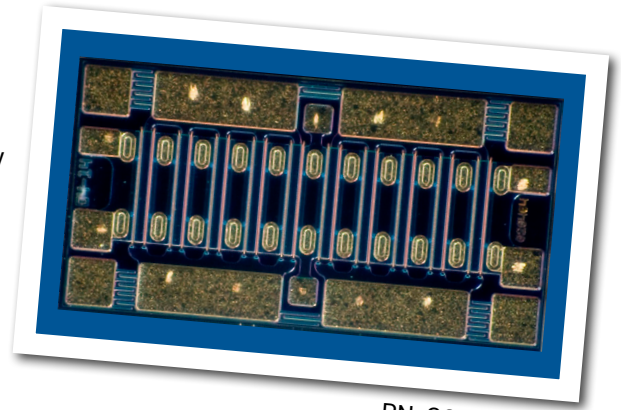


# CGH60030D

30 W, 6.0 GHz, GaN HEMT Die

Cree's CGH60030D 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: CGH60030D

## FEATURES

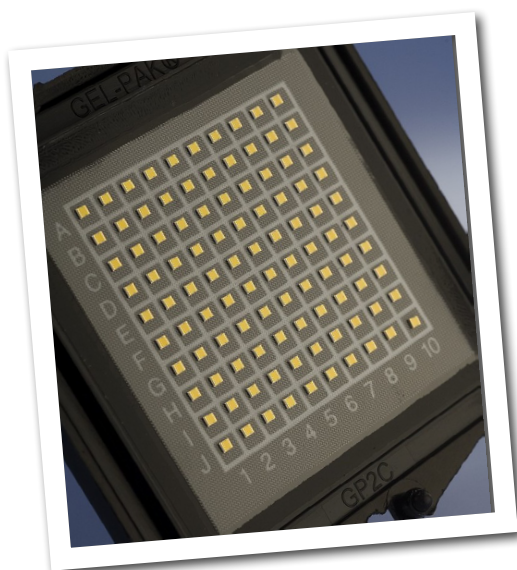
- 15 dB Typical Small Signal Gain at 4 GHz
- 12 dB Typical Small Signal Gain at 6 GHz
- 30 W Typical  $P_{SAT}$
- 28 V Operation
- High Breakdown Voltage
- High Temperature Operation
- Up to 6 GHz Operation
- High Efficiency

## 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

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	$V_{DS}$	84	VDC	25°C
Gate-source Voltage	$V_{GS}$	-10, +2	VDC	25°C
Storage Temperature	$T_{STG}$	-65, +150	°C	
Operating Junction Temperature	$T_J$	225	°C	
Maximum Forward Gate Current	$I_{GMAX}$	7.0	mA	25°C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	3.0	A	25°C
Thermal Resistance, Junction to Case (packaged) <sup>2</sup>	$R_{\theta JC}$	4.8	°C/W	
Thermal Resistance, Junction to Case (die only)	$R_{\theta JC}$	3.0	°C/W	85°C
Mounting Temperature (30 seconds)	$T_S$	320	°C	30 seconds

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

Note<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; $T_C = 25^\circ\text{C}$ )

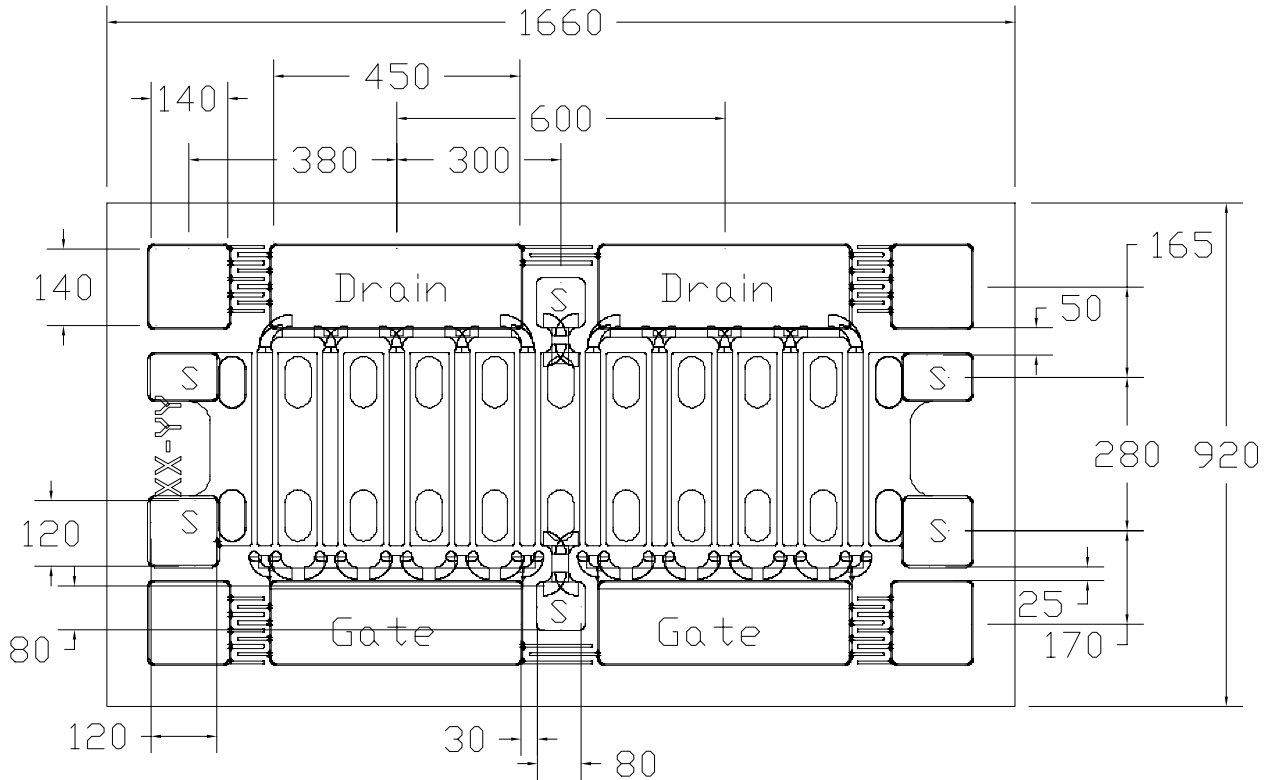
Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.8	-3.0	-2.3	V	$V_{DS} = 10\text{ V}, I_D = 7.2\text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	V <sub>DC</sub>	$V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}$
Drain Current	$I_{DS}$	5.8	7.0	-	A	$V_{DS} = 6.0\text{ V}, V_{GS} = 2.0\text{ V}$
Drain-Source Breakdown Voltage	$V_{BD}$	120	-	-	V	$V_{GS} = -8\text{ V}, I_D = 7.2\text{ mA}$
On Resistance	$R_{ON}$	-	0.5	-	$\Omega$	$V_{DS} = 0.1\text{ V}$
Gate Forward Voltage	$V_{G-ON}$	-	1.9	-	V	$I_{GS} = 7.2\text{ mA}$
<b>RF Characteristics</b>						
Small Signal Gain	$G_{SS}$	-	15	-	dB	$V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}$
Saturated Power Output <sup>1</sup>	$P_{SAT}$	-	30	-	W	$V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}$
Drain Efficiency <sup>2</sup>	$\eta$	-	65	-	%	$V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}, P_{SAT} = 30\text{ W}$
Intermodulation Distortion	IM3	-	-30	-	dBc	$V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}, P_{OUT} = 30\text{ W PEP}$
Output Mismatch Stress	VSWR	-	-	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}, P_{OUT} = 30\text{ W CW}$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	-	8.2	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$
Output Capacitance	$C_{DS}$	-	1.7	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$
Feedback Capacitance	$C_{GD}$	-	0.4	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$

### Notes:

<sup>1</sup>  $P_{SAT}$  is defined as  $I_G = 0.7\text{ mA}$ .

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

## DIE DIMENSIONS (units in microns)



Overall die size 1660 x 920 (+0/-50) microns, die thickness 100 (+/- 10) microns.  
All Gate and Drain pads must be wire bonded for electrical connection.

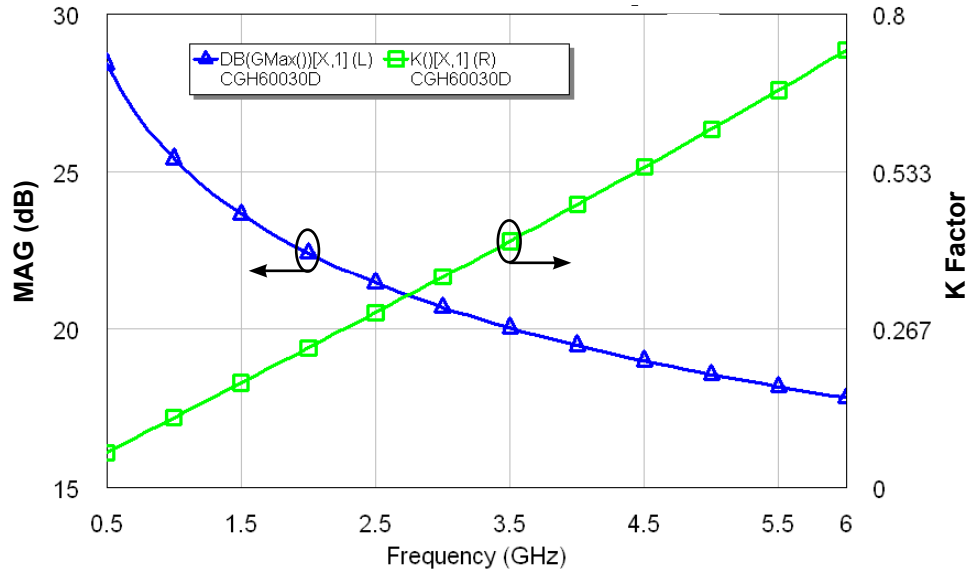
### Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to Cree's website for the Eutectic Die Bond Procedure application note at [http://www.cree.com/products/wireless\\_documents.asp](http://www.cree.com/products/wireless_documents.asp)
- 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

**Simulated Maximum Available Gain and K Factor of the CGH60030D**

$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$

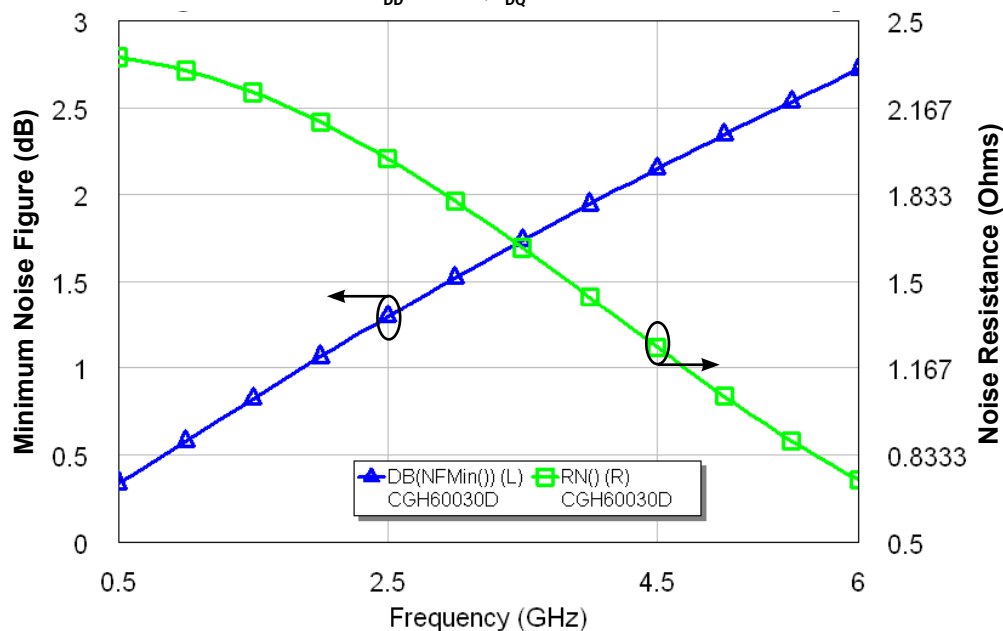


Intrinsic die parameters - reference planes at centers of gate and drain bonding pads. No wire bonds assumed.

## Typical Noise Performance

**Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH60030D**

$V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$



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	0.928	-148.38	12.12	97.65	0.026	8.46	0.377	-137.96
600 MHz	0.927	-153.41	10.18	93.73	0.026	4.70	0.383	-141.15
700 MHz	0.926	-157.06	8.75	90.48	0.026	1.62	0.389	-143.08
800 MHz	0.926	-159.83	7.66	87.68	0.026	-1.02	0.397	-144.26
900 MHz	0.926	-162.00	6.80	85.17	0.026	-3.37	0.406	-144.97
1.0 GHz	0.927	-163.74	6.10	82.88	0.026	-5.49	0.415	-145.39
1.1 GHz	0.927	-165.17	5.53	80.75	0.026	-7.46	0.425	-145.63
1.2 GHz	0.927	-166.37	5.05	78.75	0.026	-9.30	0.435	-145.76
1.3 GHz	0.928	-167.39	4.64	76.85	0.026	-11.03	0.446	-145.83
1.4 GHz	0.929	-168.26	4.28	75.04	0.026	-12.68	0.457	-145.87
1.5 GHz	0.929	-169.03	3.97	73.30	0.026	-14.26	0.468	-145.91
1.6 GHz	0.930	-169.70	3.70	71.62	0.025	-15.78	0.479	-145.96
1.7 GHz	0.931	-170.30	3.46	69.99	0.025	-17.24	0.491	-146.02
1.8 GHz	0.932	-170.83	3.24	68.41	0.025	-18.66	0.502	-146.10
1.9 GHz	0.933	-171.31	3.04	66.88	0.025	-20.03	0.514	-146.22
2.0 GHz	0.934	-171.75	2.87	65.39	0.025	-21.36	0.525	-146.35
2.1 GHz	0.934	-172.16	2.71	63.93	0.024	-22.65	0.537	-146.52
2.2 GHz	0.935	-172.53	2.56	62.51	0.024	-23.90	0.548	-146.71
2.3 GHz	0.936	-172.87	2.43	61.13	0.024	-25.13	0.559	-146.92
2.4 GHz	0.937	-173.19	2.31	59.77	0.024	-26.32	0.570	-147.16
2.5 GHz	0.938	-173.49	2.19	58.45	0.024	-27.48	0.581	-147.42
2.6 GHz	0.939	-173.77	2.09	57.15	0.023	-28.61	0.592	-147.70
2.7 GHz	0.940	-174.04	1.99	55.89	0.023	-29.71	0.602	-147.99
2.8 GHz	0.941	-174.29	1.90	54.65	0.023	-30.79	0.613	-148.30
2.9 GHz	0.942	-174.53	1.82	53.44	0.023	-31.84	0.623	-148.63
3.0 GHz	0.943	-174.76	1.74	52.25	0.022	-32.86	0.633	-148.97
3.2 GHz	0.945	-175.19	1.60	49.95	0.022	-34.84	0.652	-149.67
3.4 GHz	0.947	-175.59	1.47	47.74	0.021	-36.72	0.670	-150.40
3.6 GHz	0.948	-175.97	1.36	45.62	0.021	-38.52	0.687	-151.16
3.8 GHz	0.950	-176.32	1.26	43.58	0.020	-40.23	0.703	-151.92
4.0 GHz	0.952	-176.65	1.17	41.62	0.020	-41.86	0.718	-152.69
4.2 GHz	0.953	-176.97	1.09	39.74	0.019	-43.42	0.732	-153.47
4.4 GHz	0.955	-177.28	1.02	37.92	0.019	-44.91	0.745	-154.24
4.6 GHz	0.956	-177.58	0.95	36.17	0.018	-46.33	0.758	-155.00
4.8 GHz	0.957	-177.86	0.89	34.49	0.018	-47.69	0.770	-155.75
5.0 GHz	0.959	-178.14	0.84	32.87	0.018	-48.99	0.781	-156.49
5.2 GHz	0.960	-178.41	0.79	31.30	0.017	-50.23	0.791	-157.22
5.4 GHz	0.961	-178.67	0.74	29.79	0.017	-51.41	0.801	-157.93
5.6 GHz	0.962	-178.92	0.70	28.33	0.016	-52.55	0.810	-158.62
5.8 GHz	0.963	-179.17	0.66	26.91	0.016	-53.64	0.819	-159.30
6.0 GHz	0.964	-179.42	0.62	25.54	0.015	-54.68	0.827	-159.97

To download the s-parameters in s2p format, go to the [CGH60030D Product Page](#) and click the documentation tab.

Typical Die S-Parameters (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 250\text{ mA}$ , magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.942	-153.97	12.93	96.51	0.019	7.34	0.456	-157.13
600 MHz	0.941	-158.22	10.84	93.23	0.019	4.23	0.462	-158.92
700 MHz	0.941	-161.30	9.31	90.53	0.019	1.69	0.467	-159.94
800 MHz	0.941	-163.63	8.15	88.20	0.019	-0.48	0.472	-160.51
900 MHz	0.941	-165.46	7.24	86.11	0.019	-2.39	0.477	-160.77
1.0 GHz	0.941	-166.93	6.51	84.20	0.019	-4.13	0.483	-160.84
1.1 GHz	0.941	-168.14	5.90	82.43	0.019	-5.74	0.488	-160.78
1.2 GHz	0.941	-169.15	5.40	80.76	0.019	-7.24	0.494	-160.64
1.3 GHz	0.942	-170.02	4.96	79.17	0.018	-8.66	0.500	-160.45
1.4 GHz	0.942	-170.77	4.59	77.65	0.018	-10.02	0.506	-160.22
1.5 GHz	0.942	-171.42	4.27	76.18	0.018	-11.32	0.512	-159.98
1.6 GHz	0.943	-171.99	3.99	74.76	0.018	-12.57	0.519	-159.73
1.7 GHz	0.943	-172.50	3.73	73.38	0.018	-13.79	0.526	-159.49
1.8 GHz	0.944	-172.96	3.51	72.03	0.018	-14.97	0.533	-159.26
1.9 GHz	0.944	-173.38	3.31	70.72	0.018	-16.11	0.540	-159.04
2.0 GHz	0.945	-173.76	3.12	69.43	0.018	-17.23	0.547	-158.85
2.1 GHz	0.945	-174.10	2.96	68.18	0.018	-18.32	0.555	-158.67
2.2 GHz	0.946	-174.42	2.81	66.94	0.018	-19.39	0.562	-158.51
2.3 GHz	0.946	-174.72	2.67	65.73	0.018	-20.43	0.569	-158.38
2.4 GHz	0.947	-174.99	2.54	64.55	0.017	-21.45	0.577	-158.27
2.5 GHz	0.947	-175.25	2.42	63.38	0.017	-22.45	0.584	-158.18
2.6 GHz	0.948	-175.49	2.31	62.23	0.017	-23.43	0.592	-158.11
2.7 GHz	0.948	-175.72	2.21	61.10	0.017	-24.39	0.599	-158.07
2.8 GHz	0.949	-175.94	2.12	60.00	0.017	-25.33	0.607	-158.04
2.9 GHz	0.949	-176.14	2.03	58.90	0.017	-26.25	0.614	-158.03
3.0 GHz	0.950	-176.34	1.95	57.83	0.017	-27.16	0.621	-158.05
3.2 GHz	0.951	-176.71	1.80	55.73	0.016	-28.92	0.636	-158.12
3.4 GHz	0.952	-177.05	1.67	53.70	0.016	-30.62	0.650	-158.27
3.6 GHz	0.953	-177.37	1.55	51.73	0.016	-32.25	0.664	-158.46
3.8 GHz	0.954	-177.67	1.44	49.82	0.015	-33.83	0.677	-158.70
4.0 GHz	0.955	-177.95	1.35	47.97	0.015	-35.35	0.690	-158.99
4.2 GHz	0.957	-178.22	1.26	46.17	0.015	-36.81	0.702	-159.31
4.4 GHz	0.958	-178.48	1.18	44.42	0.015	-38.22	0.714	-159.66
4.6 GHz	0.959	-178.73	1.11	42.73	0.014	-39.57	0.726	-160.03
4.8 GHz	0.960	-178.98	1.05	41.09	0.014	-40.88	0.737	-160.42
5.0 GHz	0.961	-179.21	0.99	39.49	0.014	-42.14	0.747	-160.82
5.2 GHz	0.961	-179.44	0.93	37.94	0.013	-43.36	0.757	-161.24
5.4 GHz	0.962	-179.67	0.88	36.43	0.013	-44.53	0.767	-161.67
5.6 GHz	0.963	-179.89	0.84	34.96	0.013	-45.65	0.776	-162.11
5.8 GHz	0.964	-179.90	0.79	33.54	0.013	-46.74	0.784	-162.55
6.0 GHz	0.965	-179.68	0.75	32.15	0.012	-47.79	0.793	-162.99

To download the s-parameters in s2p format, go to the [CGH60030D Product Page](#) and click the documentation tab.

Typical Die S-Parameters (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 400\text{ mA}$ , magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.948	-155.97	12.94	96.03	0.016	6.87	0.489	-162.06
600 MHz	0.948	-159.93	10.84	92.98	0.016	3.99	0.495	-163.44
700 MHz	0.947	-162.79	9.31	90.46	0.016	1.65	0.499	-164.22
800 MHz	0.947	-164.96	8.15	88.28	0.016	-0.36	0.503	-164.63
900 MHz	0.947	-166.67	7.24	86.34	0.016	-2.13	0.507	-164.80
1.0 GHz	0.947	-168.04	6.51	84.56	0.016	-3.73	0.512	-164.82
1.1 GHz	0.947	-169.17	5.90	82.91	0.016	-5.21	0.516	-164.72
1.2 GHz	0.948	-170.12	5.40	81.35	0.016	-6.60	0.521	-164.56
1.3 GHz	0.948	-170.93	4.97	79.86	0.016	-7.91	0.525	-164.35
1.4 GHz	0.948	-171.63	4.60	78.44	0.016	-9.17	0.530	-164.11
1.5 GHz	0.948	-172.24	4.28	77.06	0.016	-10.37	0.535	-163.85
1.6 GHz	0.949	-172.78	4.00	75.73	0.016	-11.53	0.541	-163.59
1.7 GHz	0.949	-173.27	3.75	74.43	0.016	-12.66	0.546	-163.33
1.8 GHz	0.949	-173.70	3.52	73.17	0.016	-13.75	0.552	-163.07
1.9 GHz	0.949	-174.09	3.32	71.93	0.016	-14.82	0.558	-162.82
2.0 GHz	0.950	-174.45	3.14	70.72	0.015	-15.86	0.563	-162.59
2.1 GHz	0.950	-174.78	2.98	69.53	0.015	-16.87	0.569	-162.37
2.2 GHz	0.951	-175.08	2.83	68.37	0.015	-17.87	0.576	-162.17
2.3 GHz	0.951	-175.36	2.69	67.22	0.015	-18.84	0.582	-161.99
2.4 GHz	0.951	-175.62	2.56	66.09	0.015	-19.79	0.588	-161.82
2.5 GHz	0.952	-175.87	2.45	64.98	0.015	-20.73	0.594	-161.67
2.6 GHz	0.952	-176.10	2.34	63.89	0.015	-21.65	0.601	-161.54
2.7 GHz	0.953	-176.31	2.24	62.82	0.015	-22.55	0.607	-161.43
2.8 GHz	0.953	-176.52	2.15	61.76	0.015	-23.44	0.613	-161.34
2.9 GHz	0.953	-176.72	2.06	60.72	0.015	-24.31	0.619	-161.27
3.0 GHz	0.954	-176.90	1.98	59.69	0.015	-25.16	0.626	-161.21
3.2 GHz	0.955	-177.25	1.83	57.68	0.014	-26.83	0.638	-161.15
3.4 GHz	0.956	-177.58	1.70	55.72	0.014	-28.44	0.651	-161.14
3.6 GHz	0.957	-177.88	1.58	53.82	0.014	-30.00	0.663	-161.19
3.8 GHz	0.957	-178.16	1.47	51.97	0.014	-31.51	0.675	-161.30
4.0 GHz	0.958	-178.43	1.38	50.16	0.013	-32.96	0.686	-161.44
4.2 GHz	0.959	-178.69	1.29	48.41	0.013	-34.37	0.698	-161.63
4.4 GHz	0.960	-178.94	1.22	46.71	0.013	-35.73	0.709	-161.84
4.6 GHz	0.961	-179.18	1.14	45.05	0.013	-37.04	0.719	-162.09
4.8 GHz	0.962	-179.41	1.08	43.43	0.012	-38.31	0.729	-162.36
5.0 GHz	0.962	-179.63	1.02	41.85	0.012	-39.54	0.739	-162.66
5.2 GHz	0.963	-179.85	0.96	40.32	0.012	-40.72	0.749	-162.97
5.4 GHz	0.964	179.93	0.91	38.83	0.012	-41.87	0.758	-163.30
5.6 GHz	0.965	179.72	0.87	37.37	0.012	-42.97	0.767	-163.64
5.8 GHz	0.965	179.52	0.82	35.95	0.011	-44.04	0.775	-163.99
6.0 GHz	0.966	179.32	0.78	34.57	0.011	-45.07	0.783	-164.35

To download the s-parameters in s2p format, go to the [CGH60030D Product Page](#) and click the documentation tab.



## 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

## Product Ordering Information

Order Number	Description	Unit of Measure
CGH60030D	GaN HEMT Bare Die	Each





## Disclaimer

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