

CGH35240F

240 W, 3100-3500 MHz, 50-ohm Input/Output Matched, GaN HEMT for S-Band Radar Systems

Cree's CGH35240F is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically with high efficiency, high gain and wide bandwidth capabilities, which makes the CGH35240F ideal for 3.1-3.5GHz S-Band radar amplifier applications. The transistor is supplied in a ceramic/metal flange package.



Package Type: 440201
PN: CGH35240F

Typical Performance Over 3.1-3.5GHz ($T_c = 25^\circ\text{C}$) of Demonstration Amplifier

| Parameter | 3.1 GHz | 3.2 GHz | 3.3 GHz | 3.4 GHz | 3.5 GHz | Units |
|------------------------|---------|---------|---------|---------|---------|-------|
| Output Power | 250 | 240 | 225 | 225 | 220 | W |
| Gain | 12.1 | 11.9 | 11.6 | 11.5 | 11.4 | dB |
| Power Added Efficiency | 60 | 59 | 57 | 52 | 48 | % |

Note:

Measured in the CGH35240F-AMP amplifier circuit, under 300 μs pulse width, 20% duty cycle, $P_{IN} = 42 \text{ dBm}$.

Features

- 3.1 - 3.5 GHz Operation
- 240 W Typical Output Power
- 11.6 dB Power Gain at $P_{IN} = 42.0 \text{ dBm}$
- 57 % Typical Power Added Efficiency
- 50 Ohm Internally Matched
- <0.2 dB Pulsed Amplitude Droop

Large Signal Models Available for ADS and MWO



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

| Parameter | Symbol | Rating | Units | Conditions |
|--|-----------------|-----------|-------|------------|
| Pulse Width | PW | 1 | ms | |
| Duty Cycle | DC | 50 | % | |
| Drain-Source Voltage | V_{DSS} | 120 | Volts | 25°C |
| Gate-to-Source Voltage | V_{GS} | -10, +2 | Volts | 25°C |
| Power Dissipation | P_{DISS} | 345 | Watts | |
| Storage Temperature | T_{STG} | -65, +150 | °C | |
| Operating Junction Temperature | T_J | 225 | °C | |
| Maximum Forward Gate Current | I_{GMAX} | 60 | mA | 25°C |
| Maximum Drain Current ¹ | I_{DMAX} | 24 | A | 25°C |
| Soldering Temperature ² | T_S | 245 | °C | |
| Screw Torque | τ | 40 | in-oz | |
| Pulsed Thermal Resistance, Junction to Case ³ | $R_{\theta JC}$ | 0.5 | °C/W | 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 Measured for the CGH35240F at $P_{DISS} = 280$ W. Pulse Width = 300 μ S, Duty Cycle = 20%.

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 | -3.0 | -2.3 | V_{DC} | $V_{DS} = 10$ V, $I_D = 57.6$ mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | - | -2.7 | - | V_{DC} | $V_{DS} = 28$ V, $I_D = 1.0$ A |
| Saturated Drain Current ² | I_{DS} | 46.4 | 56.0 | - | A | $V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V |
| Drain-Source Breakdown Voltage | V_{BR} | 120 | - | - | V_{DC} | $V_{GS} = -8$ V, $I_D = 57.6$ mA |
| RF Characteristics³ ($T_C = 25^\circ\text{C}$, $F_0 = 3.1\text{-}3.5$ GHz unless otherwise noted) | | | | | | |
| Output Power ₁ at 3.1 GHz | P_{OUT} | 210 | 250 | - | W | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Output Power ₂ at 3.3 GHz | P_{OUT} | 200 | 225 | - | W | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Output Power ₃ at 3.5 GHz | P_{OUT} | 180 | 220 | - | W | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Power Added Efficiency ₁ at 3.1 GHz | PAE | 48 | 60 | - | % | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Power Added Efficiency ₂ at 3.3 GHz | PAE | 48 | 57 | - | % | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Power Added Efficiency ₃ at 3.5 GHz | PAE | 40 | 48 | - | % | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Power Gain ₁ at 3.1 GHz | G_P | 11.0 | 12.0 | - | dB | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Power Gain ₂ at 3.3 GHz | G_P | 10.8 | 11.5 | - | dB | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Power Gain ₃ at 3.5 GHz | G_P | 10.5 | 11.5 | - | dB | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = 42$ dBm |
| Small Signal Gain | S21 | 11.4 | 14 | - | dB | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = -10$ dBm |
| Input Return Loss | S11 | - | -9 | -4.5 | dB | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = -10$ dBm |
| Output Return Loss | S22 | - | -10 | -4.5 | dB | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{IN} = -10$ dBm |
| Pulsed Amplitude Droop | D | - | 0.1 | - | dB | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A |

Notes:

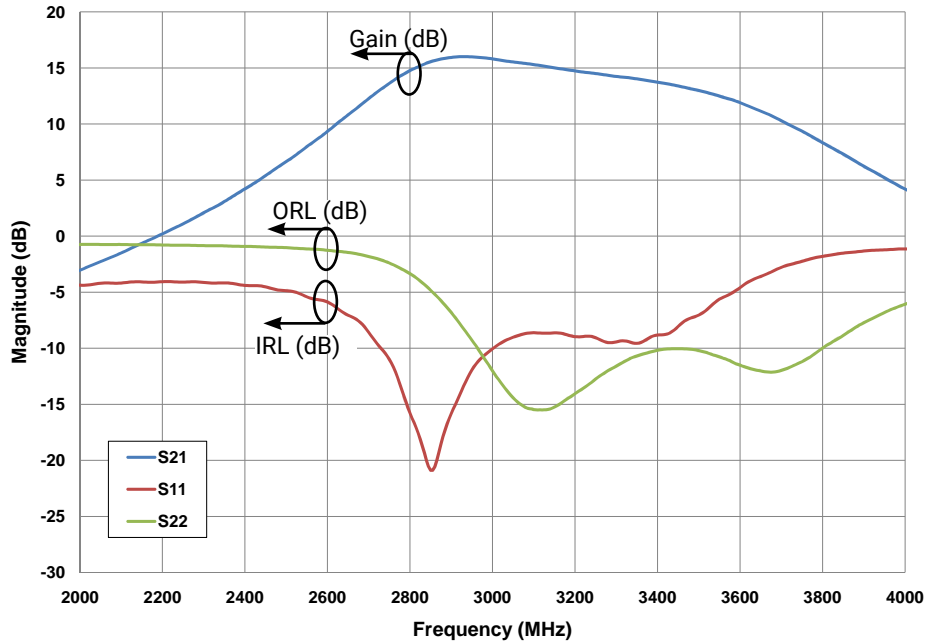
¹ Measured on wafer prior to packaging.

² Scaled from PCM data.

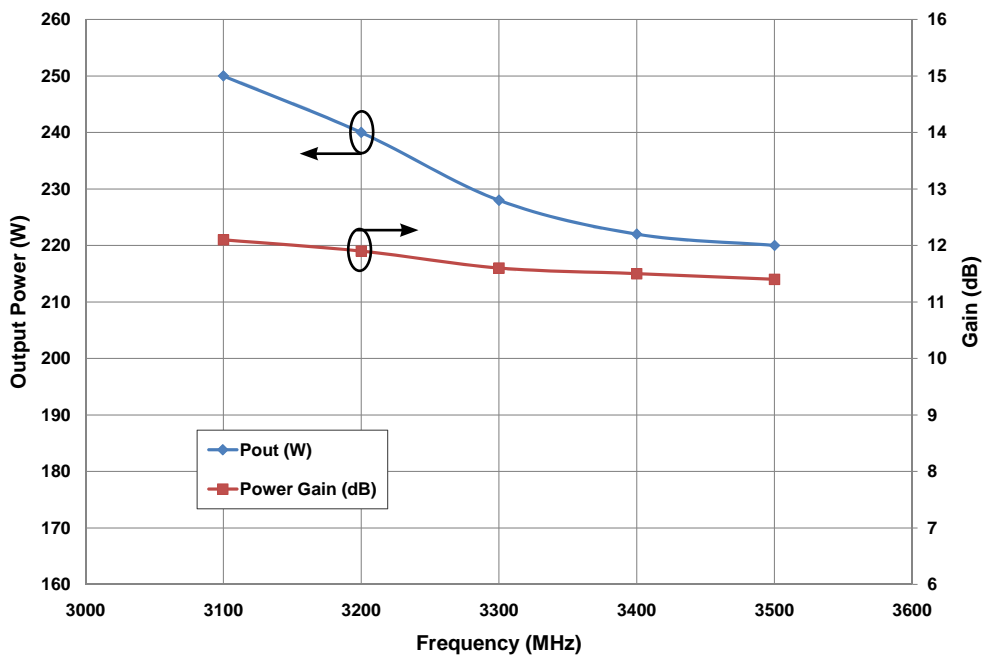
³ Measured in CGH35240F-AMP. Pulse Width = 300 μ S, Duty Cycle = 20%.

Typical Performance

Gain and Return Losses vs Frequency
Measured in CGH35240-AMP Amplifier Circuit.
 $V_{DS} = 28\text{ V}, I_{DS} = 1\text{ A}$

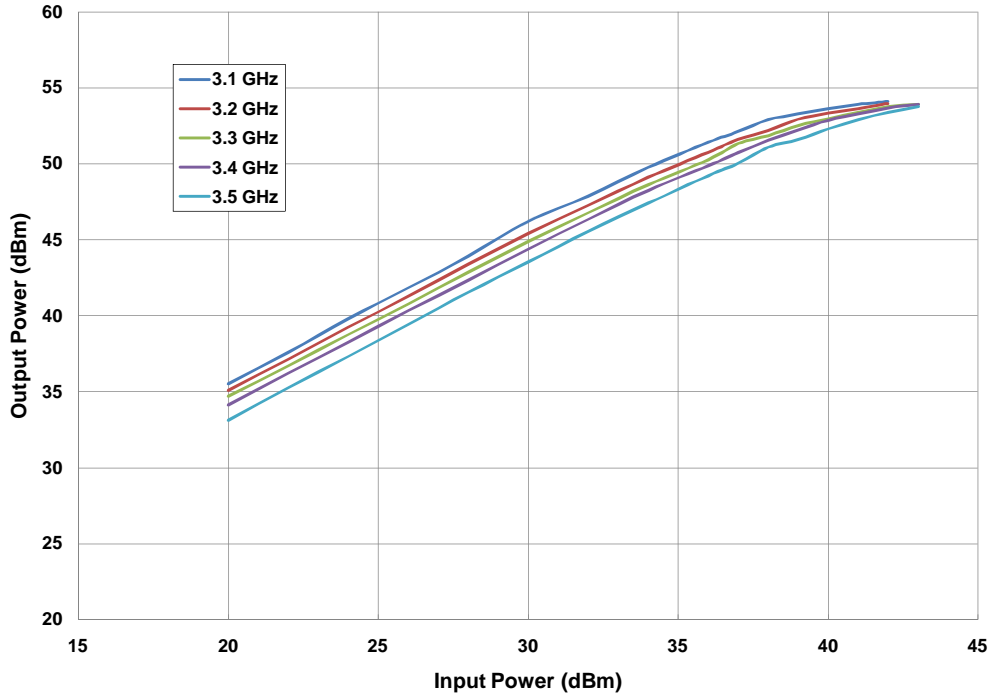


Typical Pulsed Output Power and Power Gain vs Frequency
Measured in CGH35240-AMP Amplifier Circuit.
 $V_{DS} = 28\text{ V}, I_{DS} = 1\text{ A}, P_{IN} = 42\text{ dBm}, \text{Pulse Width} = 300\ \mu\text{s}, \text{Duty Cycle} = 20\%$

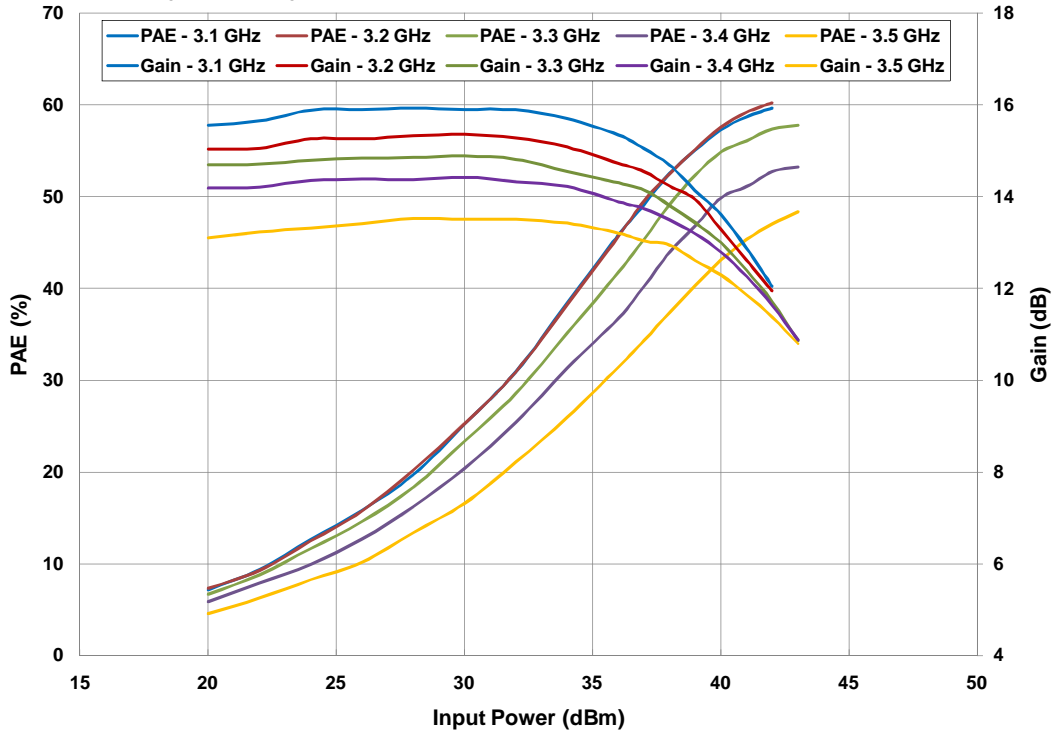


Typical Performance

CGH35240 Output Power vs Input Power
 $V_{DS} = 28\text{ V}$, $I_{DS} = 1\text{ A}$, Pulse Width = 300 μS , Duty Cycle = 20 %



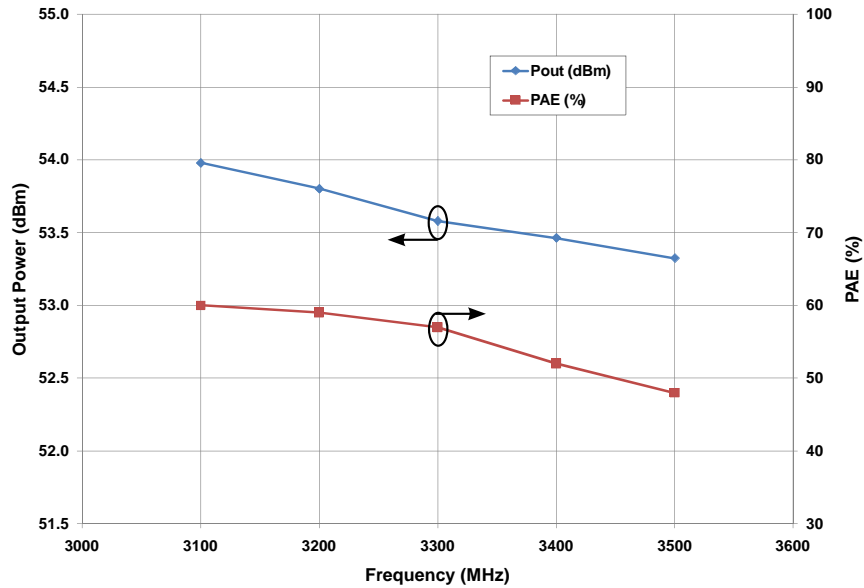
CGH35240 PAE & Gain vs Input Power
 $V_{DS} = 28\text{ V}$, $I_{DS} = 1\text{ A}$, Pulse Width = 300 μS , Duty Cycle = 20 %



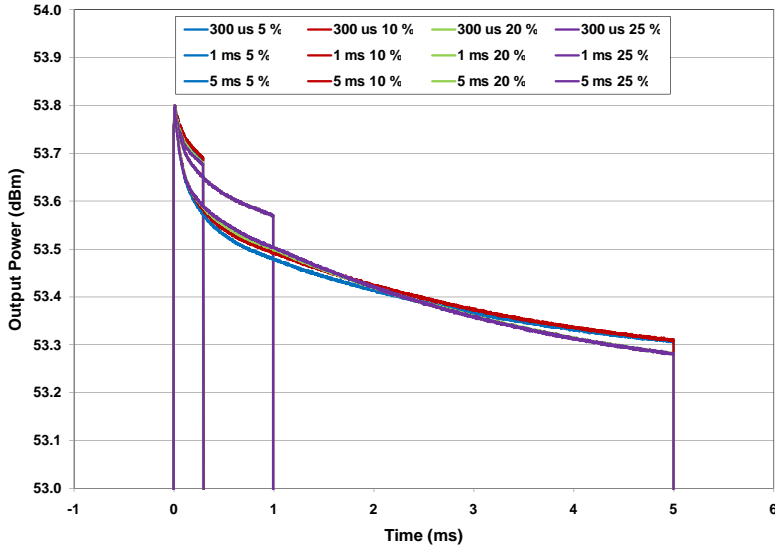
Typical Performance

Typical Pulsed Output Power and Power Added Efficiency vs Frequency Measured in CGH35240-AMP Amplifier Circuit.

$V_{DS} = 28\text{ V}$, $I_{DS} = 1\text{ A}$, $P_{IN} = 42\text{ dBm}$, Pulse Width = $300\text{ }\mu\text{s}$, Duty Cycle = 20%



Typical Pulse Droop Performance

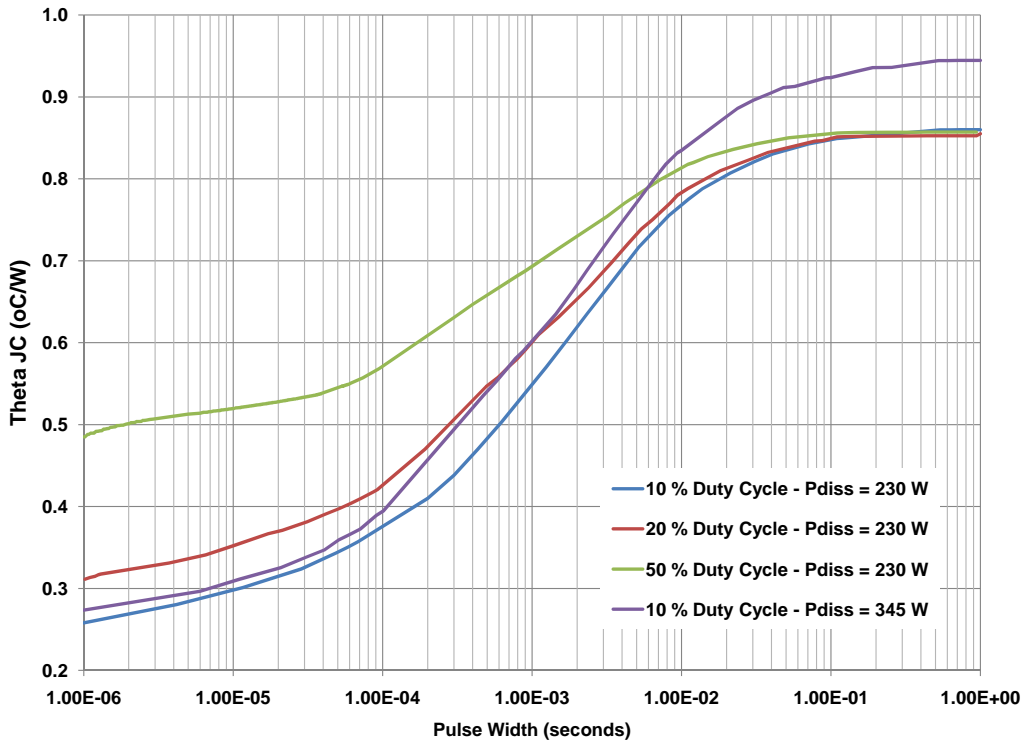


| Pulse Width | Duty Cycle (%) | Droop (dB) |
|-------------|----------------|------------|
| 10 us | 5-25 | 0.05 |
| 50 us | 5-25 | 0.05 |
| 100 us | 5-25 | 0.10 |
| 300 us | 5-25 | 0.15 |
| 1 ms | 5-25 | 0.30 |
| 5 ms | 5-25 | 0.60 |

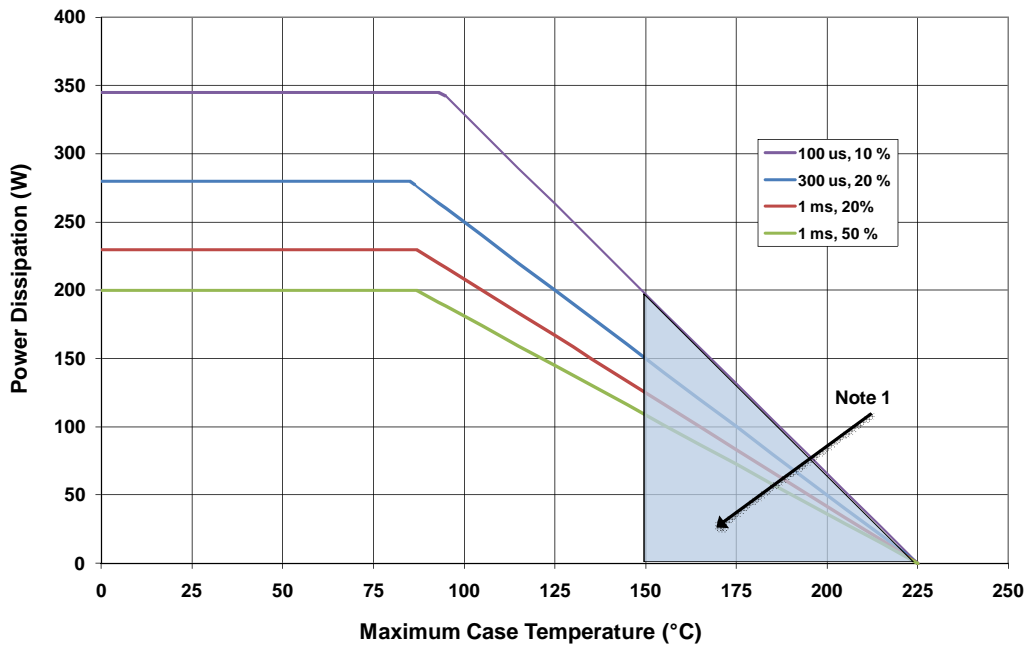
Electrostatic Discharge (ESD) Classifications

| Parameter | Symbol | Class | Test Methodology |
|---------------------|--------|------------------|---------------------|
| Human Body Model | HBM | 1A (> 250 V) | JEDEC JESD22 A114-D |
| Charge Device Model | CDM | II (200 < 500 V) | JEDEC JESD22 C101-C |

CGH35240F Transient Thermal Curve



CGH35240F Transient Power Dissipation De-rating Curve

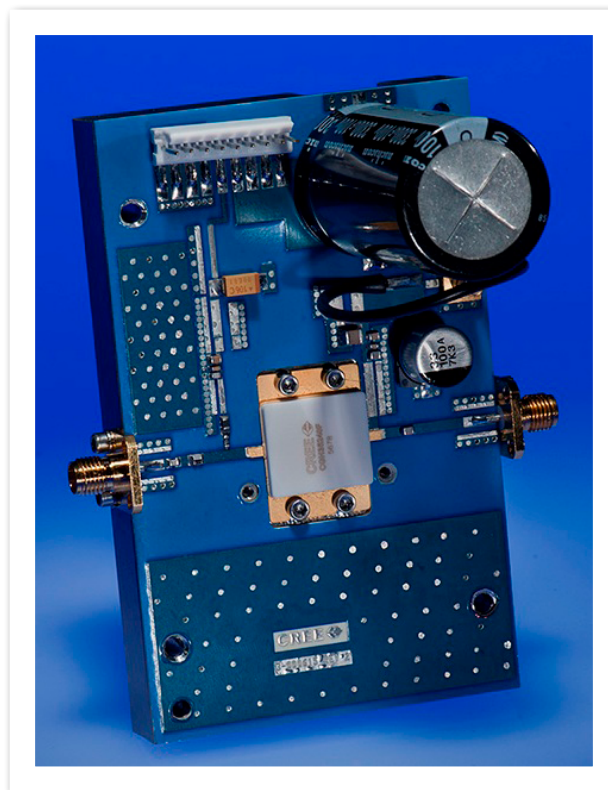


Note 1. Area exceeds Maximum Case Operating Temperature (See Page 2).

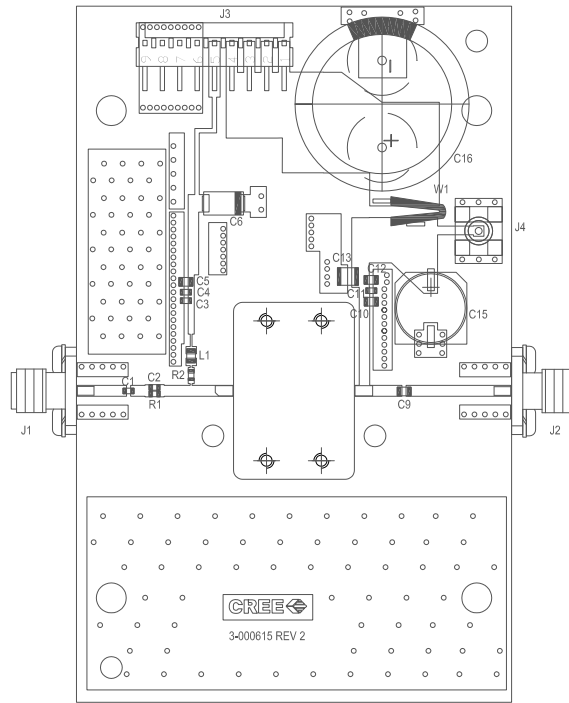
CGH35240F-AMP Demonstration Amplifier Circuit Bill of Materials

| Designator | Description | Qty |
|------------|--|-----|
| R1 | RES, 511 OHM, +/- 1%, 1/16W,0603 | 1 |
| R2 | RES, 5.1,OHM, +/- 1%, 1/16W,0603 | 1 |
| C1,C3 | CAP, 10.0pF, +/-5%,250V, 0603, | 2 |
| C2 | CAP, 6.8pF, +/- 0.25 pF,250V, 0603 | 1 |
| C4,C11 | CAP, 470PF, +/-5%, 100V, 0603, X | 2 |
| C15 | CAP, 33 UF, 20%, G CASE | 1 |
| C5,C12 | CAP,33000PF, 0805,100V, X7R | 2 |
| C13 | CAP, 1.0UF, 100V, 10%, X7R, 1210 | 1 |
| C6 | CAP 10UF 16V TANTALUM | 1 |
| C9,C10 | CAP, 10pF, +/- 1%, 250V, 0805 | 2 |
| C16 | CAP, 3300 UF, +/-20%, 100V, ELECTROLYTIC | 1 |
| J1,J2 | CONN, SMA, PANEL MOUNT JACK, FL | 2 |
| J3 | HEADER RT>PLZ .1CEN LK 9POS | 1 |
| J4 | CONNECTOR ; SMB, Straight, JACK,SMD | 1 |
| W1 | CABLE ,18 AWG, 4.2 | 1 |
| L1 | FERRITE, 22 OHM, 0805, BLM21PG220SN1 | 1 |
| - | PCB, R04350, 2.5 X 4.0 X 0.030 | 1 |
| Q1 | CGH35240F | 1 |

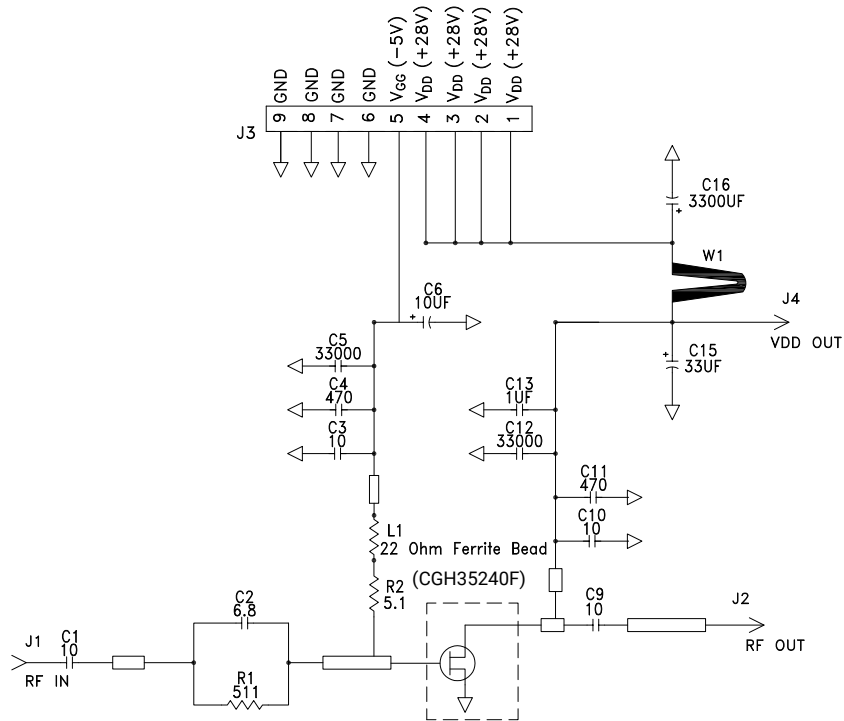
CGH35240F-AMP Demonstration Amplifier Circuit



CGH35240F-AMP Demonstration Amplifier Circuit Outline



CGH35240F-AMP Demonstration Amplifier Circuit Schematic



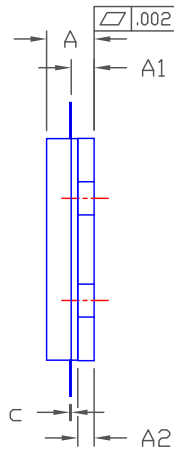
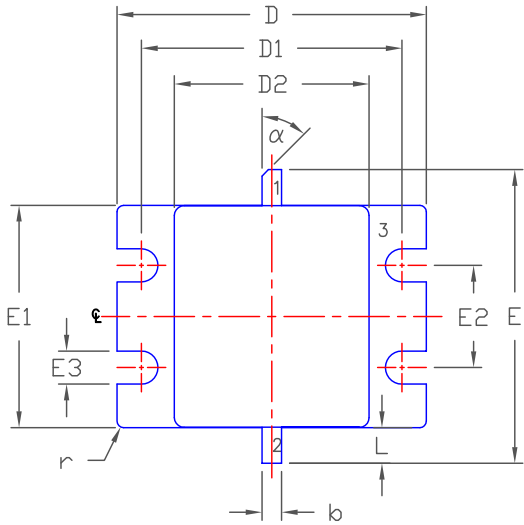


Typical Package S-Parameters for CGH35240F
 (Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 1000\text{ mA}$, angle in degrees)

| Frequency | Mag S11 | Ang S11 | Mag S21 | Ang S21 | Mag S12 | Ang S12 | Mag S22 | Ang S22 |
|-----------|---------|---------|---------|---------|---------|---------|---------|----------|
| 500 MHz | 0.909 | -110.39 | 0.67 | 85.30 | 0.001 | 7.79 | 0.931 | -175.71 |
| 600 MHz | 0.887 | -133.63 | 0.68 | 52.25 | 0.001 | -22.14 | 0.926 | 161.61 |
| 700 MHz | 0.861 | -157.29 | 0.67 | 21.72 | 0.002 | -50.42 | 0.925 | 140.70 |
| 800 MHz | 0.831 | 178.80 | 0.65 | -6.95 | 0.002 | -74.38 | 0.924 | 120.94 |
| 900 MHz | 0.800 | 154.60 | 0.64 | -34.16 | 0.002 | -110.45 | 0.924 | 101.95 |
| 1.0 GHz | 0.770 | 130.18 | 0.63 | -60.27 | 0.002 | -135.64 | 0.924 | 83.44 |
| 1.2 GHz | 0.723 | 80.74 | 0.64 | -110.13 | 0.002 | 166.59 | 0.919 | 46.75 |
| 1.4 GHz | 0.698 | 29.48 | 0.69 | -160.34 | 0.002 | 127.53 | 0.896 | 9.09 |
| 1.6 GHz | 0.618 | -28.54 | 0.76 | 137.30 | 0.004 | 116.81 | 0.766 | -28.92 |
| 1.8 GHz | 0.443 | -48.39 | 0.45 | 107.33 | 0.003 | 53.00 | 0.861 | -47.01 |
| 2.0 GHz | 0.569 | -89.52 | 0.69 | 73.39 | 0.003 | -0.59 | 0.915 | -88.98 |
| 2.1 GHz | 0.594 | -111.61 | 0.83 | 51.20 | 0.004 | -23.48 | 0.913 | -108.69 |
| 2.2 GHz | 0.606 | -133.58 | 1.01 | 28.33 | 0.005 | -45.69 | 0.908 | -128.26 |
| 2.3 GHz | 0.607 | -155.92 | 1.25 | 4.25 | 0.007 | -71.50 | 0.902 | -148.11 |
| 2.4 GHz | 0.595 | -179.54 | 1.59 | -21.28 | 0.009 | -99.04 | 0.895 | -168.80 |
| 2.5 GHz | 0.561 | 154.35 | 2.11 | -49.48 | 0.013 | -129.12 | 0.883 | 169.09 |
| 2.6 GHz | 0.499 | 124.82 | 2.87 | -80.80 | 0.018 | -161.39 | 0.861 | 144.62 |
| 2.7 GHz | 0.376 | 85.52 | 4.03 | -118.36 | 0.027 | 161.11 | 0.813 | 115.40 |
| 2.8 GHz | 0.177 | 20.59 | 5.38 | -164.13 | 0.039 | 115.01 | 0.690 | 79.55 |
| 2.9 GHz | 0.165 | -127.79 | 6.17 | 144.62 | 0.049 | 64.36 | 0.480 | 37.79 |
| 3.0 GHz | 0.309 | 163.81 | 6.11 | 96.28 | 0.052 | 15.24 | 0.288 | -7.26 |
| 3.1 GHz | 0.354 | 118.49 | 5.80 | 52.70 | 0.052 | -28.98 | 0.208 | -64.36 |
| 3.2 GHz | 0.329 | 74.79 | 5.47 | 11.41 | 0.052 | -70.29 | 0.236 | -120.98 |
| 3.3 GHz | 0.286 | 23.15 | 5.19 | -29.09 | 0.052 | -110.99 | 0.302 | -160.98 |
| 3.4 GHz | 0.300 | -38.01 | 4.94 | -70.05 | 0.052 | -151.88 | 0.354 | 167.78 |
| 3.5 GHz | 0.406 | -96.34 | 4.55 | -112.29 | 0.050 | 165.57 | 0.350 | 142.39 |
| 3.6 GHz | 0.565 | -143.08 | 4.00 | -154.80 | 0.046 | 122.85 | 0.300 | 127.36 |
| 3.7 GHz | 0.708 | 177.87 | 3.32 | 163.85 | 0.040 | 81.34 | 0.271 | 127.66 |
| 3.8 GHz | 0.799 | 143.73 | 2.64 | 125.19 | 0.033 | 42.95 | 0.321 | 129.68 |
| 3.9 GHz | 0.847 | 113.69 | 2.09 | 89.39 | 0.027 | 7.05 | 0.410 | 122.23 |
| 4.0 GHz | 0.868 | 85.65 | 1.65 | 56.14 | 0.022 | -25.45 | 0.497 | 108.92 |
| 4.2 GHz | 0.853 | 30.51 | 1.10 | -6.76 | 0.016 | -84.72 | 0.622 | 78.62 |
| 4.4 GHz | 0.803 | -32.21 | 0.75 | -69.35 | 0.012 | -148.46 | 0.700 | 47.77 |
| 4.6 GHz | 0.765 | -101.68 | 0.51 | -131.73 | 0.008 | 147.89 | 0.743 | 16.36 |
| 4.8 GHz | 0.770 | -166.93 | 0.32 | 167.88 | 0.005 | 101.70 | 0.762 | -17.52 |
| 5.0 GHz | 0.785 | 141.18 | 0.20 | 113.11 | 0.004 | 59.25 | 0.747 | -56.70 |
| 5.2 GHz | 0.786 | 100.39 | 0.13 | 60.03 | 0.005 | 5.11 | 0.676 | -106.08 |
| 5.4 GHz | 0.761 | 65.91 | 0.08 | -1.66 | 0.007 | -83.46 | 0.447 | -179.99 |
| 5.6 GHz | 0.691 | 35.57 | 0.03 | -48.77 | 0.005 | 159.03 | 0.055 | 2 122.03 |
| 5.8 GHz | 0.608 | 11.51 | 0.02 | -59.15 | 0.004 | 57.07 | 0.310 | 23.86 |
| 6.0 GHz | 0.604 | -18.74 | 0.01 | -102.12 | 0.003 | -9.32 | 0.594 | -75.04 |

To download the s-parameters in s2p format, go to the [CGH35240F Product Page](#) and click on the documentation tab.

Product Dimensions CGH35240F (Package Type – 440201)





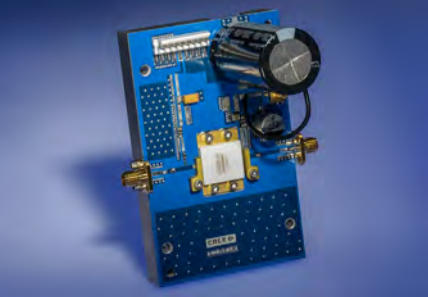
- PIN 1. GATE
 2. DRAIN
 3. SOURCE

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 | 0.128 | 0.148 | 3.25 | 3.76 | |
| A1 | 0.057 | 0.067 | 1.45 | 1.70 | |
| A2 | 0.035 | 0.045 | 0.89 | 1.14 | |
| b | 0.055 | 0.065 | 1.40 | 1.65 | 2x |
| c | 0.004 | 0.007 | 0.08 | 0.15 | |
| D | 0.948 | 0.958 | 24.08 | 24.33 | |
| D1 | 0.798 | 0.808 | 20.27 | 20.52 | |
| D2 | 0.595 | 0.605 | 15.11 | 15.37 | |
| E | 0.880 | 0.930 | 22.35 | 23.62 | |
| E1 | 0.680 | 0.694 | 17.27 | 17.63 | |
| E2 | 0.310 | 0.320 | 7.87 | 8.13 | |
| E3 | 0.097 | 0.107 | 2.46 | 2.72 | 4x |
| L | 0.095 | 0.125 | 2.41 | 3.18 | 2x |
| r | 0.02 TYP | | 0.51 TYP | | 4x |
| α | 45° REF | | 45° REF | | |

Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|---------------|------------------------------------|-----------------|---|
| CGH35240F | GaN HEMT | Each |  |
| CGH35240F-TB | Test board without GaN HEMT | Each |  |
| CGH35240F-AMP | Test board with GaN HEMT installed | Each |  |



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