

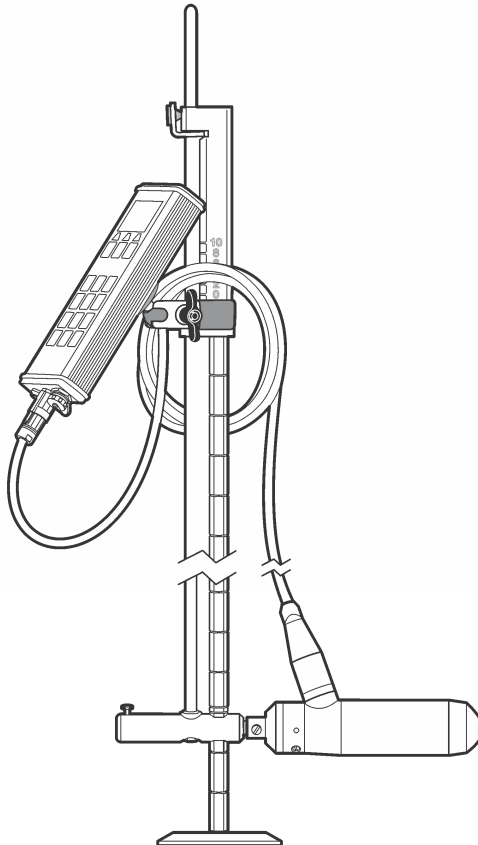


DOC026.53.80104

OTT Acoustic Digital Current (ADC) Meter

05/2013, Edition 3 (North American Version) 10.500.001.B.U.

User Manual



WARRANTY AND ASSISTANCE

This equipment is warranted by CAMPBELL SCIENTIFIC (CANADA) CORP. ("CSC") to be free from defects in materials and workmanship under normal use and service for **twelve (12) months** from date of shipment unless specified otherwise. ***** **Batteries are not warranted.** ***** CSC's obligation under this warranty is limited to repairing or replacing (at CSC's option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CSC. CSC will return such products by surface carrier prepaid. This warranty shall not apply to any CSC products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CSC is not liable for special, indirect, incidental, or consequential damages.

Products may not be returned without prior authorization. To obtain a Return Merchandise Authorization (RMA), contact CAMPBELL SCIENTIFIC (CANADA) CORP., at (780) 454-2505. An RMA number will be issued in order to facilitate Repair Personnel in identifying an instrument upon arrival. Please write this number clearly on the outside of the shipping container. Include description of symptoms and all pertinent details.

CAMPBELL SCIENTIFIC (CANADA) CORP. does not accept collect calls.

Non-warranty products returned for repair should be accompanied by a purchase order to cover repair costs.



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SCIENTIFIC

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Specifications

Specifications are subject to change without notice.

Specification	Details
Velocity measurement (Acoustic Ultrasonic Transducers)	Measurement range: – 0.2 m/s to 2.4 m/s (–0.65 ft/s to 7.87 ft/s)
	Accuracy: $\pm 1\%$ of the measured value, ± 0.25 cm/s (± 0.01 ft/s)
	Resolution: 0.001 m/s (0.001 ft/s)
Ultrasonic transducers	Frequency: 6 MHz
	Beam angle: 20°
Measured volumes	Distance from the sensor: 10 cm (3.93 in.)
	Diameter: 1 cm (0.39 in.) per sound pulse
	Length: 5 cm (1.97 in.)
Depth measurement (Piezoresistive pressure cell (absolute))	Measurement range: 0 to 5 m (0 to 16.4 ft)
	Accuracy: 0.1% FS
	Resolution: 0.01% FS
	Maximum overload: 1.5 times the measuring range
Temperature measurement	Measuring range: –5 to 40°C (23 to 104 °F)
	Accuracy: ± 0.5 °C
	Resolution: 0.1 °C (0.1 °F)
Salinity	Range: 0 to 50 ppt (mg/L)
Power supply	Type of batteries: Rechargeable NiMH, fixed battery pack
	Life duration: > 14 hours (the battery lifetime is affected by environmental conditions and charging cycles)
	Charging cycles: > 500 (charging cycles vary by use, environment and other factors)
	Nominal voltage: 9.6 VDC
	External class II AC/DC power supply: Input 90–240V, 50/60 Hz
	Output voltage of power supply: 18 VDC/VAC
Operating conditions	Operating temperature range: –20 to 60 °C (–4 to 140 °F)
	Storage temperature range: –40 to 85 °C (–40 to 185 °F)
	Shock resistance: compatible with EN 60068-2-32
Dimensions and weight	Cylindrical sensor body: Ø 40 mm (0.20 in.) Length: 14.5 cm (5.71 in.) Weight in air: 800 g (1.76 lb) Weight in water: 620 g (1.37 lb)
	Handheld unit: Dimensions: 23.3 x 8.3 x 3.2 cm (9.20 x 11.41 x 1.26 in.) Weight: 700 g (1.76 lb)

Specification	Details
Material	Sensor housing: Delrin®/stainless steel
	Screws: stainless steel
	Handheld unit: aluminium, powder coated
	Keypad: Autotex V 150 XI
IP protection class	Handheld unit: IP65 (housing, keypad) Sensor: IP68
EMC	EN 61000-6-2 EN 61000-6-4 FCC Part 15 EMC Directive 2004/108/EU, Article 5
Internal data memory	Capacity: 4 MB (flash)
OTT QReview software	Operating system: Windows®98, Windows®ME, Windows®NT, Windows®2000, Windows®XP, Windows® Vista, Windows® 7 Functionality: Data transfer from handheld unit, Data check and processing, Data export (XML, ASCII)

General information

Revised editions are found on the manufacturer's website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Use of hazard information

▲ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

▲ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

▲ CAUTION






Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol indicates that a risk of explosion is present.
	This symbol indicates that a risk of fire is present.
	This symbol indicates the need for protective eye wear.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user. Note: For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.

Certification

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

Product overview

The OTT Acoustic Digital Current meter (ADC) is a mobile acoustic current meter designed specifically for measuring point velocities and water depth in open channels and natural streams. Examples of ideal uses include single or multiple point velocity measurements and discharge measurements.

Velocity and depth information from the sensor is displayed in real time on the graphical display of the handheld unit.

Discharge measurements are based on standard vertical or sub-section measurement techniques associated with MID and MEAN section discharge calculations. The process used to calculate discharge measurements is based on internationally recognized USGS and ISO748 standards. Mean velocity and depth measurements taken by the OTT ADC, along with the position of a vertical relative to a reference, are used to calculate the discharge.

All measurements, including quality checks, velocity and discharge measurements can be downloaded using the QReview application software. QReview displayed provides basic analysis tools, graphics, one-second time series, reports, and review of potential quality issues. Data can be exported in different formats.

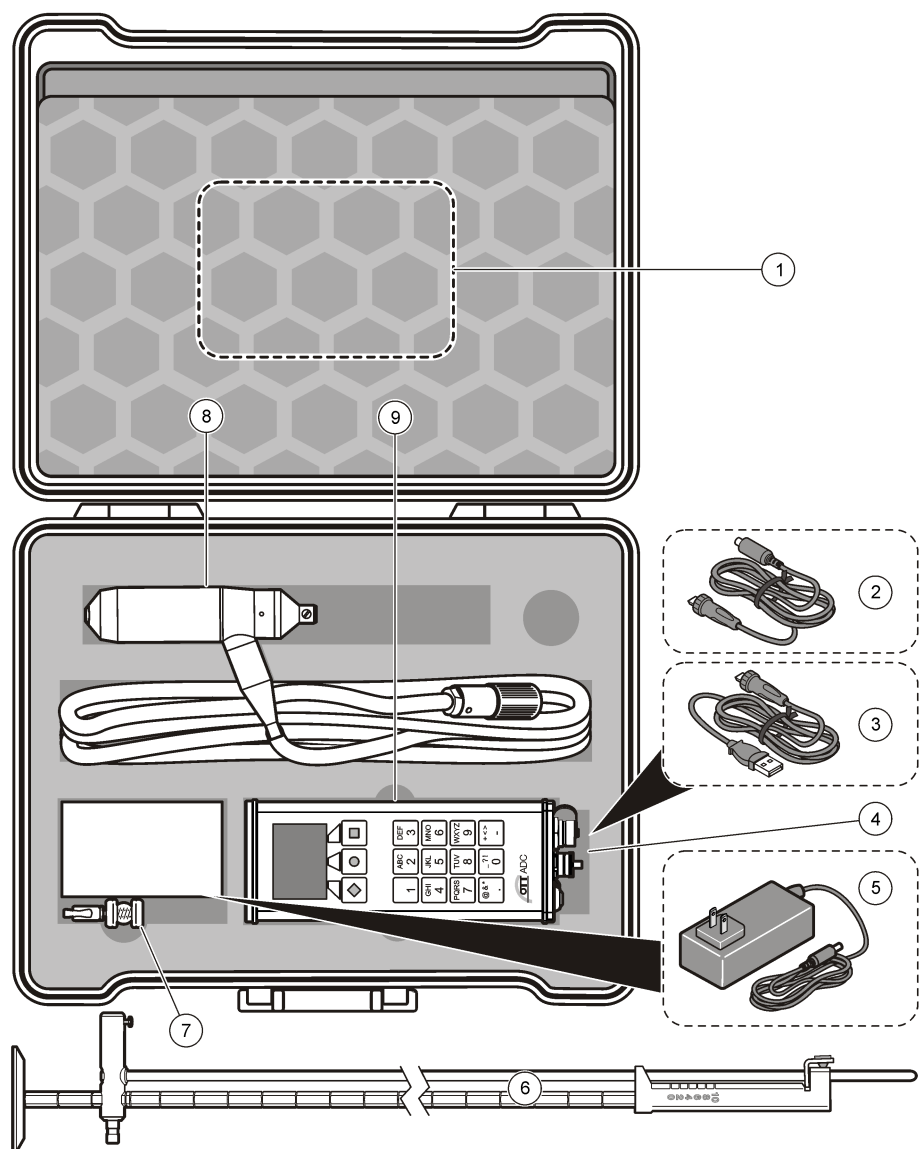
System components

The system consists of two components: the sensor, and the handheld display with sensor connection cable. The sensor itself contains two 6 MHz acoustic transducers, along with a temperature and depth sensor.

Other components of the system include wading rod adapter, power adapters, charging and connection cables. Refer to [Figure 1](#) for a complete list of system components.

The handheld unit contains calibration data for the temperature sensor and the pressure cell of the relevant sensor. Sensors and handheld units that are used together as part of the same measurement system must have the same serial numbers. The sensor serial number is engraved on the rear of the sensor body, below the sensor cable connector. The serial number is also listed on the gray label on the back of the handheld display.

Figure 1 OTT ADC components



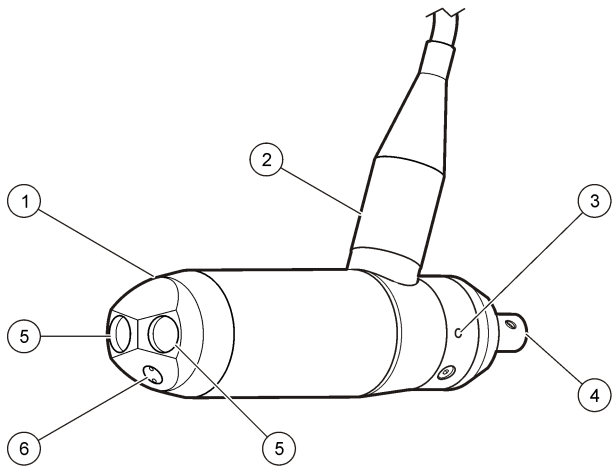
1 Location of user documentation and software	6 Wading rod (accessory)
2 USB charging cable	7 Mounting clamp
3 USB download cable	8 Sensor
4 Power charger (not shown, located below handheld unit)	9 ADC handheld unit
5 AC/DC adapter	

About the sensor

The sensor components are shown in [Figure 2](#).

The transducers transmit ultrasonic signals which are reflected back to the sensor by air bubbles or particles suspended in the water column. These received backscatter echoes are amplified in the sensor head and digitized in the digital signal processor (DSP) inside the handheld display. This transmit-and-receive process is repeated to generate a second echo pattern. The DSP uses a pulse-coherent technique to calculate the phase of each returned pulse echo. Phase differences (lag time) between the returned pulse echoes is proportional to the flow velocity. Each measurement is validated against quality thresholds for accuracy.

Figure 2 Sensor components




1 Sensor head	4 Sensor end piece (for attachment to wading rod)
2 Sensor connection cable	5 Ultrasonic transducers
3 Pressure cell chamber	6 Temperature sensor

Temperature compensation

The OTT ADC is equipped with a temperature sensor. Water temperature is an important parameter, both for the calculation of the speed of sound and for the temperature-compensated depth measurement given by the pressure cell. Therefore, a best practice when starting a measurement is to allow the sensor to adjust to the water temperature. The temperature adjustment of the sensor under extreme conditions (from approximately 50 °C to 5 °C) takes approximately 5 to 6 minutes.

Installation

⚠ CAUTION



Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

About the power supply and battery

⚠ WARNING



Explosion hazard. Incorrect battery installation can cause the release of explosive gases. The battery pack cannot be replaced by the user. Contact technical support.

Power for both the sensor and handheld unit is provided by a rechargeable battery installed in the handheld unit. A battery symbol in the upper right corner of the display indicates the battery charge level. The charge level can also be viewed by selecting Main menu>System Status>Battery.

A fully charged battery can provide more than 14 hours of measurement operation. The battery can be charged more than 500 times. Charging cycles vary by use, environment and other factors.

All data saved on the handheld unit are retained even if the battery becomes fully discharged.

The battery cannot be replaced by the user. Attempts by a user to replace the battery will void applicable warranties. Refer to [Contact information](#) on page 48 for repair contact information.

Battery specifications

Values listed in the table are typical and approximate.

Hours of measurement operation per charge	14
Number of possible charge cycles	500
Length of charge cycle, in hours (complete discharge to full charge)	2

Charge the battery

⚠ WARNING



Fire and explosion hazard. The power supply is designed specifically for this product. Do not attempt to use this product with any other power supply even if the device conforms to the USB standard. This may cause damage to the battery.

Although the unit is shipped with the battery partially charged, the manufacturer recommends that the battery be charged to full capacity before the system is used.

A completely discharged battery will reach full charge after approximately 2 hours of charging time. Entries may be made in the handheld unit while the battery is being charged.

1. Connect the charging cable connector of the power supply to the charging cable with the barrel connector.
2. Connect the charging cable to the handheld unit with the USB connection.
3. Connect the plug of the power supply to the electrical outlet.

The battery begins to charge and the unit switches on. A charging icon appears in the upper right corner of the display. The battery icon will appear solid when the battery is fully charged.

Note: The battery can also be charged with a vehicle voltage converter, available as an accessory. Refer to the *Parts and Accessories list* for more information.

Connect the sensor cable to the handheld unit

Refer to [Figure 3](#) and the steps to connect the sensor to the handheld unit.

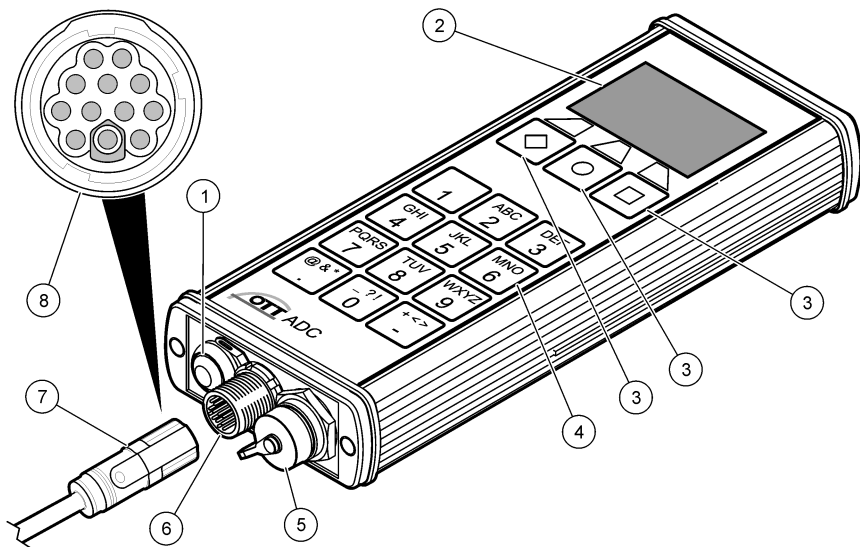


Figure 3 Handheld unit overview and connections

1 On/Off switch	5 USB connection
2 Liquid crystal display (LCD)	6 Sensor connection
3 Operating keys	7 Sensor cable
4 Keypad	8 Connector contact pins

1. Align the red markings on the sensor connector cable and the handheld unit connector.
2. Grasp the sensor connector cable plug and push it on to the handheld unit connector until it snaps in place.
3. Turn the sensor connector cable plug clockwise until clicking sounds are heard. The clicks indicate the connection is secure.

To disconnect the sensor

1. Grasp the sensor cable connector and turn it counterclockwise until the red mark on the sensor cable is aligned with the red mark on the handheld unit.
2. Pull back on the sensor cable connector plug until it disengages from the handheld unit.

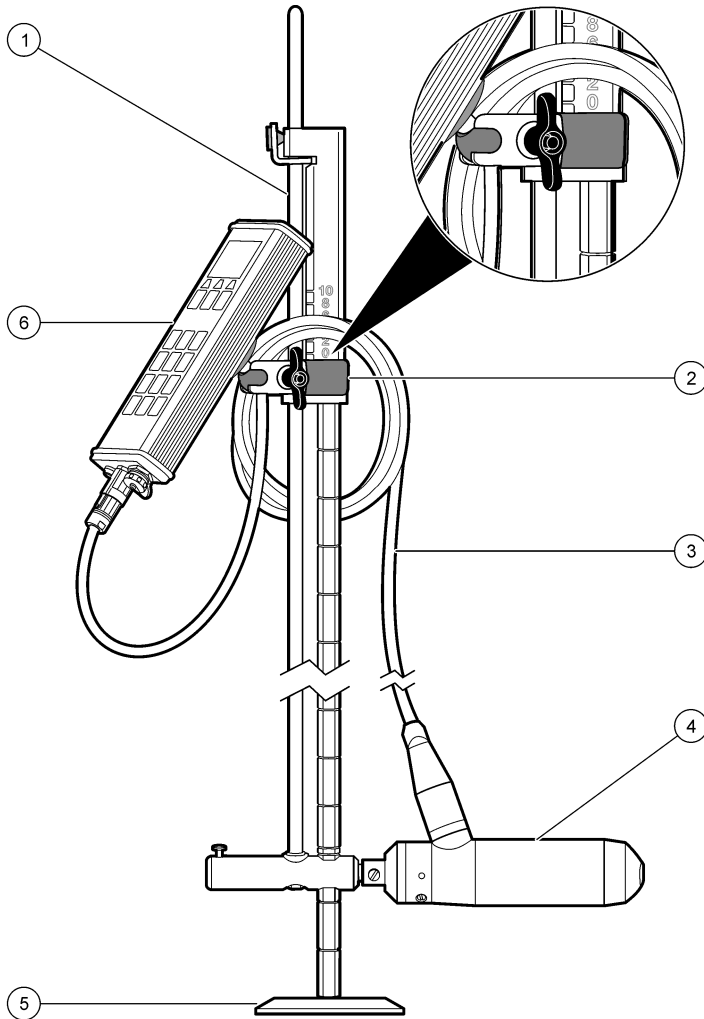
Attach the handheld display unit to the wading rod

The OTT ADC is supplied with a universal attachment for USGS wading rods. The unit is manufactured with a fixing plate on the rear of the handheld unit that contains a ball head. This arrangement allows the unit to move and rotate in different directions.

Refer to the steps and [Figure 4](#) to attach the handheld unit to the wading rod.

Note: Attach the sensor cable to the handheld display before attaching the handheld display to the wading rod.

Figure 4 Attach the handheld unit



1 Wading rod assembly	4 Sensor
2 Handheld unit clamp	5 Wading rod base plate
3 Sensor connection cable	6 Handheld display unit

1. Attach the silver ends of the universal wading rod mounting bracket to the ball on the backside of the handheld display.
2. Place the black ends of the universal wading rod mounting bracket on the handle of the top-setting wading rod, or near the top of the standard wading rod.
Note: Make sure that the handheld display faces in the direction opposite of the sensor. Also make sure the relocating rod of the top-setting wading rod can move freely when the sensor is raised or lowered.
3. Tighten the wingnut on the bracket to secure the clip to the wading rod.
4. To position the sensor vertically, press the rubber stopper of the catch on the handle, move the sensor to the new position, and release the rubber stopper to secure.

Attach the sensor to a wading rod

- OTT ADC sensor with sensor end piece.
- USGS type standard or top-setting wading rod
- Extensions for rod if necessary

Refer to [Figure 5](#) for a top-setting wading rod. Refer to [Figure 6](#) for a standard wading rod. Follow the steps to attach the sensor.

1. Push the sensor on to the receiver of the meter/sensor bracket of the wading rod. Make sure the sensor connection cable is vertically aligned with the wading rod.
2. Secure the sensor by tightening the mechanical adapter fixing screw.
3. Extend the rod as required.

Figure 5 Attachment of the sensor to a top-setting wading rod

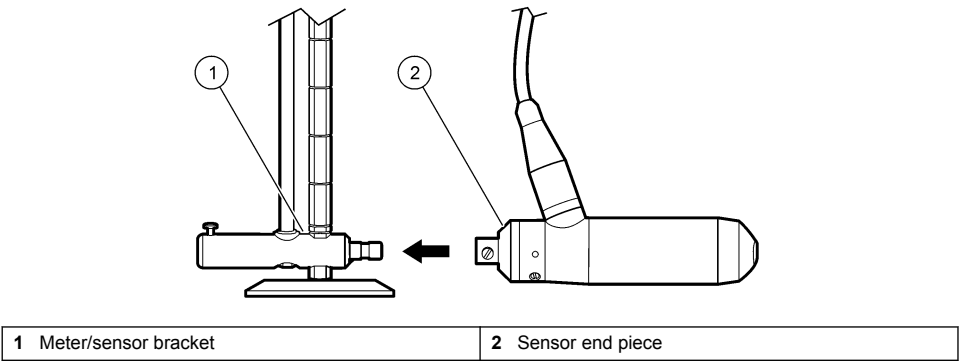
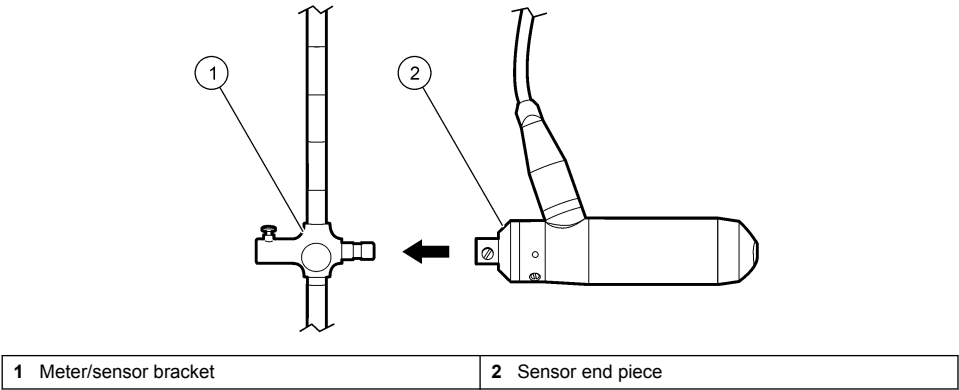


Figure 6 Attachment of the sensor to a USGS rod



Operation

Turn the handheld unit On and Off

To turn the unit on or off, press the On/Off switch and hold it for approximately one second. The startup process takes approximately ten seconds. During this time, the upper edge of the display will show a series of + symbols until the startup process is complete.

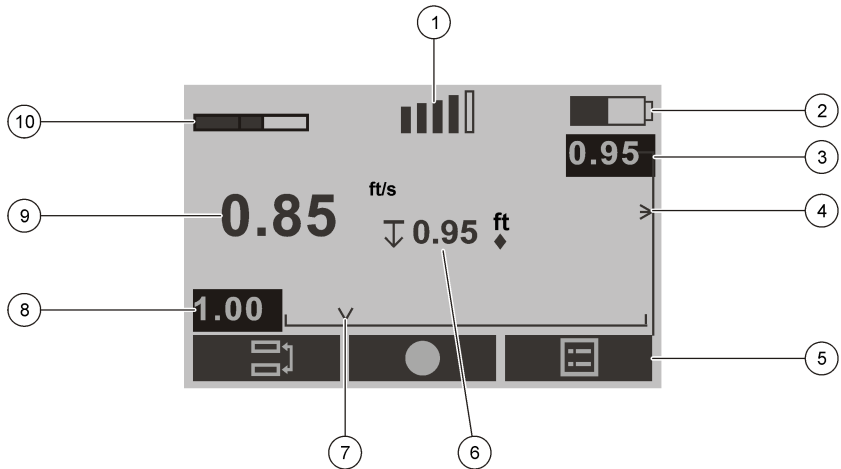
Note: To conserve battery power, the unit is equipped with an automatic shut off feature. If no key presses or communications have occurred for 15 minutes while the unit is under battery power, the unit turns off. Remove the USB data cable to make sure this feature operates correctly.

Display screen

Saved data and current measurement information are shown on the display screen (Figure 7).

To conserve battery power, if no keys are pressed for 30 seconds, the display background illumination turns off. The auto turn-off feature is active by default but can be made inactive through the Display Settings menu.

Figure 7 Display screen



1 Data quality (correlation) indicator	6 Actual depth indicator
2 Battery charge indicator	7 Position of the verticals
3 Target submersion depth (set value)	8 Distance of verticals from the reference point
4 Position of the sensor on the vertical	9 Flow velocity
5 Key function indicator	10 Measurement progress indicator





Operating key icons

The function of the operating keys depends on the current operating situation. The function associated with a key is shown in the display directly above the key. Symbols and their functions are shown in Table 1.

Table 1 Symbols and functions

	Call main menu		Return to previous menu
	OK and continue		Delete character
	Delete or Cancel		Confirm entry

Table 1 Symbols and functions (continued)

	Move Up or Down in multipart menu or list		Call help
	Switch between two display views		Start measurement

Menu navigation and data entry

To select a menu or menu option, press the key with the menu or option number.

Some menus, such as the Main Menu and Measurement Settings menus, are divided in to multiple parts. Each part may be divided in to other sub-menus and screens.

The current menu and the number of available menus are shown in the display screen next to the main heading. For example, Main Menu [1/2] means the user is in the first of two available Main Menu divisions. Navigate to the next division of the menu by pressing the down arrow key.

Fields accept alpha and numeric data depending on the use and application. Entry modes are automatically selected by the handheld unit.

To enter data in a field, press the key that shows the letter or number. The first key press causes the first alpha character on the key to appear in the display. Additional key presses will cause the rest of the letters to appear in order, followed by the key number before the cycle begins again. For example, to enter the letter K, press the 5 key two times in quick succession. To enter the numeral 5, press the 5 key four times.

Approximately one second after an alpha or numeric entry is made, the entry is saved and the cursor automatically moves one space to the right. To move the cursor back to a previous position, press the backspace key.

Display symbols

Display symbols give information on the system status and the current measurement. During a measurement, the symbols give information on the sensor position. Display symbols and their meaning are shown in [Table 2](#).

Table 2 Display symbols and meaning















	Battery charge indicator		Distance of verticals from cross-section zero point
	Data quality (correlation) indicator		Position of vertical
	Measurement progress indicator		Position of sensor on the vertical (actual value)
	Water temperature		Position of sensor on the vertical (set value)
	Battery power supply		Depth of the sensor (actual value)

Table 2 Display symbols and meaning (continued)

	Flow velocity		Note: Leave sensor at current position (depth)
	No signal (symbol flashes)		Note: Position sensor further up or down

Main Menu

The Main Menu of the OTT ADC is divided in to two windows, each with specific options. The function of the menu options are given in the tables in the steps below. More details can be found in the respective sections of this manual.

1. If the unit shows the measurement window, press the menu key to view the first Main Menu window [1/2].

Option	Description
Load	Load basic settings from a saved file.
Quick Quality Check	Choose this option to perform a quick quality check of the handheld unit.
Measurement Settings	Choose this option to enter basic settings for a measurement.
Start Measurement	Choose this option to start a discharge measurement.
View Data	Choose this option to view data from a completed measurement.

2. Scroll down to view the second window of the Main Menu [2/2].

Option	Description
Depth calibration	Choose this option to perform a depth calibration.
Delete Files	Choose this option to delete existing files.
System Status	Choose this option to view system information, including amount of available memory, unit serial number, firmware revision and amount of battery charge.
System Settings	Choose this option to change the date and time, sound level and display characteristics.
Advanced [1/2]	In the first Advanced Settings window, change the quality thresholds, turn the measurement guidance feature on or off, format the memory, or reset the handheld unit settings to the default values.
Advanced [2/2]	In the second Advanced Settings window, turn the key sound on or off and set the units to be used in measurements.

System settings

Use the System Settings menu to set the Date and Time, Display, and Sound Level options for the handheld unit. From the second Main Menu [2/2], select System Settings.

1. To change the date or time, select Date and Time and change or update the entries. The current date and time will show in the display when all entries are completed. Push OK to save the information. An example of the date and time display is shown below the table.

Option	Description
Hour (0 - 24)	Current time in whole hours
Minutes (0 - 60)	Current time in minutes
Seconds (0 - 60)	Current time in seconds

Option	Description
Day (1 - 31)	Current day
Month (0 - 12)	Current month
Year (0 - 99)	Current year

Time:
14:22:32

Date: 11/13/08

- To change the display options, in the System Settings menu, select Display and change or update the entries. Press OK to save the information.

Option	Description
Backlight --On, Automatic, Off	<p>If set to on, the display illumination remains turned on until the handheld unit is switched off. Use of this option may increase the rate of battery discharge.</p> <p>If set to Automatic, the illumination turns off after 30 seconds if no entry or communication has occurred. If a key is pressed, the illumination turns on and the timer is again set to 30 seconds.</p> <p>If set to Off, there is no display illumination.</p>
Contrast (0 - 10)	Sets the display contrast (1 = low contrast, 10 = maximum contrast)
Velocity display--Continuous, Result only	<p>If set to continuous, the measurement results for flow velocity measurement are continuously displayed and updated each second.</p> <p>Note: <i>The continuous display allows a visual impression of the waterway flow turbulence.</i></p> <p>If set to Result Only, only the end result of the flow velocity measurement is displayed.</p>

- To change the sound volume for key clicks and feedback sounds, go to System menu and select Sound Level. Enter a value between 0 and 10 (0=no sound, 10= maximum volume). Push OK to save the setting.

Advanced settings

The Advanced option has two windows. The second window in the Advanced menu is used to set the language, key sound and units options, format the memory, and reset the unit to the default values. To update any of these options, in the second Main Menu [2/2] window, select option 5 Advanced. Measurement Guidance and Quality Thresholds settings can also be accessed through the Advanced menu. Details for these options are given in respective sections in this manual.

- To change the language, scroll to the second Advanced menu window [2/2] and select 1. Language. Press the number of the language to be used in the handheld unit display.

Option	Description
1. English	Available languages for the handheld display.
2. Dutch	
3. German	
4. Spanish	
5. French	
6. Russian	

The display switches to the selected language.

2. To turn the key sound on or off, select option 2 Key Sound in the Advanced [2/2] window. Press the number 2 key to toggle the sound on and off. The current state is shown in the display.

Option	Description
On	The unit emits sound when keys are pressed (default).
Off	The unit does not emit a sound when keys are pressed.

3. To set the units used in measurement displays, select option 3 Units in the Advanced [2/2] window and enter the option number.

Option	Description
1. Metric	Measurement values are shown in metric units.
2. Imperial	Measurement values are shown in imperial units (default).

4. Depth can be measured with the water surface or the streambed as a reference. To change the reference depth settings, scroll to the Advanced Menu [2/2] and select Option 4 Depth Reference.

Option	Description
Surface	The water surface is used as the reference point. Depth and sensor positions are shown as distance from the water surface. During a measurement, the depth is shown on the display by an underlined arrow pointing down. If a manual depth entry is required, the value entered must be equal to the distance from the water surface. The distance displayed in the point results screen is referenced to the water surface.
Bottom	The bottom, i.e., the streambed, is used as the reference point. Depth and sensor positions will be shown as distance from the streambed. During a measurement, depth is shown on the display by an underlined arrow pointing up. If a manual depth entry is required, the value entered must be equal to the distance from the streambed. The distance displayed in the point results screen is referenced to the streambed.

5. To format the memory, scroll up to the first Advanced [1/2] menu window, and select option 4 Format Recorder (a warning statement will appear). To begin the formatting process, select 1. To return to the menu without formatting, press the BACK key.

Note: The Format Recorder option will cause all data stored in memory to be erased. Make sure all data is downloaded before the format process is started.

6. To reset the handheld unit settings to their default values, select option 4 in the first Advanced [1/2] window. A warning statement will appear. To continue, press the number 1 key. To return to the menu without resetting the values, press the BACK key.

Upgrade firmware

Each handheld unit is supplied with a particular version of firmware. The manufacturer periodically releases new versions of the firmware. The firmware should be periodically upgraded to make sure the instrument has the most current features and functionality.

- Download all saved data before the upgrade is started. The upgrade will cause a hard format and all saved data will be lost.
- Make sure the battery is fully charged
- Make sure that the QReview software is installed on the PC
- Make sure the handheld unit USB driver is installed on the PC
- Make sure the current firmware is saved on the PC

The current version of the firmware can be viewed through the second Main Menu [2/2]. Select **System Status, System Info** to view the current version.

Information about current or new firmware releases is available at <http://www.ott.com>. The firmware file name has the naming convention ADC_Vxxx.bin, where xxx is the version number. **Do not change the filename.**

To start the firmware upgrade process, do the following:

Note: During the upgrade, the On/Off switch is disabled.

1. Place the handheld unit in upgrade mode.
 - a. Switch off the device.
 - b. Connect the handheld unit to the PC via the USB connection.
 - c. Press and hold the . and the - keys and turn on the handheld unit.
The message FIRMWARE UPGRADE CHECKING STATUS appears on the display. After a few seconds a prompt for the upgrade code appears.
 - d. Enter the upgrade code (1234) and push OK.
The handheld unit is now in firmware upgrade mode.
2. Start the QReview application.
3. From the Tools menu, select ADC Firmware Upgrade.
4. In the window under Upgrade file, select the current firmware and click Open.
5. Select the COM port (serial port) used by the USB interface.
6. Click Start.
The upgrade process begins and a progress indicator shows the upgrade status. When the upgrade is complete, a message appears indicating the process is complete. The unit is placed into ready mode and switches off automatically.

Performing measurements

Station set up

Measurement quality is dependent on the correct selection of a measurement cross section. The first step in making a current-meter measurement is to select a reach of stream with the following characteristics:

- Cross section lies within a straight reach and stream lines are parallel to each other.
- The streambed is stable and free of large rocks, weeds, and protruding obstructions such as piers that create turbulence.
- The streambed has a flat profile. This helps eliminate vertical velocity components.

It is often impossible to completely satisfy all of the above conditions. Use the criteria to select the best possible reach and then select a cross section.

Number of verticals and vertical spacing

For a well-chosen cross-section, 25 to 30 partial sections is typically sufficient. If the cross section is very smooth and the velocity distribution is consistent, the number of sections can be reduced.

The partial sections should be spaced so that no individual section contains no more than 10 percent of the discharge. The ideal measurement is one in which each partial section contains 5 percent or less ($\leq 5\%$) of the total discharge, but this is rarely achieved when 25 sections are used. Partial sections should not have equal widths across the entire cross section unless the discharge is well-distributed.

Distances between verticals are generally smaller where water depth and flow velocities change significantly. Places where depth and velocities may change significantly include bank areas, vertical or steep slopes, ledges in divided cross-sections and transitions from the main stream bed to the foreland. Verticals should also be located at points of significant changes in the stream bed profile.

The measurement cross section must be set at right angles to the direction of flow. Avoid cross sections with still areas, counter currents or eddies. Do not place the sensor in deep pools, below large inflows, or near ship moorings, ferries or sluices.

The percentage of the computed discharge for each measured vertical is automatically calculated by the OTT ADC and is shown on the display of the handheld unit when the vertical measurement is complete.

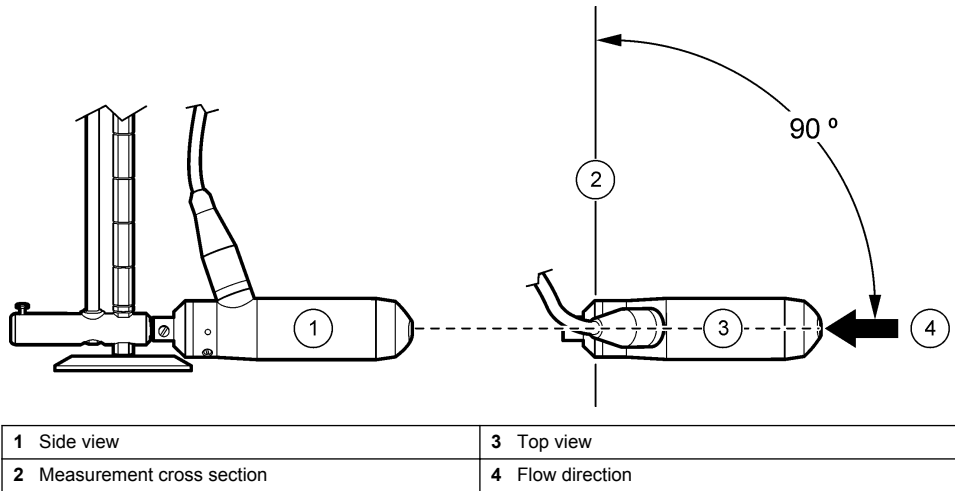
Angle of flow

The angle of flow is defined as the angle between the symmetry axis of the sensor and the direction of flow. In an ideal situation, the flow angle is 0°. The flow angle can affect the quality of measurement. The best measurement stations have a low angle of flow when the sensor is positioned at right angles to the measurement cross-section and the flow is parallel to the edges.

In the field, it may be difficult to achieve flow angles of 0°. In field tests of the OTT ADC, velocity measurement has been found to be unaffected by flow angles of up to 10°. Flow angles of 20° and 30° typically result in measurement errors of approximately 6% and 8% respectively.

Figure 8 shows two views of a sensor in proper position.

Figure 8 Sensor position and angle of flow



Quality control

Quality parameters determine whether the measurement value is valid. Information about each parameter is given below. Quality threshold values are output in the Discharge Summary File. If there are no changes input by the user, the default settings appear. If the user has made changes to the settings, the user-defined settings appear.

- **Signal to Noise Ratio**--The strength of the reflected acoustic signal relative to the noise in the OTT ADC electronics.
- **Maximum angle**--Maximum angle (+/-) between the direction of a measured velocity and the X-axis.
- **Correlation**--Pairs of echoes from the sensor are used to calculate the average velocity. In stable flow conditions, the correlation between the averaged raw measurements is higher than 70% and correspond to small standard deviations. Turbulent conditions result in lower correlation values. The signal bars in the handheld display indicate the correlation value. Each bar corresponds to a 20% correlation. The default minimum is 40%. During the majority of a measurement, at least two bars should be visible. The minimum correlation factor necessary for measurement can be decreased to below 40. However, the quality of the measurement may be lower and may not meet the same specifications. For example, if the correlation is reduced to 20, the associated measurement error is 5%. Reducing the correlation threshold can be useful when working in turbulent streams. If the correlation threshold is set to lower than 40 and the unit is turned off, the display will show a correlation warning when the unit is again turned on.
- **Velocity Gradient**--The instantaneous measurement minus the previous measurement. A valid measurement must have a velocity gradient below 0.82 ft/s (0.25 m/s). This helps make sure that measurement spikes are not included in the final measurement value.

- **Standard Deviation**--Indicates measurement accuracy. The standard deviation is calculated only from values that have passed the quality control.
- **% Discharge per Vertical**--Percentage of total discharge in a vertical. Defined ideal standard is less than 5% and no more than 10%.
- **1-point Maximum Depth**--Maximum depth for a 1 point measurement. If this depth is exceeded, a warning message appears on the handheld unit and the user is prompted to change to a 2-point measurement.

Table 3 gives the value range for each quality threshold. Default values are shown in parentheses.

Table 3 Quality threshold ranges

Quality threshold (resolution and units)	Range
Minimum correlation xx.x%	01-100 (40)
Maximum angle (xx.x °)	0-45 (20)
Velocity gradient (x.xx ft/s, m/s)	0.0-2.5 (0.82 ft/s)
Standard deviation (x.xx ft/m)	0.0-2.5 (0.33 ft)
% Discharge per vertical (xx %)	0-100 (5)
Minimum signal-to-noise ratio (SNR) (xx dB)	10-100 (10)
1-Point maximum depth (xx.x ft/m)	User defined (1.5 ft)

If less than 50% of the measured values meet their defined criteria, the measurement is discarded and the user is asked to repeat the measurement, accept the measurement as is or skip the measurement. If the measurement is skipped, measured values will not be included in calculations. Data from all valid measurements is stored in the handheld unit.

All valid averaged data is recorded in the Discharge Measurement Summary file. QReview can be used to review and export this file and to review all one-second time series data.

Adjust quality thresholds

Quality thresholds can be adjusted for specific measurements.

1. From the second Main Menu [2/2], select Advanced.
The Advanced [1/2] window appears.
2. Select option 1, Quality Thresholds.
The QA Thresholds [1/2] window appears.
3. Enter the number of the quality threshold to be adjusted and update or change the entry.

Option	Description
Minimum correlation	xx.x, default 40.0
Maximum angle	xx.x, default 20.0
Velocity gradient	x.xx, default 0.82
Standard deviation	x.xx, default 0.33
Minimum SNR	xx, default 10%

4. Scroll down to view the second Quality Thresholds [2/2] window. Update or change the entries.

Option	Description
%Discharge/Vertical	xx%, default 5%

Option	Description
1-Point Maximum Depth	xx.x, default 1.5 ft
Set to defaults	Reset to default settings.

- To return to the Main Menu, scroll up to the first Quality Thresholds window, and press the BACK key.

Quick quality checks

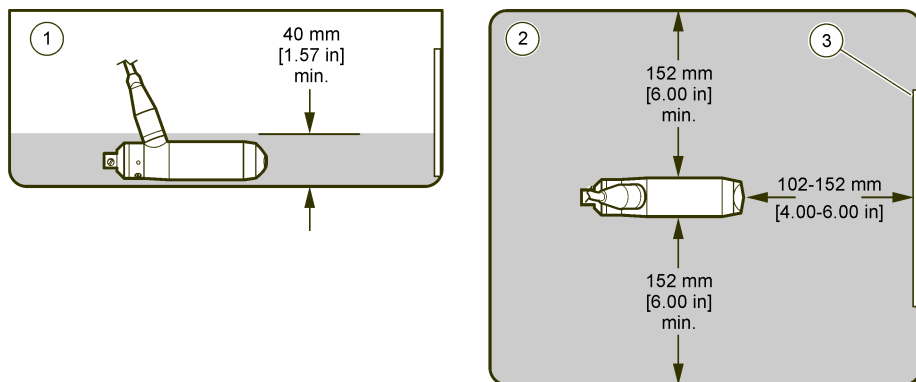
A Quick Quality Check (QQC) helps make sure the system is ready for use and will give reliable and accurate measurement data. The Quick Quality Check option is found in the Main Menu [1/2] screen.

It is recommended that a Quick Quality Check be done before the system is moved to the field, although this is not mandatory. A container with appropriate dimensions and a metal plate placed 4-6 inches in front of the sensor can be used. The metal plate should be at least as high as the depth of water, and 10" wide. Refer to [Figure 9](#) for minimum container dimensions and sensor placement.

At least 50% of the quick quality check parameters must be within their specified values for the quality check to pass.

The results of a quick quality check are stored with a default or user-defined name and the file can be downloaded with QReview. The file has a .QQC extension and the following default naming convention: QCMMDDYYXXXXXX_QQC, where MM = month, DD = Day, YY = Year and XXXXXX = the ADC serial number.

Figure 9 Container dimensions



1 Side view	3 Metal plate
2 Top view	

To do a quick quality check, do the following:

- From the Main menu, select Quick Quality Check.
- Enter a name for the QQC file or proceed directly to the depth calibration. In the latter situation, the default name for the QQC file will be used. (For example, QCMMDDYYXXXXXX_QQC, where XXXXXX is the device serial number). File names are limited to 20 alpha numeric characters.
- Select option 2, Depth Calibration. Refer to [Calibrate the pressure cell \(depth calibration\)](#) on page 22. The absolute pressure cell built in to the OTT ADC sensor body determines the water and sensor depths. The pressure cell must be calibrated in the existing air pressure conditions to make sure depth readings are accurate. If the depth sensor is not calibrated before a QQC is started, a warning message will appear.
- Place the sensor in the water, select option 3 and in the QQC screen press the start key to begin the quality check. The following parameters are examined by the handheld unit during the quality check: signal amplitude, signal-to-noise, depth, temperature, battery voltage, and noise.

The quality check starts. A PASS or FAIL message will appear in the handheld unit display. Scroll to additional screens to view information about the test results. Push OK to confirm the quality check results and return to the QQC menu.

5. To verify the depth sensor performance, check the instantaneous reading against a reference such as the wading rod.

Internal quality check

Internal quality checks are closely linked to the flow velocity measurement process. Each measured value is internally checked against the following criteria:

- Correlation > 40%
- Velocity > -0.25 m/s and < 0.25 m/s
- Velocity gradient (the difference between the current measurement and the previously measured velocity) < 0.25 m/s
- Signal to Noise Ratio (SNR) > 10 dB

Measured values that meet the criteria are saved. If the measurement time (integration time) is set to 30 seconds, for example, the OTT ADC collects a maximum of 30 values for each sound pulse. At the end of the measurement time, the OTT ADC checks whether at least 50% of all measured values meet the associated criteria. If the 50% standard is not met, the measurement is rejected and the user is prompted to repeat the measurement.

If the measured values are confirmed, the OTT ADC calculates the mean and standard deviation for the measured velocities in the cells closest to and furthest from the sensor. Based on the result of the calculation, the final velocity is determined and shown in the display.

The focus of an internal quality check for flow velocity measurement is based on the parameters given in [Table 4](#).

Table 4 Internal quality check parameters for flow velocity measurement

Parameter	Description	Comment
Signal to Noise Ratio (SNR)	Indicator for the strength of the reflections caused by particles in the water.	If the SNR value is too low, a valid measurement is not possible. Limit SNR > 10 db.
Correlation Factor (CF)	Indicator for the consistency of sequentially received scan patterns	Limit CF > 40%
Peaks	Outliers in the measured velocity values caused by environmental conditions	Peaks are eliminated in the velocity gradient check
Standard deviation	Standard deviation for the velocity indicator for the measurement accuracy	Standard deviation is decisive for the determination of the valid measuring range.
%Q	Percentage proportion of a discharge segment to the total discharge	Ideal < 5% Maximum 10% After a measurement is completed, the percentage proportion of each segment of the total discharge is shown on the display of the handheld unit. The user can then decide whether additional verticals need to be allocated.

Calibrate the pressure cell (depth calibration)

Water depth is given by an absolute pressure cell built in to the OTT ADC sensor body. The pressure cell must be calibrated to make sure the sensor measurement values are correct. This calibration must be done under the current air pressure conditions with the sensor outside of the water in air. A depth calibration is done before a measurement is started. Once a measurement is started, an

internal timer in the handheld unit prompts for a depth calibration every 30 minutes unless the depth sensor is turned off.

In some situations, it may be convenient or even necessary to turn the depth sensor off. This can be done through the third Measurement Settings [3/3] menu.

Note: If the depth sensor is turned off, a calibration is still required because calibration data is related to the noise level measurement. However, the automatic calibration prompts are disabled, and the ADC assumes the noise level from the last calibration unless a quick quality check has been done.

To do a depth calibration:

1. With the sensor in the air, from the first of the two Main Menus [1/2], select Depth Calibration.
2. Verify the sensor offset and current reading and push Start.
3. When the reading on the handheld unit display is stable, push OK to accept the calibration.

Turn the depth sensor on or off

By default, the depth sensor is turned on. To turn the depth sensor off, do the following:

1. From the first Main Menu [1/2], select Measurement Setting.
2. Scroll to the third Measurement Setting [3/3] screen and select option 2, Depth Sensor.
Each time the number 2 key is pressed, the sensor turns on or off, whichever is opposite of the current state.

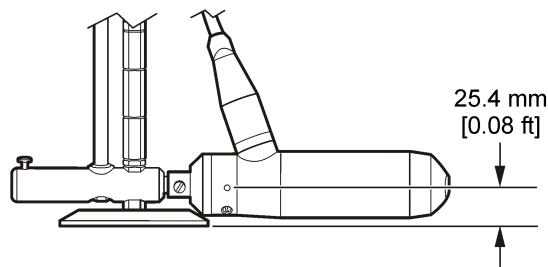
About sensor offsets

This is the offset between the depth sensor and the wading rod. Rod Offsets can be changed in the third [3/3] Measurement Settings menu. Two offsets can be entered, a Sensor Offset or a Point Offset.

The Point Offset refers to the distance between the flat base and a pointed end. Standard USGS top-setting and standard wading rods do not have a point below the flat base. Therefore, the point offset for each is set to zero and does not need to be entered.

A sensor offset must be entered. For a standard USGS top-setting wading rod this offset should be around 0.10 feet. This is the default value. Refer to [Figure 10](#).

Figure 10 Sensor offset



Do the steps below to verify if the offset is correct.

1. Set the OTT ADC to the bottom of the wading rod and rest the rod base on the bottom of the channel or stream.
2. Compare the displayed depth read by the pressure sensor with the depth indicated on the wading rod.
3. If the depths indicated are different, adjust the Sensor Offset until the depths are the same.

Perform a single point measurement

Place the handheld unit in Measure mode.

1. Place the sensor in the flow. Make sure the sensor faces upstream and is aligned perpendicular to the cross section.
2. With the sensor in the flow, push the START key.
The unit performs a measurement. The measurement duration is based on the average setting in the Measurement Settings [2/3] screen.

3. Enter a filename at the prompt.
The measurement file is stored with the entered name.

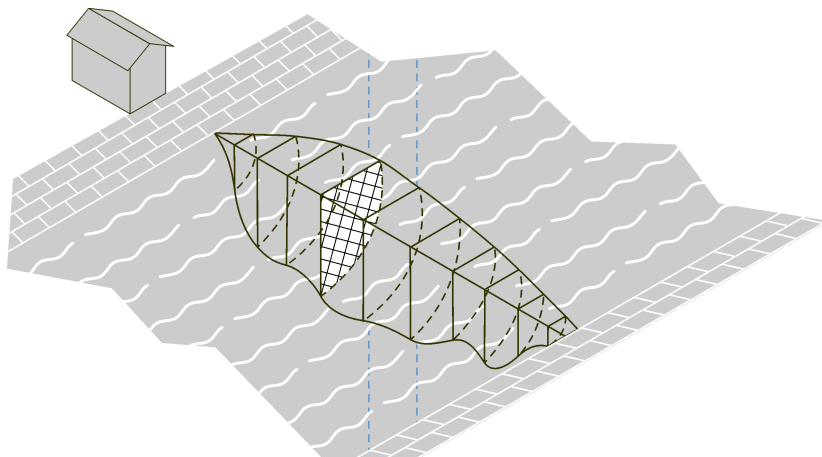
Note: If a warning message appears at the end of the measurement, the filename prompt will appear after the warning is acknowledged.

Velocity and discharge measurement methods

Discharge in a waterway with flow is defined as the volume of water that flows through a particular cross-section per unit time. Discharge is normally given in m^3/s or ft^3/s and is the product of the discharge cross-section and the average velocity of the water through the cross-section.

Figure 11 shows an example of a cross-section used for discharge measurement.

Figure 11 Discharge cross section



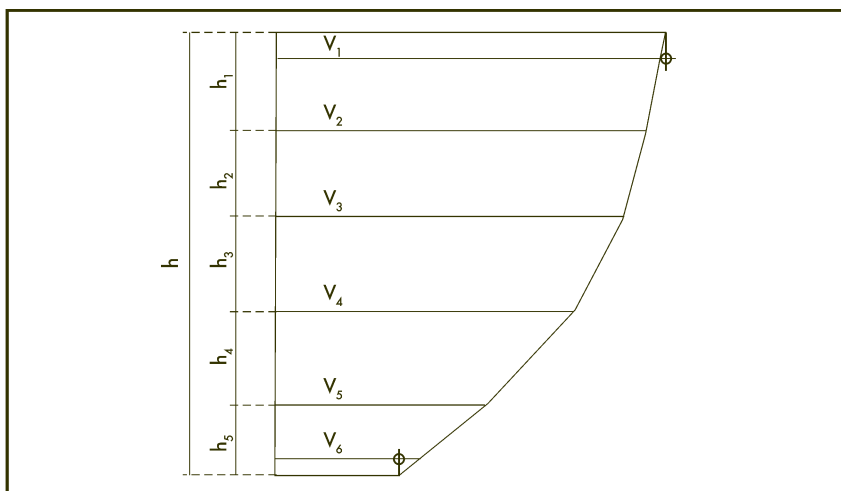
The discharge measurement method that uses the classic verticals process is an indirect measurement method. When the average flow velocity of the specified verticals and the discharge cross-section have been determined, a mathematical model is used to calculate the discharge.

Methods for velocity measurement

The average flow velocity at a vertical is calculated from a defined number of individual measurements at different depths. These individual velocities when applied to the vertical depth give an image of the velocity distribution. The quotient of velocity surface and water depth equals the average flow velocity.

Figure 12 shows how the average flow velocity is calculated.

Figure 12 Example of average flow-velocity calculation, multi-point method



$$V_m = \frac{(V_1 + V_2) \times h_1 + (V_2 + V_3) \times h_2 + \dots + (V_{n-1} + V_n) \times h_{n-1}}{2h}$$

There are various ways to arrange the individual points. Methods include the Reduced Measure Points Method, the 2-point KREPS measurement, the Velocity Distribution Method (Multi-point Method), and supplementary methods. More information about each type of method is given below.

- **Reduced measurement points methods (1 or 2-point)**--These require less time, but assume a consistent, logarithmic velocity distribution. Confirm the accuracy of these methods through comparison to multi-point measurements.
- **2-point KREPS measurement**--Velocity measurements are taken near the surface and at 38% of the depth. Also requires less time and assumes consistent distribution. Should be confirmed through comparative multi-point measurements.
- **Multi-point methods**--Measurement points are freely determined based on depth and flow conditions. Highest and lowest measurement points should be as close to the surface and the bottom as possible. The multi-point method gives a more precise reading of the velocity surfaces, but measurement reliability decreases as water levels vary. [Table 5](#) gives a guide to the number of measurement points for a given water depth.
- **Supplementary methods**--In methods where the velocity near the surface (V_o) and the velocity near the bed (V_s) are measured, the sensor must be positioned as near as possible to the surface and the bed. The sensor must be submerged when near the surface, and the high and low points must be the same for each vertical to the extent possible. Measurements made below the surface must not be influenced by wind or surface waves.

Table 5 Water depth and number of measurement points (valid for multi-point method)

Water depth in feet	Number of measurement points
< 3.3	3-4
3.3 - 9.8	4-6
13 - 23	5-8
> 23	6-10

Methods of discharge calculation

Discharge calculation can be done with graphical or arithmetic methods. The OTT ADC supports arithmetic calculation methods including the MEAN section method, and the MID section method. More information about each is given below.

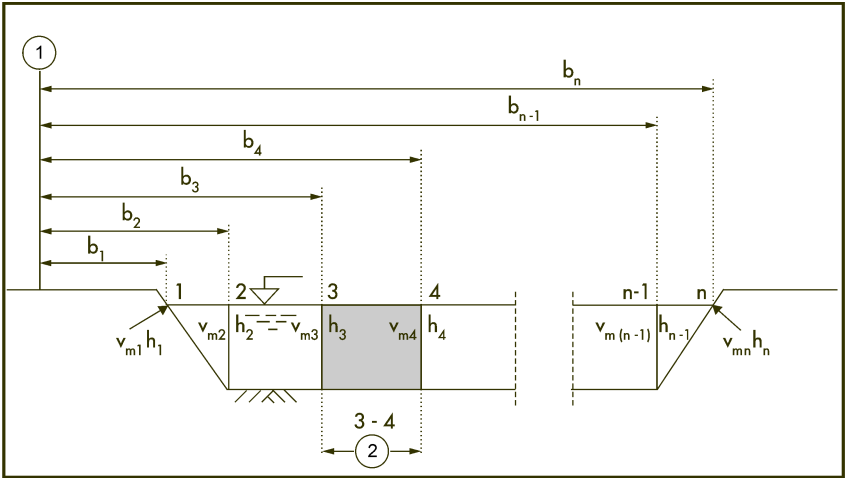
MEAN section method (procedure with average cross-section)

With this method, the measurement cross-section is divided in individual flow segments. Each partial segment is limited by two adjacent verticals.

The equation describes the discharge calculation for an individual segment for the MEAN section method. The total discharge is equal to the sum of the partial discharges of all segments. The MEAN section method is illustrated in Figure 13.

Note: The additional discharge element of the two edge segments is calculated with the assumption that speed and depth at the edges are zero.

Figure 13 MEAN section method



$$q_{3-4} = \left(\frac{V_{m3} + V_{m4}}{2} \right) \times \left(\frac{h_3 + h_4}{2} \right) \times (b_4 - b_3)$$

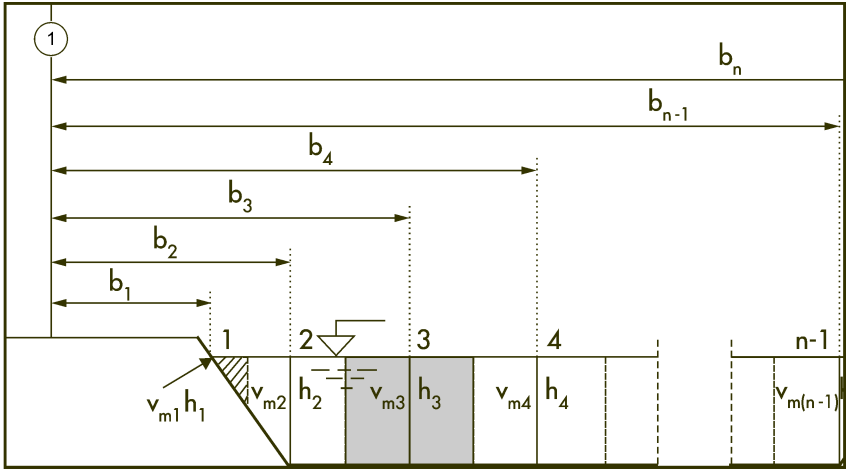
1 Cross section zero point	2 Segment
----------------------------	-----------

MID section method (mid cross section method)

In this method, the measurement cross section is also divided in to individual segments. The individual segments do not lie between the verticals, but are defined by half the distance to the neighboring vertical in each case. For this reason, the first and last verticals should be as close to the edges as possible when this method is used. Figure 14 illustrates the concept.

The equation gives the the discharge calculation for an individual segment when the MID section method is used. The total discharge is the sum of the partial discharges of all segments.

Figure 14 MID section method



$$q_3 = V_{m3} \times \left(\frac{(b_3 - b_2) + (b_4 - b_3)}{2} \right) \times h_3$$

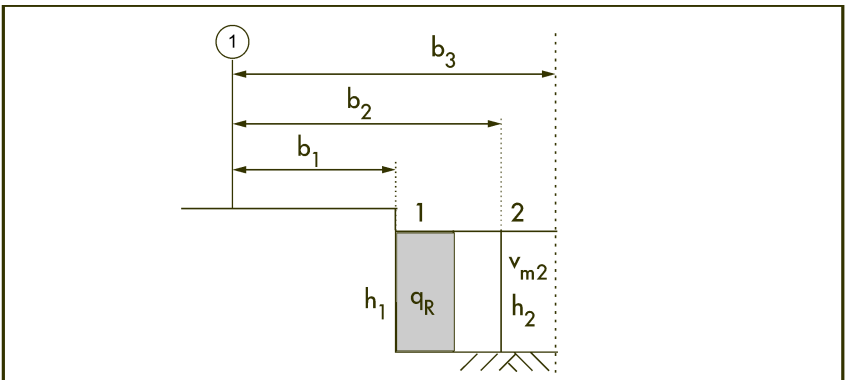
1 Cross section zero point

Experience shows that the MID section method gives more exact results when compared to the average cross section method, and requires less calculation time. For these reasons, it is the default setting for the handheld unit of the OTT ADC.

Vertical edges and measurements

The flow element in the edge areas with vertical edge walls is accounted for with the method illustrated in Figure 15. In the equation, K_R equals the edge factor that allows for the roughness of the edge wall.

Figure 15 Vertical edges in discharge calculations



$$q_R = \left(h_1 \times \frac{(b_2 - b_1)}{2} \times K_R \times V_{m2} \right)$$

The edge factor is dependent on the roughness of the edge. Use K_R values listed below as guide values.

Edge characteristics	K_R
Smooth edge with no vegetation (e.g. concrete, steel, cement)	0.8 - 0.9
Brick sides with vegetation	0.7
Rough walls with heavy vegetation	0.6 - 0.5

Measurement settings menus

Measurement settings [1/3]

The Measurement Settings menu is divided into three screens where the basic settings for a discharge measurement are entered. These settings are used as input parameters for internal advance planning of measurements and for calculating partial flows and complete discharge. The settings available in the first screen are described in the steps below. Scroll down to view the other Measurement Settings screens.

Note: Step 1 describes how to load settings from a previous measurement or continue from the point where a previous measurement was halted.

1. To use settings from a previous measurement or to continue a previous measurement, navigate to the first Main Menu [1/2] and select Load.

Option	Description
Load settings only	Calls the list of saved files. After selecting a file, the saved settings of that file are loaded and will be used for the new measurement. The settings can be modified.
Continue previous measurement	Calls the list of saved files. After a file is selected, the settings of the file are loaded. Additional measurement points can be added. Press the START key three times to return to the measuring mode. The vertical and position of the next measurement point are shown.

2. For a new measurement, from the first Main Menu [1/2], select Measurement Setting.
3. In the Measurement Settings [1/3] screen, enter the information for the displayed options.

Option	Description
File/Station name	This is the name that will be given to the measurement file or station. The name can be up to 20 alphanumeric characters.
Station Number	This is the station identification number. The number can be up to 20 numeric characters.
Measurement Number	This is the Measurement identification number. Can be up to 8 numeric characters.
Operator	This is the name of the operator who does the measurement.

Note: A file/station name and station number are required for a measurement. Entries for other settings are optional, and if not changed, default values will be used.

Measurement settings [2/3]

This is the second of the three screens in the Measurement Settings menu.

1. Enter the information for the Estimated or Rated discharge.
2. Enter the estimated width of the discharge measurement cross section.
3. Enter the value for vertical spacing. This is the distance from one vertical to the next.
4. Enter the gage height at the start and finish verticals.
5. Enter a value for the averaging interval in seconds.

Measurement settings [3/3]

This is the third screen of the Measurement Settings menu. Update or change the entries for each option.

1. Select Rod Offsets. Rod offsets compensate for the fact that the symmetry axis of the sensor never lies directly on the waterway bed.

Option	Description
Sensor offset (Range 0.00 - 1.00 ft)	Distance between the symmetry axis of the sensor and the base plate of the rod. A sensor offset must be entered.
Point offset (Range 0.00 - 0.50 ft)	Distance between the base plate of the rod and the waterway bed. (Does not apply to Standard USGS top-setting wading rods or standard wading rods.)

2. Select Depth Sensor to turn the sensor on or off.

Option	Description
On	During a measurement, the handheld unit prompts the user to perform a depth calibration every 30 minutes.
Off	The handheld unit does not prompt the user to perform a depth calibration.

3. Select Salinity and enter a value in ppt. Range: 0 - 50. The salinity influences the speed of sound and is used as a parameter in the velocity measurement. In freshwater waterways, the value is generally 0 ppt. The current salinity value is shown in the display.

4. Select the Measurement Method.

Option	Description
1-point	Position of measure points: $0.6 \times h$ Mean velocity formula: $V_m = V_{0.6}$
2-point	Position of measure points: $0.2 / 0.8 \times h$ Mean velocity formula: $V_m = (V_{0.2} + V_{0.8})/2$
3-point	Position of measure points: $0.2 / 0.6 / 0.8 \times h$ Mean velocity formula: $V_m = 0.25 \times (V_{0.2} + 2 \times V_{0.4} + V_{0.8})$
4-point	Position of measure points: $0.2 / 0.4 / 0.7 / 0.9 \times h$ Mean velocity formula: $V_m = 0.25 \times (V_{0.2} + V_{0.4} + V_{0.7} + V_{0.9})$
5-point	Position of measure points: near to surface / $0.2 / 0.6 / 0.8 \times h$ / near to bed Mean velocity formula: $V_m = 0.1 \times (V_o + 3 \times V_{0.2} + 3 \times V_{0.6} + 2 \times V_{0.8} + V_s)$
6-point	Position of measure points: near to surface / $0.2 / 0.4 / 0.6 / 0.8 \times h$ / near to bed Mean velocity formula: $V_m = 0.1 \times (V_o + 2 \times V_{0.2} + 2 \times V_{0.4} + 2 \times V_{0.6} + 2 \times V_{0.8} + V_s)$
2-point Kreps	Position of measure points: near to surface / $0.62 \times h$ Mean velocity formula: $V_m = 0.31 \times V_o + 0.634 \times V_{0.62}$
1-point ICE 0.5	Position of measure points: $0.5 \times h_{\text{effective}}$ Mean velocity formula: $V_m = V_{0.5} \times K_{\text{ice}}$ where $K_{\text{ice}} = 0.88 - 0.90$ (ISO 1996)
1-point ICE 0.6	Position of measure points: $0.6 \times h_{\text{effective}}$ Mean velocity formula: $V_m = V_{0.6} \times K_{\text{ice}}$ where $K_{\text{ice}} = 0.92$ (USGS)
2-point ICE	Position of measure points: $0.2 / 0.8 \times h_{\text{effective}}$ Mean velocity formula: $V_m = (V_{0.2} + V_{0.8}) / 2$

Option	Description
Surface 1-point ISO	Position of measure points: near to surface Mean velocity formula: $V_m = V_o \times K_o$ where $K_o = 0.84 - 0.9$ (ISO 748)
Multi-point measurement	Position of measure points: Number and position of measure points are freely selected Mean velocity formula: Refer to Calculation of Average Flow Velocity figure.

5. Enter the correction factor for the 1-point ice measurement and the surface 1-point measurement. Range : 0.7 - 1.0.

Note: Can only be selected if *Ice, Single point* or *ISO, surface method* has been selected as the Measure Method.

6. Select the Discharge Method. Press the number 5 key to toggle between the options.

Option	Description
Mid-section	Individual segments are defined by half the distance to the adjacent vertical.
Mean section	The measurement cross-section is divided in to individual flow segments defined by a vertical on either side.

Field quality checks

Quality checks can also be done while in the field environment. The Field Quality Check option can be found in the Start Measurement screen. If a field QC is repeated, the previous check is overwritten.

At least 50% of the quick quality check parameters must be within their specified values for the quality check to pass. This rule applies whether user-defined parameter values or the default parameter values are used for the quality check.

To do a field quality check, do the following:

Note: If necessary, adjust the quality thresholds for the site before the quality check is started.

1. Do a depth calibration. The absolute pressure cell built in to the OTT ADC sensor body determines the water and sensor depths. The pressure cell must be calibrated in the existent air pressure conditions to make sure depth readings are accurate. If the depth sensor is not calibrated before a QQC is started, a warning message will appear.
Note: Depth sensor calibration is still required if the depth sensor is turned off.
2. Select number 3, Start Measurement.
3. Read the depth indicated on the wading rod.
4. Read the depth indicated on the handheld unit display.
5. Verify that the readings are within ± 0.01 ft. If the readings are not within this specification, check the rod offset.
6. Place the sensor in the mean flow at 6/10 depth, as close to the middle of the cross section as possible.
7. Push the start button to begin the field quality check.
The unit performs the field check, and the QC Results [1/3] screen will appear. Scroll down to view additional screens. The information in these screens includes whether the field check passed or failed, status of the amplitude and correlation checks, depth, temperature and other parameters. The details of the field check can also be viewed in the QReview Summary File.

Perform a discharge measurement

Measurement notes

- The sensor is ideally positioned when the head points against the direction of flow and the symmetry axis is at right angles to the measurement cross section.
- Make sure there are no obstructions near the sensor.

- Allow time for the temperature sensor of the OTT ADC to adjust to the water temperature (5-6 minutes in extreme conditions).
- If conducting a wading measurement, stand so that submerged portions of the body (e.g., legs and feet) give no or minimal resistance to the flow of water that reaches the sensor.
- All discharge measurement data are automatically saved on the handheld unit.
- After it is started, a measurement can be interrupted by switching off the unit. When the unit is again powered on, a warning message will prompt the user to continue the measurement.
- If no name has been specified when the Start menu option is selected, the user is prompted to enter a name for the measurement file.
- During a velocity measurement, the depth measurement display updates automatically every 3 seconds. If the tolerance for the actual depth compared to the target depth exceeds 1% (assuming a minimum of 0.79 inches (2 cm), the target depth in the upper right corner blinks. An up or down arrow appears on the display to indicate whether the depth needs to be increased or decreased. When the actual and target depths are within the 1% tolerance, the arrow disappears and is replaced by a black diamond.

1. Do a field quality check.
2. From the first Main Menu [1/2], select Measurement Setting.
3. In the Measurement Setting menu, select the Station Name option and enter a name for the discharge measurement file. Push Enter to confirm.
4. Select the Station number option and enter a value. Push Enter to confirm.
5. The settings entered in the Measurement Settings menus will be used for the discharge measurement. To use settings from a previous measurement, or to continue a previous measurement, go to the Main Menu [1/2] and select Load.
***Note:** Both a Station Name and Station Number are required for a measurement. Other measurement settings are optional. For example, an estimated/rated Discharge can be entered in the measurement settings, and the measurement method and averaging time can be modified.*
6. To start the discharge measurement, go to the first Main Menu [1/2] and select Start Measurement.
If no name for the discharge measurement file has been entered, the unit displays a **No Filename** warning. Enter a name for the file and press Enter, then select Start Measurement. The Start Measurement screen appears.
7. Select one of the options in the Start Measurement screen, update the entries as necessary and press OK to confirm.

Option	Description
1. Depth calibration	Choose this option to calibrate the depth sensor.
2. Field quality check	Choose this option to initiate a field quality check.
3. Start Edge	Choose this option to enter a value and position for the starting edge of the discharge measurement. <ol style="list-style-type: none"> 1. Start at:-- Left or Right. Press the number 1 key to toggle between Left and Right. 2. Position:--Enter the position value of the starting edge. Range: 0.00-985.00 ft. The position value = 0 if the near edge corresponds to the reference point for calculating the position of the verticals. As a rule, the reference point is the cross section zero point of a measured discharge cross section. The position value > 0 if the near edge is not the reference point. The value is then equal to the distance of the near edge from the reference point. 3. Depth:--Depth of the water at the near edge. (Range: 0.00 - 33.00 ft). The depth is typically 0 for natural waterways and > 0 for right angled cross sections. 4. Roughness:--Roughness factor of the side wall. Range: 0 = rough, 1=smooth. This value is relevant only for right angled cross sections and is used in calculating the discharge proportion of the edge areas.

Option	Description
4. First Vertical [1/2]	Information about the first vertical is shown in the display. To update an entry, enter the option number. <ol style="list-style-type: none"> Position--Position of the first vertical in feet from the starting edge Depth (if an ICE measurement, refer to the ICE Measurement section)--Depth in feet of the first vertical. (When defining the depth of water associated with a vertical, first lower the sensor to the bottom of the stream). <i>Note: If the vertical location of the depth sensor does not meet the 1% criteria, a manual depth can be entered. This will be logged in QReview.</i> Number of points--Number of measurement points on the first vertical Gage height--Height of the gage in feet Notes--Used to enter notes about the first vertical
First Vertical [2/2]	<ol style="list-style-type: none"> Define obstruction--Values for the first and last edge and width of a defined obstruction End measurement--Select this option to end the measurement

The point screen appears.

- Update and verify the information in the point screen and press OK to confirm.

Option	Description
1. Position	Position of the measure point in feet
2. Water depth	Water depth as measured by the pressure sensor (cannot be zero)
3. Current measurement method	The measurement method currently used by the handheld unit
4. End this vertical	Ends the vertical

The unit switches to measurement mode.

- Place the sensor at the bottom of the channel or streambed. Raise or lower the sensor as indicated on the display screen. A black diamond next to the depth reading indicates an acceptable depth level for the sensor.
*Note: If a **Depth Calibration required** warning appears, do a depth calibration, and press OK.*
- Press 2 to select the depth shown on the screen.
- Push the **START** key to begin the measurement.
The measurement runs for the set averaging time. If the measurement is successful, the measurement information for the point is displayed.
If the measurement is not successful, a warning message will appear. The specific warning message depends on the underlying reason for the warning, e.g., a quality threshold that has not been met.
- Some warnings prompt the user to repeat the point, prompt the user to go to the next point, or recommend possible corrective action. If this warning message appears, enter the number of the option.

Option	Description
1. Repeat this point	The measurement is repeated at the same point on the same vertical.
2. Go to next point	The next measurement will be done on the next point of the discharge measurement.

- Press OK to continue with the measurements of points on the current vertical. When a vertical is complete, the Vertical Complete [1/3] screen appears.

- The first two Vertical Completed screens show information about the vertical. The third screen gives additional options as shown in the table below. Scroll down to view this screen and select an option.

- b. Press OK in any of the Vertical Completed screens to advance to the next point in the discharge measurement.

Note: Depending on the measurement mode, the next measure point may be on another vertical.

Option	Description
1. Review measurement	Choose this option to view information about the measurement up to the current measurement point.
2. Notes	Choose this option to enter notes.
3. Insert vertical	Choose this option to insert another vertical. Enter the position of the new vertical in feet and follow the screens to take a measurement at this position. <i>Note: If the new vertical is in the same position as an existing vertical, the measurement of the new vertical replaces the measurement of the existing vertical.</i>
4. End measurement	End the measurement.

14. When the next vertical screen [1/2] appears, place the sensor at the correct position for the next measure point. Verify the information for the vertical and press OK to confirm. The next measurement point screen appears.
15. Verify the information for the measurement point as necessary and press OK to confirm. The unit switches to measure mode.
16. Repeat steps 8 to 13 for the remaining points and verticals.
When all measurements for all points on all verticals are completed, select End Discharge Measurement from the Completed Vertical [3/3] screen.
17. Update the values for the First and Last edges and Stream width. Push OK to confirm.

Option	Description
Finish edge	Displays Edges screen where the user can update values for the first and last edges and stream width.
Quality Rating	Assign a quality rating for the discharge measurement
Review	Review information for the discharge measurement
End	Confirm the end of the discharge measurement

The handheld unit shows shows the complete discharge measurement.

Perform an ICE measurement

1. From the Measurement Settings menu, select Measurement Method, 1 or 2 Point ICE.
 - a. If 1 Point, select either 0.5 or 0.6.
 - b. Verify the coefficient for the chosen option (Table 6), or enter a user selectable coefficient.

Table 6 Coefficient values

Measurement option	Coefficient value
0.5	0.89 (default)
0.6	0.92 (default)

2. Press Start Discharge Measurement.
3. Calibrate the depth sensor.
4. Conduct a Field QC test (optional).
5. Define the Start Edge.
6. Measure the first vertical.
 - a. Enter the vertical position.

- b. Manually measure the ice thickness and enter the value in the handheld.
- c. Measure the distance from the water surface (WS) to the bottom of the ice.
 1. Place the ADC sensor below the ice.
 2. Confirm the sensor offset (upper offset).
- d. Measure the distance from the water surface to the bottom of slush.

Note: This step is used only if slush is present or to determine if slush is present. Entry of data is not required.

 1. Place the ADC below the ice.
 2. From the menu, select WS to bottom of Slush.
 3. Move the ADC down in the water column until the SNR is > 10 db and the Corr and Ampl check pass. This establishes the slush boundary.
 4. Press OK to accept this depth value. This stores the depth of the sensor below the water surface at the slush boundary.

Note: If slush is present, the water surface to bottom of ice depth measurement is used to calculate area.
- e. Place the sensor on the bottom of the streambed to find the WS to streambed depth. The Effective Depth automatically populates.
7. Conduct the measurement.
8. Review the Completed Point measurement.
9. Review the Completed Vertical measurement.

Screen [2a/4] includes Ice thickness, WS to Bottom of Ice and Slush thickness values.
10. Select End Discharge Measurement.
 - a. Review the Discharge Measurement.

The mean ice thickness value is included with the current parameters.

Discharge measurement window

When a discharge measurement is completed, the discharge measurement window appears. The information in the window is summarized below.

Name	File name of the discharge measurement
Discharge	Calculated total discharge (ft ³ /s)
Details	
Discharge	Calculated total discharge (ft ³ /s)
Average Velocity	Average flow velocity (ft/s)
Average Depth	Average water depth
Area	Size of the measurement cross section (ft ²)
Press the Start key to view the details of the Uncertainty ISO 748 calculation.	
Overall	6.3%
Accuracy	1.0%
Depth	0.5%
Velocity	5.5%
Width	0.2%
Method	2.5%
Number of verticals	1.4%

Vertical nr.i [x%] ([x%] shows the proportion of the total discharge represented by the partial discharge of the vertical i).	
Position	Distance of the respective vertical i from the reference point (ft)
Discharge	Partial discharge represented by vertical i (ft ³ /s)
Average velocity	Average flow velocity at vertical i (m/s)
Depth	Water depth at vertical i (ft)
Area	Cross section of the measured discharge segment represented by vertical i (ft ² /s)

QReview discharge measurement summary file

The information from a discharge measurement can be found in a summary file in the QReview software. The information in a typical summary file is given below. The information has been categorized in individual tables for visual understanding. The appearance in the QReview application may be different.

Discharge measurement summary	
Station number	Units
Date/Time	Discharge method
OTT ADC (Serial number, firmware)	Measurement method
Measurement number	Averaging interval
Operator	Mean correlation
Start edge	Standard deviation
Number of verticals	Mean temperature
Total width	Estimated / Rate Q
Total area	Gage Height start
Total discharge	Gage height finish
Mean depth	Depth sensor (On/Off)
Mean velocity	Measurement guidance (On/Off)
Mean SNR	Measurement rating
Rod offsets (Sensor, Point offsets)	

Quality threshold settings	
Minimum correlation	% discharge per vertical
Maximum angle	Minimum signal to noise (SNR) ratio
Velocity gradient	1-point maximum depth
Standard deviation	

Field quality check	
Parameter	Threshold
Number of valid measurements	—

Field quality check	
Amplitude check	0.8 - 1.2
Mean SNR	10 - 100
Depth	0-16.4 ft
Temperature	-5 to 35
Battery voltage	9 to 15
Mean velocity	-0.65 to 7.87 ft/s
Mean flow angle	0 - 45°
Mean correlation	
Beam 1	> 40
Beam 2	> 40
Mean signal amplitude	
Beam 1	30 - 255
Beam 2	30 - 255
Noise level	40 to 100

Time Series														
Time	Vert	Pos	Depth	Vel	%Q	Area	Std Dev	Amp 1	Amp 2	Corr 1	Corr 2	Flow ^o	SNR	Temp

In addition to the above, the QReview summary file lists all notes, including notes entered for individual verticals, flag messages, and the Warning Log along with corrective action if applicable. Warnings are related to verticals.

Example: Vertical 3, Corr. too low - Skipped

This example indicates that the correlation for vertical 3 was too low to give a valid measurement. The user chose to skip the vertical.

Delete a file

Files saved on the handheld unit can be deleted. Backup important files or data before deletion.

1. Navigate to the second Main Menu [2/2], and select option 2, Delete Files.
The Delete screen appears and shows a list of saved files. The list may continue on multiple screens. Scroll down to view items in the additional screens. The first item in each screen will have the number 1.
2. Enter the number of the file to be deleted.
A warning screen appears asking to confirm the file deletion.
3. Push OK to delete the file, or push Cancel to return to the list of files.

QReview software

Overview

The QReview software is used to retrieve data from the ADC and transfer this data to a PC. All measurements, including quality checks, velocity and discharge measurements can be downloaded using the QReview application software. QReview displayed provides basic analysis tools, graphics, one-second time series, reports, and review of potential quality issues.

QReview main menu options

This section gives an overview of the menu options available in the QReview main screen menu bar. To access menu options, do the following:

1. Click an option in the menu bar.
Available sub menu options will appear in a drop down menu.
2. Select an option in the drop down menu.

Option	Description
File	Select this option to Open a file, Print a report, or perform a Printer Setup.
Edit	Select this option to make changes to Configuration and Vertical settings and perform a new calculation with the new settings.
Settings	Select this option to set the Units and Language used in QReview displays.
Tools	Select this option to update the ADC firmware. Refer to the OTT ADC user manual for more information on how to perform firmware updates.
ADC	Select this option to connect the ADC to the PC.
Export	Select this option to save or export data to a specified location or printer.
Help	Select this option to view the QReview help or information about the QReview application.

The software performs the selected action or a pop up screen or window may appear. Refer to specific sections of this manual for more details on how to perform the associated tasks.



Installation

Install the QReview software

The program is supplied as a stand-alone executable on the CD included with the ADC unit. The software can also be downloaded from <http://www.hachhydromet.com>. This file does not alter any registry settings and requires no additional steps for installation.

1. Copy the executable file to a suitable location and start the setup program.
A wizard screen will appear. Use the wizard as a guide for how to name files, where to place them, and the rest of the installation process. A shortcut can also be created on the desktop. After installation, the Q-review application is ready to be used.
2. Double click the executable file or the desktop shortcut to open the QReview program.
3. If a security warning window appears, select Run to launch the QReview program.
The QReview Main screen appears.

Operation

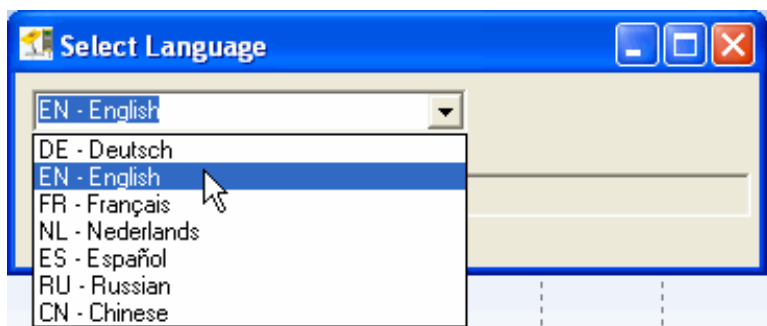
▲ WARNING	
	Fire and explosion hazard. This equipment is intended for only aqueous type samples. Use with flammable samples can result in a fire or explosion.
▲ CAUTION	
	Chemical hazard. Always follow appropriate laboratory safety procedures when chemicals are handled. Always wear all personal protective equipment appropriate to the chemicals used.

Change the language

This option sets the language for all text and menus. The default language is English.

1. In the menu bar of the QReview main screen, click Settings, then select Language. The Select Language pop up window appears.

Figure 16 Select Language screen (English)



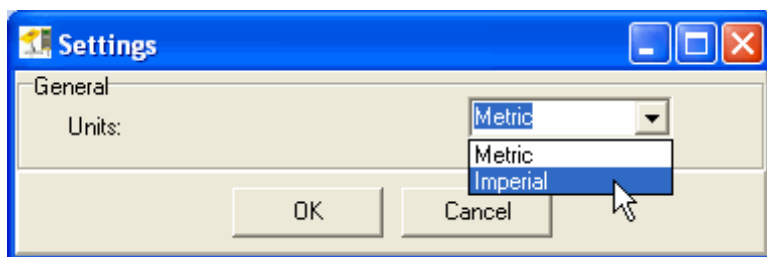
2. Click the drop down menu to view the list of available languages.
3. Highlight the language to be used. The text of all tabs and menus changes to the selected language.
4. Close the Select Language window.

Change the units

Set the units through the Calculations menu. If the open file is an ADC file, only the Units field will be shown.

1. In the menu bar of the QReview main screen, click Settings, then select Calculations. A Settings pop up window appears.

Figure 17 Select units



2. Click the drop down menu arrow to view the list of available units.
3. Highlight the units option to be used. A warning appears that says the program must be closed and started again for the change to take effect.
4. Click OK. Close QReview and then launch QReview again to complete the units change.

Connect the ADC

Make sure the QReview software and the correct USB drivers are installed on the PC.

1. Attach the end of the USB connection cable with the blue locking ring to the ADC handheld unit USB connector. Hand tighten the locking ring to secure the connection.
2. Attach the other end of the USB connection cable to the USB port of the PC.
3. Power on the handheld unit.

4. Launch the QReview application.

Note: If this is the first time the QReview application has been opened since it was installed, the Units must be changed to Imperial. In the main screen, go to Settings, Calculations and select the Units from the drop down menu.

5. Make sure the correct COM port is selected on the PC.

- a. Go to the PC Control Panel and select System.
- b. Select the Hardware tab, then click Device Manager.
- c. In the device manager list, expand the Ports option and select from the available COM ports.

6. In the menu bar of the QReview main screen, click ADC, then select Connect.

The Connecting to ADC window appears. When a successful connection is established, the OTT ADC screen will appear. This screen shows details about the ADC instrument, the files on the instrument available for download, and the folder on the PC where downloaded files will be placed. Files that have been downloaded to that location are also shown.

Retrieve ADC data

The QReview software is used to retrieve data from the ADC and transfer this data to a PC. All measurements, including quality checks, velocity and discharge measurements can be downloaded using the QReview application software. The QReview display provides basic analysis tools, graphics, one-second time series, reports, and review of potential quality issues.

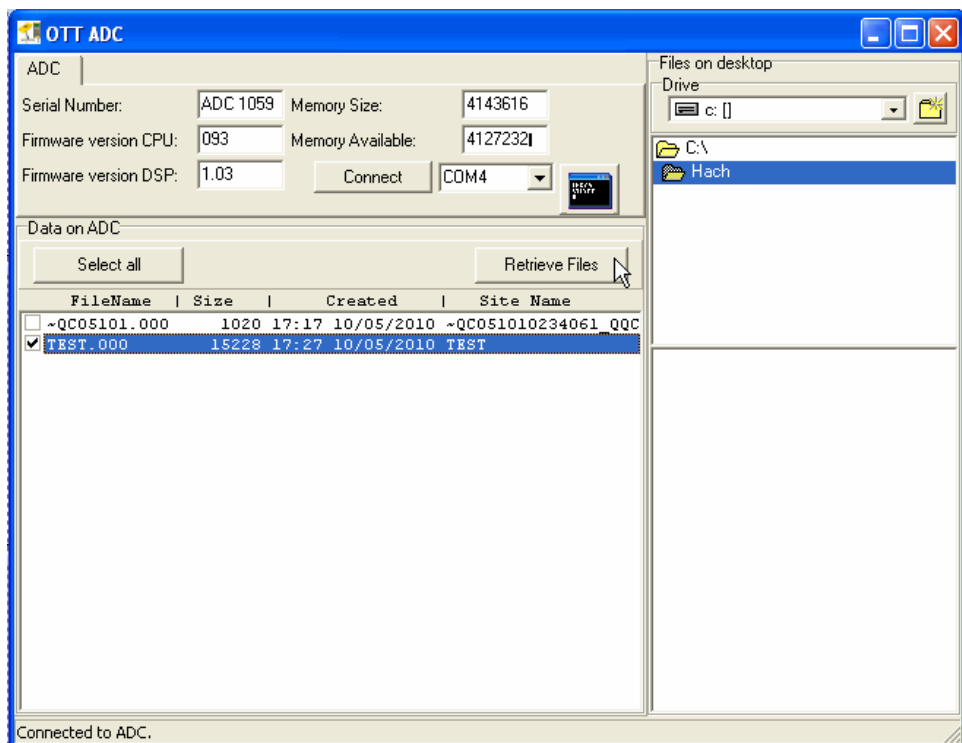
Make sure the correct USB drivers have been installed and make sure the serial port used by the ADC has been identified.

1. Make sure the ADC is connected to the PC and the list of files stored on the unit is shown in the OTT ADC screen.
2. Click the check boxes next to the files to be downloaded, or click Select all to select all listed files.
3. Select the directory where the files are to be stored.
4. Click Retrieve Files.

The data is transferred from the ADC to the specified location.

Note: The files cannot be opened from the OTT ADC screen.

Figure 18 Files available for download



Open and view ADC data files

1. In the menu bar of the QReview main screen, click File, then select Open.
The Select File to open screen appears.
2. If necessary, in the File area, click the **Data from** arrow and select ADC from the drop down menu.
The list of ADC files available on the handheld unit are shown in the window.
3. Select a file from the list of ADC files and click OK.
The review program reads all verticals, and shows an overview of the data with the Graphics tab selected by default. The three main graphs give an overview of the total measurement. The table summarizes the information shown in the graphs.

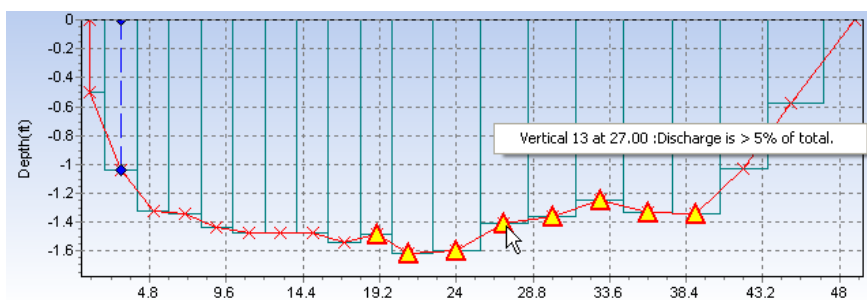
Figure 19 File data graphs



Table 7 Overview of graphs

Parameter	Description
Velocity (ft/s)	Mean velocity over the total depth for each vertical. The arrows indicate the velocity and direction related to the direction of the cross section.
Q/Vertical (ft³/s)	Discharge corrected for the width of the measured section. The line shows the absolute discharge and the bars show the relative discharge. A green bar indicates <5% and a red one >5% discharge of the specific vertical in relation to the whole discharge.
Depth (ft)	Bathymetric profile of the measured section. The areas used in the discharge calculation are marked with a red line.

In the Depth portion of the graphs, triangles indicate the positions of verticals that have associated warning information. To view warning details, click on a triangle. The information appears in a small pop-up window.



4. The graph on the right side of the screen gives data for individual vertical profiles. Click the up and down arrow buttons next to the Vertical field to view different vertical profiles.

Data			
Vertical:	5	Position(ft)	11.00
Mean Vel.(ft/s)	0.159	Depth(ft)	-1.470
Discharge(ft ³ /s)	0.467		

5. Select the Overview, More, Settings or Notes tabs below to view additional data about the selected vertical.

Overview		More..	Settings	Notes
Site:	USGS_BIG_THOMPSON			
Date/Time	10/01/2010 15:07:33 -> 16:02:16			
Discharge(ft ³ /s)	15.259	+/- 0.33		
Width(ft)	48.00			
Area(ft ²)	59.608			
Mean depth(ft)	1.242			
Mean Velocity(ft/s)	0.256			

Note: The settings tab displays two types of data: 1) data controlled by the Q-Review software, and 2) data controlled by the ADC. The data controlled by the ADC appears against a darker background.

6. Select other tabs above the left side graph area to view additional measurement data.

Option	Description
Discharge Summary	This tab displays discharge measurement summary information in a table format. Information includes details about the test, information about the depth sensor, the quality threshold settings, and the field quality check. Notes, warnings, possible quality issues and time series data are also shown.
Uncertainty According to ISO 748	<ul style="list-style-type: none"> Overall 6.3% Accuracy 1.0% Velocity 5.5% Method 2.5% Depth 0.5% Width 0.2% Number of verticals 1.4%
Time Series	This tab displays Averaged Points and Raw Point Data in a time series table format.

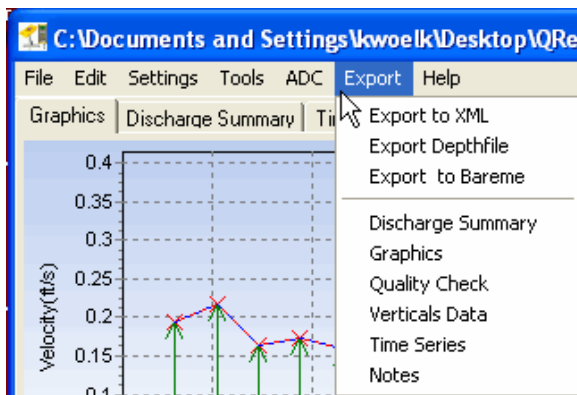
Option	Description
Verticals Data	This tab displays the data about each vertical in a table format. Quality issues and ADC warnings are included at the bottom of the window.
Field Quality Check	This tab displays the data of the latest Field Quality Check (FQC).
Notes	This tab displays any General or Vertical-related notes that were entered while the measurement was performed.

Note: Save and Print buttons are available under each of the Discharge Summary, Time Series, Verticals Data and Notes tabs. If either of these buttons are used, location or printer selection windows will open. A location for the saved file and a printer must be confirmed or selected to save or print the file.

Export data

1. If necessary, open the file that contains the data to be exported.
2. In the menu bar of the QReview main screen, click Export.
3. Select one of the drop down menu options. A Save Report window will open.

Figure 20 Export menu options



4. In the Save in box, click the arrow to navigate to the location where the data will be saved.
5. In the File name box, enter a name for the saved file.
6. Select the file type from the Save As Type drop down menu.
7. Click Save.

Edit screen

Use the Edit option to make changes to general settings. The Edit option can also be used to step through individual profiles and edit the position or depth of each profile.

1. Open a file in QReview.
2. In the menu bar of the QReview main screen, click Edit.
The Edit screen appears.

Note: The original files are copied to <filename>.BAK files when the Edit screen opens. If the Cancel button is clicked before changes are applied, the .BAK files are removed and the Edit window closes. The original data files are not changed until an Apply button is clicked.

Figure 21 Edit screen

Edit

Configuration

First Edge Position: 1.00 Depth: 0.50 Factor: 0.70

Last Edge Position: 49.00 Depth: 0.00 Factor: 0.70

Calculation method: MID

Apply

Verticals

Vertical: 1 Position: 3.00 Depth: 1.04

☒ Valid 1

Apply

Recalculate All OK Cancel

3. Change or update the values in the Configuration or Verticals areas.
4. Click Apply in the applicable areas to save the new values.
5. Click Recalculate All to calculate the entire measurement with the new settings and update the graphs.
6. Click OK when edits are complete.

Print a report

The Print option can be used to print a report of a measurement. Make sure the printer has been set up correctly and selected before the printout is started.

1. To select and set up a printer, do the following:
 - a. From the main screen, click File, then select Printer Setup. The Print Setup window opens.
 - b. Click the Printer Name drop down menu to select the printer.
 - c. Update or change the settings for the selected printer.
 - d. Click OK to save the printer setup.
2. Open the necessary file in QReview.
3. Click the tab that has the data to be printed.
4. Click File, then select Print from the drop down menu options. The report is sent to the printer.

Maintenance

⚠ CAUTION



Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

Handheld unit maintenance

Under normal circumstances, the handheld unit requires minimal maintenance. The following are general considerations and tips that will help keep the unit in good operating condition.

- Keep the protective cover on the USB port closed when the connector unit is not in use.
- Examine the battery level before and after a measurement. Charge the battery if necessary when the charge level is low. The battery can be charged more than 500 times. The battery cannot be replaced by the user. Refer to [Contact information](#) on page 48 for repair contact information.
- Make sure the unit is clean and dry before it is placed in the storage case.
- Store the unit in the case when it is not in use to keep it dry and protected from dust and other possible contamination.
- If the unit is soiled, wipe it with a damp, lint free cloth. Do not use wet cloths or harsh solvents or abrasive cleaning materials or solutions to clean the unit.

Sensor maintenance

Under normal circumstances, the sensor requires minimal maintenance. The following tips and suggestions will help keep the sensor in good operating condition.

- Remove any contamination from the sensor and rod with a dry, lint free absorbent cloth.
- Check the ultrasonic transducers regularly for contamination such as sand. If necessary, the transducers can be cleaned with a lint free cloth or with a soft brush.
- After the sensor has been used in sandy or muddy waterways, clean the sensor body under clear, running water. Make sure the holes for the pressure cell chambers are washed out and all contamination removed. If the sensor is heavily soiled, place it in clear water for a few minutes to dissolve hardened contamination.
- To protect the sensor from dust, moisture and contamination, store the sensor in the protective case when not in use.

Troubleshooting

Measurement guidance

The Measurement Guidance option determines which warning messages are shown. The option can be set to ON (default) or OFF.

When Measurement Guidance is set to ON, all warning messages, including those in the Discharge Measurement Summary file in Q-Review, are shown.

When Measurement Guidance is set to OFF, only applicable warning messages are shown. Warning messages that are not applicable are not shown.

Common problems

Problem	Possible cause	Action or resolution
Measured depth is unrealistic or inaccurate	Sensor not calibrated properly, e.g. sensor was calibrated in water	Calibrate the pressure cell
	Sand or mud in the pressure cell chamber	Clean the chamber. Refer to the full version of this manual for details on how to clean the chamber.
No velocities are displayed during a measurement	Continuous data output not set	Set the measured value display to Continuous.
	Ultrasonic transducers are dirty	Clean the ultrasonic transducers
	Sensor incorrectly connected to the handheld unit	Check the sensor connection cable. Check the alignment of the connector contact pins.

Problem	Possible cause	Action or resolution
The measured velocity seems unrealistic	Ultrasonic transducers may be soiled or damaged	Check the transducers for contamination or damage. Clean the transducers with an absorbent lint-free cloth or soft brush. Conduct a Quick Quality Check.
	Sensor incorrectly aligned	Align the sensor at right angles to the measurement cross-section. Make sure the rod is held straight.
	Sensor is obstructed	Clear any obstruction or select a different measuring position.
	Data quality is not sufficient (e.g., SNR > 10)	Choose a different measuring position
The SNR value does not change or only changes a small amount	The sensor is not properly calibrated in air	Calibrate the pressure cell

Device warning messages

These warning messages may appear as a result of quality checks or at the end of a velocity measurement.

Message or error	Probable cause	Possible actions
% Q for vertical measured is greater than specified % of Total Q threshold	Vertical spacing is too wide	Insert vertical
		Accept
Average correlation below 40	Turbulent water or near boundary	Take another measurement
		Accept
		Go to the next point (measured values are saved in raw data but are not included in the measurement)
Poor correlation-Potential boundary issue?	Measurement interference from submerged obstruction or bank	Repeat the measurement, Accept, or Go to the next point.
Actual Average Velocity Std Deviation is equal to or greater than quality threshold setting	Turbulent waters, measurement was taken near an obstruction or rocks on the streambed	Take another measurement
		Accept
		Go to the next point (measured values are saved in raw data but are not included in the measurement)
SNR < 10 dB	Too few scatterers in the water	Go upstream and disperse dirt in the water to increase scatterers, then measure again.
		Go to the next point (measured values are saved in raw data but are not included in the measurement)
8/10 vel > 2/10 vel		Add 6/10 velocity
		Ignore
2/10 2 X 8/10 vel	8/10 velocity measurement may be near a boundary or obstruction	Add 6/10 velocity
		Ignore

Message or error	Probable cause	Possible actions
Flow angle > 20°	Angle of sensor orientation compared to the tag line is too large. Large flow angles may occur near boundaries such as a start or finish edge.	Accept
		Repeat measurement
		Go to the next point (measured values are saved in raw data but are not included in the measurement)
Depth > 1-Point Method	Depth for 1-point method exceeded	Switch to 2-point method
		Ignore
Low Battery	Battery has approximately 20% life remaining	Press OK to accept message
		Charge battery when possible
Discharge Mode	Handheld meter was turned off while still in the discharge mode	Continue measurement

Measurement warnings and errors

Certain warnings and error messages are specific to measurement processes. The meaning of the warnings and suggested actions are listed in the table.

Table 8 Measurement warnings and errors

Warning	Meaning	Action
Stream width is incorrect. Check edges.	The distance between the near and far edges is too small (< 1.6 ft).	Change the position of the near and far edges as appropriate.
The file already exists. Press 1 to overwrite.	A file already exists with the name entered.	Push the 1 key to overwrite the file (this will delete the existing data) or use a different file name.
Cannot calculate the number of verticals. Spacing = 0	The distance between the verticals was entered as 0.	Enter a value for number of verticals that is greater than 0.
Position is beyond the edge	The position of the verticals lies outside the area defined by the near and far edges.	Check the near and far edges and adjust the position of the verticals as appropriate.
Depth cannot be zero.	At the start of the measurement of the first measurement point of a new vertical, the water depth is automatically set to zero. For each vertical, the user must give a water depth value.	Enter a valid depth value.
Not enough valid data	There are not enough valid measured values available to calculate the average flow velocity. Possible causes are an SNR value that is too low or water turbulence that is too high.	Make sure as many measured values as possible meet acceptable criteria.
Critical error messages (Discharge measurement cannot be completed)		
File System Fail. Press 1 to format	Can occur after switching on a new handheld unit for the first time or after a new memory chip has been installed.	Format the flash memory (all data will be lost)

Table 8 Measurement warnings and errors (continued)

Warning	Meaning	Action
Could not open/close/write to/delete the file	Error in the internal file system	Select Format Recorder from the Advanced Settings. If the error occurs again, the device must be sent for repair.
Error while starting sensor	The handheld unit CPU cannot make a connection to the digital signal processor.	The device must be sent for repair.

View system status

The system status option shows information about the system. This information may be useful when troubleshooting problems.

1. Navigate to the second Main Menu [2/2] window and select option 3, System Status. The System Info screen appears.
2. Press OK to return to the Main Menu window.

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