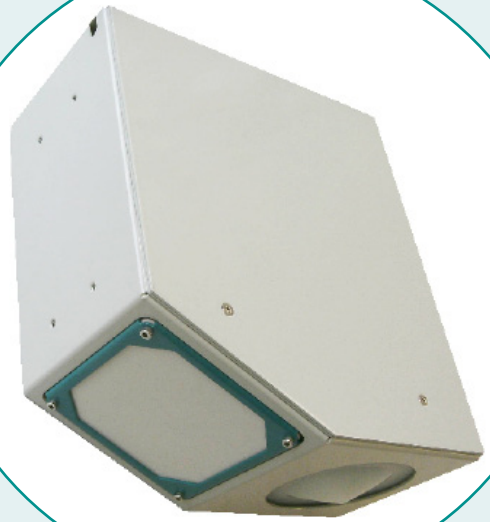


RQ-30

Contact-free discharge measurement for channels and open rivers using radar technology



Properties and benefits

- » Maintenance free
- » No need for a structure in the water
- » Fully operating even in flood water situations
- » Solar powered due to low power consumption
- » Detection of flow direction
- » Velocity range of 0.10 to 15 m/s (depending on flow conditions)
- » Recognition of hysteresis effects
- » Measures in a back water situation
- » Also measures vegetal invasion
- » Measures in tide influenced rivers
- » Automatic installation angle correction
- » Optional: analog outputs 4 to 20 mA

General

Introduction

The RQ-30 radar sensor continuously measures the discharge of rivers and channels. The device combines two contact-free radar measurement methods to determine the surface velocity and water level.



Contact-free = failsafe = low maintenance

Because of the contact-free measurement the system cannot be harmed by sediments and floating refuse. The result is very low maintenance and an increased reliability, especially in flood water situations.



Application

Assembly

The sensor can be easily mounted on bridges, superstructures of channels or the ceilings of closed channels. Installation at measurement locations previously too difficult to realize is now possible.

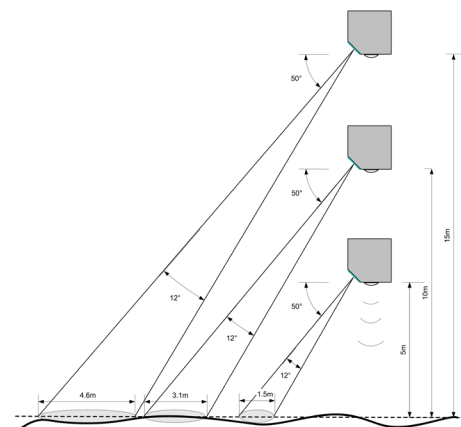
Criteria

The main criteria for measurement sites are the properties of the riverbed, the water surface and the flow conditions. The riverbed must not change to ensure a consistent measurement. The water surface must not be flat. Wavelets should be visible. Stones, maelstroms or standing waves should not occur within the measuring area.



Measurement range

Depending on the properties of the water surface the device can be installed in a height of 0.5 to 35 m. The measurable velocity range is between 0.10 and 15 m/s. Additionally the direction of flow is detected, enabling the operation in tide influenced rivers.



Measurement principle

Flow velocity

The flow velocity is measured using the Doppler effect. A radar signal with a frequency of 24 GHz is transmitted towards the water surface. The signal is partially reflected, the moving water causes a frequency change due to the Doppler effect. A spectral analysis is performed on the reflected signal and the water's surface velocity is calculated. The signal has to be transmitted at an angle to the water surface. This angle is internally measured to automatically correct the calculated velocity.

Water level

The water level is calculated using a time measurement. The radar device sends short pulses perpendicular to the water surface. To conclude the distance to the water surface and thus the water level, the time between transmission and reception of these pulses is measured.

Discharge

The discharge Q is determined by the continuity equation.

$$Q = v_m \cdot A(h)$$

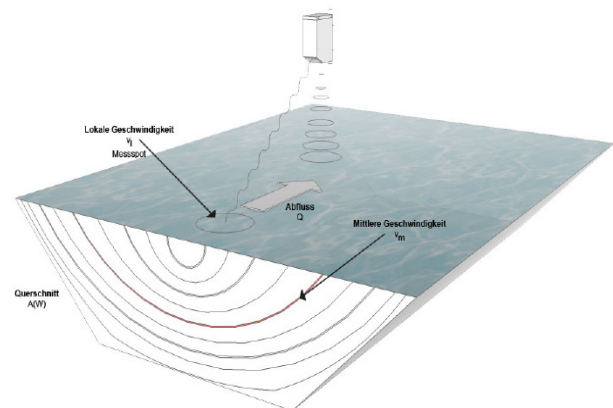
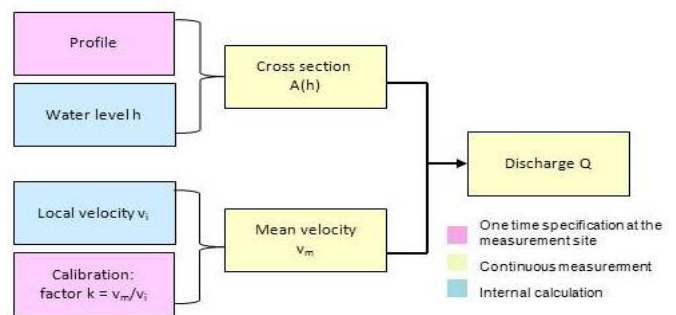
The moistened cross-sectional area $A(h)$ as a function of the water level is determined by the cross-sectional profile of the measuring point. The RQ-30 does not measure the mean velocity v_m but the local surface velocity v_l . The mean velocity is calculated with the conversion factor k .

$$v_m = v_l \cdot k$$

The k-factor k can either be determined by a reference measurement or by modeling using the RQ-Commander Modeling for example. The surface level, the k-factors and cross-sectional areas can be stored on the device. This enables the RQ-30 to calculate and output the discharge directly from the measured speed and water level.

The RQ-Commander uses the following equation to calculate the discharge:

$$Q = A(h) \cdot v_l \cdot k$$



Technical Data

General	
Dimension in mm	338 x 333 x 154 mm 2 brackets for pipe Ø 34 - 48 mm
Total weight	5.4 kg
Protection	IP 67
Power supply	6 ... 30 V
Consumption at 12 V	Standby appr. 1 mA active measurement about 140 mA
Operation temperature	- 35° ... 60° C
Storage temperature	- 40° ... 60° C
Lightning protection	integrated lightning protection
Level measurement	
Level range	<ul style="list-style-type: none"> 0 ... 15 m - Standard version 0 ... 35 m - Extended measuring range (optional)
Resolution	1 mm
Accuracy	+/- 2 mm
Radar frequency	26 GHz (K-Band)
Radar opening angle	10°
Velocity measurement	
Detectable measurement range	0.10 ... 15 m/s (depending on flow conditions)
Accuracy	+/- 0.01 m/s; +/- 1 % FS
Resolution	1 mm/s
Direction recognition	+/-
Measurement duration	5 ... 240 sec.
Measurement interval	8 sec. ... 5 h
Measurement frequency	24 GHz (K-Band)
Radar opening angle	12°
Distance to water surface	0.50 ... 35 m
Necessary minimum wave height	3 mm
Automatical vertical angle compensation	
Accuracy	+/- 1°
Resolution	+/- 0.1 °
Interface	
Analog Output (RQ-30 a)	3 x outputs 4 - 20 mA for level, velocity and discharge
Interface	Interface: 1x SDI-12 1x RS 485 or Modbus Transfer rate: 1.2 to 19.2 kBd Protocol: various ASCII-Protocols, Output: discharge, flow velocity, level, quality parameter