

The logo for HydroMet, featuring a white diagonal slash followed by the text "HydroMet" in a bold, white, sans-serif font.

**/ HydroMet**

User Manual

# WeatherSens

The KISTERS logo, consisting of a white stylized 'K' symbol followed by the word "KISTERS" in a bold, white, sans-serif font. Below the logo is the tagline "Empowering decisions of tomorrow" in a smaller, white, sans-serif font.

**KISTERS**  
Empowering decisions of tomorrow

# Table of Contents

I	Disclaimer	3
II	Scope of Delivery	4
III	Safety Instructions	5
Part I	Introduction	6
1.1	Product Overview .....	6
1.2	AR Series Anemometer and MP-Series, MPS100, MPR100/101 .....	7
1.2.1	Anemometer AR200 .....	7
1.2.2	Anemometer WS200 .....	7
1.2.3	WeatherSens MP Series .....	8
1.2.4	WeatherSens WS Series .....	9
Part II	Installation	12
2.1	Select the Location .....	12
2.2	Mounting Kit .....	12
2.2.1	Tube1 Dimensions .....	13
2.2.2	Tube2 Dimensions .....	13
2.3	Mounting Method .....	13
2.3.1	Tube1 .....	14
2.3.2	Tube2 .....	14
2.4	Alignment .....	15
2.4.1	Alignment Method I .....	15
2.5	Sensor Connector, Cable .....	15
2.5.1	M12-8pol Pin Connector & Cable .....	16
Part III	Operation	17
3.1	Communication Protocol .....	17
3.1.1	SDI-12 V1.3 .....	17
3.1.2	ASCII - Protocol .....	20
3.1.3	MODBUS-RTU Protocol .....	23
3.1.4	NMEA-0183 Protocol .....	25
Part IV	Repair	27
Part V	Technical Data	28
5.1	Anemometers .....	28
5.2	WeatherSens MP Series .....	29
5.3	WeatherSens WS Series .....	30
5.4	Others .....	31
Part VI	Obligations of the Operator and Disposal	33
6.1	Obligations of the Operator .....	33
6.2	Dismantling / Disposal .....	33

# I Disclaimer

The information provided in this manual was deemed accurate as of the publication date. However, updates to this information may have occurred.

This manual does not include all of the details of design, production, or variation of the equipment nor does it cover every possible situation which may arise during installation, operation or maintenance. KISTERS shall not be liable for any incidental, indirect, special or consequential damages whatsoever arising out of or related to this documentation and the information contained in it, even if KISTERS has been advised of the possibility of such damages.

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## II Scope of Delivery

- One of each sensor model inside an overseas transportation box:
  - Sensor model: WS200, WS500, WS600, WS650
  - Sensor model MP-Series: AR200, MP500, MP600, MP650, MPR100, MPS101; MPS100
- Installation Guide WS or MP-Series
- Factory Acceptance Test Protocol
- 10 m cable M12 SAC 8-pol
- Factory setting: SDI-12 Version 1.3

# III Safety Instructions

- Read the user manual including all operating instructions prior to installing, connecting and powering up the KISTERS WeatherSens. The manual provides information on how to operate the product. The manual is intended to be used by qualified personnel, i.e. personnel that have been adequately trained, are sufficiently familiar with installation, mounting, wiring, powering up and operation of the product.
- Keep the user manual on hand for later reference!
- If you encounter problems understanding the information in the manual (or part thereof), please consult the manufacturer or its appointed reseller for further support.
- KISTERS WeatherSens is intended to be used in hydrometeorological or environmental monitoring applications.
- Before starting to work, you have to check the functioning and integrity of the system.
  - Check for visible defects on the WeatherSens, this may or may not include any or all of the following mounting facilities, connectors and connections, mechanical parts, internal or external communication devices, power supplies or power supply lines, etc.
  - If defects are found that jeopardize the operational safety, work must be stopped. This is true for defects found before starting to work as well as for defects found while working.
- Do not use the KISTERS WeatherSens in areas where there is a danger of explosion.
- The present user manual specifies environmental/climatic operating conditions as well as mechanical and electrical conditions. Installation, wiring, powering up and operating the KISTERS WeatherSens must strictly comply with these specifications.
- Perform maintenance only when tools or machinery are not in operation.
- If guards are removed to perform maintenance, replace them immediately after servicing.
- Never make any electrical or mechanical diagnostics, inspections or repairs under any circumstances. Return the product to the manufacturer's named repair centre. You can find information on how to return items for repair in the relevant section of the KISTERS website.



- Disposal instructions: After taking the KISTERS WeatherSens out of service, it must be disposed of in compliance with local waste and environmental regulations. The KISTERS WeatherSens is never to be disposed in household waste!



- Inputs and outputs of the device are protected against electric discharges and surges (so-called ESD). Do not touch any part of the electronic components! If you need to touch any part, please discharge yourself, i.e. by touching grounded metal parts.

# 1 Introduction

Thank you for choosing our product. We hope you will enjoy using the device.

KISTERS manufactures, sells, installs and operates quality instrumentation, data loggers and communication technology. Products are designed with passion for environmental monitoring and with a deep understanding of the quality, accuracy and robustness needed to fulfil the requirements of measurement practitioners in the field.

The present User Manual will help you understand, install and deploy the device. If, however, you feel that a particular information is missing, incomplete or confusing, please do not hesitate to contact us for further support!

For more information, see the following subsections:

- [Product Overview](#) 
- [AR Series Anemometer and MP-Series, MPS100, MPR100/101](#) 

## 1.1 Product Overview

The compact weather sensors do provide reliable data for weather monitoring and wide field of applications where efficient deployment costs and compact design and a small installation foot-print is required.

**Data Output:** The sensor provides 1 second instantaneous data and does not aggregate further mean values or extended meteorological and statistical calculations:

- **Wind data:** Calculation of wind gusts as 3-second moving averages based on a sampling rate of 4 Hz (4 values per second).
- **Precipitation:** 1 minute, hourly and daily cumulative precipitation as moving average. The 1 minute data can be used as cumulative amount or to calculate intensities and rain rates:
  - Intensity: 1 minute amount value multiplied by 60 to result in intensity data in mm/h according to WMO guide line No8.
  - Rain rate: sum of various 1 minute data expressed as cumulative rain in a specific time interval. The rain rate of 10 minutes is calculated of ten 1 minute amount values, which refer to a 10 minutes rating interval.
  - Hourly cumulative rain amount: Cumulative rain amount in past hour as moving average. Usually recorded in the data logger at every full hour.
  - Daily cumulative rain amount: Cumulative rain amount in past hour as moving average. Usually recorded in the data logger at midnight. This value is not available on SDI-12 interface and data output.  
**Note** that all cumulative values require a permanent power supply of the sensor. Any power outage during a day will result in incorrect daily rain data.
- **All other meteorological parameter:** One second instantaneous output data to be used for the further aggregation into high-quality mean values. For this, permanent power supply is required.

### Measured parameters:

- Wind speed and direction
- Temperature
- Relative humidity
- Air-Pressure
- Solar radiation
- Rain

### Applications:

- Smart Cities, Urban Areas and Municipalities
- Automatic weather stations, ASOS AWOS
- Offshore platforms and Wind Energy Industry
- Road Weather Monitoring
- Power Grid Transmission stations
- Photovoltaic farms
- Hydro-Meteorological monitoring
- Traffic control on roads, bridge and tunnel
- Navigation on ships, vessels and ferries
- Marine application and harbour monitoring
- Airfield and helicopter platform
- Environmental monitoring
- Agrometeorological stations such as ETo (evapotranspiration) or irrigation stations
- Building Automation

## Features

- All-in-one weather measurements
- Choice of parameters to suit required applications
- Rainfall measurements by photoelectric or piezoelectric technique
- Built-in data pre-processing capability
- Selectable interface and output protocols according to SDI-12 and MODBUS standard
- Ease of use, install and integrate into 3rd party systems
- Low power consumption
- Maintenance free instruments without any moving parts

## 1.2 AR Series Anemometer and MP-Series, MPS100, MPR100/101

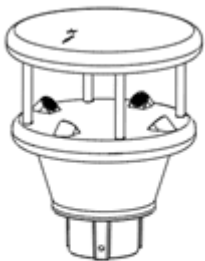
This chapter contains the following subsections:

- [Anemometer AR200](#) <sup>7</sup>
- [Anemometer WS200](#) <sup>7</sup>
- [WeatherSens MP Series](#) <sup>8</sup>
- [WeatherSens WS Series](#) <sup>9</sup>

### 1.2.1 Anemometer AR200

The AR200 sensors based on ultrasonic measuring principle by reflection method determines and calculates wind speed and direction with 4 Hz sampling interval to provide floating means on vector and scalar output. This durable metal version of aluminium alloy with teflon coating is corrosion-resistant and complies to the WMO Guide to Instruments and Methods of Observation (WMO), section on wind measurements.

**Note:** The data logger has to poll in 1 second interval and to aggregate vectorial or scalar mean values or any further meteorological and statistical calculation.

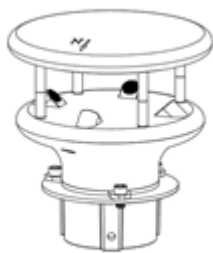


AR200

### 1.2.2 Anemometer WS200

The WS200 sensors based on ultrasonic measuring principle by reflection method determines and calculates wind speed and direction with 4 Hz sampling interval to provide running means on vector and scalar output. This version made of corrosion-resistant polycarbonate material according to IP 66 and complies to the WMO Guide to Instruments and Methods of Observation (WMO), section on wind measurements.

**Note:** The datalogger has to poll in 1 second interval and to aggregate vectorial or scalar mean values or any further meteorological and statistical calculation.



WS200

Model	Wind Speed	Wind Direction	Remark
AR200	✓	✓	60 m/s / IP66
WS200	✓	✓	45 m/s / IP66

### 1.2.3 WeatherSens MP Series

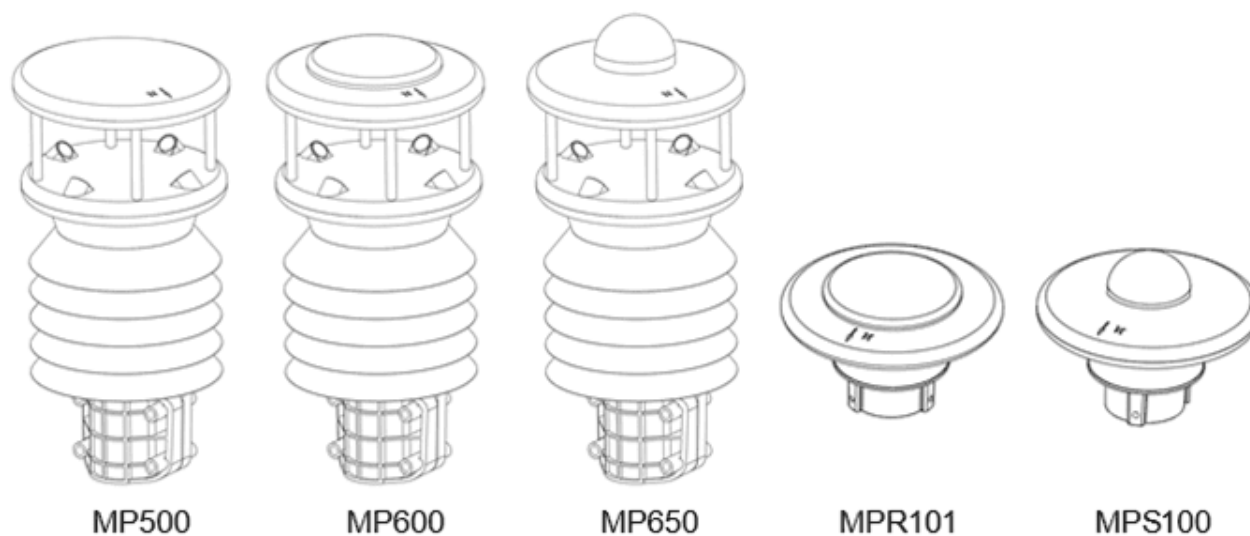
The MP Series Compact Weather Sensors are designed for robust and maintenance-free measurements in hydrology, meteorology and weather-critical applications where durability, precision and operations in different climatic conditions are expected.

MPR100/101 as single sensor or embedded in a model.

The MPR100 sensor is based on the measurement of the kinetic energy of each rain drop by piezo-electronic sensing element. The MPR101 sensor is based on the method of forward scattering of each rain drop by optoelectronic LEDs and photo-diodes. Each drop is calculated with its drop size and individual water equivalent to result in a cumulative output of rain amount in 1 minute, hourly or daily values.

- **Precipitation:** 1 minute, hourly and daily cumulative precipitation as moving average. The 1 minute data can be used as cumulative amount or to calculate intensities and rain rates:
  - Intensity: 1 minute amount value multiplied by 60 to result in intensity data in mm/h according to WMO guide line No8.
  - Rain rate: sum of various 1 minute data expressed as cumulative rain in a specific time interval. The rain rate of 10 minutes is calculated of ten 1 minute amount values, which refer to a 10 minutes rating interval.
  - Hourly cumulative rain amount: Cumulative rain amount in past hour as moving average. Usually recorded in the data logger at every full hour.
  - Daily cumulative rain amount: Cumulative rain amount in past hour as moving average. Usually recorded in the data logger at midnight. This value is not available on SDI-12 interface and data output.
- **Note** that all cumulative values require a permanent power supply of the sensor. Any power outage during a day will result in incorrect daily rain data.
- The measuring parameter Rain is only valid at temperatures above 2 °C for monitoring liquid precipitation and also hail.
- Wind speed measuring range up to 60 m/s.
- Housing consisting of Aluminum alloy with Teflon coating.





Not all models are shown in the figure above.

Model	Wind speed	Wind direction	Temperature	Humidity	Pressure	Rain	Solar radiation	Remark
MP500	✓	✓	✓	✓	✓			
MP600	✓	✓	✓	✓	✓	✓		Piezo-electrical
MP601	✓	✓	✓	✓	✓	✓		Opto-electrical
MP650	✓	✓	✓	✓	✓		✓	
MP700	✓	✓	✓	✓	✓	✓	✓	Opto-electrical
MPR100						✓		Piezo-electrical
MPR101						✓		Opto-electrical
MPS100							✓	

**Table 1 - WeatherSens MP-Series Overview**

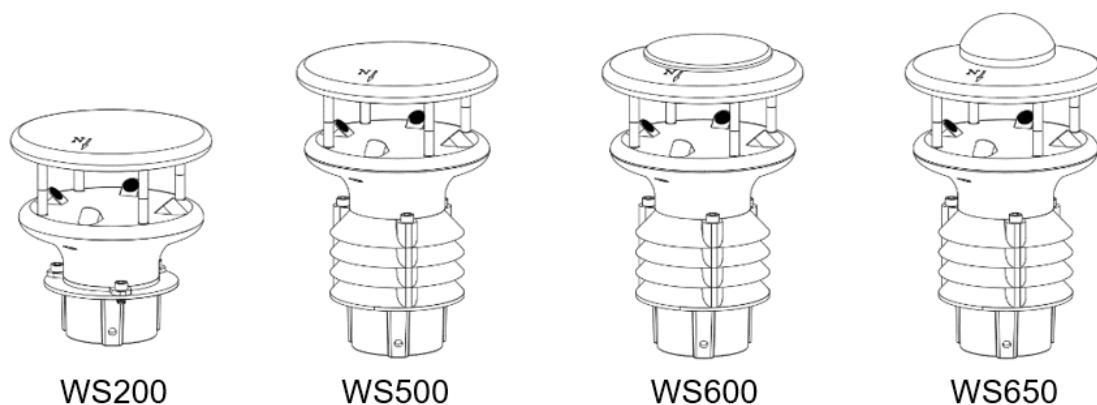
#### 1.2.4 WeatherSens WS Series

The WS-Series Compact Weather Sensors are designed for robust and maintenance-free measurements in hydrology, meteorology and weather-critical applications where durability, precision and operations in different moderate climatic conditions are expected.

MPR100/101 technology is embedded in WS-Series and models. The MPR100 sensor is based on the measurement of the kinetic energy of each rain drop by piezo-electronic sensing element. The MPR101 sensor is based on the method of forward scattering of each rain drop by optoelectronic LEDs and photo-diodes. Each drop is calculated with its drop size and individual water equivalent to result in a cumulative output of rain amount in 1 minute, hourly or daily values.

- **Precipitation:** 1 minute, hourly and daily cumulative precipitation as moving average. The 1 minute data can be used as cumulative amount or to calculate intensities and rain rates:

- Intensity: 1 minute amount value multiplied by 60 to result in intensity data in mm/h according to WMO guide line No8.
- Rain rate: sum of various 1 minute data expressed as cumulative rain in a specific time interval. The rain rate of 10 minutes is calculated of ten 1 minute amount values, which refer to a 10 minutes rating interval.
- Hourly cumulative rain amount: Cumulative rain amount in past hour as moving average. Usually recorded in the data logger at every full hour.
- Daily cumulative rain amount: Cumulative rain amount in past hour as moving average. Usually recorded in the data logger at midnight. This value is not available on SDI-12 interface and data output.  
**Note** that all cumulative values require a permanent power supply of the sensor. Any power outage during a day will result in incorrect daily rain data.  
The measuring parameter Rain is only valid at temperatures above 2 °C and for monitoring liquid precipitation and also hail.
- Wind speed measuring range up to 45 m/s.
- Housing consisting of corrosion-resitant polycarbonate material.



Model	Wind speed	Wind direction	Temperature	Humidity	Pressure	Rain	Solar radiation	Remark
WS200	✓	✓						
WS500	✓	✓	✓	✓	✓			
WS600	✓	✓	✓	✓	✓	✓		Piezo-electrical
WS601	✓	✓	✓	✓	✓	✓		Opto-electrical
WS650	✓	✓	✓	✓	✓		✓	

**Table 2 - WeatherSens WS-Series Overview**

AR200, WS200, MPS and MPR sensors are designed as single sensors or incorporated into the compact weather sensors. Typical applications for the sensors are 10 m automatic weather stations according to WMO guide line or compact weather stations for 2" poles.

### Environment certificates

The sensors have been tested and are approved for following environment applications and conditions:

- Ingress protection: IP66.
- Temperature from -40 to +70 °C.
- Humidity from 5 to 100 % RH.
- Wind resistibility from 0 to 60 m/s (AR/MP series) or 45 m/s (WS series).
- Vibration resistibility: ---
- Salt spray resistibility: ---
- Solar radiation resistibility from 0 to 2000 W/m<sup>2</sup> according to latest WMO guideline and measuring range.

All sensors are not equipped with heater and can be operated without heater function also down to -40 °C under conditions of non-cumulation of snow and non-icing accretion. The low power consumption in the typical range of 150 to 200 mW (max 600 mW with embedded photoelectric sensor for rain intensity) is ideal for the supply of solar power packages with typical 50 Watt solar panel size and 50 Ah battery size.

For an individual and precise determination and calculation of panel size and battery size it is required to include the power consumption of the sensor, the connected data logger and of communication devices. You can additionally use commercial solar power calculation tools free of charge, where you enter geo data like longitude and latitude to calculate the solar radiation electrical power.

**Note** that an intermittent power supply is not applicable due to the fast-changing parameters for wind and precipitation monitoring to require permanent power supply.

### Measurements:

Principal measurements provided by HS WeatherSens are:

- Wind speed and direction data by measuring interval of 4 Hz to process 3 second wind gust calculation and output according to WMO guide line by factory setting.
- Further mean value aggregation to be proceeded by connected datalogger, weather station or SCADA system such as gliding 2 or 10 minutes mean interval.
- 3 seconds Instantaneous data for all met parameters such as temperature, humidity, air-pressure, solar radiation.
- Rain intensity by 1 minute interval in mm/h resp inch/h.
- 1 minute amount of precipitation to be processed by datalogger, automatic weather station or SCADA system by 1 minute intensity rate referred to mm/min or inch/min (mm/h value divided by 60).
- All parameters in metric units according to factory settings or imperial units by command setting.

### Interfaces:

HS WeatherSens is equipped with the SDI-12 version 1.3 serial interface according to factory settings and with the RS-485 interface. For RS-485, various protocols can be used, e.g. MODBUS RTU or ASCII to be configured by commands. All interfaces are implemented but cannot be operated simultaneously. Only one interface can be configured and operated.

A firmware update can be proceeded at KISTERS authorized and certified Hubs and partners. Usually it is supposed that new firmware versions are developed under maintenance aspects to serve and comply to new and future requirements and features.

The UMB protocol included in the RS-485 interface is implemented in the current firmware release. If you are in need of a separate communication description, please contact your HS Hubs and partners.

## 2 Installation

See also HS WeatherSens MP/WS installation guide.

This chapter contains the following subsections:

- [Select the Location](#) <sup>12</sup>
- [Mounting Kit](#) <sup>12</sup>
- [Mounting Method](#) <sup>13</sup>
- [Alignment](#) <sup>13</sup>
- [Sensor Connector, Cable](#) <sup>15</sup>

### 2.1 Select the Location



**Warning:** To protect the people and the products, a lightning rod should be installed with the tip at least one meter above the sensor. The rod must be properly grounded, compliant with all applicable local safety regulations.



**Note:** Installations on top of high buildings or masts and in sites on opening grounds are vulnerable to lightning strikes. A nearby lightning strike may induce a high-voltage surge not tolerable by the internal surge suppressors of the instrument.

Additional protection is needed in regions with frequent, severe thunderstorms, especially when long line cables (> 30m) are used.

Finding a right place to install the sensors is important for getting representative ambient measurements. The environmental conditions of the chosen location may influence measurement results. The WMO Guide to Instruments and Methods of Observation (WMO No. 8) contains useful advice on the installation of sensors at suitable measuring sites.

It is important to taking into account the topography and surrounding area to achieve optimum performance. Trees, buildings, or other objects situated in the vicinity of weather sensors disturb free air flow and thus affect the accuracy of the measurement results.

### 2.2 Mounting Kit

Depending on the different installation location, a variety of mounting options are available. Users can select the appropriate mounting kit according to the location requirements. Mounting of sensor must be placed vertically and fixed firmly.

#### Mounting Kit Checklist

Mounting method	Applicable models
<a href="#">Tube1</a> <sup>14</sup> , Ø 40 - 50 mm	MPS100, MPR100/101, AR200, WS series
<a href="#">Tube2</a> <sup>14</sup> , Ø 50 - 60 mm	MP series

## 2.2.1 Tube1 Dimensions

MPS100, MPR100/101, AR200, WS series

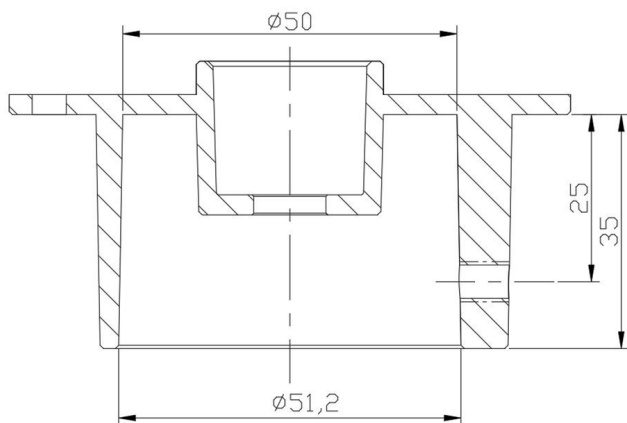
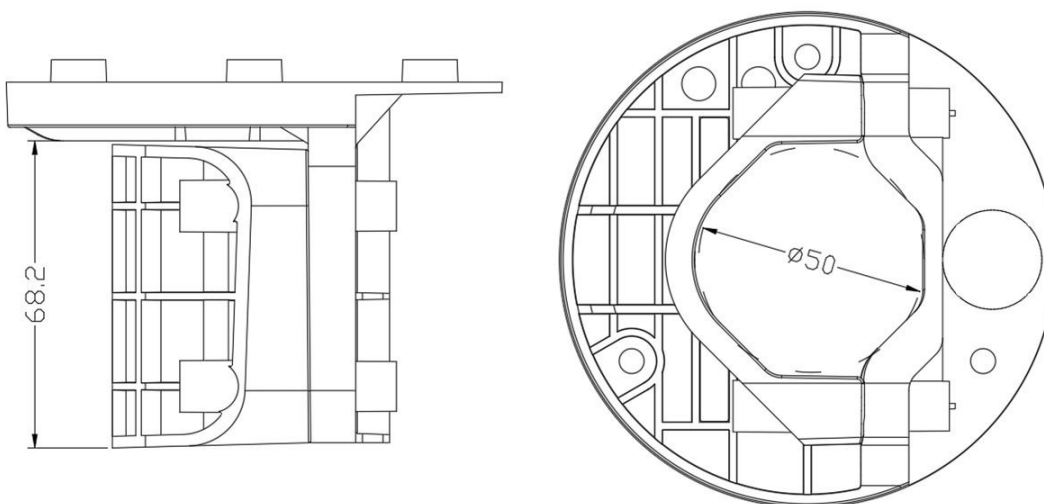


Figure 1 - Dimensional Drawing



## 2.2.2 Tube2 Dimensions

MP-Series



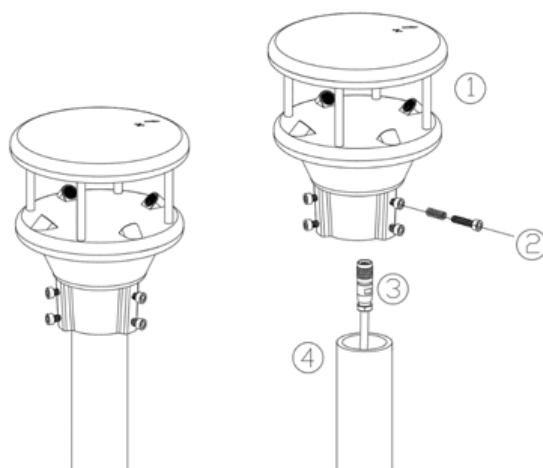
## 2.3 Mounting Method

This chapter contains the following subsections:

- [Tube1](#) 
- [Tube2](#) 

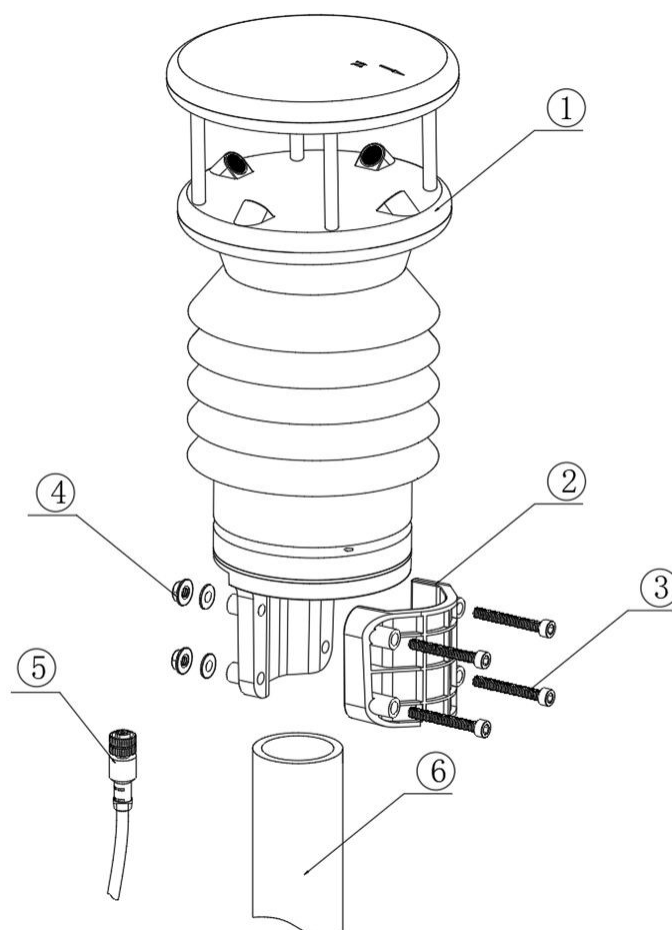
### 2.3.1 Tube1

1. Sensor
2. M6 screw and spring
3. Cable and plug
4. Fixing rod (OD 50 mm)




### 2.3.2 Tube2

1. Sensor
2. Bracket
3. Screws
4. Nuts
5. Cable and plug
6. Fixing rod (min OD 50 mm)



## 2.4 Alignment

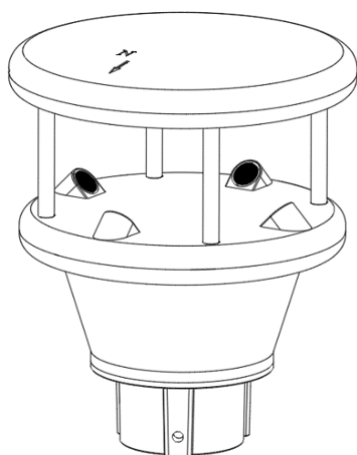
Alignment method changes depending on different models.

Model	Alignment
AR200 MP series, WS series	<a href="#">see Method I</a> 
MPS-100, MPR100, MPR101	No need, vertical installation is good

### 2.4.1 Alignment Method I

The measurement of wind direction is closely related to the mounting position of the weather sensor. Before fixing the instrument, the sensor should be aligned in such a way that the indicator arrow "N" points to the North/South direction of the earth's geographic meridians.

The North can be referred either to true North, which uses the earth's geographic meridians, or to the magnetic North, which is read with a magnetic compass. The magnetic declination is the difference in degrees between the true North and magnetic North. When aligning to the magnetic North, the declination (variation) must be taken into account.



**Figure 2 - Applicable on all models with parameter wind-speed and wind-direction**

Procedure:

1. If the sensor is already installed, loosen both nuts evenly until you can turn the sensor easily;
2. Using the compass, identify the North and fix a point of reference on the horizon;
3. Position the sensor in such a way that the South and North sensors are in alignment with the fixed point of reference in the North.

## 2.5 Sensor Connector, Cable

In this manual, one type of connector used is described. Other customized connectors are not included in the manual.

## 2.5.1 M12-8pol Pin Connector & Cable

### Definition

No.	Colour	RS-485	SDI-12
1	White	VCC	VCC
2	Brown	Power GND	Power GND
3	Green		SDI-12 GND
4	Yellow		SDI-12 Data
5	Grey	485A	
6	Pink	485B	
7	Blue		
8	Red		

#### Note:



- The sensor can be used with either SDI-12 or RS-485. The SDI-12 connectors allow 3 or 4 terminal connection.
- When using SDI-12, the RS-485 signals **MUST** remain disconnected.
- When using RS-485, the SDI-12 signal **MUST** remain disconnected.
- Power lines such as Power VCC + and Power GND must be connected. Otherwise, the sensor will not turn on.

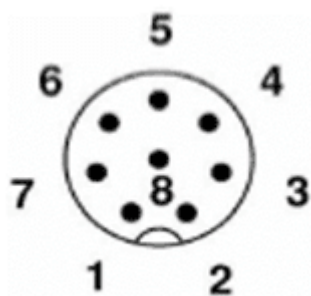


Figure 3 - 8-pin M12 connector from sensor side

#### Remarks:

1. The interface and protocol are switched through ASCII commands.



## 3 Operation

This chapter contains the following subsections:

- [Communication Protocol](#) <sup>17</sup>

### 3.1 Communication Protocol

Weather sensors supports the following communication protocols:

- SDI-12 (version 1.3) - factory settings
- ASCII-Protocol
- MODBUS - RTU
- NMEA Extended (version 0183)

The protocol will be preconfigured at the factory according to the requirements specified when ordering the sensors. Standard factory setting is SDI-12 for all published articles and part numbers.

For more information, see the following subsections:

- [SDI-12 V1.3](#) <sup>17</sup>
- [ASCII - Protocol](#) <sup>20</sup>
- [MODBUS-RTU Protocol](#) <sup>23</sup>
- [NMEA-0183 Protocol](#) <sup>25</sup>

#### 3.1.1 SDI-12 V1.3

Text-based communication with devices is possible using ASCII protocol.

For more information, see the following subsections:

- [Configuration Commands for Users](#) <sup>17</sup>
- [Command Details](#) <sup>18</sup>

##### 3.1.1.1 Configuration Commands for Users

No.	Function	Steps	Commands	Detail
1	Switch to SDI-12 protocol	1	\$AACFG 1<CR><LF>	AA: address, Default: 00, 1: Back to ASCII mode.
		2	\$AAQ 04<CR><LF>	Select SDI-12 protocol.
2	Switch to MODBUS-RTU Floating protocol	1	\$AACFG 1<CR><LF>	AA: address, Default: 00, 1: Back to ASCII mode.
		2	\$AAQ 02<CR><LF>	Select MODBUS-RTU Floating protocol.
3	Switch to Lufft UMB protocol	1	\$AACFG 2<CR><LF>	AA: address, Default: 00, 2: Back to Lufft setting mode.  ** Setting is invalid after power off and needs to be



Identification command Example	
MPR100	6 characters specifying the sensor model number
101	3 characters specifying the firmware version
T1910001	8-character serial number
<CR><LF>	Response terminator

Parameters			Start Measurement Command		Measurement Completed	Request Measurement Data	
No.	Parameters	Detail	Commands	Response	Response	Commands	Response
0	Composite Measurement		0M!	Otttn<cr><lf>	0<cr><lf>	OD0! OD1! (if required)	O+WS+WD+TE MP+H+P+RI+R R+RC+SR<cr>< lf>  (see Note 1 below)
1	Wind	Wind	0M1!	Otttn<cr><lf>	0<cr><lf>	OD0!	O+WS+WD<cr> ><lf>
2	PTU	Temperature, humidity, and pressure	0M2!	Otttn<cr><lf>	0<cr><lf>	OD0!	O+TEMP+H+P <cr><lf>
3	Rain	Precipitation	0M3!	Otttn<cr><lf>	0<cr><lf>	OD0!	O+RI+RR+RC<c r><lf>
4	Solar Radiation	Solar Radiation	0M4!	Otttn<cr><lf>	0<cr><lf>	OD0!	O+SR<cr><lf>
5	All Parameters	All Parameters	0C!	Otttnn<cr><lf>		OD0! OD1! (if required)	O+WS+WD+TE MP+H+P+RI+R R+RC+SR<cr>< lf>  (see Note 1 below)
6	Composite Measurement With CRC		0MC!	Otttn<cr><lf>	0<cr><lf>	OD0! OD1! (if required)	O+WS+WD+TE MP+H+P+RI+R R+RC+SR(CRC) <cr><lf>  (see Note 1 below)
7	Wind With CRC	Wind	0MC1!	Otttn<cr><lf>	0<cr><lf>	OD0!	O+WS+WD(CR C)<cr><lf>

Parameters			Start Measurement Command	Measurement Completed	Request Measurement Data		
No.	Parameters	Detail	Commands	Response	Response	Commands	Response
8	PTU With CRC	Temperature, humidity, and pressure	OMC2!	Otttn<cr><lf>	0<cr><lf>	OD0!	O+TEMP+H+P(CRC)<cr><lf>
9	Rain With CRC	Precipitation	OMC3!	Otttn<cr><lf>	0<cr><lf>	OD0!	O+RI+RR+RC(CRC)<cr><lf>
10	Solar Radiation With CRC	Solar Radiation	OMC4!	Otttn<cr><lf>	0<cr><lf>	OD0!	O+SR(CRC)<cr><lf>
11	All Parameters With CRC	All Parameters	OCC!	Otttn<cr><lf>		OD0! OD1! (if required)	O+WS+WD+TEMP+H+P+RI+RR+RC+SR(CRC)<cr><lf> (see Note 1 below)
12	Address Query Command	Address Query Command	?!	0<cr><lf>			
13	Change Address Command	Change Address Command	aAb!	b<cr><lf>	a Device address, b Address change to (Address Range 0 - 9)		
14	Active command	Active command	O!	0<cr><lf>			
15	Identification command	Identification command	O!	O13ccccccmmmmmvvxxx xxxxx<cr><lf>			

Note 1: The sensor only replies with parameters that are applicable to the corresponding model. e.g., AR200 → WS+WD only

### 3.1.2 ASCII - Protocol

Text-based communication with devices is possible using ASCII protocol.

ASCII protocol is network-compatible and serves exclusively for online data requests. The device will not respond to incomprehensible ASCII commands.

For more information, see the following subsections:

- [Factory Settings](#) 
- [Command Details](#) 

### 3.1.2.1 Factory Settings

The default values for weather sensors are:

- Interface: RS-485
- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None
- Device address: 0x01

### 3.1.2.2 Command Details

Command	Description	Response	Example
\$AANN<CR><LF>	Change the device address AA = the old address. NN = the new address. Default Address: 0x01.	!NN<CR><LF>	Send: \$0109<CR><LF> Response: ! 09<CR><LF> 01:Old address 09:New address
\$AAM<CR><LF>	Device ID reading AA = the device address.	!ID<CR><LF>	Send: \$01M<CR><LF> Response: ! AR200<CR><LF> Device ID:AR200
\$AAZBR<CR><LF>	Baud rate setting AA = the device address. Default baud rate = 9600.	! <CR><LF>	Send: \$01Z19200<CR><LF> Response: ! <CR><LF> Baud rate:19200
\$AAZ<CR><LF>	Baud rate reading AA = the device address.	! BR<CR><LF>	Send: \$01Z<CR><LF> Response: ! 19200<CR><LF> Baud rate:19200
#AAO<CR><LF>	Wind speed value reading AA = the device address.	>Value<CR><LF>	Send: #010<CR><LF> Response: >0.1<CR><LF>

Command	Description	Response	Example
			Unit: m/s
#AA1<CR><LF>	Wind direction value reading AA = the device address.	>Value<CR><LF>	Send: #011<CR><LF> Response: >20.3<CR><LF> Unit: degrees
#AA2<CR><LF>	Relative Humidity value reading AA = the device address.	>Value <CR><LF>	Send: #012<CR><LF> Response: >61.2 <CR><LF> Unit: %
#AA3<CR><LF>	Air Temperature value reading AA = the device address.	>Value<CR><LF>	Send: #013<CR><LF> Response: >27.6<CR><LF> Unit: °C
#AA4<CR><LF>	Barometric Pressure value reading AA = the device address.	>Value<CR><LF>	Send: #014<CR><LF> Response: >997.2<CR><LF> Unit: hPa
#AA<CR><LF>	Five parameters reading AA = the device address.	>Value1, Value2, Value3, Value4, Value5,<CR><LF> Value1:wind speed Value2:wind direction Value3: air humidity Value4: air temperature Value5: barometric pressure	Send: #01<CR><LF> Response: >0.1,20.3,60.5,27.6,997.2<CR><LF> Unit: m/s, degree,%,°C, hPa
#AAAC<CR><LF>	Seven parameters reading AA = the device address.	>Value1, Value2, Value3, Value4, Value5,Value6,Value7,Value8, Value9,Value10<CR><LF> Value1:wind speed Value2:wind direction Value3: air humidity Value4: air temperature	Send: #01AC<CR><LF> Response: >4.1,97.0, 78.5,29.4,994.3,0,0,0, 0,99<CR><LF> Unit:

Command	Description	Response	Example
		Value5: barometric pressure Value6:Minute rainfall Value7:Hour rainfall Value8:Day rainfall Value9:Total rainfall Value10:Solar radiation	m/s, degree, %,°C, hPa, mm, mm, mm, mm, W/m <sup>2</sup>

### 3.1.3 MODBUS-RTU Protocol

This chapter contains the following subsections:

- [Factory Settings](#) <sup>23</sup>
- [Transmission Format](#) <sup>23</sup>
- [Register Definition](#) <sup>24</sup>

#### 3.1.3.1 Factory Settings

The default values for sensors are:

- Interface: RS-485
- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None
- Check Mode: CRC-16

#### 3.1.3.2 Transmission Format

##### Read Data Message

Address: 0x01, Function Code: 0x03

Request Format:

Address	Function Code	Register Start Address	Register Numbers	CRC-16
1byte	1byte	2bytes	2bytes	2bytes

Return Format:

Address	Function Code	Length of Data	Data	CRC-16
1byte	1byte	1byte	Numbers of Data	2bytes

##### Write Data Message

Address: 0x01, Function Code: 0x06

Request Format:

Address	Function Code	Register Start Address	Register Numbers	CRC-16
1byte	1byte	2bytes	2bytes	2bytes

Return Format:

Address	Function Code	Register Address	Data	CRC-16
1byte	1byte	2bytes	2bytes	2bytes

### 3.1.3.3 Register Definition

Register Address	Detail	Format	Unit
40001 - 40002	Wind Speed Value	32-bit Floating Value	m/s
40003 - 40004	Wind Angle Value	32-bit Floating Value	Degree
40005 - 40006	Relative Humidity	32-bit Floating Value	%
40007 - 40008	Temperature	32-bit Floating Value	°C
40009 - 40010	Pressure	32-bit Floating Value	hPa
40011 - 40012	Minute Precipitation	32-bit Floating Value	mm
40013 - 40014	Hour Precipitation	32-bit Floating Value	mm
40015 - 40016	Day Precipitation	32-bit Floating Value	mm
40017 - 40018	Total Precipitation	32-bit Floating Value	mm
40019 - 40020	Radiation intensity	32-bit Floating Value	W/m <sup>2</sup>

When using a Modbus function code 3, 6, or 16, an address base of 40001 is assumed. The Register Address field is an offset from this base.

Examples:

If an address of 40001 needs to be accessed, then a Register Address of 0 is used (40001 - 40001 base = offset address of 0).

**Note:** Registers are read with the Most Significant Byte (MSB) first. 32-bit floating-point values are encoded per IEEE Standard 754. For floating-point format variables, each data point appears twice because two 16-bit addresses are required to hold a 32-bit float value. The 16-bit Most Significant Word (MSW) is in the lower address of the register pair, while the Least Significant Word (LSW) is in the upper address.

#### Tx + Rx Message Example:

WeatherSens AR200 Modbus address 1 - the Tx message requests 0004 x 16-bit registers to be returned, starting at register address 0000.

(44 09 at the end of the Tx message is the CRC-16 Cyclic Redundancy Check)



Wind Speed	0.98
Wind Direction	336.41

```
Tx: 01 03 00 00 00 04 44 09
Rx: 01 03 08 E1 48 3F 7A 34 7B 43 A8 00 35
```

The Rx message reply indicates that there are 08 data bytes to follow - (note that 0004 x 16-bit registers in the Tx request = 08 data bytes in the reply)

(00 35 at the end of the Rx message is the CRC-16 Cyclic Redundancy Check)

The data byte order in the Rx message is: "Little Endian Byte Swap"

Wind Speed = E1 48 3F 7A swap byte order to 3F 7A E1 48 then convert the hex value to IEEE754 Float = 0.98

Wind Angle = 34 7B 43 A8 swap byte order to 43 A8 34 7B then convert the hex value to IEEE754 Float = 336.41

### 3.1.4 NMEA-0183 Protocol

The default values for weather sensors are:

- Interface: RS-485 as 2-wire system
- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None
- Transmission interval: 1.0 seconds

For more information, see the following subsections:

- [\\$WIMWV](#)<sup>25</sup>
- [\\$WIXDR](#)<sup>26</sup>

#### 3.1.4.1 \$WIMWV

### Summary

The NMEA 0183 protocol provides the wind speed and wind direction, in relation to the vessel's bow/center line.

### Syntax

\$WIMWV,<1>,<2>,<3>,<4>,<5>\*hh<CR><LF>

### Fields

Field	Description
<1>	Wind direction, 0.0 to 359.9 degrees, in relation to the vessel's bow/center line. If the data for this field is not valid, the field will be blank.
<2>	Reference: R = Relative (apparent wind, as felt when standing on the moving ship). T = Theoretical (calculated actual wind, as though the vessel were stationary).
<3>	Wind speed, to the nearest tenth of a unit. If the data for this field is not valid, the field will be blank.
<4>	Wind speed units: K = km/hr

Field	Description
	M = m/s N = knots S = statute miles/hr Default: N (knots)
<5>	Status: A = data valid V = data invalid
<CR><LF>	Response terminator

### Default State

Enabled. Transmitted once per second.

### 3.1.4.2 \$WIXDR

#### Summary

The WIXDR protocol provides all weather parameters that are available for the models. Missing parameters, e.g. in the case of an MP500P-HN, are indicated by not assigning any values to them.

## 4 Repair

KISTERS precision instruments and data loggers are produced in quality-controlled processes. All KISTERS production and assembly sites in Australia, New Zealand and Europe are ISO 90001 certified. All equipment is factory tested and/or factory calibrated before it is shipped to the client. This ensures that KISTERS products perform to their fullest capacity when delivered.

Despite KISTERS most rigorous quality assurance (QA), malfunction may occur within or outside of the warranty period. In rare cases, a product may not be delivered in accordance with your order.

In such cases KISTERS' return and repair policy applies. For you as a customer, this means the following:

- Contact KISTERS using the Repair Request Form and the Declaration of Contamination made available online:

Region (Language)	Download Link
Asia-Pacific (English)	<a href="#">Repair Request Form (APAC)</a> <a href="#">Declaration of Contamination (APAC)</a>
Europe, the Middle East and Africa (English)	<a href="#">Repair Request Form (EMEA)</a> <a href="#">Declaration of Contamination (EMEA)</a>
Germany (German)	<a href="#">Repair Request Form (DE)</a> <a href="#">Declaration of Contamination (DE)</a>

In response you will receive a reference number that must be referenced on all further correspondence and on the freight documents accompanying your return shipment.

- Please provide as much information and/or clear instructions within the return paperwork. This will assist our test engineers with their diagnosis.
- Please do not ship the goods prior to obtaining the reference number. KISTERS will not reject any equipment that arrives without reference number; however, it may take us longer to process.

Custom requirements for items sent to KISTERS for warranty or non-warranty repairs: Check with your national customs/tax authorities for details, processes and paperwork regarding tax exempt return of products. Typically, special custom tariff codes are available (such as HS Code = 9802.00) that verify the item is being returned for repair and has no commercial value. Please note that the customs invoice / dispatch documents should also clearly state: "Goods being returned to manufacturer for repair - No Commercial value". It is mandatory to have any returned goods accompanied by a commercial invoice on headed paper. KISTERS reserves the right to charge the customer for time spent rectifying incorrect customs documents.

**Note:** Please ensure that your goods are packed carefully and securely. Damage that occurs during transit is not covered by our warranty and may be chargeable.

## 5 Technical Data

This chapter contains the following subsections:

- [Anemometers](#) <sup>28</sup>
- [WeatherSens MP Series](#) <sup>29</sup>
- [WeatherSens WS Series](#) <sup>30</sup>
- [Others](#) <sup>31</sup>

### 5.1 Anemometers

Parameters	AR200
Wind speed measuring range	0 to 60 m/s
Accuracy	±0.3 m/s or ±3 %
Wind direction measuring range	0 to 360°
Accuracy	±3°
IP Class	IP 66
Dimensions	Height 195 mm Diameter 160 mm
Weight	1.1 kg
Digital Signal	SDI-12 (Factory setting) RS-485,9600,8,N,1
Supply Voltage	10 ... 30 VDC
Power Consumption	20 mA at 12 VDC
Overall Heating	None
Operating temperature	-40 ... +70 °C
Operating humidity	5 % ... 100 % RH
Connector	M12-8pol
Connection cable (Accessories)	10 m

## 5.2 WeatherSens MP Series

Parameters inside MP500; MP600/601; MP650; MP700 (see table <a href="#">WeatherSens MP-Series Overview</a> )			
Parameters	Measuring ranges	Accuracies	Resolution
Wind speed	0 to 60/75 m/s	± 0.3 m/s or ± 3 %	0.1
Wind direction	0 to 360°	± 3°	0.1
Temperature	-40 to +80 °C	± 0.3 °C; ± 0.2 °C at (0 to +40 °C)	0.1
Humidity	0 to 100 % RH	± 3 % RH	0.1
Air-Pressure	500 to 11000 hPa	± 0.3 hPa	0.1
Solar radiation MPS100	200 to 2100 nm - 0 to 2000 W/m <sup>2</sup>	± 3 %	0.1
Rain MPR100 - Piezo-electrical	0 to 200 mm/h	± 0.2 mm or ± 10 % <b>Note:</b> Rain (liquid) and hail stones at (0 to +80 °C)	0.1
Rain MPR101 - Optic-electrical	0 to 400 mm/h	± 0.2 mm or ± 10 % <b>Note:</b> Rain (liquid) and hail stones at (0 to +80 °C)	0.1

Parameters	MP500	MP600/601	MP650	MP700
IP Class	IP66	IP66	IP66	IP66
Dimensions	Height 308 mm Width 160 mm	Height 318 / 350 mm Width 160 mm	Height 333 mm Width 160 mm	Height 360 mm Width 160 mm
Weight	1.4 kg	1.4 / 1.5 kg	1.4 kg	1.6 kg
Digital Interface	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1
Supply Voltage	10 ... 30 VDC	10 ... 30 VDC	10 ... 30 VDC	10 ... 30 VDC
Power Consumption	23 mA at 12 VDC	26 / 57 mA at 12 VDC	27 mA at 12 VDC	63 mA at 12 VDC
Operating temperature <b>Note:</b> Non-heated - without snow cumulation and/or ice accretion.	-40 ... +70 °C	-40 ... +70 °C	-40 ... +70 °C	-40 ... +70 °C

Parameters	MP500	MP600/601	MP650	MP700
Operating humidity	5 % ... 100 % RH	5 % ... 100 % RH	5 % ... 100 % RH	5 % ... 100 % RH
Connector	M12-8pol	M12-8pol	M12-8pol	M12-8pol
Connection (Accessories) cable	10 m	10 m	10 m	10 m

### 5.3 WeatherSens WS Series

Parameters inside WS500; WS600/601; WS650; WS200 (see table <a href="#">WeatherSens WS-Series Overview</a> <sup>(10)</sup> )			
Parameters	Measuring ranges	Accuracies	Resolution
Wind speed	0 to 45 m/s	± 0.3 m/s or ± 3 %	0.1
Wind direction	0 to 360°	± 3°	0.1
Temperature	-40 to +80 °C	± 0.3 °C; ± 0.2 °C at (0 to +40 °C)	0.1
Humidity	0 to 100 % RH	± 3 % RH	0.1
Air-Pressure	500 to 11000 hPa	± 0.3 hPa	0.1
Solar radiation MPS100	200 to 2100 nm - 0 to 2000 W/m <sup>2</sup>	± 3 %	0.1
Rain MPR100 - Piezo-electrical	0 to 200 mm/h	± 0.1 mm or ± 5 % <b>Note:</b> Rain (liquid) and hail stones at (0 to +80 °C)	0.1
Rain MPR101 - Optic-electrical	0 to 400 mm/h	± 0.1 mm or ± 5 % <b>Note:</b> Rain (liquid) and hail stones at (0 to +80 °C)	0.1

Parameters	WS500	WS600/601	WS650	WS200
IP Class	IP66	IP66	IP66	IP66
Dimensions	Height 208 mm Width 126 mm	Height 218 / 266 mm Width 126 mm	Height 233 mm Width 126 mm	Height 152 mm Width 126 mm
Weight	0.6 kg	0.7 / 0.8 kg	0.7 kg	0.5 kg
Digital Interface	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1
Supply Voltage	10 ... 30 VDC	10 ... 30 VDC	10 ... 30 VDC	10 ... 30 VDC
Power Consumption	23 mA at 12 VDC	26 / 57 mA at 12 VDC	27 mA at 12 VDC	20 mA at 12 VDC
Operating temperature <b>Note:</b> Non-heated - without snow cumulation and/or ice accretion.	-40 ... +70 °C	-40 ... +70 °C	-40 ... +70 °C	-40 ... +70 °C
Operating humidity	5 % ... 100 % RH	5 % ... 100 % RH	5 % ... 100 % RH	5 % ... 100 % RH
Connector	M12-8pol	M12-8pol	M12-8pol	M12-8pol
Connection cable (Accessories)	10 m	10 m	10 m	10 m

## 5.4 Others

Parameters	Measuring ranges	Accuracies	Resolution
Solar radiation MPS100	200 to 2100 nm - 0 to 2000 W/m <sup>2</sup>	± 3 %	0.1
Rain MPR100 - Piezo-electrical	0 to 200 mm/h	± 0.2 mm or ± 10 % <b>Note:</b> Rain (liquid) and hail stones at (0 to +70 °C)	0.1
Rain MPR101 - Optic-electrical	0 to 400 mm/h	± 0.2 mm or ± 10 % <b>Note:</b> Rain (liquid) and hail stones at (0 to +70 °C)	0.1

Parameters	MPR100	MPR101	MPS100
IP Class	IP66	IP66	IP66
Dimensions	Height 120 mm Width 160 mm	Height 160 mm Width 160 mm	Height 140 mm Width 160 mm
Weight	1.2 kg	1.3 kg	1.0 kg
Digital Interface	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1	SDI12 V 1.3 (Factory setting) or RS-485,9600,8,N,1
Supply Voltage	10 ... 30 VDC	10 ... 30 VDC	10 ... 30 VDC
Power Consumption	15 mA at 12 VDC	12 mA at 12 VDC	17 mA at 12 VDC
Operating temperature <b>Note:</b> Non-heated - without snow cumulation and/or ice accretion.	-40 ... +70 °C	-40 ... +70 °C	-40 ... +70 °C
Operating humidity	5 % ... 100 % RH	5 % ... 100 % RH	5 % ... 100 % RH
Connector	M12-8pol	M12-8pol	M12-8pol
Connection (Accessories)      cable	10 m	10 m	10 m



## 6 Obligations of the Operator and Disposal

This chapter contains the following subsections:

- [Obligations of the Operator](#) <sup>331</sup>
- [Dismantling / Disposal](#) <sup>331</sup>

### 6.1 Obligations of the Operator

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#### *European Union*

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In the Single European Market it is the responsibility of the operator to ensure that the following legal regulations are observed and complied with: national implementation of the framework directive (89/391/EEC) and the associated individual directives, in particular 2009/104/EC, on minimum safety and health requirements for the use of work equipment by employees at work.

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#### *Worldwide*

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Regulations: If and where required, operating licences must be obtained by the operator. In addition, national or regional environmental protection requirements must be complied with, regardless of local legal provisions regarding the following topics:

- Occupational safety
- Product disposal

Connections: Local regulations for electrical installation and connections must be observed.

### 6.2 Dismantling / Disposal

When disposing of the units and their accessories, the applicable local regulations regarding environment, disposal and occupational safety must be observed.

#### **Before dismantling**

- Electrical Devices:
  - Switch off the units.
  - Disconnect electrical appliances from the power supply, regardless of whether the appliances are connected to the mains or to another power source.
- Mechanical devices:
  - Fix all loose components. Prevent the device from moving independently or unintentionally.
  - Loosen mechanical fastenings: Please note that appliances can be heavy and that loosening the fastenings may cause them to become mechanically unstable.

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#### *Disposal*

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Operators of old appliances must recycle them separately from unsorted municipal waste. This applies in particular to electrical waste and old electronic equipment.

Electrical waste and electronic equipment must not be disposed of as household waste!

Instead, these old appliances must be collected separately and disposed of via the local collection and return systems.

Integrated or provided batteries and accumulators must be separated from the appliances and disposed of at the designated

collection point. At the end of its service life, the lithium-ion battery must be disposed of according to legal provisions.

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*EU WEEE Directive*

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As players in the environmental market, KISTERS AG is committed to supporting efforts to avoid and recycle waste. Please consider:

- Avoidance before recycling!
- Recycling before disposal!



This symbol  indicates that the scrapping of the unit must be carried out in accordance with Directive 2012/19/EU. Please observe the local implementation of the directive and any accompanying or supplementary laws and regulations.

# Contact Data

<b>Europe</b>	KISTERS Europe	 +49 2408 9385 0
		 <a href="mailto:hydromet.sales@kisters.eu">hydromet.sales@kisters.eu</a>
		 <a href="http://www.kisters.eu">www.kisters.eu</a>
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		 <a href="mailto:sales@kisters.com.au">sales@kisters.com.au</a>
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		 <a href="http://www.kisters.es">www.kisters.es</a>

