Operate the Hydrolab
SDI-12 / Modbus / RS232 TTY
Communications Module
(HL Series Sonde)

04/2018, Edition 1

6748600
(USB)

9039600
(SDI-12)

9039700
(RS485
Modbus)

9039800
(RS232
Modbus)

9312900
(RS232
TTY)

User Manual
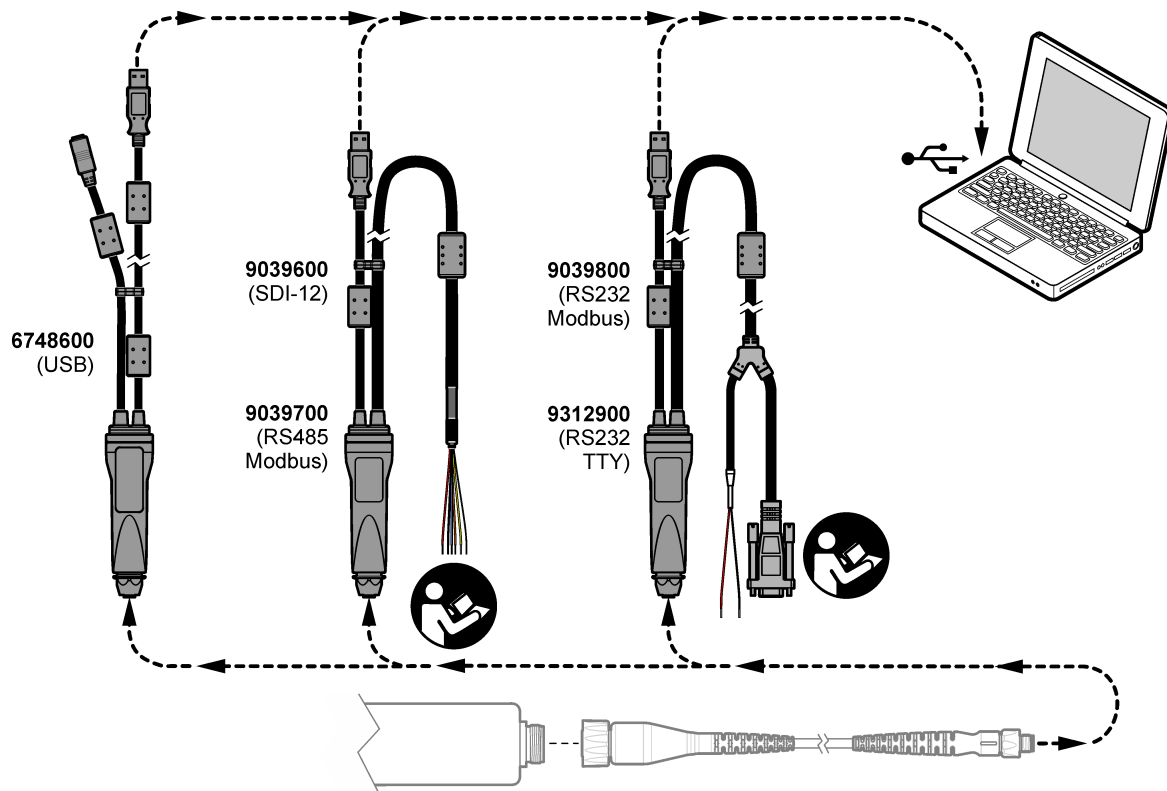
Overall Contents

Part A – Operate the Hydrolab SDI-12 Communications Module

Part B – Operate the Hydrolab RS232 TTY Communications Module

Part C – Operate the Hydrolab Modbus Communications Modules

Operate the Hydrolab SDI-12 Communications Module

Contents

1.0: SDI-12 Interface Summary

1.1: General Information

This document describes how the Hydrolab SDI-12 Communications Module functions when connected to an SDI-12 interface. The commands defined in this document are the SDI-12 commands that are supported by the Hydrolab SDI-12 Communications Module.

The Hydrolab SDI-12 Communications Module will not respond to SDI-12 commands when the USB is connected to a PC.

When the SDI-12 communications module USB is connected to a PC the sonde enters a low-power-usage mode 10 seconds after the last command. The sonde will not enter the low-power-usage mode when the sonde is communicating with Hydrolab Operating Software, Surveyor HL, or other Hydrolab interface. The sonde will enter the low-power-usage mode after every measurement cycle, if the measurement interval is greater than 10 seconds.

1.2: SDI-12 Communications Module Setup

1. Connect the USB connector of the SDI-12 communications module to the PC.
2. Start the Hydrolab Operating Software. The communications module shows in the "Connect to Device" field.
3. Select the communications module and then click "Connect." The configuration window opens.
4. In the "Communications" area, select the:
    - Address for the instrument (0–9)
    - Delay between the time when a measure is requested and the data becomes ready (0–999 seconds)
5. In the "Parameter Order" area, add the parameters to transmit to the data logger (maximum of 10).
    - To add a parameter, click "Add."
    - In the Parameter field, select the parameter to add.
    - In the Resolution field, set the resolution (number of significant digits) for the parameter (1–9), then click "OK."
6. To remove a parameter, select the parameter and click "Delete."
7. Put the parameters in the order that they will be transmitted to the data logger. The parameter at the top is transmitted first. To move a parameter up or down in the list, select the parameter and click the UP and DOWN arrows.
8. Click "Back to Sonde" to go back to the instrument window.

1.3: Hardware Connections

The hardware connections are shown in the table below. This table is also available in the Communications Modules User Instructions, Document Number DOC276.97.80350.

		Red	Black	Blue	Orange	Silver	Yellow
	EN	8–24 VDC	Power ground	Data ground	SDI-12 data	Shield	—
	DE	Rot	Schwarz	Blau	Orange	Silber	Gelb
		8–24 VDC	Masse (Rückleitung)	Daten erde	SDI-12 daten	Schirm	—
	IT	Rosso	Nero	Blu	Arancione	Argento	Giallo
		8–24 VDC	Massa alimentazione (ritorno)	Massa dati	Dati SDI-12	Schermo	—
9039600	**FR**	Rouge	Noir	Bleu	Orange	Argent	Jaune
		8–24 VDC	Masse (retour)	Données terre	Données SDI-12	Blindage	—
	ES	Rojo	Negro	Azul	Naranja	Plata	Amarillo
		8–24 VDC	Toma de tierra (retorno)	Datos de toma a tierra	Datos SDI-12	Blindaje	—
	PT-BR	Vermelho	Preto	Azul	Laranja	Prata	Amarelo
		8–24 VDC	Aterramento de energia (retorno)	Dados de aterramento	Dados SDI-12	Blindagem	—
	ZH	红色	黑色	蓝色	橙色	银	黄色
		8–24 VDC	电源接地 （回路）	数据基础	SDI-12 数据	屏蔽	—

The SDI-12 power connections are power and ground. 12VDC power is recommended, but up to 24V is supported. The SDI-12 data connection is through two wires: SDI-12 data and Data ground.

1.4: Power Considerations

The Hydrolab SDI-12 Communications Module can provide external power to Hydrolab HL Series sondes. The Hydrolab power supply (Part Number 8760200, "KIT, POWER SUPPLY AND ADAPTERS, HL4") outputs 12VDC at 1.25Amp, which is adequate to power a communications module and an HL Series sonde. Contact OTT Hydromet Technical Support for information about sonde power budget.

2.0: SDI-12 Standard Commands

2.1: Address Query Command (?!)

This command is used to query the address of a sensor on the SDI-12 bus. Use this command to determine the address of the Hydrolab SDI-12 Communications Module.

Command	Response
?!	a<CR><LF>
	a - the sensor address
! - terminates the command	<CR><LF> - terminates the response

2.2: Acknowledge Active Command (a!)

This command is used to ensure that a sensor is responding to a data recorder or another SDI-12 device. This command asks a sensor to acknowledge its presence on the SDI-12 bus.

Command	Response
a!	a\<CR>\<LF>
a - the sensor address	a - the sensor address
! - terminates the command	\<CR>\<LF> - terminates the response

2.3: Send Identification Command (aI!)

This command is used to query the Hydrolab SDI-12 Communications Module for its SDI-12 compatibility level. It also queries the connected HL Series sonde for its model number and firmware version.

Command	Response
aI!	allccccccccmmmmmmvvvxxx . . . xxx\<CR>\<LF>
I - the send identification command	a - the sensor address
! - terminates the command	ll - the SDI-12 version number, indicating SDI-12 version compatibility; The Com-Module supports version 1.3 encoded as "13" cccccccc - an 8 character vendor identification, encoded as "HYDROLAB"
	mmmmmm - 6 characters specifying the sensor model number
	vvv - characters specifying the sensor version
	xxx…xxx - the serial number of the sonde (max 13 characters)
	\<CR>\<LF> - terminates the response

2.4: Change Address Command (aAb!)

This command changes the SDI-12 address of the Hydrolab SDI-12 Communications Module.

Command	Response
aAb!	b\<CR>\<LF>
a - the sensor address	b - the new address of the sensor
A - the change address command	\<CR>\<LF> - terminates the response
b - the address to change to	
! - terminates the command	

2.5: Start Measurement Command (aM!)

This command wakes the HL Series sonde from sleep and commands the sonde to take a measurement. The Hydrolab SDI-12 Communications Module returns the time until one or more measurements will be ready and the number of measurements that it will return. The measurement is not returned to the data recorder after this command. The send data (aD0!) command must be issued to get the measurement(s).

Command	Response
aM!	atttn<CR><LF>
a - the sensor address	a - the sensor address
M – the start measurement	ttt - the specified time, in seconds, until the HL Series sonde will have all measurements ready. This time can be setup with an extended command n - the number of Parameters will return in one or more subsequent D
! - terminates the command	commands; n is a single digit integer with a valid range of 1 to 9.
	<CR><LF> - terminates the response

2.6: Start Concurrent Measurement Command (aC!)

This command wakes the HL Series sonde from sleep and commands it to take a measurement. It returns the time until one or more measurements will be ready and the number of measurements that it will return. The send data (D0!) command must be issued to get the measurement(s). There is no functional difference between this command and the *Start Measurement Command (aM!)*.

Command	Response
aC!	atttnn<CR><LF>
a - the sensor address	a - the sensor address
C – the start measurement	ttt - the specified time, in seconds, until the HL Series sonde will have all measurements ready. This time can be setup with an extended command, if continuous mode enabled, then the waiting time response is always 2 seconds.
	nn - the number of Parameters will return in one or more subsequent D
! - terminates the command	commands; n is a single digit integer with a valid range of 1 to 10.
	<CR><LF> - terminates the response

2.7: Send Data Command (aD0! . . . aD9!)

This command requests groups of data from the HL Series sonde. (aD0!) is issued after an (aM!),(aC!), or (aV!) command. The HL Series sonde responds by sending the data. If the expected number of measurements are not returned in response to a (aD0!) command, the data recorder issues (aD1!, aD2!, etc.) until all measurement values are received. The expected number of measurements is given in the response to an (aM!), (aC!), or (aV!) command.

Command	Response
aDx! (aD0...aD9)	a\<values\>\<CR\>\<LF\>
a - the sensor address	a - the sensor address
C – the start measurement	\<values\> - see below
! - terminates the command	\<CR\>\<LF\> - terminates the response

	\<values\> - pd.d
	p - the polarity sign (+ or -)
	d - 1 or more digits
	. - decimal point (optional)
	    The maximum number of digits is 7, even without the decimal point.
	    The minimum number of digits is 1, excluding the decimal point.
	    The maximum number of characters to a value is 9, e.g. (+dddddd.d).

The Hydrolab SDI-12 Communications Module will return a maximum of 3 values for each (aD[0..9]!) command. If the user configured the maximum 10 values to be recorded, then the user must issue one (aM!) command and then (aD0!, aD1!, aD2! and aD3!, etc.) to return all of the measured values.

Prior to sending the (aD0!) command, the SDI-12 master must wait the number of seconds returned by the (aM!) command response or no parameters will be returned and another (aM!) command must be issued.

2.8: Report Continuous Data Command (aRx!)

Sensors that are able to continuously monitor the sensor to be measured, such as a shaft encoder, do not require a start measurement command (M, C, etc.). They can be read directly with the (R) commands. The Extended Command (aX1!) must be sent to enable continuous data mode. If continuous measurement has not been enabled on the Hydrolab SDI-12 Communications Module (using the aX1! command), then it will respond with a<CR><LF>.

Command	Response
aRx! (aR0...aR9)	a<value><CR><LF>
a - the sensor address	a - the sensor address
R - return continuous measurement	<value> - Up to 75 characters can be sent
x - measurement location in list	
! - terminates the command	<CR><LF> - terminates the response

Only one parameter is returned with an (aRx!) command. The parameters are referenced in order of their definition in the Hydrolab SDI-12 Communications Module (0-9). The parameters do not need to be referenced in order and any parameter may be retrieved at any time.

2.9: Start Verification (aV!)

This command returns the status from the last (aM!) measurement. The send data (aD0!) commands must be issued to return the status information.

Command	Response
aV!	a0006<CR><LF>
a - the sensor address	a - the sensor address
V – the Verification command	0006 - the numbers of statuses will return in one or more subsequent D commands; <CR><LF> - terminates the response .
! - terminates the command	
aD0!	a<value 0><value 1><value 2><CR><LF> a - the sensor address <value 0> number of measurements <value 1> number of bus resets <value 2|> numbers of CRC errors <CR><LF> - terminates the response
aD1!	a<value 3><value 4><CR><LF> a - the sensor address <value 3> number of frame errors <value 4|> numbers of timeout errors <value 5> numbers of SDI-12 break / reset events <CR><LF> - terminates the response

3.0: SDI-12 Extended Commands

Extended commands are sensor specific commands that a manufacturer adds to their SDI-12 implementation to handle specific situations unique to their own devices.

3.1: Set Continuous Mode (aXn!)

This command enables or disables the Continuous Mode.

Command	Response
aXn!	aXn<CR><LF>
a - the sensor address	a - the sensor address
X – the Continuous Mode command n - Set Continuous Mode 0 : disable Continuous Mode 1 : enable Continuous Mode.	X – the Continuous Mode Command response n - Continuous Mode state
! - terminates the command	<CR><LF> - terminates the response

This enables the (aRn!) command, allowing it to get individual values from an HL Series sonde without using the (aM!) command. However, it also allows the (aDn!) command to get immediate values from the HL Series sonde after at least one (aM!) command is also issued. This sequence of commands allows an SDI-12 master to request data from a slave sonde. The fastest possible rate is 1 request per second. It takes at least three (aD!) calls before the data is fully sampling.

3.2: Initiate a cleaning Cycle (aXC!)

This command initiates a cleaning cycle. The cleaning cycle rotates the wiper on the Turbidity sensor, and if present, it will rotate the cleaning brush.

Command	Response
aXC!	aXC<CR><LF>
a - the sensor address	a - the sensor address
XC – Start cleaning Cycle command	XC - Start cleaning Cycle command response
! - terminates the command	<CR><LF> - terminates the response

3.3: Set measurement delay time (aXDnnn!)

This command sets the measurement delay time. The delay is the time between when a measurement is requested and when the data is made available. This command allows the user to customize the delay through SDI-12 if the delay time is longer than "Minimum System Stabilization Time Required" plus 5 seconds. The user can also do this with Hydrolab Operating Software.

Command	Response
aXDnnn!	aXDnnn<CR><LF>
a - the sensor address	a - the sensor address
XD – Set delay command	XD - Set delay command response
nnn – Delay time in seconds [0 … 999]	nnn – Delay time response
! - terminates the command	<CR><LF> - terminates the response

3.4: Read measurement delay time (aXD!)

This command reads the current measurement delay time.

Command	Response
aXD!	aXD+n<CR><LF>
a - the sensor address	a - the sensor address
XD – read delay command	XD - Set delay command response
! - terminates the command	+n – Delay time response
	<CR><LF> - terminates the response

Operate the Hydrolab RS232 TTY Communications Module

Contents

1.0: Introduction

1.1: General Information

This document describes how the Hydrolab RS232 TTY Communications Module functions when connected to an external device.

The Hydrolab RS232 TTY Communications Module transmits ASCII data over an RS232 interface. This module is a Hydrolab custom design and adheres to no industry standard.

When the Hydrolab RS232 TTY Communications Module USB connector is connected to a PC, the sonde enters a low-power-usage mode 10 seconds after the last command. The sonde will not enter the low-power-usage mode when the sonde is communicating with Hydrolab Operating Software, Surveyor HL, or other Hydrolab interface. The sonde will enter the low-power-usage mode after every measurement cycle, if the measurement interval is greater than 10 seconds.

1.2: RS232 TTY Communications Module Setup

1. Connect the USB connector of the RS232 TTY communications module to the PC.
2. Start the Hydrolab Operating Software. The communications module shows in the "Connect to Device" field.
3. Select the communications module, then click "Connect." The configuration window for the communications module shows.
4. In the "Communications" area, select the:
   - Sample rate (1–3600 seconds)
   - Baud rate
   - Data bits (7 or 8)
   - Stop bits (1 or 2)
   - Parity (none, odd or even)
   - Update interval (1–3600 seconds)
   - Time Stamp format (e.g., HHMMSS or DDMMYYYYHHMMSS)
5. In the "Parameter Order" area, add the parameters to transmit to the data logger (maximum of 10).
   a. To add a parameter, click "Add."
   b. In the Parameter field, select the parameter to add.
   c. In the Resolution field, set the resolution (number of significant digits) for the parameter (1–9).
   d. In the Field Width field, set the number of characters sent back for each parameter (1–9), then click "OK."
6. To remove a parameter, select the parameter and click "Delete."
7. Put the parameters in the order that they will be transmitted. The parameter at the top is transmitted first. To move a parameter up or down in the list, select the parameter and click the UP and DOWN arrows.
8. Click "Back to Sonde" to go back to the instrument window.

1.3: Hardware Connections

The hardware connections are shown in the table below. This table is also available in the Communication Modules User Instructions, document number DOC276.97.80350.

	EN	Red	8–24 VDC	Black	Power ground
	DE	Rot	8–24 VDC	Schwarz	Masse (Rückleitung)
	IT	Rosso	8–24 VDC	Nero	Massa alimentazione (ritorno)
	FR	Rouge	8–24 VDC	Noir	Masse (retour)
9039800, 9312900	**ES**	Rojo	8–24 VDC	Negro	Toma de tierra (retorno)
	PT-BR	Vermelho	8–24 VDC	Preto	Aterramento de energia (retorno)
	ZH	红色	8–24 VDC	黑色	电源接地 （回路）
	JA	赤	8–24 VDC	黒	電源接地 （リターン）
	PL	czerwony	8–24 VDC	czarny	Uziemienie ochronne

The hardware connections for the Hydrolab RS232 TTY Communications Module are Power, Ground and an RS232 DB9 connector. 12 VDC power is recommended, but up to 24VDC is supported. The DB9 is a data circuit-terminating equipment, or DCE device, which means that a computer can connect to the communication module with a "straight-through" cable. If the user requires a connection to another DCE device (like a modem) then a null-modem is required to interchange the Rx and Tx lines.

1.4: Power Considerations

The Hydrolab RS232 TTY Communications Module can provide external power to Hydrolab HL Series sondes. The Hydrolab power supply (Part Number 8760200, "KIT, POWER SUPPLY AND ADAPTERS, HL4") outputs 12 VDC at 1.25 A, which is adequate to power a communications module and an HL Series sonde. Contact OTT Hydromet Technical Support for information about sonde power budget.

2.0: Hydrolab RS232 TTY Operation

2.1: The TTY Serial Port

The Hydrolab RS232 TTY Communications Module is wired so that a PC can connect via serial port directly to the communications module. If the user wants to attach the communications module to a modem then a null-modem converter is required.

The serial connection can interface to any RS232 communications device.

There are two available modes for the Hydrolab RS232 TTY Communications Module: Report Mode and Command Mode. In Report Mode, the Hydrolab RS232 TTY Communications Module reports the configured parameters at the *Update Interval* to the serial port. In Command Mode, a controller device requests data when it is required.

2.2: Output Format

There are two configurable formatting sections in Hydrolab Operating Software for the Hydrolab RS232 TTY Communications Module Settings: Time Stamp and Parameter Order.

2.2.1: Time Stamp Format

The Time Stamp default format is "YYYY-MM-DD HH:MM:SS."

There are eight available timestamp formats and a "Disabled" option, as shown in the below screen capture.

2.2.2: Parameter Order: Resolution and Field Width Format

Resolution defines the number of digits to the *right* of the decimal point. Choose a value between 0 and 5. The radix on the RS232 TTY Communications Module is always a decimal point; it is not able to be configured to be a comma.

Width defines the total width of the ASCII field holding the parameter value. There is always one space inserted between all fields. If the resolution of the field takes up less space than the field width allotted, then the extra spaces are put to the left of the value. In other words, the parameter value is right-justified.

Warning: If the user sets a Resolution value that occupies more space than is allowed by the Width, then the Hydrolab RS232 TTY Communications Module will output "#.####" instead of a measured value. This warns the user to modify the configuration, rather than truncating the parameter value. If the value can be negative, allow space for the sign character in the field width.

2.3: TTY Commands

The TTY commands are shown in the table below. This table is also available in the Hydrolab Operating Software Manual, document number DOC026.53.80346.

TTY command menu

Command	Description	Reply	Notes

H	Show the instrument ID, then a header that identifies the data fields with the names and units	`<cr><lf>Instrument Id<cr><lf>`
		`<cr><lf><sp><sp>Time<sp><sp><sp>Temp<sp><sp>Ibatt<cr><lf>`
		`HHMMSS<sp><sp><sp><sp><sp>°C<sp><sp>Volts<cr><lf>`
		First line—Free-field text (maximum of 20 characters in length)
		Second line—Skipped and the data names given.
		Last line—Corresponding units for the data fields
			Data names and units are right-justified and 5 to 8 characters wide (6 typical). Any name can show in any field when configured in ANSI mode.

M	Force the instrument to send one line of data before the next data display interval.[1]	`231302<sp><sp>24.59<sp><sp><sp>12.0<cr><lf>`	Data values can be followed by a special character (*, ~, @, #, or ?). Data values with an appended character may not have a space separator. Data values are right-justified and 5 to 8 characters. Data values are adjusted as necessary to fit in the width field (##.##). The sign and decimal point are kept.

?	Show the detailed command menu	`<cr><lf>Main Menu<cr><lf>`
		`(H)eader<cr><lf>`
		`(M)easure<cr><lf>`
		`(Q)uit TTY Mode<cr><lf>`
		`Please enter your choice:<sp>`	

Q or q	Quit TTY mode and set the instrument to full terminal mode		Enter Q before the instrument is connected to the Hydrolab Operating Software.

[1] Use this command to synchronize the data acquisition software with the instrument data output.

To send a TTY command to the instrument, establish communication via HyperTerminal software or a comparable terminal emulator. Push the spacebar (or send an ASCII space character). The instrument will complete the last line, then send "<cr><lf>" and the command menu (H, M, ?).

<cr><lf>HM?:<sp>

Enter one of the commands in the table above (e.g., <sp>H<cr><lf>). The instrument will send the same command back if the command is accepted.

Note: If a command is not accepted, an ASCII BEL character is sent back. An ASCII escape character will abort the menu after a cancel message is shown.

If the TTY menu is not used, a line of data is periodically shown on the next available line. The update period is the "Update Interval" that the user set in the Communications

Settings page. If the screen is full, the lines are scrolled. All data lines stop with <cr><lf> and have the same formatting as the (M)easure command.

On power up, the Hydrolab RS232 TTY Communications Module enters Report Mode. Therefore, it sends out a short startup message and then outputs the parameters which were defined in Hydrolab Operating Software. An example screen capture is shown below.
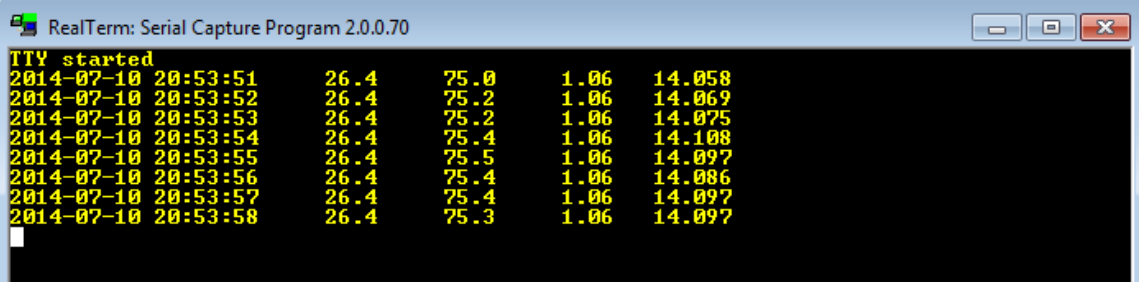
Report Mode can be interrupted by pressing the spacebar (or sending ASCII Space) at any time to have it respond only to direct commands. The commands and their format is shown in the table above, titled "TTY Command Menu." Note that the commands are echoed back to the transmitter. An example screen capture is shown below.
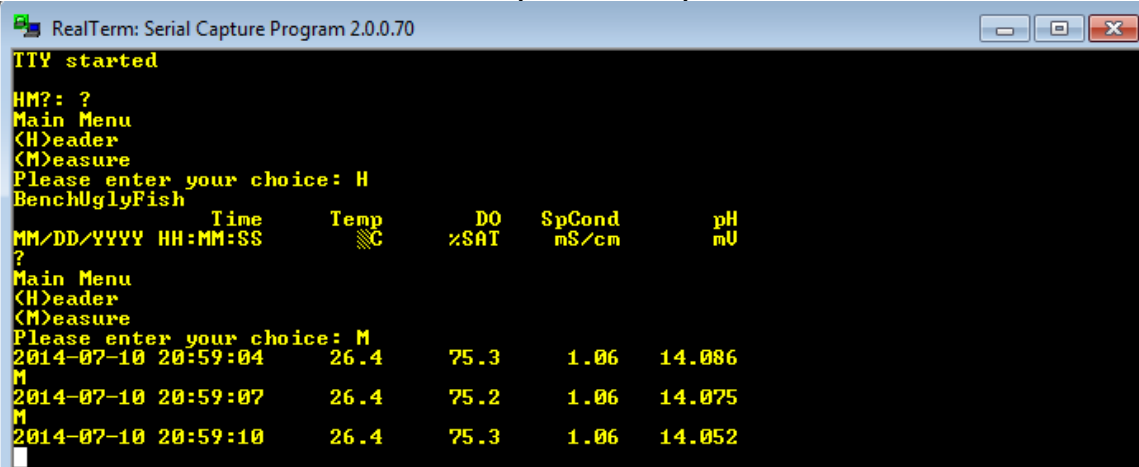
2.4: Timing Requirements

The Hydrolab RS232 TTY Communications Module allows the user to configure the Sample Rate and the Update Interval. The Sample Rate is the rate at which the Hydrolab RS232 TTY Communications Module requests data from the HL Series sonde. The Update Interval is the rate at which the Hydrolab RS232 TTY Communications Module sends data via the serial port.

It is strongly recommended to configure the Sample Rate to be equal to or faster than the Update Interval. Sampling faster than the Update Interval eliminates doubts about the time the sample was measured and the time the data was reported.

When the Hydrolab RS232 TTY Communications Module is in Command Mode with a slow sample rate, the user sees a delay between when the request for a measurement is given (M) and when the data is reported. This delay results from the Hydrolab RS232 TTY Communications Module waiting for next sample time.

Operate the Hydrolab Modbus Communications Modules

Contents

1.0: Introduction

1.1: General Information

This document describes how the Hydrolab Modbus Communications Module functions when connected to Modbus data loggers or similar devices. The two available versions of the Hydrolab Modbus Communications Module are:

1. USB/Modbus RS485
    a. Part Number 9039700 "si aa COMMUNICATIONS MODULE, RS485, HL"
2. USB/Modbus RS232
    a. Part Number 9039800 "si aa COMMUNICATIONS MODULE, RS232 MODBUS, HL"

More information about the Modbus communication protocol, including protocol specifications, is available at: www.modbus.org.

The Modbus interface to a data logger is active with a connected HL Series sonde only after the communications module is disconnected from the USB port. The communications module will not respond to any Modbus commands while the USB is connected to the PC.

When the Hydrolab Modbus Communications Module USB connector is connected to a PC, the sonde enters a low-power-usage mode 10 seconds after the last command. The sonde will not enter the low-power-usage mode when the sonde is communicating with Hydrolab Operating Software, Surveyor HL, or other Hydrolab interface. The sonde will enter the low-power-usage mode after every measurement cycle, if the measurement interval is greater than 10 seconds.

1.2: Modbus Communications Module Setup

1. Connect the USB connector of the Modbus communications module to the PC.
2. Start the Hydrolab Operating Software. The communications module shows in the "Connect to Device" field.
3. Select the communications module, then click "Connect." The configuration window for the communications module shows.
4. In the "Communications" area, select the:
   - Address for the instrument (1–254)
   - Baud rate (1200, 2400, 4800, 9600 or 19,200)
   - Data bits (7 or 8)
   - Stop bits (1 or 2)
   - Parity (none, odd or even)
5. In the "Parameter Order" area, add the parameters to transmit to the data logger (maximum of 10).
   a. To add a parameter, click "Add."
   b. In the Parameter field, select the parameter to add.
   c. In the Resolution field, set the resolution (number of significant digits) for the parameter (1–9).
6. To remove a parameter, select the parameter and click "Delete."
7. Put the parameters in the order that they will be transmitted. The parameter at the top is transmitted first. To move a parameter up or down in the list, select the parameter and click the UP and DOWN arrows.
8. Click "Back to Sonde" to go back to the instrument window.

1.3: Hardware Connections

1.3.1 RS232 Hydrolab Modbus Communications Module

The RS232 Hydrolab Modbus Communications Module hardware connections are shown in the table below. This table is also available in the Communications Modules User Instructions, document number DOC276.97.80350.

	EN	Red	8–24 VDC	Black	Power ground
	DE	Rot	8–24 VDC	Schwarz	Masse (Rückleitung)
	IT	Rosso	8–24 VDC	Nero	Massa alimentazione (ritorno)
	FR	Rouge	8–24 VDC	Noir	Masse (retour)
9039800, 9312900	**ES**	Rojo	8–24 VDC	Negro	Toma de tierra (retorno)
	PT-BR	Vermelho	8–24 VDC	Preto	Aterramento de energia (retorno)
	ZH	红色	8–24 VDC	黑色	电源接地（回路）
	JA	赤	8–24 VDC	黒	電源接地（リターン）
	PL	czerwony	8–24 VDC	czarny	Uziemienie ochronne

The RS232 Hydrolab Modbus Communications Module connections are power (12V and Ground recommended, but up to 24V is supported) and an RS232 DB9 connector. The DB9 is wired as a DCE device, which means that a computer can connect to the Hydrolab Modbus Communications Module with a "straight-through" cable. If the user requires a connection to another DCE device (a modem, for example) then a null-modem is required to interchange the Rx and Tx lines.

1.3.2 RS485 Hydrolab Modbus Communications Module

The RS232 Hydrolab Modbus Communications Module hardware connections are shown in the table below. This table is also available in the Communications Modules User Instructions, document number DOC276.97.80350.

		Red	Black	Blue	Orange	Yellow	Silver
EN		8–24 VDC	Power ground	Data return	RS-485 A	RS-485 B	Shield
DE		Rot	Schwarz	Blau	Orange	Gelb	Silber
		8–24 VDC	Masse (Rückleitung)	Datenrückgabe	RS-485 A	RS-485 B	Schirm
IT		Rosso	Nero	Blu	Arancione	Giallo	Argento
		8–24 VDC	Massa alimentazione (ritorno)	Restituzione dei dati	RS-485 A	RS-485 B	Schermo
FR		Rouge	Noir	Bleu	Orange	Jaune	Argent
		8–24 VDC	Masse (retour)	Retour de données	RS-485 A	RS-485 B	Blindage
ES		Rojo	Negro	Azul	Naranja	Amarillo	Plata
		8–24 VDC	Toma de tierra (retorno)	Retorno de datos	RS-485 A	RS-485 B	Blindaje
PT-BR		Vermelho	Preto	Azul	Laranja	Amarelo	Prata
		8–24 VDC	Aterramento de energia (retorno)	Devolução de dados	RS-485 A	RS-485 B	Blindagem
ZH		红色	黑色	蓝色	橙色	黄色	银
		8–24 VDC	电源接地（回路）	数据返回	RS-485 A	RS-485 B	屏蔽
JA		赤	黒	青	橙色	黄色	銀
		8–24 VDC	電源接地（リターン）	データの戻り	RS-485 A	RS-485 B	シールド
PL		czerwony	czarny	niebieski	pomarańczowy	żółty	srebrny
		8–24 VDC	Uziemienie ochronne	Powrót danych	RS-485 A	RS-485 B	Ekran

(left margin: 9039700)

The RS485 Hydrolab Modbus Communications Module power connections are the same as the RS232 Hydrolab Modbus Communications Module (12V and Ground recommended, but up to 24V is supported).

If communication fails, disconnect power and interchange the RS-485A and RS-485B wires. Then connect power and attempt communication.

1.4: Power Considerations

The Hydrolab SDI-12 Communications Module can provide external power to Hydrolab HL Series sondes. The Hydrolab power supply (Part Number 8760200, "KIT, POWER SUPPLY AND ADAPTERS, HL4") outputs 12 VDC at 1.25 A, which is adequate to power a communications module and an HL Series sonde. Contact OTT Hydromet Technical Support for information about sonde power budget.

The Hydrolab Modbus Communications Module is in "Continuous Monitor" mode, so while the HL Series sonde will enter the low-power-usage mode if the communications module's sample interval is long enough, the communications module itself is always on.

2.0: Hydrolab Modbus Operation

2.1: Modbus Description

Modbus is a transport protocol. This means that Modbus does not have any protocol features that indicate the types of data being transported in a message packet, nor does it specify the transport medium. The Hydrolab Modbus Communications Module protocol is used over either an RS485 or RS232 link.

Modbus is a master/slave protocol. The protocol assumes that a single master computer initiates commands to one or more slave devices. The slave devices do not send any data on the communication link unless specifically commanded to send data. The Hydrolab Modbus architecture allows only one slave device (HL Series sonde, for example) per Hydrolab Modbus Communications Module.

The Hydrolab Modbus Communications Module automatically populates the registers with the appropriate data after the HL Series sonde is awake and the warm-up time expires. The HL Series sonde warm-up time will be equal to the longest warm-up time of the sensors present on the sonde. Typically, this time is between 15 and 50 seconds. If the sonde has a Turbidity sensor, the warm-up time must be greater than or equal to 50 seconds. If an active log file is on the sonde, the warm-up time will be the time the user configured in Hydrolab Operating Software for the log file. The warm-up time for the log file on the sonde overrides the automatic warm-up time calculated by the HL Series sonde. The Hydrolab Modbus Communications Module continues to automatically re-populate the data registers at the Sample Rate configured for the module.

2.2: Modbus Communication Modes

The Hydrolab Modbus Communications Modules use the Modbus RTU format to transfer data. RTU mode is binary, so it is not "human readable." For this reason, there is no way to configure the parameter resolution or spacing. Those details are managed by the programs that use the data.

2.3: Protocol Overview

Modbus has message structures to read and write data to/from a device. While the protocol has optional manufacturer extensions, the Hydrolab Modbus Communications Modules adhere to the standard read/write message structures with no extensions.

2.3.1: General Message Formats

The general message format consists of a device address, a function code, a data payload, and a message validity checksum.

2.3.2: RTU Message Format

The RTU message format is binary bytes. There is no start character or end character to identify the beginning or end of the packet. The end of the packet is identified by a time delay equivalent to a 3 byte transfer time on the communication link without any data transmitted.

Computer (Master) Message Format:

Device Address	Function Code	Data Payload	CRC

- Device Address: Direct address or broadcast.
- Function Code: Tells the device what to read or write.
- Data Payload: 0-N bytes configuring the register addresses to access.
- CRC: CRC16 results in a 16 bit integer.

Device (Slave) Response Format:

Device Address	Function Code	Data Payload	CRC

- Device Address: Echo of device address sent in the message to the device.
- Function Code: Echo of the function code sent to the device in the message packet. If an error occurs, the top bit of the byte is set and the data payload is the 1 byte error code from the device.
- Data Payload: 0-N bytes with response data from the device. For an error response, the payload will be a 1 byte value 1-255.
- CRC: CRC of packet data (not including CRC bytes).

2.3.3: Function Codes

Function codes in a message packet instruct the device what operation to perform. The function code is always in the byte following the device address. There are several function codes defined for Modbus. The Hydrolab Modbus Communications Module uses only function *03: Read Holding Registers* (see Section 1.2).

The available "Holding Registers" are configured by the user in Hydrolab Operating Software by setting the *Parameter Order* (see Section 1.2).

2.3.4: Data Addresses (Registers)

As shown in Section 2.3.5, the function code from the Master's message instructs the Slave device what operation to perform. A Modbus device typically has a published "Register Map" that defines the register addresses that can be accessed in the device. The Hydrolab Modbus Communications Module defines the register addresses by the order in which the parameters are configured by the user (see Section 1.2). In other words, Registers 0 & 1 contain the data for the first parameter defined.

Note: Register Maps typically use 1-based numbering system whereas the protocol requires that the data address/register number passed to a device to be 0-based. For third party interfaces, consult the manufacturer's documentation to determine how to enter address registers.

Holding Register addresses are associated with data comprised of two-byte words. The HL Series sonde parameter data format is Single Precision Floating Point, which is a four-byte binary value, therefore it uses two holding registers for each parameter value. Section 2.3.6 explains this byte order.

2.3.5: Read Holding Register Command Message Format

The "Read Holding Register" command reads one or more registers from the Hydrolab Modbus Communications Module.

Message (8 bytes):			Response (5 + N bytes):		
Address	1 Byte	1-247	Address	1 Byte	1-247
Function Code	1 Byte	0x03	Function Code	1 Byte	0x03
Data Address	2 Bytes	0 to 9	Byte Count	1 Byte	0 to 40
Register Count	2 Bytes	2 to 20	Data Payload	N Bytes	
CRC	2 Bytes		CRC	2 Bytes	

- Where Byte Count is the #bytes in the Data Payload (does not include CRC bytes). Byte Count = 2 * Register Count.

2.3.6: Single Precision Floating Point

Modbus defines all input/output in terms of two-byte blocks called registers. Modbus does not formally define blocks for floating point values or strings. The Hydrolab Modbus Communications Modules combine two registers for each parameter to create the IEEE754 Single Precision Floating Point data value.

Different data loggers explain how their data is formatted in different ways. If the data does not look as expected, change the data logger settings for register and byte order, one change at a time, until the data look correct. A data logger transmission and the Hydrolab Modbus Communications Module response is formatted as follows:

Each data value is returned in two 16-bit words with the least significant register being transmitted first. Within each word, the high byte is transmitted first (Big Endian). Each byte is transmitted most significant bit first. For example, the floating point value 1.56 = 0x3FC7AE14 would be transmitted as 0xAE 0x14 0x3F 0xC7.

Read Parameter 2 = 1.56 in floating-point format:

Field name (hex)	Examples
Dev. Addr	0x01
Function	0x03
Start Addr Hi-byte	0x00
Start Addr Lo-byte	0x02
No. of Registers Hi-byte	0x00
No. of Registers Lo-byte	0x02
Checksum CRC 16	

Inquiry

Field name (hex)	Examples
Dev. Addr	0x01
Function	0x03
Byte Count	0x04
Data Hi-byte (Register 0000)	0xAE
Data Lo-byte (Register 0000)	0x14
Data Hi-byte (Register 00001)	0x3F
Data Lo-byte (Register 00001)	0xC7
Checksum CRC 16	

3.0: Modbus Parameter Registers

Register Address	Size (registers)	Mode (R/W)	Data Type	Description
1	2	R	float	Parameter 1
3	2	R	float	Parameter 2
5	2	R	float	Parameter 3
7	2	R	float	Parameter 4
9	2	R	float	Parameter 5
11	2	R	float	Parameter 6
13	2	R	float	Parameter 7
15	2	R	float	Parameter 8
17	2	R	float	Parameter 9
19	2	R	float	Parameter 10

5.0: References

- http://www.ott.com
- www.modbus.org
- http://www.simplymodbus.ca/FAQ.htm