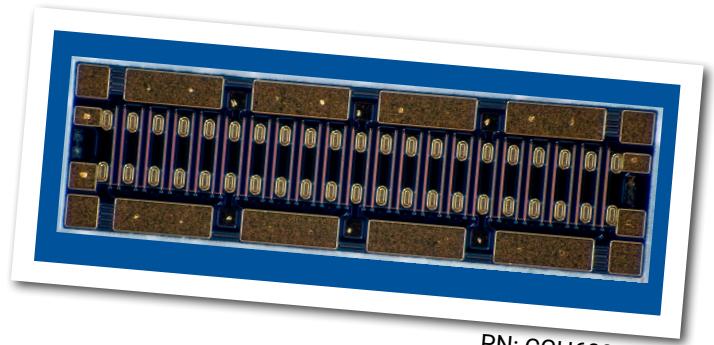


CGH60060D

60 W, 6.0 GHz, GaN HEMT Die

Cree's CGH60060D 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: CGH60060D

FEATURES

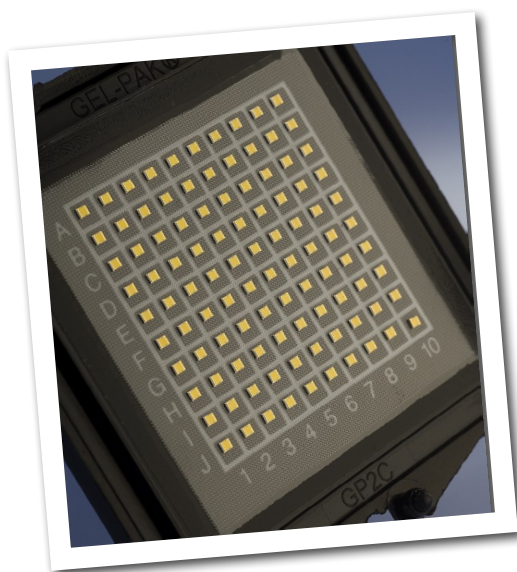
- 13 dB Typical Small Signal Gain at 4 GHz
- 12 dB Typical Small Signal Gain at 6 GHz
- 60 W Typical P_{SAT}
- 28 V Operation
- High Breakdown Voltage
- High Temperature Operation
- Up to 6 GHz Operation
- High Efficiency

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 ADS and MWO

Absolute Maximum Ratings (not simultaneous) at 25°C

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DS}	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}	15	mA	25°C
Maximum Drain Current ¹	I_{DMAX}	6	A	25°C
Thermal Resistance, Junction to Case (packaged) ²	$R_{\theta JC}$	2.8	°C/W	
Thermal Resistance, Junction to Case (die only)	$R_{\theta JC}$	1.5	°C/W	85°C
Mounting Temperature (30 seconds)	T_S	320	°C	30 seconds

Note¹ Current limit for long term, reliable operation

Note² Eutectic die attach using 80/20 AuSn mounted to a 60 mil thick CuMoCu carrier.

Electrical Characteristics (Frequency = 4 GHz unless otherwise stated; $T_C = 25^\circ\text{C}$)

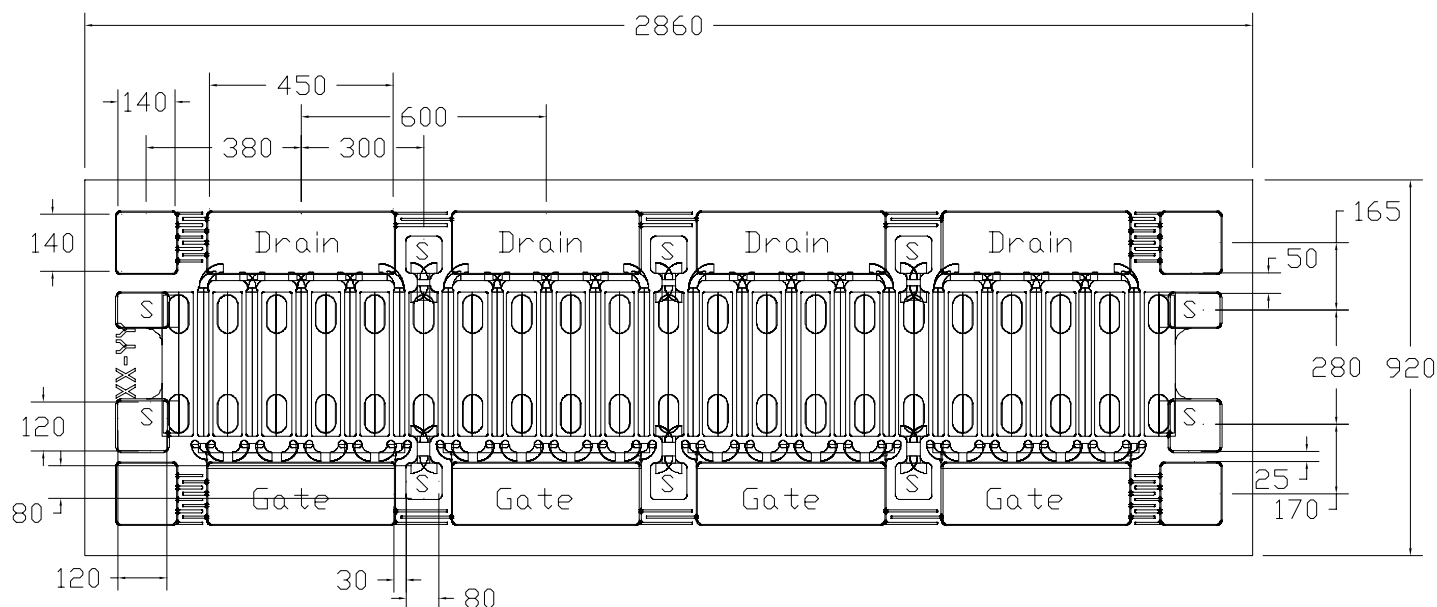
Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.8	-3.0	-2.3	V	$V_{DS} = 10\text{ V}, I_D = 14.4\text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V _{DC}	$V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}$
Drain Current	I_{DS}	11.6	14.0	–	A	$V_{DS} = 6.0\text{ V}, V_{GS} = 2.0\text{ V}$
Drain-Source Breakdown Voltage	V_{BD}	120	–	–	V	$V_{GS} = -8\text{ V}, I_D = 14.4\text{ mA}$
On Resistance	R_{ON}	–	0.25	–	Ω	$V_{DS} = 0.1\text{ V}$
Gate Forward Voltage	V_{G-ON}	–	1.9	–	V	$I_{GS} = 14.4\text{ mA}$
RF Characteristics						
Small Signal Gain	G_{SS}	–	13	–	dB	$V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}$
Saturated Power Output ¹	P_{SAT}	–	60	–	W	$V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}$
Drain Efficiency ²	η	–	65	–	%	$V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}, P_{SAT} = 60\text{ W}$
Intermodulation Distortion ³	IM3	–	-30	–	dBc	$V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}, P_{OUT} = 60\text{ W PEP}$
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, $V_{DD} = 28\text{ V}, I_{DQ} = 400\text{ mA}, P_{OUT} = 60\text{ W CW}$
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	17.0	–	pF	$V_{DS} = 28\text{ V}, V_{GS} = -8\text{ V}, f = 1\text{ MHz}$
Output Capacitance	C_{DS}	–	3.5	–	pF	$V_{DS} = 28\text{ V}, V_{GS} = -8\text{ V}, f = 1\text{ MHz}$
Feedback Capacitance	C_{GD}	–	0.8	–	pF	$V_{DS} = 28\text{ V}, V_{GS} = -8\text{ V}, f = 1\text{ MHz}$

Notes:

¹ P_{SAT} is defined as $I_G = 1.4\text{ mA}$.

² Drain Efficiency = P_{OUT} / P_{DC} .

DIE Dimensions (units in microns)



Overall die size 2860 x 920 (+0/-50) microns, die thickness 100 (+/- 10) microns.
All Gate and Drain pads must be wire bonded for electrical connection.

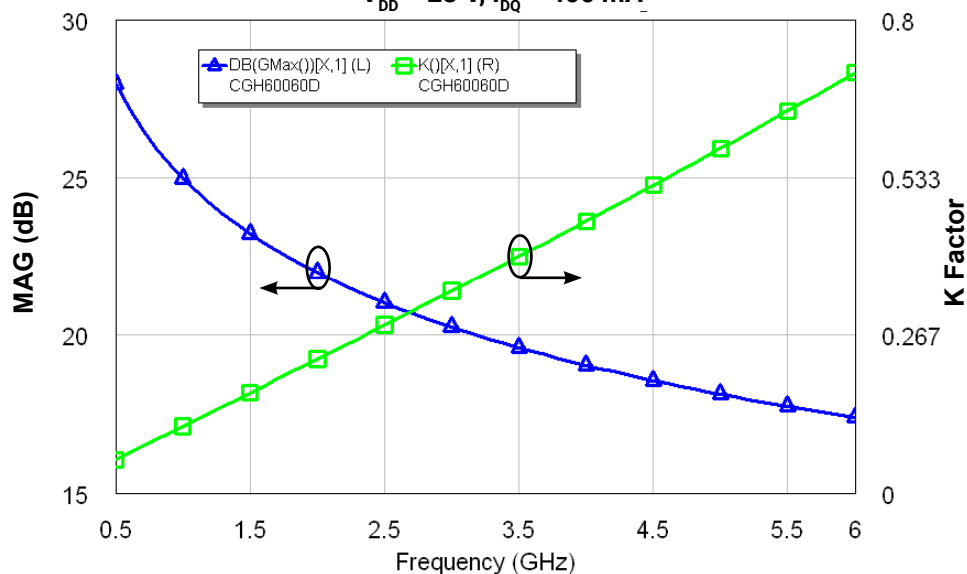
Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to Cree's website for the Eutectic Die Bond Procedure application note at 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.

Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH60060D

$V_{DD} = 28\text{ V}$, $I_{DQ} = 400\text{ mA}$

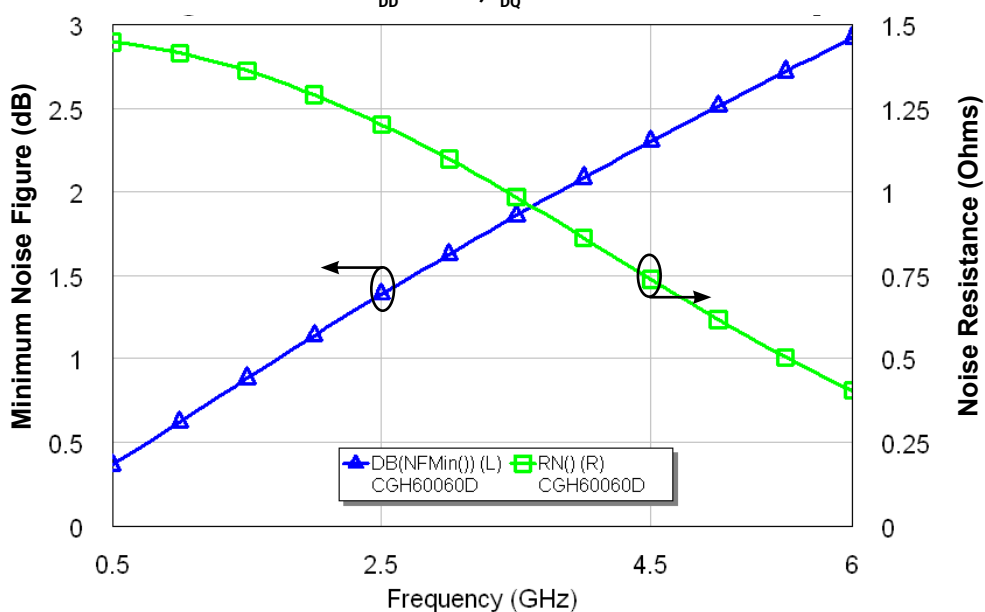


Intrinsic die parameters - reference planes at centers of gate and drain bonding pads. No wire bonds assumed.

Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH60060D

$V_{DD} = 28\text{ V}$, $I_{DQ} = 400\text{ mA}$



Typical Die S-Parameters (Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 400\text{ mA}$, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.958	-168.55	7.79	88.19	0.012	-1.00	0.654	-172.20
600 MHz	0.958	-170.42	6.48	85.81	0.012	-3.22	0.657	-172.35
700 MHz	0.958	-171.76	5.54	83.69	0.012	-5.16	0.661	-172.29
800 MHz	0.959	-172.76	4.83	81.75	0.012	-6.94	0.664	-172.13
900 MHz	0.959	-173.54	4.28	79.93	0.012	-8.59	0.668	-171.90
1.0 GHz	0.959	-174.16	3.83	78.20	0.012	-10.15	0.672	-171.63
1.1 GHz	0.960	-174.67	3.47	76.54	0.012	-11.65	0.676	-171.34
1.2 GHz	0.960	-175.09	3.16	74.94	0.012	-13.09	0.681	-171.05
1.3 GHz	0.960	-175.45	2.90	73.38	0.012	-14.48	0.686	-170.76
1.4 GHz	0.961	-175.76	2.68	71.86	0.012	-15.83	0.691	-170.47
1.5 GHz	0.961	-176.03	2.48	70.38	0.012	-17.15	0.696	-170.20
1.6 GHz	0.962	-176.27	2.31	68.93	0.012	-18.43	0.701	-169.95
1.7 GHz	0.962	-176.48	2.16	67.51	0.012	-19.68	0.706	-169.71
1.8 GHz	0.963	-176.67	2.02	66.13	0.012	-20.91	0.712	-169.49
1.9 GHz	0.963	-176.84	1.90	64.77	0.011	-22.10	0.718	-169.29
2.0 GHz	0.964	-177.00	1.79	63.43	0.011	-23.27	0.723	-169.11
2.1 GHz	0.964	-177.14	1.69	62.13	0.011	-24.41	0.729	-168.95
2.2 GHz	0.965	-177.27	1.60	60.85	0.011	-25.52	0.735	-168.81
2.3 GHz	0.965	-177.40	1.51	59.59	0.011	-26.62	0.740	-168.69
2.4 GHz	0.966	-177.51	1.44	58.36	0.011	-27.68	0.746	-168.59
2.5 GHz	0.966	-177.62	1.37	57.15	0.011	-28.73	0.752	-168.50
2.6 GHz	0.967	-177.72	1.30	55.96	0.011	-29.75	0.757	-168.43
2.7 GHz	0.967	-177.82	1.24	54.80	0.011	-30.74	0.763	-168.38
2.8 GHz	0.968	-177.92	1.18	53.66	0.010	-31.72	0.768	-168.34
2.9 GHz	0.969	-178.01	1.13	52.54	0.010	-32.67	0.774	-168.32
3.0 GHz	0.969	-178.09	1.08	51.45	0.010	-33.60	0.779	-168.31
3.2 GHz	0.970	-178.26	0.99	49.32	0.010	-35.40	0.789	-168.33
3.4 GHz	0.971	-178.41	0.91	47.27	0.010	-37.11	0.800	-168.40
3.6 GHz	0.972	-178.56	0.84	45.30	0.009	-38.75	0.809	-168.50
3.8 GHz	0.973	-178.70	0.78	43.41	0.009	-40.31	0.818	-168.63
4.0 GHz	0.974	-178.84	0.73	41.59	0.009	-41.79	0.827	-168.79
4.2 GHz	0.975	-178.97	0.67	39.85	0.009	-43.21	0.835	-168.97
4.4 GHz	0.976	-179.09	0.63	38.16	0.009	-44.56	0.843	-169.16
4.6 GHz	0.976	-179.22	0.59	36.54	0.008	-45.85	0.851	-169.37
4.8 GHz	0.977	-179.34	0.55	34.98	0.008	-47.08	0.858	-169.59
5.0 GHz	0.978	-179.46	0.52	33.48	0.008	-48.25	0.864	-169.83
5.2 GHz	0.979	-179.58	0.49	32.03	0.008	-49.37	0.870	-170.06
5.4 GHz	0.979	-179.69	0.46	30.63	0.008	-50.43	0.876	-170.30
5.6 GHz	0.980	-179.80	0.43	29.28	0.007	-51.45	0.882	-170.55
5.8 GHz	0.980	-179.91	0.41	27.97	0.007	-52.42	0.887	-170.79
6.0 GHz	0.981	179.98	0.39	26.71	0.007	-53.35	0.892	-171.04

To download the s-parameters in s2p format, go to the [CGH60060D Product Page](#) and click on the documentation tab.

Typical Die S-Parameters (Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 800\text{ mA}$, magnitude / angle)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.966	-169.62	7.61	88.58	0.010	-0.60	0.693	-174.43
600 MHz	0.966	-171.35	6.34	86.43	0.010	-2.57	0.696	-174.53
700 MHz	0.966	-172.58	5.42	84.54	0.010	-4.29	0.698	-174.48
800 MHz	0.966	-173.51	4.73	82.80	0.010	-5.85	0.700	-174.35
900 MHz	0.967	-174.23	4.20	81.17	0.010	-7.31	0.703	-174.16
1.0 GHz	0.967	-174.81	3.76	79.62	0.010	-8.68	0.706	-173.95
1.1 GHz	0.967	-175.29	3.41	78.13	0.010	-10.00	0.709	-173.72
1.2 GHz	0.967	-175.69	3.11	76.69	0.010	-11.27	0.712	-173.47
1.3 GHz	0.967	-176.03	2.86	75.28	0.009	-12.51	0.715	-173.23
1.4 GHz	0.968	-176.32	2.64	73.91	0.009	-13.70	0.718	-172.99
1.5 GHz	0.968	-176.58	2.45	72.57	0.009	-14.87	0.722	-172.75
1.6 GHz	0.968	-176.80	2.29	71.26	0.009	-16.01	0.726	-172.52
1.7 GHz	0.969	-177.00	2.14	69.97	0.009	-17.13	0.729	-172.30
1.8 GHz	0.969	-177.18	2.01	68.71	0.009	-18.22	0.733	-172.09
1.9 GHz	0.969	-177.35	1.89	67.46	0.009	-19.30	0.737	-171.90
2.0 GHz	0.970	-177.49	1.78	66.24	0.009	-20.35	0.741	-171.72
2.1 GHz	0.970	-177.63	1.69	65.04	0.009	-21.38	0.746	-171.55
2.2 GHz	0.970	-177.76	1.60	63.85	0.009	-22.39	0.750	-171.39
2.3 GHz	0.971	-177.88	1.52	62.69	0.009	-23.38	0.754	-171.25
2.4 GHz	0.971	-177.99	1.44	61.55	0.009	-24.35	0.758	-171.12
2.5 GHz	0.971	-178.09	1.37	60.42	0.009	-25.31	0.763	-171.00
2.6 GHz	0.972	-178.19	1.31	59.31	0.009	-26.25	0.767	-170.90
2.7 GHz	0.972	-178.28	1.25	58.22	0.009	-27.16	0.771	-170.81
2.8 GHz	0.972	-178.37	1.20	57.15	0.008	-28.07	0.776	-170.73
2.9 GHz	0.973	-178.45	1.15	56.09	0.008	-28.95	0.780	-170.66
3.0 GHz	0.973	-178.54	1.10	55.05	0.008	-29.82	0.784	-170.60
3.2 GHz	0.974	-178.69	1.01	53.02	0.008	-31.50	0.793	-170.52
3.4 GHz	0.974	-178.83	0.93	51.06	0.008	-33.12	0.801	-170.48
3.6 GHz	0.975	-178.97	0.87	49.17	0.008	-34.67	0.809	-170.48
3.8 GHz	0.976	-179.10	0.80	47.33	0.008	-36.16	0.817	-170.51
4.0 GHz	0.977	-179.22	0.75	45.56	0.007	-37.59	0.824	-170.56
4.2 GHz	0.977	-179.35	0.70	43.84	0.007	-38.96	0.831	-170.64
4.4 GHz	0.978	-179.46	0.66	42.18	0.007	-40.27	0.838	-170.74
4.6 GHz	0.978	-179.58	0.61	40.57	0.007	-41.53	0.845	-170.86
4.8 GHz	0.979	-179.69	0.58	39.02	0.007	-42.74	0.852	-170.99
5.0 GHz	0.980	-179.80	0.54	37.51	0.007	-43.90	0.858	-171.13
5.2 GHz	0.980	-179.90	0.51	36.06	0.007	-45.01	0.863	-171.29
5.4 GHz	0.981	179.99	0.48	34.65	0.006	-46.07	0.869	-171.46
5.6 GHz	0.981	179.89	0.46	33.28	0.006	-47.09	0.874	-171.63
5.8 GHz	0.982	179.79	0.43	31.96	0.006	-48.06	0.879	-171.81
6.0 GHz	0.982	179.69	0.41	30.67	0.006	-49.00	0.884	-171.99

To download the s-parameters in s2p format, go to the [CGH60060D Product Page](#) and click on the documentation tab.

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
CGH60060D	GaN HEMT Bare Die	Each

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