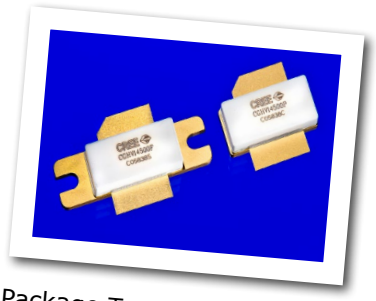
# CGHV14500

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

Cree's CGHV14500 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically with high efficiency, high gain and wide bandwidth capabilities, which makes the CGHV14500 ideal for 1.2 - 1.4 GHz L-Band radar amplifier applications. The transistor could be utilized for band specific applications ranging from UHF through 1800 MHz. The package options are ceramic/metal flange and pill package.



Package Type: 440117, 440133
PN: CGHV14500

### Typical Performance Over 1.2-1.4 GHz ($T_c$ = 25°C) of Demonstration Amplifier

| Parameter | 1.2 GHz | 1.25 GHz | 1.3 GHz | 1.35 GHz | 1.4 GHz | Units |
|---|---|---|---|---|---|---|
| Output Power | 505 | 510 | 510 | 510 | 510 | W |
| Gain | 17.0 | 17.1 | 17.1 | 17.1 | 17.1 | dB |
| Drain Efficiency | 70 | 72 | 70 | 67 | 67 | % |

Note:
Measured in the CGHV14500-TB amplifier circuit, under 500 µs pulse width, 10% duty cycle, $P_{IN}$ = 40 dBm.

## Features

- Reference design amplifier 1.2 - 1.4 GHz Operation
- FET tuning range UHF through 1800 MHz
- 500 W Typical Output Power
- 17 dB Power Gain
- 70% Typical Drain Efficiency
- <0.3 dB Pulsed Amplitude Droop
- Internally pre-matched on input, unmatched output

Rev 0.1 – August 2013

## 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 | $I_{GMAX}$ | 84 | mA | 25°C |
| Maximum Drain Current[1] | $I_{DMAX}$ | 36 | A | 25°C |
| Soldering Temperature[2] | $T_S$ | 245 | °C | |
| Screw Torque | τ | 40 | in-oz | |
| CW Thermal Resistance, Junction to Case[3] | $R_{\theta JC}$ | 0.47 | °C/W | $P_{DISS}$ = 334 W, 65°C |
| Pulsed Thermal Resistance, Junction to Case[3] | $R_{\theta JC}$ | 0.28 | °C/W | $P_{DISS}$ = 334 W, 500 µsec, 10%, 85°C |
| Pulsed Thermal Resistance, Junction to Case[4] | $R_{\theta JC}$ | 0.31 | °C/W | $P_{DISS}$ = 334 W, 500 µsec, 10%, 85°C |
| Case Operating Temperature[5] | $T_C$ | -40, +130 | °C | $P_{DISS}$ = 334 W, 500 µsec, 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 CGHV14500P
[4] Measured for the CGHV14500F
[5] See also, the Power Dissipation De-rating Curve on Page 5

## Electrical Characteristics

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **DC Characteristics[1] ($T_C$ = 25°C)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -3.8 | -3.0 | -2.3 | $V_{DC}$ | $V_{DS}$ = 10 V, $I_D$ = 83.6 mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | – | -2.7 | – | $V_{DC}$ | $V_{DS}$ = 50 V, $I_D$ = 500 mA |
| Saturated Drain Current[2] | $I_{DS}$ | 62.7 | 75.2 | – | A | $V_{DS}$ = 6.0 V, $V_{GS}$ = 2.0 V |
| Drain-Source Breakdown Voltage | $V_{BR}$ | 125 | – | – | $V_{DC}$ | $V_{GS}$ = -8 V, $I_D$ = 83.6 mA |
| **RF Characteristics[3] ($T_C$ = 25°C, $F_0$ = 1.3 GHz unless otherwise noted)** | | | | | | |
| Output Power | $P_{OUT}$ | – | 510 | – | W | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 40 dBm |
| Drain Efficiency | $D_E$ | – | 70 | – | % | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 40 dBm |
| Power Gain | $G_P$ | – | 17.1 | – | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 40 dBm |
| Pulsed Amplitude Droop | D | – | -0.3 | – | dB | $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA |
| Output Mismatch Stress | VSWR | – | 5 : 1 | – | Ψ | No damage at all phase angles, $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 40 dBm Pulsed |

Notes:
[1] Measured on wafer prior to packaging.
[2] Scaled from PCM data.
[3] Measured in CGHV14500-TB. Pulse Width = 500 µS, Duty Cycle = 10%.



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

## Typical Performance

**Figure 1. - CGHV14500 Typical Sparameters**
**$V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA**

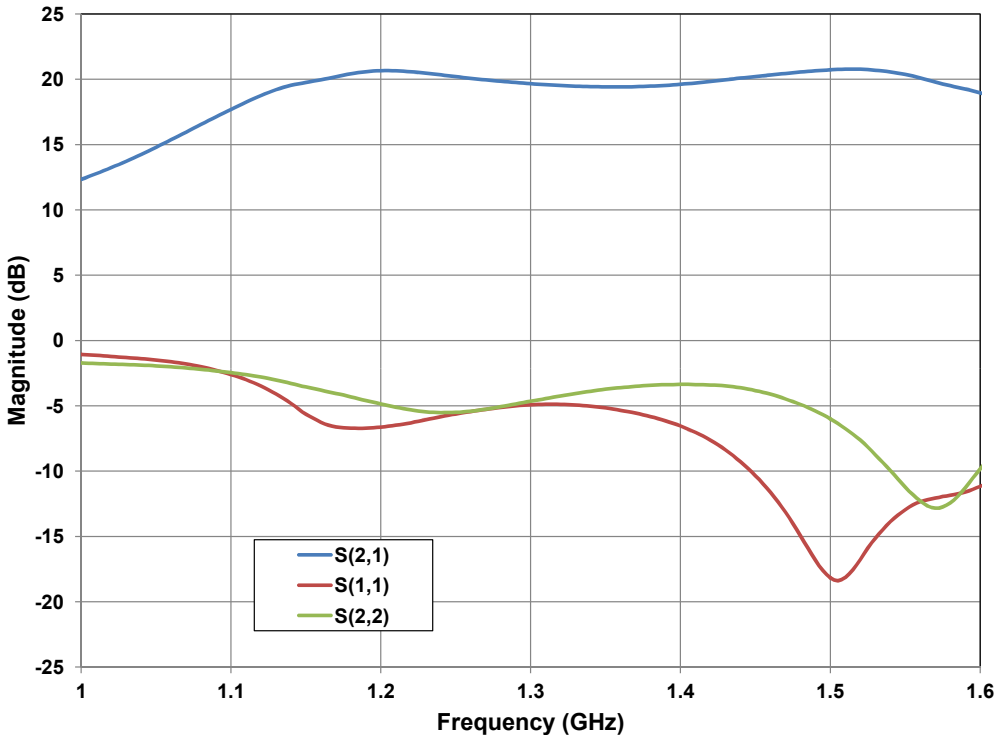
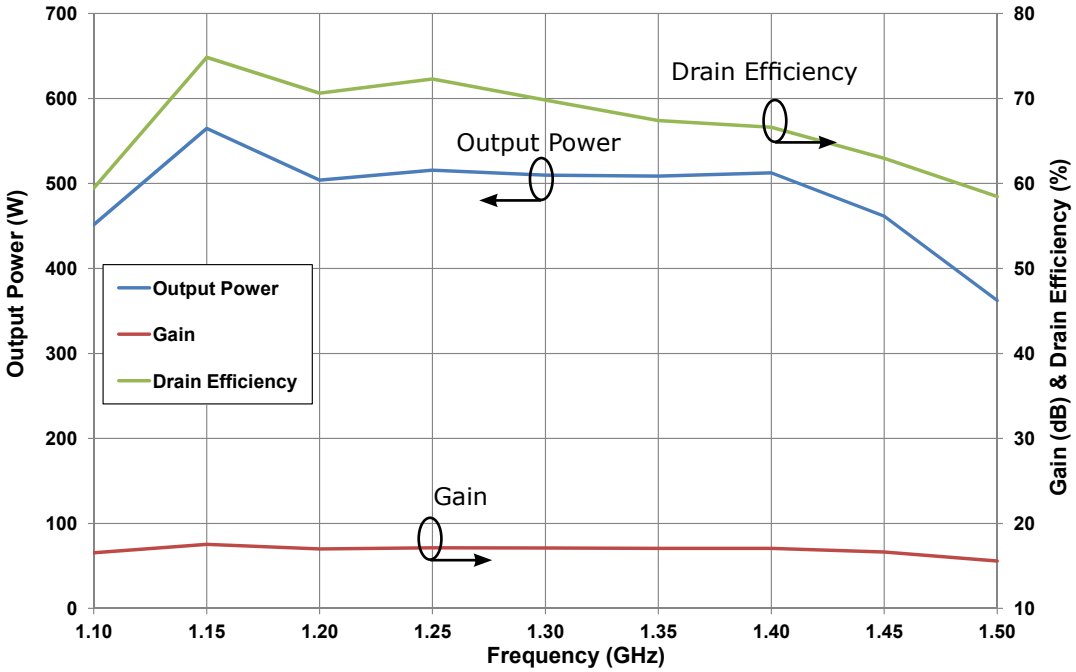



**Figure 2. - CGHV14500 Typical RF Results**
**$V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 40 dBm**
**Tcase = 25°C, Pulse Width = 500 µs, Duty Cycle = 10 %**






Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

## Typical Performance

**Figure 3. - CGHV14500 Typical RF Results**
**$V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 40 dBm**
**Tcase = 85°C, Pulse Width = 500 µs, Duty Cycle = 10 %**

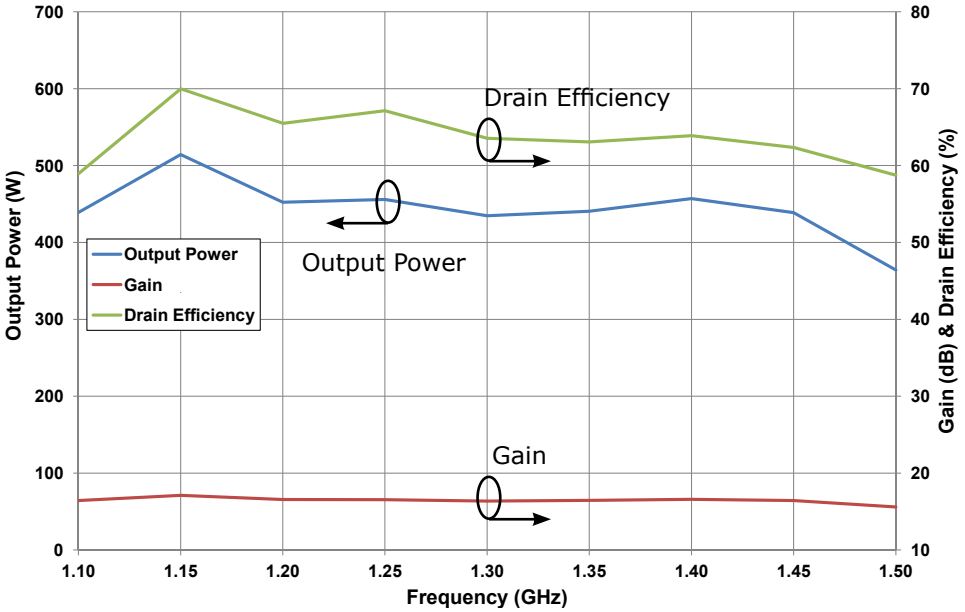
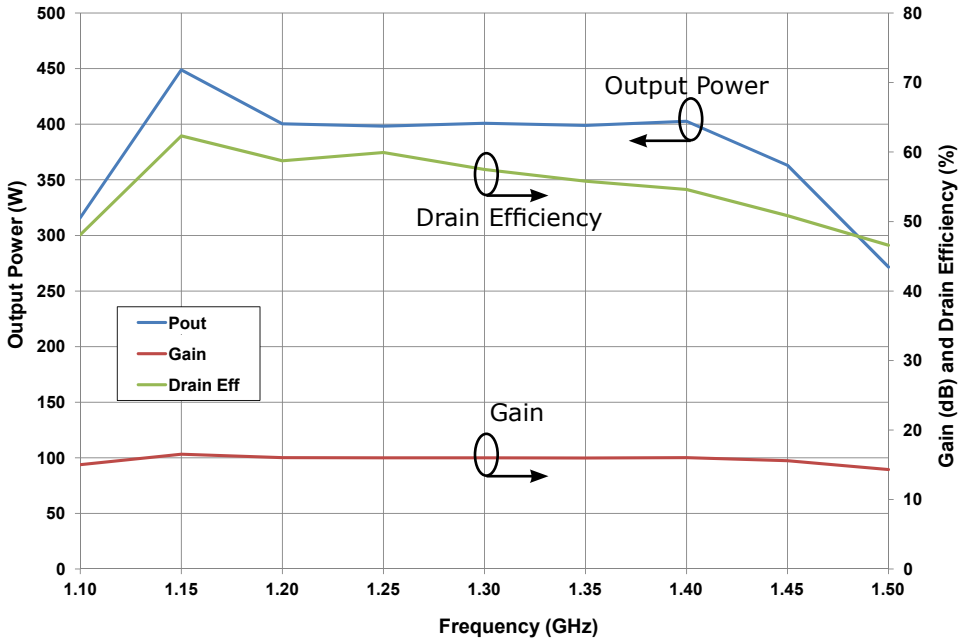


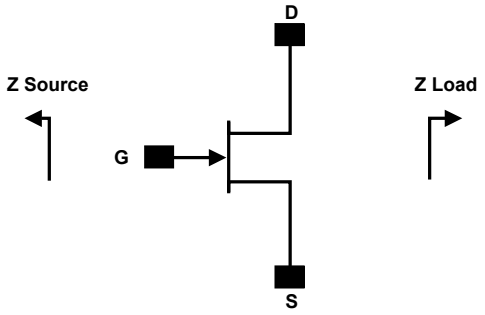

**Figure 4. - CGHV14500 Typical CW RF Results**
**$V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA, $P_{IN}$ = 40 dBm**
**Tcase = 50°C, Pulse Width = 500 µs, Duty Cycle = 10 %**






Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

## Source and Load Impedances

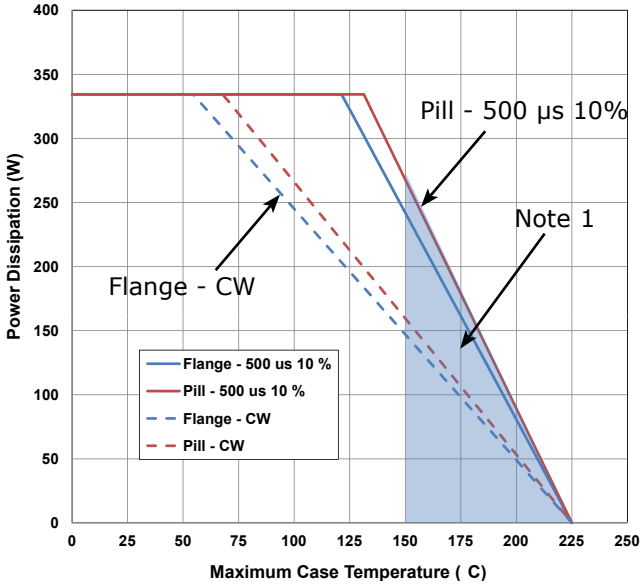



| Frequency (MHz) | Z Source | Z Load |
|---|---|---|
| 900 | 0.3 - j0.3 | 2.1 + j1.4 |
| 1000 | 0.3 - j0.4 | 2.0 +j0.7 |
| 1100 | 0.6 - j0.4 | 1.8 + j0.9 |
| 1200 | 0.8 - j0.7 | 1.5 + j0.9 |
| 1300 | 1.1 - j0.7 | 1.3 + j0.7 |
| 1400 | 1.2 - j0.1 | 1.2 + j0.5 |
| 1500 | 1.8 - j0.1 | 1.1 + j0.4 |

Note 1. $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA in the 440117 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

## CGHV14500 Power Dissipation De-rating Curve

**Figure 5. - CGHV14500 Transient Power Dissipation De-Rating Curve**




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

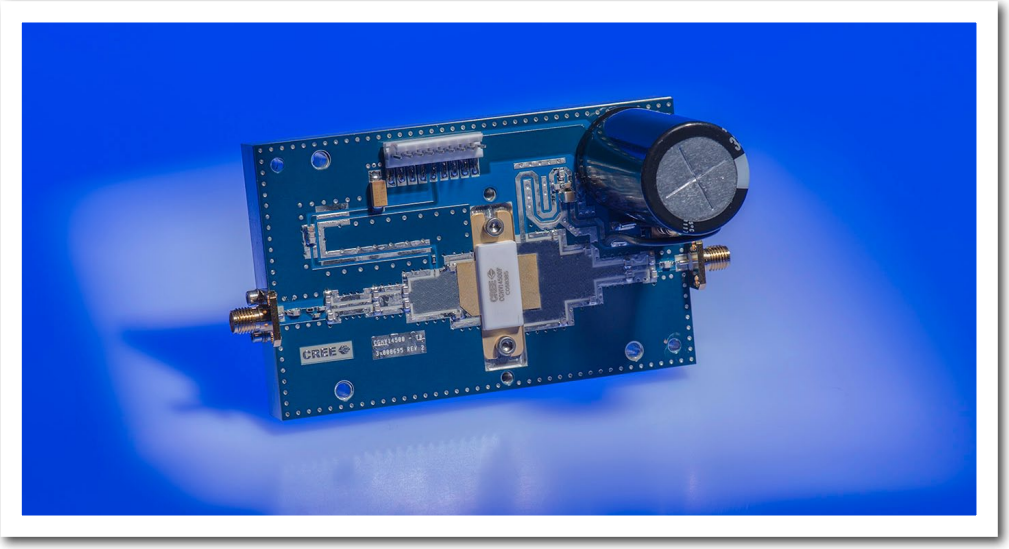


Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

## CGHV14500-TB 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, 1.5pF, +/-0.05pF, 250V, 0805, ATC 600F | 2 |
| C5,C6 | CAP, 1.8pF, +/-0.1pF, 250V, 0805, ATC 600F | 2 |
| C7,C8 | CAP, 4.3pF, +/-0.1pF, 250V, 0805, ATC 600F | 2 |
| C9,C10 | CAP, 7.5pF, +/-0.1pF, 250V, 0805, ATC 600F | 2 |
| 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 | CAP, 5.6pF, +/-0.1pF, 250V, 0805, ATC 600F | 2 |
| C17,C18 | CAP, 3.6pF, +/-0.1pF, 250V, 0805, ATC 600F | 2 |
| C19,C20 | CAP, 2.0pF, +/-0.1pF, 250V, 0805, ATC 600F | 2 |
| C21,C22 | CAP, 0.7pF, +/-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, RO4350B, 0.020' MIL THK, CGHV14500, 1.2-1.4GHZ | 1 |
| Q1 | CGHV14500 | 1 |

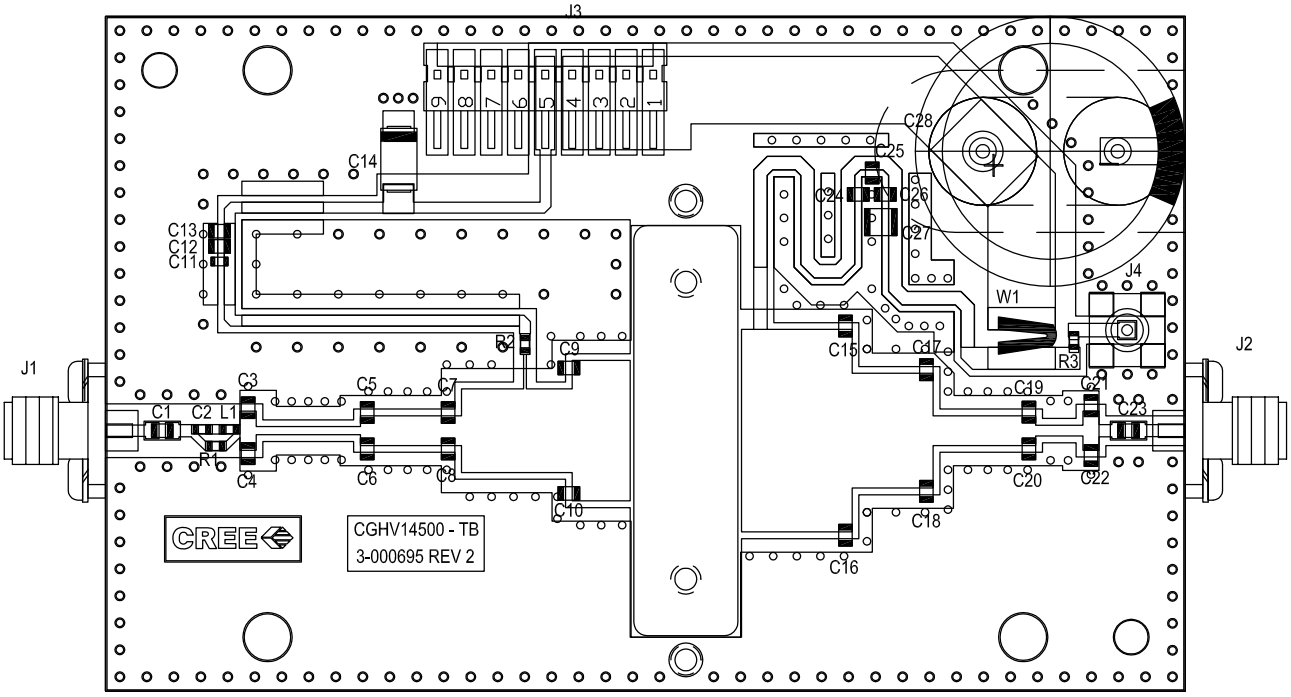
## CGHV14500-TB Demonstration Amplifier Circuit



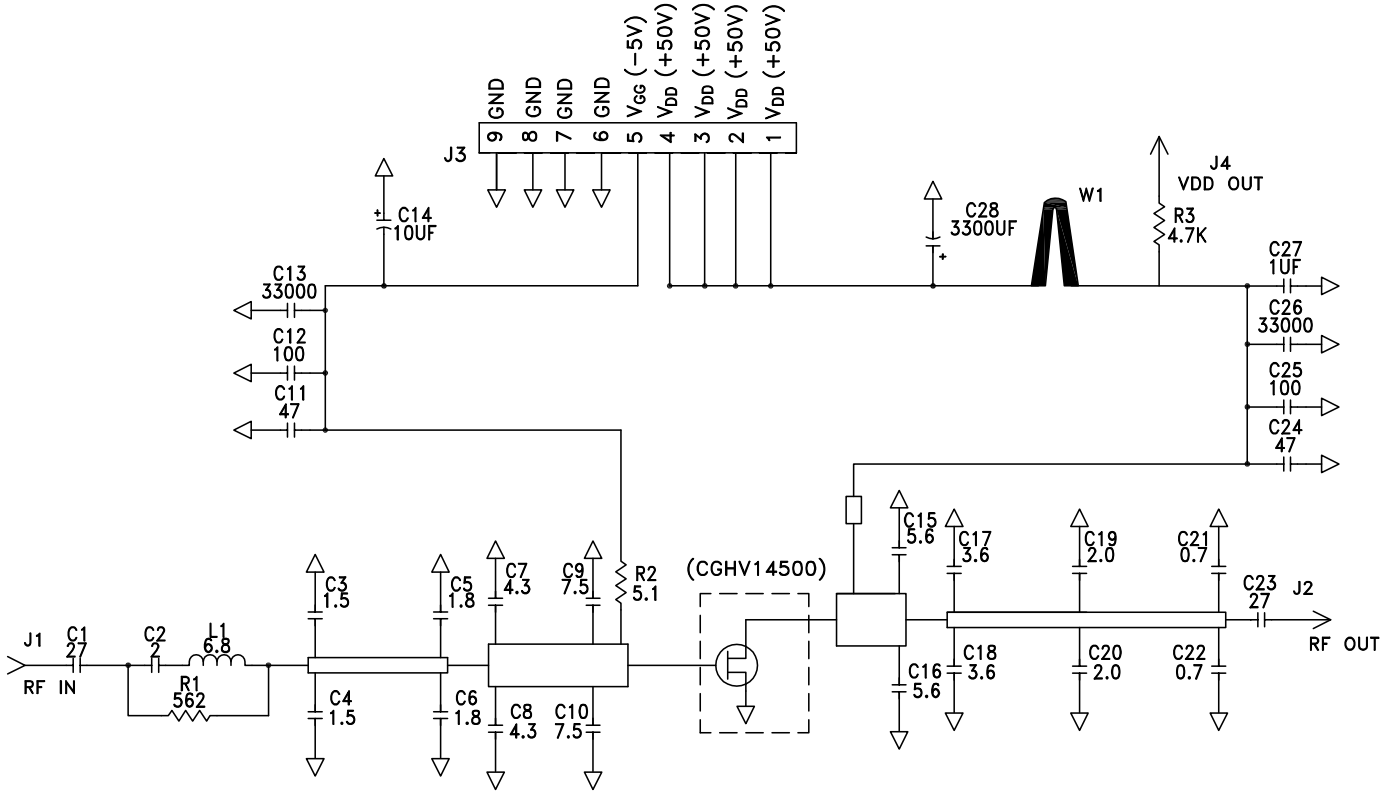


Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

## CGHV14500-TB Demonstration Amplifier Circuit Outline



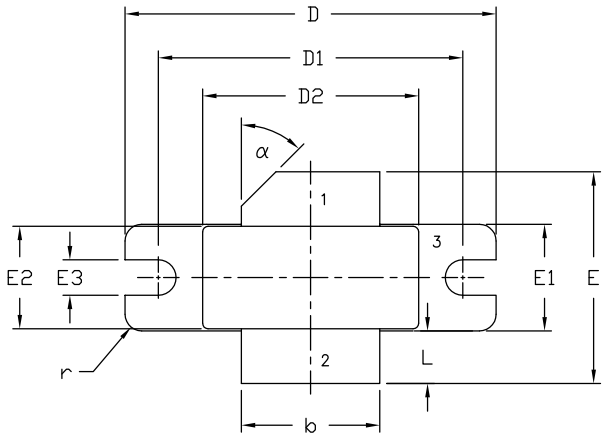

## CGHV14500-TB Demonstration Amplifier Circuit Schematic

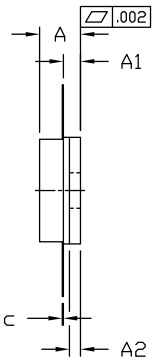





Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

## Product Dimensions CGHV14500F (Package Type — 440117)



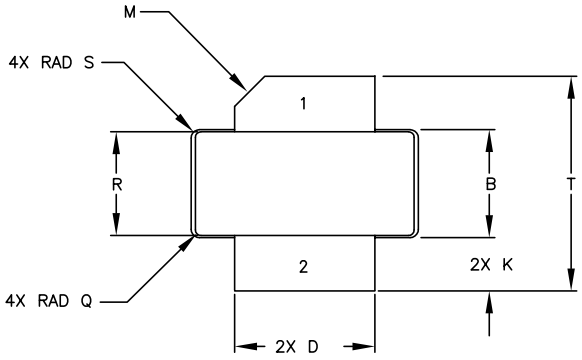

PIN 1. GATE
2. DRAIN
3. SOURCE

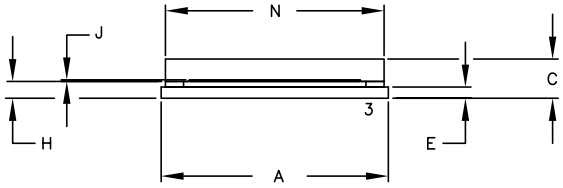
NOTES:

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.

| | INCHES | | MILLIMETERS | | NOTES |
|---|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX | |
| A | 0.138 | 0.158 | 3.51 | 4.01 | |
| A1 | 0.057 | 0.067 | 1.45 | 1.70 | |
| A2 | 0.035 | 0.045 | 0.89 | 1.14 | |
| b | 0.495 | 0.505 | 12.57 | 12.83 | 2x |
| c | 0.003 | 0.006 | 0.08 | 0.15 | |
| D | 1.335 | 1.345 | 33.91 | 34.16 | |
| D1 | 1.095 | 1.105 | 27.81 | 28.07 | |
| D2 | 0.773 | 0.787 | 19.63 | 20.00 | |
| E | 0.745 | 0.785 | 18.92 | 19.94 | |
| E1 | 0.380 | 0.390 | 9.65 | 9.91 | |
| E2 | 0.365 | 0.375 | 9.72 | 9.53 | |
| E3 | 0.123 | 0.133 | 3.12 | 3.38 | |
| L | 0.170 | 0.210 | 4.32 | 5.33 | 2x |
| r | 0.06 TYP | | 0.06 TYP | | 4x |
| α | 45° REF | | 45° REF | | |

## Product Dimensions CGHV14500P (Package Type — 440133)




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 PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

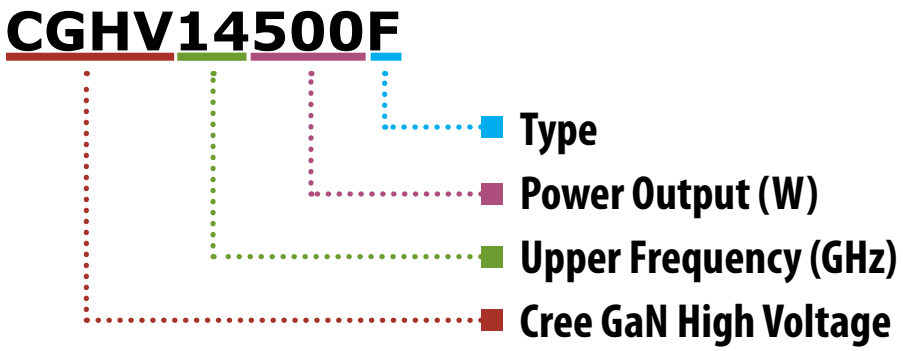
| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.805 | 0.815 | 20.45 | 20.70 |
| B | 0.380 | 0.390 | 9.65 | 9.91 |
| C | 0.135 | 0.149 | 3.43 | 3.78 |
| D | 0.495 | 0.505 | 12.57 | 12.83 |
| E | 0.035 | 0.045 | .89 | 1.14 |
| H | 0.057 | 0.067 | 1.45 | 1.70 |
| J | 0.003 | 0.006 | .08 | .15 |
| K | 0.170 | 0.210 | 4.32 | 5.33 |
| M | 45° REF | | 45° REF | |
| N | 0.773 | 0.787 | 19.63 | 19.99 |
| Q | 0.020 REF | | 0.51 REF | |
| R | 0.364 | 0.374 | 9.25 | 9.50 |
| S | 0.030 REF | | 0.76 REF | |
| T | 0.745 | 0.785 | 18.92 | 19.94 |

STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

## Part Number System




| Parameter | Value | Units |
|---|---|---|
| Upper Frequency[1] | 1.4 | GHz |
| Power Output | 500 | W |
| Type | F = Flanged<br>P = Package | - |

**Table 1.**

**Note[1]:** 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<br>2H = 27.0 GHz |

**Table 2.**



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf

## Disclaimer

Specifications are subject to change without notice. Cree, Inc. believes the information contained within this data sheet to be accurate and reliable. However, no responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Cree. Cree makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose. "Typical" parameters are the average values expected by Cree in large quantities and are provided for information purposes only. These values can and do vary in different applications and actual performance can vary over time. All operating parameters should be validated by customer's technical experts for each application. Cree products are not designed, intended or authorized for use as components in applications intended for surgical implant into the body or to support or sustain life, in applications in which the failure of the Cree product could result in personal injury or death or in applications for planning, construction, maintenance or direct operation of a nuclear facility.

For more information, please contact:

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

Sarah Miller
Marketing & Export
Cree, RF Components
1.919.407.5302

Ryan Baker
Marketing
Cree, RF Components
1.919.407.7816

Tom Dekker
Sales Director
Cree, RF Components
1.919.407.5639





Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
www.cree.com/rf