THE APPLICATION
OF TECHNOLOGY

KEHUI

ZDT-300 DC Earth Fault Locator

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The word Kehui, literally means the Application of Technology in the Chinese language. This phrase perfectly defines the company's commitment to technological innovation, which it achieves whilst striving for the highest levels of quality.

The company was founded in 1991 as a joint venture with a major US organisation, before becoming independent in 2005. It has utilised the best of Asian, European and American expertise to develop a selection of cable and transmission line fault locators, as well as equipment for the automation of electrical distribution systems and its range of switched reluctance motors.

ZDT-300 DC Earth Fault Locator

The DC system in a substation provides power to a variety of equipment involved in the control and protection of the electrical power system. It is therefore very important that this system is working correctly. As the DC system is a floating unearthed system, an earth fault on either the positive or negative terminal will not cause a disturbance and the system will continue to run normally. However, should an earth fault occur simultaneously on the other terminal, it will result in a virtual short-circuit between positive and negative through the earth, causing the failure of the DC supply in the substation. To prevent this, it is important to identify the faulty feeder and to trace the fault location quickly and precisely when the initial fault occurs. This process should not disturb the normal operation of the system.

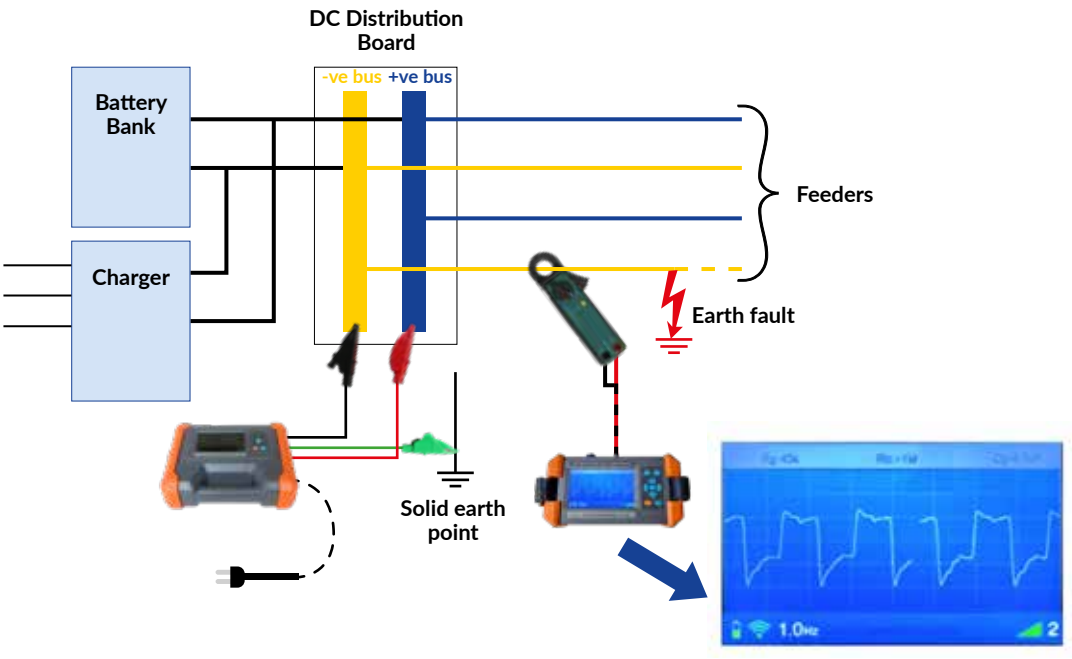
The ZDT-300 DC Earth Fault Locator has been developed for the fast identification and location of earth faults on the DC system to ensure the damage which would occur in the event of a second fault is avoided. The system quickly and accurately finds the fault point, while overcoming the influence of the distributed capacitance of the system. It provides effective indentification of high resistance faults, low resistance faults, faults creating system loops, on systems with single or multiple faults. It can also identify the presence of AC interference on the DC system.

Models

Standard version	500V output for application to substation DC systems with maximum fault resistance 500kΩ
Extended version	1000V output for application to DC systems with long cables, such as railway applications, with maximum fault resistance 1MΩ

Benefits of the ZDT-300

- Direct location of earth faults on DC systems
- Two modes of operation:
  - Real-time fault location using the current waveform mode
  - High sensitivity allowing insulation faults to be measured up to 1MΩ in current difference mode (1000V version only)
- Identification of stray AC voltage on the DC network, preventing damage to connected devices.
- Identification of DC system voltage with automatic adjustment of output voltage.
- The status of the system earthing is automatically checked with an alarm if an earth is present, which is usually due to a fault condition.
- Indication of the current direction, to assist with fault location.
- Detection of fault information such as positive and negative bus voltage, fault resistance, grounding capacitance, and balance resistance.
- The transmitter can be powered directly from the DC system. Where the voltage is insufficient to do this an alternative AC supply is available.
- The optimal output frequency of the transmitter is automatically determined by measuring the DC earth resistance and the distributed capacitance to earth.



Transmitter

The Transmitter unit of the ZDT-300 can measure the voltage of both the positive and negative buses of the DC circuit. If the system is unstable or has a fault, the measured voltage will be displayed along with the balance resistance, fault resistance and system capacitance, allowing the faulted bus to be identified. It will then inject a low frequency signal into both the positive and negative buses and from this, it can calculate the balance resistance, fault resistance and system capacitance.

The transmitter uses an isolated programmable constant current source to inject a series of small current pulses into the system. Each pulse will flow along the faulty bus, and finally go to earth at the resistive fault point, which appears to it as an earthing resistance.

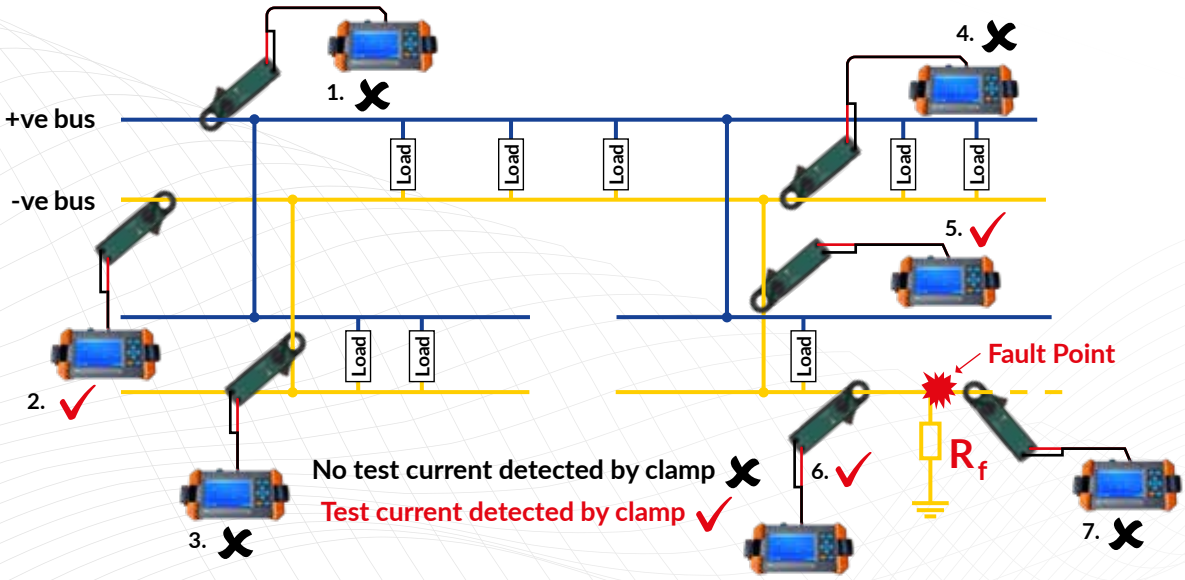
Receiver

The receiver will be applied to the feeders at different points to determine whether the transmitter signal can be seen. It calculates and displays the magnitude and direction of the resistive current in real time, allowing the relative position of the fault to be identified. If the clamp is positioned in front of the fault position, it will detect the magnitude of the injected current signal; if it is clamped beyond the fault position, the injected current signal cannot be detected by the clamp; hence the ground fault point is between the two points. In this way, it can be used to pinpoint the fault along the faulty bus by identifying the point at which the signal is lost, this being the fault point.

To pinpoint the fault, the clamp or current sensor is connected to the receiver and this assembly is used to measure the signal at different points on the DC network.

Fault Finding

The ZDT-300 uses the Tree method of locating the fault. With the transmitter connected to the busbars, the receiver is clamped to each of the adjacent feeders to determine whether the fault is on the positive or negative bus. The receiver is moved to where the feeder splits into two branches, each is then tested to see which is in the fault path. This allows the fault path to be followed to the next branch, where the process is repeated until the fault point is identified.



Faults on long cables (1000v version only)

If the equipment is used on long cables rather than internal dc networks, the impedance and capacitance will attenuate the signal injected by the transmitter and lead to a higher overall fault impedance. If the normal waveform method is unable to identify the fault, the current difference locating mode (1000v version only) can be used. In this mode, the receiver can calculate the difference between the current value before and after the high voltage signal injection. This allows it to obtain the resistive current in real time and determine the fault point. Using this method, the test sensitivity is greatly improved, allowing faults up to 1MΩ to be measured. The fault probability indicator on the receiver in this mode gives an indication of the presence of a fault in the location being measured. The comparison process for the decision can take up to 15s.

ZDT-300 Technical Specification

General	
DC Voltage levels	Suitable for 220V, 110V, 48V and 24V DC systems
Maximum distributed capacitance to earth	≤47μF per branch ≤150μF total
Earth resistance range	0-500kΩ (Standard version) 0-1000kΩ (Extended version)
Operating temperature	-10 to +50°C
Storage temperature	-40 to +50°C
Humidity	5 – 90% relative humidity
Ingress protection	IP54
Transmitter	
Maximum output voltage	500V (Standard version) 1000V (Extended version)
Transmitting signal	≤5mA rms
Output frequency	0.1 – 0.5 Hz (automatic)
Power supply	110/220V DC, 220V AC 50/60Hz
Dimensions	19.5 x 11.2 x 6.5cm
Weight	0.80kg
Receiver	
Power supply	7.2V rechargeable
Dimensions	19.5 x 11.2 x 4.5cm
Weight	0.55kg
Current Clamp	
Power supply	2 x AA battery
Dimensions	19.5 x 11.2 x 4.5cm
Weight	.21kg
Current sensor	
Dimension	13 x 18 x 3cm
Weight	0.2kg

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