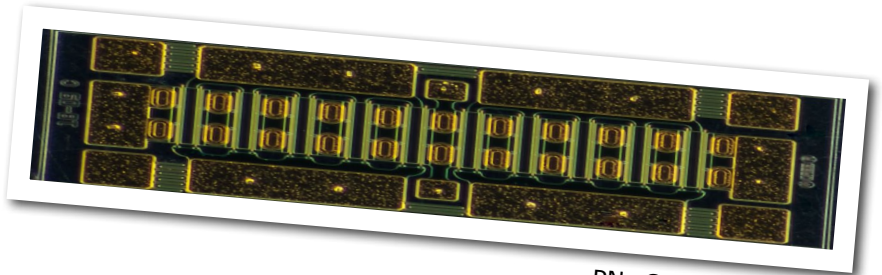


CGHV60040D

40 W, 6.0 GHz, GaN HEMT Die

Cree's CGHV60040D 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.



PN: CGHV60040D

FEATURES

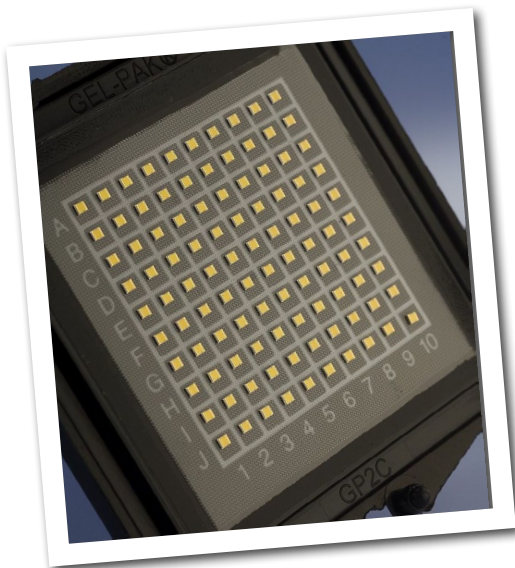
- 18 dB Typical Small Signal Gain at 4 GHz
- 17 dB Typical Small Signal Gain at 6 GHz
- 65% Typical Power Added Efficiency
- 40 W Typical P_{SAT}
- 50 V Operation
- High Breakdown Voltage
- Up to 6 GHz Operation

APPLICATIONS

- Cellular Infrastructure
- Class AB, Linear amplifiers suitable for OFDM, W-CDMA, LTE, EDGE, CDMA waveforms

Packaging Information

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



Absolute Maximum Ratings (not simultaneous)

| Parameter | Symbol | Rating | Units | Conditions |
|--|-----------------|-----------|----------|-------------------------|
| Drain-source Voltage | V_{DS} | 150 | V_{DC} | 25°C |
| Gate-source Voltage | V_{GS} | -10, +2 | V_{DC} | 25°C |
| Storage Temperature | T_{STG} | -65, +150 | °C | |
| Operating Junction Temperature | T_J | 225 | °C | |
| Maximum Drain Current ¹ | I_{MAX} | 3.2 | A | 25°C |
| Maximum Forward Gate Current | I_{GMAX} | 5.2 | mA | 25°C |
| Thermal Resistance, Junction to Case (packaged) ² | $R_{\theta JC}$ | 5.10 | °C/W | 85°C, 20.8W Dissipation |
| Thermal Resistance, Junction to Case (die only) | $R_{\theta JC}$ | 3.27 | °C/W | 85°C, 20.8W Dissipation |
| Mounting Temperature | T_S | 320 | °C | 30 seconds |

Note¹ Current limit for long term reliable operation.

Note² Eutectic die attach using 80/20 AuSn mounted to a 10 mil thick Cu15Mo85 carrier.

Electrical Characteristics (Frequency = 6 GHz unless otherwise stated; $T_C = 25^\circ C$)

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---------------------------------------|------------|------|------|--------|----------|---|
| DC Characteristics | | | | | | |
| Gate Pinch-Off Voltage | V_P | -3.8 | -3.0 | -2.3 | V | $V_{DS} = 10 V, I_D = 5.2 mA$ |
| Drain Current ¹ | I_{DSS} | 4.2 | 5.2 | - | A | $V_{DS} = 6 V, V_{GS} = 2.0 V$ |
| Drain-Source Breakdown Voltage | V_{BD} | 150 | - | - | V | $V_{GS} = -8 V, I_D = 5.2 mA$ |
| On Resistance | R_{ON} | - | 0.56 | - | Ω | $V_{DS} = 0.1 V$ |
| Gate Forward Voltage | V_{G-ON} | - | 1.9 | - | V | $I_{GS} = 5.2 mA$ |
| RF Characteristics | | | | | | |
| Small Signal Gain | G_{SS} | - | 17 | - | dB | $V_{DD} = 50 V, I_{DQ} = 65 mA$ |
| Saturated Power Output ^{2,3} | P_{SAT} | - | 40 | - | W | $V_{DD} = 50 V, I_{DQ} = 65 mA$ |
| Drain Efficiency ⁴ | η | - | 65 | - | % | $V_{DD} = 50 V, I_{DQ} = 65 mA, P_{SAT} = 40 W$ |
| Intermodulation Distortion | IM3 | - | -30 | - | dBc | $V_{DD} = 50 V, I_{DQ} = 65 mA, P_{OUT} = 40 W PEP$ |
| Output Mismatch Stress | VSWR | - | - | 10 : 1 | Ψ | No damage at all phase angles, $V_{DD} = 50 V, I_{DQ} = 65 mA, P_{OUT} = 40 W CW$ |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{GS} | - | 7.1 | - | pF | $V_{DS} = 50 V, V_{GS} = -8 V, f = 1 MHz$ |
| Output Capacitance | C_{DS} | - | 1.6 | - | pF | $V_{DS} = 50 V, V_{GS} = -8 V, f = 1 MHz$ |
| Feedback Capacitance | C_{GD} | - | 0.15 | - | pF | $V_{DS} = 50 V, V_{GS} = -8 V, f = 1 MHz$ |

Notes:

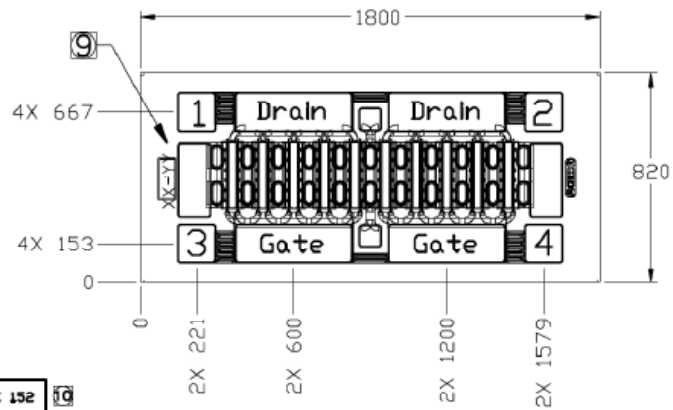
¹ Scaled from PCM data



² P_{SAT} is defined as $I_G = 0.52 mA$.

³ Pulsed 100 μsec , 10%

⁴ Drain Efficiency = P_{OUT} / P_{DC}

DIE DIMENSIONS (units in microns)



| | | | |
|---------------|--------------------|-----------|---|
| BOND PAD 1, 2 | DRAIN INTERCONNECT | 156 X 152 |  |
| BOND PAD 3, 4 | GATE INTERCONNECT | 156 X 152 |  |
| 2X DRAIN PAD | | 464 X 156 | |
| 2X GATE PAD | | 464 X 156 | |

Overall die size 820 x 1800 (+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 Cree's website for the Eutectic Die Bond Procedure application note at www.cree.com/wireless.
- 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, see arrow 9 in the drawing above.

Typical Performance

Figure 1. - CGHV60040D Output Power, Gain and Efficiency vs. Input Power at Tcase = 25°C
 $V_{DD} = 50\text{ V}$, $I_{DQ} = 65\text{ mA}$, Frequency = 2.7 GHz

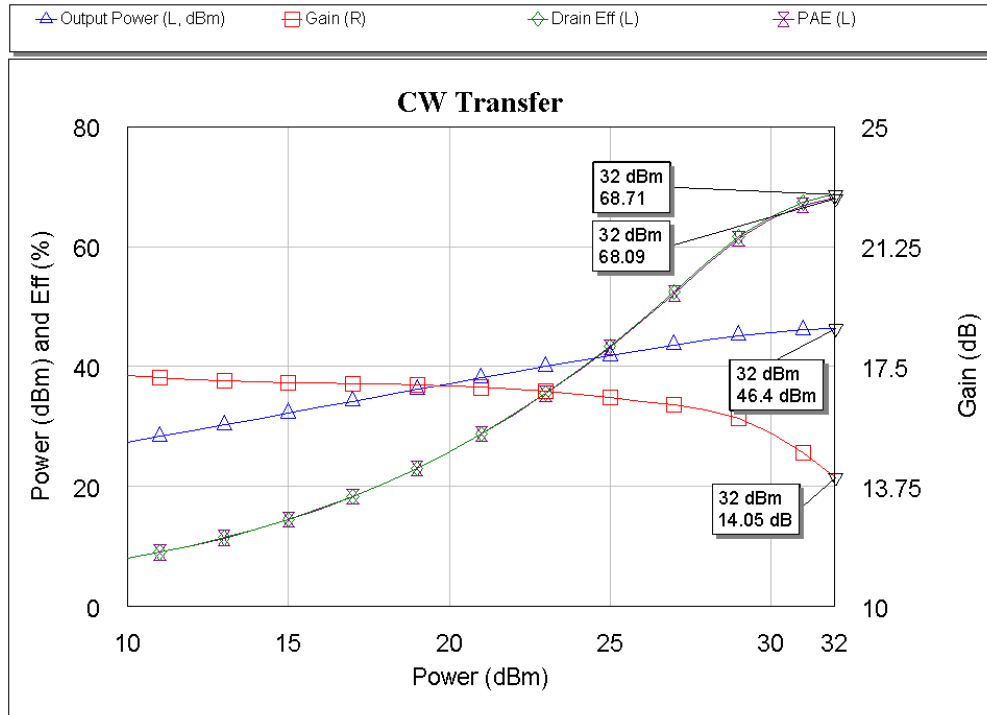
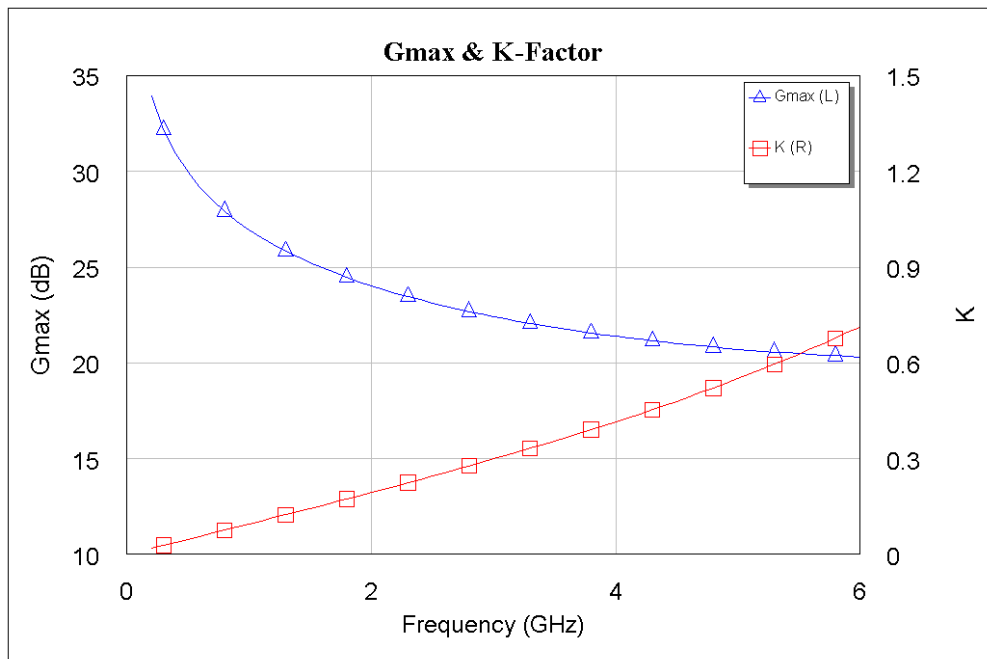


Figure 2. - CGHV60040D G_{MAX} and K Factor vs. Frequency at Tcase = 25°C
 $V_{DD} = 50\text{ V}$, $I_{DQ} = 65\text{ mA}$



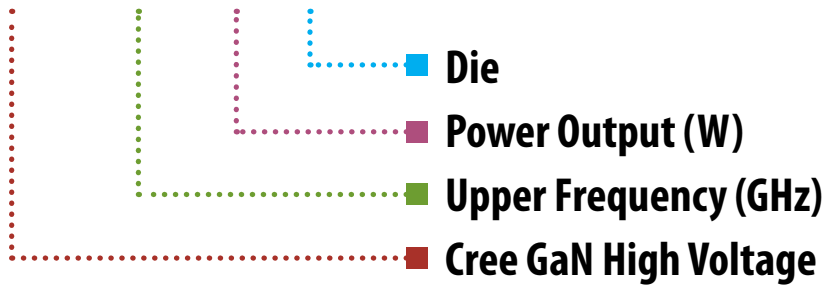
Typical Die S-Parameters (Small Signal, $V_{DS} = 50\text{ V}$, $I_{DQ} = 65\text{ mA}$, magnitude / angle)

| Frequency | Mag S11 | Ang S11 | Mag S21 | Ang S21 | Mag S12 | Ang S12 | Mag S22 | Ang S22 |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| 0.500 | 0.935 | -124.81 | 17.697 | 105.17 | 0.018 | 16.26 | 0.468 | -61.04 |
| 0.600 | 0.932 | -132.78 | 15.111 | 99.07 | 0.019 | 10.39 | 0.461 | -66.42 |
| 0.700 | 0.930 | -138.77 | 13.108 | 93.98 | 0.019 | 5.52 | 0.462 | -71.19 |
| 0.800 | 0.929 | -143.42 | 11.520 | 89.59 | 0.019 | 1.35 | 0.468 | -75.54 |
| 0.900 | 0.929 | -147.12 | 10.235 | 85.69 | 0.019 | -2.32 | 0.478 | -79.56 |
| 1.000 | 0.929 | -150.12 | 9.175 | 82.18 | 0.019 | -5.62 | 0.491 | -83.30 |
| 1.100 | 0.930 | -152.61 | 8.287 | 78.96 | 0.018 | -8.62 | 0.506 | -86.79 |
| 1.200 | 0.931 | -154.70 | 7.532 | 75.98 | 0.018 | -11.38 | 0.521 | -90.07 |
| 1.300 | 0.932 | -156.49 | 6.884 | 73.19 | 0.018 | -13.94 | 0.537 | -93.16 |
| 1.400 | 0.933 | -158.04 | 6.320 | 70.57 | 0.018 | -16.34 | 0.553 | -96.07 |
| 1.500 | 0.934 | -159.39 | 5.827 | 68.10 | 0.018 | -18.59 | 0.570 | -98.82 |
| 1.600 | 0.936 | -160.58 | 5.391 | 65.75 | 0.017 | -20.72 | 0.586 | -101.42 |
| 1.700 | 0.937 | -161.64 | 5.003 | 63.51 | 0.017 | -22.73 | 0.602 | -103.88 |
| 1.800 | 0.939 | -162.59 | 4.657 | 61.38 | 0.017 | -24.64 | 0.617 | -106.22 |
| 1.900 | 0.940 | -163.45 | 4.346 | 59.35 | 0.016 | -26.45 | 0.633 | -108.45 |
| 2.000 | 0.941 | -164.24 | 4.065 | 57.40 | 0.016 | -28.18 | 0.647 | -110.56 |
| 2.100 | 0.943 | -164.95 | 3.810 | 55.53 | 0.016 | -29.82 | 0.661 | -112.57 |
| 2.200 | 0.944 | -165.61 | 3.579 | 53.73 | 0.016 | -31.39 | 0.675 | -114.49 |
| 2.300 | 0.946 | -166.22 | 3.367 | 52.01 | 0.015 | -32.89 | 0.688 | -116.32 |
| 2.400 | 0.947 | -166.79 | 3.174 | 50.35 | 0.015 | -34.32 | 0.701 | -118.07 |
| 2.500 | 0.948 | -167.32 | 2.996 | 48.75 | 0.015 | -35.70 | 0.713 | -119.74 |
| 2.600 | 0.950 | -167.82 | 2.833 | 47.21 | 0.014 | -37.01 | 0.724 | -121.34 |
| 2.700 | 0.951 | -168.29 | 2.682 | 45.73 | 0.014 | -38.26 | 0.735 | -122.87 |
| 2.800 | 0.952 | -168.73 | 2.542 | 44.29 | 0.014 | -39.47 | 0.745 | -124.33 |
| 2.900 | 0.953 | -169.14 | 2.413 | 42.91 | 0.014 | -40.62 | 0.755 | -125.74 |
| 3.000 | 0.954 | -169.54 | 2.294 | 41.57 | 0.013 | -41.73 | 0.765 | -127.08 |
| 3.200 | 0.957 | -170.27 | 2.079 | 39.03 | 0.013 | -43.81 | 0.782 | -129.62 |
| 3.400 | 0.959 | -170.94 | 1.892 | 36.65 | 0.012 | -45.72 | 0.798 | -131.95 |
| 3.600 | 0.960 | -171.55 | 1.729 | 34.42 | 0.012 | -47.49 | 0.812 | -134.12 |
| 3.800 | 0.962 | -172.11 | 1.585 | 32.31 | 0.011 | -49.12 | 0.825 | -136.13 |
| 4.000 | 0.964 | -172.64 | 1.458 | 30.33 | 0.011 | -50.63 | 0.837 | -137.99 |
| 4.200 | 0.965 | -173.13 | 1.346 | 28.45 | 0.010 | -52.03 | 0.848 | -139.73 |
| 4.400 | 0.966 | -173.59 | 1.246 | 26.67 | 0.010 | -53.32 | 0.857 | -141.35 |
| 4.600 | 0.967 | -174.02 | 1.156 | 24.99 | 0.009 | -54.51 | 0.866 | -142.87 |
| 4.800 | 0.969 | -174.43 | 1.076 | 23.38 | 0.009 | -55.62 | 0.874 | -144.29 |
| 5.000 | 0.970 | -174.82 | 1.004 | 21.85 | 0.009 | -56.64 | 0.882 | -145.63 |
| 5.200 | 0.970 | -175.19 | 0.939 | 20.39 | 0.008 | -57.59 | 0.888 | -146.88 |
| 5.400 | 0.971 | -175.54 | 0.880 | 19.00 | 0.008 | -58.46 | 0.894 | -148.07 |
| 5.600 | 0.972 | -175.88 | 0.826 | 17.66 | 0.008 | -59.27 | 0.900 | -149.18 |
| 5.800 | 0.973 | -176.20 | 0.777 | 16.37 | 0.007 | -60.01 | 0.905 | -150.24 |
| 6.000 | 0.973 | -176.51 | 0.732 | 15.14 | 0.007 | -60.69 | 0.910 | -151.24 |

To download the s-parameters in s2p format, go to the [CGHV60040D](#) Product Page and click the documentation tab.

Part Number System

CGHV60040D



| Parameter | Value | Units |
|------------------------------|----------|-------|
| Upper Frequency ¹ | 6.0 | GHz |
| Power Output | 40 | W |
| Package | Bare Die | - |

Table 1.

Note¹: 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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