# 60W Quarter Brick 14~160Vdc Ultra-wide Input Railway DC-DC Converter RQB60W12 series



(Bottom View)

UL62368-1 IEC62368-1

Railway Automate Industrial Security Network Telecom

## Features

- Quarter-brick(2.28" x 1.45" x 0.5") with industrial standard pin-out
- Compliance with railway standard EN50155, design meet EN45545-2
- 12:1(14~160Vdc) ultra-wide input range
- Wide operating temperature range -40 ~ +90℃
- No minimum load required
- Full encapsulated
- Protections: Short circuit (Continuous) / Overload / Over temperature / Over voltage / Input under voltage
- 3KVDC or 2KVAC I/O isolation
- Remote ON/OFF control and remote sense
- Triming output(±10%)
- 3 years warranty

## Applications

- Bus, tram, metro or railway system
- Telecom/datacom system
- Wireless network
- Industrial control facility
- Instrument
- Analyzer
- Highly vibrating, heavily dusty, exteremely low or high temperature harsh environment

## GTIN CODE

MW Search: https://www.meanwell.com/serviceGTIN.aspx

## Description

RQB60W12 series is 60W module type DC-DC reliable railway with quarter brick package. It features international standard pins, a high efficiency up to 91.5%, wide working temperature range -40~+90℃, 3KVDC or 2KVAC I/P-O/P isolation voltage, compliance with EN50155, meet to EN45545-2 with external circuits, continuous-mode short circuit protection, etc. The models input for 14~160VDC 12:1 ultra-wide input range, and various output voltage, 5V/12V/24V/48V/54V for single output, which are suitable for railway, trams, buses and also can be used in the harsh environment with high vibration, high dust, extremely low or high temperature, etc.

## Model Encoding

**RQB 60 W12 – 110 S 05**

- 05 — Output voltage (5/12/24/48/54Vdc)
- S — Single output
- 110 — Nominal input voltage (110Vdc)
- W12 — 12:1 Ultra wide input voltage (14~160Vdc)
- 60 — Rated wattage
- RQB — Series name

## MODEL SELECTION TABLE

| ORDER NO. | INPUT | | | OUTPUT | | EFFICIENCY (Typ.) | CAPACITOR LOAD (MAX.) |
|---|---|---|---|---|---|---|---|
| | INPUT VOLTAGE (RANGE) | INPUT CURRENT | | OUTPUT VOLTAGE | OUTPUT CURRENT | | |
| | | NO LOAD | FULL LOAD | | | | |
| RQB60W12-110S05 | Nominal 24V,36V,48V,72V,96V,110V (14 ~ 160V) | 15mA | 610mA | 5V | 12A | 89% | 20000μF |
| RQB60W12-110S12 | | 15mA | 610mA | 12V | 5A | 90% | 3300μF |
| RQB60W12-110S24 | | 15mA | 610mA | 24V | 2.5A | 89% | 1200μF |
| RQB60W12-110S48 | | 15mA | 610mA | 48V | 1.25A | 90% | 390μF |
| RQB60W12-110S54 | | 15mA | 610mA | 54V | 1.111A | 91.5% | 330μF |

| SPECIFICATION | | | | |
|---|---|---|---|---|
| INPUT | VOLTAGE RANGE | 14 ~ 160Vdc | | |
| | SURGE VOLTAGE (1s max.) | 200Vdc | | |
| | FILTER | Pi type | | |
| | PROTECTION | 10A fast acting fuse | | |
| | SETUP TIME | 40ms(100% Load at Nominal Vin) | | |
| OUTPUT | VOLTAGE ACCURACY | ±1.0% | | |
| | RATED POWER | 60W | | |
| | RIPPLE & NOISE Note.2 | 150mVp-p | | |
| | LINE REGULATION Note.3 | ±0.2% | | |
| | LOAD REGULATION Note.4 | ±0.2% | | |
| | SWITCHING FREQUENCY (Typ.) | 250KHz | | |
| | EXTERNAL TRIM ADJ. RANGE (Typ.) | ±10% | | |
| | HOLD UP TIME | Please refer to page 5 & 6 Hold up time | | |
| PROTECTION | SHORT CIRCUIT | Protection type : Continuous, automatic recovery | | |
| | OVERLOAD | 110 ~ 180% rated output power | | |
| | | Protection type : Recovers automatically after fault condition is removed | | |
| | OVER VOLTAGE | Protection type : Clamp by zener diode | | |
| | OVER TEMPERATURE | +115℃ thermal shutdown, recovers automatically after fault condition is removed | | |
| | UNDER VOLTAGE LOCKOUT (Table 3) | Start-up voltage | 13.6V | |
| | | Shutdown voltage | 12.7V | |
| FUNCTION | REMOTE CONTROL | Power ON: R.C ~ -Vin > 3 ~ 12Vdc or open circuit<br>Power OFF: R.C ~ -Vin < 1.2Vdc or short | | |
| ENVIRONMENT | COOLING | Free-air convection | | |
| | WORKING TEMP. | -40 ~ +90℃ (Refer to "Derating Curve") | | |
| | CASE TEMPERATURE | +105℃ max. | | |
| | WORKING HUMIDITY | 5% ~ 90% RH non-condensing | | |
| | STORAGE TEMP., HUMIDITY | -55 ~ +125℃, 10 ~ 95% RH non-condensing | | |
| | TEMP. COEFFICIENT | 0.05% / ℃ (0 ~ 65℃) | | |
| | SOLDERING TEMPERATURE | 1.5mm from case of 3 ~ 5sec./260℃ max. | | |
| | VIBRATION | EN61373 | | |
| | OPERATING ALTITUDE | 3000 meters | | |
| SAFETY & EMC (Note.6) | SAFETY STANDARDS | CB IEC62368-1, UL62368-1, EAC TP TC 020/2011 approved | | |
| | WITHSTAND VOLTAGE | I/P-O/P:3KVDC or 2KVAC | | |
| | ISOLATION RESISTANCE | I/P-O/P:1000M Ohms / 500VDC / 25℃/ 70% RH non-condensing | | |
| | ISOLATION CAPACITANCE (Typ.) | 1500pF | | |
| | EMC EMISSION | **Parameter** | **Standard** | **Test Level / Note** |
| | | Conducted | BS EN/EN55032 | Class A/B with external components |
| | | Radiated | BS EN/EN55032 | Class A/B with external components |
| | EMC IMMUNITY | **Parameter** | **Standard** | **Test Level / Note** |
| | | ESD | BS EN/EN61000-4-2 | Level 3, ±8KV air, ±6KV contact |
| | | Radiated Susceptibility | BS EN/EN61000-4-3 | Level 3, 10V/m |
| | | EFT/Bursts(Note.5) | BS EN/EN61000-4-4 | Level 3, On power input port, ±2KV external input capacitor required |
| | | Surge(Note.5) | BS EN/EN61000-4-5 | Level 3, On power input port, ±2KV external input capacitor required |
| | | Conducted | BS EN/EN61000-4-6 | Level 3, 10V/m |
| | | Magnetic Field | BS EN/EN61000-4-8 | Level 3, 10V/m |
| | RAILWAY STANDARD | EN50155 / IEC60571 including EN61373 for shock & vibration, EN50121-3-2 for EMC; Meet to EN45545-2 | | |
| OTHERS | MTBF | 205Khrs MIL-HDBK-217F(25℃) | | |
| | DIMENSION (L*W*H) | **57.9*36.8*12.7mm (2.28*1.45*0.5 inch)** | | |
| | CASE MATERIAL | Aluminum base plate with plastic case | | |
| | PACKING | 68g ; 11pcs/per tube, 132pcs/12 tube/per carton | | |
| NOTE | 1.All parameters are specified at normal input(110Vdc), rated load, 25℃ 70% RH ambient.<br>2.Ripple & noise are measured at 20MHz by using a 12" twisted pair terminated with a 0.1μf & 47μf capacitor.<br>3.Line regulation is measured from low line to high line at rated load.<br>4.Load regulation is measured from 0% to 100% rated load.<br>5.External input capacitor required 330μF/220V.<br>6.The final equipment must be re-confirm that it still meet EMC directives. For guidance on how to perform these EMC tests, please refer to "EMI testing of component power supplies."(as available on http://www.meanwell.com)<br>※ Product Liability Disclaimer : For detailed information, please refer to https://www.meanwell.com/serviceDisclaimer.aspx | | | |

## External Output Trimming

In order to trim the voltage up or down, one needs to connect the trim resistor either between the trim pin and -Vout for trim_up or between trim pin and +Vout for trim_down. The output voltage trim range is -10% to +10%. This is shown in Figures 1 and 2:

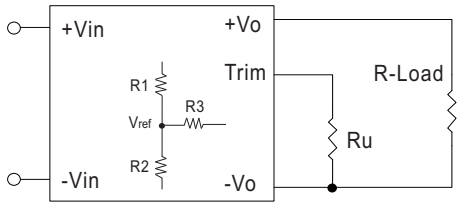



Figure 1. Trim_up Voltage Setup

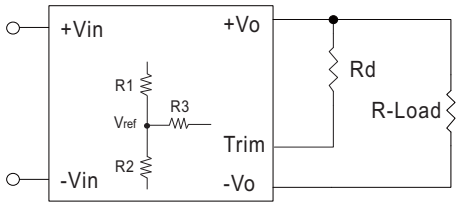



Figure 2. Trim_down Voltage Setup

**1. The value of Rtrim_up defined as:**

$$A = \frac{V_{ref}}{V_o' - V_{ref}} \times R1$$

$$R_{trim\_up} = \frac{AR2}{R2-A} - R3$$

For example, to trim_up the output voltage of 5.0V module (RQB60W12-110S05) by 10% to 5.5V, $R_{trim\_up}$ is calculated as follows:

$V_{o,nom}$ = 5V

$V_o'$ = 5.5V

$V_{ref}$ = 1.25V

R1 = 30.3 KΩ

R2 = 10 KΩ

R3 = 68KΩ

$$A = \frac{V_{ref}}{V_o' - V_{ref}} \times R1$$

$$= \frac{1.25}{5.5 - 1.25} \times 30.3 = 8.911$$

$$R_{trim\_up} = \frac{AR2}{R2-A} - R3$$

$$= \frac{8.911 \times 10}{10 - 8.911} - 68$$

$$= 13.827K\Omega$$

Table 1 – Trim_up and Trim_down Resistor Values

| Model Number | Vo,nom (V) | Vref (V) | R1 (KΩ) | R2 (KΩ) | R3 (KΩ) |
|---|---|---|---|---|---|
| RQB60W12-110S05 | 5 | 1.25 | 30.3 | 10 | 68 |
| RQB60W12-110S12 | 12 | 2.5 | 12.56 | 3.3 | 24.9 |
| RQB60W12-110S24 | 24 | 2.5 | 17.2 | 2 | 15 |
| RQB60W12-110S48 | 48 | 2.5 | 36.4 | 2 | 15.8 |
| RQB60W12-110S54 | 54 | 2.5 | 41.2 | 2 | 15.8 |

Note:

1. $R_{trim\_up}$, $R_{trim\_down}$ is mean trim resistor, please check the formula.
2. A & B: user define parameter, no actual meanings.
3. $V_o'$ is target trim voltage.
4. Value for R1, R2, R3 and Vref refer to above table.

**2. The value of Rtrim_down defined as:**

$$A = \frac{V_o' - V_{ref}}{V_{ref}} \times R2$$

$$R_{trim\_down} = \frac{AR1}{R1-A} - R3$$

For example, to trim_down the output voltage of 5.0V module (RQB60W12-110S05) by 10% to 4.5V, $R_{trim\_down}$ is calculated as follows:

$V_{o,nom}$ = 5V

$V_o'$ = 4.5V

$V_{ref}$ = 1.25V

R1 = 30.3 KΩ

R2 = 10 KΩ

R3 = 68 KΩ

$$A = \frac{V_o' - V_{ref}}{V_{ref}} \times R2$$

$$= \frac{4.5 - 1.25}{1.25} \times 10 = 2.6 \times 10 = 26$$

$$R_{trim\_down} = \frac{AR1}{R1-A} - R3$$

$$= \frac{26 \times 30.3}{30.3 - 26} - 68$$

$$= 115.2K\Omega$$

## ■ Hold-up Time

As Figure 3 shows, an electrolytic cap (Cbus) about 47μF connected between Vbus and -Vin is necessary. The Vbus can provide or absorb transient power and make the converter operating stable.

In Figure 4 when input voltage is below 56Vdc, the Vbus voltage will keep at 60V. As the input voltage increase and over 60V, the Vbus and Vin will had the same voltage level.

During the transition of different power source, the electric power on the train become unstable in a short time. Such as a sudden voltage drop or a short-term power failure. Under this situation, hold-up time circuit is suitable for this situation.

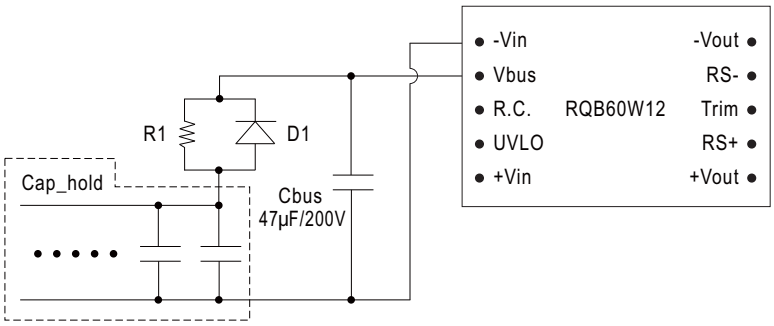



Figure 3 Vbus circuit for hold up Cap

Table 2 – Cap_hold table (Hold up time)

| Nominal Vin | 24V | 48V | 72V | 96V | 110V |
|---|---|---|---|---|---|
| 10ms(S2) | 800μF | 800μF | 440μF | 180μF | 120μF |
| 30ms(C2) | 2200μF | 2200μF | 1200μF | 540μF | 400μF |

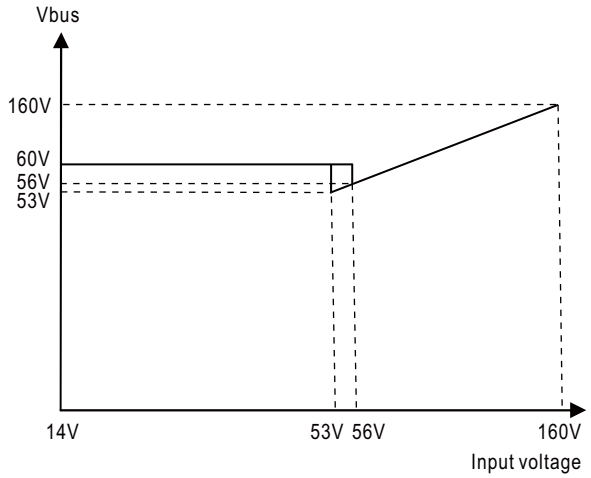



Figure 4 Input and Vbus voltage relationship

As Figure 3 shows, hold-up time circuit comprises R1, D1 and Cap_hold. The capacity of Cap_hold decides the hold-up time during interruption of input power. And Table 2 shows the table for Cap_hold with different input voltage. For Example, if input voltage is 24V, and output load is full load. The Cap_hold need 800μF for hold-up 10ms.

During start up, R1 endures a high pulse power, and should be selected carefully. The power is related to Vbus and Cap_hold. We recommend to use 25 ohm/10W resistor.

## ■ UVLO

The under voltage threshold can set by external resistor placed between the UVLO and -Vin. (Please refer to Table 3)

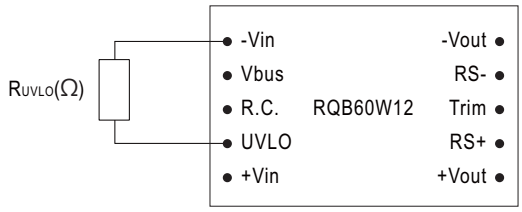
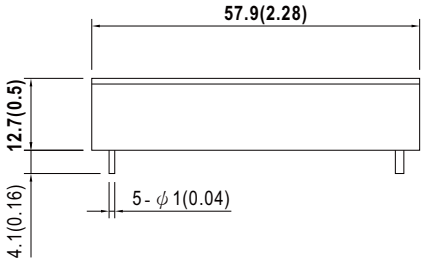


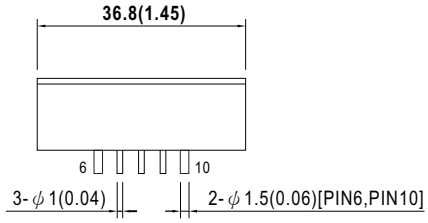

Table 3 – UVLO

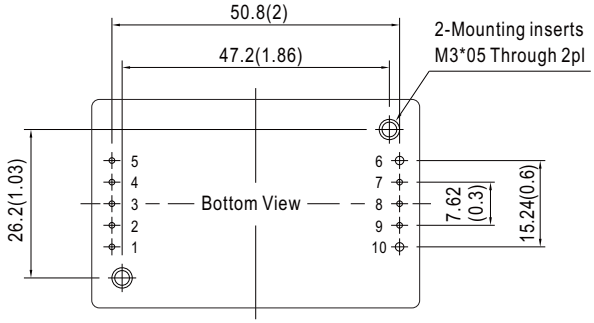
| UVLO External Resistor RUVLO(Ω) | OPEN | 140K | 62K |
|---|---|---|---|
| **Shutdown** | 12.7V | 19.6V | 26.3V |
| **Start up** | 13.6V | 20.4V | 27.3V |

## ■ Mechanical Specification

- All dimensions in mm(inch)
- Tolerance: x.x±0.5mm (x.x±0.02")
  x.xx±0.25mm(x.xx±0.01")
- Pin size is:1.x±0.1mm (0.04"±0.005")

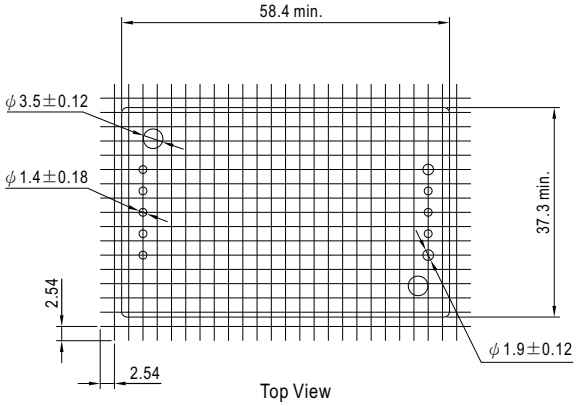


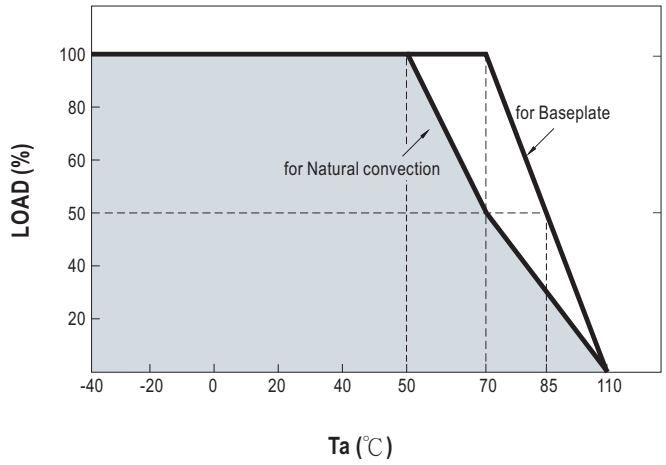




## ■ Plug Assignment

| Pin-Out | | | |
|---|---|---|---|
| Pin No. | Output | Pin No. | Output |
| 1 | +Vin | 6 | -Vout |
| 2 | UVLO | 7 | RS- |
| 3 | Remote ON/OFF | 8 | Trim |
| 4 | Vbus | 9 | RS+ |
| 5 | -Vin | 10 | +Vout |



## ■ Derating Curve




**Power Derating Curve**

Power module can operate in variety of thermal environments. However, sufficient cooling should be provided to ensure the reliable operation of the unit. Heat can be removed by conduction, convection, and radiation to the surrounding environment. Figure 5 is the PCB layout, which to measure RQB60W12 thermal performed, the dimension is **137 * 88 * 1.6mm, 2 OZ**. There copper can help RQB60W12 to conduct heat through the body to the PCB.

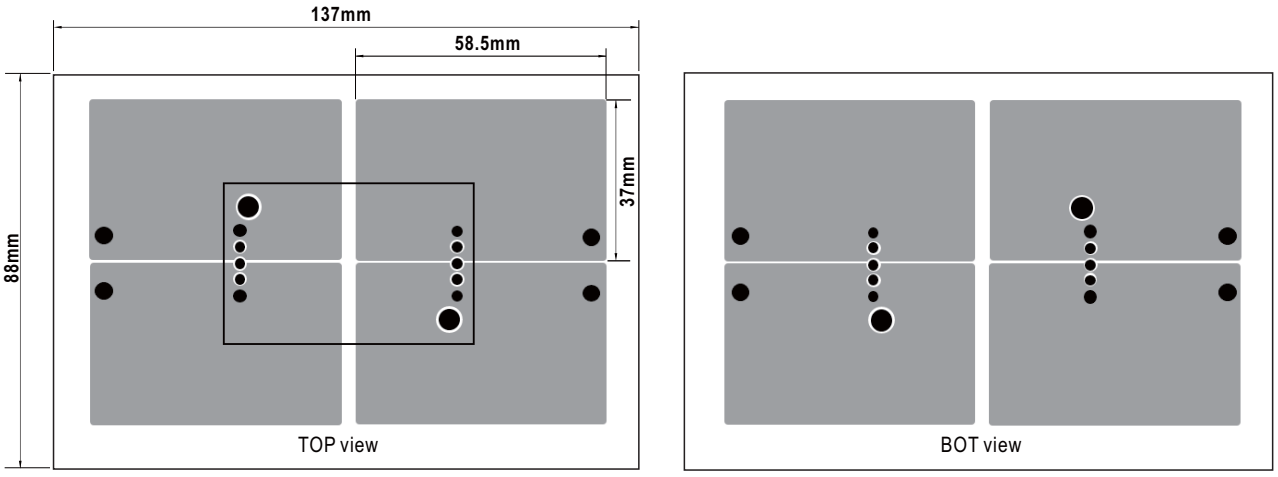
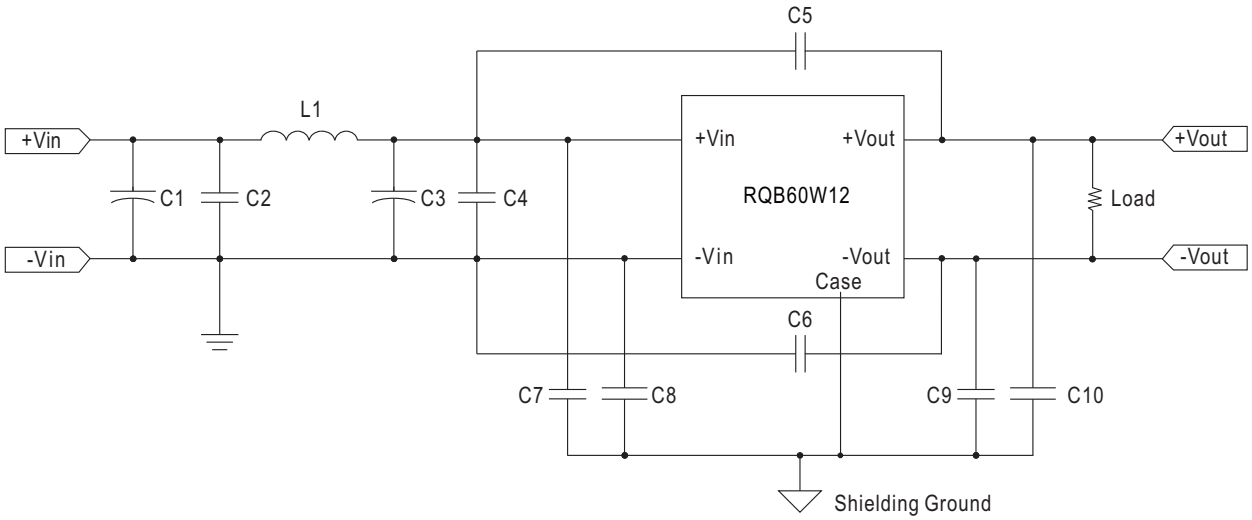



Figure 5

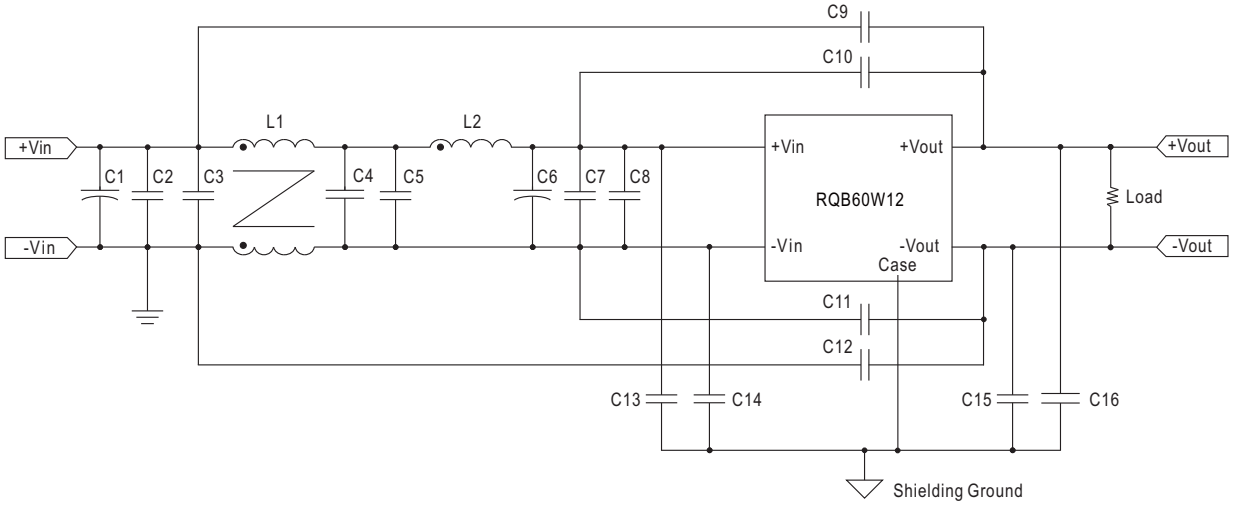
## ■ EMC Suggestion Circuit

※ EMI Test standard: BS EN/EN55032 Class A Output Conducted & Radiated Emission are as below:
(Test Condition: Input Voltage: 110Vdc, Output Load: Full Load)



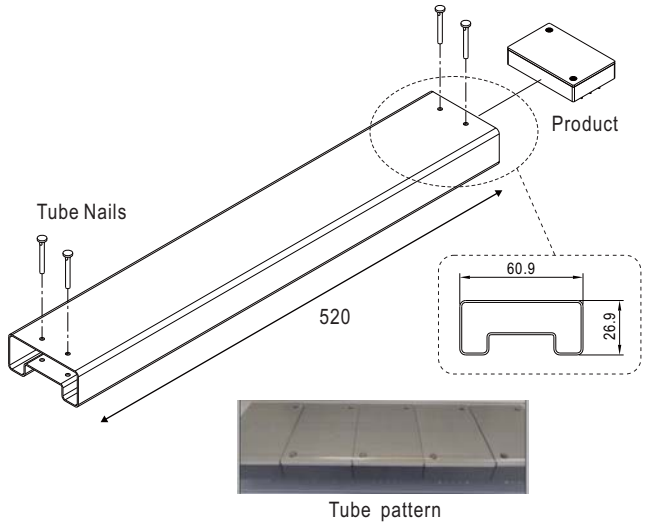
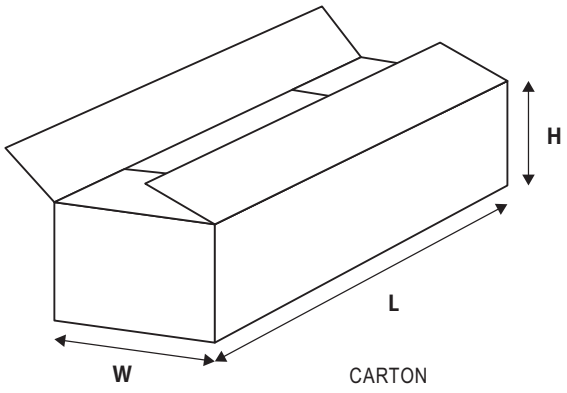

| Model No. | BS EN/EN55032 Class A | | | | | | |
|---|---|---|---|---|---|---|---|
| | C1 | C2,4 | C3 | C5 | C6 | C7,8,9,10 | L1 |
| RQB60W12-110S05 | 100μF/200V Aluminum Cap. | 0.68μF/250V Ceramic Cap. | 47μF/200V Aluminum Cap. | 1000pF/3KV Ceramic Cap. | 1000pF/3KV Ceramic Cap. | 1000pF/2KV Ceramic Cap. | 10μH GSTD1265PE-100M |
| RQB60W12-110S12 | | | | | | | |
| RQB60W12-110S24 | | | | 2200pF/3KV Ceramic Cap. | | | |
| RQB60W12-110S48 | | | | | 2200pF/3KV Ceramic Cap. | | |
| RQB60W12-110S54 | | | | | | | |

※ EMI Test standard:BS EN/EN55032 Class B Output Conducted & Radiated Emission are as below:
(Test Condition: Input Voltage: 110Vdc, Output Load: Full Load)




| Model No. | BS EN/EN55032 Class B | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | C1 | C2,3,4,5,7,8 | C6 | C9,C12 | C10 | C11 | C13,14,15,16 | L1 | L2 |
| RQB60W12-110S05 | 100μF/200V Aluminum Cap. | 0.68μF/250V Ceramic Cap. | 47μF/200V Aluminum Cap. | N.C | 3300pF/3KV | 3300pF/3KV | 4700pF/2KV | Commom Choke A10 T16x12x8C 2.2mH±35% | 4.7μF GSTD1265PE 4R7M |
| RQB60W12-110S12 | | | | 1500pF/3KV | 2200pF/3KV Ceramic Cap. | 2200pF/3KV | 1000pF/2KV Ceramic Cap. | | |
| RQB60W12-110S24 | | | | 1000pF/3KV | | 1000pF/3KV | | | |
| RQB60W12-110S48 | | | | N.C | | 2200pF/3KV Ceramic Cap. | 4700pF/2KV Ceramic Cap. | | |
| RQB60W12-110S54 | | | | | | | | | |

## ■ Packing

| Standard Tube Packing | MPQ Per Tube (PCS) | One Tube G.W. | Max. Q'TY/ Carton(PCS) | One Carton G.W. |
|---|---|---|---|---|
| Unit : mm<br>  <br><br><br>Tube pattern<br>  <br><br>CARTON<br>L545 x W145 x H220 | 11 | 880g | 132 | 11.5Kg |

## ■ Installation Manual

Please refer to : http://www.meanwell.com/manual.html