USER MANUAL
FOR WD0100 SERIES ECO-SOUNDER



KILICHAIN (JIAXING) TECHNOLOGY CO., LTD.
WWW.KILICHAIN.COM

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WD Series Depth Surveyer User Manual

1 Applications

The WD series depth sounder is a single-beam echo ranging device for underwater applications; it must be deployed beneath the water surface to function properly. All circuits of the depth sounder are integrated within the probe itself, eliminating the need for any external circuit boards; once powered on, it can perform depth sounding, distance measurement, or scanning of underwater targets. The measurement data is output via an RS485 (or TTL) serial port. Featuring compact dimensions, lightweight construction, and ease of installation, this device is widely used for depth measurement in lakes or oceans, underwater obstacle avoidance for vessels, and mud level measurement in water channels or water towers.

The WD series depth sounder features two operating modes: the depth measurement mode and the scanning mode. The depth measurement mode is used to measure distances to the seabed, water surface, or obstacles; during each detection cycle, it continuously records up to 16 targets, outputting via the serial port the distance to the nearest target, the distance to the strongest target, the distance to the farthest target (or the maximum target distance), as well as the corresponding echo levels. This capability enables the acquisition of more detection data in complex environments and facilitates the identification of valid targets.

The scanning mode is used for a general survey of the seabed topography or the distribution of multiple targets within the water; during each detection cycle, the system continuously outputs changes in echo level via a serial port, with a data output sampling rate of 15 kHz, enabling the acquisition of detection results similar to those obtained by an imaging sonar.

Additionally, this series of depth sounders is equipped with two sets of display and control software running on the Windows operating system: one set is designed for the ranging mode, enabling continuous measurement, recording, and display of how water depth (or obstacle distance) changes over time; the other set is designed for the scanning mode, enabling continuous scanning, recording, and display of the general seabed topography or the distribution of multiple targets within the water column.

2 Product Appearance and Technical Specifications

The WD0100 subseries has a measurement range of 0.2 m to 100 m (with a resolution of 10 mm); this range refers to the permissible detection distance range that the sonar can be configured for. If the set value exceeds the maximum range, the maximum range will be used instead. It should be noted that the actual maximum detection distance achievable by the instrument depends on the target intensity and water quality: the higher the target intensity and the better the water quality, the greater the detectable distance. When used in seawater, the maximum detection distance may be reduced due to the higher sound absorption coefficient of seawater compared to freshwater.

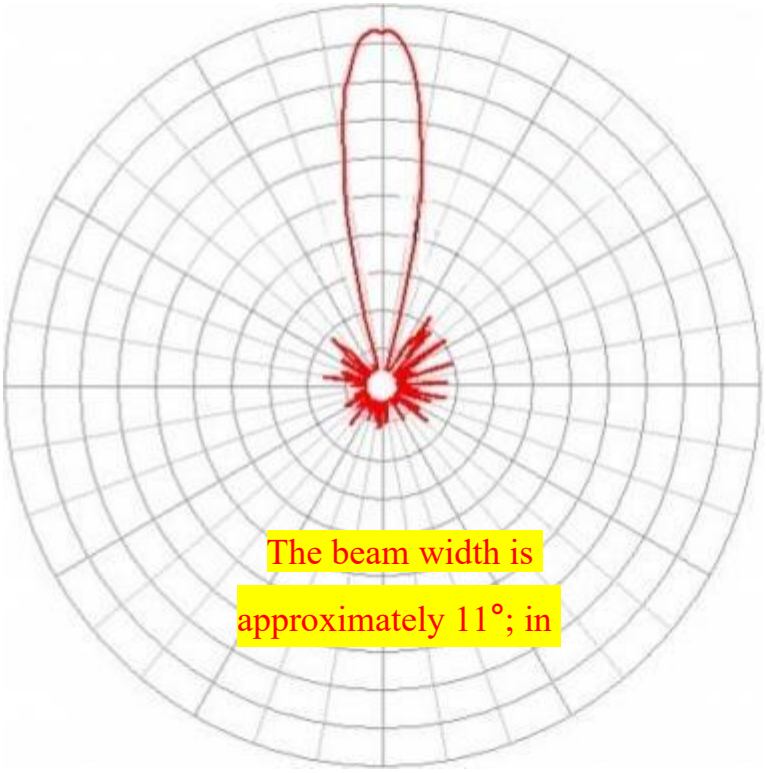
When the power supply exhibits significant ripple or when the operating environment is subject to strong electromagnetic interference, this can cause substantial fluctuations in measurement data or even prevent the accurate acquisition of measurements; it is recommended to use a 12 V battery for powering the device.

The WD0100 sub-series depth sounders comprise three models: WD0100, WD0101, and WD0102. All three models share identical physical dimensions and acoustic performance, similar to those of the WD0010 sub-series; the WD0101 model builds upon the WD0100 by incorporating multi-device communication functionality, while the WD0102 model adds a parameter storage function to the WD0101. Additionally, the WD0100 sub-series depth sounders are available in versions with either cable sheathing treatment or a SubConn watertight connector, corresponding to the models WD0100G, WD0101G, WD0102G, WD0100P, WD0101P, and WD0102P, respectively.

The external dimensions of the WD0100 sub-series depth sounder are identical to those of the WD0200 sub-series depth sounder, but they are slightly larger than those of the WD0010 sub-series depth sounder; actual physical photographs are shown in the figure below.



The beam width of the WD series depth sounder is approximately 11°; its transmit and receive acoustic beam patterns are shown in the figure below.



WD0100 Sub-Series Depth Sounder – Main Specifications

1) Detection method: single-beam echo detection;

2) Detection range: 0.2 m – 100 m (the maximum detection range depends on the target intensity and water quality; the initial range is 100 m);

3) Distance resolution: 10 mm;

4) Detection pulse width: 0.01 ms–2.5 ms (initial value: 0.05 ms);

5) Operating frequency: 350 kHz–400 kHz (initial value: 378.8 kHz);

6) Beam width: approximately 11°;

7) Detection cycle: 0.1 s–5s (initial value: 1 s);

8) Sound speed: Initial value is 1480 m/s (sound speed in fresh water at a temperature of 20°C and depth of 0 m);

9) Data interface: RS485 (optional: 3.3V TTL serial port);

10) A single serial port on the host computer can connect to 1–255 depth sounders (unique to the WD0101 and WD0102 models);

11) Parameter saving function (WD0102 exclusive);

12) Power supply: DC 12V ±3V (battery power supply is recommended);

13) Average power consumption: approximately 0.5 W;

14) Maximum working depth: 500 m (a greater working depth can only be achieved through hull penetration installation);

15) Housing material: stainless steel;

16) Main dimensions: φ58 mm × 60 mm;

17) Installation joint: M10 transverse bolt; bolt length: 20 mm;

M16 through-bore screw; the cable shall undergo rubber sheathing treatment (models ending with "G");

M24×1.5 screw; Subconn watertight connector (models ending with "P");

18) Cable length: 2 m (other lengths can be customized);

19) Weight: Approximately 600 g (excluding cable weight).

3 Wiring and Operating Instructions

For a WD depth profiler equipped with a 4-core shielded cable, connect the red wire to the positive power supply; connect the black wire and the shielding wire to the negative power supply (ground); connect the yellow wire to 485A (or

the TTL serial port's TXD pin of the depth profiler); and connect the green wire to 485B (or the TTL serial port's RXD pin of the depth profiler). Inside the depth profiler, the black wire is connected to the negative power terminal of the circuit board, while the shielding wire is connected to the stainless steel housing of the device (some depth profilers do not have this connection to the stainless steel housing). During operation, connecting both the black wire and the shielding wire to the negative power supply can help reduce electromagnetic interference.

The WD depth sounding device, equipped with a Subconn watertight socket, has the following pin assignments: Pin 1 connects to 485A (or the depth sounding device's TTL serial port TXD); Pin 2 connects to 485B (or the depth sounding device's TTL serial port RXD); Pin 3 connects to the positive power supply; Pin 4 connects to the negative power supply (ground); Pin 5 connects to the stainless steel housing of the depth sounding device; all other pins are left unconnected.

For WD0101 and WD0102, multiple depth sounders can have their 485A and 485B ports connected in parallel to a serial port on a host computer; this allows the host computer to control 1−255 depth sounders via a single serial port, as shown in the figure below.



Upon powering on, the depth sounder will output four hexadecimal values (AB, FF, 93, XX) via the serial port; for the WD0100 and WD0200 models, XX is 00; for the WD0101 and WD0102 models, XX represents the device ID of the depth sounder (ranging from 01 to FF). Once the host computer receives these four bytes, it can confirm that the depth sounder has been powered on and is operational.

Upon power-on, parameters such as the sonar's detection cycle, pulse width, and sound speed are all set to their initial factory-default values. Users can adjust these parameters via serial port commands based on their specific operational requirements; however, for sonar units without a parameter saving function, these parameters will revert to their initial factory settings upon subsequent power-on. Only certain models, such as the WD0102 series featuring a parameter saving function, allow users to save their custom settings as default parameters upon power-on.

The depth (or distance) measurement error of the measuring instrument is primarily determined by the error in the sound speed; the more accurately the sound speed is set, the smaller the error. The initial value for the sound speed is 1480 m/s—this value represents the sound speed under conditions of freshwater, a water temperature of 20°C, and a depth of 0 m; the actual sound speed can be calculated using the following formula:

$$c=1450+4.21t-0.037t2+1.14(s-35)+0.0175d$$

c: Speed of sound, unit: m/s;

t: Water temperature, unit: °C;

s: Thousandths of salinity; for freshwater, use 0; for seawater, use 33–37;

d: Depth, unit: m.

4. Serial Communication Protocol Description

For the WD0101 and WD0102 models, each command sent from the host computer to the depth sounder contains a one-byte device ID; the depth sounder will only receive and execute the corresponding command function if this device ID matches the device ID of the depth sounder. If the value of the device ID byte in the command sent from the host computer to the depth sounder is 0, all depth sounders receiving this command will execute the corresponding command function without performing device ID identification. The commands or measurement results returned by the depth sounder to the host computer also contain a one-byte device ID; the host computer can use this device ID byte to identify which specific depth sounder has returned the data. The range of device IDs is 1–255; when purchasing the WD0102 depth sounder, users do not need to specify a particular device ID; instead, users may set their desired device ID as needed.

For the WD0100 device, all commands sent from the host computer to the depth sounder are received without performing machine ID identification; in the

measurement results returned by the depth sounder to the host computer, the machine ID byte is fixed at the value 0.

4.1 Serial Port Format

Serial port type: RS485; TTL is optional.

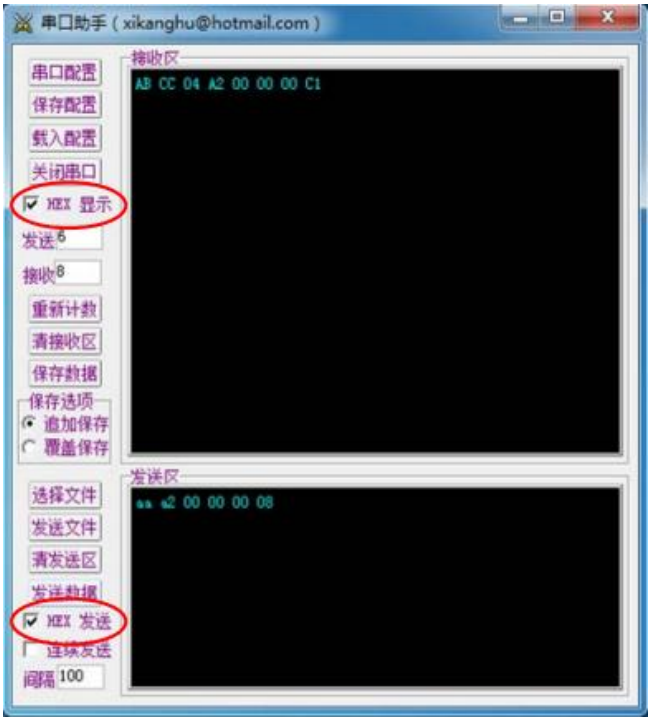
Data format: 8-bit data, 1-bit stop bit, no parity bit.

Baud rate: In the depth sounding mode, the baud rate can be selected from 9600 to 256000; in the scanning mode, the baud rate is fixed at 256000; the initial baud rate when the depth sounder is powered on is 9600.

4.2 Serial port command format sent by the host computer to the depth profiler

Each instruction is fixed at 6 bytes: the first byte is the instruction start byte (fixed to the hexadecimal value AA), the second byte is the instruction code, the third byte is the machine identifier, the fourth and fifth bytes contain the instruction parameters, and the sixth byte contains the XOR checksum of the preceding 5 bytes of the instruction.

You can send commands to the depth sounder via programming, or use a serial port utility to send commands to the depth sounder and receive the data it returns. When using a serial port utility to send commands and receive data, you must check both the "HEX Display" and "HEX Send" options; refer to the figure below for details



4.2.1 Distance Measurement 1 Command

Command function: Initiates a distance measurement using the depth sounder; if a valid target distance is detected, the system will return the measurement data via the serial port; if no target distance is detected (e.g., there are no obstacles in front of the depth sounder), no data will be returned.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A0	device number	XX	XX	XOR checksum of the first 5 bytes

Instruction:

The first byte is the instruction start byte, which is fixed at the hexadecimal value AA.

The second byte contains the instruction code; the instruction code for one ranging measurement is the hexadecimal value A0.

The third byte represents the device identification byte; when this byte is 01, it indicates that the instruction is intended for the Depth Survey Instrument No.01. For the WD0101 and WD0102 depth survey instruments, only the Depth Survey Instrument No.01 will respond to this instruction and perform a single distance measurement. If the device identification byte is 02, then only the Depth Survey Instrument No.02 will respond to this instruction; this pattern continues accordingly. When the device identification byte is 00, all depth survey instruments connected to the serial port will respond to this instruction and perform a single distance measurement. Therefore, if the device identification number of the depth survey instrument is unknown or only a single instrument is connected to the serial port, the third byte may be set arbitrarily to 00. For the WD0100 depth survey instrument, since it does not perform device identification, regardless of the value of the third byte, the instrument will always respond to this instruction and perform a single distance measurement. In such cases, if multiple depth survey instruments are connected to the serial port, they will simultaneously return measurement data, leading to data conflicts; therefore, only one WD0100 depth survey instrument may be connected to a single serial port. In subsequent instructions, the function of the device identification byte is identical and will not be further elaborated upon.

The 4th and 5th bytes can represent any value ('XX' represents any value; '00' is acceptable, and the same applies below).

The 6th byte is the XOR checksum of the first 5 bytes of this instruction. On a calculator, the XOR operator is denoted as 'XOR'. The calculation process involves XOR-ing the 1st byte with the 2nd byte, then XOR-ing the result with the 3rd byte, followed by XOR-ing that result with the 4th byte, and finally XOR-ing the

resulting value with the 5th byte; the final result obtained at this stage constitutes the XOR checksum for the first 5 bytes of this instruction.

Command example: AA A0 00 00 00 0A – these 6 bytes (hexadecimal values; the same applies below) are sent via the serial port to the depth sounder, which will then perform a distance measurement and return the measurement data via the serial port; if no target is detected, no data will be returned.

The depth sounding device returns a total of 17 bytes of measurement data; the meaning of each byte is as follows:

Byte 1: Fixed as AB;

Byte 2: Fixed to A0;

Byte 3: Fixed to 0D;

Byte 4: Depth sounder's serial number;

Byte 5–6: The first target distance (closest target distance); the first target distance = Byte 5 × 256 + Byte 6; unit: 1 mm (WD0010 sub-series); unit: 10 mm (other models).

Bytes 7–8: First target intensity (echo level); Echo level = Byte 7 × 256 + Byte 8; a higher value indicates a stronger echo signal;

Byte 9–10: Maximum target distance; Maximum target distance = Byte 9 × 256 + Byte 10; Unit: 1 mm (WD0010 sub-series); Unit: 10 mm (other models);

Byte 11–12: Maximum target strength (echo level); echo level = Byte 11 × 256 + Byte 12; a higher value indicates a stronger echo signal;

Bytes 13–14: The final target distance (maximum target distance); the final target distance = Byte 13 × 256 + Byte 14; unit: 1 mm (WD0010 sub-series); unit: 10 mm (other models).

Bytes 15–16: Last target intensity (echo level); Echo level = Byte 15 × 256 + Byte 16; a higher value indicates a stronger echo signal;

Byte 17: The XOR checksum result of the first 16 bytes of this instruction.

4.2.2 Scan Once Command

Command Function: Initiates a single scan measurement using the depth sounder. During this scan, the depth sounder continuously collects echo levels at a sampling frequency of 15 kHz (equivalent to collecting an echo level every 5 cm) and returns the acquired data via the serial port until the maximum distance range is reached. Due to the large volume of data returned by this command, the serial port baud rate must be set to 256,000 before using this command. Given the complexity of the returned data format, detailed explanations are not provided here; it is recommended to use our company's dedicated scanning

software for conducting scan measurements – there is no need to program using this command separately.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A1	device number	XX	XX	XOR checksum of the first 5 bytes

Command example: AA A1 00 00 00 0B – these 6 bytes are sent via the serial port to the depth sounder, which will then perform a scanning measurement and return the measurement data.

4.2.3 Start timed ranging command

Command Function: Enables the depth finder to perform continuous distance measurements according to a preset ranging interval (Timed Ranging Mode). If the device detects a valid target distance, it will transmit the measurement data via the serial port; if no target distance is detected, no data will be transmitted. The default initial ranging interval upon powering on the depth finder is once every 1 second.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A2	device number	XX	XX	XOR checksum of the first 5 bytes

Command example: AA A2 00 00 00 08 – these 6 bytes are transmitted via the serial port to the depth sounder, which will then perform distance measurements continuously according to the preset ranging cycle and return the measurement data; the format of the returned measurement data is identical to that returned by the "Single Ranging Measurement" command described in Section 4.2.1.

Upon receiving this command, the depth sounder will first return the sequence of 8 digits: AB CC 04 A2 00 00 00 C1 before initiating continuous distance measurements; once the host computer receives these 8 digits, it can confirm that the depth sounder has correctly received the start timed ranging command and has entered the timed ranging state.

For most commands sent by the host computer to the bathymeter, upon receiving such a command, the bathymeter immediately returns the content of the received command to notify the host computer that the bathymeter has responded to the current command. The returned data consists of 8 bytes: the first three bytes are fixed as AB CC 04; the fourth through seventh bytes contain the content of the received command (excluding the command start byte AA and the XOR checksum result); and the eighth byte contains the XOR checksum computed over the preceding seven bytes. The return format for

subsequent commands follows the same structure as described above; therefore, it will not be reiterated here.

4.2.4 Stop Time-Based Distance Measurement Command

Command function: Causes the depth sounder to exit the timed ranging mode.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A3	device number	XX	XX	XOR checksum of the first 5 bytes

Command example: AA A3 00 00 00 09 – these 6 bytes are sent via the serial port to the depth sounder, causing the depth sounder to exit its timed ranging mode.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 A3 00 00 00 C0; once the host computer receives these eight bytes, it can confirm that the depth sounder has exited the timed ranging state.

4.2.5 Set Distance Measurement Cycle Command

Command function: Sets the timer-based ranging interval (ranging period).

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A4	device number	Range Measurement Cycle High Byte	Distance measurement cycle (low byte)	XOR checksum of the first 5 bytes

Instruction:

Distance measurement period = high byte of distance measurement period × 256 + low byte of distance measurement period; the unit of the calculated distance measurement period is 0.1 ms. If the set distance measurement period is shorter than the time required for the detection range, then the time required for the detection range shall be used as the distance measurement period.

Command example: AA A4 00 4E 20 60 – by sending these 6 bytes via the serial port to the depth sounder, the time interval for timed ranging can be set to 2 seconds.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 A4 00 4E 20 A9; once the host computer receives these eight bytes, it can confirm that the depth sounder has set the timed ranging time interval to 2s.

4.2.6 Set Pulse Width Command

Command function: Set the width of the detection acoustic pulse (the duration for emitting the detection acoustic wave). A wider pulse width results in

higher energy of the emitted acoustic wave and a greater detection range; however, this also leads to a larger near-range detection blind zone. Under normal circumstances, using the default initial pulse width is sufficient.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A5	device number	pulse length	XX	XOR checksum of the first 5 bytes

Instruction:

The 4th byte represents the pulse width, with the unit being 0.01 ms.

Command example: AA A5 00 01 00 0E – by sending these 6 bytes to the depth sounder via the serial port, the pulse width can be set to 0.01 ms.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 A5 00 01 00 C7; once the host computer receives these eight bytes, it can confirm that the depth sounder has set the pulse width to 0.01 ms.

4.2.7 Set Sound Speed Command

Command Function: Sets the propagation speed of sound in water (sound velocity). The more accurately the sound velocity is set, the smaller the range measurement error will be. The default sound velocity value is 1480 m/s; under normal circumstances, using this default value is sufficient. However, if higher range measurement accuracy is required and a precise sound velocity value is known, this command can be used to override the default sound velocity setting.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A6	device number	Sound Speed Byte	Low Sound Speed Byte	XOR checksum of the first 5 bytes

Instruction:

Sound speed = High byte of sound speed × 256 + Low byte of sound speed; the unit of the calculated sound speed is 0.1 m/s.

Command example: AA A6 00 3A 98 AE – by sending these 6 bytes via the serial port to the depth sounder, the sound speed can be set to 1500 m/s.

Upon receiving this command, the depth sounder will return the eight digits: AB CC 04 A6 00 3A 98 67; once the host computer receives these eight digits, it can confirm that the depth sounder has set the sound speed to 1500 m/s.

4.2.8 Set Initial Threshold Instruction

Command function: Sets the threshold for the minimum distance (initial threshold). The initial threshold for the depth profiler upon power-on is 40 dB; this means that a target is detected when the

echo level exceeds the background noise level by 40 dB. For details on the definition of the initial threshold, refer to Section 5.1.2.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A7	device number	Initial threshold	XX	XOR checksum of the first 5 bytes

Instruction:

The 4th byte represents the initial threshold, measured in dB.

Command example: AA A7 00 32 00 3F – by sending these 6 bytes via the serial port to the depth sounder, the initial threshold can be set to 50 dB.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 A7 00 32 00 F6; once the host computer receives these eight bytes, it can confirm that the depth sounder has already set the initial threshold to 50 dB.

4.2.9 Set Final Threshold Command

Command function: Set the threshold for the maximum distance (final threshold); the default final threshold upon powering on the depth meter is 20 dB; for details regarding the definition of the final threshold, refer to Section 5.1.2.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A8	device number	Final threshold	XX	XOR checksum of the first 5 bytes

Instruction:

The 4th byte represents the final threshold, with the unit being dB.

Command example: AA A8 00 14 00 16 – by sending these 6 bytes via the serial port to the depth sounder, the final threshold can be set to 20 dB.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 A8 00 14 00 DE; once the host computer receives these eight bytes, it can confirm that the depth sounder has set the final threshold to 20 dB.

4.2.10 Set short-range shielding command

Command function: Sets the duration for blocking close-range targets (close-range blocking); for the definition of close-range blocking, refer to the description in Section 5.1.2.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	A9	device number	Short-range shielding time	XX	XOR checksum of the first 5 bytes

Instruction:

The 4th byte represents the short-range shielding time, with the unit being 0.1 ms.

Command example: AA A9 00 0A 00 09 – by sending these 6 bytes via the serial port to the depth sounder, the short-range shielding time can be set to 1 ms.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 A9 00 0A 00 C0; once the host computer receives these eight bytes, it can confirm that the depth sounder has set its short-range shielding time to 1 ms.

4.2.11 Set Distance Range Command

Instruction function: The depth sounder can be configured to detect a maximum detection range (distance range); when a target is located beyond this maximum detection range, it will not be detected. For the WD0100 (WD0101) model, the maximum configurable detection range is 100 m, with an initial detection range of 100 m upon power-on; for depth sounders with dual resolution, if the current distance resolution is 1 mm, the maximum configurable detection range can be set to 20 m. If the configured detection range exceeds the maximum configurable detection range, the maximum configurable detection range shall be used instead.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	AA	device number	High-range byte	Low range byte	XOR checksum of the first 5 bytes

Instruction:

The 4th byte represents the distance range, with the unit being 0.01 m.

Command example: AA AA 00 27 10 37 – by sending these 6 bytes via the serial port to the depth sounder, the distance measurement range can be set to 100 m.

Upon receiving this command, the depth sounder will return the eight numerical values: AB CC 04 AA 00 27 10 FE; once the host computer receives these eight values, it can confirm that the depth sounder has set its distance range to 100 m.

Changing the distance measurement range will affect the timing-based ranging period; therefore, the ranging period must be reconfigured to ensure its accuracy.

4.2.12 Set transmit power command

Command function: Sets the power of the sonar detection signal emitted by the depth finder; this command allows you to set the emission power of the detection signal to either high or low power. Currently, this feature is available only on the WD0100 sub-series depth finders, with the default initial emission power being low.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	AB	device number	Power parameters	XX	XOR checksum of the first 5 bytes

Instruction:

The 4th byte contains the power parameter: a value of 00 indicates transmission of a low-power detection acoustic signal, while a value of 01 indicates transmission of a high-power detection acoustic signal.

Command example: AA AB 00 01 00 00 – by sending these 6 bytes via the serial port to the depth sounder, the transmission power can be set to high power.

Upon receiving this command, the depth sounder will return the eight numerical values: AB CC 04 AB 00 01 00 C9; once the host computer receives these eight values, it can confirm that the depth sounder has set its transmission power to high power.

4.2.13 Set Output Data Mode Instruction

Command function: This command is used to configure the output data mode of the depth sounder. Upon power-on, the default state of the depth sounder is such that it only outputs data when a distance measurement is detected; otherwise, no data is output. Using this command, the depth sounder can be set to operate in the forced data output mode. In this mode, even when no distance measurement is detected, a set of data will still be output, with the closest target distance, strongest target distance, and farthest target distance all set to 0.01 m.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	AC	device number	Model Parameters	XX	XOR checksum of the first 5 bytes

Instruction:

The 4th byte serves as the mode parameter: when this byte is set to 01, the depth sounder is configured to the forced output data mode; when this byte is set to 00, the depth sounder is restored to its default output data mode.

Command example: AA AC 00 01 00 07 – by sending these 6 bytes via the serial port to the depth sounder, you can configure the depth sounder to enter forced output data mode.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 AC 00 01 00 CE; once the host computer receives these eight bytes, it can confirm that the depth sounder has been set to the forced output data mode.

4.2.14 Machine Number Setting Command

Command Function: Sets the device ID (address) for the depth sounder's serial communication; this command is only available for depth sounders equipped with a parameter saving function.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	AD	Original machine number	New serial number	XX	XOR checksum of the first 5 bytes

Instruction:

The third byte represents the original device identifier; if the host computer's serial port is connected to only one depth sounder, the original device identifier can be set to 00.

The 4th byte contains the new serial number that needs to be set.

Command example: AA AD 00 09 00 0E – by sending these 6 bytes via the serial port to the depth sounder, the device ID of the depth sounder can be changed to "9".

Upon receiving this command, the depth sounder will return the eight digits: AB CC 04 AD 00 09 00 C7; once the host computer receives these eight digits, it can confirm that the depth sounder has successfully updated its serial number to "9".

Note: After sending this command, you must send another command to save the user's configuration parameters to persist the settings; otherwise, the depth finder will revert to its original parameters if powered off.

4.2.15 Serial Communication Baud Rate Setting Command

Command function: Sets the baud rate for the sonar's serial communication. The default initial baud rate upon powering on the sonar is 9600; this command can be used to modify the serial communication baud rate. For example, when using the scanning function, it is necessary to first change the baud rate to 256000.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	AE	device number	Baud rate parameter	XX	XOR checksum of the first 5 bytes

Instruction:

The 4th byte represents the baud rate parameter; the conversion formula for this parameter is: Baud Rate = 1041666 / (256 – Baud Rate Parameter). If the calculated baud rate parameter is not an integer, round it to the nearest integer.

Example command: AA AE 00 FC 00 F8 – transmit these six bytes via the serial port to the depth sounder to set the baud rate to 256,000.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 AE 00 FC 00 31. Once the host computer receives these eight bytes, it can confirm that the depth sounder has already set its baud rate to 256000. It should be noted that upon receiving this command, the depth sounder first sets its baud rate to 256000 before returning the sequence AB CC 04 AE 00 FC 00 31. Therefore, after the host computer sends the command AA AE 00 FC 00 F8, it must immediately adjust its own baud rate to 256000 in order to correctly receive the returned sequence AB CC 04 AE 00 FC 00 31.

4.2.16 Set Pulse Frequency Instruction

Instruction function: This function is used to set the frequency of the detection pulse sound signal emitted by the depth finder. The initial pulse frequency upon power-on of the depth finder already corresponds to the optimal operating frequency; unless there are specific requirements, no modification to the pulse frequency is necessary. If the set pulse frequency differs significantly from the initial value, it may cause the depth finder to operate abnormally.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	AF	device number	frequency parameter	XX	XOR checksum of the first 5 bytes

Instruction:

The 4th byte contains the frequency parameter; the conversion relationship between the frequency parameter and the pulse frequency is: Pulse Frequency = 12,500,000 / Frequency Parameter.

Command example: AA AF 00 23 00 26 – by sending these 6 bytes via the serial port to the depth sounder, the pulse frequency can be set to 357.143 kHz.

Upon receiving this command, the depth sounding instrument will transmit the eight data values: AB CC 04 AF 00 23 00 EF. Upon receiving these eight values, the host computer can confirm that the depth sounding instrument has set its pulse frequency to 357.143 kHz.

4.2.17 Set Power-On Timing Measurement Command

Command function: Enables the setting of whether the depth sounder begins timed distance measurement upon power-on; this command is available only on depth sounders with parameter saving functionality.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	B0	device number	XX	XX	XOR checksum of the first 5 bytes

Instruction:

When the 4th byte is 00, the depth sounder will not initiate timed distance measurement upon power-on; when this byte is 01, the depth sounder will begin timed distance measurement upon power-on.

Command example: AA B0 00 01 00 1B – by sending these 6 bytes via the serial port to the depth sounder, you can configure the device to begin timed distance measurement immediately upon power-on.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 B0 00 01 00 D2; once the host computer receives these eight bytes, it can confirm that the depth sounder has been configured to begin timed distance measurement immediately upon power-on.

Note: After sending this command, you must send another command to save the user's configuration parameters to persist the settings; otherwise, the depth finder will revert to its original parameters if powered off.

4.2.18 Read Current Parameters Command for Depth Sounder

Command function: Reads all parameters currently set on the depth sounder, including the sound speed, distance range, ranging period, pulse width, etc.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	B1	device number	XX	XX	XOR checksum of the first 5 bytes

Command example: AA B1 00 00 00 1B – send these 6 bytes via the serial port to the depth sounder, which will then return all currently configured parameters; the returned data consists of a total of 30 bytes, with each byte having the following meaning:

Bytes 1–3 are fixed as AB B1 1A;

Byte 4 is the serial number of the sonar unit;

Bytes 5–6 contain the sound speed value: a 2-byte integer where the high-order byte comes first; dividing this value by 33.03018 yields the sound speed currently used by the sonar system, with the unit being m/s.

Bytes 7–8 represent the distance range; these are two-byte integers with the high-order byte preceding the low-order byte. Dividing this value by 135.435 yields the current measurement range of the sonar system, expressed in meters.

Bytes 9–16 are internal parameters; users do not need to concern themselves with them.

Byte 17 contains the initial threshold — a 1-byte integer measured in dB, representing the level increment added to the background noise. When the

amplitude of the echo signal exceeds this threshold, a target is detected; the maximum value for this threshold can be configured based on the background noise level: the higher the background noise, the lower the maximum value that can be set.

Byte 18 specifies the final threshold — a 1-byte integer in dB units representing the additional level value added to the background noise; when the amplitude of the echo signal exceeds this value, a target is detected; the final threshold must not exceed the initial threshold.

Bytes 19–20 represent internal parameters; users do not need to concern themselves with them.

Byte 21 specifies the short-range shielding time, with the unit being 0.1 ms;

Byte 22 is an internal parameter; users do not need to concern themselves with it;

Bytes 23–24 correspond to the ranging period; these bytes contain a 2-byte integer, which can be used to calculate the ranging period using the following formula: Ranging period = (65536 − this integer) / 10000 + 2 × range / speed of sound, where the unit is seconds (s).

Bytes 25–26: Internal parameters; users do not need to concern themselves with these.

Byte 27 specifies the pulse width, with the unit being 0.01 ms;

Byte 28 is the frequency parameter; using this frequency parameter, the frequency of the detection pulse sound signal emitted by the sonar can be calculated: Pulse sound signal frequency = 12,500,000 / Frequency parameter (unit: Hz);

Byte 29 is an internal parameter; users do not need to concern themselves with it.

Byte 30 is the XOR checksum of the preceding 29 bytes.

4.2.19 Read Depth Sounder Product Serial Number Command

Command function: Reads the depth sounder's firmware version number and product series number.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	B2	device number	XX	XX	XOR checksum of the first 5 bytes

Command example: AA B2 00 00 00 18 − send these 6 bytes via the serial port to the depth sounder for depth measurement.

The device will return the software version number and product series number, totaling 20 bytes; the meaning of each byte is as follows:

Bytes 1–3 are fixed as AB B2 10;

Bytes 4–5 contain the firmware version number;

Bytes 6–19 contain the product series number in ASCII format; for example, the byte sequence `53 46 30 30 35 30 2C 30 35 31 39 30 30 31` corresponds to the ASCII series number `WD0050,0519001`.

Byte 20 is the XOR checksum of the preceding 19 bytes.

4.2.20 Set Output Format Instruction

Command Function: Sets the output format for bathymetric ranging results; this command is available only for bathymeters equipped with a parameter saving function.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	B3	device number	XX	XX	XOR checksum of the first 5 bytes

Instruction:

When the 4th byte is 00, the output format for the depth sounding device's ranging results is the HEX format (default); when this byte is 01, the output format for the depth sounding device's ranging results is the SDDBT data format.

Command example: AA B3 00 01 00 18 – transmit these 6 bytes via the serial port to the depth sounder to configure its distance measurement output format to the SDDBT data format.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 B3 00 01 00 D1; once the host computer receives these eight bytes, it can confirm that the depth sounder has already configured the output format for distance measurement results to the SDDBT data format.

Note: After sending this command, you must send another command to save the user's configuration parameters to persist the settings; otherwise, the depth finder will revert to its original parameters if powered off.

4.2.21 Save User Configuration Parameters Command

Command function: Saves the user-defined parameters as the default parameters upon power-on; this command is only available on depth sounders equipped with parameter saving functionality.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	B4	device number	XX	XX	XOR checksum of the first 5 bytes

Instruction:

After the user has configured parameters such as the serial port communication address, serial port baud rate, measurement range, detection cycle, pulse width, sound speed, threshold, and power-on timed detection, the user must send this command again to permanently save the configured parameters; otherwise, upon the next power-on, the original parameters will be restored.

Command example: AA B4 00 00 00 1E – by sending these 6 bytes via the serial port to the depth sounder, the user-defined parameters can be permanently saved as the default settings upon power-on.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 B4 00 00 00 D7; once the host computer receives these eight bytes, it can confirm that the depth sounder has successfully saved the user-defined parameters.

4.2.22 Restore Factory Settings Command

Command Function: Restores the parameters set during factory reset as the default parameters upon power-on; this command is available only on depth sounders equipped with a parameter saving function.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	B6	device number	XX	XX	XOR checksum of the first 5 bytes

Instruction:

When the 4th byte is 00, the factory-default parameters can be restored as the default settings upon power-on.

When the 4th byte is 55, the parameters configured by the user are used as the default parameters upon power-on.

Command example: AA B6 00 00 00 1C – by sending these 6 bytes via the serial port to the depth sounder, the parameters set during factory calibration can be restored as the default parameters upon power-on.

Upon receiving this command, the depth sounder will return the eight bytes: AB CC 04 B6 00 00 00 D5; once the host computer receives these eight bytes, it can confirm that the depth sounder has restored its parameters to their factory-default settings, which will serve as the default parameters upon power-on.

Note: Upon receiving this command, the depth sounder does not need to send a command to save the user's configuration parameters; the configuration results will be permanently saved. If the user has configured an incorrect baud rate, resulting in failed serial communication with the depth sounder, the user can send the command "AA B6 00 00 00 1C" at a baud rate of 9600 to the depth

sounder within the first 2 seconds after power-on, which will restore the parameters set during factory calibration as the default parameters upon power-on.

4.2.23 Set threshold descent mode instruction

Command function: This command sets the method for adjusting the detection threshold from the initial threshold to the final threshold; this command is available only on depth-measuring instruments equipped with a threshold descent adjustment function.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	B8	device number	XX	XX	XOR checksum of the first 5 bytes

Instruction:

When the 4th byte is 00, the threshold descent mode is set to the linear descent mode (when the system detects the end of the range, the detection threshold decreases linearly from the initial threshold to the final threshold; upon power-on, the depth finder defaults to this linear descent mode). When the 4th byte is 01, the threshold descent mode is set to the accelerated descent mode (when the system detects a distance equal to one-quarter of the range, the detection threshold decreases from the initial threshold to the final threshold, after which it remains constant at the final threshold).

Command example: AA B8 00 01 00 13 – transmit these six bytes over the serial port to the depth sounding device to set its threshold reduction mode to the accelerated reduction mode.

Upon receiving this command, the depth profiler will return the eight bytes: AB CC 04 B8 00 01 00 DA; once the host computer receives these eight bytes, it can confirm that the depth profiler has set the threshold descent mode to the acceleration descent mode.

4.2.24 Select the SDDBT Output Data Instruction

Command Function: The WD series depth finder can obtain three distance measurements – the nearest target, the strongest target, and the farthest target – for each survey. When selecting to output the measurement results in SDDBT format, only one distance measurement is output; by default, the distance to the nearest target is output. This command allows you to specify which of the three distance measurements (nearest, strongest, or farthest) should be output in SDDBT format. This command is available only on depth finders that support the SDDBT output format.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte

AA	BE	device number	XX	XX	XOR checksum of the first 5 bytes

Instruction:

When the fourth byte is 00, the SDDBT format outputs the nearest target distance; when the fourth byte is 01, the SDDBT format outputs the strongest target distance; when the fourth byte is 02, the SDDBT format outputs the farthest target distance.

Command example: AA BE 00 01 00 15 – by sending these 6 bytes via the serial port to the depth sounder, the distance data in SDDBT format can be configured to represent the maximum target distance.

Upon receiving this command, the depth sounder will return the eight numerical values: AB CC 04 BE 00 01 00 DC; once the host computer receives these eight values, it can confirm that the depth sounder has configured the distance data output in SDDBT format to represent the maximum target distance.

4.2.25 Select Distance Resolution Command

Command function: For depth sounders with dual resolution capabilities, the default distance resolution is 1 mm and the default distance range is 20 m; this command can be used to set the current distance resolution to either 1 mm or 1 cm. When the distance resolution is changed from 1 cm to 1 mm, if the distance range exceeds 20 m, it will automatically be set to 20 m.

instruction format:

First byte	2nd byte	3rd byte	4th byte	5th byte	6th byte
AA	BF	device number	XX	XX	XOR checksum of the first 5 bytes

Instruction:

When the 4th byte is 00, the current distance resolution is set to 1 mm; when the 4th byte is 01, the current distance resolution is set to 1 cm.

Command example: AA BF 00 01 00 14 – by sending these 6 bytes via the serial port to the depth sounder, you can set the current distance resolution to 1 cm.

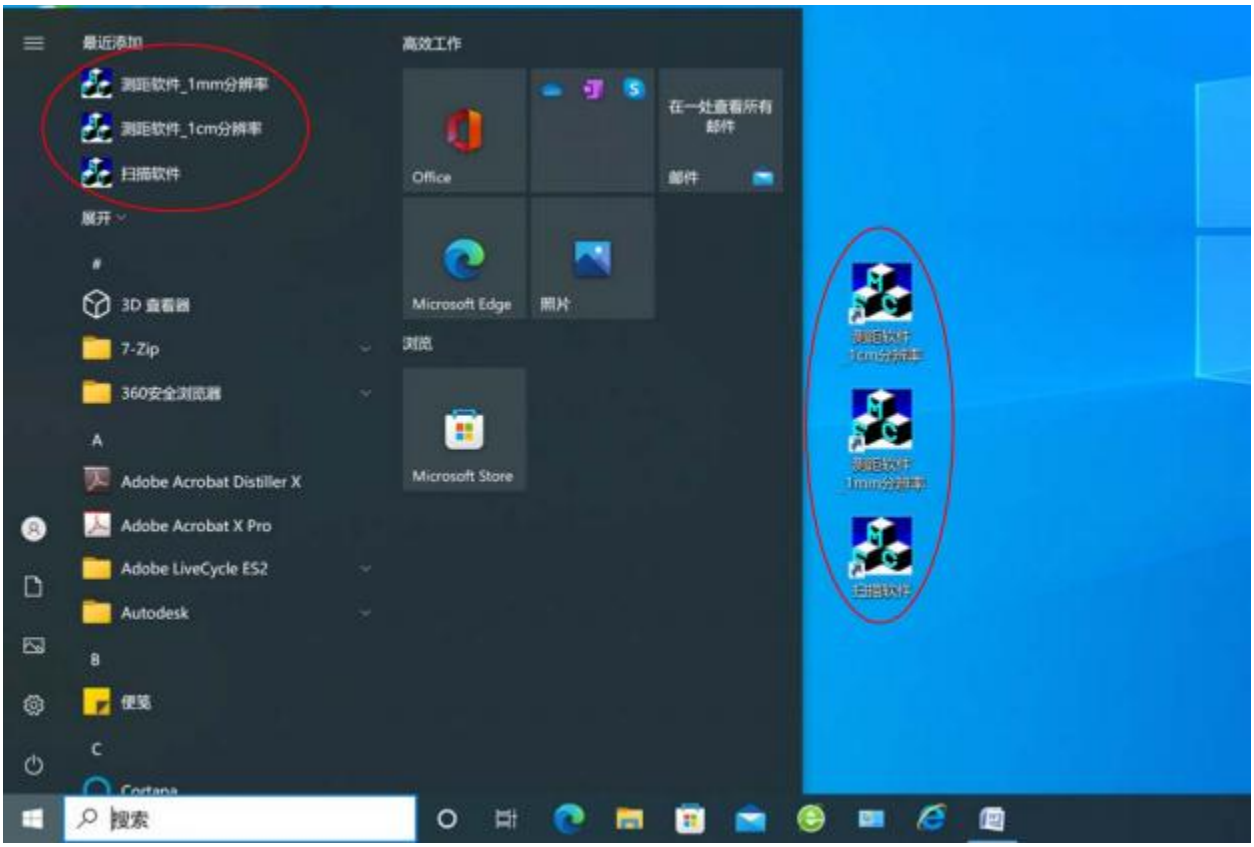
Upon receiving this command, the depth sounding instrument will transmit the eight numerical values AB CC 04 BF 00 01 00 DD; upon receiving these values, the host computer can confirm that the depth sounding instrument has set its current distance resolution to 1 cm.

5 User Manual for Supporting Software

The WD depth profiler is equipped with two sets of software: one set is the ranging software, and the other is the scanning software. The ranging software itself is further divided into two types: one with a 1 cm resolution and the other

with a 1 mm resolution; the appropriate version should be selected based on the resolution specifications of the depth profiler.

The software can run on operating systems such as Windows XP, Windows 7, Windows 8, and Windows 10; by executing the SETUP.EXE file contained in the software installation package, the software can be installed on the computer. During the installation process, you can choose the installation directory as needed, and the entire installation process will be completed automatically. Once the installation is complete, shortcuts to the software will be automatically created on the computer's desktop and in the Start menu, as shown in the figure below.

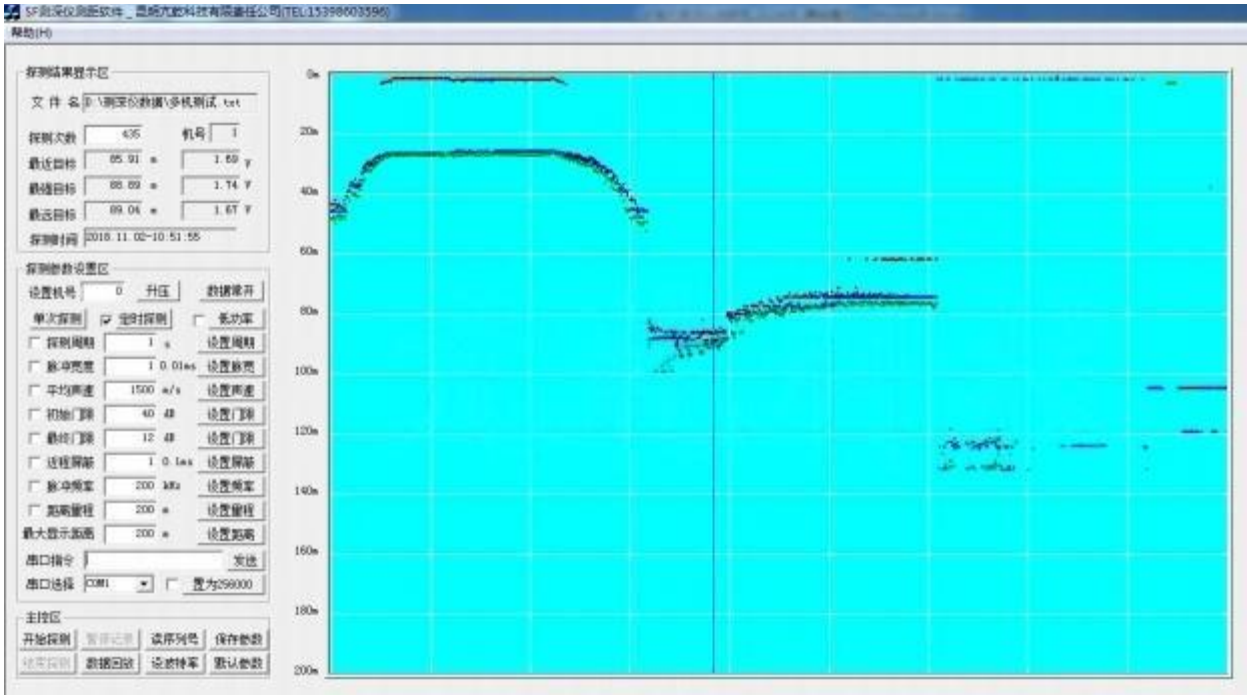


A depth sounder controls and retrieves measurement results via a serial port; therefore, the computer must have an available serial port. If the computer does not have a serial port, a USB-to-serial adapter can be used to add a serial port.

5.1 Distance Measurement Software

5.1.1 Main Functions and Operating Procedures

The interface of the ranging software is shown in the figure below; it primarily uses a text box to display various parameters and employs a time-history curve to continuously display the detection results for depth or distance.



The vertical axis of the figure represents distance or depth, while the horizontal axis represents time.

The time-history curve continuously displays, using red, blue, and green curves, how the distance to the nearest detected target, the distance to the strongest detected target, and the distance to the farthest detected target change over time. During each detection cycle, the sonar transmits a single sounding acoustic pulse; when this pulse reflects off an underwater object, an echo signal is generated. If the amplitude of the echo signal exceeds a preset detection threshold, the presence of a target is confirmed. When multiple objects exist at different distances, multiple echo signals will be received in sequence; the nearest target refers to the underwater object corresponding to the first echo signal, the strongest target refers to the underwater object with the highest echo signal amplitude, and the farthest target refers to the underwater object corresponding to the last echo signal. For each detection cycle, the distances of the nearest, strongest, and farthest targets, along with the corresponding echo

signal amplitudes, are returned via the serial port; if there is only a single target in the water, all three sets of data will contain identical values.

After the software starts, you must use the "Serial Port Selection" function to specify the serial port to which the depth sounder is connected in order to perform distance detection or configure relevant parameters; the software will automatically remember the last selected serial port number.

After the software starts, a machine number selection dialog box appears in the parameter configuration section; the default machine number in this dialog box is 0. For the WD0101 model, when the machine number is 0.

If multiple depth sounders are connected to a single serial port, all depth sondes connected to this serial port will receive commands sent by the host computer and transmit the operation results back to the host computer via the serial port. Since data transmission does not respect a specific sequence, data collisions may occur, preventing the host computer from receiving the correct data. Therefore, only when a single depth sounder is connected to a serial port can Initial Machine Number 0 be used; otherwise, the machine number of the depth sounder to be controlled must be entered in the Machine Number Selection dialog box before proceeding with any subsequent operations. For the WD0100 model, only one depth sounder can be connected to a single serial port.

The initial baud rate after software startup is 9600; similarly, the initial baud rate upon powering on the depth sounder is also 9600. By clicking the button located on the right side of the serial port selection window, you can simultaneously configure the serial baud rates for both the software and the depth sounder. The configured baud rate can switch between 9600 and 256000. Upon successful configuration, a checkmark will automatically appear in the checkbox to the left of this button (Note: this checkmark appears automatically when the software receives feedback from the lower-level device, rather than by manually clicking the checkbox). Only when the checkbox to the left of the button displays a checkmark will it be confirmed that the parameters have been successfully configured in the depth sounder. After all subsequent parameter configurations are completed successfully, the corresponding checkboxes to the left of their respective buttons will also display a checkmark; this explanation will not be reiterated below.

Click the "Scheduled Detection" button with the left mouse button; the depth meter will then begin transmitting detection sound pulses at the preset interval (the initial detection interval is 1 s) and measure the distance to the underwater target. The measurement results are displayed in the corresponding text box; clicking this button again will stop the scheduled detection.

Click the "Low Power" button with the left mouse button; the sonar will reduce its transmission power by approximately 10 dB. Clicking this button again will restore the high-power transmission mode. The initial state of the sonar upon powering on is the low-power transmission mode.

Click the "Start Detection" button using the left mouse button; the software will then display a file name selection dialog box where you can enter the filename for saving the measurement results (the default filename is generated based on the computer system's current timestamp). After entering the filename and clicking "OK," the software will save the measurement results to the specified file and simultaneously begin continuously displaying the detection results via a time-history curve. The detection results are saved as a TXT file, which can be viewed using the "Data Playback" feature or other text editing software.

Click the "Pause Recording" button with the left mouse button; the software will pause the recording of measurement results. Clicking this button again will resume the recording of measurement results.

Click the "End Measurement" button with the left mouse button; the software will then stop recording measurement results and close the data file containing these results.

After the measurement is complete, you can click the "Data Playback" button with the left mouse button, select the data file you wish to playback from the pop-up file selection dialog box, and then playback the measurement results.

When the time-history curve of the measurement results exceeds the length of the display window, the software will automatically scroll the display.

As shown, in the time-history curve display window, press the right mouse button and move the mouse to the right (or left); after releasing the right mouse button, the time-history curve will shift to the right (or left) to facilitate viewing all measurement results. This feature can only be used after completing the detection or during data playback.

After the detection phase is completed, you can use the cursor (activate the cursor by clicking with the left mouse button at the desired position on the time-history curve) to read the values of the nearest target distance, the maximum target distance, the farthest target distance, and the echo level amplitude for each time instant; you can move the cursor left or right using the mouse scroll wheel.

By using buttons such as "Set Cycle," "Set Pulse Width," "Set Sound Speed," "Set Threshold," "Set Shielding," "Set Frequency," or "Set Range" in the software, you can configure the parameters displayed in the text box to the left of each button directly into the depth finder. When you click these buttons, if

the depth finder receives a valid configuration command, it will return the command code via the serial port; simultaneously, the check box to the left of the corresponding button will be checked. Before configuring these parameters, you must first click the "Stop Transmission" button to halt the depth finder's operation; once the configuration is complete, you may resume normal operation.

The "Set Distance" button is used to set the maximum display distance for the time-domain curve display window to the value shown to the left of the button; this function only modifies the display results of the ranging software and does not affect the sonar's detection range.

5.1.2 Meaning of Key Parameters

Detection Cycle: The interval between two consecutive detections; the initial value upon power-on is 1s. This parameter can be configured via the serial port, with a permissible range of 0.1s to 5s. The farther the detection distance, the longer the detection cycle should be; furthermore, the detection cycle must be greater than the time required for the acoustic signal to travel twice the detection range.

Distance range: The maximum detectable distance; for the WD0100 (WD0101) model, the default initial value upon power-on is 100 m, and the maximum setting can be configured up to 100 m.

Pulse width: the duration of the detection pulse acoustic signal; the initial value for the WD0100 (WD0101) upon power-on is 0.05 ms. A wider pulse width results in greater energy of the detection pulse acoustic signal and a longer detection range; however, at short distances, this may lead to significant measurement blind zones.

The initial threshold refers to the threshold value used at the beginning of each detection cycle (the threshold corresponding to the closest range); when the echo signal exceeds this threshold, it indicates the presence of a target. The threshold value gradually decreases as the detection range increases until the maximum detection range (the set range) is reached; at this point, the threshold becomes the final threshold, which must not exceed the initial threshold. A higher threshold setting results in a lower false alarm probability, but may lead to missed targets. For the sonar system, the initial threshold upon power-on is 40 dB, and the final threshold is 12 dB; if false targets are detected, these two thresholds can be appropriately increased. Both the initial and final thresholds are set by adding a value to the background noise level.

The threshold value is set such that, if the background noise level is 50 dB and the initial threshold is 40 dB, the echo level must exceed 90 dB for the system to determine that a target is present. Since the background noise level varies depending on the operating environment, the maximum allowable value for the initial threshold is not fixed; the higher the background noise level, the lower the maximum initial threshold value can be set, and the initial threshold should generally not exceed 70 dB.

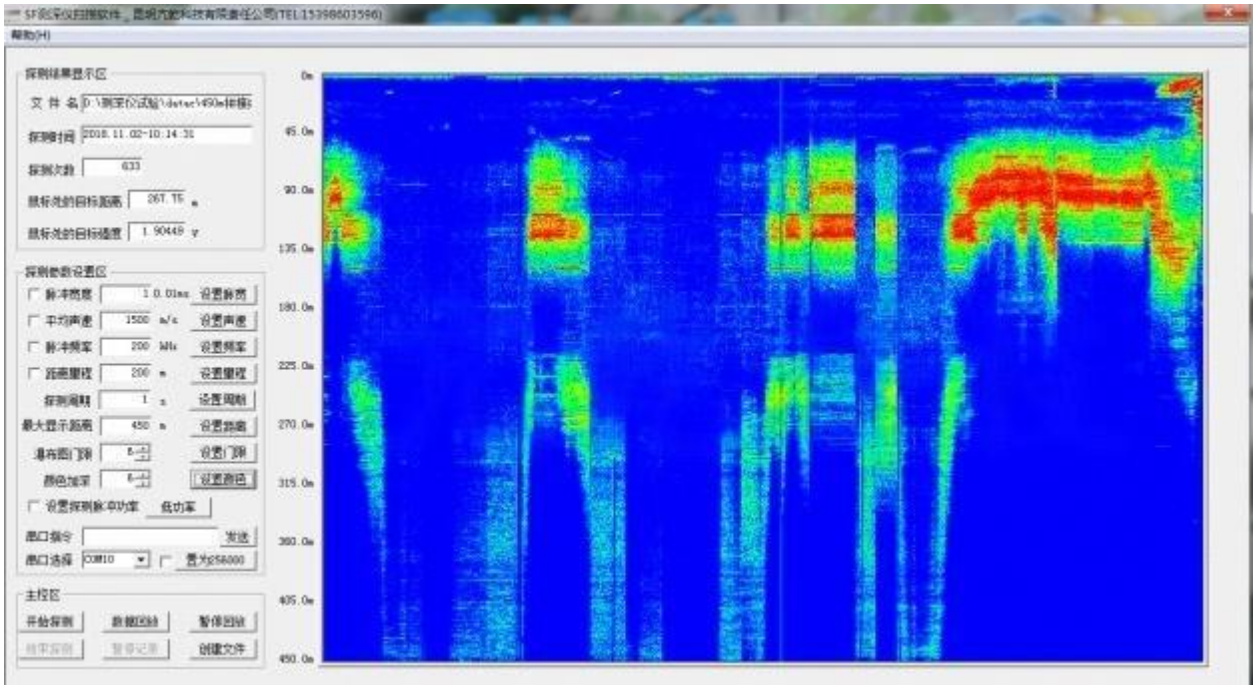
Short-range shielding: This refers to the practice of not performing target detection within the shortest possible distance (during the short-range shielding period) for each detection cycle. For example, if the short-range shielding duration is 1 ms and the pulse width is 0.2 ms, then no target detection will occur during the initial 1.2 ms period; this corresponds to a range of up to 0.9 m in front of the depth finder where no target detection takes place – only targets located beyond 0.9 m will be detected.

Pulse frequency: The frequency of the detection acoustic pulses; the pulse frequency can be modified via the serial port, but it is not recommended to do so, as the default value has already been set to the optimal operating frequency.

5.2 Scanning Software

The interface of the scanning software is shown in the figure below.

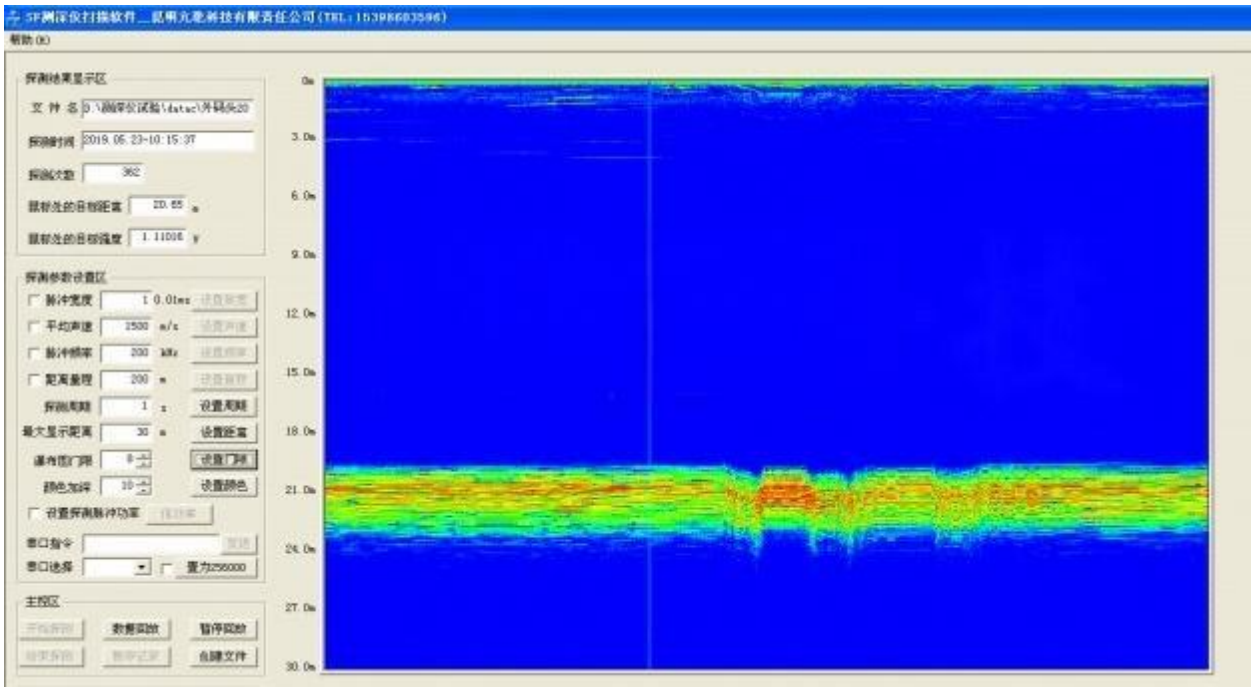
Results of horizontal sounding survey conducted at the dock and distant shallow waters



The scanning software displays the evolution of echo signals under scanning mode using a waterfall plot; each scan generates only one vertical scan line. The

figure above shows the result after 900 scans, where the colors transition from blue to green and then to red, corresponding to the gradual increase in echo signal strength. This plot allows for a general assessment of the size and distance of underwater obstacles, as well as for a preliminary survey of the seafloor topography.

Results of the bathymetric depth sounder's vertical scanning of the seabed



After the software starts, the initial device number in the Device Number Selection dialog box is 0. For the WD0101 model, the initial device number 0 can only be used when only one depth profiler is connected to a single serial port; otherwise, the user must enter the device number of the specific depth profiler to be controlled in the Device Number Selection dialog box before proceeding with any subsequent operations. For the WD0100 model, only one depth profiler can be connected to a single serial port.

The initial baud rate after launching the scanning software is 256000; however, the initial baud rate upon powering on the depth sounder is 9600. To initiate scanning measurements, click "Set to 256000" using the left mouse button to configure the depth sounder's baud rate to 256000. The remaining operation procedures for the scanning software are largely similar to those for the distance-measuring software; please refer to the above instructions for guidance.

The waterfall plot threshold is used to set the display threshold for the echo signal; plotting begins only when the amplitude of the echo signal exceeds this threshold; otherwise, the area below this threshold is displayed as a blue background. The range for setting the waterfall plot threshold is from level 1 to

level 30 – level 1 represents the lowest threshold, while level 30 represents the highest threshold. After entering the desired threshold level, click the "Set Threshold" button with your left mouse button; the software will then redraw the waterfall plot using the new threshold.

The 'Deepen Color' feature is used to set the display color for the waterfall chart; the adjustment range spans from 0 to 10 levels. After entering a color level, click the "Set Color" button with the left mouse button, and the software will re-display the waterfall chart using the new color.

Click any position on the waterfall plot with the left mouse button; the corresponding distance and echo signal amplitude will then be displayed in the text box on the left side. This feature allows you to view the distance and echo signal amplitude at any position within the waterfall plot.

6 Precautions

The black rubber section of the sonar device serves as the transducer probe; its interior contains piezoelectric ceramic, which may be damaged by impacts; therefore, appropriate protection should be taken during both use and storage.

The depth sounding device must be submerged in water to perform surveying operations; conducting surveys in air may damage the device and typically will not yield any measurement data;

Using a voltage stabilizer power supply equipped with overcurrent protection or a battery with very low output current to power the depth finder may prevent the device from starting normally;

Using a switching power supply with significant ripple to power the depth profiler may cause substantial fluctuations in the measurement data, or even render it impossible to obtain accurate measurements; it is recommended to use a 12V battery for power supply;

When the operating environment is subject to strong electromagnetic interference or vibration-induced noise, it may cause significant fluctuations in the measurement data; connecting the black core wire and the shielding wire of the sonar cable to the negative power terminal can effectively mitigate electromagnetic interference; similarly, using a serial port module with isolation capability can also reduce electromagnetic interference.

Kilichain Technology Co., Ltd.

Address: No. 18 Huxin Avenue, 314100 Jiashan County,
Jiaxing City, Zhejiang Province, P.R.C.

Support E-mail: support@kilichain.com
Sales E-mail: sales@kilichain.com
Tel: +86 0573 8497 1822
Web: www.kilichain.com

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