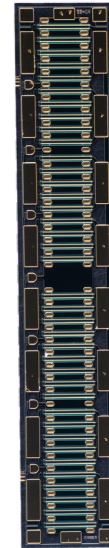


# CGHV40320D

320 W, 4.0 GHz, GaN HEMT Die

## Description

WolfSpeed's CGHV40320D is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT). GaN has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity, and higher thermal conductivity. GaN HEMTs offer greater power density and wider bandwidths compared to Si and GaAs transistors.



## Features

- 19 dB Typical Small Signal Gain at 4 GHz
- 65% Typical Power Added Efficiency
- 320 W Typical  $P_{SAT}$
- 50 V Operation
- High Breakdown Voltage
- Up to 4 GHz Operation

## Applications

- Broadband amplifiers
- Tactical communications
- Satellite communications
- Industrial, Scientific, and Medical amplifiers
- Class A, AB, Linear amplifiers suitable for OFDM, W-CDMA, EDGE, CDMA waveforms

## Packaging Information



- Bare die are shipped in Gel-Pak® containers
- Non-adhesive tacky membrane immobilizes die during shipment

 Large Signal Models Available for ADS and MWO





## Absolute Maximum Ratings (not simultaneous)

| Parameter  | Symbol          | Rating    | Units    | Conditions                |
|--|-----------------|-----------|----------|---------------------------|
| Drain-Source Voltage   | $V_{DSS}$       | 150       | $V_{DC}$ | 25°C                      |
| Gate-to-Source Voltage                                       | $V_{GS}$        | -10, +2   |          |                           |
| Storage Temperature  | $T_{STG}$       | -65, +150 | °C       |                           |
| Operating Junction Temperature                               | $T_J$           | 225       |          |                           |
| Maximum Drain Current <sup>1</sup>                           | $I_{DMAX}$      | 12        | A        | 25°C                      |
| Maximum Forward Gate Current                                 | $I_{GMAX}$      | 41.8      | mA       |                           |
| Thermal Resistance, Junction to Case (packaged) <sup>2</sup> | $R_{\theta JC}$ | 0.44      | °C/W     | 85°C, 167.2 W Dissipation |
| Thermal Resistance, Junction to Case (die only)              |                 | 0.35      |          |                           |
| Mounting Temperature   | $T_s$           | 320       | °C       | 30 seconds                |

Notes:

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

<sup>2</sup> Eutectic die attach using 80/20 AuSn mounted to a 10 mil thick Cu15Mo85 carrier

## Electrical Characteristics (Frequency = 4 GHz unless otherwise stated; $T_c = 25^\circ\text{C}$ )

| Characteristics                     | Symbol     | Min. | Typ.  | Max.   | Units    | Conditions   |
|-------------------------------------|------------|------|-------|--------|----------|--|
| <b>DC Characteristics</b>           |            |      |       |        |          |  |
| Gate Pinch-Off Voltage              | $V_P$      | -3.8 | -3.0  | -2.3   | V        | $V_{DS} = 10\text{ V}, I_D = 41.8\text{ mA}$   |
| Drain Current <sup>1</sup>          | $I_{DSS}$  | 33   | 41.8  | —      | A        | $V_{DS} = 6\text{ V}, V_{GS} = 2.0\text{ V}$   |
| Drain-Source Breakdown Voltage      | $V_{BR}$   | 125  | —     | —      | V        | $V_{GS} = -8\text{ V}, I_D = 41.8\text{ mA}$   |
| On Resistance                       | $R_{ON}$   | —    | 0.07  | —      | $\Omega$ | $V_{DS} = 0.1\text{ V}$  |
| Gate Forward Voltage                | $V_{G-ON}$ | —    | 1.9   | —      | V        | $I_{GS} = 41.8\text{ mA}$  |
| <b>RF Characteristics</b>           |            |      |       |        |          |  |
| Small Signal Gain                   | $G_{SS}$   | —    | 19    | —      | dB       | $V_{DD} = 50\text{ V}, I_{DQ} = 500\text{ mA}$   |
| Saturated Power Output <sup>1</sup> | $P_{SAT}$  | —    | 320   | —      | W        |  |
| Drain Efficiency <sup>2</sup>       | $\eta$     | —    | 65    | —      | %        | $V_{DD} = 50\text{ V}, I_{DQ} = 500\text{ mA}, P_{SAT} = 320\text{ W}$   |
| Intermodulation Distortion          | IM3        | —    | -30   | —      | dBc      | $V_{DD} = 50\text{ V}, I_{DQ} = 500\text{ mA}, P_{OUT} = 320\text{ W PEP}$                                     |
| Output Mismatch Stress              | VSWR       | —    | —     | 10 : 1 | $\Psi$   | No damage at all phase angles,<br>$V_{DD} = 50\text{ V}, I_{DQ} = 500\text{ mA}, P_{OUT} = 320\text{ W Pulse}$ |
| <b>Dynamic Characteristics</b>      |            |      |       |        |          |  |
| Input Capacitance                   | $C_{GS}$   | —    | 55.6  | —      | pF       | $V_{DS} = 50\text{ V}, V_{GS} = -8\text{ V}, f = 1\text{ MHz}$   |
| Output Capacitance                  | $C_{DS}$   | —    | 11.56 | —      |          |  |
| Feedback Capacitance                | $C_{GD}$   | —    | 1.23  | —      |          |  |

Notes:

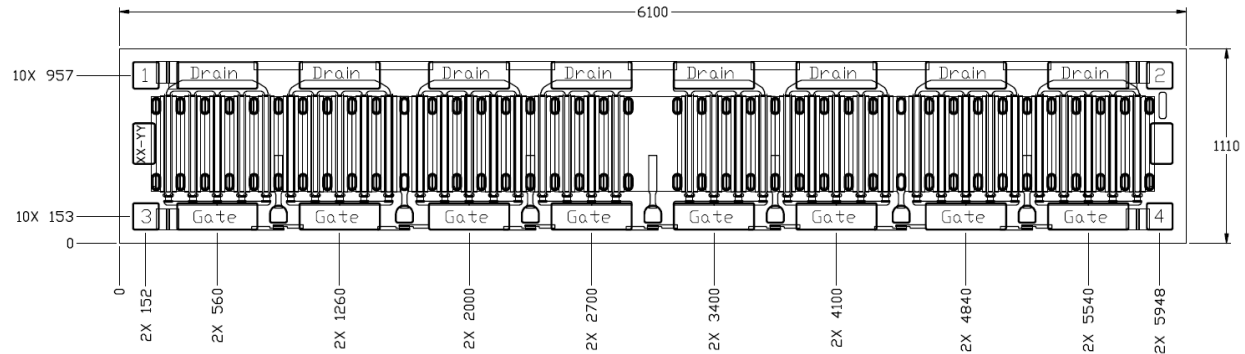
<sup>1</sup> Scaled from PCM data

<sup>2</sup>  $P_{SAT}$  is defined as  $I_G = 4.0\text{ mA}$

<sup>3</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$



## DIE Dimensions (units in microns)



Overall die size 6100 x 1110 (+0/-50) microns, die thickness 100 microns.  
All Gate and Drain pads must be wire bonded for electrical connection.

### Assembly Notes:

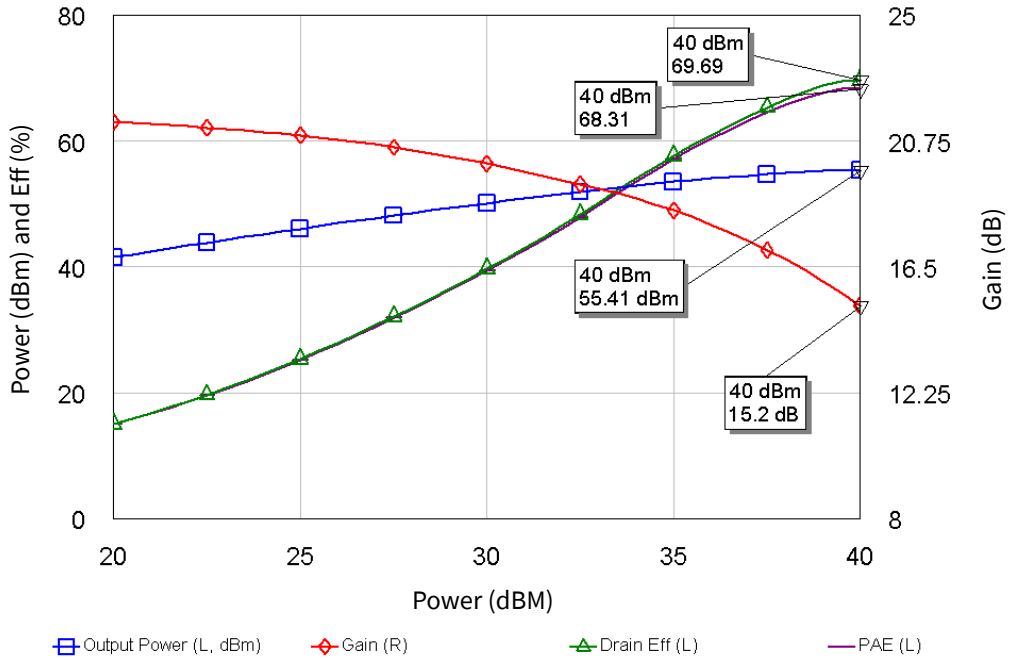
- Recommended solder is AuSn (80/20) solder. Refer to Wolfstreak's website for the Eutectic Die Bond Procedure application note at <https://www.wolfstreak.com/rf/document-library>
- Vacuum collet is the preferred method of pick-up.
- The backside of the die is the Source (ground) contact.
- Die back side gold plating is 5 microns thick minimum.
- Thermosonic ball or wedge bonding are the preferred connection methods.
- Gold wire must be used for connections.
- Use the die label (XX-YY) for correct orientation.

### Electrostatic Discharge (ESD) Classifications

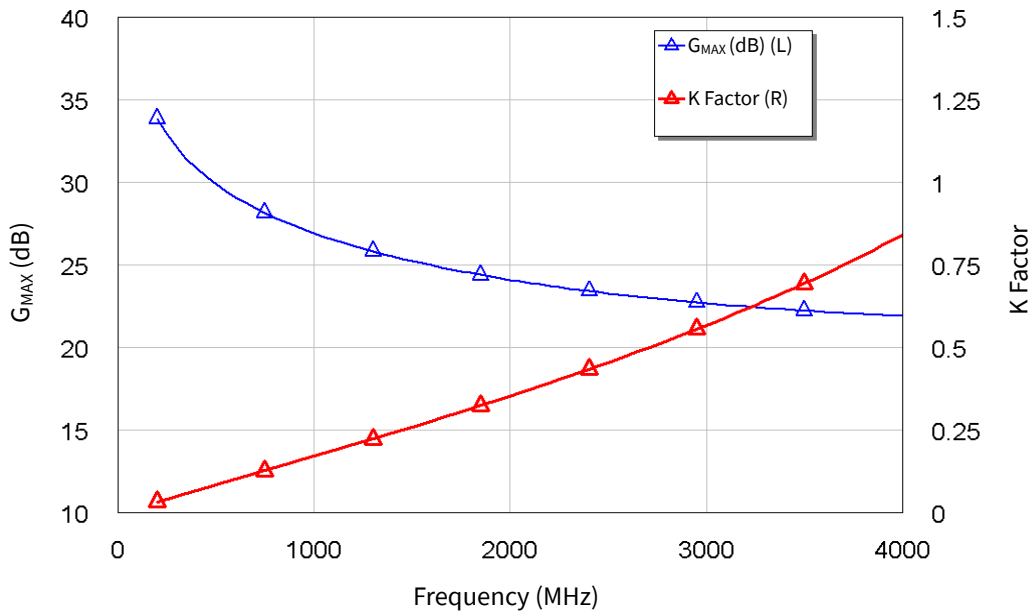
| Parameter        | Symbol | Class | Classification Level           | Test Methodology    |
|------------------|--------|-------|--------------------------------|---------------------|
| Human Body Model | HBM    | TBD   | ANSI/ESDA/JEDEC JS-001 Table 3 | JEDEC JESD22 A114-D |



Typical Performance



**Figure 1.** CGHV40320D Output Power, Gain and Efficiency vs. Input Power at  $T_{CASE} = 25^{\circ}C$   
 $V_{DD} = 50V, I_{DQ} = 500\text{ mA}$ , Frequency = 2.7 GHz



**Figure 2.** CGHV40320D  $G_{MAX}$  and K Factor vs. Frequency at  $T_{CASE} = 25^{\circ}C$   
 $V_{DD} = 50\text{ V}, I_{DQ} = 500\text{ mA}$



## Typical Die S-Parameters (Small Signal, $V_{DS} = 50\text{ V}$ , $I_{DQ} = 500\text{ mA}$ , magnitude/angle)

| Frequency | Mag S11 | Ang S11 | Mag S21 | Ang S21 | Mag S12 | Ang S12 | Mag S22 | Ang S22 |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| 0.5       | 0.964   | -175.19 | 5.49    | 73.16   | 0.005   | -15.49  | 0.719   | -171.16 |
| 0.6       | 0.966   | -175.83 | 4.48    | 69.32   | 0.005   | -19.04  | 0.732   | -170.45 |
| 0.7       | 0.967   | -176.28 | 3.75    | 65.72   | 0.005   | -22.35  | 0.746   | -169.86 |
| 0.8       | 0.969   | -176.62 | 3.20    | 62.34   | 0.005   | -25.45  | 0.761   | -169.41 |
| 0.9       | 0.970   | -176.88 | 2.77    | 59.16   | 0.005   | -28.35  | 0.776   | -169.08 |
| 1         | 0.972   | -177.10 | 2.42    | 56.17   | 0.005   | -31.06  | 0.790   | -168.88 |
| 1.1       | 0.973   | -177.28 | 2.14    | 53.35   | 0.005   | -33.59  | 0.804   | -168.78 |
| 1.2       | 0.974   | -177.44 | 1.90    | 50.70   | 0.004   | -35.96  | 0.817   | -168.76 |
| 1.3       | 0.976   | -177.59 | 1.70    | 48.21   | 0.004   | -38.16  | 0.829   | -168.81 |
| 1.4       | 0.977   | -177.71 | 1.53    | 45.87   | 0.004   | -40.22  | 0.841   | -168.91 |
| 1.5       | 0.978   | -177.83 | 1.38    | 43.66   | 0.004   | -42.13  | 0.852   | -169.06 |
| 1.6       | 0.979   | -177.95 | 1.25    | 41.59   | 0.004   | -43.91  | 0.862   | -169.24 |
| 1.7       | 0.980   | -178.05 | 1.14    | 39.65   | 0.004   | -45.56  | 0.871   | -169.44 |
| 1.8       | 0.981   | -178.15 | 1.04    | 37.81   | 0.004   | -47.11  | 0.879   | -169.66 |
| 1.9       | 0.982   | -178.24 | 0.96    | 36.08   | 0.003   | -48.54  | 0.887   | -169.89 |
| 2         | 0.983   | -178.33 | 0.88    | 34.45   | 0.003   | -49.88  | 0.895   | -170.12 |
| 2.1       | 0.984   | -178.42 | 0.81    | 32.90   | 0.003   | -51.12  | 0.901   | -170.36 |
| 2.2       | 0.985   | -178.50 | 0.75    | 31.44   | 0.003   | -52.28  | 0.907   | -170.61 |
| 2.3       | 0.985   | -178.58 | 0.70    | 30.06   | 0.003   | -53.36  | 0.913   | -170.85 |
| 2.4       | 0.986   | -178.65 | 0.65    | 28.75   | 0.003   | -54.37  | 0.918   | -171.08 |
| 2.5       | 0.987   | -178.73 | 0.61    | 27.50   | 0.003   | -55.30  | 0.923   | -171.32 |
| 2.6       | 0.987   | -178.80 | 0.57    | 26.32   | 0.003   | -56.17  | 0.927   | -171.55 |
| 2.7       | 0.988   | -178.86 | 0.53    | 25.19   | 0.003   | -56.99  | 0.931   | -171.77 |
| 2.8       | 0.988   | -178.93 | 0.50    | 24.11   | 0.002   | -57.74  | 0.935   | -171.99 |
| 2.9       | 0.989   | -178.99 | 0.47    | 23.08   | 0.002   | -58.45  | 0.938   | -172.20 |
| 3         | 0.989   | -179.05 | 0.44    | 22.10   | 0.002   | -59.10  | 0.942   | -172.41 |
| 3.2       | 0.990   | -179.17 | 0.39    | 20.26   | 0.002   | -60.28  | 0.947   | -172.80 |
| 3.4       | 0.990   | -179.28 | 0.35    | 18.56   | 0.002   | -61.29  | 0.952   | -173.17 |
| 3.6       | 0.991   | -179.39 | 0.32    | 16.99   | 0.002   | -62.15  | 0.957   | -173.52 |
| 3.8       | 0.991   | -179.49 | 0.29    | 15.54   | 0.002   | -62.87  | 0.960   | -173.84 |
| 4         | 0.992   | -179.58 | 0.26    | 14.18   | 0.002   | -63.47  | 0.964   | -174.15 |
| 4.2       | 0.992   | -179.68 | 0.24    | 12.90   | 0.002   | -63.94  | 0.967   | -174.43 |
| 4.4       | 0.992   | -179.76 | 0.22    | 11.71   | 0.001   | -64.30  | 0.969   | -174.70 |
| 4.6       | 0.993   | -179.85 | 0.20    | 10.58   | 0.001   | -64.55  | 0.971   | -174.96 |
| 4.8       | 0.993   | -179.93 | 0.19    | 9.51    | 0.001   | -64.68  | 0.973   | -175.20 |
| 5         | 0.993   | 179.99  | 0.17    | 8.50    | 0.001   | -64.70  | 0.975   | -175.42 |
| 5.2       | 0.993   | 179.92  | 0.16    | 7.54    | 0.001   | -64.59  | 0.977   | -175.64 |
| 5.4       | 0.993   | 179.84  | 0.15    | 6.62    | 0.001   | -64.35  | 0.978   | -175.84 |
| 5.6       | 0.994   | 179.77  | 0.14    | 5.75    | 0.001   | -63.96  | 0.980   | -176.03 |
| 5.8       | 0.994   | 179.70  | 0.13    | 4.91    | 0.001   | -63.41  | 0.981   | -176.22 |
| 6         | 0.994   | 179.63  | 0.12    | 4.10    | 0.001   | -62.68  | 0.982   | -176.39 |

To download the s-parameters in s2p format, go to the [CGHV40320D](#) Product page and click on the documentation tab.



**Part Number System**

**CGHV40320D**



**Table 1.**

| Parameter                    | Value    | Units |
|------------------------------|----------|-------|
| Upper Frequency <sup>1</sup> | 4.0      | GHz   |
| Power Output                 | 320      | W     |
| Package                      | Bare Die | —     |


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<br>2H = 27.0 GHz |



### Product Ordering Information

| Order Number | Description       | Unit of Measure | Image  |
|--------------|-------------------|-----------------|--|
| CGHV40320D   | GaN HEMT Bare Die | Each            |  A vertical, rectangular microscopic image of a GaN HEMT bare die. The die is dark in color with a grid of small, light-colored rectangular features, likely solder pads or wire bonds, arranged in a regular pattern along its length. |

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## Notes & Disclaimer

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