

CMPA5585030F

30 W, 5.5 - 8.5 GHz, GaN MMIC, Power Amplifier

Description

Cree's CMPA5585030F 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: CMPA5585030F
Package Type: 440213

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
$S_{21}^{1,2}$	25.9	23.8	26.5	24.5	26.7	dB
Power Gain ^{2,5}	22.3	19.0	20.9	21.6	21.2	dB
PAE ^{1,2,4,5}	24.7	20.7	20.3	22.6	22.9	%
ACLR ^{1,2,3,5}	-37	-42	-33	-34	-40	dBc

Notes (unless otherwise specified):

¹ At 25°C

² Measurements are performed using Cree test fixture AD-938516

³ Under QPSK modulated signal, 1.6 Msps, PN23, Alpha Filter = 0.2

⁴ Power Added Efficiency = $(P_{\text{OUT}} - P_{\text{IN}}) / \text{PDC}$

⁵ Measured at $P_{\text{OUT}} = 41\text{ dBm}$

Features

- 25 dB Small Signal Gain
- 30 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 Radar
- Satellite Communication Uplink

RoHS
COMPLIANT

Absolute Maximum Ratings (not simultaneous)

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DS}	84	V_{DC}	25 °C
Gate-source Voltage	V_{GS}	-10, +2	V_{DC}	25 °C
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 ¹	T_S	245	°C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.16	°C/W	CW, 85 °C, $P_{DISS} = 66$ W
Case Operating Temperature	T_C	-40, +150	°C	

Note:

¹ Refer to the Application Note on soldering at wolfspeed.com/rf/document-library**Electrical Characteristics (Frequency = 5.5 GHz to 8.5 GHz unless otherwise stated; $T_C = 25$ °C)**

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics¹						
Gate Threshold Voltage	V_{TH}	-3.8	-2.8	-2.3	V	$V_{DS} = 10$ V, $I_{DS} = 12.7$ mA
Saturated Drain Current ²	I_{DS}	9.2	12.7	–	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	V_{BD}	84	–	–	V	$V_{GS} = -8$ V, $I_{DS} = 12.7$ mA
RF Characteristics						
Small Signal Gain ³	S21	22.85	26	–	dB	$V_{DD} = 28$ V, $I_{DQ} = 285$ mA, $P_{IN} = -20$ dBm
Input Return Loss ³	S11	–	-7	–	dB	$V_{DD} = 28$ V, $I_{DQ} = 285$ mA, $P_{IN} = -20$ dBm
Output Return Loss ³	S22	–	-7	–	dB	$V_{DD} = 28$ V, $I_{DQ} = 285$ mA, $P_{IN} = -20$ dBm
Output Mismatch Stress	VSWR	–	–	5:1	Ψ	No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 285$ mA, $P_{OUT} = 43$ dBm

Notes:

¹ Measured on-wafer prior to packaging² Scaled from PCM data³ Measured using network analyzer (Power = -20 dBm)



Electrical Characteristics Continued (TC = 25 °C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
RF Characteristics^{1,2,4,6}						
Power Added Efficiency, 5.8 GHz ⁵	PAE1	19.0	25.8	–	%	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Added Efficiency, 6.4 GHz ⁵	PAE2	16.0	22.4	–	%	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Added Efficiency, 7.2 GHz ⁵	PAE3	16.2	22.0	–	%	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Added Efficiency, 7.9 GHz ⁵	PAE4	18.0	23.9	–	%	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Added Efficiency, 8.4 GHz ⁵	PAE5	19.2	25.0	–	%	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Gain, 5.8 GHz	G _{P1}	18.25	22.4	–	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Gain, 6.4 GHz	G _{P2}	16.35	20.2	–	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Gain, 7.2 GHz	G _{P3}	16.85	21.0	–	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Gain, 7.9 GHz	G _{P4}	17.15	22.2	–	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
Power Gain, 8.4 GHz	G _{P5}	17.65	21.8	–	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
OQPSK Linearity, 5.8 GHz	ACLR1	–	-42	-32	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
OQPSK Linearity, 6.4 GHz	ACLR2	–	-44	-33	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
OQPSK Linearity, 7.2 GHz	ACLR3	–	-34	-27.5	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
OQPSK Linearity, 7.9 GHz	ACLR4	–	-37	-28	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm
OQPSK Linearity, 8.4 GHz	ACLR5	–	-40	-32	dB	V _{DD} = 28 V, I _{DQ} = 285 mA, P _{OUT} = 41 dBm

Notes:

¹ At 25 °C

² Measurements are to be performed using Cree CMPA5585030F-AMP

³ Measured using network analyzer (Power = -20 dBm)

⁴ Under OQPSK modulated signal, 1.6 Msps, PN23, Alpha Filer = 0.2

⁵ Power Added Efficiency = (P_{OUT} - P_{IN})/PDC

⁶ Fixture loss de-embedded using the following offset. The offset is subtracted from the input offset value and added to the output offset value.

- a. 5.8 GHz - 0.182 dB
- b. 6.4 GHz - 0.200 dB
- c. 7.2 GHz - 0.217 dB
- d. 7.9 GHz - 0.234 dB
- e. 8.4 GHz - 0.246 dB

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 CPA5585030F

Figure 1. Gain vs. Frequency & Output Power OQPSK 1.6 Msps
 $V_{DD} = 28\text{ V}, I_{DQ} = 285\text{ mA}$

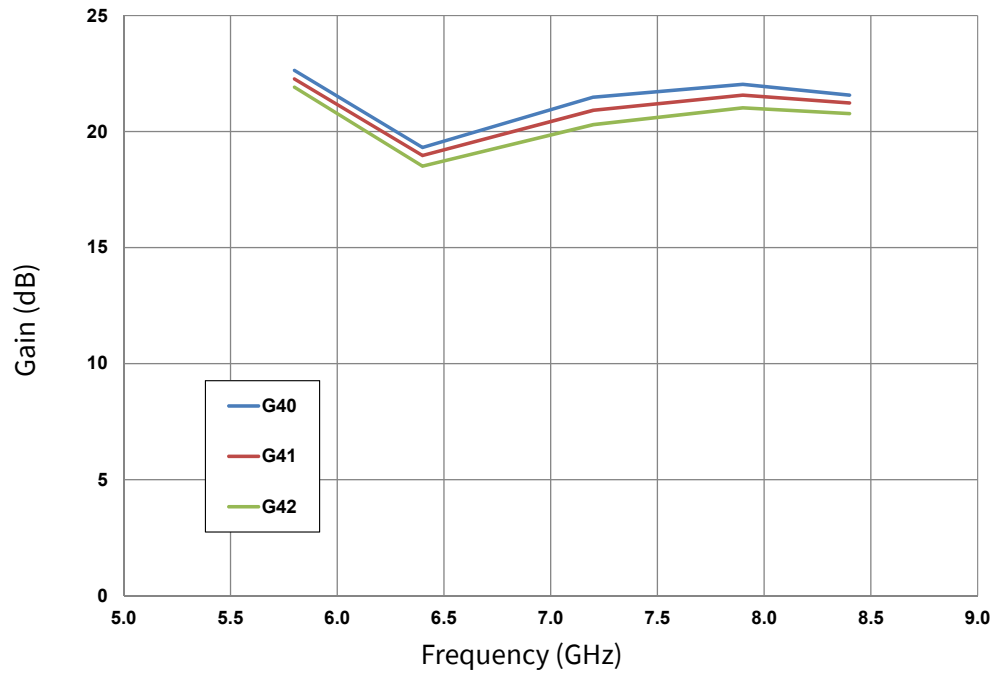
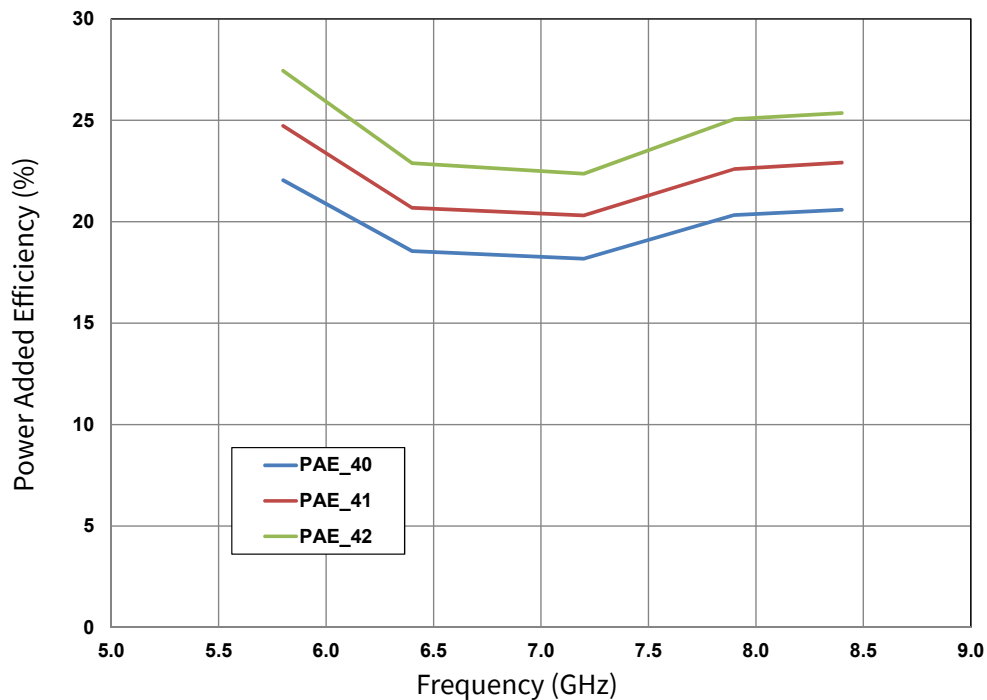


Figure 2. Power Added Efficiency vs. Frequency & Output Power OQPSK 1.6 Msps
 $V_{DD} = 28\text{ V}, I_{DQ} = 285\text{ mA}$





Typical Performance of the CPA5585030F

Figure 3. ACLR vs. Frequency & Output Power OQPSK 1.6 Msps

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

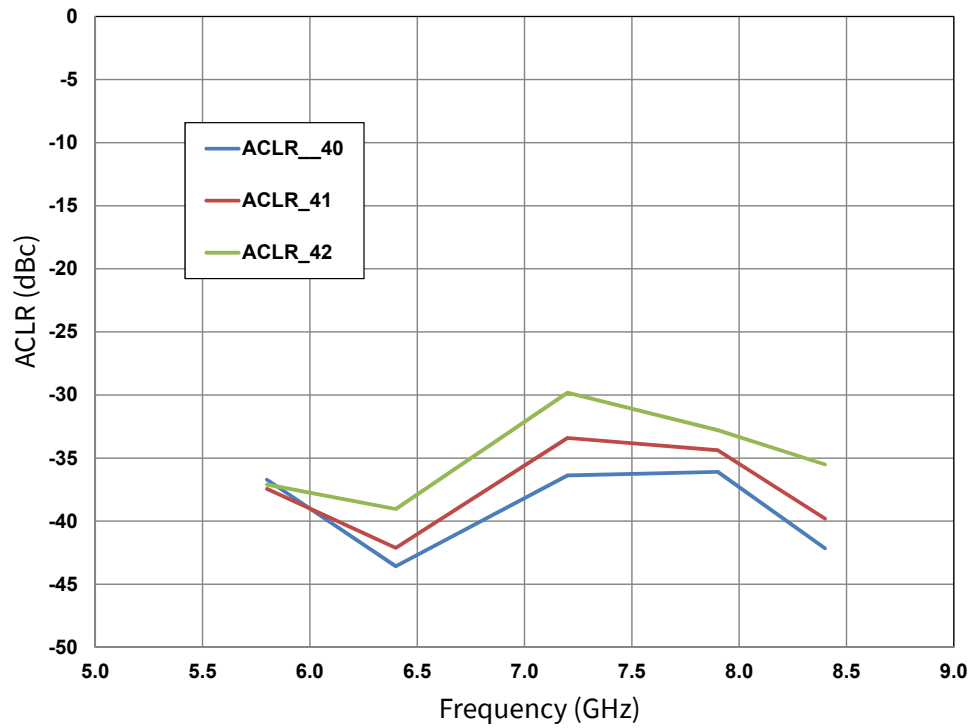
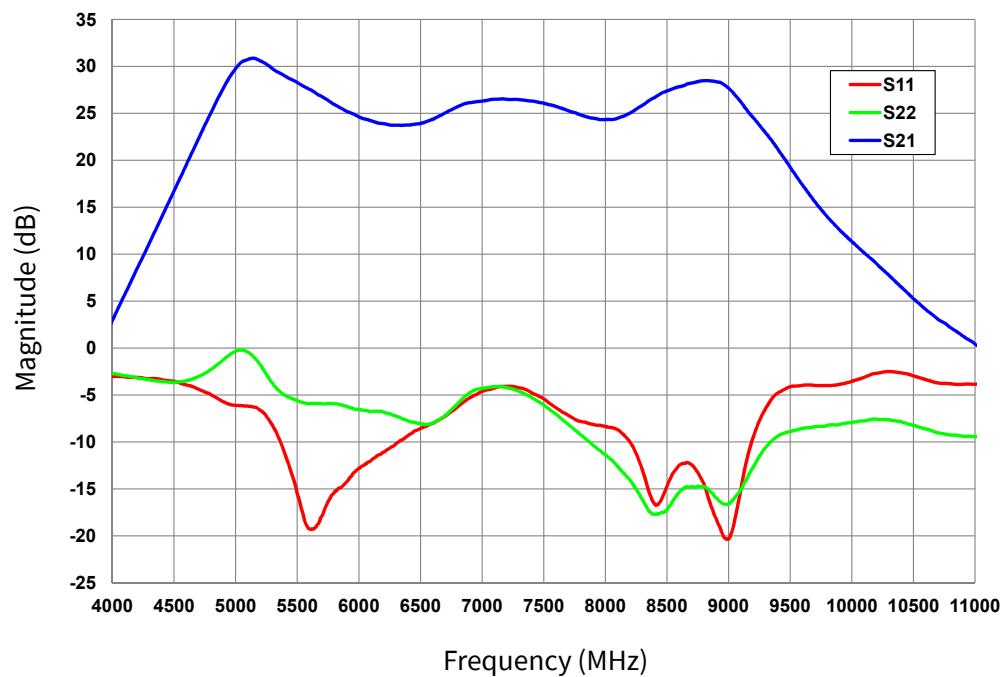
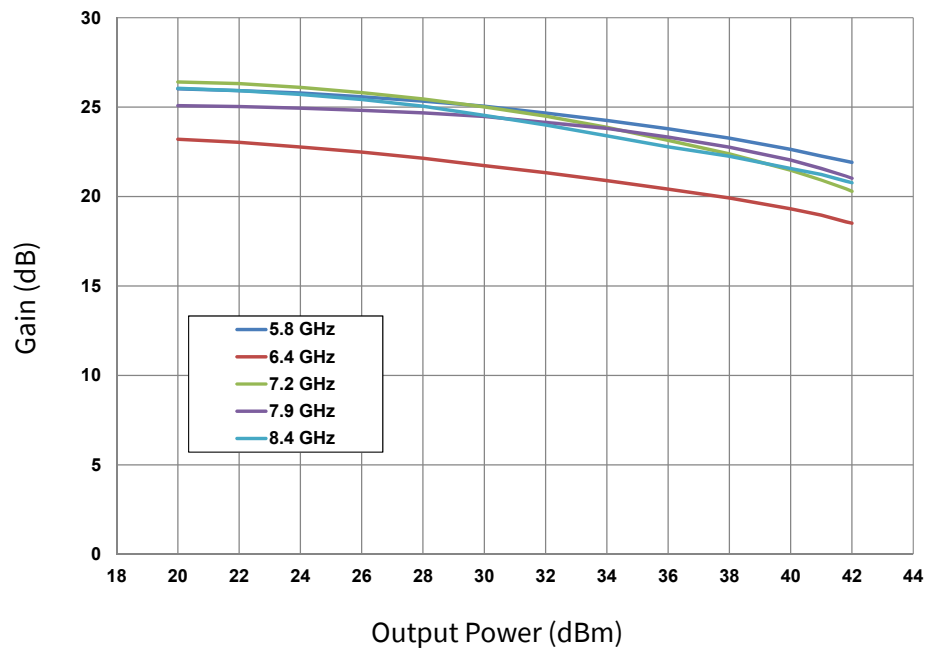
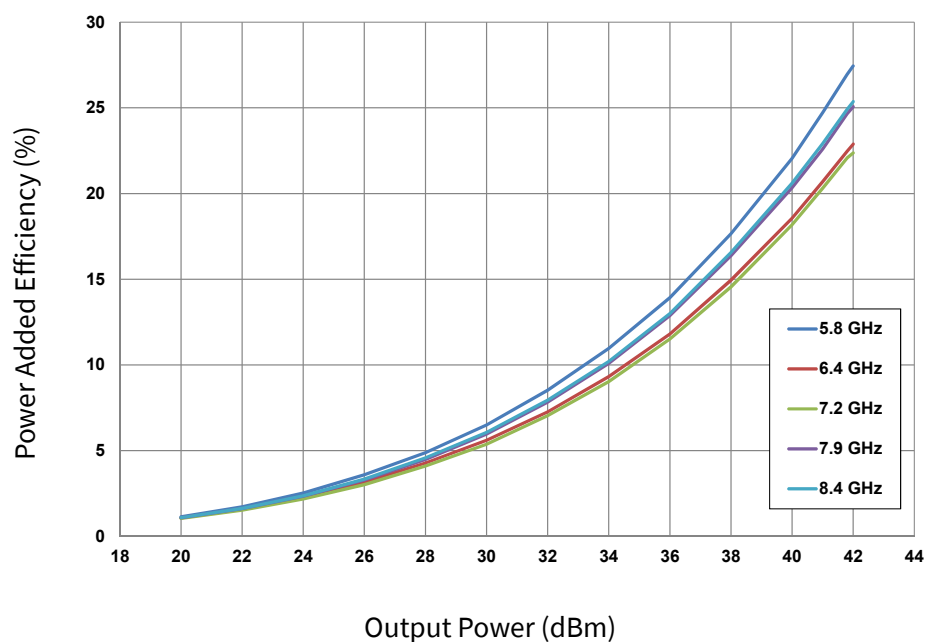
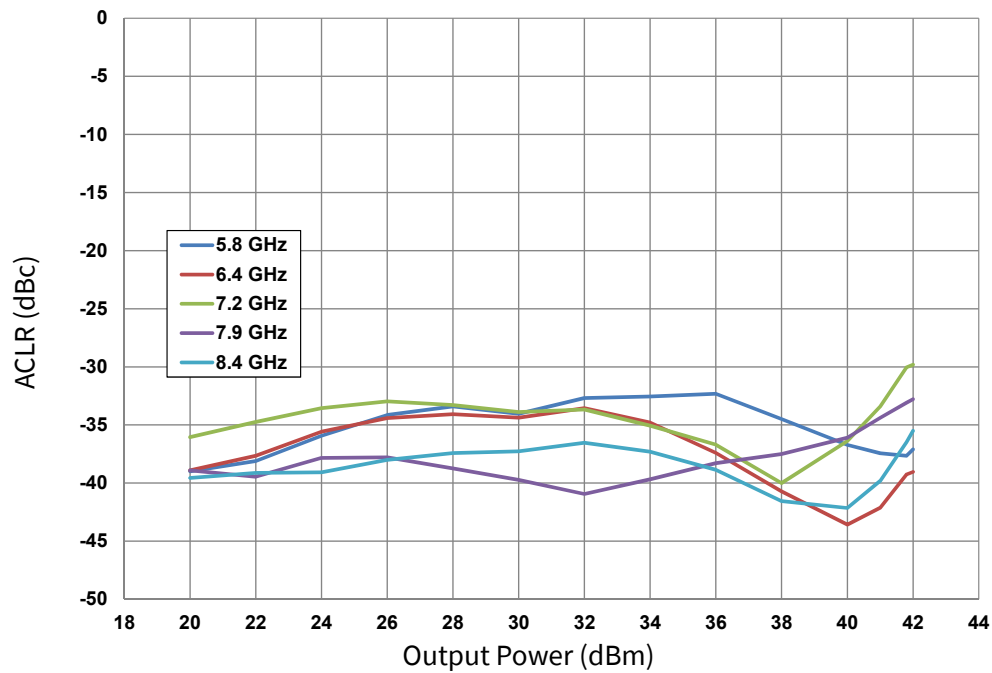
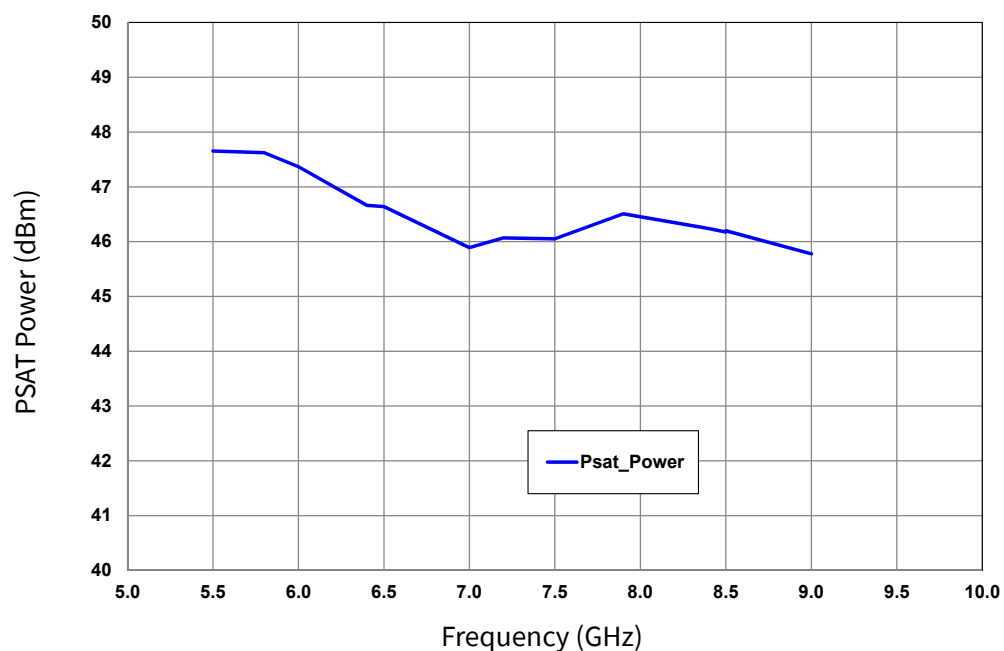


Figure 4. Typical S-Parameters

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



Typical Performance of the CMPA5585030F**Figure 5. Gain vs. Output Power and Frequency OQPSK 1.6 Msps** $V_{DD} = 28\text{ V}$, $I_{DQ} = 285\text{ mA}$ **Figure 6. Power Added Efficiency vs. Output Power and Frequency OQPSK 1.6 Msps** $V_{DD} = 28\text{ V}$, $I_{DQ} = 285\text{ mA}$ 

Typical Performance of the CMPA5585030F**Figure 7. ACLR vs. Output Power and Frequency OQPSK 1.6 Msps** $V_{DD} = 28\text{ V}$, $I_{DQ} = 285\text{ mA}$ **Figure 8. PSAT Power vs. Frequency** $V_{DD} = 28\text{ V}$, $I_{DQ} = 800\text{ mA}$, Pulsed Width = 100 μs , Duty Cycle = 10%

Typical Performance of the CMPA5585030F

Figure 9. Power Added Efficiency @ Saturated Power vs. Frequency
 $V_{DD} = 28\text{ V}$, $I_{DQ} = 800\text{ mA}$, Pulsed Width = $100\text{ }\mu\text{s}$, Duty Cycle = 10%

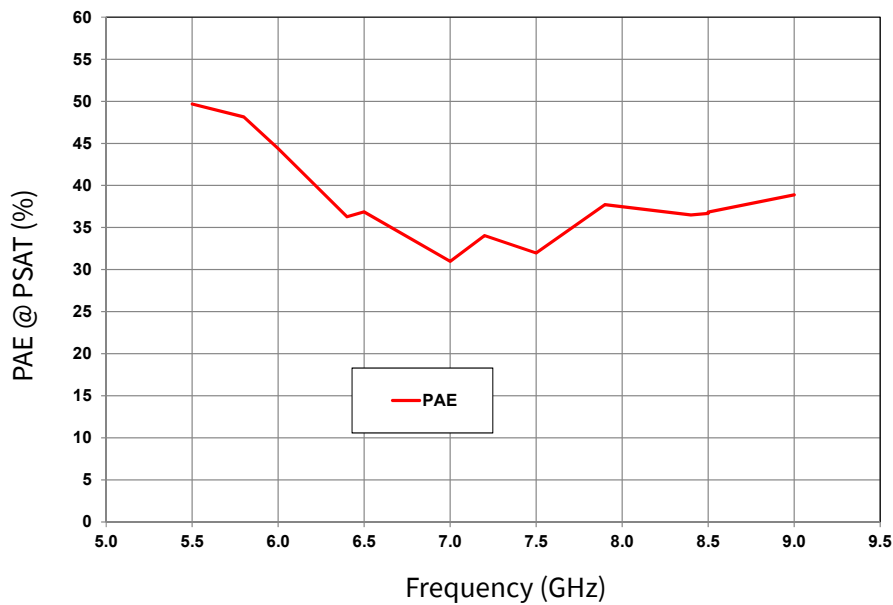
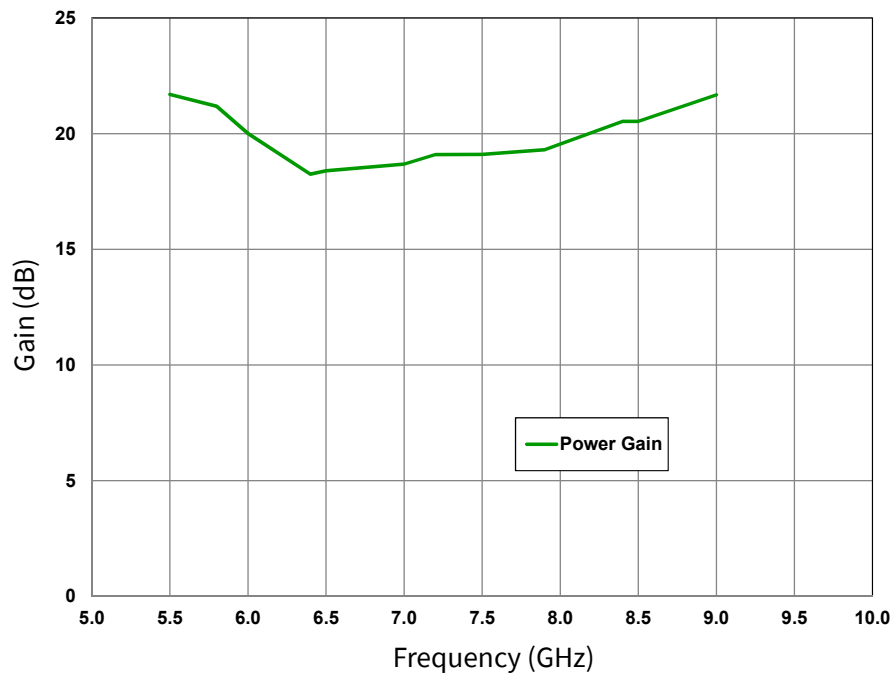
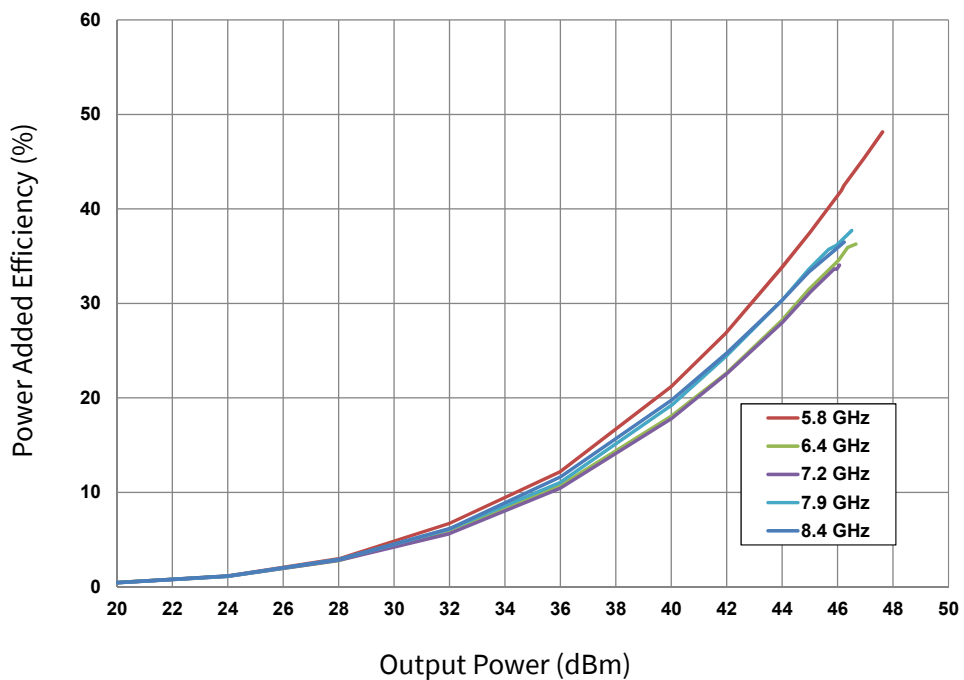
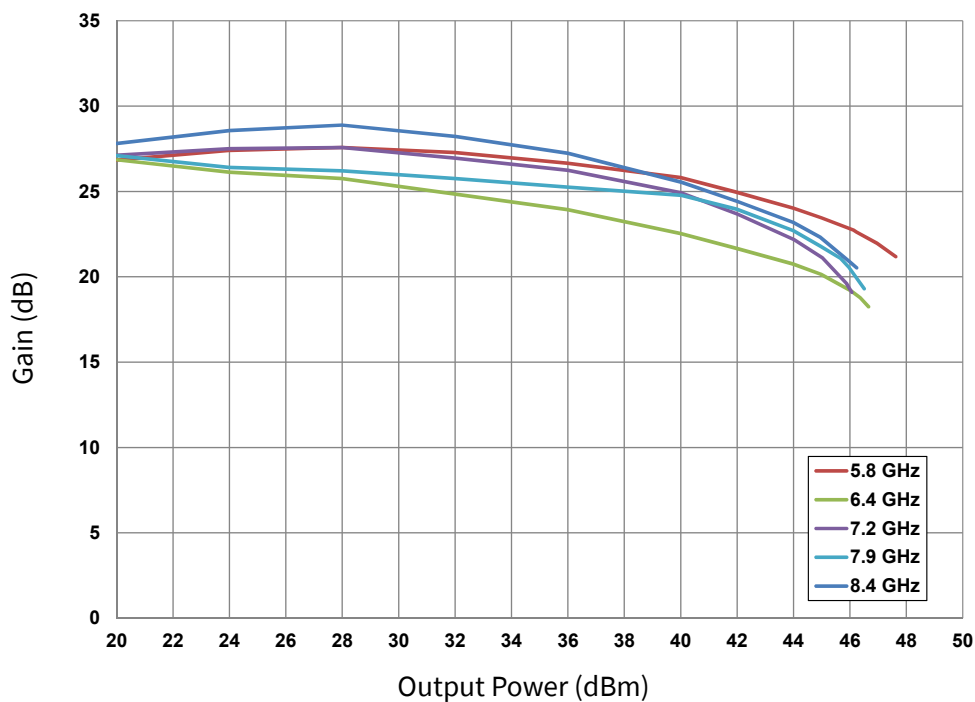
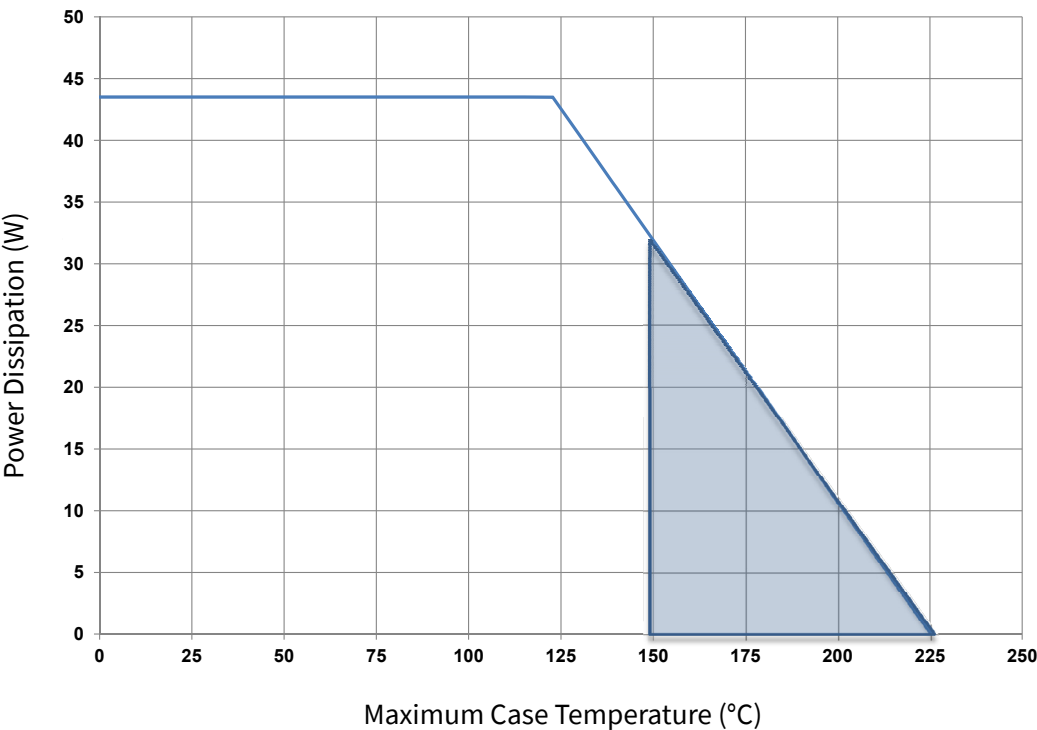


Figure 10. Gain @ Saturated Power vs. Frequency
 $V_{DD} = 28\text{ V}$, $I_{DQ} = 800\text{ mA}$, Pulsed Width = $100\text{ }\mu\text{s}$, Duty Cycle = 10%



Typical Performance of the CMPA5585030F**Figure 11. PAE vs. Output Power and Frequency** $V_{DD} = 28\text{ V}$, $I_{DQ} = 800\text{ mA}$, Pulsed Width = 100 μs , Duty Cycle = 10%**Figure 12. Gain vs. Output Power and Frequency** $V_{DD} = 28\text{ V}$, $I_{DQ} = 800\text{ mA}$, Pulsed Width = 100 μs , Duty Cycle = 10%

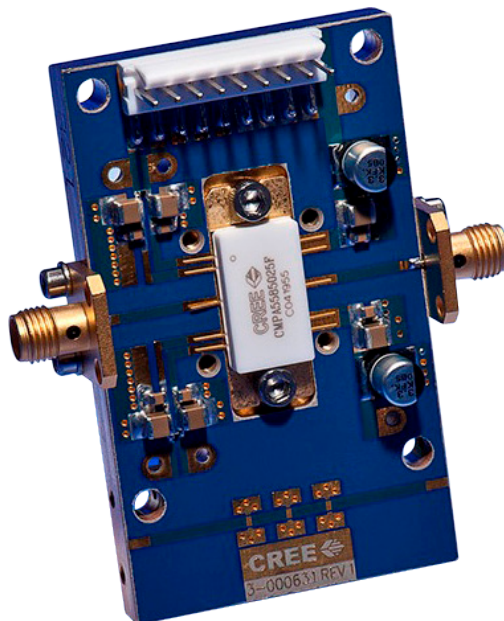
CPMA5585030F Power Dissipation De-rating Curve



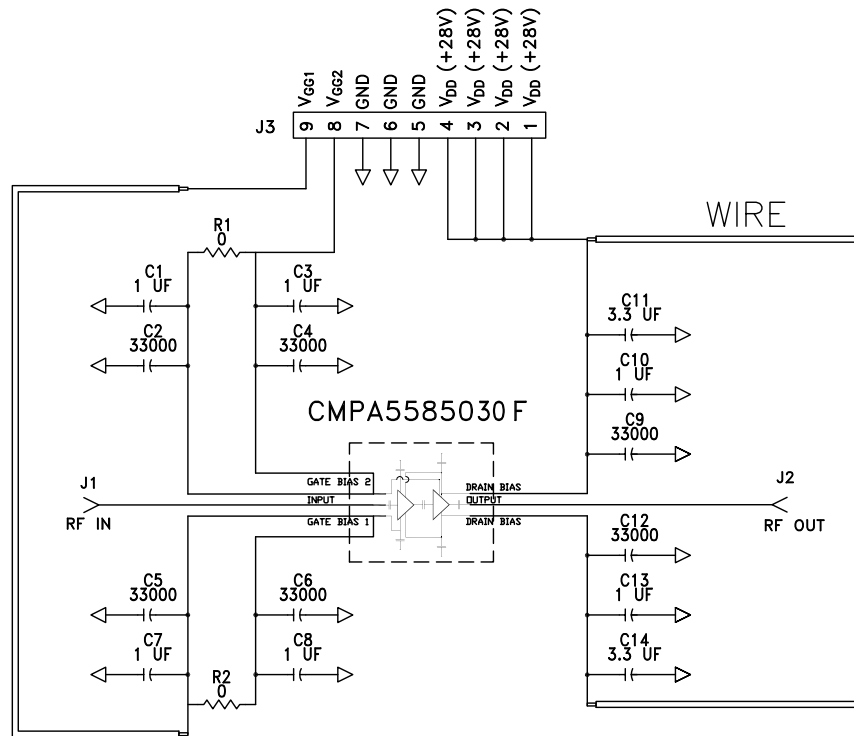
Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2)

CMPA5585030F-AMP Demonstration Amplifier Circuit Bill of Materials

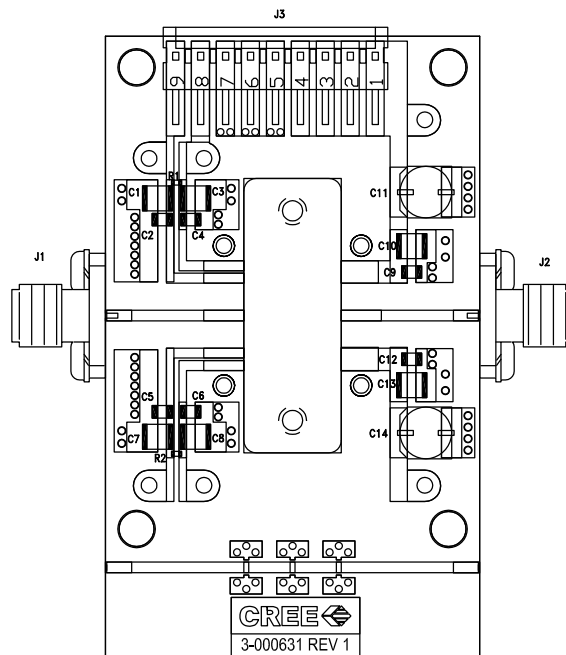
Designator	Description	Qty
C1, C3, C7, C8, C10, C13	CAP, 1.0 uF, +/-10%, 1210, 100V, X7R	6
C2, C4, C5, C6, C9, C12	CAP, 33000 pF, 0805, 100V, X7R	6
C11, C14	CAP ELECT 3.3UF 80V FK SMD	2
R1, R2	RES 0.0 OHM 1/16W 0402 SMD	2
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J3	CONNECTOR, HEADER, RT>PLZ .1CEN LK 9POS	1
-	PCB, TACONIC, RF-35P-0200-CL1/CL1	1
Q1	CMPA5585030F	1

CMPA5585030F-AMP Demonstration Amplifier Circuit

CMPA5585030F-AMP Demonstration Amplifier Circuit

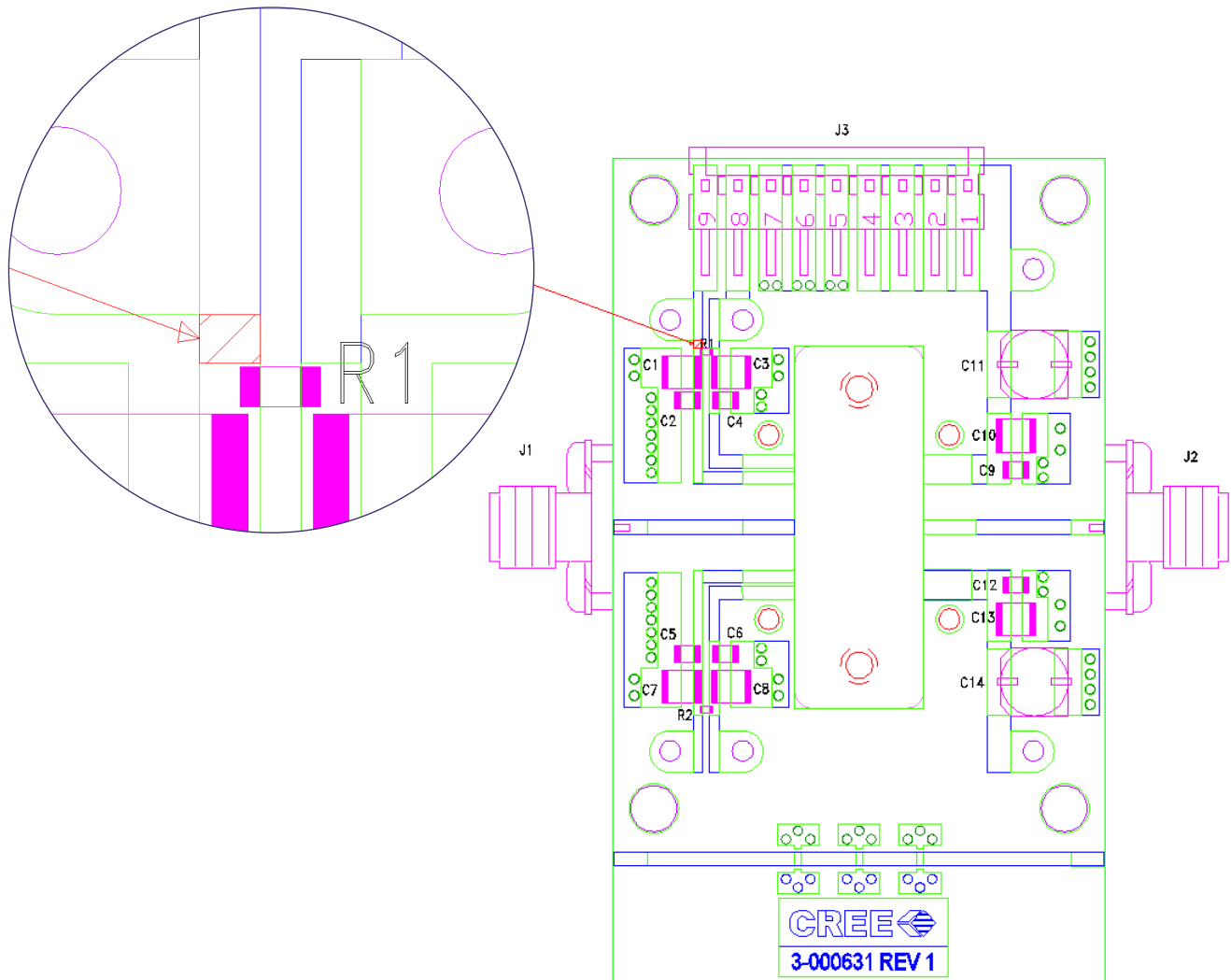


CMPA5585030F-AMP Demonstration Amplifier Circuit Outline

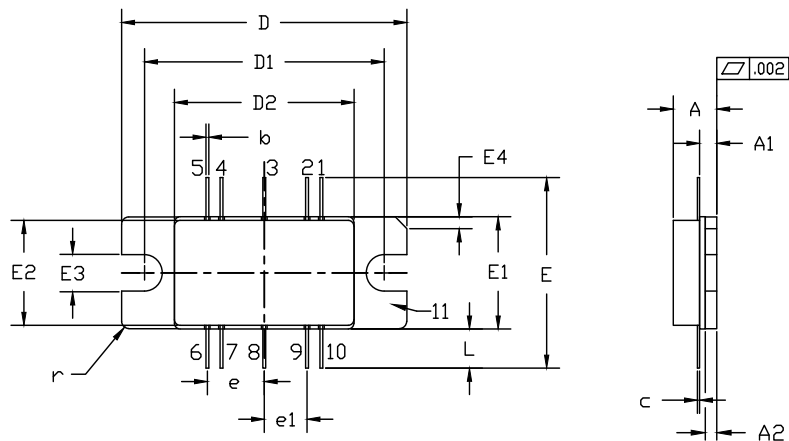


CMPA5585030F-AMP Demonstration Amplifier Circuit

To configure the CMPA5585030F test fixture to enable independent VG1 / VG2 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 VG1 and Pin 8 will supply VG_{G2}.



Product Dimensions CPA5585030F (Package Type — 440213)

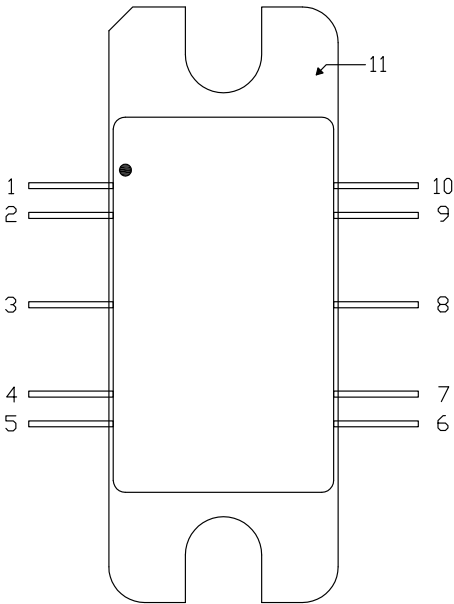


PIN 1: GATE BIAS 6: DRAIN BIAS
2: GATE BIAS 7: DRAIN BIAS
3: RF IN 8: RF OUT
4: GATE BIAS 9: DRAIN BIAS
5: GATE BIAS 10: DRAIN BIAS
11: SOURCE

- 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

CMPA5585030F

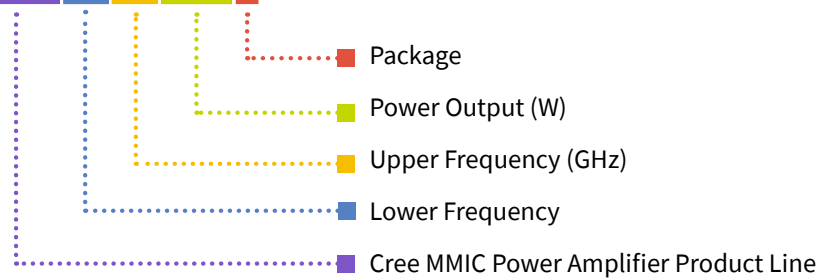


Table 1.

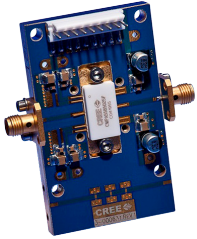
Parameter	Value	Units
Lower Frequency	5.5	GHz
Upper Frequency ¹	8.5	GHz
Power Output	30	W
Package	Flange	-

Note¹: 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
CMPA5585030F	GaN MMIC	Each	
CMPA5585030F-AMP	Test board with GaN MMIC installed	Each	

For more information, please contact:

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Notes

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