

CMPA601C025F Rev. V1

#### **Features**

Saturated Power: 40 W
Power Added Efficiency: 30%
Large Signal Gain: 24 dB
Small Signal Gain: 34 dB
Input Return Loss: -5 dB
Output Return Loss: -5 dB

CW Operation

#### **Applications**

Electronic Warfare

X-band Radar

#### **Description**

The CMPA601C025F is a 40 W package MMIC HPA utilizing a high performance, 0.25 µm GaN-on-SiC production process. The CMPA601C025F operates from 6 - 12 GHz and supports a variety of both defense and commercial related applications. The CMPA601C025F achieves 40 W of saturated output power with 24 dB of large signal gain and typically 30% power-added efficiency under CW operation.

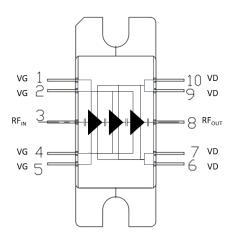
Packaged in a bolt-down, flange package, the CMPA601C025F provides superior RF performance and thermal management allowing customers to improve SWaP-C benchmarks in their next generation systems.

### **Ordering Information**

Part Number	Package (MOQ/ Mult)
CMPA601C025F	Tray (10/10)
CMPA601C025F-AMP	Sample Board (1/1)



#### **Functional Schematic**



## Pin Configuration<sup>1</sup>

Pin#	Function
1, 2, 4, 5	Gate Bias
6, 7, 9, 10	Drain Bias
3	RF Input
8	RF Output

 The base of the package bottom must be connected to RF, DC and thermal ground.



CMPA601C025F Rev. V1

## RF Electrical Specifications: $V_D = 28 \text{ V}$ , $I_{DQ} = 2 \text{ A}$ , CW, $T_C = 25 ^{\circ}\text{C}$ , $Z_0 = 50 \Omega$

Parameter	Test Conditions	Frequency (GHz)	Units	Min.	Тур.	Max.
Output Power		6 9.5 12	dBm	45.5 45.5 43.0	46.0 46.5 45.5	_
Power Added Efficiency	P <sub>IN</sub> = 22 dBm	6 9.5 12	%	23.0 26.0 15.5	25.0 33.0 28.0	_
Large Signal Gain		6 9.5 12	dB	_	24.0 24.5 23.5	_
Small Signal Gain	P <sub>IN</sub> = -20 dBm	6 9.5 12	dB	28 28 25	35 35 30	_
Input Return Loss	1 IN20 dbiii	6 - 12	dB	_	-5	_
Output Return Loss		6 - 12	dB	_	-5	_

## **DC Electrical Specifications**

Parameter		Min.	Тур.	Max.
Drain Voltage	V	_	28	_
Gate Voltage	V	_	-2.45	_
Quiescent Drain Current		_	2	_
Saturated Drain Current		_	5.0	_



CMPA601C025F Rev. V1

## **Recommended Operating Conditions**

Parameter	Symbol	Unit	Min.	Тур.	Max.
Input Power	P <sub>IN</sub>	dBm	_	22	_
Drain Voltage	$V_D$	V	_	28	_
Gate Voltage	V <sub>G</sub>	V	_	-2.45	_
Quiescent Drain Current	I <sub>DQ</sub>	Α	_	2	_
Operating Temperature	T <sub>C</sub>	°C	-40	_	+85

## **Absolute Maximum Ratings<sup>2,3</sup>**

Parameter	Symbol	Unit	Min.	Max.
Input Power	P <sub>IN</sub>	dBm	_	24
Drain to Source Voltage	V <sub>DS</sub>	V	_	84
Drain Voltage	V <sub>D</sub>	V	_	28
Gate Voltage	V <sub>G</sub>	V	-8	+2
Drain Current	I <sub>D</sub>	Α	_	7.1
Gate Current	I <sub>G</sub>	mA	_	23
Dissipated Power @ +85°C	P <sub>DISS</sub>	W	_	164.7
VSWR			_	7:1
Junction Temperature (MTTF > 1E6 Hrs)	TJ	°C	_	+225
Storage Temperature	T <sub>STG</sub>	°C	-55	+150
Mounting Temperature (30 seconds)	T <sub>M</sub>	°C	_	+260
Screw Torque	τ	in-oz	_	40

<sup>2.</sup> Exceeding any one or combination of these limits may cause permanent damage to this device.

## **Handling Procedures**

Please observe the following precautions to avoid damage:

## **Static Sensitivity**

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM class 1A and CDM class C3 devices.

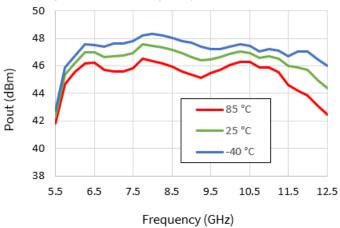
<sup>3.</sup> MACOM does not recommend sustained operation near these survivability limits.



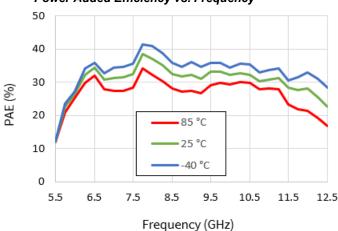
## **Typical Performance Curves - Large Signal over Temperature**

 $V_D$  = 28 V,  $I_{DQ}$  = 2.0 A, CW,  $P_{IN}$  = 22 dBm

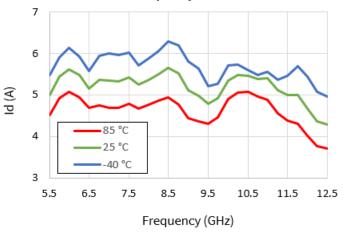
#### Output Power vs. Frequency



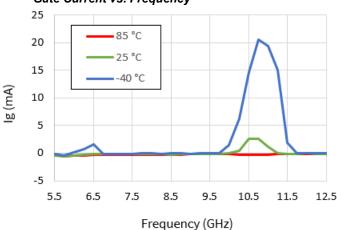
#### Power Added Efficiency vs. Frequency



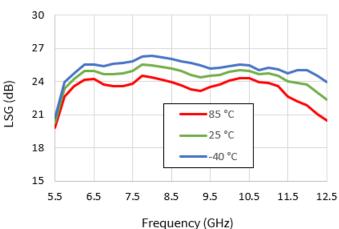
#### Drain Current vs. Frequency



#### Gate Current vs. Frequency



### Large Signal Gain vs. Frequency

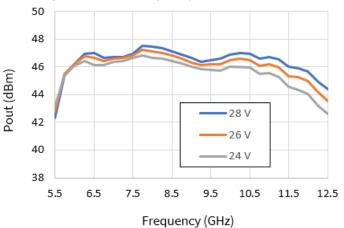




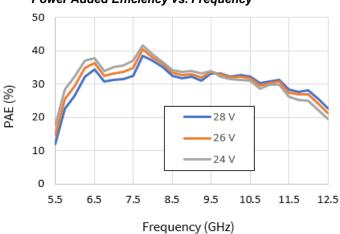
## Typical Performance Curves - Large Signal over V<sub>D</sub>

 $I_{DQ} = 2.0 \text{ A, CW, } P_{IN} = 22 \text{ dBm, } T_{C} = 25^{\circ}\text{C}$ 

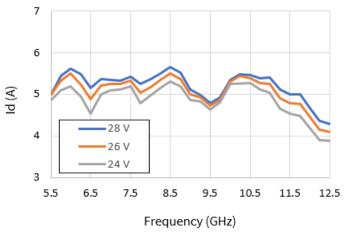
#### Output Power vs. Frequency



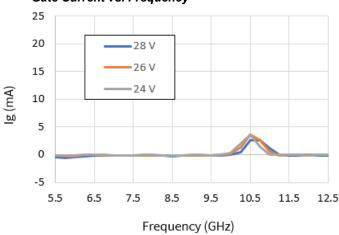
#### Power Added Efficiency vs. Frequency



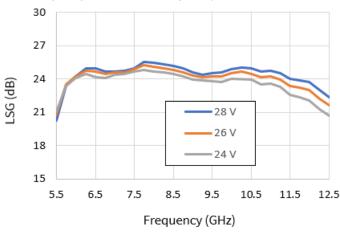
#### Drain Current vs. Frequency



#### Gate Current vs. Frequency



### Large Signal Gain vs. Frequency



MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

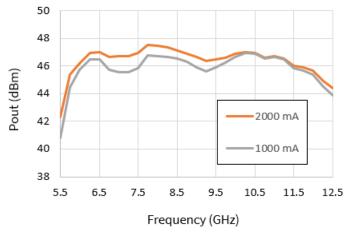
Visit <a href="https://www.macom.com">www.macom.com</a> for additional data sheets and product information.



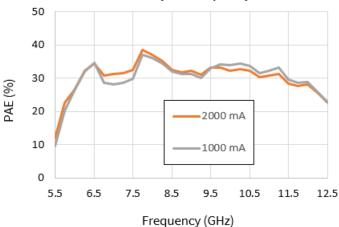
## Typical Performance Curves - Large Signal over IDQ

 $V_D$  = 28 V, CW,  $P_{IN}$  = 22 dBm,  $T_C$  = 25°C

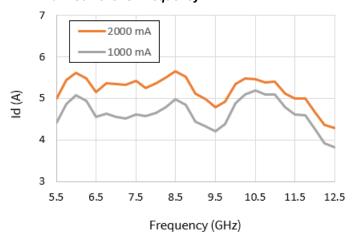
#### Output Power vs. Frequency



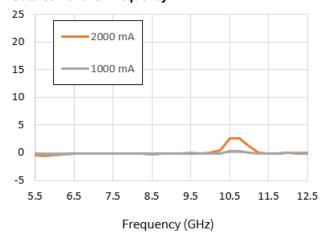
#### Power Added Efficiency vs. Frequency



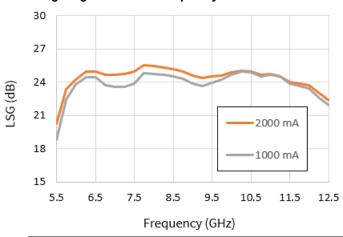
#### Drain Current vs. Frequency



Gate Current vs. Frequency



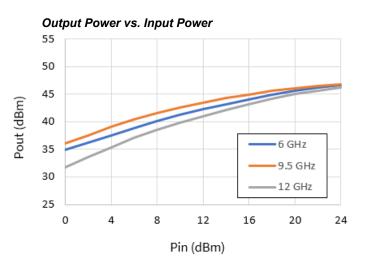
#### Large Signal Gain vs. Frequency



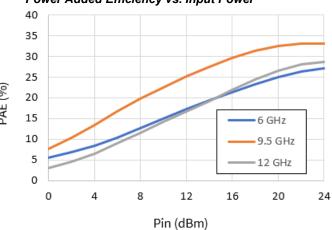


### **Typical Performance Curves - Drive-Up over Frequency**

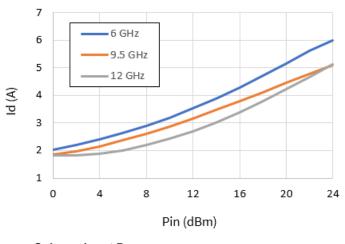
 $V_D = 28 \text{ V}, I_{DQ} = 2.0 \text{ A}, \text{ CW}, T_C = 25^{\circ}\text{C}$ 



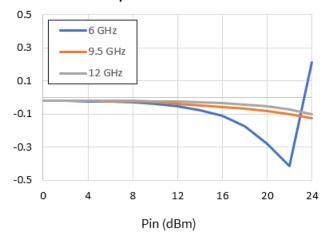
#### Power Added Efficiency vs. Input Power



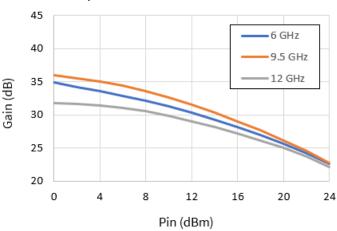
#### Drain Current vs. Input Power



#### Gate Current vs. Input Power



#### Gain vs. Input Power



MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit <a href="https://www.macom.com">www.macom.com</a> for additional data sheets and product information.

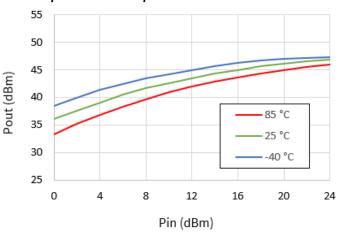
lg (mA)



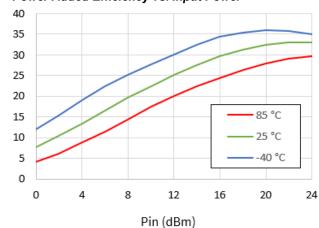
## **Typical Performance Curves - Drive-Up over Temperature**

 $V_D = 28 \text{ V}$ ,  $I_{DQ} = 2.0 \text{ A}$ , CW, Frequency = 9.5 GHz

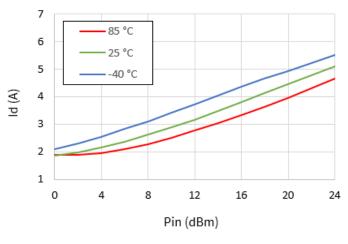
#### Output Power vs. Input Power



#### Power Added Efficiency vs. Input Power

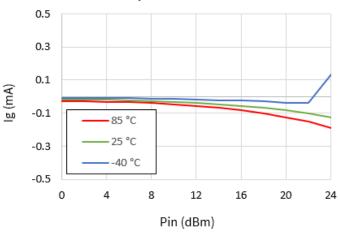


#### Drain Current vs. Input Power

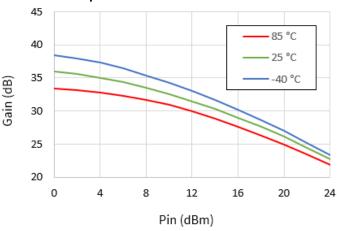


#### Gate Current vs. Input Power

PAE (%)



#### Gain vs. Input Power

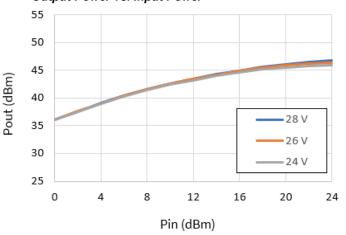




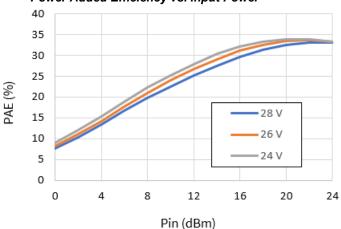
## Typical Performance Curves - Drive-Up over V<sub>D</sub>

 $I_{DQ}$  = 2.0 A, CW, Frequency = 9.5 GHz,  $T_{C}$  = 25°C

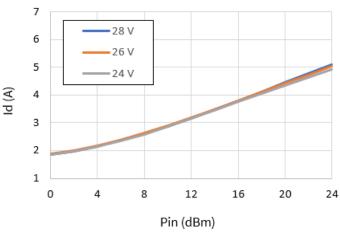
#### Output Power vs. Input Power



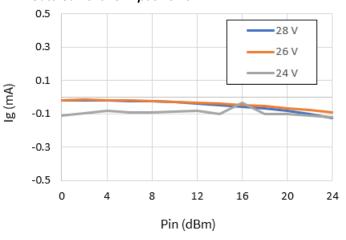
#### Power Added Efficiency vs. Input Power



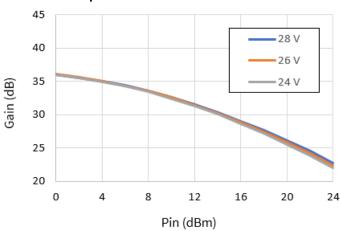
#### Drain Current vs. Input Power



#### Gate Current vs. Input Power



#### Gain vs. Input Power

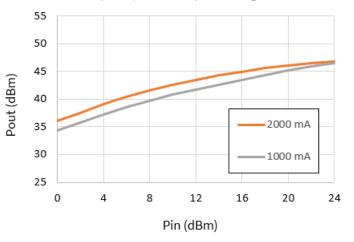




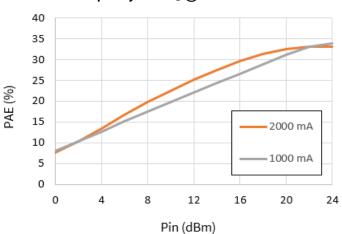
### Typical Performance Curves - Drive-Up over IDQ

 $V_D$  = 28 V, CW, Frequency = 9.5 GHz,  $T_C$  = 25°C

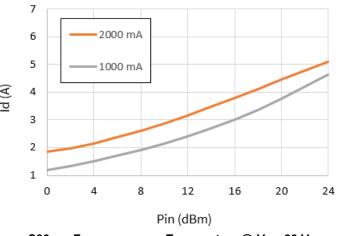
S21 vs. Frequency over Temperature @  $V_D$  = 28 V



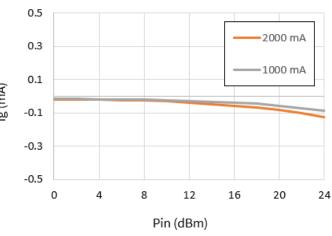
S21 vs. Frequency over V<sub>D</sub> @ 25°C



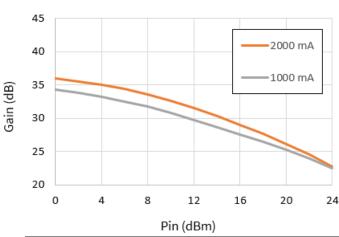
S11 vs. Frequency over Temperature @  $V_D$  = 28 V



S11 vs. Frequency over V<sub>D</sub> @ 25°C



S22 vs. Frequency over Temperature @  $V_D$  = 28 V



S22 vs. Frequency over V<sub>D</sub> @ 25°C



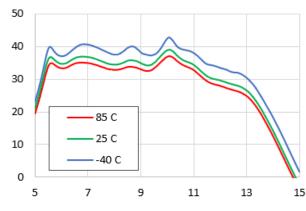
## Typical Performance Curves - Small Signal over Temperature and $\ensuremath{V_D}$

S21 (dB)

S11 (dB)

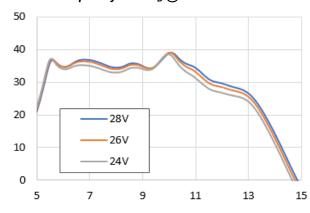
 $I_{DQ} = 2.0 \text{ A}, CW, P_{IN} = -20 \text{ dBm}$ 

S21 vs. Frequency over Temperature @  $V_D$  = 22 V



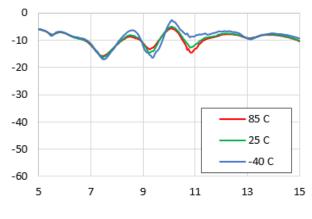
Frequency (GHz)

S21 vs. Frequency over V<sub>D</sub> @ 25°C



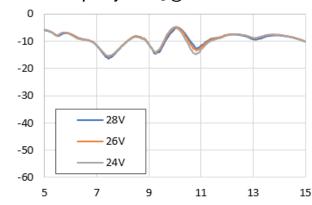
Frequency (GHz)

S11 vs. Frequency over Temperature @  $V_D$  = 22 V



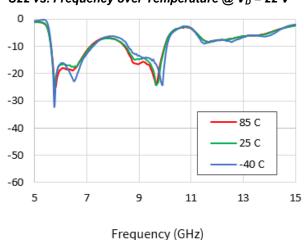
Frequency (GHz)

S11 vs. Frequency over V<sub>D</sub> @ 25°C

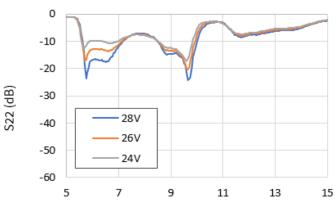


Frequency (GHz)

S22 vs. Frequency over Temperature @  $V_D$  = 22 V



S22 vs. Frequency over V<sub>D</sub> @ 25°C



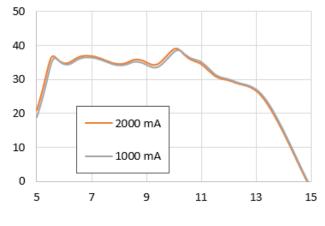
Frequency (GHz)



## Typical Performance Curves - Small Signal over IDQ

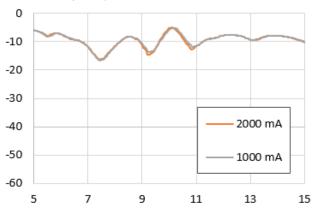
 $V_D$  = 28 V, CW,  $P_{IN}$  = -20 dBm,  $T_C$  = 25°C

#### S21 vs. Frequency over IDQ



S11 vs. Frequency over  $I_{DQ}$ 

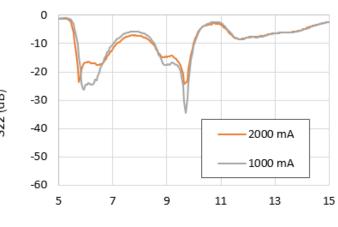
S11 (dB)



Frequency (GHz)

#### Frequency (GHz)

#### S22 vs. Frequency over IDQ



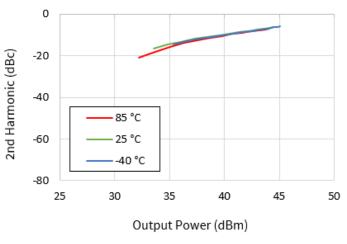
Frequency (GHz)



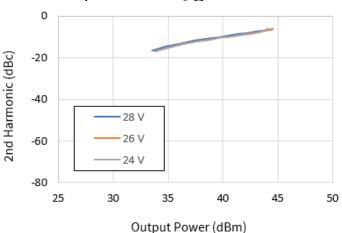
## Typical Performance Curves - Harmonics over Temperature and $\boldsymbol{V}_{\boldsymbol{D}}$

 $V_D = 28 \text{ V}$ ,  $I_{DQ} = 2.0 \text{ A}$ , CW,  $T_C = 25^{\circ}\text{C}$  (unless otherwise noted)

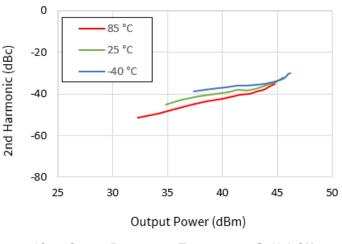
#### 2f vs. Output Power over Temperature @ 6.0 GHz



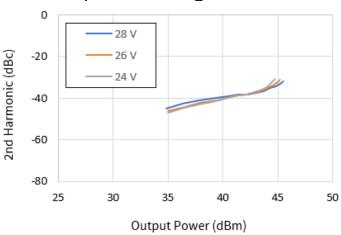
#### 2f vs. Output Power over VD @ 6.0 GHz



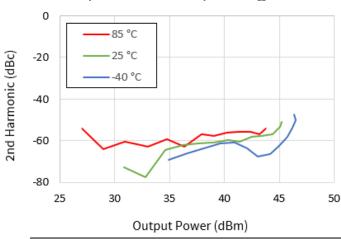
2f vs. Output Power over Temperature @ 9.5 GHz



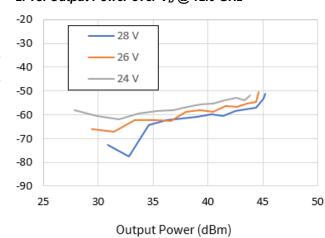
2f vs. Output Power over V<sub>D</sub> @ 9.5 GHz



2f vs. Output Power over Temperature @ 12.0 GHz



2f vs. Output Power over V<sub>D</sub> @ 12.0 GHz



MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit <a href="https://www.macom.com">www.macom.com</a> for additional data sheets and product information.

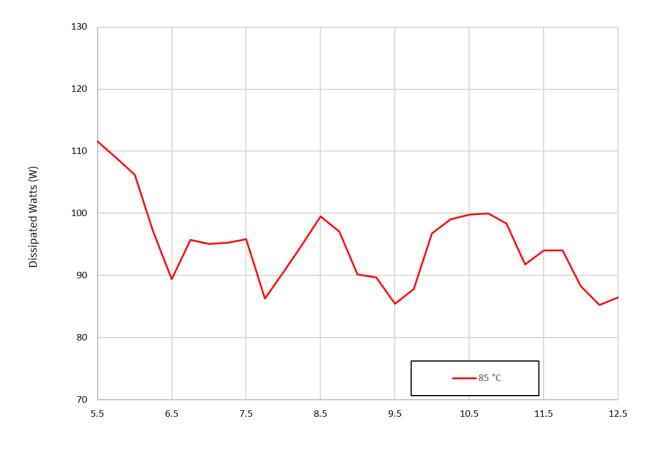
2nd Harmonic (dBc)



#### **Thermal Characteristics**

Parameter	Operating Conditions	Value
Operating Junction Temperature (T <sub>J</sub> )	Freq = 9.5 GHz, $V_D$ = 28 V, $I_{DQ}$ = 2.0 A, $I_{DRIVE}$ = 4.30 A, $P_{IN}$ = 22 dBm, $P_{OUT}$ = 45.45 dBm, $P_{DISS}$ = 84.42 W,	156.8°C
Thermal Resistance, Junction to Case $(R_{\theta JC})$		

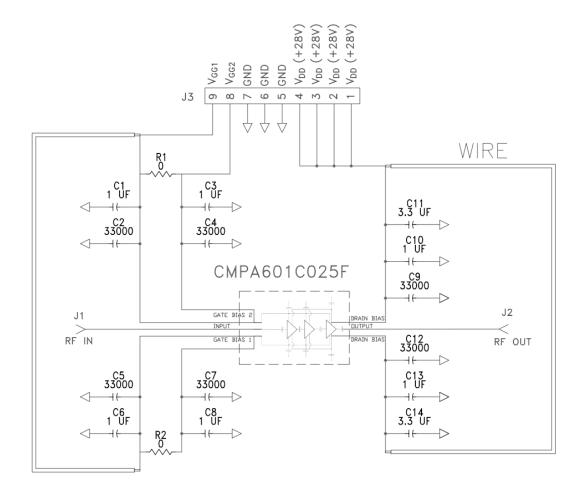
#### Power Dissipation vs. Frequency ( $T_c = 85^{\circ}C$ )



Frequency (GHz)



## **Evaluation Board Schematic (CMPA601C025F-AMP)**

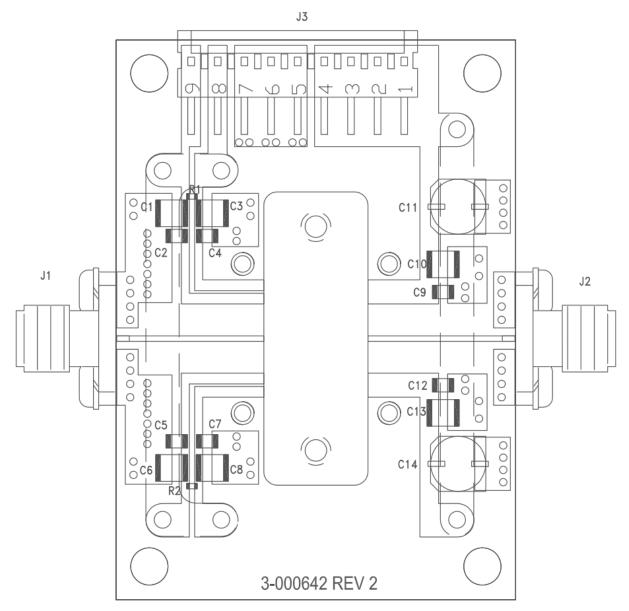


#### **Parts List**

Part	Value	Qty.
C2, C4, C5, C7, C9, C12	CAP, 33000 pF, 0805, 100V, X7R	6
C1, C3, C6, C8, C10, C13	CAP, 1 μF, 100V, 10%, X7R, 1210	6
C11, C14	CAP ELECT 3.3 µF 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	HEADER RT>PLZ .1CEN LK 9POS	1
W1	WIRE, BLACK, 22 AWG ~ 1.50"	1
W2	WIRE, BLACK, 22 AWG ~ 1.75"	1
Q1	CMPA601C025F	1



## **Evaluation Board Assembly Drawing (CMPA601C025F-AMP)**



#### **Bias On Sequence**

- 1. Ensure RF is turned-off
- 2. Apply pinch-off voltage of -5 V to the gate (V<sub>G</sub>)
- 3. Apply nominal drain voltage (V<sub>D</sub>)
- 4. Adjust Vg to obtain desired quiescent drain current (I<sub>DQ</sub>)
- 5. Apply RF

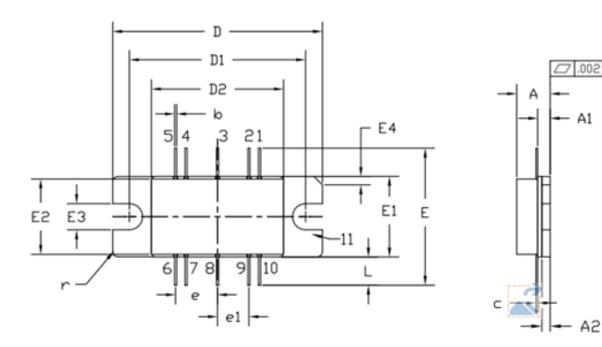
## **Bias Off Sequence**

- 1. Turn RF off
- 2. Apply pinch-off to the gate  $(V_G = -5 V)$
- 3. Turn off drain voltage (V<sub>D</sub>)
- 4. Turn off gate voltage (V<sub>G</sub>)



A1

#### **Mechanical Information**



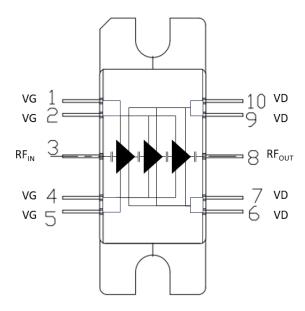
- 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M -1994.
- 2. CONTROLLING DIMENSION: INCH.
- 3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020' BEYOND EDGE OF LID.
- 4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008' IN ANY DIRECTION.

	INCHES		MILLIM	ETERS	NOTES
DIM	MIN	MAX	MIN	MAX	
Α	0.155	0.175	3.94	4.45	
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
С	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	
Ε	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	0.20	0 TYP	5.08 TYP		4x
e1	0.15	0 TYP	3.81 TYP		4x
L	0.115	0.155	2.92	3.94	10x
r	0.025 TYP		.635 TYP		3x



## **Pin Description**

Pin#	Name	Description
1, 2	VG	Pins 1 and 2 are same VG node and must be electrically connected to the gate bias voltage.
3	RF <sub>IN</sub>	RF Input. 50-ohm matched. Internally DC blocked.
4, 5	VG	Pins 4 and 5 are same VG node and must be electrically connected to the gate bias voltage.
6, 7	VD	Pins 6 and 7 are same VD node and must be electrically connected to the drain bias voltage.
8	RF <sub>OUT</sub>	RF Output. 50-ohm matched. Internally DC blocked.
9, 10	VD	Pins 9 and 10 are same VD node and must be electrically connected to the drain bias voltage.
Base	GND	RF and DC ground.





CMPA601C025F Rev. V1

## **Revision History**

Rev	Date	Change Description
V1	12/11/2024	Production release.



CMPA601C025F Rev. V1

#### MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.