



PowerFlex DC Field Controller Overvoltage Protection Device

Catalog Numbers 23P-FCOVPD-B-FA, 23P-FCOVPD-B-FB, 23P-FCOVPD-D-FA, 23P-FCOVPD-D-FB, 23P-FC-RB100, 23P-FC-RB200, 23P-FC-RB300, 23P-FC-RB400, 23P-FC-RB500

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The overvoltage protection device (voltage clamp) helps to provide protection against overvoltage for the PowerFlex® DC field controller when used with a highly inductive load. An overvoltage can occur when the AC supply voltage is turned off before the field controller is disabled. The resulting overvoltage can damage the field controller.

The voltage clamp (cat. no. 23P-FCOVPD-x-Fx) is composed of a pair of Silicon Controlled Rectifier (SCR) modules and a circuit board. The circuit board detects the load voltage level. When a potentially damaging voltage level is detected, the voltage clamp activates the appropriate SCR, based on the direct of current flow. The SCRs conduct the excess current and allow the resistance in the motor field to gradually decay. The voltage clamp must not be used to discharge inductive loads routinely. The voltage clamp requires approximately 30 minutes to dissipate the energy from an overvoltage condition before power can be reapplied to the device.

A dampening resistor (RB) must be installed in combination with the voltage clamp. The dampening resistor is required to dampen the overvoltage that results from undershooting holding current when the voltage clamp SCR stops conduction. Dampening resistor kits (cat. no. 23P-FC-RBn00) 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. The dampening resistor terminals are rated IP00. Therefore, these devices must be enclosed in a protective enclosure or appropriate guards must be provided to help protect against an electric shock and/or burn hazard.

Product Advisories

Qualified Personnel



ATTENTION: 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



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



ATTENTION: 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.



BURN HAZARD: 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.

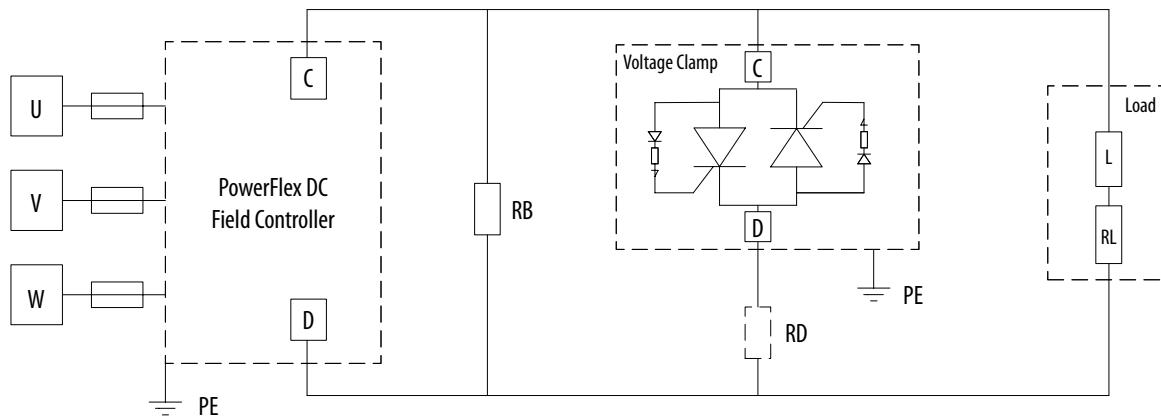
Required Tools and Hardware

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

Tools	Hardware	Hardware
Nut driver or torque wrench (10 mm, 13 mm, 15 mm).	M6 screws (8) for voltage clamp and dampening resistor mounting.	M6 bolts and washers (2) for device cat. no. 23P-FCOVPD-B-FA and 23P-FCOVPD-D-FA power terminals (C, D).
Flat-nose and hexalobular screwdriver (T30).	M8 bolt and washer for voltage clamp ground (PE) terminal.	M10 bolts and washers (2) for device cat. no. 23P-FCOVPD-B-FB and 23P-FCOVPD-D-FB power terminals (C, D).

System Wiring Diagram

This diagram represents the recommended wiring configuration for a PowerFlex DC field controller, voltage clamp, required dampening resistor (RB), and optional discharge resistor (RD).



Dampening Resistor

A dampening resistor (RB) must be installed with the voltage clamp to dampen the overvoltage that results from undershooting holding current when the SCR stops conduction. Purchase and install the appropriate resistor kit that is listed in the Dampening Resistor (RB) Kits table, or use the sizing information to install a customer-supplied resistor.

Dampening Resistor Sizing Calculations

The value of resistor RB is determined by the 500 mA SCR holding current at the rectified voltage value. The dielectric strength of resistor RB is at least double the rectified voltage value and its power loss is two to three times (for margin) the power dissipation that is calculated, considering the rectified nominal voltage of the load.

Size a customer-supplied discharge resistor (RB) as follows:

$$\text{RB value} = 1.35 * \text{V_line} / 500 \text{ mA}$$

$$\text{RB dielectric strength} \geq 2 * 1.35 * \text{V_line}$$

$$\text{RB power} = 2 * (\text{V_load})^2 / \text{RB}$$

The available dampening resistor kits are shown in the Dampening Resistor (RB) Kits table. The resistor kits are sized with the value of resistor RB as a function of V_line with a typical inductive load that is connected to the PowerFlex DC field controller. For most applications, the typical DC output voltage is approximately 1.08 * V_line. By using the typical DC output voltage value as a guideline, the power dissipation value can be forced to be a function of the AC input line voltage. Size a dampening resistor (RB) where V_load = 1.08 * V_line:

$$\text{RB value} = 1.35 \text{ V_line} / 500 \text{ mA}$$

$$\text{RB dielectric strength} \geq 2 * 1.35 * \text{V_line}$$

$$\text{RB power} = 2 * (1.08 * \text{V_line})^2 / \text{RB}$$

(RB power = 2 increases the power dissipation margin.)

Dampening Resistor (RB) Kits

Field Controller AC Input Voltage Range (Vrms)	RB Resistor Value Ohms	RB Resistor Size Watts	RB Resistor Kit Cat. No. ⁽¹⁾
60...100V	220	930	23P-FC-RB100
101...200V	390	930	23P-FC-RB200
201...300V	680	930	23P-FC-RB300
301...400V	1000	930	23P-FC-RB400
401...500V	1200	930	23P-FC-RB500

(1) Resistor kits are IP00 / Open Type and must be installed in an enclosure.

Optional External Discharge Resistor

An external discharge resistor (RD) must be installed to reduce the load current discharge time if the load τ is greater than the rated operation time, as calculated in the Calculate the Average Power Dissipation Value for Resistor RD section on page 4. The time constant for the load is calculated as:

$$\tau = L / R, \text{ where } L \text{ is the load inductance and } R \text{ is the internal resistance of the load}$$

The addition of resistor RD decreases the discharge time constant: $\tau = L / (R + RD)$

Optional External Discharge Resistor Calculations

Calculate the Resistance Value of Resistor RD

To calculate the resistance value of resistor RD, the inductance and resistance of the existing load must be known. The desired time constant of the "updated circuit" is expressed as:

$$\tau = L / (R + RD)$$

Solve for RD.

Calculate the Peak Power Rating Value for Resistor RD

Calculate the peak power rating value for RD in watts, where the initial current is equal to the load current.

$$RD_{\text{peak_Power}} = (I_{\text{load}})^2 * RD$$

Solve for RD_peak_Power.

Calculate the Average Power Dissipation Value for Resistor RD

Calculate the average power dissipation for resistor RD.

The initial current, I_0 , of the discharge circuit is the load current. The load actually consists of an inductance and a resistance in series (though the only visible object is the load coil).

During the current discharge, the energy that is stored in the magnetic field of the load inductance is dissipated in the internal load resistance and the external optional added resistor RD.

E = Energy, Joules

P = Power, Watts (Joules/Second)

L = Inductance, Henrys

R = Resistance, Ohms

I = Current, amps

I_0 = Initial Current, amps

τ = Circuit Time Constant L/R, Seconds

$$E = \frac{1}{2} * L_{\text{load}} * I_0^2 \quad (\text{The initial value of the energy stored load inductance})$$

$$\tau = L / (RD + R_{\text{load}})$$

$$P_{\text{rd}} = [E / 6 * \tau] * [RD / (RD + R_{\text{load}})]$$

P_{rd} = Average power dissipation of resistor RD over six time constants (discharge time of the circuit).

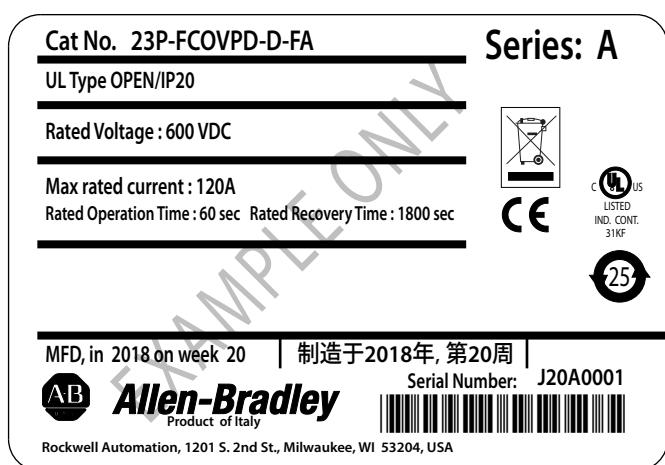
Solve for P_{rd} .

Voltage Clamp Thermostat

A thermal-trip interlock terminal block (TB1) is provided on the top of the voltage clamp. Use this terminal block to interlock the voltage clamp with the field controller control circuit. The thermal trip circuit opens when the voltage clamp heat-sink temperature is too high. When the thermostat is open, the field controller is disabled.

Voltage Clamp Nameplate Data

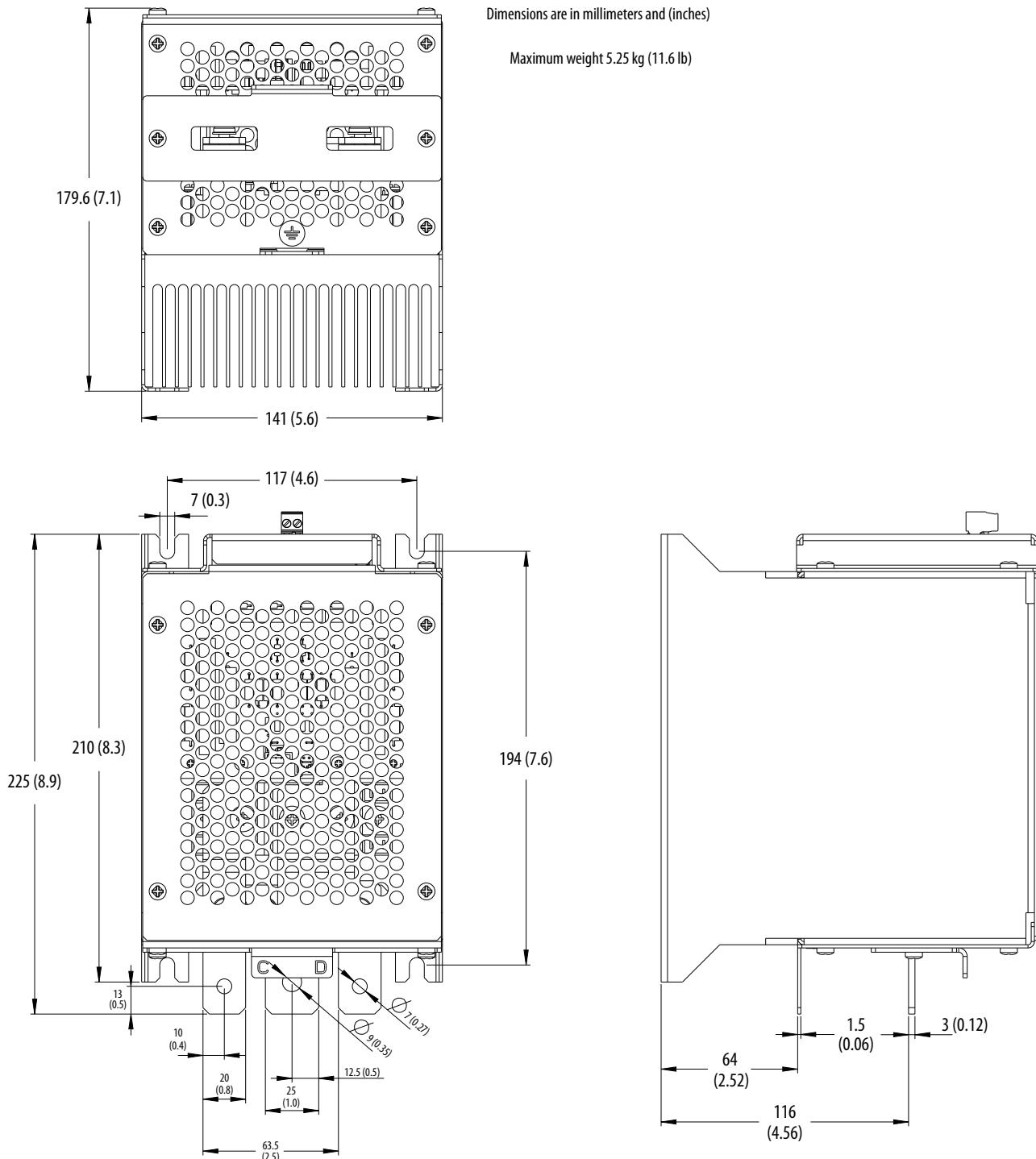
The voltage clamp contains a data nameplate label on the side of each module. This nameplate identifies the specific catalog number, serial number, and applicable power data. Include this information when communicating with Rockwell Automation personnel about this product.



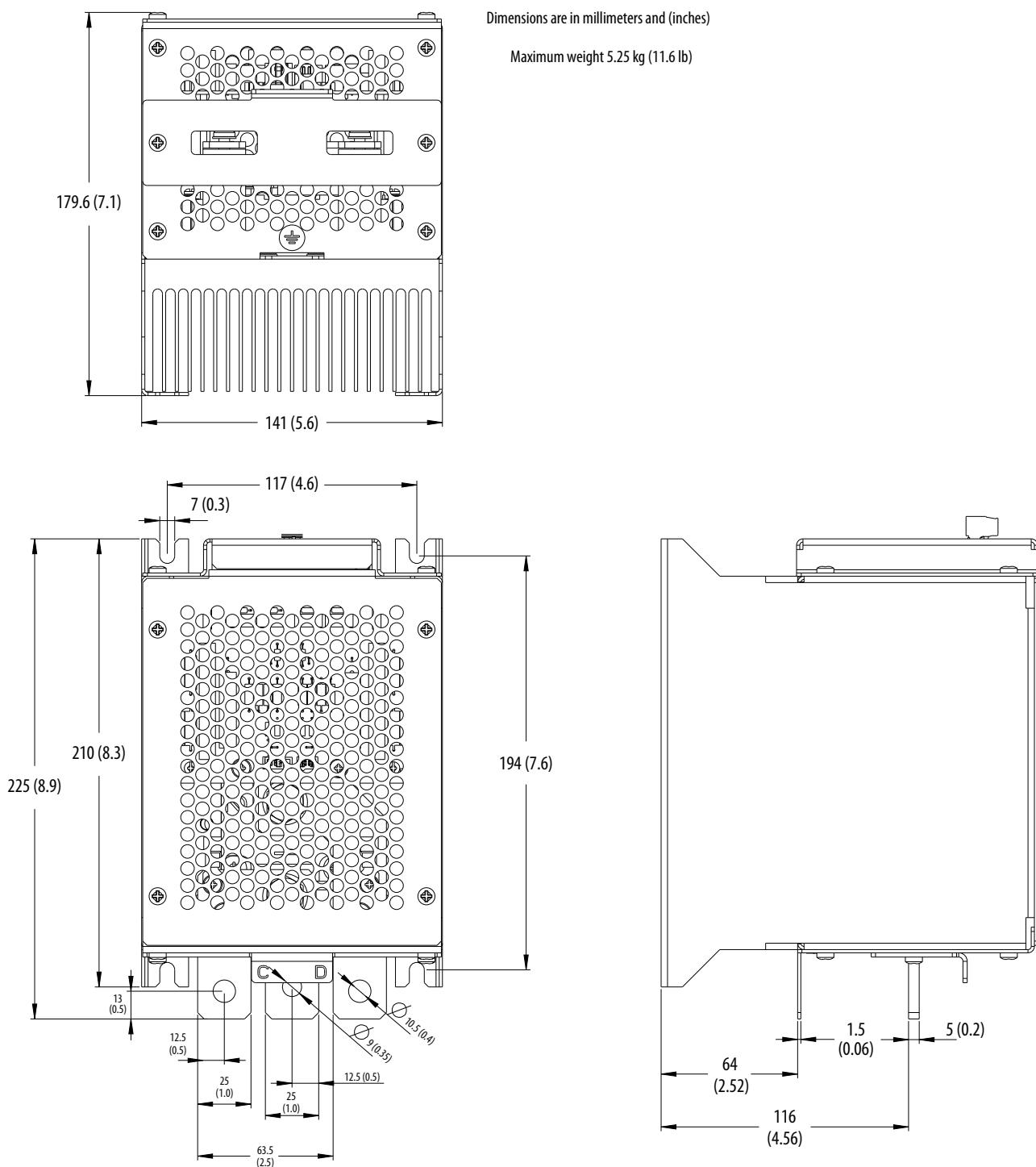
Product Dimensions and Weights

These illustrations provide the approximate dimensions and weights for the voltage clamp and dampening resistor kits. Use these dimensions for mounting these devices.

Voltage Clamp Catalog Numbers 23P-FCOVPD-B-FA and 23P-FCOVPD-D-FA



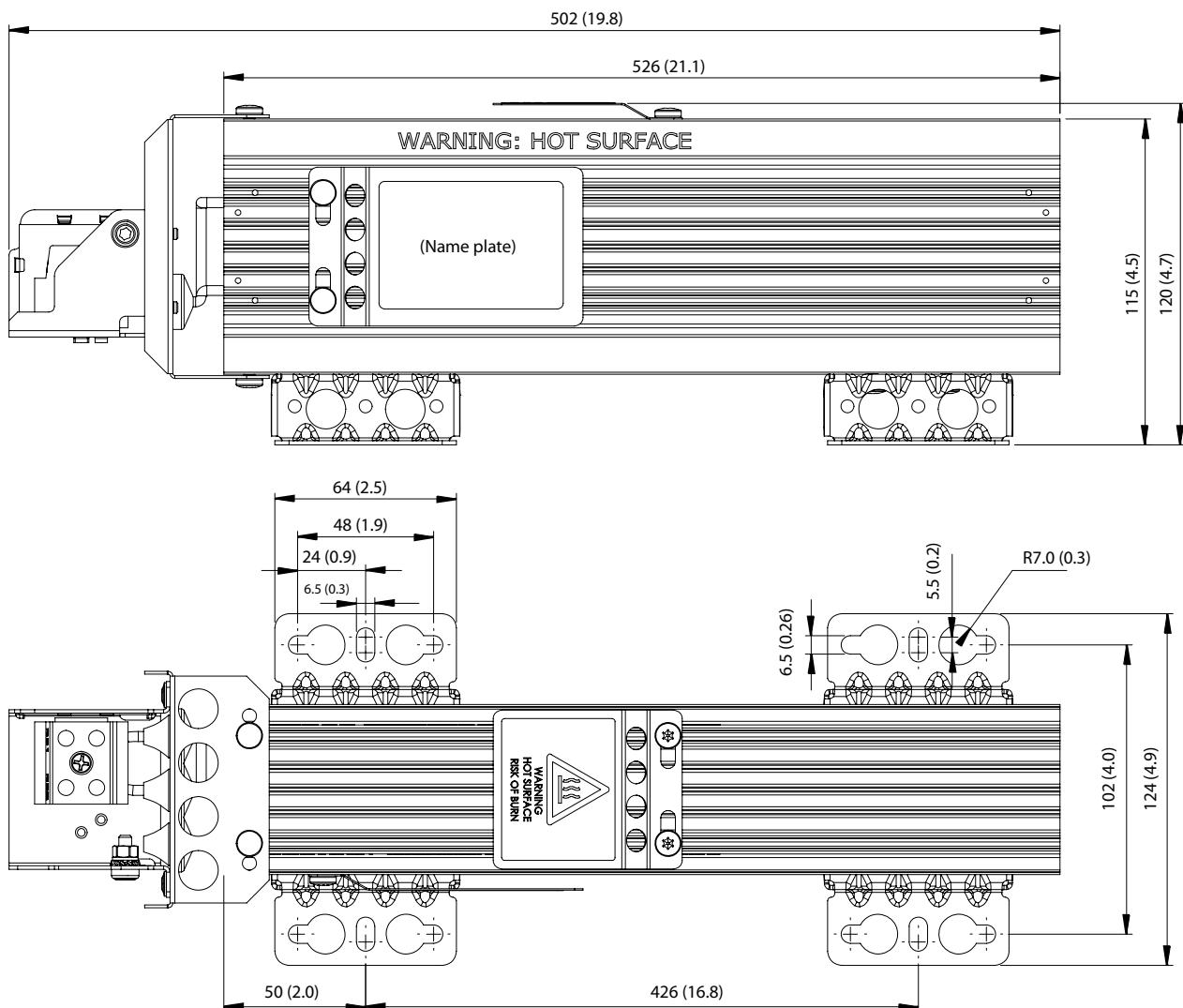
Voltage Clamp Catalog Numbers 23P-FCOVPD-B-FB and 23P-FCOVPD-D-FB



Dampening Resistor Dimensions

Dimensions are in millimeters and (inches)

Weight 3.9 kg (8.6 lb)

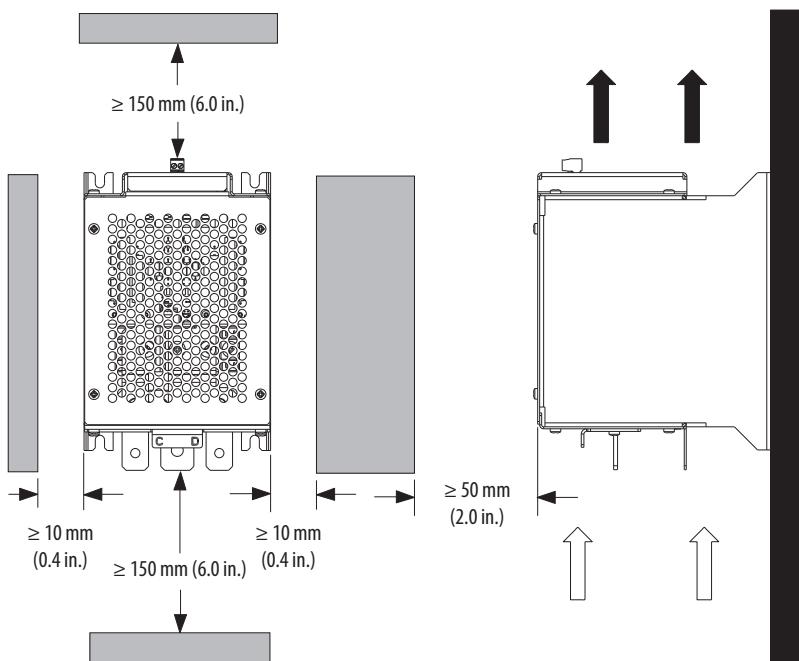


Minimum Mounting Clearances

The minimum clearances that are specified in this section must be provided to help avoid device overheating.

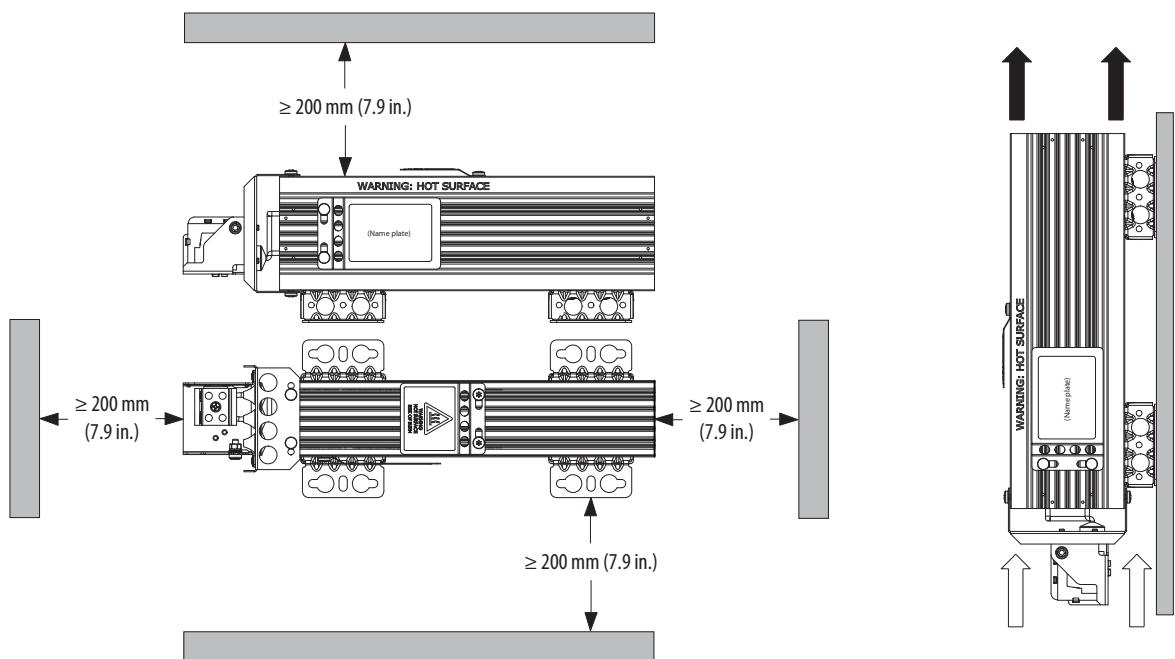
Voltage Clamp Clearances

Minimum clearance requirements for the voltage clamp are intended to be from device to device. Other objects can occupy this space; however, reduced airflow can cause the voltage clamp to overheat. Air circulation through the device must not be impeded. The voltage clamp assembly must be mounted in a vertical orientation (as shown here).



Dampening Resistor Clearances

Minimum clearance requirements for the dampening resistor are intended to be from device to device. The resistor assembly can be mounted horizontally, or vertically. When mounted vertically, the terminal block must be below the resistor assembly (as shown here).



Install the Voltage Clamp and Dampening Resistor

Follow these steps to install the voltage clamp and dampening resistor with a PowerFlex DC field controller.

Remove Power from the PowerFlex DC Field Controller

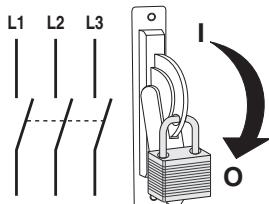


ATTENTION: Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electric arc can occur. An electric arc can cause personal injury or property damage by:

- 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 Voltage Clamp

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

IMPORTANT Mount the voltage clamp as close as possible to the PowerFlex DC field controller. The minimum clearances must be met (see Minimum Mounting Clearances on page [8](#) for details).

1. Mark and verify the hole pattern on the panel on which you intend to mount the voltage clamp. See page [5](#) or page [6](#) for dimensions.
2. Partially install the lower M6 mounting screws into the mounting panel.
3. Lift the 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

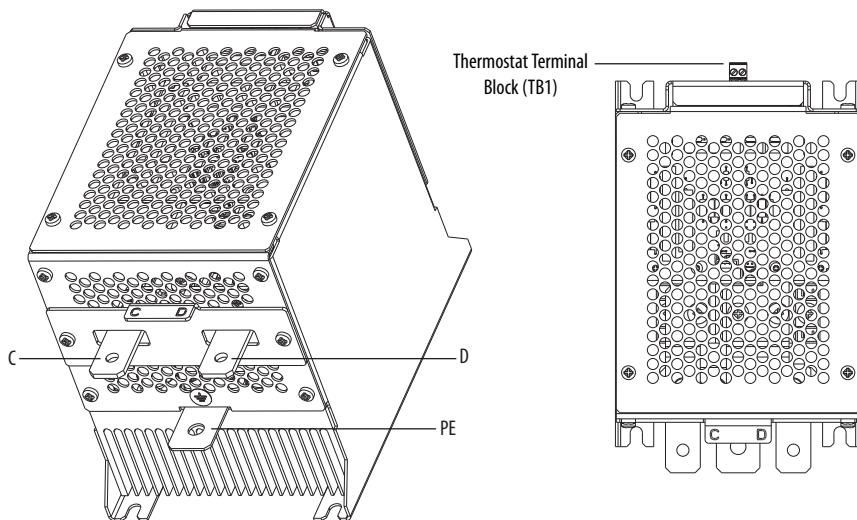
The dampening resistor weighs 3.9 kg (8.6 lb). Follow the steps to mount the dampening resistor.

1. Mark and verify the hole pattern on the panel on which you intend to mount the dampening resistor. See page [7](#) for dimensions.
2. Partially install the four M6 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 Voltage Clamp

Use the information in this section and the System Wiring Diagram on page [2](#) to wire the power and ground (PE) connections on the voltage clamp.

Voltage Clamp Power, Ground, and Thermostat Terminal Identification



Voltage Clamp Power and Ground (PE) Terminal Specifications

Terminal	Description	Wire Size	Cat. No.	Terminal Bolt Size	Recommended Torque
C, D	DC Power connections	Same as the connected PowerFlex DC field controller.	23P-FCOVPD-B-FA, 23P-FCOVPD-D-FA	M6	7 N·m (62 lb·in)
			23P-FCOVPD-B-FB, 23P-FCOVPD-D-FB	M10	25 N·m (221.2 lb·in)
PE	Safety ground		All	M8	15 N·m (132.7 lb·in)

Voltage Clamp Thermostat Terminal Block and Wire Specifications

Terminal	Wire Size		Recommended Torque
	Flexible / Multi-core (mm ²)	AWG	
1	0.14...1.5	26...14	0.5 N·m (4.4 lb·in)
2			

Wire the Dampening Resistor

Use the information in this table and the System Wiring Diagram on page [2](#) to wire the dampening resistor.

Dampening Resistor Terminal Block and Wire Specifications

Terminals	Description	Wire Size	Wire Strip Length	Minimum Wire Insulation Rating	Recommended Terminal Torque
	Power connection from voltage clamp terminals C and D.	14 AWG 2.5 mm ²	12 mm (0.5 in.)	600V, 80 °C (176 °F)	1.5...1.8 N·m (0.6...0.7 lb·in)

Voltage Clamp Ratings

Cat. No.	23P-FCOVPD-B-FA	23P-FCOVPD-B-FB	23P-FCOVPD-D-FA	23P-FCOVPD-D-FB
Maximum rated supply system voltage (VAC)	200	200	500	500
Maximum rated load system current (A DC)	120	570	120	570
Thyristor module (or equivalent)	SKKT132/16E	MCC501-16io2	SKKT132/16E	MCC501-16io2
Rated operation time (s)		60		
Rated recovery time (s)		1800		
Operation ambient temperature - °C (°F)		0...50 (32...122)		
Transportation and storage temperature - °C (°F)		-25...+55 (13...131)		
Degree of protection		IP20; except power terminals - IP00		
Overvoltage category		III		
Pollution degree		2		
Installation altitude above sea level (m)		≤ 1000		
Thermal protection temperature threshold - °C (°F)		70 (158)		
Thermal protection ratings (max.)		250V, 2 A		
Weight - kg (lb)	3.7 (8.2)	5.25 (11.6)	3.7 (8.2)	5.25 (11.6)

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
PowerFlex DC Field Controller Installation Instructions, publication 23PFC-IN001	Provides installation instructions for the PowerFlex DC Field Controller.
PowerFlex DC Field Controller Programming Manual, publication 23PFC-PM001	Provides information on how to start up, program, and troubleshoot the PowerFlex DC Field Controller.
PowerFlex DC Drive Technical Data, publication 20P-TD001	Provides detailed information on: <ul style="list-style-type: none"> • Basic product selection • Field controller specifications • Option specifications • Circuit protection
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, http://www.rockwellautomation.com/global/certification/overview.page	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at <http://www.rockwellautomation.com/global/literature-library/overview.page>. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Rockwell Automation Support

Use the following resources to access support information.

Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	https://rockwellautomation.custhelp.com/
Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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At the end of its life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at
<http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page>.

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