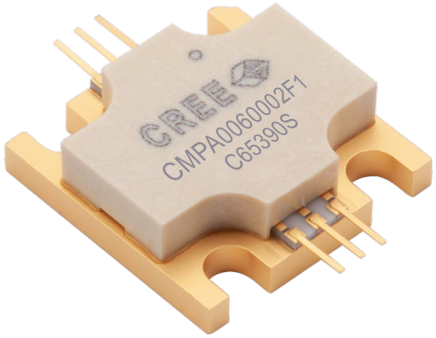
CMPA0060002F1

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



PN: CMPA0060002F1
Package Type: 440219

Description

Cree'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.

Typical Performance Over 20 MHz - 6.0 GHz (T_c = 25˚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[1]: 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[2]: V_{DD} = 28 V, I_{DQ} = 100 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

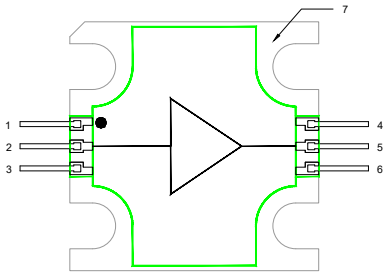


Figure 1

RoHS COMPLIANT

Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Symbol	Rating	Units
Drain-source Voltage	V_{DSS}	84	VDC
Gate-source Voltage	V_{GS}	-10, +2	VDC
Storage Temperature	T_{STG}	-65, +150	˚C
Operating Junction Temperature	T_J	225	˚C
Maximum Forward Gate Current	I_{GMAX}	4	mA
Soldering Temperature[1]	T_S	245	˚C
Screw Torque	τ	40	in-oz
Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.3	˚C/W
Case Operating Temperature[2,3]	T_C	-40, +150	˚C

Note:
[1] Refer to the Application Note on soldering at wolfspeed.com/rf/document-library
[2] Measured for the CMPA0060002F1 at P_{DISS} = 2 W

Electrical Characteristics (TC = 25˚C)

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

Note:
[1] 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 V, I_{DQ} = 100 mA

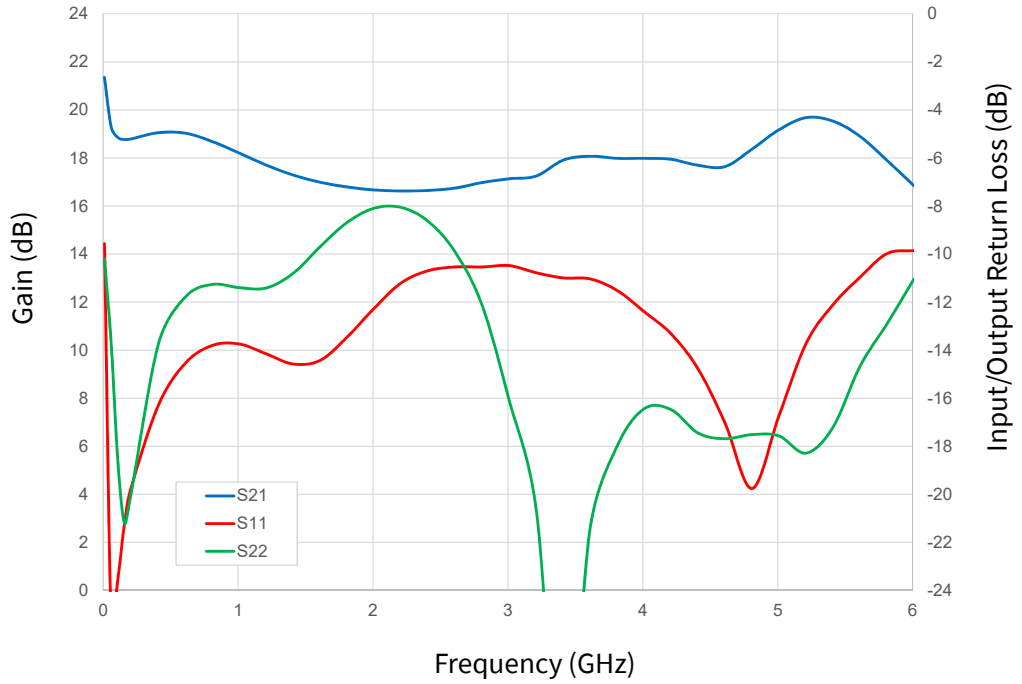
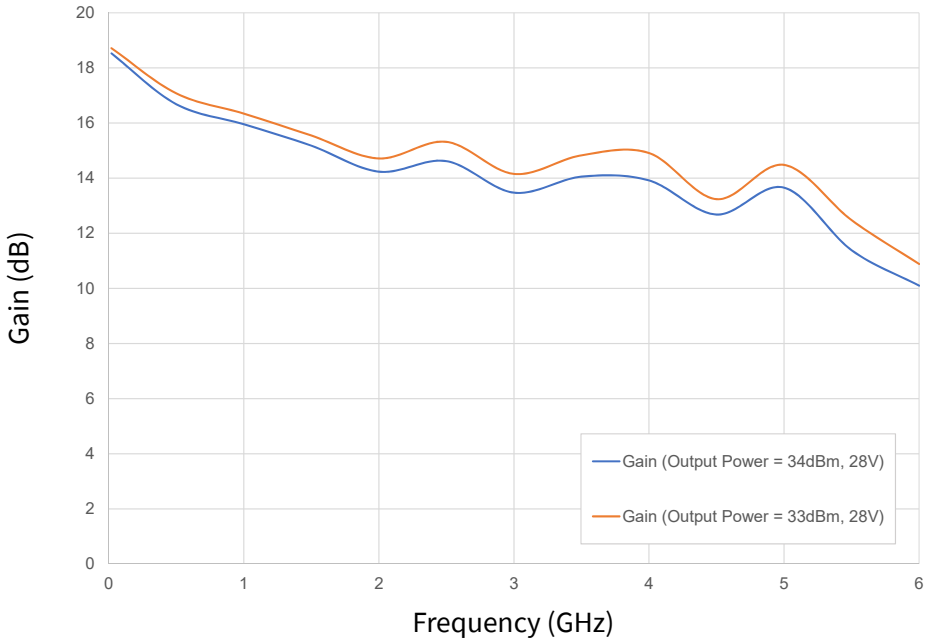
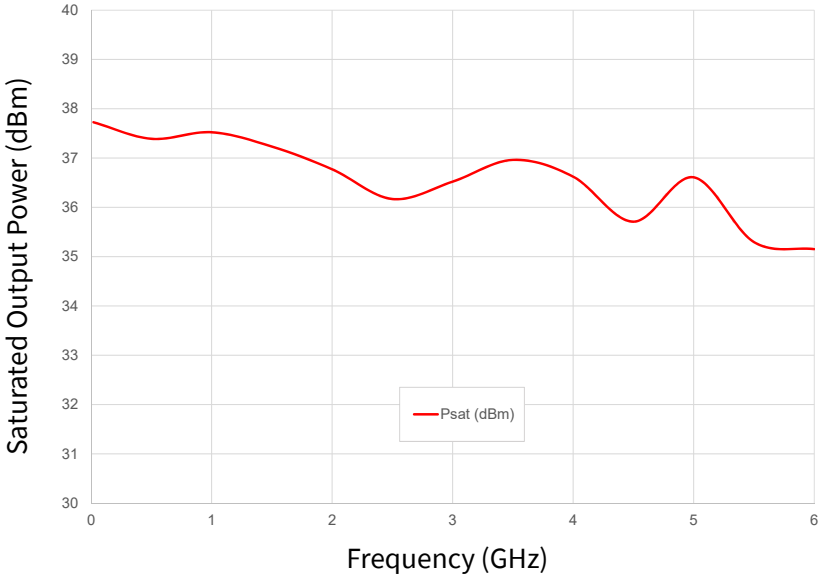


Figure 2. Power Gain vs Frequency
V_{DD} = 28 V, I_{DQ} = 100 mA



Typical Performance

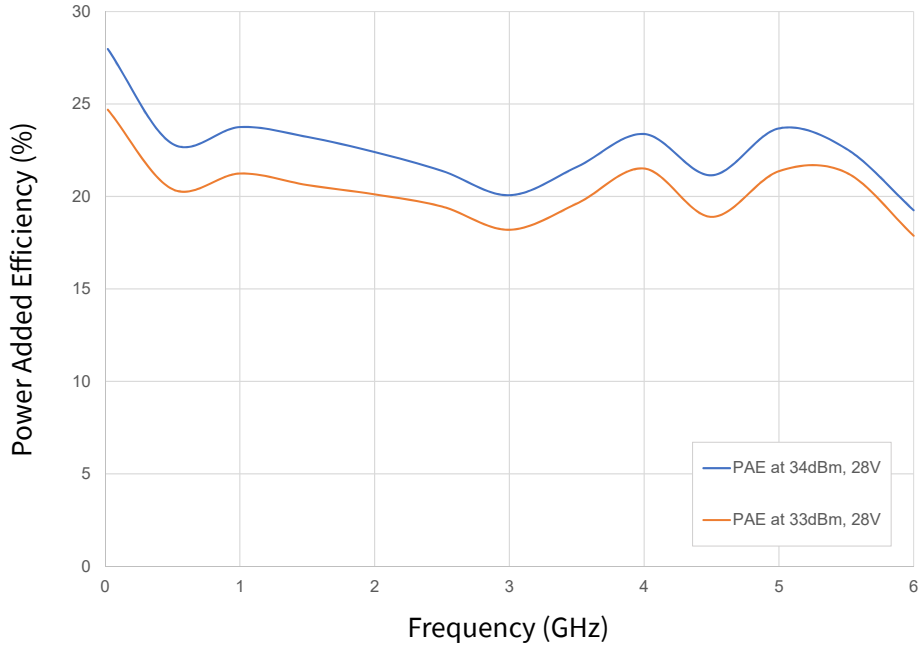
Figure 3. Saturated Output Power Performance (P_{SAT}) vs Frequency
V_{DD} = 28 V, I_{DQ} = 100 mA



Frequency (GHz)	P_{SAT} at 28V (dBm)	P_{SAT} 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

Note: 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

Figure 4. PAE at 33 & 34 dBm Output Power vs Frequency
V_{DD} = 28 V, I_{DQ} = 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.

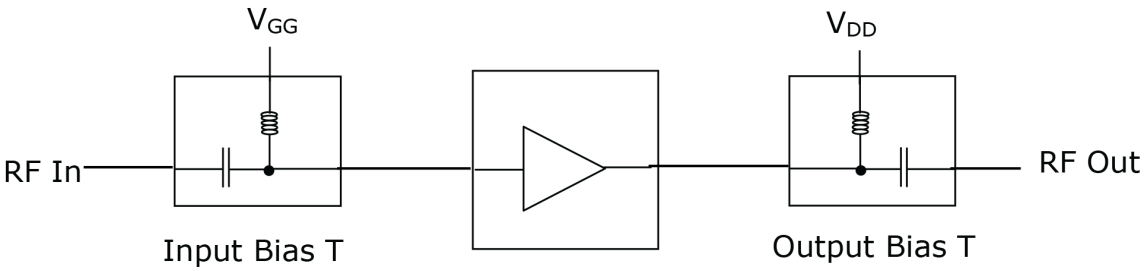
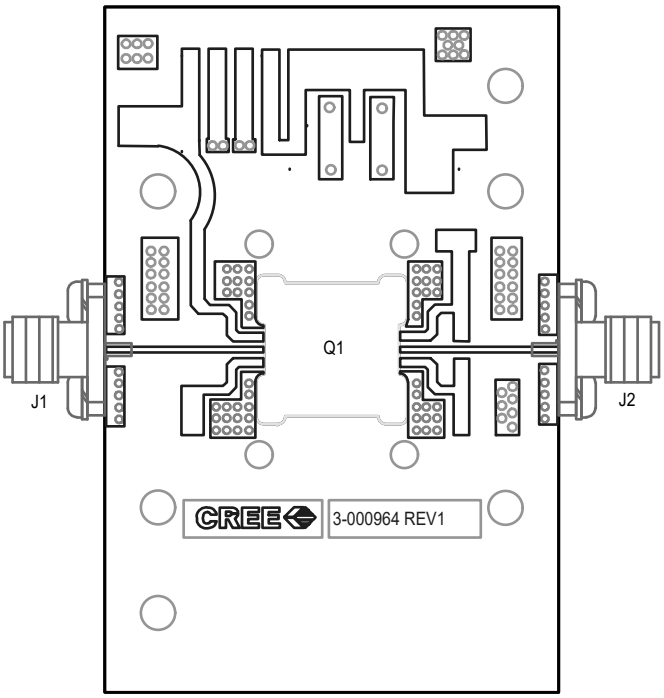


Figure 5. Typical test system setup required for measuring CMPA0060002F1-AMP

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (200 < 500V)	JEDEC JESD22 C101-C

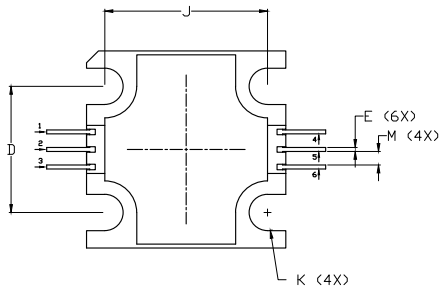
CMPA0060002F1-AMP Demonstration Amplifier Circuit Outline

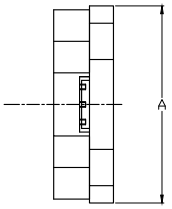


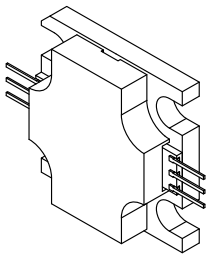
CMPA0060002F1-AMP Demonstration Amplifier Circuit Bill of Materials

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

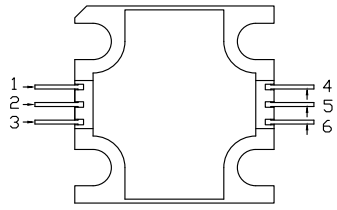
Product Dimensions CMPA0060002F1 (Package Type — 440219)







NOT TO SCALE



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

NOTES:

1. DIMENSIONING AND TOLERANICING 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

	INCHES		MILLIMETERS	
DIM	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	ø .092		2.34	
L	0.075	0.085	1.905	2.159
M	0.032	0.040	0.82	1.02

Part Number System

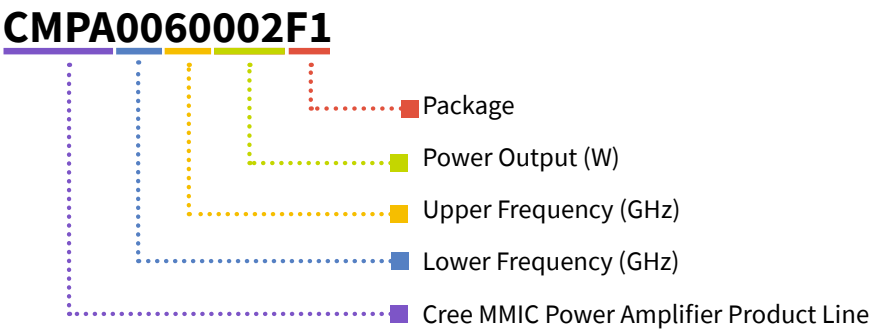


Table 1.

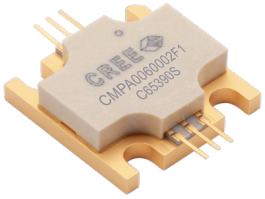
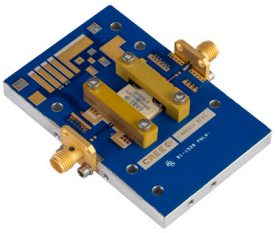
Parameter	Value	Units
Lower Frequency	20	MHz
Upper Frequency[1]	6.0	GHz
Power Output	2	W
Package	Flange	-

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

Product Ordering Information

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

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Notes

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