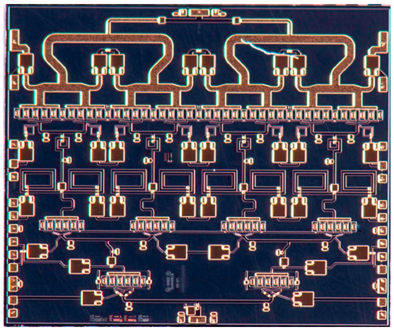
CMPA1D1E030D

30 W, 13.75 - 14.5 GHz, 40 V GaN MMIC, Power Amplifier



PN: CMPA1D1E030D

Description

Wolfspeed's CMPA1D1E030D 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.

Typical Performance Over 13.75-14.5 GHz (T_C = 25°C)

Parameter	13.75 GHz	14.0 GHz	14.5 GHz	Units
Small Signal Gain	27	26	25	dB
P_{SAT} @ P_{IN} = 26 dBm	33	34	30	W
P_{3dB} Backoff @ P_{IN} = 20 dBm	20	20	16	W
PAE @ P_{IN} = 26 dBm	24	23	22	%
PAE @ P_{IN} = 20 dBm	22	21	20	%

Note: All data in this table is based on fixtured, CW performance

Features

- 27 dB Small Signal Gain
- 30 W Typical P_{SAT}
- Operation up to 40 V
- High Breakdown Voltage
- High Temperature Operation

Applications

- Satellite Communications Uplink

RoHS compliant

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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		
Storage Temperature	T_{STG}	-55, +150	°C	
Operating Junction Temperature	T_J	225		
Maximum Forward Gate Current	I_{GMAX}	10	mA	25°C
Maximum Drain Current Stage 1[1]	I_{DMAX}	0.6	A	
Maximum Drain Current Stage 2[1]		0.96		
Maximum Drain Current Stage 3[1]		2.2		
Thermal Resistance, Junction to Case[2]	$R_{\theta JC}$	1.5	°C/W	85°C, P_{DISS} = 94W
Mounting Temperature (30 seconds)	T_S	320	°C	30 seconds

Notes:
[1] Current limit for long term, reliable operation. Total current when biased from top and bottom drain pads
[2] Eutectic die attach using 80/20 AuSn solder mounted to a 20 mil thick CuMoCu carrier.

Electrical Characteristics (Frequency = 13.75 GHz to 14.5 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold	V_{TH}	-3.7	-3.2	-2.8	V	V_{DS} = 10 V, I_D = 18.2 mA
Drain-Source Breakdown Voltage	V_{BD}	84	100	—		V_{GS} = -8 V, I_D = 18.2 mA
RF Characteristics[1]						
Small Signal Gain at 13.75 GHz	S21	20.75	26	—	dB	V_{DD} = 40 V, I_{DQ} = 300 mA, P_{IN} = 10 dBm
Small Signal Gain at 14.5 GHz		19.9	25	—		
Input Return Loss	S11	—	-16	—		V_{DD} = 40 V, I_{DQ} = 300 mA
Output Return Loss	S22	—	-9	—		
Power Output at 13.75 GHz	P_{OUT}	37	42	—	W	V_{DD} = 40 V, I_{DQ} = 300 mA , P_{IN} = 25 dBm
Power Output at 14.5 GHz		35	40	—		
Power Added Efficiency	PAE	—	30	—	%	V_{DD} = 40 V, I_{DQ} = 300 mA, CW, P_{IN} = 24 dBm
		23	25	—		V_{DD} = 40 V, I_{DQ} = 300 mA, P_{IN} = 18 dBm
Power Gain	G_P	—	22	—	dB	V_{DD} = 40 V, I_{DQ} = 300 mA
Output Mismatch Stress	VSWR	—	—	5:1	Ψ	No damage at all phase angles, V_{DS} = 40 V, I_{DQ} = 300 mA, P_{OUT} = 25 W CW

Notes:
[1] All data pulse tested on-wafer with Pulse Width = 3µs from DC pulse
[2] RF power and DC current measurements are made 6µs from start of RF pulse

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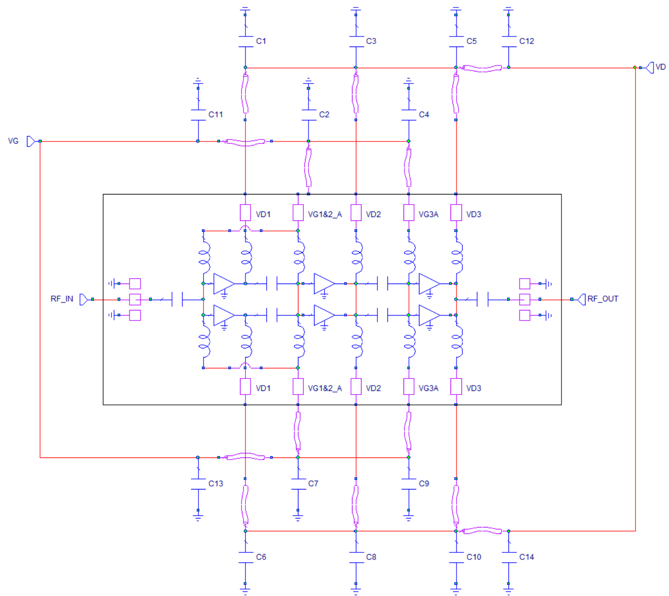
Block Diagram Showing Additional Capacitors for Operation Over 13.75 to 14.5 GHz



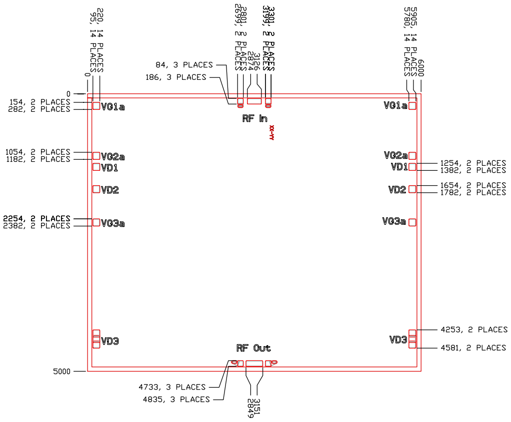
Designator	Description	Qty
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10	CAP, 51pF, +/-10%, SINGLE LAYER, 0.030”, Er 3300, 100V, Ni/Au TERMINATION	10
C11, C12, C13, C14	CAP, 680pF, +/-10%, SINGLE LAYER, 0.070”, Er 3300, 100V, Ni/Au TERMINATION	4

Note:
[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 2 mil gold bond wires

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	TBD	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D

Die Dimensions (units in microns)



Overall die size 5000 x 6000 (+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 (microns)	Note
1	RF_IN	RF-Input pad. Matched to 50 ohm	102x252	5
2	VG1A bottom	Gate control for stage 1. V_G = -2.0 to -3.5 V	128x125	1, 2
3	VG1A top			
4	VG2A bottom	Gate control for stage 2. V_G = -2.0 to -3.5 V		
5	VG2A top			
6	VD1 bottom	Drain control for stage 1. V_D = 40 V		1, 3
7	VD1 top			
8	VD2 bottom	Drain control for stage 2. V_D = 40 V		1, 4
9	VD2 top			
10	VG3A bottom	Gate control for stage 3. V_G = -2.0 to -3.5 V		1, 2
11	VG3A top			
12	VD3 bottom	Drain control for stage 3. V_D = 40 V	328x125	1, 4
13	VD3 top			
14	RF_OUT	RF-Output pad. Matched to 50 ohm	102x302	5

Note:
[1] Attach bypass capacitor to pads 2-13 per aplications circuit
[2] VG1A&2A&3A top and bottom are connected internally, so it would be enough to connect either one for proper operation
[3] VD1 top and bottom are not connected internally and have to be biased from both sides for proper operation
[4] For current handling, it is recommended to bias VD2 and VD3 from both top and bottom sides
[5] The RF Input and Output pads have a ground-signal-ground with a nominal pitch of 10 mil (250 µm). The RF ground pads are 102 x 102 microns

Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to Wolfspeed's website for the Eutectic Die Bond Procedure application note at https://www.wolfspeed.com/document-library/?productLine=rf&q=Eutectic+Die+Bond+Procedure+application
- 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

Part Number System

CMPA1D1E030D

- Package
- Power Output (W)
- Upper Frequency (GHz)
- Lower Frequency (GHz)
- Wolfspeed MMIC Power Amplifier Product Line

Table 1.

Parameter	Value	Units
Lower Frequency	13.75	GHz
Upper Frequency[1]	14.5	GHz
Power Output	30	W
Package	Bare Die	—

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

Table 2.

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

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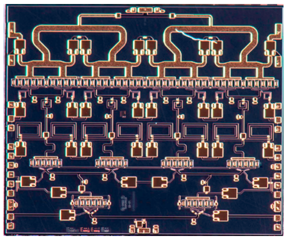
Product Ordering Information

Order Number	Description	Unit of Measure	Image
CMPA1D1E030D	GaN MMIC, Bare Die	Each	

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