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Manual

ZEROMATIC 2/1 and 2/2

Automatic Reversal Measurement Head with
One or Two ZEROTRONIC-Sensors

WyBUS-Technology



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Änderungen / Modifications:

Date	Modified by	Description of the modification
1.2.2010	MG	complete redesign
20.7.2012	MG	New command set, configurator 2.0
23.4.2013	MG	Adaption to firmware 345 and configurator 2.0.2
21.1.2014	MG	Adaption to Configurator 2.0.3

The measuring system fulfils the requirements of the EU regulation.
WYLER AG confirms the successful test of the instrument by applying
the CE-sign.



INTRODUCTION

1.1 DESCRIPTION AND FUNCTIONALITY

The 2-dimensional inclination sensors ZEROMATIC 2/1 and 2/2 are very well suited for the monitoring of smallest changes in inclination over a long period of time.

The very high accuracy is achieved by measuring and compensating any drift of the absolute zero by regular, automatic **reversal measurements**.

ZEROMATIC 2/1 is equipped with **1 inclination sensor**.

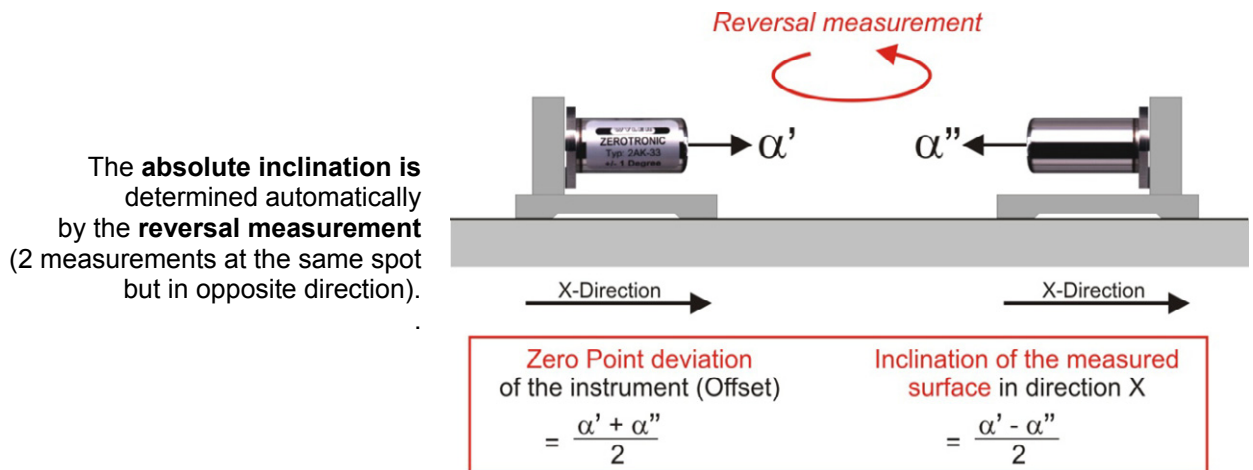
Every reversal measurement provides 1 new set of measuring values for the absolute inclination in X and Y direction. A continuous measurement is possible either in X or in Y direction only.

ZEROMATIC 2/2 is equipped with **2 inclination sensors**.

The ZEROMATIC 2/2 has therefore the option to measure the inclination continuously in both X- and Y- direction.

In the ZEROMATIC 2/1 resp. 2/2 a high precision a rotor is integrated allowing the so called **reversal measurement**. After a programmable time interval or through a software command an automatic reversal measurement can be triggered allowing the compensation of any potential offset.

Thus the **zero offset of the sensors**, due to temperature and / or due to other long-term influences as well as the **absolute inclination** of the surface can be determined (see sketch below).



ZEROMATIC 2/x:

After a programmable interval, a reversal measurement is triggered for the ZEROMATIC 2/x.

The calculated inclination values can be read either with a BlueMETER or with a PC and corresponding software and treated further e.g. saved in a file.

ZEROMATIC 2/1:

ZEROMATIC 2/1 is equipped with **1 inclination sensor with a measuring range of $\pm 1^\circ$** .

During the reversal measurement the inclination is measured in all 4 directions 270° , 180° , 90° , 0° with the same sensor.

After the reversal measurement, the new calculated absolute inclinations in X- and Y- direction can be **read** including the incremented sequence number.

Afterwards the sensor turns into the requested measuring position. Now the **continuous measurement** starts and after the programmable measuring interval a new set of measurement values can be read. A new set of values can be identified with the corresponding sequence number which is incremented by 1 each time.

ZEROMATIC 2/2:

ZEROMATIC 2/2 is equipped with **2 inclination sensors with a measuring range of $\pm 1^\circ$** .

Since the ZEROMATIC 2/2 has 2 sensors with orthogonal orientation, it is sufficient for a reversal measurement to carry out 2 measurements only at the positions 180° and 0° .

After the reversal measurement, the new calculated absolute inclinations in X- and Y- direction can be **read** including the incremented sequence number.

Afterwards the **continuous measurement** starts and after the programmable measuring interval a new set of measurement values can be read. A new set of values can be identified with the corresponding sequence number which is incremented by 1 each time.

1.2 CONTROLS

SYSTEM:

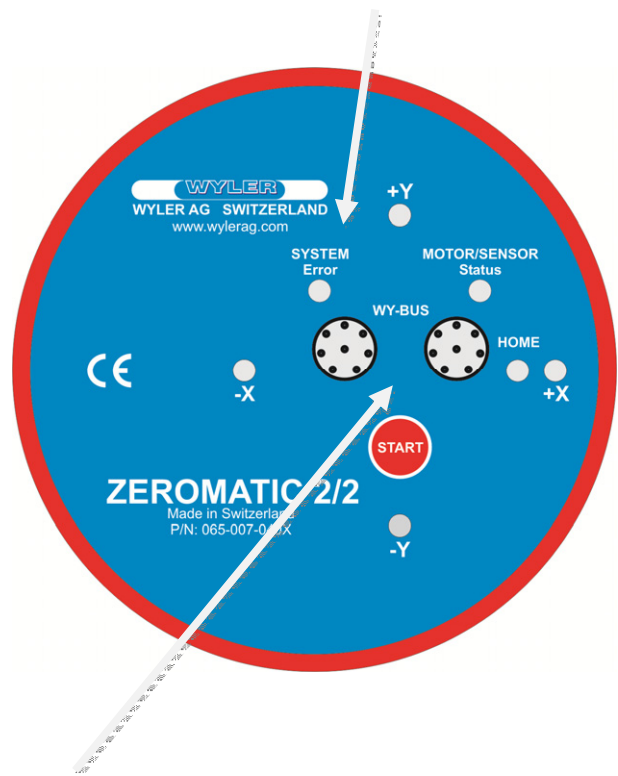
LED "ERROR" RED

- shines when the 10 volt power is too low. At the same time the green LED "+X" is shining.
- shines when the 24 volt power is too low. At the same time the green LED "+Y" is shining.
- shines if there are communication problems with the ZEROTRONIC sensor. At the same time the green LED "-X" is shining.
- shines when problems with the stepping motor occur. At the same time the green LED "-Y" is shining.
-



START:

Allows the manual start of a reversal measurement sequence



WY-BUS (2 connectors)

These 2 connectors are used to connect the power to the system as well as the cable for data transmission. Both connectors are identical and compatible

ZEROMATIC "LED-Status", (from firmware version FW0345)

Functions	Sensor-Position LED	Motor LEDs	System LED	Duration [sec]
ZEROMATIC 2/2	-Y -X +Y +X Home	Status	Error	
1. Power up	ON ON ON ON ON	R ON G ON B ON	ON	approx. 2
2. Idle				
3. RM Measurement				80
Search Home		<>		6
Drive 0°... 180°	<> <>			23
180° Measurement	ON ON	ON		16
Drive 180°... 0°		<> <>		19
0° Measurement		ON ON	ON	16
4. Continuous Measurement	ON ON			
5. Error				
10V Power	(ON) (ON) (ON) ON		ON	
24V Power	(ON) (ON) ON (ON)		ON	
Zerotronic connection	(ON) ON (ON) (ON)		ON	
Stepping motor	ON (ON) (ON) (ON)		ON	

Functions	Sensor-Position LED	Motor LEDs	System LED	Duration [sec]
ZEROMATIC 2/1	-Y -X +Y +X Home	Status	Error	
1. Power up	ON ON ON ON ON	R ON G ON B ON	ON	approx. 2
2. Idle				
3. RM Measurement				130
Search Home		<>		6
Drive 0°... 270°	<>			34
270° Measurement	ON	ON		15
Drive 270°... 180°	<>			10
180° Measurement	ON	ON		15
Drive 180°... 90°	<>			10
90° Measurement	ON	ON		15
Drive 90°... 0°		<>		10
0° Measurement		ON ON	ON	15
4. Continuous Measurement x		ON	ON	
Continuous Measurement y	ON	ON	ON	
5. Error				
10V Power	(ON) (ON) (ON) ON		ON	
24V Power	(ON) (ON) ON (ON)		ON	
Zerotronic connection	(ON) ON (ON) (ON)		ON	
Stepping motor	ON (ON) (ON) (ON)		ON	

"<>" = blinking
 "ON" = luminescent

Status LED – "green": Measurement in progress. Is the LED more than 10s luminescent, a continuous measurement is active.

Status LED – "blue: Idle state

1.3 PIN-ASSIGNMENT OF THE ZEROMATIC 2/X SOCKETS

The two connectors are wired identically:

Pin Number	Pin Name	Pin Type	Pin Function
1	+24 Volt DC	Power	external power supply
2	0V (GND)	Power	ground
3	-	-	
4	RTA	Serial Data	RS485-line (bidirectional)
5	RTB	Serial Data	RS485-line (bidirectional)
6			
7			
8			

0V (GND) is connected to the housing of the ZEROMATIC. Therefore ground voltage variations between 2 or several ZEROMATIC mounted onto the same metal construction (electrically conducting) must be avoided

Remarks regarding "Power Up":

When powering up you should first connect the 24V connector of the power supply with the ZEROMATIC and only afterwards you should connect the power supply to the net. Thus the power supply will perform a soft start.

Disconnection from power should be done in the opposite sequence: disconnect first the power supply from the net and only afterwards the 24 V from the ZEROMATIC.

1.4 SEQUENCE OF THE REVERSAL MEASUREMENT / CONTINUOUS MEASUREMENT / MEASURING AXIS

1.4.1 REVERSAL MEASUREMENT / DETERMINATION OF THE ZERO-OFFSET

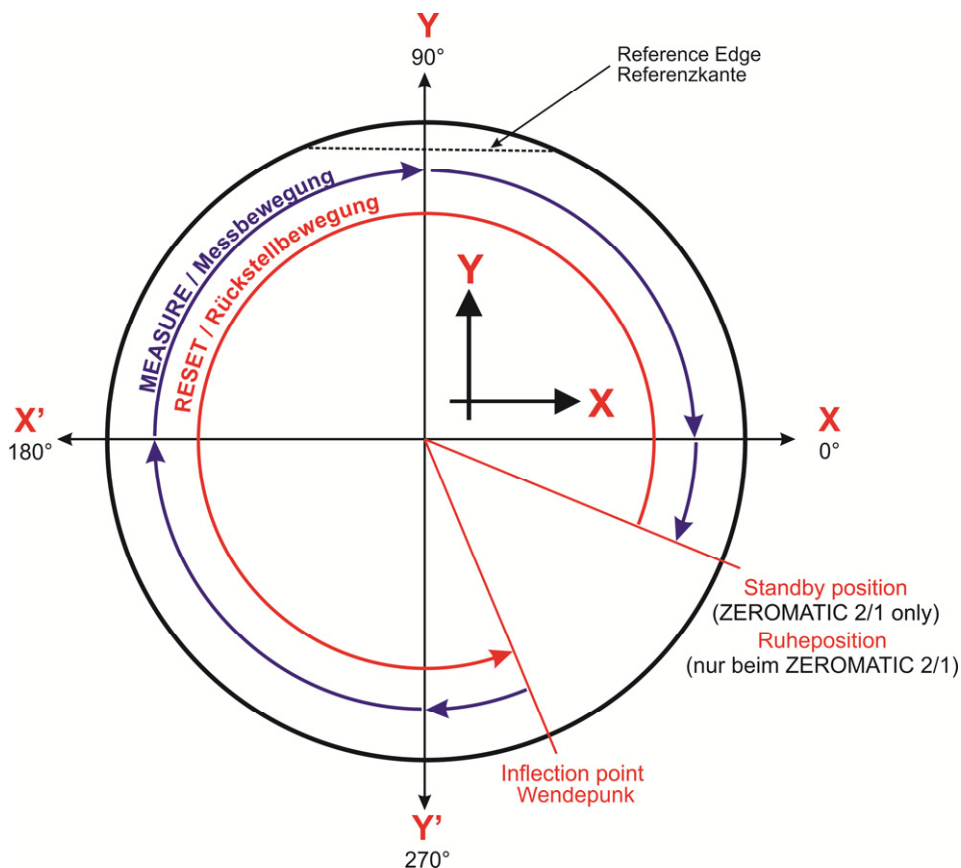
The interval between 2 reversal measurements is defined by the number of measuring values per time unit and memorised in the ZEROMATIC.

A reversal measurement can be triggered by a software command or manually by pressing the start button. After each reversal measurement the absolute inclination values in both axis can be read out. These values will be kept until the next reversal measurement.

The stability of the environment defines the required frequency to recalculate the zero-offset by executing a reversal measurement. The interval can be chosen between a few minutes (at least 2 minutes for the ZEROMATIC 2/2) up to several hours. The chosen interval can be programmed by software or with the help of a BlueMETER and is stored in the ZEROMATIC. Furthermore a reversal measurement can be triggered at any time with a software command. During a reversal measurement the continuous measurement of the ZEROMATIC 2/2 is interrupted.

Quality of the measured inclination values of a reversal measurement:

- Ideally, during a reversal measurement there should be calm static conditions
- A set of 8 measurements is taken in each direction and the average is determined. This value is used for the calculation of the absolute inclination
- At the same time the "nError-value" is calculated from these 8 values (see section 7.1 read and write commands). This value is an indicator for the quality of the reversal measurement. More stable conditions are leading to lower "nError-values".



When starting a reversal measurement, the rotor first seeks the standby position. Then it turns to the reflection point and turns then to the measuring positions:

ZEROMATIC 2/1:

270° / 180° / 90° / 0°. The sensor remains in the "0°-position" until the next reversal measurement starts

ZEROMATIC 2/2:

180° / 0°. The sensor remains afterwards in the "0°-position" and starts to measure continuously

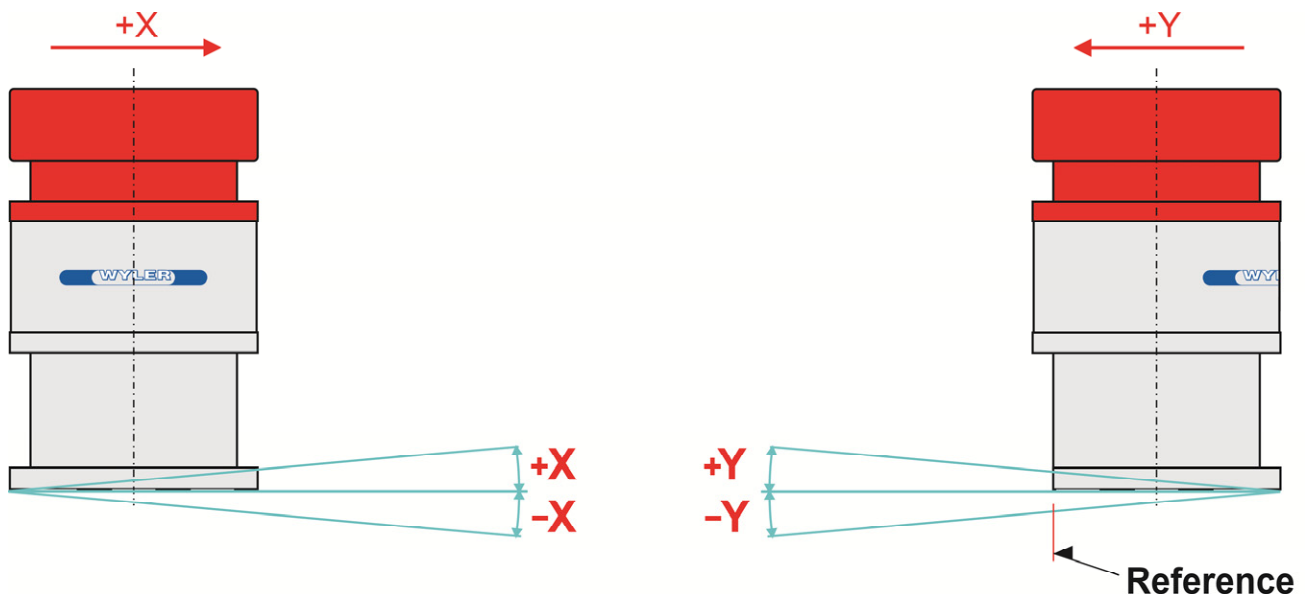
1.4.2 CONTINUOUS MEASUREMENT

- The **ZEROMATIC_2/1** does not provide the option for a continuous measurement
- As soon as the reversal measurement is finished, the **ZEROMATIC 2/2** is ready to start continuous measurement in X- and Y- axis

The measuring interval for the continuous measurement must be programmed in milliseconds [ms]. The interval can be programmed between 100 ms to 8000 ms. After each measuring interval a new set of inclination values in X- and Y-direction is provided. The sequence number increased by 1 indicates that there is a new measuring value.

During the whole duration of the measuring interval the measured values are integrated in the sensor itself!

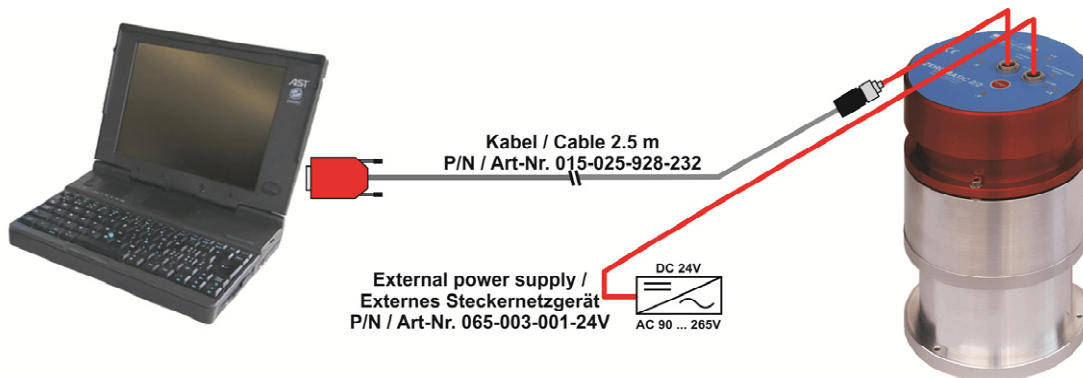
1.4.3 MEASURING AXIS / SIGN OF THE INCLINATIONS



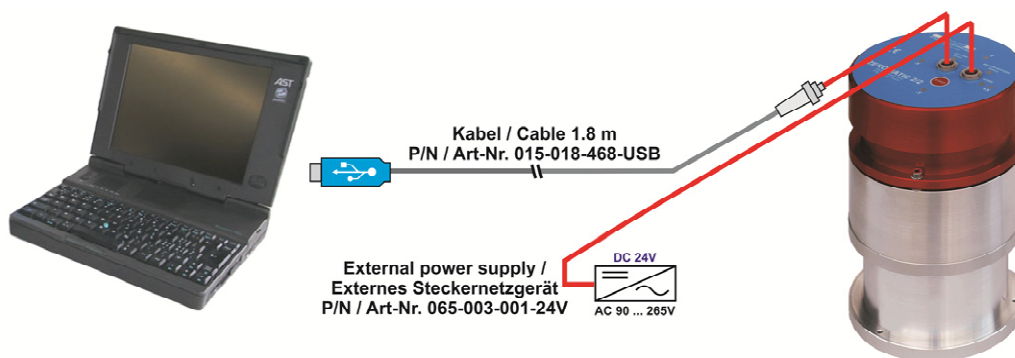
1.5 CONFIGURATIONS

1.5.1 TEST CONFIGURATION

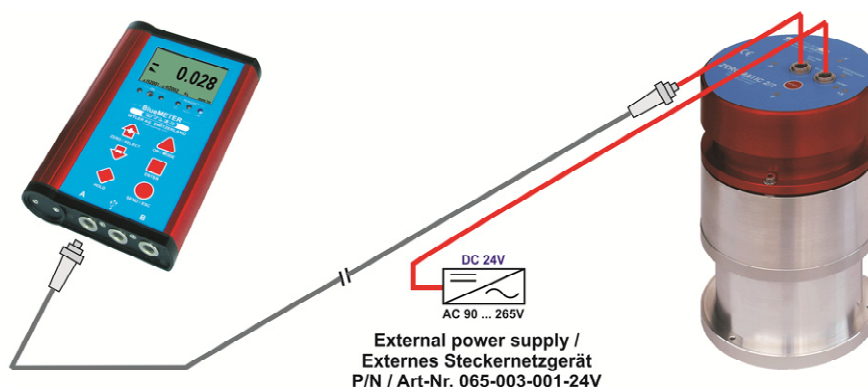
Hardware configuration (through **serial connector**):



Hardware configuration (through **USB-connector**):



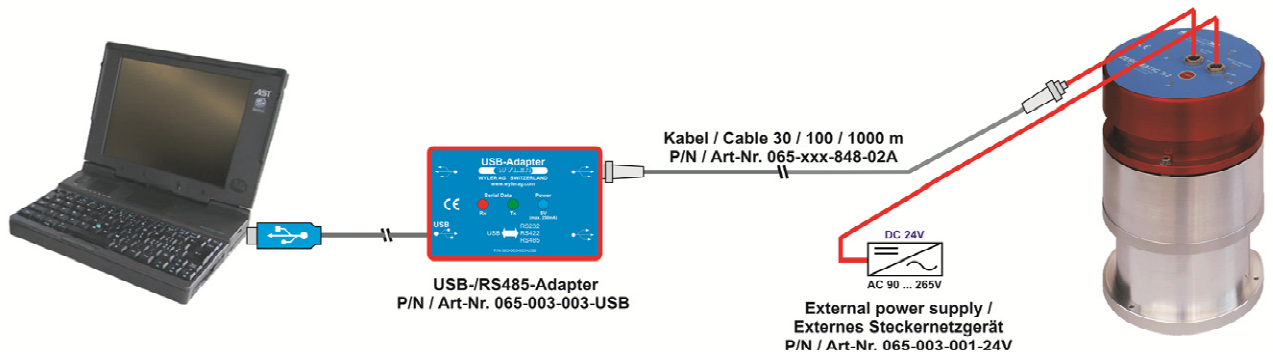
1.5.2 CONFIGURATION WITH BLUEMETER



Cable: ZEROTRONIC "Universal" 065-025-878-001
Connect the ZEROMATIC with the BlueMETER.

1.5.3 CONFIGURATION "NETWORK" WITH USB-ADAPTER

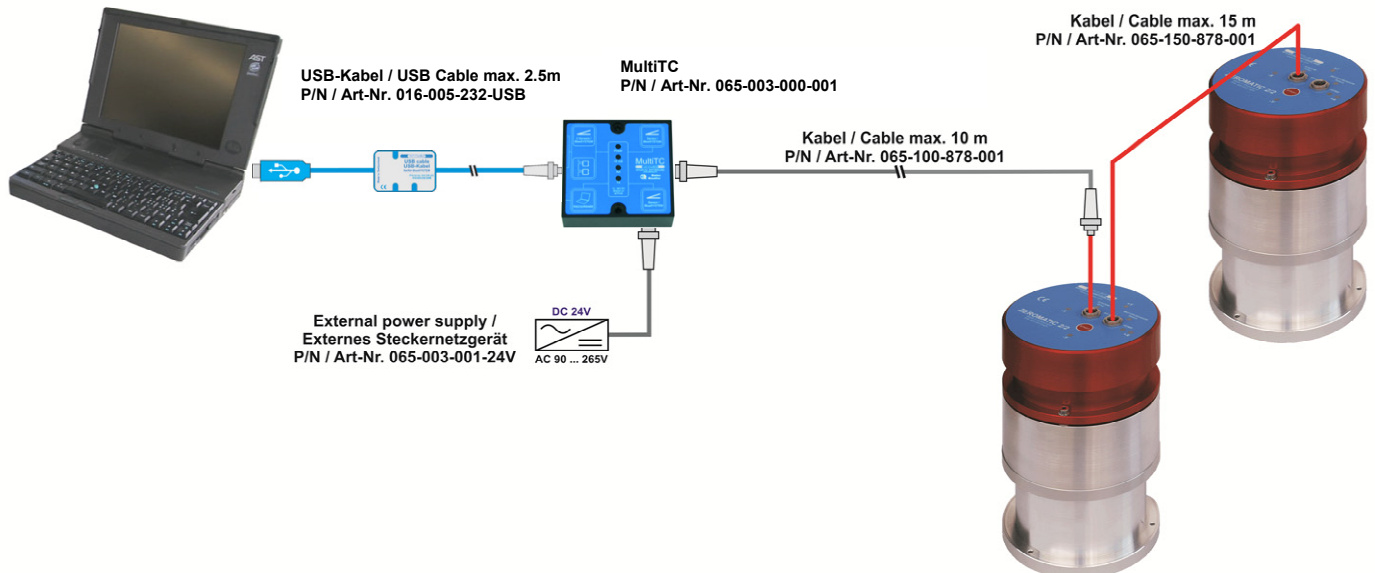
ZEROMATIC at remote location requiring a long cable



USB-Adapter: 065-003-003-USB
Cable: ZEROTRONIC "Bus": 065-xxxM848-02A (xxx. length of cable in [m], max. 1000m)

1.5.4 CONFIGURATION "LARGER NETWORK"

Two ZEROMATIC 2/X are connected in sequence



MultiTC: 065-003-000-001
USB-Kabel: 016-005-232-USB
Power Supply: 065-003-001-24V
Cable ZEROTRONIC "Universal" 10m: 065-100-878-001
Cable ZEROTRONIC "Universal" 15m: 065-150-878-001

Remark regarding Power supply for several ZEROMATIC:

It is recommended that not more than two ZEROMATIC should be connected in sequence due to the current limitation of the connectors.

A "star" type cabling is preferred

For larger distances it is recommended to use a power supply for each sensor or to provide the power supply through a special low-resistance wire.

2. TECHNICAL DATA

2.1 MEASURING VALUES

Axis:	[2/1]: single axis, X und Y (with 1 sensor) [2/2]: dual-axis, X und Y (with 2 sensors set at 90° to each other)
Measuring range:	± 1 arc degree
Storage temperature range:	-10° ... +60°C
Operating temperature range:	-10° ... +60°C
Rel. humidity:	up to 92%, not condensating
Inclination value:	[2/1]: after a reversal measurement a set of inclination values in X- and Y- direction can be read. This value will only change after the next reversal measurement [2/2]: after a reversal measurement a set of inclination values in X- and Y- direction can be read. Afterwards the measuring values can be collected continuously according to the settings of "measuring interval".
Measuring interval:	this value can be programmed between 100 mSec and 8000 mSec. The measuring values are integrated in the ZEROTRONIC sensor itself for the duration of this interval. For the measurements of a reversal measurement sequence this value is set to 1 second.
Interval reversal measurements:	programmable in minutes (from 3 to 65535 minutes). Remark: if the 2 parameters "measuring intervals" and "interval reversal measurements" are set to 0 then the rotor goes to the standby position.
Duration of reversal measurement	[2/1]: about 2 minutes [2/2]: about 1 minute

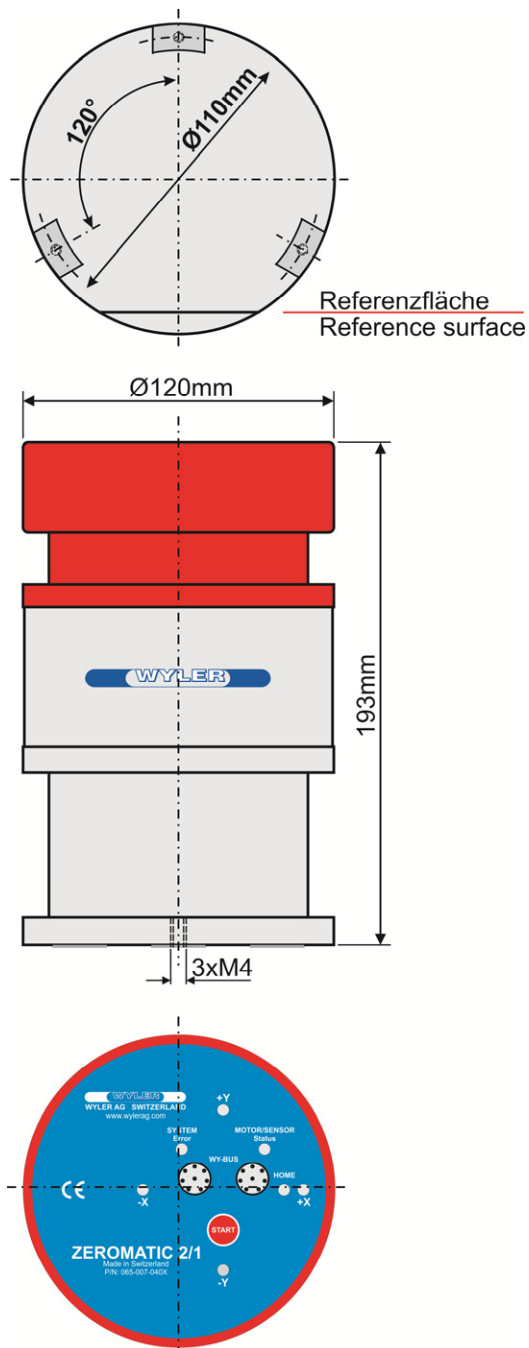
2.2 MECHANICAL DATA

Type of material used:	mostly aluminium alloy
Drive:	stepping motor with high precision transmission
Internal sensors:	1 high precision positioning sensor as "Home-Switch"
Weight:	[2/2]: 3.8 kg; [2/1]: 3.68 kg
Diameter of housing:	Ø120 mm
Height of housing:	193.5 mm (no cables connected) Layout of fixation holes / threads- a) 3 x M3-thread (in the support) on a diameter of 110 mm b) 3 x Ø 4,3mm for M4-screws (through support) on a diameter of 110mm
Alignment of Axis:	milled edge (Sector of 60mm) parallel to X-axis
Protection level (DIN40050):	IP 63, provided that both connectors are covered either with a cable connector or with a blind cover
3 supporting surfaces:	The 3 supporting surfaces are specially machined and lapped to ensure a precise measuring. The instrument has therefore always to be placed very carefully on the flat and cleaned surface to be measured.

2.3 ELECTRICAL DATA

Supply voltage:	24 Volt ±10% (DC)
Current consumption:	While rotor is moving [2/1] & [2/2] 225mA @ 24Volt Rotor in standby position [2/1] 20mA @ 24Volt During continuous measurement [2/2] 25mA @ 24Volt
Microprocessor:	RISC-Processor
Communication format:	RS485 / asynchr. / 7 DataBits / 2 StopBits / 9600 bps
Parity, Handshake:	none
Data protocol:	according to specification of "WYBUS" (WYLER AG). Further information on the serial data exchange is provided in chapter 7.1 "Serial data communication PC <<< -- >>> ZEROMATIC 2/2.

2.4 DIMENSIONS



2.5 SPECIFICATIONS

Measuring Range	±1 Arc degree
Stability of Zero / Limits of error (Repetition, Drift, Usage) over a period of several months	±1 Arcsec
Linearity (Gain) / Limits of error	0.5% R.O.
Rollover Error / sensor in horizontal position	within ±1° lateral inclination 1Arcsec + 0,2% of lateral inclination
Temperature Error of the GAIN Linearity	0.08% R.O. / °C

Remark: R.O. Read out

3. MAINTENANCE

As a guideline we recommend the following: if the instrument is programmed to carry out a reversal measurement every hour then the instrument should be sent back to the manufacturer for a factory control after 5 years (this corresponds to roughly 45'000 reversal measurements). Depending on the frequency of reversal measurement in your application this period is shortened or extended. The number of reversal measurements performed can be read out with the command "ReadRMN", the reply value corresponds to the number of 90° turns. A factory inspection is recommended when this value exceeds 200'000.

=> We recommend a **maintenance contract**

4. CONTROL OF THE ZEROMATIC

4.1 CONTROL WITH THE BLUEMETER

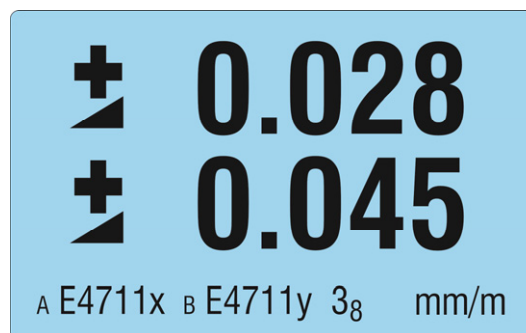
The BlueMETER allows on one side to read and indicate values from a ZEROMATIC-sensor and on the other hand to set the parameters in the sensor. A ZEROMATIC can be read on a BlueMETER similarly to any other WYLER instruments or sensors. As soon as a ZEROMATIC is connected to Port A of a BlueMETER the function REV.MEAS is available in the menu. This special function allows to read and to adjust the settings of the parameters "interval for reversal measurement" and "measuring intervals"

A general description of the BlueMETER can be found in the manual "BlueSYSTEM"

4.1.1 READING INCLINATION VALUES AT THE BLUEMETER

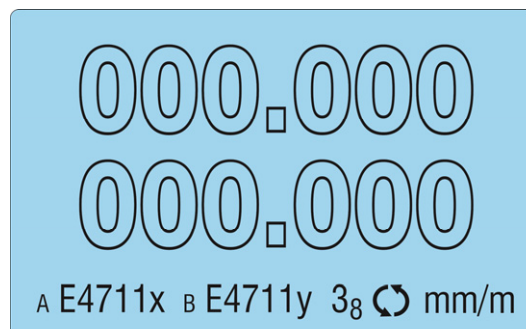
If ZEROMATIC-sensors are connected with the BlueMETER, the inclination values can be read and displayed on the BlueMETER: Choose the function [REFRESH] to update the internal sensor-list in the BlueMETER. Afterwards the axis of the ZEROMATIC to be displayed can be chosen with the function [SENSOR]. In order to properly identify sensor and axis the sensor-list shows an "x" behind the serial number for the X-axis and a "y" for the Y-axis.

As an example, the X-axis of the ZEROMATIC with the serial number E4711 is indicated as E4711x and its Y-axis is indicated as E4711y. The same identification is used during the display of the measuring values:



While the measuring values are continuously updated for the ZEROMATIC 2/2 (in the frequency of the parameter "measuring interval"), for the ZEROMATIC 2/1 the values after the last reversal measurement are shown.

During a reversal measurement no measuring data is available. This is indicated on the BlueMETER with empty zeroes and with the symbol for reversal measurement in the status line:



As soon as the reversal measurement is completed, the new measuring values are displayed.

4.1.2 CONFIGURATION OF THE ZEROMATIC WITH THE BLUEMETER

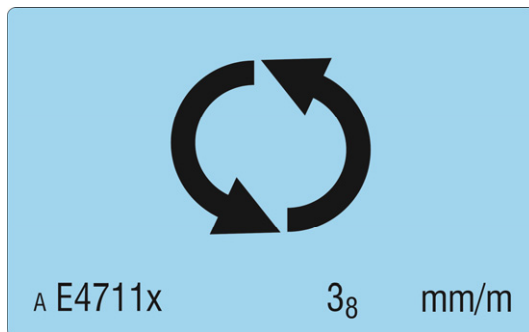
The 2 parameters "interval between two reversal measurements" and "measurement interval" can be read and programmed if a ZEROMATIC is connected to Port A of a BlueMETER. This functionality is not available on Port B. When connected, the function [REV.MEAS] will be available in the menu of the BlueMETER. This function allows the start of a reversal measurement and the setting of the 2 parameters.

REV.MEAS

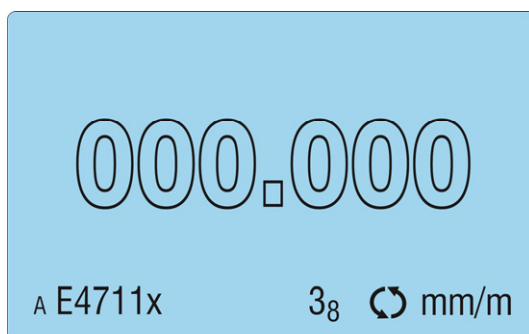
(this function is only available if a ZEROMATIC is connected to Port A of the BlueMETER)

Start of a reversal measurement

- Press <ON/MODE>, select function [REV.MEAS] and confirm with the <ENTER> key
- The symbol for "reversal measurement" is shown



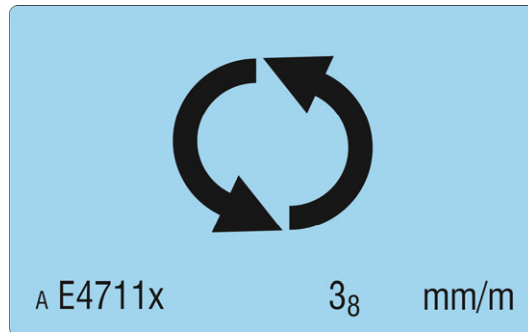
- Pressing the <ENTER> key again will start the reversal measurement



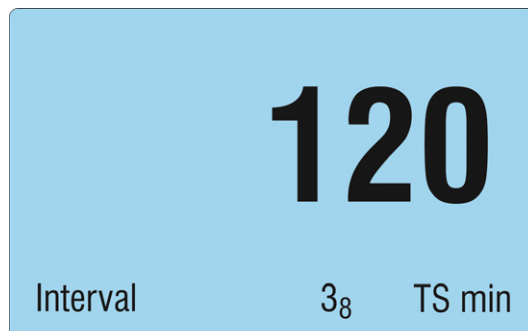
- Duration for a reversal measurement is about 130 seconds for a ZEROMATIC 2/1 and about 80 seconds for a ZEROMATIC 2/2

Reading and programming the 2 parameters "interval between two reversal measurements" and "measurement interval"

- Press <ON/MODE>, select function [REV.MEAS] and confirm with the <ENTER> key

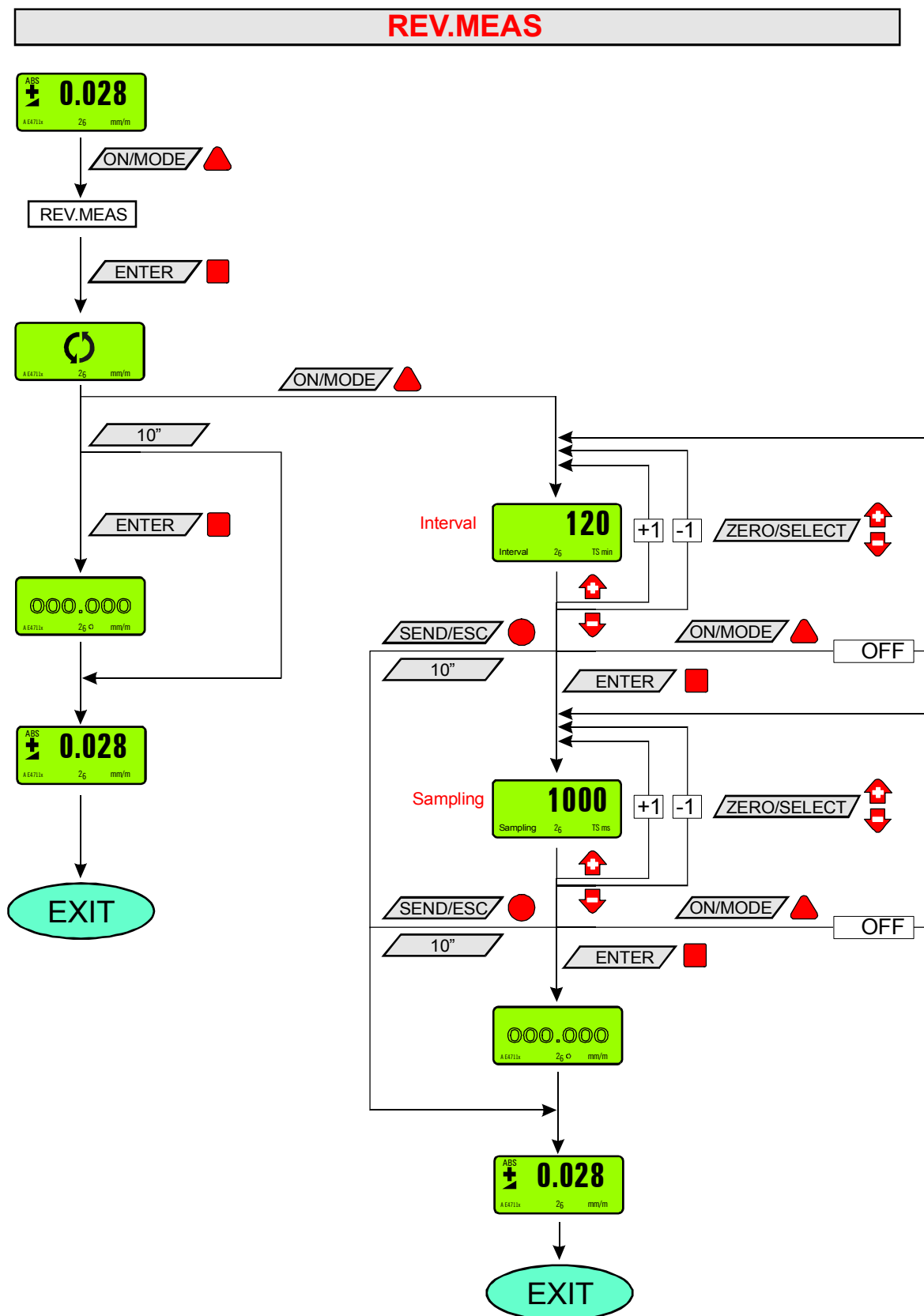


- Press <ON/MODE> will display the current value of the parameter "interval between two reversal measurements" in minutes. With the 2 keys <ZERO/SELECT + and -> the interval can be changed. Pressing <ON/MODE> again will switch off the automatic reversal measurement. Thus the value for "interval between two reversal measurements" will be reset to 15 minutes. To leave the menu, press <SEND/ESC> or do not press any key during 10 s. Any change made will not be saved and the actual measuring values will be displayed again.



- Press <ENTER> to confirm and save the changes made.
- With the ZEROMATIC 2/1 a reversal measurement is started and a new set of values will be displayed afterwards.
- With the ZEROMATIC 2/2 the current value for the parameter "measuring interval" is indicated in milliseconds (ms). With the 2 keys <ZERO/SELECT + and -> the interval can be changed. Pressing <ON/MODE> will switch off the continuous measurement. Thereby the measuring interval will be reset to the standard value of 1000 ms. To leave the menu, press <SEND/ESC> or do not press any key during 10 s. Any change made will not be saved and the actual measuring values will be displayed again.
- If the parameter "measuring interval" is set to zero or switched off, the ZEROMATIC 2/2 will behave like a ZEROMATIC 2/1: after each reversal measurement, the rotor will turn into parking position.
- Press <ENTER> to confirm and save the changes made. This will start a reversal measurement and a new set of values will be displayed afterwards.

4.1.3 FLOW CHART



4.2 SOFTWARE "ZEROMATIC-CONFIGURATOR"

The software ZEROMATIC-Configurator allows an easy configuration and commissioning of the ZEROMATIC 2/X sensors. The 2 parameters "interval between two reversal measurements" and "measurement interval" as well as the individual RS 485 device address can be programmed. Furthermore it provides a way to register inclination as well as the temperature in the sensor manually or automatically (time based).

4.2.1 INSTALLATION OF THE SOFTWARE

The software ZEROMATIC-Configurator is supplied by WYLER AG together with the ZEROMATIC 2/X. The program is a Windows application based on .NET Framework 3.5. It requires the installation of .NET Framework 3.5. The application is programmed in Visual Studio 2008 in C#. The source code is available on the CD as well and can be used to program customer specific applications.

The CD contains:

Software ZEROMATIC-Configurator as executable and installable software
Source code of the ZEROMATIC-Configurator in C# as a Visual Studio 2008 project
Readme-file with additional information

4.2.2 CONTROL OF THE SOFTWARE

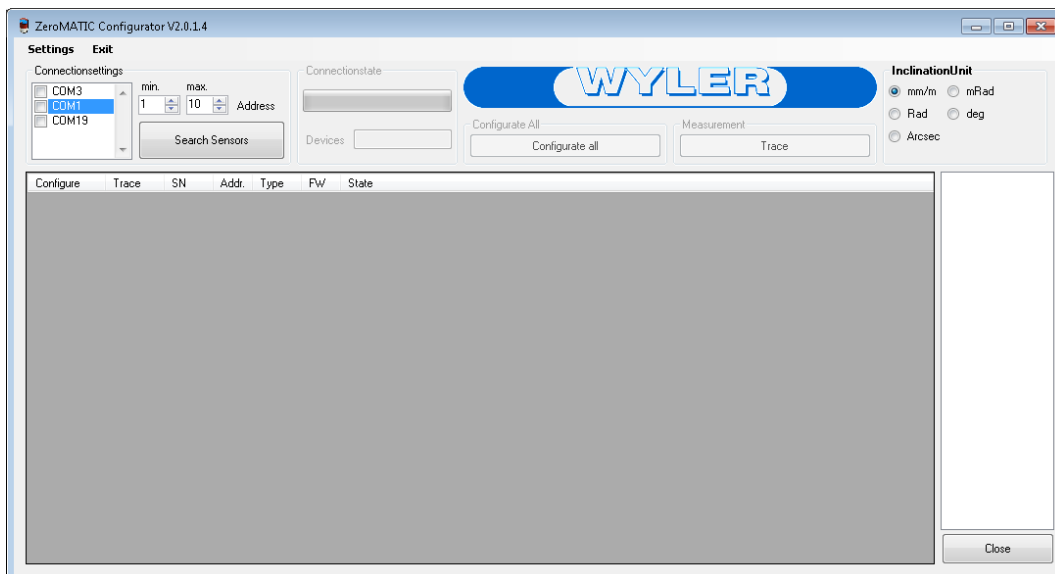
The Software offers the following functions:

- Connection of ZEROMATIC-sensors through the available COM-ports
- Display and configuration of the RS485 device addresses, as well as of the 2 parameters "interval between two reversal measurements" and "measurement interval"
- Display of the inclination in both axes in various formats as well as the temperature and other sensor data
- Change of units
- Manual measurements; trigger controlled measurements as well as time-controlled measurements are possible
- ring of measuring data in the .CSV format
- Automatic loading/storage of settings in "ZMConfigurator2.ini"

Start of the Software:

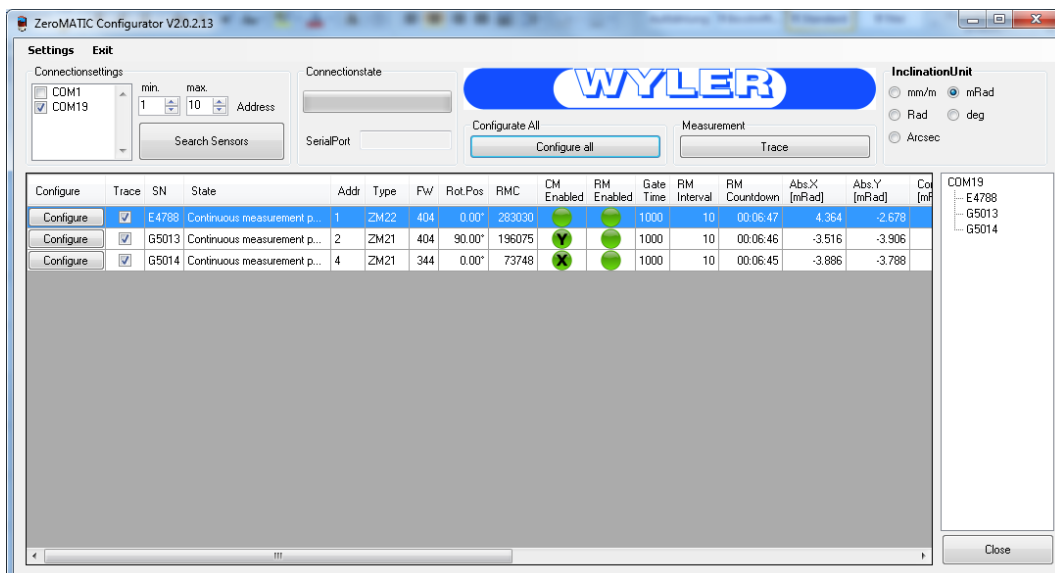
Please click on: **"Start" => "Programs" => "WYLER" => "ZeromaticConfigurator2"**

The following window will appear:



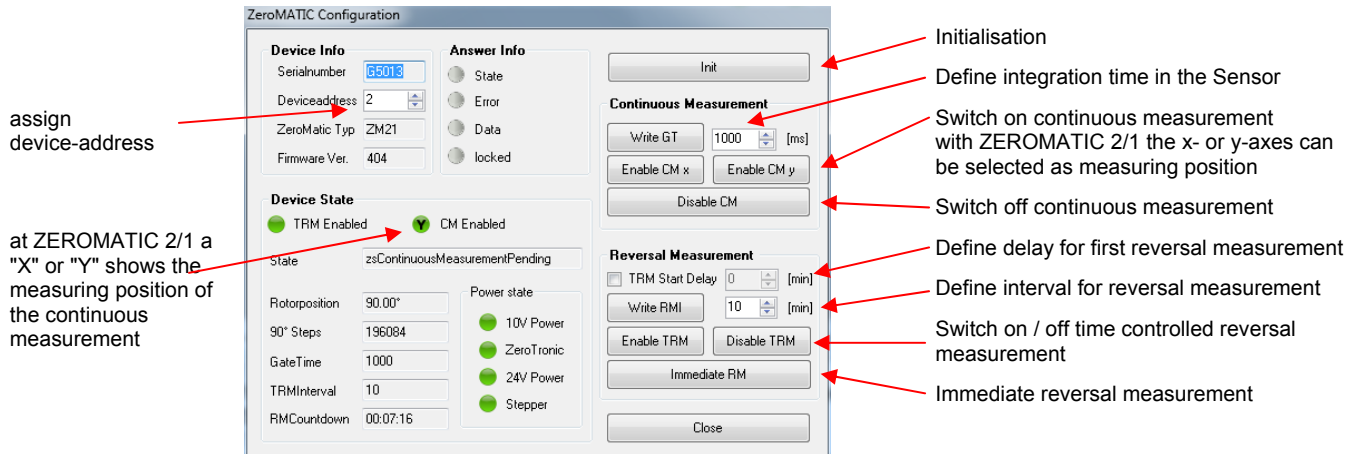
Connecting the ZEROMATIC-Sensors:

In the area "Connectionsettings" please select the COM-Ports through which the ZEROMATIC sensors are connected. In order to speed up the search process, the range of device addresses can be limited. With "Search Sensors" you can start the search and all ZEROMATIC Sensors connected will be listed. In case not all instruments connected appear in the list, you have either limited the range of device addresses too much or two or more instruments have the same device address. In this case connect each sensor individually one by one and assign a specific device address to each sensor.



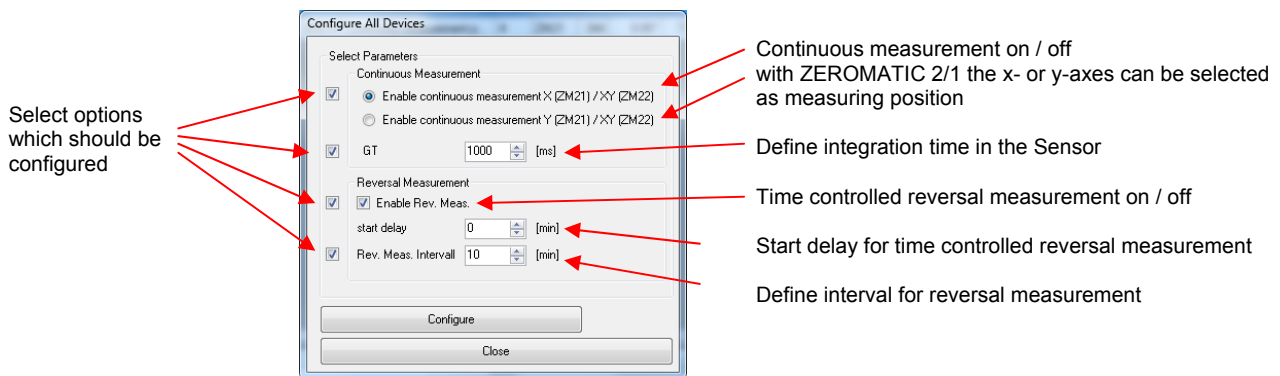
Configuration of the ZEROMATIC-Sensors

With a double click on the respective sensor the individual settings can be modified.



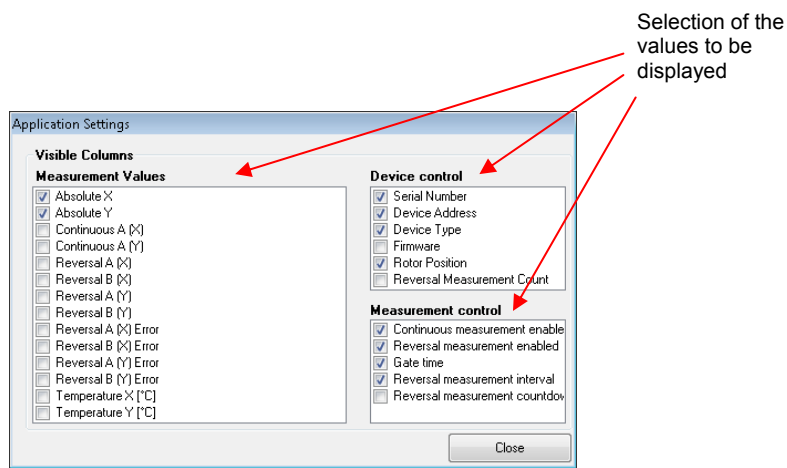
The dialogue appearing shows the device information and the present settings. It enables to further configure the ZEROMATIC sensors.

Using "Configure all" all sensors can be configured in one go. "Configure" transmits the settings and "Cancel" closes the dialogue.



Application settings:

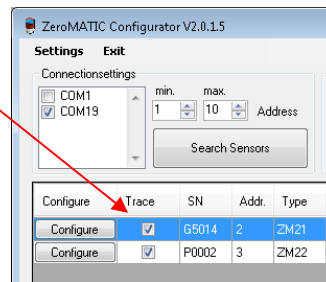
In the menu "Settings" -> "View settings" various adjustments can be performed, such as the selection of the measuring unit or the values to be displayed. As soon as you leave the dialog the settings will be activated and memorised.



	Name	Abbrev.	Description
1	Absolute X	Abs. X	absolute angle in X-direction, e.g. continuous measurement value minus Zero-Offset of last reversal measurement
2	Absolute Y	Abs. Y	absolute angle in Y-direction, e.g. continuous measurement value minus Zero-Offset of last reversal measurement
3	Continuous X	Cont. X	continuous measurement value in X-direction
4	Continuous Y	Cont. Y	continuous measurement value in Y-direction
5	Reversal X Position A	Rev. X A	angle X-direction of the last reversal measurement at position A
6	Reversal Y Position A	Rev. X B	angle X-direction of the last reversal measurement at position B
7	Reversal X Position B	Rev. Y A	angle Y-direction of the last reversal measurement at position A
8	Reversal Y Position B	Rev. Y B	angle Y-direction of the last reversal measurement at position B
9	Error X Position A	Rev.Err. X A	sum of the last eight squared deviations from the mean value at the reversal measurement in X-direction at position A
10	Error X Position B	Rev.Err. X B	sum of the last eight squared deviations from the mean value at the reversal measurement in X-direction at position B
11	Error Y Position A	Rev.Err. Y A	sum of the last eight squared deviations from the mean value at the reversal measurement in Y-direction at position A
12	Error Y Position B	Rev.Err. Y B	sum of the last eight squared deviations from the mean value at the reversal measurement in Y-direction at position B
13	Temperature Sensor X	Temp. X	temperature of the X-Sensors
14	Temperature Sensor Y	Temp. Y	temperature of the Y-Sensors

Storing and displaying of measuring values:

Before starting the trace function you have to select the sensors of which the measuring values should be stored in the column "trace".



Before starting the "Trace" function, the "Trace" dialogue enables you to individually adjust, what should be stored and when. Then before actually starting the "Trace" function you have to select an output file path.

Select the start resp. stop time Select the measuring unit Select the output file path Start resp. Stop the Trace Selection of the measuring values

Settings

Measurement Time

Start time: 13.03.2013 09:03:34 ☐ Start Time Control

End time: 13.03.2013 09:03:34 ☐ End Time Control

Current time: 13.03.2013 09:04:26

Unit

☒ mm/m ☐ Arcsec

☐ Rad ☐ deg

☐ mRad

Control

Destination directory:

Start Measurement

Stop Measurement

Close

File path:

Trace values

- ☒ Reversal B (X)
- ☒ Reversal A (Y)
- ☒ Reversal A (X) Error
- ☒ Reversal B (X) Error
- ☒ Reversal A (Y) Error
- ☒ Reversal B (Y) Error
- ☒ Temperature X [°C]
- ☒ Temperature Y [°C]

Table:

Date	Time	State	Abs. X [mm/m]	Abs. Y [mm/m]	ContA X [mm/m]	ContA. Y [mm/m]	RevA. X [mm/m]	RevB. X [mm/m]	RevA. Y [mm/m]	RevB. Y [mm/m]	RevA. Err X [mm/m]	RevB. Err X [mm/m]	RevA. Err Y [mm/m]	RevB. Err Y [mm/m]
13.03.2013	09:04:04	ConMeas Pe...	3.073	-4.028	3.188	-3.926	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	
13.03.2013	09:04:06	ConMeas Pe...	3.064	-4.030	3.195	-3.926	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	
13.03.2013	09:04:08	ConMeas Pe...	3.064	-4.030	3.195	-3.928	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	
13.03.2013	09:04:10	ConMeas Pe...	3.053	-4.027	3.183	-3.925	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	
13.03.2013	09:04:12	ConMeas Pe...	3.059	-4.028	3.190	-3.926	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	
13.03.2013	09:04:17	ConMeas Pe...	3.051	-4.027	3.182	-3.925	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	
13.03.2013	09:04:20	ConMeas Pe...	3.049	-4.027	3.180	-3.925	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	
13.03.2013	09:04:23	ConMeas Pe...	3.066	-4.028	3.197	-3.926	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	
13.03.2013	09:04:26	ConMeas Pe...	3.115	-4.030	3.196	-3.928	3.182	-2.920	-3.930	4.134	2.652	82.124	0.660	

5. REPAIR OF MEASURING INSTRUMENTS

Normally any instruments requiring repair can be sent to the local WYLER partner (local distributor) who will take the necessary steps and make the arrangements for repair on behalf of the customer.

Express Repair Service, ERS

A large number of customers can not miss the instruments for a longer period as these are in daily operation. For these cases WYLER SWITZERLAND has created a new service called "Express Repair Service, ERS". Employing this service the transport time from the user to WYLER SWITZERLAND and back and thus the complete repair time can be reduced considerably.



A simplified description of this service:

- The customer announces the repair request to the local WYLER partner in his country.
- The WYLER partner will inform the customer about the possibility of the ERS service outlining the advantages and consequences of this service, such as e.g.
 - reduced total repair time
 - required acceptance to repair without quote up to 65 % of the price for a new instrument
 - suitable packing for air transport
 - expenses of the ERS
- In case the customer decides to use the ERS, the customer informs the local WYLER partner or directly WYLER SWITZERLAND providing the necessary data.
- The customer will receive all information and instructions necessary for a smooth handling, the customer has just to pack the product suitably and to fill in a form for the **TNT courier service** as well as to announce the readiness to the local TNT office for pick-up. Everything else will run automatically.
- Products reaching WYLER SWITZERLAND under this service will be handled with **first priority, and** the instrument will be returned using the same carrier.
- The invoicing will be through the WYLER partner in your country.

Please do not hesitate to make use of this service in order to have your WYLER instrument back at your disposal as soon as possible. In case of any questions please contact WYLER SWITZERLAND or your local distributor, we will gladly help you to use the ERS successfully.

WYLER AG
Im Hölzli
CH-8405 WINTERTHUR
Switzerland

Tel. 0041 (0) 52 233 66 66
Fax. 0041 (0) 52 233 20 53

Homepage: <http://www.wylerag.com>
E-Mail: wyler@wylerag.com

6. ACCESSORIES TO ZEROMATIC 2/1 AND 2/2

- Power supply for indoor use only 065-003-001-24V
- Power supply for outdoor use (IP 67) 065-003-002-24V (Option)
- For **short connections**:(RS232 or USB port)
 - RS-232 cable with integrated RS-485 interface 015-025-829-232
 - USB-adapter with LEDs (USB <> RS232) 024-232-USB (Option)
 - (if PC does not have RS-232 port)
 - USB-cable (USB <> RS485), max. 1.8m 015-018-468-USB (Option)
- For **longer connections**:
 - MiniTC (with RS232/485-driver) 065-003-000-005
 - USB-Adapter (with RS232/485-driver) 065-003-003-USB
 - with status-LEDs/ 3x WYLER-Bus connection 065-050-878-001
 - ZEROTRONIC universal cable 5 m 065-100-878-001
 - ZEROTRONIC universal cable 10 m 065-100M848-02A
 - ZEROTRONIC bus cable 100 m (24Volt supply at the ZM) 065-300M848-02A
 - ZEROTRONIC bus cable 300 m (24Volt supply at the ZM)

7. INFORMATION FOR THE SOFTWARE-INTEGRATION

7.1 SERIAL COMMUNICATION PC <<< -- >>> ZEROMATIC 2/X

Serial Interface

- DataBits : 7
- StopBits : 2
- Parity / Handshake : none
- Baudrate : 9600 bps

Used characters

- ASCII numbers '0' ... '9'
- ASCII characters 'A' ... 'F'
- ASCII special character '~'
- ASCII control character <CR>

Used type of interrogation

- The instrument does not provide spontaneous messages
- The instrument only replies to a call command with a response
- The same data format is used for commands as well as responses

Sequence of communication

- The command can be transmitted to the measuring instrument at maximum speed or with longer time intervals between the individual characters.
- Directly after the end of the command the instrument will start to send the response.

Calculation of Checksum (WYLER AG)

Examples of commands:

~~~~~011D00000000F<CR> (command to read the inclination value of the sensor with address 1)

~~~~~021D0000000010<CR> ((command to read the inclination value of the sensor with address 2)

Remark: The last 2 characters contain the check sum

The Checksum is the sum of the 12 characters following the '~' characters.

Important Remark: do not add the ASCII values themselves, but the values which are represented by these ASCII values!

Example: ~~~~~051D0000000013<CR> the sum of the 12 characters after the '~' is 19 (decimal)
19 divided by 16 is 1 remaining 3
therefore the checksum is '13' (hexadecimal)

The ASCII character 'D' represents the decimal value **13** which means that the value 13 is added to the checksum.

CONVERSION TABLE FOR BINARY NUMBERS

| ASCII | HEXADEC. | BINARY | DECIMAL |
|-------|----------|--------|---------|
| ,0' | 0 | 0000 | 0 |
| ,1' | 1 | 0001 | 1 |
| ,2' | 2 | 0010 | 2 |
| ,3' | 3 | 0011 | 3 |
| ,4' | 4 | 0100 | 4 |
| ,5' | 5 | 0101 | 5 |
| ,6' | 6 | 0110 | 6 |
| ,7' | 7 | 0111 | 7 |

| ASCII | HEXADEC. | BINARY | DECIMAL |
|-------|----------|--------|---------|
| ,8' | 8 | 1000 | 8 |
| ,9' | 9 | 1001 | 9 |
| ,A' | A | 1010 | 10 |
| ,B' | B | 1011 | 11 |
| ,C' | C | 1100 | 12 |
| ,D' | D | 1101 | 13 |
| ,E' | E | 1110 | 14 |
| ,F' | F | 1111 | 15 |

7.2 DATA TRANSFER FORMAT USED

The structure of the messages is described in the following table:

| | | | |
|-------------|--|--|--|
| Header | ASCII ,~'
ASCII ,~'
ASCII ,~'
ASCII ,~' | | Start of each command and response.
Used for synchronisation of the receiver.
At least 4 of these characters should be sent. |
| Address | ASCII ,0' .. ,9' ,A' .. ,F' Bit[7..4] ⇒ +
ASCII ,0' .. ,9' ,A' .. ,F' Bit[3..0] ⇒ + | | Sensor target of source address in the range of [1..255]. A single instrument can always be contacted using the address 255 independently from the actual address of the sensor. Using address 0 all instruments connected will be addressed but no response will be returned. |
| Sub Address | ASCII ,1' .. ,9' ,A' .. ,F' Bit[3..0] ⇒ + | | Sensor sub-address |
| Opcode | ASCII ,0' .. ,9' ,A' .. ,F' Bit[3..0] ⇒ + | | Command number or response status |
| Data | ASCII ,0' .. ,9' ,A' .. ,F' Bit[31..28] ⇒ +
ASCII ,0' .. ,9' ,A' .. ,F' Bit[27..24] ⇒ +
ASCII ,0' .. ,9' ,A' .. ,F' Bit[23..20] ⇒ +
ASCII ,0' .. ,9' ,A' .. ,F' Bit[19..16] ⇒ +
ASCII ,0' .. ,9' ,A' .. ,F' Bit[15..12] ⇒ +
ASCII ,0' .. ,9' ,A' .. ,F' Bit[11..8] ⇒ +
ASCII ,0' .. ,9' ,A' .. ,F' Bit[7..4] ⇒ +
ASCII ,0' .. ,9' ,A' .. ,F' Bit[3..0] ⇒ + | | Command or response data or extended command structure.
ASCII-characters or hexadecimal number |
| CheckSum | ASCII ,0' .. ,9' ,A' .. ,F' Bit[7..4] ⇐
ASCII ,0' .. ,9' ,A' .. ,F' Bit[3..0] | | Checksum for data security |
| Trailer | ASCII <CR> | | End of command or response |

7.3 SET OF COMMANDS

The set of commands is divided in commands with a simple and with an extended structure. In the extended structure the field "Data" is divided in further blocks which contain a larger set of commands.

7.3.1 COMMANDS WITH SIMPLE STRUCTURE

| 1..6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---------------|---|-------------|------|------|------|------|------|------|------|------|------|--------|------|----------|--|
| ----- | ASCII-Characters '0' ... '9' und 'A' bis 'F' ⇔ Nibble Values 0...15 | | | | | | | | | | | | | | <CR> |
| HEADER | RS485 Address | Sub Address | Op | Data | | | | | | | | | | Checksum | Trailer |
| | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | |
| | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | cccc | cccc | d=Data c[7...0] = Checksum of data nibbles |
| | aaaa | aaaa | ssss | | | | | | | | | | | | a[7...0] = RS485-Address s[3...0] = Sub-Address |
| ReadID | HOST to ZEROMATIC | | | 0001 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | |
| | ZEROMATIC to HOST | | | 0000 | uuuu | uuuu | uuuu | uuuu | 0000 | iiii | iiii | iiii | | | i[11..0] = Type(15h=21=Z'MATIC2/1; 22= Z'MATIC2/2)
u[15..0] = Z'MATIC-Firmware (zB:0FFh=255=FW0255) |
| ReadAngle | HOST to ZEROMATIC | | | 1101 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | | |
| | ZEROMATIC to HOST | | | 0000 | ssss | ffff | ffff | ffff | ffff | ffff | ffff | fff(f) | | | s[3..0] = Sequence; f[27..0] = signed integer Angle [radian];
Unit [(2^24) -1 Rad] .
"(f)"[0] : if LSB = 0, then "reversal measurement ongoing" |
| ReadEEPROM | HOST to ZEROMATIC | | | 0010 | 0000 | 0000 | 0000 | 0aaa | aaaa | aaaa | 0000 | 0000 | | | a[10..0] = EEPROM-Address |
| | ZEROMATIC to HOST | | | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | dddd | dddd | | d[7..0] = EEPROM-Data |
| WriteEEPROM * | HOST to ZEROMATIC | | | 1100 | 0000 | 0000 | 0000 | 0aaa | aaaa | aaaa | dddd | dddd | | | a[10..0] = EEPROM-Address d[7..0] = EEPROM-Data |
| | ZEROMATIC to HOST | | | 0000 | #### | #### | #### | #### | #### | #### | #### | #### | | | |

Remarks: (#) = undefined / don't care

(*) = **Attention:** An erroneous entry into the EEPROM can disable the function of the ZEROMATIC, necessary repair works are excluded from the warranty.

7.3.2 DESCRIPTION OF THE COMMANDS WITH A SIMPLE STRUCTURE

7.3.2.1 ReadID

Parameter:

| | |
|---------------|--|
| RS485-Address | [1..255], 255 stands for "all instruments" |
| SUB-Address | 1 |
| Opcode | 0x1 |

Response value:

| | |
|------------------------------------|---|
| ChipID (Data-Bit 11..0) | 21 (0x15) corresponds to ZEROMATIC 2/1,
22 (0x16) corresponds to ZEROMATIC 2/2 |
| Firmware version (Data-Bit 31..16) | |

7.3.2.2 ReadAngle

Parameter:

| | |
|---------------|--|
| RS485-Address | [1..255], 255 stands for "all instruments" |
| SUB-Address | [1..14], description see below |
| Opcode | 0xD |

Response value:

| | |
|------------------------------------|---|
| Sequence number (Data-Bit 31...28) | [0...15] The sequence number is increased by 1 with every measurement. During a reversal measurement the sequence number does not change! |
| Angle or temperature (27...0) | Unit for angle: [1/(2^24) rad]
Unit for temperature [1/100 °C] |

Function of the sub address:

SUB-Address

- 1 - Read Axis X 'nAngle_ConPosAmRevApBd2'
- 2 - Read Axis Y 'nAngle_ConPosAmRevApBd2'
- 3 - Read Axis X 'nAngle_ConPosA'
- 4 - Read Axis Y 'nAngle_ConPosA'
- 5 - Read Axis X 'nAngle_RevPosA'
- 6 - Read Axis X 'nAngle_RevPosB'
- 7 - Read Axis Y 'nAngle_RevPosA'
- 8 - Read Axis Y 'nAngle_RevPosB'
- 9 - Read Axis X 'nError_RevPosA'
- 10 - Read Axis X 'nError_RevPosB'
- 11 - Read Axis Y 'nError_RevPosA'
- 12 - Read Axis Y 'nError_RevPosB'
- 13 - Read Axis X 'nTemperature'
- 14 - Read Axis Y 'nTemperature'

Explanation of abbreviations:

| | |
|-----------|---|
| Con | continuous measurement |
| Rev | value of the last reversal measurement |
| PosA | measuring direction +Axis |
| PosB | measuring direction –Axis |
| mRevApBd2 | minus Zero-Offset of the last reversal measurement (see detailed description on page 4) |
| nError | sum of the last eight squared deviations from the mean value |

The LSB of the inclination values with the sub addresses 1 and 2 serves at the same time as status information. If this bit is "0", a reversal measurement is in progress, if it is "1" this is not the case. This ensures the backward compatibility, it is recommended to use the respective commands of the extended structure.

7.3.2.3 ReadEEPROM

This command is contained to ensure the backward compatibility.

Parameter:

| | |
|----------------------------------|---|
| RS485-Address | [1...255], 255 stands for "all instruments" |
| SUB-Address | 1 |
| Opcode | 0x2 |
| EEPROM-Address (Data-Bit 18...8) | |

Response value:

EEPROM-Data (Data-Bit 7..0)

7.3.2.4 WriteEEPROM

This command is contained to ensure the backward compatibility.

Attention:

Parameter:

RS485-Address[1..255], 255 entspricht "alle Geräte"
SUB-Address 1
Opcode 0xC
EEPROM-Adresse (Data-Bit 18..8)
EEPROM-Data (Data-Bit 7..0)

Response value:

-

7.3.3 COMMANDS WITH EXTENDED STRUCTURE

The extended command structure allows a simple control of the ZEROMATIC and enables a status request in any situation. In addition an error processing is contained.

The Opcode 0xA labels the extended set of commands. The former field "Data" is divided into the blocks "Data/Mode", "Answer No" and "Data".

- **Data/Mode** contains the codes for the extended commands
- **Answer Number** is any number between 0 and 16 which can be attached to the commands. In the respective response it will be returned unchanged. Thus a response and a command can be assigned to each other.
- **Data** contains the respective data.

| 1..6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|--------------|---|------|-------------|---------|-------------|------|------------|------|------|------|------|----------|------|--|------|
| ~~~~~ | ASCII-Characters '0' ... '9' and 'A' to 'F' ⇔ Nibble Values 0..15 | | | | | | | | | | | | | | <CR> |
| HEADER | RS485 Address | | Sub Address | Op-code | Data / Mode | | Answer Nr. | Data | | | | Checksum | | Trailer | |
| | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | |
| | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | cccc | cccc | d=Data c[7..0] = Checksum of data nibbles | |
| | aaaa | aaaa | ssss | 0000 | eeee | eeee | nnnn | | | | | | | a[7..0] = RS485-Address; s=[3..0] = Sub-Address, here always = 1 | |
| | | | | | | | | | | | | | | o[3..0] = Opcode; e[7..0] = Data / Mode | |
| | | | | | | | | | | | | | | n[3..0] = Answer Number | |
| ReadGT | HOST to ZEROMATIC | | | 1010 | 0000 | 1100 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 1100 | nnnn | 0000 | 0000 | dddd | dddd | dddd | dddd | d[11..0] = GateTime | |
| ReadRMI | HOST to ZEROMATIC | | | 1010 | 0000 | 1101 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 1101 | nnnn | 0000 | dddd | dddd | dddd | dddd | dddd | d[15..0] = Reversal Measurement Interval | |
| ReadTRMC | HOST to ZEROMATIC | | | 1010 | 0000 | 1110 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 1110 | nnnn | dddd | dddd | dddd | dddd | dddd | dddd | d[11..0] = Timed Reversal Measurement count down | |
| ReadState | HOST to ZEROMATIC | | | 1010 | 0000 | 1111 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | |
| | ZEROMATIC to HOST | | | 0000 | ssss | ssss | nnnn | dddd | 0000 | pppp | pppp | pppp | pppp | s[7..0] = State of ZEROMATIC; see chapter 7.3.5
if s[7..4] = 'E' => HW Errors:
s[3] = Stepper timeout;
s[2] = Inclination Sensor not found
s[1] = 24V Power;
s[0] = 10V Power;
d[3] = Continuous Measurement: 1= enabled; 0= disabled
d[2] = Timed Reversal Measurement: 1= enabled; 0= disabled
d[1] = Sensor Type: 1= ZM2/2; 0= ZM 2/1
d[0] = Reversal Measurement Values 1 = valid; 0 = not valid
p[11..0] = Rotor Position [LSB = 0.18°] | |
| ReadSerialNr | HOST to ZEROMATIC | | | 1010 | 0001 | 0000 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | |
| | ZEROMATIC to HOST | | | 0000 | 0101 | 0000 | nnnn | dddd | dddd | dddd | dddd | dddd | dddd | d[19..0] = Number, SerialNr = Year letter + 4 digit number
Year letter = Number / 10000, i.e. A=1, B=2 ...
4 digit number = Number mod 10000 | |
| ReadFw | HOST to ZEROMATIC | | | 1010 | 0001 | 0001 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | |
| | ZEROMATIC to HOST | | | 0000 | 0101 | 0001 | nnnn | 0000 | 0000 | dddd | dddd | dddd | dddd | d[11..0] = Firmware Number | |
| ReadRMN | HOST to ZEROMATIC | | | 1010 | 0001 | 0010 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | | |
| | ZEROMATIC to HOST | | | 0000 | 0101 | 0010 | nnnn | dddd | dddd | dddd | dddd | dddd | dddd | d[19..0] = Reversal Measurement Number [LSB=90°] | |
| WriteGT | HOST to ZEROMATIC | | | 1010 | 0000 | 0001 | nnnn | 0000 | 0000 | dddd | dddd | dddd | dddd | d[11..0] = GateTime | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 0001 | nnnn | 0000 | 0000 | dddd | dddd | dddd | dddd | OK; d[11..0] = GateTime | |
| EnableCM | HOST to ZEROMATIC | | | 1010 | 0000 | 0010 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | Error; r[3..0] = Error Code; d[11..0] = GateTime | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 0010 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | ZM 2/1 only: d[0] = measuring axes, 0 = x-axes, 1 = y-axes | |
| DisableCM | HOST to ZEROMATIC | | | 1010 | 0000 | 0011 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | OK, Continuous Measurement enabled | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 0011 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | Error; r[3..0] = Error Code | |
| Write RMI | HOST to ZEROMATIC | | | 1010 | 0000 | 0100 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | OK, Continuous Measurement disabled | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 0100 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | Error; r[3..0] = Error Code | |
| Enable TRM | HOST to ZEROMATIC | | | 1010 | 0000 | 0101 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | OK; d[15..0] = Reversal Measurement Interval | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 0100 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | Error; r[3..0] = Error Code; d[15..0] = Reversal Measurement Interval | |
| Enable TRM | HOST to ZEROMATIC | | | 1010 | 0000 | 0101 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | OK; d[15..0] = Reversal Measurement Interval | |
| | ZEROMATIC to HOST | | | 0000 | 0100 | 0101 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | Error; r[3..0] = Error Code; d[15..0] = Reversal Measurement Interval | |

| | | | | | | | | | | | |
|--------------|-------------------|------|------|------|------|------|------|------|------|------|--|
| | ZEROMATIC to HOST | 0000 | 0100 | 0101 | nnnn | 0000 | dddd | dddd | dddd | dddd | OK; Timed Reversal Measurement enabled |
| | | 0000 | 1000 | 0101 | nnnn | rrrr | dddd | dddd | dddd | dddd | Error; r[3..0] = Error Code; d[15..0] = Time until Rev. Meas. starts |
| Disable TRM | HOST to ZEROMATIC | 1010 | 0000 | 0110 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | |
| | | | | | | | | | | | |
| | ZEROMATIC to HOST | 0000 | 0100 | 0110 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | OK; Timed Reversal Measurement disabled |
| | | 0000 | 1000 | 0110 | nnnn | rrrr | 0000 | 0000 | 0000 | 0000 | Error; r[3..0] = Error Code |
| Immediate RM | HOST to ZEROMATIC | 1010 | 0000 | 0111 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | Start immediate Reversal Measurement |
| | | | | | | | | | | | |
| | ZEROMATIC to HOST | 0000 | 0100 | 0111 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | OK; Reversal Measurement started |
| | | 0000 | 1000 | 0111 | nnnn | rrrr | 0000 | 0000 | 0000 | 0000 | Error; r[3..0] = Error Code |
| Init | HOST to ZEROMATIC | 1010 | 0000 | 1011 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | Initialize ZEROMATIC |
| | | | | | | | | | | | |
| | ZEROMATIC to HOST | 0000 | 0100 | 1011 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | Init accepted |
| | | 0000 | 1000 | 1011 | nnnn | 0000 | 0000 | 0000 | 0000 | 0000 | Init rejected |

Remarks: (#) = undefined / don't care

7.3.4 DESCRIPTION OF THE COMMANDS WITH EXTENDED STRUCTURE

The following parameters remain identical for all the commands with extended structure and are therefore not described again with each single command.

Parameter:

| | | |
|---------------|----------|---|
| RS485-Address | a[7...0] | [1...255], 255 stands for "all instruments" |
| SUB-Address | s[3...0] | 1 |
| Opcode | o[3...0] | 0xA |
| Answer Number | n[3...0] | any number between 0 to 16 |

Response value:

| | | |
|---------------|----------|---------------------------------|
| Data/Mode | e[7...0] | see table below |
| Answer Number | n[3...0] | same number as in the parameter |
| nError | r[3...0] | Error Code |

In the write-command the response will show in the field data the actually stored value similar to the corresponding read command. The values in the block Data/Mode are described in the status table below.

The meanings of the individual commands are concentrated in the following table, whereas Cc stands for the command code and Dc respectively Rc in case of an error stands for the answer code as a hexadecimal value. For the answer code, if a command has been accepted, the rule is that $Dc = Cc + 0x40$. In case of an error $Rc = Cc + 0x80$. A detailed overview is contained in the status table here after.

| Cc | Command | Description | Value transmitted | Dc | Value returned |
|----|----------------------|---|--|----|--|
| 01 | WriteGateTime | Write "Gate Time", i.e. the time span within which single measuring values are averaged | Gate Time [ms] | 41 | Actual Gate Time [ms] |
| 02 | EnableCM | Enable continuous measurements | | 42 | |
| 03 | DisableCM | Disable continuous measurements | | 43 | |
| 04 | WriteTRMInterval | Write interval for reversal measurements for time controlled reversal measurement | Interval of reversal measurement [min] | 44 | Interval of reversal measurement [min] |
| 05 | EnableTRM | Enable time controlled reversal measurement | | 45 | |
| 06 | DisableTRM | Disable time controlled reversal measurement | | 46 | |
| 07 | IRM | Start reversal measurement | | 47 | |
| 0B | Init | Initialise | | 4B | |
| 0C | ReadGateTime | Read "Gate Time", i.e. the time span within which single measuring values are averaged | | 4C | Gate Time [ms] |
| 0D | ReadReversalInterval | Read time interval for time controlled reversal measurements | | | Interval of reversal measurement [min] |
| 0E | ReadTRMCountdown | Time remaining until next reversal measurement | | | Time [s] |
| 0F | ReadState | Status of the ZEROMATIC | | | Status (see below) |
| 10 | ReadSerialnumber | Read Serial Number | | | Serial Number [ASCII sign plus number] |
| 11 | ReadFirmware | Read Firmware number | | | Firmware number |
| 12 | ReadReversalnumber | Answer Reversal number | | | |
| 25 | CM (intern) | | | | |
| 26 | Init (intern) | | | | |
| | | | | E# | Spontaneously transmitted error number |
| xx | unknown command | Unknown command code | | BF | |

7.3.5 TABLE OF COMMANDS AND STATUS MESSAGES, EXTENDED SET OF COMMANDS:

The table below gives you an overview of the commands in the extended set of commands as well as of the status information of the ZEROMATIC obtainable with the command "ReadState". Thereby the codes stand for

Cc command code
 Zs ZEROMATIC state
 Dc accepted command (Done)
 Rc rejected command (Rejected)
 Ec error code

The error code corresponds to the LEDs described at the beginning. The value has the following meaning

0x01 10V power supply defective
 0x02 24V power supply defective
 0x04 Connection to the ZEROTRONIC sensor defective
 0x08 Stepping motor defective

The individual error codes can also appear combined. Thus e.g. an error code 0xEA means that the 24 volt power supply (0x02) as well as the stepping motor (0x08) have failed.

| Host to ZEROMATIC | | ZEROMATIC to Host | | | | Read State | | | |
|-------------------|----------------------|-------------------|-------------------------|----|-----------------------|------------|-----------------|----|---------------|
| Cc | Commands | Dc | Done (Answer) | Rc | Rejected (Answer) | Zs | Pending (State) | Ec | Error (State) |
| 00 | 233 command | | | | | 00 | Idle | | |
| 01 | WriteGateTime | 41 | WriteGateTime Succ. | 81 | WriteGateTime Rej. | | | | |
| 02 | EnableCM | 42 | EnableCM Successful | 82 | Enable CM Rejected | 02 | CM Pending | | |
| 03 | DisableCM | 43 | Disable CM Successful | 83 | Disable CM Rejected | | | | |
| 04 | WriteTRMInterval | 44 | WriteTRMInterval Succ. | 84 | WriteTRMInterval Rej. | | | | |
| 05 | EnableTRM | 45 | EnableTRM Successful | 85 | Enable TRM Rejected | 05 | TRM Pending | | |
| 06 | DisableTRM | 46 | Disable TRM Successful | 86 | Disable TRM Rejected | | | | |
| 07 | IRM | 47 | IRM Successful | 87 | IRM Rejected | 07 | IRM Pending | | |
| 0B | Init | 4B | Init Successful | 8B | Init Rejected | 0B | Init Pending | | |
| 0C | ReadGateTime | 4C | Answer GateTime | | | | | | |
| 0D | ReadReversalInterval | 4D | Answer ReversalInterval | | | | | | |
| 0E | ReadTRMCountdown | 4E | Answer TRMCountdown | | | | | | |
| 0F | ReadState | ss | Answer State | | | | | | |
| 10 | ReadSerialNumber | 50 | Answer SerialNumber | | | | | | |
| 11 | ReadFirmware | 51 | Answer Firmware | | | | | | |
| 12 | ReadReversalnumber | 52 | Answer Reversalnumber | | | | | | |
| 25 | CM (intern) | | | | | | | | |
| 26 | Init (intern) | | | | | | | | |
| | | | | | | | | E# | Error |
| xx | unknown command | | | BF | unknown command | | | | |

7.3.6 SET OF COMMANDS FOR EARLIER VERSIONS

This set of commands is still supported in order to assure the backwards compatibility, it should, however, no longer be used.

| 1 ... 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---------------|--|------|-------------|---------|------|------|------|------|------|------|------|------|----------|--------|---|
| ~~~~~ | ASCII-Characters '0'...'9' und 'A' to 'F' ⇔ Nibble Values 0...15 | | | | | | | | | | | | | | <CR> |
| HEADER | RS485 Address | | Sub Address | Op code | Data | | | | | | | | Checksum | | Trailer |
| | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | 3210 | |
| | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | dddd | cccc | cccc | d=Data c[7...0] = Checksum of data nibbles |
| | aaaa | aaaa | ssss | | | | | | | | | | | | a[7...0] = RS485-Address s[3...0] = Sub-Address |
| ReadID | HOST to ZEROMATIC | | | 0001 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | |
| | ZEROMATIC to HOST | | | 0000 | uuuu | uuuu | uuuu | uuuu | uuuu | 0000 | iiii | iiii | iiii | iiii | i[11..0] = Type(15h=21=Z'MATIC2/1; 22= Z'MATIC2/2)
u[15..0] = Z'MATIC-Firmware (zB:0E6h=230=FW0230) |
| WriteGateTime | HOST to ZEROMATIC | | | 1010 | 0000 | 0000 | 0011 | 1010 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | |
| | ZEROMATIC to HOST | | | 0000 | #### | #### | #### | #### | #### | #### | #### | #### | #### | #### | |
| ReadAngle | HOST to ZEROMATIC | | | 1101 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | |
| | ZEROMATIC to HOST | | | 0000 | ssss | fff | fff | fff | fff | fff | fff | fff | fff(f) | fff(f) | s[3..0] = Sequence; f[27..0] = signed integer Angle [radian];
Unit [(2^24) -1 Rad] .
*(f)[0] : if LSB = 0, then "reversal measurement ongoing" |
| ReadEEPROM | HOST to ZEROMATIC | | | 0010 | 0000 | 0000 | 0000 | 0aaa | aaaa | aaaa | 0000 | 0000 | 0000 | 0000 | a[10..0] = EEPROM-Address |
| | ZEROMATIC to HOST | | | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | 0000 | dddd | dddd | dddd | d[7..0] = EEPROM-Data |
| WriteEEPROM * | HOST to ZEROMATIC | | | 1100 | 0000 | 0000 | 0000 | 0aaa | aaaa | aaaa | dddd | dddd | dddd | dddd | a[10..0] = EEPROM-Address d[7..0] = EEPROM-Data |
| | ZEROMATIC to HOST | | | 0000 | #### | #### | #### | #### | #### | #### | #### | #### | #### | #### | |

Remarks: (#) = undefined / don't care
 (*) = **Attention:** An erroneous entry into the EEPROM can disable the function of the ZEROMATIC, necessary repair works are excluded from the warranty.

```
//-----
//
// Description 'ZEROMATIC 21 & 22'    ChipID = 21, 22    Software Version 0230 and 0233
//
//-----
//
// nChipID = ReadID (RS485-Address, SUB-Address, OpCode "1")
//
// RS485-Address ----> 1..255 (a single instrument can always be addressed via the service address 255;
//                             independently of the actual address of the unit)
//
// SUB-Address -----> 1
//
// [ - besides the ChipID, the firmware version can be read: bit 14..11 in the response string to the command ReadID]
//
// EEPROM-Data = ReadEEPROM (RS485-Address, SUB-Address, OpCode "2", EEPROM-Address[x])
//
// RS485-Address ----> 1..255 (a single instrument can always be addressed via the service address 255;
//                             independently of the actual address of the unit)
//
// SUB-Address ----->    1
//
//
```

```

// WriteEEPROM (RS485-Address, SUB-Address, OpCode "C", EEPROM-Address[x], EEPROM-Data)
//
// Warning: writing an incorrect value in the EEPROM can prevent the ZEROMATIC from functioning correctly.
//           A repair as consequence of this would not be covered by our warranty.
//
// RS485-Address ---> 1..255 (a single instrument can always be addressed via the service address 255;
//                             independently of the actual address of the unit)
//
// SUB-Address -----> 1
//
// EEPROM[0] = GlobalAddress.Bit7..0
//
// EEPROM[10] = SerialNr.Byte0
// EEPROM[11] = SerialNr.Byte1
// EEPROM[12] = SerialNr.Byte2
// EEPROM[13] = SerialNr.Byte3
//
// EEPROM[16] = GateTime.Byte0, lower Byte / (time[ms]/2)-1 = value(dez) => convert to hex
// EEPROM[17] = GateTime.Byte1, higher Byte
//
// EEPROM[18] = ReversalInterval.Byte0, lower Byte / time[min] = value(dez) => convert to hex
// EEPROM[19] = ReversalInterval.Byte1, higher Byte
//
// WriteGateTime (RS485-Address, SUB-Address, OpCode "A", {GateTime | Reversal-Interval })
//
// RS485-Address ---> 1..255 (a single instrument can always be addressed via the service address 255;
//                             independently of the actual address of the unit)
//
// [ - If Reversal Measurement and Continuous Measurement are set to Zero, the ZEROMATIC will turn to the
// Standby-Position ]
// SUB-Address -----> 4 – Start Reversal Measurement (without further parameters)
//                       This command starts an immediate reversal measurement. The current value of
//                       the parameter "ReversalInterval" is not affected and remains valid
//
//                       5 – Apply Settings from EEPROM (without further parameters)
//                       Same procedure as with a start after "Power Up":
//                       with the command "Apply" the latest changes in the EEPROM for the parameters
//                       "GateTime" and "ReversalInterval" are applied and executed immediately
//
// -----
// Procedure for parameter hand-over for the interval of reversal measurements:
// 1. WriteEEPROM [18], ReversalInterval lower Byte
// 2. WriteEEPROM [19], ReversalInterval higher Byte
// 3. WriteGateTime with Subaddress 5 ("Apply settings") to apply the new value for "Reversal Interval"
// -----
//
// nValue = ReadAngle (RS485-Address, SUB-Address, Opcode "D")
//
// RS485-Address ---> 1..255 (a single instrument can always be addressed via the service address 255;
//                             independently of the actual address of the unit)
//
// SUB-Address -----> 1 - Read Axis X 'nAngle_ConPosAmRevApBd2' _____ [1/(2^24) rad]
//                      2 - Read Axis Y 'nAngle_ConPosAmRevApBd2' _____ [1/(2^24) rad]
//                      3 - Read Axis X 'nAngle_ConPosA' _____ [1/(2^24) rad]
//                      4 - Read Axis Y 'nAngle_ConPosA' _____ [1/(2^24) rad]
//                      5 - Read Axis X 'nAngle_RevPosA' _____ [1/(2^24) rad]
//                      6 - Read Axis X 'nAngle_RevPosB' _____ [1/(2^24) rad]
//                      7 - Read Axis Y 'nAngle_RevPosA' _____ [1/(2^24) rad]
//                      8 - Read Axis Y 'nAngle_RevPosB' _____ [1/(2^24) rad]
//                      9 - Read Axis X 'nError_RevPosA' _____ [1/(2^24) rad]
//                      10 - Read Axis X 'nError_RevPosB' _____ [1/(2^24) rad]
//                      11 - Read Axis Y 'nError_RevPosA' _____ [1/(2^24) rad]
//                      12 - Read Axis Y 'nError_RevPosB' _____ [1/(2^24) rad]

```

```
//          13 - Read Axis X 'nTemperatur' _____ [1/100 °C]
//          14 - Read Axis Y 'nTemperatur' _____ [1/100 °C]
```

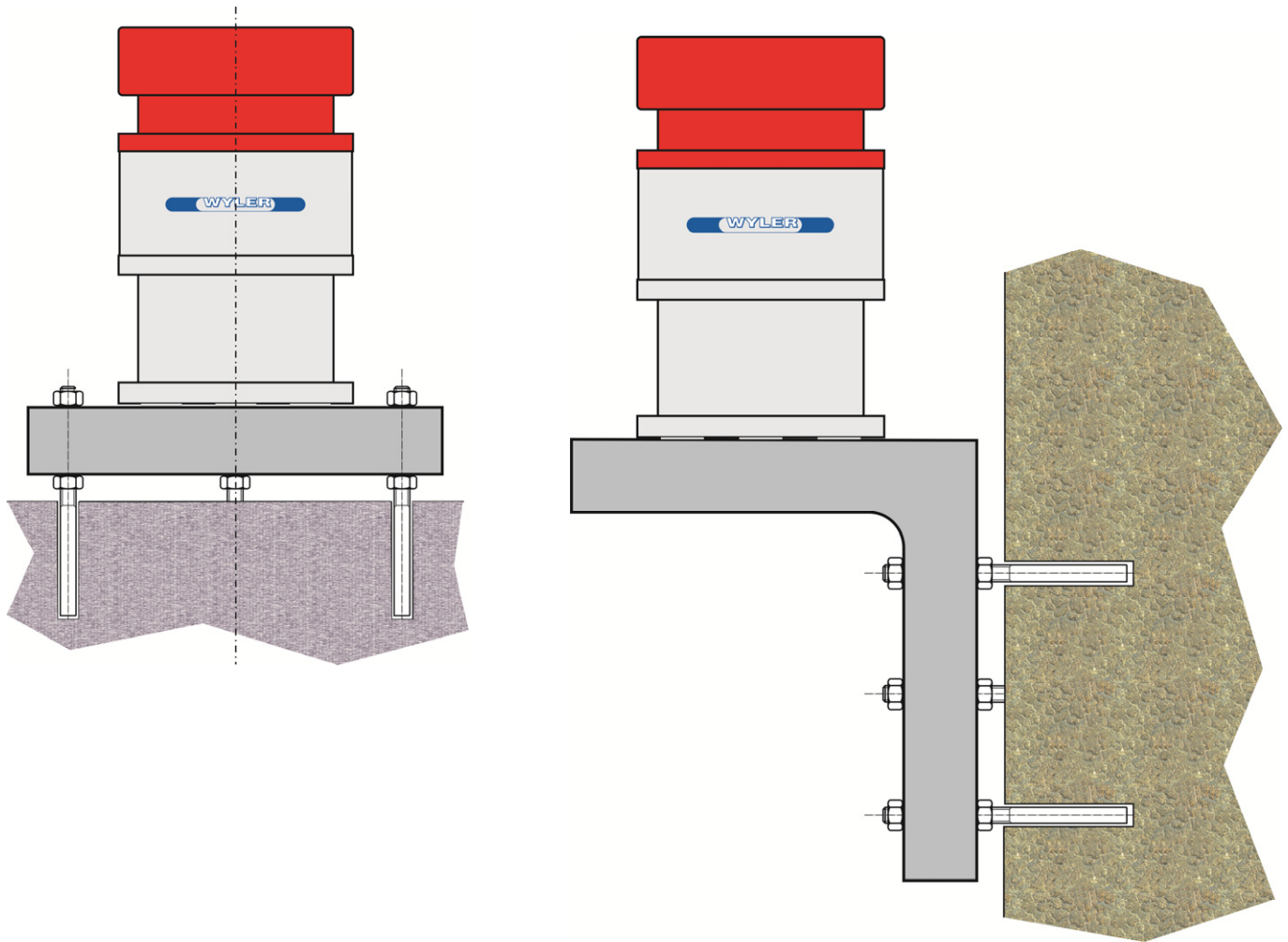
```
//
// [ - Is the ZEROMATIC currently "busy" doing a reversal measurement?
//     This can be checked and verified with the command "ReadAngle" and the subaddresses 1 & 2:
//     If the lowest bit of the response string is equal to 0; the reversal measurement is active. If that bit is "1",
//     this is not the case
//     - Read-commands are accepted during a reversal measurement; Write commands are not possible]
//
//// - Readout of the inclination with the command "ReadAngle":
//     together with the angular value there is always a sequence number provided [0..15]:
//     This sequence number is incremented by "1" each time a new inclination value is calculated
//     and provided: either directly after a reversal measurement or after each time out of the Gate time.
//     During a reversal measurement the sequence number remains unchanged!
//
//
```

```
/////-----
//// Abbreviations:
//     Con          = ContinuousMeasurement
//     Rev          = ReversalMeasurement
//     PosA         = Measurement direction +Axis
//     PosB         = Measurement direction -Axis
//     mRevApBd2    = minus Zero-Offset from last Reversal-Measurement (see detailed description page 4)
//     nError       = sum of eight squared deviations to the average
//
/////-----
```

8 RECOMMENDATION FOR THE MOUNTING OF THE ZEROMATIC 2/1 AND 2/2

8.1 INTRODUCTION

When measurements are performed inside buildings, usually a mounting base (square or angular profile) is required (see examples in the sketch below).



With the ZEROMATIC instruments high precision inclination measurements are possible. It is however important to consider the following recommendations for the mounting:

8.2 TEMPERATURE / HUMIDITY

Temperature changes may have a great influence on the measured results. It has therefore to be ensured that the temperature is distributed evenly around the sensor.

- The instrument should not be placed too close to a massive object. (Heat accumulator)
- No direct exposure to the sun (nor to any other heat source)
- Draft should be avoided or evenly channelled
- Protect the instrument against dropping water

8.3 MECHANICAL TENSION

Mechanical tension between the ZEROMATIC and the mounting bracket and/or the anchorage must be avoided as these tensions are often the cause of instable values. Avoid tensions

- by ensuring flat mounting surfaces (flatness within 0.01 mm)
- by applying correct mechanical design to avoid any leverages
- by using heavy and rugged design of the mounting bracket

Check:

Install the ZEROMATIC on the mounting bracket (bolted down). After an acclimatization time, start measurements. Now the mounting bolts are carefully loosened while the measurements are running without touching the instrument (temperature change). In case the measured values are changing, the support is under tension. In that case the design is not suitable for accurate measurements.

8.4 THREE POINT MOUNTING / DESIGN

Use, whenever possible, a three point mounting jig.

- Use the same geometry and the same homogenous material for all three pillars
- Make a "centre symmetrical" design

8.5 HORIZONTAL MOUNTING

In order to achieve high precision inclination measurements the ZEROMATIC has to be precisely horizontally adjusted. WYLER spirit levels are perfectly suited to help you with this task: we recommend the use of the following types:

e.g.

- Cross Spirit Level 76, 176-080-120-300, sensitivity 0,3mm/m
or
- Cross Spirit Level 78, 178-150-123-100, sensitivity 0,1mm/m



Cross Spirit Level 76 / 176-080-120-300



Cross Spirit Level 78 / 178-150-123-100

The specialists at WYLER AG are gladly at your disposal for any questions regarding the mounting.



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