ISOLATED DC-DC CONVERTER
CHB100-110S SERIES
APPLICATION NOTE

Approved By:

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Contents

CHB100-110S Series
Application Note V13

1. Introduction

The CHB100-110S series of DC-DC converters offers 100 watts of output power @ single output voltages of 12, 15, 24, 48VDC with industry standard half-brick. It has a wide (3:1) input voltage range of 66 to 160VDC (110VDC nominal) and 3000Vac isolation.

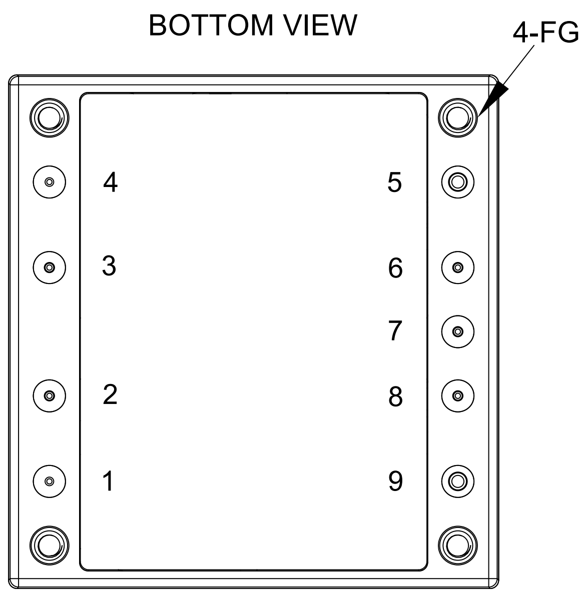
Compliant with EN50155, EN45545-2. High efficiency up to 89%, allowing case operating temperature range of -40°C to 100°C. An optional heat sink is available to extend the full power range of the unit. Very low no load power consumption (10mA), an ideal solution for energy critical systems.

The standard control functions include remote on/off 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.

CHB100-110S series is designed suitable for distributed power architectures, telecommunications, battery operated equipment, industrial and mobile equipment application.

2. Pin Function Description

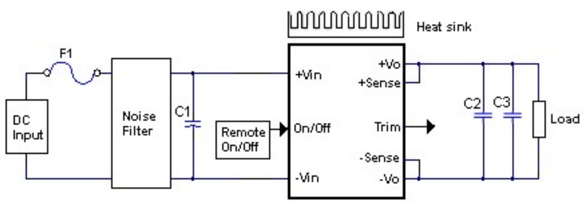


No	Label	Function	Description	Reference
1	+Vin	+V Input	Positive Supply Input	**Section 7.1**
2	ON/OFF	On/Off	External Remote On/Off Control	**Section 6.5**
3	NC	NC	No Connection with Pin	**--**
4	-Vin	-V Input	Negative Supply Input	**Section 7.1**
5	-Vo	-V Output	Negative Power Output	**Section 7.2/7.3**
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**

Note: Base plate can be connected to FG through M3 threated mounting insert. Recommended torque 5Kgf-cm.

3. Connection for Standard Use

The connection for standard use is shown below. An external input capacitor (C1) 47uF for all models is recommended to reduce input ripple voltage. External output capacitors (C2, C3) are recommended to reduce output ripple and noise, 47uF aluminum and 1uF ceramic capacitor for 48Vout, and 10uF tantalum and 1uF ceramic capacitor for other models.



Symbol	Component	Reference
F1	Input fuse	**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℃.

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:

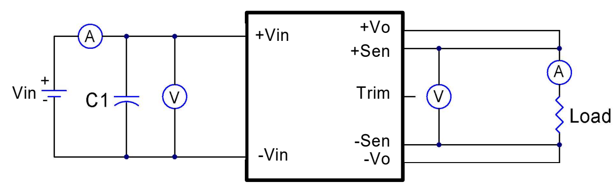
V_{FL} is the output voltage at full load
V_{NL} is the output voltage at no load

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

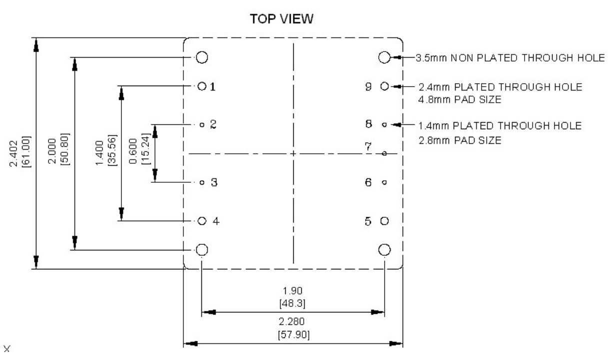


CHB100-110S series Test Setup

C1: 47uF/200V ESR<0.3ohm

5. Recommend Layout, PCB Footprint and Soldering Information

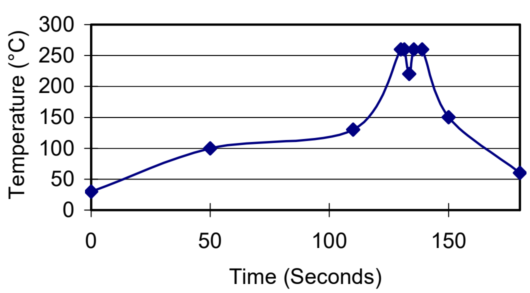
The system designer or end user must ensure that metal and other components in the vicinity of the converter meet the spacing requirements for which the system is approved. Low resistance and inductance PCB layout traces are the norm and should be used where possible. Due consideration must also be given 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 50W). Furthermore, the recommended soldering profile is shown below.

Lead Free Wave Soldering Profile

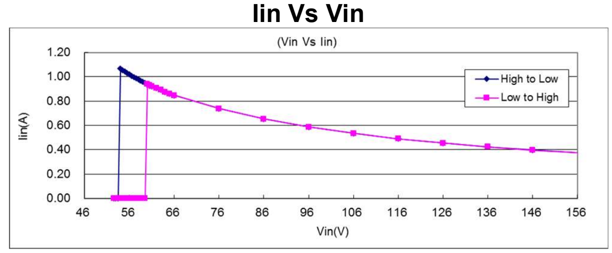


6. Features and Functions

6.1 UVLO (Under Voltage Lock Out)

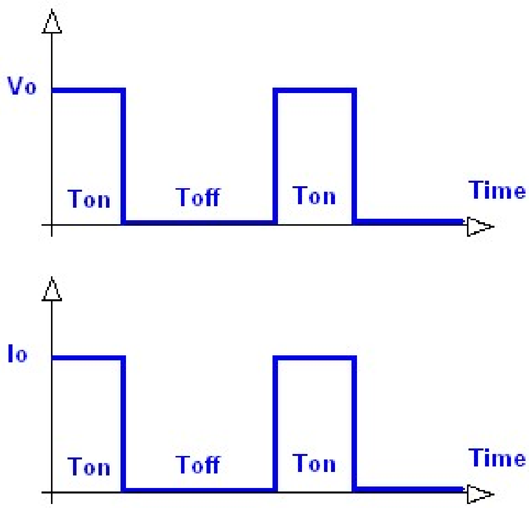
Input under voltage lockout is standard on the CHB100-110S series unit. The unit will shut down when the input voltage drops below a threshold, and the unit will operate when the input voltage goes above the upper threshold.

CHB100-110SXX
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.



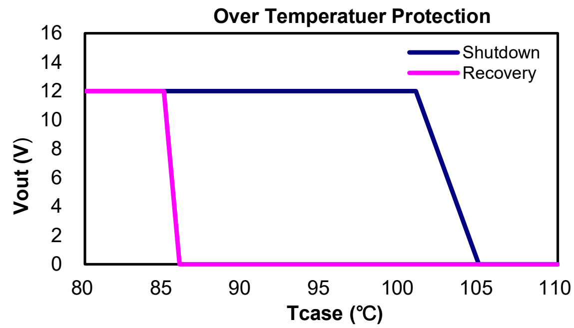
6.3 Output Over Voltage Protection

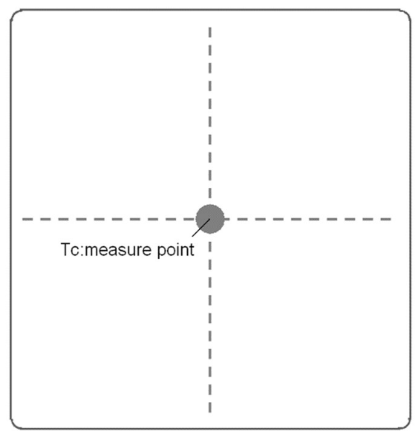
The output over voltage protection consists of circuitry that internally limits the output voltage. If more accurate output over voltage protection is required, then an external circuit can be used via the remote on/off pin.

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. 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.





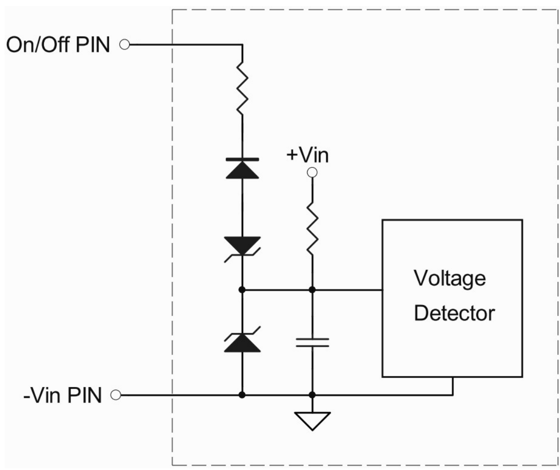
6.5 Remote On/Off

The CHB100-110S 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" versions. The converter turns on if the remote **on/off** pin is high (open circuit). Setting the pin low (0 to<1.8Vdc) will turn the converter off. The signal level of the remote **on/off** input is defined with respect to ground.

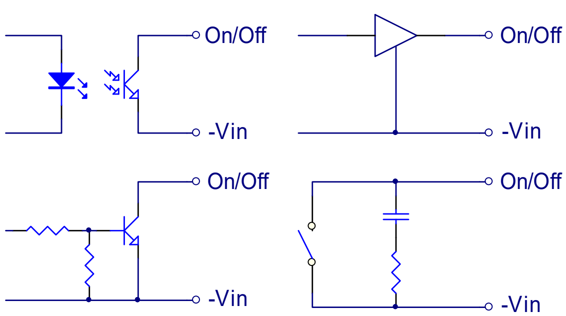
If not using the remote **on/off** pin, leave the pin open (converter will be on). If the remote **on/off** pin is high (open circuit),The converter turns on. If the **on/off** pin input is low (0 to <1.8Vdc),Note that the converter is off by default.

Logic State (Pin 2)	Positive Logic
Logic Low	Module off
Logic High	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.



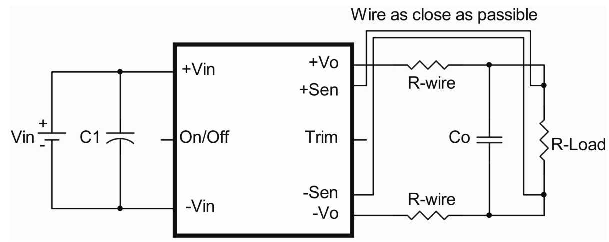
Remote On/Off Connection Example

6.6 Output Remote Sensing

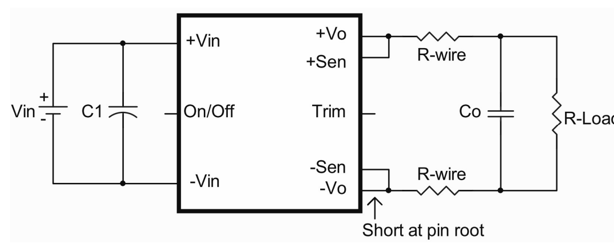
The CHB100-110S series converter has the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the CHB100-110S 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 +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.

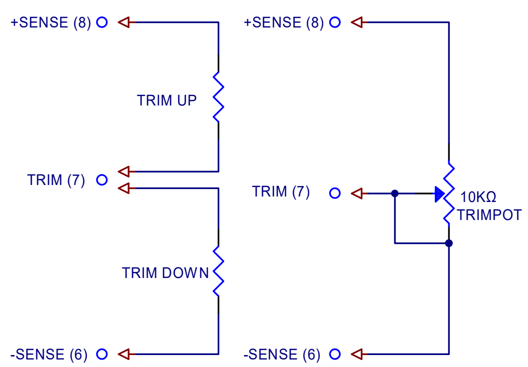


Note:

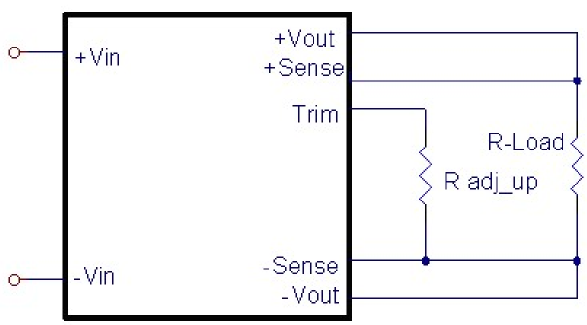
Although the output voltage can be varied (increased or decreased) by both remote sense and trim, the maximum variation for the output voltage is the larger of the two values not the sum of the values. The output power delivered by the module is defined as the voltage at the output terminals multiplied 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

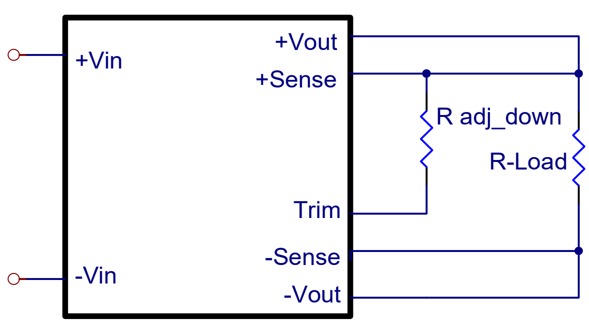
Output may be externally trimmed (±10%) with a fixed resistor or an external trim pot as shown (optional). Model specific formulas for calculating trim resistors are available upon request as a separate document.



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



Trim-up Voltage Setup



Trim-down Voltage Setup

Model Number	Output Voltage (V)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	Vr (V)	Vf (V)
CHB100-110S12	12	9.1	51	5.1	2.5	0.46
CHB100-110S15	15	12	56	8.25	2.5	0.46
CHB100-110S24	24	20	130	6.2	2.5	0.46
CHB100-110S48	48	40.2	270	5.1	2.5	0.46

The value of R_{trim_up} defined as:

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

Where:

- R_{trim_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

For example, to trim-up the output voltage of 12V module (CHB100-110S12) by 5% to 12.6V, R_{trim_up} is calculated as follows:

$V_o - V_{o,nom} = 12.6 - 12 = 0.6V$

R1 = 9.1 KΩ

R2 = 51 KΩ

R3 = 5.1KΩ

V_r= 2.5 V

V_f=0.46 V

$$R_{trim\_up} = \left[\frac{18.944}{0.6}\right] - 4.636 = 26.94\ (K\Omega)$$

The typical value of R_{trim_up}

Trim up (%)	12V	15V	24V	48V
	R_{trim_up} (KΩ)			
1%	153.23	160.73	165.83	166.56
2%	74.30	76.77	79.95	80.78
3%	47.99	48.78	51.33	52.18
4%	34.83	34.79	37.02	37.89
5%	26.94	26.39	28.43	29.31
6%	21.68	20.80	22.71	23.59
7%	17.92	16.80	18.62	19.50
8%	15.10	13.80	15.55	16.44
9%	12.90	11.47	13.17	14.06
10%	11.15	9.60	11.26	12.15

The value of R_{trim_down} defined as:

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

Where:

- R_{trim_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 12V module (CHB100-110S12) by 5% to 11.4V, R_{trim_down} is calculated as follows:

$V_{o\_nom} - V_o = 12 - 11.4 = 0.6$ V
R1 = 9.1 KΩ
R2 = 51 KΩ
V_r= 2.5 V

$$Rtrim\_down = \frac{9.1 \times (11.4 - 2.5)}{0.6} - 51 = 83.98\ \ (K\Omega)$$

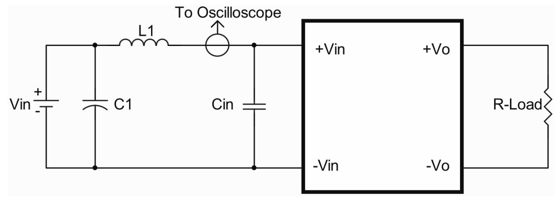
The typical value of R_{trim_down}

Trim down (%)	12V	15V	24V	48V
	R_{trim_down} (KΩ)			
1%	660.32	932.00	1641.67	3500.43
2%	300.11	432.00	745.83	1595.11
3%	180.04	265.33	447.22	960.01
4%	120.00	182.00	297.92	642.46
5%	83.98	132.00	208.33	451.93
6%	59.97	98.67	148.61	324.90
7%	42.82	74.86	105.95	234.18
8%	29.95	57.00	73.96	166.13
9%	19.95	43.11	49.07	113.20
10%	11.94	32.00	29.17	70.86

7. Input / Output Considerations

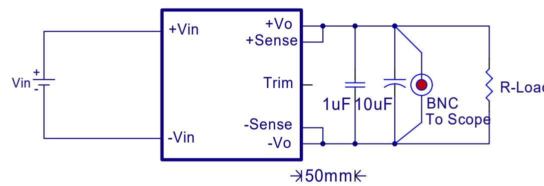
7.1 Input Capacitance at the Power Module

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).



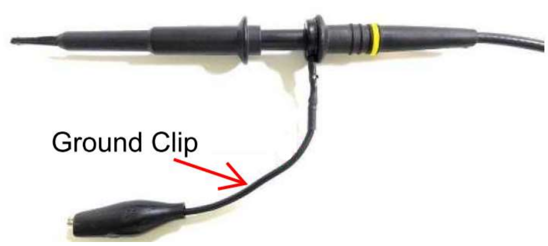
L1: 12uH
C1: 47uF ESR<0.3ohm @100KHz
Cin: 47uF ESR<0.3ohm @100KHz

7.2 Output Ripple and Noise

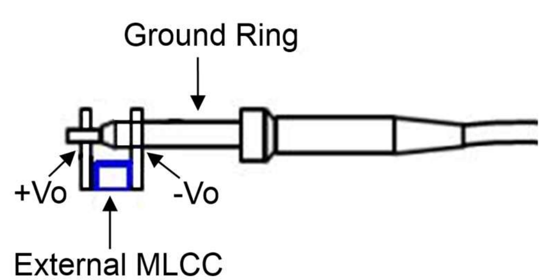


Output ripple and noise measured with 10uF tantalum and 1uF ceramic capacitor across output f. A 20 MHz bandwidth oscilloscope is normally used for the measurement.

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.



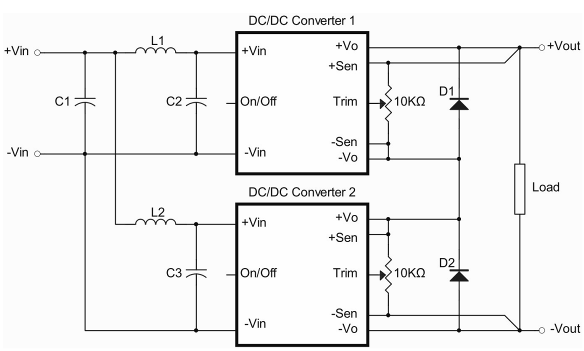
7.3 Output Capacitance

The CHB100-110S 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

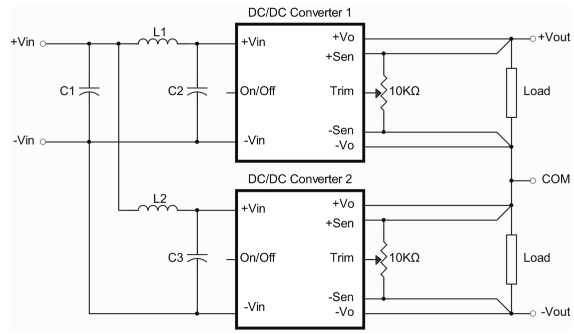
L1, L2: 1.0uH

C1, C2, C3: 47uF/200V ESR<0.3Ω

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: 47uF/200V ESR<0.3Ω

Note:

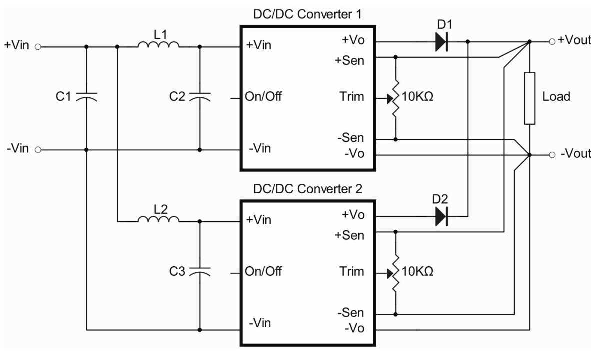
If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20℃.

8.2 Parallel Operation

The CHB100-110S 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: 47uF/200V ESR<0.3Ω

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 CHB100-110S 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 quarter 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

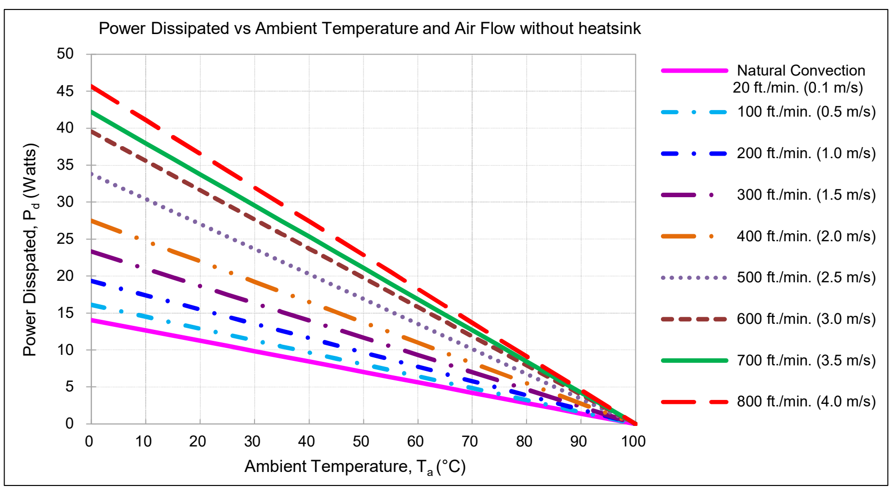
To predict the approximate cooling needed for the half brick module, refer to the power derating curves in **section 9.4**. These derating curves are approximations of the ambient temperatures and airflows required to keep the power module temperature below its maximum rating. Once the module is assembled 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 CHB100-110S series is -40℃ to +100℃. When operating the CHB100-110S series, proper derating 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 CHB100-110S 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 CHB100-110S12 operating at nominal line voltage, an output current of 8.3A, and a maximum ambient temperature of 40℃?

Solution:

Given: V_{in}=110V_{dc}, Vo=12V_{dc}, I_o=8.3A

Determine Power dissipation (P_d): P_d=P_i-P_o= P_o(1-η)/η, P_d=12×8.3×(1-0.85)/0.85=17.576Watts

Determine airflow: Given: P_d=15.576W and T_a= 40℃

Check *Power Derating* curve: Minimum airflow=500 ft./min.

Verify:

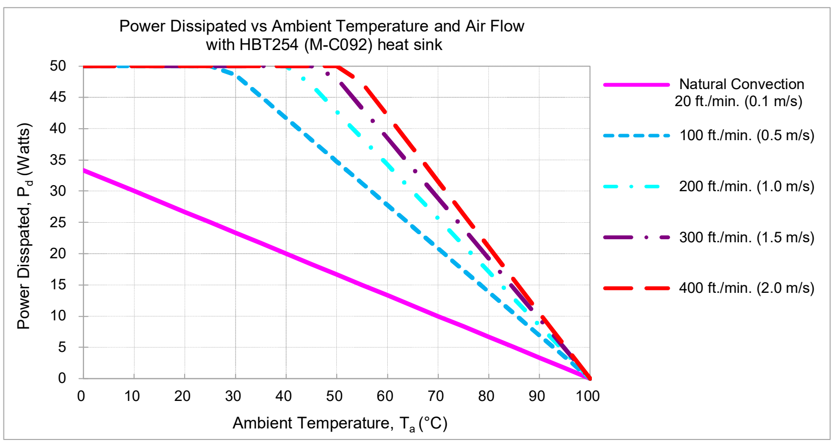
Maximum temperature rise is ΔT= P_d × R_{ca}=15.576×2.96=52.02℃

Maximum case temperature is T_c = T_a +ΔT=92.02℃<100℃

Where:

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

T_a is ambient temperature and T_c is case temperature.



AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	3 ℃/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

Example with heat sink HBT254 (M-C092):

What is the minimum airflow necessary for a CHB100-110S24 operating at nominal line voltage, an output current of 4.17A, and a maximum ambient temperature of 40℃?

Solution:

Given: V_{in}=110Vdc, V_o=24V_{dc}, I_o=4.17A

Determine Power dissipation (P_d): P_d=Pi-Po=Po(1-η)/η, P_d=24×4.17×(1-0.87)/0.87=14.95Watts

Determine airflow: Given: P_d=14.95W and T_a=40℃

Check above Power de-rating curve: P_d<20W, Natural Convection

Verify:

Maximum temperature rise is ΔT= P_d × R_{ca}=14.95×3=44.85℃

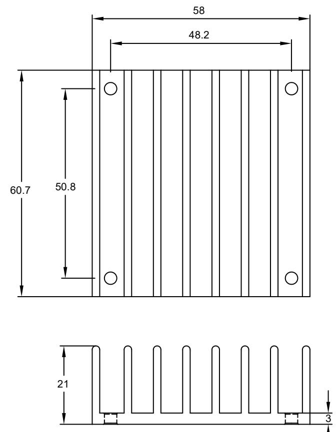
Maximum case temperature is T_c= T_a +ΔT=84.85℃<100℃

Where:

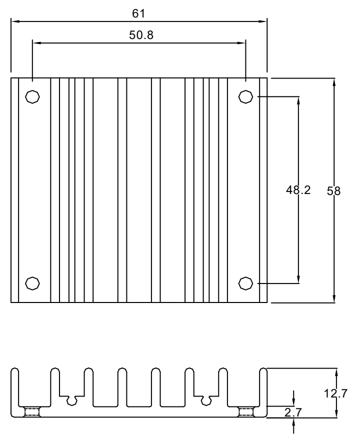
The R_{ca} is thermal resistance from case to ambient environment.

T_a is ambient temperature and T_c is case temperature.

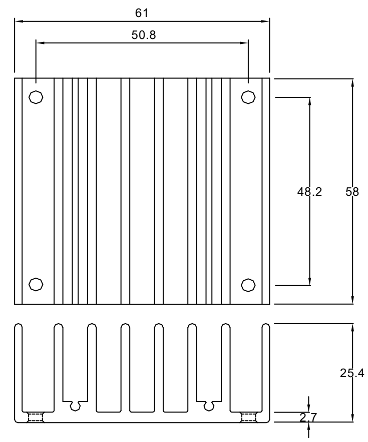
9.5 Half Brick Heat Sinks:



M-C308



M-C091



M-C092

HBL210 (M-C308) G6620400201
Longitudinal Heat Sink

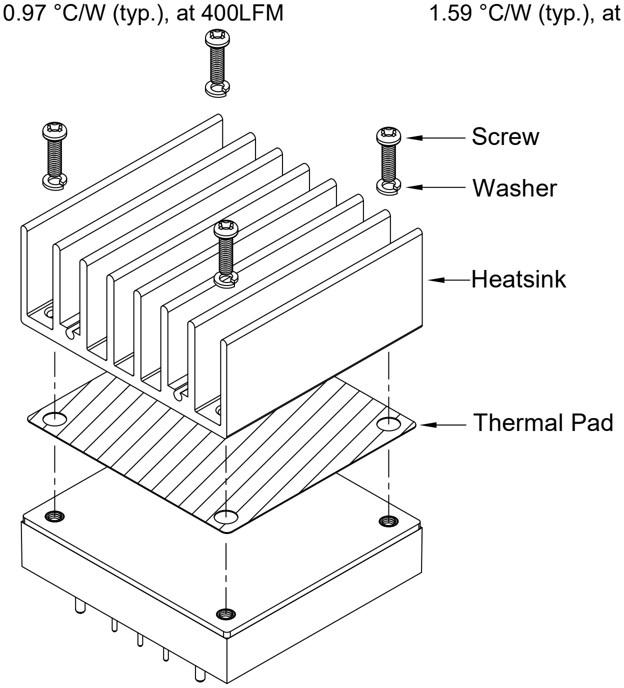
Rca:
3.90 °C/W (typ.), natural convection
1.74 °C/W (typ.), at 100LFM
1.33 °C/W (typ.), at 200LFM
1.12 °C/W (typ.), at 300LFM
0.97 °C/W (typ.), at 400LFM

HBT127 (M-C091) G6610120402
Transverse Heat Sink

Rca:
4.70 °C/W (typ.), natural convection
2.89 °C/W (typ.), at 100LFM
2.30 °C/W (typ.), at 200LFM
1.88 °C/W (typ.), at 300LFM
1.59 °C/W (typ.), at 400LFM

HBT254 (M-C092) G6610130402
Transverse Heat Sink

Rca:
3.00 °C/W (typ.), natural convection
1.44 °C/W (typ.), at 100LFM
1.17 °C/W (typ.), at 200LFM
1.04 °C/W (typ.), at 300LFM
0.95° C/W (typ.), at 400LFM

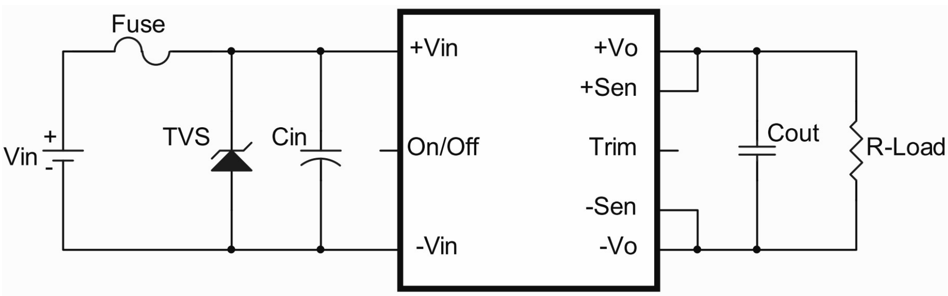


Heatsink: HBL210 (M-C308)
HBT127 (M-C091)
HBT254 (M-C092)
THERMAL PAD PH01: SZ 56.9*60*0.25 mm (G6135041091)
Screw & Washer K308W: M3*8L & WS3.2N (G75A1300322)
Recommended torque 5Kgf-cm

10. Safety & EMC

10.1 Input Fusing and Safety Considerations

The CHB100-110S series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 4A time delay fuse for all 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 CHB100-110S series has to meet EN61000-4-4, EN61000-4-5.

The Cin recommended a 220uF/200V (Rubycon YXF series) aluminum capacitor. And the TVS recommended 1.5KE180A for all models.

10.2 EMC Considerations

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

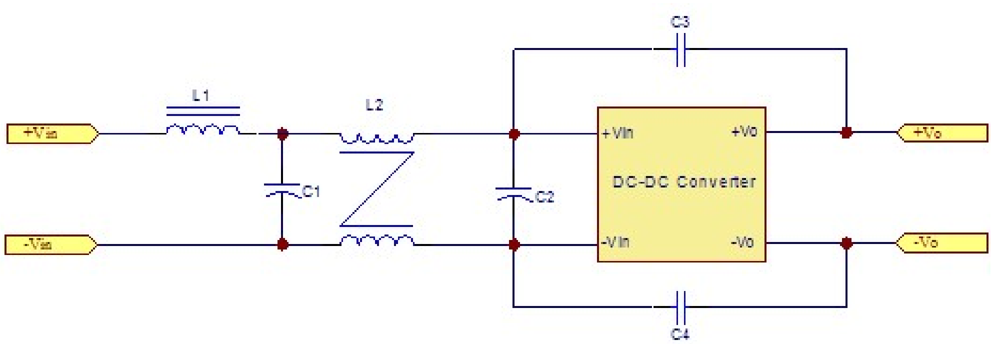


Figure1 Connection circuit for conducted EMI Class A testing

Model No.	C1	C2	C3	C4	L1	L2
CHB100-110SXX	220uF/200V YXF	220uF/200V YXF	2200pF	2200pF	5uH	0.5mH

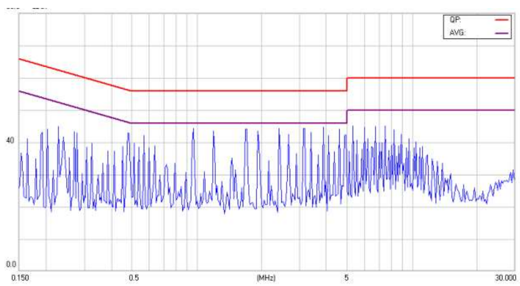
Note:

C1, C2: RUBYCON YXF series aluminum capacitors
C3, C4: ceramic capacitor
L1: 5uH (ψ0.8mm*2/11T) or equivalent
L2: 0.5mH (ψ1.0mm/6T) or equivalent

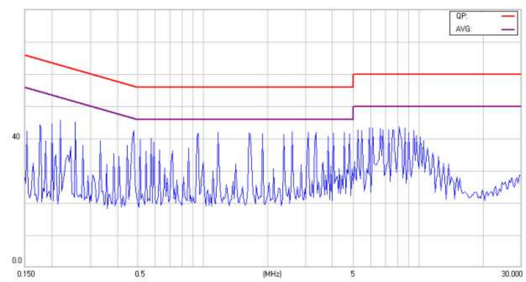
CHB100-110S Series
Application Note V13

EMI and Conducted Noise Meet EN 55032 Class B:

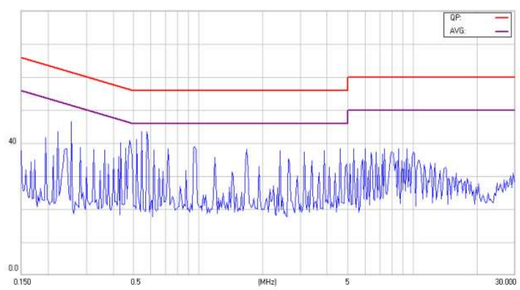
CHB100-110S12



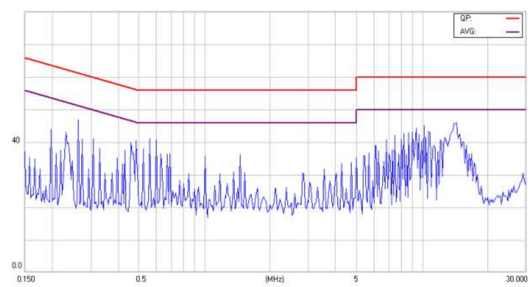
CHB100-110S15



CHB100-110S24

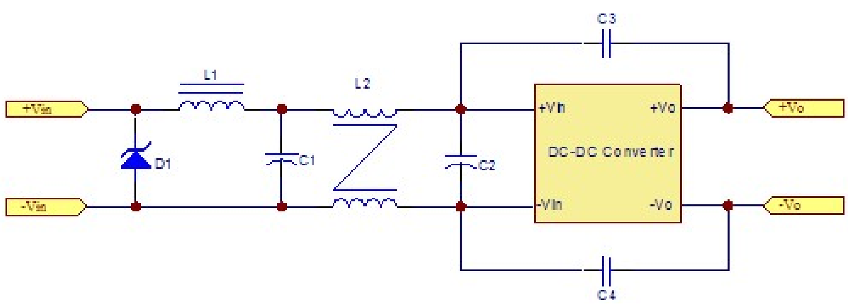


CHB100-110S48



(2) EMC Test standard: EN 50121-3-2 (EN 55011 Class A Conducted & Radiated Emission)

Test Condition: Input Voltage: Nominal, Output Load: Full Load



Model No.	D1	C1	C2	C3	C4	L1	L2
CHB100-110SXX	1.5KE180A Littelfuse	220uF/200V YXF	220uF/200V YXF	2200pF	2200pF	5uH	0.5mH

Note:

C1, C2: RUBYCON YXF series aluminum capacitors

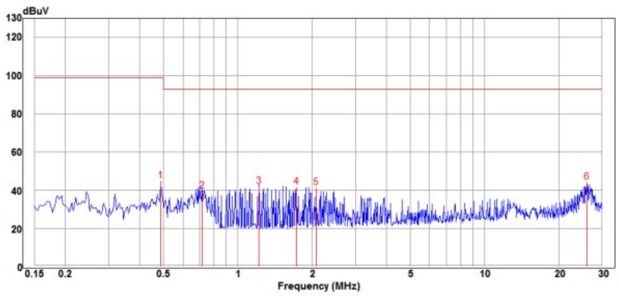
C3, C4: ceramic capacitor

L1: 5uH (ψ0.8mm*2/11T) or equivalent

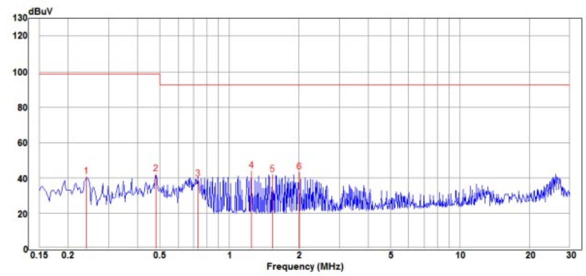
L2: 0.5mH (ψ1.0mm/6T) or equivalent

EMI and Conducted Noise Meet EN 55011 Class A:

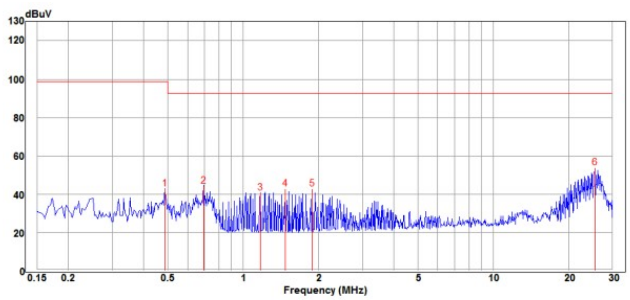
CHB100-110S12



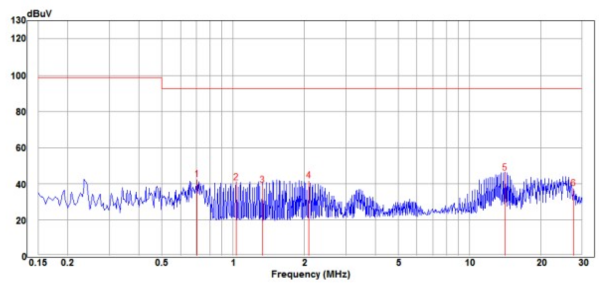
CHB100-110S15



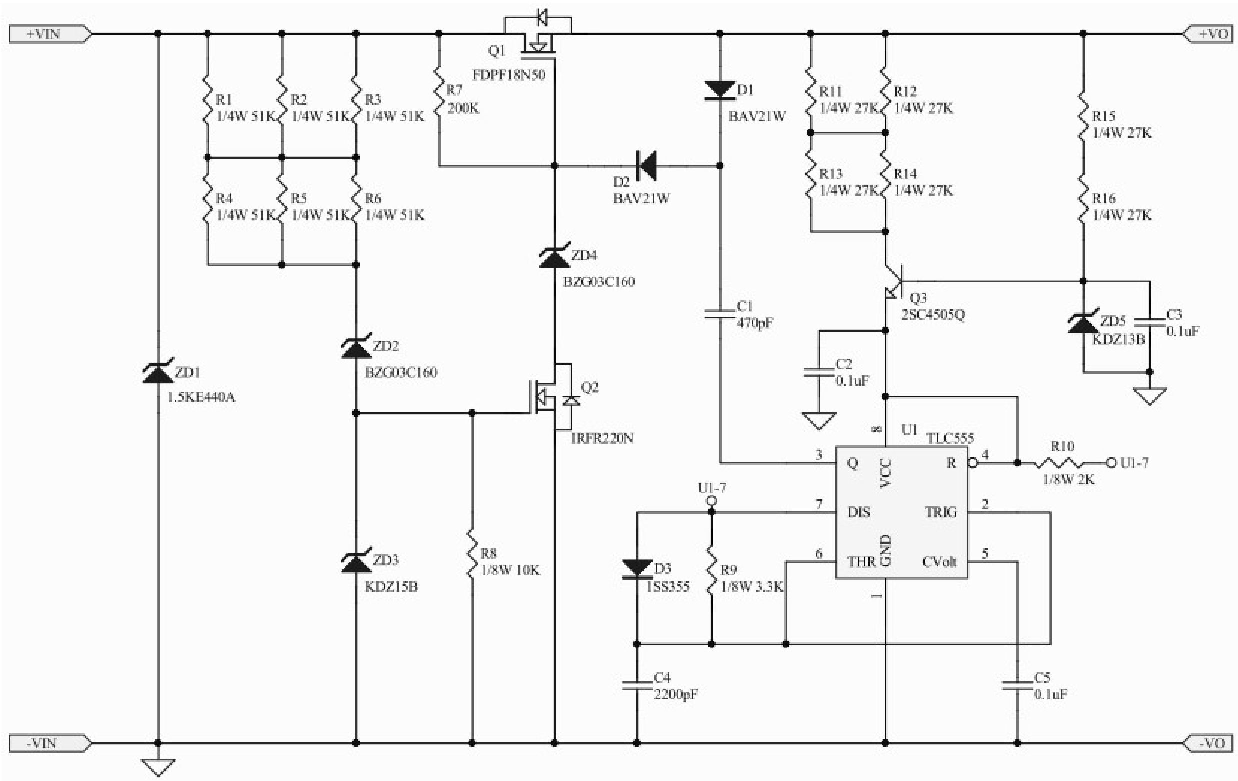
CHB100-110S24



CHB100-110S48



10.3 Suggested Configuration for RIA12 Surge Test



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