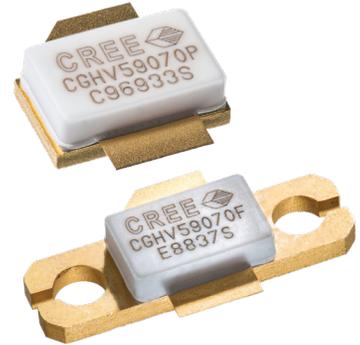


CGHV59070

70 W, 4.4 - 5.9 GHz, 50 V, RF Power GaN HEMT

Description

Cree's CGHV59070 is an internally matched gallium nitride (GaN) high electron mobility transistor (HEMT). The CGHV59070, 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 CGHV59070 ideal for linear and compressed amplifier circuits. The transistor is available in a flange and pill package.



Package Type: 440224, 440170
PN's: CGHV59070F, CGHV59070P

Typical Performance Over 4.8 - 5.9 GHz ($T_c = 25^\circ\text{C}$)

| Parameter | 4.8 GHz | 5.0 GHz | 5.2 GHz | 5.4 GHz | 5.6 GHz | 5.8 GHz | 5.9 GHz | Units |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|-------|
| Power Gain at 50 V | 13.7 | 14.2 | 14.5 | 14.6 | 14.3 | 13.7 | 13.3 | dB |
| Output Power at 50 V | 84 | 93 | 101 | 102 | 95 | 84 | 76 | W |
| Drain Efficiency at 50 V | 55 | 56 | 57 | 56 | 54 | 50 | 48 | % |

Note: Measured in CGHV59070F-AMP (838269) under 100 μs pulse width, 10% duty cycle, Pin = 35.5 dBm (3.5 W)

Features

- 4.4 - 5.9 GHz Operation
- 90 W POUT typical at 50 V
- 14 dB Power Gain
- 55% Drain Efficiency
- Internally Matched

Applications

- Marine Radar
- Weather Monitoring
- Air Traffic Control
- Maritime Vessel Traffic Control
- Port Security
- Troposcatter Communications
- Beyond Line of Sight - BLOS
- Satellite Communications

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

| Parameter | Symbol | Rating | Units | Conditions |
|---|-----------------|-----------|-------|--|
| Drain-Source Voltage | V_{DSS} | 150 | Volts | 25 °C |
| Gate-to-Source Voltage | V_{GS} | -10, +2 | Volts | 25 °C |
| Storage Temperature | T_{STG} | -65, +150 | °C | |
| Operating Junction Temperature | T_J | 225 | °C | |
| Maximum Forward Gate Current | I_{GMAX} | 10.4 | mA | 25 °C |
| Maximum Drain Current ¹ | I_{DMAX} | 6.3 | A | 25 °C |
| Soldering Temperature ² | T_S | 245 | °C | |
| Screw Torque | τ | 40 | in-oz | |
| Thermal Resistance, Junction to Case ³ | $R_{\theta JC}$ | 2.99 | °C/W | 85 °C, CW @ $P_{DISS} = 57$ W |
| Thermal Resistance, Junction to Case ³ | $R_{\theta JC}$ | 0.85 | °C/W | 85 °C, 100 μ sec, 10% Duty Cycle @ $P_{DISS} = 70$ W |
| Case Operating Temperature ⁴ | T_C | -40, +150 | °C | |

Notes:

¹ Current limit for long term, reliable operation

² Refer to the Application Note on soldering at wolfspeed.com/rf/document-library

³ Simulated for the CGHV59070F at $P_{DISS} = 57.6$ CW or $P_{DISS} = 70$ W Pulsed

⁴ See also, the Power Dissipation De-rating Curve on Page 8

Electrical Characteristics ($T_C = 25^\circ\text{C}$)

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|--------------|-------|------|-------|----------|--|
| DC Characteristics¹ | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -3.8 | -2.8 | -2.3 | V_{DC} | $V_{DS} = 10$ V, $I_D = 10.4$ mA |
| Saturated Drain Current ² | I_{DS} | 6.8 | 9.7 | - | A | $V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V |
| Drain-Source Breakdown Voltage | V_{BR} | 125 | - | - | V_{DC} | $V_{GS} = -8$ V, $I_D = 10.4$ mA |
| RF Characteristics³ ($T_C = 25^\circ\text{C}$, $F_0 = 5.2\text{-}5.9$ GHz unless otherwise noted) | | | | | | |
| Small Signal Gain | G_{SS} | 15.55 | 17 | - | dB | $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 10$ dBm, Freq = 5.2 GHz |
| Output Power | P_{OUT1} | 75.9 | 100 | - | W | $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 35.5$ dBm, Freq = 5.2 GHz |
| Output Power | P_{OUT2} | 75.9 | 100 | - | W | $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 35.5$ dBm, Freq = 5.55 GHz |
| Output Power | P_{OUT3} | 62.4 | 77 | - | W | $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 35.5$ dBm, Freq = 5.9 GHz |
| Drain Efficiency | EFF_1 | 50 | 55 | - | % | $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 35.5$ dBm, Freq = 5.2 GHz |
| Drain Efficiency | EFF_2 | 46 | 54 | - | % | $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 35.5$ dBm, Freq = 5.55 GHz |
| Drain Efficiency | EFF_3 | 40 | 48 | - | % | $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 35.5$ dBm, Freq = 5.9 GHz |
| Power Gain | PG | - | 14.5 | - | dB | $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 35.5$ dBm, Freq = 5.2 GHz |
| Output Mismatch Stress | VSWR | - | - | 5 : 1 | Ψ | No damage at all phase angles, $V_{DD} = 50$ V, $I_{DQ} = 0.15$ A, $P_{IN} = 35.5$ dBm Pulsed |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{GS} | - | 36 | - | pF | $V_{DS} = 50$ V, $V_{GS} = -8$ V, $f = 1$ MHz |
| Output Capacitance | C_{DS} | - | 109 | - | pF | $V_{DS} = 50$ V, $V_{GS} = -8$ V, $f = 1$ MHz |
| Feedback Capacitance | C_{GD} | - | 0.26 | - | 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 Measured in CGHV59070F-AMP

⁴ Drain Efficiency = P_{OUT} / P_{DC}



Typical Performance

Figure 1. Small Signal Gain and Return Losses of the CGHV59070-AMP vs Frequency
 $V_{DD} = 50\text{ V}, I_{DQ} = 150\text{ mA}$

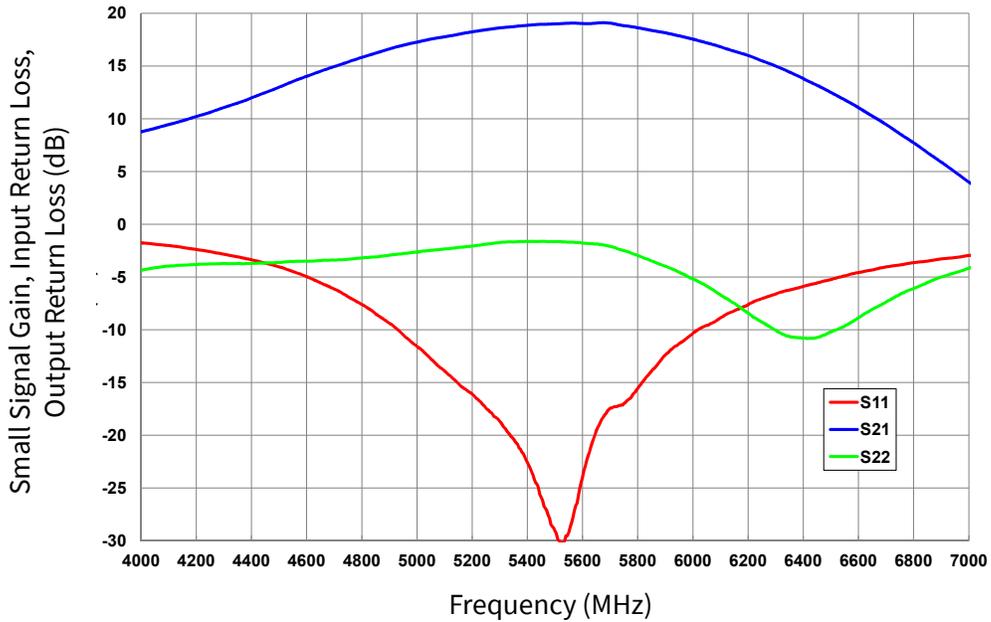
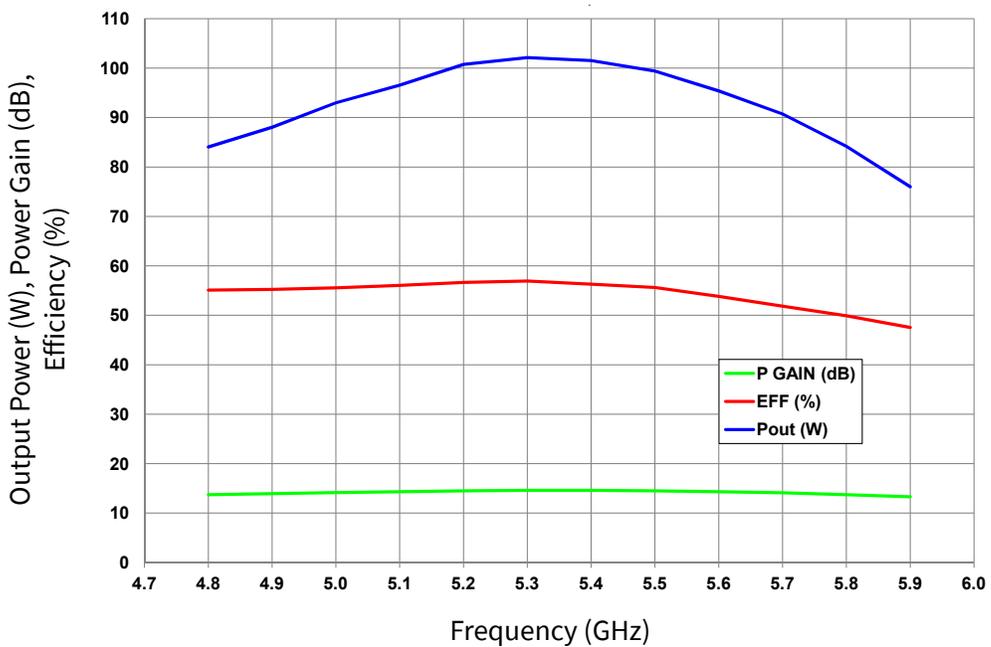


Figure 2. Power Gain, Drain Efficiency, and Output Power vs Frequency measured in Amplifier Circuit CGHV59070P-AMP

$V_{DD} = 50\text{ V}, I_{DQ} = 150\text{ mA}, P_{IN} = 35.5\text{ dBm}, \text{Pulse Width} = 100\ \mu\text{sec}, \text{Duty Cycle} = 10\%$





Typical Performance

Figure 3. Maximum Available Gain and K Factor of the CGHV59070
 $V_{DD} = 50\text{ V}, I_{DQ} = 150\text{ mA}$

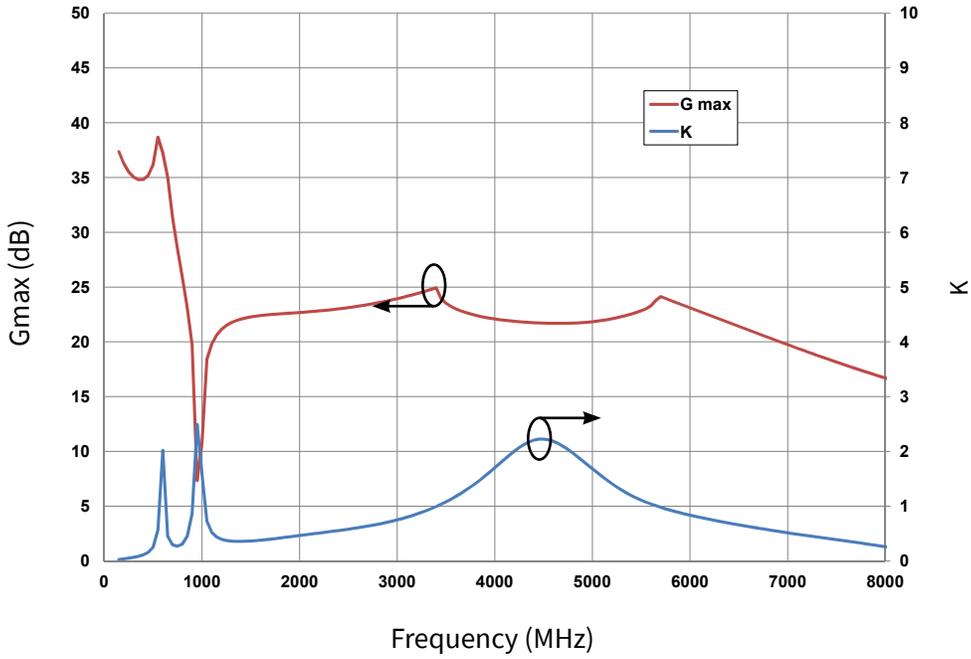
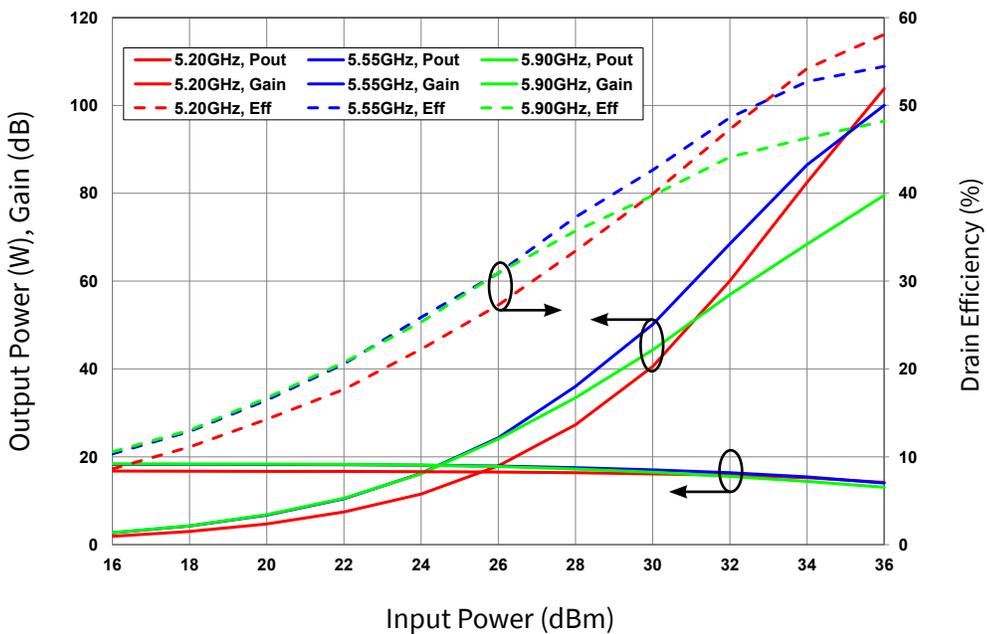
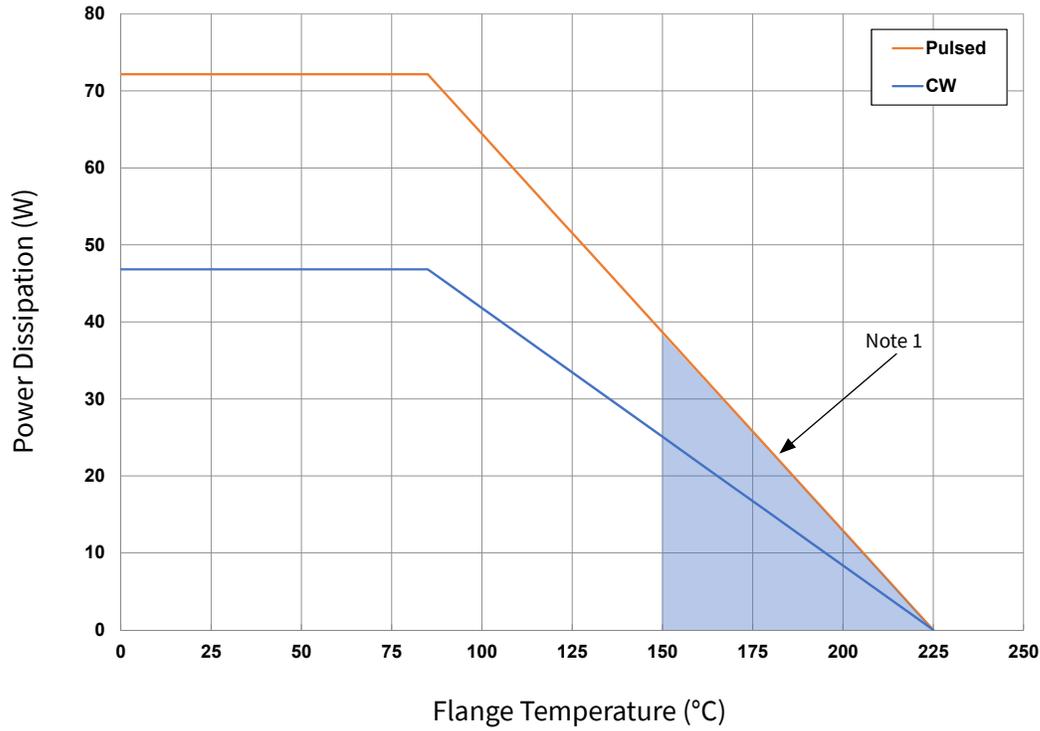


Figure 4. Power Gain, Drain Efficiency and Output Power vs Input Power of the CGHV59070
 $V_{DD} = 50\text{ V}, I_{DQ} = 150\text{ mA}, \text{Pulse Width} = 100\ \mu\text{sec}, \text{Duty Cycle} = 10\%$



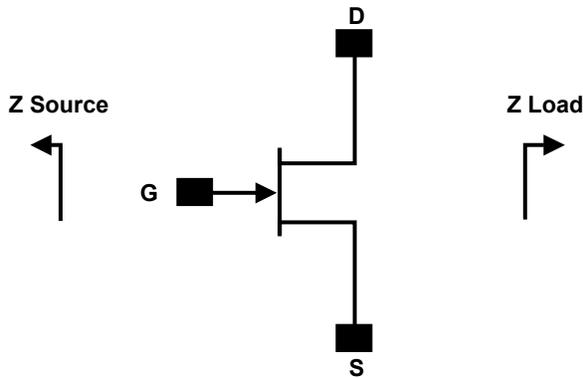


**CGHV59070 Power Dissipation De-Rating Curve, Pulsed & CW
(Pulsed Width = 100 μS, Duty Cycle = 10%)**



Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2)

Simulated Source and Load Impedances



| Frequency (MHz) | Z Source | Z Load |
|-----------------|-------------|--------------|
| 4400 | 2.6 - j12.9 | 14.0 - j6.9 |
| 4600 | 3.8 - j14.2 | 15.0 - j6.7 |
| 4800 | 5.8 - j15.3 | 16.0 - j7.0 |
| 5000 | 8.8 - j15.4 | 16.7 - j8.0 |
| 5200 | 8.8 - j14.7 | 17.1 - j9.1 |
| 5300 | 8.5 - j14.5 | 16.9 - j10.0 |
| 5400 | 8.1 - j14.2 | 16.5 - j10.7 |
| 5500 | 7.8 - j13.9 | 15.4 - j11.4 |
| 5600 | 7.5 - j13.6 | 15.4 - j12.0 |
| 5700 | 7.2 - j13.3 | 14.6 - j12.5 |
| 5800 | 6.9 - j13.3 | 13.8 - j12.8 |
| 5900 | 6.6 - j12.7 | 12.9 - j13.1 |

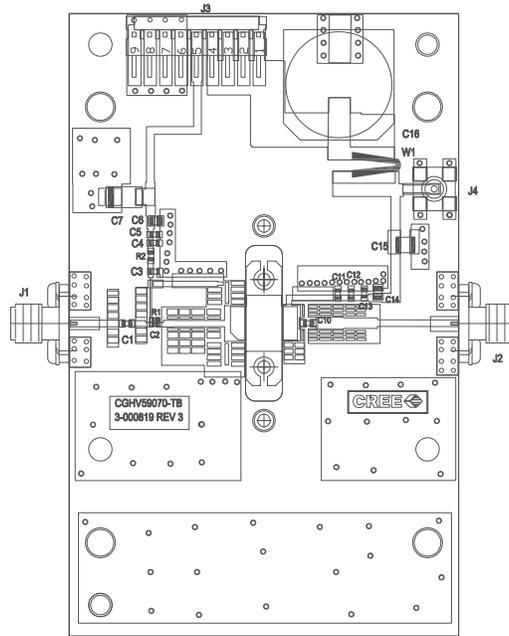
Note 1. $V_{DD} = 50\text{ V}$, $I_{DQ} = 150\text{ mA}$ in the 440224 package

Note 2. Optimized for power gain, P_{SAT} and PAE

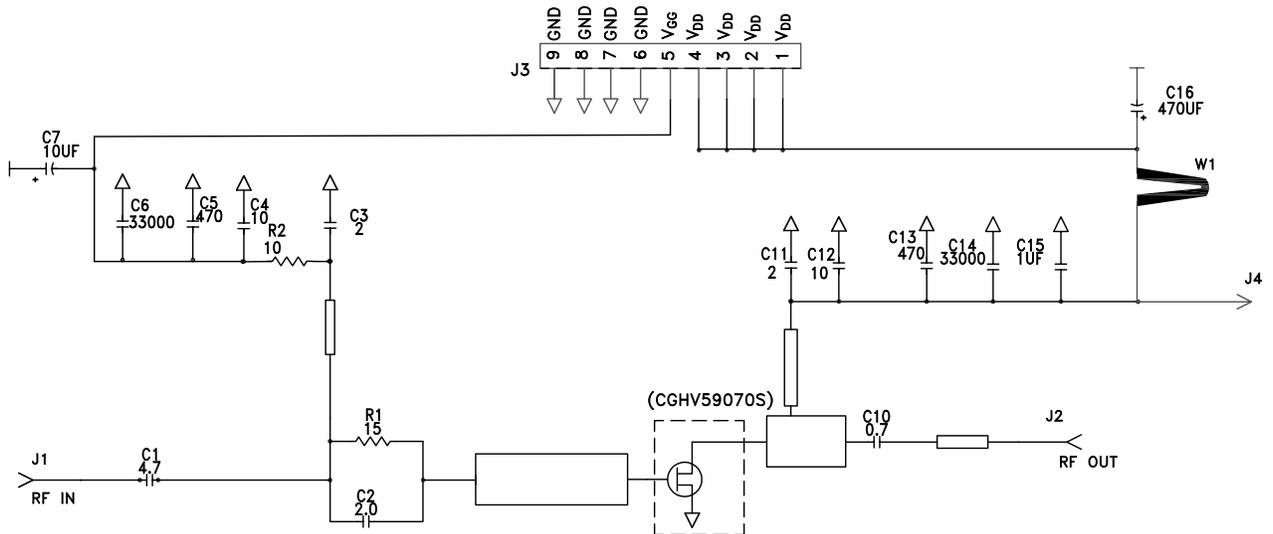
Note 3. When using this device at low frequency, series resistors should be used to maintain amplifier stability



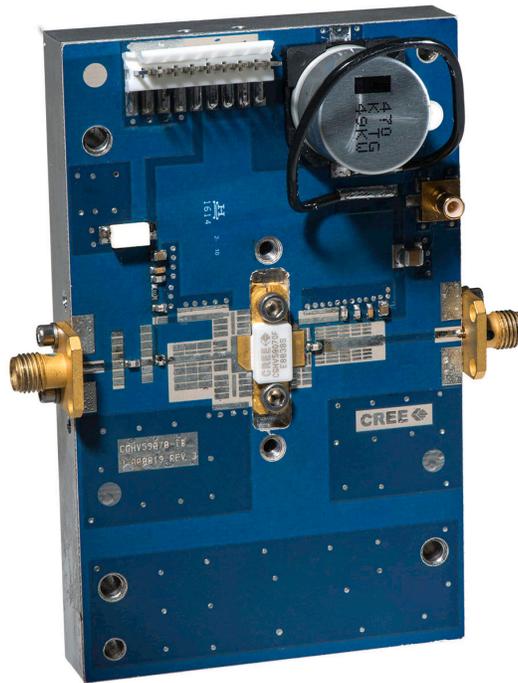
CGHV59070-AMP Demonstration Amplifier Circuit Outline



CGHV59070-AMP Demonstration Amplifier Circuit Schematic



CGHV59070-AMP Demonstration Amplifier Circuit

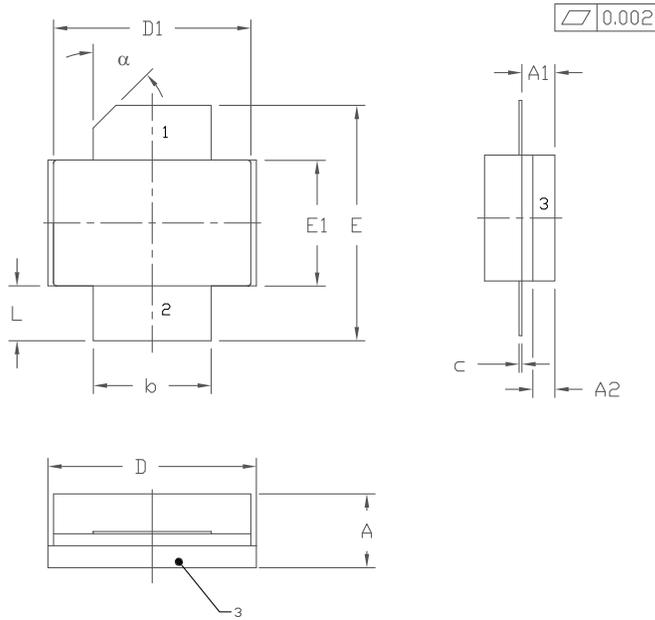


CGHV59070-AMP Demonstration Amplifier Circuit Bill of Materials

| Designator | Description | Qty |
|------------|---|-----|
| R1 | RES, 15,OHM, +/- 1%, 1/16W, 0402 | 1 |
| R2 | RES,1/16W,0603,1%,10.0 OHMS | 1 |
| C1 | CAP, 4.7 pF,+/-0.1pF, 0603, ATC600S | 1 |
| C10 | CAP, 1.3 pF,+/-0.1pF, 0603, ATC600S | 1 |
| C3,C11 | CAP, 2.0 pF,+/-0.1pF, 0603, ATC600S | 1 |
| C2 | CAP, 2.0 pF, +/- 0.05 pF, 0402, ATC600L | 1 |
| C4,C12 | CAP, 10pF,+/-5%, 0603, ATC600S | 2 |
| C5,C13 | CAP, 470PF, 5%, 100V, 0603, X | 2 |
| C6,C14 | CAP, 33000PF, 0805,100V, X7R | 2 |
| C15 | CAP, 1.0UF, 100V, 10%, X7R, 1210 | 1 |
| C7 | CAP 10UF 16V TANTALUM | 1 |
| W1 | CABLE ,18 AWG, 4.2 inch | 1 |
| C16 | CAP, 470uF, 20%, 80V, ELECT, SMD Size K | 1 |
| J1,J2 | CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE | 2 |
| J3 | HEADER RT>PLZ .1CEN LK 9POS | 1 |
| J4 | CONNECTOR ; SMB, Straight, JACK,SMD | 1 |
| - | Taconic RF-35, PCB, 20 mil | 1 |
| Q1 | CGHV59070 | 1 |



Product Dimensions CGHV59070P (Package Type — 440170)



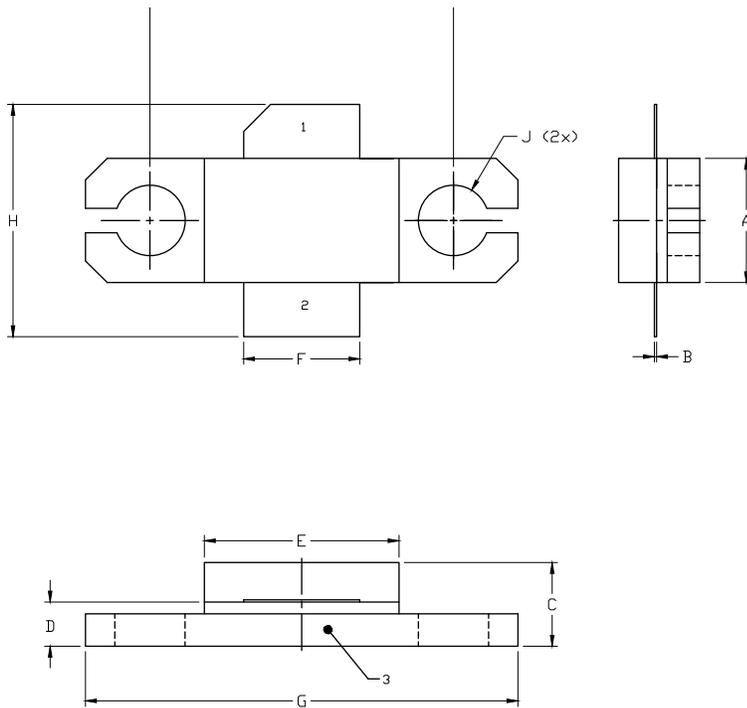
NOTES:

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.

| DIM | INCHES | | MILLIMETERS | | NOTES |
|-------|--------|-------|-------------|-------|-------|
| | 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 |
| alpha | 45° | REF | 45° | REF | |

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

Product Dimensions CGHV59070F (Package Type — 440224)



NOTES:

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



Part Number System

CGHV59070F



Table 1.

| Parameter | Value | Units |
|------------------------------|-------------|-------|
| Upper Frequency ¹ | 5.9 | GHz |
| Power Output | 70 | W |
| Package | Flange/Pill | - |

Note¹: 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 2H = 27.0 GHz |



Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|----------------|------------------------------------|-----------------|-------|
| CGHV59070F | GaN HEMT | Each | |
| CGHV59070P | GaN HEMT | Each | |
| CGHV59070F-AMP | Test board with GaN HEMT installed | Each | |



For more information, please contact:

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Durham, North Carolina, USA 27703
www.wolfspeed.com/RF

Sales Contact
RFSales@cree.com

Notes

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