

proceq

profometer®
Operating Instructions



Scope of Delivery



Scope of Delivery

Profometer 600 (39210001)									
Profometer 630 AI / 650 AI (39220001 / 39230001)									
Profometer Corrosion (39250001)									
Upgrade kit to Profometer Corrosion (39250002)									
Upgrade kit to Profometer 600 Cover Meter (39250003)									
Profometer Corrosion rod electrode (39250010)									
Profometer Corrosion wheel electrode (33001001)									
Profometer Corrosion four wheel electrode (33001004)									
A Carrying case	•				•	•	•	•	•
B Profometer touchscreen						•	•	•	•
C Battery complete						•	•	•	•
D Power supply incl. cables						•	•	•	•
E USB cable						•	•	•	•
F DVD with software and documentation				•	•	•	•	•	•
G Documentation				•	•	•	•	•	•
H Activation key				•			•		
I Carrying strap complete						•	•	•	•
J Probe cable 1.5 m (5 ft)				•			•	•	
K Universal probe with ruggedized scan cart				•			•	•	
L Chalk				•			•	•	
M Interface box					•	•			
N Cable coil l=25 m (82 ft) with clamp					•	•			
O Rod electrode with spare parts			•						
P Copper sulphate, 250g	•	•	•						
Q Citric acid, 250g	•	•							
R Rod electrode cable, 1 lead, l=1.5 m (5 ft)			•						
S Tool kit	•	•							
T Wheel electrode with cables and spare parts		•							
U Four wheel electrode with cables and spare parts	•								

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1. Safety and Liability

1.1 General Information

This manual contains important information on the safety, use and maintenance of the Profometer 6. Read through the manual carefully before the first use of the instrument. Keep the manual in a safe place for future reference.

1.2 Liability

Our “General Terms and Conditions of Sales and Delivery” apply in all cases. Warranty and liability claims arising from personal injury and damage to property cannot be upheld if they are due to one or more of the following causes:

- Failure to use the instrument in accordance with its designated use as described in this manual.
- Incorrect performance check for operation and maintenance of the instrument and its components.
- Failure to adhere to the sections of the manual dealing with the performance check, operation and maintenance of the instrument and its components.
- Unauthorised modifications to the instrument and its components.
- Serious damage resulting from the effects of foreign bodies, accidents, vandalism and force majeure

All information contained in this documentation is presented in good faith and believed to be correct. Proceq SA makes no warranties and excludes all liability as to the completeness and/or accuracy of the information.

1.3 Safety Instructions

The equipment is not allowed to be operated by children or anyone under the influence of alcohol, drugs or pharmaceutical preparations. Anyone who is not familiar with this manual must be supervised when using the equipment.

- Carry out the stipulated maintenance properly and at the correct time.
- Following completion of the maintenance tasks, perform a functional check.

1.4 Correct Usage

- The instrument is only to be used for its designated purpose as describe herein.
- Replace faulty components only with original replacement parts from Proceq.
- Accessories should only be installed or connected to the instrument if they are expressly authorized by Proceq. If other accessories are installed or connected to the instrument then Proceq will accept no liability and the product guarantee is forfeit.

2. General Operation

2.1 Getting Started

Battery installation

To install the battery, remove the protection foil and lift the stand as shown. Insert the battery and fasten in place with the screw.



There are two status LEDs (Figure 1, **1**) and above them a light sensor. The upper LED is red while charging and turns to green when it is fully charged. The other LED is application specific.



NOTE! Only use the power supply provided.

- A complete charge requires < 9h (Instrument not operating).
- Charging time is much longer if the instrument is in use.
- An optional quick charger (Part No. 327 01 053) can be used to charge a spare battery or to charge the battery outside of the instrument. In this case it takes < 4h for a complete charge.

Energy Saving

Energy saving may be programmed as desired under System/Power settings.



Figure 1: Main menu, leds, buttons

Buttons

Lift the protective visor.

On the upper right of the screen there are three buttons (Figure 1, **2**).



Power On/Off – Press to power on. Press and hold to power off.



Fullscreen / PDF viewer / Hard Keys Mode.



Back Button – returns to previous screen.

Probes connection Profometer 6

Connect the universal probe to either of the two sockets ① or ② on the upper side of the Profometer touchscreen using the probe cable.

Profometer Corrosion

Mount the interface box on the right side of the Profometer touchscreen using the attached screws ③ and ④ and connect the cable to either of the two sockets ⑤ or ⑥ on the upper side of the Profometer touchscreen. Connect the electrode signal cable to socket ⑤ and the ground cable to the socket ⑥ of the interface box. Wheel electrodes: connect the path measurement cable to socket ⑦ of the interface box.



USB Host:

Connect a mouse, keyboard or USB stick.

USB Device:

Connect application specific probes and PC.

Ethernet:

Connection for firmware upgrades.

Power Supply:

Connect the power supply through this connection.



2.2 Main Menu

On start up, the main menu is displayed. All functions are accessible directly via the touchscreen.

Return to the previous menu by pressing the back button or the return icon (arrow) at the top left of the touchscreen.



Measurement

Select to access either Cover Meter or Corrosion measuring modes.



Settings

Application specific settings.



Explorer

File manager application for reviewing saved measurements.



System

Select your preferred interface language, date and time settings and power saving options.



Information

Open documentation (Operating Instructions and additional PDF files) and device info.



Power off

Switch off the device.

2.3 Upgrade procedure

The following procedure has to be performed in order to upgrade to Profometer 630 AI / 650 AI functionalities from a Profometer 600 unit or to unlock Profometer 600 / 630 AI / 650 AI Cover Meter functionalities on a Profometer Corrosion unit.

The Activation Key can be provided together with the initial purchase (when a Profometer 630 AI or 650 AI unit is supplied) or can be ordered anytime after the initial purchase in order to upgrade / unlock to further functionalities.

1. Press the **Power On/Off** button to power on the touchscreen
2. Access the **System** menu, then go to **Features** and **Enter activation key**



3. Enter the **activation key**

2.4 Cover Meter and Corrosion functionalities

A Profometer unit can have both the features of Cover Meter and Corrosion Analysis Instrument in the following cases

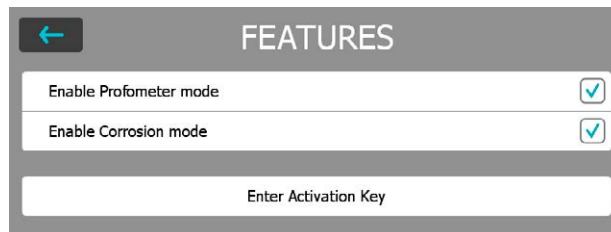
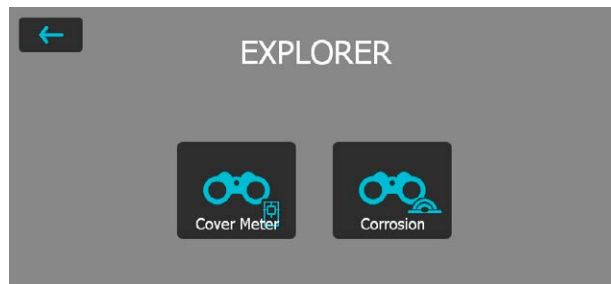
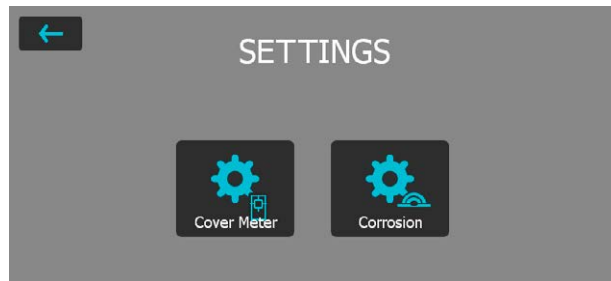
- Profometer 6 Cover Meter with the upgrade kit to Profometer Corrosion (392 50 002)
- Profometer Corrosion with the upgrade kit to Profometer 600 Cover Meter (392 50 003) plus any possible upgrade to Profometer 630 AI or 650 AI

In either case the corresponding functionality (Cover Meter and/or Corrosion) will be available on the Platform depending on whether the universal probe or the interface box respectively is initially connected to the unit.

An image on the top of the measuring screen will indicate whether the universal probe  and/or the interface box  are connected to the unit.

When going into the Settings or Explorer menus the user will be prompted whether to access the Cover Meter or Corrosion corresponding sub-menus.

The user can disable at any time either feature by going into the System / Features menu and unchecking the corresponding box.



3. Profometer 6 Cover Meter

3.1 Measuring Principle

3.1.1. Pulse induction

The Profometer 6 uses electromagnetic pulse induction technology to detect rebars. Coils in the probe are periodically charged by current pulses and thus generate a magnetic field. On the surface of any electrically conductive material which is in the magnetic field, eddy currents are produced. They induce a magnetic field in the opposite direction. The resulting change in voltage can be utilized for the measurement.

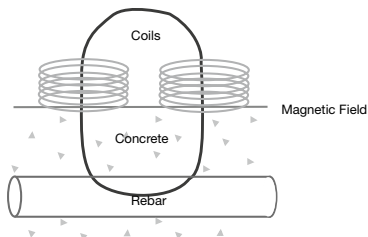


Figure 2: Measurement principle

The Profometer 6 uses different coil arrangements to generate several magnetic fields. Advanced signal processing allows locating a rebar as well as measuring of cover and rebar diameter.

This method is unaffected by all non conductive materials such as concrete, wood, plastics, bricks etc. However any kind of conductive materials within the magnetic field (sphere of approx. 200 mm / 8 inch radius) will have an influence on the measurement.



NOTE! Remove all metallic objects such as rings and watches before you start measuring.

3.1.2. Calibrated Measuring with Profometer 6

The Profometer 6 is calibrated to measure on a normal rebar arrangement; which is an arrangement of non-stainless steel rebars fastened with binding wires only e.g. when measuring on welded mesh wires the cover and diameter readings must be corrected (see “3.2.4. Practical Hints”). The following information on accuracy, measuring ranges and resolutions refer to measurements on normal rebar arrangements.

3.1.3. The Measuring Range

The measuring range is dependent on the bar size. The expected accuracy of the cover measurement is indicated in the graphic below. It complies with BS1881 part 204, for a single rebar with sufficient spacing.

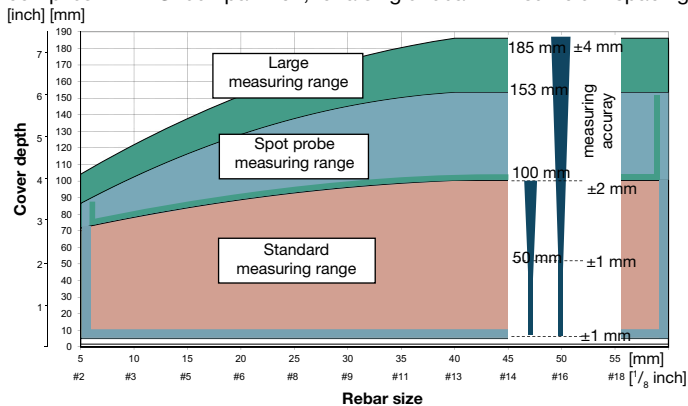


Figure 3: Measuring ranges and accuracy: up to the indicated limits the cover is measured and displayed. In the Locating Mode a rebar is shown. In the Single-Line Mode the cover curve is shown but a rebar is only set up to 90 % of the maximum cover.

3.1.4. Resolution

There is a limit to the minimum spacing of bars depending on the cover depth and rebar diameter. It is impossible to distinguish between individual bars above these limits.

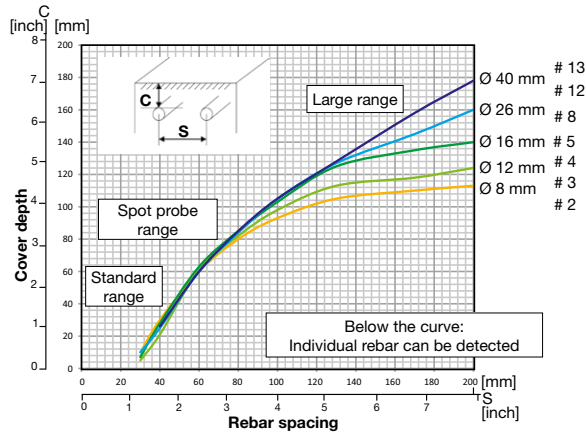


Figure 4: Resolution

3.1.5. Sphere of influence by Ferromagnetic Material

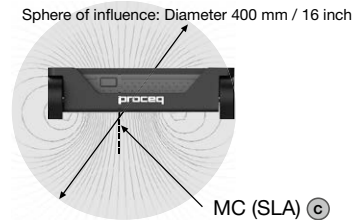


Figure 5: Influence sphere

Any ferromagnetic material within the sphere may have an influence on the signal value (e. g. during a reset).

3.2 Cover Meter Operation

3.2.1. Cover Meter Operation

Scroll up and down the screen by dragging your finger up or down the screen. The current setting is displayed on the right hand side. Tap on an item to adjust it.

Settings	Measuring Mode					Adjustable after data storage
	Locate	Single-Line	Multi-Line	Cross-Line	Are-Scan	
Measuring Range	•	•	•	•	•	No
Rebar Diameter Scan X	•	•	•	•	•	Yes
Rebar Diameter Scan Y ¹⁾				•		Yes
Artificial Intelligence ²⁾ / Neighboring Rebar Correction	•	•	•	•	•	Yes
Cover Calibration ²⁾	•	•	•	•	•	Yes
Unit	•	•	•	•	•	No
Minimum Cover	•	•	•	•	•	Yes
Maximum Cover			•	•	•	Yes
Cover Offset	•	•	•	•	•	No
Display Inclined Rebar	•					Yes
Sharpen			•	•		Yes
Display Curve		•				Yes
Align Rebar Positions			•	•		No

Settings	Measuring Mode					Adjust-able after data storage
	Locate	Single-Line	Multi-Line	Cross-Line	Are-Scan	
Return to start on new line			•	•		Yes
Line Height			•	•	•	Yes
Grid Width				•	•	Yes

¹⁾ This parameter affects all measurement modes (in addition to Cross-Line) whenever Artificial Intelligence Correction is selected

²⁾ Only available on Profometer 630 AI / 650 AI

Measuring Range

Select between **Standard**, **Large** or **Auto** ranges (see Figure 3). The Standard range setting is the default setting and the most accurate. Auto range setting automatically switches between Standard and Large range; it is only available when in the Locating Mode. Spot range setting should be selected for measurements of small areas, in corners and where the distance between reinforcing bars is small. The Large range setting should be selected when the concrete cover is deeper, to provide more accurate results.

Rebar Diameter Scan X / Rebar Diameter Scan Y

Select the Rebar Diameter (6 to 40 mm / #2 to #12, see “10.1 Appendix A1: Rebar Diameters”), either determined from the drawing or as measured. Tap on the info button on top of the Settings page to view a graphical overview of the above mentioned parameters.

Artificial Intelligence / Neighboring Rebar Correction

It compensates the influence of 1st and 2nd layer neighbor rebars (AI) or 1st layer neighbor rebars only (NRC) on cover measurement of 1st layer rebars. If both a_1 and a_2 spacings are entered, $\Phi_1 \leq \Phi_2$ and Standard Range is set, then the Artificial Intelligence is automatically applied. If only a_1 spacing is entered or $\Phi_1 > \Phi_2$ or Large/Spot Range is set, then the Neighboring Rebar Correction (only taking into account 1_{st} layer) is automatically applied.

The user can enter the spacing value manually or choose the Auto function, which redirects to a Single-Line scan where the spacing is automatically measured and averaged.

The rebar size measurement is anyway only corrected with NRC.

Tap on the info button on top of the Settings page to view a graphical overview of the above mentioned parameters.

Cover Calibration

This correction is used for calibrating the cover measured by the instrument (Measured Cover) to the actual value directly measured on a open location (Reference Cover). The corresponding Rebar Diameter Setting is also to be specified.

This correction can be used regardless of rebar geometry and Measuring Range selected

Unit

Select **Metric**, **Metric Japanese**, **Imperial** or **Imperial Diameter**, **Metric Cover** and **Distance**.

Minimum Cover

A Minimum Cover value from 10 to 142 mm / 0.40 to 5.56 inch can be set in 1 mm / 0.04 inch steps (see “10.3 Appendix A3: Minimum / Maximum Cover”). In the Single-Line, Multi-Line and Cross-Line Mode/View rebars with less than minimum cover will be shown in red color. In the Single-Line View and Statistical View a horizontal, respectively vertical dotted line in red indicates the Minimum Cover value set.

Maximum Cover

A Maximum Cover value from 20 to 190 mm / 0.80 to 7.48 inch can be set in steps of 1 mm / 0.04 inch (see “10.3 Appendix A3: Minimum / Maximum Cover”). In the Single-Line, Multi-Line and Cross-Line Mode/View rebars with cover exceeding the Maximum cover will be shown in grey color.



NOTE! The Maximum Cover must be at least 10 mm / 0.40 inch higher than the Minimum Cover. If not, the instrument will correct it automatically.

The Maximum Cover should also be set for different files measured on the same surface to get the same color range for comparison purposes.

Cover Offset

When a Cover Offset value is set the measured cover will be reduced by this value; e. g. when a wooden or plastic plate is used to measure with the probe cart on rough surfaces (see “3.2.4. Practical Hints”). In this case the plate thickness must be set as Cover Offset value). A value from 1 to 50 mm / 0.04 to 1.92 inch can be set.

Display Inclined Rebar

By setting this feature the inclined rebar is displayed in the Locating Mode when all four wheels of the cart have passed over the inclined rebar. In the Single-Line and Multi-Line Modes it is only shown in the cart symbol.



NOTE! In areas with small rebar spacing this feature may not work properly.

Sharpen

With this setting the signal strength color spectrum of the Multi-Line and Cross-Line Views can be sharpened.

Display Curve

Select **Cover Value**, **Signal Strength** or **None**. The respective curve or no curve is displayed in Single-Line View.

Align Rebar Positions

When measuring in the Multi-Line or Cross-Line Mode along at least two lines of at least 55 cm / 22.00 inch length, the rebar positions of subsequent lines are aligned to the rebar positions of the previous lines.



NOTE! This feature should only be set if the rebars are running parallel to the start line (X- or Y-line). It is not activated during the measurements (activated only when storing the data).

Return to start on new line

With this feature set, the cursor jumps back to the start line when changing line in the Multi-Line and Cross-Line Modes.

Line Height (in Y-direction)

The line height of must be set in the Multi-Line, Area-Scan and Cross-Line Modes. It determines the spacing between the measuring rows. A height of 5 to 203 cm / 2.00 to 80.00 inch can be set.

Grid Width (in X-direction)

The grid width must be set in the Area-Scan and Cross-Line Modes. A width from 5 to 203 cm / 2.00 to 80.00 inch can be set.

3.2.2. Cover Meter Measurement Modes

When Measurement Mode is selected for the first time after switching on the instrument, zeroing of the probe is performed. Confirm it and wait for the button assessment window. Wait or tap anywhere on the screen. The Measurement Modes available are shown in the menu on the top of the screen.

	Locating	Single-Line	Multi-Line	Area-Scan	Cross-Line
Profometer 600	•				
Profometer 630 AI	•	•	•	•	
Profometer 650 AI	•	•	•	•	•



NOTE! Valid for all Measuring Modes: In case measuring data shall be stored create a folder in the Explorer (see “5. Explorer Document Handling”) and check if the correct folder is active.



Figure 6: Universal Probe overview

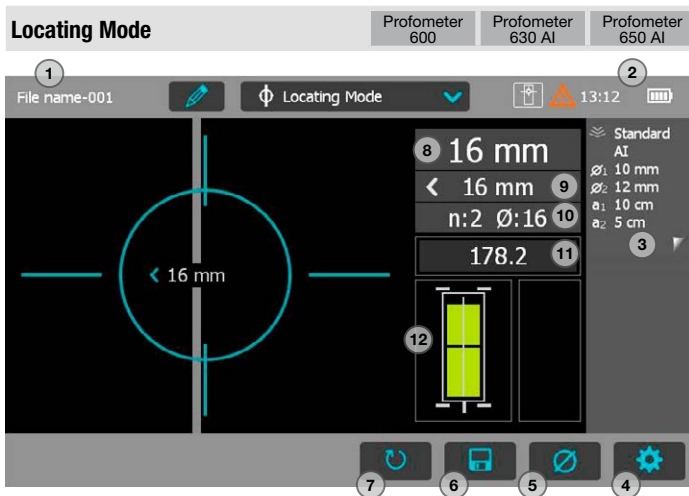


Figure 7: Locating Mode

- 1 **File name:** enter the file name and tap return. Saved measurements will be stored with this file name. If several measurements are made under the same filename, a suffix increments after each measurement and follows the file name.
- 2 Probe connected, current time, battery status and warning triangle for zeroing the probe when needed: after 5 minutes in orange, after 10 minutes in red.



NOTE! Tap on the triangle to perform zeroing.

3 Display of selected Settings:

- Measuring Range
- Type of correction (None, AI, NRC, CAL)
- 1st and 2nd layer rebar size and spacing
- Cover Offset (if set)
- Probe Direction X: Undefined direction
 ^, v, <, >: On vertical wall, probe head towards up, down, left, right
 _ , ¯: On horizontal surface, on soffit

4 Settings: switches to the settings menu

5 Rebar Diameter: measuring of rebar diameter

6 Store measured data

7 Restart: all data of current measurement are deleted

8 Actual Cover

9 Distance to the nearest rebar

10 Nos. / Measured diameter

11 Signal strength

12 Coils indicator

Whenever possible start with locating the rebars of the first layer, E.g on a column this would be the horizontal stirrups.

Holding the CL E horizontally, move vertically up or down until the Arrow LED lights up and then move back until the MC LED lights up.

After having located the first layer rebars continue with locating the second layer rebars.

- Position the MC (C or D depending on the set Measuring Range) at the mid line of the first layer rebars, e. g. on a column hold the probe with the CL running vertically and move the probe cart vertically until both rectangles in the probe symbol 12 are green and of equal size. Whenever the coils rectangles 12 are of different size and red, the probe po-

sition is not optimal and the cover / diameter measurement becomes not reliable

- Now move the probe cart horizontally until one of the Arrow LEDs F lights up and then move back until MC LED C or D lights up.
- At this position you may also measure the diameter either by pushing B on the right side of the probe or 5 (see Figure 7) on the Touchscreen unit (e. g. when the probe is fixed to the telescopic extension rod).
- If the spacing of parallel or orthogonal rebars is between 5 and 30 cm (2.00 to 12.00 inch), activate AI or NRC correction. If the cover is too small for diameter measurement “too close” is displayed.
- In this case place a wooden or plastic board on the surface and set the board thickness as Cover Offset to measure the diameter.

Finally the measured diameter must be set. The cover reading will be corrected according to the diameter set.



NOTE! A rebar is shown only within the cover ranges indicated in Figure 3; for more details about diameter measurement see “3.2.4. Practical Hints”.

- Tap **6** to store the diameter and cover measurement.
- Repeat this procedure at each rebar.

The saved data can be seen in the Snapshot and Normal Statistics View (see “3.2.3. Cover Meter Display Views”).

Whenever a rebar is inclined to the Cover of the probe, if Display Inclined Rebars is set, the angle will be shown on the display (minimum detected inclination is 6 degrees).



NOTE! Cover values are only saved for later viewing, if the diameter was measured and saved.

Single-Line View

Profometer
630 AI

Profometer
650 AI

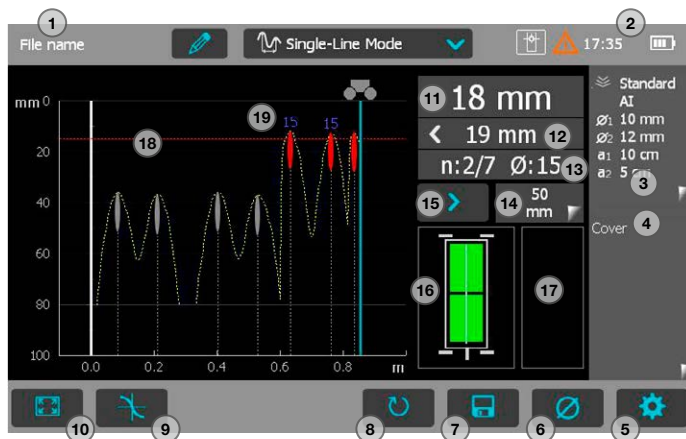


Figure 8: Single-Line Mode

- 1 File name:** enter the file name and tap return. Saved measurements will be stored with this file name. If several measurements are made under the same filename, a suffix increments after each measurement and follows the file name.
- 2** Probe connected, current time, battery status and warning triangle for zeroing the probe when needed: after 5 minutes in orange, after 10 minutes in red..



NOTE! Tap on the triangle to perform zeroing.

3 Display of selected Settings:

- Measuring Range
- Type of correction (None, AI, NRC, CAL)
- 1st and 2nd layer rebar size and spacing
- Cover Offset (if set)
- Probe Di- X: Undefined direction rection

^, v, <, >: On vertical wall, probe head towards up, down, left, right

_, -: On horizontal surface, on soffit



Zoom in by placing thumb and index finger together on the screen and spreading them apart. This can be used in both the horizontal and vertical directions when making a measurement.



Zoom out by placing thumb and index finger apart on the screen and pinching them together.

Pan the image from left to right by dragging.

4 Curve displayed: Cover / Signal strength / None

5 Settings: switches to the settings menu

6 Rebar Diameter: measuring of rebar diameter

7 Store measured data

8 Restart: all data of current measurement are deleted

9 Zoom in to cursor position

10 Zoom to fit the whole scan

11 Actual Cover

12 Distance to the nearest rebar

13 Nos. / Measured diameter

14 Skip distance

15 Skip button

16 Coils indicator

17 Speed bar

18 Minimum set cover value (if set)

19 Measured diameter



NOTE! It is advisable to locate the first and second layer rebars with the Locating Mode to find the optimum line position prior to measuring with the Single-Line Mode.

- Position the probe cart at the start line in an optimum position (see Figure 9, the MC **C / D** at the mid line of the rebars running parallel to the moving direction, both rectangles in 16 are of equal size).

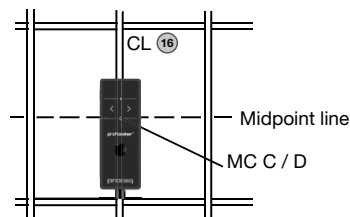


Figure 9: Optimal probe position

- Start with the measurement if the cursor is at the start line. If not perform a reset 8.
- Move the probe cart with constant speed crosswise over the rebars, not exceeding the maximum speed (speed bar 17 half filled in green).
- Above each rebar, when the red LED of MC **C / D** lights up, you may measure the rebar diameter and on completion, it will be displayed in blue. The measured diameter may be deleted within 5 seconds by tapping on 6.

- In case the spacing between parallel or orthogonal rebars is in the range of 5 to 30 cm (2.00 to 12.00 inch), activate AI or NRC correction.

The cursor position can be adapted in two ways to a changed cart position:

- Tap on the cursor and wait until it becomes white and orange. Move the cursor to the desired position (even left to the zero line is possible). Be aware: Scanning is no longer possible between the cursor and the zero-line. Rebars that have already been scanned cannot be removed by a new scan, but you may scan to the left of the first rebar or to the right of the last rebar. To delete rebars already scanned, tap **8** and confirm with Yes.
- Tap on **14** and set the skip distance. For example, if you have to make a break in the scan due to an obstacle such as a column, move the cart until the right wheels touch the column, then set the skip distance to the width of the column plus 107mm / 4.2 inches for the cart and reposition the cart at the other side of the column with the left wheels touching the column. Tap on **15**. A blue dotted line is set at the beginning of the skipped interval.

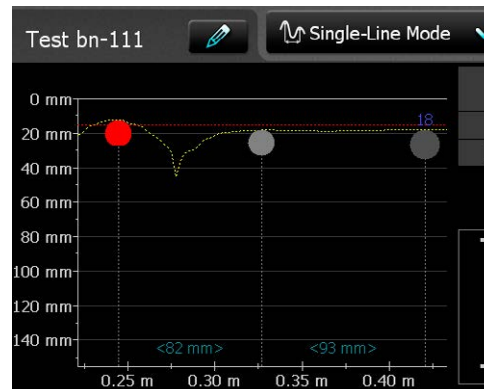


NOTE! The cover curve is shown (if selected) within the cover ranges indicated in Figure 3 but a rebar will only be shown up to 90 % of those limits.

To display a rebar as a circle zoom the horizontal and vertical axis to the same scale.

The spacings of the rebars are shown in blue.

The distances from the start line to the first rebar and from the end line to the last rebar are shown in white color. If the figures are not shown, zoom in.

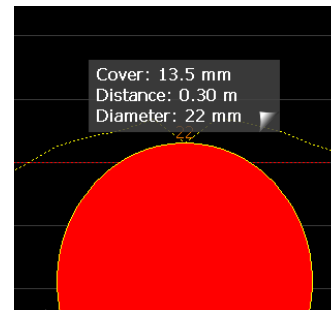
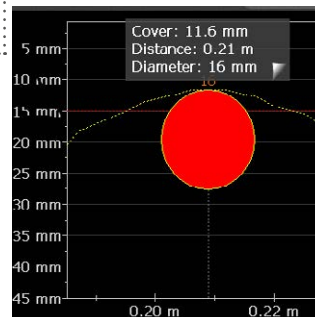


Spacing between rebars (in blue)

Figure 10: Screen of Single-Line Mode with cover curve

- To change a diameter tap on the rebar. A window opens.
- Tap on the window and change diameter. To erase set diameter to zero.

The new diameter is set and shown in orange. The cover changes accordingly but the cover curve remains except above the rebar axis.



New set diameter shown in orange

Figure 11: Single-Line View zoomed, showing change of rebar diameter



Figure 12: Single-Line option to mask a rebar by double-tapping on it

When utilizing the Single-Line Mode, the user has the option to display the Cover curve, Signal Strength curve or no curve. The Signal Strength curve is used to confirm the presence of reinforcing bars. Local effects such as metallic elements present below the surface (metallic wire, anchorage, etc.) or changes in testing speed when obtaining the data can result in an “apparent” reinforcing bar appearing on the screen. It is possible to hide the “apparent” reinforcing bar by double tapping on the corresponding dot when in Single-Line Cover or Signal Strength View and selecting the “Mask” option. The corresponding cover values will not be taken into account in the Statistical View (refer to Section “3.2.3. Cover Meter Display Views”).

The path length measurement accuracy depends on the test surface. The accuracy of measurements done on a smooth concrete surface (concrete poured in metallic shuttering) is shown in the specifications, see “7. Technical Specifications”. On rougher surfaces the measured length may be reduced or checked at certain intervals by setting markings on the test surface and comparing with marks set on the display (long push on **A**).

After storage (tap **7**), the data can be seen in the Statistics View, the Single-Line View and also in the Snapshot View if at least one diameter was measured (see “3.2.3. Cover Meter Display Views”). The maximum scan length is 999 m / 3’280 feet in each direction (to the right and to the left from the zero line).

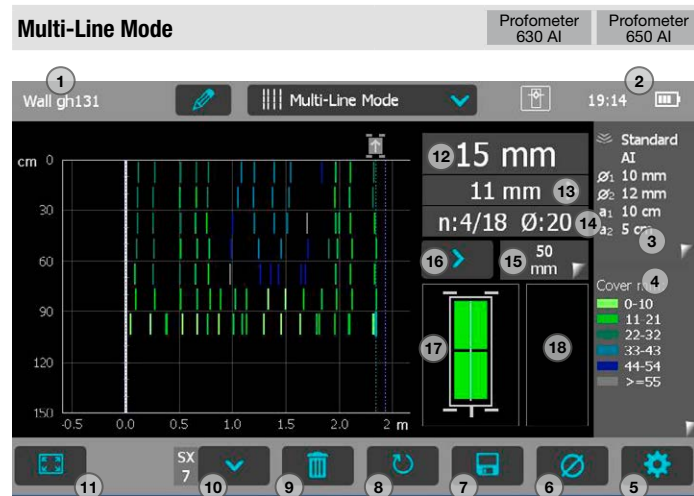


Figure 13: Multi-Line Mode

- File name:** enter the file name and tap return. Saved measurements will be stored with this file name. If several measurements are made under the same filename, a suffix increments after each measurement and follows the file name.

- 2 Probe connected, current time, battery status and warning triangle for zeroing the probe when needed: after 5 minutes in orange, after 10 minutes in red..



NOTE! Tap on the triangle to perform zeroing.

3 **Display** of selected Settings:

- Measuring Range
- Type of correction (None, AI, NRC, CAL)
- 1st and 2nd layer rebar size and spacing
- Cover Offset (if set)
- Probe Direction X: Undefined direction
^, v, <, >: On vertical wall, probe head towards up, down, left, right
_, ¯: On horizontal surface, on soffit



Zoom in by placing thumb and index finger together on the screen and spreading them apart. This can be used in both the horizontal and vertical directions when making a measurement.



Zoom out by placing thumb and index finger apart on the screen and pinching them together.

Pan the image from left to right by dragging.

- 4 **Measured values displayed:** Cover / Diameter
- 5 **Settings:** switches to the settings menu
- 6 **Rebar Diameter:** measuring of rebar diameter
- 7 **Store measured data**

8 **Restart:** all data of current measurement are deleted

9 **Delete current line**

10 **Move to next line / Rotate probe**

11 **Zoom to fit the whole scan**

12 **Actual Cover**

13 **Distance to the nearest rebar**

14 **Nos. / Measured diameter**

15 **Skip distance**

16 **Skip button**

17 **Coils indicator**

18 **Speed bar**



NOTE! It is advisable to locate the first and second layer rebars with the Locating Mode to find the optimum line position prior to measuring with the Multi-Line Mode (see Figure 9). "Align Rebar Position" should only be set, if all rebars are running parallel to the start line (Y-axis). For large areas it is advisable not to set "Return to start on new line" and to measure the lines alternatively start to end, back from end to start.

- Position the probe cart at the start line in an optimum position (see Figure 9, the MC C / D at the mid line of the rebars running parallel to the moving direction, both rectangles in 16 are of equal size).
- Start with the measurement if the cursor is at the start line. If not perform a reset 8.
- Move the probe cart crosswise over the rebars. Above each rebar, when the red LED of MC C / D lights up, you may measure the rebar diameter and on completion, it will be displayed. If the spacing between parallel or orthogonal rebars is in the range of 5 to 30 cm (2.00 to 12.00 inch), activate AI or NRC correction. At the end of the first line a marker (dotted blue line) is set. To proceed with the next line tap 10

or push A and B simultaneously on the probe. The cursor jumps to the next measuring row, either to the start line or remains at the end line, depending on whether “Return to start on new line” is set or not. Changing the cursor position works like in the Single-Line Mode (tap and drag the cursor or use the Skip button). At the start of each line you may change the probe direction (e. g. when measuring on a wall along the bottom line close to the slab).

- Tap on 10. The arrow in the probe cart symbol changes from  to . For the next line you may change back to .



NOTE! By changing the setting “Line Height” during the measurements the height of all lines including the ones already measured will change and hence, also the line positions. Change the line height only if it was previously wrongly

At each rebar you may measure the rebar diameter. At the end, set one common diameter, normally the smallest one (see “3.2.4. Practical Hints”).

When displaying the Cover values in the color palette the range is defined by the Minimum and Maximum Cover values used in Settings.

When displaying the Diameter values in the color palette all rebars will be shown in the respective color. Rebars for which the diameter was not measured or set are shown in white; diameters set in the Single-Line View (Figure 11) are shown additionally with an orange cross bar in the middle of the rebar.

After storage (tap 7), the data can be seen in the Statistics View, the Single-Line View, the Multi-Line View and also in the Snapshot View if at least one diameter was measured. In the Multi-Line View the signal strength spectrum can be seen in addition to the cover and diameter, see “3.2.3 Cover Meter Display Views”.

In one measuring sequence a maximum of 62 lines can be scanned and stored in one file.



NOTE! A rebar will only be shown up to 90 % of the limits of Figure 3.

Area-Scan Mode

Profometer
630 AI

Profometer
650 AI

The Area-Scan Mode is mainly used to show the first layer rebar covers on large areas, e.g. of concrete slabs in car parks. It is best suited for a combination with half-cell potential measurements; e. g. combined with Profometer Corrosion measurements; in this case the line height and grid width should be the same for both measurements.

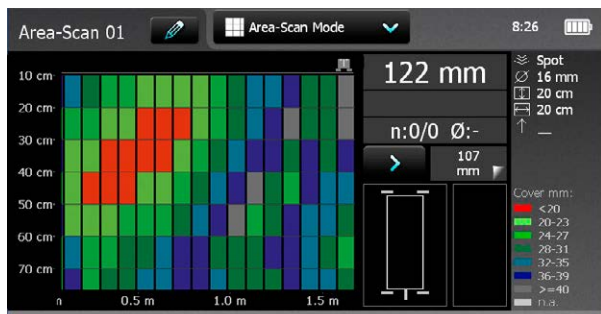
The main differences with the Multi-Line Mode is that instead of the single rebars, only the lowest cover value inside every cell is displayed; the single cell area is defined by the Line Height (same meaning as for Multi-Line Mode) and the Grid Width. This latest should be set at least 1.1 times larger than the maximum rebar spacing of the first layer rebars, in order to be sure that at least one rebar is located within one cell.



NOTE! Since the Area-Mode is used on rather large areas, “Return to start on new line” should not be set.

The measuring procedure including turning the probe cart and changing cursor position is the same as for Multi-Line Mode.

Figure 14 is a plan view, where the cover values are shown as rectangles of different colors. Red means the cover is smaller than the minimum set.



A cover will only be shown up to 90 % of the cover ranges indicated in Figure 3.

Figure 14: Screen of Area-Scan Mode

After storage (tap 7), the data can be seen in the Statistics View, the Multi-Line View and also in the Snapshot View if at least one diameter was measured (see “3.2.3. Cover Meter Display Views”). Erroneous or non valid readings can be deleted simply by double tapping on the corresponding field and choosing the “Mask” option; a cross will appear into the masked fields and the corresponding cover values will not be taken into account in the Statistical View.



Figure 15: Area-Scan option to mask a field by double-tapping on it

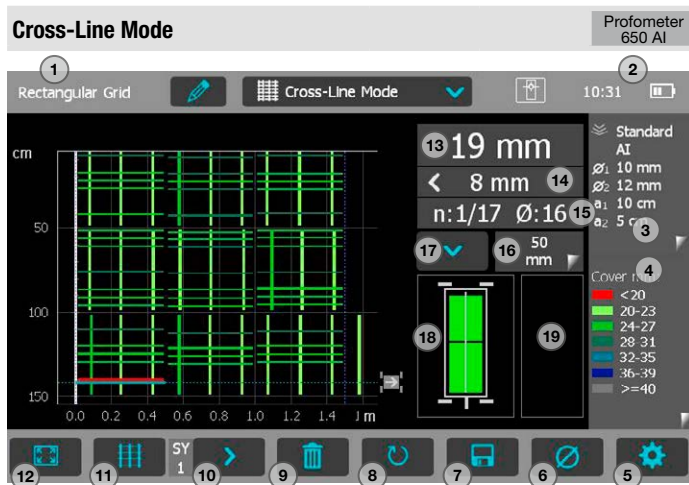


Figure 16: Cross-Line Mode

- 1 File name:** enter the file name and tap return. Saved measurements will be stored with this file name. If several measurements are made under the same filename, a suffix increments after each measurement and follows the file name.
- 2** Probe connected, current time, battery status and warning triangle for zeroing the probe when needed: after 5 minutes in orange, after 10 minutes in red..



NOTE! Tap on the triangle to perform zeroing.

3 Display of selected Settings:

- Measuring Range
- Type of correction (None, AI, NRC, CAL)
- 1st and 2nd layer rebar size and spacing
- Cover Offset (if set)
- Probe Direction X: Undefined direction
 - ^, v, <, >: On vertical wall, probe head towards up, down, left, right
 - _, -: On horizontal surface, on soffit



Zoom in by placing thumb and index finger together on the screen and spreading them apart. This can be used in both the horizontal and vertical directions when making a measurement.



Zoom out by placing thumb and index finger apart on the screen and pinching them together.

Pan the image from left to right by dragging.

- 4 **Measured values displayed:** Cover / Diameter
- 5 **Settings:** switches to the settings menu
- 6 **Rebar Diameter:** measuring of rebar diameter
- 7 **Store measured data**
- 8 **Restart:** all data of current measurement are deleted
- 9 **Delete current line**
- 10 **Move to next line / Rotate probe**
- 11 **Switch from X scan to Y scan and vice versa**
- 12 **Zoom to fit the whole scan**
- 13 **Actual Cover**
- 14 **Distance to the nearest rebar**

15 Nos. / Measured diameter

16 Skip distance

17 Skip button

18 Coils indicator

19 Speed bar

The Cross-Line Mode is used to display the rebars of the first and second layer arranged in a rectangular mesh. The measuring procedure including turning the probe cart and changing cursor position is the same as for Multi-Line Mode. In fact it is a Multi-Line scanning in X- and Y direction, where the user can switch between horizontal and vertical scans by tapping on 11.

In addition to the Multi-Line settings the grid width to define the spacing between the Y-lines must be set.

3.2.3. Cover Meter Display Views

Measured data can be displayed in six different views: Snapshot, Statistics, Single-Line, Multi-Line, Area-Scan and Cross-Line View. All the settings stored with the measurements can be changed afterwards. The views will change accordingly; to store the measuring series with the changes tap Store.



NOTE! Each View can be changed in a measuring mode in order to add data. Tap on  Set the cursor to the new starting position and continue with the measurements (see “3.2.3. Cover Meter Display Views”). All data and settings will be stored in the reopened file.

Snapshot View

Profometer
600

Profometer
630 AI

Profometer
650 AI

The Snapshot View can be displayed if at least one diameter was measured and stored in one of the measurement Modes.

The cover values are shown as vertical bars to scale and the diameter as a figure, both in the unit set. The Minimum Cover is not displayed in the Snapshot View.

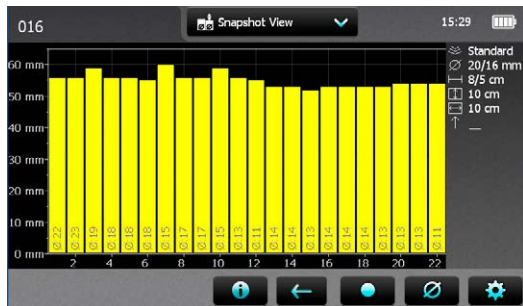


Figure 17: Snapshot View

Statistics View

Profometer
600

Profometer
630 AI

Profometer
650 AI

The Statistics View can be displayed for measurements done and stored in one of the measurement Modes. It shows the statistical calculation of the cover values measured.

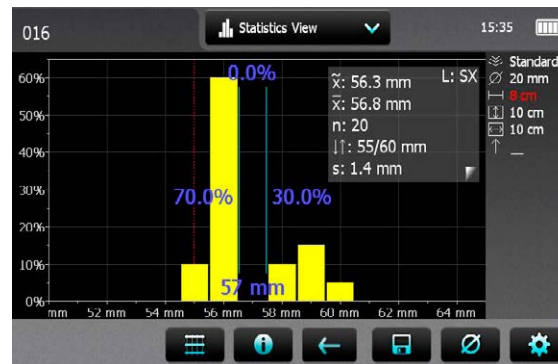
For measurements with the Cross-Line Mode the statistical evaluation of the cover readings is done for each layer independently. Hence there is a Statistical View each for the scanning in the X- and Y-direction.



NOTE! In practice only the cover values and statistical evaluation of the 1st layer rebars (closer to the surface) is of interest.

On the horizontal axis the cover values in the unit set are displayed. The vertical bars show the percentage of the respective cover values measured and stored. The vertical cursor bar can be moved to any cover value. The figure on the left of the cursor bar shows the percentage of measured cover values smaller than the cursor position. The value on the right shows percentage of measured cover values larger than the cursor position. The cover value is displayed at the bottom of the cursor bar and at the top the percentage of measured covers for that cover is shown. Minimum required cover is shown as a vertical dotted line in red (if set). Covers below the minimum are shown as red bars, covers above the minimum as yellow bars. There are two different Statistics Views, the **Normal** (see Figure 18) and the **DBV-Evaluation** (see Figure 19). Tap on the statistical values windows to switch from Normal to DBV.

Statistics values box "Normal" showing Median, Mean, Number of covers measured, lowest/highest, Standard Deviation.

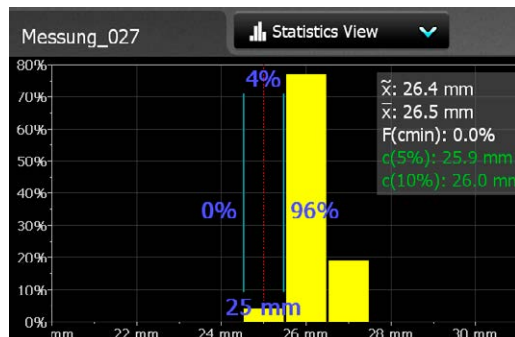


Change from X- to Y-direction view (for Cross-Line Mode data only) by tapping on / . The actual window is shown on top right (either of scan direction SX or SY)

Figure 18: Statistics View Normal

The DBV-Evaluation is an evaluation of the cover readings according to the German Concrete and Construction Association DBV (Deutscher Beton- und Bautechnik Verein). It is also recommended by RILEM. The DBV-Evaluation requires at least 20 cover readings. The distribution function $F(c_{min})$ as well as the threshold values $c(5\%)$ and $c(10\%)$ are calculated. The $c(x\%)$ -values are displayed in green when the measuring series is accepted, respectively in red if not.

Statistics values box DBV:



Above the measuring series is accepted, below not.

Cover values above the calculated upper boundary are not considered and shown as bars with a yellow frame only (see on the right side bars at cover values 17 mm, 18 mm and 19 mm).

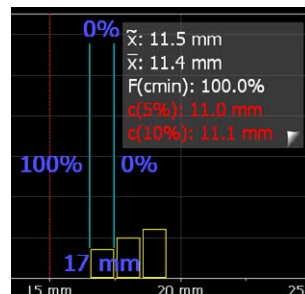


Figure 19: Statistics Views DBV-Evaluation

For more details of the DBV-Evaluation please refer to the Info sheet “Statistics according to DBV-Evaluation” available as pdf-file on the Profometer Touchscreen under Information/Documents and in the download section of www.proceq.com.

Single-Line View

Profometer
630 AI

Profometer
650 AI

The Single-Line View can be displayed if measurements have been done and stored in the Single-Line, Multi-Line or Cross-Line Mode (not from Area-Scan Mode). It shows the rebar positions in a cross section. The rebars are shown to scale depending on the diameter set. To show them as a circle zoom the horizontal and vertical axis to the same scale. However, for measurements over a long distance, like in a tunnel the scale of the horizontal axis will be much smaller and the rebars shown as vertical bars.

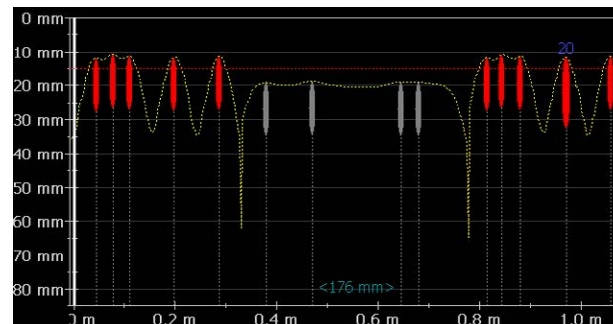


Figure 20: Single-Line View with cover curve

Figure 20 shows a Single-Line View with Metric Unit, Minimum Cover (dotted horizontal line in red) and Cover Curve (dotted curve in yellow). In case a diameter was measured its value is shown in blue above the rebar in the unit set. In case the diameter was manually set it is shown in orange.

Figure 21 shows a Single-Line with the Signal Strength Curve (dotted

curve in yellow) set. The vertical axis shows the signal strength; hence the Minimum Cover line is not shown.

It is a Single-Line View from measurements done in the Multi-Line View, because at position ⑩ the 1 refers to the measuring row displayed. Tap on ⑩ to display the Single-Line View of the next row.

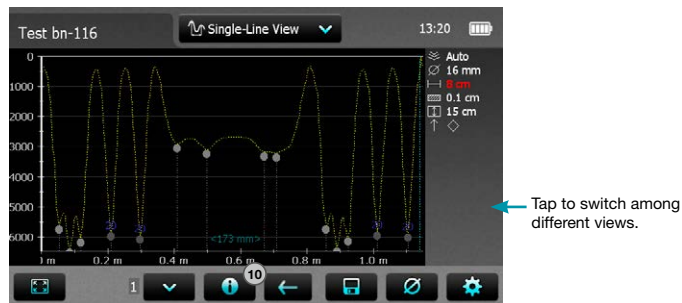


Figure 21: Single-Line View with Signal Strength Curve

The spacing among the rebars as well as the distance from the start line to the first rebar and from the last rebar to the end line are displayed as figures in the unit set, but only if the spacing on the screen is large enough. If not shown zoom in until the figures appear.

For more details like changing a diameter or masking a rebar refer to Single-Line Mode in chapter “3.2.2. Cover Meter Measurement Modes”. To set a new diameter you may have to measure it first at the particular location of the structure in the Locating Mode and set it manually.



masked and unmasked in the corresponding Single-Line View (see “3.2.2. Cover Meter Measurement Modes”); masked rebars will be displayed in dark grey with a dotted line and their cover values will not be taken into account in the Statistical View.

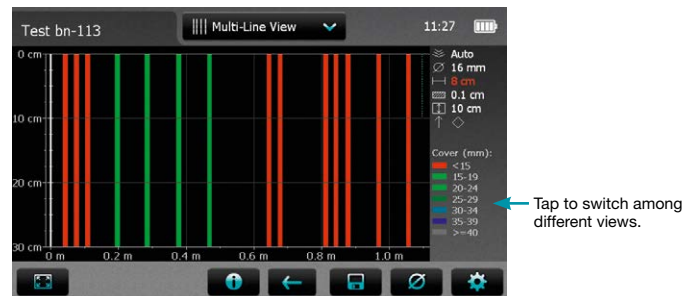


Figure 22: Multi-Line View with cover values displayed



Figure 23: Multi-Line View with masked rebars

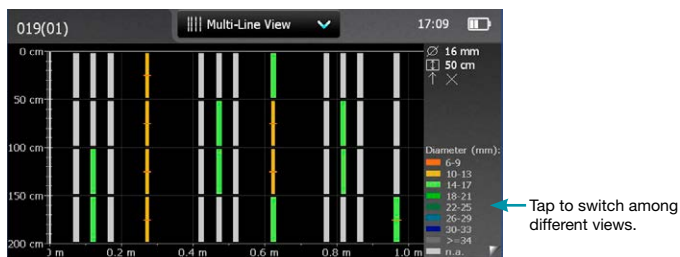


Figure 24: Multi-Line View with diameter values displayed (if measured)

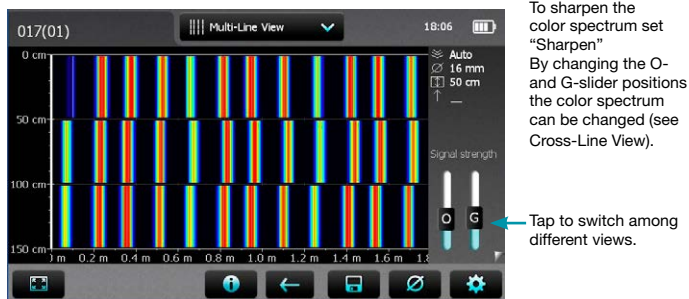


Figure 25: Multi-Line View with Signal Strength color spectrum

Area-Scan View

The Area-Scan View is in fact a simplified Multi-Line View which only shows the lowest cover values in a predefined grid. It is mainly used in combination with potential field measurements; e.g. combined with Profometer Corrosion measurements. Erroneous or non valid readings can be masked and unmasked (see "3.2.2. Cover Meter Measurement Modes"); a cross will appear into the masked fields and the corresponding cover values will not be taken into account in the Statistical View.



Figure 26: Area-Scan View (X- and Y-axis with different scale)

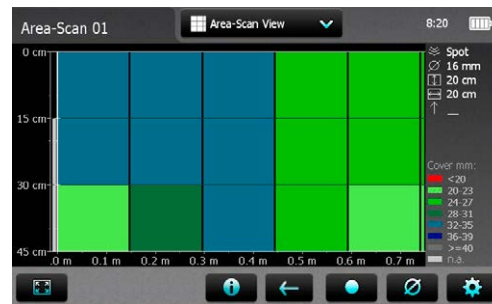
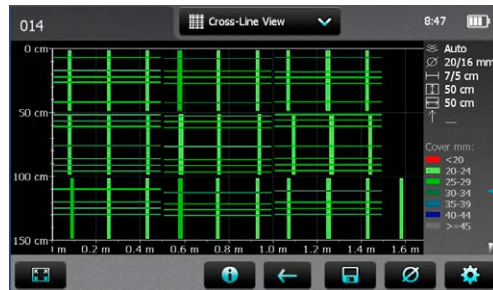


Figure 27: Area-Scan View (zoomed to show X- and Y-axis in the same scale)

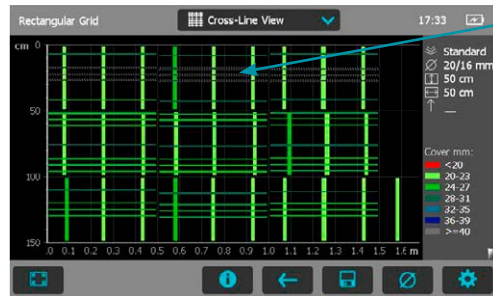
Cross-Line View

Profometer
650 AI

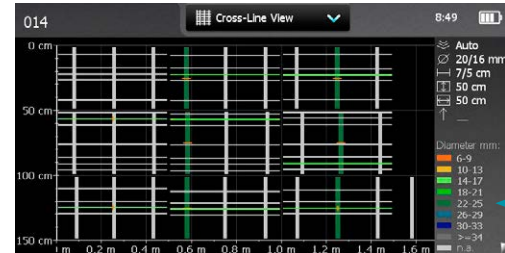
The Cross-Line View can be displayed only if measurements have been done and stored in the Cross-Line Mode. It is a plan view of the first and second layer rebars. Rebars can be masked and unmasked in the corresponding Single-Line View (see “3.2.2. Cover Meter Measurement Modes”); masked rebars will be displayed in dark grey with a dotted line and their cover values will not be taken into account in the Statistical View.



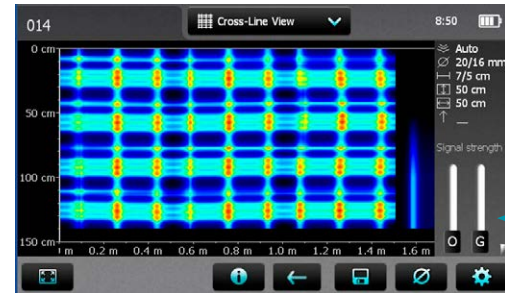
Tap to switch among different views.



Masked rebars



Tap to switch among different views.



Two diameters and two NRC-spacings (if set) are shown. Left of / it's the value of the SX (scanning in X-direction of the rebars running in Y-direction), right of / it's the value of the SY (scanning in Y-direction of the rebars running in X-direction).

Either cover, diameter or signal strength spectrum is displayed.

Tap to switch among different views.

Tap on  to change the global diameter of the active layer (SX or SY)

Figure 28: Cross-Line Views: Cover, Diameter, Signal Strength

In the signal strength spectrum view two sliders are shown on the right.

- With the O-slider (Offset) the signal strength range is set (from full actual signal strength range to higher strength only).
- With the G-slider (Gain) the signal strength resolution is set. The signal strength is accordingly displayed in colors from full color spectrum to part of it only, e. g. blue to violet only.

Three demo files are stored on the Profometer 6 Touchscreen in the explorer under Demo Files and the document “Profometer 650 AI Demo Files Tutorial.pdf” under Information\Documents.

Try out different slider positions to get familiarized with the display of the signal strength color spectrum, e. g. the extreme positions:

- O-** and **G**-slider lowest position: Full color spectrum, full Signal Strength range (of actual measurements)
- O-** and **G**-slider highest position: Full color spectrum, highest Signal Strength (shallower rebars) only
- O-** highest, **G**-slider lowest position: Blue/violet only, highest Signal Strength (shallower rebars) only
- O-** lowest, **G**-slider highest position: Only grey color displayed, Signal Strength beyond actual one

To sharpen the color spectrum set “Sharpen”.

3.2.4. Practical Hints

Measuring diameter and cover

The procedure for evaluating the diameter of the reinforcing bar and cover is as follows:

- Map out the actual grid on the surface of the element using the Locating Mode or Single-Line Mode.
- Evaluate the rebar layout and determine the ideal location for measuring diameter and cover according to the minimum spacing requirements (see Figure 29); if the spacing S_1 of parallel rebars is between 5 cm and 13 cm (2.0 ” to 5.2 ”), set the respective Neighboring Rebar Correction value first.
- Measure the diameter and use the derived value as setting for cover measurement



NOTE! The Determination of the rebar diameter is limited to a maximum cover of about 63 mm (2.50 inch)
Do not use the Spot Range when measuring a diameter

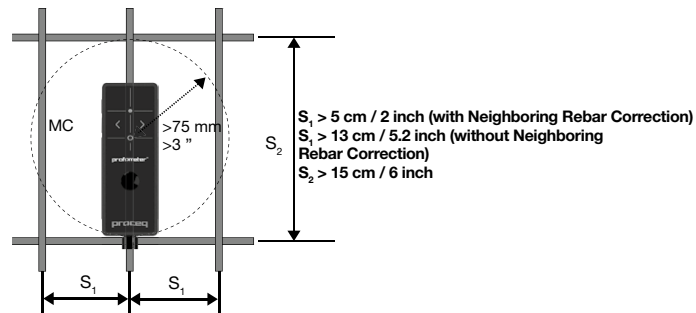


Figure 29: Minimum spacing for diameter measurement

Diameter measurement accuracy is a complicated function of both first and second layer rebar size and spacing; for all practical purposes, when the minimum spacing requirements are met (see Figure 29 as stated in the Technical Specifications, $S_1 > 5 \text{ cm} / 2 \text{ inch}$, $S_2 > 15 \text{ cm} / 6 \text{ inch}$) it can be summarized as stated the Technical Specifications, that is to say ± 1 rebar size.

When a certain diameter assessment is required for structural purposes it is advisable to use **Profometer 6 diameter estimation as a preliminary homogeneity check**, in order to define how many possible different rebar sizes are involved. **A direct observation on an open spot is then advisable on every different location.**

In multiple layer arrangements (see Figure 30) the deeper rebars may affect the diameter measurements on the shallow ones, causing the measured values to be overestimated (see Figure 30).

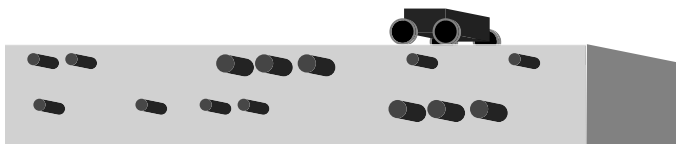


Figure 30: Multiple reinforcement layers

In overlapping areas the measured diameter will be generally 1,4 times higher than the actual single rebar size (see Figure 31).

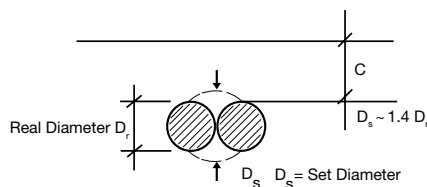


Figure 31: Apparent diameter on overlapping rebars

In any of the two cases mentioned above, or more generally whenever the requirements of the minimum spacings are not met, **the diameter to be set in order to have correct cover readings is the one that is measured by the Profometer 6, regardless of the actual rebar size (apparent diameter).**

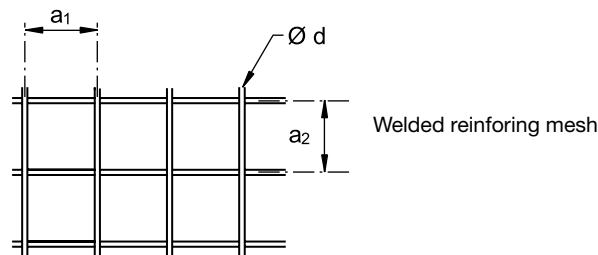
Rebar Orientation

The strongest signal results when the Center Line (CL) of the probe is parallel to a bar. The CL E of the Profometer 6 probe is the longitudinal axis of the probe. This property is used to help determine the orientation of the rebars by rotating the probe slowly and searching for the maximum signal.

Welded Meshes

The instrument cannot detect whether the rebars are welded to one another or connected with binding wires. The two reinforcement types with the same dimensions however create different signals.

The setting of the bar diameter must be slightly higher than the actual diameter of the mesh rebar. The input depends on the bar diameter and on the mesh width. This input value should be determined by means of a test measurement on an open system with specific rebar mesh wire arrangements. Measure on each arrangement with different covers to find out the diameter setting at which the correct cover is indicated.



a_1 [mm]	a_2 [mm]	current d [mm]	d to be set [mm]
100	100	5	8
150	150	6	7

Figure 32: Examples for diameter settings at welded meshes to measure correct cover values



NOTE! The “Standard Range” must be selected. With the “Large Range” or “Spot Range” selected, locating of the rebars may be completely wrong.

Diameter Measurements on welded Reinforcement Meshes

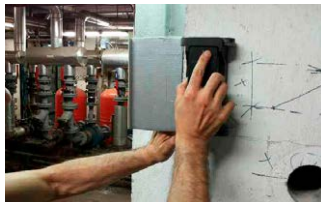
In most cases a diameter can be measured but the displayed value is far too large and cannot be used. The only way to determine the diameter is by an inspection hole.

Scanning on Small Surfaces and Near to Edges

On small areas and near edges you may have to place a cover sheet for scanning with the probe cart.



For correct cover measurements the sheet thickness must be set as Cover Offset value.



In this case no Cover Offset value must be set

Figure 33: Scanning near to the edge

4. Profometer Corrosion

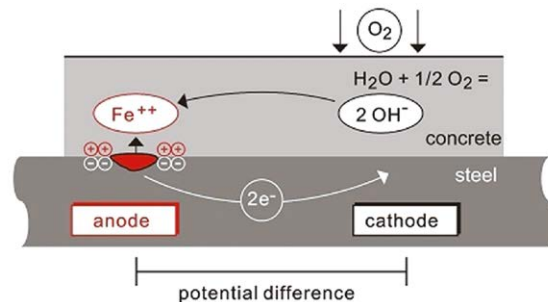
4.1 Measuring Principle

4.1.1. Corrosion and Half-cell Potential

Under normal conditions reinforcement steel is protected from corrosion by a thin, passive film of hydrated iron oxide.

This passive film is decomposed due to the reaction of the concrete with atmospheric carbon dioxide (CO_2 , carbonation), or by the penetration of substances aggressive to steel, in particular chlorides from de-icing salt or salt water.

At the anode ferrous ions (Fe^{++}) are dissolved and electrons are set free. These electrons drift through the steel to the cathode, where they form hydroxide (OH^-) with the generally available water and oxygen. This principle creates a potential difference that can be measured by the half-cell method.



Principle of steel corrosion in concrete with oxygen availability

Figure 34: Principle of steel corrosion in concrete with oxygen availability

The basic idea of the potential field measurement is to measure the potentials at the concrete surface, in order to get a characteristic picture of the state of corrosion of the steel surface within the concrete. For this purpose a reference electrode is connected via a high-impedance voltmeter to the steel reinforcement and is moved in a grid over the concrete surface.

The reference electrode of the Profometer Corrosion system is a Cu/CuSO₄ half-cell. It consists of a copper rod immersed in a saturated copper sulphate solution, which maintains a constant, known potential.

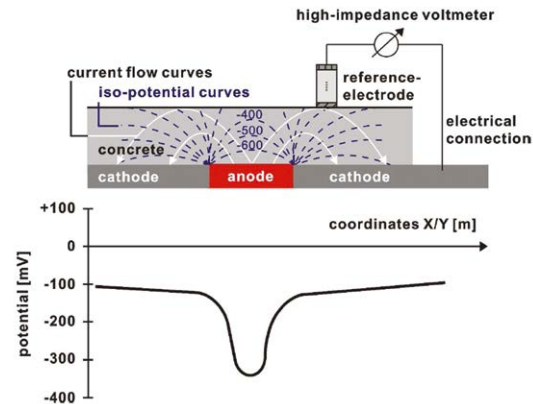


Figure 35: Measuring Principle

4.1.2. Typical Potential Range

Typical orders of magnitude (for information only) for the half-cell potential of steel in concrete measured against a Cu/CuSO₄ reference electrode are in the following range (RILEM TC 154-EMC):

- water saturated concrete without O₂: -1000 to -900 mV
- moist, chloride contaminated concrete: -600 to -400 mV

- moist, chloride free concrete: -200 to +100 mV
- moist, carbonated concrete: -400 to +100 mV
- dry, carbonated concrete: 0 to +200 mV
- dry, non-carbonated concrete: 0 to +200 mV

In general terms the probability of corrosion rises with low (negative) potentials; active corrosion can be expected at locations where a negative potential is surrounded by increasingly positive potentials, i.e. locations with a positive potential gradient. Potential differences of around +100mV within a 1m measurement area, together with negative potentials can be a clear indication of active corrosion.

The actual potential absolute value (corrosion threshold) below which active corrosion can be expected may vary significantly on different structures. It is however useful to mention the thresholds suggested by ASTM C 876-09, Appendix X1, assigning a 90% probability of corrosion ongoing to the areas more negative than -350 mV, and a 90% probability of no corrosion to the areas more positive than -200 mV, judging uncertain the behavior in the regions in between the two thresholds. Be sure to note the conditions stated by ASTM as to the applicability of these threshold values.

4.1.3. Factors affecting the Potential Measurement

Provided that the corrosion conditions are equal (chloride content or carbonation of the concrete at the steel surface) the main influences upon the half-cell potentials are:

Moisture

See the chart above for moist, carbonated concrete and dry, carbonated concrete. Moisture has a large effect on the measured potential leading to more negative values.

Concrete cover thickness (Measure with Profometer / Profoscope)

The potential that can be measured at the surface becomes more positive with increasing concrete cover. Variations in the concrete cover can cause deviations in the measurements. Very low concrete cover can lead to more negative potentials which would seem to indicate high levels of corrosion. Therefore it is advisable to make concrete cover measurements along with the half-cell measurements.

Electrical resistivity of the concrete

Low electrical resistivity leads to more negative potentials that can be measured on the surface and the potential gradients become flatter.

In this case the measurement grid for potential measurements may be coarser, as the risk of undetected anodic areas with flatter gradients becomes lower. However, as the resolution between corroding and passive areas is reduced, this may lead to an overestimation of the actively corroding surface area.

High electrical resistivity leads to more positive potentials that may be measured on the surface and potential gradients become steeper.

In this case the measuring grid must be made finer, in order to be able to locate an anode with a very steep gradient. However, the mere potentials may be misinterpreted as passive areas when only considering the absolute value of the potential.

Temperature

The main effect of temperature on potential measurements is given by its influence on the electrical resistivity. High temperature will cause concrete resistivity to be lower and low temperature will cause concrete resistivity to be higher; the resulting effect on potential value is as described in the previous paragraph "Electrical resistivity of the concrete". In order to measure the potential there must be a contact between the probe and the electrolytes in the pore system of the concrete. Therefore a measurement below the freezing point is not recommended and can lead to incorrect readings.

Oxygen content at the reinforcement

With decreasing oxygen concentration and increasing pH-value at a steel surface its potential becomes more negative. In certain cases of concrete components with a high degree of water saturation, low porosity and/or very high concrete cover and thus low oxygen supply, the potential at the steel surface may be highly negative even though no active corrosion is taking place. Without checking the actual corrosion state this may lead to misinterpretation of the potential data.

The air permeability of the concrete may be tested with Proceq's Torrent instrument.

4.1.4. Application Limits of the Potential Measurement Technique

The potential field measurement even with a coarse grid delivers good results for chloride induced corrosion. This type of corrosion is typified by pitting developing into troughs. Corrosion due to carbonation is typified by the development of smaller macro-elements and is only possible to determine by using a very fine grid if at all.

Corrosion of pre-stressed steel reinforcement is not possible to detect if it is located within a protective tube.

The potential field measurement alone offers no quantitative conclusions about the rate of corrosion. Empirical studies have shown that there is a direct relationship between the corrosion rate and the electrical resistivity. However corrosion rate readings are of limited value as the rebar corrosion rate varies considerably with time. It is more reliable to work with corrosion readings taken over a period of time.

4.2 Profometer Corrosion Operation

4.2.1. Preliminary Operations

Prepare the electrode(s)

Rod Electrode - Before filling, remove the cap with the wooden plug and soak it in water for about an hour to allow the wood to saturate and swell.

Wheel Electrode - The wooden plug is not intended to be removed. Immerse the wheel in water well before you intend to use it to allow water to soak into the plug. The felt hoops and the felt hoop connector should be saturated with water before measuring.

Copper Sulphate (Rod and Wheel) - Prepare the saturated solution by mixing 40 units by weight of copper sulphate with 100 units by weight of distilled water. In order to ensure that the solution remains saturated, add an additional teaspoonful of copper sulphate crystals into the electrode. The electrode should be filled as completely as possible with a minimum of air in the compartment. This ensures that the solution is in contact with the wooden plug even when measuring in an upwards direction.



NOTE! When handling copper sulphate be careful to take note of the safety instructions on the packaging.

Selecting the correct grid and marking the surface

One method is to use a relatively large grid for a first estimate, e.g. 0.50 x 0.50 m up to a max of 1.0 x 1.0 m using the coarse grid. (See "4.2.2. Corrosion Settings").

Suspect areas can be further investigated using a finer grid (e.g. 0.15 x 0.15 m), to identify the extent of the surface that will require corrective maintenance.

Vertical elements usually require a smaller grid (e.g. 0.15 x 0.15 m). The same applies to slender elements, for which the grid will be defined by the geometry, (e.g. steps, beams and joints etc.).

For large horizontal surfaces (parking decks, bridge decks etc.) a grid of 0.25 x 0.25 m to 0.5 x 0.5m is typically sufficient.

It is recommended to mark out a grid on the surface corresponding to the grid you wish to use. For small areas where point measurements will be made with the Rod Electrode this can be done by using a tape or by drawing the grid on the element. For large areas such as parking and bridge decks the wheel electrode is preferable. The integrated path measurement ensures the correct grid in the direction of measurement. To ensure the correct grid between parallel measurement paths marks can be drawn on the surface. Please note the 4-Wheel Electrode ensures a stable parallel grid and requires less marks to be drawn on the surface.

Choosing the appropriate electrode

Depending on the surface under test, it is necessary to choose which type of electrode will be employed. For small areas or areas that are difficult to access, the small and light Rod Electrode will typically be used. For more accessible horizontal, vertical or overhead surfaces, it is much faster to use the 1-Wheel Electrode. For large horizontal surfaces the 4-Wheel Electrode is recommended for the reason of the significantly faster automatic measurement in a pre-defined grid.

Connect to the reinforcement

The ground cable must be connected to the reinforcement of the surface to be measured. This is usually done by chiseling or drilling to the reinforcement. In some cases it may be possible to use existing building elements that are connected to the reinforcement (e.g. water pipes, earth points). The connection to the reinforcement should be made with the least possible resistance. To this end it may be beneficial to grind the reinforcement (e.g. using an angle grinder) and to connect the cable with welding tongs. A secure connection can be also obtained by drilling a 25 mm hole into the concrete above the rebar, then drill a 4 mm hole into the rebar and insert a self tapping screw with attached lead into the hole in the steel. The connection should be tested for continuity. This requires at least one other point of the reinforcement to be exposed and to check the resistance between the two with an Ohmmeter. The connections should be situated as far as possible in opposing corner areas of the surface under test. The measured resistance should not be more than 1 Ω above the resistance of the cable used.

Coated surfaces

It is not possible to make a measurement through an electrically isolating coating (e.g. an epoxy resin coating, sealing sheets or asphalt layers.)

It is possible to make a measurement through thin dispersion coatings, that are often used, for example on the walls and ceiling of underground car parks, however this can cause a small shift of the potentials.

It is always necessary to check whether or not a measurement can be made through a coating.

To do this, potentials should be measured at a few locations

- in the first place through the coating and
- with the coating removed

If possible, areas with largely varying potentials should be chosen. If there is no alteration of the potential, or if a shift of the potential can be compensated by a correction (e.g. $\Delta V = \pm 50$ mV), then a measurement can be made directly on the coating. If not, then the coating must be removed before making the measurement.

Pre-moistening

The contact between the pore solution of the concrete and the probe can be impaired by a dried out concrete skin. This can greatly increase the electrical resistivity of the concrete.

It is therefore recommended to moisten the surface approximately 10 to 20 minutes before carrying out the measurement.

If this is not possible, it must be ensured that the sponge on the Rod Electrode or the felt hoops on the wheel electrode are sufficiently moistened. In this case, when making a measurement, the probe must be held against the surface until a stable end value is reached. (If the surface is dry at the beginning of the measurement, it has to be moistened by the sponge on the probe so a stable value will not be present initially.)

This is only possible with the Rod Electrode.

Proceq provides an additional sponge that connects to the rod electrode in order to increase the overall surface contact area, to prevent testing immediately above a large aggregate.

In the case of the wheel electrode with its continual automatic measure-

ment, it is not possible to monitor whether or not the measured value is stable. Therefore it is recommended to pre-moisten the surface in sections and to measure in intervals of a few minutes.

4.2.2. Corrosion Settings

Enter Settings from the Main Menu (see “2.2 Main Menu”); scroll up and down the screen by dragging your finger up or down the screen. The current setting is displayed on the right hand side. Tap on an item to modify it.

Settings	Measuring Mode (Electrode)		Adjustable after data storage
	Rod	Wheel(s)	
Probe Type	•	•	No
Grid X Spacing	•	•	No
Grid Y Spacing	•	•	No
Enable Grid Limits	•	•	No
Unit	•	•	Yes
Measurement Path	•		No
Coarse Grid Factor	•		No
Auto Save	•		No
Direction of Next Line	•	•	No
Potential Max Threshold (Highest)	•	•	Yes
Potential Min Threshold (Lowest)	•	•	Yes
Potential Range Palette	•	•	Yes
Minimum Passive Limit	•	•	Yes
Maximum Active Limit	•	•	Yes
Half-cell Solution	•	•	No

Probe Type

Select between **Rod**, **One Wheel** and **Four wheel** depending on the electrode connected

Grid X Spacing

It determines the horizontal width of the measured cell (wheel electrode) or the horizontal distance between measured points (rod electrode).

Grid Y Spacing

It determines the vertical distance between two adjacent measuring lines (wheel electrode) or the vertical distance between measured points (rod electrode). In case of four wheel electrode it should be set equal to the distance between the wheels (150 mm, 250 mm or custom).

Enable Grid Limits

If set the user can define the maximum extent of the investigated area.

Unit

Select **Metric** or **Imperial**

Measurement Path

It determines the direction of the measuring sequence when using the rod electrode (Left / Right / Up / Down)

Coarse Grid Factor

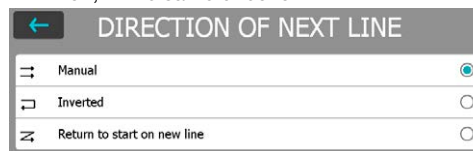
It determines how many times the coarse grid is larger than the XY-Grid already defined. Example: when distance between measurement points in the XY-Grid is set to 150 mm and the Coarse Grid is set to 5, the distance between measurement points in the coarse grid is $5 \times 150 = 750$ mm. This is useful for carrying out an initial sweep and switching to a fine grid later for detailed investigations.

Auto Save

If selected, then measured values of $< -50\text{mV}$ will be acquired automatically once the value has stabilized. If automatic measuring is not selected then values have to be acquired manually. In both cases, values $> -50\text{mV}$ have to be acquired by manually.

Direction of Next Line

- Select **Manual** if the next line begins at the same x coordinate of the end point of the previous one, keeping the same direction.
- Select **Inverted** if the next line begins at the same x coordinate of the end point of the previous one, inverting direction.
- Select **Return to start on new line** if all the lines start at zero position, in the same direction.



At the beginning of each line (for the first 100 cm / 40 inch) the direction as previously set will be displayed on the screen by four flashing arrows and the user will have the option to invert it manually (see “4.2.3. Corrosion-Scan Mode”).

Potential Max Threshold (Highest)

It defines the highest (most positive) potential value associated with the display color palette.

Potential Min Threshold (Lowest)

It defines the lowest (most negative) potential value associated with the display color palette.

Potential Range Palette

Multicolor / Red / Blue / Gray

Minimum Passive Limit

It defines the lowest (most negative) potential value associated with a passive, non corroding area. It is displayed as a green vertical cursor in the Cumulative Distribution View and it defines the areas displayed in green in the Chipping Graph View (see “4.2.4. Corrosion Display Views”).

Maximum Active Limit

It defines the highest (more positive) potential value associated with an actively corroding area. It is displayed as a red vertical cursor in the Cumulative Distribution View and it defines the areas displayed in red in the Chipping Graph View (see “4.2.4. Corrosion Display Views”).

Half-cell Solution

Cu/CuSO₄ (Copper / Copper sulphate), Ag/AgCl (Silver / Silver chloride) or Hg/Hg₂Cl₂ (SCE Calomel).. It is a label that is associated to the data file and displayed in the Profometer Link Software.

4.2.3. Corrosion-Scan Mode

The Corrosion-Scan is the only measurement mode available when the interface box is connected to the platform. The measurement window and the displayed settings depend on whether a Rod or Wheel electrode is selected as Probe Type.



NOTE! In case measuring data shall be stored create a folder in the Explorer (see “5. Explorer Document Handling”) and check if the correct folder is active.

Rod electrode

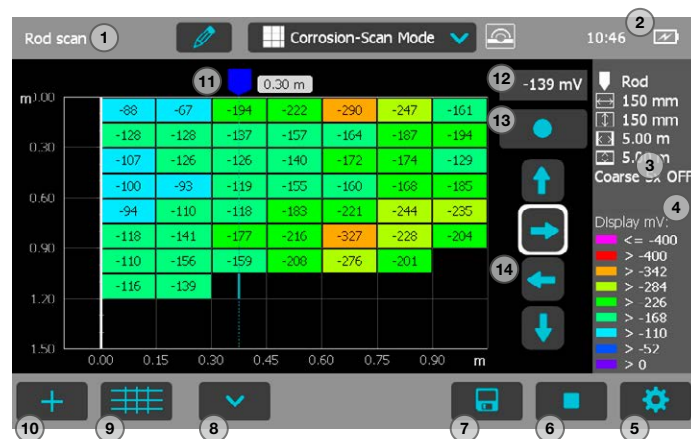


Figure 36: Corrosion-Scan Mode with rod electrode

- 1 File name:** enter the file name and tap return. Saved measurements will be stored with this file name. If several measurements are made under the same filename, a suffix increments after each measurement and follows the file name. A file name given by the user ending already with a number will be incremented on next measurement based on this last number).
- 2 Interface box connected, current time, battery status.**
- 3 Display of selected Settings:**
 - Probe Type
 - Grid X Spacing
 - Grid Y Spacing
 - Grid Limits (if set)
 - Coarse Grid Factor



Zoom in by placing thumb and index finger together on the screen and spreading them apart. This can be used in both the horizontal and vertical directions when making a measurement.



Zoom out by placing thumb and index finger apart on the screen and pinching them together.

Pan the image from left to right by dragging.

The potential values associated with each cell can be visualized by zooming in at the needed level.

Double tap: zoom to fit the whole scan

- 4 **Color palette of displayed potential values**
- 5 **Settings:** switches to the settings menu
- 6 **Start / stop measurement**
- 7 **Store measured data**
- 8 **Move to next line**
- 9 **Coarse Grid On / Off**
- 10 **Edit notes / Edit cell values / Reset all values:** tap cell to edit
- 11 **Probe position and horizontal distance from start**
- 12 **Actual measured potential value**
- 13 **Save actual measured value at cursor position and move cursor to the next cell (defined by the Measurement on Settings or Direction buttons on the screen)**
- 14 **Direction buttons:** tap once to modify the measurement path as defined in Setting (framed in white). Tap on the framed button to actually move the cursor on the screen

In order to allow for an easier handling of the unit during the measurement, the Store (13) and Move to next line (8) buttons can be replicated on the hard Keys.



Store measured data and move cursor to next cell



Toggle Hard Keys Mode On/Off (tap on screen to confirm)



Move to next cell

Measurement procedure

The cursor begins by default in the top left hand corner of the screen.

- Press 6 to start the measurement sequence
- Moisten the foam rubber plug of the electrode with water and press it lightly onto the first measuring point. The measured value will be shown in the 12 box. Once it stabilizes, a beep will indicate when the measurement has been acquired automatically. (if Auto Save is selected in Settings and the measured value is $< -50\text{mV}$) and the cursor will move to the next point to be measured. You can force the storing of the current value and move to the next cell by pressing 13.

Changing the cursor position can be done by tapping and dragging the cursor or using the Direction buttons 14.

- Following the measurement it should be possible to see a wet patch when applied on dry concrete. If this is not the case then the foam rubber plug should be moistened with water again.
- After the last point of a row you can press 8 and the cursor will move to the next line (zero or current point depending on the Direction of Next Line setting).
- You can switch anytime between Coarse and Fine grid by pressing 9; when coarse grid is activated the cursor will skip a number of cells defined by the Coarse Grid Factor after storing or when moved with the Direction buttons. Skipped cells are displayed in white.
- You can edit or delete the measured value at cursor position by pressing 10; alternatively the value can be overwritten by simply positioning the cursor and storing the new measured value.

- You can add text notes to a defined area by tapping 10: just tap on the desired cells, confirm with  and enter your text; the selected area will be highlighted with a white transparent overlay. The note can be deleted anytime later by tapping on the area and pressing .

After storage (tap 7), the data can be seen in the Corrosion-Scan View, Distribution View, Cumulative Distribution View, Chipping Graph View, Chipping Graph ASTM (see “4.2.4. Corrosion Display Views”).

One wheel and four wheel electrode

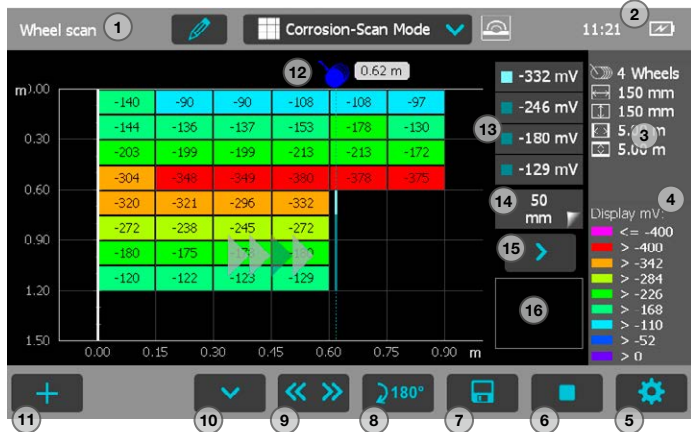


Figure 37: Corrosion-Scan Mode with one and four wheel electrode

- File name:** enter the file name and tap return. Saved measurements will be stored with this file name. If several measurements are made under the same filename, a suffix increments after each measurement and follows the file name. A file name given by the user ending already with a number will be incremented on next measurement based on this last number).

- Interface box connected, current time, battery status.

- Display** of selected Settings:

- Probe Type
- Grid X Spacing
- Grid Y Spacing
- Grid Limits (if set)



Zoom in by placing thumb and index finger together on the screen and spreading them apart. This can be used in both the horizontal and vertical directions when making a measurement.



Zoom out by placing thumb and index finger apart on the screen and pinching them together.

Pan the image from left to right by dragging.

The potential values associated with each cell can be visualized by zooming in at the needed level.

Double tap: zoom to fit the whole scan

- Color palette of displayed potential values**
- Settings:** switches to the settings menu
- Start / stop measurement**
- Store measured data**
- Rotate probe (only four wheel electrode)** in the first 1 m / 40 inch of a new line
- Direction button:** in the first 1 m / 40 inch of a new line it switches the direction of the scan (default direction is defined under Direction of Next Line setting)
- Move to next line**
- Edit notes / Edit cell values / Reset all values:** tap cell to edit
- Probe position and horizontal distance from start**

13 Actual measured potential value(s)

14 Skip distance

15 Skip button

16 Speed bar: green until maximum suggested speed of 1m/s

In order to allow for an easier handling of the unit during the measurement, the Start / Stop (6) and Move to next line (10) buttons can be replicated on the hard Keys.



Start / Stop



Toggle Hard Keys Mode On/Off (tap on screen to confirm)



Move to next line

Measurement procedure

The cursor begins by default in the top left hand corner of the screen.

- Press 6 and start the measurement along the first line: the potential will be continuously measured and the lowest value in the cell will be stored. Note that when using the four wheel electrode the long cursor will display an highlighted segment corresponding always to the first wheel.
- Changing the cursor position can be done by tapping and dragging the cursor (tap on the cursor and wait until it becomes white and orange) or using the Skip function (see “3.2.2 Single-Line Mode”).
- At the end of the line press 10 and the cursor will move to the next line, at zero or current position depending on what defined in Settings under Direction of Next Line.
- At the beginning of each line (for the first 100 cm / 40 inch) the default direction defined in the Direction of Next Line setting is displayed on the screen by four flashing arrows. You can manually change the direc-

tion (button 9) and the orientation of the four wheel electrode (button 8).

- After the first 100 cm / 40 inch the line will automatically be oriented in the set direction, regardless of the actual rotating direction of the wheel.
- At any time you can edit or delete any measured cell value by pressing 11; alternatively the values can be overwritten by simply repeating the scan and storing the new measured values.
- You can add text notes to a defined area by tapping 11: just tap on the desired cells, confirm with  and enter your text; the selected area will be highlighted with a white transparent overlay. The note can be deleted anytime later by tapping on the area and pressing .

After storage (tap 7), the data can be seen in the Corrosion-Scan View, Distribution View, Cumulative Distribution View, Chipping Graph View, Chipping Graph ASTM (see “4.2.4 Corrosion Display Views”).

4.2.4. Corrosion Display Views

Measured data can be displayed in five different views: Corrosion-Scan View, Distribution View, Cumulative Distribution View, Chipping Graph View, Chipping Graph ASTM. All the settings stored with the measurements can be changed afterwards. The views will change accordingly; to store the measuring series with the changes tap Store.



NOTE! Each View can be changed in a measuring mode in order to add data. Tap on . Set the cursor to the new starting position and continue with the measurements (see “4.2.3 Corrosion Measurement Modes”). All data and settings will be stored in the reopened file.



Figure 38: Corrosion-Scan View

The Corrosion-Scan View provides an area mapping of the measured potential values. The cells where no potential value was measured are displayed in white. You can zoom and scroll to any desired location, change

the color palette and the Potential Thresholds under Settings to enhance the readability and highlight the desired details. Text notes can be added to any cell or group of cells as described in 4.2.3 Corrosion-Scan Measurement Mode.

Distribution View

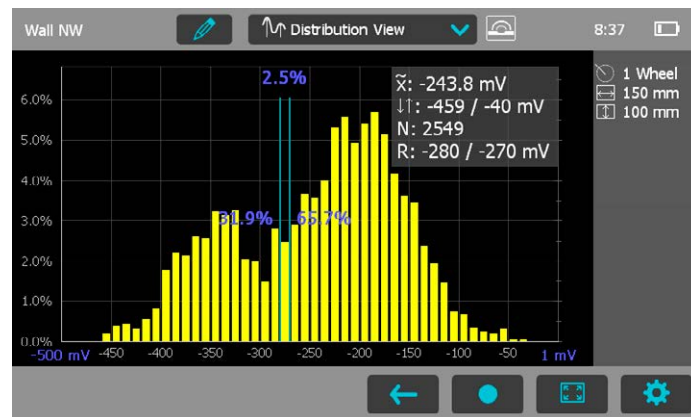


Figure 39: Distribution View

On the horizontal axis the potential values are displayed; the vertical bars show the percentage of the respective potential values measured and stored; you can adjust the horizontal scale with the Zoom button. The vertical cursor bar can be moved to any potential value; the figure on the left of the cursor bar shows the percentage of measured values smaller than the cursor position and the value on the right shows the percentage of measured values larger than the cursor position. In the upper right corner the median, minimum and maximum values are displayed, together with the number of measurements and the current interval set with the

vertical cursor. If the surface under test has both actively corroding as well as passive rebars, then the two states exhibit two distinct partially overlapping distributions, with the corroding areas centered on a more negative potential.

Cumulative Distribution View

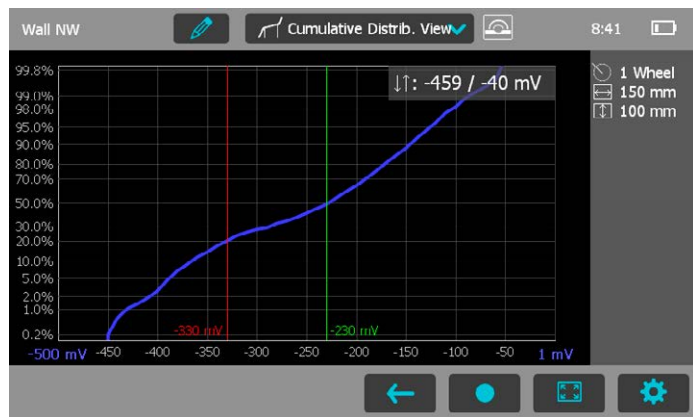


Figure 40: Cumulative Distribution View

The cumulative distribution graph is used to determine the active and passive potential thresholds that will affect the Chipping Graph, discriminating actively corroding areas from passive areas where no corrosion is to be expected.

If the surface under test has both actively corroding as well as passive rebars, then the curve will typically exhibit a central region with a lower gradient (more flat). The two points where the gradient changes can be marked on the screen by dragging the two vertical cursors. The red cursor will define the maximum (most positive) potential value expected of the active distribution.

The green cursor will define the minimum (most negative) potential of the passive distribution.

Active corrosion is to be expected in the region of the left hand (more negative) straight section.

Once these cursor lines have been set, the surfaces in this potential range will be automatically displayed in the corresponding color in the Chipping Graph View.



NOTE! It is always advisable to perform direct visual check on open locations in order to confirm/refine the expected corrosion potential thresholds

Chipping Graph View



Figure 41: Chipping Graph View

The Chipping Graph View provides an area mapping of the measured potential values with a fixed green/yellow/red color palette referring to the thresholds set in the Cumulative Distribution View. An immediate overview is then provided discriminating the actively corroding areas (red) from the passive areas (green) and the uncertain regions (yellow). You can zoom and scroll to any desired location and add text notes to any cell or group of cells as described in 4.2.3 Corrosion-Scan Measurement Mode.



NOTE! It is always advisable to perform direct visual check on open locations in order to confirm/refine the expected corrosion potential thresholds.



NOTE! It is always advisable to perform direct visual check on open locations in order to confirm/refine the expected corrosion potential thresholds.

The Chipping Graph ASTM is a Chipping Graph View with the potential thresholds suggested by ASTM C 876-09, Appendix X1, assigning a 90% probability of corrosion ongoing to the areas more negative than -350 mV, and a 90% probability of no corrosion to the areas more positive than -200 mV, judging uncertain the behavior in the regions in between the two thresholds. An immediate overview is then provided discriminating the actively corroding areas (red) from the passive areas (green) and the uncertain regions (yellow). You can zoom and scroll to any desired location and add text notes to any cell or group of cells as described in 4.2.3 Corrosion-Scan Measurement Mode.

Chipping Graph ASTM

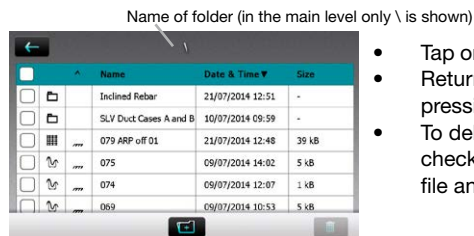


Figure 42: Chipping Graph ASTM

5. Explorer Document Handling

From the main menu select Explorer to review saved files.

If folders have been created as suggested in the first note of “3.2.2. Cover Meter Measurement Modes” the folders are shown in the first lines from top (see following figure).



- Tap on a saved file to open it.
- Return to the Explorer list by pressing the back button.
- To delete a file tap in the check box to the left of the file and delete it.

- Tap on to access the files stored in it.
- To create a new folder tap on , write the name and tap on
- To cut/copy a file/files tap on to the left of the file(s) to become and tap on /
- To insert/copy a file tap on to open the folder and tap on

The cut and insert functions are useful in case a file is/files are stored in the wrong folder or a specific folder was only created after the files have been stored in the main level.

Below the subfolder “Inclined Rebar” is open

	Name	Date & Time	Size
	..	-	-
	031	01/07/2014 09:30	18 kB
	024	03/06/2014 16:00	38 kB

- Tap on the first with the name “..” to go back to the upper folder
- Download measuring files to an USB stick:
- Connect the USB-stick to the USB Device plug on the left side of the Profometer Touchscreen

☒		079 ARP off 01	21/07/2014 12:48	39 kB
☒		075	09/07/2014 14:02	5 kB

- Click on the checkbox of each file to be downloaded and click on
- The name of the downloaded file is “PM-Product version_Year_Month_Day_Time”

Upload pdf-files from an USB-stick:

- Create the folder “PQ-Import” in the main directory of the USB-stick (not as a subfolder in another folder) and fill it with all the pdf-files to be uploaded to the Profometer Touchscreen
- Go to Information/Documents
- Connect the USB-stick to the USB Device plug on the left side of the Profometer Touchscreen
- Click on and confirm with click on

The uploaded pdf-files appear on the bottom of the document list.

6. Ordering Information

6.1 Units

Part No.	Description
392 10 001	Profometer 600 consisting of Profometer touchscreen, universal probe with ruggedized cart, probe cable 1.5 m (5 ft), power supply, USB cable, chalk, DVD with software, documentation, carrying strap and carrying case
392 20 001	Profometer 630 AI consisting of Profometer touchscreen, universal probe with ruggedized cart, probe cable 1.5 m (5 ft), power supply, USB cable, chalk, DVD with software, documentation, activation key, carrying strap and carrying case
392 30 001	Profometer 650 AI consisting of Profometer touchscreen, universal probe with ruggedized cart, probe cable 1.5 m (5 ft), power supply, USB cable, chalk, DVD with software, documentation, activation key, carrying strap and carrying case
392 50 001	Profometer Corrosion consisting of Profometer touchscreen, interface box, battery charger, cable coil l=25 m (82 ft) with clamp, USB cable, DVD with software, documentation, carrying strap and carrying case
392 50 010	Profometer Corrosion rod electrode, with spare parts, cable and copper sulphate (250g)
330 01 001	Profometer Corrosion one wheel electrode, with telescopic handle, encoder, cables, spare parts, tool kit, copper sulphate (250g), citric acid (250g)
330 01 004	Profometer Corrosion four wheel electrode, with telescopic handle, encoder, cables, spare parts, tool kit, copper sulphate (250g), citric acid (250g), carrying case

6.2 Upgrades

Part No.	Description
392 00 115	Software Upgrade from Profometer 600 to 630 AI
392 00 116	Software Upgrade from Profometer 630 AI to 650 AI
392 00 201	Upgrade kit from Profometer 630 to 630 AI consisting of software upgrade (activation key) and ruggedized cart for Profometer 6 universal probe
392 00 202	Upgrade kit from Profometer 650 to 650 AI consisting of software upgrade (activation key) and ruggedized cart for Profometer 6 universal probe
392 50 002	Upgrade kit to Profometer Corrosion consisting of interface box, cable coil, l=25 m (82 ft) with clamp, DVD with software, documentation and carrying case
392 50 003	Upgrade kit to Profometer 600 Cover Meter consisting of universal probe with ruggedized probe cart, probe cable 1.50m (5ft), software upgrade to cover meter

6.3 Parts and Accessories

Part No.	Description
392 40 010	Profometer touchscreen
327 01 033	Battery complete
351 90 018	USB-cable 1.8 m (6 ft)
327 01 061	Power supply
711 10 013	Power supply cable USA 0.5 m (1.7 ft)
711 10 014	Power supply cable UK 0.5 m (1.7 ft)
711 10 015	Power supply cable EU 0.5 m (1.7 ft)

327 01 045	Carrying strap complete
392 00 112	Profometer 6 carrying case
392 40 020	Profometer 6 Universal probe
327 01 050	Profometer 6 Probe cable 1.5 m (5 ft)
325 34 018S	Chalk (set of 10)
392 50 080	Profometer Corrosion carrying case
392 50 100	Interface box
330 00 286	Cable coil, l=25 m (82 ft), with clamp
392 40 040	Telescopic extension rod for universal probe 1.6 m (5.3 ft) with probe cable 3 m (10 ft)
327 01 063	Profometer 6 probe cable 3 m (10 ft)
327 01 068	Profometer 6 probe cable 10 m (33 ft)
392 00 004S	Profometer 6 self-adhesive protective film for probe (set of 3)
330 00 322	Telescopic extension rod for rod electrode, with 3 m cable
330 01 225	Cable clip for telescopic extension
392 50 011	Rod electrode cable, 1 lead, l=1.5 m (5 ft) for Profometer Corrosion, including spade terminal adapter for third party electrodes
327 01 053	Quick Charger (external)
356 00 082	Display antiglare protection film for touchscreen unit

7. Technical Specifications

Profometer 6 Cover Meters

Cover measuring range	Up to 185 mm (7.3 inch)
Cover measuring accuracy	± 1 to ± 4 mm (0.04 to 0.16 inch)
Measuring resolution	Depending on diameter and cover
Path measuring accuracy on smooth Surface	± 3 mm (0.12 inch) + 0.5% to 1.0% of measured length
Diameter measuring range	Cover up to 63 mm (2.50 inch), Diameter up to 40 mm (# 12)
Diameter measuring accuracy	± 1 mm ($\pm$ # 1) on single rebar
Standards and guidelines	BS 1881-204, DIN 1045, DGZfP B2, SN 505262, SS 78-B4, DBV guidelines, CE certification

Profometer Corrosion

Voltage measuring range	-1000 to + 1000 mV
Voltage resolution	1 mV
Impedance	100 M Ω
Sampling rate	900 Hz
Standards and guidelines	ASTM C876, RILEM TC 154-EMC, DGZfP B3, SIA 2006, UNI 10174, JGJ/T 152, JSCE E 601, CE certification

Profometer Touchscreen Universal

Display	7" colour display 800x480 pixels
Memory	Internal 8 GB flash memory
Regional settings	Metric and imperial units and multi-language and timezone supported
Power input	12 V +/-25 % / 1.5 A
Dimensions	250 x 162 x 62 mm
Weight (of display device)	1525 g (incl. battery)
Battery	3.6 V, 14 Ah
Battery lifetime	> 8h (in standard operating mode)
Humidity	< 95 % RH, non condensing
Operating temperature	-10°C to +50°C
IP classification	Touchscreen IP54, universal probe IP67



NOTE! For the full ASTM C876 compliance, depending on the maximum aggregate size of the investigated concrete, the user may have to provide the larger contact sponge than supplied with the rod electrode.

8. Maintenance and Support

8.1 Maintenance and Cleaning

To guarantee consistent, reliable and accurate measurements, the instrument should be calibrated on a yearly basis. The customer may however, determine the service interval based on his or her own experience and usage.

Do not immerse the instrument in water or other fluids. Keep the housing clean at all times. Wipe off contamination using a moist and soft cloth. Do not use any cleaning agents or solvents. Do not open the housing of the instrument yourself.

Maintenance of the Rod Electrode

- Unscrew the two caps, wash with water and carefully clean the inner side of the tube.
- Clean the copper rod using emery cloth.
- Refill the electrode with copper sulphate (See section “4.2.1. Preliminary Operations”)

Maintenance of the Wheel Electrode

- Remove the felt hoops and wash in lukewarm water.
- Remove the plastic filling screw and pour the copper sulphate solution into a container. (This can be reused.)
- Flush out several times with water.
- Dissolve 1 part citric acid in 10 parts hot water and half fill the wheel.
- Replace the filling screw.
- Leave for 6 hours, shaking occasionally.
- Pour out the citric acid solution (no special disposal procedure is required) and flush out several times with water.
- Refill the electrode with copper sulphate solution. (See section “4.2.1. Preliminary Operations”)

- Replace the felt hoops. The felt hoop connector must be in place between the dampening nozzle and the wooden plug of the wheel electrode.
- When not in use, store the wheel electrode with the wooden plug facing upwards.



NOTE! When handling copper sulphate be careful to take note of the safety instructions on the packaging.

8.2 Support Concept

Proceq is committed to providing a complete support service for this instrument by means of our global service and support facilities. It is recommended that the user register the product on www.proceq.com to obtain the latest on available updates and other valuable information.

8.3 Standard Warranty and Extended Warranty

The standard warranty covers the electronic portion of the instrument for 24 months and the mechanical portion of the instrument for 6 months. An extended warranty for one, two or three years for the electronic portion of the instrument may be purchased up to 90 days of date of purchase.

8.4 Disposal



Disposal of electric appliances together with household waste is not permissible. In observance of European Directives 2002/96/EC, 2006/66/EC and 2012/19/EC on waste, electrical and electronic equipment and its implementation, in accordance with national law, electric tools and batteries that have reached the end of their life must be collected separately and returned to an environmentally compatible recycling facility.

9. Profometer Link Software

9.1 Starting Profometer Link



Locate the file “Profometer Link Setup.exe” on your computer or on the DVD and click on it. Follow the instructions on the screen.

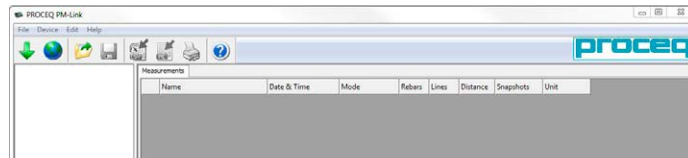


Make sure that the “Launch USB Driver install” tick is selected.

The USB driver installs a virtual com port which is needed to communicate with the Profometer Touchscreen Unit.



Double click on the Profometer Link Icon on your desktop or start the Link via the start menu. The Link starts with a blank list.

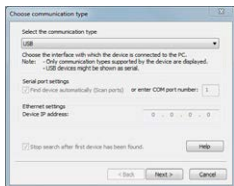


Application Settings

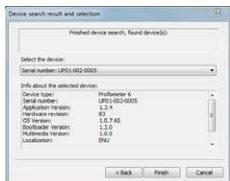
The menu item “File - Application Settings” allows the user to select the language, the date and time format and the color scheme of the displayed results (suggested background preference: black background when viewing on the monitor and white background when the results are to be printed).

9.2 Connecting to a Profometer Touchscreen Unit

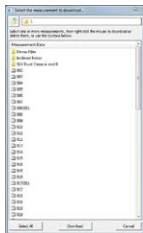
Connect the Profometer Touchscreen Unit to a USB port, then select  to download data from the Profometer Touchscreen Unit. The following window will be displayed: Select “USB” as the communication type. Click on “Next >”.



When a Profometer Unit has been found its details will be displayed on screen. Click on the “Finish” button to establish the connection



Click on “Next >”. When a Profometer Touchscreen Unit has been found its details will be displayed on screen. Click on the “Finish” button to establish the connection.



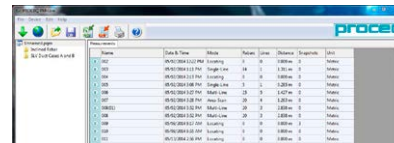
Measurement files stored on the device will be displayed as shown on the left; choose whether to see only Cover meter files, Corrosion files or both by flagging the related box on top of the window.

Select one or more measurements and click “Download”.

9.3 Viewing Cover Meter Data

The selected measurements on your Profometer Touchscreen Unit will be displayed on the screen:

- Click on a folder to access the files stored in it or to paste-in other files.
- Click on the double arrow icon in the first column to see more details. By clicking on the respective colored words one can switch:
 - Among Views **Snapshot**, **Statistics**, **Single-Line**, **Multi-Line**, **Area-Scan** and **Cross-Line View**.
 - In Statistics View, results are displayed either for the Scan-**X** or Scan-**Y** (when measurements done in the Cross-Line Mode).
 - In Single-Line View, when measurements are obtained in the Cross-Line, Multi-Line and Area-Scan Mode, the Scan-**X** and Scan-**Y** results are displayed separately for each scan performed. Additionally the Cover curve, Signal Strength curve or no curve can be selected. When viewing the results with the Cover curve or Signal Strength curve, the rebar number, cover, traversed distance and diameter of the individual rebar can be displayed by setting the cursor on the rebar. By right clicking on the rebar, the user can Mask/Unmask or change the set diameter.
- In Multi-Line and Cross-Line Views among Display Measurement **Cover**, **Diameter** and **Signal Strength**. When Signal Strength is set, you may click on **Sharpen** and adjust the color spectrum with the **O**- and **G**- sliders.
- Between Statistics **Normal** and **DBV**.

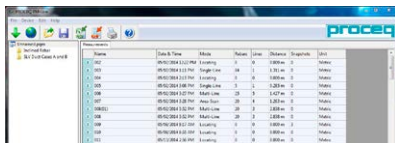


Settings can be changed except the ones used for measurements like Measuring Ranges, Display Inclined Rebars, Return to start on new Line, Line Height and Grid Width.

9.4 Viewing Corrosion Data

The selected measurements on your Profometer Touchscreen Unit will be displayed on the screen:

- Click on a folder to access the files stored in it or to paste-in other files.



By clicking on respective colored words one can switch between Corrosion-Scan View, Distribution View, Cumulative Distribution View, Chipping Graph View, Chipping Graph ASTM. Please refer to “4.2.4 Corrosion Display Views” for the related explanations. Zoom level can be adjusted by the lens / zoom buttons in the top right corner (The following settings related to the data display can be edited (see “4.2.2. Corrosion Settings”):

- Unit
- Potential Max Threshold (Highest)
- Potential Min Threshold (Lowest)
- Potential Range Palette
- Minimum Passive Limit
- Maximum Active Limit

9.5 Editing and moving data files

Rebars	Lines	Distance	Snapshots	Unit
0	0	0.000 m	0	Metric
14	1	1.311 m	0	Metric
0	0	0.000 m	0	Metric
5	1	0.935'	0	Imperial
25	5	4.682'	0	Imperial
20	4	4.444'	0	Imperial
20	3	9.311'	0	Imperial
20	3	9.311'	0	Imperial
0	0	0.000 m	3	Metric
0	0	0.000 m	0	Metric
0	0	0.000 m	0	Metric

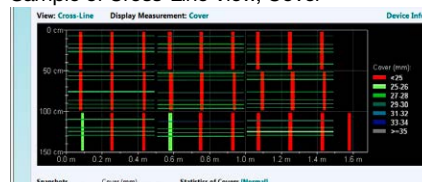
By right click with the cursor in a marked cell of the column “unit” the unit can be changed for the marked measurements.

By holding the cursor on **Device Info** the information about, hardware, software and probe is displayed.



NOTE! Click on “Add” to attach a comment to the object.

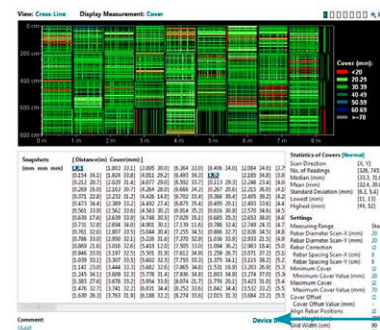
Sample of Cross-Line View, Cover



To paste or delete measurements select one or more rows then right click the mouse and choose one of these options: “Cut/ Copy” or “Delete”. To paste in another folder click on it and right click paste.

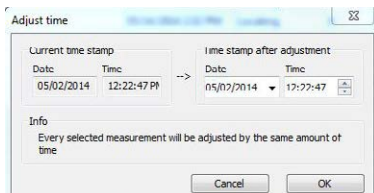
Name	Date & Time	Mode	Rebars	Lines	Distance	Snapshots	Unit
002	05/02/2014 12:22 PM	Locating	0	0	0.000 m	0	Metric
003	05/02/2014 1:11 PM	Single-Line	14	1	1.311 m	0	Metric
004	05/02/2014 3:11 PM	Locating	0	0	0.000 m	0	Metric
005	05/02/2014 3:08 PM	Single-Line	5	1	0.935 m	0	Metric
006	05/02/2014 3:27 PM	Multi-Line	25	5	4.682 m	0	Metric
007	05/02/2014 3:26 PM	Area-Scan	20	4	4.444 m	0	Metric
008(1)	05/02/2014 3:52 PM	Multi-Line	20	3	9.311 m	0	Metric

Sample of View with very large numbers of measurements



To see more data, drag the slider to the right.

Adjusting date and time



Right click in the “Date & Time” column.

The time will be adjusted for the selected series only.

The menu item “Edit – Delete” allows you to delete one or more selected series from the downloaded data.



NOTE! This does not delete data from the Profometer Touchscreen Unit, only data in the current project.

The menu item “Edit – Select all”, allows the user to select all series in the project for deletion, exporting etc.

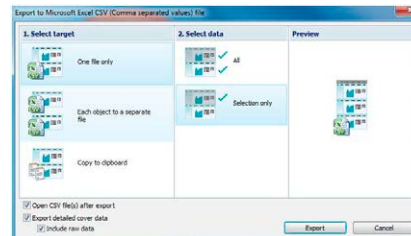
9.6 Exporting Data

Profometer Link allows you to export selected objects or the entire project for use in third party programs. Click on the measurement object you wish to export. It will be highlighted as shown.

	Name	Date & Time	Mode	Rebars	Lines	Distance	Snapshots	Unit
025		06/17/2014 10:55 AM	Single-Line	0	1	0.236 m	0	Metric
026		06/20/2014 2:02 PM	Locating	0	0	0.000 m	0	Metric
026		06/27/2014 2:08 PM	Cross-Line	34	9	2.954 m	0	Metric
027		06/30/2014 2:21 PM	Locating	0	0	0.000 m	0	Metric
043		07/08/2014 9:36 AM	Locating	0	0	0.000 m	0	Metric



Click on the “Export as CSV file(s)” icon. The data are exported as a Microsoft Office Excel comma separated file or files. The export options may be chosen in the following window:



Select “Export detailed cover data” to export the entire calculated concrete cover curve values and not only individual cover values over reinforcing bars. When “Include raw data” is selected, the exported data will include the raw values as measured by the two coils within the probe in addition to the calculated cover curve data.



Click on the “Export as graphic” icon to open the following window which allows the various export options to be chosen.



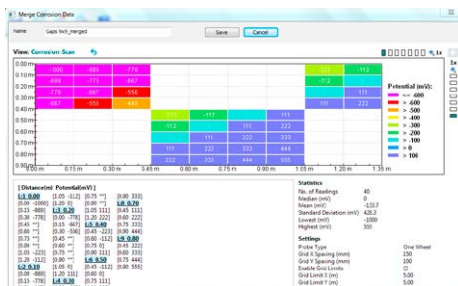
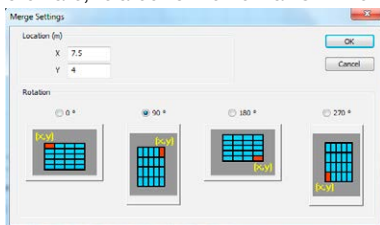
In both cases, the preview window shows the effects of the current output selection.



NOTE! Prior to exporting set the desired View, unit, curve in the corresponding file

9.7 Merging Corrosion Scans

Open the first file you want to combine and click the Add button . A “Merge settings” window will pop up, where you have the option to select the desired rotation by 90° increment. Once Ok is clicked, the “Merge Corrosion Data” window will display the current selected data. You can add any other file to the same window by clicking its Add button and specifying the desired rotation and the positioning of its zero origin coordinate, related to the new axis in the “Merge Corrosion Data Window”.



Two restraints apply:

- The file to be added has to have the same x and y grid size (after rotation) of the previous one(s).
- The insert coordinate (X and Y) has to lay on a grid point (it has to be a multiple of x and y grid size respectively).

Once all the desired files are added to the “Merge Corrosion Data” window, you can save the resulting file with a new Name.

9.8 Further Functions

The following menu items are available via the icons at the top of the screen:



“PQUUpgrade” icon - Allows you to upgrade your firmware via the internet or from local files.



“Open project” icon – Allows you to open a previously saved .pqm project.



“Save project” icon – Allows you to save the current project.



“Print” icon – Allows you to print out the project. You may select in the printer dialog, if you want to print out all of the data or selected readings only.

10. Appendices

10.1 Appendix A1: Rebar Diameters

Following rebar diameters can be selected:

Metric		Imperial			Japanese	
Bar size	Diam. (mm)	Bar size	Diam. (inch)	Diam (mm)	Bar size	Diam. (mm)
6	6	#2	0.250	6	6	6
7	7	#3	0.375	10	9	9
8	8	#4	0.500	13	10	10
9	9	#5	0.625	16	13	13
10	10	#6	0.750	19	16	16
11	11	#7	0.875	22	19	19
12	12	#8	1.000	25	22	22
13	13	#9	1.125	29	25	25
14	14	#10	1.250	32	29	29
...	...	#11	1.375	35	32	32
35	35	#12	1.500	38	35	35
36	36				38	38
37	37					
38	38					
39	39					
40	40					

10.2 Appendix A2: Neighboring Bar Correction

Following rebar spacings can be selected:

Metric, Imperial cm, Japanese		Imperial inch	
5	cm	2.0	inch
6	cm	2.4	inch
7	cm	2.8	inch
8	cm	3.2	inch
9	cm	3.6	inch
10	cm	4.0	inch
11	cm	4.4	inch
12	cm	4.8	inch
13	cm	5.2	inch

10.3 Appendix A3: Minimum / Maximum Cover

Following covers can be selected:

Metric, Imperial mm, Japanese		Imperial inch	
10	mm	0.40	inch
11	mm	0.44	inch
...	mm	...	inch
141	mm	5.52	inch
142	mm	5.56	inch
up to 190	mm	up to 7.48	inch

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