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Instruction manual

Version 1.8 dated 03.01.2011

ZRS 5060
Retroreflectometer R_A for traffic signs

Index

Exclusion of liability

The figures and descriptions as well as the technical data correspond to the present operating instructions at the time of printing. Changes of any type, resulting from technical progress, modified design or similar, are reserved. The operating instructions have been prepared with the greatest care. Nevertheless, errors cannot be completely excluded. The manufacturer cannot be made liable for any errors in these operating instructions and possible damage resulting from these.

The manufacturer is always grateful for suggestions, proposals for improvement and indications of errors.

1 Safety precautions and warnings

1.1 Dangers

Attention!

This note is included in this instruction manual wherever it is warned about dangers which will arise to life and limb of persons if the apparatus is handled improperly. Observe these notes and be particularly careful in these cases. Also inform other users on all safety notes. Besides the notes in these instruction manual the generally applicable safety instructions and regulations for prevention of accidents have to be taken into account.

Caution

This note comprises instructions to be observed in order to comply with guidelines, instructions, notes and the proper procedure of the work, and to avoid damaging or destruction of the apparatus.

- The ZRS 5060 is exclusively designed for the visual determination of night visibility of road markings. Any other application is not in accordance with the regulations. The manufacturer is not liable for any damages resulting from inappropriate application. The user bears the full responsibility.
- Avoid any mode of operation which could affect safe working with the ZRS 5060. Especially the determination of the night visibility must take place as described in this operating manual.
- Only spare parts and optional components provided by the manufacturer may be used in combination with the ZRS 5060. If components other than provided by ZEHNTNER are used with the ZRS 5060, ZEHNTNER will cancel guarantee for resulting damages, defects or malfunctions.
- Unauthorised modifications and changes of the ZRS 5060 are not allowed. These will invalidate the guarantee. The manufacturer is not liable for damages resulting from unauthorised modifications; the user bears the full responsibility.

2 Delivery of apparatus

2.1 Damages during carriage

During carriage the ZAA 2300 is to be handled with the usual care. To ensure carriage without damages the device is to be transported in the original packaging and under normal freight conditions. Pushes during carriage are to be avoided.

At the receipt of the goods, you have to check if there are any visible damages at the outer packaging. If the packing is alright, you can sign the receipt documents. If you even suspect by your visual impression that damage has occurred, make a note of the suspected damage on the delivery receipt or freight papers and get the carrier to sign it. Moreover, the forwarding agent/courier service must be held responsible for the damage in writing.

If a hidden damage is discovered while unpacking, you have to inform and must held the forwarding agent / courier service immediately in the following way: “When opening the parcel we had to notice that …. etc. etc.“ This superficial checking of the goods has to be done before the time limit of the forwarding agent / courier service expires which is normally within 7 days. However, the period could be less. Hence, it is recommended to check the exact time limit when receiving the goods.

If there are any damages inform also immediately your authorized ZEHNTNER trader or **Zehntner GmbH Testing Instruments** directly.

2.2 Extent of delivery

The ZRS 5060 Retroreflectometer R_A will be delivered together with the following parts:

- 1 retroreflectometer
- 1 integrated accumulator package
- 1 battery charger (100 - 240 V, 50 - 60 Hz)
- 1 reference standard
- 1 software for data identification and storage
- 1 instruction manual,
- 1 certificate of manufacturer
- 1 certificate of calibration
- 1 carrying case

2.3 Optional accessories

- barcode reader article No.: ACC 017
- GPS unit article No.: ACC 018
- remote-display article No.: ACC 019
- extendable handle from 1.7 m up to 3.0 m article No.: ACC 020
- extendable handle from 2.2 m up to 4.0 m article No.: ACC 021
- voltage converter 12V/230V be plugged into the car cigarette lighter article No.: ACC 090
- data transfer cable serial article No.: ACC 022
- data transfer cable USB article No.: ACC 097
- adapter for illumination angle 20º article No.: ACC 114
- adapter for illumination angle 30º article No.: ACC 115
- adapter for illumination angle 40º article No.: ACC 116

3 General Description

3.1 Care and Maintenance

The ZRS 5060 is a high precision retroreflection measuring device. Its compact design and straightforward operation make it ideal for quick measurements directly at the roadside. In order to obtain reliable results and to avoid damage a few basic rules must be followed.

Maintenance

No parts of the ZRS 5060 shall be repaired or replaced by the user.

Perfect functioning and maximum durability are guaranteed by regular service by the manufacturer. Please refer to your supplier in the case of any fault or for carrying out any service.

Bulb Change

Changing the measuring bulb has to be accompanied by subsequent adjustment and calibration of the measuring device.

Therefore please leave any lamp change to be made **only by the manufacturer** or by **authorised dealers**. The device could otherwise suffer damage or produce a false measurement result.

3.2 Storage and Transport

Always store and transport the ZRS 5060 and its accessories in the specially designed carrying case. This offers optimal protection against vibration, superficial damage and - to a certain extent - inclement weather conditions (rain, fog, snow). Nevertheless, avoid exposing case and equipment to excessive vibration or extreme precipitation.

The ZRS 5060 including the charging equipment and the reference sample should only be stored indoors in a dry place and only at temperatures from 0 ... + 35°C (32 … 95 F)!

Longer storage outside this temperature range can lead to a change in the characteristics of the reference sample so that its reflective value no longer corresponds to the one printed.

The sample should only be stored in its protective cover and only cleaned carefully with a damp cloth. Never touch the reference sample with bare hands. Avoid scratching or scoring or similar occurrences at all costs!

If possible do not leave the ZRS 5060 near heaters or in direct sunlight for extended periods. In particular storage in a parked vehicle left in full sunlight is to be avoided.

3.3 Operation

Basically, the same hints given for transport and storage apply for operation also: excessive vibration and extreme moisture as well as use of the ZRS 5060 in heavy rain should be avoided.

If the Retroreflectometer is taken into indoor warmth after extended usage or storage in low temperatures this could result in internal moisture condensation with adverse effects on operational functioning. In such a case wait for a period of time (approx. two hours) until the ZRS 5060 has warmed up enough and the precipitation e.g. from the glass cover on the front of the instrument has disappeared.

Please note that the available battery power decreases in low temperatures.

3.4 Cleaning

Slight dirt on the ZRS 5060 casing or handle can be removed with a damp cloth, detergent or glass cleaner.

Do not use gasoline or organic solvents like acetone!

Only paper cloths suitable for optic lenses should be used to clean the ZRS 5060's glass cover front and the red glass filter of the barcode reader module.

Damage to the glass by scratching or breaking is to be avoided at all costs as the measurement accuracy can be affected.

While cleaning make sure that no moisture intrudes into the instrument.

The reference sample may only be wiped with a damp cloth and if necessary, a mild detergent. Make sure that the surface is not damaged by scratching etc. as the sample will otherwise lose its stated reflective value.

3.5 Power Supply

The Retroreflectometer is powered by an integral high grade battery. On being fully charged, this gives approx. 600 readings and approx. 400 readings when using a GPS module and barcode reader.

When the battery is low, a complete recharging is necessary before the next measuring operation. A complete charge of the battery takes about 1½ hours.

The integral battery loses capacity also if unused over an extended period of time, approx. 1% per day of the original charge at room temperature.

The ZRS 5060's integral power cells contain heavy metals (nickel cadmium cells or nickel hydride cells) and must not be disposed of with normal household rubbish. Following the end of their life expectancy they should be handed in to an authorized disposal site.

Replacement of the battery should only be carried out by an authorised dealer or by the manufacturer.

4 Device Specifications

4.1 Area of Operation

The portable Retroreflectometer ZRS 5060 measures the coefficient of retroreflection of **retroreflective materials**.

The measured material index is the coefficient of retroreflection:

R_A [cd • lx^{-1} • m^{-2}]

4.2 Preparation

Depending on the individual equipment a barcode reader and/or GPS module can be connected.

Due to the broad scale of measurement from 0,1 cd • lx^{-1} • m^{-2} (best decomposition) to 2000 cd • lx^{-1} • m^{-2} practically all retroreflective material types can be surveyed with the ZRS 5060.

The ZRS 5060 is immediately operational after switching on and requires no extra calibration or warming up period.

4.3 Method of Measurement

To carry out a measurement, a circular, evenly lit area is produced on the material under survey by means of a halogen light bulb. The light reflected by the sample and the light emission by the bulb are measured and used to calculate the coefficient of retroreflection RA.

4.4 Measuremet Trigger

The ZRS 5060 triggers measurements automatically if it is aligned horizontally with the traffic sign/sample and slightly pressed on the sign/sample surface.

This minimizes the probability of false measurements due to wrong alignment or stray light intrusion

5 Operation

5.1 Control Panel

The following figures illustrate the control and display panels.

ZRS 5060
Operation Panel

1: LC Display
2: Colour Selector Switch
3: Mode Selector Switch
4: Barcode Push Button
5: Menu Push Button
6: Operation Indicator
7: GPS Indicator
8: Barcode Reader Indicator

5.2 Switching on

To carry out measurements, switch on the Retro-Checker with Mode Selector (3). After turning on the measurement unit the display (1) shows for about 3 seconds the report “ZRS 5060”. Then you can choose between the two measurement modes single measurement or multiple measurement. The Operation Indicator **ON** (6) above the display (1) should be green. After switching on, until the first reading, the display shows

5.3 Colour Selector

The colour of the object to be measured is selected with the Colour Selector Switch. (2). Here, as of standard, white, yellow, red, green, blue and brown can be chosen.

To obtain a correct reading you must select the desired colour **before** the actual measurement.

5.4 Measurements of not calibrated reflex colours

Our ZRS 5060 Retroreflectometer R_A is able to measure also colours which are not adjustable on the colour selector switch (2). There are different possibilities:

5.4.1 Average method

At this method the coefficient of retroreflection (night visibility) of a colour which is not adjustable on the ZRS 5060 Retroreflectometer R_A will be determined by measuring neighbouring colours. The average of the two measurements is the coefficient of retroreflection of the colour not adjustable.

Colour not adjustable	Solution
Black	Measurements with white
Brown	Measurements with yellow. (Brown is a dark yellow)
Fluorescent DIN-yellow (fluorescent yellow-green)	Measurements with yellow and green. The average of these two readings is the requested measuring result.
Orange:	Measurements with yellow and red. The average of these two readings is the requested measuring result.

5.4.2 Three-sentence method

With the three-sentence method more exact measured values can be obtained than with the average value method. However, for this purpose a calibration sample with the needed colour witch is measured out by a accredited laboratory (e.g. BAM) is necessary. At first, the customer has to choose white on the colour selection switch white, then the calibration sample has to be measured. Now the customer has to measure the testsample. Because of the fact that the measuring sensor is according to V (λ) will white obtain the highest accuracy.

$$\frac{\text{actual measuring vlaue of calibration sample}}{\text{documented value of the calibration sample}} \times \text{Measuring value test sample} = \textbf{measuring result}$$

5.5 Measurement

Single measurement

For a single measurement turn the Mode Selector Switch (3) from the OFF position one step to the right (position ϟ). With the Menu Push Button (5) you can switch the display between measured value and number of measurements.

Multiple measurements (Averages)

In order to obtain an average value out of multiple measurements turn the Mode Selector Switch (3) from the OFF position two steps to the right

(position). The display looks like this:

The first 0 shows the number of measurements since turning on the ZRS 5060. “s” (single) tells that the shown value is an individual measurement and the “0.0” is the measured coefficient of retroreflection (from the individual measurement).

After the measurement the display changes like in the following examples:

If you now choose the average mode by pressing the Menu Push Button (5) the calculated average out of these 3 individual measurements is shown:

 (“a” standing for average)

If another value is measured in this setting it will be added to the average automatically (up to 99 measurements).

The individual measured value will be shown when pressing the Menu Push Button (5).

The measurements series can be ended by turning off the ZRS 5060 or by turning the Mode Selector Switch (3) to another position.

Taking a measurement

To start a measurement press the ZRS 5060 right-angled against the sign/sample. The trigger will be activated. Start and completion of the measurement are indicated with a beep. Wait until the second beep before removing the instrument from the sign/sample.

Please note

Always hold the ZRS 5060 **upright** on a vertical sample!

Fig 2: Correct Measuring alignment on Vertical Sample

5.6 Reading the measured value

After the final beep the result is shown on the display (1) and remains there until the next measurement or until the ZRS 5060 is manually or automatically switched off.

5.7 Changing the measuring band

To attain the highest possible measurement accuracy the ZRS 5060 automatically chooses the optimal measuring band.

Sample	Range	Resolution
Sample under 200	0 – 199.9	0.1
Sample 200 – 2000	200 – 2000	1

All values in: $cd \cdot lx^{-1} \cdot m^{-2}$

Please note:

After changing the colour selection a new measurement must be carried out.

5.8 Switching Off

After ending the measurement you should switch the ZRS 5060 off to avoid using unnecessary battery power. To do so the Band Selector Switch (3) is turned to **OFF**.

5.9 Stand-By Mode

If you forget to switch off then the ZRS 5060 changes automatically to stand-by mode about four minutes after the last measurement. At the same time, the display (1) is switched off, too.

Therefore make sure that you make a note of the reading within this time.

To reactivate the ZRS 5060, it only has to be positioned on a sign/sample in the same way as for measuring. For issuing a measurement, you have to press the ZRS 5060 again against the sign/sample.

As the ZRS 5060 requires a small amount of residual energy on stand-by mode, the Band Selector Switch (3) should always be switched to **OFF** during periods of storage or transport.

5.10 Alarms

All error messages are shown on the display (1) and are indicated acoustically by a beep.

A further measurement is prevented. The ZRS 5060 has to be switched off first before a new measurement can be started.

Possible sources of malfunction could be a low battery, a defective bulb or interruption of the measurement before the end signal (removing the ZRS 5060 too early from the sign/sample).

Please note:

To protect against stray light intrusion and to prevent mechanical damage the measuring front is equipped with a rubber covering.

This Rubber Covering must not be damaged, otherwise stray light can penetrate the measuring slot and lead to wrong measuring results.

5.11 Battery level

Before starting a series of measurements or after lengthy storage it is wise to check the charging level of the battery. To do so the Band Selector Switch (3) is turned to the symbol. The display (1) shows alternating the battery level, date and time.

To obtain a correct measurement the battery should still have more than 10% of its nominal capacity.

For example a display

1 0 0

shows a **fully charged** battery.

e.g. a value of

1 0

is an indication of an **almost empty** battery.

5.12 Charging

To charge, switch the ZRS 5060 to **OFF** and connect it to the power supply systems with the accompanying ZRS 5060 mains adapter device.

To ensure maximum battery capacity and an extended lifetime, you should charge the battery only at room temperature and when it is discharged extensively. In the case of a fully run-down battery a charging time of **approx. 1½ hours** is required. The charging time is accordingly shorter in cases where the battery is only slightly run-down.

The colour selection during the charging is insignificant.

5.13 Charge Indicator

During the charge operation the red lamp on the battery charger is on.

The red lamp is blinking when the charge operation is finished. (The charger supplies a trickle charge to maintain the charging level). A manual override of the charge mode is not possible.

Never open up the mains adapter - mains supply circuit parts could become accessible, with consequent risk to life!

5.14 Power Point

To charge the internal battery with the delivered charger, please use the power connection on the back of the ZRS 5060.

5.15 GPS module

The ZRS 5060 is prepared for the connection of a GPS module that can also be acquired after purchase of the ZRS 5060 from Zehntner. An error-free functionality is only guaranteed with the original GPS module.

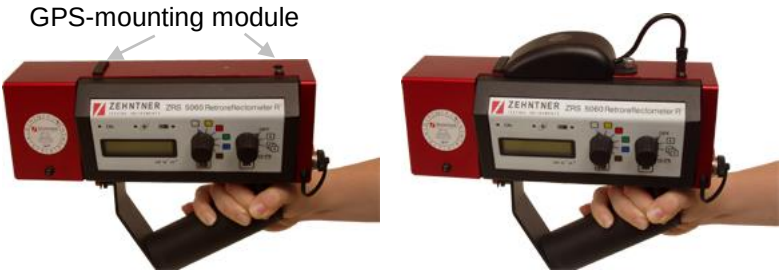


Fig 3: GPS module plugged out and plugged in

The housing of the ZRS 5060 is equipped with a GPS-mounting module. Put the GPS in the mounting module tighten the screw and plug the connection to the appropriate socket.

Fig 4: GPS module

After connecting the GPS module and switching on the ZRS 5060 please check the GPS Indicator (7):

GPS Indicator (7):

OFF: GPS module is not connected
red: no reception, only saved data
green: GPS coordinates are received

Please note:

After connecting the GPS module it can take up to 3 min until the unit is receiving coordinates. No coordinates can be received indoors.

The GPS coordinates are stored in an internal memory and can only be read with the ZRS 5060 software Retroreflectometer ZRS 5060. They cannot be seen on the display.

Format (example):

Latitude	Longitude
49,517717 N	8,389103 E

The number of possible measurements with the GPS module is reduced from up to 600 to approx. 400 per battery load.

Measurements can also be taken without GPS module if no GPS coordinates are needed. If doing so the number of measurements per load is increased. In this case pull out the GPS-plug from the socket.

5.16 Barcode reader

The ZRS 5060 can be equipped with a barcode reader. Therefore Zehntner has developed a module that is installed underneath the housing in front of the handle.

The barcode is saved for all following measurements until a new barcode is read or the ZRS 5060 is switched off.

Fig 5: Barcode reader dismantled

Barcode reading

- Push Barcode Button (4)
- Barcode Reader Indicator (8) flashes (yellow)
- Read the barcode with the laser beam (in front, in direction of measurement) The laser beam has to be wider than the barcode.
- The reading is confirmed with a short beep, the Barcode Indicator (8) flashes and the laser beam is switched off.
- If no barcode is registered within 30 seconds the barcode reader turns off automatically. The malfunction is signalled by a triple beep and the Barcode Reader Indicator (8) is switched off.

Important note:

When the barcode reader is dismantled the interface plug in front of the handle has to be covered with a protective cap.

The red glass that covers the barcode reader front is an optical filter. Take care that it will not be scratched or broken. If it is soiled it should be cleaned with paper cloths suitable for optical lenses. In no case use strong detergents or organic solvents.

5.17 Memory

The ZRS 5060 has an internal memory for 1'000 measurements. Stored are number of measurement, date, time, coefficient of retroreflection, barcode, GPS parameter and GPS coordinates. All data can be read out with the program Retroreflectometer ZRS 5060.

5.18 Show Number of Data Sets

To see the number of data sets in the ZRS 5060's internal memory, press the M-Button twice in quick succession.

5.19 Delete Memory

To delete the ZRS 5060's internal memory press the Barcode-Button, the M-Button and the measurement trigger simultaneously.

5.20 Extendable handles

For easy reaching and fast measuring of traffic signs mounted in high positions the ZRS 5060 can be fixed to extendable handles (see picture). There are two versions available:

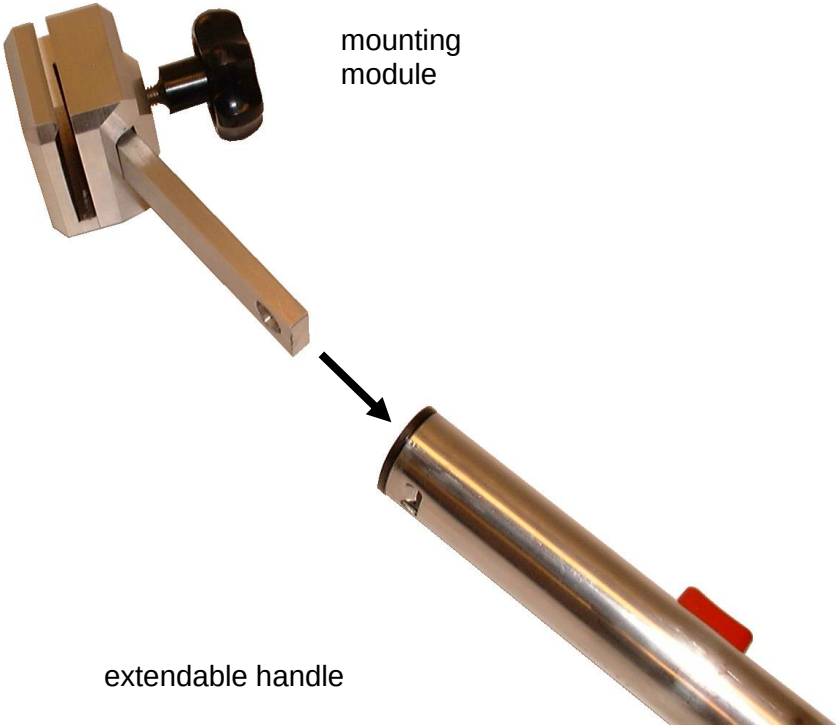
- extendable handle from 1.7 m up to 3.0 m article No.: ACC 020
- extendable handle from 2.2 m up to 4.0 m article No.: ACC 021

Both extendable handles can be acquired from Zehntner also after purchase of the ZRS 5060 Retroreflectometer RA.

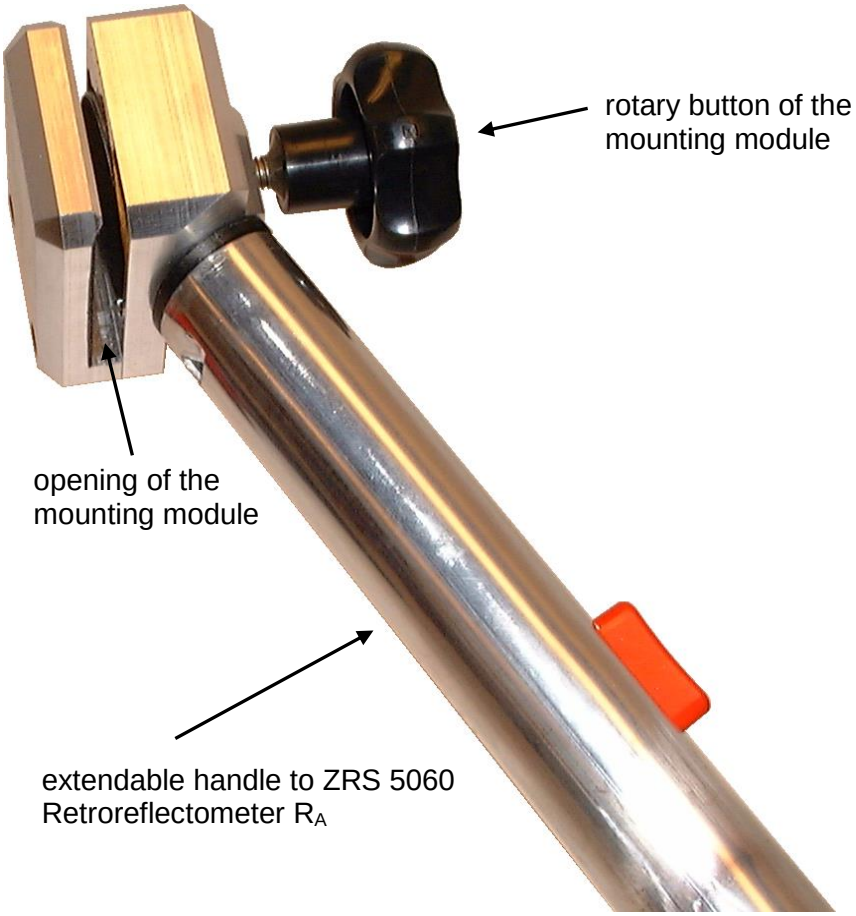
ZRS 5060 with extendable handles

5.20.1 Mounting of the extendable handles

For mounting the ZRS 5060 Retroreflectomter R_A you have to put the mounting module into the extendable handle.



After putting the mounting module into the extendable handle to the ZRS 5060 Retroreflectometer R_A you will see the following:



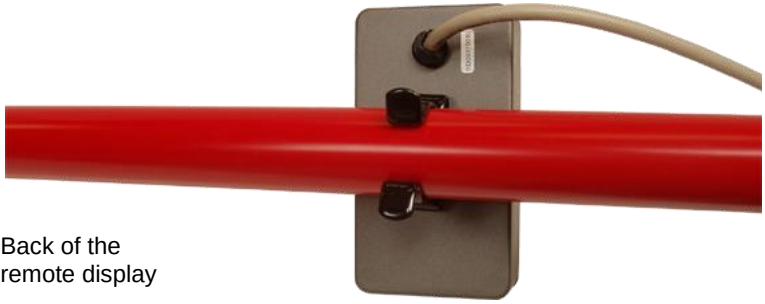
Afterwards you have to put the handle of the ZRS 5060 Retroreflectometer R_A into the opening of the mounting module until the handle touches the ground. Close the mounting module by turning the rotary button in clockwise direction for fixing.

For removing the ZRS 5060 Retroreflectometer R_A from the extendable handle, you have to turn the rotary button against the clockwise direction.

5.21 Remote Display

To ease the measurement of traffic signs mounted in a high position with the telescopic arm a remote display for the ZRS 5060 has been developed. It shows an identical copy of the ZRS 5060's display.

The remote display is connected to the power socket of the ZRS 5060.



Back of the remote display

Remote display attached to the extendable handle

5.22 Date / Time

The ZRS 5060 has an integrated clock. The time of each measurement is stored.

Setting date / time:

- Turn Band Selector Switch (3) to the position clock / storage battery the battery level, date and time are shown alternatingly
- press Barcode Button (4)
  the date is shown, decade position flashes on the LC Display (1)
- the value can be changed by pressing the Menu Push Button (5)
- press Barcode Button (4) again
  next position flashes
- change value by pressing the Menu Push Button (5)
- after changing all date positions time appears on the LC Display (1) automatically
- the time can be set in the same way as the date
- if the last position (minutes) has been set the current settings stored by pressing the Menu Push Button (5)
- on the LC Display (1) the battery level, date and time are shown alternatingly again

5.23 Interface

On the back of the ZRS 5060 there is a serial RS 232 interface (Sub-D 9-pin) to read out the internal memory with the help of the program “Data Export” (refer to next chapter).

5.24 Software for data collection and management

On the CD delivered with the ZRS 5060 you will find software to export the data stored in the memory of the device:
To install this software, please follow the guided install procedure that will come up as soon as you insert the CD into your CD drive.

Functions of the Software:

Function	Description
Read data to Excel	Reads the data into an MS Excel file
Read data to text	Reads the data into a text file (.txt)
Read data to Fugawi file	Converts the data into a format that can be imported by the Mapping Software Fugawi 3. The file will be stored as a text file
Delete data	Deletes all records stored in the memory

For further help on the Data Export software please open the help file by clicking on Help.

5.25 Error Messages

Error Message	Description
OV	exceeded measuring band (> 2000) or defective bulb
MAX	too many measured values in multiple measurements (> 99)
LOW BAT	voltage too low
ERROR	interruption of the measurement by releasing the start button
E CLOCK	Lack of data date/time. Please set date/time
Reg Time	Faulty handling Please contact Zehntner at repeated occurrence.

6 Calibration procedure

6.1 General introduction

In this document the handling of the re-calibration features of ZRS 5060 software version 1.1 is described.

The re-calibration function enables the calibration of the ZRS 5060 without any connection to a PC. It allows to calibrate a single colour (CAL ONE) which can be selected with the colour switch or to calibrate all colours (CAL ALL) by the same factor.

Please note: "CAL ALL" will alter the calibration for all colours by the same factor. If you want to adjust calibration of one colour independently select "CALL ONE"

6.2 Abbreviations

CAL ONE – Single colour calibration

CALL ALL - Calibration of all colours

6.3 Calibration mode selection

For "CAL ONE" switch the colour selector switch to the colour you wish to re-calibrate.

To initiate the re-calibration mode press and hold the Barcode / Menu button respectively before switching on the ZRS 5060.

M (Menu) button (right) => for CAL ONE

Bar code button (left) => for CAL ALL

Then switch ZRSW 5060 on.

Press button for one second until the device name (for example “ZRS 5060”) is shown on the LC display.

Release button.

After switching on the selected mode is indicated. Additionally a message regarding RS232 is shown, if the instrument is connected to a PC.

Mode	Button	LCD message	RS232 message (if connected)
Single colour calibration	Menu (right)	CAL ONE	Calib Mod = CAL ONE
All colours calibration	Bar code (left)	CALL ALL	Calib Mod = CAL ALL

6.4 Calibration measuring

Initiate measuring and assess calibration sample.

During the calibration the message “CALIBRAT” is displayed. When the measuring is finished the actual value of the sample is indicated.

6.5 Target value setting

The indicated actual value of the sample can be modified with help of the buttons Barcode / Menu.

```
Barcode button (left)     => Value is reduced
Menu button (right)       => Value is increased
```

According to how long you press the buttons, the modified digit and thus the modification speed is varied. Short pressing will modify the last digit, pushing the buttons for two seconds or five seconds changes the preceding digits respectively.

	Indicated value	Short press	After 2 seconds	After 5 seconds
Digit modified on LCD		**123.4**	**123.4**	**123.4**
Digit modified on LCD	200 - 2000	**1567**	**1567**	**1567**

6.6 Calibration finishing

The re-calibration phase is finished by pressing the measuring trigger once more after having set the target value on the display (see section 5).

The message „CAL END“ is indicated and the calibration factor is re-calculated. The display is set to “0.0”.

If connected to a PC, the message is reported via the RS232 interface.

Example: „Col 1 CFOld = 58862 CFNew = 62311“ .

For "CAL ALL" corresponding messages are reported for all colours.

7 Maintenance / Repairs

The ZRS 5060 contains no parts intended to be serviced by the user. Therefore never try to open the casing or carry out other such measures yourself, otherwise it could result in irreparable damage.

On opening the casing, the manufacturer's guarantee expires!

7.1 Bulb

The life expectancy of the halogen bulb in the ZRS 5060 is at least 10,000 measurements. Therefore under normal conditions of use no change of the bulb should be necessary between service intervals.

During every reading the functionality of the bulb is electronically checked. If a malfunction is detected, an error-message is shown on the LC Display (1).

If the bulb is working properly, a round evenly lit surface should be seen on the sample surface, To check this trigger a measurement without pressing the instrument to a sign/sample (trigger manually) and hold it over a sheet of paper or your hand.

7.2 Battery

The battery of the ZRS 5060 has a capacity of about 600 readings per loading cycle or 400 readings using GPS module and barcode reader.

It can be recharged at least 1000 times given normal ambient temperatures and working conditions. Accordingly a typical battery lifecycle allows about 600.000 measurements or 400.000 measurements using GPS module and barcode reader.

An exchange during maintenances intervals therefore is not necessary. A repair-exchange can be done ONLY by the manufacturer or authorised dealer.

Do not throw the battery into normal garbage!

7.3 Malfunctions

In the event of a constantly recurring malfunction, please make a note the exact accompanying circumstances, e.g. measured sample, temperature range, adjustment of measuring scale and colour.

These data supply an important diagnostic aid. It helps to keep the service periods of the ZRS 5060 as short as possible.

7.4 Reference Sample

By means of the accompanying reference sample you can check the proper function and calibration of the ZRS 5060 yourself. Switch the Colour Selector Switch (2) to white (if the reference sample is white) and trigger a measurement by placing the sample on the front (see Fig. 9).

Make sure that the ZRS 5060 is held **upright**, and the sample is held **vertically** on the surface front.

The ZRS 5060 must have a clear and unscratched glass face.

Correct Measurement alignment

The value shown on the Display (1) must be within the tolerance area indicated on the reference sample. If it is not, a service is advisable. To ensure measuring results are correct you should carry out this check before every series of readings.

7.5 Regular Service

The manufacturer recommends an annual service of the ZRS 5060 to ensure proper function, to check all equipment functions and if necessary to repair damaged parts. The next service date is indicated on the service sticker on the rear of the device.

For individual services or a service contract please contact your supplier or the manufacturer.

Sticker displaying next year and month of service

8 Technical Data

Article No.:	Standards	Illumination angle β	Observation angle α
5060.D	DIN 67520, EN 12899-1	+5°	0.33°
5060.S	Individual requirements (e.g.)	+5°	0.20°
5060.A	ASTM E 1709	-4°	0.20°

Light source:	Halogen lamp with stabilized luminous intensity
Measuring sensor:	according to V(λ)
Spectral specification:	based on standard light source type A (Tf = 2856K) and visual sensitivity V (λ)
Deployment Position:	vertical upright
Sample illumination	halogen bulb 6V / 10W
Receiver:	Si-photo diode
Illumination:	approx. 30 lx on sample surface
Measuring range:	R_A = 0 to 2‘000 cd·lx^{-1}·m^{-2} highest decomposition: $R_A$min = 0.1 cd • lx^{-1} • m^{-2} max. measured value: $R_A$max = 2'000 cd • lx^{-1} • m^{-2} • automatically measuring band selection • manually colour adjustment
Memory:	1‘000 measurements

Measuring speeds:	• Approx. 3 seconds for one reading • Approx. 2 seconds between two readings • Automatic switch off after about 4 minutes
Maximal measurement error:	• ± 7% from measured reading ± 2 Digit (Reflex material type 1 and 2, white)
Display:	LCD display
Battery:	Nickel Cadmium or Nickel Metal-hydride batteries, in total 9,6V • Exchangeable by maintenance service • Sufficient for approx. 600 measurements per load or 400 measurements using GPS module and barcode reader
Power supply:	13,5 to 16V DC, type. 0.8 A during protected against reversal of polarity.
Operational temperature:	+5 to +35°C (41 to 95 F)
Storage temperature:	0 C to +35°C (32 to 95 F)
Dimensions (LxWxH):	280 mm x 85 mm x 250 mm (incl. handle)
Weight:	1,9 kg (incl. Barcode reader and GPS) GPS-Module 120 g Barcode reader 100 g
Warranty:	2 years