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GrowNET™ MODBUS Devices

Agrowtek systems and devices are accessible through MODBUS RTU, or MOSBUS TCP via a GCX controller.

MODBUS RTU (Serial)

All of Agrowtek's GrowNET™ peripheral devices support serial MODBUS RTU directly to your PLC or host device via RS-422 (LX2) or USB (LX1.)

Climate Sensors

Outlet Relays

Irrigation Valve Controller

LX Link Modules

Hydroponics Sensors

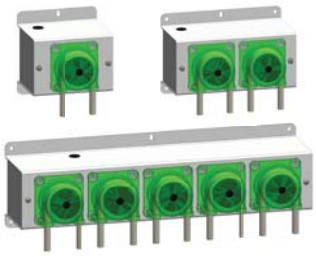
Wet & Dry Contacts

Irrigation Panels

GrowNET™ Hub

Motor Controllers

Dosing Pumps



Weather Sensors

DIN Rail I/O

MODBUS TCP (Ethernet)

Agrowtek's GCX control systems and BDX Fertigation systems allow advanced access to GrowNET™ devices, control settings, recipes, etc. through MODBUS TCP via the standard CAT5/WiFi network connection.

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MODBUS

Agrowtek's intelligent sensors, relays, peristaltic pumps and other components are designed to communicate via the standard industrial MODBUS protocol for PLC, PC, embedded and OEM control applications.

Connection Types

MODBUS data can be accessed using a PLC directly from GrowNET™ devices using a serial "RTU" connection. Multiple devices (up to 247) can be connected via RTU using Agrowtek's HX8 communication hubs to a LX link module. LX1 (USB) or LX2 (RS-485) modules interface the GrowNET™ device network with a PLC or PC.

MODBUS data can also be accessed via local area networks or remotely through the internet using MODBUS TCP when the application involves a GrowControl™ GCX control system to which GrowNET™ devices are connected.

Supported Commands

0x01 Read Coils
0x03 Read Multiple Registers
0x05 Write Single Coil
0x06 Write Single Register

Sensors	**Relays**	**Pumps**
Read 16bit Signed	Read Coil Status	Read Pump Speed
Read 32bit Float	Write Coil Status	Write Pump Speed
Write Calibration	Read Close Count	Read Pump Hours
Read Manufacturing Info		

Register Types

Data registers are 16 bits wide with addresses using the standard MODICON protocol.

Floating point values use the standard IEEE 32-bit format occupying two contiguous 16 bit registers.

ASCII values are stored with two characters (bytes) per register in hexadecimal format.

Coil registers are single bit values which control and indicate the status of a relay; 1 = on, 0 = off.

Register Offset (+40001)

MODBUS registers are often describe with an offset to indicate the type of register (holding, analog input, etc.) This register offset is NOT INCLUDED in the register request.

Holding registers are described with a 40,001 offset; a register "40101" would be sent over the wire as "100."

Example: Request four sensor registers 40101 - 40104 from a SXC climate sensor with device address 1:

<0x01> <0x03> <0x00> <0x64> <0x00> <0x04> <0x05> <0xD6>

MODBUS RTU

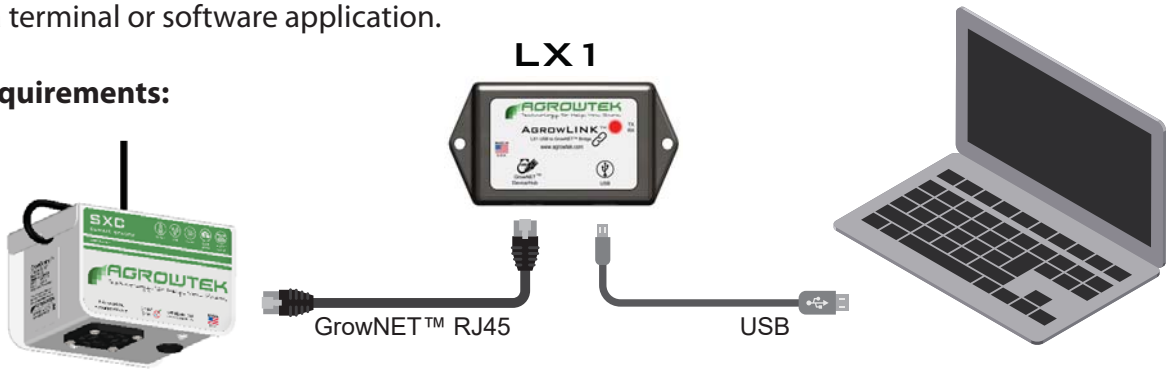
Agrowtek's GrowNET™ components can communicate directly using the standard industrial MODBUS RTU serial protocol for PLC and OEM control applications. Each device may be assigned an address of 1-247. Address 254 is a universal broadcast address. Addresses may be sent to the address register by MODBUS command, or configured using the LX1 USB link with PC software.

LX1 USB AgrowLINK

The LX1 USB AgrowLINK may be used for USB/UART communications to devices, or for firmware updates, calibration, addressing and testing/manual operation using free PC software.

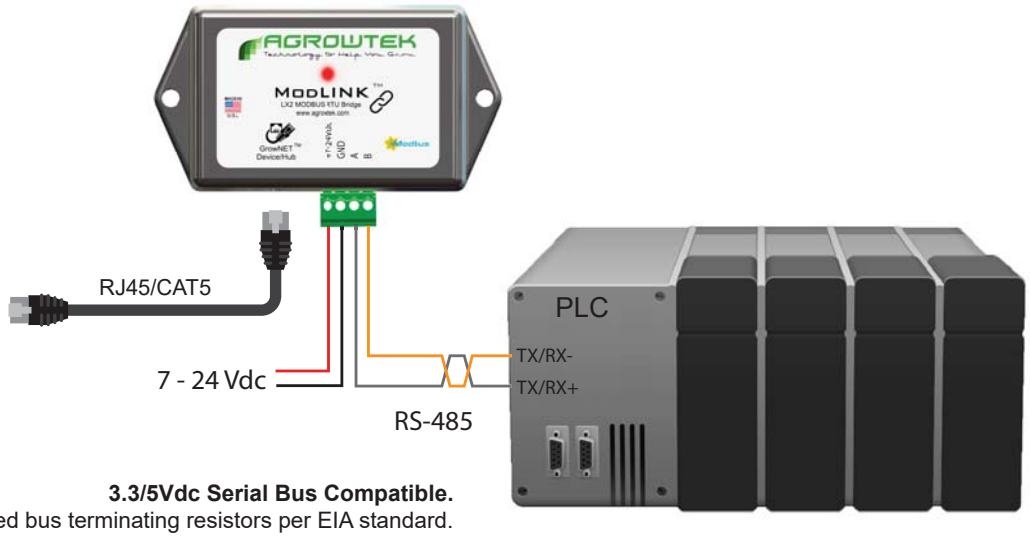
Standard drivers automatically install in Windows for the LX1 USB AgrowLINK. MODBUS commands may be sent over USB from a terminal or software application.

USB Connection Requirements:
115,200 baud, 8-N-1



LX2 ModLINK™

LX2 ModLINK™ connects Agrowtek's intelligent sensors, peristaltic dosing pumps, and control relays equipped with a GrowNET™ RJ45 port to a standard RS-485 serial bus for use with the MODBUS RTU protocol. ModLINK is an MCU-buffered bridge between Agrowtek's high-speed, full duplex GrowNET™ devices connected with RJ45 cables, to a terminal block for integration with PLC systems. 15kV ESD rated RS485 terminals with 70V fault protection to protect against wiring errors and short circuits. LX2 may be configured for 19,200 -115,200 baud rates and any serial data format usung the LX1 USB Link and free PC application.



3.3/5Vdc Serial Bus Compatible.
Include required bus terminating resistors per EIA standard.

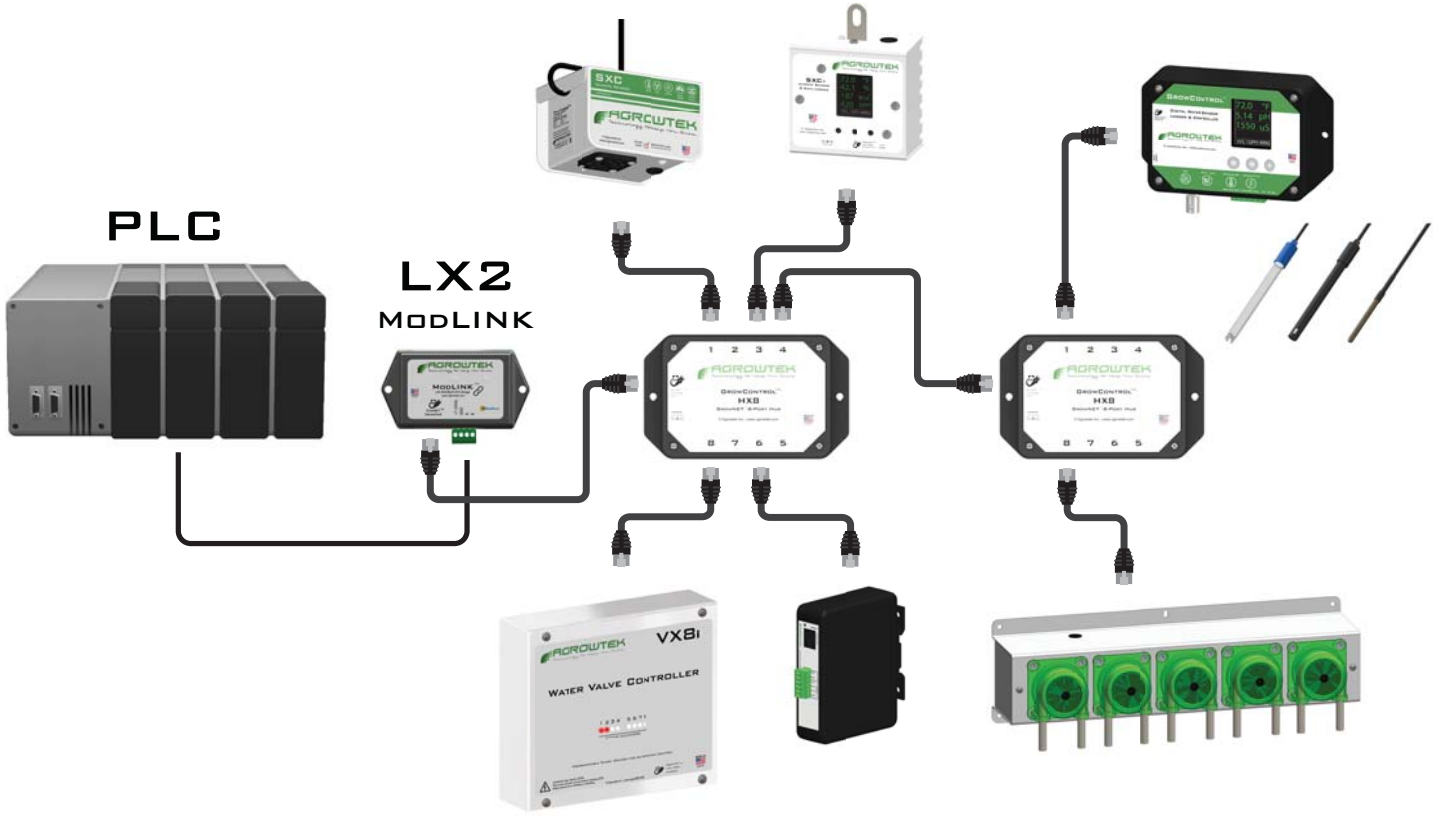
GrowNET™ Network with HX8 Hubs

HX8 GrowNET hubs connect multiple devices to a MODBUS network using only one LX2 ModLINK or LX1 USB AgrowLINK.

HX8 hubs supply power to all 8 ports from one power supply to operate sensors and relays from the GrowNET (Ethernet) cable connection for fast, easy installation (pumps and valve controllers require their own power supply.)

HX8 Hubs are fully buffered for excellent signal performance in long distance and distributed applications. Daisy chain hubs as needed for the number of ports required.

Uses standard RJ45 Ethernet cable for all connections.



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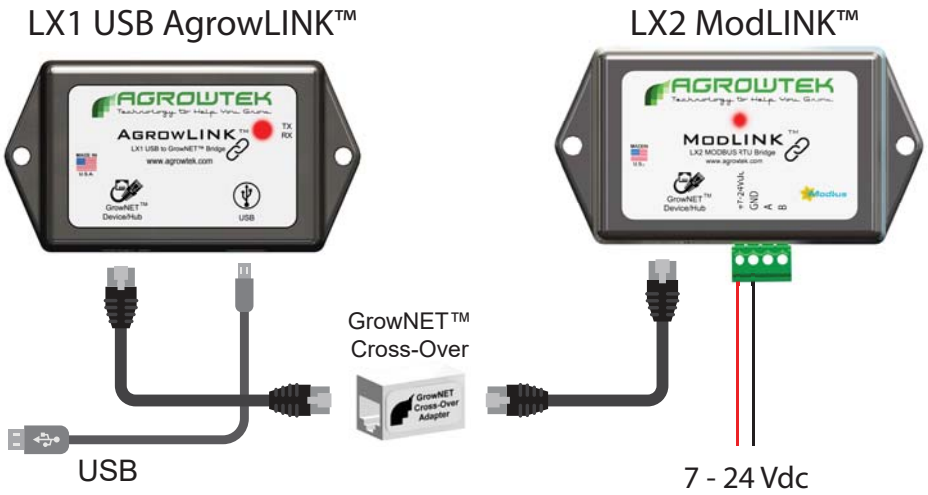
LX2 ModLINK™ Configuration

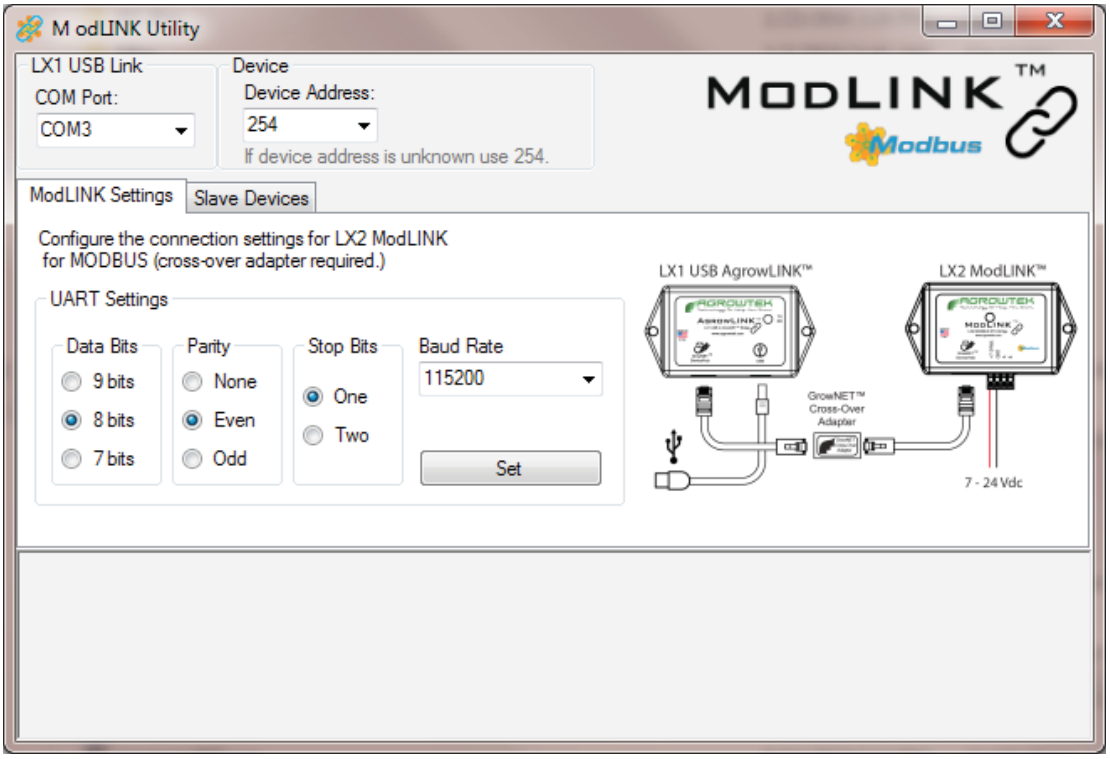
The default serial data format for the LX2 ModLINK interface is: **19,200 baud, 8-N-1**.

Alternate speeds and formats may be configured with the LX1 USB AgrowLINK and the cross-over adapter supplied with the LX2 ModLINK.



[Download ModLINK Utility]

Open the ModLINK utility and set:
Device Address = 254 *(address must be set to 254 to configure the LX2.)*



Configure the serial settings according to your master control device, then press the "Set" button.

"OK" reply confirms the settings have been successfully configured on the LX2.

Device Address

The device address (slave ID) is stored in each device at address register 1 (40001) and can be modified in several ways:

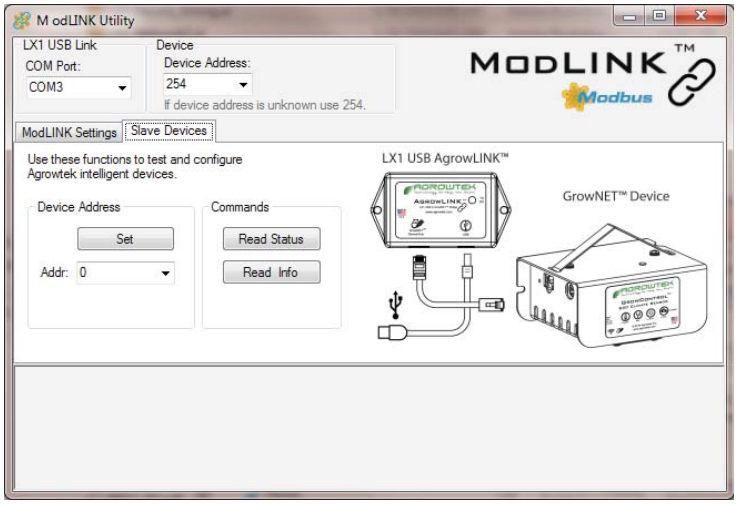
1. Send a modbus command using the broadcast address (254) to modify the value in register 1.
2. Use the LX1 USB link connected to a device with the AgrowLINK software utility to set the address.

Set Address via Modbus

Device address 254 is a universal broadcast address which can be used to set an address on a device which has an unknown address or has a 0 address. The device to be configured must be the only device on the bus when using the broadcast address or conflicts may occur.

To set a device address of "5", send the value "5" to register# 1 (40001) using address 254.

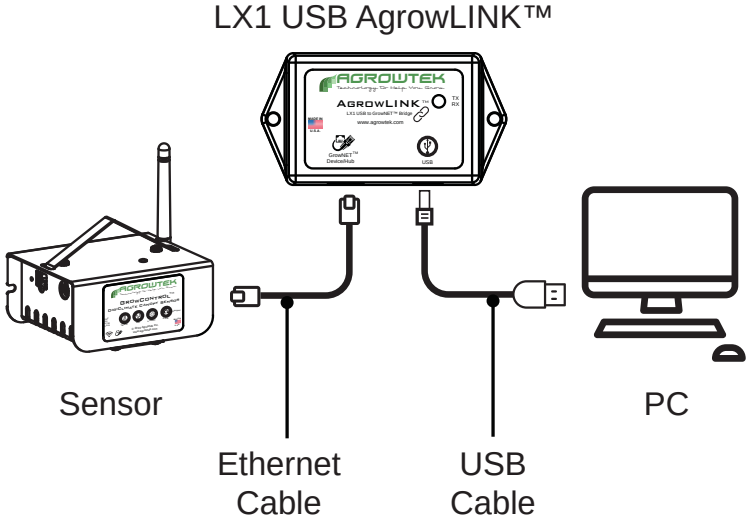
Set Address via LX1 USB Link



The LX1 USB AgrowLINK may be used to configure the LX2 ModLINK and set device (slave) addresss of devices.

Download ModLINK Utility

1. Connect the GrowNET™ device to the USB AgrowLINK with a standard Ethernet cable.
2. Connect the USB AgrowLINK to the PC and allow the drivers to install automatically.
   If the drivers do not install automatically download and install them Download Driver.



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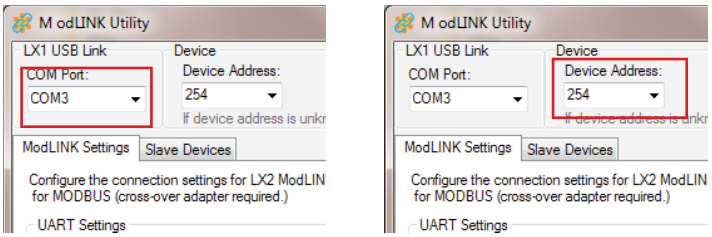
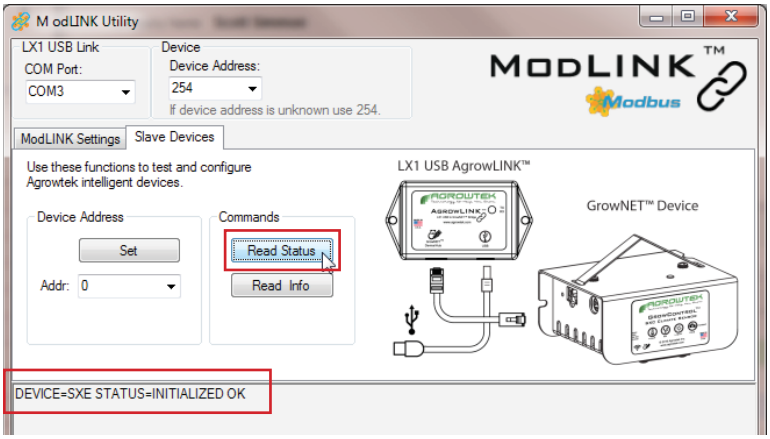
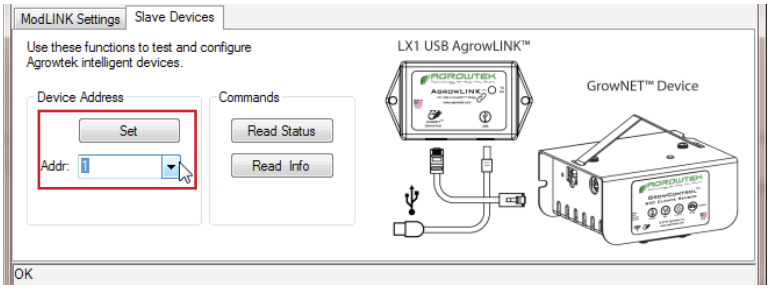
3. The COM port should be automatically selected when the program is opened if the drivers are installed.
Select the COM Port drop-down to refresh and scan for a USB AgrowLINK.
4. Ensure device address "254" (universal broadcast address) is selected in the Connection box.



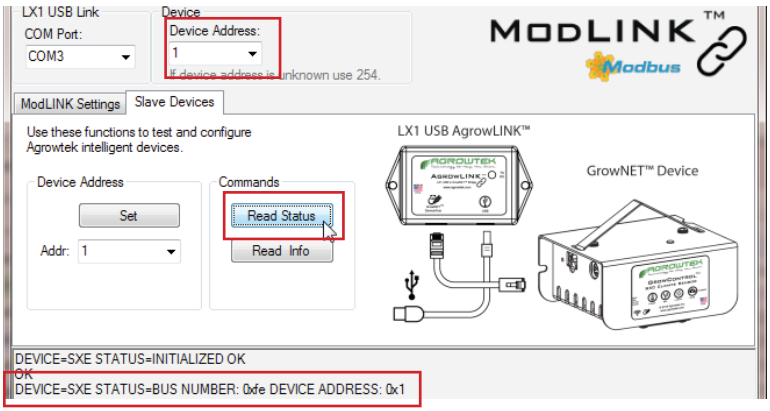
5. Check the device connection by clicking the "Read Status" button; you should get a reply with last internal status update from the device.



6. Set the device address to the desired value by selecting the "Addr." drop down then press "Set."



7. Verify the new address by selecting the new address in the Connection box then press "Read Status."



8. The device is ready to be deployed on a MODBUS network. Set the Device Address in the Connection box back to "254" to connect to the next device.

MODBUS RTU Registers

RTU registers are accessed directly on the device via a serial connection through a LX1 or LX2 link module.

All Devices

Parameter	Description	Range	Type	Access	Address
Address	Device Slave Address	1 - 247	8 bit	R/W	40001
Serial#	Device Serial Number	ASCII	8 char	R	40004
DOM	Date of Manufacture	ASCII	8 char	R	40008
HW Version	Hardware Version	ASCII	8 char	R	40012
FW Version	Firmware Version	ASCII	8 char	R	40016
Device Model	Product Model Number	ASCII	8 char	R	40020

A request to read or write a register that is not available will return an illegal address error (0x02).

Environment Sensors (SXC, SXE, SXW)

Parameter	Description	Range	Type	Access	Address
Toggle Units	Toggle sensor units	1 - 4	16 bit, unsigned	W	41002
Heater Power	RH Sensor Heater	0 - 16 [(1)]	16 bit, unsigned	W	41003
Sensor Reading, Integer	Temperature	-2000 - 6000 (-20 - 60°C) x100	16 bit, signed	R	40101
	Humidity	0 - 1000 (0 - 100%) x10			40102
	Light	SXE/SXW: 0 - 1000 W/m2 / SXC: 0 - 5000 umol/m2/s			40103
	CO2	0 - 40,000ppm			40104
	PLIR Leaf IR Temperature	-4000 - 8500 (-40 - 85°C) x100			40105
Sensor Reading, Float	Temperature	-20.00- 60.00 °C	32 bit, floating pt	R	40201
	Humidity	0 - 100.0 %			40203
	Light	SXE/SXW: 0 - 1000 W/m2 / SXC: 0 - 5000 umol/m2/s			40205
	CO2	0 - 40,000ppm			40207
	PLIR Leaf IR Temperature	-4000 - 8500 (-40 - 85°C) x100			40209
Calibration Input, Offset (Zero)	Temperature	See integer ranges above.	16 bit, signed	W	41101
	Humidity				41102
	Light				41103
	CO2				41104
Calibration Input, Analog Output	Temperature	-255 - 255 (bits)	16 bit, signed	W	41301
	Humidity				41302
	Light				41303
	CO2				41304
Reset to Factory Calib.	Clear Calibration	Write "1" to clear calibration.	16 bit, unsigned	W	41401

Sensors with alternate units may toggle the units using the "toggle units" register. To toggle the units, send the sensor channel number to to the toggle register. *This register is write-only.*

For example: to toggle between °F and °C, send "1" to register 1002.

Gas Sensors (SXG)

Parameter	Description	Range	Type	Access	Address
Sensor Value	CO2	0 - 40,000ppm	16 bit, signed	R	40101
	CO2	0 - 40,000ppm	32 bit float	R	40201
Calibration Input, Offset (Zero)	CO2*	400 ppm only	16 bit, signed	W	41101
Clear Calibration	Reset All to Factory	Signed Int	16 bit	W	41401

*CO2 calibration can only be performed at 400ppm (outdoor air) and no other values will be accepted.

Clear Calibration
To reset all calibration values, write "1" to the clear calibration register.

Hydroponics Sesnors (SXH, PHX)

Parameter	Description	Range	Type	Access	Address
Toggle Units	Toggle sensor units	1 - 4	16 bit, unsigned	W	41002
Sensor Reading, Integer	Temperature	-2000 - 6000 (-20 - 60°C)	16 bit, signed	R	40101
	pH	0 - 1400 (0 - 14.00pH)			40102
	Conductivity	0 - 5000 microSiemens 0 - 2500 ppm			40103
	O.R.P. / D.O.	-1000 - +1000 mV 0 - 4000 (0 - 40.00 mg/L)			40104
	Flow	0 - 30gpm (0-150lpm)			40104
Sensor Reading, Float	Temperature	-20.00- 60.00 °C	32 bit, floating pt	R	40201
	pH	0 - 14.00pH			40203
	Conductivity	0 - 5000 microSiemens 0 - 2500 ppm			40205
	O.R.P. / D.O.	-1000 - +1000 mV 0 - 4000 (0 - 40.00 mg/L)			40207
	Flow	0 - 30gpm (0-150lpm)			40207
Calibration Input, Zero	Temperature	See integer ranges above.	16 bit, signed	W	41101
	pH				41102
	Conductivity				41103
	O.R.P. / D.O. / Flow				41104
Calibration Input, Span Point	Temperature	See integer ranges above.	16 bit, signed	W	41201
	pH				41202
	Conductivity				41203
	O.R.P. / D.O. / Flow				41204
Calibration Input, Analog Output	Temperature	-255 - 255 (bits)	16 bit, signed	W	41301
	pH				41302
	Conductivity				41303
	O.R.P. / D.O. / Flow				41304
Clear Calibration	Reset All to Factory	Write "1" to reset calibration.	16 bit	W	41401

Dissolved Oxygen (SXO2)

Parameter	Description	Range	Type	Access	Address
Toggle Units	Toggle sensor units	1 - 4	16 bit, unsigned	W	41002
Sensor Reading, Integer	Temperature	-2000 - 6000 (-20 - 60°C)	16 bit, signed	R	40101
	D.O.	0 - 5000 (0 - 50.00 mg/L)			40102
Sensor Reading, Float	Temperature	-20.00- 60.00 °C	32 bit, floating pt	R	40201
	D.O.	0 - 5000 (0 - 50.00 mg/L)			40203
Calibration Input, Zero	Temperature	See integer ranges above.	16 bit, signed	W	41101
	D.O.				41102
Calibration Input, Span Point	Temperature	See integer ranges above.	16 bit, signed	W	41201
	O.R.P. / D.O.				41202
Clear Calibration	Reset All to Factory Default	Signed Int	16 bit	W	41401

VWC Sensor Hubs (HXT, HXG)

Parameter	Description	Range	Type	Access	Address
VWC RAW Count, Integer		---	16 bit, unsigned	R	40101 - 40108
Electrical Conductivity		0 - 20,000 uS	16 bit, unsigned	R	40109 - 40116
Temperature		-40° - 60°C x10	16 bit, unsigned	R	40117 - 40124

Dosing Pumps (ADi)

Parameter	Function	Range	Type	Access	Address
Motor Speed (%)	Pump 1	0 - 100	16 bit, unsigned	R/W	40101
	Pump 2		16 bit, unsigned		40102
	Pump 3		16 bit, unsigned		40103
	Pump 4		16 bit, unsigned		40104
	Pump 5		16 bit, unsigned		40105
	Pump 6		16 bit, unsigned		40106
Timeout (seconds)	Turn off pumps if no communication	0 - 32767	16 bit, unsigned	R/W	41001
Accumulated Run Time (seconds)	Pump 1	Unsigned Int	32 bit, unsigned	R	49001
	Pump 2				49003
	Pump 3				49005
	Pump 4				49007
	Pump 5				49009
	Pump 6				49011

Relays & I/O Modules (RX, RD, DX, VX series)

Parameter	Access	Address
Output Coil 1	R/W	1
Output Coil 2	R/W	2
Output Coil 3	R/W	3
Output Coil 4	R/W	4
Output Coil 5	R/W	5
Output Coil 6	R/W	6
Output Coil 7	R/W	7
Output Coil 8	R/W	8

Parameter	Description	Range	Type	Access	Address
Analog Input Value, Integer	Input 1	Signed Int	16 bit, signed	R	40101
	Input 2				40102
	Input 3				40103
	Input 4				40104
	Input 5				40105
	Input 6				40106
	Input 7				40107
	Input 8				40108
Analog Input Value, Floating Point	Input 1	Floating Point	32 bit, float	R	40201
	Input 2				40203
	Input 3				40205
	Input 4				40207
	Input 5				40209
	Input 6				40211
	Input 7				40213
	Input 8				40215
PWM Output (Duty Cycle %) 0-10V Output (0-10,000mV)	Output 1	0-100 or 0-10,000	16 bit, signed	R/W	40301
	Output 2				40302
	Output 3				40303
	Output 4				40304
	Output 5				40305
	Output 6				40306
Timeout (seconds)	Turn off outputs if no communication	0 - 32767	16 bit, unsigned	R/W	41001
Output Closure Count, Discrete	Output 1	Unsigned Int	32 bit, unsigned	R	49001
	Output 2				49003
	Output 3				49005
	Output 4				49007
	Output 5				49009
	Output 6				49011
	Output 7				49013
	Output 8				49015

Digital Light Module (LXD)

Parameter	Description	Range	Type	Access	Address
Light Manufacturer	Protocol Number	1...n (# of mfg protocols)	16 bit, unsigned	R/W	40100
Channel 1	Recipe Value, Channel 1	0-255	16 bit, unsigned	R/W	40101
Channel 2	Recipe Value, Channel 2	0-255	16 bit, unsigned	R/W	40102
Channel 3	Recipe Value, Channel 3	0-255	16 bit, unsigned	R/W	40103
Channel 4	Recipe Value, Channel 4	0-255	16 bit, unsigned	R/W	40104
Channel 5	Recipe Value, Channel 5	0-255	16 bit, unsigned	R/W	40105
Channel 6	Recipe Value, Channel 6	0-255	16 bit, unsigned	R/W	40106
Channel 7	Recipe Value, Channel 7	0-255	16 bit, unsigned	R/W	40107
Channel 8	Recipe Value, Channel 8	0-255	16 bit, unsigned	R/W	40108
Timeout (sec)	Turn off light if no coms	0-32767	16 bit, unsigned	R/W	41001

Manufacturer Spectrum Channels

Manufacturer	#	Version	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
ThinkGrow I/H	1	0.0.13+	White (0-100)	Red (0-100)						
DLI	2	0.0.13+	Brightness (0-100)							
Hydrofarm	3	0.0.13+	Brightness (0-100)							
Scynce	4	0.0.13+	Zone # (0-20)	Master (0-255)	White Shft (0-255)	White Inty (0-255)	Red Shift (0-255)	Red Inty (0-255)		
Fohse	5	0.0.13+	Brightness (0-100)	Spectrum (0-100)						
Revolution	6	0.0.13+	Brightness (0-100)							
DLI CRI-Series UV 150W DE	7	0.0.13+	UV (0-100)							
ThinkGrow Model I-Plus	8	0.0.17+	White (0-100)	Far Red (0-100)	Deep Red (0-100)	UV (0-100)				
Fohse A3i-Pro	9	0.0.13+	Brightness (0-100)	UV (0-100)	Blue (0-100)	Green (0-100)	Cool (0-100)	Warm (0-100)	Red (0-100)	Far Red (0-100)
Illuminar	10	0.0.13+	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Faven Matrix Flexstar	11	0.0.18+	Brightness (0-100)	Red (0-100)	Far-Red (0-100)	UV (0-100)	HPS (0-100)			

Quantum Light Sensor (SXQ)

Parameter	Description	Range	Type	Access	Address
Sensor Reading, Float	Lux	0 - 500,000 Lux	32 bit, floating pt	R	40201
	CCT	0 - 10,000 °K			40203
	Frequency	0 / 50 / 60 Hz			40205
BIN Values, Float	F1				40207
	F2				40209
	F3				40211
	F4				40213
	F5				40215
	F6				40217
	F7				40219
	F8				40221
	F9				40223
	F10				40225
	F11				40227
	F12				40229
	F13				40231

Intensity "BIN" data is used to calculate the spectral intensity to produce a relative spectral intensity graph and to calculate the PPFD (photosythetic photon flux density, umol/m2/s.) The calculation is done in conjution with a spectral reconstruction matrix and calculations detailed in the SXQ Integration Application Note available from Agrowtek Inc.

GCX MODBUS TCP/IP

MODBUS registers are available to read and write data to peripheral devices on the GCX system. *The TCP Command server must be enabled and may be operated on port 502 or 4040.*

Each device on the GCX system can be accessed individually by the device address assigned to each device on the GrowNET™ bus.

Device ID (Device Address)
GrowNET™ devices on the GCX system are assigned a device address from 1 to 100 on each GrowNET™ bus. GCX+ systems suport two GrowNET™ busses for a total of 200 devices.

MODBUS addresses on bus 0 = Device address 1-100 on GCX system.
MODBUS addresses on bus 1 = Device address 101-200 on GCX system.
Note: Ensure devices on GCX systems follow the required address ranges for proper register access.

Supported Commands
0x01 Read Output Coils
0x02 Read Input Coils
0x03 Read Holding Registers
0x05 Force Single Output Coil
0x06 Write Single Holding Register

Standard Error Responses
-Unsupported MODBUS commands will return an 'illegal function' error (0x01.)
-Unsupported registers or request lengths will return an 'illegal data address' error (0x02.)
-Writing invalid data to a register will return an 'illegal data value' error (0x03.)
-Writing data to regsiters that require diagnostic mode will return a 'slave device busy' error (0x06.)

Register Types
All registers are 16 bits wide with addresses using the standard MODICON protocol. Floating point values use the standard IEEE 32-bit format occupying two contiguous 16 bit registers. ASCII values (text strings) are stored with two characters (bytes) per register in hexadecimal format with trailing 0x00 for empty bytes.

Coil Registers
Devices with discrete coil registers (relays) may be accessed beginning with the first output (1) up to the number of outputs on the device (8 max. typical.) Forcing a coil register will set the output to Off or On mode, disabling the Auto mode.

Input Registers
Devices with discrete input registers (input modules) may be accessed beginning with input 1 (register 10001) up to the number of inputs on the device (8 maximum typical.) Input modules feature both analog and discrete registers for each input. Discrete inputs register "true" when the analog voltage is above 20% of the input range.

Holding Registers

Holding registers contain data and from sensors and devices in 16 bit or 32 bit "word" data structures.

Parameter	Description	Values	Type	Access	Address
Name Max 80 char, 40 registers	Device Name	ASCII Characters	2 chars/register	R	40001
Integer Register	Integer Value 1	Sensor Reading Analog Input Value Analog Output Value PWM Output (% Duty) Pump Speed (%)	16 bit, signed	R	40101
	Integer Value 2				40102
	Integer Value 3				40103
	Integer Value 4				40104
	Integer Value 5				40105
	Integer Value 6				40106
	Integer Value 7				40107
	Integer Value 8				40108
Float Register	Floating Point Value 1		32 bit, floating pt	R	40201
	Floating Point Value 2				40203
	Floating Point Value 3				40205
	Floating Point Value 4				40207
	Floating Point Value 5				40208
	Floating Point Value 6				40211
	Floating Point Value 7				40213
	Floating Point Value 8				40215
Throttle Register*	Throttle Channel 1	Analog Output Value PWM Output (% Duty)	16 bit, signed	R/W	40301
	Throttle Channel 2				40302
	Throttle Channel 3				40303
	Throttle Channel 4				40304
	Throttle Channel 5				40305
	Throttle Channel 6				40306
	Throttle Channel 7				40307
	Throttle Channel 8				40308

*Setting a value in the throttle register that is greater than zero automatically sets the manual override to the ON / MAN position. To disable the manual throttle and reset it to zero, set channel back to Off or Auto modes (see Output Override registers.) Setting the throttle to zero is not a valid entry as the system does not know whether to switch the channel back to Off or Auto mode.

Integer Register Scaling

Sensor values are available in integer or floating point formats depending on the register requested (see map.) Some integer formatted values are scaled by factors of 10's to maintain decimal precision and require division to calculate the final value.

Environment Sensors (SXC, SXE)

Sensor #	Type	Integer Scale	Range
1	Temperature	x100	-2000 - 6000 (-20 - 60°C) / -400 - 14000 (-4 - 140°F)
2	Humidity	x10	0 - 1000 (0 - 100%)
3	Light	x1	SXE/SXW: 0 - 1000 W/m2 SXC: 0 - 5000umol/m2/s
4	CO2	x1	0 - 10,000 ppm
5	Leaf IR Temperature	x100	-2000 - 6000 (-20 - 60°C) / -400 - 14000 (-4 - 140°F)
6	VPD	x100	0 - 10 kPa

Weather Sensors (SXW)

Sensor #	Type	Integer Scale	Range
1	Temperature	x100	-2000 - 6000 (-20 - 60°C) / -400 - 14000 (-4 - 140°F)
2	Humidity	x10	0 - 1000 (0 - 100%)
3	Light	x1	0 - 1000 W/m2
4	CO2	x1	0 - 10,000 ppm
5	Speed	x1	0 - 125mph
6	Direction	x1	0 - 359°
7	Barometric Pressure		*NOT CURRENTLY AVAILABLE*
8	Rain		0 - 1

Hydroponics Sensors (SXH, GXH, PHX)

Sensor #	Type	Integer Scale	Range
1	Temperature	x100	-2000 - 6000 (-20 - 60°C)
2	pH	x100	0 - 1400 (0 - 14.00pH)
3	Conductivity	x1	0 - 2500 ppm
4	O.R.P.	x1	-1000 - +1000 mV
5	D.O.	x100	0 - 2000 (0 - 20.00 mg/L)
6	Flow	x10	0 - 125 gpm

Input Modules (DXI8)

Type	Integer Scale	Range
Voltage	x1	0 - 5000 mV
Current	x100	0 - 2000 (0 - 20 mA)

Discrete Registers

Discrete registers provide details on the I/O status of on/off type of outputs, and allow manual overrides of outputs. Output status registers are read-only; manual control is accomplished via the override registers.

Override Registers
A "force-on" and "force-off" register is available for each output.

To force an output on or off, set the respective register to "true."
Setting either of the force-override registers to "false" will return the output to "auto" mode.

Note: Setting one override to true will automatically set the opposite override to false.

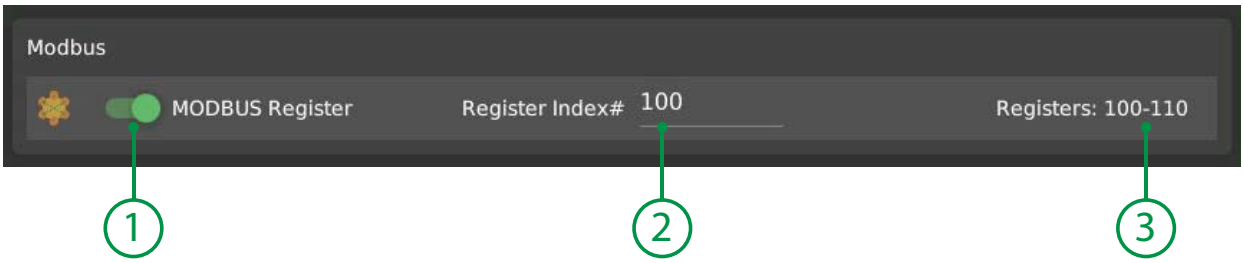
Parameter	Description	Type	Access	Address
Output Status Register	Output 1	bit	R	1
	Output 2			2
	Output 3			3
	Output 4			4
	Output 5			5
	Output 6			6
	Output 7			7
	Output 8			8
Output Override OFF	Force-Off 1	bit	R/W	101
	Force-Off 2			102
	Force-Off 3			103
	Force-Off 4			104
	Force-Off 5			105
	Force-Off 6			106
	Force-Off 7			107
	Force-Off 8			108
Output Override ON	Force-On 1	bit	R/W	201
	Force-On 2			202
	Force-On 3			203
	Force-On 4			204
	Force-On 5			205
	Force-On 6			206
	Force-On 7			207
	Force-On 8			208

Control Function Registers

Control function values can be accessed if a MODBUS register is set for the specific control function setting. This allows read and write of control parameters using MODBUS registers.

Device Address
Access to control functions is performed through device address **201**.

Register Index
Function registers are accessed by setting a primary register which subsequent registers are indexed from. The user or integrator must set an index register for each function setting to access the settings.



1. Enable Modbus — Enable access to the function registers with MODBUS.
2. Register Index — Number to use as the first (index) register for accessing the settings.
3. Register Preview — Displays the range of registers used for this setting according to the index.

Accessing Registers
The settings are accessed by sending read-register requsts to device address 201, at the index or specific register number requested according to the offset tables on the following pages. Multiple registers can be requested up to the Modbus limit.

For example; requesting the registers from the graphic above for the "Function Status" and "Function Value":

Device Address = 201
Start Register = 1000
Number of Registers = 2

Device ID Registers

Different sets of registers are accessed through different device ID's.

Registers by Device ID

Device ID	Device Type	Description	Values
1 - 100	System Hardware, Bus 0	Sensors, Relays, etc.	Sensor Readings, I/O Status, Overrides, etc.
101 - 200	System Hardware, Bus 1	Sensors, Relays, etc.	Sensor Readings, I/O Status, Overrides, etc.
201	Controls Functions	Function Parameters	Settings and Assignmnets in Controls
202	Dosing Recipes	Nutrient/pH Recipes	Dosing/pH Recipe Parameters & Set Points
203	Function Names	Names of Functions	Characters packed two per WORD
204	Rule Names	Names of Rules	Characters packed two per WORD
301+	Workspaces	Day/Night Functions	Day Count, Day/Night Mode, etc.

Standard Registers

Some of the same parameters are contained in every control function. The standardized registers are shown on this page to avoid repeating the information for every function specification.

There are two sets of registers for each function; those based off of the function register index (which is applied to the base function) and those based off of the rule register index (which is applied to the rule within the function.

Function Registers

Index	Parameter	Description	Values	Type	Access
+0	Status, Function	Function Status <1 = False, 1 = True	-1 = Error 0 = Idle, 1 = Active	Int	R
+1	Value, function	Analog Value of Function	0 - 100, etc.	Int	R
+2	Reserved				
+3	Enable Mode	Setting Enable Mode	0 = Disabled, 1 = Enabled 2 = If(Output On) 3 = If(Output Off) 4 = If(Function True) 5 = If(Function False) 6 = If(Input On) 7 = If(Input Off)	Int	R/W
+4	Enable Device Address / Control Workspace Index		Device Address / Workspace #	Int	R/W
+5	Enable Output Number / Control Function Index		Output # / Function Index	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+0	Status, Rule	Rule Status <1 = False, 1 = True	-1 = Error 0 = Idle, 1 = Active	Int	R
+1	Start Hour	Scheduler Start Time	0 - 23	Int	R/W
+2	Start Minute		0 - 59	Int	R/W
+3	End Hour	Scheduler End Time	0 - 23	Int	R/W
+4	End Minute		0 - 59	Int	R/W
+5	First Day#	Scheduler Day Range	1 - 9999	Int	R/W
+6	Last Day#		1 - 9999	Int	R/W
+7	Grow Stage	Any, Prop, Veg, etc.	0 - 4	Int	R/W
+8	Days of Week	Binary Encoded 7-Days	0 (All Days) - 0b01111111	Int	R/W
+9-11	Reserved				
+12	Schedule Mode	Normal, Maint, Pause	0 - 2	Int	R/W

Clock Timer

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Output Type	Discrete or Analog	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+7	Analog Output	Value to send to output	0 - 100%	Int	R/W
+8	Output Mode	Turn On or Off	0 = Turn ON, 1=Turn OFF	Int	R/W
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W

Rule Registers

No additional registers for this function.

Count Timer

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Output Type	Discrete or Analog	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+7	Analog Output	Value to send to output	0 - 100%	Int	R/W
+8	Output Mode	Turn On or Off	0 = Turn ON, 1=Turn OFF	Int	R/W
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Mode	Timer Operation Mode	0 = Delay-On 1 = Delay-Off 2. = One-Shot On 3. = One-Shot Off	Int	R/W
+14	Preset	Timer Value	1 - 65535	Int	R/W
+15	Units	Timer Units	0 = Seconds 1 = Minutes 2 = Hours	Int	R/W

Cycle Timer

Function Registers

Index	Parameter	Description	Values	Type	Access
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Preset	Off Timer Value	1 - 65535 (Seconds)	Int	R/W
+14	Units	Timer Units	0 = Seconds 1 = Minutes 2 = Hours	Int	R/W
+15	Preset	On Timer Value	1 - 65535 (Seconds)	Int	R/W
+16	Units	Timer Units	0 = Seconds 1 = Minutes 2 = Hours	Int	R/W

Thermostat/Humidistat/Photostat/CO2

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Output Type	Discrete or Analog	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+7	Analog Output	Value to send to output	0 - 100%	Int	R/W
+8	Output Mode	Turn On or Off	0 = Turn ON, 1=Turn OFF	Int	R/W
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W
+11	Restart Delay	Minimum Output Off Time	0-999 Minutes	Int	R/W
+12	Sensor Device	Device Address	1-200	Int	R/W
+13	Mode	Operation Mode	0 = Cool/Dehu/Bright/Exhaust 1 = Heat/Humid/Dark/Inject 2 = Inject w/Dark Disable (CO2)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+14	Set Point	Sensor Setting	- 40F to 160F (-20C to 60C) (x10) 0 - 100% (x10) 0 - 1000 W/m2	Int	R/W
+15	Dead Band	Difference from Set Point	0 - 999	Int	R/W

Lighting

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Enable Discrete	Discrete Output Control	0 = Disable, 1 = Enable	Int	R/W
+9	Discrete Device	Discrete Device Address	1 - 200	Int	R/W
+10	Discrete Channel	Discrete Output #	1 - 8 (typical)	Int	R/W
+11	Restart Delay	Minimum Discrete Off Time	0-999 Minutes	Int	R/W
+12	Enable Dimming	Dimming Output Control	0 = Disable, 1 = Enable	Int	R/W
+13	Dimming Device	Dimming Device Address	1 - 200	Int	R/W
+14	Dimming Channel	Dimming Output #	1 - 8 (typical)	Int	R/W
+15	Temperature Device	Temp. Device Address	1-200	Int	R/W
+16	Light Device	Amb. Light Device Address	1-200	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Current Intensity	Current Dimming Output	0 - 100 %	Int	R
+14	Max Intensity	Dimming Set Point	0 - 100 %	Int	R/W
+15	Min Intensity	Dimming Set Point	0 - 100 %	Int	R/W
+16	Change Rate	Dimming Ramp Rate	0 - 100 % per Minute	Int	R/W
+17	Light Set Point	Set Point for Dimming	W/m2	Int	R/W
+18	Max Temperature	Dim/Shut Down Temp.	°F/°C	Int	R/W
+19	Temp Deadband	Dimming Temp Deadband	°F/°C	Int	R/W

Position Control

Function Registers

Index	Parameter	Description	Values	Type	Access
+9	MX Device	MX Device Address	1 - 200	Int	R/W
+12	Controller Mode	Shade / Ventilation	0 = Shade, 1 = Ventilation	Int	R/W
+13	Min % Open	Minimum Position	0-100%	Int	R/W
+14	Max % Open	Maximum Position	0-100%	Int	R/W
+15	Temperature Device	Temp. Device Address	1-200	Int	R/W
+16	Light Device	Amb. Light Device Address	1-200	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Position Target	Output Target of Setting	0 - 100%	Int	R
+14	Active Stage	Current Vent Stage	0 - 8	Int	R
+15	Enable Static	Static position	0 = Disabled, 1 = Enabled	Int	R/W
+16	Static Position	Static position setting	0 - 100 %	Int	R/W
+17	Solar Position	Position for Solar setting	0 - 100 %	Int	R/W
+18	Solar Intensity	Sensor setting	W/m2	Int	R/W
+19	Stage First Position	Position for First Vent Stage	0 - 100 %	Int	R/W
+20	Stage Final Position	Position for Final Vent Stage	0 - 100 %	Int	R/W
+21	Stage Tempeature	Temperature for Stage 1	°F/°C	Int	R/W
+22	Number of Stages	Position stages in vent.	1 - 8	Int	R/W
+23	Stage Separation	Temperature b/w stages	°F/°C	Int	R/W
+24	Rain Position	Position limit during rain	0 - 100 %	Int	R/W
+25	Wind Position	Position limit high wind	0 - 100 %	Int	R/W
+26	Low Temp Position	Position limit low temp	0 - 100 %	Int	R/W

Irrigation

Function Registers

Index	Parameter	Description	Values	Type	Access
+8	Enable Master	Master Feed Valve/Pump	0 = Disabled, 1 = Enabled	Int	R/W
+9	Master Device	Master Feed Device Address	1 - 200	Int	R/W
+10	Master Channel	Master Feed Output #	1 - 8 (typical)	Int	R/W
+11	Master Feed Delay	Valve Open Delay	0-999 Seconds	Int	R/W
+12	Keep On Mode	Keep Master On	0 = Normal, 1 = Keep On	Int	R/W
+13	Enable Drain	Drain Valve Option	0 = Disabled, 1 = Enabled	Int	R/W
+14	Drain Device	Drain Device Address	1 - 200	Int	R/W
+15	Drain Channel	Drain Output #	1 - 8 (typical)	Int	R/W
+16	Drain Duration	Time Delay	0-999 Seconds	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Current Mode	Active Irrigation Mode	0 = Pump Delay 1 = Feeding 2 = Draining	Int	R
+14	Current Stage	Active Irrigation Stage#	0 - 65535	Int	R
+15	Cycle Count	Completed Irrigation Cycles	0 - 65535	Int	R
+16	Repeats	Number of Repeats Set	0 - 9999	Int	R/W
+17	Repeat Delay	Delay between Repeats	0 - 65535 (seconds)	Int	R/W
+18	Delay Units	Time Delay Units	0 = Seconds, 1 = Minutes	Int	R/W
+19	Valve Delay	Delay between Valves	0 - 65535 (seconds)	Int	R/W
+20	Valve Mode	Sequence Mode	0 = Sequential, 1 = Simultaneous	Int	R/W
+21	Enable Moisture	Use Moisture Triggering	0 = Disabled, 1 = Enabled	Int	R/W
+22	Moisture Level	Minimum Moisture Level	0 - 100%	Int	R/W
+30	Stage Count	Number of Irrigation Stages	0 - 65535 (seconds)	Int	R
+31+3(n-1)	Feed Time	Time Duration of Stage n	0 - 65535 (seconds)	Int	R/W
+32+3(n-1)	Valve Device	Valve Device Address	1 - 200	Int	R/W
+33+3(n-1)	Valve Channel	Valve Output #	1 - 8 (typical)	Int	R/W

Tank Level

Function Registers

Index	Parameter	Description	Values	Type	Access
+9	Fill Device	Device Address	1 - 200	Int	R/W
+10	Fill Channel	Output #	1 - 8 (typical)	Int	R/W
+11	Sensor Type	Discrete or Analog	0 = Discrete, 1 = Analog	Int	R/W
+12	High Input Device / Analog Device	Device Address	1 - 200	Int	R/W
+13	High Input Channel	Input #	1 - 8 (typical)	Int	R/W
+14	Low Input Device	Device Address	1 - 200	Int	R/W
+15	Low Input Channel	Input #	1 - 8 (typical)	Int	R/W
+16	Drain Device	Device Address	1 - 200	Int	R/W
+17	Drain Channel	Output #	1 - 8 (typical)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Is Triggered	Drain/Fill is Active	0 = Inactive, 1 = Active	Int	R
+14	Active Stage	Current Operation Stage	0 = Off 1 = Drain 2 = Fill	Int	R
+15	Mode	Operation Mode	0 = Fill 1 = Drain 2 = Flush	Int	R/W
+16	Timeout	Fill/Drain Time-out	0 - 65535 (seconds)	Int	R/W
+17	Timeout Units	Seconds/Minutes	0 = Seconds 1 = Minutes	Int	R/W
+18	High Level	Depth	Inches x10 / cm	Int	R/W
+19	Low Level	Depth	Inches x10 / cm	Int	R/W

Nutrient Dosing

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Output Type	Discrete or Analog	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W
+11	Dosing Mode	Recirculating / Batch	0 = Recirculating, 1 = Batch	Int	R/W
+12	Dosing Delay	Start Delay	0 - 65535 seconds	Int	R/W
+13	Stop on Alarm	Stop Dosing on Sensor Alarm	0 = Disabled, 1 = Enabled	Int	R/W
+14	Sensor Device	Device Address	1 - 200	Int	R/W
+15	pH Up Enable	Enable pH Up Dosing	0 = Disabled, 1 = Enabled	Int	R/W
+16	pH Down Enable	Enable pH Down Dosing	0 = Disabled, 1 = Enabled	Int	R/W
+17	ORP Enable	Enable ORP Dosing	0 = Disabled, 1 = Enabled	Int	R/W
+20	Pump Count	Number of Pumps	0 - 24	Int	R/W
+21+2(n-1)	Pump Device	Device Address	1 - 200	Int	R/W
+22+2(n-1)	Pump Head #	Pump Output #	1 - 8 (typical)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Current Group	Dosing Group (A, B, C...)	0 - 26	Int	R
+14	Nutrient Lock	Stop pH/ORP when dosing	0 = Disabled, 1 = Enabled	Int	R/W
+15	pH Up Flowrate	ml/Min dosing rate	0.1 - 999 (x10)	Int	R/W
+16	pH Down Flowrate	ml/Min dosing rate	0.1 - 999 (x10)	Int	R/W
+17	ORP Flowrate	ml/Min dosing rate	0.1 - 999 (x10)	Int	R/W
+50	Name Length	Length of Recipe Name	0 - 80	Int	R
+51 + n	Recipe Name	Name of Recipe	ASCII Characters	2 Chars/Register	R

Dosing Recipe Registers

Dosing recipe values can be accessed and modified by MODBUS TCP.

Device Address
Access to dosing recipes is performed through device address **202**.

Accessing Registers
The settings are accessed by sending read-register requsts to device address 202, at the register number requested according to the tables below. Multiple registers can be requested up to the Modbus limit.

Property Registers
Many recipes can be stored in the GCX memory. The properties of each recipe can be accessed and edited with a standard set of "property registers." To populate the property registers with data from a specific recipe, the recipe index register must be set. Once the index register has been written, the property values can be read back or modified with a write command.

Recipes

Register	Parameter	Description	Values	Type	Access
1	Recipe Count	Number of Recipes	0 - n	Int	R
2	Reserved				
3	Recipe Index	Recipe Selector	0 - n recipes	Int	R/W
4	Dosing Units	Recipe Units	0 = ml/gal 1 = ml/l (future) 2 = 1:n ratio (future)	Int	R/W
5	pH Mode	Enable pH Dosing	0 = Disabled, 1 = Enabled	Int	R/W
6	pH Target	pH Set-Point	0 - 1400 (pH x100)	Int	R/W
7	pH Deadband	pH Drift Allowed		Int	R/W
8	ORP Mode	Enable ORP Dosing	0 = Disabled, 1 = Enabled	Int	R/W
9	ORP Target	ORP Set-Point	-1000 to 1000mV	Int	R/W
10	ORP Deadband	ORP Drift Allowed		Int	R/W
11	Nutrient Mode	Enable Nutrient Dosing	0 = Disabled, 1 = Enabled	Int	R/W
12	Nutrient Target	EC/ppm Set-Point	0 - 5000uS (0 - 2500ppm)	Int	R/W
13	Nutrient Deadband	EC/ppm Drift Allowed		Int	R/W
14	Nutrient Count	Number of Nutrient Parts	0 - 24	Int	R
15	Part Index	Nutrient Part Selector	1 - 24	Int	R/W
16	Nutrient Group	Group A - Z	0 - 25	Int	R/W
17	Dose	mL Dose Size	0 - 999.9 (x10 mL)	Int	R/W
18	Mix Delay	Time Delay, seconds	0 - 65535	Int	R/W
19	Name Length	Nutrient Part Name Length	0 - 30 (60 characters max)	Int	R
20	Nutrient Name	Name of Nutrient Part	ASCII Characters	2 Chars/Register	R
50	Name Length	Recipe Name Length	0 - 30 (60 characters max)	Int	R
51	Recipe Name	Name of Recipe	ASCII Characters	2 Chars/Register	R

Output Link

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Output Type	Discrete or Analog	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+7	Analog Output	Value to send to output	0 - 100%	Int	R/W
+8	Output Mode	Turn On or Off	0 = Turn ON, 1=Turn OFF	Int	R/W
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Trigger Device	Device Address	1 - 200	Int	R/W
+14	Input Channel	Input #	1 - 8 (typical)	Int	R/W

Input Control

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Output Type	Discrete or Analog	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+7	Analog Output	Value to send to output	0 - 100%	Int	R/W
+8	Output Mode	Turn On or Off	0 = Turn ON, 1=Turn OFF	Int	R/W
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Input Type	Discrete / Analog	0 = Discrete 1 = Analog	Int	R/W
+14	Mode	Action Mode (analog)	0 = Lower 1 = Raise	Int	R/W
+15	Set Point	Analog set point	0 - 6553.5 (x10)	Int	R/W
+16	Deadband	Analog comparator deadband	0 - 6553.5 (x10)	Int	R/W
+17	Input Device	Device Address	1 - 200	Int	R/W
+18	Input Channel	Input #	1 - 8 (typical)	Int	R/W

Logic

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Output Type	Discrete or Analog	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+7	Analog Output	Value to send to output	0 - 100%	Int	R/W
+8	Output Mode	Turn On or Off	0 = Turn ON, 1=Turn OFF	Int	R/W
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Logical Operator	Logic Operator	0 = AND, 1 = NAND, 2 = OR 3 = NOR, 4 = XOR, 5 = XNOR	Int	R/W
+14	Operator A Type	Input Value Type	0 = Output Status 1 = Function Status	Int	R/W
+15	Device Address / Control Workspace Index (A)		Device Address / Workspace #	Int	R/W
+16	Device Output Number / Control Function Index (A)		Output # / Function Index	Int	R/W
+17	Operator B Type	Input Value Type	0 = Output Status 1 = Function Status	Int	R/W
+18	Device Address / Control Workspace Index (B)		Device Address / Workspace #	Int	R/W
+19	Device Output Number / Control Function Index (B)		Output # / Function Index	Int	R/W

Alert

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Output Type	Discrete or Analog	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+7	Analog Output	Value to send to output	0 - 100%	Int	R/W
+8	Output Mode	Turn On or Off	0 = Turn ON, 1=Turn OFF	Int	R/W
+9	Output Device	Device Address	1 - 200	Int	R/W
+10	Output Channel	Output #	1 - 8 (typical)	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Sensor Type	Type of Sensor Value	1=Temperature, etc.	Int	R/W
+14	Sensor Device	Device Address	1 - 200	Int	R/W
+15	Action	Email Action	0 = No Action, 1 = Email Once 2 = Email Continuous	Int	R/W
+16	High Alert	Sensor Value	See Sensor Register Scaling	Int	R/W
+17	Low Alert	Sensor Value	See Sensor Register Scaling	Int	R/W

CO2 Gas Alarm

Function Registers

Index	Parameter	Description	Values	Type	Access
+6	Enable Exhaust	Exhaust Fan	0 = No Output 1 = Discrete, 2 = Analog	Int	R/W
+9	Exhaust Device	Device Address	1 - 200	Int	R/W
+10	Exhaust Channel	Output #	1 - 8 (typical)	Int	R/W
+11	CO2 Sensor Device	Device Address	1 - 200	Int	R/W
+12	Enable AXG #1	Alarm Module #1	0 = Disabled, 1 = Enabled	Int	R/W
+13	AXG #1 Device	Device Address	1 - 200	Int	R/W
+14	Enable AXG #2	Alarm Module #2	0 = Disabled, 1 = Enabled	Int	R/W
+15	AXG #2 Device	Device Address	1 - 200	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	High Limit	Alarm ppm	0 - 10,000 (5000 OSHA STD)	Int	R/W
+14	Safe Level	Safe ppm	0 - 10,000	Int	R/W

Message

Function Registers

Index	Parameter	Description	Values	Type	Access
There are no additional function parameters for messages.					

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Action	Email Action	0 = No Action, 1 = Email Once 2 = Email Continuous	Int	R/W
+14	Type	Message Type	0 = Note, 1 = Reminder, 2 = Alert	Int	R/W
+150	Message Length	Length of message body	0 - 250 registers	Int	R/W
+151	Message	Message body	ASCII Characters	2 Chars/Register	R

HVAC+RH Control

Function Registers

Index	Parameter	Description	Values	Type	Access
+11	Sensor Device	Device Address	1-200	Int	R/W
+12	HVAC Mode	Enable HVAC Control	0 = Disabled, 1 = Enabled	Int	R/W
+13	HVAC Device	Device Address	1-200	Int	R/W
+14	RH Mode	Enable RH Control	0 = Disabled, 1 = Enabled	Int	R/W
+15	RH Device	Device Address	1-200	Int	R/W
+16	Reheat Mode	Enable Reheat Dehum	0 = Disabled, 1 = Enabled	Int	R/W

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Heat Setpoint	Heating End Temperature	- 40F to 160F (-20C to 60C)	Int	R/W
+14	Heat Deadband	Allowed Temperature Drop	0 - 50 Degrees	Int	R/W
+15	Heat Separation	Allowed Drop Before Stage 2	0 - 50 Degrees	Int	R/W
+16	Cool Setpoint	Cooling Start Temperature	- 40F to 160F (-20C to 60C)	Int	R/W
+17	Cool Deadband	Termperature Drop to Stop	0 - 50 Degrees	Int	R/W
+18	Cool Separation	Allowed Rise Before Stage 2	0 - 50 Degrees	Int	R/W
+19	Humidify Setpoint	Humidify End RH	0 - 100% (x10) / 0 -10 kPa (x100)	Int	R/W
+20	Humid Deadband	Allowed RH Drop	0 - 50% (x10) / 0 -5 kPa (x100)	Int	R/W
+21	Humid Separation	Allowed RH Drop Before Stage 2	0 - 50% (x10) / 0 -5 kPa (x100)	Int	R/W
+22	Dehu Setpoint	Dehumidify Start RH	0 - 100% (x10) / 0 -10 kPa (x100)	Int	R/W
+23	Dehu Deadband	Humidity Drop to Stop	0 - 50% (x10) / 0 -5 kPa (x100)	Int	R/W
+24	Dehu Separation	Allowed Rise Before Stage 2	0 - 50% (x10) / 0 -5 kPa (x100)	Int	R/W
+25	Humidity Mode	RH or VPD Control	0 = RH, 1 = VPD	Int	R/W

Workspace Day/Night Control

Rule Registers

Index	Parameter	Description	Values	Type	Access
+13	Enable Light Sensor	Use Light Sensor	0 = Disabled, 1 = Enabled	Int	R/W
+14	Light Device	Light Sensor Device Address	1-200	Int	R/W
+15	Set Point	Light Level Set Point	0 - 1000 w/m2	Int	R/W
+16	Deadband	Light Level Deadband	0 - 200 w/m2	Int	R/W

Name Registers

Names of functions and rules can be read by accessing the registers using the name device ID's.

Text data is encoded as two charcters per MODBUS data WORD.

Registers by Device ID

Device ID	Device Type	Description	Values
203	Function Names	Names of Functions	Characters packed two per WORD
204	Rule Names	Names of Rules	Characters packed two per WORD

Function Name Registers

Index	Parameter	Description	Values	Type	Access
+0	Name Length	Length of Function Name	0 - 80	Int	R
+1	Function Name	Name of Function	ASCII Characters	2 Chars/Register	R

Rule Name Registers

Index	Parameter	Description	Values	Type	Access
+0	Name Length	Length of Rule Name	0 - 80	Int	R
+1	Rule Name	Name of Rule	ASCII Characters	2 Chars/Register	R

BDX MODBUS TCP/IP

MODBUS registers are available to read and write data to peripheral devices on Agrowtek's Fertigation systems.

The TCP Command server must be enabled and may be operated on any port.

Supported Commands
0x01 Read Output Coils
0x02 Read Input Coils
0x03 Read Holding Registers
0x05 Force Single Output Coil
0x06 Write Single Holding Register

Standard Error Responses
-Unsupported MODBUS commands will return an 'illegal function' error (0x01.)
-Unsupported registers or request lengths will return an 'illegal data address' error (0x02.)
-Writing invalid data to a register will return an 'illegal data value' error (0x03.)
-Writing data to regsiters that require diagnostic mode will return a 'slave device busy' error (0x06.)

Register Types
All registers are 16 bits wide with addresses using the standard MODICON protocol. Floating point values use the standard IEEE 32-bit format occupying two contiguous 16 bit registers. ASCII values (text strings) are stored with two characters (bytes) per register in hexadecimal format with trailing 0x00 for empty bytes.

System Status (Reg 40001)
Reports the current system status as an integer value.
Register may be written to to change the system status *(value 2 can not be written and will return an error).*

Response	Meaning
0	System is paused, running event will be suspended & new events will not be started.
1	System is in automtic run mode, no errors.
2	System is in error condition (and paused.)
3	System is in manual diagnostic mode.

Job Status (Reg 40002)
Reports the current job status as an integer value.

Response	Meaning
0	PENDING; a job is queued to run but has not begun.
1	FILLING; mixing tank is filling with water.
2	DOSING; System is currently dosing chemicals and mixing a batch.
3	FEEDING; System is feeding the batch to the prescribed zone valve(s).
4	DRAINING; Job is aborted, tank is draining through drain valve.
5	COMPLETED; Job is completed.
6	WAITING; No jobs scheduled, waiting for a job to queue.

Current Event (Reg 40003)
Returns an index value of the current event being run or pending.

Current Recipe (Reg 40004)
Returns an index value of the current recipe being run or pending.

Current Tank Volume (Reg 40005)
Returns an integer value of the current tank volume (not accurate during the FEED stage.)

Number of Events / Recipes (Reg 40006/40007)
Returns an integer value of the number of events or recipes stored in the system memory.

Sensor Integer Values (Reg 40101 - 40110)
Integer values are multiplied by a scaling coefficient to preserve the precision of a decimal value. Reporting the value correctly requires division of the value by the coefficient.

Sensor Type	Integer Scale	Range
Temperature	x100	-2000 - 6000 (-20 - 60°C)
pH	x100	0 - 1400 (0 - 14.00pH)
Conductivity	x1	0 - 5000 microSiemens
O.R.P.	x1	-1000 - +1000 mV
Flow	x100	0 - 6000 (0 - 60gpm)

Pump Speed (Reg 40201 - 40210)
Returns an integer value of the current pump speed.
Registers may be written to if the system is in **diagnostic mode** for pump testing & priming.
Only values 0 and 100 are valid when writing the pump speed.

Recipe & Event Properties (Reg 40301-40399, 40401-40499)
The properties of individual recipes and events can be displayed in dedicated "property" registers. This allows the examination of dynamic recipe and event data using a fixed set of register addresses. To access the properties of a specific recipe or event, the property index register must be set to the index of the desired receipe (or event) to examine. *If the property index entered is outside of the number of recipes (or events) in the machine, an illegal data value exception (0x03) will be returned and the property registers will not be changed.*

Using the property registers:
1. Check the number of available recipes (or events) by reading the register 40006 (or 40007).
2. Set the property index register 40301 (or 40401) to a valid recipe (or event) index.
3. Read the desired property registers 40302+ (or 40402+).

Reading a Name:
1. Set the property index register 40301 (or 40401) to a valid recipe (or event) index.
2. Read the name length register 40302 (or 40402) to determine the number of registers to request.
3. Send a Read Holding Register request (0x03) to address 40350 (or 40450) for the number of registers returned in step 2. A two-byte per register packet will be returned with trailing 0x00 for any empty characters.

MODBUS Holding Registers

Parameter	Description	Range	Type	Access	Address
System Status	Pause, Run, Error, Diagnostic	0 - 3	16 bit signed	R/W	40001
Job Status	Pending, Fill, Dose, etc.	0 - 6	16 bit signed	R	40002
Current Event	Schedule Event Index	0 - n	16 bit signed	R	40003
Current Recipe	Recipe Index	0 - n	16 bit signed	R	40004
Current Tank Volume	Water in Mix Tank	0 - 1000 gal	16 bit signed	R	40005
Number of Events	Events stored on the machine	0 - n events	16 bit signed	R	40006
Number of Recipes	Recipes stored on the machine	0 - n recipes	16 bit signed	R	40007
Number of Events Queued	Number of Events in Queue	0 - 999	16 bit signed	R	40008
Sensor Value	Temperature 1	-2000 - 6000 (-20 - 60°C)	16 bit signed	R	40101
	Temperature 2		16 bit signed	R	40102
	pH 1	0 - 1400 (0 - 14pH)	16 bit signed	R	40103
	pH 2		16 bit signed	R	40104
	EC 1	0 - 5000 uS	16 bit signed	R	40105
	EC 2		16 bit signed	R	40106
	ORP 1	-1000 - 1000 mV	16 bit signed	R	40107
	ORP 2		16 bit signed	R	40108
	Flow 1	0 - 6000 (0 - 60gpm)	16 bit signed	R	40109
	Flow 2		16 bit signed	R	40110
Speed, Dosing Pump	Pump 1	0 - 100% Only 0 or 100 valid for write. System must be in diagnostic mode to write to pump speed registers.	16 bit signed	R/W	40201
	Pump 2		16 bit signed	R/W	40202
	Pump 3		16 bit signed	R/W	40203
	Pump 4		16 bit signed	R/W	40204
	Pump 5		16 bit signed	R/W	40205
	Pump 6		16 bit signed	R/W	40206
	Pump 7		16 bit signed	R/W	40207
	Pump 8		16 bit signed	R/W	40208
	Pump 9		16 bit signed	R/W	40209
	Pump 10		16 bit signed	R/W	40210
	Pump 11		16 bit signed	R/W	40211
	Pump 12		16 bit signed	R/W	40212

Parameter	Description	Range	Type	Access	Address
Recipe Properties	Recipe Property Index	0 - n recipes	16 bit signed	R/W	40301
	Recipe Name Length	0 - 25 registers	16 bit signed	R	40302
	pH Target, Final	0 - 1400	16 bit signed	R	40303
	EC Target	0 - 5000	16 bit signed	R	40304
	ORP Target	-1000 - 1000	16 bit signed	R	40305
	pH Target, Initial	0 - 1400	16 bit signed	R	40306
	Recipe Units	0 - 3	16 bit signed	R	40307
	DO Target (future)		16 bit signed	R	40308
	Recipe Name	ASCII Characters	2 chars/register	R	40350
Event Properties	Event Property Index	0 - n events	16 bit signed	R/W	40401
	Event Name Length	0 - 25 registers	16 bit signed	R	40402
	Event Recipe Index	0 - n recipes	16 bit signed	R	40403
	Batch Volume	1 - 1000 gal	16 bit signed	R	40404
	Schedule Start Hour	0 - 23	16 bit signed	R	40405
	Schedule Start Minute	0 - 59	16 bit signed	R	40406
	Event Valve Assignment	1-14	16 bit signed	R	40407
	Enabled for Scheduling	0 - 2	16 bit signed	R	40408
	Date Mode	0 - 2	16 bit signed	R	40409
	First Day Number	1 - 65536	16 bit signed	R	40410
	Last Day Number	1 - 65536	16 bit signed	R	40411
	Skip Today	0 - 1	16 bit signed	R	40412
	Send to Drain	0 - 1	16 bit signed	R	40413
	Event Name	ASCII Characters	2 chars/register	R	40450
Recipe Part Properties	Part Property Index (12 parts)	0 - 11	16 bit signed	R/W	40501
	Part Name Length	0 - 25 registers	16 bit signed	R	40502
	Part Type (Off, Nute, pH...)	(See chart below)	16 bit signed	R	40503
	Part Dose x10 pH/ORP = mL/min Nutrient by Vol = mL/gal Nutrient by Targ = mL/min	0 - 65535	16 bit signed	R	40504
	Part Delay (mins)	0 - 99	16 bit signed	R	40505
	EC Dose Mode	0 = By Volume 1 = By Target	16 bit signed	R	40506
	EC Target Value	0 - 7000 uS 0 - 3500 ppm	16 bit signed	R	40507
	Part Name	ASCII Characters	2 chars/register	R	40550
Event Queue	Queue Property Index	0 - n queue events	16 bit signed	R	40601
	Event Name Length	0 - 25 registers	16 bit signed	R	40602
	Event Valve / Zone	1 - 14	16 bit signed	R	40603
	Event Index	1 - 65535	16 bit signed	R	40604
	Event Name	ASCII Characters	2 chars/register	R	40650
	Index of Event to Enqueue	0 - n events	16 bit signed	W	41001

Reading the Recipe Part Properties
The Recipe Index and Part Index must be set to the proper index values to read the part properties. Recipes can contain up to 12 parts.

Part Type
Part Types are returned as follows:

Mode	Value
Off	0
Nutrient A - J	1 - 10
pH Down	20
pH Up	30
ORP	40

Writing to Machine Output Coil Registers
The system must be in DIAGNOSTIC mode (0x03) to write to the machine's I/O coil registers.
See register 40001, system status.

Recipe/Event Properties
Discrete property values may be accessed similar to holding registers properties by setting the property index registers (40301 / 40401) then reading the bit values.
See the "using property registers" section on the previous page.

MODBUS Coil Registers

Parameter	Description	Access	Address
Machine I/O	RX1 Main Pump Relay	R/W	1
	Fill Valve	R/W	2
	Mixing Valve	R/W	3
	Zone Valve 1	R/W	4
	Zone Valve 2	R/W	5
	Zone Valve 3	R/W	6
	Zone Valve 4	R/W	7
	Zone Valve 5	R/W	8
	Zone Valve 6	R/W	9
	Zone Valve 7	R/W	10
	Zone Valve 8	R/W	11
	Zone Valve 9	R/W	12
	Zone Valve 10	R/W	13
	Zone Valve 11	R/W	14
	Zone Valve 12	R/W	15
	Zone Valve 13	R/W	16
	Zone Valve 14	R/W	17
Recipe Properties	Property, Recipe EC Target Mode Enabled	R	101
Event Properties	Property, Event Enabled for Scheduling	R	102

Machine Input Registers
The input registers provide information about the physical discrete inputs on the machine.
All discrete input registers are read-only.

MODBUS Discrete Input Registers

Input	Parameter	Physical Input	Access	Address
1	Tank Low Level Sensor	BDX Input 1	R	10001
2	Tank High Level Sensor	BDX Input 2	R	10002
3	Trigger Input 1	BDX Input 3	R	10003
4	Trigger Input 2	BDX Input 4	R	10004
5	Trigger Input 3	DXI8 Module #1 Input 1	R	10005
6	Trigger Input 4	DXI8 Module #1 Input 2	R	10006
7	Trigger Input 5	DXI8 Module #1 Input 3	R	10007
8	Trigger Input 6	DXI8 Module #1 Input 4	R	10008
9	Trigger Input 7	DXI8 Module #1 Input 5	R	10009
10	Trigger Input 8	DXI8 Module #1 Input 6	R	10010
11	Trigger Input 9	DXI8 Module #1 Input 7	R	10011
12	Trigger Input 10	DXI8 Module #1 Input 8	R	10012
13	Trigger Input 11	DXI8 Module #2 Input 1	R	10013
14	Trigger Input 12	DXI8 Module #2 Input 2	R	10014
15	Trigger Input 13	DXI8 Module #2 Input 3	R	10015
16	Trigger Input 14	DXI8 Module #2 Input 4	R	10016
17	Trigger Input 15	DXI8 Module #2 Input 5	R	10017
18	Trigger Input 16	DXI8 Module #2 Input 6	R	10018
19	Trigger Input 17	DXI8 Module #2 Input 7	R	10019
20	Trigger Input 18	DXI8 Module #1 Input 8	R	10020

END