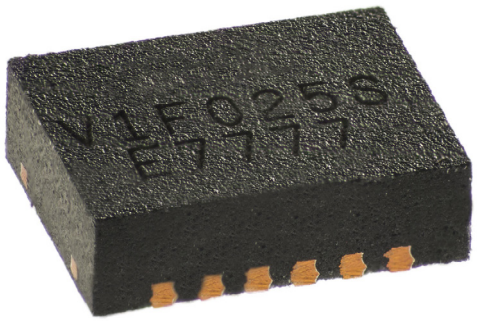
CGHV1F025S

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



Package Type: 3x4 DFN
PN: CGHV1F025S

Description

The 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.

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 100µs 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

Rev. 4.7, 2022-12-2

Absolute Maximum Ratings (not simultaneous) at 25°C

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	120	V	25°C
Gate-to-Source Voltage	V_{GS}	-10, +2		
Storage Temperature	T_{STG}	-65, +150	°C	
Operating Junction Temperature	T_J	225		
Maximum Forward Gate Current	I_{GMAX}	4.8	mA	25°C
Maximum Drain Current[1]	I_{DMAX}	2	A	
Soldering Temperature[2]	T_S	245	°C	
Case Operating Temperature[3,4]	T_C	-40, +150		
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
[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 (100µs, 10% Duty). Rth for the 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_{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	–	%	
Output Mismatch Stress[4]	VSWR	–	–	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	C_{GS}	–	5.9	–	pF	V_{DS} = 40 V, V_{GS} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	2	–		
Feedback Capacitance	C_{GD}	–	0.21	–		

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

Electrical Characteristics When Tested in CGHV1F025S-AMP1

Characteristics	Symbol	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	–	%	
Output Mismatch Stress[2]	VSWR	–	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 100µs, 10% duty cycle

Typical Performance - CGHV1F025S

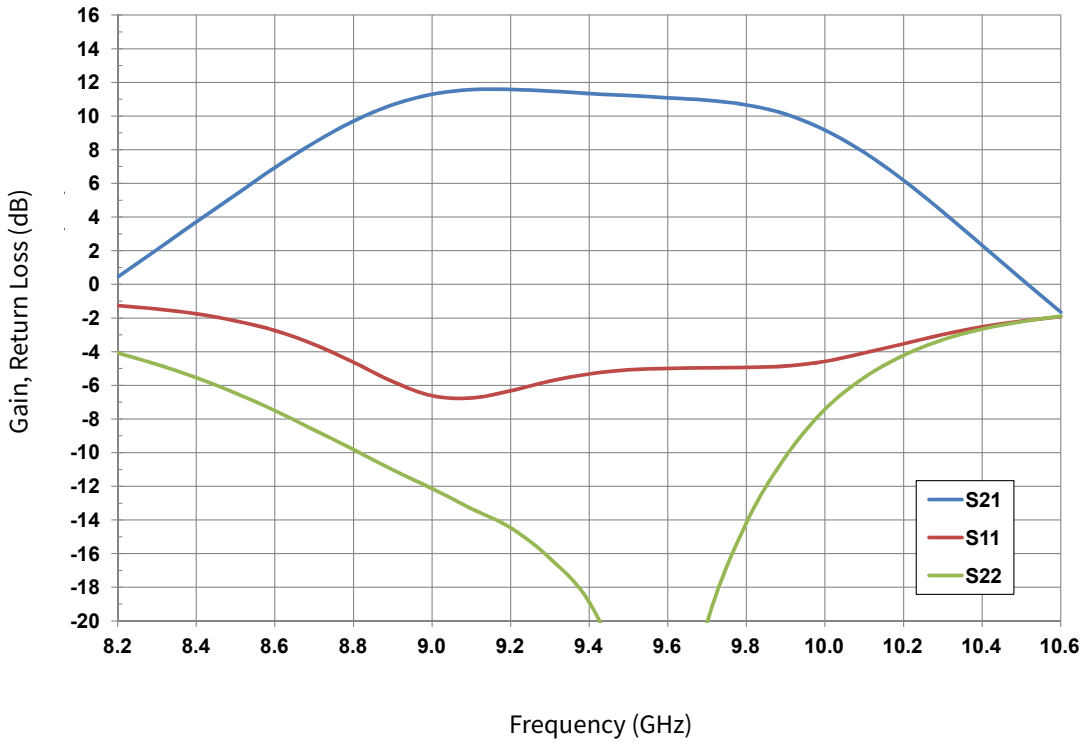


Figure 1. Typical Small Signal Response of CGHV1F025S-AMP1 Application Circuit
V_{DD} = 40 V, I_{DQ} = 150 mA

Typical Performance in Application Circuit CGHV1F025S-AMP1

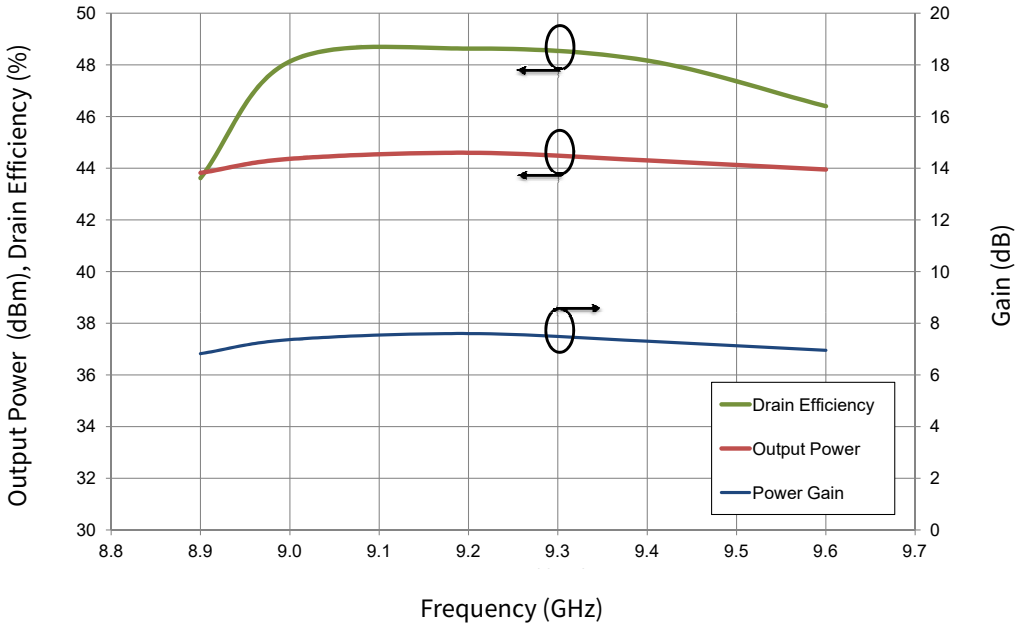


Figure 2. Typical Large Signal Response
V_{DD} = 40 V, I_{DQ} = 150 mA, P_{IN} = 37 dBm
T_{CASE} = 25°C, Pulse Width = 100µs, Duty Cycle = 10%

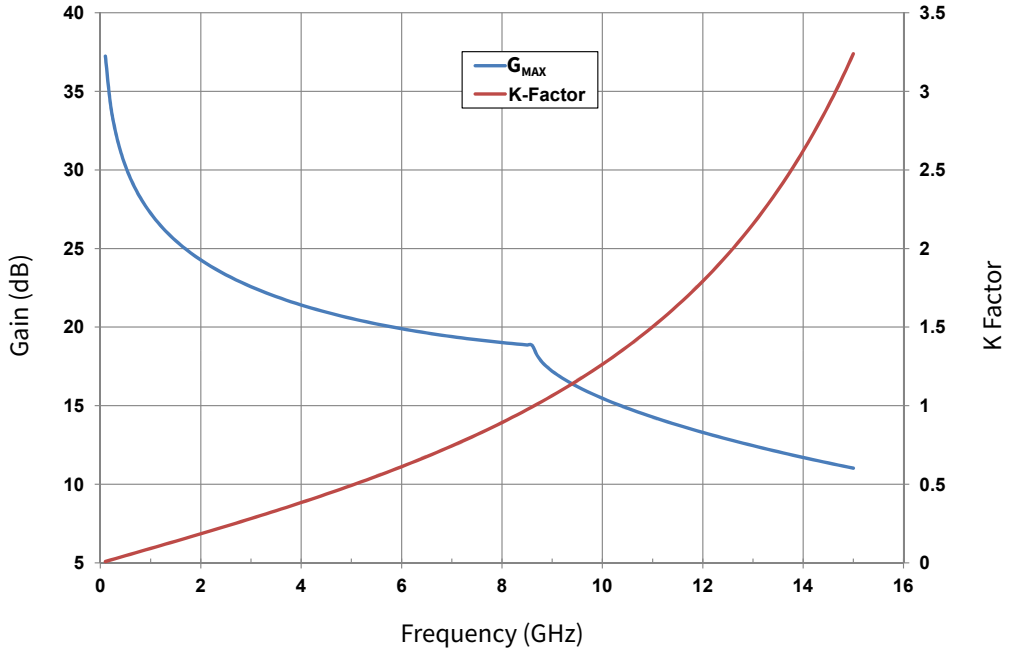
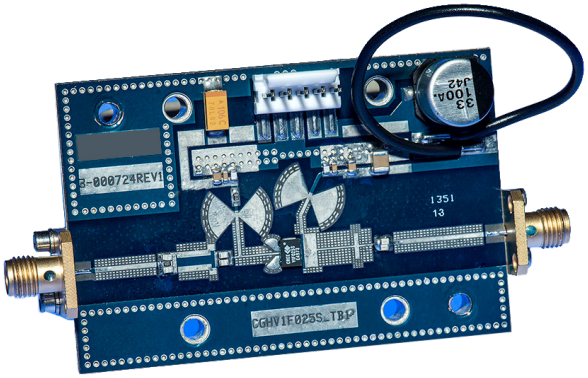


Figure 3. G_{MAX} and K-Factor vs Frequency
V_{DD} = 40 V, I_{DQ} = 150 mA, T_{CASE} = 25°C

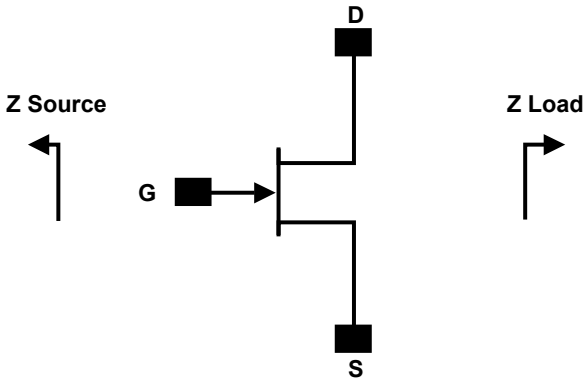
CGHV1F025S-AMP1 Application Circuit Bill of Material

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, ±0.1pF, 0603, ATC	3
C3, C4	CAP, 1.8pF, ±0.1pF, 0603, ATC	3
C9, C10	CAP, 0.6pF, ±0.1pF, 0603, ATC	1
C5, C11	CAP, 10pF, ±5%, 0603, ATC	1
C6, C12	CAP, 470pF, 5%, 100 V, 0603, X	2
C7, C13	CAP, 33000pF, 0805, 100V, X7R	1
C14	CAP, 1.0µF, 100V, 10%, X7R, 1210	3
C8	CAP, 10µF, 16V TANTALUM	3
C15	CAP, 33µF, 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

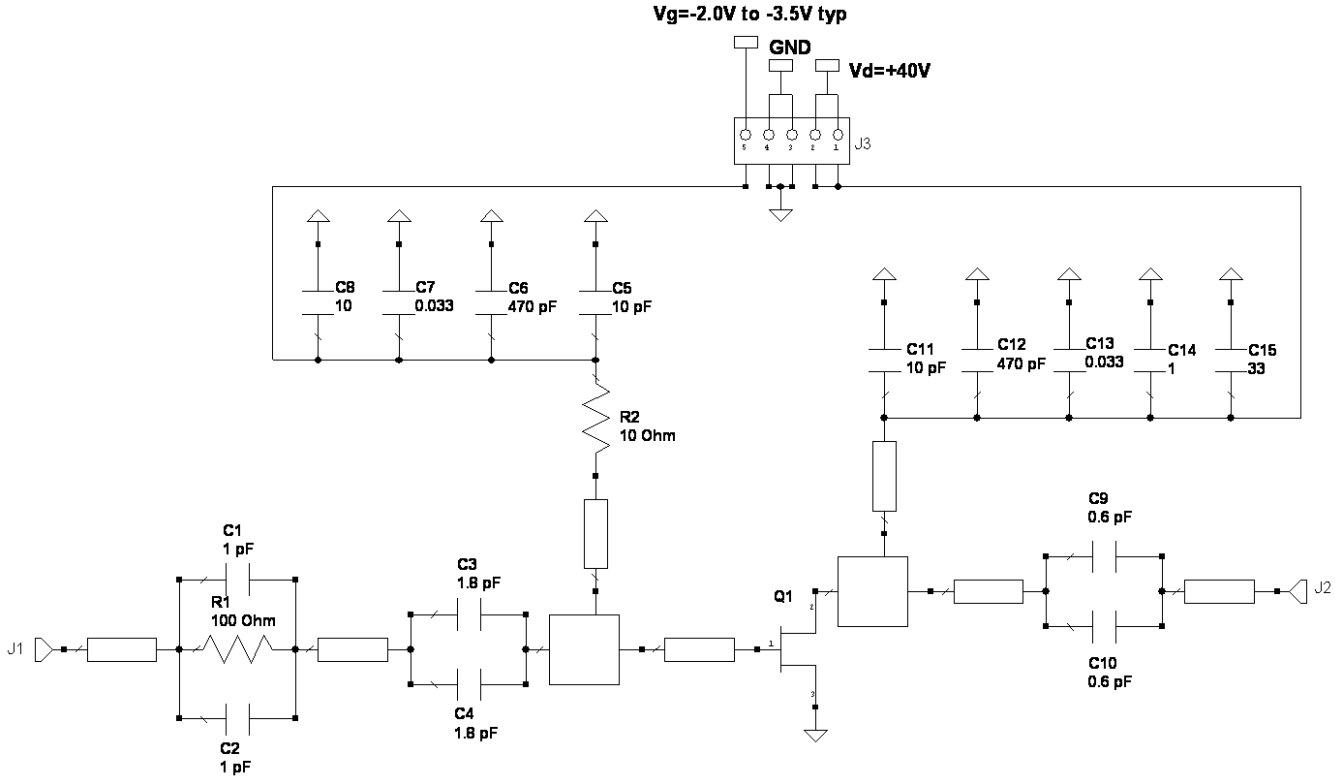
Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	1A	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	C3	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C

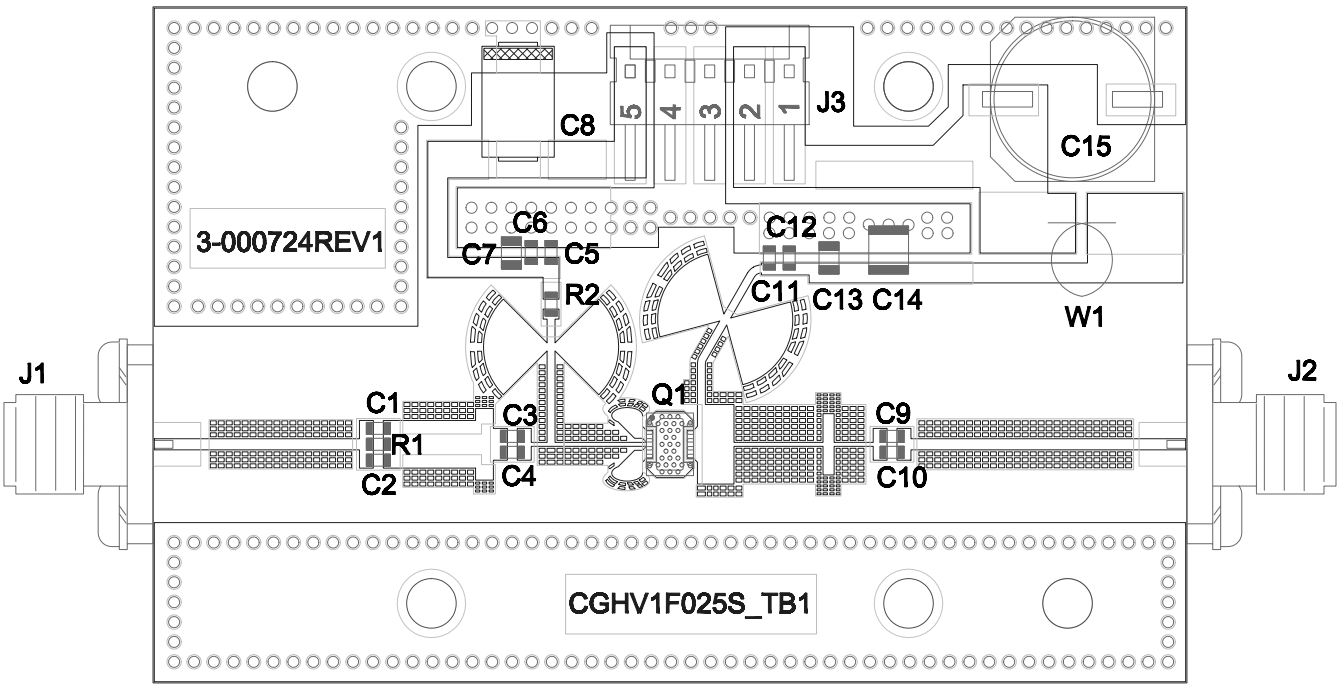
Moisture Sensitivity Level (MSL) Classification

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

CGHV1F025S-AMP1 Application Circuit Schematic

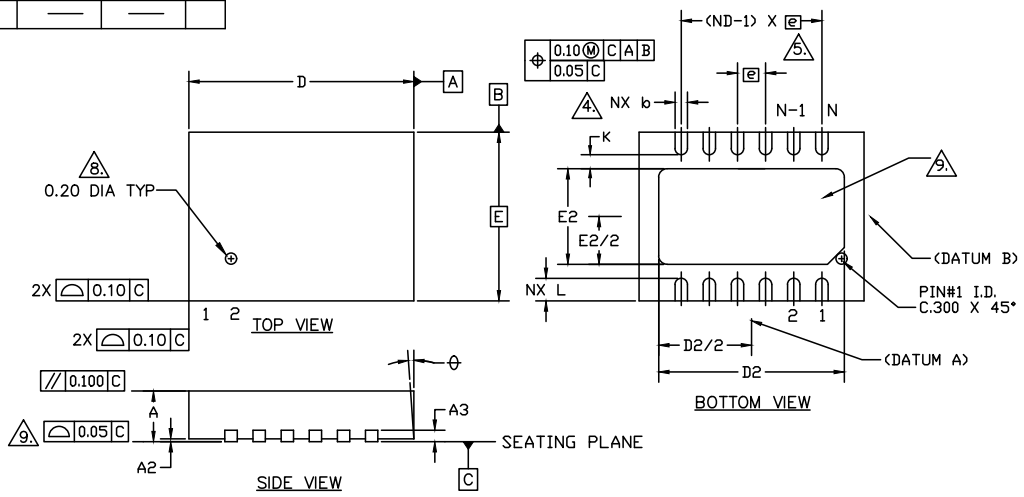


CGHV1F025S-AMP1 Application Circuit Outline

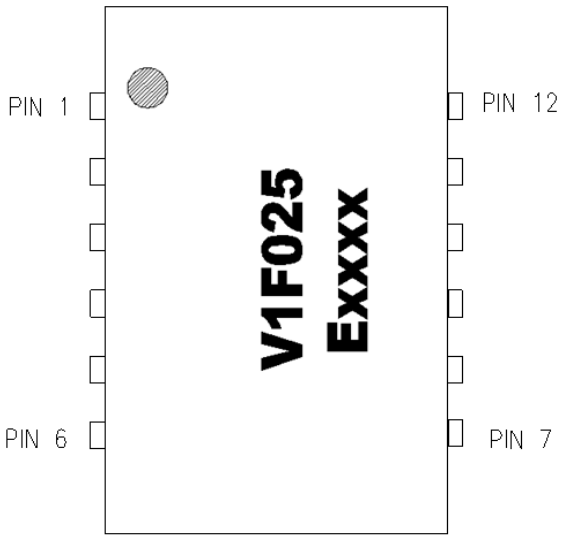


Product Dimensions CGHV1F025S (Package 3 x 4 DFN)

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

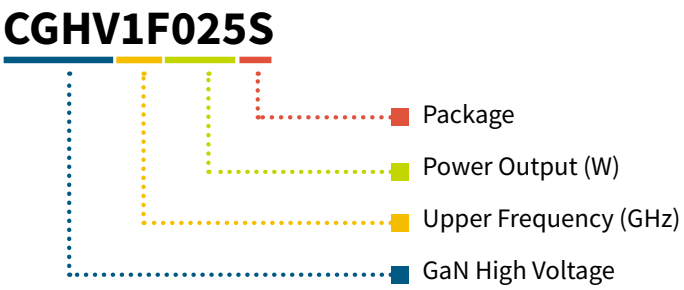


Table 1.

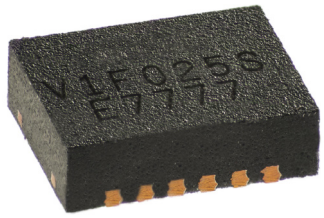
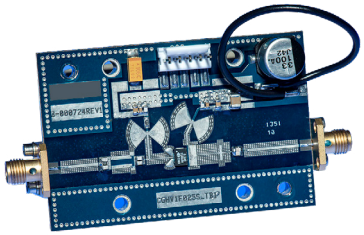
Parameter	Value	Units
Upper Frequency[1]	15.0	GHz
Power Output	25	W
Package	Surface Mount	–

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	

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