

RiverSurveyor S5 & M9

Basic description of offering

The RiverSurveyor S5 and M9 systems from SonTek represent a complete redesign from earlier versions. The electronics, mechanical hardware, software, telemetry, and floating platforms are all new. This system was specifically designed for open channel discharge measurements – unlike previous generations for acoustic Doppler instruments that were designed with oceanographic applications in mind. Consult with the brochure or technical documentation to get more general information.

What does the hardware consist of?

The system starts with a base acoustic Doppler unit. The Doppler unit can be one of either an S5 unit (a five-beam system with a velocity measurement range of up to 5 m), or an M9 unit (a nine-beam system with a velocity profiling range of up to 40 m).

In addition, there are power-communication (PCM) and GPS modules, as well as floating platform options.

What is new about the software?

The new software is called *RiverSurveyor Live* and is available in both PC and Mobile phone versions. Note that this new software is not compatible with the previous generation of RiverSurveyor systems. Furthermore, the previous versions of RiverSurveyor and Stationary software are not compatible with the S5 and M9 hardware.

What are some of the key new features that differentiate these products from the previous generation of river profilers?

- **Multi-frequency acoustics** – The S5 and M9 represent a new generation of Doppler instruments that incorporate multi-frequency acoustics. In the past, range (both minimum and maximum), cell size, and precision were limited by a single acoustic frequency. The S5 and M9 both use the latest in high-speed microelectronics, which enables extremely high ping rates.
- **Fully automated setup and operation** – The S5 and M9 both automatically set their own cell size and pulse scheme to adapt to the river conditions. Note that it does this dynamically while you are taking a measurement, so optimal performance is ensured throughout the measurement process. The M9 even changes automatically from 3.0 MHz to 1.0 MHz as the depth changes. This powerful feature allows for the most comprehensive shallow-to-deep discharge measurements possible.
- **Vertical Beam** – The vertical beam enables superior channel definition. This is particularly evident in trapezoidal canal situations or other channels where there are steep slopes or unusual bathymetric conditions. The previous generation relied on the average of three

or four beams at a 20-30 degree angle. The vertical beam also enables the S5 or M9 to dramatically extend its bottom detection range well beyond the capability of the velocity beams (up to 15 m with the S5, and 80 m with the M9). This is useful in extreme situations such as floods where depths are greater than normal.

- **Internal Discharge calculation** – All discharge data is computed inside the Doppler instrument, as opposed to a handheld device or a laptop. This means that as long as the instrument is turned on and started, data collection and recording is assured, regardless of whether or not you have a telemetry link. That is, you can turn off your mobile device or PC while the M9 is operating, and not only will no data be lost, but the device will show the latest discharge value and other parameters.
- **Mobile phone operation** – *RiverSurveyor Live Mobile* operates on a SonTek-supplied mobile phone via Bluetooth link making one-person discharge measurements as easy as ever. Because all discharge data are calculated and stored inside either the S5 or M9, there is no risk of data loss when telemetry is interrupted.
- **Fully integrated GPS solutions** – The SonTek RiverSurveyor S5 and M9 can be factory configured with differential and RTK GPS options. This is useful for augmenting bottom tracking in moving bed situations (such as during a flood event) and assigning geographic positions to data samples.
- **Side Lobe Suppression** – The River Surveyor S5 and M9 employ SonTek's proprietary method of acoustic side lobe suppression on each of its transducers. This innovative design technique allows for the primary side lobe to be reduced by as much as 20dB, which is equivalent to 100 times the energy level as a non-suppressed design. A transducer with a significantly reduced primary side lobe allows for greater acoustic directivity, and therefore increases the useful working environment of acoustic sensors in shallow water and near-boundary locations.
- **Independent data sampling** – The data output from a single 1-Hz sample contains all the necessary information to construct the entire profile (including system and user settings) and compute all discharge related information at that point in time.

I see the M9 works in water that is as shallow as the S5. If that's the case, why would I need an S5?

The M9 uses the same 3 MHz acoustics as the S5, so the performance of the M9 in water depths up to 5 m will essentially be identical. However, the reasons why you might prefer the S5 to the M9 include:

- **Size** – The S5 transducer head diameter is 3.2 inches in diameter, versus 5 inches for the M9. This means in the very shallow sections of a channel, there will be less flow disturbance near the head of the instrument.
- **Performance** – The S5 vertical beam is higher in frequency (1.0 MHz versus 0.5 MHz), and will work in slightly shallower depths.
- **Price** – The S5 is priced lower than the M9 and is designed for smaller river/open-channel applications that are less than 5 m deep.

Why are there so many beams?

Historically, SonTek systems have used three beams for velocity, and we have used upward-looking beams on our Argonaut products for water level. For the new RiverSurveyor, we use a four-beam Janus design for velocity for the following reasons:

- It provides some benefit when measuring near an edge on a steep or vertical wall when making stationary measurements.
- It does provide a slightly more accurate geometrical solution for velocity calculation (considering a four-beam geometry at a 25 degree slant angle versus a three beam geometry at a 25 degree slant angle).
- Four-beam Janus is more commonly accepted amongst the user community.

The vertical acoustic beam is a key component in moving boat applications for ADCPs as it provides much better data for defining the channel cross-section geometry than does the average of multiple beams at significant angles.

If I purchase both an S5 and an M9, can I use the same power/communications box with either system?

Yes. All the Doppler profiling and processing electronics are located inside the same housing with the transducer components. Therefore, any PCM is compatible with either system.

Do the multiple frequencies of the M9 operate at the same time during a discharge measurement?

For moving boat applications in open channels, the system uses a technique we call “frequency hopping”. The system automatically detects the bottom depth and water velocity and will switch from using the 1.0 MHz acoustics to 3.0 MHz acoustics automatically. The two frequencies do not operate concurrently.

How does the system automatically set the cell sizes? Can I set them myself?

The system comes pre-set from the factory with internal settings that will automatically switch the cell sizes depending on a number of factors. This was designed with the basic idea of maximizing performance and resolution while keeping the system as easy to use as possible. There are specific commands that can override these, but it is not recommended under normal circumstances.

I presently use RiverSurveyor Stationary Mode. Does this new system support that feature?

The initial-release version of *RiverSurveyor Live* for the S5 and M9 supports underway discharge measurement only. There are plans to release an update that will include stationary measurements later in 2009.

The vertical beam is like a built in echo sounder. Can I use it for hydrographic surveying with a software package like Hypack?

As configured from the factory, the primary intention of the vertical beam is to define more accurate channel geometry for area/discharge calculations using RiverSurveyor. There are plans in place for the M9 to mimic the outputs of commercial echo sounders via a special firmware feature that will make it useful with programs like Hypack. Details about this will be forthcoming later in 2009.

What kind of range can I expect from the Bluetooth telemetry solutions?

When using Bluetooth with the mobile telephone supplied by SonTek, the range is about 60 m. When running *RiverSurveyor Live* with a laptop PC and the provided USB Bluetooth antenna, the range increases to about 200 m. Note that the antennas are omni directional.

Do I need GPS in order for the S5 and M9 to properly compute discharge?

Neither GPS nor DGPS is necessary. Both the S5 and M9 fully support bottom tracking. As long as there is good bottom lock, and the bottom is not moving, you can achieve excellent discharge results without GPS.

What are the GPS options for the S5 and M9?

When purchasing an S5 or M9, SonTek offers two GPS/DGPS hardware solutions:

- Inclusive GPS in the PCM (called “VTG” on the brochure)
- SonTek RTK solution

There will be separate documentation that explains this more fully, but basically, what we are calling the “VTG” GPS provides sub-meter precision via either a Doppler based VTG string or a differential corrected GCA string. When this option is ordered, all the hardware is enclosed in the same PCM that is connected to the S5 or M9. It is highly recommended that users elect this optional feature.

The SonTek RTK solution includes all the performance and features of the VTG described above plus an RTK corrected GCA string. This will provide state of the art 0.03 m positioning and can be used either in lieu of, or to augment, bottom tracking. This is most useful in extreme situations such as floods when there are moving bottoms. Note that when this option is purchased, it also includes the base station, tripod, and telemetry link.

If you require further explanation of these options, please contact SonTek.

I have my own GPS equipment. Can I use it with the S5 and M9?

This is possible by feeding the GPS strings directly into the S5 or M9 via the dedicated GPS connector included on the power/communications cable. Note that this deviates from the previous generation of RiverSurveyor systems where the integration was done via an additional serial port on the PC. The S5 and M9 integrate GPS via the instrument firmware; the GPS data are then included in a serial data string that is either recorded or output to the PC running *RiverSurveyor Live*. Please see the technical documentation or contact SonTek if you have questions about the compatibility of your GPS system.

Will the new *RiverSurveyor Live!* software run the previous RiverSurveyor ADP systems?

No, the new *RiverSurveyor Live!* Windows software is not backward-compatible and will not operate or open data files collected by earlier RiverSurveyor systems.

I have an existing mobile phone that supports Bluetooth. Can I use it to operate the RiverSurveyor?

The only phone presently supported is the model supplied by SonTek as part of the system. Please call SonTek support if you have questions.

I want to deploy my S5 or M9 in an autonomous mode (e.g., on the bottom of a river or harbor). Is this possible?

At the present time, the firmware and hardware to conduct a self-contained deployment are not available.

How do I mount the systems? Is there a catamaran or trimaran available for the S5/M9?

The S5 and M9 may be used by themselves over the side of a small boat with similar type mounting arrangements used for the previous RiverSurveyor systems. In addition, SonTek is offering a trimaran solution for the S5 and M9 that holds both the acoustic Doppler unit and the power-communications box and antenna (if this option is specified).

SonTek are also working on a single hull solution for tethered operation. This will be available shortly following the instrument release.

If I have an existing trimaran or aluminum hull set for the RiverCAT, can I use these with the M5/M9?

The hardware for mounting the S5 and M9 with power communication box is significantly different from the previous generation. Therefore we recommend purchasing a new floating platform with your product if you intend to use it that way.