ULTIMA® MOS-5E

Hydrogen Sulphide
Smart Transmitter
MODBUS Specification

MOS5EMODBUS, Rev 00

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1. Introduction

1.1. Scope

The ULTIMA MOS 5E detector complies with a standard MODBUS protocol. This document specifies all of the device specific features and documents MODBUS Protocol implementation details. The functionality of this Field Device is described sufficiently to allow its proper application in a process and its complete support in MODBUS Host Applications.

There shall be no changes in any of the performance criteria of the ULTIMA MOS 5E due to the addition of the MODBUS protocol communications channel.

1.2. Purpose

This specification is designed to complement the ULTIMA MOS 5E Instruction Manual by providing a complete description of this field device from a MODBUS Communications perspective.

1.3. Who should use this document?

This specification is designed to be a technical reference for MODBUS capable host application developers, system integrators, and knowledgeable end users.

1.4. References

DOCUMENT NAME	DOCUMENT RELATIONSHIP
MODBUS Communications Protocol Specifications	This is used to insure compliance with the MODBUS Communication Protocol.
ULTIMA MOS 5E Instruction Manual	This is the MSA ULTIMA MOS 5E Product Instruction Manual.

2. Modbus RTU Serial Interface

2.1. General

The Modbus communications interface is based on the RS485 standard. It is implemented as a 2 wire, half-duplex, balanced differential interface which conforms to the EIA-485 specification. Each slave device must have its unique address so that more than one device can be connected to an independently addressed on the same RS485-link.

The Smart Transmitter Interface implements the RTU protocol as described in the “Modicon Protocol Reference Guide PI-MBUS-300 Rev. G. The Modbus RTU is an asynchronous NRZ format. The RTU mode and serial format must be the same for all devices on a Modbus network. The instrument acts as a Modbus communications “Slave”.

Two Modbus connections (Modbus 1 and Modbus 2), are provided, sharing the node address and all other Modbus parameters.

The device receives and transmits on both connections simultaneously, requiring the host for Modbus 2 to be quiescent when Modbus 1 connection is active and vice versa.

The Modbus interface factory defaults are set to Node Address 1, 19K2 baud, no parity and 1 stop bit. When the instrument is powered up, the Modbus setup defaults to the settings used before it was powered down. The interface supports a maximum of 2 bits for stop bit and parity information. A selection of 2 stop bits causes no parity to be implemented.

The Modbus Interface and Menu Interface can be used simultaneously for Modbus read commands only. For write commands, the operation is mutually exclusive. Any attempts to perform a Modbus write are inhibited while the Menu Interface is active. This is indicated by returning the Slave Device Busy response (Exception Code 6).

2.2. Modbus Message Characteristics

Baud rate	2K4, 4K8, 9K6 or 19K2
Byte length (11 bits) max	11 / (Baud rate) ms
Inter message spacing or Modicon specification min	3.5 bytes
Inter Byte spacings per Modicon specification min/max	0 bytes / 1.5 bytes
Number of Bytes per message min/max	7 / 15

2.3. Modbus Exception Codes

Code Name	Description	Hex value
Illegal function	Function code is not recognised by the slave	01
Illegal data address	Data address specified is not supported by the slave	02
Illegal data value	Data value specified is not supported by the slave	03
Slave device busy	The slave is engaged in completing a long duration programme command	06

2.4. Modbus Read/Write - Commands

Function Code	Description	Access Type
1	Read coil status	Read
2	Read input status	Read
3	Read holding registers	Read
4	Read input registers	Read
5	Force single coil	Write
6	Preset single register	Write
15	Force multiple coils	Write
16	Preset multiple registers	Write

Any of commands with Function Code 1, 2, 3, 4 allow data to be read from the instrument. The message structure for each read command specifies a start register address. A maximum of 5 consecutive registers can be accessed including the start register address. Each register configures the data as 2 bytes with the most significant byte first. If more than 5 registers are addressed or if there is an attempt to access any register outside the valid read register address space, the Illegal Data Address response (Exception Code 2) is returned.

Any of the commands with Function Code 5, 6 15, 16 allow write data to be written to the instrument. The message structure for each write command specifies a register address to which data is written. The message structure for each multiple write command (15, 16) specifies a register address with the byte count set at 2 to allow single register access. If more than 1 register is addressed or if there is an attempt to access any register outside the valid write register address space, the Illegal Data Address response (Exception Code 2) is returned. Broadcast mode uses address 0 and sends the same data to all attached slaves.

The issue of a write command to a single valid write register normally causes all of the data specified to be overwritten. In certain situations, it is impossible to force a condition due to the presence of an external event e.g. attempts to clear a fault while the fault condition is still present results in the fault not being cleared. For other situations, any attempts to assign unused, read-only or out of range values will have no effect. It is advisable to issue a read of the same register range to verify the true data value present subsequent to the write cycle.

2.5. Modbus Register Configuration

Registers 1, 2, 4, 5, 6 and 8 contain the value of the single parameter specified, the remaining registers contain composite parameters. Attempts to write a data value out of range for these parameters will result in the Illegal Data Value response (Exception Code 3). Unused bits are set to 0.

Register	Function	Access Type	Hex address	Scaling	
1	Analogue output current	Read	00	0mA 20mA	=0x8000 =0xFFFE
2	Sensor response at calibration in Kohms	Read	01	0 10000	=0x8000 =0xFFFE
3	Alarm, fault and analogue output status	Read	02	NA	
4	Option setup (1, 5, & 9)	Read	03	0 100	=0x8000 =0xFFFE
5	A1 alarm trip level setup	Read/write	04	0 100	=0x8000 =0xFFFE
6	A2 alarm trip level setup	Read/write	05	0 100	=0x8000 =0xFFFE
7	Open collector outputs and analogue output current at calibration setup	Read/write	06	NA	
8	Number of successful calibrations	Read/write	07	0 65535	=0x0000 =0xFFFF
9	Modbus setup	Read/write	08	NA	
10	Clear latched alarms and faults	Write	09	NA	

2.5.1 Register 3

A bit value of 1 denotes that the corresponding element is active. A bit value of 0 denotes that the corresponding element is inactive. All of the 16 bits in the register are simultaneously accessed during a read.

Description	Alarm/Fault Type	Bit Position
A2 Alarm	latching/non-latching	15
A1 Alarm	latching/non-latching	14
Analogue output at cal level	-	13
-	-	12
-	-	11
-	-	10
F09 calibration (check) time-out	latching	9
F08 Sensor short circuit	non-latching	8
F07 EEPROM CRC error	latching	7
F06 Power low	non-latching	6
F05 Sensor heater short circuit	non-latching	5
F04 Sensor heater open circuit	non-latching	4
F03 Low response	latching	3
F02 Fail to calibrate	latching	2
F01 Analogue output open circuit	non-latching	1
-	-	0

2.5.2 Register 7

Description	Bit position	Dec. value	Function
-	15-6	0	-
Analogue output at calibration	5-4	0 1 2	0.0mA 1.5mA 2.0mA
A2 alarm open collector output normally energised/de-energised	3	0 1	de-energised energised
A1 alarm open collector output normally energised/de-energised	2	0 1	de-energised energised
A2 alarm open collector output normally latching/non-latching	1	0 1	Non-latching Latching
A1 alarm open collector output normally latching/non-latching	0	0 1	Non-latching Latching

2.5.3 Register 9

Description	Bit position	Dec. value
Node address	15-8	1-255
1 stop bit 2 stop bits	7	0 1
No parity Odd parity Even parity	6-5	0 1 2
-	4-2	0
Baud rate 19200 Baud rate 9600 Baud rate 4800 Baud rate 2400	1-0	0 1 2 3

The Node address specified in the high data byte is not written during a broadcast write of the register.

2.5.4 Register 10

The clear register is written a value of 1 to clear a latched Fault or Alarm indicated in the status register. Each issue of the clear command clears a single latched Fault or Alarm in order of priority, provided the Fault or Alarm condition no longer exists.

Safety Warning

Installation and maintenance must be carried out by suitably skilled and competent personnel only.

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