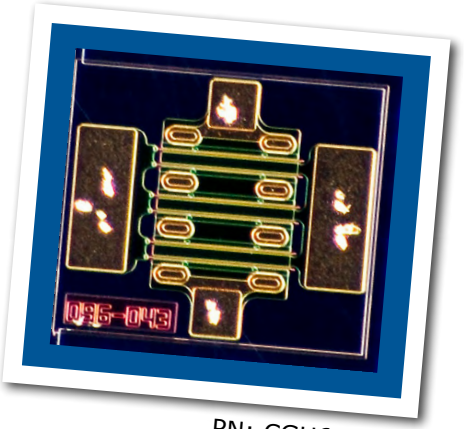
CGH60008D

8 W, 6.0 GHz, GaN HEMT Die



PN: CGH60008D

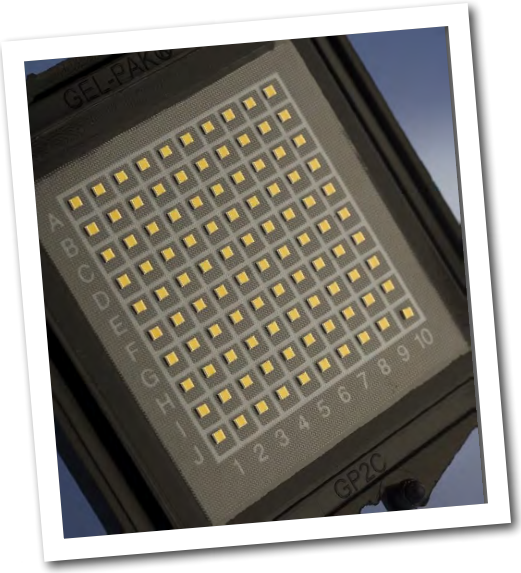
Cree's CGH60008D is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT). GaN has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity, and higher thermal conductivity. GaN HEMTs offer greater power density and wider bandwidths compared to Si and GaAs transistors.

FEATURES

- 15 dB Typical Small Signal Gain at 4 GHz
- 12 dB Typical Small Signal Gain at 6 GHz
- 8 W Typical P_{SAT} @ 28 V Operation
- 5 W Typical P_{SAT} @ 20 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

RoHS COMPLIANT

- 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}	2.1	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	0.75	A	25˚C
Thermal Resistance, Junction to Case (packaged)[2]	$R_{\theta JC}$	8.9	˚C/W	
Thermal Resistance, Junction to Case (die only)	$R_{\theta JC}$	5.7	˚C/W	85˚C
Mounting Temperature (30 seconds)	T_S	320	˚C	30 seconds

Note[1] Current limit for long term, reliable operation

Note[2] Eutectic die attach using 80/20 AuSn mounted to a 20 mil thick Cu carrier.

Electrical Characteristics (Frequency = 4 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.8	-3.0	–2.3	V	V_{DS} = 10 V, I_D = 2.1 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DD} = 28 V, I_{DQ} = 60 mA
Drain Current	I_{DS}	1.75	2.1	–	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 = 2.1 mA
On Resistance	R_{ON}	–	1.6	–	Ω	V_{DS} = 0.1 V
Gate Forward Voltage	V_{G-ON}	–	1.9	–	V	I_{GS} = 2.1 mA
RF Characteristics						
Small Signal Gain	G_{SS}	–	15	–	dB	V_{DD} = 28 V, I_{DQ} = 60 mA
Saturated Power Output[1]	P_{SAT}	–	8	–	W	V_{DD} = 28 V, I_{DQ} = 60 mA
Drain Efficiency[2]	η	–	65	–	%	V_{DD} = 28 V, I_{DQ} = 60 mA, P_{SAT}
Intermodulation Distortion	IM3	–	-30	–	dBc	V_{DD} = 28 V, I_{DQ} = 60 mA, P_{OUT} = 8 W PEP
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 60 mA, P_{OUT} = 8 W CW
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	2.5	–	pF	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	0.5	–	pF	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.1	–	pF	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz

Notes:

[1] P_{SAT} is defined as I_G = 0.2 mA.

[2] Drain Efficiency = P_{OUT} / P_{DC}

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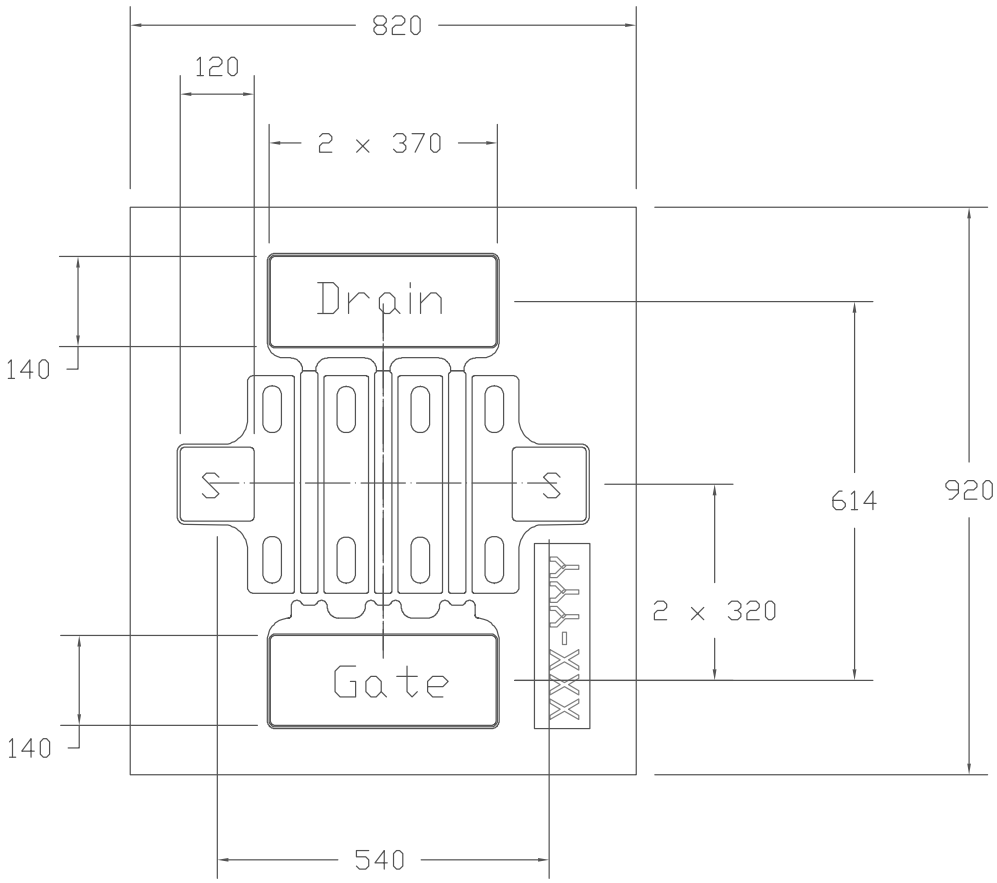
DIE Dimensions (units in microns)



Overall die size 820 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
- 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 (XXX-YYY) for correct orientation.

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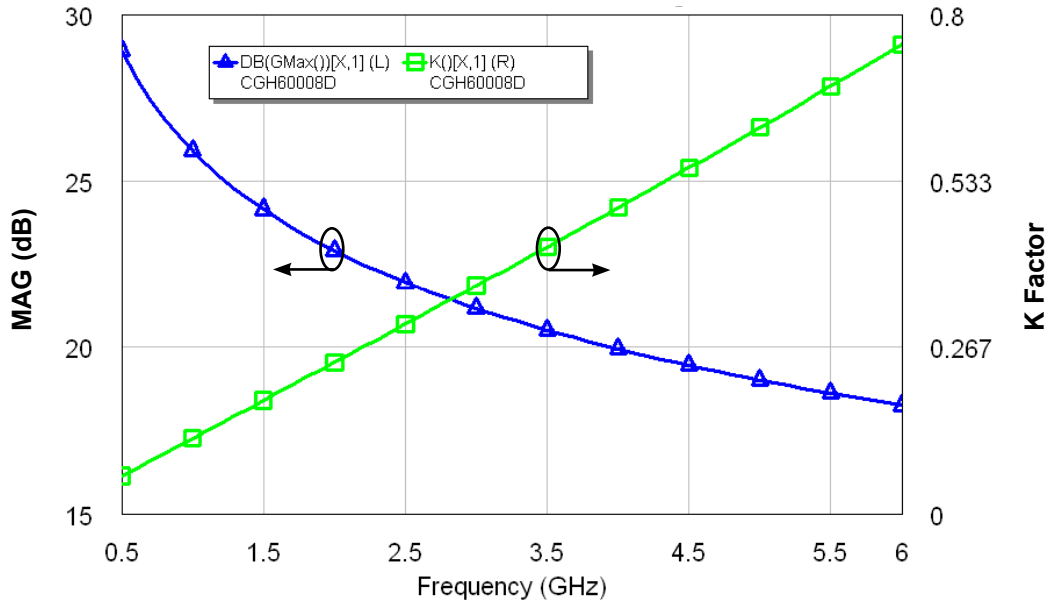
Typical Performance

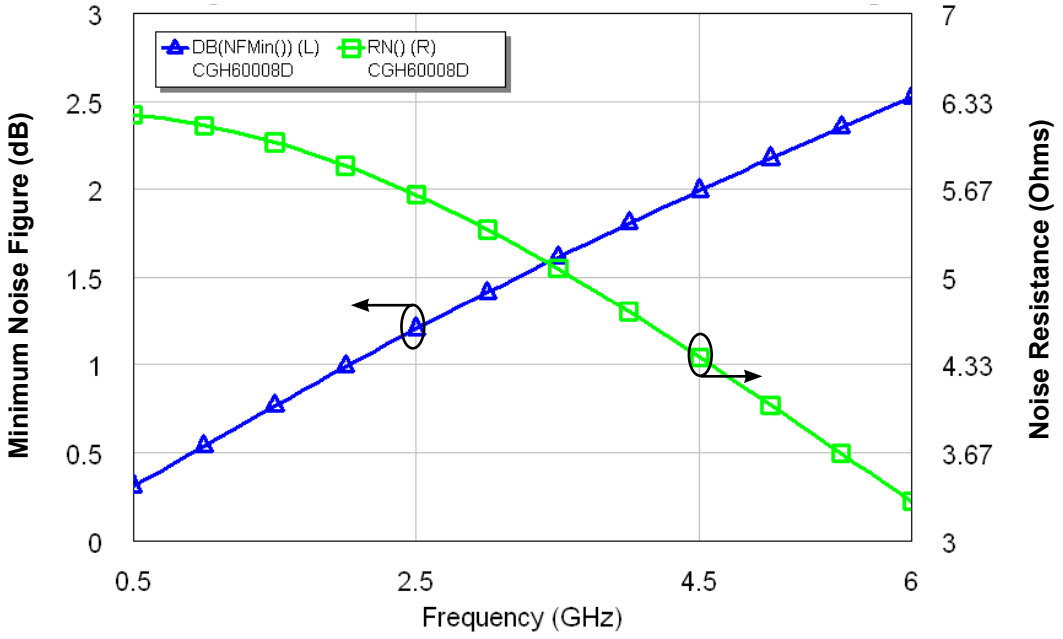
Simulated Maximum Available Gain and K Factor of the CGH60008D
V_{DD} = 28 V, I_{DQ} = 100 mA



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 CGH60008D
V_{DD} = 28 V, I_{DQ} = 100 mA



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Typical Die S-Parameters (Small Signal, V_{DS} = 28 V, I_{DQ} = 60 mA, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.949	-88.97	19.19	130.14	0.025	40.93	0.457	-46.50
600 MHz	0.940	-99.46	17.32	124.14	0.027	35.09	0.426	-51.93
700 MHz	0.933	-108.14	15.69	119.09	0.028	30.19	0.400	-56.47
800 MHz	0.928	-115.36	14.27	114.78	0.029	26.04	0.379	-60.31
900 MHz	0.923	-121.43	13.05	111.05	0.030	22.47	0.363	-63.61
1.0 GHz	0.920	-126.58	12.00	107.79	0.031	19.36	0.350	-66.51
1.1 GHz	0.917	-130.99	11.08	104.89	0.031	16.62	0.340	-69.08
1.2 GHz	0.914	-134.80	10.28	102.28	0.032	14.18	0.332	-71.39
1.3 GHz	0.913	-138.12	9.58	99.92	0.032	11.97	0.327	-73.50
1.4 GHz	0.911	-141.05	8.96	97.76	0.032	9.97	0.323	-75.45
1.5 GHz	0.910	-143.64	8.41	95.76	0.032	8.12	0.320	-77.26
1.6 GHz	0.909	-145.94	7.92	93.89	0.032	6.42	0.319	-78.96
1.7 GHz	0.908	-148.02	7.48	92.15	0.032	4.83	0.319	-80.57
1.8 GHz	0.908	-149.89	7.08	90.50	0.033	3.34	0.319	-82.10
1.9 GHz	0.907	-151.59	6.72	88.93	0.033	1.93	0.321	-83.55
2.0 GHz	0.907	-153.14	6.39	87.44	0.033	0.60	0.323	-84.95
2.1 GHz	0.907	-154.56	6.09	86.02	0.033	-0.67	0.325	-86.29
2.2 GHz	0.906	-155.86	5.82	84.65	0.033	-1.88	0.329	-87.59
2.3 GHz	0.906	-157.07	5.56	83.33	0.033	-3.04	0.332	-88.84
2.4 GHz	0.906	-158.19	5.33	82.06	0.033	-4.16	0.336	-90.06
2.5 GHz	0.906	-159.24	5.11	80.82	0.033	-5.23	0.340	-91.24
2.6 GHz	0.906	-160.21	4.91	79.62	0.033	-6.28	0.344	-92.39
2.7 GHz	0.906	-161.12	4.72	78.45	0.032	-7.29	0.349	-93.51
2.8 GHz	0.906	-161.98	4.55	77.31	0.032	-8.27	0.354	-94.60
2.9 GHz	0.906	-162.79	4.38	76.20	0.032	-9.22	0.359	-95.66
3.0 GHz	0.906	-163.55	4.23	75.11	0.032	-10.15	0.364	-96.70
3.2 GHz	0.906	-164.95	3.95	73.01	0.032	-11.94	0.375	-98.72
3.4 GHz	0.907	-166.23	3.70	70.97	0.032	-13.66	0.386	-100.66
3.6 GHz	0.907	-167.38	3.48	69.01	0.032	-15.31	0.397	-102.54
3.8 GHz	0.908	-168.44	3.28	67.10	0.032	-16.90	0.408	-104.34
4.0 GHz	0.908	-169.43	3.10	65.24	0.031	-18.44	0.420	-106.09
4.2 GHz	0.909	-170.34	2.93	63.43	0.031	-19.93	0.432	-107.79
4.4 GHz	0.909	-171.19	2.78	61.67	0.031	-21.38	0.443	-109.44
4.6 GHz	0.910	-171.99	2.64	59.94	0.031	-22.79	0.455	-111.05
4.8 GHz	0.910	-172.74	2.51	58.25	0.030	-24.17	0.467	-112.61
5.0 GHz	0.911	-173.46	2.39	56.59	0.030	-25.51	0.478	-114.14
5.2 GHz	0.912	-174.14	2.28	54.97	0.030	-26.82	0.489	-115.63
5.4 GHz	0.912	-174.79	2.18	53.37	0.030	-28.09	0.500	-117.08
5.6 GHz	0.913	-175.41	2.09	51.81	0.029	-29.34	0.511	-118.50
5.8 GHz	0.914	-176.01	2.00	50.27	0.029	-30.57	0.522	-119.89
6.0 GHz	0.914	-176.58	1.92	48.75	0.029	-31.76	0.533	-121.25

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Typical Die S-Parameters (Small Signal, V_{DS} = 28 V, I_{DQ} = 120 mA, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.938	-100.12	21.07	124.88	0.030	35.53	0.466	-62.41
600 MHz	0.929	-110.15	18.68	119.23	0.032	30.01	0.428	-69.18
700 MHz	0.923	-118.17	16.69	114.61	0.034	25.53	0.399	-74.78
800 MHz	0.918	-124.66	15.03	110.76	0.035	21.80	0.376	-79.46
900 MHz	0.914	-129.99	13.63	107.48	0.035	18.66	0.358	-83.42
1.0 GHz	0.911	-134.43	12.45	104.64	0.036	15.95	0.344	-86.81
1.1 GHz	0.909	-138.17	11.44	102.15	0.036	13.59	0.334	-89.73
1.2 GHz	0.908	-141.36	10.58	99.92	0.037	11.50	0.326	-92.27
1.3 GHz	0.906	-144.11	9.82	97.91	0.037	9.62	0.320	-94.48
1.4 GHz	0.905	-146.49	9.16	96.08	0.037	7.91	0.316	-96.43
1.5 GHz	0.905	-148.59	8.58	94.39	0.037	6.35	0.314	-98.16
1.6 GHz	0.904	-150.43	8.07	92.82	0.037	4.91	0.313	-99.70
1.7 GHz	0.904	-152.08	7.61	91.34	0.037	3.57	0.312	-101.09
1.8 GHz	0.903	-153.55	7.19	89.96	0.037	2.32	0.313	-102.34
1.9 GHz	0.903	-154.87	6.82	88.64	0.037	1.14	0.314	-103.47
2.0 GHz	0.903	-156.06	6.48	87.39	0.037	0.02	0.316	-104.51
2.1 GHz	0.903	-157.14	6.17	86.20	0.037	-1.05	0.319	-105.46
2.2 GHz	0.903	-158.13	5.89	85.05	0.037	-2.07	0.321	-106.35
2.3 GHz	0.903	-159.04	5.63	83.94	0.037	-3.04	0.325	-107.17
2.4 GHz	0.903	-159.87	5.39	82.87	0.037	-3.98	0.328	-107.95
2.5 GHz	0.903	-160.64	5.17	81.83	0.037	-4.89	0.332	-108.67
2.6 GHz	0.903	-161.35	4.97	80.82	0.037	-5.76	0.336	-109.36
2.7 GHz	0.903	-162.00	4.78	79.84	0.037	-6.61	0.341	-110.02
2.8 GHz	0.903	-162.62	4.60	78.89	0.037	-7.44	0.345	-110.64
2.9 GHz	0.903	-163.19	4.43	77.95	0.037	-8.24	0.350	-111.25
3.0 GHz	0.903	-163.72	4.28	77.04	0.037	-9.02	0.355	-111.83
3.2 GHz	0.904	-164.69	3.99	75.27	0.037	-10.53	0.365	-112.93
3.4 GHz	0.904	-165.55	3.74	73.56	0.037	-11.98	0.376	-113.98
3.6 GHz	0.905	-166.31	3.52	71.91	0.036	-13.37	0.387	-114.98
3.8 GHz	0.906	-167.00	3.32	70.31	0.036	-14.71	0.398	-115.94
4.0 GHz	0.906	-167.62	3.13	68.75	0.036	-16.00	0.409	-116.88
4.2 GHz	0.907	-168.18	2.97	67.23	0.036	-17.26	0.420	-117.79
4.4 GHz	0.908	-168.70	2.81	65.75	0.036	-18.48	0.431	-118.68
4.6 GHz	0.909	-169.17	2.67	64.30	0.035	-19.67	0.442	-119.55
4.8 GHz	0.909	-169.61	2.55	62.89	0.035	-20.82	0.453	-120.40
5.0 GHz	0.910	-170.02	2.43	61.50	0.035	-21.95	0.464	-121.25
5.2 GHz	0.911	-170.40	2.32	60.14	0.035	-23.05	0.475	-122.08
5.4 GHz	0.912	-170.75	2.22	58.80	0.034	-24.12	0.486	-122.89
5.6 GHz	0.913	-171.08	2.12	57.49	0.034	-25.17	0.497	-123.70
5.8 GHz	0.914	-171.39	2.03	56.20	0.034	-26.20	0.507	-124.50
6.0 GHz	0.914	-171.69	1.95	54.94	0.033	-27.20	0.517	-125.28

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Typical Die S-Parameters (Small Signal, V_{DS} = 28 V, I_{DQ} = 300 mA, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.937	-108.13	22.00	121.21	0.028	31.85	0.404	-72.20
600 MHz	0.930	-117.71	19.30	115.84	0.029	26.61	0.372	-79.50
700 MHz	0.925	-125.21	17.11	111.51	0.030	22.42	0.348	-85.45
800 MHz	0.921	-131.20	15.31	107.94	0.031	18.98	0.330	-90.35
900 MHz	0.918	-136.06	13.83	104.92	0.031	16.09	0.317	-94.43
1.0 GHz	0.916	-140.08	12.59	102.31	0.032	13.61	0.307	-97.85
1.1 GHz	0.915	-143.44	11.54	100.03	0.032	11.46	0.300	-100.74
1.2 GHz	0.913	-146.29	10.65	97.99	0.032	9.55	0.295	-103.19
1.3 GHz	0.913	-148.74	9.88	96.15	0.032	7.85	0.292	-105.28
1.4 GHz	0.912	-150.86	9.20	94.47	0.033	6.30	0.290	-107.07
1.5 GHz	0.911	-152.71	8.61	92.92	0.033	4.88	0.289	-108.62
1.6 GHz	0.911	-154.34	8.09	91.48	0.033	3.56	0.289	-109.96
1.7 GHz	0.911	-155.79	7.62	90.12	0.033	2.34	0.290	-111.13
1.8 GHz	0.910	-157.09	7.20	88.84	0.033	1.19	0.292	-112.16
1.9 GHz	0.910	-158.25	6.83	87.63	0.033	0.11	0.294	-113.08
2.0 GHz	0.910	-159.30	6.49	86.47	0.033	-0.92	0.297	-113.89
2.1 GHz	0.910	-160.25	6.17	85.36	0.033	-1.90	0.300	-114.62
2.2 GHz	0.910	-161.12	5.89	84.29	0.033	-2.84	0.303	-115.28
2.3 GHz	0.910	-161.92	5.63	83.26	0.033	-3.74	0.307	-115.88
2.4 GHz	0.910	-162.65	5.39	82.26	0.033	-4.61	0.311	-116.43
2.5 GHz	0.910	-163.32	5.17	81.29	0.033	-5.44	0.315	-116.94
2.6 GHz	0.910	-163.95	4.97	80.35	0.033	-6.26	0.320	-117.42
2.7 GHz	0.910	-164.52	4.77	79.43	0.033	-7.05	0.324	-117.87
2.8 GHz	0.911	-165.06	4.60	78.54	0.032	-7.81	0.329	-118.30
2.9 GHz	0.911	-165.56	4.43	77.66	0.032	-8.56	0.334	-118.70
3.0 GHz	0.911	-166.03	4.28	76.80	0.032	-9.29	0.339	-119.09
3.2 GHz	0.911	-166.88	3.99	75.13	0.032	-10.70	0.349	-119.83
3.4 GHz	0.912	-167.63	3.74	73.51	0.032	-12.05	0.360	-120.53
3.6 GHz	0.912	-168.31	3.52	71.94	0.032	-13.36	0.371	-121.21
3.8 GHz	0.913	-168.91	3.32	70.42	0.032	-14.62	0.382	-121.87
4.0 GHz	0.913	-169.46	3.13	68.94	0.032	-15.85	0.393	-122.52
4.2 GHz	0.914	-169.95	2.97	67.49	0.031	-17.03	0.404	-123.16
4.4 GHz	0.914	-170.41	2.82	66.07	0.031	-18.19	0.415	-123.79
4.6 GHz	0.915	-170.83	2.68	64.68	0.031	-19.32	0.426	-124.43
4.8 GHz	0.916	-171.21	2.55	63.32	0.031	-20.42	0.437	-125.06
5.0 GHz	0.916	-171.57	2.43	61.99	0.031	-21.49	0.448	-125.69
5.2 GHz	0.917	-171.91	2.33	60.68	0.030	-22.54	0.458	-126.32
5.4 GHz	0.918	-172.22	2.22	59.39	0.030	-23.57	0.469	-126.95
5.6 GHz	0.919	-172.51	2.13	58.12	0.030	-24.58	0.480	-127.57
5.8 GHz	0.919	-172.79	2.04	56.88	0.030	-25.56	0.490	-128.20
6.0 GHz	0.920	-173.05	1.96	55.66	0.029	-26.53	0.500	-128.82

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