



FlowTracker Handheld ADV[®] Firmware 3.1 and Software 2.10

IMPORTANT NOTE

If your system already has FlowTracker firmware version 3.1 installed, do **not** use the instructions in this Release Note to install firmware version 3.2. Instead, use the instructions in the Release Notes for firmware version 3.2 [FlowTracker Release Notes (FWv3.2 SWv2.11).pdf].

The new FlowTracker firmware (version 3.1) and software (version 2.10) represent a major improvement in FlowTracker operation that greatly expands instrument capabilities.

- **Section 1 – System Requirements**
- **Section 2 – Installing Firmware and Software Updates**
- **Section 3 – Overview of New Features**
- **Section 4 – New Discharge Data Collection Techniques**
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- **Section 6 – Other New Features (Including Multi-Language Support)**
- **Section 7 – New FlowTracker Software**
- **Section 8 – New FlowTracker Keypad**

1. System Requirements

FlowTracker firmware version 3.1 requires 512 KB of internal memory. Note that:

- Systems shipped in 2002 or later have 512 KB of memory. As such, FlowTracker serial numbers P135 and later do not require a hardware upgrade.
- Systems shipped in 2001 may require a hardware upgrade. If your FlowTracker's serial number is before P135, please contact SonTek/YSI to see if a hardware upgrade is needed.
NOTE: Systems meeting this condition must NOT update their firmware until you verify its status with SonTek.

FlowTracker software version 2.10 works with the following operating systems.

- Windows XP
- Windows 2000 Service Pack 4 (Internet Explorer version 6.0)

2. Installing Firmware and Software Updates

To install firmware version 3.1:

- Before updating your FlowTracker's firmware:
 - Ensure your FlowTracker meets the system requirements listed in §1 (above).
 - Download any data files from the FlowTracker to your computer, and then format the FlowTracker's recorder.
 - **Important:** A new parameter (Nominal Noise Level) was added to the FlowTracker to check noise levels as part of a data quality check (§5). For new systems, this value is set at the factory. For systems that are being updated by users, this value is set during the firmware update process, but requires that you perform the update in a "low noise" environment. As such, when you are updating the FlowTracker's firmware:
 - Do not touch the probe or the probe's transducers. The probe can be in air or in water, but should not be touching anything (particularly electronics or a person).

- Keep the system as far as practical from other electronics, including the computer. Our suggestion is to lay the FlowTracker on a table away from any electronics and the computer (as allowed by the communication cable).
- After updating the firmware, run the Auto QC test (§5). If the system fails with a “bad noise value” message, contact SonTek for further instructions.
- If necessary, download the *FlowTracker Firmware v3.1 Update Package* from our web site (<http://www.sontek.com/product/fw/ftfw.htm>). This package contains the firmware hex file (hh031.hex) and access code file (hh031.sfc) needed to install the firmware. Extract these files and save them to a folder on your computer.
- If needed, download and install *SonUtils* version 4.00 (or later) from the SonTek website.
 - <http://www.sontek.com/product/sw/sonutils/sonutils.htm>
- Connect the FlowTracker to a COM port on your computer.
- Run *SonUtils* and select the appropriate COM port in the upper left portion of the screen.
- Click the **Break** icon to establish communications with the system.
 - You should see a wake up message from the FlowTracker.
- Click **Instrument|Update Firmware**.
- Use the **Browse** window to select the firmware hex file (hh031.hex).
 - The access code should load automatically.
 - Use the **Binary** transfer mode, and be sure the **Verify new firmware** and **Use fast connection** boxes are selected.
 - Click **Start** when ready.
- *SonUtils* will show updates as the new firmware is loaded; this takes about five minutes.
- After installing the firmware update, run the Automatic QC Test (§5).

To install *FlowTracker* software version 2.10:

- Download and install the *FlowTracker* (version 2.10) software from the SonTek website.
 - <http://www.sontek.com/product/sw/flowtracker/flowtracker.htm>
- For more information on the software, see §7.

To update the decal for the FlowTracker keypad:

- **Several new features require changes to the FlowTracker keypad (§8)**. Contact your local sales agent (especially International users) or SonTek (USA users) to obtain the permanent keypad overlay. Note: You can use a temporary paper decal; see §8.
- Remove the FlowTracker batteries to avoid turning the system on while installing the decal.
- Clean and dry the existing keypad using damp cloth or a mild cleaner. Make sure the keypad is completely dry before installing the decal.
- Remove the cover for the self-adhesive backing on the decal.
- Carefully align the decal with the existing keypad starting at the bottom (**Figure 1**). Slowly work towards the top of the keypad. The embossed keys on the decal should exactly match the existing keypad.
- Thoroughly smooth the decal over the entire surface.



Figure 1 – Keypad Decal Installation

3. Overview of New Features

Given the number of new features, we recommend reading this overview and refer to detailed sections that are of particular interest. We encourage you to begin using the new firmware and software, using these notes and the FlowTracker manual as a reference if questions arise.

Note: Installing the *FlowTracker* software also installs PDF copies of the following documents:

- Detailed FlowTracker Technical Manual (English only)
- Abbreviated FlowTracker User's Manuals (English, Chinese, French, German, Italian, Japanese, Spanish)
- Quick Start Guides (English, Chinese, French, German, Italian, Japanese, Portuguese, Spanish)

- Several new features require changes to the FlowTracker keypad. Section §8 shows the new keypad layouts, which can be printed and temporarily pasted over the keypad. A permanent decal is available to update the key labels; see §2 for installation instructions.
- To process data files collected using the new firmware, *FlowTracker* software version 2.10 must be used. The new software can read either old or new FlowTracker files, but the old software will not be able to read the new data files.
- Discharge calculation equations (§4.1)
 - The discharge equation is the algorithm used to calculate discharge in a river.
 - The FlowTracker now supports three discharge equations.
 - Mid section equation (used in previous versions)
 - Mean section equation
 - Japanese equation
- Discharge measurement methods (§4.2)
 - The selected method specifies how to determine the mean velocity at each station.
 - Different methods change the number and location of velocity measurements.
 - The FlowTracker supports several new methods.
 - **0.6 * depth**
 - **0.2/0.8 * depth**
 - **0.2/0.6/0.8 * depth**
 - **Ice 0.6 * effective depth**
 - **Ice 0.5 * effective depth**
 - **Ice 0.2 / 0.8 * effective depth**
 - **Kreps 2** – near surface, 0.62 * depth
 - **5 Point** – near surface, 0.2 / 0.6 / 0.8 * depth, near bottom
 - **Multi Pt** – any number of points at user specified depths
 - **None** – velocity is estimated based on adjacent stations (used for multiple channels to specify an internal island)
 - **Input V**: user estimated velocity entry (when no velocity measurement is possible)
- New, automated, quality control (QC) tests ensure the highest possible data quality.
 - Automatic QC data review (§5.1) – QC parameters are reviewed for potential problems.
 - Automatic QC test (§5.2) – Evaluates all aspects of FlowTracker operation.
 - Discharge uncertainty calculation (§5.3) – The overall uncertainty of the discharge measurement is calculated for each completed measurement.
- A variety of other new features are also available (§6)
 - Multi-language support – English, Spanish, French, German, Italian
 - **QC Menu** available during data collection

- Expanded supplemental data
 - Multiple gauge height and rated flow values with time stamp
 - User-entered comments to document the data set
- Mobile phone style text entry (see new keypad layout in §8)

4. New Discharge Data Collection Techniques

4.1. New Discharge Calculation Equations

The discharge calculation equation determines how measurements at different locations across the river are combined to determine total discharge. Previous FlowTracker versions supported only the Mid section equation; now three different equations are supported.

- Mid section equation (Figure 2)
- Mean section equation (Figure 3)
- Japanese equation (Figure 4)
 - Every second station records depth only (no velocity measurement)
 - Every depth value is measured twice; the mean is used as station depth.
 - Each velocity measurement is done twice; the mean value is used.

To select the discharge equation:

- From the **Main Menu**, press **1** for **Setup Parameters**
- Select **5** for **Discharge Settings**
- Select **1** to specify **Discharge Equation**
- Settings for **Repeat Depth** and **Repeat Velocity** can be turned on and off independently

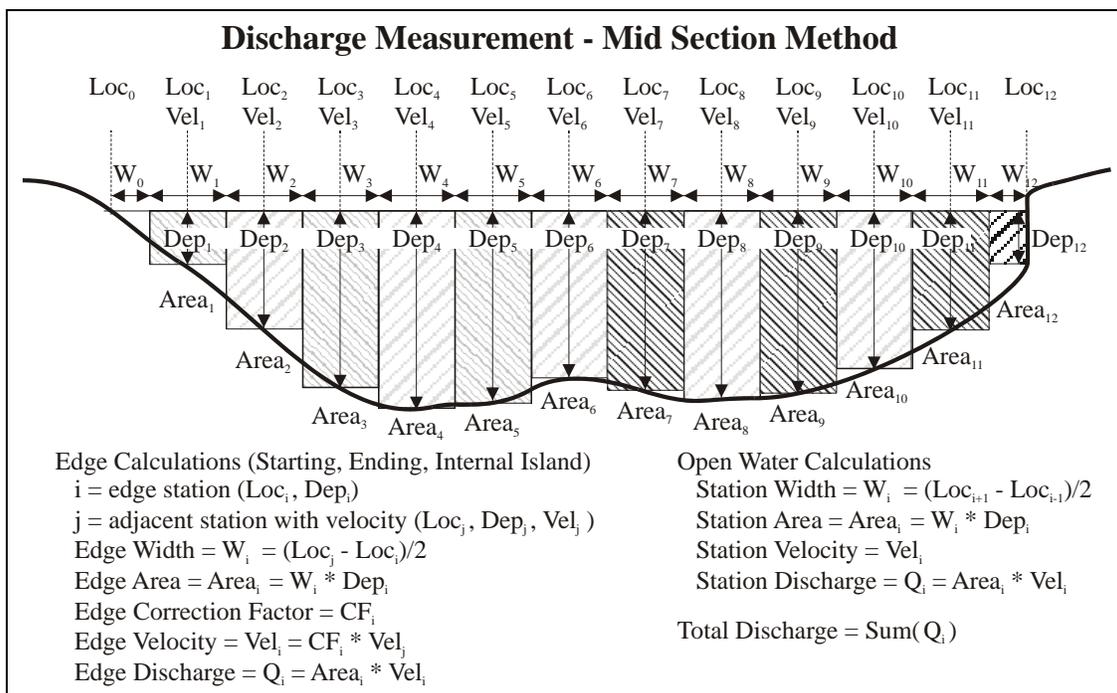


Figure 2 – Mid Section Discharge Equation

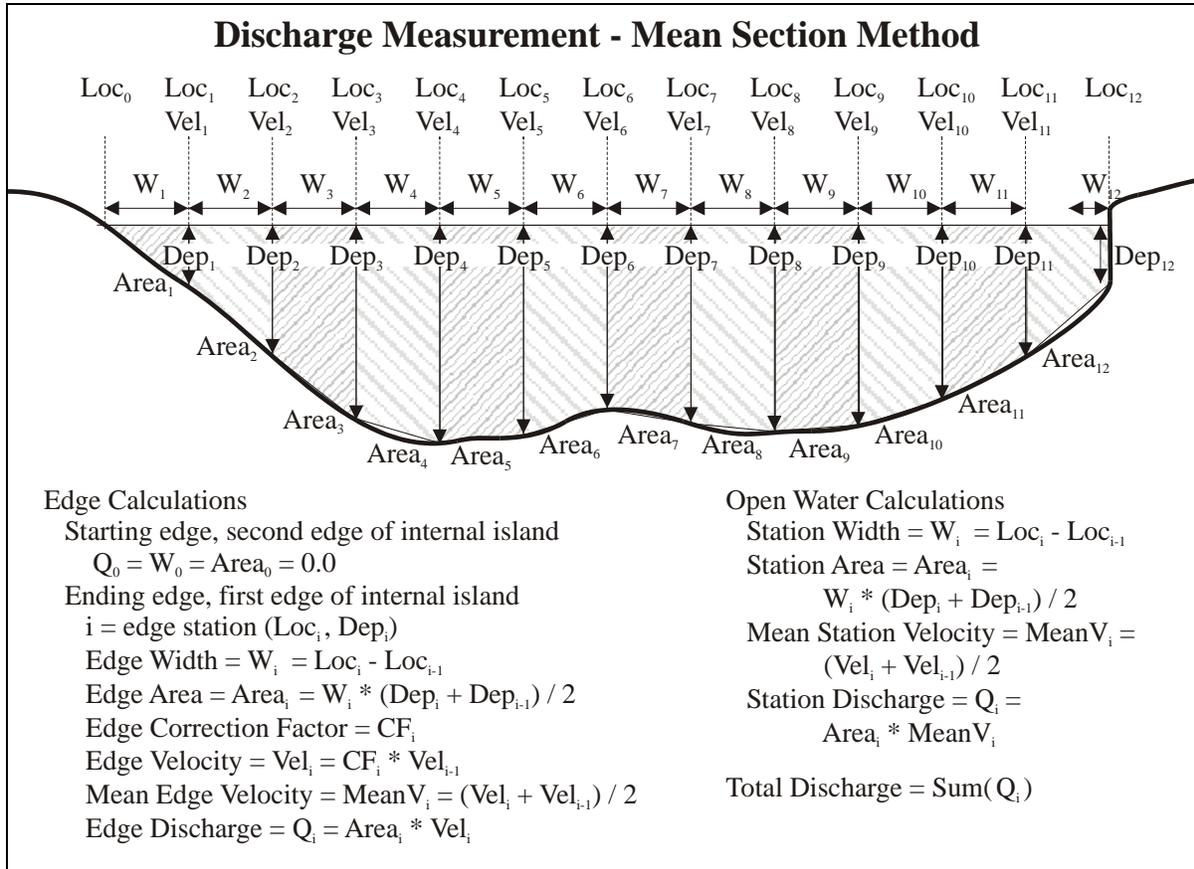


Figure 3 – Mean Section Discharge Equation

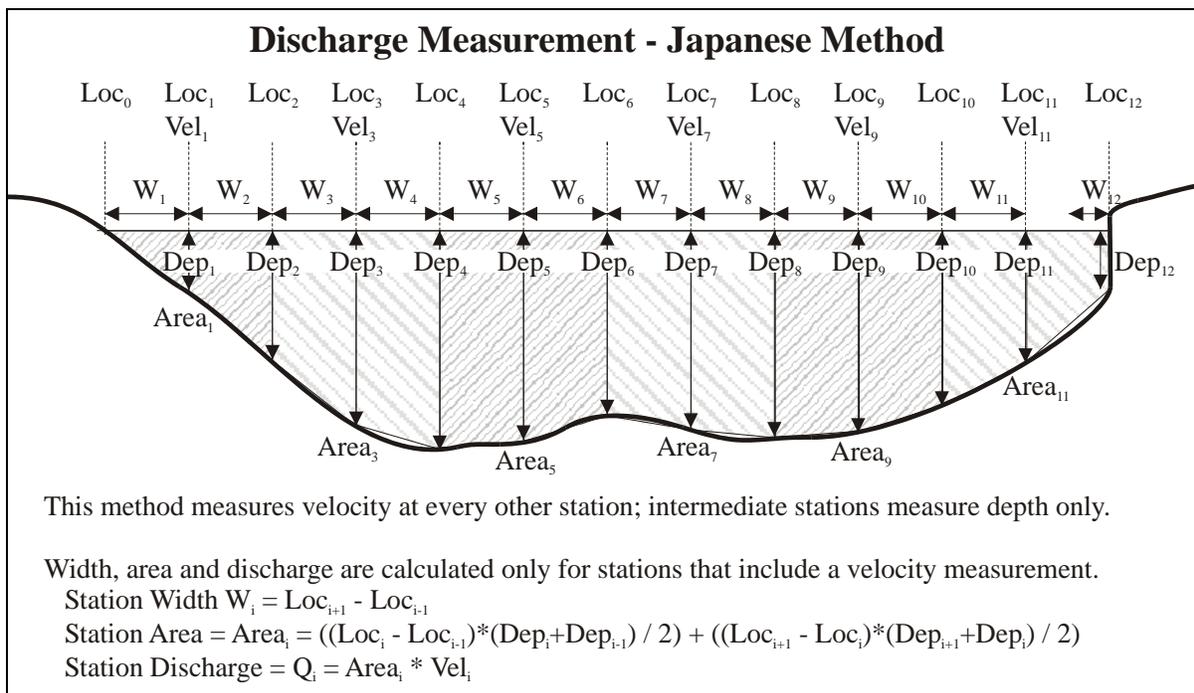


Figure 4 – Japanese Discharge Equation

4.2. *New Velocity Measurement Methods*

The discharge method specifies how the FlowTracker determines mean velocity at each station.

- The method involves changes in the number and location of velocity measurements.
- **Table 1** describes all methods supported by the FlowTracker.
- Methods involving more than one measurement can be done in either direction (from surface towards the bottom, or from the bottom towards the surface).
 - The FlowTracker automatically alternates between directions at adjacent stations to make setting the probe location easier.
- The user selects the method using the **Method +** and **Method –** keys.
- You can specify which methods to display (if some methods will never be used).
 - From the **Main Menu**, press **1** for **Setup Parameters**.
 - Select **5** for **Discharge Settings**.
 - Select **8** to specify **Methods Displayed**.
- Both fractional and real depths are displayed by the FlowTracker for each measurement.
 - An example display is **0.6(0.24)**: **0.6** is the fractional depth; **0.24** is the real depth.
 - Effective depth is water depth minus ice depth.
 - Fractional depth is the fraction of effective depth below the surface (i.e., 0.6 indicates 0.6*effective depth down from the surface).
 - Real depth is the measured distance (in meters or feet) above the bottom.

Table 1 – Discharge Measurement Methods

Method	Measurement Locations	Mean Velocity Equation
0.6	0.6 * depth	$V_{\text{mean}} = V_{0.6}$
0.2/0.8 0.8/0.2	0.2 * depth 0.8 * depth	$V_{\text{mean}} = (V_{0.2} + V_{0.8}) / 2$
.2/.6/.8 .8/.6/.2	0.2 * depth 0.6 * depth 0.8 * depth	$V_{\text{mean}} = (V_{0.2} + 2*V_{0.6} + V_{0.8}) / 4$
Ice 0.6	0.6 * effective depth	$V_{\text{mean}} = 0.92*V_{0.6}$ (Correction Factor 0.92 can be changed by user)
Ice 0.5	0.5 * effective depth	$V_{\text{mean}} = 0.89*V_{0.5}$ (Correction Factor 0.89 can be changed by user)
Ice 2/8 Ice 8/2	0.2 * effective depth 0.8 * effective depth	$V_{\text{mean}} = (V_{0.2} + V_{0.8}) / 2$
Kreps 2- Kreps 2+	0.0 (near surface) 0.62 * depth	$V_{\text{mean}} = 0.31*V_{0.0} + 0.634*V_{0.62}$
5 Point- 5 Point+	0.0 (near surface) 0.2 * depth 0.6 * depth 0.8 * depth 1.0 (near bottom)	$V_{\text{mean}} = (V_{0.0} + 3*V_{0.2} + 3*V_{0.6} + 2*V_{0.8} + V_{1.0}) / 10$
Multi Pt	Any number of points at user specified depths	Integrated velocity average (Figure 5) – Measurements can be made in any order; they are sorted by depth to calculate the integrated mean velocity. Repeat measurements at the same depth are averaged before calculating the integrated velocity.
None	No velocity measurement	$V_{\text{mean}} = CF * V_{\text{adjacent}}$ – Mean velocity is based on the velocity from the adjacent station(s), multiplied by a user specified correction factor. This method is used when velocity measurements cannot be made, and to specify the edges of an internal island in a multiple channel river.
Input V	User input velocity	$V_{\text{mean}} = V_{\text{input}}$ – User enters an estimated velocity value. This method is used when velocity measurement is possible, most commonly due to weed growth along a riverbank.

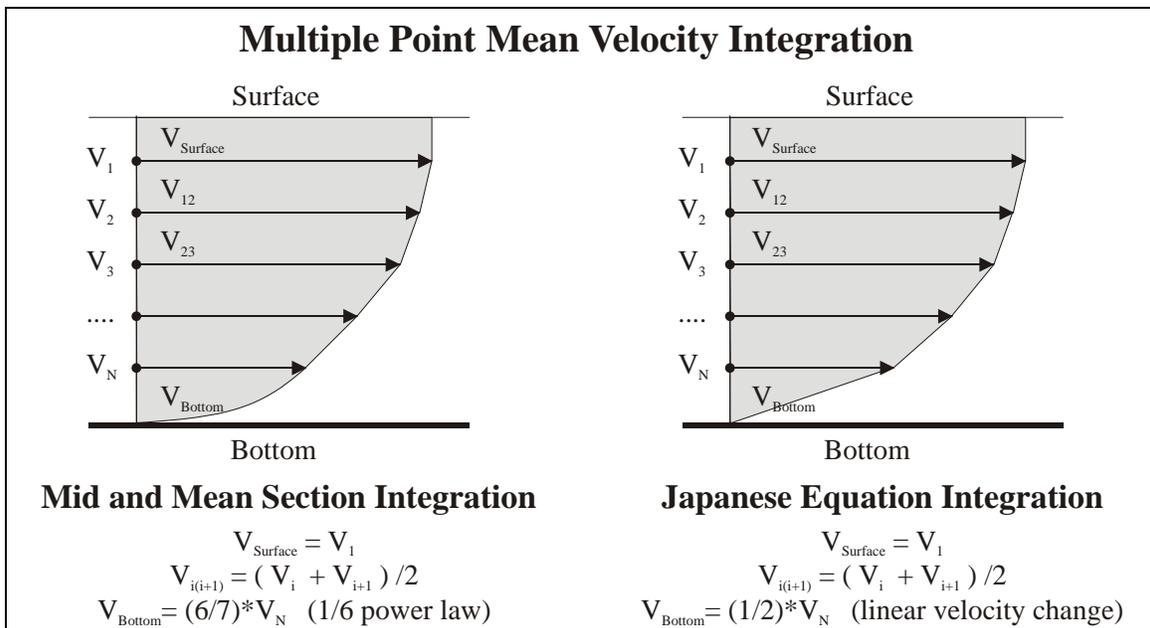


Figure 5 – Multiple Point Mean Velocity Integration

5. Automated Quality Control (QC) and Uncertainty Estimation

5.1. Automatic QC Data Review

The FlowTracker records a variety of quality control (QC) data with every measurement.

- QC parameters are automatically reviewed with each measurement and at the completion of a discharge section.
 - If any QC value exceeds expected criteria, a warning is given.
 - [Table 2](#) below describes QC warning messages.

All quality control criteria can be modified or disabled. To access quality control settings:

- From the **Main Menu**, press **1** for **Setup Parameters**.
- From **Setup Parameters**, select **4** for **QC Settings**.
 - **SNR Threshold**, **σ V Threshold**, **Spike Threshold**, **Max Velocity Angle**
- From **Setup Parameters**, select **5** for **Discharge Settings**.
 - **Max Section Discharge**, **Max Depth Change**, **Max Location Change**
- To disable any QC criteria, set that parameter to a value of **0**.

5.2. Automatic QC Test

Many users rely on the *ADVCheck* or *BeamCheck* software programs to evaluate FlowTracker operation. The functions of this software are now available as an automated test.

- Users are prompted to run this test at the start of each data file.
 - When the test is done within a data file, results are recorded with the file.
 - You can also run the tests before opening a data file, but the results are not recorded.
 - From the **Main Menu**, press **2** for **System Functions**.
 - From **System Functions**, select **7** for **Auto QC Test**.
- Place the probe in moving water well away from any underwater obstacles.
 - The FlowTracker collects data for about 30 seconds.
 - The data are analyzed based on several criteria.
 - Noise level
 - SNR
 - Peak shape (can only be checked with SNR > 7 dB).
 - Peak location (can only be checked with SNR > 7 dB).
 - If any warnings are issued, you are given an option to repeat the test.
 - Repeat the test once, after carefully checking that the probe and sampling volume are well away from any underwater obstacles.
 - If multiple warnings are received, run *ADVCheck* or *BeamCheck* from a PC to evaluate FlowTracker system performance in more detail.

Table 2 – QC Warning Messages

Warning	QC Criteria (Default)	Description	Suggested Action
Low SNR	-	SNR < 4 dB	<ul style="list-style-type: none"> Consider ways to increase SNR
Beam SNR	SNR Threshold (10 dB)	Difference in SNR for any two beams is > SNR Threshold .	<ul style="list-style-type: none"> Look for underwater obstacles; repeat measurement. Check probe operation (run ADVCheck / BeamCheck)
SNR Variation	-	One-second SNR data varies more than 5 dB during a measurement. May indicate underwater interference or a highly aerated environment.	<ul style="list-style-type: none"> Look for underwater obstacles; repeat measurement. Look for environmental sources (aerated water).
SNR Change	SNR Threshold (dB)	SNR more than SNR Threshold different from previous measurements, or a major change in measurement conditions.	<ul style="list-style-type: none"> Look for underwater obstacles or other changes in river conditions; repeat measurement.
High σV	σV Threshold (0.01 m/s; 0.033 ft/s)	σV > σV Threshold . The threshold is adjusted based on previous measurements and measured velocity. High values could indicate interference or a highly turbulent environment.	<ul style="list-style-type: none"> Look for underwater obstacles or other changes in river conditions. Consider real turbulence levels in river. Repeat measurement.
High Spikes	Spike Threshold (10%)	Spikes > Spike Threshold percent of samples. May indicate poor measurement conditions.	<ul style="list-style-type: none"> Look for underwater obstacles or other unusual conditions (aerated water). Repeat measurement.
High Angle	Max Velocity Angle (20°)	Angle > Max Velocity Angle . May only indicate non-ideal measurement environment.	<ul style="list-style-type: none"> Consider if measured angle is realistic. Repeat measurement if needed.
High %Q	Max Section Discharge (10%)	%Q > Max Section Discharge . Station contains a large portion of the total discharge.	<ul style="list-style-type: none"> Consider adding more stations.
Suspect Depth Value	Max Depth Change (50%)	Station depth is different from adjacent stations by more than Max Depth Change %; possibly a data entry problem.	<ul style="list-style-type: none"> Verify station depth value. Re-enter if needed.
Suspect Location Value	Max Location Change (100%)	Distance between stations has changed by more than Max Location Change %; possibly a data entry problem.	<ul style="list-style-type: none"> Verify station location value. Re-enter if needed.
Location Out of Order / Location Outside River Edge	-	Location value out of sequence or outside the edge; possibly a data entry problem. Out of sequence stations are allowed and sorted into correct location.	<ul style="list-style-type: none"> Verify station location value. Re-enter if needed.
Bad Boundary QC	-	Boundary QC is FAIR or POOR . Indicates possible interference from underwater obstacles.	<ul style="list-style-type: none"> Consider re-locating probe and repeating test. Measurement can proceed if results are consistent.

5.3. Discharge Uncertainty Calculation

The FlowTracker estimates the uncertainty of every discharge measurement. This calculation can be done using two methods: **Statistical** or **ISO**.

- The **Statistical** uncertainty calculation uses a method developed by researchers at the U.S. Geological Survey. This is the default calculation as it provides the most reliable indicator of measurement quality.
- The **ISO** method is based on the international standard. It provides users with the results of a published, standard technique; however, in many cases this calculation does not provide a reliable indicator of data quality.
- You can change the uncertainty calculation by pressing **9** from the **Discharge Settings** menu (from **Setup Parameters**, select **5** for **Discharge Settings**).

The uncertainty calculations are based on several parameters. In addition to overall uncertainty, the FlowTracker also looks at the contribution of each parameter.

- **Accuracy** – the accuracy of FlowTracker velocity (this is generally negligible).
- **Depth**
 - In the **Statistical** calculation, this term includes both uncertainty in the depth measurement and the effect of changes in depth between stations.
 - In the **ISO** calculation, this term includes only the uncertainty in depth measurements.
- **Velocity**
 - In the **Statistical** calculation, this term includes both uncertainty in the velocity measurement and the effect of changes in velocity between stations.
 - In the **ISO** calculation, this term includes only the uncertainty in velocity measurements.
- **Method** – Discharge measurement method ([§4.2](#))
 - Used for the **ISO** method only.
- **Number of stations**
 - Used for the **ISO** method only.
- **Width**
 - Used for the **ISO** method only.

Uncertainty is displayed with the calculated discharge. The largest individual source of uncertainty is also displayed. Outputs from the *FlowTracker* software show the contribution of each parameter to the overall uncertainty. A complete description of the discharge uncertainty calculations can be found in the FlowTracker Technical Manual.

6. Other New Features (Including Multi-Language Support)

- Multi-language operation
 - Five languages are supported: English, Spanish, French, German, and Italian.
 - The keypad has also been translated (§8)
 - From the **Main Menu**, press **1** for **Setup Parameters**, then **7** for **Language**
- Most menus now use **0** as the exit key instead of **9** (allowing more menu items).
- The user can enter site and operator names with each file to document the data set.
- **QC Menu** (#8) key is active during data collection to access the following functions.
 - Supplemental data: gauge height, rated flow, comments (see below)
 - Gauge height entry is prompted at the start and end of each file.
 - **QC Settings**
 - **Discharge Settings (§4)**
 - **Set Averaging Time**
 - **Raw Velocity Data**
 - **Auto QC Test (§5.2)**
- Expanded supplemental data – gauge height, rated flow, user comments
 - Previously, only two gauge height and one rated flow value was allowed.
 - You can now enter up to 20 values each of gauge height and rated flow at any point during data collection.
 - Each gauge height or rated flow value is automatically marked with a time stamp.
 - Comments can be added with each gauge height / rated flow entry.
 - From the **QC Menu**, press **1** for **Gauge/RatedQ/Com.**
- File name and comments use the same text entry method as mobile phones.
- All metric velocity data is now output in m/s (instead of cm/s)
- Re-open file after **End Section**
 - Pressing **Measure** after **End Section** gives the option to add measurements to the file.
 - Once the file is closed with **Calc Discharge**, no more changes can be made.
- Reference for section discharge (%Q) calculations
 - Section discharge (%Q) can be calculated based on **Rated** or **Measured** values.
 - From the **Main Menu**, press **5** for **Discharge Settings**, then **8** for **Reference**
 - Select the desired reference, **Rated** or **Measured**.
 - The default setting is **Rated**.
 - If no **Rated** value is specified, the **Measured** value is used.
- Changes to discharge measurement depth display
 - Real depth (**0.32** below) and fractional depth (**0.2** below) are both shown.
 - Fractional depth is referenced from surface down
 - Real depth (in m or ft) is distance above the bottom
 - Effective depth (water minus ice) is shown when ice depth is not zero (**EffD**)

Stn 1	Loc 21.00
.2/.8	0.2(0.32)
	Dep 0.400
	Press Meas

7. New FlowTracker Software

The updated *FlowTracker* software, version 2.10, is intended to be self-explanatory and should require little documentation. A few notes when using the new software are below.

- To run the software:
 - Click **Start | Programs | SonTek Software | FlowTracker**
 - Both old and new *FlowTracker* software versions can be installed on your computer at the same time. To differentiate between the versions, look at the icon.
 - Old software icon: 
 - New software icon: 
- The new *FlowTracker* software can read both old and new FlowTracker data files.
 - The old software will not read data files collected with the new firmware.
- Please note that some FlowTracker output files have changed format to accommodate the new features. Please look at all files closely to be sure they are being interpreted correctly.

8. New FlowTracker Keypad

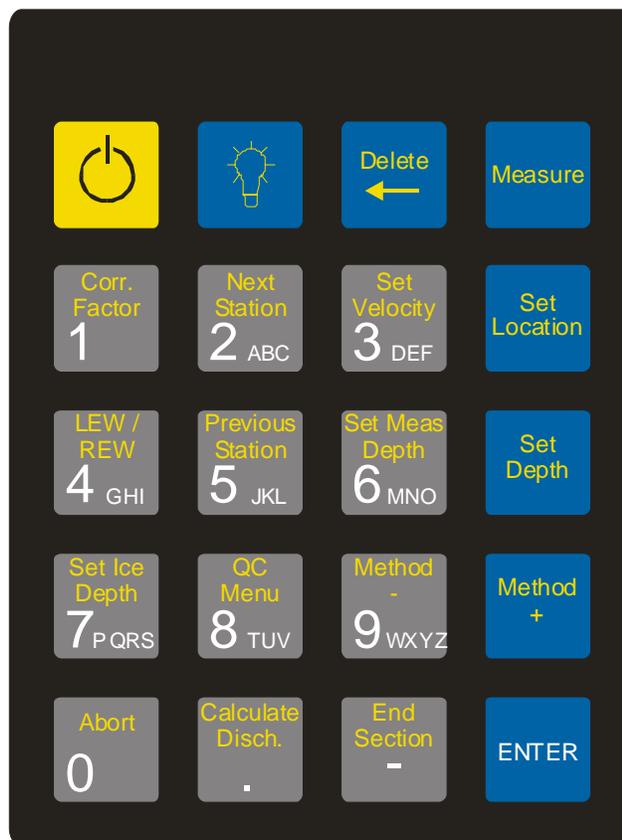
Several new features in firmware version 3.1 require changes to the FlowTracker keypad.

Additionally, the keypad has been translated into each language that the FlowTracker now supports (English, Spanish, French, German, and Italian). Changes to the keypad are listed below.

- **QC Menu** key to access quality control features during data collection.
- **Set Velocity** key for Input Velocity discharge method (§4.2).
- Alphabet labels to number keys for mobile phone style text input.

The new keypad is shown in each language in the remainder of this document.

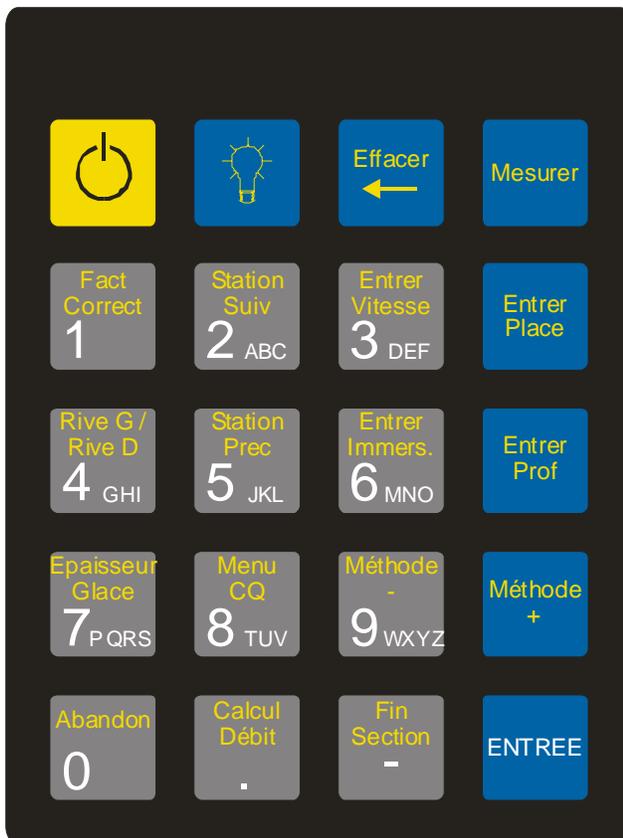
- The keypads are shown in actual size within the document, so they can be printed and temporarily taped over the keypad for testing purposes.
 - Select **Page Scaling: None** when printing to ensure the keypad size is correct.
- High quality, permanent embossed decals to overlay existing keypads are available in each supported language; please contact your local sale agent (especially International users) or SonTek/YSI (USA users) for details.



English Keypad



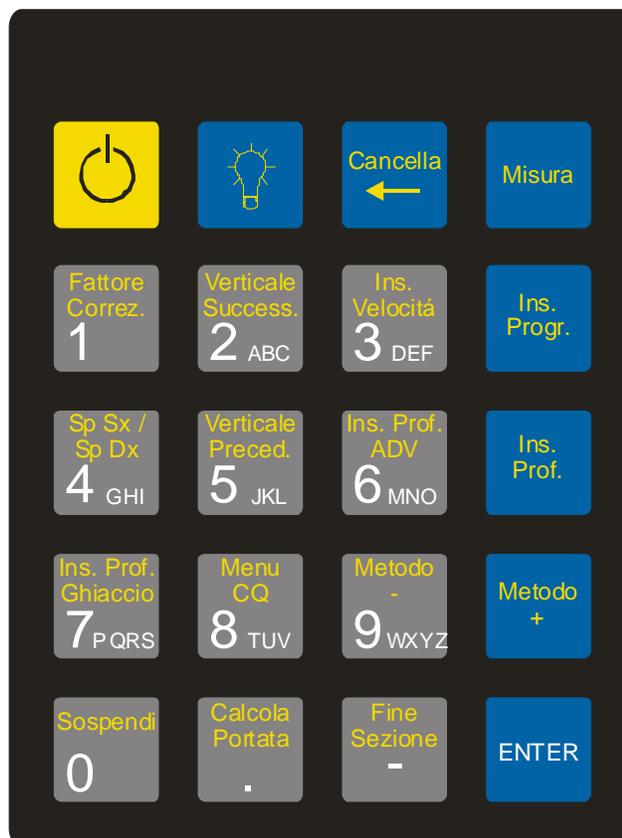
Spanish Keypad



French Keypad



German Keypad



Italian Keypad