

CGHV14250

250 W, 1200 - 1400 MHz, GaN HEMT for L-Band Radar Systems

Cree's CGHV14250 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically with high efficiency, high gain and wide bandwidth capabilities, which makes the CGHV14250 ideal for 1.2 - 1.4 GHz L-Band radar amplifier applications. The transistor could be utilized for band specific applications ranging from 900 through 1800 MHz. The package options are ceramic/metal flange and pill package.



Package Type: 440162, 440161
PN: CGHV14250F, CGHV14250P

Typical Performance Over 1.2-1.4 GHz ($T_c = 25^\circ\text{C}$) of Demonstration Amplifier

| Parameter | 1.2 GHz | 1.25 GHz | 1.3 GHz | 1.35 GHz | 1.4 GHz | Units |
|------------------|---------|----------|---------|----------|---------|-------|
| Output Power | 365 | 365 | 350 | 310 | 330 | W |
| Gain | 18.6 | 18.6 | 18.4 | 17.9 | 18.2 | dB |
| Drain Efficiency | 80 | 80 | 77 | 74 | 76 | % |

Note:

Measured in the CGHV14250-AMP amplifier circuit, under 500 μs pulse width, 10% duty cycle, $P_{IN} = 37 \text{ dBm}$.

Features

- Reference design amplifier 1.2 - 1.4 GHz Operation
- FET Tuning range UHF through 1800 MHz
- 330 W Typical Output Power
- 18 dB Power Gain
- 77% Typical Drain Efficiency
- <0.3 dB Pulsed Amplitude Droop
- Internally pre-matched on input, unmatched output

Large Signal Models Available for ADS and MWO

Absolute Maximum Ratings (not simultaneous)

| Parameter | Symbol | Rating | Units | Conditions |
|--|------------------|-----------|-------|---|
| Drain-Source Voltage | V_{DSS} | 125 | 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} | 42 | mA | 25°C |
| Maximum Drain Current ¹ | I_{DMAX} | 18 | A | 25°C |
| Soldering Temperature ² | T_S | 245 | °C | |
| Screw Torque | τ | 40 | in-oz | |
| CW Thermal Resistance, Junction to Case ³ | $R_{\theta JC}$ | 0.95 | °C/W | $P_{DISS} = 167 \text{ W}, 65^\circ\text{C}$ |
| Pulsed Thermal Resistance, Junction to Case ³ | $R_{\theta JCS}$ | 0.57 | °C/W | $P_{DISS} = 167 \text{ W}, 500 \mu\text{sec}, 10\%, 85^\circ\text{C}$ |
| Pulsed Thermal Resistance, Junction to Case ⁴ | $R_{\theta JC}$ | 0.63 | °C/W | $P_{DISS} = 167 \text{ W}, 500 \mu\text{sec}, 10\%, 85^\circ\text{C}$ |
| Case Operating Temperature ⁵ | T_C | -40, +130 | °C | $P_{DISS} = 167 \text{ W}, 500 \mu\text{sec}, 10\%$ |

Note:

¹ Current limit for long term, reliable operation

² Refer to the Application Note on soldering at <http://www.cree.com/rf/document-library>

³ Measured for the CGHV14250P

⁴ Measured for the CGHV14250F

⁵ See also, the Power Dissipation De-rating Curve on Page 5

Electrical Characteristics

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|--------------|------|-------|------|----------|--|
| DC Characteristics¹ ($T_C = 25^\circ\text{C}$) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -3.8 | -3.0 | -2.3 | V_{DC} | $V_{DS} = 10 \text{ V}, I_D = 41.8 \text{ mA}$ |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | - | -2.7 | - | V_{DC} | $V_{DS} = 50 \text{ V}, I_D = 500 \text{ mA}$ |
| Saturated Drain Current ² | I_{DS} | 31.4 | 37.6 | - | A | $V_{DS} = 6.0 \text{ V}, V_{GS} = 2.0 \text{ V}$ |
| Drain-Source Breakdown Voltage | V_{BR} | 150 | - | - | V_{DC} | $V_{GS} = -8 \text{ V}, I_D = 41.8 \text{ mA}$ |
| RF Characteristics³ ($T_C = 25^\circ\text{C}, F_0 = 1.3 \text{ GHz}$ unless otherwise noted) | | | | | | |
| Output Power | P_{OUT} | 275 | 330 | - | W | $V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 37 \text{ dBm}$ |
| Drain Efficiency | D_E | 63 | 77 | - | % | $V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 37 \text{ dBm}$ |
| Power Gain | G_p | - | 18.2 | - | dB | $V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 37 \text{ dBm}$ |
| Pulsed Amplitude Droop | D | - | -0.3 | - | dB | $V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}$ |
| Output Mismatch Stress | VSWR | - | 5 : 1 | - | Ψ | No damage at all phase angles, $V_{DD} = 50 \text{ V}, I_{DQ} = 500 \text{ mA}, P_{IN} = 37 \text{ dBm}$ Pulsed |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{GS} | - | 150 | - | pF | $V_{DS} = 50 \text{ V}, V_{GS} = -8 \text{ V}, f = 1 \text{ MHz}$ |
| Output Capacitance | C_{DS} | - | 16 | - | pF | $V_{DS} = 50 \text{ V}, V_{GS} = -8 \text{ V}, f = 1 \text{ MHz}$ |
| Feedback Capacitance | C_{GD} | - | 1.35 | - | pF | $V_{DS} = 50 \text{ V}, V_{GS} = -8 \text{ V}, f = 1 \text{ MHz}$ |

Notes:

¹ Measured on wafer prior to packaging.

² Scaled from PCM data.

³ Measured in CGHV14250-AMP. Pulse Width = 500 μs , Duty Cycle = 10%.

Typical Performance

Figure 1. - CGHV14250 Typical Sparameters

$T_{case} = 25^{\circ}C$ $V_{DD} = 50 V$, $I_{DQ} = 500 mA$

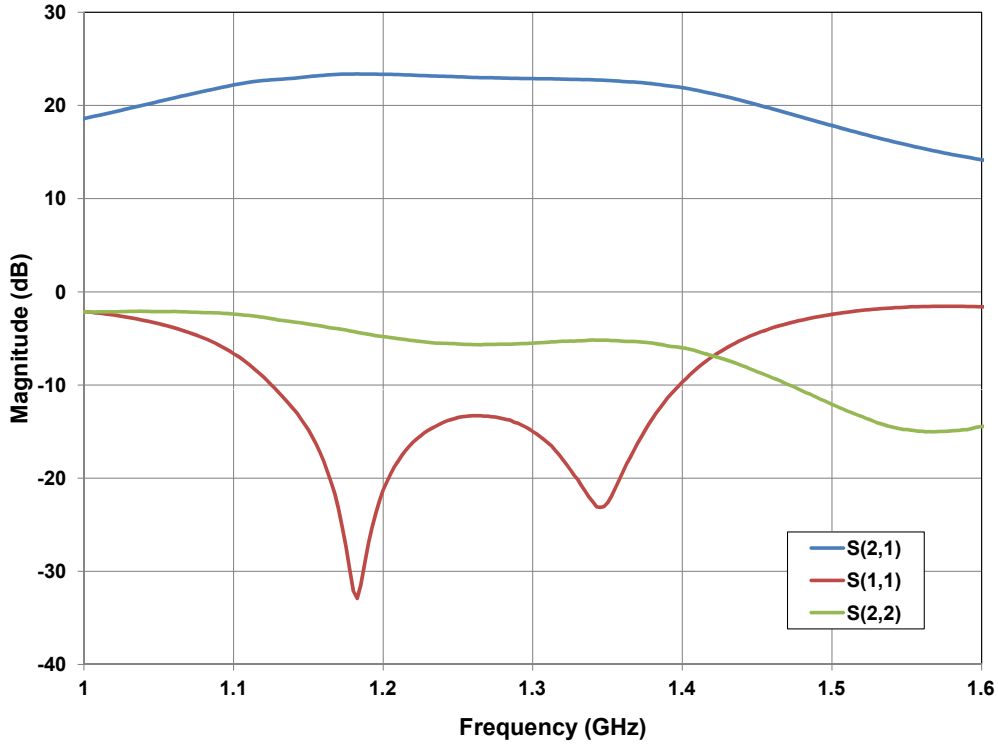
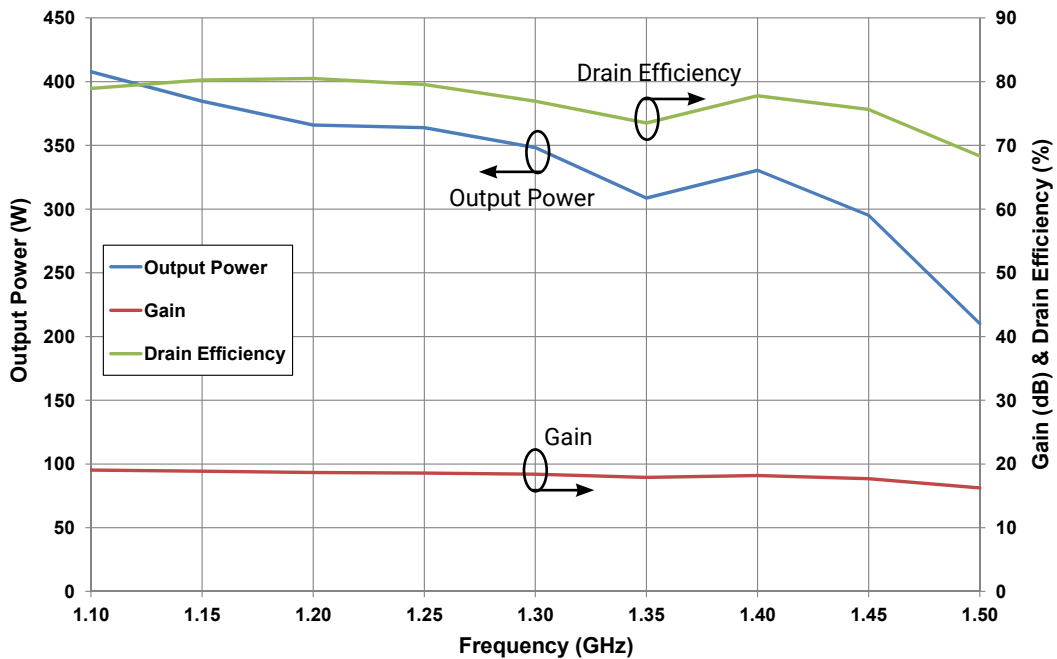


Figure 2. - CGHV14250 Typical RF Results

$V_{DD} = 50 V$, $I_{DQ} = 500 mA$, $P_{IN} = 37 dBm$
 $T_{case} = 25^{\circ}C$, Pulse Width = 500 μs , Duty Cycle = 10 %



Typical Performance

Figure 3. - CGHV14250 Typical RF Results

$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 37\text{ dBm}$
 $T_{case} = 85^\circ\text{C}$, Pulse Width = $500\ \mu\text{s}$, Duty Cycle = 10 %

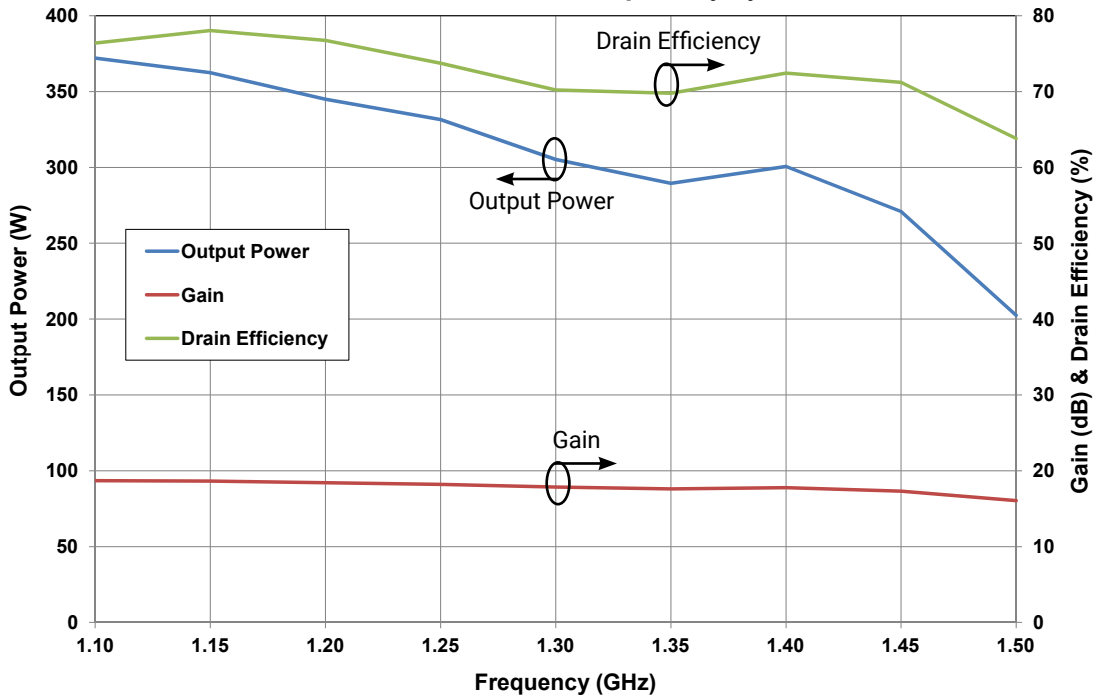
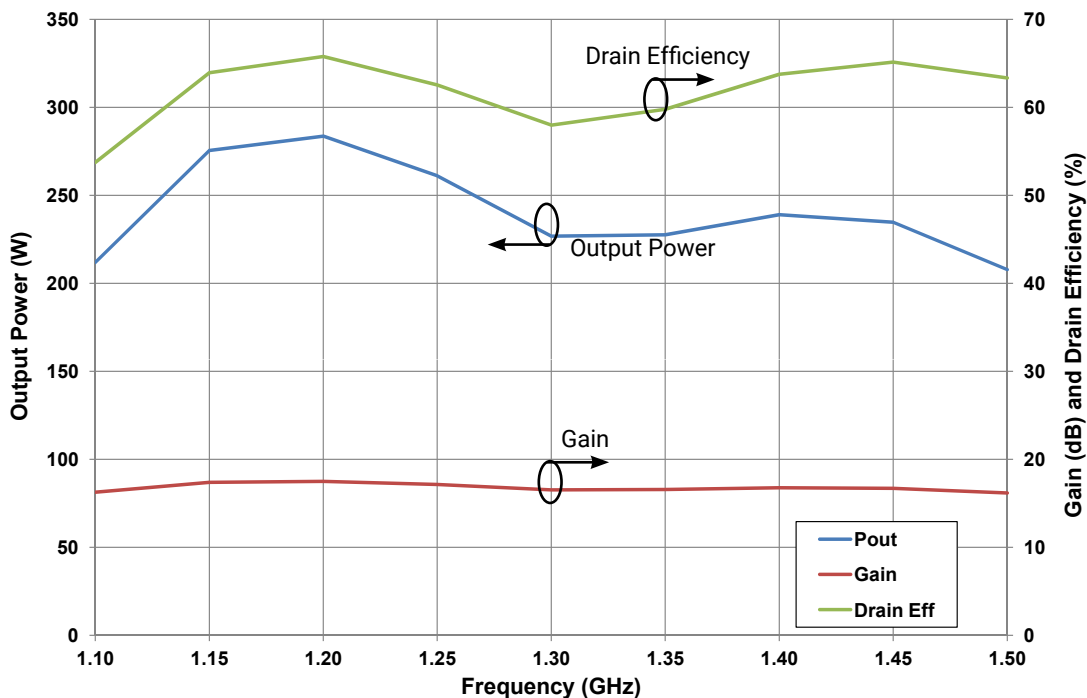
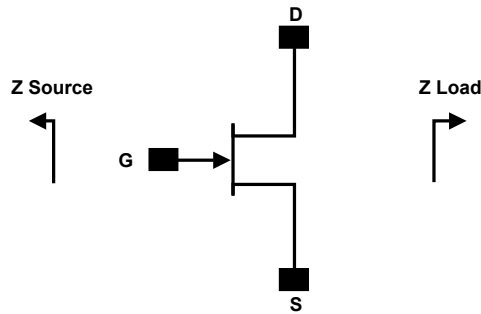


Figure 4. - CGHV14250 CW RF Results

$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 37\text{ dBm}$, $T_{case} = 65^\circ\text{C}$



Source and Load Impedances



| Frequency (MHz) | Z Source | Z Load |
|-----------------|------------|------------|
| 900 | 0.6 - j0.3 | 5.3 + j0.1 |
| 1000 | 0.7 - j0.8 | 4.3 + j0.8 |
| 1100 | 1.3 - j1.1 | 3.3 + j0.8 |
| 1200 | 1.8 - j1.1 | 3.0 + j0.4 |
| 1300 | 2.5 - j0.7 | 2.5 + j0.4 |
| 1400 | 3.4 - j0.7 | 2.3 + j0.1 |
| 1500 | 1.8 - j0.9 | 2.3 + j0 |

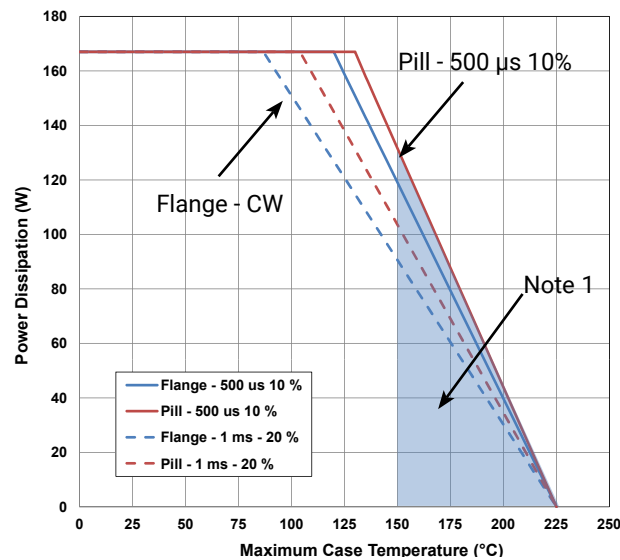
Note 1. $V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$ in the 440162 package

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

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

CGHV14250F Power Dissipation De-rating Curve

Figure 4. - CGHV14250 Transient Power Dissipation De-Rating Curve

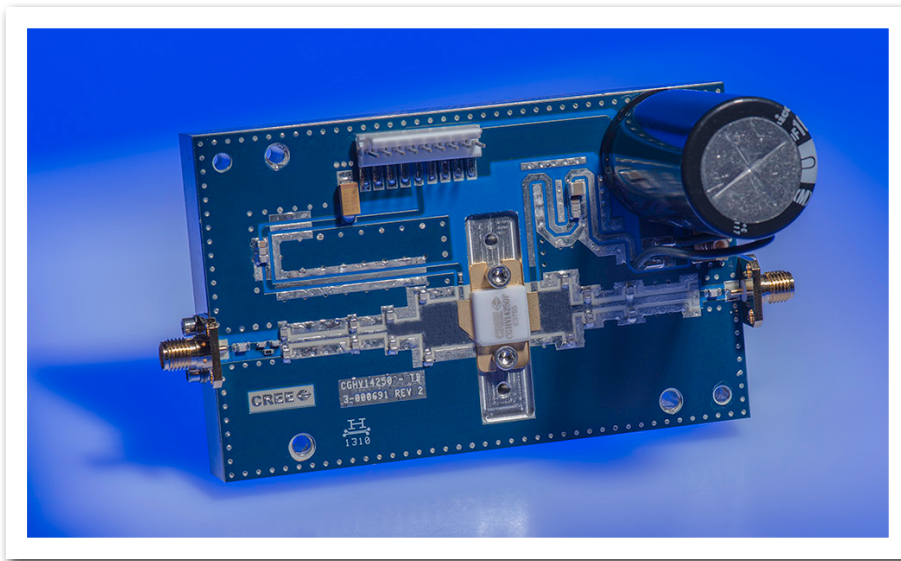


Note 1. Area exceeds Maximum Case Temperature (See Page 2).

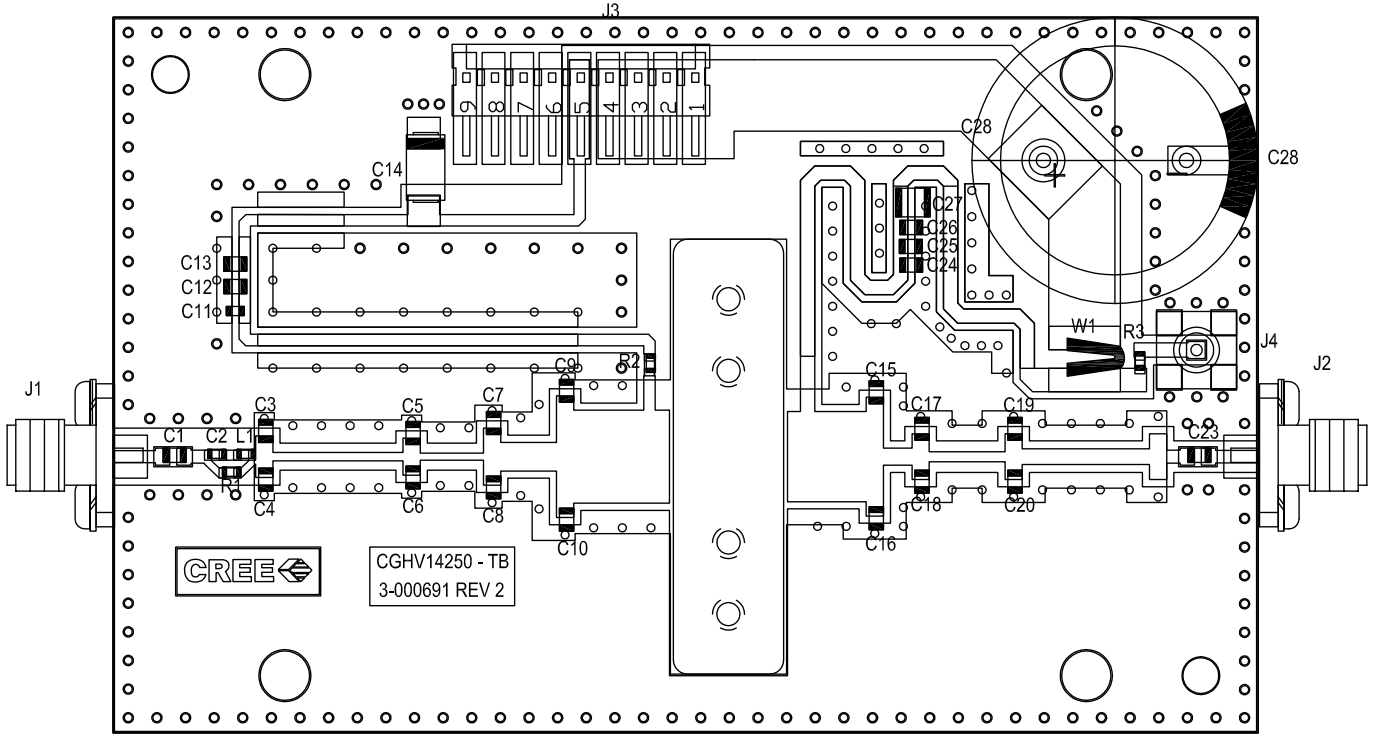
CGHV14250-AMP Demonstration Amplifier Circuit Bill of Materials

| Designator | Description | Qty |
|-----------------|---|-----|
| R1 | RES, 1/16W, 0603, 1%, 562 OHMS | 1 |
| R2 | RES, 5.1 OHM, +/-1%, 1/16W, 0603 | 1 |
| R3 | RES, 1/16W, 0603, 1%, 4700 OHMS | 1 |
| L1 | INDUCTOR, CHIP, 6.8 nH, 0603 SMT | 1 |
| C1, C23 | CAP, 27pF, +/- 5%, 250V, 0805, ATC 600F | 2 |
| C2 | CAP, 2.0pF, +/- 0.1pF, 0603, ATC | 1 |
| C3, C4 | CAP, 0.5pF, +/-0.05pF, 0805, ATC 600F | 2 |
| C5,C6 | CAP, 1.0pF, +/-0.05 pF, 0805, ATC 600F | 2 |
| C7,C8,C9,C10 | CAP, 3.0pF, +/-0.1pF, 250V, 0805, ATC 600F | 4 |
| C11,C24 | CAP, 47pF,+/-5%, 250V, 0805, ATC 600F | 2 |
| C12,C25 | CAP, 100pF, +/-5%, 250V, 0805, ATC 600F | 2 |
| C13,C26 | CAP, 33000PF, 0805,100V, X7R | 2 |
| C14 | CAP 10uF 16V TANTALUM | 1 |
| C15,C16,C17,C18 | CAP, 3.9pF, +/-0.1pF, 250V, 0805, ATC 600F | 4 |
| C19,C20 | CAP, 1.2pF, +/-0.05pF, 0805, ATC 600F | 2 |
| C27 | CAP, 1.0UF, 100V, 10%, X7R, 1210 | 1 |
| C28 | 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 |
| | PCB, RO4350, 0.020 MIL THK, CGHV14250, 1.2-1.4GHZ | 1 |
| Q1 | CGHV14250 | 1 |

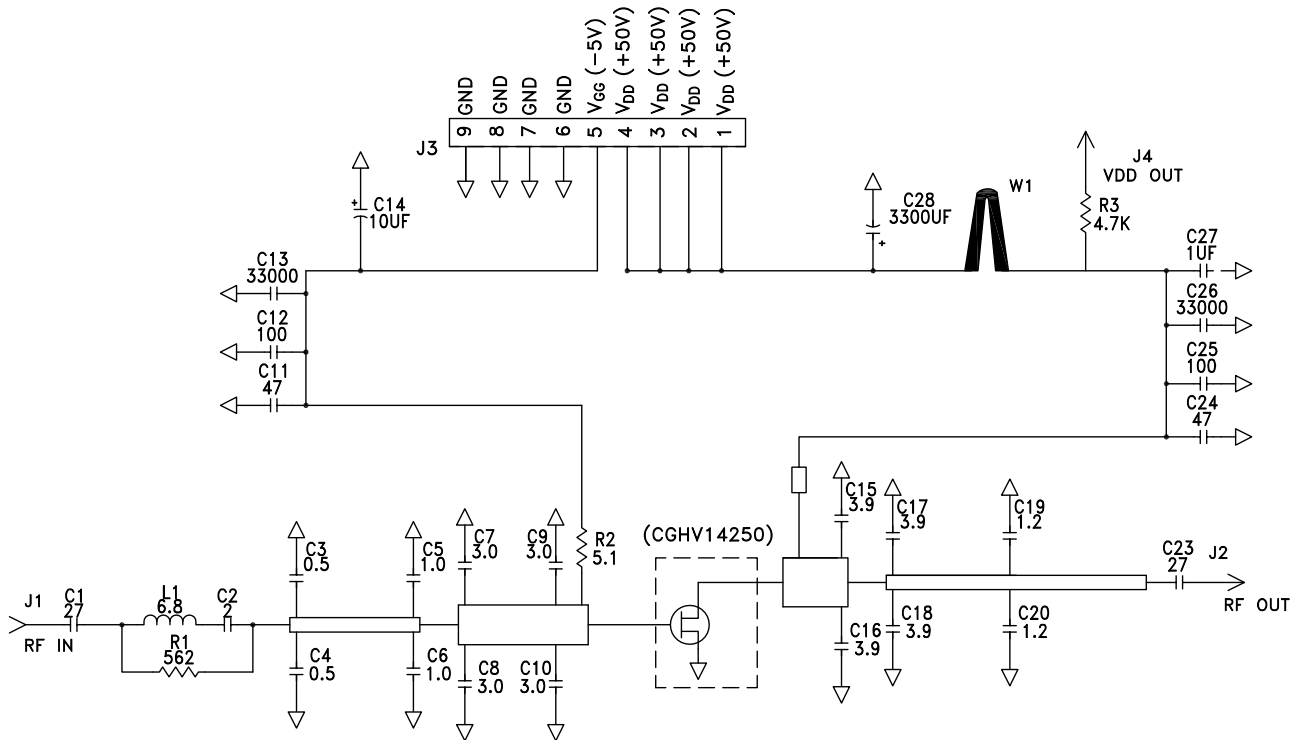
CGHV14250-AMP Demonstration Amplifier Circuit



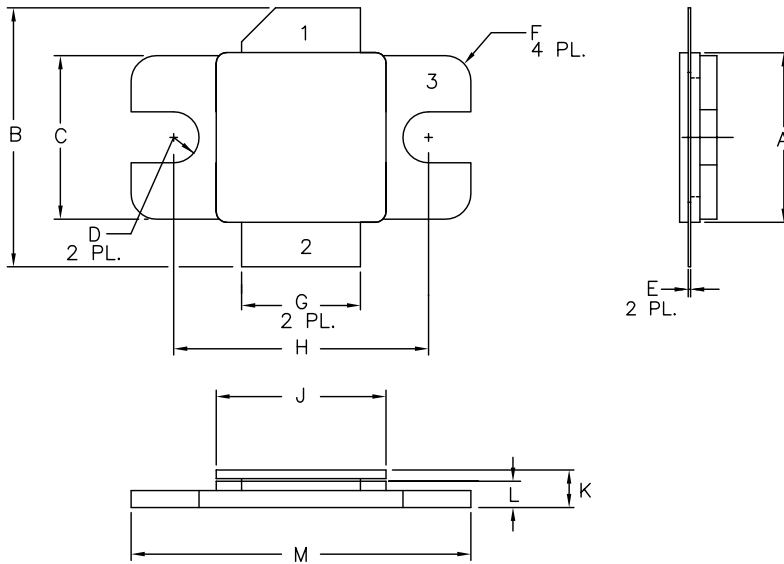
CGHV14250-AMP Demonstration Amplifier Circuit Outline



CGHV14250-AMP Demonstration Amplifier Circuit Schematic



Product Dimensions CGHV14250F (Package Type – 440162)



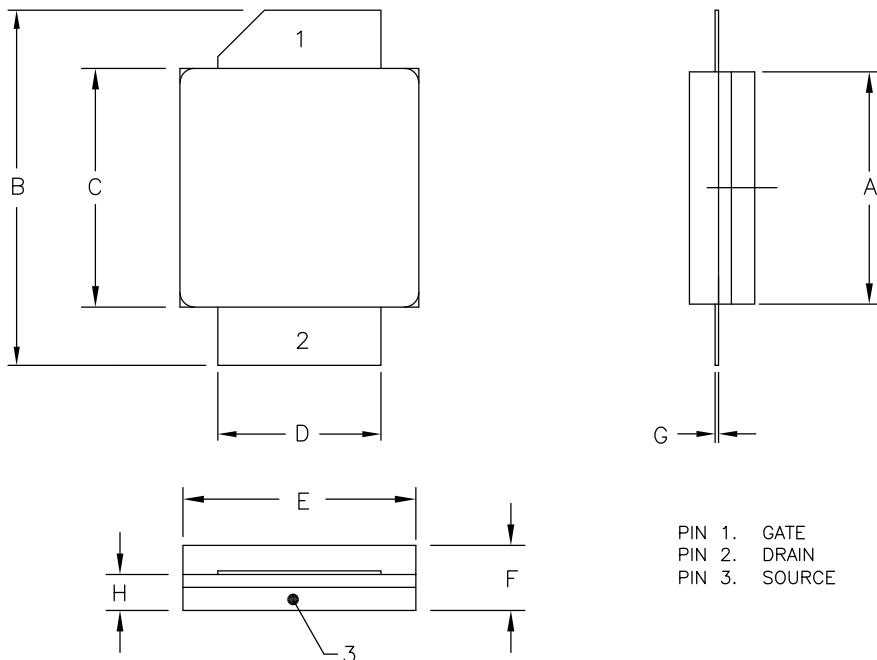
NOTES:

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.

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | .395 | .405 | 10.03 | 10.29 |
| B | .580 | .620 | 14.73 | 15.75 |
| C | .380 | .390 | 9.65 | 9.91 |
| D | .055 | .065 | 1.40 | 1.65 |
| E | .004 | .006 | 0.10 | 0.15 |
| F | .055 | .065 | 1.40 | 1.65 |
| G | .275 | .285 | 6.99 | 7.24 |
| H | .595 | .605 | 15.11 | 15.37 |
| J | .395 | .405 | 10.03 | 10.29 |
| K | .129 | .149 | 3.28 | 3.78 |
| L | .053 | .067 | 1.35 | 1.70 |
| M | .795 | .805 | 20.19 | 20.45 |

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

Product Dimensions CGHV14250P (Package Type – 440161)



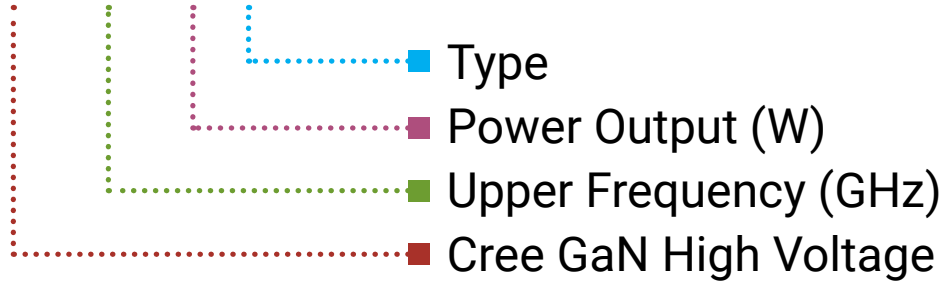
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4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | .395 | .407 | 10.03 | 10.34 |
| B | .594 | .634 | 15.09 | 16.10 |
| C | .395 | .407 | 10.03 | 10.34 |
| D | .275 | .285 | 6.99 | 7.24 |
| E | .395 | .407 | 10.03 | 10.34 |
| F | .129 | .149 | 3.28 | 3.78 |
| G | .004 | .006 | 0.10 | 0.15 |
| H | .057 | .067 | 1.45 | 1.70 |

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

CGHV14250F



| Parameter | Value | Units |
|------------------------------|----------------------------|-------|
| Upper Frequency ¹ | 1.4 | GHz |
| Power Output | 250 | W |
| Type | F = Flanged P = Package | - |

Table 1.

Note¹: Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

| 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 |

Table 2.

Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|----------------|------------------------------------|-----------------|---|
| CGHV14250F | GaN HEMT | Each |  |
| CGHV14250P | GaN HEMT | Each |  |
| CGHV14250-TB | Test board without GaN HEMT | Each |  |
| CGHV14250P-AMP | Test board with GaN HEMT installed | Each | |
| CGHV14250F-AMP | Test board with GaN HEMT installed | Each |  |



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For more information, please contact:

Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
www.cree.com/rf

Sarah Miller
Marketing
Cree, RF Components
1.919.407.5302

Ryan Baker
Marketing & Sales
Cree, RF Components
1.919.407.7816

Tom Dekker
Sales Director
Cree, RF Components
1.919.407.5639

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