SeaTek
5 MHz Ultrasonic
Ranging System

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SeaTek 5 MHz Ranging System

This SeaTek ranging system is composed of 32 transducers, and an electronics package. The acoustic operating frequency of this system is 5 MHz. The electronics package communicates with a PC via a USB communications port. The electronics package is capable of running up to 32 transducers, and sampling up to 4 external analog channels.

Setup

The electronics package has a connector for USB communications. The supplied cable should be connected to the electronics box and connected to the serial communication port of the logging PC.

Any communication program that supports serial communications will work with this system, however the Seatek program is recommended.

Before communication is established with the system, both the supply power and the USB communication cable needs to be connected, and the instrument needs to be turned on. If the instrument is turned off, or if the USB connection is disconnected, the communication program may need to be restarted in order to re-establish communication.

The supplied CD contains a setup.exe file. Run this file to install the Seatek program on the logging PC. Once installed, start the Seatek program to communicate with the electronics package. The program has an auto-detect feature. In order to begin communication with the electronics package select the ‘connect’ button at the top of the dialog box. The system should now display a ‘Cmd’ prompt.

If connection is not established, drivers may need to be installed to communicate with the electronics package. If drivers are required to communicate over the USB port, then open the Driver folder on the Seatek CD. The required driver and instructions for installing the driver are contained in this folder. The processor used in the Seatek system for USB communications is an Arduino Due.

On the side of the electronics box are 8 connectors for transducers. Make sure that the appropriate cable connectors are connected to the electronics package before firing any of the transducers. Firing of a channel without a transducer attached may damage the transmitter circuitry. The connector for the supplied USB communications cable is the smaller circular connector to the right of the transducer connectors.

Power Supply

The electronics are set up to accept AC power ranging from 110 to 240 Volts, at 50 to 60 Hz. There is also an option for running the system off of a 12-volt DC supply. The center pin of the 2.5 x 5.5 mm barrel connector is for plus 12 V; the outer circular conductor is for ground. Connect appropriate power to the electronics box, and turn the unit on. The LED should light indicating that the unit is on. The electronics should be turned off when not in use for an extended period of time. After the system has been turned off, let it de-energize for at least 10 seconds before turning it back on. Make sure that the ground for the power supply is the same ground as for the communication computer. This is especially important if running the system off of battery power.

Transducers

All of the transducers are housed in stainless steel housings. There are 32 transducers included with this system. The transducers operate at 5 MHz; have a half beam angle of 0.9 degrees, and a transducer diameter of 1 cm. The closest range measurement of this system is 3.5 cm; the furthest range is 110 cm.

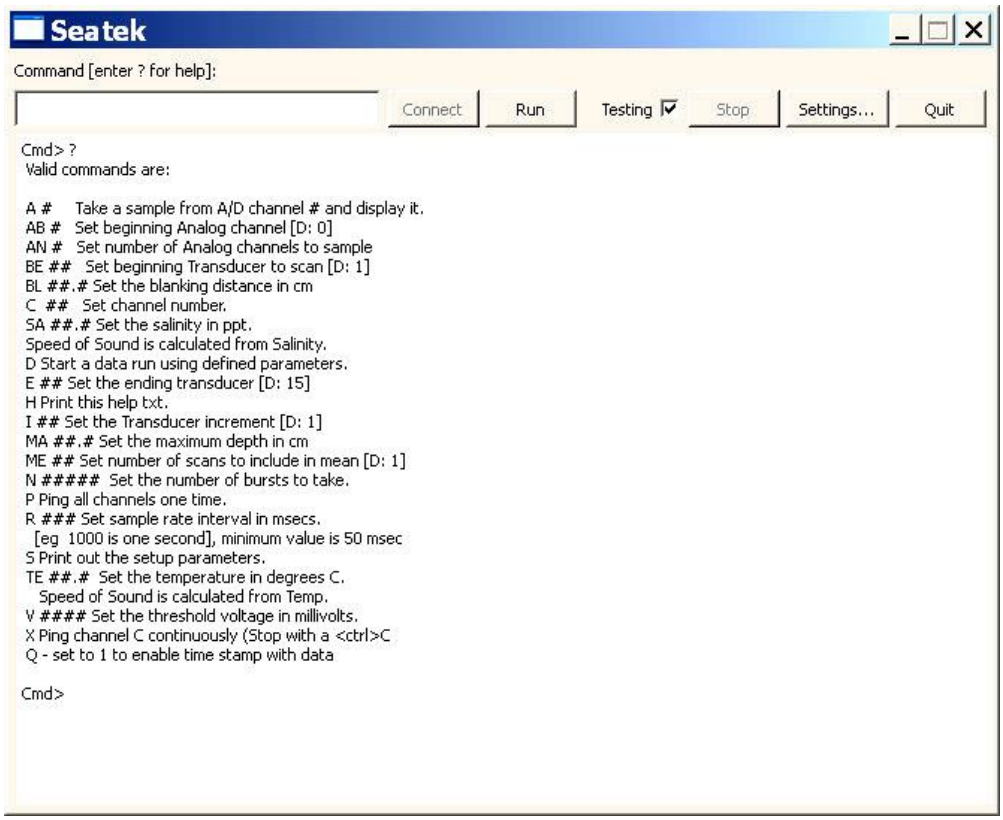
The transducers are numbered at both ends of the cable. When the cables are plugged into the appropriate connectors on the electronics package, the numbers correspond to the transducer numbers defined in the electronics. The cylindrical transducers are housed in ½" diameter stainless steel housings. The transducer housings are 1 inch in height.

Care should be taken so that the cables are not crimped, pulled, or forced into a small radius bend. Each cable is composed of 4 coaxial wires. For best results, do not coil the cables during data runs. When the cables are coiled, the signal to noise ratio may decrease. It is recommended that the transducers not be left submerged for long periods of time when not in use. Pouches and covers are provided to protect the transducers during storage and transit. The transducers should always be properly supported. Care should be taken so that the cable alone does not support the transducers.

Transducer settings and setup

Below is a description of how to set up the instrument for data collection using the Seatek program. The selections from the main Seatek window are:

Connect	Opens communication between the PC and the electronics package.
Settings	Opens a 'Seatek Settings' dialog box to set the data collection parameters for the Seatek system.
Testing	Select the 'Testing' box to run the system without recording data.
Run	Select 'Run' to start collecting data. A screen will appear to enter the folder and file name for the collection of data. The run can be stopped by selecting 'Quit' at any time during data collection and data collection will stop and the file will be saved.
Stop	Select to stop data collection and return to Cmd prompt. Data will still be saved to a file if data was being logged.
Help on settings	Hover over any of the '?'s in the dialog box for help.
Quit	Exits the Seatek program



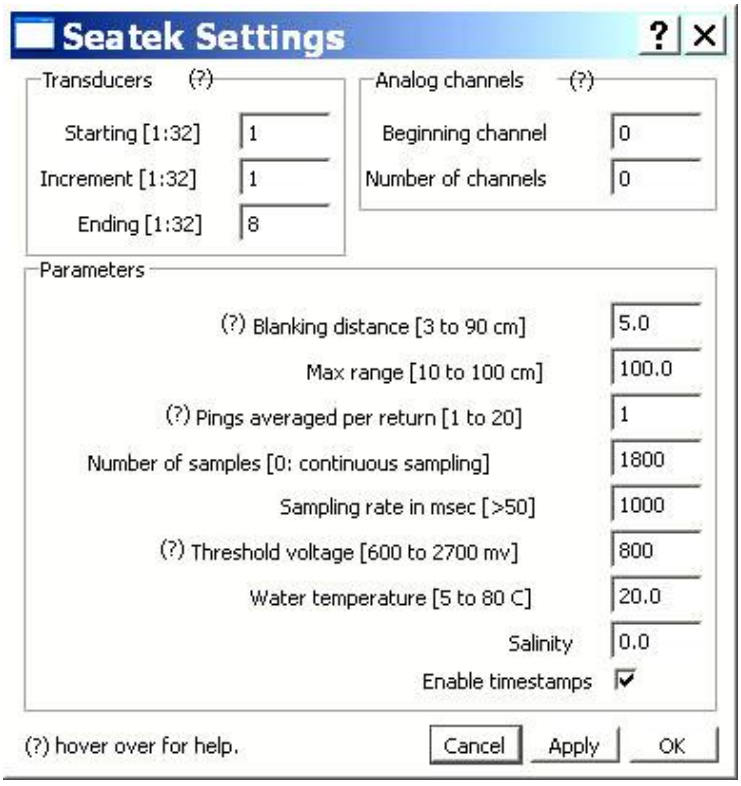
Seatek program main window

The data output will start each scan with the *Starting* transducer and continue to scan in increasing order by the assigned *Increment* until the *Ending* transducer is reached.

Set the *Number of samples* to record and the *sampling rate*. The sample rate should be entered as the number of milliseconds between the beginning of each scan. The maximum sample rate setting is 50 msec (20 Hz), which should be entered as 50. A sample rate of 1 second should be entered as 1000. Below is a chart showing maximum frequencies for different configurations. If a sample rate is entered that is faster than the instrument is capable of running, the instrument will run as fast as possible (with no delays between scans).

Number of Transducers	Number of Analog channels	Maximum Frequency
32	0	9 Hz
12	0	20 Hz
32	4	8 Hz

Each scan consists of the range readings for the selected transducers in centimeters and the analog input values for the selected analog channels. If the *Enable timestamps* feature is selected, a time stamp in milliseconds will be included at the end of each scan.



Settings window from Seatek program

Blanking distance

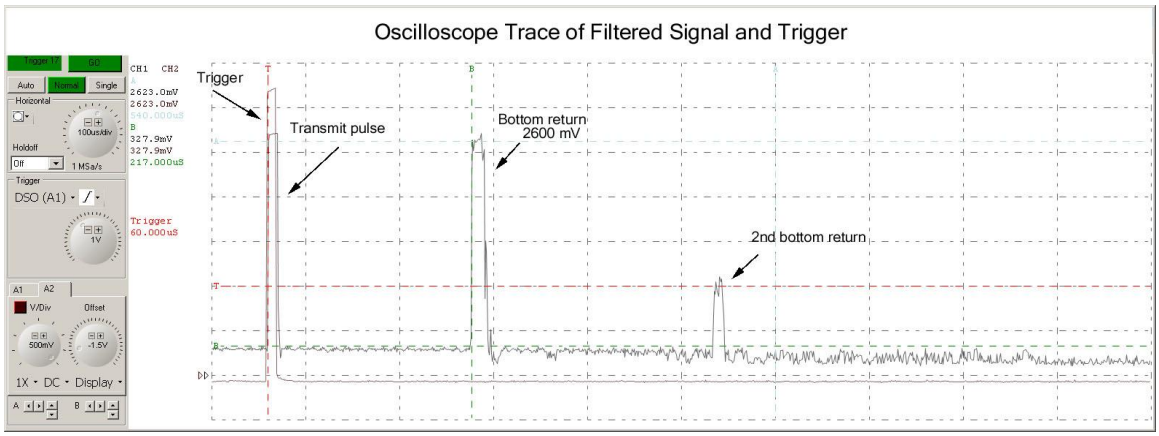
In order to reduce the occurrence of false readings, the blanking should be set to a range (or distance) from the transducer that is close to (but not greater than) the range to the desired target. For instance, if the distance from the transducer to the target is approximately 10 cm, and at no time is this range expected to be less than 9 cm, a good blanking distance would be 8cm. The instrument does not look for echo returns within the *Blanking distance*. Blanking is most useful when there are a lot of acoustic reflectors (suspended sediment, bubbles, etc.) between the transducer and the target. Precise blanking is generally not needed in clear water conditions.

Threshold Voltage

This instrument records a range measurement when the processed acoustic return exceeds a *Threshold voltage*. Setting this threshold voltage is critical to making quality measurements. In most situations, the default threshold value will work satisfactorily. If the instrument is recording fluctuating range measurements from a stationary position, the threshold voltage should be adjusted. If the recorded distance is closer than the range to the target, then the threshold voltage should be increased (and possibly the blanking increased). If the recorded distance is greater than the range to the target or a value of zero is returned, the threshold should be decreased (and the blanking should be checked). Acceptable threshold voltages are between 600 and 2600 mV.

This instrument is equipped with Time Varying Gain (TVG). This means that the amplification of the received acoustic backscatter signal is increased over time. TVG increases the gain to account for the attenuation of sound by water and for spherical spreading of the acoustic waves. TVG, theoretically, will produce the same amplitude of a return from a target regardless of range. This means that the threshold should not have to be changed often once an appropriate setting has been found for a given target. The drawback of TVG is that noise in the signal is also increasingly amplified over time. This is why an appropriate threshold setting for a certain target will sometimes give a distance measurement even if the transducer is out of the water (when no return is present). The ‘noise’ in the signal gets increasingly amplified until it reaches the threshold level. Thus, if range measurements are greater than the distance to the target, the threshold level should be decreased until solid range readings are given. Also, make sure that the blanking distance is less than the range to the target.

The following figure is a capture from a digital oscilloscope. It shows the transmit pulse (on the left) and the bottom return from a sand target located 16 cm from the transducer. Basically, the trigger goes high (3.3V) for 10 usec., right before the transmit pulse is sent. This signal should be used to trigger the oscilloscope. The noise in this instance is well below the 500 mV level, thus any threshold value between 600 and 2600 mV should work well in this instance. The default threshold level of 800 mV would be advised for such a situation.



Maximum Range

The *Max range* should be set to a value that is not expected to be exceeded during the run. In the event that a strong return (greater than the threshold voltage) was not received between the blanking distance and the maximum range, the receiver electronics will disregard any other signal from a range greater than the maximum range.

Several range measurements can be included in each range calculation recorded. The maximum range setting will eliminate any returns from a range further than the anticipated maximum range in the calculation of the range reading to be recorded. If no returns greater than the threshold level were received between the blanking distance and the maximum range, then the range reading output would be 0.00 cm

Number of pings to process per return

Up to 20 individual range readings (or pings) can be used in calculating the range measurement that is recorded. The system selects the transducer and then pings the transducer the prescribed number of times. A range reading is made for each ping. These range readings are then sorted. Only range readings between the 'blanking distance' and the 'maximum range' are used in determining the recorded measurement. If the number of pings to process is set to 20, and 20 acceptable ranges are recorded, the longest and the shortest ranges are excluded from the set. The remaining 18 range measurements are then averaged. It is this value that is then recorded as the range for the selected transducer. The next transducer is then selected and the process is repeated.

Analog inputs

This instrument has the capability to sample up to 4 external analog channels. The inputs for these channels are the BNC connectors located on the instrument panel. The input values are 0 to 5 volts. The readings for these channels are given in millivolts in the data set. Every time range measurements are recorded from the selected transducers, readings are also recorded from the selected analog channels.

The analog channels will be sampled starting from the *Beginning channel* and continuing for the next selected *Number of channels*. This instrument is set up with 4 analog channels. The input values for the analog channels are 0-5 volts. The analog readings are given in millivolts.

Testing Ports

On the front panel of the electronics package are 2 testing ports. In the event that fine-tuning is necessary, these can be looked at with an oscilloscope. The 'trigger' should be connected to the trigger of the scope. The trigger level can be set to 1 volt. The 'filtered signal' is the acoustic backscatter signal after it has been rectified and filtered. The threshold level setting can be fine-tuned by viewing the rectified signal. The threshold level should be set to a value below the amplitude of the desired return echo, and above the level of noise in the vicinity of the target. Monitoring of the testing ports during important data runs is not recommended, as these connections may increase the amount of noise in the system.

For test purposes, it is best to select one transducer and ping it at a rapid rate.

Reset

The datalogger may be reset using the reset connector located on the instrument panel. To reset, connect the center conductor with the outer conductor (ground) of the reset connector. Any small metal object (such as a pin) can be used to reset the system.

List of Commands

Below is a list of valid commands.
This list can be seen at the Cmd prompt by typing "?" and enter.

A # Take a sample from A/D channel # and display it
AB # Set beginning Analog channel [D: 0]
AN # Set number of Analog channels to sample
BE ## Set beginning Transducer to scan [D: 1]
BL ##.# Set the blanking distance in cm
C ## Set channel number.
SA ##.# Set the salinity in ppt.
Speed of Sound is calculated from Salinity.
D Start a data run using defined parameters.
E ## Set the ending transducer [D: 15]
H Print this help txt.
I ## Set the Transducer increment [D: 1]
MA ##.# Set the maximum depth in cm
ME ## Set number of scans to include in mean [D: 1]
N ##### Set the number of bursts to take.
P Ping all channels one time.
R ### Set sample rate interval in msecs.
[eg 1000 is one second], minimum value is 50 msec
S Print out the setup parameters.
TE ##.# Set the temperature in degrees C.
Speed of Sound is calculated from Temp.
V #### Set the threshold voltage in millivolts.
X Ping channel C continuously (Stop with a <ctrl>C
Q - set to 1 to enable time stamp with data

A guide to supplied software

A CD called SeaTek Ultrasonic Ranging System contains all of the software necessary to run the instrument and all required documentation. This CD contains:

- Setup.exe – used to install Seatek program on logging PC
- drivers for USB communications
- JPG photos of the system.
- this manual in Microsoft Word format.

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