ISOLATED DC-DC CONVERTER
CHASSIS MOUNT
CHB300W-110S CMFC(D) SERIES
APPLICATION NOTE

Approved By:

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Contents

CHB300W-110S CMFC(D) Series Application Note V13

1. Introduction

The CHB300W-110SXX-CMFC(D) series of chassis mountable DC-DC converters offers 198-300 watts of output power @ single output voltages of 3.3, 5, 12, 24, 28, 48VDC. It has a wide (4:1) input voltage range of 43 to 160VDC (110VDC nominal) and 3000VDC basic isolation.

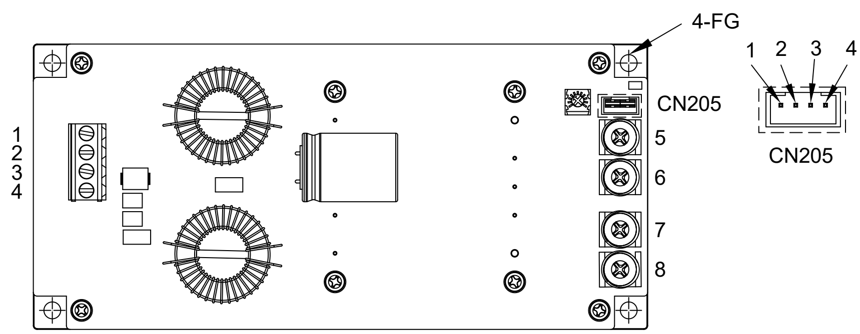
High efficiency up to 90.5%, allowing case operating temperature range of -40℃ to 100℃. An external heatsink is required to expand the full power range of the product. Very low no load power consumption (15mA), an ideal solution for energy critical systems.

Built-in EMI EN50155, EN50121-3-2 filter. Meet EN45545. 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 and over-temperature and continuous short circuit conditions.

CHB300W-110SXX-CMFC(D) series is designed primarily for common railway applications of 72V, 96V, 110V nominal voltage and also suitable for distributed power architectures, telecommunications, battery operated equipment and industrial applications.

2. Pin Function Description



No		Description	Reference
1	Case	Connected to Base Plate	
2	On/Off	External Remote On/Off Control	**Section 6.5**
3	-V Input	Negative Supply Input	**Section 7.1**
4	+V Input	Positive Supply Input	**Section 7.1**
5	-V Output	Negative Power Output	**Section 7.2/7.3**
6	-V Output	Negative Power Output	**Section 7.2/7.3**
7	+V Output	Positive Power Output	**Section 7.2/7.3**
8	+V Output	Positive Power Output	**Section 7.2/7.3**
--	--	Clear Mounting Insert (FG)	**Section 9.5**

No	CN205	Description	Reference
1	+Sense	Positive Output Remote Sense	**Section 6.6**
2	+V Output	Positive Power Output	**Section 7.2/7.3**
3	-Sense	Negative Output Remote Sense	**Section 6.6**
4	-V Output	Negative Power Output	**Section 7.2/7.3**

Note: Base plate can be connected to FG through Ø4.5 mounting insert. Recommended torque 9.6~12.8Kgf-cm.

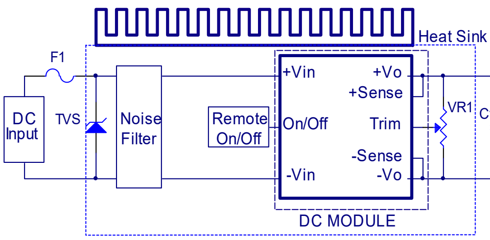
3. Terminal Block

Input and Output Terminal Block

PIN	Terminal Type	Screw Torque Value (Kgf-cm)	Suitable Electric Wire (AWG)	Current Rating (max.)
1~4	EK500V-04P or Equivalent	5	12-24	20A
5~8	M5 Terminal Screw	25	12-10	30A

4. Connection for standard use

The connection for standard use is shown below. An external output capacitor (C1) is recommended to reduce output ripple and noise, output capacitor recommended 1uF ceramic capacitor.



Symbol	Component	Reference
F1	Input fuse	**Section 10.1**
Noise Filter	Internal input noise filter	**Section 10.2**
Remote On/Off	External Remote On/Off control	**Section 6.5**
Trim	Internal output voltage adjustment by variable resistor	**Section 6.7**
Heat sink	External heat sink	**Section 9.4/9.5**
+Sense/-Sense	--	**Section 6.6**

5. 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:

$$\eta = \frac{Vo \times Io}{Vin \times Iin} \times 100\%$$

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:

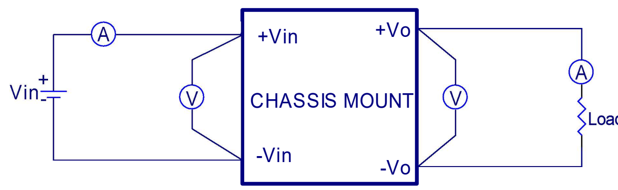
V_{FL} is the output voltage at full load
V_{NL} is the output voltage at no load

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



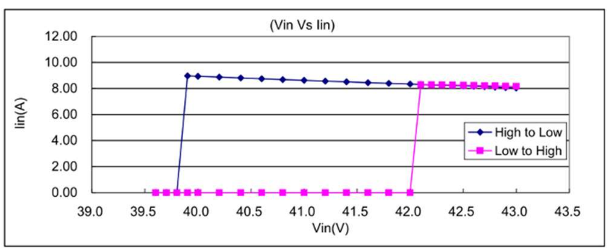
CHB300W-110SXX-CMFC(D) Series Test Setup

6. Features and Functions

6.1 UVLO (Under Voltage Lock Out)

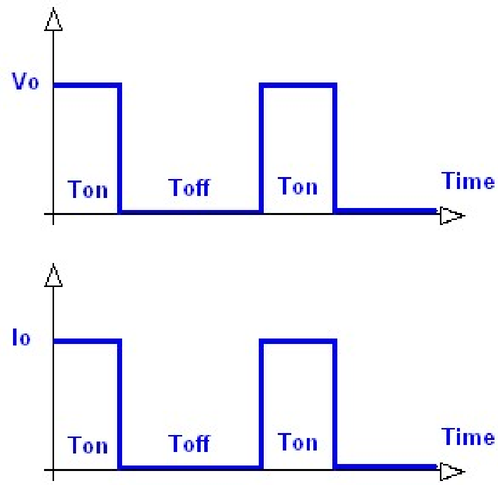
Input under voltage lockout is standard on the CHB300W-110SXX-CMFC(D) unit. The unit will shut down when the input voltage drops below a threshold, and the unit will operate when the input voltage goes above the upper threshold.

CHB300W-110SXX-CMFC(D)
Iin Vs Vin



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.



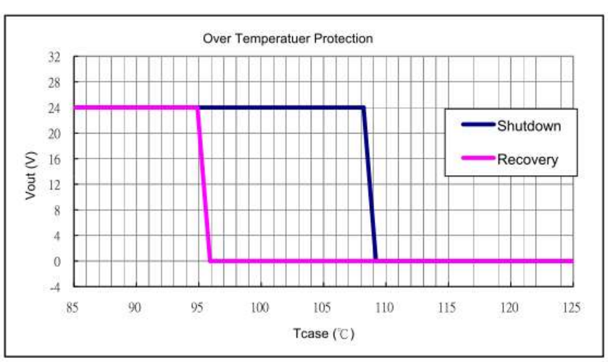
6.3 Output Over Voltage Protection

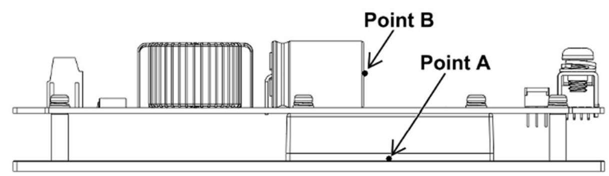
The output over voltage protection consists of circuitry that internally limits the output voltage. If more accurate output over voltage protection is required, then an external circuit can be used via the remote **on/off** pin.

Note: Please note that device inside the power supply might fail when voltage more than rate output voltage is applied to output pin. This could happen when the customer tests the over voltage protection of unit.

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 measured at point A. (Measuring point A refer to the following figure)





6.5 Remote On/Off

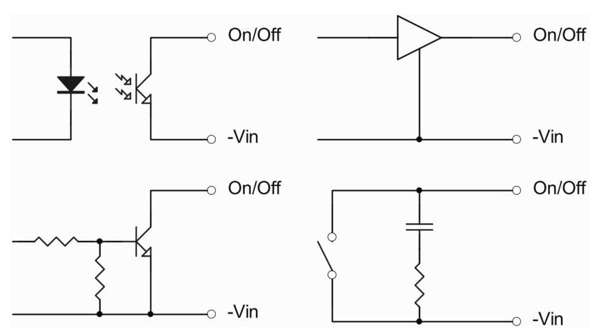
The CHB300W-110SXX-CMFC(D) series allows the user to switch the module on and off electronically with the remote on/off feature. All models are available in "positive logic" and "negative logic" (optional) versions. The converter turns on if the remote **on/off** pin is high (>3.5Vdc to 160Vdc or open 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 160Vdc 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 – Switch Closed	Module on	Module off
Logic High – Switch Open	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.
Connection examples see below.



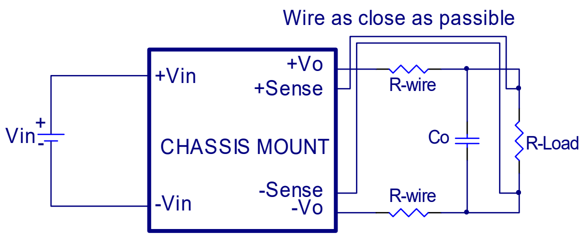
Remote On/Off Connection Example

6.6 Output Remote Sensing

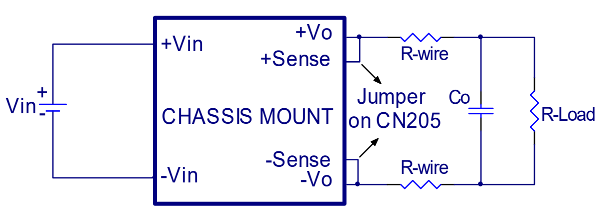
The CHB300W-110SXX-CMFC(D) series converter has the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the CHB300W-110SXX-CMFC(D) 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 sensing is used, please remove the jumper of CN205. 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 of impedance of wiring and load condition when length of wire is exceeding 400mm. This is shown in the schematic below.



When the CHB300W-110SXX-CMFC(D) module are shipped from a factory, they come with a dedicated jumper being mounted on CN205. 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 +Vout pin at the module and the -Sense pin should be connected to the -Vout pin at the module. Wire between +Sense and +Vout and between -Sense and -Vout 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.

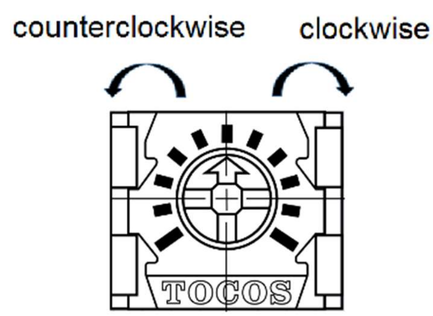


Note:

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

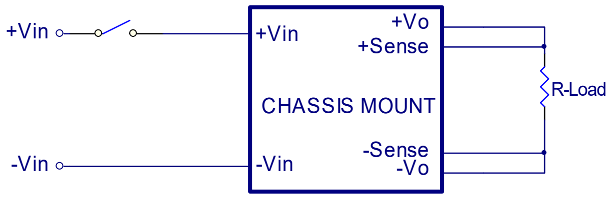
Output voltage can be adjusted by internal variable resistor (adjustment range: +10% to -10% of nominal output). Turning internal variable resistor clockwise reduces the output voltage and counterclockwise increases the output voltage.

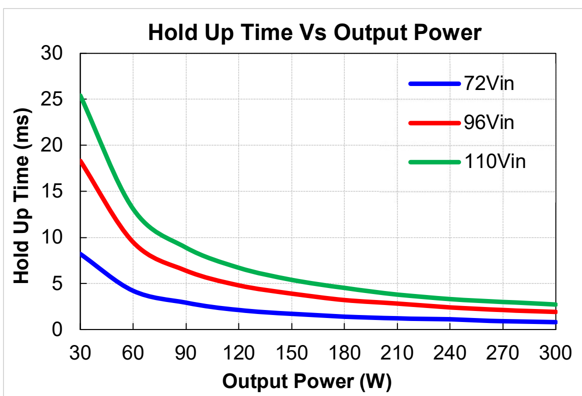


7. Input / Output Considerations

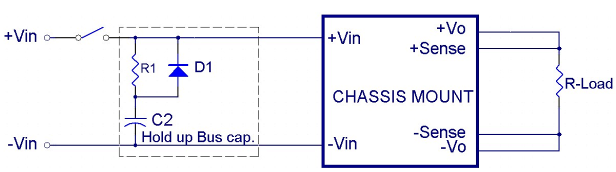
7.1 Hold up Time

Hold up time is defined as the duration of time that DC/DC converter output will remain active following a loss of input power. The test condition and test curve refer to below.





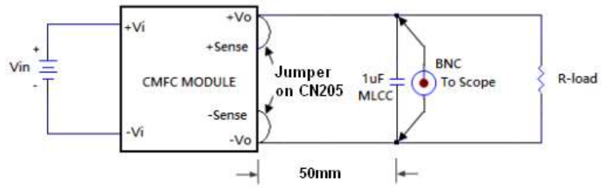
To meet power supply interruptions, an external circuit is required, shown below.



D1:200V/10A
R1:100Ω/10W

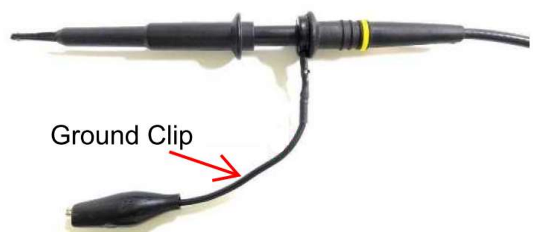
C2	72Vin	96Vin	110Vin
Hold up time for 10ms	2700uF	1000uF	700uF
Hold up time for 30ms	8000uF	3400uF	2400uF
Hold up time for 10ms (Vo: 3.3V)	1600uF	600uF	400uF
Hold up time for 30ms (Vo: 3.3V)	5100uF	2200uF	1500uF

7.2 Output Ripple and Noise

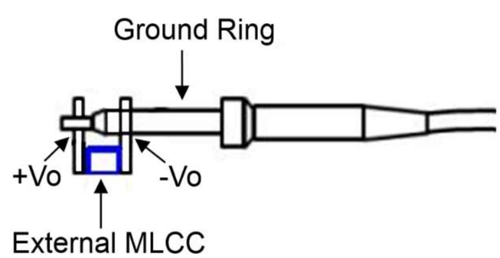


Output ripple and noise measured with 1uF ceramic capacitors across output. A 20 MHz bandwidth oscilloscope is normally used for the measurement.

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.



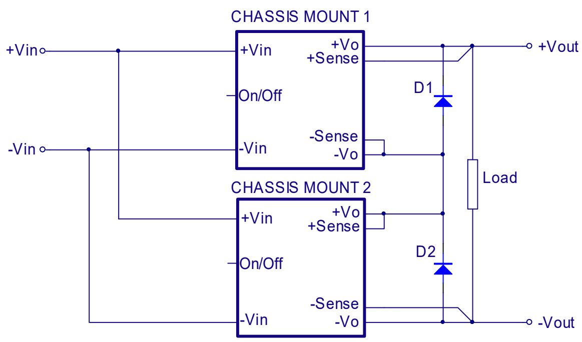
7.3 Output Capacitance

The CHB300W-110SXX-CMFC(D) 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 technical specifications.

8. Series and Parallel Operation

8.1 Series Operation

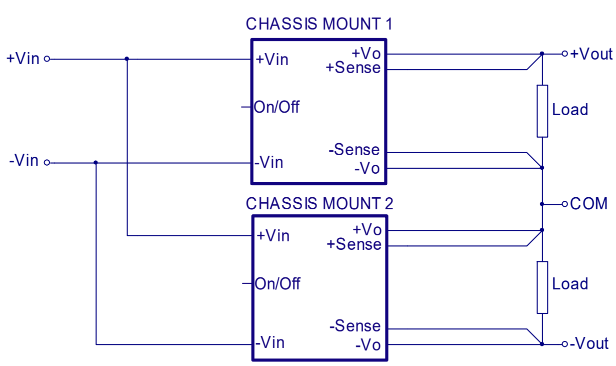
Series operation is possible by connecting the outputs two or more units. Connection is shown in below. The output current in series connection should be lower than the lowest rate current in each power module



Simple Series Operation Connect Circuit

Note:
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.



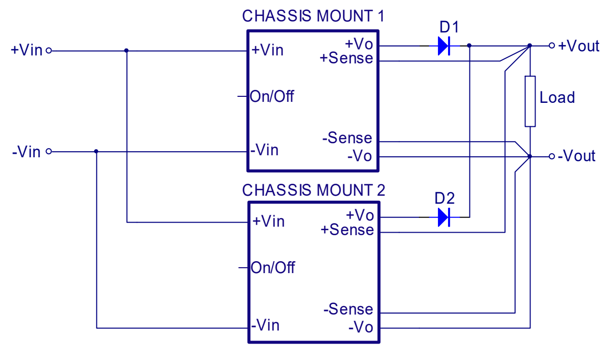
Simple ±Output Operation Connect Circuit

8.2 Parallel Operation

The CHB300W-110SXX-CMFC(D) 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 internal variable resistor to adjust output voltage from each power supply.



Simple Redundant Operation Connect Circuit

9. Thermal Design

9.1 Operating Temperature Range

The CHB300W-110SXX-CMFC(D) 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 chassis mount 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 aluminum plate (point A) and aluminum capacitor (point B) temperature should be monitored to ensure it does not exceed 100℃ (measuring point A and measuring point B refer to the **section 6.4**).

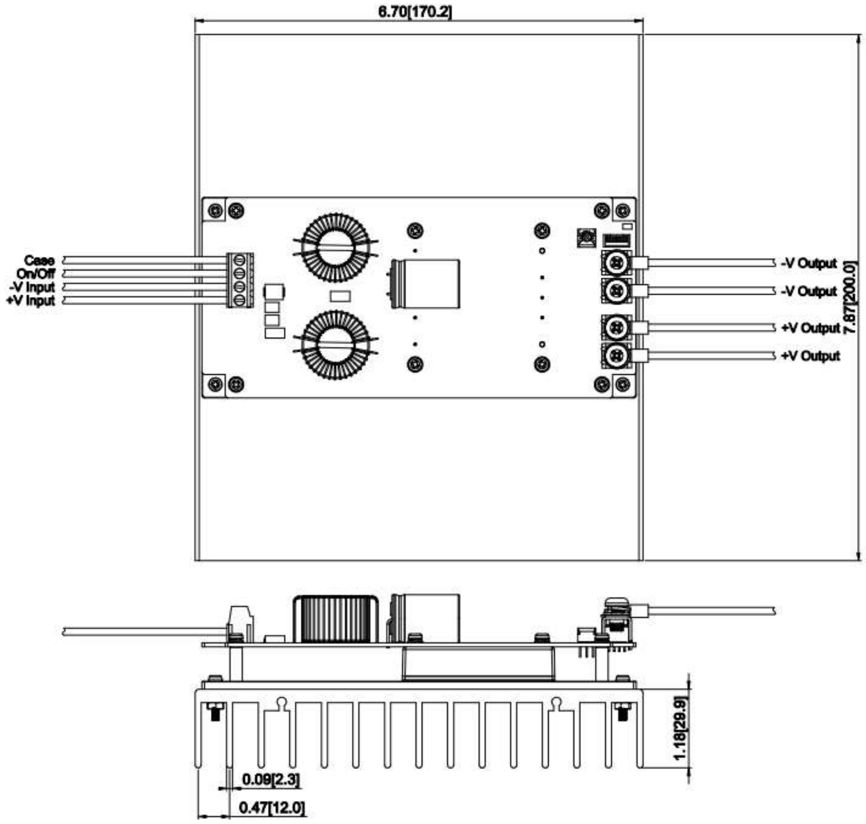
9.3 Thermal Considerations

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 $I_{o\_max.}$).

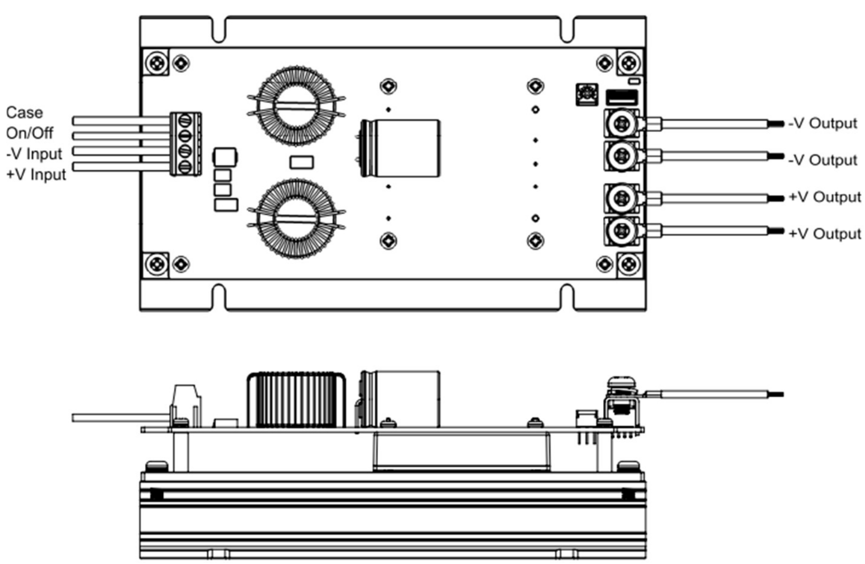
9.4 Power Derating

The operating case temperature range of CHB300W-110SXX-CMFC(D) series is -40℃ to +100℃. When operating the CHB300W-110SXX-CMFC(D) series, proper derating or cooling is needed. The point A and point B maximum temperature under any operating condition should not exceed 100°C (point A and point B refer to the **section 6.4**). The following curve is the de-rating curve of CHB300W-110SXX-CMFC(D) series with heat sink at nominal vin and natural convection.

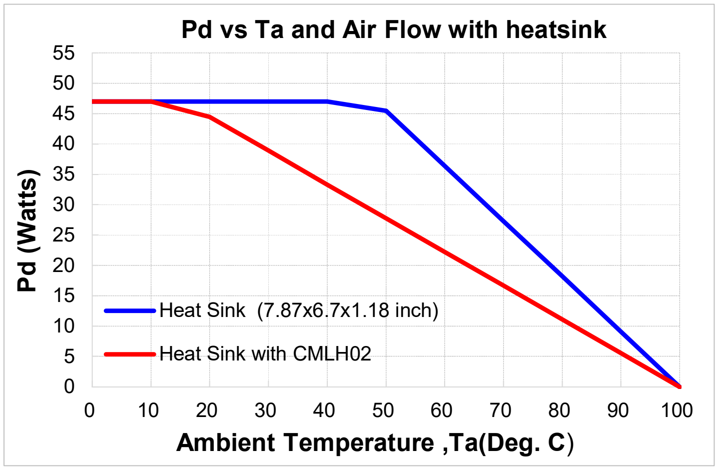
The test condition refer to following figures.



Figures 1 CHB300W-110SXX-CMFC with Heat Sink (7.87x6.7x1.18inch)



Figures 2 CHB300W-110SXX-CMFC with Heat Sink CMLH02



AIR FLOW RATE	TYPICAL R_{ca}
Heat Sink **(7.87x6.7x1.18 inch)**	1.1 ℃/W
Heat Sink with CMLH02	1.8 ℃/W

Example (with heat sink):
How to make a CHB300W-110S24-CMFC operating at nominal line voltage, an output current of 12.5A, and a maximum ambient temperature of 55℃?

Solution:

Given:

Vin=110Vdc, Vo=24Vdc, Io=12.5A

Determine Power dissipation (P_d):

Pd=Pi-Po=Po(1-η)/η

Pd=24.0×12.5×(1-0.89)/0.89=37.1Watts

Determine airflow:

Given: Pd=37.1W and Ta=55℃

Check above Power de-rating curve:

Heat sink with 7.87x6.7x1.18inch

Verify:

Maximum temperature rise is $\triangle T = P_d \times R_{ca}$=37.1×1.1=40.8℃

Maximum case temperature is $T_c = T_a + \triangle T$=95.8℃<100℃

Where:

The Rca is thermal resistance from case to ambient environment.

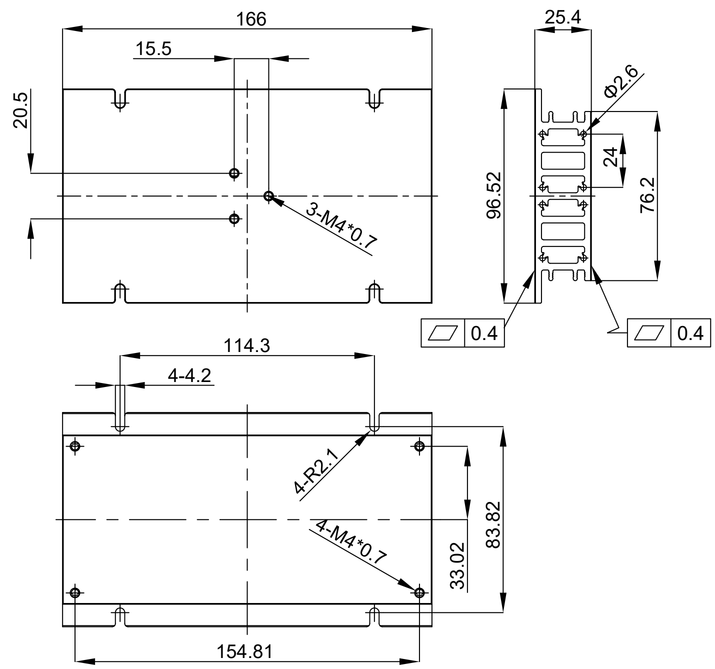
Ta is ambient temperature and T_c is case temperature

9.5 Heat Sink

Heat Sink CMLH02

All Dimension In mm

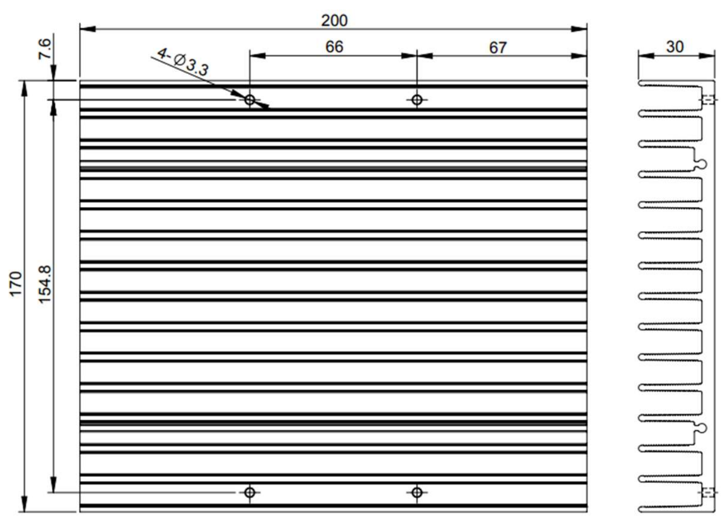
Longitudinal Fins



Heat Sink: 166*96.52*25.4 CMLH02 (G6621140202)
Thermal PAD PCM02: PMP-P-400 164x75.2x0.25mm (G6135151B23)
Screws: SMP4X8N M4*8mm (G75A3300992) & Washer (G75A47A0832)

Heat Sink (7.87x6.7x1.18inch)

All Dimension In mm

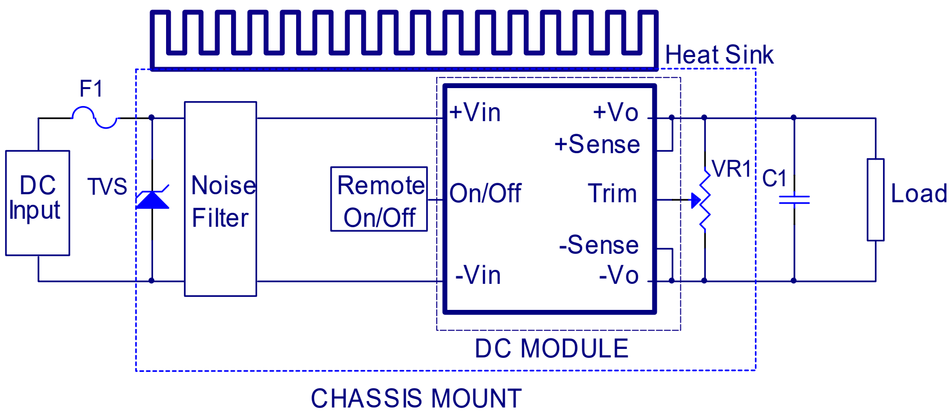


Heat Sink: 200*170*30
Thermal Paste: TIG1500 WHITE MOMENTIVE (G6226402010)
Screw Nut K320N: M3*20L (G75A1300052) & NH+WOM3*P0.5N (G75A2440392)

10. Safety & EMC

10.1 Input Fusing and Safety Considerations

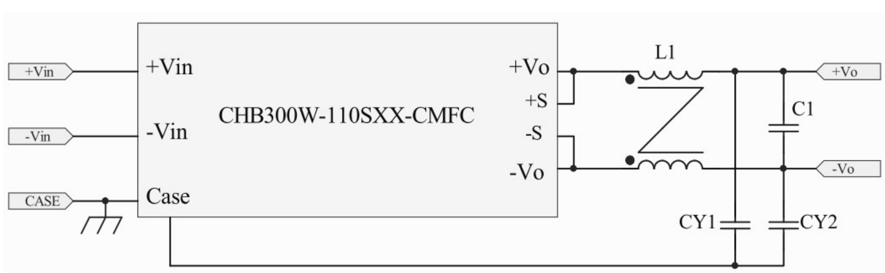
The CHB300W-110SXX-CMFC(D) series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 8A time delay fuse for Vo=3.3V and 10A for Others models. CHB300W-110SXX-CMFC(D) module have a transient voltage suppressor diode (TVS) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage (as shown).



10.2 EMC Considerations

EMI Test standard: EN50121-3-2:2016 Conducted & Radiated Emission
Test Condition: Input Voltage: 110Vdc, Output Load: Full Load

(1) EMI meet EN50121-3-2:2016:



Connection circuit for EMI testing

	Model Number				
	110S3V3/05-CMFC	110S12-CMFC	110S24-CMFC	110S28-CMFC	110S48-CMFC
C1	1uF/100V X7R 1206	1uF/100V X7R 1206	1uF/100V X7R 1206	1uF/100V X7R 1206	1uF/100V X7R 1206
CY1 CY2	10000pF/Y2	10000pF/Y2	10000pF/Y2	10000pF/Y2	10000pF/Y2
L1	FERROXCUBE T29/19/15-3E6 0.17mH, Φ1.0mm*4/4T	VAKOS R10K T22*16*6.5C 0.28mH, Φ 1.0mm*2/7T	VAKOS R12K T18*12*6C 0.28mH, Φ 1.0mm*1/7T	VAKOS R12K T18*12*6C 0.28mH, Φ 1.0mm*1/7T	VAKOS R12K T18*12*6C 0.28mH, Φ 1.0mm*1/7T

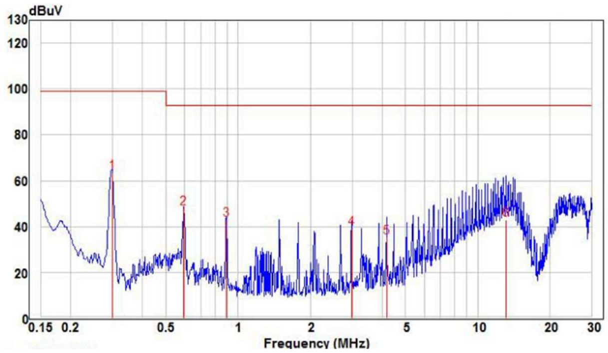
Note:

CYxx is MURATA Y2 capacitor or equivalent.

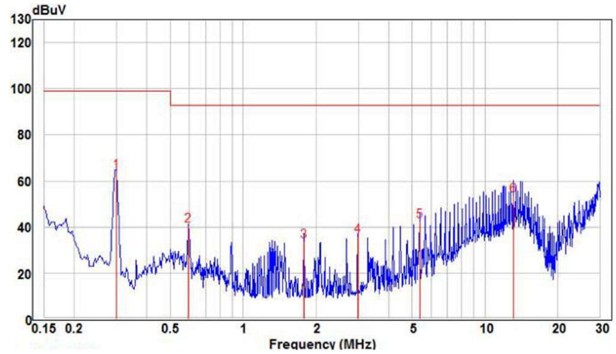
Conducted Emission(Input):

CHB300W-110S05-CMFC

Line

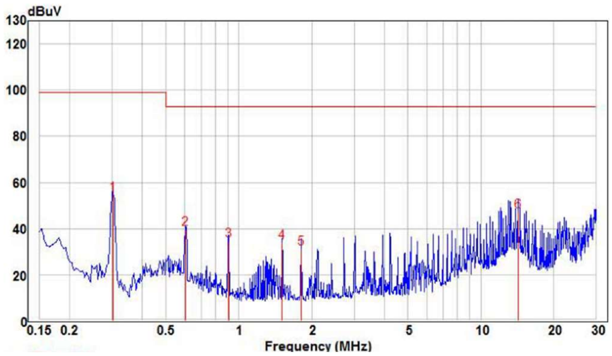


Neutral

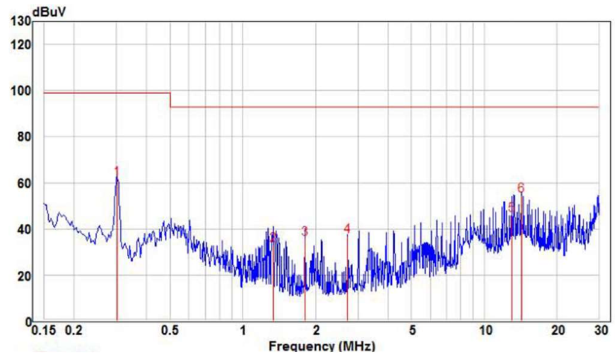


CHB300W-110S12-CMFC

Line

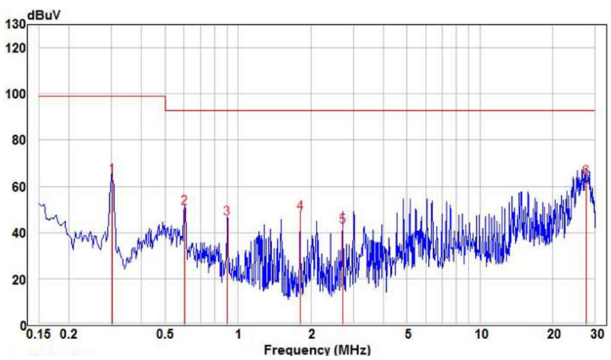


Neutral



CHB300W-110S24-CMFC

Line



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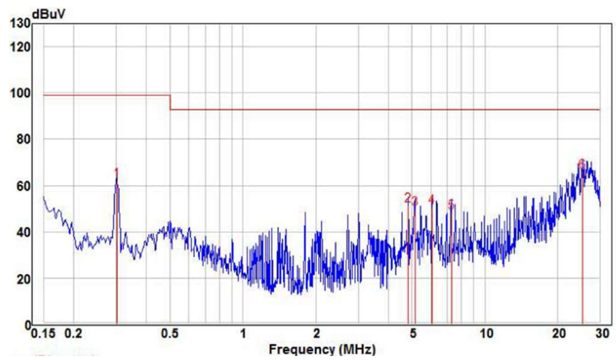
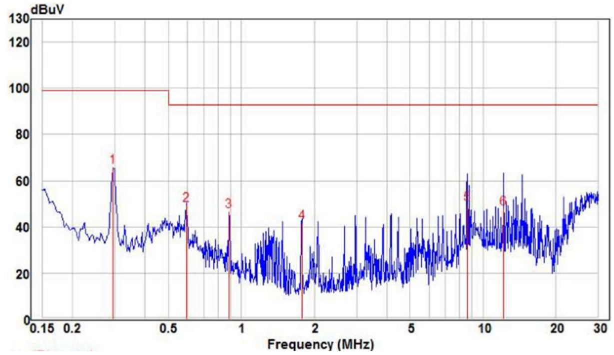


CHB300W-110S28-CMFC

Line



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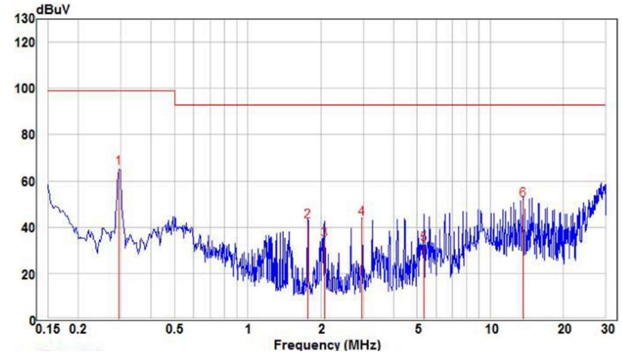
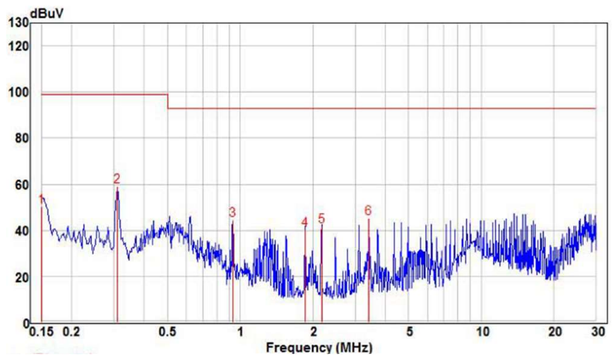


CHB300W-110S48-CMFC

Line



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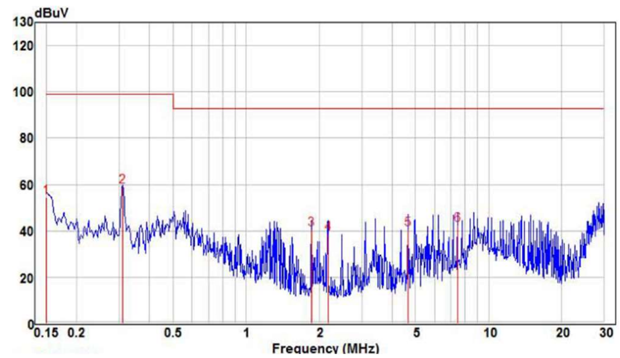
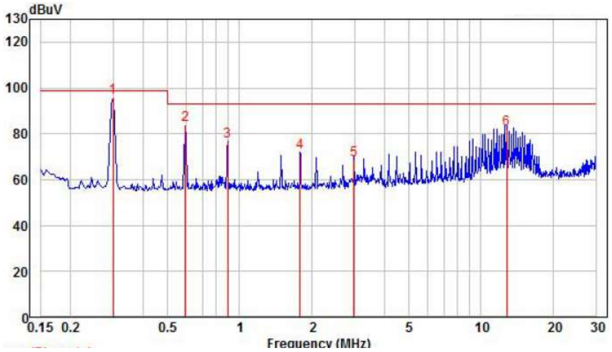


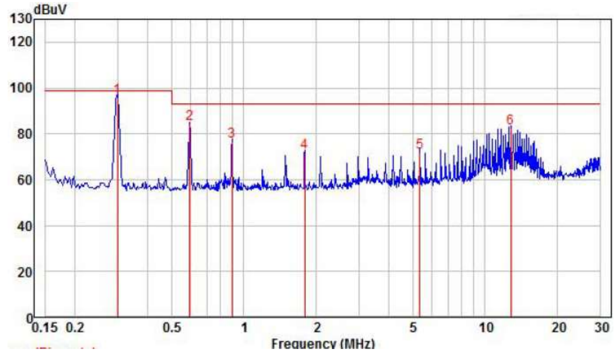
Conducted Emission(Output):

CHB300W-110S05-CMFC

Positive

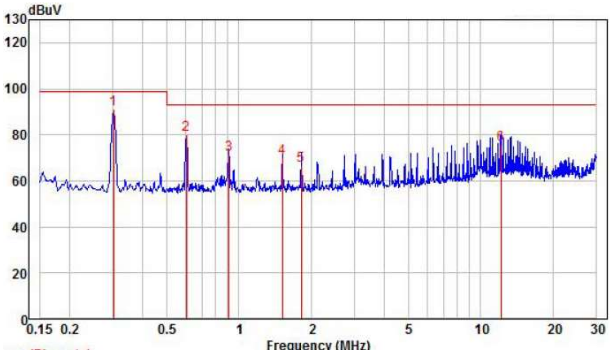


Negative

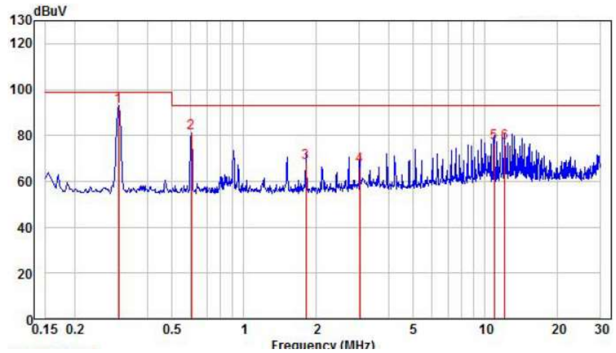


CHB300W-110S12-CMFC

Positive

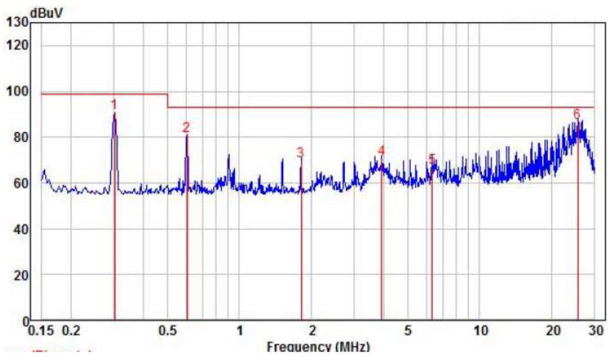


Negative

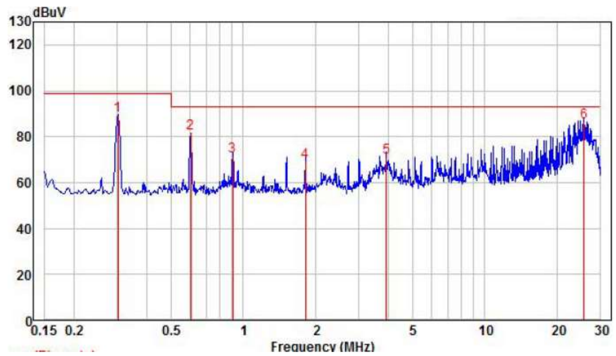


CHB300W-110S24-CMFC

Positive

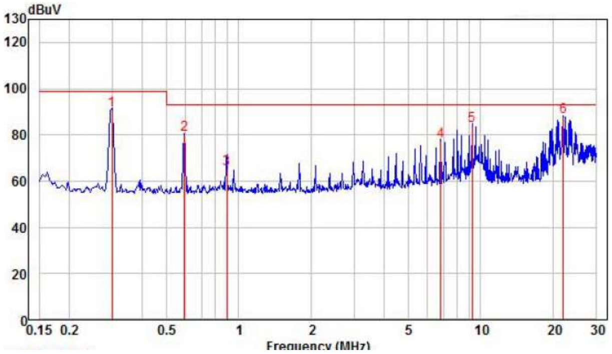


Negative

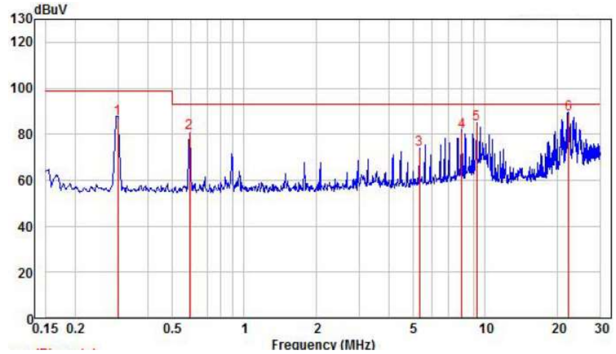


CHB300W-110S28-CMFC

Positive

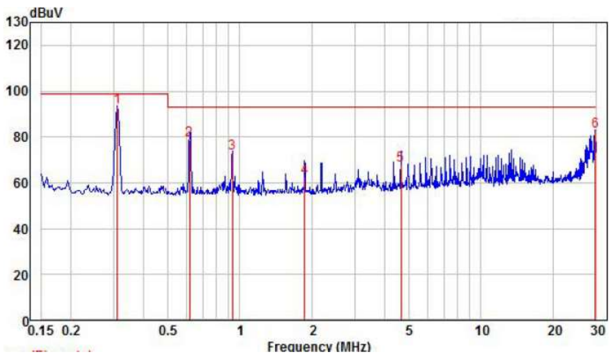


Negative

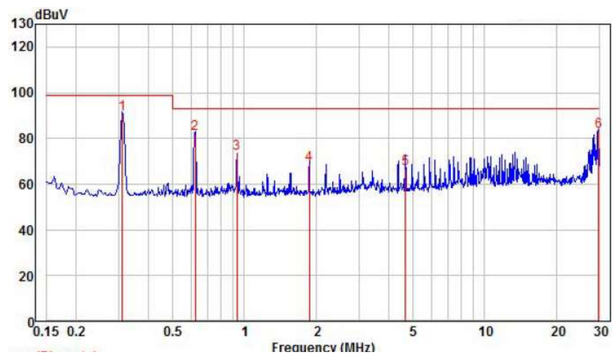


CHB300W-110S48-CMFC

Positive



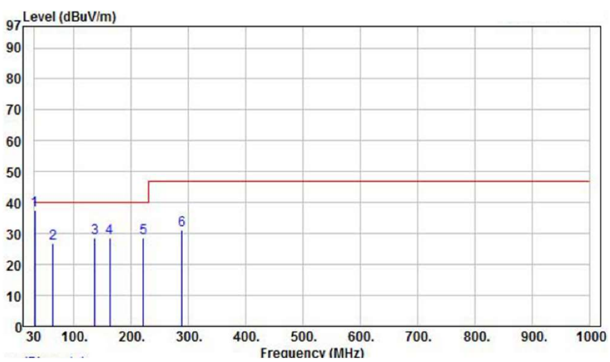
Negative



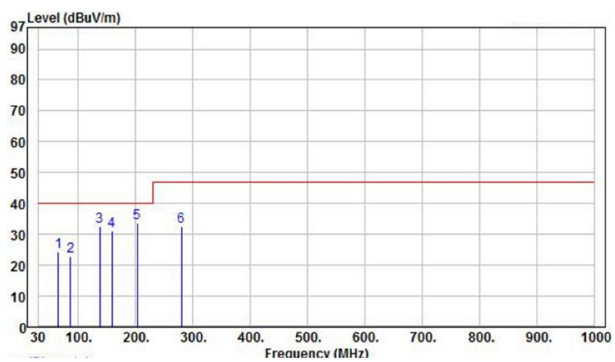
Radiated Emission:

CHB300W-110S05-CMFC

Vertical

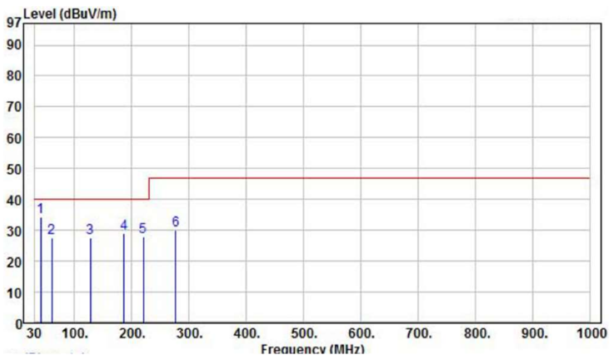


Horizontal

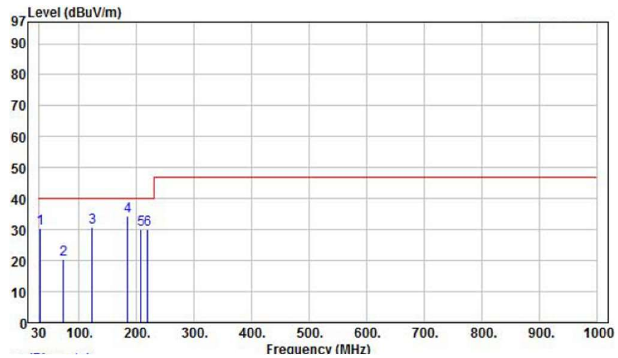


CHB300W-110S12-CMFC

Vertical

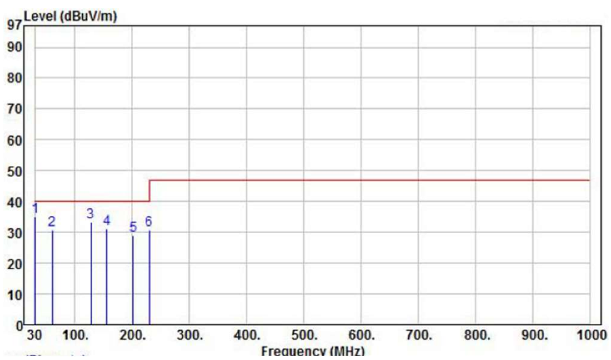


Horizontal

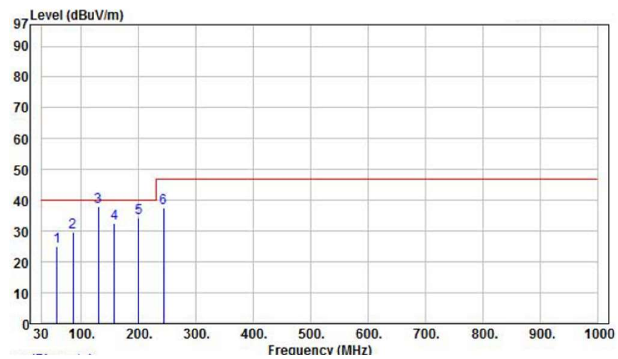


CHB300W-110S24-CMFC

Vertical

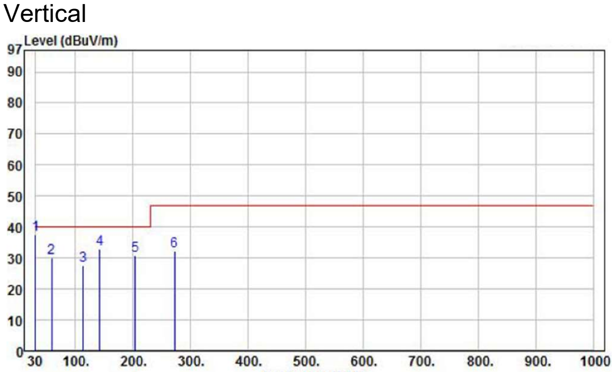


Horizontal

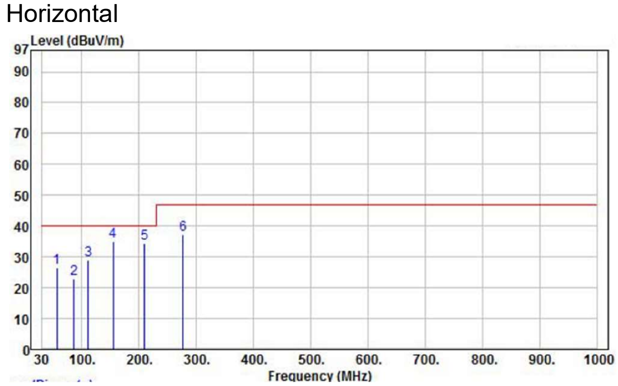


CHB300W-110S28-CMFC

Vertical

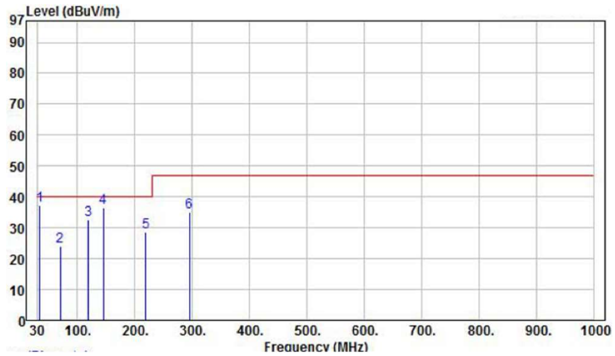


Horizontal

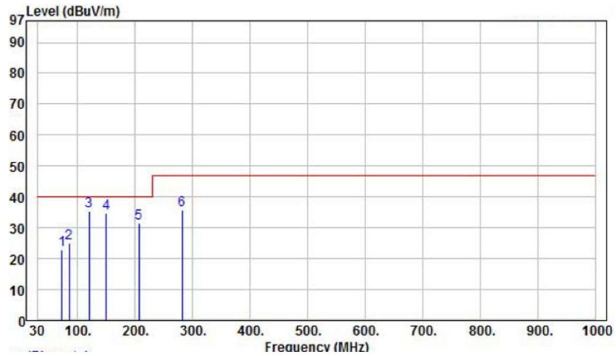


CHB300W-110S48-CMFC

Vertical



Horizontal



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