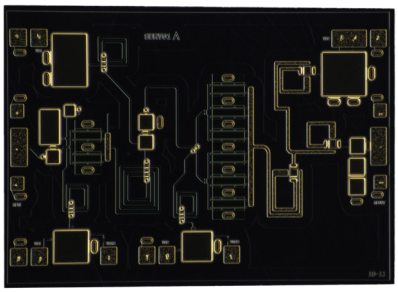
CMPA2735015D

15 W, 2.7 - 3.5 GHz, GaN MMIC, Power Amplifier



Description

The CMPA2735015D is a gallium nitride (GaN) high electron mobility transistor (HEMT) based monolithic microwave integrated circuit (MMIC). 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 also offer greater power density and wider bandwidths compared to Si and GaAs transistors. This MMIC contains a two-stage reactively matched amplifier design approach enabling very wide bandwidths to be achieved.

Features

- 35 dB small signal gain
- 20 W typical P_{SAT}
- Operation up to 50 V
- High breakdown voltage
- High temperature operation
- Size 0.118 x 0.071 x 0.004 inches

Applications

- Civil and military pulsed radar amplifiers

Typical Performance Over 2.7-3.5 GHz (T_C = 25 °C)

Parameter	2.7 GHz	2.9 GHz	3.1 GHz	3.3 GHz	3.5 GHz	Units
Small Signal Gain	36	35	35	35	35	dB
Output Power[1]	20	22	26	27	26	W
Power Gain[1]	27	27	28	28	28	dB
PAE[1]	51	57	54	52	52	%

Note:
[1] P_{IN} = 16 dBm, pulse width = 500 µs; duty cycle = 10%.

Absolute Maximum Ratings (Not Simultaneous) at 25 °C

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	150	V_{DC}	
Gate-to-Source Voltage	V_{GS}	-10, +2	V_{DC}	
Storage Temperature	T_{STG}	-65, +150	°C	
Operating Junction Temperature	T_J	225	°C	
Maximum Forward Gate Current	I_{GMAX}	0.0038	A	
Maximum Drain Current[1]	I_{DMAX}	3.53	mA	
Thermal Resistance, Junction to case (Packaged)[2]	$R_{\theta JC}$	9.33	°C/W	500 µs, 10%
Mounting Temperature	T_S	260	°C	

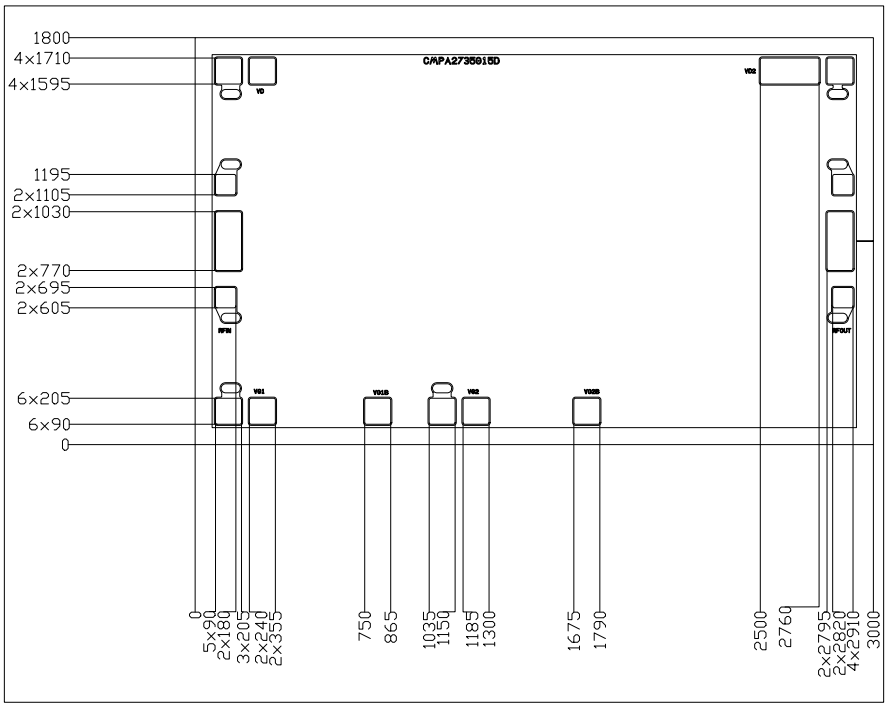
Notes:
[1] Current limit for long term, reliable operation.
[2] Eutectice die attach using 0.005" thick 80/20 AuSn mounted to a 0.04" thick CMC carrier bottom of the CMC carrier fixed at 85 °C and is at 15 W dissipated power.

Electrical Characteristics (Frequency = 2.7 GHz to 3.5 GHz Unless Otherwise Stated; T_C = 25 °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 V, I_D = 3.8 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 50 V, V_{DQ} = 80 mA
Saturated Drain Current[1]	I_{DS}	2.7	3.5	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BD}	100	–	–	V	V_{GS} = -8 V, I_D = 3.8 mA
RF Characteristics[2]						
Small Signal Gain[1]	S21	28	33	–	dB	V_{DD} = 50 V, I_{DQ} = 80 mA, P_{IN} = 0 dBm, Frequency = 2.7 GHz
Small Signal Gain[2]	S21	26.5	32	–	dB	V_{DD} = 50 V, I_{DQ} = 80 mA, P_{IN} = 0 dBm, Frequency = 3.1 GHz
Small Signal Gain[3]	S21	26.2	33	–	dB	V_{DD} = 50 V, I_{DQ} = 80 mA, P_{IN} = 0 dBm, Frequency = 3.5 GHz
Output Power[1]	P_{OUT}	17	23	–	W	V_{DD} = 50 V, I_{DQ} = 80 mA, P_{IN} = 16 dBm, Frequency = 2.7 GHz
Output Power[2]	P_{OUT}	24	31	–	W	V_{DD} = 50 V, I_{DQ} = 80 mA, P_{IN} = 16 dBm, Frequency = 3.1 GHz
Output Power[3]	P_{OUT}	24	33	–	W	V_{DD} = 50 V, I_{DQ} = 80 mA, P_{IN} = 16 dBm, Frequency = 3.5 GHz
Power Added Efficiency[1]	PAE	50	54	–	%	V_{DD} = 50 V, I_{DQ} = 80 mA, Frequency = 2.7 GHz
Power Added Efficiency[2]	PAE	52	57	–	%	V_{DD} = 50 V, I_{DQ} = 80 mA, Frequency = 3.1 GHz
Power Added Efficiency[3]	PAE	50	55	–	%	V_{DD} = 50 V, I_{DQ} = 80 mA, Frequency = 3.5 GHz
Input Return Loss	S11	–	-8	–	dB	V_{DD} = 50 V, I_{DQ} = 80 mA
Output Return Loss	S22	–	-8	–	dB	V_{DD} = 50 V, I_{DQ} = 80 mA
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No Damage at All Phase Angles, V_{DD} = 50 V, I_{DQ} = 80 mA, P_{OUT} = 15 W Pulsed

Notes:
[1] Scaled from PCM data.
[2] All data pulse tested on-wafer with pulse width = 10 µs, duty cycle = 1%.

DIE Dimensions (Units in Microns)



Overall Die Size 2000 X 3000 (+0/-50) Microns, Die Thickness 100 (+/-10) Microns.
All Gate and Drain Pads Must be Wire Bonded for Electrical Connection.

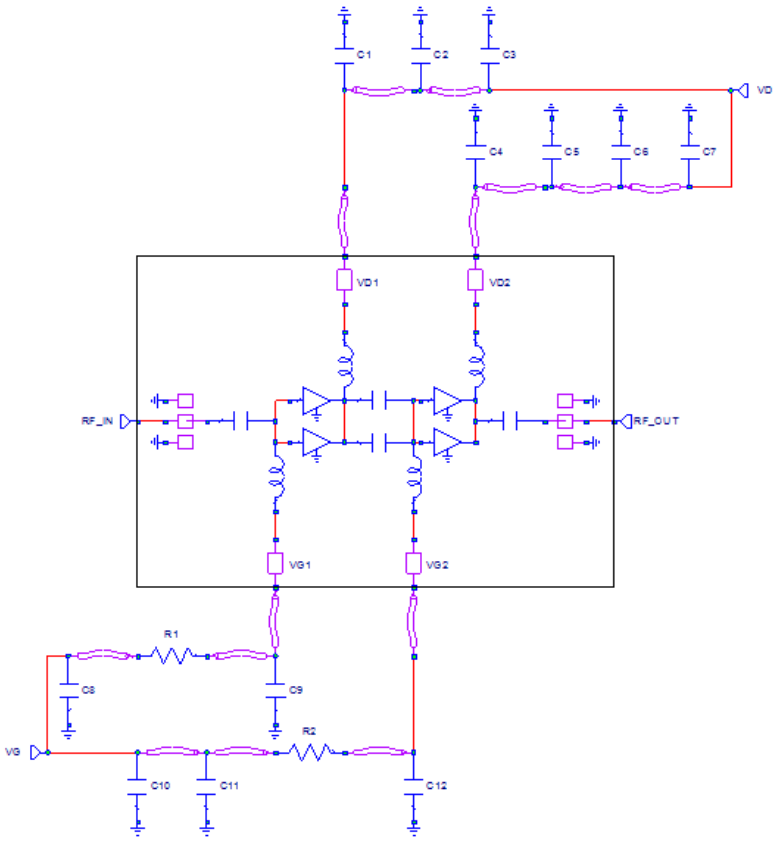
Pad Number	Function	Description	Pad Size (Microns)	Note
1	RF_IN	RF Input Pad. Matched to 50 Ohms	270 x 125	2
2	V_{D1}	Drain Supply for Stage 1. V_D = 50 V	115 x 115	1
3	V_{D2}	Drain Supply for Stage 2. V_D = 50 V	260 x 115	1
4	V_{G1}	Drain Supply for Stage 1. V_G ~ -3.5 V to -2 V	115 x 115	1
5	V_{G2}	Drain Supply for Stage 2. V_G ~ -3.5 V to -2 V	115 x 115	1
6	RF_OUT	RF Input Pad. Matched to 50 Ohms	260 x 115	2

Notes:
[1] Attach bypass capacitors to pads 2-5 per application circuit.
[2] The RF input and output pads have a ground-signal-ground with a nominal pitch of 250 um (10 mil). The RF ground pads are 100 um x 100 um.

Assembly Notes:

- Recommended solder is AuSn (80/20) solder. Refer to the website for the Eutectic Die Bond procedure Application Note
- 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 & Output Matching Section for Operation Over 2.7 to 3.5 GHz



Designator	Description	Quantity
C1, C2, C3, C4	110 pF, +/-40% SINGLE LAYER, 103 X 180, Er 3300, 100 V, Ni/Au TERMINATION	4
C5, C6	560 pF +/-40% SINGLE LAYER, 103 X 180, Er 3300, 100 V, Ni/Au TERMINATION	2

Notes:
[1] The input, output and decoupling capacitors should be attached as close as possible to the die- typical distance is 40 to 50 mils.
[2] The MMIC die and capacitors should be connected with 1 mil gold bond wires.

Typical Performance

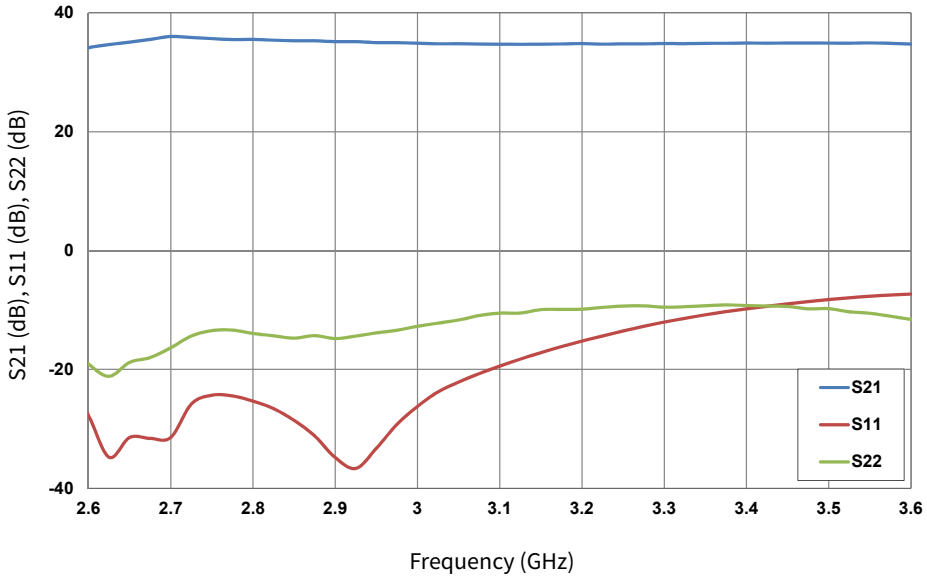


Figure 1. Gain and Input Return Loss vs Frequency in the CMPA2735015S
V_{DD} = 50 V, I_{DQ} = 0.08 A

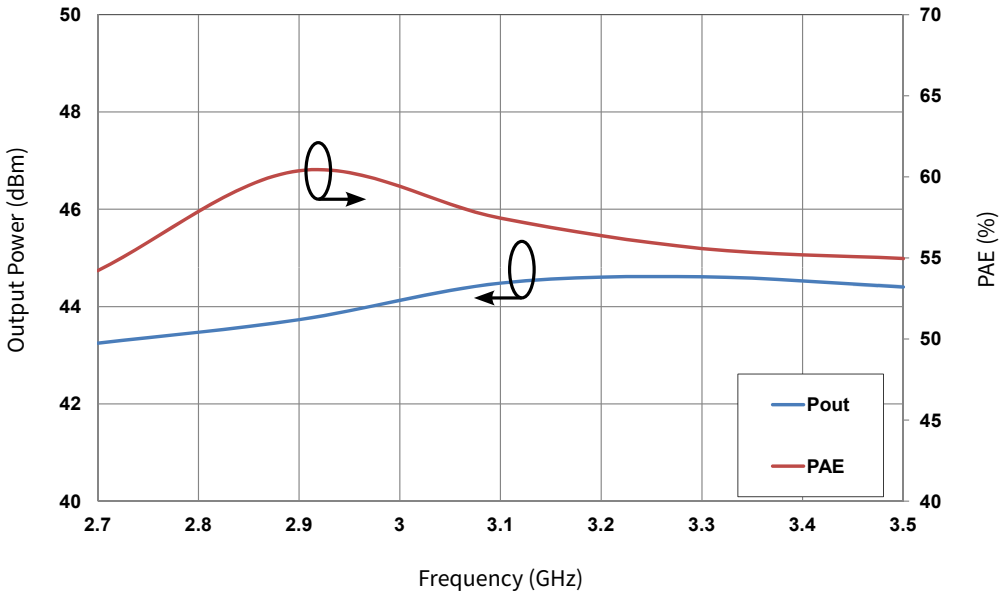


Figure 2. Output Power and PAE vs Frequency in the CMPA2735015S
V_{DD} = 50 V, I_{DQ} = 0.08 A, P_{IN} = 16 dBm, Pulse Width = 500 µs, Duty Cycle = 10%

Typical Performance

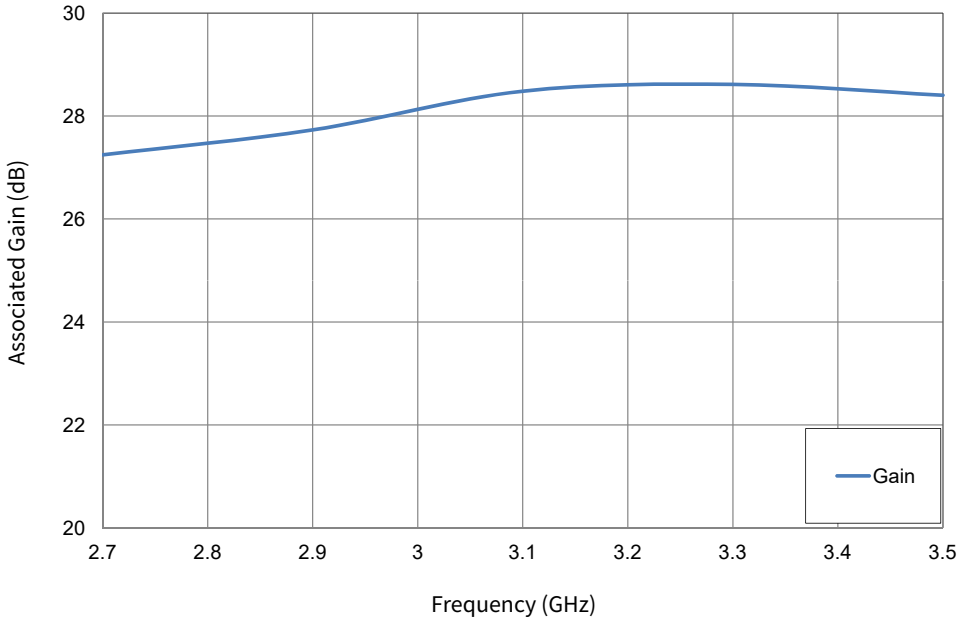


Figure 3. Associated Gain vs Frequency in the CMPA2735015S
V_{DD} = 50 V, I_{DQ} = 0.08 A, P_{IN} = 16 dBm Pulse Width = 500 µs,Duty Cycle = 10%

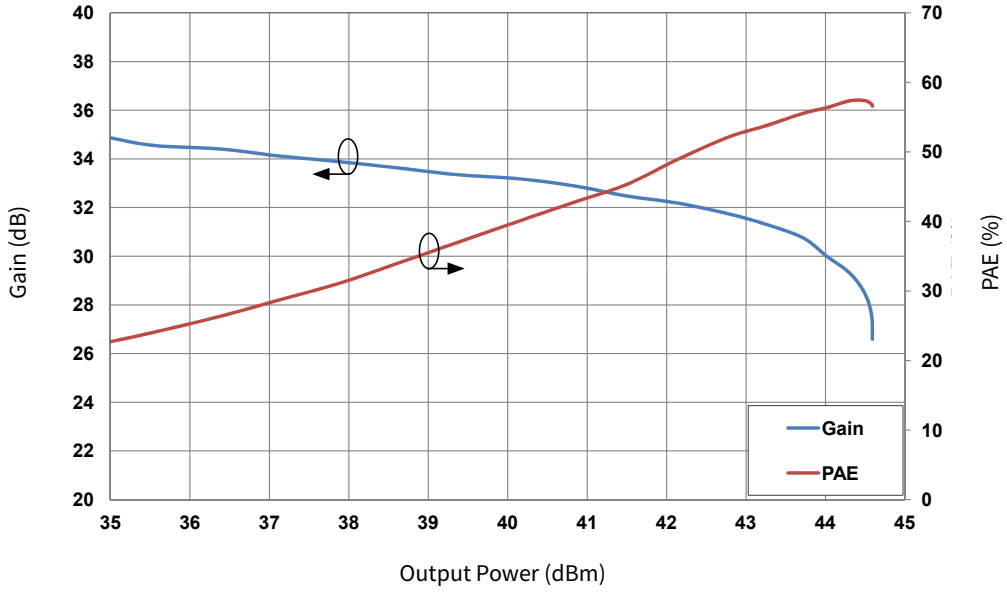


Figure 4. Gain and Power Added Efficiency vs Output Power in the CMPA2735015S
V_{DD} = 50 V, I_{DQ} = 0.08 A, Frequency = 3.1 GHz Pulse Width = 500 µs, Duty Cycle = 10%

Part Number System

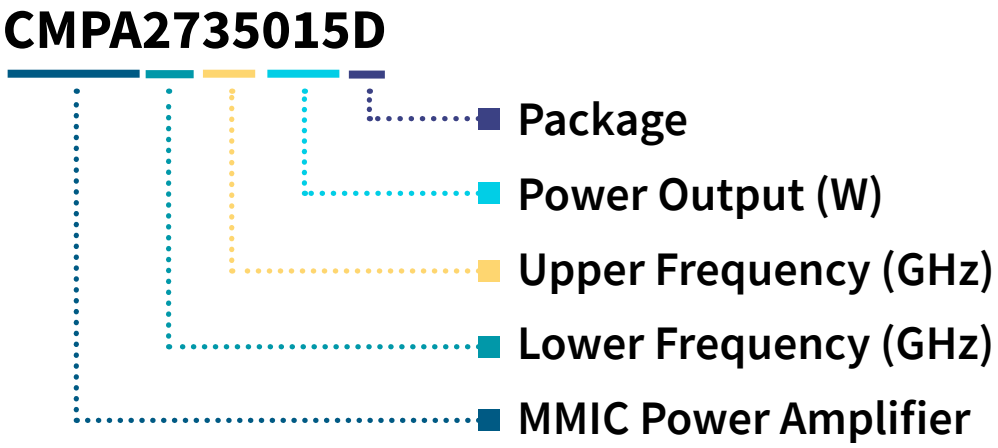


Table 1.

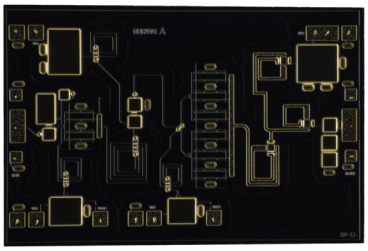
Parameter	Value	Units
Lower Frequency	2.7	GHz
Upper Frequency	3.5	GHz
Power Output	15	W
Package	Bare Die	–

Note:
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:	1 A = 10.0 GHz 2 H = 27.0 GHz

Product Ordering Information

Order Number	Description	Unit of Measure	Image
CMPA2735015D	GaN MMIC Die	Each	

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