AC-DC Switching Brick Power Module
CBM300S Series
Application Note

Approved By:

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Contents

1. Introduction

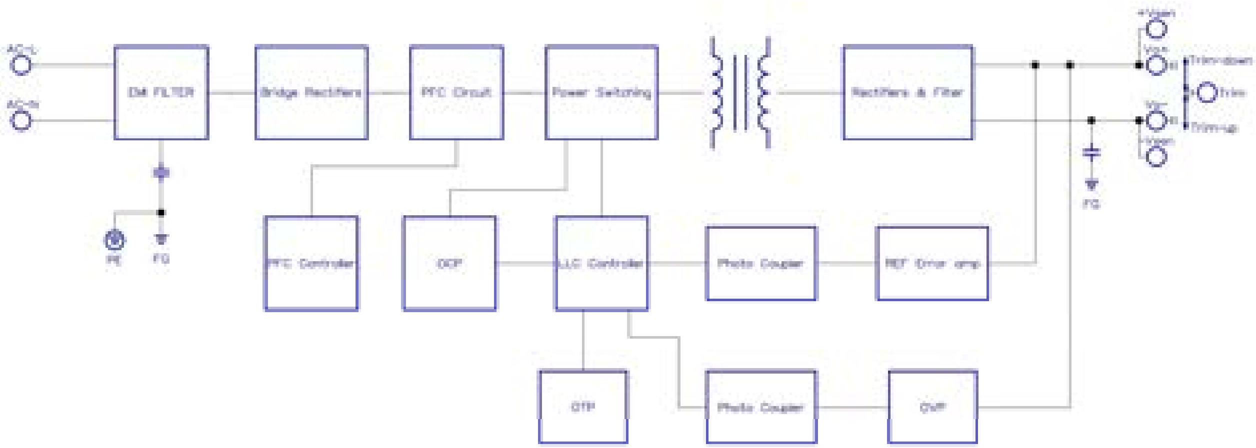
This application note describes the features and functions of Cincon's CBM300S series, switching AC-DC brick power module. The CBM300S does not require any extremal components to pass EMI class B. These are highly efficient, reliable, compact, high power density, single output AC/DC power modules. The module is fully protected against short circuit and over-voltage conditions. Cincon's world class automated manufacturing methods, together with an extensive testing and qualification program, ensure that the CBM300S series brick power module is extremely reliable.

2. Pin Function Description

No	Label	Function	Description
1	AC/L	AC Line	Positive Supply Input
2	AC/N	AC Neutral	Negative Supply Input
3	FG	Mounting Insert	Mounting Insert (FG)
4	+Sen	+V Sense	Positive Power Output Sense
5	+Vout	+V Output	Positive Power Output
6	Trim	Trim	External Output Voltage Adjustment
7	-Vout	-V Output	Negative Power Output
8	-Sen	-V Sense	Negative Power Output Sense

Note: Base plate can be connected to FG through M3 threaded mounting insert. Recommended torque 3Kgf-cm.

3. Electrical Block Diagram



4. Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown in Figure 1. When testing the Cincon's CBM300S series 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:

$$Load\ reg. = \frac{V_1 - V_2}{V_2} \times 100\%$$

Where:

V_1 is the output voltage at 60% load
V_2 is the output voltage at 60%±40% 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

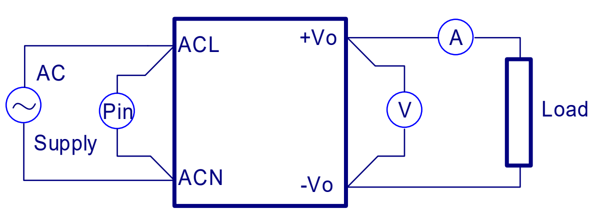


Figure 1. CBM300S Series Test Setup

5. Features and Functions

5.1 Over Current 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.

5.2 Over Voltage Protection

All different voltage models have a fully continuous over voltage protection. The brick power module will supply OVP. In the event of happen the OVP, will go into latch off protection.

5.3 Over Temperature Protection

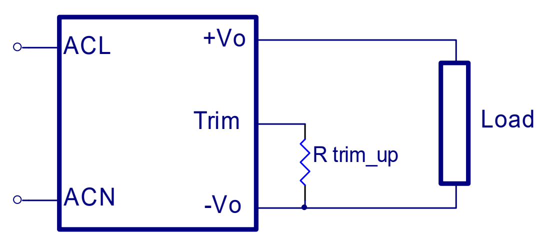
These modules have an over temperature protection circuit to safeguard against thermal damage. Shutdown occurs with the maximum case reference temperature is exceeded. The module will restart when the case temperature falls below over temperature recovery threshold. Please measure case temperature of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

5.4 Output Voltage Adjustment

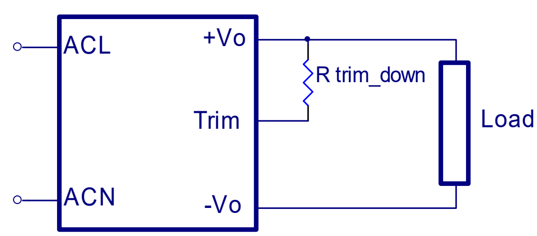
Output may be externally trimmed (-5% to +5%) with a fixed resistor. P_o≦max. rated power, I_o≦$I_{o\_max.}$. Trim up/down is extra features, changing the output voltage will cause some electrical properties to be substandard.

Example:

Output voltage ±1%, etc.



Trim-up Voltage Setup



Trim-down Voltage Setup

The value of Trim_up defined as:

$$R_{Trim\_up} = \left[\frac{V_r * (R_1 + R_2) * R_3}{V_o * R_3 - V_r * (R_1 + R_2) - V_r * R_3}\right] - R_t(K\Omega)$$

Where:

R_{Trim_up} is the external resistor in KΩ.

V_o is the desired output voltage.

R1, R2, R3, Rt and Vr are internal to the unit and are defined in Table 1.

Table 1 – Trim up and Trim down Resistor Values

Model Name	Output Voltage(V)	R_1 (KΩ)	R_2 (KΩ)	R_3 (KΩ)	R_T (KΩ)	V_r (V)
CBM300S120	12.0	24	1.8	6.8	1	2.5
CBM300S150	15.0	33	1	6.8	1	2.5
CBM300S240	24.0	51	7.5	6.8	1	2.5
CBM300S280	28.0	68	1.4	6.8	1	2.5
CBM300S360	36.0	82.5	8.66	6.8	1	2.5
CBM300S480	48.0	82.5	41.2	6.8	1	2.5
CBM300S540	54.0	110	30.1	6.8	1	2.5

For example, to trim-up the output voltage of 12V module (CBM300S120) by 5% to 12.6V, R_{Trim_up} is calculated as follows:

R1=24KΩ, R2=1.8KΩ, R3=6.8KΩ, Rt=1KΩ, Vr=2.5V, Vo=12.6V

$$R_{Trim_{up}} = \frac{2.5 * (24 + 1.8) * 6.8}{12.6 * 6.8 - 2.5 * (24 + 1.8) - 2.5 * 6.8} - 1 = 103.93\ (K\Omega)$$

The typical value of R_{Trim_up}

Trim up (%)	12V	15V	24V	28V	36V	48V	54V
	R_{Trim_up} (KΩ)						
1%	477.82	565.67	627.63	652.99	659.02	614.96	656.56
2%	252.23	282.33	308.43	317.18	322.13	313.9	325.53
3%	171.14	187.89	204.22	209.23	212.93	210.52	216.19
4%	129.38	140.67	152.52	155.97	158.9	158.24	161.71
5%	103.93	112.33	121.63	124.24	126.65	126.68	129.08

The value of R_{Trim_down} defined as:

$$R_{Trim\_up} = \left[\frac{V_o * R_3 * (R_1 + R_2) - V_r * R_3 * (R_1 + R_2)}{V_r * (R_1 + R_2) - V_o * R_3 + V_r * R_3}\right] - R_t(K\Omega)$$

Where:

R_{Trim_up} is the external resistor in KΩ.

V_o is the desired output voltage.

R1, R2, R3, Rt and Vr are internal to the unit and are defined in Table 1.

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CBM300S360	36.0	82.5	8.66	6.8	1	2.5
CBM300S480	48.0	82.5	41.2	6.8	1	2.5
CBM300S540	54.0	110	30.1	6.8	1	2.5

For example, to trim-down the output voltage of 12V module (CBM300S120) by 5% to 11.4V, R_{Trim_down} is calculated as follows:

R1=24KΩ, R2=1.8KΩ, R3=6.8KΩ, Rt=1KΩ, Vr=2.5V, Vo=11.4V

$$R_{Trim\_down} = \frac{11.4 * 6.8 * (24 + 1.8) - 2.5 * 6.8 * (24 + 1.8)}{2.5 * (24 + 1.8) - (11.4 * 6.8) + (2.5 * 6.8)} - 1 = 391.32\ (K\Omega)$$

The typical value of R_{Trim_down}

Trim down (%)	12V	15V	24V	28V
	R_{Trim_down} (KΩ)			
1%	2297.36	2798.33	5027.08	5938.03
2%	1059.43	1381.67	2522.16	3010.69
3%	681.93	909.44	1670.31	2001.33
4%	499.15	673.33	1241.14	1490.11
5%	391.32	531.67	982.6	1181.25

Trim down (%)	36V	48V	54V
	R_{Trim_down} (KΩ)		
1%	8061.44	12159.89	13042.68
2%	4066.24	5873.14	6495.37
3%	2698.73	3842.76	4293.21
4%	2008.06	2839.37	3188.39
5%	1591.42	2241.05	2524.3

6. Input / Output Considerations

6.1 Output Ripple and Noise Measurement

The test set-up for noise and ripple measurements is shown in Figure 2 Measured method:

Add a C2=0.1uF ceramic capacitor and a C1=10uF electrolytic capacitor to output at 20 MHz bandwidth.

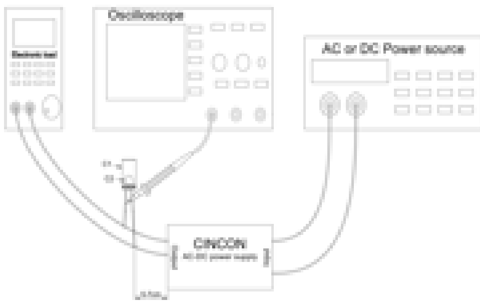


Figure 2. Output Voltage Ripple and Noise Measurement Set-Up

7. Thermal Design

7.1 Operating Temperature Range

The highly efficient design of Cincon's CBM300S series brick power module has resulted in their ability to operate within ambient temperature environments from -40℃ to +80℃. Due consideration must be given to the de-rating curves when ascertaining the maximum power that can be drawn from the module. The maximum power which can be drawn is influenced by a number of factors, such as:

- Input voltage range
- Permissible Output load (per derating curve)
- Forced air or natural convection
- Heat sink (optional)

7.2 Convection Requirements for Cooling

To predict the approximate cooling needed for the brick power module, refer to the power derating curves in section 7.4. These derating curves are approximations of the ambient temperatures and airflows required to keep the brick 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 90℃ (T_c) as measured at the center of the top of the case (thus verifying proper cooling).

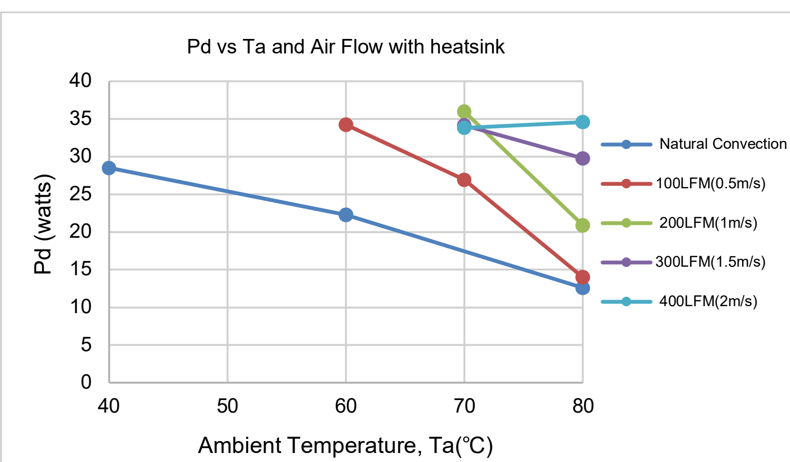
7.3 Thermal Considerations

The brick 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 7.4**. The power output of the module should not be allowed to exceed rated power (V_{o_set} x $I_{o\_max.}$).

7.4 Power Derating

The operating case temperature range of CBM300S series is -40℃ to +90℃ (T_c). When operating the CBM300S series, proper derating or cooling is needed (at 110Vac). The maximum case temperature under any operating condition should not exceed 90℃ (T_c).

The following curve is the derating curve of CBM300S series with heatsink.
Note: P_d is calculated after 1 minute of burn-in.



AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection	1.6 ℃/W
100 ft./min. (0.5m/s)	0.8 ℃/W
200 ft./min. (1.0m/s)	0.5 ℃/W
300 ft./min. (1.5m/s)	0.3 ℃/W
400 ft./min. (2.0m/s)	0.2 ℃/W

Example with heatsink (K-B022-A)**:**

What is the minimum airflow necessary for a CBM300S120 operating at 110V_{ac}, an output current of 25A, and a maximum ambient temperature of 40℃ with heatsink (K-B022-A)

Solution:

Given: V_{in}=110V_{ac}, V_o=12V_{dc}, I_o=25A

Determine power dissipation (P_d): $P_d=P_i-P_o=P_o(1-\eta)/\eta$, P_d=12V×25A×(1-0.912)/0.912=28.94Watts

Determine airflow: Given: P_d=28.94W and T_a=40℃

Check above power de-rating curve: Minimum airflow= Natural Convection

Verify:

Maximum temperature rise is $\Delta T=P_d \times R_{ca}$=28.94×1.6=46.315℃

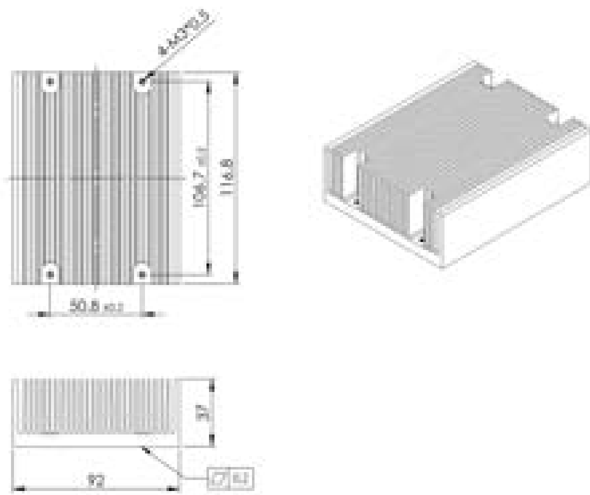
Maximum case temperature is $T_c=T_a+\Delta T$=86.315℃<90℃

Where:

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

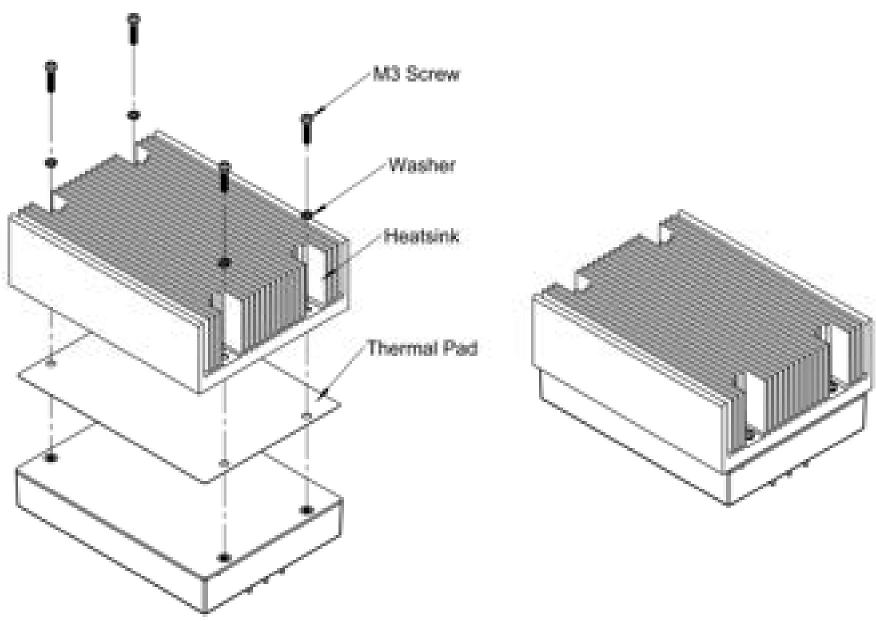
T_a is ambient temperature and T_c is case temperature

8. Heat Sinks



All Dimensions in mm
Heat Sink: 116.8*92*37mm (K-B022-A G6621281221)
Rca:

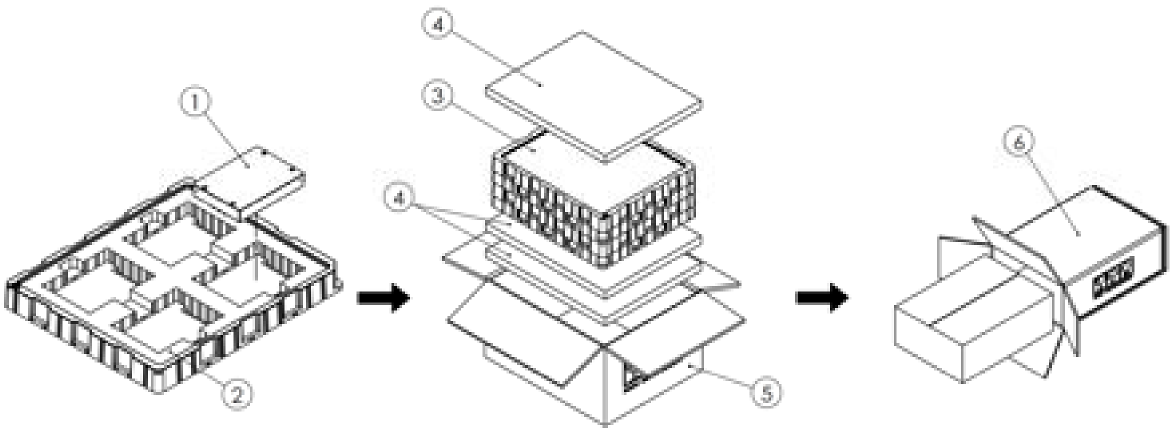
- 1.6℃/W (typ.), At natural convection
- 0.8℃/W (typ.), At 100LFM
- 0.5℃/W (typ.), At 200LFM
- 0.3℃/W (typ.), At 300LFM
- 0.2℃/W (typ.), At 400LFM



All Dimensions in mm
Heat Sink: 116.8*92*37mm (K-B022-A G6621281221)
Thermal pad: SR115.8*84*0.25mm (G61236RD304)
Screw SMP+SW M3*8L (G75A1300322)

9. Packing Information

CBM150S 40 PCS a box, including the total weight of package material about 14.6Kg



ITEM	PART NO.	NAME	OUTSIDE DIM(mm)	PCS
1	-	CBM300S Product	116x85x19.7	16
2	G64G20142	Antistatic Plastic blister	338.4x283.4x34.2	4
3	G64G20141	Antistatic Plastic blister	340x285x35	4
4	G64301087	Antistatic Foma	360x290x20	3
5	G64211308	No.114 Inner Cardboard Box	364x294x200	1
6	G64114293	No.114 Cardboard Box	400x320x225	1

Each Box Packaging 16 PCS Products
Gross weight Ref. 8.8 Kg

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