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LTL-XL RETROREFLECTOMETER

Manual

On site quality control of road markings & road surfaces in accordance with CEN / ASTM specifications



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NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his / her own expense.

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Version 1.04a English



R&TTE Declaration of Conformity (DoC)

Unique identification of this DoC: 80_LTL-XL EU_DoC 001

We,

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

declare under our sole responsibility that the product:

Product name: LTL-XL Retrometer
Trade name: DELTA LTL-XL
Type or model: All types pursuant to the referenced trade name

to which this declaration relates is in conformity with the essential requirements and other relevant requirements of the R&TTE Directive (1999/5/EC).

The product is in conformity with the following standards:

HEALTH & SAFETY (Art. 3(1)(a)):
EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011
EMC (Art. 3(1)(b)):
EN 301489-1 V1.8.1:2008
EN 301489-3 V1.4.1:2002
SPECTRUM (Art. 3(2)):
EN 300440-2 V1.4.1:2010

Supplementary information:

The equipment incorporates a GPS module.
The equipment is Class 1 radio equipment which can be placed on the market and be put into service without restrictions.

Technical file held by the undersigned.

Place and date of issue (of this DoC): July 1st 2012

Signed by or for the manufacturer:


.....
(Signature of authorized person)

Name (in print):
Pernille Veje
Vice President QA/RA & E



US Attestation of Conformity (AoC)

Unique identification of this AoC: 80_LTL-XL US_AoC 001

We,

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

declare under our sole responsibility that the product:

Product name: LTL-XL Retrometer
Trade name: DELTA LTL-XL
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 A)
47 CFR Part 15B, subpart 15.109 (Class A)

The equipment is safety tested with CB Scheme certification under the internationally harmonized safety standard:

IEC 60950-1:2005 (2nd Edition); Am 1:2009

Supplementary information:

The equipment incorporates a GPS module.

Technical file held by the undersigned.

Place and date of issue (of this AoC): July 1st 2012

Signed by or for the manufacturer:



(Signature of authorized person)

Name (in print):
Pernille Veje
Vice President QA/RA & E

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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SECTION 1

OPERATING INFORMATION

LTL-XL introduction

The LTL-XL retroreflectometer is a portable field instrument intended for measuring the retroreflection and reflection properties of road markings. LTL-XL measures the R_L value (coefficient of retroreflected luminance at night) and the Q_d value (day light visibility). R_L is a measure of the lightness of the road marking as seen by drivers of motorized vehicles in car headlight illumination. The road is illuminated at an angle of 1.24° . The illumination for Q_d is diffuse. The reflected light for both R_L and Q_d is measured at an angle of 2.29° , which corresponds, to an observation distance of 30 meters. This is relevant for a motorist's viewing situation under normal conditions. Further information on measuring principles and standards can be found on www.roadsensors.com.

R_L and Q_d are important factors in the **ON-SITE** quality control of road markings.



Figure 1. The instrument

The operation of the retroreflectometer is very simple and requires minimal instruction.

The LTL-XL measures the retroreflectivity and calculates R_L and Q_d according to the international CEN and ASTM standards. Results are presented in plain text on a large graphic display. Error messages or warnings are shown in the display in case of any problems during use. The memory of the instrument provides registration of measurements with corresponding date, time and other relevant data. The following data is also registered (if enabled):

- Name of measuring series (road name)
- Profile icon for road marking type
- User name
- GPS data (if installed)
- Temperature & humidity
- Instrument status

The measurement results can be printed by the built-in printer (optional). Communication with a PC using the RSC (Road Sensor Control) software program (**see pg. 36**) allows for data exchange with other PC programs.

A rechargeable NiMH (Nickel-Metal Hydride) standard battery powers the LTL-XL, allowing approx. 1,100 measurements on a new and fully charged battery. The optional high capacity battery can provide approx. 2,500 measurements. A mains powered 15V power adaptor for charging is supplied as customary delivery. Charging time is approx. 1½ hour for the standard battery and 3½ hour for the high capacity battery. The instrument can also be charged from a 15-18 VDC source. For field charging the 15V power supply could be powered from an “AC power inverter” connected to the car battery.

LTL-XL retroreflectometer features

- Portable instrument
- Ergonomic operation height
- Fast measurement (completed in less than 1 sec. for R_L or Q_d and 3 sec. for $R_L + Q_d$)
- Measuring on dry and wet surfaces
- Will measure flat, textured & profiled markings up to 5 mm
- Fully documented measurements with automatic data storage, user and series identification for labeling and grouping measurements
- Audible signals during use (if enabled)
- RSC (Road Sensor Control) PC software for data exchange. Log data can be exported to applications such as Microsoft Excel or displayed on Google Earth
- Easy one-step calibration procedure
- Traceable and accredited calibrated reflection standard
- User replaceable battery
- Fast charging, approx. 1½ hour for standard and 3½ hour for high capacity battery
- Rechargeable from mains using power
- Average (2-99 readings)
- Multiple languages

Options

- Built-in GPS for precise logging of measuring location
- Wheel unit and extendable handle
- Build-in thermal printer
- High capacity battery

Getting started

Buttons:

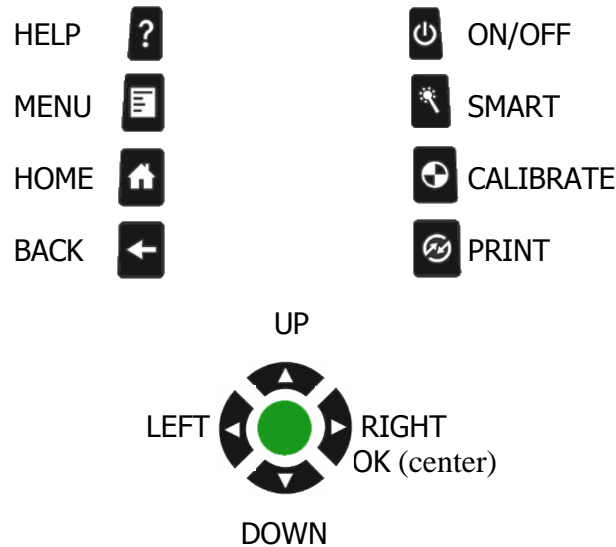



Figure 2. Buttons

Height adjustment (optional)

Before using the LTL-XL, notice that the operating panel can be adjusted in height for ergonomic considerations. The height is adjusted by pressing the red knob on the front of the instrument and at the same time lifting the handle on the operating panel. Release the knob and continue lifting until the handle locks.


Turn on

Turn on the LTL-XL by pressing and holding the ON/OFF button  until the display turns on. The instrument will be ready for measuring within 10 seconds. The LTL-XL wakes up from standby within 1 second.

Measuring


Calibrate the instrument if needed. DELTA recommends calibrating the instrument every time the instrument is switched on and / or starts a new series of measurements or minimum once a day typically in the morning before measurement start. See **Calibration**, pg. 40

Place the instrument on the road marking. See **positioning on the road** pg. 12





Press the green OK-button  to take a measurement. A single R_L or Q_d measurement takes approx. 1 sec. A combined R_L and Q_d measurement takes 3 sec.

When the measurement is complete, the R_L and/or Q_d value will be displayed. Data is automatically transferred to the data log. If there is a problem with the measurement a warning icon or an error icon will pop up (see **Errors and warnings**, pg. 36) and an audible alarm will sound (if enabled, see **Sound settings**, pg 23).




Measurements taken with a low battery warning are marked in the log and a warning icon appears. If battery voltage gets too low measurements can't be taken and an error icon appears.


To print the latest measurement data, press the PRINT button  (Requires the printer option).

User select (user initials)

If a user icon  is displayed in the upper icon row on the measuring display, press the UP button  and if necessary  or  to mark the user icon. Press the OK button to enter the user select menu. For further information see **Selecting a user id, pg19**

Series ID select (name)

If a user icon  is displayed in the upper icon row on the measuring display press the UP button  to mark the road icon. Press the OK button  to enter the Series ID select menu. Select a name from the list using UP or DOWN and accept with OK or ENTER / EDIT a new name.

If the  icon is not shown or if further information is need, see **Series Id, pg. 28**


Calibration

The instrument is supplied with a reference calibration unit. The reference calibration unit is factory calibrated and traceable to PTB (Physikalisch-Technische Bundesanstalt, Germany) and NIST (National Institute of Standards and Technology, USA).

Calibration procedure

Before a calibration is carried out make sure that the calibration unit is clean.

To carry out a calibration go through the following steps:

- Before mounting the calibration unit check the R_L and Qd values stamped on the calibration unit.
- Mount the calibration unit underneath the instrument. Make sure that the pins on the interface plate fit into the holes on the calibration unit. Be very careful when you place the instrument on the calibration plate not to damage the calibration unit and / or the light diodes
- Press the CALIBRATION button  once. Select R_L or Qd calibration to calibrate one at a time.
- Adjust the calibration value shown in the display so it matches the value stamped on the calibration unit. See the Calibration section for details.
- Press the OK button to finish the calibration. If an error occurs ensure that the
- preceding steps have been taken and try again.
- Repeat the calibration process for the other quantity (R_L , Qd)

The calibration procedure is now complete. Remove the calibration unit and store it properly. Press OK to return to the measurement display. For further details see **pg. 42**.


Errors and warnings

An error or warning icon will appear in the upper row of the display if the LTL-XL detects




a problem. Press the UP button ▲ to get a description of the most serious error or warning. Press the UP button ▲ to get a description of the most serious error or warning. Now press the OK-button to display a total list of all errors or warnings related to the measurement and the instrument in general.

Sound setting

Press the MENU button  and select **SETTINGS / SOUND**. Select **KEY CLICK** or **SOUNDS** to set the individual sound levels for key click and system sounds. Use the UP ▲ or DOWN ▼ button to set the level. Accept the setting by pressing the OK button.

Miscellaneous

The HOME screen can be activated at any time by pressing the HOME button .

Reset log: Press the MENU button  and select **LOG / CLEAR DATA**. Now select from the menu: **CLEAR LAST DATA**, **CLEAR ALL DATA** or **CLEAR SERIES DATA**.

Date and time: Press the MENU button and select **SETTINGS / DATE & TIME / SET TIME/DATE**. Use the UP ▲ and DOWN ▼ buttons to set the different time related settings.

Power save: Press the MENU button and select **SETTINGS / POWER / AUTO SLEEP, AUTO OFF**. Use ▲ and ▼ to edit the values.

Data exchange / communication

The RSC software program, developed by DELTA for use on a PC, allows data to be exchanged between the LTL-XL and a PC. See **RSC-program**, pg. 36.

Important guide lines for the correct use of the LTL-XL

Positioning of the instrument on the road marking

Select an area of the pavement marking that is level when taking readings. The measurement field is marked with a yellow sticker on one side of the base cover. The measurement field is approximately 50 mm / 1.97 inch wide and 185 mm / 7.28 inch long. Ensure that the pavement marking to be measured before taking measurements is free of debris. Make sure that the instrument is stable positioned.

Reason: The LTL-XL has three support pads, each with a small footprint, two smaller in the front and one larger at the back. An uneven marking or a small piece of gravel trapped below one of the pads will move the measurement field and affect the reading.

Taking the measurement

Press the green OK button to take a single or double reading as selected. Do not put pressure on the handle when taking a measurement.

Reason: Pressure on the handle can tilt the instrument slightly and affect the measurement geometry and thus influence the reading.

Number of measurements.

For accurate readings, do not take just one reading of a road marking. Three readings will give a more accurate result than one reading. Five readings will give an even more accurate result than three readings, etc. Take the readings in adjacent areas of the marking. Let the instrument calculate the average of the readings (fixed or moving average options).

Reason: A road marking's retroreflectivity varies from area to area. It is not unusual to see variations of 5% - 20% when the instrument is moved even less than 10 mm / ½" in either direction.

Protective display shield.

For the protection of the display and longevity of the instruments keep the display shield closed when the instrument is not used. For further information please see section 2.

Remember:

- LTL-XL is an optical precision instrument, handle with care.
- Keep the protection window and calibration unit clean and undamaged.
- Store in a clean, dust free and dry environment.

Read:

Measurement practise for road markings. This leaflet can be located on:
<http://www.roadsensors.com>


SECTION 2

GENERAL INFORMATION

Measurements

The LTL-XL retroreflectometer measures the R_L (coefficient of retroreflected luminance) parameter and Qd (the day light visibility). The R_L parameter represents the brightness of road markings seen by drivers of motor vehicles by headlight illumination. Qd represents the visibility of the road markings under day light conditions.

In the LTL-XL the illumination angle is 1.24 degrees for R_L , the illumination for Qd is diffuse. Both observation angles are 2.29 degrees. According to both ASTM and CEN standards these angle simulates a driver's viewing distance of 30 meters. The instrument's illumination field is approximately 185 mm x 50 mm / 1.97 x 7.28 inch.

Push the  button from the HOME screen to take a measurement. Shortly after, the R_L and related information are presented on the colour display. The result is automatically transferred to the internal memory. The measurement, along with its corresponding time, date, and other data can be printed using the (optional) built-in printer.

Every measurement contains status information. If an error occurs the information can be interpreted by the warning/error icon in the top line of the display. The information is available until a new measurement is taken. The status information is stored in the log.

Notes on error sources

Stray light can occasionally enter the instrument but will be insignificant under normal measurement conditions. The LTL-XL compensates for stray light automatically.

Instrument drift and offset errors are compensated by means of data obtained during the calibration procedure. It is very important to keep the dust-protection window and the ceramic on the calibration unit clean.

The LTL-XL illumination angle is 1.24° relative to the road surface. Because of this small angle accurate placement on the road is important. Avoid pebbles and abnormal irregularities. The LTL-XL must be parallel and in contact with the marking surface.

The LTL-XL retroreflectometer is a rugged instrument, but it is an optical instrument and must be handled as such.

The LTL-XL is factory calibrated. Nevertheless start measurements with a calibration. Study the display for any warning or error icons. See **also Section 4 - Maintenance**

Note

Keep the dust-protection window and ceramics on the calibration unit clean.
Keep the battery fully charged. A well charged battery is more resistant to aging and damage.

High temperature conditions.

Display

If the display is exposed to intense direct sunlight during a longer period of time the display may overheat. It is recommended to close the protective display shield. The shield also protects against damages and scratches. "Daylight readable" displays are vulnerable to high temperatures. High temperature will decrease the display service life.

Battery

The battery is rated to operate between 0°C / 32°F and 45°C / 113°F.

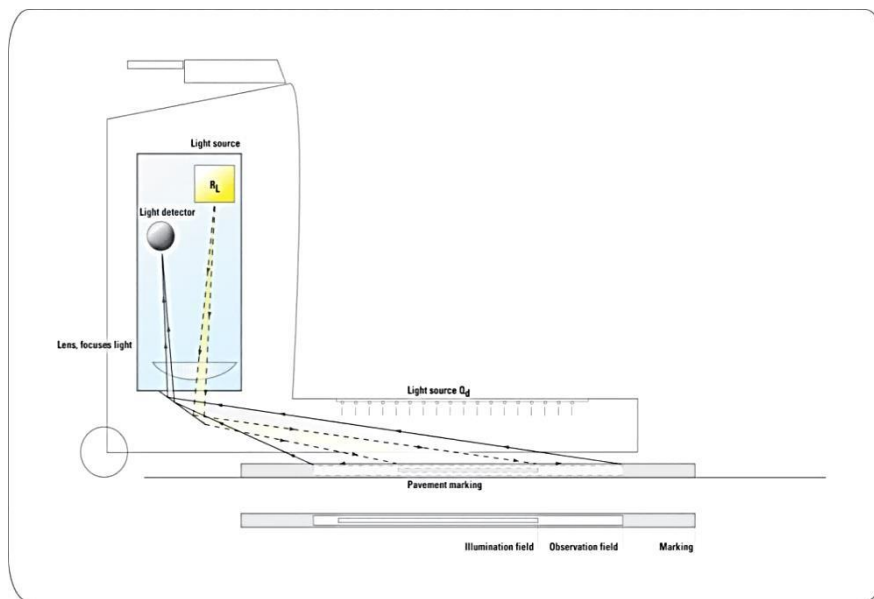


Fig 3. LTL-XL, the inside

SECTION 3

THE USER INTERFACE



Figure 4: The HOME screen

Display and keyboard layout

The user interface consists of a rectangular display surrounded by push buttons. The display has two main modes: the *measurement display* (HOME screen) and the *menu display*. The instrument will start up with the measurement display shown. The display area is divided into four areas: a large main display in the middle, an icon row at the top, a message or caption field underneath and an icon row at the bottom.

Measurement display / HOME screen


Here the latest measured R_L and/or Q_d values are presented with large digits together with other information. On the graphic in figure 4, all available information's are shown in the display. If a function is deactivated, it will not be shown. The actual date and time is always shown.

Upper icon row

The upper row of icons is accessed by pressing the UP button \blacktriangle . One of the icons is then highlighted and can be activated by pressing the OK button. The other icons in the row can be accessed by using the LEFT \blacktriangleleft or RIGHT \blacktriangleright buttons. The meanings of the icons are (from left to right):

- Series ID selection, can be switched off (see **pg.28**).
- User ID selection, can be switched off (see **pg. 19**).
- Error/warning alarm. Will be shown in case of an error/warning (see **pg. 36**).
- GPS indication (see **pg. 24**).
- Battery status (see **pg. 40**).

Lower icon row

- From the lower icon row you can select a road marking icon that will be saved together with the measurement in the log (see **pg. 18**). Access the icons by pressing the DOWN button ▼. Use the LEFT or RIGHT button to mark the preferred icon. Pressing DOWN again shows more icon rows from a roll stack of five rows. One row, marked with a "PR" for "Preset" can be preset by the user (see **pg. 30**) and is saved separately for each measuring series. It will be the active icon row, ready for selection, when a measuring series is selected.
- Activate the marked icon with the OK button or exit with the HOME  or UP ▲ button. The selected icon is now shown in the left side of the HOME screen and the instrument is again ready for measuring.
- Other functionality regarding the lower icon row:
Activating an already selected icon will cancel the activation and remove the icon from the main display (and no icon will be saved by the next measurement).

Push buttons

OK 

When the message row shows MEASURE, press the OK button to take a measurement. In most other cases pressing the OK button will activate a highlighted selection.

ON/OFF 

The button turns the instrument *ON* or *OFF* and enters the *standby mode*. Press the button to turn the instrument *ON*. The start-up time is ~10 seconds when the LTL-XL is turned OFF. If the LTL-XL is in standby it turns on within 1 second.

Press the ON/OFF button for 1 second to enter standby mode.

Press the ON/OFF button for 5 seconds to turn the LTL-XL off.

When the instrument is in standby mode, a short press on the button will turn on the display. It is not possible to turn off the instrument during battery charging or when connected to a USB port.

HOME 

Bring you back to the measurement display.

BACK 

Bring you backward one step in the menu and cancel new settings, which have not yet been confirmed by the OK button. In most cases the LEFT button has the same function.

HELP 

The button presents a context sensitive help text. The help presented will be on the subject headline shown in the display. Another press on the button will open up a general help menu.

Menu 

The button selects the top level of the menu tree, the main menu. Use the UP and the DOWN buttons to scroll through the menu items. Press OK to select the highlighted item. In most cases it opens up further submenu levels.

SMART 

This button is user programmable to one out of several functions, e.g. to clear the last measurement, see **pg. 24**.

CALIBRATE 

This button starts the calibration wizard, see **pg. 42**.

PRINT 

Print out the last measurement or selected parts of the log to the (optional) printer. In the diagnostics menu you can print out different instrument information's.

The menu tree

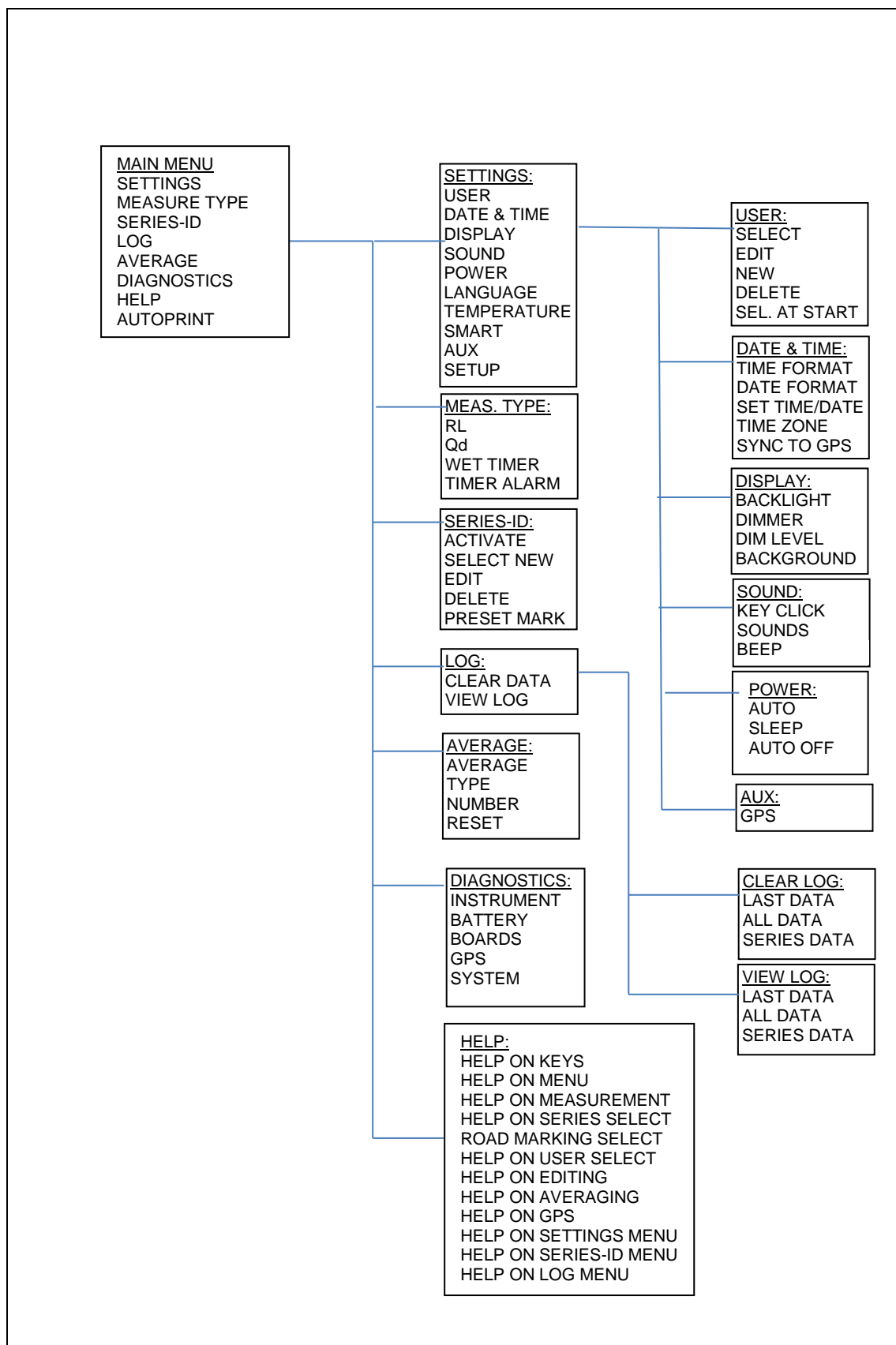


Figure: 5 – The menu tree

Setting up for measurements


Selecting a User ID

The user ID (user profile) is used to identify the operator and is saved in the log together with each measurement. If enabled, it can be seen at the lower left side of the measurement display. Measurements can also be taken without a user ID. Unlimited user ID's can be stored in the instrument.

Certain instrument settings are stored individually for each user. Selecting a user will restore these settings. Following settings are stored:

- User, sel at start
- Time format
- Sync to gps
- Backlight time
- Dimmer time
- Dim level
- Background (on/off)
- Key repeat (time)
- Setup (basic/advanced)
- Auto off time
- Auto sleep time
- Key click sound level
- Sound level
- Beep (on/off)
- Activated series
- Average (on/off)
- Average type
- Average number
- Wet timer
- Wet timer alarm/measure
- Calibration value
- Temperature units (°C/°F)
- Languages
- Smart key function

The select procedure.

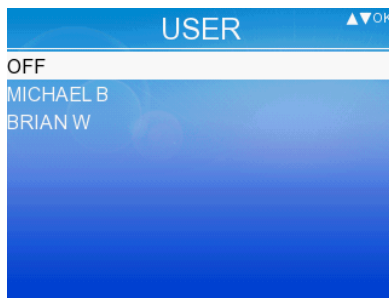
If a user select icon  is not seen in the upper icon row:

Press the MENU button and select **SETTINGS / USER / SELECT** to display the **USER** menu.



If a user select icon is seen in the upper icon row:

Press the UP button. Then, if necessary use the LEFT or RIGHT button to highlight the user icon. Press the OK button. The **USER** menu is shown:



Now use the UP or DOWN button to highlight a user name. Press the OK button to accept the name.

Changes made to the above mentioned individual instrument settings are automatically stored in the selected User ID.

Selecting *OFF* will deactivate the user function and set all individual instrument settings to default.

Edit user

User names can be edited from the menu **SETTINGS / USER / EDIT** (see editing pg. 35).

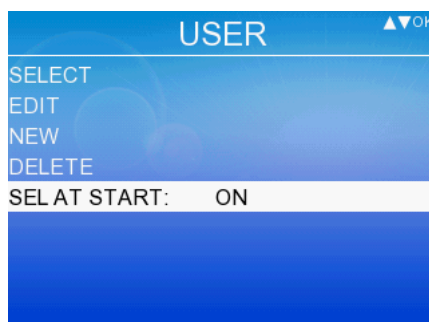
New user

A new user can be entered from the menu **SETTINGS / USER / NEW** (see editing pg. 35).

Clear user

Deleting the User ID will remove the user and settings from the memory.

Select at start



Enabling *SEL. AT START* will force the user to select a user ID each time the LTL-XL is turned on.

Press the MENU button and select SEL. AT START. Press OK to toggle between YES and NO

Selecting a road marking icon

The purpose of a road marking icon.

The road marking icons are used as labels for the individual measurement corresponding to the measured road marking and will be saved in the log together with the measuring result. The icon will then be presented together with the corresponding measurement when viewing the log or by using the RSC program (see pg. 30).

There are 24 fixed icons to select from. Six of the icons can be programmed as individual presets for each series (see pg. 30) and will be ready for selection when a series is selected.

The procedure.

From the HOME screen press the DOWN button. Then use the LEFT or RIGHT button to highlight the wanted icon. Pressing DOWN steps through and displays the five icon rows. Pressing UP will return to the HOME screen without selecting a new icon.

Pressing the OK button will activate the selected icon. The selected icon is now shown in the left side of the measuring field and the instrument is again ready for measuring.

Deactivating the profile icon.

Activating an already selected marking icon will cancel the activation and remove the icon from the main display.

Setting the date and time

Date and time is always shown in the display. Every measurement taken is marked with the date and time, so it is essential that the settings are correct.

Press the MENU button and select **SETTINGS / DATE & TIME**. Press OK and the time format sub menu is shown.

Setting the time format



Press OK when **TIME FORMAT** is highlighted and scroll between 12 and 24 hr format by pushing the OK button.

Setting the date format

Navigate to **DATE FORMAT** and push OK



Highlight the preferred date format using UP or DOWN. Press OK to accept.

Adjusting the time and date

Press OK when **SET TIME/DATE** is highlighted.



Press OK to activate each line and use UP or DOWN to set the figure. Press OK to accept the setting.

Setting the Time zone

Press OK when *TIMEZONE* is highlighted. Press OK to open the list of geographical locations. Choose your area. Press OK to select. Now a new list shows up with national time zones. Scroll to your location and press OK to select.

Time zone is used in relation with automatic daylight saving and When *SYNC. TO GPS* is enabled.

Note:

The time in this menu is not updated live, but it will synchronize the time shown in the HOME screen.

Synchronize to GPS (optional)

When GPS is installed and *SYNC. TO GPS* is highlighted press OK to toggle between *ON* and *OFF*. By activating this function make sure that the time zone is correct otherwise the clock in the LTL-XL and the time stamp in the log data will probably not be correct.

Setting the dimmer and back light (Display)

The backlight and dimmer can be adjusted. Press the MENU button and select **SETTINGS / DISPLAY**.



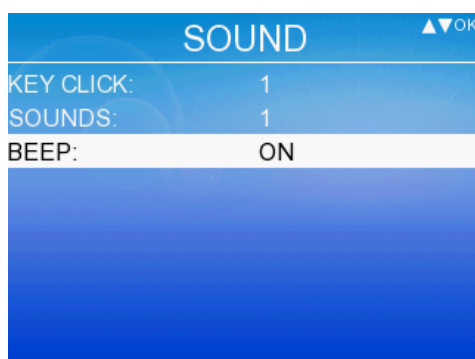
The levels can be adjusted on a scale from 1 (lowest brightness) to 10. Press OK to activate the function and use UP and DOWN to change the values. Press LEFT or BACK to store. It is also possible to adjust the time before the light switch to dimmer mode from 5 to 120 seconds or set to OFF. The back-ground colour of the display can be switched off.

WARNING: Using high brightness will drain the battery faster!

Setting the sound level

Press the MENU button and select **SETTINGS / SOUND**. Select *KEY CLICK* or *SOUNDS* to set the individual sound levels for key click and system sounds. Use the UP or DOWN button to set the level. Accept the setting by pressing the OK-button.

To activate a highly audible beep when the instrument has finished measurement set *BEEP* to *ON* by pushing the OK-button.



Note:

The beep indicates that the measurement is taken and the instrument can be removed from the road marking. Data processing can be on going after the beep and after a moment the display is updated.

Auto Sleep (Power)

To save power the instrument can be setup to automatically change to Auto Sleep mode. The Auto Sleep time can be set from 1 to 30 min. in intervals of 1 min. or it can be deactivated (*OFF*). Press the ON/OFF button to wake up from sleep/standby.

Press the MENU button and select **SETTINGS / POWER / AUTO SLEEP**. Use UP and DOWN to edit the auto turn sleep time. Press OK, LEFT or BACK to accept.

Auto Off (Power)

To save power, the instrument can be programmed to automatically turn off if not used for a while.

Press the MENU button and select **SETTINGS / POWER / AUTO OFF**. Use UP and DOWN to edit the auto turn off time. The off time can be set from 1 to 8 hours in intervals of 1 hour or it can be deactivated (*OFF*). Press OK, LEFT or BACK to accept.

The LTL-XL will not turn off when either the power supply or a PC is connected.

When communicating with RSC program or when the power supply is connected the instrument will not power down automatically. The startup time will be approx 10 seconds.

Setting the language

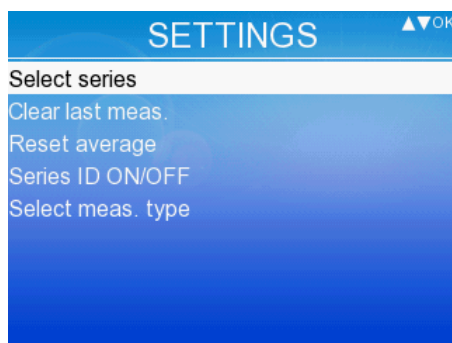
Press the MENU button and select **SETTINGS / LANGUAGE**. Use the UP or DOWN button to select a language. Accept by pressing the OK button or leave unchanged by pressing BACK.

Setting the temperature unit

Press the MENU button and select **SETTINGS / TEMPERATURE**. Use the OK button to select between Celsius and Fahrenheit. Accept by pressing the BACK button.

Setting the SMART key function

This button is user programmable to one of several functions, e.g. to clear the last measurement. Press the MENU button and select **SETTINGS / SMART**.



Use the UP or DOWN button to select the SMART KEY function. Accept by pressing the OK button.

The selected function is now accessed every time  is pressed

Using GPS (optional)


The GPS system, if installed, is used to log position data (latitude and longitude) to the log together with the measurement data.


If the GPS is activated the GPS icon is shown in the upper icon row



The icon will display the quality (reliability) of the GPS signal.

GOOD:  The GPS HDOP (Horizontal Dilution Of Precision) value is below 5.

FAIR:  The GPS HDOP value is larger than 5, but the GPS can FIX.

NO:  The GPS cannot FIX (weak or no signal).

The GPS position data, HDOP value, and the number of satellites used in the position calculation are saved in the log together with the R_L and Qd data.

Activating the GPS

Press the MENU button and select **SETTINGS / AUX**, highlight the GPS line and press the OK button to toggle the GPS ON or OFF. Press the BACK button or the HOME button to return to the HOME screen.

The GPS data can be viewed from the HOME screen by pressing the UP button and then highlighting the GPS icon by using LEFT or RIGHT buttons. Press the OK button to display the GPS data. When the GPS data changes the display is updated.

If the GPS cannot acquire fix and a measurement is taken a warning menu appears. You will be presented with the following option:

- No GPS fix. Measure anyway: NO / YES?

More about the GPS

The GPS unit will typically acquire satellite signals and process a position fix in 1-15 seconds after the LTL-XL is turned on. If the GPS receiver has been turned off for a long period of time or the instrument has been moved far away from its last position, the time to first fix will take longer.

LTL-XL logs the following GPS information:

LATITUDE, LONGITUDE, UTC TIME, HDOP, NUMBER OF SATELLITES USED, POSITION FIX FLAGS AND DATUM.

“Position Fix Flags” is interpreted by the LTL-XL software and the information’s are shown in plain text in the View log,

Datum is by default set to: *WGS84* and cannot be changed.

Latitude and Longitude are output in the format:

Degrees, Minutes and (Decimal) Fractions of Minutes.

The GPS engine used has a navigation performance of 2.5 m CEP¹⁾

The precision of the GPS receiver is determined by many factors. A few are listed below:

- Signal obstruction. The GPS receiver requires a clear view of the sky. Trees, buildings and other environmental objects may affect the satellite signals.
- Satellite constellation and geometry.
- Multi path (reflection of signal from buildings etc.).

The HDOP (Horizontal Dilution of Precision) is a number that indicates the quality and precision of the received GPS data (low values are better than high).

A HDOP value <1 indicates a high precision position. HDOP signals between 1 and 5 indicate a fair precision and HDOP values >5 a poor precision

When the GPS is used, the operating time for the LTL-XL is slightly decreased and you may have to charge the battery more often.

¹⁾ CEP (Circular Error Probable):

A statistical measure of the horizontal precision. The CEP value is defined as a circle's radius, when centered at the true position, encloses 50% of the data points in a horizontal scatter plot. Thus, half the data points are within a 2-D CEP circle and half are outside the circle.

Setup (basic and advanced)

Setup is used to separate between basic and advanced users. The basic settings reduce the number of menus available to the user. For example, in basic menu operation, users cannot clear the log.

The following menu points can be selected in basic mode:

Settings:	User, Date & Time, Display, Sound and Temperature, Setup
Measurement type:	R _L , Qd, Wet timer, Timer alarm
Log:	View log
Diagnosis:	Instrument, Battery, Boards, GPS, System
Help:	All menus available
Auto Print	

ADVANCED setting will provide access to all menu functions.

To change the setup, press **MENU** and select **SETTINGS / SETUP**. Pressing **OK** will toggle between *ADVANCED* and *BASIC*. To return from setup press **BACK** or **HOME**.

MEASURE TYPE

R_L & Q_d

When taking wet or rain simulation measurements some procedures describe to wait a certain amount of time from the marking is made wet and to the measurement is taken. The WET TIMER assists the operator to time this kind of measurements.

Wet timer

The wet timer function works for R_L measurements only. The timer can be adjusted between 15 and 60 seconds. The wet timer automatically carries out the measurement or sound an alarm after the set period of time.

Timer Alarm

Toggle between “Measure” or “Alarm”. The selected option is used when wet timer times out.

SERIES ID

Working with series ID

The purpose of a series ID

The series ID is a label, for example the name of a road. Although measurements can be performed without selecting a series ID, it is convenient to group (name) the measurements for each geographical spot, road or part of a road for easier recognition. The series ID for such a group of measurements will be saved in the log together with the measuring results. The ID must be selected prior to the measurement.


The individual measurements in a group can further be labeled by selecting a road marking icon (see pg. 27) corresponding to the actual road.

Activate

To use the series ID it must be activated. Press the MENU button and select: **SERIES ID / ACTIVATE SERIES**. By pressing OK you can toggle between *ON* and *OFF*, to activate or deactivate the series ID function. Press BACK or press the HOME button to return to the HOME screen. When the series ID is off no ID is shown in the display.



Selecting a series ID

From the HOME screen press UP. If necessary, use the LEFT or RIGHT button to highlight the road icon . Press the OK button. The **SERIES ID** menu is shown. Choose **SELECT** to access the available series ID.



Press the OK button to accept the name.

Enter a new series ID

Do the same as above but select **NEW** from **MAIN MENU / SERIES ID**. Proceed by spelling the series name. Press END in the spelling section to save.

Edit a series ID

Do the same as above but select **EDIT** from **MAIN MENU / SERIES ID**. Proceed by editing the series name. Press END in the spelling section to save.

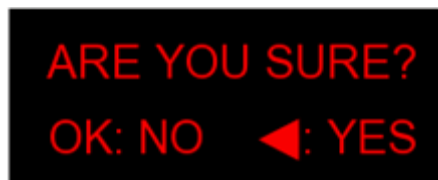
Removing a series ID

This will remove the series ID from the selection list. Press the MENU button and select **SERIES-ID / DELETE**:



Use UP or DOWN to select the series that should be deleted. Accept by pressing the OK button.

A confirmation menu is shown:



Note! All measurements in the selected series will be erased from the log!

If a large numbers of Series Id's are to be deleted this can more easily be done from the RSC program from the *project tab* click . (Road Sensor Program) see page 40

Presetting the road marking icon

Six of the 24 road marking icons can be programmed as individual presets for each series ID and will be ready for selection when a series ID is selected. Press the MENU button and select **SERIES-ID / PRESET ROAD MARKINGS** to enter the **SELECT MARKING** menu:



The bottom line shows the present six preset icons.



Use the LEFT, RIGHT, UP and DOWN buttons to choose a new icon for the first position, accept by pressing the OK button and the cursor (frame) will move to the second icon. Repeat for all six icons and the programming is done. You can amend at any point by pressing the BACK button and start over again. Press the BACK button to save.

THE LOG

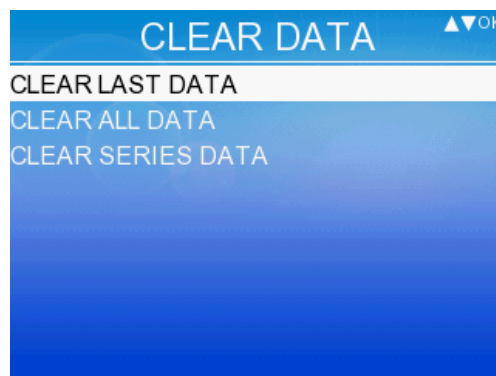
Every measurement is stored in the log. The following data, among others, are saved, if enabled:

- Measurement result incl. average
- Date and time.
- Name of measuring series (road name) and sequence number.
- Road marking icon
- User name
- GPS data (if installed).
- Instrument status
- Temperature & humidity

The instrument can store >200.000 measurements in the log.

Clearing data in the log

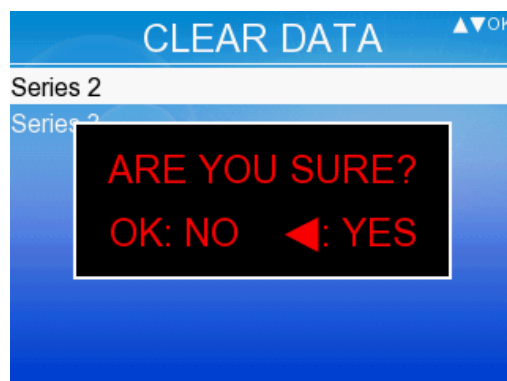
Press the MENU button and select **LOG / CLEAR DATA**:



This menu gives the option to clear information stored in the log:

- the last measurement,
- all measurements
- one of the series

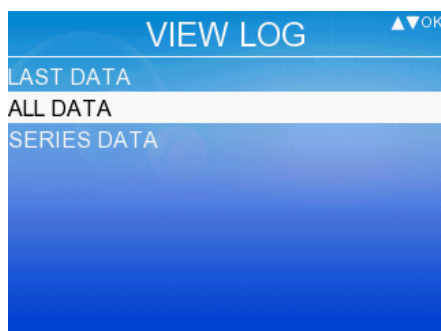
By pressing the OK button you will be asked to confirm the erasure of the data. By pressing LEFT data will be cleared. By pressing OK they will not be cleared.



If you selected **SERIES**, you may select the series you wish to delete from the log from the list shown. Only the log entries will be erased. The series will still be available in the series select list.

Viewing the log

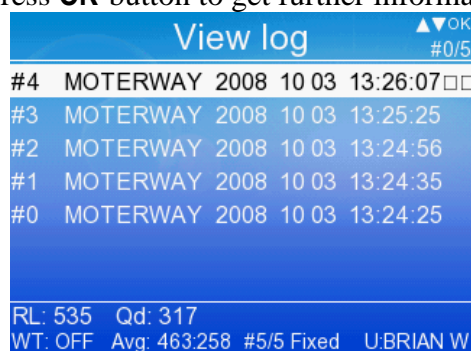
Press the MENU button and select **LOG / VIEW LOG**:



This menu gives the possibility to view and print data from information stored in the log:

- the last measurement
- all measurements
- one of the series

Selecting All Data or Series Data will display a list of measurements. Scroll through the list with **UP** or **DOWN** button. Press **OK**-button to get further information on the selected log entry:



The figure below shows detailed information on the data logged from a measurement



In the first line, the menu shows the R_L and Q_d value, thereafter in the following lines other key measurement data. To view a list of the individual errors/warnings in the status, print out the measurement (see below).

Press the **PRINT** button to print the log from the highlighted measurement. Any warning or errors detected during the measurement will be shown in the print out.

To return to the log menu, press **BACK**

View series data.

In the log menu, select **SERIES DATA** to view the list of series.

The menu shows a series ID in each line. By pressing **DOWN** or **UP**, the individual series are highlighted. Highlight a series and press the **OK** button to view the individual measurements.

Highlight a measurement in the individual display and press the **PRINT** button to print the measurements.

To return press the **BACK** button.

For transfer of measurement data for processing check about the **RSC** program, see page 40

The LTL-XL log and display will be able to show the most recent 500 measurement taken, additional measurements will still be kept in the log and can be viewed when transferred to a PC.

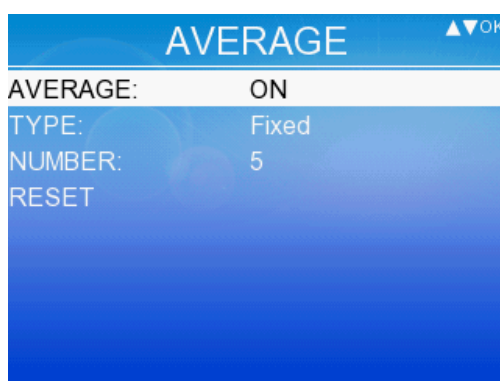
The LTL-XL log is not intended for data storage. Even if the log may store up to 200.000 measurements an increasing number of logged measurements will gradually slow down the performance of the LTL-XL. If a slowdown is seen make a transfer of data to reduce or empty the log.

OTHER SETTINGS

Average function

An average function can be activated showing the average of the measured R_L & Q_d values calculated over a selectable number of measurements ($N = 2$ to 99). The average mode can be **fixed** or **moving**. In **moving** mode the average is always calculated from the last N measurements where N is the selected number of measurements. In **fixed** mode the averaging will start over again when N measurements have been taken. The average data is shown in the HOME screen at the lower right corner (see picture pg. 15).

Press the MENU button and select AVERAGE:



AVERAGE:

Use the UP or DOWN button to highlight the first line. Press the OK button to toggle between AVERAGE *ON* and AVERAGE *OFF*.

TYPE:

When selected press the OK button to toggle between type: MOVING and type: FIXED.

NUMBER:

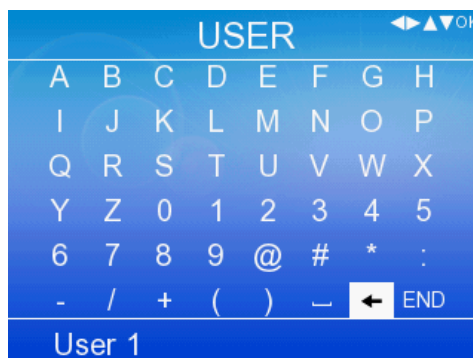
When selected press the OK button to focus on the NUMBER digits. Use the UP or DOWN button to change the value between 2 and 99. Finally press the OK button to confirm the new value. The default setting is 4.

RESET:

Select RESET and press the OK button to reset the calculated average value and reset the number of measurements included in the average to zero.

Editing names

From certain points you arrive to the EDIT menu e.g. if you want to define a USER. You will arrive to the following screen:



With UP, DOWN, LEFT and RIGHT you can navigate around the letters, numbers, symbols and space. The “arrow” will delete the last character. Press enter to select. When you have finished, press END for returning to the menu, where you started.

Auto print

Press the MENU button and highlight **AUTOPRINT**. Press the OK button to toggle between ON and OFF. If **AUTOPRINT** is activated a print is automatically made every time a measurement is taken. Press BACK to return to MENU.

Diagnostics

Press the MENU button. Highlight the line **DIAGNOSTICS**. Press the OK button, and the menu showing the following:





Each line gives information aimed at extended service and factory use. The information presented on the screen will be printed if you press the PRINT button.

The help system

Press the HELP button to show a context dependent help page. Pressing HELP once more will present a general help menu in which you can highlight a subject by using the UP or DOWN button and then press the OK button to show the help text. The HELP section is also accessible on the main menu.

Errors and warnings

When a measurement is taken, a warning text is generated if a problem arises and saved in the log together with the measurement. If a problem occurs, a warning icon  or an error icon  is shown above the HOME screen and an audible alarm is sounded (if enabled) and error is stored in the log.

To view the nature of the problem, press the UP button and the warning/error icon will be highlighted. The most severe problem will be stated in the message line underneath. Then press the OK button to view a total list of problems starting with the most severe. Press the BACK button to return to the HOME screen. If the problem did not hinder the completion of the measurement, the erroneous value(s) will be saved in the log, which can identify the problems when the log is evaluated using the RSC program. If an error is registered the measurement will not be recorded.

RSC software program

Main features of the RSC (Road Sensor Control) software program delivered together with the LTL-XL:

- Transfer of log data to a PC
- Export of log data to other programs e.g. spread sheets
- Printing reports of the log data

For more details see the separate user's manual for the RSC program, found on the installation CD.

SECTION 4

MAINTENANCE

General care

The LTL-XL retroreflectometer is constructed for outdoor use in ordinary good weather conditions. It will stand moist weather with wet roads, but caution must be taken against heavy rain and dirt. The LTL-XL retroreflectometer is an optical instrument and shall be handled as such. Avoid shock and vibration if possible.

Protection window

The protection window is accessible from underneath of the instrument. The protection window is coated with a high-efficiency anti-reflection coating. Take care not to damage this coating when cleaning. Compressed air or a fine brush can be used for removing loose particles/dust. If this is not sufficient the window should be cleaned using a soft paper tissue or cloth and some window cleaning liquid.

MAKE SURE THE PROTECTION WINDOW IS CLEAN AND UNDAMAGED AT ANY TIME TO ENSURE CORRECT MEASUREMENT RESULTS

Battery

The LTL-XL retroreflectometer is equipped as standard with a 12V/2.1 Ah NiMH (Nickel-Metal Hydride) battery. A high capacity 12V/4.5 Ah NiMH battery may be installed as an option to add more measurements on one charge. Under normal use, these batteries require no maintenance. However it is recommended to keep the battery fully charged. A fully charged battery is more capable of withstanding degeneration.

A mains powered 15V power supply for charging is supplied as customary delivery. The instrument will automatically power on when the power adaptor is connected. The battery icon in the upper right corner indicates the charging state.

The standard 2.1 Ah battery typically yields ~ 1,100 measurements when fully charged. The charge time for the 2.1Ah battery is ~1½ hours.

The 4.5Ah battery typically yields ~2,500 measurements when fully charged. The charge time for the 4.5Ah battery is ~3½ hours.

For “field” charging the 15V power supply could be powered from an “AC power inverter” connected to the car battery.

When storing the instrument for a long period of time fully charge the battery.

THE BATTERY SUPPLIED WITH LTL-XL IS SPECIALLY DESIGNED FOR THE INSTRUMENT TO ENSURE SAFE USE. IF A NON DELTA SUPPLIED OR APPROVED BATTERY IS USED, DELTA CAN TAKE NO RESPONSIBILITY FOR ANY DAMAGES CAUSED DUE TO THE PERFORMANCE OF THIS BATTERY.

Replacing the battery

A depleted battery will not hold a charge very long, and it should be replaced. This can be done by the user.

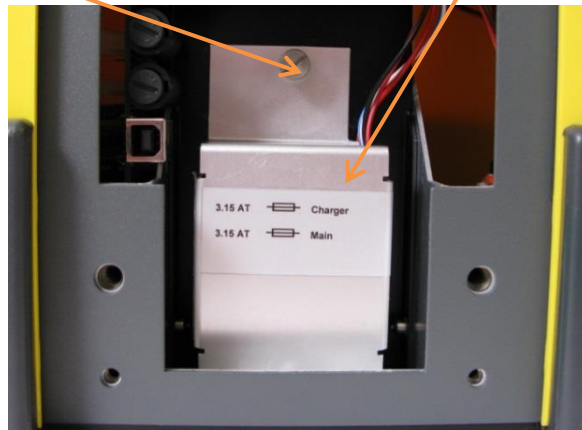
Notes:

Always turn off LTL-XL before removing the battery to make sure that the processor is shut down properly.
Disconnecting the battery for a longer period of time can reset the internal clock in the instrument.

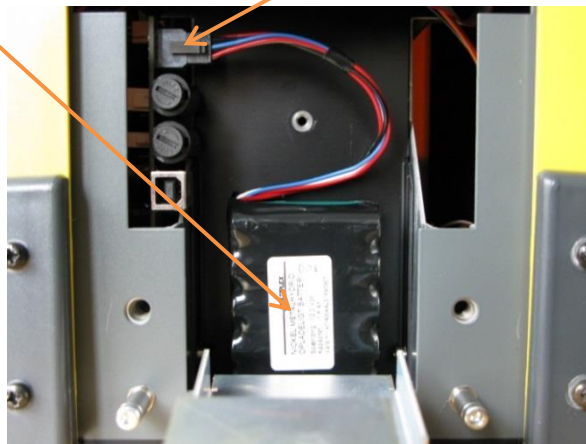
Always make sure the power supply is disconnected before removing the battery.
Do not connect the power supply unless the battery is properly connected to the circuit board.

The battery is located in a compartment at the low end of the rear of the tower. To replace the battery, remove the screws from the back cover and remove the cover.

Loosen the big screw at the battery cover. You can now remove the cover








Lift the battery out of the compartment. Press the snap-on clip on the connector and carefully withdraw it from the printed circuit board



The battery can now be removed and replaced. Refit in reverse order. Please check your local regulation for disposal of the battery.

Battery status

The capacity of the battery can be seen from the icon in the upper icon row.

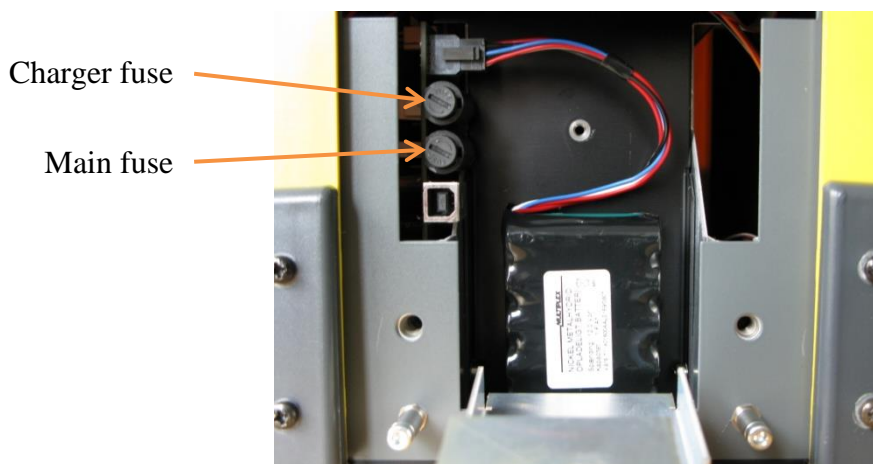
-  Indicates that the battery is fully charged
-  Shows that the charging is finished
-  Shows that charging takes place
-  Indicates that the capacity of the battery is half empty
-  The battery is almost empty and need recharging

Fuses

Two fuses are located in the battery compartment. The **charger fuse** protects the battery against short circuit and other errors in the power supply or charging system.

The **main fuse** protects the battery and electronics against short circuit and other errors in the electronic system. If the main fuse is removed no power will be drawn from the battery.

Always replace a blown fuse with one of equal rating **See Electrical Characteristics pg. 46**. To change the fuses you need access to the battery compartment. **See replacing battery pg. 38**. Carefully unscrew the plastic cap fuse holder by using e.g. a coin. Pull out the fuse from the cap and insert the new one and reassemble



Lamp

The lamps are maintenance free LED lamps. Only trained personnel should replace the lamps if damaged.

Calibration unit

Reference

The road marking is simulated by a piece of white ceramic (the reference) mounted on an aluminum profile. Ceramics have very stable optical properties because of the smooth surface.



Figure: 6 - Calibration unit

To make sure that calibration of the retroreflectometer is correct it is important that the ceramics on the calibration reference is clean and undamaged. Always keep the calibration unit well protected.

If the ceramic is stained, scratched or broken, the calibration unit must be replaced. In case of dust on the ceramics surface of the reference, the use of compressed air is recommended for removal. The use of a soft damp cloth is recommended if compressed air fails to remove the dirt. If necessary, use a mild household detergent.

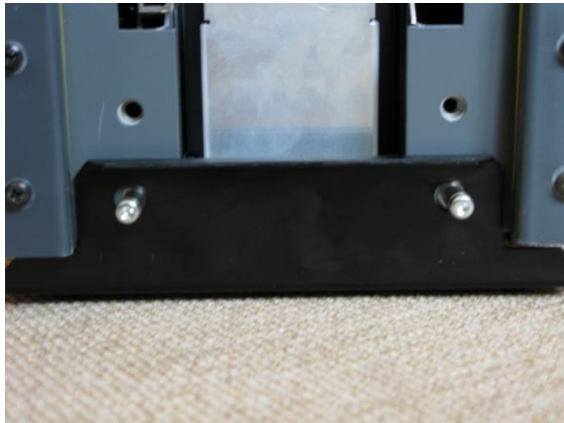
Service

To ensure reliable measurements, it is recommended that the calibration unit be periodically recalibrated to a traceable standard or replaced. DELTA offers calibration traceable to PTB (Physikalisch-Technische Bundesanstalt, Germany) and NIST (National Institute of Standards and Technology, USA).

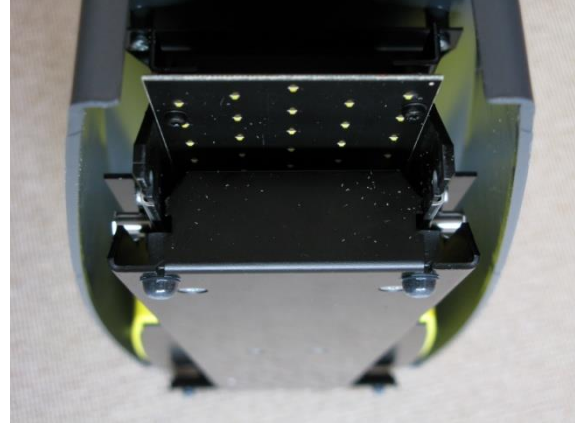
For information in service please contact your distributor or DELTA directly. At DELTA you can forward your request via our web-site www.roadsensors.com or send a mail directly to: roadsensors@delta.dk.

Calibration

The LTL-XL is factory calibrated and very stable but a calibration should always be carried out before starting a new series of measurements. The instrument is supplied with a calibration unit to carry out a fast and easy calibration.



Back




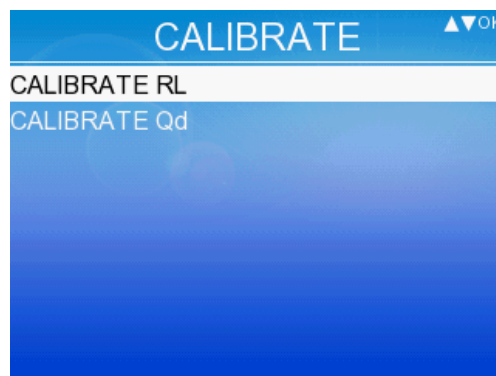
Front

Figure 7: Placing the calibration unit

Calibration procedure

- Before mounting the calibration unit check the R_L and Q_d values stamped on the calibration unit. Place the instrument upon the calibration unit and pull back until the pins at the back and front of the LTL-XL are in place, see figure 7. Please be very careful when you place the instrument on the calibration plate not to damage the calibration unit and / or the light diodes

Press the CALIBRATION button  once. Select **CALIBRATE R_L** or **CALIBRATE Q_d** .



Continue the calibration process applying the following steps

- Check the value displayed and if necessary adjust the calibration value shown in the display so it matches the value stamped on the calibration unit.



- Press the OK button to finish the calibration or repeat if erroneous.
- Repeat the calibration process for the other measure (R_L , Q_d)

The calibration procedure is now complete. To check the calibration, make a normal measurement on the calibration unit. The recorded values should be with $\pm 2-3$ units of the values stamped on the calibration unit. Remove the calibration unit and store it properly. Press OK to return to the measurement display. For further details see **pg. 42**.

The instrument automatically compensates for zero signals, leakage and other known errors, and calculates a calibration factor.

Always store the calibration unit in a dry, dust free and clean environment.

If stained, scratched or broken it must be replaced.

Printer (optional)

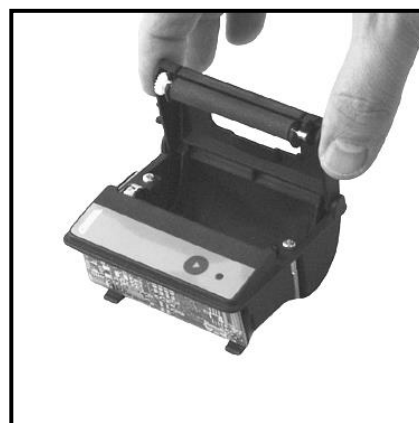
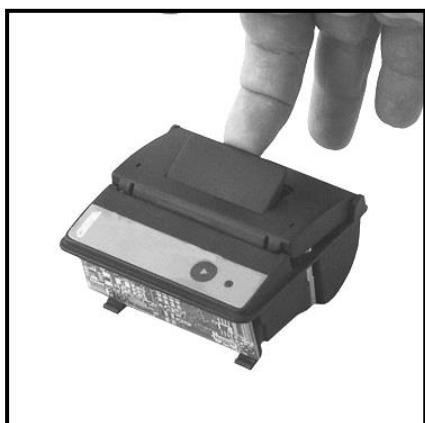
The printer is located at the back of the tower. The printer is a high-speed high quality mini thermal printer. It has only a few moving parts and does not require any special or periodic maintenance.

The printer uses a thermal paper roll, width: 57.5 ± 0.5 mm (2.26 in), diameter: max. 31 mm (1.22 in)

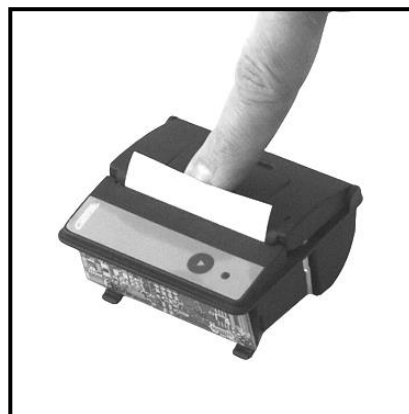
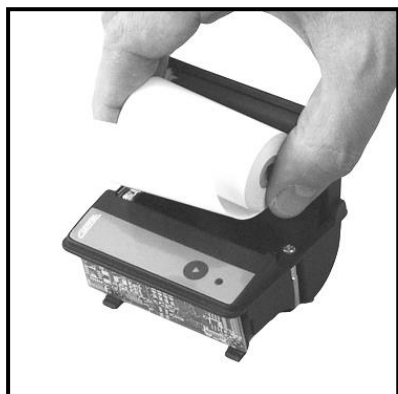


Replacing paper

Pull the lever out with your finger and the cover will open into the paper roll compartment.



Insert the new paper roll and let a short paper tail hanging out at the top. Close the cover with a firm push and with some of the paper sticking out.



Mounting the wheel unit (option)

A wheel unit can be mounted in the rear of the instrument for easy transportation during heavy use.

The wheels are mounted easily to the rear by fastening the two nuts mounted on the wheel block.

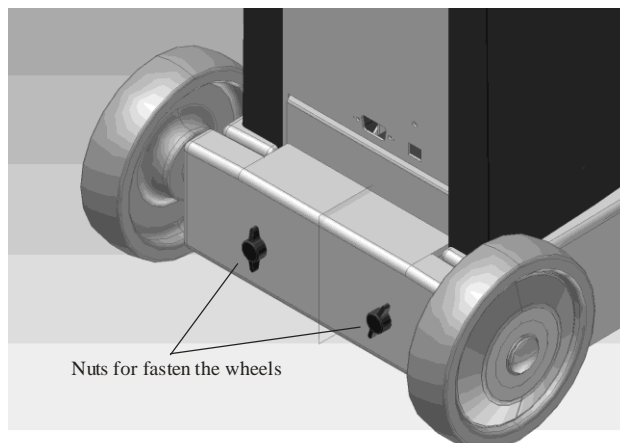


Figure: 8 – Wheel fastening nuts

APPENDIX A

COMMUNICATION FACILITIES

The LTL-XL is equipped with a USB host port and a USB device port.



The USB host port can be used to connect to a USB memory stick, e.g. for software updates.

The USB device port is used to connect the instrument to a PC.

The ethernet connector is for test / service purposes.

RSC software program

Main features of the LTL RSC (Road Sensor Control) software program delivered together with the LTL-XL:

- Transfer of logged data to a PC via the USB connection
- Export of logged data to other programs e.g. Excel
- Upload / download projects between PC and LTL-L
- Printing reports of the logged data

For more details see the separate user's manual for the RSC program. This can be found on the internet (www.roadsensors.com) or in the "documentation pack" with LTL-XL.

APPENDIX B

SPECIFICATION

General characteristics

Illumination angle..... 1.24°
Observation angle 2.29°
Equivalent observer distance 30 m

Observation angular spread ±0.17°
Type 30m CEN

Illumination angular spread horizontal 0.33°
Illumination angular spread vertical 0.17°

Field of measurement:

Width..... 50 mm (2.0 in)
Length (typ.)..... 185 mm (7.3 in)

R_L range ($\text{mcd} \cdot \text{m}^{-2} \cdot \text{lx}^{-1}$)..... 0-2000
 Q_d range ($\text{mcd} \cdot \text{m}^{-2} \cdot \text{lx}^{-1}$) 0-318

Radio:EN 300440-1 V1.6.1:2010
EMC: EN 301489-1 V1.8.1:2008, EN 301489-3 V1.4.1:2002
Safety :EN/IEC 60950-1 :2006, EN/IEC 60950-22 :2006
FCC: 47 CFR, FCC Part 15B, Class A

Power supply:

Battery, standardBuilt in 12 volt / 2.1 Ah NiMH
Battery, high capacityBuilt in 12 volt / 4.5 Ah NiMH
External charger power supplyFriwo FW7530/15 (100-240 VAC / 15VDC)
Charging time, standard battery Approx. 1 hour 30 min
Charging time, high capacity battery Approx. 3 hour 30 min

Charger fuse (5*20 mm) T3.15A
Power supply fuse (5*20 mm) T3.15A

Data memory >200.000 measurements

Data transferUSB 2.0

Environmental characteristics

Temperature:

Operating..... 0°C to + 45°C (32°F to +113° F)

Storage^{*)}..... -15°C to + 55°C (5° F to +131° F)

Humidity..... 85% and non-condensing

^{*)} Battery must be fully charged

Mechanical characteristics

Max. length..... 573 mm / 22.6 in

Max. width..... 222 mm / 8.7 in

Max. height..... 538 mm / 21.2 in

Weight of base unit..... 7 kg / 15.5 lbs

Construction:

Structural parts Aluminum

Housing Polymer

Keyboard Silicone rubber

Circuit boards Epoxy glass

Printer:

Thermal paperwidth/dia. 57.5 ±0.5 mm / 31mm (2.26 in / 1.22in)

APPENDIX C

DELIVERY

