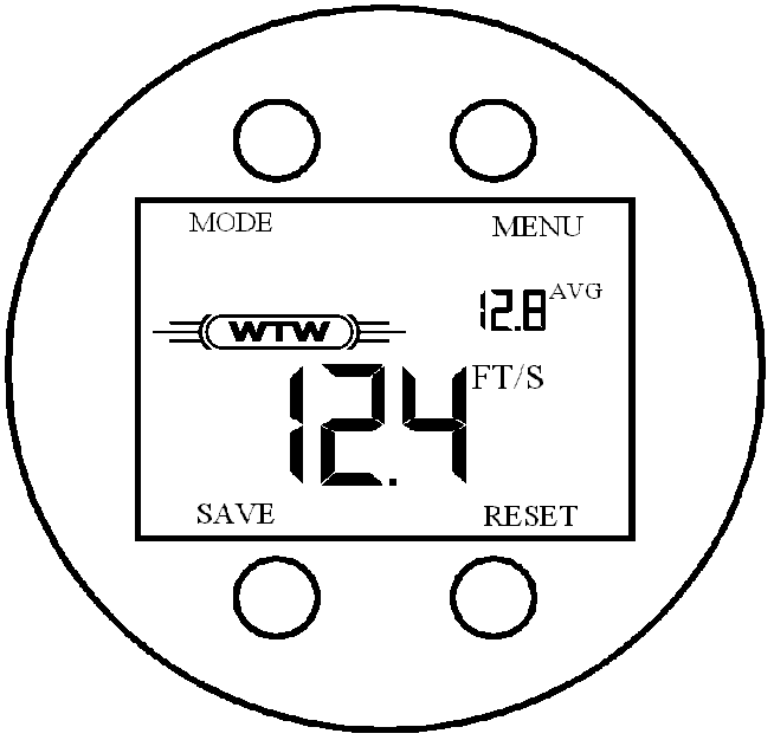
Operating manual

CP-1 / CP-2



Current Probe

ba75810e01 04/2010

Accuracy when going to press

The use of advanced technology and the high quality standard of our instruments are the result of a continuous development. This may result in differences between this operating manual and your instrument. Also, we cannot guarantee that there are absolutely no errors in this manual. Therefore, we are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions.



Note
The latest version of the present operating manual can be found on the Internet under www.WTW.com.

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1 Description

The WTW current probe is a rugged and highly accurate water velocity instrument for measuring currents in open channels and partially filled pipes. The water velocity probe consists of a protected propeller and water bearing for measuring water velocity, coupled to a telescoping probe handle ending in with a LCD display current computer. The current probe is ideal for storm water runoff studies, sewer current measurements, measuring currents in rivers and streams, and monitoring water velocity in ditches and canals.

The current computer incorporates true velocity averaging for the most accurate current measurements. The computer's primary display shows the instantaneous velocity and is updated once per second. A secondary display can be toggled between average velocity, minimum or maximum velocity, and a timer than can be used to measure the length of time in seconds that measurements are being taken. A reset function allows the average, minimum and maximum velocity measurements to be restarted; as well as resetting the timer to zero. Up to 30 separate measurements of average, minimum and maximum velocity can be stored in memory and viewed at any time. Velocities can be displayed in both m/s (meters per second) or ft/s (feet per second), a simple menu function allows you to switch between these units at any time without changing previously stored data.

The current probe computer is self contained and sealed. It has an internal lithium battery that should last approximately 5 years depending on use. The computer floats, and is shock and water resistant for safe use in rugged wet environments.

2 General Instructions

- Remove any debris that may interfere with the current probe's propeller. Make sure that the propeller turns freely by blowing on it. Some chattering of the propeller in air is normal. the bearing is designed to operate best when wet.
- Point the propeller directly into the current you wish to measure. Face the arrow inside the propeller housing downstream. The CP-1 probe handle is a two-piece rod expandable from approximately 0.9 to 1.8 m, and the CP-2 is a three-section rod expandable from 1.5 to 4.5 m. To expand the rod for correct placement in current, loosen the locking nut on the handle, pulling out the top piece and retightening the nut.
- To extend battery life, a low power mode is incorporated that will take effect after 5 minutes of inactivity. If the propeller is stopped and none of the pushbuttons are pressed for 5 minutes, this mode will take effect and the velocity displays will go blank. Press any of the 4 pushbuttons to start the computer back up for taking measurements or viewing stored data.
- To make a measurement, make sure that the computer is not in low power mode by confirming that the velocity displays are shown. If these displays are blank, press any button to restart the computer. Place the propeller at the desired measuring point and press the RESET button to begin taking new average, minimum and maximum readings. If you do not reset this data, the minimum reading will be zero and the average will include all zero readings since the last reset. The measurements are updated once per second. Pressing RESET before beginning a measurement is required for best accuracy.
- To determine current from the velocity data, measure or calculate the cross-sectional area of your current stream in m^2 (or ft^2 when taking measurements in ft/s). If you are measuring current in round pipes, measure the depth of water and pipe diameter, then use the enclosed tables to determine cross-sectional area (see Appendix A: Calculations for Current in Partially Filled Pipes). If you are measuring current in another channel type, manually measure water depth at several points across the current. These measurements are most easily recorded by drawing a diagram on graph paper with a scale of 1 m (or ft) per graph paper square. Cross-sectional area (in m^2 or ft^2) can then be found by counting the number of squares in the stream.
- The average velocity times the cross-sectional area equals current or $Q = V \times A$; where velocity is in m/s and area is in m^2 (or ft/s and ft^2).
- If the propeller gets fouled while measuring current, clean it until the prop turns freely and start over.

3 Average Velocity

The Current probe is used to measure the average water velocity. Stream current velocity varies for several reasons:

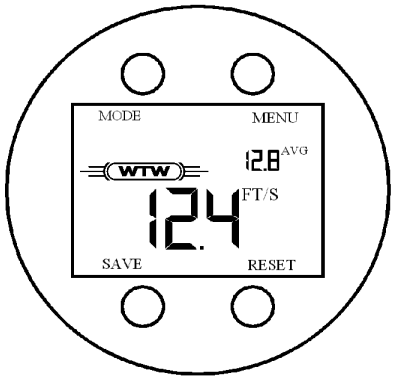
- The velocities vary throughout the current's cross-section due to the friction between the water and the channel. In general, the velocities are greater in the center of the current and less near the bottom and sides of the channel.
- The water surges in velocity with time. In a smooth running stream, the velocity at a specific point can easily vary 0.3-0.6 m/s (1-2 ft/s) over the period of a minute. This pulsating or surging of current should be averaged to obtain an accurate average current reading (leave the probe in the current through a series of current surges).
- The water is not always moving in the same direction. Even the smoothest water current contains turbulence that causes the water to move in different directions. These velocity vectors not parallel to the current will be seen as moving slower because only a part of the vector parallel to current. Unlike other types of water velocity measuring devices, the WTW's Current probe propeller's protective housing will channel the water parallel to current and help to eliminate errors caused by improperly measuring velocity vectors not parallel to current.
- Large obstructions in the current such as rocks and trees will cause the water to flow around them, which may cause the current to change direction for a short distance from these obstructions. To properly measure the true water velocity, the current probe needs to be directly inline with the current.

The current probe can be used in three ways to determine average velocity in a stream.

- For small streams and pipes, the probe can be moved slowly and smoothly throughout the current during average velocity measurements. Move the probe smoothly and evenly back and forth from top to bottom of the current so that the probe stays at each point in the current for approximately the same amount of time. The timer function in the display can be used to monitor the measurement time. Keep moving the probe for 20-40 s to obtain an accurate average value that accounts for surging. (Move the probe as if you were spray painting and attempting to get an even coat of paint over the entire surface.)
  The current probe uses true velocity averaging. Pushing the RESET button zeros the average/minimum/maximum velocities and a running average is started. As long as the probe remains in the current, the averaging continues. To stop averaging press the SAVE button, in Save Data mode the averaging is halted. In this mode the function of the SAVE button changes to SET. Press SET to store the data and reset avg/min/max, or press BACK to resume the previous averaging without storing the data to memory. One reading is taken per second, and a continuous average is displayed. For example, after 10 s, 10 readings are totaled and then divided by 10 and this average is displayed. Once the average reading becomes steady, the true average velocity of the stream is obtained.
- For larger streams and rivers where the Current probe can't easily be moved throughout the current, divide the stream into subsections 0.3-1 m (1-3 ft) wide, depending on the width of the stream. We recommend dividing subsections on your graph paper diagram of the current profile. Run a measuring tape across the stream for reference. Obtain a vertical current profile at the center of each subsection: zero the averaging function and move the Current probe vertically from the surface to the bottom, up and down, slowly and smoothly for 20-40 seconds to obtain a good average. The average velocity (obtained with the Current probe) times the area of the subsection (use your graph paper diagram) equals the current for the subsection ($Q = V \times A$). Once the current of each subsection is obtained, add all of the subsection currents to obtain the total stream current.
- For the USGS "6 tens method", the Current probe is placed at the center of the subsection at a depth from the surface of 0.6 of the total depth. The Current probe is held in place and the average velocity is obtained over a period of 40 s. The 0.6 depth is assumed to be the average velocity point for the vertical profile. Therefore, this average is similar to that obtained in technique 2 (above) however; we feel that technique 2 is more accurate.

4 Computer Operation

4.1 Main Display



In the main display, the 4 buttons are labeled as shown.

The MODE button toggles the upper display between average velocity minimum, maximum and timer. The label next to this display changes to correctly indicate which parameter is shown.

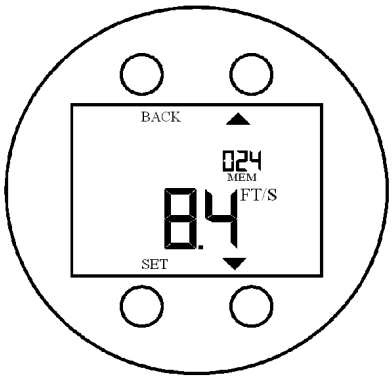
The MENU button is used to view stored data, delete data, set the current units to m/s or ft/s, and change the calibration setting. Press the MENU button for 2 seconds to enter the setup menu. In menu mode, the labeling of the 4 buttons on the LCD display may change to indicate different functions.

The SAVE button is used to save the average, minimum and maximum velocity data to memory.

The RESET button causes the average, minimum and maximum data to be set to the current instantaneous velocity shown in the large lower display. Averaging and storage of minimum and maximum values begins at that time at the rate of once per second.

Note that the propeller should already be in position to begin taking measurements when the RESET button is pressed; if it isn't, the button can be pressed again. When the RESET button is pressed while the propeller is not turning, the avg/min/max parameters are all set to zero. This will cause the minimum velocity to always read zero and the average velocity will include all the zero readings since the last reset. *Press the RESET button when beginning to take any new measurement*.

4.2 Save to Memory



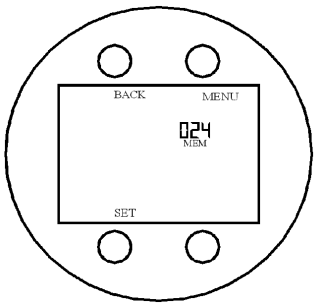
When the SAVE button is pressed, the save data screen is displayed and the function of the buttons is changed. In this mode, the averaging and accumulation of minimum and maximum values is halted. The upper display shows the next empty memory location, in this case 024. The lower display shows the current average reading. Press the BACK button to return to the main display mode without saving and resume data collection where it left off. Pressing the SET button stores the current parameters to the memory location shown in the upper display and the computer returns to the main display mode;

automatically resetting the average, minimum and maximum values.

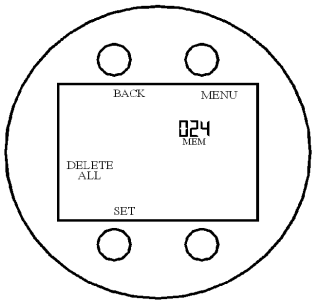
The memory location is automatically incremented. That is, if data is saved to location 024, the next time SAVE is pressed the location will show 025. There are a total of 30 memory locations. Once data is saved to location 030, the next save function will wrap around back to location 001, take care to not overwrite previously saved data. If you do not want to store data into the location shown, use the UP and DOWN arrow buttons to select the desired memory location before pressing SET. If there is already data stored in a particular memory location, pressing SET will overwrite the old data with the new data and no warning will be given.

4.3 Setup Menu

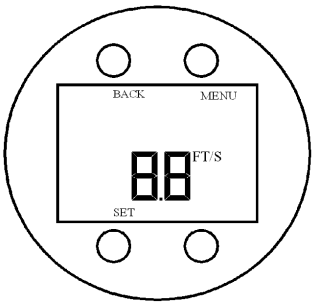
To enter the setup menu, press and hold the MENU button for 2 seconds. Each press of the MENU button cycles through 1 of 4 options, Press BACK at any time to return to the main display mode. The 4 menu options are View data, Delete All Data, Set Velocity Units and Set Calibration Number; press SET to enter the setup screen for the current menu function.



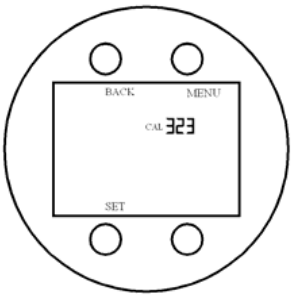
View Data



Delete All

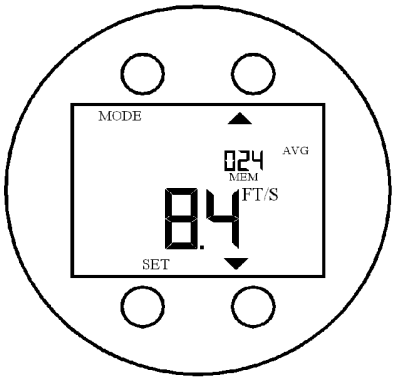


Set Units



Set Cal

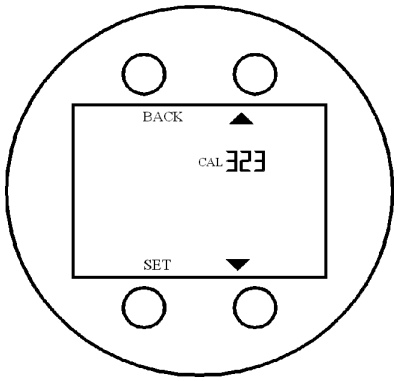
4.4 View Data



From the View Data menu screen, press SET to review recorded data.

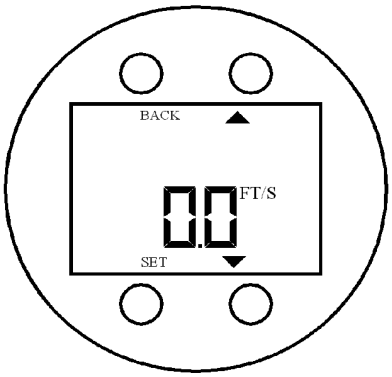
The memory location is shown in the upper display and the data is shown in the lower larger display. Use the UP and DOWN arrow buttons to change the memory location you wish to view. Use the MODE button to select the average, minimum or maximum data value for the selected memory location. The AVG, MIN or MAX icon is shown at the far right to indicate which data value is being displayed, AVG in the example shown. Press the SET button to return to the menu display.

4.5 Delete All



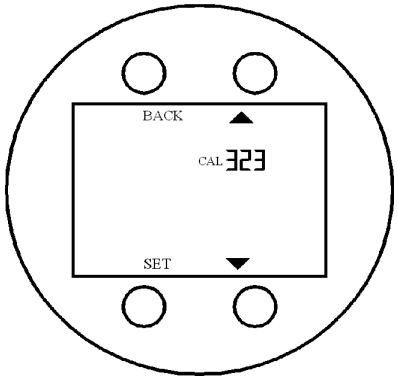
From the Delete All menu screen, press SET to delete all stored data. The upper display shows the number of stored data sets and the lower display reads zero. As a warning, the display is flashing. Press BACK to abort the Delete All function and return to the menu screen. Press SET to delete all data from memory. Once deleted, the data cannot be recovered.

4.6 Set Current Units



From the Set Units menu display, press SET to change the current units. The lower display shows the current current units of either m/s or ft/s. Use the UP and DOWN arrows to select a new unit. Press SET to save the new selection and return to the menu screen. Press BACK to return to the menu screen without saving. In the menu screen, the current unit selected is displayed.

4.7 Set Calibration Factor



From the Set Calibration menu screen, press Set to change the calibration factor.

The calibration factor is factory set and will generally not need to be changed. If you wish to change it, press SET. Use the UP and DOWN arrow buttons to select a new calibration factor. Press SET to save the new selection and return to the menu screen. Press BACK to return to the menu screen without saving. In the menu screen, the calibration number shown indicates the current stored setting.

The current probe computer is factory calibrated to each current probe at the time of purchase and should not need to be changed. The calibration factor is supplied on the calibration certificate that comes with each current probe. Should this scaling factor be accidentally changed, consult this calibration certificate for the current probe or contact WTW and provide the serial number of the current probe. Because each current probe varies slightly, the calibration factor may be different for each one. If a replacement computer is purchased, or the computer is to be used on a different current probe, the calibration factor may need to be changed in order to gain the most accuracy. The scaling factor is used to calibrate out the differences between current probes only, there is no variation from one computer to another.

5 Specifications

Range:	0.1 to 6.1 m/s (0.3 to 19.9 ft./s)
Accuracy:	0.03 m/s (0.1 ft./s)
Averaging:	True digital running average. updated once per second.
Display:	LCD, glare and UV protected
Sensor Type:	Turbo-Prop propeller with magnetic pickup.
Instrument weight:	CP-1: approx. 1 kg (2 lbs) CP-2: approx. 1.4 kg (3 lbs)
Approx length:	CP-1: 0.9 to 1.8 m (3 to 6 ft.) CP-2: 1.5 to 4.5 m (5 to 15 ft.)
Materials:	Probe: PVC and anodized aluminum with stainless steel water bearing Computer: ABS/Polycarbonate housing with polyester overlay
Power:	Internal Lithium, Approx 5 year life
Operating Temperature:	-20 to 70 °C (-4 to 158 °F), non-freezing
Storage Temperature:	-30 to 80 ºC (-22 to 176 °F)

6 Maintenance

6.1 Probe Handle

When the Current probe expansion joint becomes submerged, water will enter the Probe handle. After use, dry the Probe by separating the two handle sections, draining the water inside the Probe handle, and letting the handle dry out in a warm place before reassembling. The Current probe handle can be cleaned with mild soap and water. You should not submerge the top of the pole and the computer. If the computer gets submerged, remove it from the Current probe and dry with a soft cloth:

6.2 Battery

There is a low battery indicator on the display that will come on when the battery becomes too low to ensure accuracy. The display will also start to become dim as the battery voltage drops. The display may normally become dim and show the low battery indicator in very cold conditions. It should return to normal at warmer temperatures.

The lifetime of the battery is normally approx. 5 years. To ensure data safety and operation safety, the batteries cannot be changed by the user. The computer including the display can easily be replaced; please return it to WTW for correct disposal. You will be sent an exchange head (type BA2001) by WTW. Please solicit a quotation.



Note
When the battery has lost its charge or the product is no longer useable for any other reason, do not discard the computer to a landfill.

6.3 Cleaning

Make sure the Turbo Prop turns freely before and after your measurements. Blow on the prop in the direction of current. The prop should turn freely. If not, rinse the probe in clean water and remove any visible strings or other debris from the prop bearing. This should correct the problem. If the prop still does not turn freely, remove the prop screw and the prop, and wash them in clean water or soap and water. Replace prop and screw. Tighten screw firmly but make sure prop still spins freely.

7 Trouble Shooting

- Blow on the propeller. The prop should spin freely and may make a noise (chatter) when you blow on it. The prop should be loose on the shaft when you push it with your finger. If the prop does not spin freely, rinse it with clean water or soak it in mild soapy water.
- A small metal magnet covered with clear adhesive is installed on one blade of the propeller. Be sure the magnet is in place and has not been removed. This magnet is necessary to generate the signal for the computer.
- Remove the computer holder from the pole handle by pulling the holder up away from the pole. The holder should come off with a snap sound. Make sure there is no moisture around the plug or socket. If the plug and socket are wet, dry the parts off and place both in a warm place overnight. Push the computer holder back on to handle until you hear a snap sound. If you don't hear this sound, the holder is not on all the way seated or the connector may be defective.
- Check the calibration number in the setup menu. This number is shown on the calibration certificate supplied with the current probe. It can also be obtained by contacting the Technical Support department at WTW, be ready to supply the serial number for the current probe.
- If the display is blank, press any of the 4 buttons to activate it. If the display remains blank, appears dim, or shows the low battery indicator; the battery may be weak. The battery is not replaceable, a new computer will need to be purchased from WTW.

8 Appendix A: Calculations for Current in Partially Filled Pipes

B	C	B	C
0.01	0.0013	0.51	0.4027
0.02	0.0037	0.52	0.4127
0.03	0.0069	0.53	0.4227
0.04	0.0105	0.54	0.4327
0.05	0.0147	0.55	0.4426
0.06	0.0192	0.56	0.4526
0.07	0.0242	0.57	0.4625
0.08	0.0294	0.58	0.4723
0.09	0.0350	0.59	0.4822
0.10	0.0409	0.60	0.4920
0.11	0.0470	0.61	0.5018
0.12	0.0534	0.62	0.5115
0.13	0.0600	0.63	0.5212
0.14	0.0668	0.64	0.5308
0.15	0.0739	0.65	0.5404
0.16	0.0811	0.66	0.5499
0.17	0.0885	0.67	0.5594
0.18	0.0961	0.68	0.5687
0.19	0.1039	0.69	0.5780
0.20	0.1118	0.70	0.5872
0.21	0.1199	0.71	0.5964
0.22	0.1281	0.72	0.6054
0.23	0.1365	0.73	0.6143
0.24	0.1449	0.74	0.6231
0.25	0.1535	0.75	0.6318
0.26	0.1623	0.76	0.6404
0.27	0.1711	0.77	0.6489
0.28	0.1800	0.78	0.6573
0.29	0.1890	0.79	0.6655
0.30	0.1982	0.80	0.6736
0.31	0.2074	0.81	0.6815
0.32	0.2167	0.82	0.6893
0.33	0.2266	0.83	0.6969
0.34	0.2355	0.84	0.7043
0.35	0.2450	0.85	0.7115
0.36	0.2546	0.86	0.7186
0.37	0.2644	0.87	0.7254
0.38	0.2743	0.88	0.7320
0.39	0.2836	0.89	0.7384
0.40	0.2934	0.90	0.7445
0.41	0.3032	0.91	0.7504
0.42	0.3130	0.92	0.7560
0.43	0.3229	0.93	0.7612
0.44	0.3328	0.94	0.7662
0.45	0.3428	0.95	0.7707
0.46	0.3527	0.96	0.7749
0.47	0.3627	0.97	0.7785
0.48	0.3727	0.98	0.7816
0.49	0.3827	0.99	0.7841
0.50	0.3927	1.00	0.7854

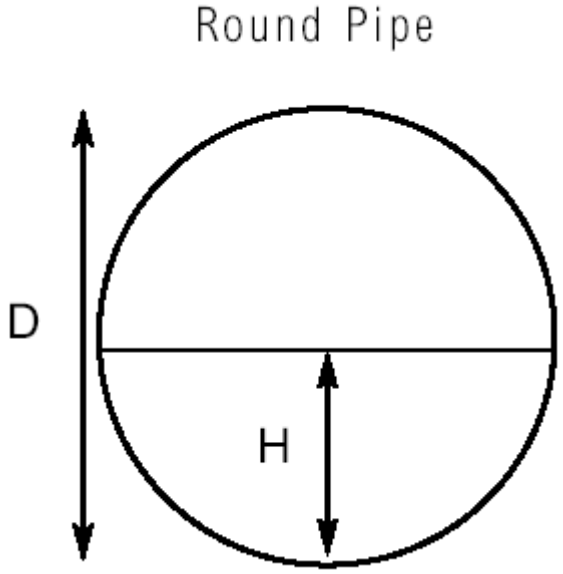
H= Height of water; D= Diameter of pipe (in m)

H/D = Column B

Read Column C adjacent to your pipe's B

C x D2 = Filled area, A (m²)

A x Average Velocity = Volumetric flow rate (Q)



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