RetroSign GRX Retroreflectometer

User Manual

On-site Quality Control of Road Traffic Signs, High Visibility Clothing, Conspicuity Tapes, and License Plates in accordance with CEN/ASTM

Manual November 2020 - English

DELTA - Venlighedsvej 4 - 2970 Hørsholm - Denmark - Tel. +45 72 19 40 00 - roadsensors@delta.dk

USA Statement

Note:

RetroSign GRX (includes a certified module: Contains FCC ID 2AIG4-MOD1) has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

RF Exposure statement:

RetroSign GRX is compliant with the requirement for RF exposure in US with 80 mm separation distance between the user and / or bystander of the device.

Canada Statement

Note:

RetroSign GRX (includes a certified module: IC: 21541-MOD1) complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil (avec un module homologué: IC: 21541-MOD1) est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

(1) l'appareil ne doit pas produire de brouillage; et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF Exposure statement:

RetroSign GRX is compliant with the requirement for RF exposure in Canada with 80 mm separation distance between the user and / or bystander of the device.

Retro Sign GRX est conforme à l'exigence de l'exposition aux RF au Canada avec une distance de séparation de 80 mm entre l'utilisateur et / ou spectateur de l'appareil.

Disclaimer

The information contained in this document is subject to change without notice.

DELTA MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICU-LAR PURPOSE. DELTA SHALL NOT BE LIABLE FOR ERRORS CONTAINED HEREIN OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, PERFORMANCE OR USE OF THIS MATERIAL.

RETROSIGN GRX IS BUILT ON GENERAL PUBLIC LICENSE COMPONENTS. THE SOURCE CODE IS AVAILABLE UPON REQUEST.

Intended use/purpose

RetroSign GRX retroreflectometer is a portable field instrument used for on-site inspection and quality control of retroreflection properties of road traffic signs, high visibility clothing, reflective tapes and license plates.

Important Safety and Handling Information

Caution: Changes/modifications not approved by the responsible party could void the user's authority to operate the equipment.

 RetroSign GRX may not be used with other batteries than those supplied with the product.

Disposal and Recycling Information

Please ask your appointed dealer concerning disposal of RetroSign GRX in your country.

Visit our web-site: http://roadsensors.madebydelta.com/

Declaration of Conformity (DoC)

Unique identification of this DoC: GRX EU 002

We,

FORCE Technology
Venlighedsvej 4
DK-2970 Hørsholm

declare under our sole responsibility that the product:

Product name:	RetroSign GRX
Trade name:	RetroSign GRX
Type or model:	All types pursuant to the referenced trade name
Serial / Batch no.:	From Serial number: 178 (incl.)

to which this declaration relates is in conformity with the essential requirements and other relevant requirements of the:

The Radio Equipment Directive (RED) (2014/53/EU)

Safety - article 3(1)(a)

Electrical safety:	EN 60950-1:2006+A11:2009+A1:2010+A12:2011+AC2011+A2:2013
EMF:	EN 62311:2008
Photobiological safety:	EN 62471:2008

EMC - article 3(1)(b) EN 301 489-1 V2.1.1:2017

Radio - article 3(2) and 3(3)
EN 300 328 V2.1.1:2016
EN 303 413 V1.1.1:2017

Restriction of the use of certain hazardous substances (RoHS) directive 2011/65/EU
Assessment of components datasheets

Supplementary information: -

Technical file held by the undersigned.

First year of CE marking: 2016

Place and date of issue (of this DoC): Hørsholm 10-July-2018

Signed by or for the manufacturer:

.....
(Signature of authorized person)

Name (in print):
Susan Bonde
QA Manager, Product Division, Electronics & Microelectronics

CE

US Attestation of Conformity (AoC)

Unique identification of this AoC: GRX US 002

We,
DELTA Dansk Elektronik, Lys & Akustik
Venlighedsvej 4, Hørsholm
DK-2970 Hørsholm

declare under our sole responsibility that the product:

Product name: RetroSign GRX
Trade name: RetroSign GRX
Type or model: All types pursuant to the referenced trade name

to which this attestation relates is in conformity with the essential requirements and other relevant requirements of 47 CFR FCC Part 15.

The product is exempted from other specific FCC rule parts than the general rule parts 15.5 and 15.29 pursuant to specific rule part 15.103(c), as it is intended solely for use as industrial test equipment. However, the product is verified according to the specific rule parts:

47 CFR Part 15B, subpart 15.107 (Class B)
47 CFR Part 15B, subpart 15.109 (Class B)

The equipment is accredited safety test with the internationally harmonized safety standard:

IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:2013

Supplementary information:
The equipment incorporates a modular transmitter module with a 2.4 GHz Wi-Fi and BT with FCC ID 2AIG4-MOD1, which may be used in handheld portable exposure conditions with no closer than 80 mm to the host platforms.

Technical file held by the undersigned.

Place and date of issue (of this AoC): Hørsholm, July 11th 2018

Signed by or for the manufacturer:

Susan Bonde

.....
(Signature of authorized person)

Name (in print):
Susan Bonde
QA Manager, Product Division, Electronics & Microelectronics

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

Table of Contents

SECTION 1: Introduction

GRX usage

RetroSign GRX retroreflectometer is a portable field instrument for on-site inspection and quality control of all types of road traffic signs, high visibility clothing, conspicuity tapes, and license plates, that are illuminated by vehicle headlights in darkness e.g. at night time or in road tunnels.

What does GRX measure?

RetroSign GRX measures the value R_A (coefficient of retroreflected luminance at night). R_A is a measure that indicates the visibility of the road traffic signs, high visibility clothing, conspicuity tapes, and license plates as seen by drivers of motorized vehicles in headlight illumination.

R_A is an important factor in the on-site quality control of road traffic signs.

Models

RetroSign GRX is a retroreflectometer with LED source technology. It measures retroreflectivity at up to 7 observation angles.

The retroreflectometer is based on point aperture geometry comparable to laboratory readings reflecting real-world driving conditions and allows detection of incorrect sheeting application.

RetroSign GRX combines CEN and ASTM geometries in one instrument and is available in three base models:

- **GRX-1**: one entrance/illumination and 1 observation angle
- **GRX-3**: one entrance/Illumination and 3 observation angles
- **GRX-7**: one entrance/illumination and 7 observation angles

When using ASTM geometry the sign is illuminated at an entrance angle of -4º, whereas CEN geometry means that the sign is illuminated at an entrance angle of +5º. DELTA can supply additional entrance/illumination angles of +10º, +20º, +30º, +40º, and +45º if required. The entrance/illumination angles are determined by the angle adapter mounted at the front of the GRX.

The exact model, with 1, 3, or, 7 observation angles, depends on the needs of the user. The observation angles available are: 0.2º, 0.33º, 0.5º, 0.7º, 1.0º, 1.5º, and 2.0º.

Depending on the chosen GRX model and the entrance/illumination angle(s) acquired, the instrument will be able to meet any angle combination stated in relevant European and US standards like EN 12899, ASTM E 1709, and ASTM E 2540 for road traffic signs, and EN 20471, ASTM 1809 for high visibility clothing.

International standards

The RetroSign GRX measures the retroreflection and calculates R_A according to international CEN and ASTM standards. The instrument complies with the following European and US standards:

- EN 12899: Fixed, Vertical Road Traffic Signs, part 1-5
  Part 1: Fixed Signs & Part 4: Factory Production Control
- EN 20471: High-Visibility Clothing - Test Methods and Requirements
- ASTM E 1709: Standard Test Method for Measurement of Retroreflective Signs Using a Portable Retroreflectometer at a 0.2 degree Observation Angle
- ASTM E 2540: Standard Test Method for Measurement of Retroreflective Signs Using a Portable Retroreflectometer at a 0.5 degree Observation Angle
- ASTM E 1809: Standard Test Method for Measurement of High-Visibility Retroreflective-Clothing at a 0.2 degree Observation Angle and an Entrance Angle of -4 degree (discontinued).
- ECE Regulation 104: Uniform provisions concerning the approval of retroreflective markings for vehicles of category M, N and O

Overview of RetroSign GRX

It is very easy to operate the RetroSign GRX and requires a minimum of instruction. The instrument provides a warning message or sound in case of unreliable measurement.

The measurement results are presented on a color touch screen.

Each measurement can be linked to a user/operator name and a series name which may contain user defined data (i.e. fields).

The GRX is equipped with a USB port for data export via a memory stick and is equipped with WiFi for wireless export.

RetroSign GRX is powered by a rechargeable battery, offering many hours of measurement capacity. A mains powered battery charger is supplied as customary delivery.

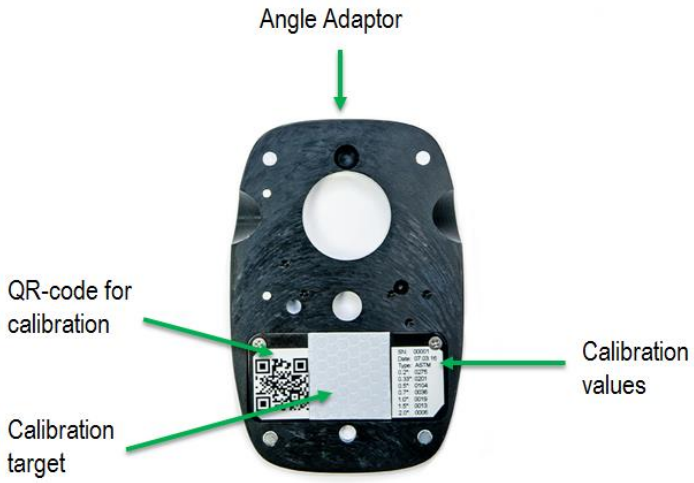
The majority of buttons on the RetroSign GRX are accessible via the touch screen. The physical buttons and features on the instrument are shown below.

Front and bottom view of RetroSign GRX

Angle adaptor

The angle adaptor is attached with magnets to the GRX and can easily be removed. It defines the entrance/illumination angle and is magnetically encoded for measurement standard and main observation angle.

The backside of the angle adaptor is used for calibration and looks like this:



See *Section 3 – Operating Information* for details on how to calibrate the GRX.

Touch screen

The RetroSign GRX has a color touch screen, which makes it easy to operate the instrument using these movements: tap, swipe, and pinch.

GRX features and accessories

The RetroSign GRX contains a number of standard and optional features and accessories.

Standard features and accessories

- High brightness 5” color touch screen
- Measures R_A, night visibility
- Photopic corrected detector and source (illuminant A)
- Easy one-step calibration procedure with built-in calibration target
- Measurement possible night and day including in full daylight
- Automatic color recognition
- Sign legend and background retroreflectivity, calculated contrast
- Sign property data collection
- Record temperature and relative humidity
- Automatic data storage
- USB port for data transfer to memory stick
- Data export to standard software programs like Excel and Google Earth
- Storage of more than 2 million measurements without pictures, more than 2,000 measurements with pictures
- 230 V/50 Hz or 120V/60 Hz mains powered battery charger
- Spare battery
- Carrying case

Optional features and accessories

- Built-in GPS receiver
- Built-in wireless communication
- Built-in camera for picture of sign, easy calibration, and scanning of barcode / QR codes
- Recognition of sign orientation and correct instrument rotation
- Additional entrance angle adapter (+10º, +20º, +30º, +40º, and 45º)
- Extension pole kit

SECTION 2: General information

Retroreflectometer

The RetroSign GRX retroreflectometer measures the R_A (coefficient of retroreflected luminance) parameter. The parameter 'R' represents the luminous intensity of the road signs as seen by drivers of motor vehicles during headlight illumination.

The RetroSign GRX executes measurements automatically when the trigger is activated or a measurement is activated on the touch screen. The result and status are shown on the touch screen. The result and other related information is stored in the internal memory.

The instrument is operated from the touch screen of the retroreflectometer. A USB memory stick is used for transferring data records to a computer for further processing.

Factory calibrations

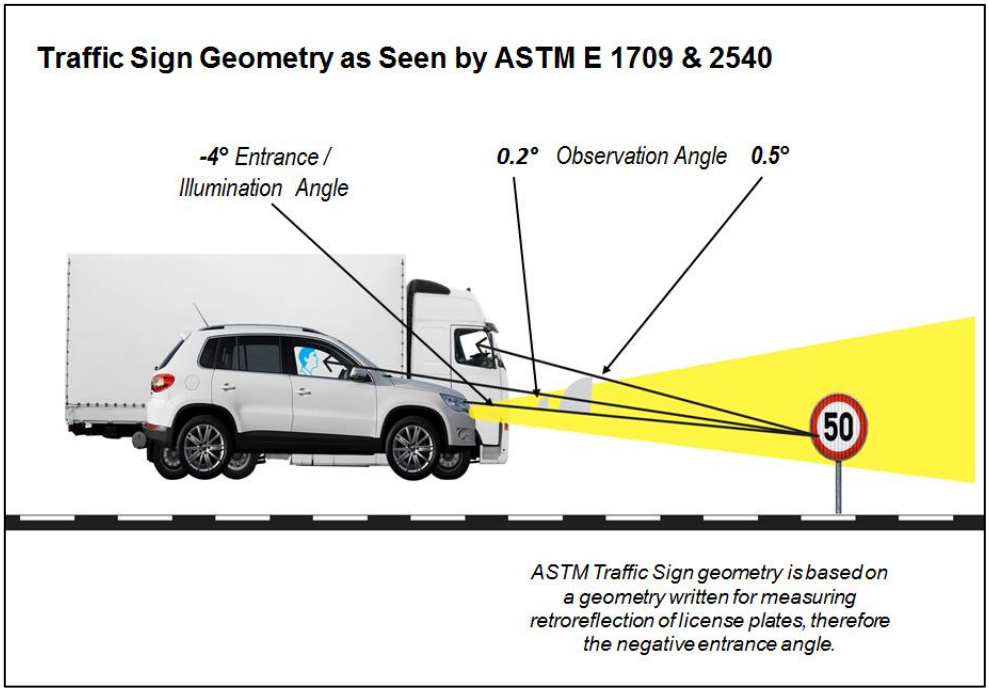
The RetroSign GRX is factory calibrated. The reference's R_A value is measured in DELTA's DANAK accredited calibration laboratory using traceable methods and equipment.

To ensure that the GRX measures retroreflection of materials correctly it is recommended to do a daily calibration using the calibration reference supplied with the instrument. The calibration target (placed on the back of the angle adaptor) should be used for verification and calibration of the retroreflectometer.

Measurement geometry

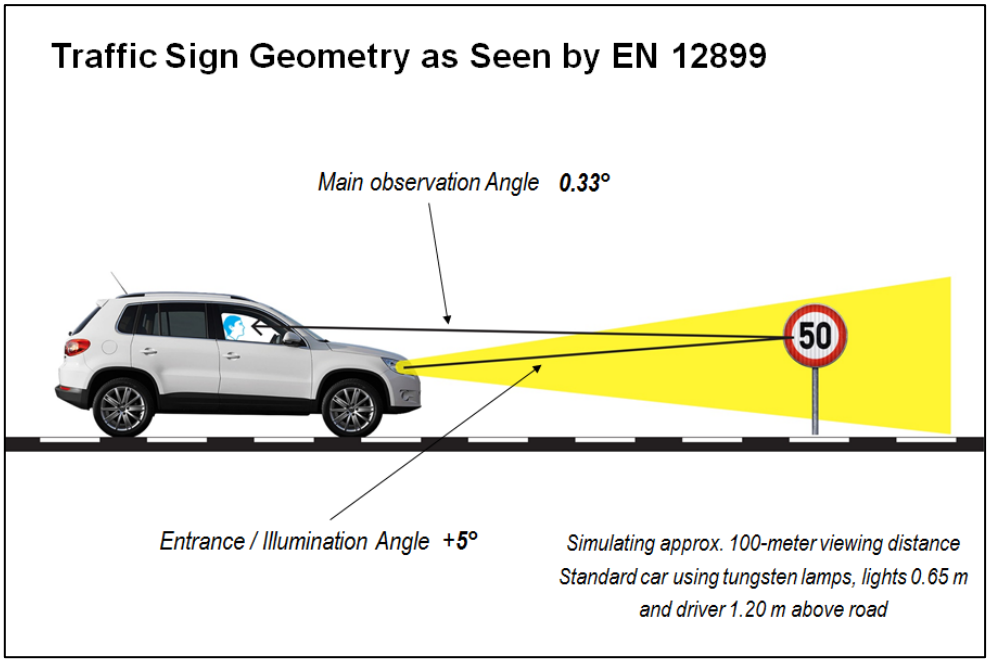
GRX type ASTM (ASTM E 1709, ASTM E 2540)

The illumination angle Beta 1 of this model is -4º. The offsets between the illumination and the primary observation angle are 0.2º (GRX-1) and the three observation angles are 0.2º, 0.5º and 1.0º (GRX-3) respectively and all available observation angles in GRX-7 (i.e. 0.2º, 0.33º, 0.5º, 0.7º, 1.0º, 1.5º, and 2.0º). The measurement area is ø 25 mm / 1 inch.



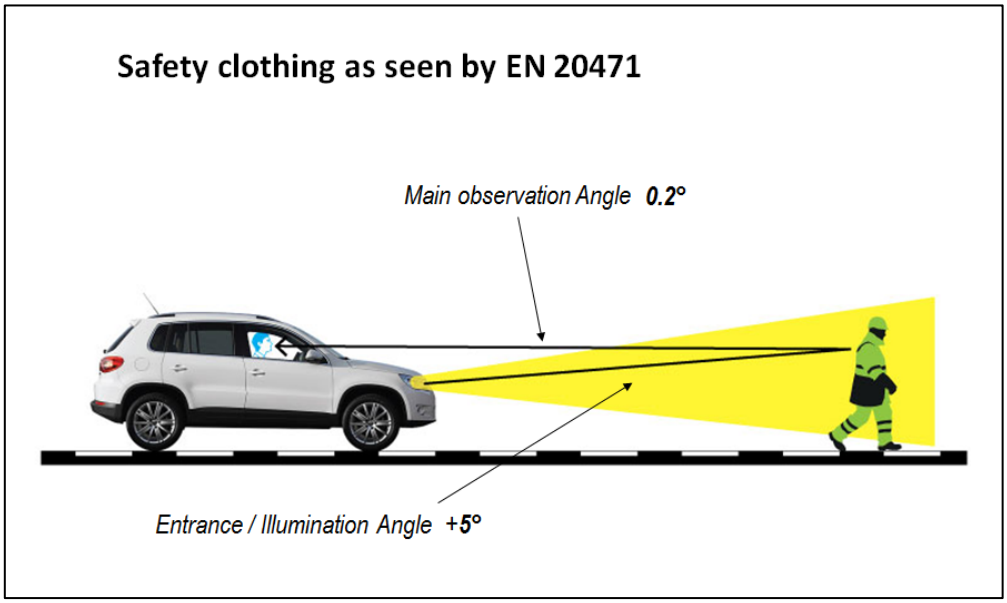
GRX type CEN (EN 12899)

The illumination angle Beta 1 of the model is +5º. The offsets between the illumination and the primary observation angle are 0.33º (GRX-1) and the three observation angles are 0.33º, 0.5º, and, 1.0º (GRX-3) respectively and all available observation angles in GRX-7 (i.e. 0.2º, 0.33º, 0.5º, 0.7º, 1.0º, 1.5º, and 2.0º). The measurement area is ø 25 mm / inch.



GRX type SAFETY (EN 20471)

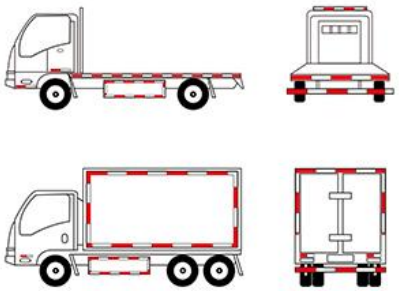
The illumination angle Beta 1 of the model is +5º and the offsets between the illumination and observation angle is 0.2º. The measurement area is ø 25 mm / 1 inch.



GRX type Conspicuity tape (ECE 104)

The illumination angle Beta 2 of the model is +5º. The offsets between the illumination and the primary observation angle are 0.33º (GRX-1) and the three observation angles are 0.33º, 0.5º, and, 1.0º (GRX-3) respectively and all available observation angles in GRX-7 (i.e. 0.2º, 0.33º, 0.5º, 0.7º, 1.0º, 1.5º, and 2.0º). The measurement area is ø 25 mm / inch.

For ECE 104 a multi-angle adapter measuring illumination angles Beta 2 of +/- 5 º, 20º, 30º, 40º and 60º can be supplied.



Battery

The instrument is powered by a Li-Ion battery, which under normal use requires no maintenance. The battery is a standard Bosch Li-Ion battery.

The battery is equipped with a thermal sensor that only allows charging within a range between 0ºC and 45ºC (32ºF and 113ºF). This ensures long battery life.

A substantial drop in obtainable measurements on a fully charged battery indicates that the battery is worn out and must be replaced.

For your safety

Do not expose the battery to heat or flames: **Danger of explosion.** Do not place the battery on a heater or expose to direct sunlight for long periods.

The battery can be stored within a temperature range between -10°C to +60°C (14°F to 140°F), but we recommend storage between 0°C to +30°C (32°F to 86°F), due to lifetime considerations of the battery.

Allow a warm battery to cool before charging.

When handling or storing the battery take special care to avoid possible short circuiting the battery contacts.

Do not insert the battery in the charger if the battery is cracked. Using a damaged battery may result in electric shock or fire.

See further details in the battery user guide.

Safety precautions:

- The battery should be protected against impact. Do not open the battery.
- Store the battery in a dry and clean place.
- Due to environmental protection do not dispose the battery with household waste.

Battery charger

A battery charger is provided as a standard accessory for charging the battery from the mains. The battery charger comes in two models:

- Bosch AL1130CV, 230V AC, 50/60 Hz
- Bosch BC330 Fast Charger, 120V AC, 60 Hz

The battery will be fully charged in approx. 45 minutes.

Due to the intelligent charging method, the charging condition of the battery is automatically detected and the battery is charged with the optimum charging current, depending on battery temperature and voltage.

To recharge the battery, first make sure that the RetroSign GRX is turned off, remove the battery from the handle and insert it in the charger. Make sure the battery and battery charger is clean and dry before and during charging takes place.

The battery charger will during charging give the following information:

Charger AL1130CV

- If the **green** indicator light is '*on*', the charger is plugged in but the battery is not inserted, or the battery is fully charged and is being trickle charged.
- If the **green** indicator light is *'flashing'*, the battery is being fast-charged. Fast-charging will automatically stop when the battery is fully charged.

Note: The rapid-charging procedure is only possible when the battery temperature is within the allowable charging temperature range (see below).

- If the **red** indicator light is *'flashing'*, the battery cannot accept a charge. The battery may be defect or the contacts of the charger or battery are contaminated. Clean the contacts of the charger or battery and check. Change the battery is no solution can be found.
- If the **red** indicator light is '*on*', the temperature of the battery is not within the allowable charging temperature range. As soon as the allowable charging temperature range is reached, the battery charger automatically switches to rapid charging.

Charger BC330

- If the **green** indicator light is '*off*', the charger is not receiving power from power supply outlet.
- If the **green** indicator light is '*on*', the charger is plugged in but the battery is not inserted, or the battery is fully charged, or the battery is too hot or cold for fast-charging. The charger will automatically switch to fast-charging once a suitable temperature is reached.
- If the **green** indicator light is '*flashing*', the battery is being fast-charged. Fast-charging will automatically stop when the battery is fully charged.

For your safety

Read all instructions. Failure to follow all instructions listed below may result in electrical shock, fire and/or serious injury.

- The battery and the charger are specifically designed for use in conjunction with one another. Charging should be done only with the charger delivered with the instrument.
- Protect the battery from rain and moisture. The penetration of water in a battery charger increases the risk of electric shock.
- Do not insert battery pack in charger if battery is cracked. Using damaged battery may result in electric shock or fire.
- Do not disassemble charger or operate the charger if it has received a sharp blow, been dropped or otherwise damaged in anyway. Incorrect reassembly or damage may result in electric shock or fire.
- Keep the battery charger clean. Contamination may cause the danger of electric shock.
- Check the battery charger, cable and plug each time before using. Do not use the battery charger when defects are detected. Do not open the battery charger yourself and have it repaired only by qualified personnel using original spare parts. Damaged battery chargers, cables and plugs increase the risk of electric shock.
- Do not operate the battery charger on easily inflammable surfaces (e.g. paper, textiles, etc.) or combustible environments. There is danger of fire due to the heating of the battery charger during charging.
- Do not store battery in charger. Storing the battery in the charger over a long period of time could lead to battery damage and fire.
- See further details in the charger user guide.

Practical advice
With continuous or repetitive charging cycles without interruption, the charger can warm up. This is of no consideration and does not indicate a technical defect of the unit.

SECTION 3: Operating information

Getting started

Turn the RetroSign GRX on by pressing the red power button underneath the instrument. After some time the system has booted and the instrument is ready for use.

The RetroSign GRX automatically switches to stand-by mode if the instrument has not been used for a specific amount of time (see *'Settings'* in this section). From stand-by mode the instrument is ready within 1-2 seconds.

Calibrate the instrument if necessary (see *'Calibration'* later in this section). To ensure high quality of data DELTA recommends calibrating the instrument minimum once a day, typically in the morning before commencing the measurements.

The instrument can be operated between 0ºC to +60ºC / +32ºF to 140ºF.

Switching the instrument on/off and stand-by

Turn on: press the red power button.

Stand-by: press the power button shortly to switch off RetroSign GRX and set it in stand-by mode. The instrument can easily be switched on again by pressing the power button again.

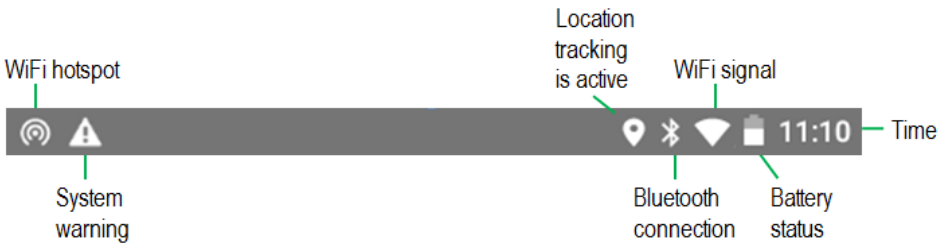
Switching off: to switch off the instrument completely press and hold the power button for a couple of seconds until *'Power off'* is written on the touch screen. Then tap the screen to turn off the instrument.

Be aware: The battery is drained off power if the instrument is not being switched off after user.

Safety precautions. In case of any severe error condition remove the battery immediately.

Icons

The icons in the status bar at the top of the screen give information about the instrument status and operational mode:

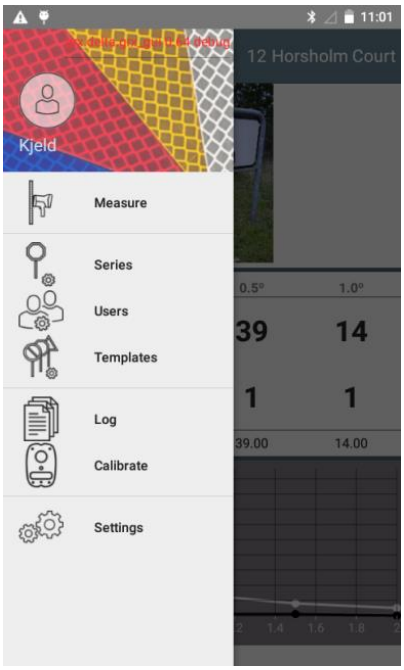


Main menu

The various instrument actions can be accessed via the main menu.

Press  at the top left corner of the GRX screen to access the main menu. You can also access the main menu by swiping the screen from the left side.

The main menu looks like this:



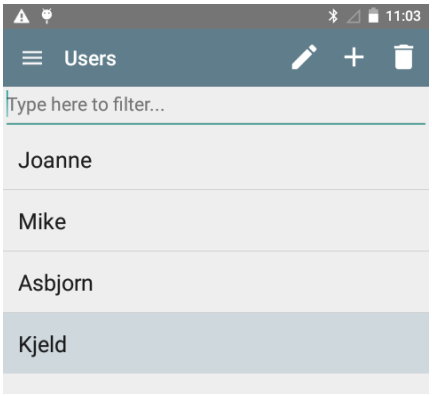
The main menu consists of these elements:

Icon	Function	Explanation
	Measure	Perform an inspection
	Series	Select, add, or delete series of measurements
	Users	Select, add, edit, or delete a user
	Templates	Add, edit, or delete templates
	Log	Overview of conducted measurements and series. Export or delete data
	Calibrate	Calibrate the GRX
	Settings	Adjust settings e.g. time, date

Users

'Users' is used to identify the operator of the instrument. The user name is saved in the log together with each measurement.

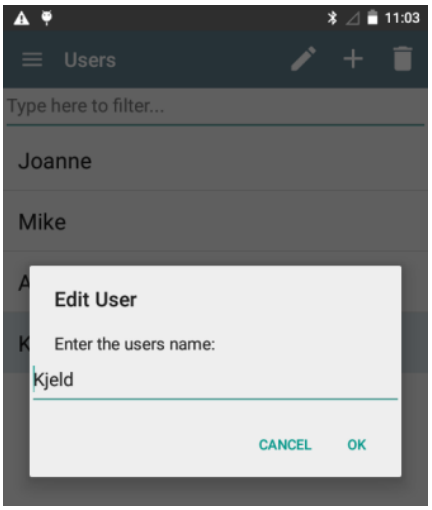
At the top of the main menu the selected user is shown. To change user, or add a new user, select  'Users' from the main menu. This is then displayed on the screen:



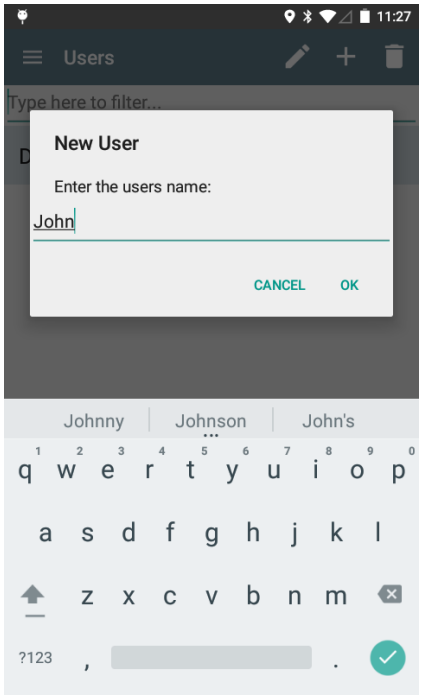
Here you have these five options:

1) **Activate** a user by tapping the relevant user name on the list.
2) **Filter or find** an existing user by tapping 'Type here to filter…' and write the relevant filter.

   Complete by pressing  .
3) **Edit** an existing user by pressing  . In the pop-up box you can change the user name:



4) **Add** new user by pressing  . In the pop-up box, enter the relevant user name of the new user and press 'OK':



5) **Delete** a user by pressing and then 'OK'.

Working with templates, series, and inspections

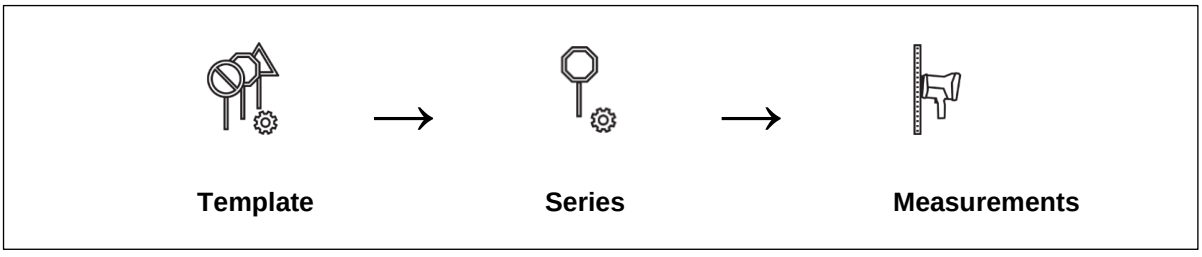
Using the GRX to conduct measurements is very easy. However, the instrument quickly contains a large number of measurements which can be rather overwhelming to look at or find, if the data is not organized. The instrument helps you organize the data.

Definitions:

- An **inspection** is defined as all the collected data and measurements on a single sign.
- A **template** defines which measurements should be conducted for a specific inspection and contains information of common interest for a series of inspections.
- A **series** relates to your specific work-assignment and contains a group of related inspections including which data should be collected in new inspections.

Note: inspections are grouped in series.

In practice, when using the GRX you start deciding on a template, then set up one or more series and finally conduct the measurements:



Recommended daily routine after calibrating the instrument:

1. **Create a series** based on the selected **template** (or select an existing series) where you can save all your measurements related to a particular assignment.
   Note: If no template is created, you must create one first.
2. **Conduct the measurements** on-site.
3. **Examine the log** to check you have all the data you need.
4. **Export the measurement data** for further analysis and reporting.

In the following sections, these steps are described in further details.

Single shot option

The GRX has a 'single shot' option for situation where just a single measurement is needed (i.e. point-and-shoot). Press on the single shot icon to activate the feature.

Note: All fields (i.e. Sign ID, Vendor, Legend etc.) must be filled out in the series. You will not be prompted for them in single shot mode.

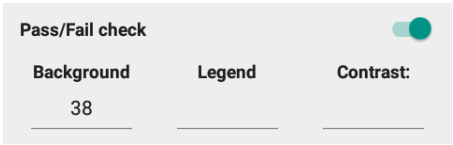
Pass/fail check

The GRX has a built-in pass/fail functionality that indicates the performance of the inspected sign. When you have completed an inspection of a sign, you will see one of these symbols:

The sign has passed the check: 

The sign has failed the check: 

For the pass/fail check to work properly, you must insert the threshold R_A/contrast values for the background, legend, and contrast. Combine the three values to fit your needs. To turn off the functionality just delete the digits or write '0'. In the below example, only the background will be checked:



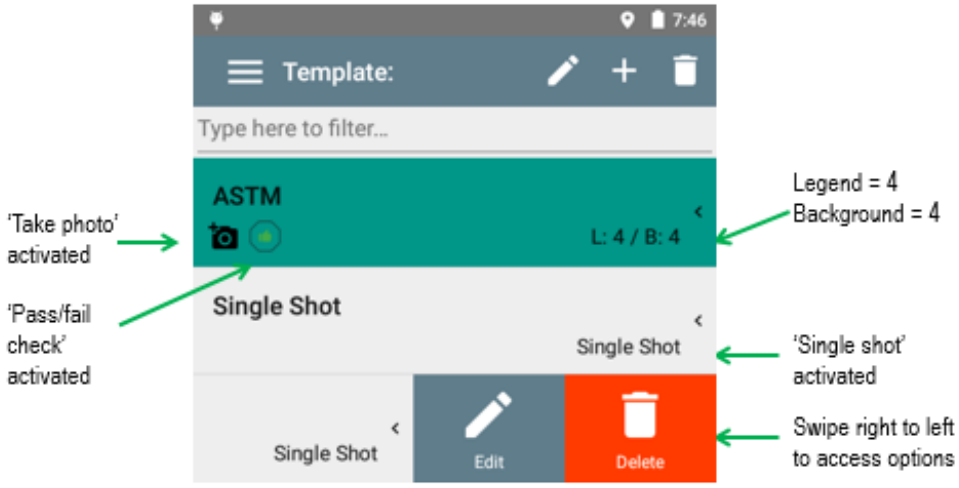
The results of the pass/fail check is automatically stored in the dataset, which you can see in the log file.

Using the pass/fail check is further described in the sections 'Templates', 'Series', and 'Measurement'.

Templates

A template defines which measurements should be conducted for a specific inspection. The template specifies the data fields to be captured during an inspection e.g. name of vendor, road, or sign ID.

To choose a template, or add a new template, select  'Templates' from the main menu. The list of stored templates is now displayed on the screen:



In the bottom line of the template name, a brief description of the template settings is shown.

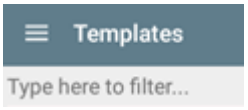
Here, you have four options:

1) **Filter or find** an existing template
2) **Edit** an existing template
3) **Add** a new template
4) **Delete** a template

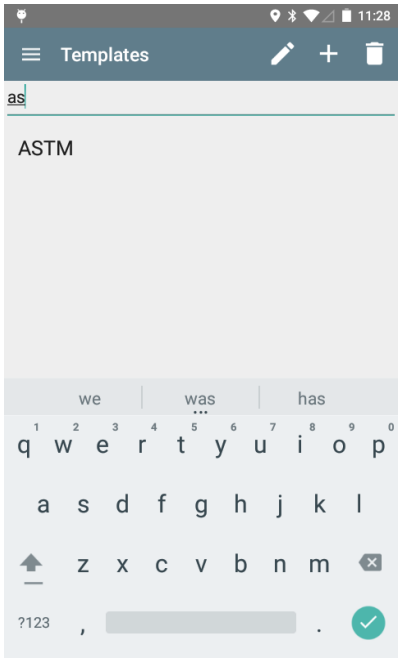
Below are instructions for each of these options.

1) Filter or find an existing template

- You filter or find an existing template by tapping 'Type here to filter…':



- Use the keyboard, which appears on the screen, to type the name of the relevant filter. When finished, press :

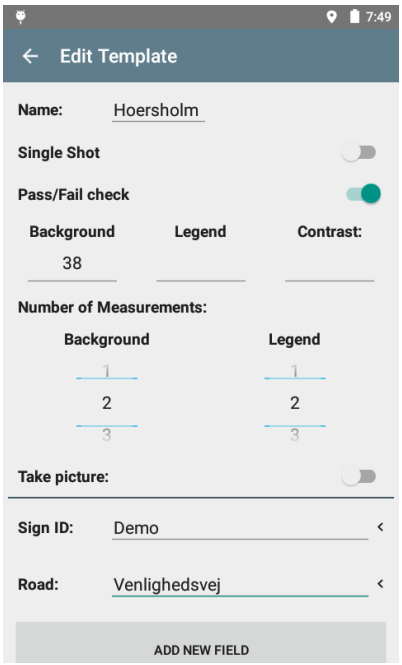


- The screen now shows the template(s) that match the filter.

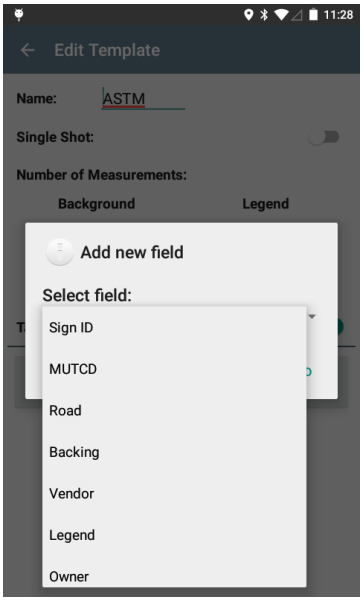
2) Edit an existing template

- Edit an existing template by first tapping on the relevant template and then press  at the top of the screen.

- This is then displayed on the screen, with the name of the template written at the top:



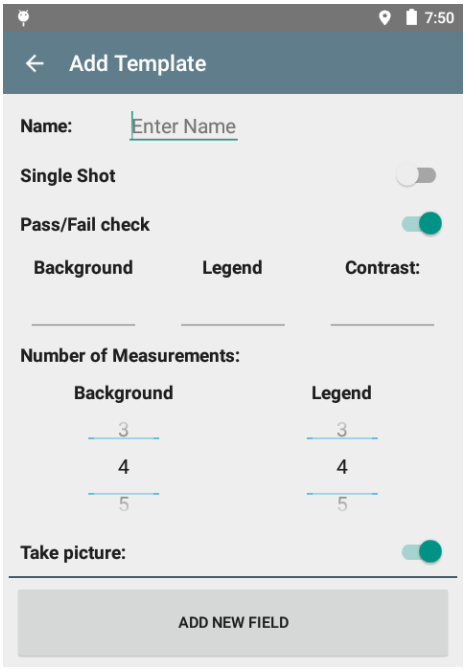
- Change the design of the template by defining these elements:
  - Should it be a **single** or multiple measurements?
    Note: if ‘Single Shot’ is activated some of the below options are disabled.
  - Should the **pass/fail check** be activated? If yes, remember to insert the desired performance values for background, legend, and contrast. Type ‘0’ or leave the field blank if a performance check for one of these is not needed.
  - How **many measurements** (of background and legend) should been taken? Use the swipe up / down functionality to select the relevant number (0-10).
  - Should a **photo** be included in the measurement? Press ‘Take Picture’? (Optional feature).
  - Which **data fields** should be linked to the template? Press ‘Add new field’ and select the type of field you want to add from the drop-down menu (press the arrow on the screen for the list to unfold – see screen shot below). Customized fields can be added by selecting ‘Add new field’ from the list and then typing in the name of your own data field. Finish adding fields by pressing ‘Add’:



Any changes made to the template are automatically stored. Once you have completed editing the template, press  to return the template list.

3) Add a new template

- Add a new template by pressing  at the top of the screen. This is then displayed on the screen:



- Enter a relevant template name and type it at the top of the screen under ‘Name’.
- Then, design the new template by defining these elements:
  - Should it be a **single** or multiple measurements?
    Note: if ‘Single Shot’ is activated some of the below options are disabled.
  - Should the **pass/fail check** be activated? If yes, remember to insert the desired performance value(s) for background, legend, and/or contrast. Type ‘0’ or leave the field blank if a performance check for one of these is not needed.
  - How **many measurements** (of background and legend) should been taken? Use the swipe up / down functionality to select the relevant number (0-10).
  - Should a **photo** be included in the measurement? Press ‘Take Picture’? (Optional feature).
  - Which **data fields** should be linked to the template? Press ‘Add new field’ and select the type of field you want to add from the drop-down menu (press the arrow on the screen for the list to unfold – see screen shot below). Customized fields can be added by selecting ‘Add new field’ from the list and then typing in the name of your own data field. Finish adding fields by pressing ‘Add’.

Any changes made to the template are automatically stored. Once you have completed designing the new template, press  to return the template list.

4) Delete a template

Delete a template by first tapping on the relevant template name and then pressing  and ‘OK’. The template is now deleted.

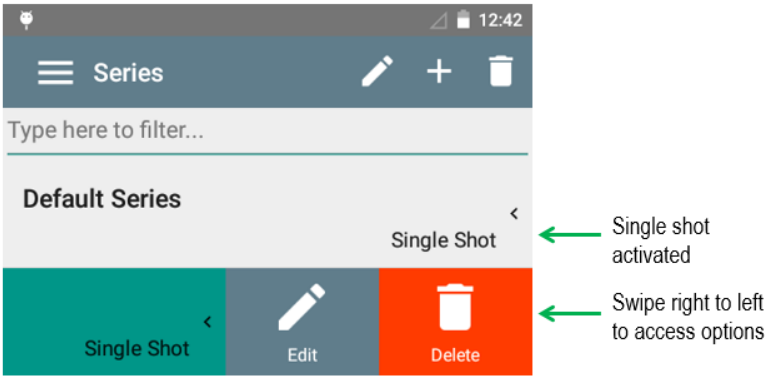
Series

Inspections are grouped into series which makes it easier and more convenient to work with the GRX.

The series name may be a label, e.g. name of a road, type of sign, or specific sign. It is convenient to group inspections for each geographical spot, road, or part of a street for easier recognition. The series name for such a group of inspections will be saved in the log together with the readings.

To use the series it must be activated. How to do this is described below.

- Open the main menu and select  'Series'. The list of series already defined in the GRX is now displayed on the screen:



- In the bottom line of the series name a brief description of the series settings is shown.

Here, you have these options (similar to templates):

1) **Activate** a series
2) **Filter or find** an existing series
3) **Edit** an existing series
4) **Add** a new series
5) **Delete** a series

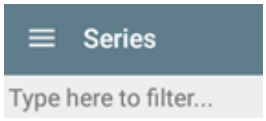
Below are instructions for each of these options.

1) Activate a series

Activate a series by selecting the relevant series name on the list.

2) Filter or find an existing series

- To filter or find an existing series name tap on 'Type here to filter…':

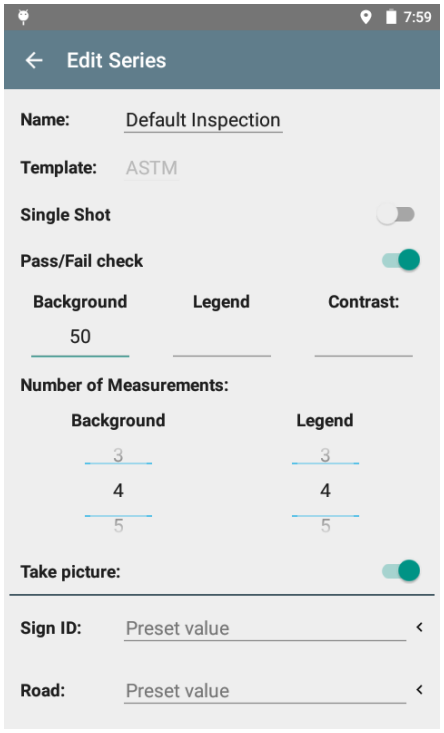


- Use the keyboard that appears on the screen, to type the name of the relevant filter. When finished, press  .

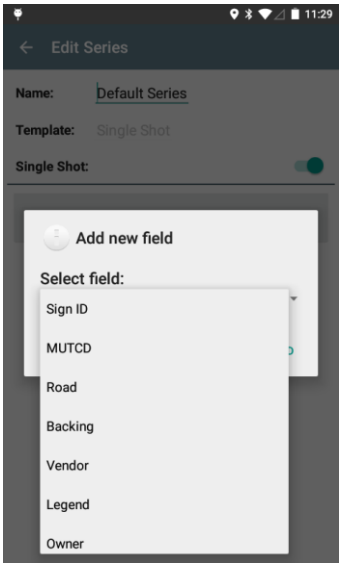
- The screen now shows the series that match your filter.

3) Edit an existing series

- Edit an existing series by pressing  at the top of the screen. This is displayed on the screen:



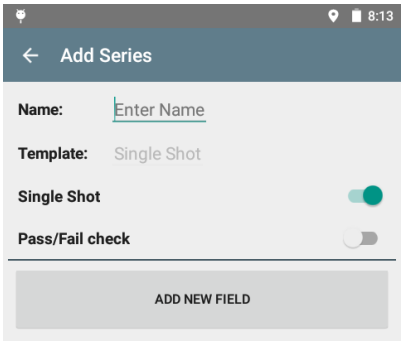
- Change the design of the series by defining these elements:
  - Should it be a **single** or multiple measurements?
    Note: if 'Single Shot' is activated some of the below options are disabled.
  - Should the **pass/fail check** be activated? If yes, remember to insert the desired performance value(s) for background, legend, and/or contrast. Type '0' or leave the field blank if a performance check for one of these is not needed.
  - How **many measurements** (of background and legend) should been taken? Use the swipe up / down functionality to select the relevant number (0-10).
  - Should a **photo** be included in the measurement? Press 'Take picture'? (Optional feature).
  - Which **data fields** should be linked to the template? Press 'Add new field' and select the type of field you want to add from the drop-down menu (press the arrow on the screen for the list to unfold – see screen shot below). Customized fields can be added by selecting 'Add new field' from the list and then typing in the name of your own data field. Finish adding fields by pressing 'Add':



Any changes made to the series are automatically stored. Once you have completed editing the series, press  to return the series list.

4) Add a new series

- To add a new series press  at the top of the screen.
- Select which template the series will be based on (see *'Templates'* described earlier in this section for instructions on setting up a template):



- Enter a relevant series name and type it at the top of the screen under 'Name'.
- Then, design the new series by defining these elements:
  - Should it be a **single** or multiple measurements?
    Note: if 'Single Shot' is activated some of the below options are disabled.
  - Should the **pass/fail check** be activated? If yes, remember to insert the desired performance value(s) for background, legend, and/or contrast. Type '0' or leave the field blank if a performance check for one of these is not needed.
  - How **many measurements** (of background and legend) should been taken? Use the swipe up / down functionality to select the relevant number (0-10).

- Should a **photo** be included in the measurement? Press ‘Take Picture’? (Optional feature).
- Which **data fields** should be linked to the template? Press ‘Add new field’ and select the type of field you want to add from the drop-down menu (press the arrow on the screen for the list to unfold – see screen shot below). Customized fields can be added by selecting ‘Add new field’ from the list and then typing in the name of your own data field. Finish adding fields by pressing ‘Add’.

Any changes made to the series are automatically stored. Once you have completed designing the new series, press  to return the series list.

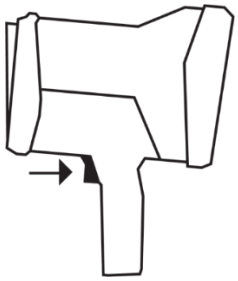
5) Delete a series

You can delete a series by first tapping on the relevant series name, then press  and ‘OK’. The series is now deleted.

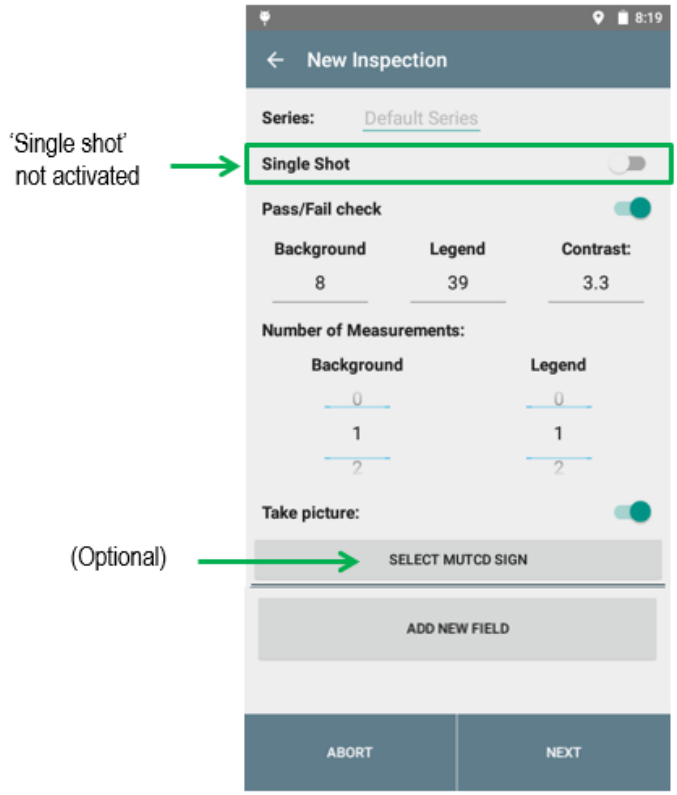
Performing an inspection

Once a series is set up, you are ready to conduct the inspections.

- Select  ‘Measure’ from the main menu and press the trigger-button on the GRX handle to initiate a new inspection:



- The display now shows an overview of the data fields specified for the inspection (if ‘single shot’ has not been activated):



- The series name is shown at the upper part of the screen. The inspection automatically inherits the data fields from the series. You just need to fill out the fields e.g. Sign ID. If needed, it is possible to alter the individual data fields at this level.
- When the 'pass/fail check' is activated (as in the example above), you may enter the threshold performance value(s) for background, legend, and/or contrast. Type '0' or leave the field blank if a performance check for one of these is not needed.
- Optional: Select the relevant MUTCD sign to update the pass/fail thresholds for MUTCD retroreflectivity compliance testing (see below section for further instructions).

Note: You can change to 'single shot' mode directly from the inspection screen. If you do so, the series chosen will be updated with this setting.

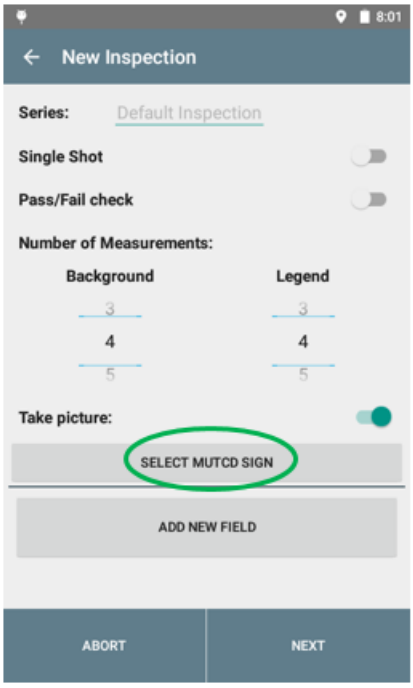
Note: to activate barcode or QR code reading (optional feature) for a field or to delete a field, just swipe the field from right to left – and this appears on the screen:

- Press the 'Scan'-icon to choose barcode reading, or press the 'Remove'-icon to delete the field.

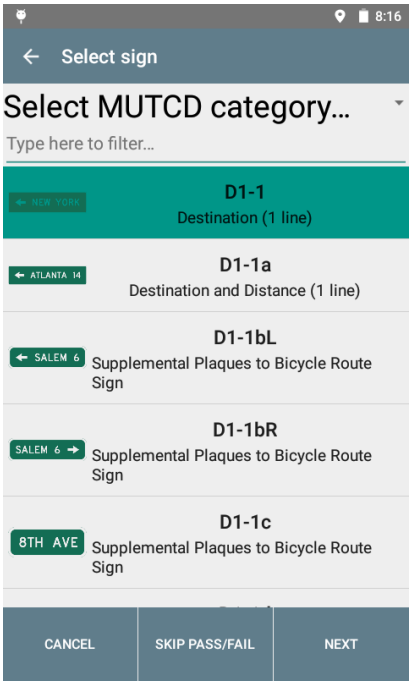
How to select MUTCD sign (optional feature - USA only)

For the USA market, the GRX uses the MUTCD library to identify the particular type of sign that is being inspected and to check that the reflectivity of the sign is above the minimum maintain reflectivity level (see section *MUTCD library* for further details). Follow the below instructions to select the relevant MUTCD sign.

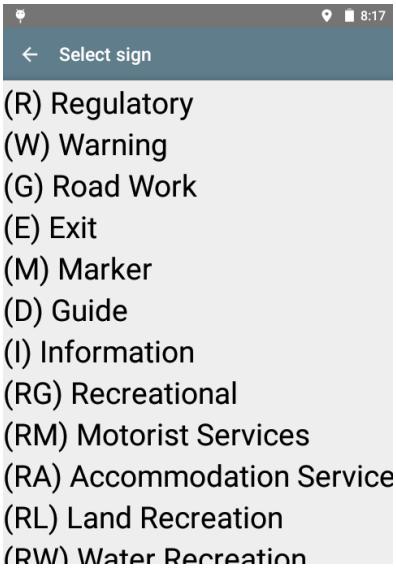
- Press ‘Select MUTCD sign’ on the screen:



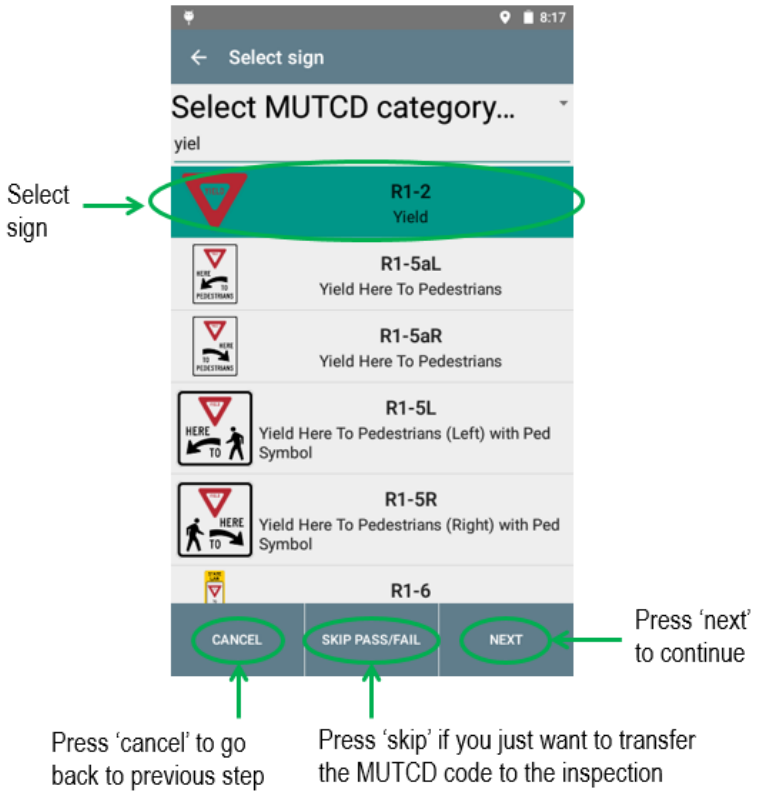
- Then select the relevant MUTCD category from the list:



- From the drop-down menu, select the relevant sign category:

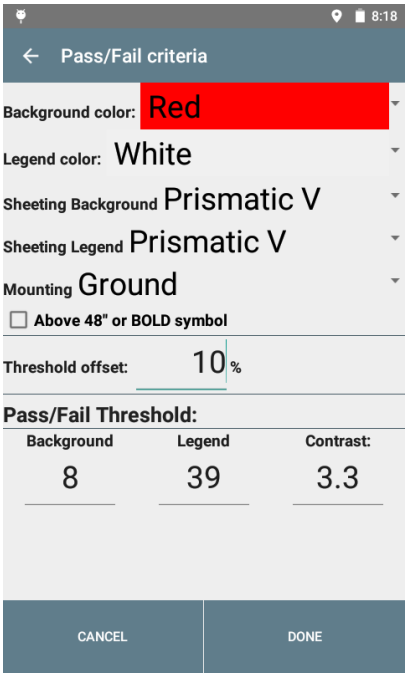


- Now a list of signs for the chosen sign category appears. Click on the relevant sign to be inspected or type text to filter the list:



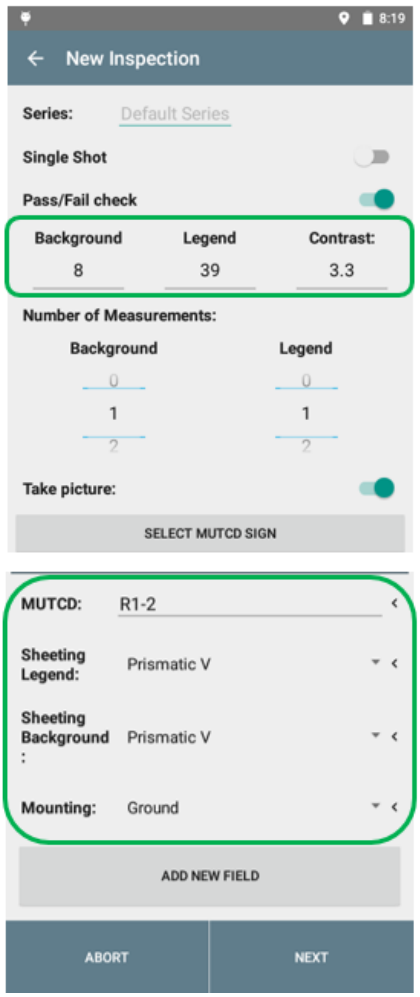
- On the next screen, choose the correct variables for the sign you are about to inspect, e.g. background color. Press the drop-down arrow next to the variable for a list of options (see example below). Select sheeting type according to ASTM D4956-11A.
- The pass/fail threshold values for background, legend, and contrast are automatically calculated (as in the example below) according to MUTCD requirements (see *'MUTCD library'*

later in *section 3 Operating information* for further details). You may alter the threshold offset value to a higher level than the required level (e.g. 10 % as in the example below).



- Press ‘done’ to transfer the information (e.g. MUTCD code, sheeting type and pass/fail threshold) to the data fields. (or press ‘cancel’ to abort).

- The pass/fall threshold values and fields are now transferred to the inspection page:



When you have completed the above steps, the inspection is ready to be performed.

- Commence the measurement readings by pressing ‘Next’ on the touch screen (or press the trigger-button), and carefully follow the instructions on the screen.

Below details the different kind of actions you might be asked to do. How many and which actions you will be asked to do depends on which elements are included in your specific template.

Take a photo (optional feature)

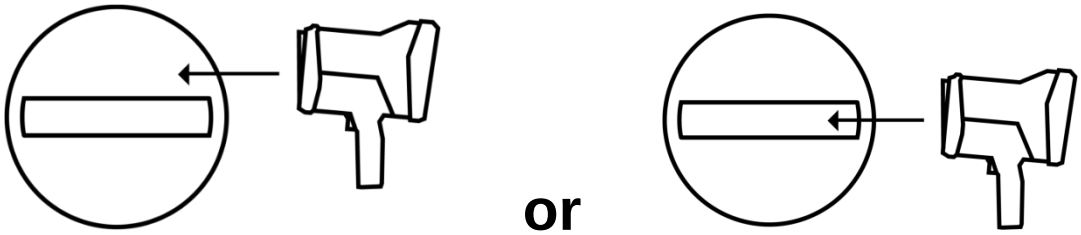
Use the GRX to take a photo of the particular sign.

- Press the trigger to take a photo (or tap the  icon):

- Then press ✓ to accept the photo and continue the inspection.
- Alternatively, to take a new photo press ↩.
- Or press ✕ to abort and continue the inspection without taking photo.

Conduct the inspection

Perform the measurement(s) when one of these messages appears on the screen:



Measure the sign background *Measure the sign legend*

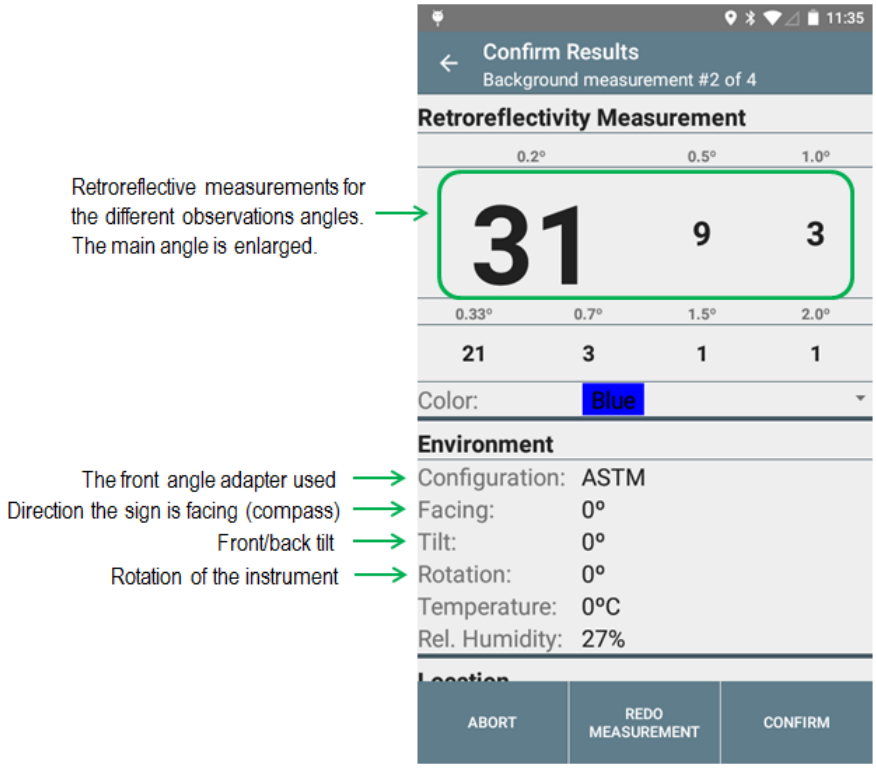
- Place the RetroSign GRX on the element you want to measure and press ‘Measure’ on the screen (or press the trigger-button on the GRX handle) to do the measurement reading. DELTA recommend that the RetroSign GRX is in contact with the element when measuring, this will ensure that the measurement angles are in accordance with the standard.

  Note: Use the red measurement field center indicators placed on the sides and bottom of the GRX instrument (indicate where the lens is positioned) as guidance to ensure you are placing the GRX correctly:

For guidance to avoid measurement errors, read '*How to limit errors' in Section 4 – Errors and Warnings.*

Confirm Results

After completing an inspection, the results are displayed on the screen for confirmation:



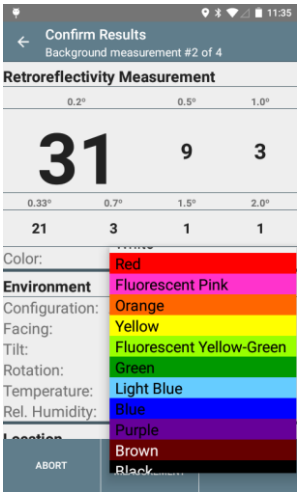
Verify the results on the screen:

- To redo the measurement, press 'Redo measurement' or press ← at the top left corner.
- To accept the results, press 'Confirm' on the screen to confirm the measurement.
- To stop the measurement completely, press 'Abort'.
  Note: all associated measurement results will be discarded.

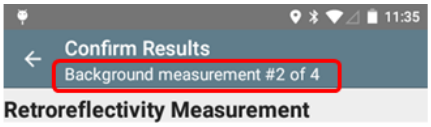
Sign color

The instrument automatically suggests a color of the sign. In some cases, e.g. when measuring worn signs or signs with orange or brown colors, the GRX may have difficulties identifying the correct color.

To change color stored with the inspection, tap the drop-down arrow, next to the color, and select the correct color from the list:



Continue performing your inspection by following the instruction steps on the screen. At the top of the screen a process indicator highlights your progress in the inspection process, e.g.:

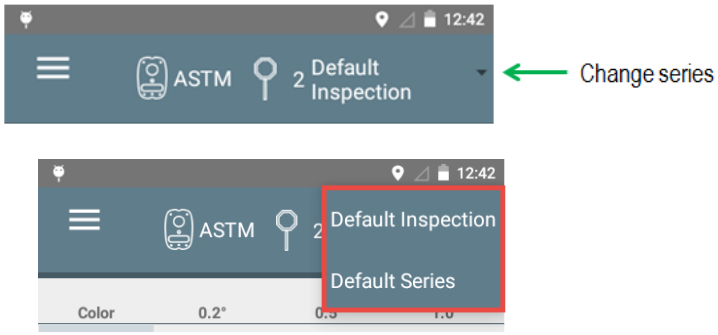


Result view

When all steps of the inspection are completed the main screen will show the results of the inspection:

You can swipe right to left to view all details of the inspection. See part: ‘Understanding the inspection’ in the ‘Log’ paragraph for further details about the inspection.

Note: From the result view you can change to another series:



When changing to another series, data from the new series will be shown.

If a problem arises during the inspection, an error or warning will occur on the screen. For further details, see *section 4 - Errors and warnings*.

MUTCD Library

The GRX uses the MUTCD library to identify the particular type of sign that is being inspected and to check that the reflectivity of the sign is above the minimum maintain reflectivity level.

MUTCD (Manual on Uniform Traffic Control Device) is a national standard, which encompasses a library of all national traffic signs in the United States.

During the use of the GRX, the instrument will ask you to choose the relevant sign type according to the below table (source: http://mutcd.fhwa.dot.gov/pdfs/2009/mutcd2009edition.pdf, page 31)

Table 2A-3. Minimum Maintained Retroreflectivity Levels[1]

Sign Color	Sheeting Type (ASTM D4956-04)				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W*; G ≥ 7	W*; G ≥ 15	W*; G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W*; G ≥ 7	W ≥ 120; G ≥ 15			Post-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			[2]
	Y*; O*	Y ≥ 75; O ≥ 75			[3]
White on Red	W ≥ 35; R ≥ 7				[4]
Black on White	W ≥ 50				–

[1] The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an observation angle of 0.2° and an entrance angle of -4.0°.
[2] For text and fine symbol signs measuring at least 48 inches and for all sizes of bold symbol signs
[3] For text and fine symbol signs measuring less than 48 inches
[4] Minimum sign contrast ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)
* This sheeting type shall not be used for this color for this application.

Bold Symbol Signs

• W1-1,2 – Turn and Curve • W1-3,4 – Reverse Turn and Curve • W1-5 – Winding Road • W1-6,7 – Large Arrow • W1-8 – Chevron • W1-10 – Intersection in Curve • W1-11 – Hairpin Curve • W1-15 – 270 Degree Loop • W2-1 – Cross Road • W2-2,3 – Side Road • W2-4,5 – T and Y Intersection • W2-6 – Circular Intersection • W2-7,8 – Double Side Roads	• W3-1 – Stop Ahead • W3-2 – Yield Ahead • W3-3 – Signal Ahead • W4-1 – Merge • W4-2 – Lane Ends • W4-3 – Added Lane • W4-5 – Entering Roadway Merge • W4-6 – Entering Roadway Added Lane • W6-1,2 – Divided Highway Begins and Ends • W6-3 – Two-Way Traffic • W10-1,2,3,4,11,12 – Grade Crossing Advance Warning	• W11-2 – Pedestrian Crossing • W11-3,4,16-22 – Large Animals • W11-5 – Farm Equipment • W11-6 – Snowmobile Crossing • W11-7 – Equestrian Crossing • W11-8 – Fire Station • W11-10 – Truck Crossing • W12-1 – Double Arrow • W16-5P,6P,7P – Pointing Arrow Plaques • W20-7 – Flagger • W21-1 – Worker

Fine Symbol Signs (symbol signs not listed as bold symbol signs)

Special Cases

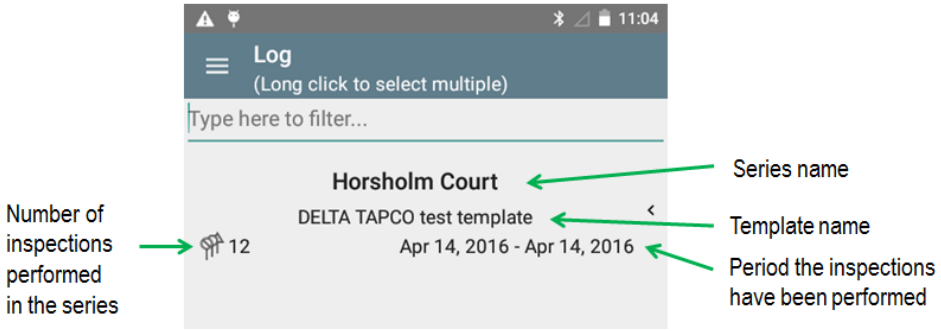
- W3-1 – Stop Ahead: Red retroreflectivity ≥ 7
- W3-2 – Yield Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35
- W3-3 – Signal Ahead: Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7
- W3-5 – Speed Reduction: White retroreflectivity ≥ 50
- For non-diamond shaped signs, such as W14-3 (No Passing Zone), W4-4P (Cross Traffic Does Not Stop), or W13-1P,2,3,6,7 (Speed Advisory Plaques), use the largest sign dimension to determine the proper minimum retroreflectivity level.

Note: special cases W3-1, W3-2, W3-3, and W3-5 are not supported by the GRX because these types of sign contain 3 or more colors.

How to work with the MUTCD library is further described in *Section 3 'Working with templates, series, and inspections'*.

Log

The RetroSign GRX keeps a log of all the inspections conducted. To access this log, select  'Log' from the main menu and the list of series is displayed on the screen:



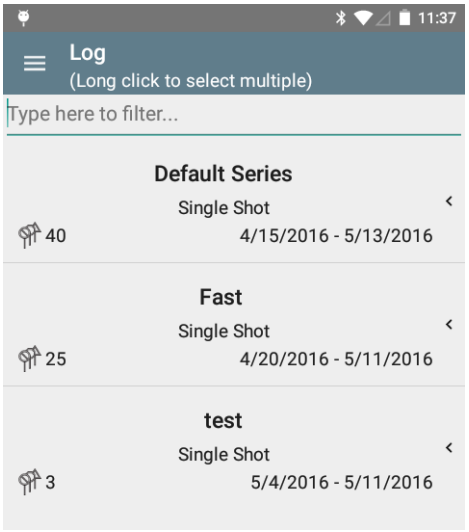
From the series list you can:

- view series and delete inspections
- delete series data
- export series data

These options are further explained below.

View series and delete inspections

To see the inspections linked to a series, tap on the relevant line in the log overview.



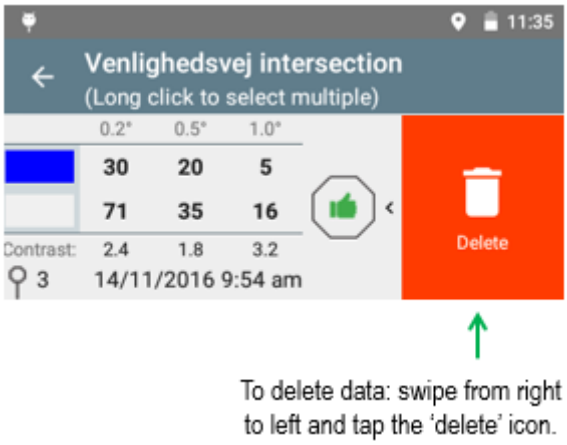
Below is an example of a data log for a series:

Here are some explanatory notes to the data viewed in the data log:

At the data log level you can:

- **view inspection:** tap on one of the inspections on the list to view the data of the particular inspection.
- **delete inspection:** swipe from right to left on the inspection and press the 'Delete' icon 

to delete the particular inspection. Alternatively, tap on an inspection to view the data and from here select the 'delete' icon  at the top right corner to delete the data.



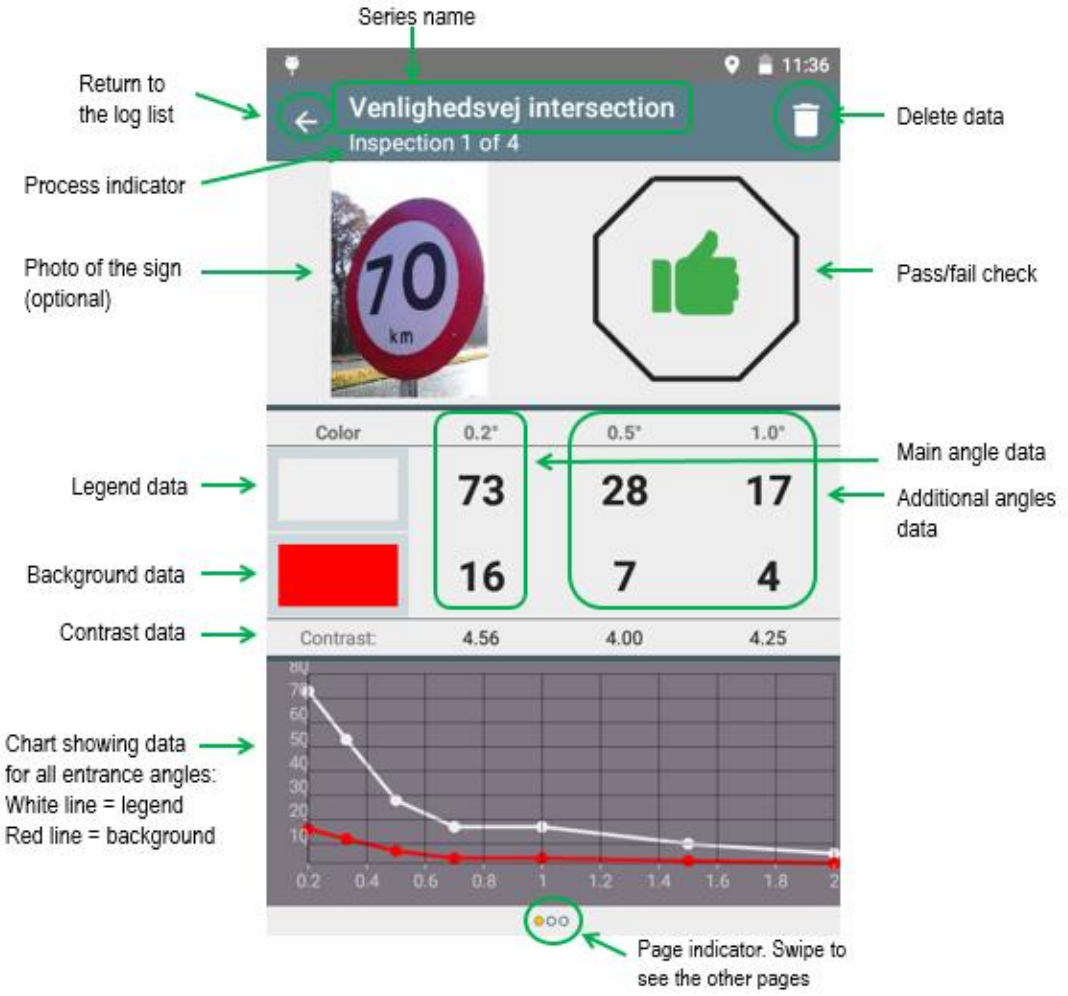
To delete data: swipe from right to left and tap the 'delete' icon.

Understanding the inspection data

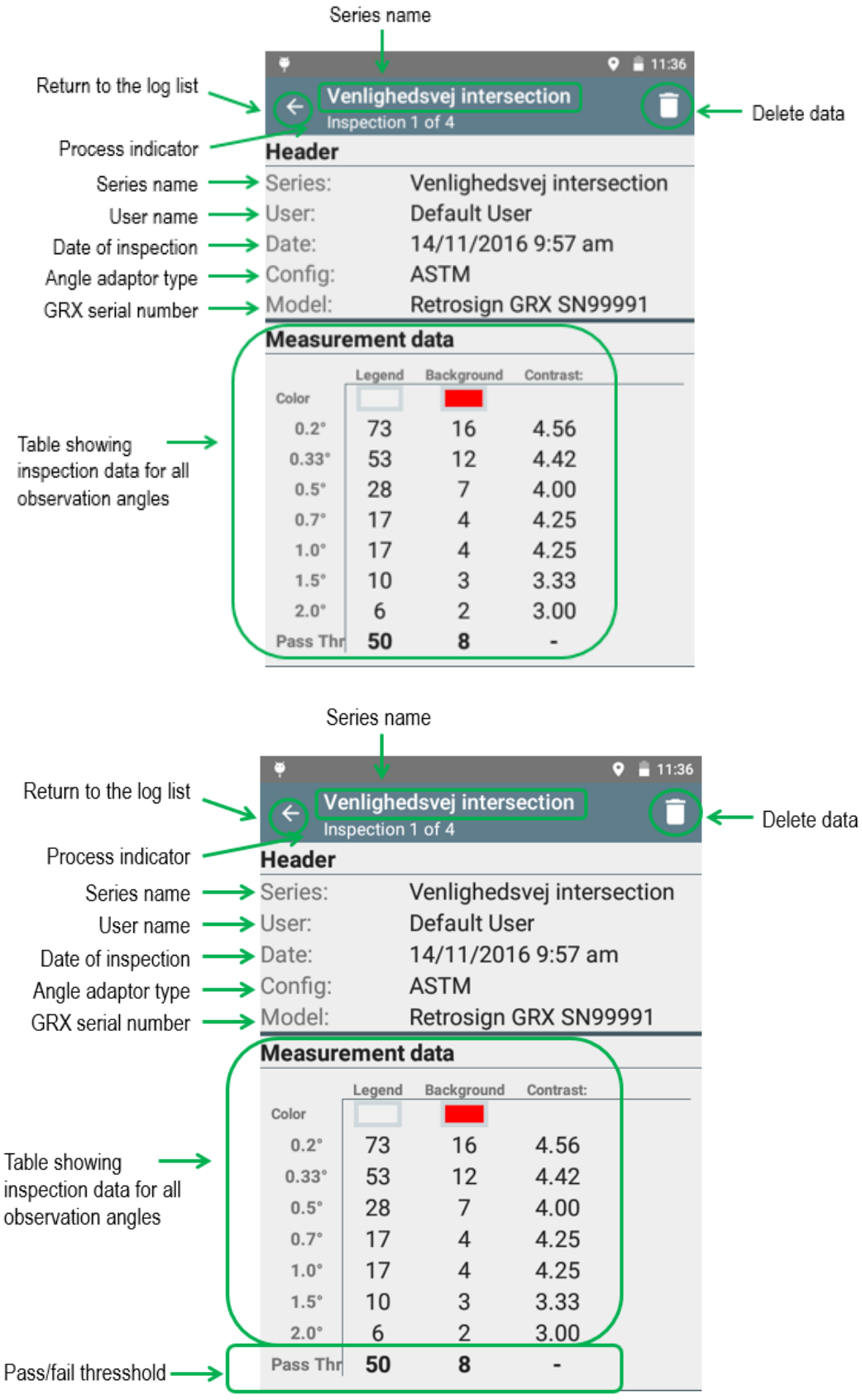
An inspection contains various data, which is displayed on the GRX screen. Below are explanations to the dataset connected to one inspection.

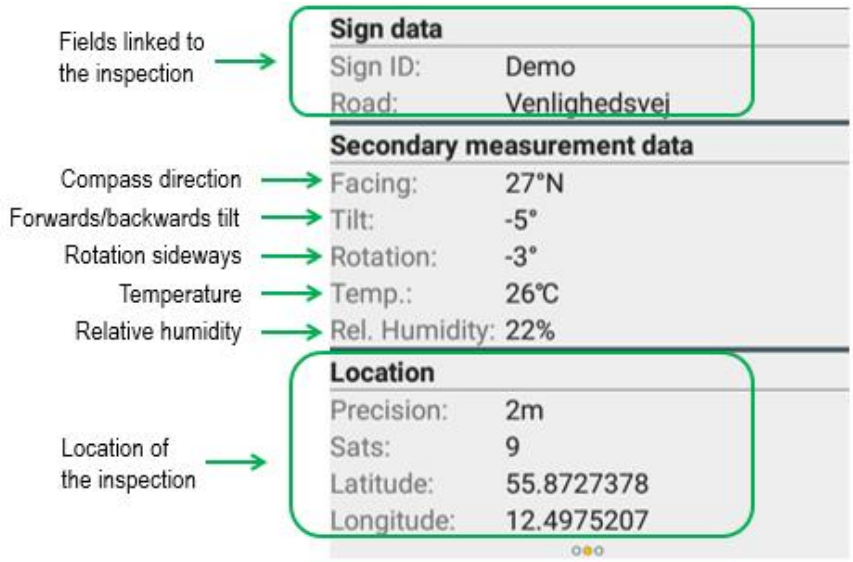
The  symbol at the bottom of the screen indicates if there are several pages. Use the swipe-functionality to flick through the pages. Also, scroll up/down to see the full dataset on page 2.

Inspection page 1:

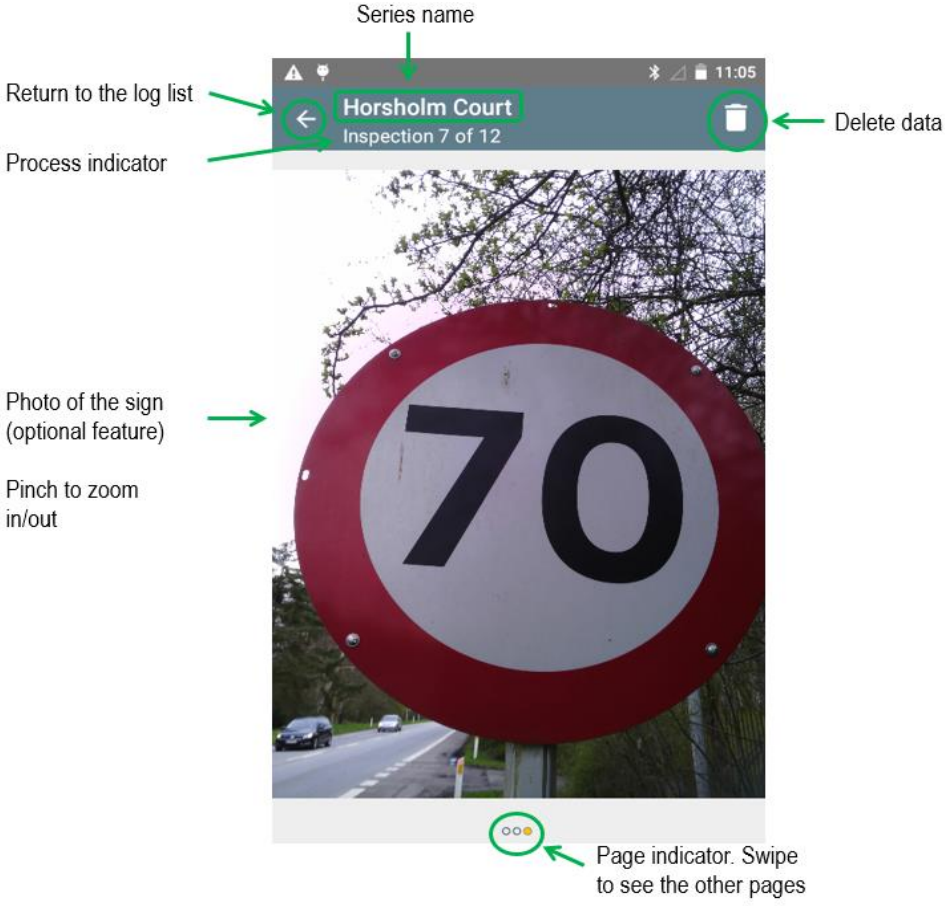


Inspection page 2:



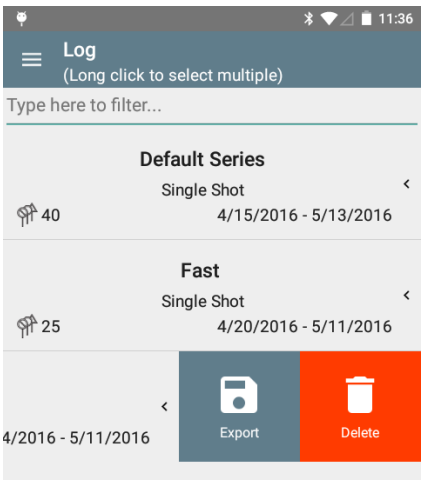


Inspection page 3:



Delete series data

To delete all data within a series, place your finger on the particular series and swipe the screen from right towards left, which will expose these icons:



- Press the 

‘Delete’-icon to delete the whole data series.

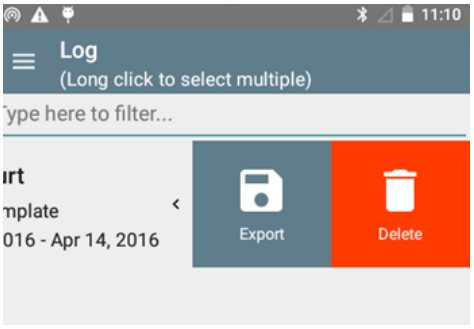
  Note: Please be aware that all inspections within the series will be deleted.

Export series data

Data can easily be exported to market available software like Excel and Google Earth.

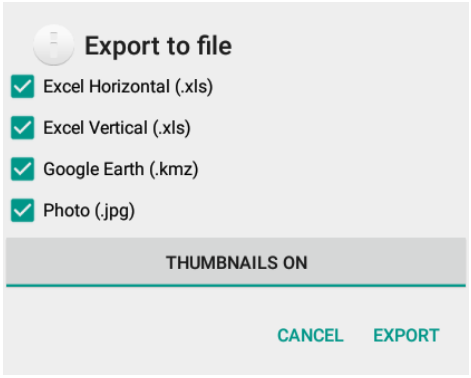
How to export data of **one** series:

- From the log list swipe the screen from right to left and these icons appear:



- Press the ‘Export’-icon 

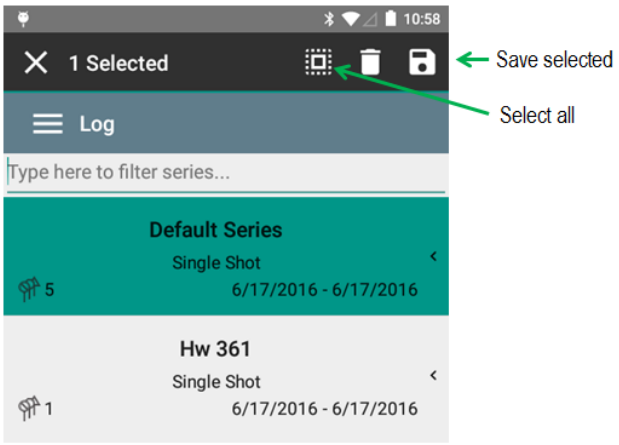
and a pop-up menu appear:



- In the pop-up box select or unselect the output you want the data exported into (.xls, .kmz, .jpg). You can choose to have data presented horizontally or vertically in the Excel data sheet. You can also choose to have thumbnail pictures included in the exported files.

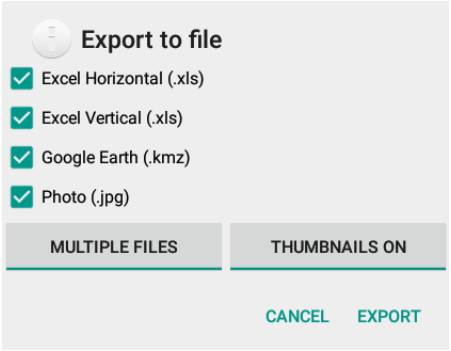
How to export data of **several series**:

- Long tap on a series to enter select multiple mode. In this mode you can select or deselect series by a single tap on the series.



- After selecting the series, tap the  'save' icon:

- In the pop-up box select or unselect the output you want the data exported to (.xls, .kmz, .jpg). You can choose to have data presented horizontally or vertically in the Excel data sheet.



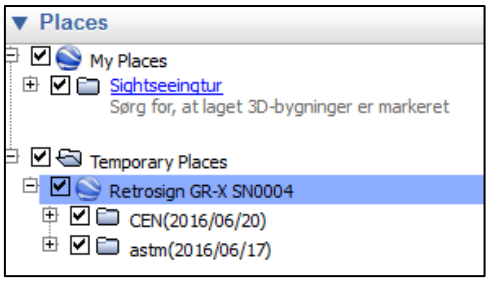
Note:
If 'Multiple files' is selected all the marked series will be saved to individual Excel / Google Earth files.

If 'Single files' is selected all the marked series will be saved in one Excel / Google Earth file.

In Excel, each series will have their own tab sheet: 

.

In Google Earth the series will be shown as multiple entries in the Temporary Places and below the RetroSign GRX header:



Note: if inspections have no location data, latitude/longitude coordinates will be set to 0/0 degrees in the .kmz file. You can also choose to have thumbnail pictures included in the export file.

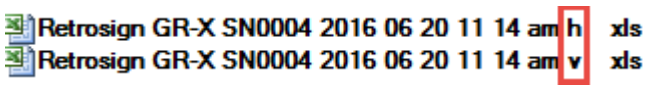
Continue exporting the data by following the below steps.

- Insert an USB stick in the USB port:

- Press 'Export' to transfer data to the USB stick.

The data transfer is completed when the message 'Export completed successfully' appears on the screen. You may now remove the USB stick with the exported data and insert the USB stick to a computer or similar.

The file name for syntax single file is: '*Retrosign GRX SNxxxx YYYY MM DD hh mm am v.xls*'. The last letter (v or h) indicates vertical or horizontal Excel organization:



For multiple files the file name is:
'Retrosign GRX SNxxxx + series name + date of last series entry + v/h.xls'

Below are examples of a data transfer that is presented horizontally and vertically in an Excel data sheet, and in Google Earth.

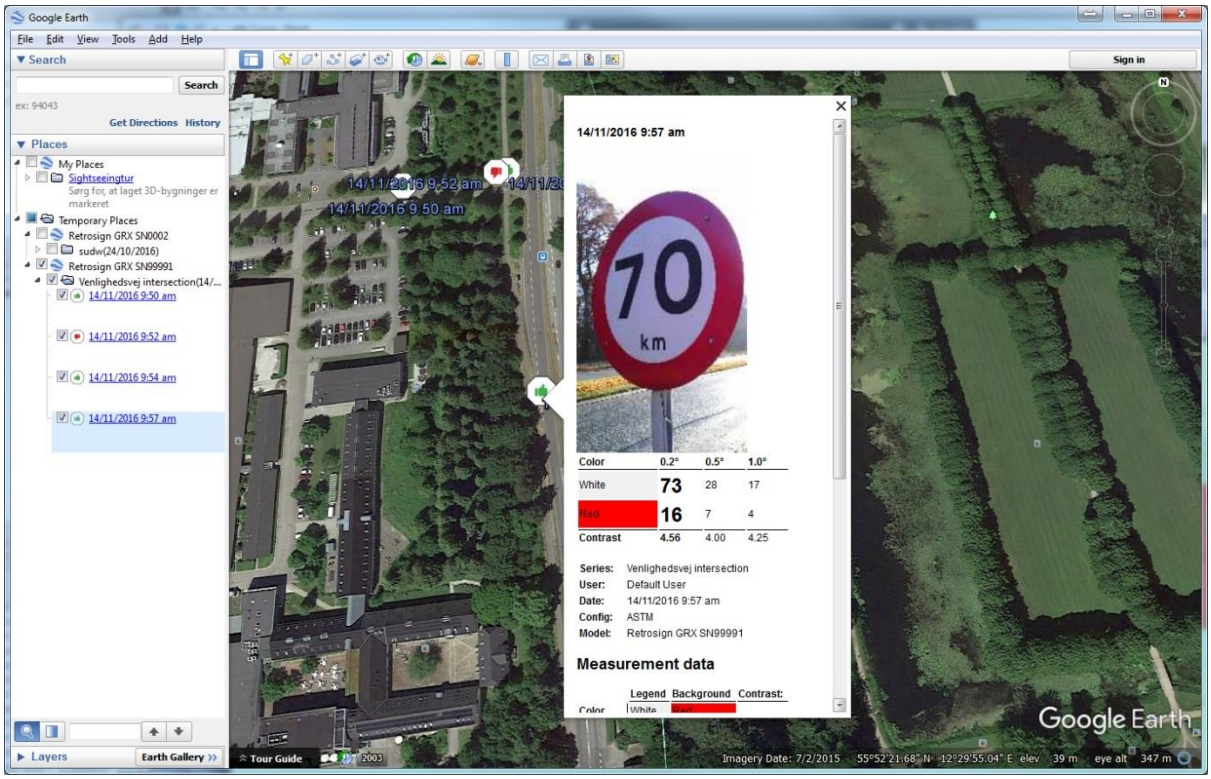
Fields marked green indicate that the sign has passed the pass/fail check whereas red indicate that it has failed the check.

Horizontal view

	A	B	C	D	E	F
1	Thumbnail					
2	Date	14-11-2016 09:50	14-11-2016 09:52	14-11-2016 09:54	14-11-2016 09:57	
3	User	Default User	Default User	Default User	Default User	
4	Template	Hoersholm	Hoersholm	Hoersholm	Hoersholm	
5	Legend Color	White	Red	White	White	
6	Legend Ra 0.2°	113	21	71	73	
7	Legend Ra 0.33°	83	15	55	53	
8	Legend Ra 0.5°	47	9	35	28	
9	Legend Ra 0.7°	29	5	22	17	
10	Legend Ra 1.0°	21	4	16	17	
11	Legend Ra 1.5°	12	2	9	10	
12	Legend Ra 2.0°	7	2	5	6	
13	Background Color	Red	White	Blue	Red	
14	Background Ra 0.2°	22	68	30	16	
15	Background Ra 0.33°	16	51	29	12	
16	Background Ra 0.5°	9	31	20	7	
17	Background Ra 0.7°	5	20	12	4	
18	Background Ra 1.0°	5	13	5	4	
19	Background Ra 1.5°	3	8	2	3	
20	Background Ra 2.0°	5	5	1	2	
21	Contrast: 0.2°	5,14	0,31	2,37	4,56	
22	Contrast: 0.33°	5,19	0,29	1,90	4,42	
23	Contrast: 0.5°	5,22	0,29	1,75	4,00	
24	Contrast: 0.7°	5,80	0,25	1,83	4,25	
25	Contrast: 1.0°	4,20	0,31	3,20	4,25	
26	Contrast: 1.5°	4,00	0,25	4,50	3,33	
27	Contrast: 2.0°	1,40	0,40	5,00	3,00	
28	Pass thr. Legend	50	50	50	50	
29	Pass thr. Background	8	8	8	8	
31	Latitude (°)	55,8736790	55,8737502	55,8737607	55,8727378	
32	Longitude (°)	12,4963672	12,4970277	12,4971085	12,4975207	
33	Facing (°)	324	246	107	27	
34	Tilt (°)	-6	-10	-5	-5	
35	Rotation (°)	2	0	3	-3	
36	Temperature (°C)	28	28	27	26	
37	Rel. Humidity (%)	21	21	21	22	

Vertical view

Google Earth file



Calibration

The RetroSign GRX is factory calibrated.

In order to ensure high quality of data DELTA recommends calibrating the RetroSign GRX once a day, typically in the morning, before commencing the measurements.

The calibration process automatically compensates for instrument offsets etc.

It is possible to make two different types of calibrations:

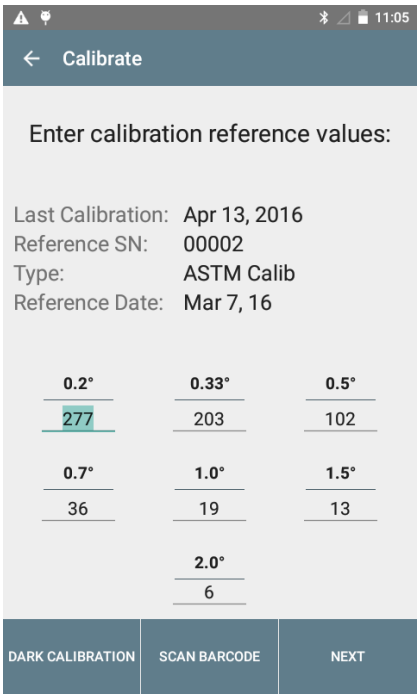
- Reference calibration
- Dark calibration + reference calibration

Normally, it is sufficient to make a reference calibration of the GRX instrument prior to conducting measurements. However, it is recommended to do a dark calibration now and then.

A simple way to test if dark calibration is needed is to point the GRX, and measure in a direction with no retroreflective objects (i.e. shiny surfaces, windows, edges, and lamps etc.) within a distance of at least 10 meters / 33 feet in front of the RetroSign GRX. The result of this measurement should be zero, or at least no more than 1-3. If you get a higher value, there might be some contamination on the optical lens. In this case clean the optics and check again.

A dark calibration (followed by a reference calibration) is then recommended in order to perform correct measurements.

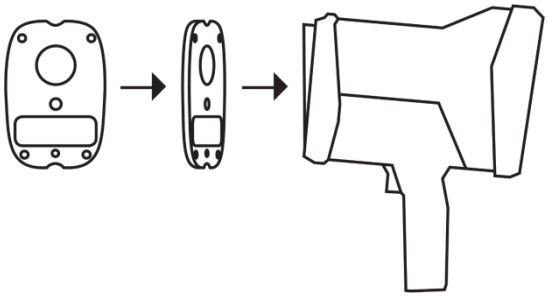
To calibrate the GRX instrument select  'Calibrate' from the main menu.



How to perform a reference calibration

- **Fill out the fields**: type in the calibration values printed on the calibration target or scan them from the calibration target by selecting 'Scan barcode' and place the barcode in front of the reader:

- Once the values have been filled in for all the fields press ‘Next’.
- **Now, calibrate the GRX:** Rotate the angle adapter so the calibration target is facing downwards and attach the calibration target to the GRX.

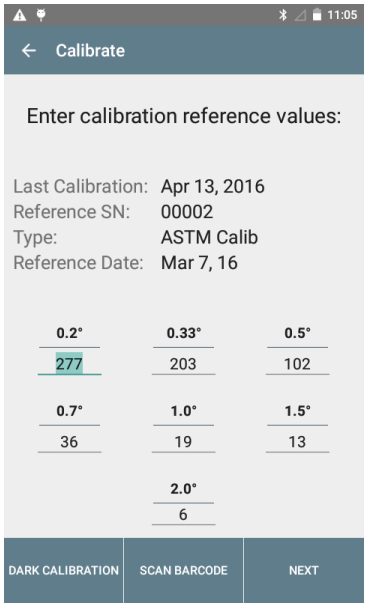


- Press the trigger (or press ‘Calibrate’) to calibrate the GRX.
- When the message ’Calibration completed’ appears on the screen, press ‘Done’ to complete the calibration session. The instrument is now ready for measuring.
  If the calibration is successful the calibration values used is stored in GRX and will be the suggested values next time a calibration is initiated.

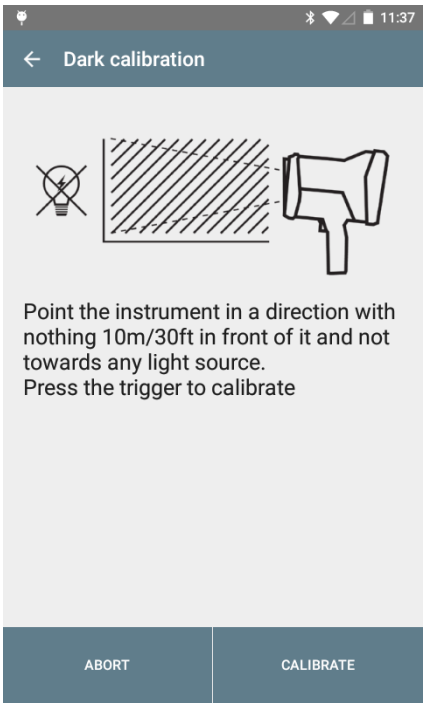
How to perform a dark calibration

To do a dark calibration, open the calibration page and follow the below steps.

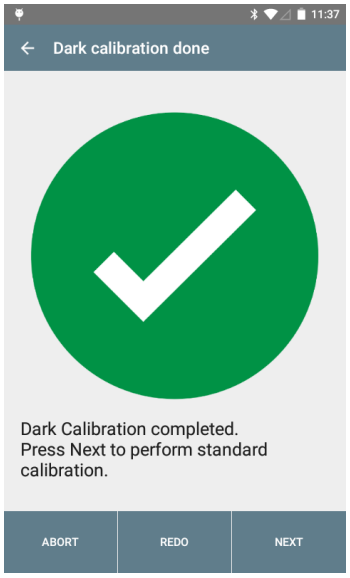
- **Fill out the fields:** type in the calibration reference values printed on the calibration target or scan them from the calibration target by selecting ‘Scan barcode’ and place the barcode in front of the reader:



- **Calibrate the GRX:** Press ‘Dark calibration’ and follow the instruction on the screen (i.e. point the instrument in a direction with nothing 10 m/33 feet in front of it and away from any light source).



- Press the trigger (or press ‘Calibrate’) to calibrate.
- When the message ’Dark Calibration completed’ appears on the screen, press ‘Next’ to complete the dark calibration session.



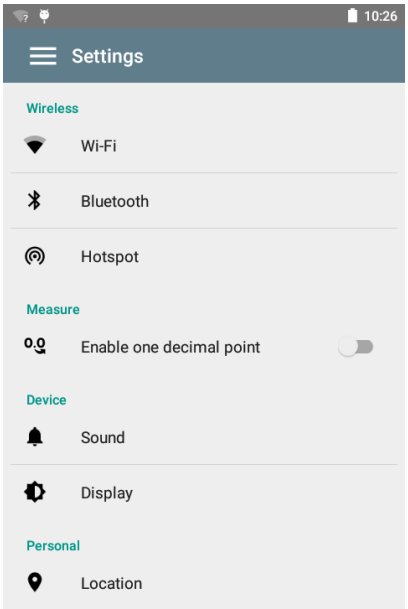
- Now, continue performing a reference calibration (see instructions above: '*How to perform a reference calibration*')
- Once the reference calibration also is completed the instrument is ready for measuring.

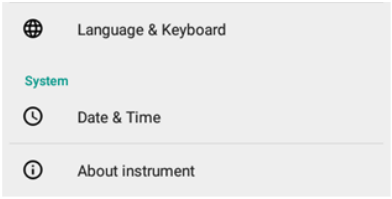
Note: If the measurement results still seem to be incorrect even after a dark calibration of the GRX, it is recommended to contact your appointed dealer or DELTA.

Settings

It is possible to adjust and configure many different data fields for the RetroSign GRX e.g. date, sound, display, wireless connection etc.

To access the list of these variables, select  'Settings' from the main menu.





Symbol	Explanation
WiFi	**Turn WiFi on/off and choose network** WiFi connection can be activated or deactivated. A list of available WiFi networks will be shown.
Bluetooth	**Turn Bluetooth on/off and pair with extension pole** The Bluetooth connection can be activated and deactivated. With Bluetooth turned on the GRX can communicate with remote button on the extension pole. The Bluetooth connection is used to perform measurements when using the extension pole for elevated placed road traffic signs.
Hotspot	**Set up WiFi hotspot** A WiFi hotspot can be activated or deactivated. If no other WiFi networks are available this option allows the GRX to create its own network.
Enable one decimal point	**Enable one decimal point** This setting adds one decimal point to the measurements throughout the instrument and exported files.
Sound	**Adjust volume, activate/inactivate high volume beeper** The instrument sound volume can be adjusted. The beep function can be activated and deactivated e.g. indicating when a measurement has been started (1 beep) and finished (2 beeps).
Display	**Adjust display brightness, set 'sleep time'** This setting allows the user to choose between user-controlled display brightness or adaptive brightness. When the adaptive brightness is activated the instrument adjusts the display brightness automatically according to the level of ambient light. This means that the display brightness will be low with low level of ambient light and high in for example bright sunshine. Minimizing the brightness will reduce power consumption. The Sleep function allows the user to decide after how long time the instrument automatically turns into sleep mode after inactivity (to save power). The function can be adjusted between 15 seconds and 30 minutes by tapping on the display.
Location	**Turn location tracking (GNSS) on/off** This setting allows the user to completely disable location tracking. Disable location will save power.

	If location is disabled, there will be no location coordinates associated with the inspections.
Language and keyboard	**Chose language and keyboard layout** This setting allows the user to change system language and keyboard layout. Beware that complete translation is not available in all the listed languages and only some sections is translated. All units displayed and exported (e.g. temperature, distance) is converted based on the default in the selected language.
Date and time	**Chose time and time zone, set time and date format** In this setting Automatic date & time and Automatic time zone can be activated and deactivated (requires internet connection). If one or both functions are activated the instrument will use internet provided information. The user can also decide on 12-hour or 24-hour clock as well as choose the date format.
About the instrument	**Information about the GRX** This section contains information related to the instrument setup and functions. This is information which DELTA may request access to in case there is a problem with the instrument.

Extension pole

For measuring signs at a high or unreachable level it is advisable to use the extension pole. The button on the extension pole has the same functionality as the trigger button on the GRX instrument.

Mounting the GRX onto the extension pole

- The extension fixture is mounted onto the GRX and the captive screw is tightened securely with a screwdriver (see photo below).

- Following this, the GRX with the mounted extension fixture can now be mounted on the extension pole.

- The extension fixture is locked in position by the integrated snap-lock in the pole.

- The tilt angle of the instrument relative to the extensions pole is adjusted with the wing nut to fit the sign height.

Note: In order to obtain correct readings when taking measurements with the extension pole, make sure that the GRX angle adapter plate is in full contact with the sign surface.

The remote button

The GRX is operated using the remote button mounted on the extension pole (see below photo).

Activating the remote button

Turn the power on by sliding the switch on the back of remote button.

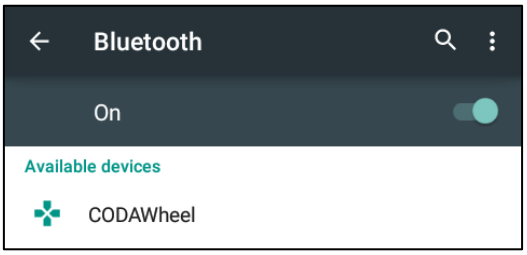
The remote button battery is expected to last several years and therefore, under normal conditions turning the power off is virtually not necessary.

Pairing the remote button

To make the remote button on the extension pole work you need to pair it with the GRX. This only needs to be done once.

- Before pairing, make sure that the remote button is not connected to any other devices. If connected with a different device, it will not enter the pairing mode. To disconnect the remote button, turn the Bluetooth connection off from the GRX. Go to ‘Settings’ in the main menu, select ‘Bluetooth’ and click the ‘On/Off’ button.

- Press the remote button for 15 seconds until a green and red LED flashes alternately. Once you come to this stage, the remote button is now ready for pairing. From the GRX, go to ‘Settings’ and select ‘Bluetooth’. Make sure the Bluetooth is switched On.



- Click on the ‘CODAWheel’ device.

Once paired, the extension pole button will have the same functionality as the GRX trigger button.

Remote button sleep mode

To conserve battery power, the button automatically enters into a sleep mode after a period of inactivity. To leave the sleep mode, simply click the remote button and a red LED lamp will start flashing to show the reconnection between the GRX and the remote button. Once the remote button becomes re-activated, it does not require any other setup.

For further information about connecting and disconnecting the CODA wheel see Appendix B, page 69.

SECTION 4: Errors and warnings

To always ensure correct measurement results and functionality the GRX monitors all results, internal measurements, dataflow, and stored data. This may trigger errors or warning messages if the instrument is operating outside recommended parameters.

Listed below are most of the errors and warnings you might get and how you should correct the fault.

At any time

Type	Text	Cause	How to resolve
Warning	The instrument's calibration is outdated. Please recalibrate.	The instrument has not been calibrated within the last day.	Recalibrate
Warning	The current angle adapter *(type of adaptor*) is not compatible with the active calibration. Please recalibrate using: *type of calibration target*	The angle adapter cannot be used with the current calibration. It will give incorrect results.	Recalibrate the instrument using the correct calibration target.
Warning	The battery is overheating. Remove battery immediately!	The temperature of the battery is too high.	Remove battery and allow it to cool. The battery might be defective.
Warning	The battery is getting low. Please replace it.	Low battery voltage.	Replace battery.
Warning	The instrument is almost out of storage.	Low storage space.	Delete unused inspections.
Error	Touch controller is not responding.	Hardware initialization fault.	Try restarting GRX. If problem persists, contact your dealer.
Error	OMU is not responding.	Hardware initialization fault.	Try restarting GRX. If problem persists, contact your dealer.
Error	Angle adapter error.	Hardware initialization fault.	Try restarting GRX. If problem persists, contact your dealer.

Calibration

Type	Text	Cause	How to resolve
Warning	The angle adapter is not in calibration position. The detected calibration target does not match the expected.	The detected calibration target does not match the one expected from the scanned QR code	Scan the QR code from the calibration block.
Warning	The Angle adapter is in reference calibration position Please remove or rotate it before proceeding.	Dark calibration must be performed with the angle adapter removed or in measurement position.	Remove the angle adapter.
Error	Slope too High/Low on channel: *channel name*	Calibration target is not as expected or internal hardware problem.	Check calibration target for damage. Clean lenses.

			If problem persists, contact your dealer.
Error	Unable to save calibration.	Internal filesystem problem.	Try restarting GRX. If problem persists, contact your dealer.
Error	Offset too High/Low on channel: *channel name*	Calibration target is not as expected or hardware problem.	Check calibration target for damage. Clean lenses. If problem persists, contact your dealer.
Error	Target value too High/Low on channel: *channel name*	The entered calibration values are not valid.	Scan the QR code from the calibration block.
Error	Dark raw value too High/Low on channel: *channel name*	Dark calibration raw values are not as expected.	Redo the calibration following the procedure described. If problem persists, contact your dealer.
Error	Signal raw value too High/Low on channel: *channel name*	Calibration raw values are not as expected.	Check calibration target for damage. Clean lenses. If problem persists, contact your dealer.
Error	Dark/Signal raw value too High/Low on channel: *Reference Dark/Target*	Hardware problem on reference channel.	If problem persists, contact your dealer.
Error	LED current too High/Low	Hardware problem with LED light source.	If problem persists, contact your dealer.

Measurement

Type	Text	Cause	How to resolve
Warning	There is no GNSS fix yet.	The GNSS receiver has not received a fix.	Move outside or wait for it to get a fix.
Warning	Angle adapter not mounted.	Angle adapter not detected.	Attach angle adapter.
Warning	RA value too High/Low on channel: *channel name*	The measured value is too extreme.	Recalibrate the instrument.
Warning	Raw value too High/Low on channel: *channel name*	Raw sensor readings are out of specifications. Hardware problems.	If problem persists, contact your dealer.

Log export

Type	Text	Cause	How to resolve
Warning	USB drive not ready.	USB drive cannot be found.	Plug in USB memory stick. Make sure it is FAT formatted and wait at least 10 seconds from inserting until pressing *Export*.
Error	USB power.	Unable to activate power to USB port. Most likely a hardware problem.	If problem persists, contact your dealer.

How to limit errors

The RetroSign GRX automatically gives a message/warning signal if there is something wrong with a measurement. To avoid measurement errors and poor quality of data a number of precautions can be taken.

Before measuring

The RetroSign GRX is factory calibrated. However, to avoid measurement errors it is recommended always to begin important measurements sessions with a calibration of the instrument. Carry out minimum one daily calibration after checking the optical surfaces are clean, free of dust, and undamaged. Dust and smear on the optical surfaces might influence the measured values considerably.

It is very important to keep the instrument front lens and the white calibration reference clean and undamaged to obtain correct calibrations and thereby correct measurement results.

See also *Section 5 - Maintenance*.

Instrument orientation

To obtain reliable inspection results the front of the RetroSign GRX must be in close contact with the sign surface when taking measurements.

However, RetroSign GRX can conduct measurements without contact to the sign surface. If you do have to perform inspections like this please consult your appointed dealer or DELTA, for instruction in your specific situation.

The measurement field center indicators, on the sides and bottom of the GRX instrument, indicate where the lens is positioned (see picture below). Use these indicators as guidance to ensure you are placing the GRX correctly.

Sign conditions
The retroreflectivity of a sign changes when the sheeting becomes wet. RetroSign GRX can perform measurements on wet or dewy sign surfaces but readings are not comparable with readings taken on dry signs.

Because of the direction sensitive optical properties of certain micro prismatic sheeting types, it is important to position the RetroSign GRX correctly and hold it vertically in order to obtain correct readings as seen by the driver of a vehicle.

When checking correct positioning of direction sensitive micro prismatic sheeting types measure the road traffic sign with the GRX in vertical and horizontal positions.

Battery condition
The instrument monitors the battery power level. The battery icon in the upper-right corner of the display shows the battery power level:

Remember to charge the battery when it is low on power.

Note: The instrument automatically turns off when the battery is depleted.

Rechargeable batteries have a limited number of charge cycles and may eventually need to be replaced.

See also '*Battery'* in *Section 2 – General Information*.

SECTION 5: Maintenance

General care

The RetroSign GRX is constructed for outdoor use in fair weather conditions. The retroreflectometer can withstand moist weather, but caution must be taken against rain or splashes and dirt from traffic. Even though the RetroSign GRX is a robust instrument, it is also an optical instrument and must be handled with care:

- Avoid exposing the instrument to high mechanical shocks and vibrations.
- Avoid exposing the instrument to rapidly changing temperatures.
- When not in use store the instrument in its case in a clean and dry environment.

Front lens

The lens does not need special maintenance. If dirty carefully moist the lens with ordinary window cleaning liquid and clean it with a soft linen cloth. If damaged send the instrument to DELTA or one of our authorized service dealers for repair.

Battery

A substantial drop in obtainable measurements on a fully charged battery indicates that the battery is worn out and must be renewed.

For your safety:
Do not expose the battery to heat or flames: **Danger of explosion.** Do not place the battery on a heater or expose to direct sunlight for long periods.

The battery can be stored within a temperature range between -10°C to +60°C (14°F to 140°F), but we recommend storage between 0°C to +30°C (32°F to 86°F), due to lifetime considerations of the battery.

Allow a warm battery to cool before charging. When handling or storing the battery take special care to avoid possible short circuiting the battery contacts.

See further details in the battery user guide.

Safety precaution:

- The battery should be protected against impact. Do not open the battery.
- Store the battery in a dry and clean place.
- Due to environmental protection do not dispose the battery with household waste.

Battery charger

Keep the battery charger clean by blowing compressed air on charger vents and wiping the charger housing with a damp cloth. Contamination may result in electric shock or fire. Make sure the battery charger is unplugged before cleaning it.

Calibration target

To make sure that the calibration of the retroreflectometer is correct it is important that the surface on the calibration target is clean and undamaged. Keep the calibration target protected, and be careful not to touch the calibration target (reflective side).

If the surface is stained, scratched, or broken the calibration target must be replaced. A replacement calibration reference can be purchased from DELTA and changed by the user by unscrewing two screws and replace the damaged calibration reference.

In case of dust on the surface, clean the calibration target gently by using a soft cloth - if necessary use a mild household detergent. Wipe carefully with dry linen cloth afterwards.

To ensure reliable measurements, it is recommended that the calibration target is periodically recalibrated or changed to a traceable standard. DELTA suggests this period to be every 2 years. The calibration target comes with a DANAK accredited calibration certificate. DELTA offers calibration traceable to PTB (Physikalisch-Technishe Bundesanstalt) and NIST (National Institute of Standards and Technology). For further information, contact your appointed dealer or DELTA, Denmark.

The RetroSign GRX may be calibrated with any DELTA approved calibration target following the calibration procedure outlined in this manual. The DANAK accredited calibration certificate delivered with a calibration target will have random numbering – the serial number of the certificate does not correspond to the serial number of the GRX instrument.

Calibration

The RetroSign GRX is factory calibrated but a reference calibration should always be carried out before starting a series of inspections, or minimum once a day when using the instrument.

The calibration process automatically compensates for instrument offsets etc.

Appendix A: Specifications

General characteristics

Type ASTM

Geometry: ..... ASTM E-1709, ASTM E 1809

Illumination angle: ..... -4°

Observation angles [1)]: ..... 0.2°, 0.33°, 0.5°, 0.7°, 1.0°, 1.5°, 2°

Type CEN

Geometry: ..... CEN EN 12899

Illumination angle: ..... +5°

Observation angles [1)]: ..... 0.2°, 0.33°, 0.5°, 0.7°, 1.0°, 1.5°, 2°

Type SAFE

Geometry: ..... CEN EN 20471

Illumination angle: ..... +5°

Observation angle: ..... 0.2°

Location position system (GNSS)

Latitude / Longitude Format ..... Decimal degrees

Datum ..... WGS 84

Common geometry parameters

Light source angular aperture: ..... 0.1°

Receptor angular aperture: ..... 0.1°

Field of measurement: ..... ø 25 mm/1 inch

Light source: ..... Illuminant »A«

Receptor sensitivity: ..... Precise eye corrected

Min. reading (cd/lx×m²): 0

Max reading (cd/lx×m²): 2000

[1)] *Some angles are optional*

Electrical characteristics

Battery: ..... Replaceable 10.8 V/2Ah Li-ion

External charger: .....Mains voltage 230 VAC/50 Hz or 120VAC/60Hz

Charge time: ..... approx. 45 minutes

Other

Data memory: ..... More than 2 million measurements without pictures
More than 2,000 measurements with pictures

Data transfer ..... USB memory stick

WiFi and wireless radios

Frequency band: ..... 2400 MHz to 2480 MHz

Maximum transmitted radio-frequency power: .....Below 93 mW

Environmental characteristics

Operation temperature: .....0°C to +60°C (32°F to 140°F)

Storage temperature: .....-10°C to +60°C (14°F to 140°F)

Recommended storage (due to lifetime considerations of the battery): .....0°C to +30°C (32°F to 86°F)

Humidity: .....Non-condensing

Mechanical characteristics

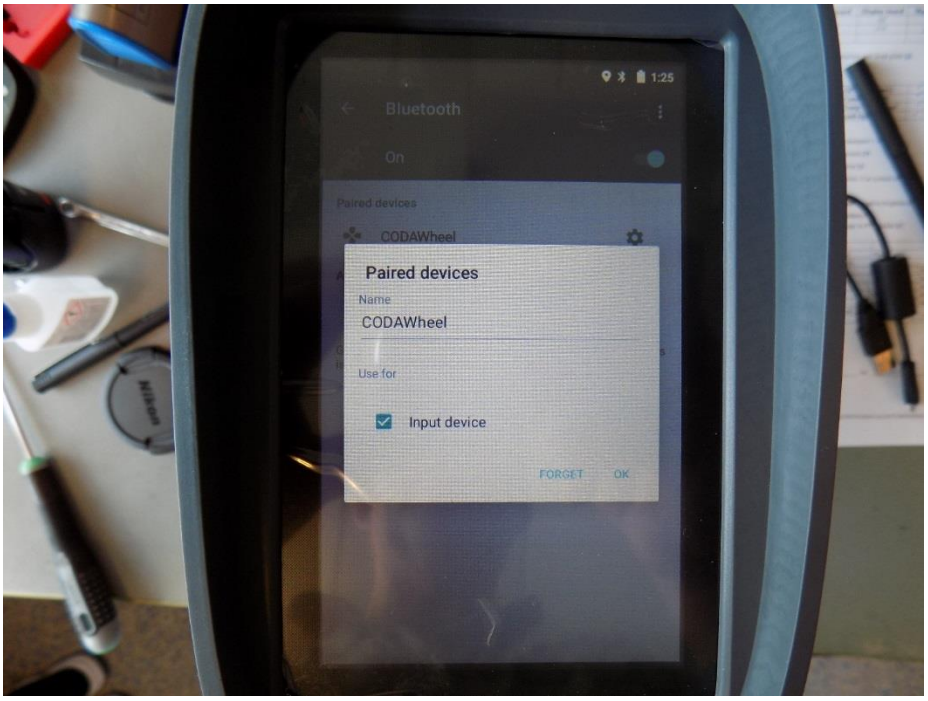
Length: .....270mm/10.6 inches

Width: .....110 mm/4.3 inches

Height: .....285 mm/11.2 inches

Weight: .....1.9 kg/4.2 lbs

Appendix B: How to connect and disconnect the CODA wheel / extension pole to the GRX



How to connect the CODA wheel / extension pole

Go to the BLUETOOTH menu in the display, but DO NOT ACTIVATE the BLUETOOTH function.

Turn on the CODA wheel (position 1 at the CODA wheel).

Press down/activate the bottom in the CODA wheel for approx. 15 seconds until you see a flashing red and green light from the small LED on the CODA WHEEL. Now activate the BLUETOOTH function in the display.

When the CODA wheel text appears in the display, push/tap on the text CODA wheel l. The instrument will now start the parring procedure. After the parring procedure, the GRX will automatically start the connection procedure. The instrument will after a few seconds connect to the CODA wheel. The entire screen will tilt 90 degrees for a few second and then go back to the normally look when the connection is established. Press the left arrow at the top of the screen to return to the measurement mode. The CODA wheel is now ready to use.

How to disconnect the CODA WHEEL.

Turn the CODA wheel OFF (position 0)

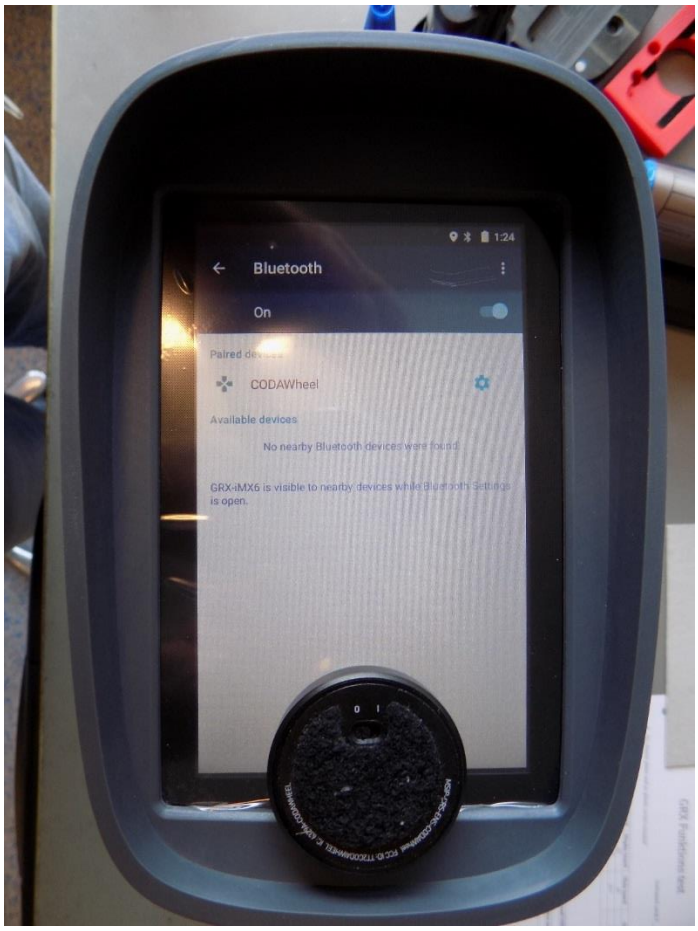
Go to the BLUETOOTH MENU, activate the BLUETOOTH function.

Wait until the instrument has finished the search for new devices.

Push directly on top of the “cogwheel” icon  . The display is very sensibel, so, if you push too long the whole text line will be marked and the instrument will start connecting to the CODA wheel. If you push too short, the instrument will also start the connection procedure. Push approx. ½ second and you will see a small square around the cogwheel icon and a new window will appear.

(If the push is not correctly performed and the instrument start connecting to the CODA wheel, then wait until the instrument has finished the connection procedure, then you can make a new push on the icon).

At this window press/push the “FORGET” field. Then turn off the BLUETOOTH function at the top of the display. Wait and turn the BLUETOOTH mode ON again. Now the CODA wheel should be disconnected.



Appendix C: Delivery

The RetroSign GRX instrument is delivered with the below items.

1. Carrying case
2. Angel adaptor
3. RetroSign GRX instrument including battery
4. Battery charger
5. Spare battery
6. USB stick for data transfer