CMPA2060035F1

35 W, 2.0 - 6.0 GHz, GaN MMIC, Power Amplifier

Description

Wolfspeed's CMPA2060035F1 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 contains a two-stage 50-ohm matched amplifier, enabling very wide bandwidths to be achieved, in a small 0.5" square, screw-down package.

PN: CMPA2060035F1
Package Type: 440219

Typical Performance Over 2.0 - 6.0 GHz ($T_C = 25^\circ C$)

Parameter	2.0 GHz	3.0 GHz	4.0 GHz	5.0 GHz	6.0 GHz	Units
Small Signal Gain[1,2]	30.0	29.4	30.4	32.0	27.5	dB
Output Power[1,3]	45.6	46.2	45.7	46.2	44.4	dBm
Power Gain[1,3]	23.6	24.2	23.7	24.2	22.4	dB
Power Added Efficiency[1,3]	52	48	38	35	30	%

Notes:
[1] V_{DD} = 28 V, I_{DQ} = 1000 mA
[2] Measured at Pin = -20 dBm
[3] Measured at Pin = 22 dBm and CW

Features

- >30% Typical Power Added Efficiency
- 30 dB Small Signal Gain
- 36W Typical P_{SAT}
- Operation up to 28 V
- High Breakdown Voltage
- High Temperature Operation

Note: Features represent typical performance across multiple frequencies under 25°C operation. Please reference the performance charts for additional details.

Applications

- Civil and Military Pulsed Radar Amplifiers
- Test Instrumentation
- Electronic Warfare Jamming

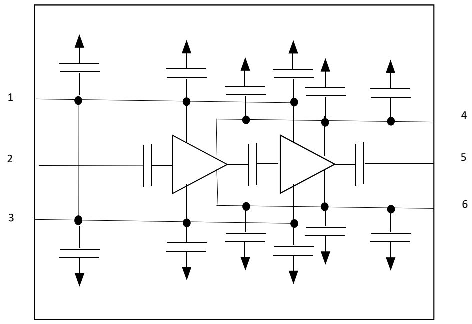


Figure 1.

RoHS COMPLIANT

Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DSS}	84	VDC	25°C
Gate-source Voltage	V_{GS}	-10, +2	VDC	25°C
Storage Temperature	T_{STG}	-55, +150	˚C	
Maximum Forward Gate Current	I_G	16.32	mA	25°C
Maximum Drain Current	I_{DMAX}	4.0	A	
Soldering Temperature	T_S	260	˚C	

Electrical Characteristics (Frequency = 2.0 GHz to 6.0 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(TH)}$	-2.6	-2.0	-1.6	V	V_{DS} = 10 V, I_D = 16.32 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-1.8	–	V_{DC}	V_{DD} = 28 V, I_{DQ} = 1000 mA
Saturated Drain Current[1]	I_{DS}	16.32	19.58	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BD}	84	–	–	V	V_{GS} = -8 V, I_D = 16.32 mA
RF Characteristics						
Small Signal Gain	$S21_1$	–	30.0	–	dB	Pin = -20 dBm, Freq = 2.0 - 6.0 GHz
Output Power[2]	P_{OUT1}	–	45.6	–	dBm	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 2.0 GHz
Output Power[2]	P_{OUT2}	–	46.2	–	dBm	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 3.0 GHz
Output Power[2]	P_{OUT3}	–	45.7	–	dBm	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 4.0 GHz
Output Power[2]	P_{OUT4}	–	46.2	–	dBm	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 5.0 GHz
Output Power[2]	P_{OUT5}	–	44.4	–	dBm	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 6.0 GHz
Power Added Efficiency[2]	PAE_1	–	52	–	%	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 2.0 GHz
Power Added Efficiency[2]	PAE_2	–	48	–	%	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 3.0 GHz
Power Added Efficiency[2]	PAE_3	–	38	–	%	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 4.0 GHz
Power Added Efficiency[2]	PAE_4	–	35	–	%	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 5.0 GHz
Power Added Efficiency[2]	PAE_5	–	30	–	%	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 6.0 GHz
Power Gain	G_{P1}	–	23.6	–	dB	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 2.0 GHz
Power Gain	G_{P2}	–	24.2	–	dB	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 3.0 GHz
Power Gain	G_{P3}	–	23.7	–	dB	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 4.0 GHz
Power Gain	G_{P4}	–	24.2	–	dB	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 5.0 GHz
Power Gain	G_{P5}	–	22.4	–	dB	V_{DD} = 28 V, I_{DQ} = 1000 mA, P_{IN} = 22 dBm, Freq = 6.0 GHz
Input Return Loss	S11	–	-14	–	dB	Pin = -20 dBm, 2.0 - 6.0 GHz
Output Return Loss	S22	–	-14	–	dB	Pin = -20 dBm, 2.0 - 6.0 GHz
Output Mismatch Stress	VSWR	–	–	5 : 1	Ψ	No damage at all phase angles

Notes:
[1] Scaled from PCM data
[2] Performance is based on production testing at a fixed input power. To see performance where the input power is optimized for either maximum output power or power added efficiency, see Figures 46 and 47.

Thermal Characteristics

Parameter	Symbol	Rating	Units	Conditions
Operating Junction Temperature	T_J	225	˚C	
Thermal Resistance, Junction to Case (packaged)[1]	$R_{\theta JC}$	1.5	˚C/W	CW

Notes:
[1]For the CMPA2060035F1 at P_{DISS} = 89 W

Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, CW, Pin = 22 dBm, T_{BASE} = +25 °C

Figure 1. Output Power vs Frequency as a Function of Temperature

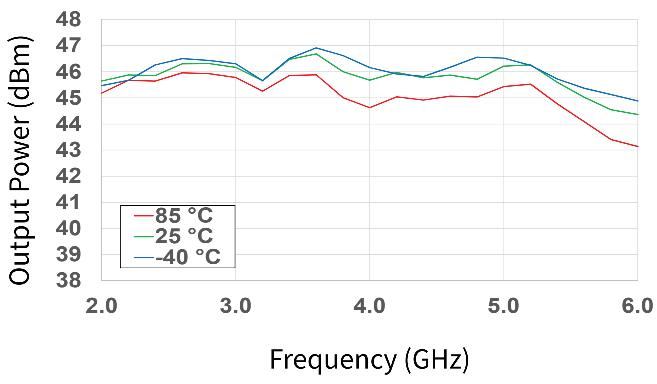


Figure 2. Output Power vs Frequency as a Function of Input Power

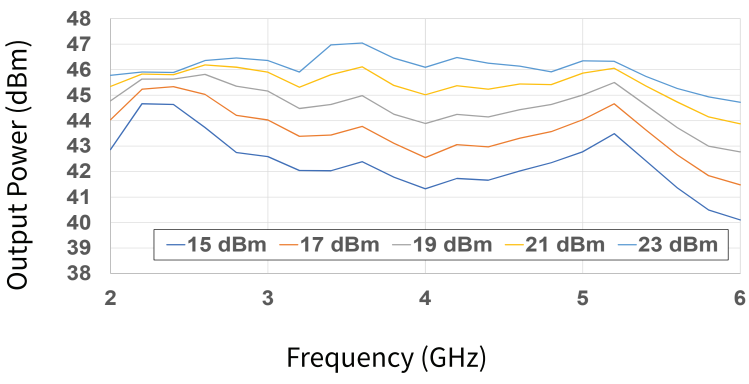


Figure 3. Power Added Eff. vs Frequency as a Function of Temperature

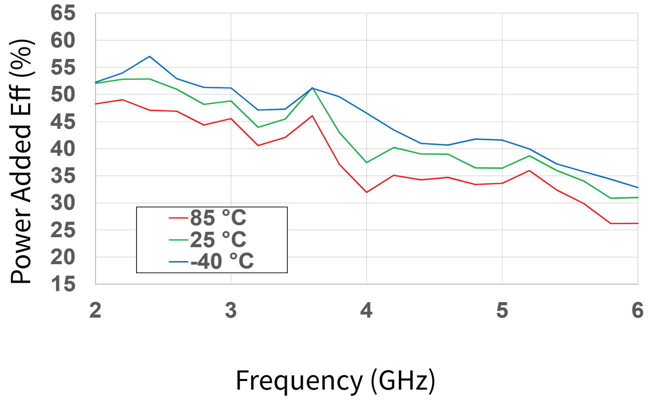


Figure 4. Power Added Eff. vs Frequency as a Function of Input Power

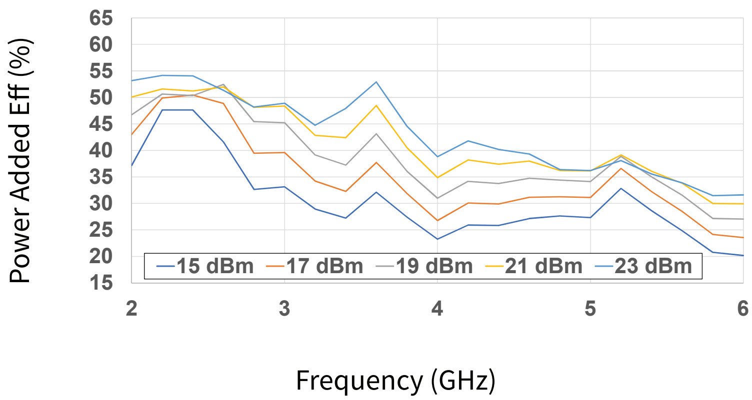


Figure 5. Drain Current vs Frequency as a Function of Temperature

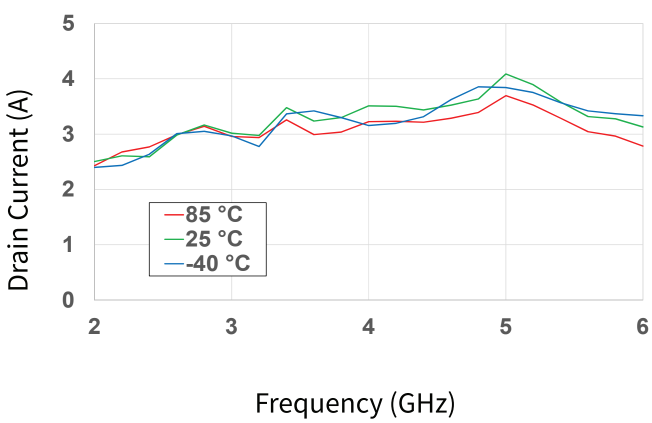
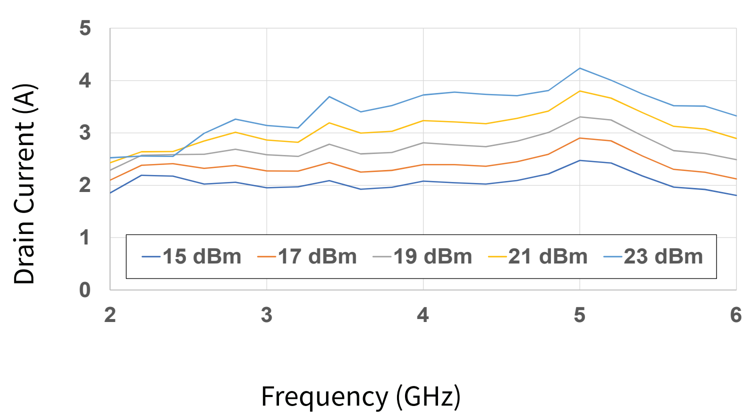


Figure 6. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, CW, Pin = 22 dBm, T_{BASE} = +25 °C

Figure 7. Output Power vs Frequency as a Function of VD

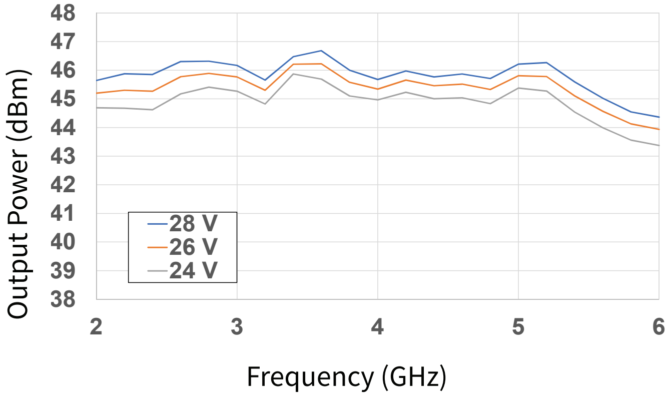


Figure 8. Output Power vs Frequency as a Function of IDQ

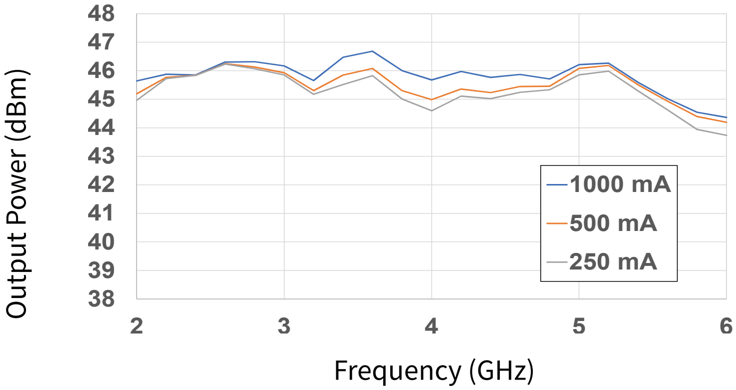


Figure 9. Power Added Eff. vs Frequency as a Function of VD

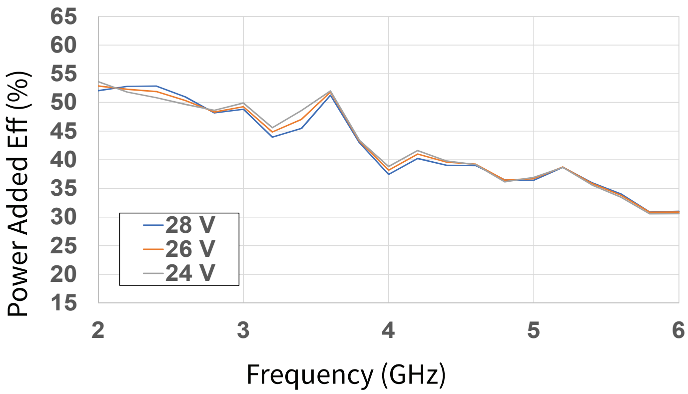


Figure 10. Power Added Eff. vs Frequency as a Function of IDQ

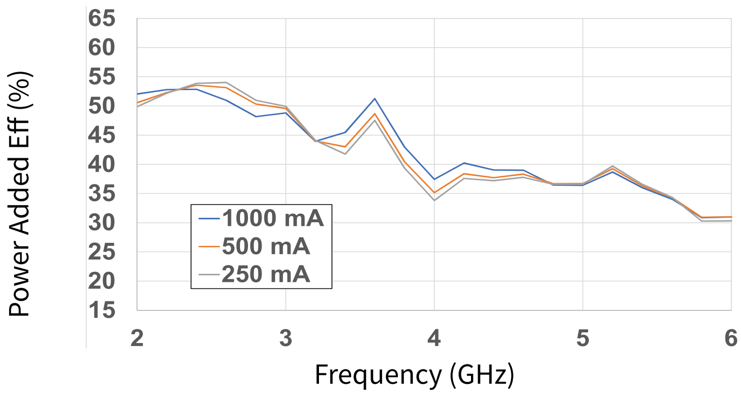


Figure 11. Drain Current vs Frequency as a Function of VD

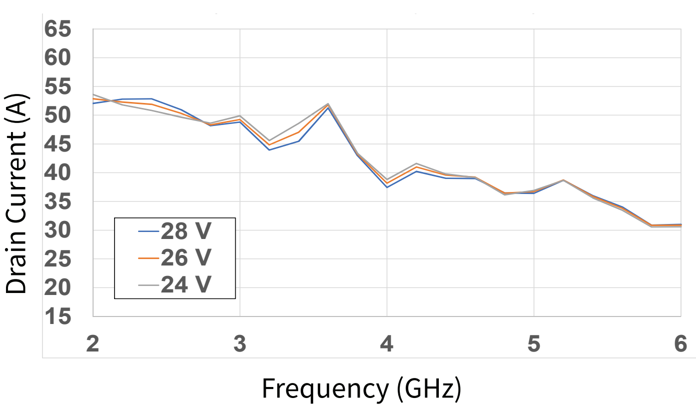
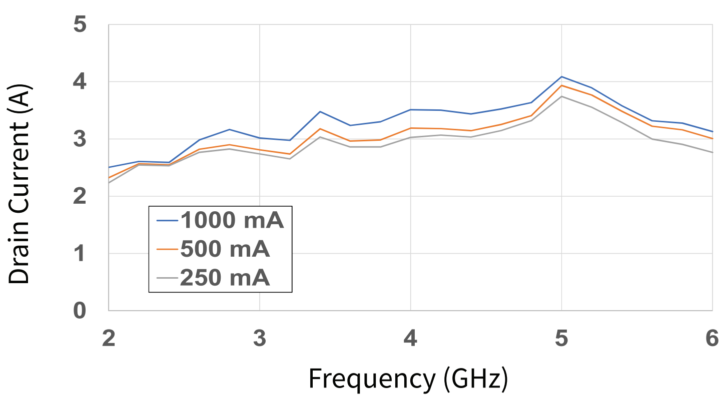


Figure 12. Drain Current vs Frequency as a Function of IDQ



Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, CW, Pin = 22 dBm, T_{BASE} = +25 °C

Figure 13. Output Power vs Input Power as a Function of Frequency

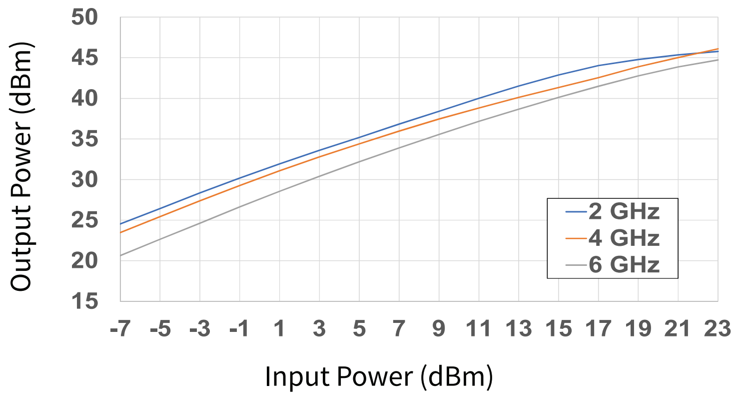


Figure 14. Power Added Eff. vs Input Power as a Function of Frequency

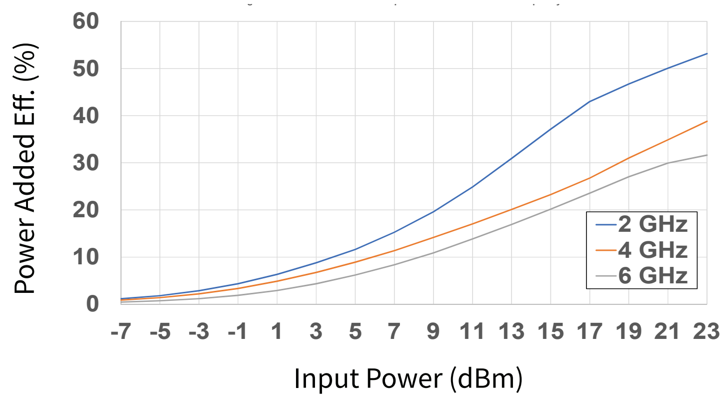


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

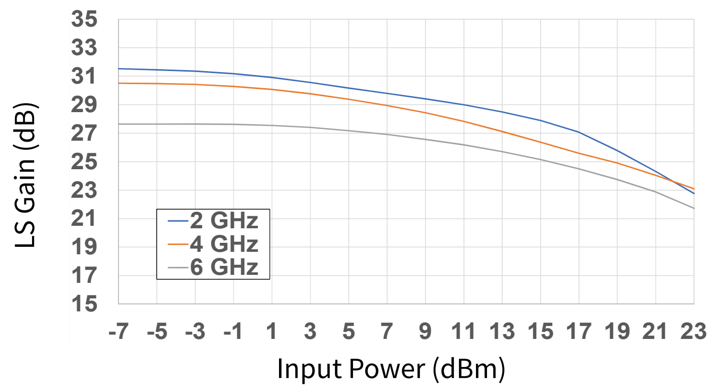


Figure 16. Drain Current vs Input Power as a Function of Frequency

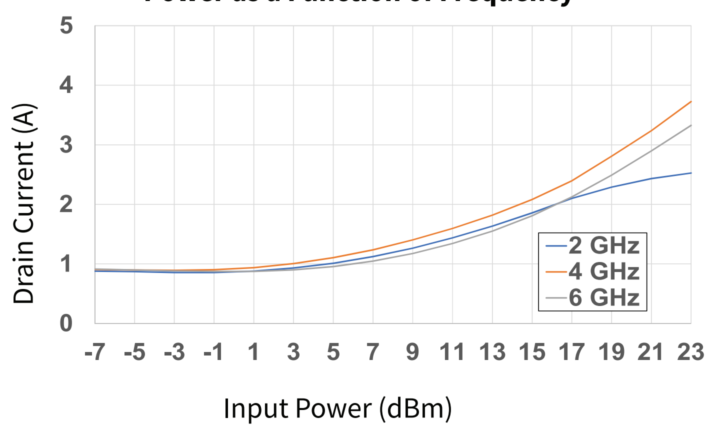
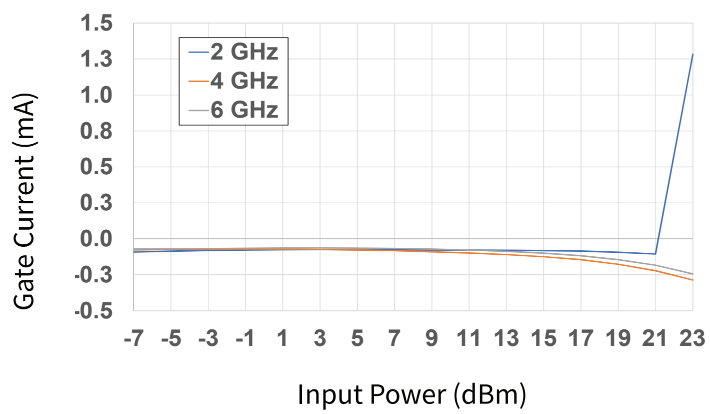


Figure 17. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, CW, Pin = 22 dBm, T_{BASE} = +25 °C

Figure 18. Output Power vs Input Power as a Function of Temperature

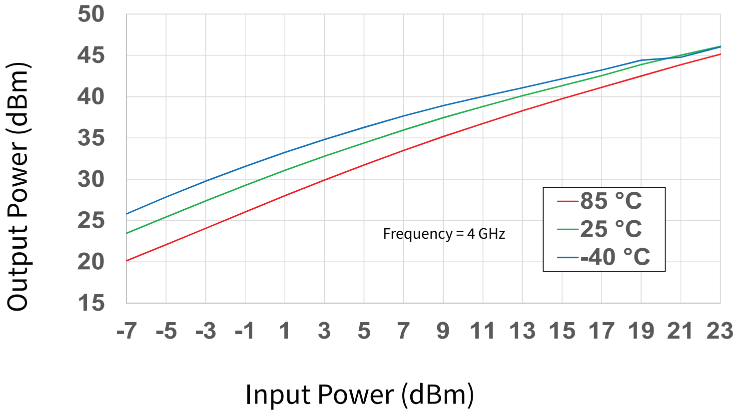


Figure 19. Power Added Eff. vs Input Power as a Function of Temperature

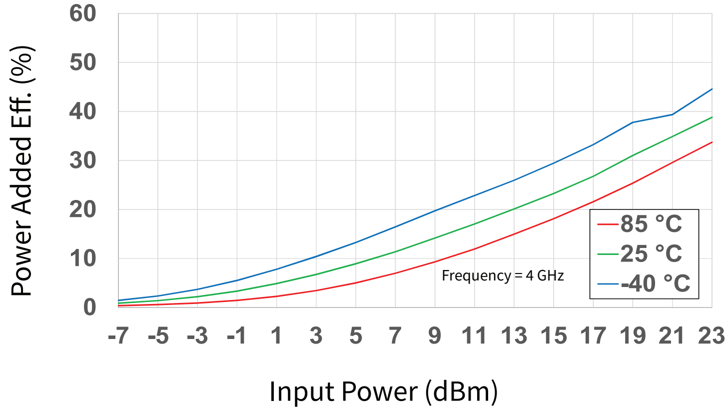


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

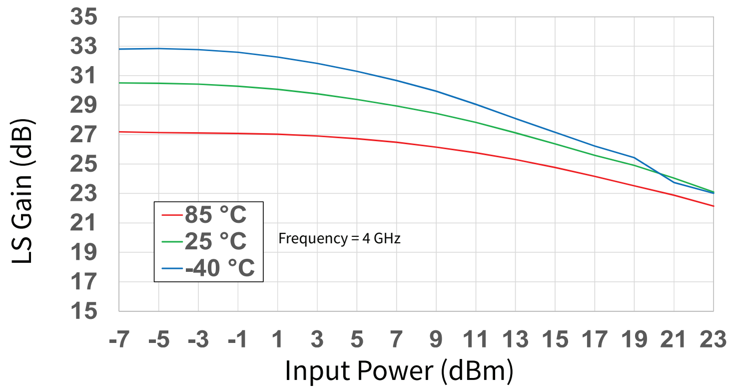


Figure 21. Drain Current vs Input Power as a Function of Temperature

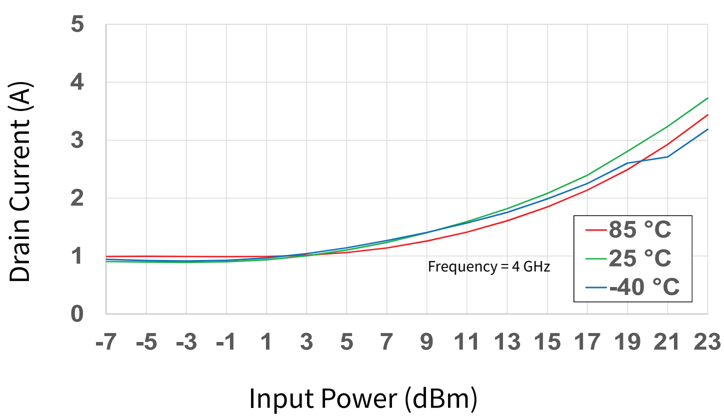
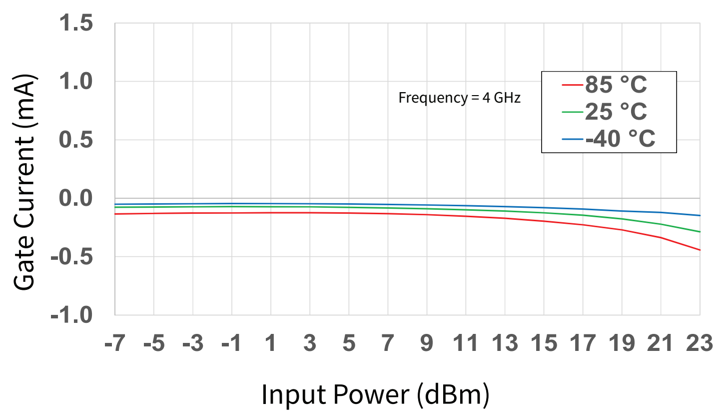


Figure 22. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, CW, Pin = 22 dBm, T_{BASE} = +25 °C

Figure 23. Output Power vs Input Power as a Function of IDQ

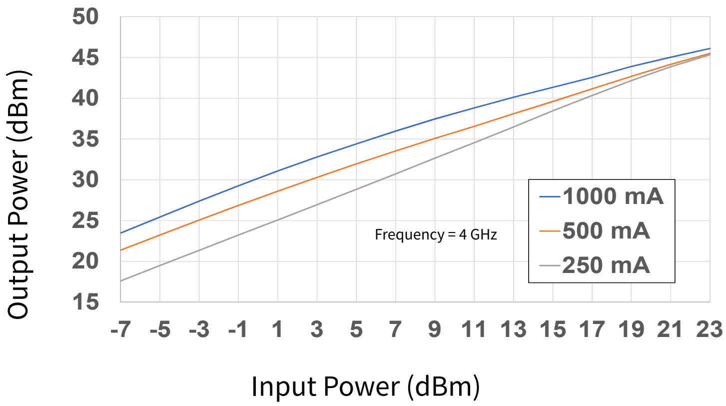


Figure 24. Power Added Eff. vs Input Power as a Function of IDQ

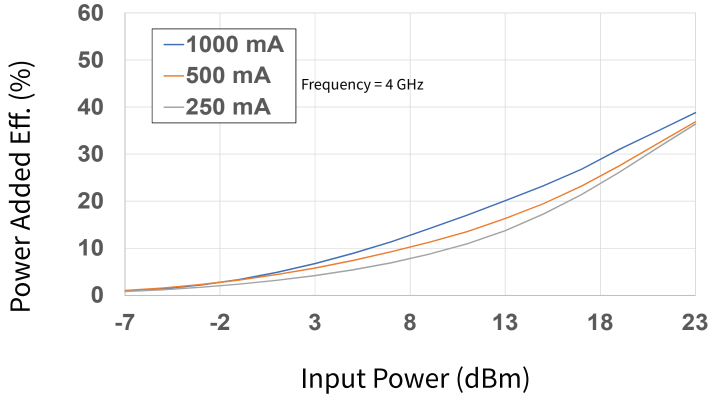


Figure 25. Large Signal Gain vs Input Power as a Function of IDQ

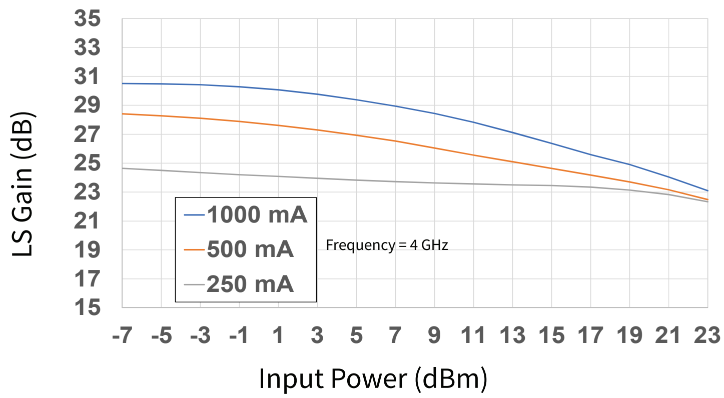


Figure 26. Drain Current vs Input Power as a Function of IDQ

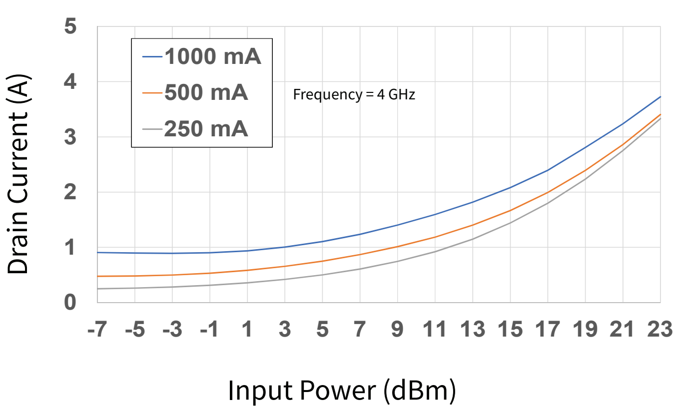
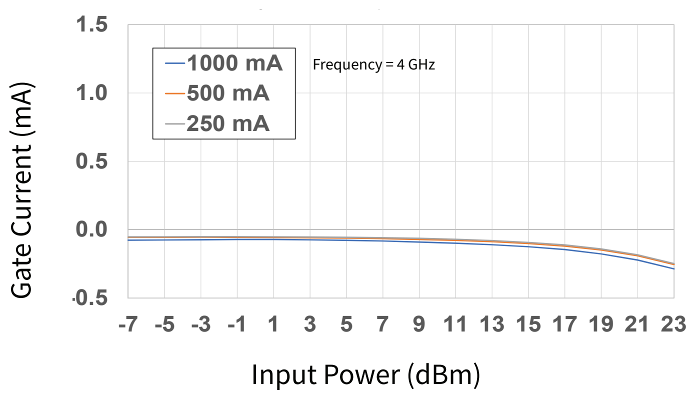


Figure 27. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, CW, Pin = 22 dBm, T_{BASE} = +25 °C

Figure 28. 2nd Harmonic vs Frequency as a Function of Temperature

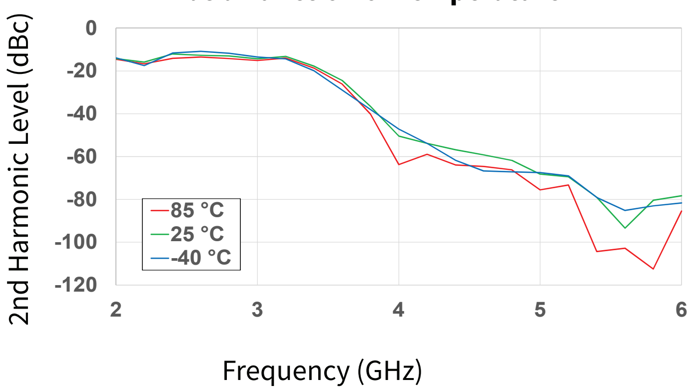


Figure 29. 3rd Harmonic vs Frequency as a Function of Temperature

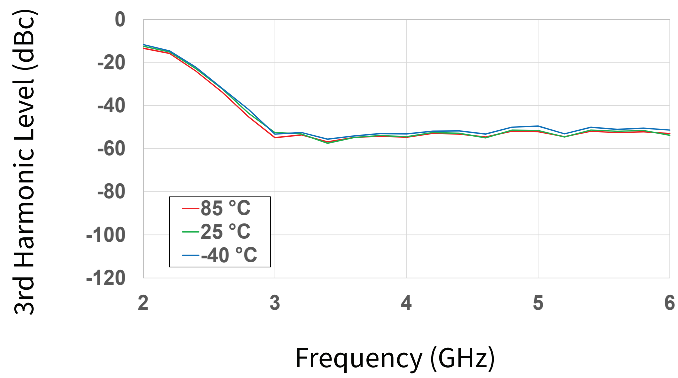


Figure 30. 2nd Harmonic vs Output Power as a Function of Frequency

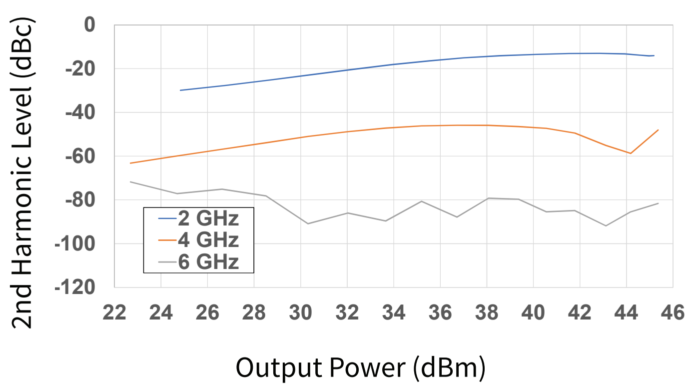


Figure 31. 3rd Harmonic vs Output Power as a Function of Frequency

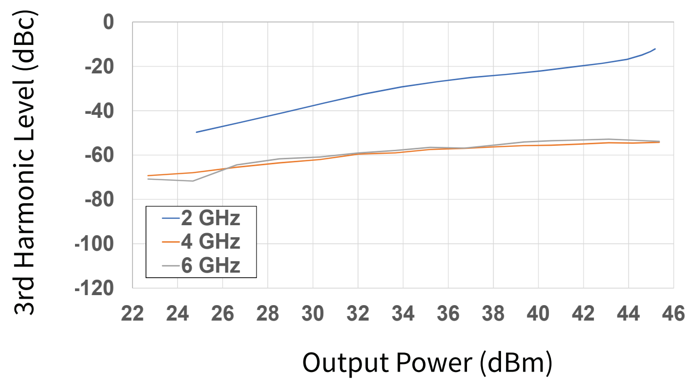


Figure 32. 2nd Harmonic vs Output Power as a Function of IDQ

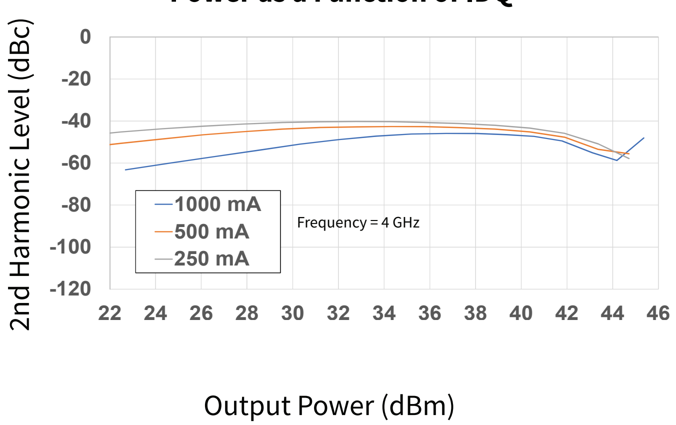
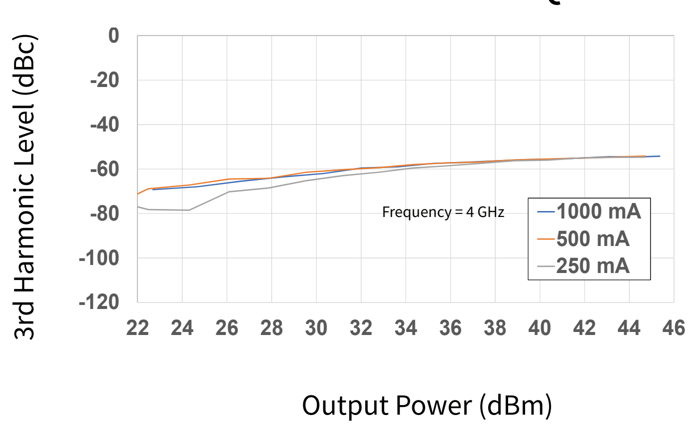


Figure 33. 3rd Harmonic vs Output Power as a Function of IDQ



Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, Pin = -20 dBm, T_{BASE} = +25 °C

Figure 34. Gain vs Frequency as a Function of Temperature

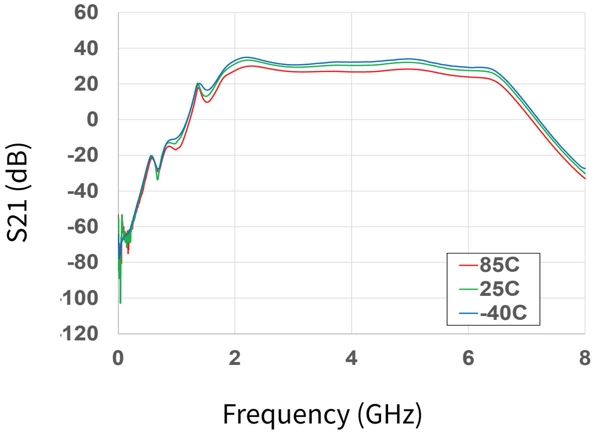


Figure 35. Gain vs Frequency as a Function of Temperature

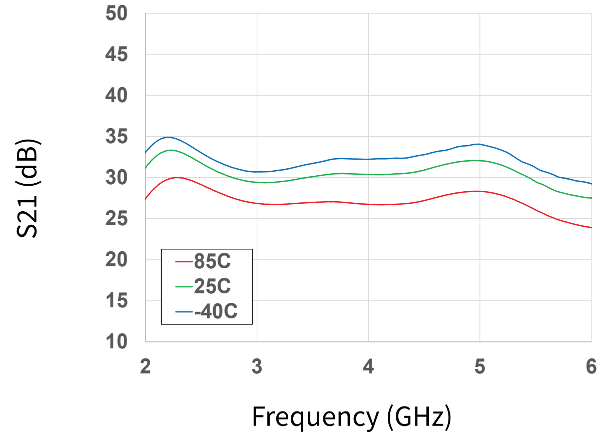


Figure 36. Input RL vs Frequency as a Function of Temperature

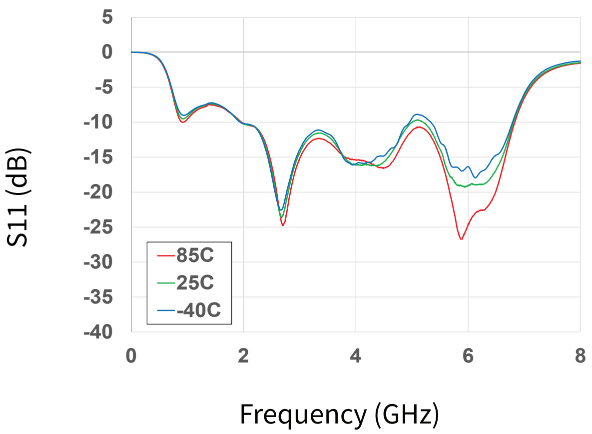


Figure 37. Input RL vs Frequency as a Function of Temperature

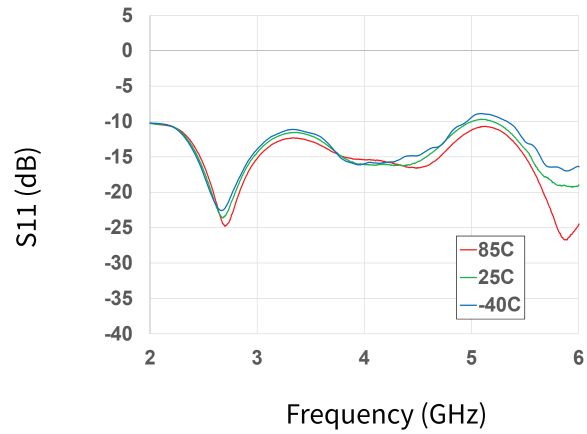


Figure 38. Output RL vs Frequency as a Function of Temperature

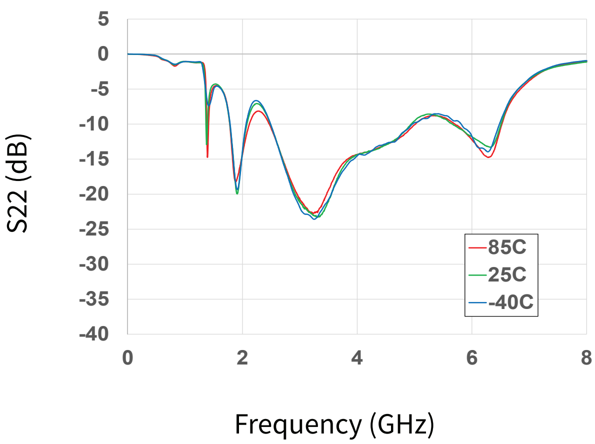
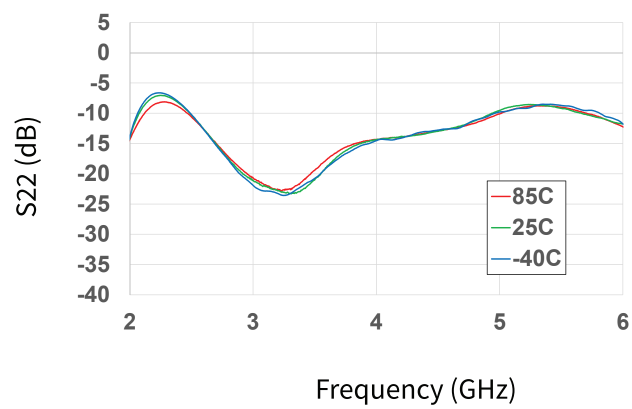


Figure 39. Output RL vs Frequency as a Function of Temperature



Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, Pin = -20 dBm, T_{BASE} = +25 °C

Figure 40. Gain vs Frequency as a Function of Voltage

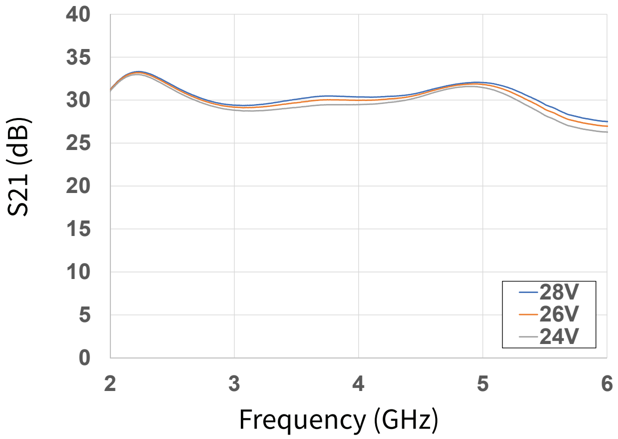


Figure 41. Gain vs Frequency as a Function of IDQ

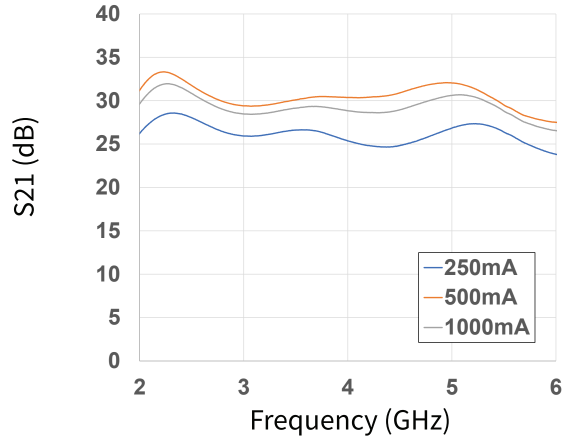


Figure 42. Input RL vs Frequency as a Function of Voltage

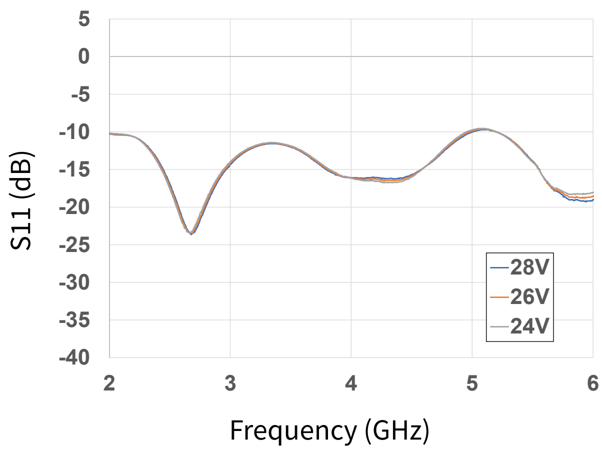


Figure 43. Input RL vs Frequency as a Function of IDQ

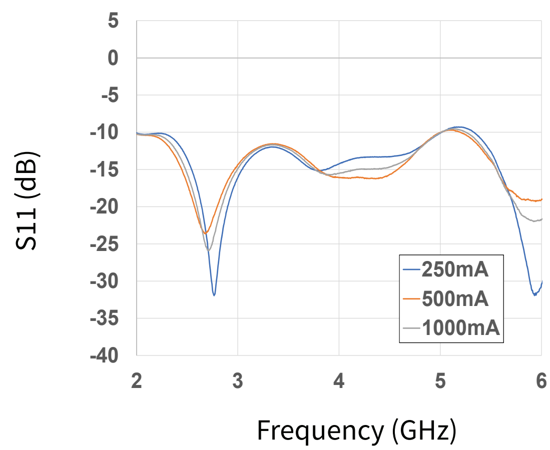


Figure 44. Output RL vs Frequency as a Function of Voltage

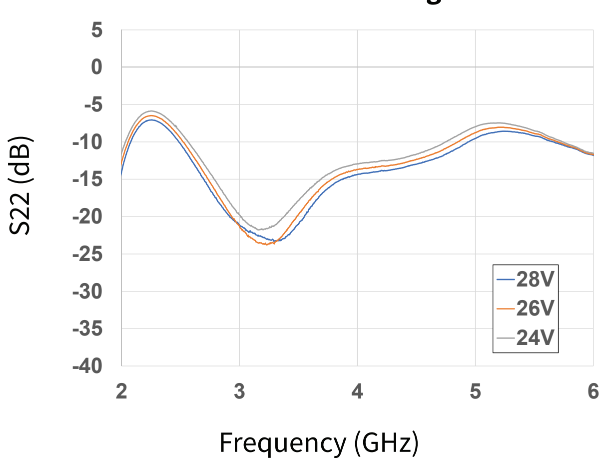
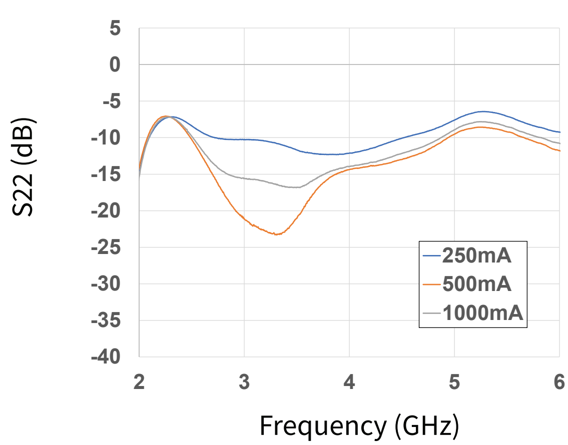


Figure 45. Output RL vs Frequency as a Function of IDQ



Typical Performance of the CMPA2060035F1

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 1000 mA, Pin = -20 dBm, T_{BASE} = +25 °C

Figure 46. Output Power and Power Added Eff. vs Frequency when Optimized for Maximum PAE

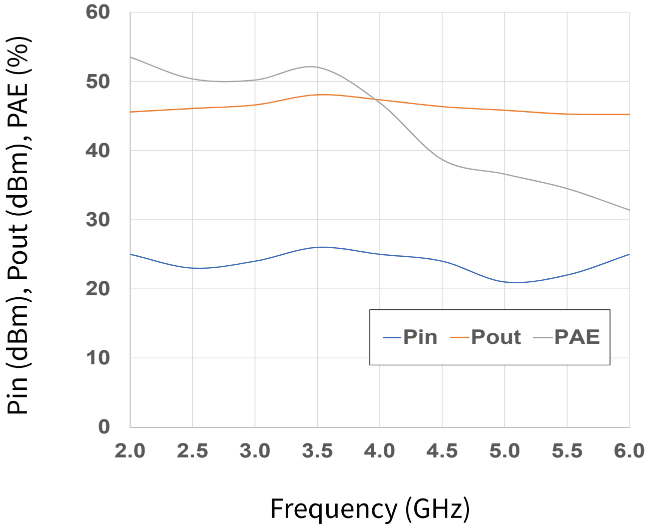
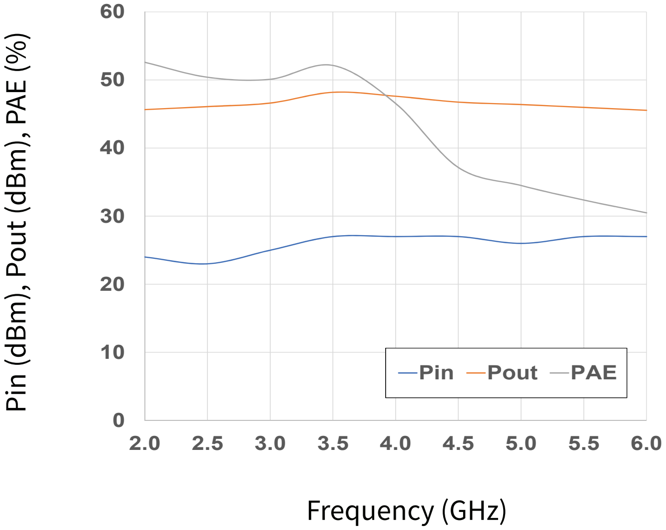
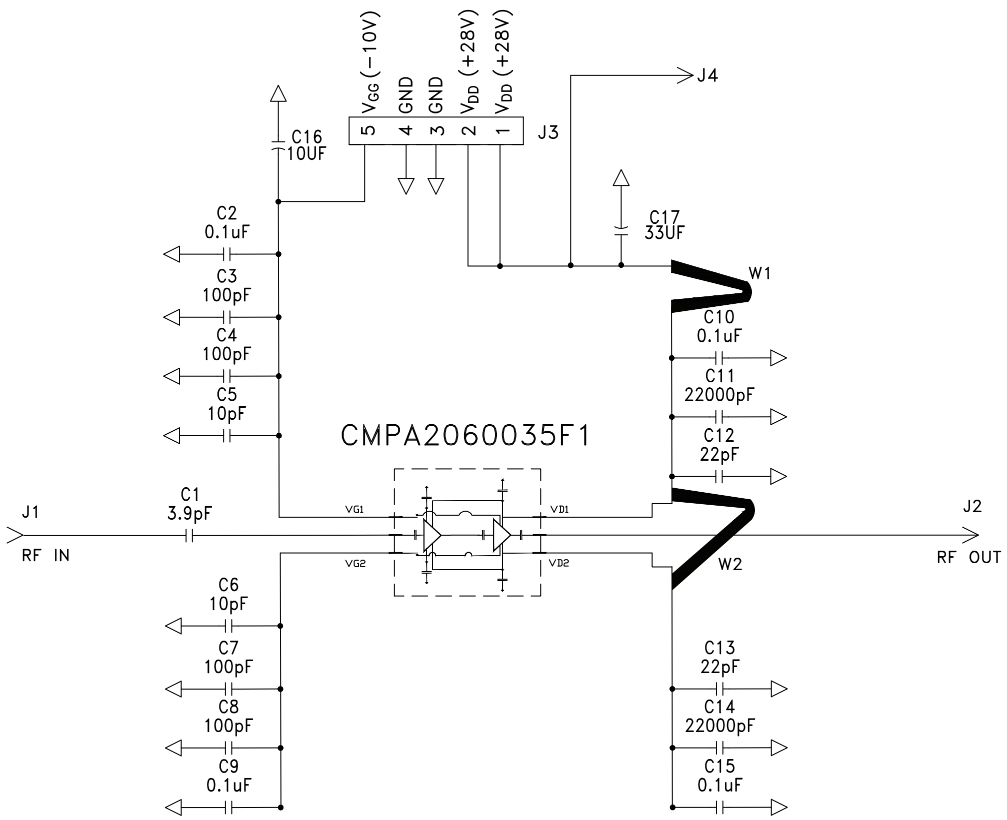


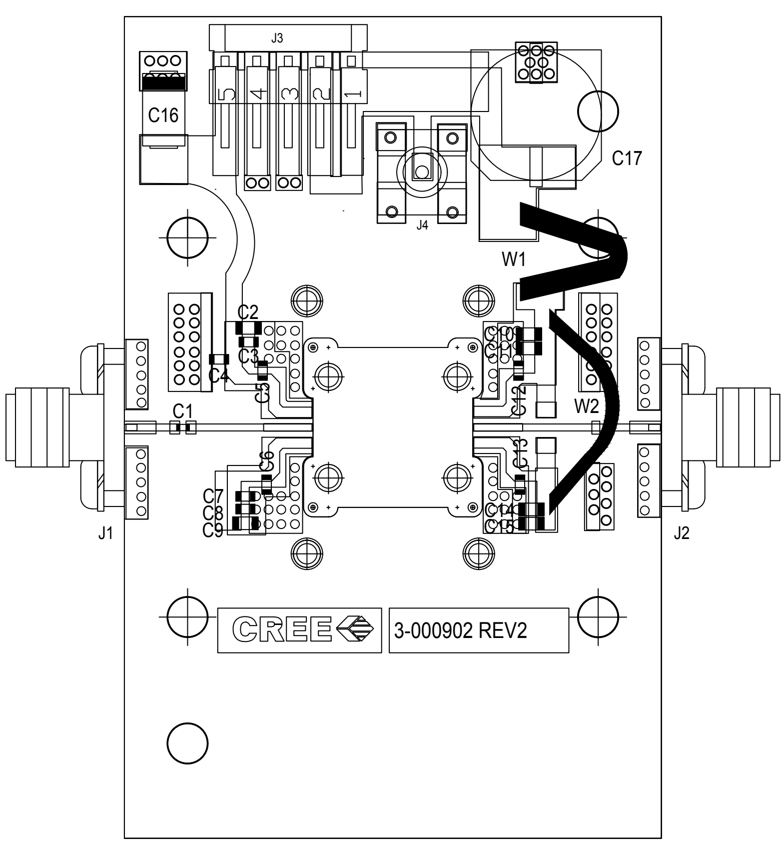
Figure 47. Output Power and Power Added Eff. vs Frequency when Optimized for Mamimum Output Power



CMPA2060035F1-AMP Evaluation Board Schematic



CMPA2060035F1-AMP Evaluation Board Outline



CMPA2060035F1-AMP Evaluation Board Bill of Materials

Designator	Description	Qty
C1	CAP, 3.9pF, +/-0.1pF, 0402, ATC	1
C11, C14	CAP CER 22,000PF 100V 10% X7R 0805	2
C12. C13	CAP, 22pF,+/-5%, 0603, ATC	2
C16	CAP 10UF 16V TANTALUM, 2312	1
C17	CAP, 33 UF, 20%, G CASE	1
C2, C9, C10,C15	CAP CER 0.1UF 100V 10% X7R 0805	4
C3, C4, C7, C8	CAP, 100.0pF, +/-5%, 0603, ATC	4
C5, C6	CAP, 10.0pF, +/-5%, 0603, ATC	2
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J3	HEADER RT>PLZ .1CEN LK 5POS	1
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
W1, W2	WIRE, BLACK, 22 AWG	2
	TEST FIXTURE, 2-6GHz, CMPA2060035F1	1
	PCB board 2.6" X1.7" , TACONIC RF35, 0.01", 440219 package	1
	BASEPLATE, AL, 2.60 X 1.70 X 2.50	1
Q1	CMPA2060035F1: GaN, MMIC PA, 35 W, 2-6 GHz, Flange	1

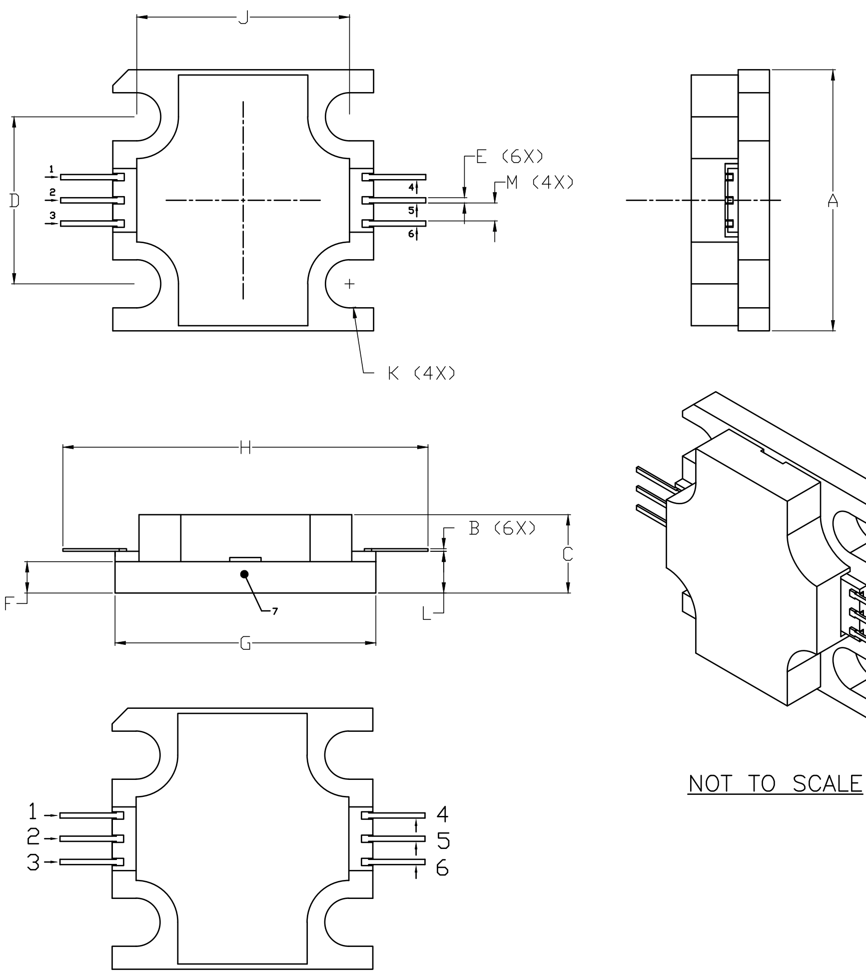
Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1B (≥ 500 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (≥ 200 V)	JEDEC JESD22 C101-C

Moisture Sensitivity Level (MSL) Classification

Parameter	Symbol	Level	Test Methodology
Moisture Sensitivity Level	MSL	3 (168 hours)	IPC/JEDEC J-STD-20

Product Dimensions CMPA2060035F1 (Package 440219)



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.495	0.505	12.57	12.82
B	0.003	0.005	0.076	0.127
C	0.140	0.160	3.56	4.06
D	0.315	0.325	8.00	8.25
E	0.008	0.012	0.204	0.304
F	0.055	0.065	1.40	1.65
G	0.495	0.505	12.57	12.82
H	0.695	0.705	17.65	17.91
J	0.403	0.413	10.24	10.49
K	ø .092		2.34	
L	0.075	0.085	1.905	2.159
M	0.032	0.040	0.82	1.02

PIN	DESC.
1	Gate 1
2	RFIN
3	Gate 2
4	Drain 1
5	RFOUT
6	Drain 2

Part Number System

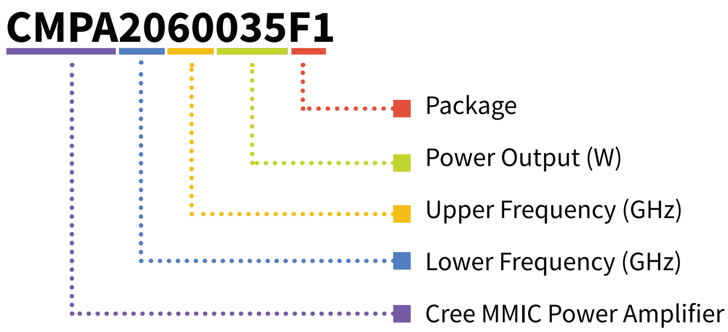


Table 1.

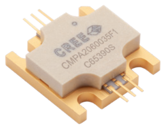
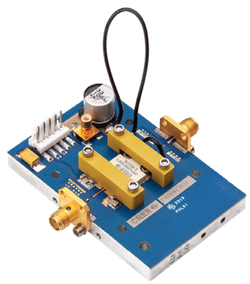
Parameter	Value	Units
Lower Frequency	2.0	GHz
Upper Frequency	6.0	GHz
Power Output	35	W
Package	Flange	-

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
CMPA2060035F1	GaN HEMT	Each	
CMPA2060035F1-AMP	Test board with GaN MMIC installed	Each	

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