Model IR700

Infrared Point Detector for Carbon Dioxide Gas Applications

Modbus Programming Guide

Instruction Manual Modbus 12-11

MANIR700M

Part No. MANIR700M
Revision A/12-11

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1.1 Serial Communications Protocol for IR700

The default Modbus setup from the factory is 9600 baud, 8-n-1 format. The default Modbus ID is 1. These defaults can be restored at any time by connecting the CAL_IO wire (brown) to power supply common and then turn on the power to the IR700. After 10 seconds the CAL_IO wire should be disconnected from the power-supply.

1.1.1 Baud Rate

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

1.1.2 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

1.1.3 Modbus Read Status Protocol (Query/Response)

1.1.3.1 Modbus Read Query Message

Byte	Modbus	Range	Referenced to IR700
1st	Slave Address	1-247* (Dec)	IR700 ID (Address)
2nd	Function Code	03	Read Holding Registers
3rd	Starting Address Hi**	00	Not Used by IR700
4th	Starting Address Lo**	00-FF (Hex)	IR700 Commands
5th	No. of Registers Hi	00	Not Used by IR700
6th	No. of Registers Lo	01	No. of 16 Bit Registers
7th	CRC Hi	00-FF (Hex)	CRC Hi Byte
8th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 2: Modbus Read 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 9999 Address Locations (0000-270E)

1.1.3.2 Modbus Read Response Message

Byte	Modbus	Range	Referenced to IR700
1st	Slave Address	1-247* (Dec)	IR700 ID (Address)
2nd	Function Code	03	Read Holding Registers
3rd	Byte Count	02	No. of Data Bytes
4th	Data Hi	00-FF (Hex)	IR700 Hi Byte Status Data
5th	Data Lo	00-FF (Hex)	IR700 Lo Byte Status Data
6th	CRC Hi	00-FF (Hex)	CRC Hi Byte
7th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 3: Modbus Read Response Message

1.1.4 Modbus Write Command Protocol (Query/Response)

1.1.4.1 Modbus Write Query Message

Byte	Modbus	Range	Referenced to IR700
1st	Slave Address	1-247* (Dec)	IR700 ID (Address)
2nd	Function Code	06	Preset Single Register
3rd	Register Address Hi	00	Not Used by IR700
4th	Register Address Lo	00-FF (Hex)	IR700 Commands
5th	Preset Data Hi	00-FF (Hex)	IR700 Hi Byte Command Data
6th	Preset Data Lo	00-FF (Hex)	IR700 Lo Byte Command Data
7th	CRC Hi	00-FF (Hex)	CRC Hi Byte
8th	CRC Lo	00-FF (Hex)	CRC Lo 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 9999 Address Locations (0000-270E)

1.1.5 Modbus Write Response Message

Byte	Modbus	Range	Referenced to IR700
1st	Slave Address	1-247* (Dec)	IR700 ID (Address)
2nd	Function Code	06	Preset Single Register
3rd	Register Address Hi	00	Not Used by IR700
4th	Register Address Lo	00-FF (Hex)	IR700 Commands
5th	Preset Data Hi	00-FF (Hex)	IR700 Hi Byte Command Data
6th	Preset Data Lo	00-FF (Hex)	IR700 Lo Byte Command Data
7th	CRC Hi	00-FF (Hex)	CRC Hi Byte
8th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 5: Modbus Write Response Message

1.2 Function Codes Supported

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

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

1.2.1 Exception Responses and Exception Codes

1.2.1.1 Exception Response

In a normal communications query and response, the master device sends a query to the IR700 and the IR700 receives the query without a communications error and handles the query normally within the master device's allowable timeout. The IR700 then returns a normal response to the master. An abnormal communications produces one of four possible events:

1. If the IR700 does not receive the query due to a communications error, then no response is returned from the IR700 and the master device will eventually process a timeout condition for the query.

2. If the IR700 receives the query, but detects a communication error (CRC, etc.), then no response is returned from the IR700 and the master device will eventually process a timeout condition for the query.

3. If the IR700 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 IR700 and the master device will eventually process a timeout condition for the query. In order to prevent this condition from occurring, the maximum response time for the IR700 is 200 milliseconds. Therefore the MASTER'S Timeout Setting should be set to 200 milliseconds or greater.

4. If the IR700 receives the query without a communications error, but cannot process it due to reading or writing to a non-existent IR700 command register, then the IR700 will return 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 IR700
1st	Slave Address	1-247* (Dec)	IR700 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 Hi	00-FF (Hex)	CRC Hi Byte
5th	CRC Lo	00-FF (Hex)	CRC Lo Byte

Table 6: IR700 Exception Response Message

1.2.1.2 Exception Code

Exception Code Field: In a normal response, the IR700 returns data and status in the data field, which was requested in the query from the master. In an exception response, the IR700 returns an exception code in the data field, which describes the IR700 condition that caused the exception. Below is a list of exception codes that are supported by the IR700:

Code	Name	Description
01	Illegal Function	The function code received in the query is not an allowable action for the IR700.
02	Illegal Data Address	The data address received in the query is not an allowable address for the IR700.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the IR700.
04	Slave Device Failure	An unrecoverable error occurred while the IR700 was attempting to perform the requested action.
05	Acknowledge	The IR700 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 IR700 is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.

Table 7: IR700 Exception Codes

1.3 IR700 Command Register Locations

Register Address (Hex)	Parameter	Function	Data Type	Data Range	Access
0000H	**Analog Output**	0-20 mA analog output	Numeric Value	0-65535 Dec, (scale to range 0-21.7mA)	R
0001h	**Operating Mode**	Set/View operating mode	Bit Map	See Table 9	R/W
0002h	**Error Status**	View present error	Bit Map	See Table 10	R
0003h	**Gas ID**	Type of gas	Numeric Value	See The register can be written with the index numbers 0 to 7 or with the Gas ID. The Gas ID codes will not change in future versions and are consistent across General Monitors products. To read the Gas ID use register 0x008D. Table 11	R/W
0004H	**Model Number**	View Model ID	Numeric Value	2104 , etc	R
0005h	**Software Rev**	Software Revision ID	2 ASCII characters	A, B, etc.	R
0006h	**Gain**	Shows detector gain	Numeric Value	0-5000	R
0007h	**Cal IO type**	Set/View Cal IO type	code	0 – LED switch, 1 –manual solenoid , 2 - ARGC	R/W
0008h	**Solenoid state**	Turn solenoid ON/OFF, read solenoid state	Code	10 – ON, 20 – OFF, 30 – disabled	R/W
0009h	**Modbus unit address**	Set/View Modbus address	Numeric Value	1-247 decimal	R/W
000Ah	**Adjusted ratio**	Adjusted ratio	Numeric Value	0-65535	R
000Bh	**Modbus Baud Rate**	Set/View Baud Rate (2400, 4800, 9600	Code	0, 1, 2, 3	R/W

		19200)			
000Ch	**Modbus Data Format**	Set/View Data Format (8N1, 8E1, 801, 8N2)	Code	0, 1, 2, 3	R/W
000Dh	**Priority fault**	Main fault for the unit	Bit Map	See Table 10	R
000Eh	**% of full scale**	Read gas concentration in % of Full Scale	Numeric Value	-9 – (+)106%	R
000Fh	**Full scale, hi**	Read hi word of full scale	Numeric Value	0	R
0010h	**Full scale, lo**	Read lo word of full scale	Numeric Value	100 %	R
0011h	**Gas measurement units**	Read gas measurement units	Code	0 - % lel, 1 –ppm	R
0012h	**PPM value, hi**	Read hi word of gas concentration in ppm	Numeric Value	0-65535	R
0013h	**PPM value, low**	Read low word of gas concentration in ppm	Numeric Value	0-65535	R
0014h	**Duplicate detector gain**	For GM usage	Numeric Value	0-5000	R
0015h	**Reserved**	N/A	N/A	N/A	R
0016h	**Hazard Watch Mode**	Set/View Hazard Watch Mode	Code	0 – disabled, 1 - enabled	R/W
0017h	**Reserved**	N/A	N/A	N/A	R
0018h	**Alarm level**	Set/View Alarm level for event logging	Numeric Value	5-95	R/W
0019h	**Warn level**	Set/View Warn level for event logging	Numeric Value	5-95	R/W
001Ah	**HART configuration**	Hi byte – AO range; Lo byte – HART enabled/disabled	Hi byte – AO range; Lo byte – HART enabled / disabled	Hi byte: 0 – hi range, 1 – lo range, Low byte: 0 – disabled, 1 – HART enabled	R/W
001Bh	**Reserved**	N/A	N/A	N/A	R
001Ch	**Reserved**	N/A	N/A	N/A	R
001Dh	**Reserved**	N/A	N/A	N/A	R
001Eh	**Reserved**	N/A	N/A	N/A	R
001Fh	**Reserved**	N/A	N/A	N/A	R
0020h	**Total Receive Errors**	Number of Receive errors	Numeric Value	0-65535 decimal	R
0021h	**Reserved**	N/A	N/A	N/A	R
0022h	**Function code errors**	Number of function code errors.	Numeric Value	0-65535 decimal	R

0023h	**Starting Register Address errors**	Number of Starting Register Address errors.	Numeric Value	0-65535 decimal	R
0024h	**Reserved**	N/A	N/A	N/A	N/A
0025h	**CRC errors HI**	Number of CRC HI errors	Numeric Value	0-65535 decimal	R
0026h	**CRC errors LO**	Number of CRC LO errors	Numeric Value	0-65535 decimal	R
0027h	**Overrun errors**	Number of Overrun errors	Numeric Value	0-65535 decimal	N/A
0028h	**Reserved**	N/A	N/A	N/A	N/A
0029h	**Framing errors**	Number of framing errors	Numeric Value	0-65535 decimal	R
002Ah	**Reserved**	N/A	N/A	N/A	N/A
002Bh	**Reserved**	N/A	N/A	N/A	N/A
002Ch	**Reserved**	N/A	N/A	N/A	N/A
002Dh	**Clear Comm. errors**	Clears communication errors	Numeric Value	See description	W
002E-008Ch	**Reserved**	N/A	N/A	N/A	N/A
008D	**Gas ID #**	Read unique Gas Identification Number	Numeric Value	See table for register 0x0003	R
008E – 00AF	**Reserved**	N/A	N/A	N/A	N/A
00B0h	**Reset Events**	Clears events of resets event flag	Numeric Value	0- Clear Events, 1 – Resets Event Happened flag	W
00B1h	**Run Time hi**	High word of Run Time in Seconds	Numeric Value	0-65535 decimal	R/W
00B2h	**Run Time low**	Low word of Run Time in Seconds	Numeric Value	0-65535 decimal	R/W
00B3h	**Real Time Clock Year, Month**	Read/Set year and month of RTC	Numeric Value	1 –99 year, 1– 12 month	R/W
00B4h	**Real Time Clock Day, Hour**	Read/Set day and hour of RTC	Numeric Value	1 – 31 day, 0 – 23 hour	R/W
00B5h	**Real Time Clock Minute, Second**	Read/Set minutes and seconds of RTC	Numeric Value	0 – 59 minutes 0 – 59 seconds	R/W
00B6h	**Power Cycled Flag**	Time Reset After power Cycled	Numeric Value	0 = Time not Reset, 1 = Time Reset	R
00B7h	**Event Index**	Index of Logged Events	Numeric Value	0 - 9	R/W
00B8h	**Running Time Hi**	Running Time Hi for Warning Event log entries	Numeric Value	0 - 65535	R

00B9h	**Running Time Low**	Running Time Low for Warning Event log entries	Numeric Value	0 - 65535	R
00Bah	**Clock Time Hi**	Hi byte = year, Lo byte month: Warning clock time	Numeric Value	1 –99 year, 1–12 month	R
00BBh	**Clock Time Mid**	Hi byte = Day, Lo byte Hour: Warning clock time	Numeric Value	1 – 31 day, 0 – 23 hour	R
00BCh	**Clock Time Low**	Hi byte = Minute, Lo byte second: Warning clock time	Numeric Value	0 – 59 minutes 0 – 59 seconds	R
00BDh	**Reserved**	Reserved	Numeric Value	0	R
00BEh	**Reserved**	Reserved	Numeric Value	0	R
00BFh	**Warning Event Count**	Total Warning Event Count	Numeric Value	0 - 65535	R
00C0h	**Running Time Hi**	Running Time Hi for Alarm Event log entries	Numeric Value	0 - 65535	R
00C1h	**Running Time Low**	Running Time Low for Alarm Event log entries	Numeric Value	0 - 65535	R
00C2h	**Clock Time Hi**	Hi byte = year, Lo byte month: Alarm clock time	Numeric Value	1 –99 year, 1–12 month	R
00C3h	**Clock Time Mid**	Hi byte = Day, Lo byte Hour: Alarm clock time	Numeric Value	1 – 31 day, 0 – 23 hour	R
00C4h	**Clock Time Low**	Hi byte = Minute, Lo byte second: Alarm clock time	Numeric Value	0 – 59 minutes 0 – 59 seconds	R
00C5h	**Reserved**	Reserved	Numeric Value	0	R
00C6h	**Reserved**	Reserved	Numeric Value	0	R
00C7h	**Alarm Event Count**	Total Alarm Event Count	Numeric Value	0 - 65535	R
00C8h	**Running Time Hi**	Running Time Hi for Fault Event log entries	Numeric Value	0 - 65535	R
00C9h	**Running Time Low**	Running Time Low for Fault Event log entries	Numeric Value	0 - 65535	R
00CAh	**Clock Time Hi**	Hi byte = year, Lo byte month: Fault clock time	Numeric Value	1 –99 year, 1–12 month	R
00CBh	**Clock Time Mid**	Hi byte = Day, Lo	Numeric	1 – 31 day,	R

		byte Hour: Fault clock time	Value	0 – 23 hour	
00CCh	**Clock Time Low**	Hi byte = Minute, Lo byte second: Fault clock time	Numeric Value	0 – 59 minutes 0 – 59 seconds	R
00CDh	**Fault Code**	See	Numeric Value	0	R
00CEh	**Reserved**	Reserved	Numeric Value	0	R
00CFh	**Fault Event Count**	Total Fault Event Count	Numeric Value	0 - 65535	R
00D0h	**Running Time Hi**	Running Time Hi for Maintenance Event log entries	Numeric Value	0 - 65535	R
00D1h	**Running Time Low**	Running Time Low for Maintenance Event log entries	Numeric Value	0 - 65535	R
00D2h	**Clock Time Hi**	Hi byte = year, Lo byte month: Maintenance clock time	Numeric Value	1 –99 year, 1–12 month	R
00D3h	**Clock Time Mid**	Hi byte = Day, Lo byte Hour: Maintenance clock time	Numeric Value	1 – 31 day, 0 – 23 hour	R
00D4h	**Clock Time Low**	Hi byte = Minute, Lo byte second: Maintenance clock time	Numeric Value	0 – 59 minutes 0 – 59 seconds	R
00D5h	**Reserved**	Reserved	Numeric Value	0	R
00D6h	**Reserved**	Reserved	Numeric Value	0	R
00D7h	**Maintenance Event Count**	Total Maintenance Event Count	Numeric Value	0 - 65535	R
00D8h	**Running Time Hi**	Running Time Hi for Calibration Event log entries	Numeric Value	0 - 65535	R
00D9h	**Running Time Low**	Running Time Low for Calibration Event log entries	Numeric Value	0 - 65535	R
00DAh	**Clock Time Hi**	Hi byte = year, Lo byte month: Calibration clock time	Numeric Value	1 –99 year, 1–12 month	R
00DBh	**Clock Time Mid**	Hi byte = Day, Lo byte Hour: Calibration clock time	Numeric Value	1 – 31 day, 0 – 23 hour	R

00DCh	**Clock Time Low**	Hi byte = Minute, Lo byte second: Calibration clock time	Numeric Value	0 – 59 minutes 0 – 59 seconds	R
00DDh	**Calibration code**	Calibration code	Numeric Value	1 – zero, 2 - calibration	R
00DEh	**Reserved**	Reserved	Numeric Value	0	R
00DFh	**Calibration Event Count**	Total Calibration Event Count	Numeric Value	0 - 65535	R

Table 8: List of Modbus Registers

1.4 IR700 Command Register Details

1.4.1 Analog

A read returns a value, which is proportional to the 0-20mA output current. The current is based on a 16-bit value. The master scaling is 0 - 65535 Decimal which corresponds to the IR700 scaling which is 0 - 21.7mA.

1.4.2 Operating Mode (Read/Write)

This register reports on the current operating mode for the IR700 detector. A Read command returns the present IR700 mode, represented by the enabled bit. The following table shows the mode represented by each bit in the 16-bit register.

Table 9: Bitmap for Operating Mode Register (Read-Only Access)

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Mode	Not Used	Initial Mode	Remove Gas (CAL Finished)	Apply Gas	CAL Pending	Zero Mode	CAL Mode	Run Mode
Bit Value	**80 hex 128 decimal**	**40 hex 64 decimal**	**20 hex 32 decimal**	**10 hex 16 decimal**	**8 hex 8 decimal**	**4 hex 4 decimal**	**2 hex 2 decimal**	**1 hex 1 decimal**

Bit	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**
Mode	Not Used	Not Used	Not Used	Not Used	Not Used	Zero & CAL Mode	Gas Check Mode	Not Used
Bit Value	**8000 hex 32768 decimal**	**4000 hex 16384 decimal**	**2000 hex 8192 decimal**	**1000 hex 4096 decimal**	**800 hex 2048 decimal**	**700 hex 1024 decimal**	**200 hex 512 decimal**	**100 hex 256 decimal**

1.4.2.1 Mode Descriptions (0x0001)

A Read command returns the present IR700 mode, represented by the enabled bit. Descriptions of the modes are provided below.

Run Mode: IR700 normal operation mode, with ppm measurement taking place. Writing 1 to mode register allows to abort zero/calibration/gas check, if gas concentration is less then 20% of Full Scale

CAL Mode: Calibration in progress at 50% full scale. Can write 0x0002 only during CAL pending mode, which lasts 30 sec

Zero Mode: Zeroing of the IR700 in progress. Writing 0x0004 to mode register sends the unit to zero mode.

CAL Pending: If 0x0002 is written to mode register during this stage, the unit starts calibration, otherwise the unit returns to run mode in 30 seconds.

Apply Gas: Waiting for 50% full scale gas to proceed with calibration

Remove Gas (CAL finished): IR700 calibration has finished, remove gas.

Startup Mode: IR700 is initializing during powerup.

Gas Check Mode: IR700 gas check is in progress

Zero and CAL Mode: Zeroing directly following by calibration. Writing 0x4000 to mode register will send the unit to zeroing mode, then to calibration, bypassing calibration pending stage.

1.4.3 Status Error (0x0002)

A Read returns the bit map for any error that is presently occurring. The following table shows the errors that are represented by each bit in the register.

Table 10: Bitmap for Status Error Delayed

Bit Position	**3**	**2**	**1**	**0**
Error	**IR High**	**Beam Block**	**Clean Windows (Negative Gas Reading)**	**Partial Beam Block**
Bit Value	8 hex / 8 decimal	4 hex / 4 decimal	2 hex / 2dec	1 hex / 1 decimal

Bit Position	**7**	**6**	**5**	**4**
Error	**Failed to Zero**	**Calibration Mode Fail**	**Low Line Condition**	**Wire Shortage**
Bit Value	80 hex / 128 decimal	40 hex / 64 decimal	20 hex / 32 decimal	10 hex / 16 decimal

Bit Position	11	10	9	8
Error	**Heater problem**	**Ref. Lamp Problem**	**Active Lamp Prob.**	**Test forgotten (remove gas)**
Bit Value	800 hex / 2048 decimal	700 hex / 1024 decimal	200 hex / 512 decimal	100 hex / 256 decimal

Bit Position	16	15	14	13
Error	**EEPROM Error**	**Excess Neg. Gas Reading**	**Misc. fault**	**Clipping fault**
Bit Value	8000 hex / 32768 decimal	4000 hex / 16384 decimal	2000 hex / 8192 decimal	1000 hex / 4096 decimal

1.4.4 Gas Selection (0x0003)

Reads/Sets gas selection for the detector. The register can be written with the index numbers 0 to 7 or with the Gas ID. The Gas ID codes will not change in future versions and are consistent across General Monitors products. To read the Gas ID use register 0x008D.

Table 11. Gas Selection Codes

Index	Gas Type
0	Carbon Dioxide
1	Not used
2	Not used
3	Not used
4	Not used
5	Not used
6	Not used
7	Not used

1.4.5 Model Type (0x0004)

A Read returns the model type for the detector, which is 700 in Decimal format.

1.4.6 Software Rev (0x0005)

A read returns the software revision of the IR700 in 2 ASCII characters. The most significant byte is the first character, the least significant byte is the second character. For example, if this register reads 0x2041 then the first digit is 0x20 (a space character) and the second is 0x41 (the character A). So in this example the firmware version is " A".

1.4.7 Gain (0x0006)

A read returns the value of the gain. The difference between the initial value and the present value indicates the dirt on the windows. This register is provided for compatibility with the IR2100. A new register 0x0054 gives a beam block percentage which is scaled in a much more convenient way.

1.4.8 Calibration IO type (0x0007)

When the Cal IO type is set to LED Magnet switch, LED is blinking during zeroing/calibration and when the unit is in fault. Solenoid is disabled. If it is set to manual solenoid or ARGC, the LED driver is disabled from blinking error codes etc. It then can be used to drive a solenoid. A write command enables/disables the normal LED function. The solenoid function cannot be used until the LED function is disabled.

Function	Value (Decimal)
Magnet LED Switch	0
Manual solenoid	1
AGRG	2

Table 12: Cal IO types

Cal IO type can't be change is solenoid is ON.

1.4.9 Solenoid On/Off (0x0008)

This feature is used for Calibration and Gas check. If Cal IO type is Magnet LED Switch, solenoid is disabled.

A write command can be used only if Cal IO type is set to manual solenoid. In case of ARGC solenoid turns on and off automatically.

Function	Value (Decimal)	Access
On	10	Read/Write
Off	20	Read/Write
Normal Operation	30	Read

Table 13: Solenoid On/Off

Exception – If a value other than 10 or 20 is used in write command, then the Exception Code 03 is returned.

1.4.10 Address (0x0009)

A read returns the address of the IR700. A write changes the address to the requested address. The range of the address is 1 to 247.

NOTE: By grounding the RESET input during power-up cycle (10 seconds), the Address will default to 1.

1.4.11 Baud Rate (0x000B)

A read returns the baud rate of the IR700. 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 re-start the communications. The factory default is 9600.

Baud Rate Codes

Code	Function	Access
03	19200	Read/Write
02	9600	Read/Write
01	4800	Read/Write
00	2400	Read/Write

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

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

NOTE: By grounding the magnetic switch (holding a magnet over the switch) input during power-up cycle (10 seconds), the IR700 Baud Rate will default to 19600.

1.4.12 Data Format (0x000C)

A read returns the data format of the IR700. A write will change the data format to the requested data format. After the data format has been changed, the addressed unit 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 re-start 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 14: Data Format

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

NOTE: By grounding the magnetic switch input during power-up cycle (10 seconds), the IR700 Data Format will default to 8-N-1.

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

1.4.13 Priority Fault (0x000D)

A read returns the primary fault currently happening on the device. See Table 10.

1.4.14 Hazard Watch Options (0x0016)

A read returns the state enabled or disabled. A write of (1) enables Hazard Watch mode. A write of (0) disables Hazard Watch mode.

1.4.15 Alarm Level (0x0018)

Sets/reads minimum gas concentration level in % of Full Scale, when alarm event is logged

1.4.16 Warn Level (0x0019)

Sets/reads minimum gas concentration level in % of Full Scale, when warn event is logged

1.4.17 HART Configuration (0x001A)

0 in low byte means HART disabled, 1 – HART enabled. 0 in high byte means low current range (1.25 -20 mA), 1 - high current range (3.5 – 20mA).

1.4.18 Total Receive Errors (0x0020)

A read indicates the total Modbus Comm. Receive Errors that occurred in the slave device. The maximum count is 65,535; the counter will roll over to zero and begin counting again. The total errors are an accumulation of the individual Comm. errors listed below.

1.4.19 Function Code Errors (0x0022)

A read indicates the number of Function Code Errors that occurred in the slave device. The maximum count is 65,535 the counter will roll over to zero and begin counting again.

1.4.20 Starting Address Errors (0x0023)

The counter is incremented for illegal register address.

A read indicates the number of Starting Address Errors that occurred in the slave device. The maximum count is 65,535; the counter will roll over to zero and begin counting again.

1.4.21 CRC Hi Errors (0x0025)

A read indicates the number of CRC Hi Byte Errors that occurred in the slave device. The maximum count is 65,535; the counter will roll over to zero and begin counting again.

1.4.22 CRC Lo Errors (0x0026)

A read indicates the number of CRC Lo Byte Errors that occurred in the slave device. The maximum count is 65,535; the counter will roll over to zero and begin counting again.

1.4.23 Overrun Errors (0x0027)

A read indicates the number of Overrun Errors that occurred in the slave device. The maximum count is 65,535; the counter will roll over to zero and begin counting again.

1.4.24 Framing Errors (0x0029)

A read indicates the number of Framing Errors that occurred in the slave device. The maximum count is 65,535; the counter will roll over to zero and begin counting again.

1.4.25 Clear Communication Errors (0x002D)

A read or write resets all the Modbus Comm. Error counters to zero.

1.4.26 Beam Block Percentage (0x0054)

This register returns a value from 0-100. When the optical path of the IR700 is clear, the reading is 0% blocked. When the register reads near 100 the optical path is blocked and must be cleaned immediately. At 100% the IR700 indicates a fault condition and is no longer capable of detecting gas. This register can be used for predictive maintenance.

1.4.27 Gas ID (0x008D)

This register provides a way to read the unique Gas ID number for the currently selected gas. The table below shows the numbers for the gasses available in the IR700. This list will be extended as more gasses are made available and will be consistent across General Monitors' product range.

Gas ID number (decimal)	CO_2 Full Scale
126	5000 ppm
127	reserved
128	2000 ppm
129	10000 ppm
130	30000 ppm
131	50000 ppm

1.4.28 Reset Events (0x00B0)

Writing 0 to this register clears all event counters, writing 1 – resets event happened flag.

1.4.29 Running Time in seconds hi word (0x00B1)

This sets/reads hi word of device running time in seconds. This value must be read/written prior to running time low byte (register 0x00B2).

1.4.30 Running Time in seconds lo word (0x00B2)

This sets/reads hi word of device running time in seconds. This value must be read/written after running time hi byte (register 0x00B1).

Table 15: Real Time Clock Time Format

Item Number	Description
1	Hi Byte =Year, Low Byte = Month
2	Hi Byte = Day, Low Byte = Hour
3	Hi Byte = Minute, Low Byte = Second

1.4.31 Real-time Clock Year, Month (0x00B3)

This is used to read/write the real time clock. The high byte will be the year minus 2000. The low byte will be a value from 1 to 12. To get or set real time, read or write year/month (0x00B3) first, then day/hour (0x00B4), then min/sec (0x00B5)

1.4.32 Real-time Clock Day, Hour (0x00B4)

This is used to read/write the real time clock. The high byte will be the day of the month from 1 to 31. The low byte will be the hour from 0 to 23. To get or set real time, read or write year/month (0x00B3) first, then day/hour (0x00B4), then min/sec (0x00B5)

1.4.33 Real-time Clock Minute, Second (0x00B5)

This is used to read/write the real time clock. The high byte will be the minute from 0 to 59 and the low byte will be the seconds from 0 to 59. To get or set real time, read or write year/month (0x00B3) first, then day/hour (0x00B4), then min/sec (0x00B5)

1.4.34 Power Cycle Flag (0x00B7)

This reads whether the time of day clock has been reset after a power has been re-cycled to the unit. If the time has been reset, this flag will be = 0; otherwise the flag will = 1.

1.4.35 Event Index (0x00B7)

This is used to indicate which of the stored events the user would like to read. There are 5 event logs: Warning events, Alarm events, Fault events, Calibration events and Maintenance events. Each of these event logs consist of 10 of their most recent occurrences. The user is able to read the logs of each of these by setting this event index followed by a reading of the desired event log. The event index is a number from 0 to 9. Zero refers to the most recent event and 9 refers to the least recent event stored in the log. For example to read time of the most recent Warning event in the Warning event log, set this register to 0 and then read registers 0xB8 and 0xB9 (for the running time in seconds) or read registers 0xBA, 0xBB, and 0xBC (for the clock time).

1.4.36 Warning Running Time in Seconds, Hi Word (0x00B8)

This register reads hi word of the running time in seconds when the warning event occurred. This time is in seconds since January 1, 2000.

1.4.37 Warning Running Time in Seconds, Low Word (0x00B9)

This register reads the low word of the running time in seconds when the warning event occurred. This time is in seconds since January 1, 2000.

The values from the above table should be read in order: first item 1, then item 2, & then item 3.

1.4.38 Warning Clock Time: Year, Month (0x00BA)

These registers are described in Table 15 as item number 1.

1.4.39 Warning Clock Time: Day, Hour (0x00BB)

These registers are described in Table 15 as item number 2.

1.4.40 Warning Clock Time: Minute, Second (0x00BC)

These registers are described in Table 15 as item number 3.

1.4.41 Total Warning Event Counter (0x00BF)

This reads the total number of warning events have been stored in the unit.

1.4.42 Alarm Running Time in Seconds, Hi Word (0x00C0)

This register reads the high word of the running time in seconds when the alarm event occurred. This time is in seconds since January 1, 2000.

1.4.43 Alarm Running Time in Seconds, Low Word (0x00C1)

This register reads the low word of the running time in seconds when the alarm event occurred. This time is in seconds since January 1, 2000.

1.4.44 Alarm Clock Time: Year, Month (0x00C2)

These registers are described in Table 15 as item number 1.

1.4.45 Alarm Clock Time: Day, Hour (0x00C3)

These registers are described in Table 15 as item number 2.

1.4.46 Alarm Clock Time: Minute, Seconds (0x00C4)

These registers are described in Table 15 as item number 3.

1.4.47 Total Alarm Event Counter (0x00C7)

This reads the total number of alarm events have been stored in the unit.

1.4.48 Fault Running Time in Seconds, Hi Word (0x00C8)

This register reads the high word of the running time in seconds when the fault event occurred. This time is in seconds since January 1, 2000.

1.4.49 Fault Running Time in Seconds, Low Word (0x00C9)

This register reads the low word of the running time in seconds when the fault event occurred. This time is in seconds since January 1, 2000.

1.4.50 Fault Clock Time: Year, Month (0x00CA)

These registers are described in Table 15 as item number 1.

1.4.51 Fault Clock Time: Day, Hour (0x00CB)

These registers are described in Table 15 as item number 2.

1.4.52 Fault Clock Time: Minute, Seconds (0x00CC)

These registers are described in Table 15 as item number 3.

1.4.53 Fault Code (0x00CD)

This register is described in Table 10.

1.4.54 Total Fault Event Counter (0x00CF)

This reads the total number of fault events have been stored in the unit.

1.4.55 Maintenance Running Time in Seconds, Hi Word (0x00D0)

This register reads the high word of the running time in seconds when the gas check event occurred. This time is in seconds since January 1, 2000.

1.4.56 Maintenance Running Time in Seconds, Low Word (0x00D1)

This register reads the low word of the running time in seconds when the gas check event occurred. This time is in seconds since January 1, 2000.

1.4.57 Maintenance Clock Time: Year, Month (0x00D2)

These registers are described in Table 15 as item number 1.

1.4.58 Maintenance Clock Time: Day, Hour (0x00D3)

These registers are described in Table 15 as item number 2.

1.4.59 Maintenance Clock Time: Minute, Seconds (0x00D4)

These registers are described in Table 15 as item number 3.

1.4.60 Total Maintenance Event Counter (0x00D6)

This reads the total number of gas check events have been stored in the unit

1.4.61 Calibration Running Time in Seconds, Hi Word (0x00D8)

This register reads the high word of the running time in seconds when the calibration event occurred. This time is in seconds since January 1, 2000.

1.4.62 Calibration Running Time in Seconds, Low Word (0x00D9)

This register reads the low word of the running time in seconds when the calibration event occurred. This time is in seconds since January 1, 2000.

1.4.63 Calibration Clock Time: Year, Month (0x00DA)

These registers are described in Table 15 as item number 1.

1.4.64 Calibration Clock Time: Day, Hour (0x00DB)

These registers are described in Table 15 as item number 2.

1.4.65 Calibration Clock Time: Minute, Seconds (0x00DC)

These registers are described in Table 15 as item number 3.

1.4.66 Calibration Code (0x00DD)

This returns 1 for zero events and 2 for calibration events.

1.4.67 Total Calibration Event Counter (0x00DF)

This reads the total number of calibration events have been stored in the unit.