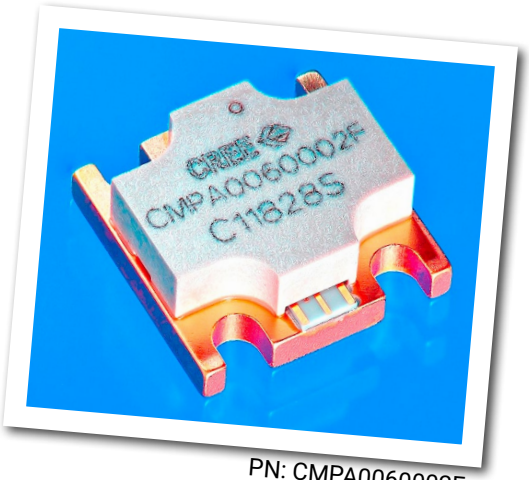
CMPA0060002F

2 W, 20 MHz - 6000 MHz, GaN MMIC Power Amplifier

Cree's CMPA0060002F 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: CMPA0060002F
Package Type: 780019

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
Gain	19.9	18.8	17.8	16.8	16.8	17.5	18.5	16.5	dB
Saturated Output Power, P_{SAT}[1]	4.3	4.1	4.5	4.2	3.7	3.9	4.8	3.7	W
Power Gain @ P_{SAT}[1]	14.7	13.1	12.6	12.2	12.6	10.9	12.2	9.5	dB
PAE @ P_{SAT}[1]	34	28	29	28	24	26	33	20	%

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

- 17 dB Small Signal Gain
- 3 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

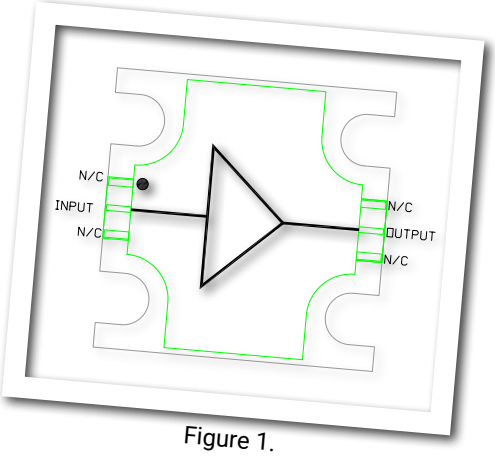


Figure 1.

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 www.cree.com/RF/Document-Library
[2] Measured for the CMPA0060002F at P_{DISS} = 2 W.

Electrical Characteristics (Frequency = 20 MHz to 6.0 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage[1]	$V_{(GS)TH}$	-3.8	-3.0	-2.7	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	13.5	17	21.5	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Input Return Loss	S11	–	-9	-5	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Output Return Loss	S22	–	-9	-5	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Power Output	P_{OUT}	2	3	–	W	V_{DD} = 28 V, I_{DQ} = 100 mA, Frequency = 4.0 GHz, P_{IN} = 23 dBm
Power Added Efficiency	PAE	–	23	–	%	V_{DD} = 28 V, I_{DQ} = 100 mA, Frequency = 4.0 GHz, P_{IN} = 23 dBm
Power Gain	G_P	10	–	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA, Frequency = 4.0 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

Notes:
[1] The device will draw approximately 20-25 mA at pinch off due to the internal circuit structure.

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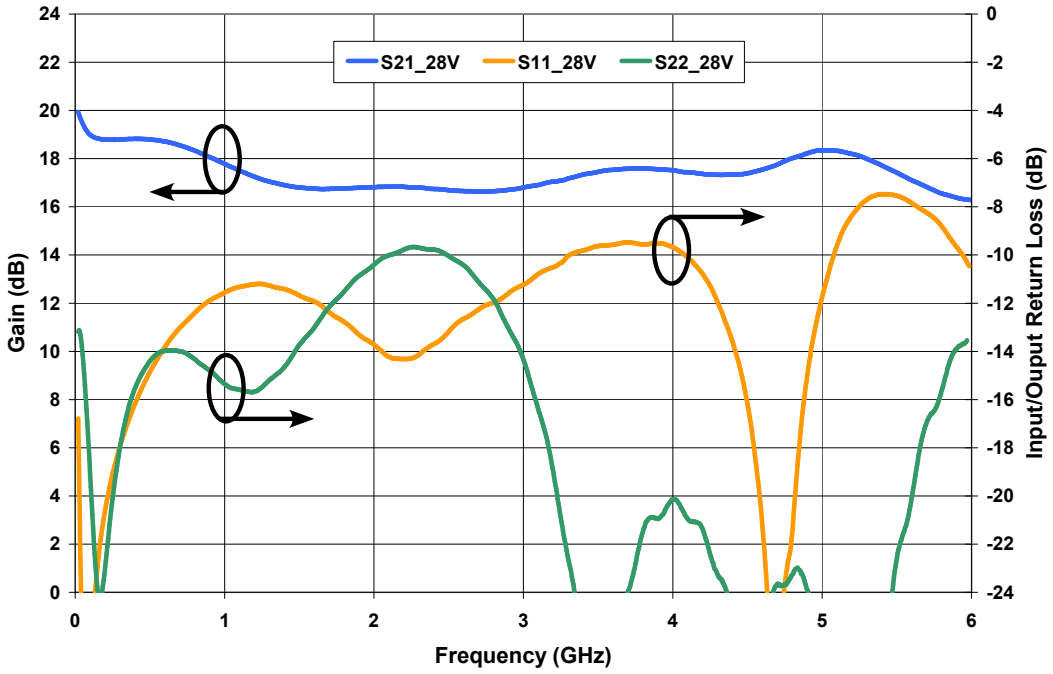
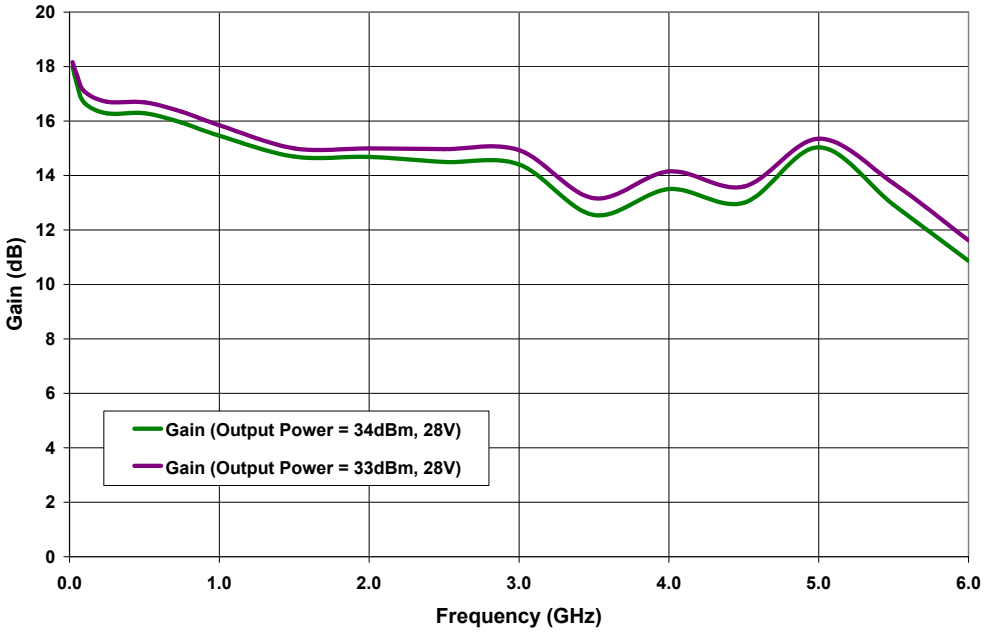
Typical Performance

Small Signal Gain and Return Losses vs Frequency at 28 V



Power Gain vs Frequency at 28V



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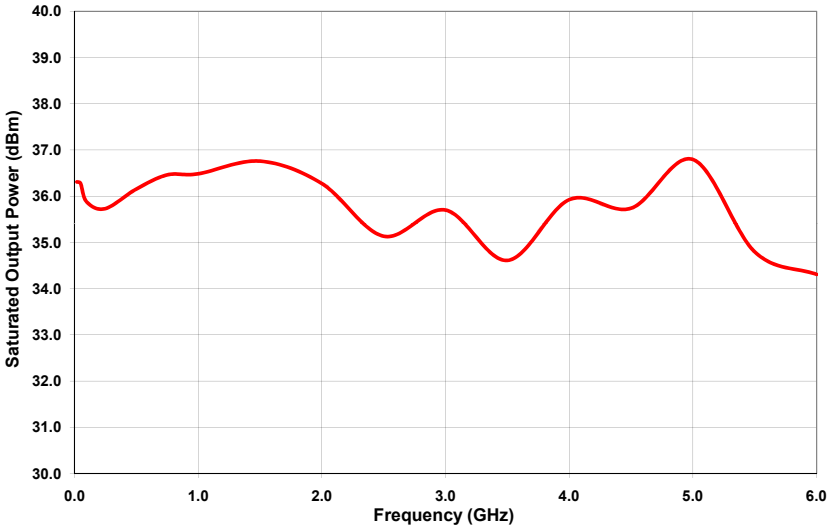
Typical Performance

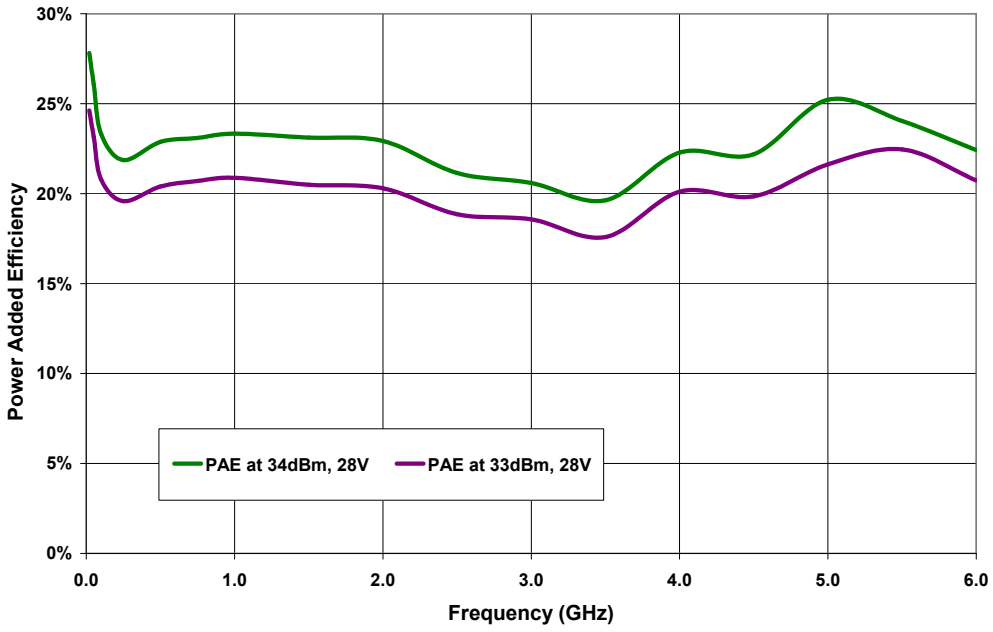
Saturated Output Power Performance (P_{SAT}) vs Frequency



Frequency (GHz)	P_{SAT} at 28V (dBm)	P_{SAT} at 28V (W)
0.02	36.6	4.3
0.5	36.2	4.1
1.0	36.5	4.5
1.5	36.8	4.7
2.0	36.3	4.2
2.5	35.1	3.3
3.0	35.7	3.7
3.5	34.6	2.9
4.0	35.9	3.9
4.5	35.7	3.8
5.0	36.8	4.8
5.5	34.8	3.0
6.0	34.3	2.7

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.

PAE at 33 & 34 dBm Output Power vs Frequency at 28 V



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General Device Information

The CMPA0060002F is a GaN HEMT MMIC Distributed Driver Amplifier, which operates between 20 MHz - 6.0 GHz. The amplifier typically provides 17 dB of small signal gain and 2 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 CMPA0060002F 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 CMPA0060002F-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 2. 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.

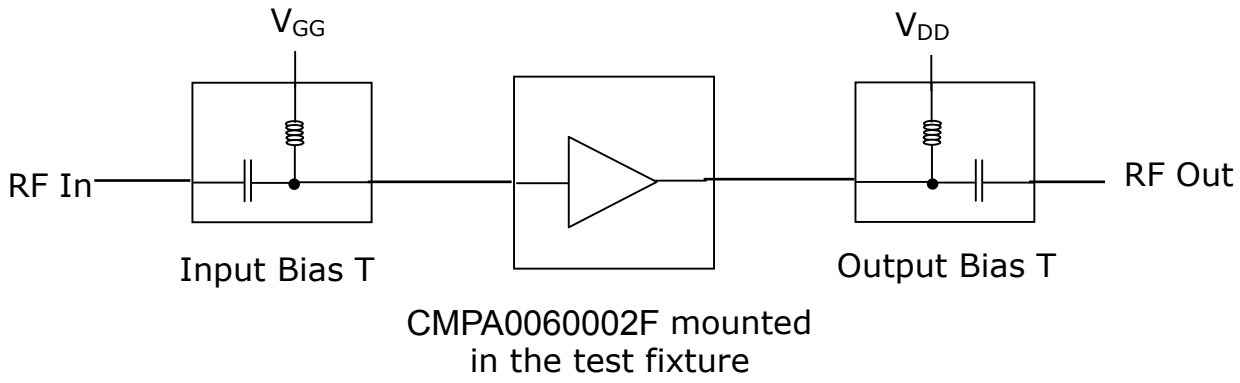

Figure 2. Typical test system setup required for measuring CMPA0060002F-AMP

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 < 500 V)	JEDEC JESD22 C101-C

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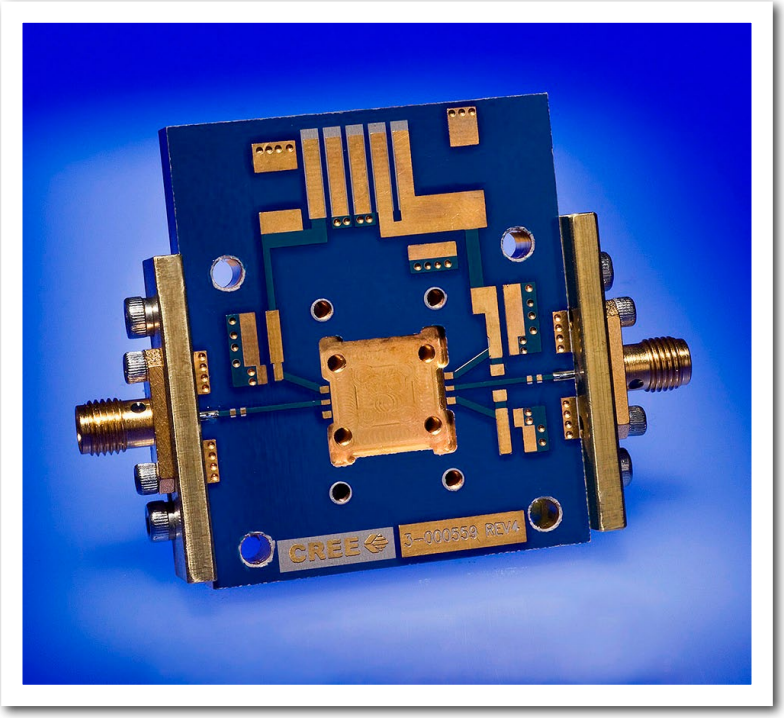
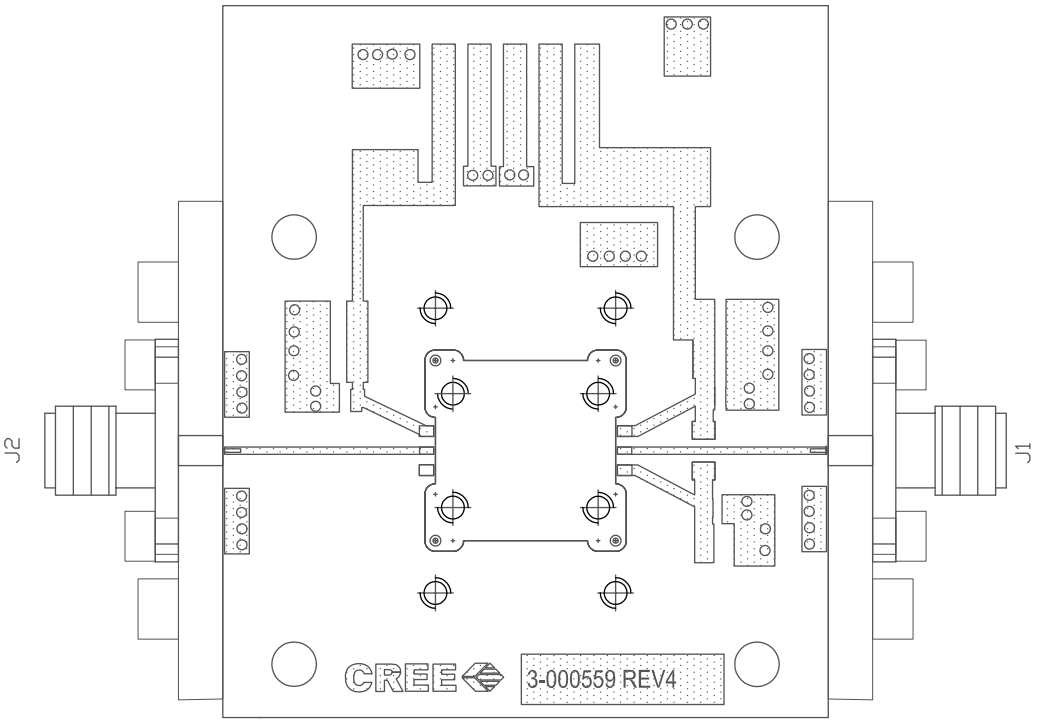
CMPA0060002F-TB Demonstration Amplifier Circuit



CMPA0060002F-TB Demonstration Amplifier Circuit Outline



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CMPA0060002F-AMP Demonstration Amplifier Circuit Bill of Materials

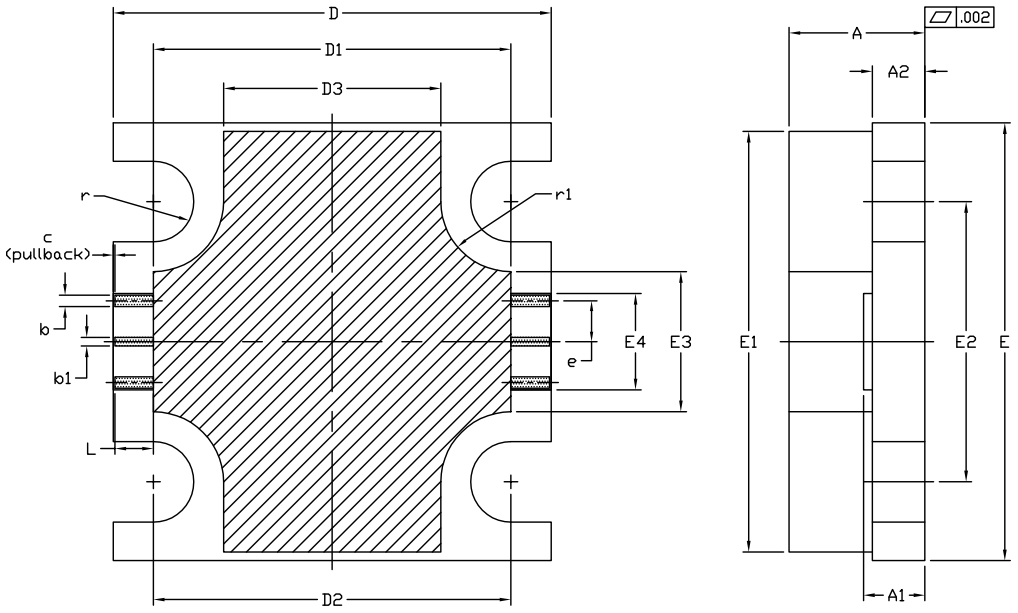
Designator	Description	Qty
J1,J2	CONNECTOR, SMA, AMP1052901-1	2
-	PCB, TACONIC, RF-35-0100-CH/CH	1
Q1	CMPA0060002F	1

Notes

[1] The CMPA0060002F is connected to the PCB with 2.0 mil Au bond wires.

[2] An external bias T is required.

Product Dimensions CMPA0060002F (Package Type — 780019)



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

DIM	INCHES		MILLIMETERS		NOTE
	MIN	MAX	MIN	MAX	
A	0.148	0.162	3.76	4.12	–
A1	0.066	0.076	1.67	1.93	–
A2	0.056	0.064	1.42	1.63	–
b	0.013		0.33		x4
b1	0.010		0.25		x2
c	0.002		0.05		x2
D	0.495	0.505	12.57	12.83	–
D1	0.403	0.413	10.23	10.49	–
D2	0.408		10.36		–
D3	0.243	0.253	6.17	6.43	–
E	0.495	0.505	12.57	12.83	–
E1	0.475	0.485	12.06	12.32	–
E2	0.320		8.13		–
E3	0.155	0.165	3.93	4.19	–
E4	0.105	0.115	2.66	2.92	–
e	0.046		1.17		x4
L	0.044		1.12		x6
r	R0.046		R1.17		x4
r1	R0.080		R2.03		x4

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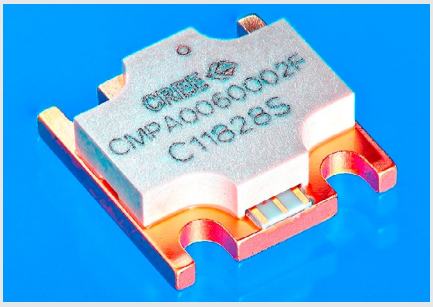
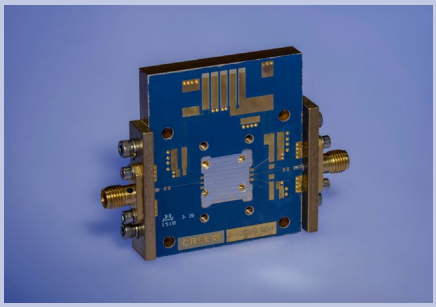
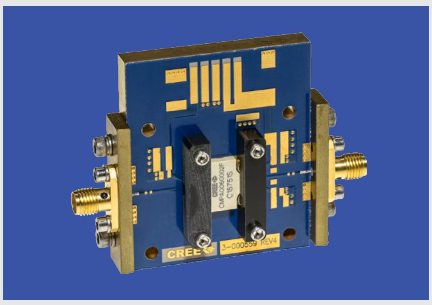
Product Ordering Information

Order Number	Description	Unit of Measure	Image
CMPA0060002F	GaN MMIC	Each	
CMPA0060002F-TB	Test board without GaN MMIC	Each	
CMPA0060002F-AMP	Test board with GaN MMIC installed	Each	

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