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Environmental Solutions



SonTek[®] M9

DISCHARGE, BATHYMETRY, VELOCITY PROFILING



BROCHURE
XA00298



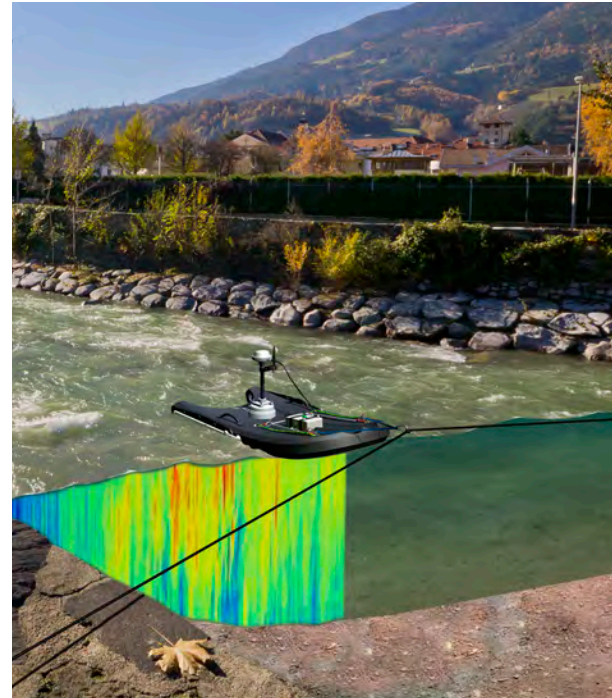
a xylem brand

SonTek M9 Advantage

The SonTek M9 is the ultimate solution for collecting both discharge data and conducting bathymetric surveys. The industry validated and reliable M9 is an all-in-one ADCP, seamlessly combining the durability of the award-winning RiverSurveyor-M9 with the adaptable bathymetric capabilities of the HydroSurveyor-M9, offering unparalleled data collection flexibility.

Designed to be intuitive and user-friendly, the rugged M9 excels in various conditions, from severe floods to dry spells. Say goodbye to complicated adjustments during extreme events - the M9 automatically handles varying water levels, changes in velocity structure, and multiple applications.

The M9 is a proven and reputable game-changer when it comes to river, stream and canal flow measurements. But as the adage goes - wait, there's more! When you team-up the M9 with our top-notch HYPACK[®] Environmental Mapping software, it transforms into the ultimate all-in-one solution. Say hello to unmatched flexibility all wrapped up in one efficient package that you can only get at SonTek.



SonTek M9 Applications



Hydrology

RiverSurveyor Live
RiverSurveyor Stationary Live

- Discharge measurement
- Index velocity calibration
- Flow/volume delivery verification
- Ground truthing discharge models
- Habitat studies
- Watershed flux and loading
- High definition velocity profiles

1 MHz beams

0.5 MHz echo sounder

3 MHz beams



Bathymetry

HYPACK MAX
or Environmental Mapping

- Reservoir surveys and capacity predictions
- Bathymetric volume calculations
- Velocity mapping
- Reconnaissance tool
- Sediment flux detection
- Longitudinal river surveys
- Geomorphology studies

Technology That Matters

The SonTek M9 is relied upon by top environmental water monitoring agencies worldwide and has redefined the ADCP industry. It achieves this distinction by being the first ADCP to employ multiple acoustic frequencies, driven by SonTek's exclusive SmartPulseHD® technology. This proprietary innovation guarantees consistently reliable measurements across a range of depths, from shallow to deep.

What further distinguishes the M9 is its advanced microcontrollers, essentially the brains of the instrument. These intelligent controllers automatically select the appropriate acoustic frequency, pulse scheme, and cell size, eliminating the need for manual instrument configuration. This means you can concentrate on what truly matters – the measurement itself.

The SonTek M9 system includes a dedicated echo sounder (vertical beam) for precise bottom bathymetry definition. Users have the option of switching between the dedicated vertical beam or an average of the bottom track (skew) beams to calculate depth, providing two independent depth references.



Features	Benefits
Multiple acoustic frequencies	Balances the highest resolution with the greatest range of depths and flow velocities.
Vertical acoustic beam i.e. echosounder	Superior channel definition for both bathymetric and discharge applications. Extends maximum discharge depth when bottom-tracking is out of range.
SmartPulseHD®	An intelligent algorithm that looks at water depth, velocity, and turbulence, then automatically adapts to conditions using pulse-coherent and incoherent techniques. High-definition cell size down to 2 cm.
Microprocessor computed discharge and secure data	Discharge computations using RiverSurveyor Live software are simultaneously done within the M9 and on the host computer. Data is not lost if communication temporarily drops out.
Standard 360° compass and two-axis tilt sensor	Compensates for vessel motion due to surface conditions. Provides velocities in Earth coordinates and magnetic error feedback in real-time and post processing.
Ping rates to 70Hz, averaged to 1Hz data output	High ping rates ensure extremely robust data collection. Ping distribution based on data collection mode – discharge or bathymetry.
Bottom-tracking	Acoustically track vessel speed over ground and ship track independent of GNSS/GPS (optional). Also supplies redundant depth measurement.
Differential GNSS* (optional)	Geo-referenced position from dual-frequency, multi-constellation with SBAS as an alternative to bottom tracking for moving bed or other difficult situations.
RTK GNSS* (optional)	Ultra precise geo-referenced position that can be used as an alternative to bottom tracking for moving bed or other difficult situations. Benchmark tie in available in HYPACK® software.
Sound speed correction with the CastAway-CTD (optional)	Built-in temperature sensor used for sound speed calculations. Optional use of CastAway-CTD interpolates sound speed in space and time with RiverSurveyor Live and (optional) HYPACK® software.

*GNSS- Global navigation satellite system is a general term describing any satellite constellation that provides positioning, navigation, and timing (PNT) services on a global or regional basis.

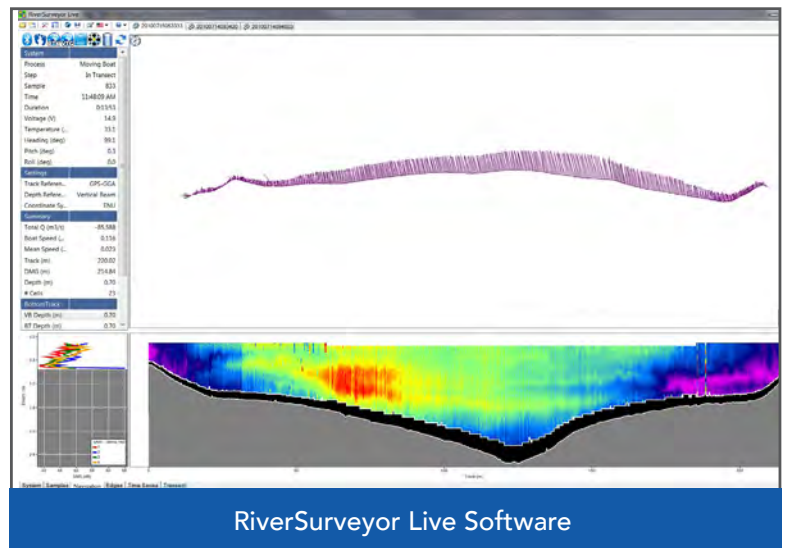
Display. Process. Analyze.

Prepare to be impressed not only during your measurements but also afterwards, thanks to the RiverSurveyor Live (RSL) software which offers multi-language support, catering to a diverse range of users. You can choose from languages such as Afrikaans, Bahasa Indonesia, Catalan, Chinese, English (UK & US), French, German, Hungarian, Italian, Japanese, Korean, Polish, Portuguese, Spanish, and Turkish.



Moving Boat: RiverSurveyor Live

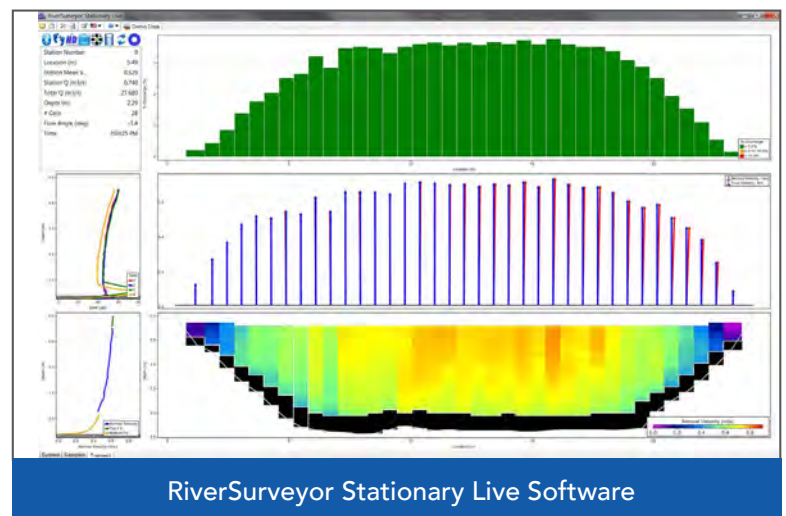
- Real-time QA/QC in the field - get feedback while taking the measurement to ensure the highest quality data.
- Enables you to efficiently navigate from one bank to the other with a full contour plot of the water velocity profile and bottom bathymetry.
- View multiple data streams (bottom-track, vertical beam, GNSS-GGA, and GNSS-VTG) simultaneously.
- Built-in USGS Loop Correction Method and Stationary Moving Bed Analysis for moving bed assessment.



Stationary: RiverSurveyor Stationary Live

(Mid-section or Mean-section)

- Additional software program that uses traditional USGS/ISO mid-section or mean-section methods.
- GNSS/GPS distance between stations or manually enter location on tagline. Mix and match GNSS distance or manual stations as needed.
- An alternative to moving boat method to improve mean velocity data collection in highly turbulent areas or moving bed environments.
- Includes under ice measurement methods.
- An option when measurement sections are braided, have islands or between bridge piers.

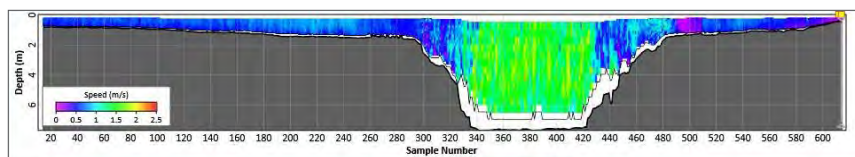


The SonTek M9 for Discharge Measurements



From the shallow floodplain to the thalweg, the SonTek M9 adapts from one sample to the next, seamlessly transitioning from slow to fast flows. This is where SmartPulse excels, with the capability to capture velocity structures within different flow fields in one single transect without any special user configuration.

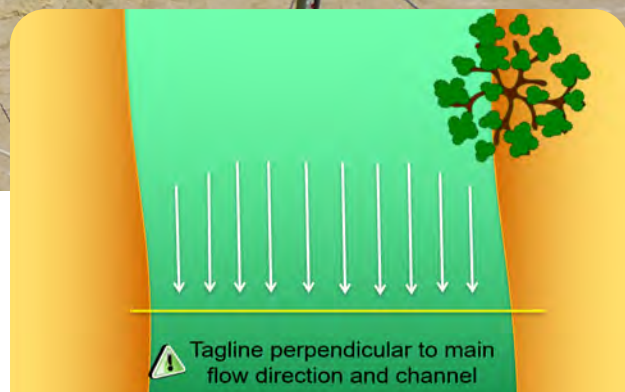
Swift velocities in natural channels can often result in a moving bed, where particles are migrating downstream along the riverbed. Testing for this phenomenon is important for selecting the appropriate track reference. The M9 and RiverSurveyor Live have you covered with two different ways to test for and quantify the presence of a moving bed - Loop and SMBA. If you opt to connect a GNSS/GPS receiver to your M9, you will be able to toggle between the recorded track references afterward, without compromising your measurement or losing any of your raw data. Magnetic interference causing you problems? The firmware and software is ready for GNSS/GPS compass data input.



Signal Attenuation got you down?

Floods often coincide with large amounts of sediment in the water, which can start to impact the acoustic range of any ADCP. One possible way to overcome this is to switch off SmartPulse and use Manual Configuration. This mode allows the user to select the lower frequency transducers and larger cell sizes for all samples, giving the M9 a better chance of punching through the sediment laden water.

VIDEO TRAINING:
Guide to Collecting Discharge
Data with a SonTek ADCP



Did You Know...

ADCP site selection in rivers and streams is crucial for accurate hydrological and environmental assessments. While ADCPs can measure a wide range of hydraulic conditions, choosing a good site ensures the best quality data, and ultimately reduces your measurement uncertainty and improves repeatability. Proper site selection should be the first step in any hydrographer's process before beginning a measurement.

Choosing an appropriate site involves considering factors like water depth, channel morphology, and the presence of obstacles that could affect the flow and/or acoustic signal.

When identifying a measurement section, look for a site with uniform, homogeneous flow. Ensure there is a straight reach of channel that can be safely accessed for measurements. Avoid bends, constrictions, and in-channel obstacles, such as boulders or vegetation. Finding a reach with minimal surface turbulence, white water, and eddies will ensure repeatability transect-to-transect. And finally, confirm that the site conditions do not exceed the specifications (water velocity, maximum depth, etc.) for the instrument used.

Ultimately, proper ADCP site selection ensures reliable data for water resource management, flood forecasting, sediment transport studies, and ecosystem preservation.

Easy Deployment Options

HydroBoard II

The tried and true HydroBoard II is a versatile and user-friendly board exclusively designed for the SonTek M9 that allows you to collect data in a wide array of flow conditions. Whether you're measuring or mapping rivers, lakes, or coastal areas, the HydroBoard II's rugged design and stable platform make it safe to operate, even for beginners. With the HydroBoard II, you can confidently navigate through water bodies, up to 5 m/s, capturing essential data for a range of applications. Say goodbye to complicated set-ups and hello to a smooth, safe and efficient measuring experience with a dive-prevention harness designed for unexpected submergence as well as dampening unintentional jerks on the line for the smoothest operating experience.



Remote Boat Options

Need to alternate between a towed float and a rope-free configuration? Just add the rQPOD (sold separately) to a Xylem Torrent Board and turn it into a remote controlled vehicle for ultimate flexibility. Imagine being able to collect water quality, discharge, and hydrographic data all from one convenient vehicle. The rQPOD platform provides water professionals the opportunity to simultaneously use the latest sensors for integrated and perfectly aligned data sets, especially in hard-to-access sites. The Torrent Board and rQPOD combination removes the need for multiple boats in your fleet, streamlining the data collection process.



Boat-side Mounting

Attaching the SonTek M9 to a boat's side enables seamless, real-time tracking of water currents across a range of depths, and increases data gathering applications. With a boat-mounted ADCP you can collect data over large areas, offering detailed insight into aquatic currents. It also enables quick setup and tear down allowing for the use of a "vessel of opportunity". Plus, it augments safety by minimizing direct exposure to risky conditions, as the instrument can be installed and then easily pulled out of the water during transport between sites. Simply lower the mounting pole once you arrive at your measurement location and get started!



The SonTek M9 for Mapping Velocity, Position and Depth

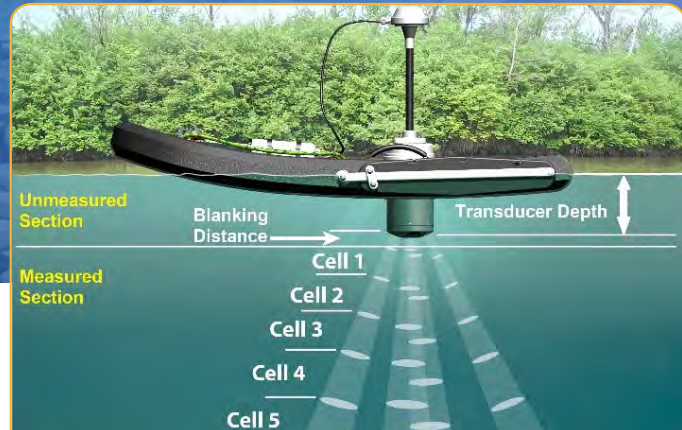
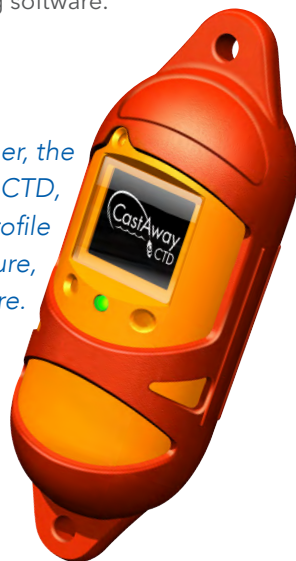


Achieve accurate and comprehensive bathymetric data collection without the need for complicated set-ups, expensive equipment, or complex software packages. The SonTek M9 is a single package that encompasses the latest and most advanced bathymetric technology.

Water column sound speed corrections are critical for accurate depth measurements

The CastAway-CTD calculates the sound speed profile based on temperature, conductivity, and pressure. With built-in GNSS/GPS and Bluetooth, the CastAway records and plots the location data for each sound velocity cast and quickly downloads this data to your PC, no cables required! Integrated with RiverSurveyor Live, HYPACK-MAX and Environmental Mapping software.

Don't forget your handy partner, the easy-to-deploy CastAway-CTD, that calculates a sound speed profile based on temperature, conductivity, and pressure.



Did You Know...

When using an ADCP, there are a number of details that can affect the data's accuracy and quality. One key factor is the transducer depth, which has a direct impact on how depth is calculated. The distance below the water surface that the ADCP is submerged can change based on the ADCP itself, additional gear installed on the floating platform, and the environment. In all cases, there is a surface layer that will not be measured by the ADCP.

This unmeasured section has two components: the transducer depth itself and the blanking distance. The blanking distance is a dynamic value determined by the instrument itself, taking into account frequency, acoustic ping type, and sample depth.

So, how much does the transducer depth matter? Well, it depends on where you're working and the application. For discharge, an error in transducer depth will propagate across the channel. When mapping bathymetry or velocity, the transducer depth determines the reference point for vertical placement of velocity vectors and total depth. That's why it's important to measure and input the transducer depth as accurately as possible. An error or a guess can drastically change the final depth calculation.

There are different methods to measure transducer depth, depending on how you deploy the SonTek M9. To get into the nitty-gritty of each option, you can check out our technical paper [Understanding the Importance of Transducer Depth](#). Knowing how transducer depth affects your data helps you get more accurate bathymetry.

Bathymetry Made Easy

Embrace an all-inclusive solution.

Benefit from full water column velocity mapping, exclusive 5-beam depth sounding, and acoustic bottom tracking (for speed over ground in GNSS/GPS blind spots), all provided within a single package. This comprehensive approach guarantees you have all the data you need for a complete solution.

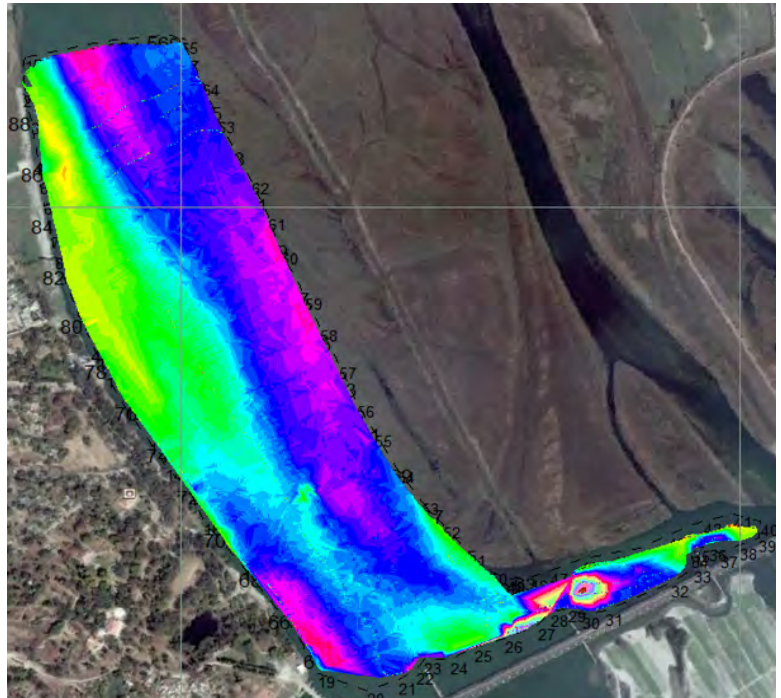
With a 5-beam, 50° swath the SonTek M9 can be easily used for bathymetric mapping - providing more coverage than a traditional single beam echosounder.

The depth to width ratio of the sounding footprint is approximately 10:9 - this means the sounding coverage will spread outward ~9 m when you are in 10 m of water depth. Larger coverage with a single instrument means less survey lines and therefore less time collecting data.

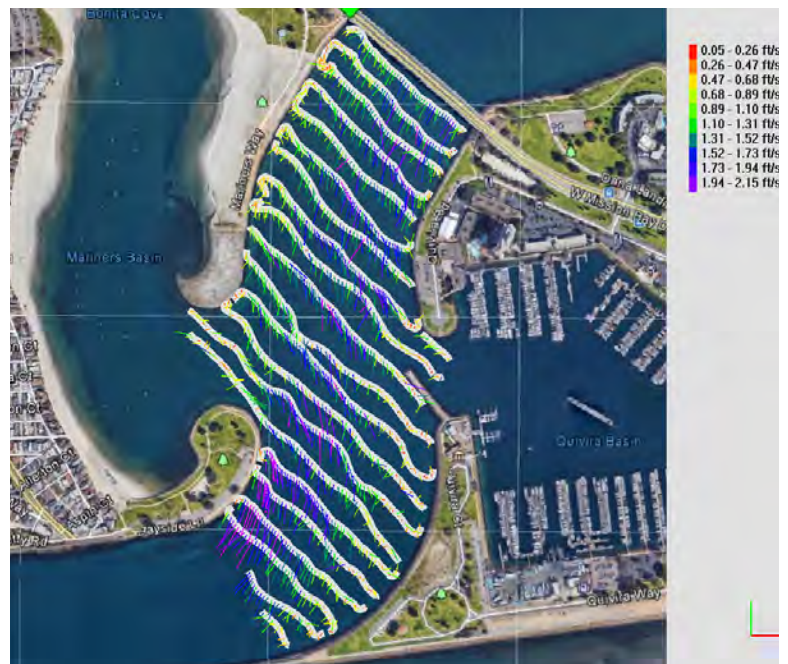
Not only is the M9 a 5-beam echosounder, it also simultaneously gathers velocity profiles for investigating scour, potential fish habitat, and geomorphology questions.

Need to identify a new long term monitoring site?

Use the SonTek M9 for site selection. The velocity and bathymetric mapping capabilities of the M9 can help you select your next monitoring site. Gather a survey of velocity data along a reach to select the section with uniform flow. Use the resulting bathymetric map to ensure you have a uniform cross-section without obstructions. Guarantee your long term data collection site is set up for success!



Bathymetry of the Ganges River above Narora Barrage in Uttar Pradesh, India. Data collected with the SonTek M9 using HYPACK software.



Velocity map of Mission Bay Channel near San Diego, California, USA. Data collected with the SonTek M9 using HYPACK software.

HYPACK® Environmental Mapping

Precision Redefined: Achieve unparalleled accuracy in environmental mapping with advanced algorithms and state-of-the-art technology, ensuring your data reflects the true nature of underwater landscapes.

Seamless Integration: Seamlessly integrate with a wide array of ADCP systems, sensors, and platforms, allowing you to effortlessly gather and consolidate data from various sources into a comprehensive visualization.

Dynamic Visualization: Transform raw data into insightful visual representations, enabling you to analyze underwater terrains, flow regimes, vegetation, habitats, and pollution levels with clarity and precision.

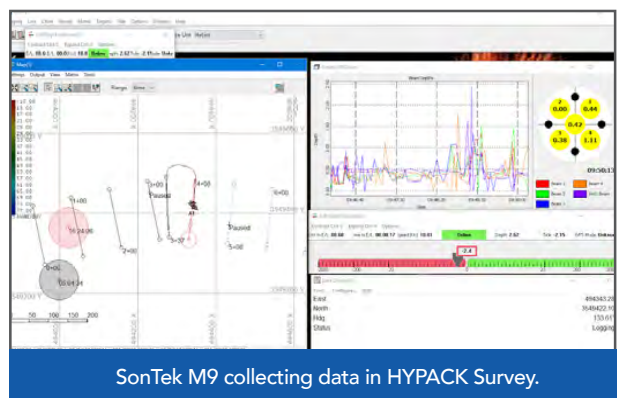
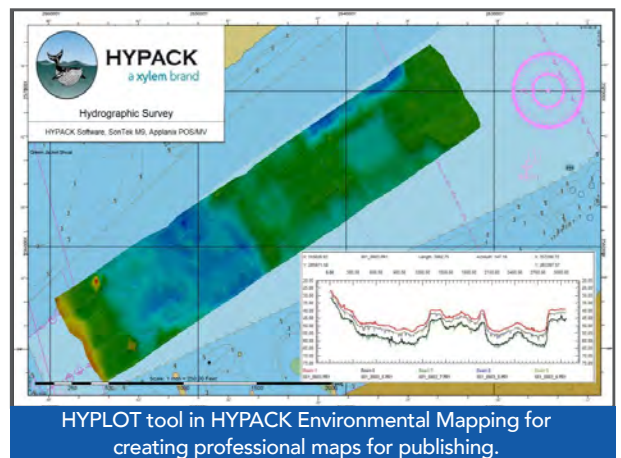
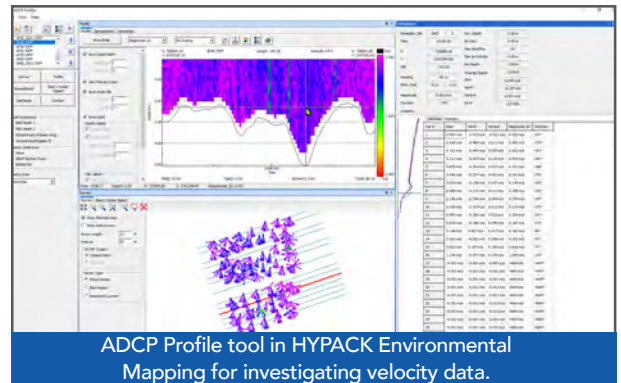
Customized Workflows: Tailor your mapping processes with flexible workflow configurations, empowering you to adapt to diverse environments and research objectives effortlessly.

Real-time Insights: Gain real-time insights into the environmental conditions as you map, enhancing decision-making capabilities and reducing the need for post-processing.

Collaborative Capabilities: Foster collaboration among teams with cloud-based data sharing and project management tools, ensuring seamless communication and efficient project progression.

Environmental Monitoring: Implement continuous monitoring strategies with automated surveys, enabling you to track changes in aquatic ecosystems over time and respond pro-actively to emerging challenges.

User-Centric Interface: Navigate through the software's intuitive interface, designed to simplify complex tasks and enhance user experience, thereby accelerating the learning curve for both novice and expert users.



Users can upgrade to HYPACK Max if they have additional mapping requirements such as side scan or lidar data collection.

Specifications

Velocity Measurement	Metric	Imperial/English
Profiling Range (Distance)	0.06 to 40 m, environmentally dependent	0.2 to 131 ft
Accuracy	Up to +/- 0.25% of measured velocity; ±0.2cm/s	+/- 0.078 in/s
Profiling Range (Velocity)	± 20 m/s ¹	± 66 ft/s
Resolution	0.001 m/s	0.0032 ft/s
Number of Cells	Up to 128	
Cell Size	0.02 to 4 m	0.06 to 13 ft
Transducer Configuration	Nine (9) transducers; Dual 4-beam 3.0 MHz/1.0 MHz Janus at 25° slant angle; 0.5 MHz vertical beam echosounder	

Depth Measurement		
Range	0.20 to 80 m	0.66 to 262 ft
Accuracy	1% [0.02% with a full water column sound speed correction]	
Resolution	0.001 m	0.003 ft

Discharge Measurement		
Range with Bottom-Track	0.3 to 40 m	1 to 131 ft
Range with GNSS/GPS	0.3 to 80 m, extrapolated beyond 40 m	1 to 262 ft
Computations	Internal	
Internal Recorder Size	8 GB	

Bathymetry Measurement		
Range	40 m (skew beams) to 80 m (vertical beam)	131 to 263 ft
Velocity Profiling Range	± 10 m/s	± 32.8 ft/s
Computations	Software	

Temperature Sensor		
Resolution	± 0.01° C	± 0.018° F
Accuracy	± 0.1° C	± 0.18° F

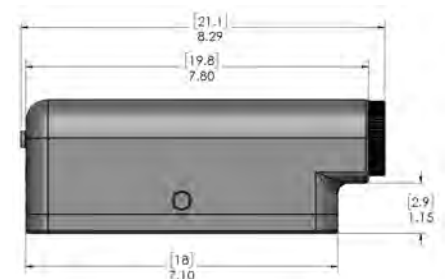
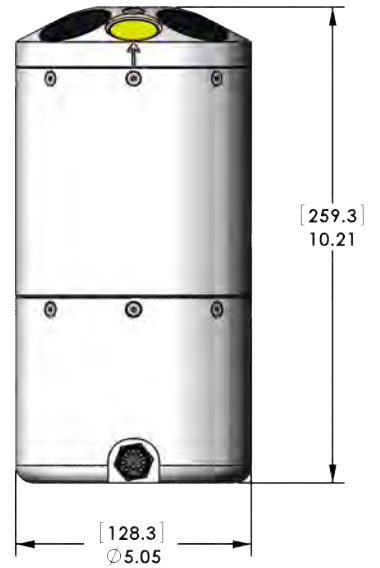
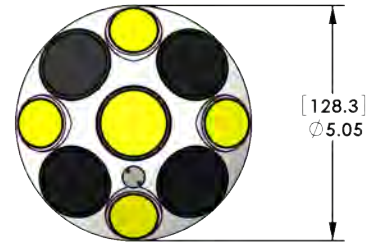
Compass/Tilt (Solid State Type)		
Range	360°	
Heading Accuracy	± 2°	
Pitch/Roll Accuracy	± 1°	

Power/Communications (No Telemetry)		
Input Voltage	12 - 18 VDC	
Communication Type	RS232 direct	
GNSS/GPS Communication	RS232 serial input	
Max Data Output Rate	1 Hz	
Internal Sampling Rate	Up to 70 Hz	

Physical Properties		
Depth (Pressure) Rating	30 m	164 ft
Operating Temperature	-5 to 45° C	23 to 113° F
Storage Temperature	-10 to 70° C	14 to 158° F
Weight in Air	2.3 kg	5 lb
Weight in Water	-0.6 kg	-1.3 lb

Power Communications Module (PCM)		
Communication Type	2.4 GHz radio	
Battery Type	Standard AA batteries ²	
Average Duration	8 hours of continuous use (6 hours with RTK)	
Radio Range ³	Standard (10 dBm) - High (22 dBm)	
Base to Rover	1000 m - 3000 m	3281 ft - 9843 ft
PC/tablet to Rover	400 m - 1500 m	1312 ft - 4921 ft

GNSS/GPS Options		
SBAS GNSS Horizontal Accuracy ⁵	<1.0 m	< 3.3 ft
RTK GNSS Horizontal Accuracy ⁵	<0.02 m	< 0.066 ft
RTK GNSS Vertical Accuracy ^{4,5}	<0.04 m	< 0.131 ft



Additional Notes

¹Please contact SonTek for accuracies better than 1%, or velocities >10 m/s.

²Standard AA batteries are defined as alkaline or NiMH rechargeables, with a diameter up to 14.5mm.

³High power may not be available in all countries; all ranges with default 2 dBi antenna and line-of-sight.

⁴Requires absolute RTK solution. Only available with HYPACK software.

⁵Depends on multipath environment, antenna selection, number of satellites in view, satellite geometry, and ionospheric activity.

Xylem ['zīləm]

- 1) The tissue in plants that brings water upward from the roots;
- 2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com



Sound Principles.
Good Advice.



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