Driving efficiency and sustainability.

OVPD

Overvoltage Protection Device for AC/DC converter

Installation Instrucion

Cod. 1S4TF1EN - 15-12-2022 - ENG

Contents

Introduction to the product

The overvoltage protection device OVPD protect the **TPD32-EV-FC** and **TPD500-FC** AC/DC converters against destructive overvoltage when used to supply a highly inductive load such as the field circuit of large DC motors or electromagnets.

An overvoltage can occur when the AC supply voltage is turned off before the field controller is disabled as in case of mains loss.

The **OVPD** voltage clamp consists of a symmetric thyristors switch and a control circuit board. The circuit board detects the load voltage level.

The control circuit monitors the load voltage level and, when detects a potentially damaging voltage level, activates the appropriate thyristor to discharge the load energy.

The energy will be discharged on the load impedance itself or even on an external discharge resistor. The use of an external resistor allows to reduce the discharge time.

The voltage clamp must not be used to discharge inductive loads routinely. It requires approximately 30 minutes to dissipate the thyristors temperature after an overvoltage condition.

A dampening resistor (RB) must be installed in combination with the voltage clamp. The RB resistor is required to dampen the overvoltage that results from undershooting holding current when the voltage clamp SCR stops conduction. Dampening resistor kits must be purchased separately, see Dampening Resistor on page 3 for details.

The voltage clamp enclosure is rated IP20 and the power terminals are rated IP00.

Information about this manual

Before using the product, read the safety instruction section carefully. Keep the manual in a safe place and available to engineering and installation personnel during the product functioning period.

WEG Automation Europe S.r.l. has the right to modify products, data and dimensions without notice. The data can only be used for the product description and they can not be understood as legally stated properties.

We will be glad to receive any possible information which could help us improvingthis manual. The e-mail address is the following: techdoc@weg.com.

Symbols used in the manual

Indicates a procedure, condition, or statement that, if not strictly observed, could result in personal injury or death.

Indicates a procedure, condition, or statement that, if not strictly observed, could result in damage to or destruction of equipment.

Indicates a procedure, condition, or statement that should be strictly followed in order to optimize these applications.

To worn of a hot surface.

Note !

Indicates an essential or important procedure, condition, or statement.

WEEE information

The **OVPD** can be disposed of as electronic waste according to national regulations in force for the disposal of electronic components.

Pursuant to Article 26 of Italian Legislative Decree no. 49 of 14 March 2014 “Implementation of Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)”

The symbol showing a crossed-out wheeled bin on equipment or its packaging indicates that the product must be collected separately from other waste at the end of its useful life.

The manufacturer is responsible for organising and managing the separate collection of this piece of equipment at the end of its useful life.

Users wishing to dispose of the equipment must therefore contact the manufacturer to obtain instructions from the same on how to have the equipment collected separately at the end of its useful life.

By collecting the disused equipment separately, it can be recycled, treated or disposed of in an environmentally friendly manner, thus helping to prevent the environment and public health from being affected negatively and enabling reuse and/or recycling of the materials forming the same equipment.

1. Safety instructions

Qualified Personnel

Warning!

Only qualified personnel familiar with DC drives, field controllers, motors and associated machinery should plan or implement the installation, startup, and subsequent maintenance of the system. Failure to comply can result in personal injury and/or equipment damage.

Personal Safety

Warning!

To avoid an electric shock hazard, verify that all power to the connected devices has been removed before you begin installation.

Warning!

To avoid an electric shock hazard, the installer must provide guarding to shield exposed electrical equipment against accidental contact. Exposed electrical components that carry potentially hazardous voltages are identified in this manual. When installing this equipment, consider the design and placement of guarding to help prevent personal injury or equipment damage.

Hot surfaces can cause severe burns. The dampening resistor assembly becomes hot during operation. To avoid a burn hazard, the installer must provide guarding to shield exposed electrical equipment against accidental contact. After operation, allow time for the resistor assembly surfaces to cool before you start maintenance.

2. Required Tools and Hardware

This table provides a list of customer-supplied tools and hardware that is required to install the **OVPD** voltage clamp.

Tools	Hardware	Hardware
Nut driver or torque wrench (10 mm, 13 mm, 15 mm).	M6 screws (8) for **OVPD** voltage clamp.	M6 bolts and washers (2) for models **OVPD**-200-185 and **OVPD**-500-185 power terminals (C, D).
Flat-nose and hexalobular screwdriver (T30).	M8 bolt and washer for **OVPD** voltage clamp ground (PE) terminal.	M10 bolts and washers (2) for models **OVPD**-200-650 and **OVPD**-500-650 power terminals (C, D).

3. Models and sizes

OVPD have two different version according to the AC line voltage and two current size for each of them:

Models	AC Input line voltage	Rated Current IN
OVPD-200-185	200VAC max	185ADC max
OVPD-200-650	200VAC max	650ADC max
OVPD-500-185	500VAC max	185ADC max
OVPD-500-650	500VAC max	650ADC max

4. Derating factors

The following derating factors have to be applied to the rated current IN by the user.

Load current = IN * KT * KALT

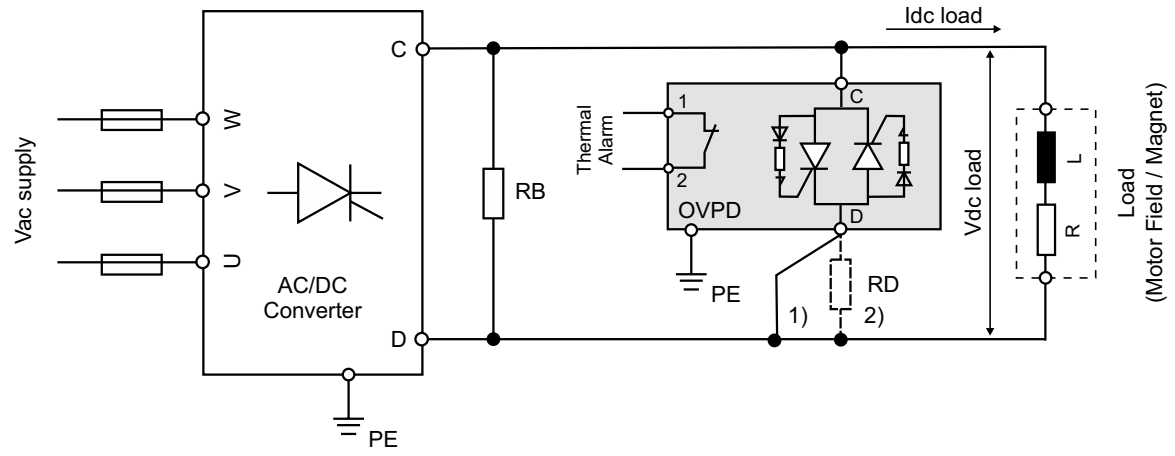
Where:

KT: derating factor for ambient temperature above 40°C = 1% each °C above 40°C (up to a maximum of 50°C)

KALT: derating factor for installation at altitude above 1000 meters a.s.l. = 1,2% each 100m increase above 1000m (up to a maximum of 2000m)

5. System Wiring Diagram

This diagram shows the wiring connection of OVPD, damping resistor RB and optional discharge resistor RB.



1) OVPD connection without discharge resistor RD
2) OVPD connection with discharge resistor RD

6. Damping Resistor RB

The damping resistor RB must be installed to dampen the overvoltage that results from undershooting holding current when the thyristor stops conduction.
Size a customized discharge resistor (RB) as follows:

$$RB\ [\Omega] = \frac{1.35 * Vac\ supply\ [V]}{0.5\ [A]}$$

$$RB\ dielectric\ strength\ [V] \geq 2 * 1.35 * Vac\ supply\ [V]$$

$$RB\ dissipation\ [W] = \frac{Vdc\ load^2\ [V]}{RB\ [\Omega]}$$

Where:
Vac supply [V] = AC main Voltage
Vdc_load [V] = Rated load DC Voltage

RB rated power [W] ≈ from 3 to 4 * RB dissipation [W]

RB rated power [W]: the power multiplier factor (from 3 to 4) is intended as margin to have a reasonable surface resistor temperature. Ask your resistor supplier for a proper evaluation.

Example:

Load Rated Voltage	200 [V]
AC Line Voltage	230 [V]

$$RB\ [\Omega] = \frac{1.35 * Vac\ supply\ [V]}{0.5\ [A]} = \frac{1.35 * 230\ [V]}{0.5\ [A]} = 621\ [\Omega]$$

$$RB\ dissipation\ [W] = \frac{Vdc\ load^2\ [V]}{RB\ [\Omega]} = 64.41\ [W]$$

Note ! Ask your resistor supplier for a proper evaluation of the resistor Power [W] according to the desired surface temperature.
Choosing a resistor with a rated power equal to the dissipation [W], it can reach a surface temperature larger than 300°C.

$$RB\ dielectric\ strength\ [V] \geq 2 * 1.35 * Vac\ supply\ [V]$$

Standard RB resistors

To have a reliable and fast solution is it possible to select the RB resistor from the following table 1.
The standard resistors are sized as a function of Vac supply and considering the typical DC/AC voltage ratio for a 2 quadrant converter (1.158).

Standard Dampening Resistor (RB)

Table 1: Standard Dampening Resistor (RB)

Mains Voltage [Vac]	Resistor Type	Code	Resistor value [Ω]	Rated power [W]	Continuous dissipated power [W]	Surface temperature (1) [°C]
100	RFD 550 270R 5%		270.00	550	50	90
230	RFH 1000 620R 5%		620.00	1000	120	100
400	RFH 1000 1050R 5%		1050.00	1000	210	140
460	RFH 2000 1240R 5%		1240.00	2000	230	125
500	RFH 2000 1350R 5%		1350.00	2000	250	150

(1) The surface temperature is indicated for an ambient temperature = 25 °C.

Note ! For UL type resistor ask to WEG Automation Europe S.r.l. Commercial Dept.

7. Optional External Discharge Resistor

The OVPD has thyristors installed on the heatsink and their sizing is made to have a working time so long that it very rarely needs the optional RD resistor (see the below example).

Anyway, if the time constant τ (Tau) of the load is greater than the OVPD rated operation time or is greater than the application expected time, the RD resistor must be installed.

Table 2: Rated Operation Time

Model	Rated Operation Time [s]
OVPD-200-185	30
OVPD-200-650	45
OVPD-500-185	30
OVPD-500-650	45

The time constant for the load is calculated as:

$$\tau\ [s] = \frac{L\ load\ [H]}{R\ load\ [\Omega]}$$

Where ***L load*** and ***R load*** are respectively the load inductance and resistance. Ask to the load builder (motor or magnet builder) to have these data.

Once 1 Tau is elapsed the DC voltage is approximately 30% the Vdc load. The full discharge takes around 6 Tau.

To check for the operation time limit consider only 1 Tau

Example: Tau calculation

Load Data

Rated Voltage	200[V]
Rated Current	89[A]
Resistance	2.25[Ω]
Inductance	6.6[H]
AC Line Voltage	230[V]
AC/DC converter type	TPD32-EV-FC-500/600-110-2B-A

OVPD Data

Type	OVPD-500-185
Rated Current	185[A]
Rated operation time	30[s]
Voltage threshold	1000[V]

$$\tau\ [s] = \frac{L\ load\ [H]}{R\ load\ [\Omega]} = \frac{6.6\ [H]}{2.25\ [\Omega]} = 2.93\ [s]$$

The τ is lower than the OVPD operation time, so it is not necessary to add an external RD discharge resistor.

Only if the τ is higher than the OVPD operation time, it is mandatory to add an external RD resistance.

The addition of the RD resistor decreases the discharge time constant τ:

$$\tau\ [s] = \frac{L\ load\ [H]}{(\ R\ load\ [\Omega] + RD\ [\Omega]\ )}$$

Calculation of the RD resistor value [Ω]

The behavior of and inductance is such that, in the starting phase of the discharge, the DC current is equal to the load current. This effect the DC voltage.
RD value must not be so large as to result in a starting DC voltage higher than the OVPD voltage threshold. So, the resistor value have to be limited to:

$$RD\ [\Omega] \leq 0.9 * \frac{Uthrs\ [V]}{Idc\ load\ [A]}$$

Where:
Uthrs [Vdc]= threshold of activation of the discharge thyristor
Idc load = DC rated current of the load

***Table 2**: Rated Operation Time*

Model	AC Input line Voltage [Vac]	Uthrs [Vdc]
OVPD-200-185	200	600
OVPD-200-650		
OVPD-500-185	500	1000
OVPD-500-650		

Calculation of the RD resistor peak power [W]

The initial current of the discharge circuit is the load rated current ***Idc load:***

$$RD\ peak\ power\ [W] = Idc\ load^2\ [A] * RD\ [\Omega]$$

Calculation of the RD resistor average dissipation power [W]

The load consist of an inductance and a resistance in series.
During the current discharge, the Energy [J] that is stored in the magnetic field of the load inductance is dissipated in the internal load resistance and in the external optional added resistor RD.

E = Energy [J] P = Power [W]
L load = load Inductance [H] R load = load Resistance [Ω]
Idc load = load rated Current [A] Tau = Time constant L/R [s]

Energy stored in the load inductance:

$$E\ [J] = \frac{1}{2} * L\ load\ [H] * Idc\ load^2\ [A]$$

$$Prd\ [W] = \frac{E\ [J]}{6 * \tau\ [s]} * \frac{RD\ [\Omega]}{RD\ [\Omega] + R\ load\ [\Omega]}$$

Where Prd [W] is the average power dissipation of the RD resistor over six time constants (discharge time of the circuit).

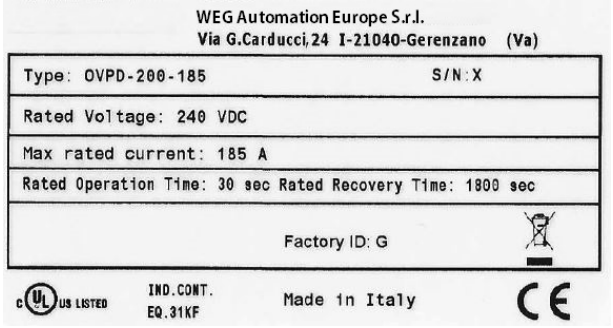
8. OVPD Voltage Clamp Thermostat

A thermal-trip interlock terminal block (TB1: terminals 1 - 2) is provided on the top of the **OVPD** voltage clamp.
Use this terminal block to interlock the **OVPD** with the field controller control circuit.
The thermal trip circuit opens when the **OVPD** voltage clamp heat-sink temperature is too high.

Note ! When the thermostat is open, the field controller must be disabled.

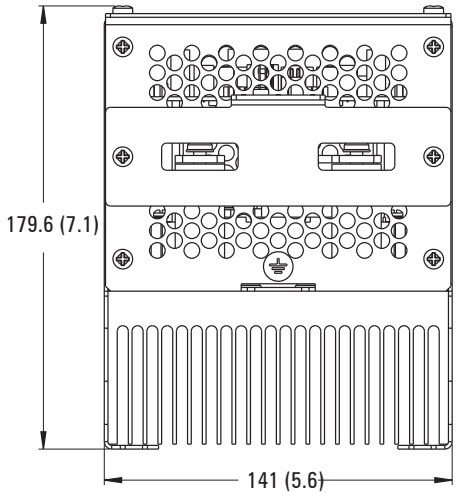
9. OVPD Voltage Clamp Nameplate Data

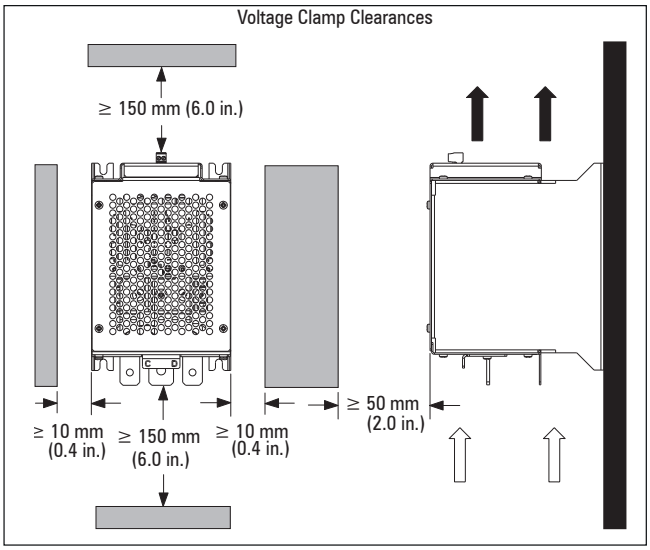
The **OVPD** voltage clamp contains a data nameplate label on the side of each module.
This nameplate identifies the specific model type, serial number, and applicable power data.
Include this information when communicating with WEG Automation Europe S.r.l. personnel about this product.

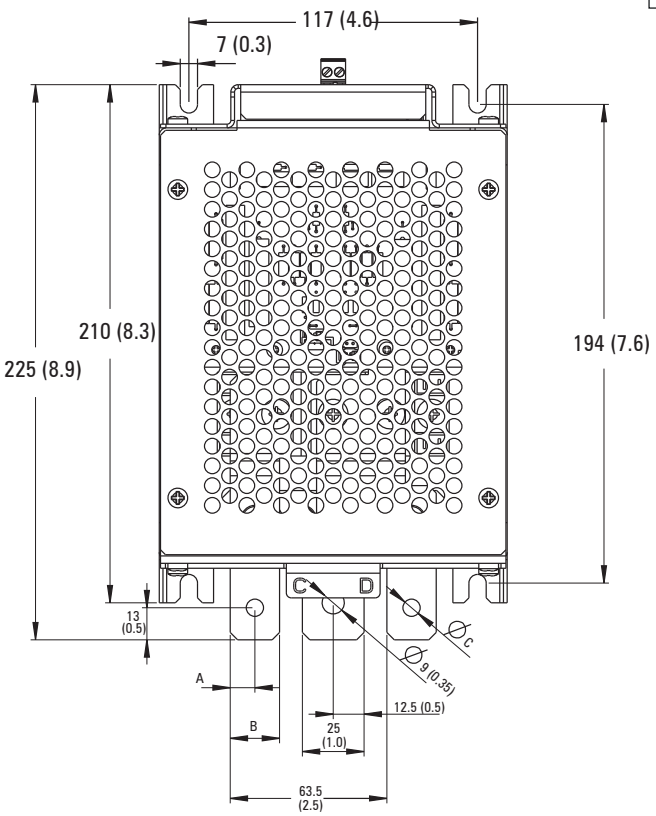


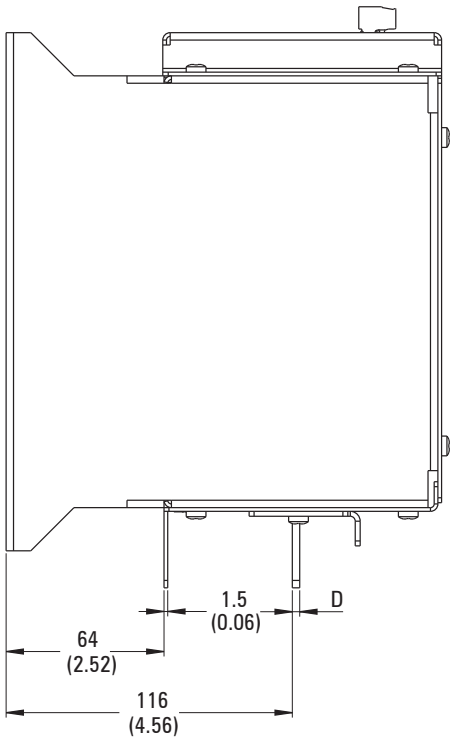
10. Product Dimensions, Weights and mounting Clearances

OVPD voltage clamp Dimensions









Dimensions are in millimeters and (inches)

OVPD models	Width [mm] (inches)	Height [mm] (inches)	Dept [mm] (inches)	A [mm] (inches)	B [mm] (inches)	C [mm] (inches)	D [mm] (inches)	Weight [kg] (lb)
OVPD-200-185 **OVPD**-500-185	141 (5.6)	225 (8.9)	179.6 (7.1)	10 (0.4)	20 (0.8)	Ø 7 (0.27)	3 (0.12)	3.7 (8.2)
OVPD-200-650 **OVPD**-500-650				12.5 (0.5)	25 (1.0)	Ø 10.5 (0.4)	5 (0.2)	5.25 (11.6)

OVPD Voltage Clamp Clearances

Minimum clearance requirements for the **OVPD** voltage clamp are intended to be from device to device.

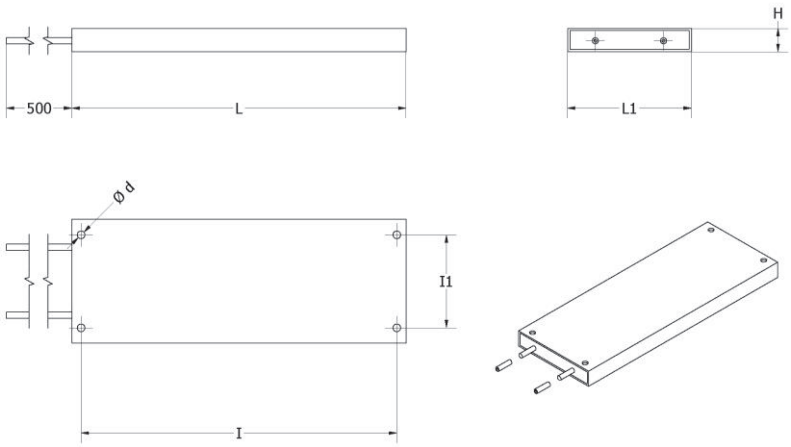
Other objects can occupy this space; however, reduced airflow can cause the **OVPD** voltage clamp to overheat.

Caution

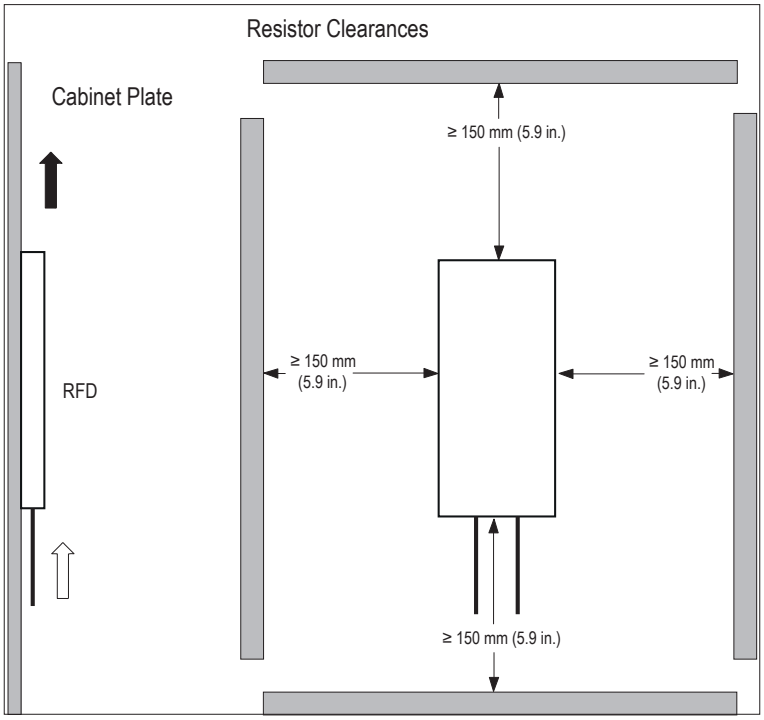
Air circulation through the device must not be impeded.

The OVPD voltage clamp assembly must be mounted in a vertical orientation (as shown above).

RFD Resistors Dimension, Weight and Mounting

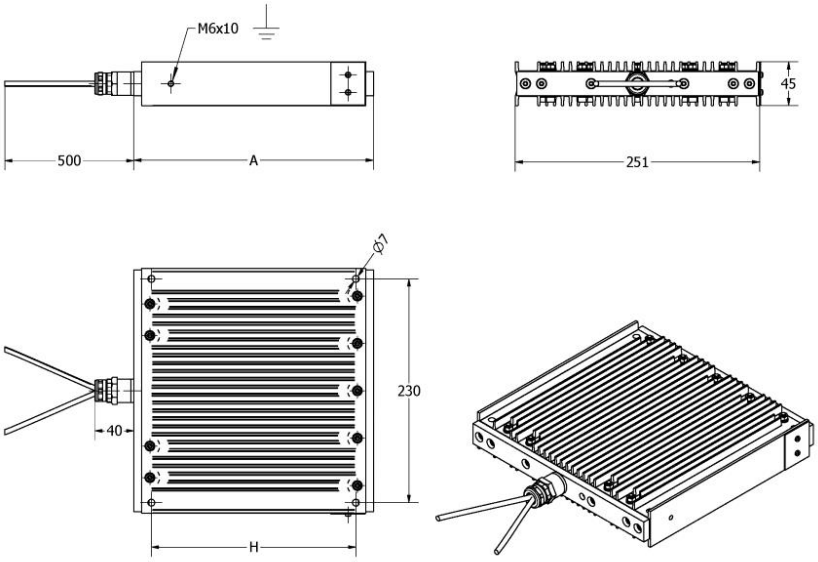


Model	L [mm] (inches)	L1 [mm] (inches)	I [mm] (inches)	I1 [mm] (inches)	H [mm] (inches)	d [mm] (inches)	Weight [kg] (lb)
RFD 550	220 [8.66]	100 [3.94]	180 [7.08]	83.5 [3.29]	20 [0.79]	6.3 [0.25]	0.98 [2.16]

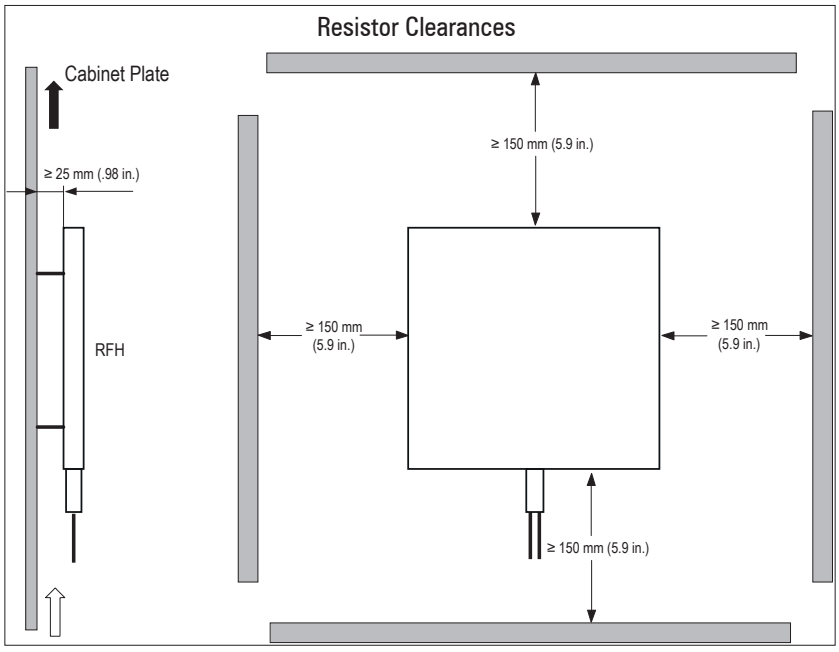


Warning!

The resistors must never be mounted with the terminals uppermost.



Model	A [mm] (inches)	H [mm] (inches)	Weight [kg] (lb)
RFH 1000	246 [9.68]	210 [8.27]	4.8 [10.6]
RFH 2000	386 [15.20]	350 [13.78]	7.5 [16.5]



11. Install the OVPD Voltage Clamp and Dampening Resistor

Follow these steps to install the **OVPD** voltage clamp and dampening resistor with a **TPD32-EV-FC (or TPD500-FC)** field controller.

Remove Power from the TPD32-EV-FC (or TPD500-FC) Field Controller

Warning!

Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electric arc can occur. An electric arc can cause personal injury or property damage by:

- **sending an erroneous signal to your system field devices, causing unintended machine motion**
- **causing an explosion in a hazardous environment**

Electrical arcing causes excessive wear to contacts on both a module and its mating connector. Worn contacts can create electrical resistance.

Remove and lockout all incoming power to the field controller and any connected devices.

Mount the OVPD Voltage Clamp

The **OVPD** voltage clamp maximum weight is 5.25 kg (11.6 lb). Follow the steps to mount the **OVPD** voltage clamp.

1. Mark and verify the hole pattern on the panel on which you intend to mount the **OVPD** voltage clamp. See page 6 for dimensions.
2. Partially install the lower M6 mounting screws into the mounting panel.
3. Lift the **OVPD** voltage clamp onto the screws that are installed in the panel.
4. Install the remaining screws into the panel and tighten all hardware to 7 N•m (62 lb•in).

Mount the Dampening Resistor

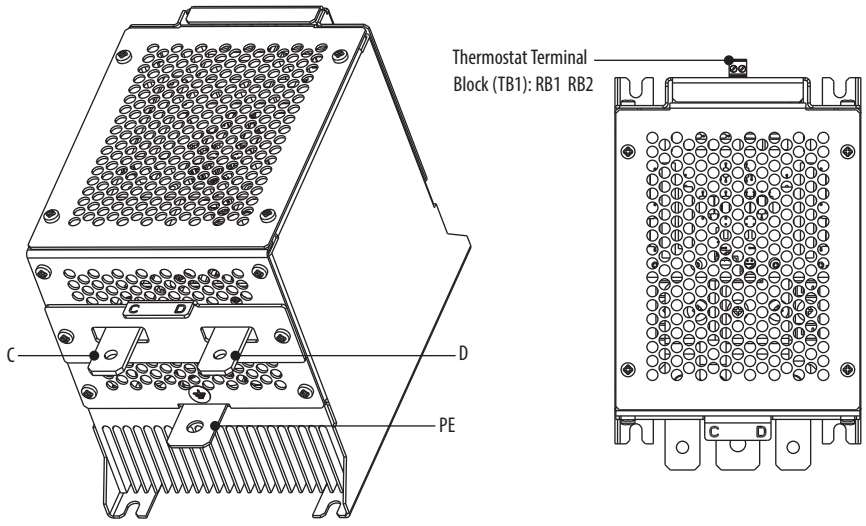
Follow the steps to mount the dampening resistor.

1. Mark and verify the hole pattern on the panel on which you intend to mount the dampening resistor. See pages 7- 8 for dimensions and weight.
2. Partially install the four mounting screws into the mounting panel.
3. Lift the dampening resistor assembly onto the screws that are installed in the panel.
4. Tighten all hardware to 7 N•m (62 lb•in).

Wire the OVPD Voltage Clamp

Use the information in this section and the System Wiring Diagram on page 3 to wire the power and ground (PE) connections on the **OVPD** voltage clamp.

OVPD Voltage Clamp Power, Ground, and Thermostat Terminal Identification



OVPD Voltage Clamp Power and Ground (PE) Terminal Specifications

Terminal	Description	Wire Size	OVPD models	Terminal Bolt Size	Recommended Torque
C, D	DC Power connections	Same as the connected **TPD500-FC** or **TPD32-EV-FC** converter	**OVPD**-200-185, **OVPD**-500-185	M6	7 N•m (62 lb•in)
			OVPD-200-650, **OVPD**-500-650	M10	25 N•m (221.2 lb•in)
PE	Safety ground		All	M8	15 N•m (132.7 lb•in)

OVPD Voltage Clamp Thermostat Terminal Block and Wire Specifications (TB1)

Terminal	Wire Size	Recommended Torque
	Flexible / Multi-core (AWG)	
1	0.14…1.5 (6…14)	0.5 N•m (4.4 lb•in)
2		

12. OVPD Voltage Clamp Ratings

Models		**OVPD**-200-185	**OVPD**-200-650	**OVPD**-500-185	**OVPD**-500-650
Rated supply voltage	[Vac]	200	200	500	500
Load rated current	[Adc]	185	650	185	650
Thyristor module (or equivalent)		SKKT132/16E	MCC501-16io2	SKKT132/16E	MCC501-16io2
Rated operation time	[s]	30	45	30	45
Rated recovery time	[s]	1800			
Operation ambient temperature	[°C] (°F)	0…40°C (32…104°F) up to max 50°C with current derating			
Transportation and storage temperature	[°C] (°F)	25…+55°C (13…131°F)			
Degree of protection		IP20 (except power bar IP00)			
Overvoltage category		III			
Pollution degree		2			
Installation altitude above sea level	[m]	≤ 1000 up to max 2000m with current derating			
Thermal protection temperature threshold	[°C] (°F)	+60°C (+140°F)			
Thermal protection ratings		Max. 250 V, 2 A			
Weight	[kg] (lb)	3.7 (8.2)	5.25 (11.6)	3.7 (8.2)	5.25 (11.6)

13. Permissible Ambient Condition

Protection degree		IP 20 (except power bar IP00) UL enclosure type 1.
Installation location		Pollution degree 2 or lower (free from direct sunligth, vibration, dust, corrosive or inflammable gases, fog, vapour oil and dripped water, avoid saline environment)
Altitude		Up to 3300 feet (1000 m) above sea level; higher altitudes a current reduction of 1.2% for every 330 feet (100 m) of additional altitude. Max 2000m (6562 feet) above sea level.
Temperature	Operation Ta	32-131° F (0 ... 55° C), over 104° F (40 °C): current reduction of 1.25% for every 1.8 °F over 104° F (1 °C over 40 °C) better than the 3K3 class per EN 50178)
	Storage Ta	-13° F ... 131° F (-25 ... +55° C) (1K4 class as per EN 50178)
	Transport Ta	-13° F ... 131° F (-25 ... +55° C) (2K3 class as per EN 50178)
Air humidity	Operation	5% up to 85%, 1 g/m^3 up to 25 g/m^3 without moisture condensation or icing (3K3 class as per EN 50178)
	Storage	5% up to 95%, 1 g/m^3 up to 29 g/m^3 (1K3 class as per EN 50178)
	Transport	95% [1], 60 g/m [2] A light condensation of moisture may occur for a short time occasionally when the device is not in operation (2K3 class as per EN 50178).
Air pressure	Operation	From 86 kPa up to 106 kPa (3K3 class per EN 50178)
	Storage	From 86 kPa up to 106 kPa (1K4 class per EN 50178)
	Transport	From 70 kPa up to 106 kPa (2K3 class per EN 50178)

1) Greatest relative air humidity occurs with the temperature 104° F (40° C) or if the temperature of the device is brought immediately from -13° F ... 86° F (-25° C to +30° C).

2) Greatest absolute air humidity if the device is brought immediately from 158° F ... 59° F (70° C to +15° C).

14. Standards

General	EN 61800-1, EN 60146-1-1
Safety	EN 61800-5-1, EN 50178
Clearances and creepage distances	Overvoltage category for circuits connected directly to the mains: III; pollution degree: 2. Double or reinforced insulation/safe separation from live parts of decisive voltage class C; see EN 61800-5 §4.2.3.
Oscillation test	EN 60721-3-3 class 3M1, EN 60068-2-6, test Fc.
Climatic conditions	EN 60721-3-3, class 3K3. EN 60068-2-2, test Bd.
EMC	EN 61800-3. See “Guide to the electromagnetic compatibility”.
Rated mains voltage	IEC 60038
Protection degree	According to EN 60529
UL/cUL approval	UL508C

Attention

The DC drive is suitable for use under the environmental service conditions (climate, mechanical, pollution, etc.) defined as usual service conditions according to EN61800-1.