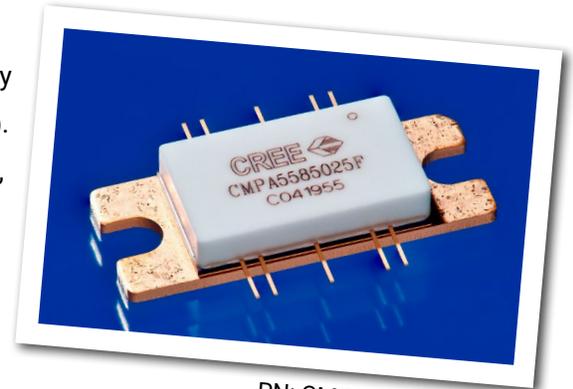


# CMPA5585025F

## 25 W, 5.5 - 8.5 GHz, GaN MMIC, Power Amplifier

Cree's CMPA5585025F 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 is available in a 10 lead metal/ceramic flanged package for optimal electrical and thermal performance.



PN: CMPA5585025F  
Package Type: 440208

### Typical Performance Over 5.8-8.4 GHz ( $T_c = 25^\circ\text{C}$ )

Parameter	5.8 GHz	6.4 GHz	7.2 GHz	7.9 GHz	8.4 GHz	Units
Small Signal Gain	29.5	24.0	24.0	24.0	22.0	dB
Output Power <sup>1</sup>	15	23	20	19	19	W
Power Gain <sup>1</sup>	21.7	19.5	17.2	18.5	18.6	dB
Power Added Efficiency <sup>1</sup>	30	25	20.5	19	19.5	%

Note<sup>1</sup>: Measured at -30 dBc, 1.6 MHz from carrier, in the CMPA5585025F-AMP under OQPSK modulation, 1.6 Msps, PN23, Alpha Filter = 0.2.

### Features

- 25 dB Small Signal Gain
- 35 W Typical  $P_{SAT}$
- Operation up to 28 V
- High Breakdown Voltage
- High Temperature Operation
- Size 1.00 x 0.385 inches

### Applications

- Point to Point Radio
- Communications
- Satellite Communication Uplink

## Absolute Maximum Ratings (not simultaneous)

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	$V_{DSS}$	84	$V_{DC}$	25°C
Gate-source Voltage	$V_{GS}$	-10, +2	$V_{DC}$	25°C
Power Dissipation	$P_{DISS}$	55	W	
Storage Temperature	$T_{STG}$	-65, +150	°C	
Operating Junction Temperature	$T_J$	225	°C	
Maximum Forward Gate Current	$I_{GMAX}$	10	mA	25°C
Soldering Temperature <sup>1</sup>	$T_S$	245	°C	
Screw Torque	$\tau$	40	in-oz	
Thermal Resistance, Junction to Case	$R_{JUC}$	1.55	°C/W	OQPSK, 85°C, $P_{DISS} = 55$ W
Thermal Resistance, Junction to Case	$R_{JUC}$	1.80	°C/W	CW, 85°C, $P_{DISS} = 77$ W
Case Operating Temperature	$T_C$	-40, +140	°C	$P_{DISS} = 55$ W
Case Operating Temperature	$T_C$	-40, +85	°C	$P_{DISS} = 77$ W

Note:

<sup>1</sup> Refer to the Application Note on soldering at [www.cree.com/RF/Document-Library](http://www.cree.com/RF/Document-Library)

## Electrical Characteristics (Frequency = 5.5 GHz to 8.5 GHz unless otherwise stated; $T_C = 25^\circ\text{C}$ )

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>DC Characteristics<sup>1</sup></b>						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.8	-3.0	-2.3	V	$V_{DS} = 10$ V, $I_D = 13.2$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	$V_{DC}$	$V_{DS} = 28$ V, $I_D = 285$ mA
Saturated Drain Current <sup>2</sup>	$I_{DS}$	10.6	12.8	-	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	$V_{BD}$	84	100	-	V	$V_{GS} = -8$ V, $I_D = 13.2$ mA
<b>RF Characteristics<sup>3</sup></b>						
Small Signal Gain	S21	18.25	24	-	dB	$V_{DD} = 28$ V, $I_{DQ} = 285$ mA, $P_{IN} = -20$ dBm
Input Return Loss	S11	-	10	-	dB	$V_{DD} = 28$ V, $I_{DQ} = 285$ mA
Output Return Loss	S22	-	6	-	dB	$V_{DD} = 28$ V, $I_{DQ} = 285$ mA
Output Mismatch Stress	VSWR	-	-	5:1	$\Psi$	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 285$ mA, $P_{OUT} = 25$ W OQPSK

Notes:

<sup>1</sup> Measured on-wafer prior to packaging.

<sup>2</sup> Scaled from PCM data.

<sup>3</sup> Measured in the CMPA5585025F-AMP

## Electrical Characteristics Continued... ( $T_c = 25^\circ\text{C}$ )

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>RF Characteristics<sup>1,2,3,4</sup></b>						
Power Added Efficiency	PAE1	24.5	30.0	–	%	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 5.8 GHz
Power Added Efficiency	PAE2	16.5	20.5	–	%	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 7.2 GHz
Power Added Efficiency	PAE3	15.5	19.0	–	%	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 7.9 GHz
Power Added Efficiency	PAE4	15.0	19.5	–	%	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 8.4 GHz
Power Gain	$G_{P1}$	19.5	21.7	–	dB	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 5.8 GHz
Power Gain	$G_{P2}$	16.25	17.2	–	dB	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 7.2 GHz
Power Gain	$G_{P3}$	16.55	18.5	–	dB	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 7.9 GHz
Power Gain	$G_{P4}$	16.75	18.6	–	dB	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 8.4 GHz
OQPSK Linearity	ACLR1	–	-36	-27.0	dB	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 5.8 GHz
OQPSK Linearity	ACLR2	–	-36	-28.5	dB	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 7.2 GHz
OQPSK Linearity	ACLR3	–	-36	-26.0	dB	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 7.9 GHz
OQPSK Linearity	ACLR4	–	-42	-32.5	dB	$V_{DD} = 28\text{ V}$ , $I_{DQ} = 285\text{ mA}$ , Frequency = 8.4 GHz

### Notes:

<sup>1</sup> Measured in the CMPA5585025F-AMP

<sup>2</sup> Under OQPSK modulated signal, 1.6 Msps, PN23, Alpha Filter = 0.2.

<sup>3</sup> Measured at  $P_{AVE} = 40\text{ dBm}$ .

<sup>4</sup> Fixture loss de-embedded.

## 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

## Typical Performance of the CMPA5585025F

Figure 1. CMPA5585025F Linear Output Power, Gain and PAE at -30 dBc, 1.6 MHz from carrier  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 285\text{ mA}$ , 1.6 Mps OQPSK Modulation

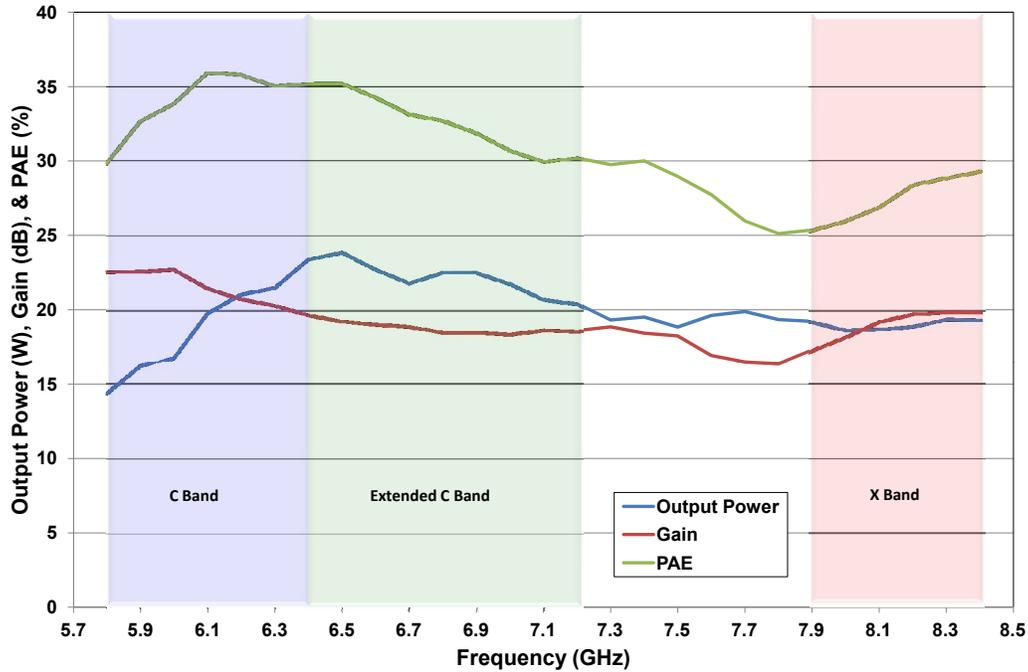
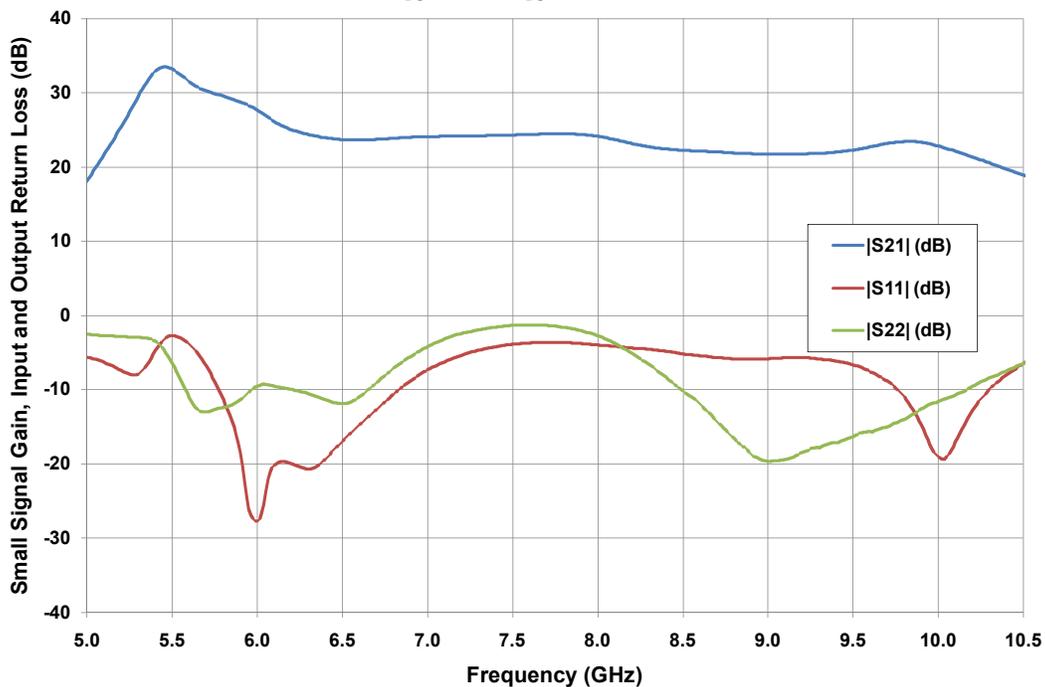


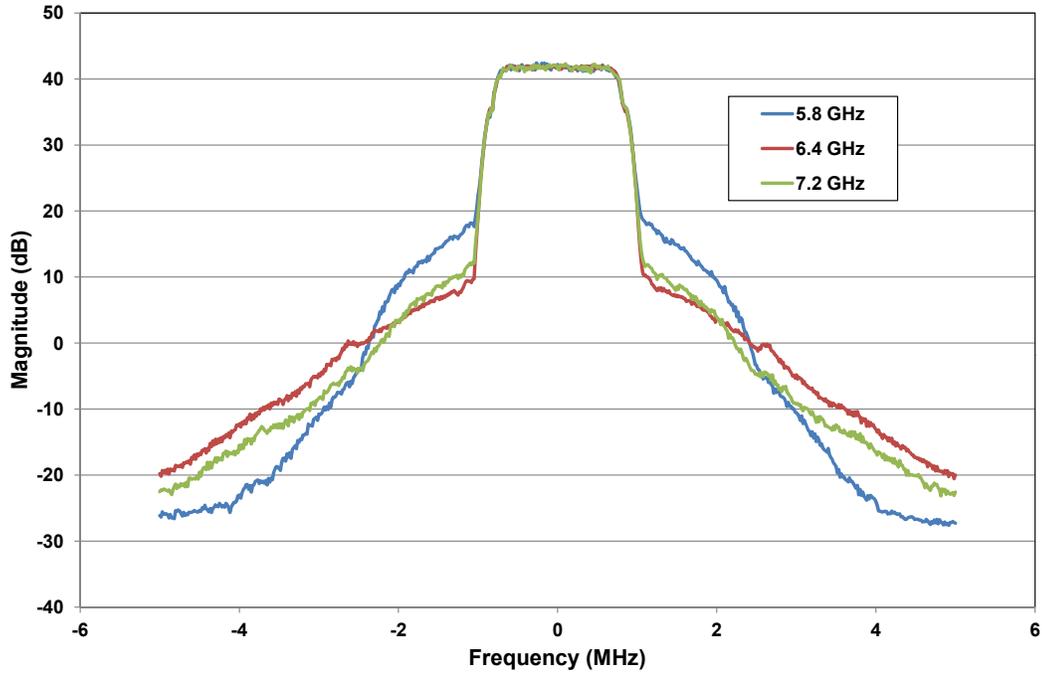
Figure 2. Typical Small Signal Gain and Return Loss vs Frequency of the CMPA5585025F measured in CMPA5585025F-AMP Amplifier Circuit.

$V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$

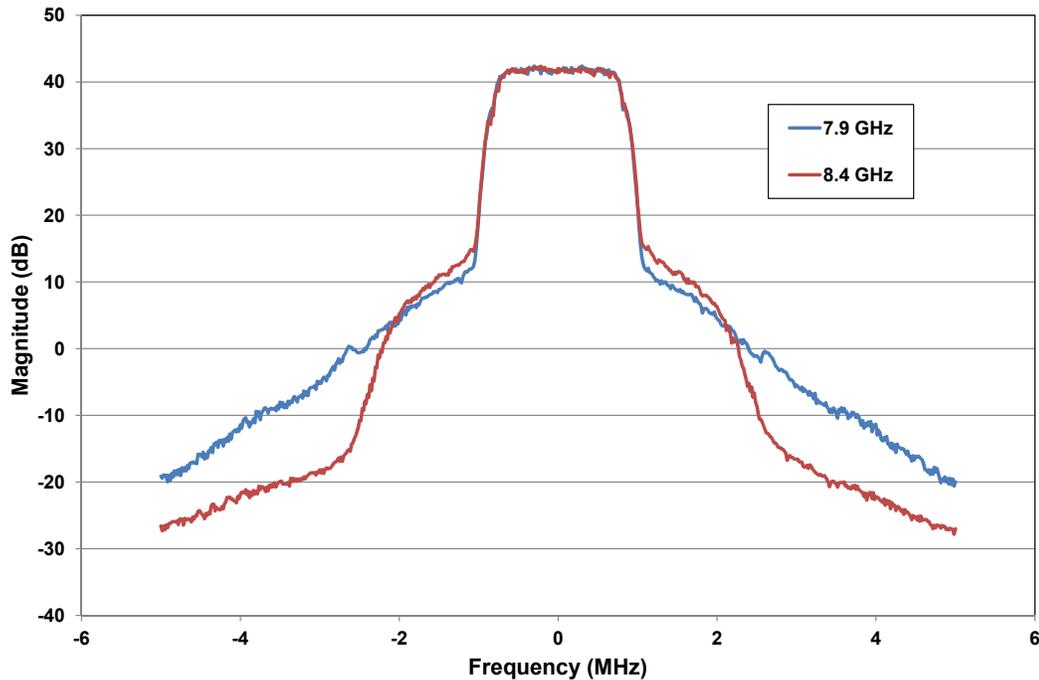


## Typical Performance of the CMPA5585025F

**Figure 3. CMPA5585025F C-band Spectral Mask at 15 W**  
 PAE = 29.1% at 5.8 GHz, 28.5% at 6.4 GHz & 25.6% at 7.2 GHz

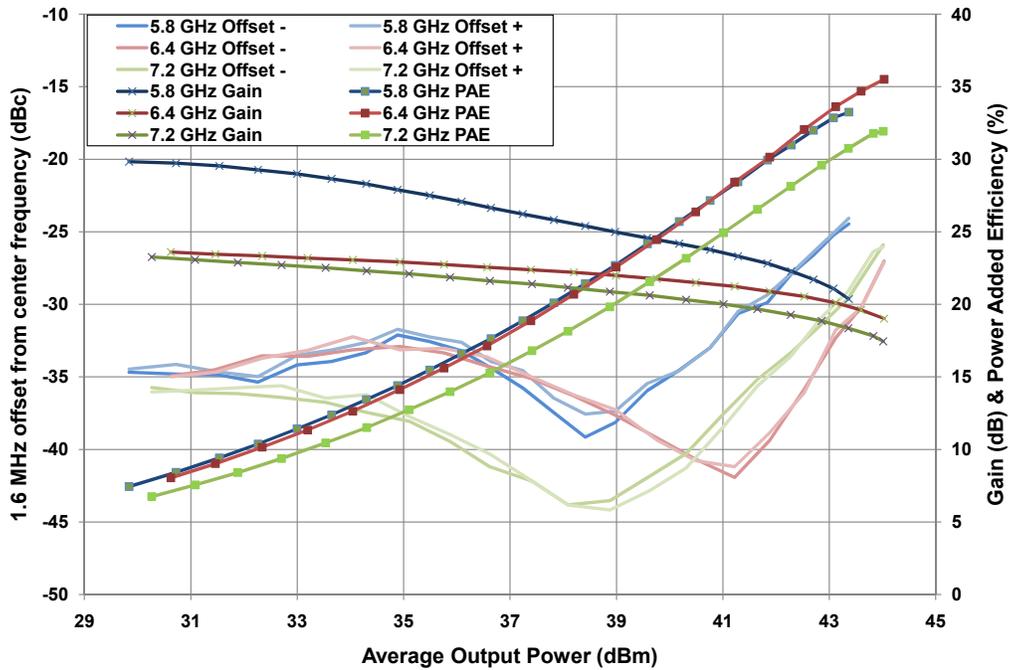


**Figure 4. CMPA5585025F X-band Spectral Mask at 15 W**  
 PAE = 25.6% at 7.9 GHz & 25.3% at 8.4 GHz

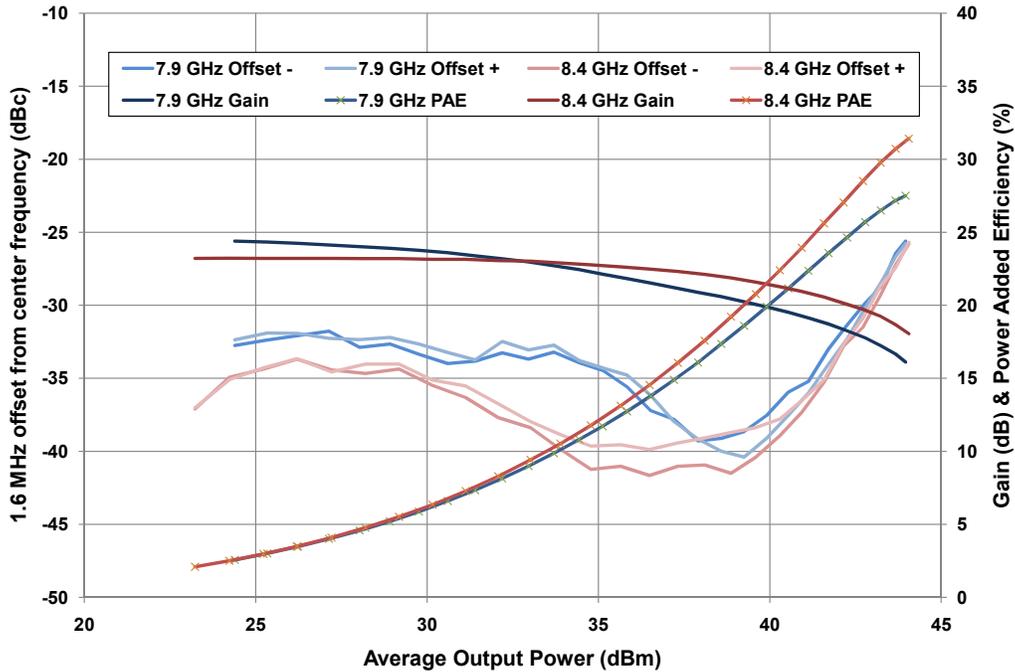


## Typical Performance of the CMPA5585025F

**Figure 5. CMPA5585025F C-band Linearity, Gain, and PAE vs Average Output Power**  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$ , OQPSK, 1.6 Msps

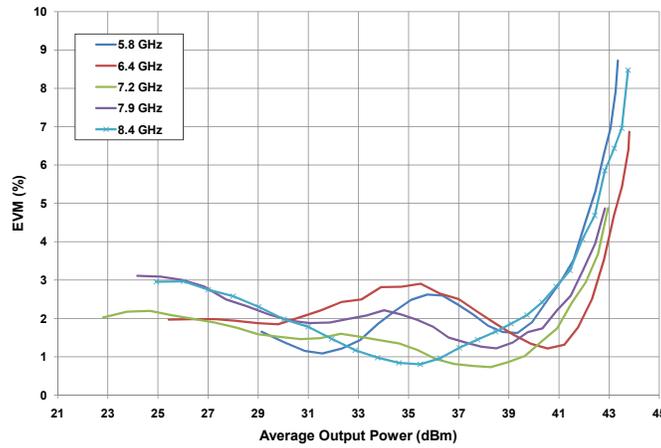


**Figure 6. CMPA5585025F X-band Linearity, Gain, and PAE vs Average Output Power**  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$ , OQPSK, 1.6 Msps

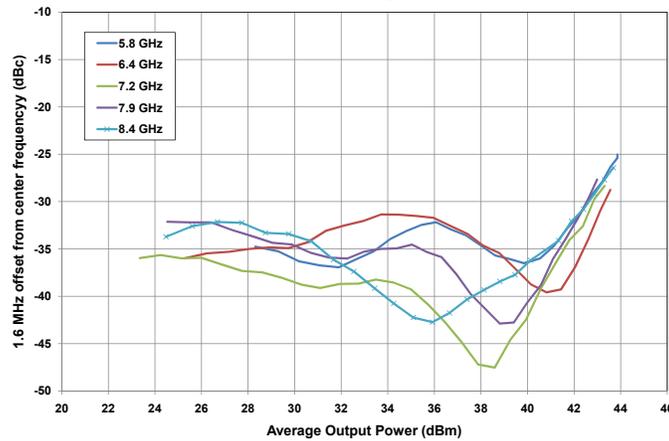


## Typical Performance of the CMPA5585025F

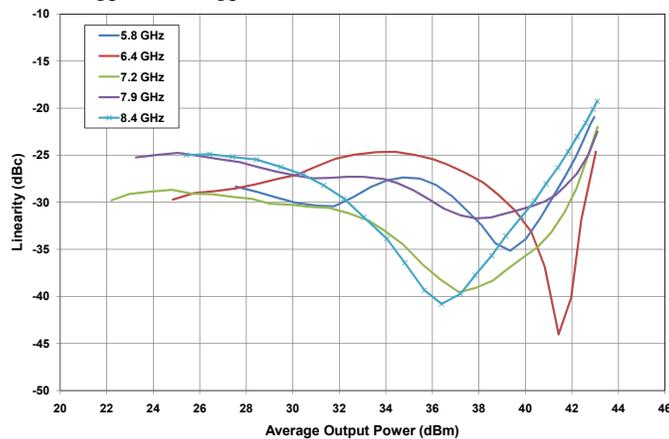
**Figure 7. CMPA5585025F EVM vs Average Output Power**  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$ , 1.6 Msps OQPSK Modulation



**Figure 8. CMPA5585025F - Linearity vs Average Output Power**  
 OQPSK, 1.6 Msps,  $I_{DS} = 285\text{ mA}$

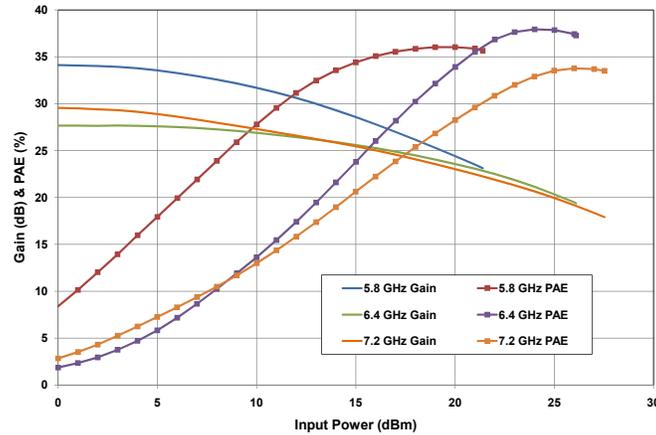


**Figure 9. CMPA5585025F Linearity vs Average Output Power**  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$ , IM3 5 MHz spacing

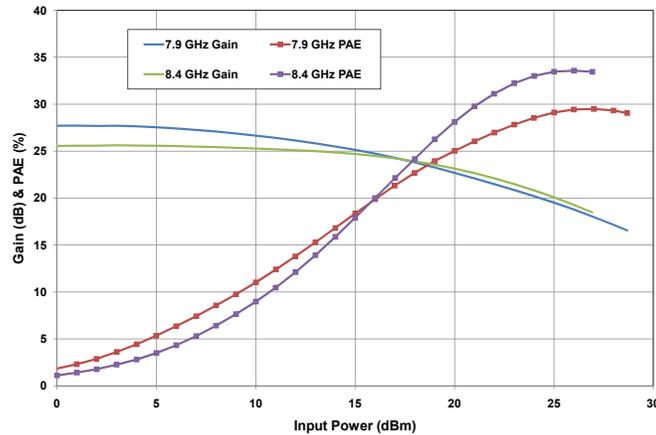


## Typical Performance of the CMPA5585025F

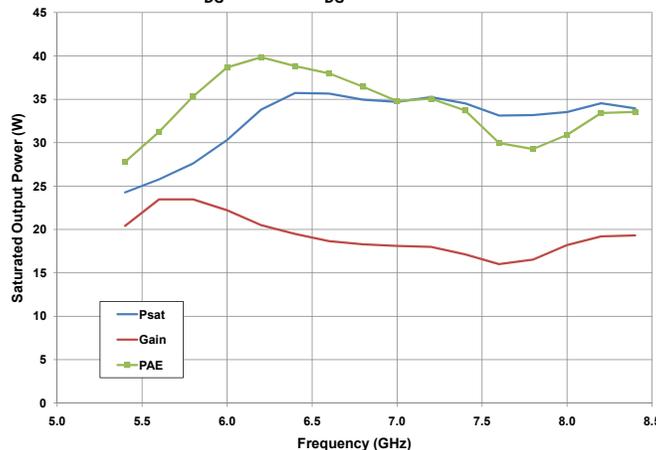
**Figure 10. CMPA5585025F - C-band Output Power, Gain and PAE vs Input Power**  
 $V_{DS} = 28\text{ V}, I_{DS} = 1.2\text{ A, CW}$



**Figure 11. CMPA5585025F - X-band Output Power, Gain and PAE vs Input Power**  
 $V_{DS} = 28\text{ V}, I_{DS} = 1.2\text{ A, CW}$

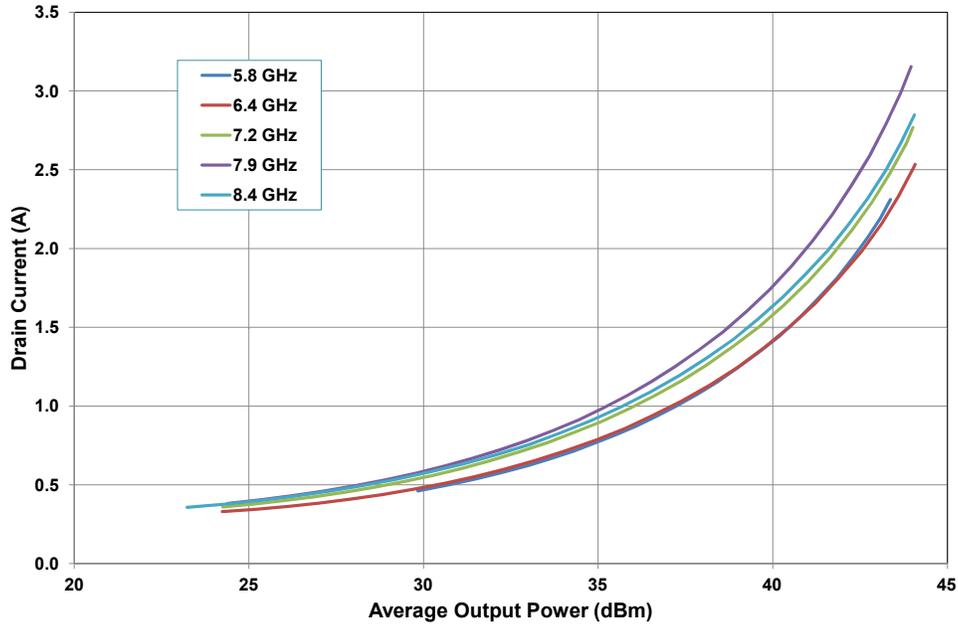


**Figure 12. CMPA5585025F - Power, Gain and PAE vs Frequency**  
 $V_{DS} = 28\text{ V}, I_{DS} = 1.2\text{ A, CW}$

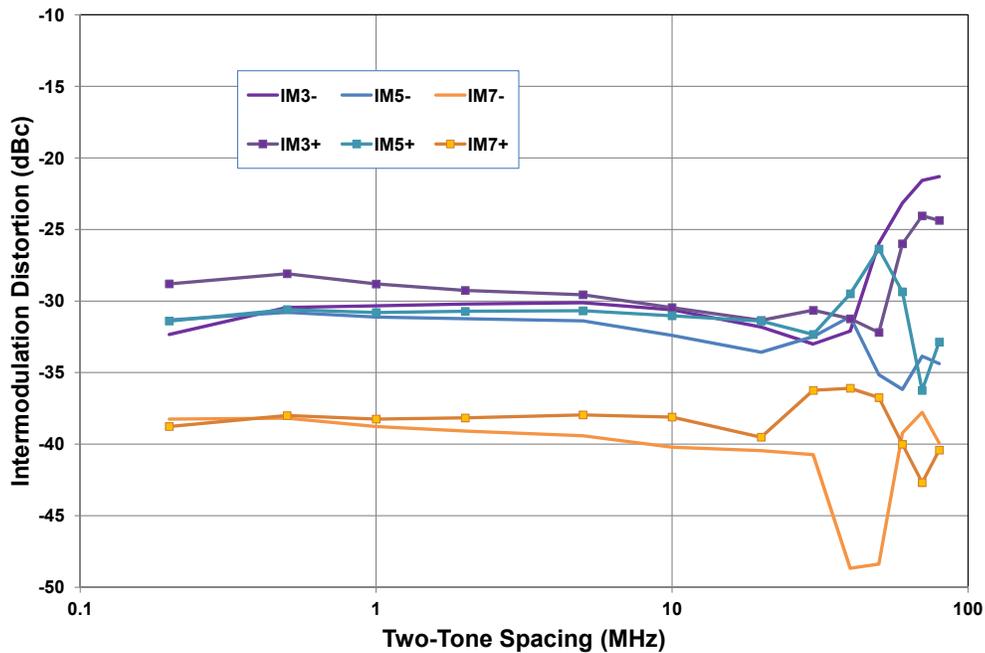


## Typical Performance of the CMPA5585025F

**Figure 13. CMPA5585025F - Typical Drain Current vs Average Output Power**  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$ , OQPSK, 1.6 Msps



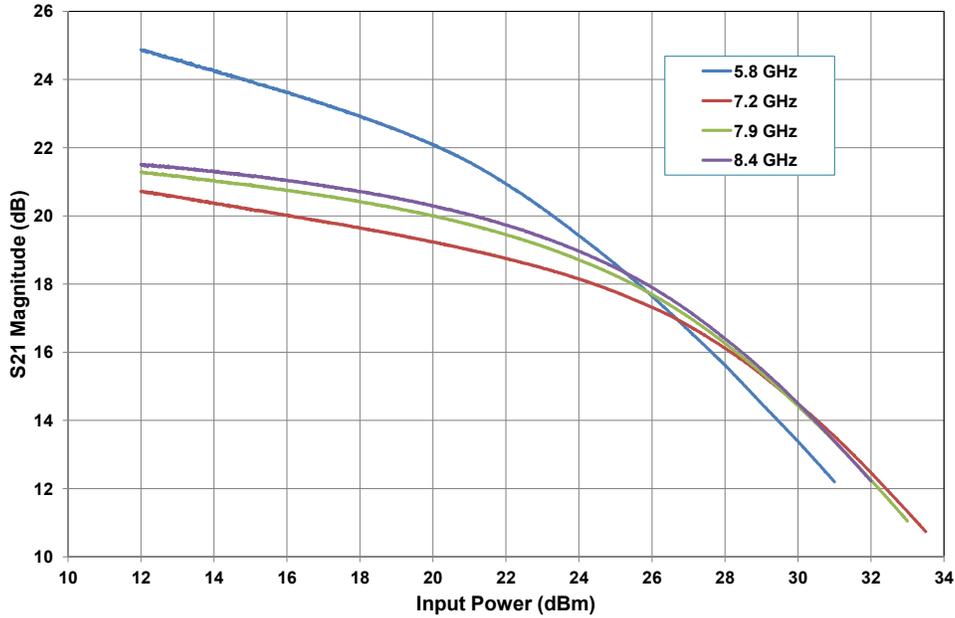
**Figure 14. CMPA5585025F - Intermodulation Distortion Products vs Tone Spacing**  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$ , Center Freq = 7.9 GHz



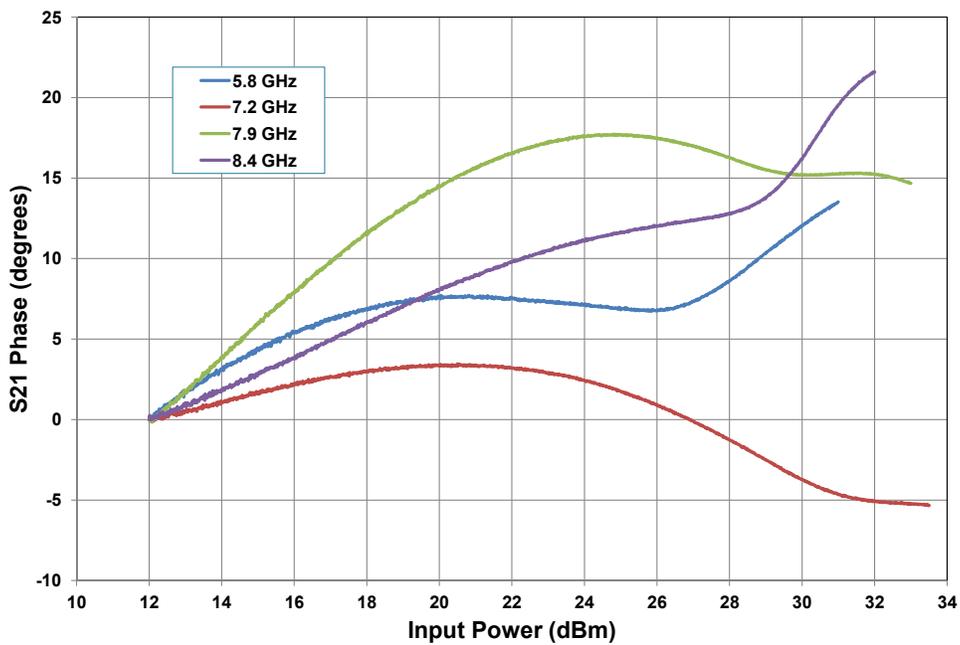
Note: Divergence in IM5 and IM7 at tone spacings greater than 20 MHz is due to the bias components on the test fixture.

## Typical Performance of the CMPA5585025F

**Figure 15. CMPA5585025F - AM-AM**  
 $V_{DS} = 28\text{ V}, I_{DS} = 285\text{ mA}$

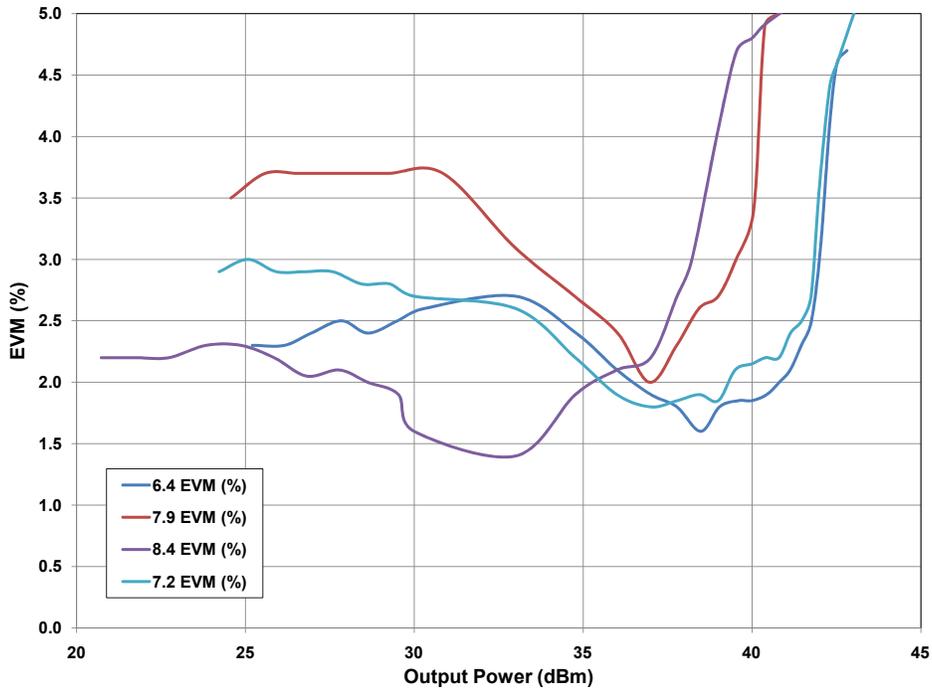


**Figure 16. CMPA5585025F -Normalized AM-PM**  
 $V_{DS} = 28\text{ V}, I_{DS} = 285\text{ mA}$

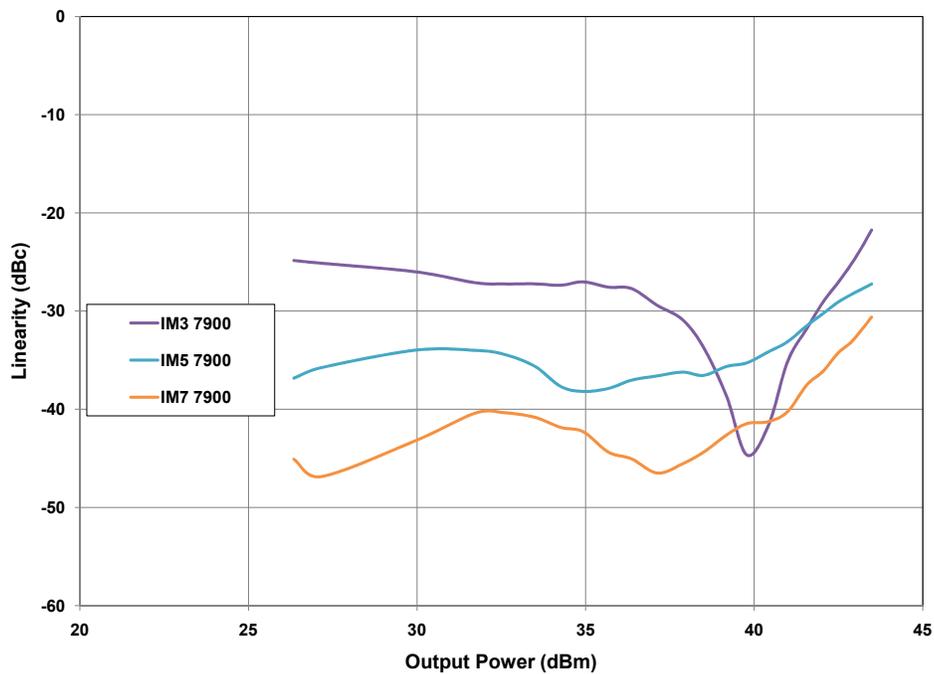


## Typical Performance of the CMPA5585025F

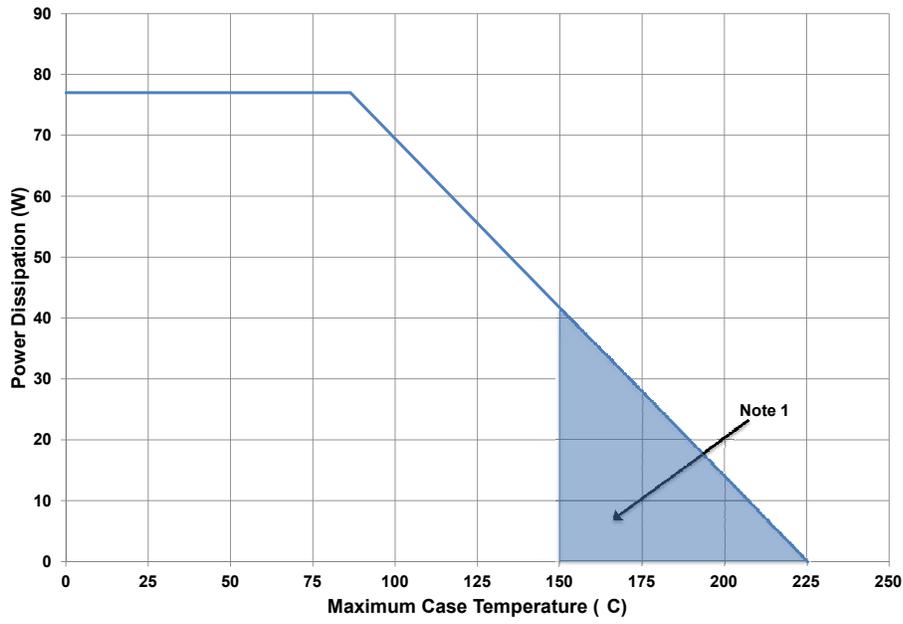
**Figure 17. CMPA5585025F EVM vs Average Output Power**  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$ , 256 QAM



**Figure 18. CMPA5585025F Linearity vs Average Output Power**  
 $V_{DS} = 28\text{ V}$ ,  $I_{DS} = 285\text{ mA}$ , IM3, IM5, IM7, 5 MHz spacing



## CMPA5585025F Power Dissipation De-rating Curve

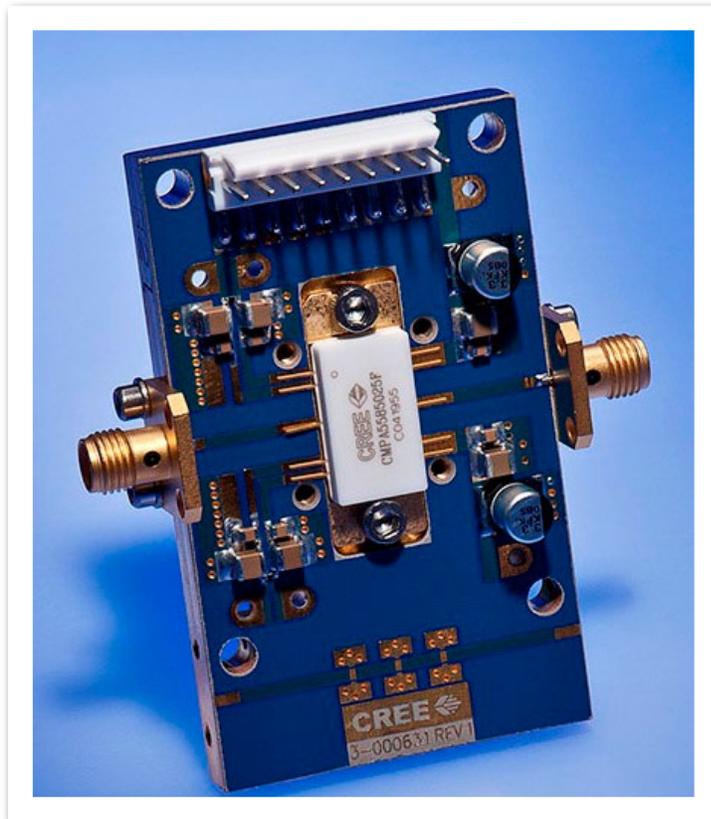


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

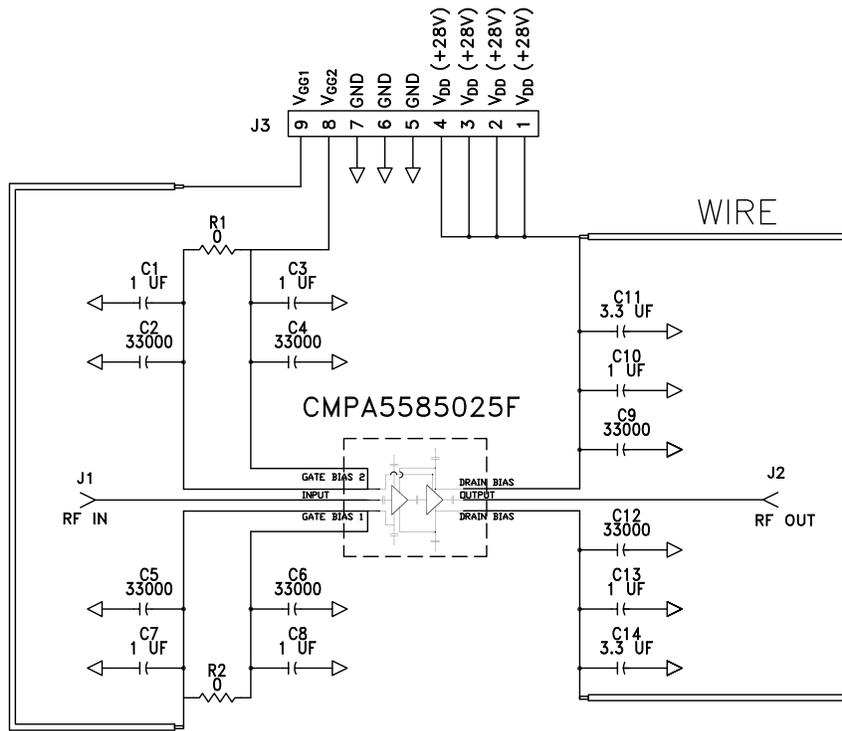
## CMPA5585025F-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1, C3, C7, C8, C10, C13	CAP, 1.0 uF, +/-10%, 1210, 100V, X7R	6
C2, C4, C5, C6, C9, C12	CAP, 33000 pF, 0805, 100V, X7R	6
C11, C14	CAP ELECT 3.3UF 80V FK SMD	2
R1, R2	RES 0.0 OHM 1/16W 0402 SMD	2
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J3	CONNECTOR, HEADER, RT>PLZ .1CEN LK 9POS	1
-	PCB, TACONIC, RF-35P-0200-CL1/CL1	1
Q1	CMPA5585025F	1

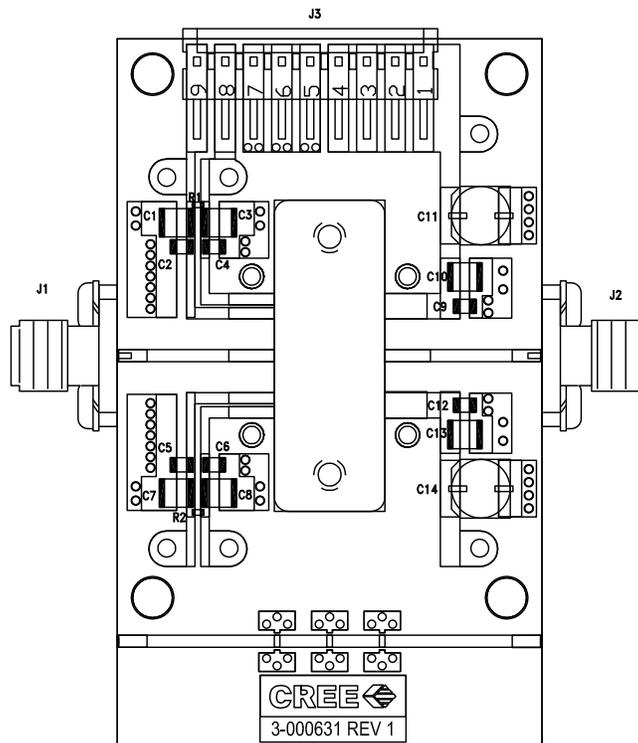
## CMPA5585025F-AMP Demonstration Amplifier Circuit



## CMPA5585025F-AMP Demonstration Amplifier Circuit

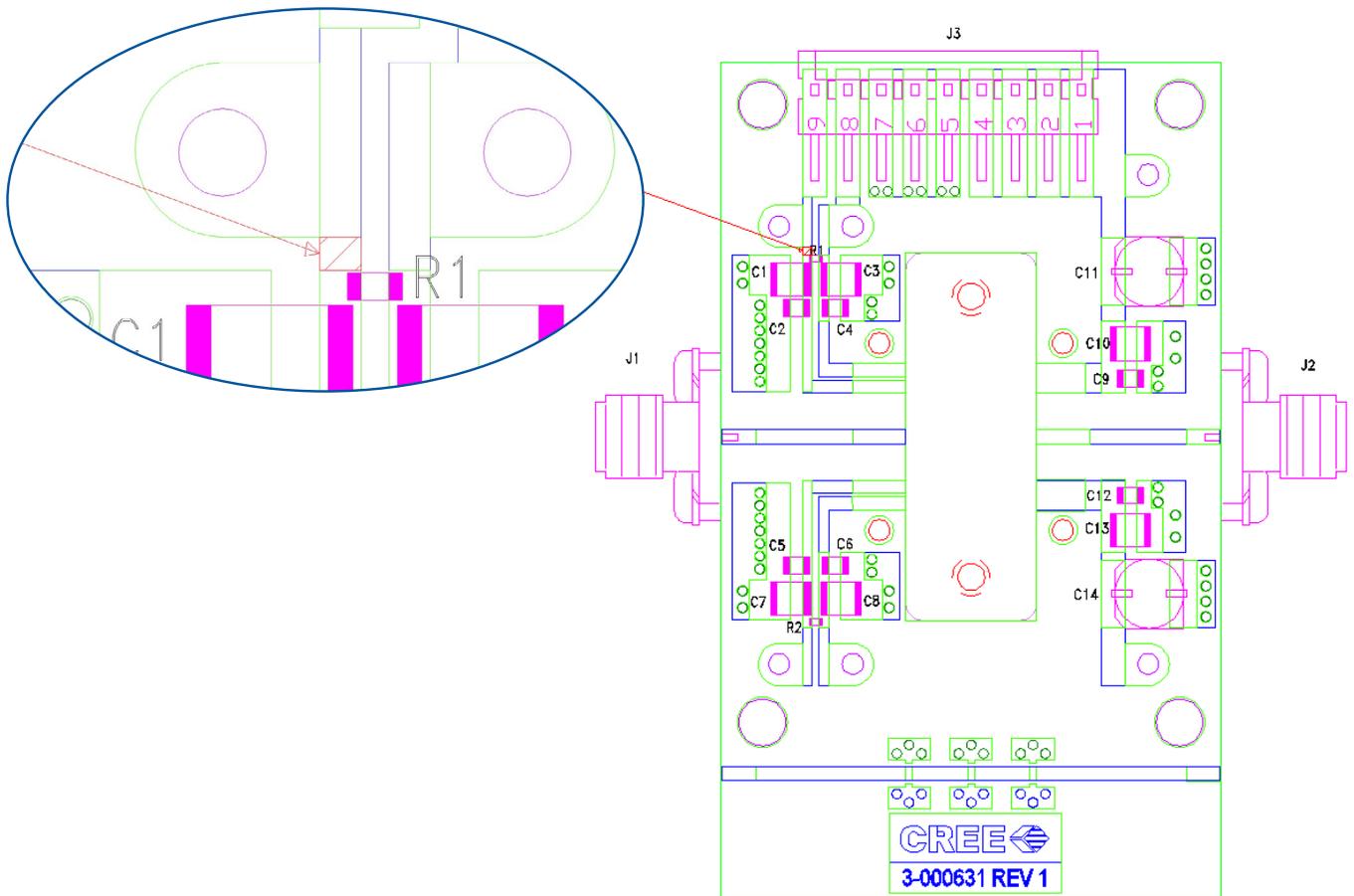


## CMPA5585025F-AMP Demonstration Amplifier Circuit Outline

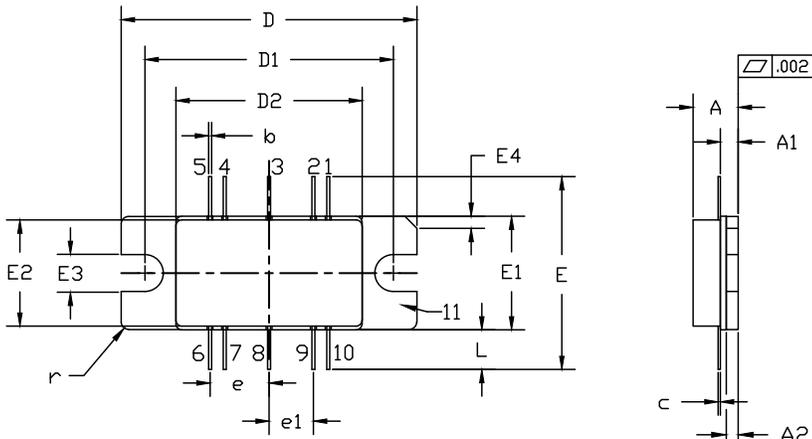


## CMPA5585025F-AMP Demonstration Amplifier Circuit

To configure the CMPA5585025F test fixture to enable independent  $V_{G1}$  /  $V_{G2}$  control of the device, a cut must be made to the microstrip line just above the R1 resistor as shown. Pin 9 will then supply  $V_{G1}$  and Pin 8 will supply  $V_{G2}$ .



## Product Dimensions CMPA5585025F (Package Type – 440208)



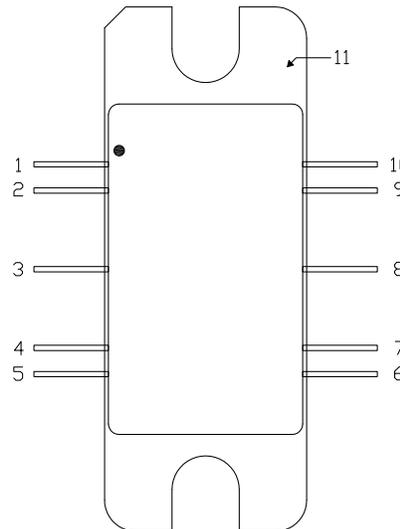
PIN 1: GATE BIAS 6: DRAIN BIAS  
 2: GATE BIAS 7: DRAIN BIAS  
 3: RF IN 8: RF OUT  
 4: GATE BIAS 9: DRAIN BIAS  
 5: GATE BIAS 10: DRAIN BIAS  
 11: SOURCE

### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M - 1994.
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 PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

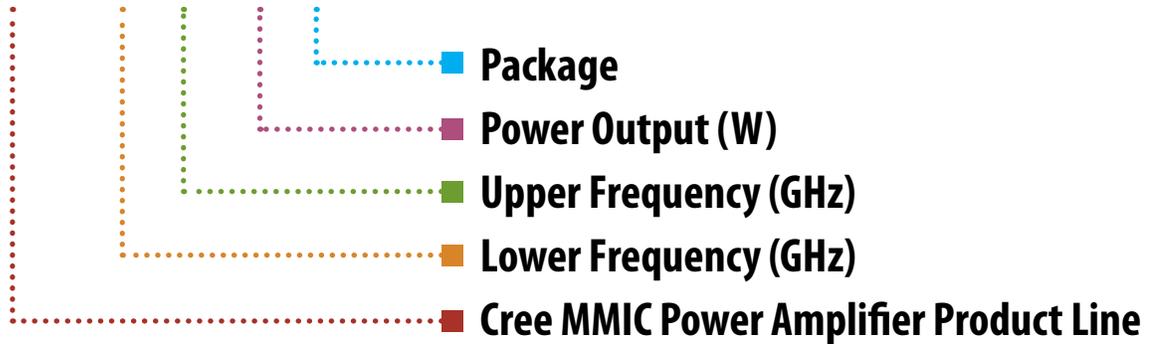
DIM	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.148	0.168	3.76	4.27	
A1	0.055	0.065	1.40	1.65	
A2	0.035	0.045	0.89	1.14	
b	0.01 TYP		0.254 TYP		10x
c	0.007	0.009	0.18	0.23	
D	0.995	1.005	25.27	25.53	
D1	0.835	0.845	21.21	21.46	
D2	0.623	0.637	15.82	16.18	
E	0.653 TYP		16.59 TYP		
E1	0.380	0.390	9.65	9.91	
E2	0.355	0.365	9.02	9.27	
E3	0.120	0.130	3.05	3.30	
E4	0.035	0.045	0.89	1.14	45° CHAMFER
e	0.200 TYP		5.08 TYP		4x
e1	0.150 TYP		3.81 TYP		4x
L	0.115	0.155	2.92	3.94	10x
r	0.025 TYP		.635 TYP		3x

Pin Number	Qty
1	Gate Bias for Stage 2
2	Gate Bias for Stage 2
3	RF In
4	Gate Bias for Stage 1
5	Gate Bias for Stage 1
6	Drain Bias
7	Drain Bias
8	RF Out
9	Drain Bias
10	Drain Bias
11	Source



## Part Number System

# CMPA5585025F



Parameter	Value	Units
Lower Frequency	5.5	GHz
Upper Frequency <sup>1</sup>	8.5	GHz
Power Output	25	W
Package	Flange	-

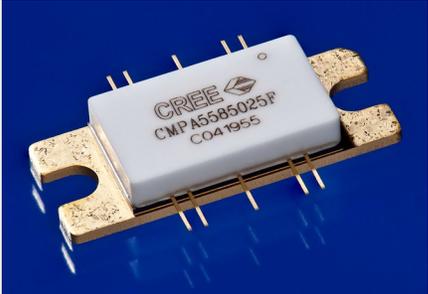
**Table 1.**

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

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

**Table 2.**

## Product Ordering Information

Order Number	Description	Unit of Measure	Image
CMPA5585025F	GaN MMIC	Each	
CMPA5585025F-TB	Test board without GaN MMIC	Each	
CMPA5585025F-AMP	Test board with GaN MMIC installed	Each	



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