

# CGH35030F

## 30 W, 3300-3900 MHz, 28V, GaN HEMT for WiMAX

Cree's CGH35030F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGH35030F ideal for 3.3-3.9GHz WiMAX and BWA amplifier applications. The transistor is supplied in a ceramic/metal flange package.



Package Type: 440166  
PN: CGH35030F

### Typical Performance Over 3.3-3.7GHz ( $T_c = 25^\circ\text{C}$ ) of Demonstration Amplifier

Parameter	3.3 GHz	3.4 GHz	3.5 GHz	3.6 GHz	3.7 GHz	Units
Small Signal Gain	10.9	11.1	10.9	10.7	10.8	dB
EVM @ 36 dBm	1.9	1.9	1.9	2.0	2.0	%
Drain Efficiency @ 36 dBm	20.8	20.8	21.6	22.7	23.9	%
Input Return Loss	11.4	8.2	5.3	4.0	3.7	dB

Note:

Measured in the CGH35030F-TB amplifier circuit, under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3.

### Features

- 3.3 - 3.9 GHz Operation
- >11 dB Small Signal Gain
- 2.0 % EVM at 4 W  $P_{OUT}$
- 23 % Efficiency at 4 W  $P_{OUT}$
- $3.7^\circ\text{C/W}$  Typical thermal resistance under 4.0 W  $P_{AVE}$  OFDM
- WiMAX Fixed Access 802.16-2004 OFDM





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

Parameter	Symbol	Rating	Units
Drain-Source Voltage	$V_{DS}$	84	Volts
Gate-to-Source Voltage	$V_{GS}$	-10, +2	Volts
Storage Temperature	$T_{STG}$	-55, +150	°C
Operating Junction Temperature	$T_J$	175	°C
Soldering Temperature	$T_S$	245	°C
Thermal Resistance, Junction to Case <sup>1</sup>	$R_{\theta JC}$	3.7	°C/W

Note:

<sup>1</sup> Measured for the CGH35030F at 14 W  $P_{DISS}$

## Electrical Characteristics ( $T_c = 25^\circ\text{C}$ )

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics<sup>4</sup></b>						
Gate Threshold Voltage	$V_{GS(th)}$	-3.6	-2.5	-	VDC	$V_{DS} = 10\text{ V}, I_D = 7.2\text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.6	-	VDC	$V_{DS} = 28\text{ V}, I_D = 120\text{ mA}$
Saturated Drain Current	$I_{DS}$	4.8	5.4	-	A	$V_{DS} = 6.0\text{ V}, V_{GS} = 2\text{ V}$
Drain-Source Breakdown Voltage	$V_{BR}$	84	100	-	VDC	$V_{GS} = -8\text{ V}, I_D = 7.2\text{ mA}$
Forward Transconductance	$g_m$	1200	1300	-	mS	$V_{DS} = 28\text{ V}, I_D = 2\text{ A}$
Case Operating Temperature	$T_c$	-10	-	+105	°C	
Screw Torque	T	-	-	60	in-oz	Reference 440166 Package Revision 3
<b>RF Characteristics<sup>2,3</sup> (<math>T_c = 25^\circ\text{C}, F_0 = 3.6\text{ GHz}</math> unless otherwise noted)</b>						
Small Signal Gain	$G_{SS}$	10.0	10.7	-	dB	$V_{DD} = 28\text{ V}, I_{DQ} = 120\text{ mA}$
Drain Efficiency <sup>1</sup>	$\eta$	20.0	22.5	-	%	$V_{DD} = 28\text{ V}, I_{DQ} = 120\text{ mA}, P_{AVE} = 4\text{ W}$
Back-Off Error Vector Magnitude	$EVM_1$	-	2.3	-	%	$V_{DD} = 28\text{ V}, I_{DQ} = 120\text{ mA}, P_{AVE} = 21\text{ dBm}$
Error Vector Magnitude	$EVM_2$	-	2.0	-	%	$V_{DD} = 28\text{ V}, I_{DQ} = 120\text{ mA}, P_{AVE} = 4\text{ W}$
Output Mismatch Stress	VSWR	-	TBD	-	$\Psi$	No damage at all phase angles, $V_{DD} = 28\text{ V}, I_{DQ} = 120\text{ mA}$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{GS}$	-	9.3	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$
Output Capacitance	$C_{DS}$	-	2.0	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$
Feedback Capacitance	$C_{GD}$	-	0.9	-	pF	$V_{DS} = 28\text{ V}, V_{gs} = -8\text{ V}, f = 1\text{ MHz}$

Notes:

<sup>1</sup> Drain Efficiency =  $P_{out} / P_{dc}$

<sup>2</sup> Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3.

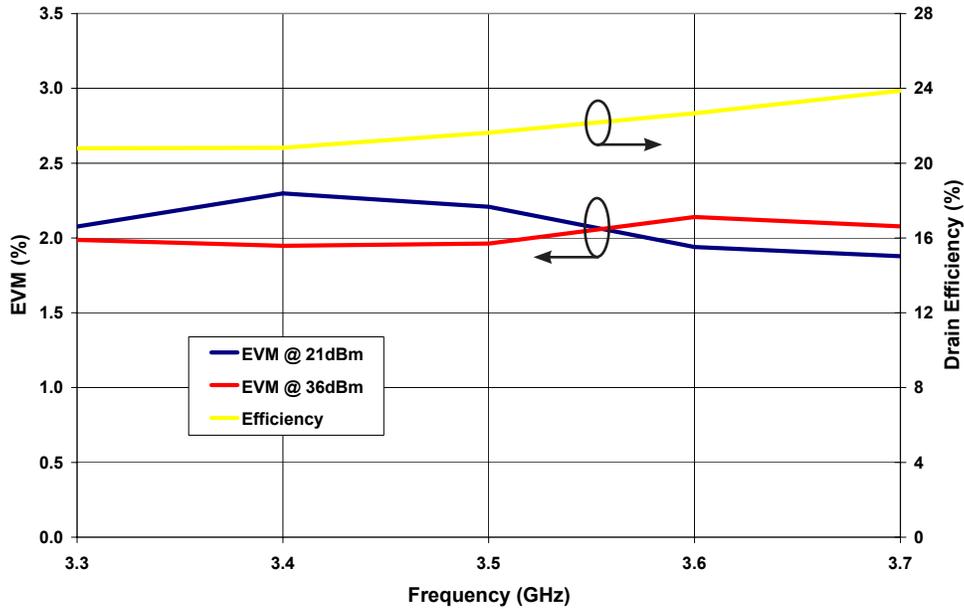
<sup>3</sup> Measured in the CGH35030F test fixture.

<sup>4</sup> Measured on wafer prior to packaging.



## Typical WiMAX Performance

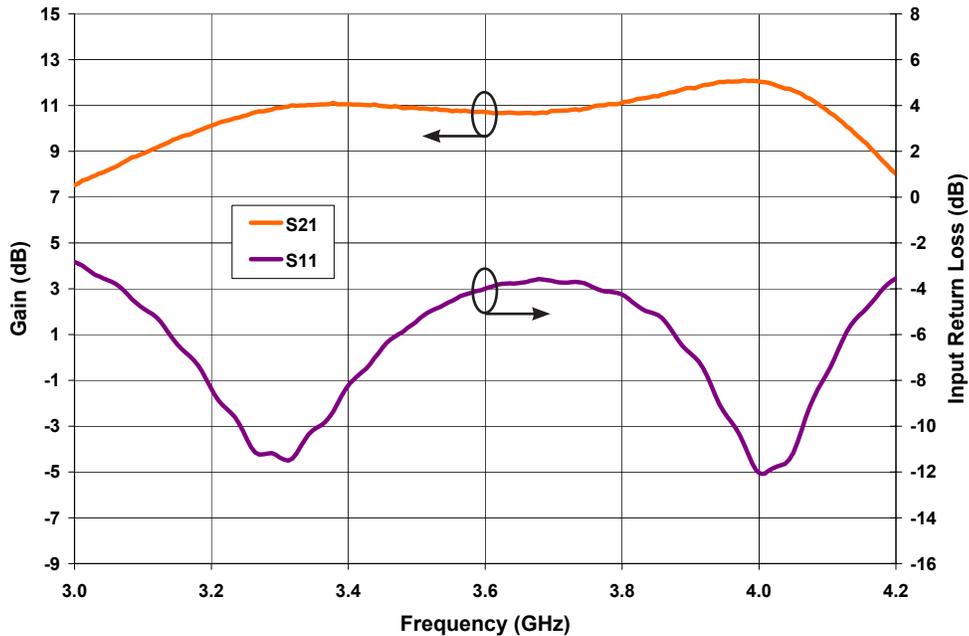
**Typical EVM and Efficiency at 21 dBm and 36 dBm vs Frequency of CGH35030F in Broadband Amplifier Circuit**



Note:

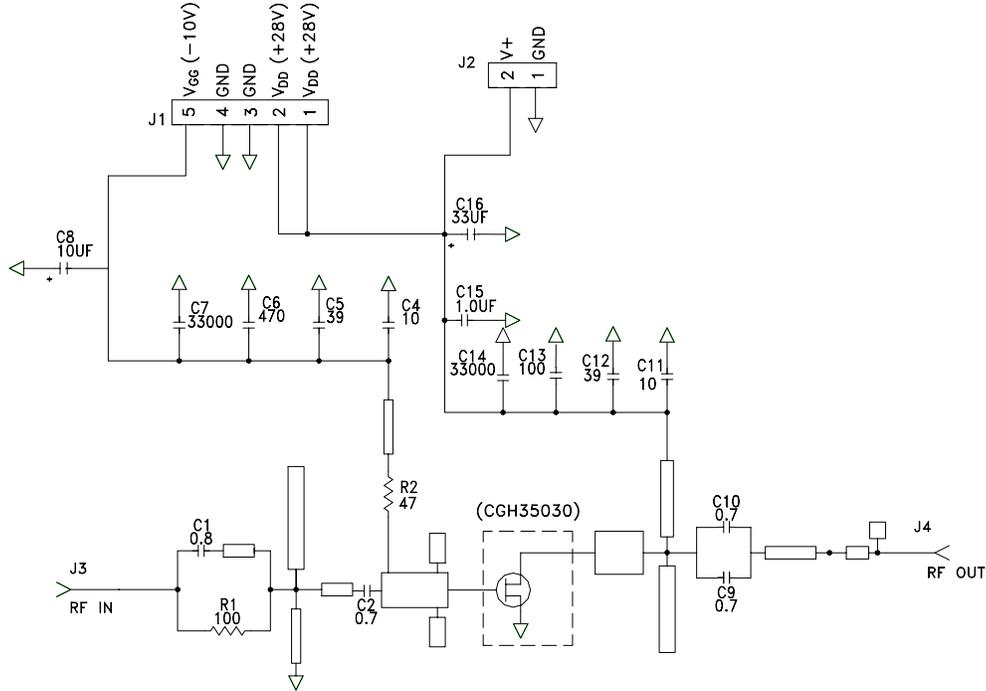
Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3.

**Gain and Return Loss vs Frequency of CGH35030F in Broadband Amplifier Circuit**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 120\text{ mA}$ , OFDM BW = 3.5 MHz

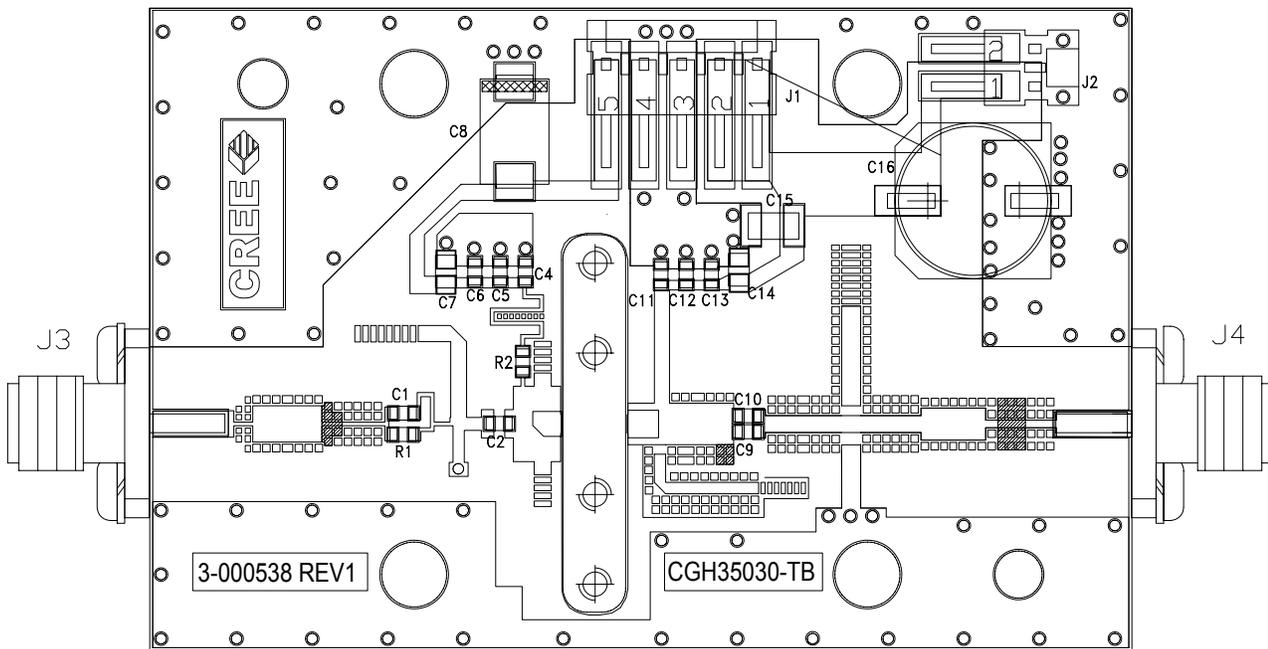




## CGH35030F-TB Demonstration Amplifier Circuit Schematic



## CGH35030F-TB Demonstration Amplifier Circuit Outline

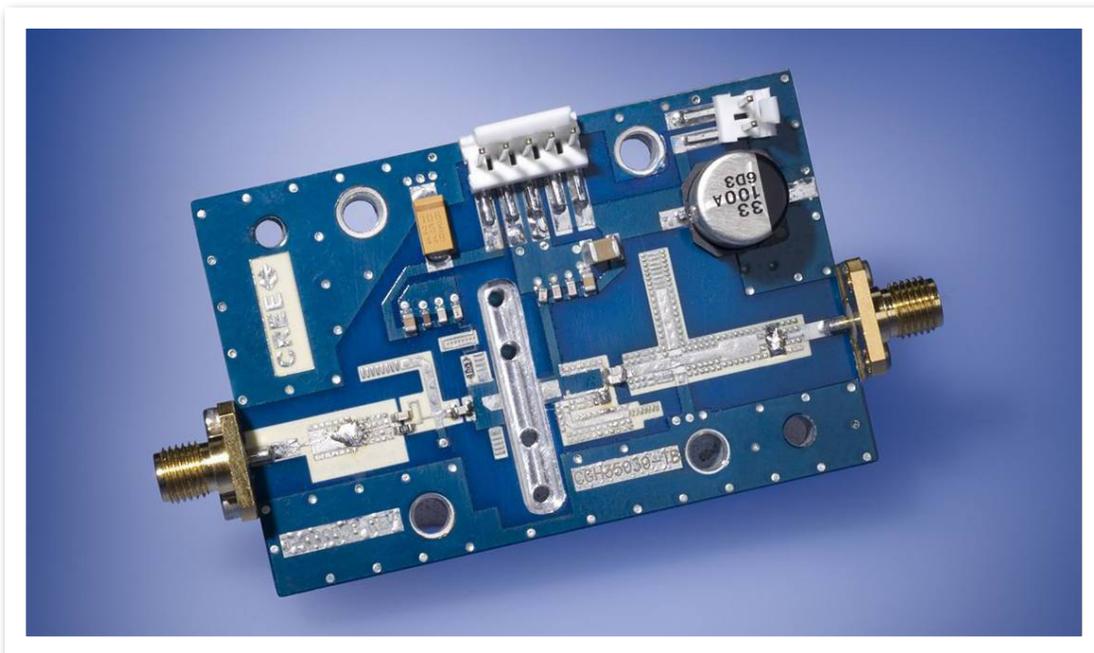




## CGH35030F-TB Demonstration Amplifier Circuit Bill of Materials

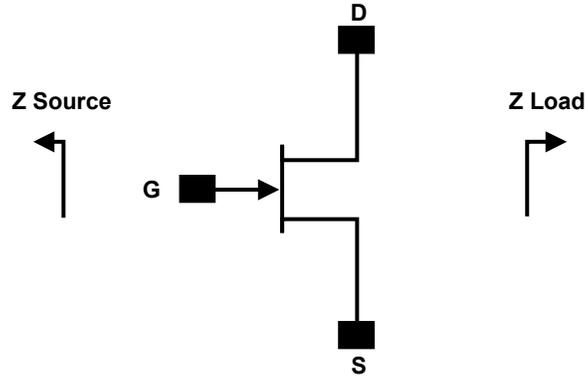
Designator	Description	Qty
R1	RES,1/16W,0603,1%,100 OHMS	1
R2	RES,1/16W,0603,1%,47 OHMS	1
C6	CAP, 470PF, 10%,100V, 0603	1
C17	CAP, 33 UF, 20%, G CASE	1
C16	CAP, 1.0UF, 100V, 10%, X7R, 1210	1
C8	CAP 10UF 16V TANTALUM	1
C13	CAP, 100.0pF, +/-5%, 0603	1
C1	CAP, 0.8pF, +/-0.05pF, 0603	1
C2,C9,C10	CAP, 0.7pF, +/-0.05pF, 0603	3
C4,C11	CAP, 10.0pF,+/-5%, 0603	2
C5,C12	CAP, 39pF, +/-5%, 0603	2
C7,C14	CAP,33000PF, 0805,100V, X7R	2
J3,J4	CONN SMA STR PANEL JACK RECP	1
J2	HEADER RT>PLZ.1CEN LK 2 POS	1
J1	HEADER RT>PLZ .1CEN LK 5POS	1
Q1	CGH35030F	1

## CGH35030F-TB Demonstration Amplifier Circuit





## Source and Load Impedances

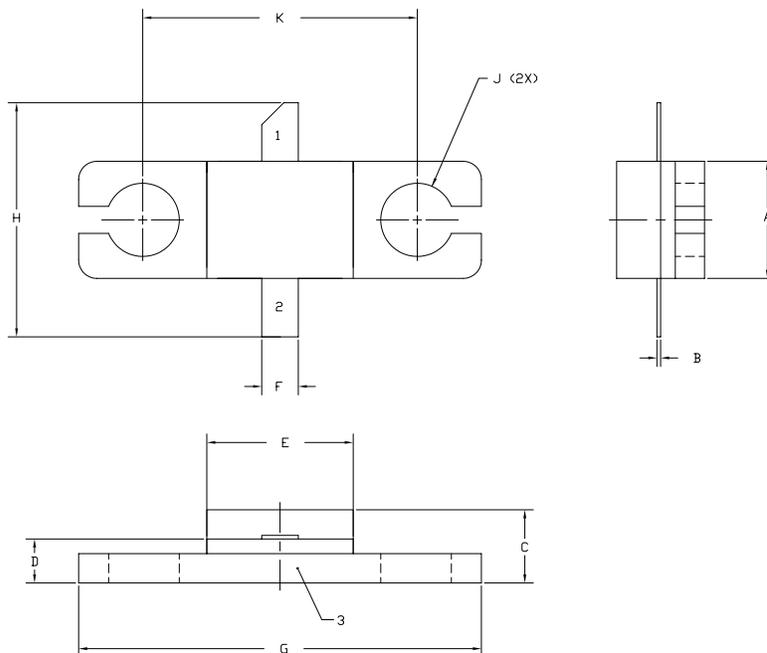


Frequency (MHz)	Z Source	Z Load
3300	5.3 - j8.9	13.3 - j10.0
3400	6.7 - j8.6	12.1 - j8.9
3500	7.7 - j9.3	11.0 - j7.8
3600	7.5 - j10.5	10.2 - j6.6
3700	6.3 - j11.0	9.5 - j5.5

Note<sup>1</sup>:  $V_{DD} = 28V$ ,  $I_{DQ} = 120mA$ . In the 440166 package.

Note<sup>2</sup>: Impedances are extracted from the CGH35030-TB demonstration circuit and are not source and load pull data off the transistors itself.

## Product Dimensions CGH35030F (Package Type – 440166)



### NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
- LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
- ALL PLATED SURFACES ARE Ni/AU

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.155	0.165	3.94	4.19
B	0.004	0.006	0.10	0.15
C	0.115	0.135	2.92	3.43
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.545	0.555	13.84	14.09
H	0.280	0.360	7.87	8.38
J	Ø .100		2.54	
K	0.375		9.53	

PIN 1. GATE  
PIN 2. DRAIN  
PIN 3. SOURCE



**Typical Package S-Parameters**  
 (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 120\text{ mA}$ , magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
200 MHz	0.9207	-135.03	16.412	108.79	0.02981	20.50	0.6269	-156.01
300 MHz	0.9136	-150.21	11.402	100.13	0.03104	12.71	0.6531	-164.20
400 MHz	0.9108	-158.59	8.683	94.76	0.03149	8.20	0.6633	-168.67
500 MHz	0.9095	-164.02	6.998	90.82	0.03169	5.12	0.6685	-171.56
600 MHz	0.9087	-167.91	5.855	87.61	0.03177	2.77	0.6716	-173.62
700 MHz	0.9083	-170.90	5.032	84.84	0.03180	0.86	0.6737	-175.22
800 MHz	0.9080	-173.33	4.410	82.33	0.03180	-0.77	0.6754	-176.52
900 MHz	0.9079	-175.38	3.925	80.01	0.03177	-2.22	0.6769	-177.62
1.0 GHz	0.9078	-177.16	3.536	77.82	0.03172	-3.53	0.6782	-178.58
1.1 GHz	0.9077	-178.76	3.218	75.72	0.03167	-4.75	0.6794	-179.45
1.2 GHz	0.9077	179.80	2.952	73.69	0.03160	-5.88	0.6807	179.76
1.3 GHz	0.9077	178.46	2.727	71.72	0.03152	-6.96	0.6819	179.01
1.4 GHz	0.9077	177.20	2.533	69.80	0.03143	-7.98	0.6832	178.31
1.5 GHz	0.9078	176.01	2.366	67.91	0.03134	-8.96	0.6845	177.64
1.6 GHz	0.9078	174.88	2.220	66.05	0.03124	-9.90	0.6858	176.99
1.7 GHz	0.9079	173.79	2.091	64.22	0.03114	-10.80	0.6871	176.35
1.8 GHz	0.9079	172.73	1.976	62.41	0.03102	-11.68	0.6885	175.73
1.9 GHz	0.9080	171.70	1.874	60.62	0.03091	-12.52	0.6899	175.11
2.0 GHz	0.9080	170.70	1.781	58.84	0.03079	-13.34	0.6914	174.50
2.1 GHz	0.9081	169.71	1.698	57.09	0.03066	-14.14	0.6928	173.89
2.2 GHz	0.9082	168.74	1.623	55.34	0.03053	-14.91	0.6943	173.28
2.3 GHz	0.9082	167.78	1.554	53.60	0.03040	-15.65	0.6958	172.67
2.4 GHz	0.9083	166.83	1.491	51.88	0.03027	-16.38	0.6974	172.06
2.5 GHz	0.9083	165.89	1.433	50.17	0.03013	-17.07	0.6989	171.45
2.6 GHz	0.9084	164.95	1.380	48.46	0.02999	-17.75	0.7005	170.83
2.7 GHz	0.9084	164.01	1.330	46.76	0.02985	-18.40	0.7020	170.20
2.8 GHz	0.9084	163.08	1.285	45.07	0.02971	-19.03	0.7036	169.57
2.9 GHz	0.9084	162.14	1.243	43.39	0.02956	-19.64	0.7052	168.92
3.0 GHz	0.9085	161.21	1.203	41.72	0.02942	-20.22	0.7067	168.27
3.1 GHz	0.9085	160.27	1.167	40.04	0.02928	-20.78	0.7083	167.61
3.2 GHz	0.9085	159.33	1.133	38.38	0.02914	-21.32	0.7099	166.94
3.3 GHz	0.9084	158.38	1.101	36.72	0.02900	-21.83	0.7114	166.26
3.4 GHz	0.9084	157.43	1.071	35.63	0.02886	-22.31	0.7129	165.58
3.5 GHz	0.9084	156.48	1.043	33.41	0.02872	-22.77	0.7144	164.87
3.6 GHz	0.9083	155.51	1.016	31.76	0.02859	-23.21	0.7159	164.16
3.7 GHz	0.9082	154.54	0.991	30.12	0.02846	-23.62	0.7173	163.44
3.8 GHz	0.9082	153.56	0.968	28.47	0.02834	-24.01	0.7188	162.70
3.9 GHz	0.9081	152.58	0.946	26.83	0.02822	-24.37	0.7202	161.95
4.0 GHz	0.9079	151.58	0.926	25.19	0.02811	-24.70	0.7215	161.19



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For more information, please contact:

Cree, Inc.  
4600 Silicon Drive  
Durham, NC 27703  
[www.cree.com/wireless](http://www.cree.com/wireless)

Ryan Baker  
Marketing  
Cree, Wireless Devices  
919.287.7816

Tom Dekker  
Sales Director  
Cree, Wireless Devices  
919.313.5639