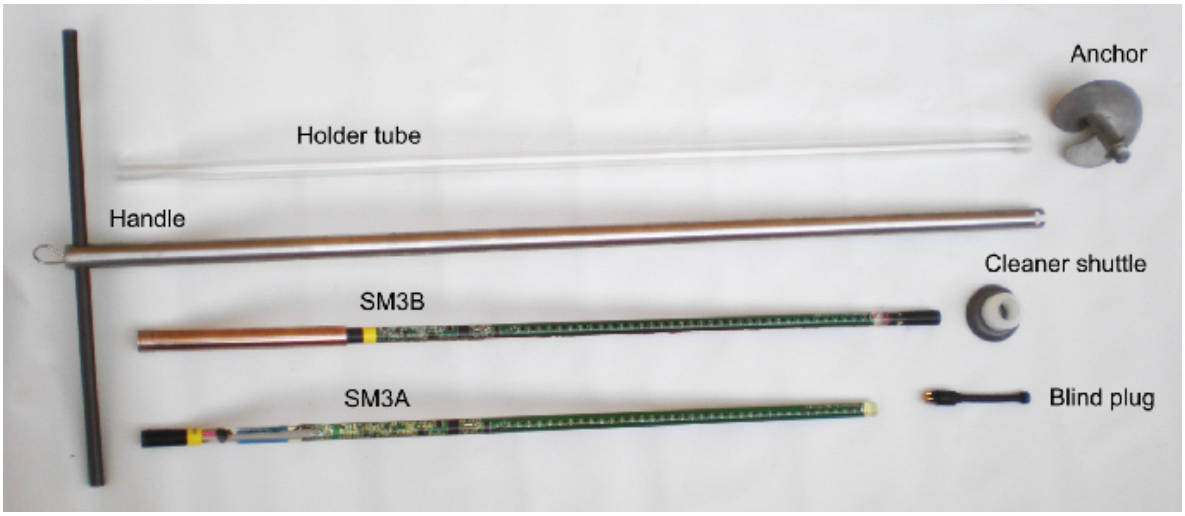
SM3 Standard Operating Procedures

Ver 1.0

Instructions for SediMeter model SM3A and SM3B



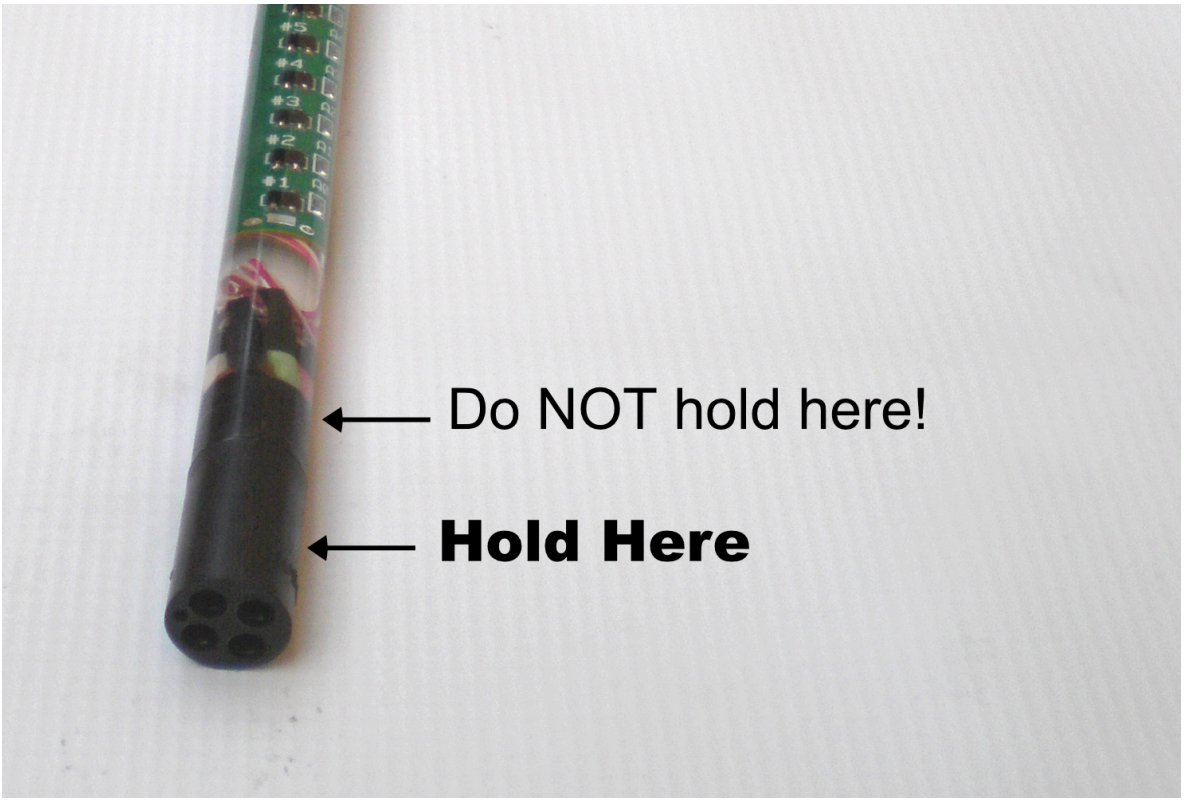
The SediMeter models and accessories. Not shown is the required cable for connecting to a computer.

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IMPORTANT

When disconnecting the cable from the instrument **only grab the black rubber connector**.
DO NOT HOLD ON TO THE PLASTIC.



Materials
The transparent liquid is paraffin. It is not expected to be harmful to marine life, and it is expected to biodegrade. The electronics contain lead. The SM3B version has a motor house made of copper-nickel, and the weight of the cleaning shuttle is made of lead.

Standard Operating Procedures

Stand-Alone Deployment

Before starting, make sure the software and driver are installed in the computer, and that it is set to the correct time and time zone. The SediMeter internal clock will always be on UTC. Have the battery charged ahead of time, since it may take over 8 hours.

1. Connect the SediMeter to a USB plug on the computer using the standard cable. Note that the underwater connectors must *never* be connected without grease present. Use the supplied grease, or equivalent (electrically isolating, compatible with rubber) if they appear dry.
2. The blue LED should now shine, indicating that external power is available (and that the internal battery is at least partly charged). In either case proceed to step 3.
3. Verify that *either* the red *or* the green LED indicating charging / fully charged, respectively. If *both* the red and the green LED light up, refer to Appendix A before continuing with step 4.
4. Verify that the yellow LED is shining. If not, reset the device by briefly approaching a magnet to the reed switch located next to the red LED. It is normal that the yellow LED blinks once during the reset. Once it remains steady on, the device is listening for communication from the computer.
5. Use the SediMeter.exe (3.0 or newer) software to communicate with the SediMeter. Select the COM port of the device (if only one device is connected, it will be the only option in the pull-down menu). Select RS485 and the baud rate of the SediMeter (9600 after a reset). Click Connect. A green virtual LED in the software will indicate that the virtual RS485 serial port has been opened.
6. Set the ID of the instrument in the "Send To" field (all SM3 instruments have ID = 1 from factory).
7. Go to the Setup tab. Click Get. If you get an error, you may have selected the wrong baud rate. Return to the Connect tab, click Disconnet, change the baud rate, click Connect, and repeat this step.
8. If the instrument has been deployed previously, refer to the **Download** section before continuing with the next step.
9. Go to the Setup tab. Set measurement interval and start time (up to 24 hours into the future). Click "Set". To verify, click "Get". Verify that the computer time matches the SediMeter time (the difference indicator to the right will show zero). NB. The minimum suggested measurement interval without cleaner is 3 seconds, and with cleaner 2 minutes.
10. If the instrument has a cleaning wiper, refer to the **Wiper** section before continuing with the next step.
11. Go to the Special tab. Click "Get". Change "Mode" to "Logging". Click "Set".
12. You may return to the Setup tab and click Get to verify that the next measurement is still in the future. If the time passed, it will be almost 24 hours until it starts measureing. (NB. While in Logging mode, you can not change the measurement parameters from the Setup mode. You first have to return to Sleep mode.)

13. Return to the Connect tab, click Disconnect, close the software.
14. When the battery is charged (green LED turns on), disconnect the cable from the SediMeter and from the computer. *NB! Grab the rubber connector on the instrument when pulling, do NOT grab the plastic tube!* Plug in a greased blind plug in the SediMeter. Protect the underwater connector on the computer cable from dirt, e.g. by wrapping it in plastic or covering it with a plastic bag tied onto it.
15. For SM3A: You may wish to cover the top with plastic to prevent biofouling on the rubber and top of the instrument. Attach the plastic with electric tape. Wind at least 5 turns of electric tape in a downward spiral, so as to create a cone near the upper end of the instrument. By pushing and twisting the instrument into the holder, this tape will serve both to hold it and to prevent debris from entering the holder tube.
16. For SM3B: No further preparation is needed. When inserted into the holder tube the instrument will rest by its own submerged weight (provided by the copper-nickel motor house, and the lead cleaning shuttle).

Download

1. Go to the Special tab. Click "Get". If the mode is "Logging", change it to "Sleep". If the baud rate is 9600, change it to 115200 (thus speading up download by a factor 12). Click "Set".
2. Go to the Downloads tab. Click the "Check" button to see how much of the memory has been used. The result will show in the graph and in the indicators to the right. Blue indicates new data (not yet read), and red indicates read data (previously downloaded or discarded).
3. To download data, click on the tab of the file name window, and select path and file name for the resulting data file. (NB. The file format for SM3 is identical to that for SM2 instruments, and the file extension *.sm3 is still used.)
4. To download only new data, click "New". To download all the data in memory, click "All". If you only wish to erase the memory, and there is "new" data present, click "Discard".
5. While it is possible to keep recording in a round-robin fashion, it is good practice to erase the memory before a new deployment. Click "Erase". It takes about a minute to erase the memory. During this time the yellow LED on the SediMeter will be OFF.

Wiper

1. Go to the Wiper tab. If the cleaning shuttle is not in the correct position (covering the "Turbidimeter" sign on the back side of the SediMeter), use the Up and Down buttons to run the shuttle up or down. Each click makes the motor run for the time selected in the pull-down control to the left. In one second it moves about 13 mm. Be careful not to run it into the motor house!
2. Set the desired cleaning interval. It is set as number of measurements per cleaning. Also set when the first cleaning should be done. A value of one (1) means that a cleaning will be performed during the next measurement. To disable cleanings set both to zero (0).

3. Note that the movement of the physical wiper over the holder tube must be loose enough so that it falls down by gravity, but not so loose that the rubber wiper makes poor contact with the tube. The lead ring and the plastic body form a nut and screw, that press the rubber wiper between them. Tightening or loosening them will tighten or loosen the grip of the rubber wiper on the holder tube. This can also be adjusted under water during the installation of the instrument in the holder tube. It is recommended to leave a couple of cm between the cleaner and the motor house so that one can lift and release the cleaner in the line to check its movement.

Description of Function

Installation of Software and Drivers
The SediMeter software must be installed from the CD or from lindorm.com, along with the device drivers. The drivers for the VPC (virtual COM port) USB to RS485-interphase cable can be downloaded from http://www.ftdichip.com/Drivers/VCP.htm

General
The SediMeter has a built-in rechargeable lithium battery. The instrument can be used either as a stand-alone logger, or as a sensor connected by cable for real-time monitoring (or remote logging). The 15 mm diameter instrument is designed to be mounted inside a holder tube. Lindorm offers a 20 mm outside, 16 mm inside diameter holder tube which attaches to a screw anchor. This holder is screwed down into the bottom with a handle. For custom installations it is acceptable to use a 3/4" outside, 5/8" inside diameter tube, since that dimension is more easily available in North America. It can be either acrylic or polycarbonate.

Set-Up
To program the SediMeter for stand-alone logging, connect it to a PC and use the SediMeter.exe software. The default baud rate is 9600. The standard cable has a USB – RS485 modem built in. Set to RS485 and 9600 baud. Also set the "Send to" ID in the bottom right corner to "1" as default. (If you are using more than one instrument connected to the same network, you can give them unique IDs, with 255 as the highest available number. All new instruments have ID = 1.)
Once you have connected you can move to other tabs and set up the SediMeter clock and measurement parameters.
When you move to the tab for Setup, as an example, the values in the tab do not reflect the values in the SediMeter until you press "Get". The suggested method is to set the measurement interval (in hh:mm:ss with 00:00:00 representing one measurement every 24 hours, and 00:00:03 being the shortest interval guaranteed to work), the starting time (in UTC, up to 23 hours and 59 minutes in the future), and then click "Set". Next click "Get" to read the values back and verify that the SediMeter has been programmed by checking that the time matches (there is an indicator to the right that gives the time difference in seconds).

Wiping interval
Proceed to do the same for the wiping interval (for version SM3B). An example may illustrate the meaning of the settings:

Start time:	14:00:00
Measurement interval:	00:05:00
Cleaning interval:	12
Next cleaning:	1

With these settings, the first measurement will be taken at 14:00, and then every 5 minutes. There will be one cleaning every hour (every 12th measurement), and the first cleaning will be at 14:00. Another example:

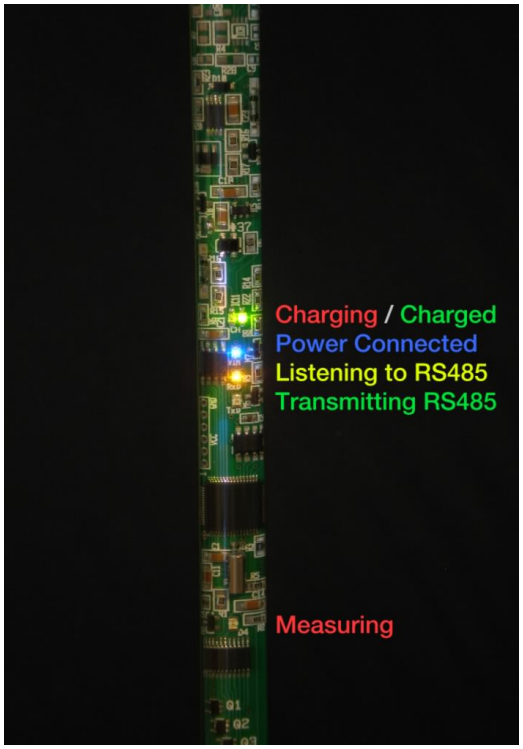
Start time:	00:00:00
Measurement interval:	00:15:00
Cleaning interval:	96
Next cleaning:	97

With these settings there will be 4 measurements per hour, one cleaning every 24 hours, with the first cleaning 24 hours after the first measurement.

Each cleaning uses a significant amount of battery, why they should not be made more often than necessary. The number of cleanings that one can get from a battery charge varies depending on factors such as battery condition and temperature, but it is in the order of one hundred. In some of the worst areas of biofouling, growth visible to the naked eye starts to form in as little as 3 to 5 days. Bacterial films form within 24 hours. The strategy of regular cleaning is not to allow macroscopic growth to form in the first place.

Battery Management

The built-in lithium battery requires about 10 hours for a complete charge. If left connected it will automatically maintain itself fully charged. Any time connected with the standard cable to a USB port it will be charged. If using another cable, the supplied voltage should be at least 5.0 V for charging to work properly, but maximum 15.0 V (a 12 V lead acid battery under charge can have a voltage of up to 14.6 V). The charge current is about 0.1 A.



A red LED lights up while the instrument is being charged, and a green LED when the charging is complete. If the battery has become discharged below the minimum allowed voltage (2.7 V) both the LEDs will shine simultaneously, and no charging will occur.
The battery should be prevented from becoming discharged below 2.7 V. Even if the instrument is not in use the battery should be charged about once per year, more often if stored above room temperature. Ideally it should be stored cold, such as in a refrigerator.
The SediMeter is programmed to stop execution if the voltage falls to 3.2 V, thus leaving a margin before the battery is completely empty. The cleanings (version SM3B) will stop already at a voltage of 3.6 V, i.e. when the battery is about half empty.
Refer to Appendix A for a workaround if the battery should become discharged below 2.7 V in spite of these precautions.

Appendix A

Safety against charging an overly discharged battery
Lithium batteries present an explosion risk if they are recharged after being discharged to below a certain voltage. For that reason the charging circuit blocks recharging if that were to happen. In that situation both the red and the green LEDs light up simultaneously.

Manual override to get data out
If that situation occurs, a side effect is that it may not be possible to read out the stored data from memory. To overcome this problem the instrument is equipped with a method to manually override the charge prevention circuit. The user does this at his own risk.
To override the safety, place a magnet near the reed switch on the right side a few centimeters above the charging LEDs. When the switch closes the green LED turns off and the battery starts charging.
The instrument will not start working until sufficient voltage has been achieved. If the green LED comes back on when the magnet is removed, there is still insufficient voltage. Test again until it stays off, then reset the instrument by approaching the magnet to the reed switch on the left side of the charging LEDs.
If the battery is completely discharged, so much so that the blue LED does not shine at all, it may be necessary to hold the magnet by the Reset switch for a few minutes to allow the voltage to climb above the minimum for a CPU reset.

Behaviour of the top 4 LEDs during charging

LED behaviour	Red	Green	Blue	Yellow
Charged	OFF	ON	ON	ON
Charging	ON	OFF	ON	ON
Discharged below 2.7 V	ON	ON	ON	ON
Discharged below 1.8 V	ON	ON	OFF or very weak	Undefined

The CPU does not function below 1.8 V. This may lead to unpredictable behaviour in the blue and yellow LEDs, since they are connected to the CPU. The memory does not function below 2.7 V. The CPU is programmed to go into deep sleep if reset while the voltage is below 2.8 V. When the CPU starts properly the yellow LED will remain on. If it goes into deep sleep the yellow LED will turn off (all of this assumes that it is properly connected to a power source and an RS485 cable).