



High Resolution Water Profiling Mode 12

Recommended Applications

1. High Resolution, Shallow water profiling in rivers, streams and estuaries.
2. Boundary layer measurements.

Water Mode 12 is the result of the continued evolution of the signal processing within our Workhorse products. It is effectively an improved version of Water Mode 1(our most robust Water Mode) offering higher sampling rates (up to 20Hz) and more precise velocity measurement. Water mode 12 was designed primarily for use in short-range, small-depth cell applications, however under the right conditions it can be used anywhere Water Mode 1 is used and results in either reduced variance for a set time period or reduced power consumption.

Conditions where you would use Mode 12.

- ✍ You require a Small Depth Cell Size (Min 1 cm)
- ✍ You require Low Standard Deviation of velocity measurement and velocities are too fast for Water Mode 11.

It is not suitable for:

- ✍ Dynamic situations. (See [Environmental Limits](#) for more detail)
- ✍ Profiling in very high turbulence.



Why is Water Mode 12 an Improvement?

Water Mode 12 is an evolution of our existing Water Mode1.

The key improvements are:-

1. Depth Cell Size can be set to 1 cm minimum (previously 5 cm)
2. Maximum number of depth cells has been increased to 255 (previously 128).
3. Sampling rates up to 20Hz over a wide range of velocities

Basic Operation:

Typically a workhorse transmits pulses, collects information on the returned signal and processes this information into a velocity measurement. The process is called a ping. With Water Mode 12 we shorten the procedure and transmit and receive a series of sub-pings that are not fully processed until the desired number have been accumulated (the number is determined by the WO command). The system then averages this data and completes the final processing to produce ping velocity values but the sub-ping raw data is not stored. The result is faster processing so more data can be collected for a given time and hence better measurement precision.

Commands relevant to Water Mode 12 use.

WM12 Selects Water Mode 12.

WV170 Used to adjust the characteristics of the transmission pulse. A higher WV allows measurement of higher velocity currents. (100 Minimum, 480 Maximum)

WK1 Sets Depth Cell (Bin) size in cm, 1cm minimum. Overrides WS command for small depth cells.

WO pp,hh where pp = number of Sub pings per ping and hh = minimum number of 0.01 seconds between Sub pings. A typical setting for a 1200KHz system for use in shallow water would be WO20,4 which transmits 20 sub-pings 40msec apart and then averages them to create the ping which is recorded.



Environmental Limits:

Maximum horizontal and vertical velocity is determined by the WV command. The default WV170 gives a maximum horizontal velocity measurement of +/- 5m/sec.

If Water Mode 12 is used on a platform or mooring that experiences large accelerations during the ping sampling period then some bias may occur.

Other Considerations:

- ✍ To achieve high sampling rates(e.g. 20Hz) the number of depth cells should be less than 60(WN command should be 60 or less).
- ✍ Maximum Sub Ping rates must be considered to avoid ping-to-ping interference.
- ✍ Maximum duration of the Sub Pings must be considered if operating in a dynamic environment.
- ✍ Maximum duration of the Sub Pings must be considered in light of Bottom Tracking – too much time separates the Water/Bottom pings – resulting in “stripy data”. It is recommended to use BP2 in these situations.

MAXIMUM PING RATES:

We have always recommended that the ping rate be no faster than 1.5 times the Bottom Tracking range. This gives the following minimum ping times for the expected full range of the instrument:

300kHz – 450ms

600kHz – 225ms

1200kHz- 67ms

These are very conservative numbers and, to our knowledge, have always worked. In the absence of a bottom within range, a more optimistic value to use is to allow absorption and range spreading enough time to attenuate the previous ping by 50 dB (so we can handle 25dB life layers). This gives the following values:

Fresh Water Salt Water



300kHz	450ms	190ms
600kHz	150ms	100ms
1200kHz	45ms	40ms

When bottoms are within range, the situation is improved once the time is set so that multiple bounces off of the bottom occur between pings. A bounce is when the previous ping has traveled to the bottom, bounced to the surface, returned to the bottom, and then back to the instrument. Each bounce dissipates energy. How much is dependant on the bottom roughness (rough is better). This loss adds to the absorption loss. We recommend the following minimum ping times for fresh water applications:

300kHz - 300ms
600kHz - 100ms
1200kHz- 40ms

EXAMPLES of Improved Standard Deviation of velocity measurement:

1. 1200kHz, 10cm Bin, in 5 meter of water:
 - WM1 takes 175ms and results in a StDev of about 30 cm/s. Thus, it takes 1.6 seconds to get to 10cm/s.
 - WM12 with 9 Sub Pings gets the same performance in 0.65 seconds.
2. 600kHz, 25cm Bin, in 10 meters of water:
 - WM1 takes 160ms and results in a StDev of about 26 cm/s. In 0.5 sec(3 Mode 1 Pings) the StDev would be ~ 16cm/s.
 - WM12 with 7 Sub Pings, StDev would be ~ 10cm/s in 0.5secs.

EXAMPLES OF IMPROVED ENERGY USEAGE:

1. 300kHz, 4m Bin, in 100 meters of water with 10 burst pings/ensemble:
 - WM1 uses 13.1 W-Sec per ensemble.
 - WM12 uses 11.3 W-Sec for 10 Sub Pings per Ensemble – a savings of 14%.
2. 600kHz, 2m Bin, in 40 meters of water with 10 burst pings/ensemble:
 - WM1 uses 5.7 W-Sec per ensemble.
 - WM12 uses 3.9 W-Sec for 10 Sub Pings per Ensemble – a savings of 32%.

NOTE: The savings are $(.0024 * \#Bins + .14)$ W-Sec per Sub Ping. The % savings are higher in shorter-range profiling.



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Application Note
