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About this Document

This instruction manual applies to the PLC Line Traps Type DLTC.

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This document has been carefully checked. If the user nevertheless detects any errors, he is asked to notify us as soon as possible.

The data contained in this manual is intended solely for the product description and is not to be deemed to be a statement of guaranteed properties. In the interests of our customers, we constantly seek to ensure that our products are developed to the latest technological standards. As a result, it is possible that some differences between the product and the product description or the instruction manual may occur.
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1 INTRODUCTION

1.1 Using the manual
The manual is written for service personnel in the high voltage (HV) power line environment. All existing safety instructions in the client's environment have to be observed and only trained and instructed personnel should work with the equipment. The manual provides the necessary instructions for all the steps in the life-cycle of the equipment, e.g. from transport, storage, commissioning to maintenance. Please refer to the appropriate section for the particular step or function.

1.2 Application of line trap type DLTC
Power Line Carrier (PLC) systems are used for communication on power lines between power system control centres, power stations & sub-stations. The PLC signal has to be coupled to the HV-line by means of PLC coupling equipment. The coupling equipment comprises of coupling device, coupling capacitor or capacitive voltage transformer and PLC line trap type DLTC.

1.3 Requirements to be met by the service personnel
- Service personnel must read and understand the instruction manual before working with the DLTC equipment.
- This product may only be installed by individuals who have received training in procedures for installing equipment on high voltage power lines and on PLC coupling equipment.
- The service personnel must strictly follow all precautions and warnings which could cause personnel injury or damage to the equipment.

1.4 Guarantee provisions
The manufacturer disclaims any responsibility for hazards and material damage, if the equipment is operated other than for its intended use as described in this manual or if the equipment is serviced by non-qualified personnel.

1.5 General information about PLC Coupling
Power line carrier (PLC) links supplied by ABB form the backbone of power utility communication systems in all parts of the world. As an economical means of transmitting information and data, PLC has made an important contribution to power system control for many years.

PLC is mainly used to reliably transmit speech, energy management data and power system protection signals. In order to meet the varying requirements of power utilities when constructing a new power system or extending an existing one, PLC equipment must be compatible and of modular design.
1.6 Purpose of PLC line traps

- Provision of defined high-voltage line impedances regardless of configuration of the primary system switchgear.
- Prevention of signal losses due to propagation into other lines.
- Attenuation of RF signal from other parts of the power systems, thus permitting multiple use of the same frequency bands.

PLC line traps are connected in series with the high-voltage lines and must therefore be rated for the maximum continuous load current and be able to withstand the maximum fault current at the place of installation. DLTC line traps are designed according to the latest IEC recommendations.

The main advantages and features of PLC line traps type DLTC are:

- **Low weight and low volume due to multi-layer techniques.**
  - Easier to suspend, less wind resistance

- **Open construction for better cooling and excellent RF characteristics with high Q and low stray capacitance.**
  - No danger of local hot-spots or cracking of insulating material
  - Higher resonant frequencies than those used for PLC transmission

- **Solid construction permits high mechanical loads on terminals.**

- **High voltage withstand of tuning units ensures high reliability**

- **Transient overvoltage protection by metal oxide arresters with better protection characteristics than arc-gap arresters.**
  - Only arresters with a rating of 10kA are used.
1.7 PLC Coupling principles

1.7.1 Single-phase coupling (phase-to-ground coupling)
This type of coupling is the simplest type of coupling of PLC signal to the high-voltage line. Since a ground fault close to the substation on the phase used for the PLC link can short-circuit the signal, single-phase coupling should only be used for power systems where transmission reliability in the event of a power system fault is of secondary importance.

1.7.2 Two-phase coupling (phase-to-phase coupling)
Coupling to two phases of the power system is much more reliable than coupling to just one phase. A ground fault in this case will normally only cause an additional attenuation of the PLC signal by about 6 dB. A two-phase coupling scheme consists of two coupling units, one of which includes a hybrid module.
Schemes are sometimes also used which couple to all three phases (three-phase coupling) or two phases of one three-phase system and two phases of another three-phase system (intersystem coupling). All of these types of coupling can be handled by modules of the MCD80 system. Details will be given with project specific documentation.
In practice, PLC coupling is a more complex problem since the units at both ends of the HV line have to be optimised for the conditions prevailing there. In the case of long lines with high attenuation, an analysis of the line is necessary to determine the arrangement with the most preferable transmission characteristics. ABB has years of experience in conducting such analyses.
Analysis is generally not necessary for short or non-transposed lines. For a horizontal conductor configuration, the centre phase is chosen for single-phase coupling and two adjacent phases for two-phase coupling. In the case of configurations with a vertical distribution, phases as high and as close as possible should be chosen. How many phases are used is largely a question of the reliability requested for the PLC link.

1.7.3 HV line impedance
Impedances of HV lines lie typically in the range 350 Ω to 450 Ω per phase for single conductors and 250 Ω to 350 Ω per phase for bundle conductors. In order to terminate the coupling filter correctly for average operating conditions, the shunting effect of the line trap and the station impedance has to be taken into account. The line traps which are inserted to compensate as far as possible the shunt impedance of the substation are designed such that the minimum shunt impedance is 1.41 times the line impedance. Accordingly, the impedance of PLC line traps shall be about 570 Ω for single conductor lines and about 400 Ω for bundle conductor lines.
The corresponding impedance for HV cables is much lower and has to be calculated in each individual case. In these cases coupling arrangement and line trap impedance has to be designed individually.
2  SAFETY INSTRUCTION AND WARNINGS

Protect your life while making any modifications!

DANGER

Before handling any part of the electrical circuits:
• Be sure that the transmission lines are not energized.
• Apply grounding clamps to high voltage line for earthing.
• Follow your company's and local safety regulations

DANGER

Do not attempt to handle, install, use or service this product until thoroughly familiar with the informations given in this instruction book.

DANGER

Hazardous voltage can shock, burn or cause death.

DANGER

This product may only be installed by individuals who have received training in procedures for installing equipment on high voltage power lines and on PLC coupling equipment.

Always consider following warnings:

• A power line can carry dangerous voltages even when switched off.
3 SYSTEM DESCRIPTION

3.1 General
The PLC line trap is in general formed by the main coil, a surge arrester and a tuning device.

3.2 Design of PLC line trap

Legend:

1 Main coil
2 Tuning device
3 Surge arrester
4 Corona caps (depending on system voltage)
5 Bird barrier (optionally)
6 Terminal
7 Lifting eye
8 Connection cable
9 Tuning device nameplate
10 Main coil name plate
11 Pedestal (optionally)
3.3 Main coil

The coil conductor is of square section aluminium and the turns are spaced by impregnated fibre glass tape or spacer rods depending on rating. The entire main coil is impregnated with a two-component epoxy resin of known good outdoor performance. Depending on the rated current and rated inductance, the main coil is wound with either one or several layers. Especially shaped fibre glass spacers or spacer rods keep the layers of multiple layer line traps apart. The multiple layer winding technique enables compact and robust line traps having a small diameter and low height.

- The spider supports in the ends of the coils are held together by tie bars of fibre glass reinforced epoxy or spacer rods.
- To achieve a reliable corrosion-proof connection, the HV terminals are welded directly to the ends of the winding. Generally, vertical flat terminals with 4 or 9 holes are fitted, but round or horizontal flat terminals can be welded to the spiders on request.
- Because of their low weight, most DLTC coils can be mounted on coupling capacitors or capacitive voltage transformers.
- They can also be mounted on insulator posts or simply suspended.
- All coils are equipped with lifting eyes on both sides. Optionally, a pedestal, bird barriers and the corona shield can also be attached to the spiders. The corona protection consists of either corona caps at the edges or corona rings, needed at the higher power system voltages.
- The tuning unit and the surge arrester are secured inside the main coil.

The electrical characteristics of the main coils are indicated on the rating plate which is placed on the top spider.

3.4 Surge arrester

The surge arrester protects the main coil and tuning device against overvoltages. All line traps are equipped with MO-surge arresters based on extremely non-linear metal oxide varistors. The components of the surge arresters are completely sealed in one housing and therefore protected against environmental conditions.

The electrical characteristics of the surge arresters are indicated on the rating plate which is placed at the top of the unit.

The surge arrester is fixed with screws at the upper spider.

3.5 Tuning device

The tuning device is connected in parallel with the main coil and the surge arrester. It provides a defined impedance or blocking resistance in the frequency band. The tuned circuit is usually of the dual-circuit broadband type. This solution has proved to produce the best results in the majority of cases.

Alternatively, the line trap can be tuned as a damped single frequency filter. The main characteristic of this type of tuning is its excellent withstand to transient overvoltages.

The tuning device may consist of up to 3 packs all of which are electrically connected in parallel. The components of the tuning device are completely sealed in one or more housings and therefore protected from environmental conditions. Only the resistors are partly placed outside the housing and surrounded by air for better cooling.

The tuning device is fixed with screws at the upper spider.

In certain cases no tuning devices are being used.

The electrical characteristics of the tuning devices are indicated on the rating plate which is placed at the top of the unit.
4 TRANSPORTATION AND STORAGE

4.1 Transportation
Line traps are fitted with top lifting eyes which shall be used for lifting during transportation.

All line traps must be fixed on the load floor of the truck or ship by appropriate tows to prevent any movement or lateral tilting during transportation.

4.2 Transportation damage
The transported goods are to be checked immediately for transport damages. In case of damage please proceed as follows:

- notify insurance company immediately
- contact the carrier and declare him liable by indicating the damage on the receipt.
- substantiate the carrier’s liability for the damage by sending him a registered letter.
- contact your contractual partner immediately, especially if transported goods were shipped at the risk of the contractual partner.

4.3 Unpacking
The line trap with fitted surge arrester and tuning device is packed in wooden frame crates or supplied on a wooden pallet with a wooden cover. The line trap is easily removed from the pallet by cutting the plastic tension bands or removing the wooden planks of the crate respectively.

The optional pedestals are either mounted on the wooden pallets under the line trap or packed separately. Mounting bolts and occasionally other mounting hardware as well as optionally used corona caps and bird barriers may be attached to the line trap in small bags fixed to the spider arms.

During unpacking care should be taken that all packing material, such as wooden braces etc. which may have been attached to the tuning device or protective device are removed. Please consider that wooden braces may be used between the housings of tuning device(s) and arrester.

4.4 Storage
The PLC line traps are shipped in a vertical position. Optionally available support insulators are shipped in a horizontal position. They have to be stored in these positions. DLTC line traps packed in wooden crates or open on pallets are suitable for outdoor storage for reasonable periods of time. The packing serves mainly as protection for mechanical damage.
5 INSTALLATION AND MOUNTING INSTRUCTIONS

5.1 Safety information

DANGER

Follow safety instructions according to chapter 2.

5.2 Mounting modes

PLC line traps type DLTC may be suspended or mounted on top of support insulators, coupling capacitors (CC) or capacitive voltage transformers (CVT). Samples of typical arrangement drawings are enclosed.

Suspension Mounting

All standard line traps type DLTC are fitted with lifting eyes at the top and the bottom. These lifting eyes can be used for suspension mounting. Special versions for suspension from 2, 3 or 4 suspension insulators are available. The maximum force of suspension system of line trap indicated on rating plate of line trap may not be exceeded.

Mounting on post insulator, CC or CVT

Various different pedestals are available for mounting of the line trap on top of support insulators, coupling capacitors (CC) or capacitive voltage transformers (CVT). If the line trap is mounted on top of CC or CVT, the electrical connection between the bottom terminal of line trap and top of CC/CVT will be carried out by the metallic pedestal itself. The cylindrical pedestal from fiberglass material is fitted with a potential connection between the top terminal and the bottom terminals of this pedestal.

In all cases where PLC line trap is mounted on top of CC or CVT line dropper of overhead line must be connected with bottom terminal of the line trap.

Line traps type DLTC may only be mounted in the vertical position.

5.3 Mounting of optional accessories

5.3.1 Pedestals

Different types of pedestals may be supplied. Pedestals with 2 and 4 legs are being used depending on the type of line trap. Cylindrical pedestals from glassfiber material are being used for mounting of line traps on top of 3 or 4 columns of support insulators or coupling capacitors. The holes in the bottom plate of the pedestal should correspond with the holes of the top flange of the support insulator, CC or CVT. Fixing blocks may be used for mounting of pedestal on the lower spider of line trap in some cases. For mounting of pedestal please refer to project specific drawings or if these are not available to the enclosed standard drawings.

5.3.2 Bird barriers

Bird barriers can optionally be attached to the PLC line traps Type DLTC. Their function is to prevent birds from penetration into the main coil and build their nests. They have to be mounted on the top and bottom side of the PLC line trap. These bird barriers are placed inside of the line trap in a bag together with optional corona caps and other optional mounting material during transportation.
5.3.2.1 Mounting of bird barrier on top of PLC line trap

- Take out one bird barrier from the bag, which is placed inside of the PLC line trap.
- There are two holes cut into the net. One in the centre for the lifting eye and the second for the terminal at the edge close to the knot of the cord. Push the latter over the terminal as given in picture 1.
- Push the centre hole of the net over the lifting eye as shown in picture 2.
- Distribute the net constantly among the top of the coil and pull the edges down around the perimeter of the coil as shown in picture 3.
- Pull the cord and adjust it round the perimeter so that cord is preferably fixed between second and third or third and fourth turn of coil as shown in picture 4.
- At last, when bird barrier net is adjusted equally round the perimeter, tie the cord and cut the remaining cord as shown in picture 5.

5.3.2.2 Mounting of bird barrier on bottom side of suspended PLC line traps

Lift the line trap and proceed with mounting of the bird barrier on the bottom side in the same sequence as described above for the top side of the line trap. The second bird barrier is placed in the same bag as the first.

5.3.2.3 Mounting of bottom side bird barrier and pedestal of PLC line traps

The legs of the pedestals can either be directly mounted to the bottom bar of the PLC line trap or by means of fixing blocks, depending on the required pitch circle diameter on the mounting plate. The mounting procedure is slightly different.

**Bird barrier mounting procedure for pedestals with fixing blocks**

- Take out the second bird barrier from the bag, which is placed inside of the PLC line trap during transportation.
- Lift the line trap and mount the fixing blocks provisionally at the lower spider arm as shown in picture 6. The contact surfaces between fixing blocks and bottom bar of line trap shall be cleaned carefully (with wire brush or similar) and subsequently treated with acidless grease appropriate for electrical connections.
- There are two holes cut into the net. One in the centre for the lifting eye and the second for the terminal at the edge close to the knot of the cord. Push this latter one over the terminal as shown in picture 7.
- Push the centre hole of the net over the lifting eye as given in the section above and distribute the net constantly among the bottom of the coil and push the edges up around the perimeter of the coil, pull the cord and adjust the net provisionally round the perimeter.
- Cut small holes in the net where the fixing blocks are located as shown in picture 8. The holes should only be as big as the fixing blocks to pass through.
- Loose the cord and take down the bottom net partly, place the fixing blocks in the correct position, push the net over the fixing blocks and mount the pedestal on the fixing blocks as shown in picture 9 by means of the enclosed mounting material. Clean carefully the contact surface between fixing blocks and legs of pedestal (with wire brush or similar) and treat it with acidless grease appropriate for electrical connections. All screws shall be tightened with the appropriate torque moment. For mounting details please refer to appropriate mounting drawings in Appendix.
- Distribute the net constantly among the bottom of the coil and push the edges up around the perimeter of the coil, pull the cord and adjust it round the perimeter so that cord is preferably fixed between second and third turn or third and fourth turn of coil as shown in picture 10.
- At last, when bird barrier is adjusted equally round the perimeter, tie the cord and cut the remaining cord.
Bird barrier mounting procedure for pedestals without fixing blocks

- Take out the second bird barrier from bag, which is placed inside of the PLC line trap.
- There are two holes cut into the net. One in the centre for the lifting eye and the second for the terminal at the edge close to the knot of the cord. Push the latter one over the terminal as shown in picture 7.
- Push the centre hole of the net over the lifting eye as given in the section above and distribute the net constantly among the bottom of the coil and push the edges up around the perimeter of the coil, pull the cord and adjust the net provisionally round the perimeter.
- Take the pedestal and place it below the bottom of the line trap exactly where it should be placed. Cut small holes in the net where the legs of the pedestal should pass through.
- Loose the cord and take down the bottom net partly, pull the legs of the pedestal through the holes of the net and fix the pedestal at the bottom bar of the line trap by means of the enclosed mounting material. Clean carefully the contact surface between bottom bar of line trap and the legs of pedestal (with wire brush or similar) and treat it with acidless grease appropriate for electrical connections. All screws shall be tightened with the appropriate torque moment. For mounting details please refer to appropriate mounting drawings in Appendix.
- Distribute the net constantly among the bottom of the coil and push the edges up around the perimeter of the coil, pull the cord and adjust it round the perimeter so that cord is preferably fixed between second and third turn or third and fourth turn of coil as shown in picture 10.
- At last, when bird barrier is adjusted equally round the perimeter tie the cord and cut the remaining cord.

Set of pictures

Picture 1

Picture 2

Picture 3

Picture 4
5.3.2.4 Mounting of pedestal for PLC line traps which are not equipped with optional bird barrier

The legs of the pedestals can either be directly mounted to the bottom bar of the PLC line trap or by means of fixing blocks, depending on the required pitch circle diameter on the mounting plate. The mounting procedure is slightly different.

Mounting procedure for pedestals with fixing blocks

- Clean carefully the contact surface between bottom bar of line trap, fixing blocks and legs of pedestal (with wire brush or similar) and treat it with acidless grease appropriate for electrical connections. Place the fixing blocks in the correct position and fix provisionally by means of the enclosed mounting material. Mount the legs of the pedestal on the fixing blocks by means of the enclosed mounting material. All screws shall be tightened with the appropriate torque moment. For mounting details please refer to appropriate mounting drawing in Appendix.

Mounting procedure for pedestals without fixing blocks

- Clean carefully the contact surface between bottom bar of line trap and the legs of pedestal (with wire brush or similar) and treat it with acidless grease appropriate for electrical connections. Fix the pedestal at the bottom bar of the line trap by means of the enclosed mounting material. All screws shall be tightened with the appropriate torque moment. For mounting details please refer to appropriate mounting drawing in Appendix.
5.3.3 Corona caps
For corona shielding purposes corona caps are being used depending on the system voltage range. These caps are fixed at all edges of the upper and lower spider arms with the exception of the terminals. Corona caps or corona rings have to be mounted after mounting of bird barriers.

For mounting proceed as follows:
• Fix the corona caps by means of the mounting hardware as given in specific project drawing or if these are not available as given in enclosed standard drawing. Secure the screw, which is welded into the caps by glue (Loctite or similar).
• Tighten all screws with the indicated torque moment.

See drawings 1KHJ 035459 for mounting illustration. Picture 11 shows a PLC line trap with mounted bird barrier and pedestal and corona caps as reference.

5.3.4 Corona rings
For corona shielding purposes in the ultra high voltage range corona rings are being used. These rings are fixed on the upper and lower spider arm.

For mounting proceed as follows:
• Corona rings of different diameters are being used. Each corona ring is electrically connected to the line trap at only one fixing point. Insulating spacers are being used on the other fixing points. The reason for this is to prevent current loops causes by the electro-magnetic field of the PLC line trap.
• Fix the appropriate corona rings with the mounting hardware as given in project specific drawings or if these are not available in the enclosed standard drawing 1KHJ 035697.
• Tighten all screws with the indicated torque moment.
5.4 Assembly of support insulators, CC or CVT and mounting of line trap

Assembly of CVT / CC
For mounting of CC or CVT please refer to the product specific manual. For complete assembly please refer to the specific project drawings. Some standard drawings of typical arrangements are enclosed.

Assembly of support insulator.
For complete assembly of support insulators please refer to the specific drawing of this equipment. The elements of the support insulators can clearly be identified by the markings on the uppermost sheds. The marking is referred to in the relevant drawings. Nuts and bolts for assembling of all sections of support insulators are enclosed in the packing of the support insulators.

- The contact surfaces on top and bottom of each support insulator element should be cleaned carefully (with wire brush or similar) and subsequently treated with acidless grease appropriate for electrical connections.
- Put the column of the bottom section onto the base plate in such a way that the position for the fixing screws are correct.
- Fix the column to the base plate with corresponding screws. Tighten them only slightly so that the column still may be moved a little bit during the consequential work.
- Put the column of the next section, if applicable, onto the bottom section in such a way that the position for the fixing screws are correct.
- Fix this column on the lower column with corresponding bolts, nuts and washers. Tighten them only slightly so that the columns still may be moved a little bit during the consequential work.
- Proceed with the next sections, if applicable, in the same way as described above.
- In case of three or four columns in parallel please proceed with the other columns in the same way as with the first column.

Mounting of line trap
- The contact surfaces of pedestal and support insulator or CC/CVT should be cleaned carefully (with wire brush or similar) and subsequently treated with acidless grease appropriate for electrical connections.
- Place the line trap with mounted pedestal in the correct position onto the top flange of the CC, CVT or support insulator respectively. Please observe the correct direction of the terminals of the line trap. In all cases where PLC line trap is mounted on top of CC or CVT line dropper of overhead line shall be connected to bottom terminal of the line trap.
- Fix the line trap with screws, washers and nuts as given in the project specific drawing or if this is not available according to the enclosed standard drawing.
- Tighten all screws of support insulator, CC or CVT and line trap with the indicated torque moment.

5.5 Connections to the line droppers from overhead line and switchyard
The line trap is connected to the overhead line and substation equipment by means of aluminium terminals placed at the spiders of the line traps in radial direction. Unless otherwise specified, terminals of line traps of type DLTC having inner diameters of 700mm may not be stressed for pull in excess of 1500N in any direction. Terminals of line traps of type DLTC with inner diameter above 700mm may not be stressed for pull in excess of 3000 in any direction unless otherwise specified.
To ensure minimum contact resistance and to avoid corrosion the following practice is recommended:

- For direct connection only clamps from aluminium are suitable. Clamps from other materials such as copper or bronze etc. shall be connected via approved bi-metal adapters.
- The contact surfaces must be cleaned carefully (with wire brush or similar) and subsequently treated with acidless grease, approved for electrical connections in HV-substations.
- Antimagnetic and non-corroding screws and nuts shall be used.
- Minimum contact resistance can be obtained by using spring washers.
- All screws shall be tightened with the appropriate torque moment.

The line-side terminal of the line trap must electrically be connected to the CC or the CVT. If line trap is mounted on top of CC or CVT, lower terminal of line trap has to be connected with line droppers from overhead line.

5.6 General mounting information

Antimagnetic screws and nuts should be used for connecting clamps to the terminals of line traps. This is for to eliminate the heating effect of eddy currents caused by the electromagnetic field of PLC line traps.

No magnetic materials shall be used in a distance of half coil diameter around the PLC line trap.

Recommended torque moments for screw connections from stainless steel A2:

<table>
<thead>
<tr>
<th>Screw connection with bolts and nuts of stainless steel type A2</th>
<th>Recommended torque moment</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>8.8 Nm</td>
</tr>
<tr>
<td>M8</td>
<td>21.4 Nm</td>
</tr>
<tr>
<td>M10</td>
<td>44 Nm</td>
</tr>
<tr>
<td>M12</td>
<td>74 Nm</td>
</tr>
<tr>
<td>M14</td>
<td>119 Nm</td>
</tr>
<tr>
<td>M16</td>
<td>183 Nm</td>
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These values are applicable unless other values are given in the relevant drawings.

All bolt and nut connections have to be greased.
6 COMMISSIONING

6.1 Safety information

Follow safety instructions according to chapter 2.

6.2 Checks during commissioning of equipment

- All packing material removed?
- All material mounted as described in installation instruction and in drawings of equipment of this project?
- Follow the path of the PLC-signal from overhead line which shall have direct connection to the top of CC/CVT.
- Make sure that line trap is electrically connected between top of CC or CVT and switchgear of substation.
- All bolts of tuning device, surge arrester, main coil, pedestal, support insulators, line droppers securely fastened with appropriate torque moment?
- Make sure that tuning device of required tuning range is connected in cases where PLC line trap is fitted with several tuning devices of different tuning ranges for frequency change.

- If cylindrical pedestals from glassfiber materials are used:
  Check inner potential connection of cylindrical pedestal. Measure contact resistance between lower terminal of line trap and uppermost flanges of support insulator or CC columns. Resistance measured shall be below 100mΩ.
7 MAINTENANCE

7.1 Safety information

DANGER

Follow safety instructions according to chapter 2.

7.2 General procedure

The line traps do not contain any parts subject to wear and they are therefore considered to be maintenance-free in this respect.

However, it is recommended that the following inspections or operations are carried out during normal circuit maintenance intervals:

- Check whether all bolts of tuning device, surge arrester, main coil, pedestal, support insulators, CC, CVT respectively and line droppers are securely fastened with correct torque moment.
- In case of heavy pollution by conducting particles cleaning is recommended.
- Check of painting. If paint “touch up” is necessary, line trap should be cleaned and exposed parts should be painted with polyurethane laquer. Specifications obtainable from manufacturer.

7.3 Inspection of HF Characteristic of line trap on site

The PLC line trap provides a defined impedance or blocking resistance in the frequency band prescribed for the PLC channel. For tuning purpose a tuning device is connected in parallel with the main coil and the surge arrester. The tuned circuit is usually of the dual-circuit broadband type. The insulation level of the tuning device has been selected with respect to the expected voltage stress.

If there are doubts regarding the HF-performance of the line trap the blocking impedance can be measured. The most common method of carrying out this measurement is the bridge circuit method which is normally only available in the workshop of the line trap manufacturer. The following measuring circuit is therefore recommended for the measurement of blocking impedance on site.

Principle diagram for blocking impedance measurement

- Overhead line must be switched off and earthed by auxiliary earth connection
- Disconnector must be in open position

Main switch  Disconnector  Line Trap  Measuring instruments
Measuring circuit for blocking impedance measurement

To disconnector

Disconnector must be in open position

Line dropper to overhead line

Overhead line must be switched off and earthed by auxiliary earth connection

This is the only earth point of measuring circuit

\[ |Z| = \frac{U_1}{U_2} - 1 \times R_H \]

Formula for calculation of Impedance \(|Z|\) based on measured voltage levels \(U_1\) and \(U_2\):

The proposed measuring instruments are common for commissioning of PLC transmission systems. The use of selective voltmeters for measuring of \(U_1\) and \(U_2\) is recommended. The blocking impedance of the PLC line trap according to IEC 60353 can be measured with this circuit. Please consider that the resistive component of blocking impedance can not be measured with this circuit.

When comparing the measured impedance curve with the impedance curve supplied with the new equipment by the manufacturer some deviations are normal due to a measuring error from stray capacitance of the long leads to the terminals of the line trap on site. Nevertheless a decision whether tuning device has been damaged or not can be derived clearly from impedance measurement as impedance characteristic of line trap will be completely different if elements of the tuning device have been damaged by transients during operation.
7.4 Replacement of tuning device

The rating plate of the tuning device indicates the actual impedance or resistive component of impedance and the specified frequency range as well as the matching type of main coil and surge arrester. In case of new frequency allocations or extensions in the PLC-system changes in the blocking impedance characteristic of line traps may be necessary. New tuning devices with different blocking bands can be manufactured and delivered for each line trap on request.

For order of new tuning devices and surge arresters please contact your local ABB sales office and submit following data:

- Serial number of existing tuning device
- Type, current rating and inductance of line trap
- Serial number of main coil.
- Required blocking impedance
- Required blocking frequency band

Removal:

1. In case line trap is provided with bird barriers, remove the upper bird barrier. Note that corona caps resp. rings must be removed before lifting the upper bird barrier.
2. Loosen the cable connection at the upper terminal of the tuning device. The second nut of the screw connection must be retained with a fork wrench. Some of the tuning devices are already equipped with cables. In this case loosen the cables of the tuning device at the respective terminals.
3. Loosen the two fixing screws of the tuning device in the upper clamping bar and take the tuning device out of the main coil as far as permitted by the cable connected to the lower terminal of tuning device.
4. Loosen the cable connection at the lower terminal of the tuning device. The second nut of the screw connection must be retained with a fork wrench. This is no longer necessary with tuning devices already equipped with cables.
5. Remove the tuning device completely.

Installation:

1. Check rating plate whether characteristics of the new tuning device are correct and insulation level is appropriate.
2. Fasten the cable connection at the lower terminal of the tuning device with nut and washers of same type. The second nut of the screw connection must be retained with a fork wrench. If tuning device is already equipped with cables, cut these cables to the same length as cables of replaced tuning device and crimp the appropriate cable terminals at the ends.
3. Place the tuning device inside the main coil and fix it by means of the two screw connections on the upper clamping bar. Please make sure that the Al-side of the bimetallic washers is on the clamping bar side of the screw connection. Use screw connections of same type as former tuning device has been connected.
4. Fasten the upper cable connection at the upper terminal of the tuning device by means of washers and nuts of the same type. The second nut of the screw connection must be retained with a fork wrench. If tuning device is already equipped with cables, fasten both cable terminals at the same terminals where former tuning device has been fastened.
5. Tighten all screws with the recommended torque moments.
6. Install bird barrier, corona caps or corona rings at upper spider, if applicable.
7.5 Replacement of surge arrester

The rating plate of the surge arrester indicates its ratings. Use surge arresters with the appropriate rating only!

Removal:
1. In case line trap is provided with bird barriers, remove the upper bird barrier. Note that corona caps resp. rings must be removed before lifting the upper bird barrier.
2. Loosen the cable connections at the upper and lower terminal of the surge arrester. The second nut of the screw connection must be retained with a fork wrench.
3. Loosen the two fixing screws of the surge arrester at the upper clamping bar and take surge arrester out of the main coil.

Installation:
1. Check rating plate whether characteristics of the new surge arrester are correct. Never use surge arresters with lower ratings!
2. Place the surge arrester inside the main coil and fix it by means of the two screw connections on the upper clamping bar. Please make sure that the Al-side of the bimetallic washer is on the clamping bar side of the screw connection. Use screw connections of same type as former surge arrester has been connected.
3. Fasten the cable connections at the upper and lower terminal of the surge arrester. The second nut of the screw connection must be retained with a fork wrench. Use screw connections of same type as former surge arrester has been fixed.
4. Tighten all screws with the recommended torque moments.
5. Install bird barrier, corona caps or corona rings at upper clamping bar, if applicable.

Please consider that blocking band characteristic may change if gapped arrester is replaced by a metal oxide arrester due to the inherent self capacitance of the metal oxide arrester. It is therefore recommended to replace tuning devices and surge arresters together.
8  APPENDIX

Following drawings form an integral part of this instruction:

Drawing HENF 471099  Typical arrangement of line trap on CC/CVT
Drawing HENF 471103  Typical arrangement of line trap on support insulator
Drawing HENF 471104  Typical arrangement of suspended line trap

Drawing HENF 333720  Mounting of pedestal H200-1PCD (without fixing blocks)
Drawing HENF 333825  Mounting of pedestal H200-1PCD (with fixing blocks)
Drawing HENF 333611  Mounting of pedestal H350-1PCD (without fixing blocks)
Drawing HENF 329085  Mounting of pedestal H350-1PCD (with fixing blocks)
Drawing HENF 325993  Mounting of pedestal H500-1PCD
Drawing HENF 329000  Mounting of pedestal H500-3PCD and H500-4PCD

Drawing 1KHJ 035459  Mounting of corona caps
Drawing 1KHJ 035697  Mounting of corona rings

Drawing HENF 333810  Mounting of line trap with pedestal H200-1PCD on 1 support insulator
Drawing HENF 333811  Mounting of line trap with pedestal H350-1PCD on 1 support insulator
Drawing HENF 333812  Mounting of line trap with pedestal H500-1PCD on 1 support insulator
Drawing HENF 329006  Mounting of line trap with pedestal H500-3PCD on 3 support insulators
Drawing HENF 329005  Mounting of line trap with pedestal H500-4PCD on 4 support insulators
Legend:

1) Line trap type DLTC
2) Lifting eye
3) Terminal with clamp
4) Pedestal
5) Coupling capacitor (CC) or capacitive voltage transformer (CVT)
6) Steel structure
7) Ground level
8) Coupling device
   Type MCD 80

S = Substation side
L = Overhead line side

A1, A2 = Minimum clearances according to relevant regulations

Equivalent circuit
Legend:

1) Line trap type DLTC
2) Lifting eye
3) Terminal with clamp
4) Pedestal
5) Support insulator
6) Steel structure
7) Ground level

S = Substation side
L = Overhead line side

A1, A2: Minimum clearances according to relevant regulations

Equivalent circuit

S ------- L

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<td>Mounting of line trap DLTC on support insulator Erection on site</td>
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Document No. HENF 471103
Equivalent circuit

Legend

1) Line trap type DLTC
2) Coupling capacitor or capacitive voltage transformer
3) Coupling device MCD 80
4) Disconnector

S = Substation side
L = Overhead line side
List of mounting material

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List of mounting material

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List of mounting material

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Mounting procedure

Corona caps are mounted on all 6 edges of spider arms, 3 pieces at the upper and 3 pieces at the lower spider arm. These corona caps have to be screwed into the threaded holes of the metallic angles which are welded on the spider arms, fix the threaded connection by a glue (LOCTITE or similar).
List of mounting material

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Cut view: A - A
Potential connection of ring and upper spider-arm of main coil

Cut view: B - B
Insulated mounting of ring to spider-arms at 3 locations on perimeter
All screws, nuts, washers shall be from stainless steel.
All screws, nuts, washers shall be from stainless steel
All screws, nuts, washers shall be from stainless steel.