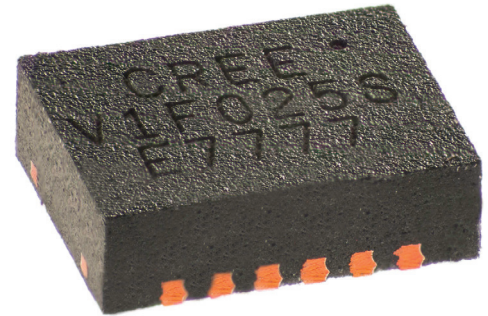


# CGHV1F025S

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 ( $T_c = 25^\circ\text{C}$ ), 40 V

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

Note: Measured in the CGHV1F025S-AMP1 application circuit. Pulsed 100  $\mu\text{s}$  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



## Absolute Maximum Ratings (not simultaneous) at 25 °C

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	$V_{DS}$	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 <sup>1</sup>	$I_{DMAX}$	2	A	25 °C
Soldering Temperature <sup>2</sup>	$T_S$	245	°C	
Case Operating Temperature <sup>3,4</sup>	$T_C$	-40, +150	°C	
Thermal Resistance, Junction to Case <sup>5</sup>	$R_{\theta JC}$	3.4	°C/W	85 °C

### Notes:

<sup>1</sup> Current limit for long term, reliable operation

<sup>2</sup> Refer to the Application Note on soldering at [wolfspeed.com/rf/document-library](http://wolfspeed.com/rf/document-library)

<sup>3</sup> Simulated at  $P_{DISS} = 24$  W

<sup>4</sup>  $T_C$  = Case temperature for the device. It refers to the temperature at the ground tab underneath the package. The PCB will add additional thermal resistance

<sup>5</sup> Pulsed (100  $\mu$ s, 10% Duty). Rth for Cree's reference design using a 10 mil Rogers 5880 PCB with 31 ( $\varnothing$ 13 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
<b>DC Characteristics<sup>1</sup></b>						
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 <sup>2</sup>	$I_{DS}$	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
<b>RF Characteristics<sup>3</sup> (<math>T_C = 25</math> °C, <math>F_0 = 5.55</math> GHz unless otherwise noted)</b>						
Gain	G	-	15.1	-	dB	$V_{DD} = 40$ V, $I_{DQ} = 120$ mA, $P_{IN} = 10$ dBm
Output Power <sup>4</sup>	$P_{OUT}$	-	44.8	-	dBm	$V_{DD} = 40$ V, $I_{DQ} = 120$ mA, $P_{IN} = 33.5$ dBm
Drain Efficiency <sup>4</sup>	$\eta$	-	51	-	%	$V_{DD} = 40$ V, $I_{DQ} = 120$ mA, $P_{IN} = 33.5$ dBm
Output Mismatch Stress <sup>4</sup>	$V_{SWR}$	-	10 : 1	-	$\Psi$	No damage at all phase angles, $V_{DD} = 40$ V, $I_{DQ} = 120$ mA, $P_{IN} = 33.5$ dBm
<b>Dynamic Characteristics</b>						
Input Capacitance <sup>5</sup>	$C_{GS}$	-	5.9	-	pF	$V_{DS} = 40$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance <sup>5</sup>	$C_{DS}$	-	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:

<sup>1</sup> Measured on wafer prior to packaging

<sup>2</sup> Scaled from PCM data

<sup>3</sup> Measured in production test fixture.

<sup>4</sup> Pulsed 100  $\mu$ s, 10% duty cycle

<sup>5</sup> Includes package



### Electrical Characteristics When Tested in CGHV1F025S-AMP1

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>RF Characteristics<sup>1</sup> (T<sub>c</sub> = 25 °C, F<sub>0</sub> = 8.9 - 9.6 GHz unless otherwise noted)</b>						
Gain	G	-	11.6	-	dB	V <sub>DD</sub> = 40 V, I <sub>DQ</sub> = 150 mA, P <sub>IN</sub> = 0 dBm
Output Power <sup>2</sup>	P <sub>OUT</sub>	-	29	-	W	V <sub>DD</sub> = 40 V, I <sub>DQ</sub> = 150 mA, P <sub>IN</sub> = 37 dBm
Drain Efficiency <sup>2</sup>	η	-	48.5	-	%	V <sub>DD</sub> = 40 V, I <sub>DQ</sub> = 150 mA, P <sub>IN</sub> = 37 dBm
Output Mismatch Stress <sup>2</sup>	V <sub>SWR</sub>	-	10 : 1	-	Ψ	V <sub>DS</sub> = 40 V, V <sub>GS</sub> = -8 V, P <sub>OUT</sub> = 25 W

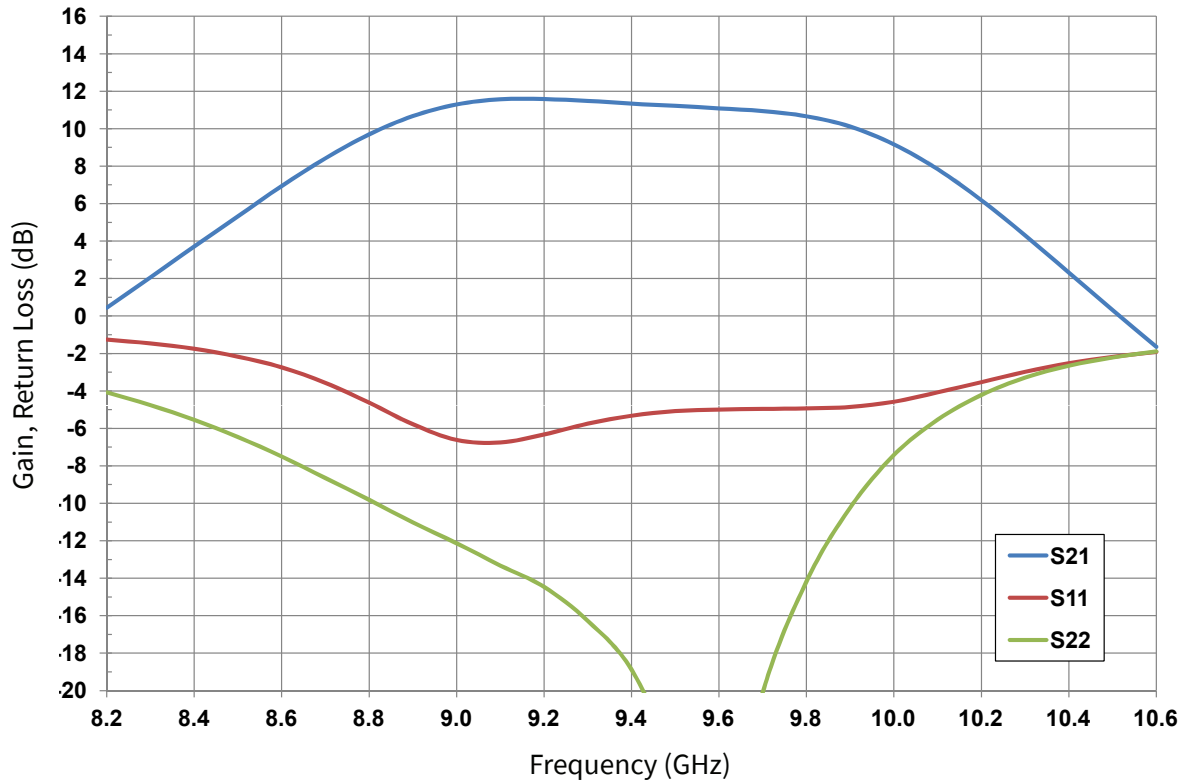
Notes:

<sup>1</sup> Measured in CGHV1F025S-AMP1 Application Circuit

<sup>2</sup> Pulsed 100 μs, 10% duty cycle

### Typical Performance - CGHV1F025S-AMP1

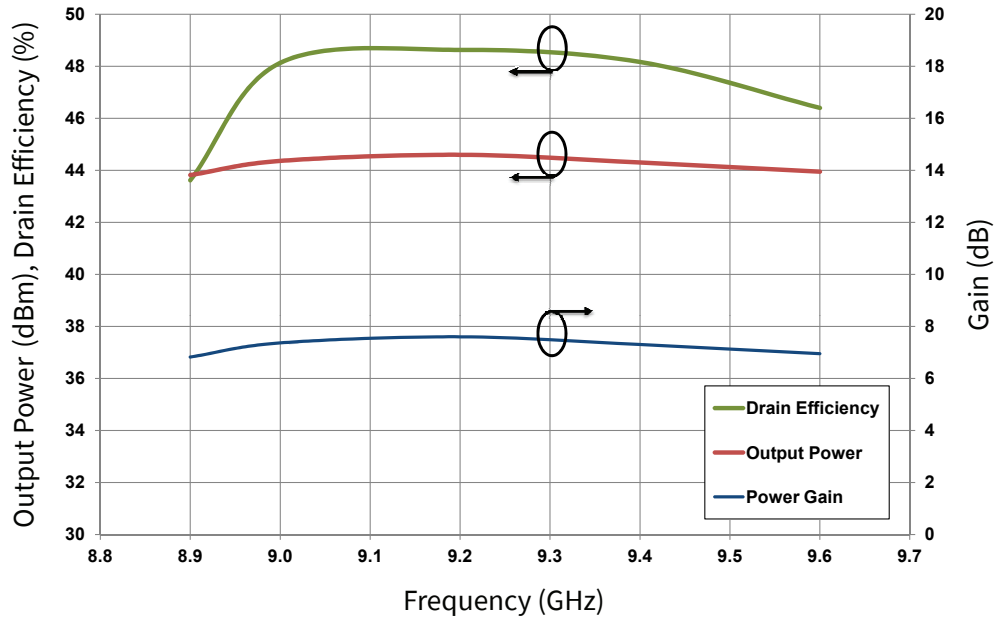
**Figure 1. Typical Small Signal Response of CGHV1F025S-AMP1 Application Circuit**  
**V<sub>DD</sub> = 40 V, I<sub>DQ</sub> = 150 mA**



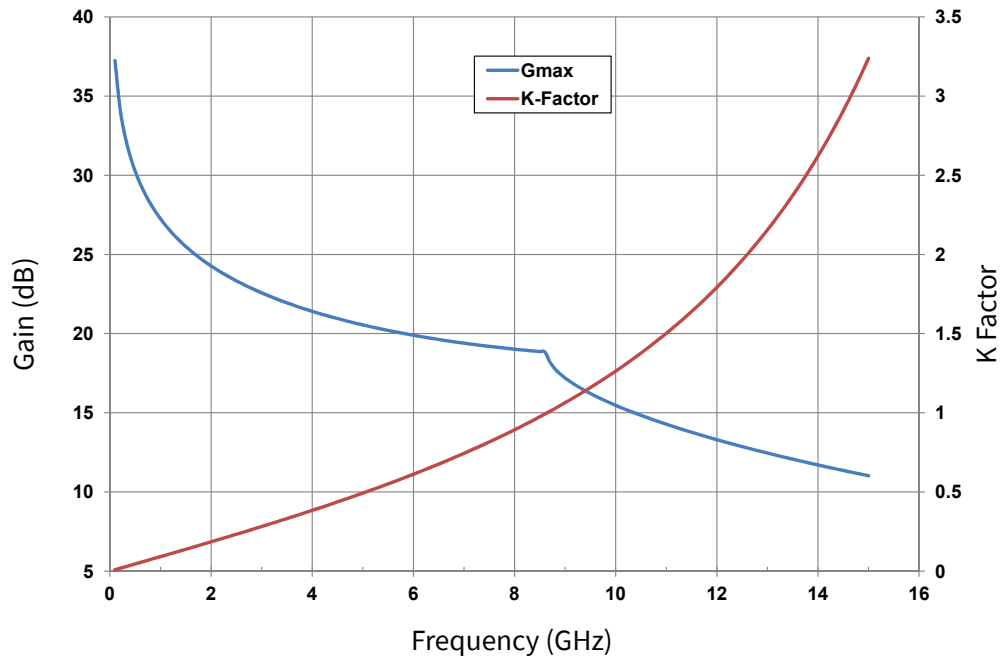


Typical Performance in Application Circuit CGHV1F025S-AMP1

**Figure 2. Typical Large Signal Response**  
 $V_{DD} = 40\text{ V}$ ,  $I_{DQ} = 150\text{ mA}$ ,  $P_{IN} = 37\text{ dBm}$   
 $T_{case} = 25^\circ\text{C}$ , Pulse Width =  $100\ \mu\text{s}$ , Duty Cycle = 10%



**Figure 3.  $G_{MAX}$  and K-Factor vs Frequency**  
 $V_{DD} = 40\text{ V}$ ,  $I_{DQ} = 150\text{ mA}$ ,  $T_{case} = 25^\circ\text{C}$

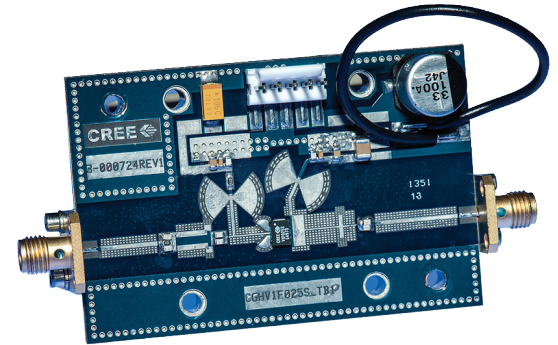




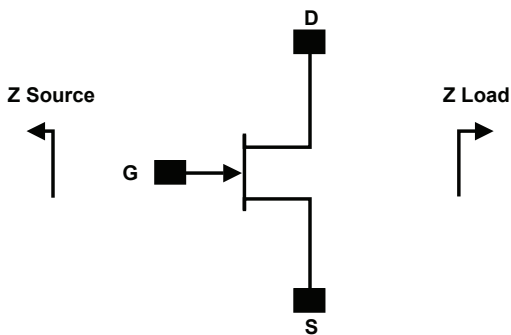
**CGHV1F025S-AMP1 Application Circuit Bill of Material**

Designator	Description	Qty
R1	RES, 100, OHM, +/-1%, 1/16 W, 0603	2
R2	RES, 10, OHM, +/-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

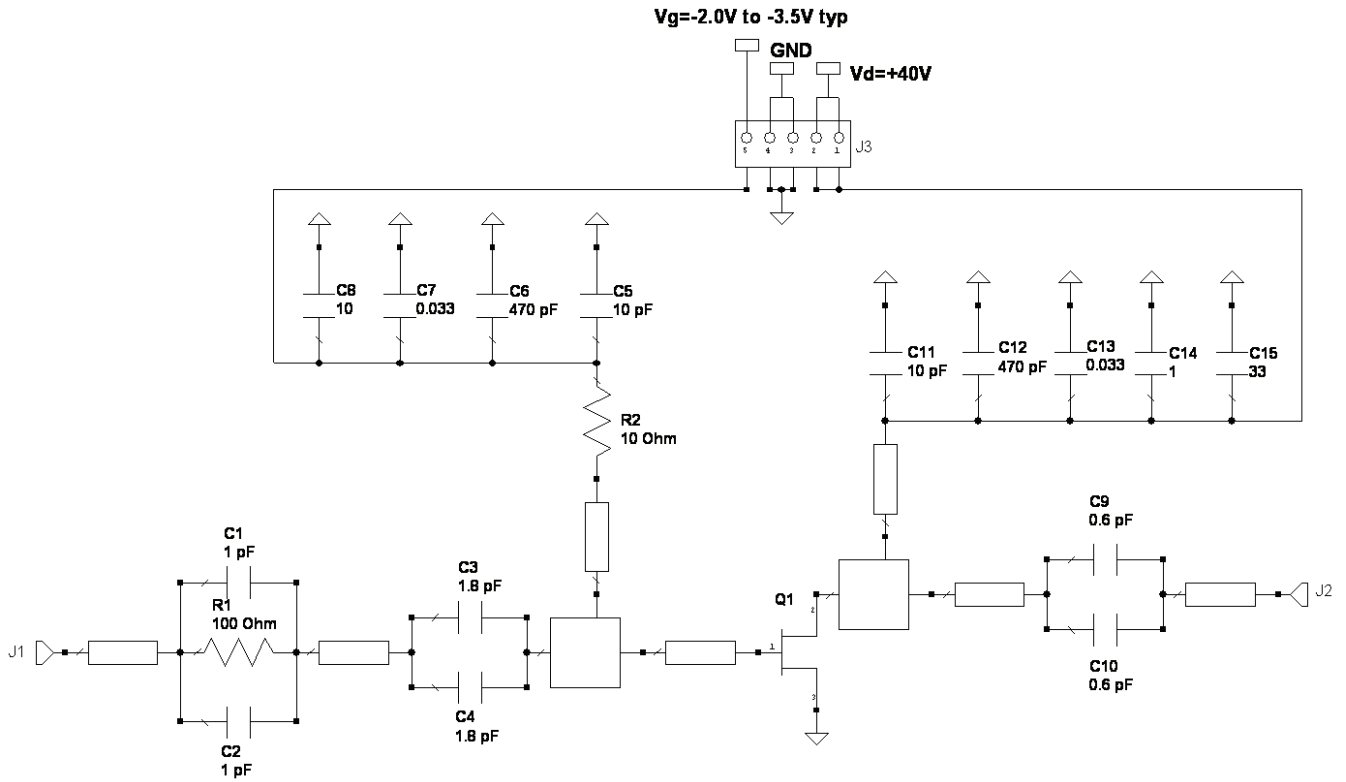
Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1B ( $\geq 500$ V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II ( $\geq 200$ V)	JEDEC JESD22 C101-C

### Moisture Sensitivity Level (MSL) Classification

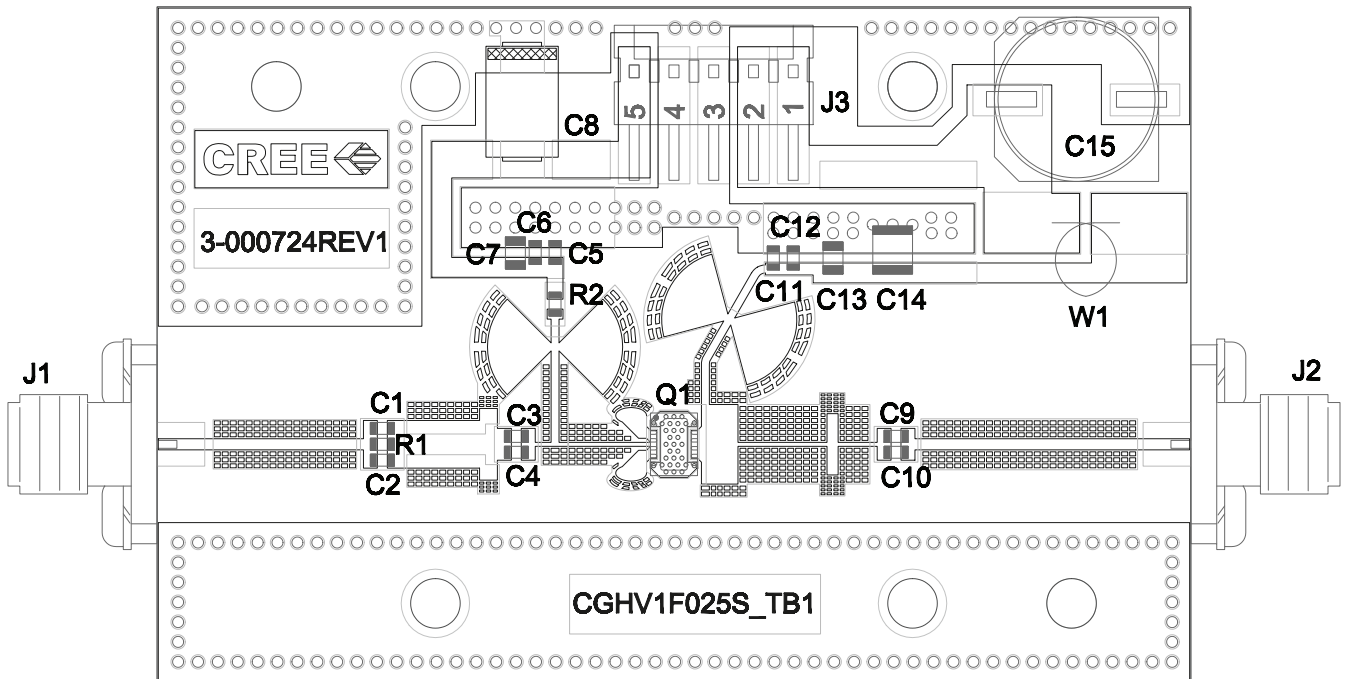
Parameter	Symbol	Level	Test Methodology
Moisture Sensitivity Level	MSL	3 (168 hours)	IPC/JEDEC J-STD-20



**CGHV1F025S-AMP1 Application Circuit Schematic**



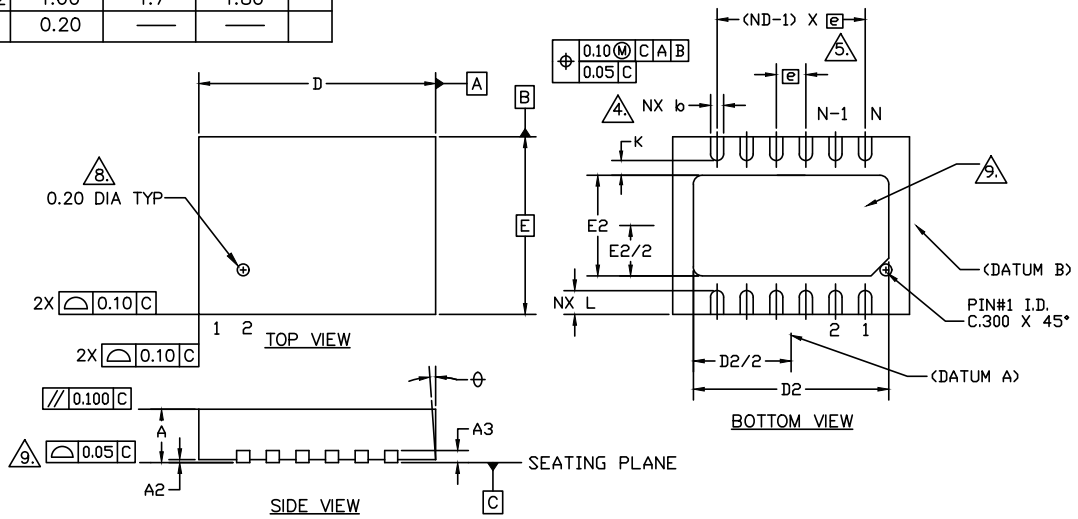
**CGHV1F025S-AMP1 Application Circuit Outline**



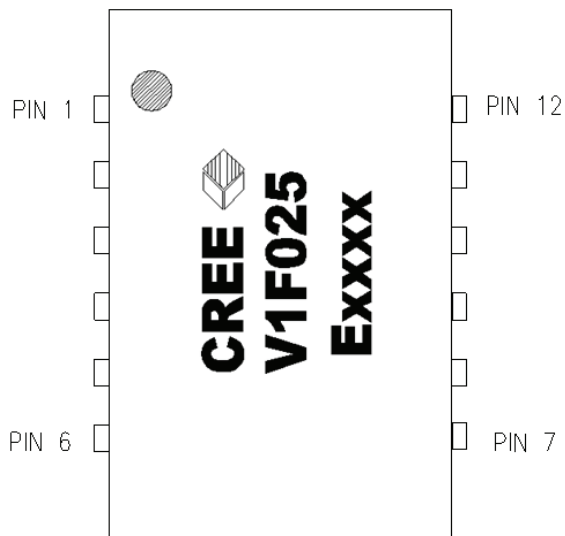


**Product Dimensions CGHV1F025S (Package 3 x 4 DFN)**

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.			
⊖	0	—	12	2
D	4.00 BSC			
E	3.00 BSC			
Ⓢ	0.50 BSC			
N	12			3
ND	6			△
L	0.35	0.40	0.45	
b	0.18	0.25	0.30	△
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

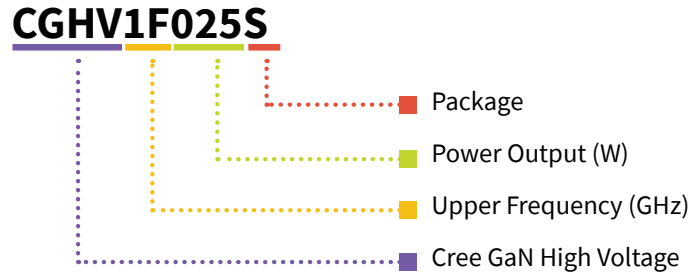


Note:  
Leadframe finish for 3x4 DFN package is Nickel/Palladium/Gold. Gold is the outer layer





**Part Number System**



**Table 1.**

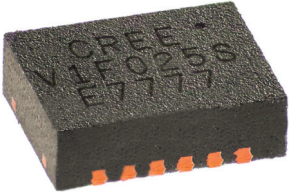
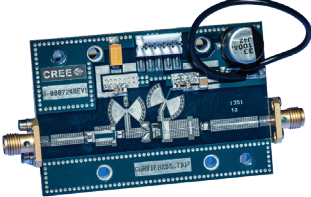
Parameter	Value	Units
Upper Frequency <sup>1</sup>	15.0	GHz
Power Output	25	W
Package	Surface Mount	-

**Note<sup>1</sup>:** 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:

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## Notes & Disclaimer

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