CHB100 Series
Application Note V13

# ISOLATED DC-DC CONVERTER
# CHB100 SERIES
# APPLICATION NOTE


**Approved By:**

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# Contents

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## 1. Introduction

The CHB100 series offers 100 watts of output power with high power density in an industry standard half-brick package. The CHB100 series has wide (2:1) input voltage ranges of 18-36VDC, 36-75VDC and provides a precisely regulated output. This series has features such as high efficiency, 1500VDC isolation and a case operating temperature range of -40℃ to 100℃. The modules are fully protected against input UVLO (under voltage lock out), output short circuit, output over voltage and over temperature conditions. Furthermore, the standard control functions include remote on/off and output voltage trimming. All models are highly suited to telecommunications, distributed power architectures, battery operated equipment, industrial, and mobile equipment applications.

## 2. DC-DC Converter Features

- 66-100W Isolated Output
- Efficiency to 89%
- 500KHz Switching Frequency
- 2:1 Input Range
- Regulated Outputs
- Continuous Short Circuit Protection
- Five-Sided Metal Case
- Half-Brick Size Meets Industrial Standard
- UL60950-1 Approval
- Without Tantalum Capacitor Inside (Except 3.3&5Vout)
- Safety Meets IEC/EN/UL 62368-1

## 3. Electrical Block Diagram

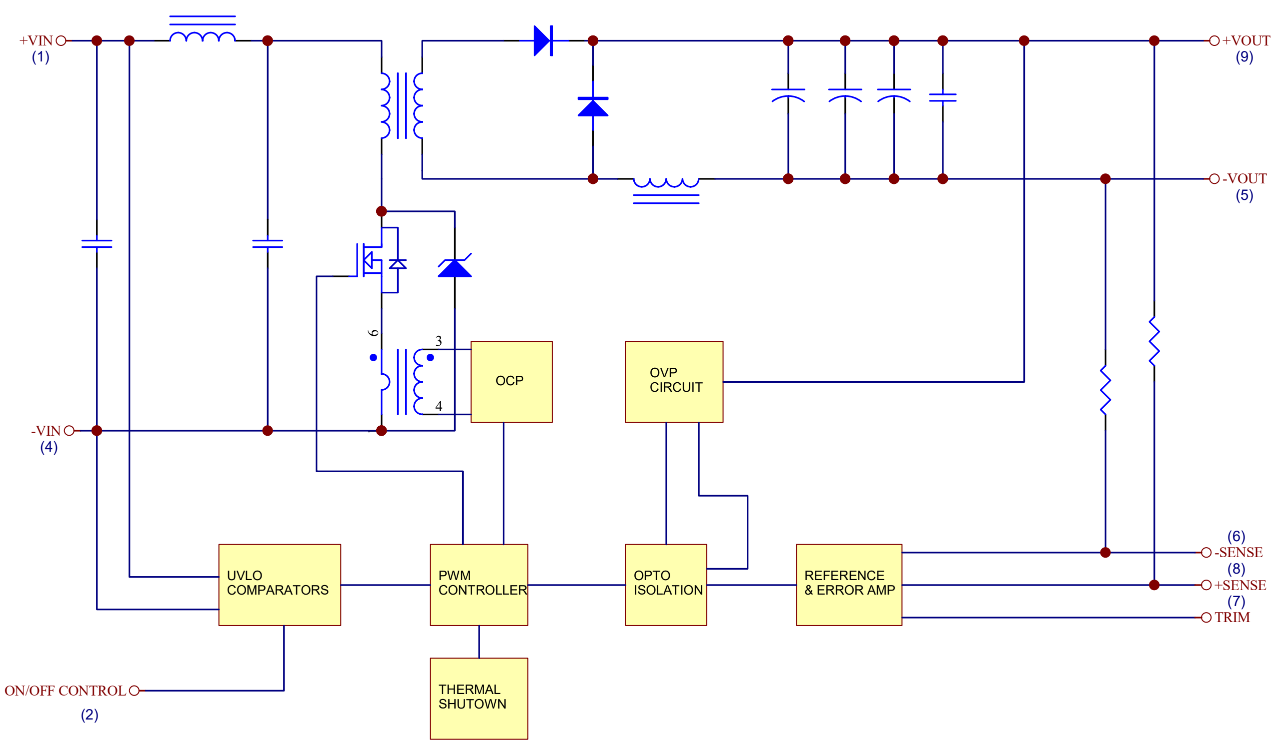



Figure 1 Electrical Block Diagram of CHB100 Series Module

# 4. Technical Specifications

(All specifications are typical at nominal input, full load at 25°C unless otherwise noted.)

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| Input Voltage | | | | | | |
| Continuous | | $24V_{in}$ | -0.3 | | 36 | $V_{dc}$ |
| | | $48V_{in}$ | -0.3 | | 75 | |
| Transient | 100ms | $24V_{in}$ | | | 50 | $V_{dc}$ |
| | | $48V_{in}$ | | | 100 | |
| Operating Case Temperature | | All | -40 | | 100 | ℃ |
| Storage Temperature | | All | -40 | | 105 | ℃ |
| Isolation Voltage | 1 Minute; input/output, input/case, output/case | All | 1500 | | | $V_{dc}$ |

## INPUT CHARACTERISTICS

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| Operating Input Voltage | | $24V_{in}$ | 18 | 24 | 36 | $V_{dc}$ |
| | | $48V_{in}$ | 36 | 48 | 75 | |
| Input Under Voltage Lockout | | | | | | |
| Turn-On Voltage Threshold | | $24V_{in}$ | | 17 | | $V_{dc}$ |
| | | $48V_{in}$ | | 34 | | |
| Turn-Off Voltage Threshold | | $24V_{in}$ | | 16 | | $V_{dc}$ |
| | | $48V_{in}$ | | 32.5 | | |
| Lockout Hysteresis Voltage | | $24V_{in}$ | | 1 | | $V_{dc}$ |
| | | $48V_{in}$ | | 1.5 | | |
| Maximum Input Current | 100% Load, $V_{in}$=18V | 24S33 | | 3.4 | | A |
| | | 24SXX | | 6.7 | | |
| | 100% Load, $V_{in}$=36V | 48S33 | | 2.3 | | |
| | | 48SXX | | 3.3 | | |
| No-Load Input Current | | All | | 50 | | mA |
| Inrush Current ($I^2t$) | | All | | | 0.1 | $A^2s$ |
| Input Reflected Ripple Current | P-P thru 12uH inductor, 5Hz to 20MHz | All | | 30 | | mA |

## OUTPUT CHARACTERISTICS

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| Output Voltage Set Point | $V_{in}$=Nominal $V_{in}$, $I_o$ = $I_{o\_max.}$, $T_c$=25℃ | Vo=3.3V | 3.267 | 3.3 | 3.333 | $V_{dc}$ |
| | | Vo=5V | 4.95 | 5 | 5.05 | |
| | | Vo=12V | 11.88 | 12 | 12.12 | |
| | | Vo=15V | 14.85 | 15 | 15.15 | |
| | | Vo=24V | 23.76 | 24 | 24.24 | |
| Output Voltage Regulation | | | | | | |
| Load Regulation | $I_o$=$I_{o\_min.}$ to $I_{o\_max.}$ | All | | | ±0.2 | % |
| Line Regulation | $V_{in}$=Low line to high line | All | | | ±0.2 | % |
| Temperature Coefficient | $T_c$=-40℃ to 100℃ | All | | | ±0.03 | %/℃ |

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| Output Voltage Ripple and Noise | | | | | | |
| Peak-to-Peak | 5Hz to 20MHz bandwidth, full load 10uF tantalum and 1.0uF ceramic capacitors | Vo=3.3&5.0V | | | 100 | mV |
| | | Vo=12&15V | | | 150 | |
| | | Vo=24V | | | 240 | |
| RMS | | Vo=3.3&5.0V | | | 40 | |
| | | Vo=12&15V | | | 60 | |
| | | Vo=24V | | | 100 | |
| Operating Output Current Range | | 24S33 | 0 | | 20 | A |
| | | 24S05 | 0 | | 20 | |
| | | 24S12 | 0 | | 8.3 | |
| | | 24S15 | 0 | | 6.7 | |
| | | 24S24 | 0 | | 4.17 | |
| | | 48S33 | 0 | | 20 | |
| | | 48S05 | 0 | | 20 | |
| | | 48S12 | 0 | | 8.3 | |
| | | 48S15 | 0 | | 6.7 | |
| | | 48S24 | 0 | | 4.17 | |
| Output DC Current Limit Inception | Output voltage=90% nominal output voltage | All | 110 | | 140 | % |
| Maximum Output Capacitance | Full load (resistive) | 24S33 | 0 | | 20000 | uF |
| | | 24S05 | 0 | | 20000 | |
| | | 24S12 | 0 | | 8300 | |
| | | 24S15 | 0 | | 6700 | |
| | | 24S24 | 0 | | 4170 | |
| | | 48S33 | 0 | | 20000 | |
| | | 48S05 | 0 | | 20000 | |
| | | 48S12 | 0 | | 8300 | |
| | | 48S15 | 0 | | 6700 | |
| | | 48S24 | 0 | | 4170 | |

## DYNAMIC CHARACTERISTICS

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| Output Voltage Current Transient | | | | | | |
| Step Change in Output Current | 75% to 100% of $I_{o\_max.}$ | All | | | ±5 | % |
| Setting Time (within 1% $V_{out}$ nominal) | $d_i/d_t$=0.1A/us | All | | | 500 | us |
| Turn-On Delay and Rise Time | | | | | | |
| Turn-On Delay Time, From On/Off Control | $V_{on/off}$ to 10%$V_{o\_set}$ | All | | 7 | | ms |
| Turn-On Delay Time, From Input | $V_{in\_min.}$ to 10%$V_{o\_set}$ | 24$V_{in}$ | | 4 | | ms |
| | | 48$V_{in}$ | | 5 | | |
| Output Voltage Rise Time | 10%$V_{o\_set}$ to 90%$V_{o\_set}$ | All | | 2 | | ms |

## EFFICIENCY

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| 100% Load | $V_{in}$=Nominal $V_{in}$ | 24S33 | | 83 | | % |
| | | 24S05 | | 84 | | |
| | | 24S12 | | 87 | | |
| | | 24S15 | | 88 | | |
| | | 24S24 | | 87 | | |
| | | 48S33 | | 82 | | |
| | | 48S05 | | 86 | | |
| | | 48S12 | | 89 | | |
| | | 48S15 | | 89 | | |
| | | 48S24 | | 88 | | |

## ISOLATION CHARACTERISTICS

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| Isolation Voltage | 1 Minute; input/output, input/case, output/case | All | | | 1500 | $V_{dc}$ |
| Isolation Resistance | | All | 10 | | | MΩ |
| Isolation Capacitance | | All | | 1000 | | pF |

## FEATURE CHARACTERISTICS

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| Switching Frequency | | All | | 500 | | KHz |
| On/Off Control, Positive Remote On/Off Logic | | | | | | |
| Logic Low (Module Off) | $V_{on/off}$ at $I_{on/off}$=1.0mA | All | 0 | | 0.8 | V |
| Logic High (Module On) | $V_{on/off}$ at $I_{on/off}$=0.0uA | All | Open Circuit | | 75 | V |
| On/Off Control, Negative Remote On/Off Logic | | | | | | |
| Logic High (Module Off) | $V_{on/off}$ at $I_{on/off}$=0.0uA | All | Open Circuit | | 75 | V |
| Logic Low (Module On) | $V_{on/off}$ at $I_{on/off}$=1.0mA | All | 0 | | 0.8 | V |
| Off Converter Input Current | Shutdown input idle current | All | | | 10 | mA |
| Output Voltage Trim Range | $P_{out}$=max. rated power | All | -10 | | +10 | % |
| Output Over Voltage Protection | | All | 115 | 125 | 140 | % |
| Over-Temperature Protection | Shutdown case temperature | All | | 100 | | ℃ |
| | Restart threshold case temperature | All | | 70 | | ℃ |

## GENERAL SPECIFICATIONS

| PARAMETER | NOTES and CONDITIONS | Device | Min. | Typical | Max. | Units |
|---|---|---|---|---|---|---|
| MTBF | $I_o$=100% of $I_{o\_max.}$; $T_a$=25°C per MIL-HDBK-217F | All | | 900 | | K hours |
| Weight | | All | | 95 | | grams |

# 5. Main Features and Functions

## 5.1 Operating Temperature Range

The CHB100 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 half brick models is influenced by usual factors, such as:

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

## 5.2 Output Voltage Adjustment

Section 6.8 describes in detail how to trim the output voltage with respect to its set point. The output voltage on all models is adjustable within the range of +10% to -10%.

## 5.3 Over Current Protection

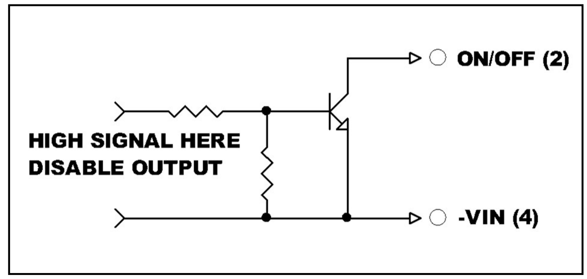
All different voltage models have full continuous short-circuit protection. To provide protection in a fault condition, the unit is equipped with internal over-current protection. The unit operates normally once the fault condition is removed. At the point of current-limit inception, the converter will go into over current protection.

## 5.4 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.

## 5.6 Remote On/Off

The CHB100 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 (open circuit). Setting the pin low (0 to <0.8Vdc) 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 (open circuit). The converter turns on if the **on/off** pin input is low (0 to <0.8Vdc). Note that the converter is off by default.




## 5.7 UVLO (Under Voltage Lock Out)

Input under voltage lockout is standard on the CHB100 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.

## 5.8 Over Temperature Protection

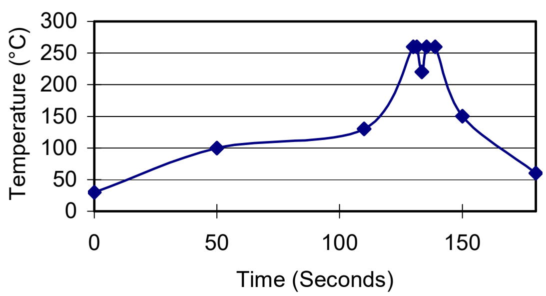
These modules have an over temperature protection circuit to safeguard against thermal damage. The module shuts down and latches off when the maximum case reference temperature is exceeded. The module will restart when the case temperature falls below restart threshold.

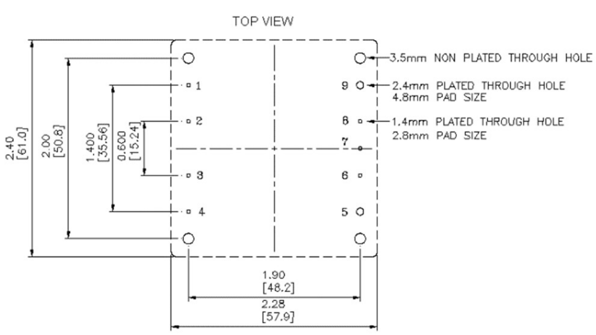
# 6. Applications

## *6.1 Recommended 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. The recommended soldering profile and PCB layout are shown below.

Lead Free Wave Soldering Profile




## *6.2 Convection Requirements for Cooling*

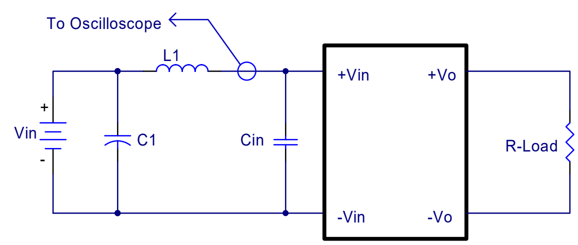
To predict the approximate cooling needed for the half brick module, refer to the power derating curves in section 6.4. These derating curves are approximations of the ambient temperatures and airflows required to keep the power module temperature below its maximum rating. Once the module is assembled 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).

## *6.3 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 6.4**. The power output of the module should not be allowed to exceed rated power ($V_{o\_set}$ x $I_{o\_max.}$).

## *6.4 Input Capacitance at the Power Module*

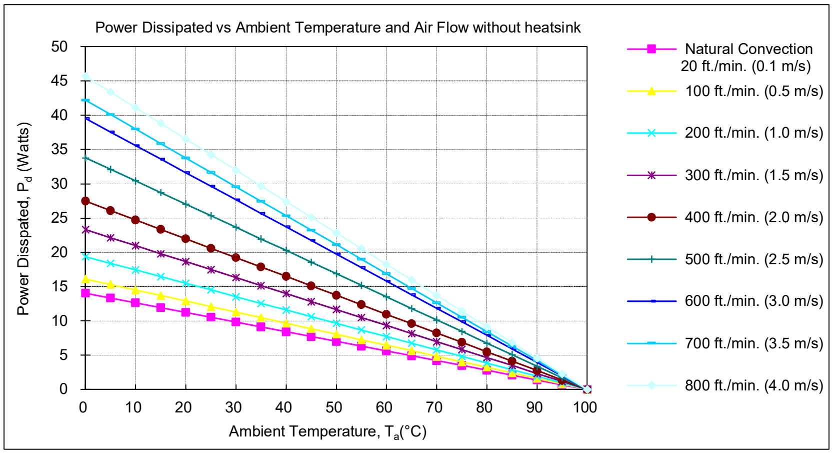
The converters must be connected to low AC source impedance. To avoid problems with loop stability source inductance should be low. Also, the input capacitors (Cin) should be placed close to the converter input pins to de-couple distribution inductance. However, the external input capacitors are chosen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




L1: Short
C1: NC
Cin: NC
Input Reflected-Ripple Test Setup

### *6.5 Power Derating*

The operating case temperature range of CHB100 series is -40℃ to +100℃. When operating the CHB100 series, proper derating or cooling is needed. The maximum case temperature under any operating condition should not exceed 100℃.




| 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 CHB100-48S12 operating at nominal line voltage, an output current of 8.3A, and a maximum ambient temperature of 50℃?

**Solution:**

**Given:**

$V_{in}$=48$V_{dc}$, $V_o$=12$V_{dc}$, $I_o$=8.3A

**Determine power dissipation ($P_d$):**

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

$P_d$=12×8.3×(1-0.89)/0.89=12.31Watts

**Determine airflow:**

Given: $P_d$=12.31W and $T_a$=50℃

**Check above power derating curve:**

Minimum airflow=400ft./min.

**Verify:**

The maximum temperature rise

$\triangle T=P_d \times R_{ca}$=12.31×3.64=44.81℃

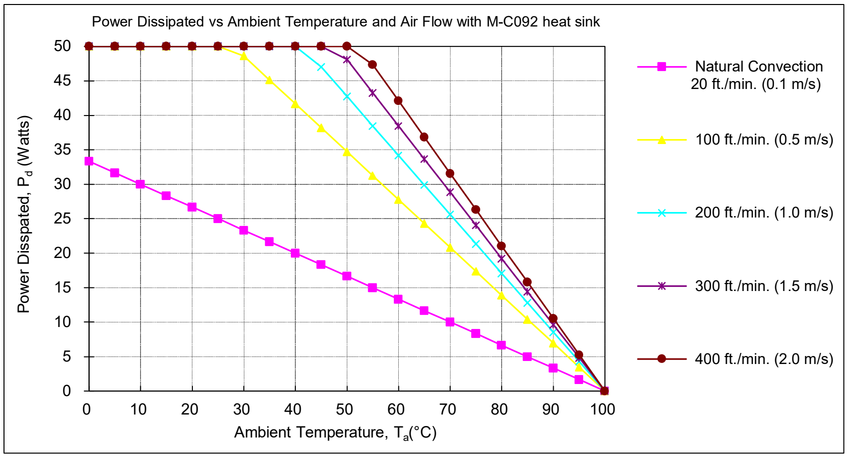
The maximum case temperature

$T_c=T_a+\triangle T$=94.81℃<100℃

**Where:**

The $R_{ca}$ is thermal resistance from case to ambience

The $T_a$ is ambient temperature and the $T_c$ is case temperature




| AIR FLOW RATE | TYPICAL $R_{ca}$ |
|---|---|
| Natural Convection 20ft./min. (0.1m/s) | 3 °C/W |
| 100 ft./min. (0.5m/s) | 1.44 °C/W |
| 200 ft./min. (1.0m/s) | 1.17 °C/W |
| 300 ft./min. (1.5m/s) | 1.04 °C/W |
| 400 ft./min. (2.0m/s) | 0.95 °C/W |

Example with heatsink HBT254 (M-C092):

What is the minimum airflow necessary for a CHB100-48S12 operating at nominal line voltage, an output current of 8.3A, and a maximum ambient temperature of 55℃?

**Solution:**

**Given:**

$V_{in}$=48$V_{dc}$, $V_o$=12$V_{dc}$, $I_o$=8.3A

**Determine power dissipation ($P_d$):**

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

$P_d$=12×8.3×(1-0.89)/0.89=12.31Watts

**Determine airflow:**

Given: $P_d$=12.31W and $T_a$=55℃

**Check above power de-rating curve:**

$P_d$<15W, Natural Convection

**Verify:**

Maximum temperature rise is $\triangle T=P_d \times R_{ca}$=12.31×3=36.93℃

Maximum case temperature is $T_c=T_a+\triangle T$=91.93℃<100℃

**Where:**

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

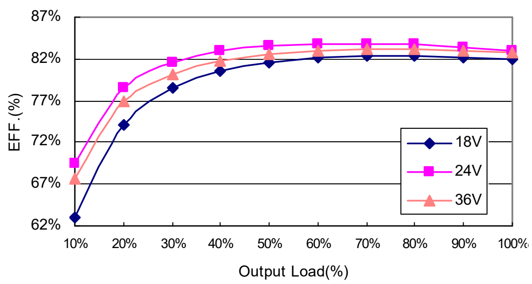
$T_a$ is ambient temperature and $T_c$ is case temperature

### *6.6 Half Brick Heat Sinks*

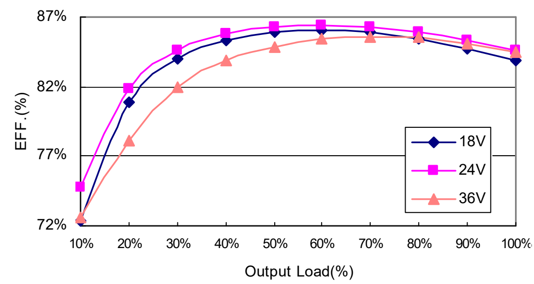
Heat sinks assembly **refer to Datasheet-Thermal**

## 6.7 Efficiency VS. Load

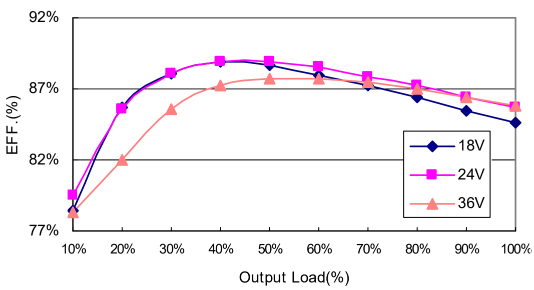
CHB100-24S33 Load VS EFF.



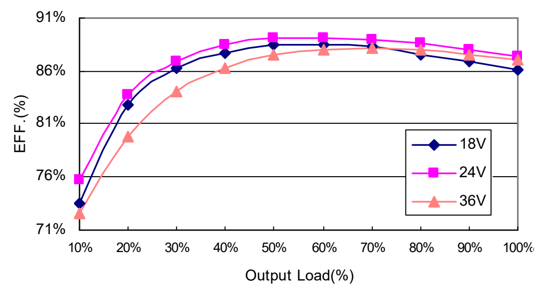

CHB100-24S05 Load VS EFF.



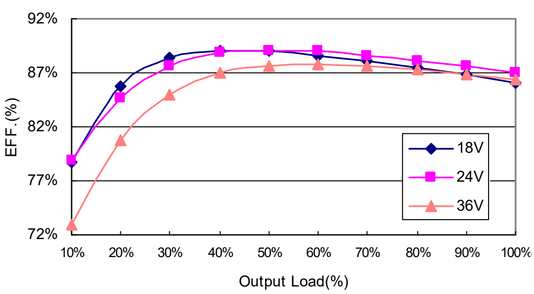

CHB100-24S12 Load VS EFF.



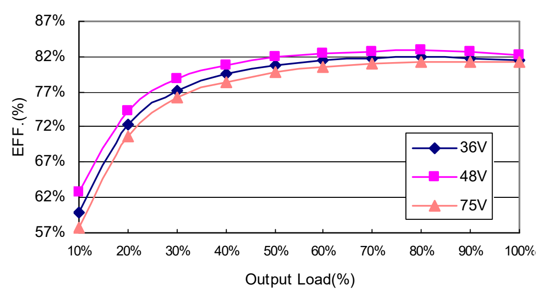

CHB100-24S15 Load VS EFF.



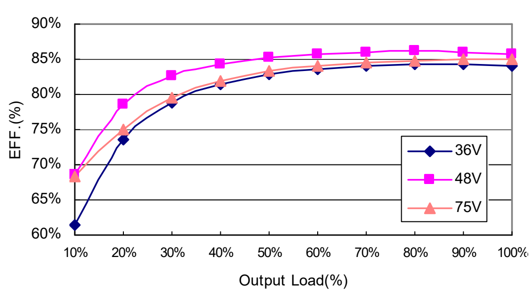

CHB100-24S24 Load VS EFF.



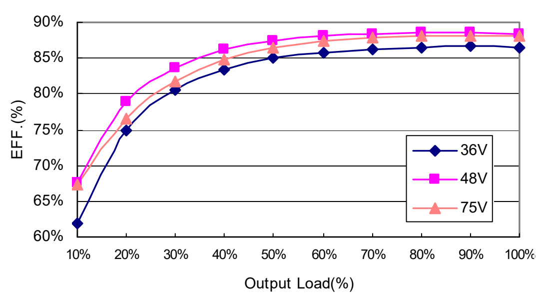

CHB100-48S33 Load VS EFF.

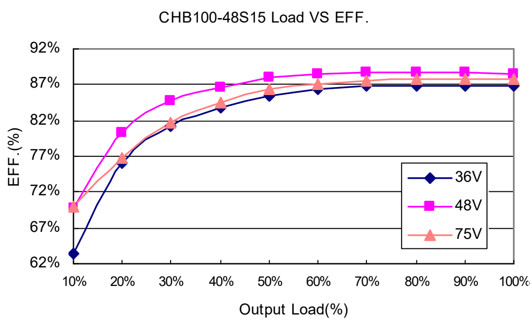


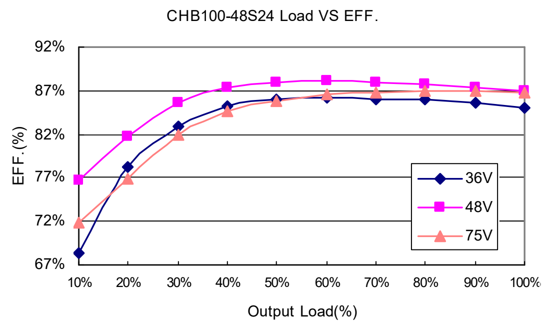

CHB100-48S05 Load VS EFF.




CHB100-48S12 Load VS EFF.




CHB100-48S15 Load VS EFF.
92%
87%
82%
77%
72%
67%
62%
EFF.(%)
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Output Load(%)
36V
48V
75V


CHB100-48S24 Load VS EFF.
92%
87%
82%
77%
72%
67%
EFF.(%)
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Output Load(%)
36V
48V
75V

### 6.8 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:

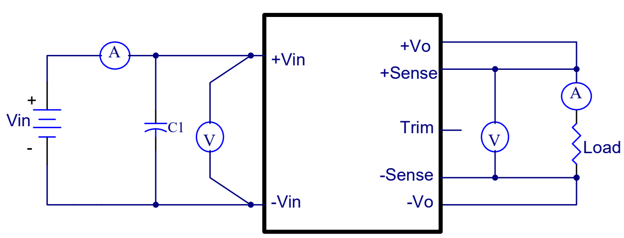
$V_{FL}$ is the output voltage at full load
$V_{NL}$ is the output voltage at no load

The value of line regulation is defined as:

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

Where:

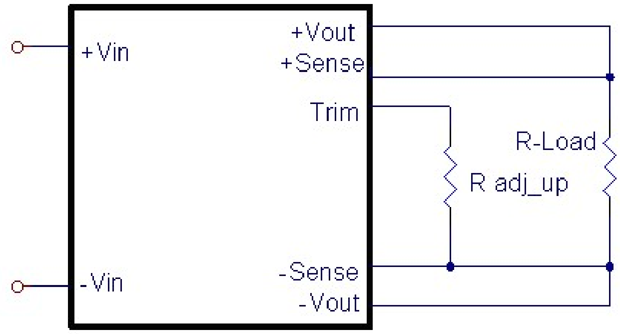
$V_{HL}$ is the output voltage of maximum input voltage at full load
$V_{LL}$ is the output voltage of minimum input voltage at full load.



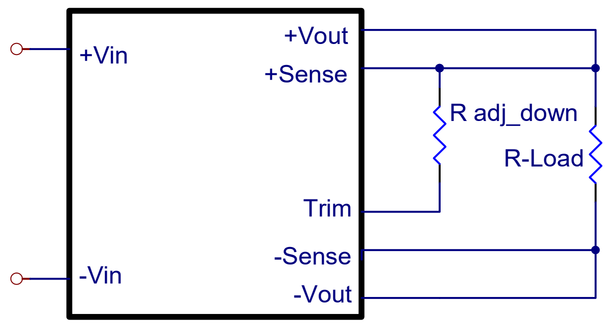

**CHB100W Series Test Setup**

### 6.9 Output Voltage Adjustment

In order to trim the voltage up or down, one needs to connect the trim resistor either between the trim pin and $-V_o$ for trim-up or between trim pin and $+V_o$ for trim-down. The output voltage trim range is ±10%. This is shown:




**Trim-up Voltage Setup**




**Trim-down Voltage Setup**

| Model No. | R1 (KΩ) | R2 (KΩ) | R3 (KΩ) | $V_r$ (V) | $V_f$ (V) |
|---|---|---|---|---|---|
| 24S33 | 3 | 12 | 4.3 | 1.24 | 0.46 |
| 48S33 | 3 | 12 | 5.1 | 1.24 | 0.46 |
| XXS05 | 2.32 | 3.3 | NC | 2.5 | 0 |
| XXS12 | 9.1 | 51 | 5.1 | 2.5 | 0.46 |
| XXS15 | 12 | 56 | 8.25 | 2.5 | 0.46 |
| XXS24 | 20 | 100 | 7.5 | 2.5 | 0.46 |

Table of trim resistor values

**The value of $R_{adj\_up}$ defined as:**

For 5V output module

$$Radj\_up = \left(\frac{R1Vr}{Vo - Vo\_nom}\right) - R2\ (K\Omega)$$

For other output module

$$Radj\_up = \left(\frac{R1(Vr - Vf(\frac{R2}{R2+R3}))}{Vo - Vo\_nom}\right) - \frac{R2R3}{R2+R3}\ (K\Omega)$$

Where:

$R_{adj\_up}$ is the external resistor in KΩ.

$V_{o\_nom}$ is the nominal output voltage.

$V_o$ is the desired output voltage.

R1, R2, R3 and $V_r$ are internal components and are defined in the table of trim resistor values

For example, to trim-up the output voltage of 5V module (CHB100-48S05) by 8% to 5.4V, $R_{adj\_up}$ is calculated as follows:

$V_o$–$V_{o\_nom}$=5.4–5.0=0.4V

R1=2.32KΩ, R2=3.3 KΩ, Vr=2.5V

$$Radj\_up = \frac{5.8}{0.4} - 3.3 = 11.2\ (K\Omega)$$

**The value of $R_{adj\_down}$ defined as:**

$$Radj\_down = \frac{R1 \times (Vo - Vr)}{Vo\_nom - Vo} - R2\ (K\Omega)$$

Where:

$R_{adj\_down}$ is the external resistor in KΩ

$V_{o\_nom}$ is the nominal output voltage

$V_o$ is the desired output voltage

R1, R2, R3 and $V_r$ are internal components

For example: to trim-down the output voltage of 5V module (CHB100-48S05) by 8% to 4.6V, $R_{adj\_down}$ is calculated as follows:

$V_{o\_nom}$–$V_o$=5.0–4.6=0.4 V

R1=2.32KΩ, R2=3.3KΩ, $V_r$=2.5 V

$$Radj\_down = \frac{2.32 \times (4.6 - 2.5)}{0.4} - 3.3 = 8.88\ (K\Omega)$$

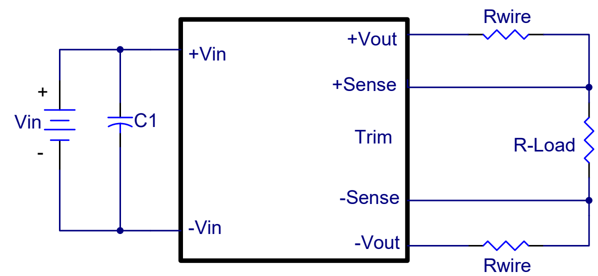
## 6.10 Output Remote Sensing

The CHB100 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 CHB100 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)] ≦ 10% of $V_{o\_nominal}$

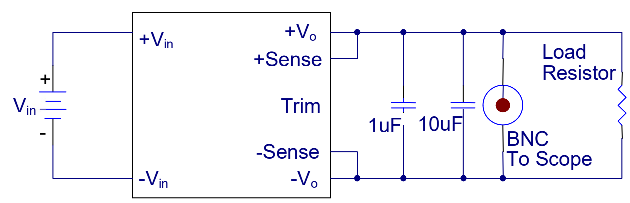
If the remote sense feature is not to be used, the sense pins should be connected locally. The **+sense** pin should be connected to the +$V_{out}$ pin at the module and the **-sense** pin should be connected to the -$V_{out}$ pin at the module.

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, $P_{ou\_max.}$ will also decrease accordingly because $I_{o\_max.}$ is an absolute limit. Thus, $P_{out\_max.}$=$V_{o\_set}$ x $I_{o\_max.}$ is also an absolute limit.

## 6.11 Output Ripple and Noise




Output ripple and noise is measured with 1.0uF ceramic and 10uF solid tantalum capacitors across the output.

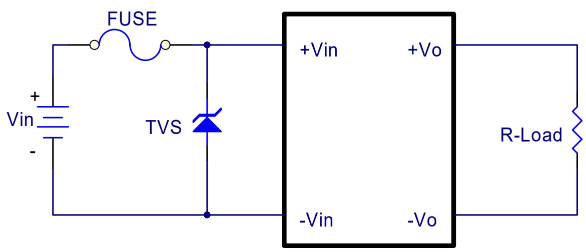
## 6.12 Output Capacitance

The CHB100 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. 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.

# 7. Safety & EMC

### *7.1 Input Fusing and Safety Considerations*

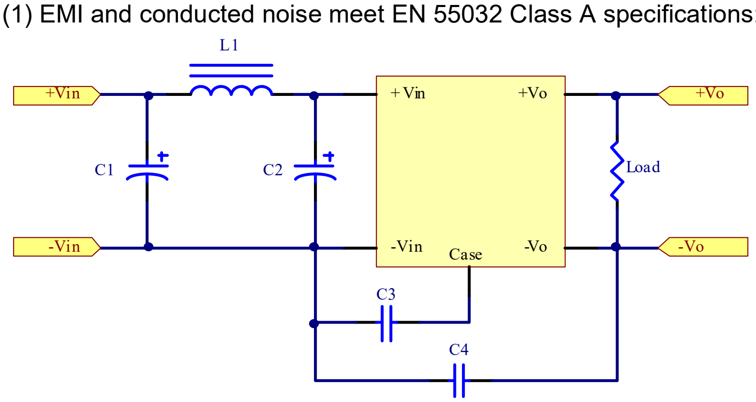
The CHB100 series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended use of fast acting type fuse 5A for 24S33, 48SXX models, 10A for 24SXX models and 3A for 48S33 models. It is recommended that the circuit have a transient voltage suppressor diode (TVS) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage (as shown).




### *7.2 EMC Considerations*

**Suggested Circuits for Conducted EMI Class A & Class B**

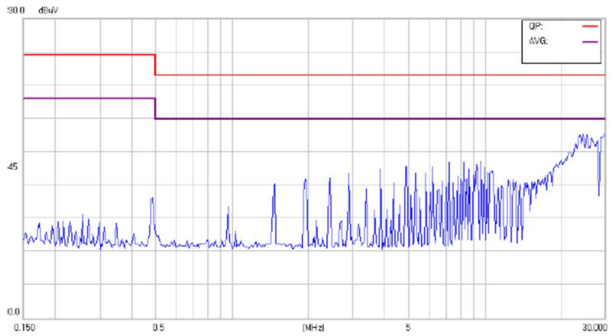
(1) EMI and conducted noise meet EN 55032 Class A specifications:



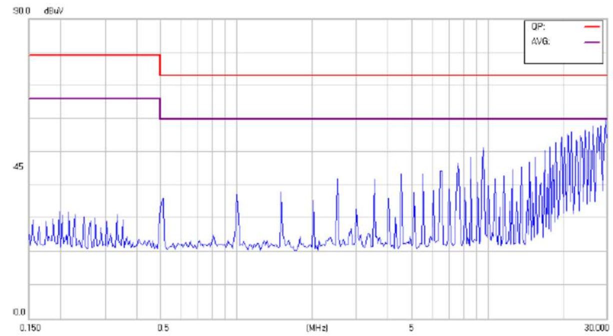

| Model No. | C1 | C2 | C3 | C4 | L1 |
|---|---|---|---|---|---|
| CHB100-24S33 | 220uF/50V | 220uF/50V | 2200pF | NC | 3.4uH |
| CHB100-24S05 | 220uF/50V | 220uF/50V | 2200pF | NC | 3.4uH |
| CHB100-24S12 | 220uF/50V | 220uF/50V | 2200pF | NC | 3.4uH |
| CHB100-24S15 | 220uF/50V | 220uF/50V | 2200pF | NC | 3.4uH |
| CHB100-24S24 | 220uF/50V | 220uF/50V | 2200pF | NC | 3.4uH |
| CHB100-48S33 | 47uF/100V | 47uF/100V | 1000pF | NC | 3.4uH |
| CHB100-48S05 | 47uF/100V | 47uF/100V | 1000pF | NC | 3.4uH |
| CHB100-48S12 | 47uF/100V | 47uF/100V | 1000pF | NC | 3.4uH |
| CHB100-48S15 | 47uF/100V | 47uF/100V | 1000pF | NC | 3.4uH |
| CHB100-48S24 | 47uF/100V | 47uF/100V | 1000pF | NC | 3.4uH |

Note:

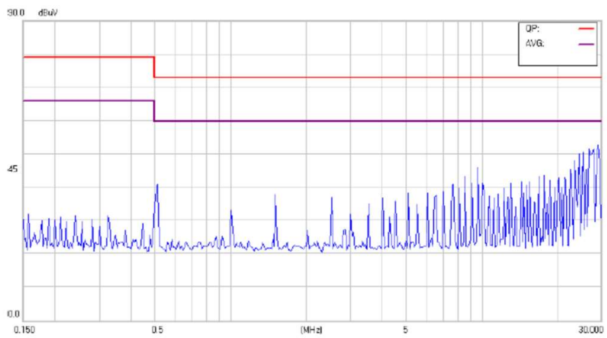
C1, C2 is aluminum capacitors, C3, C4 is ceramic capacitors



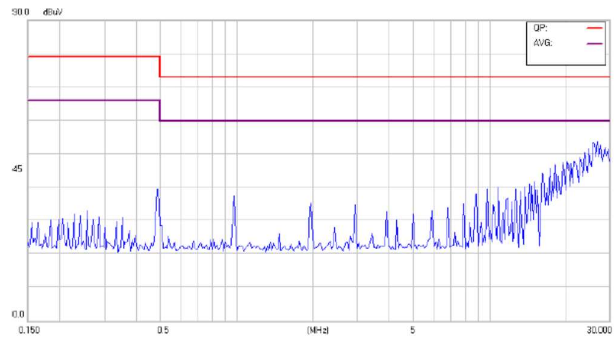
Conducted Class A of CHB100-24S33



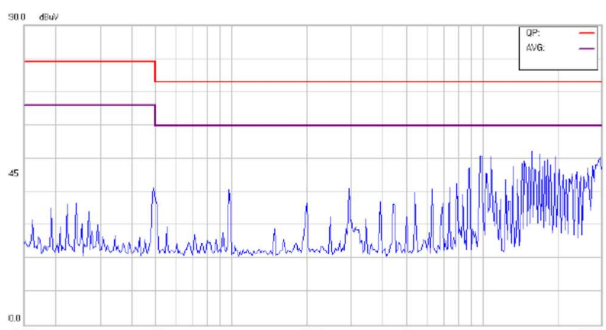
Conducted Class A of CHB100-24S05



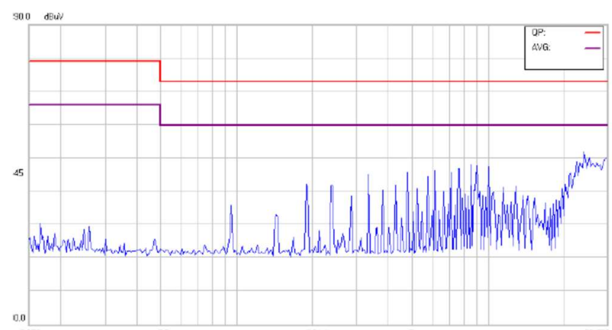
Conducted Class A of CHB100-24S12



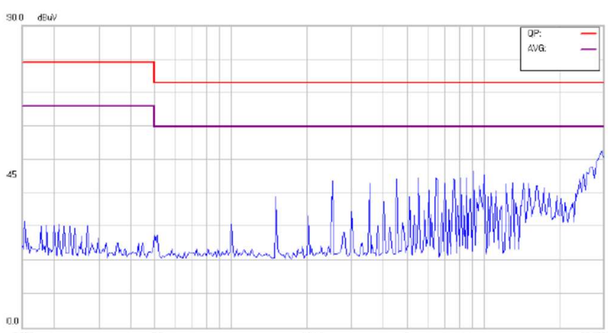
Conducted Class A of CHB100-24S15



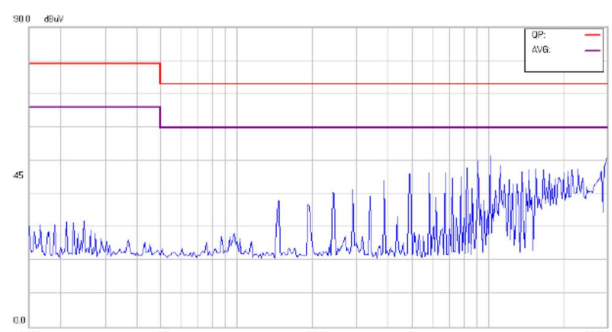
Conducted Class A of CHB100-24S24



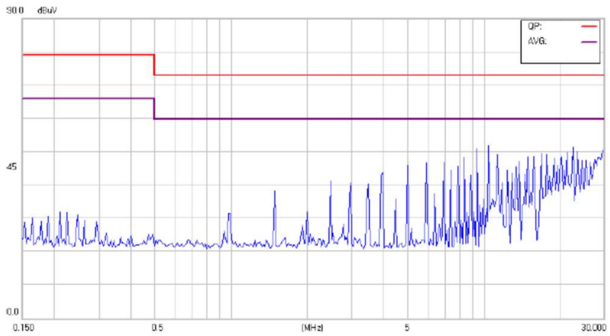
Conducted Class A of CHB100-48S33



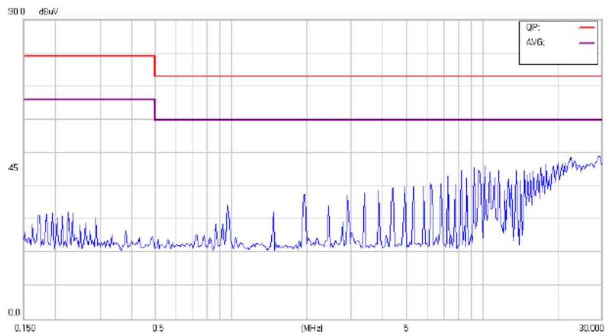
Conducted Class A of CHB100-48S05



Conducted Class A of CHB100-48S12

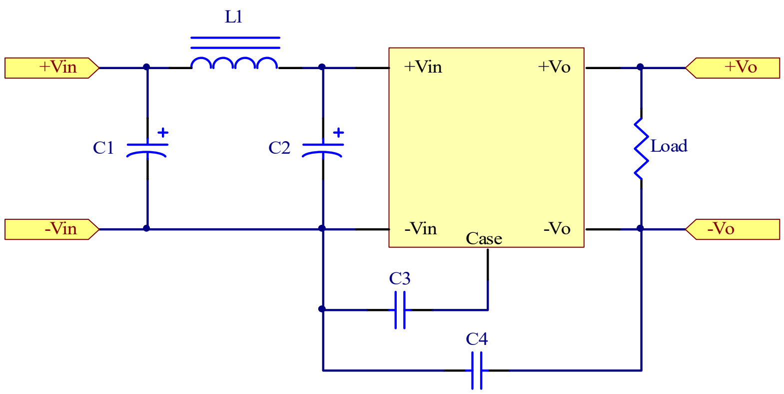


Conducted Class A of CHB100-48S15



Conducted Class A of CHB100-48S24

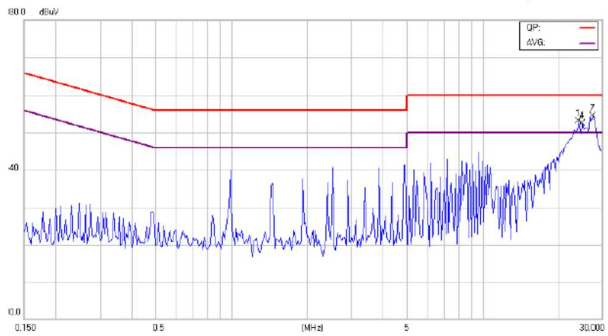
(2) EMI and conducted noise meet EN 55032 Class B specifications:



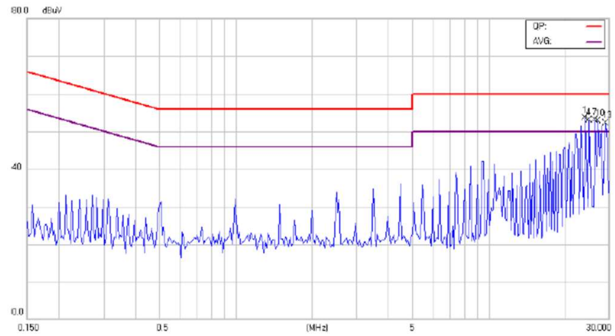

| Model No. | C1 | C2 | C3 | C4 | L1 |
|---|---|---|---|---|---|
| CHB100-24S33 | 220uF/63V | 220uF/63V | 1500pF | 1500pF | 17.3uH |
| CHB100-24S05 | 220uF/63V | 220uF/63V | 1500pF | 1500pF | 17.3uH |
| CHB100-24S12 | 220uF/63V | 220uF/63V | 1500pF | 1500pF | 17.3uH |
| CHB100-24S15 | 220uF/63V | 220uF/63V | 1500pF | 1500pF | 17.3uH |
| CHB100-24S24 | 220uF/63V | 220uF/63V | 1500pF | 1500pF | 17.3uH |
| CHB100-48S33 | 47uF/100V | 47uF/100V | 1500pF | 1500pF | 3.4uH |
| CHB100-48S05 | 47uF/100V | 47uF/100V | 1500pF | 1500pF | 3.4uH |
| CHB100-48S12 | 47uF/100V | 47uF/100V | 1500pF | 1500pF | 3.4uH |
| CHB100-48S15 | 47uF/100V | 47uF/100V | 1500pF | 1500pF | 3.4uH |
| CHB100-48S24 | 47uF/100V | 47uF/100V | 1500pF | 1500pF | 3.4uH |

Note:

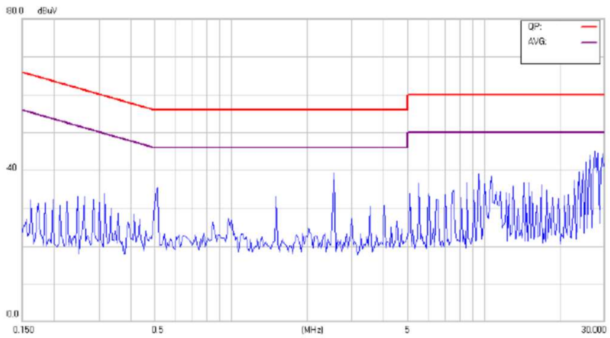
C1, C2 is aluminum capacitors, C3, C4 is ceramic capacitors.



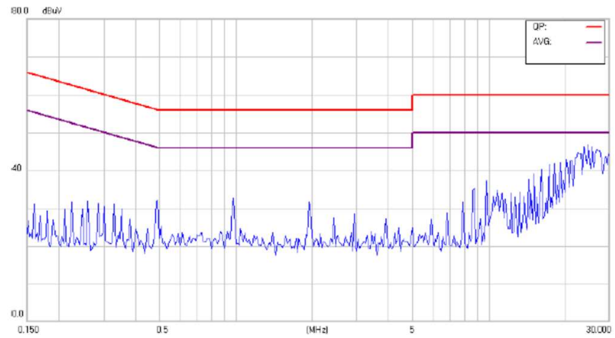
Conducted Class B of CHB100-24S33



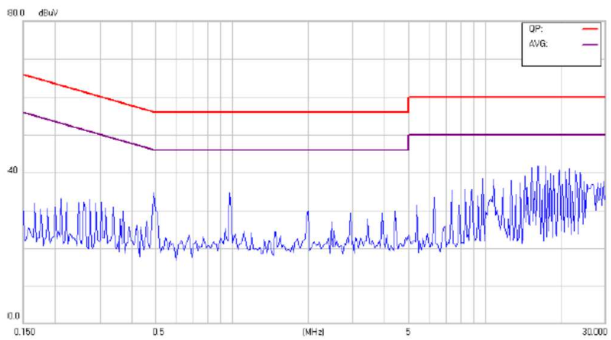
Conducted Class B of CHB100-24S05



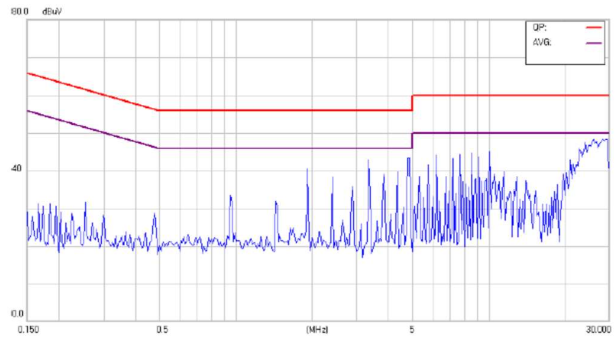
Conducted Class B of CHB100-24S12



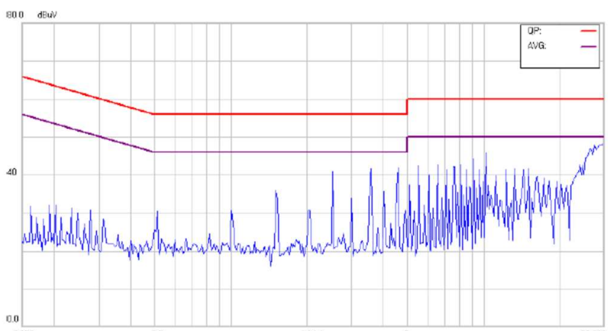
Conducted Class B of CHB100-24S15



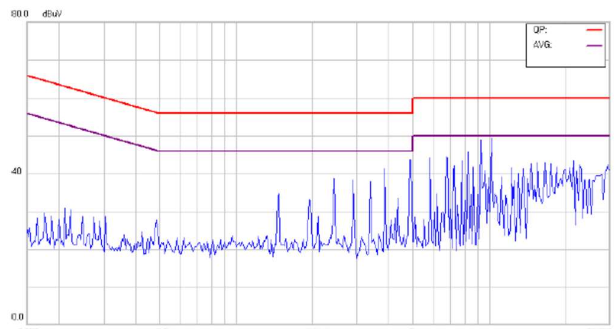
Conducted Class B of CHB100-24S24



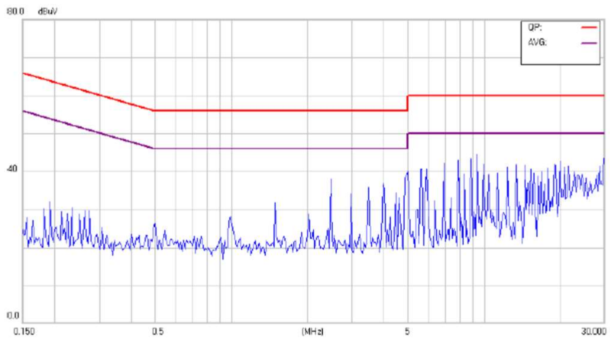
Conducted Class B of CHB100-48S33



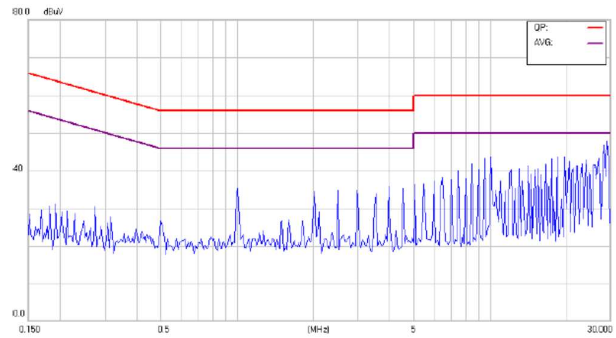
Conducted Class B of CHB100-48S05



Conducted Class B of CHB100-48S12




Conducted Class B of CHB100-48S15




Conducted Class B of CHB100-48S24

## 8. Part Number

Format: CHB100 – II X OO L Y

| Parameter | Series | Nominal Input Voltage | Number of Outputs | Output Voltage | Remote On/Off Logic | Mounting Inserts |
|---|---|---|---|---|---|---|
| Symbol | CHB150 | II | X | OO | L | Y (Option) |
| Value | CHB100 | 24 : 24 Volts<br>48 : 48 Volts | S : Single | 33 : 3.3Volts<br>05 : 05Volts<br>12 : 12Volts<br>15 : 15Volts<br>24 : 24Volts | None : Positive<br>N : Negative | -C : Clear Mounting Insert (3.2mm DIA.) |

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