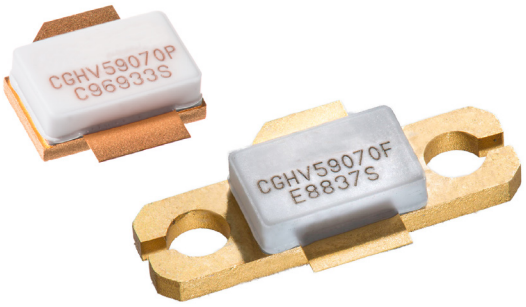
# CGHV59070

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

### Description

The 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. The good efficiency, high gain and wide bandwidth capabilities make the CGHV59070 ideal for linear applications such as wireless infrastructure and for compressed amplifier circuits. The transistor is available in a flange and pill package.




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

### Features

- 4.4 - 5.9 GHz Operation
- 90 W $P_{OUT}$ typical at 50 V
- 14 dB Power Gain
- 55% Drain Efficiency
- Internally Matched

### Applications

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

### Typical Performance Over 4.8 - 5.9 GHz ($T_C$ = 25˚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 | % |

Notes:
[1] Measured in CGHV59070F-AMP (838269) under 100µs pulse width, 10% duty cycle, $P_{IN}$ = 35.5 dBm (3.5 W)

**Large Signal Models Available for ADS and MWO**

RoHS compliant





Rev. 2.7, 2022-12-8

## 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 | | |
| Storage Temperature | $T_{STG}$ | -65, +150 | °C | |
| Operating Junction Temperature | $T_J$ | 225 | | |
| Maximum Forward Gate Current | $I_{GMAX}$ | 10.4 | mA | 25°C |
| Maximum Drain Current[1] | $I_{DMAX}$ | 6.3 | A | |
| 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] | | 0.85 | | 85°C, 100µs, 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
[3] Measured 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°C)

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **DC Characteristics[1]** | | | | | | |
| 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 Characteristics[3] ($T_C$ = 25°C, $F_0$ = 5.2 - 5.9 GHz unless otherwise noted)** | | | | | | |
| Small Signal Gain at 5.2 GHz | $G_{SS}$ | 15.55 | 17 | — | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 0.15 A, $P_{IN}$ = 10 dBm |
| Output Power at 5.2 GHz | $P_{OUT}$ | 75.9 | 100 | — | W | $V_{DD}$ = 50 V, $I_{DQ}$ = 0.15 A, $P_{IN}$ = 35.5 dBm |
| Output Power at 5.55 GHz | | | | — | | |
| Output Power at 5.9 GHz | | 62.4 | 77 | — | | |
| Drain Efficiency at 5.2 GHz | η | 50 | 55 | — | % | |
| Drain Efficiency at 5.55 GHz | | 46 | 54 | — | | |
| Drain Efficiency at 5.9 GHz | | 40 | 48 | — | | |
| Power Gain at 5.2 GHz | $G_P$ | — | 14.5 | — | dB | |
| 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 | — | | |
| Feedback Capacitance | $C_{GD}$ | — | 0.26 | — | | |

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

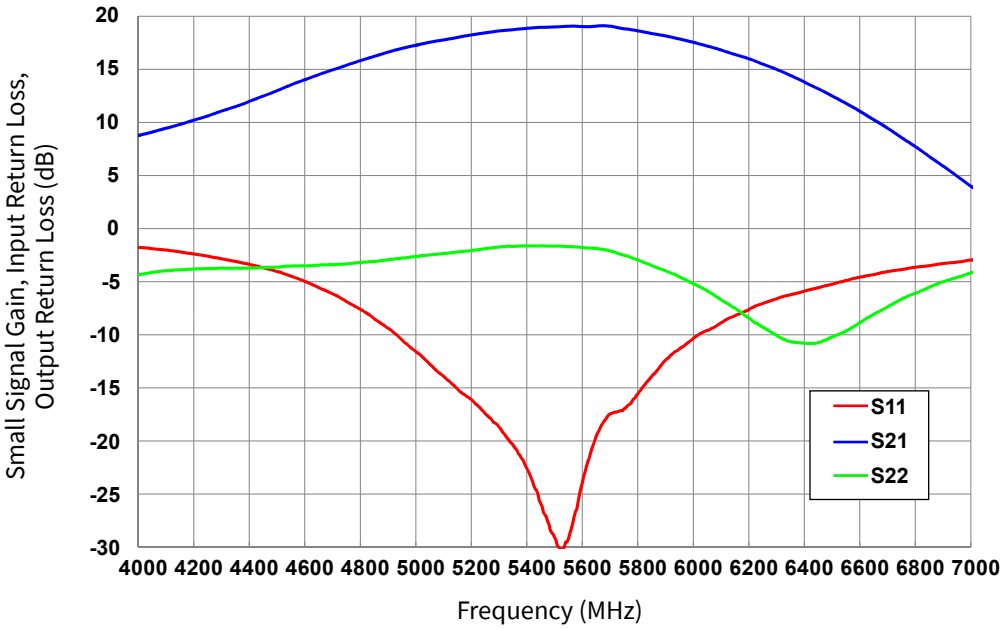



**Figure 1.** Small Signal Gain and Return Losses of the CGHV59070-AMP vs Frequency
$V_{DD}$ = 50 V, $I_{DQ}$ = 150 mA

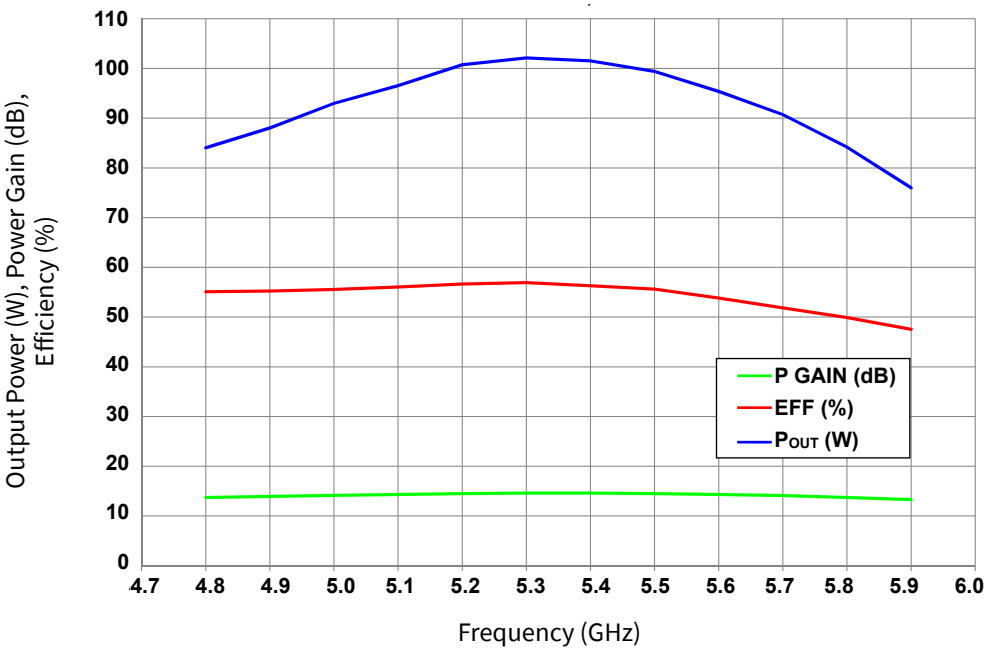



**Figure 2.** Power Gain, Drain Efficiency, and Output Power vs Frequency measured in Amplifier Circuit CGHV59070P-AMP
$V_{DD}$ = 50 V, $I_{DQ}$ = 150 mA, $P_{IN}$ = 35.5 dBm, Pulse Width = 100µsec, Duty Cycle = 10%

## Typical Performance

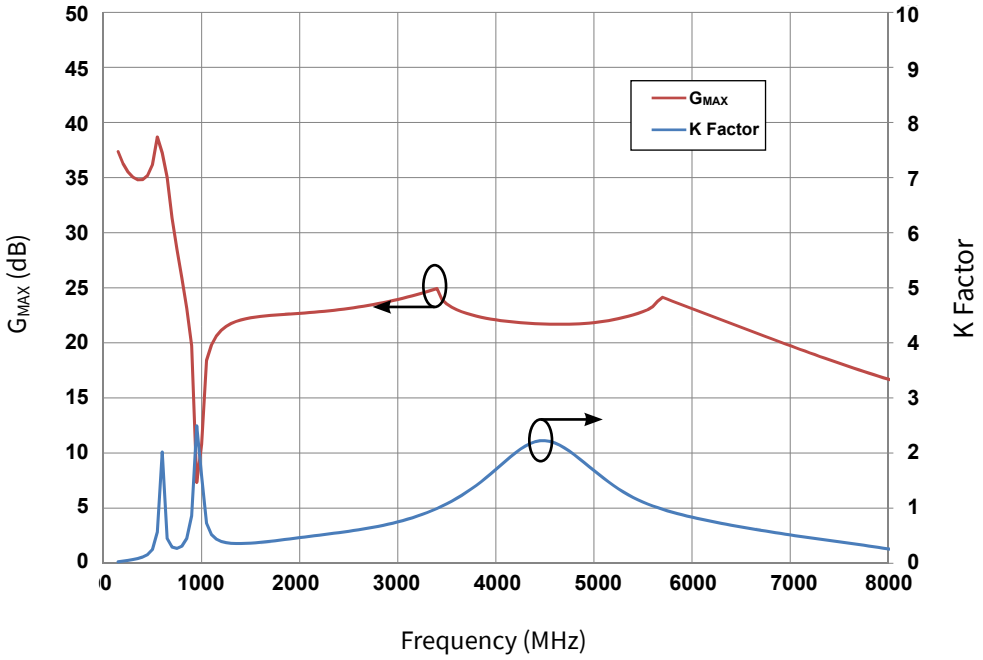



**Figure3.** Maximum Available Gain and K Factor of the CGHV59070
$V_{DD}$ = 50 V, $I_{DQ}$ = 150 mA

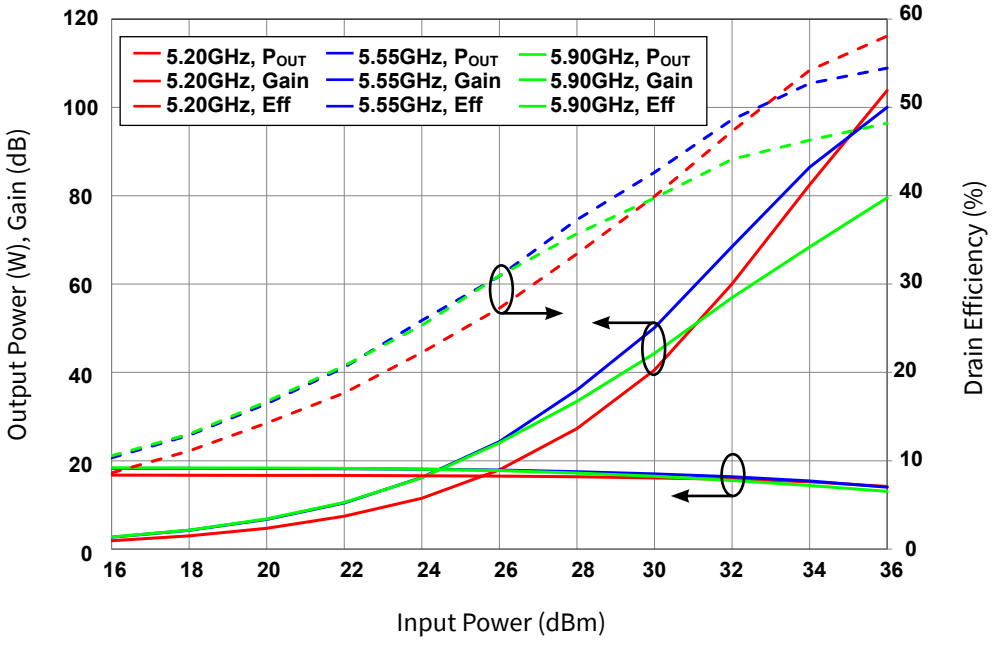



**Figure 4.** Power Gain, Drain Efficiency, and Output Power vs Input Power of the CGHV59070
$V_{DD}$ = 50 V, $I_{DQ}$ = 150 mA, Pulse Width = 100µsec, Duty Cycle = 10%

## Typical Performance

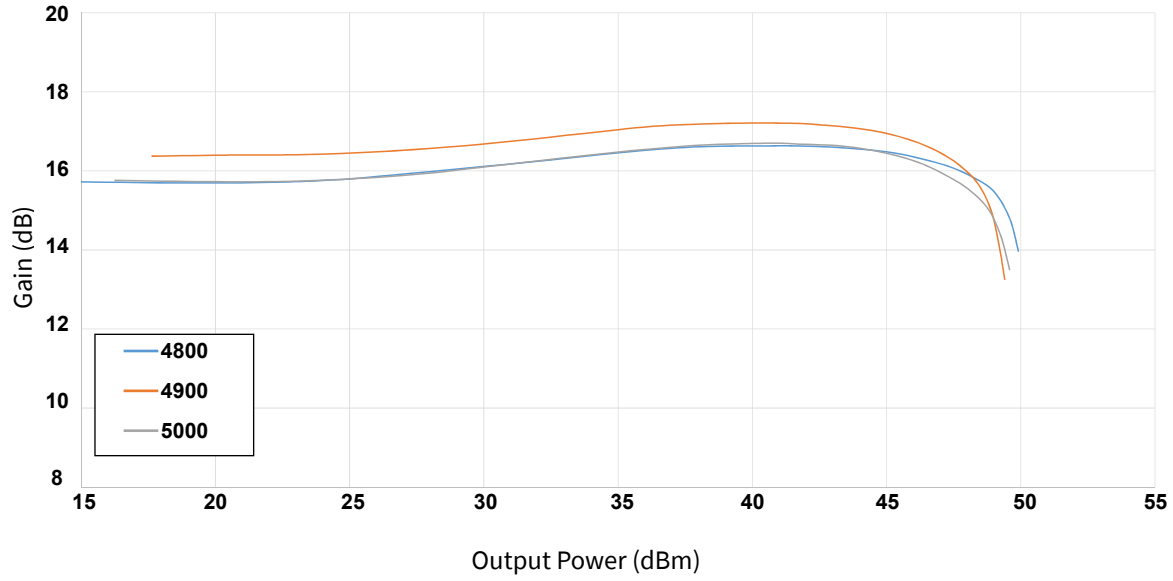



**Figure 5.** Gain vs Output Power Measured in CGHV59070F-AMP4
$V_{DD}$ = 50 V, $I_{DQ}$ = 75 mA

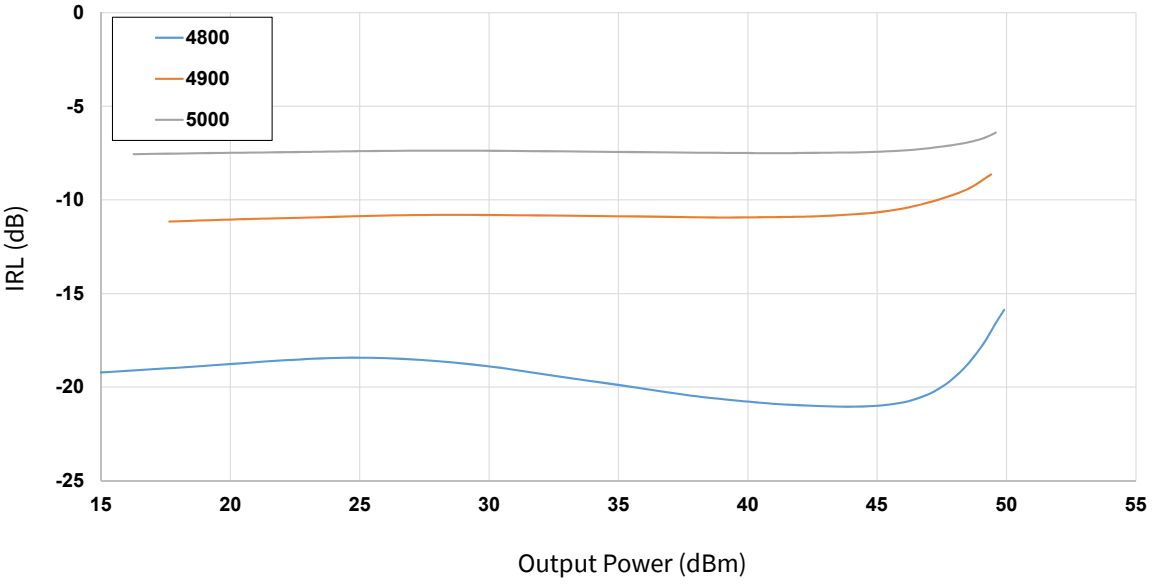



**Figure 6.** Input Return Loss vs Output Power Measured in CGHV59070F-AMP4
$V_{DD}$ = 50 V, $I_{DQ}$ = 75 mA

## Typical Performance

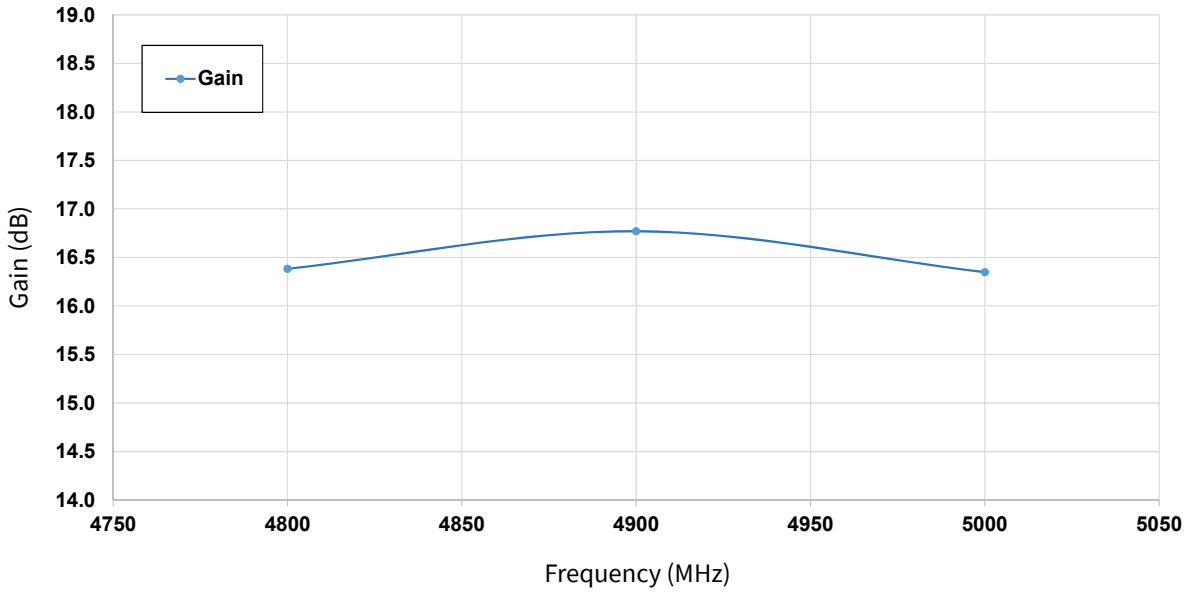



**Figure 7.** Gain vs Frequency Measured in CGHV59070F-AMP4
$V_{DD}$ = 50 V, $I_{DQ}$ = 75 mA, $P_{OUT}$ = 42 dBm

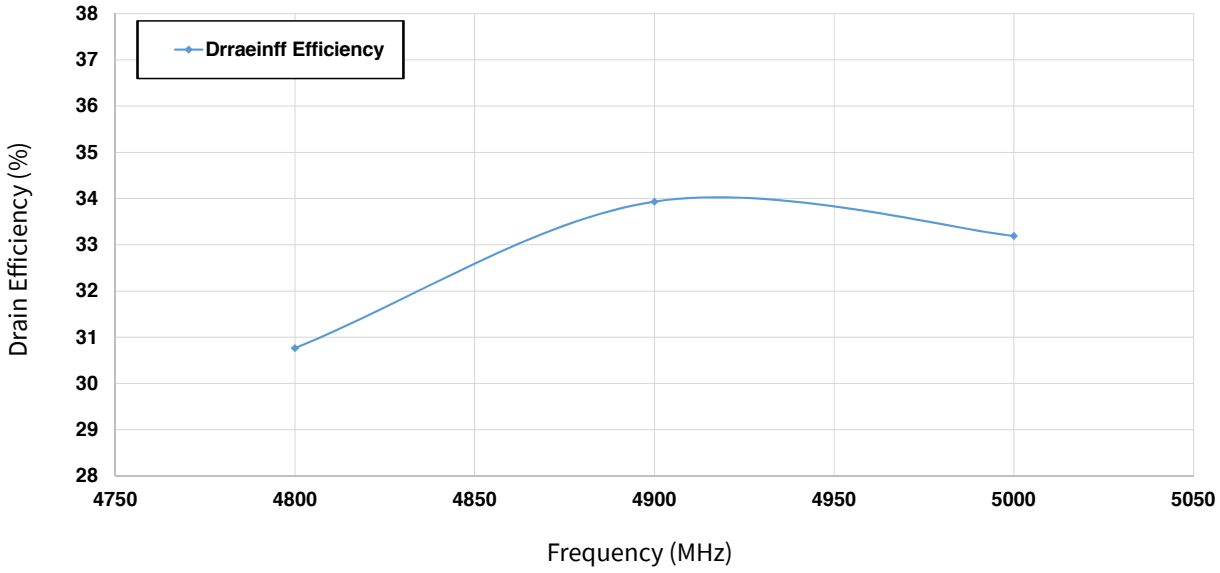



**Figure 8.** Drain Efficiency vs Frequency Measured in CGHV59070F-AMP4
$V_{DD}$ = 50 V, $I_{DQ}$ = 75 mA, $P_{OUT}$ = 42 dBm

## Typical Performance

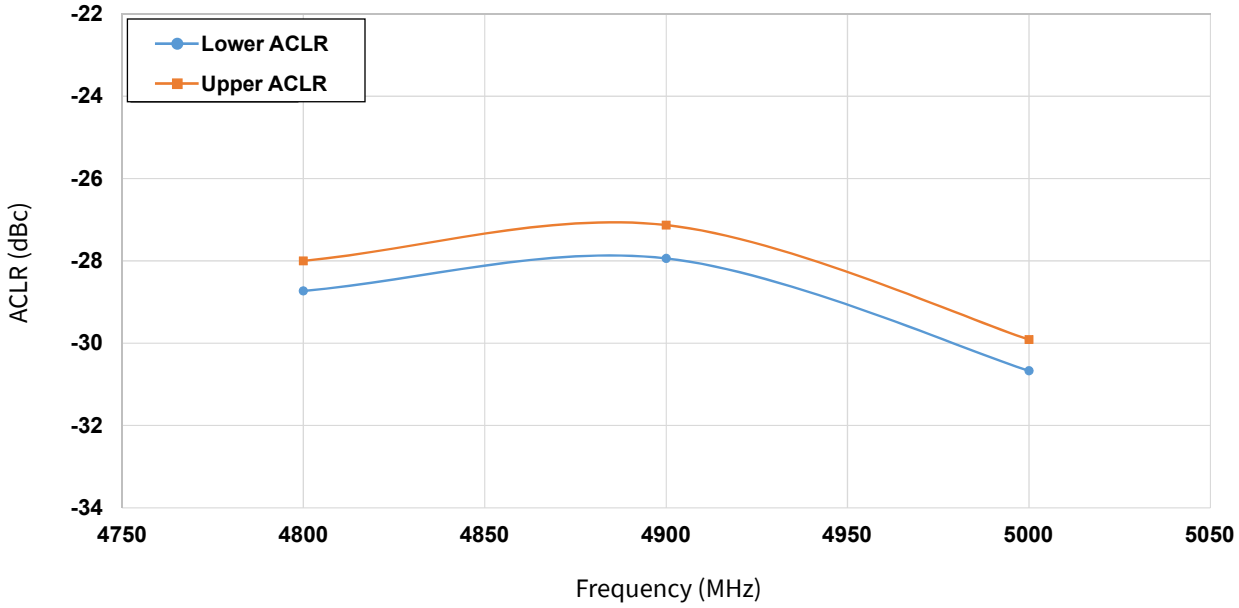
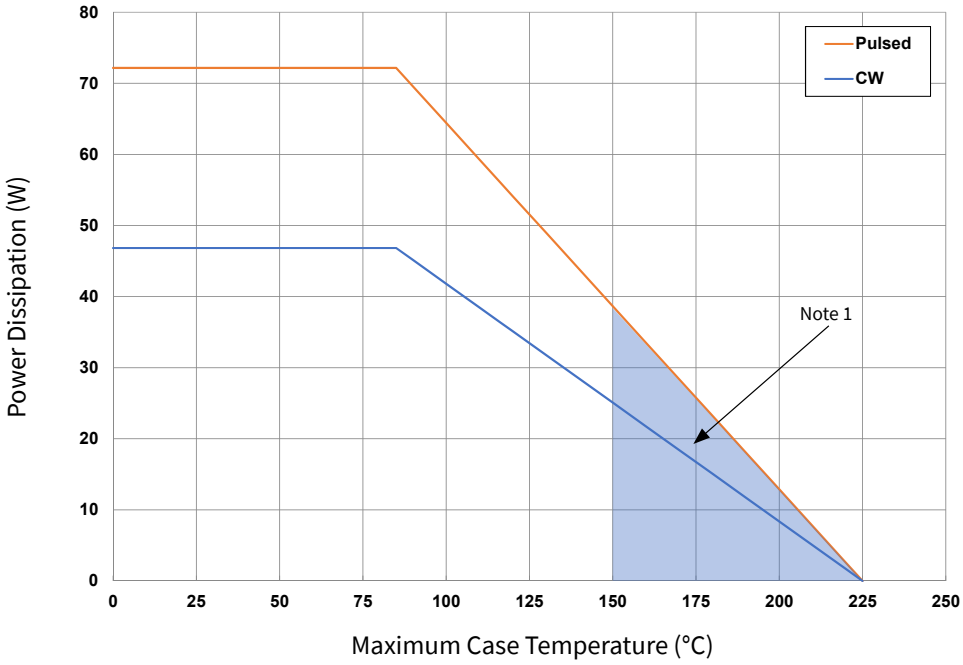



**Figure 9.** ACLR vs Frequency Measured in CGHV59070F-AMP4
$V_{DD}$ = 50 V, $I_{DQ}$ = 75 mA, $P_{OUT}$ = 42 dBm, WCDMA 7.5 dB PAR Signal

## Electrostatic Discharge (ESD) Classifications

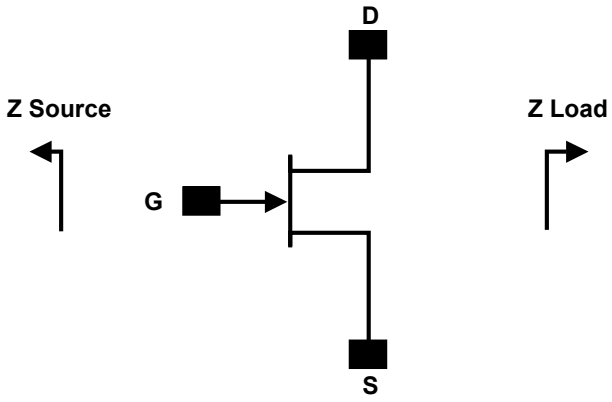
| Parameter | Symbol | Class | Classification Level | Test Methodology |
|---|---|---|---|---|
| Human Body Model | HBM | 1B | ANSI/ESDA/JEDEC JS-001 Table 3 | JEDEC JESD22 A114-D |
| Charge Device Model | CDM | C3 | ANSI/ESDA/JEDEC JS-002 Table 3 | JEDEC JESD22 C101-C |

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




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

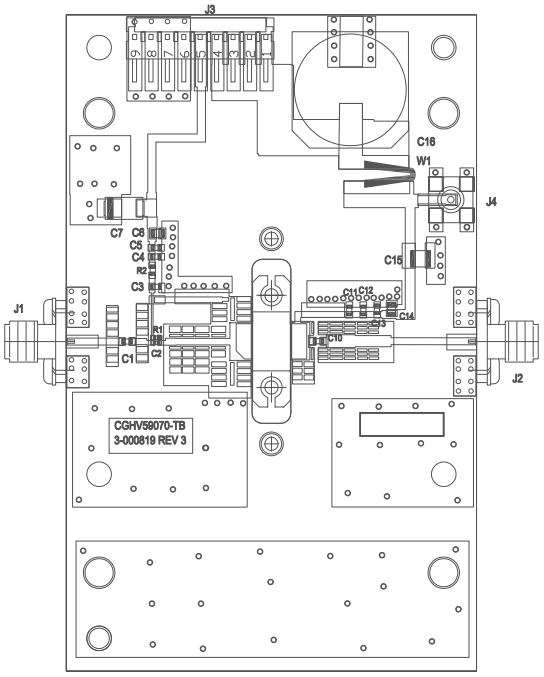
## Simulated Source and Load Impedances



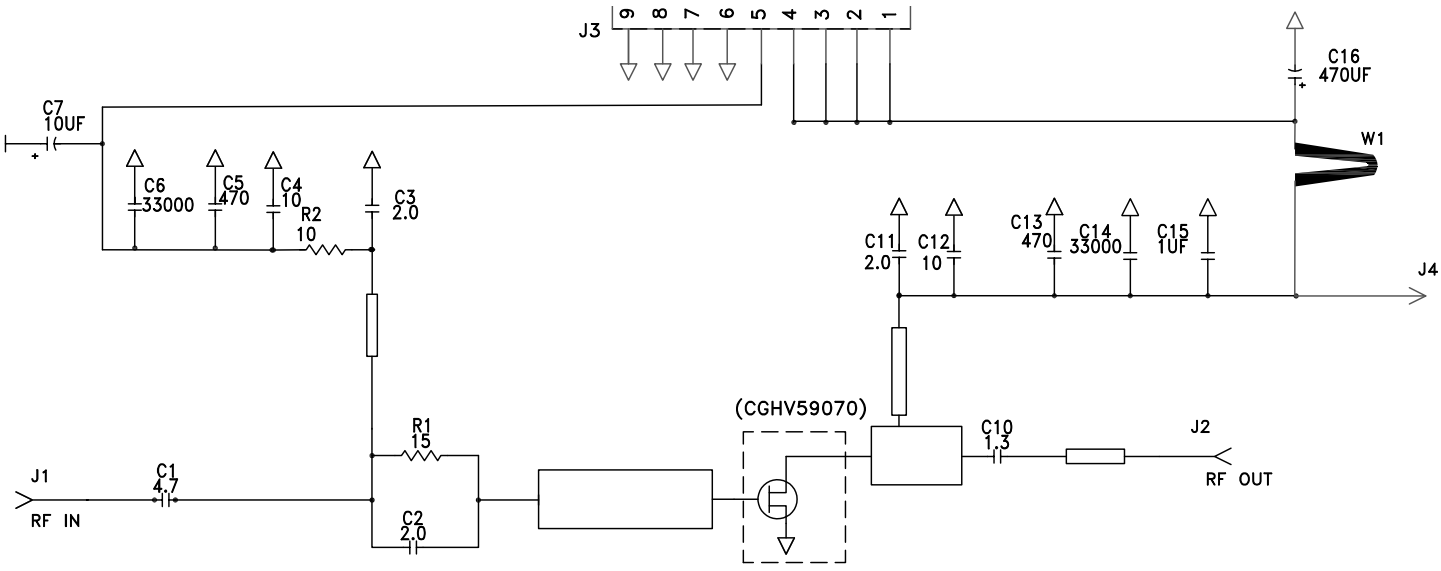

| Frequency (MHz) | Z Source | Z Load |
|---|---|---|
| 4400 | 2.6 - j12.9 | 14.0 - j6.9 |
| 4600 | 3.8 - j14.2 | 15.0 - j6.7 |
| 4800 | 5.8 - j15.3 | 16.0 - j7.0 |
| 5000 | 8.8 - j15.4 | 16.7 - j8.0 |
| 5200 | 8.8 - j14.7 | 17.1 - j9.1 |
| 5300 | 8.5 - j14.5 | 16.9 - j10.0 |
| 5400 | 8.1 - j14.2 | 16.5 - 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 |

Notes:
[1] $V_{DD}$ = 50 V, $I_{DQ}$ = 150 mA in the 440224 package
[2] Optimized for power gain, $P_{SAT}$ and PAE
[3] When using this device at low frequency, series resistors should be used to maintain amplifier stability

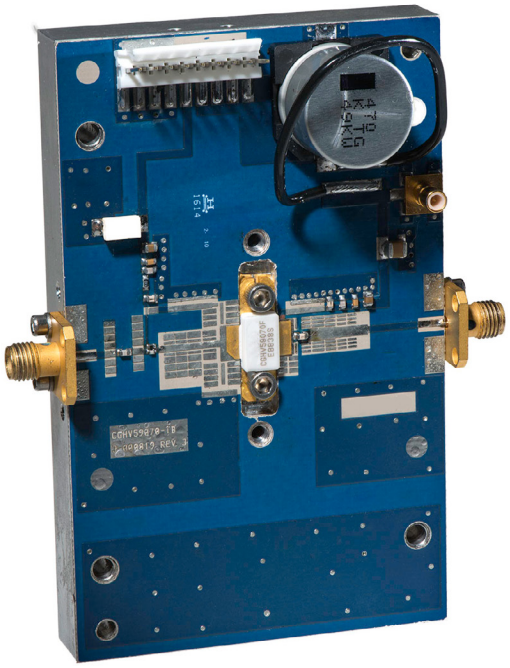
## CGHV59070-AMP Demonstration Amplifier Circuit Outline




## CGHV59070-AMP Demonstration Amplifier Circuit Schematic



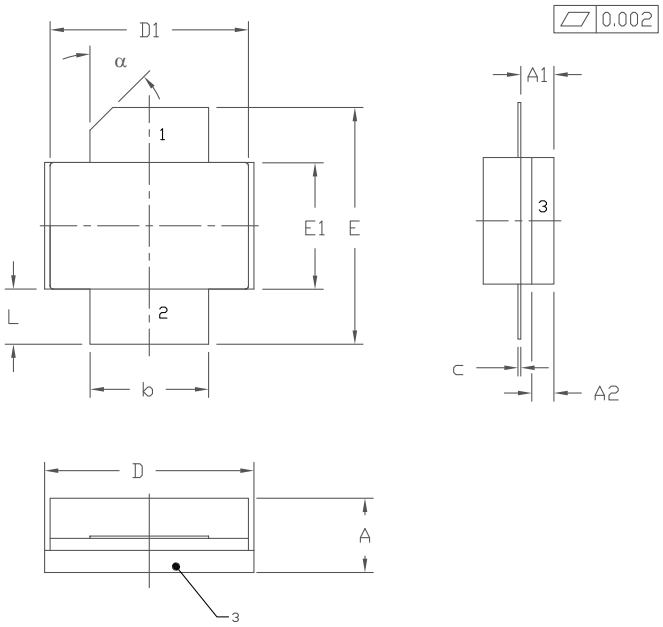
## CGHV59070-AMP Demonstration Amplifier Circuit



## 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, 4.7pF, +/-0.1pF, 0603, ATC600S | 1 |
| C10 | CAP, 1.3pF, +/-0.1pF, 0603, ATC600S | 1 |
| C3, C11 | CAP, 2.0pF, +/-0.1pF, 0603, ATC600S | 1 |
| C2 | CAP, 2.0pF, +/- 0.05pF, 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, 1.0µF, 100V, 10%, X7R, 1210 | 1 |
| C7 | CAP, 10µF 16V TANTALUM | 1 |
| W1 | CABLE, 18 AWG, 4.2 inch | 1 |
| C16 | CAP, 470µF, 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)



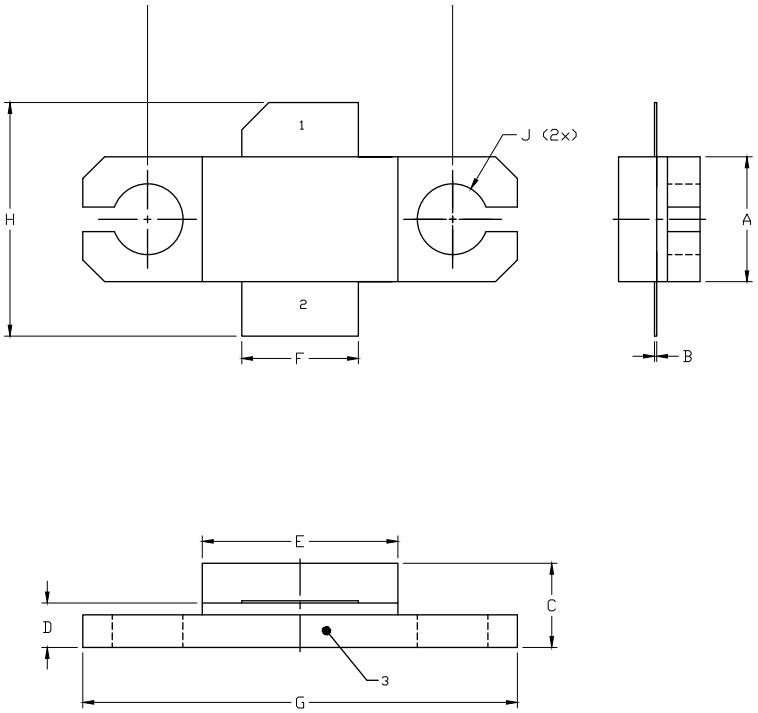

NOTES:

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.

| | 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

## Product Dimensions CGHV59070F (Package Type — 440224)




1982.

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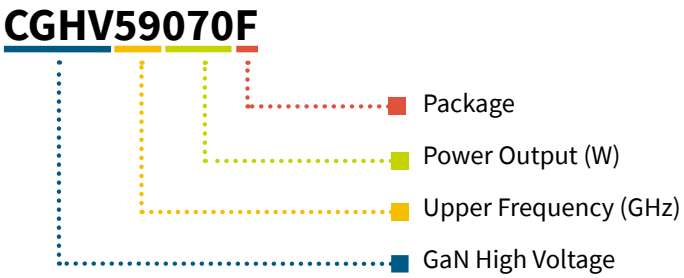
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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




### Table 1.

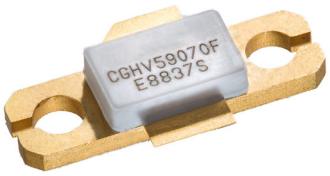
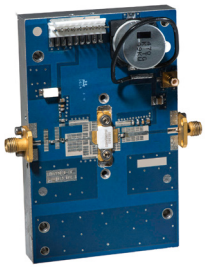
| Parameter | Value | Units |
|---|---|---|
| Upper Frequency[1] | 5.9 | GHz |
| Power Output | 70 | W |
| Package | Flange/Pill | — |

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 |
|---|---|---|---|
| CGHV59070F | GaN HEMT | Each |   |
| CGH59070P | GaN HEMT | Each |   |
| CGHV59070F-AMP | Test board with GaN HEMT installed | Each |  |

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