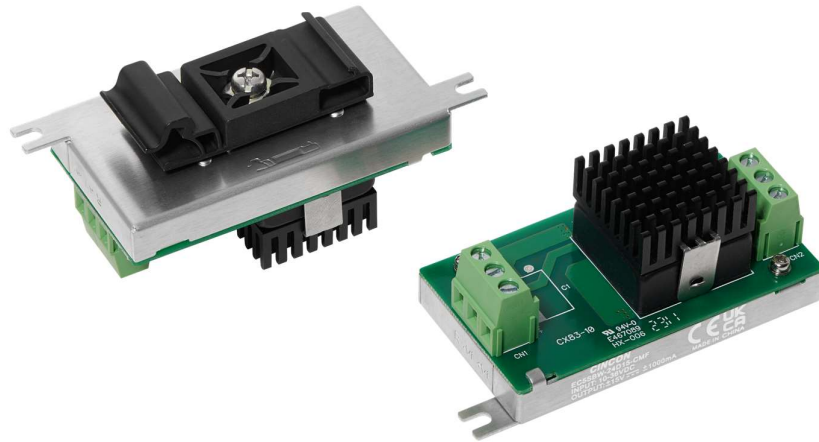




EC5SBW-C(D)MF Series Application Note V10

ISOLATED DC-DC CONVERTER EC5SBW-C(D)MF SERIES APPLICATION NOTE



Approved By:

Department	Approved By	Checked By	Written By
Research and Development Department	Jacky	Danny/ Zhu Hai	Lihaibo
Design Quality Department	Benny	JoJo	



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1. Introduction

The EC5SBW-C(D)MF series of DC-DC converters offers 30 watts of output power @ output voltages of 3.3, 5, 12, 15, ± 12 , ± 15 VDC. It has a wide (4:1) input voltage range of 10 to 36VDC (24VDC nominal), 19 to 74VDC (48VDC nominal) and 1500VDC isolation.

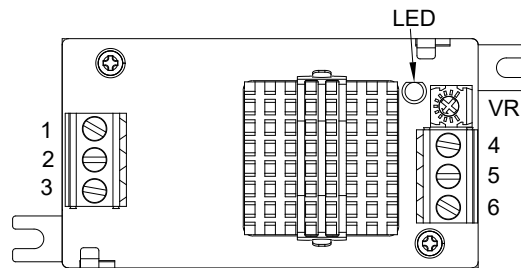
High efficiency up to 90%, allowing case operating temperature range of -40°C to 105°C . Very low no load power consumption (10mA), an ideal solution for energy critical systems.

Fully protected against input UVLO (under voltage lock out), output over-current, output over-voltage, over-temperature and continuous short circuit conditions.

The standard control functions include remote on/off (positive or negative) and +10%, -10% adjustable output voltage (single output only).

EC5SBW-C(D)MF series is designed suitable for distributed power architectures, telecommunications, battery operated equipment, industrial and mobile equipment application.

2. Pin Function Description



Single Output

No	Label	Function	Description	Reference
1	R	Remote On/Off	External Remote On/Off Control	Section 6.5
2	-Vi	-V Input	Negative Supply Input	Section 7.1
3	+Vi	+V Input	Positive Supply Input	Section 7.1
4	-Vo	-V Output	Negative Power Output	Section 7.1/7.2
5	Trim	Trim	External Output Voltage Adjustment	Section 6.6
6	+Vo	+V Output	Positive Power Output	Section 7.1/7.2

Dual Output

No	Label	Function	Description	Reference
1	R	Remote On/Off	External Remote On/Off Control	Section 6.5
2	-Vi	-V Input	Negative Supply Input	Section 7.1
3	+Vi	+V Input	Positive Supply Input	Section 7.1
4	-Vo	-V Output	Negative Power Output	Section 7.1/7.2
5	Com	Common	Common Power Output	Section 7.1/7.2
6	+Vo	+V Output	Positive Power Output	Section 7.1/7.2

3. Terminal Block

Input and Output Terminal Block

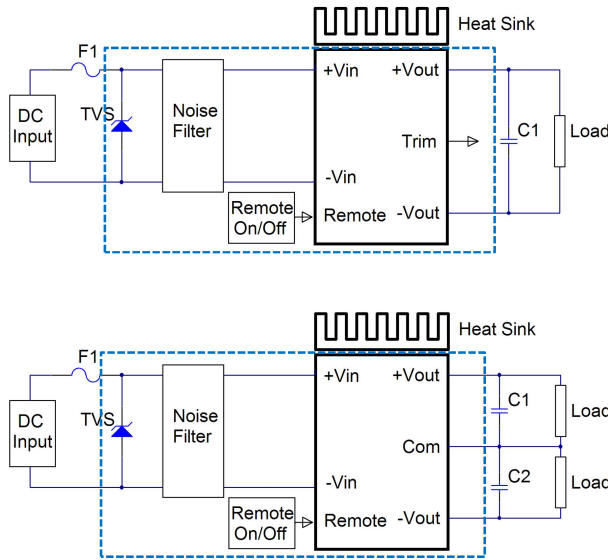
Terminal Type	Screw Torque Value (Kgf-cm)	Suitable Electric Wire (AWG)	Current Rating (max.)
EK508V-03P or Equivalent	5	12-24	24A



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4. Connection for Standard Use

The connection for standard use is shown below. External output capacitors (C1, C2) are recommended to reduce output ripple and noise, 1uF ceramic capacitor for all models.



Symbol	Component	Reference
F1	Input fuse	Section 10.1
C1, C2	External capacitor on the output side	Section 7.1/7.2
Noise Filter	Internal input noise filter	Section 10.2
Remote On/Off	External remote on/off control	Section 6.5
Trim	Internal output voltage adjustment By variable resistor	Section 6.6
Heat sink	Internal heat sink	Section 9.1/9.2/9.3

5. Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown below. When testing the modules 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:

$$Load\ reg. = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

Where:

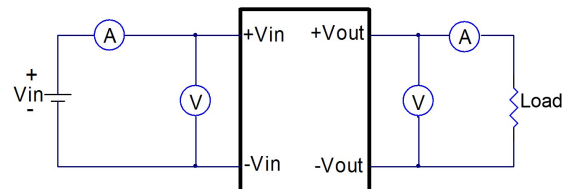
- V_{FL} is the output voltage at full load
- V_{NL} is the output voltage at no load

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



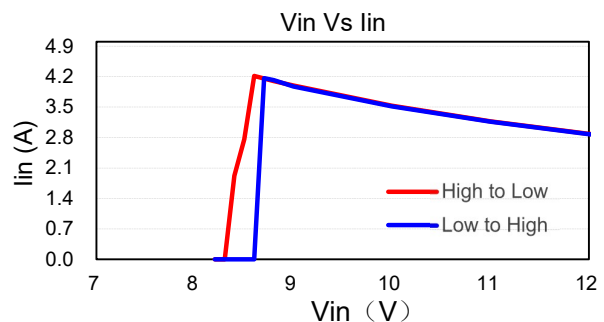
EC5SBW-C(D)MF Series Test Setup

6. Features and Functions

6.1 UVLO (Under Voltage Lock Out)

Input under voltage lockout is standard on the EC5SBW-C(D)MF series unit. The unit will shut down when the input voltage drops below a threshold, and the unit will operate when the input voltage goes above the upper threshold.

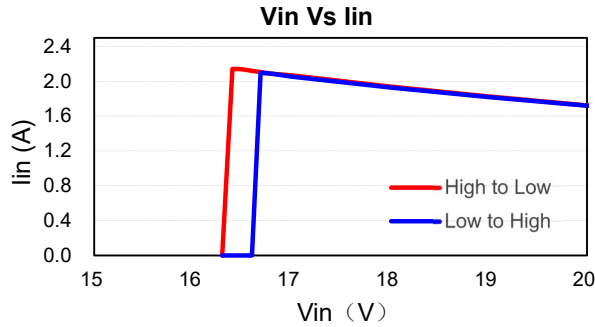
EC5SBW-24SXX-C(D)MF





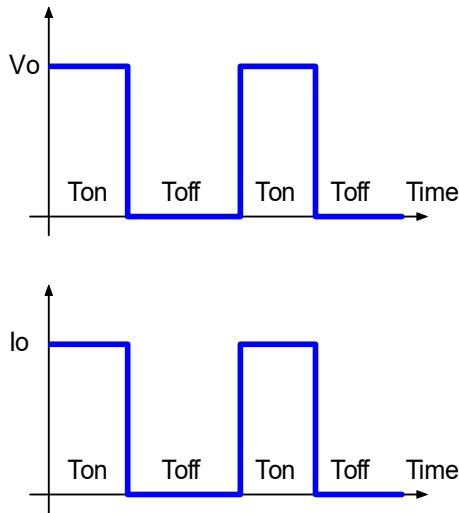
EC5SBW-C(D)MF Series Application Note V10

EC5SBW-48SXX-C(D)MF



6.2 Over Current / Short Circuit 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.



6.3 Output Over Voltage Protection

The over-voltage protection consists of a zener diode to limiting the out voltage.

6.4 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. Different input voltage the over temperature protection turn on/off points will drift. Please measure

temperature of the center part of metal case, see [EC5SBW Series Application Note](#).

6.5 Remote On/Off

The EC5SBW-C(D)MF series allows the user to switch the module on and off electronically with the remote on/off feature. All models are available in "positive logic" and "negative logic" (optional) versions. The converter turns on if the remote On/Off pin is high (>3.5Vdc to 74Vdc or open circuit). Setting the pin low (0 to <1.2Vdc) will turn the converter off. The signal level of the remote on/off input is defined with respect to ground.

If not using the remote on/off pin, leave the pin open (converter will be on). Converter will be turn on in positive mode.

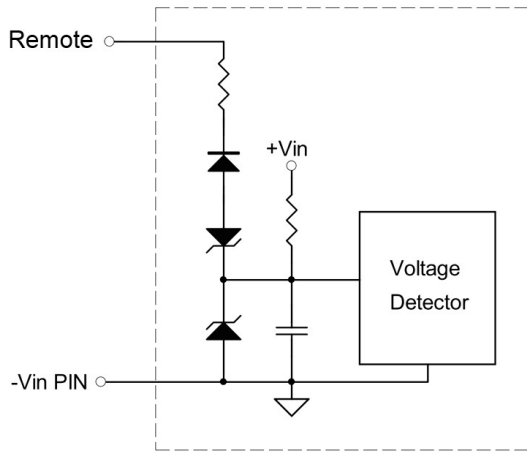
Models with part number suffix "N" are the "negative logic" remote on/off version. The unit turns off if the remote on/off pin is high (>3.5Vdc to 74Vdc or open circuit). The converter turns on if the On/Off pin input is low (0 to <1.2Vdc). Note that the converter is off by default.

Logic State (Pin 1)	Negative Logic	Positive Logic
Logic Low	Module on	Module off
Logic High	Module off	Module on

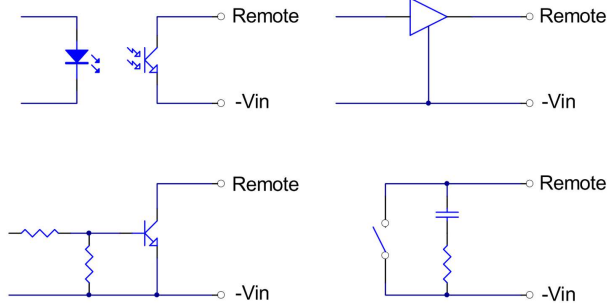


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The converter remote on/off circuit built-in on input side. The ground pin of input side remote on/off circuit is -vin pin. Inside connection sees below.



Connection examples see below.

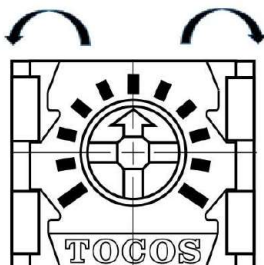


Remote On/Off Connection Examples

6.6 Output Voltage Adjustment

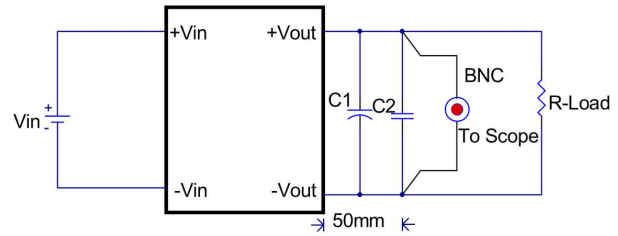
Output voltage can be adjusted by internal variable resistor (adjustment range: +10% to -10% of nominal output). Turning internal variable resistor clockwise reduces the output voltage and counterclockwise increases the output voltage.

counterclockwise clockwise



7. Input / Output Considerations

7.1 Output Ripple and Noise

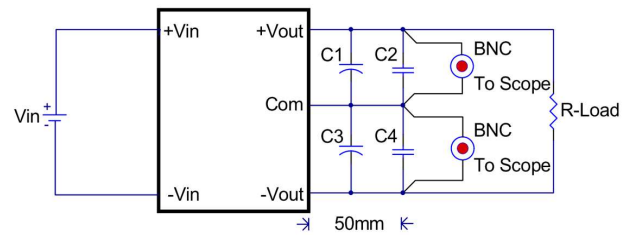


Note:

C1: NC

C2: 1uF ceramic capacitor.

EC5SBW-C(D)MF single output module



Note:

C1 & C3: NC

C2 & C4: 1uF ceramic capacitor

EC5SBW-C(D)MF dual output module

Output ripple and noise measured with 1uF ceramic capacitor across output, A 20 MHz bandwidth oscilloscope is normally used for the measurement.

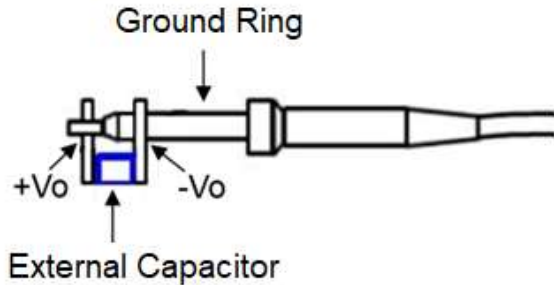
The conventional ground clip on an oscilloscope probe should never be used in this kind of measurement. This clip, when placed in a field of radiated high frequency energy, acts as an antenna or inductive pickup loop, creating an extraneous voltage that is not part of the output noise of the converter.





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Another method is shown in below, in case of coaxial-cable/BNC is not available. The noise pickup is eliminated by pressing scope probe ground ring directly against the -Vout terminal while the tip contacts the +Vout terminal. This makes the shortest possible connection across the output terminals.



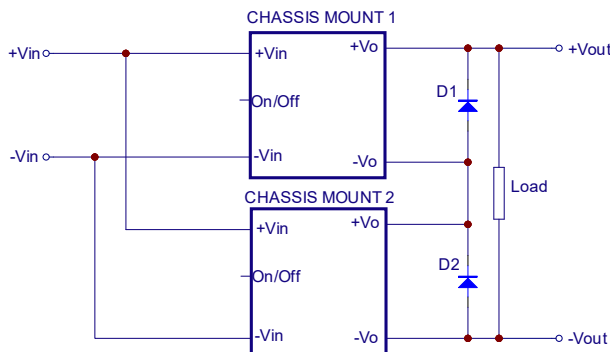
7.2 Output Capacitance

The EC5SBW-C(D)MF series converters provide unconditional stability with or without external capacitors. For good transient response, low ESR output capacitors should be located close to the point of load (<100mm). PCB design emphasizes low resistance and inductance tracks in consideration of high current applications. Output capacitors with their associated ESR values have an impact on loop stability and bandwidth. Cincon's converters are designed to work with load capacitance to see technical specifications.

8. Series and Parallel Operation

8.1 Series Operation

Series operation is possible by connecting the outputs two or more units. Connection is shown in below. The output current in series connection should be lower than the lowest rate current in each power module.

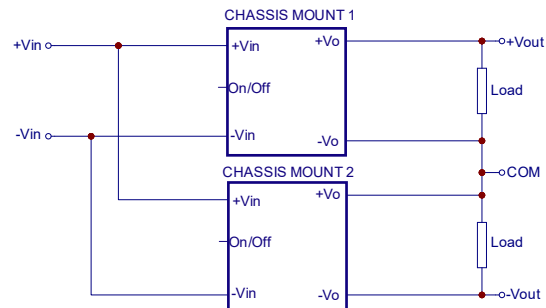


Simple Series Operation Connect Circuit

Note:

Recommend Schottky diode (D1, D2) be connected across the output of each series connected converter, so that if one converter shuts down for any reason, then the output stage won't be thermally overstressed. Without this external diode, the output stage of the shut-down converter could carry the load current provided by the other series converters, with its MOSFETs conducting through the body diodes. The MOSFETs could then be overstressed and fail. The external diode should be capable of handling the full load current for as long as the application is expected to run with any unit shut down.

Series for \pm output operation is possible by connecting the outputs two units, as shown in the schematic below.



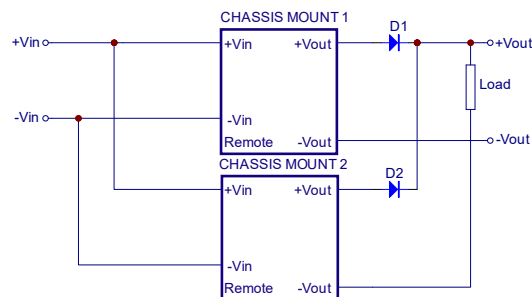
Simple \pm Output Operation Connect Circuit

8.2 Parallel Operation

The EC5SBW-C(D)MF series parallel operation is not possible.

8.3 Redundant Operation

Parallel for redundancy operation is possible by connecting the units as shown in the schematic below. The current of each converter become unbalance by a slight difference of the output voltage. Make sure that the output voltage of units of equal value and the output current from each power supply does not exceed the rate current. Suggest use an internal variable resistor to adjust output voltage from each power supply.



Simple Redundant Operation Connect Circuit



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9. Thermal Design

9.1 Operating Temperature Range

The EC5SBW-C(D)MF series converters can be operated within a wide case temperature range of -40°C to 105°C. Consideration must be given to the derating curves when ascertaining maximum power that can be drawn from the converter. The maximum power drawn from models is influenced by usual factors, such as:

- Input voltage range
- Output load current
- Forced air or natural convection

9.2 Convection Requirements for Cooling

To predict the approximate cooling needed for the chassis mount module, refer to the power derating curves to see technical specifications. 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 105°C as measured at the center of the top of the case (thus verifying proper cooling).

9.3 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 power output of the module should not be allowed to exceed rated power ($V_{o_set} \times I_{o_max}$).

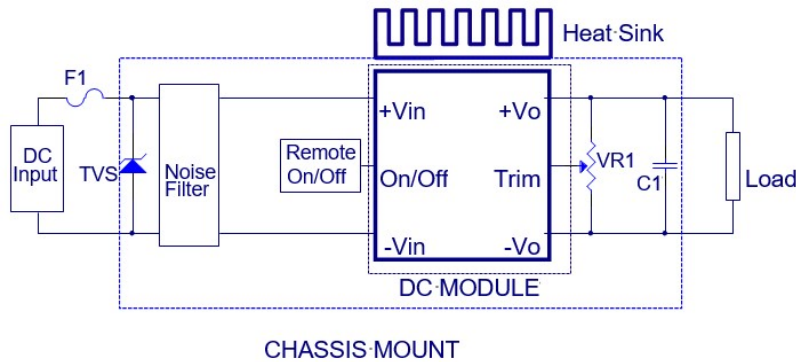


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10. Safety & EMC

10.1 Input Fusing and Safety Considerations

EC5SBW-C(D)MF series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a fast acting fuse 6A for 24Vin models and 3A for 48Vin modules. Chassis mount module have a transient voltage suppressor diode (TVS) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage (as shown).



10.2 EMC Considerations

EMI Test standard: EN55032 Conducted & Radiated Emission.

Test Condition: Input Voltage: Nominal Input, Output Load: Full Load

(1) EMI meet EN55032

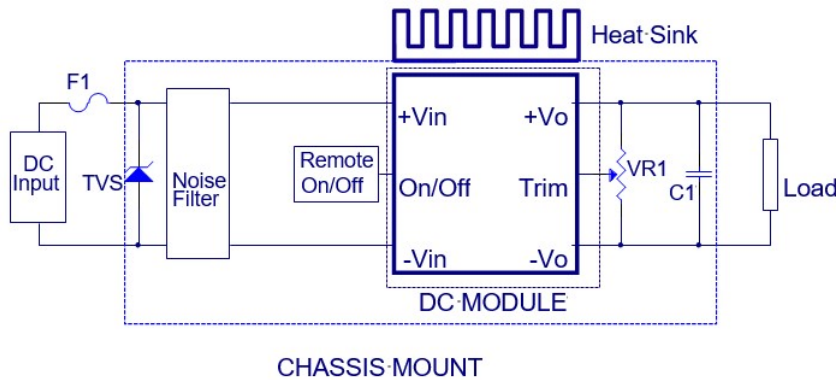


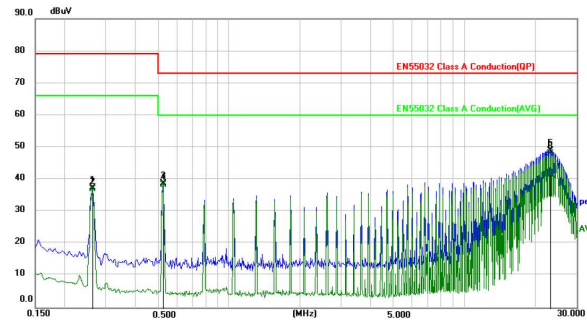
Figure 11. Connection circuit for conducted EMI testing



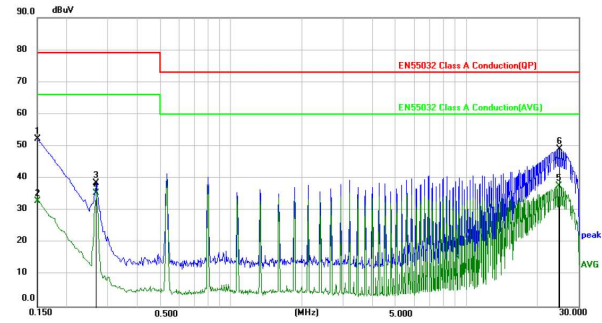
EC5SBW-C(D)MF Series Application Note V10

Conducted Emission Class A:

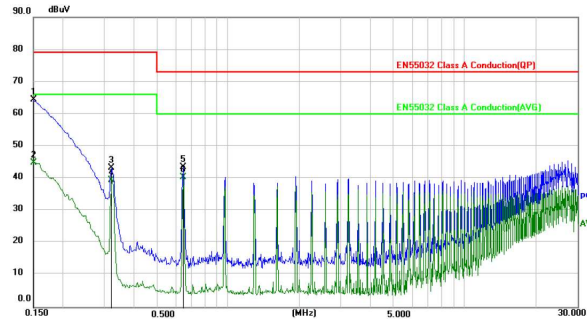
EC5SBW-24S33-CMF



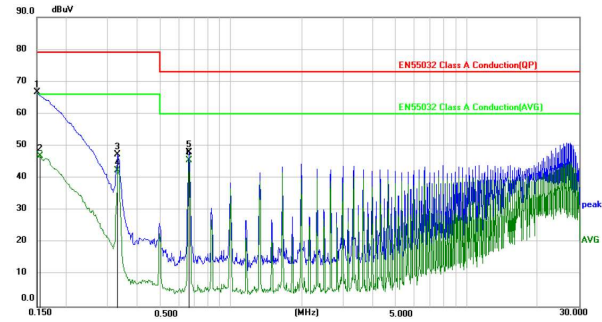
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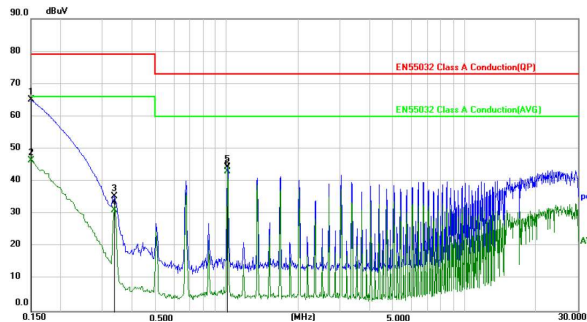
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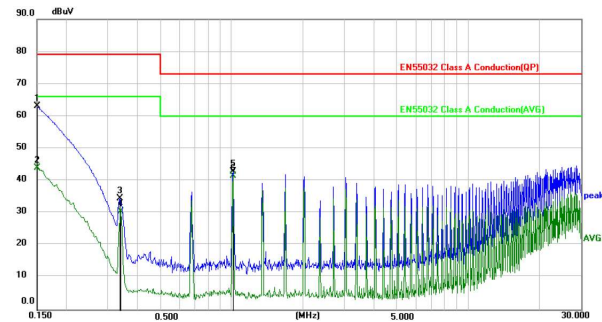
EC5SBW-24S15-CMF



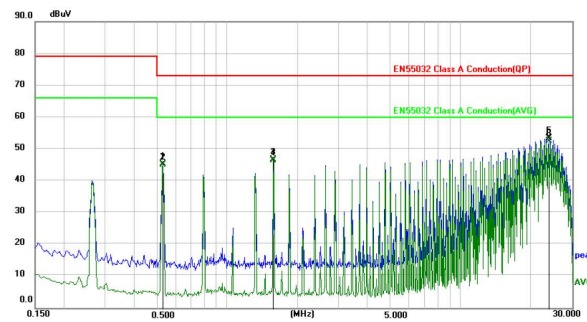
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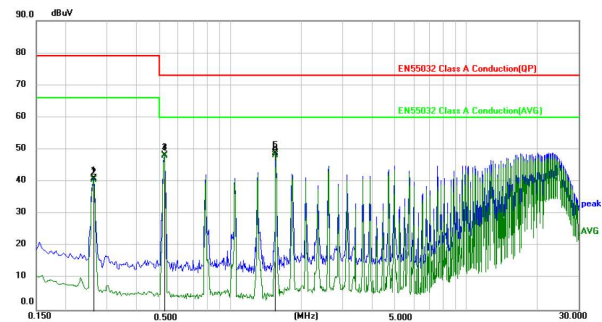
EC5SBW-24D15-CMF



EC5SBW-48S33-CMF



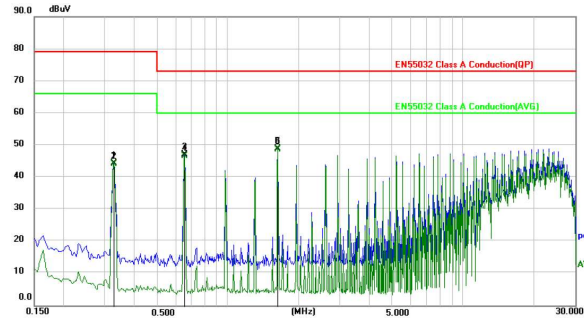
EC5SBW-48S05-CMF



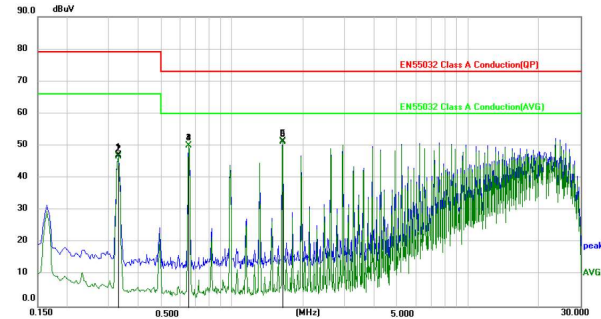


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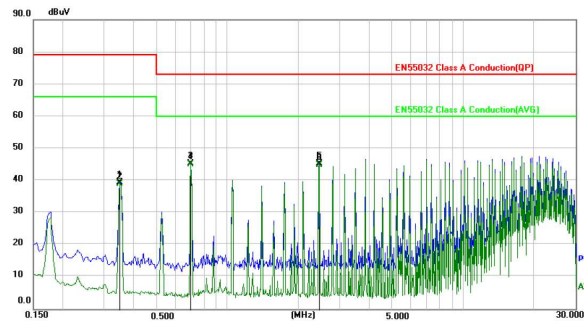
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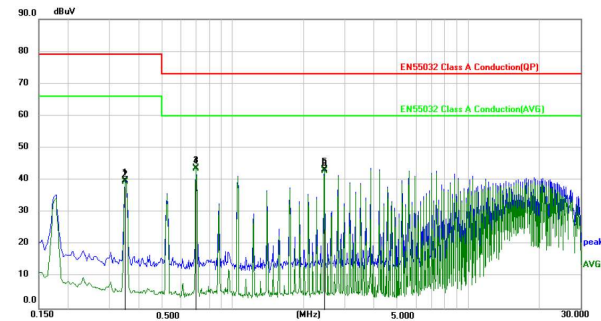
EC5SBW-48S15-CMF



EC5SBW-48D12-CMF



EC5SBW-48D15-CMF



Headquarters:

14F, No.306, Sec.4, Hsin Yi Rd.
Taipei, Taiwan
Tel: 886-2-27086210
Fax: 886-2-27029852
E-mail: sales@cincon.com.tw
Web Site: <https://www.cincon.com>

CINCON ELECTRONICS CO., LTD.

Factory:

No. 8-1, Fu Kung Rd.
Fu Hsing Industrial Park
Fu Hsing Hsiang,
ChangHua Hsien, Taiwan
Tel: 886-4-7690261
Fax: 886-4-7698031

Cincon North America:

1655Mesa Verde Ave. Ste 180
Ventura, CA93003
Tel: 805-639-3350
Fax: 805-639-4101
E-mail: info@cincon.com