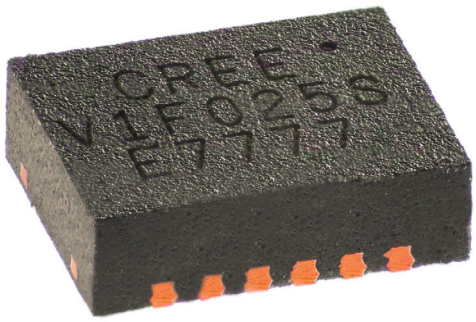
CGHV1F025S

25 W, DC - 15 GHz, 40 V, GaN HEMT

Description

Cree's CGHV1F025S is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities. The device can be deployed for L, S, C, X and Ku-Band amplifier applications. The datasheet specifications are based on a X-Band (8.9 - 9.6 GHz) amplifier. The CGHV1F025S operates on a 40 volt rail circuit while housed in a 3mm x 4mm, surface mount, dual-flat-no-lead (DFN) package. Under reduced power, the transistor can operate below 40V to as low as 20V V_{DD}, maintaining high gain and efficiency.



Package Type: 3x4 DFN
PN: CGHV1F025S

Typical Performance 8.9 - 9.6 GHz (T_C = 25˚C), 40 V

Parameter	8.9 GHz	9.2 GHz	9.4 GHz	9.6 GHz	Units
Output Power @ P_{IN} = 37 dBm	24	29	27	25	W
Drain Efficiency @ P_{IN} = 37 dBm	43.5	48.5	48	46	%
Gain @ P_{IN} = 0 dBm	10.7	11.6	11.3	11.1	dB

Note: Measured in the CGHV1F025S-AMP1 application circuit. Pulsed 100 µs 10% duty

Features

- Up to 15 GHz Operation
- 25 W Typical Output Power
- 11 dB Gain at 9.4 GHz
- Application circuit for 8.9 - 9.6 GHz

Large Signal Models Available for ADS and MWO

RoHS COMPLIANT

Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	120	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}	4.8	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	2	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Case Operating Temperature[3,4]	T_C	-40, +150	˚C	
Thermal Resistance, Junction to Case[5]	$R_{\theta JC}$	3.4	˚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} = 24 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] Pulsed (100 µs, 10% Duty). Rth for Cree's reference design using a 10 mil Rogers 5880 PCB with 31 (Ø13 mil) Vias would be 3.6 °C/W.
For CW operation, the Rth numbers increase to 5°C/W for just the device, and 7.3 °C/W including the board

Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	-2.3	V_{DC}	V_{DS} = 10 V, I_D = 4.8 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 40 V, I_D = 120 mA
Saturated Drain Current[2]	I_{DS}	3.5	4.8	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	100	–	–	V_{DC}	V_{GS} = -8 V, I_D = 4.8 mA
RF Characteristics[3] (T_C = 25˚C, F_0 = 5.55 GHz unless otherwise noted)						
Gain	G	–	15.1	–	dB	V_{DD} = 40 V, I_{DQ} = 120 mA, P_{IN} = 10 dBm
Output Power[4]	P_{OUT}	–	44.8	–	dBm	V_{DD} = 40 V, I_{DQ} = 120 mA, P_{IN} = 33.5 dBm
Drain Efficiency[4]	η	–	51	–	%	V_{DD} = 40 V, I_{DQ} = 120 mA, P_{IN} = 33.5 dBm
Output Mismatch Stress[4]	V_{SWR}	–	10 : 1	–	Ψ	No damage at all phase angles, V_{DD} = 40 V, I_{DQ} = 120 mA, P_{IN} = 33.5 dBm
Dynamic Characteristics						
Input Capacitance[5]	C_{GS}	–	5.9	–	pF	V_{DS} = 40 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance[5]	C_{DS}	–	2	–	pF	V_{DS} = 40 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.21	–	pF	V_{DS} = 40 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging
[2] Scaled from PCM data
[3] Measured in production test fixture.
[4] Pulsed 100 µs, 10% duty cycle
[5] Includes package

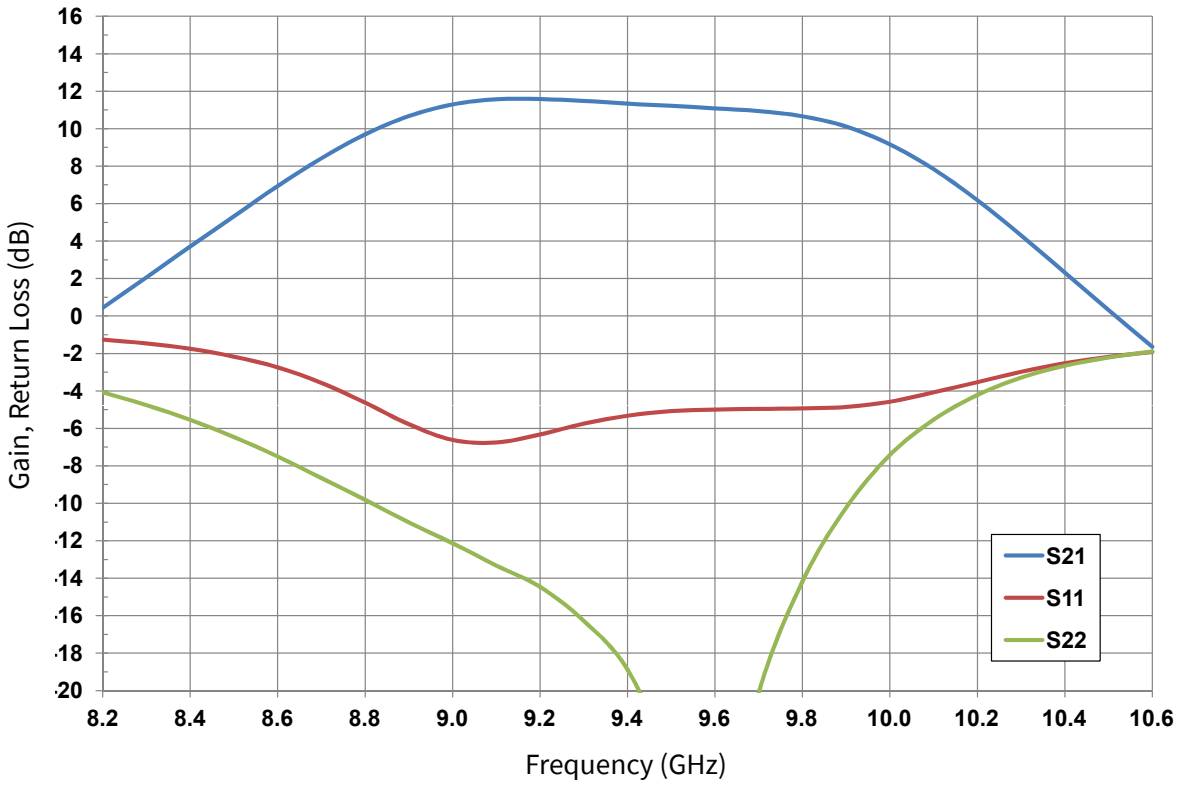
Electrical Characteristics When Tested in CGHV1F025S-AMP1

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
RF Characteristics[1] (T_C = 25˚C, F_0 = 8.9 - 9.6 GHz unless otherwise noted)						
Gain	G	–	11.6	–	dB	V_{DD} = 40 V, I_{DQ} = 150 mA, P_{IN} = 0 dBm
Output Power[2]	P_{OUT}	–	29	–	W	V_{DD} = 40 V, I_{DQ} = 150 mA, P_{IN} = 37 dBm
Drain Efficiency[2]	η	–	48.5	–	%	V_{DD} = 40 V, I_{DQ} = 150 mA, P_{IN} = 37 dBm
Output Mismatch Stress[2]	V_{SWR}	–	10 : 1	–	Ψ	V_{DS} = 40 V, V_{gs} = -8 V, P_{OUT} = 25 W

Notes:
[1] Measured in CGHV1F025S-AMP1 Application Circuit
[2] Pulsed 100 µs, 10% duty cycle

Typical Perfromance - CGHV1F025S-AMP1

Figure 1. Typical Small Signal Response of CGHV1F025S-AMP1 Application Circuit
V_{DD} = 40 V, I_{DQ} = 150 mA



Typical Performance in Application Circuit CGHV1F025S-AMP1

Figure 2. Typical Large Signal Response
V_{DD} = 40 V, I_{DQ} = 150 mA, P_{IN} = 37 dBm
Tcase = 25°C, Pulse Width = 100 µs, Duty Cycle = 10%

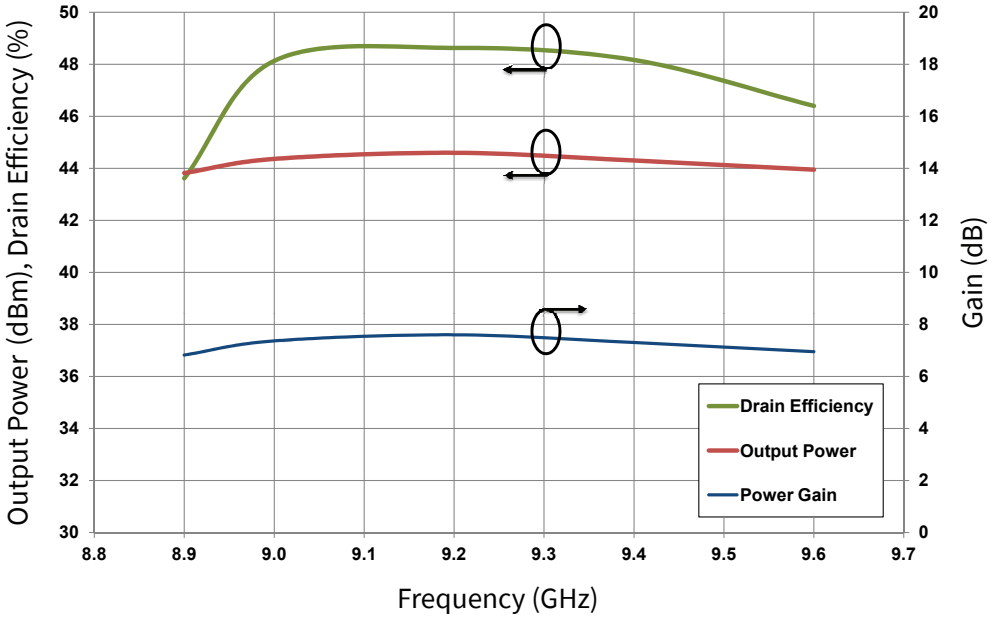
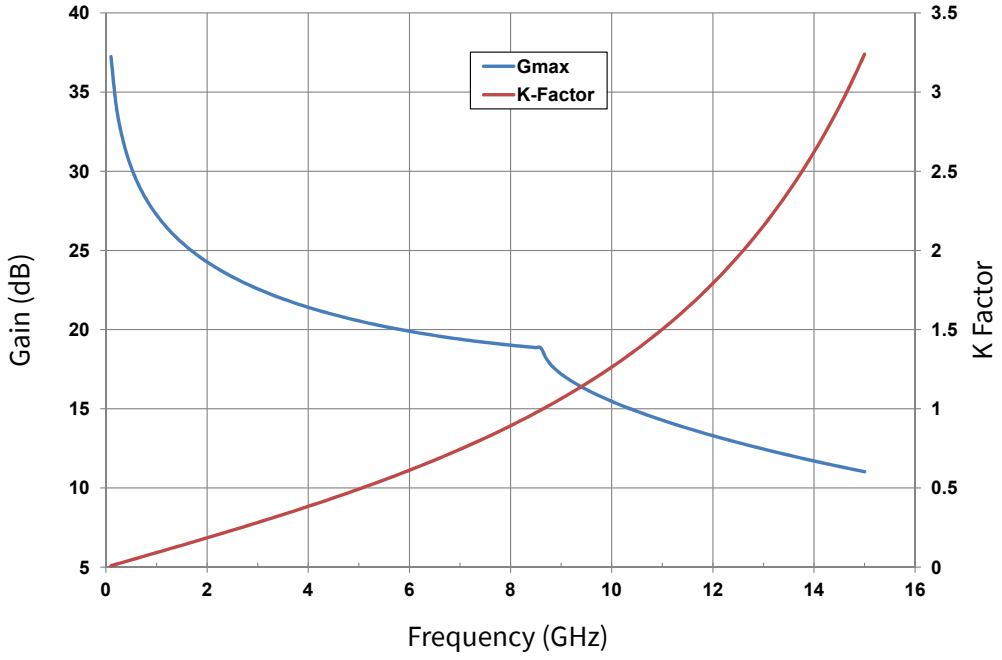


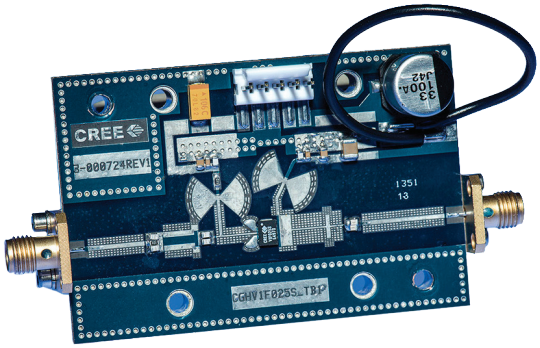
Figure 3. G_{MAX} and K-Factor vs Frequency
V_{DD} = 40 V, I_{DQ} = 150 mA, Tcase = 25°C



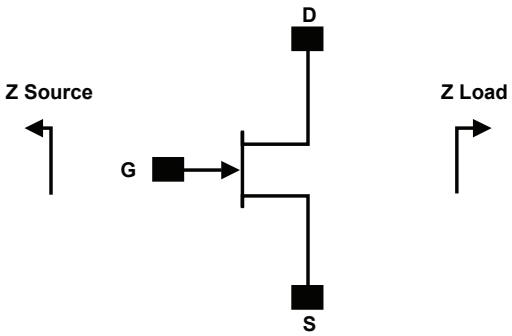
CGHV1F025S-AMP1 Application Circuit Bill of Material

Designator	Description	Qty
R1	RES, 100, OHM, +1/-1%, 1/16 W, 0603	2
R2	RES, 10, OHM, +1/-1%, 1/16 W, 0603	1
C1, C2	CAP, 1pF, ±0.1 pF, 0603, ATC	3
C3, C4	CAP, 1.8pF, ±0.1 pF, 0603, ATC	3
C9, C10	CAP, 0.6pF, ±0.1 pF, 0603, ATC	1
C5, C11	CAP, 10 pF, ±5%, 0603, ATC	1
C6, C12	CAP, 470 pF, 5%, 100 V, 0603, X	2
C7, C13	CAP, 33000 pF, 0805, 100V, X7R	1
C14	CAP, 1.0 UF, 100V, 10%, X7R, 1210	3
C8	CAP, 10 UF, 16V TANTALUM	3
C15	CAP, 33UF, 20%, G CASE	1
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE	1
J3	HEADER RT>PLZ .1CEN LK 5POS	2
Q1	QFN TRANSISTOR CGHV1F025S	1
W1	CABLE, 18 AWG, 4.2	1

CGHV1F025S-AMP1 Application Circuit



Source and Load Impedances



Frequency (GHz)	Z Source	Z Load
8.00	1.16 - j12.0	4.33 - j3.47
8.25	1.12 - j12.92	4.20 - j4.34
8.50	0.96 - j13.39	3.37 - j5.23
8.75	1.07 - j14.33	3.50 - j6.11
9.00	1.06 - j14.80	3.45 - j6.99
9.25	1.15 - j15.76	3.38 - j7.44
9.50	1.17 - j16.24	3.31 - j7.89
9.75	1.14 - j17.21	3.25 - j8.78
10.00	1.30 - j17.70	3.21 - j9.23

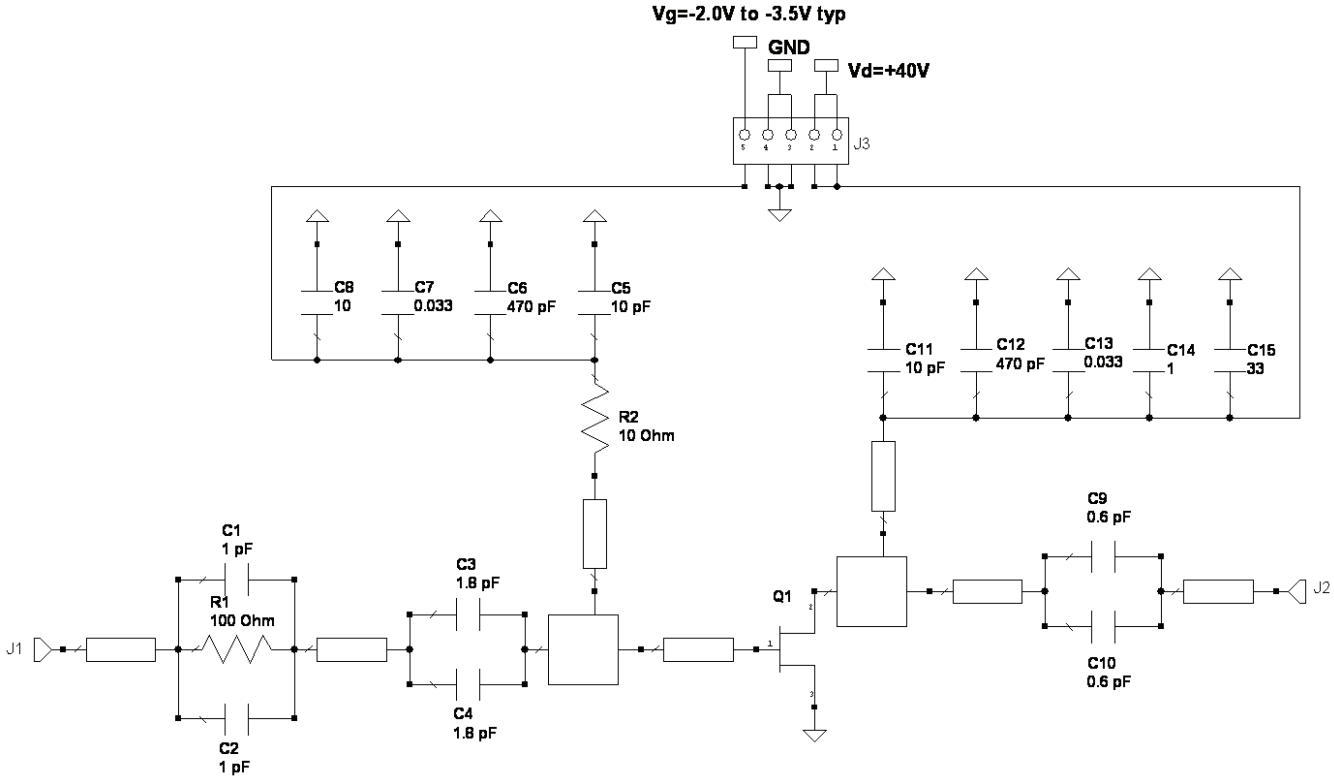
Electrostatic Discharge (ESD) Classifications

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

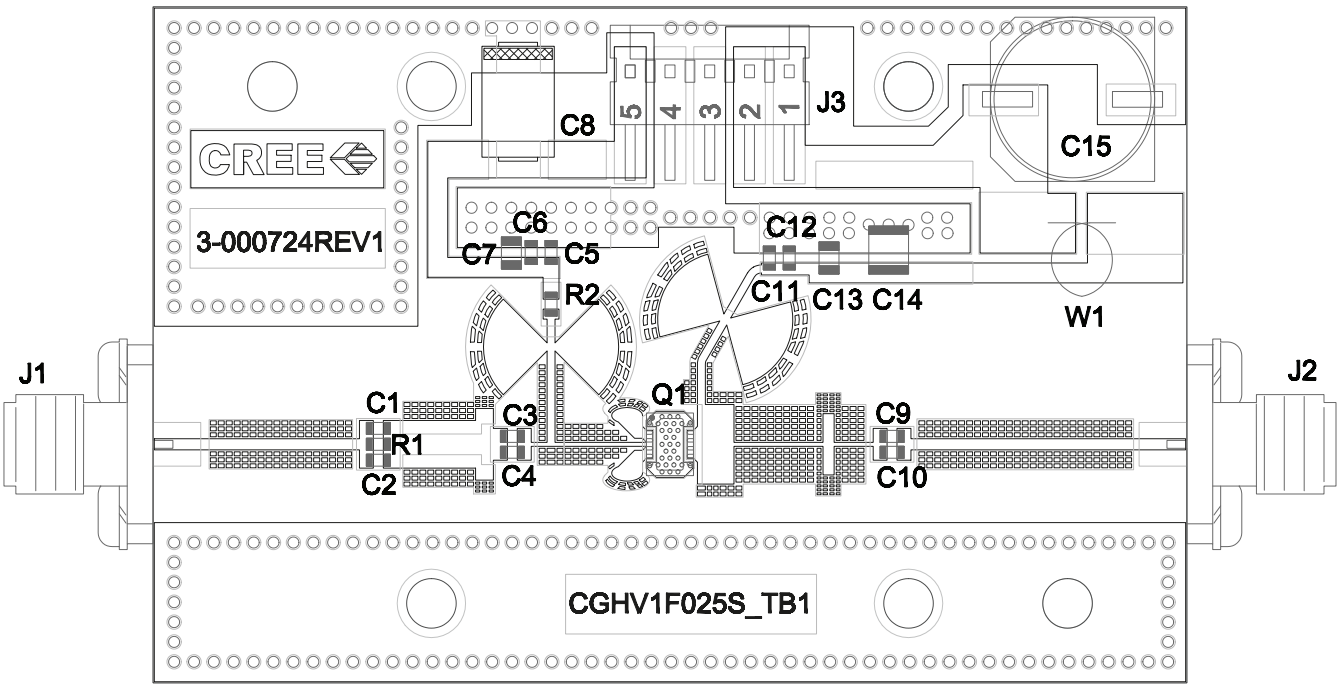
Moisture Sensitivity Level (MSL) Classification

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

CGHV1F025S-AMP1 Application Circuit Schematic

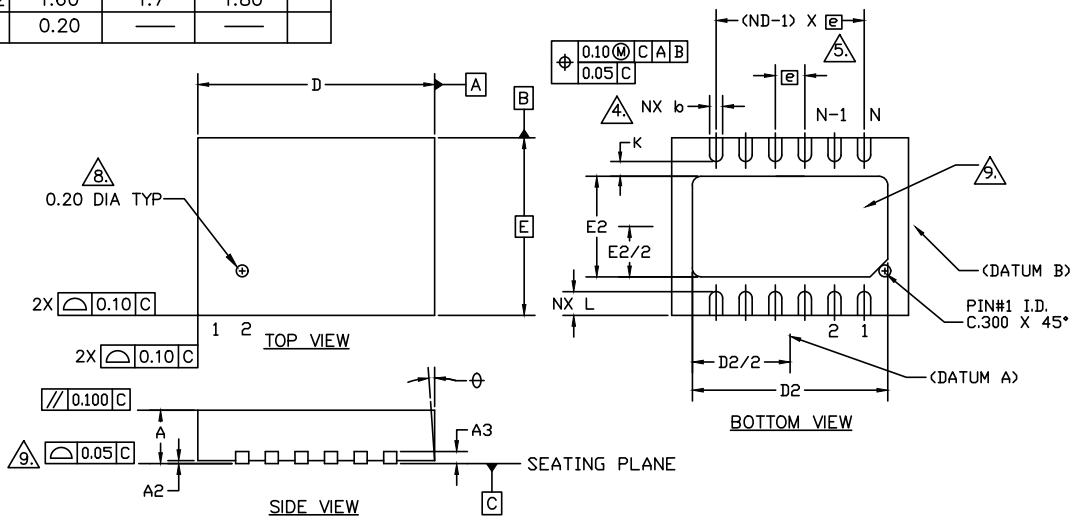


CGHV1F025S-AMP1 Application Circuit Outline

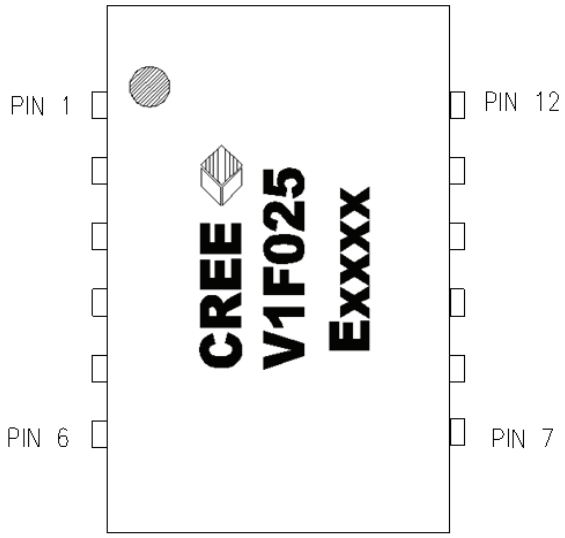


Product Dimensions CGHV1F025S (Package 3 x 4 DFN)

SYMBOL	COMMON DIMENSIONS			NOTE
	MIN.	NOM.	MAX.	
A	0.80	0.90	1.0	
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	——	——	



Frequency	Z Source
1	GND
2	RF IN
3	RF IN
4	RF IN
5	RF IN
6	GND
7	GND
8	RF OUT
9	RF OUT
10	RF OUT
11	RF OUT
12	GND



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

Part Number System

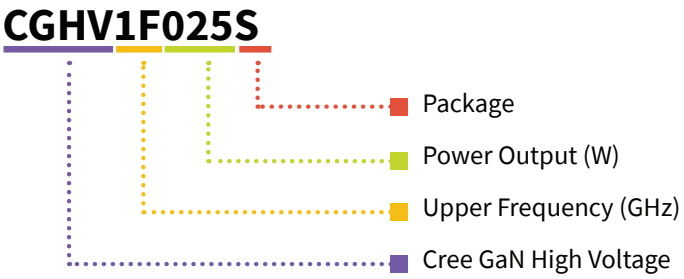


Table 1.

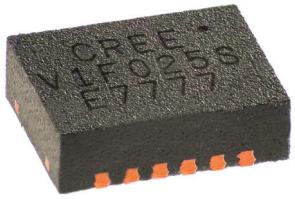
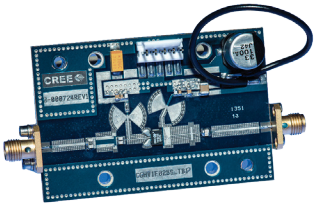
Parameter	Value	Units
Upper Frequency[1]	15.0	GHz
Power Output	25	W
Package	Surface Mount	-

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
CGHV1F025S	GaN HEMT	Each	
CGHV1F025-AMP1	Test board with GaN HEMT installed	Each	

For more information, please contact:

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

Sales Contact
rfsales@cree.com

Notes & Disclaimer

Specifications are subject to change without notice. “Typical” parameters are the average values expected by Cree in large quantities and are provided for information purposes only. Cree products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death. No responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from use of the information contained herein. No license is granted by implication or otherwise under any patent or patent rights of Cree.