RiverSurveyor S5/M9 SmartPulseHD®* Feature

The RiverSurveyor S5 and M9 systems now feature SmartPulseHD® technology for dynamic selection and optimization of the acoustic pulsing scheme. In general terms, SmartPulseHD® works as follows:

- The system continuously tracks water velocity and depth, and based upon these values it selects the optimum processing configuration.
- At any given time, the system is sending multiple pulse types, potentially at multiple frequencies, using different processing techniques to achieve the optimum system performance.
- For the M9, up to three frequencies are used (3.0 MHz, 1.0 MHz, 0.5 MHz); for the S5, up to two frequencies are used (3.0 MHz, 1.0 MHz).
- A variety of different ping types and processing techniques are utilized: bottom tracking, bottom detection, incoherent, pulse coherent, and broadband. Many of these ping types are used in combination with each other, and the exact ping types being used at any given time will depend on the operating conditions.
- The system tracks velocity and depth on a second-by-second basis, and updates the ping types and processing methods as needed based on changing conditions.

For the S5, two primary data types are output:

- When the water is sufficiently shallow and slow, the system reports data from 3.0 MHz pulse coherent pings using a 2 cm cell size.
    o Maximum operating depth is about 1.5 m.
    o At a depth of 1.5 m, the maximum velocity limit is about 0.4 m/s. The maximum velocity increases significantly in shallower water.
- In water depths and velocities greater than above, the system uses 3.0 MHz incoherent pings with the cell size optimized based on the current water depth.
    o Depths less than 2 meters use 0.1 m cells
    o Depths 2-4 meters use 0.2 m cells.
    o Depths greater than 4 meters use 0.4 m cells.

For the M9, several different data types are output.

- When the water is sufficiently shallow and slow, the system reports data from 3.0 MHz pulse coherent pings using a 2 cm cell size.
    o Maximum operating depth is about 1.5 m.

- o At a depth of 1.5 m, the maximum velocity limit is about 0.4 m/s. The maximum velocity increases significantly in shallower water.
- In moderate depth/velocity conditions, the system reports data from 1.0 MHz pulse coherent pings using a 6 cm cells size.
    - o Maximum operating depth is about 5.0 m.
    - o At a depth of 5.0 m, the maximum velocity limit is about 0.4 m/s. The maximum velocity increases significantly in shallower water.
- In water depths less than 5.0 m with velocities greater than the above, the system uses 3.0 MHz incoherent pings with the cell size optimized based on the current water depth.
    - o Depths less than 2 meters use 0.1 m cells
    - o Depths 2-4 meters use 0.2 m cells.
    - o Depths greater than 4 meters use 0.4 m cells.
- In water depths greater than 5.0 m, the system uses 1.0 MHz incoherent pings with the cell size optimized based upon the current water depth.
    - o Depths less than 10 meters use 0.5 m cells
    - o Depths 10-20 meters use 1.0 m cells.
    - o Depths greater than 20 meters use 2.0 m cells.

The RiverSurveyor SmartPulseHD® feature utilizes the system's powerful CPU with multi-thread parallel processing routines; some key advantages from this are listed below.

- The RiverSurveyor runs multiple pings types from multiple frequencies at the same time. At any given site, the RiverSurveyor may use a total of 8-10 different ping types; at any given moment, it is typically running 3-5 ping types simultaneously.
- The parallel processing capabilities allows the system to collect new acoustic pings while at the same time analyzing data from the last set of pings. This continuous evaluation of data allows the system to modify operation, on a second by second basis, to ensure it always uses the best ping types for the conditions at that moment.
- In the case of the M9, the RiverSurveyor has the added advantage of using multiple acoustic frequencies for velocity profiling. It combines different frequencies and different Doppler processing techniques to optimize performance for the current operating conditions. The added power and flexibility provided by the additional acoustic frequency is significant, and makes a major difference in final instrument performance.
- The high speed of the CPU means that the RiverSurveyor has no limits in the type of processing or analysis that is done. The final performance of the RiverSurveyor is limited only by the physics of underwater sound.

SmartPulseHD® processing should be able to automatically adapt to any operating condition without any user input. Despite this (as a safety precaution), the updated RiverSurveyor Live PC and Mobile software includes an option to disable SmartPulseHD® processing.

- This option should be needed only rarely for very particular conditions where the SmartPulseHD® algorithms may fail.

- We have not yet encountered conditions where SmartPulseHD® does not work properly, but it is conceivable.
- If you use the RiverSurveyor Live option to disable SmartPulseHD® processing, the system will run Incoherent pings only exactly as done with previous firmware releases.

We welcome any comments, questions, or suggestions you may have.

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*Patent Pending