



# ULTIMA<sup>®</sup> MOS-5

Intelligent Sensor for  
Hydrogen Sulfide Gas Detection  
Modbus Specifications



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## **Modbus Specifications**

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**Part No.**  
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**MOS5MODBUS**  
**00**

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# 1.0 Introduction

## 1.1 Scope

The ULTIMA MOS 5 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 5 due to the addition of the MODBUS protocol communications channel.

## 1.2 Purpose

This specification is designed to complement the ULTIMA MOS 5 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

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

## 2.0 Modbus Interface

### 2.1 Baud Rate

The baud rate is selectable via the Modbus Communications Interface. The selectable baud rates are 19200, 9600, 4800, or 2400 bits per second.

### 2.2 Data Format

The Data Format is selectable via the Modbus Communications Interface. The selectable data formats are as follows:

Data Bits	Parity	Stop Bit	Format
8	None	1	8-N-1
8	Even	1	8-E-1
8	Odd	1	8-O-1
8	None	2	8-N-2

Table 6: Data Format

### 2.3 Modbus Read Status Protocol (Query/Response)

#### 2.3.1 Modbus Read Query Message

Byte	Modbus	Range	Referenced to ULTIMA MOS-5 Intelligent Sensor
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	ULTIMA MOS-5 Intelligent Sensor ID (Address)
2 <sup>nd</sup>	Function Code	03	Read Holding Registers
3 <sup>rd</sup>	Starting Address Hi**	00	Not Used by ULTIMA MOS-5 Intelligent Sensor
4 <sup>th</sup>	Starting Address Lo**	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Commands
5 <sup>th</sup>	No. Of Registers Hi	00	Not Used by ULTIMA MOS-5 Intelligent Sensor
6 <sup>th</sup>	No. Of Registers Lo	01	No. Of 16 Bit Registers
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

**\*NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

**\*\* NOTE:** Start Address can be a maximum of 9999 Address Locations (0000-270E).

### 8.3.2 Modbus Read Response Message

Byte	Modbus	Range	Referenced to ULTIMA MOS-5 Intelligent Sensor
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	ULTIMA MOS-5 Intelligent Sensor ID (Address)
2 <sup>nd</sup>	Function Code	03	Read Holding Registers
3 <sup>rd</sup>	Byte Count	02	No. Of Data Bytes
4 <sup>th</sup>	Data Hi	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Hi Byte Status Data
5 <sup>th</sup>	Data Lo	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Lo Byte Status Data
6 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
7 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

## 2.4 Modbus Write Command Protocol (Query/Response)

### 2.4.1 Modbus Write Query Message

Byte	Modbus	Range	Referenced to ULTIMA MOS-5 Intelligent Sensor
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	ULTIMA MOS-5 Intelligent Sensor ID (Address)
2 <sup>nd</sup>	Function Code	06	Preset Single Register
3 <sup>rd</sup>	Register Address Hi	00	Not Used by ULTIMA MOS-5 Intelligent Sensor
4 <sup>th</sup>	Register Address Lo	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Commands
5 <sup>th</sup>	Preset Data Hi	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Hi Byte Command Data
6 <sup>th</sup>	Preset Data Lo	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Lo Byte Command Data
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

**\*NOTE:** Address 0 is reserved for broadcast mode and will not be supported at this time.

**\*\*NOTE:** Start Address can be a maximum of 9999 Address Locations (0000-270E).

### 2.4.2 Modbus Write Response Message

Byte	Modbus	Range	Referenced to ULTIMA MOS-5 Intelligent Sensor
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	ULTIMA MOS-5 Intelligent Sensor ID (Address)
2 <sup>nd</sup>	Function Code	06	Preset Single Register
3 <sup>rd</sup>	Register Address Hi	00	Not Used by ULTIMA MOS-5 Intelligent Sensor
4 <sup>th</sup>	Register Address Lo	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Commands
5 <sup>th</sup>	Preset Data Hi	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Hi Byte Command Data
6 <sup>th</sup>	Preset Data Lo	00-FF (Hex)	ULTIMA MOS-5 Intelligent Sensor Lo Byte Command Data
7 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
8 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

## 2.5 Function Codes Supported

Function Code 03 (Read Holding Registers) is used to read status from the slave unit.

Function Code 06 (Preset Single Register) is used to write a command to the slave unit.

## 2.6 Exception Responses and Exception Codes

### 2.6.1 Exception Response

In a normal communications query and response, the master device sends a query to the ULTIMA MOS-5 Intelligent Sensor and the ULTIMA MOS-5 Intelligent Sensor receives the query without a communications error and handles the query normally within the master device's allowable timeout. The ULTIMA MOS-5 Intelligent Sensor then returns a normal response to the master. An abnormal communications produces one of four possible events:

- If the ULTIMA MOS-5 Intelligent Sensor does not receive the query due to a communications error, then no response is returned from the ULTIMA MOS-5 Intelligent Sensor and the master device eventually processes a timeout condition for the query.
- If the ULTIMA MOS-5 Intelligent Sensor receives the query, but detects a communication error (CRC, etc.), then no response is returned from the ULTIMA MOS-5 Intelligent Sensor and the master device eventually processes a timeout condition for the query.
- If the ULTIMA MOS-5 Intelligent Sensor receives the query without a communications error, but cannot process the response to the master within the master's timeout setting, then no response is returned from the ULTIMA MOS-5 Intelligent Sensor. The master device eventually processes a timeout condition for the query. In order to prevent this condition from occurring, the maximum response time for the ULTIMA MOS-5 Intelligent Sensor is 200 milliseconds. Therefore, the master's timeout setting should be set to 200 milliseconds or greater.
- If the ULTIMA MOS-5 Intelligent Sensor receives the query without a communications error, but cannot process it due to reading or writing to a non-existent ULTIMA MOS-5 Intelligent Sensor command register, then the ULTIMA MOS-5 Intelligent Sensor returns an exception response message informing the master of the error.

The exception response message (ref. No. 4 above) has two fields that differentiate it from a normal response:

Byte	Modbus	Range	Referenced to ULTIMA MOS-5 Intelligent Sensor
1 <sup>st</sup>	Slave Address	1-247* (Decimal)	ULTIMA MOS-5 Intelligent Sensor ID (Address)
2 <sup>nd</sup>	Function Code	83 or 86 (Hex)	MSB is set with Function Code
3 <sup>rd</sup>	Exception Code	01 - 06 (Hex)	Appropriate Exception Code (See Below)
4 <sup>th</sup>	CRC Lo	00-FF (Hex)	CRC Lo Byte
5 <sup>th</sup>	CRC Hi	00-FF (Hex)	CRC Hi Byte

### 2.6.2 Exception Code

**Exception Code Field:** In a normal response, the ULTIMA MOS-5 Intelligent Sensor returns data and status in the data field, which was requested in the query from the master. In an



exception response, the ULTIMA MOS-5 Intelligent Sensor returns an exception code in the data field, which describes the ULTIMA MOS-5 Intelligent Sensor condition that caused the exception. Below is a list of exception codes that are supported by the ULTIMA MOS-5 Intelligent Sensor:

<b>Code</b>	<b>Name</b>	<b>Description</b>
01	Illegal Function	The function code received in the query is not an allowable action for the ULTIMA MOS-5 Intelligent Sensor
02	Illegal Data Address	The data address received in the query is not an allowable address for the ULTIMA MOS-5 Intelligent Sensor.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the ULTIMA MOS-5 Intelligent Sensor.
04	Slave Device Failure	An unrecoverable error occurred while the ULTIMA MOS-5 Intelligent Sensor was attempting to perform the requested action.
05	Acknowledge	The ULTIMA MOS-5 Intelligent Sensor has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master.
06	Device Busy	The ULTIMA MOS-5 Intelligent Sensor is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.

**Table 7: Exception Codes**

## 2.7 ULTIMA MOS-5 Command Register Locations

Parameter	Function	Type	Scale	Access	Register Address	Master I/O Address
Analog	0-20 mA Current Output	Value	16-Bit	R	0000	40001
Mode	Indicates and Controls Mode	Bit		R/W	0001	40002
Status/Error	Indicates Errors		Bit	R	0002	40003
Not Used	N/A				0003	40004
Unit Type	Identifies the ULTIMA MOS-5 Intelligent Sensor in Decimal	Value	16-Bit	R	0004	40005
Software Rev	Indicates the Software Revision	ASCII	2-Char	R	0005	40006
Status Block	Returns Analog, Mode, Status, Error, and Sensor Life Returns Address 6,7,8	Multi	6-bytes	R	0006	40007
Analog	Analog 2	Value		R	0006	40007
Mode	Mode	Bit		R	0006	40007
Error 2	Error 2	Bit		R	0007	40008
Error 1	Error 1	Bit		R	0007	40008
Sensor Life	Sensor Life	Value		R	0008	40009
Display	Display (LED & MSD)	Bit /ASCII		R	0009	40010
Display	Display (Mid & LSD)	ASCII		R	000A	40011
Serial Number	Upper serial number	Value		R	000B	40012
Serial Number	Lower serial number	32 bit		R	000C	40013
Alarm Settings	Read or change settings for the high alarm	Bit	(0-15)	R/W	000D	40014
Warn Settings	Read or change settings for the low alarm	Bit	(0-15)	R/W	000E	40015
Com1 Addr.	Read or change settings for the Com1 Address	Value	8-Bit	R/W	000F	40016
Com1 Baud	Read or change settings for the Com1 Baud Rate	Bit	(0-7)	R/W	0010	40017
Com1 Data Format	Read or change settings for the Com1 Data Format	Bit	(0-7)	R/W	0011	40018
Com2 Addr.	Read or change settings for the Com2 Address	Value	8-Bit	R/W	0012	40019
Com2 Baud	Read or change settings for the Com2 Baud Rate	Bit	(0-7)	R/W	0013	40020
Com2 Data Format	Read or change settings for the Com2 Data Format	Bit	(0-7)	R/W	0014	40021
Not Used	N/A				0015	40022
Reset Alarms	Reset any latched alarms	Bit	(0)	W	0016	40023
Sensor Life	Read the Remaining Sensor Life	Bit	(0)	R	0017	40024
Sensor Scale	Change the Scale for the H <sub>2</sub> S sensors on the ULTIMA MOS-5 Intelligent Sensor	Value	8-Bit	R/W	0018	40025
NFPA 72 Controller (Co)	Indicates Calibration Success	Value	8-Bit	R/W	0019	40026
Not Used					001A	40027
Not Used					001B	40028

Parameter	Function	Type	Scale	Access	Register Address	Master I/O Address
Not Used					001C	40029
HART EN/DE	Enable/Disable	Bit	1/0	R/W	001D	40030
HART Test	Transmit a constant 1 or 0 signal	Value	0,1,2	R/W	001E	40031
Cal Abort	Abort calibration			R/W	001F	40032
Total Receive Errors	Total # of Receive Errors	Value	8-Bit	R	0020	40033
Bus Activity Rate %	Bus Activity Rate in % of This Addressed Node vs. Other Addressed Nodes	Decimal		R	0021	40034
Function Code Errors	Total # of Function Code Errors	Value	8-Bit	R	0022	40035
Starting Addr. Errors	Total # of Starting Address Errors	Value	8-Bit	R	0023	40036
No. of Register Errors	Total # of Register Errors	Value	16-Bit	R	0024	40037
RXD CRC Hi Errors	Total # of RXD CRC Hi Errors	Value	16-Bit	R	0025	40038
RXD CRC Low Errors	Total # of RXD CRC Low Errors Same as 38	Value	16-Bit	R	0026	40039
Ch1 Parity Errors	Total parity errors	Value	16-Bit	R	0027	40040
Ch1 Overrun errors	Total overrun errors	Value	16-Bit	R	0028	40041
Ch1 Framing errors	Total Framing errors	Value	16-Bit	R	0029	40042
Ch1 Software Errors	Total Software request errors	Value	16-Bit	R	002A	40043
Not used					002B	40044
Clear CH1 Errors	Clear Ch1 Hardware Errors	Bit	(0)	W	002C	40045
Clear Ch1 Errors	Clear Ch 1 Software Errors	Bit	(0)	W	002D	40046
HART Ao Range	Changes the range of Ao for HART only			R/W	002E	40047
Not used	Internal use only				002F	40048
Event Timer	Event Set Time Hi				0030	40049
Event Timer	Event Set Time Lo				0031	40050
	<b>See Event CHART</b>					
	Clear Event				005F	40096
User Info	User information 1				0060	40097
User Info	User information 2				0061	40098
	"	"				
	"					
User info	User information 16				006F	40112
Ch2 Total Receive Errors	Total # of Receive Errors	Value	16-Bit	R	0070	40113

Parameter	Function	Type	Scale	Access	Register Address	Master I/O Address
Ch2 Bus Activity Rate %	Bus Activity Rate in % of This Addressed Node vs. Other Addressed Nodes	Decimal		R	0071	40114
Ch2 Function Code Errors	Total # of Function Code Errors	Value	16-Bit	R	0072	40115
Ch2 Starting Addr Errors	Total # of Starting Address Errors	Value	16-Bit	R	0073	40116
Ch2 No of Register Errors	Total # of Register Errors	Value	16-Bit	R	0074	40117
Ch2	CRC errors	Value	16-Bit	R	0075	40118
Ch2	CRC errors	Value	16-Bit	R	0076	40119
Ch2 Parity Errors	Total parity errors	Value	16-Bit	R	0077	40120
Ch2 Overrun errors	Total overrun errors	Value	16-Bit	R	0078	40121
Ch2 Framing errors	Total Framing errors	Value	16-Bit	R	0079	40122
Ch2 Software Errors	Total Ch 2 Software request errors	Value	16-Bit	R	007A	40123
Not used	Not used				007B	40124
Ch2 Clear errors	Ch2 Clear Hardware errors	Bit	0	R/W	007C	40125
Ch2 Clear errors	Ch2 Clear Software errors	Bit	0	R/W	007D	40126
Not used	Not used				007E	40127

**Table 8: Command Register Locations**

## 2.8 ULTIMA MOS-5 Command Register Details

### 2.8.1 Analog (00H)

A read returns a value, which is proportional to the 0-20 mA output current. The current is based on a 16-bit value. The scaling is 0 - 65535 decimal, which corresponds to 0 - 21.7 mA.

### 2.8.2 Mode (01H)

A read returns the present mode of the ULTIMA MOS-5 Intelligent Sensor.

A write command changes the mode to the requested mode. A data value of 08 starts calibration mode if the unit is in the run mode. It also goes from cal check to cal mode.

Exception: Returns an exception code 01 (illegal function) if an illegal write is requested.

A calibrate command returns an exception code 01 (Acknowledge 05). The operation will take a long time to complete.

Function	Bit Position	Access
Calibration Complete	7 MSB	Read
Spanning	6	Read
Zero Complete, Waiting for Gas	5	Read
Zeroing	4	Read
Calibration Mode	3	Read/Write
Calibration Check Mode	2	Read/Write
Run Mode	1	Read
Startup Mode	0 LSB	Read

### 2.8.3 Status/Error (02H)

A read returns the alarm state and errors that are occurring at the present time, which are indicated, by bit position.

Function	Bit Position	Access
Alarm	15 MSB	Read
Warn	14	Read
Fault	13	Read
Not Used	12	Read
Not Used	11	Read
Not Used	10	Read
Not Used	9	Read
Switch Error	8	Read
Setup Error	7	Read
Calibration Check Timeout	6	Read
EEPROM Error	5	Read
EPR0M Error	4	Read
Sensor Error	3	Read
Fail to Calibrate	2	Read
Low Supply Voltage	1	Read

**2.8.4 Not Used (03H)**

**2.8.5 Unit Type (04H)**

A read returns the decimal value 4005. This identifies the ULTIMA MOS-5 Intelligent Sensor.

**2.8.6 Software Revision (05H)**

A read returns the software revision of the ULTIMA MOS-5 Intelligent Sensor in 2 ASCII characters.

**2.8.7 Status Block (06H)**

A read returns a 6-byte message containing the analog (2 bytes), mode (1 byte), status/error (2 bytes), and sensor life (1 byte) in that order. For the format of each byte, refer to the appropriate individual commands.

---

**NOTE:** These registers can be read individually or as a group. Only when the starting address is 06 is a block return.

---

**2.8.8 Analog Value (06H)**

A value which is proportional to the 0-20 mA output current. The current is based on a 16-bit value. The scaling is 0 - 65535 decimal, which corresponds to 0 - 21.7 mA.

**2.8.9 Mode & Error (07H)**

See mode (02)

Calibration Complete	8000
Spanning	4000
Zero Complete, Waiting for Gas	2000
Zeroing	1000
Calibration Mode	0800
Calibration Check Mode	0400
Run Mode	0200
Startup Mode	0100
Alarm	0080
Warn	0040
Error ( any error)	0020
NA	0010
NA	0008
NA	0004
Internal	0002
Switch	0001

**2.8.10**

## 2.8.11 Error Sensor & Sensor Life (08H)

### 2.8.11.1 Upper Bit for Sensor Errors

Setup error	80
Cal Check error	40
EEPROM Check sum error	20
Flash Check sum	10
Sensor	08
Calibration error	04
Low supply	02
NA	01

### 2.8.11.2 Lower Bit for Sensor Life

Sensor Life	0-100%
-------------	--------

## 2.8.12 Display (0x09H & 0x0AH)

The display is also present on the Modbus. It is at address 0x09 and 0x0A. The first address (0x09) contains the LED, the decimal point location, and the most significant digit (MSD). The upper word represents the LED and Decimal point. They are defined as shown below. The lower word is the ASCII value for the MSD. The second address (0x0A) represents the middle digit (MID) and the least significant digit (LSD) in ASCII. The upper word represents the MID and the lower word represents the LSD.

DP_LSD	0x01
DP_MID	0x02
DP_MSD	0x04
WRN_LED	0x08
ALM_LED	0x10

## 2.8.13 Serial Number (0BH/0CH)

The serial number is a 32-bit word but the value is only 23 bits long. The upper bits are always zero. This is done to keep the same serial number as the HART serial number. Address 0x0C contains the lower part of the number and address 0x0B contains the upper part.

## 2.8.14 Alarm Settings (0DH)

A read returns the present alarm settings of the ULTIMA MOS-5 Intelligent Sensor. A write command changes the settings to the requested values. The set points are programmable in 5% FS steps (1% FS steps for 20 ppm range).

**NOTE:** The maximum alarm setting for the ULTIMA MOS-5 Intelligent Sensor is 60% LEL.

A “1” in the 9<sup>th</sup> bit position means the output is latching, a “0” means it is non-latching. A “1” in the 8<sup>th</sup> bit position means the output is normally energized a “0” means it is normally de-energized. The alarm set point cannot be set below the warn set point.

**Factory default is 60% FS, latching, de-energized.**

Exception: Returns an exception code 01 (illegal function) if an illegal write is requested.

Byte	Function	Bit Position	Access
High	Not Used	15 MSB	Read
	Not Used	14	Read
	Not Used	13	Read
	Not Used	12	Read
	Not Used	11	Read
	Not Used	10	Read
	Latching/Non-Latching	9	R/W
	Energized/De-Energized	8	R/W
Low	Set point	(7-0)	R/W

### 2.8.15 Warn Settings (0EH)

A read returns the present warn settings of the ULTIMA MOS-5 Intelligent Sensor. A write command changes the settings to the requested values. The set points are programmable in 5% FS steps (1% FS steps for 20 ppm range).

**NOTE:** The maximum alarm setting for the ULTIMA MOS-5 Intelligent Sensor is 60% LEL.

A “1” in the 9<sup>th</sup> bit position means the output is latching, a “0” means it is non-latching. A “1” in the 8<sup>th</sup> bit position means the output is normally energized a “0” means it is normally de-energized. The warn set point cannot be set above the alarm set point.

**Factory default is 30% FS, non-latching, de-energized. The maximum allowable set point is 50 ppm.**

Exception: Returns an Exception Code 01 (illegal function) if an illegal write is requested.

Byte	Function	Bit Position	Access
High	Not Used	15 MSB	Read
	Not Used	14	Read
	Not Used	13	Read
	Not Used	12	Read
	Not Used	11	Read
	Not Used	10	Read
	Latching/Non-Latching	9	R/W
	Energized/De-Energized	8	R/W
Low	Set point	(7-0)	R/W

### 2.8.16 Com1 Address (0FH)

A read command returns the current address for Com1. A write command changes the address to the requested value. Valid addresses are 1-247 decimal. **Factory default is 1.**

Exception: If the address is not in range an illegal data value (03) is returned.



### 2.8.17 Com1 Baud Rate (10H)

A read command returns the current baud rate for Com1. A write command changes the baud rate to the requested values. Valid settings are shown in the table on the following page. **Factory default is 19200.**

Baud Rate	Value	Access
2400	24	Read/Write
4800	48	Read/Write
9600	96	Read/Write
19200	192	Read/Write

Table 9: Com1 Baud Rate

Exception: If the baud rate is not in range, an illegal data value (03) is returned.

### 2.8.18 Com1 Data Format (11H)

A read command returns the current data format for Com1. Write command changes the data format to the requested values. Valid settings are shown in the table below. **Default format is 8-N-1.**

Data	Parity	Stop	Format	Data(Bits 9-8)	Access
8	None	1	8-N-1	0	Read/Write
8	Even	1	8-E-1	1	Read/Write
8	Odd	1	8-O-1	2	Read/Write
8	None	2	8-N-2	3	Read/Write

Table 10: Com1 Data Format

Exception: If the data format is not in range, an illegal data value (03) is returned.

### 2.8.19 Com2 Address (12H)

A read command returns the current address for Com2. A write command changes the address to the requested values. Valid addresses are 1-247 decimal. **Factory default is 2.**

Exception: If the address is not in range an illegal data value (03) is returned.

### 2.8.20 Com2 Baud Rate (13H)

A read command returns the current baud rate for Com2. A write command changes the baud rate to the requested values. Valid settings are shown in the table below. **Factory default is 19200.**

Baud Rate	Value	Access
2400	24	Read/Write
4800	48	Read/Write
9600	96	Read/Write
19200	192	Read/Write

Table 11: Com2 Baud Rate

Exception: If the baud rate is not in range an illegal data value (03) is returned.

### 2.8.21 Com2 Data Format (14H)

A read command returns the current data format for Com2. Write command changes the data format to the requested values. Valid settings are shown in the table below. **Factory default is 8-N-1.**

Data	Parity	Stop	Format	Data(Bits 9-8)	Access
8	None	1	8-N-1	0	Read/Write
8	Even	1	8-E-1	1	Read/Write
8	Odd	1	8-O-1	2	Read/Write
8	None	2	8-N-2	3	Read/Write

**Table 12: Com2 Data Format**

Exception: If the data format is not in range an illegal data value (03) is returned.

### 2.8.22 Not Used (15H)

### 2.8.23 Reset Alarms (16H)

A write to this register with a data value of 1 resets any latched alarms provided the current gas level is below the alarm set point.

### 2.8.24 Sensor Life (17H)

A read returns the current estimate of remaining sensor life in percentage.

### 2.8.25 Sensor Scale (18H)

A read returns the current H<sub>2</sub>S sensor scale selected: 0-20 ppm, 0-50 ppm, 0-100 ppm. A write changes the scale to the desired scale. If the scale is changed, a calibration fault is generated, forcing the operator to calibrate the unit.

H <sub>2</sub> S Sensor Scale	Value (decimal)
0-20 ppm	20
0-50 ppm	50
0 –100 ppm	100

**Table 13: Sensor Scale**

### 2.8.26 NFPA 72 Controller (Co – Calibration Output) (19H)

This register indicates when a successful calibration takes place. In NFPA 72 Controller mode, the current goes to 3.2 mA for five seconds then to 4.0 mA. An aborted calibration would go straight to 4.0 mA. A read to this register will return the status of the NFPA 72 Controller option.

0x01 enables this option, 0x00 disables this option, similar to the write.

### 2.8.27 Not Used (1A, AB, 1C H)

## 2.9 HART Enable (1D H)

This command enables or disables the HART. A “0” is Modbus a “1” is HART.

### 2.9.1 HART Test (1Eh)

This command is used to test the HART output. It produces constant zeros or constant ones on the HART output.

Code	Results
0	Normal
1	Constant ones
2	Constant zeros

### 2.9.2 Abort Calibration (1Fh)

Sending a “1” causes a calibration or calibration abort.

### 2.9.3 Total Receive Errors (20H)

A read indicates the total number of Modbus communication receive errors that occurred in the slave device. When the counter for these errors reaches 255, it rolls over to zero and begins counting again. The total errors are an accumulation of the individual communication errors listed below.

### 2.9.4 Bus Activity Rate % (21H)

A read indicates the bus activity rate in percent of this Slave’s addressed node versus other addressed nodes. Range of this value is in hex (0-64) which translates to decimal (0-100%).

### 2.9.5 Function Code Errors (22H)

A read indicates the number of function code errors that occurred in the slave device. When the counter for these errors reaches 255, it rolls over to zero and begins counting again.

### 2.9.6 Starting Address Errors (24H)

The counter is incremented for each address that does not equal the device address.

A read indicates the number of starting address errors that occurred in the slave device. When the counter for these errors reaches 255, it rolls over to zero and begins counting again.

### 2.9.7 RXD CRC Errors Hi (25H)

A read indicates the number of RXD CRC errors that occurred in the slave device. When the counter for these errors reaches 255, it rolls over to zero and begins counting again.

### 2.9.8 RXD CRC Errors Lo (Same as Hi) (26H)

**NOTE:** Hi and Lo CRC errors are now reported in the same word. A read from either Hi or Lo returns the same count.

### **2.9.9 Parity Errors (27H)**

A read indicates the number of hardware UART parity errors that occurred in the slave device. When the counter for these errors reaches 65535, it rolls over to zero and begins counting again.

### **2.9.10 Overrun Errors (28H)**

A read indicates the number of hardware UART overrun errors that occurred in the slave device. When the counter for these errors reaches 65535, it rolls over to zero and begins counting again.

### **2.9.11 Framing Errors (29H)**

A read indicates the number of hardware UART framing errors that occurred in the slave device. When the counter for these errors reaches 65535, it rolls over to zero and begins counting again.

### **2.9.12 Total Software CH1 Errors (2AH)**

A read indicates the number of address or data errors that occurred in the slave device. When the counter for these errors reaches 65535, it rolls over to zero and begins counting again.

### **2.9.13 Not Used (2BH)**

### **2.9.14 Clear Hardware Errors (2CH)**

Clear parity, framing, and overrun errors.

### **2.9.15 Clear Communication Errors (2DH)**

#### **2.9.15.1 HART Low Current Select (2EH)**

Normally in HART mode the low current does not decrease below 3.5 mA. If use of current levels below 3.5mA is required by an application, the ULTIMA MOS-5 Intelligent Sensor features an expanded scale that permits faults to be set as low as 1.25 mA. A read returns "1" or "0."

Condition	HART Current Normal	HART Expanded Scale
Run	4 to 20 mA	4 to 20 mA
Off Line	3.5 mA	1.5 mA
Fault	3.5 mA	1.25 mA

#### **2.9.15.2 Internal Use (2FH)**

#### **2.9.15.3 Event Logging (30H to 5FH)**

### Faults

- Whenever the fault word changes, the time is recorded.
- Time of fault is saved.
- The quantity of faults is saved in a counter.
- When the fault is removed, it is not saved and the counter is not incremented.
- A fault event is logged for every 30 seconds recorded.
- There are a total of ten event time stamps stored.

### Warning

The time the gas level reaches the warning level is recorded. Each time this happens a counter is incremented. The end of the event is when the gas goes below 5%.The counter is also saved. There are a total of ten event time stamps stored.

### Alarm

The time where the gas level reaches the alarm level is recorded. Each time this happens a counter is incremented. The end of the event is when the gas goes below 5%.The counter is also saved. There are a total of ten event time stamps stored.

### Calibration

The time a successful zero and calibration occurs is saved in the event log. A counter is increment for each successful calibration. If the unit fails to zero or calibrate, the event is not recorded. If the calibration is aborted the event is also not recorded. Note the zero and calibration are one operation in the ULTIMA MOS-5 Intelligent Sensor. There are a total of ten event time stamps stored.

### Maintenance

The time a Check Calibration occurs is saved in the maintenance event log. Each successful calibration increments the maintenance counter. There are a total of 10 event time stamps stored.

### Setting structure clock

See table below.

**Event Logging Registry Table**

Address (hex)	Parameter	Function	Data Type	Data range	Access
30	Seconds Time Hi	Seconds Time Hi	Numeric value	0 – 65535	<b>Timer Sec</b>
31	Seconds Time Low	Seconds Time	Numeric value	0 – 65535	<b>Timer Sec</b>
32	Real Time Clock Year, Month	Read/Set year and month of RTC	2 Numeric Values	0-99 year, 1 – 12 month	<b>Timer Struct</b>
33	Real Time Clock Day, Hour	Read/Set day and hour of RTC	2 Numeric Values	1 – 31 day, 0 – 23 hour	
34	Real Time Clock Minute, Second	Read/Set minutes and seconds of RTC	2 Numeric Values	0 – 59 minute, 0 – 59 second	<b>Timer Struct</b>
35	Power Cycle Flag	Read Power Cycle Flag.	Numeric Value	1 – Time Not Reset; 0 – Time Was Reset	<b>Flag</b>
36	Event Index	Event index of Logged Event	Numeric value	0 - 9	<b>Index</b>

37	Warn Seconds Time Hi	Seconds Time Hi for warning event log entries	Numeric value	0 – 65535	<b>Warn</b>
38	Seconds Time Low	Seconds Time Low for warning event log entries	Numeric value	0 – 65535	<b>Warn</b>
39	Structure time Hi	Hi byte – year, low byte – month for warning	Numeric value	0 – 65535	<b>Warn</b>
3A	Structure time Mid	Hi byte – day, low byte – hour warning event log entries	Numeric value	0 – 65535	<b>Warn</b>
3B	Structure time Low	Hi byte – min, low byte – sec for warning event log entries	Numeric value	0 – 65535	<b>Warn</b>
3C	Reserved	Reserved	Numeric value	0	
3D	Reserved	Reserved	Numeric value	0	
3E	Warn Event Count	Warning Event Count	Numeric value	0 – 65535	<b>Warn</b>
3F	Alarm Seconds Time Hi	Seconds Time Hi for alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
40	Seconds Time Low	Seconds Time Low for alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
41	Structure time Hi	Hi byte – year, low byte – month for alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
42	Structure time Mid	Hi byte – day, low byte – hour alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
43	Structure time 44Low	Hi byte – min, low byte – sec for alarm event log entries	Numeric value	0 – 65535	<b>Alarm</b>
44	Reserved	Reserved	Numeric value	0	
45	Reserved	Reserved	Numeric value	0	
46	Alarm Event Count	Alarm Event Count	Numeric value	0 – 65535	<b>Alarm</b>
47	Fault Seconds Time Hi	Seconds Time Hi for fault event log entries	Numeric value	0 – 65535	<b>Fault</b>
48	Seconds Time Low	Seconds Time Low for fault event log entries	Numeric value	0 – 65535	<b>Fault</b>
49	Structure time Hi	Hi byte – year, low byte – month for fault event log entries	Numeric value	0 – 65535	<b>Fault</b>
4A	Structure time Mid	Hi byte – day, low byte – hour alarm event log entries	Numeric value	0 – 65535	<b>Fault</b>
4B	Structure time Low	Hi byte – min, low byte – sec for fault event log entries	Numeric value	0 – 65535	<b>Fault</b>
4C	Fault code	Fault code. Same code as register 2	Numeric value	0 – 65535	<b>Fault</b>
4D	Reserved	Reserved	Numeric value	0	
4E	Fault	Fault Event Count	Numeric value	0 – 65535	<b>Fault</b>

	Event Count				
4F	Maintenance Seconds Time Hi	Seconds Time Hi for lamp test event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
50	Seconds Time Low	Seconds Time Low for lamp test event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
51	Structure time Hi	Hi byte – year, low byte – month for lamp test event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
52	Structure time Mid	Hi byte – day, low byte – hour lamp test event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
53	Structure time Low	Hi byte – min, low byte – sec for lamp test event log entries	Numeric value	0 – 65535	<b>Maintenance</b>
54	Maintenance code	Cal check	Numeric value	0	<b>Maintenance</b>
55	Reserved	Reserved	Numeric value	0	
56	Maintenance Count	Maintenance Count	Numeric value	0 – 65535	<b>Maintenance</b>
57	Calibrate Seconds Time Hi	Seconds Time Hi for lamp test event log entries	Numeric value	0 – 65535	<b>Calibrate</b>
58	Seconds Time Low	Seconds Time Low for lamp test event log entries	Numeric value	0 – 65535	<b>Calibrate</b>
59	Structure time Hi	Hi byte – year, low byte – month for lamp test event log entries	Numeric value	0 – 65535	<b>Calibrate</b>
5A	Structure time Mid	Hi byte – day, low byte – hour lamp test event log entries	Numeric value	0 – 65535	<b>Calibrate</b>
5B	Structure time Low	Hi byte – min, low byte – sec for lamp test event log entries	Numeric value	0 – 65535	<b>Calibrate</b>
5C	Calibrate code	Cal	Numeric value	0	<b>Calibrate</b>
5D	Reserved	Reserved	Numeric value	0	
5E	Calibrate Count	Calibrate Count	Numeric value	0 – 65535	<b>Calibrate</b>
5F	Reset Event Counters	Reset Event Counters	Numeric value	1	<b>Reset</b>

### 2.9.16 User Information (60H to 6FH)

There is a section in memory that allows the user to store information. This is useful if the physical location or other user identification is required. The only restriction on the information is it must be Modbus compatible. Only one word can be written per command. There are a total of 16 words for the user.

### **2.9.17 CH2 Total Receive Errors (70H)**

A read indicates the total Modbus communication hardware receive errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again. The total errors are an accumulation of the individual communication errors listed below.

### **2.9.18 CH2 Bus Activity Rate % (71H)**

A read indicates the bus activity rate in percent of this slave's addressed node versus other addressed nodes. Range of this value is in hex (0-64), which translates to decimal (0-100%).

### **2.9.19 CH2 Function Code Errors (72H)**

A read indicates the number of function code errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

### **2.9.20 CH2 Starting Address Errors (73H)**

The counter is incremented for each address that does not equal the device address. A read indicates the number of starting address errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

### **2.9.21 CH2 Number of Register Errors (74H)**

A read indicates the number of register errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

### **2.9.22 CH2 RXD CRC Errors Hi (75H)**

A read indicates the number of RXD CRC errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

### **2.9.23 CH2 RXD CRC Errors Lo (Same as Hi) (76H)**

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**NOTE:** Hi and Lo CRC errors are now reported in the same word. A read from either Hi or Lo will return the same count.

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### **2.9.24 CH2 Parity Errors (77H)**

A read indicates the number of hardware UART parity errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

### **2.9.25 CH2 Overrun Errors (78H)**

A read indicates the number of hardware UART overrun errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.



### **2.9.26 CH2 Framing Errors (79H)**

A read indicates the number of hardware UART framing errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

### **2.9.27 CH2 Total Software CH1 Errors (7AH)**

A read indicates the number of address or data errors that occurred in the slave device. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

### **2.9.28 Not Used (7BH)**

### **2.9.29 CH2 Clear UART Errors (7CH)**

### **2.9.30 CH2 Clear Stats (7DH)**

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