# CGHV96100F2

**100 W, 7.9 - 9.6 GHz, 50-ohm, Input/Output Matched GaN HEMT**

Cree's CGHV96100F2 is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT) on Silicon Carbide (SiC) substrates. This GaN Internally Matched (IM) FET offers excellent power added efficiency in comparison to other technologies. 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 also offer greater power density and wider bandwidths compared to GaAs transistors. This IM FET is available in a metal/ceramic flanged package for optimal electrical and thermal performance.

PN: CGHV96100F2
Package Type: 440217

### Typical Performance Over 8.4-9.6 GHz ($T_c$ = 25°C)

| Parameter | 8.4 GHz | 8.8 GHz | 9.0 GHz | 9.2 GHz | 9.4 GHz | 9.6 GHz | Units |
|---|---|---|---|---|---|---|---|
| Linear Gain | 12.7 | 12.4 | 12.7 | 13.1 | 13.1 | 12.4 | dB |
| Output Power | 151 | 147 | 150 | 152 | 140 | 131 | W |
| Power Gain | 10.8 | 10.6 | 10.7 | 10.7 | 10.5 | 10.2 | dB |
| Power Added Efficiency | 44 | 42 | 44 | 43 | 45 | 45 | % |

Note: Measured in CGHV96100F2-AMP (838179) under 100 µS pulse width, 10% duty, Pin 41.0 dBm (12.6 W)

## Features

- 8.4 - 9.6 GHz Operation
- 145 W $P_{OUT}$ typical
- 10 dB Power Gain
- 45 % Typical PAE
- 50 Ohm Internally Matched
- <0.3 dB Power Droop

## Applications

- Marine Radar
- Weather Monitoring
- Air Traffic Control
- Maritime Vessel Traffic Control
- Port Security

Large Signal Models Available for ADS and MWO

## Absolute Maximum Ratings (not simultaneous)

| Parameter | Symbol | Rating | Units | Conditions |
|---|---|---|---|---|
| Drain-source Voltage | $V_{DSS}$ | 100 | Volts | 25˚C |
| Gate-source Voltage | $V_{GS}$ | -10, +2 | Volts | 25˚C |
| Power Dissipation | $P_{DISS}$ | 115.2 / 222.0 | Watts | (CW / Pulse) |
| Storage Temperature | $T_{STG}$ | -65, +150 | ˚C | |
| Operating Junction Temperature | $T_J$ | 225 | ˚C | |
| Maximum Drain Current[1] | $I_{DMAX}$ | 12 | Amps | |
| Maximum Forward Gate Current | $I_{GMAX}$ | 28.8 | mA | 25˚C |
| Soldering Temperature[2] | $T_S$ | 245 | ˚C | |
| Screw Torque | $\tau$ | 40 | in-oz | |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.73 | ˚C/W | Pulse Width = 100 µs, Duty Cycle = 10%, 85˚C, $P_{DISS}$ = 173 W |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 1.07 | ˚C/W | CW, 85˚C, $P_{DISS}$ = 115.2 W |
| Case Operating Temperature[3] | $T_C$ | -40, +125 | ˚C | |

Note:

[1] Current limit for long term reliable operation.

[2] Refer to the Application Note on soldering at http://www.cree.com/rf/document-library

[3] See also, the Power Dissipation De-rating Curve on Page 9.

## Electrical Characteristics (Frequency = 9.6 GHz unless otherwise stated; $T_C$ = 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 | $V_{DS}$ = 10 V, $I_D$ = 28.8 mA |
| Gate Quiscent Voltage | $V_{GS(Q)}$ | – | -2.7 | – | V | $V_{DS}$ = 40 V, $I_D$ = 1000 mA |
| Saturated Drain Current[2] | $I_{DS}$ | 21.0 | 26.0 | – | A | $V_{DS}$ = 6.0 V, $V_{GS}$ = 2.0 V |
| Drain-Source Breakdown Voltage | $V_{BD}$ | 100 | – | – | V | $V_{GS}$ = -8 V, $I_D$ = 28.8 mA |
| **RF Characteristics[3]** | | | | | | |
| Small Signal Gain | S21 | 10.5 | 12.4 | – | dB | $V_{DD}$ = 40 V, $I_{DQ}$ = 1000 mA, $P_{IN}$ = -20 dBm |
| Input Return Loss 1 | S11 | – | –5.2 | -2.8 | dB | $V_{DD}$ = 40 V, $I_{DQ}$ = 1000 mA, $P_{IN}$ = -20 dBm, 8.4 - 9.4 GHz |
| Input Return Loss 2 | S11 | – | – | -3.3 | dB | $V_{DD}$ = 40 V, $I_{DQ}$ = 1000 mA, $P_{IN}$ = -20 dBm, 9.4 - 9.6 GHz |
| Output Return Loss | S22 | – | –12.3 | -6.0 | dB | $V_{DD}$ = 40 V, $I_{DQ}$ = 1000 mA, $P_{IN}$ = -20 dBm |
| Power Output[3,4] | $P_{OUT}$ | 100 | 131.0 | – | W | $V_{DD}$ = 40 V, $I_{DQ}$ = 1000 mA, $P_{IN}$ = 41 dBm |
| Power Added Efficiency[3,4] | PAE | 30 | 45 | – | % | $V_{DD}$ = 40 V, $I_{DQ}$ = 1000 mA, $P_{IN}$ = 41 dBm |
| Power Gain[3,4] | $P_G$ | – | 10.2 | – | dB | $V_{DD}$ = 40 V, $I_{DQ}$ = 1000 mA, $P_{IN}$ = 41 dBm |
| Output Mismatch Stress | VSWR | – | – | 5:1 | Ψ | No damage at all phase angles, $V_{DD}$ = 40 V, $I_{DQ}$ = 1000 mA, |

Notes:

[1] Measured on-wafer prior to packaging.

[2] Scaled from PCM data.

[3] Measured in CGHV96100F2-AMP (838179) under 100 µS pulse width, 10% duty

[4] Fixture loss de-embedded using the following offsets: Frequency = 9.6 GHz. Input = 0.5 dB and Output = 0.5 dB.



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**Figure 1. - Small Signal Gain and Return Loss vs Frequency of CGHV96100F2 measured in CGHV96100F2-AMP**
**$V_{DS}$ = 40 V, $I_{DQ}$ = 1000mA**

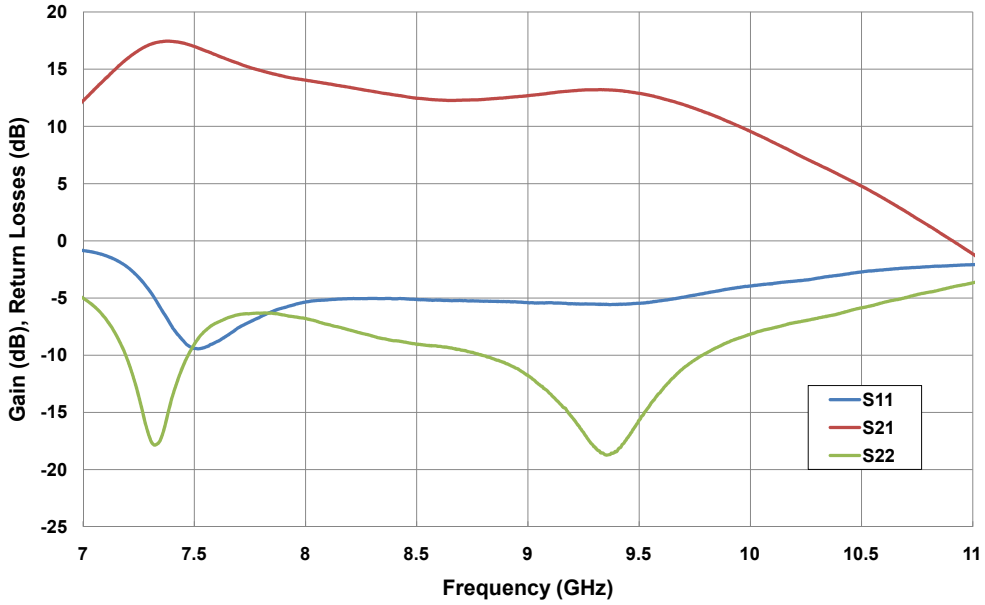


**Figure 2. - Power Gain vs. Frequency and Input Power**
**$V_{DD}$ = 40 V, Pulse Width = 100 µsec, Duty Cycle = 10%**

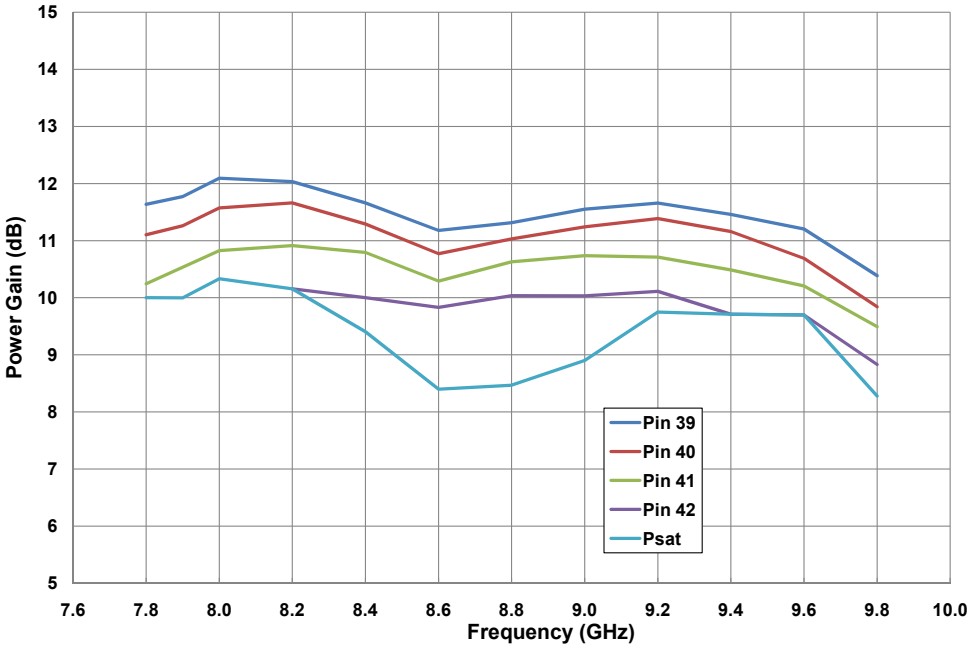




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**Figure 3. - Output Power vs. Input Power**
**$V_{DD}$ = 40 V, Pulse Width = 100 µsec, Duty Cycle = 10%**

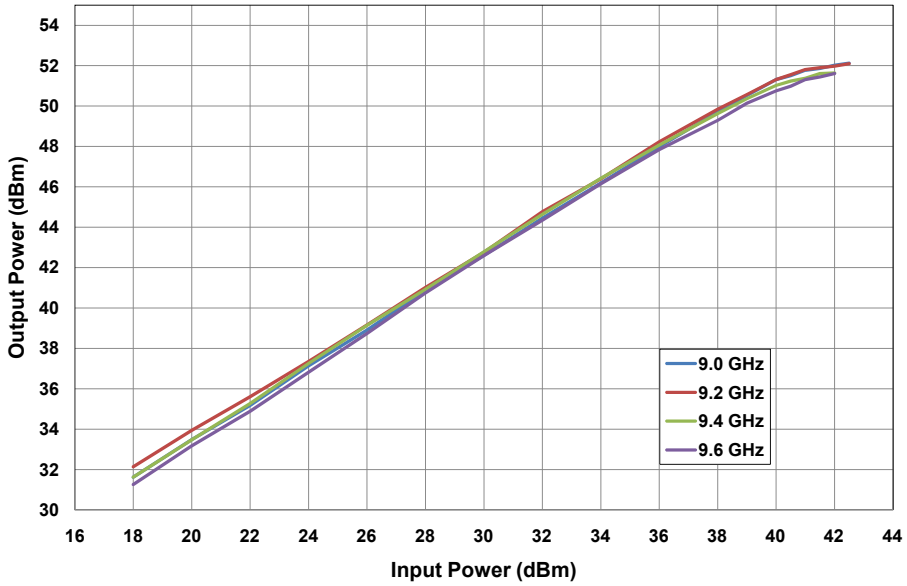


**Figure 4. - Power Gain vs. Frequency and Input Power**
**$V_{DD}$ = 40 V, Pulse Width = 100 µsec, Duty Cycle = 10%**

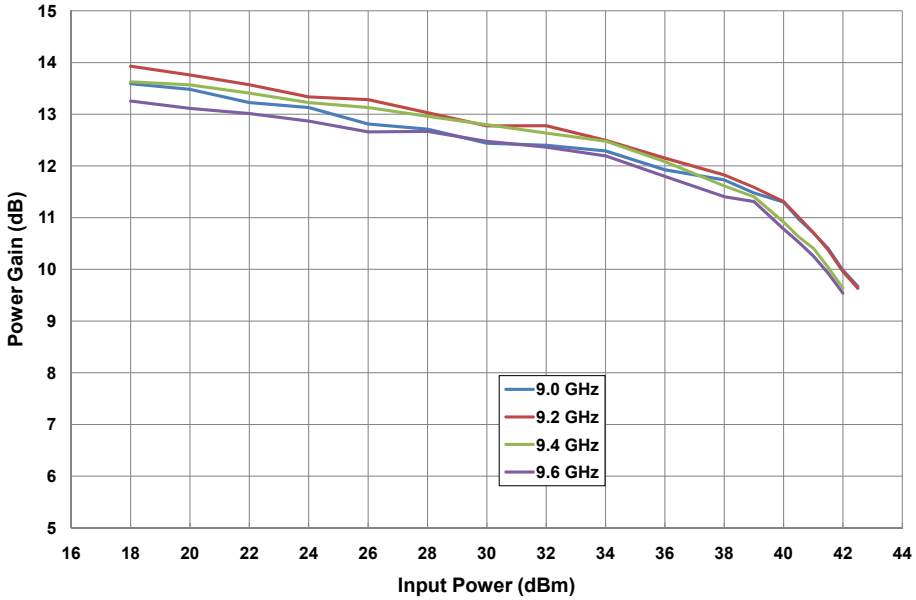




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**Figure 5. - Power Added Efficiency vs. Input Power**
**$V_{DD}$ = 40 V, Pulse Width = 100 µsec, Duty Cycle = 10%**

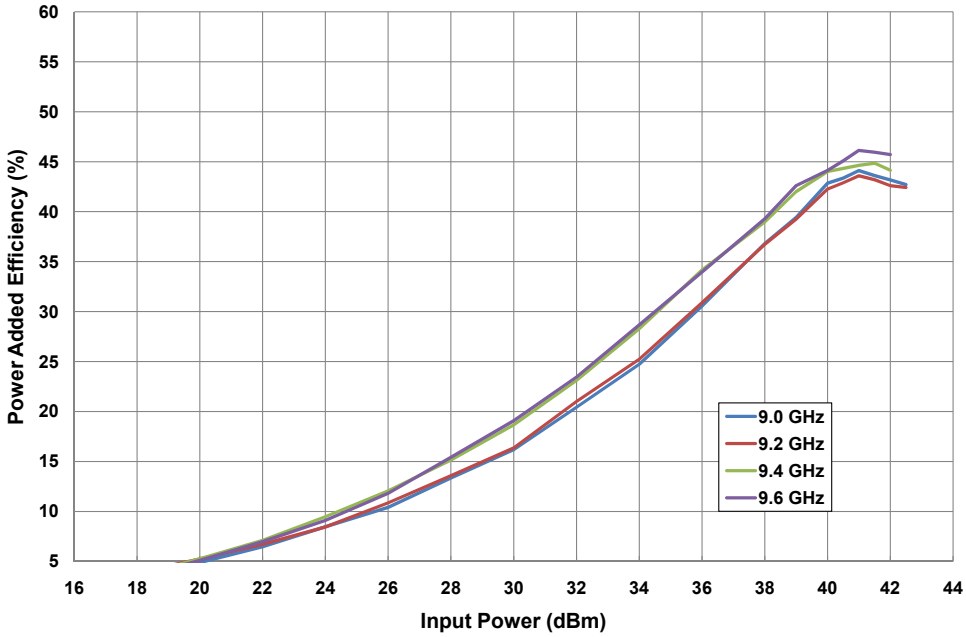


**Figure 6. - Output Power vs. Time**
**$V_{DD}$ = 40 V, $P_{IN}$ = 41 dBm, Duty Cycle = 10%**

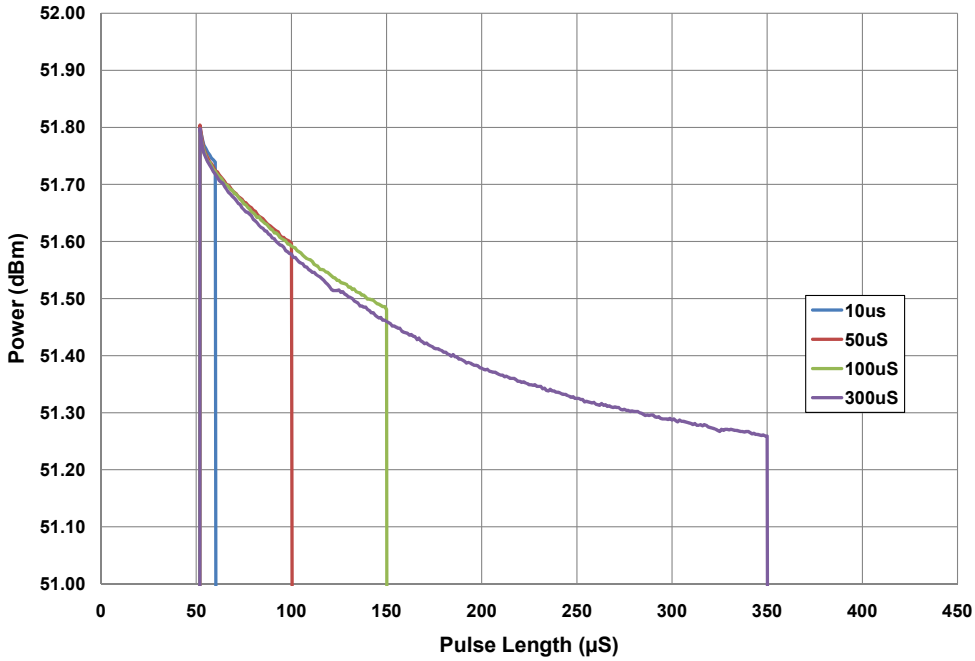




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**Figure 7. - Output Power vs. Input Power & Frequency**
**$V_{DD}$ = 40 V, Pulse Width = 100 µsec, Duty Cycle = 10%**

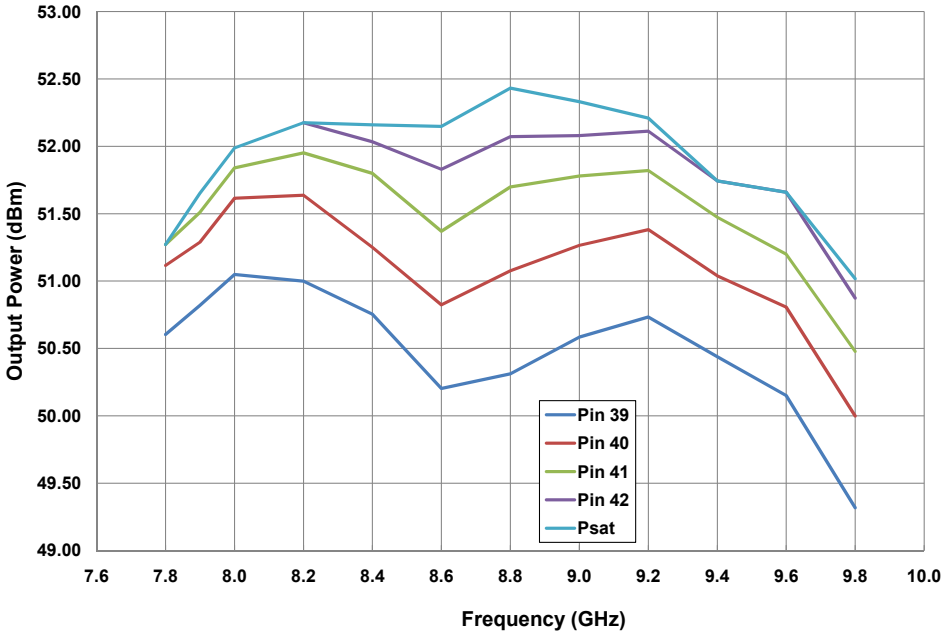
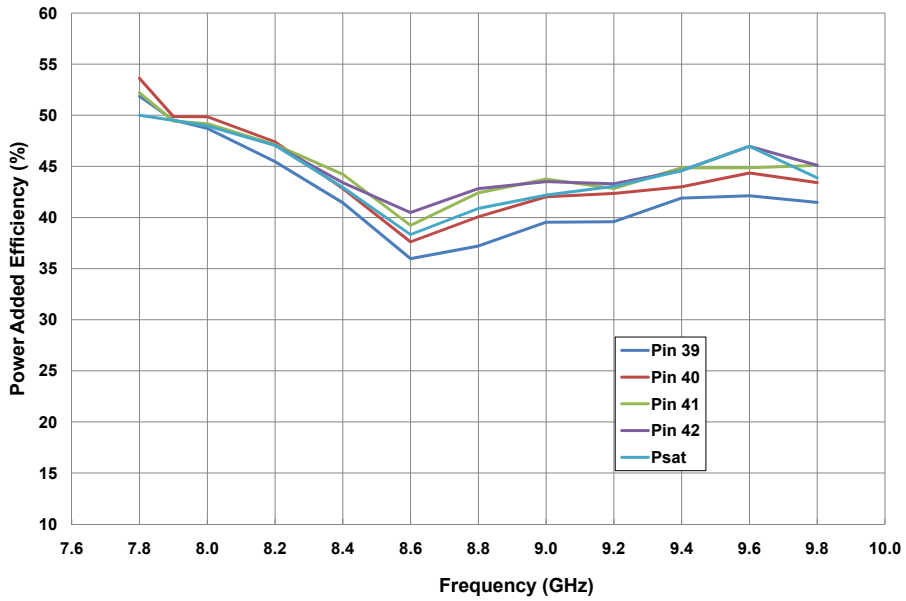



**Figure 8. - Power Added Efficiency vs. Input Power & Frequency**
**$V_{DD}$ = 40 V, Pulse Width = 100 µsec, Duty Cycle = 10%**



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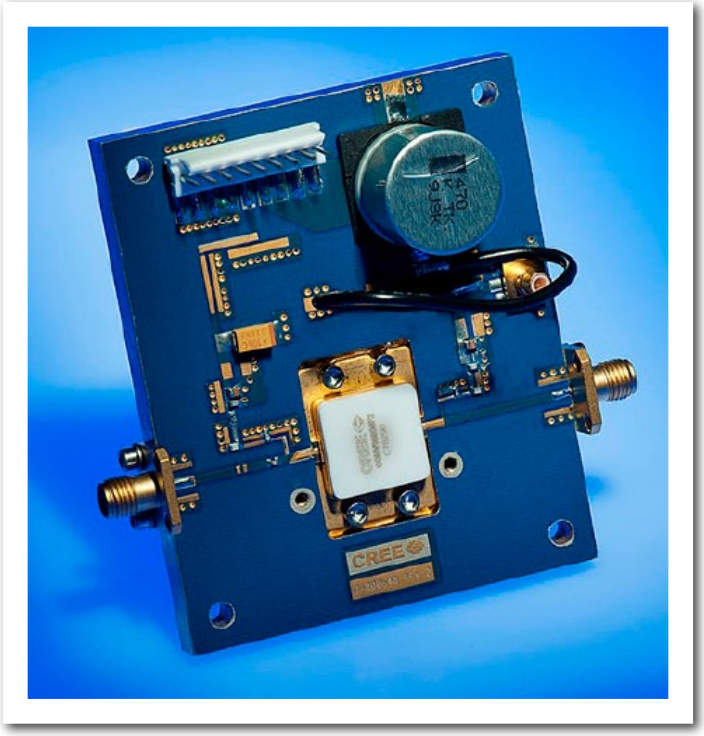
## CGHV96100F2-AMP Demonstration Amplifier Circuit Bill of Materials

| Designator | Description | Qty |
|---|---|---|
| R1 | RES, 47 OHM +/-1%, 1/16 W, 0603, SMD | 1 |
| C1, C11 | CAP, 1.6pF, +/- 0.1 pF, 200V, 0402, ATC 600L | 2 |
| C2, C12 | CAP, 1.0pF, +/- 0.1 pF, 200V, 0402 ATC 600L | 2 |
| C3, C13 | CAP, 10 pF +/-5%, 0603, ATC | 2 |
| C4, C14 | CAP, 470 pF +/-5%, 100 V, 0603 | 2 |
| C5, C15 | CAP, 33,000 pF, 0805, 100 V, X7R | 2 |
| C6 | CAP, 10 uF, 16 V, TANTALUM | 1 |
| C18 | CAP, 470 uF +/-20%, ELECTROLYTIC | 1 |
| J1,J2 | CONNECTOR, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST, 20MIL | 2 |
| J3 | CONNECTOR, HEADER, RT>PLZ .1CEN LK 9POS | 1 |
| J4 | CONNECTOR, SMB, STRAIGHT JACK | 1 |
| - | PCB, TEST FIXTURE, TACONICS RF35P, 20 MIL THK, 440210 PKG | 1 |
| - | 2-56 SOC HD SCREW 1/4 SS | 4 |
| - | #2 SPLIT LOCKWASHER SS | 4 |
| Q1 | CGHV96100F2 | 1 |

## CGHV96100F2-AMP Demonstration Amplifier Circuit



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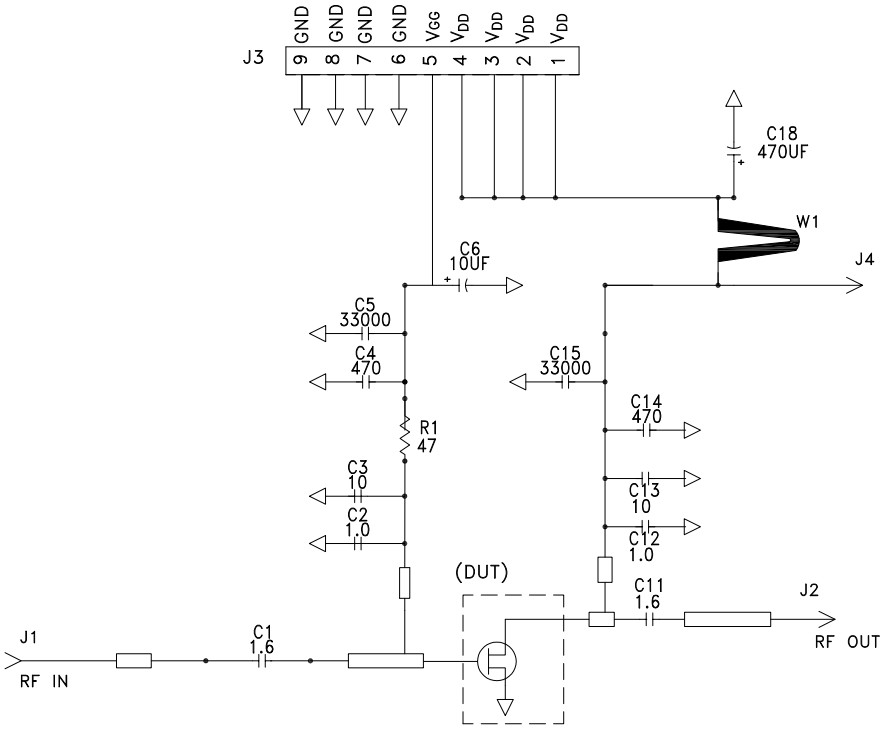
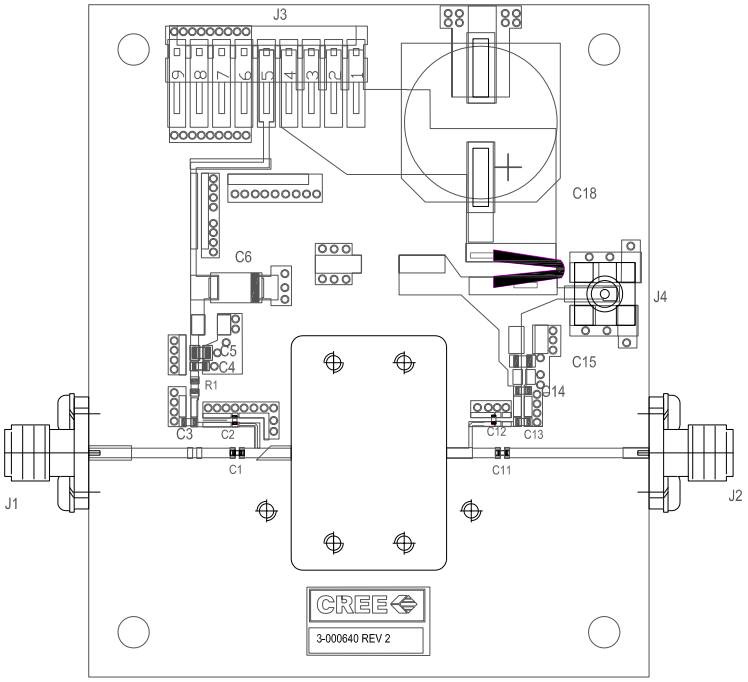
## CGHV96100F2-AMP Demonstration Amplifier Circuit Schematic




## CGHV96100F2-AMP Demonstration Amplifier Circuit Outline



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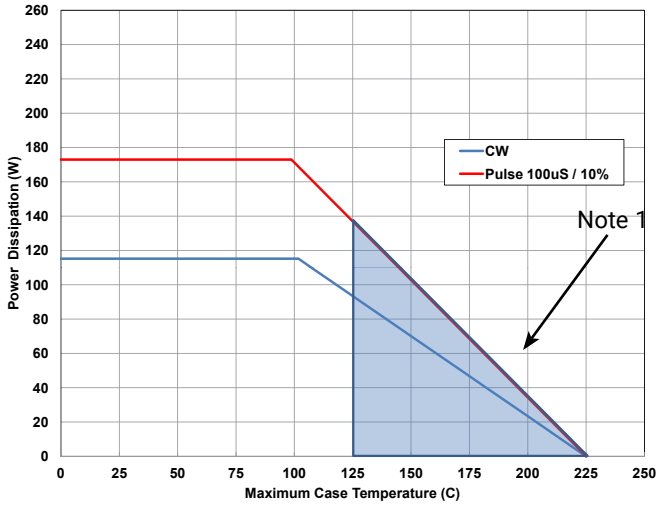
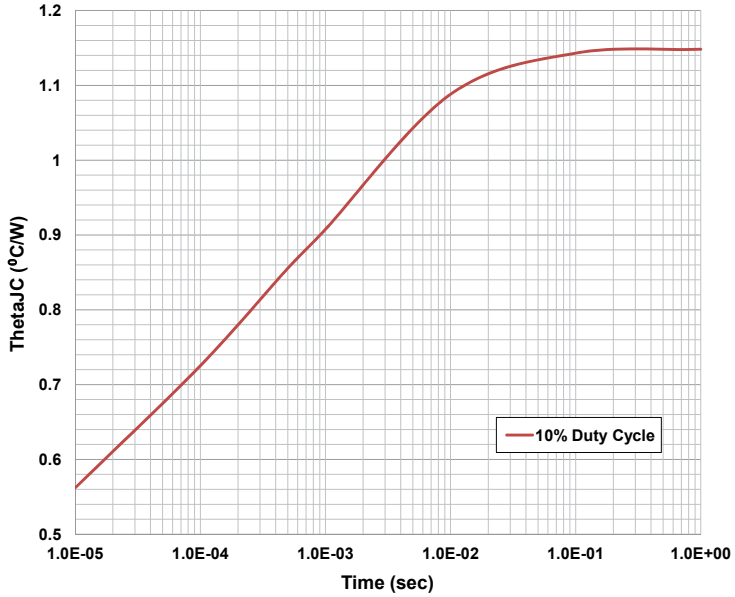
## CGHV96100F2 Power Dissipation De-rating Curve




Note 1 : Shaded area exceeds Maximum Case Operating Temperature (See Page 2)

## CGHV96100F2 Transient Curve




## Electrostatic Discharge (ESD) Classifications

| Parameter | Symbol | Class | Test Methodology |
|---|---|---|---|
| Human Body Model | HBM | 1A (> 250 V) | JEDEC JESD22 A114-D |
| Charge Device Model | CDM | II (200 < 500 V) | JEDEC JESD22 C101-C |



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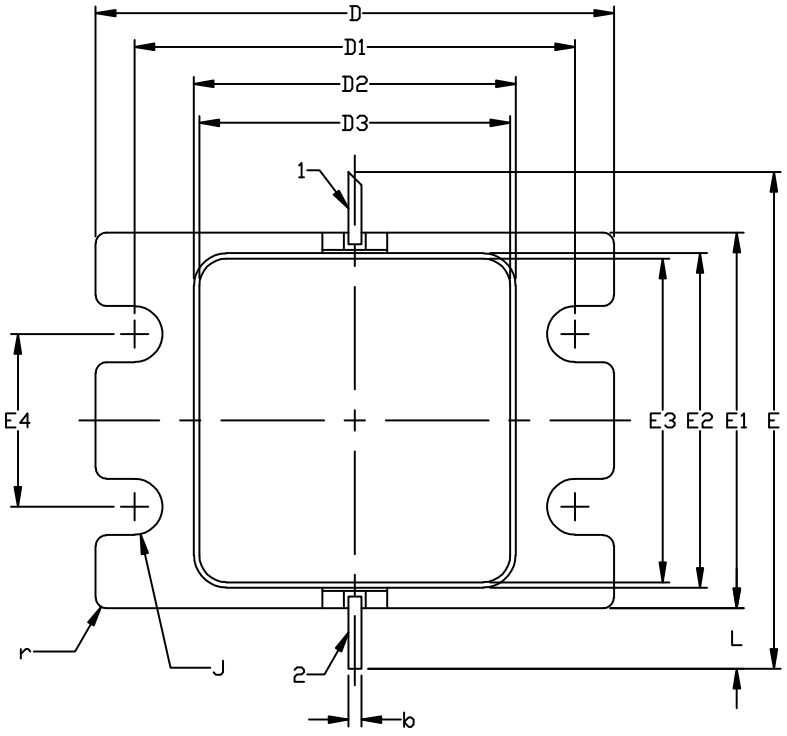
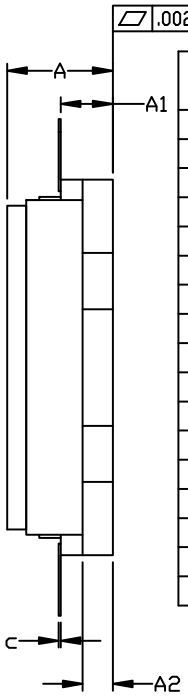
## Product Dimensions CGHV96100F2 (Package Type — 440217)

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M-2009
2. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF .020 BEYOND EDGE OF LID
3. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF .008 IN ANY DIRECTION
4. ALL PLATED SURFACES ARE GOLD OVER NICKEL




1. GATE
2. DRAIN

| DIM | INCHES | | MILLIMETERS | | NOTES |
|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | |
| A | 0.188 | 0.198 | 4.78 | 5.03 | |
| A1 | 0.088 | 0.100 | 2.24 | 2.54 | 2x |
| A2 | 0.049 | 0.061 | 1.24 | 1.55 | |
| b | 0.022 | 0.026 | 0.56 | 0.66 | 2x |
| c | 0.002 | 0.006 | 0.05 | 0.15 | |
| D | 0.935 | 0.955 | 23.75 | 24.26 | |
| D1 | 0.797 | 0.809 | 20.24 | 20.55 | 2x |
| D2 | 0.581 | 0.593 | 14.76 | 15.06 | |
| D3 | 0.563 | 0.571 | 14.30 | 14.50 | |
| E | 0.906 | | 23.01 | | REF |
| E1 | 0.679 | 0.691 | 17.25 | 17.55 | |
| E2 | 0.604 | 0.616 | 15.34 | 15.65 | |
| E3 | 0.586 | 0.594 | 14.88 | 15.09 | |
| E4 | 0.309 | 0.321 | 7.85 | 8.15 | 2x |
| J | ø0.097 | ø0.107 | ø2.46 | ø2.72 | 4x |
| L | 0.090 | 0.130 | 2.29 | 3.30 | 2x |
| r | 0.02 TYP | | 0.51 TYP | | 12x |



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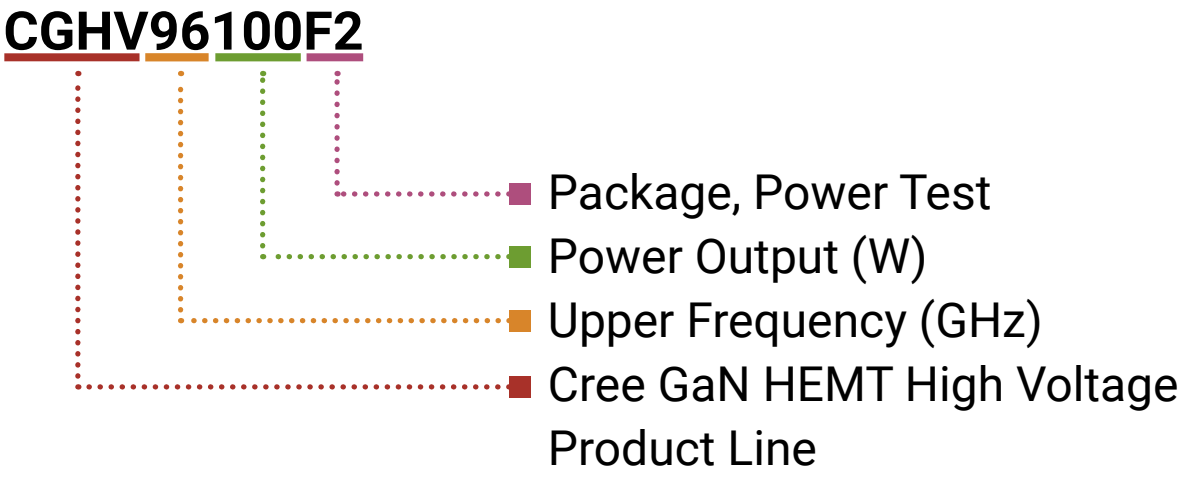
## Part Number System




| Parameter | Value | Units |
|---|---|---|
| Upper Frequency[1] | 9.6 | GHz |
| Power Output | 100 | W |
| Package | Flange | - |

**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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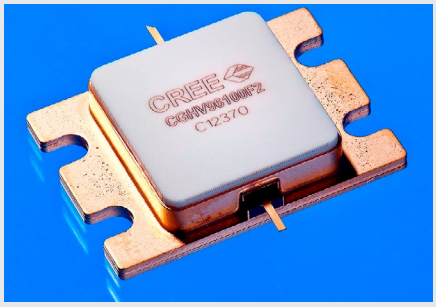
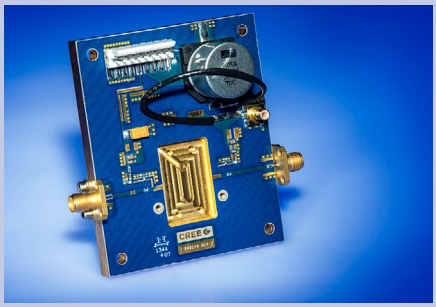
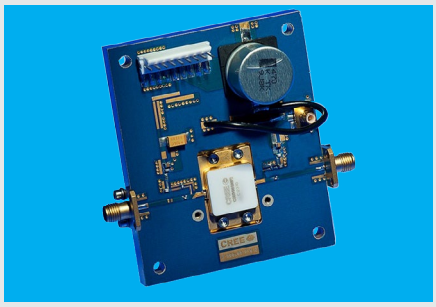
## Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|---|---|---|---|
| CGHV96100F2 | GaN HEMT | Each |  |
| CGHV96100F2-TB | GaN HEMT | Each |  |
| CGHV96100F2-AMP | Test board without GaN HEMT | Each |  |
| CGHV96100F2-JMT | CGHV96100F2 Delivered in a JEDEC Matrix tray | 50 parts / tray.<br>Order multiple = 50pcs | |



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