

## Operating Manual

Publication number 1HC0023892

## Low Voltage Limiter Type HVL 120-0.3

With metal oxide varistor and thyristors  
from ABB

Silicon housing material for indoor and  
outdoor applications

Transport, storage, operation, assembly,  
installation and maintenance



Low Voltage Limiter HVL 120-0.3  
with accessories

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#### Published by:

ABB Switzerland Ltd  
Surge arresters  
Jurastrasse 45  
CH-5430 Wettingen 1  
Switzerland

#### Contact details:

Phone +41 58 585 29 11  
Telefax: +41 58 585 55 70  
E-mail: sales.sa@ch.abb.com  
www.abb.com/arrestersonline

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## 1 GENERAL

This document is applicable to the ABB low voltage limiter, type HVL 120-0.3

The data in this operating manual describes the product, but does not establish the right to a guarantee claim. In the interest of our customers, we continually strive to improve our products and adapt them to the latest technological standards. Consequently, it is possible that small differences may occur between the supplied product and the product description or the operating manual.

This document was written for **qualified service personnel** working in the field of railway engineering technology. All safety regulations of the railway operator and the national safety authorities must be observed and complied with, and only qualified and instructed personnel who have the required experience of safety practices may install and maintain these devices. This manual does not in any way replace the required training and experience with regard to safety regulations. Precautionary measures and warnings must be strictly followed where there is a danger to persons or where the installation may be damaged.

The information contained here is intended to ensure that this product is installed correctly. As in all work situations, ABB has no control over the conditions present in the electrical network of the railway operator, which can have a marked effect on the installation of the product. It remains the responsibility of the product user to choose the most suitable methods of installation. ABB accepts no liability for direct or indirect damage arising from the use or misuse of this product.

## 2 DESCRIPTION AND FUNCTION

Stationary installations for the supply of railway traction current employ the rails, amongst other means, as the return path for the traction current. In the case of DC current railways, electrically conductive parts or structures located in the area of the overhead line and the current collector are not simultaneously connected to the return current path and the earth potential. This simultaneous connection is not allowed to be of long duration, owing to the stray current diffusion in the ground and the associated effects. Electrically conductive parts that are not connected to the earth potential can become live with unacceptable shock-hazard voltages.

The low voltage limiter HVL 120-0.3 is used in the case of DC current railways, to provide effective protection for personnel and equipment. It fulfils the tasks of a voltage limiting device in accordance with EN 50122-1, and limits the occurring shock-hazard voltages to safe values. The resulting values are distinctly below the limit values defined for these voltages in the EN 50122-1 standard.

An important benefit of the low voltage limiter is its resetting capability under certain operating conditions.

Tests must be carried out to establish whether the requirements for the protection of personnel and equipment can still be guaranteed, not just in the case of new structures, but also where structural modifications are made to existing systems. If these requirements are no longer fulfilled, the use of the low voltage limiter HVL 120-0.3 should be examined.

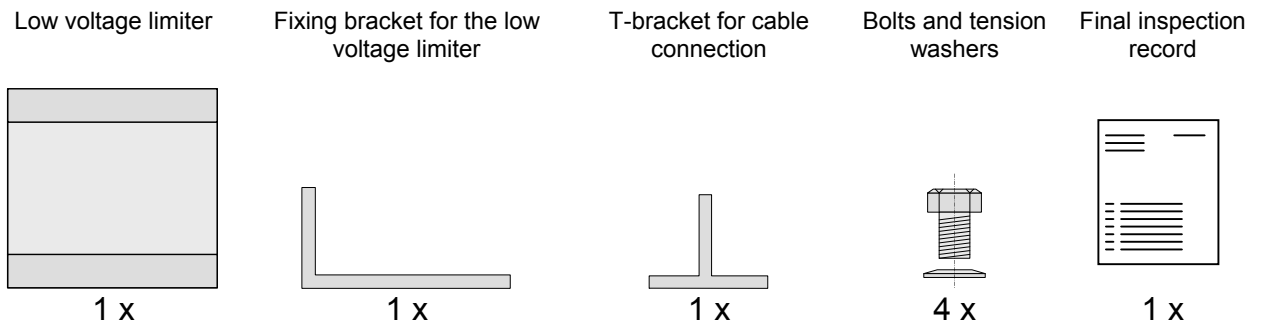
**Area of application for the low voltage limiter**

Protection of personnel	Protection of equipment
At all locations where dangers can occur from the rail potential	As overvoltage protection
On fully-conductive or semi-conductive components which are not part of the operating electrical circuit and which are located in the area of the overhead line or current collector and which are not earthed	
On parts which can become live in the event of a fault	
On further high-current systems, telecommunications and other electrical systems which are at risk, or which could be at risk, from the railway's electrical power supply	

**3 TRANSPORT AND STORAGE**

The low voltage limiter is supplied ex works, packed in a cardboard box. The accessories (fixing brackets, fixing bolts and tension washers) are supplied separately from the low voltage limiter. Each consignment is accompanied by final inspection record.

**Scope of supply**



Following delivery, each consignment must be checked for completeness and correctness (compare against the order and delivery documents). In the case of incompleteness or deviations from the delivery documents, the supplier and the carrier must be notified immediately.

The supplied goods must be examined for transport damage immediately on receipt. In the event of transport damage, this must be reported immediately to the insurance agent, the carrier and the supplier, and a damage report must be completed. Low voltage limiters which show any signs of damage must not be installed in the system or be put into service.

The supplied equipment must be stored in a well-ventilated room and must be protected from dirt or damage. The original transport package can be used for storage purposes.

## 4 TECHNICAL DATA / DESIGN

### Technical data in accordance with EN 50123-5: 1997

Area of application:	For DC current railway networks for indoor and outdoor applications
Rated voltage $U_r$ :	50 V (DC)
Highest withstand voltage $U_w$ :	60 V (DC)
Limiting voltage $U_s$ :	120 V (DC)
High-current strength:	20 kA for 0.1 s <sup>1)</sup>
Current according to the resetting capability test $I_{rev}$ :	300 A for 60 s <sup>2)</sup>
Long-time current strength $I_w$ without guarantee of resetting capability:	500 A for 1800 s <sup>1)</sup>
LVL classification:	LVLa
Temperature range:	-20°C to +45°C
Height without accessories:	123 mm
Diameter without accessories:	130 mm
Weight without accessories:	3.8 kg

<sup>1)</sup> After responding, the resetting capability cannot be guaranteed. The protective function has been verified up to the specified values. The low voltage limiter then represents a low-impedance connection (short circuit).

<sup>2)</sup> Up to this current value in the stated time period, the low voltage limiter resets itself back to its starting condition after responding. If the current is higher than this or if the time period is greater than that stated, the resetting capability cannot be guaranteed. If the low voltage limiter does not reset to its starting condition, it becomes permanently conductive. In this way, the protective function continues to be fulfilled up to parameters as stated at <sup>1)</sup>.

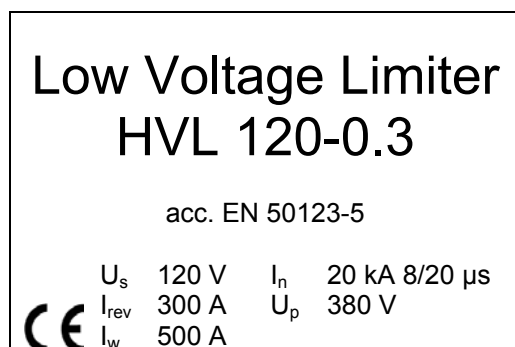
### Technical data for the integrated metal oxide varistor in accordance with IEC 60099-4: 2001

Nominal discharge current $I_n$ :	20 kA 8/20 $\mu$ s
High-current impulse $I_{hc}$ :	100 kA 4/10 $\mu$ s
Residual voltage at nominal discharge current $U_p$ :	380 V

### Type plate



Name of manufacturer

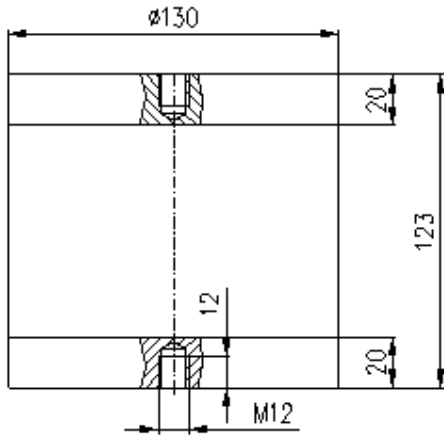


HVL	Type designation (HVL = Hybrid Voltage Limiter)
$U_s$	Limiting voltage
$I_{rev}$	Current according to the resetting capability test
$I_w$	Long-time current strength without guarantee of resetting capability
$I_n$	Nominal discharge current

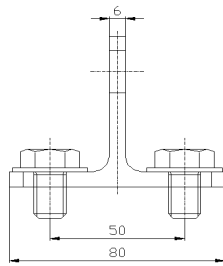
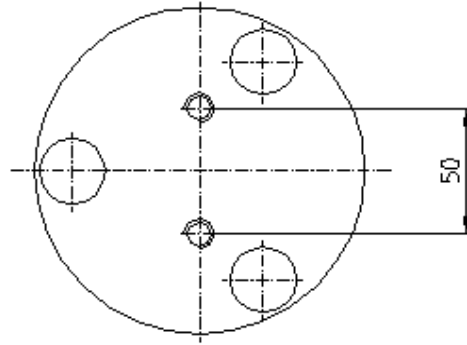
No. HA .....

$U_p$  Residual voltage at nominal discharge current  $I_n$ :  
Serial number

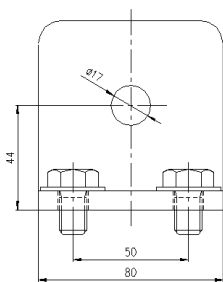
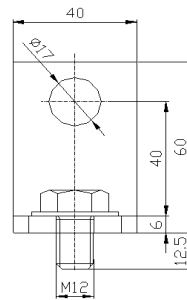
**Dimensions**



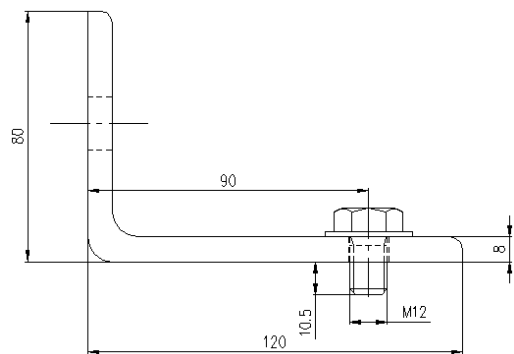
Low voltage limiter



T-bracket for cable connection

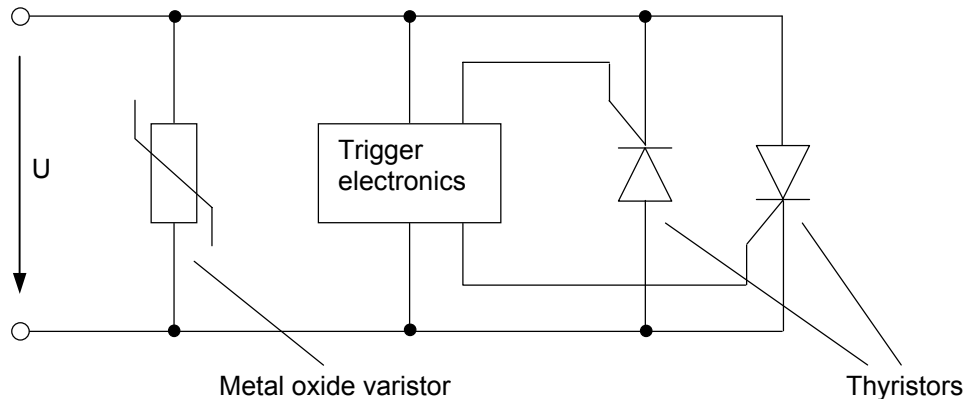


Fixing bracket for the low voltage limiter



## 5 OPERATION AND STRUCTURE

### Basic circuit diagram



### Operation

The low voltage limiter consists of a parallel metal oxide varistor circuit, with two anti-parallel thyristors, which are fired through a trigger electronics system. This hybrid design allows optimum protection against short-time overvoltages and against overvoltages that continue for very long periods of time.

The metal oxide varistor changes its resistance depending on the input voltage U. This occurs without any appreciable delay (in the region of several nanoseconds). In this way, the metal oxide varistor provides protection against short-time overvoltages such as those that can occur, e.g. from the effects of lightning or switching operations in the electricity network. Longer-lasting overvoltages in the range from milliseconds up to hours cannot be limited by the metal oxide varistor for reasons related to the energy involved. Here, the thyristors are employed which, after a time delay, short out the metal oxide varistor and consequently provide protection against thermal loads. The delay is itself dependent on the input voltage U applied to the low voltage limiter and typically lies in the region of several hundred microseconds.

The duration of the overvoltage is therefore the controlling factor for the value of the voltage limitation. If the duration lies in the region of several hundred microseconds, then the characteristic curve of the metal oxide varistor alone defines the voltage limitation (for example, 380 V at 20 kA pulse current peak value of the pulse waveform 8/20  $\mu$ s). If the overvoltage is applied for longer than the stated value, then one of the two thyristors is fired (depending the polarity of the overvoltage) and accommodates the flow of current. By this means, the voltage is limited to values less than 3 V. This condition remains in existence until the minimum thyristor holding current is no longer met (between 10mA and 500mA, depending on the application).

In a very short space of time, the resulting shock-hazard voltage lies distinctly below the value permitted by the EN 50122-1 standard for short-time conditions.

### Resetting capability after possible loads

Current through the low voltage limiter	Possible cause	Resetting capability guaranteed?
100 kA 4/10 $\mu$ s	Extreme lightning strike	Yes
20 kA 8/20 $\mu$ s	Normal lightning strike	Yes
300 A for 60 s	Operating current	Yes
20 kA for 0.1 s	Short circuit	No
500 A for 1800 s	Fault in the network	No

## 6 ASSEMBLY AND INSTALLATION

### Safety instructions

On stationary railway installations in the vicinity of overhead line and current collector areas, voltages occur which can be dangerous to the human body.

To ensure successful and safe operation, assembly and maintenance of the low voltage limiter, the following fundamental safety instructions must be observed and followed:

- Installation and assembly of the low voltage limiter must only be carried out by qualified personnel who by reason of their knowledge, abilities and experience, can carry out the work in the technically correct manner, and who can independently evaluate the dangers involved.
- Before beginning the work, all members of the workforce must be sufficiently informed of the possible dangers which arise through operation of the railway. For their personal protection, all members of the workforce must carry out precautionary and/or safety measures.
- Depending on the local conditions, the measures to establish and to secure the de-energised condition must be carried out on installations or installation components, where necessary.
- The low voltage limiter must only be assembled, installed and operated with the supplied accessories for its intended purpose and in accordance with its specifications.
- Modifications and repairs to the low voltage limiter itself and to its mounting parts are prohibited.
- If special problems arise which were not covered or were insufficiently covered in this operating manual, please contact ABB Schweiz.

**Before beginning any electrical installation work, the following 5 safety rules for establishing and securing the de-energised condition must be strictly observed.**

- **Isolate the installation**
- **Secure against switching on again**
- **Check the de-energised state**
- **Earth and short-circuit**
- **Safely cover up or fix barriers around adjacent and live parts**

Compliance with these safety measures will assist in preventing personal injury and material damage.

Signs used in this operating manual:

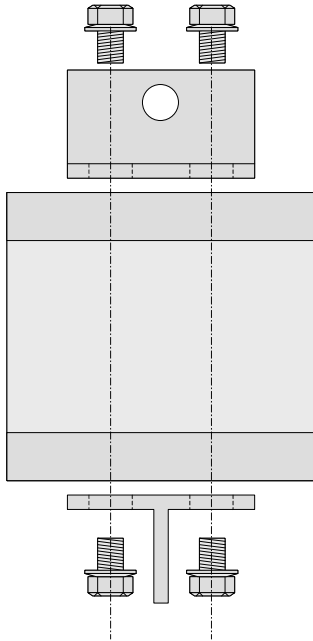


**Warning of electrical voltage:** This sign is used in the individual chapters and sections of this manual and means that death or severe personal injury can occur, if the safety measures are not followed.



**Warning of dangers:** This sign is used in the individual chapters and sections of this manual and means that death or severe personal injury can occur during assembly work at high level and as a consequence of traffic, if the safety measures are not followed.

## Assembly



- Assemble the fixing bracket for the low voltage limiter and the T-bracket for the cable connection according to the illustration.
- For this purpose, use the supplied M12x20 stainless steel bolts and tension washers.
- Tighten the bolts to a torque of 25 Nm. Use a suitable torque wrench for this purpose.
- The low voltage limiter is now pre-assembled and can be installed at the intended position in the network.

## Installation



**Before beginning the work, check the safety distance to adjacent live parts or equipment. If there is a danger of inadvertent touching, the 5 safety rules for establishing and securing the de-energised condition at the work location must be carried out (see the section entitled Safety instructions).**



**Secure yourself against falling, if the intended mounting position is on a mast or on a high-level structure. For this purpose, use a secure working platform and wear your personal protective equipment.**

The contact surface, to which the low voltage limiter is to be fitted by means of the fixing bracket, must be flat and clean.

The mounting position of the low voltage limiter can be freely chosen. It must be noted, however, that the type plate and serial number should remain easily readable without removing the low voltage limiter. Polarity reversal is not possible owing to the bipolar design.

The cable connection should be maintained as short as possible, since the protective effect of the low voltage limiter (especially in the case of fast-acting processes which can occur, for example, from the effects of lightning) is greatly influenced by this length dimension.

The cross section of the cable connection must be constructed in compliance with the national regulations and the requirements of the railway network operator.

## Putting into service

No further action or work is required at the installation location to put the equipment into service.

## 7 MAINTENANCE / SERVICING

The low voltage limiter HVL 120-0.3 contains no parts that are subject to wear, and therefore is maintenance-free. Spare parts are not required.

We recommend that the following work is carried out at regular intervals (at the latest, however, every 5 years) on all low voltage limiters that are in service.



**Before beginning the work, check the safety distance to adjacent live parts or equipment. If there is a danger of inadvertent touching, the 5 safety rules for establishing and securing the de-energised condition at the work location must be carried out (see the section entitled Safety instructions).**



**Secure yourself against falling if the intended mounting position is on a mast or on a high-level structure. For this purpose, use a secure working platform and wear your personal protective equipment.**

- Inspect the low voltage limiter for any kind of damage such as, for example, the effects of electrical arcing or defects in the housing. Damaged low voltage limiters must be replaced by new ones.
- Inspect all screwed connections.
- In the event of exceptional contamination, the low voltage limiter should be cleaned. For this, we recommend that a soft cloth is used with warm water and a mild household cleaner (do not use solvents or abrasive cleaning agents).

### Faults and reserve equipment

The low voltage limiter is a protective equipment element and therefore overloading can never be completely excluded. Depending on the number of units in operation, it is recommended that a suitable number of spare units is kept in reserve.

### Note on behaviour in fire

The silicon housing of the low voltage limiter is self-extinguishing (Oxigene Index LOI equates to 26.9% in accordance with ISO 4589/84).

### Effects of animal damage

Slight mechanical damage to the silicon grouting (for example, from the bites of animals such as birds and martens) does not impair the function of the low voltage limiter.

### Function checks by means of resistance measuring

A complete function check of the low voltage limiter is not possible at the installed location. Overloading of the low voltage limiter can lead to a breakdown (short circuiting) of one or both thyristors. If there are any doubts about the function of the low voltage limiter, we recommend that a resistance measurement is carried out with a standard Multimeter. Before carrying out this measurement, the low voltage limiter must be removed from the electrical circuit.



Before beginning the work, check the safety distance to adjacent live parts or equipment. If there is a danger of inadvertent touching, the 5 safety rules for establishing and securing the de-energised condition at the work location must be carried out (see the section entitled Safety instructions).



Secure yourself against falling if the intended mounting position is on a mast or on a high-level structure. For this purpose, use a secure working platform and wear your personal protective equipment.

A low voltage limiter must not be removed from the electrical circuit until its operating condition has been determined! For this, proceed as follows:

1. Measure the voltage via the connections of the HVL 120-0.3 with a measuring device suitable for DC voltage.
2. Measure the current through the HVL 120-0.3 with a current probe suitable for DC current. **During this operation, never disconnect a connection! Otherwise, there is the danger of an electric shock.**
3. If the voltage measurement gives a value greater than 50 V or the current measurement gives a value greater than 0.3 A, then first of all the cause must be determined. If the cause is found and rectified, the checks under Point 1. and Point 2. must be repeated.
4. The HVL 120-0.3 must be shorted out with a conductor of sufficient dimensions (observe the national regulations and the requirements of the railway network operator). This conductor must be arranged to ensure that detachment of the connection during removal of the HVL 120-0.3 cannot occur.
5. Take a further measurement of the voltage via the connections of the HVL 120-0.3 with a measuring device suitable for DC voltage. The voltage measurement should now give a value less than 1 V. If this is the case, then the HVL 120-0.3 can be removed. Otherwise, the current circuit must be checked again.
6. The volume resistance of the HVL 120-0.3 can now be measured with a standard Multimeter<sup>3)</sup>. The resistance value obtained must be at least 1 k $\Omega$ . If this is not the case, then the HVL 120-0.3 is defective and must be replaced. If the resistance value is equal to, or greater than 1 k $\Omega$ , it can be concluded that the thyristors are functional, and the HVL 120-0.3 can be re-fitted.
7. The conductor used for shorting-out, must only be removed when the HVL 120-0.3 has been completely re-fitted.

<sup>3)</sup> For the resistance measurement, do not use an insulation resistance meter (Megger)! This could lead to a false evaluation, since such measuring devices work at voltage levels which will cause the low voltage limiter to change into its conductive state.

## 8 SQS CERTIFICATE

The company ABB Switzerland Ltd has established a management system which complies with the requirements of the international standards for quality management and quality assurance (ISO 9001) as well as for environmental management (ISO 14001).

## 9 EU DECLARATION OF CONFORMITY



**EU Declaration of Conformity**  
in accordance with the low voltage directives 73/23/EEC for  
**electrical equipment**

The construction of the electrical equipment  
**product: low voltage limiter HVL 120-0.3**

was developed, designed, manufactured and brought into service in conformity with the EC directive 73/23/EEC

**Company: ABB Switzerland Ltd**  
**Surge arresters**  
**Jurastrasse 45**  
**CH-5430 Wettingen**  
**Switzerland**

The following EC directives and harmonised standards have been applied:  
EC directive 73/23/EEC, low voltage electrical equipment

The following European standards have been applied:  
Railway applications – stationary installations, DC current switchgear  
EN 50123-5

The technical documentation is fully available  
The operating manual relating to product is available

- **X** in the original edition
- ... in the language of user's country

Place, date	stamp / signature	Quality management
Wettingen, 01.09.2003	Engineering manager	
	<b>Bernhard Doser</b> <i>signature</i>	<b>Werner Boenzli</b> <i>signature</i>



## EU-Konformitätserklärung

im Sinne der Niederspannungsrichtlinien 73/23/EWG für  
**elektrische Betriebsmittel**

Die Bauart des **elektrischen Betriebsmittels**

**Fabrikat: Niederspannungsbegrenzer HVL 120-0.3**

wurde entwickelt, konstruiert, gefertigt und in den Verkehr gebracht in Übereinstimmung mit  
der EG-Richtlinie 73/23/ EWG,

**Firma: ABB Schweiz AG**

**Ueberspannungsableiter**

**Jurastrasse 45**

**CH-5430 Wettingen**

Folgende EG-Richtlinien und harmonisierte Normen wurden angewendet:

EG-Richtlinie 73/23/EWG, Elektrische Betriebsmittel und Niederspannung

Folgende europäische Normen wurden angewendet:

Bahnanwendung - Ortsfeste Anlagen Gleichstrom-Schaltanlagen

EN 50123-5

Die technische Dokumentation ist vollständig vorhanden.

Die zum Produkt gehörende Betriebsanleitung liegt vor:

- in der Originalfassung
- ... in der Landessprache des Anwenders

Ort, Datum

Wettingen 01.09.2003

Stempel / Unterschrift  
Technischer Leiter

Bernhard Doser

Qualitäts-Management

Werner Boenzli