Installation, Operation and Maintenance Manual
VCIOM-15081-EN Rev. 7
October 2022

Bettis XTE3000

Modbus RTU Module

BETTIS™

EMERSON™

Revision Details

Rev.	Date	Description	Prepared	Checked	Approved
7	October 2022	Update Figure 15			

Table of Contents

Section 1: Introduction

Section 2: Operation and Storage

Section 3: Communication Features

Section 4: Modbus RTU Module

Section 5: Modbus RTU Protocol Description

Section 6: Modbus Wirings

Section 7: Modbus I/O List

Section 8: Modbus Function Description

Section 9: Configuration via Local Interface of XTE3000

Section 10: Annex A

Section 11: Annex B

Section 1: Introduction

The XTE3000 Modbus RTU is an electronic module that allows connecting the Bettis electrical actuator XTE3000 to a Modbus RTU serial communication line. The module has its microprocessor, it is controlled by a program stored internally, it works as a pure BUS interface and does not affect the actuator control integrity. It is installed inside the actuator housing and takes the electrical power from the actuator power supply module. The RS485 interface is located on the module board. The data lines are fully isolated from the actuator electronics.

All features described in this document are applicable for software revision 2.01 or subsequently.

XTE3000 Modbus RTU module can be mounted only on base card revision 9.00 or higher.

1.1 References

Modbus over serial line specification and implementation guide V1.02.
Available from www.modbus.org.

Modbus application protocol specification V1.1b3. Available from www.modbus.org.

XTE3000 Installation, Operation and Maintenance Manual, VCIOM-14012-EN.

1.2 Modbus RTU or ASCII

Modbus protocol is currently supported by most Programmable Logic Controllers (PLCs). Modbus is a very simple Master/Slave serial protocol. It supports both ASCII (rarely used) and Binary (RTU) form of transmission. In ASCII transmission mode each 8-bit byte in a message is sent as 2 ASCII characters. In RTU transmission mode each 8-bit byte is sent as 2 four-bit hexadecimal characters. The main advantage of RTU mode is that it allows greater character density than in ASCII mode at the same baud rate.

The structure of a Modbus message is shown below.

Address	Function	Data	Checksum

Section 2: Operation and Storage

The module is designed to work and to be stored in the same environment of the actuator.

Section 3: Communication Features

Communication Protocol:	Modbus RTU
Transmission Technology:	RS485, half duplex
Network Topology:	Line (BUS) structure
Transmission Medium:	Twisted, screened copper cable
Data Rate:	600, 1200, 2400, 4800, 9600, 19200, 38400 bit/s
Device Number:	Maximum 32 devices per segment. If more than 32 devices are present on the BUS, repeaters should be used
Slave Address:	From 1 to 247 (address 0 reserved for broadcast messages), configurable via local operator interface of actuator
BUS Access:	Polling between masters and slaves
Electrical Power:	Actuator powered
BUS Termination:	Available on board, configurable via local operator interface of actuator
Temperature:	-40 °C, +85 °C
Fieldbus Redundancy:	Available by setting the MODE function (CH1, CH2, AUTO)
Auto Baud Rate:	Available by setting “Baud Rate = AUTO”
EMC Protections:	EN 50081-2 and EN 50082-2
Baud Rate:	Configurable via local operator interface of actuator
Addressing:	Configurable via local operator interface of actuator
Coding System:	8 bits binary, hexadecimal 0-9, A-F. Two hexadecimal characters contained in each 8-bit field of the message
Bits per byte:	1 start bit
	8 data bits, least significant bit sent first
	1 bit for Even/Odd parity; no bit for no parity; configurable via local operator interface of actuator
	1 stop bit with parity; 2 Stop bits without parity
Error Check Field:	Cyclical Redundancy Check (CRC)

Section 4: Modbus RTU Module

The module consists in a single PCB that is installed inside the actuator housing. It is connected to the XTE3000 base card via strip connector.

The internal wiring connects the RS485 data lines to the actuator terminal board.

Figure 1 Top Side

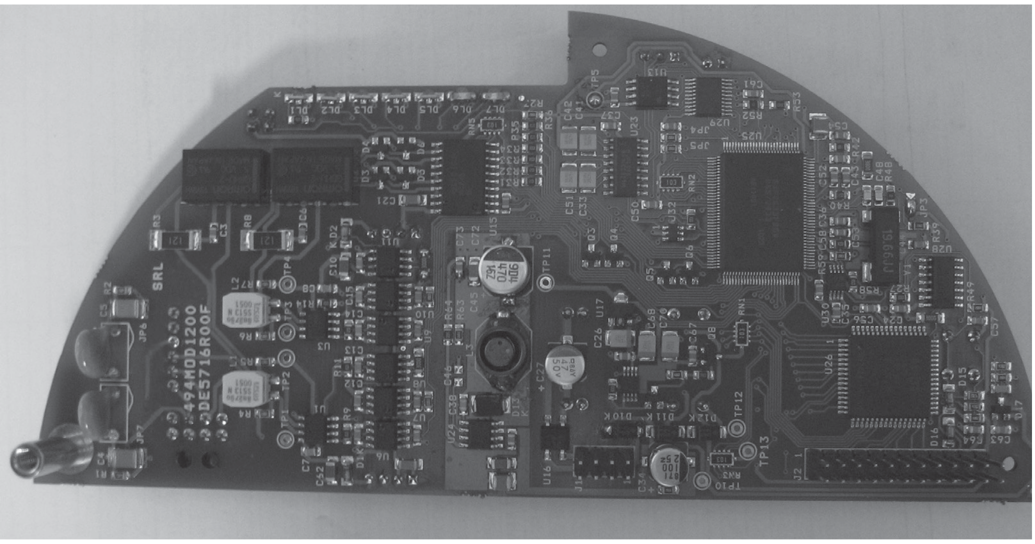
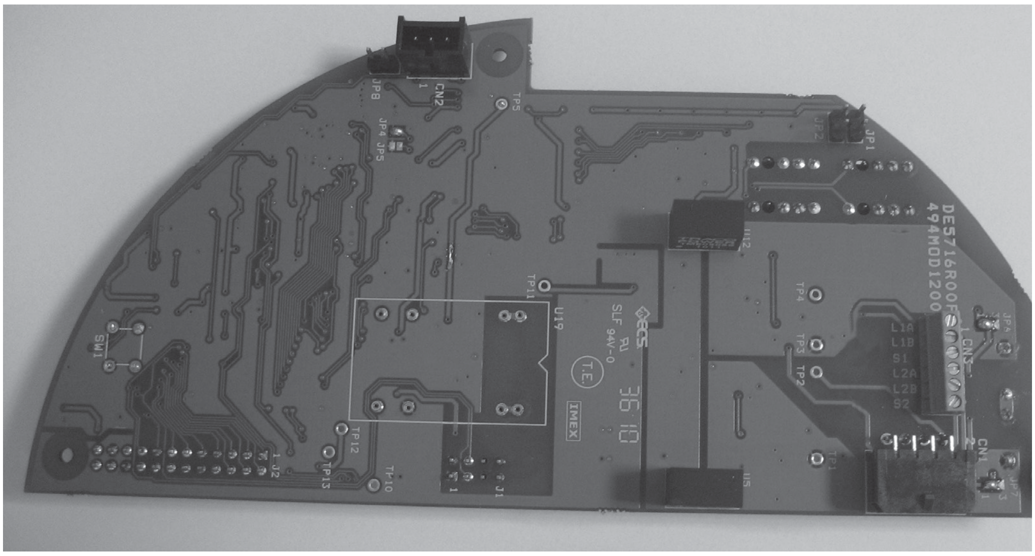


Figure 2 Bottom Side



4.1 On Board Indications and Jumpers

Seven LEDs are mounted on the Modbus RTU module to give the following indications for the field service. LEDs indicators are active only when jumper JP1 is closed.

DL1 (green) Power Supply:	ON: When the Modbus RTU module is correctly powered from the main power supply OFF: When the Modbus RTU module is not correctly powered from the power supply
DL2 (green) CH1 Comm. Status:	ON: Data Message received or transmit from Modbus RTU interface OFF: Silence between Data Modbus messages BLINK: Auto Baud Rate Running
DL3 (green) CH2 Comm. Status:	ON: Data Message received or transmit from Modbus RTU interface OFF: Silence between Data Modbus messages BLINK: Auto Baud Rate Running
DL4 (green) Termination CH1:	ON: Termination Resistance Active on CH1 OFF: Termination Resistance Not Active on CH1
DL5 (green) Termination CH2:	ON: Termination Resistance Active on CH2 OFF: Termination Resistance Not Active on CH2
DL6 (red) Base Card Comm. Status:	ON: Communication Errors OFF: Not Communication Errors
DL7 (red) Data Area Empty:	ON: When Data Area on interface card is not yet loaded OFF: When Data Area is completely loaded BLINK: When Data Area is being read from base card

JP1: LEDs jumper. Short this jumper to power LEDs. (default OFF)

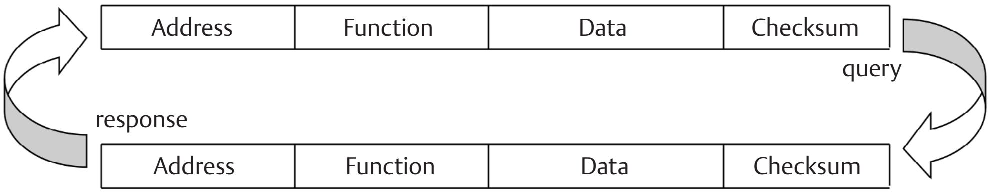
JP2: Program jumper. Used to download new firmware on microcontroller (manufacturer use only)

Section 5: Modbus RTU Protocol Description

Modbus protocol is a messaging structure, used in a wide range of application in process automation to establish master-slave communication between intelligent devices. Since Modbus is only a messaging structure, it is independent from the physical layer. It is traditionally implemented using RS232 or RS422 or RS485. The central controllers (as PLC) communicate via serial connection with field devices (as sensors, actuators). The central controller (called master) reads the input information from the field devices (called slaves) and writes the output information to the slaves. The master initiates the transmission which is called "query." The slave devices answer by sending the requested data (called "response") and performing the action requested in the query. The master can address individual slaves or can send a broadcast message to all slaves.

The figure below shows a query-response cycle.

Figure 3



No response from slaves is done in case of broadcast message. Address 0 is used for the broadcast message.

If a slave receives the request, but detects a communication error (parity, CRC, etc.) no response is returned.

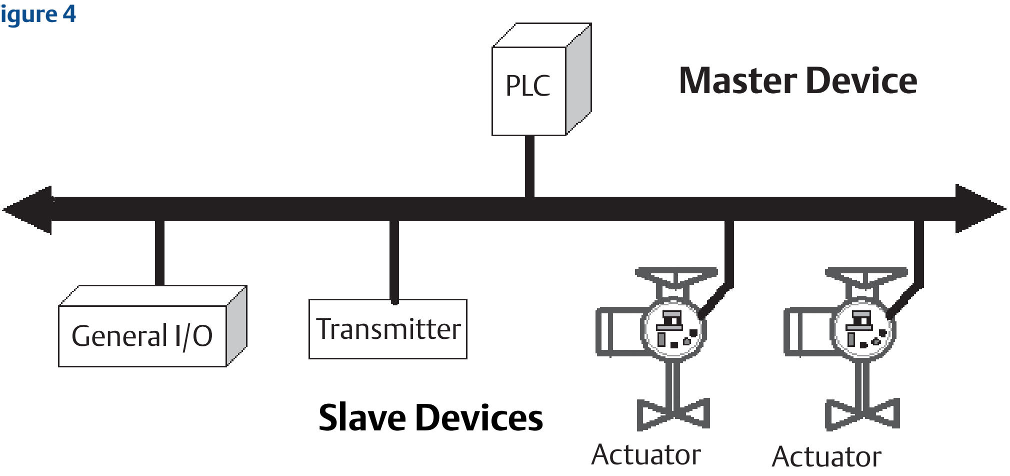
If a slave receives the request without a communication error, but cannot handle it (for example, if the request is to read a non-existent output or register), the slave will return an exception response informing the master of the nature of error.

Section 6: Modbus Wirings

The maximum number of master and slave devices in a BUS segment is 32 without repeaters.
The maximum cable length depends on the speed of transmission. Higher is the speed shorter should be the cable length.

The figure below shows a Modbus RTU configuration with 1 master device and different slave devices.

Figure 4



6.1 RS485 Transmission Mode

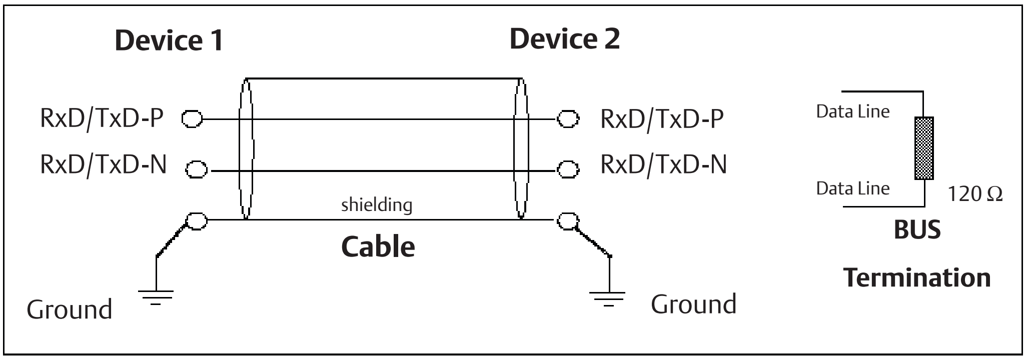
The XTE3000 Modbus RTU module uses a half-duplex, multidrop, serial communication line RS485.
The module communicates with the masters via RS485 interface and the transmission media consists in a shielded twisted pair cable. Transmission speed from 600 bit/s to 38400 bit/s is available.
One unique transmission speed is allowed for all devices on the BUS when the system works.

All devices are connected in a BUS structure. Up to 32 stations (master and slaves) can be connected in one segment. Repeaters should be used to extend the number of devices on one BUS.
Addresses range is from 1 to 247. Address 0 is reserved for broadcast messages.

The BUS must be terminated by a resistor of 120 Ω at the beginning and at the end of each segment. Only two terminations in one BUS segment must be provided. To ensure error-free operation and to increase driving capability, pull-up and pull-down resistors should be provided on the termination network. The maximum cable length depends on the transmission speed.

The data lines must not be reversed. To avoid polarity inversion, it is suggested to use different colours for each data line. Use of shielded cable is mandatory for having high system immunity against electromagnetic disturbs. The data lines should be kept separate from all other cables.
It should be laid in separate, conductive and earthed cable trunking. It must be ensured that there is not voltage difference between individual nodes of BUS.

Figure 5

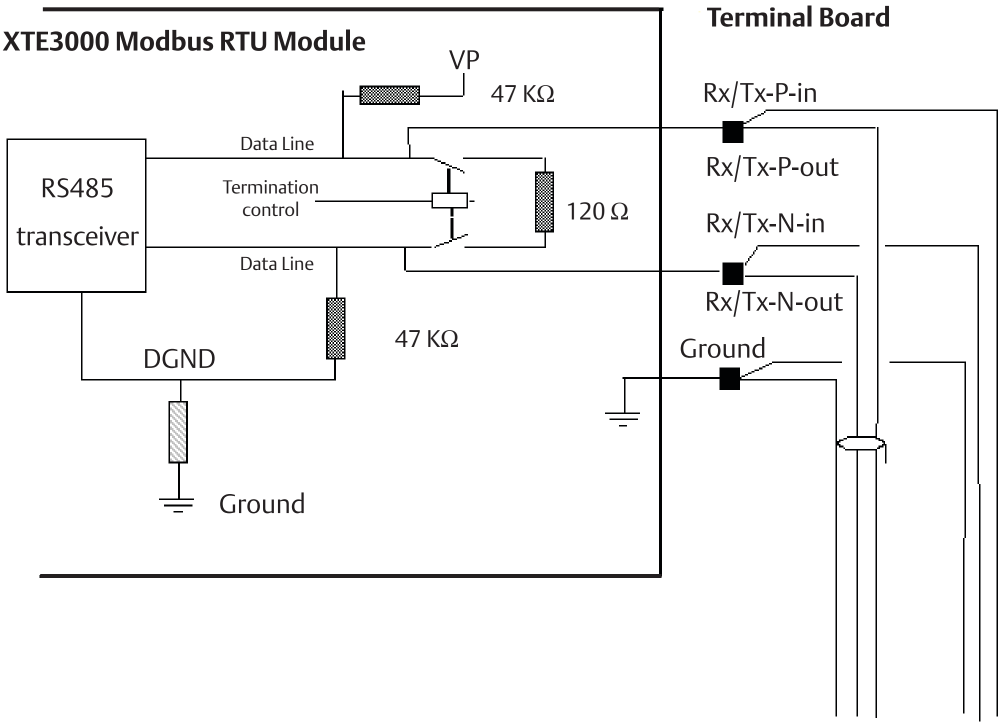


The XTE3000 Modbus RTU module takes its electrical supply from the actuator power supply module. The RS485 BUS transceiver is isolated from the actuator electronics. The BUS termination, located inside the actuator, should be used only if the actuator is at the beginning or at the end of the BUS segment and if there is no external termination.

The BUS terminations can be switched on the data lines by means of 2 links, configurable via local operator interface.

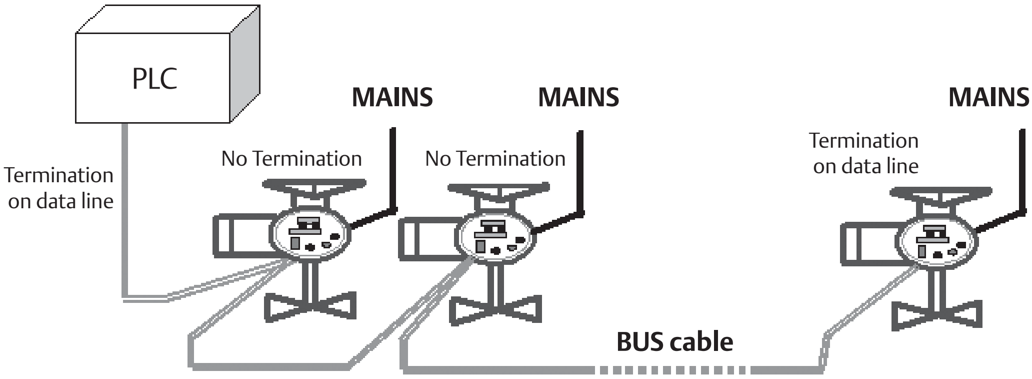
The figure below shows the wiring in case of single BUS cable.

Figure 6



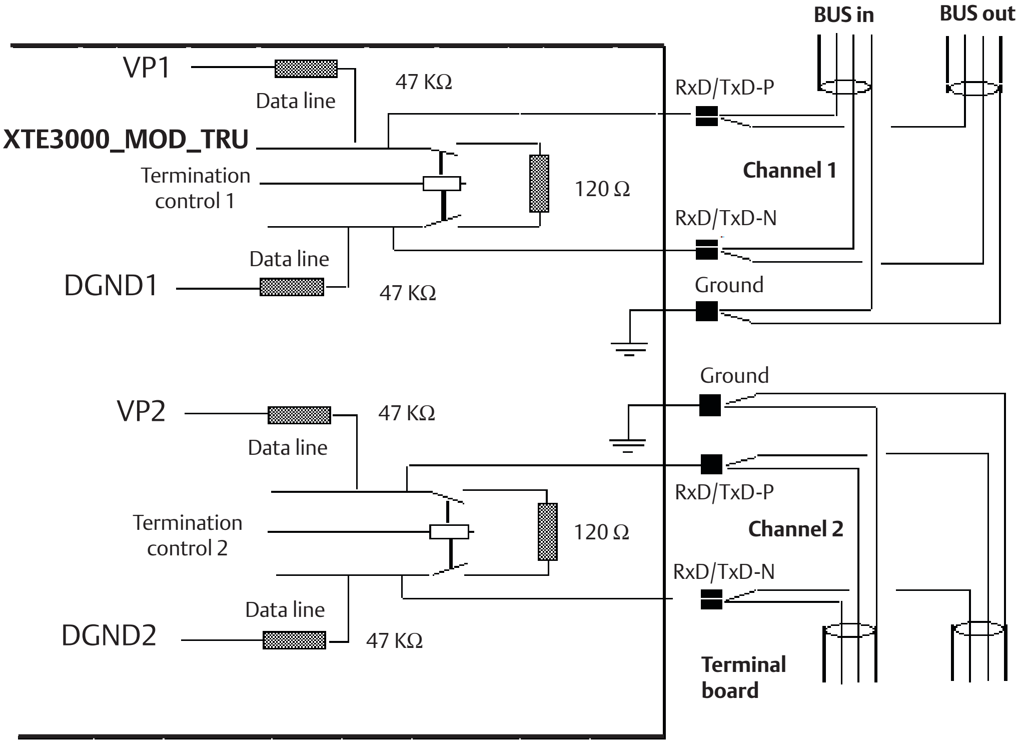
The figure below shows the BUS with an actuator at the end of the BUS segment.

Figure 7



The XTE3000 Modbus RTU module is provided with 2 RS485 transceivers and 2 BUS terminations for application with redundant cable. The BUS terminations can be switched on the data lines by means of 2 links, configurable via local operator interface. One channel at time works, according to the configuration received from BUS or via local operator interface. The figure below shows the wiring necessary in case of redundant BUS cable. The termination must be linked to the data lines only if the actuator is at the beginning or at the end of the BUS segment.

Figure 8



Section 7: Modbus I/O List

The following paragraph describes the I/O composition of the Modbus interface implemented in the XTE3000 Modbus RTU module. The XTE3000 Modbus RTU module concentrates all the available data in the Holding Register Data Area, but to grant the backward compatibility with the ICON2000v4, it maintains also the former data structure.

The Modus interface is divided in four areas and each area is accessible via the specific Modbus Function Code as described in Section 8.

7.1 Discrete Inputs

In the Discrete Input Data Area, the XTE3000 Modbus RTU module implements the same 32 discrete inputs available on ICON2000v4.

Status of discrete inputs is indicated as 1 = ON and 0 = OFF.

The following table shows the discrete inputs implemented in the XTE3000 Modbus RTU module:

Table 1.

Input Status Number	Input Status Address	Description
ICON2000v4 legacy data block		
1	0	Close Limit
2	1	Open Limit
3	2	Actuator Moving
4	3	Monitor Relay
5	4	Selector in LOCAL
6	5	Selector in REMOTE
7	6	Alarm
8	7	Warning
9	8	DIN1 (See Note 1)
10	9	DIN2 (See Note 1)
11	10	DIN3 (See Note 1)
12	11	DIN4 (See Note 1)
13	12	DIN5 (See Note 1)
14	13	DIN6 (See Note 1)
15	14	Interlock Open
16	15	Interlock Close
17	16	Fail Safe Action
18	17	Actuator Opening
19	18	Actuator Closing
20	19	Selector in OFF
21	20	ESD/PST Control (see Section 11.1 for details)
22	21	Hardwired Remote Mode
23	22	Positioner Mode
24	23	Motor Operation Inhibited
25	24	Channel 1 Active
26	25	Hardwired Open Command
27	26	Hardwired Close Command
28	27	Hardwired Stop Command
29	28	Hardwired BUS-on
30	29	Base Card Communication Error (Reserved)
31	30	Reserved (always 0)
32	31	Reserved (always 0)

NOTE:

DIN1, DIN2, DIN3, DIN4, DIN5, and DIN6:
Via local operator interface of the actuator, the bits DIN1, DIN2, DIN3, DIN4, DIN5, and DIN6 can be individually configured to be set to "1" if one of the following condition occurs: open limit, close limit, position >= xx%, position <= xx%, closing, opening, motor running, blinker, mid travel position, local selected, remote selected, local stop active, ESD signal on, manual operation, motor over temperature, high-high torque, high-high torque in opening, high-high torque in closing, valve jammed, valve jammed in open, valve jammed in close, low alkaline battery (if present), mid travel alarm in opening or closing, warning. The following settings are supplied as standard:

- **DIN1:** Mid travel position
- **DIN2:** Local stop active
- **DIN3:** Motor over temperature (Motor thermostat alarm)
- **DIN4:** High-high torque alarm
- **DIN5:** Valve jammed alarm
- **DIN6:** Mid travel alarm in opening or closing

7.2 Coils

In the Coils Data Area, the XTE3000 Modbus RTU module implements the same 11 coils available on ICON2000v4.

Status of coils is indicated as 1 = ON and 0 = OFF.

The following table shows the coils implemented in the XTE3000 Modbus RTU module.

Table 2.

Coil Number	Coil Address	Description
ICON2000v4 legacy data block		
1	0	Open Command (See Note 1 and 2)
2	1	Close Command (See Note 1 and 2)
3	2	Stop Command (See Note 1 and 2)
4	3	ESD/PST Command (See Note 2 and 3)
5	4	Positioner Mode (See Note 2 and 4)
6	5	Reserved (always 0)
7	6	Reserved (always 0)
8	7	Reserved (always 0)
9	8	Reserved (always 0)
10	9	Reserved (always 0)
11	10	Reserved (always 0)

NOTE:

1. Open Command, Close Command, Stop Command:
"Open" and "Close" commands are self-maintained.
If "Open command" is active and "Close command" is received, the movement is reversed and "Open command" is cleared.
If "Close command" is active "Open command" is received, the movement is reversed and "Close command" is cleared.
If "Stop Command" is received, "Open command" and "Close command" will be ignored.
When "Stop Command" return to 0, "Open command" and "Close command" can be carried out.
To clear "Open command" it's necessary to set "Stop Command" to ON and to set "Open command" to OFF.
To clear "Close command" it's necessary to set "Stop Command" to ON and to set "Close command" to OFF.

2. Open, Close, Stop, ESD, Positioner mode:
"Local Stop pressed," "Selector in OFF," "Selector in REMOTE" stops temporarily all commands; when the local STOP is depressed, or the selector returns in REMOTE position, the previous command is restored.

3. ESD/PST Command:
If the value is ON, an ESD/PST command is generated. When the signal returns to OFF, the ESD/PST command is cleared. See Section 11.1 for details.

4. Positioner Mode:
"Positioner Mode" command is available only in modulating actuators.
If its value is ON, the positioner function is enabled, and the actuator will position according to the content of position request register (Holding Register address 1).

7.3 Analog Inputs

In the Analog Input Data Area, the XTE3000 Modbus RTU module implements the same 369 input registers available on ICON2000v4.

The following table shows the input registers implemented in the XTE3000 Modbus RTU module:

Table 3.

Input Register Number	Input Register Address	Range Value	Description
ICON2000v4 legacy data block			
1	0	0 - 1000	Actuator Position (0=0.0%, 1000=100.0%)
2	1	-100 - 100	Output Torque (See Note 1)
3	2	0 - 65535	Warnings (See Note 2)
4	3	0 - 65535	Alarms1 (See Note 3)
5	4	0 - 65535	Alarms2 (See Note 4)
6	5	0 - 65535	Opening Time (s)
7	6	0 - 65535	Closing Time (s)
8	7	0 - 65535	Contactor Cycles (1/2) (See Note 5)
9	8	0 - 65535	Contactor Cycles (2/2) (See Note 5)
10	9	0 - 65535	Motor Run Time (1/2) (See Note 6)
11	10	0 - 65535	Motor Run Time (2/2) (See Note 6)
12	11	0 - 65535	Time without electrical power (1/2) (See Note 6)
13	12	0 - 65535	Time without electrical power (2/2) (See Note 6)
14	13	0 - 100	Reserved - Util. Rate (0=0%, 100=100%)
15	14	-	Test Date (1/2) (See Note 7)
16	15	-	Test Date (2/2) (See Note 7)
17	16	-	Recent Log Date (1/2) (See Note 7)
18	17	-	Recent Log Date (2/2) (See Note 7)
19	18	0 - 65535	Recent Contactor Cycles (1/2) (See Note 5)
20	19	0 - 65535	Recent Contactor Cycles (2/2) (See Note 5)
21	20	0 - 65535	Recent Motor Run Time (1/2) (See Note 6)
22	21	0 - 65535	Recent Motor Run Time (2/2) (See Note 6)
23	22	0 - 65535	Recent time without electrical power (1/2) (See Note 6)
24	23	0 - 65535	Recent time without electrical power (2/2) (See Note 6)
25	24	0 - 100	Reserved - Recent Util. Rate (0=0%, 100=100%)
26	25	0 - 65535	Torque profile in OP - Break Out
27	26	0 - 65535	Torque profile in OP - Peak
28	27	0 - 65535	Torque profile in OP - Ending
29	28	-	Date of last torque profile in OP (1/2) (See Note 7)
30	29	-	Date of last torque profile in OP (2/2) (See Note 7)
31	30	0 - 65535	Torque profile in CL - Break Out
32	31	0 - 65535	Torque profile in CL - Peak
33	32	0 - 65535	Torque profile in CL - Ending

Input Register Number	Input Register Address	Range Value	Description
ICON2000v4 legacy data block			
34	33	-	Date of last torque profile in CL (1/2) (See Note 7)
35	34	-	Date of last torque profile in CL (2/2) (See Note 7)
36	35	0 - 65535	Torque reference in OP - Break Out
37	36	0 - 65535	Torque reference in OP - Peak
38	37	0 - 65535	Torque reference in OP - Ending
39	38	-	Date of torque reference in OP (1/2) (See Note 7)
40	39	-	Date of torque reference in OP (2/2) (See Note 7)
41	40	0 - 65535	Torque reference in CL - Break Out
42	41	0 - 65535	Torque reference in CL - Peak
43	42	0 - 65535	Torque reference in CL - Ending
44	43	-	Date of torque reference in CL (1/2) (See Note 7)
45	44	-	Date of torque reference in CL (2/2) (See Note 7)
46-47-48-49-50	45-46-47-48-49	-	Alarms1 Code, date, time (See Note 8)
51-52-53-54-55	50-51-52-53-54	-	Alarms2 Code, date, time (See Note 8)
56-57-58-59-60	55-56-57-58-59	-	Alarms3 Code, date, time (See Note 8)
61-62-63-64-65	60-61-62-63-64	-	Alarms4 Code, date, time (See Note 8)
66-67-68-69-70	65-66-67-68-69	-	Alarms5 Code, date, time (See Note 8)
71-72-73-74-75	70-71-72-73-74	-	Warning1 Code, date, time (See Note 9)
76-77-78-79-80	75-76-77-78-79	-	Warning2 Code, date, time (See Note 9)
81-82-83-84-85	80-81-82-83-84	-	Warning3 Code, date, time (See Note 9)
86-87-88-89-90	85-86-87-88-89	-	Warning4 Code, date, time (See Note 9)
91-92-93-94-95	90-91-92-93-94	-	Warning5 Code, date, time(See Note 9)
96	95	-	Nominal Torque/Thrust (1/4) (See Note 10)
97	96	-	Nominal Torque/Thrust (2/4) (See Note 10)
98	97	-	Nominal Torque/Thrust (3/4) (See Note 10)
99	98	-	Nominal Torque/Thrust (4/4) (See Note 10)
100	99	-127 - 127	Min. temperature of base card (°C)
101	100	-127 - 127	Max. temperature of base card (°C)
102	101	-127 - 127	Min. temperature of terminal board (°C)
103	102	-127 - 127	Max. temperature of terminal board (°C)
104	103	-127 - 127	Max. temperature of motor (°C)
105	104	0 - 65535	Number of motor alarm
106	105	0 - 65535	Number of torque alarm

Input Register Number	Input Register Address	Range Value	Description
ICON2000v4 legacy data block			
107	106	-127 - 127	Recent min. temperature of base card (°C)
108	107	-127 - 127	Recent max. temperature of base card (°C)
109	108	-127 - 127	Recent min. temperature of terminal board (°C)
110	109	-127 - 127	Recent max. temperature of terminal board (°C)
111	110	-127 - 127	Recent max. temperature of motor (°C)
112	111	0 - 65535	Recent number of motor alarm
113	112	0 - 65535	Recent number of torque alarm
114 - 177	113 - 176	-	Last Close Torque Curve (See Note 11)
178 - 241	177 - 240	-	Reference Close Torque Curve (See Note 11)
242 - 305	241 - 304	-	Last Open Torque Curve (See Note 11)
306 - 369	305 - 368	-	Reference Open Torque Curve (See Note 11)

NOTE:

1. Output Torque:

This register assumes negative values for torque in opening direction and positive values for torque in closing direction. The engineering unit is percent.

2. Warnings:

This is a bit-enumerated register. The possible values are:

Values	Description
b0	1 = Hi-Hi Torque in open direction
b1	1 = Hi-Hi Torque in close direction
b2	1 = Hi-Hi Temperature
b3	1 = Main Voltage
b4	1 = Contactor Cycles
b5	1 = Maintenance Request
b6	1 = Motor Current
b7	1 = Wrong Stroke Limit
b8	1 = PST Error - Max. T1
b9	1 = PST Error - Max. T2
b10	1 = PST Error - Over Travel
b11	1 = PST Error - PST Failed
b12	Spare - Not Used
b13	Spare - Not Used
b14	Spare - Not Used
b15	1 = General Warning

3. Alarms1:
This is a bit enumerated register. The possible values are:

Values	Description
b0	1 = Motor Thermostat
b1	1 = Hi-Hi Torque in open direction
b2	1 = Hi-Hi Torque in close direction
b3	1 = Blocked in open
b4	1 = Blocked in close
b5	1 = Hi-Hi Temperature
b6	1 = Positioner Sensor
b7	1 = Speed Sensor
b8	1 = Main Voltage
b9	1 = K1 Contactor
b10	1 = K2 Contactor
b11	1 = Configuration Error
b12	1 = Hardware Error
b13	1 = Low Battery
b14	1 = Lost Phase
b15	1 = Request Signal

4. Alarms2:
This is a bit enumerated register. The possible values are:

Values	Description
b0	1 = Max. torque intermediate position
b1	1 = Jammed in close
b2	1 = Jammed in open
b3	1 = Direction test fail
b4	1 = Mid travel in open
b5	1 = Mid travel in close
b6 - b15	Spare - Not used

5. Contactor Cycles, Recent Contactor Cycles:
These data are contained in two registers. The first register contains high order bits, the second contains the low order bits. Resolution data: 100 cycles.

6. Motor Run Time, Recent Motor Run Time, Time without electrical power, Recent time without electrical power:
These data are contained in two registers. The first register contains high order bits, the second contains the low order bits. Engineering unit: hours.

7. Test Date, Recent Log Date, Date of last torque profile in OP, Date of last torque profile in CL, Date Of Torque Reference In OP, Date Of Torque Reference in Close:
These registers contain date data that are represented in BCD format. The first register contains the day (in the first byte) and the month (in the second byte); the second register contains the year.
Example: Test Date (I. Registers 15, 16 - Address 14, 15)

Input Register 14 = 0x1210	→	Day: 12, Month: 10 (October)
Input Register 15 = 0x2008	→	Year: 2008

8. Alarm Log:

These registers contain several types of data: the first register is an enumerated register and contains the alarm code; the second and the third registers contain the date of the alarm; the forth and the fifth registers contain the time of the alarm.
Time registers are represented in BCD format; the first register contains the hours; the second contains the minutes (in the first byte) and the seconds (in the second byte).
Also, date registers are represented in BCD format, see Note 7 for details.
Registers from address 45 to 49 contain data of the most recent alarm; registers from address 50 to 54 contain data of the second recent alarm; registers from address 55 to 59 contain data of the third recent alarm; registers from address 60 to 64 contain data of the forth recent alarm; registers from address 65 to 69 contain data if the fifth recent alarm.

The table below shows the possible values of the alarm code:

Values	Description
0	None
1	Configuration Error
2	Motor Thermostat
3	Hi-Hi Temperature
4	Low Battery
5	Hi-Hi Torque in close direction
6	Hi-Hi Torque in open direction
7	Valve Jammed in close
8	Valve Jammed in open
9	Position Sensor
10	Speed Sensor or Direction
11	Main Voltage
12	Lost Phase
13	K1 Contactor
14	K2 Contactor
15	Mid travel alarm in close
16	Mid travel alarm in open
17	Hardware 1
18	Request Signal
19	Direction Test
20	Hardware 2
21	Hardware 3
22	Hardware 4
23	Hardware 5
24	Hardware 6
25	Hardware 7
26	Hardware 8
27	Hardware 9
28	Hardware 10
29	EFS Mid Travel
30	Hardware 11
31	Hardware 12

9. Warning Log:

These registers contain several types of data: the first register is an enumerated register and contains the warning code; the second and the third registers contain the date of the warning; the forth and the fifth registers contain the time of the warning.
Date and time are represented in BCD format, see Notes 6 and 7 for details.
Registers from address 65 to 69 contain data of the most recent warning; registers from address 70 to 74 contain data of the second recent warning; registers from address 75 to 79 contain data of the third recent warning; registers from address 80 to 84 contain data of the forth recent warning; registers from address 85 to 89 contain data if the fifth recent warning.

The table below shows the possible values of the warning code:

Values	Description
b0	1 = Hi-Hi Torque in open direction
b1	1 = Hi-Hi Torque in close direction
b2	1 = Hi-Hi Temperature
b3	1 = Main Voltage
b4	1 = Contactor Cycles
b5	1 = Maintenance Request
b6	1 = Motor Current
b7	1 = Wrong Stroke Limit
b8	1 = PST Error - Max. T1
b9	1 = PST Error - Max. T2
b10	1 = PST Error - Over Travel
b11	1 = PST Error - PST Failed
b12	Spare - Not Used
b13	Spare - Not Used
b14	Spare - Not Used
b15	1 = General Warning

10. Nominal Torque/Thrust:

These registers contain two type of data. The first register (address 95) contains the torque/thrust engineering unit in the first byte and an ASCII character in the second byte.
Other registers contain ASCII character, one character for each byte.

The table below shows the engineering unit codes:

Values	Description
0	lbf
1	Nm
2	lb
3	KN

11. Last Close Torque Curve, Reference Close Torque Curve, Last Open Torque Curve, Reference Open Torque Curve:

These registers contain several types of data; the combination of this data is described, byte per byte, in the table below:

Values	Description
1st - 101st	Torque Samples* (One sample for each byte)
102nd	Date of torque curve (BCD format): Day
103rd	Date of torque curve (BCD format): Month
104th	Date of torque curve (BCD format): Year minus 2000
105th	Time of torque curve (BCD format): seconds
106th	Time of torque curve (BCD format): minutes
107th	Time of torque curve (BCD format): hours
108th	Electronic temperature (signed char, engineering unit: °C)
109th	Terminal board temperature (signed char, engineering unit: °C)
110th	Mot/speed temperature (signed char, engineering unit: °C)
111th- 112th	Voltage. First byte contains most significant bits. (engineering unit: V)
113th - 114th	Closing/Opening time. First byte contains most significant bits (engineering unit: seconds)
115th - 128th	Reserved data

Each register contains 2 bytes of torque curve data.
*The index of these bytes indicates the actuator position.
Example: index 1 indicates the output torque on the position 0%; index 2 indicates the output torque on the position 1%, and so on).

7.4 Holding Registers

In the Holding Register Data Area, the XTE3000 Modbus RTU module implements the same Holding Registers available on ICON2000v4 and starting from Holding Register number 23, the new set of data.

For each register is declared the access in only reading (R) or in reading and writing (RW).

The following table shows the coils implemented in the XTE3000 Modbus RTU module.

Table 4.

Input Register Number	Input Register Address	RW	Range Value	Description
ICON2000v4 legacy data block				
1	0	RW	0 - 5	Actuator Commands (See Note 9)
2	1	RW	0 - 1000	Position Request (0=0.0%, 1000=100.0%)
3	2	RW	1 - 255	Deadband (1=0.1%, 255=25.5%)
4	3	RW	1 - 255	Motion Inhibit Time (seconds)
5	4	R	-	Reserved (always 0)
6	5	R	-	Reserved (always 0)
7	6	R	-	Reserved (always 0)
8	7	RW	0 - 4	Safety Behaviour (See Note 1)
9	8	RW	0 - 255	Delay before initiating safe action (seconds)
10	9	RW	0 - 100	Safe position (0=0%, 100=100%)
11	10	R	-	Reserved (always 0)
12	11	RW	-	Next Maintenance Date (1/2) (See Note 2)
13	12	RW	-	Next Maintenance Date (2/2) (See Note 2)
14	13	RW	-	Last Maintenance Date (1/2) (See Note 2)
15	14	RW	-	Last Maintenance Date (2/2) (See Note 2)
16	15	RW	-	Date Sync (1/2 - Reserved)
17	16	RW	-	Date Sync (2/2 - Reserved)
18	17	RW	-	Time Sync (1/2 - Reserved)
19	18	RW	-	Time Sync (2/2 - Reserved)
20	19	RW	-	Start Up Date (1/2) (See Note 2)
21	20	RW	-	Start Up Date (2/2) (See Note 2)
22	21	RW	0 - 2	Channel mode (See Note 3)

Input Register Number	Input Register Address	RW	Range Value	Description
ICON2000v4 legacy data block				
23 - 44	22 to 43	R	-	Reserved (always 0)
45	44	R	-	Actuator ID (always 0x9000)
46	45	R	-	Compatibility Number (always 0x0001)
47 - 3000	46 to 2999	R	-	Reserved (always 0)
3001	3000	R	-	Bettis3000 Identifier (always 0x9000)
3002	3001	R	0 - 65535	Actuator Status 1 (See Note 4)
3003	3002	R	0 - 65535	Actuator Status 2 (See Note 5)
3004	3003	R	0 - 65535	Actuator Status 3 (See Note 6)
3005	3004	R	0 - 1000	Current Position (0 = 0.0%, 1000 = 100.0%)
3006	3005	R	-100 - 100	Output Torque (See Note 7)
3007	3006	RW	-	Actuator Commands 1 (See Note 8)
3008	3007	RW	0 - 1000	Set Point (0=0.0%, 1000=100.0%)
3009	3008	RW	0 - 5	Actuator Commands 2 (See Note 9)
3010	3009	R	0 - 65535	Warnings (See Note 10)
3011	3010	R	0 - 65535	Alarms1 (See Note 11)
3012	3011	R	0 - 65535	Alarms2 (See Note 12)
3013	3012	R	0 - 65535	Aux. Analog Input mA (1 = 0.01 mA)
3014	3013	R	0 - 4095	Aux. Analog Input 12 bit (1 = 0.024%, See Note 19)
3015	3014	RW	0 - 1	Clear Alarms and Warnings Log (See Note 20)
3016	3015	RW	0 - 1	Reset Alarms and Warnings (See Note 21)
3017	3016	R	-	Spare - Not Used
3018	3017	RW	1 - 255	Deadband (1=0.1%, 255=25.5%)
3019	3018	RW	1 - 255	Motion Inhibit Time (s)
3020	3019	RW	0 - 4	Safety Behaviour (See Note 1)
3021	3020	RW	0 - 255	Delay before initiating safe action (s)
3022	3021	RW	0 - 100	Safe position (0=0%, 100=100%)
3023	3022	RW	0 - 2	Channel mode (See Note 3)
3024	3023	RW	-	Date Sync (1/2 - Reserved)
3025	3024	RW	-	Date Sync (2/2 - Reserved)
3026	3025	RW	-	Time Sync (1/2 - Reserved)
3027	3026	RW	-	Time Sync (2/2 - Reserved)
3028	3027	R	0 - 1	Interlock Mode (0=Standard, 1=Interlock). See 11.1 for details.
3029	3028	R	0 - 1	ESD Input Mode (0=PST-EFS, 1=EFS) See Section 11.1 for details.
3030	3029	R	-	Spare - Not Used
3031	3030	R	-	Spare - Not Used
3032	3031	R	-	Spare - Not Used

Input Register Number	Input Register Address	RW	Range Value	Description
ICON2000v4 legacy data block				
3033	3032	R	-	Spare - Not Used
3034	3033	R	-	Spare - Not Used
3035	3034	R	-	Actuator Identifier (ASCII, 1/8 - MSB)
3036	3035	R	-	Actuator Identifier (ASCII, 2/8)
3037	3036	R	-	Actuator Identifier (ASCII, 3/8)
3038	3037	R	-	Actuator Identifier (ASCII, 4/8)
3039	3038	R	-	Actuator Identifier (ASCII, 5/8)
3040	3039	R	-	Actuator Identifier (ASCII, 6/8)
3041	3040	R	-	Actuator Identifier (ASCII, 7/8)
3042	3041	R	-	Actuator Identifier (ASCII, 8/8 - LSB)
3043	3042	R	-	Actuator Serial Number (ASCII, 1/14 - MSB)
3044	3043	R	-	Actuator Serial Number (ASCII, 2/14)
3045	3044	R	-	Actuator Serial Number (ASCII, 3/14)
3046	3045	R	-	Actuator Serial Number (ASCII, 4/14)
3047	3046	R	-	Actuator Serial Number (ASCII, 5/14)
3048	3047	R	-	Actuator Serial Number (ASCII, 6/14)
3049	3048	R	-	Actuator Serial Number (ASCII, 7/14)
3050	3049	R	-	Actuator Serial Number (ASCII, 8/14)
3051	3050	R	-	Actuator Serial Number (ASCII, 9/14)
3052	3051	R	-	Actuator Serial Number (ASCII, 10/14)
3053	3052	R	-	Actuator Serial Number (ASCII, 11/14)
3054	3053	R	-	Actuator Serial Number (ASCII, 12/14)
3055	3054	R	-	Actuator Serial Number (ASCII, 13/14)
3056	3055	R	-	Actuator Serial Number (ASCII, 14/14 - LSB)
3057	3056	R	-	Valve Tag Name (ASCII, 1/14 - MSB)
3058	3057	R	-	Valve Tag Name (ASCII, 2/14)
3059	3058	R	-	Valve Tag Name (ASCII, 3/14)
3060	3059	R	-	Valve Tag Name (ASCII, 4/14)
3061	3060	R	-	Valve Tag Name (ASCII, 5/14)
3062	3061	R	-	Valve Tag Name (ASCII, 6/14)
3063	3062	R	-	Valve Tag Name (ASCII, 7/14)
3064	3063	R	-	Valve Tag Name (ASCII, 8/14)

Input Register Number	Input Register Address	RW	Range Value	Description
ICON2000v4 legacy data block				
3065	3064	R	-	Valve Tag Name (ASCII, 9/14)
3066	3065	R	-	Valve Tag Name (ASCII, 10/14)
3067	3066	R	-	Valve Tag Name (ASCII, 11/14)
3068	3067	R	-	Valve Tag Name (ASCII, 12/14)
3069	3068	R	-	Valve Tag Name (ASCII, 13/14)
3070	3069	R	-	Valve Tag Name (ASCII, 14/14 - LSB)
3071	3070	R	-	Base Card SW Version (ASCII, 1/2 - MSB)
3072	3071	R	-	Base Card SW Version (ASCII, 2/2 - LSB)
3073	3072	R	-	Modbus Interface SW Version (ASCII, 1/2 - MSB)
3074	3073	R	-	Modbus Interface SW Version (ASCII, 2/2 - LSB)
3075	3074	R	-	Nominal Torque/Thrust (See Note 13)
3076	3075	R	-	Nominal Torque/Thrust (See Note 13)
3077	3076	R	-	Nominal Torque/Thrust (See Note 13)
3078	3077	R	-	Nominal Torque/Thrust (See Note 13)
3079	3078	R	-	Test Date (1/2) (See Note 2)
3080	3079	R	-	Test Date (2/2) (See Note 2)
3081	3080	R	-	Spare - Not Used
3082	3081	R	-	Spare - Not Used
3083	3082	RW	-	Start Up Date (1/2) (See Note 2)
3084	3083	RW	-	Start Up Date (2/2) (See Note 2)
3085	3084	RW	-	Next Maintenance Date (1/2) (See Note 2)
3086	3085	RW	-	Next Maintenance Date (2/2) (See Note 2)
3087	3086	RW	-	Last Maintenance Date (1/2) (See Note 2)
3088	3087	RW	-	Last Maintenance Date (2/2) (See Note 2)
3089	3088	R	-	Recent Log Date (1/2) (See Note 2)
3090	3089	R	-	Recent Log Date (2/2) (See Note 2)
3091-3095	3090 - 3094	R	-	Alarms1 Code, date, time (See Note 15)
3096-3100	3095 - 3099	R	-	Alarms2 Code, date, time (See Note 15)
3101-3105	3100 - 3104	R	-	Alarms3 Code, date, time (See Note 15)
3106-3110	3105 - 3109	R	-	Alarms4 Code, date, time (See Note 15)
3111-3115	3110 - 3114	R	-	Alarms5 Code, date, time (See Note 15)
3116-3120	3115 - 3119	R	-	Warning1 Code, date, time (See Note 16)
3121-3125	3120 - 3124	R	-	Warning2 Code, date, time (See Note 16)

Input Register Number	Input Register Address	RW	Range Value	Description
ICON2000v4 legacy data block				
3126-3130	3125 - 3129	R	-	Warning3 Code, date, time (See Note 16)
3131-3135	3130 - 3134	R	-	Warning4 Code, date, time (See Note 16)
3136-3140	3135 - 3139	R	-	Warning5 Code, date, time (See Note 16)
3141	3140	R	-	Spare - Not Used
3142	3141	R	-	Spare - Not Used
3143	3142	R	-	Spare - Not Used
3144	3143	R	-	Spare - Not Used
3145	3144	R	-	Spare - Not Used
3146	3145	R	0 - 65535	Opening Time (s)
3147	3146	R	0 - 65535	Closing Time (s)
3148	3147	R	0 - 65535	Contactor Cycles (1/2) (See Note 14)
3149	3148	R	0 - 65535	Contactor Cycles (2/2) (See Note 14)
3150	3149	R	0 - 65535	Motor Run Time (1/2) (See Note 17)
3151	3150	R	0 - 65535	Motor Run Time (2/2) (See Note 17)
3152	3151	R	0 - 65535	Time without electrical power (1/2) (See Note 17)
3153	3152	R	0 - 65535	Time without electrical power (2/2) (See Note 17)
3154	3153	R	0 - 100	Reserved - Utilization Rate (0=0%, 100=100%)
3155	3154	R	0 - 65535	Recent Contactor Cycles (1/2) (See Note 14)
3156	3155	R	0 - 65535	Recent Contactor Cycles (2/2) (See Note 14)
3157	3156	R	0 - 65535	Recent Motor Run Time (1/2) (See Note 17)
3158	3157	R	0 - 65535	Recent Motor Run Time (2/2) (See Note 17)
3159	3158	R	0 - 65535	Recent time without electrical power (1/2) (See Note 17)
3160	3159	R	0 - 65535	Recent time without electrical power (2/2) (See Note 17)
3161	3160	R	0 - 100	Reserved - Recent Util. Rate (0=0%, 100=100%)
3162	3161	R	-127 - 127	Min. temperature of base card (°C)
3163	3162	R	-127 - 127	Max. temperature of base card (°C)
3164	3163	R	-127 - 127	Min. temperature of terminal board (°C)
3165	3164	R	-127 - 127	Max. temperature of terminal board (°C)
3166	3165	R	-127 - 127	Max. temperature of motor (°C)
3167	3166	R	0 - 65535	Number of motor alarm
3168	3167	R	0 - 65535	Number of torque alarm
3169	3168	R	-127 - 127	Recent min. temperature of base card (°C)

Input Register Number	Input Register Address	RW	Range Value	Description
ICON2000v4 legacy data block				
3170	3169	R	-127 - 127	Recent max. temperature of base card (°C)
3171	3170	R	-127 - 127	Recent min. temperature of terminal board (°C)
3172	3171	R	-127 - 127	Recent max. temperature of terminal board (°C)
3173	3172	R	-127 - 127	Recent max. temperature of motor (°C)
3174	3173	R	0 - 65535	Recent number of motor alarm
3175	3174	R	0 - 65535	Recent number of torque alarm
3176	3175	R	-	Spare - Not Used
3177	3176	R	-	Spare - Not Used
3178	3177	R	-	Spare - Not Used
3179	3178	R	-	Spare - Not Used
3180	3179	R	-	Spare - Not Used
3181	3180	R	0 - 65535	Torque profile in OP - Break Out
3182	3181	R	0 - 65535	Torque profile in OP - Peak
3183	3182	R	0 - 65535	Torque profile in OP - Ending
3184	3183	R	-	Date of last torque profile in OP (1/2) (See Note 2)
3185	3184	R	-	Date of last torque profile in OP (2/2) (See Note 2)
3186	3185	R	0 - 65535	Torque profile in CL - Break Out
3187	3186	R	0 - 65535	Torque profile in CL - Peak
3188	3187	R	0 - 65535	Torque profile in CL - Ending
3189	3188	R	-	Date of last torque profile in CL (1/2) (See Note 2)
3190	3189	R	-	Date of last torque profile in CL (2/2) (See Note 2)
3191	3190	R	0 - 65535	Torque reference in OP - Break Out
3192	3191	R	0 - 65535	Torque reference in OP - Peak
3193	3192	R	0 - 65535	Torque reference in OP - Ending
3194	3193	R	-	Date of torque reference in OP (1/2) (See Note 2)
3195	3194	R	-	Date of torque reference in OP (2/2) (See Note 2)
3196	3195	R	0 - 65535	Torque reference in CL - Break Out
3197	3196	R	0 - 65535	Torque reference in CL - Peak
3198	3197	R	0 - 65535	Torque reference in CL - Ending
3199	3198	R	-	Date of torque reference in CL (1/2) (See Note 2)
3200	3199	R	-	Date of torque reference in CL (2/2) (See Note 2)
3201-3264	3200 - 3263	R	-	Last Close Torque Curve (See Note 18)
3265-3328	3264 - 3327	R	-	Reference Close Torque Curve (See Note 18)
3329-3392	3328 - 3391	R	-	Last Open Torque Curve (See Note 18)
3393-3456	3392 - 3455	R	-	Reference Open Torque Curve (See Note 18)

Input Register Number	Input Register Address	RW	Range Value	Description
ICON2000v4 legacy data block				
3457	3456	R	-	Reserved
3458	3457	R	-	Reserved
3459	3458	R	-	Reserved
3460	3459	R	-	Spare - Not Used
3461	3460	R	-	Actuator Type (ASCII, 1/14 - MSB) (See Note 22)
3462	3461	R	-	Actuator Type (ASCII, 2/14) (See Note 22)
3463	3462	R	-	Actuator Type (ASCII, 3/14) (See Note 22)
3464	3463	R	-	Actuator Type (ASCII, 4/14) (See Note 22)
3465	3464	R	-	Actuator Type (ASCII, 5/14) (See Note 22)
3466	3465	R	-	Actuator Type (ASCII, 6/14) (See Note 22)
3467	3466	R	-	Actuator Type (ASCII, 7/14) (See Note 22)
3468	3467	R	-	Actuator Type (ASCII, 8/14) (See Note 22)
3469	3468	R	-	Actuator Type (ASCII, 9/14) (See Note 22)
3470	3469	R	-	Actuator Type (ASCII, 10/14) (See Note 22)
3471	3470	R	-	Actuator Type (ASCII, 11/14) (See Note 22)
3472	3471	R	-	Actuator Type (ASCII, 12/14)(See Note 22)
3473	3472	R	-	Actuator Type (ASCII, 13/14) (See Note 22)
3474	3473	R	-	Actuator Type (ASCII, 14/14 - LSB) (See Note 22)

NOTE:

1. Safety Behavior:

It's an enumerated register, the possible values are:

Values	Description
0	Off
1	Close Command
2	Open Command
3	Stay Put
4	Go to xx%

2. Next Maintenance Date, Last Maintenance Date, Start Up Date, Test Date, Recent LogDate, Date of last torque profile in OP, Date of last torque profile in CL, Date of torque reference in OP, Date of torque reference in CL:

These registers contain date data that are represented in BCD format. The first register contains the day (in the first byte) and the month (in the second byte); the second register contains the year.

Example: Next Maintenance Date (H. Registers 13, 14 - Address 12, 13)

Holding Register 12 = 0x1511	→	Day: 15, Month: 11 (November)
Holding Register 13 = 0x2008	→	Year: 2008

3. Channel Mode:

It's an enumerated register, the possible values are:

Values	Description
0	Channel1 Enabled, Channel2 Disabled
1	Channel2 Enabled, Channel1 Disabled
2	Auto: Channel1 Enabled, Channel2 Enabled

4. Actuator Status 1:

This is a bit enumerated register. The possible values are:

Values	Description
b0	1 = Close Limit
b1	1 = Open Limit
b2	1 = Actuator Moving
b3	1 = Monitor Relay
b4	1 = Selector in LOCAL
b5	1 = Selector in REMOTE
b6	1 = Alarm
b7	1 = Warning
b8	1 = DIN1
b9	1 = DIN2
b10	1 = DIN3
b11	1 = DIN4
b12	1 = DIN5
b13	1 = DIN6
b14	1 = Interlock Open
b15	1 = Interlock Close

5. Actuator Status 2:
This is a bit enumerated register. The possible values are:

Values	Description
b0	1 = Fail Safe Action
b1	1 = Actuator Opening
b2	1 = Actuator Closing
b3	1 = Selector in OFF
b4	1 = ESD/PST Control
b5	1 = Hardwired Remote Mode
b6	1 = Positioner Mode
b7	1 = Motor Operation Inhibited
b8	1 = Channel1 Active
b9	1 = Hardwired Open Command
b10	1 = Hardwired Close Command
b11	1 = Hardwired Stop Command
b12	1 = Hardwired BUS-on
b13	1 = Base Card Communication Error (Reserved)
b14	1 = ESD in progress
b15	1 = PST in progress

6. Actuator Status 3:
This is a bit enumerated register. The possible values are:

Values	Description
b0	1 = Last PST Aborted
b1	1 = Last PST Passed
b2 - b15	Spare - Not Used

7. Output Torque:
This register assumes negative values for torque in opening direction and positive values for torque in closing direction. The engineering unit is percent.

8. Actuator Commands 1:
“Open” and “Close” commands are self-maintained.
“Local Stop pressed,” “Selector in OFF,” “Selector in LOCAL” stops temporarily “Open,” “Close,” “Stop,” “ESD/PST,” “Positioner Mode” commands; when the local STOP is depressed, or the selector returns in REMOTE position, the previous command is restored.
If “ESD/PST command” value is ON, an ESD/PST command is generated. When the signal returns to OFF, the ESD/PST command is cleared. See Section 11.1 for details.
“Positioner Mode” command is available only in modulating actuators.
If its value is ON, the positioner function is enabled, and the actuator will position according to the content of position request register (Holding Register address 1).

The table below shows the possible values:

Values	Description
b0	1 = Close Command
b1	1 = Open Command
b2	1 = Stop Command
b3	1 = ESD Command
b4	1 = Enable Positioner Mode

9. “Actuator Commands,” “Actuator Commands 2”:
It’s an enumerated register, the possible values are:

Values	Description
0	Clear Commands
1	Generate Close Command
2	Generate Open Command
3	ESD Command (see See Section 11.1 for details)
4	Enable Positioner Mode
5	PST Command (see See Section 11.1 for details)

Each command is active until a new value of this register is received from the host.
“Open Command” and “Close Command” are also cleared in the following situations:

- Local STOP Pressed
- Local selector in OFF or LOCAL
- ESD/PST Command active
- Remote Hardwired controls active
- Alarm*
- End of travel

When “Enable Positioner Mode” command is sent to the Modbus interface, the actuator will position according to content of “Position Request” register (holding register address 1).
The command “Enable Positioner Mode” and the register addressed from 1 to 3 are available only in modulating actuators.

PST command is automatically cleared by the device.

The commands can be sent to the actuator also with Function Codes 05 (Write Single Coil) and 15 (Write Multiple Coils); it is recommended to verify the absence of conflict between commands from coils and commands from registers.

*Starting from FW Revision 2.02, “Low Battery” alarm (HR 3010 “Alarms1,” bit 13) doesn’t clear Open and Close commands.

10. Warnings:
This is a bit enumerated register. The possible values are:

Values	Description
b0	1 = Hi Torque in open direction
b1	1 = Hi Torque in close direction
b2	1 = Hi Temperature
b3	1 = Main Voltage
b4	1 = Contactor Cycles
b5	1 = Maintenance Request
b6	1 = Motor Current
b7	1 = Wrong Stroke Limit
b8	1 = PST Error - Max T1
b9	1 = PST Error - Max T2
b10	1 = PST Error - Over Travel
b11	1 = PST Error - PST Failed
b12	Spare - Not Used
b13	Spare - Not Used
b14	Spare - Not Used
b15	1 = General Warning

11. Alarms1:

This is a bit enumerated register. The possible values are:

Values	Description
b0	1 = Motor Thermostat
b1	1 = Hi-Hi Torque in open direction
b2	1 = Hi-Hi Torque in close direction
b3	1 = Blocked in open
b4	1 = Blocked in close
b5	1 = Hi-Hi temperature
b6	1 = Positioner Sensor
b7	1 = Speed Sensor
b8	1 = Main Voltage
b9	1 = K1 Contactor
b10	1 = K2 Contactor
b11	1 = Configuration Error
b12	1 = Hardware Error
b13	1 = Low Battery
b14	1 = Lost Phase
b15	1 = Request Signal

12. Alarms2:

This is a bit enumerated register. The possible values are:

Values	Description
b0	1 = Max. Torque intermediate position
b1	1 = Jammed in close
b2	1 = Jammed in open
b3	1 = Direction Test fail
b4	1 = Mid travel in open
b5	1 = Mid travel in close
b6	Spare - Not Used
b7	Spare - Not Used
b8	Spare - Not Used
b9	Spare - Not Used
b10	Spare - Not Used
b11	Spare - Not Used
b12	Spare - Not Used
b13	Spare - Not Used
b14	Spare - Not Used
b15	Spare - Not Used

13. Nominal Torque/Thrust:

These registers contain two types of data. The first register (address 3074) contains the torque/thrust engineering unit in the first byte and an ASCII character in the second byte.
Other registers contain ASCII character, one character for each byte.

The table below shows the engineering unit codes:

Values	Description
0	lbf
1	Nm
2	lb
3	KN
b4	1 = Enable Positioner Mode

14. Contactor Cycles, Recent Contactor Cycles:
These data are contained in two registers. The first register contains high order bits, the second contains the low order bits. Resolution data: 100 cycles.

15. Alarm Log:
These registers contain several types of data: the first register is an enumerated register and contains the alarm code; the second and the third registers contain the date of the alarm; the forth and the fifth registers contain the time of the alarm.
Time registers are represented in BCD format; the first register contains the hours; the second contains the minutes (in the first byte) and the seconds (in the second byte).
Also, date registers are represented in BCD format, see Note 2 for details.
Registers from address 3090 to 3094 contain data of the most recent alarm; registers from address 3095 to 3099 contain data of the second recent alarm; registers from address 3100 to 3104 contain data of the third recent alarm; registers from address 3105 to 3109 contain data of the forth recent alarm; registers from address 3110 to 3114 contain data if the fifth recent alarm.

The table below shows the possible values of the alarm code:

Values	Description
0	None
1	Configuration Error
2	Motor Thermostat
3	Hi-Hi Temperature
4	Low Battery
5	Hi-Hi Torque in close direction
6	Hi-Hi Torque in open direction
7	Valve Jammed in close
8	Valve Jammed in open
9	Position Sensor
10	Speed Sensor or Direction
11	Main Voltage
12	Lost Phase
13	K1 Contactor
14	K2 Contactor
15	Mid travel alarm in close
16	Mid travel alarm in open
17	Hardware 1
18	Request Signal
19	Direction Test
20	Hardware 2
21	Hardware 3
22	Hardware 4
23	Hardware 5
24	Hardware 6
25	Hardware 7
26	Hardware 8
27	Hardware 9
28	Hardware 10
29	EFS Mid Travel
30	Hardware 11
31	Hardware 12

16. Warning Log:

These registers contain several types of data: the first register is an enumerated register and contains the warning code; the second and the third registers contain the date of the warning; the forth and the fifth registers contain the time of the warning.
Time registers are represented in BCD format; the first register contains the hours; the second contains the minutes (in the first byte) and the seconds (in the second byte).
Also, date registers are represented in BCD format, see Note 2 for details.
Registers from address 3115 to 3119 contain data of the most recent warning; registers from address 3120 to 3124 contain data of the second recent warning; registers from address 3125 to 3129 contain data of the third recent warning; registers from address 3130 to 3134 contain data of the forth recent warning; registers from address 3135 to 3139 contain data if the fifth recent warning.

The table below shows the possible values of the warning code:

Values	Description
0	None
1	Hi Torque in open direction
2	Hi Torque in close direction
3	Hi Temperature
4	Main Supply
5	Contactor Cycles
6	Maintenance Request
7	Motor Current
8	Wrong Stroke Limits
9	BUS Fail
10	PST Failed
11	PST Max T1
12	PST Max T2
13	PST Over Travel

17. Motor Run Time, Recent Motor Run Time, Time without electrical power, Recent time without electrical power:

These data are contained in two registers. The first register contains high order bits, the second contains the low order bits. Engineering unit: hours.

18. Last Close Torque Curve, Reference Close Torque Curve, Last Open Torque Curve, Reference Open Torque Curve:

These registers contain several types of data; the combination of this data is described, byte per byte, in the table below:

Values	Description
1st - 101st	Torque Samples* (One sample for each byte)
102nd	Date of torque curve (BCD format): Day
103rd	Date of torque curve (BCD format): Month
104th	Date of torque curve (BCD format): Year minus 2000
105th	Time of torque curve (BCD format): seconds
106th	Time of torque curve (BCD format): minutes
107th	Time of torque curve (BCD format): hours
108th	Electronic temperature (signed char, range: -127 - +127, engeering unit: °C)
109th	Terminal board temperature (signed char, range: -127 - +127, engeering unit: °C)
110th	Mot/speed temperature (signed char, range: -127 - +127, engeering unit: °C)
111th - 112th	Voltage. First byte contains most significant bits. (engineering unit: V)
113th - 114th	Closing/Opening time. First byte contains most significant bits (engineering unit: s)
115th - 128th	Reserved data

Each register contains 2 bytes of torque curve data.
* The index of these bytes indicates the actuator position.
Example: index 1 indicates the output torque on the position 0%; index 2 indicates the output torque on the position 1%, and so on).

19. Aux. Analog Input 12 bit:

This register contains the Auxiliary Analog Input value scaled on 0-4095 (12 bit).
If the Auxiliary Analog Input is lower or equal to 4 mA, it assumes the value 0.
If the Auxiliary Analog Input is higher or equal to 20 mA, it assumes the value 4095.

20. Clear Alarms and Warnings Log

This register is available from Modbus Interface firmware revision 2.02. It's always read as 0.

Values	Description
0	No command
1	Clear Alarms and Warnings Log command

If it's set to 1, it's automatically cleared by the device.

21. Reset Alarms and Warnings

This register is available from Modbus Interface firmware revision 2.02. It's always read as 0.

Values	Description
0	No command
1	Reset Alarms and Warnings command

If it's set to 1, it's automatically cleared by the device.

22. Actuator Type

These registers are available from Modbus Interface firmware revision 2.03.

Section 8: Modbus Function Description

The following paragraph describes the input and output messages of XTE3000 Modbus RTU module. In all cases it is called "input signal" a data flowing from actuator to BUS, vice versa it is called "output signal" a data flowing from BUS to slave.

The following functions are supported by XTE3000 Modbus RTU module:

Table 5.

Function Code	Modbus Name
01	Read Coils Status
02	Read Discrete Inputs
03	Read Holding Registers
04	Read Input Registers
05	Write Single Coil
06	Write Single Register
08	Diagnostic
15 (0F Hex)	Write Multiple Coils
16 (10 Hex)	Write Multiple Registers
17 (11 Hex)	Report slave ID

8.1 Function Code 01 (0x01) Read Coils Status

References 0x

This function code is used to read the status of contiguous coils in a slave device.
Status of coils is indicated as 1 = ON and 0 = OFF.
XTE3000 Modbus RTU module has implemented 11 coils.

If quantity of coils requested is less than 1 or more than 11, the Exception Code 03 (0x03) is generated. If the combination of the starting address and the quantity of coils requested is more than 11, the Exception Code 02 (0x02) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated. If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are not allowed.

The list of the coils implemented in the XTE3000 Modbus RTU module is described in Section 7.2.

Example of a request to read coils 1 - 4 from device 12:

Table 6. Request

Field Name	Value (HEX)
Address	0C
Function Code	01
Start address Hi	00
Start address Lo	00
Quantity of Outputs Hi	00
Quantity of Outputs Lo	04
CRC	-

Table 7. Response

Field Name	Value (HEX)
Address	0C
Function Code	01
Byte Count	01
Output Status Address 3-0*	00
CRC	-

* bits 7-5 should be zero filled.

8.2 Function Code 16 (0x10) Write Multiple Registers

References 1x

This function code is used to read from 1 to 2000 contiguous status of discrete inputs in a slave device. Status of discrete inputs is indicated as 1 = ON and 0 = OFF.

XTE3000 Modbus RTU Module has implemented 32 discrete inputs.

If quantity of inputs requested is less than 1 or more than 32, the Exception Code 03 (0x03) is generated.

If the combination of the starting address and the quantity of inputs requested is more than 32, the Exception Code 02 (0x02) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are not allowed.

The list of the discrete inputs implemented in the XTE3000 Modbus RTU module is described in Section 7.1.

Example of a request to read discrete inputs 2 - 13 from device 18:

Table 8. Request

Field Name	Value (HEX)
Address	12
Function Code	02
Start address Hi	00
Start address Lo	01
Quantity of Inputs Hi	00
Quantity of Inputs Lo	0C
CRC	-

Table 9. Response

Function Code	Modbus Name
Address	12
Function Code	02
Byte Count	02
Input Status Address 9-1	00
Input Status Address 13-10*	00
CRC	-

* bits 7-4 are zero filled.

8.3 Function Code 03 (0x03) Read Holding Registers

References 4x

This function code is used to read the contents of a contiguous block of holding registers (from 1 to 125) in a slave device.

If quantity of registers requested is less than 1 or more than 125, Exception Code 03 (0x03) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are not allowed.

The list of the holding registers implemented in the XTE3000 Modbus RTU module is described in Section 7.4.

Example of a request to read Holding Registers 1 - 2 from device 13:

Table 10.

Field Name	Value (HEX)
Address	0D
Function Code	03
Start address Hi	00
Start address Lo	00
Quantity of Register Hi	00
Quantity of Register Lo	02
CRC	-

Table 11.

Field Name	Value (HEX)
Address	0D
Function Code	03
Byte Count	04
Holding Register Address 0 Hi	-
Holding Register Address 0 Low	-
Holding Register Address 1 Hi	-
Holding Register Address 1 Low	-
CRC	-

8.4 Function Code 04 (0x04) Read Input Registers

References 3x

This function is used to read from 1 to 125 contiguous input registers in a slave device.

XTE3000 Modbus RTU module has implemented 369 input registers.

If quantity of registers requested is less than 1 or more than 125, Exception Code 03 (0x03) is generated.

If the combination of the starting address and the quantity of registers requested is more than 369, Exception Code 02 (0x02) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are not allowed.

The list of the input registers implemented in the XTE3000 Modbus RTU module is described in Section 7.3.

Example of a request to read Input Registers 5 - 16 (Address 4 - 15) from device 4:

Table 12. Request

Field Name	Value (HEX)
Address	04
Function Code	04
Start address Hi	00
Start address Lo	04
Quantity of Register Hi	00
Quantity of Register Lo	0C
CRC	-

Table 13. Response

Field Name	Value (HEX)
Address	04
Function Code	04
Byte Count	18
Input Register Address 04 Hi	-
Input Register Address 04 Low	-
Input Register Address 05 Hi	-
Input Register Address 05 Low	-
Input Register Address 06 Hi	-
Input Register Address 06 Low	-
-	-
Input Register Address 0E Hi	-
Input Register Address 0E Low	-
Input Register Address 0F Hi	-
Input Register Address 0F Low	-
CRC	-

8.5 Function Code 05 (0x05) Write Single Coil

References 0x

This function is used to write a single coil to either ON or OFF in a remote device.

XTE3000 Modbus RTU Module has implemented 11 coils.

If coil address is more than 10, Exception Code 02 (0x02) is generated.

If coil value in data field is different from 0xFF00 or 0x0000, Exception Code 03 (0x03) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are allowed, no response is generated after a broadcast request.

The list of the coils implemented in the XTE3000 Modbus RTU module is described in Section 7.2.

The commands can be sent to the actuator also with Function Codes 06 (Write Single Register), 15 (Write Multiple Coils) and 16 (Write Multiple Registers); it is recommended to verify the absence of conflict between commands from coils and commands from registers.

Example of a request to write coil 1 (address 0) in the slave device 12:

Table 14. Request

Field Name	Value (HEX)
Address	0C
Function Code	05
Output address Hi	00
Output address Lo	00
Output Value Hi	FF
Output Value Lo	00
CRC	-

Table 15. Response

Field Name	Value (HEX)
Address	0C
Function Code	05
Output Address Hi	00
Output Address Lo	00
Output Value Hi	FF
Output Value Lo	00
CRC	-

8.6 Function Code 06 (0x06) Write Single Register

References 4x

This function code is used to write a value of a single holding register in a remote device.

XTE3000 Modbus RTU Module has implemented 22 holding registers.

If value of register is out of range (see Tables below for details), Exception Code 03 (0x03) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are allowed, no response is generated after a broadcast request.

The list of the holding registers implemented in the XTE3000 Modbus RTU module is described in Section 7.4.

The commands can be sent to the actuator also with Function Codes 05 (Write Single Coil), 15 (Write Multiple Coils) and 16 (Write Multiple Registers); it is recommended to verify the absence of conflict between commands from coils and commands from registers.

Example of a request to write Holding Register 1 (address 0) in the field device 15:

Table 16. Request

Field Name	Value (HEX)
Address	0F
Function Code	06
Register address Hi	00
Register address Lo	00
Register Value Hi	00
Register Value Lo	02
CRC	-

Table 17. Response

Field Name	Value (HEX)
Address	0F
Function Code	06
Output Address Hi	00
Output Address Lo	00
Output Value Hi	00
Output Value Lo	02
CRC	-

8.7 Function Code 08 (0x08) Diagnostic

This function code provides a certain number of tests to check the communication system between a master and a slave device, or for checking various internal error conditions within a slave.

The type of test to be executed can be selected using the two bytes sub-function code field in the query.

If sub-function code is not supported, Exception Code 01 (0x01) is generated.

If data field value is not valid, Exception Code 03 (0x03) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are not allowed.

The sub-functions implemented in the XTE3000 Modbus RTU Module are:

Table 18.

Sub-Function Code	Name
0 (0x0000)	Return Query Data
11 (0x000B)	Return Bus Message Count
12 (0x000C)	Return Bus Communication Error Count
13 (0x000D)	Return Bus Exception Error Count
14 (0x000E)	Return Slave Message Count
17 (0x0011)	Return Slave Busy Count
18 (0x0012)	Return Bus Character Overrun Count

8.7.1 Sub-Function 00 (0x0000) Return Query Data

The data passed in the request data field is to be returned (looped back) in the response. The entire response message should be identical to the request.

Any value of the Data Field in the request is valid.

The Data Field in the response is the echo of the Data Field in the request.

8.7.2 Sub-Function 11 (0x000B) Return Bus Message Count

The response data field returns the quantity of messages that the slave device has detected on the communications system since its last restart, clear counters operation, or power up.

Only 0x0000 code is valid in the request data field, otherwise Exception Code 03 (0x03) is generated.

8.7.3 Sub-Function 12 (0x000C) Return Bus Communication Error Count

The response data field returns the quantity of Modbus exception responses returned by the slave device since its last restart, clear counters operation, or power up.

Only 0x0000 code is valid in the request data field, otherwise Exception Code 03 (0x03) is generated.

8.7.4 Sub-Function 13 (0x000D) Return Bus Exception Error Count

The response data field returns the quantity of Modbus exception responses returned by the slave device since its last restart, clear counters operation, or power up.

Only 0x0000 code is valid in the request data field, otherwise Exception Code 03 (0x03) is generated.

8.7.5 Sub-Function 14 (0x000E) Return Slave Message Count

The response data field returns the quantity of messages addressed to the slave device or broadcast, that the slave device has processed since its last restart, clear counters operation, or power up.

Only 0x0000 code is valid in the request data field, otherwise Exception Code 03 (0x03) is generated.

8.7.6 Sub-Function 17 (0x0011) Return Slave Busy Count

The response data field returns the quantity of messages addressed to the remote device for which it returned a Slave Device Busy exception response, since its last restart, clear counters operation, or power up.

Only 0x0000 code is valid in the request data field, otherwise Exception Code 03 (0x03) is generated.

8.7.7 Sub-Function 18 (0x0012) Return Bus Character Overrun Count

The response data field returns the quantity of messages addressed to the slave device that it could not handle due to a character overrun condition, since its last restart, clear counters operation, or power up.

Only 0x0000 code is valid in the request data field, otherwise Exception Code 03 (0x03) is generated.

Example of a request to Return Query Data to the slave device 22:

Table 19. Request

Field Name	Value (HEX)
Address	16
Function Code	08
Sub-Function Code Hi	00
Sub-Function Code Lo	00
Data Hi	A5
Data Lo	B6
CRC	-

Table 20. Response

Field Name	Value (HEX)
Address	16
Function Code	08
Sub-Function Code Hi	00
Sub-Function Code Lo	00
Data Hi	A5
Data Lo	B6
CRC	-

8.8 Function Code 15 (0x0F) Write Multiple Coils

This function code is used to write the coils indicated in the query to ON or OFF state.

XTE3000 Modbus RTU Module has implemented 11 coils.

If quantity of coils is less than 1 or more than 11, Exception Code 03 (0x03) is generated.

Exception code 03 (0x03) is also generated if the byte count value is not correct.

If starting address or its combination with the quantity of coils is more than 11, Exception Code 02 (0x02) is generated.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are allowed, no response is generated after a broadcast request.

The list of the coils implemented in the XTE3000 Modbus RTU module is described in Section 7.2.

The commands can be sent to the actuator also with Function Codes 05 (Write Single Coil), 06 (Write Single Register) and 16 (Write Multiple Registers); it is recommended to verify the absence of conflict between commands from coils and commands from registers.

Example of a request to write coils 1 - 5 (address 0 - 4) to device 3:

Table 21. Request

Field Name	Value (HEX)
Address	03
Function Code	0F
Starting Address Hi	00
Starting Address Lo	00
Quantity of Coils Hi	00
Quantity of Coils Lo	05
Byte Count	01
Coils Value (data bits 7-0)*	08
CRC	-

*bits 7-5 should be zero filled.

Table 22. Response

Field Name	Value (HEX)
Address	03
Function Code	0F
Starting Address Hi	00
Starting Address Lo	00
Quantity of Coils Hi	00
Quantity of Coils Lo	05
CRC	-

8.9 Function Code 16 (0x10) Write Multiple Registers

This function code is used to write a block of contiguous registers in a slave device.

If quantity of registers is less than 1 or more than 123, Exception code 03 (0x03) is generated.

Exception Code 03 (0x03) is also generated if byte count field is not twice of the value of quantity of registers.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are allowed, no response is generated after a broadcast request.

The list of the holding registers implemented in the XTE3000 Modbus RTU module is described in Section 7.4.

The commands can be sent to the actuator also with Function Codes 05 (Write Single Coil), 06 (Write Single Register) and 15 (Write Multiple Coils); it is recommended to verify the absence of conflict between commands from coils and commands from registers.

Example of a request to write holding registers 1 - 4 (address 0 - 3) to device 2:

Table 23. Request

Field Name	Value (HEX)
Address	02
Function Code	10
Starting Address Hi	00
Starting Address Lo	00
Quantity of Registers Hi	00
Quantity of Registers Lo	03
Byte Count	06
Register Value Hi (address 0)	00
Register Value Lo (address 0)	04
Register Value Hi (address 1)	01
Register Value Lo (address 1)	F4
Register Value Hi (address 2)	00
Register Value Lo (address 2)	0A
CRC	-

Table 24. Response

Field Name	Value (HEX)
Address	02
Function Code	10
Starting Address Hi	00
Starting Address Lo	00
Quantity of Registers Hi	00
Quantity of Registers Lo	03
CRC	-

8.10 Function Code 17 (0x11) Report Slave ID

This function code is used to read the information relevant to the type of slave device.

XTE3000 Modbus RTU Module returns information about actuator type, actuator serial number, valve tag name, and software revision.

82 bytes of additional data are returned; each byte of the Additional Data contains an ASCII character.

If an error occurs while the slave device is performing the action requested in the query, Exception Code 04 (0x04) is generated.

If slave device is engaged to complete a request from the logic card, Exception Code 06 (0x06) is generated.

Broadcast messages are not allowed.

The following Tables describe the additional data field for XTE3000 actuator:

Table 25. Additional Data Field for XTE3000 Actuator

Data Bytes	Description
0 - 15	“Bettis XTE3000” (Act. Type)
16 - 43	Actuator Serial Number
44 - 71	Valve Tag Name
72 - 75	Base Card Software Revision
76 - 77	Blank characters
78 - 81	Modbus Interface SW Revision
CRC	-

Example of a request of Report Slave ID to device 8 (XTE3000 actuator):

Table 26. Request

Field Name	Value (HEX)
Address	08
Function Code	11
CRC	-

Table 27. Response

Field Name	Value (HEX)
Address	08
Function Code	11
Byte Count	52
Slave ID	00
Run Indicator Status	00
Actuator Type (16 bytes)	-
Actuator Serial Number (28 bytes)	-
Valve Tag Name (28 bytes)	-
Base Card SW Revision (4 bytes)	-
Blank Characters (2 byte)	-
Interface SW Revision (4 bytes)	-
CRC	-

8.11 Exception Codes

When a master sends a request to a slave, it expects a response. The following cases may occur:

- The slave receives the request and returns the normal response.
- The slave does not receive the request and no response is returned. In this case the master waits for a certain time (timeout) and then it restarts with a new request.
- The slave receives the request but is detects a communication error (CRC). In this case the slave does not return a response; the master waits for a certain time (timeout) and then it restarts with a new request.
- The slave receives the request without communication error, but it cannot process the data. In this case the slave returns an Exception Error message that describes the error.

XTE3000 Modbus RTU module has implemented the following Exception Codes:

Table 28.

Exception Code	Name	Description
01	Illegal Function Code	The function code requested is not supported in the slave device selected.
02	Illegal Data Address	The data address contained in the request message is not allowable in the slave device, or the combination of reference number and transfer length is invalid.
03	Illegal Data Value	A value contained in the request data field is not valid for the slave device.
04	Slave Device Failure	An error occurred while the slave device was performing the action requested by the request.
06	Slave Device Busy	The slave device is busy. The master should retransmit the request later.

Section 9: Configuration via Local Interface of XTE3000

The Modbus RTU interface “MOD_RTU_MOD” is an additional module that allows connecting the XTE3000 to a Modbus RTU fieldbus. The module can be used with either the base version or the optional modules of XTE3000. Here below are described the facilities available by the view and setup menu of XTE3000.

9.1 BUS Control

DIN 1 - DIN 6: by this routine it is possible to choose the condition associated to bits 8 - 13 of function code 02 (read input status). Here are the lists of the available conditions:

Status

- Open limit
- Closed limit
- Position >= xx %
- Position <= xx %
- Closing
- Opening
- Motor running
- Blinker
- Mid-travel position
- Local selected
- Remote selected
- Local stop active
- ESD signal on
- Manual operation

Alarm

- Motor over-temperature
- Over-torque
- Over-torque in OP
- Over-torque in CL
- Valve jammed
- Warnings
- Valve jammed in OP
- Valve jammed in CL
- Low alkaline battery (if present)
- Mid travel alarm in CL/OP

The following setting is supplied as standard:

- DIN 1: mid travel position
- DIN 2: local stop active
- DIN 3: motor over-temperature (motor thermostat alarm)
- DIN 4: over-torque (Hi-Hi torque alarm)
- DIN 5: valve jammed alarm
- DIN 6: mid travel alarm in OP/CL

- Baud rate: by this function it is possible to set the transmission speed. All devices on the same data line must have the same transmission speed.
- Parity: this routine allows to choose the parity in the Modbus RTU message (ODD, EVEN, NO PARITY)
- Node: by this function it is possible to enter the node address. Each device must have its address. Each address must be associated to one only device. The available address range is from 1 to 247.
- Termin 1 status: by this routine the internal termination of channel 1 can be connected to the BUS line (ON/OFF). Set “termin 1 = ON” only if the actuator is at the begin or at the end of the BUS line and if channel 1 is selected.
- Termin 2 status: by this routine the internal termination of channel 2 can be connected to the BUS line (ON/OFF). Set “termin 2 = OFF” if single BUS line is used.
- Mode: by this routine the channel 1 or channel 2 are enabled to work. The option is used only when redundant cable is requested. Set “mode = CH1” if single BUS line is used.

Configuration Procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the setup mode”. When the message of display is “SETUP MODE OK?” press YES. Press YES to select actuator setup menu, press NO to scroll the list of available routines and then press YES to select BUS CONTROL.
- Press YES if the condition linked to DIN 1 is correct, or press NO to change, then press YES.
- Repeat the previous step for DIN 2, DIN 3 - DIN 6
- Press YES if the configured value of the BAUD RATE is correct, or press NO to change, then press YES.
- Press YES if the configured parity (PARITY) is correct (ODD, EVEN, NONE), or press NO to change, then press YES
- Press YES if the configured value of the node address (NODE) is correct (from 1 to 247), or press NO to change, then press YES.
- Press YES if the configured status of termination 1 (TERMIN 1) is correct (ON/OFF), or press NO to change, then press YES.
- Press YES if the configured status of termination 2 (TERMIN 2) is correct (ON/OFF), or press NO to change, then press YES.
- Press YES if the configured MODE is correct (CH1, CH2, AUTO), or press NO to change, then press YES.

View Procedure

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode”. When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator setup menu, press NO to scroll the list of available routines and then press YES to select BUS CONTROL.
- Press YES to scroll the list of BUS CONTROL parameters.

9.2 Positioner Function

The function is available only on the modulating actuators. The value 0 of position request, received from BUS, corresponds to close request and the value 1000 corresponds to open request. The XTE3000 compares the present position % of the actuator with the position request % received from the BUS, and if the difference is greater than the dead band, the actuator is driven to reach the new requested position.

The following options can be configured via either bus or local operator interface:

- Dead band: configurable from 0.0% to 25.5% of the maximum position error (difference among position request % and present position %). The configured value should be great enough to avoid "hunting" effect of the actuator.
- Motion inhibit time: it allows to adjust the length of the delay time between two cycles of the motor. It can be configured from 0 to 255 seconds and allows to set the maximum number of start / hour of electrical motor.

Configuration Procedure

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions "entering the setup mode." When the message of display is "SETUP MODE OK?" press YES. Press YES to select actuator setup menu, press NO to scroll the list of available routines and then press YES to select POSITIONER.
- Press YES if the configured value of the Dead Band is correct (from 0 to 25.5% of position error), or press NO to change, then press YES.
- Press YES if the configured value of the Motion Inhibit Time is correct (from 0 to 255 seconds), or press NO to change, then press YES.

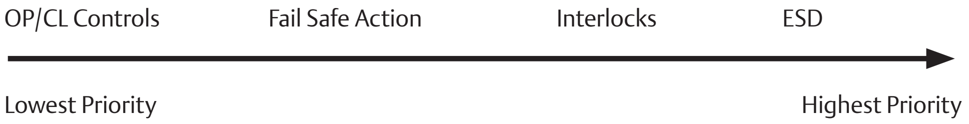
View Procedure

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions "entering the view mode". When the message of display is "VIEW MODE OK?" press YES. Press YES to select actuator setup menu, press NO to scroll the list of available routines and then press YES to select the routine (POSITIONER).
- Press YES to scroll the list of parameters.

9.3 Fail Safe Function

This function is available only if requested on order. It allows configuring the action of the actuator in case of loss of the BUS signal. The action takes place only if the local selector is in REMOTE and if BUS is operating. When the BUS signal restores, also the actuator restores at its normal functioning.
The fail safe function can be configured via either BUS or local operator interface.

The hardwired controls ESD and INTERLOCKS override the Fail Safe action according to the following diagram (the hardwired controls INTERLOCKS are available only if optional modules APTM/APTM1 or PSM/PSM1 are present.



OP/CL Controls Fail Safe Action Interlocks ESD

Lowest Priority Highest Priority

The following options can be configured:

- Fail safe action: open, close, stay-put, go to position %, no action (OFF)
- Length of the delay time before than the fail safe action takes place
(length = 10 seonds + configured value)

Configuration Procedure

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the setup mode.” When the message of display is “SETUP MODE OK?” press YES. Press YES to select actuator setup menu, press NO to scroll the list of available routines and then press YES to select FAIL SAFE.
- Press YES if the configured ACTION is correct (open, close, stay-put, go to position xx%, off), or press NO to change, then press YES.
- Press YES if the configured value of the DELAY is correct (from 0 to 255 seconds), or press NO to change, then press YES.

View Procedure

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode.” When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator setup menu, press NO to scroll the list of available routines and then press YES to select the routine (FAIL SAFE).
- Press YES to scroll the list of parameters.

9.4 Viewing Transmission Info

The following procedure allows to see the most significant info relevant to the BUS data transmission:

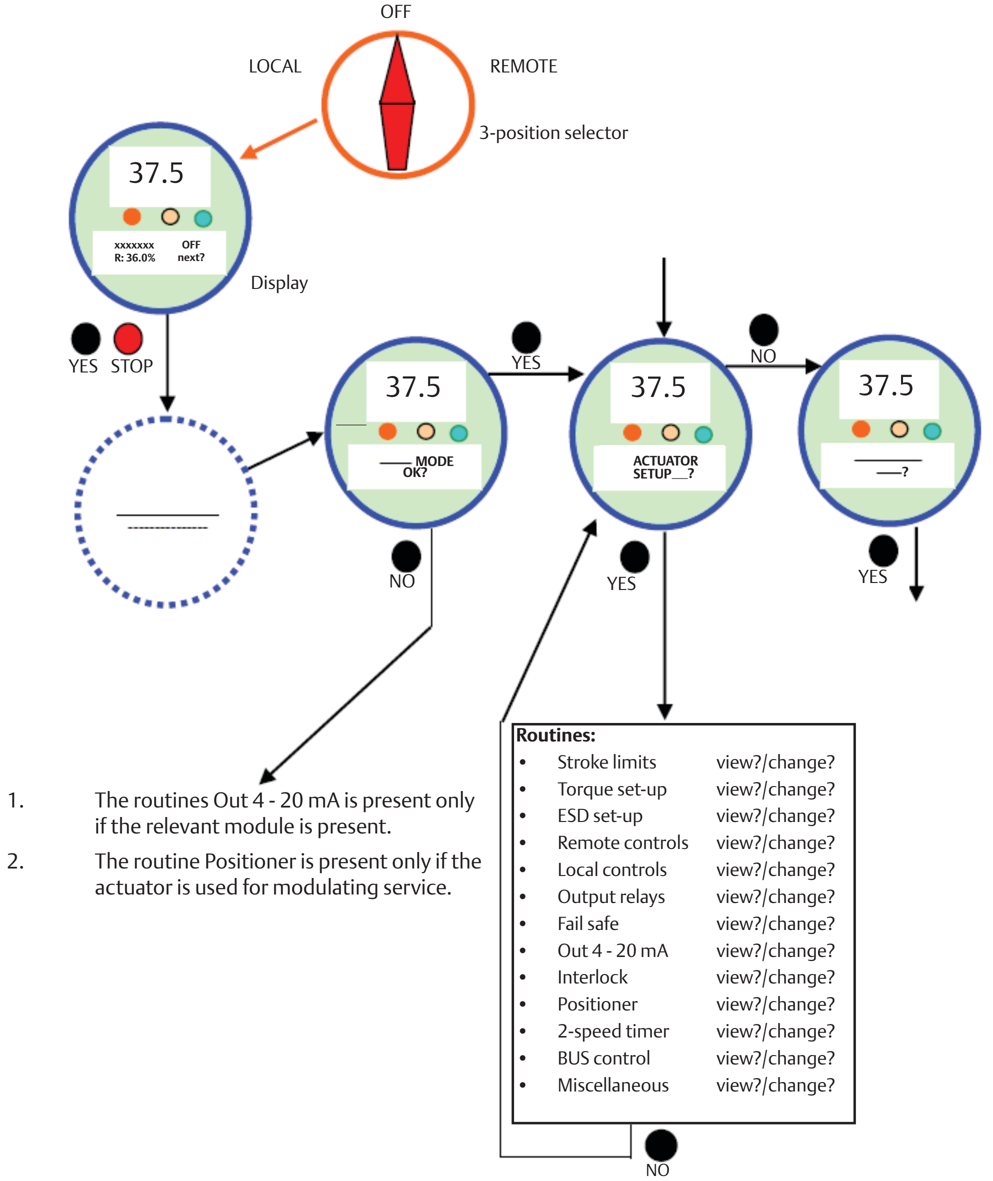
- Move the local selector to OFF or REMOTE and then press YES until the display shows NODE REPORT.
- Press NO to exit or press YES to scroll the list of transmission information.

9.5 BUS Signal Failure Indication

In case of loss of BUS signal, a warning is generated. It is signalled by the flashing of the relevant ALARM/WARNING LED and by indication on the local 2 lines/16 character display.

The figure below shows the list of routines available in the XTE3000 view or setup menu.

Figure 9



Routines:

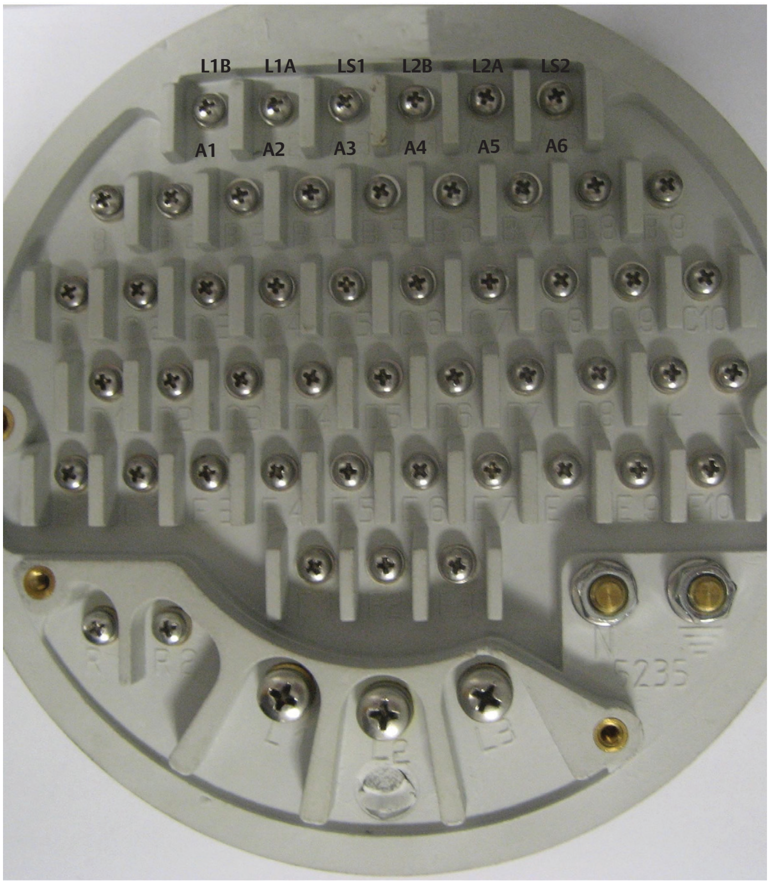
•	Stroke limits	view?/change?
•	Torque set-up	view?/change?
•	ESD set-up	view?/change?
•	Remote controls	view?/change?
•	Local controls	view?/change?
•	Output relays	view?/change?
•	Fail safe	view?/change?
•	Out 4 - 20 mA	view?/change?
•	Interlock	view?/change?
•	Positioner	view?/change?
•	2-speed timer	view?/change?
•	BUS control	view?/change?
•	Miscellaneous	view?/change?

1. The routines Out 4 - 20 mA is present only if the relevant module is present.
2. The routine Positioner is present only if the actuator is used for modulating service.

NOTE:
On order, the XTE3000 can be configured to inhibit “BUS signal failure” indication.

9.6 Actuator Terminal Board

Figure 10



Legend:

EIA/TIA 485 Name	Modbus Specification	Terminal Board	CN3
B/B’ CH1	D1 CH1	A1	L1B
A/A’ CH1	D0 CH1	A2	L1A
C/C’ CH1	Common CH1	A3	LS1
B/B’ CH2	D1 CH2	A4	L2B
A/A’ CH2	D0 CH2	A5	L2A
C/C’ CH2	Common CH2	A6	LS2

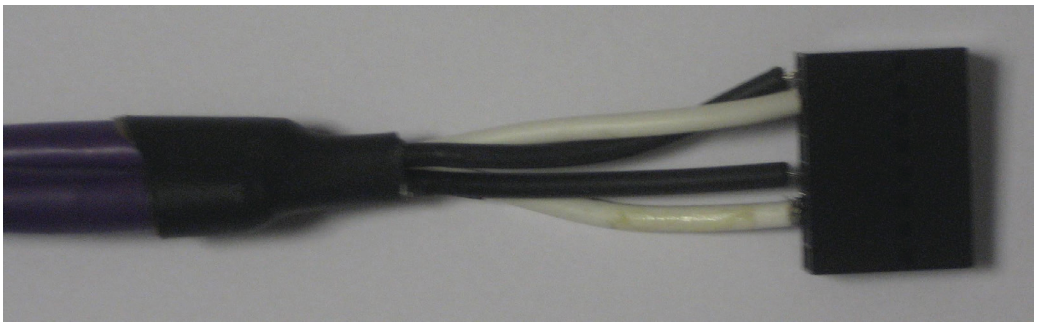
Section 10: Annex A

10.1 Replacement of 494MOD1000 with 494MOD1200

XTE3000 Modbus RTU module can be mounted only on base card revision 6.03 or subsequently. When a user needs to replace an older 494MOD1000 card with a new 494MOD1200 module, it's necessary to provide the following operations:

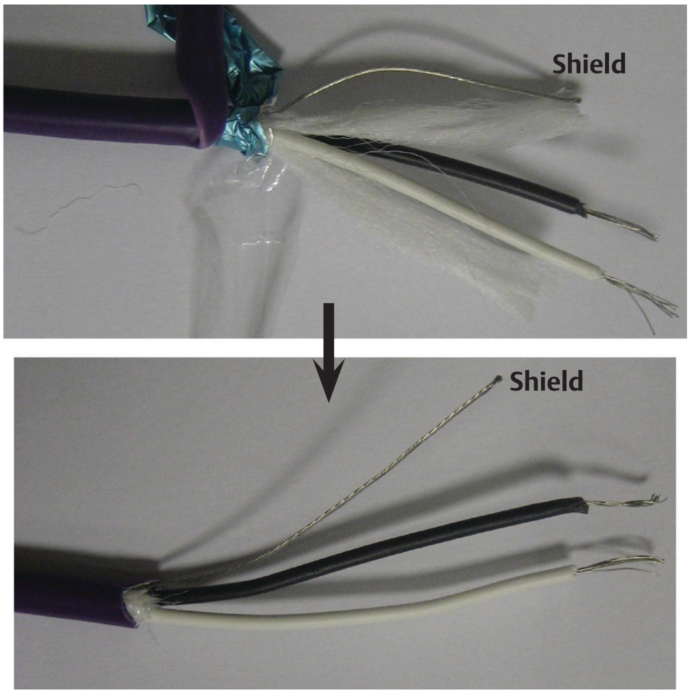
- Disconnect the 494MOD1000 card from the cable linked to the terminal board (see the Figure below).

Figure 11



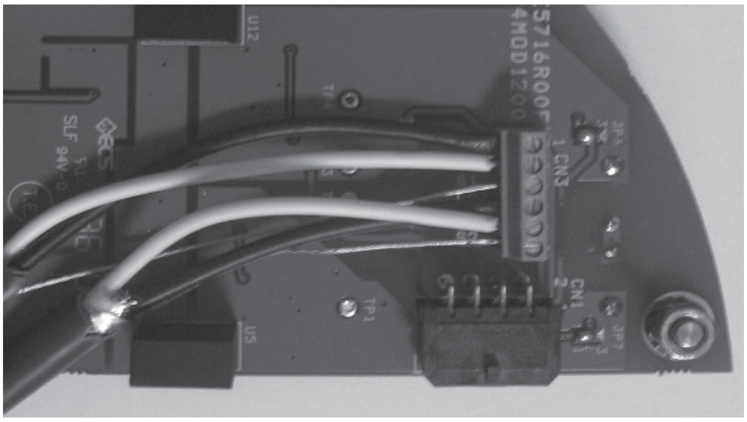
- Remove the 494MOD1000 interface card.
- Cut the cable to have all the six wires available (1 shield and 2 signals for each channel):

Figure 12



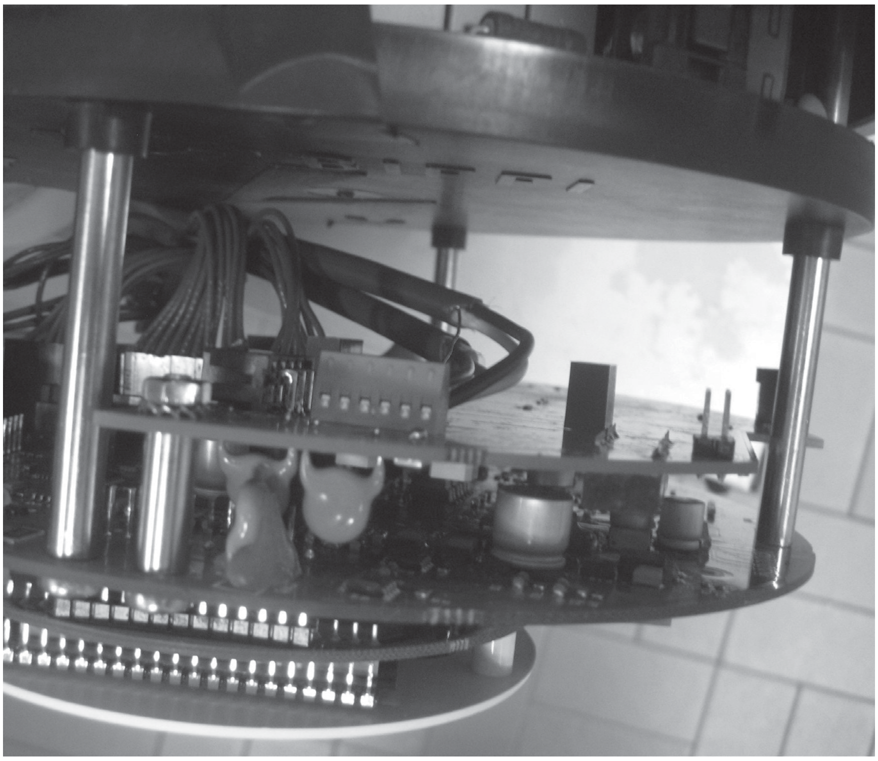
- Check through a tester, the link between the cable and the terminal board and connect every wire to the correspondent pin of CN3 connector (see the table in Section 9.6).

Figure 13



- Now connect the 494MOD1200 interface card to the actuator logic card.

Figure 14



Section 11: Annex B

This addendum explains some functionality introduced with base card Firmware version 7.00.

The revision of base card can be checked by reading Holding Registers 3070-3071 or by using Function Code 17 (0x11) Report Slave ID.

If revision of base card is less than 7.00 this addendum is not relevant.

11.1 Multiple Functionality of ESD Command and Status

The ESD command and status can assume the meaning of PST signal, based on type of actuator and setting of “ESD Input Mode” parameter.

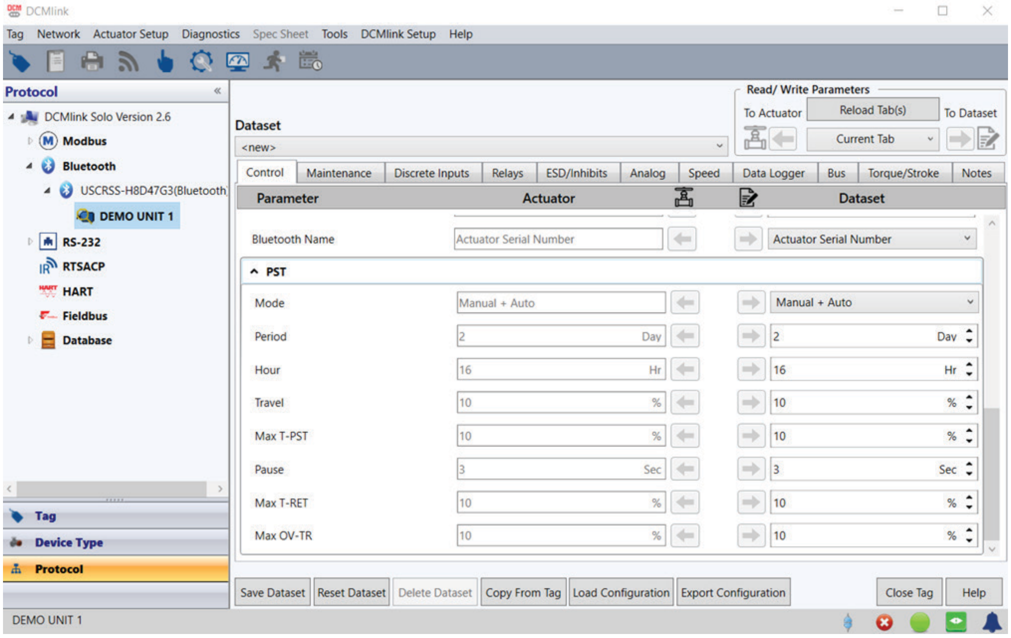
The Table below explicit its functionality:

Table 29.

Actuator Model	ESD Input Mode Parameter	ESD Command Functionality	ESD Status Functionality
XTE	PST-efs	Electrical ESD	ESD IN PROGRESS
XTE	EFS	Electrical ESD	ESD IN PROGRESS
EFS	PST-efs	PST	PST IN PROGRESS
EFS	EFS	Spring ESD	ESD IN PROGRESS
A/A’ CH2	D0 CH2	A5	L2A
C/C’ CH2	Common CH2	A6	LS2

The ESD input mode parameter can be set on “Actuator Setup” menu of local control or AManager software (see the Figure below):

Figure 15



Dataset
<new>

Parameter	Actuator	Dataset
Bluetooth Name	Actuator Serial Number	Actuator Serial Number
PST		
Mode	Manual + Auto	Manual + Auto
Period	2 Day	2 Day
Hour	16 Hr	16 Hr
Travel	10 %	10 %
Max T-PST	10 %	10 %
Pause	3 Sec	3 Sec
Max T-RET	10 %	10 %
Max OV-TR	10 %	10 %

This page is intentionally left blank

World Area Configuration Centers (WACC) offer sales support, service, inventory and commissioning to our global customers.
Choose the WACC or sales office nearest you:

NORTH & SOUTH AMERICA

19200 Northwest Freeway
Houston TX 77065
USA
T +1 281 477 4100

Av. Hollingsworth
325 Iporanga Sorocaba
SP 18087-105
Brazil
T +55 15 3413 8888

ASIA PACIFIC

No. 9 Gul Road
#01-02 Singapore 629361
T +65 6777 8211

No. 1 Lai Yuan Road
Wuqing Development Area
Tianjin 301700
P. R. China
T +86 22 8212 3300

MIDDLE EAST & AFRICA

P. O. Box 17033
Jebel Ali Free Zone
Dubai
T +971 4 811 8100

P. O. Box 10305
Jubail 31961
Saudi Arabia
T +966 3 340 8650

24 Angus Crescent
Longmeadow Business Estate East
P.O. Box 6908 Greenstone
1616 Modderfontein Extension 5
South Africa
T +27 11 451 3700

EUROPE

Holland Fasor 6
Székesfehérvár 8000
Hungary
T +36 22 53 09 50

Strada Biffi 165
29017 Fiorenzuola d'Arda (PC)
Italy
T +39 0523 944 411

For complete list of sales and manufacturing sites, please visit www.emerson.com/actuationtechnologieslocations or contact us at info.actuationtechnologies@emerson.com

www.emerson.com/bettis

The contents of this publication are presented for informational purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available upon request. We reserve the right to modify or improve the designs or specifications of such products at any time without notice.

BETTIS™

EMERSON™