General River Profiling - Mode 1

Is:

- General Purpose
- Works with turbulence and shear
- Works with low current, low backscatter,high background noise
- Deeper Water Profiling

Is Not:

- High resolution

Profiling Modes – There are three user-selectable profiling modes: 1, 5, and 8, that are set by the WM command (e.g. WM1 for Mode 1). They are used to tune the ADCP for different flow conditions. Each mode has its own window of operation, as shown in Figure 1. In this application note, we concentrate on the characteristics and setup criteria for Mode 1. Refer to the High Resolution River Profiling – Mode 5 and 8 application note for information on Modes 5 and 8.

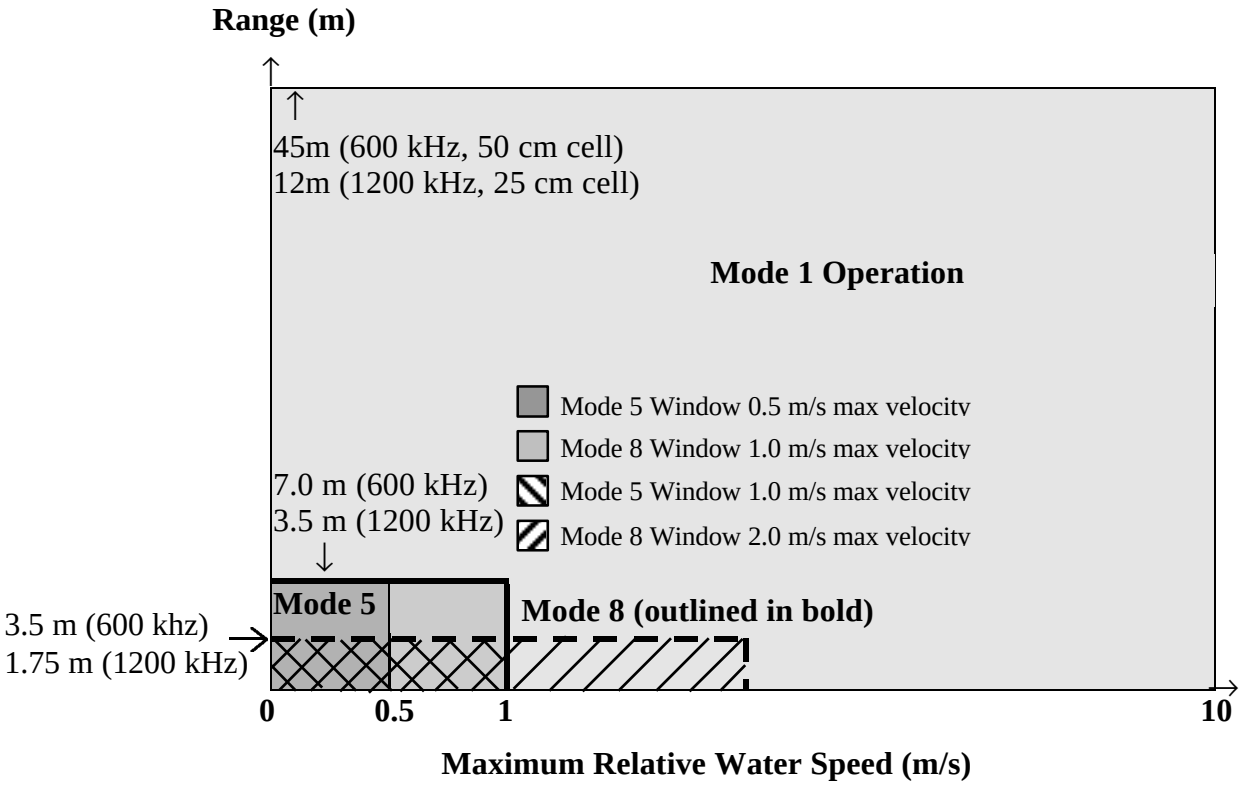

Figure 1. Operational Windows for Profiling Modes 1, 5, and 8

Mode 1 Description - Mode 1 is our general-purpose water-profiling mode. It covers a wide range of water speeds and provides the greatest possible profiling range. In Mode 1, the ADCP transmits a phase-coded sequence of pulses separated by short lags. Because of the short lags, Mode 1 is not as susceptible to decorrelation effects as the high-resolution modes 5 and 8, and it can work in flows with turbulence and shear.

Window of Operation - Mode 1 is the most robust profiling mode. It works well in areas of slow currents, turbulent flows, strong shears, low backscatter concentrations (or where signal returns are apt to be weak), high background noise (such as being used from a ship), and in areas where the water changes from shallow (1 m) to deep (>6 m). Mode 1 can profile in apparent water speeds up to +/- 10 m/s. It has a maximum profiling range up to 70 m for the 600 kHz (4m cell size) and up to 20 m for the 1200 kHz (2m cell size). For shallow and slow flows, where high vertical resolution (small cell sizes) and low standard deviations are required, use the High Resolution Profiling Modes 5 and 8.

Performance Specifications – The following table summarizes the expected performance of the 600 and 1200 kHz Rio Grande ADCP as a function of cell size. The profiling range values are referenced from the transducer face. To determine the maximum and minimum water depths, add the transducer depth.

Table 1. Mode 1 Profiling Specifications

Freq.	Blanking	Bin Size	Single-Ping Std Dev.	Range to First Depth Cell	Profiling Range (m)	
					Min.	Max
600kHz	WF25	WS50	18.0 cm/s	0.87 m	1.7 m	45 m
	WF25	WS100	6.6 cm/s	1.36 m	2.7 m	52 m
	WF25	WS200	3.0 cm/s	2.35 m	4.8 m	60 m
	WF25	WS400	1.8 cm/s	4.32 m	9.0 m	67 m
1200kHz	WF25	WS25	18.0 cm/s	0.56 m	1.0 m	12 m
	WF25	WS50	6.6 cm/s	0.81 m	1.6 m	14 m
	WF25	WS100	2.9 cm/s	1.30 m	2.6 m	16 m
	WF25	WS200	1.8 cm/s	2.29 m	4.7 m	18 m

Note: Specifications assume water temperature is 10°C and salinity is 0 ppt.

Setting the Ambiguity Velocity - To operate the ADCP using water-profiling Mode 1, you must correctly set the ambiguity velocity (WV command). The ambiguity velocity tells the ADCP processor the maximum expected velocity the ADCP will

measure. The ADCP uses phase to determine velocities, and it uses the WV value to set up internal scaling so that no ambiguity errors are made. One might wonder why you wouldn't just set a very large ambiguity velocity value and therefore never have to worry about getting ambiguity velocity errors in your data. The reason is that the standard deviation of the velocity measurement increases with larger ambiguity velocity values. There is a trade-off between allowing a large enough ambiguity velocity and reducing the standard deviation of the measurement. As an example, refer to the ambiguity velocity settings shown in Table 2 for a 600 kHz ADCP with a 1 m cell size and compare the standard deviation value of 4.9 cm/s for WV100 versus the standard deviation of 10.2 cm/s for WV480.

To set the ambiguity velocity, you need to have an idea of the maximum apparent velocity the ADCP will measure. The apparent (relative) velocity is a combination of the boat and water velocities as shown in Figure 2.

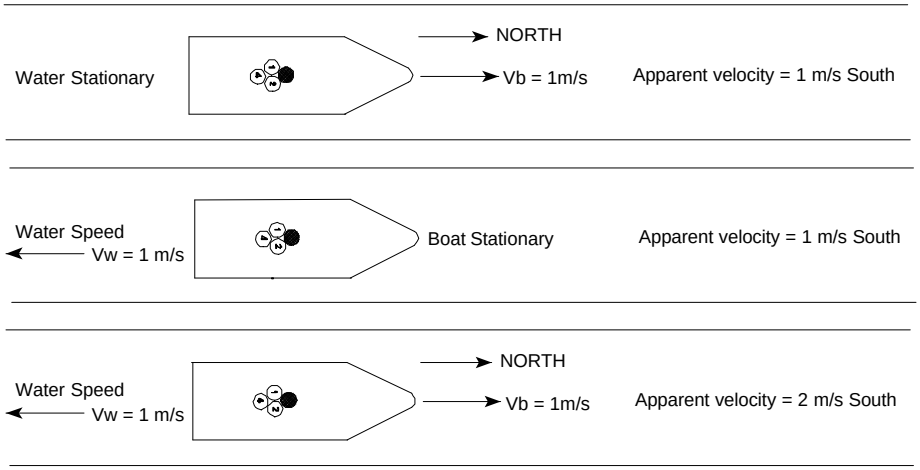

Figure 2. Apparent Water Velocity

The ambiguity velocity is set to the maximum expected apparent velocity the ADCP will measure along any one of the beams. The concept of horizontal versus beam velocity is illustrated in Figure 3.

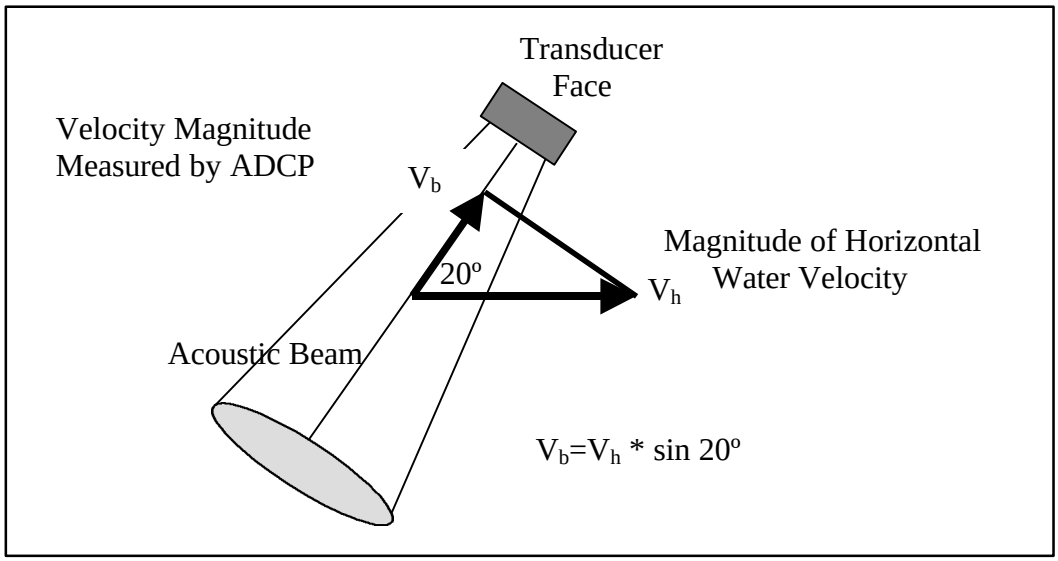

Figure 3. Horizontal versus Beam Velocity

Use the following formula to set the WV-command:

WV = (max. apparent velocity in cm/s) * (sin B) * (1.5)

Where:

B = Beam angle (20° for WorkHorse Rio Grande – all frequencies)

(1.5) = The highest safety margin. You can reduce this safety margin if you are sure you will not exceed the maximum apparent velocity. We recommend a minimum safety margin of 1.2.

Table 2. Example Ambiguity Velocity Values

WV – Command Setting	Ambiguity Velocity	Horizontal Apparent Velocity	Standard Deviation	
			600 kHz 1m Cell	1200 kHz 0.5m Cell
WV100 (minimum)	100 cm/s	+/- 3 m/s	4.9 cm/s	4.9 cm/s
WV170 (default)	170 cm/s	+/- 5 m/s	6.6 cm/s	6.6 cm/s
WV480 (maximum)	480 cm/s	+/- 15 m/s	10.2 cm/s	10.3 cm/s