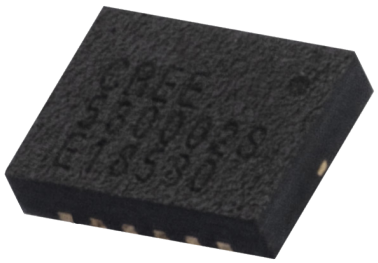
CMPA0530002S

2 W, 0.5 - 3.0 GHz, 28 V, GaN HEMT



Package Type: 3x4 DFN
PN: CMPA0530002S

Description

Cree's CMPA0530002S is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities. The CMPA0530002S operates on a 28 volt rail while housed in a 3mm x 4mm, surface mount, dual-flat-no-lead (DFN) package. Under reduced power, the transistor can operate below 28V to as low as 20V V_{DD}, maintaining high gain and efficiency.

Typical Performance Over 0.5 - 3.0 GHz (T_C = 25˚C), 28 V

Parameter	0.5 GHz	1.0 GHz	1.5 GHz	2.0 GHz	2.5 GHz	3.0 GHz	Units
Small Signal Gain	18.10	17.90	18.30	17.90	17.90	17.52	dB
Output Power[1]	2.85	2.80	2.99	2.99	2.84	2.90	W
Power Gain[1]	13.05	12.97	13.26	13.25	13.04	13.12	dB
Power Added Efficiency[1]	56.0	48.7	56.2	51.2	46.0	49.1	%

[1]Note: P_{IN} = 21.5 dBm, CW

Features for 28 V in CMPA0530002S-AMP

- 18 dB Small Signal Gain
- 2.9 W Typical P_{SAT}
- Operation up to 28 V
- High Breakdown Voltage
- High Temperature Operation
- Size 0.118 x 0.157 x 0.033 inches

Applications

- Civil and Military Communications
- Broadband Amplifiers
- Electronic Warfare
- Industrial Scientific & Medical
- Radar

Large Signal Models Available for ADS and MWO

RoHS COMPLIANT

Absolute Maximum Ratings (not simultaneous) at 25˚C Case Temperature

Parameter	Symbol	Rating	Units	Notes
Drain-Source Voltage	V_{DSS}	84	Volts	25˚C
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts	25˚C
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	0.8	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	0.33	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Thermal Resistance, Junction to Case[5]	$R_{\theta JC}$	24.0	˚C/W	85˚C

Notes:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering at wolfspeed.com/rf/document-library
[3] Simulated at P_{DISS} = 2.2 W
[4] T_C = Case temperature for the device. It refers to the temperature at the ground tab underneath the package. The PCB will add additional thermal resistance
[5] The R_{TH} for Cree's application circuit, CMPA0530002S-AMP1, with 15 (Ø13 mil) via holes designed on a 20 mil thick Rogers 3450B PCB, is 24°C/W. The total R_{TH} from the heat sink to the junction is 24°C/W + 6.5°C/W = 30.5°C/W

Electrical Characteristics (T_C = 25˚C), 28 V Typical

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.6	-3.1	-2.4	V	V_{DS} = 10 V, I_D = 0.8 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.4	–	mA	V_{DS} = 28 V, I_D = 90 mA
Saturated Drain Current[2]	I_{DS}	0.58	0.8	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	84	–	–	V	V_{GS} = -8 V, I_D = 0.8 mA
RF Characteristics[3,4] (T_C = 25˚C, F_0 = 3.0 GHz unless otherwise noted)						
Small Signal Gain	S_{21}	-	16.4	-	dB	V_{DS} = 28 V, I_{DQ} = 90 mA
Input Return Loss	S_{11}	-	-19.3	–	dB	V_{DS} = 28 V, I_{DQ} = 90 mA
Output Return Loss	S_{22}	-	-14.7	–	dB	V_{DS} = 28 V, I_{DQ} = 90 mA
Output Power	P_{OUT}	-	33.5	–	dBm	V_{DS} = 28 V, I_{DQ} = 90 mA
Drain Efficiency	η	-	52	–	%	V_{DS} = 28 V, I_{DQ} = 90 mA
Output Mismatch Stress	VSWR	-	10 : 1	–	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 90 mA, P_{IN} = 23 dBm
Dynamic Characteristics						
Input Capacitance[5]	C_{GS}	–	0.93	–	pF	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz
Output Capacitance[5]	C_{DS}	–	0.41	–	pF	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.04	–	pF	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging
[2] Scaled from PCM data
[3] Measured in CMPA0530002S high volume test fixture at 3.0 GHz and may not show the full capability of the device due to source inductance and thermal performance.
[4] P_{IN} = 23 dBm, CW
[5] Includes package

Electrical Characteristics When Tested in CMPA0530002S-AMP1 at 0.5 - 3.0 GHz, CW

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
RF Characteristics[1] (T_C = 25˚C, F_0 = 0.5 - 3.0 GHz unless otherwise noted)						
Gain[2]	G	–	13.2	–	dB	V_{DD} = 28 V, I_{DQ} = 90 mA, P_{IN} = 21.5 dBm
Output Power[2]	P_{OUT}	–	34.6	–	dBm	V_{DD} = 28 V, I_{DQ} = 90 mA, P_{IN} = 21.5 dBm
Power Added Efficiency[2]	η	–	51	–	%	V_{DD} = 28 V, I_{DQ} = 90 mA, P_{IN} = 21.5 dBm
Output Mismatch Stress[2]	VSWR	–	10:1	–	Ψ	No damage at all phase angles, V_{DS} = 28 V, I_{DQ} = 90 mA

Notes:
[1] Measured in CMPA0530002S-AMP1 Application Circuit
[2] CW

Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

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

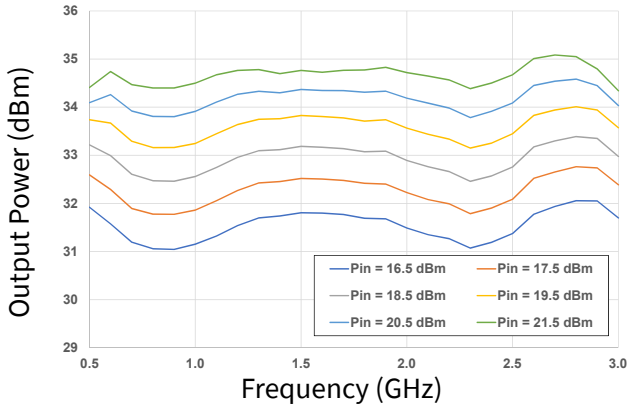


Figure 2. Power Added Efficiency vs Frequency as a Function of Input Power

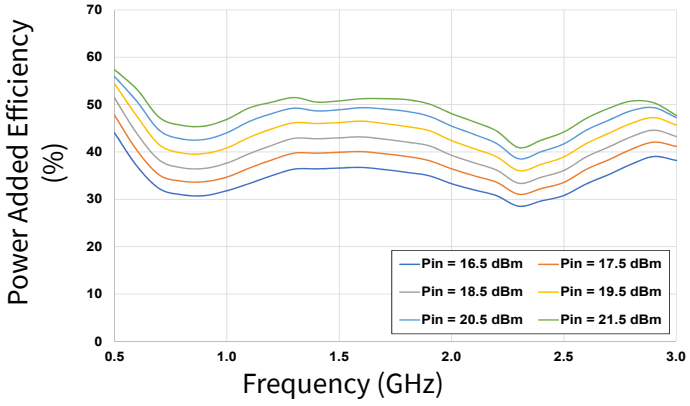


Figure 3. Drain Current vs Frequency as a Function of Input Power

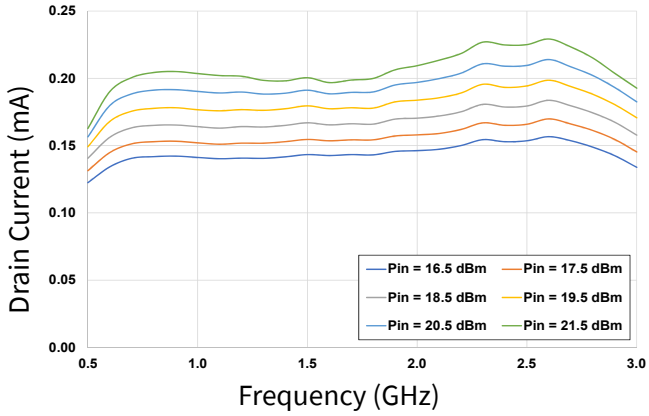


Figure 4. Output Power vs Frequency as a Function of Temperature

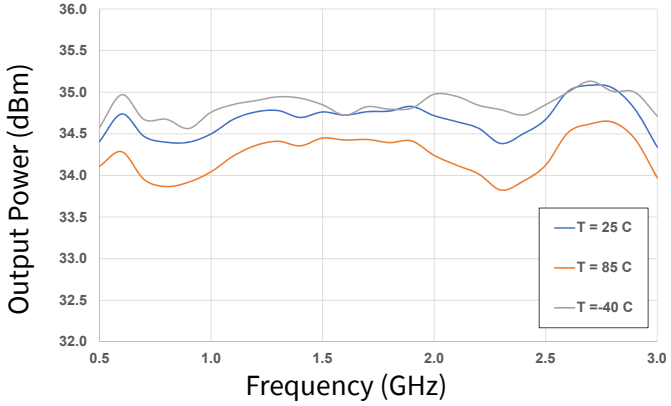


Figure 5. Power Added Efficiency vs Frequency as a Function of Temperature

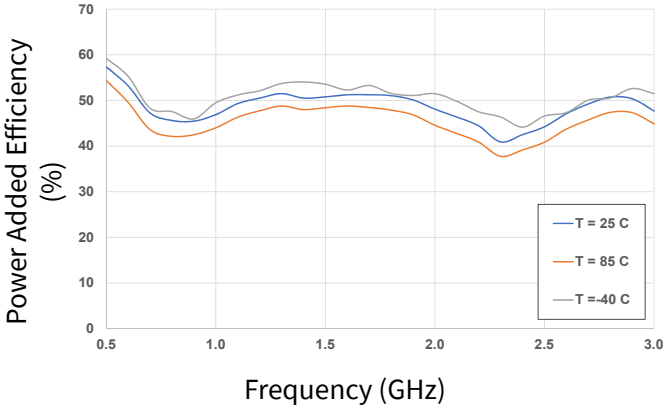
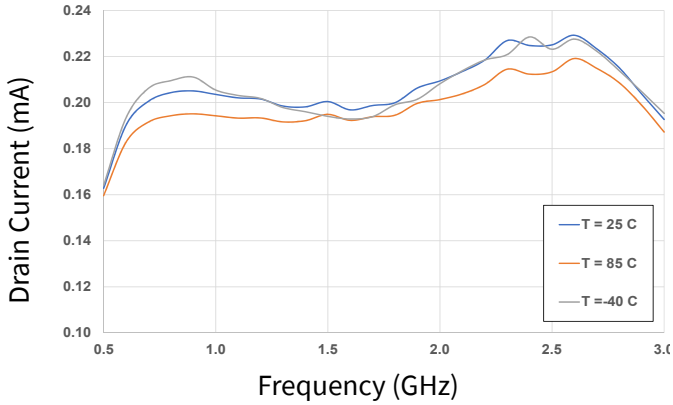


Figure 6. Drain Current vs Frequency as a Function of Temperature



Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

Figure 7. Output Power vs Frequency as a Function of Drain Voltage

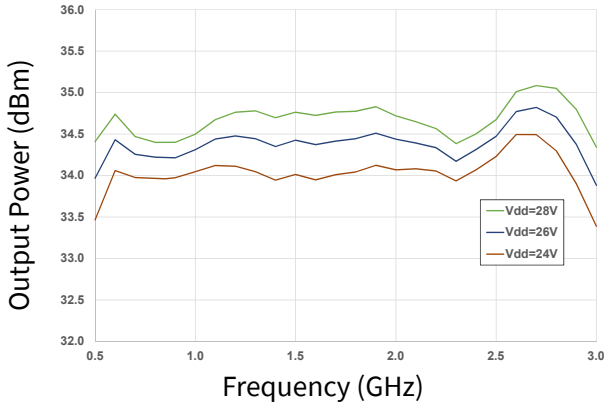


Figure 8. Power Added Efficiency vs Frequency as a Function of Drain Voltage

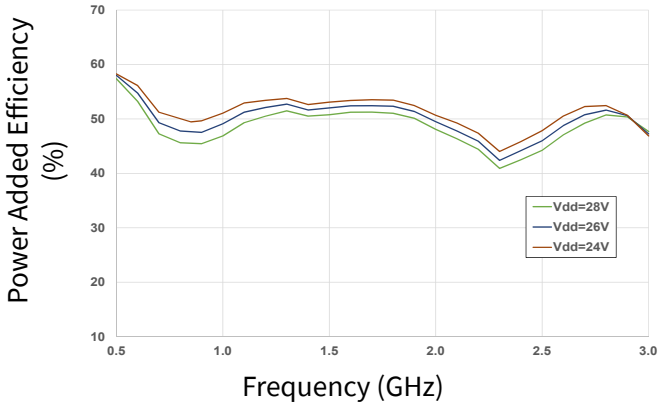


Figure 9. Drain Current vs Frequency as a Function of Drain Voltage

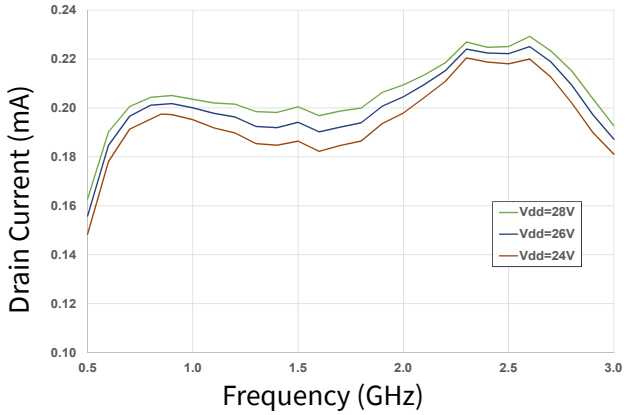


Figure 10. Output Power vs Frequency as a Function of IDQ

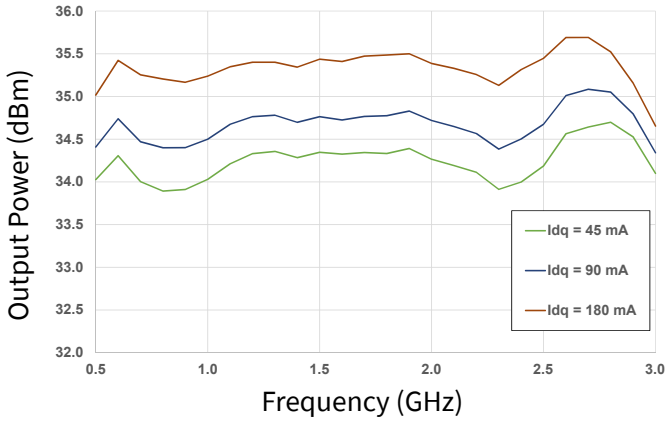


Figure 11. Power Added Efficiency vs Frequency as a Function of IDQ

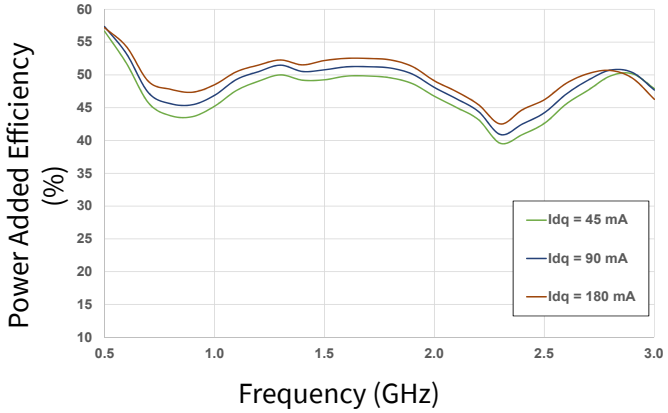
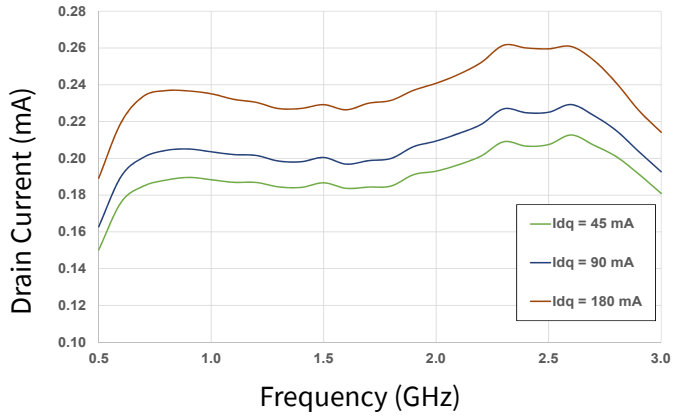


Figure 12. Drain Current vs Frequency as a Function of IDQ



Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

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

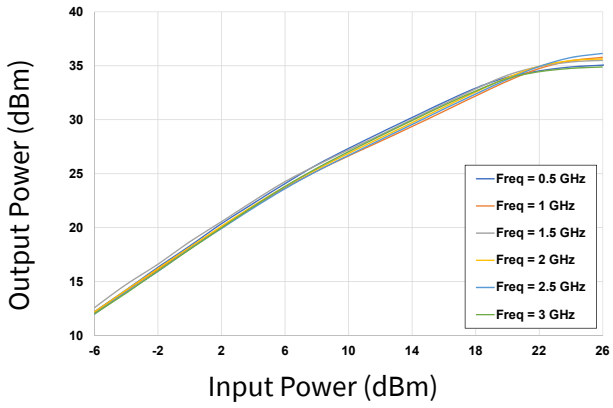


Figure 14. Power Added Efficiency vs Input Power as a Function of Frequency

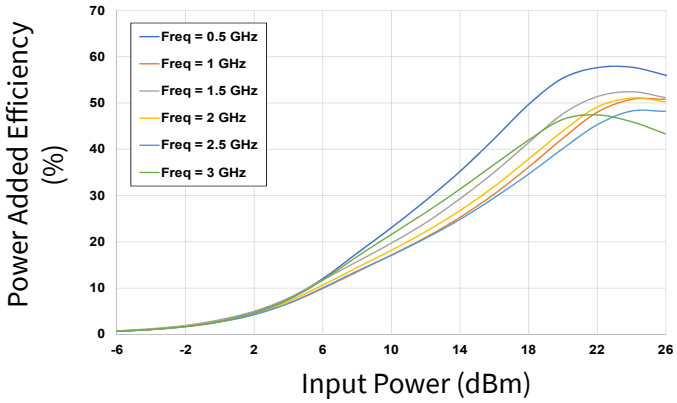


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

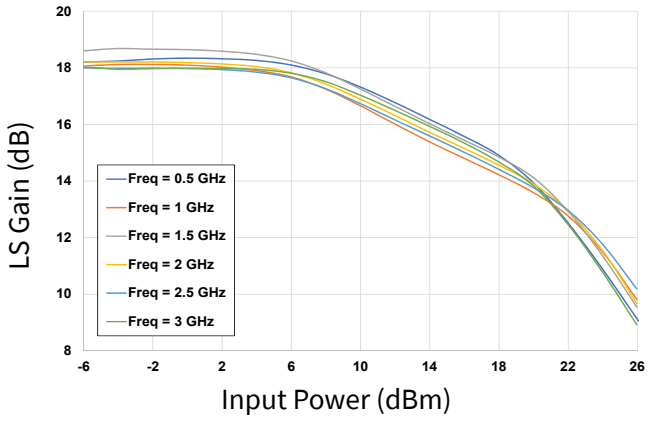


Figure 16. Drain Current vs Input Power as a Function of Frequency

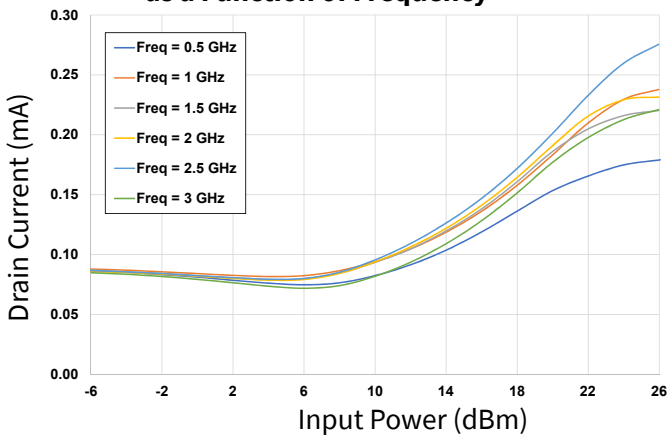


Figure 17. Gate Current vs Input Power as a Function of Frequency

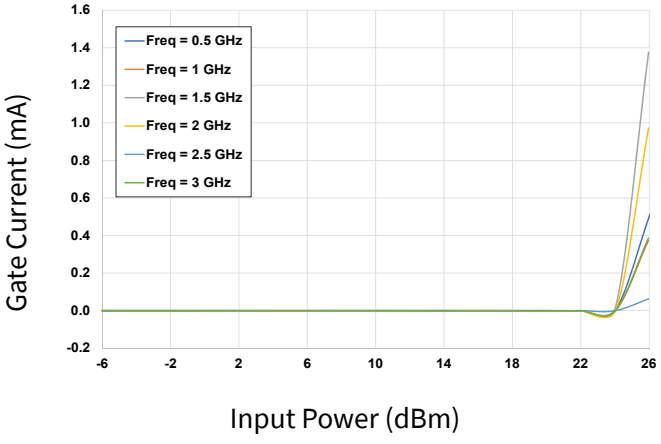
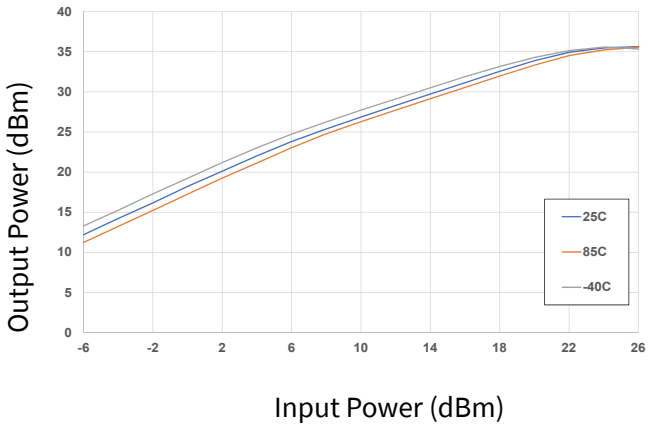


Figure 18. Output Power vs Input Power as a Function of Temperature



Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

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

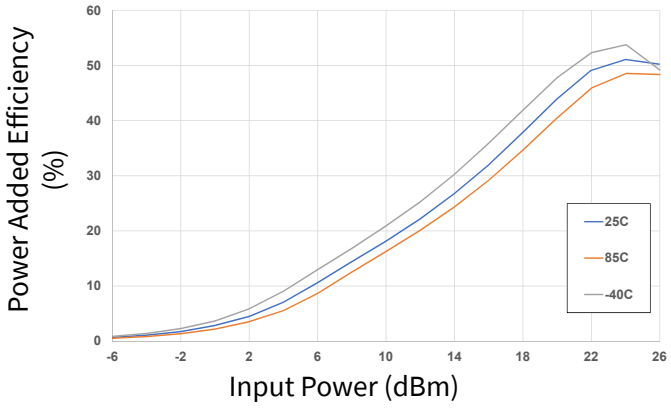


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

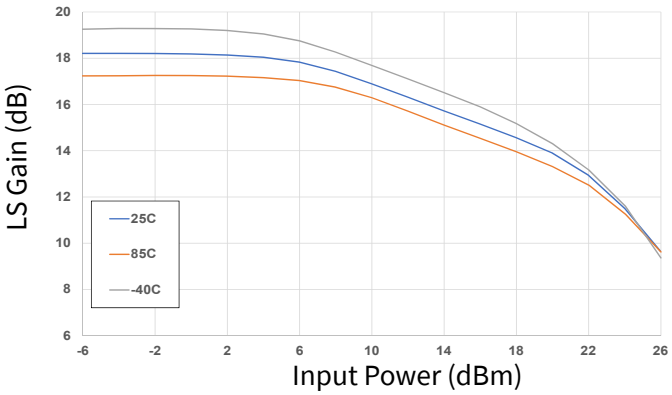


Figure 21. Drain Current vs Input Power as a Function of Temperature

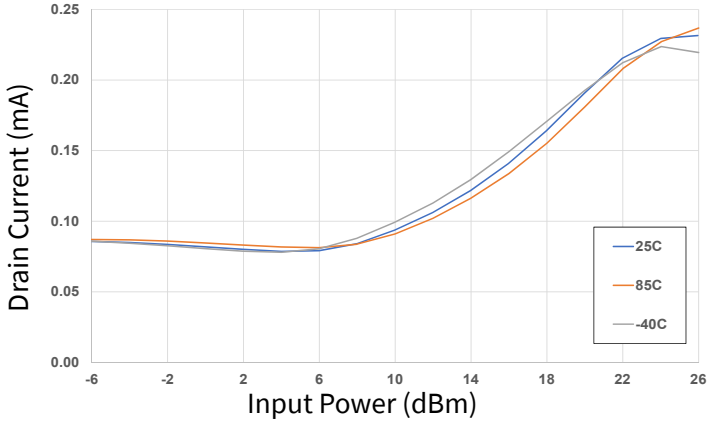


Figure 22. Gate Current vs Input Power as a Function of Temperature

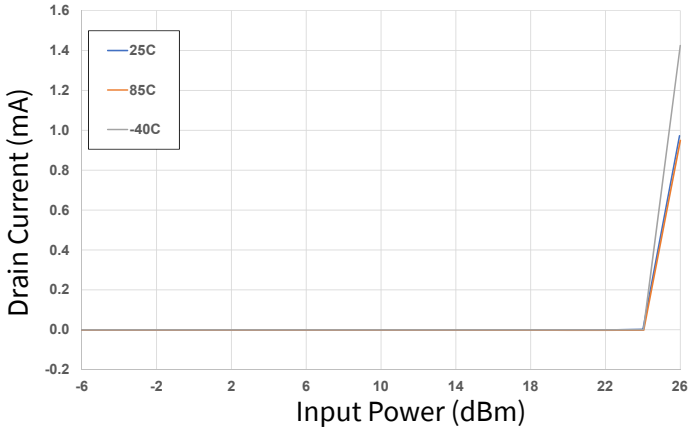


Figure 23. Output Power vs Input Power as a Function of IDQ

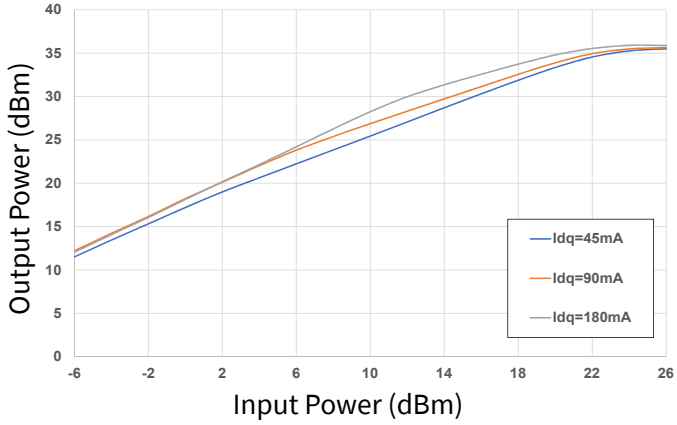
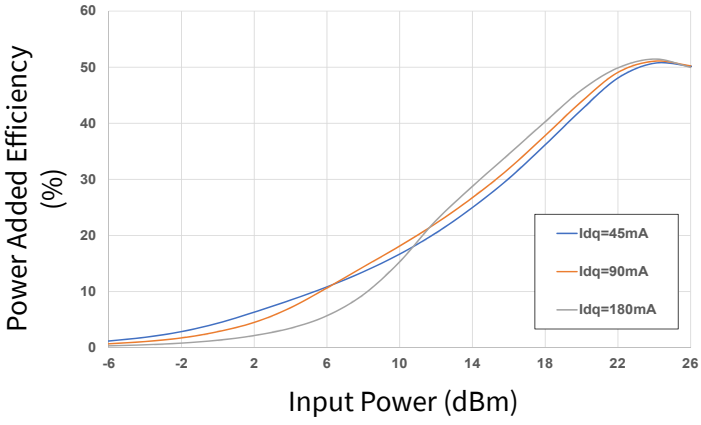


Figure 24. Power Added Efficiency vs Input Power as a Function of IDQ



Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

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

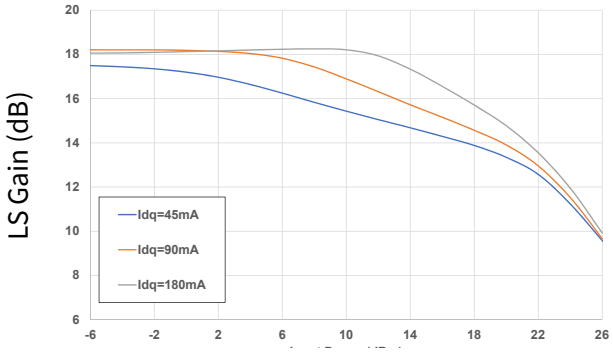


Figure 26. Drain Current vs Input Power as a Function of IDQ

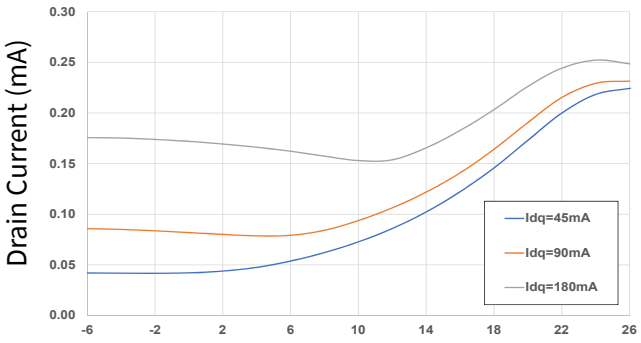
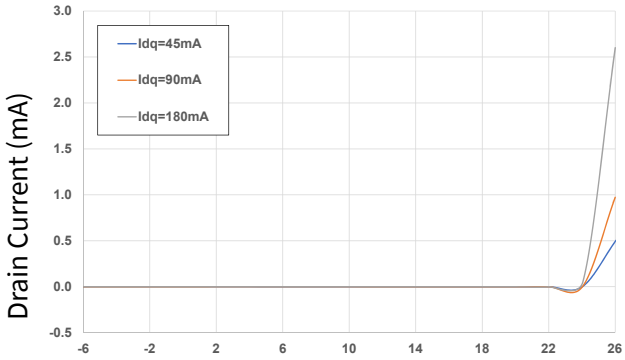


Figure 27. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

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

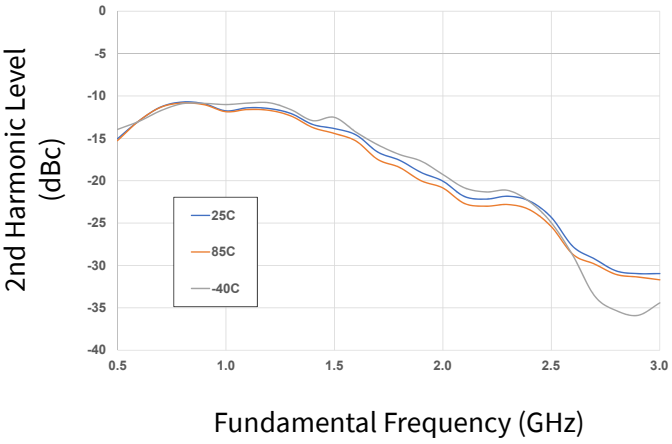


Figure 29. 3rd Harmonic vs Frequency as a Function of Temperature

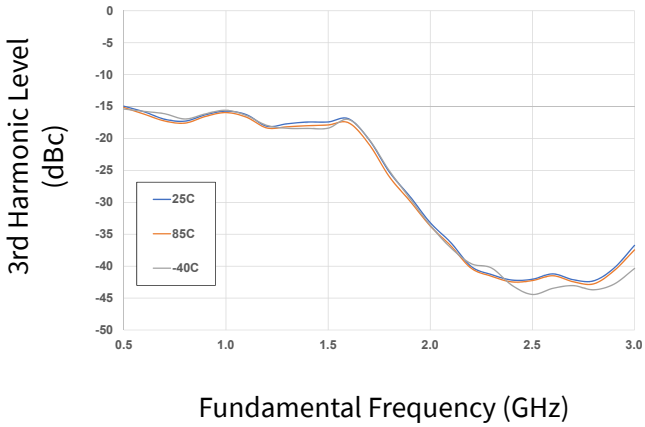


Figure 30. 2nd Harmonic vs Output Power as a Function of Frequency

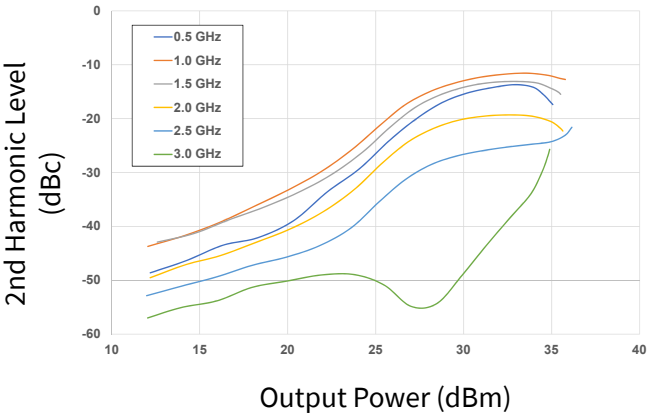


Figure 31. 3rd Harmonic vs Output Power as a Function of Frequency

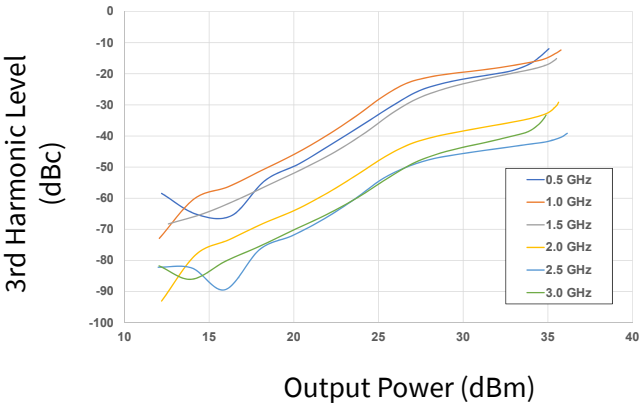


Figure 32. 2nd Harmonic vs Output Power as a Function of IDQ

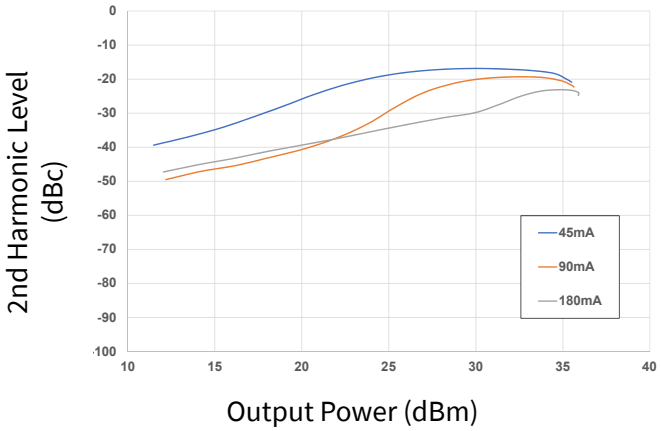
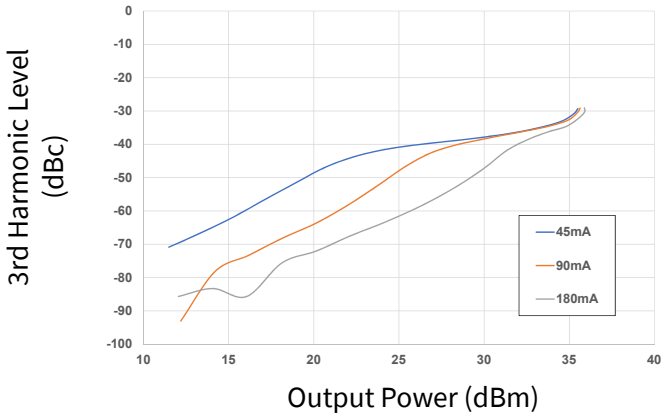


Figure 33. 3rd Harmonic vs Output Power as a Function of IDQ



Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

Figure 34. Input RL vs Frequency as a Function of Temperature

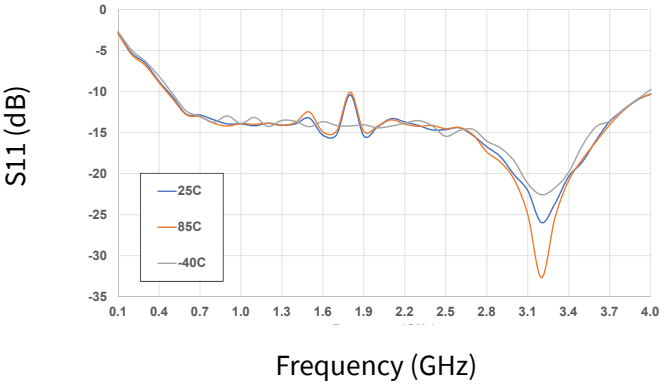


Figure 35. Input RL vs Frequency as a Function of Temperature

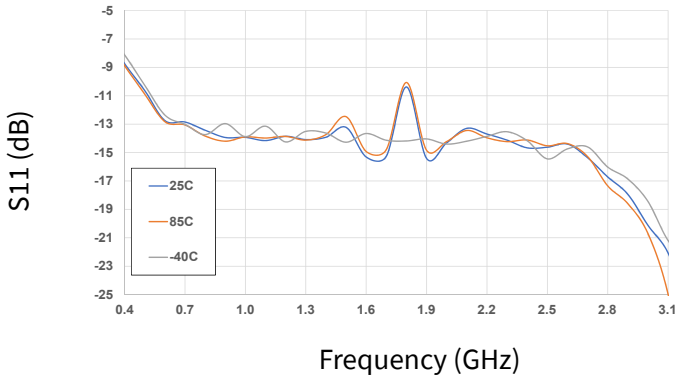


Figure 36. Gain vs Frequency as a Function of Temperature

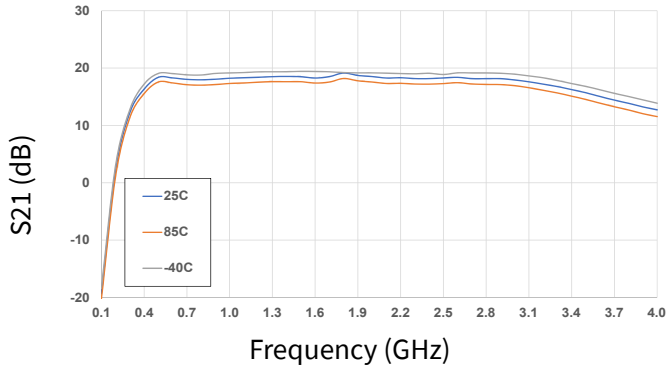


Figure 37. Gain vs Frequency as a Function of Temperature

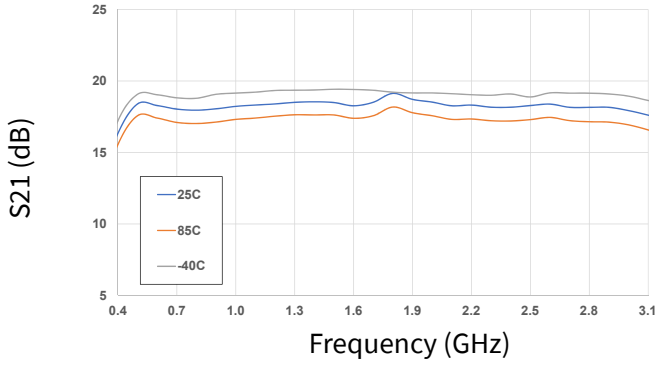


Figure 38. Output RL vs Frequency as a Function of Temperature

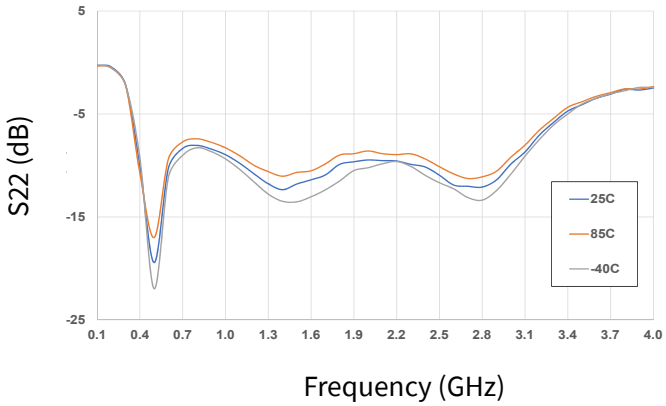
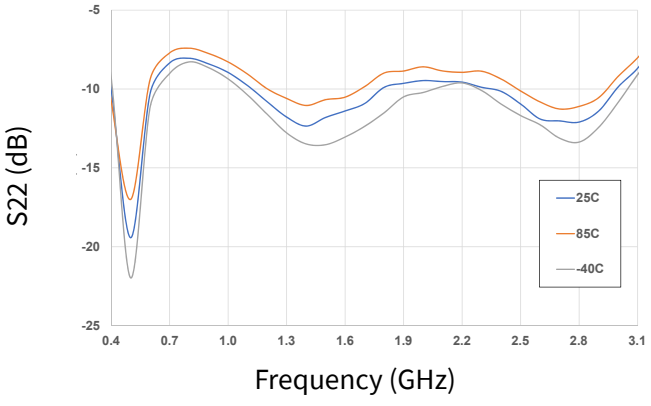


Figure 39. Output RL vs Frequency as a Function of Temperature



Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

Figure 40. Input RL vs Frequency as a Function of Drain Voltage

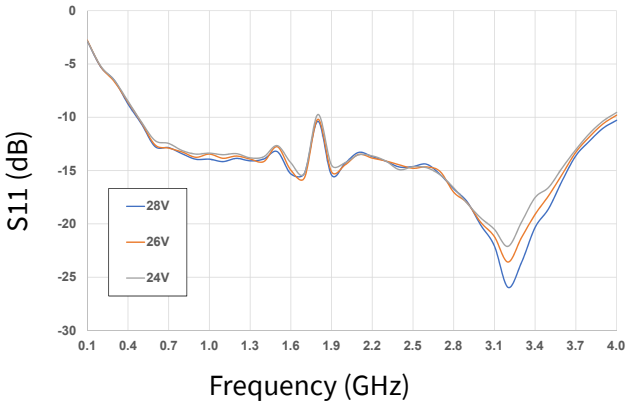


Figure 41. Input RL vs Frequency as a Function of Drain Voltage

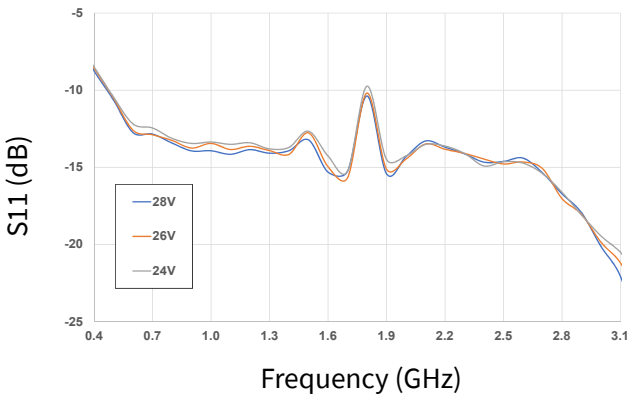


Figure 42. Gain vs Frequency as a Function of Drain Voltage

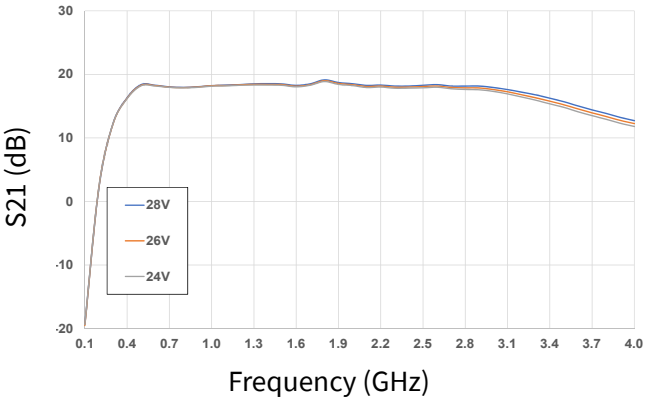


Figure 43. Gain vs Frequency as a Function of Drain Voltage

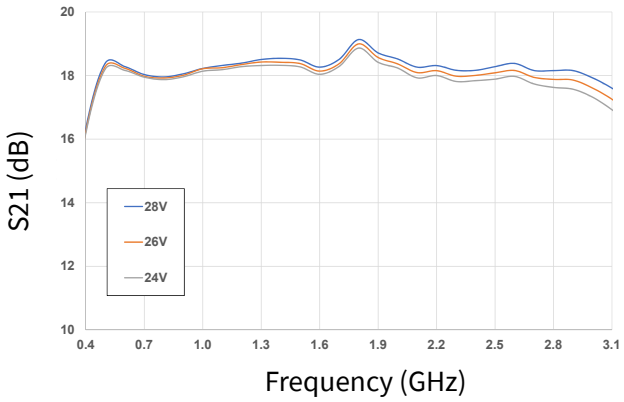


Figure 44. Output RL vs Frequency as a Function of Drain Voltage

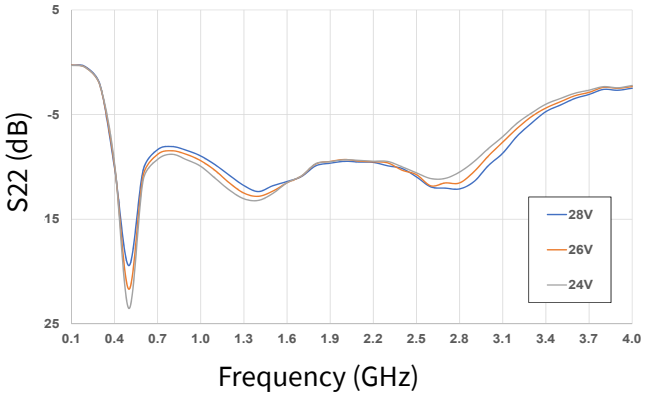
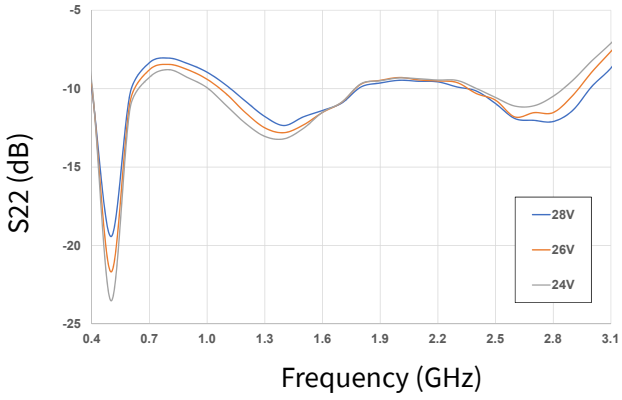


Figure 45. Output RL vs Frequency as a Function of Drain Voltage



Typical Performance of the CMPA0530002S

Test conditions unless otherwise noted: V_D = 28 V, I_{DQ} = 90 mA, CW, Pin = 21.5 dBm, Frequency = 2 GHz, T_{BASE} = +25 °C

Figure 46. Input RL vs Frequency as a Function of IDQ

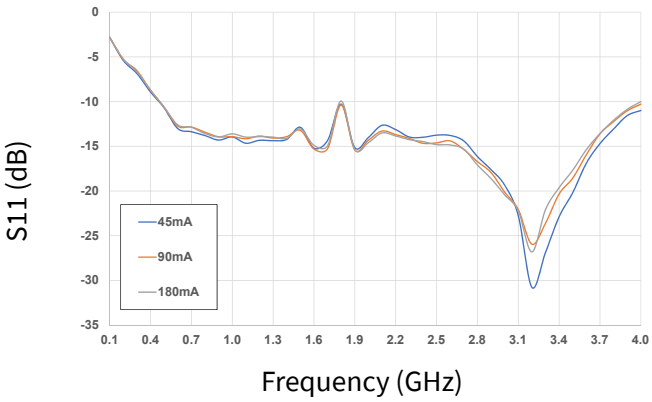


Figure 47. Input RL vs Frequency as a Function of IDQ

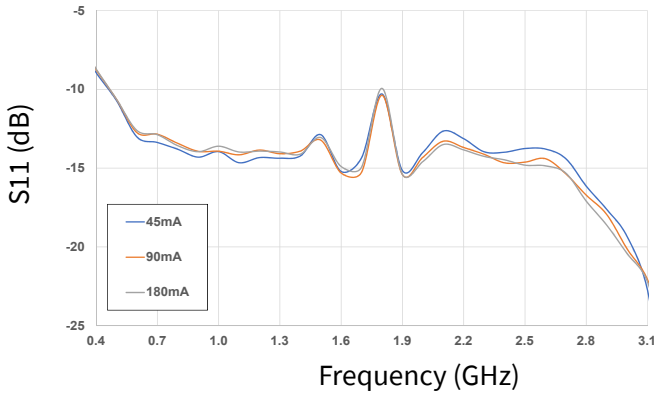


Figure 48. Gain vs Frequency as a Function of IDQ

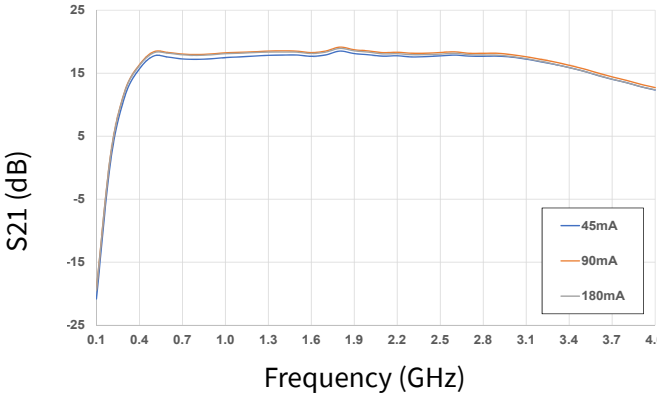


Figure 49. Gain vs Frequency as a Function of IDQ

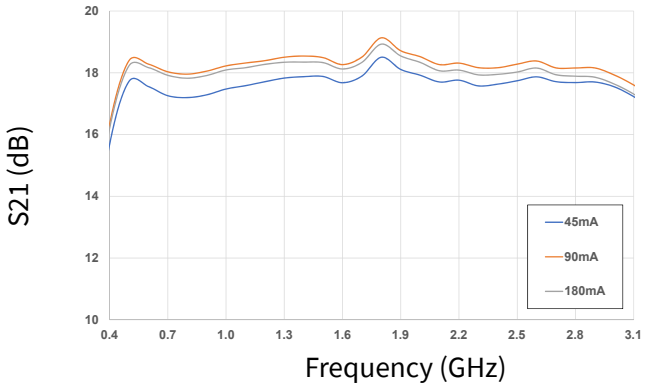


Figure 50. Output RL vs Frequency as a Function of IDQ

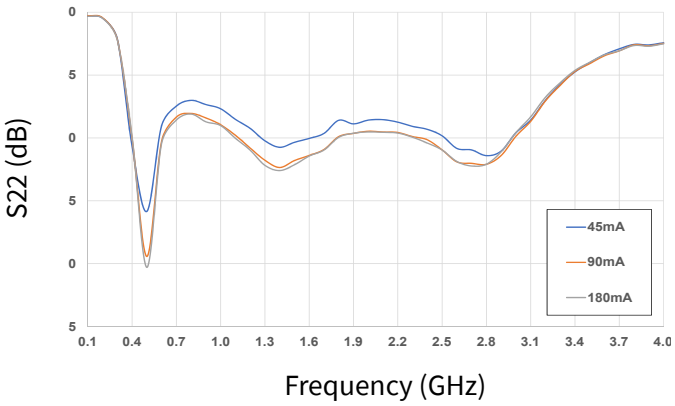
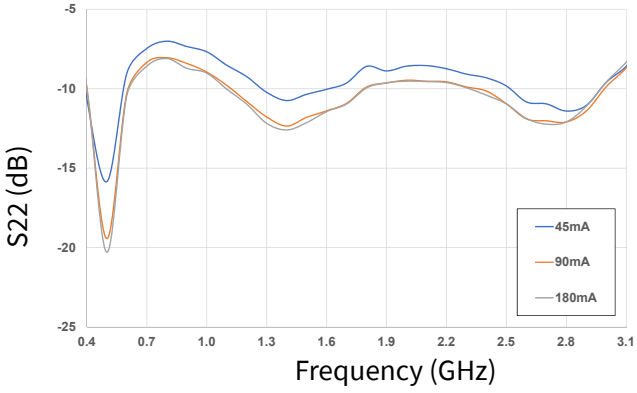


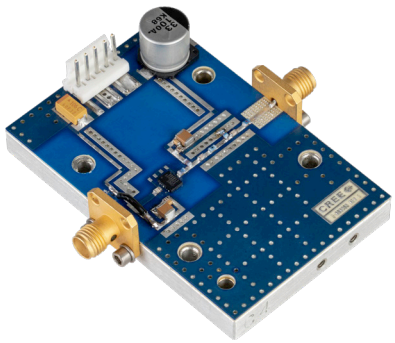
Figure 51. Output RL vs Frequency as a Function of IDQ



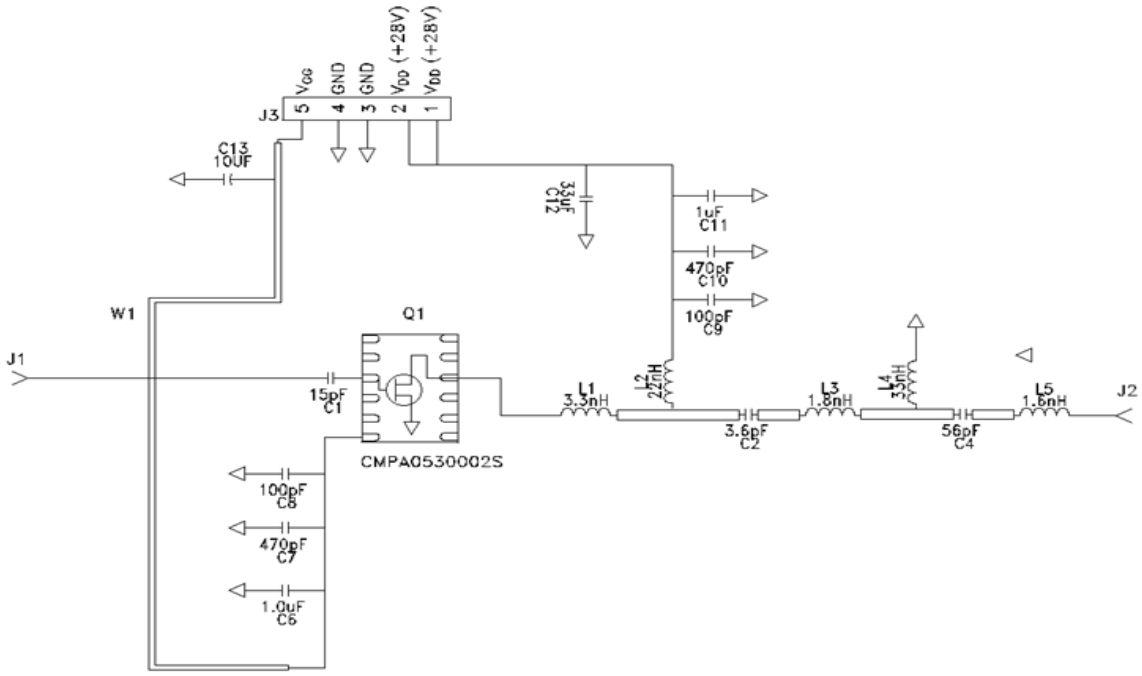
CMPA0530002S-AMP1 Application Circuit Bill of Materials

Designator	Description	Qty
C1	CAP, 15 pF, 5%, 0603, ATC600S	1
C2	CAP, 3.6 pF, 5%, 0603, ATC600S	1
C4	CAP, 56 pF, 5%, 0603, ATC600S	1
C8, C9	CAP, 100 pF, 5%, 0603, ATC600S	2
C7, C10	CAP, 470 pF, 5%, 100V, 0603, X7R, AVX	2
C6, C11	CAP, 1.0UF, 100V, 10%, X7R, 1210, muRata	2
C12	CAP, 33 UF, 20%, G CASE, Panasonic	1
C13	CAP, 10UF, 16V, TANTALUM, 2312, AVX	1
L1	INDUCTOR, CHIP,3.3nH,0603 SMT, Coilcraft	1
L2	INDUCTOR, CHIP,22nH,0603 SMT, Coilcraft	1
L3	INDUCTOR, CHIP,1.8nH,0603 SMT, Coilcraft	1
L4	INDUCTOR, CHIP,33nH,0603 SMT, Coilcraft	1
L5	INDUCTOR, CHIP,1.6nH,0603 SMT, Coilcraft	1
Q1	MMIC, GaN HEMT, DFN3x4, CMPA0530002S	1
	PCB, RO4350B, 0.020 THK, CMPA0530002S,	1
	BASEPLATE, AL, 2.60 X 1.7 X 0.25	1
	2-56 SOC HD SCREW 1/4 SS	4
	#2 SPLIT LOCKWASHER SS	4
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE,	2
J3	HEADER RT>PLZ .1CEN LK 5POS	1
W1	Wire, Black, 22 AWG, ~ 1”	1

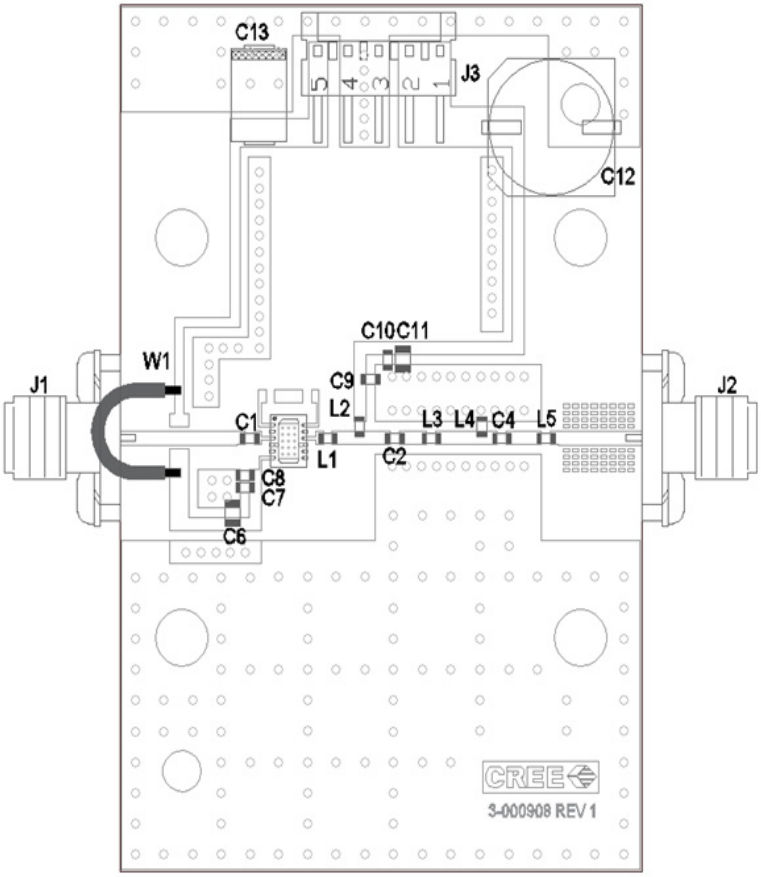
CMPA0530002S-AMP1 Application Circuit



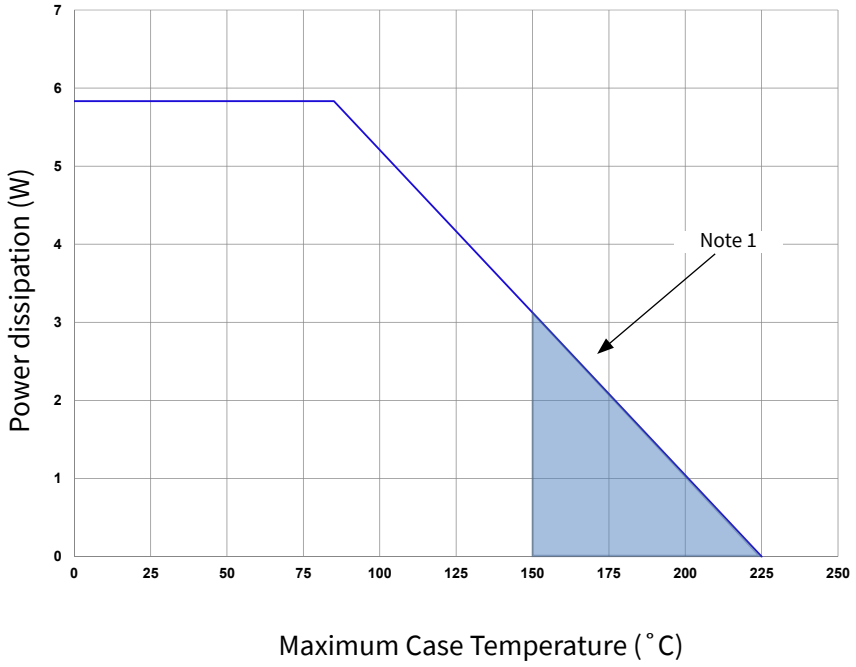
CMPA0530002S-AMP1 Application Circuit Schematic



CMPA0530002S-AMP1 Application Circuit Outline



CMPA0530002S Power Dissipation De-rating Curve



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

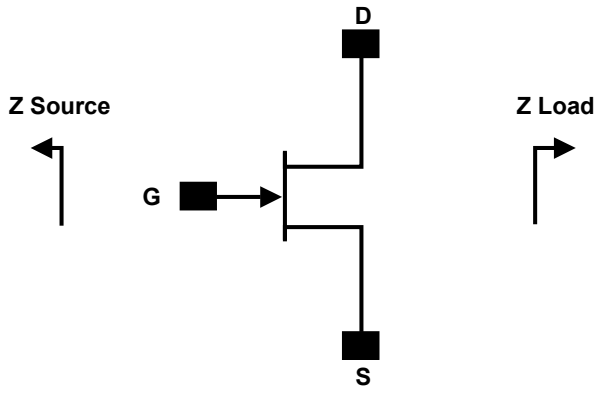
Electrostatic Discharge (ESD) Classifications

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

Source and Load Impedances

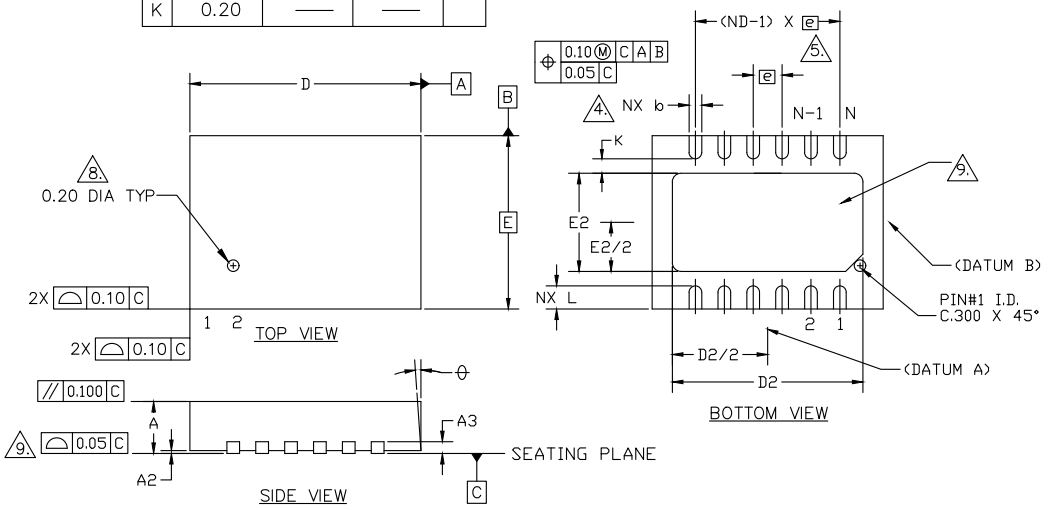


Frequency (GHz)	Z Source	Z Load
0.5	49.81 - j4.94	120.85 + j24.29
1.0	50.23 - j0.76	65.28 + j15.87
1.5	50.75 + j1.20	70.37 + j20.78
2.0	51.36 + j2.49	62.60 + j23.33
2.5	52.58 + j3.98	51.31 + j44.84
3.0	51.68 + j2.92	60.64 + j75.97

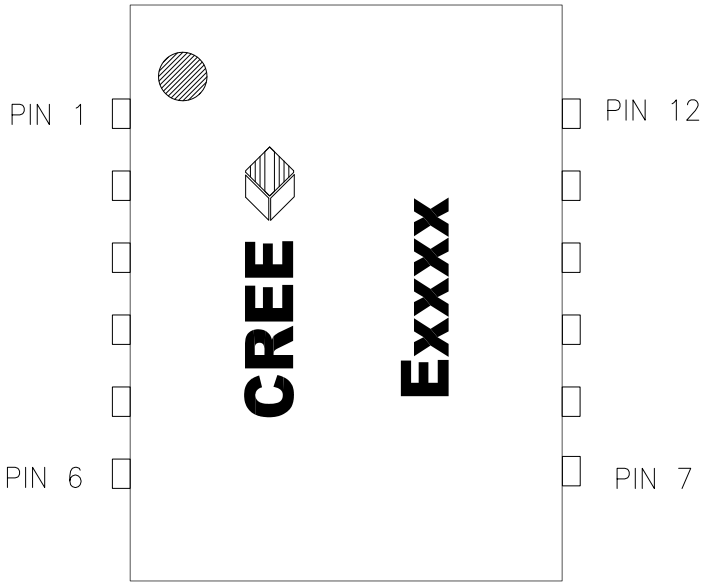
Note 1. V_{DD} = 28 V, I_{DQ} = 90 mA
Note 2. Impedances are extracted from source and load pull data derived from the transistor

Product Dimensions CMPA0530002S (Package 3 x 4 DFN)

SYMBOL	COMMON DIMENSIONS MIN.	NOM.	MAX.	NOTE
A	0.80	0.85	0.90	
A1	0.00	0.02	0.05	
A3		0.203 REF.		
θ	0	——	12	2
D		4.00 BSC		
E		3.00 BSC		
e		0.50 BSC		
N		12		3
ND		6		5
L	0.35	0.40	0.45	
b	0.18	0.25	0.30	4
D2	3.20	3.30	3.40	
E2	1.60	1.7	1.80	
K	0.20	——	——	



Pin	Input/Output
1	NC
2	NC
3	RF IN
4	GND
5	NC
6	V_G
7	NC
8	NC
9	GND
10	RF OUT & V_{DD}
11	NC
12	NC



Note: Leadframe finish for 3x4 DFN package is Nickel/Palladium/Gold. Gold is the outer layer

Part Number System

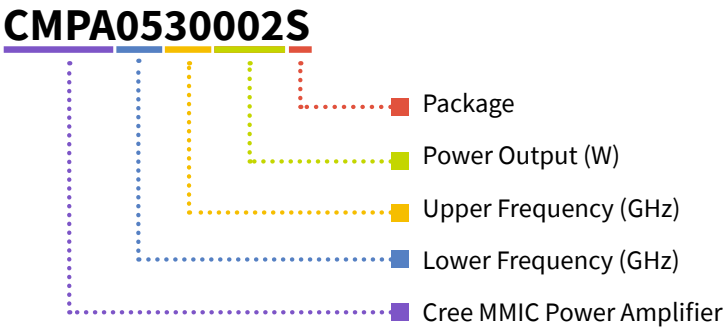


Table 1.

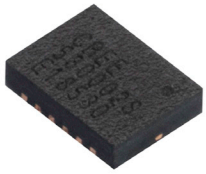
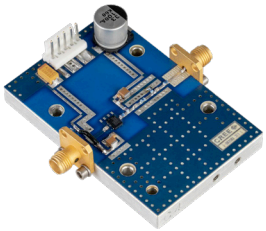
Parameter	Value	Units
Upper Frequency[1]	3.0	GHz
Power Output	2	W
Package	Surface Mount	-

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
CMPA0530002S	GaN HEMT	Each	
CMPA0530002S-AMP1	Test board with GaN MMIC installed	Each	

For more information, please contact:

4600 Silicon Drive
Durham, North Carolina, USA 27703
www.wolfspeed.com/RF

Sales Contact
RFSales@wolfspeed.com

RF Product Marketing Contact
RFMarketing@wolfspeed.com

Notes

Disclaimer

Specifications are subject to change without notice. Cree, Inc. believes the information contained within this data sheet to be accurate and reliable. However, no responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Cree. Cree makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose. “Typical” parameters are the average values expected by Cree in large quantities and are provided for information purposes only. These values can and do vary in different applications and actual performance can vary over time. All operating parameters should be validated by customer’s technical experts for each application. Cree products are not designed, intended or authorized for use as components in applications intended for surgical implant into the body or to support or sustain life, in applications in which the failure of the Cree product could result in personal injury or death or in applications for planning, construction, maintenance or direct operation of a nuclear facility.

© 2020 Cree, Inc. All rights reserved. Wolfspeed® and the Wolfspeed logo are registered trademarks of Cree, Inc.