

# CGH60120D

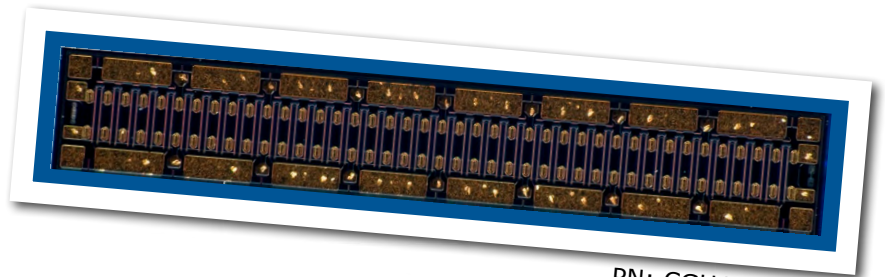
## 120 W, 6.0 GHz, GaN HEMT Die

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.



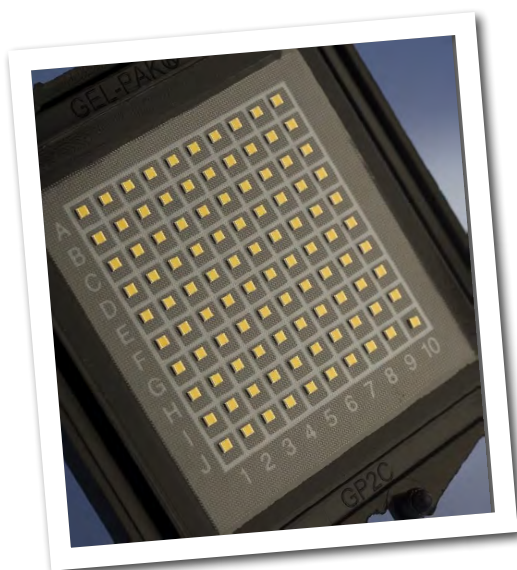
PN: CGH60120D

### 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



- 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	$I_{GMAX}$	30	mA	25 °C
Maximum Drain Current <sup>1</sup>	$I_{DMAX}$	12	A	25 °C
Thermal Resistance, Junction to Case (packaged) <sup>2</sup>	$R_{\theta JC}$	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<sup>1</sup> Current limit for long term, reliable operation

Note<sup>2</sup> 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
<b>DC Characteristics</b>						
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 <sub>DC</sub>	$V_{DD} = 28 V, I_{DQ} = 800 mA$
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	$I_{GS} = 28.8 mA$
<b>RF Characteristics</b>						
Small Signal Gain	$G_{SS}$	-	13	-	dB	$V_{DD} = 28 V, I_{DQ} = 800 mA$
Saturated Power Output <sup>2</sup>	$P_{SAT}$	-	120	-	W	$V_{DD} = 28 V, I_{DQ} = 800 mA$
Drain Efficiency <sup>1</sup>	$\eta$	-	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, $V_{DD} = 28 V, I_{DQ} = 800 mA, P_{OUT} = 120 W CW$
<b>Dynamic Characteristics</b>						
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	$V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz$

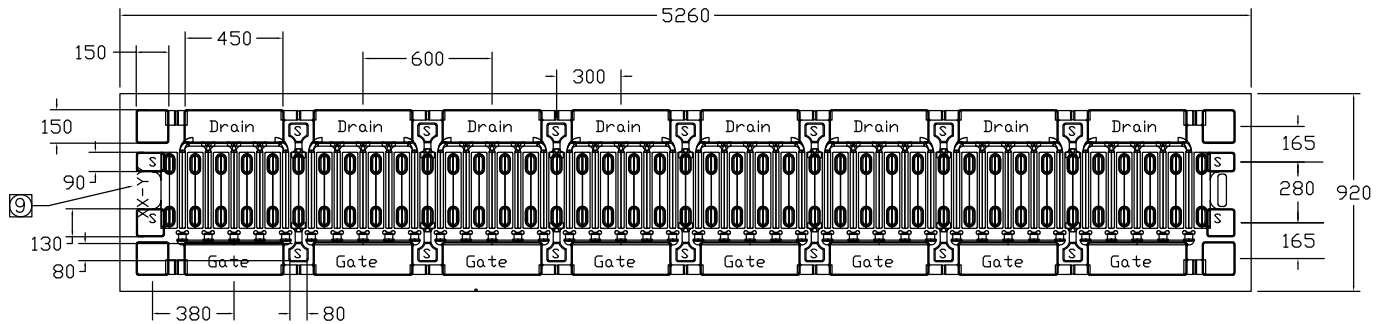
Notes:

<sup>1</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$

<sup>2</sup>  $P_{SAT}$  is defined as  $I_G = 3.0 mA$ .



## DIE Dimensions (units in microns)



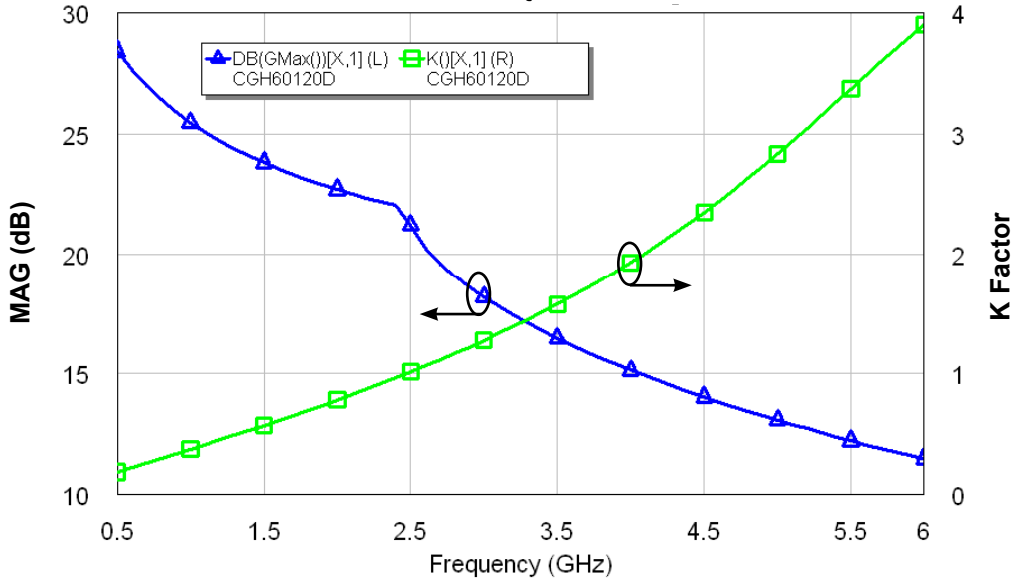
Overall die size 5260 x 920 (+0/-50) microns, die thickness 100 (+/- 10) microns.  
All Gate and Drain pads must be wire bonded for electrical connection.

### 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](http://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.

## Typical Performance

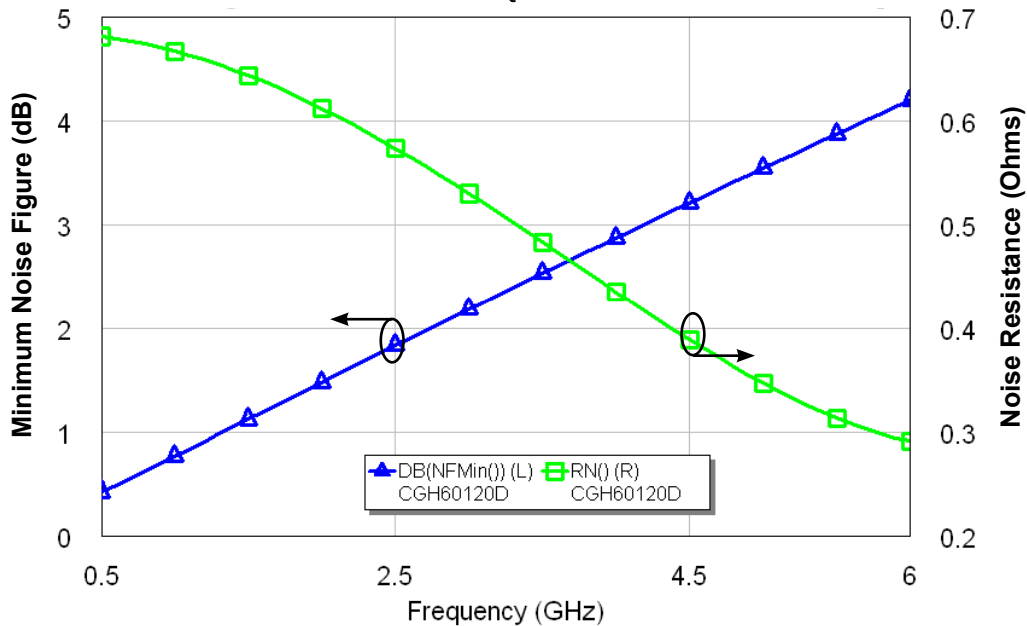
**Simulated Maximum Available Gain and K Factor of the CGH60120D**  
 $V_{DD} = 28 \text{ V}, I_{DQ} = 1000 \text{ mA}$



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**  
 $V_{DD} = 28 \text{ V}, I_{DQ} = 1000 \text{ mA}$





**Typical Die S-Parameters (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ , 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

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**Typical Die S-Parameters (Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 1.0\text{ A}$ , 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

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