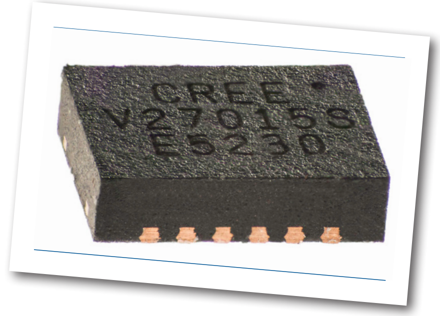
# CGHV27015S

## 15 W, DC - 6.0 GHz, 50 V, GaN HEMT

Cree's CGHV27015S is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CGHV27015S ideal for LTE, 4G Telecom and BWA amplifier applications. The CGHV27015S GaN HEMT device is unmatched so it is suitable for power amplifier applications from 10MHz through 6000 MHz, such as tactical communications, CATV, UAV data links, as well as a driver stage amplifier for RADAR, EW, and SatCom devices. At a Vdd of 50 V, the device provide 2.5W of average power or 15W of peak power. At a Vdd of 28V, the device provides 1W of average power and 7W of peak power. The transistor is available in a 3mm x 4mm, surface mount, dual-flat-no-lead (DFN) package.




Package Type: 3x4 DFN
PN: CGHV27015S

### Typical Performance 2.4-2.7 GHz ($T_C$ = 25˚C) , 50 V

| Parameter | 2.4 GHz | 2.5 GHz | 2.6 GHz | 2.7 GHz | Units |
|---|---|---|---|---|---|
| Small Signal Gain | 23 | 22 | 21.7 | 21.2 | dB |
| Adjacent Channel Power @ $P_{OUT}$ = 2.5 W | -36.7 | -40.7 | -42.4 | -42.5 | dBc |
| Drain Efficiency @ $P_{OUT}$ = 2.5 W | 35.9 | 33.5 | 30.4 | 30.2 | % |
| Input Return Loss | -9.312 | -9.6 | -8.6 | -7.8 | dB |

Note:
Measured in the CGHV27015S-AMP1 application circuit.
Under 7.5 dB PAR single carrier WCDMA signal test model 1 with 64 DPCH.

### Features for 50 V in CGHV27015S-AMP1

- 2.4 - 2.7 GHz Operation
- 15 W Typical Output Power
- 21 dB Gain at 2.5 W $P_{AVE}$
- -38 dBc ACLR at 2.5 W $P_{AVE}$
- 32% efficiency at 2.5 W $P_{AVE}$
- High degree of APD and DPD correction can be applied

Large Signal Models Available for ADS and MWO

Rev 3.0 – June 2019

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

| Parameter | Symbol | Rating | Units | Notes |
|---|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 125 | 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 | $I_{GMAX}$ | 2 | mA | 25˚C |
| Maximum Drain Current[1] | $I_{DMAX}$ | 0.9 | A | 25˚C |
| Soldering Temperature[2] | $T_S$ | 245 | ˚C | |
| Case Operating Temperature[3] | $T_C$ | -40, +150 | ˚C | |
| Thermal Resistance, Junction to Case[4] | $R_{\theta JC}$ | 11.1 | ˚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] $T_C$ = Case temperature for the device. It refers to the temperature at the ground tab underneath the package. The PCB will add additional thermal resistance. See also, the Power Dissipation De-rating Curve on page 7.

[4] Measured for the CGHV27015S at $P_{DISS}$ = 5 W

[5] The $R_{TH}$ for Cree's demonstration amplifier, CGHV27015S-AMP1, with 31 x 0.011 via holes designed on a 20 mil thick Rogers 4350 PCB, is 3.9°C. The total $R_{TH}$ from the heat sink to the junction is 11.1°C + 3.9°C = 15°C/W.

## Electrical Characteristics ($T_C$ = 25˚C)

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **DC Characteristics[1]** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -3.8 | -3.0 | -2.3 | $V_{DC}$ | $V_{DS}$ = 10 V, $I_D$ = 2 mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | – | -2.6 | – | $V_{DC}$ | $V_{DS}$ = 50 V, $I_D$ = 60 mA |
| Saturated Drain Current | $I_{DS}$ | 1.48 | 1.78 | – | A | $V_{DS}$ = 6.0 V, $V_{GS}$ = 2.0 V |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | 150 | – | – | $V_{DC}$ | $V_{GS}$ = -8 V, $I_D$ = 2 mA |
| **RF Characteristics[2,3] ($T_C$ = 25˚C, $F_0$ = 2.7 GHz unless otherwise noted)** | | | | | | |
| Gain | G | – | 21.6 | - | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 60 mA, $P_{IN}$ = 10 dBm |
| Output Power[4] | $P_{OUT}$ | – | 41.9 | – | dBm | $V_{DD}$ = 50 V, $I_{DQ}$ = 60 mA, $P_{IN}$ = 25 dBm |
| Drain Efficiency[4] | η | – | 67 | - | % | $V_{DD}$ = 50 V, $I_{DQ}$ = 60 mA, $P_{IN}$ = 25 dBm |
| Output Mismatch Stress[4] | VSWR | - | 10 : 1 | - | Ψ | No damage at all phase angles, $V_{DD}$ = 50 V, $I_{DQ}$ = 60 mA, $P_{IN}$ = 25 dBm |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance[5] | $C_{GS}$ | – | 3.15 | – | pF | $V_{DS}$ = 50 V, $V_{gs}$ = -8 V, f = 1 MHz |
| Output Capacitance[5] | $C_{DS}$ | – | 1.06 | – | pF | $V_{DS}$ = 50 V, $V_{gs}$ = -8 V, f = 1 MHz |
| Feedback Capacitance | $C_{GD}$ | – | 0.058 | – | pF | $V_{DS}$ = 50 V, $V_{gs}$ = -8 V, f = 1 MHz |

Notes:

[1] Measured on wafer prior to packaging

[2] Scaled from PCM data

[3] Measured in Cree's production test fixture. This fixture is designed for high volume test at 2.7 GHz

[4] Un-modulated pulsed signal, 100 μs, 10% duty cycle

[5] Includes package and internal matching components



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## Typical Performance in Application Circuit CGHV27015S-AMP1

Figure 1. - Small Signal Gain and Return Losses vs Frequency
$V_{DD}$ = 50 V, $I_{DQ}$ = 60 mA

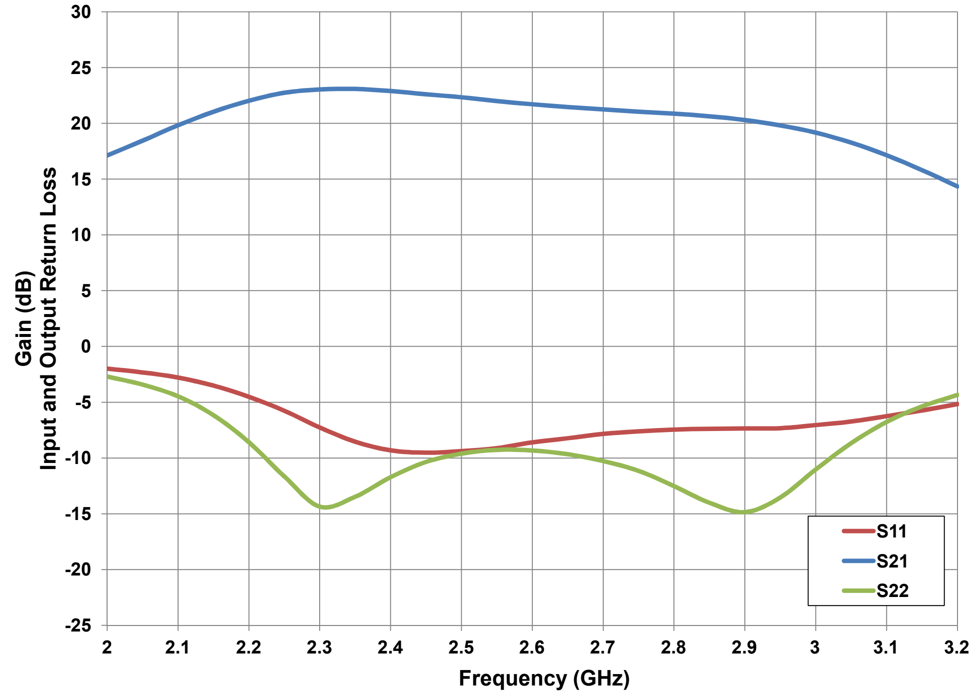
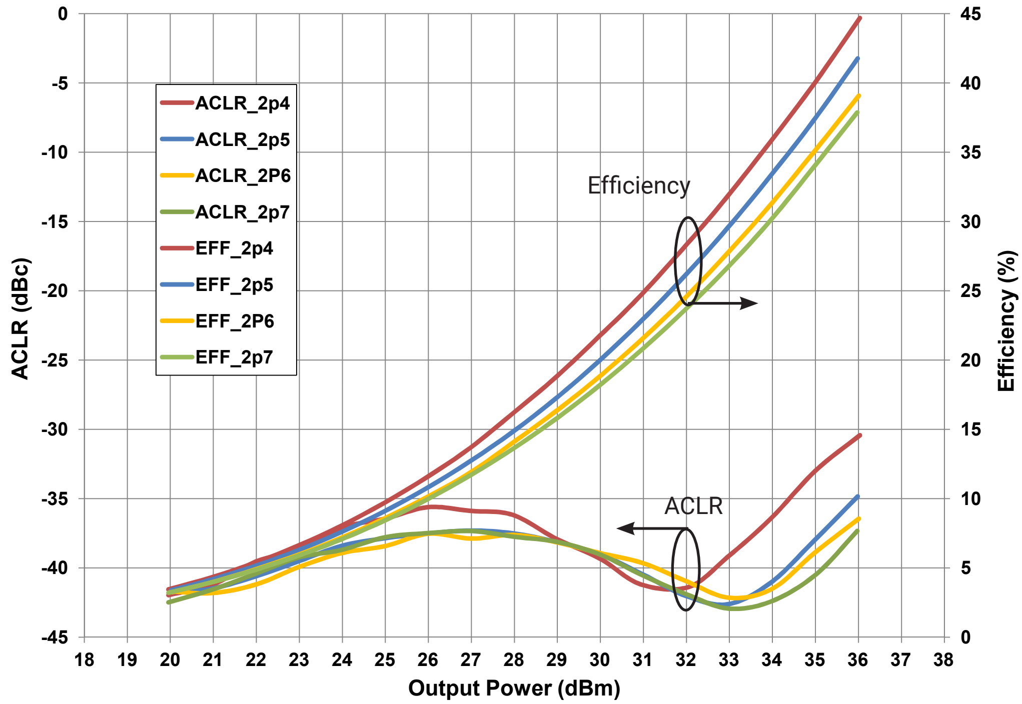



Figure 2. - Typical Drain Efficiency and ACLR vs. Output Power
$V_{DD}$ = 50 V, $I_{DQ}$ = 60 mA, 1 Carrier WCDMA, PAR = 7.5 dB



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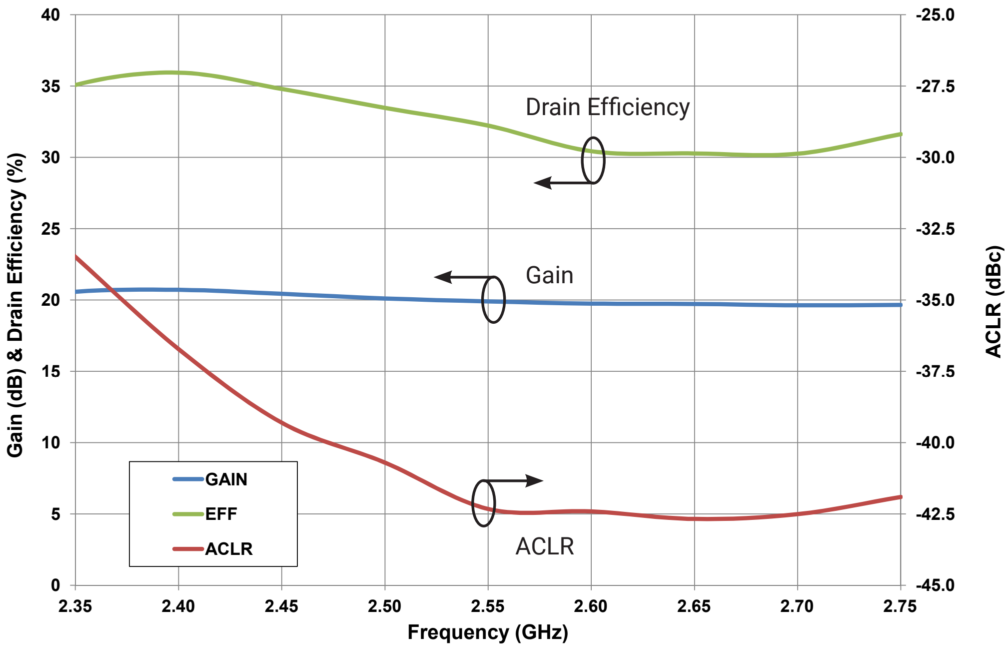
## Typical Performance in Application Circuit CGHV27015S-AMP1

Figure 3. - Typical Gain, Drain Efficiency and ACLR vs Frequency
$V_{DD}$ = 50 V , $I_{DQ}$ = 60 mA, $P_{AVE}$ = 2.5 W, 1 Carrier WCDMA, PAR = 7.5 dB




## 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 |

## Moisture Sensitivity Level (MSL) Classification

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



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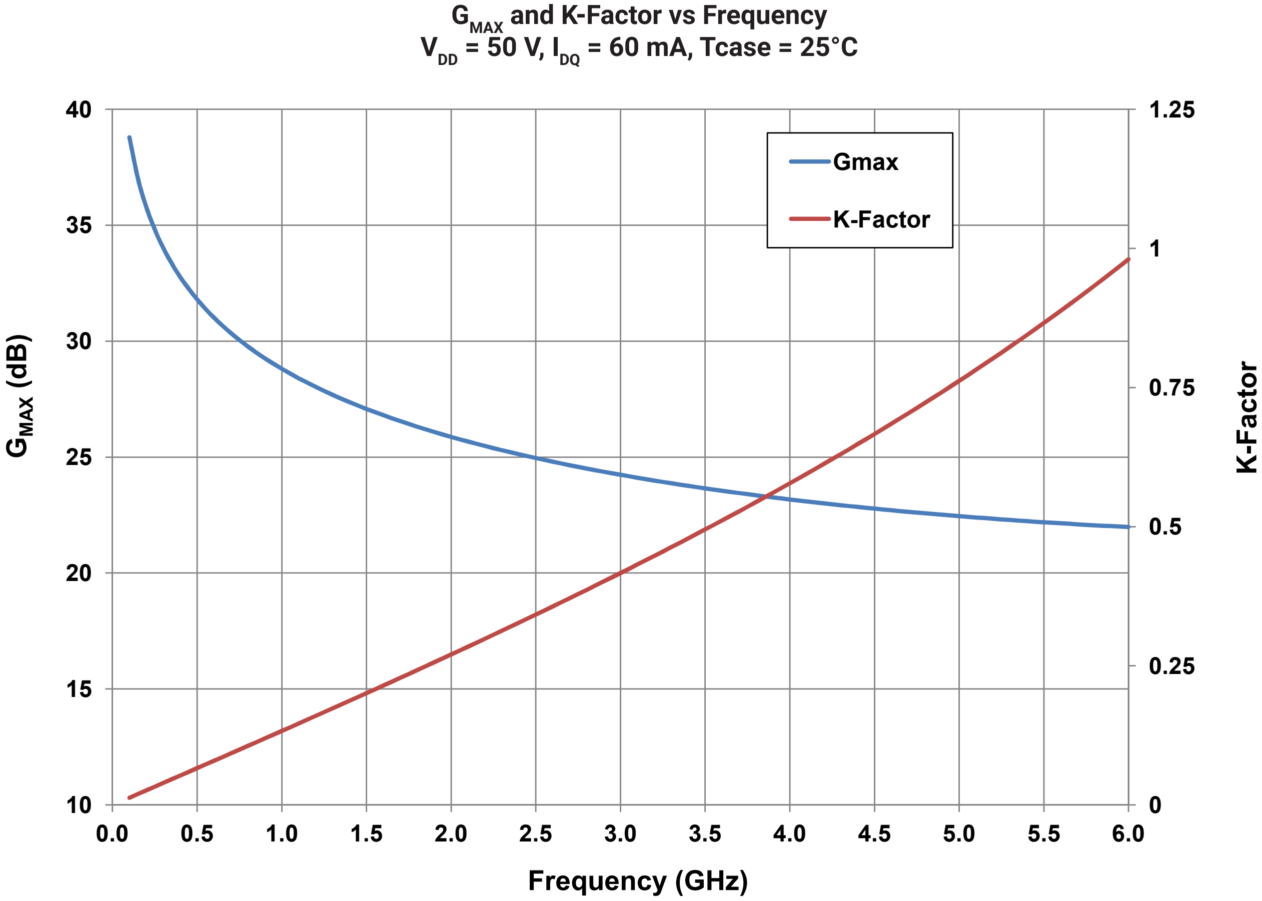
## Typical Performance



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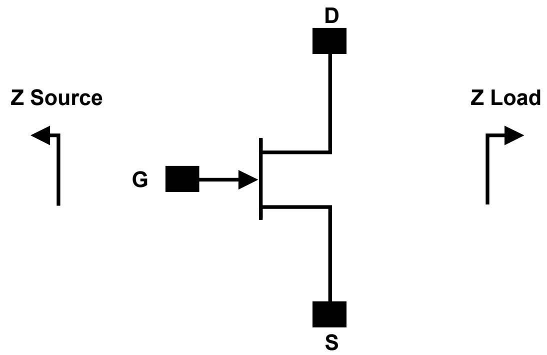
## Source and Load Impedances for Application Circuit CGHV27015S-AMP1




| Frequency (MHz) | Z Source | Z Load |
|---|---|---|
| 2400 | 7.9 + j2.14 | 15.8 + j43.1 |
| 2500 | 8 + j2.9 | 18.3 + j43.7 |
| 2600 | 7.9 + j3.6 | 19.7 + j43.4 |
| 2700 | 7.7 - j4.4 | 19.7 + j43.4 |

Note[1]: $V_{DD}$ = 50 V, $I_{DQ}$ = 60 mA in the DFN package.
Note[2]: Impedances are extracted from the CGHV27015S-AMP1 application circuit and are not source and load pull data derived from the transistor.

## CGHV27015S-AMP1 Application Circuit Bill of Materials

| Designator | Description | Qty |
|---|---|---|
| R1 | RES, 332,OHM, +/- 1%, Vishay | 1 |
| R2 | RES, 22.6,OHM, +/- 1%, 1/16W, 0603 | 1 |
| R3, R4 | RES, 2.2,OHM, +/- 1%, 1/16W, 0603 | 1 |
| C1, C4 | CAP, 27pF, +/- 5%, 0603, ATC | 2 |
| C2 | CAP, 2.0pF,+/-0.1pF, 0603 ATC | 1 |
| C3 | CAP, 0.1pF,+/-0.05 pF, 0603, ATC | 2 |
| C8 | CAP, 6.2pF, +/-0.1pF, 0603, ATC | 1 |
| C13 | CAP, 10pF +/-5%, 0603, ATC | 1 |
| C6, C11 | CAP, 33000pF, 0805, ATC | 2 |
| C7, C12 | CAP, 470PF, 5%, 100V, 0603, | 2 |
| C10 | CAP, 1.0UF, 100V, 10%, X7R, 1210 | 1 |
| C5 | CAP 10UF 16V TANTALUM | 1 |
| C9 | CAP, 33UF, 20%, G CASE | 1 |
| J1, J2 | CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST | 2 |
| J3 | HEADER RT>PLZ .1CEN LK 5POS | 1 |
| Q1 | CGHV27015S, DFN | 1 |



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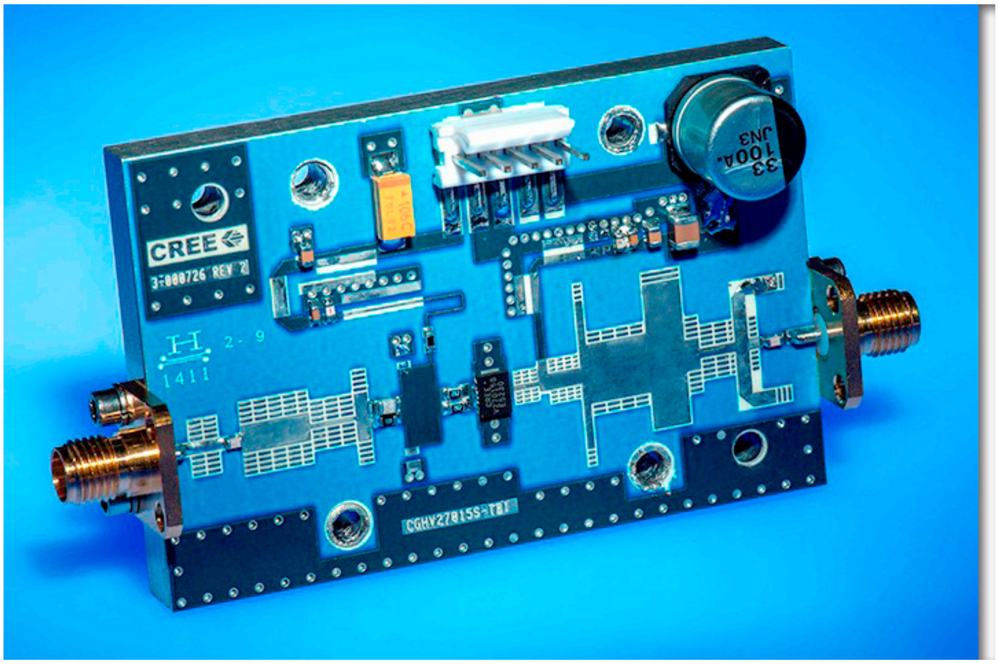
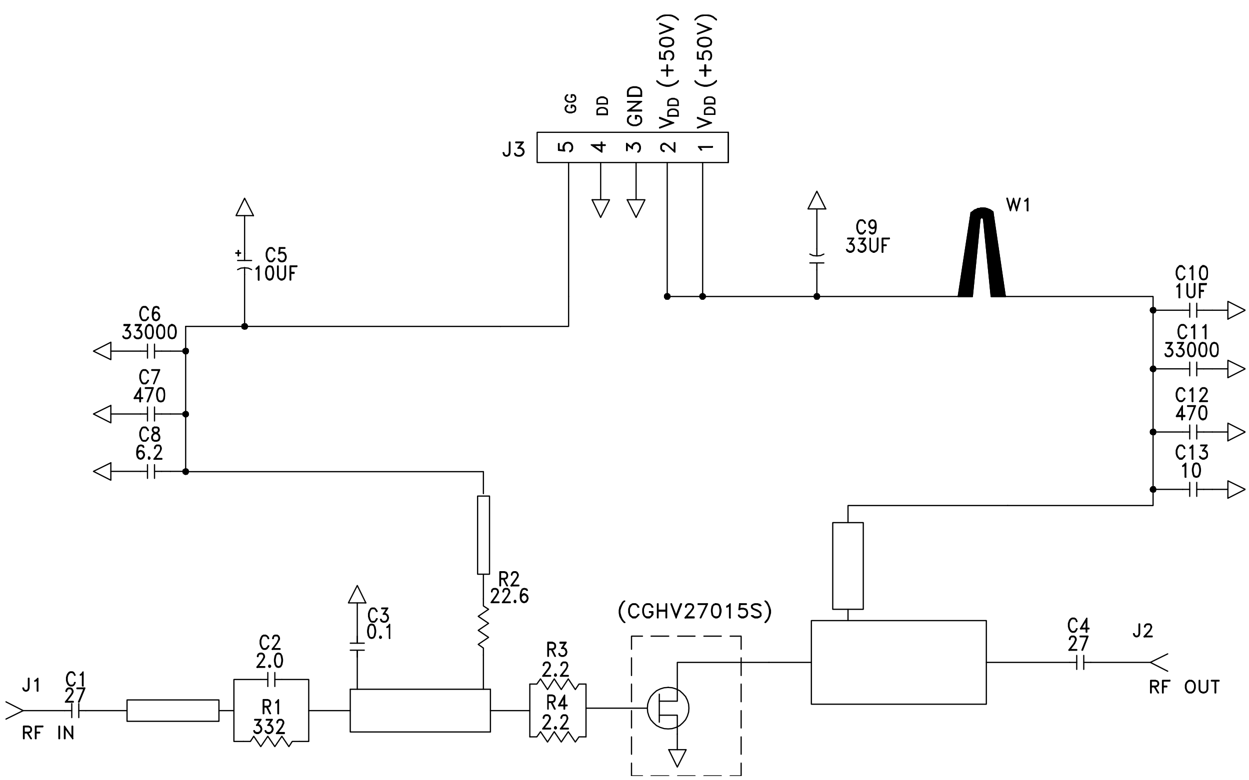
## CGHV27015S-AMP1 Application Circuit, 50 V




## CGHV27015S-AMP1 Application Circuit Schematic, 50 V



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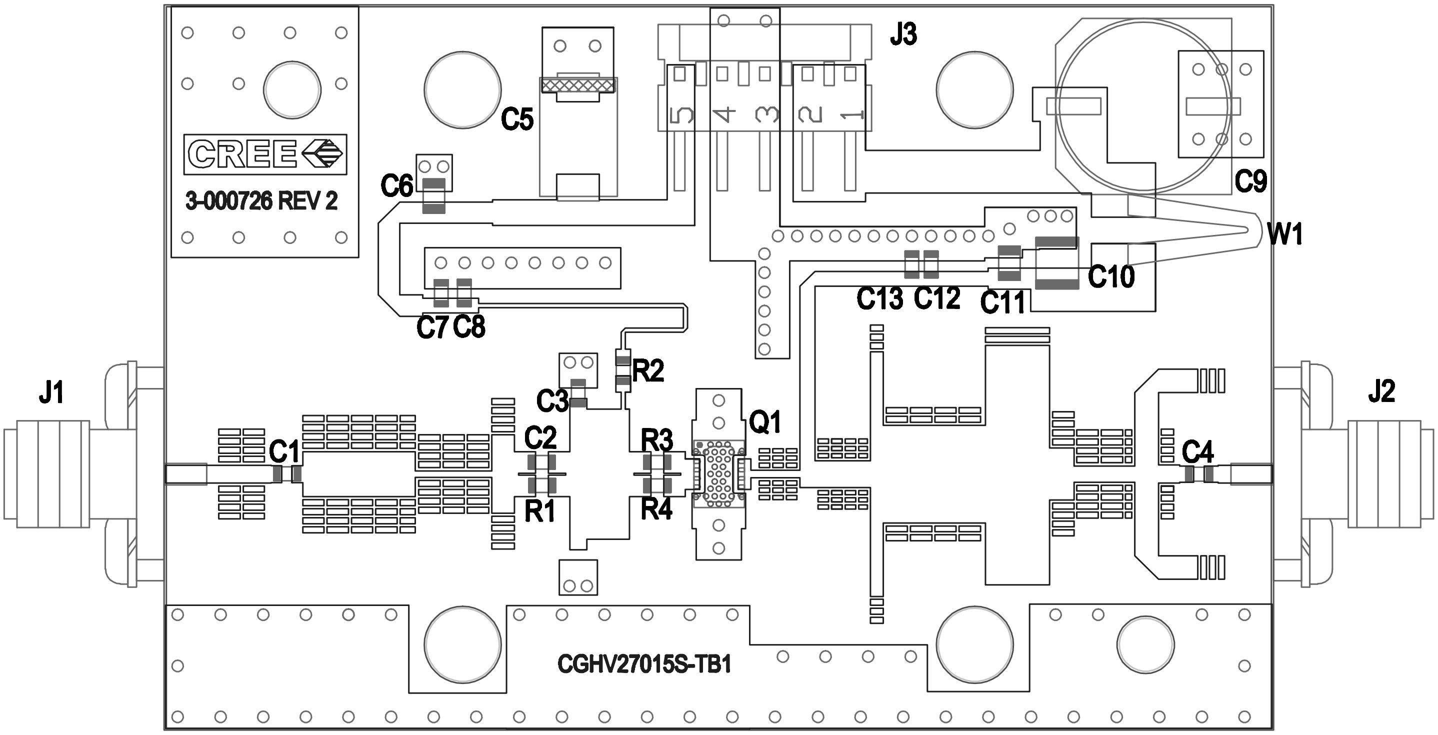
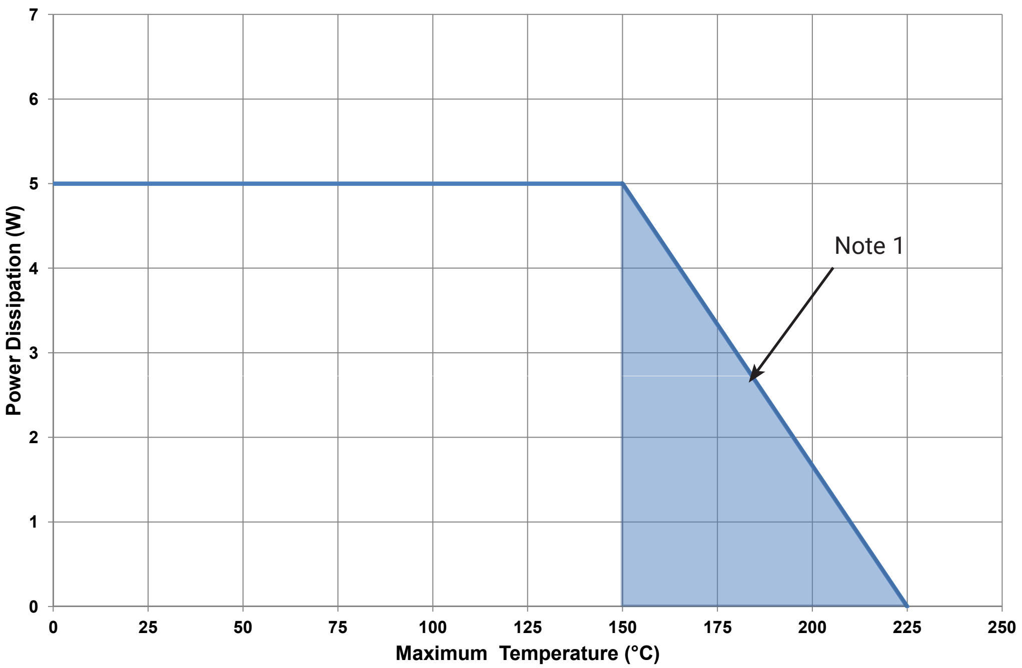
## CGHV27015S-AMP1 Application Circuit, 50 V




## CGHV27015S-AMP1 Power Dissipation De-rating Curve




Note 1. Area exceeds Maximum Case Temperature (See Page 2)



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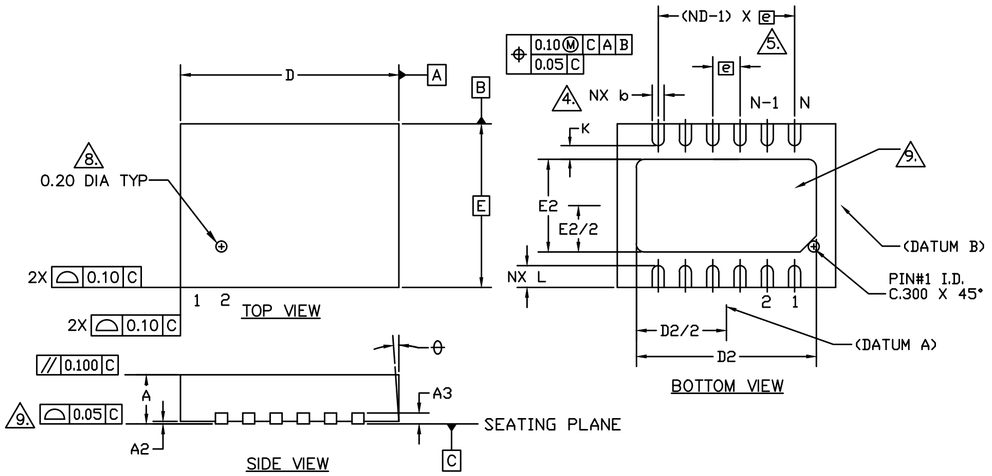
## Product Dimensions CGHV27015S (Package 3 x 4 DFN)

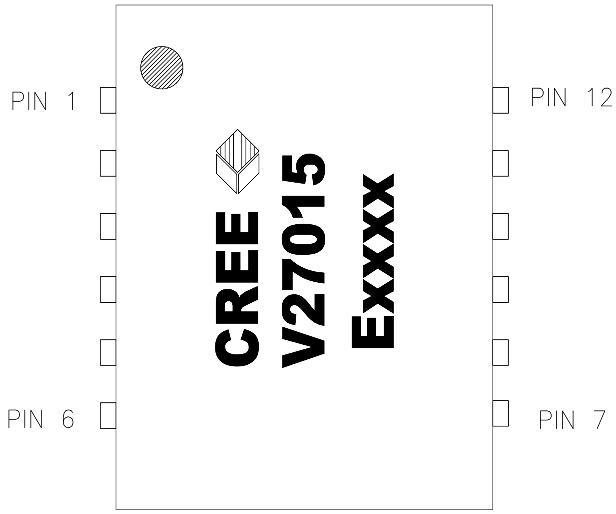
| | | | | |
|---|---|---|---|---|
| A3 | 0.203 REF. | | | |
| θ | 0 | —— | 12 | 2 |
| D | 4.00 BSC | | | |
| E | 3.00 BSC | | | |
| e | 0.50 BSC | | | |
| N | 12 | | | 3 |
| ND | 6 | | | 5 |
| L | 0.35 | 0.40 | 0.45 | |
| b | 0.17 | 0.22 | 0.27 | 4 |
| D2 | 3.20 | 3.30 | 3.40 | |
| E2 | 1.60 | 1.7 | 1.80 | |
| K | 0.20 | —— | —— | |




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.
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.
10. THIS DRAWING CONFORMS TO JEDEC REGISTERED OUTLINE MO–229.
11. ALL PLATED SURFACES ARE AU.

| Pin | Input/Output |
|---|---|
| 1 | GND |
| 2 | NC |
| 3 | RF IN |
| 4 | RF IN |
| 5 | NC |
| 6 | GND |
| 7 | GND |
| 8 | NC |
| 9 | RF OUT |
| 10 | RF OUT |
| 11 | NC |
| 12 | GND |




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



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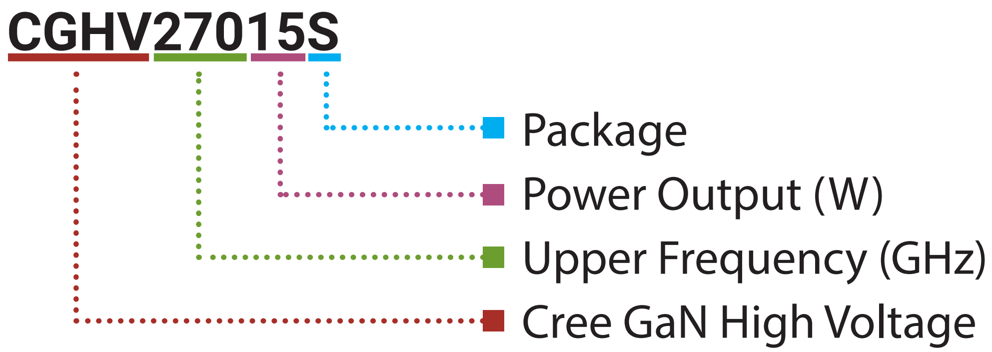
## Part Number System




| Parameter | Value | Units |
|---|---|---|
| Upper Frequency[1] | 2.7 | GHz |
| Power Output | 15 | 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<br>2H = 27.0 GHz |

**Table 2.**



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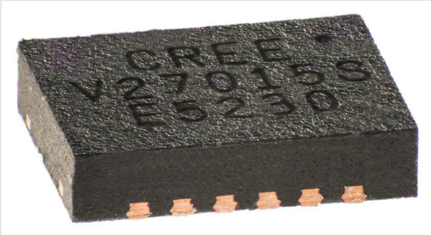
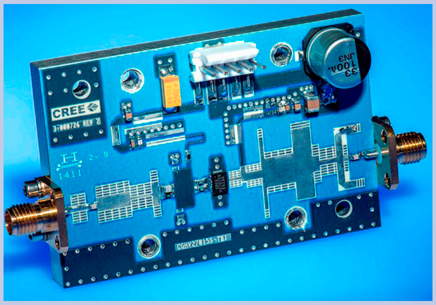
## Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|---|---|---|---|
| CGHV27015S | GaN HEMT | Each |   |
| CGHV27015S-AMP1 | Test board with GaN HEMT installed | Each |  |
| CGHV27015S-TR | Delivered in Tape and Reel | 250 parts / reel | |



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