Cable & Wire Tracer
TraceMeter TM30

User manual v. X1.0

VESALA®

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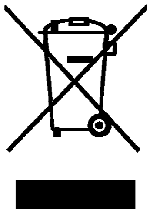


This symbol means that this product should not be discarded with household or general waste after its end-of-life. Instead it should be returned for recycling according to EU *Waste Electrical and Electronic Equipment directive* (WEEE) or according local regulations. For more information about the separate collection, please contact your local distributor or www.vesala.fi.

1. Overview

1.1. General information about cable tracing

A cable tracer does not locate the actual cable, rather the magnetic or electric field, which exists in the cable by nature or has been induced to it using the transmitter. As the shape of the magnetic field depends on other wires and pipes that may be located near the target object, it is important for the user to be familiar with the properties of the device as well as possible. We recommend that this manual be read thoroughly prior to using the **TM30** tracer.

1.2. Purpose of the device

With the versatile **TM30** cable tracer user can locate telecom and mains cables, antenna cables, wire pairs, floor heating cables and much more. Device can be operated indoors out outdoors and it is safe also with live mains targets.

TM30 is designed for:

- Tracing and locating cables
- Tracing single wires and wire pairs
- Spotting short circuits
- Tracing floor heating cable routes
- Identifying communication on wire pairs
- Performing a DSLAM test on digital subscriber lines
- DC and AC voltage metering
- Interference free communication identifying

2. TM30 equipment

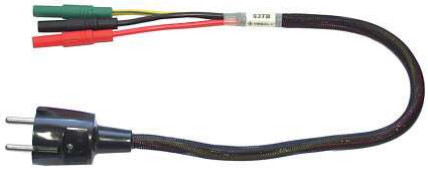
2.1. TM30 basic set-up and accessories

TM30 basic set-up

TMT30 transmitter for galvanic signal feeding & communication identification on wire pairs.

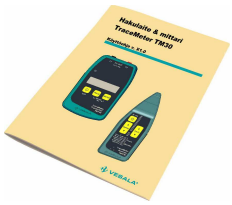
TB10m and **TB10p** CAT-III –feeding cord (black and red, 1.0m, 4mm safety banana plugs).

XKKp and **XKKm** safety crocodile clip (black and red).



S3TB feeding cord, 0.5m Schuko/ 3 pcs. safety banana plugs.

TMR30 Receiver for receiving the signal of the transmitter and monitoring of wires without galvanic contact.



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KLTM30 Carrying bag for the ready-to-use equipment, accessories and other installation tools (Polypropylene, approx. 400 x 360 x 90mm).

Accessories

10/TX Groundstake (ground pick)

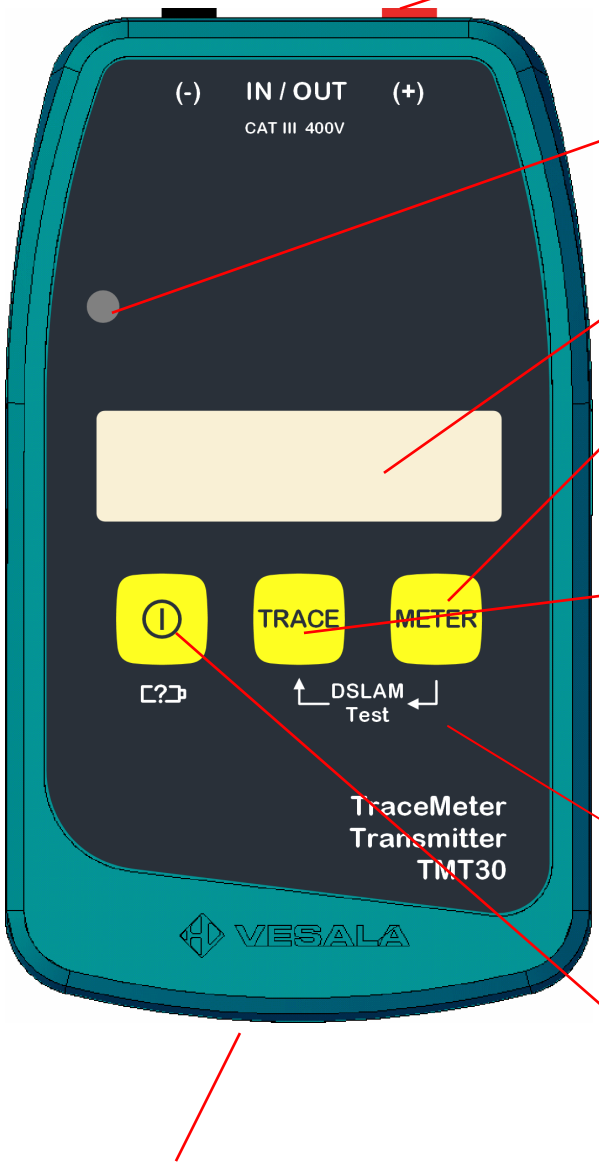
SJ20 Feeding cord (2.0m, 4mm standard banana plugs). To be used with adapters where safety banana plugs can't be used.

AP15B cord to connect transmitter to RJ45 sockets

PM50 (Ø34mm) Clamp-on transformer for signal feeding when direct galvanic connection to cable is not possible. **PM100** (Ø100mm, no image), larger diameter and higher output signal.

SPA10 Pipe transmitter antenna for following e.g. empty electrical piping in buildings and for locating blockages within (length 10m).

2.2. Transmitter TMT30



IN/OUT connectors:
2 pcs. 4mm safety banana jacks for signal feeding and metering functions.

Light sensor for LCD backlight automatic intensity adjustment.

LCD-display

METER mode for measuring frequency and DC and AC voltages of the target object.

METER	200kHz
+48.0V	~0.0V

TRACE mode for feeding tracing signal to the target object. Displays also output current and target DC and AC voltage.

TRACE	10mA
-48.0V	~1.0V

A long press activates or deactivates the **CONT. BEEP** continuity indicator.

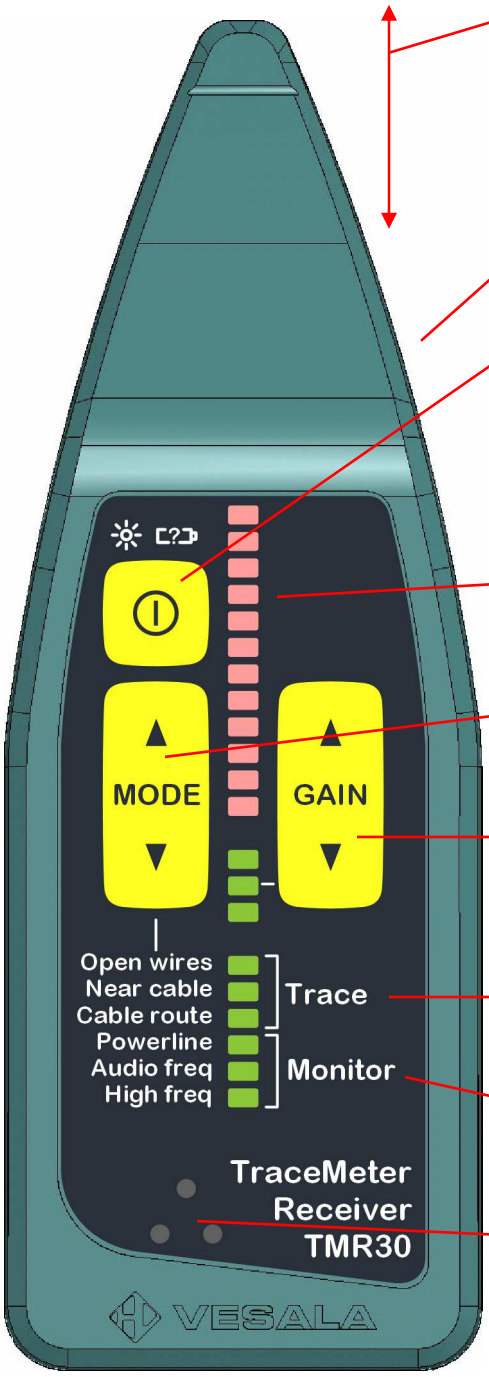
DSLAM Test:
Test starts by keeping METER button pressed and simultaneously pressing TRACE button briefly.

Power button:
To switch the device on and off. LCD will display battery voltage while start-up or if Power button is pressed briefly during use. A long press during start-up prevents automatic switch-off function.

Battery compartment is located at the back of the device. Lid has two screws. Device operates with six 1.5V LR6 (AA) batteries. Rechargeable NiCd or NiMH cells can be used too but they have to be charged in a separate charger. If batteries are low, a BATTERY LOW text blinks on LCD.

Figure 2.2. TMT30 user interface

2.3. Receiver TMR30



Nose section with antennas :
Nose has three integrated antennas: Capacitive antenna for Monitor modes and Open wires mode, close range antenna for Near cable mode and rod probe for Cable-route mode.

Work light:
The LED light under the nose turns on and off by briefly pressing Power button.

Power button:
To switch the device on and off. Level bar will display battery level while start-up or if Power button is pressed briefly during use. Device always starts to the same mode that was used the previous time. A long press during start-up prevents automatic switch-off function.

Level bar:
LED bar display for indicating receiving signal strength.

MODE buttons:
Use these up & down buttons to choose the right Trace or Monitor mode.

GAIN buttons:
Use these up & down buttons to choose suitable receiving sensitivity at which signal audio and **Level**-bar won't get overdriven.

Trace modes are for receiving signals generated by the transmitter. One of three LEDs displays which mode is active.

Monitor modes are to monitor signals other than those generated by the transmitter. One of three LEDs displays which mode is active.

Speaker for indicating received tracing signal sound and for internal sound signals & beeps.

Battery compartment is located at the back of the device. Lid has two screws. Device operates with four 1.5V LR3 (AAA) batteries. Rechargeable NiCd or NiMH cells can be used too but they have to be charged in a separate charger. If batteries are low, active **MODE** LED will blink.

Figure 2.3. TMR30 user interface

3. Batteries and warnings for use

3.1 Batteries

TMT30 transmitter uses 6 pcs. 1.5V LR20 (size AA, Mignon) alkaline batteries and **TMR30** receiver 4 pcs. 1.5V LR03 (size AAA) alkaline batteries. Both have a battery compartment at the back of the device, under a lid with two screws.

If a there is Battery Low message on **TMT30 LCD** or the active mode LED of **TMR30** blinks, batteries are weak and should be replaced to ensure the optimal functioning of the equipment. If batteries are very low, devices turn automatically off to avoid battery leaking.

Rechargeable NiCd or NiMH cells can be used too but they have to be charged in a separate charger.

3.2 WARNINGS CONCERNING THE TRANSMITTER

- **When operating with mains targets, always use contact proof and right safety class cords and adapters, and follow safety instructions.**
- **Transmitter may be connected to max. 400V rms voltage!**
- **If either transmitter output terminal is connected to a live target, dangerous voltage or current may appear on wires connected to the other output, unless they are properly grounded.**
- **Avoiding interference with telecommunication or electric network is always the responsibility of the user.**

Danger of electric shock: Always disconnect feeding cords before opening the battery lid or enclosure.

3.3 WARNINGS CONCERNING THE RECEIVER

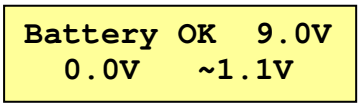
- **Though the receiver nose section is electrically safe to the user up to 600V, we do not recommend using the receiver so that the nose touches live targets.**
- **Never expose other parts of the enclosure to direct contact to mains wires or other live objects.**
- **Always follow safety instructions when working with live mains objects.**

Caution! Do not use TMR30 to verify if an object is live or not!

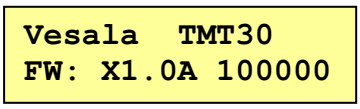
4. Using the transmitter

4.1 General

TMT30 will always start to the same mode (METER tai TRACE) that was used the previous time. **LCD** will display battery voltage while start-up and during operation user can check battery level by pressing **Power** button briefly.



Device displays firmware (software) version as long as **Power** button is held down during start-up.



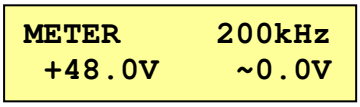
IN/OUT connectors are connected to the target object with the **TB10m** and **TB10p** feeding cords and a suitable adapter or safety crocodile clips or with the **S3TB** feeding cord to Schuko socket. Always ensure electrical safety when connecting the device.

Device will automatically switch-off after three hours, unless buttons are pressed in the mean time. To prevent the automatic switch-off, press the **Power** button for 2 seconds during start-up until a *ti-ti* sound is heard.

4.2 METER mode

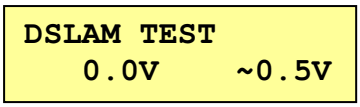
In **METER** mode transmitter does not send anything, nor does it disturb e.g. possible data transmission in the target object. Transmitter only measures the target voltages and frequencies, much like a multimeter.

LCD upper right corner displays detected frequency. The lower row of LCD displays both DC and AC voltages. Device sustains max. 400V mains voltage.



4.3 DSLAM test

With **DSLAM TEST** user can check whether there is an exchange side DSL modem (DSLAM) present on the line. During test **TMT30** sends a handshake request to the line and waits for an answer from an ADSL or VDSL DSLAM.

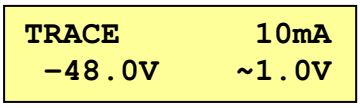


DSLAM TEST starts by keeping the **METER** button pressed and simultaneously pressing **TRACE** button briefly. Test will take max. 15 seconds during which LCD displays **DSLAM TEST**. Then either **DSLAM FOUND** or **DSLAM NOT FOUND** message is displayed and after that device will automatically resume **METER** mode.

4.4 TRACE mode

In **TRACE** mode device constantly transmits a 125kHz signal to the target connected to the **IN/OUT** connectors.

LCD upper right corner displays output current, which depends on target impedance. Second row displays both DC and AC voltages.



If output current exceeds 1mA, device makes a beep sound. If the **CONT. BEEP** continuity indicator is set active, beep is continuous. **CONT. BEEP** setting can be activated (**On**) or deactivated (**Off**) with a long press of **TRACE** button.

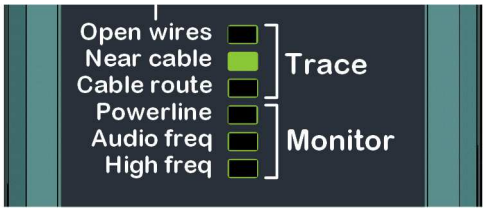
5. Using the receiver

5.1 General

TMR30 starts when **Power** button is pressed until a beep sound is heard. **Level** bar will display battery level while start-up; the higher LED bar, the higher is battery voltage.

If **Power** button is pressed briefly during use, the **work light** under the nose turns on and **Level** bar displays battery level just like during start-up. **Work light** turns off by pressing **Power** button again or by shutting down the device.

TMR30 Receiver has six operating modes, which have been divided into two categories: **Trace** modes are to be used for receiving signals generated by the **TMT30** transmitter. **Monitor** modes are used for monitoring signals other than generated by the transmitter.



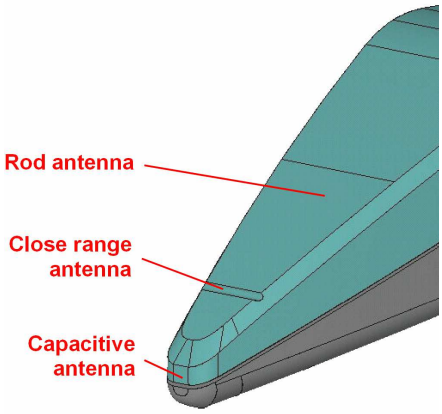
Device always starts to the same mode that was used the previous time and one of **MODE LED**s will display which mode is active. MODE up & down buttons are used to change mode.

Device will automatically switch-off after 20 minutes, unless buttons are pressed in the mean time. To prevent the automatic switch-off, press the **Power** button for 2 seconds during start-up until a *ti-ti* sound is heard.

5.2 Antennas and choosing right mode

There are three integrated antennas inside the **TMR30** nose section and device automatically chooses one of them according to the user-selected mode:

- Capacitive antenna is right at the tip of the nose where it has best possible accuracy.
- Inductive close range probe is located under the small grooves seen on the top and bottom of the nose. The grooves point the most sensitive spot of the antenna.
- Inductive rod probe is located in the middle of the nose and its most sensitive direction is the same as the nose direction.



Trace modes – Choose one of these three modes according to the target object:

- **Open wires** (capacitive antenna): For wire pairs and other uncovered conductive objects when distance is <20cm.
- **Near cable** (close range probe): For wires and cables when distance is <40cm.
- **Cable route** (rod probe): For tracing conductive objects inside walls or tracing underground cables.

Monitor modes – Choose one of these three modes according to the target object:

- **Powerline**: For tracing and locating live mains wires and cables inside walls etc.
- **Audio freq**: For listening audio frequencies e.g. on wires or close to electrical appliances.
- **High freq**: For monitoring high frequencies such as DSL, PCM etc.

  All Monitor modes use the capacitive antenna.

5.3 Adjusting receiving gain

Receiving gain (sensitivity) can be adjusted with the 3-step **GAIN** adjustment and **GAIN LED**s display which gain setting is on. It is recommendable to use gain, which makes the **Level bar** height to be approx. in the middle; that way changes in signal strength are easiest to notice.

Level bar displays target location either as maximum signal (e.g. wire pairs) or minimum (e.g. cable tracing). Audio signal strength from the **speaker** is dependant of the **GAIN** setting too.

6. Introduction to operating modes

Tracing a cable or wire or another object is always based on detecting the electric field (capacitive tracing) or the magnetic field (inductive tracing) of a conductive object. These basics are common to all tracing so understanding them is vital.

6.1. Open wires mode and capacitive antenna

As the name suggests, **Open wires** mode is intended for close range tracing of open (disconnected) wires and pairs and other conductive objects. Wires that are under a shield or deep inside other structures can't be traced with this mode. **Open wires** mode works relatively close to the target, usually less than 20cm, and it is best with wire & pair identification and tracing.

Depending on the situation, transmitter is connected either to the traced wire pair or between one wire and grounding. When the receiver nose tip (i.e. the capacitive antenna) is close to the target, **Level** bar rises accordingly and loud signal can be heard. The direction of the nose has almost no significance, as the shape of the capacitive antenna sensitivity area is spherical (ball shaped), as shown in below figure. Figure shows also the typical shape of the capacitive field generated by a single wire.

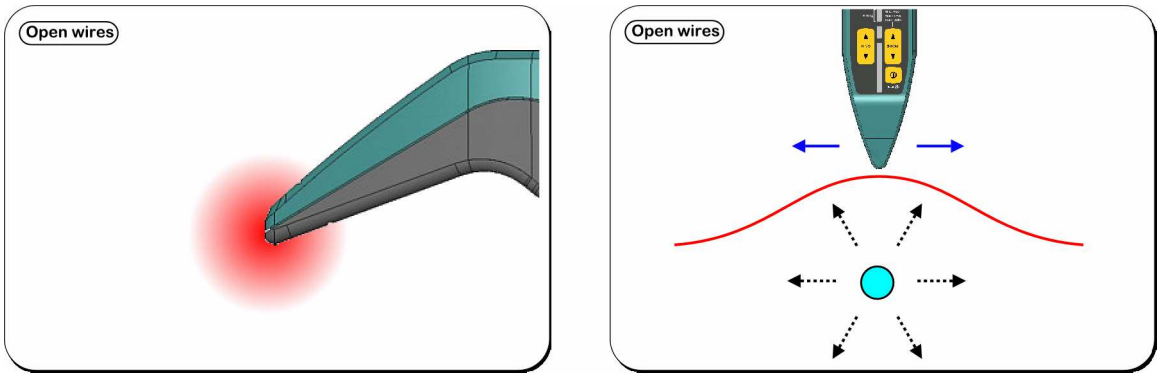


Figure 6.1. Capacitive antenna sensitivity area shape in Open wires mode (left) and typical shape of a capacitive field (right).

6.2 Near cable mode and close range probe

Near cable is a very versatile mode. It can be used to trace wires and cables up to 40cm distance and even inside structures or big bunch of wires or cables. **Near cable** mode works nicely when open (unconnected) cross connection wires need to be traced or when telecom pairs, electric wiring or antenna cables need to be located and traced.

Near cable mode is based on inductive tracing in which a magnetic field created by a current running in a wire is detected with the **TMR30** close range antenna. The stronger the current, the higher **Level** bar display and louder the signal can be heard with the receiver. Usually there is however a precise minimum point when the close range probe is right above the right wire or cable.

The location of the close range probe and also the most sensitive receiving area is marked with the small grooves on the top and bottom of the nose. This also means that in **Near cable** mode the sensitivity is best at the top or bottom of the nose, not at the tip of the nose, as seen in the figure to the right.

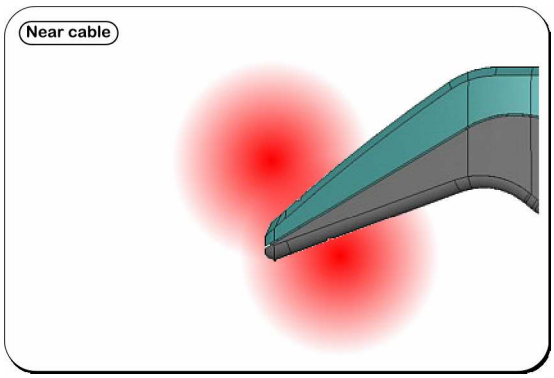


Figure 6.2.a. The sensitive area of the close range probe in Near cable mode.

Due to the specific directional field shape of **Near cable** mode, receiver nose has to be taken close to the target wire or cable so that either the top or bottom side groove marked sensitive spot is closest to the target, as seen in the below figures. Figures show also the minimum point when the close range probe is right above the right wire or cable.

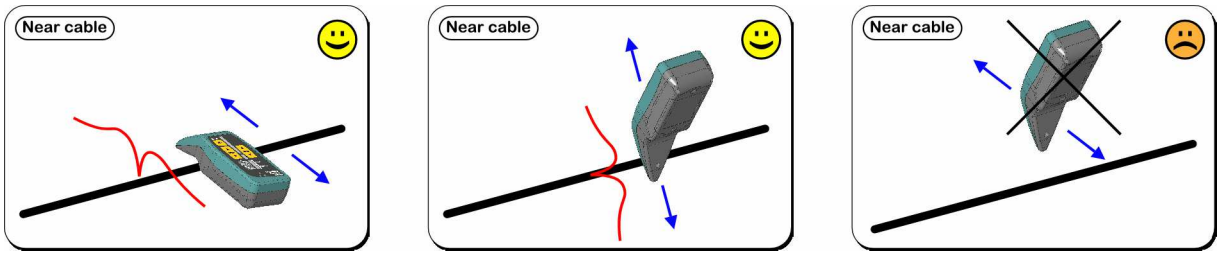


Figure 6.2.b. Two right ways and one wrong way how to use receiver in Near cable mode and corresponding field shapes with the minimum spot.

6.3 Cable route mode and rod probe

Cable route mode is intended for tracing cables and tubes even underground.

Also **Cable route** mode is based on inductive tracing in which a magnetic field created by a current running in a wire is detected with the **TMR30** rod antenna. Stronger current gives higher signal and longer detection distance. There is however a precise minimum point right above the right wire or cable.

Rod antenna is very unilateral, i.e. it has very sharp and narrow sensitive area pointing to the direction of the nose, as shown in the figure to the right.

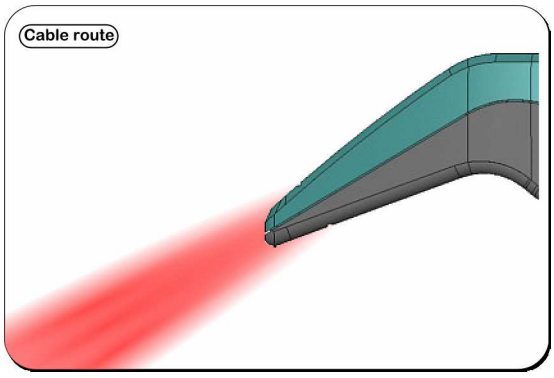


Figure 6.2.a. The sensitive area of rod probe in Cable route mode.

When using **Cable route** mode it is recommendable to keep the receiver all the time in upright position towards the target, as in the two figures below. Pendulous moving (rightmost figure) may detect minimum spots caused by return currents or other cables and hence mislead the user to wrong conclusion.

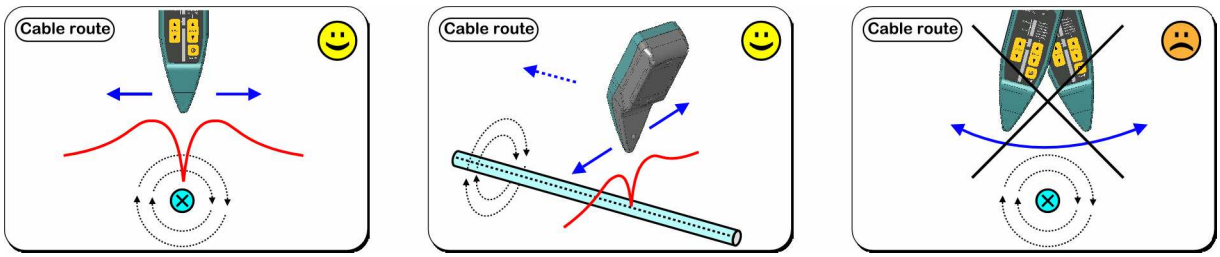


Figure 4.2.b. Right and wrong ways to use receiver in Cable route mode and corresponding field shapes and the minimum spot of a straight wire.

6.4 Monitor modes

TMR30 offers three monitoring modes to identify communication signals on wires and signals generated by e.g. electric appliances. These modes use the capacitive antenna, so the most sensitive area is at the tip of the **TRM30** nose. The direction of the nose has little significance, as the capacitive antenna sensitivity area is spherical (ball shaped) with no minimum spots etc, as shown earlier in figure 6.1.

Powerline mode is intended for tracking 50-60Hz mains wires e.g. inside walls and also to identify phase connector of a wall socket like with a mainstester.

Audio freq mode monitors audio frequencies up to 10kHz on wires or e.g. on electric appliances. As audio signal fields are by nature very weak, **TMR30** nose must be as close to the target as possible.

High freq mode is for tracing frequencies over 10kHz on wires or terminals. E.g. DSL signals can be detected with this mode.

7. Practical usage examples

In this paragraph there are two symbols used to describe grounding & earth connection:

This symbol means grounding through constructions, such as grounded pipes, metal chassis, mains wall socket protective earth connector etc.

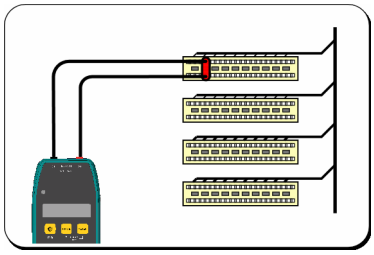
This symbol means direct earthing to soil with a ground pick or other similar means so that no other constructions are involved.

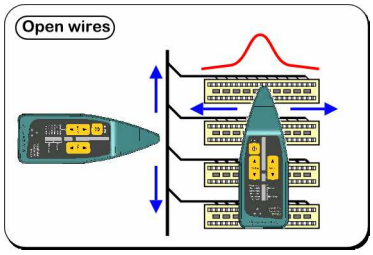
7.1 Tracing wire pairs

7.1.1 Cross connection pairs

Task: Unused or active pair needs to be traced at cross connection terminals.

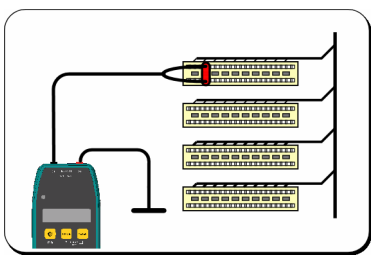
- Connect transmitter to the traced pair. Transmitter shows possible voltage and frequency on pair.
- Choose **Open wires** mode with receiver and move receiver nose close to the wire bunch along the cross connection rack.
- When the right terminal block is found, strongest signal can be heard above the right pair when distance is <5cm.
- If possible verify the result by short-circuiting the pair: signal should disappear.

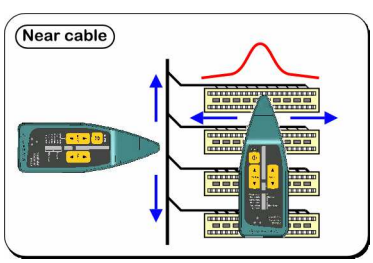




Task: Unused (open) pair needs to be traced at cross connection racks without knowing its route or ending area.

- Short-circuit the traced pair wires at the starting point. Connect transmitter between the shorted pair and grounded cross connection rack.
- Choose **Near cable** mode with receiver. Scan the wire bunches on the rack shelves with the receiver nose. Right bunch gives strongest signal.
- Follow the right bunch to the correct terminal block or to the open wire ends. Receiver gain often needs to be adjusted lower when the right pair gets closer.

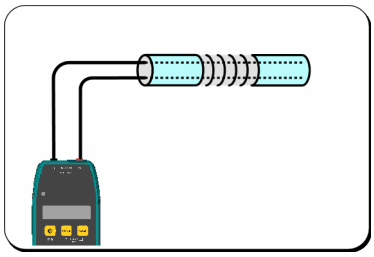


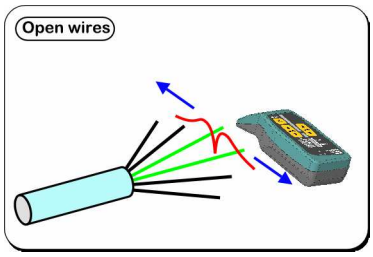


7.1.2 Tracing wires pairs at cable ends or joints

Task: A pair needs to be recognized at the end of an open cable or joint.

- Connect transmitter to the traced pair.
- Choose **Open wires** mode with receiver and move receiver nose close to the exposed wires.
- Right pair gives the strongest signal. If the wires ends of the right pair are apart enough from each other, a signal minimum can be detected between the wires.



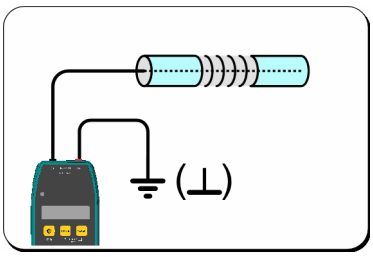


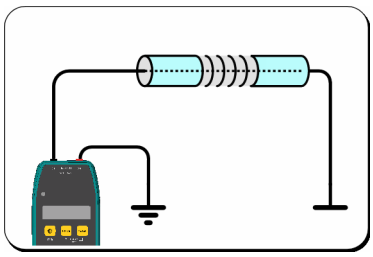
7.2 Tracing underground cables and routes

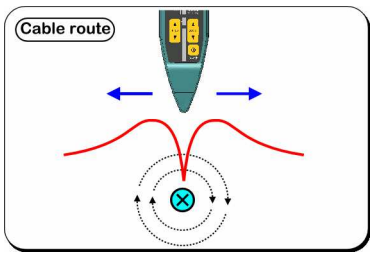
7.2.1 Neutral electric cables and telecom cables

Task: The route of a neutral electric cable or telecom cable must be traced above ground.

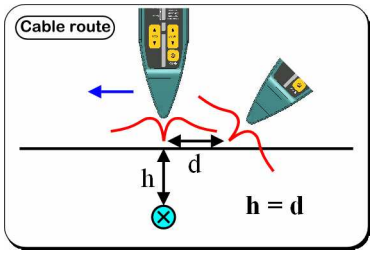
- Connect one transmitter output terminal to one or more wires of the cable. Often better tracing result is achieved if the same wires are grounded at the other end.
- Connect transmitter second output terminal to a good grounding. If possible, use ground pick and press it deep into damp soil for best earth connection.
- Choose **Cable route** mode with receiver.
- Trace the cable route by following the signal minimum in the receiver nose direction.







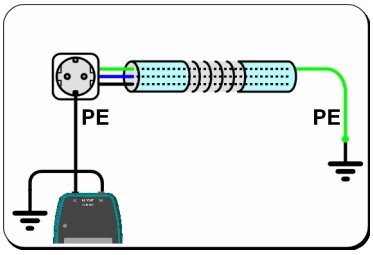
- To determine cable depth (h), turn the receiver to 45° angle right above ground and trace until a second minimum is found perpendicular to the cable route. Cable depth is same as the distance (d) between the two minimums, as shown in the figure.

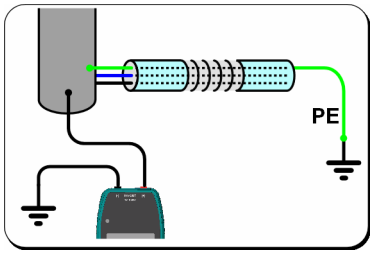


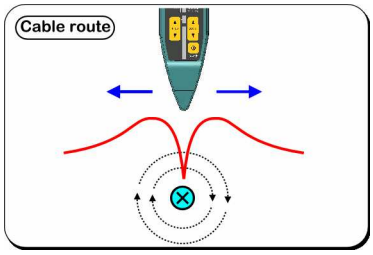
7.2.2 Live mains cables

Task: The route of a live electric cable must be traced above ground.

- Connect one transmitter output terminal to the protective earth wire of the cable or e.g. to a wall socket PE contact. If the task is to trace the feeder cable of a metallic light pole, transmitter can be connected to the earthed pole itself.
- Connect transmitter second output terminal to a good grounding as far as possible from the transmitter using a ground pick and press it deep into damp soil for best earth connection.
- Choose **Cable route** mode with receiver.
- Trace the feeding cable route by following the signal minimum in the receiver nose direction.



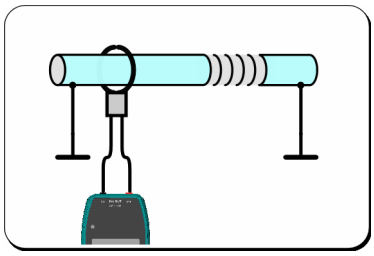


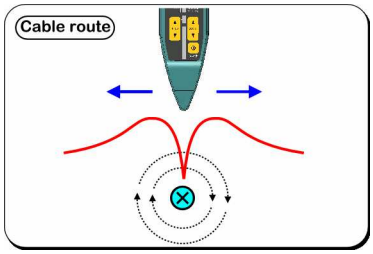


7.2.3 Cables that can’t be reached for galvanic feeding

Task: The route of a live or neutral cable must be traced above ground but cable ends can’t be reached.

- Connect transmitter to a clamp-on transformer such as **PM50** or **PM100**. Place the clamp around the cable in a place where the cable is visible.
- Choose **Cable route** mode with receiver.
- Trace the cable route by following the signal minimum in the receiver nose direction. This method requires that cable is grounded at both ends.



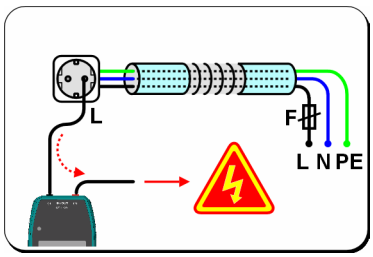


7.3 Tracing cables and wires indoors

7.3.1 Live and neutral electric cables

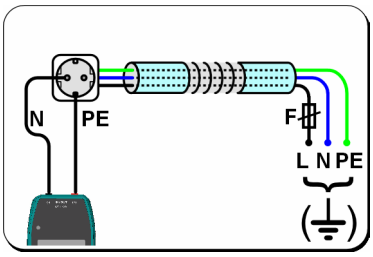
To connect transmitter to live targets, always use proper contact proof safety class cords and adapters and follow safety instructions.

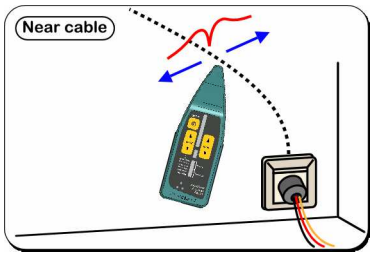
WARNING! If either transmitter output terminal is connected to a live target as shown in the figure, dangerous voltage appears on wires connected to the other output as well, unless they are properly grounded.

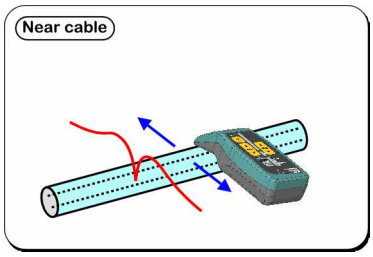


Task: The route of a live or neutral cable must be traced from a short distance, e.g. inside walls or on cable shelves.

- Connect transmitter to the Schuko wall socket neutral (N) and protective earth (PE) contacts (not to phase contact) with **S3TB** cord's corresponding wires.
- Same method applies to situations where cable is disconnected or a fuse has been blown.
- Choose **Near cable** mode with receiver. Trace the cable route by following the signal maximum. Right above the cable there is often a signal minimum.

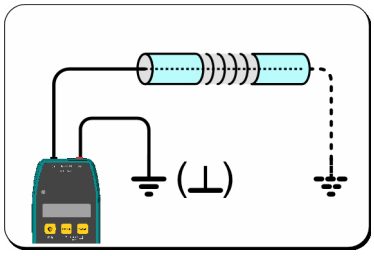


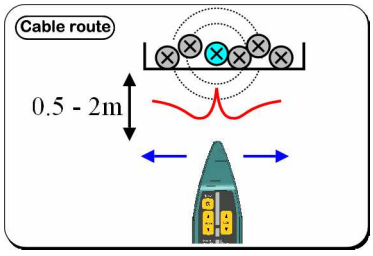




Task: The route of a live or neutral cable must be traced from a longer distance, e.g. near roof or on cable shelves which can't be reached.

- Connect one transmitter output terminal to a neutral wire of the cable and the second output terminal to a good grounding, preferably using a ground pick for best earth connection.
- Choose **Cable route** mode with receiver.
- Trace the cable route by following the signal minimum in the receiver nose direction. This method usually enables tracing up to two metres distance. Closer to the cable it's possible to use **Near cable** mode with receiver as well.
- If cable's wires are disconnected at the other end, signal gets weaker along the path with **Cable route** mode. In that case it is recommendable to change to **Near cable** mode and close range tracing. Closer to the end, signal minimum gradually disappears and there is only a signal maximum above the right cable.

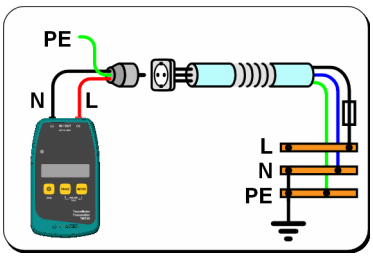


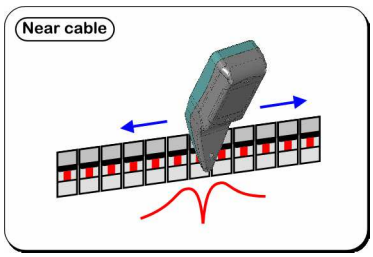


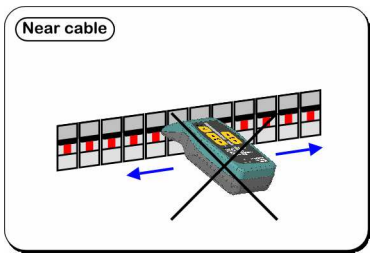
7.3.2 Wall sockets and circuit breakers & fuses

Task: Electronic circuit breaker for a certain live wall socket needs to be located at the electrical panel or cabinet.

- Connect transmitter to the Schuko wall socket between phase (P) and either neutral (N) or protective earth (PE) contacts with the **S3TB** cord respective wires.
- Choose **Near cable** mode with receiver. If necessary, the route of the cable can be traced as shown in paragraph 7.3.1.
- At the electrical panel it is highly recommended to use the receiver so that the nose top side groove marked sensitive spot is closest to the fuses, not the nose tip, as seen in the figures below.
- First, track <u>all</u> circuit breakers which give a strong signal. It is normal that several circuit breakers give a signal, as they are parallel connected via their phase rail.
- The right circuit breaker usually has a very strong signal and there is a sharp minimum in the middle, which distinguishes it from other circuit breakers.
- If the right circuit breaker is turned off, signal level decreases significantly. In this case the signal can however be detected with **Open wires** mode as well (see the next example).





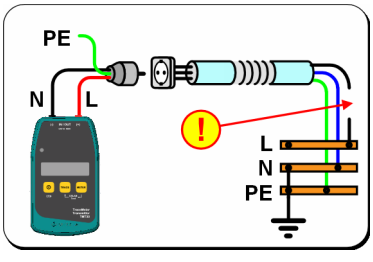


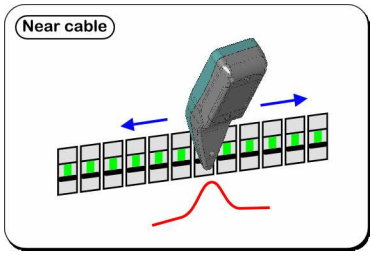
- Signal behaviour and receiver usage are somewhat different with ceramic fuses with respect to electronic circuit breakers. Therefore it is recommendable to practise receiver use beforehand with known fuses/breakers.

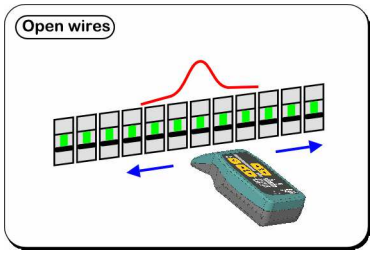
NOTE! Parallel wall sockets with loads such as heaters or lights will cause transmitter current spread to other directions than towards the circuit breaker, which may affect locating the right circuit breaker.

Task: A turned-off electronic circuit breaker or removed fuse base for a neutral wall socket needs to be located at the electrical panel or cabinet.

- Connect transmitter to the Schuko wall socket between phase (P) and neutral (N) contacts with the **S3TB** cord respective wires.
- With receiver choose either **Near cable** mode (remember to direct the nose top side groove towards the circuit breakers) or **Open wires** mode (point the tip of the nose towards the circuit breakers).
- Above the right circuit breaker there is a strong signal but no minimum. Other circuit breakers usually have no signal.



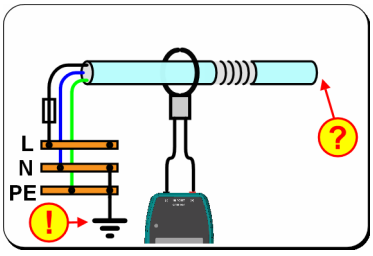


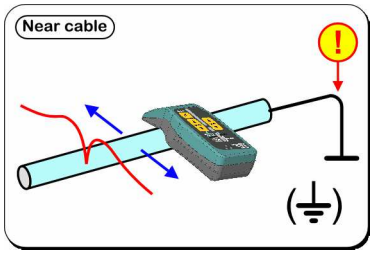


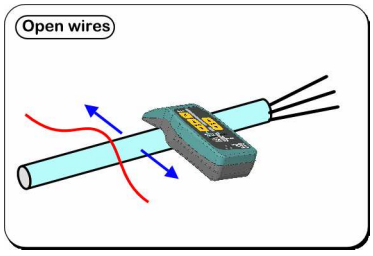
7.3.3 Electric cables which can't be galvanically connected

Task: The route and end of a cable from a cabinet needs to be located without disconnecting the cable or opening the cabinet.

- Connect transmitter with a clamp-on transformer (**PM50** or **PM100)** to the cable at a place where the cable is visible. Note that using a clamp-on transformer always requires that the near end of the cable is grounded.
- If cable is reachable, choose **Near cable** mode with receiver. If the other end of the cable is grounded, trace the right cable by finding strongest signal, which has a sharp minimum right above it. Even **Cable route** mode may work, enabling tracing up to two metres distance.
- If cable's wires are disconnected at the other end, usually no minimum can be detected but tracing is possible by following the strongest signal with **Near cable** mode or **Open wires** mode.





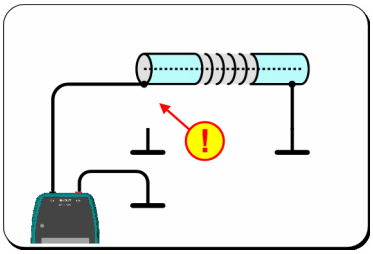
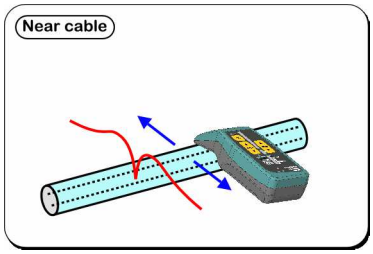


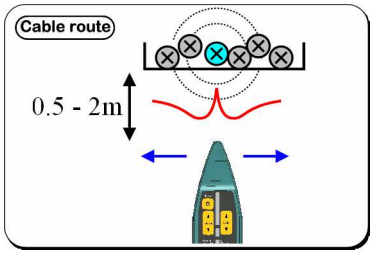
7.4 Tracing special cables

7.4.1 Coaxial cables and other shielded cables

Task: Route of a coaxial cable needs to be traced on cable shelves.

- Connect one transmitter output terminal to the coaxial cable shield. Make sure that the shield is not grounded at this end (other end may be grounded or not)
- Connect transmitter second output terminal to a grounding, e.g. to a nearby wall socket protective earth (PE) contact.
- If cable is reachable, choose **Near cable** mode with receiver. If the other of the cable is grounded, trace the right cable by finding strongest signal, which has a sharp minimum. If cable's wires are disconnected at the other end, usually no minimum can be detected but tracing is possible by following the strongest signal with **Near cable** mode or **Open wires** mode.
- If the other end of the cable is grounded, even **Cable route** mode may work, enabling tracing up to two metres distance by following the signal minimum in the receiver nose direction.

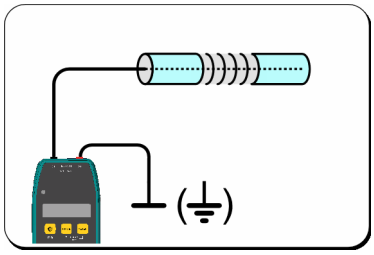



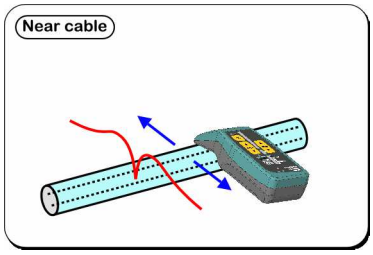


7.4.2 Generic cabling systems (data cables and RJ45 sockets)

Task: Route of one generic cabling system cable needs to be traced.

- Connect one transmitter output terminal to one wire or pair of the traced cable RJ45-socket.
- Connect transmitter second output terminal to grounding such as the protective earth (PE) contact of a wall socket. Note that the wall socket feeding cable must not run the same route as the traced cable.
- Choose **Near cable** mode with receiver. Trace the right cable on shelves or cable ducts by finding strongest signal, which has a sharp minimum when receiver nose top or bottom side groove is right above the cable.
- You may also try **Cable route** mode and trace the cable route by following the signal minimum in the receiver nose direction.





Task: Terminating socket of a generic cabling system cable needs to be tracked at distribution cabinet.

- Connect transmitter to one pair of the RJ45-socket of the corresponding cable.
- Choose **Open wires** mode with receiver. At the distribution cabinet insert receiver nose into each potential RJ45-socket as deep as it fits; right socket gives the strongest signal.
- Generic cabling system minimizes electromagnetic leakages by nature and signal can be heard only from a very close distance. Therefore try to get the receiver nose as deep into the RJ45 socket as possible.

7.5 Floor heating cables and their faults

7.5.1 Typical reasons to floor heating faults

Mistakes during assembly

- Cable has been damaged during assembly after which it has worked for some time but heating current has gradually burned the conductors, resulting in an open or short-circuit fault. There may be several faults in the same cable.
- Cable runs through a so-called air pocket in the concrete mass, causing cable over heating and eventually an open or short-circuit.

Damages caused by later reasons

- Cable has been exposed to pressure due some renovation work at the area, resulting in a latent but developing damage.
- Holes have been drilled to the floor causing immediate or developing damage.
- The floor structure has changed, e.g. fallen down, causing cracks and damage to cable.

7.5.2 Preliminary inspection of the target area

As a first step it is always recommendable to perform a systematic inspection at the cable assembly area, assembly method as well as fault type.

When and how the fault appeared

- Did it blow a fuse (short circuit)
- Did the cable just stop heating (cut cable)
- Did a residual current device trip (ground leak)
- Have there been renovation or other changes going on at the target area, such as added furniture or drilled holes before the fault. As faults may appear quite a long time afterwards, knowledge of previous renovation history may help too.

Measure cable resistances and capacitances

- Make sure that cable wires are not live and disconnect all from the feeding cable.
- Measure resistances and capacitances between all heating cable wires and shield and compare them to normal values of an intact cable:
    - Phase / neutral
    - Phase / protective earth
    - Neutral / protective earth
- As it possible that heating cable is shorted to concrete reinforcement, it is worth measuring all wires against the building's earthing too.
- Resistance values usually reveal the fault type and which wires are affected. Capacitances may help defining the fault distances from the measuring point.

Define the heating cable route

- Follow the route of the heating cable from start to end as explained in paragraph 7.5.3 and carefully mark the route on floor. Often the exact route may reveal faults due to bad assembly or later renovations, such as:
    - Cable has been placed under fixed furniture like closets
    - Sauna stove or bench screws have been inserted too close to the cable
    - Toilet seat screws hit the cable route
- If the fault can't be determined by following the route only, it is necessary to try to find spots along the route where the tracing signal level suspiciously changes (see paragraph 7.5.3):
    - In case of a short circuit, signal usually can be followed till the fault spot where it get stronger and then quickly weakens or disappears.
    - In case of an open circuit, signal usually starts to weaken starting from the fault spot, but change is less distinct.

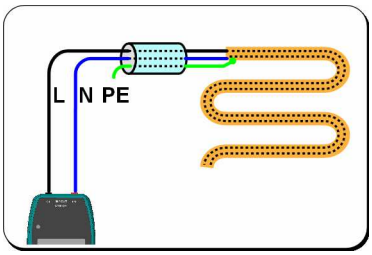
7.5.3 Tracing floor heating cables and their faults

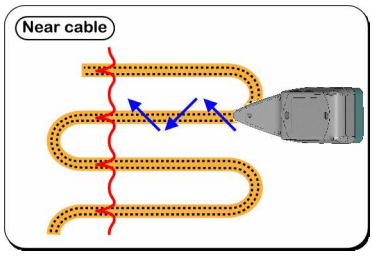
Task: Floor heating cable route needs to be traced e.g. for defining a fault location or for drilling holes to safe spots.

- Make sure that cable wires are not live and disconnect all from the feeding cable.
- There are two possible methods to trace the cable route and it depends on the target which one works best.
- It is advisable to mark the route to the floor with chalk or tape.

Near cable method

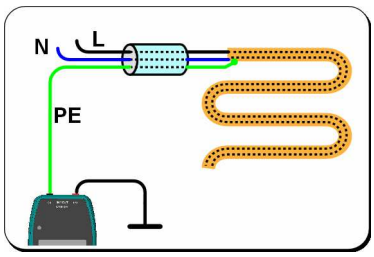
- Connect transmitter between the cable's phase (L) and neutral (N) wires.
- Choose **Near cable** mode with receiver. Use the receiver in upright position or upside down as in the figure, so that either nose groove spot is close to the floor.
- Trace the cable route by following the signal minimum.
- It is usual that changes in cable depth and cable's back and forth looping affect how clearly the minimum can be detected.

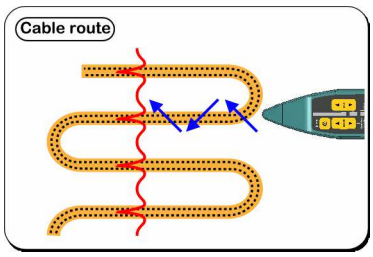




Cable route method

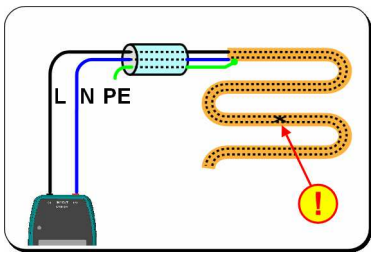
- Connect one transmitter output terminal to the cable shield and second output to a good grounding, e.g. to the feeding cable's protective earth PE wire.
- Choose **Cable route** mode with receiver. Trace the cable route by following the signal minimum in the receiver nose direction.
- **Cable route** method works better especially with cables that have an open fault (cut wire).

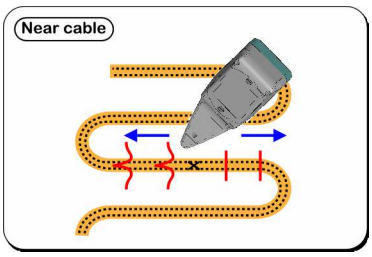




Task: A short circuit in a floor heating cable needs to be traced.

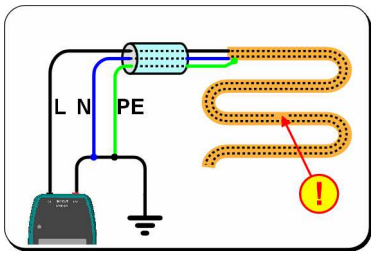
- Connect transmitter between the **shorted** wires of the cable (in the below figure phase and neutral are shorted). Leave the third wire unconnected.
- Choose **Near cable** mode with receiver. Again, use the receiver upside down, so that its nose topside groove marked spot is close to the floor.
- Monitor signal strength along the cable route. At fault spot signal gets stronger and then quickly weakens or disappears.

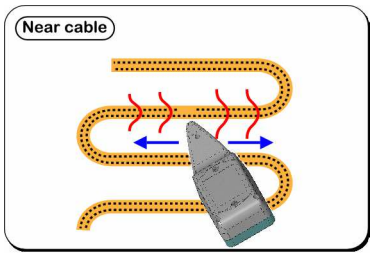




Task: An open in a floor heating cable needs to be traced.

- Several factors affect tracing an open in a heating cable, such as what cable type is at hand, is the cable fully cut or just one wire and what kind of grounding there is to concrete reinforcement. All these require carefulness while tracing and yet it is possible that exact fault location can't be determined.
- When the cable route has been traced, connect one transmitter output terminal to the cut wire. Connect the second output to the remaining two wires parallel (in the figure shielding i.e. protective earth and the neutral wire) and connect both of them also to a good grounding, preferably using a ground pick to ensure best earth connection and minimum return current interference.
- Check transmitter output current level: the higher current, the further is the cut fault from the transmitter.
- Choose **Near cable** mode with receiver. Again, use the receiver upside down, so that its nose topside groove marked spot is close to the floor.
- Monitor signal strength along the cable route. In this case signal is typically weak and no minimum can be detected. At fault spot signal gets even weaker.



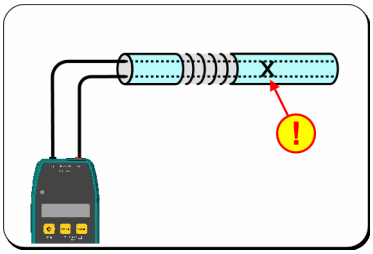


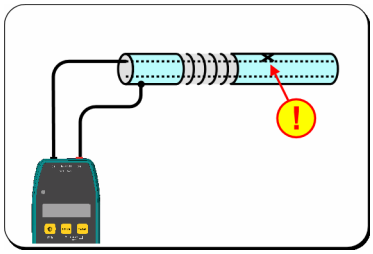
7.6 Tracing cable faults

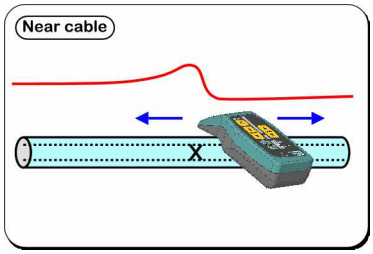
7.6.1 Location of a short circuit fault

Task: Cable has a short circuit fault which location needs to be traced.

- Connect transmitter between the **shorted** wires of the cable.
- Choose **Near cable** mode with receiver. Monitor signal strength around the cable surface. At fault spot signal gets stronger and then quickly disappears.
- Low-ohmic short-circuit faults are easier to find. Shorts, which are caused by water in a cable, are harder to find and result depends on how wet the cable is.
- Ground leaks and shorts or shorts from wires to cable jacket are traced similarly.



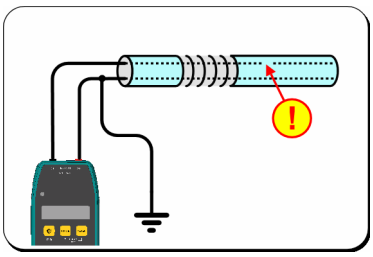


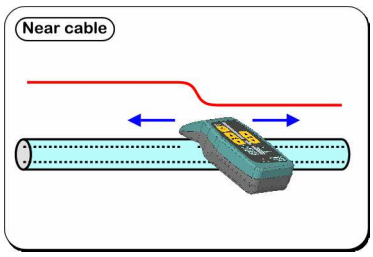


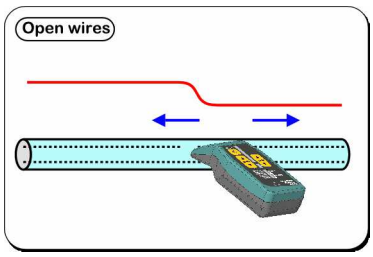
7.6.2 Location of a open wire (cut fault)

Task: Cable has a open (cut fault) which location needs to be traced

- Connect one transmitter output terminal to the open wire. Connect second output parallel to the remaining wires (e.g. with mains cable) and possible shielding and all of them finally to a good grounding, preferably using a ground pick to ensure best earth connection.
- With shielded cables choose **Near cable** mode with receiver. With unshielded cables **Open wires** mode may also work.
- Monitor signal strength around the cable surface. At fault spot signal quickly weakens or disappears. With **Near cable** mode no minimum can be detected.





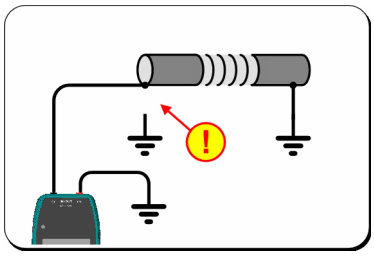


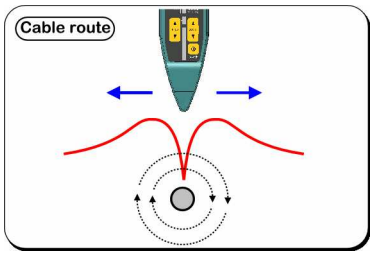
7.7 Tracing tubes and ducts

7.7.1 Conductive tubes and ducts inside walls or under ground.

Task: The route of a metallic tube needs to be traced under ground or inside wall.

- Connect one transmitter output terminal to the tube and the second output terminal to a good grounding using a ground pick which is inserted to the soil as far as possible from the tube.
- Choose **Cable route** mode with receiver.
- Trace the tube route by following the signal minimum in the receiver nose direction.
- With tubes that are inside walls it is possible to use **Near cable** mode with receiver as well.

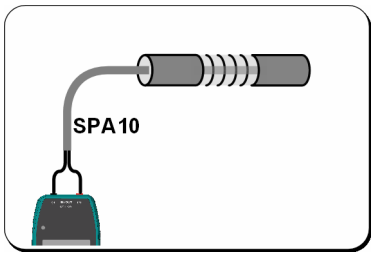


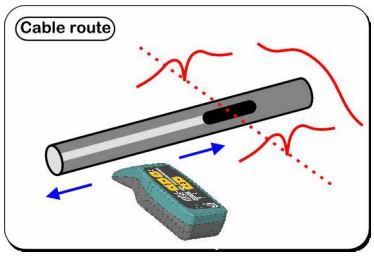


7.7.2 Non-conductive pipes inside walls etc.

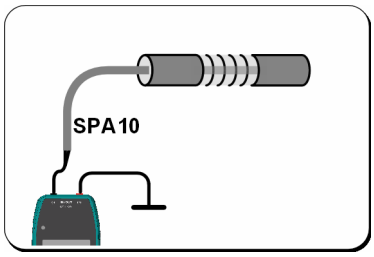
Task: The route of a non-conductive tube or possible tube blockage needs to be traced inside wall.

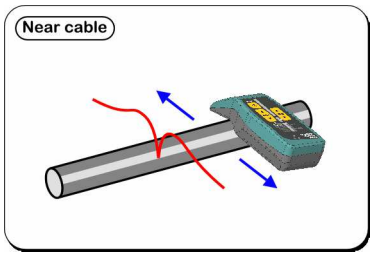
- Use the 10m long **SPA10** pipe transmitter antenna accessory, which is inserted into the tube such as an electrical pipe.
- If there is a **blockage in a tube** which needs to be located, connect both **SPA10** terminals to the transmitter and push the antenna into the tube until it hits the blockage.
- Choose **Cable route** mode with receiver. The **SPA10** head is located where there is a longitudinal minimum and transversal maximum in the signal strength (see closer instructions in the **SPA10** manual).





- If the **route of a tube** is to be traced, connect one transmitter output terminal to both **SPA10** terminals (parallel) and the second output terminal to a grounding, e.g. to a wall socket protective earth PE contact.
- Choose **Near cable** mode with receiver. Trace the tube by following the signal minimum. If necessary, use the receiver upside down.



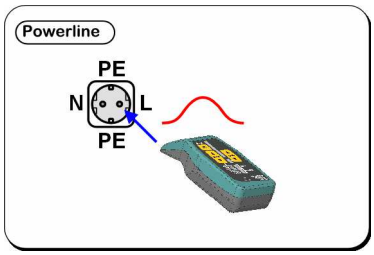


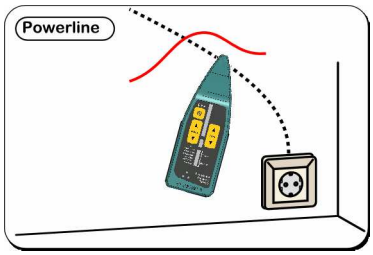
7.8 Using receiver monitor modes

7.8.1 Powerline mode (”mains tester”)

Task: Mains wall socket phase contact needs to be recognized or mains wires inside walls need to be located.

- In **Powerline** mode receiver can be used without transmitter e.g. as a mains tester: Scan the wall socket (Schuko) and its contacts with the receiver nose tip: Strongest signal can be heard closest to the phase (L) contact, but there is a smaller signal above Neutral (N) and protective earth (PE) contacts too.
- To locate mains wires inside walls, use **Powerline** mode to scan wall surface with the receiver nose. There are usually many mains related fields indoors, so is recommendable to keep receiver gain low to be able to find wires.





7.8.2 Audio freq mode

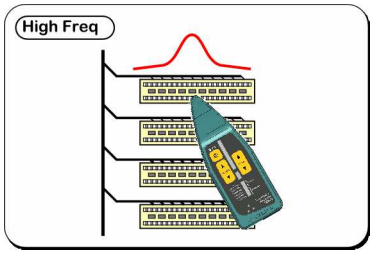
Task: Monitor audio frequencies of various objects.

- Use **Audio freq** mode to monitor audio frequencies up to 10kHz without galvanic contact to the object, e.g. to wires.
- The monitored audio signal level must be relatively high and receiver nose must be taken as close to the target object as possible.
- From twisted pairs signal usually can't be heard unless receiver nose can be inserted inside the wire loops.
- **Audio freq** mode can be used to monitor external fields generated by electric or electronic appliances.

7.8.3 High freq mode

Task: Monitor high frequencies on wires and terminals.

- Use **High freq** mode to monitor frequencies above 10kHz, such as DSL signals without galvanic contact to the object, e.g. on wires and terminals.
- From twisted data pairs signal usually can't be heard unless receiver nose can be placed very close to a single wire.



8. Technical data, maintenance and service

8.1. Technical data

Transmitter TMT30

DC voltage metering	-600...+600V, ±2% or ±0.5V
DC voltage metering	RMS 0...400V, ±2% or ±1V, f<5kHz
Frequency metering	0...5MHz, ±0.1% or ±2Hz
Tracing signal	125kHz sinusoidal, 270Hz AM
Tracing signal level	11.9Vpp, 2.9Vrms
Max. output current	26mArms
Output impedance	115Ω @ 125kHz
DSLAM-test frequencies	According to ITU-T G.992.1 Annex A
DSLAM-test method	According ITU-T G.994.1
DSLAM-test level	4.1Vpp open loop, 1.8Vpp to 100Ω
Meter modes impedance	420kΩ @ 50Hz
Trace modes impedance	105kΩ @ 50Hz
Indicators	2x16-character LCD display with backlight
Batteries	6pcs, 1.5V IEC LR6 alkaline batteries (or similar NiMH cells), max. battery voltage 15V, low bat warning at approx. 6.5V

Power consumption	9...80mA, average 55mA
Rated voltage	AC: 400Vrms, DC: 600V
Output connectors	2 pcs 4mm safety banana sockets
Output fuse	200mA, fast, 600V
Over voltage class	EN 61010-1 CAT III 600V
Enclosure	ABS, 155 x 90 x 50mm
Weight	Approx. 460g (with batteries)
Enclosure protection rating	IEC 60529 IP55
Storage conditions	-30...+60C, dry conditions
Usage conditions	-20...+40C, dry or damp conditions

Receiver	**TMR30**
Receiving frequencies	Trace modes: modulated 125kHz
Monitor modes:	Powerline: 50Hz (<200Hz) Audio freq: <10kHz High freq: >10kHz
Adjustments	3-level gain adjustment
Connectors	None
Indicators	12-level LED bar display for receiving signal strength, 9 other LEDs, internal speaker for trace signal and indication tones
Batteries	4pcs. 1.5V IEC LR03 alkaline batteries (or similar NiMH cells), max. battery voltage 6.5V, low bat warning at approx. 4.5V
Power consumption	16...100mA, average 30mA
Enclosure	ABS, 180 x 61 x 50mm
Weight	Approx. 250g (with batteries)
Enclosure protection rating	IEC 60529 IP34
Storage conditions	-40...+60C, dry conditions
Usage conditions	-40...+60C, dry or damp conditions

8.2. Maintenance, storage and warranty

TM30 cable and wire tracer does not have any parts that require maintenance by the user, excluding changing of batteries (see paragraph 3.1). A damaged device must be returned to the manufacturer for repair. A soiled device can be cleaned using a damp cloth and it must be dried carefully before returning it to the carrier bag. We recommend that the device is stored in its own carrier bag under dry conditions and at room temperature. If device becomes immersed in water, batteries must be immediately removed and the battery compartment lid left open in order to allow for the device to dry. The device is left to dry at room temperature.

H.Vesala Oy (Ltd.) shall not accept liability of any financial losses or damages, nor for any damage incurred to people, the environment, telecommunications traffic or similar as a result of the use of or the failure to use the device.

TM30 has a one-year warranty against factory defects. Warranty shall not cover batteries or faults resulting from normal wear and tear or misuse. Users are advised to contact the manufacturer in case of faults or queries relating to the use of the device. The product has been designed and manufactured in Finland. VESALA® is a registered trademark of H.Vesala Oy (Ltd.).

Manufacture, sales and maintenance

H.VESALA Oy

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