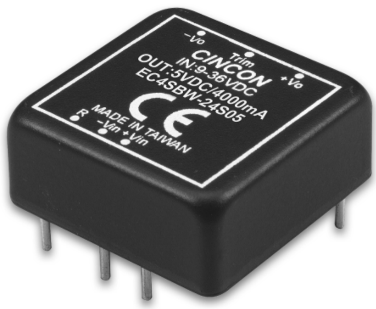
EC4SBW 20W Isolated DC-DC Converters

Application Note V10 June 2017

ISOLATED DC-DC CONVERTER
EC4SBW SERIES
APPLICATION NOTE



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Content

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1. Introduction

The EC4SBW series offer 20 watts of output power in a 1.00x1.00x0.4 inches copper packages. The EC4SBW series has a 4:1 wide input voltage range of 9-36 and 18-75VDC, and provides a precisely regulated output. This series has features such as high efficiency, 1500VDC of isolation and allows an ambient operating temperature range of –40°C to 85°C (de-rating above 65 °C). The modules are fully protected against input UVLO (under voltage lock out), output over-current, over-voltage protection and continuous short circuit conditions. Furthermore, the standard control functions include remote on/off and adjustable output voltage. All models are very suitable for distributed power architectures, telecommunications, battery operated equipment and industrial applications.

2. DC-DC Converter Features

* 1"x1"0.4" Shielded Metal Case
* Very High Efficiency Up to 90.5%
* Low No Load Power Consumption
* 4:1 Input Range
* Regulated Outputs
* Fixed Switching Frequency
* Input Under-Voltage Protection
* Over Current Protection
* Remote On/Off
* Continuous Short Circuit Protection
* Without Tantalum Capacitors inside
* CE Mark Meets 2014/30/EU
* Safety Meets UL60950-1, EN60950-1, and IEC60950-1

3. Electrical Block Diagram

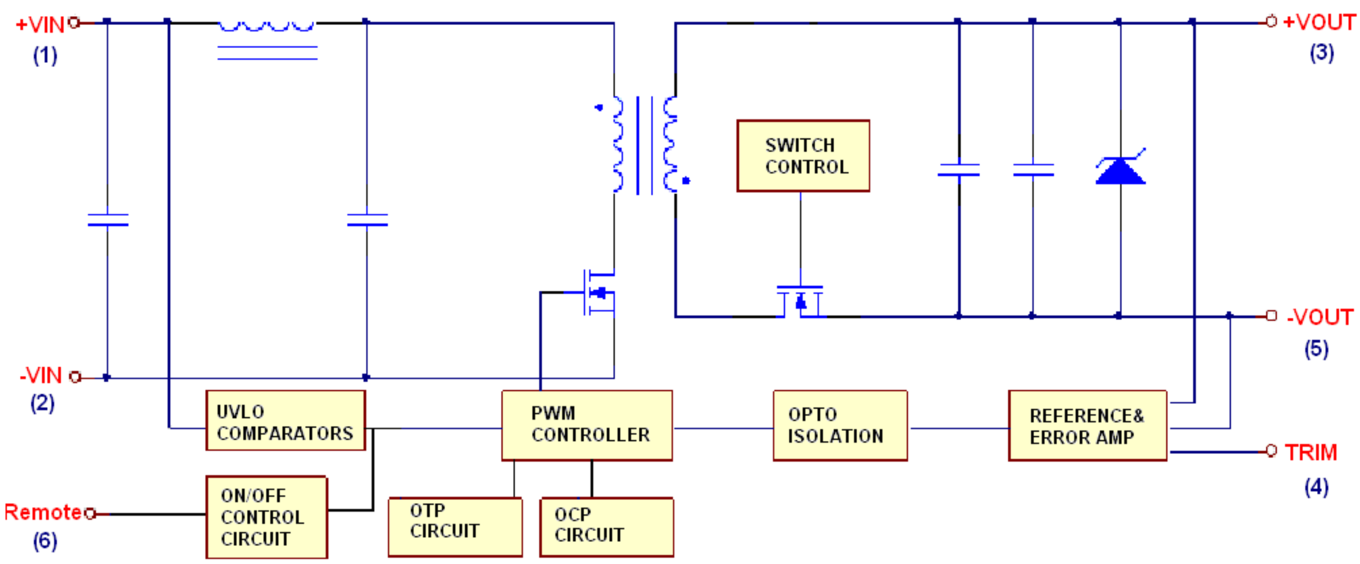


Figure 1. Electrical Block Diagram of XXS33 and XXS05

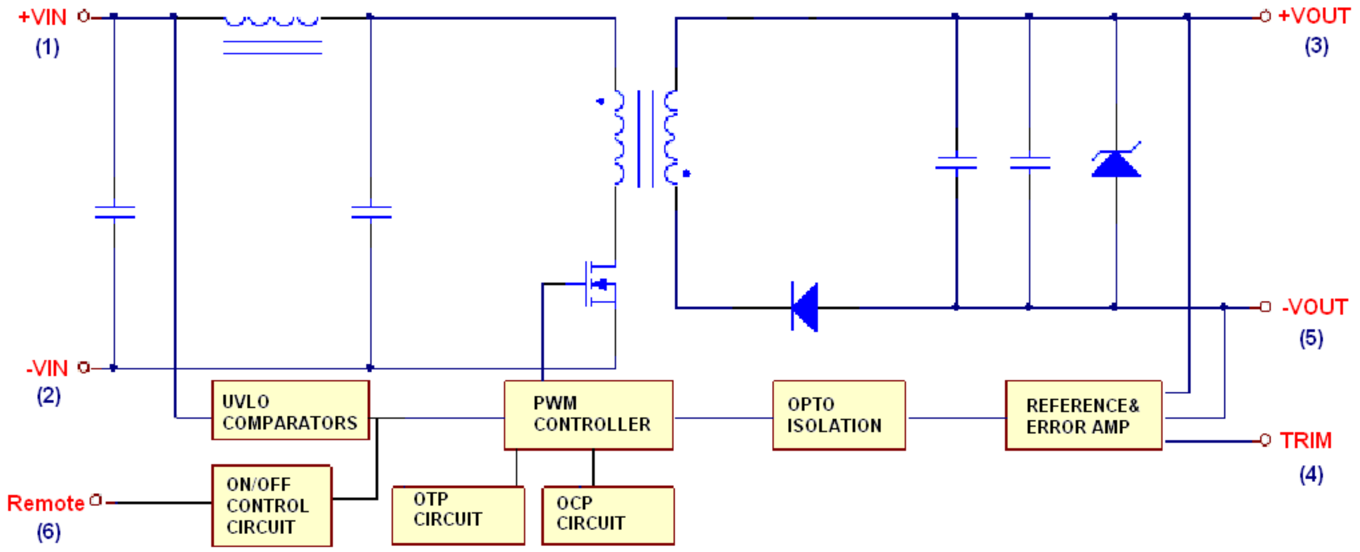


Figure 2. Electrical Block Diagram of XXS12 and XXS15

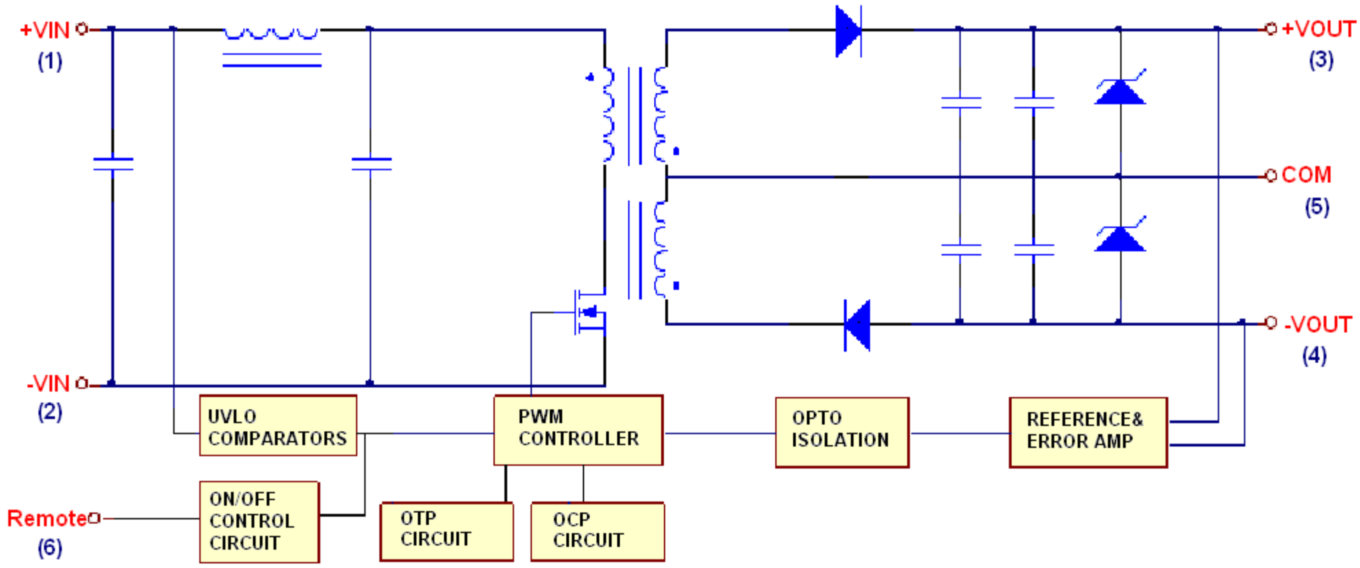


Figure 3. Electrical Block Diagram of dual output module

4. 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.	Typical	Max.	Units
Input Voltage						
Continuous		$24V_{in}$ $48V_{in}$	-0.3 -0.3		36 75	Vdc
Transient	100ms	$24V_{in}$ $48V_{in}$			50 100	Vdc
Operating Ambient Temperature	Derating, Above 65℃	All	-40		+85	℃
Case Temperature		All			105	℃
Storage Temperature		All	-55		+125	℃
Input/Output Isolation Voltage	1 minute	All			1500	Vdc

INPUT CHARACTERISTICS						
PARAMETER	**NOTES and CONDITIONS**	Device	Min.	Typical	Max.	Units
Operating Input Voltage		$24V_{in}$ $48V_{in}$	9 18	24 48	36 75	Vdc
Input Under Voltage Lockout						
Turn-On Voltage Threshold		$24V_{in}$ $48V_{in}$	8 16.5	8.5 17	8.8 17.5	Vdc
Turn-Off Voltage Threshold		$24V_{in}$ $48V_{in}$	7.7 15.5	8 16	8.3 16.5	Vdc
Lockout Hysteresis Voltage		$24V_{in}$ $48V_{in}$		0.5 1		Vdc
Maximum Input Current	100% Load, V_{in} =9V	$24V_{in}$			2600	mA
	100% Load, V_{in} =18V	$48V_{in}$			1300	
No-Load Input Current	V_{in} =Nominal input	24S33 24S05 24S12 24S15 24D12 24D15 48S33 48S05 48S12 48S15 48D12 48D15		10 10 10 10 10 10 8 8 8 8 8 8		mA
Off Converter Input Current	Shutdown input idle current	All		4	10	mA
Inrush Current (I^2t)	As per ETS300 132-2	All			0.1	A^2s
Input Reflected-Ripple Current	P-P thru 12uH inductor, 5Hz to 20MHz	All			30	mA

OUTPUT CHARACTERISTIC						
PARAMETER	**NOTES and CONDITIONS**	Device	Min.	Typical	Max.	Units
Output Voltage Set Point	V_{in} =Nominal V_{in} , I_o = I_{o_max}, Tc=25℃	Vo=3.3 Vo=5.0 Vo=12 Vo=15 Vo=±12 Vo=±15	3.2505 4.925 11.82 14.775 11.82 14.775	3.3 5 12 15 12 15	3.3495 5.075 12.18 15.225 12.18 15.225	Vdc
Output Voltage Balance	V_{in} =nominal, Io= I_{o_max}, Tc=25℃	Dual			±1.5	%
Output Voltage Regulation						
Line Regulation	V_{in} =High line to Low line Full Load	Single Dual			±0.2 ±0.5	% %
Load Regulation	I_o = Full Load to min. Load	Single Dual			±0.2 ±1.0	% %
Cross Regulation	Load cross variation 10%/100%	Dual			±5	%
Temperature Coefficient	T_C=-40℃ to 85℃	All			±0.03	%/℃
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth					
Peak-to-Peak	Full Load, 20MHz bandwidth 10uF tantalum and 1uF ceramic capacitor **See 6.7**	Vo=3.3V Vo=5V			75	mV
		Vo=15V Vo=12V Vo=±15V Vo=±12V			100	
Operating Output Current Range		Vo=3.3V Vo=5V Vo=12V Vo=15V Vo=±12V Vo=±15V	0 0 0 0 0 0		4500 4000 1670 1330 ±830 ±660	mA
Output DC Current-Limit Inception	Output Voltage=90% $V_{O,\ nominal}$ **See 5.4**	24S33 24S05	110	170	200	%
		Others	110	140	170	
Maximum Output Capacitance	Full load, Resistance	Vo=3.3V Vo=5V Vo=12V Vo=15V Vo=±12V Vo=±15V	0 0 0 0 0 0		5000 4000 1650 1300 800 650	uF
DYNAMIC CHARACTERISTICS						
PARAMETER	**NOTES and CONDITIONS**	Device	Min.	Typical	Max.	Units
Output Voltage Current Transient						
Step Change in Output Current	75% to 100% of I_{o_max} di/dt=0.1A/us	All			±5	%
Setting Time (within 1% $Vo_{nominal}$)		All			250	us
Turn-On Delay and Rise Time						
Turn-On Delay Time, From On/Off Control	$V_{on/off}$ to 10%V_{o_set}	All		10		ms
Turn-On Delay Time, From Input	V_{in_min} to 10%V_{o_set}	All		10		ms
Output Voltage Rise Time	10% V_{o_set} to 90% V_{o_set}	All		10		ms

EFFICIENCY						
PARAMETER	**NOTES and CONDITIONS**	Device	Min.	Typical	Max.	Units
100% Load	V_{in} =12 V_{dc}, I_o = I_{o_max}, Tc=25℃ **See 6.3**	24S33		88		%
		24S05		90		
		24S12		89		
		24S15		89		
		24D12		88.5		
		24D15		89		
	V_{in} =24 V_{dc}, I_o = I_{o_max}, Tc=25℃ **See 6.3**	24S33		88.5		%
		24S05		90.5		
		24S12		89		
		24S15		89		
		24D12		88.5		
		24D15		89		
100% Load	V_{in} =24 Vdc, I_o = I_{o_max}, Tc=25℃ **See 6.3**	48S33		89		%
		48S05		90.5		
		48S12		89.5		
		48S15		89		
		48D12		89.5		
		48D15		89.5		
	V_{in} =48 Vdc, I_o = I_{o_max}, Tc=25℃ **See 6.3**	48S33		88.5		%
		48S05		90.5		
		48S12		89.5		
		48S15		89		
		48D12		88.5		
		48D15		88.5		

ISOLATION CHARACTERISTICS						
PARAMETER	**NOTES and CONDITIONS**	Device	Min.	Typical	Max.	Units
Input to Output	1 minutes	All	1500			Vdc
Isolation Resistance		All	1000			MΩ
Isolation Capacitance		All		1500		pF

FEATURE CHARACTERISTICS						
PARAMETER	**NOTES and CONDITIONS**	Device	Min.	Typical	Max.	Units
Switching Frequency		Vo=3.3V Vo=5V		270		KHz
		Others		330		
On/Off Control, Positive Remote On/Off logic						
Logic High (Module On)	$V_{on/off}$ at $I_{on/off}$=0.1uA	All	3.5 or Open Circuit		75	Vdc
Logic Low (Module Off)	$V_{on/off}$ at $I_{on/off}$=1.0mA	All	0		1.2	Vdc
On/Off Control, Negative Remote On/Off logic						
Logic High (Module Off)	$V_{on/off}$ at $I_{on/off}$=1.0mA	All	3.5 or Open Circuit		75	Vdc
Logic Low (Module On)	$V_{on/off}$ at $I_{on/off}$=0.1uA	All	0		1.2	Vdc

On/Off Current (for both remote on/off logic)	$I_{on/off}$ at $V_{on/off}$=0V	All		0.3	1	mA
Leakage Current (for both remote on/off logic)	Logic High, $V_{on/off}$=15V				30	uA
Output Over Voltage Protection	Zener or TVS Clamp **See 5.5**	Vo=3.3V Vo=5.0V Vo=12V Vo=15V Vo=±12V Vo=±15V		3.9 6.2 15 18 ±15 ±18		Vdc

GENERAL SPECIFICATIONS

PARAMETER	**NOTES and CONDITIONS**	Device	Min.	Typical	Max.	Units
MTBF	I_o =100%of I_{o_max};Ta=25℃ per MIL-HDBK-217F	Vo=3.3V Vo=5.0V Others		925 1290		K hours
Weight		All		18		grams

Case Material	Black Coated Copper	
Baseplate Material	Plastic, DAP	
Potting Material	UL 94V-0	
Pin Material	Base: Copper Plating: Matte Tin	
Shock/Vibration	MIL-STD-810F	
Humidity	95% RH max. Non Condensing	
Altitude	2000m Operating Altitude	12000m Transport Altitude
Thermal Shock	MIL-STD-810F	
EMI	Meets EN55022, Conducted with external input filter (**See 7.2**)	Class A/B
ESD	IEC61000-4-2 Level 3: Air ±8kV, Level 2: Contact ±4kV	Perf. Criteria A
Radiated immunity	EN61000-4-3 Level 2: 80~1000MHz, 3V/m	Perf. Criteria A
Fast Transient	EN61000-4-4 Level 1: On power input port, ±0.5kV, external input TVS required, **See 7.1**	Perf. Criteria A
Surge	EN61000-4-5 Level 1: Line to line, ±0.5kV	Perf. Criteria A
Conducted immunity	EN61000-4-6 Level 2: 0.15~80MHz, 3V	Perf. Criteria A

5. Main Features and Functions

5.1 Operating Temperature Range

The EC4SBW series converters can be operated by a wide ambient temperature range from -40℃ to 85℃(de-rating above 65℃). The standard model has a Copper case and case temperature can not over 105℃ at normal operating.

5.2 Remote On/Off

The EC4SBW 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" versions. The converter turns on if the remote on/off pin is high (>3.5Vdc to 75Vdc 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).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 75Vdc 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. **See 6.9**

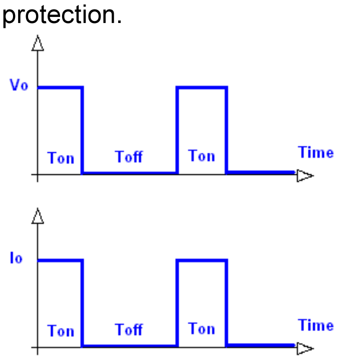
Logic State (Pin 6)	Negative Logic	Positive Logic
Logic Low – Switch Closed	Module on	Module off
Logic High – Switch Open	Module off	Module on

5.3 UVLO (Under Voltage Lock Out)

Input under voltage lockout is standard on the EC4SBW 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.

5.4 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.



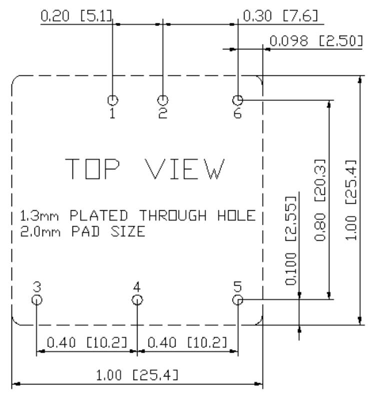
5.5 Over Voltage Protection

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

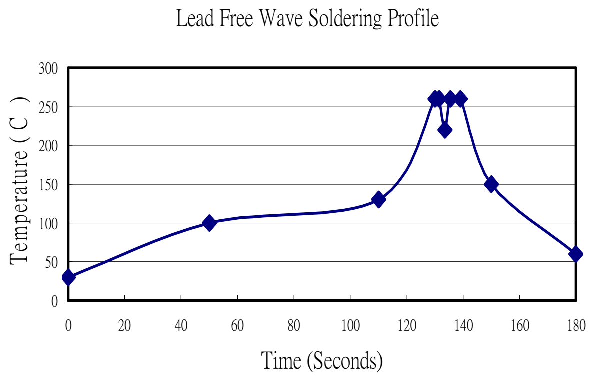
6. Applications

6.1 Recommended Layout PCB Footprints and Soldering Information

The system designer or the end user must ensure that other components and metal in the vicinity of the converter meet the spacing requirements to which the system is approved. Low resistance and low inductance PCB layout traces are the norm and should be used where possible. Due consideration must also be given to proper low impedance tracks between power module, input and output grounds. The recommended footprints and soldering profiles are shown as Figure 4.



Note: Dimensions are in inches (millimeters)



Note：

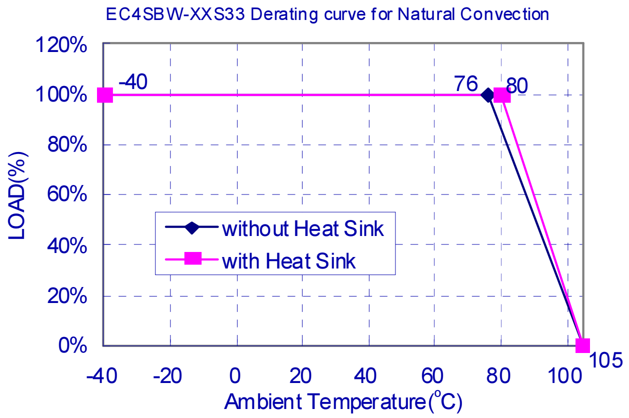
1. Soldering Materials: Sn/Cu/Ni
2. Ramp up rate during preheat: 1.4 ℃/Sec (From 50℃ to 100℃)
3. Soaking temperature: 0.5 ℃/Sec (From 100℃ to 130℃), 60±20 seconds
4. Peak temperature: 260℃, above 250℃ 3~6 Seconds
5. Ramp up rate during cooling: -10.0 ℃/Sec (From 260℃ to 150℃)

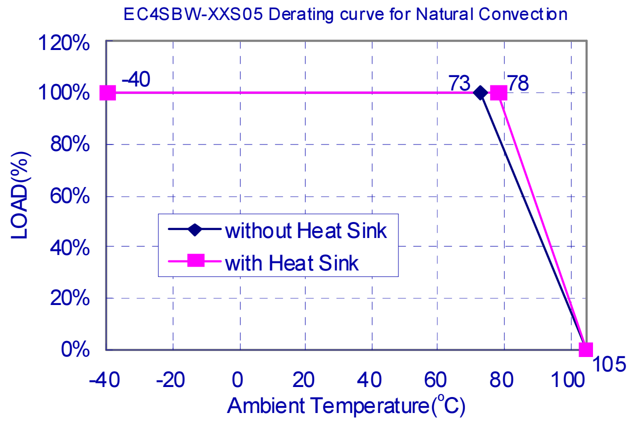
Figure 4. Recommended PCB Layout Footprints and Wave Soldering Profiles for SB packages

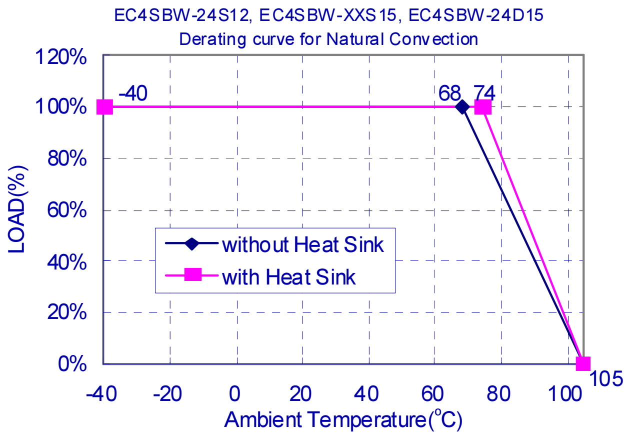
6.2 Power De-Rating Curves for EC4SBW Series

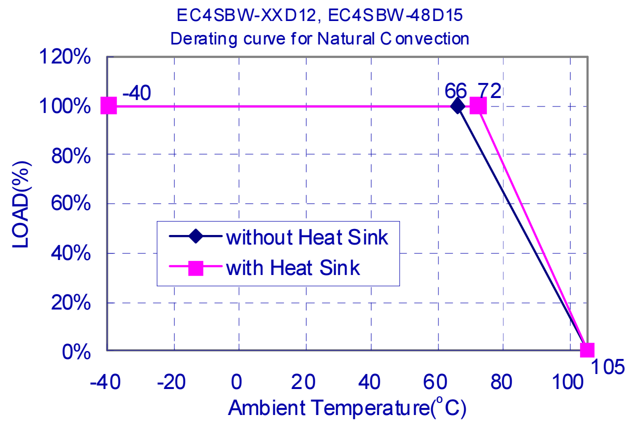
Operating Ambient temperature Range: -40℃ ~ 85℃ (with derating).

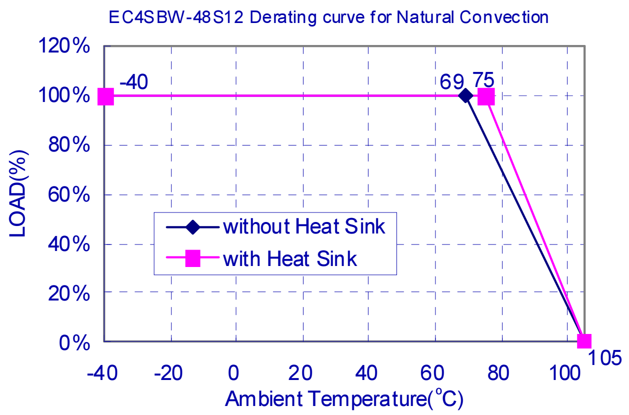
Maximum case temperature under any operating condition should not exceed 105℃.



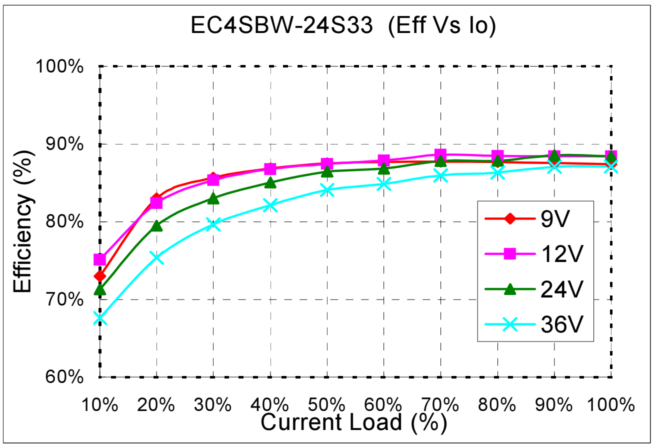


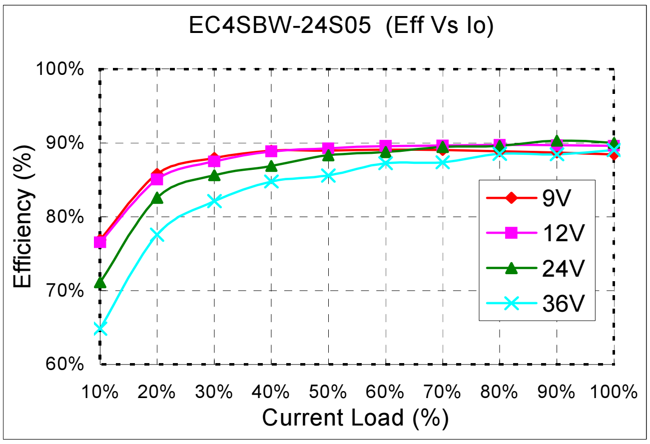


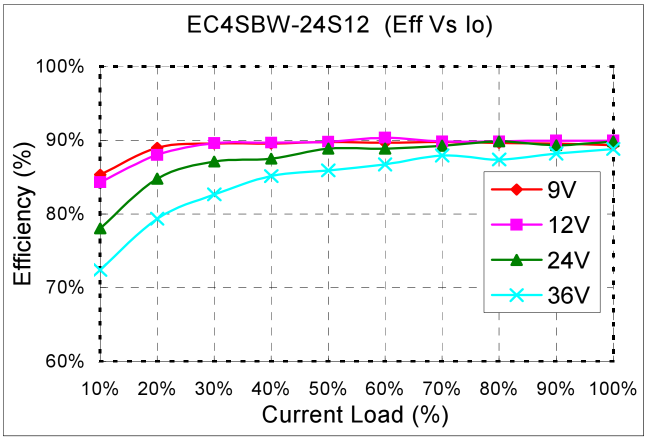


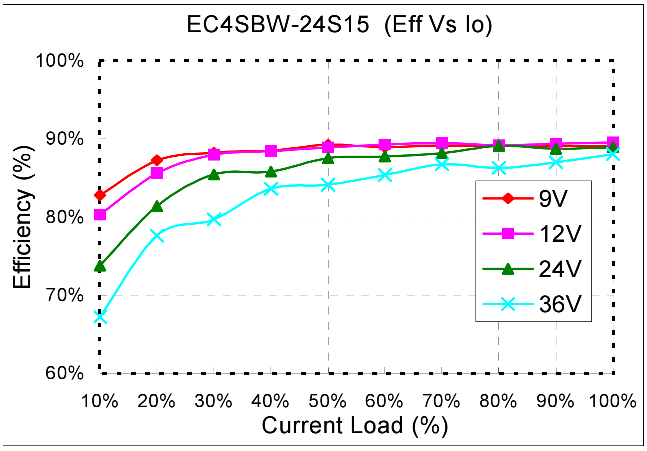


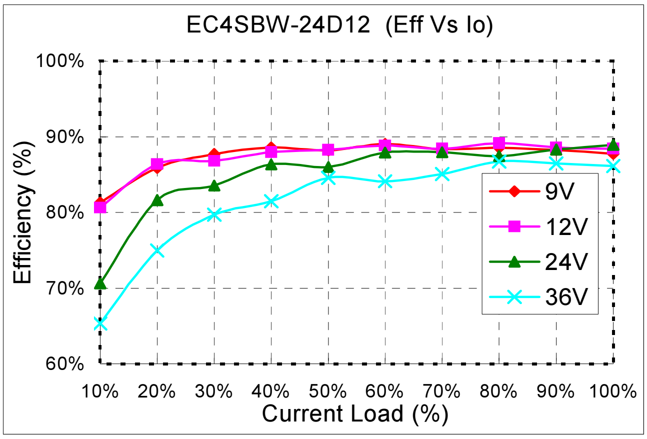
6.3 Efficiency vs. Load Curves

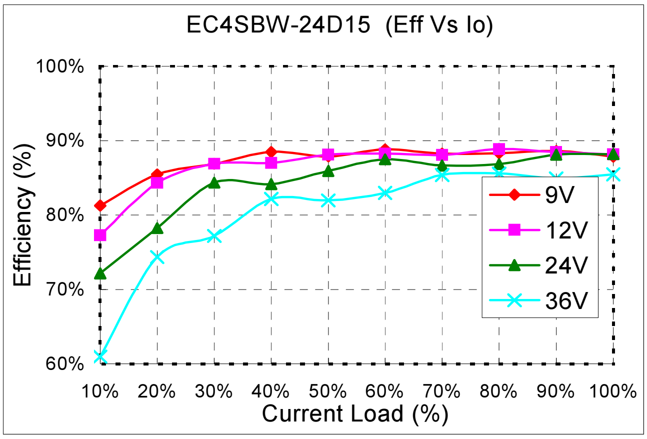


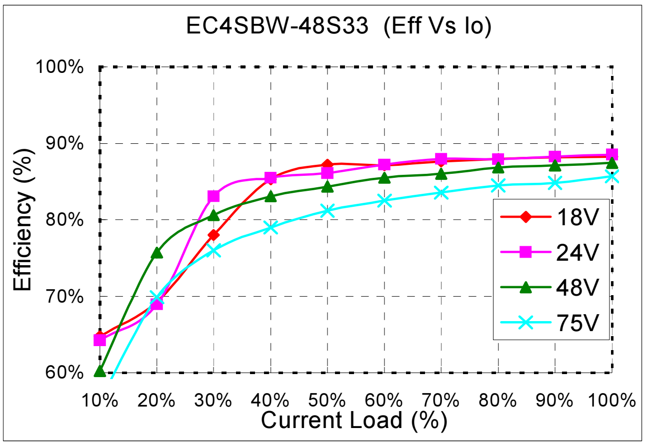


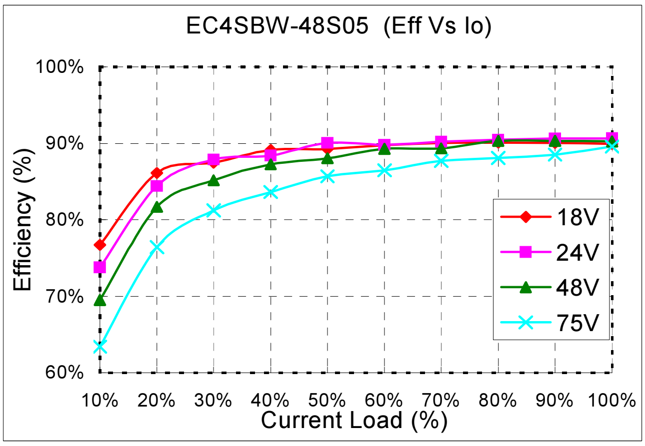


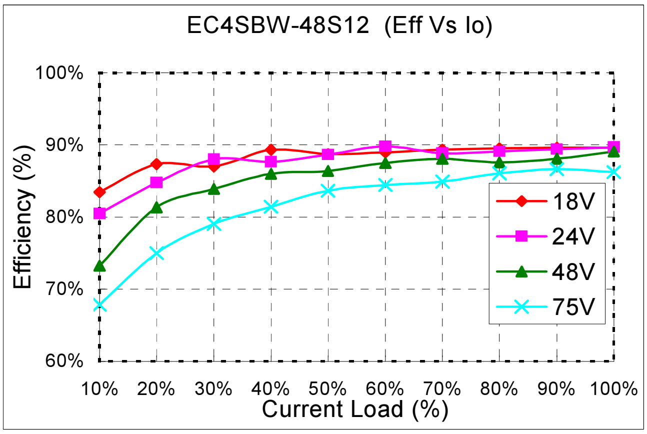


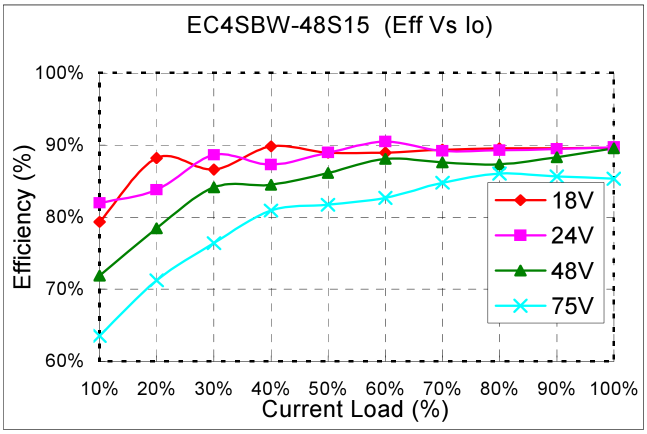


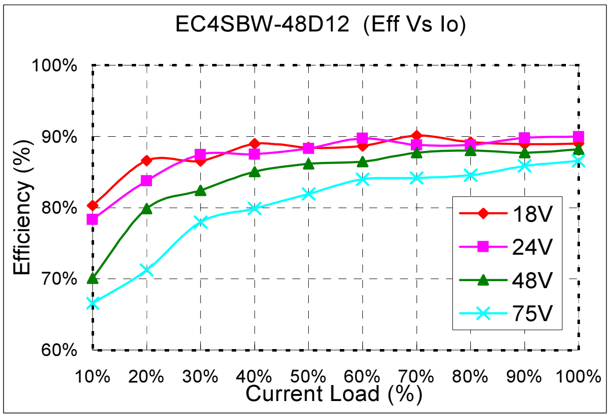


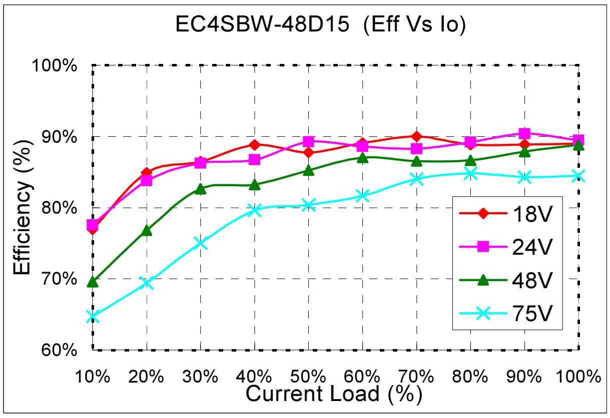

EC4SBW-48S33 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


EC4SBW-48S05 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


EC4SBW-48S12 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


EC4SBW-48S15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V

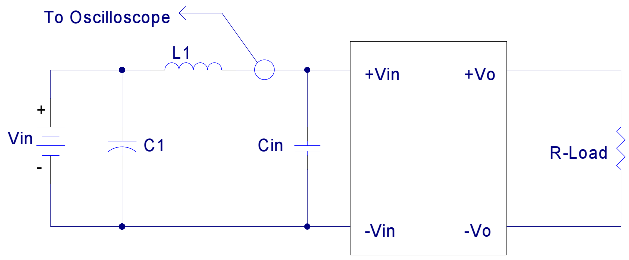

EC4SBW-48D12 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


EC4SBW-48D15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V

6.4 Input Capacitance at the Power Module

The converters must be connected to low AC source impedance. To avoid problems with loop stability source inductance should be low. Also, the input capacitors (Cin) should be placed close to the converter input pins to de-couple distribution inductance. However, the external input capacitors are chosen for suitable ripple handling capability. Low ESR capacitors are good choice. Circuit as shown in Figure 5 represents typical measurement methods for reflected ripple current. C1 and L1 simulate a typical DC source impedance. The input reflected-ripple current is measured by current probe to oscilloscope with a simulated.

Source Inductance (L1).



L1: 12uH
C1: NC
Cin: 47uF ESR<0.17ohm @100KHz

Figure 5. Input Reflected-Ripple Test Setup

6.5 Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown in Figure 6. 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 the

- 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,
VIN 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 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.

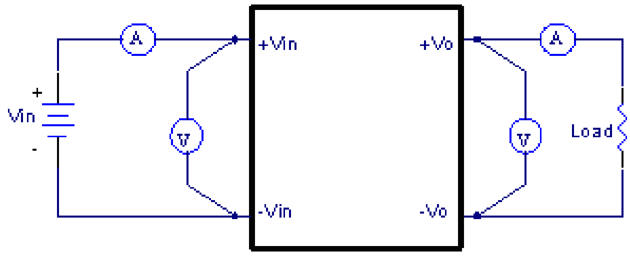


Figure 6. EC4SBW Series Test Setup

6.6 Output Voltage Adjustment

In order to trim the voltage up or down one needs to connect the trim resistor either between the trim pin and -Vo for trim-up and between trim pin and +Vo for trim-down. The output voltage trim range is ±10%. This is shown in Figure 7 and Figure 8:

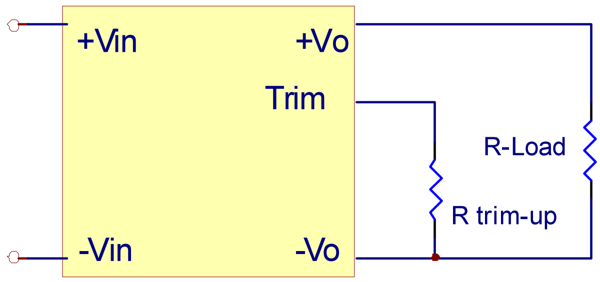


Figure 7. Trim-up Voltage Setup

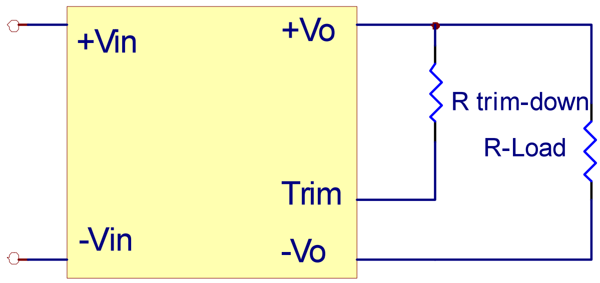


Figure 8. Trim-down Voltage Setup

1. The value of Rtrim-up defined as:

$$R_{trim-up} = \left(\frac{V_r \times R1 \times (R2 + R3)}{(V_O - V_{O,nom}) \times R2}\right) - R_t \quad (\text{K}\Omega)$$

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, Rt, R2, R3 and Vr are internal to the unit and are defined in Table 1.

Table 1 – Trim up and Trim down Resistor Values

Model Number	Output Voltage(V)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	Rt (KΩ)	Vr (V)
EC4SBW24S33 EC4SBW48S33	3.3	2.74	1.8	0.27	9.1	1.24
EC4SBW24S05 EC4SBW48S05	5.0	2.32	2.32	0	8.2	2.5
EC4SBW24S12 EC4SBW48S12	12.0	6.8	2.4	2.32	22	2.5
EC4SBW24S15 EC4SBW48S15	15.0	8.06	2.4	3.9	27	2.5

For example, to trim-up the output voltage of 5.0V module (EC4SBW-24S05) by 10% to 5.5V, R trim-up is calculated as follows:

$V_o - V_{o,\ nom} = 5.5 - 5.0 = 0.5\text{V}$

R1 = 2.32 KΩ

R2 = 2.32 KΩ

R3 = 0 KΩ

Rt = 8.2 KΩ,

Vr= 2.5 V

$$R_{trim-up} = \left(\frac{2.5 \times 2.32 \times (2.32 + 0)}{0.5 \times 2.32}\right) - 8.2 = 3.4(\text{K}\Omega)$$

2.The value of R trim-down defined as:

$$R_{trim-down} = R1 \times \left(\frac{V_r \times R1}{(V_{O,nom} - V_O) \times R2} - 1\right) - R_t \quad (\text{K}\Omega)$$

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, Rt, R2, R3 and Vr are internal to the unit and are defined in Table 1.

For example, to trim-down the output voltage of 5.0V module (EC4SBW-24S05) by 10% to 4.5V, R trim-down is calculated as follows:

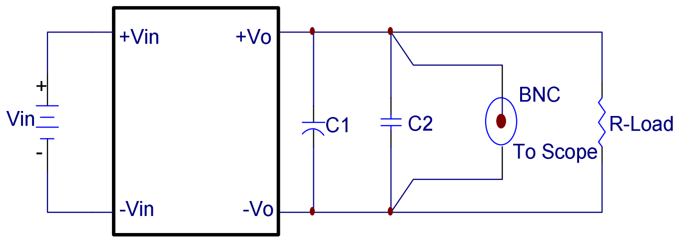
$V_{O,nom} - V_O = 5.0 - 4.5 = 0.5\text{V}$

R1 = 2.32 KΩ
R2 = 2.32 KΩ
R3 = 0 KΩ
Rt = 8.2 KΩ
Vr= 2.5 V

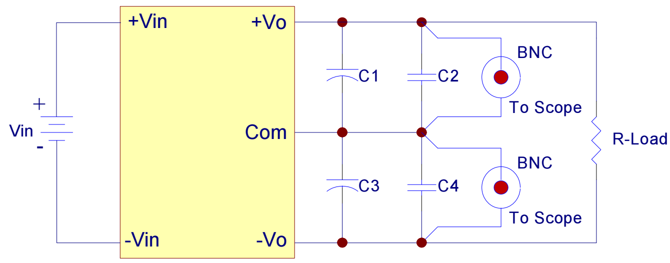
$$R_{trim-down} = 2.32 \times \left(\frac{(2.5 \times 2.32)}{0.5 \times 2.32} - 1\right) - 8.2 = 1.08 \quad (\text{K}\Omega)$$

6.7 Output Ripple and Noise Measurement

The test set-up for noise and ripple measurements is shown in Figure 9. A coaxial cable was used to prevent impedance mismatch reflections disturbing the noise readings at higher frequencies. Measurements are taken with output appropriately loaded and all ripple/noise specifications are from D.C. to 20MHz Band Width.



Single Output module



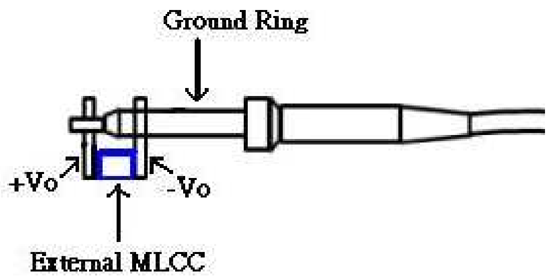
Dual Output module

Note: C1, C3: 10uF tantalum capacitor
C2, C4: 1uF ceramic capacitor

Figure 9. Output Voltage Ripple and Noise Measurement Set-Up

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.

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.

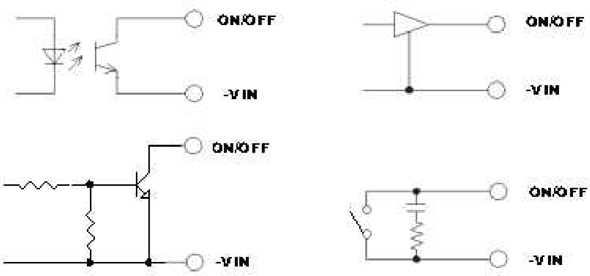


6.8 Output Capacitance

The EC4SBW 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. These series converters are designed to work with load capacitance to see technical specifications.

6.9 Remote On/Off circuit

The converter remote On/Off circuit built-in on input side. The ground pin of input side Remote On/Off circuit is –Vin pin. **Refer to 5.2** for more details. Connection examples see below.



Remote On/Off Connection Example

7. Safety & EMC

7.1 Input Fusing and Safety Considerations.

The EC4SBW series converters have not an internal fuse. However, to achieve maximum safety and system protection, always use an input line fuse. We recommended a fast acting fuse 3.15A for 24Vin models and 1.6A for 48Vin models. Figure 10 circuit is recommended by a Transient Voltage Suppressor diode across the input terminal to protect the unit against surge or spike voltage and input reverse voltage.

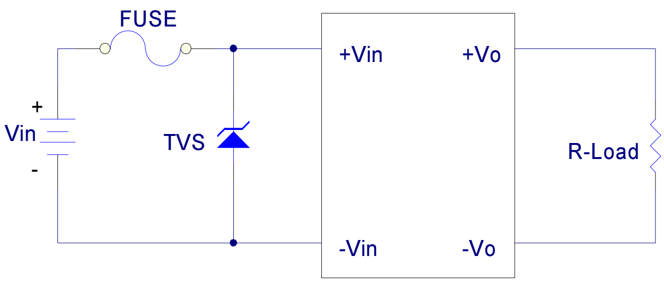


Figure 10. Input Protection

7.2 EMC Considerations

(1) EMI Test standard: EN55022 Class A Conducted Emission
Test Condition: Input Voltage: Nominal, Output Load: Full Load

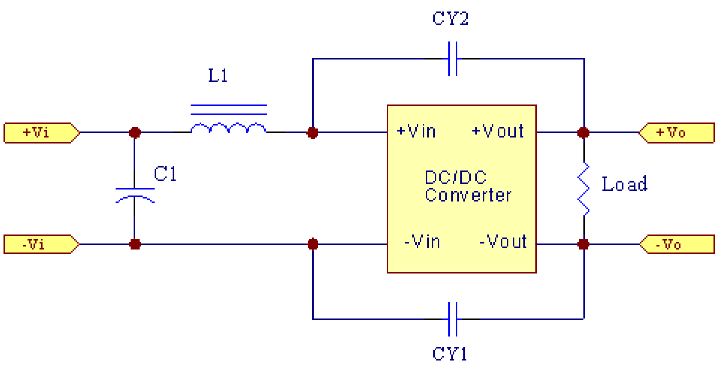


Figure 11. Connection circuit for conducted EMI testing

EN55022 class A									
Model No.	C1	L1	CY1	CY2	Model No.	C1	L1	CY1	CY2
EC4SBW-24S33	47uF/100V	1.0uH	NC	NC	EC4SBW-48S33	47uF/100V	2.2uH	NC	NC
EC4SBW-24S05	47uF/100V	1.0uH	NC	NC	EC4SBW-48S05	47uF/100V	2.2uH	NC	NC
EC4SBW-24S12	47uF/100V	1.0uH	1000pF/2KV 1206	1000pF/2KV 1206	EC4SBW-48S12	47uF/100V	2.2uH	1000pF/2KV 1206	1000pF/2KV 1206
EC4SBW-24S15	47uF/100V	1.0uH	1000pF/2KV 1206	1000pF/2KV 1206	EC4SBW-48S15	47uF/100V	2.2uH	1000pF/2KV 1206	1000pF/2KV 1206
EC4SBW-24D12	47uF/100V	1.0uH	NC	NC	EC4SBW-48D12	47uF/100V	2.2uH	NC	NC
EC4SBW-24D15	47uF/100V	1.0uH	NC	NC	EC4SBW-48D15	47uF/100V	2.2uH	NC	NC

Note: C1 is CHEMI-CON KY aluminum capacitors, CY1&CY2 are ceramic capacitors
L1:1.0uH is ABC SR04031R0MLB, 2.2uH is CHILISIN SCD0403T-2R2M-N

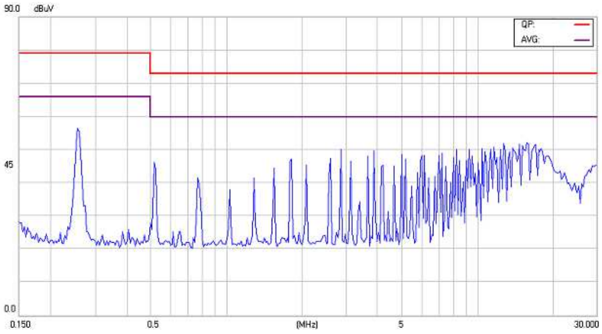


Figure 12. Conducted Class A of EC4SBW-24S33

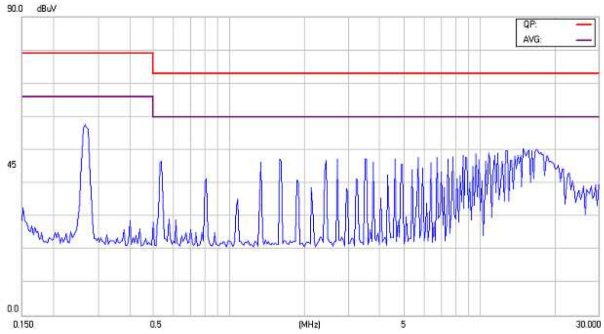


Figure 13. Conducted Class A of EC4SBW-24S05

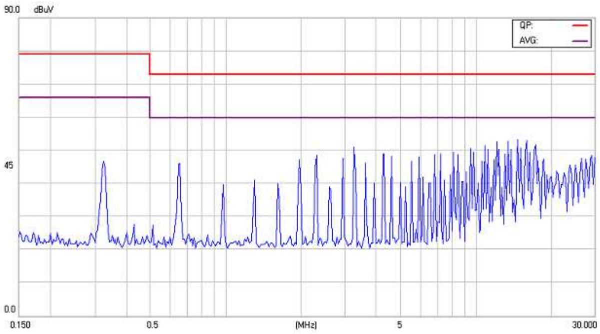


Figure 14. Conducted Class A of EC4SBW-24S12

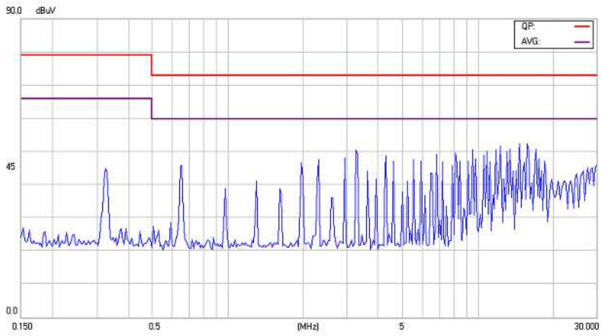


Figure 15. Conducted Class A EC4SBW-24S15

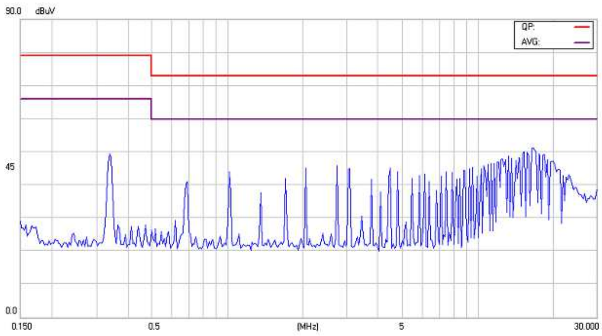


Figure 16. Conducted Class A of EC4SBW-24D12

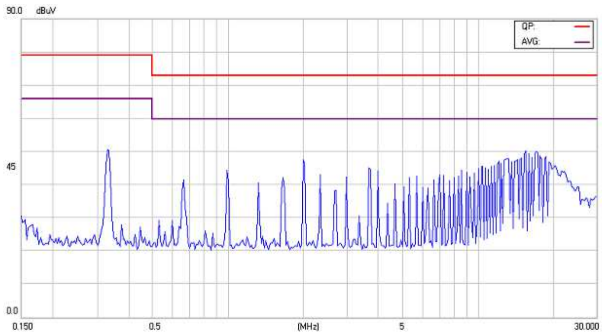


Figure 17. Conducted Class A of EC4SBW-24D15

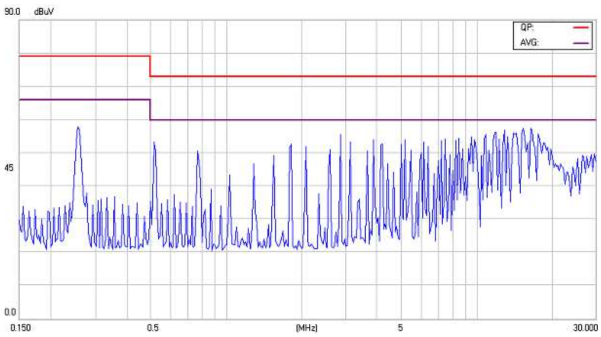


Figure 18. Conducted Class A of EC4SBW-48S33

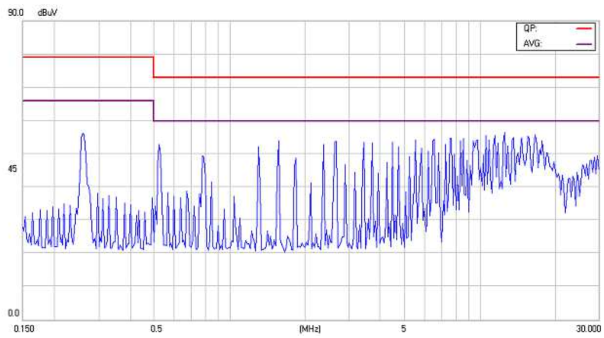


Figure 19. Conducted Class A of EC4SBW-48S05

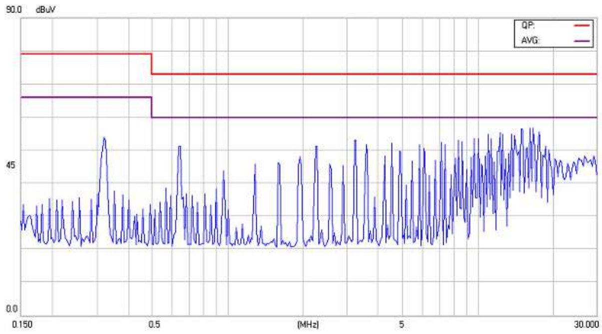


Figure 20. Conducted Class A of EC4SBW-48S12

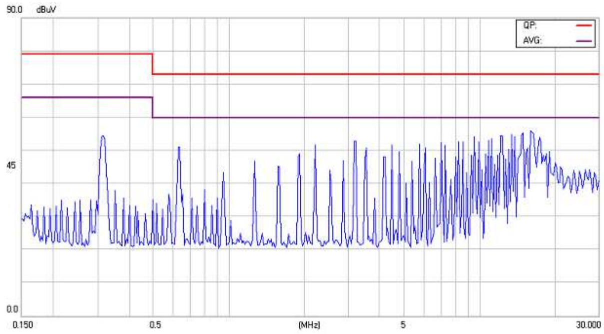


Figure 21. Conducted Class A of EC4SBW-48S15

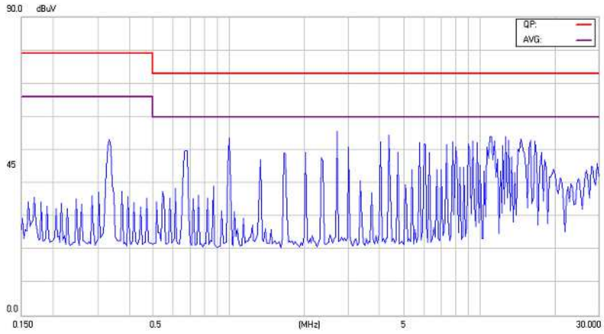


Figure 22. Conducted Class A of EC4SBW-48D12

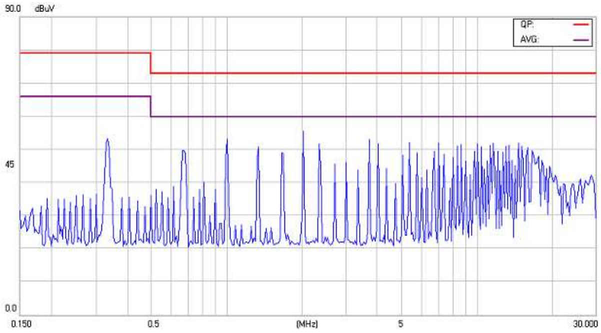


Figure 23. Conducted Class A of EC4SBW-48D15

(2) EMI Test standard: EN55022 Class B Conducted Emission
Test Condition: Input Voltage: Nominal, Output Load: Full Load

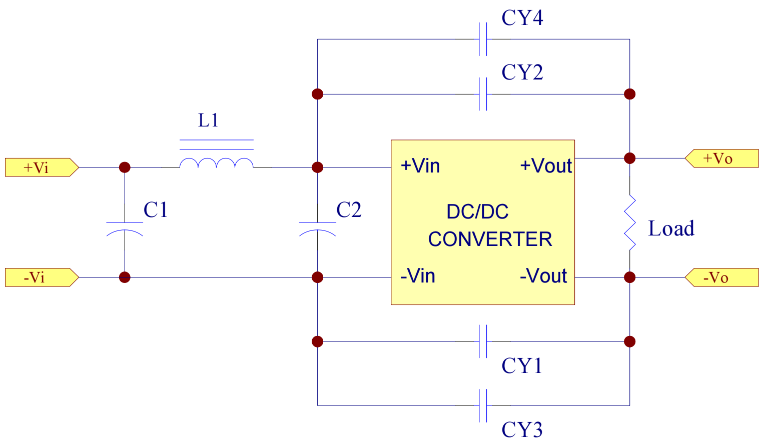


Figure 24. Connection circuit for conducted EMI testing

EN55022 class B													
Model No.	C1,C2	L1	CY1	CY2	CY3	CY4	Model No.	C1,C2	L1	CY1	CY2	CY3	CY4
EC4SBW-24S33	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	NC	NC	NC	EC4SBW-48S33	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	4700pF/ 2KV 1808	2200pF/ 2KV 1808	2200pF/ 2KV 1808
EC4SBW-24S05	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	NC	NC	NC	EC4SBW-48S05	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	4700pF/ 2KV 1808	2200pF/ 2KV 1808	2200pF/ 2KV 1808
EC4SBW-24S12	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	4700pF/ 2KV 1808	NC	NC	EC4SBW-48S12	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	4700pF/ 2KV 1808	2200pF/ 2KV 1808	2200pF/ 2KV 1808
EC4SBW-24S15	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	4700pF/ 2KV 1808	NC	NC	EC4SBW-48S15	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	4700pF/ 2KV 1808	2200pF/ 2KV 1808	2200pF/ 2KV 1808
EC4SBW-24D12	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	NC	NC	NC	EC4SBW-48D12	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	4700pF/ 2KV 1808	2200pF/ 2KV 1808	2200pF/ 2KV 1808
EC4SBW-24D15	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	NC	NC	NC	EC4SBW-48D15	47uF/ 100V	2.2uH	4700pF/ 2KV 1808	4700pF/ 2KV 1808	2200pF/ 2KV 1808	2200pF/ 2KV 1808

Note: C1&C2 are CHEMI-CON KY aluminum capacitors, CY1&CY2&CY3&CY4 are ceramic capacitors
L1:2.2uH is VISHAY IHLP2525CZER2R2M01

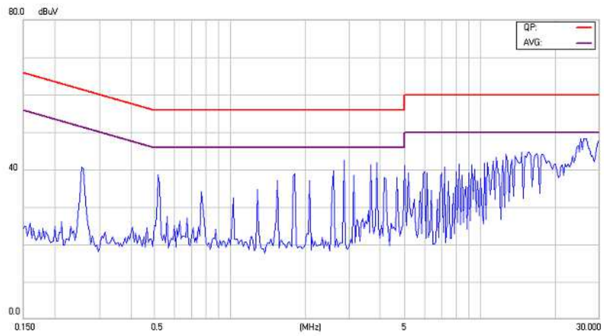


Figure 25. Conducted Class B of EC4SBW-24S33

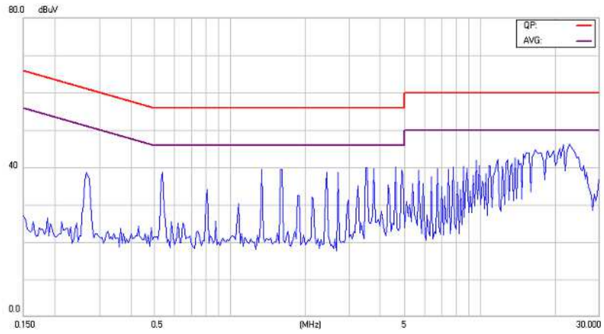


Figure 26. Conducted Class B of EC4SBW-24S05

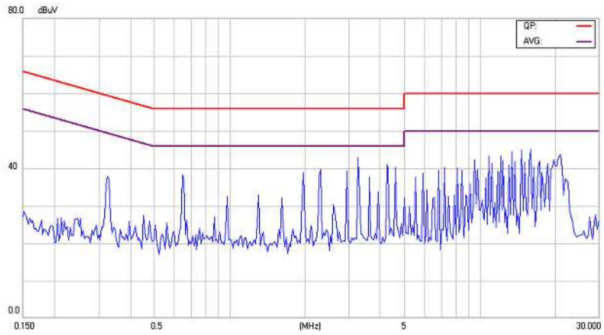


Figure 27. Conducted Class B of EC4SBW-24S12

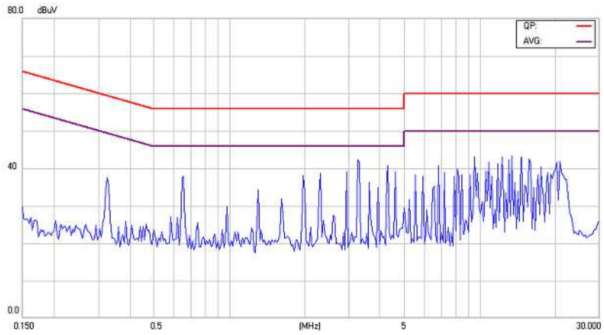


Figure 28. Conducted Class B EC4SBW-24S15

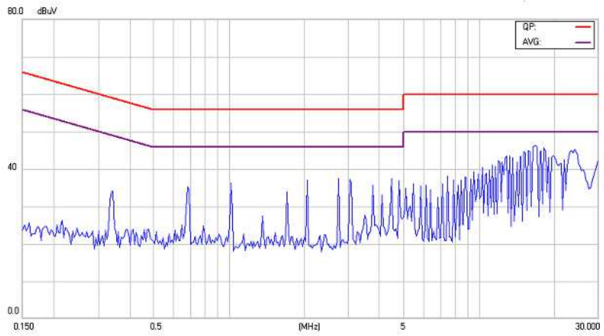


Figure 29. Conducted Class B of EC4SBW-24D12

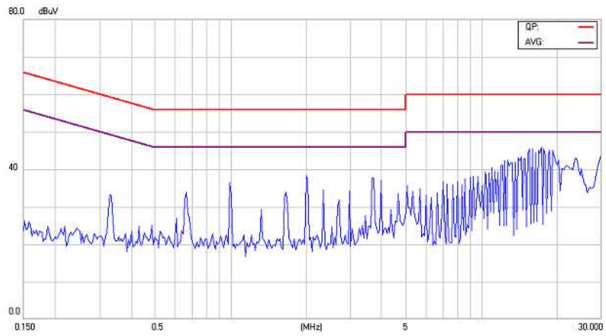


Figure 30. Conducted Class B of EC4SBW-24D15

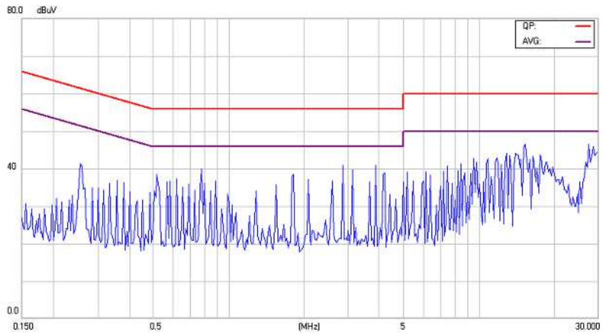


Figure 31. Conducted Class B of EC4SBW-48S33

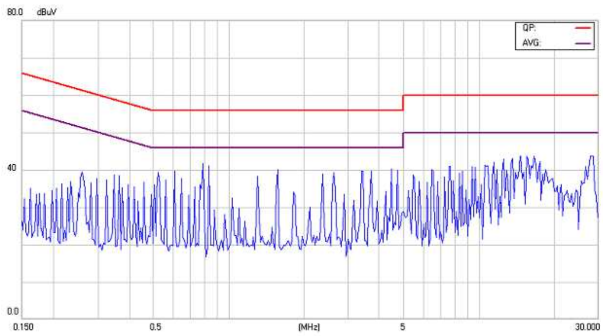


Figure 32. Conducted Class B of EC4SBW-48S05

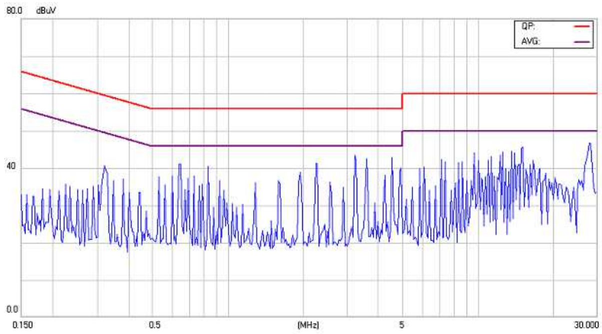


Figure 33. Conducted Class B of EC4SBW-48S12

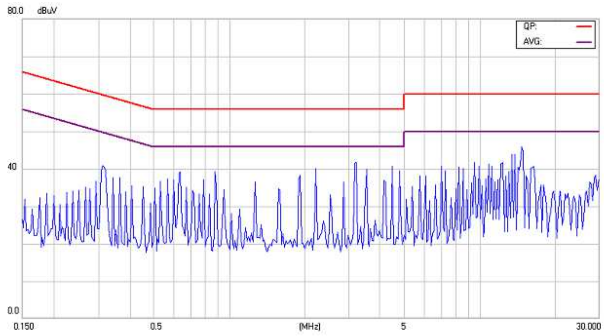


Figure 34. Conducted Class B of EC4SBW-48S15

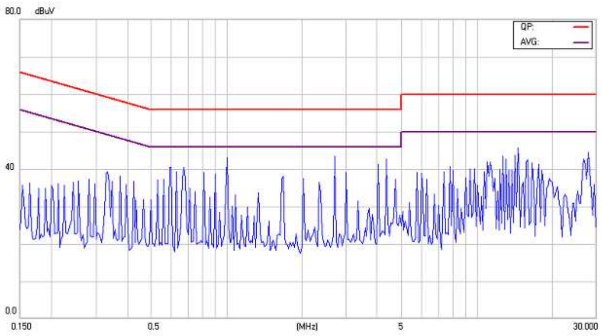


Figure 35. Conducted Class B of EC4SBW-48D12

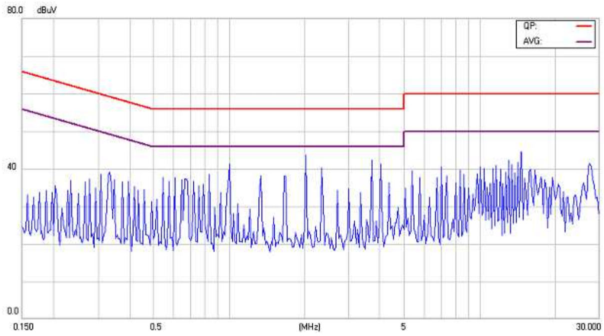


Figure 36. Conducted Class B of EC4SBW-48D15

8. Part Number

EC4SBW – XX X XX X

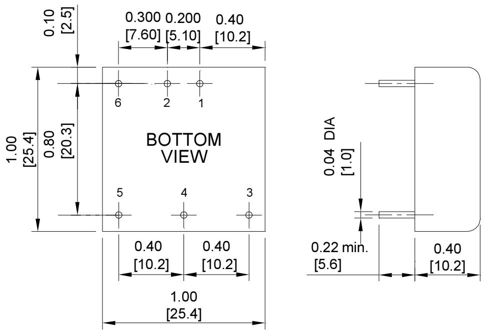
- EC4SBW Series
- 24 : Nominal Input Voltage 24VDC
- 48 : Nominal Input Voltage 48VDC
- S : Single Output
- D : Dual Output
- 33 : Output Voltage 3.3 VDC
- 05 : Output Voltage 5 VDC
- 12 : Output Voltage 12 VDC
- 15 : Output Voltage 15 VDC
- None : Positive Logic Remote On/Off
- N : Negative Logic Remote On/Off

9. Mechanical Specifications

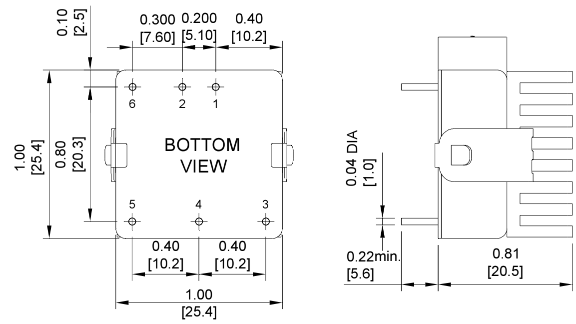
All Dimensions In Inches (mm)

Tolerances Inches: X.XX= ±0.04 , X.XXX= ±0.010

Millimeters: X.X= ±1.0 , X.XX=±0.25



Suffix "+K-C087" Type



PIN CONNECTION		
Pin	Single	Dual
1	+Input	+Input
2	-Input	-Input
3	+V Output	+V Output
4	Trim	Common
5	-V Output	-V Output
6	Remote	Remote

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