COMMUNICATION NETWORKS

DLTC

Power Line Carrier Line Traps
ABB Line Traps Type DLTC
A reliable component for PLC communication.

Transmitting information along high-voltage lines (PLC) has been one of the main and certainly the most economic means of communication in electric power systems for more than 50 years.

The purpose of PLC line traps:
- Provision of defined high voltage line impedances regardless of the configuration of the primary system switchgear
- Prevention of signal losses due to propagation into other lines
- Attenuation of RF signals from other parts of the power system, thus permitting multiple use of the same frequency bands
- PLC line traps are connected in series with the high-tension 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 fulfill all the RF requirements as well as all the power system requirements of the latest IEC recommendations

Principal advantages of PLC line traps type DLTC
- Low volume and small diameter due to multilayer techniques, hence less wind resistance and simpler maintenance of spacing between conductors
- Open construction and therefore better cooling. No danger of local hot-spots or cracking of Insulating material
- Excellent RF characteristics with high Q and low stray capacitance. Higher resonant frequencies than those used for PLC transmission
- All versions available for either pedestal mounting or suspended installation
- Wide choice of pedestals suitable for mounting on insulator posts, coupling capacitors and instrument transformers
- Provision for nearly every type of conductor terminal
- Solid construction permits high mechanical loads on terminals
- High voltage withstand of tuning devices ensures high reliability
- Tuning devices are tuned for either broadband blocking or damped single frequency blocking
- Transient overvoltage protection by metal oxide arresters with better characteristics than arc-gap arresters. Only arresters with a rating of 10 kA are used
- Integrates optimally in the overall PLC network, because ABB not only supplies the line traps, but everything else for PLC systems
- Modern production techniques ensure consistent product quality
- Backed by 50 years of experience in the design, manufacture and operation of PLC line traps
- Quality management systems according to ISO 9001
- Environmental management system according to ISO 14001
- Occupational health and safety management system according to ISO 18001

<table>
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<tr>
<th>Continuous rated current I_c (kA)</th>
<th>Coordination Standard</th>
<th>Steady state component of short-time current I_s (kA)</th>
<th>Asymmetric peak of short-time current I_k (kA)</th>
<th>Inductance L_t (mH)</th>
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Transport of Electrical Energy

Transport of Data, Speech and Protection Signals
ABB Line Traps design
Based on more than 50 years of experience.

Construction of a PLC line trap
PLC line traps comprise 3 components: the main coil, a surge arrester and a tuning device.

Main coil
- The construction of the DLTC line traps is based on the former series TLJO and DLTA.
- Well-proven techniques and materials have been retained and modified to satisfy today’s performance requirements. DLTC line traps conform to the latest IEC recommendations.
- The coil conductor is made of square section aluminum and the turns are spaced by fiberglass spacer rods.
- There is no insulation around the conductor and therefore no problems can arise due to local hot-spots or cracks in the Insulation. This “open”-type construction provides for excellent cooling by the surrounding air.
- This method of construction achieves a good RF characteristic with a high Q, low stray capacitance and a high resonant frequency of the coil itself.
- 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.
- The same fiberglass spacer used for the turns separates the layers of multiple-layer line traps apart. The multiple-layer winding technique enables extremely compact and robust line traps with small diameter and low height to be manufactured.
- The spider supports in the ends of the coils are held together by the fiberglass 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. To avoid additional thermal and mechanical stress in the event of a power system fault, no current is conducted by the spiders.
- Because of their low weight, DLTC coils can be mounted on insulator posts or simply suspended.
- All coils are equipped with lifting eyes on both sides. In addition to a pedestal, a bird barrier and the corona shield needed at the higher power system voltages can also be attached to the spiders.
- The tuning device and the surge arrester are mounted inside the main coil.

ABB Surge Arresters
Providing better protection.

ABB line traps are equipped with a modern surge arrester which does not have a spark gap. Two alternative surge arresters are available for protecting PLC line traps type DLTC.
- The small- and medium-size line traps are protected by standard ABB station arresters type Polim.
- Large line traps are equipped with specially designed surge arresters for extremely high electromagnetic fields. They employ the same non-linear metal oxide varistors (MO arrester) that are used in the ABB station arresters.

The main advantages of the MO surge arresters are:
- High surge suppression capacity
- Fast response to the high-rise transient surges which typically occur when isolators across line traps are operated
- Low, stable level of protection

The inherent leakage capacitance of the MO surge arrester is taken into account when designing the tuning device. ABB MO surge arresters are especially designed for operation in the strong electromagnetic fields which prevail inside PLC line traps. In particular they do not contain any unnecessary metal parts in which the magnetic field would induce eddy currents and cause an inadmissible temperature rise.

The modification of the MO surge arresters is built to suit the operating conditions of PLC line traps as only necessary because ABB also manufactures this plant equipment and is fully familiar with the problems which arise in practice. The surge arresters used with DLTC line traps have a rated current of 10 kA.

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 prescribed for the PLC channel. 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.

Many years of successful operation have confirmed that the bandwidth obtained for a given main coil impedance and transient over-voltage withstand is an optimum. Special attention has always been paid to the proper insulation coordination between the main coil, tuning device and surge arrester.

Typical resistance characteristic of a metal oxide surge arrester

![Construction of a PLC Line Trap](image-url)
ABB Tuning Devices
Guaranteeing the correct blocking bandwidth.

ABB Line Traps
Conforming to the latest international recommendations.

- Standard values for the blocking resistance of line traps in overhead lines are 400 Ω for bundle conductors and 600 Ω for single conductors. The curves on the right show the blocking bands which can be achieved with broadband line traps for different values of inductance. Detailed frequency tables are available for both methods of line trap tuning and other values of blocking resistance.
- 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.
- Field tunable devices are available for line traps with 0.2 mH and 0.5 mH.
- Extensive tests in outdoor switchyards and GIS installations have demonstrated that a large number of transients with extremely short rise times are generated when an isolator across a PLC line trap is operated.
- These tests supported by computer simulations verified that DLTC line traps with a damped single frequency blocking characteristic withstand such stresses better than broadband line traps. Damped single frequency line traps are therefore recommended for power system voltages from 500 kV upwards and in systems with frequent switching operations. The blocking bandwidth of a damped single frequency line trap for a given main coil inductance is narrower than that of a broadband line trap.
- Connections
The standard versions of the DLTC line traps are supplied with vertical aluminium flat terminals. The arrangement of the terminals permits the conductors to be routed either vertically or horizontally, when using standard clamps. Other types of terminal (e.g. round, horizontal or double) or alternative methods of connection are available on request.
- The blocking bandwidth of line traps with 0.2 mH and 0.315 mH can be tuned in a frequency range of up to 1000 kHz.
- For line traps with 0.5 mH, 1.0 mH and 2.0 mH, when intended for use above 500 kHz, it has to be clarified with the manufacturer first, whether the selected type is suitable for the required application.

Mounting PLC line traps
Suspended
The line traps have a lug on the upper spider for this kind of installation. A lug on the bottom enables the line traps to be anchored. Multiple suspension points can also be provided.

Standing
Small and medium-size line traps can be equipped with a pedestal of non-magnetic material for mounting on coupling capacitors, capacitive voltage transformers or insulator posts. Pedestals for mounting on 3 or 4 insulator posts are available for large line traps or medium-size line traps exposed to high mechanical stresses (high winds or earthquakes).