OPERATING INSTRUCTIONS

Voltage limiting device
Type HVL
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1 About this document
These operating instructions are part of the HVL voltage limiting device and describe safe and proper use in all phases of operation.
Language of the original operating instructions: German

1.1 Validity
These operating instructions are valid for the HVL 120-0.3 voltage limiting unit as per data sheet 1HC0075863 AD (and newer) and the HVL 60-0.3 as per data sheet 1HC0129170 AA (and newer).

1.2 Target group
The target group of these operating instructions is professionals in the field of high-voltage technology.
The HVL may only be commissioned and maintained by persons instructed in proper use and handling.

2 Safety precautions

2.1 Symbols and advice
Important information and technical notes are emphasized.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Safety Sign]</td>
<td>This is a safety sign. It warns you of the danger of injury and property damage. Follow all measures marked with the safety sign to avoid injury, death and property damage.</td>
</tr>
<tr>
<td>![Electric Shock Sign]</td>
<td>This safety sign warns you of the danger of death or serious injury from electric shocks. Follow all measures marked with the safety sign to avoid injury or death.</td>
</tr>
<tr>
<td>▶</td>
<td>This mark indicates that an action is to be performed.</td>
</tr>
</tbody>
</table>

Warnings in these operating instructions indicate special dangers and list measures for prevention of the danger. There are three warning levels:

<table>
<thead>
<tr>
<th>Warning word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER</td>
<td>Immediate, impending endangerment of your life and health</td>
</tr>
<tr>
<td>WARNING</td>
<td>Possible impending endangerment of your life and health</td>
</tr>
<tr>
<td>CAUTION</td>
<td>Possible impending danger of minor injury or property damage</td>
</tr>
</tbody>
</table>

Warnings are structured as follows:

WARNING WORD!
The type and source of danger appear here.
Possible consequences which could occur if the measures are not followed appear here.
▶ Measures for avoiding the danger appear here.
2.2 Basic safety precautions

2.2.1 Product safety
HVLs have been constructed using state-of-the-art technology and officially recognized safety-related rules. However, danger to life and limb of the user or third parties could arise or damage of HVLs and other property could occur while HVLs are in use.
- HVLs are only to be used in technically sound condition, for the intended purpose and with safety and the possible dangers in mind while observing the operating instructions.
- Keep the operating instructions intact and fully readable and store them in such a way that they are accessible to operating personnel at all times.
- Decommission and replace overloaded or damaged HVL units.

2.2.2 Personnel-related measures
- Train personnel in professional and safe working with high-voltage technology.
- Train and instruct personnel in working on the HVL using the operating instructions.
- Personnel to be trained, taught, instructed or provided with general education may only work with HVLs under constant supervision by an experienced high-voltage technology professional.

2.2.3 Organizational measures
- Observe all safety- and danger-related information regarding HVLs.
- The safety rules of the owner of the rail systems and all regulations of the respective national safety authorities are to be observed.
- Only trained and instructed professionals may be authorized.
- Clearly assign areas of responsibility for working with HVLs, make them known and adhere to them.
- Only personnel who have read and understood the operating instructions, especially the "Basic safety precautions" section, may be allowed to carry out activities with HVLs.
- Check to ensure that work is being performed in a safety-conscious way with awareness of possible dangers and while observing the operating instructions.
3 Description

3.1 Intended use

The HVL (hybrid voltage limiter) is a voltage limiting device (VLD) corresponding to class 2.2 of standard EN 50526-2 used primarily in DC traction systems to protect against hazardous touch voltages.

The manufacturer is not liable for resulting damage from further, unintended use. The owner is solely responsible for the risk here.

3.2 Area of application of the voltage limiting device

The track systems of DC trains (return conductors) are laid insulated to prevent stray current in the ground. Voltage limiting devices are used with DC trains to ensure personal protection. They are connected between grounded system parts (e.g. train stops) and tracks which have been laid insulated. Voltage limiting devices monitor the potential difference at their connections. If limit values specified in standards (EN 50122-1) are exceeded, they are to cause temporary equipotential bonding, thus preventing the tapping of impermissible touch voltages by people in case a fault occurs (VLD-F) or impermissible tappable voltages during operation (VLD-O).

3.3 Structure and function

3.3.1 Circuit diagram of the voltage limiter Type HVL

![Circuit Diagram]

1 MO surge arrester
2 Trigger electronics
3 Thyristor

3.3.2 Method of functioning

The HVL consists of the parallel switching of a metal oxide (MO) surge arrester with no spark gaps and two anti-parallel connected thyristors. Transient surges caused by lightning and switching operations in the system are limited by the MO arrester. If surges occur for a longer period of time (milliseconds to hours) due to faults in the system or for operational reasons, the thyristors fire to limit touch voltages. As soon as a zero-current transition occurs, the thyristors cut off the current flow and the original condition is restored.

Within the defined current range, the HVL is recoverable, i.e. it returns back to the insulating condition after the current flow. If, however, the short-circuit current is too high or active for too long in case a fault occurs, the thyristors could be overloaded, alloy and become very low resistance. In this case, both surge and personal protection are still guaranteed, but the measure for limiting stray currents is no longer in effect and the HVL must be replaced.
The HVL is a class 2.2 (bi-directional) voltage limiting device and is type-tested as per EN 50526-2. Mechanically, the HVL features a very rugged design. As with all high-voltage arresters from ABB, the active component is directly molded in using gray silicone. This well-proven design protects the device from any possible environmental stresses, such as UV radiation, vibrations and pollution. The HVL is corrosion resistant and can be used either outdoors or indoors. The HVL does not require a power supply from the mains grid. The HVL complies with both VLD-O and VLD-F functionality in the specified current range.

3.4 Technical data

The technical data, dimensions and weights are specified in the following documents:

- Data sheet of the HVL 120-0.3 voltage limiting device in document 1HC0075863
- Data sheet of the HVL 60-0.3 voltage limiting device in document 1HC0129170
- HVL dimensional drawings
- Dimensional drawings of the accessories

Rating plate of the HVL

The technical data is engraved into the electrodes:

<table>
<thead>
<tr>
<th>Marking</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB</td>
<td>Manufacturer name</td>
</tr>
<tr>
<td>Voltage Limiting Device</td>
<td>HVL voltage limiting device</td>
</tr>
<tr>
<td>HVL 120-0.3</td>
<td>Type designation</td>
</tr>
<tr>
<td>Class 2.2 acc. EN 50526-2</td>
<td>Class according to test standard</td>
</tr>
<tr>
<td>HA xxxxxxxx</td>
<td>Serial number</td>
</tr>
<tr>
<td>04-2017</td>
<td>Production date</td>
</tr>
<tr>
<td>Uₜₚ</td>
<td>Nominal triggering voltage</td>
</tr>
<tr>
<td>Iₜₚ-n</td>
<td>Lightning current impulse</td>
</tr>
<tr>
<td>Iₘₜ DC recoverable</td>
<td>Short-time withstand current for DC, recoverable</td>
</tr>
<tr>
<td>Iₘₜ AC recoverable</td>
<td>Short-time withstand current for AC, recoverable</td>
</tr>
<tr>
<td>Iₘ AC &amp; DC</td>
<td>Rated current for AC and DC</td>
</tr>
<tr>
<td>Iₘ DC non-recoverable</td>
<td>Short-time withstand current for DC, non-recoverable</td>
</tr>
</tbody>
</table>

3.5 Usage guide

The usage guide in accordance with EN 50526-3 applies for the use of voltage limiting devices.

Operating instructions | EN | 1HC0023892 AC
4 Transporting, unpacking and storing

4.1 Transporting

**CAUTION!**

**HVL voltage limiting device not secured for transport.**

Damage of the HVL voltage limiting device due to falling.

- Secure HVL against sliding or falling before transportation.

4.2 Unpacking

The HVL voltage limiting devices provided are packaged in sturdy cardboard boxes. The accessories are either included in the carton or supplied separately in case of large quantities. The routine test reports for the final electrical inspection are included with the packaging material.

- After receiving the shipment, compare the order and delivery documents immediately to check for completeness and accuracy of the shipment.
  - In case of incompleteness or deviations, inform the supplier and shipper immediately.

**WARNING!**

**Damaged HVL voltage limiting device.**

Damage to property and personal injury due to the installation and commissioning of damaged HVL voltage limiting device.

- Do not use damaged HVLs.
- Examine shipment immediately to check for damage.
- Notify the insurance company, the shipper and the supplier of the damage immediately and create a damage report.

4.3 Storing

The original packaging materials can be used for storage.

- Store HVL voltage limiting device in a well-ventilated, dry room.
- Remove plastic film to prevent the formation of condensation water.
- Storage temperature: –40 to +80 °C
5 Commissioning

5.1 Safety

**DANGER!**

System uses high voltage.
Death or serious bodily harm may result from an electric shock.
- Allow only authorized professionals to perform work on the HVL voltage limiting device.
- Observe the safety rules of EN 50110-1 before working on the system:
  - Disconnect the system from the power supply.
  - Secure the system against being switched on again.
  - Ensure that the system is de-energized.
  - Ground the system and short-circuit it.
  - Cover or cordon off neighboring energized parts.

5.2 Electrical check before commissioning

Each HVL was tested by the manufacturer. The routine test report is included with the packaging. Additional electrical testing before commissioning is not necessary.

5.3 Mounting

5.3.1 Mounting the accessories

There are a variety of different accessory versions for the HVL which are to be mounted in the system before installation. The most commonly used accessory (optional) is bracket 1800 (1, top) and T-bracket 2801 (2, bottom) (see dimensional drawing 2GHV040446).

1 Bracket 1800
2 "ABB" marking
3 T-bracket 2801

Mount attachment bracket for the HVL voltage limiting device and T-bracket for the cable connection as shown in the figure.
- For this purpose, use the accompanying M12x20 stainless-steel screws and tension washers.
- Tighten screws with a tightening torque of 25 Nm.
  - Use a torque wrench for this purpose.

The HVL voltage limiting device is now pre-mounted and can be installed in the intended location in the mains.
5.3.2 Connecting cables

- Observe national regulations and the requirements of the system owner regarding the cable cross-section.
- Connect HVL to the system ground over a short path.
- Recommended cable cross sections for connections of the HVL:
  - Copper  70 mm$^2$ cross section
  - Aluminum  100 mm$^2$ cross section

5.3.3 Attaching

The base, wall or carrier for the HVL voltage limiting device must be flat, clean and suitable for the loads which arise.

The following materials made of stainless or galvanized steel are to be provided by the customer, depending on the application and selected fitting.

- Bolts
- Nuts
- Bolt locks
- Any required balancing washers

- Carefully clean contact surfaces before mounting and lubricate with acid-free contact grease.
- Ensure selection of suitable material pairs.

5.3.4 Connecting the HVL voltage limiting device

The HVL voltage limiting device is to be connected in hazardous locations (e.g. train stops) between the grounded system parts (mast and shelter building) and the rails (return conductor), where the mounting recommendations according to EN 50526-3 are to be heeded.
6 Maintaining, servicing
The HVL voltage limiting device does not contain wearing parts and is therefore maintenance-free. Replacement parts are not needed. The HVL voltage limiting device is a protective element, and overloading is possible. This is why its function must be tested at regular intervals.

6.1 Safety

DANGER!
System uses high voltage.
Death, serious bodily harm and damage to the switchgear may result from an electric shock.

- Allow only authorized professionals to perform work on the HVL voltage limiting device.
- Observe the safety rules of EN 50110-1 before working on the system.

6.2 Reserves

- Keep an appropriate number of HVLs in stock as a reserve.

6.3 Functional testing

Depending on the level of current which the HVL must conduct in case of a fault in the system, it can switch to non-recoverable (i.e. low resistance) mode. Personal protection is still ensured, but impermissible stray currents may be flowing.

CAUTION!
Impermissible stray currents due to overloaded, low-resistance HVL voltage limiting device.

- Check the HVLs on a regular basis to ensure that they are in sound condition.
- Replace overloaded and short-circuited HVL.

6.4 Functional checking of an HVL 120-0.3

Overloading of the HVL voltage limiting device can lead to alloy (short circuiting) of one or both thyristors. We recommend testing the HVL at regular intervals.

A complete functional check of the HVL voltage limiting device on site can be carried out with a suitable insulation testing unit (e.g. the Megger MIT 1025 or Fluke 1555 insulation testing unit).

CAUTION!
Damage due to incorrect use of the insulation testing unit or use of an unsuitable testing unit.

Damage to the HVL voltage limiting device and insulation testing unit.

- Read the operating instructions of the insulation testing unit thoroughly before use and follow them during use.

Functional checking is carried out in the following steps:

- Remove HVL from the circuit
- Carry out functional check of the HVL
Removing HVL from the circuit

- Bridge HVL with a suitably sized cable (see 5.3.2).
  - When doing so, arrange cable in such a way that the connection cannot come loose during removal of the HVL.

Carrying out functional check of the HVL

A functional check using the Megger MIT 1025 insulation testing unit is explained in the following.

- Information on use of the Megger MIT 1025 can be found in the associated installation instructions.

- Connect HVL to the testing unit.

**Setting 1**

- Set the "Ramp" function at the test mode knob.
- Set voltage rise to 100 V/min.

**Setting 2**

- Set voltage range to 500 V/min.

**Setting 3**

- Start test: Press and hold "TEST" button for approx. 1.5 minutes.

- The leakage current is measured at a voltage of approx. 83 V, i.e. at a level below the non-triggering voltage.
- Target resistance of the resistor: 0.5 MΩ to 2 MΩ
- The measured values appear in the display (example): Applied voltage: 83 V DC; Resistance: 1,006 MΩ; Leakage current: 82.6 µA
Setting 4
- Observe rise in voltage: It rises to the triggering voltage after 1 minute.
  - When the display on the device crashes and the resistance value fluctuates widely, the HVL has been triggered.
  - The highest voltage displayed in the display before triggering of the HVL corresponds to the measured triggering voltage.
  - Setpoint trigger voltage for HVL 120-0.3: $U_{\text{trigger}} = 96$ to $120$ V

Setting 5
- Replace connections on the HVL for testing the other polarity.
- Repeat testing (“Setting 3” and “Setting 4”).

Evaluating the test results
The HVL is fully functional if both the measured resistance and the triggering voltage meet the setpoint values in both polarities.

Installing the HVL
- Depending on the results of the functional check, reinstall the functional HVL or install a new HVL.
- After reinstalling the HVL, remove the cable used for bridging.

6.5 Cleaning in case of heavy contamination
Thanks to the hydrophobic nature of the silicone housing, normal pollution does not affect the insulation capacity of the housing. If pollution exceeding this is present (heavy deposit layer, strongly clinging foreign objects), the HVL can be cleaned.

CAUTION!
Solvents and abrasive equipment.
Damage to the silicone housing.
- Do not use cleaning agents containing solvents for cleaning, with the exception of isopropyl alcohol.
- Do not use abrasive equipment for cleaning.
- Do not treat with silicone grease or oil after cleaning.
- A selection of recommended cleaning methods:
  - Clean, warm water and a soft, lint-free cloth.
  - A water jet with max. 10 bar of pressure.
  - Soft, lint-free cloth saturated with isopropyl alcohol – treat the entire surface evenly.
HVL voltage limiting devices are environmentally-friendly products which must be disposed of based on the respective applicable regional regulations in an environmentally friendly manner. The materials should be given up for recycling.

Constituent components include:
- Silicone rubber (non-halogenated) for the external insulation
- Mounting sections and other parts made of aluminum
- Metal-oxide varistors
- RoHS-compliant electronic components
- Steel mounting hardware

Silicone rubber (non-halogenated)
The silicone rubber can break down into SiO₂ and CO₂, thus uncovering the encased metal-oxide varistors and thyristors.

Metal-oxide varistors
The metal-oxide varistors are sintered ceramics consisting of about 90% ZnO. The following additions are also contained within:
- Percent by weight between 1 and 4%: Bi₂O₃ and/or Sb₂O₃, which are considered to be dangerous substances according to EU ordinances
- Percent by weight between 0.1 and 1%: NiO and Cr₂O₃, which are considered poisonous and dangerous materials pursuant to EU guideline 91/689/EEC

Metal-oxide varistors are coated with a thin glass coating containing lead-oxide (< 0.1% of the weight of the metal-oxide varistor).

The substances are ligated as a mixed oxide in metal-oxide varistors. A wash-out test in accordance with an EPA specification (Federal Register/vol. 45, No 98 /Rules and regulations) has shown that the sintered metal-oxide varistors can be disposed of as industrial waste without infringing on EEC directives.

No danger to personal health or the environment is present during normal operation.
For further information, please contact:

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High Voltage Products
Surge arresters
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CH-5430 Wettingen/Switzerland
Phone: +41 58 585 29 11
Fax: +41 58 585 55 70
Email: sales.sa@ch.abb.com

www.abb.com/arrestersonline

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