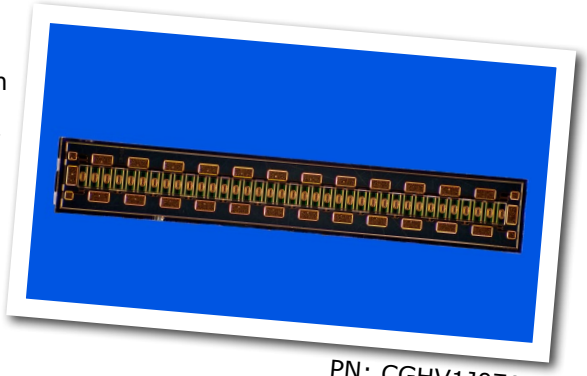
CGHV1J070D

70 W, 18.0 GHz, GaN HEMT Die

Cree's CGHV1J070D is a high voltage gallium nitride (GaN) High Electron Mobility Transistor (HEMT) on a silicon carbide substrate, using a 0.25 µm gate length fabrication process. This GaN-on-SiC product offers superior high frequency, high efficiency features. It is ideal for a variety of applications operating from 10 MHz to 18 GHz at 40 V with a high breakdown voltage.



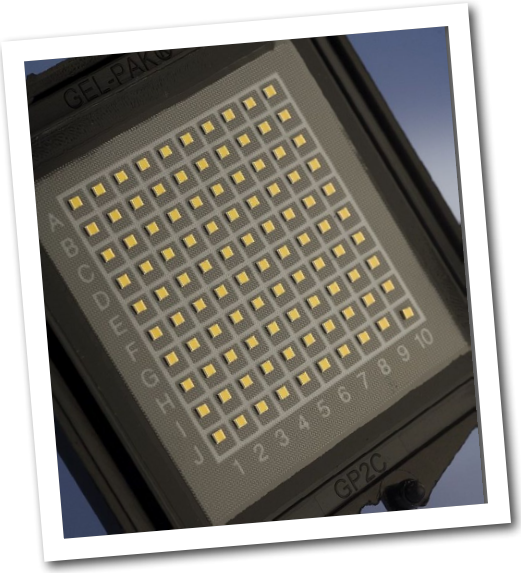
PN: CGHV1J070D

FEATURES

- 17 dB Typ. Small Signal Gain at 10 GHz
- 60% Typ. PAE at 10 GHz
- 70 W Typical Psat
- 40 V Operation
- Up to 18GHz Operation

APPLICATIONS

- Satellite Communications
- PTP Communications Links
- Marine Radar
- Pleasure Craft Radar
- Port Vessel Traffic Services
- Broadband Amplifiers
- High Efficiency Amplifiers



Packaging Information

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

Large Signal Models Available for SiC & GaN

Subject to change without notice.
www.cree.com/rf

Absolute Maximum Ratings (not simultaneous)

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DSS}	100	Volts	25˚C
Gate-source Voltage	V_{GS}	-10, +2	Volts	25˚C
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	14.4	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	6.0	A	25˚C
Thermal Resistance, Junction to Case (packaged)[2]	$R_{\theta JC}$	1.8	˚C/W	85˚C
Thermal Resistance, Junction to Case (die only)[2]	$R_{\theta JC}$	1.1	˚C/W	85˚C
Mounting Temperature	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 CMC carrier.

Electrical Characteristics (Frequency = 10 GHz unless otherwise stated; T_C = 25˚C)

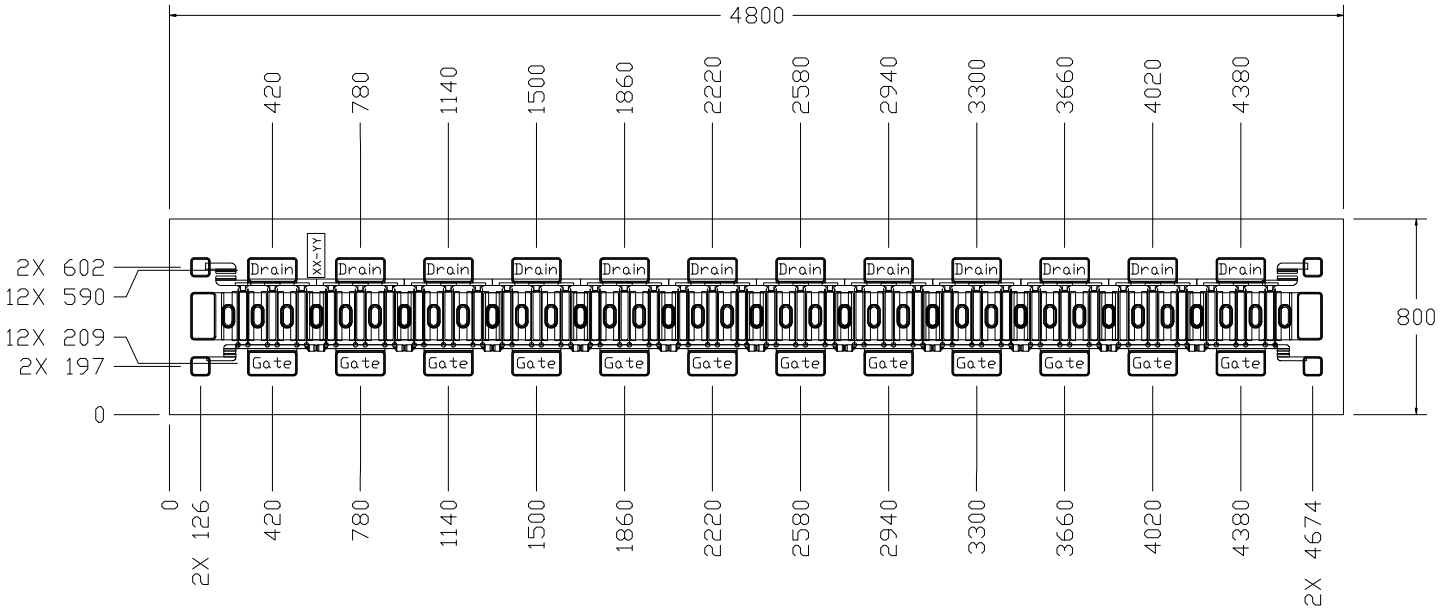
Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{(GS)TH}$	-3.8	-3.0	–2.3	V	V_{DS} = 10 V, I_D = 14.4 mA
Gate Quiescent Voltage	$V_{(GS)Q}$	–	-2.7	–	VDC	V_{DD} = 40 V, I_{DQ} = 720 mA
Saturated Drain Current[1]	I_{SAT}	11.5	13.0	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BD}	100	–	–	V	V_{GS} = -8 V, I_D = 14.4 mA
On Resistance	R_{ON}	–	0.2	–	Ω	V_{DS} = 0.1 V, V_{GS} = 0 V
Gate Forward Voltage	V_{G-ON}	–	1.85	–	V	I_{GS} = 14.4 mA
RF Characteristics						
Small Signal Gain	G_{SS}	–	17	–	dB	V_{DD} = 40 V, I_{DQ} = 720 mA
Saturated Power Output[1]	P_{SAT}	–	70	–	W	V_{DD} = 40 V, I_{DQ} = 720 mA
Drain Efficiency[2]	η	–	60	–	%	V_{DD} = 40 V, I_{DQ} = 720 mA
Intermodulation Distortion	IM3	–	-30	–	dBc	V_{DD} = 40 V, I_{DQ} = 720 mA, P_{OUT} = 70 W PEP
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 40 V, I_{DQ} = 720 mA, P_{OUT} = 70 W CW
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	24.0	–	pF	V_{DS} = 40 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	4.2	–	pF	V_{DS} = 40 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.6	–	pF	V_{DS} = 40 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Scaled from PCM unit cell.
[1] P_{SAT} is defined as I_G = 1.44 mA.
[2] Drain Efficiency = P_{OUT} / P_{DC}

Copyright © 2011-2014 Cree, Inc. All rights reserved. The information in this document is subject to change without notice. Cree and the Cree logo are registered trademarks of Cree, Inc. Other trademarks, product and company names are the property of their respective owners and do not imply specific product and/or vendor endorsement, sponsorship or association.

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 800 x 4800 (+0/-50) microns, die thickness 100 (+/-10) microns.
All Gate and Drain pads must be wire bonded for electrical connection.

Pad	Size (microns)
Drain	200 x 100
Gate	200 x 100
Interconnect	80 x 80

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 (XX-YY) for correct orientation.

Copyright © 2011-2014 Cree, Inc. All rights reserved. The information in this document is subject to change without notice. Cree and the Cree logo are registered trademarks of Cree, Inc. Other trademarks, product and company names are the property of their respective owners and do not imply specific product and/or vendor endorsement, sponsorship or association.

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

Figure 1. CGHV1J070D - Stability with Gmax and K Factor
V_{DD} = 40 V, I_{DS} = 360 mA

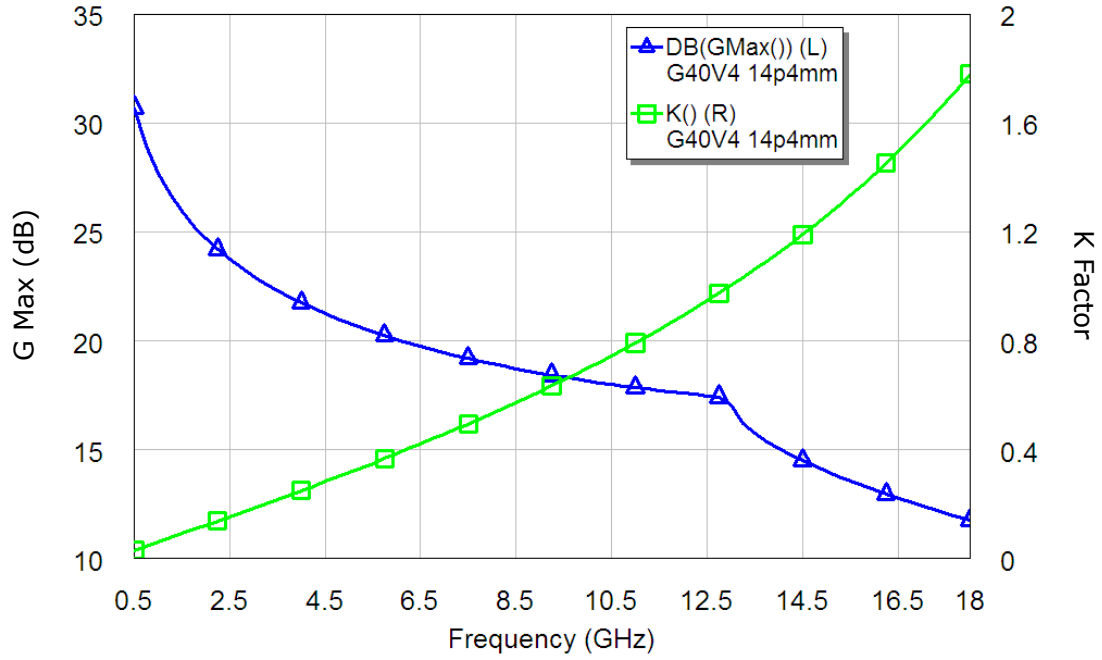
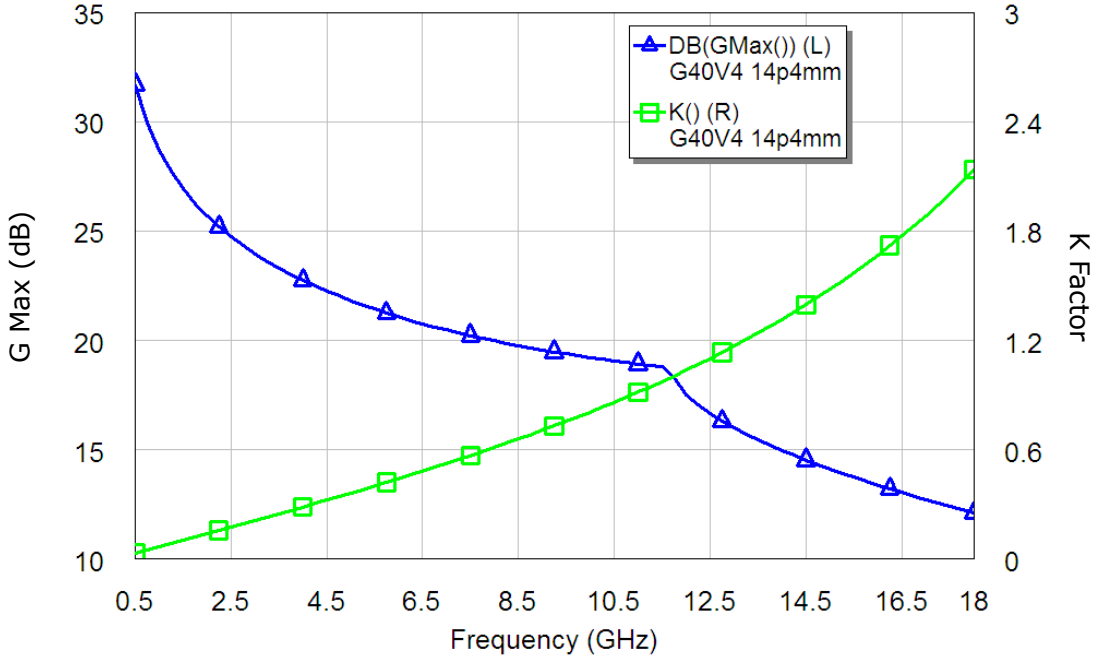


Figure 2. CGHV1J070D - Stability with Gmax and K Factor
V_{DD} = 40 V, I_{DS} = 720 mA



Copyright © 2011-2014 Cree, Inc. All rights reserved. The information in this document is subject to change without notice. Cree and the Cree logo are registered trademarks of Cree, Inc. Other trademarks, product and company names are the property of their respective owners and do not imply specific product and/or vendor endorsement, sponsorship or association.

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

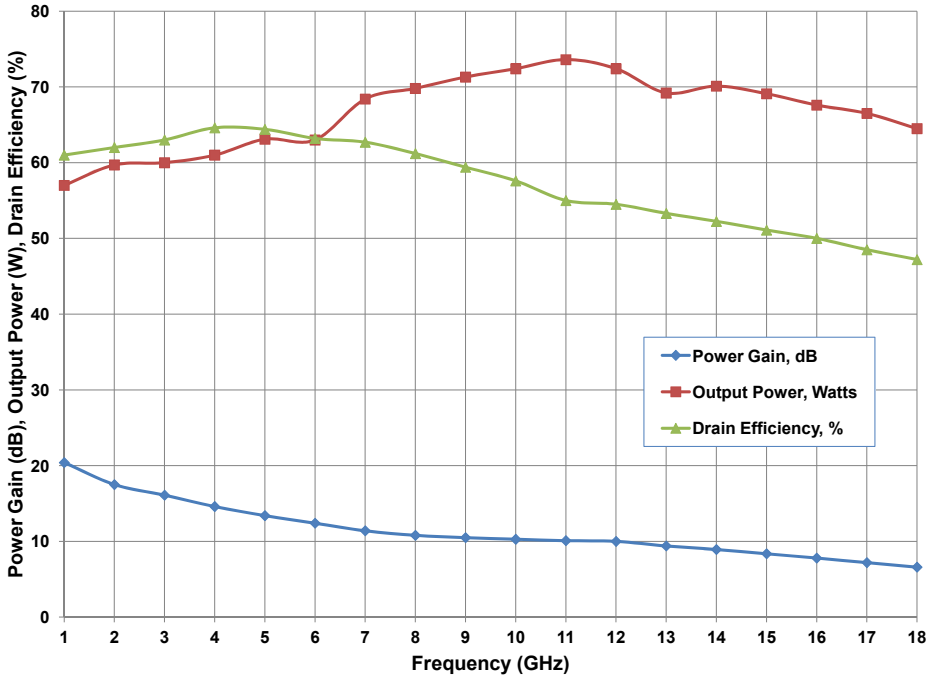
Source and Load Impedances

Frequency (GHz)	Source Impedance (ohms)	Load Impedance (ohms)	Series Gate Stability Resistor (ohms)
1.0	2.77 + j3.567	11 + j8.57	2.40
2.0	1.33 + j1.78	5.83 + j8.15	1.15
3.0	0.76 + j1.11	3.06 + j6.97	0.65
4.0	0.627 + j0.778	2.06 + j5.82	0.45
5.0	0.55 + j0.57	1.48 + j4.88	0.325
6.0	0.458 + j0.41	1.07 + j4.16	0.250
7.0	0.465 + j0.296	0.896 + j3.5	0.180
8.0	0.453 + j0.19	0.785 + j3.2	0.125
9.0	0.399 + j0.096	0.71 + j2.86	0.090
10.0	0.328 + j0.01	0.643 + j2.56	0.060
11.0	0.245 – j0.018	0.61 +j2.32	0.035
12.0	0.173 – j0.03	0.52 + j2.06	0.013
13.0	0.247 – j0.085	0.474 + j1.917	0
14.0	0.149 – j0.19	0.417 + j1.73	0
15.0	0.143 – j0.268	0.377 + j1.57	0
16.0	0.144 – j0.34	0.34 + j1.43	0
17.0	0.142 – j0.41	0.31 + j1.29	0
18.0	0.158 – j0.478	0.279 + j1.18	0

Table 1.

Note: V_{DD} = 40 V, I_{DQ} = 535 mA.

Figure 3. CGHV1J070D - Power Gain, Output Power and Drain Efficiency using Source and Load Pull Impedances (Series gate stability resistor values chosen to make K>1)



Copyright © 2011-2014 Cree, Inc. All rights reserved. The information in this document is subject to change without notice. Cree and the Cree logo are registered trademarks of Cree, Inc. Other trademarks, product and company names are the property of their respective owners and do not imply specific product and/or vendor endorsement, sponsorship or association.

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 S-Parameters for CGHV1J070D
(Small Signal, V_{DS} = 40 V, I_{DQ} = 360 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.944	-165.60	12.49	87.69	0.011	-1.78	0.603	-167.23
1.00 GHz	0.947	-172.19	6.08	75.58	0.010	-13.31	0.637	-166.40
1.50 GHz	0.952	-174.26	3.86	66.38	0.010	-21.95	0.680	-164.85
2.00 GHz	0.957	-175.28	2.72	58.56	0.009	-29.21	0.725	-164.11
2.50 GHz	0.962	-175.92	2.03	51.82	0.009	-35.39	0.766	-164.10
3.00 GHz	0.967	-176.39	1.57	45.99	0.008	-40.66	0.802	-164.56
3.50 GHz	0.971	-176.78	1.25	40.95	0.007	-45.14	0.832	-165.26
4.00 GHz	0.974	-177.11	1.02	36.56	0.007	-48.97	0.857	-166.06
4.50 GHz	0.977	-177.40	0.84	32.73	0.006	-52.24	0.877	-166.88
5.00 GHz	0.980	-177.67	0.70	29.35	0.006	-55.05	0.894	-167.69
5.50 GHz	0.982	-177.91	0.60	26.36	0.005	-57.47	0.908	-168.45
6.00 GHz	0.983	-178.12	0.52	23.69	0.005	-59.58	0.919	-169.16
6.50 GHz	0.985	-178.32	0.45	21.29	0.005	-61.41	0.928	-169.82
7.00 GHz	0.986	-178.51	0.39	19.11	0.004	-63.02	0.936	-170.42
7.50 GHz	0.987	-178.68	0.35	17.12	0.004	-64.43	0.943	-170.98
8.00 GHz	0.988	-178.84	0.31	15.29	0.004	-65.68	0.949	-171.49
8.50 GHz	0.989	-178.99	0.28	13.61	0.004	-66.79	0.953	-171.96
9.00 GHz	0.989	-179.13	0.25	12.04	0.003	-67.77	0.958	-172.40
9.50 GHz	0.990	-179.27	0.22	10.58	0.003	-68.65	0.961	-172.80
10.00 GHz	0.990	-179.40	0.20	9.21	0.003	-69.42	0.964	-173.18
10.50 GHz	0.991	-179.52	0.19	7.92	0.003	-70.12	0.967	-173.52
11.00 GHz	0.991	-179.63	0.17	6.70	0.003	-70.74	0.970	-173.85
11.50 GHz	0.991	-179.75	0.16	5.55	0.003	-71.29	0.972	-174.15
12.00 GHz	0.992	-179.85	0.15	4.45	0.003	-71.77	0.974	-174.43
12.50 GHz	0.992	-179.96	0.14	3.40	0.002	-72.20	0.975	-174.70
13.00 GHz	0.992	179.94	0.13	2.39	0.002	-72.58	0.977	-174.95
13.50 GHz	0.992	179.84	0.12	1.43	0.002	-72.91	0.978	-175.19
14.00 GHz	0.992	179.75	0.11	0.50	0.002	-73.20	0.979	-175.41
14.50 GHz	0.993	179.65	0.10	-0.39	0.002	-73.43	0.980	-175.62
15.00 GHz	0.993	179.56	0.10	-1.26	0.002	-73.63	0.981	-175.82
15.25 GHz	0.993	179.52	0.09	-1.68	0.002	-73.71	0.982	-175.92
15.50 GHz	0.993	179.47	0.09	-2.09	0.002	-73.79	0.982	-176.01
15.75 GHz	0.993	179.43	0.09	-2.50	0.002	-73.85	0.983	-176.11
16.00 GHz	0.993	179.39	0.09	-2.90	0.002	-73.90	0.983	-176.20
16.25 GHz	0.993	179.34	0.08	-3.30	0.002	-73.95	0.983	-176.28
16.50 GHz	0.993	179.30	0.08	-3.69	0.002	-73.98	0.984	-176.37
16.75 GHz	0.993	179.26	0.08	-4.07	0.002	-74.00	0.984	-176.45
17.00 GHz	0.993	179.21	0.08	-4.45	0.002	-74.02	0.985	-176.54
17.25 GHz	0.993	179.17	0.07	-4.82	0.002	-74.02	0.985	-176.62
17.50 GHz	0.993	179.13	0.07	-5.19	0.001	-74.01	0.985	-176.70
17.75 GHz	0.993	179.09	0.07	-5.56	0.001	-73.99	0.985	-176.77
18.00 GHz	0.993	179.05	0.07	-5.92	0.001	-73.97	0.986	-176.85

To download the s-parameters in s2p format, go to the CGHV1J070D Product Page and click on the documentation tab.

Copyright © 2011-2014 Cree, Inc. All rights reserved. The information in this document is subject to change without notice. Cree and the Cree logo are registered trademarks of Cree, Inc. Other trademarks, product and company names are the property of their respective owners and do not imply specific product and/or vendor endorsement, sponsorship or association.

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 S-Parameters for CGHV1J070D
(Small Signal, V_{DS} = 40 V, I_{DQ} = 720 mA, angle in degrees)

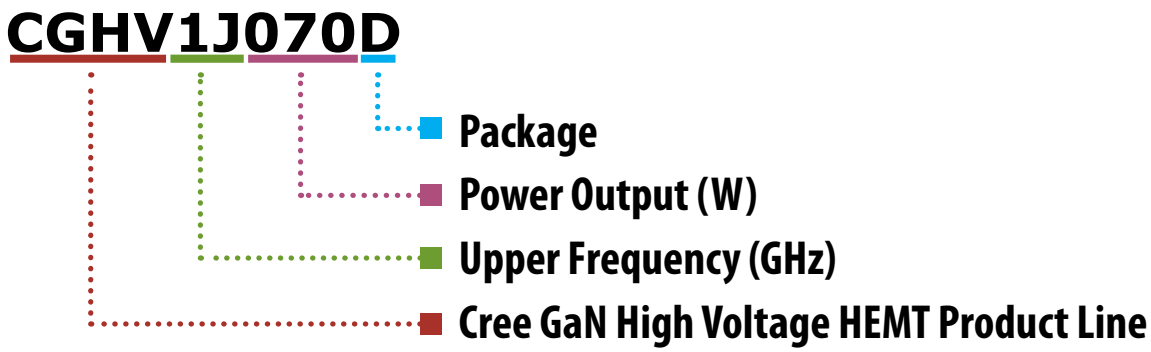
Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.956	-167.23	12.34	87.98	0.008	-1.48	0.639	-170.66
1.00 GHz	0.958	-173.22	6.04	77.07	0.008	-11.78	0.664	-169.66
1.50 GHz	0.961	-175.13	3.87	68.67	0.008	-19.59	0.696	-168.00
2.00 GHz	0.964	-176.05	2.76	61.38	0.007	-26.29	0.731	-166.94
2.50 GHz	0.968	-176.62	2.08	54.97	0.007	-32.11	0.766	-166.50
3.00 GHz	0.971	-177.03	1.63	49.32	0.007	-37.17	0.797	-166.52
3.50 GHz	0.974	-177.36	1.31	44.34	0.006	-41.56	0.825	-166.85
4.00 GHz	0.977	-177.64	1.07	39.94	0.006	-45.36	0.848	-167.34
4.50 GHz	0.979	-177.89	0.89	36.05	0.005	-48.66	0.868	-167.91
5.00 GHz	0.981	-178.11	0.75	32.60	0.005	-51.52	0.885	-168.52
5.50 GHz	0.983	-178.31	0.64	29.50	0.005	-54.01	0.899	-169.13
6.00 GHz	0.984	-178.50	0.55	26.72	0.004	-56.19	0.910	-169.72
6.50 GHz	0.986	-178.67	0.48	24.21	0.004	-58.10	0.920	-170.28
7.00 GHz	0.987	-178.83	0.42	21.92	0.004	-59.77	0.929	-170.81
7.50 GHz	0.987	-178.98	0.38	19.83	0.004	-61.25	0.936	-171.30
8.00 GHz	0.988	-179.12	0.34	17.91	0.003	-62.56	0.942	-171.76
8.50 GHz	0.989	-179.26	0.30	16.13	0.003	-63.71	0.948	-172.19
9.00 GHz	0.990	-179.38	0.27	14.48	0.003	-64.74	0.952	-172.60
9.50 GHz	0.990	-179.51	0.25	12.93	0.003	-65.64	0.956	-172.97
10.00 GHz	0.990	-179.62	0.22	11.49	0.003	-66.45	0.960	-173.32
10.50 GHz	0.991	-179.73	0.20	10.13	0.003	-67.16	0.963	-173.65
11.00 GHz	0.991	-179.84	0.19	8.84	0.002	-67.79	0.965	-173.96
11.50 GHz	0.991	-179.94	0.17	7.62	0.002	-68.34	0.968	-174.25
12.00 GHz	0.992	179.96	0.16	6.46	0.002	-68.82	0.970	-174.52
12.50 GHz	0.992	179.86	0.15	5.36	0.002	-69.23	0.972	-174.77
13.00 GHz	0.992	179.77	0.14	4.30	0.002	-69.58	0.974	-175.02
13.50 GHz	0.992	179.67	0.13	3.29	0.002	-69.88	0.975	-175.25
14.00 GHz	0.993	179.58	0.12	2.32	0.002	-70.12	0.976	-175.46
14.50 GHz	0.993	179.50	0.11	1.38	0.002	-70.30	0.978	-175.67
15.00 GHz	0.993	179.41	0.11	0.48	0.002	-70.44	0.979	-175.86
15.25 GHz	0.993	179.37	0.10	0.03	0.002	-70.48	0.979	-175.96
15.50 GHz	0.993	179.32	0.10	-0.40	0.002	-70.52	0.980	-176.05
15.75 GHz	0.993	179.28	0.10	-0.82	0.001	-70.54	0.980	-176.14
16.00 GHz	0.993	179.24	0.09	-1.24	0.001	-70.54	0.981	-176.23
16.25 GHz	0.993	179.20	0.09	-1.66	0.001	-70.53	0.981	-176.32
16.50 GHz	0.993	179.16	0.09	-2.06	0.001	-70.51	0.982	-176.40
16.75 GHz	0.993	179.12	0.09	-2.46	0.001	-70.48	0.982	-176.48
17.00 GHz	0.993	179.08	0.08	-2.86	0.001	-70.43	0.983	-176.56
17.25 GHz	0.993	179.04	0.08	-3.25	0.001	-70.37	0.983	-176.64
17.50 GHz	0.993	179.00	0.08	-3.63	0.001	-70.29	0.983	-176.72
17.75 GHz	0.993	178.96	0.08	-4.01	0.001	-70.20	0.984	-176.80
18.00 GHz	0.993	178.92	0.08	-4.39	0.001	-70.09	0.984	-176.87

To download the s-parameters in s2p format, go to the CGHV1J070D Product Page and click on the documentation tab.

Copyright © 2011-2014 Cree, Inc. All rights reserved. The information in this document is subject to change without notice. Cree and the Cree logo are registered trademarks of Cree, Inc. Other trademarks, product and company names are the property of their respective owners and do not imply specific product and/or vendor endorsement, sponsorship or association.

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

Part Number System



Parameter	Value	Units
Lower Frequency	DC	GHz
Upper Frequency[1]	18.0	GHz
Power Output	70	W
Package	Bare Die	-

Table 1.

Note[1]: Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

Character Code	Code Value
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
J	8
K	9
Examples:	1A = 10.0 GHz 2H = 27.0 GHz

Table 2.

Copyright © 2011-2014 Cree, Inc. All rights reserved. The information in this document is subject to change without notice. Cree and the Cree logo are registered trademarks of Cree, Inc. Other trademarks, product and company names are the property of their respective owners and do not imply specific product and/or vendor endorsement, sponsorship or association.

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/wireless

Sarah Miller
Marketing
Cree, RF Components
1.919.407.5302

Ryan Baker
Cree, Marketing, RF Components
1.919.407.7816

Tom Dekker
Cree, Sales Director, RF Components
1.919.313.5639

Copyright © 2011-2014 Cree, Inc. All rights reserved. The information in this document is subject to change without notice. Cree and the Cree logo are registered trademarks of Cree, Inc. Other trademarks, product and company names are the property of their respective owners and do not imply specific product and/or vendor endorsement, sponsorship or association.

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

OCEAN CHIPS
Океан Электроники
Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».

AVIC JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

FORSTAR®

Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А