06	16.11	106.58	0.023	17.60	0.296	-116.39
700 MHz	0.931	-140.21	14.07	102.67	0.024	13.87	0.295	-121.49
800 MHz	0.929	-145.02	12.46	99.42	0.024	10.79	0.295	-125.23
900 MHz	0.928	-148.86	11.16	96.65	0.024	8.19	0.297	-128.01
1.0 GHz	0.927	-152.01	10.10	94.21	0.024	5.93	0.299	-130.10
1.1 GHz	0.926	-154.64	9.21	92.03	0.024	3.92	0.303	-131.68
1.2 GHz	0.926	-156.86	8.46	90.05	0.024	2.11	0.307	-132.90
1.3 GHz	0.926	-158.77	7.82	88.22	0.024	0.45	0.312	-133.83
1.4 GHz	0.925	-160.43	7.26	86.52	0.024	-1.08	0.317	-134.56
1.5 GHz	0.925	-161.89	6.78	84.91	0.024	-2.51	0.322	-135.14
1.6 GHz	0.925	-163.19	6.35	83.39	0.024	-3.86	0.328	-135.60
1.7 GHz	0.925	-164.34	5.97	81.94	0.024	-5.14	0.334	-135.98
1.8 GHz	0.925	-165.38	5.63	80.54	0.024	-6.36	0.340	-136.29
1.9 GHz	0.926	-166.33	5.32	79.20	0.024	-7.53	0.347	-136.56
2.0 GHz	0.926	-167.19	5.05	77.90	0.024	-8.66	0.354	-136.80
2.1 GHz	0.926	-167.98	4.80	76.64	0.024	-9.75	0.361	-137.02
2.2 GHz	0.926	-168.71	4.57	75.42	0.024	-10.80	0.368	-137.22
2.3 GHz	0.926	-169.39	4.36	74.22	0.024	-11.82	0.375	-137.42
2.4 GHz	0.927	-170.02	4.16	73.05	0.024	-12.82	0.382	-137.61
2.5 GHz	0.927	-170.61	3.98	71.91	0.024	-13.79	0.389	-137.81
2.6 GHz	0.927	-171.16	3.82	70.79	0.024	-14.74	0.397	-138.01
2.7 GHz	0.927	-171.68	3.66	69.69	0.024	-15.67	0.404	-138.22
2.8 GHz	0.928	-172.17	3.52	68.60	0.023	-16.58	0.412	-138.43
2.9 GHz	0.928	-172.64	3.39	67.54	0.023	-17.47	0.419	-138.66
3.0 GHz	0.928	-173.08	3.26	66.49	0.023	-18.34	0.427	-138.89
3.2 GHz	0.929	-173.90	3.03	64.44	0.023	-20.05	0.442	-139.38
3.4 GHz	0.930	-174.66	2.83	62.45	0.023	-21.69	0.457	-139.91
3.6 GHz	0.931	-175.36	2.65	60.50	0.022	-23.29	0.471	-140.48
3.8 GHz	0.931	-176.01	2.49	58.61	0.022	-24.84	0.486	-141.08
4.0 GHz	0.932	-176.62	2.34	56.75	0.022	-26.35	0.500	-141.71
4.2 GHz	0.933	-177.20	2.21	54.94	0.022	-27.81	0.515	-142.37
4.4 GHz	0.934	-177.75	2.08	53.17	0.021	-29.24	0.528	-143.06
4.6 GHz	0.935	-178.27	1.97	51.43	0.021	-30.63	0.542	-143.76
4.8 GHz	0.936	-178.77	1.87	49.73	0.021	-31.98	0.555	-144.48
5.0 GHz	0.936	-179.26	1.77	48.06	0.021	-33.30	0.568	-145.22
5.2 GHz	0.937	-179.72	1.69	46.42	0.020	-34.59	0.581	-145.96
5.4 GHz	0.938	-179.83	1.61	44.81	0.020	-35.85	0.593	-146.72
5.6 GHz	0.939	-179.39	1.53	43.24	0.020	-37.07	0.605	-147.48
5.8 GHz	0.940	-178.96	1.46	41.69	0.019	-38.27	0.616	-148.24
6.0 GHz	0.941	-178.54	1.40	40.17	0.019	-39.43	0.627	-149.01

To download the s-parameters in s2p format, go to the [CGH60015D Product page](#) and click on the documentation tab.



## Typical Die S-Parameters (Small Signal, $V_{DS} = 28\text{ V}$ , $I_{DQ} = 500\text{ mA}$ , magnitude/angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.940	-129.62	18.94	109.96	0.020	20.83	0.303	-122.59
600 MHz	0.936	-137.35	16.21	105.32	0.021	16.37	0.304	-128.82
700 MHz	0.934	-143.16	14.12	101.63	0.021	12.86	0.306	-133.18
800 MHz	0.933	-147.68	12.48	98.57	0.022	9.97	0.309	-136.30
900 MHz	0.932	-151.28	11.17	95.95	0.022	7.54	0.312	-138.55
1.0 GHz	0.931	-154.23	10.10	93.66	0.022	5.42	0.315	-140.20
1.1 GHz	0.930	-156.68	9.21	91.60	0.022	3.55	0.319	-141.41
1.2 GHz	0.930	-158.76	8.46	89.74	0.022	1.85	0.323	-142.30
1.3 GHz	0.930	-160.55	7.81	88.01	0.022	0.31	0.327	-142.95
1.4 GHz	0.930	-162.10	7.26	86.40	0.022	-1.12	0.332	-143.43
1.5 GHz	0.930	-163.47	6.77	84.88	0.022	-2.46	0.337	-143.77
1.6 GHz	0.930	-164.68	6.34	83.45	0.022	-3.72	0.342	-144.01
1.7 GHz	0.930	-165.76	5.96	82.07	0.022	-4.92	0.347	-144.19
1.8 GHz	0.930	-166.74	5.62	80.75	0.022	-6.06	0.353	-144.30
1.9 GHz	0.930	-167.62	5.32	79.48	0.022	-7.16	0.358	-144.38
2.0 GHz	0.930	-168.43	5.04	78.24	0.022	-8.21	0.364	-144.44
2.1 GHz	0.930	-169.18	4.79	77.05	0.022	-9.23	0.370	-144.48
2.2 GHz	0.930	-169.86	4.57	75.88	0.022	-10.22	0.376	-144.51
2.3 GHz	0.931	-170.50	4.36	74.74	0.022	-11.18	0.383	-144.53
2.4 GHz	0.931	-171.10	4.16	73.63	0.021	-12.12	0.389	-144.56
2.5 GHz	0.931	-171.65	3.99	72.54	0.021	-13.03	0.395	-144.59
2.6 GHz	0.931	-172.17	3.82	71.46	0.021	-13.92	0.402	-144.63
2.7 GHz	0.931	-172.66	3.67	70.41	0.021	-14.80	0.408	-144.68
2.8 GHz	0.932	-173.13	3.53	69.38	0.021	-15.65	0.415	-144.74
2.9 GHz	0.932	-173.57	3.39	68.36	0.021	-16.49	0.422	-144.80
3.0 GHz	0.932	-173.99	3.27	67.35	0.021	-17.32	0.428	-144.89
3.2 GHz	0.933	-174.77	3.04	65.39	0.021	-18.93	0.442	-145.08
3.4 GHz	0.933	-175.49	2.84	63.47	0.021	-20.49	0.455	-145.33
3.6 GHz	0.934	-176.16	2.66	61.60	0.020	-22.00	0.469	-145.63
3.8 GHz	0.935	-176.78	2.50	59.77	0.020	-23.47	0.482	-145.97
4.0 GHz	0.935	-177.36	2.36	57.98	0.020	-24.90	0.495	-146.36
4.2 GHz	0.936	-177.92	2.22	56.22	0.020	-26.30	0.508	-146.78
4.4 GHz	0.937	-178.44	2.10	54.50	0.019	-27.66	0.521	-147.24
4.6 GHz	0.937	-178.95	1.99	52.81	0.019	-28.99	0.534	-147.73
4.8 GHz	0.938	-179.43	1.89	51.16	0.019	-30.28	0.546	-148.25
5.0 GHz	0.939	-179.89	1.80	49.53	0.019	-31.55	0.558	-148.80
5.2 GHz	0.940	179.66	1.71	47.93	0.019	-32.78	0.570	-149.36
5.4 GHz	0.940	179.22	1.63	46.36	0.018	-33.99	0.582	-149.95
5.6 GHz	0.941	178.80	1.55	44.82	0.018	-35.17	0.593	-150.55
5.8 GHz	0.942	178.38	1.48	43.30	0.018	-36.32	0.604	-151.16
6.0 GHz	0.942	177.98	1.42	41.81	0.018	-37.45	0.615	-151.78

To download the s-parameters in s2p format, go to the [CGH60015D Product page](#) and click on the documentation tab.



## 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

## Product Ordering Information

Order Number	Description	Unit of Measure
CGH60015D	GaN HEMT Bare Die	Each



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## Notes & Disclaimer

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