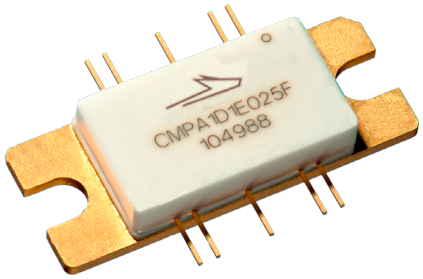
CMPA1D1E025F

25 W, 13.75 - 14.5 GHz, 40 V, Ku-Band GaN MMIC, Power Amplifier



PN: CMPA1D1E025F
Package Type: 440213

Description

Wolfspeed's CMPA1D1E025F is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT) based monolithic microwave integrated circuit (MMIC) on a silicon carbide (SiC) substrate, using a 0.25 µm gate length fabrication process. The Ku-Band 25W MMIC is targeted for commercial Ku-Band satellite communications applications. It offers high gain and superior efficiency while meeting OQPSK linearity required for Satcom applications at 3dB backed off P_{SAT} operations. This Ku-Band MMIC is available in a 10 lead, 25 mm x 9.9 mm metal/ceramic flanged package.

Typical Performance Over 13.75-14.5 GHz (T_c = 25°C)

Parameter	13.75 GHz	14.0 GHz	14.25 GHz	14.5 GHz	Units
Small Signal Gain	24	24.5	24.5	24	dB
Linear Output Power	24	23	21	20	W
Power Gain	21	21	20	20	dB
Power Added Efficiency	22	20	18	18	%

Note:
[1] Measured at -30 dBc, 1.6 MHz from carrier, in the CMPA1D1E025F-AMP under OQPSK modulation, 1.6 Msps, PN23, Alpha Filter = 0.2

Features

- 24 dB Small Signal Gain
- 40 W Typical Pulsed P_{SAT}
- Operation up to 40 V
- 20 W linear power under OQPSK
- Class A/B high gain, high efficiency 50 ohm MMIC Ku-Band high power amplifier

Applications

- Satellite Communication Uplink

RoHS compliant

4600 Silicon Drive | Durham, NC 27703 | Tel: +1.919.313.5300

Absolute Maximum Ratings (not simultaneous)

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DSS}	120	V_{DC}	25°C
Gate-source Voltage	V_{GS}	-10, +2		
Power Dissipation	P_{DISS}	94	W	
Storage Temperature	T_{STG}	-55, +150	°C	
Operating Junction Temperature	T_J	225		
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	$R_{\theta JC}$	1.5	°C/W	P_{DISS} = 94 W, 85°C
Case Operating Temperature	T_C	-40, +85	°C	CW, P_{DISS} = 94 W

Note: Refer to the Application Note on soldering at wolfspeed.com/rf/document-library

Electrical Characteristics (Frequency = 13.75 GHz to 14.5 GHz unless otherwise stated; T_C = 25°C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold	$V_{GS(th)}$	-3.4	-3.0	-2.6	V	V_{DS} = 10 V, I_D = 18.2 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–		V_{DS} = 40 V, I_D = 240 mA
Saturated Drain Current[2]	I_{DS}	13.1	18.2	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	100	–	–	V	V_{GS} = -8 V, I_D = 18.2 mA
RF Characteristics[3]						
Small Signal Gain	S21	20.9	24	–	dB	V_{DD} = 40 V, I_{DQ} = 240 mA, P_{IN} = -15 dBm
Input Return Loss	S11	–	-7	-6		
Output Return Loss	S22	–				
Output Mismatch Stress	VSWR	–	–	5:1	Ψ	No damage at all phase angles, V_{DD} = 40 V, I_{DQ} = 240 mA, P_{OUT} = 41 dBm OQPSK

Notes:
[1] Measured on-wafer prior to packaging
[2] Scaled from PCM data
[3] Measured in the CMPA1D1E025F-AMP

Electrical Characteristics Continued (T_C = 25°C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
RF Characteristics[1,2,3,4]						
Power Added Efficiency at 13.75 GHz	PAE	14.5	20.5	–	%	V_{DD} = 40 V, I_{DQ} = 240 mA
Power Added Efficiency at 14.5 GHz		12.5	18	–		
Power Gain at 13.75 GHz	G_P	19.25	23	–	dB	
Power Gain at 14.5 GHz		17.75	22	–		
OQPSK Linearity at 13.75 GHz	ACLR	–	-40	-32	dBc	
OQPSK Linearity at 14.5 GHz		–	-38	-30.5		

Notes:
[1] Measured in the CMPA1D1E025F-AMP
[2] Under OQPSK modulated signal, 1.6 Msps, PN23, Alpha Filter = 0.2
[3] Measured at P_{AVE} = 41 dBm
[4] Fixture loss de-embedded

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	TBD	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	TBD	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C

Typical Performance

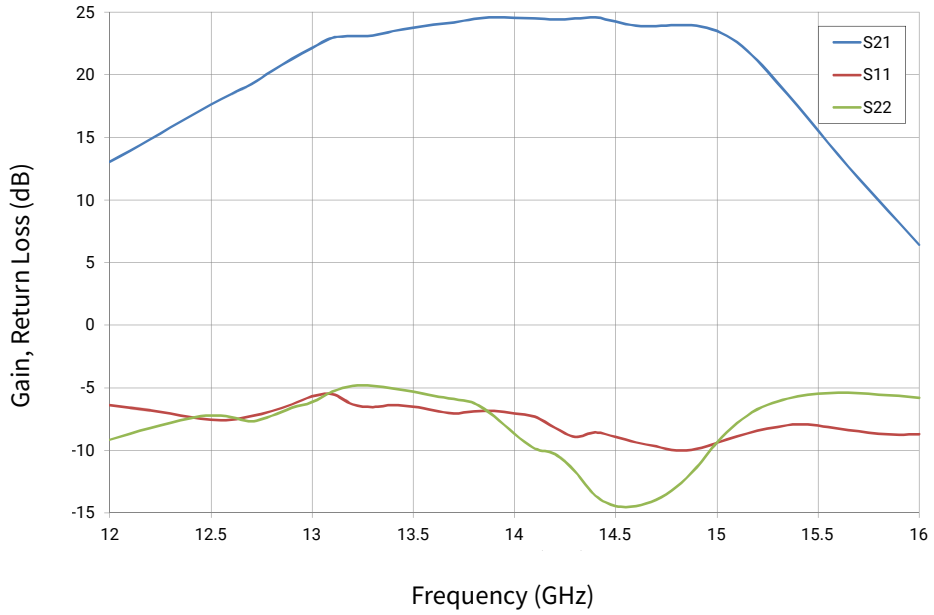


Figure 1. Small Signal S-Parameters CMPA1D1E025F in Test Fixture
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

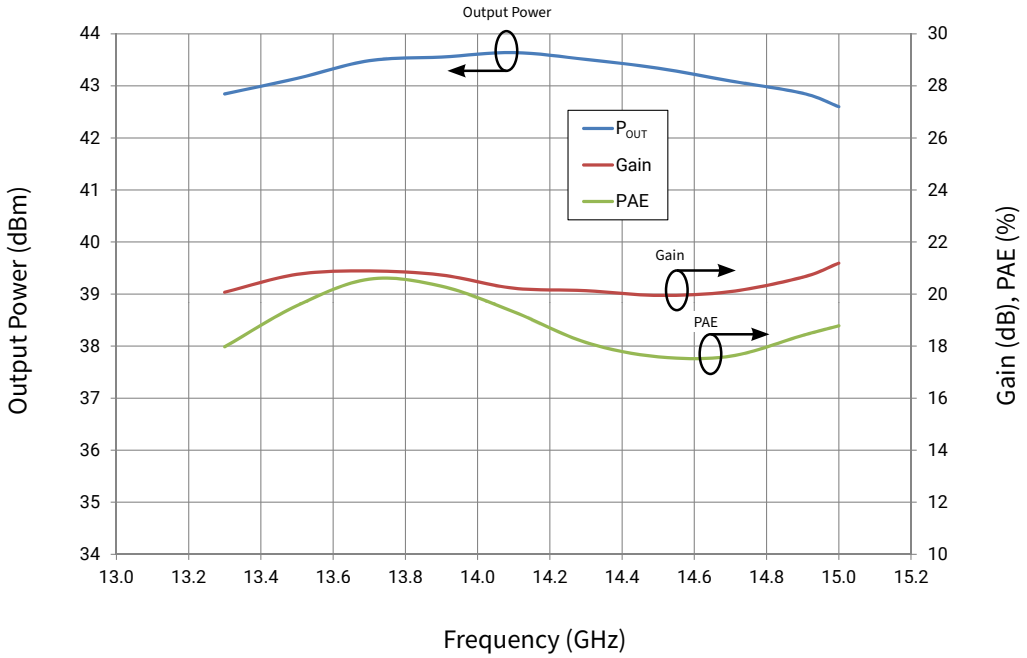


Figure 2. Modulated @ Spectral Regrowth = -30 dBc, 1.6 MHz from Carrier
1.6 Msps OQPSK Modulation
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

Typical Performance

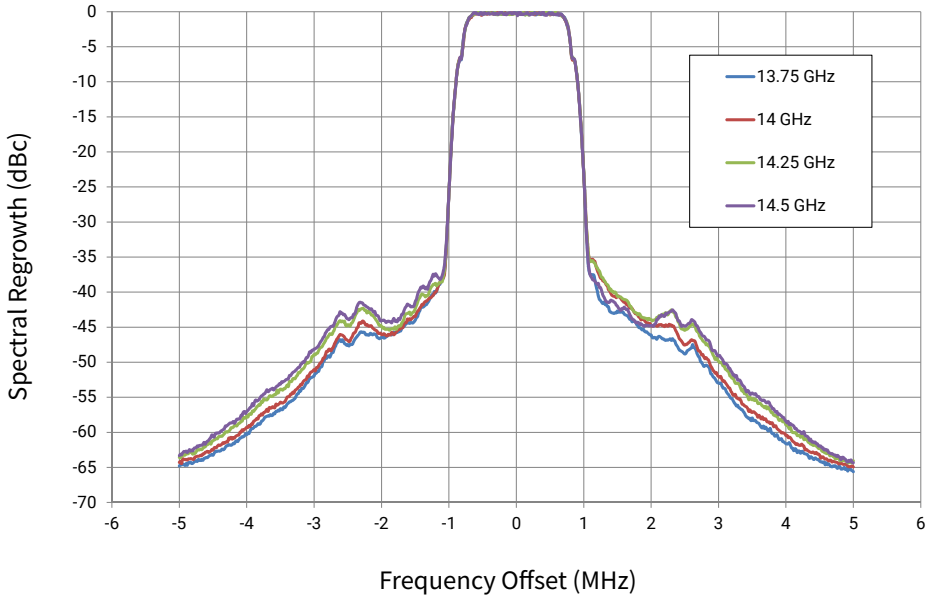


Figure 3. Spectral Mask @ Average Output Power = 41 dBm
1.6 Msps OQPSK Modulation
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

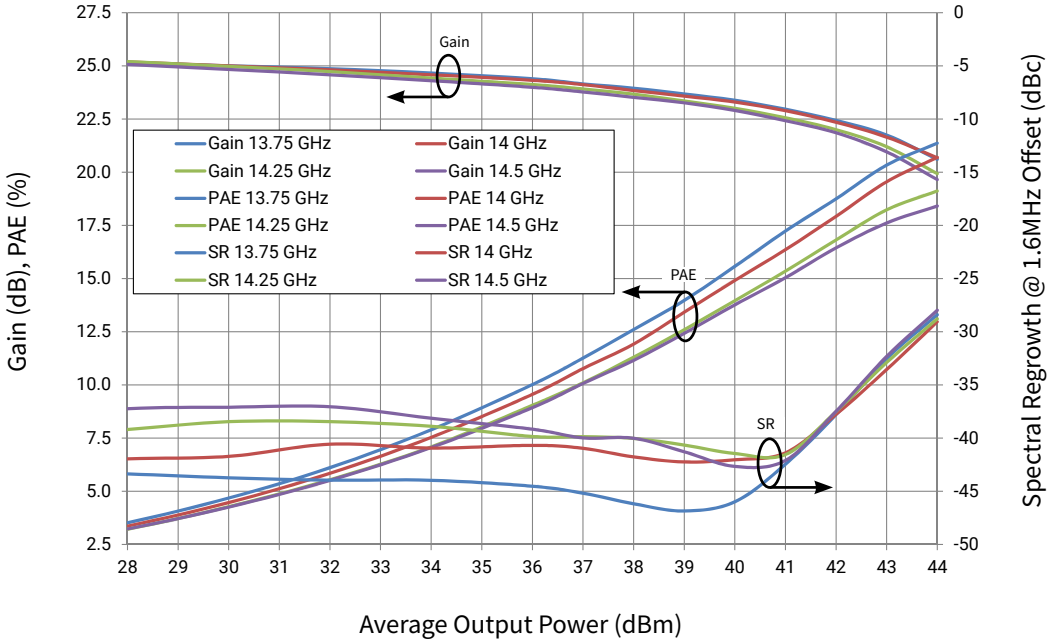


Figure 4. CMPA1D1E025F Modulated Power Sweep
1.6 Msps OQPSK Modulation
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

Typical Performance

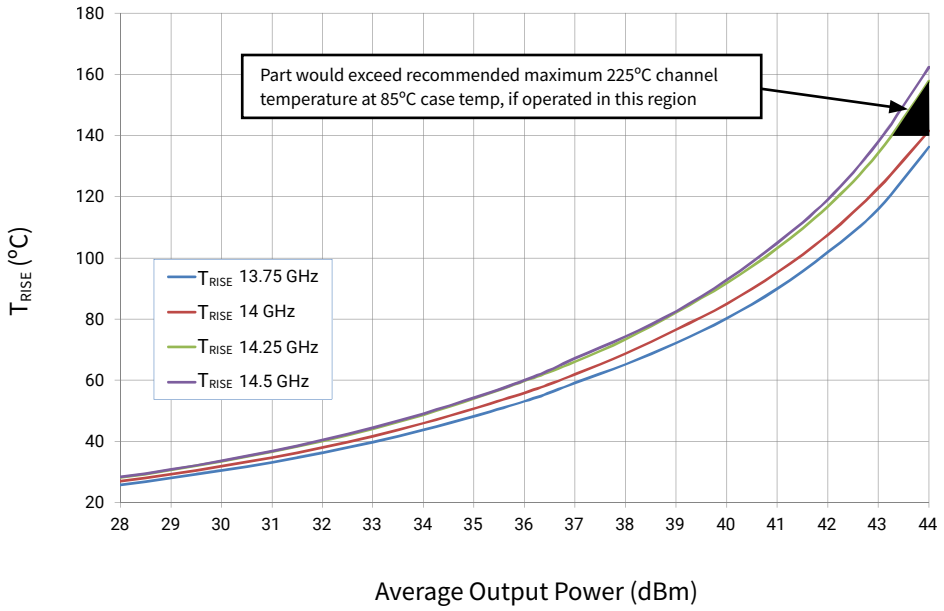


Figure 5. Modulated Power Sweep
1.6 Msps OQPSK Modulation
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

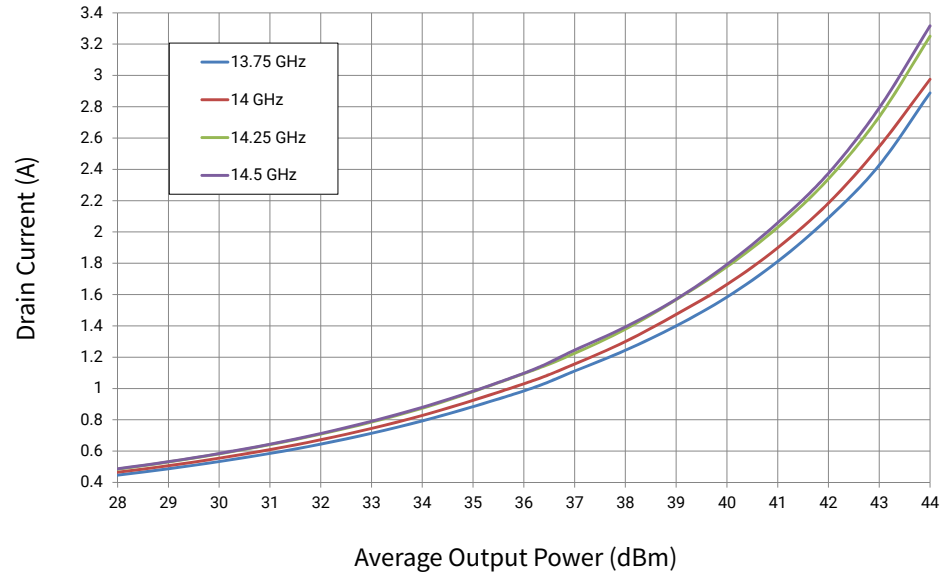


Figure 6. CMPA1D1E025F Modulated Power Sweep
1.6 Msps OQPSK Modulation
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

Typical Performance

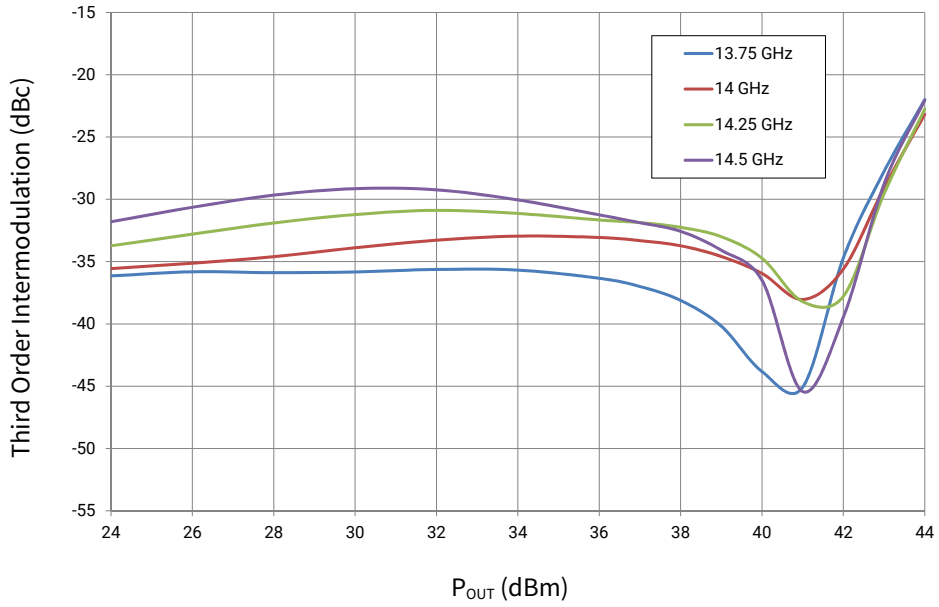


Figure 7. CMPA1D1E025F Two Tone Power Sweep
IMD3 @ 1 MHz Carrier Spacing
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

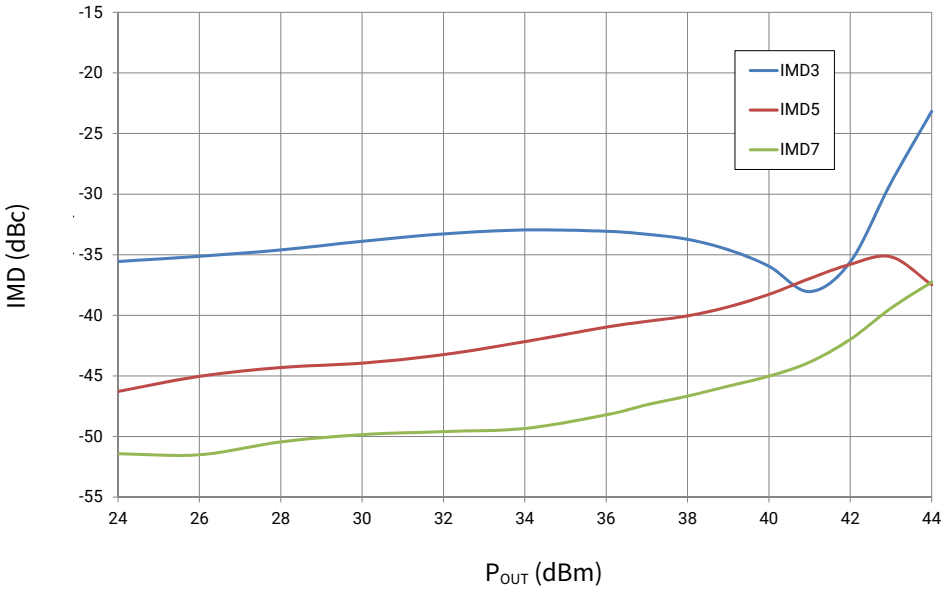


Figure 8. Two Tone Power Sweep
IMD @ 1 MHz Carrier Spacing, 14 GHz
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

Typical Performance

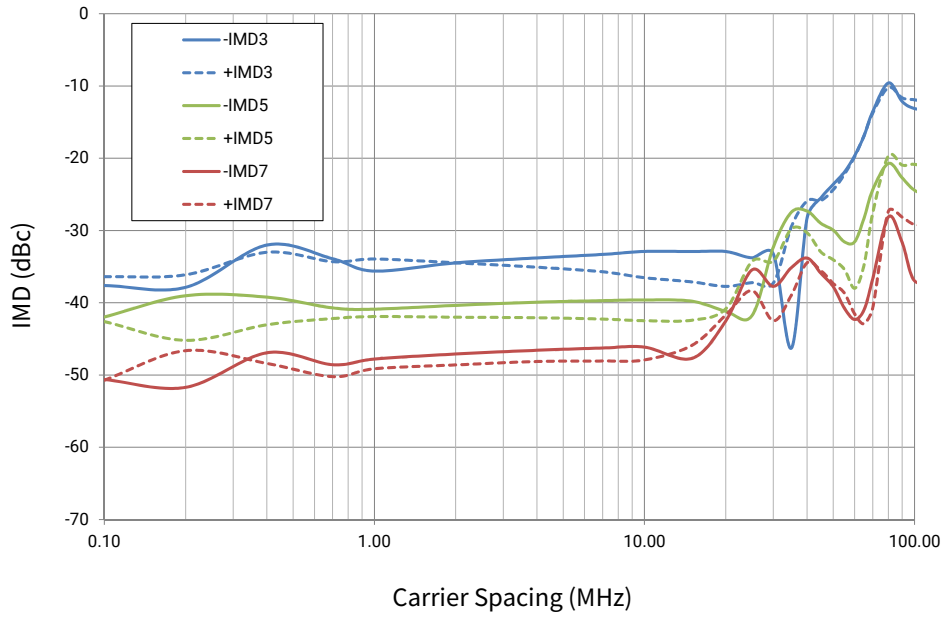


Figure 9. Two Tone Carrier Spacing Sweep @ 38 dBm Average Ouput Power, 14 GHz
V_{DD} = 40 V, I_{DQ} = 1 A, T_{CASE} = 25°C

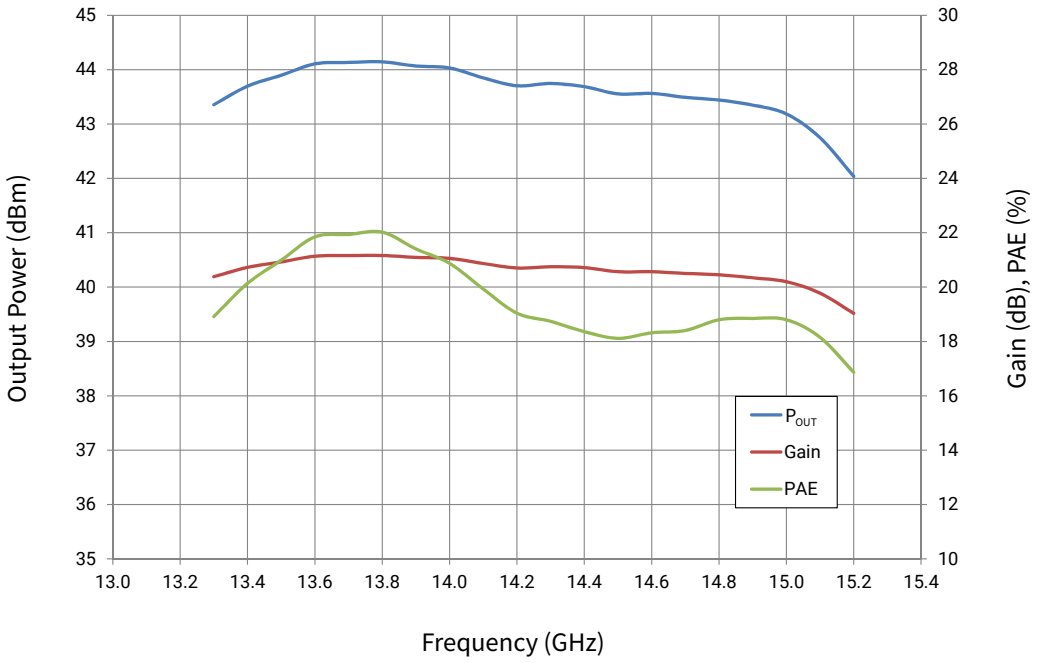


Figure 10. CW vs Frequency @ P_{IN} = 23 dBm
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

Typical Performance

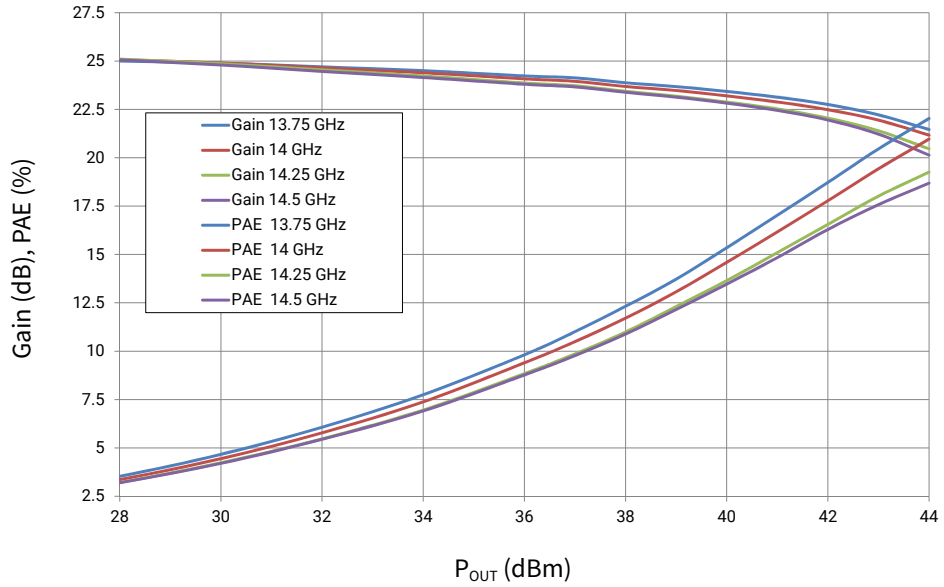


Figure 11. CW Power Sweep CMPA1D1E025F in Test Fixture
V_{DD} = 40V, I_{DQ} = 240 mA, T_{CASE} = 25°C

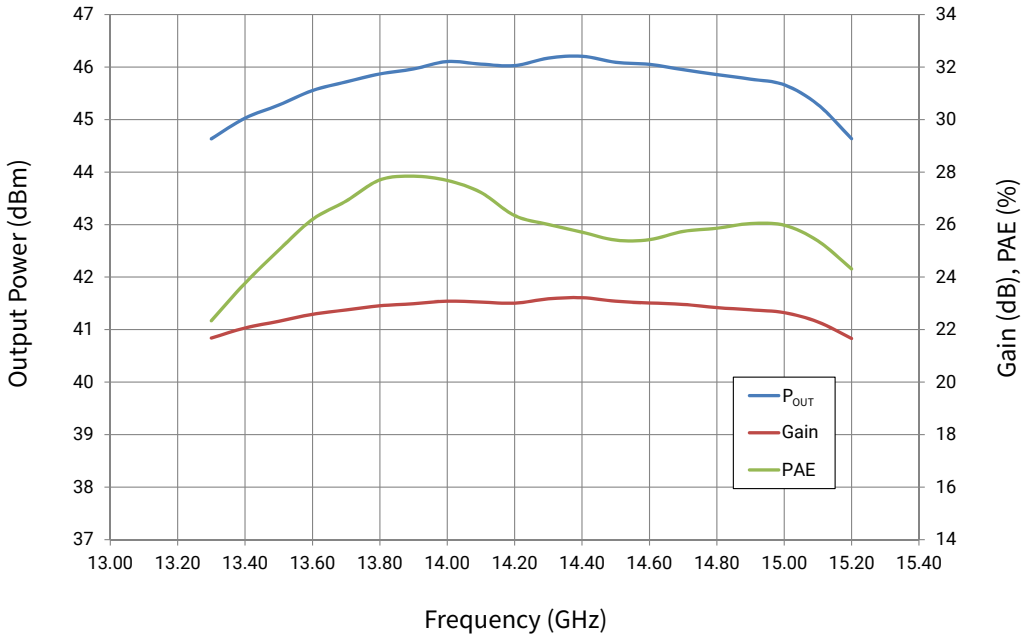


Figure 12. Pulsed vs Frequency @ P_{IN} = 23 dBm CMPA1D1E025F in Test Fixture
V_{DD} = 40 V, I_{DQ} = 240 mA, 100µs Pulse Width, 10% Duty Cycle, T_{CASE} = 25°C

Typical Performance

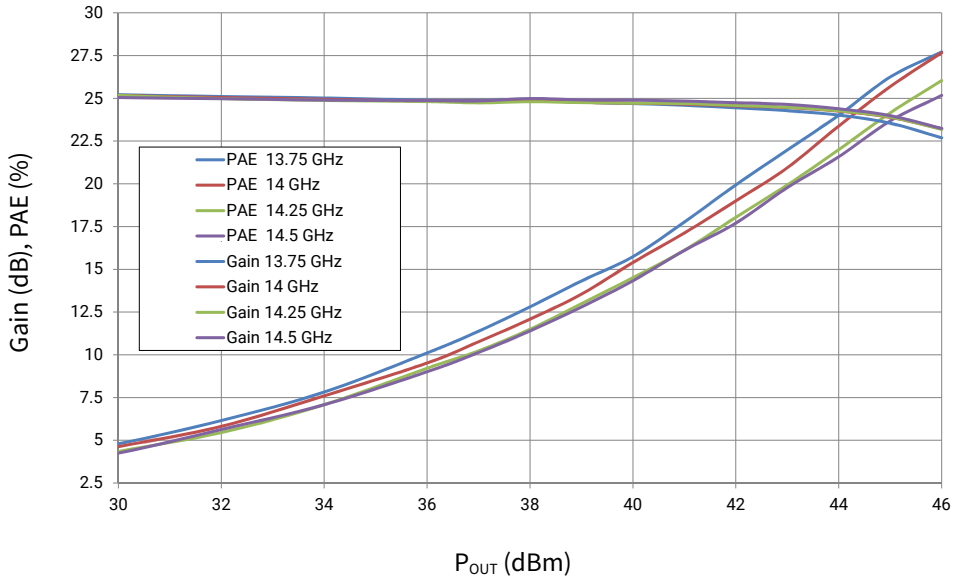


Figure 13. Pulsed Power Sweep CMPA1D1E025F in Test Fixture
10% Duty, 100µs Pulse Width
V_{DD} = 40V, I_{DQ} = 240 mA, T_{CASE} = 25°C

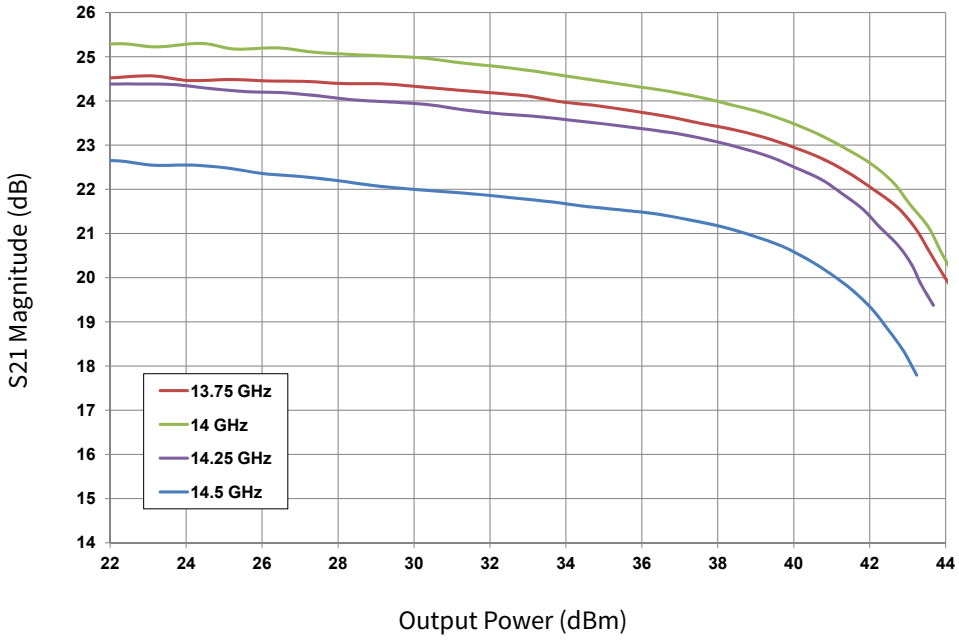


Figure 14. AM-AM
V_{DD} = 40 V, I_{DQ} = 240 mA, T_{CASE} = 25°C

Typical Performance

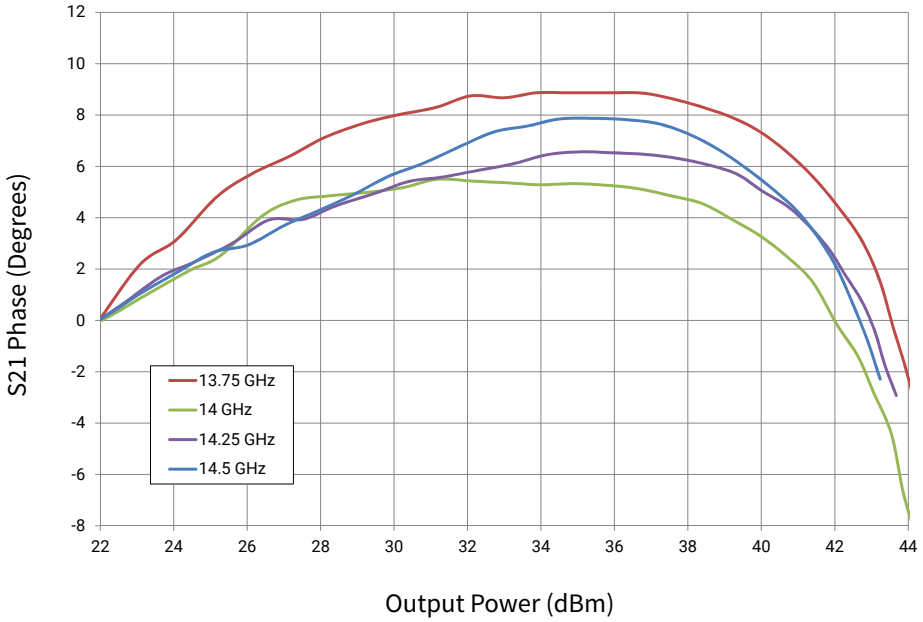


Figure 15. AM-PM
V_{DD} = 40V, I_{DQ} = 240 mA, T_{CASE} = 25°C

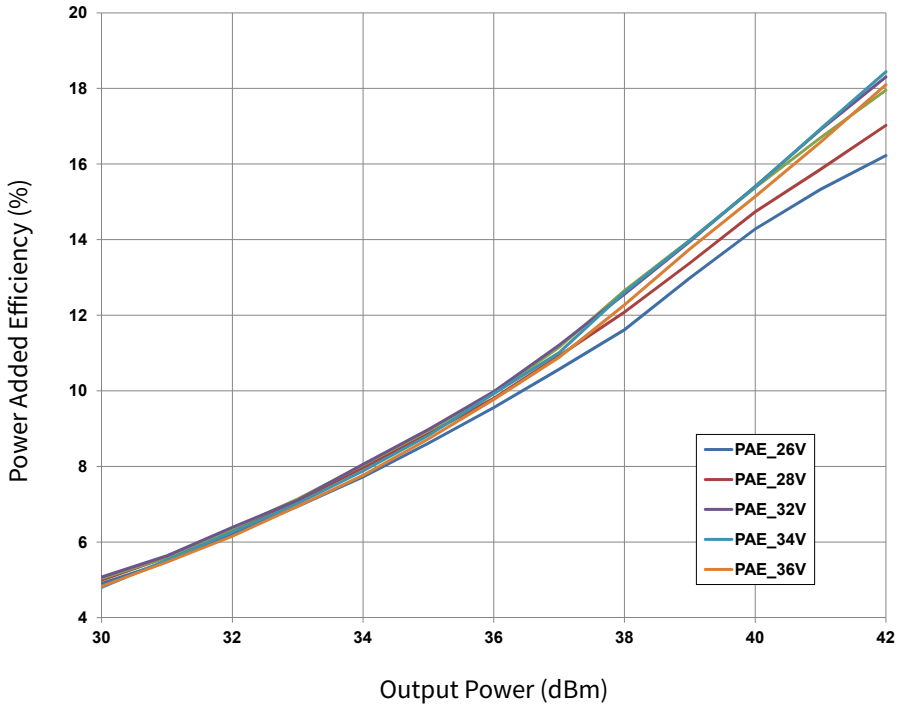


Figure 16. CMPA1D1E025F Modulated Power Sweep (PAE and G_P)
1.6 Msps OQPSK Modulation, Frequency = 14 GHz
V_{DD} = 26-36 V, I_{DQ} = 150 mA, T_{CASE} = 25°C

Typical Performance

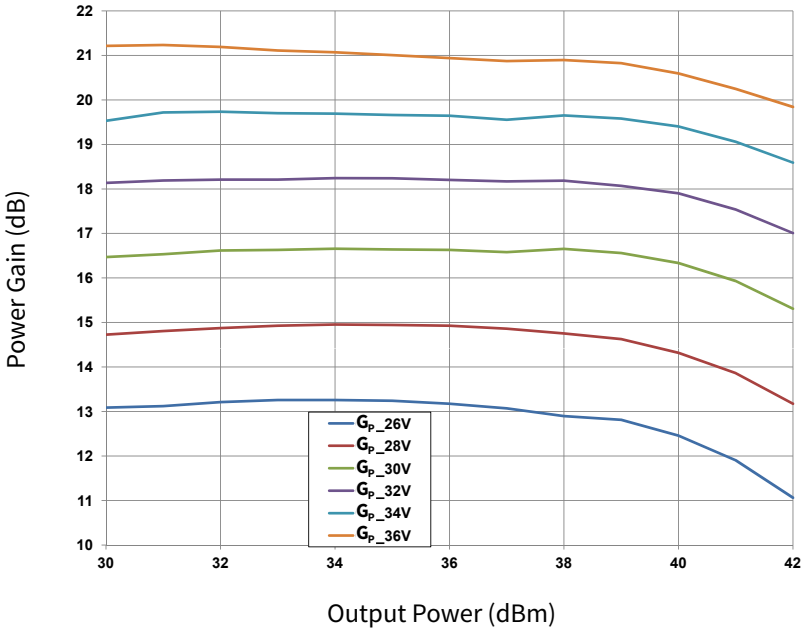


Figure 17. CMPA1D1E025F Modulated Power Sweep (G_P)
1.6 Msps OQPSK Modulation, Frequency = 14 GHz
V_{DD} = 26-36 V, I_{DQ} = 150 mA, T_{CASE} = 25°C

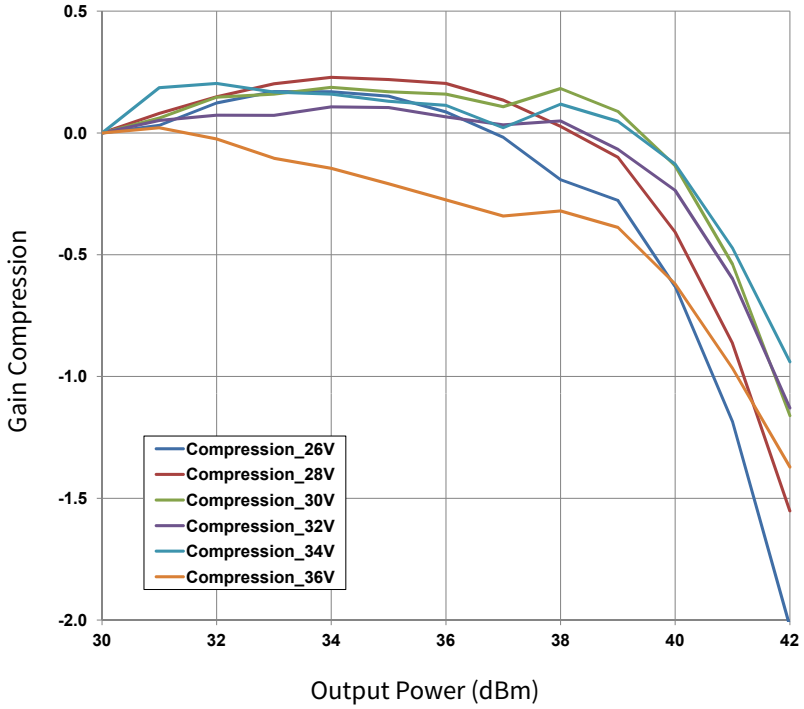
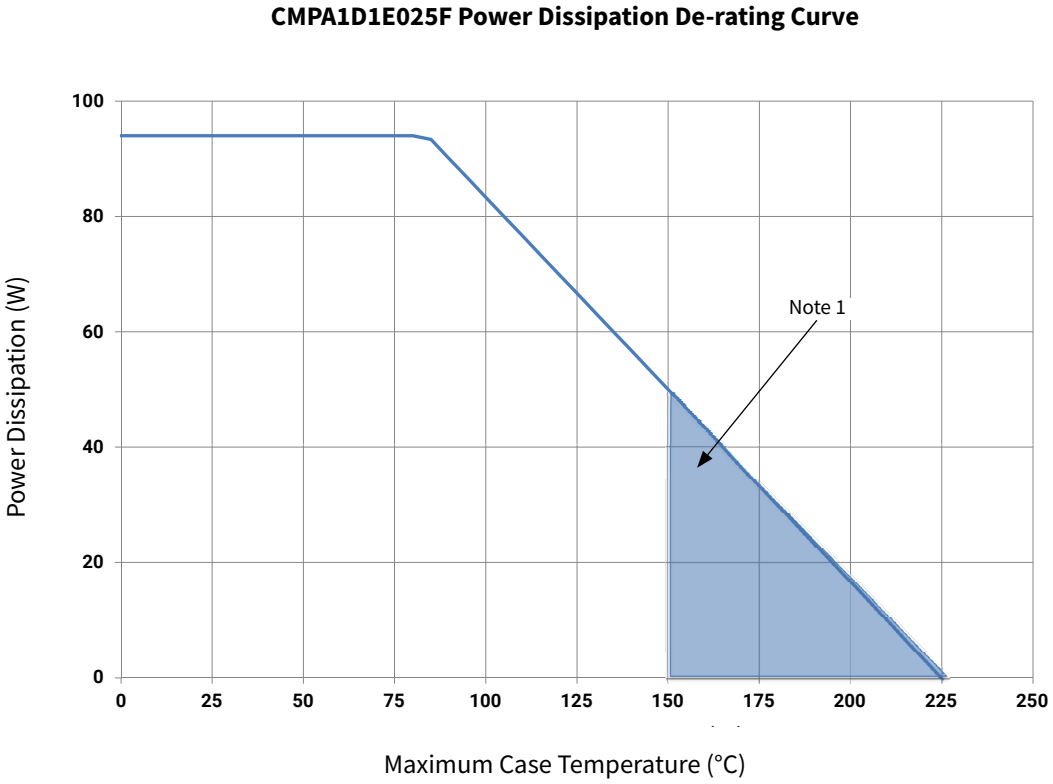


Figure 18. CMPA1D1E025F Modulated Power Sweep (Gain Compression)
1.6 Msps OQPSK Modulation, Frequency = 14 GHz
V_{DD} = 26-36 V, I_{DQ} = 150 mA, T_{CASE} = 25°C

Typical Performance

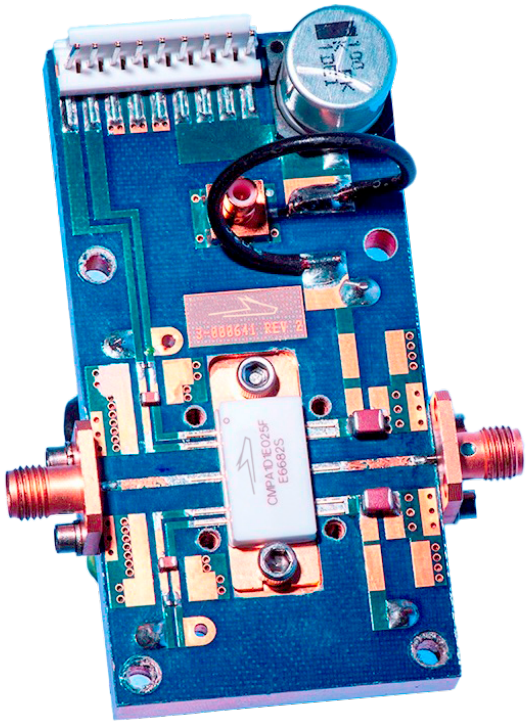


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2)

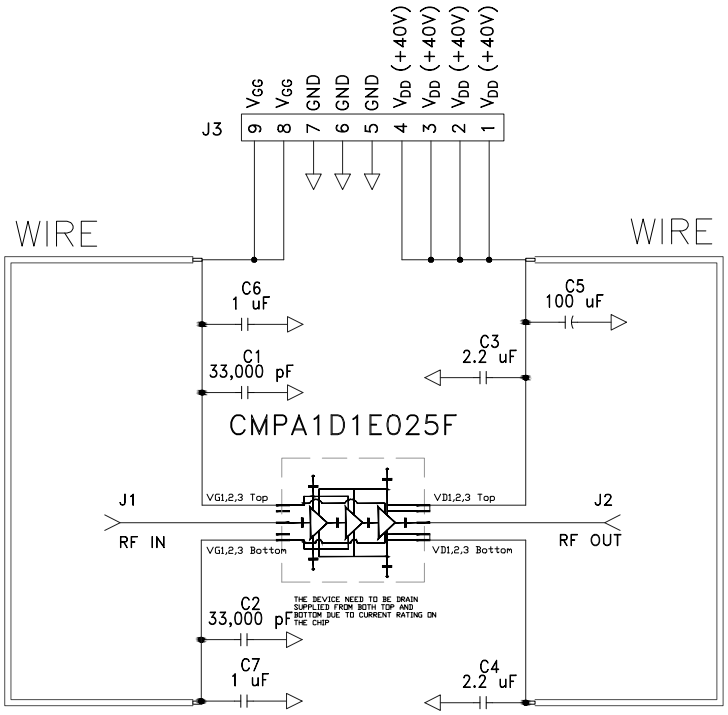
CMPA1D1E025F-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C5	CAP ELECT 100µF 80V AFK SMD	1
C1, C2	CAP, 33000pF, 0805, 100V, X7R	2
C3, C4	CAP, 2.2µF, 100V, 10%, X7R, 1210	2
C6, C7	CAP, 1.0µF, 100V, 10%, X7R, 1210	2
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
J3	HEADER RT>PLZ .1CEN LK 9POS	1
W1, W2, W3	WIRE, BLACK, 22 AWG	1
	PCB, TEST FIXTURE, TACONICS RF35P, 20 MILS	1
	2-56 SOC HD SCREW 3/16 SS	4
-	#2 SPLIT LOCKWASHER SS	4
Q1	CMPA1D1E025F	1

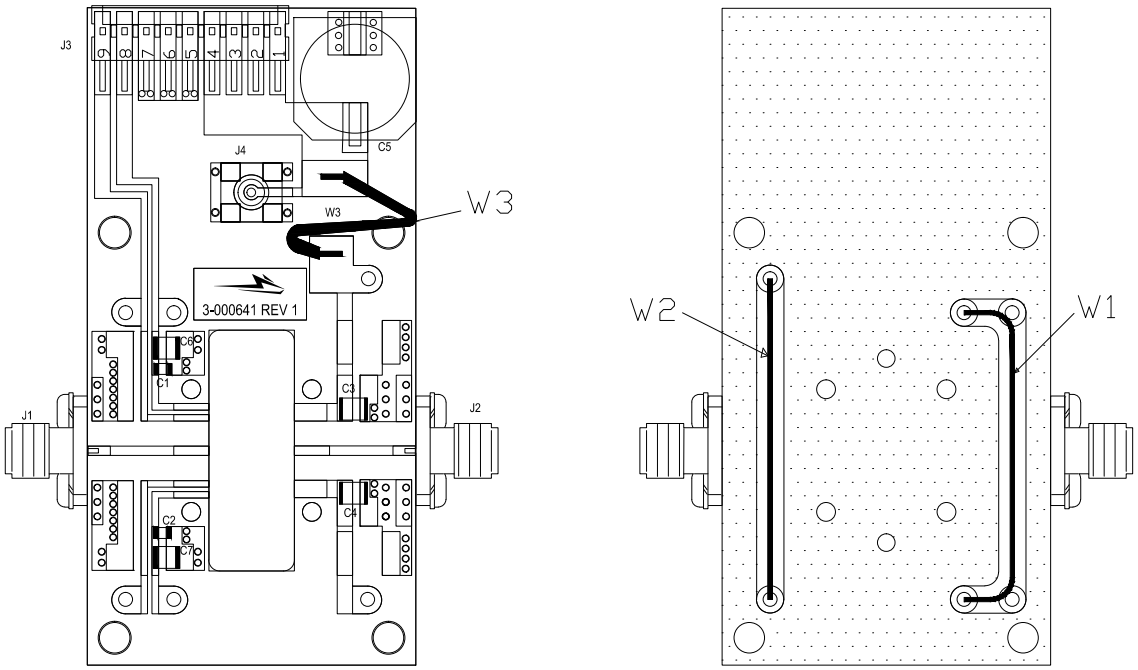
CMPA1D1E025F-AMP Demonstration Amplifier Circuit



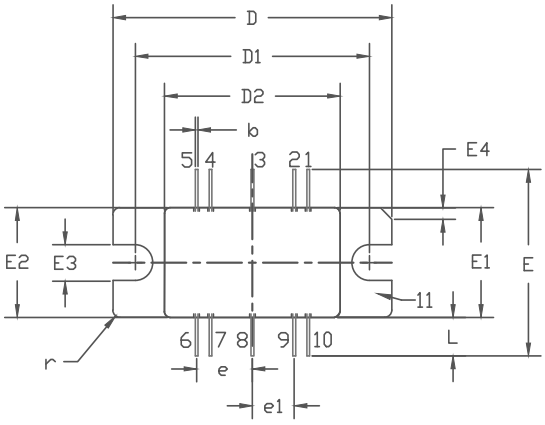
CMPA1D1E025F-AMP Demonstration Amplifier Circuit Schematic

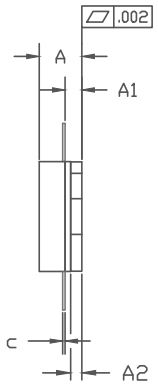


CMPA1D1E025F-AMP Demonstration Amplifier Circuit Outline



Product Dimensions CMPA1D1E025F (Package Type — 440213)





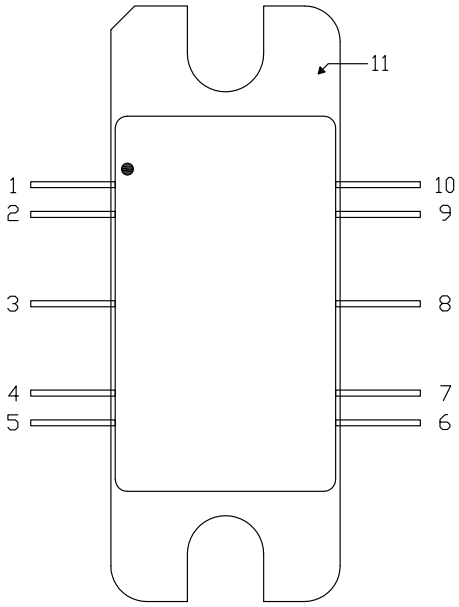
PIN 1: GATE BIAS 6: DRAIN BIAS
2: GATE BIAS 7: DRAIN BIAS
3: RF IN 8: RF OUT
4: GATE BIAS 9: DRAIN BIAS
5: GATE BIAS 10: DRAIN BIAS
11: SOURCE

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.

	INCHES		MILLIMETERS		NOTES
DIM	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	0.380	0.390	9.65	9.91	
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
2	NC
3	RF IN
4	NC
5	Gate Bias
6	Drain Bias
7	
8	RF OUT
9	Drain Bias
10	
11	Source



Part Number System

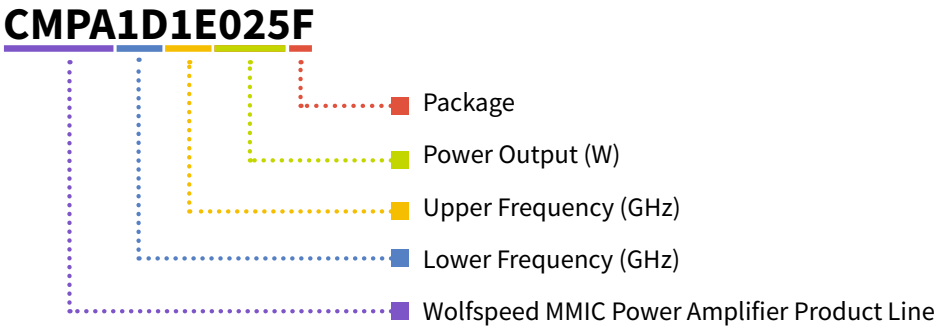


Table 1.

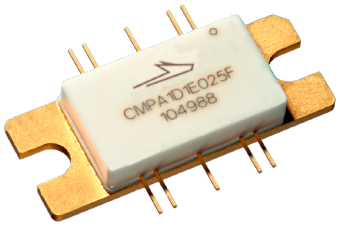
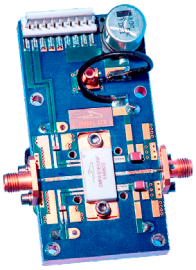
Parameter	Value	Units
Lower Frequency	13.75	GHz
Upper Frequency[1]	14.5	
Power Output	25	W
Package	Flange	–

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
CMPA1D1E025F	GaN HEMT	Each	
CMPA1D1E025F-AMP	Test board with GaN MMIC installed	Each	

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Notes & Disclaimer

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