ISOLATED DC-DC CONVERTER
CHB200W SERIES
APPLICATION NOTE

Approved By:

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Contents

CHB200W Series
Application Note V17 February 2025

1. Introduction

The CHB200W series of DC-DC converters offers 165-200 watts of output power at single output voltages of 3.3, 5, 12, 15, 24, 28, 48VDC with industry standard half brick. It has a wide (4:1) input voltage range of 10 to 36VDC (24VDC nominal) ,18 to 75VDC (48VDC nominal) and 1500VDC isolation.

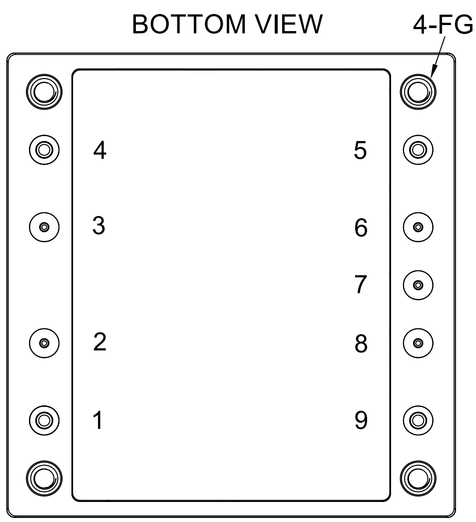
High efficiency up to 89%, allowing case operating temperature range of -40℃ to 100℃. An optional heat sink is available to extend the full power range of the unit.

The standard control functions include remote **on/off** (positive or negative) and +10%, -10% 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.

CHB200W series can be used in the field of telecommunications, data communications, wireless communications, servers etc.

2. Pin Function Description

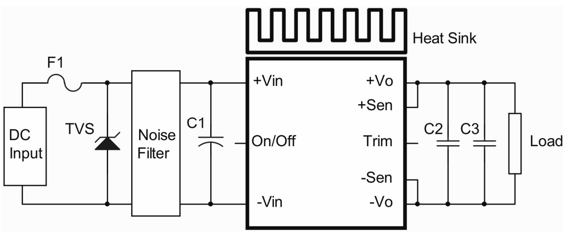


No	Label	Function	Description	Reference
1	+Vin	+V Input	Positive Supply Input	**Section 7.1**
2	Remote	On/Off	External Remote On/Off Control	**Section 6.5**
3	Case	Case	Connected to Base Plate	
4	-Vin	-V Input	Negative Supply Input	**Section 7.1**
5	-Vo	-V Output	Negative Power Output	**Section 7.2/7.3**
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 7.2/7.3**
--	--	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 3Kgf-cm.

3. Connection for Standard Use

The connection for standard use is shown below. An external input capacitor (C1) 470uF for 24Vin and 47uF for 48Vin models are recommended to reduce input ripple voltage. External output capacitors (C2, C3) are recommended to reduce output ripple and noise, 10uF solid tantalum (for 48Vout with 10uF aluminum) and 1uF ceramic capacitors across the output.
The output terminal of models required a minimum capacitor to maintain specified regulation.



Symbol	Component	Reference
F1, TVS	Input fuse, TVS	**Section 10.1**
C1	External capacitor on input side	**Note Section 7.1**
C2, C3	External capacitor on the output side	**Section 7.2/7.3**
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 capacitor 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:

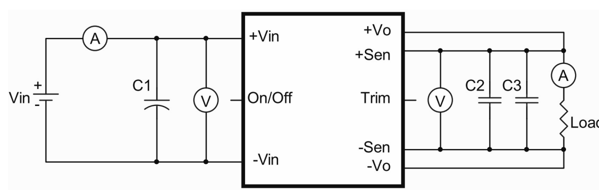
$$Load\ reg. = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

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 full load.



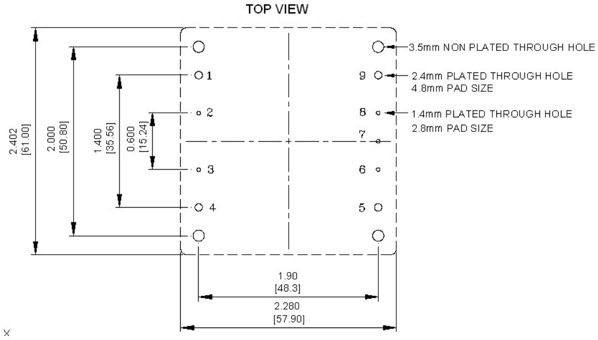
CHB200W Series Test Setup

C1: 470uF for 24Vin, 47uF for 48Vin models
C2: 1uF/1210 ceramic capacitor
C3: 10uF solid tantalum (for 48Vout with 10uF Aluminum solid capacitor)

Note:
The output terminal of models required a minimum capacitor to maintain specified regulation.

5. Recommend Layout, PCB Footprint and Soldering Information

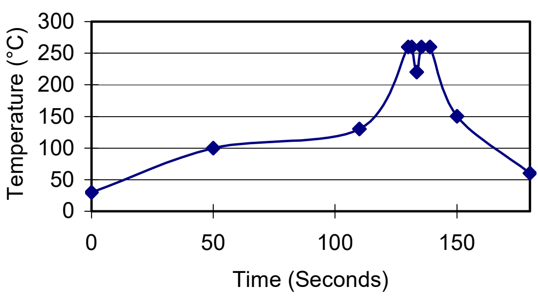
The system designer or end user must ensure that metal and other components in the vicinity of the converter meet the spacing requirements for which the system is approved. Low resistance and inductance PCB layout traces are the norm and should be used where possible. Due consideration must also be given 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 changed 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℃ for up to 5seconds (less than 90W). Furthermore, the recommended soldering profile is shown below, and PCB layout is referring to Section 10.2.

Lead Free Wave Soldering Profile



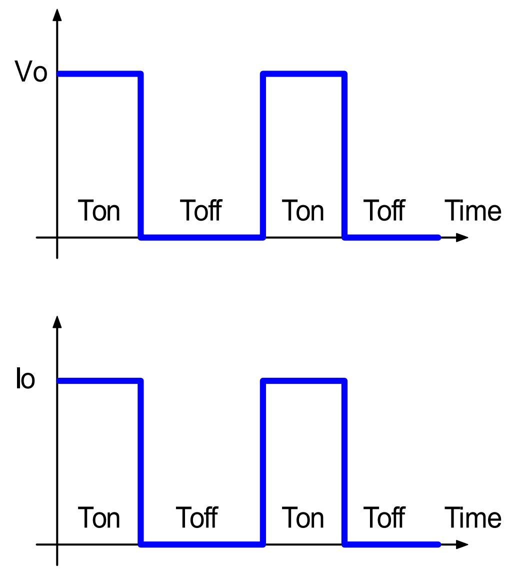
6. Features and Functions

6.1 UVLO (Under Voltage Lock Out)

Input under voltage lockout is standard with this converter. At input voltages below the input under voltage lockout limit, the module operation is disabled.

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

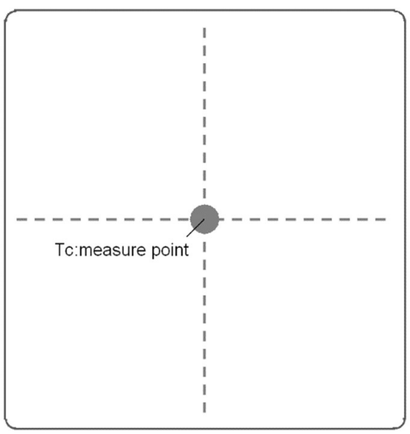
The converter is protected against output over voltage conditions. When the output voltage is higher than the specified range, the module enters a hiccup mode of operation. The operation is identical with over current protection.

Note:

Please note that device inside the power supply might fail when voltage more than rate 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.

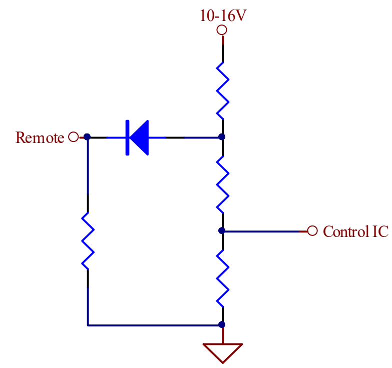


6.5 Remote On/Off

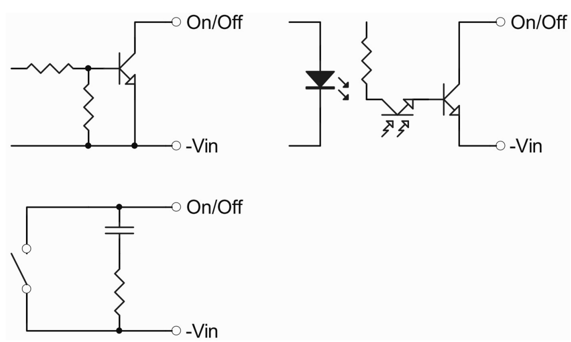
The **on/off** input pin permits the user to turn the power module on or off via a system signal. Two remote **on/off** options are available. Positive logic turns the module on during a logic high voltage on the **on/off** pin, and off during a logic low. Negative logic remote **on/off** turns the module off during a logic high and on during a logic low. The **on/off** pin is internally pulled up through a resistor. A properly de-bounced mechanical switch, open collector transistor, or FET can be used to drive the input of the **on/off** pin. If not using the remote **on/off** feature: For positive logic, leave the **on/off** pin open. For negative logic, short the **on/off** pin to -Vin.

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

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



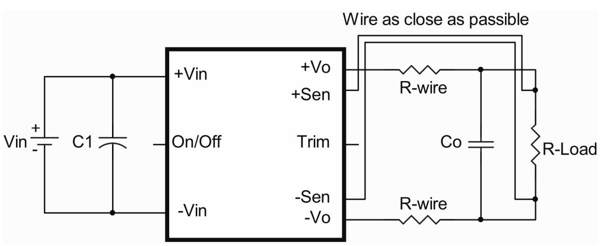
Remote On/Off Connection Example

6.6 Output Remote Sensing

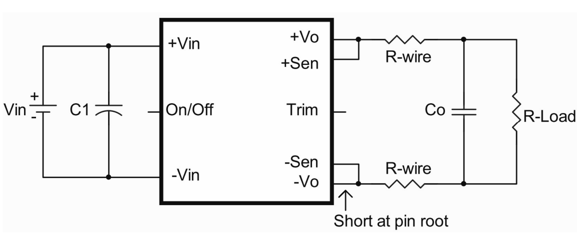
The CHB200W series converter has the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the CHB200W 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:

$[(+V_{out}) - (-V_{out})] - [(+Sense) - (-Sense)] \leqq 10\%$ 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, heave current flows and the pattern may be damaged. Output voltage might become unstable because of 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.



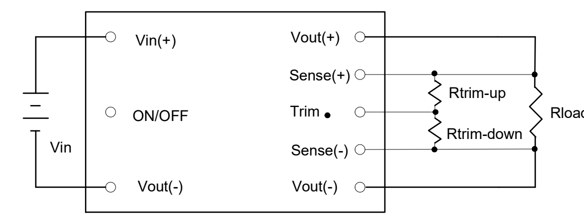
Note:

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.

6.7 Output Voltage Adjustment

Output may be externally trimmed (-10% to +10%) 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.

Method 1



Output Voltage Trim Circuit Configuration

The Trim pin should be left open if trimming is not being used. Connecting an external resistor ($R_{trim\text{-}down}$) between the Trim pin and the V_{out} (-) (or Sense (-)) pin decreases the output voltage. The following equation determines the required external resistor value to obtain a down percentage output voltage change of Δ%

For V_o: 3.3, 5, 12, 15, 24, 28V

$$R_{trim-down} = \left[\frac{511}{\Delta\%} - 10.22\right] k\Omega$$

For V_o: 48V

$$R_{trim-down} = \left[\frac{2000}{\Delta\%} - 40\right] k\Omega$$

Where

$$\Delta\% = \left(\frac{V_{o,set} - V_{desired}}{V_{o,set}}\right) \times 100$$

For example, to trim-down the output voltage of 12V module (CHB200W-48S12) by 5% to 11.4V, $R_{trim-down}$ is calculated as follow:
Δ%=5

$$R_{trim-down} = \left(\frac{511}{5} - 10.22\right) k\Omega$$

$$R_{trim-down} = 91.98 k\Omega$$

Connecting an external resistor ($R_{trim-up}$) between the Trim pin and the V_{out} (+) (or Sense (+)) pin increases the output voltage. The following equations determine the required external resistor value to obtain a up percentage output voltage change of Δ%.

For Vo: 3.3, 5, 12, 15, 24, 28V

$$R_{trim-up} = \left[\frac{5.11 V_{out}(100 + \Delta\%)}{1.225 \times \Delta\%} - \frac{511}{\Delta\%} - 10.22\right] k\Omega$$

For Vo: 48V

$$R_{trim-up} = \left[\frac{20 V_{out}(100 + \Delta\%)}{1.225 \times \Delta\%} - \frac{2000}{\Delta\%} - 40\right] k\Omega$$

Where

$$V_{out} = V_{o,set}, \Delta\% = \left(\frac{V_{desired} - V_{o,set}}{V_{o,set}}\right) \times 100$$

For example, to trim-up the output voltage of 12V module (CHB200W-48S12) by 5% to 12.6V, $R_{trim-up}$ is calculated as follow:
Δ%=5

$$R_{trim-up} = \left(\frac{5.11 \times 12 \times (100 + 5)}{1.225 \times 5} - \frac{511}{5} - 10.22\right) k\Omega$$

$$R_{trim-up} = 938.78 k\Omega$$

The typical value of R_{trim_up}

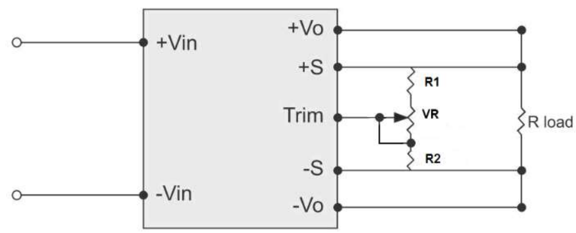
Trim up %	3.3V	5V	12V	15V
	R_{trim_up} (KΩ)			
1%	869.1	1585.4	4534.6	5798.5
2%	436.3	798	2287.2	2925.4
3%	292.1	535.5	1538.1	1967.7
4%	219.9	404.3	1163.5	1488.9
5%	176.7	325.6	938.8	1201.6
6%	147.8	273.1	789	1010
7%	127.2	235.6	681.9	873.2
8%	111.7	207.5	601.7	770.6
9%	99.7	185.6	539.2	690.8
10%	90.1	168.1	489.3	627

Trim up %	24V	28V	48V
	R_{trim_up} (KΩ)		
1%	9590.3	11275.6	77111
2%	4840.1	5691.1	38927.3
3%	3256.7	3829.6	26199.5
4%	2465	2898.8	19835.5
5%	1990	2340.4	16017.1
6%	1673.3	1968.1	13471.6
7%	1447.1	1702.2	11653.3
8%	1277.4	1502.7	10289.6
9%	1145.5	1347.6	9228.9
10%	1039.9	1223.5	8380.4

The typical value of R_{trim_down}

Trim down %	3.3V	5V	12V	15V	24V	28V	48V
	R_{trim_up} (KΩ)						
1%	500.8	500.8	500.8	500.8	500.8	500.8	1960
2%	245.3	245.3	245.3	245.3	245.3	245.3	960
3%	160.1	160.1	160.1	160.1	160.1	160.1	626.7
4%	117.5	117.5	117.5	117.5	117.5	117.5	460
5%	92	92	92	92	92	92	360
6%	74.9	74.9	74.9	74.9	74.9	74.9	293.3
7%	62.8	62.8	62.8	62.8	62.8	62.8	245.7
8%	53.7	53.7	53.7	53.7	53.7	53.7	210
9%	46.6	46.6	46.6	46.6	46.6	46.6	182.2
10%	40.9	40.9	40.9	40.9	40.9	40.9	160

Method 2



Output Voltage Trim Circuit Configuration with VR

Recommend Resistor Values:

V_{out} (V)	R1 (KΩ)	R2 (KΩ)	VR (KΩ)
3.3	9.1	7.5	10
5	13.7	5.6	10
12	30	4.3	20
15	36	3.9	20
24	43	2.7	20
28	51	2.67	20
48	68	2	20

For CHB200W-xxS3V3, 05, 12, 15, 24, 28

$$R1 + VR \geq \frac{37.543 \times \mathrm{R2} \times \mathrm{Vo} - 40.88 \times \mathrm{R2}}{40.88 - \mathrm{R2}} (K\Omega) \;\ldots.(1)$$

$$R1 \leq \frac{45.886 \times R2 \times Vo - 61.32 \times R2}{61.32 + R2} (K\Omega) \;\ldots\ldots\ldots.(2)$$

$$VR \geq (1) - (2)$$

For CHB200W-xxS48

$$R1 + VR \geq \frac{146.939 \times R2 \times Vo - 160 \times R2}{160 - R2} (K\Omega) \;\ldots.(1)$$

$$R1 \leq \frac{179.592 \times R2 \times Vo - 240 \times R2}{240 + R2} (K\Omega) \;\ldots\ldots\ldots.(2)$$

$$VR \geq (1) - (2)$$

Ex: CHB200W-24S12

If R2=4.3KΩ

$$R1 + VR \geq \frac{37.543 \times 4.3 \times 12 - 40.88 \times 4.3}{40.88 - 4.3} = 48.153K\Omega$$

$$R1 \leq \frac{45.886 \times 4.3 \times 12 - 61.32 \times 4.3}{61.32 + 4.3} = 32.064K\Omega$$

$$VR \geq 48.153 - 32.064 = 16.089K\Omega$$

R1 use 30K, VR use 20K

Ex: CHB200W-24S48

If R2=2KΩ

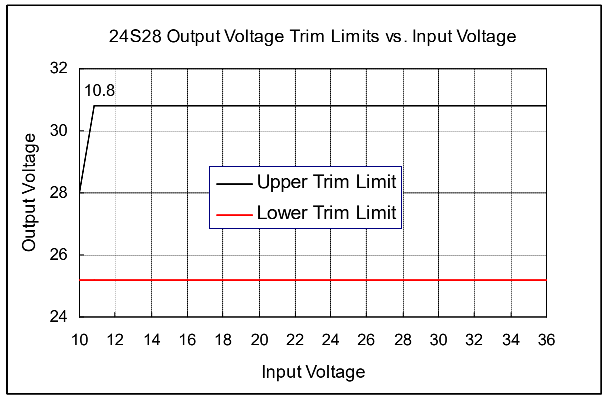
$$R1 + VR \geq \frac{146.939 \times 2 \times 48 - 160 \times 2}{160 - 2} = 87.254K\Omega$$

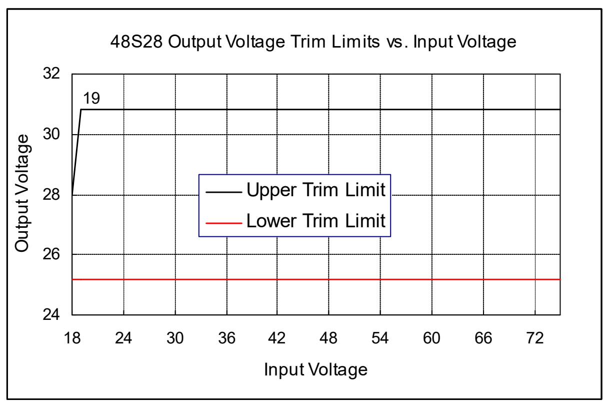
$$R1 \leq \frac{179.592 \times 2 \times 48 - 240 \times 2}{240 + 2} = 69.26K\Omega$$

$$VR \geq 87.254 - 69.26 = 17.994K\Omega$$

R1 use 68K, VR use 20K

The output voltage on 28V models, see input& output trim curves for trim up and trim down is -10%.

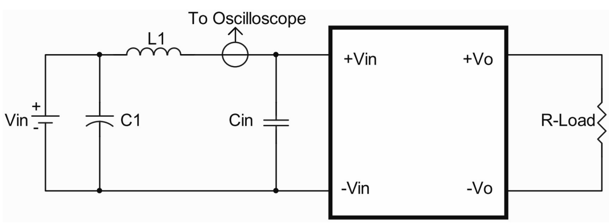




7. Input / Output Considerations

7.1 Input Capacitance at the Power Module

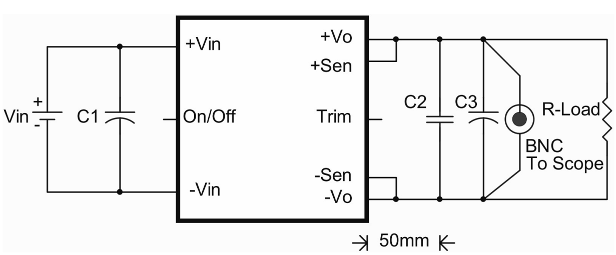
The converters must be connected to low AC source impedance. To avoid problems with loop stability source inductance should be low. Also, the input capacitors (Cin) should be placed close to the converter input pins to de-couple distribution inductance. However, the external input capacitors are chosen 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).



Input Reflected-Ripple Test Setup

C1: NC
For 24SXX
L1: 1.2uH
Cin: 470uF ESR<0.2ohm @100KHz
For 48SXX
L1: 12uH
Cin: 47uF ESR<0.7ohm @100KHz

7.2 Output Ripple and Noise

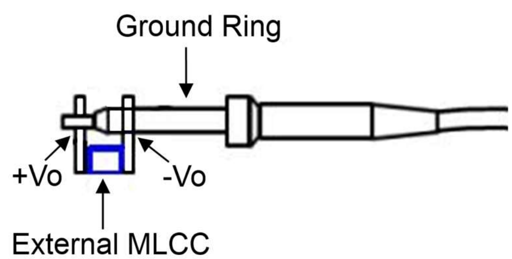


C1: None
C2: 1uF/1210 ceramic capacitor
C3: 10uF solid tantalum (for 48Vout with 10uF Aluminum solid capacitor)
Cout: The output terminal of models required a minimum capacitor to maintain specified regulation.

Output ripple and noise measured with 10uF solid tantalum (for 48Vout with 10uF Aluminum) and 1uF 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.

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.



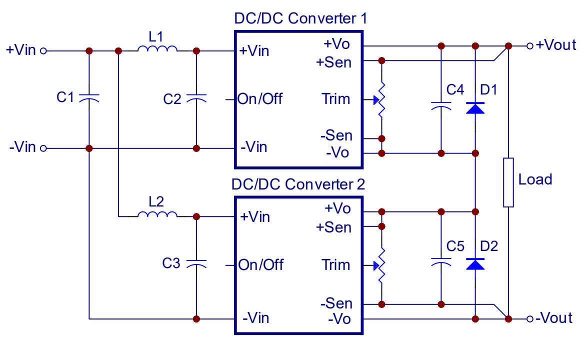
7.3 Output Capacitance

The CHB200W 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

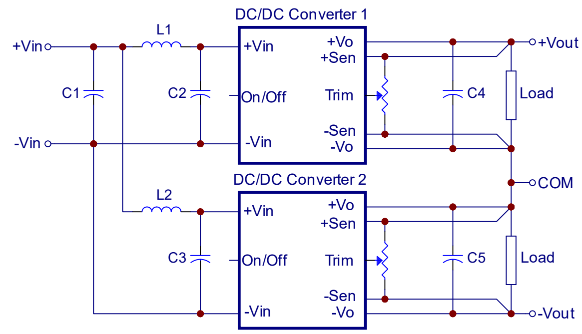
C1, C2, C3: 470uF for 24Vin, 47uF for 48Vin models

C4, C5: The output terminal of models required a minimum capacitor to maintain specified regulation

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℃.
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.

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



Simple ±Output Operation Connect Circuit

L1, L2: 1.0uH

C1, C2, C3: 470uF for 24Vin, 47uF for 48Vin models

C4, C5: The output terminal of models required a minimum capacitor to maintain specified regulation

Note:

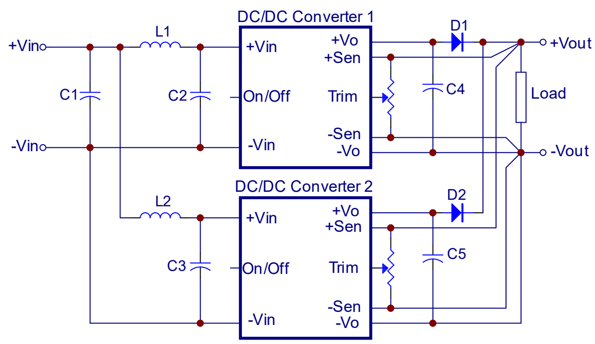
If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20℃.

8.2 Parallel Operation

The CHB200W series parallel operation is not possible.

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 rate 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: 470uF for 24Vin, 47uF for 48Vin models

C4, C5: The output terminal of models required a minimum capacitor to maintain specified regulation

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℃.

9. Thermal Design

9.1 Operating Temperature Range

The CHB200W series converters can be operated within a wide case temperature range of -40℃ to 100℃. 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 100℃ as measured at the center of the top of the case (thus verifying proper cooling).

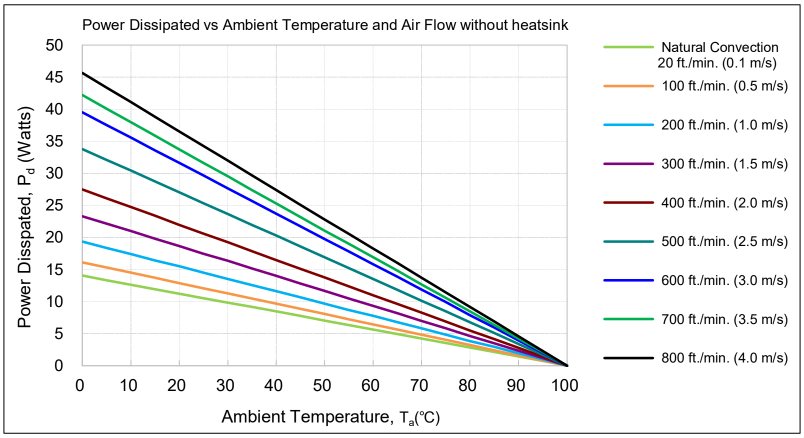
9.3 Thermal Considerations

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} x $I_{o\_max.}$).

9.4 Power Derating

The operating case temperature range of CHB200W series is -40℃ to +100℃. When operating the CHB200W series, proper de-rating or cooling is needed. The maximum case temperature under any operating condition should not exceed 100℃.

The following curve is the de-rating curve of CHB200W series without heat sink.



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

Example:

What is the minimum airflow necessary for a CHB200W-48S05 operating at nominal line voltage, an output current of 40A, and a maximum ambient temperature of 40℃.

Solution:

Given:

V_{in}=48V_{dc}, V_o=5V_{dc}, I_o=40A

Determine power dissipation (P_d):

$P_d=P_i-P_o=P_o(1-\eta)/\eta$

P_d=5V×40A×(1-0.89)/0.89=24.72Watts

Determine airflow:

Given: P_d=24.72W and T_a=40℃

Check power derating curve:

Minimum airflow=800ft./min.

Verify:

Maximum temperature rise is

$\Delta T=P_d\times R_{ca}$=24.72W×2.19=54.14℃

Maximum case temperature is

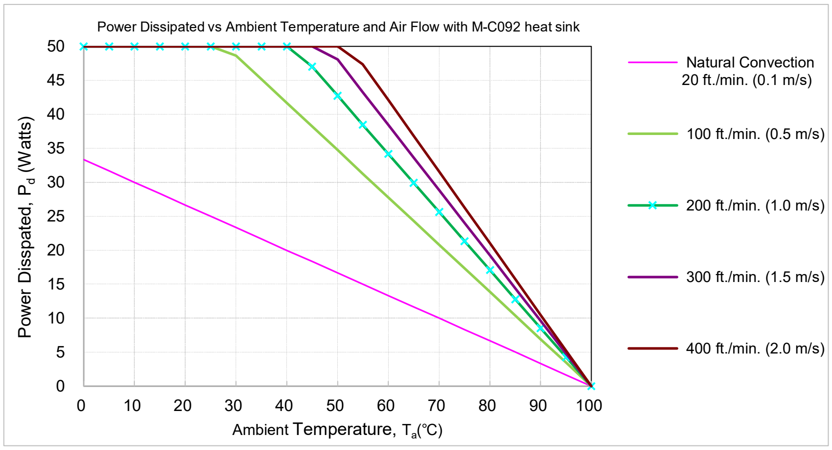
$T_c=T_a+\Delta T$=94.14℃<100℃

Where:

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

T_a is ambient temperature and T_c is case temperature

Example with heatsink HBT254 (M-C092):



AIR FLOW RATE	TYPICAL R_{ca}
Natural convection 20ft./min. (0.1m/s)	3.00 ℃/W
100 ft./min. (0.5m/s)	1.44 ℃/W
200 ft./min. (1.0m/s)	1.17 ℃/W
300 ft./min. (1.5m/s)	1.04 ℃/W
400 ft./min. (2.0m/s)	0.95 ℃/W

What is the minimum airflow necessary for a CHB200W-48S12 operating at nominal line voltage, an output current of 16.7A, and a maximum ambient temperature of 40℃.

Solution:

Given:

V_{in}=48V_{dc}, V_o=12V_{dc}, I_o=16.7A

Determine power dissipation (P_d):

$P_d=P_i-P_o=P_o(1-\eta)/\eta$

P_d=12×16.7×(1-0.88)/0.88=27.33Watts

Determine airflow:

Given: P_d=27.33W and T_a=40℃

Check above power derating curve:

Minimum airflow=100 ft./min.

Verify:

Maximum temperature rise is

$\Delta T=P_d \times R_{ca}$=27.33×1.44=39.36℃

Maximum case temperature is

$T_c=T_a+\Delta T$=79.36℃<100℃

Where:

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

T_a is ambient temperature and T_c is case temperature

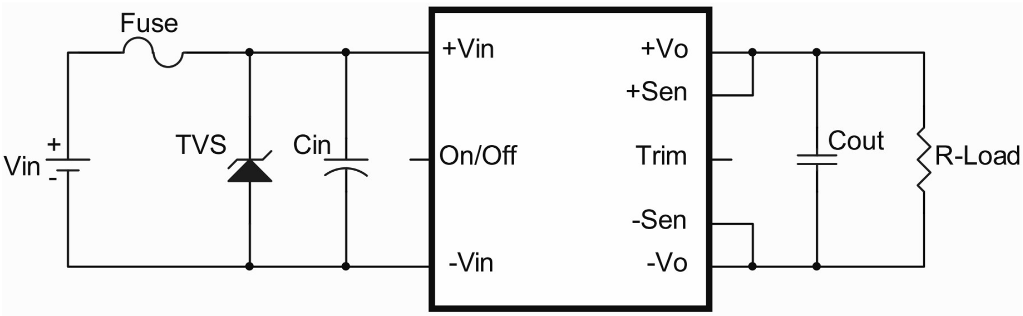
9.5 Half Brick Heat Sinks

Heat sinks assembly **refer to Datasheet-Thermal**

10. Safety & EMC

10.1 Input Fusing and Safety Considerations

The CHB200W series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 40A time delay fuse for 24Vin models, and 20A for 48Vin 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 (Cin) and transient voltage suppressor diode (TVS) are required if CHB200Wseries has to meet EN 61000-4-4, EN 61000-4-5.

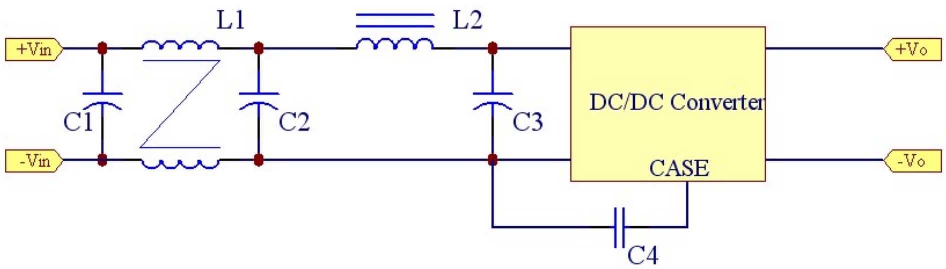
The Cin recommended 470uF for 24Vin, 47uF for 48Vin models aluminum capacitor. And the TVS recommended SMDJ40A for 24Vin models, and SMDJ78A for 48Vin models.

The output terminal of models required a minimum capacitor to maintain specified regulation.

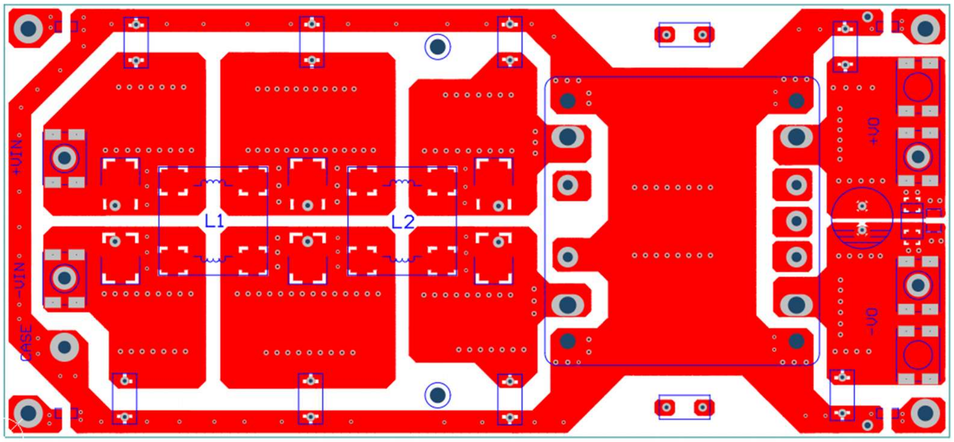
10.2 EMC Considerations

EMI Test standard: EN 55032 Class A Conducted Emission
Test Condition: Input Voltage: Nominal, Output Load: Full Load

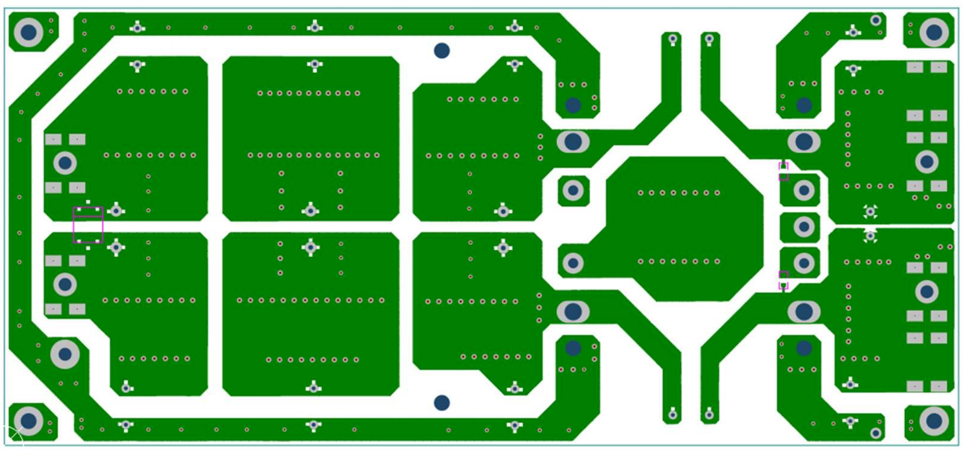
(1) EMI and conducted noise meet EN 55032 Class A:



Connection Circuit For Conducted EMI Class A Testing



EMI Test Board Top Side

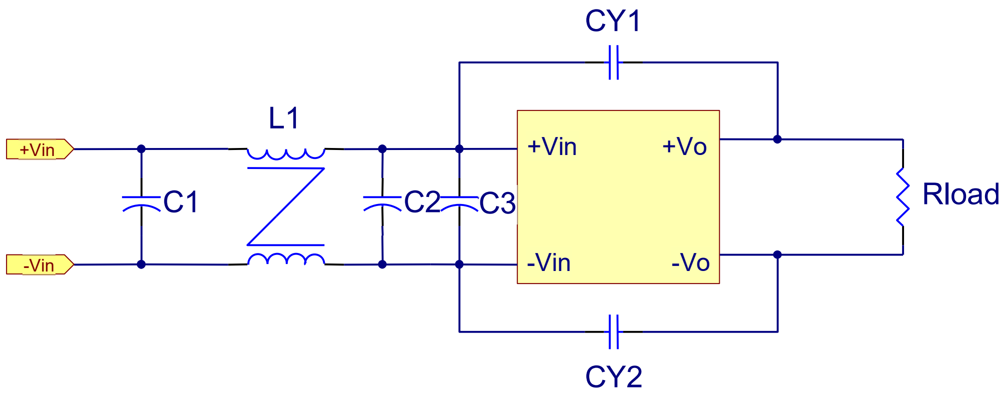


EMI Test Board Bottom Side

EN55032 Class A						
Model No.	C1	C2	C3	C4	L1	L2
CHB200W-24S3V3	47uF/100V	47uF/100V	NC	NC	0.5mH	Short
CHB200W-24S05	82uF/100V	82uF/100V	NC	NC	0.5mH	Short
CHB200W-24S12	120uF/100V	120uF/100V	NC	NC	0.5mH	Short
CHB200W-24S15	47uF/100V	47uF/100V	NC	NC	0.5mH	Short
CHB200W-24S24	100uF/100V	100uF/100V	NC	NC	0.5mH	Short
CHB200W-24S28	100uF/100V	100uF/100V	NC	NC	0.5mH	Short
CHB200W-48S3V3	47uF/100V	47uF/100V	NC	NC	0.1mH	Short
CHB200W-48S05	47uF/100V	47uF/100V	NC	NC	0.5mH	Short
CHB200W-48S12	82uF/100V	82uF/100V	NC	NC	0.5mH	Short
CHB200W-48S15	82uF/100V	82uF/100V	NC	NC	0.5mH	Short
CHB200W-48S24	82uF/100V	82uF/100V	NC	NC	0.7mH	Short
CHB200W-48S28	150uF/100V	150uF/100V	NC	NC	0.5mH	Short

Note: C1, C2 NIPPON CHEMI-CON KY series aluminum capacitors

(2) EMI and conducted noise meet EN55032 Class A:

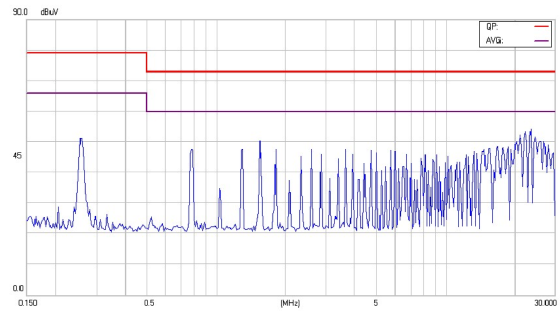


EN55032 Class A						
Model No.	C1	C2	C3	CY1	CY2	L1
CHB200W-24S48	100uF/100V	100uF/100V	100uF/100V	680pF/2KV	680pF/2KV	1.0mH
CHB200W-48S48	100uF/100V	100uF/100V	100uF/100V	680pF/2KV	680pF/2KV	1.0mH

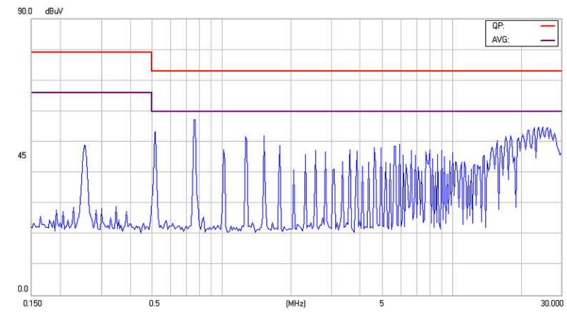
Note: C1, C2, C3 NIPPON CHEMI-CON KY series aluminum capacitors, CY1, CY2 is ceramic capacitors

Conducted Emission

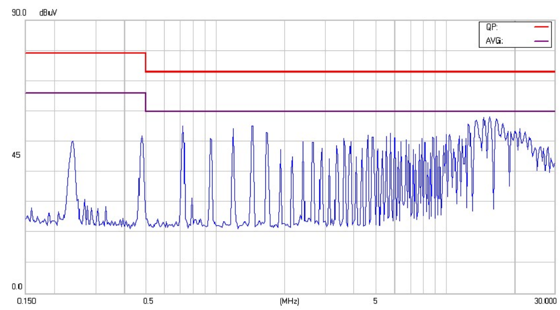
Conducted Class A of CHB200W-24S3V3



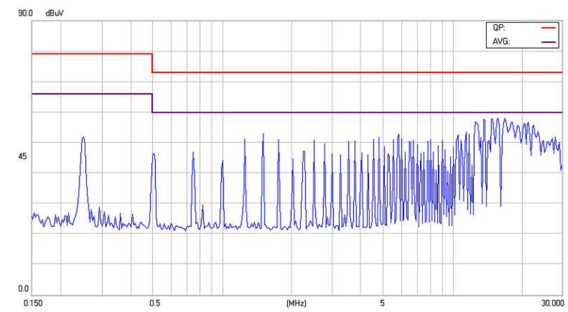
Conducted Class A of CHB200W-24S05



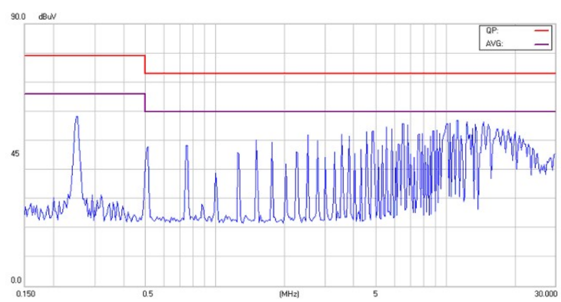
Conducted Class A of CHB200W-24S12



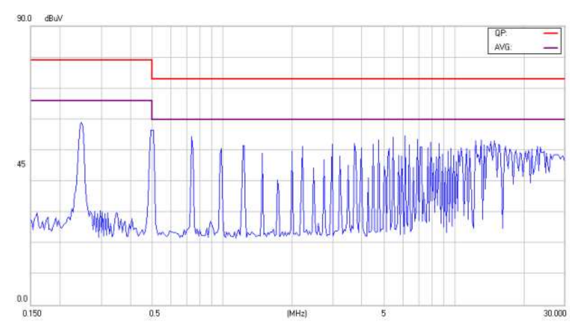
Conducted Class A of CHB200W-24S15



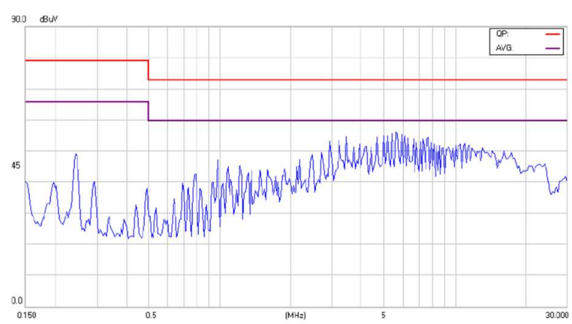
Conducted Class A of CHB200W-24S24



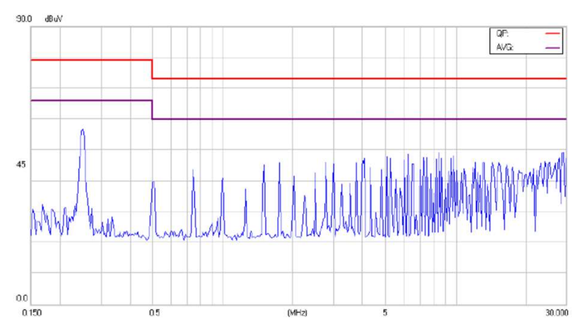
Conducted Class A of CHB200W-24S28



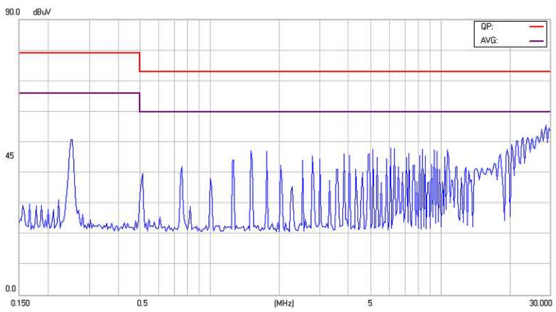
Conducted Class A of CHB200W-24S48



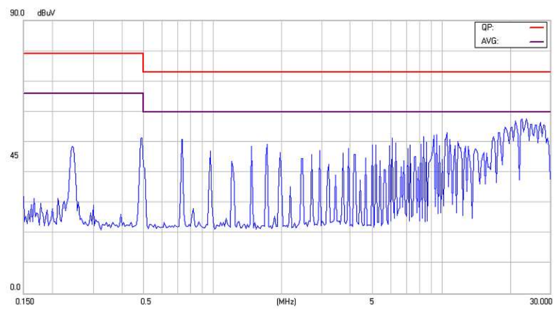
Conducted Class A of CHB200W-48S3V3



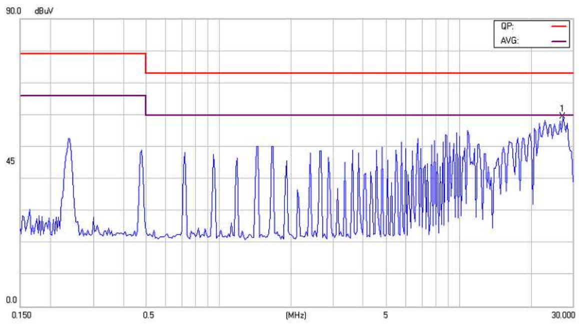
Conducted Class A of CHB200W-48S05



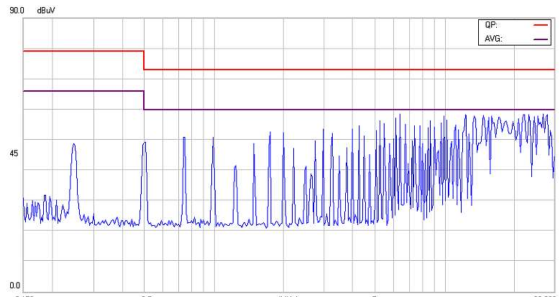
Conducted Class A of CHB200W-48S12



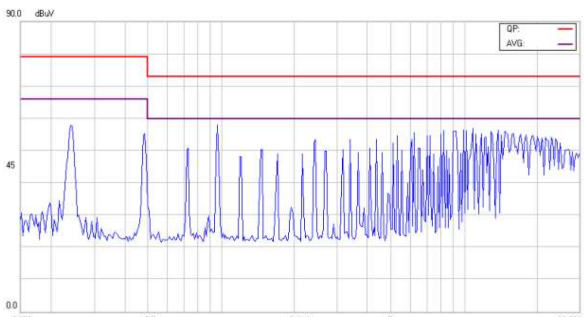
Conducted Class A of CHB200W-48S15



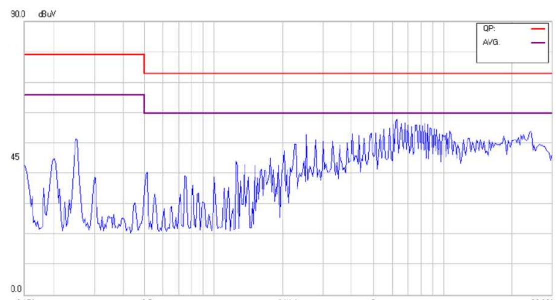
Conducted Class A of CHB200W-48S24



Conducted Class A of CHB200W-48S28

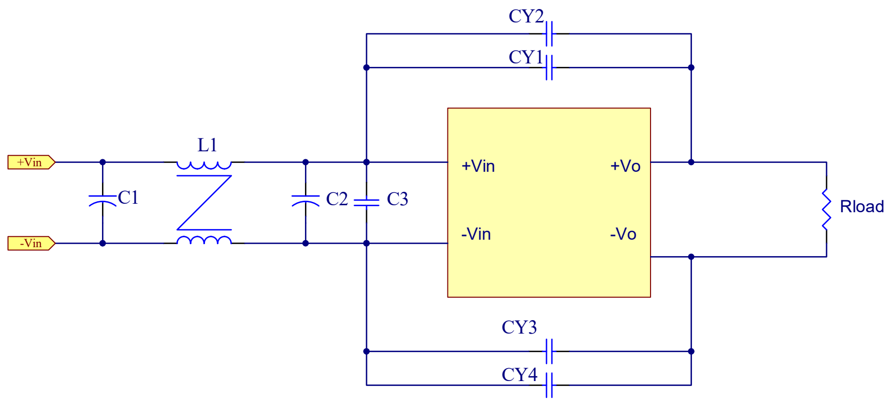


Conducted Class A of CHB200W-48S48



EMI Test standard: EN 55032 Class B Conducted Emission
Test Condition: Input Voltage: Nominal, Output Load: Full Load

(1) EMI and conducted noise meet EN 55032 Class B:

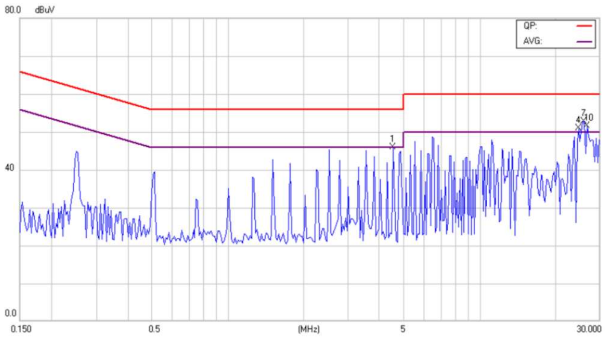


EN55032 Class B								
Model No.	C1	C2	C3	CY1	CY2	CY3	CY4	L1
CHB200W-24S24	120uF/100V	120uF/100V	10uF/50V	1000pF/2KV	NC	1000pF/2KV	NC	0.5mH
CHB200W-24S48	82uF/100V	82uF/100V	4.7uF/100V	1000pF/2KV	680pF/2KV	1000pF/2KV	680pF/2KV	0.45mH
CHB200W-48S12	120uF/100V	120uF/100V	4.7uF/100V	1000pF/2KV	NC	680pF/2KV	NC	0.5mH
CHB200W-48S48	82uF/100V	82uF/100V	4.7uF/100V	2200pF/2KV	NC	2200pF/2KV	680pF/2KV	0.45mH

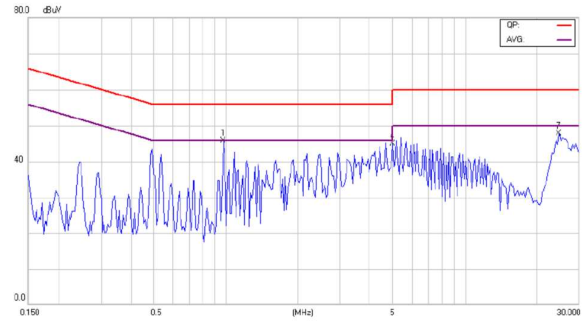
Note: C1, C2 NIPPON CHEMI-CON KY series aluminum capacitors, C3, CY1, CY2, CY3, CY4 is ceramic capacitors

Conducted Emission

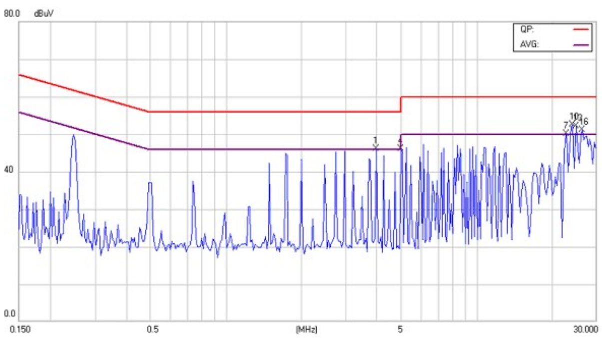
Conducted Class B of CHB200W-24S24



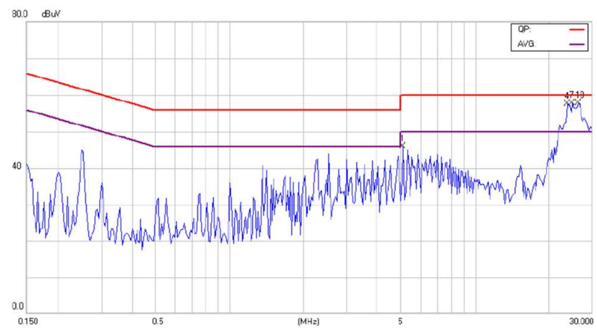
Conducted Class B of CHB200W-24S48



Conducted Class B of CHB200W-48S12



Conducted Class B of CHB200W-48S48



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