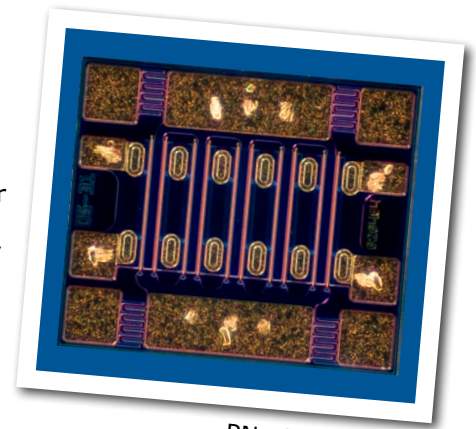


# CGH60015D

**15 W, 6.0 GHz, GaN HEMT Die**

Cree'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

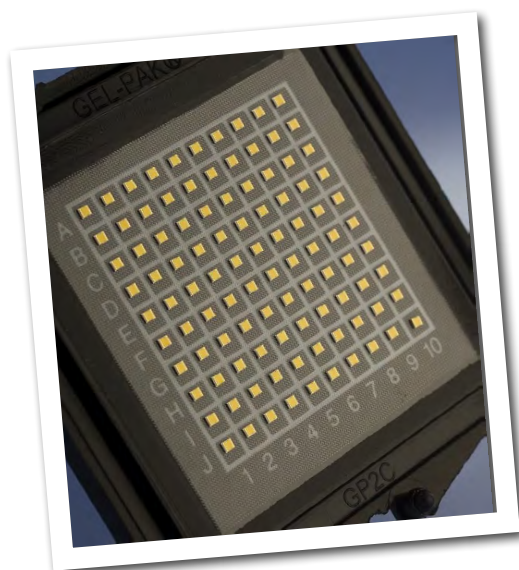
## FEATURES

- 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 SiC & GaN



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

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	$V_{DSS}$	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	$I_{GMAX}$	4.0	mA	25 °C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	1.5	A	25 °C
Thermal Resistance, Junction to Case (packaged) <sup>2</sup>	$R_{\theta JC}$	8.0	°C/W	
Thermal Resistance, Junction to Case (die only)	$R_{\theta JC}$	5.1	°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; $T_C = 25 °C$ )

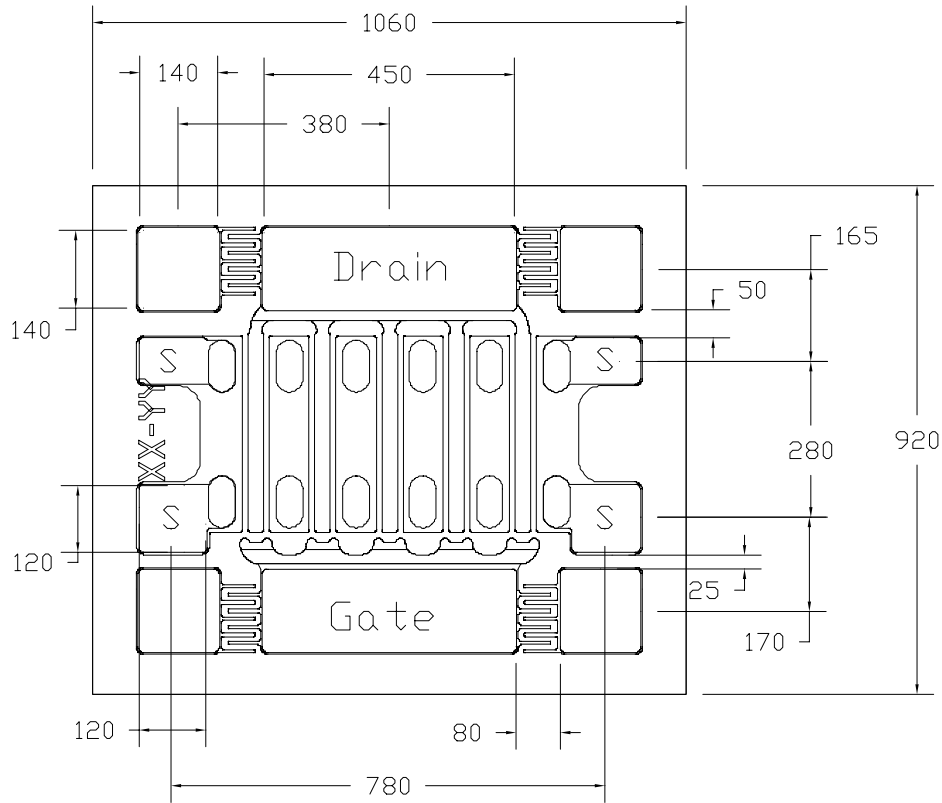
Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.8	-3.0	-2.3	V	$V_{DS} = 10 V, I_D = 3.6 mA$
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	$V_{DC}$	$V_{DD} = 28 V, I_{DQ} = 100 mA$
Drain Current	$I_{DS}$	2.9	3.5	-	A	$V_{DS} = 6.0 V, V_{GS} = 2.0 V$
Drain-Source Breakdown Voltage	$V_{BD}$	120	-	-	V	$V_{GS} = -8 V, I_D = 3.6 mA$
On Resistance	$R_{ON}$	-	1.0	-	$\Omega$	$V_{DS} = 0.1 V$
Gate Forward Voltage	$V_{G-ON}$	-	1.9	-	V	$I_{GS} = 3.6 mA$
<b>RF Characteristics</b>						
Small Signal Gain	$G_{SS}$	-	15	-	dB	$V_{DD} = 28 V, I_{DQ} = 100 mA$
Saturated Power Output <sup>1</sup>	$P_{SAT}$	-	15	-	W	$V_{DD} = 28 V, I_{DQ} = 100 mA$
Drain Efficiency <sup>2</sup>	$\eta$	-	65	-	%	$V_{DD} = 28 V, I_{DQ} = 100 mA, P_{SAT} = 15 W$
Intermodulation Distortion	IM3	-	-30	-	dBc	$V_{DD} = 28 V, I_{DQ} = 100 mA,$ $P_{OUT} = 15 W PEP$
Output Mismatch Stress	VSWR	-	-	10 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 28 V, I_{DQ} = 100 mA,$ $P_{OUT} = 15 W CW$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	-	4.1	-	pF	$V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz$
Output Capacitance	$C_{DS}$	-	0.9	-	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:

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

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

## DIE Dimensions (units in microns)



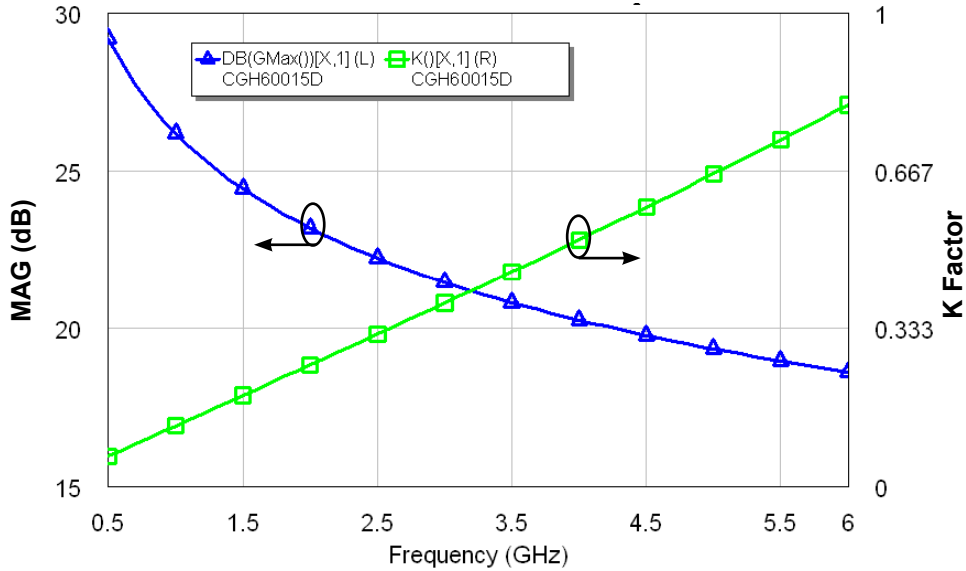
Overall die size 1060 x 920 (+0/-50) microns, die thickness 100 (+/- 10) microns.  
All Gate and Drain pads must be wire bonded for electrical connection.

### Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to 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

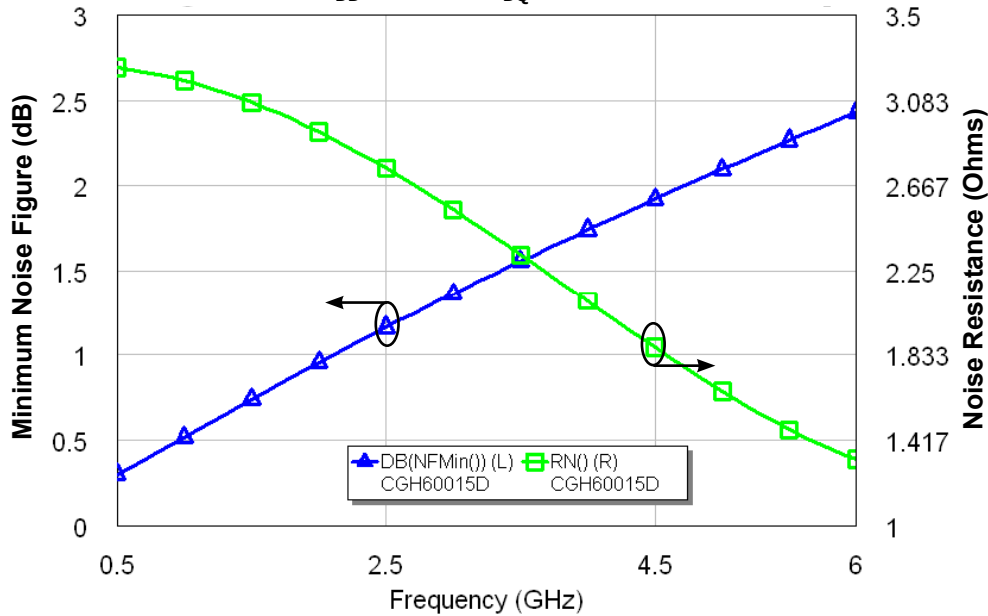
**Simulated Maximum Available Gain and K Factor of the CGH60015D**  
 $V_{DD} = 28\text{ V}, I_{DQ} = 200\text{ mA}$



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

## Typical Noise Performance

**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

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**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

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**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

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