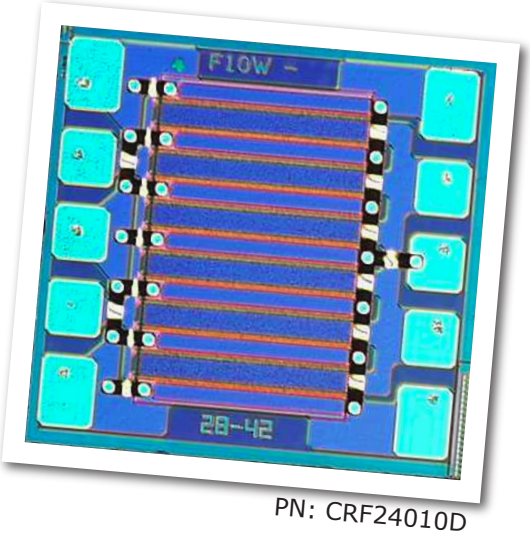
PRELIMINARY

CRF24010D

10 W SiC RF Power MESFET Die



PN: CRF24010D

Cree's CRF24010 is a silicon carbide (SiC) RF power Metal-Semiconductor Field-Effect Transistor (MESFET). SiC has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity, and higher thermal conductivity. SiC MESFETs offer greater power density and wider bandwidths compared to Si and GaAs transistors.

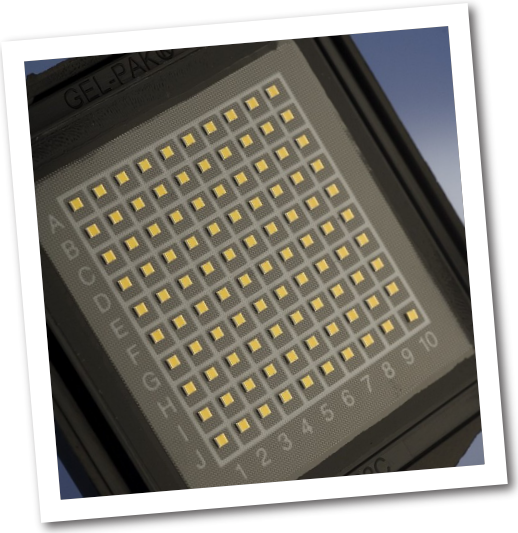
FEATURES

- 15 dB Small Signal Gain
- 10 W Minimum P_{1dB}
- 48 V Operation
- High Breakdown Voltage
- High Temperature Operation
- Up to 5 GHz Operation
- High Efficiency

APPLICATIONS

- Wideband Military Communications
- Secure Comms for Homeland Defense
- Class A, AB Amplifiers
- TDMA, EDGE, CDMA and W-CDMA
- Broadband Amplifiers
- MMDS

RoHS COMPLIANT



Packaging Information

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

Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Symbol	Rating	Units
Drain-source Voltage	V_{DSS}	120	VDC
Gate-source Voltage	V_{GS}	-20, +3	VDC
Storage Temperature	T_{STG}	-55, 150	˚C
Operating Junction Temperature	T_J	255	˚C
Thermal Resistance, Junction to Case[1]	$R_{\theta JC}$	5.6	˚C/W
Mounting Temperature (30 seconds)	T_S	320	˚C

[1]Eutectic die attach using 80/20 AuSn mounted to a 40 mil thick CuMoCu carrier.

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(th)}$	-12	-10	–	VDC	V_{DS} = 10 V, I_D = 0.5 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-9	–	VDC	V_{DS} = 48 V, I_D = 250 mA
Zero Gate Voltage Drain Current	I_{DSS}	1.2	1.5	1.8	A	V_{DS} = 10 V, V_{GS} = 0 V
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	100	–	–	VDC	V_{GS} = -18 V, I_D = 10 mA
Forward Transconductance	g_m	140	160	–	mS	V_{DS} = 48 V, I_D = 250 mA
RF Characteristics						
Gain	G_{SS}	13	15	–	dB	V_{DD} = 48 V, I_{DQ} = 500 mA, f = 2000 MHz
Power Output at 1 dB Compression	P_{1dB}	10	12	–	W	V_{DD} = 48 V, I_{DQ} = 500 mA, f = 2000 MHz
Drain Efficiency[1,2]	η	40	45	–	%	V_{DD} = 48 V, I_{DQ} = 250 mA, f = 2000 MHz P_{OUT} = P_{1dB}
Intermodulation Distortion	IMD_3	–	-31	–	dBc	V_{DD} = 48 V, I_{DQ} = 250 mA f1 = 2000.0 MHz, f2 = 2000.1 MHz P_{OUT} = 10 W PEP
Minimum Noise Figure	NF_{min}	–	3.1	–	dB	V_{DD} = 48 V, I_{DQ} = 500 mA, f = 2000 MHz
Output Mismatch Stress	VSWR	10:1	–	–	–	No damage at all phase angles V_{DD} = 48 V, I_{DQ} = 500 mA, f = 2000 MHz P_{OUT} = 10 W CW
Dynamic Characteristics						
Input Capacitance	C_{ISS}	–	1.9	–	pF	V_{DS} = 48 V, V_{gs} = -16 V, f = 1 MHz
Output Capacitance	C_{OSS}	–	1.3	–	pF	V_{DS} = 48 V, V_{gs} = -16 V, f = 1 MHz
Reverse Transfer Capacitance	C_{RSS}	–	0.44	–	pF	V_{DS} = 48 V, V_{gs} = -16 V, f = 1 MHz

Notes:
[1] Drain Efficiency = P_{OUT}/P_{DC}
[2] Power Added Efficiency (PAE) = $(P_{OUT}-P_{IN})P_{DC}$

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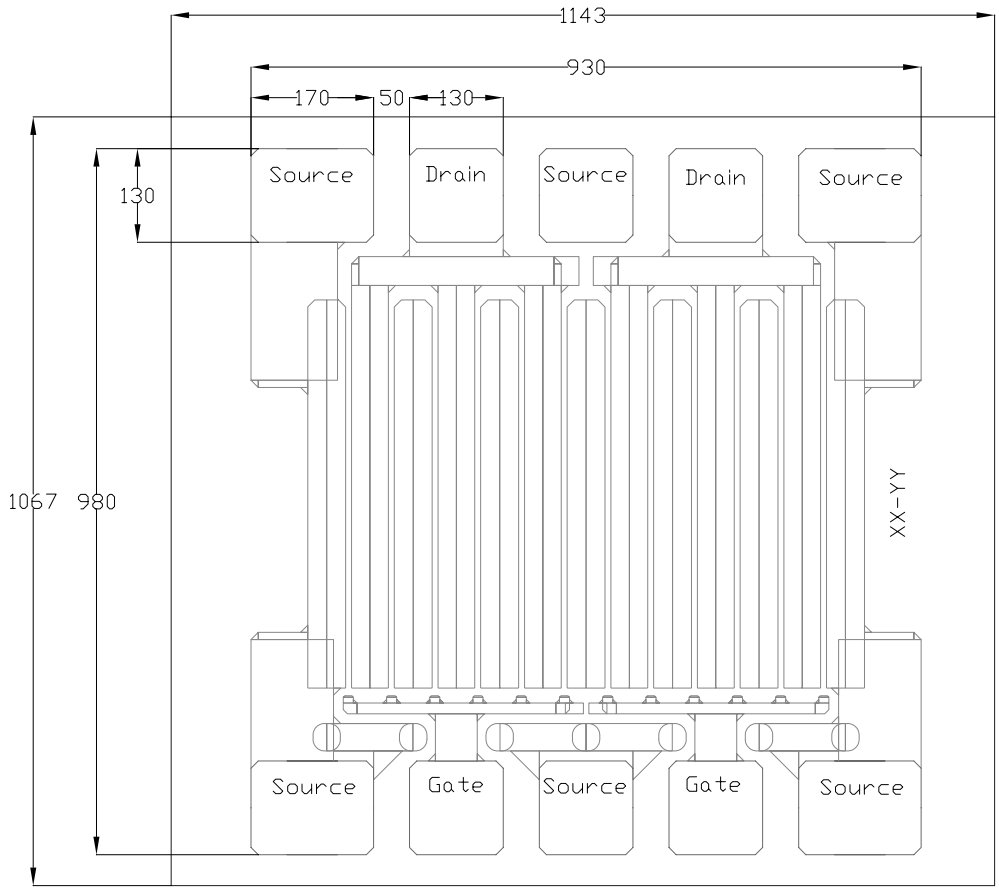
DIE Dimensions (units in microns)



Overall die size 1143 x 1067 (+/-25) microns, die thickness 300 microns
All pads must be bonded for electrical connection (sources not connected to backside metal).

Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to Cree's website for the Eutectic Die Bond Procedure application note at www.cree.com/wireless.
- Vacuum collet is the preferred method of pick-up.
- Die back side gold plating is 5 microns thick minimum.
- Use caution to prevent air bridge damage.
- Thermosonic ball or wedge bonding are the preferred connection methods.
- Gold wire must be used for connections.

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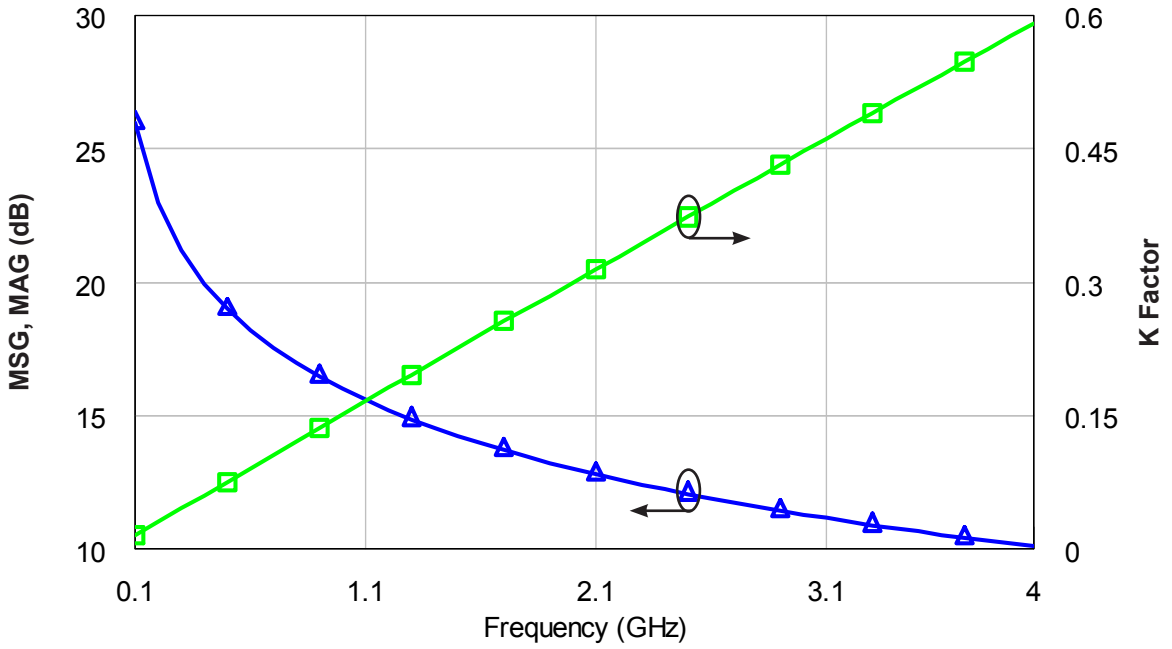
Typical Performance

Maximum Stable Gain, Maximum Available Gain and K Factor of the CRF24010D

V_{DD} = 48 V, I_{DQ} = 500 mA



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

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Typical Die S-Parameters (Small Signal, V_{DS} = 48 V, I_{DQ} = 100 mA, magnitude / angle)

Frequency	S(1,1)	S(2,1)	S(1,2)	S(2,2)
100.0MHz	0.99267 / -20.318	7.3595 / 167.29	0.022007 / 77.767	0.21373 / -34.427
200.0MHz	0.97487 / -39.393	6.9690 / 155.39	0.041676 / 66.345	0.24838 / -61.654
300.0MHz	0.95169 / -56.399	6.4362 / 144.80	0.057726 / 56.240	0.28699 / -81.339
400.0MHz	0.92819 / -71.036	5.8598 / 135.68	0.070063 / 47.592	0.32133 / -95.582
500.0MHz	0.90720 / -83.393	5.3038 / 127.90	0.079249 / 40.293	0.34943 / -106.11
600.0MHz	0.88969 / -93.743	4.7982 / 121.26	0.086009 / 34.138	0.37185 / -114.06
700.0MHz	0.87559 / -102.41	4.3520 / 115.56	0.090980 / 28.909	0.38986 / -120.19
800.0MHz	0.86443 / -109.70	3.9633 / 110.59	0.094652 / 24.418	0.40462 / -124.97
900.0MHz	0.85567 / -115.87	3.6261 / 106.20	0.097381 / 20.511	0.41706 / -128.78
1.000GHz	0.84882 / -121.13	3.3334 / 102.28	0.099416 / 17.069	0.42785 / -131.83
1.100GHz	0.84349 / -125.66	3.0784 / 98.737	0.100930 / 14.000	0.43750 / -134.32
1.200GHz	0.83935 / -129.58	2.8551 / 95.493	0.102060 / 11.233	0.44633 / -136.37
1.300GHz	0.83616 / -133.00	2.6585 / 92.497	0.102890 / 8.7128	0.45461 / -138.07
1.400GHz	0.83374 / -136.02	2.4845 / 89.705	0.103470 / 6.3968	0.46250 / -139.51
1.500GHz	0.83192 / -138.69	2.3297 / 87.084	0.103870 / 4.2514	0.47012 / -140.72
1.600GHz	0.83061 / -141.07	2.1910 / 84.608	0.104120 / 2.2500	0.47757 / -141.76
1.700GHz	0.82972 / -143.21	2.0664 / 82.256	0.104240 / 0.3715	0.48490 / -142.67
1.800GHz	0.82916 / -145.13	1.9537 / 80.009	0.104260 / -1.4013	0.49216 / -143.46
1.900GHz	0.82890 / -146.88	1.8514 / 77.855	0.104190 / -3.0824	0.49937 / -144.16
2.000GHz	0.82888 / -148.47	1.7582 / 75.783	0.104040 / -4.6831	0.50655 / -144.79
2.100GHz	0.82907 / -149.93	1.6728 / 73.781	0.103830 / -6.2130	0.51372 / -145.36
2.200GHz	0.82944 / -151.27	1.5945 / 71.844	0.103560 / -7.6798	0.52088 / -145.88
2.300GHz	0.82996 / -152.51	1.5223 / 69.964	0.103240 / -9.0901	0.52803 / -146.37
2.400GHz	0.83062 / -153.66	1.4556 / 68.136	0.102880 / -10.449	0.53518 / -146.82
2.500GHz	0.83139 / -154.73	1.3937 / 66.354	0.102480 / -11.763	0.54231 / -147.25
2.600GHz	0.83226 / -155.72	1.3362 / 64.616	0.102050 / -13.034	0.54943 / -147.66
2.700GHz	0.83321 / -156.66	1.2826 / 62.918	0.101590 / -14.266	0.55653 / -148.06
2.800GHz	0.83425 / -157.54	1.2326 / 61.256	0.101090 / -15.462	0.56361 / -148.44
2.900GHz	0.83534 / -158.37	1.1857 / 59.628	0.100580 / -16.626	0.57065 / -148.82
3.000GHz	0.83650 / -159.15	1.1418 / 58.032	0.100040 / -17.758	0.57766 / -149.18
3.100GHz	0.83771 / -159.89	1.1005 / 56.467	0.099479 / -18.862	0.58463 / -149.55
3.200GHz	0.83896 / -160.60	1.0617 / 54.929	0.098901 / -19.939	0.59154 / -149.90
3.300GHz	0.84024 / -161.27	1.0250 / 53.418	0.098306 / -20.989	0.59841 / -150.26
3.400GHz	0.84156 / -161.92	0.99039 / 51.932	0.097697 / -22.016	0.60522 / -150.61
3.500GHz	0.84291 / -162.53	0.95764 / 50.471	0.097075 / -23.020	0.61196 / -150.97
3.600GHz	0.84427 / -163.12	0.92662 / 49.033	0.096440 / -24.001	0.61863 / -151.32
3.700GHz	0.84566 / -163.69	0.89720 / 47.616	0.095794 / -24.962	0.62523 / -151.67
3.800GHz	0.84705 / -164.24	0.86925 / 46.221	0.095139 / -25.903	0.63176 / -152.02
3.900GHz	0.84846 / -164.77	0.84268 / 44.847	0.094475 / -26.825	0.63820 / -152.38
4.000GHz	0.84988 / -165.28	0.81739 / 43.492	0.093804 / -27.728	0.64457 / -152.73

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Typical Die S-Parameters (Small Signal, V_{DS} = 48 V, I_{DQ} = 250 mA, magnitude / angle)

Frequency	S(1,1)	S(2,1)	S(1,2)	S(2,2)
100.0MHz	0.99189 / -21.939	8.4860 / 166.58	0.021161 / 77.031	0.17500 / -46.177
200.0MHz	0.97244 / -42.339	7.9748 / 154.15	0.039769 / 65.054	0.23158 / -76.017
300.0MHz	0.94793 / -60.239	7.2952 / 143.28	0.054564 / 54.646	0.28669 / -94.931
400.0MHz	0.92397 / -75.374	6.5808 / 134.09	0.065617 / 45.910	0.33137 / -107.91
500.0MHz	0.90330 / -87.935	5.9095 / 126.40	0.073639 / 38.667	0.36554 / -117.30
600.0MHz	0.88653 / -98.303	5.3125 / 119.92	0.079419 / 32.650	0.39141 / -124.32
700.0MHz	0.87333 / -106.88	4.7948 / 114.42	0.083602 / 27.600	0.41127 / -129.69
800.0MHz	0.86307 / -114.02	4.3502 / 109.67	0.086655 / 23.304	0.42690 / -133.87
900.0MHz	0.85513 / -120.02	3.9687 / 105.51	0.088904 / 19.595	0.43957 / -137.18
1.000GHz	0.84898 / -125.10	3.6404 / 101.81	0.090572 / 16.346	0.45018 / -139.83
1.100GHz	0.84421 / -129.45	3.3565 / 98.471	0.091814 / 13.463	0.45935 / -141.98
1.200GHz	0.84053 / -133.21	3.1093 / 95.428	0.092735 / 10.873	0.46751 / -143.74
1.300GHz	0.83769 / -136.47	2.8927 / 92.624	0.093412 / 8.5216	0.47495 / -145.20
1.400GHz	0.83552 / -139.34	2.7017 / 90.016	0.093899 / 6.3653	0.48188 / -146.42
1.500GHz	0.83389 / -141.88	2.5323 / 87.571	0.094235 / 4.3715	0.48846 / -147.45
1.600GHz	0.83270 / -144.14	2.3811 / 85.262	0.094449 / 2.5140	0.49480 / -148.32
1.700GHz	0.83186 / -146.16	2.2455 / 83.070	0.094564 / 0.77226	0.50097 / -149.07
1.800GHz	0.83132 / -147.98	2.1231 / 80.977	0.094596 / -0.87042	0.50703 / -149.71
1.900GHz	0.83103 / -149.63	2.0123 / 78.970	0.094558 / -2.4275	0.51301 / -150.27
2.000GHz	0.83095 / -151.14	1.9114 / 77.039	0.094461 / -3.9099	0.51895 / -150.77
2.100GHz	0.83105 / -152.51	1.8192 / 75.174	0.094313 / -5.3268	0.52487 / -151.21
2.200GHz	0.83130 / -153.78	1.7346 / 73.367	0.094313 / -5.3268	0.53078 / -151.61
2.300GHz	0.83169 / -154.94	1.6568 / 71.612	0.093888 / -7.9928	0.53668 / -151.97
2.400GHz	0.83219 / -156.02	1.5849 / 69.905	0.093621 / -9.2534	0.54259 / -152.30
2.500GHz	0.83279 / -157.03	1.5183 / 68.240	0.093323 / -10.472	0.54850 / -152.61
2.600GHz	0.83348 / -157.97	1.4565 / 66.615	0.092997 / -11.653	0.55442 / -152.91
2.700GHz	0.83425 / -158.84	1.3989 / 65.024	0.092646 / -12.798	0.56034 / -153.18
2.800GHz	0.83509 / -159.67	1.3452 / 63.467	0.092272 / -13.912	0.56626 / -153.45
2.900GHz	0.83598 / -160.45	1.2949 / 61.940	0.091878 / -14.996	0.57218 / -153.71
3.000GHz	0.83693 / -161.18	1.2477 / 60.441	0.091464 / -16.052	0.57809 / -153.96
3.100GHz	0.83793 / -161.88	1.2034 / 58.968	0.091034 / -17.083	0.58400 / -154.21
3.200GHz	0.83897 / -162.54	1.1617 / 57.520	0.090587 / -18.090	0.58989 / -154.45
3.300GHz	0.84005 / -163.17	1.1224 / 56.097	0.090127 / -19.074	0.59577 / -154.69
3.400GHz	0.84116 / -163.77	1.0852 / 54.695	0.089653 / -20.037	0.60162 / -154.93
3.500GHz	0.84230 / -164.34	1.0501 / 53.314	0.089167 / -20.980	0.60744 / -155.18
3.600GHz	0.84346 / -164.90	1.0168 / 51.953	0.088670 / -21.903	0.61324 / -155.42
3.700GHz	0.84464 / -165.43	0.98524 / 50.611	0.088162 / -22.809	0.61900 / -155.66
3.800GHz	0.84584 / -165.94	0.95526 / 49.288	0.087646 / -23.697	0.62472 / -155.91
3.900GHz	0.84706 / -166.43	0.92673 / 47.982	0.087120 / -24.568	0.63039 / -156.16
4.000GHz	0.84829 / -166.90	0.89958 / 46.694	0.086587 / -25.423	0.63603 / -156.41

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Frequency	S(1,1)	S(2,1)	S(1,2)	S(2,2)
100.0MHz	0.9908 / -23.969	9.7872 / 165.59	0.020995 / 76.032	0.16990 / -54.425
200.0MHz	0.9690 / -45.966	9.1031 / 152.45	0.039053 / 63.323	0.24179 / -84.694
300.0MHz	0.9428 / -64.866	8.2244 / 141.21	0.052919 / 52.530	0.30581 / -102.83
400.0MHz	0.9183 / -80.486	7.3337 / 131.93	0.062908 / 43.686	0.39018 / -123.87
500.0MHz	0.8981 / -93.182	6.5231 / 124.31	0.06993 / 36.506	0.39018 / -123.87
600.0MHz	0.8822 / -103.48	5.8205 / 118.01	0.074861 / 30.639	0.41619 / -130.40
700.0MHz	0.8701 / -111.88	5.2235 / 112.71	0.078359 / 25.777	0.43558 / -135.36
800.0MHz	0.8609 / -118.79	4.7187 / 108.17	0.080873 / 21.679	0.45046 / -139.21
900.0MHz	0.8538 / -124.55	4.2908 / 104.22	0.082703 / 18.167	0.46229 / -142.25
1.000GHz	0.8484 / -129.40	3.9260 / 100.72	0.084048 / 15.106	0.47201 / -144.67
1.100GHz	0.8443 / -133.52	3.6128 / 97.580	0.085041 / 12.401	0.48027 / -146.64
1.200GHz	0.8412 / -137.07	3.3418 / 94.719	0.085773 / 9.9770	0.48752 / -148.24
1.300GHz	0.8387 / -140.15	3.1055 / 92.085	0.086307 / 7.7804	0.49406 / -149.50
1.400GHz	0.8369 / -142.84	2.8980 / 89.637	0.086688 / 5.7693	0.50009 / -150.67
1.500GHz	0.8355 / -145.22	2.7145 / 87.343	0.086948 / 3.9113	0.50577 / -151.60
1.600GHz	0.8345 / -147.33	2.5513 / 85.177	0.087112 / 2.1814	0.51121 / -152.38
1.700GHz	0.8338 / -149.22	2.4051 / 83.120	0.087196 / 0.5597	0.51648 / -153.04
1.800GHz	0.8334 / -150.92	2.2736 / 81.155	0.087214 / -0.9697	0.52164 / -153.62
1.900GHz	0.8332 / -152.46	2.1546 / 79.270	0.087177 / -2.4198	0.52673 / -154.11
2.000GHz	0.8331 / -153.86	2.0465 / 77.455	0.087092 / -3.8007	0.53178 / -154.54
2.100GHz	0.8332 / -155.14	1.9478 / 75.700	0.086967 / -5.1213	0.53681 / -154.92
2.200GHz	0.8334 / -156.31	1.8575 / 74.000	0.086806 / -6.3880	0.54183 / -155.26
2.300GHz	0.8338 / -157.40	1.7744 / 72.347	0.086613 / -7.6083	0.54686 / -155.56
2.400GHz	0.8342 / -158.40	1.6977 / 70.737	0.086392 / -8.7856	0.55191 / -155.83
2.500GHz	0.8347 / -159.34	1.6268 / 69.166	0.086147 / -9.9246	0.55696 / -156.08
2.600GHz	0.8353 / -160.21	1.5609 / 67.630	0.085878 / -11.029	0.56204 / -156.32
2.700GHz	0.8360 / -161.03	1.4996 / 66.127	0.085589 / -12.102	0.56713 / -156.53
2.800GHz	0.8367 / -161.80	1.4424 / 64.652	0.085281 / -13.146	0.57224 / -156.74
2.900GHz	0.8375 / -162.52	1.3890 / 63.206	0.084956 / -14.163	0.57736 / -156.94
3.000GHz	0.8383 / -163.20	1.3389 / 61.784	0.084616 / -15.155	0.58250 / -157.13
3.100GHz	0.8392 / -163.85	1.2918 / 60.387	0.084261 / -16.124	0.58764 / -157.32
3.200GHz	0.8401 / -164.46	1.2475 / 59.011	0.083892 / -17.072	0.59279 / -157.50
3.300GHz	0.8411 / -165.05	1.2058 / 57.656	0.083511 / -18.000	0.59794 / -157.69
3.400GHz	0.8420 / -165.61	1.1663 / 56.321	0.083119 / -18.908	0.60309 / -157.87
3.500GHz	0.8430 / -166.14	1.1291 / 55.005	0.082716 / -19.799	0.60823 / -158.05
3.600GHz	0.8441 / -166.65	1.0937 / 53.707	0.082303 / -20.672	0.61337 / -158.20
3.700GHz	0.8451 / -167.14	1.0602 / 52.425	0.081881 / -21.530	0.61849 / -158.42
3.800GHz	0.8462 / -167.62	1.0284 / 51.160	0.081451 / -22.371	0.62359 / -158.61
3.900GHz	0.8473 / -168.07	0.9982 / 49.910	0.081012 / -23.199	0.62868 / -158.80
4.000GHz	0.8484 / -168.52	0.9693 / 48.675	0.080567 / -24.011	0.63374 / -158.99

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