MSA

The Safety Company

FlameGard® 5 UV/IR

Ultraviolet/Infrared
Flame Detector
MODBUS Specification

Part No.	**MAN5UVIR-EU**
Revision	**0**

Table of Contents

1.0 Introduction

Scope

The FlameGard 5 UV/IR flame 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 FlameGard 5 UV/IR due to the addition of the MODBUS protocol communications channel.

Purpose

This specification is designed to complement the FlameGard 5 UV/IR Instruction Manual by providing a complete description of this field device from a MODBUS Communications perspective.

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.

References

DOCUMENT NAME	DOCUMENT RELATIONSHIP
MODBUS Communications Protocol Specifications	This is used to insure compliance with the MODBUS Communication Protocol.
FlameGard 5 UV/IR Instruction Manual	This is the MSA FlameGard 5 UV/IR Product Instruction Manual.

2.0 Modbus Interface

Standard FlameGard 5 UV/IR Flame Detectors include a single Modbus that is referenced as Comm 1. A dual Modbus feature is optional, which includes two independent communications channels referenced as Comm 1 and Comm 2.

NOTE: If the dual Comm option is ordered, the analog output & HART will not be available.

2.1 Baud Rate

The Baud Rate is a selectable setting via the Modbus communications interface. The selectable baud rates are 19.2K, 9600, 4800, or 2400 bits per second.

2.2 Data Format

The Data Format is a selectable setting 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 1: Data Format

2.3 Modbus Read Status Protocol (Query/Response)

2.3.1 Modbus Read Query Message

Byte	Modbus	Range	Referenced to FlameGard 5 UV/IR Flame
1st	Slave Address	1-247 *	FlameGard 5 UV/IR Flame (X = 0 or 1 Model Type)
2nd	Function Code	03	Read Holding Registers
3rd	Starting Address Hi**	00	Not Used by FlameGard 5 UV/IR Flame Detector
4th	Starting Address Lo**	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Commands
5th	No. of Registers Hi	00	Not Used by FlameGard 5 UV/IR Flame Detector
6th	No. of Registers Lo	01	No. of 16 Bit Registers
7th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8th	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 2: Modbus Query Messages

**NOTE*: Address 0 is reserved for broadcast mode and will not be supported at this time.
NOTE**: Start Address can be a maximum of 247 Address Locations (0000-0x00F7)**

2.3.2 Modbus Read Response Message

Byte	Modbus	Range	Referenced to FlameGard 5 UV/IR, FlameGard 5 UV/IR1
1st	Slave Address	1-247* (Decimal)	FlameGard 5 UV/IR Flame Detector ID (Address)
2nd	Function Code	03 or 04	Read Holding Registers
3rd	Byte Count	02 – FF (Hex)	No. of Data Bytes
4th	Data Hi	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Hi Byte Status Data
5th	Data Lo	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Lo Byte Status Data
6th	CRC Lo	00-FF (Hex)	CRC Lo Byte
7th	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 3: Modbus Read Response Messages

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

2.4 Modbus Write Command Protocol (Query/Response)

2.4.1 Modbus Write Query Message

Byte	Modbus	Range	Referenced to FlameGard 5 UV/IR Flame Detector
1st	Slave Address	1-247* (Decimal)	FlameGard 5 UV/IR Flame Detector (Address)
2nd	Function Code	06	Preset Single Register
3rd	Register Address Hi**	00	Not used by FlameGard 5 UV/IR Flame Detector
4th	Register Address Lo**	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Commands
5th	Preset Data Hi	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Hi Byte Command Data
6th	Preset Data Lo	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Lo Byte Command Data
7th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8th	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 4: Modbus Write Query Message

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

NOTE:** Start Address can be a maximum of 247 Address Locations (0000-0x00F7).

2.4.2 Modbus Write Response Message

Byte	Modbus	Range	Referenced to FlameGard 5 UV/IR Flame Detector
1st	Slave Address	1-247* (Decimal)	FlameGard 5 UV/IR Flame Detector ID (Address)
2nd	Function Code	06	Preset Single Register
3rd	Register Address Hi**	00	Not used by FlameGard 5 UV/IR Flame Detector
4th	Register Address Lo**	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Commands
5th	Preset Data Hi	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Hi Byte Command Data
6th	Preset Data Lo	00-FF (Hex)	FlameGard 5 UV/IR Flame Detector Lo Byte Command Data
7th	CRC Lo	00-FF (Hex)	CRC Lo Byte
8th	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 5: Modbus Write Response Message

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

NOTE**: Start Address can be a maximum of 247 Address Locations (0000-0x00F7).

2.4.3 Function Codes Supported

Function Code 03 or 04 (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.

2.5 Exception Responses and Exception Codes

In a normal exchange, the master device sends a query to the FlameGard 5 UV/IR Flame Detector. The FlameGard 5 UV/IR Flame Detector receives the query and returns a normal response to the master. If a normal communications error occurs, there are 4 possible responses from the FlameGard 5 UV/IR Flame Detector:

1. If the FlameGard 5 UV/IR Flame Detector does not recognize the query due to a communications error, then no response is returned from the FlameGard 5 UV/IR Flame Detector and the master device will eventually process a timeout condition for the query.

2. If the FlameGard 5 UV/IR Flame Detector receives the query, but detects a communication error (CRC, etc.), then no response is returned from the FlameGard 5 UV/IR Flame Detector and the master device will eventually process a timeout condition for the query.

3. An exception code is returned when the FlameGard 5 UV/IR Flame Detector receives the query without a communications error, but cannot process it due to reading or writing to a non-existent or illegal Function Code, Illegal Command Starting Address or Register Address, or Illegal Data Value. The exception response message has two fields that differentiate it from a normal response. See the next section for more information.

2.5.1 Exception Responses

Byte	Modbus	Range	Referenced to FlameGard 5 UV/IR Flame Detector
1st	Slave Address	1-247* (Decimal)	FlameGard 5 UV/IR Flame Detector ID (Address)
2nd	Function Code	83 or 86 (Hex)	MSB is set with Function Code
3rd	Exception Code	01 - 06 (Hex)	Appropriate Exception Code (See below)
4th	CRC Lo	00-FF (Hex)	CRC Lo Byte
5th	CRC Hi	00-FF (Hex)	CRC Hi Byte

Table 6: Exception responses

2.5.1.1 Exception Code Field

In a normal response, the FlameGard 5 UV/IR Flame Detector returns data and status in the data field, requested in the query from the master. In an exception response, the FlameGard 5 UV/IR Flame Detector returns an exception code in the data field, which describes the condition that caused the exception. Below is a list of exception codes that are supported by the FlameGard 5 UV/IR Flame Detector:

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

Table 7: Exception Code Field

2.6 Command Register Locations

2.6.1 Operational Mode Commands

See section number listed below and reference Section 2.7 for details of each register.

NOTE: The FlameGard 5 UV/IR Flame Detector has Modbus error reporting. The optional dual Modbus has error reporting for each channel. It can also provide simultaneous block mode.

R - indicates Read Only Access   **R/W - indicates Read/Write Access**

Parameter	Function	Type	Scale	Access	REG Addr	Master I/O Addr
Analog	0-20 mA Current Output	Value	16-Bit	R	0000	40001
Mode	Indicates Fire Status Mode	Value	(0-11)	R	0001	40002
Status/Error	Indicates Error	Bit	16-Bit	R	0002	40003
UV/IR Only	Indicates Detection of UV Only	Bit	2-Bit	R	0003	40004
Model Type	Identifies the FlameGard 5 UV/IR Flame Detector	Decimal	310X	R	0004	40005
Software Rev	Indicates the Software Revision	ASCII	2-Char	R	0005	40006
COPM Fault	UV/IR COPM Fault	Bit	2-Bit	R	0006	40007
Override	Override Dipswitch Settings	Bit	1-Bit	R/W	0007	40008
Options	Indicates Unit Options	Bit	8-Bit	R/W	0008	40009
Comm 1 Address	Unit Address	Decimal Hex	(1-247) (01-F7)	R/W	0009	40010
Not Used					000A	40011
Comm 1 Baud Rate	Baud Rate (2400, 4800, 9600,19.2K)	Value	(0-3)	R/W	000B	40012
Comm 1 Data Format	Data Format (8N-1, 8E-1, 8O-1, 8N-2)	Value	(0 - 3)	R/W	000C	40013
UV Sig Count	Indicates No. of UV Signal Pulses within 500 ms	Value	16-Bit	R	000D	40014
IR Sig Count	Indicates No. of IR Signal Pulses within 500 ms	Value	16-Bit	R	000E	40015
UV Fault Total	Indicates Total No. of UV COPM Faults	Value	16-Bit	R	000F	40016
IR Fault Total	Indicates Total No. of IR COPM Faults	Value	16-Bit	R	0010	40017
Remote Reset	Remotely Resets the Alarm & Warn Relays	Bit	1-Bit	R/W	0011	40018

Parameter	Function	Type	Scale	Access	REG Addr	Master I/O Addr
Remote Alarm Test	Remotely Activates Alarm Test	Bit	1-Bit	R/W	0012	40019
Clear COPM Faults	Clears UV/IR COPM Fault Counters	Bit	1-Bit	R/W	0013	40020
	NOT Used				0014	40021
Serial Number	Serial Number Upper	Value	16 bit	R	0015	40022
Serial Number	Serial Number Lower	Value	16 bit	R	0016	40023
	NOT Used				0017-1C	40024-40029
Optional HART	HART Enable	Bit	1 bit	R/W	001D	40030
All "1" or "0"	HART Test 0 off 1, 2	Bit	2 Bit	R/W	001E	40031
	Not Used				001F	40032
Comm 1 Register errors	Total # of Register Errors	Value	16-Bit	R	0020	40033
Comm 1 Bus Activity Rate %	Bus Activity Rate in % Of this Addressed Node vs. Other Addressed Nodes	Decimal Hex	(0-100%) (0-64)	R	0021	40034
Comm 1 Function Code Errors	Total # of Function Code Errors	Value	16-Bit	R	0022	40035
Comm 1 Starting Address Errors	Total # of Starting Addresses Errors	Value	16-Bit	R	0023	40036
Comm 1 Total Receive Errors	Total # of Comm 1 Receive Errors	Value	16-Bit	R	0024	40037
Comm 1 RXD CRC Errors	Total # of RXD CRC Errors	Value	16-Bit	R	0025	40038
Comm 1 RXD CRC Errors	Total # of RXD CRC Errors	Value	16-Bit	R	0026	40039
Comm 1 Overrun Errors	Total # of Overrun Errors	Value	16-Bit	R	0027	40040

Parameter	Function	Type	Scale	Access	REG Addr	Master I/O Addr
Comm 1 Parity Errors	Total # of Parity Errors	Value	16-Bit	R	0028	40041
Comm 1 Framing Errors	Total # of Framing Errors	Value	16-Bit	R	0029	40042
Comm 1 UART errors	Total # of UART errors	Value	16 Bit		002A	40043
Comm 1 Total Receive Errors	Total # of Comm 1 Receive Errors	Value	16-Bit	R	002B	40044
Comm 1 Clear UART	Clear UART errors	Bit	1-Bit	R/W	002C	40045
Comm1 Clear Stats	Clear Comm Stats	Bit	1-Bit	R/W	002D	40046
HART Current Range	3.5 ma to 20 ma 1.25 ma to 20 ma	Bit	1-Bit	R/W	002E	40047
Comm 2 Address	Unit Address	Decimal Hex	(1-247) (01-F7)	R/W	002F	40048
Comm 2 Baud Rate	Indicates present Baud Rate (2400, 4800, 9600, 19.2K)	Value	(0-3)	R/W	0030	40049
Comm 2 Data Format	Indicates present Data Format (8N-1, 8E-1, 8O-1, 8N-2)	Value	(0-3)	R/W	0031	40050
	Not Used				0032	40051
Input Voltage	Indicates the 24 volts	Value	16-Bit	R	0033	40052
Voltage at the alarm input	Indicates alarm test input voltage	Value	16-Bit	R	0034	40053
Voltage at the Reset input	Indicates reset input voltage	Value	16-Bit	R	0035	40054
The position of the dip switch	Dip Switch Data	Bits	16-Bit	R	0036	40055
	Not used				0037 003F	40056 40064

Parameter	Function	Type	Scale	Access	REG Addr	Master I/O Addr
EVENT LOGGING	Event logging See Section 6.0	Value			0040 0067	40065 40104
USER INFO	User Information	Value	16-Bit	R/W	0068 0077	40105 40120
Comm 2 Register errors	Total # of Register Errors	Value	16-Bit	R	0078	40121
Comm 2 Bus Activity Rate %	Bus Activity Rate in % Of this Addressed Node vs. Other Addressed Nodes	Decimal Hex	16-Bit	R	0079	40122
Comm 2 Function Code Errors	Total # of Function Code Errors	Value	16-Bit	R	007A	40123
Comm 2 Starting Address Errors	Total # of Starting Addresses Errors	Value	16-Bit	R	007B	40124
Comm 2 Total Receive Errors	Total # of Comm 2 Receive Errors	Value	16-Bit	R	007C	40125
Comm 2 RXD CRC Errors	Total # of RXD CRC Errors	Value	16-Bit	R	007D	40126
Comm 2 RXD CRC Errors	Total # of RXD CRC Errors	Value	16-Bit	R	007E	40127
Comm 2 Overrun Errors	Total # of Overrun Errors	Value	16-Bit	R	007F	40128
Comm 2 Parity Errors	Total # of Parity Errors	Value	16-Bit	R	0080	40129
Comm 2 Framing Errors	Total # of Framing Errors	Value	16-Bit	R	0081	40130
Comm 2 UART errors	Total # of UART errors	Value	16-Bit	R	0082	40131
	Not Used				0083	40132
Comm 2 Clear UART	Clear UART errors	Bit	1-Bit	R/W	0084	40133
Comm2 Clear Stats	Clear Comm Stats	Bit	1-Bit	R/W	0085	40134

Table 8: Operational Mode Commands

2.7 FlameGard 5 UV/IR Operational Mode Command Register Details

2.7.1 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 master scaling is 0-65535 decimal, which corresponds to the FlameGard 5 UV/IR Flame Detector scaling which is 0-20 mA.

2.7.2 Mode (01H)

A read returns the fire status mode of the FlameGard 5 UV/IR Flame Detector.

Mode	Decimal Value
Power-up Delay	1
Warn Non-latching Only	2
Warn & Alarm Non-Latching	3
Warn Latching Only	4
Alarm Latching Only	5
Warn & Alarm Latching	6
Ready State (No Fire)	7
UV Only Fire	8
IR Only Fire	9
Alarm Test	10
COPM Fault Detected	11

Table 9: Fire Status Mode

2.7.3 Status/Error (02H)

A read returns the errors that are occurring, which are indicated by bit position.

Byte	Function Bit	Position	Hex
High	Reset Line Shorted	8	0x8000
	UV 10 Minute	7	0x4000
	Not Used	6	0x2000
	Not Used	5	0x1000
	Output Current Fault	4	0x0800
	Not Used	3	0x0400
	Not Used	2	0x0200
	Not Used	1	0x0100
Low	Flash Checksum	8	0x0080
	EEPROM Checksum	7	0x0040
	RAM Test	6	0x0020
	Low Line Voltage Check	5	0x0010
	UV COPM	4	0x0008
	IR COPM	3	0x0004
	Not Used	2	0x0002
	Internal Voltage	1	0x0001

Table 10: Status/Error

2.7.4 Faults

Reset Line Shorted: The Detector sees a continuous short. Check TB1-3.

UV 10 Minute: The UV detector sees a constant source of UV. Check for welding, arcing, very bright lights or other sources of UV.

Output Current Fault: There is an error in the current output circuit. Return for service.

Flash Checksum: The main program memory is not functioning properly. Return for service.

EEPROM Checksum: There are two sources of EEPROM error. One is recoverable, the other must be sent back to the factory. The recoverable error can be reset by turning the power on and off. The user then must check all the FlameGard 5 UV/IR Flame Detector options; Latch/Non-latch, Energized/De-energized, Baud rate etc.

RAM Test: The memory is not functioning. Return for service.

Low Line Voltage Check: The input voltage is low. Check the input voltage with a meter or via HART or Modbus.

UV COPM: The UV window needs to be cleaned.

IR COPM: The IR window needs to be cleaned.

Internal Voltage: The FlameGard 5 UV/IR Flame Detector monitors various internal voltages. Return for service.

2.7.5 UV/IR Only (03H)

A read indicates the detection of UV Only or IR only when using the FlameGard 5 UV/IR Flame Detector.

UV Only Detected = 01 (Lo Data Byte)

IR Only Detected = 02 (Lo Data Byte)

The High Data Byte is Not Used.

2.7.6 Model Type (04H)

A read returns the Decimal Value 3100, which identifies each particular type of unit by model number.

Model	Configuration	HART ID	Modbus ID	
FlameGard 5 UV/IR	Standard UV/IR	NA	3100	0x0C1C
FlameGard 5 UV/IR	Standard UV/IR	0x90	3103	0x0C1F
FlameGard 5 UV/IR	Long Range	0x90	3106	0x0C22
FlameGard 5 UV/IR	Hydrogen	0x90	3105	0x0C21

Table 11: Model Type

2.7.7   Software Revision (05H)

A read returns the software revision of the FlameGard 5 UV/IR Flame Detector in 2 ASCII characters. (REV "A" appears as a blank and the letter A).

2.7.8   COPM Fault (06H)

A read returns the type of Continuous Optical Path Monitoring (COPM) Fault which is an UV COPM Fault or an IR COPM Fault, or both. The UV COPM and/or the IR COPM Faults indicate that the UV and/or IR windows are dirty and need to be cleaned, or that there is a hardware problem with the UV and/or IR detection circuitry.

UV COPM Fault = 01 (Lo Data Byte)

IR COPM Fault = 02 (Lo Data Byte)

The High Data Byte is Not Used.

2.7.9   EEPROM Override (07H)

A read indicates the status of the EEPROM Override bit. A write command changes the state of the EEPROM Override bit. When the EEPROM Override bit is enabled, the options for the Detector Sensitivity, Relay Delay, Relay Latching/Non-Latching and Relay Energized/Non-Energized features are now controlled by the data stored in the EEPROM and are no longer controlled by the 8-position DIP switch located on the bottom of the Power/Relay Board. When the EEPROM Override bit is disabled the options are under the control of the 8-position DIP switch. The EEPROM Override bit is located in the LSB of the Low Data Byte and the High Data Byte is not used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

Table 12: EEPROM Override

NOTE: By grounding the ALARM TEST input during power-up cycle (approximately 10 seconds), the FlameGard 5 UV/IR Flame Detector will disable the EEPROM Override and set the Bit = 0, thus enabling the 8-position DIP switch.

2.7.10 Options (08H)

A read returns the status of the settings for the Detector Sensitivity, Relay Delay, Relay Latching/Non-Latching and Relay Energized/Non-Energized features either from the Options Dipswitch or the EEPROM depending on the setting of the EEPROM Override bit listed above. A write command changes the settings for the EEPROM only when the EEPROM Override bit is set.

EXCEPTION - If an attempt to change the EEPROM Options is made while the EEPROM Override bit is not set, then the unit shall return an Exception Code 01 (Illegal Function).

These functions are indicated on the Low Data Byte and the High Data Byte is not used.

Function	Bit Position	Conditions				Access
Warn Energized	8 (MSB)	1 = Energized 0= Non-Energized				Read/Write
Alarm Energized	7	1 = Energized 0= Non-Energized				Read/Write
Warn Latched	6	1 = Latched 0 = Non-Latched				Read/Write
Alarm Latched	5	1 = Latched 0 = Non-Latched				Read/Write
		10	8	4	2	Time Delay in Seconds
Alarm Time Delay 2	4	1	0	0	1	Read/Write
Alarm Time Delay 1	3	1	1	0	0	Read/Write
		100	75	50		% Sensitivity
Sensitivity 2	2	0	0	1		Read/Write
Sensitivity 1	1 (LSB)	0	1	0		Read/Write

Table 13: Setting Options

2.7.11 Comm 1 Address (09H)

A read returns the Comm 1 address of the FlameGard 5 UV/IR Flame Detector. A write changes the address to the requested address. The range of the address is 1 to 247 (01 to F7 Hex). After the address has been changed to the slave unit, the Modbus communications will cease because the address has changed; therefore the master will have to change its query address to the slave's new address in order to restart the communications.

EXCEPTION - If an illegal data value is entered (must be between 1, 0x00F7), then the Exception Code 03 (Illegal Data Value) is returned.

NOTE: By grounding the RESET input during power-up cycle (approximately 10 seconds), the FlameGard 5 UV/IR Flame Detector Address will default to 1.

2.7.12 Comm 1 Baud Rate (0BH)

A read returns the Comm 1 baud rate of the FlameGard 5 UV/IR Flame Detector. A write changes the baud rate to the requested baud rate. After the baud rate has been changed to the addressed unit, the Modbus communications will cease because the baud rate has changed; therefore the master will have to change its baud rate to the slave's new baud rate in order to restart the communications.

Baud Rate	Low Data Byte	Access
19.2K	03	Read/Write
9600	02	Read/Write
4800	01	Read/Write
2400	00	Read/Write

Table 14: Comm 1 Baud Rate

This function is indicated on the Low Data Byte (the High Data Byte is not used).

EXCEPTION - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

NOTE: By grounding the RESET input during power-up cycle (approximately 10 seconds), the FlameGard 5 UV/IR Baud Rate will default to 19.2K.

2.7.13 Comm 1 Data Format (0CH)

A read returns the Comm 1 data format of the FlameGard 5 UV/IR Flame Detector. A write changes the data format to the requested data format. After the data format has been changed to the addressed unit, the Modbus communications may cease or start producing Comm errors because the data format has changed; therefore the master will have to change its data format to the slave's new data format in order to restart or provide proper communications.

Data	Parity	Stop	Format	Low Data Byte	Access
8	None	1	8-N-1	00	Read/Write
8	Even	1	8-E-1	01	Read/Write
8	Odd	1	8-O-1	02	Read/Write
8	None	2	8-N-2	03	Read/Write

Table 15: Comm 1 Data Format

This function is indicated on the Low Data Byte and the High Data Byte is not used.

EXCEPTION - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

NOTE: By grounding the RESET input during power-up cycle (approximately 10 seconds), the FlameGard 5 UV/IR Data Format will default to 8-N-1.

2.7.14 UV Signal Count (0DH)

A read indicates the number of UV Signal Counts that have occurred within 500 ms, which is the time duration that is required to detect a fire in the UV spectrum.

2.7.15 IR Signal Count (0EH)

A read indicates the number of IR Signal Counts that have occurred within 500 ms which is the time duration that is required to detect a fire in the IR spectrum.

2.7.16 UV Fault Total (0FH)

A read indicates the total number of UV COPM Faults for an indefinite period of time until the Clear COPM Fault command is activated. The maximum count is 65535 and then the counter will rollover to zero and begin counting again.

2.7.17 IR Fault Total (10H)

A read indicates total number of IR COPM Faults for an indefinite period of time until the Clear COPM Fault command is activated. The maximum count is 65535 and then the counter rolls back to zero and begins counting again.

2.7.18 Remote Reset (11H)

Writing a 1 to the bit activates the Remote Reset function that resets the Alarm and Warn Relays. The function is active momentarily and resets automatically after being used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

Table 16: Remote Reset

EXCEPTION - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

2.7.19 Remote Alarm Test (12H)

Writing a 1 to the bit activates the Remote Alarm Test function, which activates the Warn and Alarm relay and causes the Analog current to show warn then alarm. Once the Alarm Test is complete, the Remote Alarm Test function should be disabled by writing a zero to the Remote Alarm Test and then resetting the Alarm and Warn relays by writing a one to the Remote Reset (referenced above).

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

Table 17: Remote Alarm Test

EXCEPTION - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

2.7.20 Clear COPM Faults (13H)

Writing a 1 to the bit activates the Clear COPM Faults function that resets both the UV and IR COPM faults. The function is active momentarily and resets automatically after being used.

Function	Bit (LSB)	Access
Enable	1	Read/Write
Disable	0	Read/Write

Table 18: Clear COPM Faults Function

EXCEPTION - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

2.7.21 Serial Number (15/16H)

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 0x16 contains the lower part of the number and address 0X15 contains the upper part.

2.7.22 HART Enable (1D)

This command enables or disables HART. A "0" is HART disabled. A "1" is HART Enabled. This is an option that must be ordered. If HART is not installed, an exception will be returned.

2.7.23 HART Test (1E)

This command is used to test the HART output. It produces constant zeros or constant ones on the HART output. This is only available if the HART option was purchased.

Code	Results
0	Normal
1	Constant ones
2	Constant zeros

2.7.24 Not Used (1F)

2.7.25 Comm 1 Total Illegal number of registers Errors (20H)

A read indicates the total illegal number of registers errors on the Modbus. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.26 Comm 1 Bus Activity Rate % (21H)

A read indicates the Comm 1 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%).

2.7.27 Comm 1 Function Code Errors (22H)

A read indicates the number of Comm Function Code Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.28 Comm 1 Starting Address Errors (23H)

A read indicates the number of Comm 1 Starting Address Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.29 Comm 1 Total Receive Errors (24H)

A read indicates the total Modbus Comm 1 Only Receive Errors that occurred in the slave device. These are address, function, etc. type of errors. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.30 RXD CRC Errors Hi (25h)

A read indicates the number of RXD CRC Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.31 RXD CRC Errors Lo (Same as Hi) (26h)

NOTE: Since the FlameGard 5 UV/IR Flame Detector has a 16 bit CRC, the Hi and Lo CRC errors are now reported in the same 16 bit word.   A read from either the old high Hi or Lo CRC address will return the same count.

2.7.32 Comm 1 Overrun Errors (27H)

A read indicates the number of Comm 1 Overrun Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

NOTE: An overrun error occurs when the next received byte of data tries to overwrite an existing received data byte, which has not been processed. Therefore, the next received byte of data is lost. This can be controlled by implementing the proper DCS or PLC Error Handling Timing Setting (ex. Reply Timeout Setting, Delay Time, and Number of Retries) and proper Baud Rate Setting.

2.7.33 Comm 1 Parity Errors (28H)

A read indicates the number of Comm 1 Only Parity Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.34 Comm 1 Framing Errors (29H)

A read indicates the number of Comm 1 Framing Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.35 Comm 1 Total UART Receive Errors (2AH)

A read indicates the total Modbus Comm 1 Receive Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again. The total errors are an accumulation of the individual Comm errors such as Overrun, CRC, Parity and Framing errors.

2.7.36 Comm 1 Total Receive Errors (2BH)

A read indicates the total Modbus Comm 1 Only Receive Errors that occurred in the slave device. These are address, function, etc type of errors. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.37 Clear Comm 1 UART Errors (2CH)

Writing a 0 to the bit activates the Clear Comm 1 Errors function, which resets all of the Modbus UART Comm Error counters to zero. The function is active momentarily and will reset automatically after being used.

2.7.38 Clear Comm 1 Modbus Errors (2DH)

Writing a 0 to the bit activates the Clear Comm 1 Errors function, which resets all of the Modbus Comm Error counters to zero. The function is active momentarily and resets automatically after being used.

2.7.39 HART Current (2E)

Normally in HART mode the low current does not go below 3.5 mA. In order for the current to distinguish between COPM Fault and Fault there is a HART setting that allows the current to go as low as 1.25 mA.   A read returns "1" or "0".

Condition	Normal HART Current	HART Expanded Scale	Units
Run	4 ,8, 12,16, 20	4 ,8, 12,16, 20	mA
COPM Fault	3.5	2.0	mA
Fault	3.5	1.25	mA

2.7.40 Comm 2 Address (2FH)

A read returns the Comm 2 address of the FlameGard 5 UV/IR Flame Detector. A write changes the address to the requested address. The range of the address is 1 to 247 (01 to F7 Hex). After the address has been changed to the slave unit, the Modbus communications will cease because the address has changed. Therefore, the master will have to change its query address to the slave's new address in order to restart communications.

EXCEPTION - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

NOTE: By grounding the RESET input during power-up cycle (approximately 10 seconds), the FlameGard 5 UV/IR Flame Detector Address defaults to 2.

2.7.41 Comm 2 Baud Rate (30H)

A read returns the Comm 2 baud rate of the FlameGard 5 UV/IR Flame Detector. A write changes the baud rate to the requested baud rate. After the baud rate has been changed to the addressed unit, the Modbus communications ceases because the baud rate has changed. Therefore, the master will have to change its baud rate to the slave's new baud rate in order to restart communications.

Baud Rate	Low Data Byte	Access
19.2K	03	Read/Write
9600	02	Read/Write
4800	01	Read/Write
2400	00	Read/Write

Table 19: Comm 2 Baud Rate

This function is indicated on the Low Data Byte (the High Data Byte is not used).

EXCEPTION - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

NOTE: By grounding the RESET input during power-up cycle (approximately 10 seconds), the FlameGard 5 UV/IR Flame Detector Baud Rate will default to 19.2K.

2.7.42 Comm 2 Data Format (31H)

A read returns the Comm 2 data format of the FlameGard 5 UV/IR Flame Detector. A write changes the data format to the requested data format. After the data format has been changed to the addressed unit, the Modbus communications may cease or start producing Comm errors because the data format has changed. Therefore, the master will have to change its data format to the slave's new data format in order to restart or provide proper communications.

Data	Parity	Stop	Format	Low Data Byte	Access
8	None	1	8-N-1	00	Read/Write
8	Even	1	8-E-1	01	Read/Write
8	Odd	1	8-O-1	02	Read/Write
8	None	2	8-N-2	03	Read/Write

Table 20: Comm 2 Data Format

This function is indicated on the Low Data Byte (the High Data Byte is not used).

EXCEPTION - If an illegal data value is entered which is not listed above, then the Exception Code 03 (Illegal Data Value) is returned.

NOTE: By grounding the RESET input during power-up cycle (approximately 10 seconds), the FlameGard 5 UV/IR Flame Detector Data Format will default to 8-N-1.

2.7.43 Not Used (32H)

2.7.44 Input Voltage (33H)

A read returns the input voltage. This allows the user to remotely read the actual input voltage via Modbus. If the measured voltage is below the required 20 volts measures should be taken or low line faults may occur.

2.7.45 Alarm Test Voltage (34H)

This is useful if the Alarm test button is located a long distance from the FlameGard 5 UV/IR Flame Detector or the ground is not a good ground. A read returns the Alarm input voltage. If the voltage is below 3.5 volts, the Alarm test is activated.

2.7.46 Reset Relays Voltage (35H)

This is useful if the Reset test button is located a long distance from the FlameGard 5 UV/IR Flame Detector or the ground is not a good ground. A read returns the Reset input voltage. If the voltage is below 3.5 volts, the Reset is activated.

2.7.47 Dip Switch Settings (36H)

A read returns a digital copy of the dip switch.   This is useful to check the FlameGard 5 UV/IR Flame Detector configuration.

2.7.48 Not Used (37 – 3FH)

2.7.49 See Event Logging - Section 6.0 (40H – 67H)

2.7.50 User Information (68h to 77h)

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.

NOTE: The following information only applies if the dual Modbus configuration was purchased.

2.7.51 Comm 2 Total Illegal Number of Registers Errors (78H)

A read indicates the total illegal number of registers errors on the Modbus. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.52 Comm 2 Bus Activity Rate % (79H)

A read indicates the Comm 2 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%).

2.7.53 Comm 2 Function Code Errors (7AH)

A read indicates the number of Comm 2 Function Code Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.54 Comm 2 Starting Address Errors (7BH)

A read indicates the number of Comm 2 Starting Address Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.55 Comm 2 Total Receive Errors (7CH)

A read indicates the total Modbus Comm 2 Only Receive Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.56 RXD CRC Errors Hi (7DH)

A read indicates the number of RXD CRC Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.57 RXD CRC Errors Lo (Same as Hi) (7EH)

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

2.7.58 Comm 2 Overrun Errors (7FH)

A read indicates the number of Comm 2 Only Overrun Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

NOTE: An overrun error occurs when the next received byte of data tries to overwrite an existing received data byte, which has not been processed. Therefore, the next received byte of data is lost. This can be controlled by implementing the proper DCS or PLC Error Handling Timing Setting (ex. Reply Timeout Setting, Delay Time, and Number of Retries) and proper Baud Rate Setting.

2.7.59 Comm 2 Parity Errors (80H)

A read indicates the number of Comm 2 Parity Flag Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.60 Comm 2 Framing Errors (81H)

A read indicates the number of Comm 2 Framing Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.61 Comm 2 Total UART Receive Errors (82H)

A read indicates the total Modbus Comm 2 UART Receive Errors that occurred in the slave device. The maximum count is 65535 and then the counter rolls over to zero and begins counting again.

2.7.62 Not Used (83H)

2.7.63 Clear Comm 2 UART Errors (84H)

Writing a 0 to the bit activates the Clear Comm 2 UART Errors function, which resets all of the Modbus UART Error counters to zero. The function is active momentarily and will reset automatically after being used.

2.7.64 Clear Comm 2 Modbus Errors (85H)

Writing a 0 to the bit activates the Clear Comm 2 Modbus Errors function, which resets all of the Modbus Error counters to zero. The function is active momentarily and will reset automatically after being used.

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