EXCOUNT
Surge arrester monitors matched with the surge 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-C) through leakage current measurement (EXCOUNT-I) to on-line monitoring and diagnostics (EXCOUNT-II).

<table>
<thead>
<tr>
<th>Surge registration</th>
<th>EXCOUNT-C</th>
<th>EXCOUNT-I</th>
<th>EXCOUNT-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of impulses</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Impulse amplitude</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leakage current measurement</th>
<th>EXCOUNT-C</th>
<th>EXCOUNT-I</th>
<th>EXCOUNT-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total current</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(also available without)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistive leakage current</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>(also available without)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Display</th>
<th>6-digit, electromechanical counter</th>
<th>6 digit, Ch-LCD</th>
<th>Remote reading, PC connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>Not applicable</td>
<td>Solar panel</td>
<td>Solar panel and field probe</td>
</tr>
</tbody>
</table>
EXCOUNT
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 countermeasures 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 complimented 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 ($U_c$), 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 recognized (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.

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 its 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 TOV’s 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 internals. Newly purchased arresters can also benefit from diagnostic monitoring right from first installation since this permits easy trend analysis to detect potential deterioration later on in its service life.
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**
The use of an impulse current transformer with a single-turn primary ensures that the voltage drop across the counter is negligible, even at the highest impulse currents encountered in service. This leads to added personnel safety and no increase in the protection level of the arrester. Since no gaps or series impedance are used, there is no risk of internal arcing and consequent explosive failure in the event of a short-circuit following an arrester failure.

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.
Surge counter EXCOUNT-C

EXCOUNT-C 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-C is to be fitted in the earth circuit between the arrester and ground. For simplicity, the EXCOUNT-C does not have a termination point for the earth cable. Instead an opening is provided to draw the entire earth conductor from the arrester completely through and down to ground. In case the conductor is too large to fit through the hole, an optional conductor kit may be ordered separately.

The secondary circuit is connected to a mechanical counting relay and all components are totally sealed in polymer. A viewing window permits easy reading of the six-digit cyclometer-type counter.

**Surge registration**
The counting threshold for EXCOUNT-C 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 plastic casing is fitted over the encapsulated internals, which makes EXCOUNT-C 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.
## EXCOUNT-C
### Technical data

<table>
<thead>
<tr>
<th>General</th>
<th>Surge registration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item number</td>
<td>1HSA448000-A</td>
</tr>
<tr>
<td>Climatic conditions</td>
<td>Sealed water-tight design, IP67</td>
</tr>
<tr>
<td>Short-circuit capability</td>
<td>65 kA according to IEC 60099-4</td>
</tr>
<tr>
<td>Power supply</td>
<td>Impulse current</td>
</tr>
</tbody>
</table>

#### Stepping criteria

![Stepping criteria graph]

#### Dimensions

![Dimensions diagram]

Optional accessory EXCOUNT-C current conductor

Item number: 1HSA448427-A
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. 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 mA). The counter will then automatically return to its normal state and display 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.
EXCOUNT-I
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 µs): 10 A
Surge counting memory capacity: 999,999 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 nm

EXCOUNT-I versions
EXCOUNT-I can be supplied with an output connection (auxiliary contact) for interfacing to external signalling 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 included</th>
</tr>
</thead>
<tbody>
<tr>
<td>1HSA440000-C</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1HSA440000-E</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>1HSA440000-J</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>1HSA440000-L</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The auxiliary pulse contact is suitable for use with AC or DC voltage (max. 250V, 1A). An auxiliary relay of suitable type must be connected separately to the EXCOUNT-I auxiliary contact (not included as standard).

Dimensions

Auxiliary contact brought out via dual-core (2 x 1 mm) cable
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.

The measured data can then be transferred to a computer for statistical analysis. Included with EXCOUNT-II is specially designed software which facilitates download of the measured data from the transceiver and permits analysis and reporting of the collected information.

**Surge registration**
EXCOUNT-II does more than just count surges. It also registers the date and time as well as amplitude of the surge each time the arrester has discharged a current over 10 A. Time and amplitude measurement gives the user better information about overvoltages in the network and the operation of the arrester.

**Leakage current measurement and condition monitoring**
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 probe.
## EXCOUNT-II 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 and field probe (battery alternative for indoor use)

### Surge registration
- **Minimum counting threshold (8/20 µs)**: 10 A
- **Amplitude classification (8/20 µs)**:
  - 10 - 99 A
  - 100 - 999 A
  - 1 000 - 4 999 A
  - 5 000 - 9 999 A
  - > 10 000 A
- **Time stamp**: Yes
- **Time resolution**: < 0.5 s
- **Memory capacity**: 1 000 registrations (wrap-around)

### Leakage current measurement
- **Measuring range of total leakage current**: 0.2 - 12 mA_{peak}
- **Measuring range of resistive leakage current (peak level)**: 10 - 2000 µA
- **Measuring frequency range**: 48 - 62 Hz

### EXCOUNT-II versions
EXCOUNT-II are available for two different frequencies depending on national regulations. Contact ABB for guidance.

#### Sensor
<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1HSA441 000-A</td>
<td>for 868.35 MHz</td>
</tr>
<tr>
<td>1HSA441 000-C</td>
<td>for 916.50 MHz</td>
</tr>
</tbody>
</table>

#### Sensors for inverted mounting
<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1HSA441 000-D</td>
<td>for 868.35 MHz</td>
</tr>
<tr>
<td>1HSA441 000-E</td>
<td>for 916.50 MHz</td>
</tr>
</tbody>
</table>

#### Transceiver model 1
Application: Measuring total leakage current and surge data
<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1HSA442 000-C</td>
<td>for 868.35 MHz</td>
</tr>
<tr>
<td>1HSA442 000-E</td>
<td>for 916.50 MHz</td>
</tr>
</tbody>
</table>

#### Transceiver model 2
Application: Measuring total leakage current, resistive leakage current and surge data.
<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1HSA442 000-A</td>
<td>for 868.35 MHz</td>
</tr>
<tr>
<td>1HSA442 000-D</td>
<td>for 916.50 MHz</td>
</tr>
</tbody>
</table>

#### External antenna
<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1HSA446 000-A</td>
<td>for 868.35 MHz</td>
</tr>
<tr>
<td>1HSA446 000-B</td>
<td>for 916.50 MHz</td>
</tr>
</tbody>
</table>
EXCOUNT-II

Dimensions

Sensor

Transceiver

External antenna
For more information please contact:

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