Introduction

Accessories — matched with the arresters

With our state-of-the-art product family EXCOUNT, ABB has the full range of counters and monitors to cater for all customer needs – from simple discharge operation count (EXCOUNT-A) through leakage current measurement (EXCOUNT-I) to on-line monitoring and diagnostics (EXCOUNT-II).

<table>
<thead>
<tr>
<th>EXCOUNT-A</th>
<th>EXCOUNT-I</th>
<th>EXCOUNT-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surge registration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of impulses</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Impulse amplitude</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Leakage current measurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total current</td>
<td>-</td>
<td>Yes *</td>
</tr>
<tr>
<td>Resistive leakage current</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Display</td>
<td>6-digit, electro-mechanical counter</td>
<td>6 digit, Ch-LCD</td>
</tr>
<tr>
<td>Power supply</td>
<td>Not applicable</td>
<td>Solar panel</td>
</tr>
</tbody>
</table>

* also available without

Monitoring the health of surge arresters

Well-designed and tested, ABB surge arresters are maintenance-free and can reasonably be expected to have a long service life. Nevertheless, considering the type of expensive equipment which an arrester is protecting, together with how costly and devastating an unplanned power outage can be, there are good reasons for “monitoring” the condition of arresters.

Surge arresters present a high impedance at normal service voltage such that they behave as an insulator for the majority of their life. This is necessary to assure a long life for the arrester itself as well as stability of the electrical network as a whole. A deterioration of an arrester’s insulating properties is therefore important to detect early before the situation becomes acute.

In order to truly evaluate the health of an arrester, testing of the kind made as routine during manufacture would need to be performed. However, such testing is not practical to make in the field and removal of the arrester to a HV lab is deemed uneconomic. Instead some kind of in-service diagnostic is required.

Surge registration

The primary reason for the use of surge counters on modern gapless ZnO arresters is to check if a particular transmission line or phase suffers from an exceptionally high number of overvoltages leading to arrester operation - lightning faults on a line, for example. If this is the case, whilst it validates the need for the arresters, use of some preventative counter-measures may be warranted to limit the number of surges. A sudden increase in the counting rate may also indicate an internal arrester fault, in which case the arrester should be investigated further.

However, simple surge counters tell only part of the story, as they only register the number of surges according to their operating characteristic. The user therefore has no way of telling the magnitude of the surge and if it was significant, nor when it occurred and if it was coincident with a system event.

Leakage current measurement

Surge counters can be complemented with the facility to measure leakage currents (total and/or resistive), with the intention of monitoring and diagnosing the condition of the arrester and its state of fitness for continued service. However it is important to understand the validity of the information provided.

At continuous operating voltage (Uc), a metal-oxide varistor acts as a capacitor, leading to a predominantly capacitive component of current and a significantly smaller resistive part. For a complete surge arrester, the capacitive current is further dependent on stray capacitances, pollution currents on the insulator surface, number of varistor columns in parallel and the actual operating voltage. Meanwhile the small resistive component of the leakage current is temperature and voltage dependant.

Since the capacitive component of the current dominates so greatly, the total leakage current measured on a basic mA-meter will be very sensitive to the installation; making interpretation of the readings difficult. Furthermore, the capacitive current does not change significantly due to deterioration of the voltage-current characteristic of the surge arrester. Consequently, measurement of capacitive current cannot reliably indicate the condition of metal-oxide arresters. Nevertheless, increasing values may be of some use in indicating that cleaning of the insulators is necessary.

Instead, it is generally recognised (IEC 60099-5) that the only reliable indicator for the condition of a gapless arrester that can be assessed during normal service
is to measure the resistive component of the leakage current (or estimate it from the 3rd harmonic). The obtained value may then be compared with the maximum allowable resistive current as given by the manufacturer under prevailing service conditions i.e. temperature and applied voltage. If a metal-oxide varistor ages or is damaged by impulses etc, the arrester resistive leakage current, and hence power losses, increase permanently. This may result in an increase in temperature, which in turn, increases the leakage current and so on until a so-called thermal runaway occurs. Early detection of a possible harmful increase may prevent a failure and subsequent unplanned shutdown. Hence, to provide true diagnostics, a good monitor must be able to detect the arrester leakage current and isolate and measure the resistive component flowing internally.

Diagnostic plan
A surge arrester does not contain any moving parts or items that can break. Consequently there is nothing to maintain, adjust, correct or repair, which is why there is normally no need to perform any form of periodical checking or monitoring. In general, a correctly chosen and installed arrester is maintenance free during its entire lifetime. A correctly chosen arrester in this context means that the electrical and mechanical characteristics are matched to actual service conditions.

Nonetheless, since external factors can place stresses on the arrester, potentially leading to its deterioration and ultimate overload, it may be prudent to draw up a schedule for regular checks. Such consideration is all the more important if an unplanned outage is unacceptable for reasons of system stability or economics. The older the arrester, the more regular these checks may need to be, since the statistical risk for overload increases with age.

As a guide, the following strategy is proposed to be made at regular intervals as required and determined by site availability and importance:

• Visual inspection and possible cleaning
• Diagnostics in advance of the designated lighting season and thereafter following periods with bad weather conditions.
• Diagnostics after special fault conditions causing flashover in the network or TOVs of high amplitude and/or long duration.

Because of their nature, old-style gapped arresters should be removed as soon as possible as part of a scheduled replacement program. Their age and inherent design does not warrant detailed evaluation. Early models of gapless arresters may require additional visual checks to look for signs of mechanical or physical deterioration as well as monitoring of the internal arcing and consequent explosive failure in the event of a short-circuit following an arrester failure.

EXCOUNT – when safety comes first
EXCOUNT draws upon over 70 years of experience by ABB in the development of arresters and associated accessories. Safety, functionality and longevity are key elements which are given priority in selection and design of components. In stark contrast to many other competing products, EXCOUNT has not neglected short-circuit safety which lies inherent in the design concept.

The EXCOUNT family is characterized by:

Highest personnel safety
• Explosion-proof for short-circuit currents up to 65 kA
• Same safe performance as ABB arresters.

Negligible residual voltage
• Does not reduce protection margins.
• Minimized risk for injury in case of accidental contact during surges.

Maintenance free
• Sealed components.
• Requires no external power supply.

Long life
• Moulded components, non-sensitive to humidity or temperature variations.

Universal application
• All makes and types of gapless surge arresters.
• All weather and temperature conditions.

Design
One further common feature with the entire EXCOUNT family is that all internal components are fully encapsulated in polymer. This provides sealing to IP67, which ensures no harmful ingress of dust or moisture as well as providing personal safety through complete protection against contact with the internals. EXCOUNT is available in different variants, depending on the user’s needs: simple, basic or extensive.
EXCOUNT-A is a simple surge counter with all the essentials for easy installation and highest personnel safety. The counter is maintenance free; powered by the surge current and suitable for all weather and temperature conditions.

Design features
EXCOUNT-A comprises an impulse current transformer with a single turn primary in the form of an insulated stranded-copper cable to be connected in the earth circuit of an arrester. The cable is fitted at both ends with tinned-copper cable lugs. The secondary circuit is connected to a mechanical counting relay and all components are totally sealed in polymer A suitably angled window permits easy reading of the 6-digit cyclometer-type counter.

Surge registration
The counting threshold for EXCOUNT-A is adapted for gapless surge arresters. Only pulses that are considered significant to the arrester capability and life are therefore registered.

Maintenance free
A robust aluminium casing is fitted over the encapsulated internals, which makes EXCOUNT-A non-sensitive to humidity or temperature variations. It can be exposed to all environments regardless of weather and temperature conditions. The current transformer secondary output is sufficient for driving the counter and an external supply source is hence not needed.

Technical data

**General**
- Item number: LB910 007-A
- Climatic conditions: Sealed water-tight design, IP67
- Short-circuit capability: 65 kA according to IEC 60099-4
- Power supply: Impulse current

**Surge registration**
- Minimum counting threshold: 1.6 kA (8/20 microseconds)

### Stepping Criteria

![Stepping Criteria Graph](image)

### Dimensions

![Dimensions Diagram](image)
EXCOUNT-I Accessories

**EXCOUNT-I**

EXCOUNT-I is a surge counter with basic leakage current measurement function. The counter provides a number of unique features such as short-circuit safety and a well-proven electronic display which is easy to read, even in direct sunlight. EXCOUNT-I is specially designed for use with all makes and types of gapless arresters and in diverse environments.

**Design features.**

As with all surge counters from ABB, EXCOUNT-I does not negatively affect the residual voltage of the arrester thanks to the use of a single turn primary. EXCOUNT-I is housed in a sealed, weather-proof case, suitable for outdoor use and proven to match the short circuit capability of the arresters. EXCOUNT-I has been designed for highest personal safety and has been successfully short circuit tested at 65 kA.

EXCOUNT-I requires no external power supply as it incorporates its own internal power source in the form of a high-efficiency capacitor charged by solar cells. The electronic display is of Cholesteric Liquid Crystal Display type. This ensures highest readability, even in direct sunlight. The display is Bi-stable, which means that power is only required during refresh of the display.

**Surge registration**

EXCOUNT-I registers the surge each time the arrester has discharged a current over 10 A. The accumulated number of surges is continuously shown on the electronic display.

**Leakage current measurement**

ABB's unique design ensures that total leakage current through the arrester can be measured without risking personnel safety. The measurement is initiated by triggering a light sensitive diode using a standard laser pointer. This will initiate EXCOUNT-I to start measuring the total leakage current for several cycles and shortly thereafter display the average value (in milliamperes). The counter will then automatically return to its normal state and display the number of impulses. Thus, the measurement can be made at a discreet distance without coming into direct contact with the equipment.

**Maintenance free**

EXCOUNT-I is a maintenance free product in outdoor applications. The display and solar panels might however need to be wiped off before measurement in extremely polluted conditions.

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### Technical data

#### General

- **Climatic conditions**: Sealed water-tight design, IP67
- **Short-circuit capability**: 65 kA according to IEC 60099-4
- **Power supply**: Built-in solar cells (battery alternative for indoor use)

#### Surge registration

- **Minimum counting threshold (8/20 microseconds)**: 10 A
- **Surge counting memory capacity**: 999999 registrations (wrap-around)
- **Time resolution**: < 0.5 s

#### Leakage current measurement

- **Measuring range of total leakage current**: 0.1 - 50 mA_peak
- **Measuring frequency range**: 48 - 62 Hz
- **Laser pointer wavelength**: 630 - 680 nm

#### EXCOUNT-I versions

EXCOUNT-I can be supplied with an output connection (auxiliary contact) for interfacing to external signaling equipment. Versions with only surge counting function are also available.

<table>
<thead>
<tr>
<th>Model</th>
<th>Surge Counting</th>
<th>Leakage Current Measurement</th>
<th>Auxiliary contact</th>
<th>Laser pointer wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1HSA440000-C</td>
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<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>1HSA440000-E</td>
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<td>1HSA440000-L</td>
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### Dimensions

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### Auxiliary contact

1HSA440000-E and 1HSA440000-L
EXCOUNT-II is our top-of-the-line product combining outstanding looks with the most extensive and powerful features. Included are a variety of surge counting features together with all the essential leakage current measurement functions. EXCOUNT-II enables users to keep track of overvoltages in the network as well as providing state-of-the-art on-line condition monitoring of arresters.

**Surge arrester monitor EXCOUNT-II**

EXCOUNT-II gives the user the possibility to measure both the total leakage current as well as the resistive component of the current through the arrester. Measurement of the resistive current gives a good indication of the arrester's condition and fitness for continued service. The measurement method employed is based on third-harmonic analysis which is considered the most reliable measuring method for condition monitoring according to IEC 60099-5.

**Safe and secure**

The sensor is housed in a sealed, weather-proof case, suitable for outdoor use and proven to match the short-circuit capability of the arrester to which it is connected. The sensor requires no external power supply as it incorporates its own internal power source in the form of a high-efficiency capacitor automatically charged by solar cells and electric field probes.

**Design features**

EXCOUNT-II is a unique monitoring system, which can be used as an aid to assess the health of the entire substation by monitoring surges transmitted in and out of the network. Each surge arrester is fitted with a sensor, which detects the total number of discharges, the surge amplitude, date and time of occurrence, as well as the leakage current through the arrester. The measurements can be remotely read when convenient with the aid of a hand-held transceiver (and optional external antenna).

Remote reading provides increased personnel safety compared with conventional counters With a communication distance of up to 60m (120m with external antenna), the person does not necessar-