

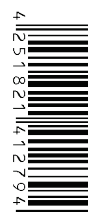


## **PD Loc**

**Partial Discharge pinpointing system**

## **Operating manual**

Issue : A (10/2021) - EN  
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## Consultation with Megger

The present system manual has been designed as an operating guide and for reference. It is meant to answer your questions and solve your problems in as fast and easy a way as possible. Please start with referring to this manual should any trouble occur.

In doing so, make use of the table of contents and read the relevant paragraph with great attention. Furthermore, check all terminals and connections of the instruments involved.

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## 1 Safety Advice

Safety precautions	<p>This manual contains basic advice for the installation and operation of the impulse transmitter <i>PD-TX</i>. It is essential to make this manual accessible to the authorised and skilled operator. He needs to read this manual closely. The manufacturer is not liable for damage to material or humans due to non-observance of the instructions and safety advices provided by this manual.</p> <p>Locally applying regulations have to be observed.</p>
Working with equipment of Megger	<p>All electrical regulations of the country where the system is operated have to be observed as well as national regulations for prevention of accidents and existing regulations for the safety and operation of equipment of the involved companies.</p> <p>Original accessories ensure safe operation of the equipment. It is not allowed and the warranty is lost if other accessories than the original ones are used with the equipment.</p>
Intended application	<p>The impulse transmitter <i>PD-TX</i> may only be operated at medium voltage cables and medium voltage cables according to its intended application.</p> <p>Safe operation is only realised when using the equipment for its intended purpose.</p> <p>The limits described under technical data may not be exceeded.</p>

## 2 Technical Description

**Necessity** Due to the fact that a partial discharge (PD) fault in a cable usually cannot be forced to a voltage breakdown, conventional methods that use high voltage cannot be used to pinpoint this type of cable faults.

However, partial discharge faults do require exact positioning with high precision just like regular cable faults in order to avoid unnecessary and cost-intensive excavation when replacing or fixing a cable.

This can often be very challenging given that the geographical course of a cable is in many cases insufficiently documented and, therefore, cannot be followed accurately. Thus, up to now one had to cut the cable in its course to locate the exact position of the fault by isolating it in a small segment. This approach, however, also suffers from incremental costs.

The here described *PD LOC* locating system (consisting of the *PD-TX* impulse transmitter and the *Teleflex SX* reflectometer) offers a new, cost-effective technique for pinpointing PD faults at mixed cables (XLPE / PILC), as well as at joints of single cables.

**Principle of operation** If a PD fault has been detected and prelocated during a partial discharge measurement with a PD diagnosis system, the impulse transmitter *PD-TX* has to be connected to the cable via an inductive impulse coupler at an easily accessible location as near as possible to the assumed PD fault location.

After that, the *PD-TX* transmits a sufficiently strong impulse signal into the exposed cable.

After that, the impulse transmitter frequently couples sufficiently strong impulses into the cable. Meanwhile, the *Teleflex SX* reflectometer, attached to the same end of the cable where the PD diagnosis took place, receives the direct impulse as well as its subsequent reflections from the far end.

The time difference between the first and the second reflection can be obtained from the graphical reflectogram of the *Teleflex SX* and is used to calculate the distance to the injection point of the impulse.

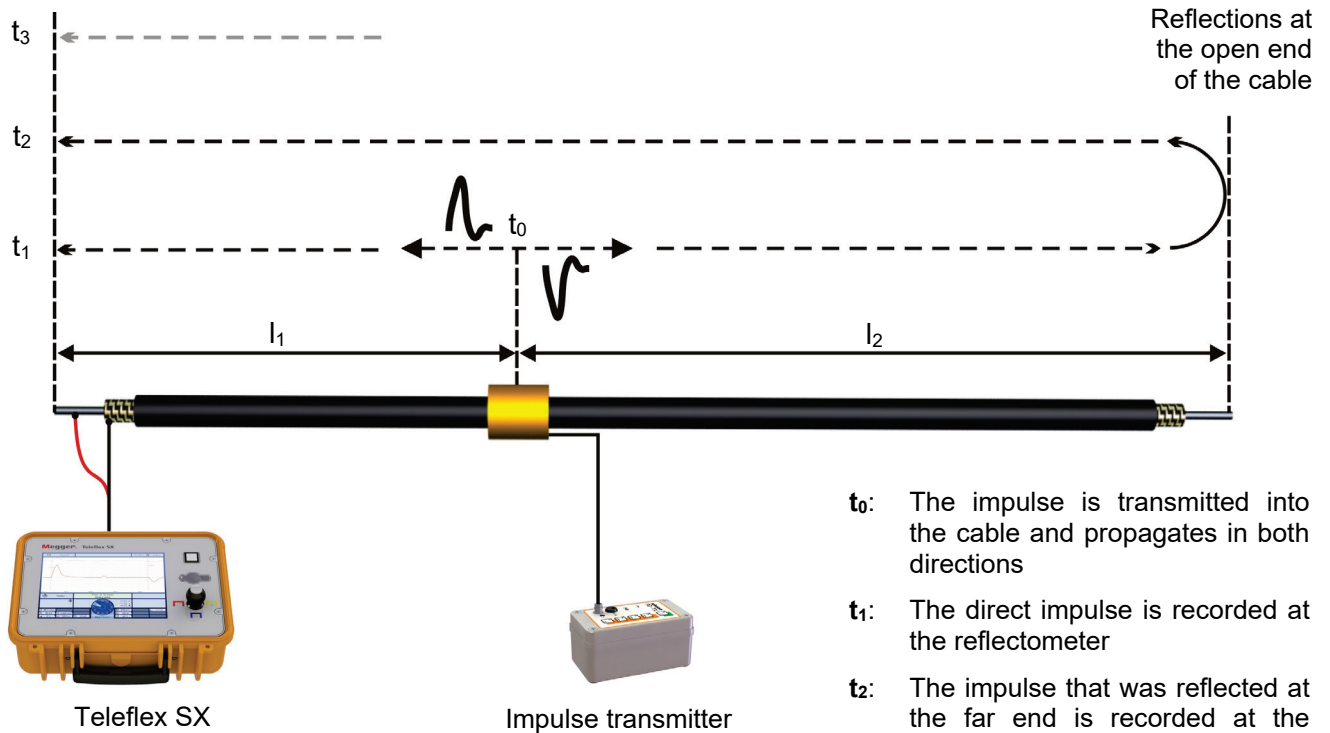
This knowledge combined with the reflectogram obtained during the PD diagnosis (using equal measuring parameters) allows drawing a proper conclusion about the exact distance between the actual fault location and the *PD-TX* transmitter, which in turn facilitates highly precise positioning of the fault location.

Coupling the artificially generated PD impulse is possible even at cables with a high dense copper screen as well as at cables with a metal sheath (lead, aluminium).

Using the above described method, the *PD LOC* locating system can also be used for cable selection.

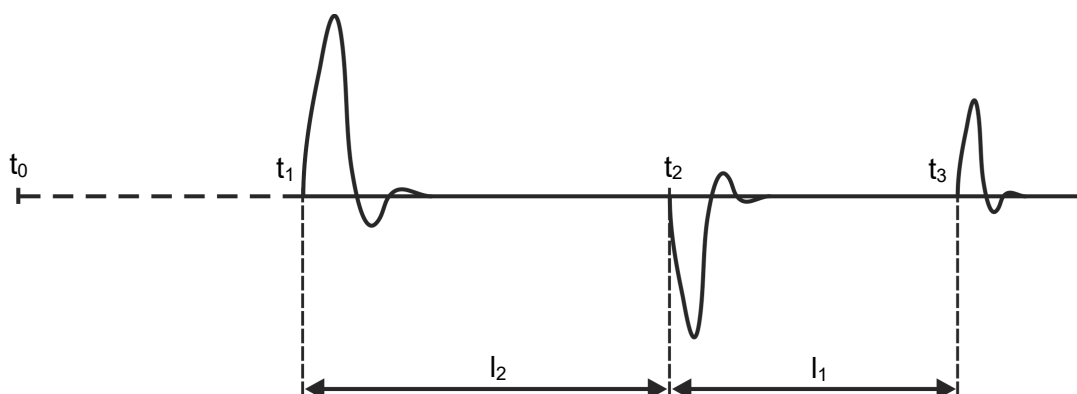
The following figure describes the method of determining the distance using the propagation time of the individual impulses/reflections.

Pulses / reflections  
arriving at the  
reflectometer



- t<sub>0</sub>:** The impulse is transmitted into the cable and propagates in both directions
- t<sub>1</sub>:** The direct impulse is recorded at the reflectometer
- t<sub>2</sub>:** The impulse that was reflected at the far end is recorded at the reflectometer
- t<sub>3</sub>:** The first reflection of the direct impulse is recorded at the reflectometer

This leads to the following **idealized** reflectogram on the reflectometer:



## Technical data

<b>Parameter</b>	<b>Value</b>
Power supply	12 V using an external adaptor or an optional KFZ-battery charger lead
Operating time	24 h with internal rechargeable lithium- battery
Impulse frequency	3.33 Hz
Pulse widths	50 ns, 200 ns, 500 ns, 1 $\mu$ s
Pulse amplitude	250 V
Impulse current	200 A
Ouput protection	Sustained short circuit proof
Weight	2.0 kg
Protection class	IP 54
Operating temperature	-10°C ... 50°C

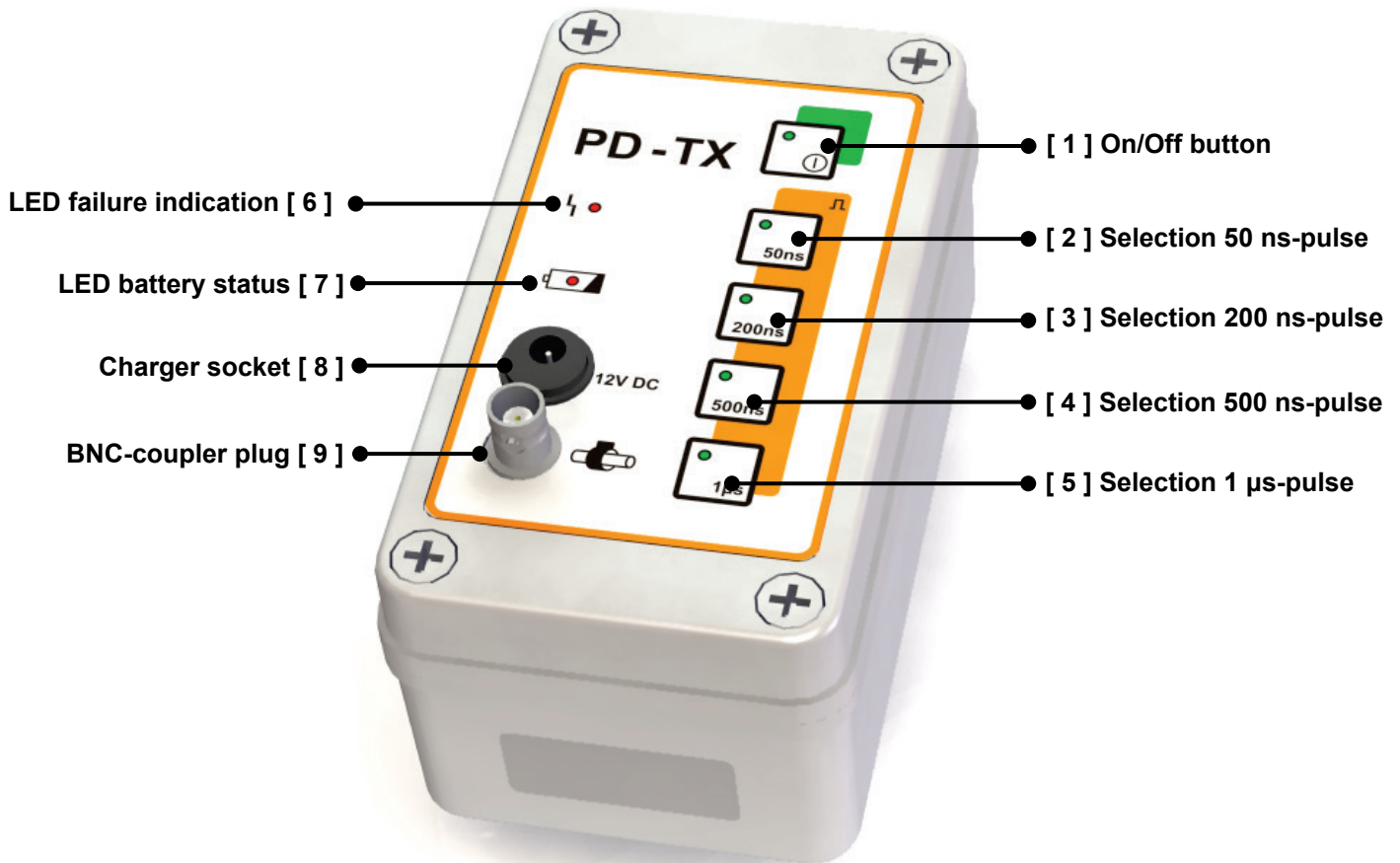
### 3 Scope of delivery

Standard	<p>The scope of delivery of the <i>PD-TX</i> impulse transmitter consists the following components:</p> <ul style="list-style-type: none"><li>• Impulse transmitter in the pelicase</li><li>• Inductive coupler, 42 mm</li><li>• Battery charger LG 12</li><li>• BNC-cable, 75 cm</li><li>• Adapter BNC to terminal post (4 mm)</li><li>• Measuring lead, 2 m</li></ul>
Optional accessories	<p>Supplemental to the standard shipment of the <i>PD-TX</i> impulse transmitter, the following accessories are available:</p> <ul style="list-style-type: none"><li>• Inductive coupler, 64 mm</li><li>• Car charger LK 12</li></ul>
<i>PD LOC</i> system	<p>In order to be able to record, evaluate and visually display the impulses that were coupled into the cable with the <i>PD-TX</i> impulse transmitter, the complete <i>PD LOC</i> locating system includes the <i>Teleflex SX</i> TDR.</p> <p>The features and operating instructions of the <i>Teleflex SX</i> are described in the appendant manual.</p>

## 4 Design

The impulse transmitter *PD-TX* is placed in a robust ABS-plastic housing. The device is assigned to the protection class IP 54.

The following figure shows the selection transmitter and its controls, connection sockets and display elements.



## 5 Start-up

Installing the impulse generator

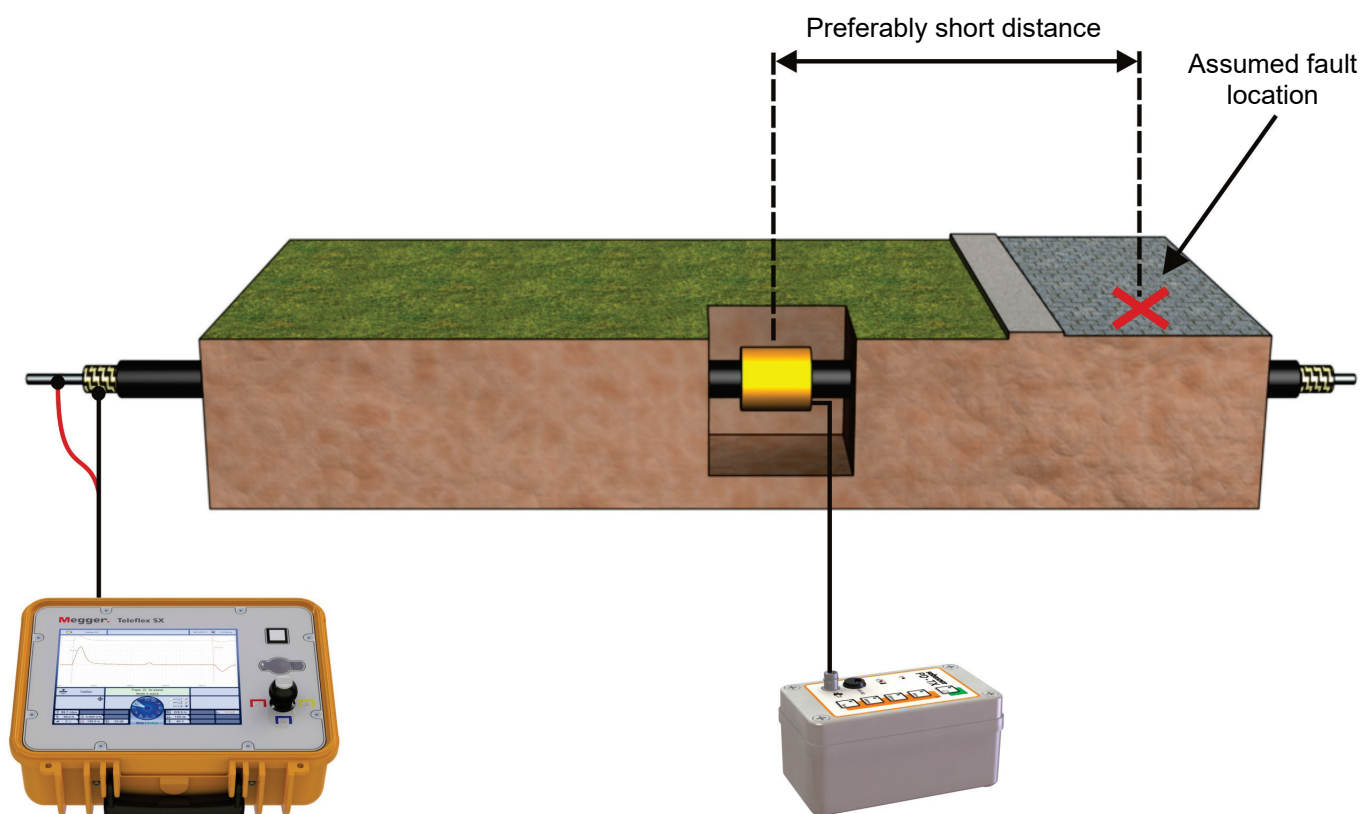
After prelocating a partial discharge fault during a PD diagnosis, its **assumed** position on the terrain is localized using the cable layout plans, if available, or by a preferably exact distance estimation.

The impulse transmitter *PD-TX* should now be attached to the defective phase of the cable at an easily accessible location as near as possible to the assumed PD fault location. For this purpose the enclosed BNC cable has to be connected with one end to the BNC-coupler plug [ 9 ] of the transmitter and with the other end to the inductive coupler.

After that, the inductive coupler is put round the cable and has to enfold it completely. Both multi-pin and female connectors have to show good electrical contact and any dirt has to be carefully removed.

If, alternatively, the 2 m measuring lead in combination with the enclosed adapter is used for connection, it has to be twisted around the defective phase at least 5 times. For long pulses, it has to be twisted around 10 times.

The *Teleflex SX* should be connected to the defective cable phase at the same cable end, at which the PD measurement took place (please refer to the *Teleflex SX* manual for further connection details).



Switching on The *PD-TX* impulse transmitter is switched on by shortly pressing the On/Off button [ 1 ]. Right after activation all LEDs are lit for 3 seconds. Afterwards, the green LED on the On/Off button signals operational readiness.

Safety mechanisms If problems occur during operation, through which a secure use of the transmitter or the protection of its components is not guaranteed anymore, the failure indication LED [ 6 ] flashes and the impulse transmission or the charging process respectively is interrupted. This can happen in the following cases:

- Overvoltage or undervoltage are detected during the charging process.
- The power consumption of the device exceeds a certain threshold.

If the failure indication LED flashes permanently or recurrently, the device has to be shipped to an authorized service centre.



## 6 Operation

After the impulse transmitter is attached to the cable and switched on, a high current impulse is transmitted through the coupler into the cable every 3.3 seconds.

The impulse width can now be changed using the buttons [2] ... [5]. The currently active pulse width is indicated by a flashing LED on the corresponding button.

Optimal pulse width


Due the attenuation and dispersion characteristics of the cable which depend on frequency, every signal is changed in amplitude and shape. This applies to the transmitter pulse and each reflection too.

As a result, narrow transmitter pulses which have a greater proportion of high frequencies than longer pulses will deformed more heavily.

This fact has to be taken into account when selecting a combination of pulse width and range of measurement. It means that short pulses are only suited for tests at short distance. On the one hand, they provide for a very good local resolution, but at long distances they are heavily attenuated and widened, on the other. Long pulses are attenuated much less, clear echoes can so be received even over long distances. At short distance, however, they are inferior to shorter pulses due to their limited local resolution.


The following ranges of measurement are allocated to the pulse widths that can be selected:

Pulse width	Propagation time	Propagation distance (when $v_{1/2} = 80 \text{ m}/\mu\text{s}$ or NVP = 0.533)
100 ns	up to 6.25 $\mu\text{s}$	up to 500 m
200 ns	6.25 $\mu\text{s}$ – 31.25 $\mu\text{s}$	500 m – 2.5 km
500 ns	31.25 $\mu\text{s}$ – 62.5 $\mu\text{s}$	2.5 km – 5 km
1 $\mu\text{s}$	from 62.5 $\mu\text{s}$	from 5 km

 Choosing the pulse width is moreover affected by the screen attenuation. A high screen attenuation requires longer impulses even for shorter cables, in order to couple more energy into the cable.

Recording a reflectogram with *Teleflex SX*


While the *PD-TX* transmits impulses into the cable, the *Teleflex SX* is used to record a reflectogram of the incoming impulses/reflections.

For this purpose, the *Teleflex SX* has to be activated as described in the corresponding manual and the  operating mode has to be selected.

Ideally, a reflectogram is displayed immediately after accessing the operation mode which shows the impulses/reflections transmitted by the impulse transmitter in their typical sequence (see operation principle *page 11*).

If this is not the case, it should be verified whether the impulse transmitter is properly attached to the correct cable/phase.

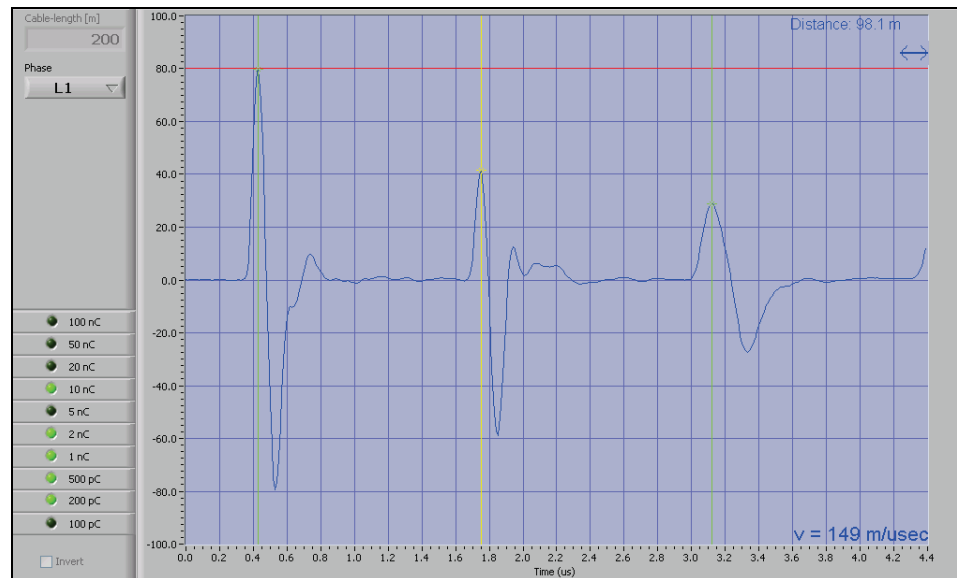
After the reflectogram at the *Teleflex SX* shows the desired curve shape, the display may be adjusted using the gain of the reflectometer depending to the attenuation and the density of the cable screen.

 The measuring range, the propagation velocity and all other measurement parameters should be adjusted analogously to the PD measurement, in order to make the obtained reflectograms comparable.

Analysing the measurement results

The following example illustrates how the reflectograms of the PD diagnosis system and the *Teleflex SX* can be compared to obtain the exact position of the PD fault.

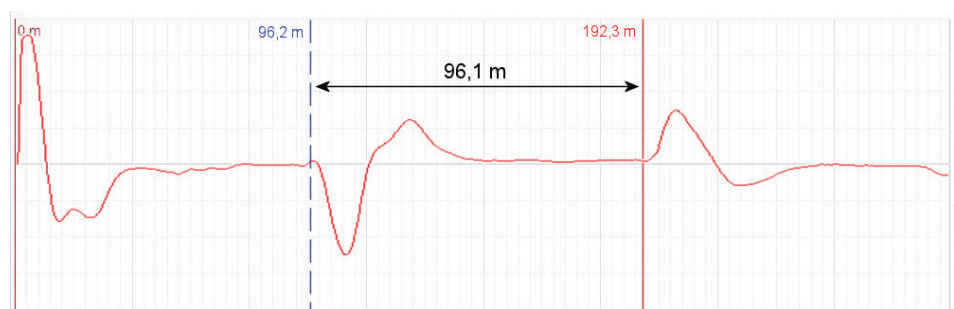
In the following reflectogram of a PD diagnosis system a PD fault can be easily identified:



With the defined  $V/2$  of  $74.5 \text{ m}/\mu\text{s}$  a distance from the PD diagnosis system to the fault location of about 98 m can be determined.

The reflectometer recorded thereupon with the *Teleflex SX* reflects the typical diagram course described on *page 11* very clearly.

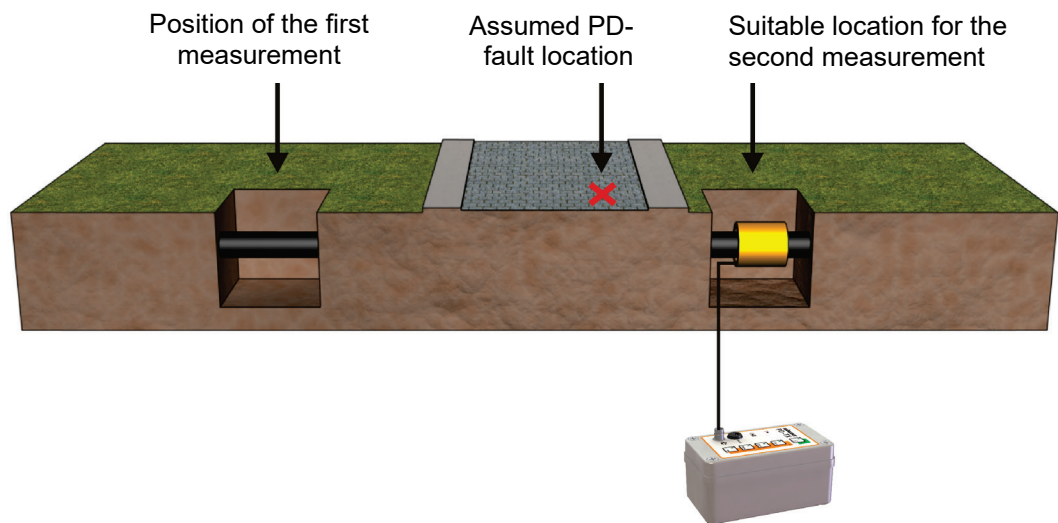
The distance of about 96 m between the second and the third impulse can be taken as the distance of the impulse generator which indicates that the impulse generator is placed about two meters in front of the actual fault position.



Conclusive determination of the fault position

Depending on the significance and interpretation of the results, it could be recommendable to perform another measurement with the impulse transmitter at an easily accessible position in order to pinpoint the fault position with even more accuracy.


As shown in the following picture, it might be advisable to change the position relative to the assumed fault position, for example by moving behind the fault position when the first measurement was obviously performed in front of it.



If the results provide an accuracy which justifies, e.g. , a cost-intensive excavation on asphalt, the excavation should be performed and the correct fault position should be verified using the impulse transmitter.

In many cases, a joint is located at this position which would prove the measured results with almost dead certainty.

## 7 Recharging the Accumulator

- Low battery power indicator** When the accumulator is almost completely discharged and needs to be recharged, the red battery status LED [ 7 ] flashes during operation.  
If the transmitter is kept in operation until the LED starts flashing, the device automatically switches off after a while in order to protect the accumulator from depth discharge.
- Charging** When charging the accumulator using either the enclosed charger or the optional car charger, the red battery status LED [ 7 ] is lit permanently.  
After the charging process is finished, the LED starts flashing.
- Operation during charging** Thanks to an adapted charging connection, the device can be operated even during the charging process.  
If the device is kept connected to the charger after the charging process is finished and is being operated at the same time, the charging process automatically starts over as soon as the battery power falls below a certain threshold.
-  When the device is connected to the car charger, it must not be switched on and operated.





Tento symbol indikuje, že výrobek nesoucí takovéto označení nelze likvidovat společně s běžným domovním odpadem. Jelikož se jedná o produkt obchodovaný mezi podnikatelskými subjekty (B2B), nelze jej likvidovat ani ve veřejných sběrných dvorech. Pokud se potřebujete tohoto výrobku zbavit, obraťte se na organizaci specializující se na likvidaci starých elektrických spotřebičů v blízkosti svého působení.



Dit symbool duidt aan dat het product met dit symbool niet verwijderd mag worden als gewoon huishoudelijk afval. Dit is een product voor industrieel gebruik, wat betekent dat het ook niet afgeleverd mag worden aan afvalcentra voor huishoudelijk afval. Als u dit product wilt verwijderen, gelieve dit op de juiste manier te doen en het naar een nabij gelegen organisatie te brengen gespecialiseerd in de verwijdering van oud elektrisch materiaal.



This symbol indicates that the product which is marked in this way should not be disposed of as normal household waste. As it is a B2B product, it may also not be disposed of at civic disposal centres. If you wish to dispose of this product, please do so properly by taking it to an organisation specialising in the disposal of old electrical equipment near you.



Този знак означава, че продуктът, обозначен по този начин, не трябва да се изхвърля като битов отпадък. Тъй като е B2B продукт, не бива да се изхвърля и в градски пунктове за отпадъци. Ако желаете да изхвърлите продукта, го занесете в пункт, специализиран в изхвърлянето на старо електрическо оборудване.



Dette symbol viser, at det produkt, der er markeret på denne måde, ikke må kasseres som almindeligt husholdningsaffald. Eftersom det er et B2B produkt, må det heller ikke bortskaffes på offentlige genbrugsstationer. Skal dette produkt kasseres, skal det gøres ordentligt ved at bringe det til en nærliggende organisation, der er specialiseret i at bortskaffe gammelt el-udstyr.



Sellise sümboliga tähistatud toodet ei tohi käidelda tavalise olmejäätmena. Kuna tegemist on B2B-klassi kuuluva tootega, siis ei tohi seda viia kohalikku jäätmekäitluspunkti. Kui soovite selle toote ära visata, siis viige see lähimasse vanade elektriseadmete käitlemisele spetsialiseerunud ettevõttesse.



Tällä merkinnällä ilmoitetaan, että kyseisellä merkinnällä varustettua tuotetta ei saa hävittää tavallisen kotitalousjätteen seassa. Koska kyseessä on yritysten välisen kaupan tuote, sitä ei saa myöskään viedä kuluttajien käyttöön tarkoitettuihin keräyspisteisiin. Jos haluatte hävittää tämän tuotteen, ottakaa yhteys lähimpään vanhojen sähkölaitteiden hävittämiseen erikoistuneeseen organisaatioon.



Ce symbole indique que le produit sur lequel il figure ne peut pas être éliminé comme un déchet ménager ordinaire. Comme il s'agit d'un produit B2B, il ne peut pas non plus être déposé dans une déchetterie municipale. Pour éliminer ce produit, amenez-le à l'organisation spécialisée dans l'élimination d'anciens équipements électriques la plus proche de chez vous.



Cuireann an siombail seo in iúl nár cheart an tairgeadh atá marcáilte sa tsíl seo a dhiúscairt sa chóras fuoil teaghlaigh. Os rud é gur tairgeadh ghnó le ghnó (B2B) é, ní féidir é a dhiúscairt ach oiread in ionaid dhiúscairthe phobail. Más mian leat an tairgeadh seo a dhiúscairt, déan é a thógáil ag eagraíocht gar duit a sainfheidhmiú in ndiúscairt sean-fhearas leictirigh.



Dieses Symbol zeigt an, dass das damit gekennzeichnete Produkt nicht als normaler Haushaltsabfall entsorgt werden soll. Da es sich um ein B2B-Gerät handelt, darf es auch nicht bei kommunalen Wertstoffhöfen abgegeben werden. Wenn Sie dieses Gerät entsorgen möchten, bringen Sie es bitte sachgemäß zu einem Entsorger für Elektroaltgeräte in Ihrer Nähe.



Αυτό το σύμβολο υποδεικνύει ότι το προϊόν που φέρει τη σήμανση αυτή δεν πρέπει να απορρίπτεται μαζί με τα οικιακά απορρίμματα. Καθώς πρόκειται για προϊόν B2B, δεν πρέπει να απορρίπτεται σε δημοτικά σημεία απόρριψης. Εάν θέλετε να απορρίψετε το προϊόν αυτό, παρακαλούμε όπως να το παραδώσετε σε μία υπηρεσία συλλογής ηλεκτρικού εξοπλισμού της περιοχής σας.



Ez a jelzés azt jelenti, hogy az ilyen jelzéssel ellátott terméket tilos a háztartási hulladékokkal együtt kidobni. Mivel ez vállalati felhasználású termék, tilos a lakosság számára fenntartott hulladékgyűjtőbe dobni. Ha a terméket ki szeretné dobni, akkor vigye azt el a lakóhelyéhez közel működő, elhasznált elektromos berendezések begyűjtésével foglalkozó hulladékkezelő központhoz.



Questo simbolo indica che il prodotto non deve essere smaltito come un normale rifiuto domestico. In quanto prodotto B2B, può anche non essere smaltito in centri di smaltimento cittadino. Se si desidera smaltire il prodotto, consegnarlo a un organismo specializzato in smaltimento di apparecchiature elettriche vecchie.



Št zíme noráda, ka izstrādājumu, uz kura tā atrodas, nedrīkst izmest kopā ar parastiem mājsaimniecības atkritumiem. Tā kā tas ir izstrādājums, ko cits citam pārdod un lieto tikai uzņēmumi, tad to nedrīkst arī izmest atkritumos tādās izgāztuvēs un atkritumu savāktuvēs, kas paredzētas vietējiem iedzīvotājiem. Ja būs vajadzīgs šo izstrādājumu izmest atkritumos, tad rīkojieties pēc noteikumiem un nogādājiet to tuvākajā vietā, kur īpaši nodarbojas ar vecu elektrisku ierīču savākšanu.



Šis simbols rodo, kad juo paženklinoto gaminio negalima išmesti kaip paprastų buitinių atliekų. Kadangi tai B2B (verslas verslui) produktas, jo negalima atiduoti ir buitinių atliekų tvarkymo įmonėms. Jei norite išmesti šį gaminį, atlikite tai tinkamai, atiduodami jį arti jūsų esančiai specializuotai senos elektrinės įrangos utilizavimo organizacijai.



Dan is-simbolu jindika li l-prodott li huwa mmarkat b'dan il-mod m'ghandux jintrema b'hal skart normali tad-djar. Minhabba li huwa prodott B2B , ma jistax jintrema wkoll f'centri civici ghar-rimi ta' l-iskart. Jekk tkun tixtieq tarmi dan il-prodott, jekk jogh'għbok għamel dan kif support billi tiegħu għand organizzazzjoni fil-qrib li tinspejalizza fir-rimi ta' tagħmir qadim ta' l-eletriku.



Dette symbolet indikerer at produktet som er merket på denne måten ikke skal kastes som vanlig husholdningsavfall. Siden dette er et bedriftsprodukt, kan det heller ikke kastes ved en vanlig miljøstasjon. Hvis du ønsker å kaste dette produktet, er den riktige måten å gi det til en organisasjon i nærheten som spesialiserer seg på kassering av gammelt elektrisk utstyr.



Ten symbol oznacza, że produktu nim opatrzonego nie należy usuwać z typowymi odpadami z gospodarstwa domowego. Jest to produkt typu B2B, nie należy go więc przekazywać na komunalne składowiska odpadów. Aby we właściwy sposób usunąć ten produkt, należy przekazać go do najbliższej placówki specjalizującej się w usuwaniu starych urządzeń elektrycznych.



Este símbolo indica que o produto com esta marcação não deve ser deixado fora juntamente com o lixo doméstico normal. Como se trata de um produto B2B, também não pode ser deixado fora em centros cívicos de recolha de lixo. Se quiser desfazer-se deste produto, faça-o correctamente entregando-o a uma organização especializada na eliminação de equipamento eléctrico antigo, próxima de si.



Acest simbol indică faptul că produsul marcat în acest fel nu trebuie aruncat ca și un gunoi menajer obișnuit. Deoarece acesta este un produs B2B, el nu trebuie aruncat nici la centrele de colectare urbane. Dacă vreți să aruncați acest produs, vă rugăm s-o faceți într-un mod adecvat, ducând-ul la cea mai apropiată firmă specializată în colectarea echipamentelor electrice uzate.



Tento symbol znamená, že takto označený výrobek sa nesmie likvidovať ako bežný komunálny odpad. Keďže sa jedná o výrobok triedy B2B, nesmie sa likvidovať ani na mestských skládkach odpadu. Ak chcete tento výrobok likvidovať, odnesť ho do najbližšej organizácie, ktorá sa špecializuje na likvidáciu starých elektrických zariadení.



Ta simbol pomeni, da izdelka, ki je z njim označen, ne smete zavreči kot običajne gospodinske odpadke. Ker je to izdelek, namenjen za druge proizvajalce, ga ni dovoljeno odlagati v centrih za civilno odlaganje odpadkov. Če želite izdelek zavreči, prosimo, da to storite v skladu s predpisi, tako da ga odpeljete v bližnjo organizacijo, ki je specializirana za odlaganje stare električne opreme.



Este símbolo indica que el producto así señalizado no debe desecharse como los residuos domésticos normales. Dado que es un producto de consumo profesional, tampoco debe llevarse a centros de recogida selectiva municipales. Si desea desechar este producto, hágalo debidamente acudiendo a una organización de su zona que esté especializada en el tratamiento de residuos de aparatos eléctricos usados.



Den här symbolen indikerar att produkten inte får blandas med normalt hushållsavfall då den är förbrukad. Eftersom produkten är en så kallad B2B-produkt är den inte avsedd för privata konsumenter, den får således inte avfallshanteras på allmänna miljö- eller återvinningsstationer då den är förbrukad. Om ni vill avfallshandera den här produkten på rätt sätt, ska ni lämna den till myndighet eller företag, specialiserad på avfallshandling av förbrukad elektrisk utrustning i ert närområde.