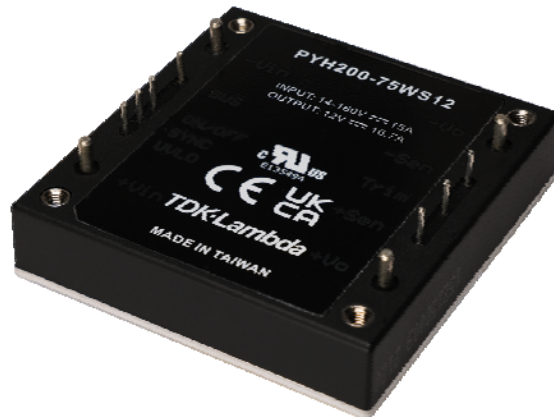


# PYH200 Series Instruction and Application Manual



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For additional information, please visit <https://product.tdk.com/en/power/py>.

## 1. PRODUCT DESCRIPTION

The PYH200 series are board mount 200W DC-DC converters in a rugged half-brick housing with silicone potting. They provide a regulated and galvanically isolated output voltage.

The most outstanding features of this series are the exceptionally wide input voltage range from 14V to 160V (12:1) and the high input/output isolation strength of 3000Vac.

The wide allowed case temperature range from -40°C to +100°C, the low heat generation, due to the high efficiencies up to 90% and the high shock and vibration resistance thanks to the potted design make this device suitable for nearly every situation.

Another unique feature is the compliance with the standard EN 50155, which is an international standard covering electronic equipment used on rolling stock for railway applications. In combination with the wide input voltage range, there are many application opportunities in this segment. Further applications for this DC-DC converter can be found in Distributed Power Architecture (DPA), telecommunications, battery-powered devices, measurement and laboratory equipment, devices in industrial environments, and many other areas.

## 2. PRODUCT FEATURES

- Half-brick (2.28x2.4") Industry Standard Footprint
- 3000Vac Input to Output Isolation
- 14-160V (12:1) Wide-range Input
- EN 50155 Railway Compliant
- IEC 62368-1 (ICT) Approved
- High Shock and Vibration Resistance Due to Potted Design
- Efficiency up to 90%
- -40 to +100°C Operating Case Temperature Range
- Remote ON/OFF Input
- Output Voltage Sense Lines
- Frequency Synchronization With External Clock

## 3. INTENDED USE

This device is designed and manufactured as a component part to be mounted on a pc-board and to be installed in electronic devices.

This device is intended for commercial use, such as in industrial control, process control, monitoring and measurement equipment or the like.

Additionally, this device is also designed for equipment that is intended for use in railway rolling stock applications according to EN 50155.

Do not use this device in equipment, where malfunctioning may cause severe personal injury or threaten human life without additional appropriate safety devices, that are suited for the end-application.

If this device is used in a manner outside of its specification, the protection provided by the device may be impaired.

## 4. INSTALLATION INSTRUCTIONS

Before operating this device, please read this manual thoroughly and retain for future reference! This device may only be installed and put into operation by qualified personnel. If damage or malfunction should occur during operation, immediately turn power off and send device to the factory for inspection. The device does not contain serviceable parts.

**⚠ WARNING** Risk of electrical shock, fire, personal injury or death.

Turn power off before working on the device. Protect against inadvertent re-powering.

Do not modify or repair the unit.

Do not open the unit as high voltages are present inside.

Use caution to prevent any foreign objects from entering the housing.

Do not use in locations where flammable gas or ignitable substances are present.

Do not use in wet locations or in areas where moisture or condensation can be expected.

Do not use in environment with strong electromagnetic field, corrosive gas or conductive substances or direct sunlight.

Do not touch during power-on, and immediately after power-off. Hot surfaces may cause burns.

**Obey the following installation instructions:**

This device may only be installed and put into operation by qualified personnel.

This device does not contain serviceable parts. Replace fuses only when explicitly permitted. If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Install the device in an enclosure providing protection against electrical, mechanical and fire hazards.

The device is designed for pollution degree 2 areas in controlled environments. No condensation or frost is allowed.

The input can be powered from batteries or similar DC sources.

Check for correct input polarity. The device will get damaged when the voltage is reversed.

Ensure sufficient cooling to avoid overloading the device.

The device is designed for altitudes up to 5000m (16400ft).

This device is not internally fused. An external input fuse must always be used. Use a 25A slow-blow fuse.

The maximum operational case temperature is +100°C (+212°F). The case temperature is defined in the middle of the top side of the cover.

The device is designed to operate in areas with a maximum relative humidity of 95%.

Do not apply return voltages from the load to the output terminals.

Do not connect the outputs of multiple devices in parallel for higher output currents.

Do not connect batteries for charging purposes to the output of the device.

## 5. FUNCTIONAL DESCRIPTION

The output is electronically protected against no-load, overload and short circuit. In case of an overload or short circuit, the device will operate intermittently (hiccup mode).

The device can supply resistive and inductive loads.

Avoid loads with large input capacitances. If the capacitive load is higher than the values specified, the device operates in an intermittent mode (hiccup mode).

PYH200-72WS12: max. 76700µF

PYH200-72WS15: max. 13500µF

PYH200-72WS24: max. 8000µF

PYH200-72WS48: max. 2200µF

The output voltage can be adjusted with an external resistor connected between the TRIM-pin and the output voltage.

The device is equipped with sense lines for the output voltage. This feature moves the output voltage regulation point from the output of the device to the point of connection of the remote sense pins.

The device is equipped with an over-temperature protection. In case of a high temperature, the output shuts down and starts automatically after cooling off.

The device is equipped with under-voltage protection on the input side. If the input voltage is too low, the device does not start or switches off. The turn-on and shut-down voltage can be adjusted externally.

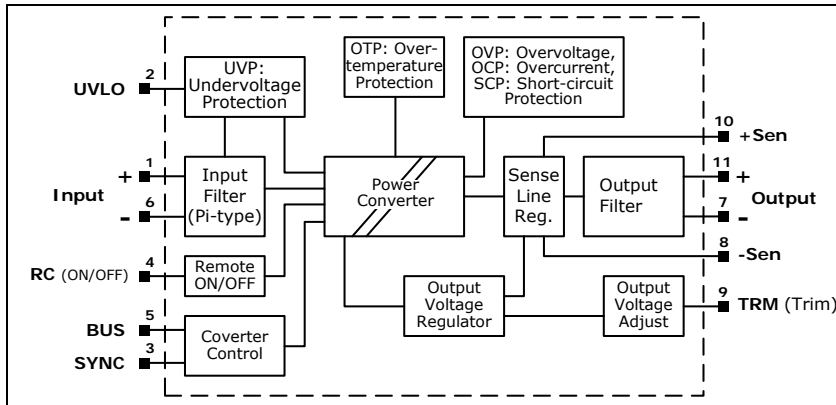
In case of an internal defect, a redundant circuit prevents the output voltage from becoming excessive or dangerous (zener diode type protection).

The device is equipped with a remote ON/OFF function.

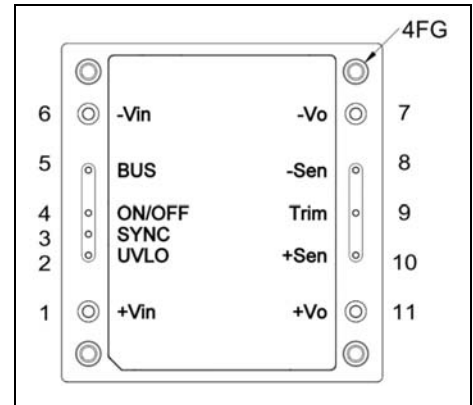
The device has an access to the internal bus voltage, which can be used to add additional components for extended hold-up time.

The device is equipped with a SYNC control pin for frequency synchronization with an external clock signal.

## 6. FUNCTIONAL DIAGRAM



Functional diagram



Pin assignment

**RC:** Remote ON/OFF control pin

**TRM:** Trim pin for output voltage adjustment

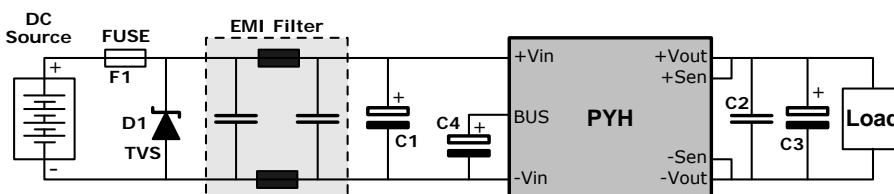
**UVLO:** Control pin for under-voltage lock-out behavior

**BUS:** Access to internal bus voltage, can be used for hold-up time purposes

**SYNC:** Control pin for frequency synchronization with external clock signal

**-Sen, +Sen:** Sense lines for output voltage

## 7. RECOMMENDED WIRING SCHEME



**Fuse F1:** The DC-DC converter is not internally fused. An external input fuse must always be used. Use a 25A slow-blow fuse.

**Capacitor C1 and Diode D1:** These two components provide higher transient resistance (surge and burst) at the input and are required if the DC-DC converter has to meet the EN61000-4-4 and EN61000-4-5 standards. The capacitor C1 should be 100µF/200V and the suppressor diode D1 should be a SMCJ180A.

**EMI Filter:** This filter reduces the conducted emission to the input. A circuit example can be found in the chapter "EMC Considerations".

**Capacitor C2, C3:** For a good transient response behavior, low ESR output capacitors should be utilized. Use a 1µF ceramic multilayer capacitor for C2 and a 10µF aluminum or tantalum capacitor for C3.

**Capacitor C4:** External capacitor connected between BUS and -Vin is necessary to keep operating stable. Use an aluminum capacitor with 240µF (e.g. VISHAY 118 AHT series)

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For additional information, please visit <https://product.tdk.com/en/power/py>.

## 8. PRODUCT NOMENCLATURE AND LIST OF MODELS

### Product Nomenclature:

PY	a	bb	-	ccc	d	ee	-	z
Series Name PY	Size H = Half Brick	Output Power 200 = 200W		Input Voltage 72W = 14-160V	Output Type S = Single Output	Output Voltage 12 = 12V 15 = 15V 24 = 24V 48 = 48V		Options  <u>Remote ON/OFF &amp; Mounting:</u> Blank = Positive Logic and M3 Thread N = Negative Logic and M3 Thread PD = Positive Logic and 3.2mm Hole ND = Negative Logic and 3.2mm Hole

### Model list:

<b>PYH200-72WS12</b>	DC-DC converter isolated, 200W, Input: 14-160V, Output: 12V 16.7A, half-brick, pcb-mount
<b>PYH200-72WS15</b>	DC-DC converter isolated, 200W, Input: 14-160V, Output: 15V 13.5A, half-brick, pcb-mount
<b>PYH200-72WS24</b>	DC-DC converter isolated, 200W, Input: 14-160V, Output: 24V 8.4A, half-brick, pcb-mount
<b>PYH200-72WS48</b>	DC-DC converter isolated, 200W, Input: 14-160V, Output: 48V 4.2A, half-brick, pcb-mount

## 9. SHORT-FORM DATA

Input voltage range	Min. 14Vdc Nom. 72Vdc Max. 160Vdc	
Input current at no load	Typ. 50mA	For all models
Input current at remote OFF	Typ. 15mA Max. 20mA	For all models For all models
Output power	Max. 200W	For all models
Output current	Nom. 16.7A <sup>1)</sup> Nom. 13.5A <sup>1)</sup> Nom. 8.4A <sup>1)</sup> Nom. 4.2A <sup>1)</sup>	For 12V model For 15V model For 24V model For 48V model
Output voltage adjustment range	Max. -20%/+15%	For all models
Output voltage remote sense range	Max. +15%	For all models
Output voltage accuracy range	±1%	Factory setting
Line regulation	Max. ±0.2%	Between 14 and 160Vdc
Load regulation	Max. ±0.2%	For a 0% to 100% to 0% load step
Transient response recovery time	250µs	For a 75% to 100% load step
Temperature coefficient	Max. ±0.02%/°C	For all models
Start-up time	Typ. 200ms	For resistive load, after applying an input voltage or remote ON signal and reaching 95% of output voltage
Ripple and noise voltage	Max. 200mVp-p Max. 240mVp-p Max. 80mV rms Max. 60mV rms Max. 100mV rms	For 12V and 15V outputs For 24V and 48V outputs For 12V output For 15V output For 24V an 48V outputs Bandwidth 20MHz, Full load, 10µF tantalum/ aluminium and 1.0µF ceramic capacitors

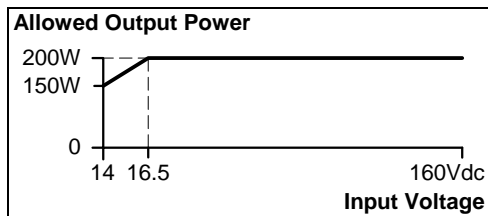
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For additional information, please visit <https://product.tdk.com/en/power/py>.

## DC-DC Converter Isolated, 200W, ½ Brick, PCB Mount

Efficiency	Typ.	88.0% to 90.0%	
Operational temperature range		-40°C to +100°C	See chapter "Thermal Considerations" for derating requirements
Case temperature	Max.	+100°C	
Storage temperature rang		-55°C to +125°C	
Relative humidity	Max.	95% RH	No condensation allowed
Altitude	Max.	5000m / 16 400ft	
Atmospheric pressure		110-54kPa	
Vibration		20Hz-1kHz:0.04g <sup>2</sup> /Hz 1-2kHz: -6dB/octave 60 minutes per axis	According to MIL-STD-810F, random vibration, units are operational
Shock		50 g, 11 ms 18 shocks (3 shocks for each ±axis)	According to MIL-STD-810F, units are operational
Size		61 x 57.9 x 12.7mm 2.4 x 2.28 x 0.5"	Length x Width x Height
Weight		105g / 0.231b	
MTBF		475 000h 551 000h 629 000h 572 000h	For 12V model For 15V model For 24V model For 48V model Acc. to MIL HDBK 217F at full load, GB25°C

- 1) This is the nominal current which must not be exceeded even at lower tuned output voltages. At higher output voltages, the current is reduced according to the nominal power. Below 16.5Vdc the continuous output power is reduced according to the following curve:

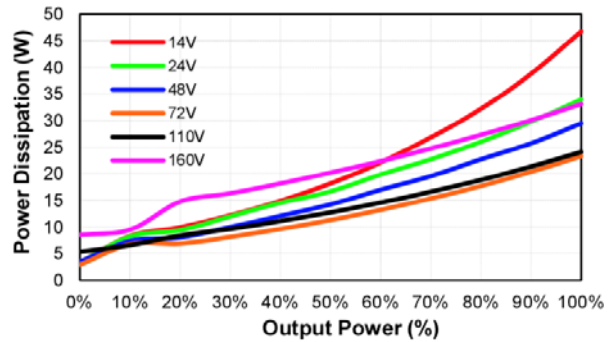
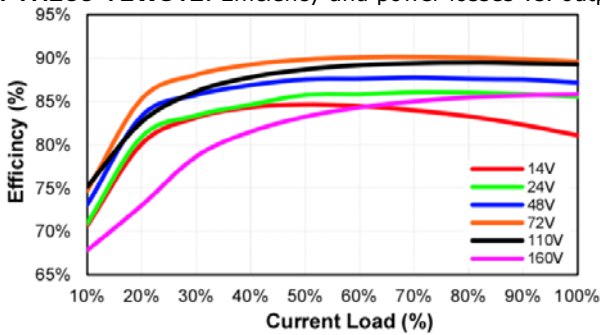


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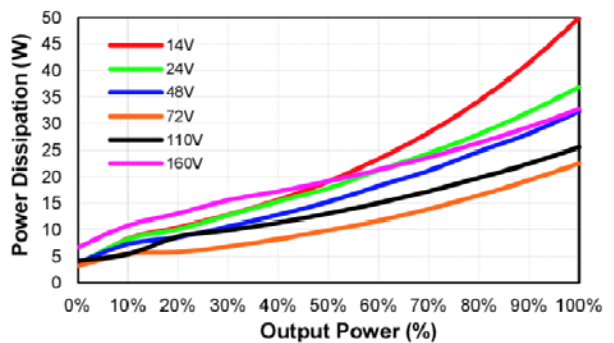
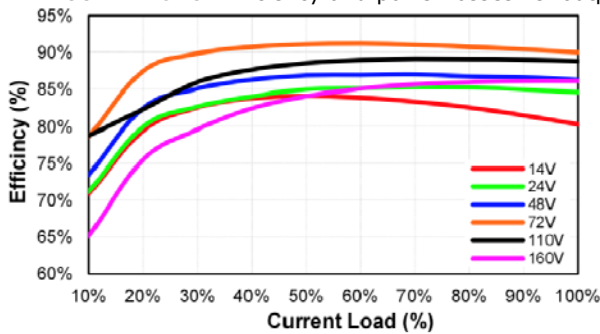
For additional information, please visit <https://product.tdk.com/en/power/py>.

### 10. EFFICIENCY AND POWER DISSIPATION CURVES

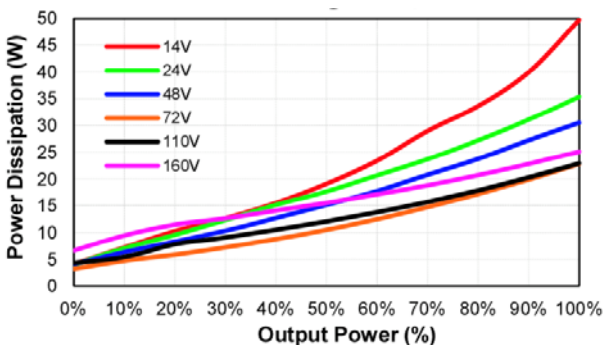
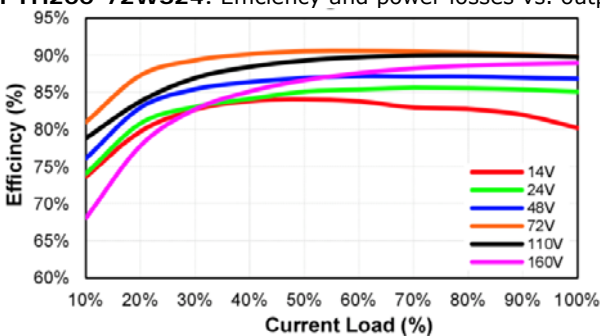
PYH200-72WS12: Efficiency and power losses vs. output load



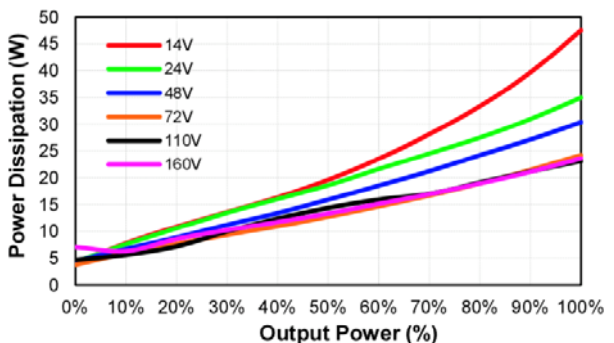
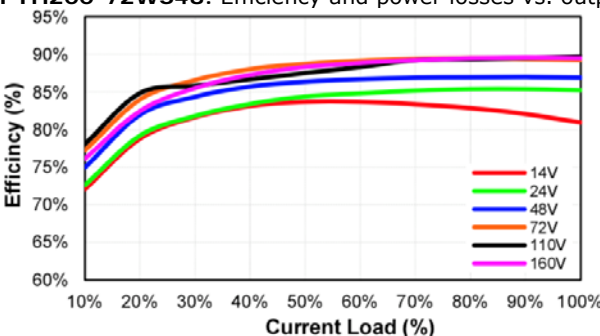
PYH200-72WS15: Efficiency and power losses vs. output load



PYH200-72WS24: Efficiency and power losses vs. output load



PYH200-72WS48: Efficiency and power losses vs. output load



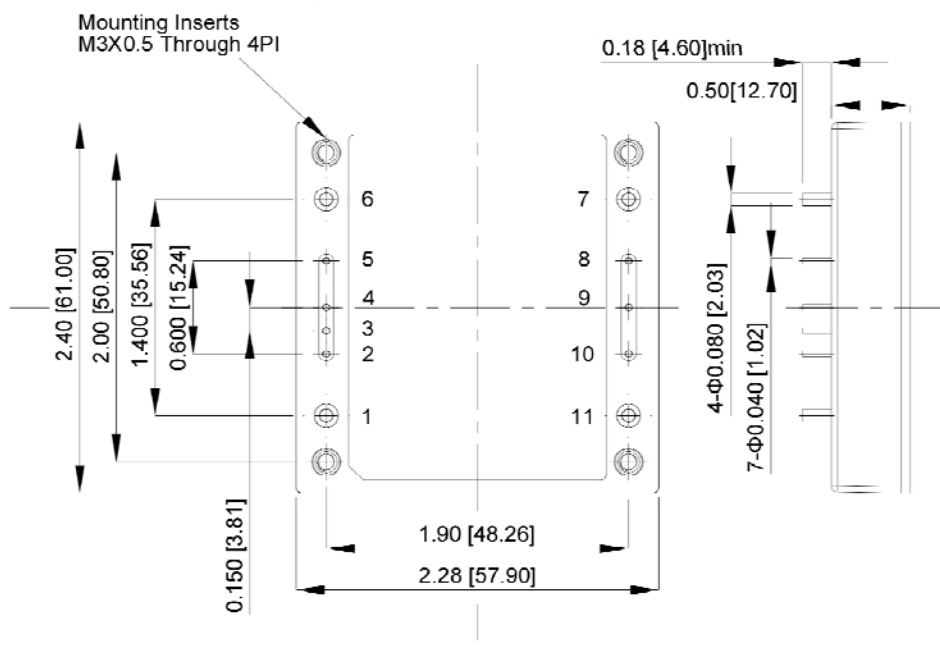
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## 11. PHYSICAL DIMENSIONS AND PIN LAYOUT:

Format	Half-Brick
Length	61.0mm, 2.4"
Width	57.9mm, 2.28"
Height	12.7mm, 0.5"
Weight	105g / 0.23lb
Case material	Plastic
Base plate	Aluminium
Potting Material	Silicone
Pin material	Base: copper Plating: nickel with matte tin



### Pin assignment

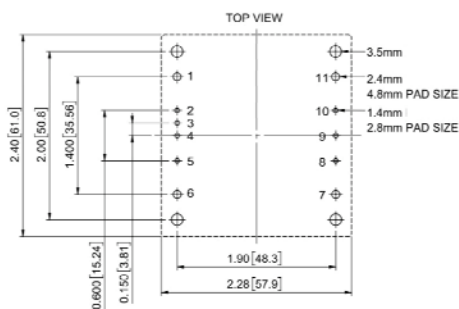
Pin	Function
1	+V Input
2	UVLO
3	Sync
4	R/C
5	BUS
6	-V Input
7	-V Output
8	- Sense
9	Trim
10	+ Sense
11	+V Output

Inch tolerances:  
x.xx±0.02, x.xxx±0.01

Millimeter tolerances:  
x.x±0.5, x.xx±0.25

All dimensions in inch [mm]

### Recommendation for pad design:



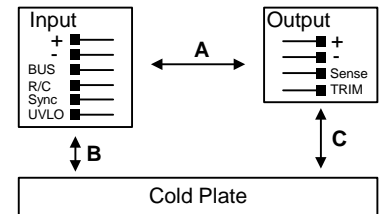
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## 12. ISOLATION AND DIELECTRIC STRENGTH

The output voltage is floating and has no ohmic connection to the input or the case.

Hi-pot tests may be repeated by the customer using appropriate test equipment, which applies the voltage with a slow ramp (2s up and 2s down). Connect all input-terminals together as well as all output poles before conducting the test.



Dielectric strength	Min.	3000Vac or	Input to output (A) for 1 minute
	Min.	4200Vdc	
	Min.	3000Vac or	Input to base plate (B) for 1 minute
	Min.	4200Vdc	
Isolation resistance	Min.	500Vac or	Output to base plate (C) for 1 minute
	Min.	700Vdc	
Isolation capacitance	Typ.	500pF	Input to output (A)
	Typ.	2nF	Output to base plate (C)

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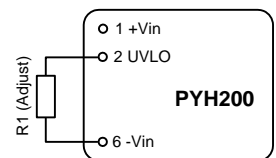
For additional information, please visit <https://product.tdk.com/en/power/py>.

## 13. PROTECTION FEATURES

Under voltage protection (UVP) Turn-On voltage	Min. 12.5Vdc Typ. 13.0Vdc Max. 13.5Vdc	For all models at 70% load, when UVLO pin is left open, can be adjusted with external resistor
Under voltage protection (UVP) Shut-down voltage	Min. 10.5Vdc Typ. 11.0Vdc Max. 11.5Vdc	For all models at 70% load, 2V lock-out hysteresis voltage
Input surge voltage	Max. 180Vdc	For maximal 100ms
Output over voltage protection (OVP)	Min. 117% Typ. 125% Max. 140%	
Output over-current protection (OCP)	Min. 110% Typ. 125% Max. 140%	Of nominal output current, intermittent operation (hiccup mode)
Output short-circuit protection (SCP)	Included	Continuous, automatic recovery
Over temperature protection (OTP)	Typ. 105°C	Temperature at the centre part of base plate, non-latching, automatic recovery when temperature falls below 95°C
Reverse input polarity protection	Not included	Use external protection diode if required
Degree of pollution	2	According to IEC 60664-1, not conductive

### Under-voltage control feature UVLO

The PYH200 series has an adjustable under voltage lockout feature for the input voltage, which will shut down the converter according to following settings.



	DC 24V	DC 36V	DC 48V	DC 72V	DC 110V
Nominal input voltage	DC 24V	DC 36V	DC 48V	DC 72V	DC 110V
Turn-on voltage	13.0V ±0.5V	22.0V ±1.0V	29.6V ±1.0V	44.6V ±1.0V	58.0V ±1.0V
Shut-down voltage	11.0V ±0.5V	20.0V ±1.0V	27.3V ±1.0V	41.6V ±1.0V	53.0V ±1.0V
Resistor between pin 2 and pin 6	open	62kΩ	34kΩ	18kΩ	10kΩ

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For additional information, please visit <https://product.tdk.com/en/power/py>.

## 14. APPROVALS AND REGULATORY COMPLIANCES

CE	EU Declaration of Conformity includes Low-Voltage and RoHS Directive
UKCA	UK Declaration of Conformity includes Electrical Safety and RoHS Directive
EN 62368-1	Safety requirements for audio/video, information and communication technology equipment
UL 62368-1	Recognized component for audio/video, information and communication technology equipment, E-File E133400, Categories QQJQ2 and QQJQ8

## 15. RAIL APPLICATIONS

The DC-DC converter with additional circuits is tested according to the following standards and is suitable for railroad applications.

EN 50155	Railway applications - Rolling stock - Electronic equipment
EN 45545-2	Fire protection on railway vehicles - Part 2: Requirements for fire behaviour of materials and components
EN 61373	Railway applications - Rolling stock equipment - Shock and vibration tests
EN 50121-3-2	Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus

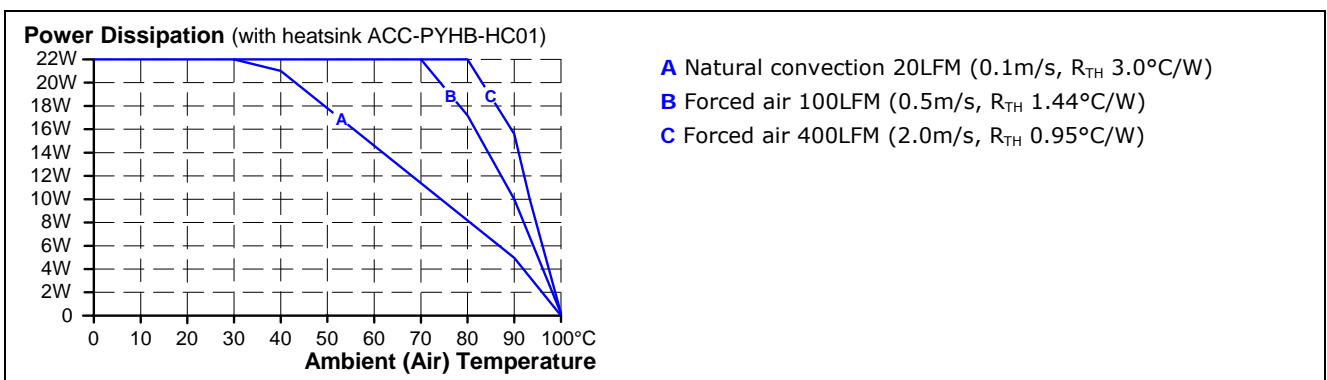
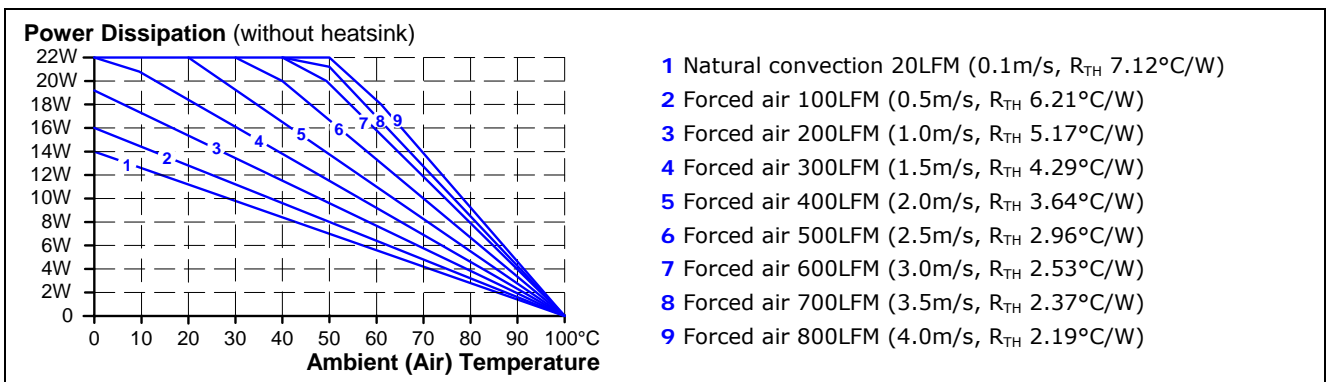
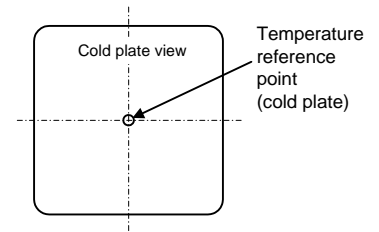
## 16. THERMAL CONSIDERATION AND DERATING

The DC-DC converters operate over a wide temperature range. Even if the heat generated by the DC-DC converters are very low, it must be removed. This can be done either by convection cooling, forced air cooling, radiation or the use of an additional heatsink.

It is important that the enclosure temperature at the indicated temperature reference point does not exceed the maximum enclosure temperature, which is 100°C.

To predict the approximate cooling needed for the DC-DC converter, refer to the following power dissipation curves. These curves are approximations of the ambient temperatures and airflows required to keep the DC-DC converter temperature below its 100°C. After installation in the actual application, the temperature of the module should be re-measured to ensure that the temperatures are not exceeded.

The following curves show the possible power dissipation that the PYH200 series can thermally dissipate without an additional heatsink and with a typical heatsink. The curves apply in vertical mounting position with natural convection cooling or forced air cooling.



The required power dissipation depend on the operating conditions of the DC-DC converter and can be taken from the curves in chapter "Efficiency and power dissipation curves".

Example:

A PYH200-72WS15 operates with 110Vdc input voltage and is loaded with 60% of the nominal output current results in a power dissipation of 15W. With these 15W you go into the above curves and determine the required airflow or the heat sink requirement. If the ambient temperature is expected to be below 55°C, the following two options could be considered:

- Option 1 without a heatsink: Curve 6 shows that 15W can be dissipated with a forced airflow of 500LFM
- Option 2 with heatsink: Curve A shows that 15W can be dissipated without forced airflow.

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For additional information, please visit <https://product.tdk.com/en/power/py>.

## DC-DC Converter Isolated, 200W, ½ Brick, PCB Mount

The derating is never hardware controlled. The user has to take this into consideration to stay below the derated current limits in order not to overload the unit.

### 17. EMC CONSIDERATIONS

In terms of EMC, this DC-DC converter module is considered a component for installation in an end device by a device manufacturer. In order to meet all the requirements of the end device, additional components may have to be deployed and final EMC measurements must be carried out in the end application.

The following tests and measurements were performed according to EN 55032 and EN 50121-3-2 (emission) and EN 55024 and EN 50121-3-2 (immunity).

All tests and measurements were carried out with standardized test set-ups.

#### EMC Immunity

Electrostatic discharge	EN 61000-4-2	Air discharge Contact discharge	±8kV ±6kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-1GHz	20V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input, with additional components see note 1)	±2kV	Criterion A
Surge voltage	EN 61000-4-5	Input, with additional components see note 1)	±2kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	10V	Criterion A

**Performance criterion A:** The device shows normal operation behavior within the defined limits.

**Note 1)** Burst and surge tests were performed with an additional 100µF/200V capacitor and 180V suppressor diode SMCJ180A.

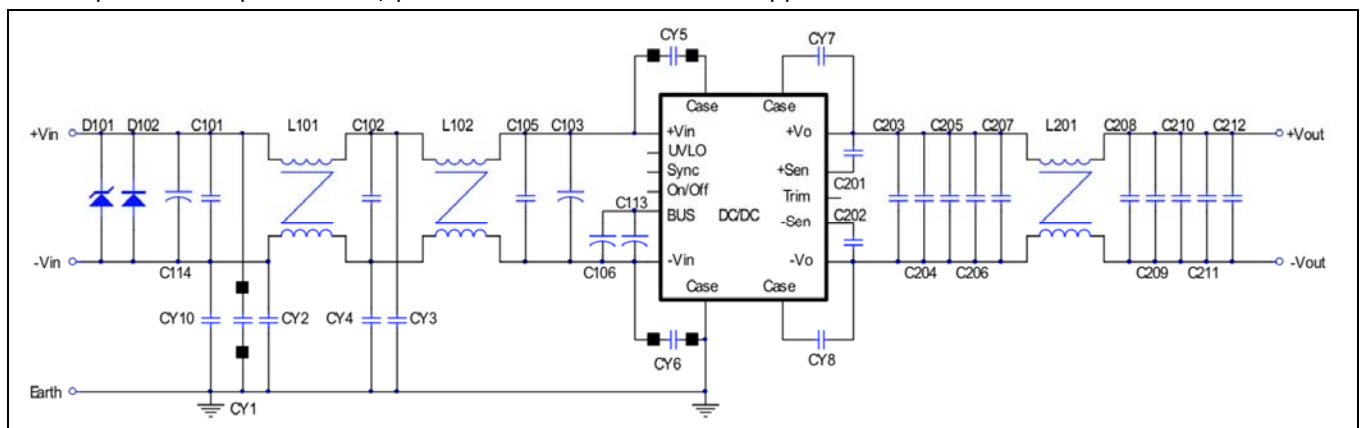
#### Switching Frequency

Main converter	Min. 432kHz Typ. 480kHz Max. 528kHz	Fixed frequency
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#### EMC Emission

##### Recommended external EMI filter for EN 55011, EN 55032 Class A and EN 50121-3-2

The placement of components and the routing of traces on the pc-board must be carried out according to EMC aspects. If help is needed, please contact our technical support team.



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## DC-DC Converter Isolated, 200W, ½ Brick, PCB Mount

BOM	PYH200-72WS12	PYH200-72WS15	PYH200-72WS24	PYH200-72WS48
C101, C102, C105	1uF/250V SMD			
C103, C113	220uF/200V, Aluminum cap. KXJ series			
C106	68uF/200V, Aluminum cap. CS series			
C114	120uF/220V, Aluminum cap. KXJ series			
C201, C202	0.1uF/100V SMD	0.068uF/50V SMD	0.1uF/100V SMD	
C203, C204	6.8uF/50V SMD			2.2uF/100V SMD
C205, C206, C207	10uF/50V SMD			2.2uF/100V SMD
C208	0.1uF/100V SMD			
C209, C210	1uF/100V SMD			
C211, C212	6.8uF/50V SMD			2.2uF/100V SMD
CY10	220pF/Y1	100pF/Y1		
CY1	100pF/Y1			220pF/Y1
CY2	220pF/Y1	100pF/Y1	NC	100pF/Y1
CY3, CY4	2200pF/Y1			
CY5, CY6	2200pF/Y1			
CY7, CY8	0.022uF/275Vac 10mm X2			
L101, L102	0.72mH 0.8mm*2/10T R-22/14/8B MA100-C ALWIN			
L201	0.12mH 0.7mm*8/2T FCNO179C WELL LIGHT		0.51mH 0.8mm*4/4T FCNO179C WELL LIGHT	
Bead core	CY5, CY6 BRI 4*1.5*2 CHILISIN (G4058651007) CY1 CHB200W12-72S15 ONLY			

### Notes:

**C101, C102, C105:** 1812 X7R ceramic.

**C103, C113:** NIPPON CHEMI-CON KXJ series aluminum capacitor or equivalent. C106: Nichicon CS series aluminum capacitor or equivalent.

**C114:** NIPPON CHEMI-CON KXJ series aluminum capacitor or equivalent.

**C201, C202:** 0805 X7R ceramic.

**C203, C204, C211, C212:** 1812 X7R ceramic.

**C205, C206, C207, C208, C209, C210:** 1206 X7R ceramic.

**CY1, CY2M CY3, CY4, CY5, CY6, CY10:** TDK Y1 capacitor or equivalent.

**CY7, CY8:** CARLI MPX Series X2 capacitor or equivalent.

**L101, L102:** 0.72mH 0.8mm\*2/10T R-22/14/8B MA100-C ALWIN (G91CA125615)

**L201:** 0.12mH 0.7mm\*8/2T, FCNO179C WELL LIGHT (G91C7425515)

0.51mH 0.8mm\*4/4T, FCNO179C WELL LIGHT (G91C7421915) D101: SMCJ180A, LITTELFUSE

**D102:** STTH8R03DJF-TR ST

## 18. REMOTE ON/OFF FUNCTION

The device is equipped with a remote ON/OFF function to turn the output ON or OFF.

Two logics are possible. With the positive logic (standard version), the output switches OFF as soon as pin 6 (-Vin) and pin 4 (R/C) are linked or a voltage of less than 1.2V is present.

The optionally available negative logic (option -N) is exactly the vice versa. Here the output switches ON as soon as pin 6 (-Vin) and pin 4 (R/C) are linked or a voltage of less than 1.2V is present.

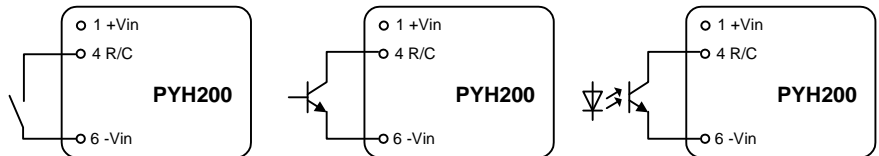
The RC-input is a sink input, which requires a maximal current of 1mA (typically 0.4mA) to be activated. The maximal allowed voltage (open circuit voltage) for this pin is 160Vdc.

### Positive logic (standard)

Converter ON: open or 3.5-160V  
 Converter OFF: closed or 0-1.2V

### Negative logic (option -N)

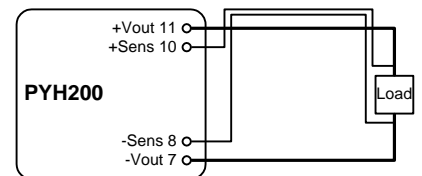
Converter ON: closed or 0-1.2V  
 Converter OFF: open or 3.5-160V



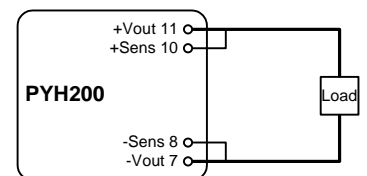
## 19. OUTPUT REMOTE SENSING

The PYH200 series has the feature to remotely sense both lines of its output. This feature moves the 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 PYH200 series in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load.

When remote sense is in use, the sense should be connected by twisted-pair wire or shield wire. Output voltage might become unstable because of impedance of wiring and load condition when length of wire is exceeding 400mm.



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. Wire between +Sense and +Vout and between -Sense and -Vout as short as possible. Loop wiring should be avoided. The converter might become unstable by noise coming from poor wiring.



**Please 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.

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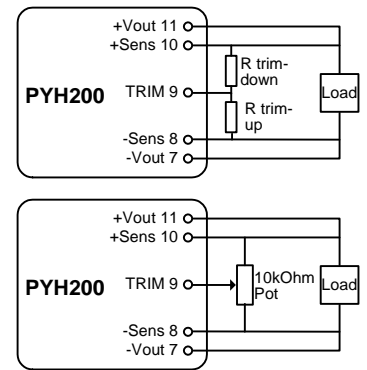


## 20. OUTPUT VOLTAGE ADJUSTMENT

The output voltage can be adjusted in the range of -20%/+15%.

To increase the output voltage, connect an external resistor between the TRIM-Pin and the negative output voltage (-Vout) and to decrease the voltage, connect the resistor between the TRIM-Pin and the positive output voltage (+Vout).

Alternatively a 10kΩ potentiometer can be used to adjust the output voltage continuously within its limits.



### Resistor values for adjusting the 12V output model

Output (V)	9.6	10.08	10.56	11.04	11.52	<b>12V</b>	12.36	12.72	13.08	13.44	13.8
	-20%	-16%	-12%	-8%	-4%		+3%	+6%	+9%	+12%	+15%
R-up (Ω)	-	-	-	-	-	-	81060	35530	20350	12760	8210
R-down (Ω)	3520	8600	17070	34010	84820	-	-	-	-	-	-

### Resistor values for adjusting the 15V output model

Output (V)	12.0	12.6	13.2	13.8	14.4	<b>15V</b>	15.45	15.9	16.35	16.8	17,25
	-20%	-16%	-12%	-8%	-4%		+3%	+6%	+9%	+12%	+15%
R-up (Ω)	-	-	-	-	-	-	92820	40410	22940	14200	8960
R-down (Ω)	8640	16080	28470	53260	127620	-	-	-	-	-	-

### Resistor values for adjusting the 24V output model

Output (V)	19.2	20.16	21.12	22.08	23.04	<b>24V</b>	24.72	25.44	26.16	26.88	27.6
	-20%	-16%	-12%	-8%	-4%		+3%	+6%	+9%	+12%	+15%
R-up (Ω)	-	-	-	-	-	-	158540	69270	39510	24640	15710
R-down (Ω)	13230	25280	45380	85560	206130	-	-	-	-	-	-

### Resistor values for adjusting the 48V output model

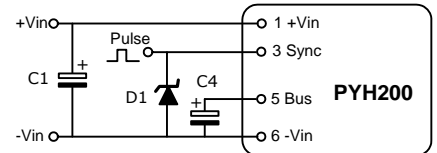
Output (V)	38.4	40.32	42.24	44.16	46.08	<b>48V</b>	49.44	50.88	52.32	53.76	55.2
	-20%	-16%	-12%	-8%	-4%		+3%	+6%	+9%	+12%	+15%
R-up (Ω)	-	-	-	-	-	-	318040	137420	77210	47110	29050
R-down (Ω)	17480	39820	77060	151540	374980	-	-	-	-	-	-

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## 21. SYNCHRONIZING THE SWITCHING FREQUENCY

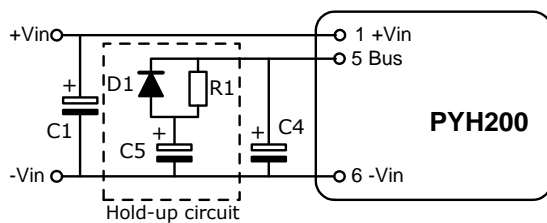
The PYH200 can be synchronized to an external clock by applying a pulse to the sync pin (3). The external clock frequency must be between 530KHz and 630KHz, which is slightly above the regular switching frequency. If the external clock frequency is less than the switching frequency, the PYH200 will ignore the synchronizing pulses. The synchronization pulse width must have a length of minimum 90nS. The sync pin (3) must be protected by a 5.6V zener diode. The amplitude of the external clock signal must be between 3.5V and 4.5V.



- C1: 100uF/200V ESR<47mΩ
- C4: 240uF (VISHAY 118 AHT series)
- D1: 5.6V Zener diode

## 22. HOLD-UP TIME CIRCUITRY

The hold time is defined as the time period during which the DC-DC converter output remains active after a loss of input power. The DC-DC converter itself is not capable of providing a hold time. For this, an external circuit with a large hold-up (storage) capacitor is required.



- D1: 200V/10A
- R1: 10Ω, 3W
- C1: 100uF/200V ESR<0.047Ω
- C4: 240uF (VISHAY 118 AHT series)
- C5: see table below, voltage of the capacitor must be larger than the supply voltage

### Sizing the hold-up capacitor C5

Input Voltage	24Vdc	36Vdc	48Vdc	72Vdc	96Vdc	110Vdc
Hold-up capacitor (C5) for 10ms	2400μF	2400μF	2400μF	2400μF	820μF	560μF
Hold-up capacitor (C5) for 30ms	7200μF	7200μF	7200μF	7200μF	2460μF	1680μF

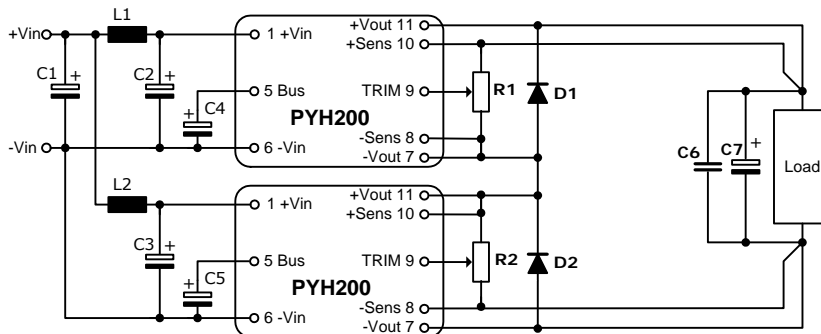
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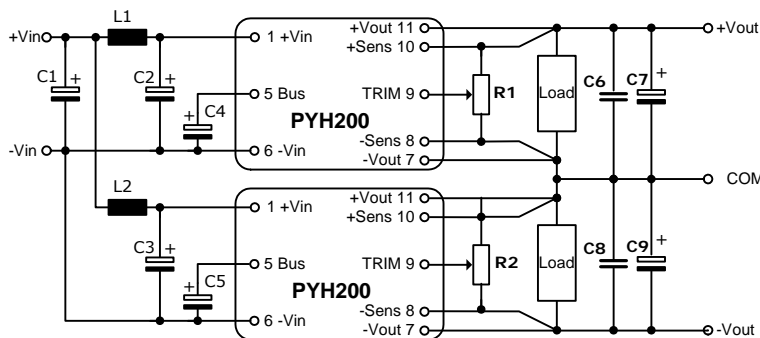
## 23. SERIES OPERATION OF OUTPUTS

Series operation is possible by connecting the outputs of two or more identical devices. The connection is shown in the following drawing.

**Series operation for higher output voltages:**



**Series operation for +/- output voltages:**



- L1, L2: 1.0uH
- C1, C2, C3: 100uF ESR<0.047Ω
- C4, C5: 240uF (e.g. VISHAY 118 AHT series)
- C6, C8: 1uF ceramic multilayer capacitor
- C7, C9: 10uF aluminum capacitor
- R1, R2: 10kΩ potentiometer

**Notes:**

- Use larger C1, C2, C3, C4, C5 or capacitors in parallel if the impedance of input line is high or unknown.
- Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20 °C.
- Use a Schottky diode (D1, D2) across the output of each device, so that if one converter shuts-down for any reason, the output converter does not get damaged.

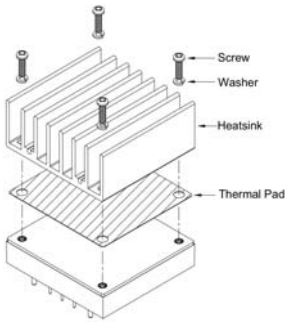
## 24. PARALLEL OPERATION OF OUTPUTS

Parallel operation of outputs for higher output currents is not possible

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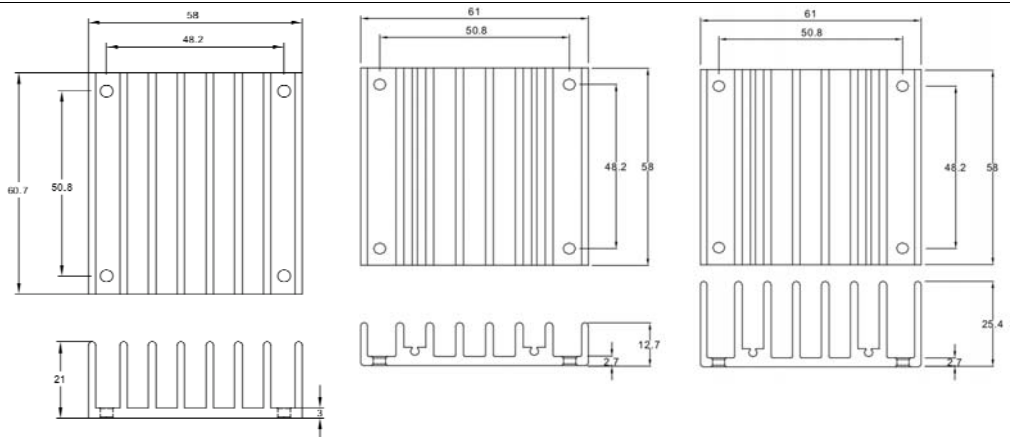
## 25. ACCESSORY – HEATSINK KITS



Heat sinks can be ordered separately and mounted on the converter by means of four screws, four washers and a thermal pad.

The heatsink kits includes one heatsink, one thermal pad, screws and washers.

Order number	ACC-PYHB-HC05	ACC-PYHB-HC02	ACC-PYHB-HC01
Fin Style	Longitudinal	Transverse	Transverse
Size (L x W x H)	58 x 60.7 x 21mm	61 x 58 x 12.7mm	61 x 58 x 25.4mm
Material	Aluminium	Aluminium	Aluminium
Weight	T.B.D.	T.B.D.	T.B.D.
Recommended Tightening Torque	3Kgf-cm	3Kgf-cm	3Kgf-cm
Screw	M3 x 8mm (4x)	M3 x 8mm (4x)	M3 x 8mm (4x)
Washer	3.2mm (4x)	3.2mm (4x)	3.2mm (4x)
Thermal Pad	56.9 x 60 x 0.25mm	56.9 x 60 x 0.25mm	56.9 x 60 x 0.25mm
Thermal impedance	3.90°C/W nat. convection 1.74°C/W with 100LFM 1.33°C/W with 200LFM 1.12°C/W with 300LFM 0.97°C/W with 400LFM	4.70°C/W nat. convection 2.89°C/W with 100LFM 2.30°C/W with 200LFM 1.88°C/W with 300LFM 1.59°C/W with 400LFM	3.00°C/W nat. convection 1.44°C/W with 100LFM 1.17°C/W with 200LFM 1.04°C/W with 300LFM 0.95°C/W with 400LFM



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## 26. CLEANING PROCESS AND SOLDERING PROFILE

### Cleaning process

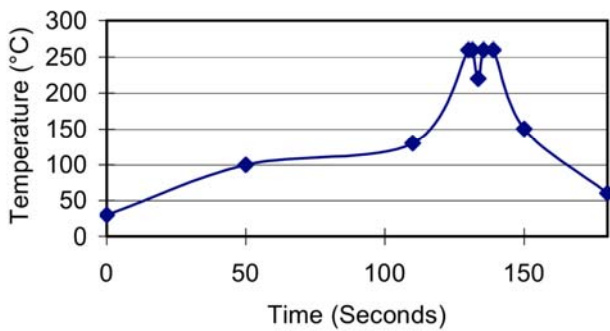
Clean the soldered side of the module with a brush, prevent liquid from getting into the module. Do not clean by soaking the module into liquid. Do not allow solvent to come in contact with product labels or resin case as this may change the color of the resin case or cause deletion of the letters printed on the product label. After cleaning, dry the modules well.

### Hand soldering

The suggested soldering iron is  $420 \pm 10^\circ\text{C}$  for up to 4~15seconds (less than 90W).

### Lead free wave soldering

Lead Free Wave Soldering Profile



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