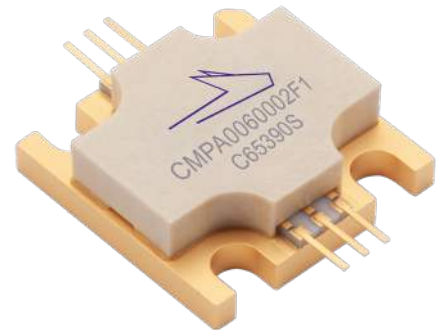


# CMPA0060002F1

2 W, DC - 6.0 GHz, GaN MMIC Power Amplifier

## Description

Wolfspeed's CMPA0060002F1 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 employs a distributed (traveling-wave) amplifier design approach, enabling extremely wide bandwidths to be achieved in a small footprint screw-down package featuring a copper-tungsten heat sink.



PN: CMPA0060002F1  
Package Type: 440219

## Typical Performance Over 20 MHz - 6.0 GHz ( $T_c = 25^\circ\text{C}$ )

Parameter	20 MHz	0.5 GHz	1.0 GHz	2.0 GHz	3.0 GHz	4.0 GHz	5.0 GHz	6.0 GHz	Units
Small Signal Gain	21.4	19.3	18.2	16.7	17.1	18.0	19.2	16.8	dB
Saturated Output Power, $P_{SAT}^1$	5.9	5.5	5.7	4.8	4.5	4.6	4.6	3.3	W
Power Gain @ $P_{SAT}^1$	12.5	11.1	10.6	8.8	10.1	9.1	8.2	7.8	dB
PAE @ $P_{SAT}^1$	39	31	32	26	24	26	24	18	%

Note<sup>1</sup>  $P_{SAT}$  is defined as the RF output power where the device starts to draw positive gate current in the range of 2-4 mA

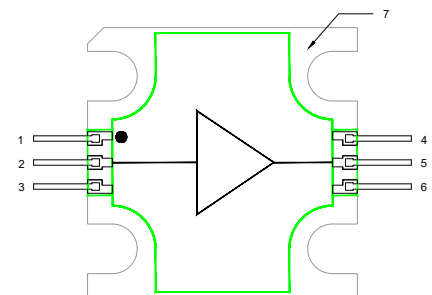
Note<sup>2</sup>  $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 100\text{ mA}$

## Features

- 18 dB Small Signal Gain
- 4.8 W Typical  $P_{SAT}$
- Operation up to 28 V
- High Breakdown Voltage
- High Temperature Operation
- 0.5" x 0.5" Total Product Size

## Applications

- Ultra Broadband Amplifiers
- Fiber Drivers
- Test Instrumentation
- EMC Amplifier Drivers





### Absolute Maximum Ratings (not simultaneous) at 25°C

Parameter	Symbol	Rating	Units
Drain-Source Voltage	$V_{DS}$	84	$V_{DC}$
Gate-Source Voltage	$V_{GS}$	-10, +2	
Storage Temperature	$T_{STG}$	-65, +150	°C
Operating Junction Temperature	$T_J$	225	
Maximum Forward Gate Current	$I_{GMAX}$	4	mA
Soldering Temperature <sup>1</sup>	$T_S$	245	°C
Screw Torque	$\tau$	40	in-oz
Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.3	°C/W
Case Operating Temperature <sup>2</sup>	$T_C$	-40, +150	°C

Notes:

<sup>1</sup> Refer to the Application Note on soldering at [wolfspeed.com/rf/document-library](http://wolfspeed.com/rf/document-library)

<sup>2</sup> Measured for the CMPA0060002F1 at  $P_{DISS} = 2\text{ W}$

### Electrical Characteristics ( $T_C = 25^\circ\text{C}$ )

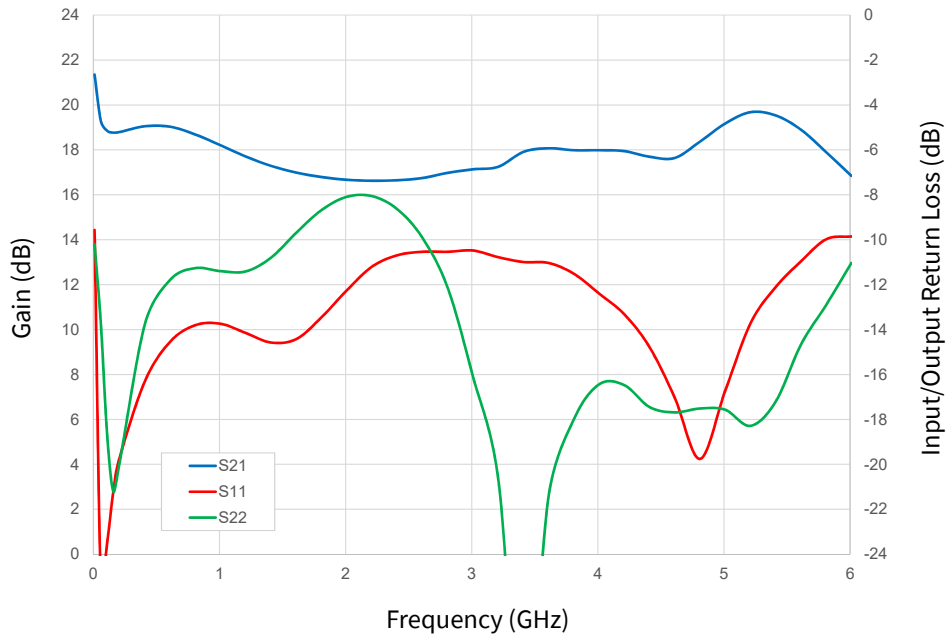
Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics</b>						
Gate Threshold Voltage <sup>1</sup>	$V_{GS(th)}$	-3.8	-3.0	—	V	$V_{DS} = 20\text{ V}, \Delta I_D = 2\text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	—	-2.7	—	$V_{DC}$	$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}$
Saturated Drain Current	$I_{DC}$	16.2	1.4	—	A	$V_{DS} = 6.0\text{ V}, V_{GS} = 2.0\text{ V}$
<b>RF Characteristics</b>						
Small Signal Gain at 20 MHz - 6.0 GHz	S21	—	15.1	—	dB	$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}$
Input Return Loss at 2.5 - 6.0 GHz	S11	—	-8.3	—		
Output Return Loss at 2.5 - 6.0 GHz	S22	—	-10.4	—		
Power Output at 3.5 GHz	$P_{OUT1}$	—	3.7	—	W	$V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}, P_{IN} = 23\text{ dBm}$
Power Output at 4.0 GHz	$P_{OUT2}$	—	3.5	—		
Power Output at 6.0 GHz	$P_{OUT3}$	—	2.2	—		
Power Added Efficiency at 3.5 GHz	$PAE_1$	—	25	—	%	
Power Added Efficiency at 4.0 GHz	$PAE_2$	—	27	—		
Power Added Efficiency at 6.0 GHz	$PAE_3$	—	19	—		
Power Gain at 3.5 GHz	$G_{P1}$	—	12.6	—	dB	
Power Gain at 4.0 GHz	$G_{P2}$	—	12.4	—		
Power Gain at 6.0 GHz	$G_{P3}$	—	10.5	—		
Output Mismatch Stress	VSWR	—	—	5 : 1	$\Psi$	No damage at all phase angles, $V_{DD} = 48\text{ V}, I_{DQ} = 100\text{ mA}, P_{IN} = 23\text{ dBm Pulsed}$

Notes:

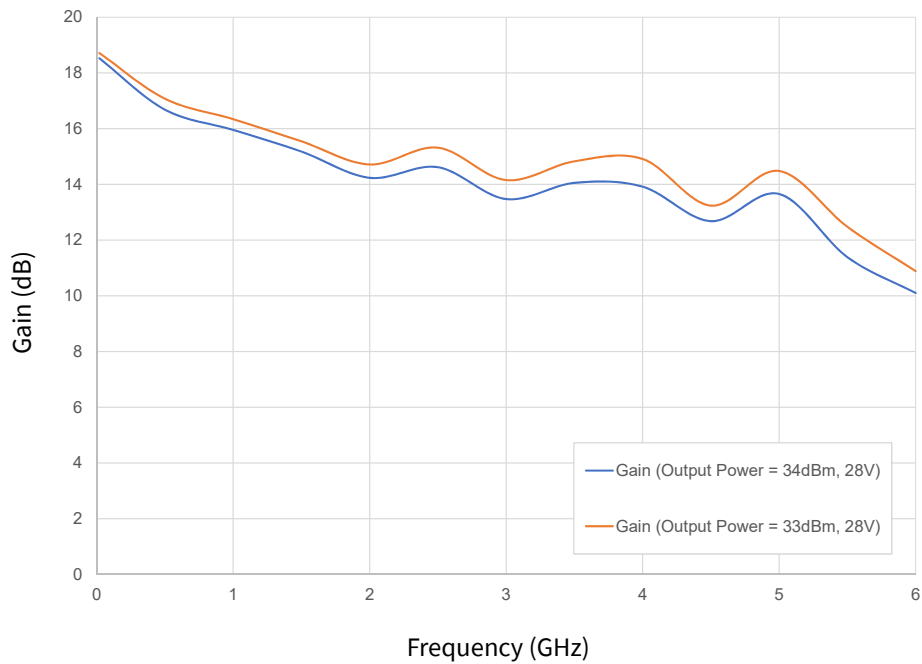
<sup>1</sup> The device will draw approximately 20-25 mA at pinch off due to the internal circuit structure



Typical Performance



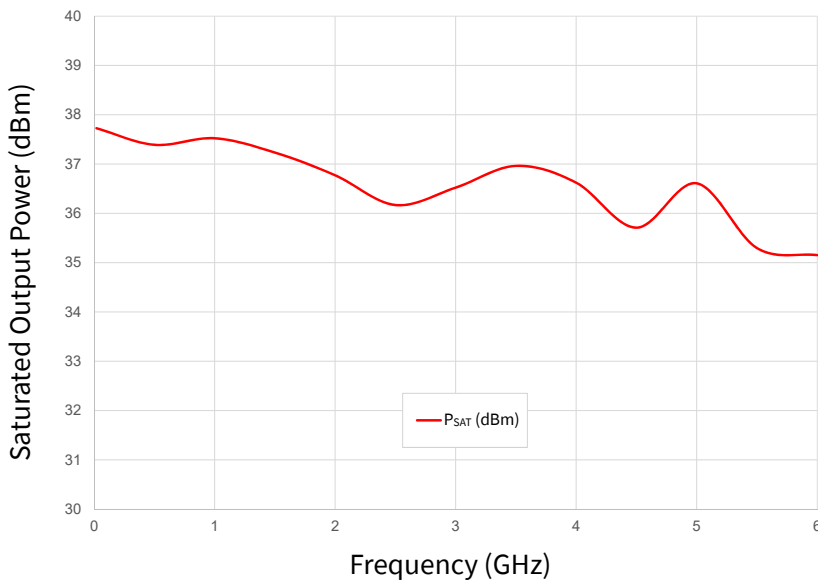
**Figure 1.** Small Signal Gain and Return Losses vs Frequency  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 100\text{ mA}$



**Figure 2.** Power Gain vs Frequency  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 100\text{ mA}$



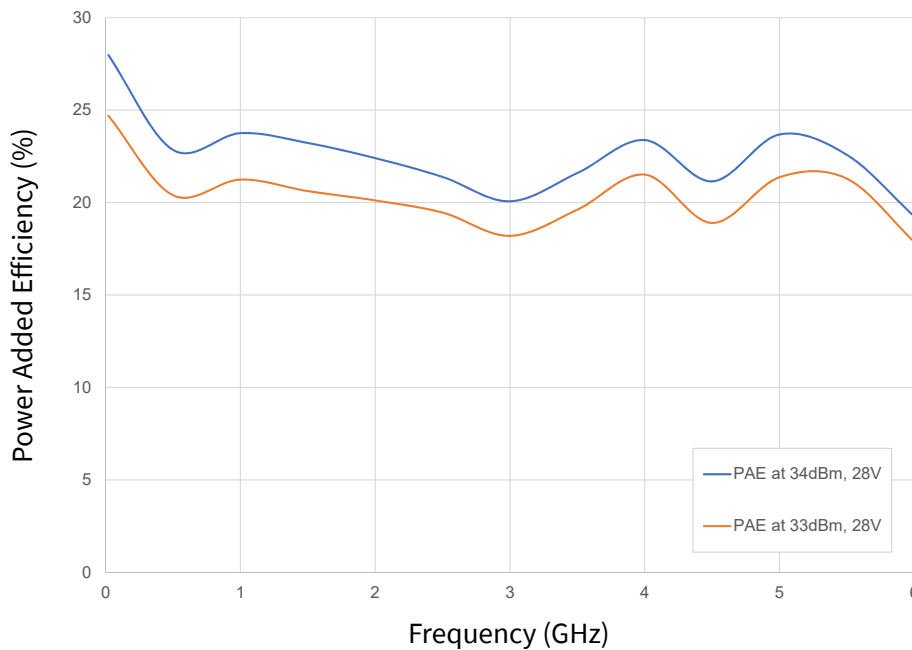
### Typical Performance



Frequency (GHz)	P <sub>SAT</sub> at 28V (dBm)	P <sub>SAT</sub> at 28V (W)
0.02	37.7	5.9
0.5	37.4	5.5
1.0	37.5	5.7
1.5	37.2	5.3
2.0	36.8	4.8
2.5	36.5	4.1
3.0	36.2	4.5
3.5	37	5
4.0	36.6	4.6
4.5	35.7	3.7
5.0	36.6	4.6
5.5	35.3	3.4
6.0	35.2	3.3

**Figure 3.** Saturated Output Power Performance (P<sub>SAT</sub>) vs Frequency  
 V<sub>DD</sub> = 28 V, I<sub>DQ</sub> = 100 mA

Note: P<sub>SAT</sub> is defined as the RF output power where the device starts to draw positive gate current in the range of 2-4 mA



**Figure 4.** PAE at 33 & 34 dBm Output Power vs Frequency  
 V<sub>DD</sub> = 28 V, I<sub>DQ</sub> = 100 mA

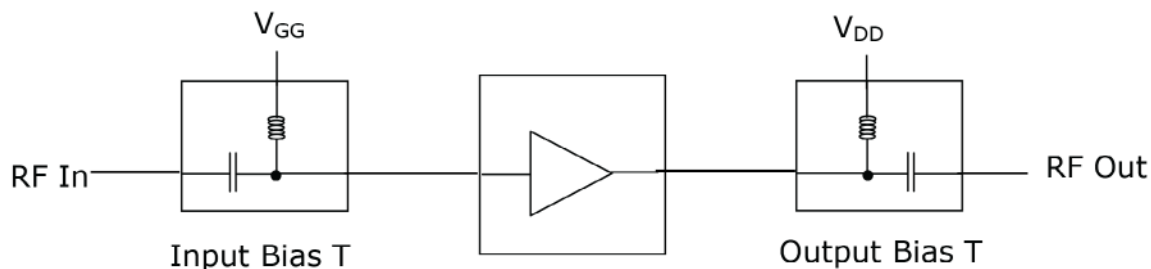


### General Device Information

The CMPA0060002F1 is a GaN HEMT MMIC Distributed Driver Amplifier, which operates between 20 MHz - 6.0 GHz. The amplifier typically provides 18 dB of small signal gain and 4.8 W saturated output power with an associated power added efficiency of better than 20%. The wideband amplifier’s input and output are internally matched to 50 Ohm. The amplifier requires bias from appropriate Bias-T’s, through the RF input and output ports.

The CMPA0060002F1 is provided in a flange package format. The input and output connections are gold plated to enable gold bond wire attach at the next level assembly.

The measurements in this data sheet were taken on devices wire-bonded to the test fixture with 2 mil gold bond wires. The CMPA0060002F1-AMP and the device were then measured using external Bias-T’s, (Aeroflex: 8800, SMF3-12; TECDIA: AMPT-06M20 or similar), as shown in Figure 5. The Bias-T’s were included in the calibration of the test system. All other losses associated with the test fixture are included in the measurements.



**CMPA0060002F1 mounted in the test fixture**

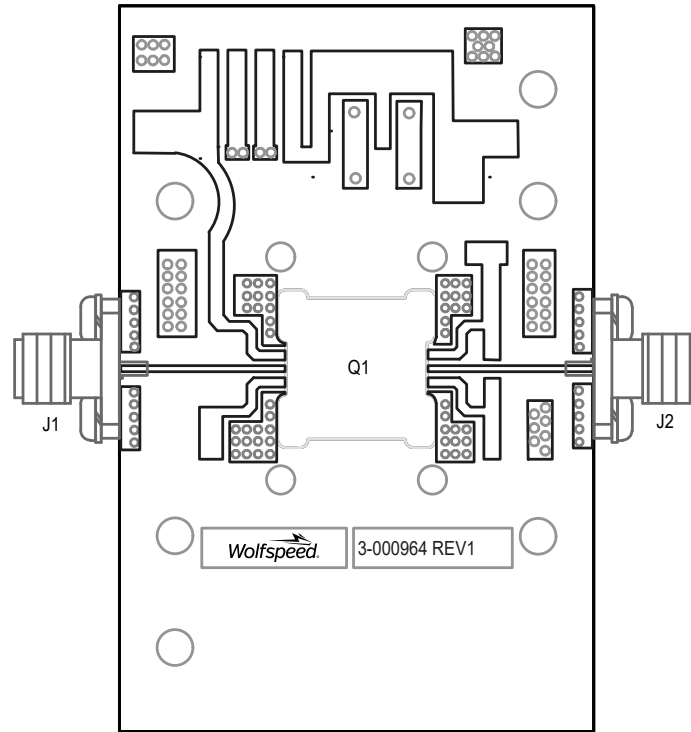
**Figure 5.** Typical test system setup required for measuring CMPA0060002F1-AMP

### Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	2	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	C3	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C



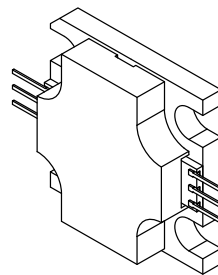
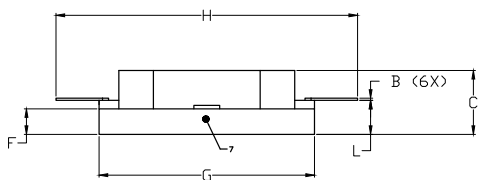
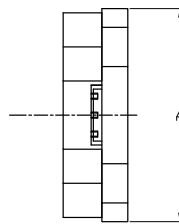
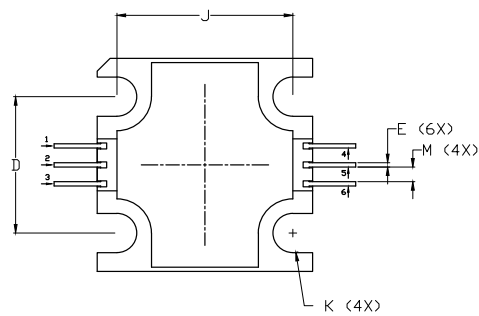
### CMPA0060002F1-AMP Demonstration Amplifier Circuit Outline



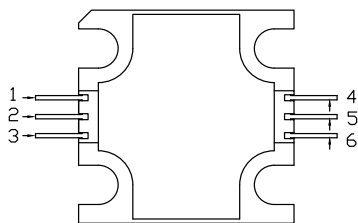
**CMPA0060002F1-AMP Demonstration Amplifier Circuit Bill of Materials**

Designator	Description	Qty
J1, J2	CONNECTOR, SMA, AMP1052901-1	2
-	PCB, TACONIC, RF-35-0100-CH/CH	1
Q1	CMPA0060002F1	1

**Product Dimensions CPM0060002F1 (Package Type – 440219)**



NOT TO SCALE



PIN	Function
1	NC
2	Gate
3	NC
4	NC
5	Drain
6	NC
7	Source

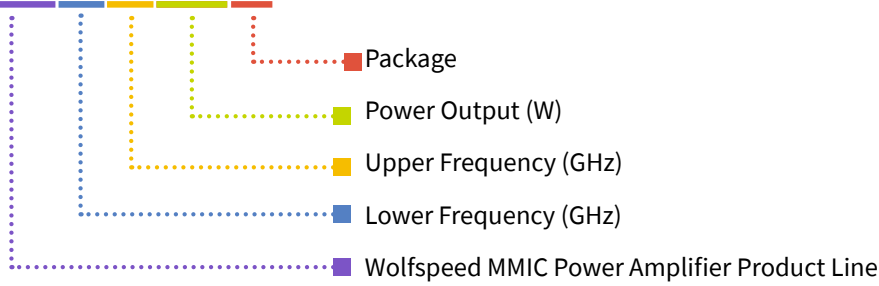
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.495	0.505	12.57	12.82
B	0.003	0.005	0.076	0.127
C	0.140	0.160	3.56	4.06
D	0.315	0.325	8.00	8.25
E	0.008	0.012	0.204	0.304
F	0.055	0.065	1.40	1.65
G	0.495	0.505	12.57	12.82
H	0.695	0.705	17.65	17.91
J	0.403	0.413	10.24	10.49
K	∅ .092		2.34	
L	0.075	0.085	1.905	2.159
M	0.032	0.040	0.82	1.02

## Part Number System

### CMPA0060002F1



**Table 1.**

Parameter	Value	Units
Lower Frequency	20	MHz
Upper Frequency <sup>1</sup>	6.0	GHz
Power Output	2	W
Package	Flange	—

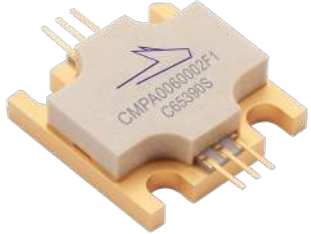

Note:  
<sup>1</sup> Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

**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



**Product Ordering Information**

Order Number	Description	Unit of Measure	Image
CMPA0060002F1	GaN MMIC	Each	
CMPA0060002F1-AMP	Test board with GaN MMIC installed	Each	

**For more information, please contact:**

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