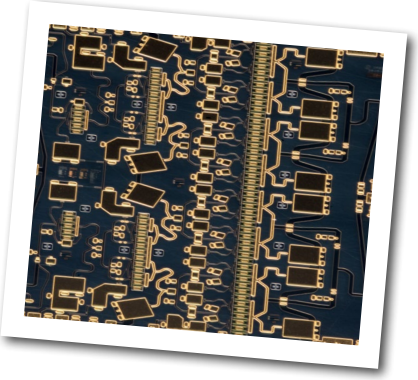
CMPA601C025D

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



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

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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

Note[1] Current limit for long term, reliable operation

Note[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)

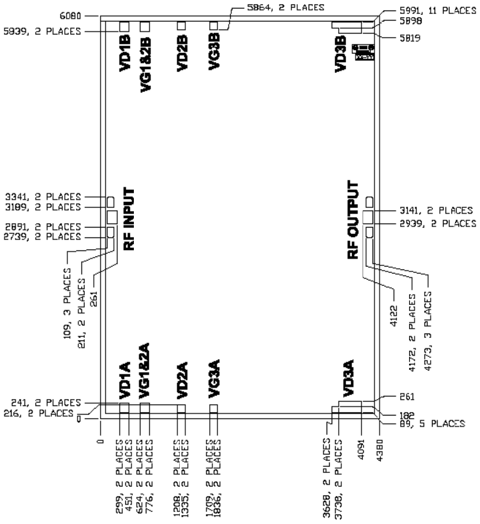
Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold	V_{TH}	-3.8	-2.8	-2.3	V	V_{DS} = 10 V, I_D = 23.2 mA
Drain-Source Breakdown Voltage	V_{BD}	84	100	–	V	V_{GS} = -8 V, I_D = 23.2 mA
RF Characteristics[2]						
Small Signal Gain @ 6 GHz	S21	29.8	35	–	dB	V_{DD} = 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	V_{DD} = 28 V, I_{DQ} = 2.4 A, P_{IN} = 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.

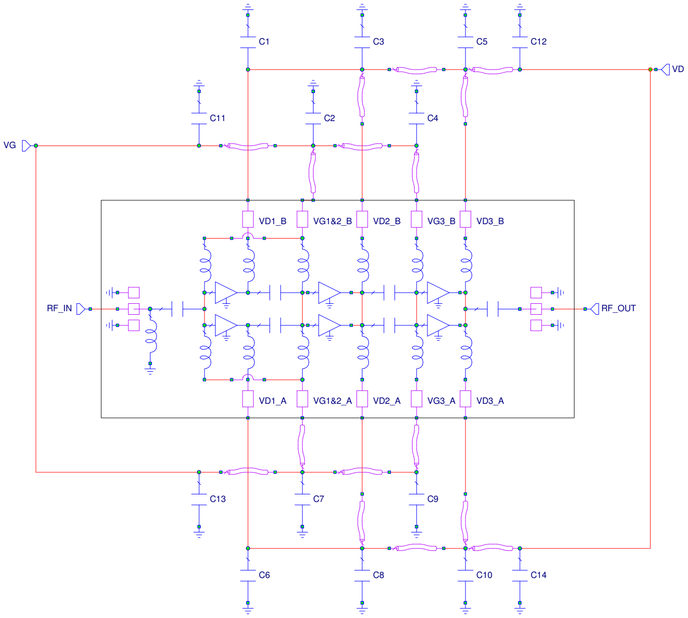
[3] VG3_A and VG3_B are connected internally so it would be enough to connect either one for proper operation.

[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



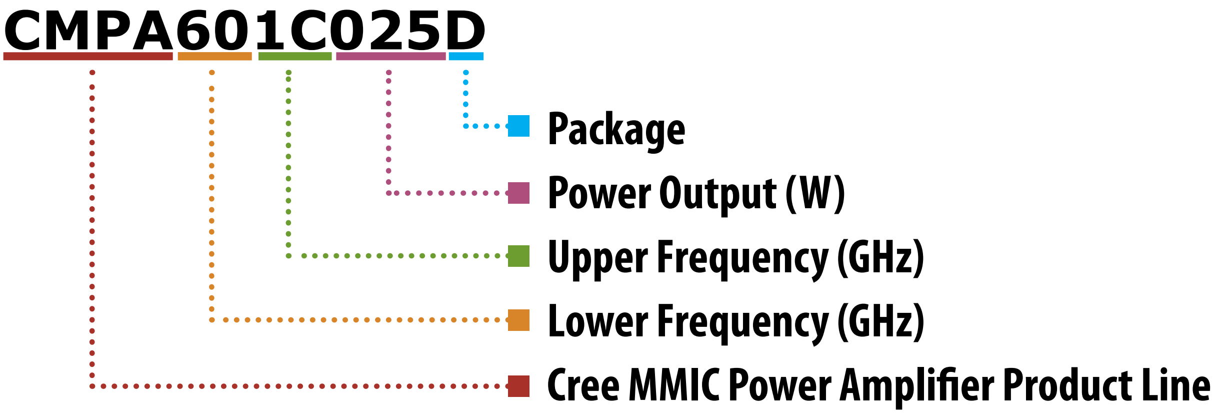
Designator	Description	Quantity
C1,C2,C3,C4,C5,C6,C7,C8,C9,C10	CAP, 51pF, +/-10%, SINGLE LAYER, 0.030”, Er 3300, 100V, Ni/Au TERMINATION	10
C11,C12,C13,C14	CAP, 680pF, +/-10%, SINGLE LAYER, 0.070”, Er 3300, 100V, Ni/Au TERMINATION	4

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.

[2] The MMIC die and capacitors should be connected with 1 mil gold bond wires.

Part Number System



Parameter	Value	Units
Lower Frequency	6.0	GHz
Upper Frequency[1]	12.0	GHz
Power Output	25	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.

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