MODBUS RTU Card for DIGICHEM Plus+
Model: DP-OPT-CARD-MODBUS (a.k.a. 6430)

**Retrofit to (or supplied with)
DIGICHEM® Plus+ controllers with
firmware S0206 ver 1.01 or later**

Supplied by:

Manufacturer: Convergent Water Controls Pty Ltd, Sydney Australia.

Note: On-going product development at Convergent Water Controls may lead to changes in the specifications of this product.

Warranty: This product is guaranteed for a period of 12 months from installation date or 18 months from Invoice date (whichever occurs first). The warranty applies to manufacturing or component defects which may cause the unit to malfunction under specified conditions. The guarantee does not cover damage due to abuse, tampering or improper installation.

Disclaimer: Convergent Water Controls will not be held liable for any consequential damage or loss arising resulting from product malfunction.

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1. INTRODUCTION

This MODBUS device is referred to as the Model 6430 throughout this user guide, and in short be referred to as the 6430. The 6430 uses MODBUS RTU protocol and it is regarded a "slave". It is an application-layer messaging protocol. It provides client/server communication between devices connected on the network. The 6430 uses 8, n, 1 data format: eight data bits, no parity, one stop bit.

Setting up the 6430 is an easy process, communication speed rate (baud rate) and MODBUS address is programmable via the DIGICHEM Plus+ menu system (refer specification at the end of this manual).

BAUDRATE

The baud rate is selectable from 4800 through 115200. Please consult Table .1 for supported baud rates.

No	Baudrate
1	4800
2	9600
3	19200
4	28800
5	38400
6	57600
7	115200

Table 1

MODBUS ADDRESS

MODBUS card address is selectable from 0x1 - 0x80.
The 6430 uses the industry standard MODBUS protocol and the most frequently used requests are listed in table 1.2.

Function	Description
01	Read Coil Status
02	Read Input Status
03	Read Holding Registers
04	Read Input registers
05	Force Single Coil
06	Preset Single register
07	Read Status Last two character of the message

Table 1.2

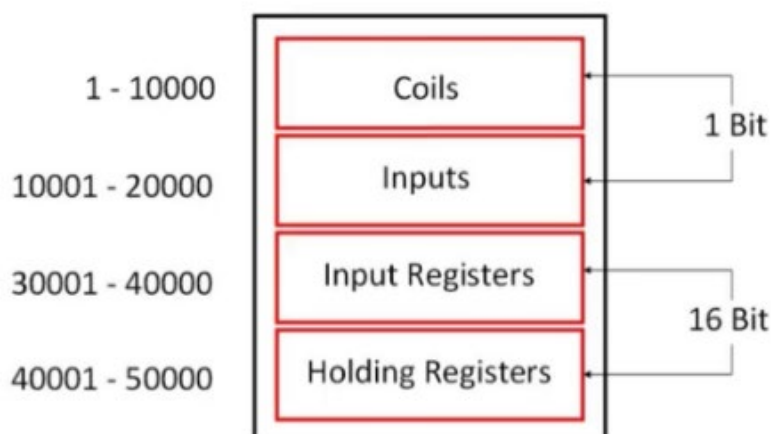The model 6430 MODBUS card only supports the following commands:

Function	Description
01	Read Coil
03	Read Holding Registers

Typical Modbus Memory Areas:

Modbus Memory Area - 4 Areas

Coils	Discrete Outputs
Inputs	Discrete Inputs
Input Registers	Analog Inputs
Holding Registers	Analog Outputs

Modbus Memory Area - 4 Areas
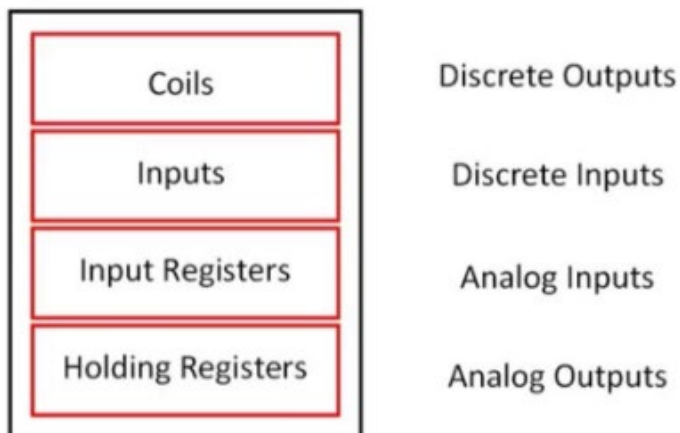
1 - 10000	Coils	
		1 Bit
10001 - 20000	Inputs	
30001 - 40000	Input Registers	
		16 Bit
40001 - 50000	Holding Registers	

NOTE: In the 6430, the Coils are used for Discrete Inputs and Outputs.

2. MODBUS EXAMPLES

Below are examples of the two supported MODBUS functions(commands)

READ COIL STATUS (Function 01)

MODBUS reserved this function to read MODBUS coils. A coil in the DP+ is represented by the status of a single bit. Each bit represents the status of either an input or output status.

For example the flow switch is an input and should the input be inactive or open, it has a value of zero(0). Should the flow switch input be closed or active, its value is said to be high(1).

For example the Bleed Solenoid Valve Output is an output and should the output be inactive or off, it has a value of zero(0). Should the output be closed or active, it's value is said to be high(1).

2.1 READ COIL STATUS EXAMPLE

When we refer to reading the coil status, the coil can either be an input or output. Only the reading of the status is allowed.

Below is an example of a MODBUS coil read from MODBUS card address 0x2, and coil starting address 1, reading the status of 32 coils. Please note all numbers are expressed in binary. For the examples we use the HEXADECIMAL presentation of the value for obvious reasons. Consult Table 1.3 for a MODBUS coil(2) request and table 1.4 for the response.

Field Name		Value(Hex)
MODBUS Card Address		02
Function		01
Data Start Address	HIGH byte	00
	LOW byte	01
Number of Coils	HIGH byte	00
	LOW byte	20
CRC	LOW byte	6C
	HIGH byte	21

Table 1.3

Response from MODBUS Card:

Field Name		Value(Hex)
MODBUS Card Address		02
Function		01
Number of coil bytes		04
Coil byte 1 (Coils 2 - 9)		C0
Coil byte 2 (Coils 10 - 17)		01
Coil byte 3 (Coils 18 -25)		01
Coil byte 4 (Coils 26 - 33)		20
CRC	LOW byte	A5
	HIGH byte	59

Table 1.4

READ HOLDING REGISTER (Function 03)

When we refer to reading a Holding Register, it refers to a reading a number from the card. The number is defined as an integer 16 bits. This represents a number from 0 to 65535. This number can be the digital value readout on a screen for say conductivity and may be presented as 0 to 9999 uS/cm. The DIGICHEM Plus+ has a total number of 6 holding registers, representing conductivity, ORP, pH, temperature and two Auxiliary readings (from the two 4-20mA inputs)

2.2 READ HOLDING REGISTER EXAMPLE

Below is an example of a MODBUS Holding Register read from MODBUS card address 0x2, starting reading from holding register 1, reading the values of 6 holding registers. Please note all numbers are expressed in binary. For the examples we use the HEXADECIMAL presentation of the value to obvious reasons.

Consult table 1.5 for MODBUS holding register read and table 1.6 for the response.

Field Name		Value(Hex)
MODBUS Card Address		02
Function		03
Data Start Address	HIGH byte	00
	LOW byte	01
Number of Registers	HIGH byte	00
	LOW byte	06
CRC	LOW byte	94
	HIGH byte	3B

Table 1.5

Response from MODBUS Card:

Field Name		Value(Hex)
MODBUS Card Address		02
Function		03
Number of data bytes		0C
Holding Register 1	HIGH byte	00
	LOW byte	00
Holding Register 2	HIGH byte	00
	LOW byte	00
Holding Register 3	HIGH byte	05
	LOW byte	78

Holding Register 4	HIGH byte	00
	LOW byte	00
Holding Register 5	HIGH byte	00
	LOW byte	00
Holding Register 6	HIGH byte	00
	LOW byte	00
CRC	LOW byte	E8
	HIGH byte	49

Table 1.6

3. MODBUS DATA TABLE

HOLDING REGISTERS FOR INTEGER 16 BITS

Address	Register Qty	Format	Property	Function	Description
40002	2	Int16	Read	03	Conductivity
40004	2	Int16	Read	03	ORP
40006	2	Int16	Read	03	pH
40008	2	Int16	Read	03	Temperature
40010	2	Int16	Read	03	AN1 (Analog/Auxiliary Input 1)
40012	2	Int16	Read	03	AN2 (Analog/Auxiliary Input 2)
40014	2	Int16	Read	03	Controller Type
40016	2	Int16	Read	03	Controller ID

Table 1.7

Tip: To check you have the readings aligned, pH should be between 0000 and 1400, Temperature should be between 000 and 100 and Controller Type should be a 3 digit number such as 0831.

Please note the pH is represented as a whole number. For example a pH value of 0x2fd equates to 765. The DIGICHEM Plus+ displays the pH as a number with 2 decimal places. Hence, the pH value should be divided by 100 to give a true value of 7.65pH

NOTE: Some Modbus readers will view the holding registers starting at 40002, each one incremented by 1. Example as follows:

Device	0x01
Function	0x03 - Holding Registers ▾
Address	0x0001
Length	0x8

ⓘ Reads: 440 / 3 - Writes: 0 / 0

Device	Address	Modbus Ad...	Value Hex	Value Dec	Value Float	Value Bin	Graph	Percent	Min	Max	Alias
● 0x01	0x0001	40002	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Conductivity
● 0x01	0x0002	40003	0x001A	26		0000 0000-0001 1010		100.0%	26	26	ORP
● 0x01	0x0003	40004	0x02D4	724		0000 0010-1101 0100		100.0%	724	724	pH
● 0x01	0x0004	40005	0x0014	20		0000 0000-0001 0100		100.0%	20	20	Temperature
● 0x01	0x0005	40006	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	AN1
● 0x01	0x0006	40007	0x0000	0		0000 0000-0000 0000		0.0%	0	0	AN2
● 0x01	0x0007	40008	0x033E	830		0000 0011-0011 1110		100.0%	830	830	Controller Type
● 0x01	0x0008	40009	0x270F	9999		0010 0111-0000 1111		100.0%	9999	9999	ID

Controller Parameters

The following controllers currently support MODBUS RTU:

Controller	Controller Type	Int16 Range	Coil Range
DIGICHEM Plus	0831	40002 - 40016	1 - 29

MODBUS COIL ADDRESSES

Address	Register Qty	Property	Function	Description
1	1	Read	01	Not Used
2	1	Read	01	Mains On
3	1	Read	01	BLEED Output
4	1	Read	01	INHIBITOR Output
5	1	Read	01	BIOA Output
6	1	Read	01	BIOB (ORP) Output
7	1	Read	01	pH Output
8	1	Read	01	Dispersant Output
9	1	Read	01	Aux Output
10	1	Read	01	Tank Level 1 Low
11	1	Read	01	Tank Level 2 Low
12	1	Read	01	Tank Level 3 Low
13	1	Read	01	Tank Level 4 Low
14	1	Read	01	Tank Level 5 Low
15	1	Read	01	Tank Level 6 Low
16	1	Read	01	Common Alarm Active
17	1	Read	01	Flow Switch Active
18	1	Read	01	Conductivity Low Alarm
19	1	Read	01	Conductivity High Alarm
20	1	Read	01	Conductivity Timer Alarm
21	1	Read	01	ORP ILw Alarm
22	1	Read	01	ORP High Alarm
23	1	Read	01	ORP Timer Alarm
24	1	Read	01	pH Low Alarm
25	1	Read	01	pH High Alarm
26	1	Read	01	pH Timer Alarm
27	1	Read	01	Time & Date Alarm
28	1	Read	01	No Flow Alarm
29	1	Read	01	'1' if Units set to TDS, '0' if Units set to Conductivity (i.e. uS)

Table 1.8

Tip: To check you have the readings aligned, Mains On should be 1 when powered, and Bleed (the field immediately after should be 1 if the controller is bleeding.

Example of Modbus Reader viewing Coils:

Device	0x01
Function	0x01 - Read Coils
Address	0x0001
Length	0x20

ⓘ Reads: 268 / 3 - Writes: 0 / 0

Device	Address	Modbus Ad...	Value Hex	Value Dec	Value Float	Value Bin	Graph	Percent	Min	Max	Alias
🔵 0x01	0x0001	2	0x0001	1		0000 0000-0000 0001		100.0%	1	1	Mains On
🔵 0x01	0x0002	3	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	BLEED
🔵 0x01	0x0003	4	0x0000	0		0000 0000-0000 0000		0.0%	0	0	INHIBITOR
🔵 0x01	0x0004	5	0x0000	0		0000 0000-0000 0000		0.0%	0	0	BIOA
🔵 0x01	0x0005	6	0x0001	1		0000 0000-0000 0001		100.0%	1	1	ORP/BIOB
🔵 0x01	0x0006	7	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	pH
🔵 0x01	0x0007	8	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Dispersant
🔵 0x01	0x0008	9	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	Aux Output
🔵 0x01	0x0009	10	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Tank Level 1 Low
🔵 0x01	0x000A	11	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	Tank Level 2 Low
🔵 0x01	0x000B	12	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Tank Level 3 Low
🔵 0x01	0x000C	13	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	Tank Level 4 Low
🔵 0x01	0x000D	14	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Tank Level 5 Low
🔵 0x01	0x000E	15	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	Tank Level 6 Low
🔵 0x01	0x000F	16	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Common Alarm
🔵 0x01	0x0010	17	0x0001	1		0000 0000-0000 0001		100.0%	1	1	Flow SW. Active
🔵 0x01	0x0011	18	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	Conductivity Low Alarm
🔵 0x01	0x0012	19	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Conductivity High Alarm
🔵 0x01	0x0013	20	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	Conductivity Timer Alarm
🔵 0x01	0x0014	21	0x0000	0		0000 0000-0000 0000		0.0%	0	0	ORP low Alarm
🔵 0x01	0x0015	22	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	ORP High Alarm
🔵 0x01	0x0016	23	0x0000	0		0000 0000-0000 0000		0.0%	0	0	ORP Timer Alarm
🔵 0x01	0x0017	24	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	pH low Alarm
🔵 0x01	0x0018	25	0x0000	0		0000 0000-0000 0000		0.0%	0	0	pH high Alarm
🔵 0x01	0x0019	26	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	pH Timer Alarm
🔵 0x01	0x001A	27	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Time & Date Alarm
🔵 0x01	0x001B	28	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	No Flow Alarm
🔵 0x01	0x001C	29	0x0000	0		0000 0000-0000 0000		0.0%	0	0	Units
🔵 0x01	0x001D	30	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	
🔵 0x01	0x001E	31	0x0000	0		0000 0000-0000 0000		0.0%	0	0	
🔵 0x01	0x001F	32	0x0000	0	0.000	0000 0000-0000 0000		0.0%	0	0	
🔵 0x01	0x0020	33	0x0000	0		0000 0000-0000 0000		0.0%	0	0	

4. WIRING THE MODBUS CARD

The MODBUS card is supplied affixed to a DIN mount bracket. Clip the bracket on the DIN rail inside the DIGICHEM Plus+ enclosure. Plug the 10-way ribbon cable into a spare socket marked I/O PORT on the motherboard. This cable provides power and communication between the DIGICHEM Plus+ and the MODBUS card. The MODBUS card has a RS485 Port for communications with a master device. Please set the Baud rate and card address via the SETUP MENU of the DIGICHEM Plus+. Please proceed with the field wiring as follows.

RS485 WIRING LEGEND:

1	B(-)
2	A(+)
3	GND

POWER CONSUMPTION	200 milli Watt
ESD Protection	2KV on RS485 lines
Electrical Isolation	1.5KV
Card address selectable in DIGICHEM Plus+ controller Advanced Setup menu	1 ..128
Baud rates selectable in DIGICHEM Plus+ controller Advanced Setup menu	4800, 9600, 19200, 28800, 38400, 57600, or 115200
Data Format	8, n, 1 data format: eight data bits, no parity, one stop bit
Data Bit	8
Parity	None (i.e. no parity)
Stop bits	1
DIGICHEM Plus+ Firmware	S206 ver 1.01 or higher (NOTE: Extra Inhibitor Dose is removed from menu with this firmware version and the MODBUS card fitted. Furthermore, drivers for 4-20mA card DP-OPT-CARD-OP are removed too)