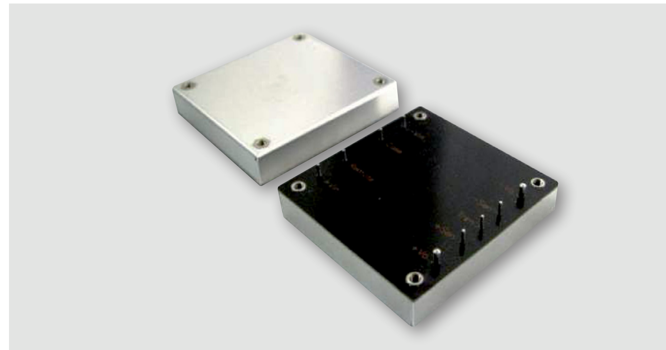
P R

B X

POWERBOX Industrial Line
PHE100W Series
100W 2:1/4:1 Single Output
DC/DC Converter
Manual V10



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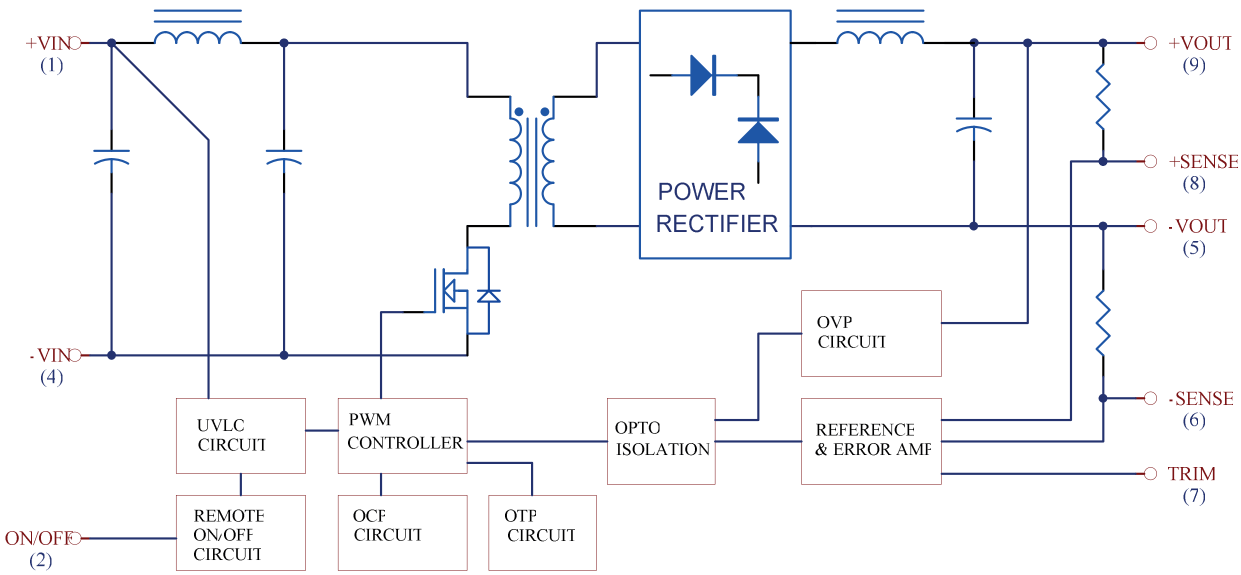
1. Introduction

The PHE100W series offers 100 watts of output power with high power density in an industry standard halfbrick package. The PHE series has wide (4:1) input voltage ranges of 9-36 and 18-75VDC and provides a precisely regulated output. This series has features such as high efficiency, 1500VDC isolation and a case operating temperature range of –40°C to 105°C.The modules are fully protected against input UVLO (under voltage lock out), output short circuit, output overvoltage and overtemperature conditions. Furthermore, the standard control functions include remote on/off and output voltage trimming. All models are highly suited to telecommunications, distributed power architectures, battery operated equipment, industrial, and mobile equipment applications.

2. DC/DC Converter Features

- 100W isolated output
- Efficiency (at full load) up to 93%
- Regulated output
- Fixed switching frequency
- Input under voltage lockout protection
- Over current protection
- Remote ON/OFF
- Continuous short circuit protection
- Industry standard half-brick package
- Fully isolated to 1500VDC

3. Electrical Block Diagram



Electrical Block Diagram

4. Technical Specifications

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

Absolute Maximum Ratings

Parameters	Notes and Conditions	Device	Min	Typical	Max	Units
Input voltage						
Continuous		24Vin	9	24	36	VDC
		48Vin	18	48	75	VDC
Transient	100 ms	24Vin			50	VDC
		48Vin			100	VDC
Operating case temperature		All	-40		105	°C
Storage temperature		All	-55		105	°C
Isolation voltage, 1 minute	Input/output, input/case, output/case	All	1500			VDC

Input Characteristics

Parameters	Notes and Conditions	Device	Min	Typical	Max	Units
Operating input voltage		24Vin	9	24	36	VDC
		48Vin	18	48	75	VDC
Input under voltage lockout						
Turn-on voltage threshold		24Vin	8	8.5	8.8	VDC
		48Vin	16.5	17	17.5	VDC
Turn-off voltage threshold		24Vin	7.7	8	8.3	VDC
		48Vin	15.5	16	16.5	VDC
Lockout hysteresis voltage		24Vin		0.6		VDC
		48Vin		0.6		VDC
Maximum input current	100% load, Vin=9V for 24V modules	24Vin			13	A
	100% load, Vin=18V for 48V modules	48Vin			6.3	A
No-load input current		24S3V3		200		mA
		24S05		200		mA
		24S12		200		mA
		24S15		200		mA
		24S24		100		mA
		24S48		100		mA
		484S3V3		130		mA
		48S05		130		mA
		48S12		100		mA
		48S15		100		mA
		48S24		100		mA
		48S48		100		mA
Inrush current (I^2t)		All			0.1	A^2s
Input reflected ripple current	P-P thru 12uH inductor, 5Hz to 20Mhz	All		30		mA

Output Characteristics

Parameters	Notes and Conditions	Device	Min	Typical	Max	Units
Output voltage set point	Vin=Nominal Vin, Io = Io_max, Tc=25°C	Vo=3.3V	3.2505	3.3	3.3495	VDC
		Vo=5.0V	4.925	5	5.075	VDC
		Vo=12V	11.82	12	12.18	VDC
		Vo=15V	14.775	15	15.225	VDC
		Vo=24V	23.64	24	24.36	VDC
		Vo=48V	47.28	48	48.72	VDC
Output voltage regulation						
Load regulation	Io=Io_min to Io_max	All			±0.2	%
Line regulation	Vin=low line to high line	All			±0.2	%
Temperature coefficient	TC=-40°C to 105°C	All			±0.03	%/°C
Output voltage ripple and noise (5Hz to 20MHz bandwidth)						
Peak-to-peak	Full load, 10uF tantalum and 1.0uF	Vo=3.3 & 5.0V			100	mV
	ceramic capacitors	Vo=12 & 15V			150	mV
	Full load, 10uF aluminum and 1.0uF	Vo=24V			240	mV
	ceramic capacitors	Vo=48V			480	mV
RMS	Full load, 10uF tantalum and 1.0uF	Vo=3.3 & 5.0V			40	mV
	ceramic capacitors	Vo=12 & 15V			60	mV
	Full load, 10uF aluminum and 1.0uF	Vo=24V			100	mV
	ceramic capacitors	Vo=48V			200	mV
Operating output current range		Vo=3.3V	0		25	A
		Vo=5.0V	0		20	A
		Vo=12V	0		8.4	A
		Vo=15V	0		6.7	A
		Vo=24V	0		4.2	A
		Vo=48V	0		2.1	A
Output DC current limit inception	Output voltage=90% , nominal output		105	125	140	%
Maximum output capacitance	Full load (resistive)	Io=25A			25000	uF
		Io=20A			20000	uF
		Io=8.4A			8400	uF
		Io=6.7A			6700	uF
		Io=4.2A			4200	uF
		Io=2.1A			2100	uF

Dynamic Characteristics

Parameters	Notes and Conditions	Device	Min	Typical	Max	Units
Output voltage current transient	*1 A/us*					
Step change in output current	75% to 100% of Io.max				±5	%
Setting time (within 1% Vonominal)	di/dt=0.1A/us				500	us
Turn-on delay and rise time						
Turn-on delay time from on/off control	Von/off to 10% Vo, set	All		10		ms
Turn-on delay time, from input	Vin,min. to 10%Vo,set	All		10		ms
Outupt voltage rise time	10%Vo,set to 90%Vo,set	All		10		ms

Efficiency

Parameters	Notes and Conditions	Device	Min	Typical	Max	Units
100% load	Vin=12VDC	24S3V3		85.5		%
		24S05		88.5		%
		24S12		90		%
		24S15		89.5		%
		24S24		88.5		%
		24S48		89.5		%
	Vin=24VDC	24S3V3		87		%
		24S05		89.5		%
		24S12		90.5		%
		24S15		90.5		%
		24S24		89		%
		24S48		88.5		%
	Vin=24VDC	484S3V3		87.5		%
		48S05		91.5		%
		48S12		92.5		%
		48S15		91.5		%
		48S24		91		%
		48S48		91.5		%
	Vin=48VDC	484S3V3		88		%
		48S05		92		%
		48S12		93		%
		48S15		92.5		%
		48S24		91		%
		48S48		90.5		%

Isolation Characteristics

Parameters	Notes and Conditions	Device	Min	Typical	Max	Units
Isolation voltage, 1 minute	Input/output, input/case, output/case				1500	VDC
Isolation resistance			10			MΩ
Isolation capacitance				1000		pF

Feature Characteristics

Parameters	Notes and Conditions	Device	Min	Typical	Max	Units
Switching frequency				250		KHz
On/off control, positive remote on/off logic						
Logic low (module off)	Von/off at Ion/off=1.0mA				1.8	V
Logic high (module on)	Von/off at Ion/off=0.0uA		3.5 or open circuit		75	V
On/off control, negative remote on/off logic						
Logic high (module off)	Von/off at Ion/off=0.0mA		3.5 or open circuit		75	V
Logic low (module on)	Von/off at Ion/off=1.0uA				1.8	V
On/off current (for both remote on/off logic)	Ion/off at Von/off=0.0V			0.3	1	mA
Leakege current (for both remote on/off logic)	Logic high, Von/off=15V				30	uA
Off converter input current	Shutdown input idle current			4	10	mA
Output voltage trim range	Pout=max rated power		-10		+10	%
Output over voltage protection			115	125	140	%
Over-temperature shutdown				105		°C

General Specifications

Parameters	Notes and Conditions	Device	Min	Typical	Max	Units
MTBF	Io=100% of Io, max:	XXS05		0.75		Mhours
	Ta=25°C per MIL-HDBK-217F	Others		0.88		Mhours
Weight				9518.4		grams

5. Main Features and Functions

5.1 Operating Temperature Range

The PHE100W 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 open half brick models is influenced by usual factors, such as:

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

5.2 Output Voltage Adjustment

Section 6.8 describes in detail how to trim the output voltage with respect to its set point. The output voltage on all models is adjustable within the range of +10% to –10%.

5.3 Over Current Protection

All models have internal overcurrent and continuous short circuit protetion. 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.

5.4 Output Overvoltage Protection

The output overvoltage protection consists of circuitry that internally limits the output voltage. If more accurate output over voltage protection is required then an external circuit can be used via the remote on/off pin.

5.5 Remote On/Off

The PHE100W 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 or open circuit). Setting the pin low (<1.8Vdc) 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 or open circuit). The converter turns on if the ON/OFF pin input is low (<1.8Vdc). Note that the converter is off by default.

5.6 UVLO (Undervoltage Lock Out)

Input under voltage lockout is standard on the PHE100W 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.

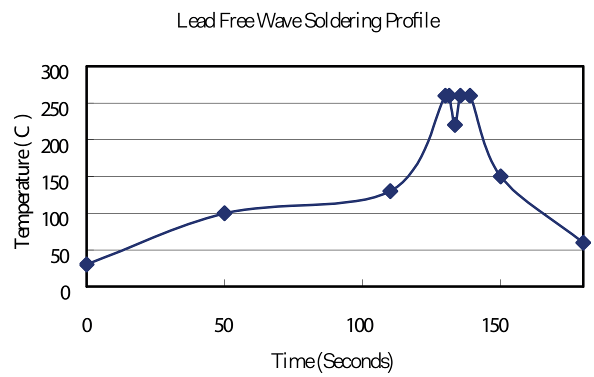
5.7 Overtemperature Protection

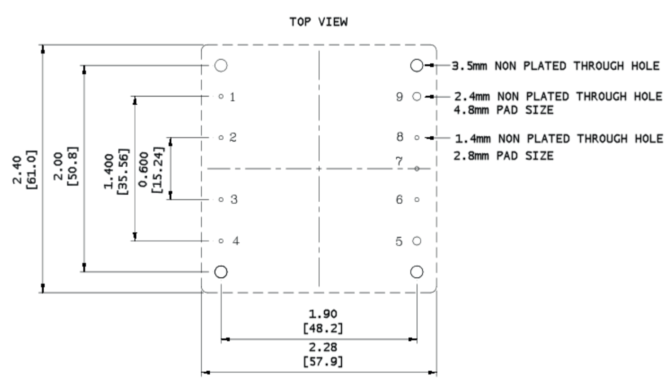
These modules have an overtemperature protection circuit to safeguard against thermal damage. Shutdown occurs with the maximum case reference temperature is exceeded. The module will restart when the case temperature falls below overtemperature shutdown threshold

6. Applications

6.1 Recommended Layout, PCB Footprint and Soldering Information

The system designer or end user must ensure that metal and other components in the vicinity of the converter meet the spacing requirements for which the system is approved. Low resistance and 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 soldering profile and PCB layout are shown below.





6.2 Convection Requirements for Cooling

To predict the approximate cooling needed for the half brick module, refer to the power derating curves in section 6.4. 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 100°C as measured at the center of the top of the case (thus verifying proper cooling).

6.3 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 test data is presented in section 6.4. The power output of the module should not be allowed to exceed rated power (Vo_set x Io_max).

6.4 Power Derating

The operating case temperature range of PHE100W series is -40°C to +105°C. When operating the CHE100W series, proper derating or cooling is needed. The maximum case temperature under any operating condition should not exceed 105°C.

Example:

What is the minimum airflow necessary for a PHE100W-48S12 operating at nominal line voltage, an output current of 8.4A, and a maximum ambient temperature of 50°C?

Solution:

Given: Vin=48Vdc, Vo=12Vdc, Io=8.4A

Determine power dissipation (P_d): $P_d = P_i - Po = P_o(1-\eta)/\eta$

$P_d = 12V \times 8.4A \times (1-0.93)/0.93 = 7.59Watts$

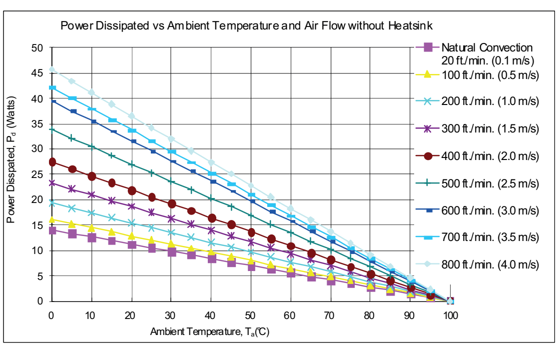
Determine airflow: Given: $P_d = 7.59W$ and $T_a = 50°C$

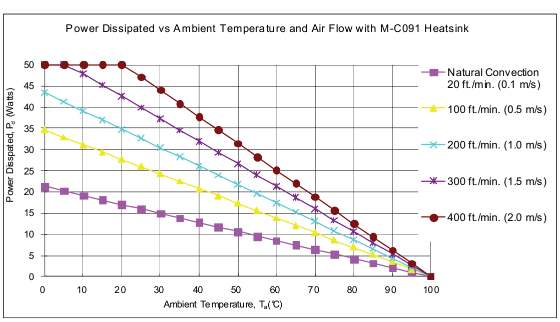
Check Power Derating curve: Minimum airflow= 100 ft./min.

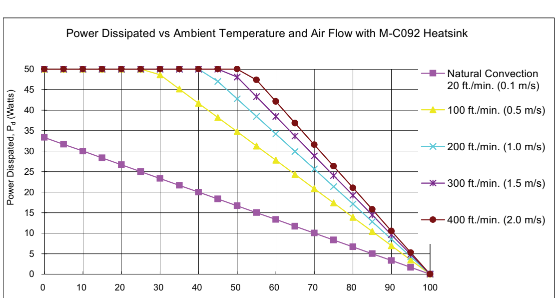
Verify:

Maximum temperature rise is $\Delta T = P_d \times R_{ca} = 7.59W \times 6.21 = 47.13°C$.

Maximum case temperature is $T_c = T_a + \Delta T = 97.13°C < 105°C$.







Where:

The R_{ca} is thermal resistance from case to ambient environment.

T_a is ambient temperature and T_c is case temperature.

Example (with heatsink M-C091):

What is the minimum airflow necessary for a PHE100W-48S12 operating at nominal line voltage, an output current of 8.4A, and a maximum ambient temperature of 60°C .

Solution:

Given: Vin=48Vdc, Vo=12Vdc, Io=8.4A

Determine Power dissipation (P_d): $P_d = P_i - P_o = P_o(1-\eta)/\eta$

$P_d = 12 \times 8.4 \times (1-0.93)/0.93 = 7.59Watts$

Determine airflow: Given: $P_d = 7.59W$ and $T_a = 60°C$

Check above power derating curve: Natural Convection

Verify:

Maximum temperature rise is $\Delta T = P_d \times R_{ca} = 7.59W \times 4.7 = 35.67°C$

Maximum case temperature is $T_c = T_a + \Delta T = 95.67°C < 105°C$

Where:

The R_{ca} is thermal resistance from case to ambient environment.

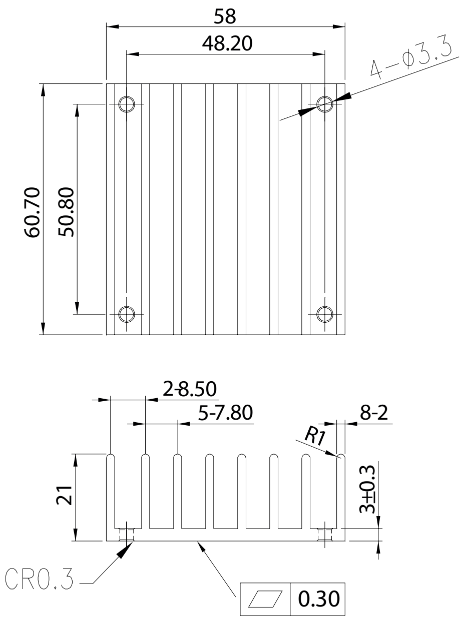
T_a is ambient temperature and T_c is case temperature.

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

Air Flow Rate	**Typical Rca**
Natural convection 20ft./min. (0.1m/s)	4.70°C/W
100 ft./min. (0.5m/s)	2.89°C/W
200 ft./min. (1.0m/s)	2.30°C/W
300 ft./min. (1.5m/s)	1.88°C/W
400 ft./min. (2.0m/s)	1.59°C/W

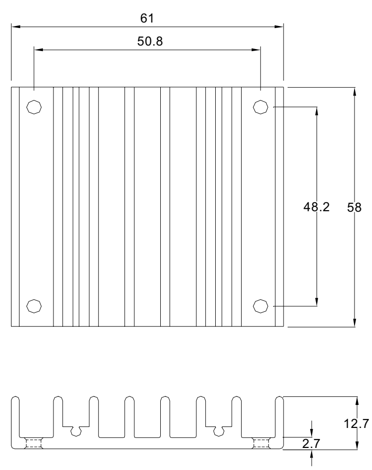
Air Flow Rate	**Typical Rca**
Natural convection 20ft./min. (0.1m/s)	3.00°C/W
100 ft./min. (0.5m/s)	1.44°C/W
200 ft./min. (1.0m/s)	1.17°C/W
300 ft./min. (1.5m/s)	1.04°C/W
400 ft./min. (2.0m/s)	0.95°C/W

6.5 Half Brick Heat Sinks



M-C308 (G6620400201)
Longitudinal Heat Sink

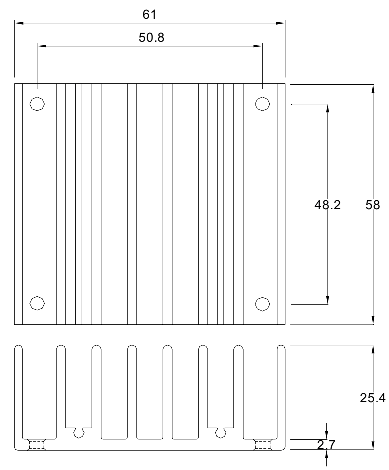
Rca:
3.90℃/W (typ.), natural convection
1.74℃/W (typ.), at 100LFM
1.33℃/W (typ.), at 200LFM
1.12℃/W (typ.), at 300LFM
0.97℃/W (typ.), at 400LFM



M-C091

M-C091 (G6610120402)
Transverse Heat Sink

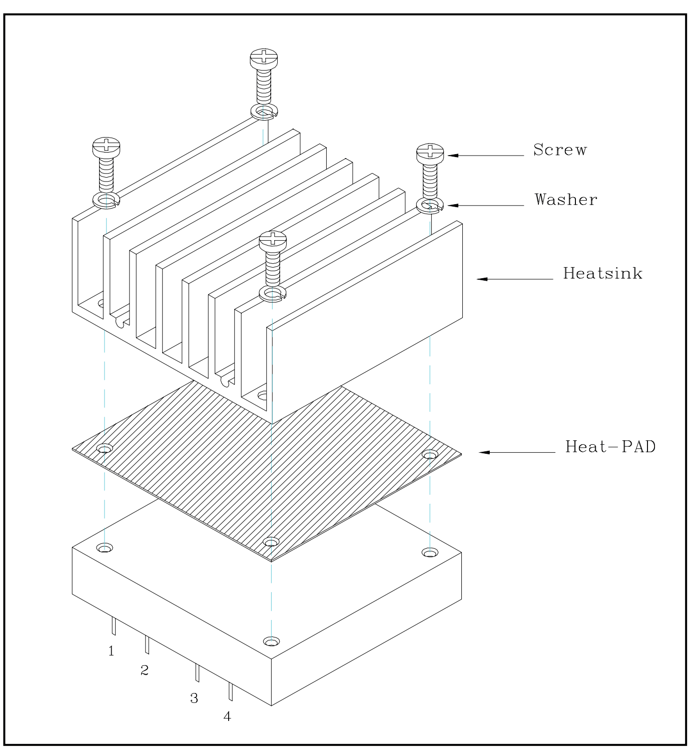
Rca:
4.70℃/W (typ.), natural convection
2.89℃/W (typ.), at 100LFM
2.30℃/W (typ.), at 200LFM
1.88℃/W (typ.), at 300LFM
1.59℃/W (typ.), at 400LFM



M-C092

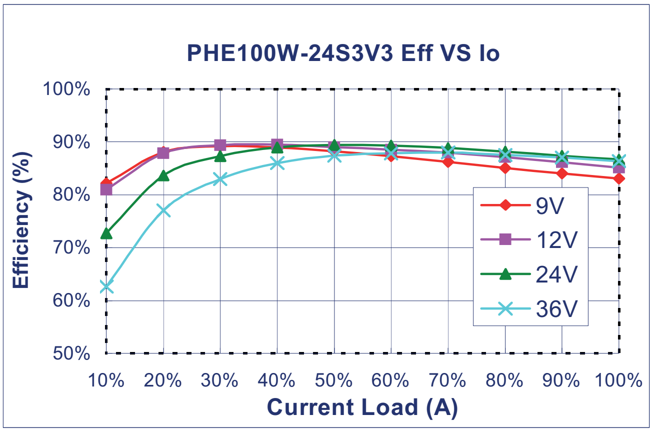
M-C092 (G6610130402)
Transverse Heat Sink

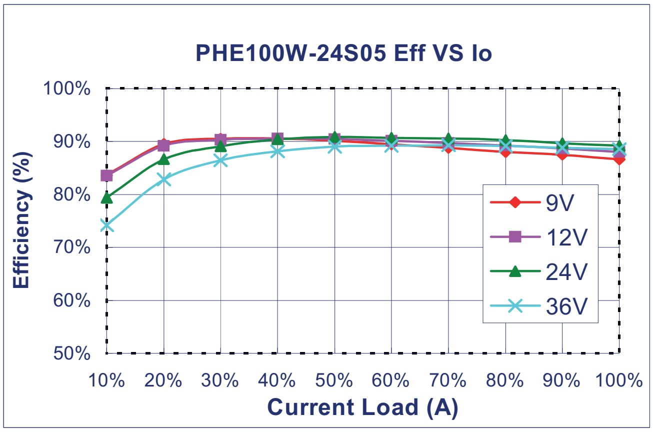
Rca:
3.00℃/W (typ.), natural convection
1.44℃/W (typ.), at 100LFM
1.17℃/W (typ.), at 200LFM
1.04℃/W (typ.), at 300LFM
0.95 °C/W (typ.), at 400LFM

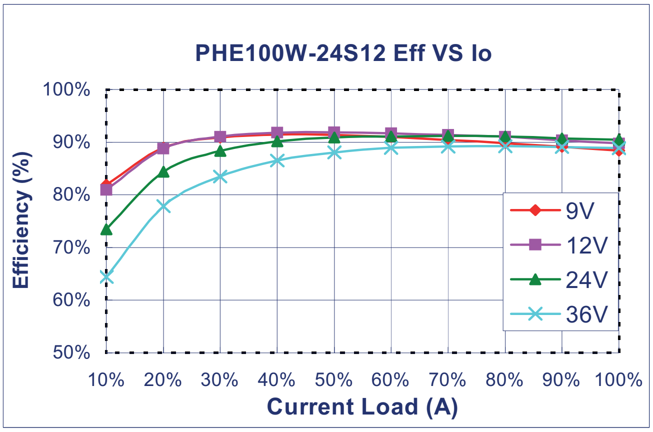


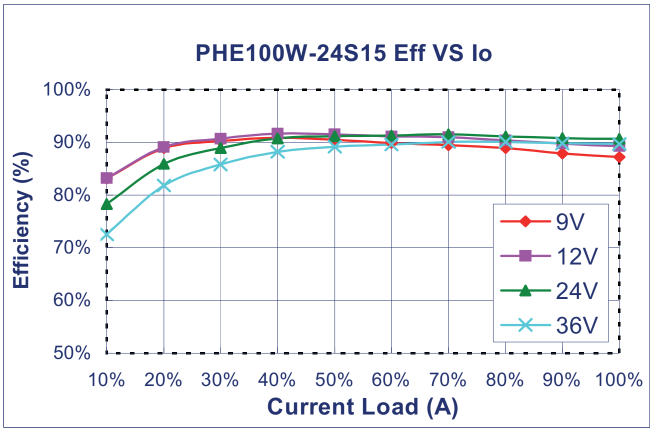
THERMAL PAD: SZ 56.9*60*0.25 mm
(G6135041091)
SCREW: SMP+SW M3*8L
(G75A1300322)

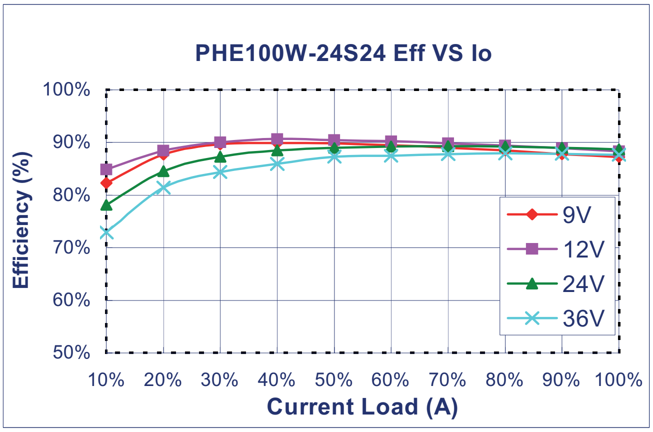
6.6 Efficiency VS Load

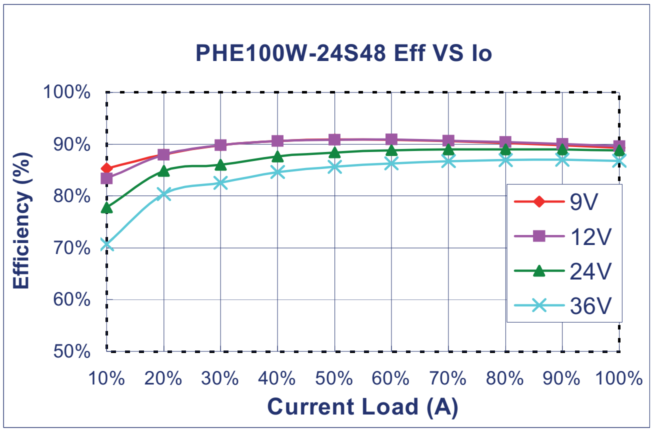


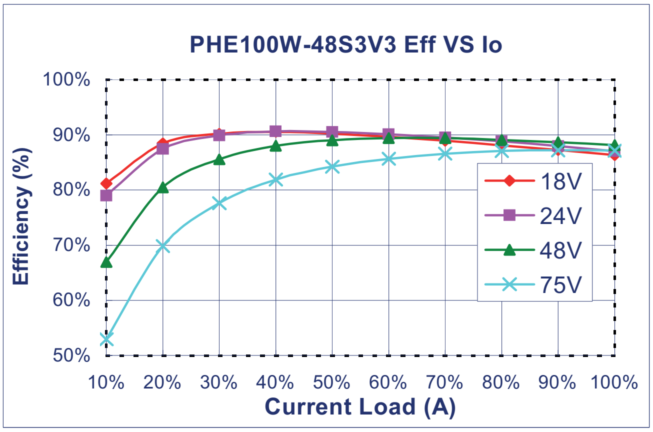


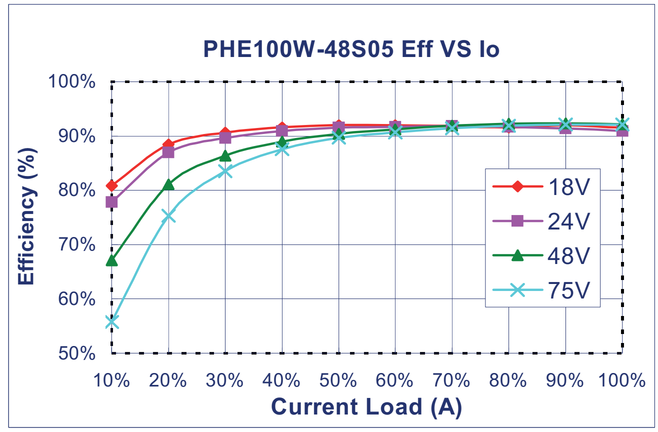


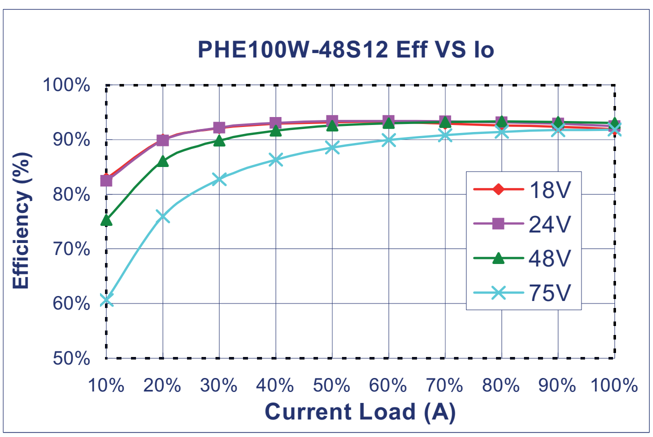


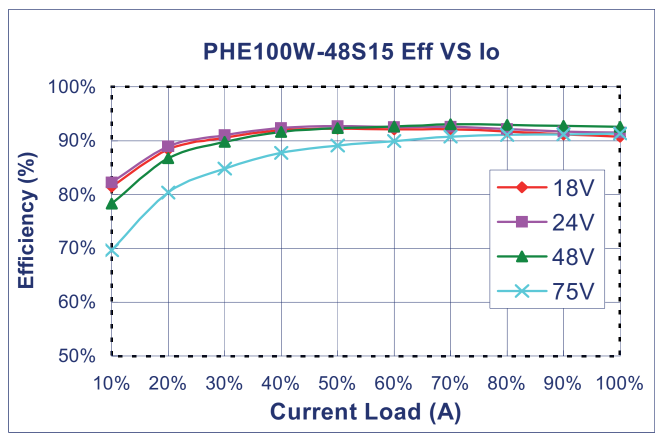


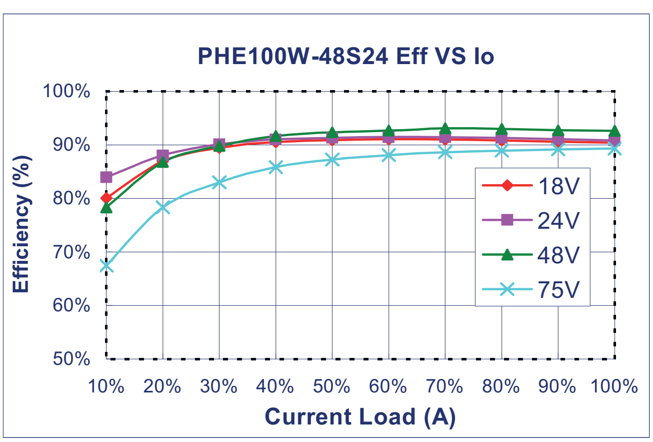


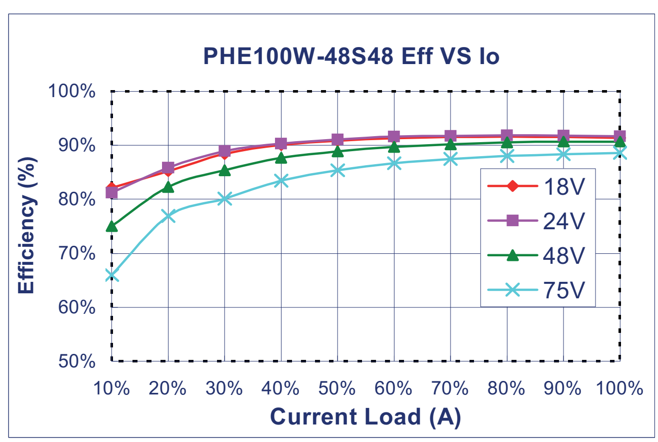












Note: The Y-axis (Efficiency) shows values from 55% to 90% EXCEPT on models 24S15, 48S12, 48S15 and 48S24. Because these models may operate at efficiencies of 90% or higher, the Y-axis (Efficiency) shows values from 60% to 100%.

6.7 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:

$$\eta = \frac{Vo \times Io}{Vin \times Iin} \times 100\%$$

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

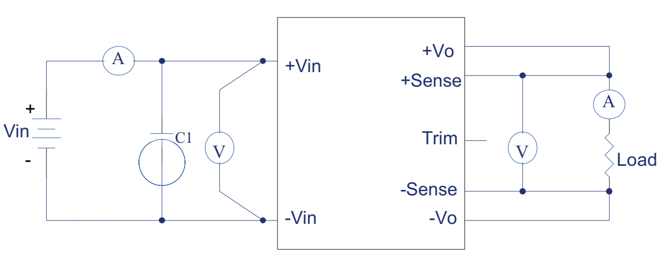
The value of line regulation is defined as:

Where:

$$Line.reg = \frac{V_{HL} - V_{LL}}{V_{LL}} \times 100\%$$

V_{HL} is the output voltage of maximum input voltage at full load.

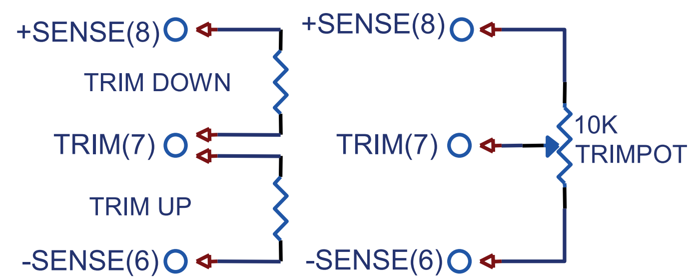
V_{LL} is the output voltage of minimum input voltage at full load.



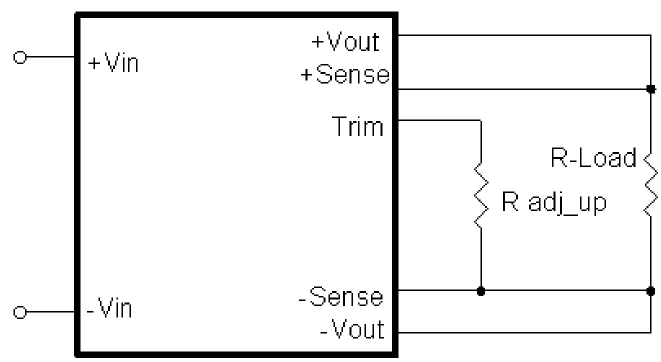
Test Setup

6.8 Output Voltage Adjustment

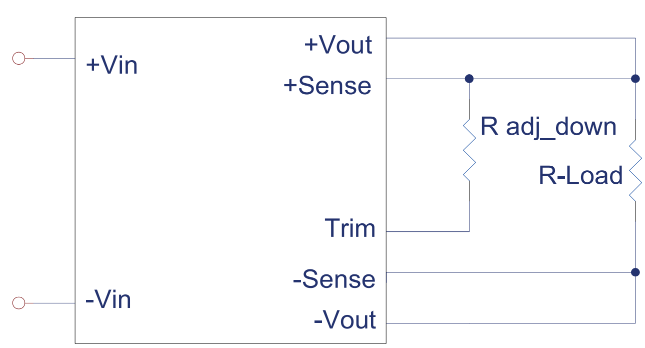
Output may be externally trimmed (±10%) with a fixed resistor or an external trimpot as shown (optional). Model specific formulas for calculating trim resistors are available upon request as a separate document.



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 or between trim pin and +Vo for trim-down. The output voltage trim range is ±10%. This is shown:



Trim-up Voltage Setup



Trim-down Voltage Setup

Vout(V)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	Vr (V)	Vf (V)
3.3V	3.0	12	4.3	1.24	0.46
5V	2.32	3.3	0	2.5	0
12V	9.1	51	5.1	2.5	0.46
15V	12	56	8.25	2.5	0.46
24V	20	100	7.5	2.5	0.46

Trim Resistor Values

The value of Rtrim-up defined as:

$$R_{trim\_up} = \left(\frac{R_1\left(V_r - V_f\left(\frac{R_2}{R_2+R_3}\right)\right)}{Vo - V_{o\_nom}}\right) - \frac{R_2 R_3}{R_2+R_3}\ (K\Omega)$$

Where
R trim-up is the external resistor in Kohm.
Vo, nom is the nominal output voltage.
Vo is the desired output voltage.
R1, R2, R3 and Vr are internal components.

For example, to trim-up the output voltage of 12V module (PHE100W-48S12) by 5% to 12.6V, R trim-up is calculated as follows:

Vo – Vo, nom = 12.6 – 12 = 0.6V
R1 = 9.1 KΩ
R2 = 51 KΩ
R3 = 5.1 KΩ
Vr=2.5 V, Vf=0.46 V

The value of R trim-down defined as:

$$R_{trim\_down} = \frac{R_1 \times (V_o - V_r)}{V_{o\_nom} - V_o} - R_2\ \ (K\Omega)$$

Where
R trim-down is the external resistor in Kohm.
Vo, nom is the nominal output voltage.
Vo is the desired output voltage.
R1, R2, R3 and Vr are internal components

For example, to trim-down the output voltage of 12V module (PHE100W-48S12) by 5% to 11.4V, R trim-down is calculated as follows:

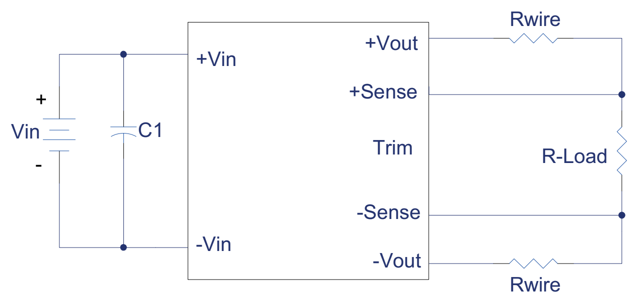
Vo,nom – Vo = 12 – 11.4 = 0.6V
R1 = 9.1 KΩ
R2 = 51 KΩ
Vr = 2.5 V

$$R_{trim\_down} = \frac{9.1 \times (11.4 - 2.5)}{0.6} - 51 = 83.98\ (K\Omega)$$

6.9 Output Remote Sensing

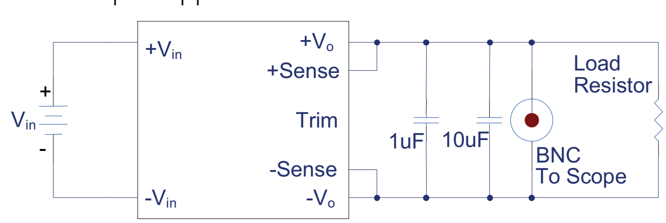
The PHE100W series converters have the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the PHE100W series in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load.
The remote-sense voltage range is:
[(+Vout) - (-Vout)] – [(+Sense) – (-Sense)] $\leq$10% of Vo_nominal

If the remote sense feature is not to be used, the sense pins should be connected locally. The +Sense pin should be connected to the +Vout pin at the module and the -Sense pin should be connected to the -Vout pin at the module. This is shown in the schematic below.



Note: Although the output voltage can be varied (increased or decreased) by both remote sense and trim, the maximum variation for the output voltage is the larger of the two values not the sum of the values. The output power delivered by the module is defined as the voltage at the output terminals multiplied by the output current. Using remote sense and trim can cause the output voltage to increase and consequently increase the power output of the module if output current remains unchanged. Always ensure that the output power of the module remains at or below the maximum rated power. Also be aware that if Vo.set is below nominal value, Pout.max will also decrease accordingly because Io.max is an absolute limit. Thus, Pout.max = Vo.set x Io.max is also an absolute limit.

6.10 Output Ripple and Noise



Vo=24 & 48V Output ripple and noise is measured with 1.0uF ceramic and 10uF/100V KMF Aluminum capacitors across the output. Other Vo Output ripple and noise is measured with 1.0uF ceramic and 10uF solid tantalum capacitors across the output.

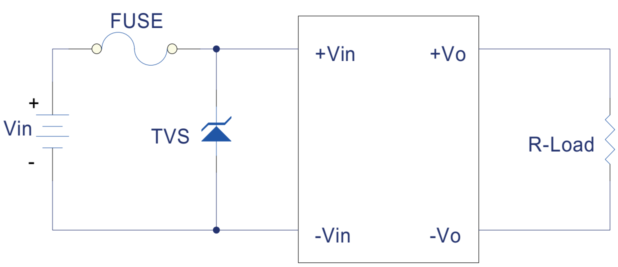
6.11 Output Capacitance

The PHE100W 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. 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 up to 1000uF per amp.

7. Safety & EMC

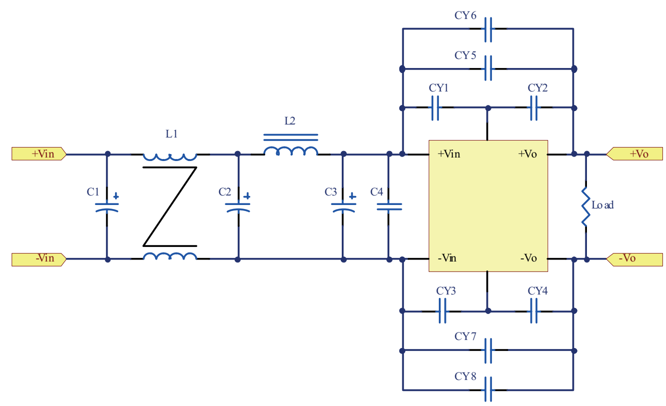
7.1 Input Fusing and Safety Considerations

The PHE100W series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 20A time delay fuse for 24Vin models, and 10A for 48Vin models. It is recommended that the circuit 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).



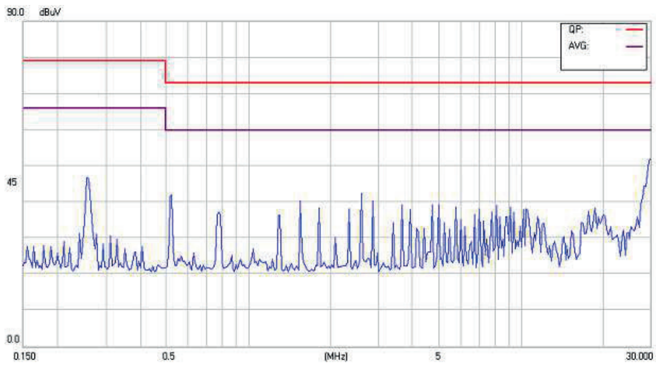
7.2 EMC Considerations

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

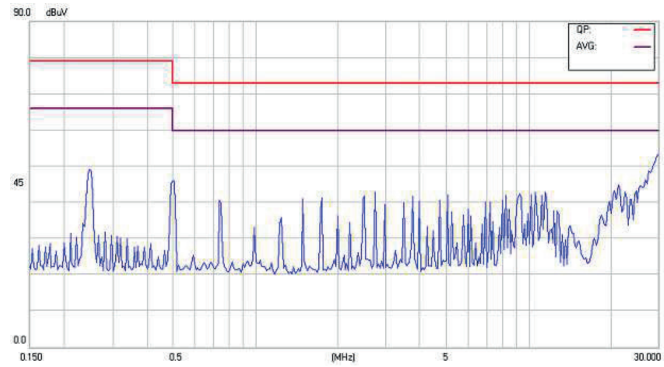


Model No.	C1	C2	C3	C4	CY1	CY2	CY3	CY4	CY5	CY6	CY7	L1	L2
PHE100W-24S33	--	220u/63V	220u/63V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-24S05	--	220u/63V	220u/63V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-24S12	--	220u/63V	220u/63V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-24S15	--	220u/63V	220u/63V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-24S24	--	220u/63V	220u/63V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-24S48	--	220u/63V	220u/63V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-48S33	--	82u/100V	82u/100V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-48S05	--	82u/100V	82u/100V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-48S12	--	82u/100V	82u/100V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-48S15	--	82u/100V	82u/100V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-48S24	--	82u/100V	82u/100V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH
PHE100W-48S48	--	82u/100V	82u/100V	2200pF	--	--	2200pF	2200pF	2200pF	--	2200pF	--	3.4uH

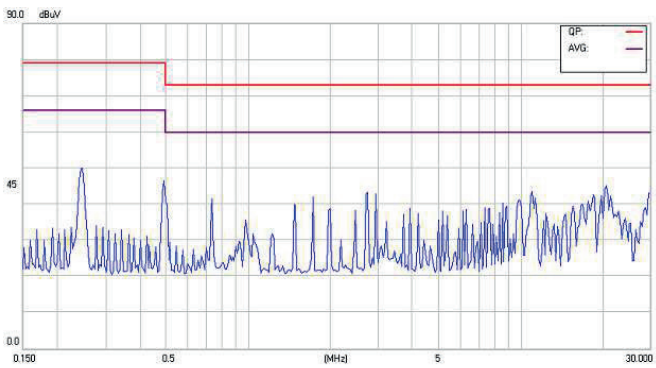
Note: The C2, C3 are aluminum KY Series capacitors, CY3, CY4, CY5, CY7 are ceramic capacitors.



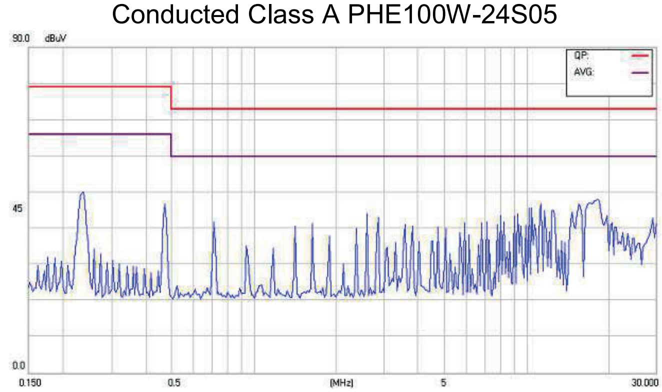
Conducted Class A of PHE100W-24S3V3



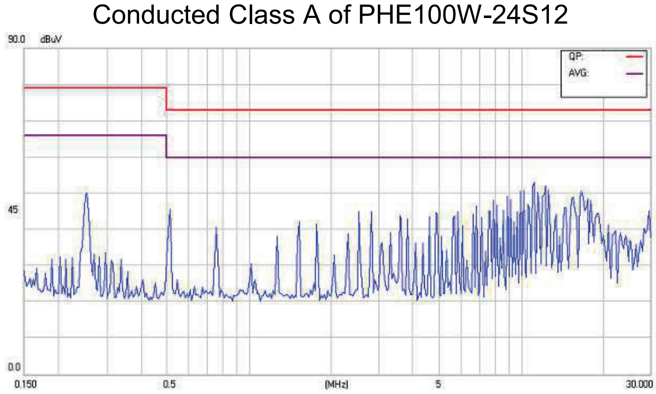
Conducted Class A PHE100W-24S05



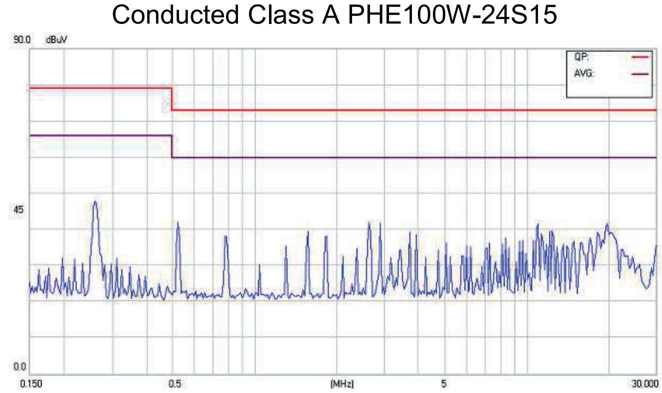
Conducted Class A of PHE100W-24S12



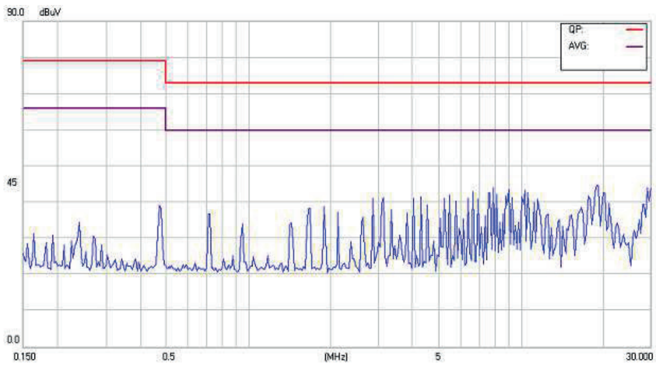
Conducted Class A PHE100W-24S15



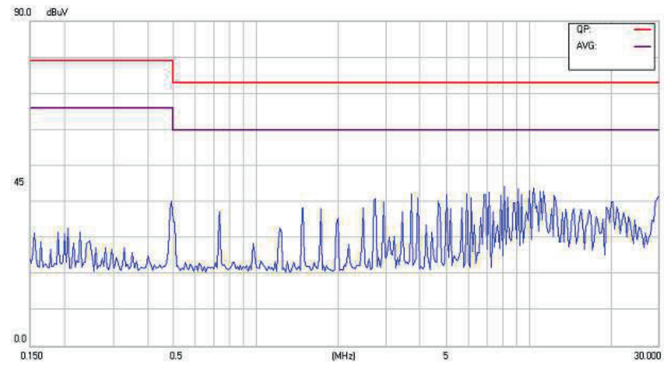
Conducted Class A of PHE100W-24S24



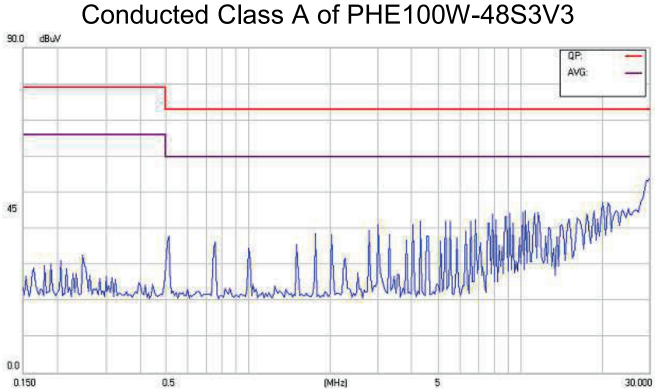
Conducted Class A PHE100W-24S48



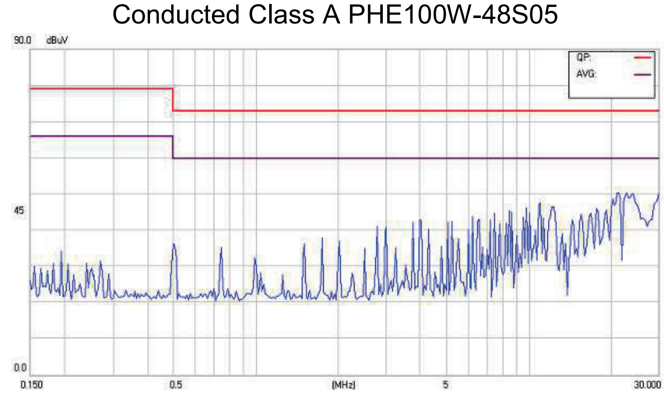
Conducted Class A of PHE100W-48S3V3



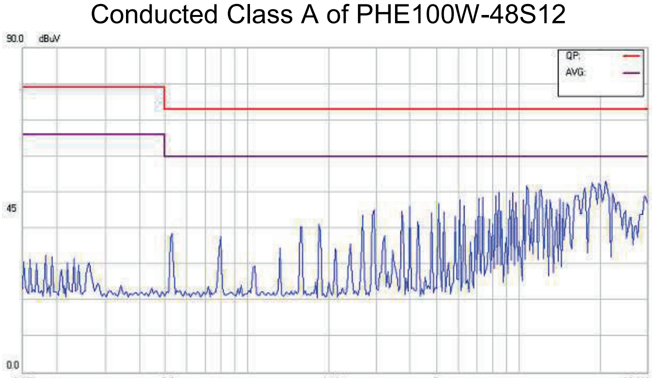
Conducted Class A PHE100W-48S05



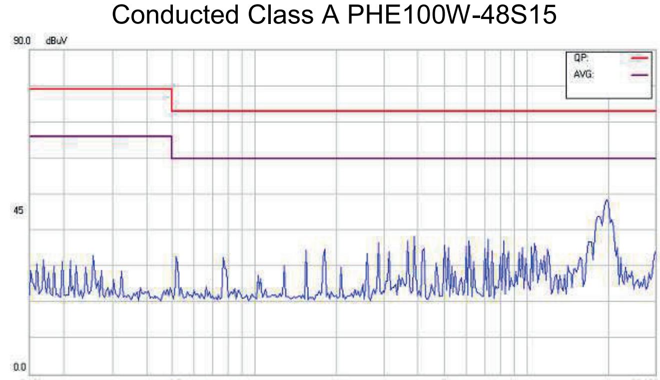
Conducted Class A of PHE100W-48S12



Conducted Class A PHE100W-48S15

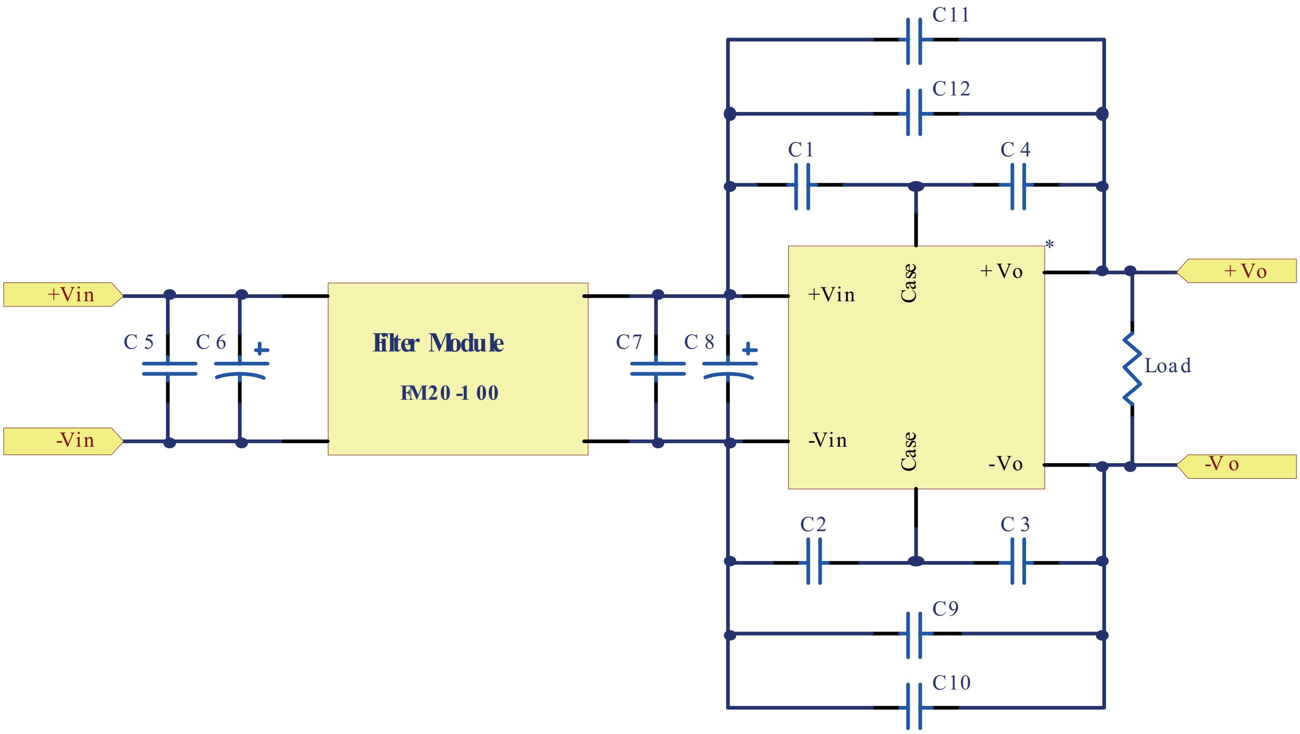


Conducted Class A of PHE100W-48S24



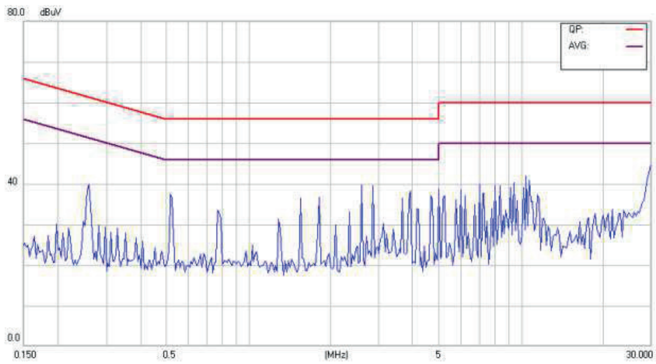
Conducted Class A PHE100W-48S48

(2) EMI and conducted noise meet EN55022 Class B:

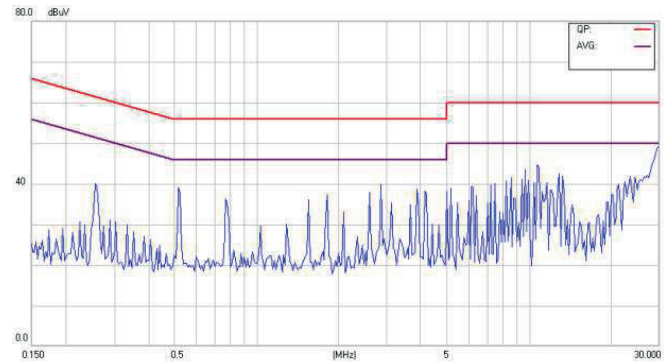


Model No.	C5	C6	Filter Module	C1	C2	C3	C4	C7	C8	C9	C10	C11	C12
PHE100W-24S33	--	330u/63V	FM20-100	--	2200pF	--	--	--	330u/63V	2200pF	--	--	2200pF
PHE100W-24S05	--	330u/63V	FM20-100	--	2200pF	--	--	--	330u/63V	2200pF	--	--	2200pF
PHE100W-24S12	--	330u/63V	FM20-100	--	2200pF	--	--	--	330u/63V	2200pF	--	--	2200pF
PHE100W-24S15	--	330u/63V	FM20-100	--	2200pF	--	--	--	330u/63V	2200pF	--	--	2200pF
PHE100W-24S24	--	330u/63V	FM20-100	--	2200pF	--	--	--	330u/63V	2200pF	--	--	2200pF
PHE100W-24S48	--	330u/63V	FM20-100	--	2200pF	--	--	--	330u/63V	2200pF	--	--	2200pF
PHE100W-48S33	--	82u/100V	FM20-100	--	2200pF	--	--	--	82u/100V	2200pF	2200pF	--	2200pF
PHE100W-48S05	--	82u/100V	FM20-100	--	2200pF	--	--	--	82u/100V	2200pF	2200pF	--	2200pF
PHE100W-48S12	--	82u/100V	FM20-100	--	2200pF	--	--	--	82u/100V	2200pF	2200pF	--	2200pF
PHE100W-48S15	--	82u/100V	FM20-100	--	2200pF	--	--	--	82u/100V	2200pF	2200pF	--	2200pF
PHE100W-48S24	--	82u/100V	FM20-100	--	2200pF	--	--	--	82u/100V	2200pF	2200pF	--	2200pF
PHE100W-48S48	--	82u/100V	FM20-100	--	2200pF	--	--	--	82u/100V	2200pF	2200pF	--	2200pF

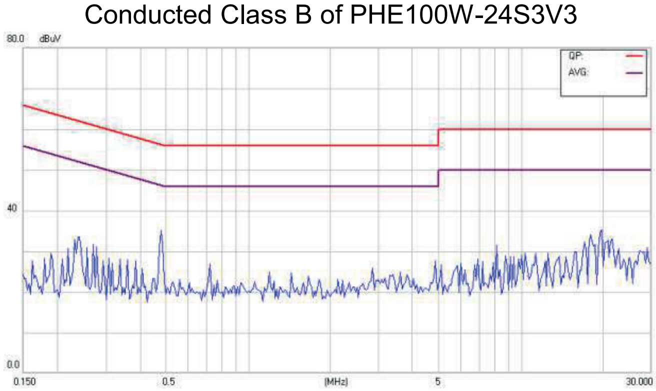
Note: The C6, C8 are aluminum KY Series capacitors, C2, C9, C10, C12 are ceramic capacitors



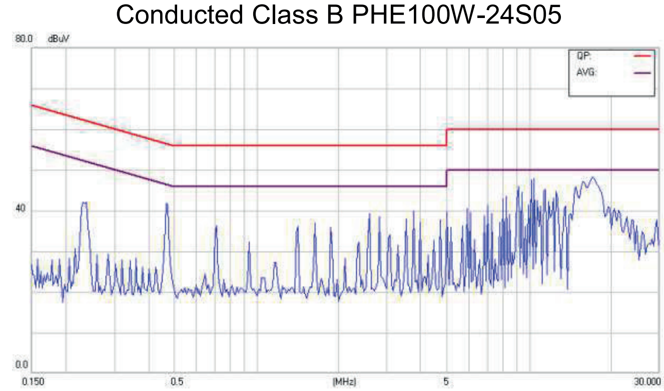
Conducted Class B of PHE100W-24S3V3



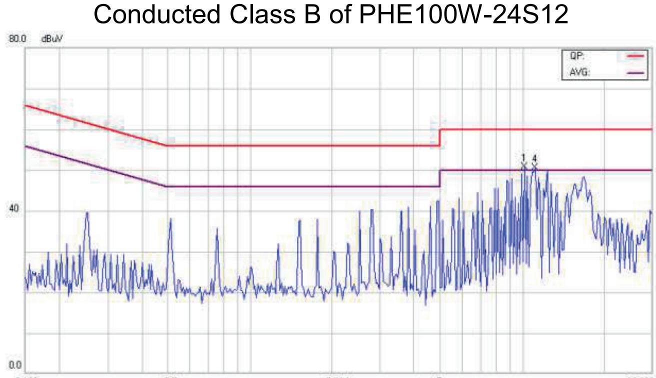
Conducted Class B PHE100W-24S05



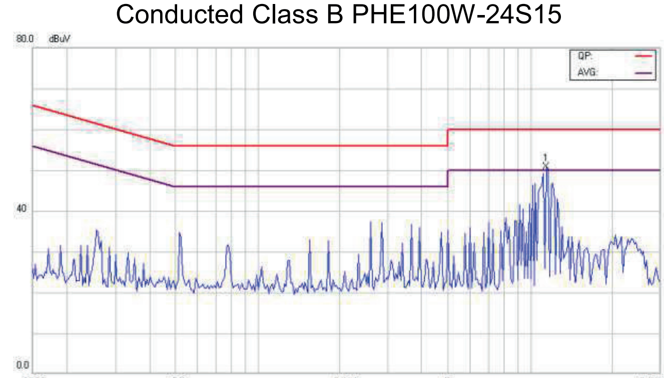
Conducted Class B of PHE100W-24S12



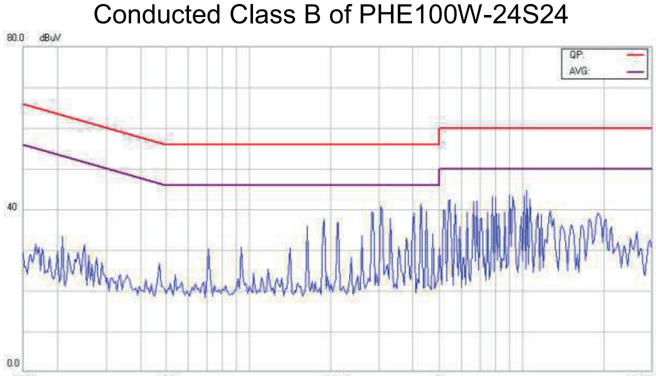
Conducted Class B PHE100W-24S15



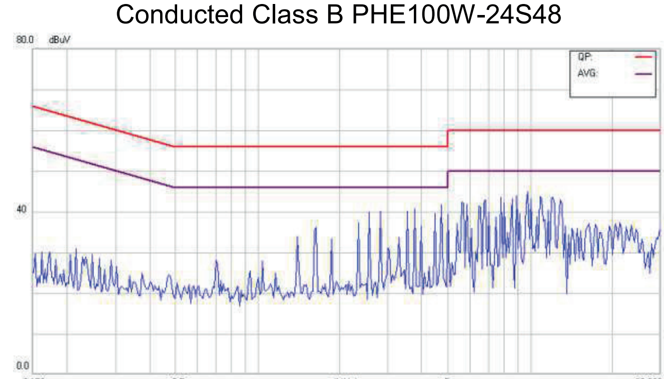
Conducted Class B of PHE100W-24S24



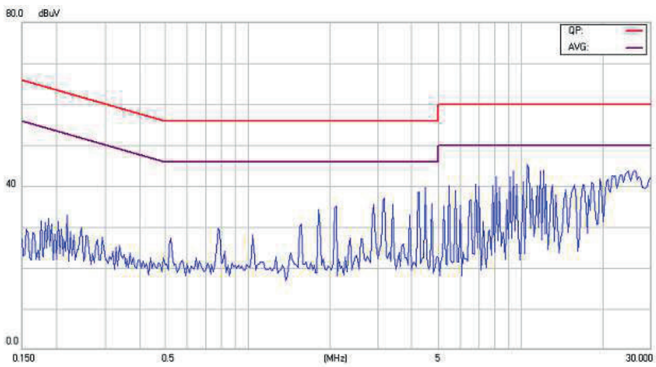
Conducted Class B PHE100W-24S48



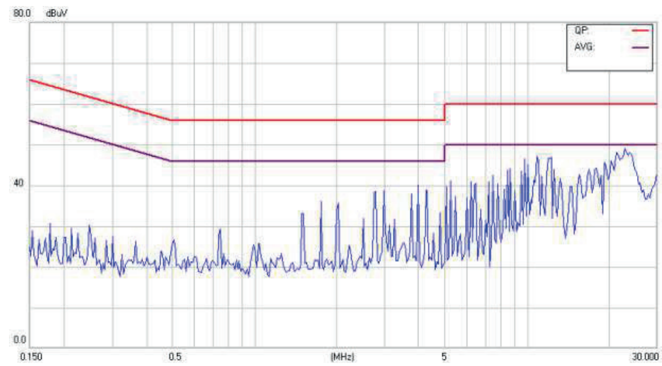
Conducted Class B of PHE100W-48S3V3



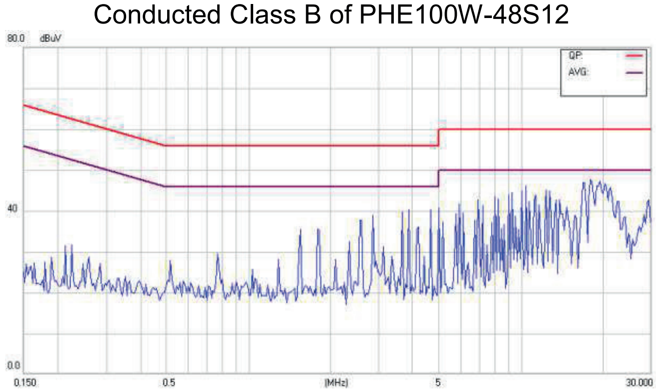
Conducted Class B PHE100W-48S05



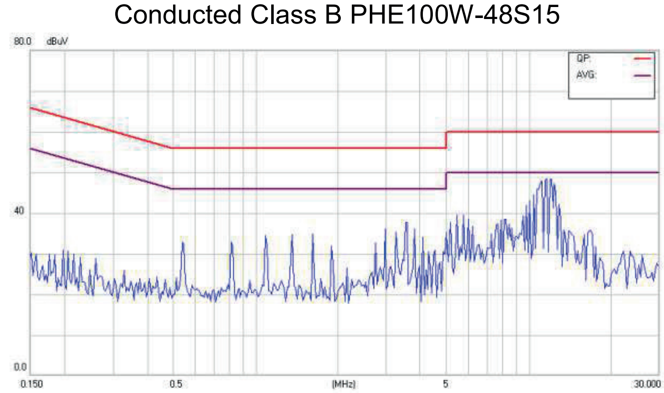
Conducted Class B of PHE100W-48S12



Conducted Class B PHE100W-48S15



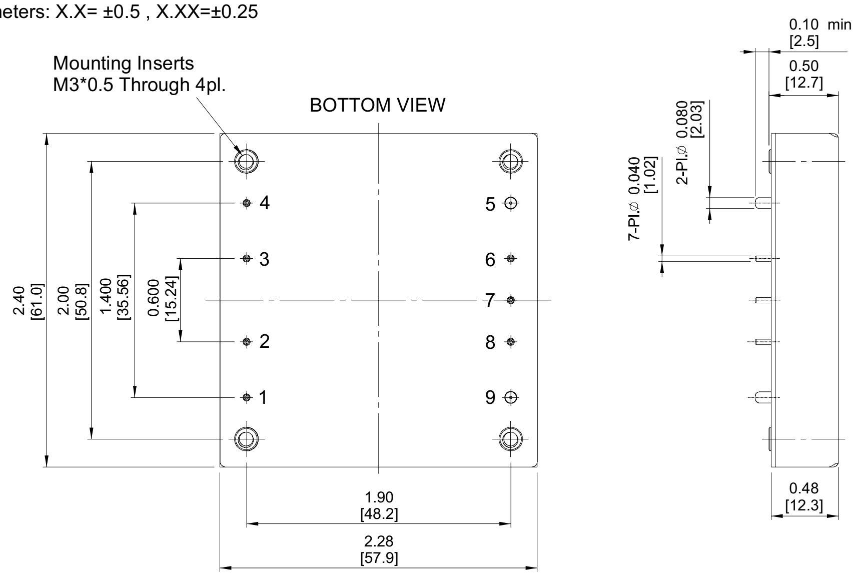
Conducted Class B of PHE100W-48S24



Conducted Class B PHE100W-48S48

8. Mechanical Outline Diagrams

All Dimensions In Inches(mm)
Tolerances Inches: X.XX= ±0.02 , X.XXX= ±0.010
Millimeters: X.X= ±0.5 , X.XX=±0.25



Pin	Function
1	+Vin
2	ON/OFF
3	CASE
4	-Vin
5	-Vout
6	-Sense
7	Trim
8	+Sense
9	+Vout