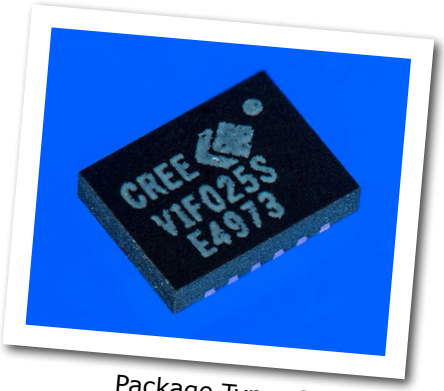
CGHV1F025S

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

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-TB1 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

Preliminary
Rev 0.2 – March 2015

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

Parameter	Symbol	Rating	Units	Notes
Drain-Source Voltage	V_{DSS}	100	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

Note:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering at www.cree.com/rf/document-library
[3] Simulated at P_{DISS} = 2.4 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 (T_C = 25˚C) - 40 V Typical

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 = 240 mA
Saturated Drain Current[2]	I_{DS}	3.8	-4.3	–	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 = 6.0 GHz unless otherwise noted)						
Gain	G	–	16	-	dB	V_{DD} = 40 V, I_{DQ} = 150 mA, P_{IN} = 0 dBm
Output Power[4]	P_{OUT}	–	29	–	W	V_{DD} = 40 V, I_{DQ} = 150 mA, P_{IN} = 34 dBm
Drain Efficiency[4]	η	–	55	-	%	V_{DD} = 40 V, I_{DQ} = 150 mA, P_{IN} = 34 dBm
Output Mismatch Stress[4]	VSWR	-	10 : 1	-	Ψ	No damage at all phase angles, V_{DD} = 40 V, I_{DQ} = 150 mA, P_{OUT} = 29 W
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 CGHV1F025S-TB
[4] Pulsed 100 µs, 10% duty cycle
[5] Includes package

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Electrical Characteristics When Tested in CGHV1F025S-TB1

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]	VSWR	–	10 : 1	–	Ψ	V_{DS} = 40 V, V_{gs} = -8 V, P_{OUT} = 25 W

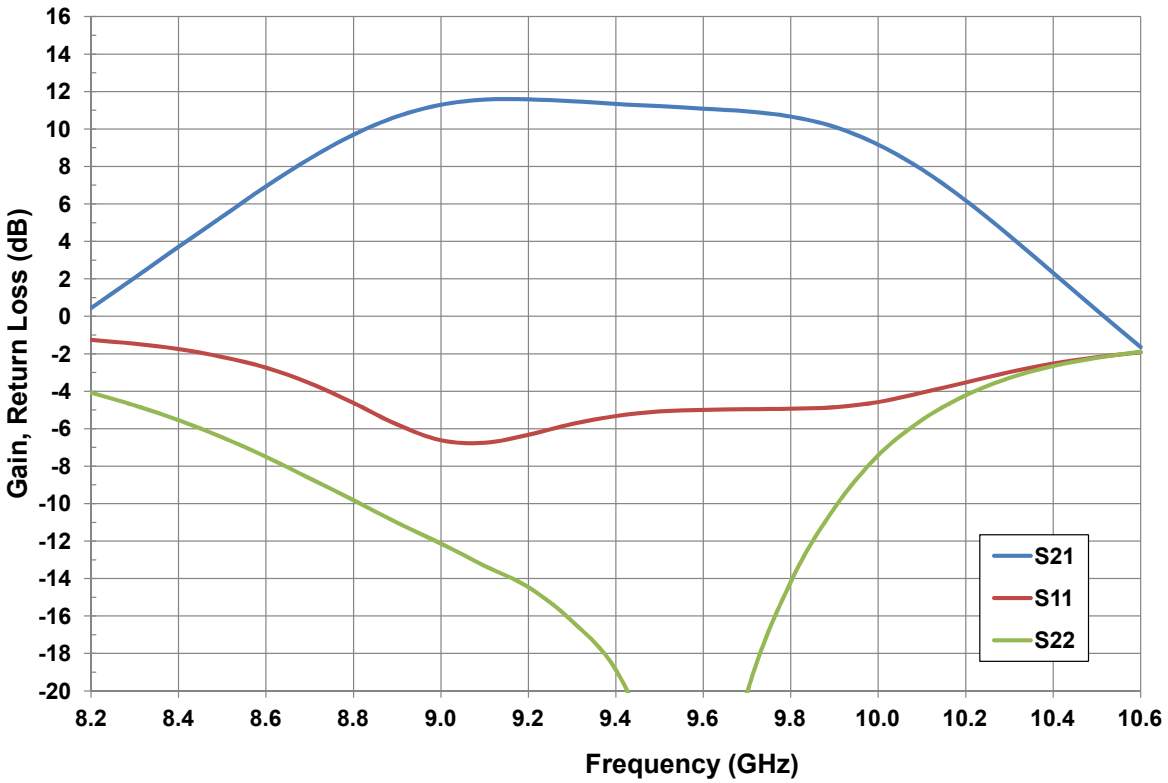
Notes:

[1] Measured in CGHV1F025S-TB1 Application Circuit

[2] Pulsed 100 µs, 10% duty cycle

Typical Performance - CGHV1F025S-TB1

Figure 1. - Typical Small Signal Response of CGHV1F025S-TB1 Application Circuit
V_{DD} = 40 V, I_{DQ} = 150 mA



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Typical Performance in Application Circuit CGHV1F025S-TB1

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 %

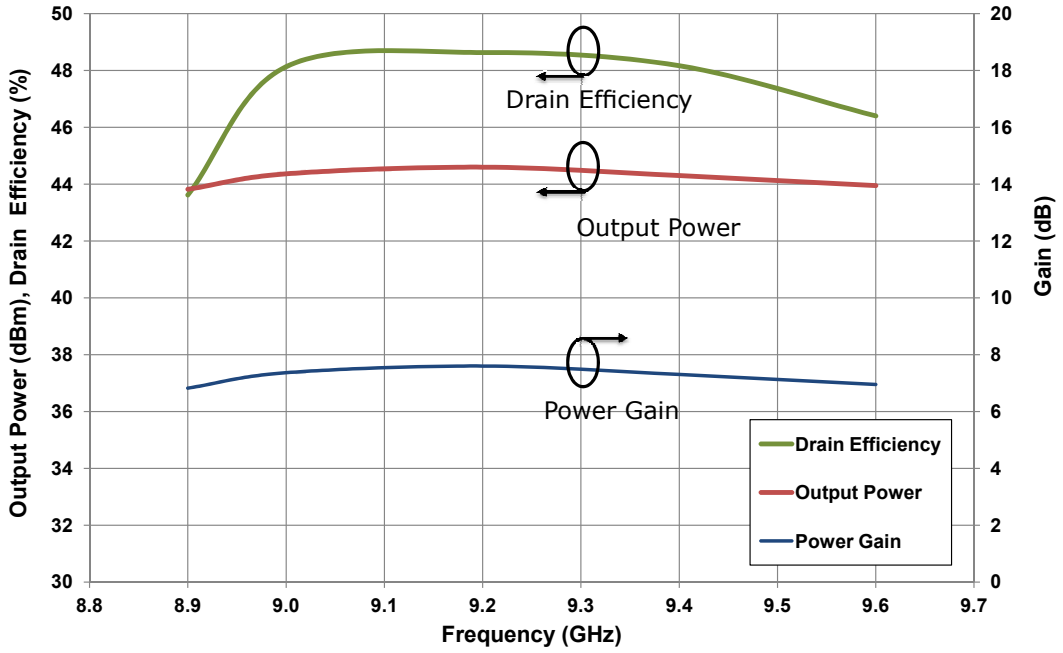
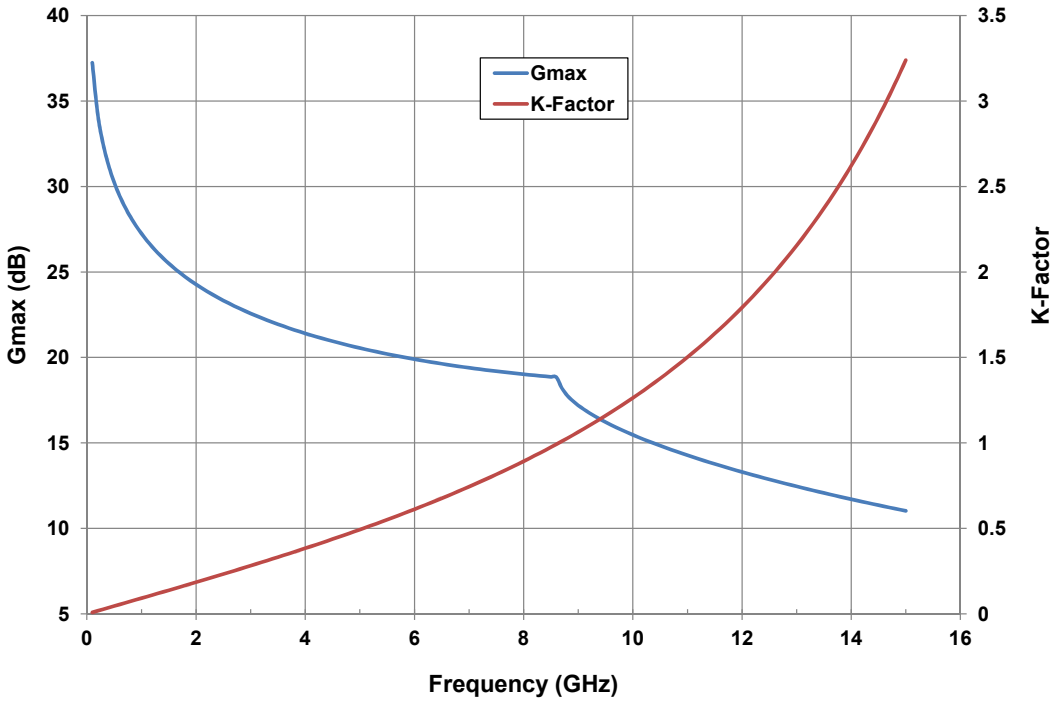


Figure 3. - G_{MAX} and K-Factor vs Frequency
V_{DD} = 40 V, I_{DQ} = 150 mA, Tcase = 25°C



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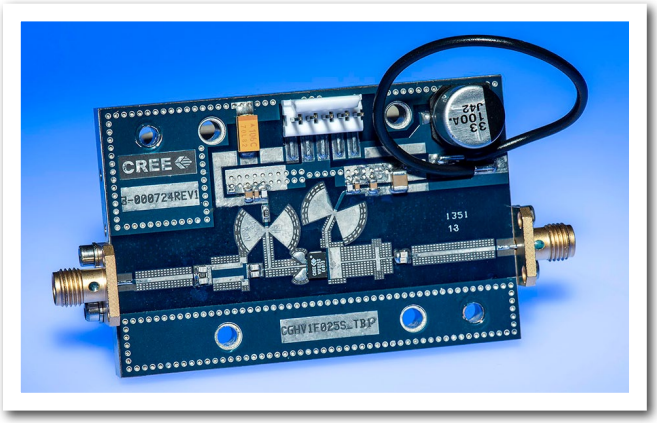
CGHV1F025S-TB1 Application Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 100, OHM, +1/-1%, 1/16 W, 0603	1
R2	RES, 10, OHM, +1/-1%, 1/16 W, 0603	1
C1, C2	CAP, 1pF, ±0.1 pF, 0603, ATC	2
C3, C4	CAP, 1.8pF, ±0.1 pF, 0603, ATC	2
C9, C10	CAP, 0.6pF, ±0.1 pF, 0603, ATC	2
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	2
C14	CAP, 1.0 UF, 100V, 10%, X7R, 1210	1
C8	CAP, 10 UF, 16V TANTALUM	1
C15	CAP, 33UF, 20%, G CASE	1
J1, J2	CONN, SMA, PANEL MOUNT JACK, FLANGE	2
J3	HEADER RT>PLZ .1CEN LK 5POS	1
Q1	QFN TRANSISTOR CGHV1F025S	1
W1	CABLE, 18 AWG, 4.2	1
	Rogers 5880 PCB 10 mils	1

CGHV1F025S-TB1 Application Circuit



Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	2 (125 V to 250 V)	JEDEC JESD22 C101-C

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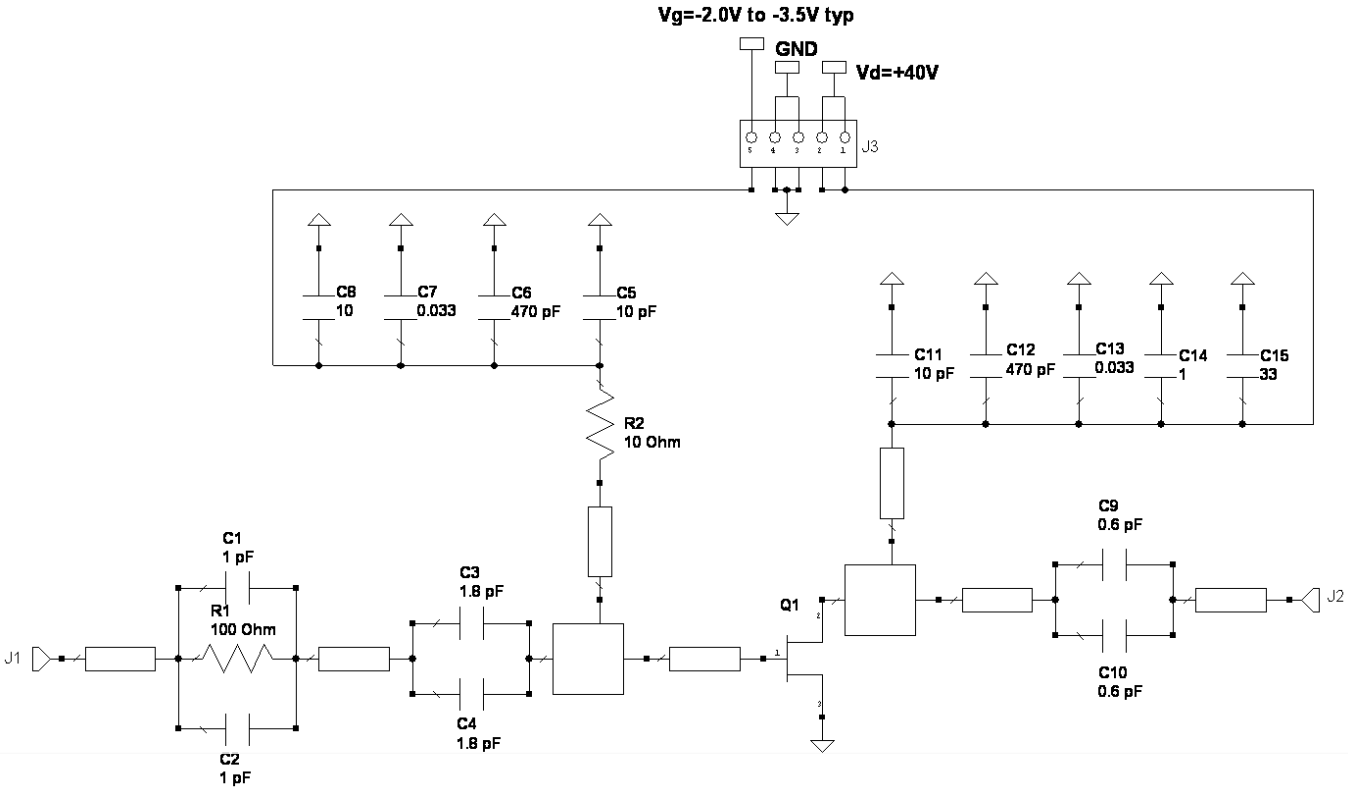
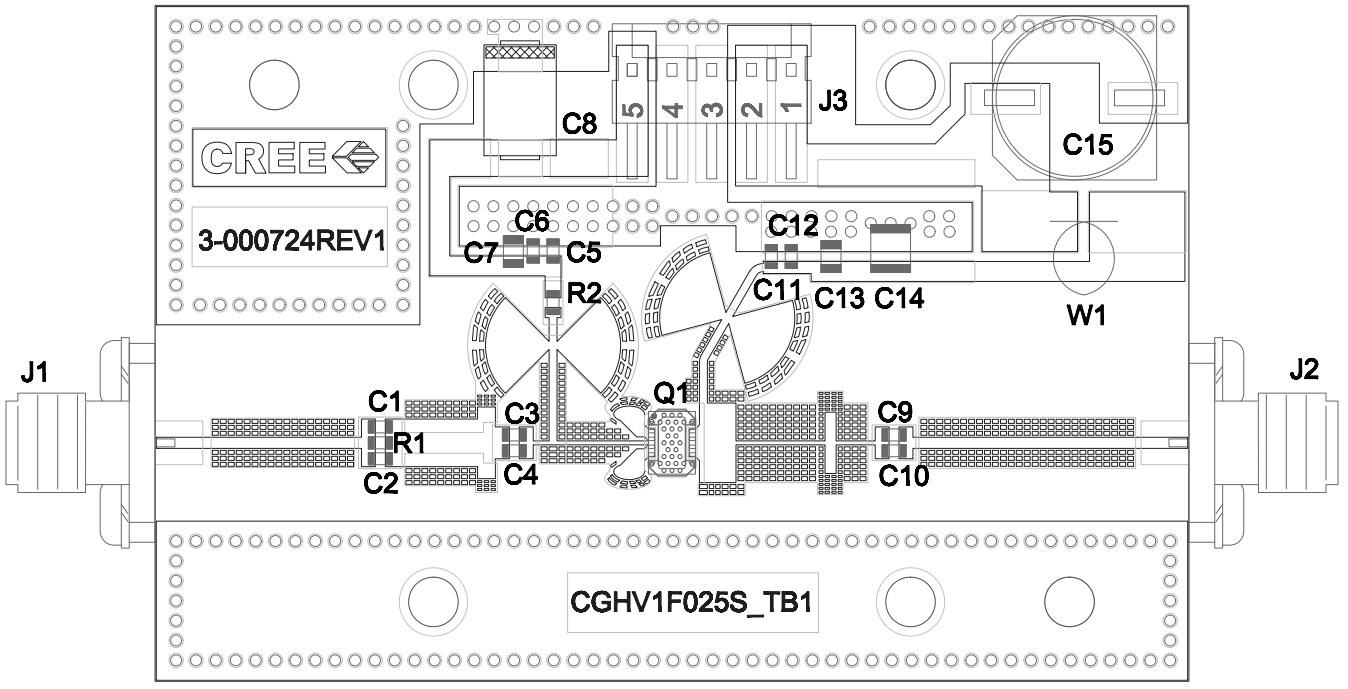
CGHV1F025S-TB1 Application Circuit Schematic



CGHV1F025S-TB1 Application Circuit Outline



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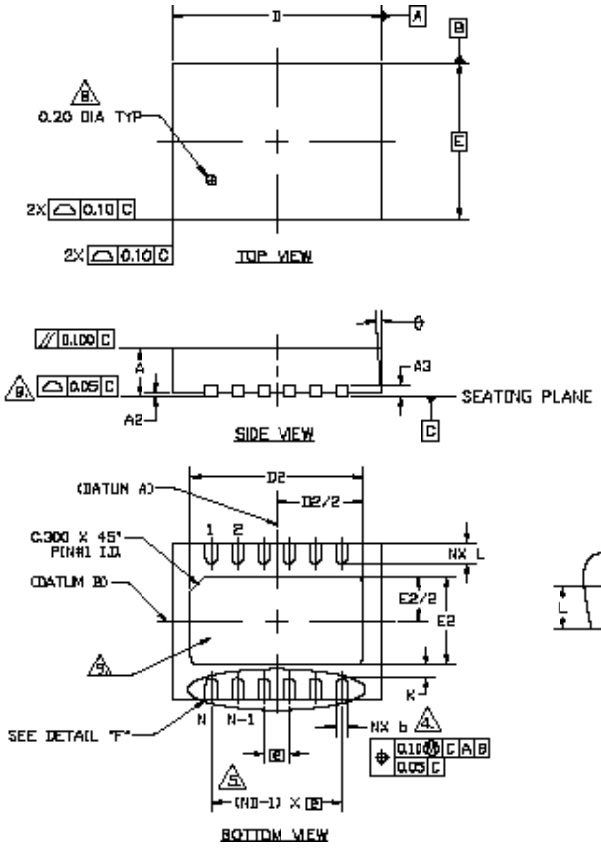
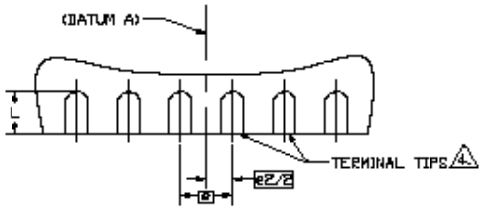
Product Dimensions CGHV1F025S (Package 3 x 4 DFN)



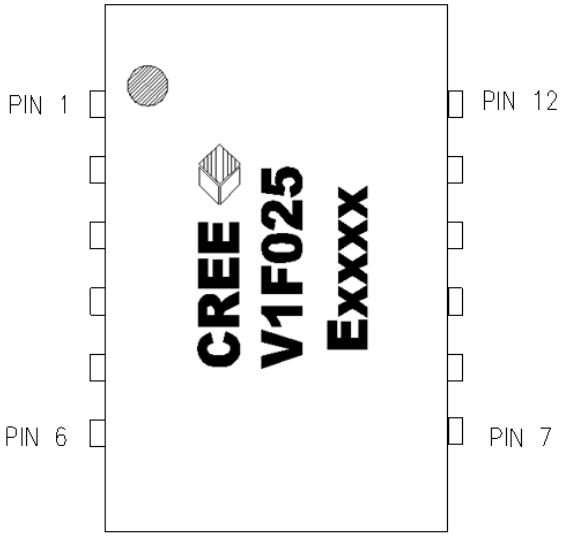
NOTES :

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5M – 1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS, θ IS IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN .15 AND .30mm FROM TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
5. ND REFERS TO THE NUMBER OF TERMINALS ON D SIDE
6. MAXIMUM PACKAGE WARPAGE IS .05 mm.
7. MAXIMUM ALLOWABLE BURRS IS .076 mm IN ALL DIRECTIONS.
8. PIN #1 ID ON TOP WILL BE LASER MARKED.
9. UNILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.



SYMBOL	COMMON DIMENSIONS			NOTE
	MIN.	NOM.	MAX.	
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		8		3
ND		12		5
L	0.35	0.40	0.45	
b	0.17	0.22	0.27	4
D2	3.20	3.30	3.40	
E2	1.60	1.7	1.80	
K	0.20	——	——	

Pin	Input/Output
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



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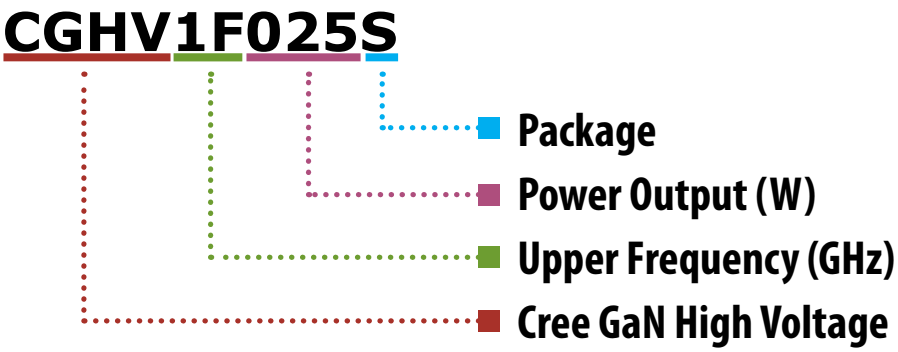
Part Number System



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

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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