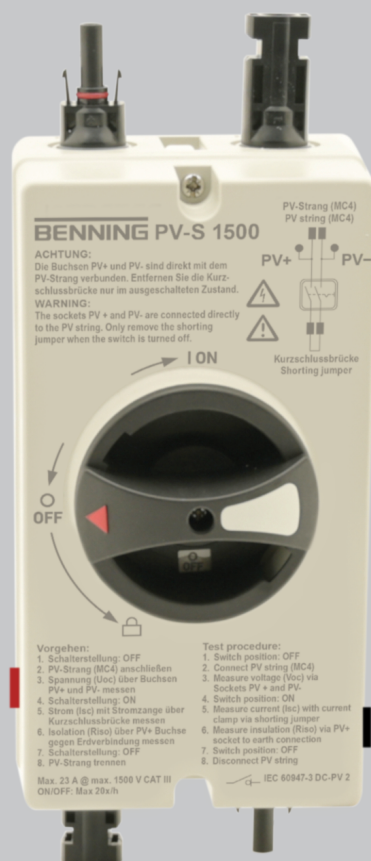


Operating manual

Translation of the German original version



Legal notice

Notes concerning the documentation

Ensure that the applicable documentation is used for this product. For safe handling, knowledge that is provided in these instructions is required.

The product may only be handled while following this documentation, particularly the safety instructions and warnings it contains. The personnel must be qualified for the respective task and have the capability to recognise risks and prevent possible dangers.

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Disclaimer

The contents of the documentation has been checked to ensure that it corresponds to the hardware and software described. Nevertheless, deviations cannot be ruled out, so Benning cannot guarantee complete correspondence. The contents of this documentation are checked at regular intervals, and any corrections that are needed are contained in the versions that follow.

General non-discrimination

Benning is aware of the importance of language with regard to the gender equality and endeavors to take this into account at all times. To improve readability, we have refrained from consistently using differentiating formulations.

Table of contents

1	Introduction.....	6
1.1	General notes.....	6
1.2	History	7
1.3	Service & support.....	8
2	Safety	9
2.1	Warning system	9
2.2	Standards applied	9
2.3	Symbols used.....	10
2.4	Intended use	11
2.5	Special types of risks	13
3	Scope of delivery	14
4	Device description.....	15
4.1	Device structure	15
5	Operation.....	16
5.1	Requirements for tests and measurements	16
5.2	Open-circuit voltage, short-circuit current and insulating resistance measurements.....	16
6	Maintenance	18
6.1	Maintenance schedule	18
6.2	Cleaning the device.....	18
7	Technical data.....	19
8	Disposal and environmental protection	20
	Index	21

Table of figures

Figure 1 BENNING PV-S 1500 device structure..... 15

List of tables

Table 1	History.....	7
Table 2	Symbols on the device.....	10
Table 3	Symbols used in the operating manual.....	10
Table 4	Maintenance schedule	18
Table 5	Technical data	19

1 Introduction

The BENNING PV-S 1500 measuring adapter described here (in the following only referred to as “device”) is intended as a PV short-circuit switch for testing PV generators up to 1 500 V and a maximum short-circuit current of 23 A.

The device enables you to perform the following tests and measurements using the following measuring instruments:

- Open-circuit voltage measurement using a voltmeter
- Short-circuit current measurement using a current measuring clamp
- Insulating resistance measurement using an insulation tester or installation tester

Further information

<https://tms.benning.de/pv-s1500>



On the Internet, you will find the following additional information directly at the specified link or at www.benning.de (product search):

- Operating manual of the device in several languages
- Further information depending on the device (e. g. brochures, technical reports, FAQs)

1.1 General notes

Target group

This operating manual is intended for the following groups of people:

- Qualified electricians and qualified technical personnel

Required basic knowledge

To understand these operating manual, you will need general knowledge of testing and measuring equipment. Moreover, you will need basic knowledge of the following issues:

- General electrical engineering

Purpose of the operating manual

This operating manual describes the device and provides you information about how to handle it.

Keep this operating manual in a safe place for later use. Read this operating manual before handling the device and follow the instructions.

NOTE

Disclaimer of liability

Please make sure that any person using the device has read and understood the instructions of this operating manual before handling the device and that the instructions are adhered to in all points. Non-observance of this operating manual might result in product damage, property damage and/or personal injury.

Benning assumes no liability for damage and malfunctions resulting from the failure to observe the instructions in this operating manual.

The devices are subject to continuous further development. Benning reserves the right to make changes to the device's design, configuration and technology. The information in this operating manual corresponds to the state of technical knowledge at the time of printing. For this reason, no claims for certain device characteristics can be derived from the contents of this operating manual.

Information in this operating manual can be changed at any time without prior notice. Benning is not obligated to make amendments to this operating manual or to keep it up to date.

Direct any technical questions to Technical Support [► page 8].

Trademarks

All trademarks used are the property of their respective owners, even if they are not separately marked as such.

1.2 History

Release number	Amendments
06/2025	• Initial release

Table 1: History

1.3 Service & support

Please contact your specialty retailer or the BENNING Service Center for any repair or service work that might be required.

Technical Support

Please contact our Technical support for technical questions on handling the device.

Phone:	+49 2871 93-555
Fax:	+49 2871 93-6555
E-Mail:	helpdesk@benning.de
Internet:	www.benning.de

Returns management

Easily and conveniently use the BENNING returns portal for a quick and smooth returns processing:

<https://www.benning.de/service-de/retourenabwicklung.html>

Phone:	+49 2871 93-554
E-Mail:	returns@benning.de

Return address

BENNING Elektrotechnik und Elektronik GmbH & Co. KG
Retourenmanagement
Robert-Bosch-Str. 20
D - 46397 Bocholt

2 Safety

2.1 Warning system

This operating manual contains notes that must be taken into consideration for your personal safety and in order to avoid injuries and damage to property. Warnings about your personal safety and to prevent personal injuries are marked with a warning triangle. Warnings on sole prevention of material damage are shown without a warning triangle. The warnings are shown in descending order depending on the hazard level as follows.



DANGER

Extremely dangerous situation for humans

If you do not pay attention to this warning, irreversible or deadly injuries will occur.



WARNING

Hazard to humans

If you do not pay attention to this warning, irreversible or deadly injuries could occur.



CAUTION

Minor hazard to humans

If you do not pay attention to this warning, minor or moderate injuries could occur.



NOTICE

Danger to property, not to persons

If you do not pay attention to this warning, material damage could occur.

If multiple hazard levels occur, the warning for the highest respective hazard level will be used. In addition, a warning about personal injuries can also include a warning about material damage.

2.2 Standards applied

The device has been built and tested in compliance with the following standards and has left the factory in perfectly safe condition.

- IEC / DIN EN 60947-3 (VDE 0660-107)
- IEC / DIN EN 61010-1 (VDE 0411-1)
- IEC / DIN EN 61010-031 (VDE 0411-031)
- IEC / DIN EN 61326-1 (VDE 0843-20-1)

2.3 Symbols used

Symbols on the device

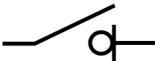
Symbol	Meaning
	Please observe the information provided in this operating manual in order to avoid dangers.
	Warning of electrical danger! Please observe the information provided in this operating manual in order to avoid dangers.
CAT III	Measuring category CAT III is applicable to testing and measuring circuits connected to the distribution circuit of the low-voltage mains installation of a building.
	The device complies with EU directives.
	The device complies with directives applicable in Great Britain.
	At the end of product life, dispose of the unserviceable device via appropriate collecting facilities provided in your community.
	The device is provided with protective insulation (protection class II).
	Please observe the operating manual.
	This symbol indicates the built-in switch-disconnector.

Table 2: Symbols on the device

Symbols used in the operating manual

Symbol	Meaning
	General warning
	Warning of electric voltage!

Table 3: Symbols used in the operating manual

2.4 Intended use

Only use the device within the framework of the corresponding technical data. Any operating conditions that deviate from this shall be considered as improper use. Solely the user of the device shall be liable for any resulting damage.

Please note the following:

- In case of improper use, the liability and warranty claims become void. Solely the user of the device shall be liable for any damage resulting from improper use. Uses not complying with the intended use include e. g.:
 - Use of components, accessories, spare or replacement parts that have not been released and approved for the respective application by Benning
 - Non-observance, manipulation, changes or misuse of the operating manual or the instructions and notes contained therein
 - Any form of misuse of the device
 - Any use other than or beyond that described in this operating manual
- Warranty and liability claims are generally excluded if the damage is the result of force majeure.
- If any prescribed services are not performed regularly or not on time, according to the manufacturer's specifications during the warranty period, a decision about a warranty claim can only be made once the findings are available.

Direct any questions to Technical Support [► page 8].

Using the device

Please observe the following basic obligations when using the device:

- The device may only be used in a technically perfect and safe condition. Always check the device for damages before using it.
- The personnel must be qualified for the respective task.
- Observe relevant regulations on occupational safety and health as well as those on environmental protection.
- The device may only be used in dry environments.
- Do not use the device in potentially explosive environments.
- Use suitable (approved) safety measuring lines.
- The device must only be used by trained technical personnel in accordance with the described device specification. Evaluate the conditions at the measuring point before measuring. If there is a risk of injury, use personal protective equipment.
- Do not touch any metal parts of the test object during tests and measurements.
- Before carrying out tests and measurements, disconnect all poles of the PV generator from the PV inverter. The PV generator must be isolated from the electric power supply! Neither the positive nor the negative pole of the PV generator must be earthed!
- Make sure that all switching and disconnecting devices are open and all PV strings are insulated from each other.
- Please observe that the PV generator must not exceed the maximum open-circuit voltage of 1 500 V, the maximum short-circuit current of 23 A and the maximum DC power ($P = V_{OC} \times I_{SC}$) of 34.5 kW.
- Please observe that the short-circuit currents (I_{SC}) of PV strings connected in parallel add up and might additionally increase due to existing capacitances of the PV generator.
- Make sure that no power optimisers are installed in the PV generator. In the event of a short-circuit, power optimisers might generate transient current peaks that significantly exceed the specified short-circuit current (I_{SC}) of the PV generator.

- Use the device only in electric circuits up to overvoltage category III with a maximum voltage of 1 500 V (conductor to conductor).
- Disconnect the device from the PV generator immediately after finishing the test or measurement.



WARNING

Dangerous voltage

Danger to life or serious injury is possible due to contact with high electric voltage in case of incorrect operation.

- Note that the PV+ and PV- measuring jacks are connected directly to the PV generator connections. Do not short-circuit these connections!
- Only remove the short-circuit jumper in the “0 OFF” switch position and after disconnecting the device from the PV generator.
- Please note that dangerous testing voltages might be applied to the device during open-circuit voltage measurements and insulating resistance measurements. These voltages might also be applied to the measuring circuit if safety measuring lines are contacted.
- Only use suitable testing and measuring instruments as well as approved safety measuring lines.
- Connect the safety measuring lines to the correspondingly marked measuring jacks of the device and check them for tight fit.
- Check that the connections of the PV generator and the short-circuit jumper are firmly connected.



WARNING

Opening the device

Danger to life or serious injury is possible due to contact with high electric voltage when opening the device. The device might get damaged.

- Do not open the device.
- Please contact your specialty retailer or the returns management [► page 8] for any repairs.

Securing the device

If the device is not in a technically perfect and operationally safe condition, safe operation is no longer guaranteed. Make sure that the following measures are taken:

- Switch off the device.
- Remove the device from the measuring point.
- Secure the device against unintentional operation.

The following characteristics indicate that safe operation is no longer guaranteed:

- The device (housing or short-circuit bridge) shows visible damage.
- The device does not work properly in compliance with regulations (e. g. errors during measurements).
- The device shows recognisable consequences of prolonged storage under inadmissible conditions.
- The device shows recognisable consequences of extraordinary stress due to transport.

2.5 Special types of risks



DANGER

Bare conductors or main line carriers

Danger to life or serious injury is possible due to contact with high electric voltage when working with bare conductors or main line carriers.

- Please observe relevant regulations on occupational safety and health.
- If necessary, use appropriate protective equipment.



WARNING

Dangerous voltage

Danger to life or serious injury is possible due to contact with high electric voltage when working on live components or equipment. Even low voltages from 30 V-AC and 60 V-DC on can be dangerous to human life!

- Please observe relevant regulations on occupational safety and health.
- If necessary, use appropriate protective equipment.

3 Scope of delivery

The scope of delivery of the device includes the following components:

- 1 x PV short-circuit switch BENNING PV-S 1500 (item no.: 11002374)
- 1 x short-circuit bridge with MC4-compatible connectors
- 1 x operating manual

4 Device description

4.1 Device structure

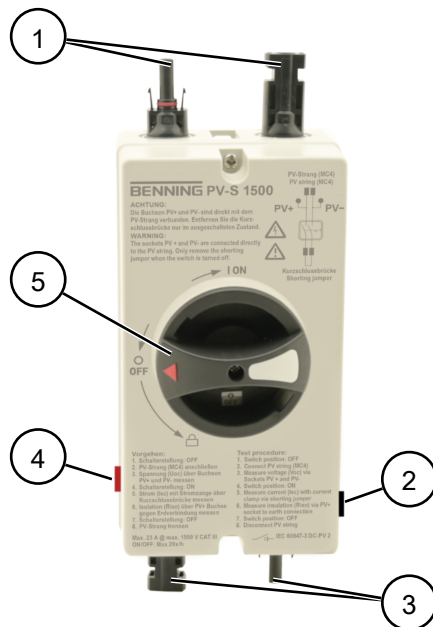


Figure 1: BENNING PV-S 1500 device structure

1	Connections for PV generator (MC4-compatible connectors)	2	4 mm measuring jack PV-
3	Connections for short-circuit bridge (MC4-compatible connectors)	4	4 mm measuring jack PV+
5	Switch-disconnector		

Switch-disconnector

The switch-disconnector has the following 3 positions (functions) when the short-circuit bridge is connected.

- I ON: short-circuit of the PV generator
- 0 OFF: opening the short-circuit
- Lock: Turn the switch to the lock symbol to create an opening on the side of the switch-disconnector. You can attach a lock to this opening to protect the switch-disconnector against unauthorised access.

5 Operation

You can use the device to carry out various tests or measurements.

5.1 Requirements for tests and measurements

Please observe the following basic requirements for tests and measurements:

- Make sure the personnel using the device is qualified for test procedures in compliance with EN 62446-1 and EN 62446-2.
- Before carrying out tests and measurements, disconnect all poles of the PV generator from the PV inverter. The PV generator must be isolated from the electric power supply! Neither the positive nor the negative pole of the PV generator must be earthed!
- Make sure that all switching and disconnecting devices are open and all PV strings are insulated from each other.
- Please observe that the PV generator must not exceed the maximum open-circuit voltage of 1 500 V, the maximum short-circuit current of 23 A and the maximum DC power ($P = V_{OC} \times I_{SC}$) of 34.5 kW.
- No power optimisers are installed in the PV generator.
- Use suitable (approved) safety measuring lines.
- Disconnect any safety measuring lines not required for the respective test or measurement from the device.



⚠ DANGER

Maximum admissible voltage

Danger to life or serious injury is possible due to contact with high electric voltage.

- Use the device only in electric circuits up to overvoltage category III with a conductor for a maximum of 1 500 V to earth.

5.2 Open-circuit voltage, short-circuit current and insulating resistance measurements

Requirements

- Please observe the requirements for measuring [► page 16].
- Voltmeter, current measuring clamp, insulation tester or installation tester (suitable for the respective test and measurement)
- The switch-disconnector is in position "0 OFF".
- The short-circuit bridge is connected to the lower connections for the short-circuit bridge.



⚠ WARNING

Dangerous voltage

Danger to life or serious injury is possible due to contact with high electric voltage in case of incorrect operation.

- Note that the PV+ and PV- measuring jacks are connected directly to the PV generator connections. Do not short-circuit these connections!
- Only remove the short-circuit jumper in the “0 OFF” switch position and after disconnecting the device from the PV generator.
- Please note that dangerous testing voltages might be applied to the device during open-circuit voltage measurements and insulating resistance measurements. These voltages might also be applied to the measuring circuit if safety measuring lines are contacted.
- Only use suitable testing and measuring instruments as well as approved safety measuring lines.
- Connect the safety measuring lines to the correspondingly marked measuring jacks of the device and check them for tight fit.
- Check that the connections of the PV generator and the short-circuit jumper are firmly connected.

Procedure

1. Connect the PV generator to be measured to the upper connections for the PV generator.
2. Connect the safety measuring lines of the voltmeter to the 4 mm measuring jacks PV+ and PV-.
3. Measure the open-circuit voltage (U_{oc}) and check for correct polarity.
4. Turn the switch-disconnector to position “I ON” to short-circuit the PV generator.
5. Use the current measuring clamp to measure the short-circuit current (I_{sc}) at the short-circuit bridge.
6. Connect the safety measuring lines of the insulation tester or installation tester to the 4 mm measuring jack PV+ and a suitable point with PE potential.
7. Measure the insulating resistance (R_{iso}) of the short-circuited PV generator. The insulating resistance must be at least 1 MΩ.
8. Turn the switch-disconnector to position “0 OFF” to open the short-circuit of the PV generator.
9. Disconnect the safety measuring lines from the device.
10. Disconnect the cables of the PV generator from the device.

6 Maintenance

There are no components in the device that you can replace.



⚠ WARNING

Opening the device

Danger to life or serious injury is possible due to contact with high electric voltage when opening the device. The device might get damaged.

- Do not open the device.
- Please contact your specialty retailer or the returns management [► page 8] for any repairs.

6.1 Maintenance schedule

The following table provides an overview of all maintenance and servicing work that you must carry out permanently or at regular intervals.

Interval	Measures
Regularly, as needed	• Cleaning the device [► page 18]

Table 4: Maintenance schedule

6.2 Cleaning the device

Clean the device regularly and as the need arises.

Requirements

- A clean and dry cloth or special cleaning cloth



NOTICE

Wrong cleaning agents

Using the wrong cleaning agents can damage the device.

- Do not use any solvents, abrasives or polishing agents.

Procedure

Clean the exterior of the device with a clean and dry cloth or a special cleaning cloth.

7 Technical data

Protection class	II (double or reinforced insulation)
Contamination level	2
Protection category (DIN VDE 0470-1, IEC / EN 60529)	IP20 1st digit: 2 = protection against solid impurities with a diameter ≥ 12.5 mm 2nd digit: 0 = no protection against water
Measuring category	CAT III 1 500 V (conductor to conductor)
Max. current	23 A
Housing dimensions (length x width x height)	255 mm x 105 mm x 115 mm
Weight (short-circuit bridge included)	0.7 kg
Electromagnetic compatibility (EMC)	IEC / DIN EN 61326-1 (VDE 0843-20-1)
Operation	
Max. number of switching cycles	20 per hour
Max. barometric altitude	2 000 m
Operating temperature	0 ... 50 °C (do not permanently expose the device to sunlight)
Max. relative air humidity	80 % RH (0 ... 30 °C), 75 % RH (30 ... 40 °C), 45 % RH (40 ... 50 °C), non-condensing
Operating conditions	To be used inside or outside buildings, both in dry environments
Storage	
Ambient temperature	-20 ... 60 °C (do not permanently expose the device to sunlight)
Max. relative air humidity	80 % RH

Table 5: Technical data

8 Disposal and environmental protection



At the end of product life, dispose of the unserviceable device via appropriate collecting facilities provided in your community.

Index

B

Basic knowledge	6
BENNING PV-S 1500	6

C

Cleaning	18
Copyright	2

D

Device	
Cleaning	18
Securing	12
Device structure	15
Disclaimer	2, 11
Disposal	20
Documentation	2

E

Environmental protection	20
--------------------------	----

F

Further information	6
---------------------	---

H

History	7
Holder of rights	2

I

Insulating resistance measurement	17
Intended use	11

M

Maintenance	18
Maintenance schedule	18
Manufacturer	2
Measurement	
Requirements	16

N

Non-discrimination	2
--------------------	---

O

Open-circuit voltage measurement	17
Operation	16

P

Purpose of the operating manual	6
PV-S 1500	6

R

Return address	8
Returns management	8

S

Scope of delivery	14
Securing	12
Service & Support	
Technical Support	8
Short-circuit current measurement	17
Standards applied	9
Switch-disconnector	15
Symbols	
Device	10
Operating manual	10

T

Target group	6
Technical data	19
Technical Support	8
Test	
Requirements	16
Trademarks	7

W

Warning system	9
Warranty	11



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