

100W DC-DC Half-Brick Regulated Single Output Converter

MHB100 series



■ Features :

- Half-brick size (2.28"X2.4"X0.5") with industry standard pin out
- 2:1 wide input range
- Protections: Short circuit / Over current / Over voltage / Over temperature
- High efficiency up to 89%
- 1500VDC I/O isolation
- Built-in remote ON/OFF control
- Built-in remote sense function
- Trimming output $\pm 10\%$
- Five-sided shield metal case
- Optional heat sinks for extended operating temperature
- Output 2.5V/3.3V/15V available
- Approvals: UL / CUL / CE
- 3 years warranty



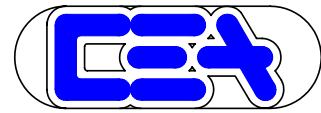
SPECIFICATION

| MODEL | MHB100-24S05 | MHB100-24S12 | MHB100-24S24 | MHB100-48S05 | MHB100-48S12 | MHB100-48S24 | | |
|---------------------------------|--|---|--------------|--------------|--------------------------------------|--------------|-----------|--------|
| OUTPUT | DC VOLTAGE | 5V | 12V | 24V | 5V | 12V | 24V | |
| | CURRENT RANGE | 0 ~ 20A | 0 ~ 8.3A | 0 ~ 4.17A | 0 ~ 20A | 0 ~ 8.3A | 0 ~ 4.17A | |
| | RATED POWER | 100W | | | | | | |
| | RIPPLE & NOISE (max.) Note.2 | 100mVp-p | 150mVp-p | 240mVp-p | 100mVp-p | 150mVp-p | 240mVp-p | |
| | VOLTAGE ACCURACY Note.3 | $\pm 1.0\%$ | | | | | | |
| | LINE REGULATION | $\pm 0.2\%$ | | | | | | |
| | LOAD REGULATION | $\pm 0.2\%$ | | | | | | |
| | SWITCHING FREQUENCY (Typ.) | 500KHz | | | | | | |
| | EXTERNAL TRIM ADJ. RANGE (Typ.) | $\pm 10\%$ | | | | | | |
| EXTERNAL CAPACITIVE LOAD (max.) | 20000uF | 8300uF | 4170uF | 20000uF | 8300uF | 4170uF | | |
| INPUT | RATED DC INPUT | 24VDC | | | 48VDC | | | |
| | VOLTAGE RANGE | 18 ~ 36VDC | | | 36 ~ 75VDC | | | |
| | SURGE VOLTAGE (100ms max.) | 50VDC | | | 100VDC | | | |
| | UNDER VOLTAGE LOCKOUT | Power up: 17VDC, Power down: 16VDC | | | Power up: 34VDC, Power down: 32.5VDC | | | |
| | EFFICIENCY (Typ.) | 84% | 87% | 87% | 86% | 89% | 88% | |
| | DC CURRENT | FULL LOAD | 502mA | 4880mA | 4905mA | 2480mA | 2445mA | 2465mA |
| | | NO LOAD | 50mA | | | 50mA | | |
| FILTER | Pi-network | | | | | | | |
| PROTECTION | OUTPUT OVER CURRENT | 110 ~ 140% rated output power Protection type : Over current limiting, recovers automatically after fault condition is removed | | | | | | |
| | OUTPUT OVER VOLTAGE (Typ.) | 115 ~ 140% rated output voltage Protection type : Output voltage clamp | | | | | | |
| | OUTPUT SHORT CIRCUIT | Protection type : Can be continuous, recovers automatically after fault condition is removed | | | | | | |
| | OVER TEMPERATURE | 100°C $\pm 5^\circ\text{C}$ of case temperature | | | | | | |
| FUNCTION OPERATING | REMOTE CONTROL | Please refer to "Remote ON/OFF Control" for details | | | | | | |
| | OUTPUT TRIMMING | $\pm 10\%$, Please refer to "External Output Trimming" for details | | | | | | |
| ENVIRONMENT | WORKING TEMPERATURE (Typ.) | -40 ~ +100°C ; Thermal shutdown at 100°C $\pm 5^\circ\text{C}$ of case temperature (please refer to "Thermal Curve") | | | | | | |
| | WORKING HUMIDITY | 0% ~ 95% RH max. | | | | | | |
| | STORAGE TEMP., HUMIDITY | -55 ~ +105°C, 0 ~ 95% RH | | | | | | |
| | TEMP. COEFFICIENT | $\pm 0.03\%/^\circ\text{C}$ (0~60°C) | | | | | | |
| SAFETY & EMC (Note 4) | SAFETY STANDARDS | UL60950-1 approved | | | | | | |
| | ISOLATION VOLTAGE | I/P-O/P:1500VDC, I/P-Case:1500VDC, O/P-Case:1500VDC | | | | | | |
| | ISOLATION RESISTANCE | I/P-O/P:100M Ohms / 500VDC / 25°C / 70% RH | | | | | | |
| | EMC EMISSION | Compliance to EN55032 (CISPR32) Class A with external components (please refer to "EMC Suggestion Circuit") | | | | | | |
| OTHERS | EMC IMMUNITY | Compliance to EN61000-4-2,3,4,5,6,8; EN55024, light industry level, criteria A | | | | | | |
| | CASE MATERIAL | Aluminum | | | | | | |
| | MTBF | 900K hrs typ. MIL-HDBK-217F (25°C) | | | | | | |
| | DIMENSION | 57.9*61*12.7mm (2.28"*2.40"*0.5") (L*W*H) | | | | | | |
| WEIGHT | 95g | | | | | | | |
| NOTE | <ol style="list-style-type: none"> 1. All parameters NOT specially mentioned are measured at 24,48VDC input, rated load and 25°C of ambient temperature. 2. Ripple & noise are measured at 20MHz of bandwidth by using a 12" twisted pair-wire terminated with a 1uf ceramic & 10uf tantalum capacitor across output. 3. The power supply need to connect "+Vout" to "+R.S" and "-Vout" to "-R.S". 4. The power supply is considered a component which will be installed into a final equipment. The final equipment must be re-confirmed that it still meets EMC directives. For guidance on how to perform these EMC tests, please refer to "EMI testing of component power supplies." | | | | | | | |

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Note: all features are subject to change without notice.



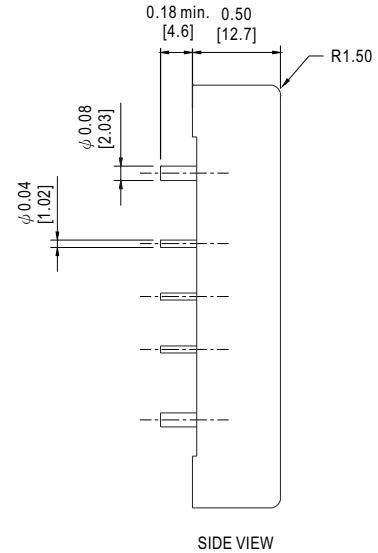
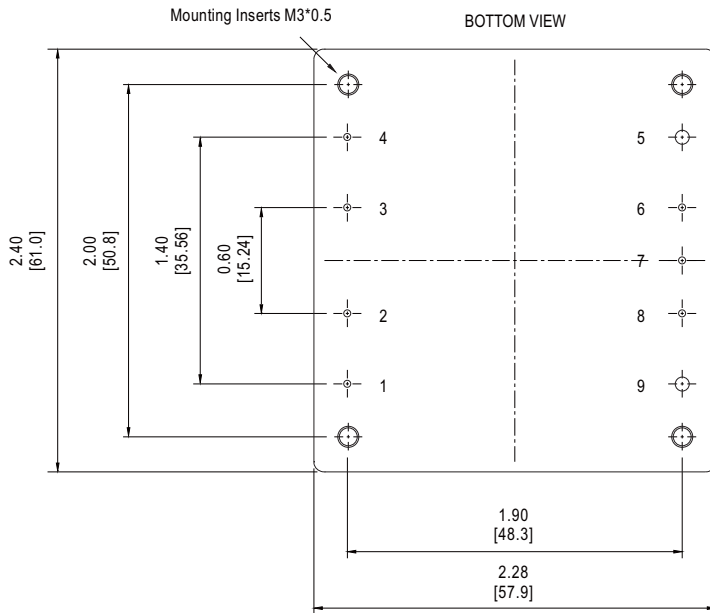
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Mechanical Specification

Unit:inch[mm]

All Dimensions In Inches [mm]
 Tolerance Inches: X.XX= ±0.02 , X.XXX= ±0.010
 Millimeters: X.X= ±0.5 , X.XX=±0.25



Pin No. Assignment

| Pin No. | Assignment | Pin No. | Assignment | Pin No. | Assignment |
|---------|------------|---------|------------|---------|------------|
| 1 | +Vin | 4 | -Vin | 7 | Trim |
| 2 | R.C. | 5 | -Vout | 8 | +R.S. |
| 3 | Case | 6 | -R.S. | 9 | +Vout |

Remote ON/OFF Control

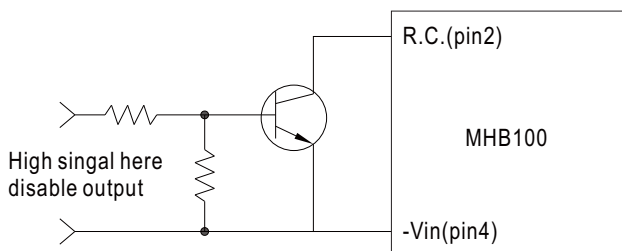
The MHB100 series allow the user to switch the power ON and OFF electronically by their remote ON/OFF feature. The MHB100 series are available with "Positive Logic" (standard) or "Negative Logic" (option).

Logic table

| Logic State(pin2) | Positive logic | Negative logic |
|-------------------------|------------------------|-------------------------|
| Logic Low-Switch Closed | Power OFF(<0.8Vdc) | Power ON(<0.8Vdc) |
| Logic High-Switch Open | Power ON(Open circuit) | Power OFF(Open circuit) |

Note: 1.Logic compatibility : R.C.(pin2) ~ -Vin(pin4).

2.Suffix "N" to the model number with Negative logic remote ON/OFF.

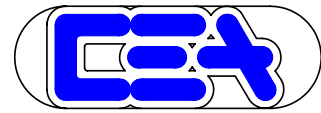


Example control circuit(positive logic)

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■ External Output Trimming

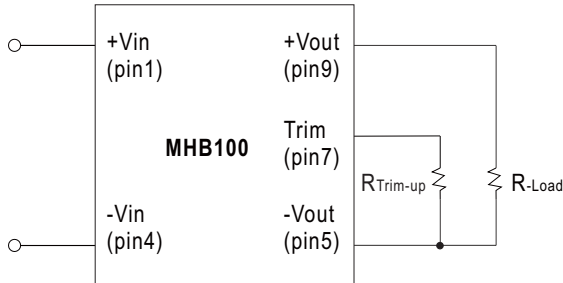


Figure 1 : Trim-up voltage setup

The value of $R_{Trim-up}$ defined as:

$$R_{Trim-up} = \frac{(R1-R2 \times (V_o - V_{o, nom}))}{(V_o - V_{o, nom})} \text{ (K}\Omega\text{)}$$

Where: $R_{Trim-up}$ is the external resistor in Kohm.

$V_{o, nom}$ is the nominal output voltage.

V_o is the desired output voltage.

$R1$ and $R2$ are inside the unit and list in Table 1

| Output Voltage(V) | R1 (Kohm) | R2 (Kohm) |
|-------------------|-----------|-----------|
| 5V | 5.8 | 3.3 |
| 12V | 18.945 | 4.636 |
| 24V | 41.442 | 6.977 |

Table 1

For example, to Trim-up the output voltage of 5.0V model (MHB100-48S05)

by 8% to 5.4V, $R_{Trim-up}$ is calculated

as follows:

$$V_o - V_{o, nom} = 5.4 - 5.0 = 0.4V$$

$$R1 = 5.8 \text{ Kohm}$$

$$R2 = 3.3 \text{ Kohm}$$

$$R_{Trim-up} = \frac{5.8 - 3.3 \times 0.4}{0.4} = 11.2 \text{ (K}\Omega\text{)}$$

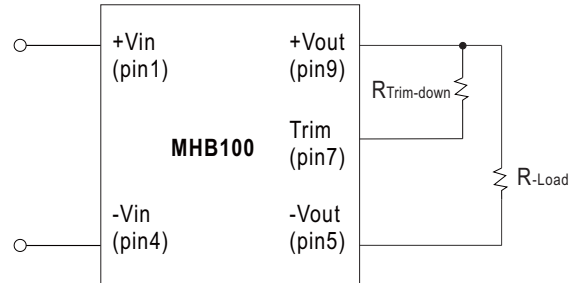


Figure 2 : Trim-down voltage setup

The value of $R_{Trim-down}$ defined as:

$$R_{Trim-down} = \frac{(R1 - R2 \times (V_o, nom - V_o))}{(V_o, nom - V_o)} \text{ (K}\Omega\text{)}$$

Where: $R_{Trim-down}$ is the external resistor in Kohm.

$V_{o, nom}$ is the nominal output voltage.

V_o is the desired output voltage.

$R1$ and $R2$ are inside the unit and list in Table 2.

| Output Voltage(V) | R1 (Kohm) | R2 (Kohm) |
|-------------------|-----------|-----------|
| 5V | 5.8 | 5.32 |
| 12V | 86.45 | 60.1 |
| 24V | 430 | 120 |

Table 2

For example, to Trim-down the output

Voltage of 5.0V model (MHB100-48S05)

by 8% to 4.6V, $R_{Trim-down}$ is

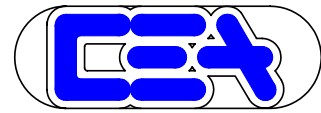
calculated as follows :

$$V_{o, nom} - V_o = 5.0 - 4.6 = 0.4V$$

$$R1 = 5.8 \text{ Kohm}$$

$$R2 = 5.32 \text{ Kohm}$$

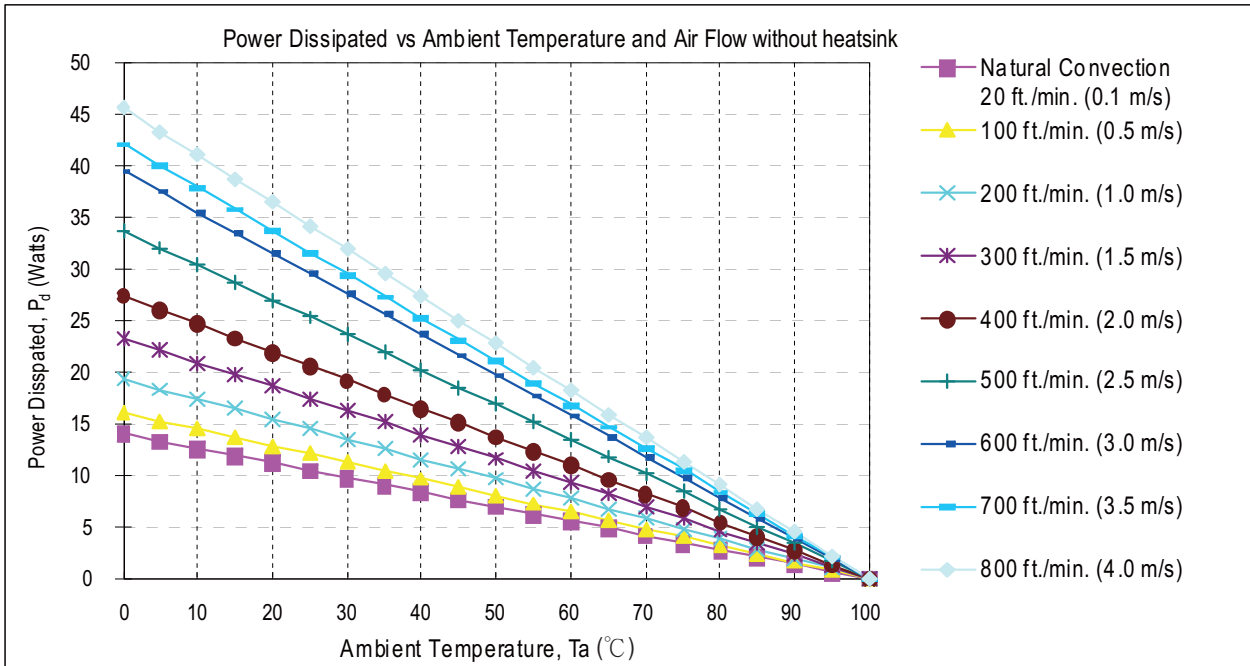
$$R_{Trim-down} = \frac{5.8 - 5.32 \times 0.4}{0.4} = 9.18 \text{ (K}\Omega\text{)}$$



Thermal Curve

The operating case temperature range of MHB-100 series is -40°C to +100°C. When operate the MHB-100 series, proper de-rating or cooling is needed.

The maximum case temperature under any operating condition should not be exceed 100°C. The following curve is the de-rating curve of MHB-100 series without heat sink.



| Air Flow Rate | Typical Rca | Air Flow Rate | Typical Rca |
|---|-------------|-----------------------|-------------|
| Natural convection 20ft./min. (0.1m/s) | 7.12°C/W | 500 ft./min. (2.5m/s) | 2.96°C/W |
| 100 ft./min. (0.5m/s) | 6.21°C/W | 600 ft./min. (3.0m/s) | 2.53°C/W |
| 200 ft./min. (1.0m/s) | 5.17°C/W | 700 ft./min. (3.5m/s) | 2.37°C/W |
| 300 ft./min. (1.5m/s) | 4.29°C/W | 800 ft./min. (4.0m/s) | 2.19°C/W |
| 400 ft./min. (2.0m/s) | 3.64°C/W | | |

Rca : Thermal resistance from case to ambience

Example:

What is the minimum airflow necessary for a MHB100-48S12 operates at nominal line, an output current of 8.3A, and a maximum ambient temperature of 40°C?

Solution:

Given: Vin=48Vdc, Vo=12Vdc, Io=8.3A, η (unit efficiency)=89%

Determine Power dissipation (Pd):

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

$$P_d = 12 \times 8.3 \times (1 - 0.89) / 0.89 = 12.31 \text{ Watts}$$

Determine airflow:

Given: Pd=12.31W and Ta=40°C

Check Thermal Curve above:

minimum airflow= 300 ft./min.

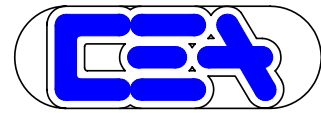
Verifying: The maximum temperature rise $\Delta T = P_d \times R_{ca} = 12.31 \times 4.29 = 52.8^\circ\text{C}$

The maximum case temperature $T_c = T_a + \Delta T = 92.8^\circ\text{C} < 100^\circ\text{C}$

Where: The Rca is thermal resistance from case to ambience.

The Ta is ambient temperature and the Tc is case temperature.





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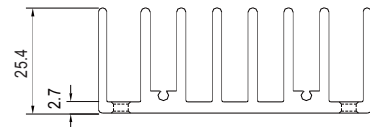
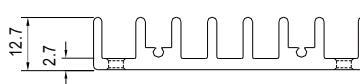
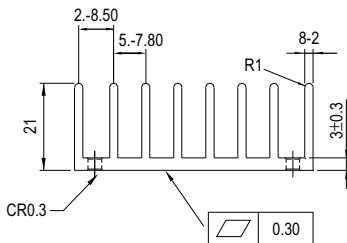
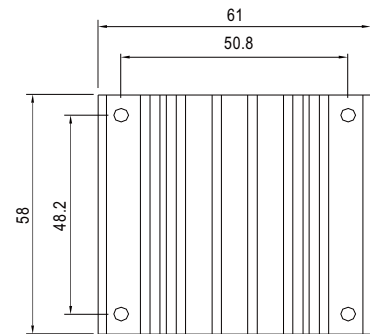
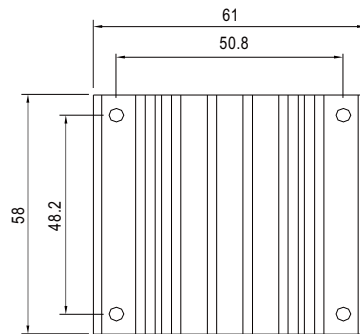
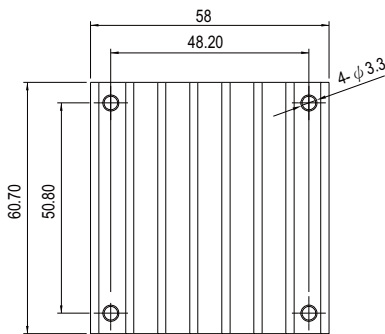
■ Case Heat Sink (Optional)

Unit:mm

Model No.: M-C308 (Vertical Fins)

Model No.: M-C091(Horizontal Fins)

Model No.: M-C092 (Horizontal Fins)



Rca:

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

Rca:

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

Rca:

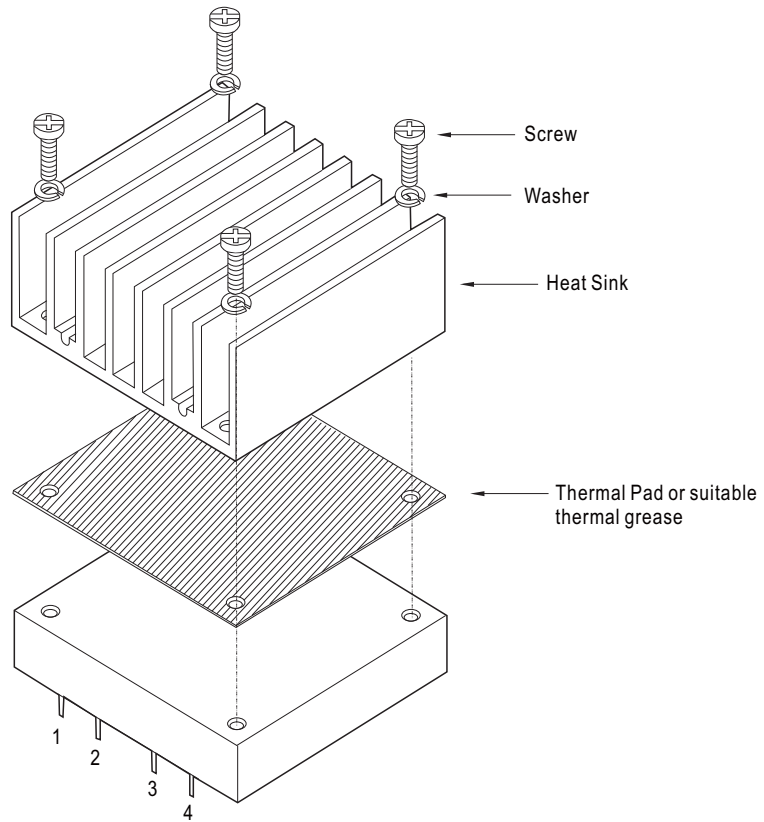
- 3.00°C / W (typ.), at natural convection
- 1.44°C / W (typ.), at 100ft./min.(LFM)
- 1.17°C / W (typ.), at 200ft./min.(LFM)
- 1.04°C / W (typ.), at 300ft./min.(LFM)
- 0.95°C / W (typ.), at 400ft./min.(LFM)

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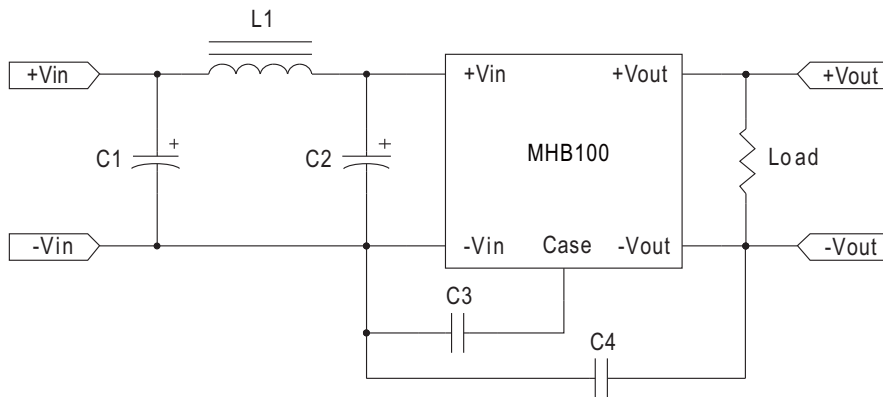
■ Heatsink Assembly



Heat Sink Order No.:
 M-C308
 M-C091
 M-C092
 Thermal Pad: 56.9x60x0.25mm
 Screw: SMP+SW M3x8L

■ EMC Suggestion Circuit

※Required external components to meet EN55022 class A conducted emission are as below:



| Model No. | C1 | C2 | C3 | C4 | L1 |
|-------------|------------------------|------------------------|--------|--------|-------|
| MHB100-24S□ | 220uF/50V ESR<0.13Ω | 220uF/50V ESR<0.13Ω | 2200pF | N.C | 3.4uH |
| MHB100-48S□ | 47uF/100V ESR<0.17Ω | 47uF/100V ESR<0.17Ω | 1000pF | 1000pF | 3.4uH |

□ =05,12,24