HydroMet



User Manual

HyQuant Edge

KISTERS
Empowering decisions of tomorrow

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I Disclaimer

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

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II Glossary + Abbreviations

Term	Description
dB	Short for decibel; The decibel is a relative unit of measurement that equals one-tenth of a bel (B). It measures the intensity of an electrical signal by comparing it with a specific level on a logarithmic scale.
Doppler	Short for Doppler Radar; a radar that is specifically designed to use the Doppler effect to generate information on the velocity of objects that are located at a distance. This is achieved by reflecting a microwave signal off an intended target and analysing how the motion of the object has affected the frequency of the returned signal.
FMCW	Short for Frequency-Modulated Continuous Wave; an FMCW radar has the ability to alter its operating frequency while measuring. This means that the transmission signal is modulated in either frequency or phase. Changes in frequency or phase are technically necessary to perform radar measurements through runtime measurements.
GHz	Short for gigahertz, a frequency unit equal to a billion hertz or cycles per second.
Gyroscope	A tool employed to measure or uphold orientation.
HDPE	Short for high-density polyethylene, a thermoplastic polymer.
IP	Short for Ingress Protection; IP ratings indicate the degree of protection provided by an enclosure against solids and liquids.
L	Short for Level or Water Level.

Term	Description
Output rate	The output rate pertains to how frequently the output data is refreshed. It remains constant and is independent of filter settings, since the data is updated discretely during each output cycle. The unit for the sample rate is Hertz (Hz). It is equivalent to the reciprocal second, as 1 Hz = 1 [s^{-1}].
Q	International short notation of the hydrological discharge determined for a stream cross-section.
Radar	Short for **R**adio **D**etection **a**nd **R**anging; a system or device that employs short radio waves to determine the position or velocity of objects by measuring the direction, frequency and timing of reflected signals.
Radome	A blend word made from radar and dome – the radome is the shelter that protects the radar antennas.
Sample rate	HyQuant Edge utilizes radar technology to convert analogue water level changes into a digital data stream. By sampling water height amplitude at specific time intervals, HyQuant Edge produces discrete data. The sampling rate is the frequency of sample collection per second, measured in samples per second (sps). The unit for the sample rate is Hertz (Hz). It is equivalent to the reciprocal second, as 1 Hz = 1 [s^{-1}].
SLA	Short for Sealed Lead-Acid; A sealed lead-acid battery, also known as a gel cell, is a type of lead-acid battery where the electrolyte, which is sulphuric acid, is thickened so that it does not spill out.
SNR	Short for Signal-to-Noise Ratio; Signal-to-Noise Ratio (SNR) is a measure of the relative strength of the desired signal to the noise signal at a specific point in time. A higher number indicates better performance. It is typically expressed in decibels (dB).
V	Short for Velocity or Surface Water Velocity.
Wi-Fi	Certification mark of the interoperability of wireless computer networking devices using wireless network protocols based on the IEEE 802.11 family.

III Symbols

Symbol	Name	Meaning / Description
	Warning / caution area	General caution symbol; often used near specific hazards or sensitive areas.
	Warning – consult the instruction manual before use.	Read Installation and User Manual before use: important safety or operating instructions must be read and under-stood to avoid damage or injury.
	Protective earth (ground)	Connection to protective earth for safety (shock protection).
Ø	Cable cross section area	The cable cross-sectional area is the surface area of the conductor in a cable, measured in square millimetres (mm^2) or in American Wire Gauge (AWG).
	CE marking	Product conforms to EU safety, health, and environmental requirements.
FCC	FCC compliance mark	Device complies with U.S. Federal Communications Commission regulations (EMC).
	Waste of Electrical and Electronic Equipment (WEEE) symbol	Do not dispose of with household waste; follow electronic recycling regulations.
S/N	Serial number	Identifies the specific unit for traceability and support.
	ESD Susceptibility Symbol	Symbol for electrostatic discharge sensitive devices
	Risk of explosion	Risk of explosion due to sparking and electrostatic charging - not intrinsically safe.
	Risk of drowning	
	Risk of falling	

IV Scope of Delivery

- 1 × HyQuant Edge Sensor Unit
- 1 × Two-part mounting bracket (tilt and swivel)
- 1 × 10 m cable with 8-pin female angled connector and open-ended wires
- 1 × Torx key (T10)
- 1 × Magnet
- 1 × Test certificate
- 1 × Quick installation guide

V Optional Accessories

- HyQuant Edge Installation & User Manual (free download from the KISTERS Product Catalogue)
- Configuration software HyComm (free download from the KISTERS Product Catalogue)
- Tube/Pole mount bracket (price on request)
- 20 m connection cable with 8-pin angled plug connector (socket) and open wire ends (price on request)
- 30 m connection cable with 8-pin angled plug connector (socket) and open wire ends (price on request)
- 40 m connection cable with 8-pin angled plug connector (socket) and open wire ends (price on request)

VI Safety Instructions

-  Read the user manual including all operating instructions prior to installing, connecting and powering up the KISTERS HyQuant Edge. 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 HyQuant Edge 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 HyQuant Edge, 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 identified that could compromise operational safety, work must be stopped immediately. This applies to defects detected both before work begins and during operation.
- Do not use the KISTERS HyQuant Edge 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 HyQuant Edge 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 HyQuant Edge out of service, it must be disposed of in compliance with local waste and environmental regulations. The KISTERS HyQuant Edge is never to be disposed of 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.

The warnings used in this user manual classify the type and severity of a given hazard. The resulting hazard levels are marked in the user manual with the signal words CAUTION and WARNING in combination with a colour coding in yellow and orange:



CAUTION

- Warning of a hazardous situation with a **low** level of risk.
- The warning indicates the type and source of the hazard. If you do not follow the handling instructions listed here, the hazardous situation can lead to minor to moderate injuries.
- Specific instructions for avoiding the hazardous situation.



WARNING

- Warning of a hazardous situation with a **medium** level of risk.
- The warning indicates the type and source of the hazard. If you do not follow the instructions given here, the hazardous situation could result in death or serious injury.
- Specific instructions for avoiding the hazardous situation.

VII Specific Safety Instructions

Intended use

HyQuant Edge is a hydrographic sensor that uses radar technology for contactless measurement of either water stage or water surface velocity or both. Do not use the sensor for other applications. At all times respect the specifications for use, deployment, maintenance, repair and disposal described in the present manual. HyQuant Edge must not be used in areas where there is a risk of explosion!



WARNING

- Risk of explosion due to sparking and electrostatic charging - not intrinsically safe.
- Operation of the HyQuant Edge in such an atmosphere may result in ignition of the atmosphere, which could cause serious damage to property and injury to personnel.
- HyQuant Edge must not be operated in a potentially explosive atmosphere. Furthermore, the HyQuant Edge does not have ATEX approval (explosion protection).

- Whether you are installing or deploying the sensor, please note and follow the detailed safety information provided for each work step.
- Working on electrical systems requires special knowledge and training. For this reason, the electrical installation of the HyQuant Edge may only be carried out by a suitably trained specialist.
- Electrical, technical and climatic specifications must be respected at all times.
- Modifications or retrofitting to the HyQuant Edge will void the warranty and the RF approval required for safe operation of the device.
- Comply with electrical safety standards.
- Comply with Health, Safety & Environment regulations and directives.



WARNING

Risk of drowning.

- Be particularly careful when working over or near to water.
- Wear a life jacket/buoyancy aid:
  - Ensure that workers at risk of falling into the water are provided with and wear a life jacket or buoyancy aid.
  - The life jacket should be thoroughly checked by the user prior to use.
- Never work alone: Always be accompanied when working near or over water.

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!

HyQuant Edge is a hydrographic sensor that uses radar technology for contactless measurement of water stage (model HyQuant Edge L) and water surface velocity (model HyQuant Edge V) or both (model HyQuant Edge L+V, which can be expanded to HyQuant Edge Q for discharge measurement). Radar sensors are characterised by long-term stability and low maintenance. HyQuant Edge has been designed to ensure stable system behaviour and stable signals in all weather conditions and for all types of natural or polluted water.

For more information, see the following subsections:

- KISTERS HyQuant Edge Sensors 12

1.1 KISTERS HyQuant Edge Sensors

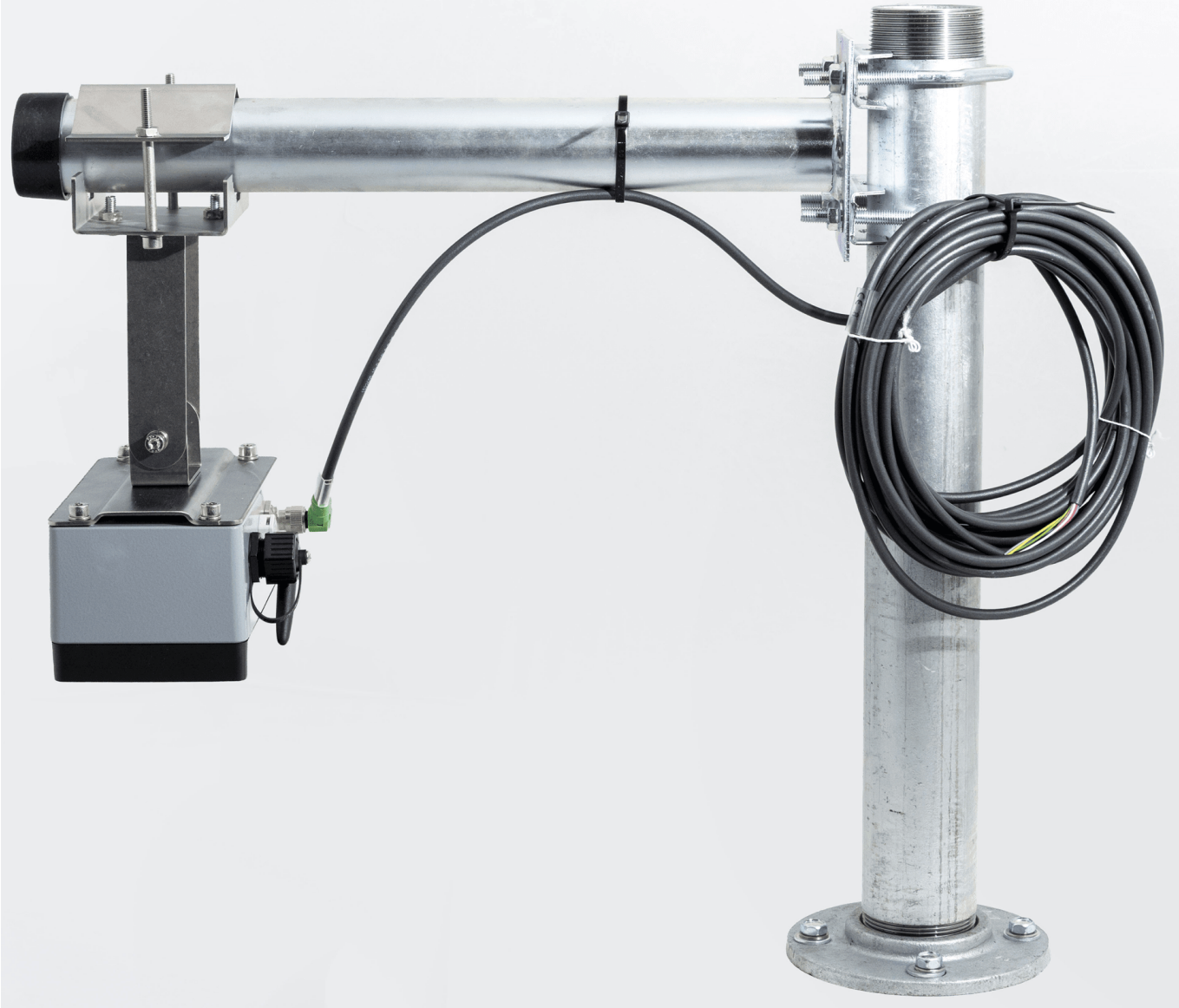


Figure 1 – HyQuant Edge Sensor with standard mounting bracket and sensor cable (pole mount assembly not included)

HyQuant Edge models are equipped with:

- A 61 GHz radar module
- HyQuant Edge L: One antenna pair for level measurement
- HyQuant Edge V: One antenna pair for surface velocity measurement
- HyQuant Edge L+V and Q: Two antenna pairs, one for level and one for velocity measurement
- Wi-Fi interface for local configuration
- Integrated worldwide LTE-M/NB-IoT modem
- Integrated memory and data logger functionality
- Aluminium die-cast housing with HDPE lid/radome
- M12 8-pin male sensor/actuator connector
- A gyroscope to determine the angular position during installation

For more information, see the following subsections:

- Types of HyQuant Edge Sensors 13
- Why RADAR technology? 14
- HyQuant Edge Components 15

1.1.1 Types of HyQuant Edge Sensors

HyQuant Edge L – Level or Stage Sensor

The distance between the antenna edge of the sensor and the surface of the medium is the measured variable for this system, with the antenna edge acting as the measurement reference plane. When properly configured, the sensor will output the absolute water level calculated with respect to a user defined reference datum.

HyQuant Edge L is available in two measuring ranges:

- HyQuant Edge L20: up to 20 m
- HyQuant Edge L50: up to 50 m

Radar levels are used for non-contact level measurement in surface water. A distance measurement is made based on the time it takes for electromagnetic waves (microwaves) to travel from the sensor to the water surface and back. As the radar sensor measures the distance between the sensor and the water level, different modes are available for referencing the water level, e.g. to a staff gauge.

HyQuant Edge V – Surface Velocity Sensor

The measured variable is the flow velocity of the water at the surface of the stream/river/brook.

HyQuant Edge V is available for installation heights of up to 20 m above the lowest expected water level.

The sensor is based on the Doppler frequency shift principle for surface velocity measurement. The sensor emits a microwave radar signal at a specific frequency. This signal is reflected when it hits the water surface. The reflected electromagnetic wave oscillates at a shifted frequency. The observed frequency shift is proportional to the surface flow velocity. The sensor samples at high speed and evaluates all the reflected signals collected to determine the surface flow velocity.

HyQuant Edge L+V – Combined Water Level/Stage and Surface velocity Sensor

HyQuant Edge L+V is available for installation heights up to 20 m at the lowest expected water level. This model combines the features of the **L** and **V** models in a single unit of the same size.

HyQuant Edge Q – Radar sensor for discharge monitoring

HyQuant Edge Q is available for installation heights up to 20 m at the lowest expected water level. HyQuant Edge Q is an **L+V** with additional, fully integrated discharge calculation capabilities.

1.1.2 Why RADAR technology?

HyQuant Edge uses RADAR technology because it provides stable, reliable and highly accurate non-contact quantification of water levels in a variety of ecological and natural contexts. The scanning frequency allows adequate detection of dynamic features, including ripples on the water surface.

Radar water level measurement offers a major advantage over other measurement systems because radar technology is largely independent of the properties of the medium being measured, such as:

- Temperature
- Viscosity
- Density
- Conductivity

Radar sensors are also unaffected by daylight, fog and light rain.

Heavy rainfall is known to affect radar measurements because it is difficult to distinguish reflections from thick droplets from those from the water surface. In addition, kinetic energy causes concentric waves to form on the water surface, further complicating the measurement process. To mitigate these effects, HyQuant Edge V, L+ V and Q are equipped with tailor-made filters.

HyQuant Edge is a microwave-based sensor. Radar beams follow the wave theory. The beam angle indicates the width of the beam opening from the antenna. The beam angle increases with distance. Ensure that HyQuant Edge radar sensors have an unobstructed vertical view of the water surface: There should be no obstructions in the beam path from the antenna to the water surface. See section Radar Beams 35 for more information on measuring the beam spread.

The sensor is supplied with a mounting bracket and has a low profile. HyQuant Edge sensors are easy to install and require minimal maintenance.

1.1.3 HyQuant Edge Components

The basic components of the actual HyQuant Edge unit are illustrated in this chapter. Figure 2 15 shows the exact position of each component.



Figure 2 – HyQuant Edge front and rear view

HyQuant Edge is a compact, self-contained device that autonomously collects data on site and transmits it to remote receivers via LTE Cat-M1 wireless or wired Ethernet communication.

No.	Description
①	Lid with integrated radome
②	M12 8-pin connector for signal cable (supplied)
③	Pressure compensating gland
④	LTE-M stubby antenna
⑤	SIM card holder
⑥	Die-cast aluminium housing
⑦	Rear mounting plate

Table 1 – List of HyQuant Edge Components

2 Installation

HyQuant Edge is always supplied with a mounting bracket and a power cable with one end terminated with an M12 8-pin female connector (HyQuant Edge side) and one end with open wires. **Note** that optional items such as longer cables and a pole mount bracket are available and can be ordered separately.

Note: Before installation, please check that all components are included according to Scope of Delivery and that they have not been damaged during transport.

HyQuant Edge Dimensions

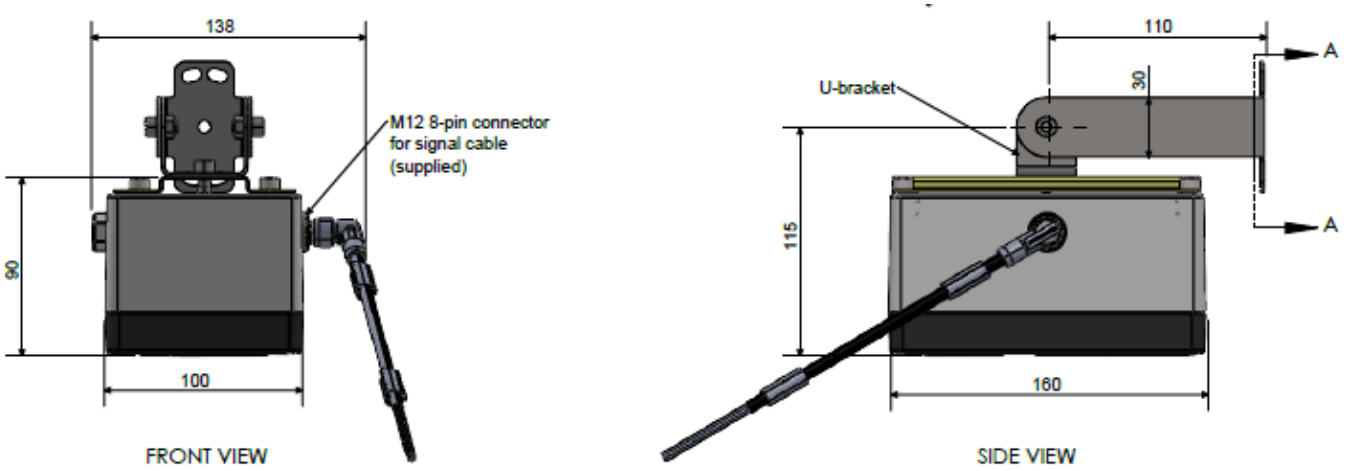


Figure 3 – Device dimensions for HyQuant Edge - all metrics in mm

For more information, see the following subsections:

- Site Selection Criteria for L and V 16
- Orientation of the HyQuant Edge 17
- Standard Installation Bracket 19
- Optional Bracket for Round Tubes 20
- Power Supply 20
- Cable and Connector Pinout 20

2.1 Site Selection Criteria for L and V

To ensure accurate measurements, careful consideration must be given to selecting suitable installation locations for water level (L) and/or flow velocity (V) sensors. HyQuant Edge sensors are designed for use in hydrological applications. HyQuant Edge sensors can be deployed in waterways, rivers, streams, brooks, lakes, reservoirs and similar bodies of water.



WARNING

- Risk of explosion due to sparking and electrostatic charging - not intrinsically safe.
- Operation of the HyQuant Edge in such an atmosphere may result in ignition of the atmosphere, which could cause serious damage to property and injury to personnel.
- HyQuant Edge must not be operated in a potentially explosive atmosphere. Furthermore, the HyQuant Edge does not have ATEX approval (explosion protection).

- Alignment: Ensure accurate alignment of the sensor in the Y and Z directions (< ±2° deviation) using the built-in tilt sensor.
- Suitable locations: Consider potential installation locations such as bridge structures, pontoons, or auxiliary constructions directly above the section of the waterway to be measured.
- Exception for steel bridges: It is advisable to avoid mounting sensors on steel bridges in the middle between two supporting poles/structures. Solar radiation can cause steel bridges to heat up, expand and sag, affecting the measured distance and therefore the hydrological water level. Steel can also be more reflective than other construction materials, so care must be taken.

- Stability and vibration: Choose a stable, vibration-free location to avoid interference from traffic or wind.
- Avoid bridge piers: Avoid flow velocity effects, backwater zones and turbulence by avoiding installation directly on or near bridge piers.
- Height placement: Mount sensors above typical high water marks to prevent antenna immersion and ensure accurate readings. Maintain a minimum distance of 0.15 metres (5.9 inches) between the sensor and the water surface.
- Water surface conditions:
  - For L measurements: Optimum water surface characteristics include a smooth surface within the circular measurement area.
  - For V measurements: Ensure a minimum water surface roughness of 2 mm around the sensor radar footprint.
  - For all parameters: Avoid areas with turbulent water surfaces, foam accumulation, obstructions causing changes in water level or flow velocity, ice or snow-covered surfaces, and protruding obstructions.
- Wind Influence on V measurements: Minimise wind effects on the water surface (such as inverse flows or side-flows resulting from cross-winds) to maintain measurement accuracy.
- Clearance: Ensure that the radar footprint of the sensor is clear of obstructions, with no inflows, outlets, weirs or other obstacles in front of the measurement point. Optimum minimum clearance: 10 times the width of the waterway.
- Bottom stability: Choose stable channel bottoms and cross sections free of large rocks and vegetation to avoid measurement inaccuracies.
- Avoid areas with variable bed load: Contactless measurement technologies require a stable riverbed, especially for determining flow velocities. In areas with variable bed load, heavy rainfall can alter the riverbed, potentially changing the direction of the flow and causing unpredictable variations in velocity. In extreme cases, the flow may shift entirely outside the sensor's measurement field, resulting in inaccurate or invalid readings.

By carefully following these criteria, suitable installation locations can be identified to ensure accurate and reliable water level and flow velocity measurements.

2.2 Orientation of the HyQuant Edge

The enclosure is made of a grey aluminium die-cast housing with a black HDPE lid. The radome is located on the smooth raised surface of the lid. HDPE has a dielectric constant that makes it virtually transparent for electromagnetic microwaves. The lid with the integrated radome protects the radar antennas from weather and mechanical shock. The KISTERS 'K' 18 is located just below the radome.

For HyQuant Edge V, L+V and Q:

Sensor Alignment and Flow Direction Interpretation

The flow sensor provides a positive flow velocity reading when the 'K' marking on the sensor lid is facing upstream (water flows from 'K' marking to the radome area of the lid). This is the manufacturer's recommended installation.

If the sensor is installed with the 'K' marking on the sensor lid facing downstream, the system will interpret this as a negative flow velocity.

This means:

- **Positive value** when 'K' marking on sensor lid faces upstream.
- **Negative value** when 'K' marking on sensor lid faces downstream.

Return Flows or Flow Reversals

If the sensor is installed correctly (with the 'K' marking on sensor lid faces upstream) and the flow direction reverses (due to return flows or unstable conditions, such as moving bed load), the system will display a negative flow velocity, indicating the change in direction.

Note: If the rain filter is activated, this interpretation of the flow direction no longer applies, as the rain filter modifies how the flow data is evaluated.

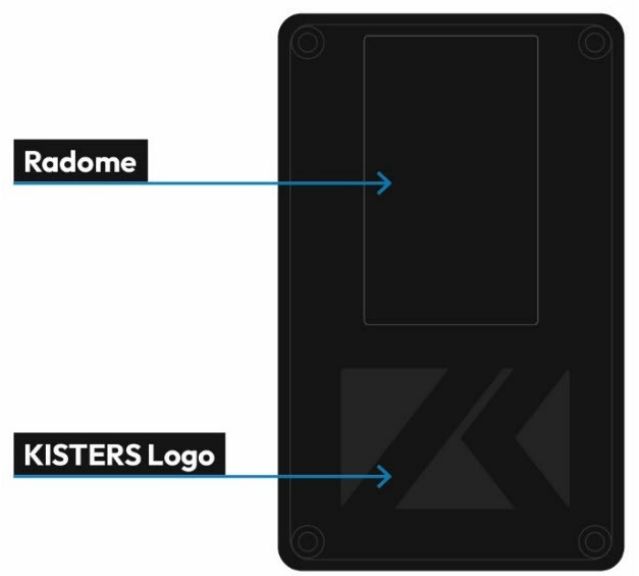


Figure 4 – Position of both the radome and the KISTERS 'K' on the lid

HyQuant Edge assumes that it is positioned parallel to the water surface. During installation, the gyro data helps the installer find the best position relative to the water surface. HyComm, the KISTERS sensor configuration software, displays the mounting angle on a mobile device connected to the sensor via Wi-Fi.

HyQuant Edge sensors must be installed parallel to the water surface (acceptable tolerance: ±2°) to ensure:

- proper orientation of the level beam, which points straight downwards at 0°,
- proper orientation of the velocity beam, which points sideways at a 45° inclination.

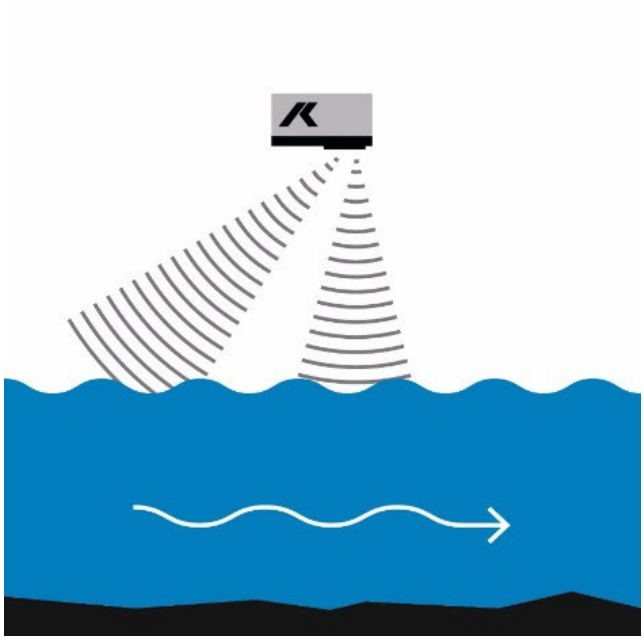


Figure 5 – Orientation of the HyQuant Edge sensor relative to the flow direction (arrow)

2.3 Standard Installation Bracket

WARNING

Risk of pinching.

- Fingers are exposed to pinch points when installing a HyQuant Edge device with bolts.
- Take precautions and wear protective gloves.

The mounting bracket is included in the foam insert base of the standard shipping box. It consists of two parts:

- a small U-shaped bracket for mounting against the base plate of the HyQuant Edge sensor, and
- a long U-shaped arm with mounting lugs.



Figure 6 – Rear side view of HyQuant Edge with mounting bracket installed

The mounting lugs and corresponding holes are designed to accept M6 screws. The standard mounting bracket is compatible with any support that provides a flat surface, including:

- Rectangular metal tubes with a minimum width of 30 mm.
- Concrete surfaces: walls, bridge support structure, …

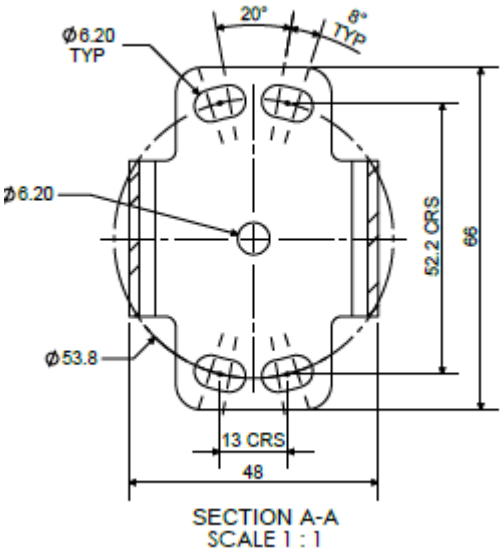


Figure 6 – Foot of the mounting bracket: Dimensions and mounting hole positioning

2.4 Optional Bracket for Round Tubes

The sensor's optional cylindrical pole mount is available as a peripheral and must be purchased separately. It facilitates installation and alignment of the sensor on a pole or tube running parallel to the water surface, with an outer diameter of up to 60.3 mm (2"). The accessory provides a flat mounting sheet for the standard mounting bracket. A clamp bracket is used to mount the sensor on round poles with diameters ranging from 1.5" to 2" (60 cm outer diameter).

2.5 Power Supply

CAUTION

- Device Operating on low DC power.
- No life or health risk except for vulnerable or highly sensitive individuals who should refrain from working with electrical devices.
- Precaution: Electrical devices should always be installed by qualified personnel.

The HyQuant Edge operates within a voltage range of 9 to 30 V dc, with a nominal operating voltage of 12 V dc, which is typical for SLA batteries (Sealed lead acid battery) - a rechargeable battery suitable for solar-powered applications. It can also be connected to a DC mains power supply.

As soon as a suitable power supply is connected, the HyQuant Edge is ready for use.

2.6 Cable and Connector Pinout

HyQuant Edge sensors are supplied with a suitable 10 m sensor/actuator cable with an 8-pin M12 female connector at one end and open wires at the other end. The HyQuant Edge enclosure is equipped with an 8-pin M12 male connector. The cable connector should be plugged into the housing receptacle.

Note: The connector only fits in one direction due to the coding.

WARNING

- Incorrect connection of the supply power may result in damage to the HyQuant Edge.
- The HyQuant Edge has a reverse polarity protected interface and power circuit to protect against this. However, it is important to note that an improper or incorrect connection between the power and interface lines could still result in damage to the instrument.
- Check the pin-out configuration and ensure that no power is applied to the connector cables other than those specifically marked 'Power VCC +' and 'Power GND -'.

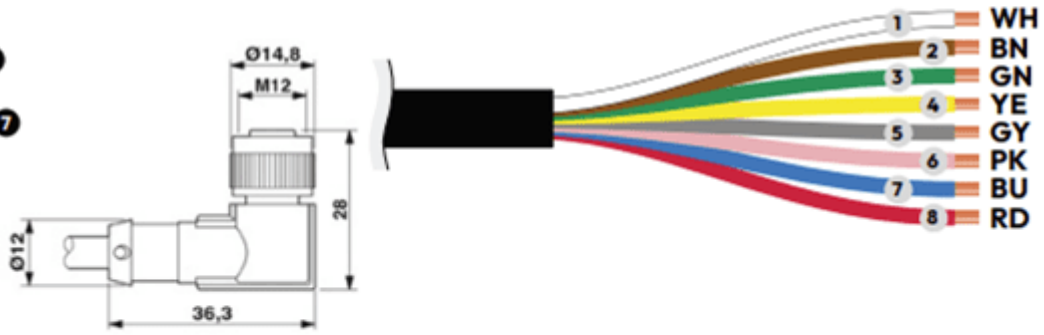
Cable and connector pinout

1	2	3	4	5	6	7	8
Power VCC +	Power GND –	NC	NC	NC	NC	NC	NC

Pin assignment (female view)



Connection diagram



Caution: Incorrect or faulty connection can damage the device. All interface and power cables are protected against reverse polarity, but incorrect connection of power cables to interface cables can damage the device.

Table 2 – Connector Pinout

3 Configuration

HyQuant Edge is equipped with an integrated Wi-Fi hotspot and can be locally configured/operated wirelessly from a PC/Notebook with activated Wi-Fi via KISTERS' HyComm software. The Wi-Fi hotspot is protected against unauthorised access from outside. This makes it impossible to read measurements or status values or change device settings via this interface without authentication. The Wi-Fi hotspot must be activated as described below.

For more information, see the following subsections:

- Configuration Software 22
- Enabling of the Local Wi-Fi Hotspot for Configuration 23
- Filters 25
- Rain Filter for Velocity Measurements 26
- Reference Level 29
- Operational Range 29
- Configuration for Q Calculation 29
- Settings 30

3.1 Configuration Software

HyComm is KISTERS software used for local communication between a Windows computer and the HyQuant Edge radar sensor. Communication is via a Wi-Fi connection, with the HyQuant Edge acting as a Wi-Fi hotspot. HyComm allows parameter configuration 30 of the sensor. You can find more information about HyComm in a separate manual that can be downloaded from the HyComm product page.

To protect the parameterisation, you can protect the device with a keyword of your choice.

3.1.1 System Requirements

Make sure your PC/laptop/tablet computer meets the following system requirements:

- Operating system: Windows 10 or later
- Wireless connection: Wi-Fi / adapter: enabled

3.1.2 HyComm Updates

When HyComm starts with Internet access, it automatically checks for a new release. If an update is available, it will be downloaded and the message shown in Figure 6 22 will be displayed:

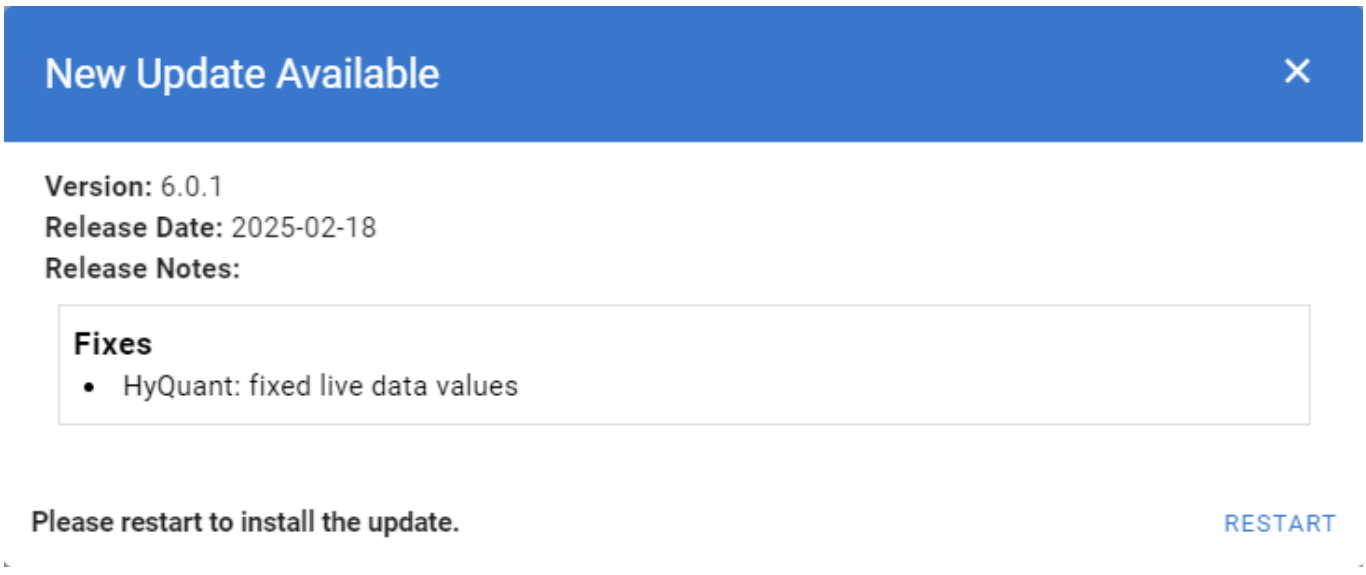


Figure 7 – HyComm Update Alert Message

Note: Windows notification settings may suppress this notification.

The update is installed in the background after HyComm is closed. This process typically takes between 20 seconds and one minute, depending on the system. For manual updates, the download link on our website will always point to the latest version.

3.1.3 Firmware Updates

HyQuant Edge firmware updates are automatically detected and downloaded to the local drive each time HyComm is started. This feature effectively allows users to be equipped with the latest firmware version when visiting sites with limited or no network coverage. When a new firmware update is available, it is instantly downloaded for offline use. All that is required is an Internet connection, not a connection to a device.

When connecting to a device with outdated firmware, you are notified of the firmware update and can choose to install the update.

Note: It is strongly recommended that the latest version of HyComm is installed before proceeding with a firmware update.

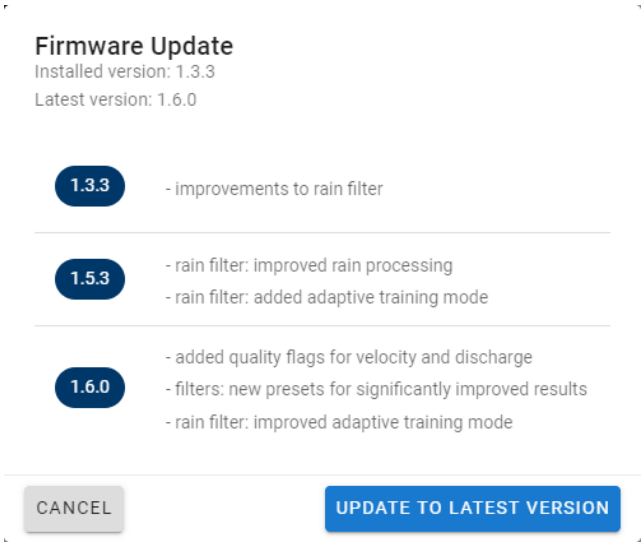


Figure 8 – HyComm for HyQuant Edge Firmware Update

3.2 Enabling of the Local Wi-Fi Hotspot for Configuration

There are different ways to enable the local Wi-Fi hotspot:

- Enable with Reed Switch / Magnet 23
- Enable via Power Cycle 24

Once the hotspot has been enabled, regardless of the method used, there will be a beep to indicate that the hotspot is starting up. It can take up to 60 seconds after the beep for the Wi-Fi hotspot to become available.

- Click on the Wi-Fi icon in in your computer's taskbar.
- Select the Wi-Fi access point named **HERYYXXXX** from the provided list, where **HERYYXXXX** is the serial number of the HyQuant Edge device.
- Once the Wi-Fi connection is established, start HyComm to communicate with the device. HyComm will prompt you to enter a password. Use the initial password printed on the FAT document supplied with the device. This password is unique to each device. For security reasons, we recommend changing it to a secure password of your choice.
- The computer connects to the Wi-Fi hotspot.

Note: It is strongly recommended to change the password using HyComm to prevent others from changing the sensor configuration.

3.2.1 Enable with Reed Switch/Magnet

The HyQuant Edge contains a reed switch which is actuated by moving a magnet in the immediate vicinity of the reed switch. The position of the reed switch integrated in the HyQuant Edge housing is shown in Figure 8 24. It is necessary to place the magnet directly on the housing.



WARNING

Risk of falling when activating the Wi-Fi hotspot.

If the HyQuant Edge is installed at a great height above the water and/or the sensor is difficult to access, there is a risk of falling when activating the Wi-Fi hotspot.

- Use personal protective equipment (PPE) to prevent falls.
- If possible, use a swivelling bracket for installation. This allows you to swivel the sensor into a safe working area for configuration.

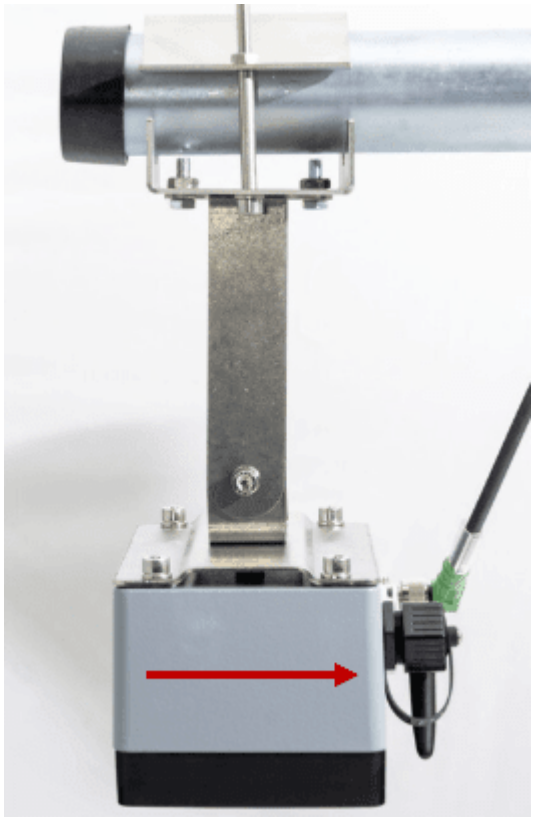


Figure 9 – HyQuant Edge: reed-switch on the blank short edge (without type label)

3.2.2 Enable via Power Cycle

HyQuant Edge automatically turns on its Wi-Fi hotspot when it is powered on. This allows to simply disconnect and reconnect the power supply to activate the Wi-Fi hotspot.

Note: If the sensor is connected to SDI-12 and the logger is configured to switch off the HyQuant Edge between measurements, this feature should be disabled using HyComm. Otherwise, the Wi-Fi hotspot will be activated every time the logger reads a value, which can increase power consumption. HyComm Navigation path: **CONNECTION** > **WI-FI** deactivate **START WI-FI WHEN SENSOR IS POWERED ON**.

3.2.3 Automatic Disabling

When HyQuant Edge is running the Wi-Fi hotspot, the power consumption is significantly higher than normal. To keep power consumption down, the hotspot is automatically deactivated after 5 minutes of inactivity. The hotspot is considered inactive as long as HyComm is not connected. As long as HyComm is connected, the Wi-Fi hotspot is not turned off.

3.3 Filters

Removing Unwanted Reflections/Outliers

Objects in close proximity to the sensor, particularly sharp metal or concrete edges, can cause unwanted reflections. Normally, the radar will detect the water surface as the most prominent reflection. However, occasionally a false reflection can be stronger.

By comparing new readings with the average of recent values, the radar sensor can identify false signals and reject them using a configurable threshold. This setting is automatically adjusted when one of the adjustable filters is selected.

User Adjustable Filters

In the KISTERS HyComm software you can choose from a total of three different filter presets. Each of them reflects digital filter settings for a typical water flow situation as found in real open channel flows.

- The filter settings are designed to remove false signals. The more turbulent the water surface, the longer the filter. Therefore, (recent) historical data will have a greater influence on the evaluation of current readings. The effect is that the correct values are correctly identified, the overall trend is not altered by the filter and no significant and real changes are missed.
- The purpose of the filter presets, with a user adjustable "strength", is to remove the "noise" caused by a turbulent surface to give a smooth measurement curve. HyComm allows to change the filter "strength" and observe the effect on the distance value in real time.

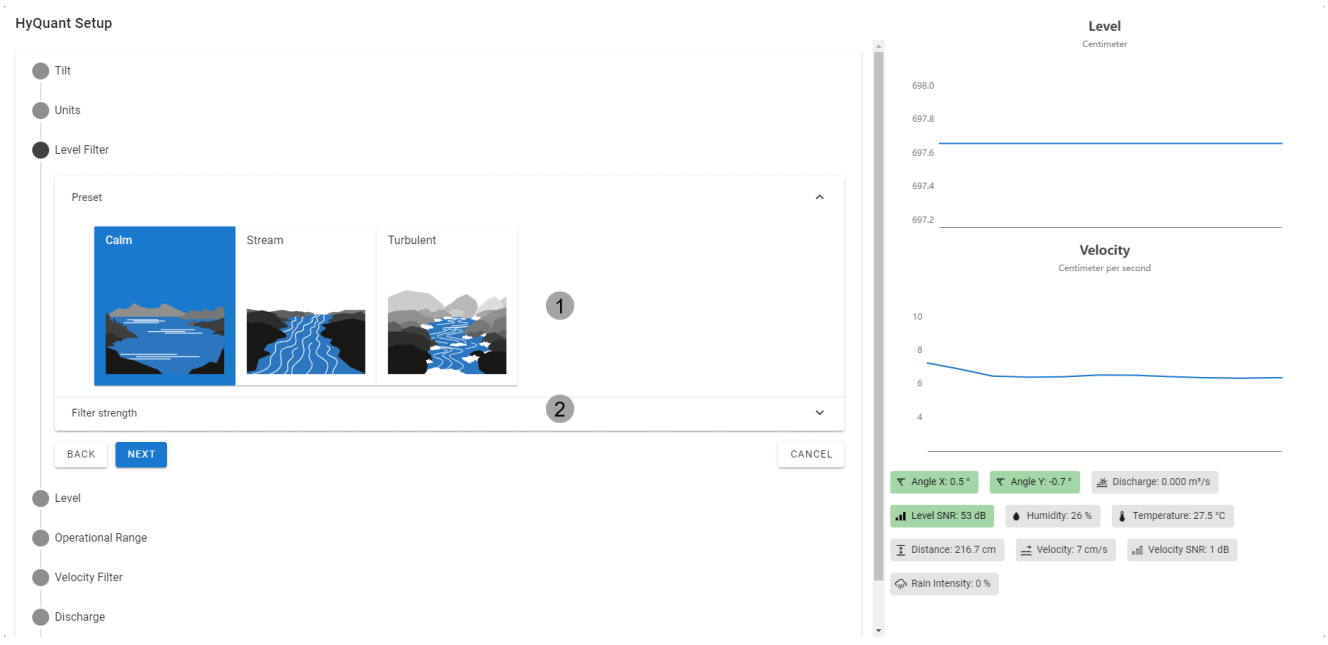


Figure 10 – Level Filter: Dialogue to select filter preset and filter strength

- One of the main advantages of the HyQuant Edge filter settings in HyComm is that they prevent you from having to enter complex digital filter parameters.

Site Conditions (Filter Type)	Description	Example
Calm	A calm body of water is a contained body of freshwater with no or very low flow velocity, but subject to some surface turbulence depending on wind conditions.	Lake, reservoir, pond, rainwater retention basin, …
Stream	Refers to an uninterrupted expanse of water flowing along a channel (or open canal) confined by its bed and banks.	River, waterway, brook, creek, tributary, open canal, open channel, etc.
Turbulent	A turbulent, continuously or intermittently flowing stream whose discharge varies greatly over short periods due to thunderstorms or snowmelt.	Torrent, natural mountain streams/brooks/creeks, whitewater, …

Table 3 – HyQuant Edge L and L+V: Filters for Level Measurement

3.4 Rain Filter for Velocity Measurements

Concept

When using HyQuant Edge in the field, it's crucial to consider the effects of the weather, especially rain, when measuring in slow-moving water.

For accurate surface velocity readings in rainy conditions, especially in low-flow scenarios, corrections or adjustments may be needed. Non-contact sensors such as the HyQuant Edge measure the surface velocity, not the velocity within the water column. To do so, HyQuant Edge detects surface ripples or waves larger than or equal to 3 mm in height. In calm conditions (no wind, no rain), the surface velocity is closely related to the mean flow velocity by a calibration factor known as the *k*-factor.

Rain alters the surface of the water by creating different interference patterns due to:

- High velocity raindrops hitting the water surface.
- Circular waves propagating from each raindrop impact, each with its own specific velocity.

These disturbances create additional surface velocities that a surface radar can detect, leading to potential inaccuracies.

Velocity dependence of the influence of rain:

- The impact of rain is more pronounced in water bodies with low flow speeds.
- For velocities below 1.5 m/s, rain-induced ripples can significantly distort surface velocity readings.
- For velocities above 1.5 m/s, the influence of rain becomes negligible, as the surface waves generated by the flow dominate over the rain-induced disturbances.

Prerequisites

- Update to the latest version of HyComm before installing new firmware.
- The Rain Filter options - **REAL TIME FILTER** and **ADAPTIVE TRAINING MODE** - must be enabled in the HyComm software.

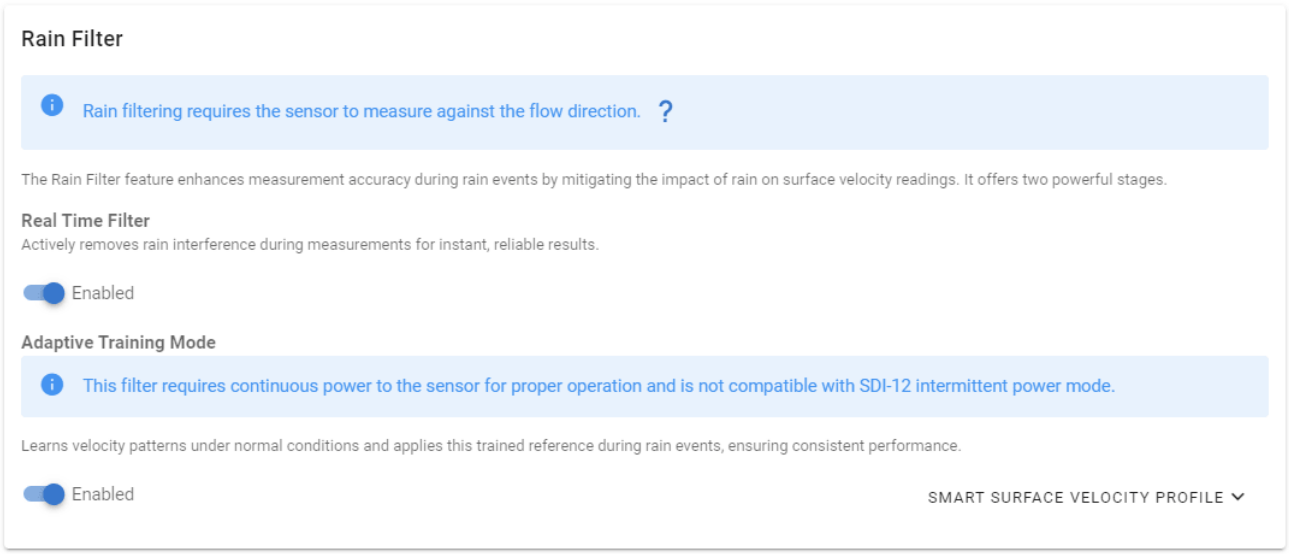


Figure 11 – HyComm Settings for Rain Filter

3.4.1 Rain Filtering Principle in HyQuant Edge

The HyQuant Edge device incorporates a two-stage rain filtering system designed to ensure reliable surface velocity measurements, even during rain. Below, you can find an overview of how it works and its key components.

Note: Rain filtering is only effective when the sensor is facing upstream (against the water flow).

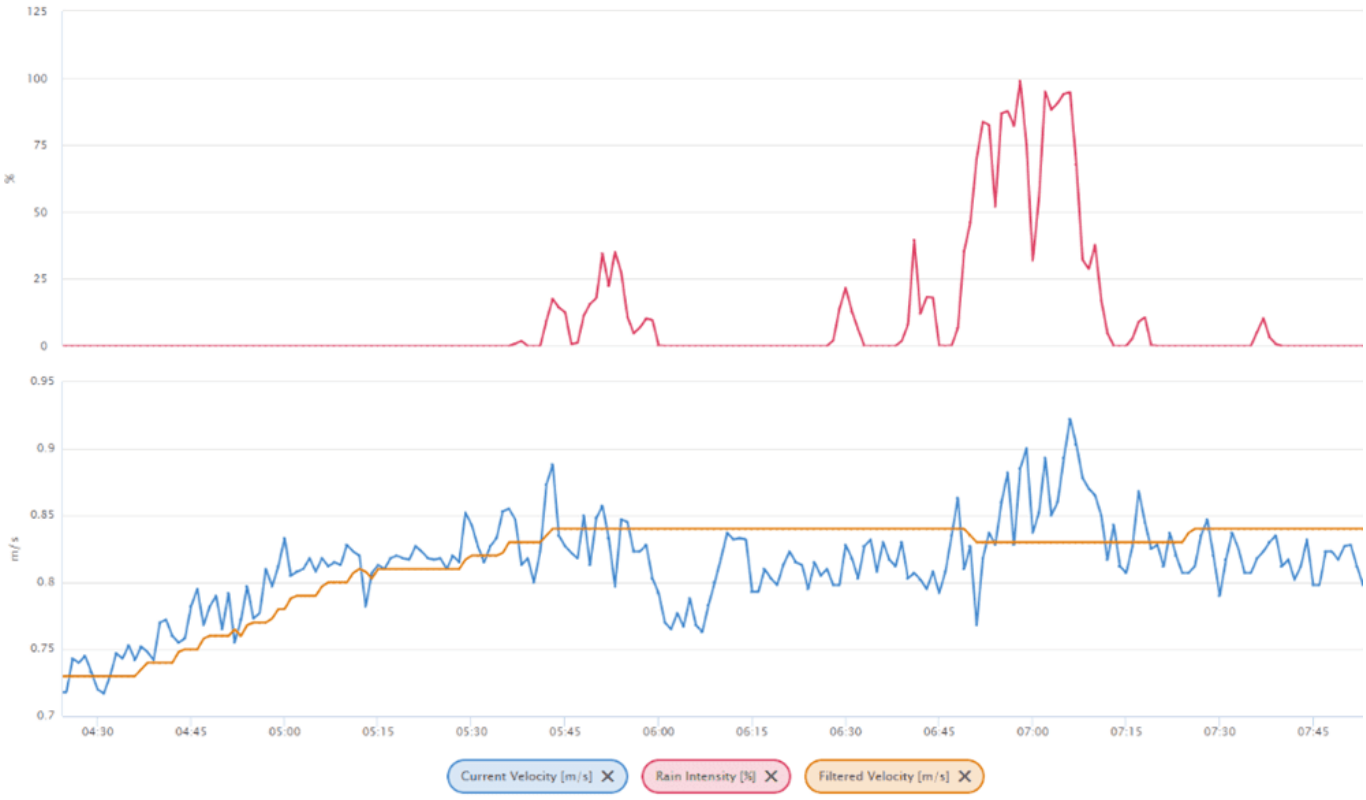


Figure 12 – Velocity measurement during a rain event

- Red graph: Rain intensity in percent.
- Blue graph: Unfiltered velocity. During rainfall, the surface velocity is disturbed by the rain.
- Orange graph: The filtered velocity uses the Smart Surface Velocity Profile to ensure a reliable velocity reading even during rain events.

Rain Intensity

The HyQuant Edge can reliably detect rain and measure its intensity.

Note: Rain intensity percentages may not be mistaken for rainfall quantity!

Two-Stage Rain Filtering System

The filter can be configured in HyComm. The settings are part of the velocity filter settings. See Figure 12 28.

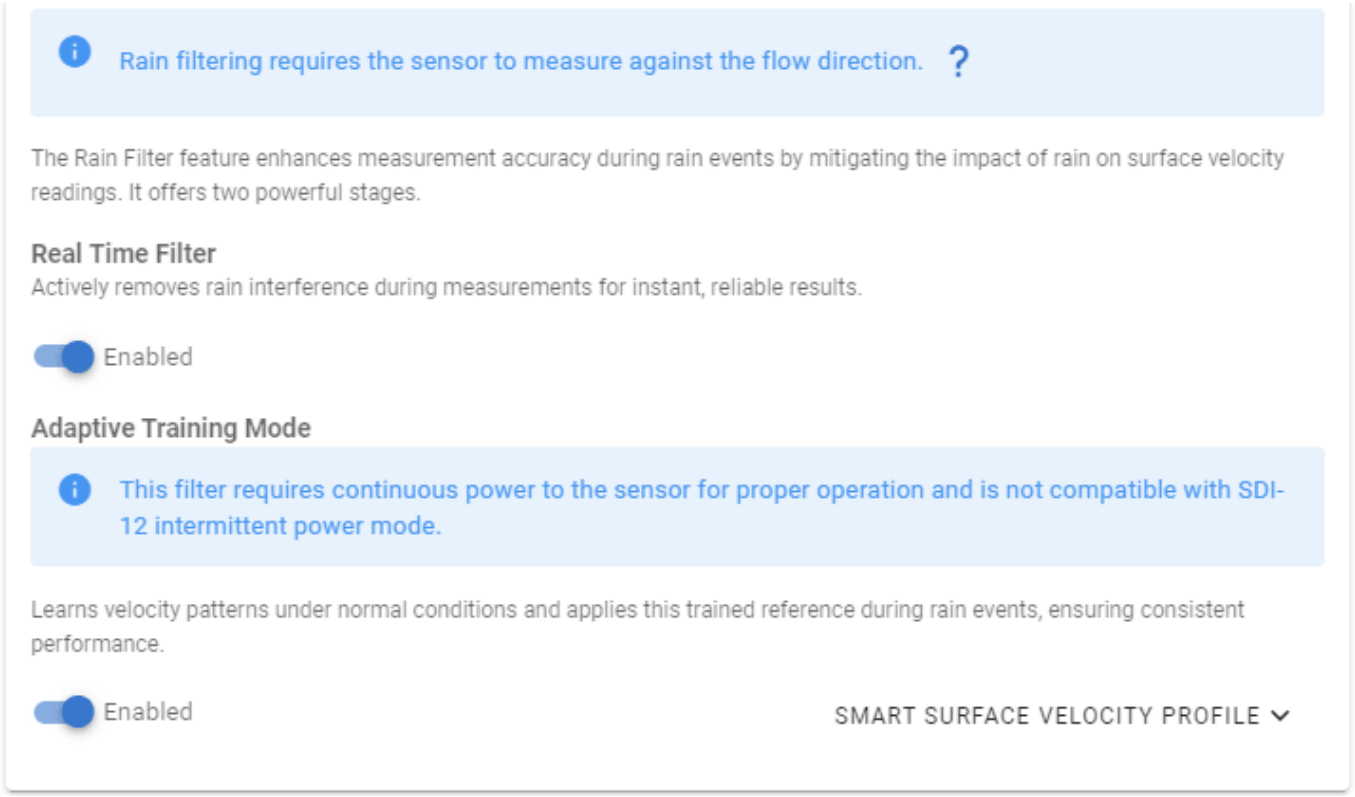


Figure 13 – HyComm – Enabling the Rain Filter and the Adaptive Training mode

Stage 1: Real-time filtering (immediate compensation)

Filters out rain-induced disturbances on the fly by removing interference caused by rain components detected by the radar.

Performance factors:

- Works best with higher water velocities and low rain intensity.
- Less effective in low flow conditions with heavy rain, where variations may still occur.

Stage 2: Adaptive training mode (long-term compensation)

Note: Adaptive training requires continuous monitoring, so it won't work if the sensor is powered intermittently (e.g. for SDI-12-only readings).

The Smart Surface Velocity Profile in Stage 2 represents a sophisticated method of improving the accuracy of water monitoring by developing a site-specific correlation between water level and surface velocity.

Key aspects:

- **Learning over time**: This feature builds a dynamic relationship between water level and surface velocity specific to the installation site, assuming a constant cross-sectional profile. The system improves its accuracy as it collects more data and adapts to the unique characteristics of the water body.
- **Rainfall adaptation**: During rainfall, pre-learned profiles are used to adjust surface velocity readings, ensuring reliable measurements despite environmental variations.
- **Installation dependency**: The profile is specific to the location of the sensor. Changing the installation, such as moving the sensor, will invalidate the existing profile. In such cases you must discard the current profile using the velocity filter settings in HyComm.

- **Device replacement**: If a HyQuant Edge instrument is replaced, the Smart Surface Velocity Profile can be saved and restored on the new instrument, maintaining continuity and reducing setup time.

Note: The real-time filter is mandatory and is automatically activated when adaptive training mode is enabled.

3.5 Reference Level

The primary measurand of a radar level sensor is the distance between the antenna and the water surface. This distance must be converted into a level reading for hydrological purposes. To obtain a level reading, the sensor must be referenced to a site-specific reference level.

Referencing can be:

- Relative to a staff gauge
- Relative to a geodetic datum

The KISTERS HyComm software is used to enter the site-specific level reference. HyComm guides you through the process with convenient input screens.

3.6 Operational Range

The operating range definition allows to restrict or limit the measurement range.

- Limit the maximum depth: This function is particularly useful to avoid false readings, for example during a drought when a stream runs dry. In such a situation, the radar beams will be reflected by any object (e.g. rocks, man-made structures, …) that happens to be in the detection area.
- Limit the minimum depth: this helps you to ignore obstacles in the radar beam in the vicinity of the installation position.

In both cases, the **OPERATIONAL RANGE** setting helps to avoid false readings. All measurements outside the operating range are ignored. HyQuant Edge returns the user-defined upper or lower limit.

3.7 Configuration for Q Calculation

Only HyQuant Edge Q models can be configured to calculate the discharge Q from the measured surface velocity V, the measured water level L and a correction constant k that relates the surface velocity to the average velocity for a given wet cross section of the stream. The KISTERS HyComm software allows to make the settings. Choose from three available mean velocity calculation methods:

- **Constant k-factor**: *k*-factors are chosen to reflect the characteristics of the chosen monitoring site. In hydrology, *k*-factors are essential for understanding the impact of stream conditions on flow. Various studies suggest *k*-factors based on empirical data. For example, one approach is to use a factor of 0.87 for natural streams, while for engineered channels it may be around 0.95. It is important to refer to specific hydrological studies or guidelines relevant to the geographical area and stream type for precise values.
- **Dynamic k-factor**: This is based on the use of imported *k*-factors to improve accuracy. The *k*-factors have been calculated using a power law. This method is more accurate but requires more effort to provide good input data for the power law model.
- **V Index**: It is based on *k*-factors calculated using statistical methods that model the relationship between measured surface velocities and the mean velocity of a cross section. The method is moderately complex and achieves good accuracy.

Also define a cross section profile: To accurately calculate the discharge (*Q*) of a stream, a cross-sectional profile of the stream is essential. This profile helps to convert the measured surface velocity into an average velocity across the entire width of the stream.

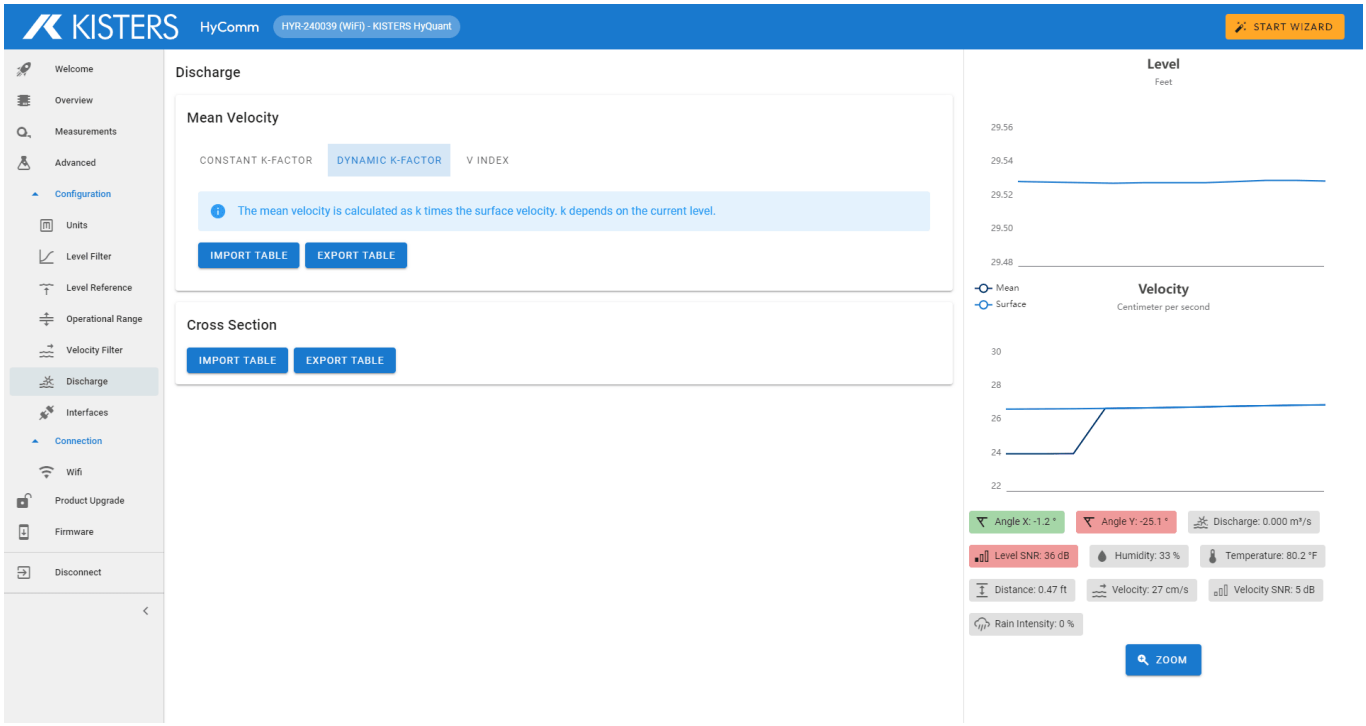


Figure 14 – HyComm Dynamic k-Factor

Format of a suitable *k*-table:

- The best way to create a table is in Microsoft EXCEL®.
  Note: For all tables, only the first two columns are used.
- The table and data values are typically exported from a cross section or rating curve editor or the corresponding module of your hydrological data management software. The KISTERS software solutions WISKI, HYDSTRA and SKED all provide the required functionality.
- Save the data in a CSV UTF-8 (Comma Separated Values) file.

Details can be found in the following PDF document, which can be downloaded from the KISTERS website: White Paper - Discharge Calculation with HyQuant Q

3.8 Settings

The following settings can be made in the KISTERS HyComm software. For more information on KISTERS HyComm, please refer to the separate user documentation: HyComm User Manual.

The settings are divided into the following subsections:

- Parameters 30
- Units 34

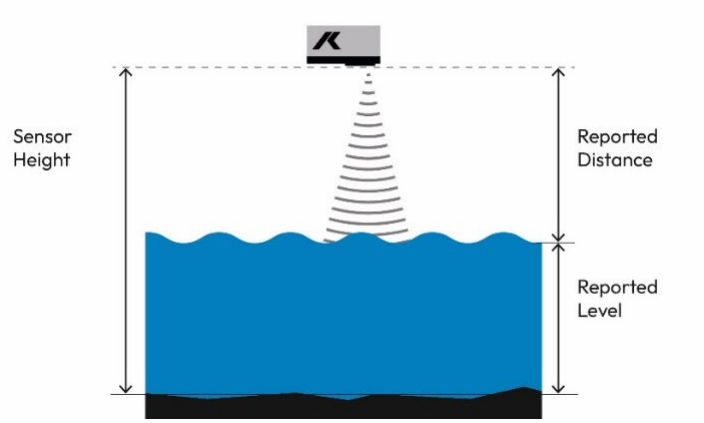
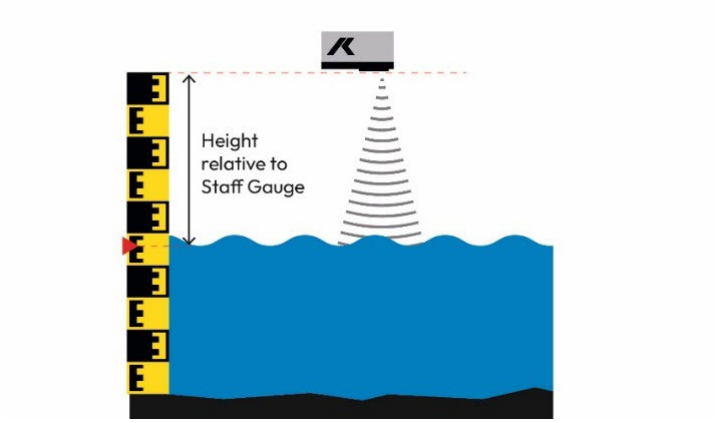
3.8.1 Parameters

The following operating parameters of the HyQuant Edge can be set using the KISTERS HyComm configuration software. The navigation path for each parameter is given at the end of the corresponding description.

Item	Description	Default
Units and decimals	Units can be adapted to local / user preferences: see Units 34. Navigation path: **CONFIGURATION** > **UNITS**	Metric units
Filter type (for level and velocity)	Select installation environment (see Table 3 26) Define filter length (1 - 200 seconds)	Calm: 10 seconds

Item	Description	Default
	Navigation path: **CONFIGURATION** > **LEVEL FILTER**	

Interface selection	Available interfaces:
	▪ LTE-M/NB-IoT
	▪ Protocols
	  ▪ WMO First Mile Protocol
	  ▪ SFTP (`.mis` and `.zrxp` file format)
	  ▪ OTTML via HTTPS
	Each can be enabled or disabled, but at least one must be enabled.
	Navigation path: **CONFIGURATION** > **INTERFACES**
		LTE-M: enabled
		WMO Fist Mile Protocol: enabled

Item	Description	Default
Gauge zero reference height	HyQuant Edge L and L+V both provide a water level reading. The water level is the height of a surface water body above a fixed reference height, known as the gauge zero reference height. The reference height is levelled and may not correspond to the level of the river bed. It must remain stable during the operating time of the water level gauge. By definition, a radar sensor measures the distance between the sensor antenna and the water surface. The absolute water level is then calculated using the following formula: Absolute water level = [Gauge zero reference height] - [Distance] Select one of the following two options to enter the required gauge zero reference height: ▪ Navigation path: **CONFIGURATION** > **LEVEL REFERENCE** > **KNOWN PARAMETER**: **SENSOR HEIGHT** (above reference level) You can enter the distance between the sensor and the reference level.  ▪ Navigation path: **CONFIGURATION** > **LEVEL REFERENCE** > **KNOWN PARAMETER**: **STAFF GAUGE** You can enter the staff gauge measurement.  See Reference Level 29.	Sensor height above reference level defaults to 0, level will be 0 unless set. Reading the staff gauge always returns 0

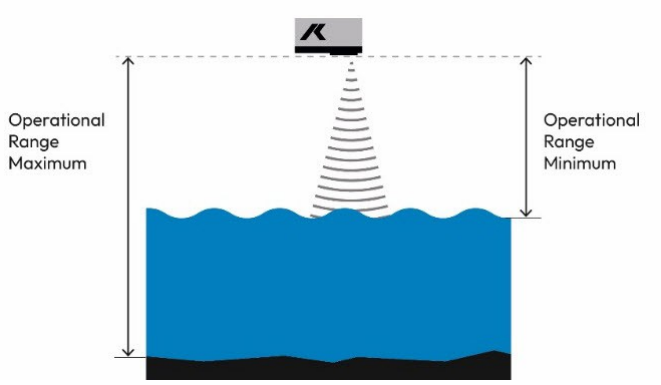
Item	Description	Default
Operating range (level)	The operational range is the range within which the readings recorded by the sensor are valid. A maximum and minimum level can be configured to define the operating range. The operating range is then by definition less than or equal to the measurement range. Values above the fixed maximum are automatically set to the maximum level and those below the minimum are set to the specified minimum level. The quality flag indicates whether or not the values are within the operating range. See Operational Range 29. Navigation path: **CONFIGURATION** > **OPERATIONAL RANGE** 	Min: 100 for L20, 150 for L50 [mm] Max: Upper range [mm]
Flow direction	HyQuant Edge detects the direction of flow. When the sensor is installed and aligned as described in chapter Orientation of the HyQuant Edge 17, with the 'K' marking on the sensor lid facing upstream, the flow velocity is measured as a positive value. If for some reason HyQuant Edge is installed with the 'K' marking on the sensor lid facing downstream, a correction is required and you must change the flow direction setting to negative. Options: positive, negative Navigation path:	positive
Wi-Fi automatically enabled on power up	See chapter Enable via Power Cycle 24 Navigation path: **CONNECTION** > **WIFI**	Enable on power up
Wi-Fi password	The password is configurable. For IT security reasons, it is advisable to change the initial password the first time you log in. **Note**: It should be noted that if you forget the password, you won't be able to change it without returning the device to KISTERS. Navigation path: **CONNECTION** > **WIFI**	Individual code printed on FAT document

Table 4 – Parameters

3.8.2 Units

The units for “filtered/current level value”, “filtered/current distance” and temperature can be set in the “KISTERS HyComm” configuration software under the **CONFIGURATION** > **UNITS** navigation path. All other units are preset at the factory.

Parameter	Description	Units
Filtered water level	Sensor height above reference point - Filtered distance ▪ Lower cut-off is the user-defined minimum level of the operating range, if enabled.	[mm, cm, m, ft, in]
Current level	Sensor height above reference point - Current distance ▪ Lower cut-off is the user-defined minimum level of the operating range, if enabled.	
Current distance	Distance measurements taken from HyQuant Edge after removal of outliers and similar spikes. The reference is the HyQuant Edge lid.	
Filtered distance	Current distance filtered with moving average filter. The moving average filter of duration N calculates the average of each consecutive set of N sensor readings. Each reading is weighted equally.	
Level quality Flag	bitfield	./.
Filtered velocity	Surface flow velocity	[mm/s, m/s, mph, km/h, fps, fpm, cm/s]
Current velocity	Surface flow velocity	
Velocity quality flag	bitfield	./.
Discharge	Discharge calculated based on cross-section	[m^3/s, ft^3/s, in^3/s]
Discharge quality flag	bitfield	./.
Supply voltage		[V]
Internal temperature		[°C, °F]
Internal relative humidity		[%]
Angle	Separate for X and Y axis	[°]
Radar SNR	Signal to noise of the current distance measurement.	[dB]
RSS	A measure of the strength of the wireless signal received by the device. Higher values indicate better communication quality and greater link reliability.	[dBm]

Table 5 – Units

4 Operation

Note: HyQuant Edge starts measuring as soon as the supply voltage is applied.

It should be noted, however, that a radar sensor always requires a correct setting of its operating parameters, in particular the reference to a defined zero point in order to convert distance measurements into hydrological water levels. It is recommended to download HyComm from the KISTERS website and to configure HyQuant Edge without delay.

Depending on the model of HyQuant Edge used, the sensor continuously determines the current water level, the current surface velocity and the current discharge.

A HyQuant Edge sensor determines additional values in parallel with the actual water measurements:

- Internal device temperature
- Internal humidity
- Tilt angle of sensor X axis
- Tilt angle of sensor Y axis
- SNR value of water level measurement
- Water level measurement status indicator
- RSS received signal strength indicator

This metadata supports measurement quality assessment and the early detection of potential error sources. It is stored together with each measurement record in the device's local memory and transmitted to remote receivers alongside the measurement data, either within the WMO First Mile/MQTTS payload or as files via SFTP.

4.1 Radar Beams

CAUTION

- Radar electromagnetic wave emissions.
- The device operates with very low emitting power radar beams.

Precaution:

- While the risk is minimal, it is advisable to avoid prolonged direct exposure.
- Vulnerable or highly sensitive individuals should exercise caution.
- Always follow standard safety guidelines when handling or installing radar devices.

Radar emits electromagnetic waves. The beam is the focused electromagnetic emission from the radar antenna. The beam is defined by the main lobe. It is accompanied by one or more side lobes.

The main lobe is the area delimited by the beam angle, i.e. the lateral positions where the attenuation reaches approximately -3 dBm.

- HyQuant Edge L and the level beam in L+V/Q models: The beam angle is defined as 8° (4° on either side of the 0° perpendicular).
- HyQuant Edge V and the velocity beam in L+V/Q models: The beam angle is defined as 8° azimuth by 12° elevation (again divided by the perpendicular).

Sidelobes are clearly identifiable accumulations of electromagnetic waves next to the main lobe. Ideally, sidelobes are completely attenuated, but this is never the case. Depending on the material and the orientation of an obstacle, sidelobes can interfere with the measurement in the main lobe. HyQuant Edge is equipped with special algorithms to filter out these interferences.

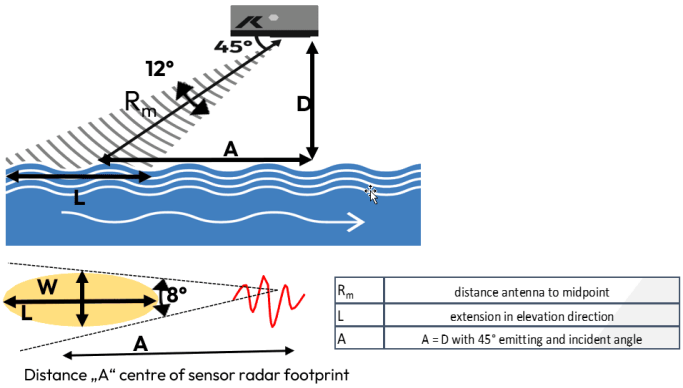
The beam angle is defined in degrees. The angle is the total geometric aperture of the beam. The concept is illustrated in Figure 14 36. The beam angle can be used to calculate the beam width at a given distance from the water surface to the sensor antenna.

HyQuant radar antenna – caution: 2 different cases:
- **Velocity:** beam angle azimuth = 8°, and elevation 12°
- **Level:** beam angle azimuth = elevation = 8°.

W=2 x D x tan (8°/2)

$$R_m = \frac{D}{\sin(45°)}$$

$$L \approx 2R_m \tan(12°/2)$$



Metric				Imperial			
D [m]	W [m]	Rm [m]	L [m]	D [ft]	W [ft]	Rm [ft]	L [ft]
---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---
20,0	2,80	28,28	5,95	65,62	19,51	92,80	19,51
15,0	2,10	21,21	4,46	49,21	14,63	69,60	14,63
10,0	1,40	14,14	2,97	32,81	9,75	46,40	9,75
7,0	0,98	9,90	2,08	22,97	6,83	32,48	6,83
5,0	0,70	7,07	1,49	16,40	4,88	23,20	4,88
3,0	0,42	4,24	0,89	9,84	2,93	13,92	2,93
2,0	0,28	2,83	0,59	6,56	1,95	9,28	1,95
1,0	0,14	1,41	0,30	3,28	0,98	4,64	0,98
0,5	0,07	0,71	0,15	1,64	0,49	2,32	0,49

Figure 15 – Beam angle and calculation of equivalent diameter on water surface for distance D

4.2 Quality Flags

Quality flags and associated measurement metadata are transmitted together with the measurement data via WMO First Mile/MQTTS, HTTPS and SFTP.

These indicators support the assessment of measurement quality and provide early warning of conditions that may affect the reliability of velocity measurements. They enable users and downstream systems to identify potentially degraded measurements and investigate possible causes.

Quality Flag	Bit definition	Description
Level	Bit 0: Level below operating range	
	Bit 1: Level above operating range	
	Bit 2: Level below hardware range	Vertical distance between sensor and water body too high (20 m for L20, V, L+V, Q; 50 m for L50).
	Bit 3: Level above hardware range	Water to close to the sensor
Velocity	Bit 0: Reserved for future use	
	Bit 1: Rain indicator (0: no rain, 1: rain)	Equal to 1 = rain is detected, and subsequently the rain intensity is greater than 0.
	Bit 2: Reading from smart surface velocity profile	Rain is detected and the filtered velocity is calculated using the Smart Surface Velocity Profile.
	Bit 3: Reserved for future use	
	Bit 4: No validated velocity in smart surface velocity profile	Rain is detected but the sensor has not yet been trained for the current condition.
Discharge	Refer to explanations for velocity quality flag	

Table 6 – Quality Flag Definition

How to decode Quality Flags

A bitwise quality flag is a specialised encoding that represents multiple quality indicators within a single binary value. To decode it:

- Convert the flag into its binary form.
- Examine the position of each bit. Each bit corresponds to a specific quality condition (as shown in Table 6 37 above).
- A bit value of 1 indicates that the condition is active, while 0 indicates that it is not.

This method efficiently represents and interprets multiple quality aspects in a compact format.

Example

```
Velocity Quality Flag = 6
Binary representation = 0000 0110
  bit 1 = 1 => Rain indicator indicates rain
  bit 2 = 1 => reading from Smart Surface Velocity Profile
```

4.3 WMO First Mile Protocol

The sensor supports the WMO First Mile protocol using MQTTS (MQTT over TLS) for secure, near real-time data transmission. This protocol enables standardised exchange of meteorological observations and provides:

- End-to-end encryption via TLS 1.3
- Mutual authentication using device-side and server-side certificates
- Reliable, low-latency data delivery

Additional information on the implementation of the WMO First Mile Protocol in KISTERS Edge sensors is available for download from the relevant product pages in the KISTERS Online Product Catalogue.

4.4 SFTP File Transfer

The device supports file-based data transfer via SFTP, with measurement data provided in `.mis` file format. Data transfer ensures confidentiality and integrity during transmission. This allows:

- Secure file transfer using SSH protocols with certificate-based authentication
- Periodic or event-driven data uploads
- Integration with file-based data processing systems

.mis File Format

The device supports the export of measurement data in `.mis` file format.

The `.mis` format is a structured, text-based data file format commonly used for the exchange of environ-mental and meteorological measurement data between sensors, data loggers, and backend systems.

Typical characteristics include:

- ASCII text-based structure, enabling human readability and easy processing.
- An (optional) header followed by one or more measurement records.
- Delimited fields containing measured parameters, timestamps, and metadata: Individual records are separated by line breaks. Fields within a record are separated by semicolons (;).
- Record-oriented organization, where each record represents a measurement set or timestamped observation
- Inclusion of device identifiers, timestamps, and sensor values in a predefined order

Note: The `.mis` format exists in several variants generated by different devices and software generations. Header structure, field order, timestamp representation, quality flags, and optional metadata fields may vary between implementations. Applications importing `.mis` files should therefore be capable of handling optional fields and format variations.

.zrxp File Format

The device supports the export of measurement data in .zrxp file format.

The .zrxp format is a structured, text-based data format commonly used in environmental and hydrological data management systems for the exchange of time series data.

Typical characteristics include:

- ASCII text-based encoding, allowing human readability and straightforward parsing
- Time series-oriented structure, representing sequences of timestamped measurement values
- Delimited records, where each record corresponds to a single observation (timestamp + value)
- Inclusion of metadata elements, such as station identifiers, parameter codes, units, and quality indicators
- Support for header sections defining context, data source, and configuration parameters

The format is designed for efficient exchange of measurement time series between data loggers, sensors, and backend systems, particularly in hydrological and meteorological applications.

4.5 OTTML via HTTPS

This interface enables:

- Retrieval and transmission of measurement data in OTTML file format via HTTPS requests
- Integration with existing REST-based systems
- Secure communication based on mutual TLS 1.3 authentication

The device supports the export of measurement data in OTTML (OTT Markup Language) file format.

OTTML is an XML-based data exchange format developed by OTT HydroMet for the transfer of hydrological, meteorological, and environmental monitoring data. In addition to measurement values, OTTML can include extensive metadata describing the monitoring station, sensors, device status, communication parameters, and system configuration.

Typical characteristics include:

- XML-based structure, providing a standardized and self-describing data format
- Human-readable text format that can be viewed and processed using standard XML tools
- Hierarchical organization of stations, channels, measurements, and metadata
- Support for timestamped measurement values and associated quality information
- Inclusion of station identifiers, channel identifiers, units, and configuration parameters

- Transmission of device status information, such as firmware version, battery voltage, signal strength, location, and communication settings

OTTML is particularly suited for automated data exchange between field devices, telemetry systems, and environmental data management platforms.

Note: The OTTML format exists in several variants generated by different OTT HydroMet devices and software generations. The structure, available metadata elements, and supported XML tags may vary between implementations. Applications importing OTTML files should therefore support optional elements and be tolerant of format extensions while maintaining compatibility with the core XML structure.

5 Maintenance



CAUTION

- Radar electromagnetic wave emissions.
- The device operates with very low emitting power radar beams.

Precaution:

- While the risk is minimal, it is advisable to avoid prolonged direct exposure.
- Vulnerable or highly sensitive individuals should exercise caution.
- Always follow standard safety guidelines when handling or installing radar devices.



WARNING

Risk of falling when activating the Wi-Fi hotspot.

If the HyQuant Edge is installed at a great height above the water and/or the sensor is difficult to access, there is a risk of falling when activating the Wi-Fi hotspot.

- Use personal protective equipment (PPE) to prevent falls.
- If possible, use a swivelling bracket for installation. This allows you to swivel the sensor into a safe working area for configuration.



WARNING

Risk of drowning.

- Be particularly careful when working over or near to water.
- Wear a life jacket/buoyancy aid:
  - Ensure that workers at risk of falling into the water are provided with and wear a life jacket or buoyancy aid.
  - The life jacket should be thoroughly checked by the user prior to use.
- Never work alone: Always be accompanied when working near or over water.

The HyQuant Edge radar sensor is designed for low maintenance. No special maintenance is required, nor is it necessary to replace components at regular intervals. However, the entire measurement point should be inspected and checked regularly. We recommend that the following maintenance operations are carried out at least once a year, e.g. as part of a measurement point inspection. Unscheduled maintenance is recommended after exceptional events (flooding) or if the readings are implausible.

Maintenance work to be carried out annually (recommended):

- Check that there are no obstructions between the radar sensor and the water surface. If necessary, remove flotsam, vegetation or other objects from the measurement section.
- Check the underside of the device with the radar antenna for soiling (insect nests, bird droppings, spider webs, other dirt deposits). If necessary, clean the underside of the device with a damp cloth and a light household detergent. Do not use aggressive cleaning agents.
- Check the sensor position and correct if necessary: the underside of the device must be aligned as parallel as possible to the water surface.
- Check the mounting point of the radar sensor for position and stability. Correct if necessary or if not possible, select a new fixing point.
- Check the angled plug connector and connecting cable for mechanical damage. If necessary, replace complete connecting cable with angled plug connector.
- Check all screw connections for sufficient tightening strength. Re-tighten screws if necessary.

- Check all metal fastening components for corrosion. If there is a risk of the radar sensor falling down due to material failure, replace corroded parts.
- Check sensor alignment [17]. Verify that the sensor is properly aligned relative to the water surface (±2°). For velocity sensors, ensure that the HyQuant Edge is correctly positioned and aligned with the flow direction: the KISTERS 'K' marking on the sensor lid must be facing upstream (water flows from 'K' marking to the radome area of the lid).
- Finally, carry out a control measurement and compare with the reference value (e.g. level staff value). If this results in an unexpectedly large deviation, the radar sensor must be re-referenced. The cause of the deviation is often a change in the position of the mounting point.

Note: In accordance with the prevailing local conditions, it may be necessary to implement maintenance procedures at more frequent intervals. This is particularly the case in instances where there is a substantial accumulation of debris at the measuring point, or where the likelihood of increased soiling is high due to unfavourable environmental conditions.

6 Troubleshooting



CAUTION

- Radar electromagnetic wave emissions.
- The device operates with very low emitting power radar beams.

Precaution:

- While the risk is minimal, it is advisable to avoid prolonged direct exposure.
- Vulnerable or highly sensitive individuals should exercise caution.
- Always follow standard safety guidelines when handling or installing radar devices.



WARNING

Risk of falling when activating the Wi-Fi hotspot.

If the HyQuant Edge is installed at a great height above the water and/or the sensor is difficult to access, there is a risk of falling when activating the Wi-Fi hotspot.

- Use personal protective equipment (PPE) to prevent falls.
- If possible, use a swivelling bracket for installation. This allows you to swivel the sensor into a safe working area for configuration.



WARNING

Risk of drowning.

- Be particularly careful when working over or near to water.
- Wear a life jacket/buoyancy aid:
  - Ensure that workers at risk of falling into the water are provided with and wear a life jacket or buoyancy aid.
  - The life jacket should be thoroughly checked by the user prior to use.
- Never work alone: Always be accompanied when working near or over water.



WARNING

- Incorrect connection of the supply power may result in damage to the HyQuant Edge.
- The HyQuant Edge has a reverse polarity protected interface and power circuit to protect against this. However, it is important to note that an improper or incorrect connection between the power and interface lines could still result in damage to the instrument.
- Check the pin-out configuration and ensure that no power is applied to the connector cables other than those specifically marked 'Power VCC +' and 'Power GND -'.

The device ensures high functional reliability, but malfunctions can occur during operation. Such malfunctions may result from the following causes:

Sensor is not ready for operation; no communication with the sensor possible

- Check the power supply to the device. Within range? Polarity reversed? Direct current?
- Check the cable connector: Mechanical damage? Not connected?
- Check the cable: Mechanical damage?
- Assess error messages if any.
- Assess changes in the installation site: for instance, new obstacles obstructing direct view to the water surface?

No data via HTTPS (REST API)

- Verify that the cellular connection is operational.
- Verify that the sensor has a valid IP configuration and Internet/network access.
- Verify that the configured server URL is correct.
- Verify that the configured API endpoint is correct.
- Verify that the destination server is operational and reachable.
- Verify that the correct authentication credentials, API key, or access token are configured.
- Verify that the server accepts connections from the sensor's IP address.
- Verify that firewalls, proxy servers, or security appliances are not blocking HTTPS traffic (TCP port 443).
- Verify that the server supports the TLS version used by the sensor.
- Verify that the server certificate is valid and trusted.
- Verify that the system date and time are correct if certificate validation is enabled.
- Check the sensor's communication logs for HTTP error codes (e.g. 401 Unauthorized, 403 Forbidden, 404 Not Found, 500 Internal Server Error).
- Verify that payload size limits imposed by the server are not exceeded.

No data via SFTP

- Verify that the cellular connection is operational.
- Verify that the sensor has a valid IP configuration and Internet/network access.
- Verify that the configured SFTP server address is correct.
- Verify that the configured SFTP port is correct (typically port 22).
- Verify that the destination server is operational and reachable.
- Verify that the configured username and password are correct.
- If key-based authentication is used, verify that the correct SSH key is installed.
- Verify that the sensor is authorized to access the specified SFTP account.
- Verify that the configured target directory exists.
- Verify that the sensor has write permissions for the target directory.
- Verify that firewalls or security appliances are not blocking SFTP traffic (TCP port 22).
- Verify that the server supports the required SSH/SFTP protocol versions and cipher suites.
- Verify that sufficient storage space is available on the destination server.
- Check communication logs for authentication or file transfer errors.

No data transmission via HTTPS, WMO First Mile/MQTTS or SFTP

Note: All HyQuant Edge communications with KISTERS IoT Platform (KIP) services are protected using TLS 1.3 and mutual certificate authentication (mTLS). Incorrect deployment, replacement, expiration, or revocation of certificates may prevent successful communication even when network connectivity is available.

- TLS / Certificate Authentication Issues
- Verify that the correct client certificate has been installed on the sensor.
- Verify that the client certificate has not expired.
- Verify that the server certificate has not expired.
- Verify that the destination server trusts the Certificate Authority (CA) that issued the sensor's client certificate.
- Verify that the sensor trusts the Certificate Authority (CA) that issued the server certificate.
- Verify that the correct certificate chain has been installed on the server.
- Verify that the configured server hostname matches the hostname contained in the server certificate.
- Verify that the system date and time are correct. Significant time deviations may cause certificate validation failures.
- Verify that the server is configured to accept TLS 1.3 connections.
- Verify that mutual TLS (mTLS) authentication is enabled and configured correctly on the receiving server.
- Verify that the certificate presented by the sensor corresponds to the identity expected by the receiving system.
- Verify that revoked certificates are not being used.
- Check the communication logs for TLS handshake or certificate validation errors.

Symptom	Possible Cause
Network connection available, but no data received	Client certificate missing or invalid
Communication stopped after months or years of operation	Certificate expired

Symptom	Possible Cause
Communication fails after server migration	Server certificate or CA chain changed
Device can reach server IP address but connection is rejected	mTLS authentication failure
HTTPS/MQTTS connection repeatedly opens and closes	Certificate validation or hostname mismatch

Unstable or no readings

- Sensor position 17 parallel to the water surface? Is the 'K' marking raised on the lid of the device, facing upstream?
- Unstable water level?
- Check the lid: deposition of dirt or scratches on the radome?
- Obstruction in the measurement beam?
- False reflections on large object in close vicinity to the sensor?
- Strong development of vegetation in the water stream?

Erroneous sensor configuration

- The sensor settings require verification to ensure they are both plausible and complete.
- Refer to section Configuration 22 for a detailed description of configuration/settings.

7 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 9001 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)	Repair Request Form (APAC) Declaration of Contamination (APAC)
Europe, the Middle East and Africa (English)	Repair Request Form (EMEA) Declaration of Contamination (EMEA)
Germany (German)	Repair Request Form (DE) Declaration of Contamination (DE)

  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.

8 Technical Data

Technical specifications	HyQuant Edge – L20 / L50	HyQuant Edge V	HyQuant Edge L + V
Radar Type / Frequency Band	FMCW 60 GHz V-Band Radar level sensor	FMCW Doppler 60 GHz V-Band Radar Velocity sensor.	Integrated FMCW 60 GHz V-band Radar Level (L) and Doppler Velocity (V) sensor
Measurement Range	▪ L20: 0.10 … 20 m (0.32 … 65.61 ft) ▪ L50: 0.15 … 50 m (0.49 … 164.04 ft)	▪ L: 0.10 … 20 m (0.32 … 65.61 ft) ▪ V: 0.05 … 15 m/s (0.16 … 49.2 ft/s)	
Sampling Rate	1 Hz (1 measurement / second)		
Accuracy	≤ 2 mm / 0.079 in (HIF approved)	L: ≤ 2 mm / 0.079 in (HIF approved) V: ▪ 0.02 … 4.5 m/s (0.07 … 14.8 ft/s): 1 % of measured value ▪ 4.5 … 15 m/s (14.8 … 49.2 ft/s): 2 % of measured value	
Resolution	±1 mm / 0.04 in	L: ±1 mm / 0.04 in V: 1 mm/s / 3.281 ft/s	
Blind Zone / Blanking Distance	▪ L20: 0.1 m / 0.328 ft ▪ L50: 0.15 m / 0.49 ft	0.1 m / 0.3281 ft	
Minimum Ripple - Velocity	N/A	2–3 mm / 0.079 … 0.12 in	
Supply Voltage (Range)	DC 10 … 30 V		
Power Consumption @ 12 V dc	▪ Typical < 15 mA @12V ▪ Peak < 80 mA @12V		
Beam Angle (azimuth by elevation)	8° by 8°	▪ L: 8° by 8° ▪ V: 8° by 12°	
Ingress Protection	IP68	IP68 means that the device is both dustproof and protected against continuous immersion in water to a maximum depth of 1.5 metres for a maximum of 3 hours. It does not provide protection against other liquids such as salt water, soapy water, alcohol or heated liquids. **Note**: To achieve IP68, ensure that the 8-pin M12 connector is correctly inserted and securely fastened.	

Wireless Communication	▪ LTE CatM1 / NB-IoT
	▪ Protocols:
	  ▪ https REST API
	  ▪ sFTP		

Operating Temperature Range	-40 … +80 °C (-40 … 176 °F), avoid ice shield		
Humidity Range	Relative Humidity 0 … 100 % non-condensing		

Dimensions & Weight	▪ HyQuant Edge sensor with backplate:
	  ▪ L×W×H: 160 × 97 × 91 mm / 6.29 × 3.81 × 3.58 in
	  ▪ Weight: 1.15 kg / 2.54 lb		

Technical specifications	HyQuant Edge – L20 / L50	HyQuant Edge V	HyQuant Edge L + V
	▪ Packaged Dimensions: ▪ L×W×H: 300 × 300 × 187 mm / 11.8 × 11.8 × 7.4 in ▪ Weight: 2.5 kg / 5.51 lb		
Power Connector	M12 8-pin		
Materials	Housing: Powder-coated aluminium and Radome / Front panel (lid) HDPE		
Compliance	CE, FCC Class B, UL, RoHS		

Table 7 – Technical Data

9 Obligations of the Operator and Disposal

This chapter contains the following subsections:

- Obligations of the Operator 48
- Dismantling / Disposal 48

9.1 Obligations of the Operator

European Union

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.

Worldwide

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.

9.2 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.

Disposal

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.

EU WEEE Directive

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.

10 Regulatory and Compliance Information

EU

Technology	Maximum Rated Output Power	Notes
WLAN 2.4 GHz	**15.0 dBm EIRP (average)**	Includes up to 2 dB FCC/ISED-based tune-up tolerance. Country-specific EIRP may vary.
Radar 60 GHz	**19.0 dBm EIRP (average)**	Includes up to 2 dB FCC/ISED-based tune-up tolerance. Country-specific EIRP may vary.

During configuration, the radar and Wi-Fi transmit simultaneously. During normal operation, only the radar is active.

US / Canada

Technology	Maximum Rated Output Power	Notes
WLAN 2.4 GHz	**21.5 dBm EIRP (average)**	Includes up to 2 dB FCC/ISED tune-up tolerance.
Radar 60 GHz	**21.0 dBm EIRP (average)**	Includes up to 2 dB FCC/ISED tune-up tolerance.

RF Exposure statement

This equipment complies with FCC and ISED radiation exposure limits set forth for an **uncontrolled environment**.

To ensure compliance:

- This equipment **should be installed and operated with a minimum distance of 20 cm** between the radiator and any body part of nearby persons.
- This transmitter **must not be co-located or operated in conjunction with any other antenna or transmitter.**

Failure to observe these guidelines may result in non-compliance with Canadian RF exposure regulations.

Compliance statement

This device complies with Part 15 of the FCC Rules and with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

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

Changes or modifications made to this equipment not expressly approved by KISTERS AG may void the FCC authorization to operate this equipment.

FCC certified modules

This product contains FCC-certified modules:

- FCC ID: RI7WE866C6
- FCC ID: RI7ME31OG1WW

These radio modules have been certified separately and comply with the requirements of FCC Part 15.

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Empowering decisions of tomorrow