



# Modbus Signal Output Adapter

## Quick Start Guide



**Delivering quality data where and when you need it most.**

### Introduction:

The 599825 is a communication adapter for the EXO multiparameter sonde platform. It converts the proprietary signal from the water quality sonde into a Modbus protocol over either RS-232 or RS-485 signals. The adapter simplifies integration into 3rd party SCADA systems, and also features a USB port that supports passthrough communication directly to the connected sonde. This feature allows configuration, calibration, and data transfer without having to disconnect the field cabling.

### Adapter Overview:

**Supply Power, 12VDC**  
Provided from external regulated power source (not included).

**Modbus I/O Terminal**  
Use either 485 (default) or RS-232 terminals.

### Safety:

Refer to EXO system manual for complete safety documentation associated with the EXO system. (Available at [EXOwater.com](http://EXOwater.com))

Follow all applicable code and regulations subject to electrical wiring and operation of the system.

**Mini USB Connector**  
Used to configure adapter settings, provide power to the adapter, and passthrough communication to the attached sonde. See **page 4** for USB passthrough info.



**Status LED**  
See **page 2** for status indications.

**Magnetic Read Switch**  
Used to rediscover attached sonde.

### Specifications

**Supply Voltage:** 9 - 16 VDC or USB 5 VDC

**Current Draw Adapter:**  
~20mA typical (@12VDC)

**Current Draw Sonde:** ~sleep 0.25mA reading and 100mA during operation

**Max Net Current Draw for Systems:**  
~200mA (@12VDC)

**Dimensions:** L=3.5", W=3.5", H=1.5"  
(89cm x 89cm x 38cm)

**Operating Temp:** -40°C to +60°C

**Storage Temp:** -50°C to +80°C

**Humidity:** 0 to 99% non-condensing

### What's Included:

Your new 599825 EXO Communication Adapter comes with:

- (1) Modbus Adapter
- (3) green wiring terminal blocks (Sonde 5-pin, Power 2-pin, Modbus 7-pin)
- (1) Panel mounting bracket
- (1) DIN rail mounting bracket
- (1) Hook and loop fastener

If any item is missing, please contact [info@ysi.com](mailto:info@ysi.com) for replacements.

### You'll also need:

- Flat blade screwdriver for terminal blocks
- Phillip's screwdriver for panel mount bracket or din rail bracket
- EXO magnetic sensor tool (optional)
- EXO Flying Lead Field cable (599008-x) or Vented Flying Lead cable (599210-x)
- EXO sonde system, sensors, and associated hardware
- Latest KOR software (available from [EXOwater.com](http://EXOwater.com)) (KOR 2.0 available Q1 of 2016)



## Getting Started

### Mounting:

The adapter should be protected from the elements, and it is recommended it be mounted inside of a sealed enclosure with desiccant to prevent condensation.

The adapter includes a panel mount or a DIN rail mount in addition to self-adhesive hook and loop fastener. Any of the three methods can be used to securely mount the adapter. Use the provided Phillips screw to secure the panel or din rail mount:

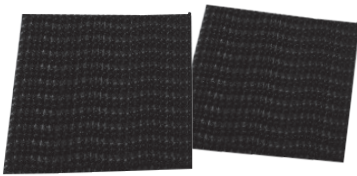
#### Panel Mount



#### DIN Rail Mount



#### Self-Adhesive Hook and Loop Fastener



**Note:** If using self adhesive hook and loop, clean and dry both surfaces before applying.

### Status LED Indications

<b>Off</b>	No power
<b>On</b>	No Sonde connected
<b>Flashing at 1 Hz</b>	Sonde connected, everything normal
<b>Flashing at 1/10 Hz</b>	Low power sleep (Will flash on for 1 second when magnetic switch is activated.)

### Configuration:

**Note:** You will need to use KorEXO 2.0 (available Q1 of 2016) if you want to edit the default communication settings on the 599825 Modbus adapter.

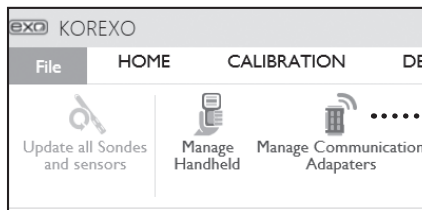
**!** For access to the beta software, or assistance changing the default settings, please contact Technical Support at [info@ysi.com](mailto:info@ysi.com).

### Default Settings

<b>Bus:</b> RS-485	<b>Parity:</b> None
<b>Mode:</b> RTU	<b>Data Bits:</b> 8
<b>Baud rate:</b> 9600	<b>Stop Bit:</b> 1
<b>Modbus Address:</b> 1 (AKA slave address)	

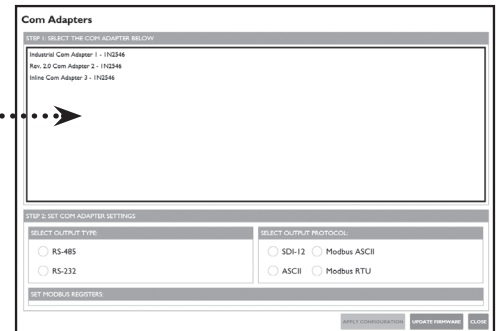
If your application requires RS-232, ASCII, or alternative addresses and baud rates please use the software to change the adapter settings:

Navigate to the **Instruments and Sensors** tab and select the **"Manage Communication Adapters"** button:

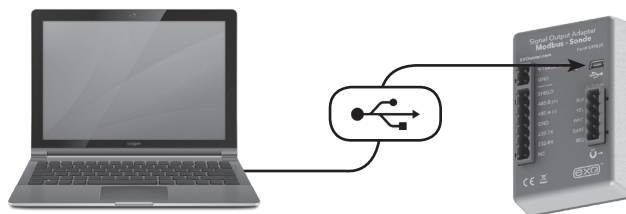


#### KorEXO Version 2.0.x

(**Note:** Software still in development, screen will change in final release.)



**USB passthrough drivers** will automatically be installed along with KOR 2.0 software, they are also available separately from the [EXOWater.com](http://EXOWater.com) website. Install these drivers on your PC to communicate with a signal output adapter (SOA) through any version of Desktop KOR:

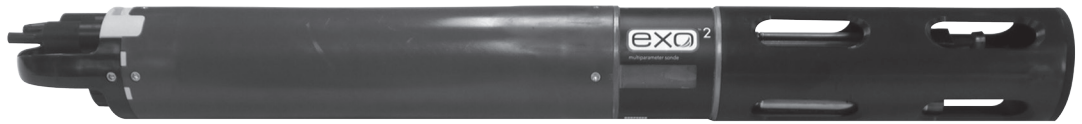


**See page 4 for USB passthrough information.**

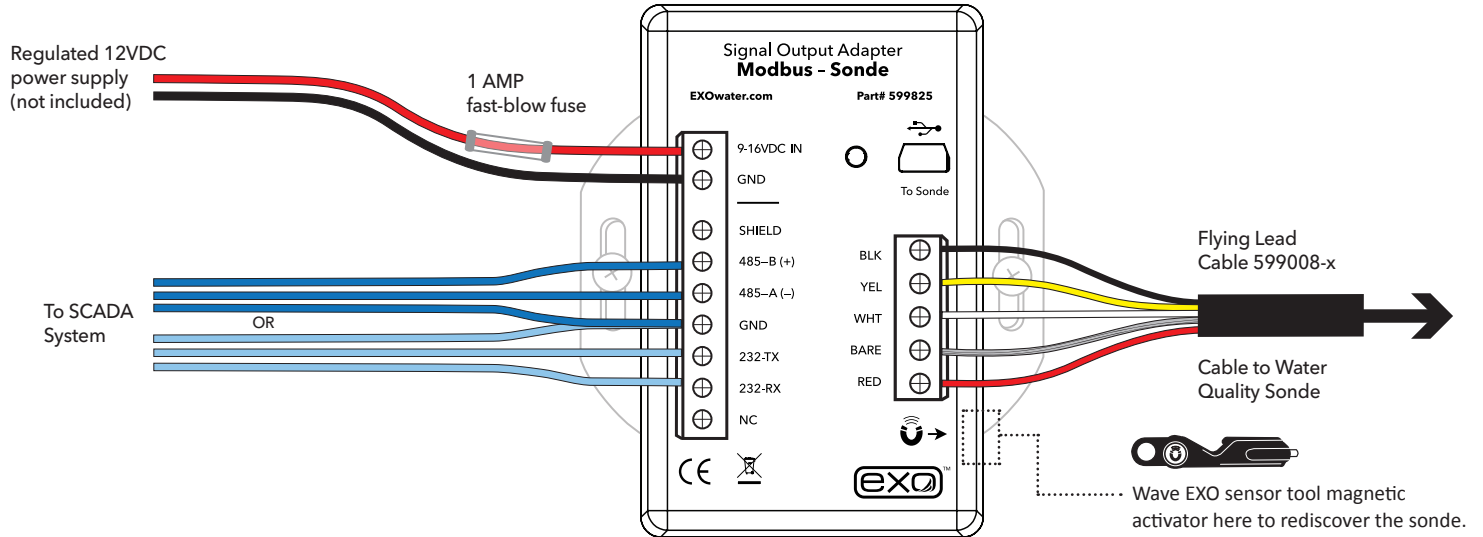
## ➤ Wiring

Have the following ready:

- EXO Sonde
- Com Adapter
- Flying Lead Cable
- Flat blade screwdriver
- Power & SCADA Wires



Next wire the flying lead cable, power, and Modbus ports as labeled:



**Note:** The orange wire on the flying lead cable to the sonde will not be used. It can be taped back during installation.

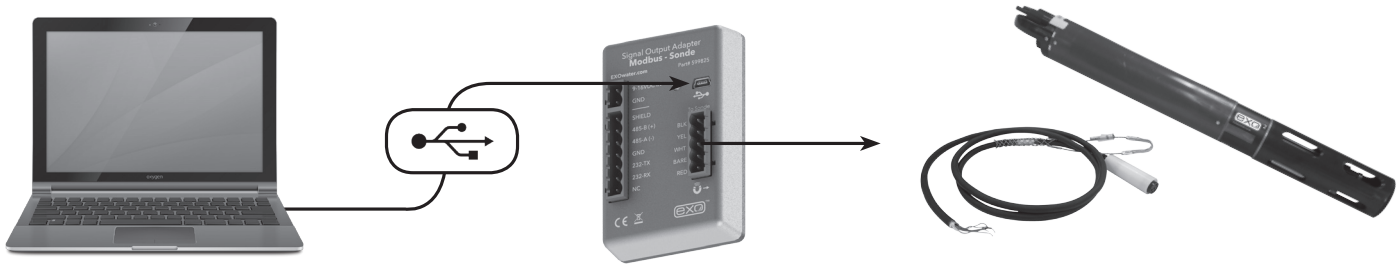
**Note:** 3rd party RS-485 to TCP adapters may be used in conjunction with the EXO Modbus Adapter, however we are unable to provide specific support or configuration settings for these modules. The gridconnect "Net485" adapter has been successfully used in applications requiring TCP Modbus interface.



When connecting new sondes to the Modbus adapter, it may be necessary to redetect the sonde. This can be done by power cycling the adapter or by using the magnetic read switch at the lower right hand side of the enclosure. Waving the magnet in the EXO sensor tool, over the area referenced by the square above, will force a network redetect where all new sensors and configurations will be discovered.

## ➤ USB Passthrough Mode

The 599825 Modbus Adapter can function in a similar fashion as the 599810 USB communication adapter. It will power the device and provide limited power to the sonde. After the Modbus adapter is wired as shown in the previous configuration, connecting to the USB port will allow direct communications with the sonde using KorEXO software.



**Note:** USB utilizes Communication Device Class (CDC) and installs as com port on PC: "YSI SOA/DCP Gen2". The USB connection may also be used to update firmware on the adapter using KOR software.

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## ➤ General Modbus Information

- Register references are to the typical Holding Registers. Depending on your SCADA system these may be the 400,000 registers, the 40,000 registers, or simply the register values defined in this document. In this document the register value will generally be used. In all cases the register value will be +1 from the address value.
- The Output adapter makes use of the Modbus Holding register system to transfer data. It will respond to the Modbus commands "Read Holding Registers", "Write Single Register" and "Preset Multiple Registers". For all other commands the 599825 Modbus Adapter will return an illegal function exception. In general if you attempt to read or write from to a reserved or unused area, the 599825 Modbus adapter will return an illegal data access exception.
- The 599825 Modbus adapter is a slave device.
- The Modbus adapter maintains a current set of data in the holding registers. Use the "Read Holding Registers" command to obtain the most recent set of data from sonde connected to the 599825 Modbus adapter. Each parameter from the EXO water quality sonde is stored in a different register (or register pair). Also in different registers is status information from the 599825 Modbus adapter and the same command is used to read status. Values in still other registers control which parameters are enabled in the sonde. Programmers can enable and disable sonde parameters by writing to these registers using the "Preset Multiple Register" command.

- There are 3 main register areas to deal with the parameters:
  - Parameter type
  - Parameter status
  - IEEE floating point parameter data (Scaled integer parameter data, available but not recommended for use.)

Each of these areas is 32 registers long, except for the floating point data area which is 32 register pairs long. The first register (or register pair for the floating point data) in each area corresponds to the first parameter, the second corresponds to the second parameter, etc.

**An example of a NEMA enclosure where PLC + Modbus adapter are wired.**



## ➤ General Modbus Information

40,000 Read Holding Address	40,000 Read Holding Register	Read/Write	Description
0	1	Read/Write Single Reg	<b>Sample Period:</b> The period in seconds at which the SOA will sample the sonde data and update holding registers (value between 0-3600)
1	2	Write Only Single Reg	<b>Force Sample:</b> Write any value here to force the SOA to update holding registers with sonde data allow 15 seconds for values to show up in data registers
2	3	Write Only Single Reg	<b>Force Wipe:</b> Write any value here to force the connected sonde to run its wiper
3-127	4-128	--	Unused – reserved for future special functions
128-159	129-160	Read/Write	<b>Parameter type:</b> The PLC must write to this area to tell the SOA what parameters it wants. Up to 32 parameters can be written here. After the last parameter the PLC must write a “0”. The table on the “ <b>Available Parameters Codes</b> ” page lists the valid parameter type codes.
160-225	161-256	--	Reserved for future parameter type
256-287	257-288	Read Only	<b>Parameter status:</b> The PLC can read back the values in these registers to check the status of the parameters. The value in register 257 corresponds to the parameter type in register 129 and so on. The meaning of the returned value is: 0 – The parameter is available. 1 – The parameter type has not been set (i.e. type = 0) 2 – The parameter requested is not currently available.
288-383	289-384	--	Reserved for future parameter status
384-447	385-448	Read Only	<b>IEEE 754 Floating point parameter data:</b> This is the actual parameter data in floating point form. Two registers are used for each value to make up the 32 bits required for a 4 byte IEEE floating point number. The value in register pair 385:386 corresponds to the parameter type in register 129 and so on. It is highly recommended that this be used rather than the scaled integer format.
448-639	449-640	--	Reserved for future IEEE floating point parameter data
640-671	641-672	Read Only	<b>Scaled integer parameter data:</b> The PLC should only read data from the SOA using this method if it cannot handle floating point data. Most PLCs can manipulate floating point values, so you should try to avoid reading scaled integer values. The value in register 641 corresponds to the parameter type in register 129 and so on. The values are scaled according to a fixed table in the SOA. The scaled data is in an unsigned integer format. Each parameter type has a specific range and resolution. Refer to the scaled integer range table (page 8) for values for each parameter. For example, temperature °C has the range of –50 to 605.35, with a resolution of 0.01. Here are some integer values that could be returned along with their engineering equivalents: <b>0:</b> -50°C or less. <b>1:</b> -49.99°C <b>2:</b> -49.98°C <b>5000:</b> 0°C <b>7234:</b> 22.34°C <b>7500:</b> 25°C <b>65534:</b> 605.34°C <b>65535:</b> 605.35°C or higher
672-767	673-768	--	Reserved for future scaled integer parameter data
768+	769+	--	Unused

**Common Acronyms:** PCL Programmable Logic Controller  
SCADA Supervisory Control and Data Acquisition

## Registry Configuration

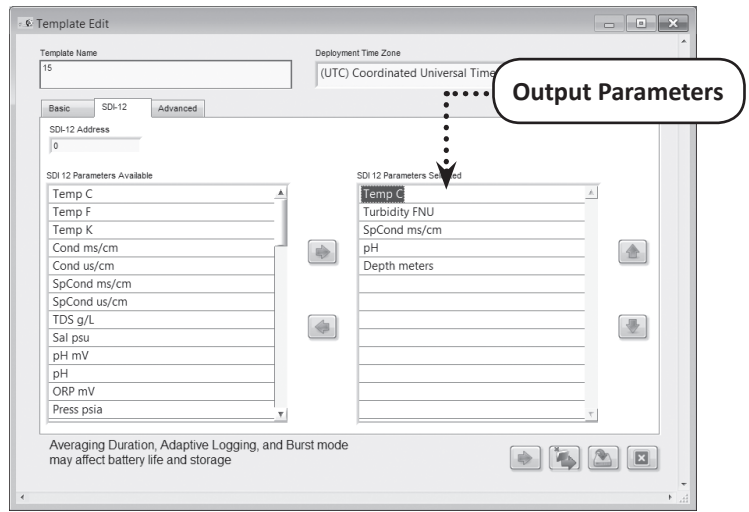
This section deals with mapping the water quality parameter types to the respective holding register 129-160. These are the measurement values generated by the water quality sonde. There are two methods to set the parameter map. The preferred method is to use the deployment templates available in any version of KorEXO. This standard functionality allows the parameters to be selected and saved. Alternatively the registers may be directly written by the SCADA system.

In the KorEXO software |**Deployment Settings**| choose the parameters and sort order, then push the template to the sonde. (Kor Version 1.0 shown on the top-right, and KorEXO version 2.0 shown above on the bottom-right.)

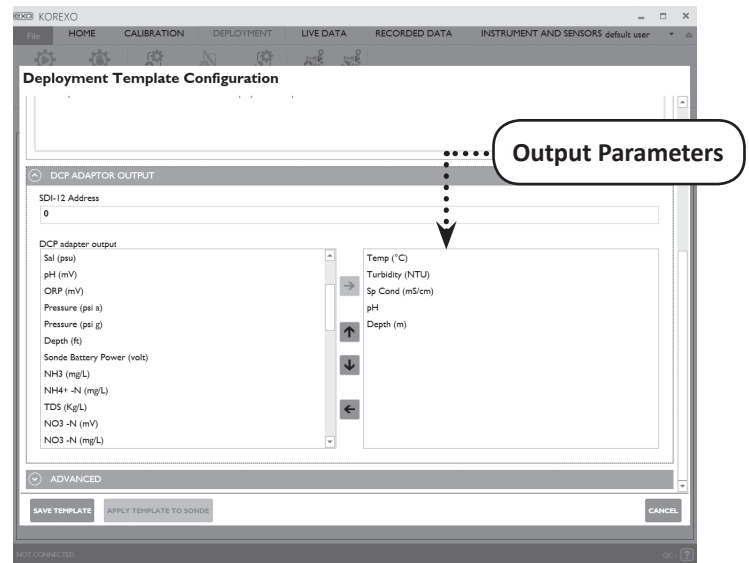
In both versions the complete list of parameters is shown in the left column and the selected parameters to output via the Modbus adapter are shown on the right. This template can be saved locally on the PC, but it must also be pushed down to the sonde for the settings to take effect. So be sure to apply the template to the sonde.

**Note:** There are two options when applying the template to the sonde, apply without logging or with logging. Either option may be used. When deploying with logging the sonde will create a redundant log file inside the sonde. Without logging, the data will only be available to the SCADA system.

In the example below: Temp °C, Turbidity, SpCond, pH, and Depth M were chosen. This will automatically create a register map as follows:



Kor Version 1.0



KorEXO Version 2.0.x

Read Holding Address	Read Holding Register	Read/Write	Value	Description
128	129	Read/Write	1	The parameter code for Temp °C is displayed here
129	130	Read/Write	223	The parameter code for Turbidity (FNU or NTU) is displayed here
130	131	Read/Write	6	The parameter code for Sp Cond ms/cm is displayed here
131	132	Read/Write	18	The parameter code for pH is displayed here
132	133	Read/Write	22	The parameter code for Depth M is displayed here
133	134	Read/Write	0	Zero indicates the end of the register/parameter map

These register maps are stored in the sonde, and automatically program the 599825 Modbus adapter when power cycled or the magnetic read switch is activated. The alternative method is to write these parameter codes using the SCADA system in the format indicated above.

Please see next page for a list of all available parameter codes for Read Holding Registers 129-160.

## ➤ Available Parameter Codes

The alternative setup method is to write these parameter codes using the SCADA system in the format indicated. The table below is the reference list of all available parameter codes for Read Holding Registers 129-160.

Parameter	Code
Temperature, °C	1
Temperature, °F	2
Temperature, °K	3
Conductivity, mS/cm	4
Conductivity, uS/cm	5
Specific Conductance, mS/cm	6
Specific Conductance, uS/cm	7
TDS, g/L	10
Salinity, PPT	12
pH, mV	17
pH	18
ORP, mV	19
Pressure, psia	20
Pressure, psig	21
Depth, m	22
Depth, ft	23
Battery, V	28
Turbidity, NTU	37
NH3 (Ammonia), mg/L	47
NH4 (Ammonium), mg/L	48

Parameter	Code
Date, DDMMYY	51
Date, MMDDYY	52
Date, YYMMDD,	53
Time, HHMMSS	54
TDS, kg/L	95
NO3 (Nitrate), mV	101
NO3 (Nitrate), mg/L	106
NH4 (Ammonium), mV	108
TDS, mg/L	110
Chloride, mg/L	112
Chloride, mV	145
TSS, mg/L	190
TSS, g/L	191
Chlorophyll, ug/L	193
Chlorophyll, RFU	194
ODO, %Sat	211
ODO, mg/L	212
ODO, %Sat Local	214
BGA-PC, RFU	216
BGA-PE, RFU	218

Parameter	Code
Turbidity, FNU	223
Turbidity, Raw	224
BGA-PC, ug/L	225
BGA-PE, ug/L	226
fDOM, RFU	227
fDOM, QSU	228
Wiper Position, V	229
External Power, V	230
BGA-PC, Raw	231
BGA-PE, Raw	232
fDOM, Raw	233
Chlorophyll, Raw	234
Potassium, mV †	235
Potassium, mg/L †	236
NLF Conductivity, mS/cm	237
NLF Conductivity, uS/cm	238
Wiper Peak Current, mA	239
Vertical Position, m	240
Vertical Position, ft	241

† **Note:** Potassium is considered future functionality, there is currently no EXO probe for Potassium (as of 2015).

The subsequent values for the parameter map are displayed in IEEE floating point parameter format (IEEE 754). The Parameter data is stored in read only address 385-448. Two address are used for each value to make up the 32 bits required for a 4 byte IEEE floating point number. The value in address pair 385:386 corresponds to the parameter type in register 129, etc.

In our example let's assume the following values: Temp 25.11°C, Turbidity 2.34 FNU, SpCond 3.02 ms/cm, pH 7.23, and Depth 1.45 M

Read Holding Address	Read Holding Register	Read/Write	Value (IEEE 754)	Description
384	385	Read	0xE147	The least significant 16 bits of the 32-bit floating point value for 25.11
385	386	Read	0x41C8	The most significant 16 bits of the 32-bit floating point value for 25.11
386	387	Read	0x47AE	The least significant 16 bits of the 32-bit floating point value for 3.02
387	388	Read	0x4041	The most significant 16 bits of the 32-bit floating point value for 3.02
388	389	Read	0x5C29	the least significant 16 bits of the 32-bit floating point value for 7.23
389	390	Read	0x40E7	The most significant 16 bits of the 32-bit floating point value for 7.23

## ➤ Advanced Configuration

The 599825 Modbus adapter will automatically sleep after 60 seconds of not being queried. To prevent the adapter from sleeping, query the adapter more frequently than 60 seconds. Alternatively program a sample interval into register 1. This is the interval the 599825 Modbus adapter will refresh its readings from the underwater sonde. It can be advantageous to sample at a 10 or 15 minute interval to extend the life of the sensors.

As an example a 10 minute (600 second) sample value in register 1 will query the sonde every 10 minutes to refresh the values in 385-448 IEEE floating point registers. It is recommended you program a sample interval into the 599825 Modbus adapter half that of your scan interval. As an example if your SCADA will query the adapter every 20 minutes (1200 seconds) then it is recommended you write a 10 minute (600 seconds) sample value in address 1. This methodology will ensure the queried data is never more than 10 minutes old.

## ➤ Scaled Integer Range Table

Parameter	Code	Scale Low	Scale High
Temperature, °C	1	-50	605.35
Temperature, °F	2	-50	605.35
Temperature, °K	3	0	655.35
Conductivity, mS/cm	4	0	655.35
Conductivity, uS/cm	5	0	65535
Specific Conductance, mS/cm	6	0	655.35
Specific Conductance, uS/cm	7	0	65535
TDS, g/L	10	0	65.535
Salinity, PPT	12	0	65.535
pH, mV	17	-1638.4	1638.35
pH	18	-27.768	39.767
ORP, mV	19	-1638.4	1638.35
Pressure, psia	20	-50	605.35
Pressure, psig	21	-50	605.35
Depth, m	22	-50	605.35
Depth, ft	23	-50	605.35
Battery, V	28	0	65.535
Turbidity, NTU	37	0	6553.5
NH3 (Ammonia), mg/L	47	0	655.35
NH4 (Ammonium), mg/L	48	0	655.35
Date, DDMMYY	51	N/A	N/A
Date, MMDDYY	52	N/A	N/A
Date, YYMMDD	53	N/A	N/A
Time, HHMMSS	54	N/A	N/A
TDS, kg/L	95	0	65.535
NO3 (Nitrate), mV	101	-1638.4	1638.35
NO3 (Nitrate), mg/L	106	0	655.35
NH4 (Ammonium), mV	108	-1638.4	1638.35
TDS, mg/L	110	0	65535
Chloride, mg/L	112	0	655.35
Chloride, mV	145	-1638.4	1638.35

**Activating the wiper:** The EXO2 system is likely equipped with an central wiper to clean the sensors. There are two different mechanisms to activate the wiper.

The first is to write any number into register #3, this will trigger the EXO sonde to wipe the sensors in both directions. 60 seconds should be allocated for the wiping to complete, and the data presented to the Modbus holding registers during the wiping sequence will not be representative of the water quality because of the effects of the wiper passing over the sensors. It may be helpful to program a routine wipe interval into the SCADA system as well as an operator button to manually trigger the wipe sequence.

The second method is to program the sonde to autonomously sample at an interval that is greater than every two minutes. By default the sonde will wipe all the sensors before taking a reading. So programming a 1 hour deployment in the KorEXO software the sonde will automatically wipe the sensors. Note the real time data presented over Modbus during the wiping sequence will not be representative of the water quality because of the effects of the wiper passing over the sensors. This methodology will generate a redundant set of data internal to the sonde to compliment the data presented to the SCADA system.

Parameter	Code	Scale Low	Scale High
TSS, mg/L	190	0	6553.5
TSS, g/L	191	0	6.5535
Chlorophyll, ug/L	193	0	655.35
Chlorophyll, RFU	194	0	655.35
ODO, %Sat	211	0	655.35
ODO, mg/L	212	0	65.535
ODO, %Sat Local	214	0	655.35
BGA-PC, RFU	216	0	655.35
BGA-PE, RFU	218	0	655.35
Turbidity, FNU	223	0	6553.5
Turbidity, Raw	224	0	655.35
BGA-PC, ug/L	225	0	655.35
BGA-PE, ug/L	226	0	655.35
fDOM, RFU	227	0	655.35
fDOM, QSU	228	0	655.35
Wiper Position, V	229	0	65.535
External Power, V	230	0	65.535
BGA-PC, Raw	231	0	655.35
BGA-PE, Raw	232	0	655.35
fDOM, Raw	233	0	655.35
Chlorophyll, Raw	234	0	655.35
Potassium, mV	235	-1638.4	1638.35
Potassium, mg/L	236	0	655.35
NLF Conductivity, mS/cm	237	0	655.35
NLF Conductivity, uS/cm	238	0	65535
Wiper Peak Current, mA	239	0	65.535
Vertical Position, m	240	-50	605.35
Vertical Position, ft	241	-50	605.35