CMPA1C1D060D

60 W, 12.7 - 13.25 GHz, 40 V, GaN MMIC, Power Amplifier

PN: CMPA1C1D060D

Description

Wolfspeed's CMPA1C1D060D 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 12.7-13.25 GHz (T_C = 25°C)

Parameter	12.7 GHz	13.0 GHz	13.25 GHz	Units
Small Signal Gain	26.5	26.2	26	dB
P_{SAT} @ P_{IN} = 28 dBm	65	63	60	W
PAE @ P_{IN} = 28 dBm	29	28	27	%

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

Features

- 26 dB Small Signal Gain
- 60 W Typical P_{SAT}
- Operation up to 40 V
- High Breakdown Voltage
- High Temperature Operation
- Size 0.209 x 0.240 x 0.004 inches

Applications

- Satellite Communications Uplink
- PTP Radio

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Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	120	V_{DC}	25°C
Gate-to-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}	16.8	mA	25°C
Maximum Drain Current Stage 1[1]	I_{DMAX}	1.8	A	
Maximum Drain Current Stage 2[1]		3.6		
Maximum Drain Current Stage 2[1]		9		
Thermal Resistance, Junction to Case[2]	$R_{\theta JC}$	1.12	°C/W	85°C, P_{DISS} = 118 W
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 = 12.7 GHz to 13.25 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 = 27 mA
Drain-Source Breakdown Voltage	V_{BD}	100	100	—		V_{GS} = -8 V, I_D = 27 mA
RF Characteristics[2]						
Small Signal Gain	S21	—	27	—	dB	V_{DD} = 40 V, I_{DQ} = 0.45 A
Input Return Loss	S11	—	-15	—		
Output Return Loss	S22	—	-5	—		
Power Output	P_{OUT}	—	75	—	W	V_{DD} = 40 V, I_{DQ} = 0.45 A, CW, P_{IN} = 30 dBm
Power Added Efficiency	PAE	—	30	—	%	
Power Gain	G_P	—	19	—	dB	
Output Mismatch Stress	VSWR	—	5:1	—	Ψ	No damage at all phase angles, V_{DD} = 40 V, I_{DQ} = 0.45 A, P_{OUT} = 30 W CW

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

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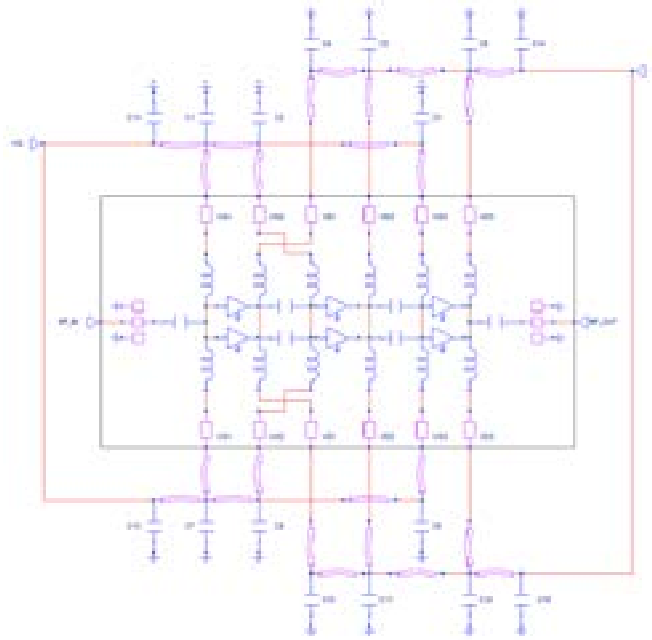
Block Diagram Showing Additional Capacitors for Operation Over 12.7 to 13.25 GHz



Designator	Description	Qty
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12	CAP, 51pF, +/-10%, SINGLE LAYER, 0.030", Er 3300, 100V, Ni/Au TERMINATION	12
C13, C14, C15, C16	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

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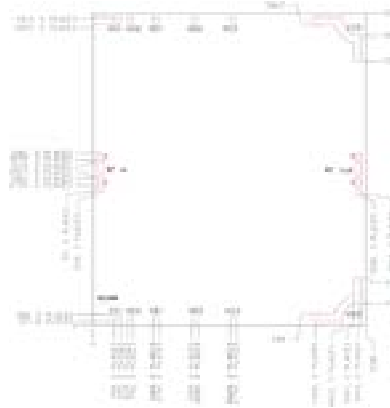
Die Dimensions (units in microns)



Overall die size 5300 x 6100 (+0/-50) microns, die thickness 100 (+/-10) microns.
All Gate and Drain pads must be wire bonded for electrical connection.

<table>
<tr><th>Pad Number</th><th>Function</th><th>Description</th><th>Pad Size (microns)</th><th>Note</th></tr>
<tr><td>1</td><td>RF_IN[1]</td><td>RF-Input pad. Matched to 50 ohm</td><td>125x250</td><td>3</td></tr>
<tr><td>2</td><td>VG1 bottom</td><td rowspan="2">Gate control for stage 1. V_G = -2.0 to -3.5 V</td><td rowspan="10">125x125</td><td rowspan="4">1, 2</td></tr>
<tr><td>3</td><td>VG1 top</td></tr>
<tr><td>4</td><td>VG2 bottom</td><td rowspan="2">Gate control for stage 2. V_G = -2.0 to -3.5 V</td></tr>
<tr><td>5</td><td>VG2 top</td></tr>
<tr><td>6</td><td>VD1 bottom</td><td rowspan="2">Drain control for stage 1. V_D = 40 V</td><td rowspan="4">1</td></tr>
<tr><td>7</td><td>VD1 top</td></tr>
<tr><td>8</td><td>VD2 bottom</td><td rowspan="2">Drain control for stage 2. V_D = 40 V</td></tr>
<tr><td>9</td><td>VD2 top</td></tr>
<tr><td>10</td><td>VG3 bottom</td><td rowspan="2">Gate control for stage 3. V_G = -2.0 to -3.5 V</td><td rowspan="2">1, 2</td></tr>
<tr><td>11</td><td>VG3 top</td></tr>
<tr><td>12</td><td>VD3 bottom</td><td rowspan="2">Drain control for stage 3. V_D = 40 V</td><td>540x150</td><td rowspan="2">1</td></tr>
<tr><td>13</td><td>VD3 top</td><td>150x500</td></tr>
<tr><td>14</td><td>RF_OUT</td><td>RF-Output pad. Matched to 50 ohm</td><td>125x125</td><td>3</td></tr>
</table>

Note:
[1] The RF In and Out pads have a ground-signal-ground configuration with a pitch of 1 mil (25µm)
[2] VG1&2&3 top and bottom are connected internally, so it would be enough to connect either one for proper operation
[3] The RF Input and Output pads have a ground-signal-ground with a nominal pitch of 10 mil (250µm). The RF ground pads are 125 x 250 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

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Typical Performance of the CMPA1C1D060D

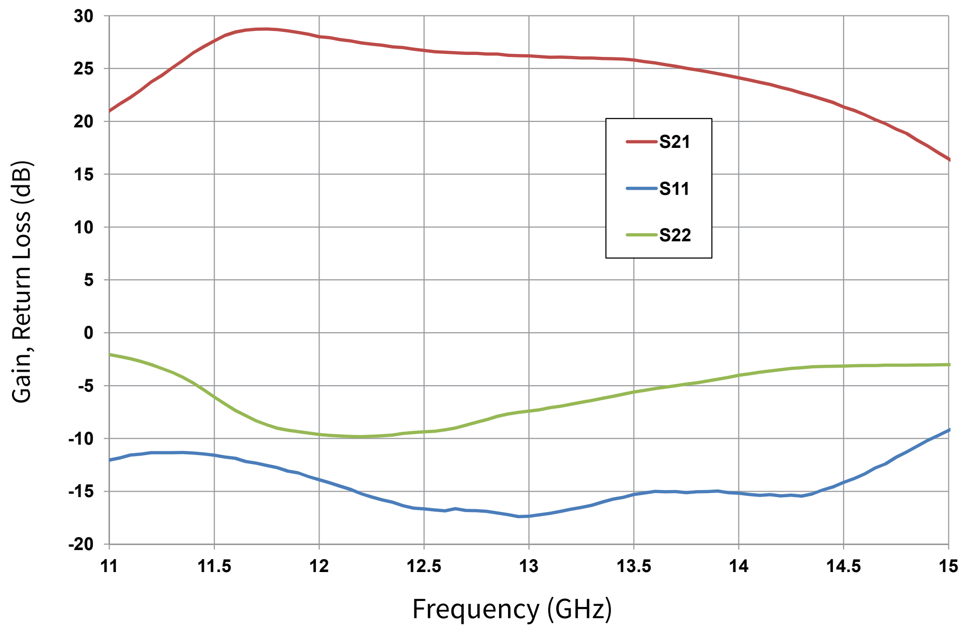

Figure 1. Small Signal Gain vs Frequency
V_{DD} = 40 V, I_{DQ} = 0.45 A

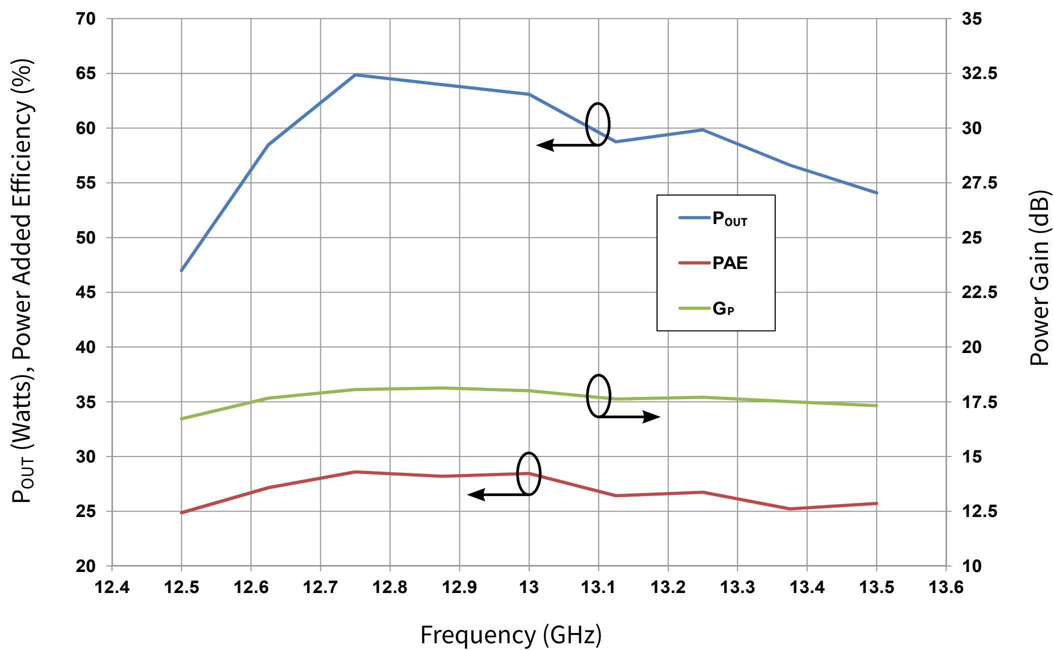

Figure 2. Output Power & PAE vs Frequency
V_{DD} = 40 V, I_{DQ} = 0.45 A, P_{IN} = 28 dBm

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Part Number System

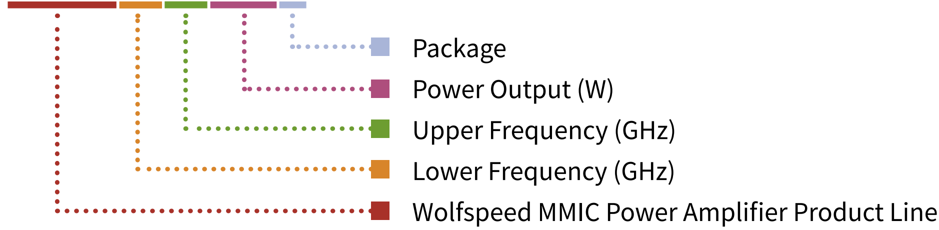

Table 1.

Parameter	Value	Units
Lower Frequency	12.7	GHz
Upper Frequency[1]	13.25	GHz
Power Output	60	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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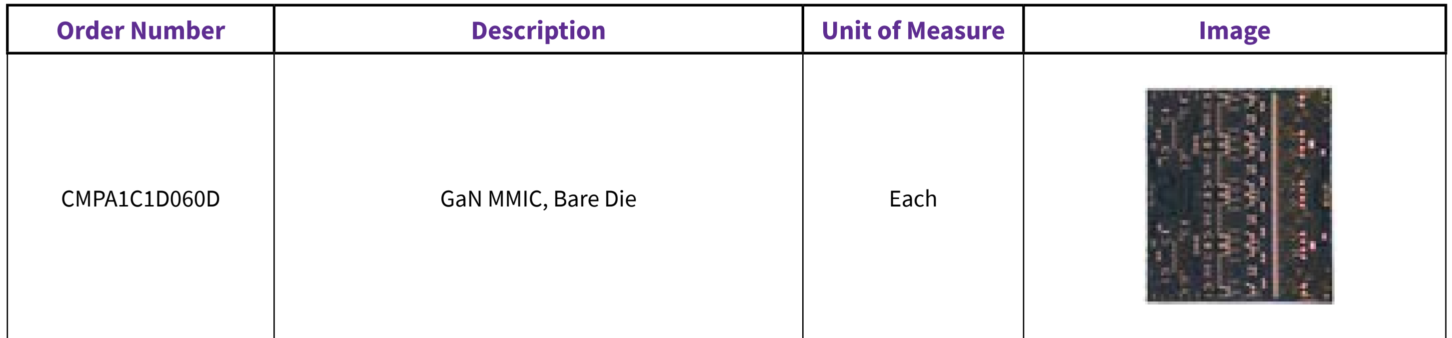
Product Ordering Information



Order Number	Description	Unit of Measure	Image
CMPA1C1D060D	GaN MMIC, Bare Die	Each	

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