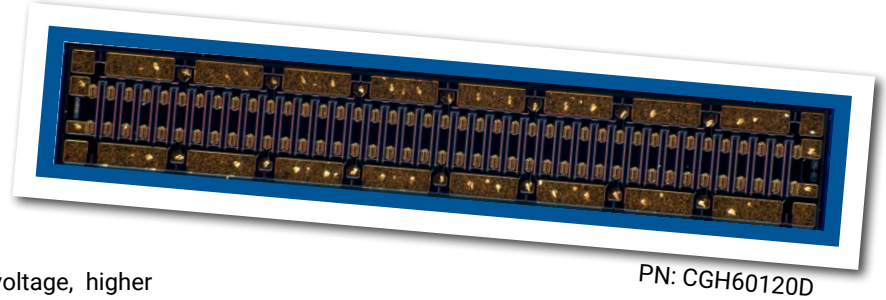
CGH60120D

120 W, 6.0 GHz, GaN HEMT Die



PN: CGH60120D

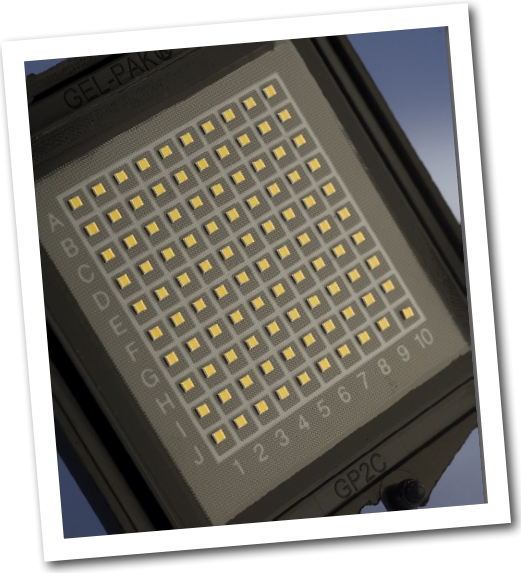
Cree's CGH60120D is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT). GaN has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity, and higher thermal conductivity. GaN HEMTs offer greater power density and wider bandwidths compared to Si and GaAs transistors.

FEATURES

- 13 dB Typical Small Signal Gain at 4 GHz
- 12 dB Typical Small Signal Gain at 6 GHz
- 120 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

RoHS COMPLIANT

- 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_{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}	30	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	12	A	25˚C
Thermal Resistance, Junction to Case (packaged)[2]	$R_{\theta JC}$	1.5	˚C/W	
Thermal Resistance, Junction to Case (die only)	$R_{\theta JC}$	0.8	˚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 60 mil thick CuMoCu 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 = 28.8 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DD} = 28 V, I_{DQ} = 800 mA
Drain Current	I_{DSS}	23.2	28.0	–	A	V_{DS} = 6 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BD}	120	–	–	V	V_{GS} = -8 V, I_D = 28.8 mA
On Resistance	R_{ON}	–	0.1	–	Ω	V_{DS} = 0.1 V
Gate Forward Voltage	V_{G-ON}	–	1.9	–	V	I_{GS} = 28.8 mA
RF Characteristics						
Small Signal Gain	G_{SS}	–	13	–	dB	V_{DD} = 28 V, I_{DQ} = 800 mA
Saturated Power Output[2]	P_{SAT}	–	120	–	W	V_{DD} = 28 V, I_{DQ} = 800 mA
Drain Efficiency[1]	η	–	65	–	%	V_{DD} = 28 V, I_{DQ} = 800 mA, P_{SAT} = 120 W
Intermodulation Distortion	IM3	–	-30	–	dBc	V_{DD} = 28 V, I_{DQ} = 800 mA, P_{OUT} = 120 W PEP
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 800 mA, P_{OUT} = 120 W CW
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	34.0	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	7.7	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	1.5	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

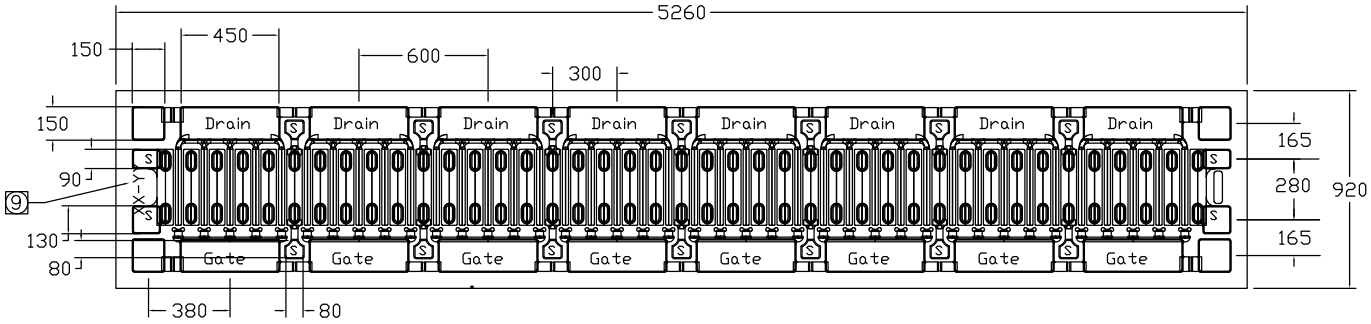
Notes:

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

[2] P_{SAT} is defined as I_G = 3.0 mA.

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

DIE Dimensions (units in microns)



Overall die size 5260 x 920 (+0/-50) microns, die thickness 100 (+/- 10) microns.
All Gate and Drain pads must be wire bonded for electrical connection.

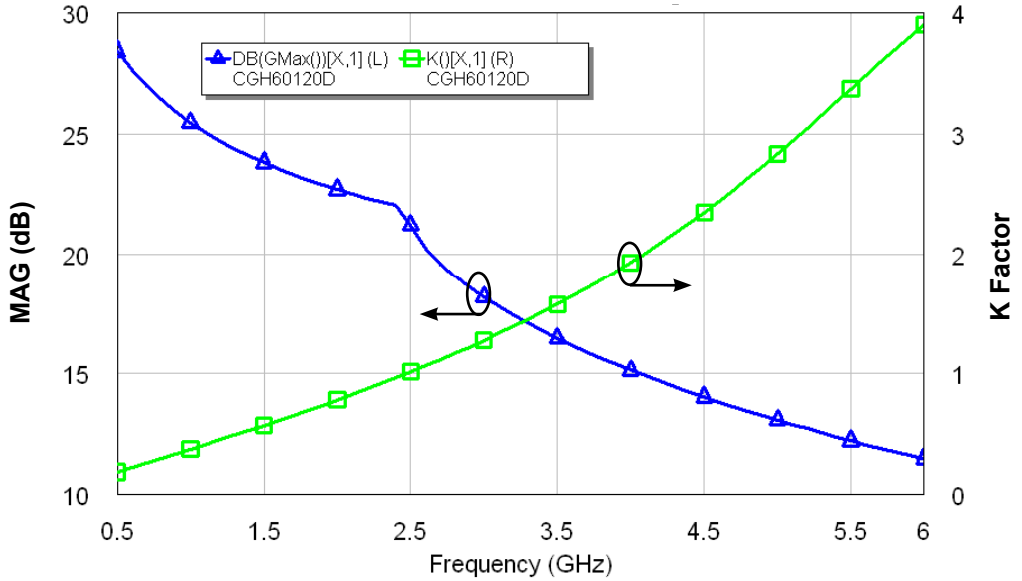
Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to Cree's website for the Eutectic Die Bond Procedure application note at www.cree.com/wireless.
- 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, see arrow 9 in the drawing above.

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Typical Performance

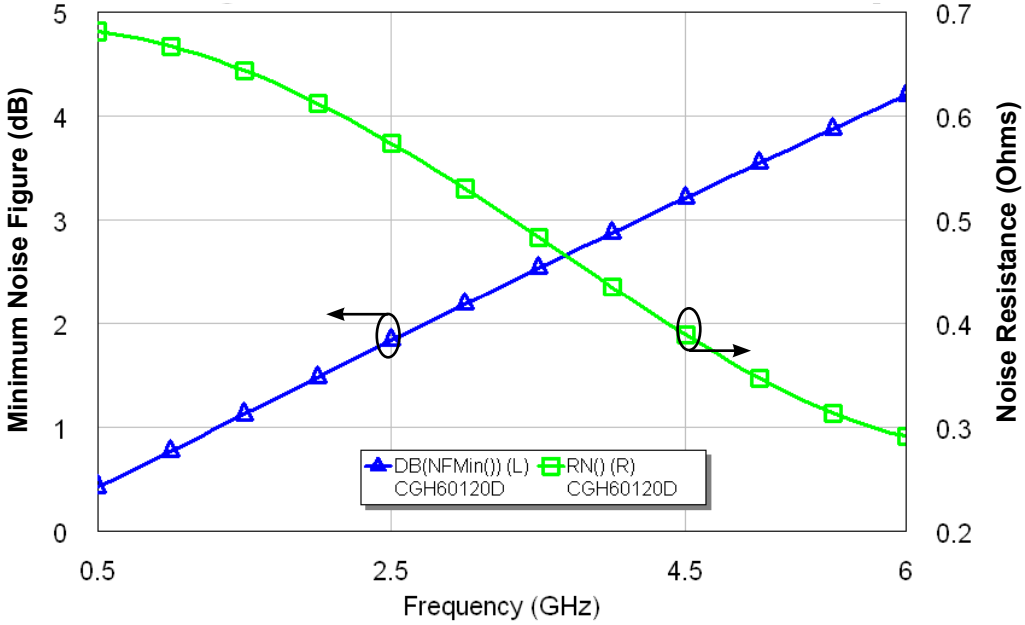
Simulated Maximum Available Gain and K Factor of the CGH60120D
V_{DD} = 28 V, I_{DQ} = 1000 mA



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 CGH60120D
V_{DD} = 28 V, I_{DQ} = 1000 mA



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Typical Die S-Parameters (Small Signal, V_{DS} = 28 V, I_{DQ} = 500 mA, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.961	-174.70	4.32	82.44	0.008	-5.29	0.780	-176.07
600 MHz	0.962	-175.52	3.58	80.05	0.008	-7.21	0.783	-175.85
700 MHz	0.962	-176.10	3.05	77.81	0.008	-8.99	0.786	-175.58
800 MHz	0.962	-176.53	2.65	75.66	0.008	-10.67	0.790	-175.30
900 MHz	0.963	-176.86	2.34	73.59	0.008	-12.27	0.794	-175.02
1.0 GHz	0.963	-177.12	2.08	71.58	0.008	-13.80	0.798	-174.74
1.1 GHz	0.964	-177.33	1.88	69.64	0.008	-15.27	0.802	-174.48
1.2 GHz	0.964	-177.50	1.70	67.75	0.008	-16.68	0.807	-174.24
1.3 GHz	0.965	-177.65	1.55	65.90	0.008	-18.04	0.812	-174.02
1.4 GHz	0.965	-177.78	1.43	64.11	0.007	-19.34	0.817	-173.82
1.5 GHz	0.966	-177.89	1.31	62.37	0.007	-20.60	0.822	-173.64
1.6 GHz	0.967	-177.99	1.22	60.67	0.007	-21.80	0.827	-173.49
1.7 GHz	0.967	-178.08	1.13	59.02	0.007	-22.95	0.832	-173.35
1.8 GHz	0.968	-178.16	1.05	57.41	0.007	-24.04	0.837	-173.24
1.9 GHz	0.968	-178.24	0.98	55.85	0.007	-25.09	0.842	-173.15
2.0 GHz	0.969	-178.31	0.92	54.33	0.007	-26.08	0.847	-173.07
2.1 GHz	0.970	-178.37	0.86	52.85	0.006	-27.03	0.851	-173.01
2.2 GHz	0.970	-178.43	0.81	51.42	0.006	-27.92	0.856	-172.97
2.3 GHz	0.971	-178.49	0.77	50.02	0.006	-28.76	0.861	-172.95
2.4 GHz	0.971	-178.55	0.72	48.67	0.006	-29.56	0.865	-172.93
2.5 GHz	0.972	-178.60	0.68	47.36	0.006	-30.30	0.870	-172.93
2.6 GHz	0.973	-178.66	0.65	46.08	0.006	-31.00	0.874	-172.94
2.7 GHz	0.973	-178.71	0.61	44.84	0.006	-31.64	0.878	-172.97
2.8 GHz	0.974	-178.76	0.58	43.64	0.005	-32.24	0.882	-173.00
2.9 GHz	0.974	-178.81	0.55	42.47	0.005	-32.78	0.886	-173.03
3.0 GHz	0.975	-178.85	0.53	41.34	0.005	-33.28	0.890	-173.08
3.2 GHz	0.975	-178.95	0.48	39.17	0.005	-34.13	0.897	-173.19
3.4 GHz	0.976	-179.03	0.44	37.12	0.005	-34.78	0.903	-173.32
3.6 GHz	0.977	-179.12	0.40	35.19	0.004	-35.24	0.909	-173.46
3.8 GHz	0.978	-179.20	0.37	33.37	0.004	-35.48	0.915	-173.62
4.0 GHz	0.979	-179.29	0.34	31.64	0.004	-35.52	0.920	-173.78
4.2 GHz	0.979	-179.37	0.31	30.01	0.004	-35.32	0.925	-173.95
4.4 GHz	0.980	-179.44	0.29	28.46	0.003	-34.89	0.929	-174.12
4.6 GHz	0.980	-179.52	0.27	27.00	0.003	-34.19	0.933	-174.29
4.8 GHz	0.981	-179.60	0.25	25.61	0.003	-33.22	0.937	-174.46
5.0 GHz	0.981	-179.67	0.24	24.29	0.003	-31.92	0.941	-174.63
5.2 GHz	0.982	-179.74	0.22	23.03	0.003	-30.27	0.944	-174.80
5.4 GHz	0.982	-179.81	0.21	21.84	0.002	-28.22	0.947	-174.97
5.6 GHz	0.982	-179.88	0.19	20.70	0.002	-25.72	0.950	-175.13
5.8 GHz	0.983	-179.95	0.18	19.61	0.002	-22.72	0.952	-175.29
6.0 GHz	0.983	179.98	0.17	18.58	0.002	-19.15	0.954	-175.45

To download the s-parameters in s2p format, go to the CGH60120D Product Page and click on the documentation tab.

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Typical Die S-Parameters (Small Signal, V_{DS} = 28 V, I_{DQ} = 1.0 A, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.969	-175.20	4.23	83.99	0.006	-3.13	0.817	-177.45
600 MHz	0.969	-175.97	3.51	81.96	0.006	-4.57	0.818	-177.31
700 MHz	0.969	-176.53	3.00	80.05	0.006	-5.88	0.820	-177.14
800 MHz	0.970	-176.94	2.61	78.23	0.006	-7.11	0.822	-176.95
900 MHz	0.970	-177.26	2.31	76.46	0.006	-8.27	0.824	-176.75
1.0 GHz	0.970	-177.51	2.06	74.75	0.006	-9.38	0.827	-176.55
1.1 GHz	0.970	-177.72	1.86	73.08	0.006	-10.44	0.829	-176.35
1.2 GHz	0.971	-177.90	1.70	71.45	0.006	-11.46	0.832	-176.16
1.3 GHz	0.971	-178.04	1.55	69.85	0.006	-12.44	0.835	-175.98
1.4 GHz	0.971	-178.17	1.43	68.28	0.006	-13.37	0.838	-175.81
1.5 GHz	0.971	-178.28	1.32	66.75	0.006	-14.27	0.841	-175.65
1.6 GHz	0.972	-178.38	1.23	65.25	0.005	-15.13	0.844	-175.50
1.7 GHz	0.972	-178.47	1.15	63.78	0.005	-15.95	0.847	-175.36
1.8 GHz	0.972	-178.55	1.07	62.33	0.005	-16.73	0.850	-175.24
1.9 GHz	0.973	-178.62	1.01	60.92	0.005	-17.47	0.854	-175.13
2.0 GHz	0.973	-178.69	0.95	59.54	0.005	-18.17	0.857	-175.03
2.1 GHz	0.974	-178.75	0.89	58.19	0.005	-18.82	0.860	-174.94
2.2 GHz	0.974	-178.81	0.84	56.87	0.005	-19.44	0.864	-174.86
2.3 GHz	0.974	-178.86	0.80	55.57	0.005	-20.01	0.867	-174.80
2.4 GHz	0.975	-178.91	0.75	54.31	0.005	-20.54	0.870	-174.74
2.5 GHz	0.975	-178.96	0.72	53.07	0.005	-21.02	0.873	-174.69
2.6 GHz	0.975	-179.01	0.68	51.86	0.005	-21.46	0.876	-174.66
2.7 GHz	0.976	-179.05	0.65	50.68	0.004	-21.86	0.880	-174.63
2.8 GHz	0.976	-179.10	0.62	49.53	0.004	-22.20	0.883	-174.61
2.9 GHz	0.976	-179.14	0.59	48.40	0.004	-22.50	0.886	-174.59
3.0 GHz	0.977	-179.18	0.56	47.30	0.004	-22.75	0.889	-174.59
3.2 GHz	0.977	-179.26	0.51	45.17	0.004	-23.11	0.894	-174.60
3.4 GHz	0.978	-179.34	0.47	43.14	0.004	-23.25	0.900	-174.63
3.6 GHz	0.978	-179.41	0.43	41.20	0.004	-23.18	0.905	-174.68
3.8 GHz	0.979	-179.49	0.40	39.36	0.003	-22.87	0.910	-174.74
4.0 GHz	0.979	-179.56	0.37	37.60	0.003	-22.32	0.915	-174.82
4.2 GHz	0.980	-179.62	0.35	35.92	0.003	-21.50	0.919	-174.91
4.4 GHz	0.980	-179.69	0.32	34.31	0.003	-20.40	0.923	-175.00
4.6 GHz	0.981	-179.76	0.30	32.78	0.003	-18.98	0.927	-175.11
4.8 GHz	0.981	-179.82	0.28	31.32	0.003	-17.23	0.930	-175.22
5.0 GHz	0.982	-179.89	0.26	29.92	0.002	-15.11	0.934	-175.33
5.2 GHz	0.982	-179.95	0.25	28.58	0.002	-12.59	0.937	-175.45
5.4 GHz	0.982	179.99	0.23	27.30	0.002	-9.66	0.940	-175.57
5.6 GHz	0.983	179.93	0.22	26.08	0.002	-6.29	0.943	-175.69
5.8 GHz	0.983	179.86	0.21	24.90	0.002	-2.48	0.945	-175.81
6.0 GHz	0.983	179.80	0.20	23.78	0.002	1.75	0.948	-175.93

To download the s-parameters in s2p format, go to the CGH60120D Product Page and click on the documentation tab.

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

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
CGH60120D	GaN HEMT Bare Die	Each

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

Disclaimer

Specifications are subject to change without notice. Cree, Inc. believes the information contained within this data sheet to be accurate and reliable. However, no responsibility is assumed by Cree for its use or for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Cree. Cree makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose. "Typical" parameters are the average values expected by Cree in large quantities and are provided for information purposes only. These values can and do vary in different applications, and actual performance can vary over time. All operating parameters should be validated by customer's technical experts for each application. Cree products are not designed, intended, or authorized for use as components in applications intended for surgical implant into the body or to support or sustain life, in applications in which the failure of the Cree product could result in personal injury or death, or in applications for the planning, construction, maintenance or direct operation of a nuclear facility. CREE and the CREE logo are registered trademarks of Cree, Inc.

For more information, please contact:

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
www.cree.com/RF

Sarah Miller
Marketing
Cree, RF Components
1.919.407.5302

Ryan Baker
Marketing & Sales
Cree, RF Components
1.919.407.7816

Tom Dekker
Sales Director
Cree, RF Components
1.919.407.5639

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf