

# **USER MANUAL**

## **HIGH VOLTAGE CABLES AND JOINTS TESTER**

### **TEST PD**





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AND JOINTS TESTER**

**TEST PD**



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Test PD tester is a modern, top quality measuring instrument, easy and safe to use, provided that the principles presented in this manual are observed. In addition, becoming acquainted with the manual will help you avoid measuring errors and will prevent any possible problems in operation.

# CONTENTS

<b>1 Safety</b> .....	<b>4</b>
<b>2 Overview</b> .....	<b>5</b>
2.1 Description .....	5
2.2 Design and controls .....	6
<b>3 Device operation</b> .....	<b>7</b>
3.1 Switching on the device.....	7
3.2 Measurement mode .....	7
3.3 Types of defects.....	8
3.4 Work in hard-to-reach places .....	9
3.5 Recommendations for measurements .....	9
3.6 Sonel TestPD mobile app.....	10
3.6.1 Live readings.....	10
a. Amplitude LF.....	11
b. Amplitude HF.....	11
c. Amplitude UHF.....	12
d. Temperature .....	12
3.6.2 Warning and alarm templates.....	13
3.6.3 Deleting data.....	13
<b>4 Cleaning and maintenance</b> .....	<b>14</b>
<b>5 Dismantling and utilisation</b> .....	<b>14</b>
<b>6 Specifications</b> .....	<b>14</b>
<b>7 Standard accessories</b> .....	<b>15</b>
<b>8 Manufacturer</b> .....	<b>15</b>

# 1 Safety

When using the device, the following conditions must be observed:

- When working near or in contact with live objects, use adequate personal protective equipment: insulating gloves, insulating poles, etc.
- The device is for personal use.
- Only duly qualified, trained and / or instructed personnel shall be allowed to perform work on this unit and its peripheral equipment. Access to the unit and equipment by other persons must be prevented.
- Using the device in a way which is not in conformity with the intended purpose may be dangerous to health and life, to the unit and associated equipment, and may also affect its appropriate use. The unit may exclusively be used for the purpose for which it has been designed by the manufacturer.
- The device may be operated only by authorised, appropriately qualified persons.
- The device and the associated peripheral equipment must at all times be in an impeccable condition in technical respect.
- During the operation, protect the device against falling and impacts that may damage its housing. Do not use the product with damaged housing!
- It is unacceptable to operate:
  - ⇒ a damaged meter which is completely or partially out of order,
  - ⇒ leads with damaged insulation,
  - ⇒ a meter stored for an excessive period of time in disadvantageous conditions (e.g. excessive humidity).
- The repair should be carried out by the manufacturer.

## 2 Overview

### 2.1 Description

Test PD is a compact, portable device designed for the effective testing of cable heads and cable joints under the voltage of 6 kV and higher.

The device is easy to use thanks to the advanced system integrated into its software, which allows the user to quickly evaluate the condition of the analysed object. This makes the device user-friendly for service personnel, not requiring a special training.

To test a cable joint, switch on Test PD, install it on an insulating stick and bring it close to the tested object. The information about the current joint condition will be immediately displayed in the form of 4-colour histograms and a cross-section of the high voltage cable.



Test PD is provided with 5 integrated sensors of different types:

- acoustic ultrasonic sensor for partial discharge measurement (AC, 40 kHz),
- electromagnetic high-frequency sensor for partial discharge measurement (HF, 0.1...2 MHz),
- capacitive VHF sensor for partial discharge measurement (VHF, 2...100 MHz),
- non-contact pyrometer ( -40°C ...+120°C),
- industrial current frequency sensor for synchronization of measurements (N).

Data from the sensors allow user to effectively evaluate condition of the cable joints and locate insulation defects.

Partial discharges are measured in three frequency modes: ultrasonic (AC), high-frequency (HF) and ultra-high-frequency (VHF). This is to detect insulation defects of various types, which manifest themselves differently in different frequency ranges.

A non-contact pyrometer is used to evaluate the temperature at the point of connection, as well as to find local defective zones with increased temperature, which indicate partial discharges.

The current sensor is used for synchronizing the measurements with the current in the cable - this is necessary to determine the type of insulation defect in the cable joint.



For complex cabling systems, Test PD uses a built-in Bluetooth module for transferring data to a smartphone.

The device has to be installed at the top of a **standard insulating stick (sec. 3.4)**.

## 2.2 Design and controls



Test PD tester is provided with a plastic housing and a colour 2.8" TFT display with a resolution of 240 x 320 pixels and one button used for activating the device and for freezing the indications.

The USB connector is located at the side of the housing for charging the internal Li-Ion battery.



## 3 Device operation

### 3.1 Switching on the device



Before turning the device on for the first time or after a long period of inactivity, it is necessary to charge it for 1 hour. The full charging cycle is approximately 6-8 hours.

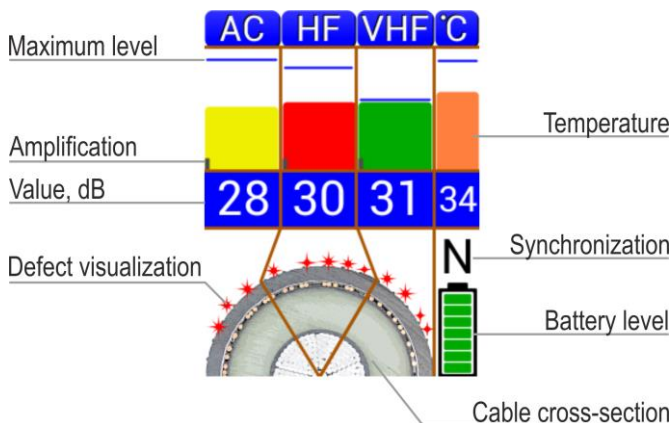
The device is switched on by pressing the button. After start, the self-diagnostic is initiated. Then the device enters the measurement mode. To turn the device off, press and hold the button for 3 seconds.

### 3.2 Measurement mode

To diagnose the condition of a high-voltage cable joint, hold the device with its back close to the joint. At the back of the housing, there is a measurement block equipped with 5 sensors. To increase the precision of the acoustic sensor and the pyrometer, the housing has special openings close to them. All the other sensors operate through the radiotransparent back wall of the device.

By moving Test PD along the surface of the cable joint, it is possible to compare values in different areas and find points with an increased emission of partial discharges or with a high temperature. They indicate defects in the joint insulation. Data on the partial discharge intensity and amplitudes, obtained in different frequency ranges, are shown on the screen of the device as digits and histograms.

Obtained information is also visualized on the figure of a cable cross-section, where measured partial discharges are displayed as stylized flickering sparks. The number of sparks and their brightness reflect the actual intensity of partial discharges in this part of the cable joint.



There are two **level markers** on the histogram: the maximum level indicator and the amplification level indicator. They show the dynamics of the histogram, allowing the user to observe even a small level change in the entire signal range.

The level markers show the maximum value. They do not change if the value is lower than the maximum. To return the level markers to their initial value, shortly press the button of the device.

In the bottom right corner of the screen the **synchronization indicator** is shown. When the current sensor in the device detects current in the cable, then symbol "N" is displayed on the screen and all defect diagnostics are linked to the phase of the mains sinusoid - then, on the basis of the dis-

charges occurring in a given quarter of the sinusoid, the instrument will determine the location of damage and the intensity of the discharges.

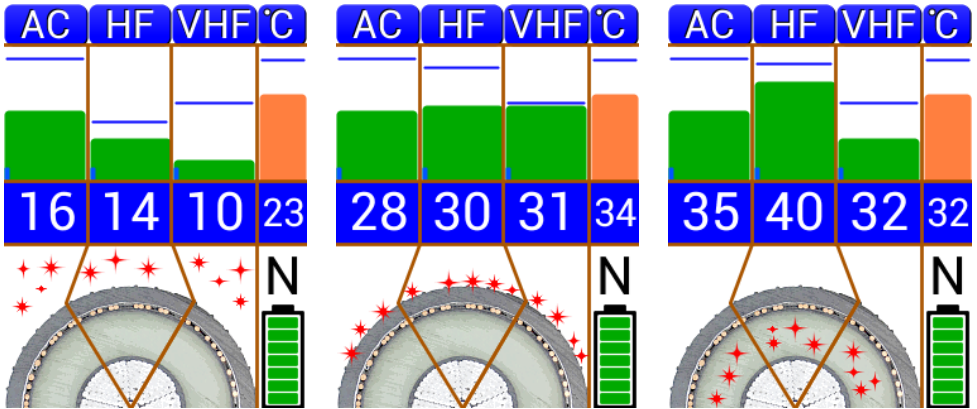
If there is no synchronization, then symbol “G” is shown on the screen and all diagnostics are carried out using an internal generator instead of the external signal.

Depending on the results provided by the advanced software system, the place of partial discharges, shown in the cable cross-section figure, may be the inside of the the cable's insulation or in the external cable sheathing.

The recorded high-frequency discharges, identified by the software system as noise, are displayed on the screen as periodically flashing sparks, located outside the cable. The increase in discharge activity is confirmed by a sound signal.

### 3.3 Types of defects

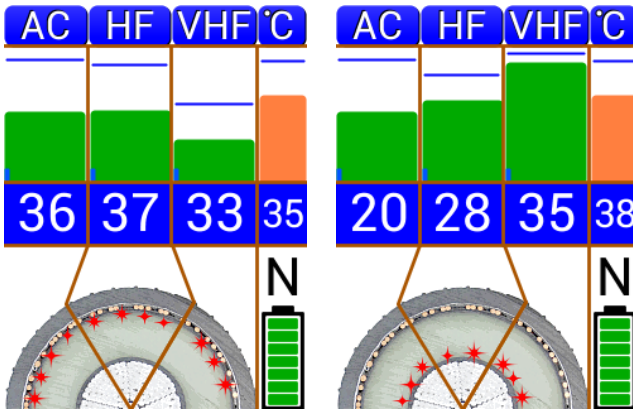
The device shows the following types of defects and noise as well as their combinations:



Noise

Partial discharge on the insulation's surface

Partial discharge in the insulation



Partial discharge in internal insulation

Partial discharge close to the cable core

### 3.4 Work in hard-to-reach places

Usually, high-voltage cable joints are installed in the ground, which makes them easy to access for efficient diagnostics with Test PD.

However, quite often there are complex cabling systems with cable joints difficult to access directly, e.g. when the cable line is inside a cable duct installed at a considerable height. To cope with such challenges, Test PD is provided with special design and firmware features.

Firstly, the Test PD has a **built-in Bluetooth radio interface**. With this interface, all the measurement results and the **data from advanced software may be accessed by other devices** with the same interface. The user can receive the information from Test PD via the radio interface using a smartphone, tablet, etc – on multiple devices at the same time. See **sec. 3.6**.

Secondly, the design of Test PD provides the **option of installing it at the end of a standard insulating stick**. In this configuration, measurements can be carried out on remote joints and on live parts of the equipment. The results are displayed on a smartphone screen.



#### WARNING

- For safety reasons, it is recommended to use an insulating rod for each measurement.
- During the measurements it is absolutely necessary to use personal protective equipment (electrical insulating gloves, etc.).



### 3.5 Recommendations for measurements

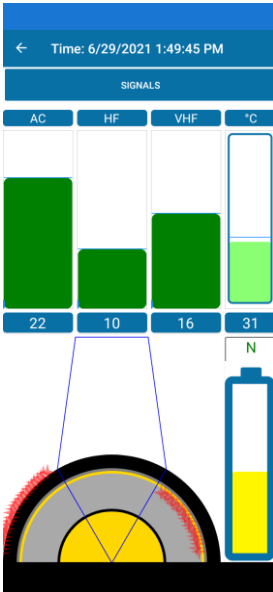
During measurements with Test PD, observe the following recommendations.

1. The measurements should be carried out, if possible, in dry and non-snowy weather, in order to avoid contact corona discharge.
2. When taking measurements, wait for data updates on the smartphone screen. Depending on the electromagnetic environment, it may take up to 10 seconds.
3. If possible, carry out measurements at the same distance from the joint, ideally - by contact (to guarantee the uniformity of measurements).
4. Place the device perpendicularly or at a slight angle relative to the cable joint. Test PD should synchronize with the joint, which is confirmed by displaying “N” symbol.
5. If during cable joint measurements all three phases have approximately the same distribution of signal levels ( $\pm 15$  dB), even if it is considerably high ( $>50$  dB), this is probably due to an external induced noise. If not, analyse the cable joint with the highest signal level.
6. The signal from the acoustic sensor is very useful, as the acoustic signal (AC) is not distributed too far - contrary to medium and high-frequency signals - and it may clearly indicate a defect in the joint.
7. When analysing the acoustic signal, take into account the possibility of corona discharge, as it is specified in par. 1 and 5.
8. Significant change in the signal level, occurring several times between measurements, indicates the user to pay more attention to the tested cable joint.

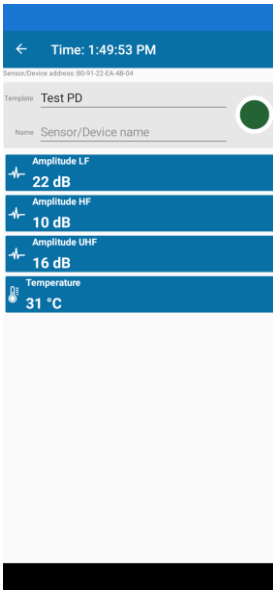
## 3.6 Sonel TestPD mobile app

A dedicated smartphone app **Sonel TestPD** may be installed from the manufacturer's website and Google Play app store. Required smartphone parameters: Android version 4.4.2 or higher, Bluetooth 4.0 or higher.

### 3.6.1 Live readings

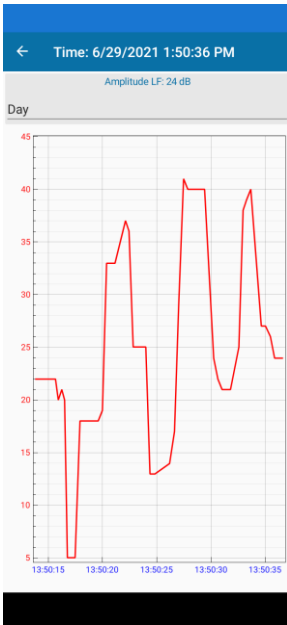


1. On your smartphone, turn on **Bluetooth** and **GPS location**.
2. Start the Sonel TestPD application. All detected Test PD instruments will be displayed.
3. Select the instrument. The projection of its screen will be displayed on the phone.
4. Select the **Signals** field.



5. At the top of the screen you can set:
  - template of warnings and alarms for current measurements,
  - individual name of a given Test PD instrument.
6. The recorded signals are shown below: **amplitude LF, amplitude HF, amplitude UHF, temperature**. On the right there are warning and alarm indicators:
  - none – inactive warning and alarm threshold,
  - green – value below the warning threshold,
  - yellow – value above the warning threshold,
  - red – value above the alarm threshold.Each item in the menu leads to a recorded signal graph.

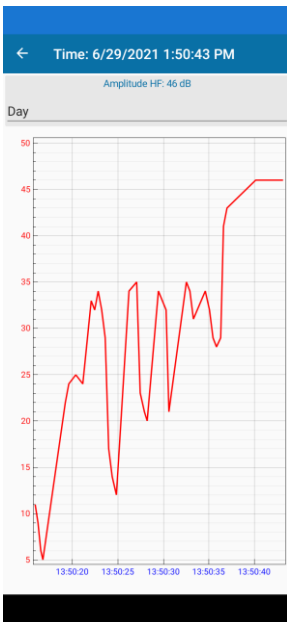
### **a. Amplitude LF**



Amplitude LF diagram.

Touch the field above the graph to change the timescale (hour / day / week).

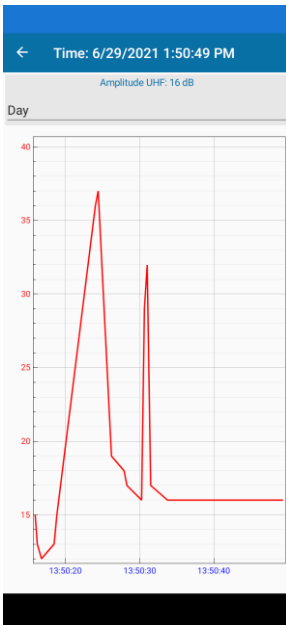
### **b. Amplitude HF**



Amplitude HF diagram.

Touch the field above the graph to change the timescale (hour / day / week).

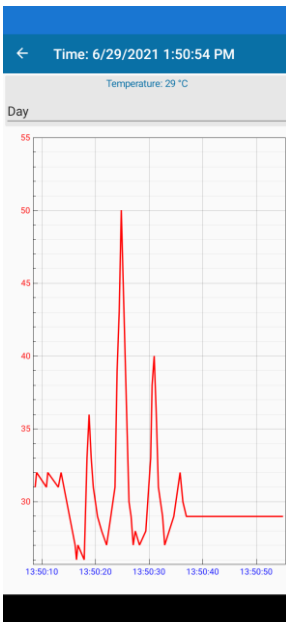
### c. Amplitude UHF



Amplitude UHF diagram.

Touch the field above the graph to change the timescale (hour / day / week).

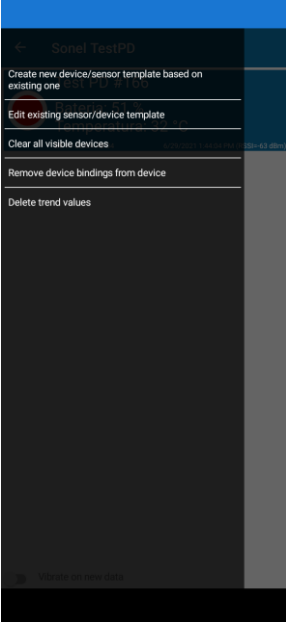
### d. Temperature



Temperature diagram.

Touch the field above the graph to change the timescale (hour / day / week).

### 3.6.2 Warning and alarm templates



Expand the side menu to see options for the warning and alarm templates. In each template, you can set the application's response to the following parameters.

- LF, HF, UHF signal amplitude.
- Battery (charge level).
- Temperature.
- Defects detected using low frequencies (LF):
  - LF Defect. Noise,
  - LF Defect. Corona,
  - LF Defect. Floating,
  - LF Defect. Internal PD (internal partial discharges).
- Defects detected using high frequencies (HF):
  - HF Defect. Noise,
  - HF Defect. Corona,
  - HF Defect. Floating,
  - HF Defect. Internal PD (internal partial discharges).
- Defects detected using ultra high frequencies (VHF):
  - UHF Defect. Noise,
  - UHF Defect. Corona,
  - UHF Defect. Floating,
  - UHF Defect. Internal PD (internal partial discharges).
- Sync.
- Maximum values of signals: max LF, max HF, max UHF.
- Signal band: gain LF, gain HF, gain UHF.

### 3.6.3 Deleting data

To remove all devices or recorded trends from the application, select the appropriate option in the side menu.

## 4 Cleaning and maintenance



### NOTE!

Use only the maintenance methods specified by the manufacturer in this manual.

The housing of the device may be cleaned with a soft, damp cloth using all-purpose detergents. Do not use any solvents or cleaning agents which may damage the housing (powders, pastes, etc.).

The cables may be cleaned using water with detergents and then they must be wiped dry. The electronic system of the device does not require maintenance.

## 5 Dismantling and utilisation

Waste electric and electronic equipment must be collected selectively, i.e. it must not be disposed with waste of another type.

Waste electronic equipment must be sent to a collection point in accordance with the law of waste electrical and electronic equipment.

Do not dismantle any elements of the equipment before sending it to a collection point.

Observe local regulations concerning disposal of packages, waste batteries and accumulators.

## 6 Specifications

a) Partial discharge frequency range	
▪ AC .....	40 kHz
▪ HF .....	0.1...2 MHz
▪ VHF.....	2...100 MHz
b) measured pulse dynamic range	
▪ AC.....	80 dB
▪ HF.....	60 dB
▪ VHF.....	60 dB
c) measured temperature range .....	-40...+120°C
d) radio interface.....	Bluetooth 4.1
e) battery .....	Li-Ion 18650 with built-in safety circuitry
f) battery life.....	10 h
g) operating temperature range .....	-20...+40°C
h) relative humidity.....	95%, non-condensing
i) display .....	240 x 320 LCD
j) device dimensions .....	205 x 85 x 75 mm
k) device weight.....	0.3 kg
l) transportation case dimensions .....	300 x 270 x 145 mm
m) weight of the whole set cased.....	2.0 kg



## 7 Standard accessories

The standard set of equipment supplied by the manufacturer includes:

- Test PD device,
- UDI-M6 adapter for connecting an insulating stick – **WAADAAUDIM6**,
- Euro-M6 adapter for connecting an insulating stick – **WAADAEUROM6**,
- charger with USB port,
- USB-microUSB cable,
- transportation case,
- user manual.

The current list of accessories can be found on the manufacturer's website.

## 8 Manufacturer

The manufacturer of the device and provider of guarantee and post-guarantee service:

**SONEL S.A.**  
Wokulskiego 11  
58-100 Świdnica  
Poland  
tel. +48 74 858 38 60  
fax +48 74 858 38 09  
E-mail: [export@sonel.pl](mailto:export@sonel.pl)  
Web page: [www.sonel.pl](http://www.sonel.pl)



### NOTE!

Service repairs must be performed only by the manufacturer.

## NOTES





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