



CHB500W Series Application Note V11 March 2025

ISOLATED DC-DC CONVERTER CHB500W SERIES APPLICATION NOTE



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1. Introduction

The CHB500W series of DC-DC converters offers 500 watts of output power at single output voltages of 12, 24, 28, 48, 54VDC with industry standard half-brick. It has a 4:1 input voltage range of 9 to 40VDC (24VDC nominal), 16.5 to 75VDC (48VDC nominal) and 3000VDC Basic isolation.

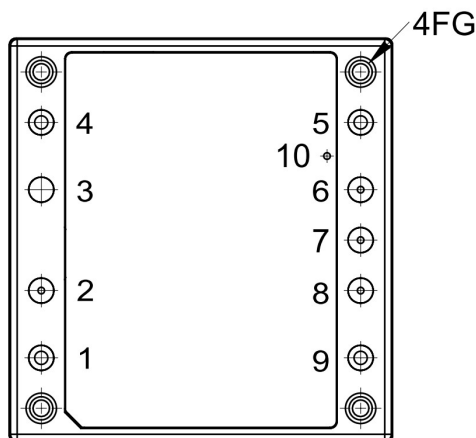
Compliant with EN 55032/EN 55035. High efficiency up to 92.5%, allowing case operating temperature range of -40°C to 105°C. An optional heat sink is available to extend the full power range of the unit.

The standard control functions include remote **on/off** (positive or negative) and +15% to -20% (except for 54Vout +10% to -20%) adjustable output voltage.

Fully protected against input UVLO (under voltage lock out), output over-current, output over-voltage, over-temperature and continuous short circuit conditions.

CHB500W series is designed primarily for common applications of 12V, 24V, 48V nominal voltage and also suitable for distributed power architectures, telecommunications, battery operated equipment and industrial applications.

2. Pin Function Description



No	Label	Function	Description	Reference
1	+Vin	+V Input	Positive Supply Input	Section 7.1/7.2
2	ON/OFF	On/Off	External Remote On/Off Control	Section 6.5
3	NP	No Pin		
4	-Vin	-V Input	Negative Supply Input	Section 7.1/7.2
5	-Vo	-V Output	Negative Power Output	Section 7.3/7.4
6	-Sen	-Sense	Negative Output Remote Sense	Section 6.6
7	Trim	Trim	External Output Voltage Adjustment	Section 6.7
8	+Sen	+Sense	Positive Output Remote Sense	Section 6.6
9	+Vo	+V Output	Positive Power Output	Section 7.3/7.4
10	PC	Parallel Control	Singal Wire Parallel Control	Section 8.2
	--	Mounting Insert	Mounting Insert (FG)	Section 9.5/10.2

Note: Base plate can be connected to FG through M3 threaded mounting insert. Recommended torque 4~8Kgf-cm.

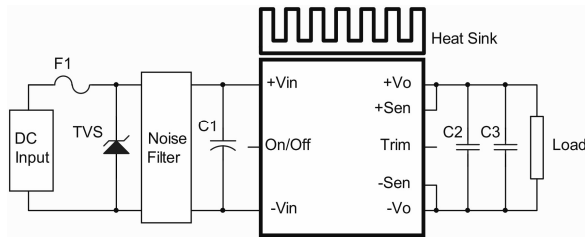


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3. Connection for Standard Use

The connection for standard use is shown below. An external input capacitor (C1) 2200uF for all models is recommended to reduce input ripple voltage. External output capacitors (C2, C3) are recommended to reduce output ripple and noise, 10uF polymer tantalum and 1uF ceramic capacitors for all models.



Symbol	Component	Reference
F1, TVS	Input fuse, TVS	Section 10.1
C1	External capacitor on the input side	Note Section 7.2
C2, C3	External capacitor on the output side	Section 7.3/7.4
Noise Filter	External input noise filter	Section 10.2
Remote On/Off	External remote on/off control	Section 6.5
Trim	External output voltage adjustment	Section 6.7
Heat sink	External heat sink	Section 9.2/9.3/9.4/9.5
+Sense/-Sense	--	Section 6.6

Note:

If the impedance of input line is high, C1 capacitance must be more than above. Use more than two recommended capacitors above in parallel when ambient temperature becomes lower than -20°C.

4. Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown below. When testing the modules under any transient conditions please ensure that the transient response of the source is sufficient to power the equipment under test. We can calculate:

- Efficiency
- Load regulation and line regulation

The value of efficiency is defined as:

$$\eta = \frac{V_o \times I_o}{V_{in} \times I_{in}} \times 100\%$$

Where:

V_o is output voltage,
 I_o is output current,
 V_{in} is input voltage,
 I_{in} is input current

The value of load regulation is defined as:

$$Load\ reg. = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

Where:

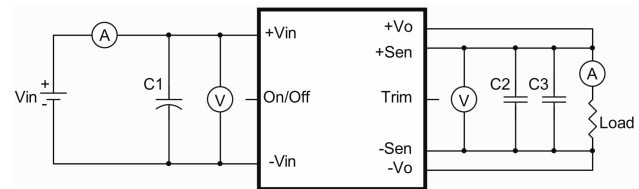
V_{FL} is the output voltage at full load
 V_{NL} is the output voltage at no load

The value of line regulation is defined as:

$$Line\ reg. = \frac{V_{HL} - V_{LL}}{V_{LL}} \times 100\%$$

Where:

V_{HL} is the output voltage of maximum input voltage at full load
 V_{LL} is the output voltage of minimum input voltage at 80% full load



CHB500W Series Test Setup

C1: 2200uF/100V ESR<0.12Ω

C2: 1uF/1210 ceramic capacitor

C3: 10uF polymer tantalum capacitor (ESR ≤ 0.05Ω)

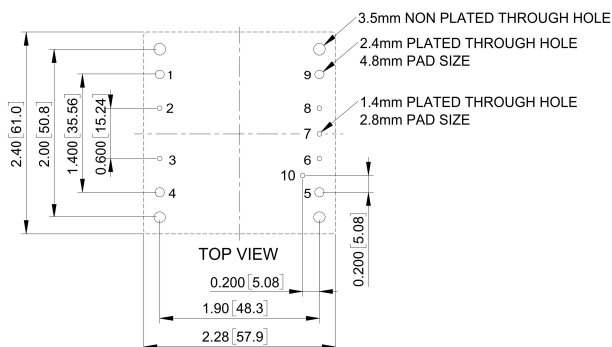


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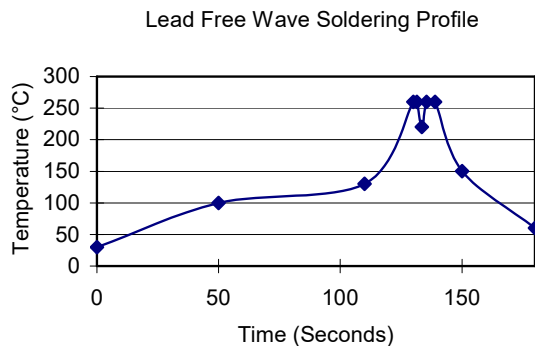
5. Recommend Layout, PCB Footprint and Soldering Information

The system designer or end user must ensure that metal and other components in the vicinity of the converter meet the spacing requirements for which the system is approved. Low resistance and inductance PCB layout traces are the norm and should be used where possible. Due consideration must also be given to proper low impedance tracks between power module, input and output grounds.



Clean the soldered side of the module with a brush, prevent liquid from getting into the module. Do not clean by soaking the module into liquid. Do not allow solvent to come in contact with product labels or resin case as this may change the color of the resin case or cause deletion of the letters printed on the product label. After cleaning, dry the modules well.

The suggested soldering iron is 450°C for up to 5 seconds (less than 50W). Furthermore, the recommended soldering profile is shown below, and PCB layout is referring to Section 10.2.

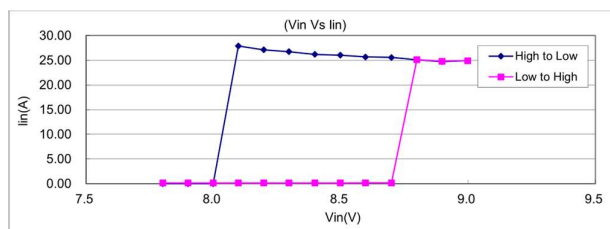


6. Features and Functions

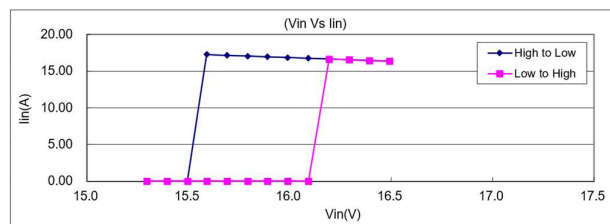
6.1 UVLO (Under Voltage Lock Out)

Input under voltage lockout is standard on the CHB500W series unit. The unit will shut down when the input voltage drops below a threshold, and the unit will operate when the input voltage goes above the upper threshold.

CHB500W-24SXX
I_{in} Vs V_{in}



CHB500W-48SXX
I_{in} Vs V_{in}



Note:

If need to configure UVLO turn off threshold to 8Vdc, please make sure the output power is no more than 80% full load, even though the 9V operating is short duration.

And the module operating between input 9Vdc to 12Vdc, please make sure the output power is no more than 80% full load.

If need to configure UVLO turn off threshold to 15.5Vdc, please make sure the output power is no more than 80% full load, even though the 16.5V operating is short duration.

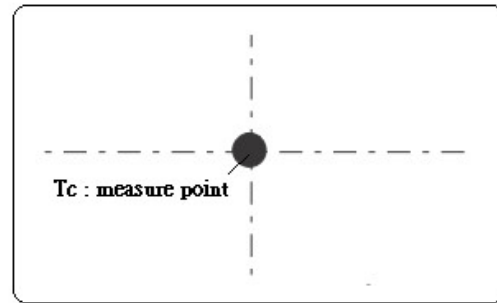
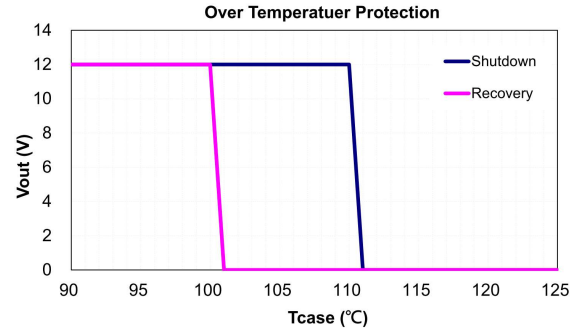
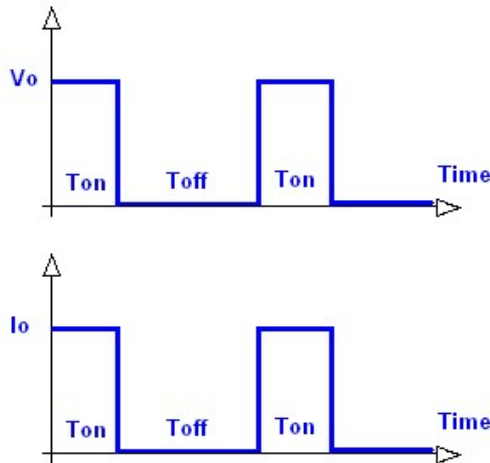


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6.2 Over Current/Short Circuit Protection

All models have internal over current and continuous short circuit protection. The unit operates normally once the fault condition is removed. At the point of current limit inception, the converter will go into hiccup mode protection.



6.3 Output Over Voltage Protection

The output over voltage protection consists of circuitry that internally limits the output voltage. If more accurate output over voltage protection is required, then an external circuit can be used via the remote **on/off** pin.

Note:

Please note that device inside the power supply might fail when voltage more than rated output voltage is applied to output pin. This could happen when the customer tests the over voltage protection of unit. OVP can be tested by using the **trim up** function. Consult us for more information.

6.4 Over Temperature Protection

These modules have an over temperature protection circuit to safeguard against thermal damage. Shutdown occurs with the maximum case reference temperature is exceeded. The module will restart when the case temperature falls below over temperature recovery threshold. Please measure case temperature of the center part of aluminum base plate.

6.5 Remote On/Off

The CHB500W series allows the user to switch the module on and off electronically with the remote **on/off** feature. All models are available in “positive logic” and “negative logic” (optional) versions. The converter turns on if the remote **on/off** pin is high (>3.5Vdc to 75Vdc or open circuit). Setting the pin low (0 to <1.2Vdc) will turn the converter off. The signal level of the remote **on/off** input is defined with respect to ground.

If not using the remote **on/off** pin, leave the pin open (converter will be on).

Models with part number suffix “N” are the “negative logic” remote **on/off** version. The unit turns off if the remote **on/off** pin is high (>3.5Vdc to 75Vdc or open circuit). The converter turns on if the **on/off** pin input is low (0 to <1.2Vdc). Note that the converter is off by default.

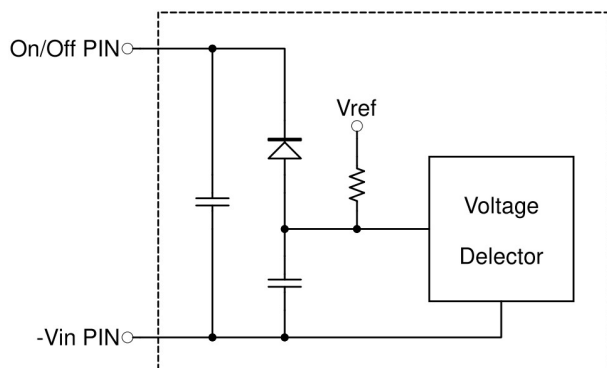
Logic State (Pin 2)	Negative Logic	Positive Logic
Logic Low	Module on	Module off
Logic High	Module off	Module on



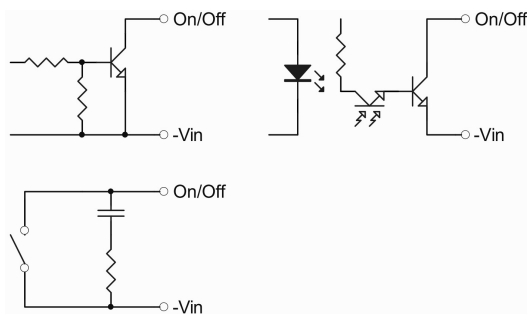
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The converter remote **on/off** circuit built-in on input side. The ground pin of input side remote **on/off** circuit is -Vin pin. Inside connection sees below.



Connection examples see below.



Remote On/Off Connection Example

6.6 Output Remote Sensing

The CHB500W series converter has the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the CHB500W series in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load. The remote-sense voltage range is:

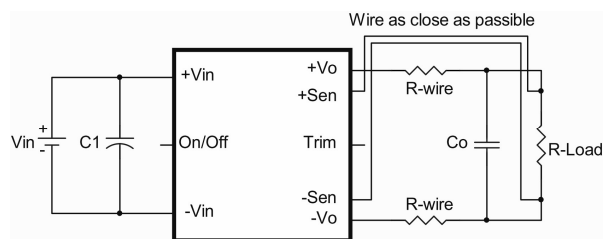
For Vo=54V

$$[(+V_{out}) - (-V_{out})] - [(+Sense) - (-Sense)] \leq 10\% \text{ of } V_{o_nominal}$$

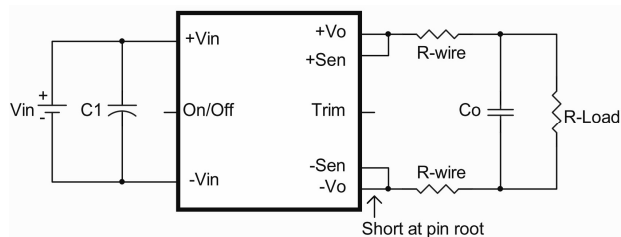
For Others

$$[(+V_{out}) - (-V_{out})] - [(+Sense) - (-Sense)] \leq 15\% \text{ of } V_{o_nominal}$$

When remote sense is in use, the sense should be connected by twisted-pair wire or shield wire. If the sensing patterns short, heavy current flows and the pattern may be damaged. Output voltage might become unstable because impedance of wiring and load condition when length of wire is exceeding 400mm. This is shown in the schematic below.



If the remote sense feature is not to be used, the sense pins should be connected locally. The +Sense pin should be connected to the +V_{out} pin at the module and the -Sense pin should be connected to the -V_{out} pin at the module. Wire between +Sense and +V_{out} and between -Sense and -V_{out} as short as possible. Loop wiring should be avoided. The converter might become unstable by noise coming from poor wiring. This is shown in the schematic below.



Note:

Although the output voltage can be varied (increased or decreased) by both remote sense and trim, the maximum variation for the output voltage is the larger of the two values not the sum of the values. The output power delivered by the module is defined as the voltage at the output terminals multiplied by the output current. Using remote sense and trim can cause the output voltage to increase and consequently increase the power output of the module if output current remains unchanged. Always ensure that the output power of the module remains at or below the maximum rated power. Also be aware that if V_{o_set} is below nominal value, P_{out_max} will also decrease accordingly because I_{o_max} is an absolute limit. Thus, $P_{out_max} = V_{o_set} \times I_{o_max}$ is also an absolute limit.

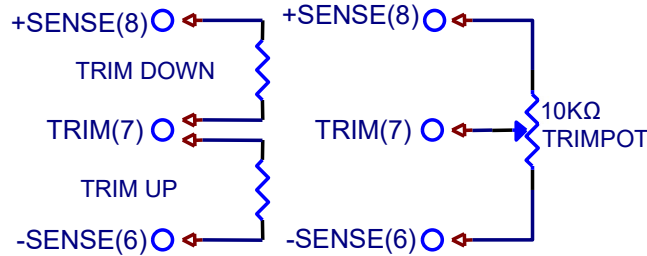


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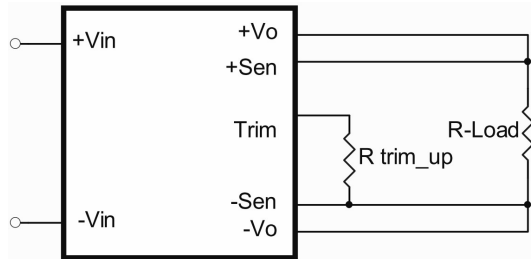
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6.7 Output Voltage Adjustment

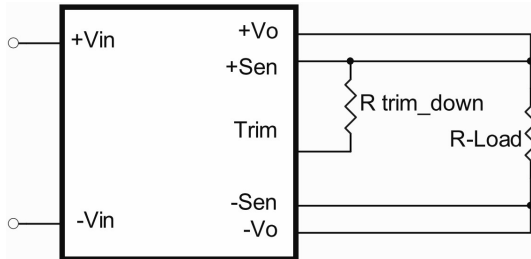
Output may be externally trimmed (+15% to -20%, except 54Vout is +10% to -20%) with a fixed resistor or an external trim pot as shown (optional). Model specific formulas for calculating trim resistors are available upon request as a separate document.



In order to trim the voltage up or down, one needs to connect the trim resistor either between the trim pin and -Sense for trim-up or between trim pin and +Sense for trim-down. The output voltage trim range is +15% to -20%, except 54Vout, it is +10% to -20%. This is shown:



Trim-up Voltage Setup



Trim-down Voltage Setup

The value of R_{trim_up} defined as:

$$R_{trim_up} = \left[\frac{V_r \times R1 \times (R2 + R3)}{R2 \times (V_o - V_{o,nom})} \right] - R_t \text{ (K}\Omega\text{)}$$

Where:

R_{trim_up} is the external resistor in K Ω

$V_{o,nom}$ is the nominal output voltage

V_o is the desired output voltage

$R1$, $R2$, $R3$, R_t and V_r are internal to the unit and are defined in Table 1

Table 1 – Trim up and Trim down Resistor Values

Model Number	Output Voltage (V)	R1 (K Ω)	R2 (K Ω)	R3 (K Ω)	Rt (K Ω)	Vr (V)
CHB500W-24S12	12.0	6.8	2.37	2.2	10	2.5
CHB500W-24S24	24.0	15	2.43	5.9	20	2.5
CHB500W-24S28	28.0	15.4	2.49	10	23.2	2.5
CHB500W-24S48	48.0	28.7	2.4	15	43.2	2.5
CHB500W-24S54	54.0	36	2.43	14	51	2.5
CHB500W-48S12	12.0	6.8	2.37	2.2	10	2.5
CHB500W-48S24	24.0	15	2.43	5.9	20	2.5
CHB500W-48S28	28.0	15.4	2.49	10	23.2	2.5
CHB500W-48S48	48.0	28.7	2.4	15	43.2	2.5

For example, to trim-up the output voltage of 12V module (CHB500W-24S12) by 15% to 13.8V, R_{trim_up} is calculated as follows:

$R1=6.8K\Omega$, $R2=2.37K\Omega$, $R3=2.2K\Omega$, $V_r=2.5V$, $V_o=13.8V$, $V_{o,nom}=12V$

$R_{trim_up} =$

$$\left[\frac{2.5 \times 6.8 \times (2.37 + 2.2)}{2.37 \times (13.8 - 12)} \right] - 10 = 8.2 \text{ (K}\Omega\text{)}$$

The typical value of R_{trim_up}

Trim up (%)	12V	24V	28V	48V	54V
	R_{trim_up} (K Ω)				
1%	263.17	515.62	666.51	1040.5	1075
2%	126.59	247.81	321.65	498.72	512.44
3%	81.06	158.54	206.70	318.04	324.63
4%	58.29	113.91	149.23	227.73	230.72
5%	44.63	87.12	114.74	173.54	174.38
6%	35.53	69.27	91.75	137.42	136.81
7%	29.02	56.52	75.33	111.62	109.98
8%	24.15	46.95	63.01	92.27	89.86
9%	20.35	39.51	53.43	77.21	74.21
10%	17.32	33.56	45.77	65.17	61.69
11%	14.83	28.69	39.50	55.32	
12%	12.76	24.64	34.28	47.11	
13%	11.01	21.20	29.85	40.16	
14%	9.51	18.26	26.06	34.21	
15%	8.21	15.71	22.78	29.05	



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CHB500W series has Trim up derating by input voltage is required shown below.

The value of R_{trim_down} defined as:

$$R_{trim_down} = R1 \times \left[\frac{V_r \times R1}{R2 \times (V_{o,nom} - V_o)} - 1 \right] - R_t (K\Omega)$$

Where:

R_{trim_down} is the external resistor in K Ω

$V_{o,nom}$ is the nominal output voltage

V_o is the desired output voltage

$R1, R2, R3, R_t$ and V_r are internal to the unit and are defined in Table 1

For example: to trim-down the output voltage of 12V module (CHB500W-24S12) by 20% to 9.6V, R_{trim_down} is calculated as follows:

$$R1=6.8K\Omega, R2=2.37K\Omega, R3=2.2K\Omega, R_t=10K\Omega, V_r=2.5V, V_o=9.6V, V_{o,nom}=12V$$

$$R_{trim_down} = 6.8 \times \left[\frac{2.5 \times 6.8}{2.37 \times (12 - 9.6)} - 1 \right] - 10 = 3.52 (K\Omega)$$

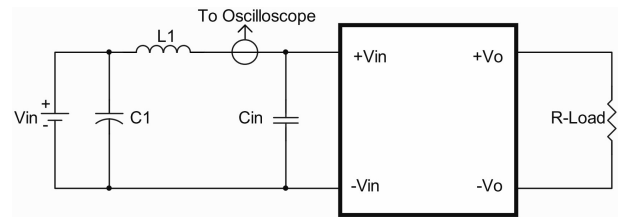
The typical value of R_{trim_down}

Trim down (%)	12V	24V	28V	48V	54V
	$R_{trim_down} (K\Omega)$				
1%	389.67	929.51	811.80	1715.6	2382.1
2%	186.43	447.25	386.60	821.86	1147.5
3%	118.69	286.50	244.87	523.94	736.05
4%	84.82	206.13	174.00	374.98	530.28
5%	64.49	157.90	131.48	285.60	406.83
6%	50.94	125.75	103.13	226.02	324.52
7%	41.27	102.79	82.89	183.46	265.73
8%	34.01	85.56	67.70	151.54	221.64
9%	28.36	72.17	55.89	126.71	187.35
10%	23.85	61.45	46.44	106.85	159.91
11%	20.15	52.68	38.71	90.60	137.47
12%	17.07	45.38	32.27	77.06	118.76
13%	14.47	39.19	26.82	65.60	102.93
14%	12.23	33.89	22.14	55.78	89.37
15%	10.30	29.30	18.09	47.27	77.61
16%	8.60	25.28	14.55	39.82	67.32
17%	7.11	21.74	11.42	33.25	58.24
18%	5.78	18.58	8.64	27.41	50.17
19%	4.59	15.76	6.16	22.18	42.95
20%	3.52	13.23	3.92	17.48	36.46

7. Input/Output Considerations

7.1 Input Capacitance at the Power Module

The converters must be connected to low AC source impedance. To avoid problems with loop stability source inductance should be low. Also, the input capacitors (C_{in}) should be placed close to the converter input pins to decouple distribution inductance. However, the external input capacitors are chosen for suitable ripple handling capability. Low ESR capacitors are good choice. Circuit as shown as below represents typical measurement methods for reflected ripple current. $C1$ and $L1$ simulate a typical DC source impedance. The input reflected-ripple current is measured by current probe to oscilloscope with a simulated source Inductance ($L1$).

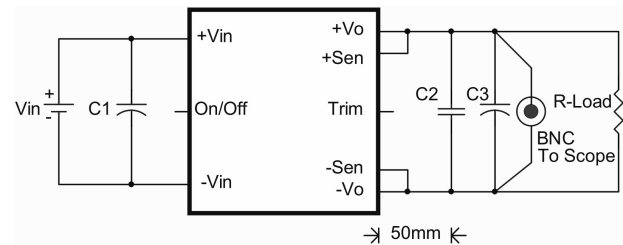


$L1: 3\mu H$

$C1: 1000\mu F/100V$ (KMG) aluminum capacitor and $470\mu F/100V$ polymer capacitor connect in parallel

$C_{in}: 1000\mu F/100V$ (KMG) aluminum capacitor and $470\mu F/100V$ polymer capacitor connect in parallel

7.2 Output Ripple and Noise



$C1: 2200\mu F/100V$ ESR<0.12 Ω

$C2: 1\mu F/1210$ ceramic capacitor

$C3: 10\mu F$ polymer tantalum capacitor (ESR $\leq 0.05\Omega$)

Output ripple and noise measured with $10\mu F$ polymer tantalum capacitor and $1\mu F$ ceramic capacitors across output. A 20 MHz bandwidth oscilloscope is normally used for the measurement.

The conventional ground clip on an oscilloscope probe should never be used in this kind of measurement. This clip, when placed in a field of radiated high frequency energy, acts as an antenna or inductive pickup loop, creating an extraneous voltage that is not part of the output noise of the converter.

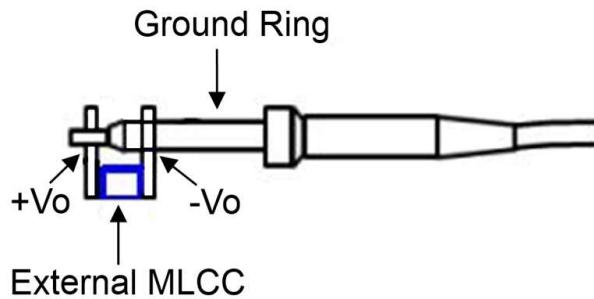


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Another method is shown in below, in case of coaxial-cable/BNC is not available. The noise pickup is eliminated by pressing scope probe ground ring directly against the -Vout terminal while the tip contacts the +Vout terminal. This makes the shortest possible connection across the output terminals.



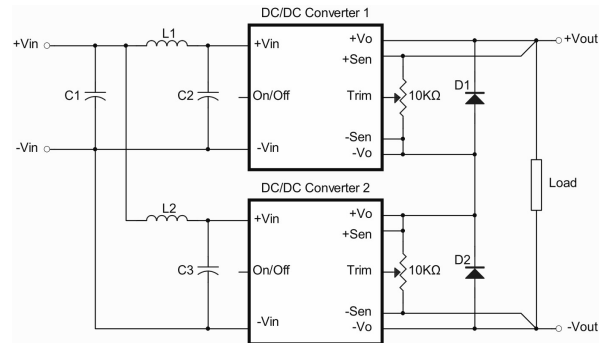
7.3 Output Capacitance

The CHB500W series converters provide unconditional stability with or without external capacitors. For good transient response, low ESR output capacitors should be located close to the point of load (<100mm). PCB design emphasizes low resistance and inductance tracks in consideration of high current applications. Output capacitors with their associated ESR values have an impact on loop stability and bandwidth. Cincon's converters are designed to work with load capacitance to see specifications.

8. Series and Parallel Operation

8.1 Series Operation

Series operation is possible by connecting the outputs two or more units. Connection is shown in below. The output current in series connection should be lower than the lowest rate current in each power module.



Simple Series Operation Connect Circuit

L1, L2: 1.0uH

C1, C2, C3: 2200uF/100V ESR<0.12Ω

Note:

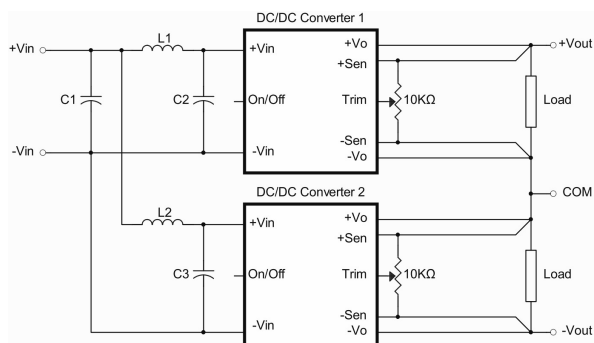
1. If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20°C.
2. Recommend Schottky diode (D1, D2) be connected across the output of each series connected converter, so that if one converter shuts down for any reason, then the output stage won't be thermally overstressed. Without this external diode, the output stage of the shut-down converter could carry the load current provided by the other series converters, with its MOSFETs conducting through the body diodes. The MOSFETs could then be overstressed and fail. The external diode should be capable of handling the full load current for as long as the application is expected to run with any unit shut down.



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Series for \pm output operation is possible by connecting the outputs two units, as shown in the schematic below.



Simple \pm Output Operation Connect Circuit

L1, L2: 1.0uH

C1, C2, C3: 2200uF/100V ESR<0.12Ω

Note:

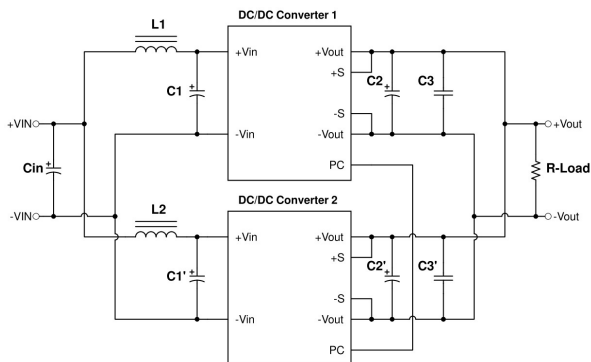
If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20°C.

8.2 Parallel Operation

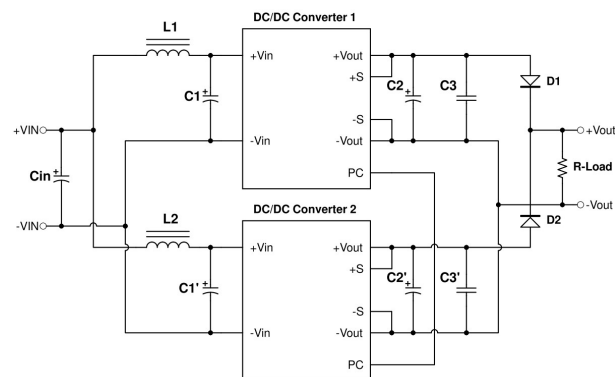
The CHB500W-24(48)SXX-PC series are also designed for parallel operation. When paralleled, the load current can be equally shared between the modules by connecting the PC pins together.

There are two different parallel operations for CHB500W-24(48)SXX-PC series, one is parallel operation when load can't be supplied by only one power unit; the other is the N+1 redundant operation which is high reliable for load of N units by using N+1 units.

(a) parallel operation



(b) N+1 redundant connection



L1, L2: 1.0uH

Cin, C1, C1': 2200uF/100V ESR<0.12Ω

C2, C2': 1000uF/63V

C3, C3': 1uF MLCC

Note:

If the impedance of input line is high, Cin, C1 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20°C.

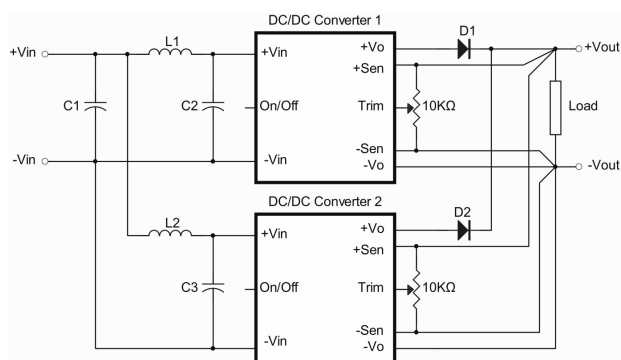


CHB500W Series

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8.3 Redundant Operation

Parallel for redundancy operation is possible by connecting the units as shown in the schematic below. The current of each converter become unbalance by a slight difference of the output voltage. Make sure that the output voltage of units of equal value and the output current from each power supply does not exceed the rated current. Suggest use an external potentiometer to adjust output voltage from each power supply.



Simple Redundant Operation Connect Circuit

L1, L2: 1.0uH

C1, C2, C3: 2200uF/100V ESR<0.12Ω

Note:

If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20°C.



CHB500W Series

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9. Thermal Design

9.1 Operating Temperature Range

The CHB500W series converters can be operated within a wide case temperature range of -40°C to 105°C . Consideration must be given to the derating curves when ascertaining maximum power that can be drawn from the converter. The maximum power drawn from open half brick models is influenced by usual factors, such as:

- Input voltage range
- Output load current
- Forced air or natural convection
- Heat sink optional

9.2 Convection Requirements for Cooling

To predict the approximate cooling needed for the half brick module, refer to the power derating curves in **section 9.4**. These derating curves are approximations of the ambient temperatures and airflows required to keep the power module temperature below its maximum rating. Once the module is assembled in the actual system, the module's temperature should be monitored to ensure it does not exceed 105°C as measured at the center of the top of the case (thus verifying proper cooling).

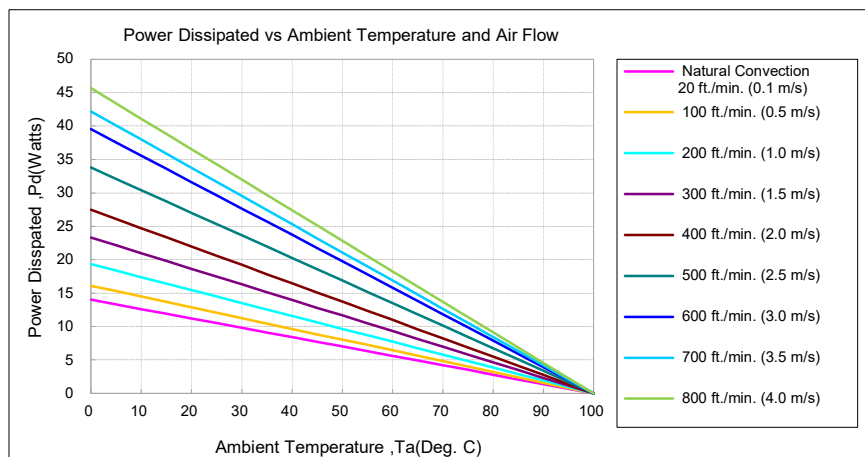
9.3 Thermal Considerations

The power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. The example is presented in **section 9.4**. The power output of the module should not be allowed to exceed rated power ($V_{o_set} \times I_{o_max.}$).

9.4 Power Derating

The operating case temperature range of CHB500W series is -40°C to $+105^{\circ}\text{C}$. When operating the CHB500W series, proper derating or cooling is needed. The maximum case temperature under any operating condition should not exceed 105°C .

The following curve is the de-rating curve of CHB500W series without heat sink.



AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	7.12°C/W
100 ft./min. (0.5m/s)	6.21 °C/W
200 ft./min. (1.0m/s)	5.17 °C/W
300 ft./min. (1.5m/s)	4.29 °C/W
400 ft./min. (2.0m/s)	3.64 °C/W
500 ft./min. (2.5m/s)	2.96 °C/W
600 ft./min. (3.0m/s)	2.53 °C/W
700 ft./min. (3.5m/s)	2.37 °C/W
800 ft./min. (4.0m/s)	2.19 °C/W



CHB500W Series

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Example:

What is the minimum airflow necessary for a CHB500W-24S24 operating at nominal line voltage, an 70% load output current of 14.6A, and a maximum ambient temperature of 25°C?

Solution:

Given: $V_{in}=24V_{dc}$, $V_o=24V_{dc}$, $I_o=14.6A$

Determine power dissipation (P_d): $P_d = P_i - P_o = P_o(1-\eta)/\eta$, $P_d = 24 \times 14.6 \times (1-0.91)/0.91 = 34.65Watts$

Determine airflow: Given: $P_d=34.65W$ and $T_a=25^\circ C$

Check power derating curve: Minimum airflow=800 ft./min.

Verify:

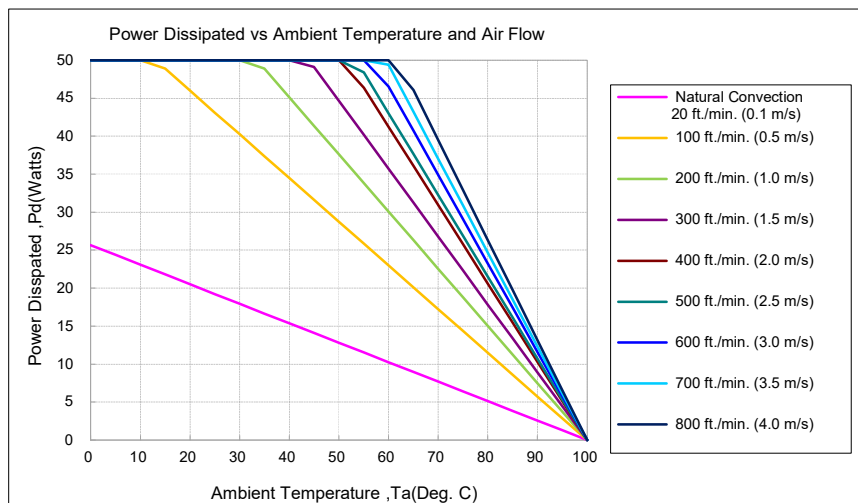
Maximum temperature rise is $\Delta T = P_d \times R_{ca} = 34.65 \times 2.19 = 75.88^\circ C$

Maximum case temperature is $T_c = T_a + \Delta T = 100.9^\circ C < 105^\circ C$

Where:

The R_{ca} is thermal resistance from case to ambient environment

T_a is ambient temperature and T_c is case temperature



AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	3.9°C/W
100 ft./min. (0.5m/s)	1.74°C/W
200 ft./min. (1.0m/s)	1.33°C/W
300 ft./min. (1.5m/s)	1.12°C/W
400 ft./min. (2.0m/s)	0.97°C/W
500 ft./min. (2.5m/s)	0.92°C/W
600 ft./min. (3.0m/s)	0.86°C/W
700 ft./min. (3.5m/s)	0.81°C/W
800 ft./min. (4.0m/s)	0.76°C/W

Example with heatsink HBL210 (M-C308):

What is the minimum airflow necessary for a CHB500W-24S24 operating at nominal line voltage, an output current of 21A, and a maximum ambient temperature of 50°C?

Solution:

Given: $V_{in}=24V_{dc}$, $V_o=24V_{dc}$, $I_o=21A$

Determine power dissipation (P_d): $P_d = P_i - P_o = P_o(1-\eta)/\eta$, $P_d = 24 \times 21 \times (1-0.91)/0.91 = 49.85Watts$

Determine airflow: Given: $P_d=49.85W$ and $T_a=50^\circ C$

Check above power de-rating curve: Minimum airflow= 400 ft./min.

Verify:

Maximum temperature rise is $\Delta T = P_d \times R_{ca} = 49.85 \times 0.97 = 48.35^\circ C$

Maximum case temperature is $T_c = T_a + \Delta T = 98.35^\circ C < 105^\circ C$

Where:

The R_{ca} is thermal resistance from case to ambient environment

T_a is ambient temperature and T_c is case temperature



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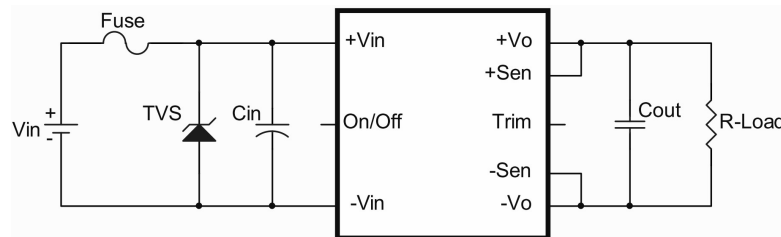
9.5 Half Brick Heat Sinks

Heat sinks assembly [refer to Datasheet-Thermal](#)

10. Safety & EMC

10.1 Input Fusing and Safety Considerations

The CHB500W series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 80A time delay fuse for 24V_{in} models, and 40A for 48V_{in} models. It is recommended that the circuit have a transient voltage suppressor diode (TVS) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage (as shown).



The external input capacitor (C_{in}) and transient voltage suppressor diode (TVS) are required if CHB500W series has to meet EN 61000-4-4, EN 61000-4-5.

The C_{in} recommended a 3300uF/100V aluminum capacitor. And the TVS recommended a SMDJ40A for 24V_{in} models, and SMDJ78A for 48V_{in} models.

10.2 EMC Considerations

EMI Test standard: EN 55032 Class A Conducted & Radiated Emission

Test Condition: Input Voltage: 24V_{dc} and 48V_{dc}, Output Load: Full Load

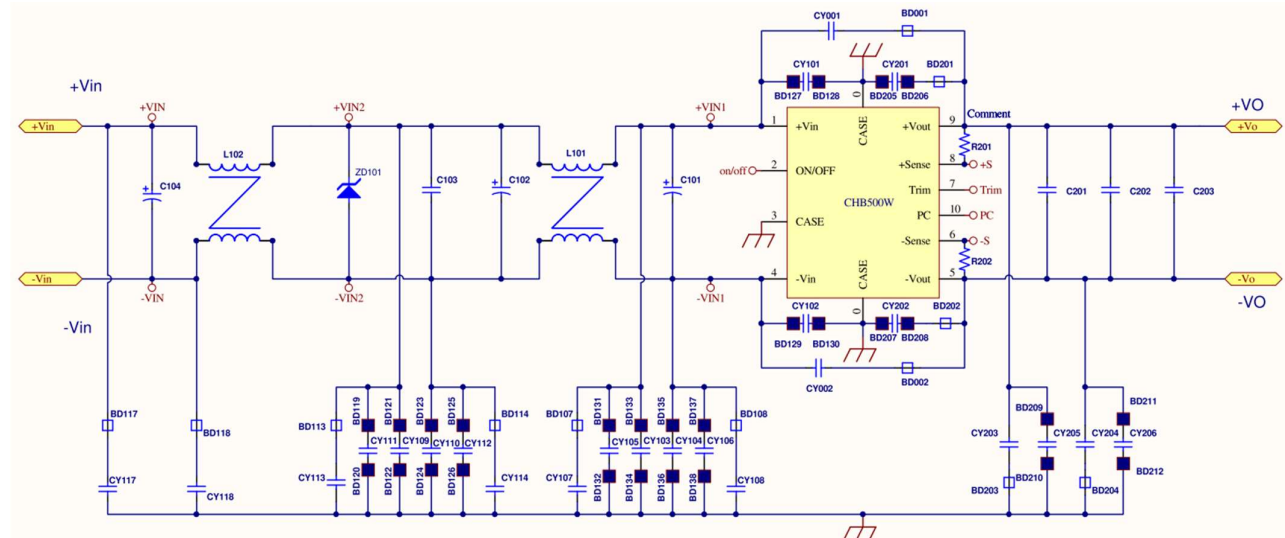


Figure1 Connection Circuit



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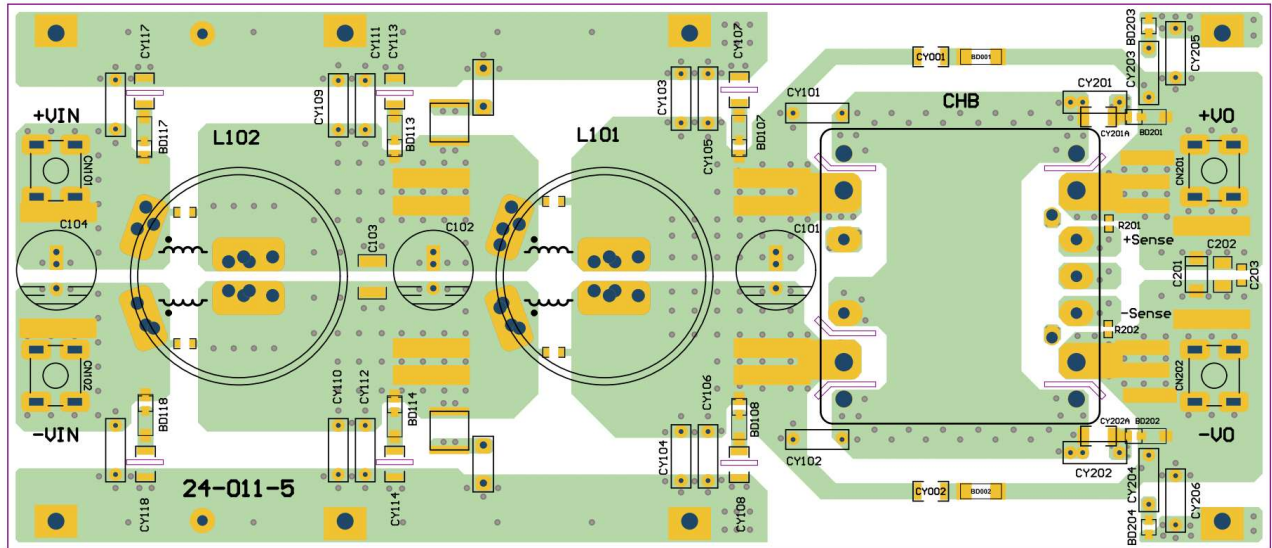


Figure2 PCB Layout Top View

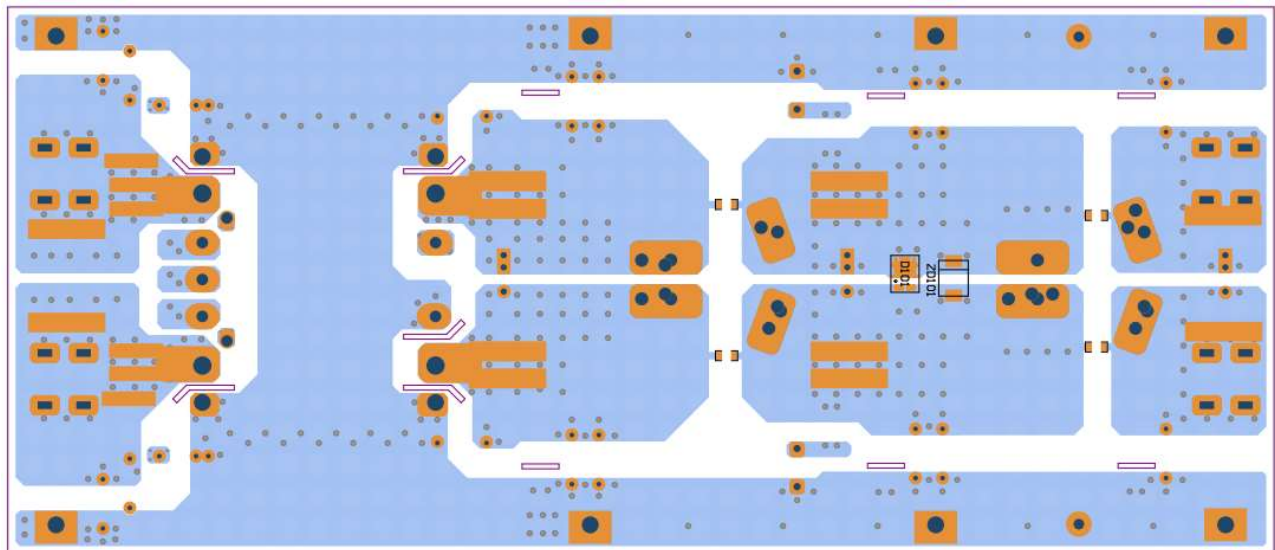


Figure3 PCB Layout Bottom View



CHB500W Series

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For CHB500W-24SXX Components Value:

	Model Number				
DC/DC	24S12	24S24	24S28	24S48	24S54
C101, C102, C104	820uF/50V				
C103	10uF/50V				
C202	1uF/250V				
CY111, CY112	2200pF/400V			4700pF/250V	
BD119, BD120 BD125, BD126	BRH3.5*3.2*1.mm			NC	
CY101, CY102 CY109, CY110	4700pF/250V				
BD121, BD122 BD123, BD124 BD127, BD128 BD129, BD130	NC				
CY105, CY106	NC		2200pF/400V		
BD133, BD134 BD137, BD138	NC				
CY201, CY202	10000pF 250V				
BD205, BD206 BD207, BD208	SN030 T28*1.7*1.2mm				
BD201, BD202	SHORT				
CY107, CY108	2200pF/250VAC				
BD107, BD108	BPH 4030225-400T-G				
R201, R202	0R 1%				
ZD101	SMDJ40A				
L101, L102	1.58mH				
CN202, CN203 CN204, CN205	P-831N				

Note:

C101, C102, C104: NIPPON CHEMI-CON KY series aluminum capacitor or equivalent

C103: 2220 X7R ceramic

C202: 1812 X7R ceramic

CY101, CY102, CY105, CY106, CY109, CY110, CY111, CY112: TDK Y1 DIP capacitor or equivalent

CY201, CY202: TDK Y2 DIP capacitor or equivalent

CY107, CY108: Y2 CAP. SMD 2211 X7R.

BD119, BD120, BD125, BD126: BRH3.5*3.2*1.2mm CHILISIN

BD107, BD108: SMD bead core TAI-TECH or equivalent

BD205, BD206, BD207, BD208: SN030 T2.8*1.7*1.2 SM

R201, R202: Chip resistor 0805.

ZD101: TVS SMD DO-214AB LITTLEFUSE

L101, L102: T60405-R6123-X263 VAC or HF322010-371B204-PF SUNLEI or MP5093015-220204BFA-L4.5 GLOBAL MAGIC or equivalent.

CN202, CN203, CN204, CN205: P-831N DINKLE



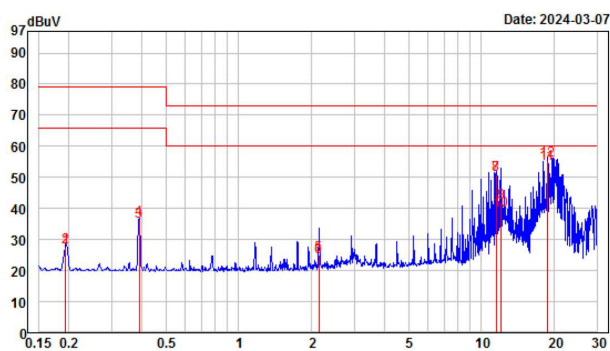
CHB500W Series

Application Note V11 March 2025

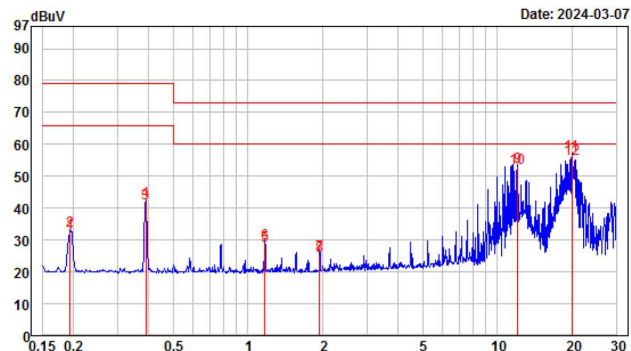
Conducted Emission:

CHB500W-24S12

Line

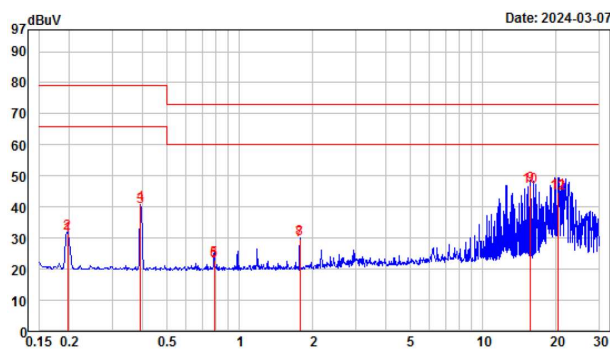


Neutral

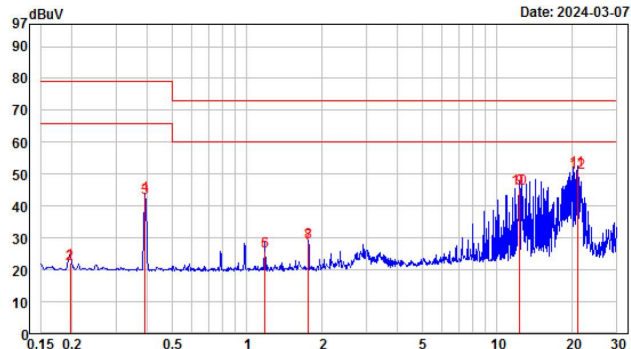


CHB500W-24S24

Line

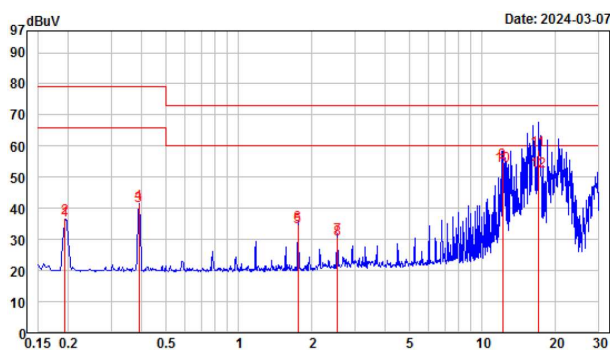


Neutral

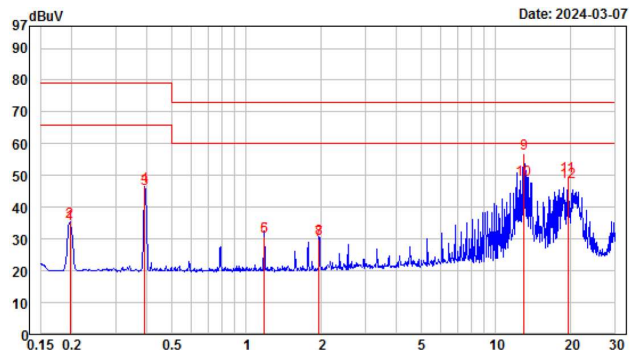


CHB500W-24S28

Line



Neutral



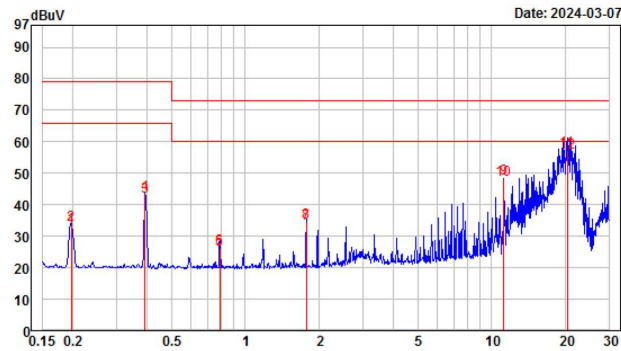


CHB500W Series

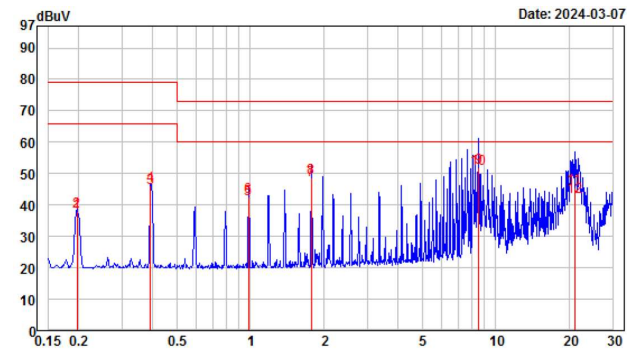
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CHB500W-24S48

Line

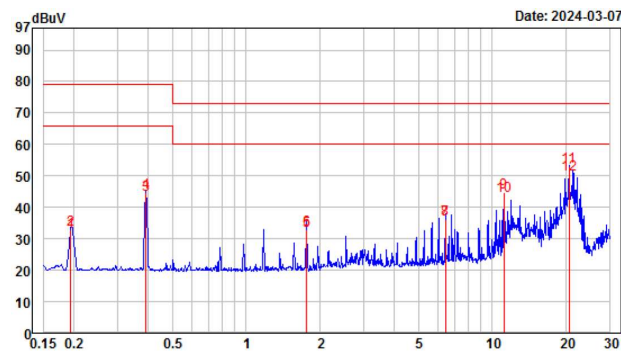


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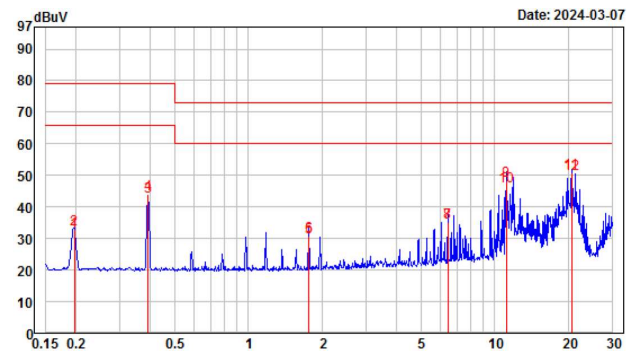


CHB500W-24S54

Line



Neutral





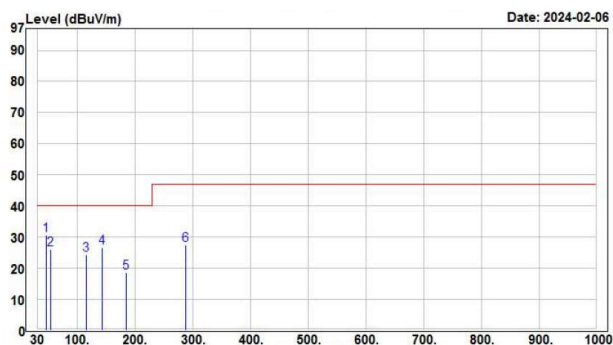
CHB500W Series

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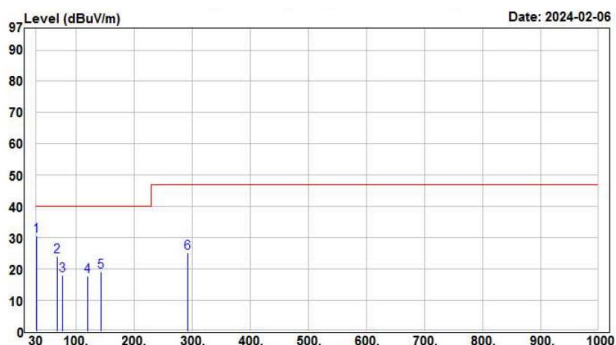
Radiated Emission:

CHB500W-24S12

Vertical

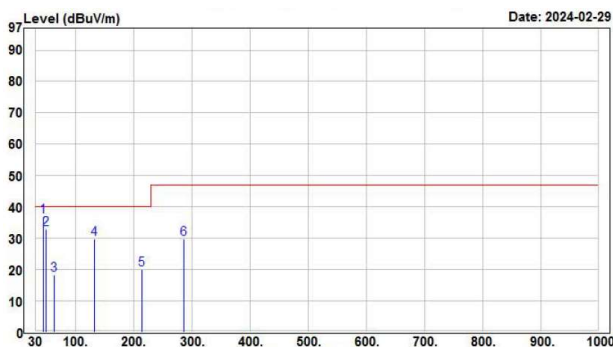


Horizontal

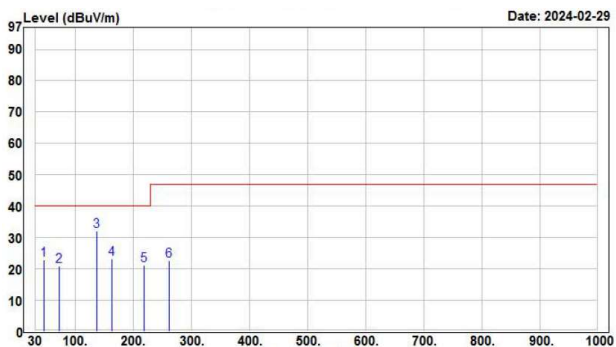


CHB500W-24S24

Vertical

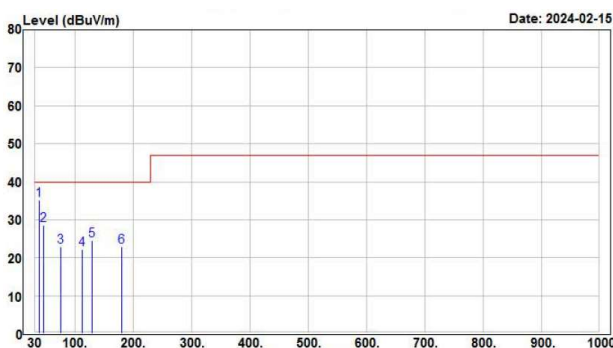


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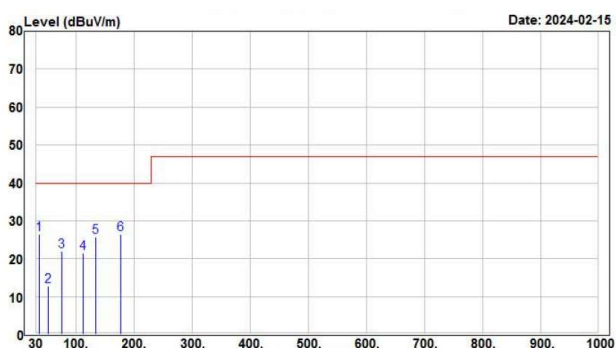


CHB500W-24S28

Vertical



Horizontal



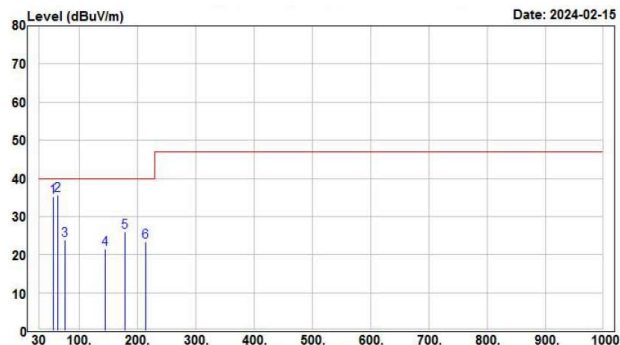


CHB500W Series

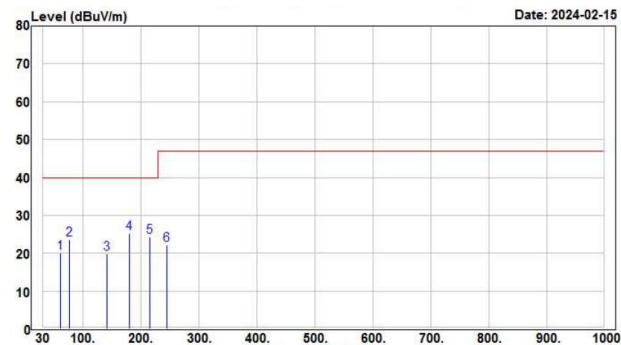
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CHB500W-24S48

Vertical

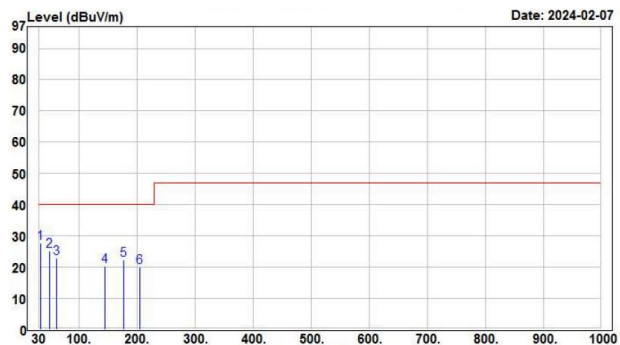


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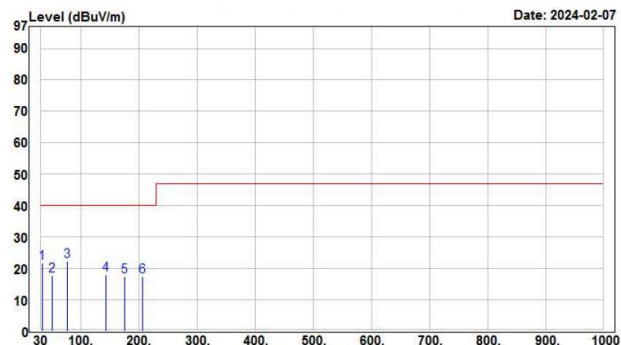


CHB500W-24S54

Vertical



Horizontal





CHB500W Series

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For CHB500W-48SXX Components value:

	Model Number			
DC/DC	48S12	48S24	48S28	48S48
C101, C102, C104	470uF/100V			
C103	4.7uF/100V			NC
C201	10uF/25V	6.8uF/50V		4.7uF/100V
C202	22uF/25V	1uF/50V		1uF/250V
C203	1uF/50V	NC	0.1uF/630V	
CY101, C102 CY111, CY112	4700pF/250V			
BD119, BD120, BD125~130	A6B T 4*1.5*2			
CY103, CY104	2200pF/400V			
BD133~136	A6B T 4*1.5*2			
CY105, CY106	NC	2200pF/400V		NC
BD133, BD134 BD137, BD138	A6B T 4*1.5*2			
CY107, CY108	1000pF/250V			2200pF/250V
BD107, BD108	BPH853025R5-101T-NB			
CY109, CY110	4700pF/250V		3300pF/250V	4700pF/250V
BD121~124	A6B T 4*1.5*2			
CY113, CY114	NC	1000pF/250V	2200pF/250V	1000pF/250V
BD113, BD114	NC	BPH853025R5-101T-NB		
CY117, CY118	NC	680pF/4KV	NC	
BD117, BD118	NC	BPH853025R5-101T-NB	NC	
CY201, CY202	10000pF250V			
BD201,BD202	BPH323023W5-400T-NB	BPH853025R5-101T-NB		
BD205~BD208	NC			
CY203, CY204	10000pF 250V		4700pF/250V	10000pF250V
BD203, BD204	NC	BPH403025W4-530T-NB	NC	BPH403025W4-530T-NB
CY205, CY206	NC		4700pF/250V	NC
BD209~BD212	A6B T 4*1.5*2			
CY001, CY002	2200pF/250V X7R 10%	1000pF/250V	NC	
BD001, BD002	2200pF/250V X7R 10%	BPH853025R5-101T-NB	NC	
ZD101	SMDJ78A			
R201, R202	0R 1%			
L101, L102	1.58mH			
CN101, CN102 CN201, CN202	P-831N			



CHB500W Series

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Note:

C101, C102, C104: SUSCON SDN series aluminum capacitor or equivalent
C103: 2220 X7R ceramic
C201, C202: 1812 X7R ceramic
C203: 1206 X7R ceramic
CY101, CY102, CY103, CY104, CY105, CY106, CY109, CY110, CY111, CY112, CY205, CY206: TDK Y1 DIP capacitor or equivalent
CY117, CY118: SMD 1808 X7R
CY201, CY202, CY203, CY204: TDK Y2 DIP capacitor or equivalent
CY107, CY108, CY113, CY114, CY001, CY002: Y2 CAP. SMD 2211 X7R
BD001, BD002: 2200pF/250V Y2 CAP. SMD 2211 X7R
BD107, BD108, BD201, BD202: SMD bead core TAI-TECH or equivalent
BD119~138, BD209~BD212: KING CORE or equivalent
BD205~BD208: SN BEAD CORE or equivalent
R201, R202: Chip resistor 0805
ZD101: TVS SMD DO-214AB LITTLEFUSE
L101, L102: T60405-R6123-X263 VAC or HF322010-371B204-PF SUNLEI or MP5093015-220204BFA-L4.5 GLOBAL
MAGIC or equivalent
CN202, CN203, CN204, CN205: P-831N DINKLE



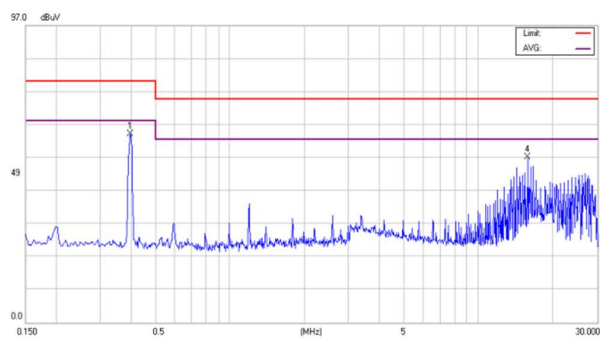
CHB500W Series

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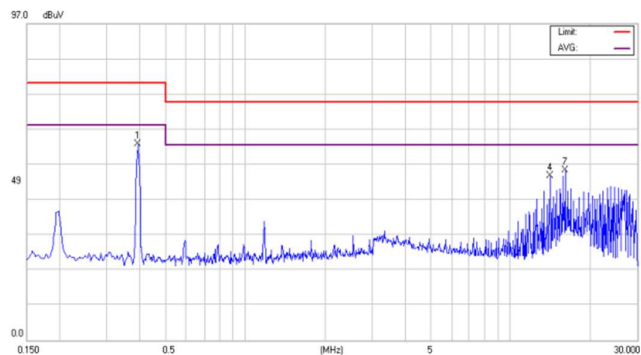
Conducted Emission:

CHB500W-48S12

Line

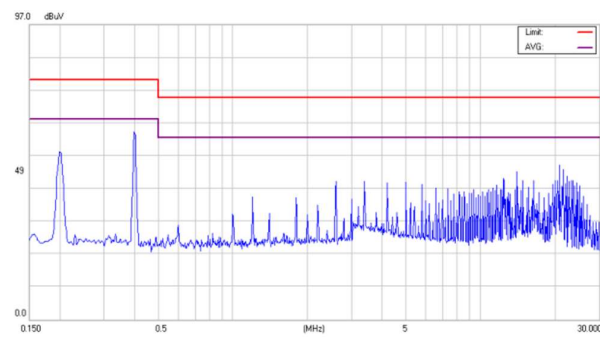


Neutral

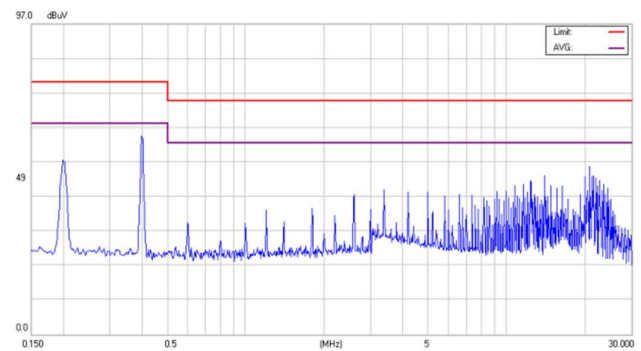


CHB500W-48S24

Line

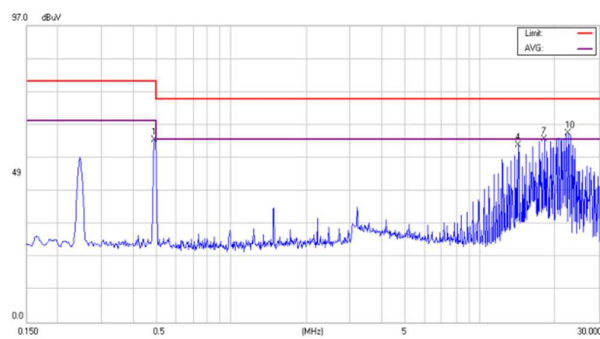


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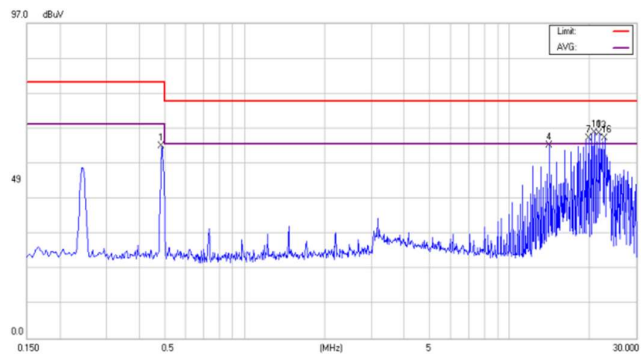


CHB500W-48S28

Line



Neutral



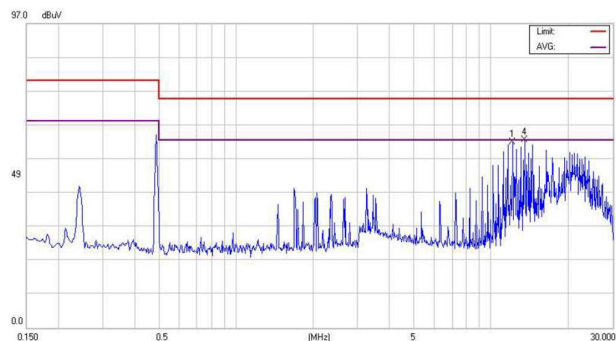


CHB500W Series

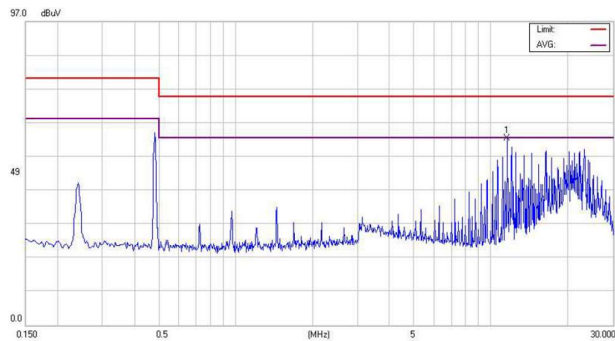
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CHB500W-48S48

Line



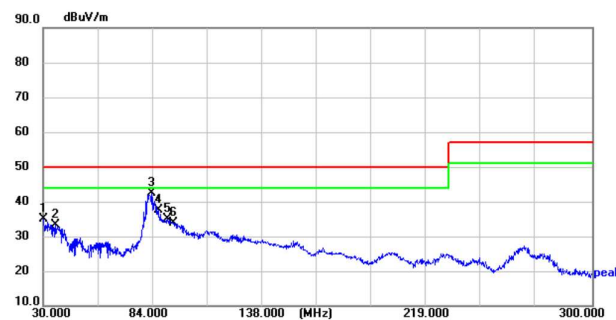
Neutral



Radiated Emission:

CHB500W-48S12

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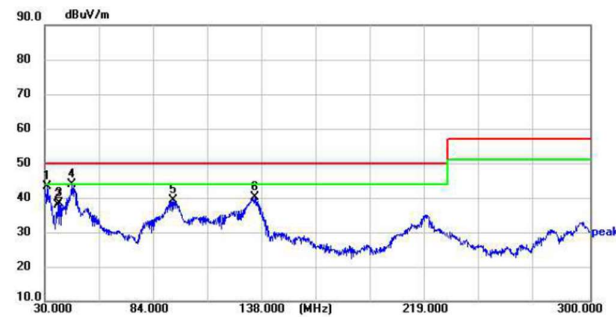


Horizontal



CHB500W-48S24

Vertical



Horizontal





CHB500W Series

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CHB500W-48S28

Vertical



Horizontal



CHB500W-48S48

Vertical



Horizontal



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