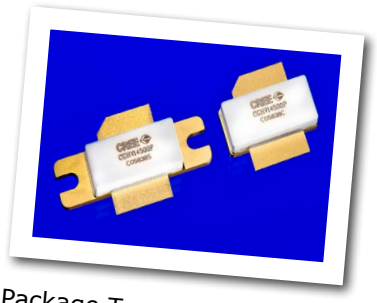
CGHV14500

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 1.1 – November 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}	422	510	–	W	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 40 dBm
Drain Efficiency	D_E	63	70	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 40 dBm
Power Gain	G_P	16.25	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

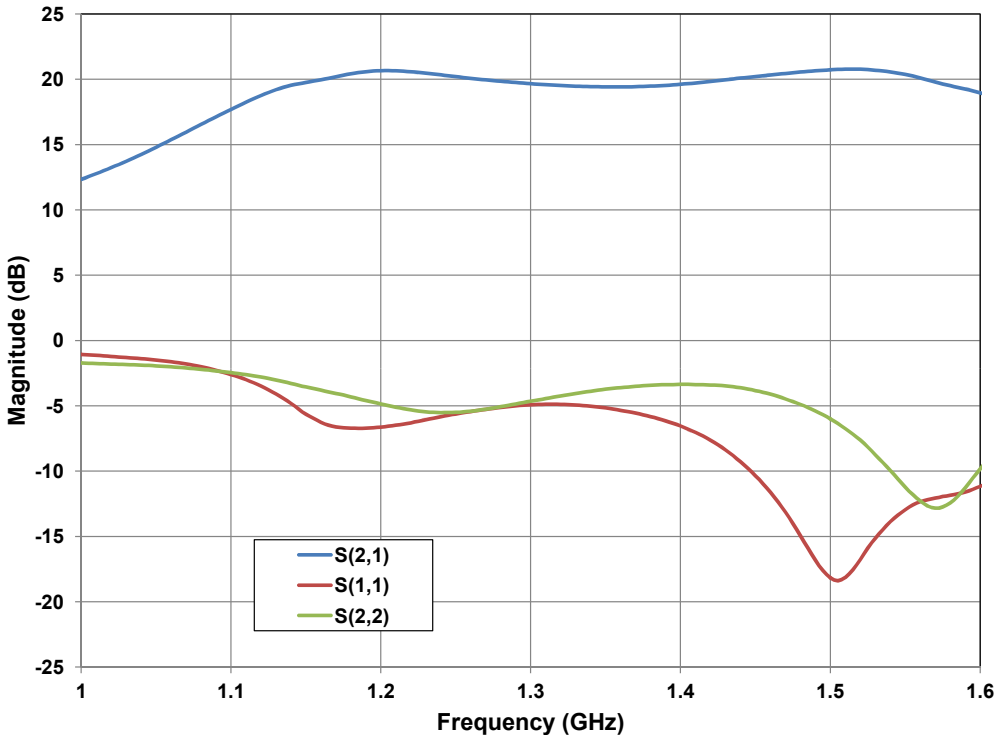
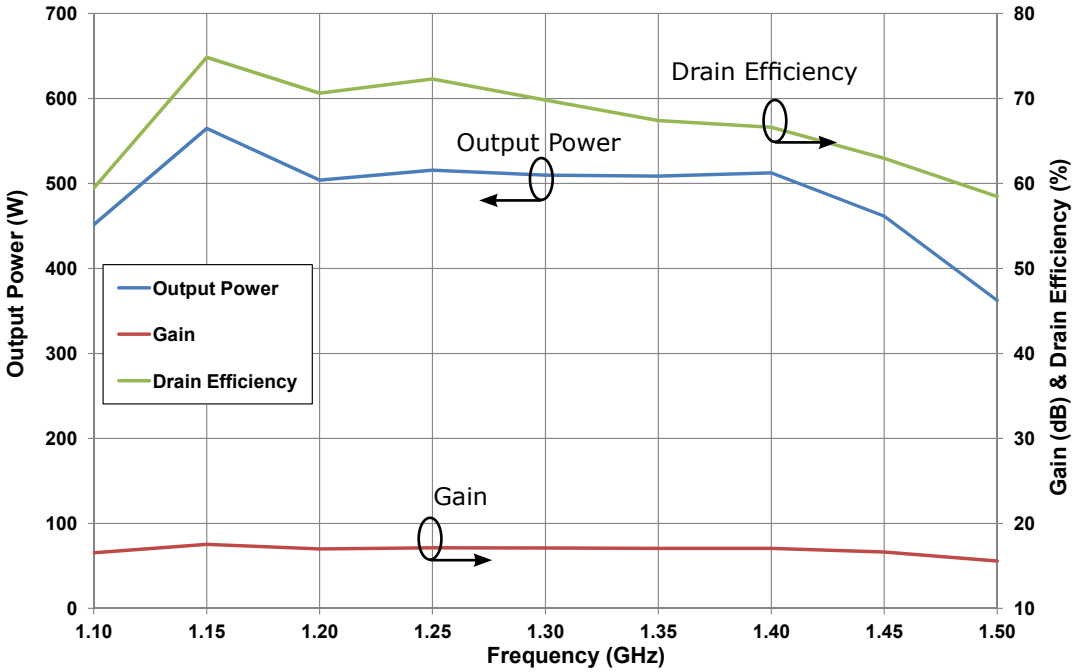


Figure 2. - CGHV14500 Typical RF Results
V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 40 dBm
Tcase = 25°C, Pulse Width = 500 µs, Duty Cycle = 10 %



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
Fax: +1.919.869.2733
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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 %

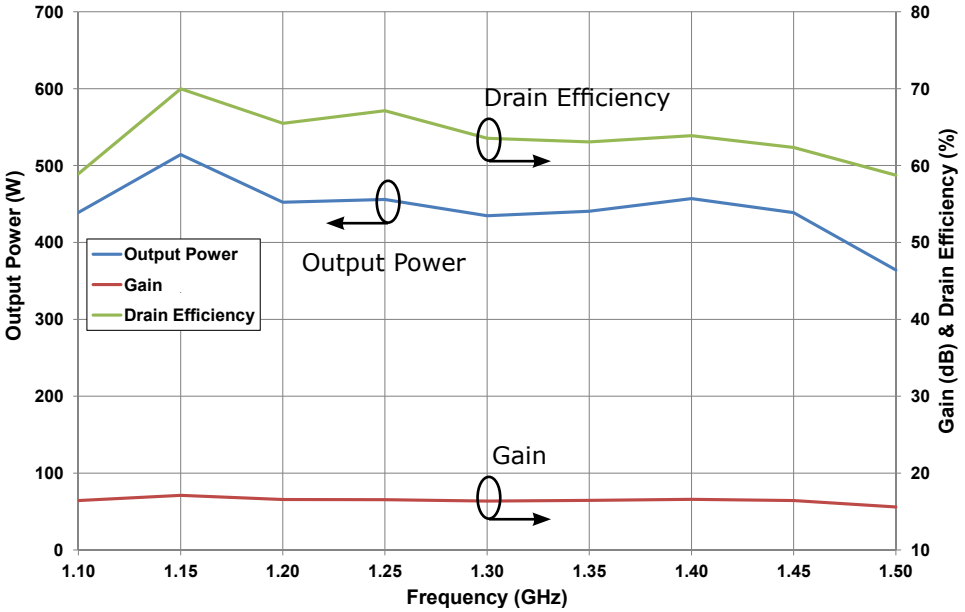
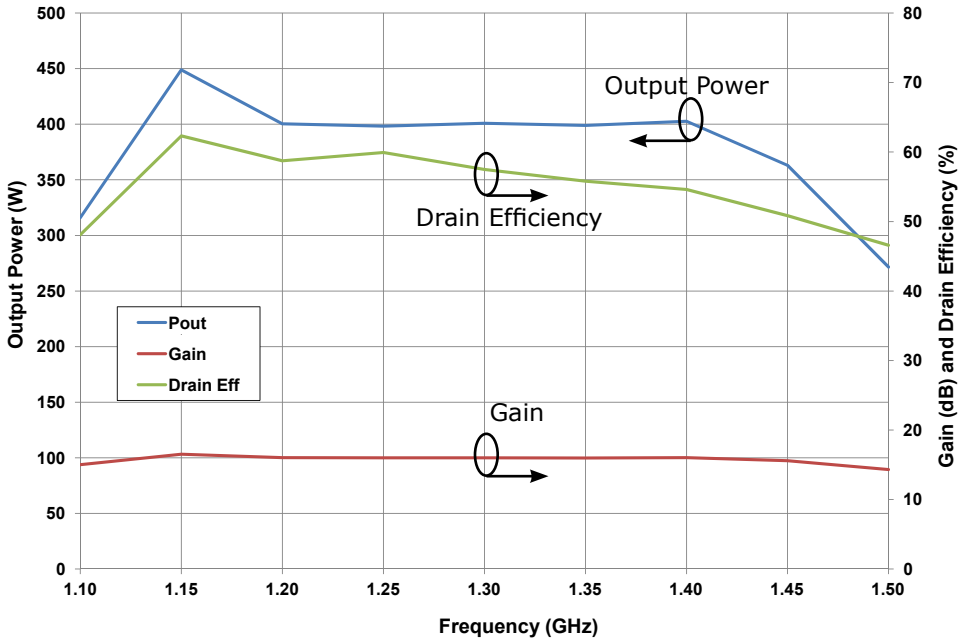


Figure 4. - CGHV14500 Typical CW RF Results
V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 40 dBm, Tcase = 50°C



Cree, Inc.
4600 Silicon Drive
Durham, North Carolina, USA 27703
USA Tel: +1.919.313.5300
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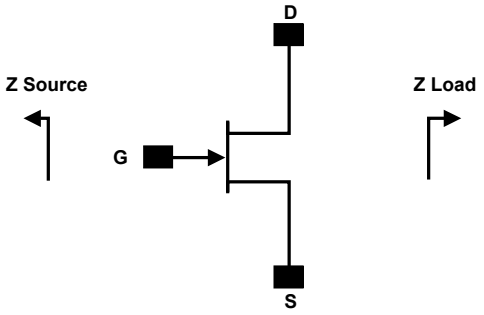
Source and Load Impedances

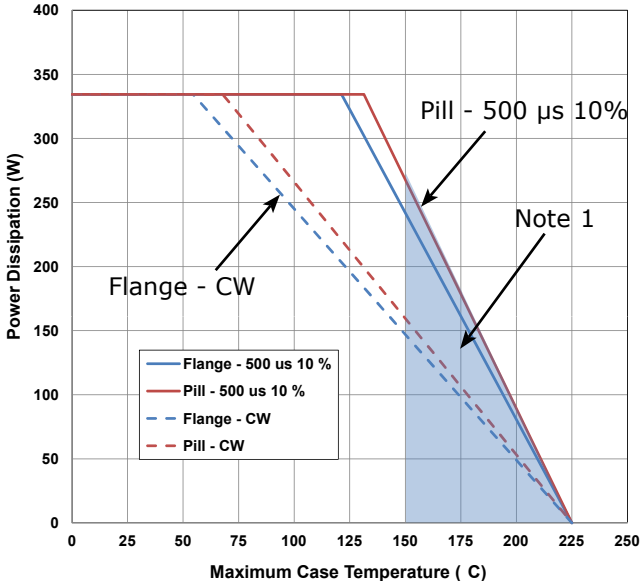


Frequency (MHz)	Z Source	Z Load
900	0.3 - j0.3	2.1 + j1.4
1000	0.3 - j0.4	2.0 +j0.7
1100	0.6 - j0.4	1.8 + j0.9
1200	0.8 - j0.7	1.5 + j0.9
1300	1.1 - j0.7	1.3 + j0.7
1400	1.2 - j0.1	1.2 + j0.5
1500	1.8 - j0.1	1.1 + j0.4

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
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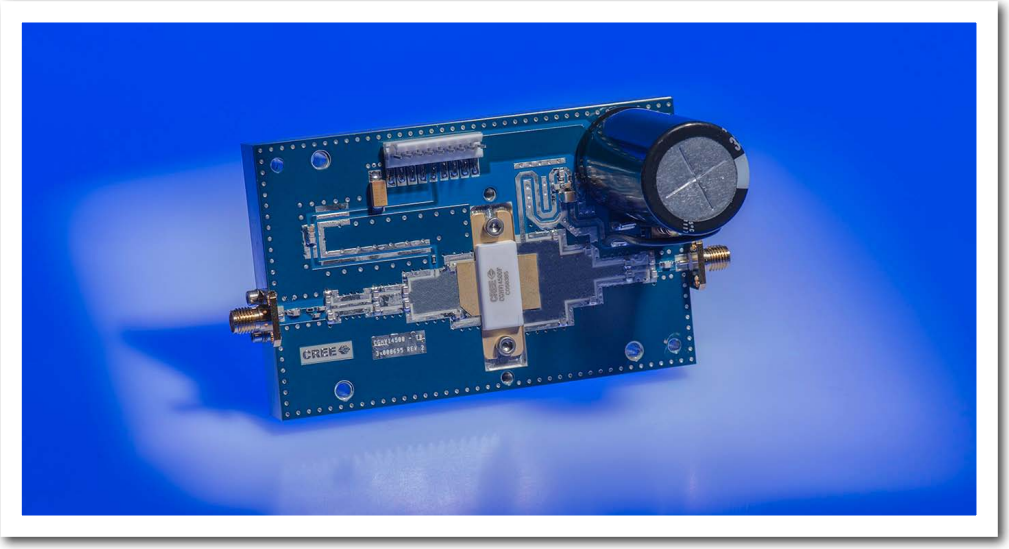
CGHV14500-TB Demonstration Amplifier Circuit Bill of Materials

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
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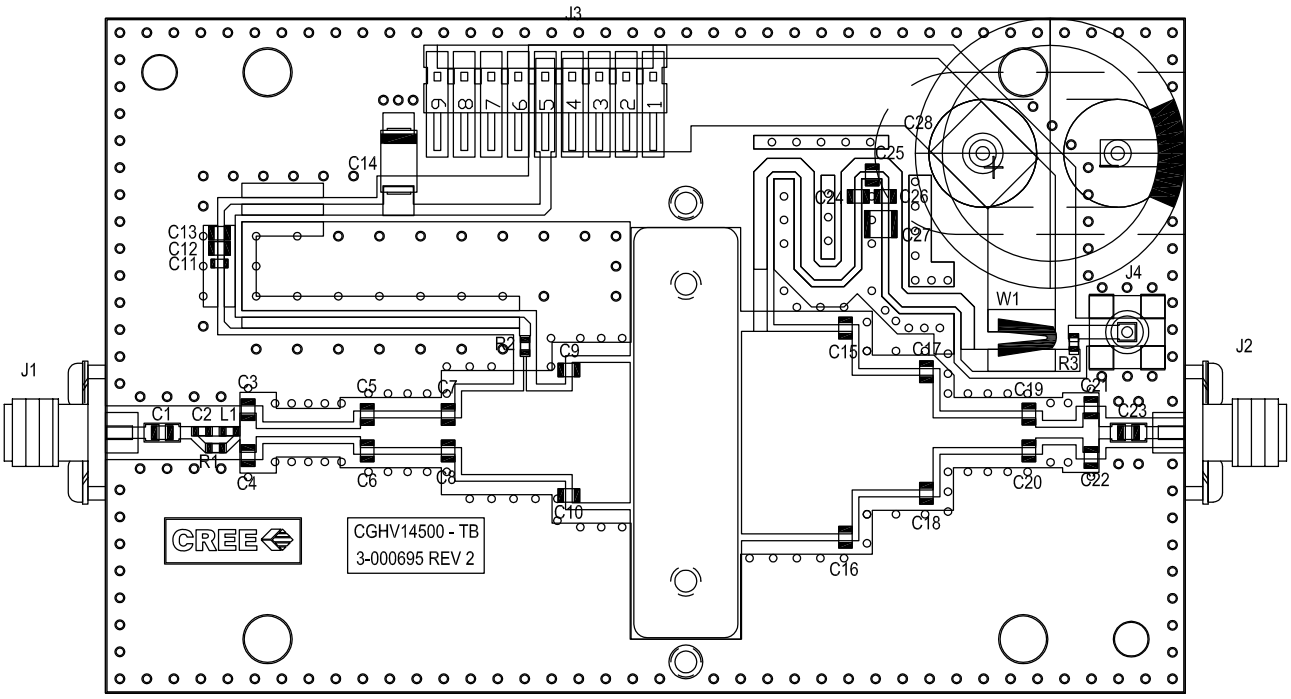
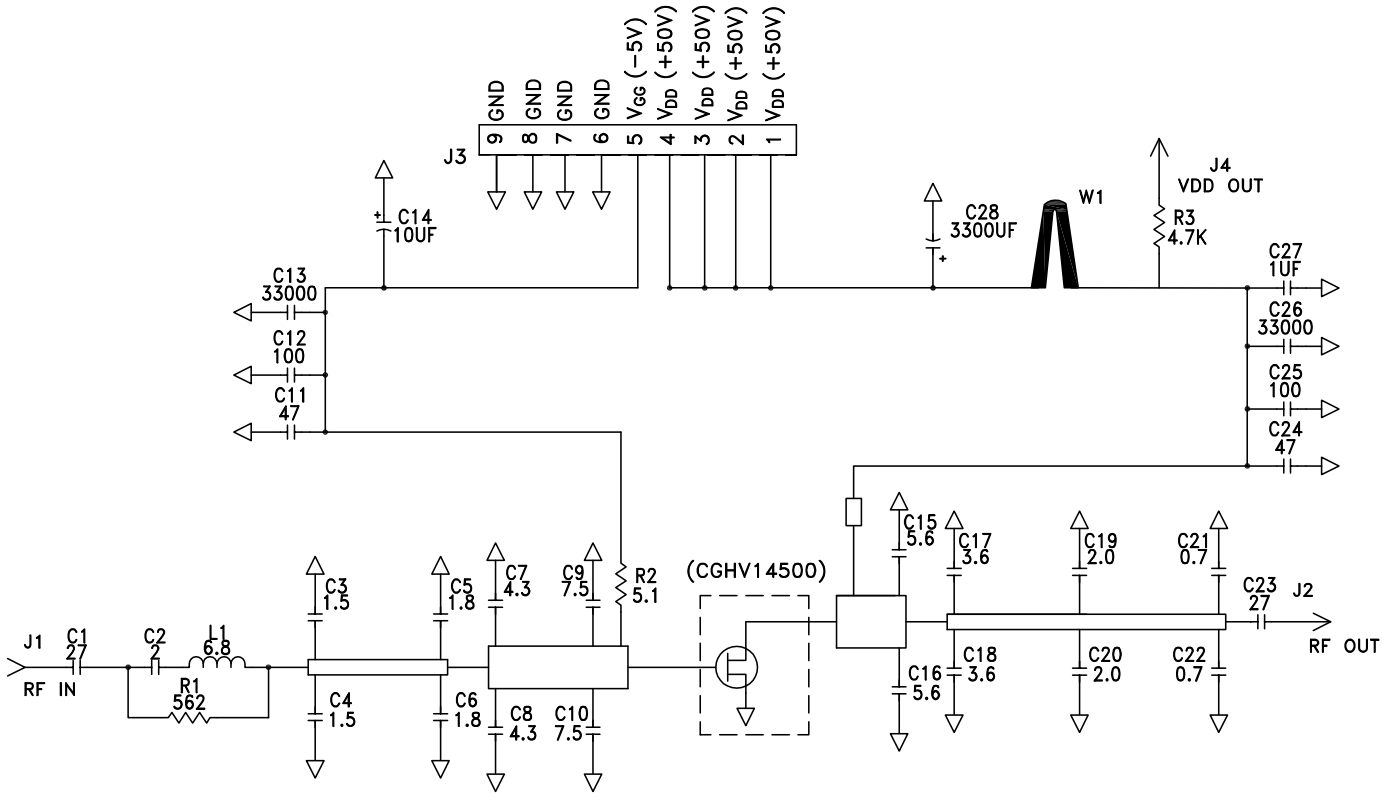
CGHV14500-TB Demonstration Amplifier Circuit Outline



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
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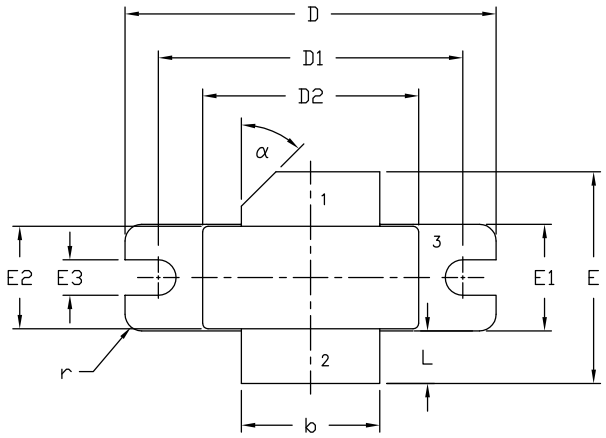
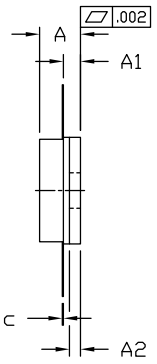
Product Dimensions CGHV14500F (Package Type — 440117)





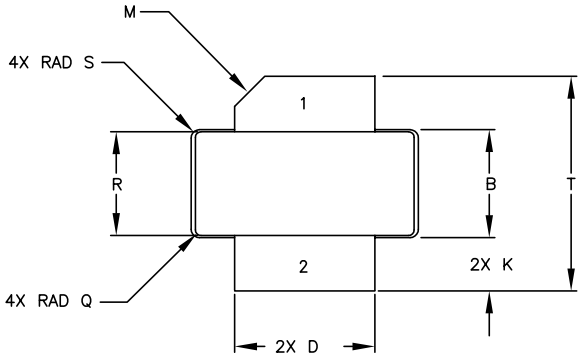
PIN 1. GATE
2. DRAIN
3. SOURCE

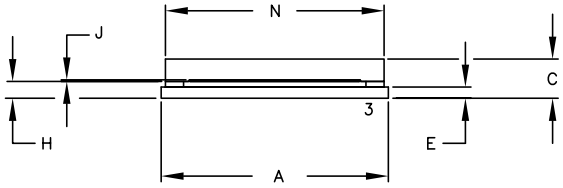
NOTES:

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)





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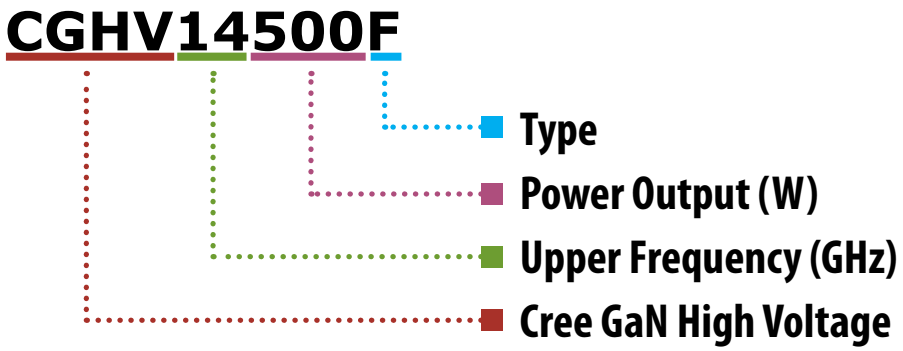
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.135	0.149	3.43	3.78
D	0.495	0.505	12.57	12.83
E	0.035	0.045	.89	1.14
H	0.057	0.067	1.45	1.70
J	0.003	0.006	.08	.15
K	0.170	0.210	4.32	5.33
M	45° REF		45° REF	
N	0.773	0.787	19.63	19.99
Q	0.020 REF		0.51 REF	
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 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 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

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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 & 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