Features

- Universal Input Range 90~264Vac
- High Efficiency up to 93%
- Class I
- No Load Input Power Consumption<0.5W
- 54V No Load Input Power Consumption<0.7W
- Approval IEC/EN/UL 62368-1
- Approval EN 55032 and CISPR/FCC Class B
- Operating Altitude 5000m
- Continuous Short Circuit Protection
- Over Voltage Protection
- 19.7mm Ultra Low Profile Package
- Full Load with Baseplate Cooled and No Fan Required
- Build-in EMI Filters Bulk Capacitor and Output Capacitors
- High Power Density 17.4W/Inches^3
- Wide Operating Temperature Range

E176177

MODEL NUMBER	OUTPUT VOLTAGE	OUTPUT CURRENT	RIPPLE & NOISE NOTE1	VOLTAGE ACCURACY NOTE2	LINE REGULATION NOTE3	LOAD REGULATION NOTE4	TRIM	%EFF. (Typ) NOTE5
CBM150S120	12 V	12.5 A	1%	±1%	±0.5%	±1%	±5%	91%
CBM150S240	24 V	6.25 A	1%	±1%	±0.5%	±1%	±5%	92%
CBM150S280	28 V	5.35 A	1%	±1%	±0.5%	±1%	±5%	93%
CBM150S360	36 V	4.16 A	1%	±1%	±0.5%	±1%	±5%	93%
CBM150S480	48 V	3.125 A	1%	±1%	±0.5%	±1%	±5%	93%
CBM150S540	54 V	2.77 A	1%	±1%	±0.5%	±1%	±5%	92%

Note:

1. Add a 0.1uF ceramic capacitor and a 10uF E.L. capacitor to output for ripple & noise measuring @20MHz BW.
2. Voltage accuracy is set at full load.
3. Line regulation is measured from 100V_{ac} to 240V_{ac} with full load.
4. Load regulation is measured from 10% to 100% full load.
5. Typical efficiency at 230 V_{ac} and full load at 25℃.
6. Power dissipation (P_d): $P_d = P_i - P_o = P_o(1-\eta)/\eta$.

PART NUMBER

Series	Number of Outputs	Nominal Output Voltage
CBM150	O	XXX
CBM150	S: Single	120: 12VDC 240: 24VDC 280: 28VDC 360: 36VDC 480: 48VDC 540: 54VDC

Part Number Example:

CBM150S120: Brick Power, 150W, Single 12Vdc Output

TECHNICAL SPECIFICATIONS

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

ABSOLUTE MAXIMUM RATINGS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Input Voltage	Safety approvals only to the AC input	All	90 120		264 370	V_{ac} V_{dc}
Operating Temperature	At the center of base plate (T_c = Case temperature)	All	-40		90	℃
Storage Temperature		All	-40		100	℃
Input/Output Isolation Voltage	1 Minute	All			3000	V_{ac}
Operating Altitude		All			5000	m

INPUT CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Operating Voltage Range		All	100		240	V_{ac}
Input Frequency Range		All	47		63	Hz
Maximum Input Current	100% Load, V_{in}=100V_{ac}	All			2	A
Inrush Current	V_{in}=240V_{ac}, Cold start @25℃	All			100	A
Leakage Current (Earth)		All			0.75	mA
Under Voltage Protection		All	65	70	75	V_{ac}
Power Factor	230V_{ac}/50Hz @ Full load	All	0.92			

OUTPUT CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Output Voltage Set Point	V_{in}=90V_{ac}~264V_{ac}, I_o=Full load Ambient temperature=25℃	CBM150S120 CBM150S240 CBM150S280 CBM150S360 CBM150S480 CBM150S540	11.88 23.76 27.72 35.64 47.52 53.46	12 24 28 36 48 54	12.12 24.24 28.28 36.36 48.48 54.54	V_{dc}
Output Voltage Trim Range	P_o≦max. rated power, I_o≦I_o_max.	All		±5		%
Operating Output Current Range	V_{in}=90V_{ac}~264V_{ac}, See Derating Curve	CBM150S120 CBM150S240 CBM150S280 CBM150S360 CBM150S480 CBM150S540			12.5 6.25 5.35 4.16 3.125 2.77	A
Holdup Time	V_{in}=115V_{ac}	All	10			ms
Load Regulation	10% Load to full load	All			±1.0	%
Line Regulation	V_{in}=High line to low line	All			±0.5	%
Over Voltage Protection	12V-48V Auto recovery 54V Latch Off	CBM150S120 CBM150S240 CBM150S280 CBM150S360 CBM150S480 CBM150S540			13.8 27 32.3 41.7 53.3 57.6	V_{dc}
Over Current Protection	Auto recovery	All	110	130	150	%
Short Circuit Protection	Auto recovery	All				
Over Temperature Protection	Auto recovery	All				

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PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Output Ripple and Noise	1. Add a 0.1uF ceramic capacitor and a 10uF aluminum electrolytic capacitor to output 2. Oscilloscope is 20MHz band width 3. Ambient temperature=25℃	CBM150S120			120	mV
		CBM150S240			240	
		CBM150S280			280	
		CBM150S360			360	
		CBM150S480			480	
		CBM150S540			540	
Load Capacitance	1. Input voltage is 115V_{ac} and 230V_{ac} 2. Output is max. full load 3. Ambient temperature=25℃	CBM150S120			13500	uF
		CBM150S240			6600	
		CBM150S280			5600	
		CBM150S360			4400	
		CBM150S480			3380	
		CBM150S540			2880	

EFFICIENCY

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Efficiency	1. Input voltage is 230V_{ac} 2. Output is 75% full load 3. Ambient temperature=25℃	CBM150S120		91		%
		CBM150S240		92		
		CBM150S280		93		
		CBM150S360		93		
		CBM150S480		93		
		CBM150S540		92		

ISOLATION CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Input to Output	1 Minute (without dielectric breakdown)	All			3000	V_{ac}
Input to Earth (Ground)	1 Minute (without dielectric breakdown)	All			1800	V_{ac}
Output to Earth (Ground)	1 Minute (without dielectric breakdown)	All			1800	V_{ac}
Isolation Resistance	Input to output	All	100			MΩ

FEATURE CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Switching Frequency		All		180		kHz

GENERAL SPECIFICATIONS

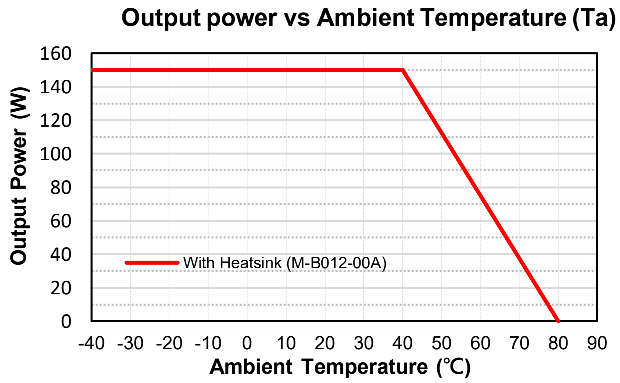
PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
MTBF	I_o=100%; T_a=25℃ per MIL-HDBK-217F	All	350			k hours
Life Time	@75% Load, 40℃	All	72			k hours
Humidity	Non-condensing	All			93	% RH
Shock	Meets MIL-STD-810F Table 516.5,TABLE 516.5-I 10ms, each axis 3 times(±-X、±Y、±Z axis)	All		75		g
Vibration	Meets MIL-STD-810F Table 514.5C-VIII,15~2000Hz, X、Y、Z axis, 1 hr (each axis),. total 3 hrs.	All		4		g
Weight		All		285		grams
Dimensions		All	4.60x2.40x0.78 Inches (116.8x61.0x19.7 mm)			
Safety	Class I, IEC/EN/UL 62368-1					Ed. 3.0
EMC Emission	EN 55032: 2015+A11: 2020, EN 61000-6-3: 2007+A1: 2011+AC: 2012, EN 61000-6-4: 2019, EN 61204-3: 2018, EN 61000-3-2:2019, EN 61000-3-3: 2013+A1: 2019, 47 CFR FCC Part 15 Subpart B					Class B
Conducted Disturbance	EN 55032: 2015+A11: 2020, 47 CFR FCC Part 15 Subpart B					Class B
Radiated Disturbance	EN 55032: 2015+A11: 2020, 47 CFR FCC Part 15 Subpart B					Class B
Harmonic Current Emissions	EN 61000-3-2:2019					Class A
Voltage Fluctuations & Flicker	EN 61000-3-3: 2013+A1: 2019					Criterion A

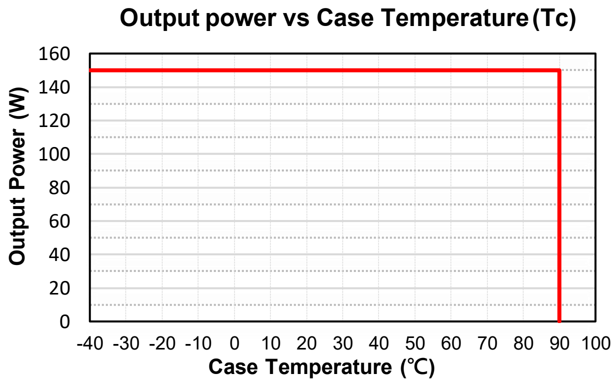
GENERAL SPECIFICATIONS

EMC Immunity	EN 55035: 2017+A1: 2020, EN 61000-6-1: 2019, EN 61000-6-2: 2019, EN 61204-3: 2018	
Electrostatic Discharge (ESD)	IEC 61000-4-2:2008 Air Discharge: ±8kV, Contact Discharge: ±4kV	Criterion A
Radio-Frequency, Continuous Radiated Disturbance	IEC 61000-4-3:2020	Criterion A
Electrical Fast Transient (EFT)	IEC 61000-4-4:2012, ±2kV	Criterion A
Surge	IEC 61000-4-5:2014+A1: 2017, L-N: ±1kV, L-E(Ground): ±2kV	Criterion A
Conducted Disturbances, Induced by RF Fields	IEC 61000-4-6:2013+COR1: 2015	Criterion A
Power Frequency Magnetic Field	IEC 61000-4-8:2009	Criterion A
Voltage Dips	IEC 61000-4-11:2020, Dip: 30% Reduction, Dip >95% Reduction	Criterion A
Voltage Interruptions	IEC 61000-4-11:2020, >95% Reduction	Criterion B

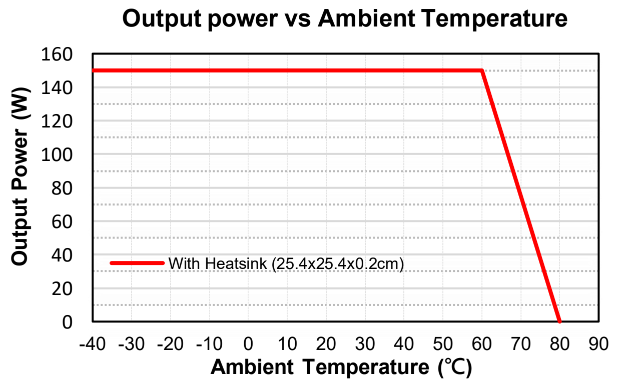
CHARACTERISTIC CURVE

Power Derating Curve



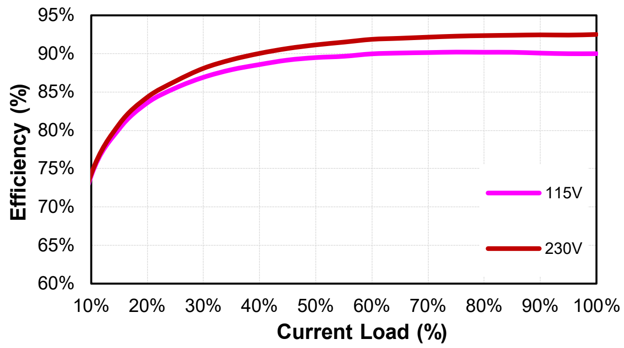


Conduction Convection with External Baseplate (25.4x25.4x0.2cm)

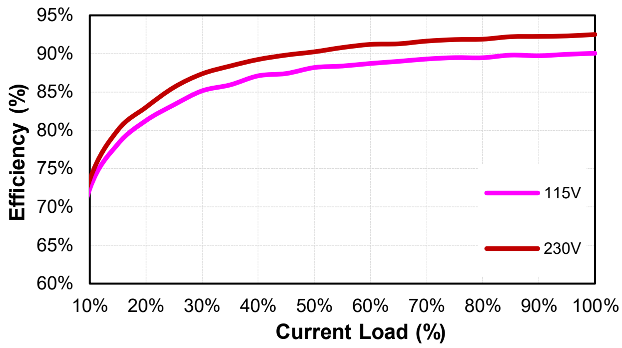


Performance Data

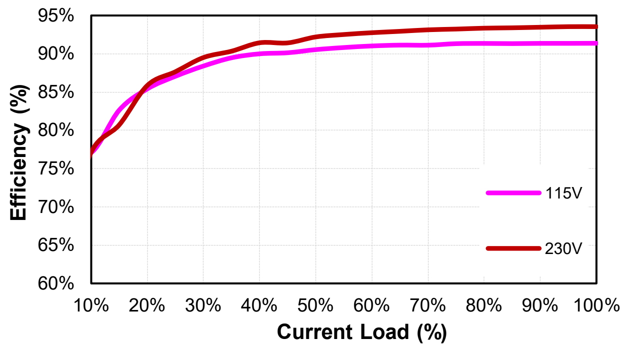
CBM150S120 (Eff Vs Io)



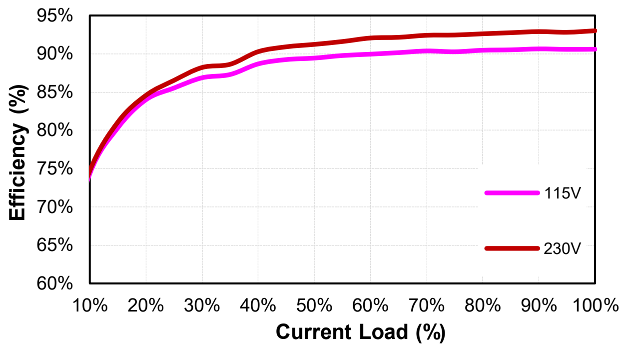
CBM150S240 (Eff Vs Io)



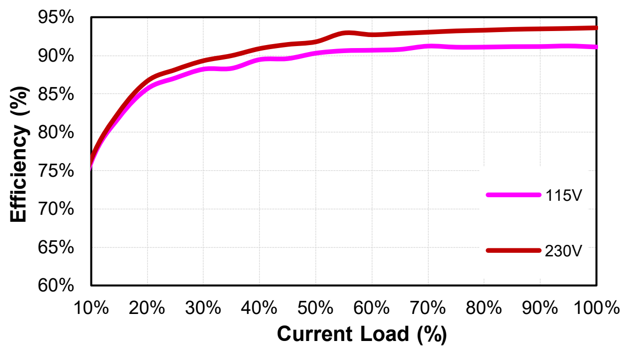
CBM150S280 (Eff Vs Io)



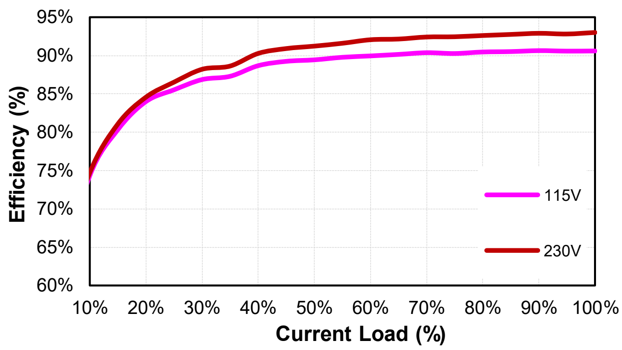
CBM150S360 (Eff Vs Io)



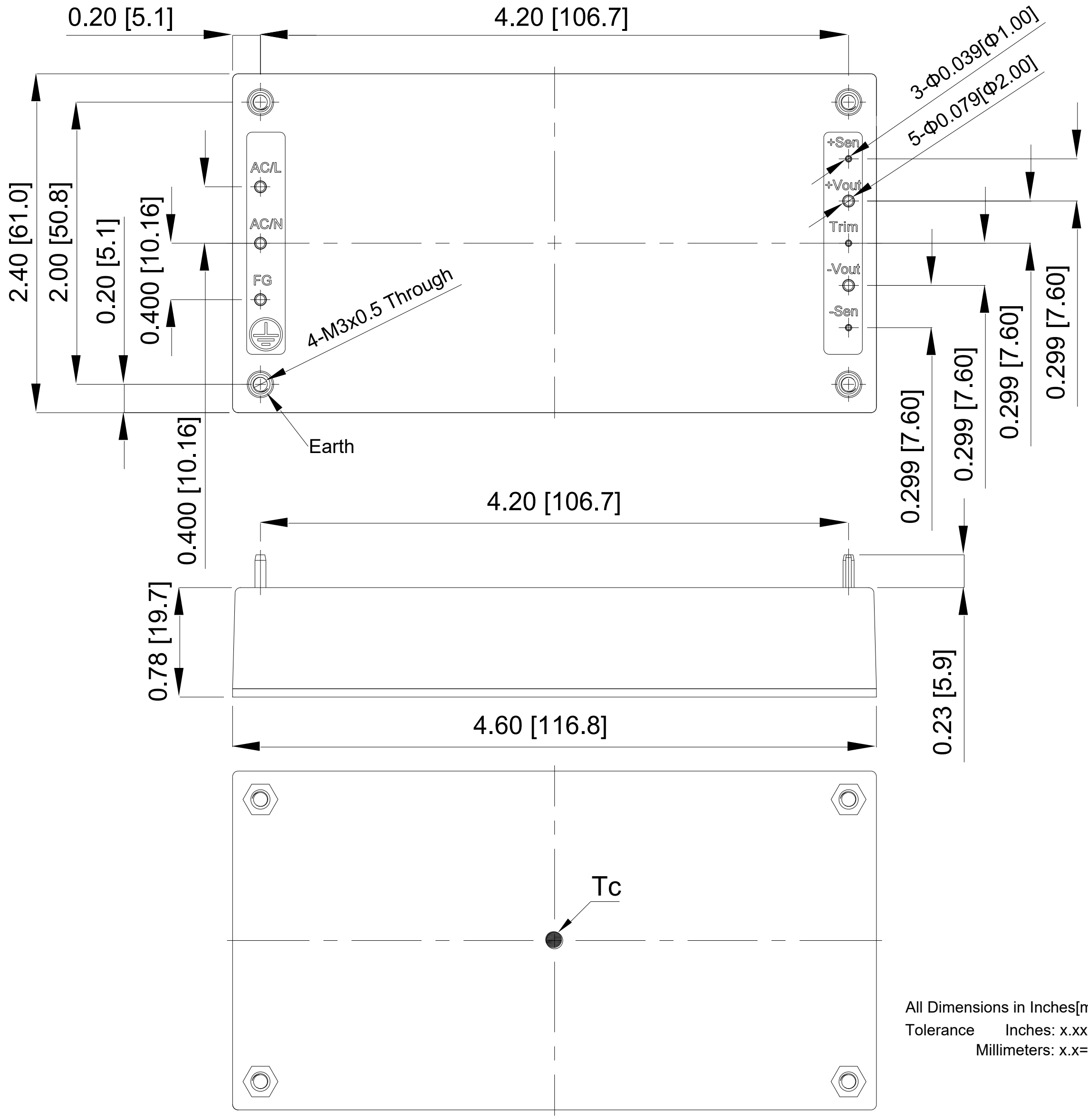
CBM150S480 (Eff Vs Io)



CBM150S540 (Eff Vs Io)



MECHANICAL SPECIFICATION



All Dimensions in Inches[mm]

Tolerance Inches: x.xx=±0.02, x .xxx=±0.020

Millimeters: x.x=±0.5, x.xx=±0.50

AC-DC Switching Brick Power Module
CBM150S Series
Application Note

Email: sales@powersolve.com.tw Web: www.powersolve.com.tw

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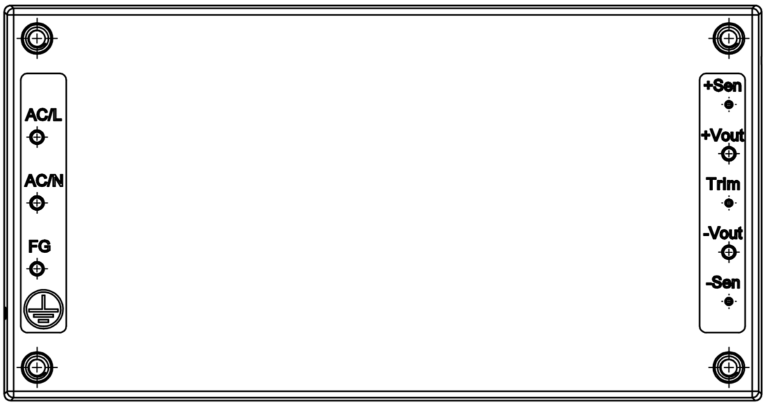
1. Introduction

This application note describes the features and functions of the CBM150S series, switching AC-DC brick power module. The CBM150S 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. Our world class automated manufacturing methods, together with an extensive testing and qualification program, ensure that the CBM150S series brick power module is extremely reliable.

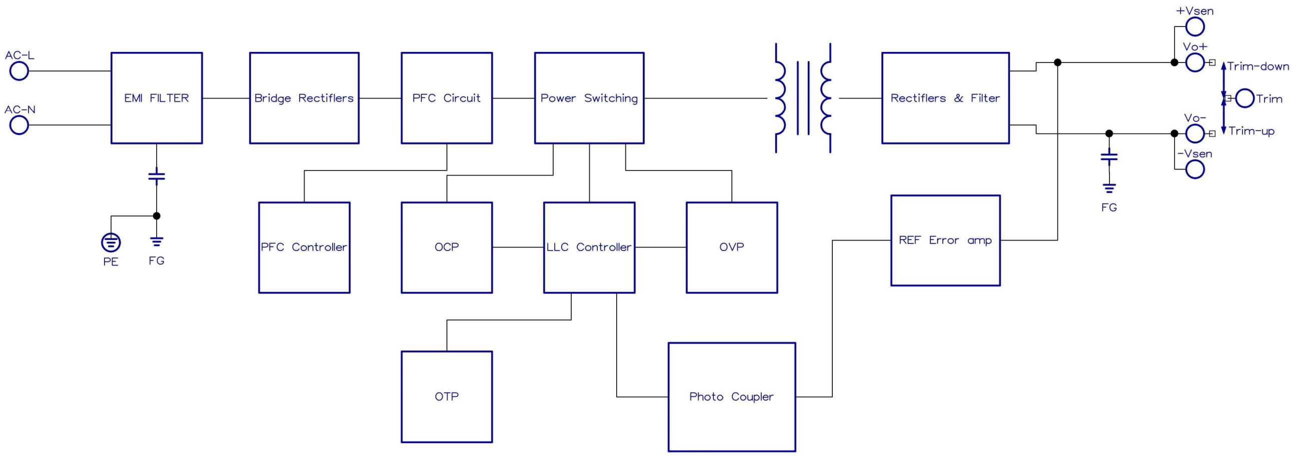
2. Pin Function Description



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



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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 CBM150S 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.

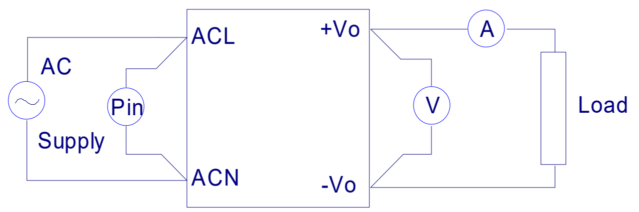


Figure 1. CBM150S Series Test Setup

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, 12V-48V will go into hiccup mode protection, but 54V 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.

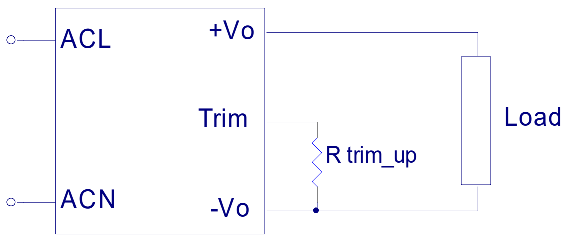
5.4 Output Voltage Adjustment

Output may be externally trimmed (-5% to +5%) with a fixed resistor. Po≦max. rated power, I_o≦I_{o_max}..

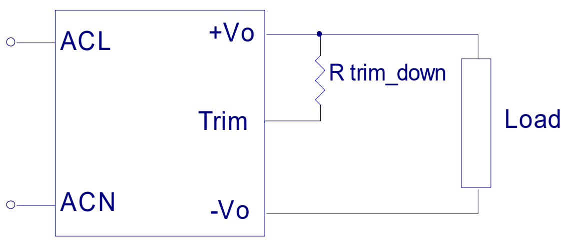
Trim up/down is extra features，changing the output voltage will cause some electrical properties to be substandard.

EX:

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)
CBM150S120	12.0	11.5	7.87	5.1	1	2.5
CBM150S240	24.0	36	7.87	5.1	1	2.5
CBM150S280	28.0	47	4.99	5.1	1	2.5
CBM150S360	36.0	53.6	14.7	5.1	1	2.5
CBM150S480	48.0	82.5	10	5.1	1	2.5
CBM150S540	54.0	100	4.75	5.1	1	2.5

For example, to trim-up the output voltage of 12V module (CBM150S120) by 5% to 12.6V, R_{Trim_up} is calculated as follows:

R1=11.5KΩ, R2=7.87KΩ, R3=5.1KΩ, Rt=1KΩ, Vr=2.5V, Vo=12.6V

$$R_{Trim\_up} = \frac{2.5 * (11.5 + 7.87) * 5.1}{12.6 * 5.1 - 2.5 * (11.5 + 7.87) - 2.5 * 5.1} - 1$$

$$= 79.05\ (K\Omega)$$

The typical value of R_{Trim_up}

Trim up (%)	12V	24V	28V	36V	48V	54V
	R_{Trim_up} (KΩ)					
1%	386.7	465.51	440.03	448.81	362.11	377.45
2%	196.73	229.85	225.16	229.87	206.05	211.57
3%	131.71	152.37	151.07	154.28	143.82	146.79
4%	98.87	113.83	113.55	115.98	110.35	112.27
5%	79.05	90.77	90.87	92.84	89.44	90.82

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.

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)
CBM150S120	12.0	11.5	7.87	5.1	1	2.5
CBM150S240	24.0	36	7.87	5.1	1	2.5
CBM150S280	28.0	47	4.99	5.1	1	2.5
CBM150S360	36.0	53.6	14.7	5.1	1	2.5
CBM150S480	48.0	82.5	10	5.1	1	2.5
CBM150S540	54.0	100	4.75	5.1	1	2.5

For example: to trim-down the output voltage of 12V module (CBM150S120) by 5% to 11.4V, R_{Trim_down} is calculated as follows:

R1=11.5KΩ, R2=7.87KΩ, R3=5.1KΩ, Rt=1KΩ, Vr=2.5V, Vo=11.4V

$$R_{Trim\_down} = \frac{11.4 * 5.1 * (11.5 + 7.87) - 2.5 * 5.1 * (11.5 + 7.87)}{2.5 * (11.5 + 7.87) - (11.4 * 5.1) + (2.5 * 5.1)} - 1$$

$$= 288.69\ (K\Omega)$$

The typical value of R_{Trim_down}

Trim down (%)	12V	24V	28V	36V	48V	54V
	R_{Trim_down} (KΩ)					
1%	1577.57	3807.37	4941.39	6648.57	12886.3	13755.5
2%	761.94	1900.72	2376.86	3195.6	5128.82	5690.03
3%	497.57	1256.58	1552.47	2087.18	3175.24	3558.12
4%	366.75	932.87	1145.77	1540.62	2285.35	2572.84
5%	288.69	738.11	903.47	1215.09	1776.31	2005.17

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.

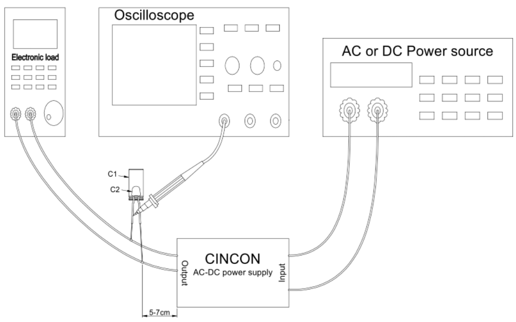


Figure 2. Output Voltage Ripple and Noise Measurement Set-Up

7. Thermal Design

7.1 Operating Temperature Range

The highly efficient design of the CBM150S 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

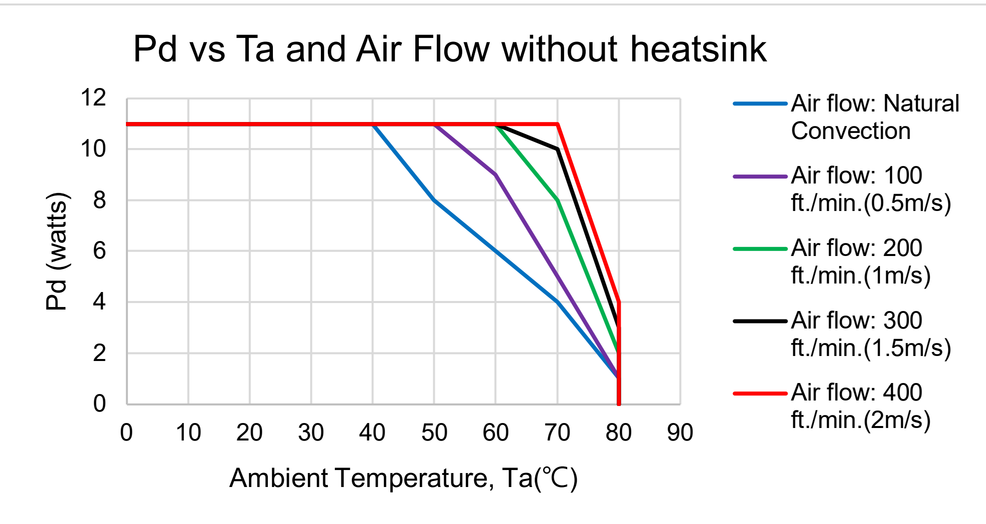
The brick power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. The example is presented in **section 7.4**. The 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 CBM150S series is -40℃ to +90℃ (T_c). When operating the CBM150S series, proper derating or cooling is needed (at 115V_{ac}). The maximum case temperature under any operating condition should not exceed 90℃ (T_c).

The following curve is the derating curve of CBM150S series without heatsink.

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



AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection	4.1 ℃/W
100 ft./min. (0.5m/s)	2.9 ℃/W
200 ft./min. (1.0m/s)	2.1 ℃/W
300 ft./min. (1.5m/s)	1.7 ℃/W
400 ft./min. (2.0m/s)	1.3 ℃/W

Example without heatsink:

What is the minimum airflow necessary for a CBM150S120 operating at 115V_{ac}, an output current of 8.33A, and a maximum ambient temperature of 50℃ without heatsink?

Solution:

Given: V_{in}=115V_{ac}, V_o=12V_{dc}, I_o=8.33A

Determine Power dissipation (P_d): P_d= P_i-P_o=P_o(1-η)/η, P_d=12V×8.33A×(1-0.895)/0.895=11.73Watts

Determine airflow: Given: P_d=11.73W and T_a=40℃

Check *Power Derating* curve: Minimum airflow= Natural Convection.

Verify:

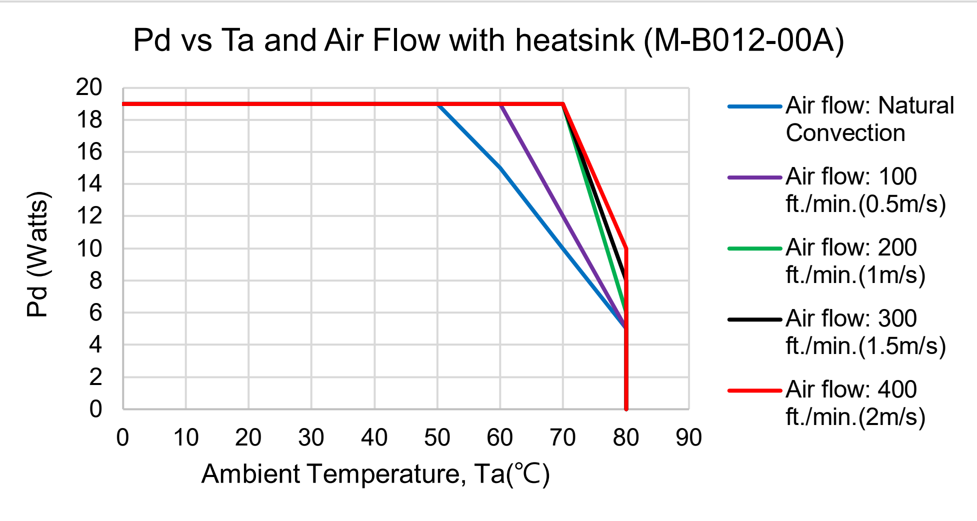
Maximum temperature rise is $\Delta T=P_d \times R_{ca}$=11.73×4.1=48.093℃

Maximum case temperature is $T_c=T_a+\Delta T$=88.093℃<90℃

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	1.88 ℃/W
100 ft./min. (0.5m/s)	1.45 ℃/W
200 ft./min. (1.0m/s)	1.04 ℃/W
300 ft./min. (1.5m/s)	0.84 ℃/W
400 ft./min. (2.0m/s)	0.73 ℃/W

Example with heatsink M-B012-00A**:**

What is the minimum airflow necessary for a CBM150S120 operating at 115V_{ac}, an output current of 12.5A, and a maximum ambient temperature of 60℃ with heatsink M-B012-00A.

Solution:

Given: V_{in}=115V_{ac}, V_o=12V_{dc}, I_o=12.5A

Determine Power dissipation (P_d): P_d=Pi-Po=Po(1-η)/η, P_d=12V×12.5A×(1-0.895)/0.895=17.60Watts

Determine airflow: Given: P_d=17.60W and T_a=50℃

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

Verify:

Maximum temperature rise is $\Delta T=P_d \times R_{ca}$=17.60×1.88=33.088℃

Maximum case temperature is T_c= $T_a+\Delta T$=83.088℃<90℃

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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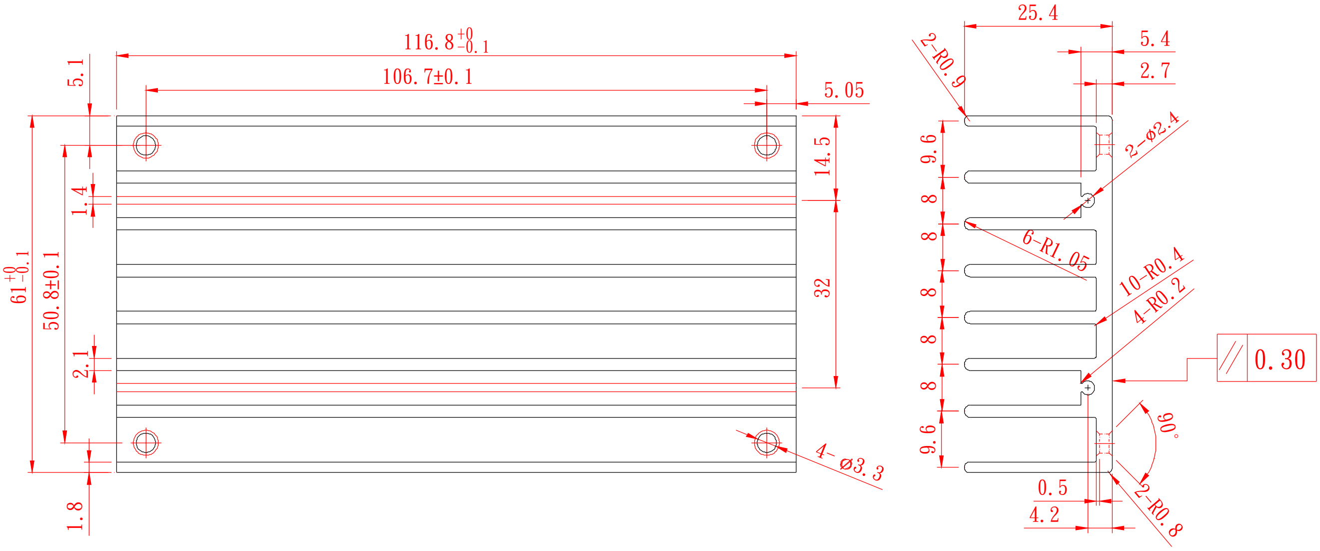
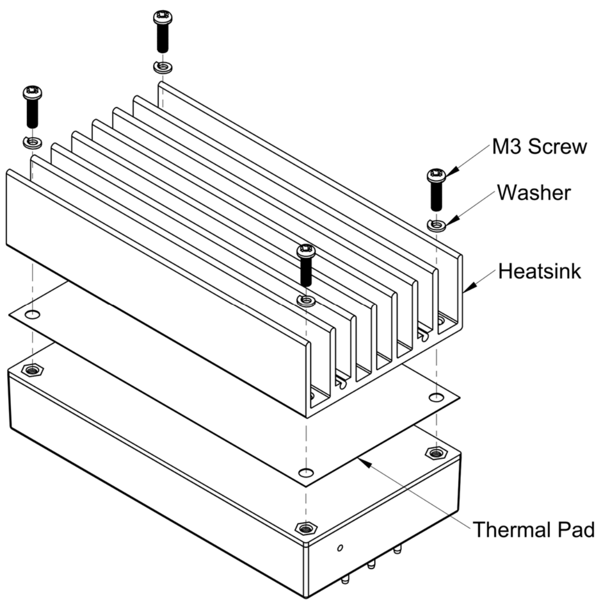
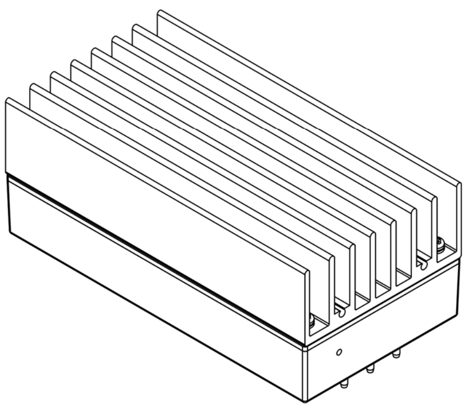
7.5 Full Brick Heat Sinks



All Dimensions in mm
Heat Sink: 116.8*61*25.4mm (M-B012-00A, G6620090204)
Rca: 1.88 ℃/W (typ.), At natural convection
1.45 ℃/W (typ.), At 100LFM
1.04 ℃/W (typ.), At 200LFM
0.84 ℃/W (typ.), At 300LFM
0.73 ℃/W (typ.), At 400LFM

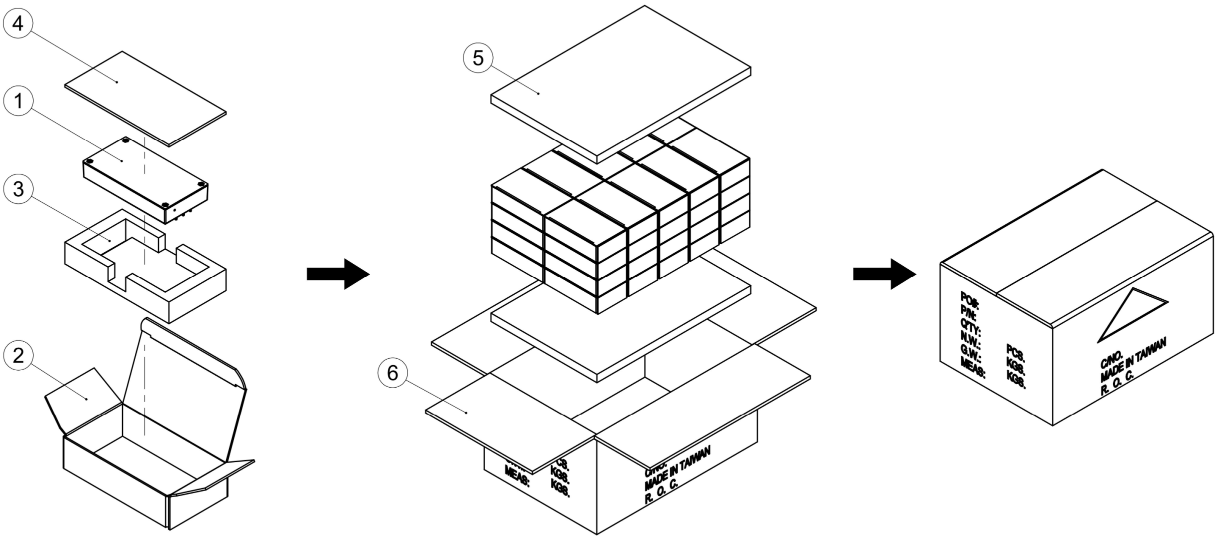




Heat Sink: 116.8*61*25.4mm (M-B012-00A, G6620090204)
Thermal pad: SR60*115.8*0.23 (G6135041073)
Screw SMP+SW M3*8L (G75A1300322)

8. Packing Information

The packing information for CBM150S SERIES is showing as follows:



ITEM	PART NO.	NAME	OUTSIDE DIM	PCS
1	G98~	CBM150S Product	116.8*61*19.7mm	40
2	G64205299	Inner Box	150*85*40mm	40
3	G64301118	Antistatic Foam	147*81*26.6mm	40
4	G64301223	Antistatic Foam	147*81*3mm	40
5	G64303228	Foam	435*300*20mm	2
6	G64112340	No. 67 Cardboard Box	454.5*318.2*230.3mm	1

Each Box Packaging 40 PCS Products
Gross weight Ref. 14.6 Kg

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