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The customer newsletter
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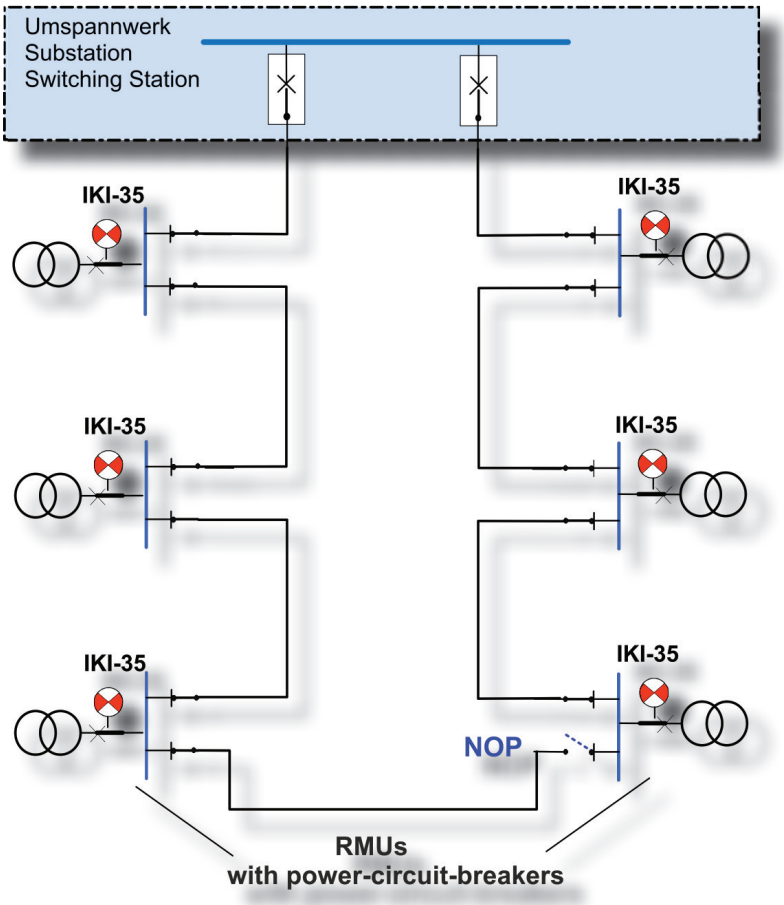
A change of paradigm in distribution network transformer protection: the self-powered and IEC 60255-compliant IKI-35 protection relay



In the wake of electromobility, but also for industrial applications, effective using and protecting distribution network transformers is of the essence.

The IKI-35 has all the necessary functions to attain these goals:

- Overload warning and protection
- Short circuit protection
- Earth fault protection
- Remote tripping
- ANSI 50, 50N, 51, 51N, 50G, 51G
- Licence-free basic configuration software

Dear readers,

Transformers have to run efficiently and need a greater degree of protection than the conventional combination of load switches and fuses can offer, especially in a world of industrial applications, electromobility, and distributed feeder and storage units.
In this edition of ON, we have the pleasure of presenting you IKI-35: the ultra compact self-powered and IEC 60255-compliant transformer protection unit for demanding distribution networks.

Warm regards from Waiblingen

Kries-Energietechnik GmbH & Co KG

Transformer protection in intelligent distribution networks:

Up to now, the combination of load switches with protection relays was mostly only used to safeguard transformers with at least 1000 kVA, whereas combinations of load switches and fuses were used for smaller transformers – at least in Germany. However, when transformers supply demanding industry customers or feed charging stations, it is an entirely different story. For these applications, circuit breakers have to be combined with self-powered protection relays to protect the transformers against overloads and short circuits. The same applies if the transformer is located far from the load switch, as this requires earth fault protection.

Temporary overloads are common in industrial applications with a volatile performance profile and also for feeding charging stations. They should not be tripped too fast in order to use the transformer and network as efficiently as possible. On the other hand, they can be used as early indicators to protect the transformer and network, as they trigger an early overload warning, after which the system power is reduced or, if required, switched off in time. This sensitive intelligence only can be provided by a protection-relay.

With combinations of load switches and fuses, you can neither ensure sensitive overload limitation nor earth fault protection.

The self-powered and IEC 60255-compliant ***IKI-35*** protection relay provides all of the advantages of comprehensive transformer protection and is as small and compact as a short circuit indicator (92 x 45 mm). Moreover, ***you can install it directly in the transformer field without an additional low-voltage compartment – even in compact Ring Main Units!***

By the way: While in some European Countries the combination of load switches and fuses still is considered a rugged and cost-effective solution to easily protect transformers from short circuits, this setup has been long replaced by circuit breakers with transformer protection relays in many other countries. At least abroad, the price difference has shrunk to a minimum and is even reversed if maintenance is needed (at the latest), as finding the approved fuses for the load switches and installing them causes considerably more costs than the circuit-breaker / protection relay solution.
In intelligent distribution networks, protection technology can not only be found in substations, but increasingly also in Ring Main Units. Nevertheless, the number of protection engineers working for utilities is not even close to what would be needed to use protection equipment in Ring Main Units.

For this reason, our designers made the IKI-35 protection relay easy to use and maintain without requiring any special protection knowledge.

A compact protection system also needs compact current transformers that easily fit into the switchgear cable compartment. The current transformers of the self-powered IKI-35 are low power CTs with a high transmission ratio, which can be used for rated transformer currents between 10A and 250A. The CTs have an accuracy class rating of 3 and are compact enough to fit on a C-cone bushing, even if the phase spacing is only 95 mm. This way, the bushing and cable connection point are also protected. As the CTs are split core types, they can alternatively be mounted on MV-cables for retrofit.

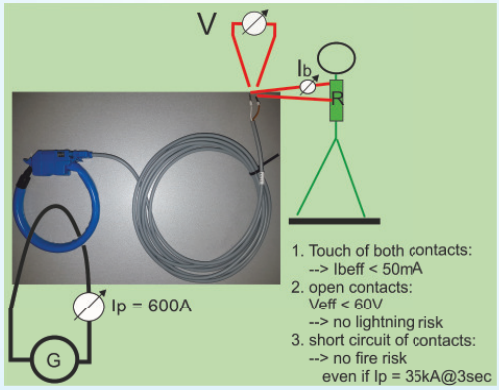
The wide range CTs of the IKI-35 impress with universal versatility, as they can be used for most transformer sizes and make switchgear prefabrication and storage easier.

Furthermore, the IKI-35's CTs are considerably safer than conventional CTs.

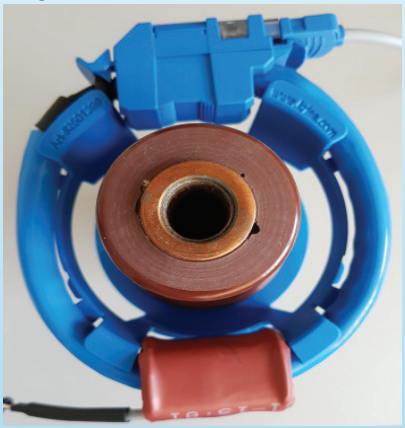
Extreme overcurrents cannot destroy the CTs and, in the event of error, there is no relevant fire load.

Another option for the IKI-35's CTs is the additional test winding. It can be operated open and fed with test currents of up to 20 A for real primary test. With the test winding, it is possible to simulate primary currents of up to 1200 A.
This way, you can test the entire protection chain without having to open the cable compartment or having to generate test currents with ampere windings.

One current transformer type for all transformer sizes that can also be mounted on a bushing or cable



Higher operational safety than any conventional ../1A o. ../5A transformer



Current transformer with additional test winding for primary testing

At primary currents from 5 A and up, the self-powered protection relay IKI-35 is fed by the CTs. At lower ampere values or after the protection mechanism is tripped, it is powered by a battery. The battery is designed to power the IKI-35 for at least 15 years even without any primary current through the CTs.

If no primary current is flowing through the CTs and somebody switches on to a fault, the IKI-35 can nonetheless trip extremely quickly (0.05 seconds + switching time). The same applies to external remote tripping inputs.

But What happens if you forget to exchange the battery or if it malfunctions?

The IKI-35 is designed for selective switch-off in less than 2 seconds without auxiliary energy or primary current and without (or with an empty) battery – even in the most critical protection scenario. Such a scenario would be, for example, a secondary 3-pole terminal short circuit, which could cause the transformer to explode within about 3 to 4 seconds.

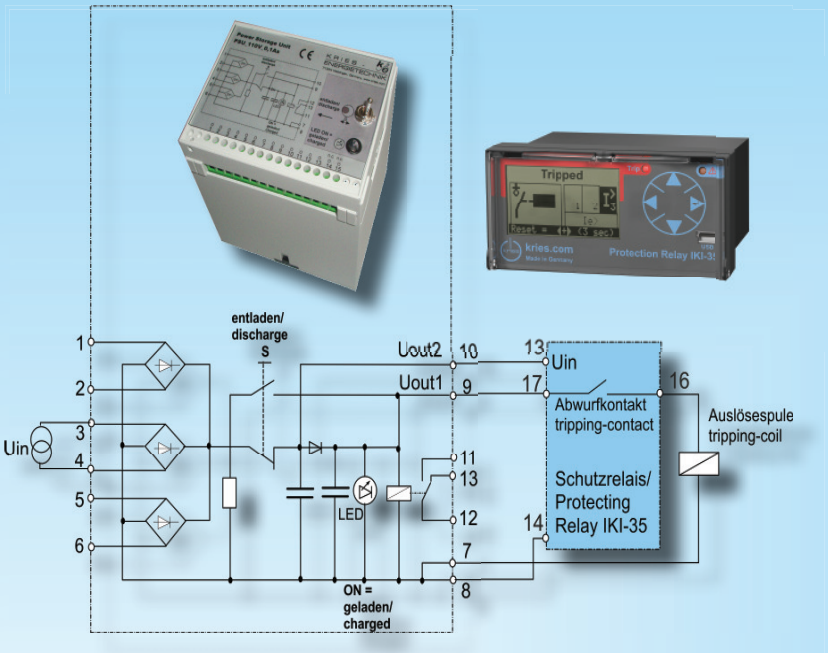
This case is particularly critical, as it would not be detected by upstream protection equipment. The IKI-35 initiates this emergency switch-off for all transformers (uk = 4%..6%).

To maintain full functionality, we recommend exchanging the battery after 15 years at the latest.

Applications / versions

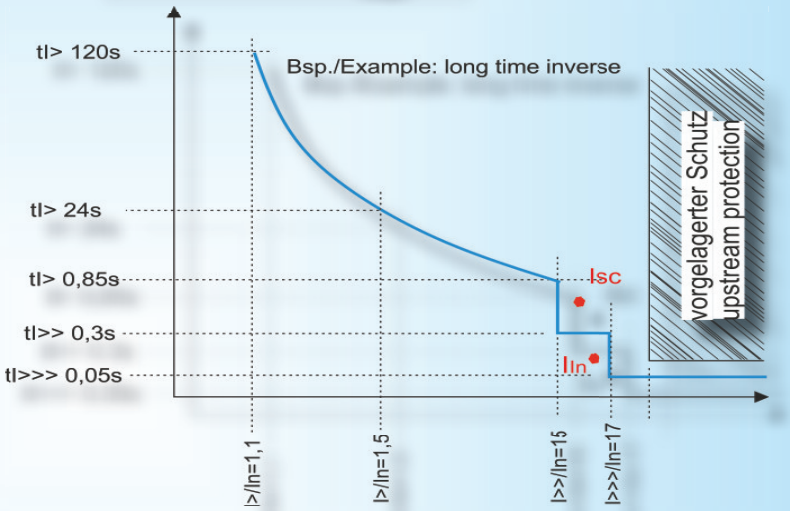
Use with auxiliary energy

The auxiliary energy input can be fed with voltages of 24 to 230 VAC/DC and allows you to operate without a battery. You can additionally increase the relay's availability by buffering the input with a buffer capacitor.
If you connect tripping coils (>0.1 Ws) other than low-energy tripping coils (0.02 Ws or 0.1 Ws) to the IKI-35, you need to use a capacitive Power Storage Unit type PSU-110V_0.1. This capacitive Power Storage works with unbuffered auxiliary voltage. You can mount the PSU on a standard rail.



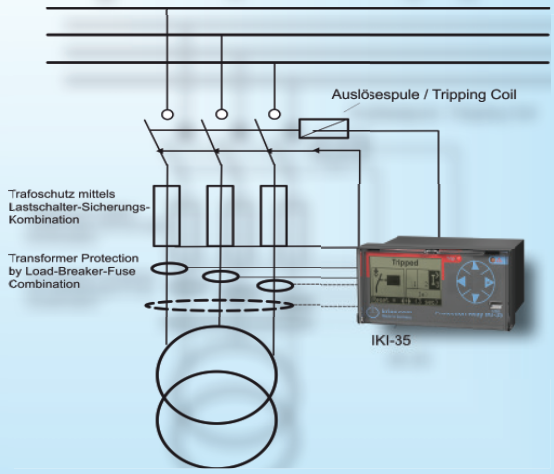
Use with emergency switch-off for the fire brigade, etc.

The IKI-35 features a remote-tripping input with which you can initiate a quick trip. This input can, for example, be activated using a Remote Terminal Unit (RTU) for an emergency transformer switch-off.



Use in combination with load switches

The IKI-35 can be used in both power circuit breaker-feeders and load breaker-feeders.
When used with load breaker feeders the short circuit level is locked and the IKI-35 only trips the load switch in case of an overload or earth fault. As an alternative to tripping, it can also only issue a warning or switch off loads via the relay contacts.
Thanks to the split-core CTs, the IKI-35 is furthermore easy to retrofit to existing load breaker feeders.



Versions

Depending on the tripping coils and rated currents of the application, the following device versions are available:

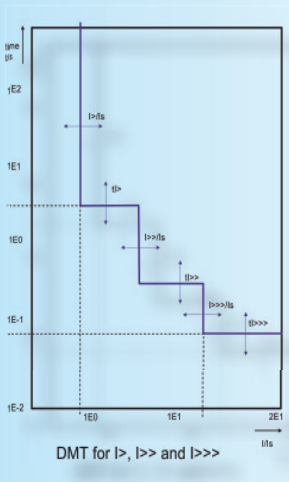
Type	for rated tranformer currents	Application without Auxiliary Energy	Application with Auxiliary Energy
IKI-35_Standard	10A-250A	suitable f. tripping coils up to 3V, 0,02Ws	suitable for all tripping coils
IKI-35_24V	10A-250A	suitable f. tripping coils up to 24V, 0,1Ws	suitable for tripping coilis up to 24V, 0,1Ws
IKI-35_630A	10A-630A	-	suitable for all tripping coils

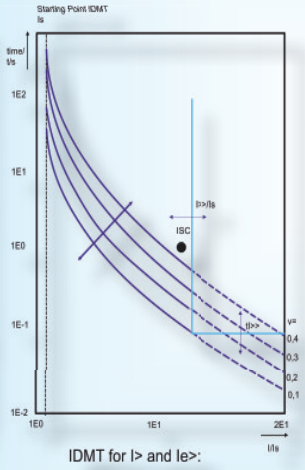
The IKI-35 can be used with one of the four IDMT curves (inverse definite minimum time) in accordance with IEC 60255 (normal inverse, very inverse, long time inverse, extremely inverse) for applications that make targeted use of a transformer's overload behaviour. The higher the overcurrent, the shorter the tripping time. We recommend to configure the short circuit level as DMT (definite minimum time) or fast-tripping level if you need a selective protective response to the upstream protection relay.

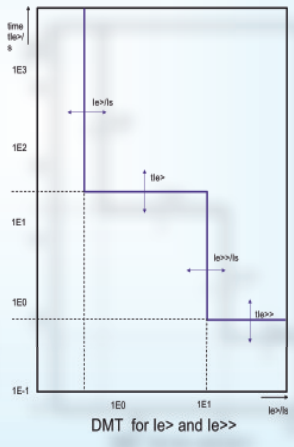
You can use the following protection levels with the IKI-35:

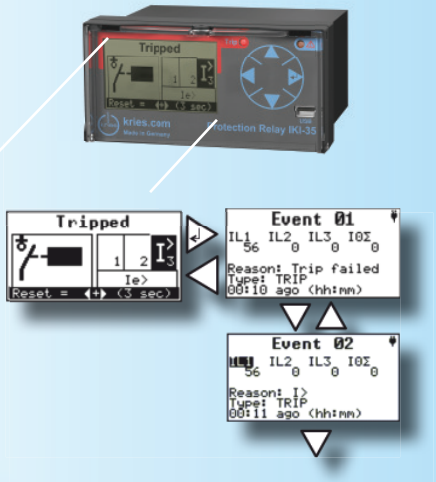
- Three overcurrent levels: I>, I>> and I>>> , with I> as DMT or IDMT, whereas the other levels are DMT levels only.
- Two earth fault levels Ie> and Ie>>, with Ie> as DMT or IDMT and the Ie>> level as DMT level.

You can choose from two methods for the earth fault level: either the Delta-I-method for low-impedance grounded networks with earth faults of more than 15 A (this method does not require a balanced core CT), or the sensitive earth fault method for earth faults starting with approximately 4 A and up, preferably for inductive grounded networks, with an optional separate balanced core CT.
As the IKI-35 only acts as transformer-feeder protection, there still is an overcompensation current during an earth fault occurs in the transformer-feeder, even in inductive grounded networks; therefore IKI-35 allows earth fault location without direction.
The IKI-35 has two alarm relays that can be configured as NC or NO contacts and for different messages (overcurrent pick-up, short-circuit, earth fault, tripping).
Use the event recorder, which can save 20 events with a relative timestamp, to check overcurrents, tripping, and the corresponding phase currents. Use the display or the Windows-software Kries-Config to download the data.



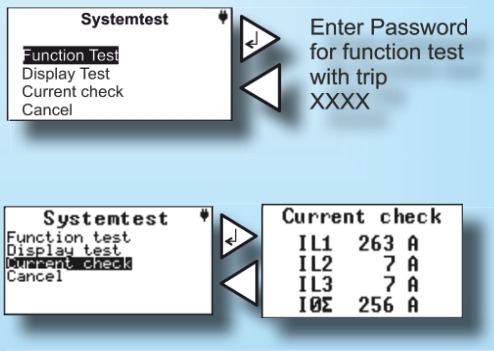






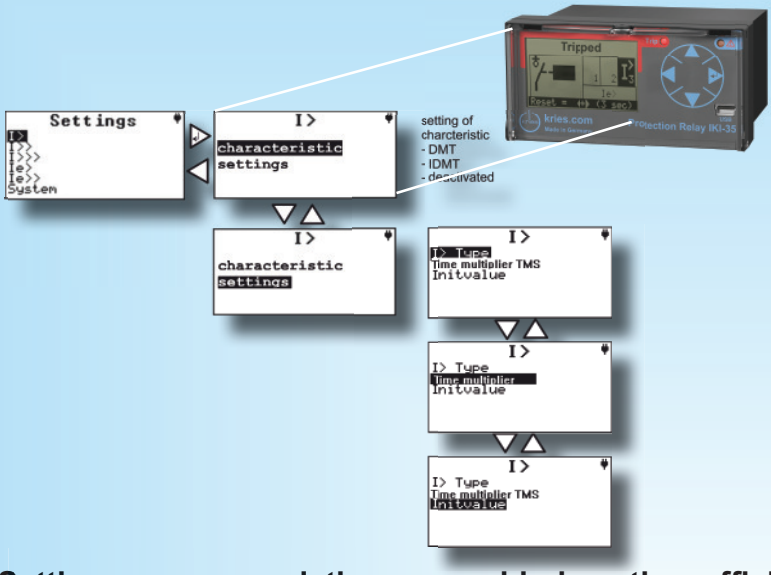
Testability

In addition to primary testing with the primary current or test winding, you can also test the function of the IKI-35 on the secondary side by applying alternating test voltage to the current transformer terminals.
For a simple maintenance test, use the functional test that you can access via the display. The system is triggered after entering a password.
We recommend an IKI-35 maintenance test with tripping at least every 4 to 6 years.
If you only want to check the device status, just push the button. Use the Current Check function to see the primary currents.



Configuration

The IKI-35 is configured using the buttons and the display. Alternatively, you can use an USB cable (mini USB to USB) to connect it to your computer and run Kries-Config for Windows.
The Windows software automatically checks the firmware, updates it and can also read the event recorder.



Setting recommendations considering the efficient overload capacity and reliable protection:

- Rated setting current In:
  Recommended: close to the rated transformer current

- Overload limit I>:
  Recommended maximum: I>/In = 1.5
  (i.e. 50% overload for a limited time!)
  Recommendation to make the best use of the transformer overload behaviour:
  Example:
  IDMT (long time inverse) with initial value of I>/In = 1.1;
  TMS=0,1

- Short circuit level I>>:
  Recommended: not higher than In/uk
  to ensure that the secondary 3-pole terminal short circuit is safely switched off in less than 2 seconds.
  Example: Transformer 630 kVA @ 20 kV; uk = 6%
  In = 18.2A -> In/uk = Isc = 303 A, i.e. Isc/In = 16.6 for <<2 sec
  Select: I>>/In = 15 for max. tI>> 0.3 sec

- Fast tripping (+inrush restraint) I>>>:
  Recommendation: I>>>/In = 17 for 0.05 sec,
  (always faster than upstream protection)

- Earth fault detection Ie>:
  - Recommendation for low-impedance networks:
    Ie> not under 15 A; combined with the delta I method (without balanced core CT)
  - Recommendation for inductive or isolated systems:
    Ie> not under 4 A;
    if Ie> under 10 A: We recommend using a balanced core CT