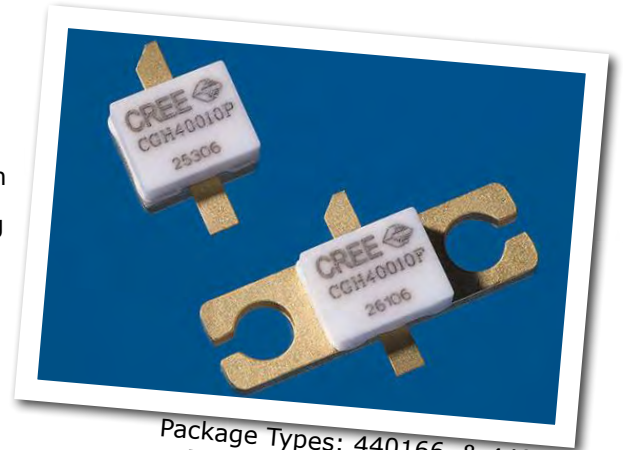


# CGH40010

## 10 W, RF Power GaN HEMT

Cree's CGH40010 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGH40010, operating from a 28 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 CGH40010 ideal for linear and compressed amplifier circuits. The transistor is available in both screw-down, flange and solder-down, pill packages.



Package Types: 440166, & 440196  
PN's: CGH40010F & CGH40010P

### FEATURES

- Up to 6 GHz Operation
- 16 dB Small Signal Gain at 2.0 GHz
- 14 dB Small Signal Gain at 4.0 GHz
- 13 W typical  $P_{SAT}$
- 65 % Efficiency at  $P_{SAT}$
- 28 V Operation

### APPLICATIONS

- 2-Way Private Radio
- Broadband Amplifiers
- Cellular Infrastructure
- Test Instrumentation
- Class A, AB, Linear amplifiers suitable for OFDM, W-CDMA, EDGE, CDMA waveforms





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

| Parameter   | Symbol          | Rating    | Units | Conditions |
|---|-----------------|-----------|-------|------------|
| Drain-Source Voltage                              | $V_{DSS}$       | 84        | 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                      | $I_{GMAX}$      | 4.0       | mA    | 25 °C      |
| Maximum Drain Current <sup>1</sup>                | $I_{DMAX}$      | 1.5       | A     | 25 °C      |
| Soldering Temperature <sup>2</sup>                | $T_S$           | 245       | °C    |            |
| Screw Torque                                      | $\tau$          | 60        | in-oz |            |
| Thermal Resistance, Junction to Case <sup>3</sup> | $R_{\theta JC}$ | 8.0       | °C/W  | 85 °C      |
| Case Operating Temperature <sup>3,4</sup>         | $T_C$           | -40, +150 | °C    | 30 seconds |

Note:

<sup>1</sup> Current limit for long term, reliable operation

<sup>2</sup> Refer to the Application Note on soldering at [www.cree.com/products/wireless\\_appnotes.asp](http://www.cree.com/products/wireless_appnotes.asp)

<sup>3</sup> Measured for the CGH40010F at  $P_{DISS} = 14$  W.

<sup>4</sup> See also, the Power Dissipation De-rating Curve on Page 6.

## Electrical Characteristics ( $T_C = 25$ °C)

| Characteristics   | Symbol       | Min. | Typ. | Max.   | Units    | Conditions   |
|---|--------------|------|------|--------|----------|--|
| <b>DC Characteristics<sup>1</sup></b>   |              |      |      |        |          |  |
| Gate Threshold Voltage  | $V_{GS(th)}$ | -3.8 | -3.0 | -2.3   | $V_{DC}$ | $V_{DS} = 10$ V, $I_D = 3.6$ mA  |
| Gate Quiescent Voltage  | $V_{GS(Q)}$  | -    | -2.7 | -      | $V_{DC}$ | $V_{DS} = 28$ V, $I_D = 200$ mA  |
| Saturated Drain Current   | $I_{DS}$     | 2.9  | 3.5  | -      | A        | $V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V   |
| Drain-Source Breakdown Voltage  | $V_{BR}$     | 120  | -    | -      | $V_{DC}$ | $V_{GS} = -8$ V, $I_D = 3.6$ mA  |
| <b>RF Characteristics<sup>2</sup> (<math>T_C = 25</math> °C, <math>F_0 = 3.7</math> GHz unless otherwise noted)</b> |              |      |      |        |          |  |
| Small Signal Gain   | $G_{SS}$     | 12.5 | 14.5 | -      | dB       | $V_{DD} = 28$ V, $I_{DQ} = 200$ mA   |
| Power Output <sup>3</sup>   | $P_{SAT}$    | 10   | 12.5 | -      | W        | $V_{DD} = 28$ V, $I_{DQ} = 200$ mA   |
| Drain Efficiency <sup>4</sup>   | $\eta$       | 55   | 65   | -      | %        | $V_{DD} = 28$ V, $I_{DQ} = 200$ mA, $P_{SAT}$  |
| Output Mismatch Stress  | VSWR         | -    | -    | 10 : 1 | $\Psi$   | No damage at all phase angles,<br>$V_{DD} = 28$ V, $I_{DQ} = 200$ mA,<br>$P_{OUT} = 10$ W CW |
| <b>Dynamic Characteristics</b>  |              |      |      |        |          |  |
| Input Capacitance   | $C_{GS}$     | -    | 4.5  | -      | pF       | $V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz  |
| Output Capacitance  | $C_{DS}$     | -    | 1.3  | -      | pF       | $V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz  |
| Feedback Capacitance  | $C_{GD}$     | -    | 0.2  | -      | pF       | $V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz  |

Notes:

<sup>1</sup> Measured on wafer prior to packaging.

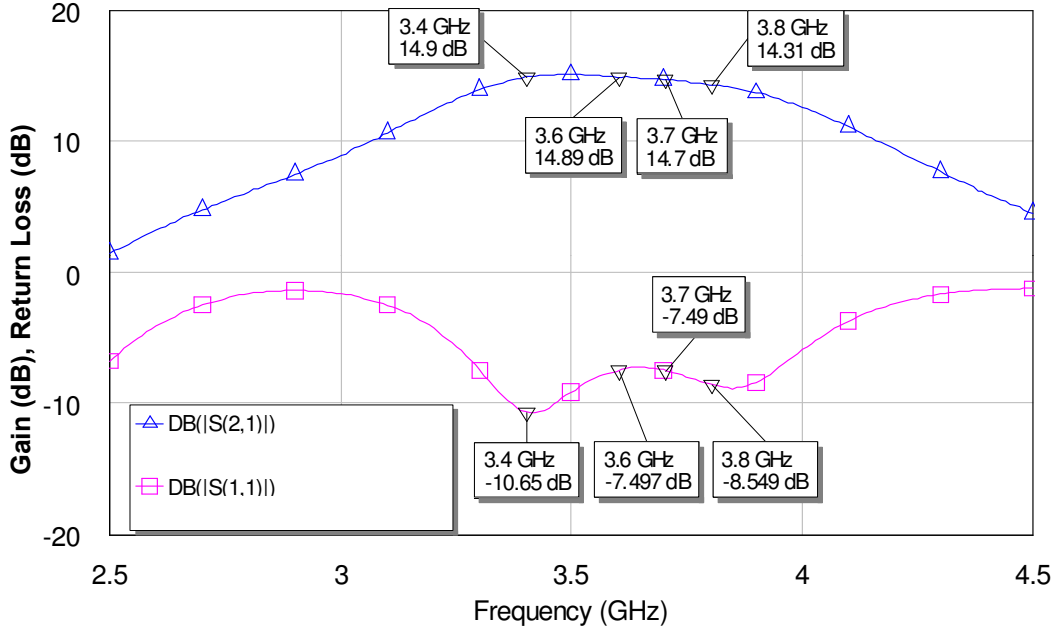
<sup>2</sup> Measured in CGH40010-TB.

<sup>3</sup>  $P_{SAT}$  is defined as  $I_G = 0.36$  mA.

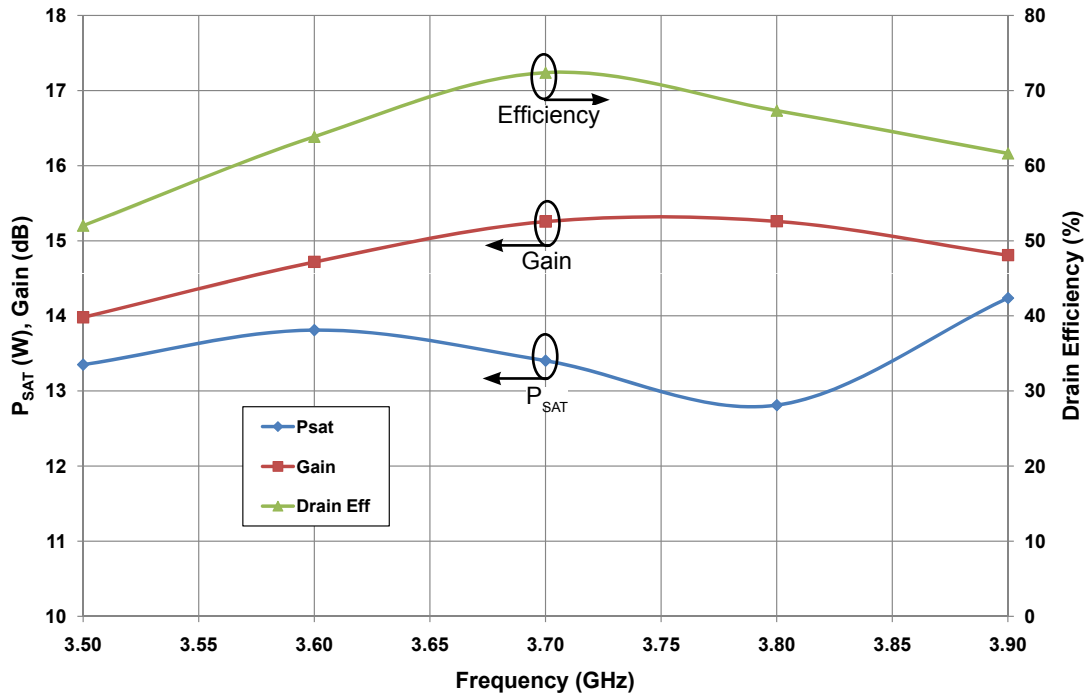
<sup>4</sup> Drain Efficiency =  $P_{OUT} / P_{DC}$

## Typical Performance

**Small Signal Gain and Return Loss vs Frequency of the CGH40010 in the CGH40010-TB**

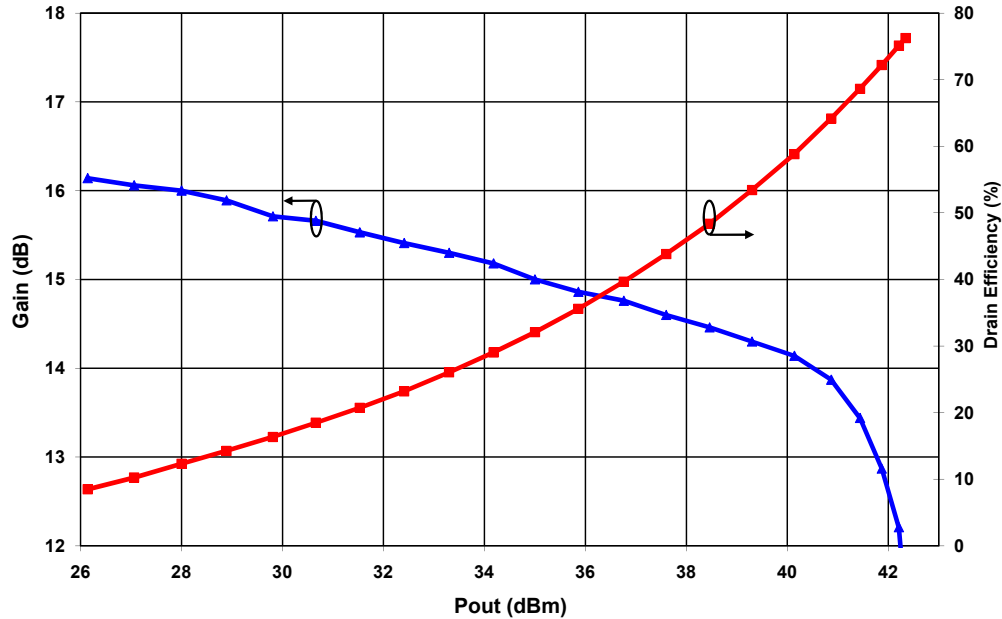


**$P_{SAT}$  Gain, and Drain Efficiency vs Frequency of the CGH40010F in the CGH40010-TB**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$

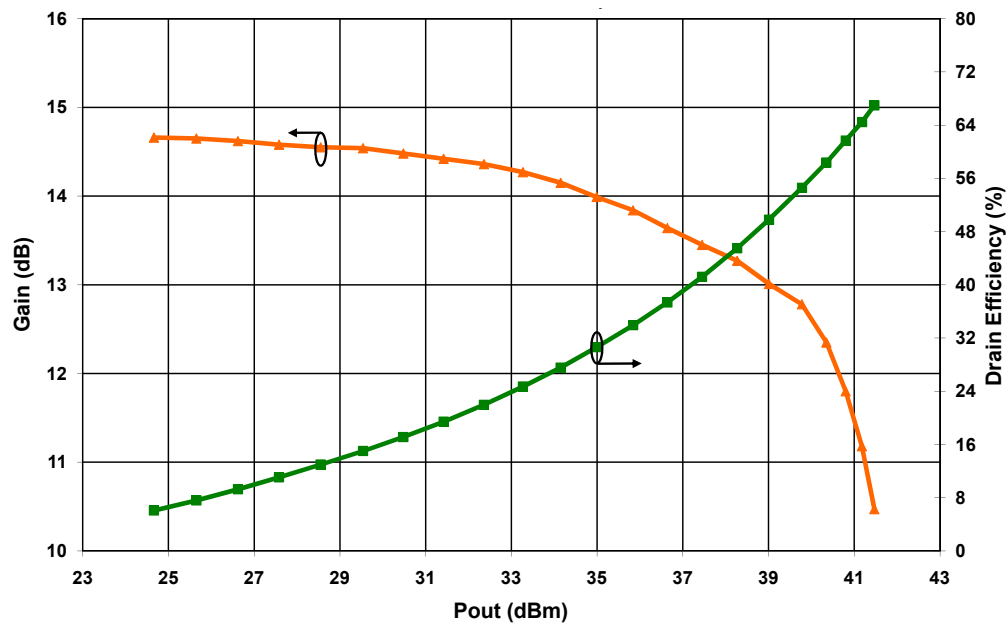


## Typical Performance

**Swept CW Data of CGH40010F vs. Output Power with Source and Load Impedances Optimized for Drain Efficiency at 2.0 GHz**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$

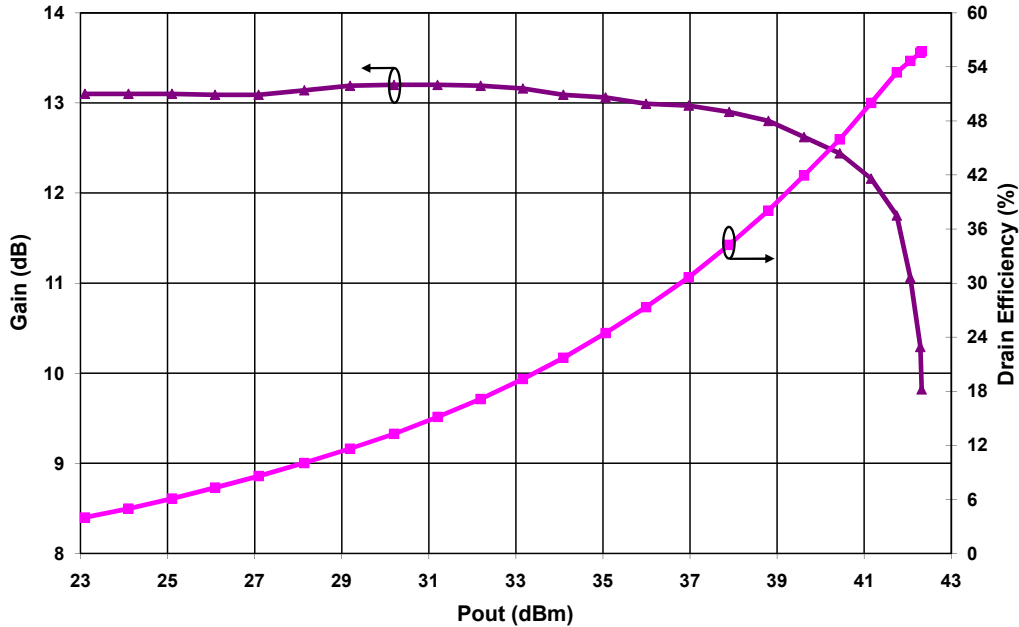


**Swept CW Data of CGH40010F vs. Output Power with Source and Load Impedances Optimized for Drain Efficiency at 3.6 GHz**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$

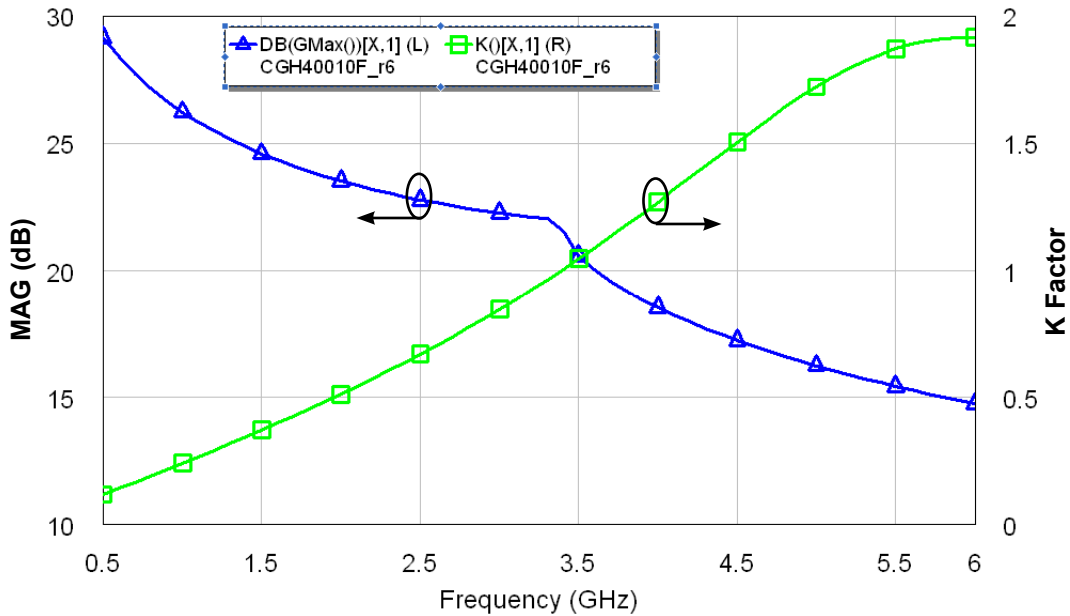


## Typical Performance

**Swept CW Data of CGH40010F vs. Output Power with Source and Load Impedances Optimized for P1 Power at 3.6 GHz**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$



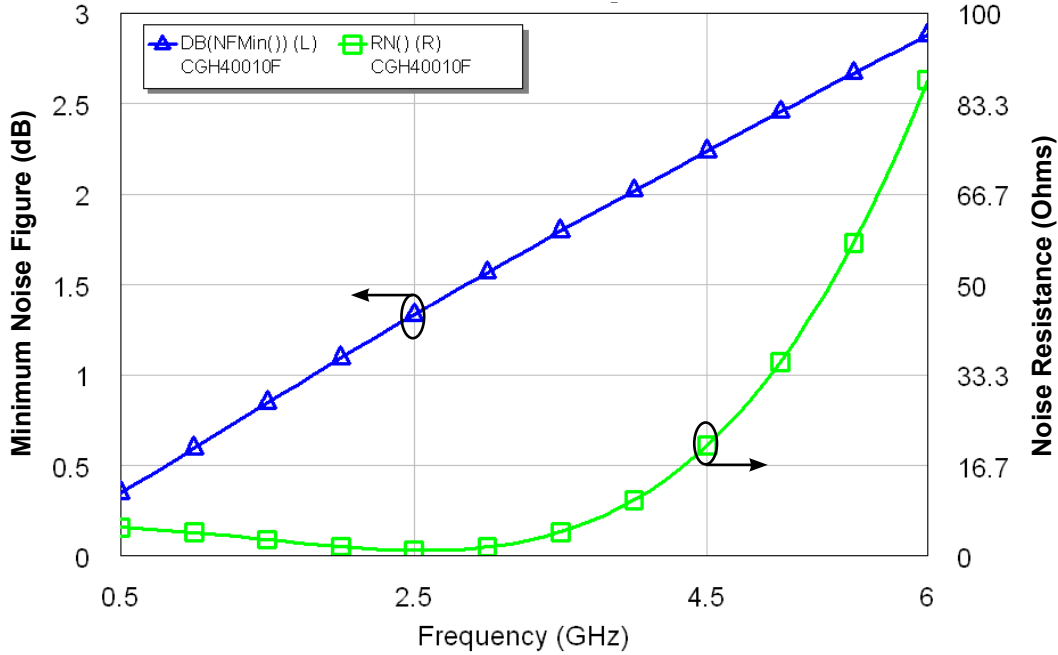
**Simulated Maximum Available Gain and K Factor of the CGH40010F**  
 $V_{DD} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$





## Typical Noise Performance

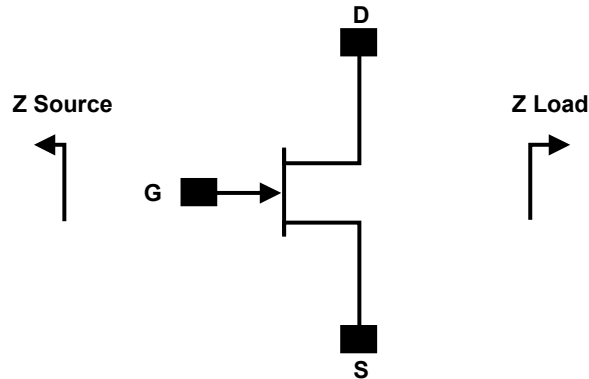
**Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH40010F**  
 $V_{DD} = 28\text{ V}, I_{DQ} = 100\text{ mA}$



## Electrostatic Discharge (ESD) Classifications

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

## Source and Load Impedances



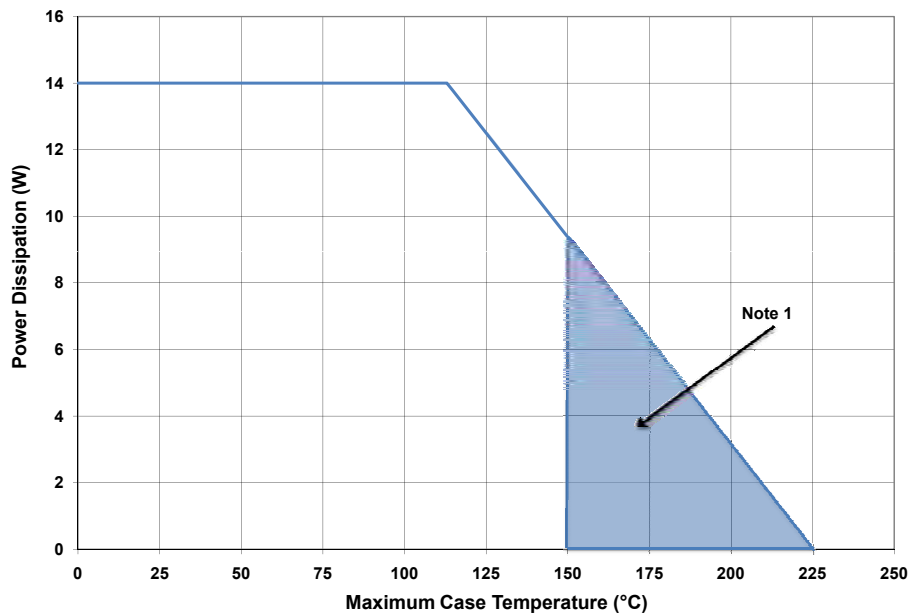
| Frequency (MHz) | Z Source      | Z Load       |
|-----------------|---------------|--------------|
| 500             | 20.2 + j16.18 | 51.7 + j15.2 |
| 1000            | 8.38 + j9.46  | 41.4 + j28.5 |
| 1500            | 7.37 + j0     | 28.15 + j29  |
| 2500            | 3.19 - j4.76  | 19 + j9.2    |
| 3500            | 3.18 - j13.3  | 14.6 + j7.46 |

Note 1.  $V_{DD} = 28V$ ,  $I_{DQ} = 200mA$  in the 440166 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.

## CGH40010 Power Dissipation De-rating Curve

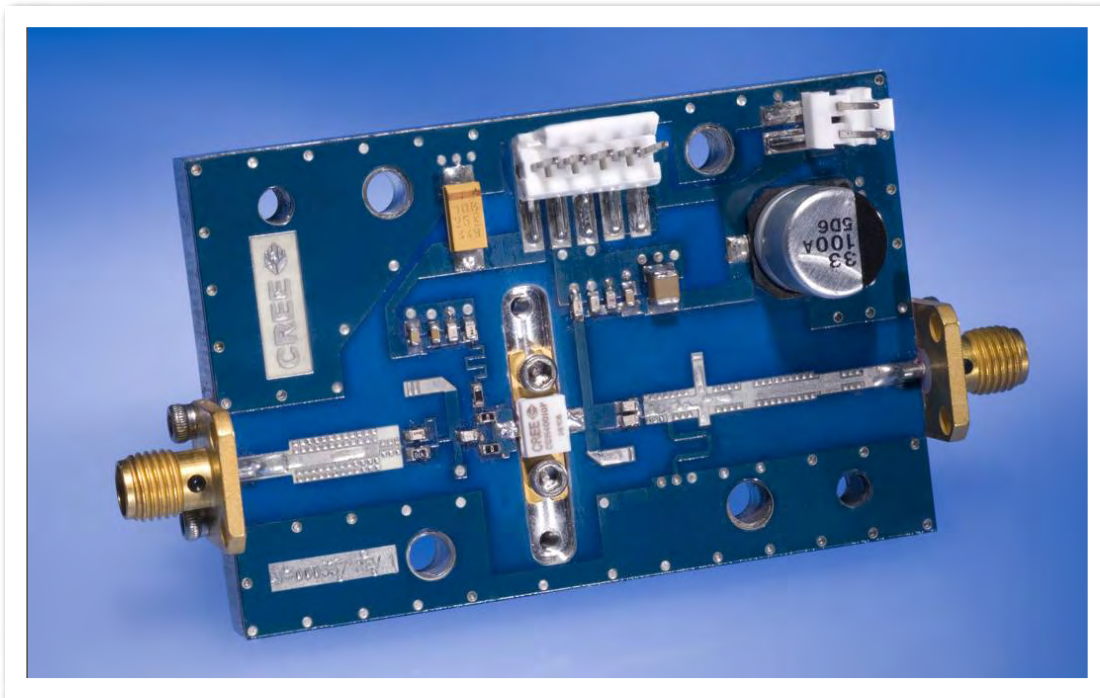


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

## CGH40010-TB Demonstration Amplifier Circuit Bill of Materials

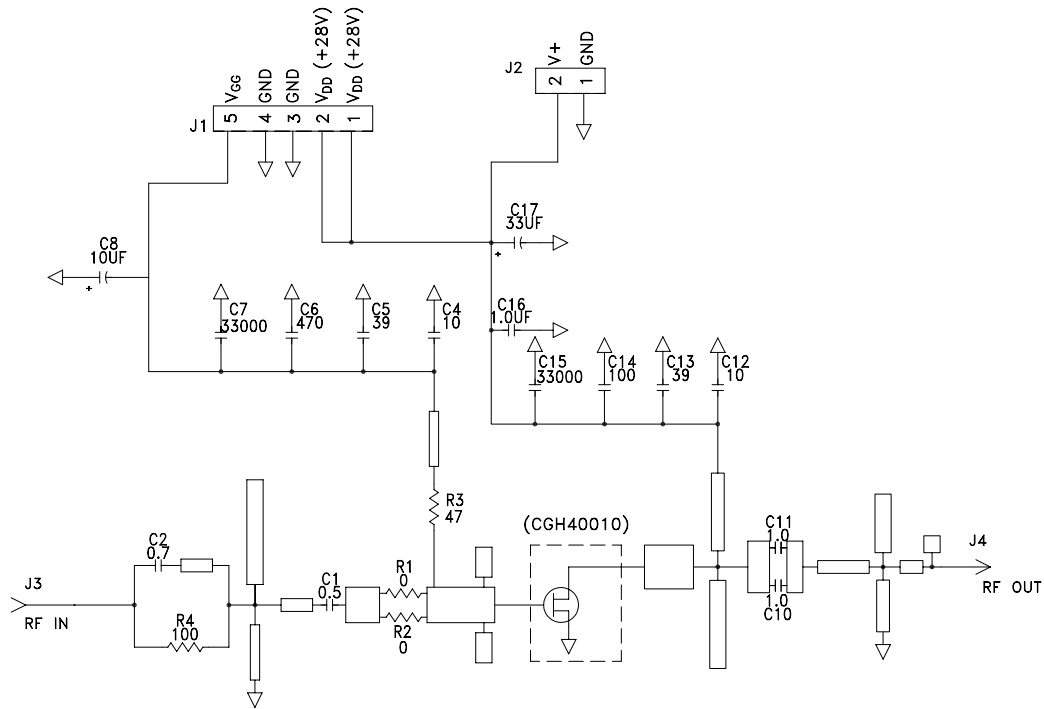
| Designator | Description                         | Qty |
|------------|-------------------------------------|-----|
| R1,R2      | RES,1/16W,0603,1%,0 OHMS            | 1   |
| R3         | RES,1/16W,0603,1%,47 OHMS           | 1   |
| R4         | RES,1/16W,0603,1%,100 OHMS          | 1   |
| C6         | CAP, 470PF, 5%,100V, 0603           | 1   |
| C17        | CAP, 33 UF, 20%, G CASE             | 1   |
| C16        | CAP, 1.0UF, 100V, 10%, X7R, 1210    | 1   |
| C8         | CAP 10UF 16V TANTALUM               | 1   |
| C14        | CAP, 100.0pF, +/-5%, 0603           | 1   |
| C1         | CAP, 0.5pF, +/-0.05pF, 0603         | 1   |
| C2         | CAP, 0.7pF, +/-0.1pF, 0603          | 1   |
| C10,C11    | CAP, 1.0pF, +/-0.1pF, 0603          | 2   |
| C4,C12     | CAP, 10.0pF,+/-5%, 0603             | 2   |
| C5,C13     | CAP, 39pF, +/-5%, 0603              | 2   |
| C7,C15     | CAP,33000PF, 0805,100V, X7R         | 2   |
| J3,J4      | CONN SMA STR PANEL JACK RECP        | 1   |
| J2         | HEADER RT>PLZ.1CEN LK 2 POS         | 1   |
| J1         | HEADER RT>PLZ .1CEN LK 5POS         | 1   |
| -          | PCB, RO4350B, Er = 3.48, h = 20 mil | 1   |
| Q1         | CGH40010F or CGH40010P              | 1   |

## CGH40010-TB Demonstration Amplifier Circuit

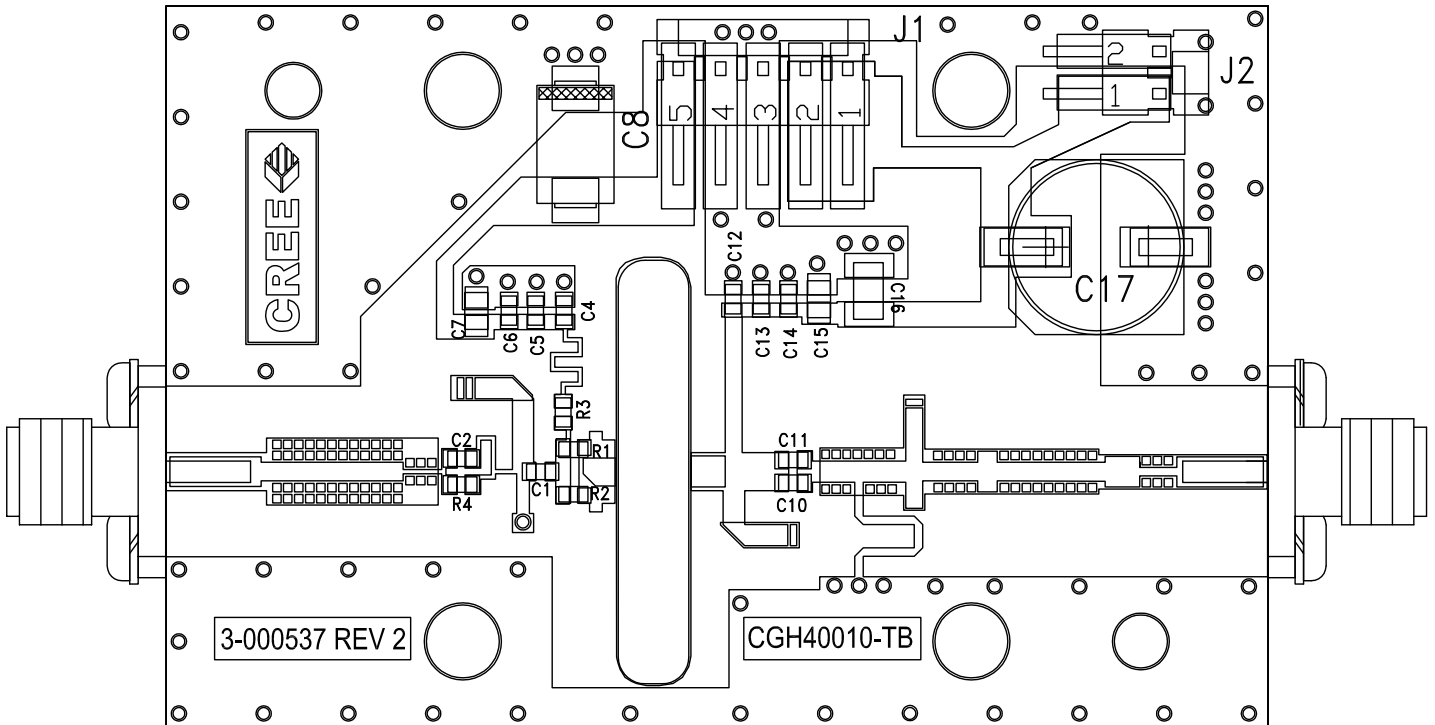




## CGH40010-TB Demonstration Amplifier Circuit Schematic



## CGH40010-TB Demonstration Amplifier Circuit Outline





**Typical Package S-Parameters for CGH40010**  
**(Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 100\text{ mA}$ , angle in degrees)**

| Frequency | Mag S11 | Ang S11 | Mag S21 | Ang S21 | Mag S12 | Ang S12 | Mag S22 | Ang S22 |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| 500 MHz   | 0.909   | -123.34 | 17.19   | 108.22  | 0.027   | 21.36   | 0.343   | -90.81  |
| 600 MHz   | 0.902   | -133.06 | 14.86   | 101.82  | 0.028   | 15.60   | 0.329   | -98.65  |
| 700 MHz   | 0.897   | -140.73 | 13.04   | 96.45   | 0.028   | 10.87   | 0.321   | -104.84 |
| 800 MHz   | 0.894   | -146.96 | 11.58   | 91.78   | 0.029   | 6.84    | 0.317   | -109.84 |
| 900 MHz   | 0.891   | -152.16 | 10.41   | 87.61   | 0.029   | 3.33    | 0.316   | -113.95 |
| 1.0 GHz   | 0.890   | -156.60 | 9.43    | 83.82   | 0.029   | 0.19    | 0.318   | -117.42 |
| 1.1 GHz   | 0.889   | -160.47 | 8.62    | 80.31   | 0.029   | -2.66   | 0.321   | -120.40 |
| 1.2 GHz   | 0.888   | -163.90 | 7.93    | 77.02   | 0.029   | -5.28   | 0.326   | -123.02 |
| 1.3 GHz   | 0.887   | -166.99 | 7.34    | 73.90   | 0.029   | -7.72   | 0.332   | -125.36 |
| 1.4 GHz   | 0.887   | -169.80 | 6.82    | 70.92   | 0.029   | -10.01  | 0.338   | -127.51 |
| 1.5 GHz   | 0.887   | -172.39 | 6.38    | 68.05   | 0.029   | -12.18  | 0.345   | -129.50 |
| 1.6 GHz   | 0.887   | -174.80 | 5.98    | 65.28   | 0.028   | -14.24  | 0.353   | -131.37 |
| 1.7 GHz   | 0.887   | -177.07 | 5.63    | 62.59   | 0.028   | -16.21  | 0.360   | -133.15 |
| 1.8 GHz   | 0.887   | -179.22 | 5.32    | 59.97   | 0.028   | -18.09  | 0.369   | -134.87 |
| 1.9 GHz   | 0.887   | 178.73  | 5.04    | 57.41   | 0.028   | -19.91  | 0.377   | -136.54 |
| 2.0 GHz   | 0.888   | 176.76  | 4.78    | 54.89   | 0.027   | -21.66  | 0.385   | -138.17 |
| 2.1 GHz   | 0.888   | 174.86  | 4.55    | 52.42   | 0.027   | -23.35  | 0.393   | -139.77 |
| 2.2 GHz   | 0.888   | 173.02  | 4.34    | 49.99   | 0.027   | -24.98  | 0.402   | -141.34 |
| 2.3 GHz   | 0.888   | 171.23  | 4.15    | 47.60   | 0.026   | -26.56  | 0.410   | -142.90 |
| 2.4 GHz   | 0.889   | 169.48  | 3.97    | 45.24   | 0.026   | -28.08  | 0.418   | -144.45 |
| 2.5 GHz   | 0.889   | 167.76  | 3.81    | 42.90   | 0.026   | -29.55  | 0.426   | -145.99 |
| 2.6 GHz   | 0.890   | 166.07  | 3.66    | 40.59   | 0.025   | -30.98  | 0.434   | -147.53 |
| 2.7 GHz   | 0.890   | 164.39  | 3.53    | 38.30   | 0.025   | -32.36  | 0.442   | -149.06 |
| 2.8 GHz   | 0.890   | 162.74  | 3.40    | 36.03   | 0.025   | -33.69  | 0.450   | -150.59 |
| 2.9 GHz   | 0.891   | 161.10  | 3.28    | 33.78   | 0.024   | -34.97  | 0.458   | -152.12 |
| 3.0 GHz   | 0.891   | 159.46  | 3.17    | 31.55   | 0.024   | -36.20  | 0.465   | -153.65 |
| 3.2 GHz   | 0.892   | 156.21  | 2.97    | 27.12   | 0.023   | -38.51  | 0.479   | -156.72 |
| 3.4 GHz   | 0.893   | 152.96  | 2.79    | 22.73   | 0.022   | -40.63  | 0.493   | -159.80 |
| 3.6 GHz   | 0.893   | 149.69  | 2.64    | 18.38   | 0.022   | -42.52  | 0.505   | -162.90 |
| 3.8 GHz   | 0.894   | 146.38  | 2.50    | 14.05   | 0.021   | -44.17  | 0.517   | -166.03 |
| 4.0 GHz   | 0.894   | 143.03  | 2.38    | 9.72    | 0.020   | -45.56  | 0.527   | -169.19 |
| 4.2 GHz   | 0.894   | 139.61  | 2.28    | 5.40    | 0.019   | -46.67  | 0.537   | -172.39 |
| 4.4 GHz   | 0.895   | 136.11  | 2.18    | 1.07    | 0.019   | -47.46  | 0.546   | -175.64 |
| 4.6 GHz   | 0.895   | 132.53  | 2.09    | -3.29   | 0.018   | -47.90  | 0.554   | -178.95 |
| 4.8 GHz   | 0.895   | 128.85  | 2.01    | -7.68   | 0.017   | -47.96  | 0.561   | -177.69 |
| 5.0 GHz   | 0.895   | 125.06  | 1.94    | -12.10  | 0.017   | -47.61  | 0.568   | 174.25  |
| 5.2 GHz   | 0.895   | 121.15  | 1.88    | -16.58  | 0.016   | -46.84  | 0.573   | 170.72  |
| 5.4 GHz   | 0.895   | 117.11  | 1.82    | -21.12  | 0.016   | -45.67  | 0.578   | 167.10  |
| 5.6 GHz   | 0.895   | 112.94  | 1.77    | -25.73  | 0.015   | -44.12  | 0.582   | 163.38  |
| 5.8 GHz   | 0.895   | 108.62  | 1.72    | -30.42  | 0.015   | -42.30  | 0.586   | 159.54  |
| 6.0 GHz   | 0.895   | 104.15  | 1.68    | -35.20  | 0.015   | -40.33  | 0.589   | 155.56  |

Download this s-parameter file in ".s2p" format at [http://www.cree.com/products/wireless\\_s-parameters.asp](http://www.cree.com/products/wireless_s-parameters.asp)



**Typical Package S-Parameters for CGH40010**  
**(Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 200\text{ mA}$ , angle in degrees)**

| Frequency | Mag S11 | Ang S11 | Mag S21 | Ang S21 | Mag S12 | Ang S12 | Mag S22 | Ang S22 |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| 500 MHz   | 0.911   | -130.62 | 18.41   | 105.41  | 0.022   | 19.44   | 0.303   | -112.24 |
| 600 MHz   | 0.906   | -139.65 | 15.80   | 99.47   | 0.023   | 14.31   | 0.299   | -119.83 |
| 700 MHz   | 0.902   | -146.70 | 13.80   | 94.50   | 0.023   | 10.17   | 0.298   | -125.50 |
| 800 MHz   | 0.899   | -152.41 | 12.22   | 90.19   | 0.023   | 6.68    | 0.299   | -129.85 |
| 900 MHz   | 0.898   | -157.17 | 10.96   | 86.34   | 0.024   | 3.67    | 0.302   | -133.28 |
| 1.0 GHz   | 0.896   | -161.24 | 9.92    | 82.82   | 0.024   | 0.99    | 0.305   | -136.05 |
| 1.1 GHz   | 0.896   | -164.79 | 9.06    | 79.56   | 0.024   | -1.41   | 0.309   | -138.34 |
| 1.2 GHz   | 0.895   | -167.95 | 8.33    | 76.49   | 0.024   | -3.62   | 0.314   | -140.30 |
| 1.3 GHz   | 0.895   | -170.80 | 7.70    | 73.57   | 0.023   | -5.66   | 0.320   | -142.01 |
| 1.4 GHz   | 0.894   | -173.41 | 7.17    | 70.78   | 0.023   | -7.56   | 0.326   | -143.54 |
| 1.5 GHz   | 0.894   | -175.82 | 6.70    | 68.08   | 0.023   | -9.35   | 0.332   | -144.94 |
| 1.6 GHz   | 0.894   | -178.09 | 6.28    | 65.47   | 0.023   | -11.05  | 0.338   | -146.24 |
| 1.7 GHz   | 0.894   | 179.78  | 5.92    | 62.92   | 0.023   | -12.66  | 0.345   | -147.48 |
| 1.8 GHz   | 0.894   | 177.75  | 5.59    | 60.43   | 0.023   | -14.19  | 0.352   | -148.68 |
| 1.9 GHz   | 0.894   | 175.81  | 5.30    | 57.99   | 0.023   | -15.65  | 0.358   | -149.84 |
| 2.0 GHz   | 0.894   | 173.94  | 5.04    | 55.59   | 0.022   | -17.05  | 0.365   | -150.99 |
| 2.1 GHz   | 0.894   | 172.13  | 4.80    | 53.23   | 0.022   | -18.39  | 0.372   | -152.12 |
| 2.2 GHz   | 0.894   | 170.37  | 4.58    | 50.91   | 0.022   | -19.67  | 0.379   | -153.26 |
| 2.3 GHz   | 0.895   | 168.65  | 4.38    | 48.61   | 0.022   | -20.90  | 0.386   | -154.39 |
| 2.4 GHz   | 0.895   | 166.96  | 4.20    | 46.33   | 0.021   | -22.08  | 0.393   | -155.54 |
| 2.5 GHz   | 0.895   | 165.30  | 4.03    | 44.08   | 0.021   | -23.20  | 0.400   | -156.69 |
| 2.6 GHz   | 0.895   | 163.66  | 3.88    | 41.84   | 0.021   | -24.27  | 0.407   | -157.85 |
| 2.7 GHz   | 0.895   | 162.04  | 3.74    | 39.63   | 0.021   | -25.28  | 0.414   | -159.03 |
| 2.8 GHz   | 0.895   | 160.43  | 3.60    | 37.43   | 0.020   | -26.25  | 0.420   | -160.22 |
| 2.9 GHz   | 0.896   | 158.83  | 3.48    | 35.24   | 0.020   | -27.16  | 0.427   | -161.42 |
| 3.0 GHz   | 0.896   | 157.24  | 3.37    | 33.06   | 0.020   | -28.02  | 0.433   | -162.64 |
| 3.2 GHz   | 0.896   | 154.06  | 3.16    | 28.74   | 0.019   | -29.57  | 0.446   | -165.13 |
| 3.4 GHz   | 0.896   | 150.87  | 2.98    | 24.44   | 0.019   | -30.88  | 0.457   | -167.69 |
| 3.6 GHz   | 0.896   | 147.66  | 2.82    | 20.16   | 0.018   | -31.95  | 0.468   | -170.31 |
| 3.8 GHz   | 0.897   | 144.41  | 2.68    | 15.89   | 0.018   | -32.76  | 0.478   | -173.00 |
| 4.0 GHz   | 0.897   | 141.10  | 2.56    | 11.61   | 0.017   | -33.30  | 0.488   | -175.77 |
| 4.2 GHz   | 0.897   | 137.72  | 2.45    | 7.33    | 0.017   | -33.55  | 0.497   | -178.61 |
| 4.4 GHz   | 0.897   | 134.26  | 2.35    | 3.03    | 0.017   | -33.50  | 0.505   | 178.47  |
| 4.6 GHz   | 0.897   | 130.71  | 2.26    | -1.31   | 0.016   | -33.18  | 0.512   | 175.46  |
| 4.8 GHz   | 0.896   | 127.06  | 2.17    | -5.68   | 0.016   | -32.58  | 0.518   | 172.36  |
| 5.0 GHz   | 0.896   | 123.30  | 2.10    | -10.09  | 0.016   | -31.74  | 0.524   | 169.16  |
| 5.2 GHz   | 0.896   | 119.42  | 2.04    | -14.57  | 0.016   | -30.72  | 0.529   | 165.86  |
| 5.4 GHz   | 0.896   | 115.41  | 1.98    | -19.10  | 0.016   | -29.60  | 0.534   | 162.44  |
| 5.6 GHz   | 0.896   | 111.26  | 1.92    | -23.71  | 0.016   | -28.46  | 0.537   | 158.89  |
| 5.8 GHz   | 0.895   | 106.97  | 1.87    | -28.40  | 0.017   | -27.41  | 0.540   | 155.20  |
| 6.0 GHz   | 0.895   | 102.53  | 1.82    | -33.19  | 0.017   | -26.54  | 0.543   | 151.36  |

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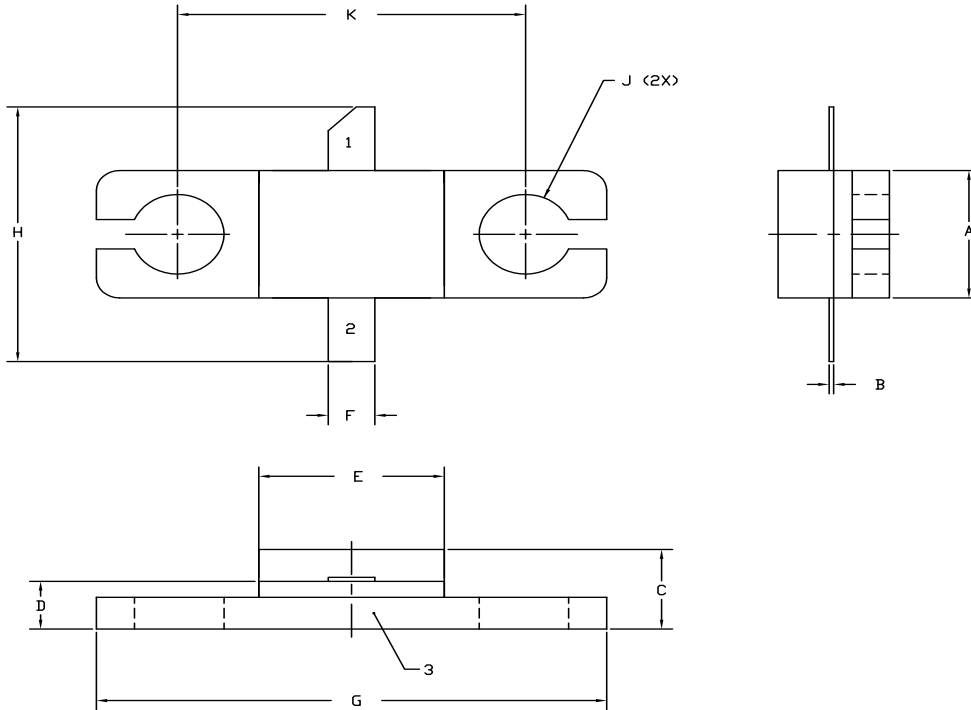


**Typical Package S-Parameters for CGH40010**  
**(Small Signal,  $V_{DS} = 28\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ , angle in degrees)**

| Frequency | Mag S11 | Ang S11 | Mag S21 | Ang S21 | Mag S12 | Ang S12 | Mag S22 | Ang S22 |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| 500 MHz   | 0.914   | -135.02 | 18.58   | 103.70  | 0.020   | 18.36   | 0.300   | -126.80 |
| 600 MHz   | 0.909   | -143.57 | 15.88   | 98.05   | 0.020   | 13.67   | 0.302   | -133.51 |
| 700 MHz   | 0.906   | -150.23 | 13.83   | 93.33   | 0.021   | 9.90    | 0.304   | -138.40 |
| 800 MHz   | 0.904   | -155.61 | 12.23   | 89.23   | 0.021   | 6.77    | 0.307   | -142.08 |
| 900 MHz   | 0.903   | -160.09 | 10.95   | 85.56   | 0.021   | 4.08    | 0.311   | -144.94 |
| 1.0 GHz   | 0.902   | -163.93 | 9.91    | 82.21   | 0.021   | 1.71    | 0.314   | -147.23 |
| 1.1 GHz   | 0.901   | -167.29 | 9.04    | 79.09   | 0.021   | -0.41   | 0.319   | -149.10 |
| 1.2 GHz   | 0.901   | -170.29 | 8.31    | 76.15   | 0.021   | -2.35   | 0.323   | -150.69 |
| 1.3 GHz   | 0.900   | -173.00 | 7.69    | 73.35   | 0.021   | -4.12   | 0.328   | -152.07 |
| 1.4 GHz   | 0.900   | -175.50 | 7.15    | 70.66   | 0.021   | -5.78   | 0.333   | -153.29 |
| 1.5 GHz   | 0.900   | -177.81 | 6.69    | 68.07   | 0.021   | -7.32   | 0.338   | -154.41 |
| 1.6 GHz   | 0.900   | -179.98 | 6.27    | 65.54   | 0.021   | -8.77   | 0.344   | -155.44 |
| 1.7 GHz   | 0.900   | 177.96  | 5.91    | 63.08   | 0.020   | -10.15  | 0.349   | -156.43 |
| 1.8 GHz   | 0.899   | 176.00  | 5.59    | 60.67   | 0.020   | -11.45  | 0.355   | -157.38 |
| 1.9 GHz   | 0.899   | 174.12  | 5.30    | 58.30   | 0.020   | -12.68  | 0.361   | -158.30 |
| 2.0 GHz   | 0.899   | 172.31  | 5.04    | 55.97   | 0.020   | -13.85  | 0.366   | -159.22 |
| 2.1 GHz   | 0.899   | 170.54  | 4.80    | 53.67   | 0.020   | -14.96  | 0.372   | -160.14 |
| 2.2 GHz   | 0.900   | 168.83  | 4.58    | 51.40   | 0.020   | -16.01  | 0.378   | -161.06 |
| 2.3 GHz   | 0.900   | 167.15  | 4.39    | 49.16   | 0.019   | -17.01  | 0.384   | -161.99 |
| 2.4 GHz   | 0.900   | 165.49  | 4.21    | 46.94   | 0.019   | -17.95  | 0.390   | -162.93 |
| 2.5 GHz   | 0.900   | 163.87  | 4.04    | 44.73   | 0.019   | -18.85  | 0.396   | -163.88 |
| 2.6 GHz   | 0.900   | 162.26  | 3.89    | 42.54   | 0.019   | -19.69  | 0.402   | -164.86 |
| 2.7 GHz   | 0.900   | 160.66  | 3.75    | 40.37   | 0.019   | -20.48  | 0.407   | -165.85 |
| 2.8 GHz   | 0.900   | 159.08  | 3.62    | 38.21   | 0.019   | -21.21  | 0.413   | -166.86 |
| 2.9 GHz   | 0.900   | 157.51  | 3.50    | 36.05   | 0.018   | -21.89  | 0.418   | -167.89 |
| 3.0 GHz   | 0.900   | 155.93  | 3.39    | 33.91   | 0.018   | -22.52  | 0.424   | -168.95 |
| 3.2 GHz   | 0.900   | 152.79  | 3.18    | 29.65   | 0.018   | -23.61  | 0.435   | -171.12 |
| 3.4 GHz   | 0.900   | 149.64  | 3.00    | 25.40   | 0.017   | -24.48  | 0.445   | -173.38 |
| 3.6 GHz   | 0.900   | 146.45  | 2.85    | 21.17   | 0.017   | -25.11  | 0.454   | -175.73 |
| 3.8 GHz   | 0.900   | 143.23  | 2.71    | 16.93   | 0.017   | -25.51  | 0.463   | -178.17 |
| 4.0 GHz   | 0.900   | 139.94  | 2.58    | 12.69   | 0.017   | -25.67  | 0.471   | 179.30  |
| 4.2 GHz   | 0.900   | 136.58  | 2.47    | 8.43    | 0.016   | -25.60  | 0.479   | 176.67  |
| 4.4 GHz   | 0.899   | 133.14  | 2.38    | 4.15    | 0.016   | -25.32  | 0.486   | 173.94  |
| 4.6 GHz   | 0.899   | 129.61  | 2.29    | -0.17   | 0.016   | -24.85  | 0.492   | 171.12  |
| 4.8 GHz   | 0.899   | 125.97  | 2.21    | -4.53   | 0.016   | -24.24  | 0.498   | 168.18  |
| 5.0 GHz   | 0.898   | 122.23  | 2.13    | -8.94   | 0.016   | -23.54  | 0.503   | 165.13  |
| 5.2 GHz   | 0.898   | 118.36  | 2.07    | -13.41  | 0.016   | -22.80  | 0.507   | 161.96  |
| 5.4 GHz   | 0.898   | 114.36  | 2.01    | -17.95  | 0.017   | -22.11  | 0.511   | 158.66  |
| 5.6 GHz   | 0.897   | 110.22  | 1.95    | -22.56  | 0.017   | -21.54  | 0.514   | 155.22  |
| 5.8 GHz   | 0.897   | 105.94  | 1.90    | -27.26  | 0.018   | -21.16  | 0.517   | 151.63  |
| 6.0 GHz   | 0.897   | 101.51  | 1.86    | -32.04  | 0.019   | -21.04  | 0.519   | 147.87  |

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## Product Dimensions CGH40010F (Package Type – 440166)



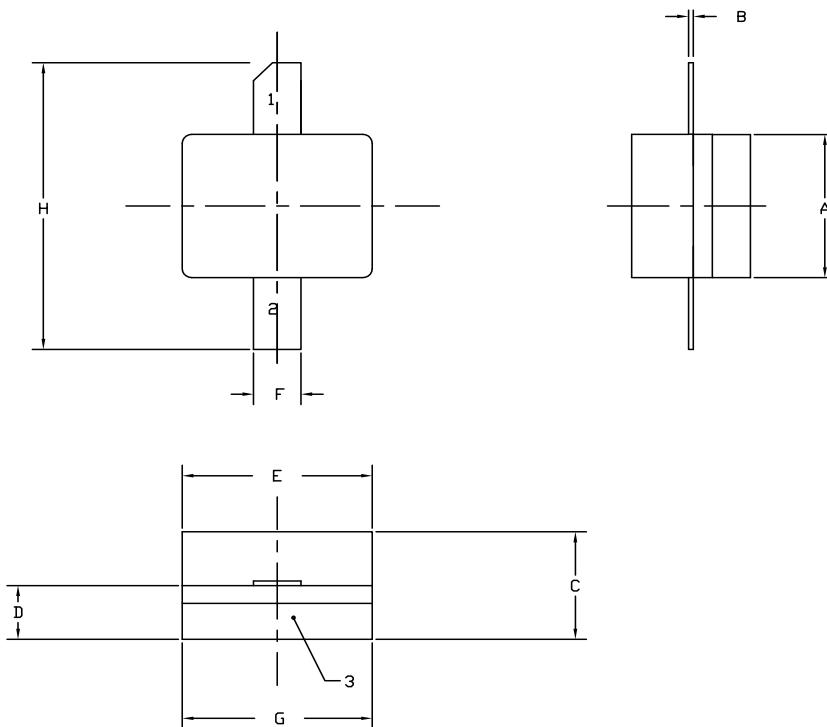
**NOTES:**

1. DIMENSIONING AND TOLERANCING 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   | 0.155  | 0.165 | 3.94        | 4.19  |
| B   | 0.004  | 0.006 | 0.10        | 0.15  |
| C   | 0.115  | 0.135 | 2.92        | 3.43  |
| D   | 0.057  | 0.067 | 1.45        | 1.70  |
| E   | 0.195  | 0.205 | 4.95        | 5.21  |
| F   | 0.045  | 0.055 | 1.14        | 1.40  |
| G   | 0.545  | 0.555 | 13.84       | 14.09 |
| H   | 0.280  | 0.360 | 7.11        | 9.14  |
| J   | Ø .100 |       | 2.54        |       |
| K   | 0.375  |       | 9.53        |       |

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

## Product Dimensions CGH40010P (Package Type – 440196)



**NOTES:**

1. DIMENSIONING AND TOLERANCING 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   | 0.155  | 0.165 | 3.94        | 4.19 |
| B   | 0.003  | 0.006 | 0.10        | 0.15 |
| C   | 0.115  | 0.135 | 2.92        | 3.17 |
| D   | 0.057  | 0.067 | 1.45        | 1.70 |
| E   | 0.195  | 0.205 | 4.95        | 5.21 |
| F   | 0.045  | 0.055 | 1.14        | 1.40 |
| G   | 0.195  | 0.205 | 4.95        | 5.21 |
| H   | 0.280  | 0.360 | 7.11        | 9.14 |

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



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