Cable Fault Locator TDR-109

TDR-109 is a high-precision 3-channel digital reflectometer **designed to determine the distances to all types of faults** in the power cable lines: open, short, sleeve, cable splice, parallel branches, wet cable, high-resistance faults, intermittent breakdown and etc.

TDR-109 provides the following measurement methods:

- **Time Domain Reflectometry (TDR)**;
- **Arc-Reflection (ARM);**
- **Oscillatory Discharge (ICM, Decay)**;

Time Domain Reflectometry (TDR) - the most accurate and safe - is effective for the diagnosis of low-resistivity cable faults, searching open and short-circuits.

Time Domain Reflectometer (TDR) is a cable device that uses the principle of a radar. The short probing pulse is supplied to the cable line. The signal propagates along the cable and reflected partially or completely at the cable impedance heterogeneity and finally returns back to the input of the device. After processing a received signal device displays the result (waveform signature) in the metric system on the screen.

Heterogeneity of the impedance are result of cables production technology violations, as well as due to mechanical and electrical defects during the construction and maintenance of the lines. The heterogeneity as usual arises in the other devices connection points to the line (coupling, tap, splice cable, coil Pupin, etc.) or in the location of the fault (open, short, soaking core of the cable, current leak to the ground, the leakage to the adjacent wire , broken steam, etc.). Time Domain Reflectometry (TDR) method allows fixing of multiple inhomogeneities both discrete and multiple, depending on the ratio of their length and the pulse width.

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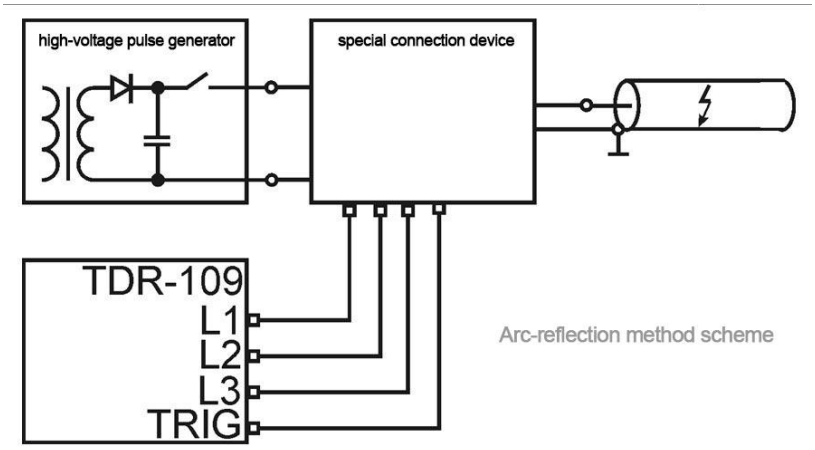
Arc Reflection Method (ARM)

Localization of the cable faults with a high transient resistance (R>10 kOhm) is usually difficult when using low-voltage TDR method. One of the ways for localization such defects in power cables is an Arc Reflection Method (ARM).

Implementation of ARM method is carried out with the additional equipment: high-voltage pulse generator (HVPG) and the special connecting device (as an external unit or internal HVPG unit).

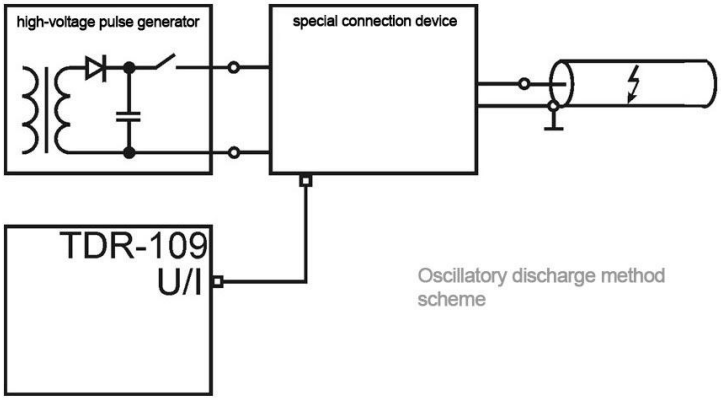


Arc-reflection method scheme

The essence of the ARM method is in creating conditions (using HPVG) for the occurrence electric arc (breakdown) for a short time (few milliseconds) in the point of the fault. Synchronously with the burning arc (sync signal obtained from HPVG) reflectometer performs sensing. The TDR's probe pulse is reflected from a low resistance of the arc with inverted polarity (like shorted circuit waveform). *The method does not require the prior isolation burning and particularly effective when working on polyethylene sheath*.

OSCILLATORY DISCHARGE METHODs: Impulse Current (ICM) and Decay Methods are based of the oscillation process period measurement which occurs due breakdown of a charged cable.

There are two ways to create an oscillatory process in the cable: a voltage wave (Decay method) or current wave creation (ICM method).



Oscillatory discharge method scheme

To create current/voltage wave, high-voltage pulse generator (HVPG) raises the voltage in the cable to the moment of breakdown occures or discharge internal capacitor to the cable.

The defect of the insulation causes a breakdown at the injury point with a spark, which has a small resistance, and the oscillatory discharge proceeds. Knowing the speed of propagation of electromagnetic waves along the cable and the period of oscillations process, we can calculate the distance to the breakdown:

$$X = v\frac{t_{nn}}{2} = \frac{C}{2 \cdot VF} \cdot t_{nn}$$

where X - the fault distance , m; v - velocity of propagation of electromagnetic waves in the cable, m/ms; tnn - the half-period oscillation process, ms, c - speed of light, which is equal to 300 m/ms; VF - the value of the velocity factor. To achieve the best accuracy only the second period of oscillations is selected.

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Implementation of the oscillatory discharge method is carried out by the use of additional equipment: high-voltage pulse generator (HVPG) and a special connecting device.

Sphere of application:

Pulse TDR TDR-109 is used for control when installing or operating the following types of cable lines:

- **power cables;**
- aerial cable lines;
- system cables communications;
- signal and control cables;
- computer networks;
- television and radio cable lines;
- to determine the length of the cable during its manufacture, storage and trade;

Features:

- the possibility of applying the most modern methods of diagnosis and cable fault prelocation: TDR method, Arc-Reflection Method (ARM), the voltage wave(Decay), the method of the current wave(ICM);
- 3 line inputs to connect to the three phase cables;
- display waveforms on a color 5.7 " TFT-LCD with a resolution of 640x480 pixels;
- the ability to display all measurement channels in all combinations (6 waveforms);
- non-volatile memory - at least 1000 waveforms, up to six of them for comparison;
- subtraction mode to show only waveform differences;
- maximum range - 128 km;
- the possibility of sensing with an increased pulse amplitude (U2 = 86 V on open circuit) to work on cables with high attenuation;
- real time measuring;
- two cursors measuring system;
- possibility of a detailed review of any portion of the reflectogram - the function of multiple zoom;
- asynchronous noise suppression;
- intermittent fault mode detection - the function "Capture";
- built-in velocity factor table up to 300 values;
- External USB Flash drive to archive waveforms library and VOP library, as well as restore libraries to the device memory from USB flash;
- splash proof and hermetically closing body with high mechanical strength (protection class IP67);

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Specifications

Measurement Modes	▪ Time Domain Reflectometry (TDR); ▪ Arc Reflection Method (ARM); ▪ Impulse Current Method (ICM) ▪ Voltage Decay Method (Decay)
Monochrome LCD display	Color TFT 5.7" (640x480 pixels)
Range measuring distance (delay time)	from 0 to 128000 m (0 to 1280 μs)
Sub-bands of distance	0 - 62.5 m, 0 - 125 m, 0 - 250 m, 0 - 500 m; 0 - 1000 m, 0 - 2000 m, 0 - 4000 m, 0 - 8000 m, 0 - 16000 m, 0 - 32000 m, 0 - 64000 m, 0 - 128,000 m
Distance instrumental error	from 0.01% to 0.2% of subband (from 12.5 cm to 8 m at VOP = 60%)
The effective sampling rate	800 MHz
Range concerted resistance	from 20 Ω to 600 Ω
Probe pulse duration	from 10 ns to 100 μs
The amplitude of the probe pulse	U1 - not less than 18 V; U2 - not less than 86 V;
Sensitivity	better than 1 mV
The dynamic range	not less 80 dB
The setting range of the velocity factor	VOP = 33.3% … 99.9% (step 0.01%)
Time delay adjustment range (ARM)	from 0 to 50 ms (step 0.2 ms)
Synchronization (ARM)	• TDR input • TRIG input
Memory	Waveform Library up to 1000 waveforms Cables Library up to 300 cables
Special modes	• subtraction mode to show only differences; • compare mode with a trace from the device memory; • PC data exchange via USB-flash; • Capture mode
Continuous battery operating time	at least 8 hours
Time of continuous operating time through the charger	unlimited
Dimensions	70x246x124 mm
Operating temperature range	from -20 °C to +40 °C
Weight with a battery	not more than 2.5 kg

Delivery Contents

	Quantity
Cable Fault Locator TDR-109	1 item
AC Adapter 12 V	1 item
Connecting cable 75 Ohm, 1.0 m, BNC.M - «Alligator clip»	1 item
Connecting cable 75 Ohm, 0.5 m, BNC.M-BNC.M	5 item
User Manual	1 item
CD-ROM with software	1 item
Accessories bag	1 item

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