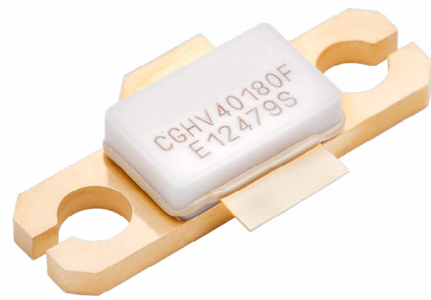
# CGHV40180F

## 180 W, DC - 2.0 GHz, 50 V, GaN HEMT

### Description

The CGHV40180F is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGHV40180F, 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 CGHV40180F ideal for linear and compressed amplifier circuits. The transistor is available in a 2-lead flange package.




Package Type: 440223
PN: CGHV40180F

### 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 | 24.9 | 24.4 | 24.3 | dB |
| Gain @ $P_{IN}$ 34 dBm | 20.4 | 20.8 | 20.3 | 20.1 | 20.1 | |
| Output Power @ $P_{IN}$ 34 dBm | 275 | 302 | 279 | 257 | 257 | W |
| EFF @ $P_{IN}$ 34 dBm | 67 | 75 | 73 | 73 | 71 | % |

Note:
Measured CW in the CGHV40180F-AMP Application circuit

### Features

- Up to 2.0 GHz 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**

RoHS compliant



Rev. 2.0, 2022-8-30

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

| Parameter | Symbol | Rating | Units | Conditions |
|---|---|---|---|---|
| Drain-source Voltage | $V_{DSS}$ | 150 | V | 25˚C |
| Gate-to-Source Voltage | $V_{GS}$ | -10, +2 | V | 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[1] | $I_{DMAX}$ | 12.1 | A | 25°C |
| Soldering Temperature[2] | $T_S$ | 245 | °C | |
| Screw Torque | τ | 40 | in-oz | |
| CGHV40180F Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.95 | °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 | |

Notes:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering
[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, $I_D$ = 41.8 mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | – | -2.7 | – | $V_{DC}$ | $V_{DS}$ = 50 V, $I_D$ = 1000 mA |
| Saturated Drain Current | $I_{DS}$ | 27.2 | 38.9 | – | A | $V_{DS}$ = 6.0 V, $V_{GS}$ = 2.0 V |
| Drain-Source Breakdown Voltage | $V_{BR}$ | 125 | – | – | $V_{DC}$ | $V_{GS}$ = -8 V, $I_D$ = 41.8 mA |
| **RF Characteristics[2] ($T_C$ = 25°C, $F_0$ = 900 MHz unless otherwise noted)** | | | | | | |
| Small Signal Gain | $G_{SS}$ | 23.4 | 24.0 | – | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{IN}$ = 10 dBm CW |
| Power Gain | $G_P$ | 19.3 | 20.3 | – | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{IN}$ = 34 dBm CW |
| Output Power | $P_{OUT}$ | 53.7 | 54.3 | – | dBm | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{IN}$ = 34 dBm CW |
| Drain Efficiency[3] | η | 64 | 74 | – | % | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{IN}$ = 34 dBm CW |
| Output Mismatch Stress | VSWR | – | – | 3:1 | Ψ | 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] Measurements are to be performed using the production test fixture AD-838292F-TB
[3] Drain Efficiency = $P_{OUT}/P_{DC}$



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## CGHV40180F Typical Performance

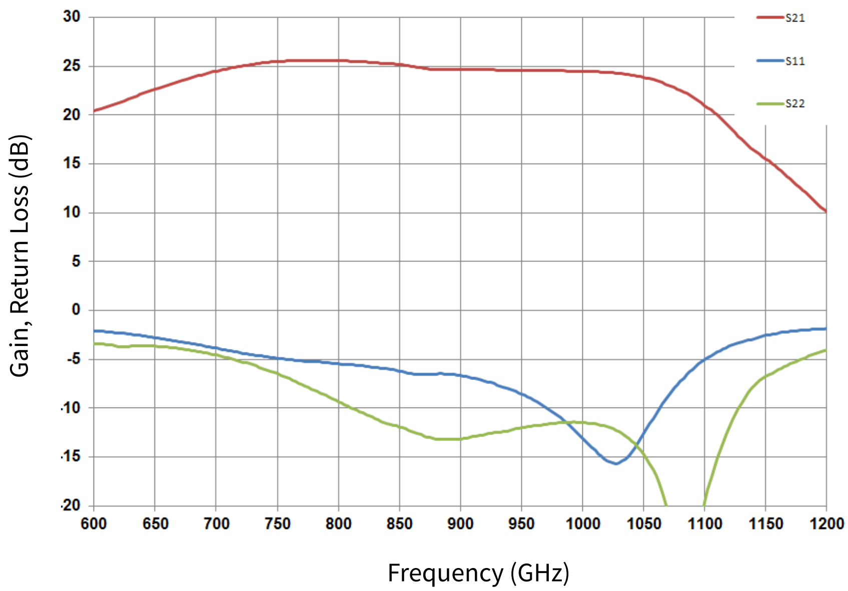



**Figure 1.** Small Signal Gain and Return Loss versus Frequency measured in application circuit CGHV40180F
$V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A

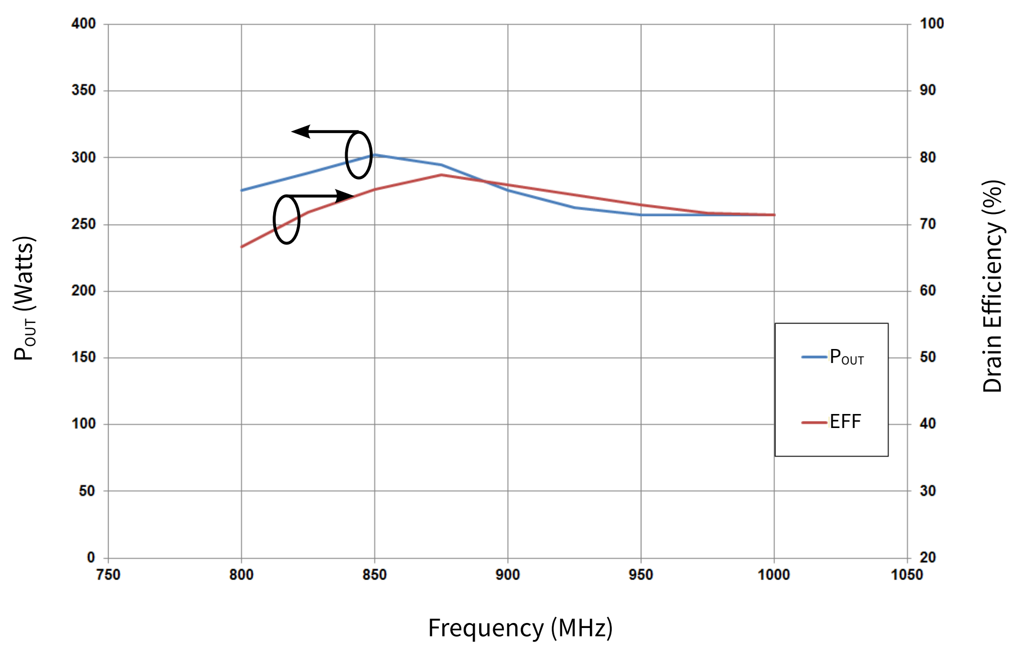



**Figure 2.** Output Power and Drain Efficiency vs Frequency CGHV40180F-TB
CW Operation, $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, @ $P_{IN}$ 34 dBm

## CGHV40180F Typical Performance

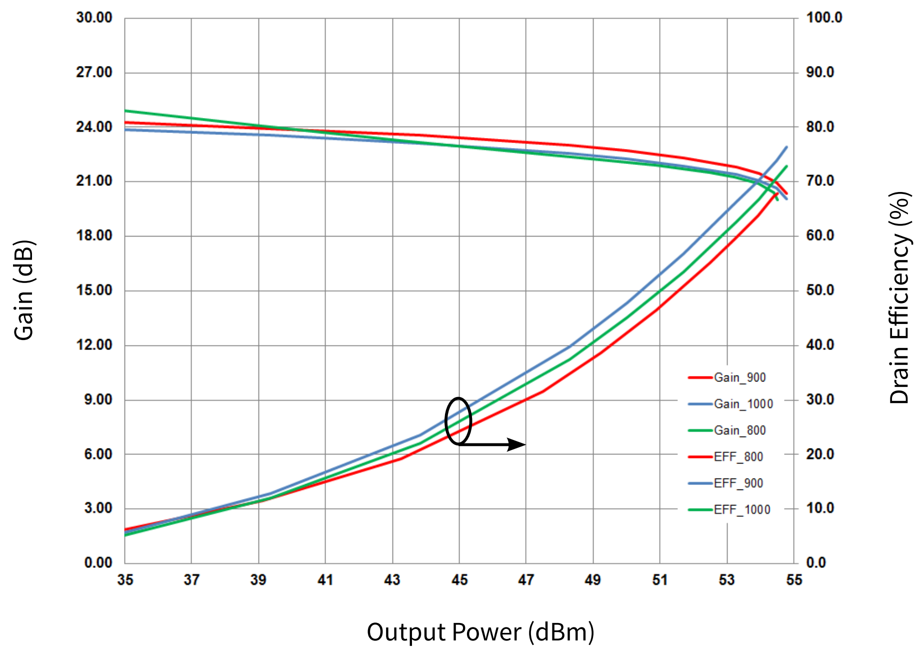



**Figure 3.** Gain and Drain Efficiency vs. Frequency and Output Power
CGHV40180F-TB CW Operation, $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0A

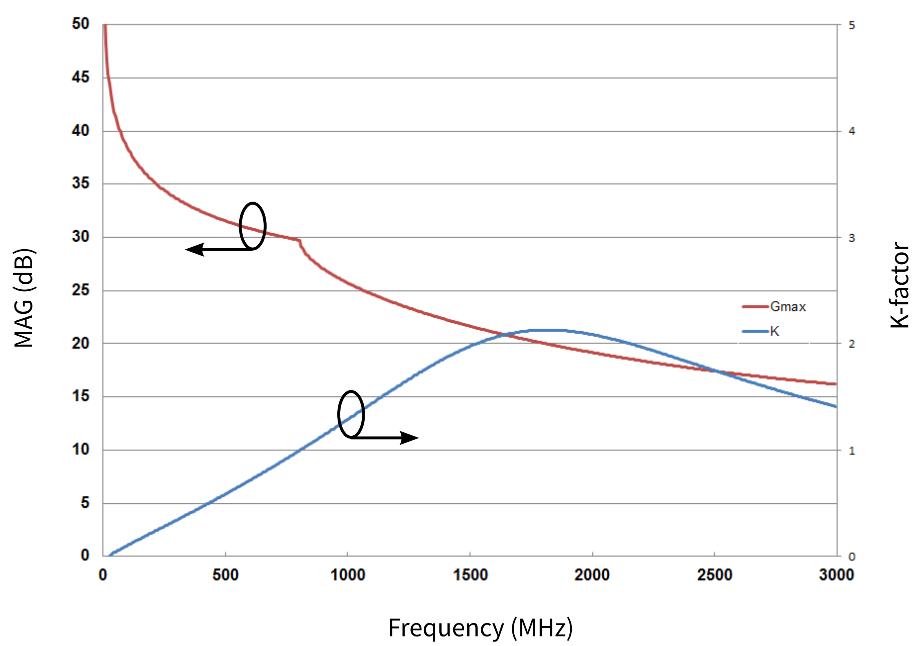



**Figure 4.** Simulated Maximum Available Gain and K-factor of the
CGHV40180F $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A

## CGHV40180F Power Dissipation De-rating Curve

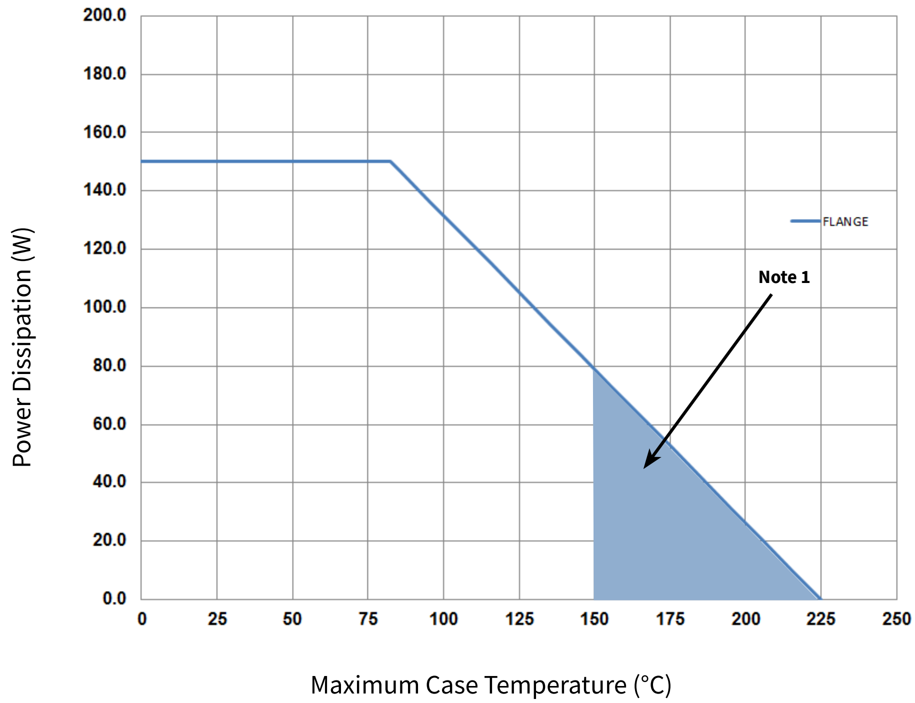
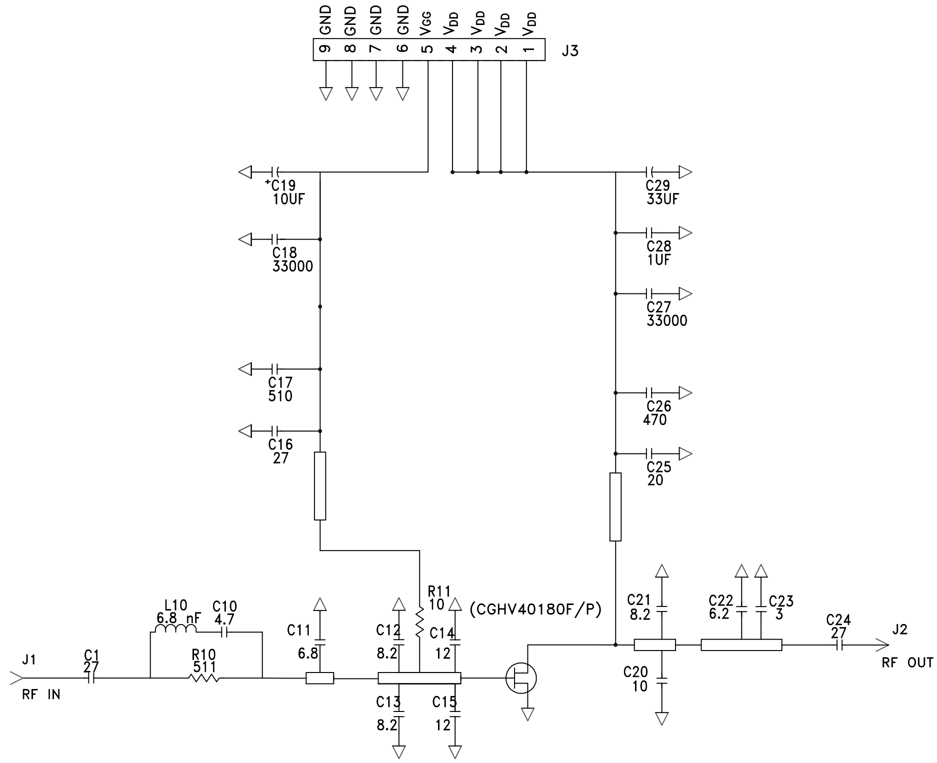


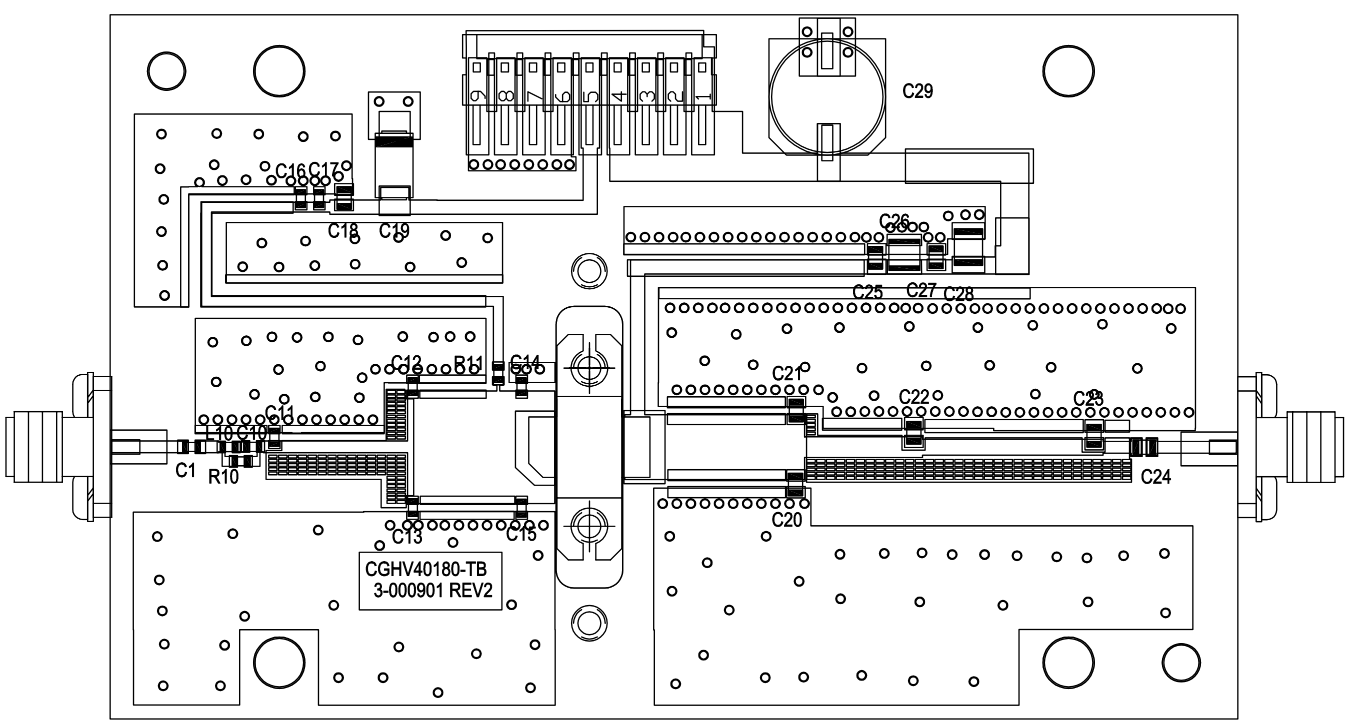

**Figure 5.** Transient Power Dissipation De-rating Curve

Note:
[1] Area exceeds Maximum Case Operating Temperature (See Page 2)

## CGHV40180F-AMP Application Circuit Schematic



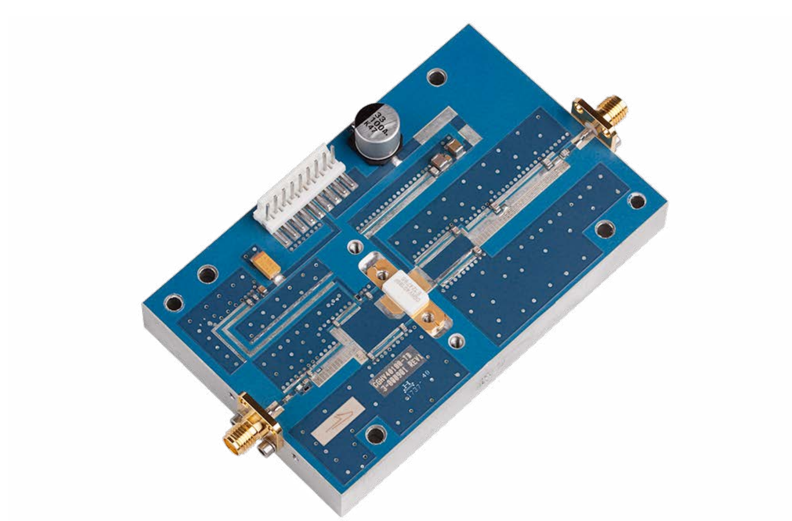

## CGHV40180F-AMP Application Circuit



## CGHV40180F-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, 33µF, 20%, G CASE | 1 |
| C28 | CAP, 1.0µF, 100V, ±10%, X7R, 1210 | 1 |
| C17 | CAP, 510pF, NPO, 5%, 100V, 0603 | 1 |
| C26 | CAP, 470pF, NPO, 5%, 250V, ATC800B | 1 |
| C19 | CAP, 10µF, 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, ±0.25pF, 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 |

## CGHV40180F-AMP Demonstration Amplifier Circuit



## Electrical Characteristics When Tested in CGHV40180F-AMP3

| Characteristics | Symbol | Typ. | Units | Conditions |
|---|---|---|---|---|
| **RF Characteristics1 ($T_C$ = 25°C, $F_0$ = 0.96 - 1.215 GHz unless otherwise noted)** | | | | |
| Small Signal Gain | $G_{SS}$ | > 20 | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A |
| Power Gain | $G_P$ | > 16 | dBm | $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{IN}$ = 38 dBm, 128 µs, 10% pulse |
| Output Power | $P_{OUT}$ | 250 | W | |
| Drain Efficiency | η | > 75 | % | |
| Output Mismatch Stress | VSWR | 3:1 | Ψ | No damage at all phase angles, $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{IN}$ = 38 dBm, 128 µs, 10% pulse |

Notes:
[1] Measured in CGHV40180F-AMP3 Application Circuit

## Typical Performance in Application Circuit CGHV40180F-AMP3

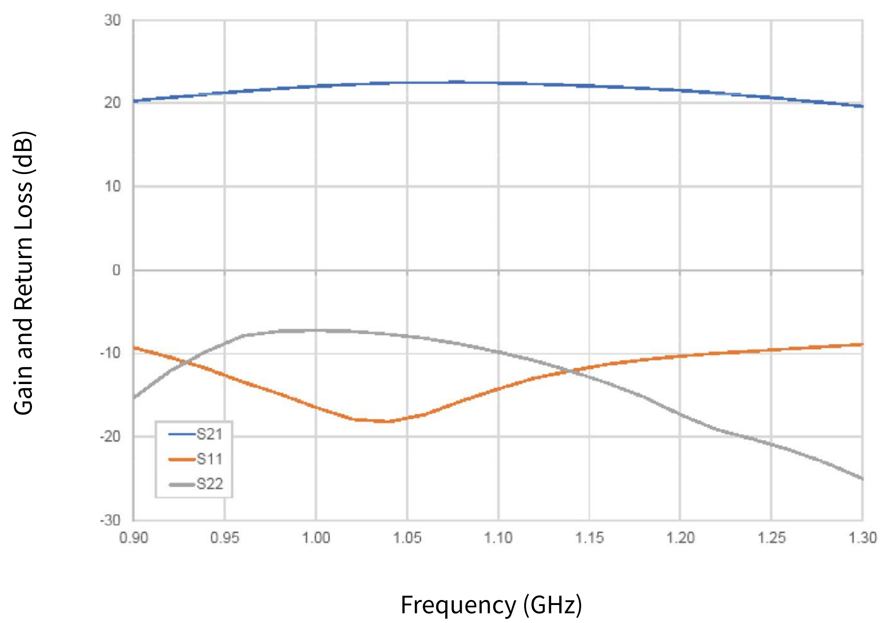



**Figure 6.** Small Signal Gain and Return Losses of the CGHV40180F
Measured in Demonstration Amplifier Circuit CGHV40180F-AMP3
CW Operation, $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A

## Typical Performance in Application Circuit CGHV40180F-AMP3

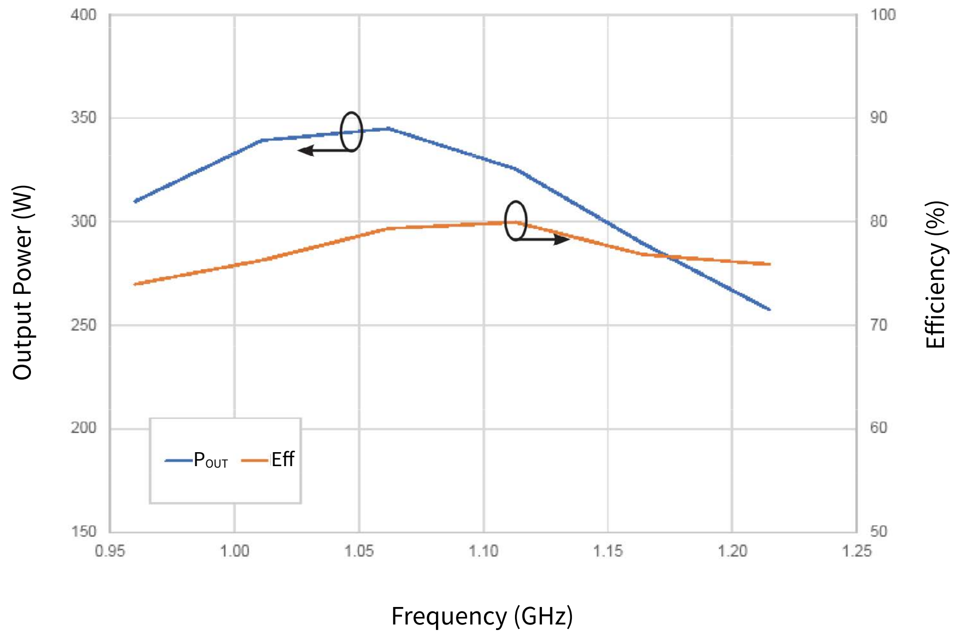



**Figure 7.** Pulsed Output Power and Drain Efficiency vs. Frequency of the CGHV40180F-AMP3 $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{IN}$ = 38 dBm, 128 µs, 10% pulse

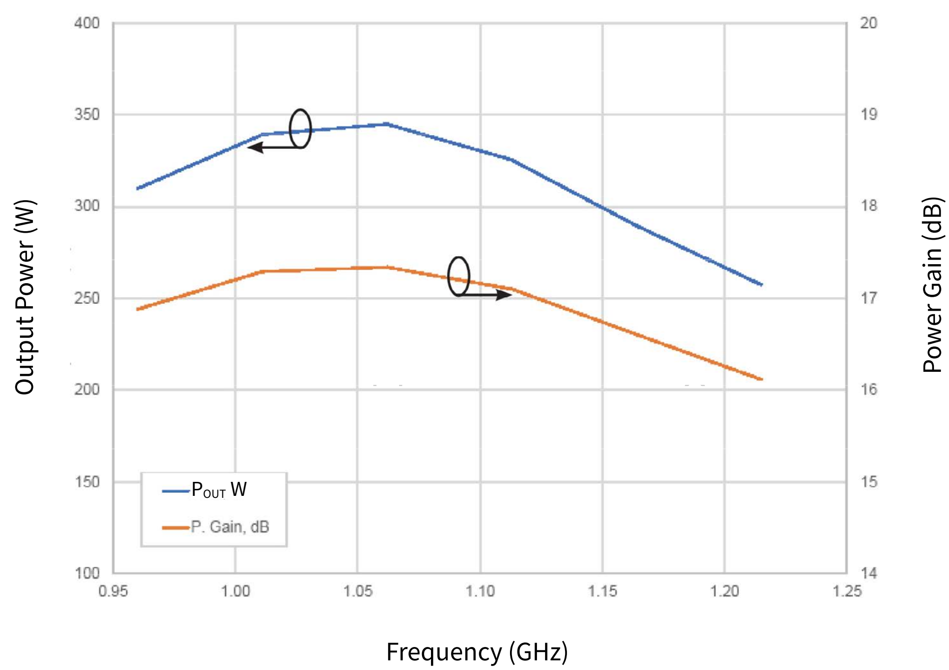
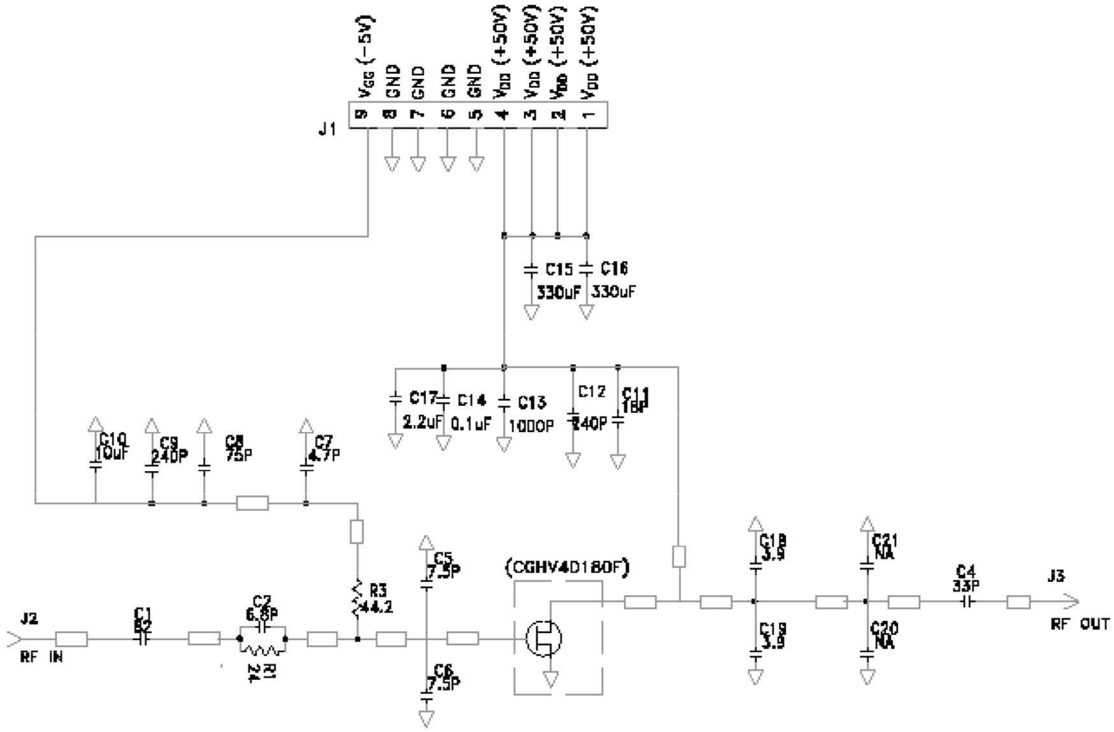
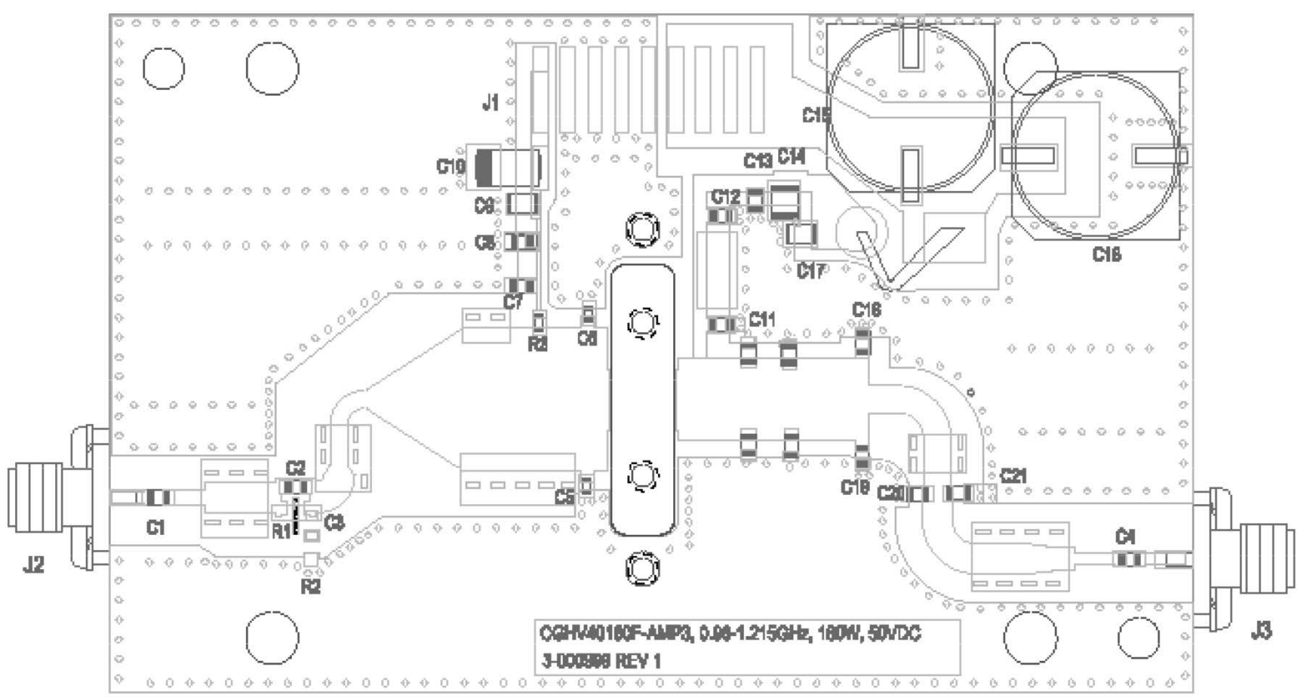



**Figure 8.** Output Power and Power Gain vs. Frequency of the CGHV40180F-AMP3 $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0 A, $P_{IN}$ = 38 dBm, 128 µs, 10% pulse

## CGHV40180F-AMP3 Application Circuit Schematic



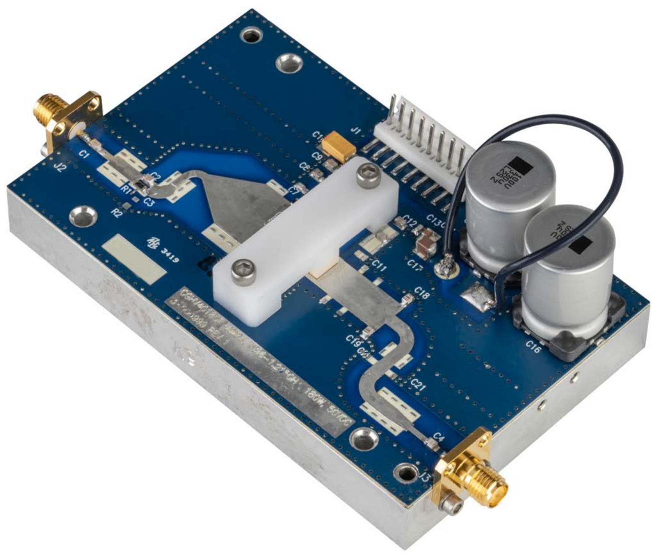

## CGHV40180F-AMP3 Application Circuit



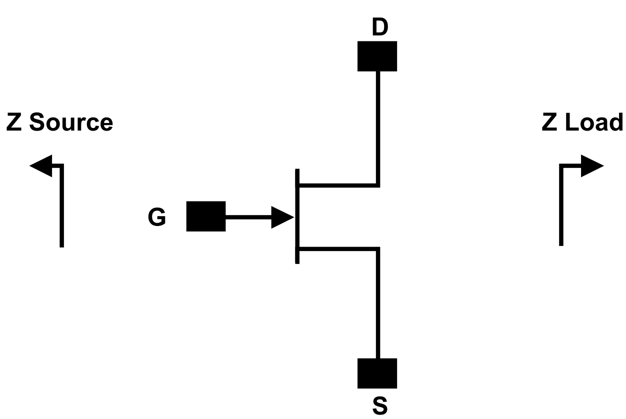
## CGHV40180F-AMP3 Bill of Materials

| Designator | Description | Qty |
|---|---|---|
| C2 | CAP, 8.2pF, +/-0.1pF, 250V, 0805, ATC600F | 1 |
| C1 | CAP, 82pF, 1%, 250V, 0805, ATC600F | 1 |
| C5, C6 | CAP,7.5pF, 1%, 0603, ATC600S | 2 |
| C9, C12 | CAP, 240pF, 5%, 250V, 0805, ATC600F | 1 |
| C7 | CAP, 4.7pF, +/-0.1pF, 250V, 0603, ATC600S | 1 |
| C8 | CAP, 75pF, 5%, 250V, 0805, ATC600F | 1 |
| C11 | CAP, 18pF, 1%, 250V, 0805, ATC600F | 1 |
| C13 | CAP, 1000pF, 5%, 250V, 0603 | 1 |
| C14 | CAP, 0.1µF, 5%, 250V, 0805 | 1 |
| C17 | CAP, 2.2µF, 5%, 100V, 1210 | 1 |
| C15, 16 | CAP, 330µF, 20%, 100V, ELEC, Vishay, MAL215099911E3 | 2 |
| C18, C19 | CAP, 3.9pF, +/-0.1pF, 250V, 0805, ATC600F | 2 |
| C4 | CAP, 33pF, 5%, 250V, 0805, ATC600F | 1 |
| C10 | CAP, 10µF, 16V, TANTLUM | 2 |
| R1 | RES, 24 OHM IMS, 1005 | 1 |
| R3 | RES, 1/16W, 0603, 1%, 44.2 OHMS | 1 |
| W1 | WIRE, 18G, BALCK, 2.5" | 1 |
| J2, J3 | CONN, SMA, PANEL MOUNT JACK, FL | 2 |
| J1 | HEADER ST, .1CEN LK 9POS, PBC05SABN | 1 |
| – | BASEPLATE | 1 |
| – | PCB, RO4350B, 2.5"x4"x0.020" | 1 |
| – | #2, WASHER, SPLIT LK, SS | 4 |
| – | 2-56 SOC HD SCREW 3/16 SS | 4 |
| Q1 | CGHV40180F | 1 |

## CGHV40180F-AMP3 Demonstration Amplifier Circuit



## Source and Load Impedances



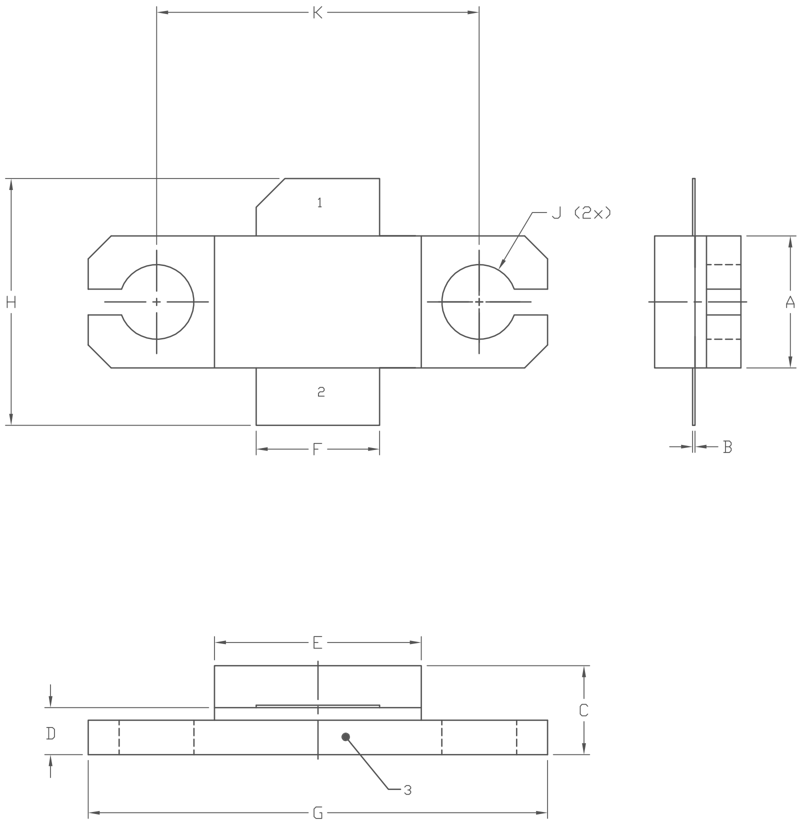

| Frequency | Z Source | Z Load |
|---|---|---|
| 50 | 23.7 + J25.9 | 7.6 + J0.6 |
| 150 | 7.4 + J8.3 | 8.1 + J0.7 |
| 250 | 4.2 +J7.9 | 7.9 + J2.2 |
| 500 | 1.4 + J1.5 | 4.7 + J2.7 |
| 750 | 1.0 + J0.0 | 3.9 + J2.3 |
| 1000 | 0.7 + J1.1 | 4.0 + J1.8 |

Notes:
[1] $V_{DD}$ = 50 V, $I_{DQ}$ = 1.0A in the 440223 package
[2] Optimized for Power Gain, $P_{SAT}$ and Drain Efficiency
[3] When using this device at low frequency, series resistor should be used to maintain amplifier stability

## Electrostatic Discharge (ESD) Classifications

| Parameter | Symbol | Class | Classification Level | Test Methodology |
|---|---|---|---|---|
| Human Body Model | HBM | 1C | ANSI/ESDA/JEDEC JS-001 Table 3 | JEDEC JESD22 A114-D |
| Charge Device Model | CDM | C3 | ANSI/ESDA/JEDEC JS-002 Table 3 | JEDEC JESD22 C101-C |

## Product Dimensions CGHV40180F (Package Type — 440223)




NOTES:

1. DIMENSIONING AND TOLERANICING PER ANSI Y14.5M, 1982.
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 THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

| DIM | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.225 | 0.235 | 5.72 | 5.97 |
| B | 0.004 | 0.006 | 0.10 | 0.15 |
| C | 0.145 | 0.165 | 3.68 | 4.19 |
| D | 0.077 | 0.087 | 1.96 | 2.21 |
| E | 0.355 | 0.365 | 9.02 | 9.27 |
| F | 0.210 | 0.220 | 5.33 | 5.59 |
| G | 0.795 | 0.805 | 20.19 | 20.45 |
| H | 0.400 | 0.460 | 10.16 | 11.68 |
| J | ø .130 | | 3.30 | |
| k | 0.562 | | 14.27 | |

PIN 1. GATE
PIN 2. DRAIN
PIN 3. SOURCE



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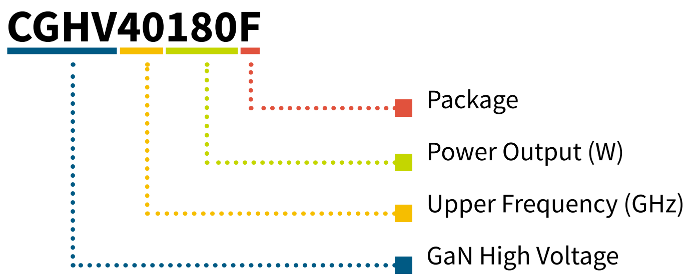
## Part Number System




### Table 1.

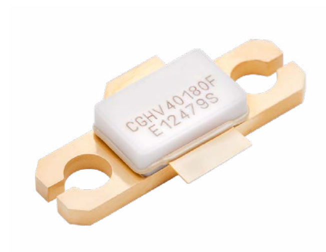
| Parameter | Value | Units |
|---|---|---|
| Upper Frequency[1] | 4.0 | GHz |
| Power Output | 100 | W |
| Package | Flange | – |

Note:
[1] 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 |
|---|---|---|---|
| CGHV40180F | GaN HEMT | Each |  |
| CGHV40180F-AMP3 | Test board with GaN HEMT (flanged) installed | Each |  |

## Notes & Disclaimer