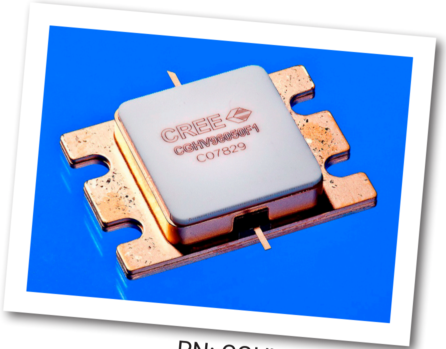
CGHV96050F1

50 W, 7.9 - 9.6 GHz, 50-ohm, Input/Output Matched GaN HEMT

Cree's CGHV96050F1 is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT) on Silicon Carbide (SiC) substrates. This GaN Internally Matched (IM) FET offers excellent power added efficiency in comparison to other technologies. 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 GaAs transistors. This IM FET is available in a metal/ceramic flanged package for optimal electrical and thermal performance.



PN: CGHV96050F1
Package Type: 440210

Typical Performance Over 7.9-8.4 GHz (T_c = 25˚C)

Parameter	7.9 GHz	8.0 GHz	8.1 GHz	8.2 GHz	8.3 GHz	8.4 GHz	Units
Linear Gain	17.0	16.7	16.4	15.9	15.2	14.6	dB
Output Power	22.4	28.2	28.2	31.6	31.6	31.6	W
Power Gain	15.6	15.0	15.1	14.5	14.0	13.2	dB
Power Added Efficiency	30	37	37	39	38	37	%

Note: Measured at -30 dBc, 1.6 MHz from carrier, in the CGHV96050F1-AMP (838176) under OQPSK modulation, 1.6 Msps, PN23, Alpha Filter = 0.2

Features

- 7.9 - 8.4 GHz Operation
- 80 W P_{OUT} typical
- >13 dB Power Gain
- 33 % Typical Linear PAE
- 50 Ohm Internally Matched
- <0.1 dB Power Droop

Applications

- Satellite Communication
- Terrestrial Broadband

Large Signal Models Available for ADS and MWO

Rev 2.0 – May 2015

CREE

Absolute Maximum Ratings (not simultaneous)

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DSS}	100	Volts	25˚C
Gate-source Voltage	V_{GS}	-10, +2	Volts	25˚C
Power Dissipation	P_{DISS}	57.6 / 86.4	Watts	(CW / Pulse)
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Drain Current	I_{DMAX}	6	Amps	
Maximum Forward Gate Current	I_{GMAX}	14.4	mA	25˚C
Soldering Temperature[1]	T_S	245	˚C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.26	˚C/W	Pulse Width = 100 μs, Duty Cycle = 10%, P_{DISS} = 86.4 W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.16	˚C/W	CW, 85˚C, P_{DISS} = 57.6 W
Case Operating Temperature[3]	T_C	-40, +150	˚C	

Note:

[1] Current limit for long term reliable operation.

[2] Refer to the Application Note on soldering at http://www.cree.com/rf/document-library

[3] See also, the Power Dissipation De-rating Curve on Page 10.

Electrical Characteristics (Frequency = 7.9 - 8.4 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.8	-3.0	-2.3	V	V_{DS} = 10 V, I_D = 14.4 mA
Gate Quiscent Voltage	V_Q	–	-3.0	–	V	V_{DS} = 40 V, I_D = 500 mA
Saturated Drain Current[2]	I_{DS}	11.5	13.0	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BD}	100	–	–	V	V_{GS} = -8 V, I_D = 14.4 mA
RF Characteristics[3]						
Small Signal Gain	S21	13.25	16	–	dB	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{IN} = -20 dBm
Input Return Loss	S11	–	−4.9	-3.0	dB	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{IN} = -20 dBm
Output Return Loss	S22	–	−10.7	-5.5	dB	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{IN} = -20 dBm
Power Gain[3, 4]	P_{G1}	10.75	15.6	–	dB	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{OUT} = 44 dBm, Freq. = 7.9 GHz
Power Gain[3, 4]	P_{G2}	10.75	13.5	–	dB	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{OUT} = 44 dBm, Freq. = 8.4 GHz
Power Added Efficiency[3, 4]	PAE_1	18	25	–	%	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{OUT} = 44 dBm, Freq. = 7.9 GHz
Power Added Efficiency[3, 4]	PAE_2	18	27	–	%	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{OUT} = 44 dBm, Freq. = 8.4 GHz
OQPSK Linearity[3, 4]	$ACLR_1$	–	–	-26	dBc	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{OUT} = 44 dBm, Freq. = 7.9 GHz
OQPSK Linearity[3, 4]	$ACLR_2$	–	–	-26	dBc	V_{DD} = 40 V, I_{DQ} = 500 mA, P_{OUT} = 44 dBm, Freq. = 8.4 GHz
Output Mismatch Stress	VSWR	–	5:1	–	Ψ	No damage at all phase angles, V_{DD} = 40 V, I_{DQ} = 500 mA

Notes:

[1] Measured on-wafer prior to packaging.

[2] Scaled from PCM data.

[3] Measured at -30 dBc, 1.6 MHz from carrier, in the CGHV96050F1-AMP (838176) under OQPSK modulation, 1.6 Msps, PN23, Alpha: Filter = 0.2.

[4] Fixture loss de-embedded using the following offsets: At 7.9 GHz, input and output = 0.45 dB. At 8.4 GHz, input = 0.50 dB and output = 0.55 dB.

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CGHV96050F1 Typical Performance

Figure 1. - Small Signal Gain and Return Loss vs Frequency of CGHV96050F1 measured in CGHV96050F1-AMP
V_{DS} = 40 V, I_{DQ} = 500mA

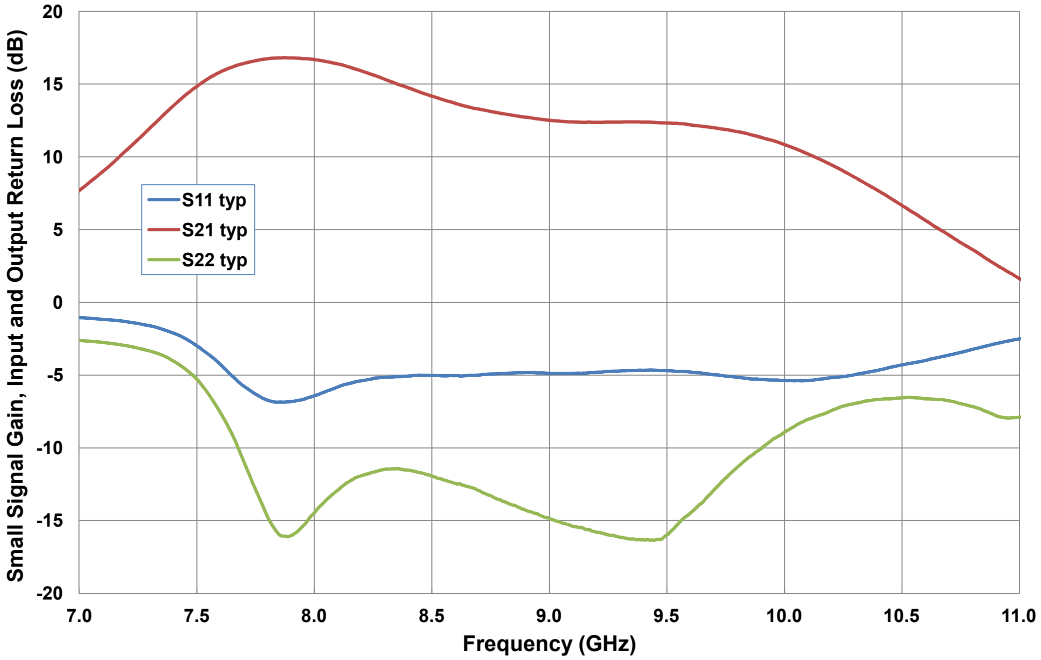

Figure 2. - Intermodulation Distortion Performance vs. Tone Spacing
V_{DD} = 40 V, Frequency = 8.2 GHz, Output Power = 44 dBm / 20 W

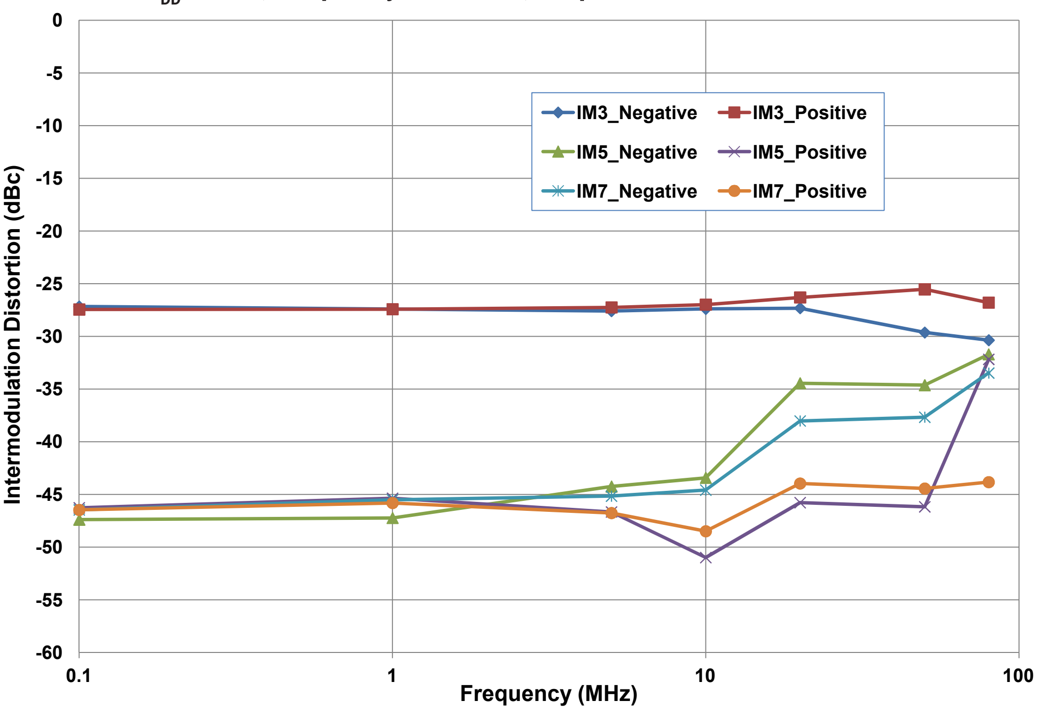

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Figure 3. - IM3 and IM5 vs. Output Power at 7.9 GHz, 8.2 GHz, and 8.4 GHz
V_{DD} = 40 V, Tone Spacing = 100 kHz

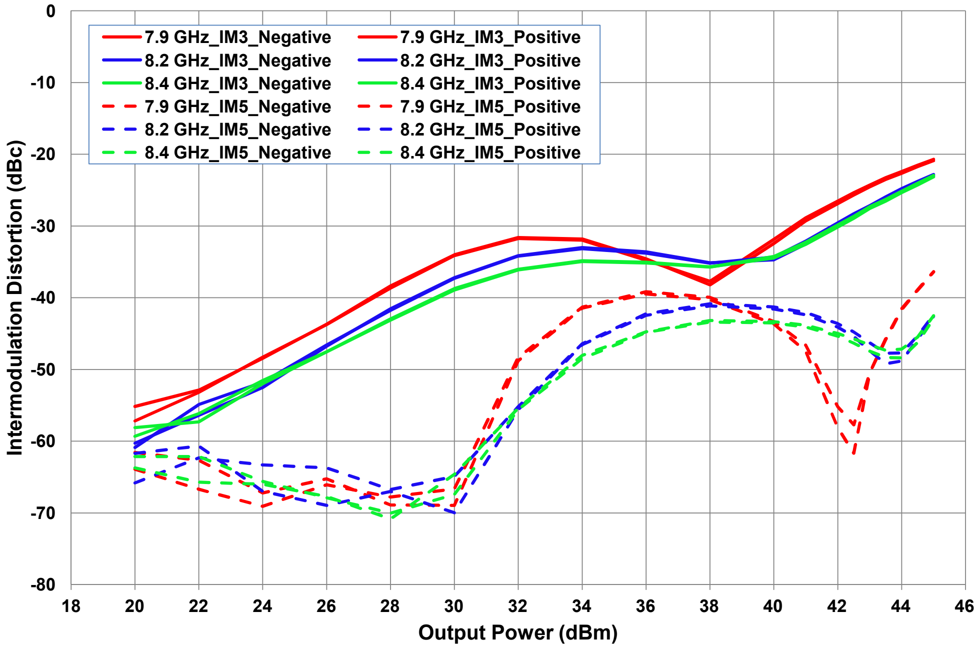
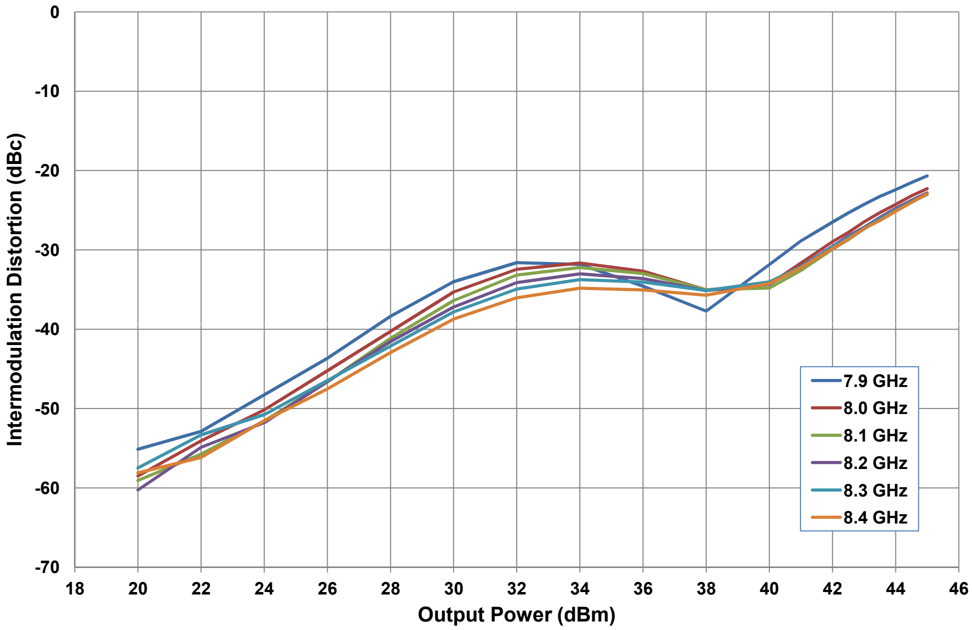


Figure 4. - Two Tone IMS vs. Output Power
V_{DD} = 40 V, Tone Spacing = 100 kHz



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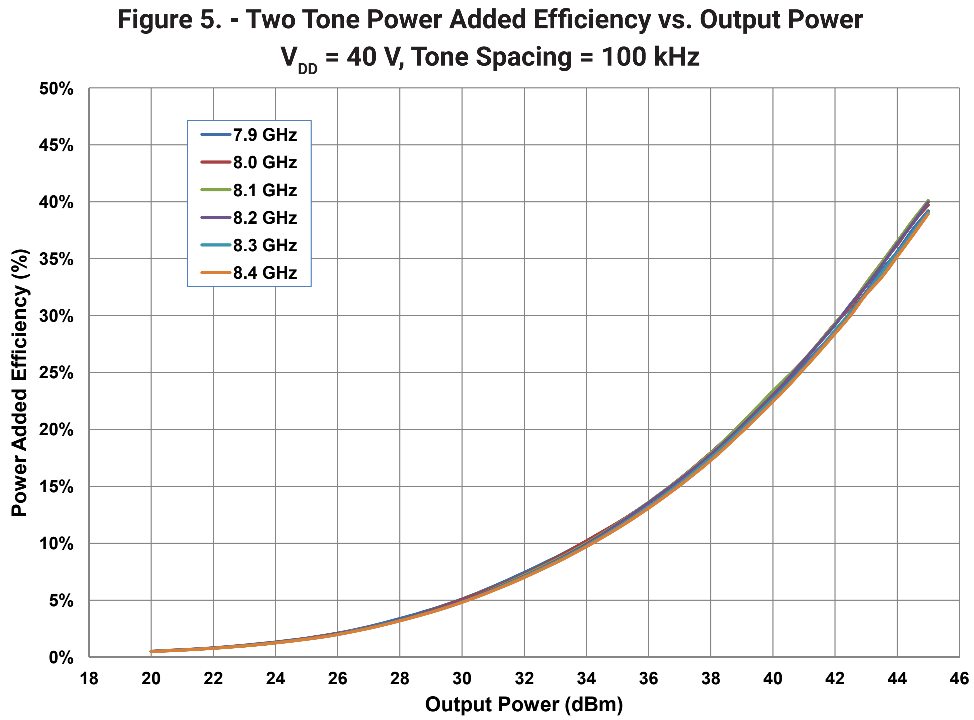

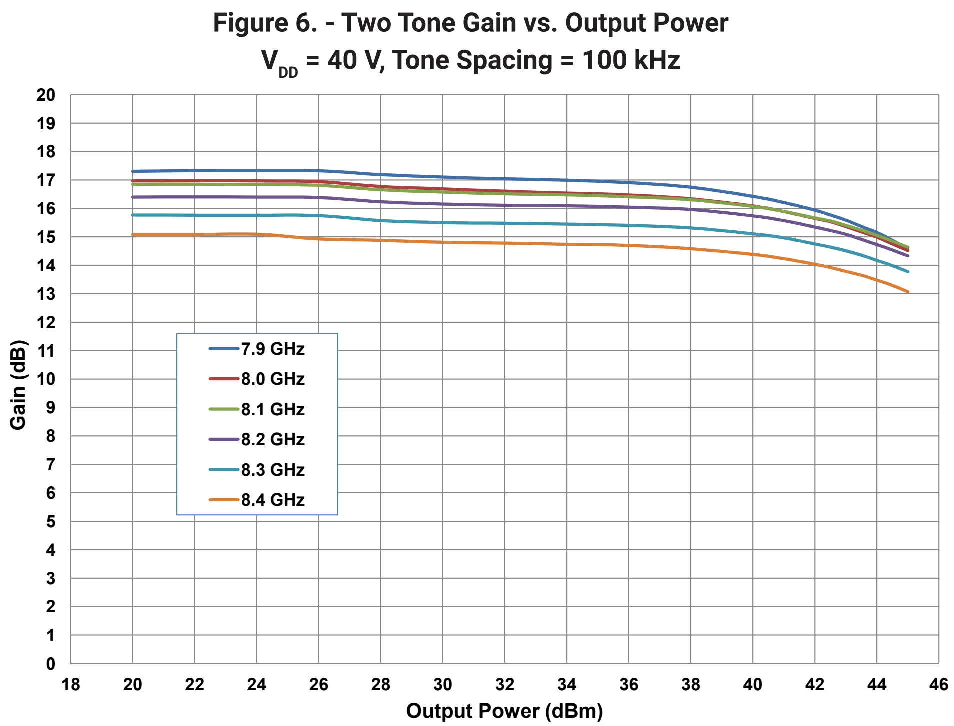

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CGHV96050F1 Typical Performance

Figure 7. - Spectral Mask under OQPSK Modulation, 1.6 Msps
V_{DD} = 40 V, Output Power = 44 dBm / 25 W

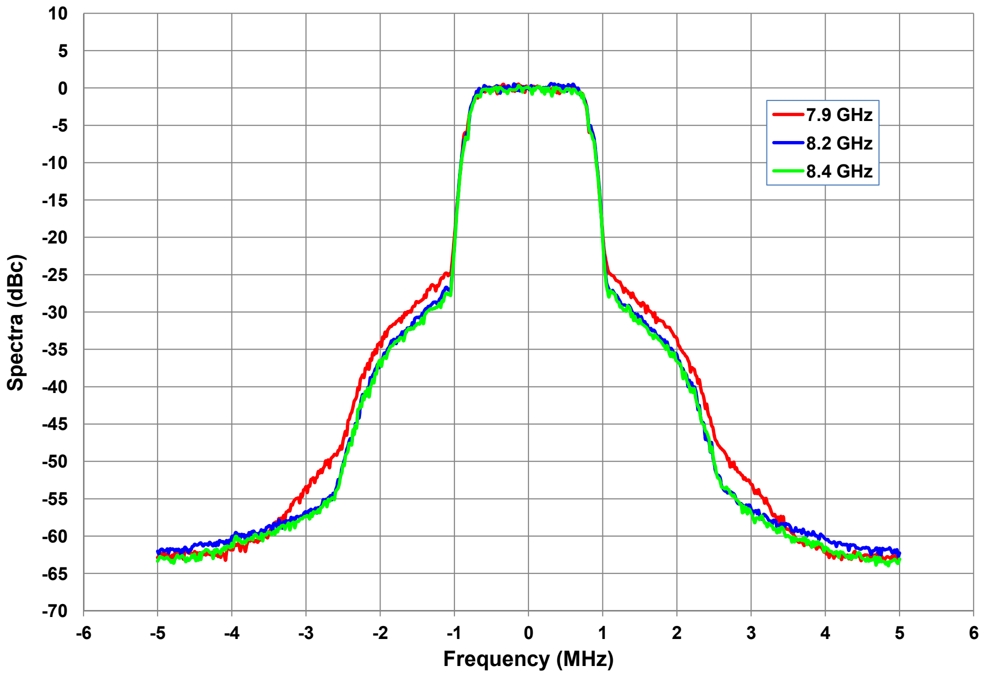

Figure 8. - Linear Output Power, Gain, and Power Added Efficiency vs Frequency
V_{DD} = 40 V, I_{DQ} = 500 mA, 1.6 Msps, OQPSK Modulation at -30 dBc

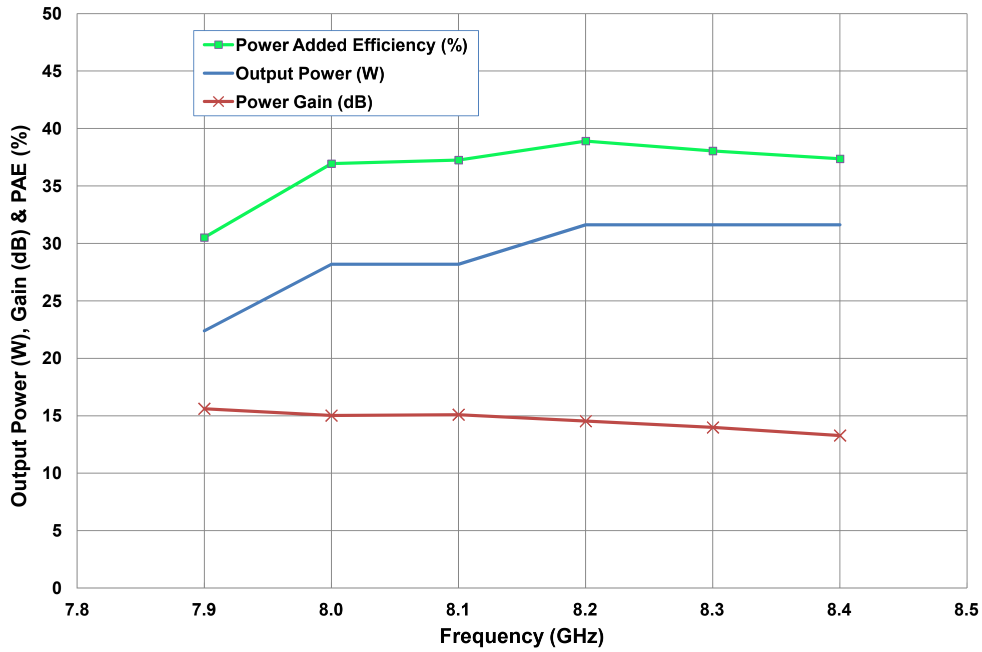

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Figure 9. - OQPSK Linearity vs Output Power

V_{DD} = 40 V, Frequency = 1.6 MHz

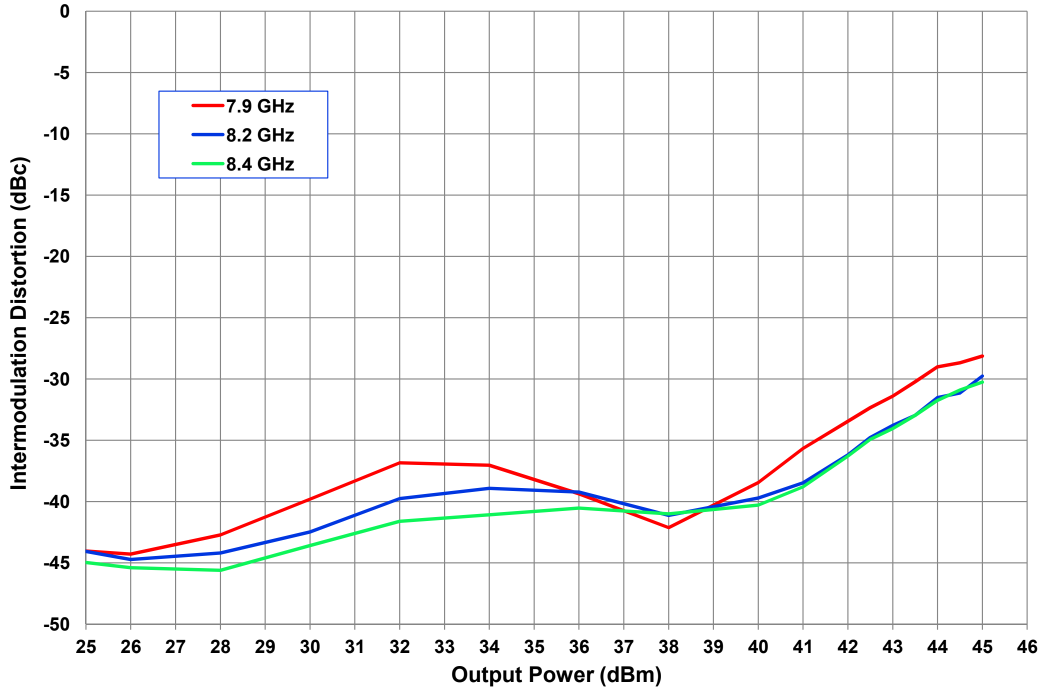
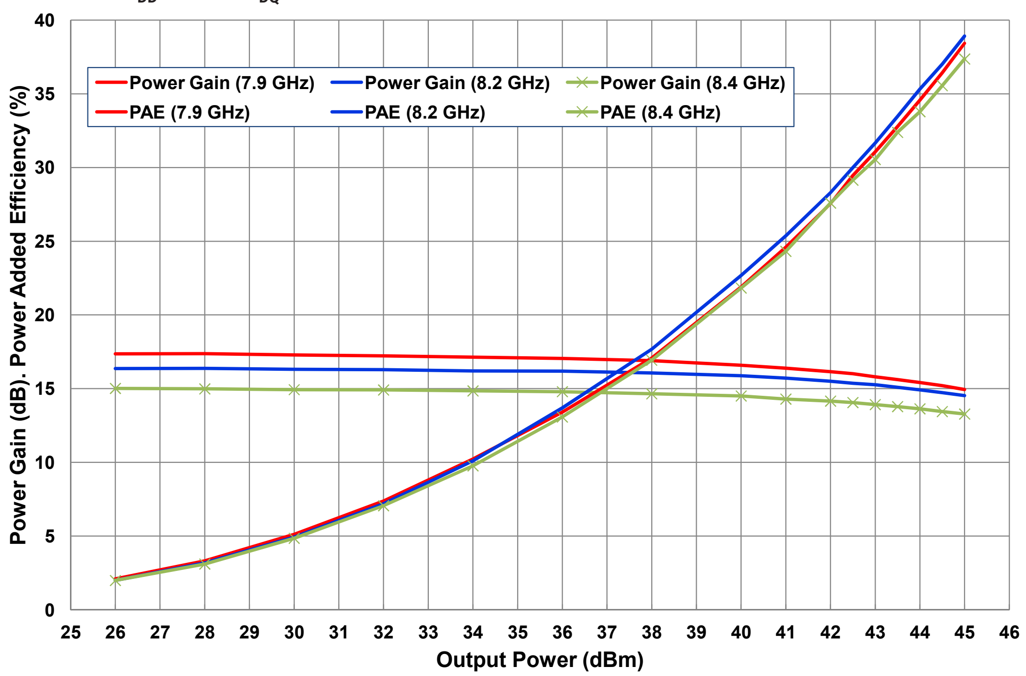


Figure 10. - Power Gain and Power Added Efficiency vs Output Power

V_{DD} = 40 V, I_{DQ} = 500 mA, 1.6 Msps, OQPSK Modulation at -30 dBc



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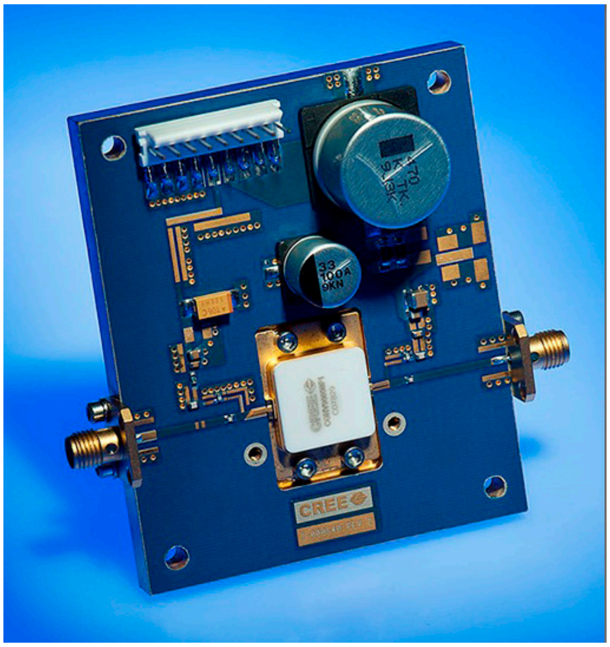
CGHV96050F1-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 47 OHM,+/-1%, 1/16 W, 0603, SMD	1
R2, R3	RES, 0 OHM +/-5%, 125 mW, 1206, SMD	2
C1	CAP, 1.6pF, +/- 0.1 pF, 200V, 0402, ATC 600L	1
C2	CAP, 1.0pF, +/- 0.1 pF, 200V, 0402, ATC 600L	1
C3, C13	CAP, 10 pF +/-5%, 0603, ATC	2
C4, C14	CAP, 470 pF +/-5%, 100 V, 0603	2
C5, C15	CAP, 33,000 pF, 0805, 100 V, X7R	2
C11, C12	CAP, 1.8pF, +/- 0.1 pF, 200V, 0402, ATC 600L	2
C16	CAP, 1 uF +/-10%, 100 V, X7P, 1210	1
C17	CAP, 33 uF +/-20%, G-CASE	1
C18	CAP, 470 uF, +/-20%, ELECTROLYTIC	1
J1,J2	CONNECTOR, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL	2
J3	CONNECTOR, HEADER, RT>PLZ .1CEN LK 9POS	1
-	PCB, TEST FIXTURE, TACONICS RF35P, 20 MIL THK, 440210 PKG	1
-	2-56 SOC HD SCREW 1/4 SS	4
-	#2 SPLIT LOCKWASHER SS	4
Q1	CGHV96050F1	1

CGHV96050F1-AMP Demonstration Amplifier Circuit



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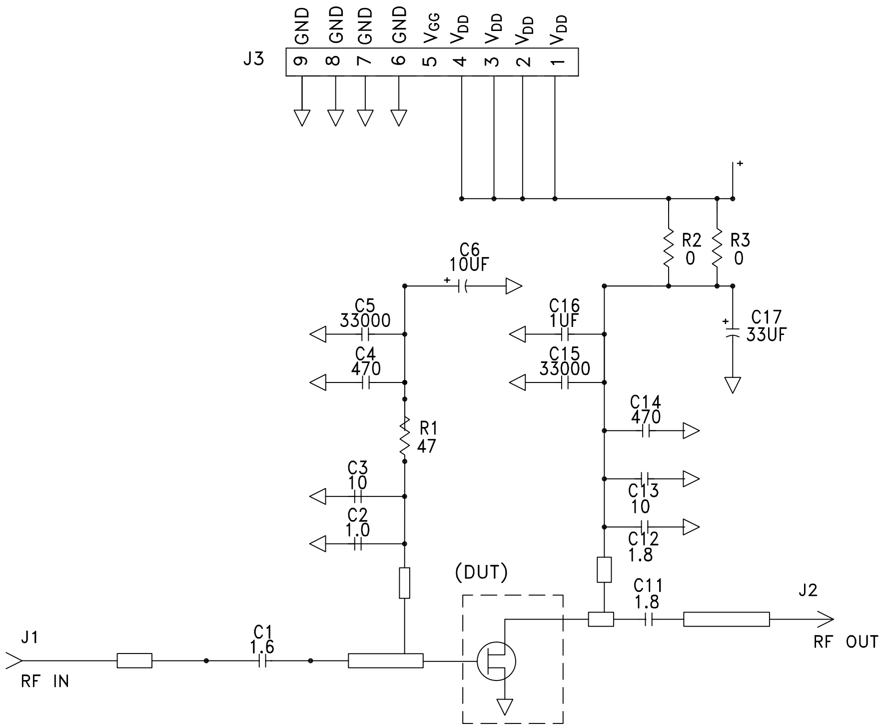
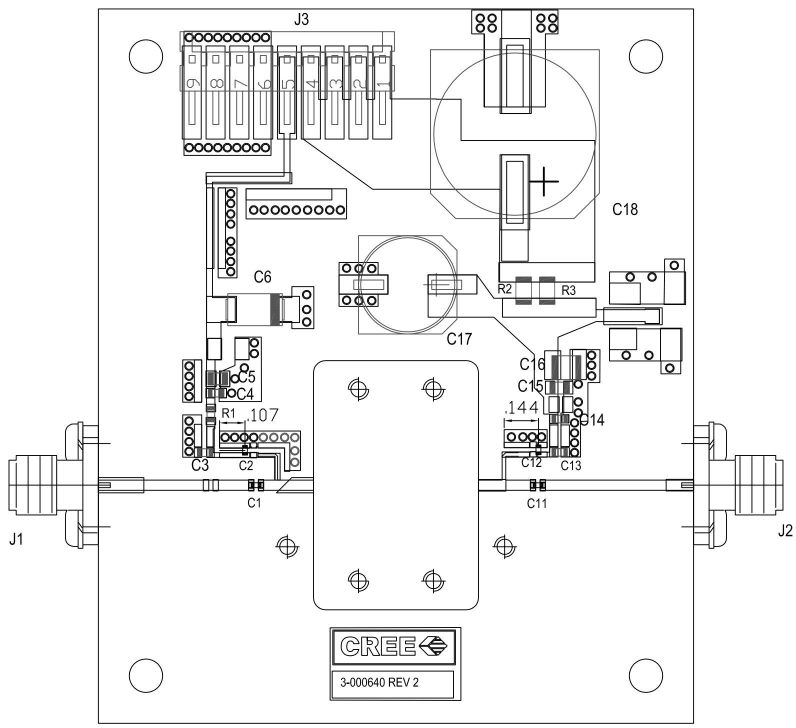
CGHV96050F1-AMP Demonstration Amplifier Circuit Schematic



CGHV96050F1-AMP Demonstration Amplifier Circuit Outline



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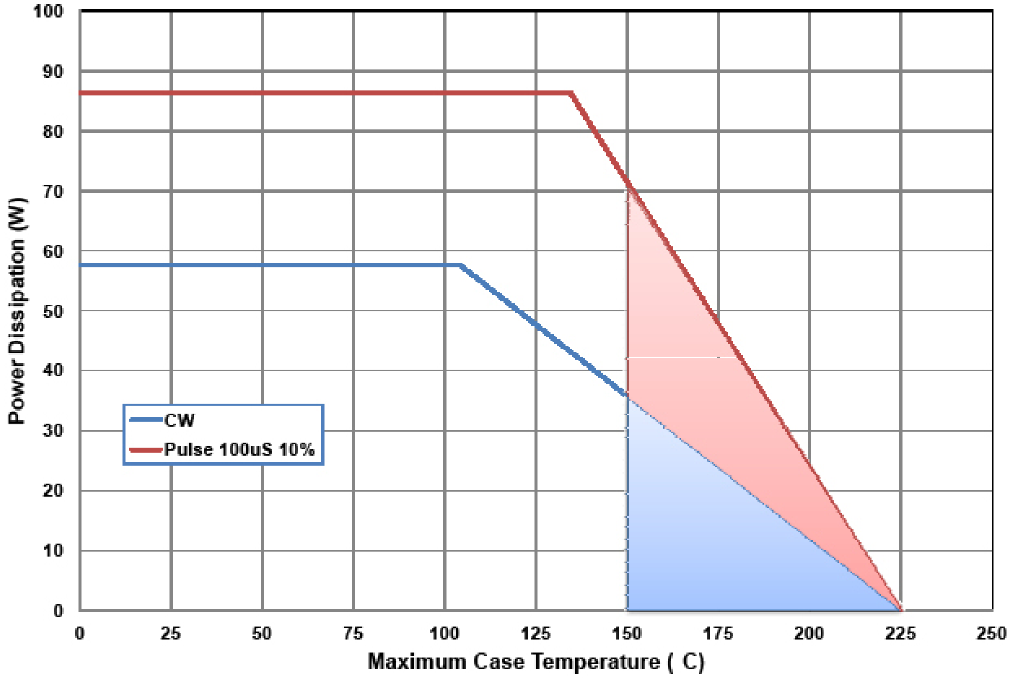
CGHV96050F1 Power Dissipation De-rating Curve



Note. Shaded area exceeds Maximum Case Operating Temperature (See Page 2)

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A > 250 V	JEDEC JESD22 A114-D
Charge Device Model	CDM	1 < 200 V	JEDEC JESD22 C101-C

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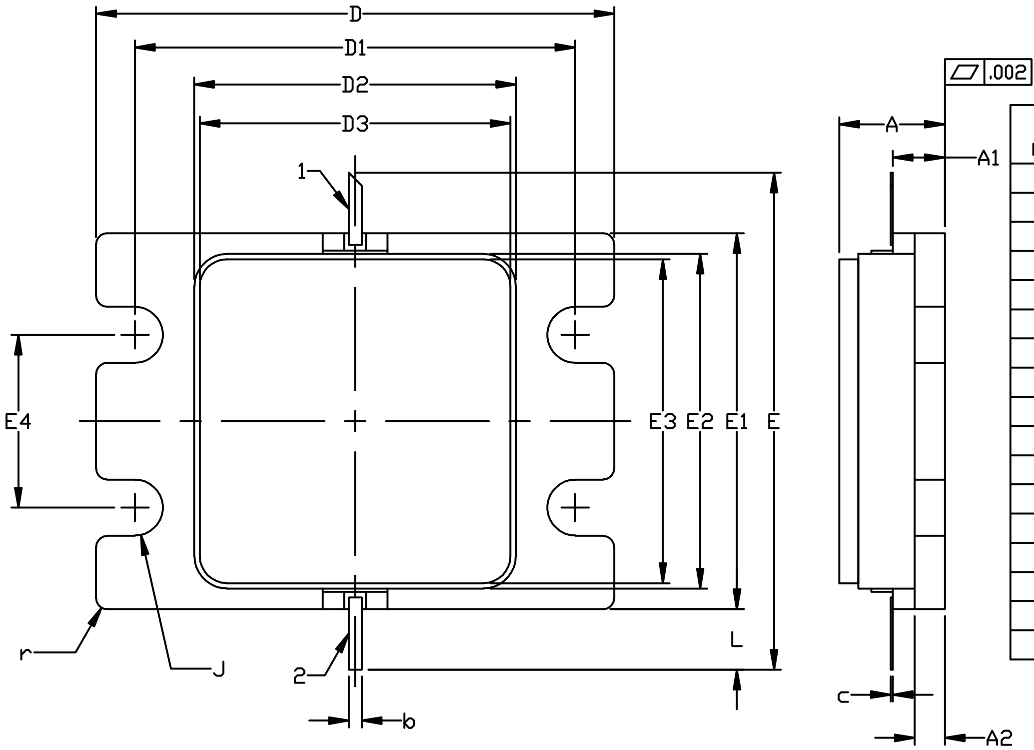
Product Dimensions CGHV96050F1 (Package Type — 440210)

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M-2009
2. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF .020 BEYOND EDGE OF LID
3. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF .008 IN ANY DIRECTION
4. ALL PLATED SURFACES ARE GOLD OVER NICKEL



1. GATE
2. DRAIN

DIM	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.188	0.198	4.78	5.03	
A1	0.088	0.100	2.24	2.54	2x
A2	0.049	0.061	1.24	1.55	
b	0.022	0.026	0.56	0.66	2x
c	0.002	0.006	0.05	0.15	
D	0.935	0.955	23.75	24.26	
D1	0.797	0.809	20.24	20.55	2x
D2	0.581	0.593	14.76	15.06	
D3	0.563	0.571	14.30	14.50	
E	0.906		23.01		REF
E1	0.679	0.691	17.25	17.55	
E2	0.604	0.616	15.34	15.65	
E3	0.586	0.594	14.88	15.09	
E4	0.309	0.321	7.85	8.15	2x
J	ø0.097	ø0.107	ø2.46	ø2.72	4x
L	0.090	0.130	2.29	3.30	2x
r	0.02 TYP		0.51 TYP		12x

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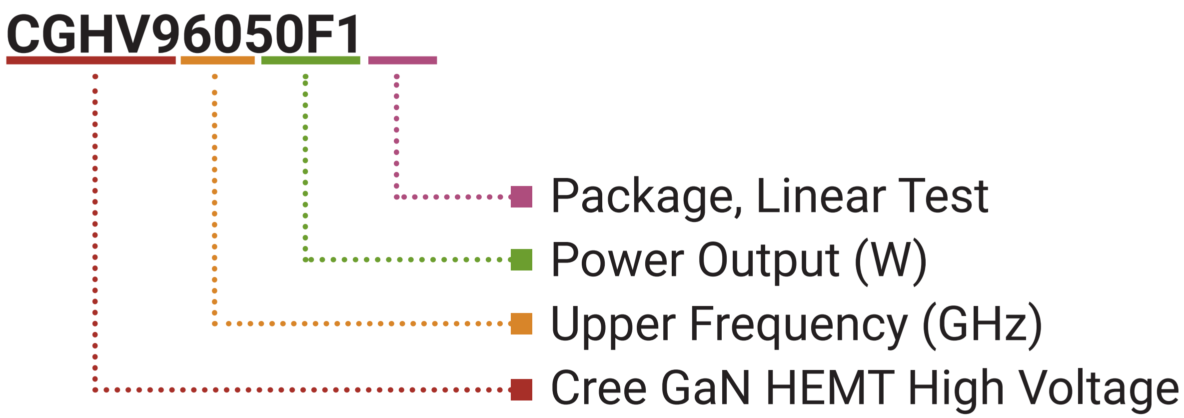
Part Number System



Parameter	Value	Units
Upper Frequency[1]	9.6	GHz
Power Output	50	W
Package	Flange	-

Table 1.

Note[1]: Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

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

Table 2.

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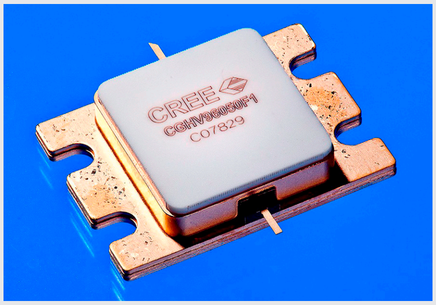
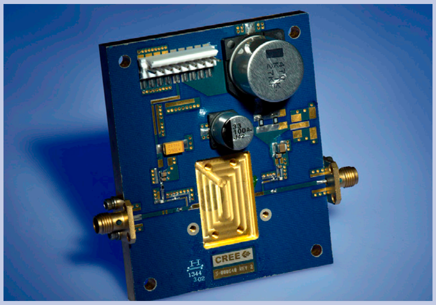
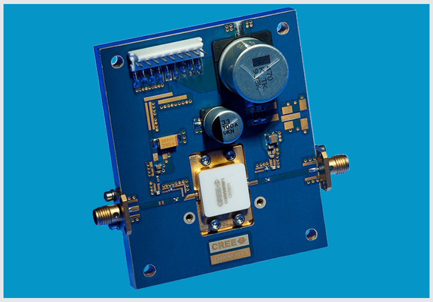
Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGHV96050F1	GaN HEMT	Each	
CGHV96050F1-TB	Test board without GaN HEMT	Each	
CGHV96050F1-AMP1	Test board with GaN HEMT installed	Each	

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