# CGHV40180P

## 180 W, DC - 1000 MHz, 50 V, GaN HEMT

Cree's CGHV40180P is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGHV40180P, operating from a 50 volt rail, offers a general purpose, broadband solution to a variety of RF and microwave applications. GaN HEMTs offer high efficiency, high gain and wide bandwidth capabilities making the CGHV40180P ideal for linear and compressed amplifier circuits. The transistor is available in a 2-lead pill package.


Package Types: 440206
PN: CGHV40180P

### Typical Performance Over 800 MHz - 1000 MHz ($T_c$ = 25°C), 50 V

| Parameter | 800 MHz | 850 MHz | 900 MHz | 950 MHz | 1000 MHz | Units |
|---|---|---|---|---|---|---|
| Small Signal Gain | 25.6 | 25.2 | 24.6 | 24.4 | 24.3 | dB |
| Gain @ Pin 34 dBm | 20.4 | 20.8 | 20.4 | 20.1 | 20.1 | dB |
| Output Power @ Pin 34 dBm | 275 | 302 | 275 | 257 | 257 | W |
| EFF @ Pin 34 dBm | 67 | 75 | 76 | 73 | 71 | % |

Note:
Measured CW in the CGHV40180P-AMP Application circuit.

RoHS COMPLIANT

### FEATURES

- Up to 1000 MHz Operation
- 24 dB Small Signal Gain at 900 MHz
- 20 dB Power Gain at 900 MHz
- 250 W Typical Output Power at 900 MHz
- 75 % Efficiency at $P_{SAT}$

### APPLICATIONS

- Military Communications
- Public Safety VHF-UHF applications
- Radar
- Medical
- Broadband Amplifiers

Large Signal Models Available for ADS and MWO

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

| Parameter | Symbol | Rating | Units | Conditions |
|---|---|---|---|---|
| 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[1] | $T_J$ | 225 | ˚C | |
| Maximum Forward Gate Current | $I_{GMAX}$ | 42 | mA | 25˚C |
| Maximum Drain Current | $I_{DMAX}$ | 18 | A | 25˚C |
| Soldering Temperature[2] | $T_S$ | 245 | ˚C | |
| CGHV40180P Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.87 | ˚C/W | $P_{DISS}$ = 150, 85˚C |
| Maximum dissipated power | | 150 | W | $P_{DISS}$ = 150, 85˚C |
| Case Operating Temperature[3] | $T_C$ | -40, +150 | ˚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] See also, Power Derating Curve on Page 5.

## Electrical Characteristics

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **DC Characteristics[1] ($T_C$ = 25˚C)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -3.8 | -3.0 | -2.3 | $V_{DC}$ | $V_{DS}$ = 10 V, $I_D$ = 20.8 mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | – | -2.7 | – | $V_{DC}$ | $V_{DS}$ = 50 V, $I_D$ = 1000 mA |
| Saturated Drain Current[2] | $I_{DS}$ | 31.4 | 37.6 | – | A | $V_{DS}$ = 6.0 V, $V_{GS}$ = 2.0 V |
| Drain-Source Breakdown Voltage | $V_{BR}$ | 150 | – | – | $V_{DC}$ | $V_{GS}$ = -8 V, $I_D$ = 41.8 mA |
| **RF Characteristics[2,3] ($T_C$ = 25˚C, $F_0$ = 900 MHz unless otherwise noted)** | | | | | | |
| Small Signal Gain | $G_{SS}$ | – | 24.6 | – | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{in}$=10dBm CW |
| Power Gain | $G_P$ | – | 19.9 | – | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{in}$=34 dBm CW |
| Power Output at Saturation | $P_{OUT}$ | – | 53.9 | – | dBm | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{in}$=34 dBm CW |
| Drain Efficiency[4] | $\eta$ | – | 71 | – | % | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{in}$=34 dBm CW |
| Output Mismatch Stress | VSWR | – | – | 3 : 1 | $\Psi$ | No damage at all phase angles, $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{OUT}$ = 180 W CW |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $C_{GS}$ | – | 57.8 | – | pF | $V_{DS}$ = 50 V, $V_{gs}$ = -8 V, f = 1 MHz |
| Output Capacitance | $C_{DS}$ | – | 13.7 | – | pF | $V_{DS}$ = 50 V, $V_{gs}$ = -8 V, f = 1 MHz |
| Feedback Capacitance | $C_{GD}$ | – | 1.23 | – | 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] Measurements are to be performed using Cree production test fixture AD-838292P-TB
[4] Drain Efficiency = $P_{OUT}$/PDC



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

## CGHV40180P Typical Performance

**Figure 1. - Small Signal Gain and Return Loss versus Frequency measured in application circuit CGHV40180P**
**$V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A**

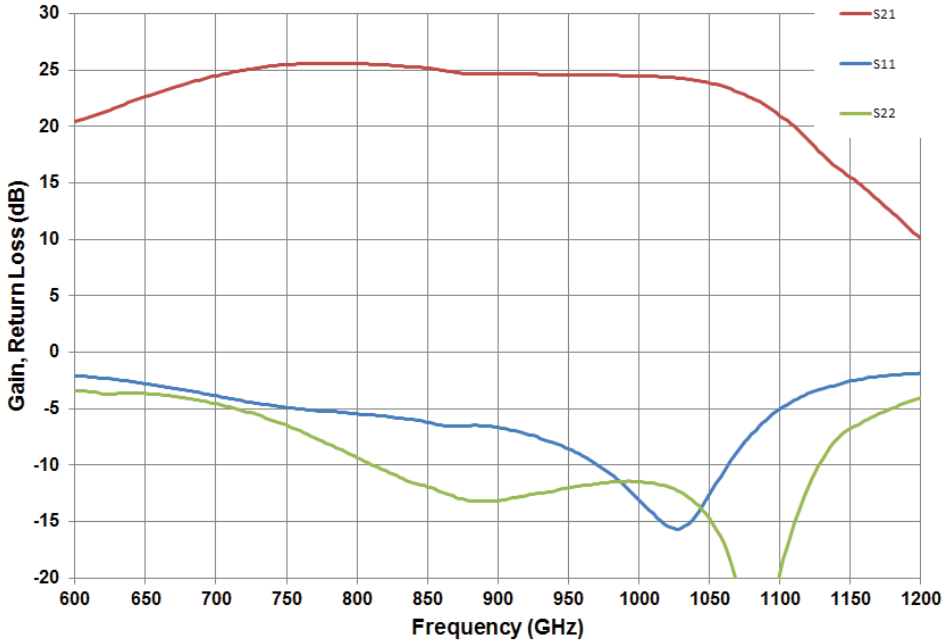
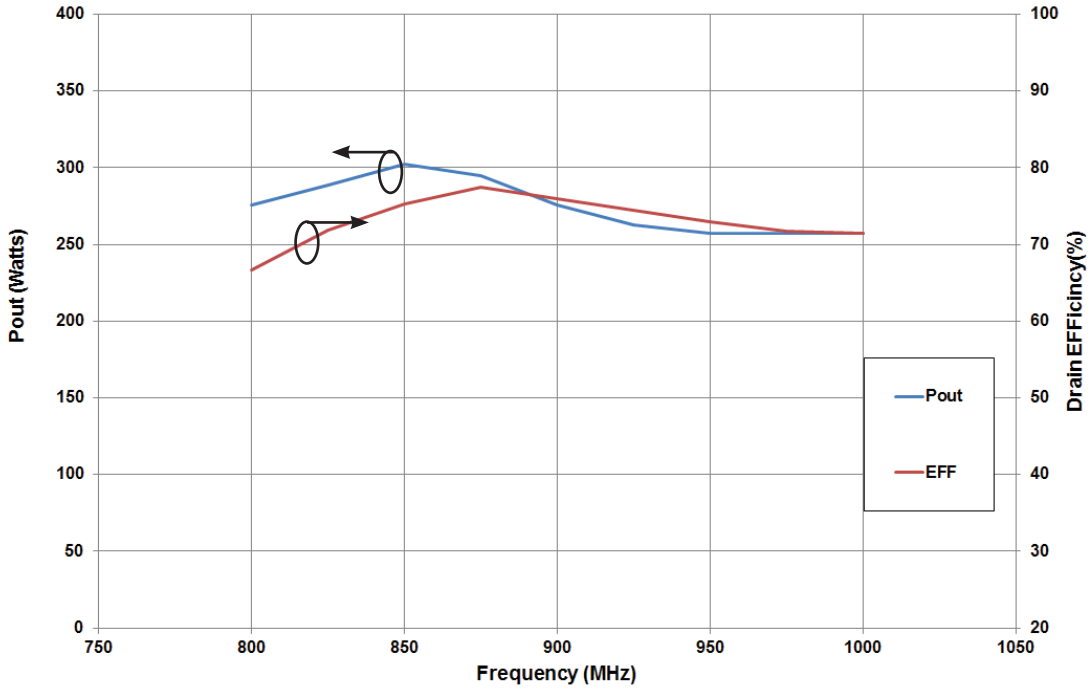



**Figure 2. - Output Power and Drain Efficiency vs Frequency CGHV40180P-TB**
**CW Operation, $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, @ $P_{IN}$ 34 dBm**






Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

**Figure 3. - Gain and Drain EFF vs. Frequency and Output Power**
**CGHV40180P-TB**
**CW Operation, $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0A**

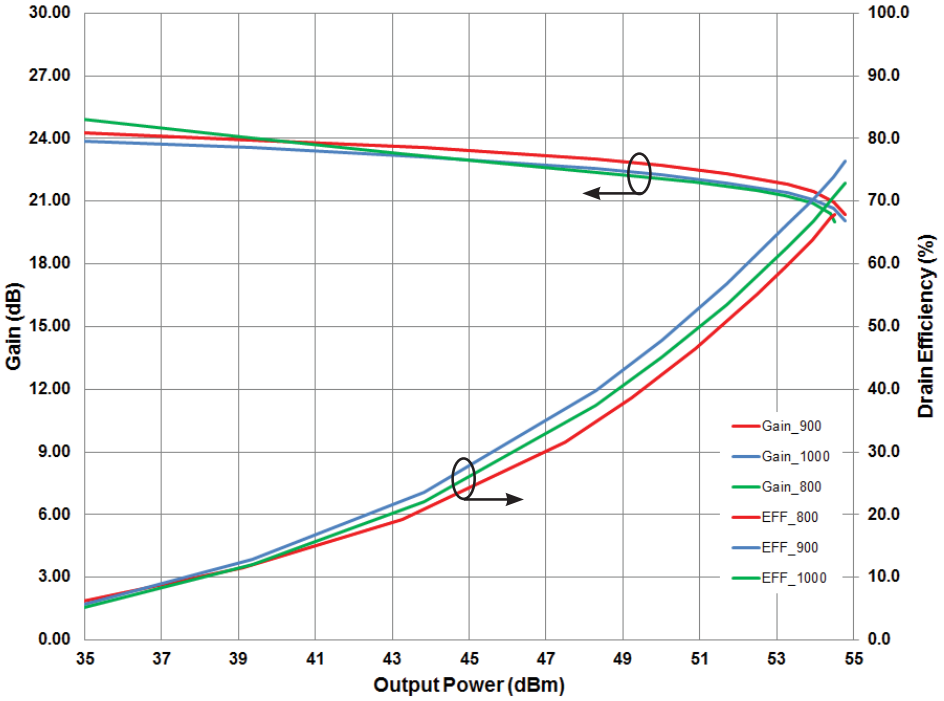
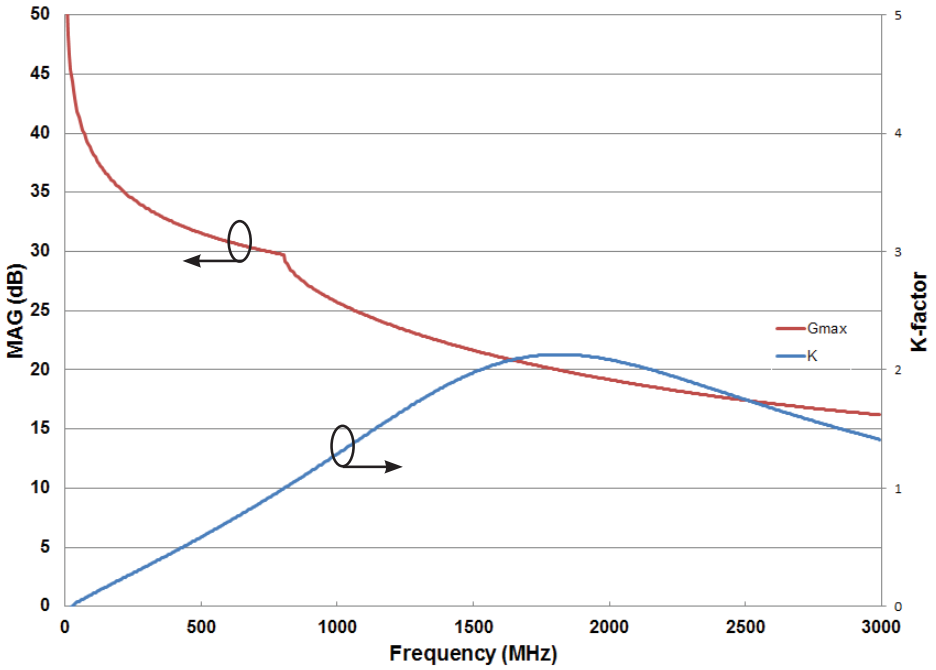


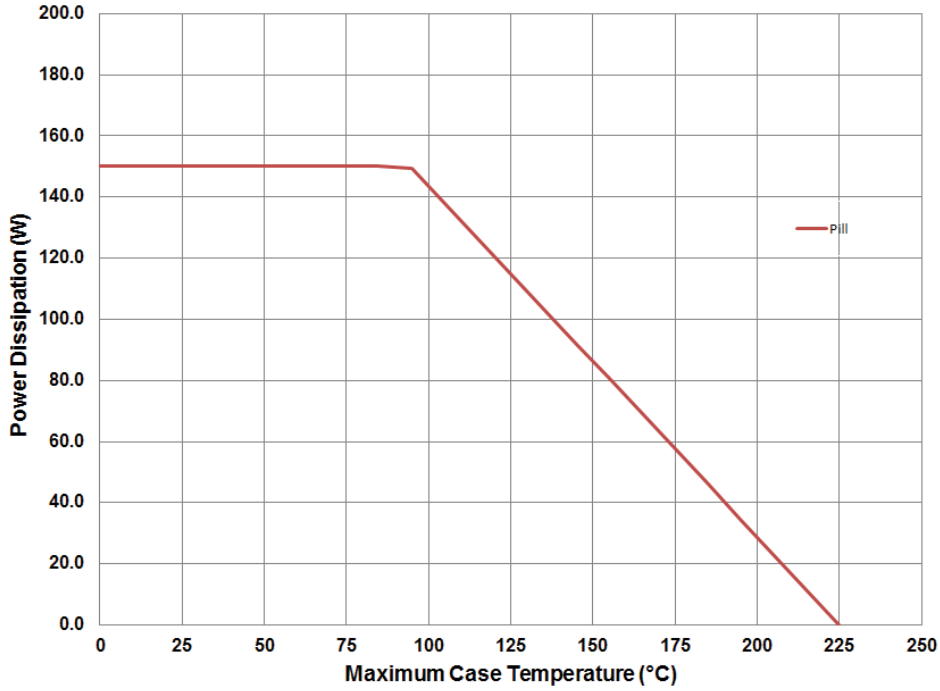

**Figure 4. - Simulated Maximum Available Gain and K-factor of the CGHV40180P**
**$V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A**






Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

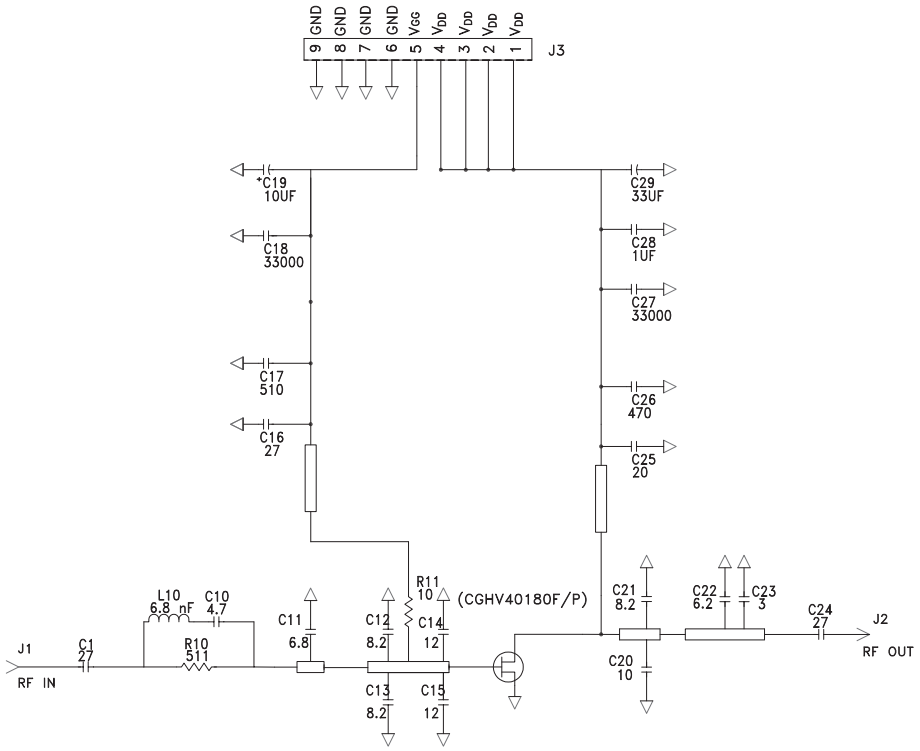
**Figure 5. - Transient Power Dissipation De-rating Curve**



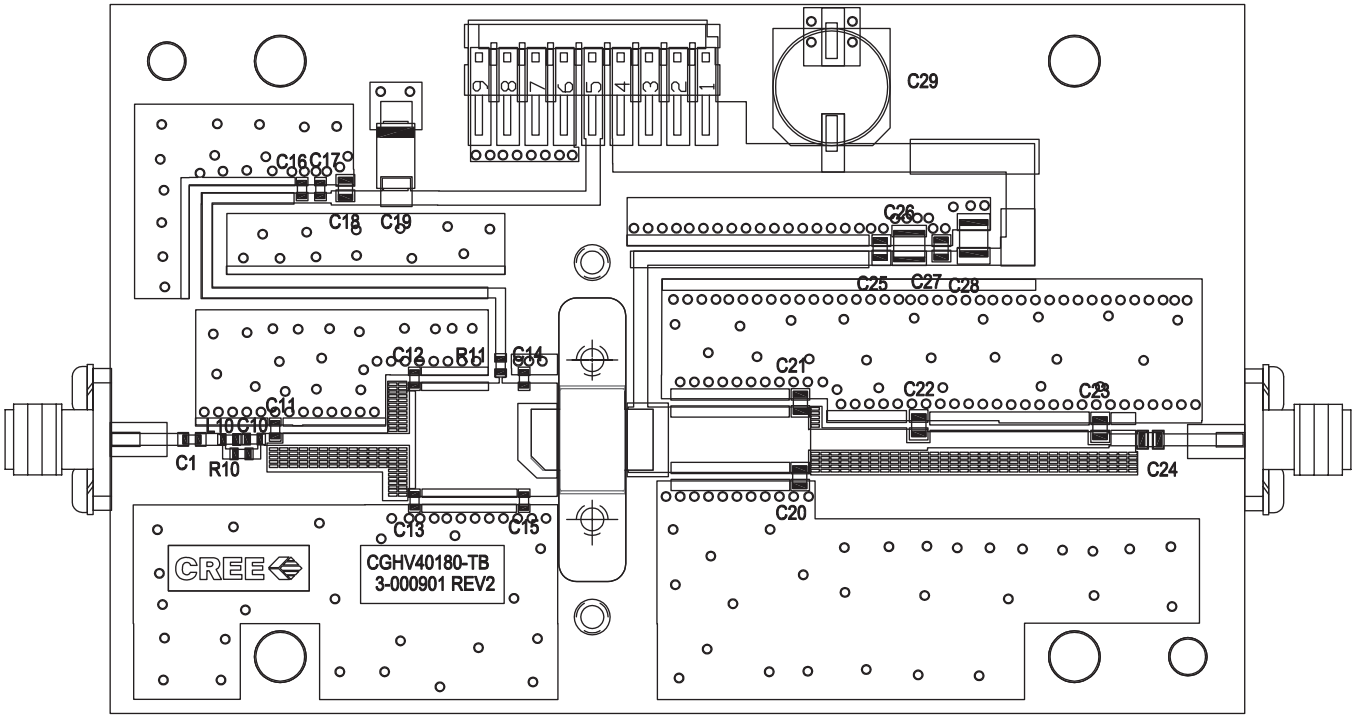



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

## CGHV40180P-AMP Application Circuit Schematic




## CGHV40180P-AMP Application Circuit



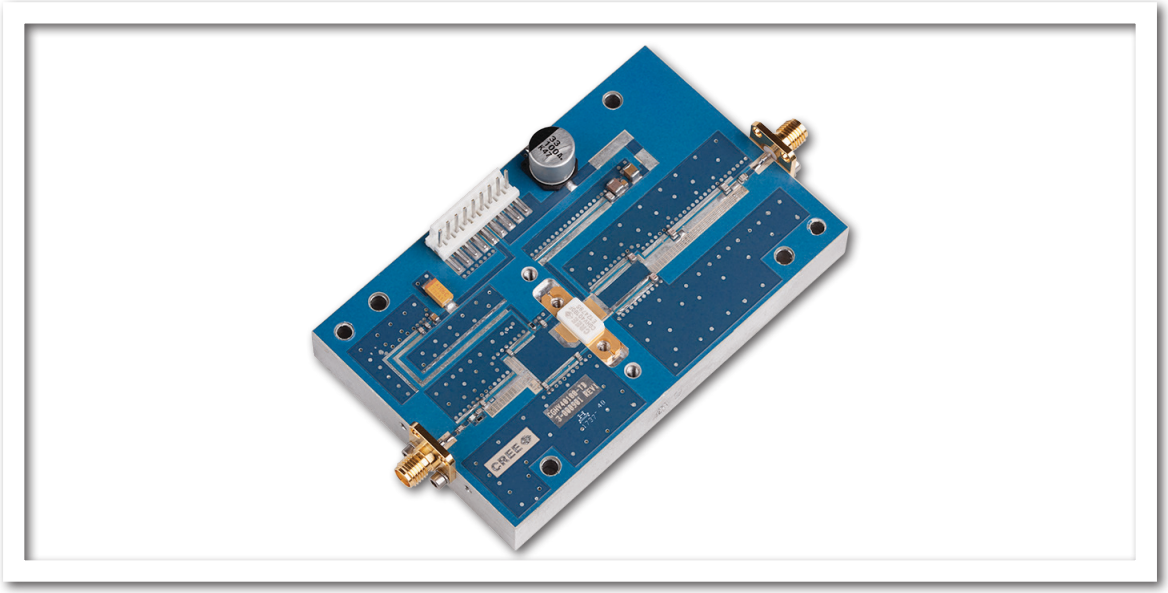



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

## CGHV40180P-AMP Application Circuit Bill of Materials

| Designator | Description | Qty |
|---|---|---|
| R11 | RES, 1/16W, 0603, 1%, 10.0 OHMS | 1 |
| R10 | RES, 1/16W, 0603, 1%, 511 OHMS | 1 |
| C29 | CAP, 33UF, 20%, G CASE | 1 |
| C28 | CAP 1.0UF, 100V, ±10%, X7R, 1210 | 1 |
| C17 | CAP, 510pF, NPO, 5%, 100V, 0603 | 1 |
| C26 | CAP, 470pF, NPO, 5%, 250V, ATC800B | 1 |
| C19 | CAP, 10UF, 16V TANTALUM, 2312 | 1 |
| C14, C15 | CAP, 12.0pF, ±5%, 0603, ATC600S | 2 |
| C1, C16 | CAP, 27pF, ±5%, 0603, ATC600S | 2 |
| C10 | CAP, 4.7pF, ±0.1pF, 0603, ATC600S | 1 |
| C11 | CAP, 6.8pF, ±0.25pF, 0603, ATC600S | 1 |
| C12, C13 | CAP, 8.2pF, ±0.25 pF, 0603, ATC600S | 2 |
| C18, C27 | CAP, 33000pF, 0805, 100V, X7R | 2 |
| C20 | CAP, 10pF, ±1%, 250V, 0805, ATC600F | 2 |
| C25 | CAP, 20pF, ±5%, 250V, 0805, ATC600F | 1 |
| C24 | CAP, 27pF, ±5%, 250V, 0805, ATC600F | 1 |
| C23 | CAP, 3.0pF, ±0.1pF, 250V, 0805, ATC600F | 2 |
| C22 | CAP, 6.2pF, ±0.1pF, 250V, 0805, ATC600F | 1 |
| C21 | CAP, 8.2pF, ±0.1pF, 250V, 0805 ATC600F | 1 |
| - | PCB ROGERS HTC6035, 0.020 THK, ER 3.60 | 1 |
| J1,J2 | CONN, SMA, PANEL MOUNT JACK, FLANGE, 4 HOLE BLUNT POST | 2 |
| J3 | HEADER RT>PLZ .1CEN LK 9POS | 1 |
| L10 | INDUCTOR, CHIP, 6.8nH, 5%, 0603 SMT, DIGIKEY 712-1432-1-ND | 1 |
| Q1 | CGHV40180 | 1 |

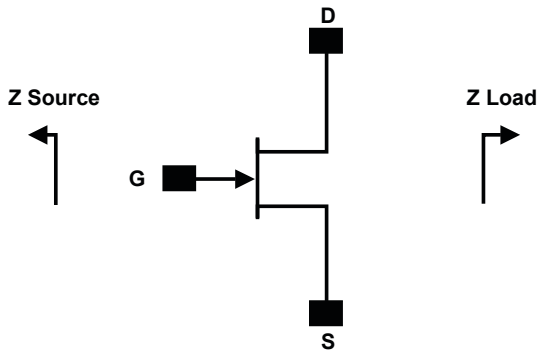
## CGHV40180-AMP Demonstration Amplifier Circuit





Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

## Source and Load Impedances




| Frequency (MHz) | Z Source | Z Load |
|---|---|---|
| 50 | 23.7 + J25.9 | 7.6 + J0.6 |
| 150 | 7.4 + J8.3 | 8.1 + J0.7 |
| 250 | 4.2 +J7.9 | 7.9 + J2.2 |
| 500 | 1.4 + J1.5 | 4.7 + J2.7 |
| 750 | 1.0 + J0.0 | 3.9 + J2.3 |
| 1000 | 0.7 + J1.1 | 4.0 + J1.8 |

Note 1. $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0A in the 440206 package.

Note 2. Optimized for Power Gain, $P_{SAT}$ and Drain Efficiency

Note 3. When using this device at low frequency, series resistor should be used to maintain amplifier stability

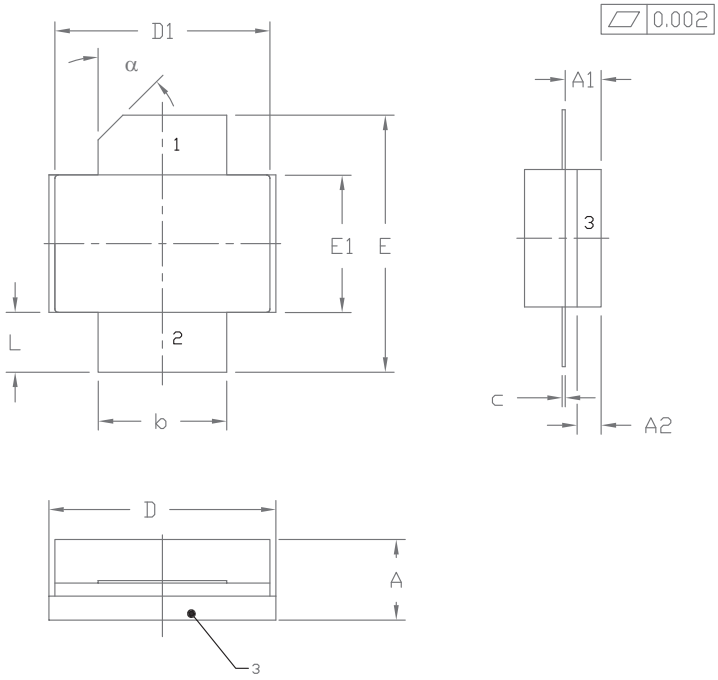
## Electrostatic Discharge (ESD) Classifications

| 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 |



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

## Product Dimensions CGHV40180P (Package Type — 440206)




NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M – 1994.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

| | INCHES | | MILLIMETERS | | NOTES |
|---|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX | |
| A | 0.125 | 0.145 | 3.18 | 3.68 | |
| A1 | 0.057 | 0.067 | 1.45 | 1.70 | |
| A2 | 0.035 | 0.045 | 0.89 | 1.14 | |
| b | 0.210 | 0.220 | 5.33 | 5.59 | 2x |
| c | 0.004 | 0.006 | 0.10 | 0.15 | 2x |
| D | 0.375 | 0.385 | 9.53 | 9.78 | |
| D1 | 0.355 | 0.365 | 9.02 | 9.27 | |
| E | 0.400 | 0.460 | 10.16 | 11.68 | |
| E1 | 0.225 | 0.235 | 5.72 | 5.97 | |
| L | 0.085 | 0.115 | 2.16 | 2.92 | 2x |
| α | 45° REF | | 45° REF | | |

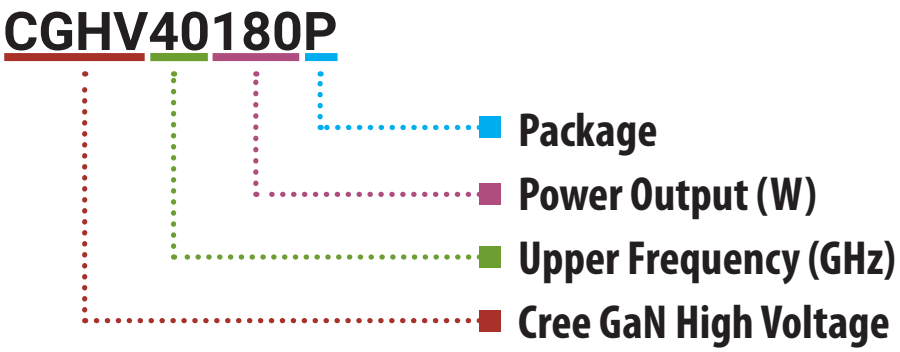
PIN 1. GATE
2. DRAIN
3. SOURCE





Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

## Part Number System




| Parameter | Value | Units |
|---|---|---|
| Upper Frequency[1] | 4.0 | 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.

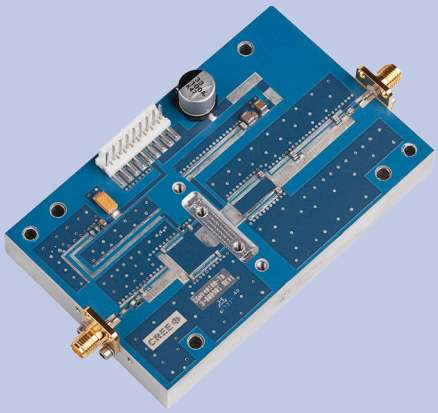
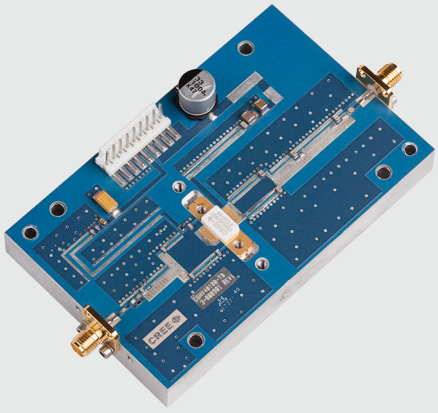
| Character Code | Code Value |
|---|---|
| A | 0 |
| B | 1 |
| C | 2 |
| D | 3 |
| E | 4 |
| F | 5 |
| G | 6 |
| H | 7 |
| J | 8 |
| K | 9 |
| Examples: | 1A = 10.0 GHz<br>2H = 27.0 GHz |

**Table 2.**



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

## Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|---|---|---|---|
| CGHV40180P | GaN HEMT | Each |  |
| CGHV40180P-TB | Test board without GaN HEMT | Each |  |
| CGHV40180P-AMP | Test board with GaN HEMT(pill) installed | Each |  |



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf

## Disclaimer

Specifications are subject to change without notice. Cree, Inc. believes the information contained within this data sheet to be accurate and reliable. However, no responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Cree. Cree makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose. “Typical” parameters are the average values expected by Cree in large quantities and are provided for information purposes only. These values can and do vary in different applications and actual performance can vary over time. All operating parameters should be validated by customer’s technical experts for each application. Cree products are not designed, intended or authorized for use as components in applications intended for surgical implant into the body or to support or sustain life, in applications in which the failure of the Cree product could result in personal injury or death or in applications for planning, construction, maintenance or direct operation of a nuclear facility.

For more information, please contact:

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
www.cree.com/RF

Sarah Miller
Marketing
Cree, RF Components
1.919.407.5302

Ryan Baker
Marketing & Sales
Cree, RF Components
1.919.407.7816

Tom Dekker
Sales Director
Cree, RF Components
1.919.407.5639





Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.CREE
Fax: +1.919.869.2733
www.cree.com/rf