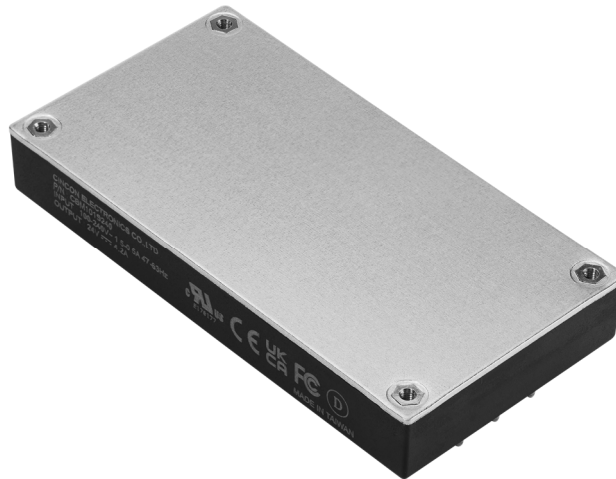




CBM101S Series Application Note V12

AC-DC Switching Brick Power Module CBM101S Series Application Note



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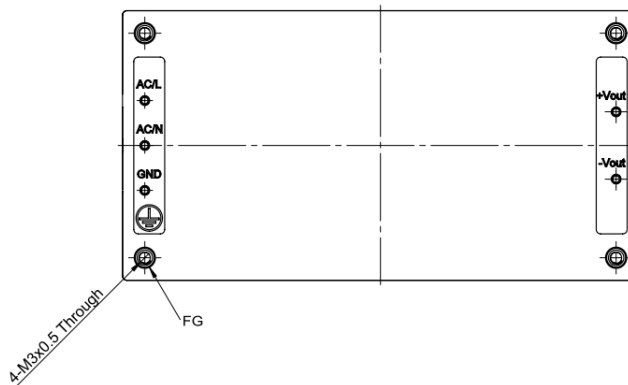


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1. Introduction

This application note describes the features and functions of Cincon's CBM101S series, switching AC-DC brick power module. The CBM101S does not require any external 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 CBM101S series brick power module is extremely reliable.

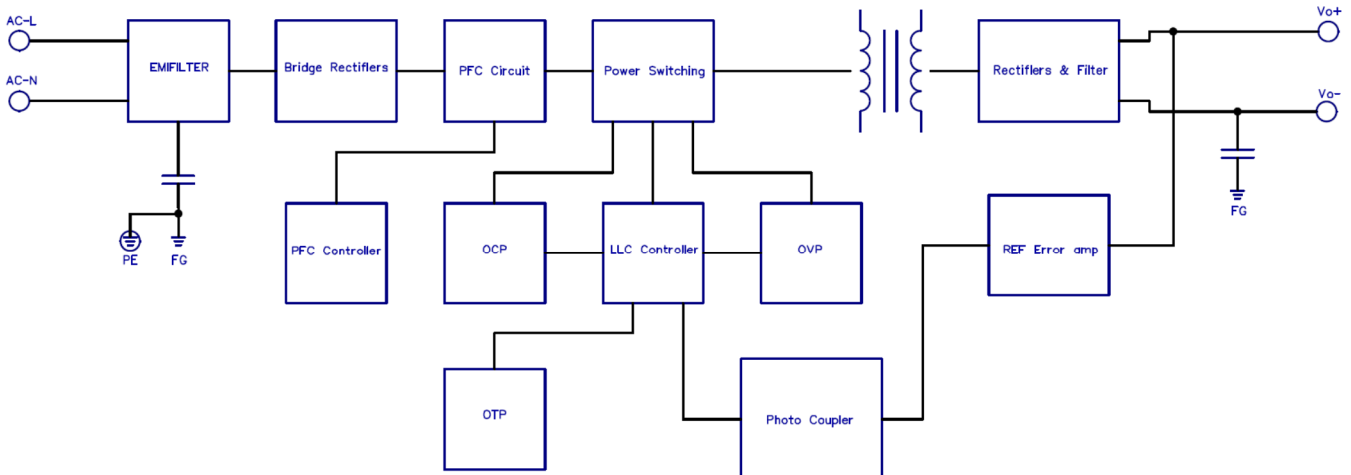
2. Pin Function Description



No	Label	Function	Description
1	AC/L	AC Line	Positive Supply Input
2	AC/N	AC Neutral	Negative Supply Input
3	GND	Mounting Insert	Mounting Insert (GND)
4	+Vout	+V Output	Positive Power Output
5	-Vout	-V Output	Negative Power Output

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

3. Electrical Block Diagram





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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 CBM101S 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 full load
- V_2 is the output voltage at 10% 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.

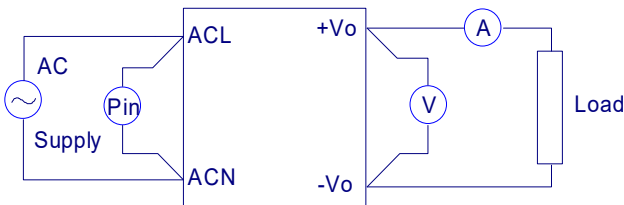
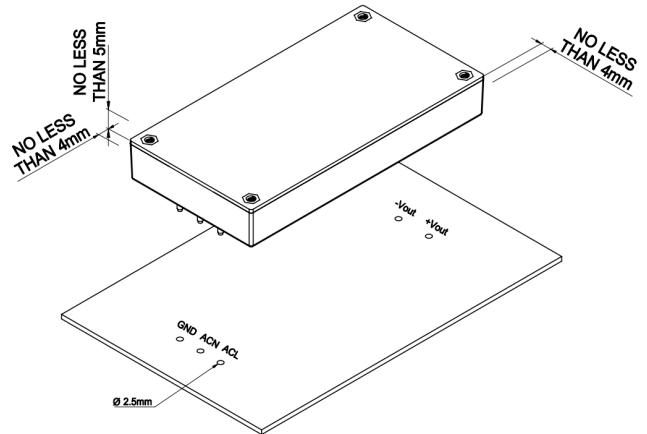


Figure 1. CBM101S Series Test Setup

5. Installation Instruction

The CBM101S mounting holes are 2.5mm. Please allow 4mm side clearance from the components and all side of the PCB and CASE. Allow 5mm clearance above the highest parts on the PCB and CASE.



6. Features and Functions

6.1 Over Current Protection

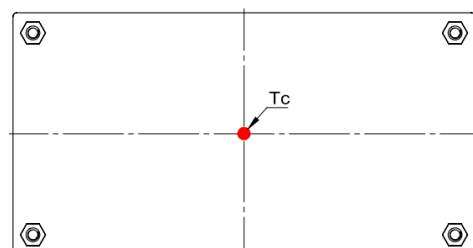
All models have internal over current and continuous short circuit protection. The unit operates normally once the fault condition is removed. At the point of current limit inception, the converter will go into hiccup mode protection.

6.2 Over Voltage Protection

All different voltage models have a fully continuous over voltage protection. The power module will supply OVP. In the event of happen the OVP, the converter will shut down, the converter will go into hiccup mode protection.

6.3 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.





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7. Input / Output Considerations

7.1 Output Ripple and Noise Measurement

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

Add a $C2=0.1\mu\text{F}$ ceramic capacitor and a $C1=10\mu\text{F}$ electrolytic capacitor to output at 20 MHz bandwidth.

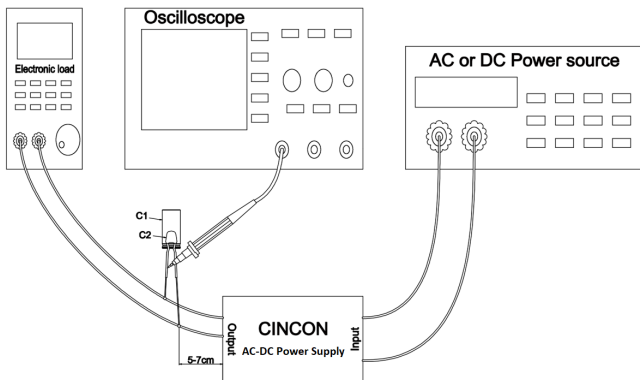


Figure 2. Output Voltage Ripple and Noise Measurement Set-Up



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8. Thermal Design

8.1 Operating Temperature Range

The highly efficient design of Cincon's CBM101S series brick power modules has resulted in their ability to operate within ambient temperature environments from -40°C to +85°C. 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)

8.2 Convection Requirements for Cooling

To predict the approximate cooling needed for the brick module, refer to the power derating curves in **section 8.4**. 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 90°C (T_c) as measured at the center of the top of the case (thus verifying proper cooling).

8.3 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 8.4**. The power output of the module should not be allowed to exceed rated power (V_{o_set} x I_{o_max}).

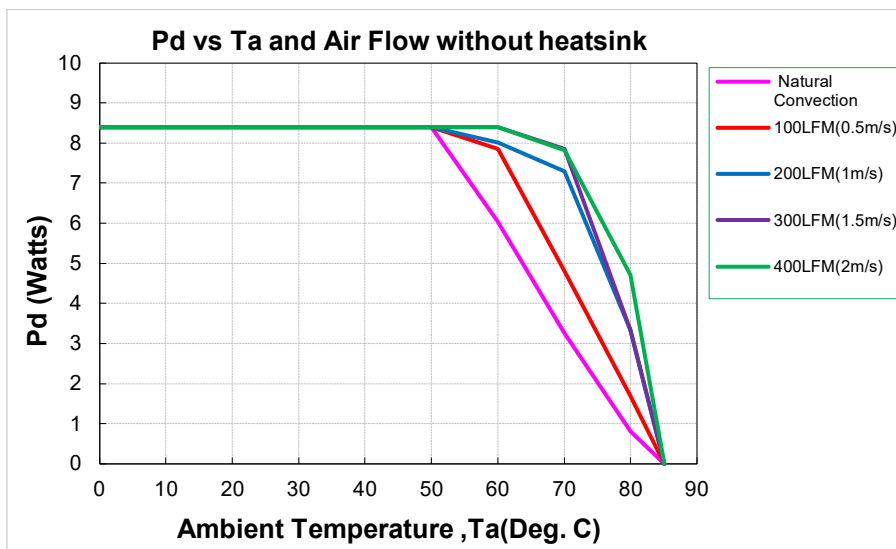
8.4 Power Derating

The operating case temperature range of CBM101S series is -40°C to +90°C (T_c). When operating the CBM101S series, proper derating or cooling is needed. (at 115V_{ac} & 230V_{ac})

The maximum case temperature under any operating condition should not exceed 90°C.

The following curve is the derating curve of CBM101S series without heatsink.

Note: Pd is calculated after 1 minute of burn-in



AIR FLOW RATE	TYPICAL R _{ca}
Natural Convection	4.81°C/W
100 ft./min. (0.5m/s)	3.85°C/W
200 ft./min. (1.0m/s)	2.75°C/W
300 ft./min. (1.5m/s)	2.43°C/W
400 ft./min. (2.0m/s)	2.05°C/W



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Example without heatsink:

What is the minimum airflow necessary for a CBM101S120 operating at 230Vac, an output current of 8.4A, and a maximum ambient temperature of 50°C without heatsink?

Solution:

Given: $V_{in}=115V_{ac}$, $V_o=12V_{dc}$, $I_o=8.4A$

Determine Power dissipation (P_d): $P_d=P_i-P_o=P_o(1-\eta)/\eta$, $P_d=12V \times 8.4A \times (1-0.927)/0.927=7.94Watts$

Determine airflow: Given: $P_d=7.94W$ and $T_a=50^\circ C$

Verify:

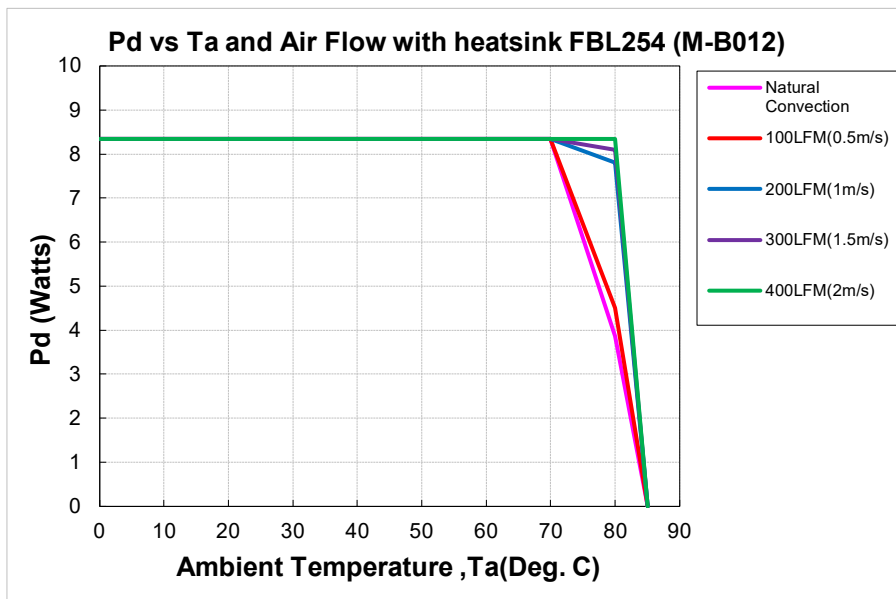
Maximum temperature rise is $\Delta T=P_d \times R_{ca}=7.94 \times 4.81=38.2^\circ C$

Maximum case temperature is $T_c=T_a+\Delta T=88.2^\circ C < 90^\circ C$

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	2.48°C/W
100 ft./min. (0.5m/s)	2.14°C/W
200 ft./min. (1.0m/s)	1.4°C/W
300 ft./min. (1.5m/s)	1.1°C/W
400 ft./min. (2.0m/s)	0.95°C/W

Example with heatsink FBL254 (M-B012):

What is the minimum airflow necessary for a CBM101S120 operating at 230Vac, an output current of 8.4A, and a maximum ambient temperature of 70°C with heatsink FBL254 (M-B012).

Solution:

Given: $V_{in}=115V_{ac}$, $V_o=12V_{dc}$, $I_o=8.4A$

Determine Power dissipation (P_d): $P_d=P_i-P_o=P_o(1-\eta)/\eta$, $P_d=12V \times 8.4A \times (1-0.927)/0.927=7.94Watts$

Determine airflow: Given: $P_d=7.94W$ and $T_a=70^\circ C$

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

Verify:

Maximum temperature rise is $\Delta T=P_d \times R_{ca}=7.94 \times 2.48=19.7^\circ C$

Maximum case temperature is $T_c=T_a+\Delta T=89.7^\circ C < 90^\circ C$

Where:

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

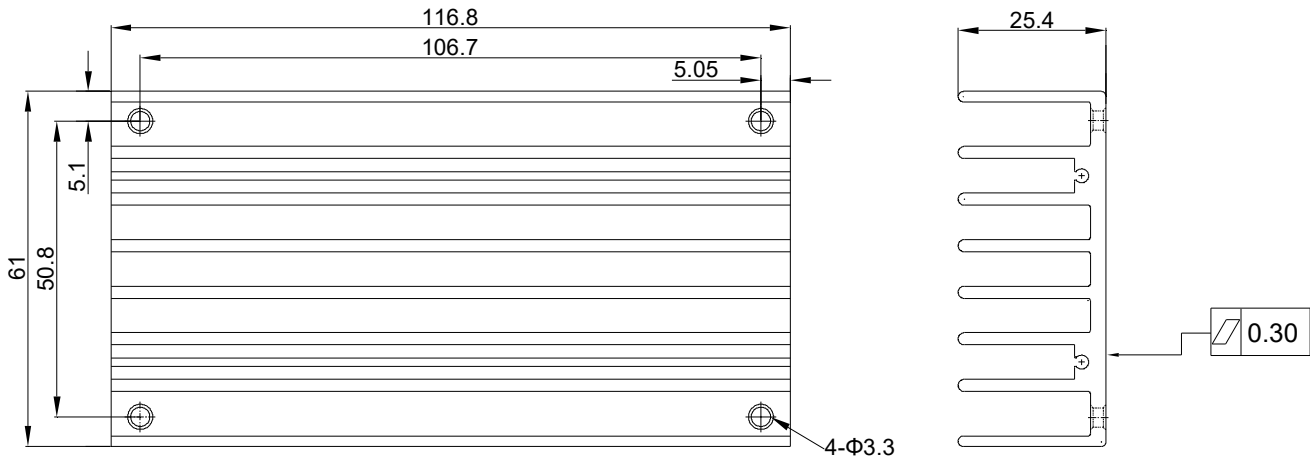
T_a is ambient temperature and T_c is case temperature.



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8.5 Full Brick Heat Sinks

All Dimension In mm



Heat Sink (Clear Mounting Inserts Φ3.3mm Through): 116.8*61*25.4 FBL254 (M-B012) G6620090204

Thermal PAD PF01: 60*115.8*0.23 (G6135041073)

Screw & Washer K308W: SMP+WS M3x8L (G75A1300322)

