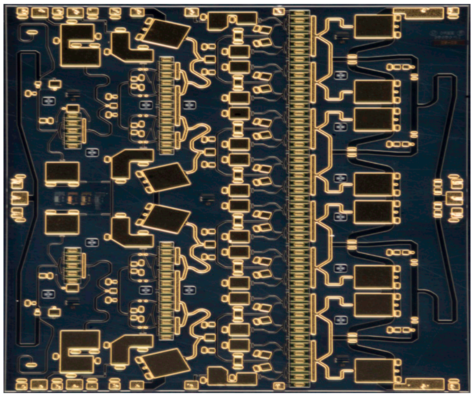
CMPA601C025D

25 W, 6.0 - 12.0 GHz, GaN MMIC, Power Amplifier



PN: CMPA601C025D

Description

Cree's CMPA601C025D is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT) based monolithic microwave integrated circuit (MMIC) on a silicon carbide substrate, using a 0.25 μm gate length fabrication process. GaN-on-SiC has superior properties compared to silicon, gallium arsenide or GaN-on-Si, including higher breakdown voltage, higher saturated electron drift velocity and higher thermal conductivity. GaN HEMTs also offer greater power density and wider bandwidths compared to Si, GaAs, and GaN-on-Si transistors. This MMIC contains a reactively matched amplifier design approach enabling very wide bandwidths to be achieved.

Typical Performance Over 6.0-12.0 GHz (T_C = 25˚C)

Parameter	6.0 GHz	8.0 GHz	10.0 GHz	12.0 GHz	Units
Small Signal Gain	40.0	42.0	43.0	36.0	dB
P_{OUT} @ P_{IN} = 19 dBm	48.0	49.0	47.4	47.3	dBm
P_{OUT} @ P_{IN} = 19 dBm	63.0	79.0	55.0	54.0	W
Power Gain @ P_{IN} = 19 dBm	29.0	30.0	28.4	27.3	dB
PAE @ P_{IN} = 19 dBm	33.0	49.0	35.0	32.0	%

Note:
All data pulse tested on-wafer with Pulse Width = 10 μs, Duty Cycle = 0.1%

Features

- 32 dB Small Signal Gain
- 30 W Typical P_{SAT}
- Operation up to 28 V
- High Breakdown Voltage
- High Temperature Operation
- Size 0.172 x 0.239 x 0.004 inches

Applications

- Jamming Amplifiers
- Test Equipment Amplifiers
- Broadband Amplifiers
- Radar Amplifiers

RoHS COMPLIANT

Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DSS}	84	V_{DC}	25˚C
Gate-source Voltage	V_{GS}	-10, +2	V_{DC}	25˚C
Storage Temperature	T_{STG}	-55, +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}	0.6	A	Stage 1, 25˚C
Maximum Drain Current[1]	I_{DMAX}	1.7	A	Stage 2, 25˚C
Maximum Drain Current[1]	I_{DMAX}	4.8	A	Stage 3, 25˚C
Thermal Resistance, Junction to Case (packaged)	$R_{\theta JC}$	0.83	˚C/W	85˚C, P_{DISS} = 92.8 W in 440213 package
Thermal Resistance, Junction to Case (die only)[2]	$R_{\theta JC}$	0.36	˚C/W	85˚C, P_{DISS} = 92.8 W
Mounting Temperature (30 seconds)	T_S	320	˚C	30 seconds

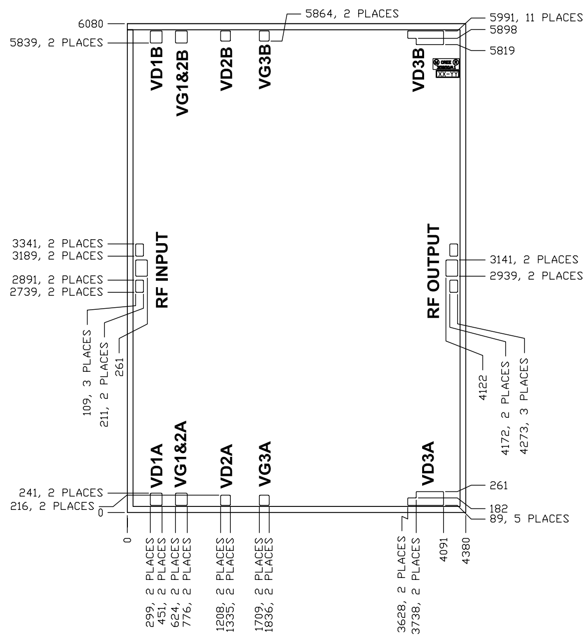
Notes:
[1] Current limit for long term, reliable operation
[2] Eutectic die attach using 80/20 AuSn mounted to a 10mil thick CuMo carrier

Electrical Characteristics (Frequency = 6.0 GHz to 12.0 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold	V_{TH}	-3.8	-2.8	–2.3	V	V_{DS} = 10 V, I_D = 23.2 mA
Drain-Source Breakdown Voltage	V_{BD}	84	100	–	V	V_{GS} = -8 V, I_D = 23.2 mA
RF Characteristics[2]						
Small Signal Gain @ 6 GHz	S21	29.8	35	–	dB	V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{IN} = 10 dBm
Small Signal Gain @ 10 GHz	S21	30.2	35	–	dB	V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{IN} = 10 dBm
Small Signal Gain @ 12 GHz	S21	27.8	35	–	dB	V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{IN} = 10 dBm
Power Output	P_{OUT}	45.5	47	–	W	VDD = 28 V, IDQ = 2.4 A, PIN = 19 dBm, Frequency = 6.0, 10.0, 12.0 GHz
Power Added Efficiency @ 6 GHz	PAE	23.0	30	–	%	V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{IN} = 19 dBm
Power Added Efficiency @ 10 GHz	PAE	23.3	32	–	%	V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{IN} = 19 dBm
Power Added Efficiency @ 12 GHz	PAE	23.7	31	–	%	V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{IN} = 19 dBm
Power Gain	G_P	–	28	–	dB	V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{IN} = 19 dBm
Input Return Loss	S11	–	-10	–	dB	V_{DD} = 28 V, I_{DQ} = 2.4 A
Output Return Loss	S22	–	-8	–	dB	V_{DD} = 28 V, I_{DQ} = 2.4 A
Output Mismatch Stress	VSWR	–	5 : 1	–	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{OUT} = 25W CW

Notes:
[1] Scaled from PCM data
[2] All data pulse tested on-wafer with Pulse Width = 10 μs, Duty Cycle = 0.1%

Die Dimensions (units in microns)



Overall die size 4380 x 6080 (+0/-50) microns, die thickness 100 (+/-10) microns.
All Gate and Drain pads must be wire bonded for electrical connection.

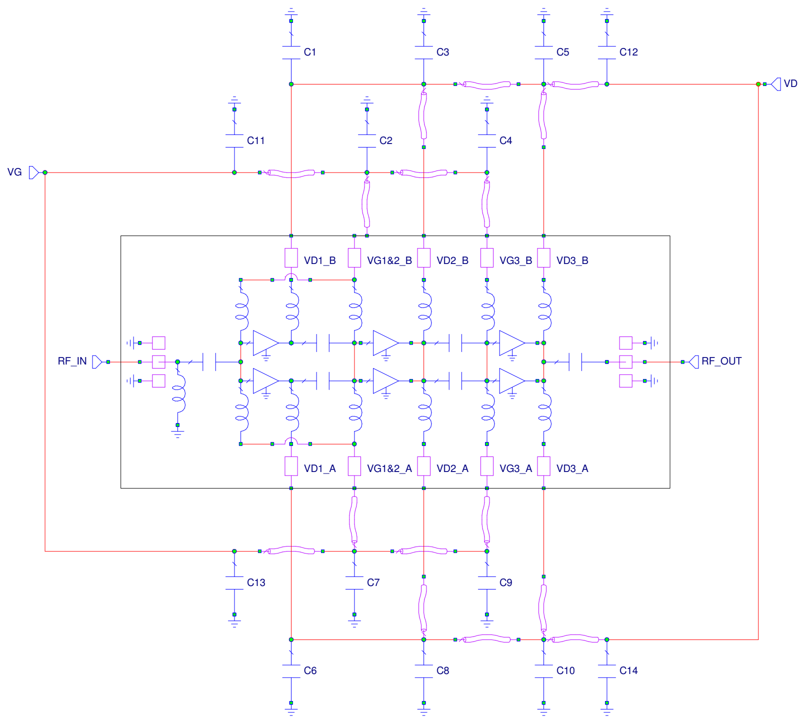
Pad Number	Function	Description	Pad Size (in)	Note
1	RF IN	RF-Input pad. Matched to 50 ohm. The DC impedance ~ 0 ohm due matching circuit.	150 x 200	4
2	VD1_A	Drain supply for stage 1A. VD = 28 V.	150 x 150	1
3	VD1_B	Drain supply for stage 1B. VD = 28 V.	150 x 150	1
4	VG1&2_A	Gate control for stage 1&2A. VG = -2.0 to - 3.5 V.	150 x 150	1,2
5	VG1&2_B	Gate control for stage 1&2B. VG = -2.0 to - 3.5 V.	150 x 150	1,2
6	VD2_A	Drain supply for stage 2A. VD = 28 V.	129 x 129	1
7	VD2_B	Drain supply for stage 2B. VD = 28 V.	129 x 129	1
8	VG3_A	Gate control for stage 3A. VG = -2.0 to - 3.5 V.	129 x 129	1,3
9	VG3_B	Gate control for stage 3B. VG = -2.0 to - 3.5 V.	129 x 129	1,3
10	VD3_A	Drain supply for stage 3A. VD = 28 V.	-	1
11	VD3_B	Drain supply for stage 3B. VD = 28 V.	-	1
12	RF-OUT	RF-Output pad. Matched to 50 ohm.	150 x 200	4

Notes:
[1] Attach bypass capacitor to pads 2-11 per application circuit
[2] VG1&2_A and VG1&2_B are connected internally so it would be enough to connect either one for proper operation
[3] VG3_A and VG3_B are connected internally so it would be enough to connect either one for proper operation
[4] The RF Input and Output pad have a ground-signal-ground with a nominal pitch of 10 mil (250 um). The RF ground pads are 100 x 100 microns

Die 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/~/media/Files/Cree/RF/Application%20Notes/Appnote%202%20Eutectic.pdf
- 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

Block Diagram Showing Additional Capacitors for Operation Over 6.0 to 12.0 GHz



Designator	Description	Quantity
C1,C2,C3,C4,C5,C6,C7,C8,C9,C10	CAP, 51pF, +/-10%, SINGLE LAYER, 0.030", Er 3300, 100V, Ni/Au TERMINATION	10
C11,C12,C13,C14	CAP, 680pF, +/-10%, SINGLE LAYER, 0.070", Er 3300, 100V, Ni/Au TERMINATION	4

Notes:
[1] The input, output and decoupling capacitors should be attached as close as possible to the die- typical distance is 5 to 10 mils with a maximum of 15 mils
[1] The MMIC die and capacitors should be connected with 1 mil gold bond wires

Part Number System

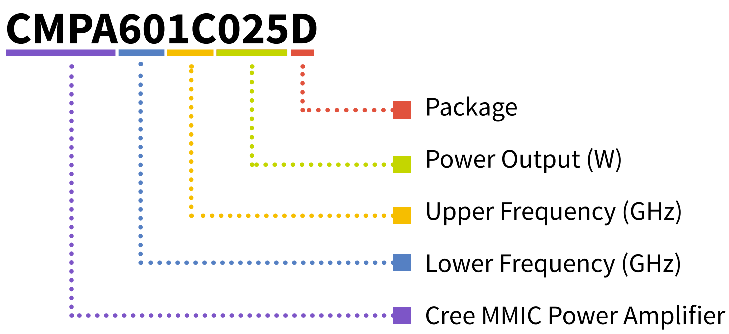


Table 1.

Parameter	Value	Units
Lower Frequency	6.0	GHz
Upper Frequency[1]	12.0	GHz
Power Output	25	W
Package	Bare Die	-

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

Table 2.

Parameter	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

Product Ordering Information

Order Number	Description	Unit of Measure
CMPA601C025D	GaN MMIC Power Amplifier Bare Die	Each

For more information, please contact:

4600 Silicon Drive
Durham, North Carolina, USA 27703
www.wolfspeed.com/RF

Sales Contact
RFSales@cree.com

Notes

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 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 planning, construction, maintenance or direct operation of a nuclear facility.