CONTROL UNIT FICO-MINI

BMS INTEGRATION

FOR WORD

The purpose of this document is to provide users with a quick and simple means to integrate the FICO-MINI system in a BMS system or any other integration.

NOTES OF USE

This document is intended for integrators who perform commissioning and integration of FICO system into any Modbus environment.

For operation and planning of integration of the fire damper control system, please refer to additional documents, such as:

- Consultants technical description of the site.
- Modbus Application Protocol Specification 1.1b
- RS485 installations guidelines

SYMBOLS

Section introduced by this symbol indicate a warning to help prevent incorrect operation.

Section introduced by this symbol indicate that the text must be read with special attention.

Paragraphs with this symbol provide tips.

ABBREVIATIONS

Abbreviation	Description
RTU	Remote Terminal Unit
Gateway	A device for transfer data between different kind of networks
LSB	Least Significant Bit
MSB	Most Significant Bit

REVISION HISTORY

Release	Date	Author
1	2019-01-13	Johan Nordlander
2	2021-02-18	Johan Nordlander

DEFAULT MODBUS RTU SLAVE SETTINGS

19200 8N1

GENERAL INFORMATION

The following section provides only a brief overview of the Modbus protocol.

For the full specification, refer to "Modicon Modbus Protocol Reference Guide PI-MBUS-300 Rev. J".

Master/slave protocol

The Modbus is a master/slave protocol. By definition, this means that a Modbus network contains one, and only one, master and at least one slave.

The Modbus master starts the transactions on the network with a slave query. The slave either responds positively with the requested service (response) or transmits an "exception message". In the remainder of this document, these query/response sequences are also referred to as "Modbus telegrams".

Function codes

The type of transaction is defined by the function code transmitted in the Modbus telegrams. A function code defines the following:

- Structure of the telegram, query and response
- Direction of data transmission (master/slave or slave/master)
- Data format of data point (bit or 16-bit register)

Transmission mode

The Modbus protocol defines two alternative serial transmission modes. These modes have the following characteristics:

RTU (Remote Terminal Unit) mode

- Binary-coded data
- Start and end of telegrams marked by timed pauses (a "silent interval") between the characters transmitted.
- Check sum algorithm: CRC (Cyclic Redundancy Check)

ASCII mode

- Data in hexadecimal notation
- Beginning and end of telegrams marked by start and end characters.
- Check sum algorithm: LRC (Longitudinal Redundancy Check)

Telegrams with points

Certain types of Modbus transactions permit the transmission of a **multiple data** variable number of Modbus data points (bit or 16-bit register) in a single telegram.

Modbus TCP

A Modbus TCP/RTU gateway can be used to connect a Modbus/TCP master to one or several slaves. The Modbus TCP/RTU gateway will act as a Modbus/TCP slave on a Ethernet network, and transform the queries to the serial Modbus network and back again.

RS485 NETWORK

RS485 is a balanced line, half-duplex transmission system that meets the requirements for a truly multi-point communications network, and the standard specifies up to 32 drivers and 32 receivers on a single (2-wire) bus. Half-duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time.

Abbreviation	
Mode of operation	Differential
Total number of drivers and Receivers on One Line (One driver active at a time for RS485 networks)	128 Driver 128 Receivers
Maximum Cable Length	1200 meter
Maximum Data Rate (10m – 1200m)	10Mb/s-100Kb/s
Maximum Driver Output Voltage	-7V to +12V
Driver Output Signal Level (Loaded Min.)	+/- 3V
Driver Output Signal Level (Unloaded Max	+/-3 V
Driver Load Impedance (Ohms)	54
Max. Driver Current in High Z State, Power On	+/-100uA
Max. Driver Current in High Z State, Power Off	+/-100uA
Slew Rate (Max.)	N/A
Receiver Input Voltage Range	-7V to +12V
Receiver Input Sensitivity	+/-150mV
Receiver Input Resistance (Ohms), (1 Standard Load for RS485)	≥12k

TOOLS

Modbus slave devices can be tested with several Modbus master simulation tools, like "Modbus Poll" or "ModScan", from a computer. Modbus Poll can be downloaded from www.modbustools.com.

A RS485/RS232 converter or a Modbus RTU/TCP gateway may be needed to connect to a computer.

TROUBLESHOOTING, TIPS

- The slave address must be unique in the network, valid addresses are from 1-247.
- Only reference addresses that are generated can be read/write, see chapter 5 for more information about the specific application.
- Baud rate, Parity and stop bits must match the network and the Master.
- The 2-wire bus is NOT interchangeable and must be connected correctly.
- In case of long distance and/or high baud rate, please consider end of line resistors like 120 Ohm on both sides (according to RS485 rules)

REGISTER MAP AND FUNCTION CODES

Modbus registers are organized into reference types identified by the leading number of the reference address: The "x" following the leading character represents a four-digit reference address.

Modbus type	Reference	Description (refer to a Master device)
Coil status	0x<addr>	Read/Write Discrete Outputs or Coils. A 0x reference address is used to drive output data to a digital 1-bit output channel.
Input status	1x<addr>	Read Discrete Inputs. The 1-bit status of a 1x reference address is controlled by the corresponding digital input channel.
Input registers	3x<addr>	Read Input Registers. A 3x reference register contains a 16-bit number received from an external source - e.g. an analog signal.
Holding registers	4x<addr>	Read/Write Output or Holding Registers. A 4x register is used to store 16-bits of numerical data (binary or decimal), or to send the data from the CPU to an output channel.

The leading character is generally implied by the function code and omitted from the address specified for a given function. The leading character also identifies the I/O data type.

FUNCTION CODES

The functions below are used to access the registers outlined in the register map of the module for sending and receiving data.

Function code	Code	Function	
01	0x<addr>	Read coil status	1)
02	1x<addr>	Read input status	1)
03	4x<addr>	Read holding registers	Implemented
04	3x<addr>	Read input registers	1)
05	0x<addr>	Force single coil	1)
06	4x<addr>	Preset single register	Implemented
15	0x<addr>	Force multiple coils	1)
16	4x<addr>	Force multiple register	Implemented

1) Implemented, but not used

When the slave device responds to the master, it uses the function code field to indicate either a normal (error-free) response, or that some kind of error has occurred (an exception response).

REGISTER VALUES

Modbus registers are normally constructed from 16 bit unsigned integers. In some cases more information are packed into each register with the following coding.

For those register that each bit have a spcific function the each bit within the register is described with the b prefix.

Example
- b0 represent bit 0
- b1 represents bit 1
- b15 reprsents bit 15

For those registers where multiple information is stored in the same registers a range of bits are used for each value.

Example
- b0..b7 represents the lowest 8 bits in the register.
  value = <register value> AND 255
- b8..b15 represents the higest 8 bits in the register.
  value = (<register value> DIV 256) AND 255

REFERENCE ADDRESSES

This chapter describes the reference addresses used in the application. Reference addresses marked “Not used” or not specified can be accessed freely with read or write access.

It is recommended not to read or write any addresses not mentioned in this manual. If So there will be an exception response and the communication fails with current firmware or any later update.

All address types starts with 1, and due to that some Master devices starts with 0 it’s in that case necessary to subtract all addresses in this manual with 1.

- 16 bit real values are presented in their actual value/unit. E.g. °C, %, Pa, l/s
- 16 bit states are presented either as a number or as a bit pattern, see the reference address description
- 1 bit status are presented as 0=Off and 1=On
- 1 bit alarms are presented as 0=Normal and 1=Alarm

MODBUS REGISTERS

4x<addr> Holding registers

Group	Register	Access	Value	Description
General information	1	R	Device type	4123 = FICO-MINI
	2	R/W	Device mode	0 = Standby 1 = Online
	3	R	Device status	b0 = Device restarted b1 = All dampers open b2 = All dampers closed b3 = Fire alarm b4 = Service alarm b5 = Damper generated fire alarm b6 = Damper failure b7 = Testing active b8 = Testing failed b9 = External alarm b10 = External interlock b11 = Modbus alarm b12 = Modbus interlock b13 = <not used> b14 = Communication error b15 = Configuration changed”
	4	R/W	Device configuration (auto detected)	b0 = damper 1 enabled b1 = damper 2 enabled b2 = damper 3 enabled b3 = damper 4 enabled b4 = detector 1 enabled b5 = detector 2 enabled
Damper 1	5	R	Status (Low)	b0..3 = Damper position 0 = Damper moving 1 = Damper closed 2 = Damper moving 3 = Damper open b4 = Damper alarm b5 = Damper failure
	6	R	Status (High)	Reserved, read as 0
Damper 2	7	R	Status (Low)	b0..3 = Damper position 0 = Damper moving 1 = Damper closed 2 = Damper moving 3 = Damper open b4 = Damper alarm b5 = Damper failure
	8	R	Status (High)	Reserved, read as 0
Damper 3	9	R	Status (Low)	b0..3 = Damper position 0 = Damper moving 1 = Damper closed 2 = Damper moving 3 = Damper open b4 = Damper alarm b5 = Damper failure
	10	R	Status (High)	Reserved, read as 0
Damper 4	11	R	Status (Low)	b0..3 = Damper position 0 = Damper moving 1 = Damper closed 2 = Damper moving 3 = Damper open b4 = Damper alarm b5 = Damper failure
	12	R	Status (High)	Reserved, read as 0
Detector 1	13	R	Status	b0..b3 = 0 = detector offline 1..15 = detector active b4 = service alarm b5 = fire alarm b6 = detector not installed b7 .. b15 = not used

Detector 2	14	R	Status	b0..b3 = 0 = detector offline 1..15 = detector active b4 = service alarm b5 = fire alarm b6 = detector not installed b7 .. b15 = not used
Device status	15	R	Dip settings	(always zero, reserved for compatibility)
	16	R	Digital input values	b0 = External input 1 (ext alarm) b1 = External input 2 (int alarm) b2 = External input 3 (test)
	17	R/W	Digital output values	
	18	R	Detector 1 - Voltage	(always zero, reserved for compabiltiy)
	19	R	Detector 2 - Voltage	(always zero, reserved for compabiltiy)
Configuration				
Time settings	51	R/W	Clock - Year	2021 or
	52	R/W	Clock - Month	1 = January 2 = February ... 12 = December
	53	R/W	Clock - Day	1..31
	54	R/W	Clock - Hour	0..23
	55	R/W	Clock - Minute	0..59
	56	R/W	Clock - Second	0..59
	57	R	Next test - Days	0..
	58	R	Next test - Hour	0..23
	59	R	Next test - Minute	0..59
	60	R	Next test - Second	0..59
Testing	61	R/W	Test Active	0 = off 1 = on Note: Manual or schedule test will also set bit 0 during testing. Writing to this dururing active tests will not have any affect.
	62	R/W	Test interval (days)	
	63	R/W	Test day of week	0 = Monday 1 = Tuesday 2 = Wednesday 3 = Thursday 4 = Friday 5 = Saturday 6 = Sunday
	64	R/W	Test time	read b0 .. b7 = hour b8 .. b15 = minute write (hour * 60) + minute
Real time clock	65	R/W	Year	
	66	R/W	Month	
	67	R/W	Day	
	68	R/W	Hour	
	69	R/W	Minute	
	70	R/W	Seconds	
Digital input 1	71	R/W	Function	0 = External alarm 1 = External interlock 2 = External interlock left damper (1+2) 3 = External interlock right dam7per (3+4) 4 = External interlock damper 1 5 = External interlock damper 2 6 = External interlock damper 3 7 = External interlock damper 4 8 = External test 9 = External alarm reset 10 = External test/alarm reset"

Digital input 2	72	R/W	Function	0 = External alarm 1 = External interlock 2 = External interlock left damper (1+2) 3 = External interlock right damper (3+4) 4 = External interlock damper 1 5 = External interlock damper 2 6 = External interlock damper 3 7 = External interlock damper 4 8 = External test 9 = External alarm reset 10 = External test/alarm reset"
Digital input 3	73	R/W	Function	0 = External alarm 1 = External interlock 2 = External interlock left damper (1+2) 3 = External interlock right damper (3+4) 4 = External interlock damper 1 5 = External interlock damper 2 6 = External interlock damper 3 7 = External interlock damper 4 8 = External test 9 = External alarm reset 10 = External test/alarm reset"
Reserverd	74	R		
Reserverd	75	R		
Forced ventilation	76	R/W	Time setting in seconds for forced ventilation	Default value 30 min (1800 seconds)
Maintenance	77	R/W	Remaining time of maintenance (s)	
Modbus Master interface	81	R	Baud rate	9600 19200 33800 57600
	82	R	Parity	0 = None 1 = Odd 2 = Even
	83	R	Stop bits	1 = One stop bit
Modbus Slave interface	84	R/W	Baud rate	9600 19200 33800 57600
	85	R/W	Parity	0 = None 1 = Odd 2 = Even
	86	R/W	Stop bits	1 = One stop bit
Device information	87	R	Firmware revision	

Slave device information				
System information	501	R	Status	b0 = Device restarted b1 = All dampers open b2 = All dampers closed b3 = Fire alarm b4 = Service alarm b5 = Damper generated fire alarm b6 = Damper failure b7 = Testing active b8 = Testing failed b9 = External alarm b10 = External interlock b11 = Modbus alarm b12 = Modbus interlock b13 = <not used> b14 = Commuication error b15 = Configuration changed
	502	R	Count	Number of units connected (1...3)
Module 1 (controller)	504	R	Device type	2 = FICO-MINI
	505	R	Device serial	Always 0
	506	R	Device status	b0 = Device restarted b1 = All dampers open b2 = All dampers closed b3 = Fire alarm b4 = Service alarm b5 = Damper generated fire alarm b6 = Damper failure b7 = Testing active b8 = Testing failed b9 = External alarm b10 = External interlock b11 = Modbus alarm b12 = Modbus interlock b13 = <not used> b14 = Commuication error b15 = Configuration changed
	507	R	Device configuration	b0 = Damper 1 installed b1 = Damper 2 installed b2 = Damper 3 installed b3 = Damper 4 installed b4 = Detector 1 installed b5 = Detector 2 installed
	508	R	Damper status	b0..1 Damper 1 Postion (0 = moving, 1=closed, 2=open) b2 Damper 1 Alarm b3 Damper 1 Failure b4..5 Damper 2 Postion (0 = moving, 1=closed, 2=open) b6 Damper 2 Alarm b7 Damper 2 Failure b8..9 Damper 3 Postion (0 = moving, 1=closed, 2=open) b10 Damper 3 Alarm b11 Damper 3 Failure b12..13 Damper 4 Postion (0 = moving, 1=closed, 2=open) b14 Damper 4 Alarm b15 Damper 4 Failure
	509	R	Detector status	b0 = Not pressent (disconnected) b1 = Fire alarm b2 = Service alarm

Module 2 (slave unit 1)	510	R	Device type	4123 = FCBB-2 4124 = FCBB-4
	511	R	Device serial	
	512	R	Device status	b0 = Device restarted b1 = All dampers open b2 = All dampers closed b3 = Fire alarm b4 = Service alarm b5 = Damper generated fire alarm b6 = Damper failure b7 = Testing active b8 = Testing failed b9 = External alarm b10 = External interlock b11 = Modbus alarm b12 = Modbus interlock b13 = <not used> b14 = Commuication error b15 = Configuration changed
	513	R	Device configuration	b0 = Damper 1 installed b1 = Damper 2 installed b2 = Damper 3 installed b3 = Damper 4 installed b4 = Detector 1 installed b5 = Detector 2 installed
	514	R	Damper status	b0..1 Damper 1 Postion (0 = moving, 1=closed, 2=open) b2 Damper 1 Alarm b3 Damper 1 Failure b4..5 Damper 2 Postion (0 = moving, 1=closed, 2=open) b6 Damper 2 Alarm b7 Damper 2 Failure b8..9 Damper 3 Postion (0 = moving, 1=closed, 2=open) b10 Damper 3 Alarm b11 Damper 3 Failure b12..13 Damper 4 Postion (0 = moving, 1=closed, 2=open) b14 Damper 4 Alarm b15 Damper 4 Failure
	515	R	Detector status	b0 = Not pressent (disconnected) b1 = Fire alarm b2 = Service alarm

Module 3 (slave unit 2)	516	R	Device type	4123 = FCBB-2 4124 = FCBB-4
	517	R	Device serial	
	518	R	Device status	b0 = Device restarted b1 = All dampers open b2 = All dampers closed b3 = Fire alarm b4 = Service alarm b5 = Damper generated fire alarm b6 = Damper failure b7 = Testing active b8 = Testing failed b9 = External alarm b10 = External interlock b11 = Modbus alarm b12 = Modbus interlock b13 = <not used> b14 = Commuication error b15 = Configuration changed
	519	R	Device configuration	b0 = Damper 1 installed b1 = Damper 2 installed b2 = Damper 3 installed b3 = Damper 4 installed b4 = Detector 1 installed b5 = Detector 2 installed
	520	R	Damper status	b0..1 Damper 1 Postion (0 = moving, 1=closed, 2=open) b2 Damper 1 Alarm b3 Damper 1 Failure b4..5 Damper 2 Postion (0 = moving, 1=closed, 2=open) b6 Damper 2 Alarm b7 Damper 2 Failure b8..9 Damper 3 Postion (0 = moving, 1=closed, 2=open) b10 Damper 3 Alarm b11 Damper 3 Failure b12..13 Damper 4 Postion (0 = moving, 1=closed, 2=open) b14 Damper 4 Alarm b15 Damper 4 Failure
	521		Detector status	b0 = Not pressent (disconnected) b1 = Fire alarm b2 = Service alarm
Device configuration (read only until unlocked	1001	R	Key 1	
	1002	R/W	Key 2	
	1003	R/W	Damper1 - Closing timeout	
	1004	R/W	Damper1 - Open timeout	
	1005	R/W	Damper2 - Closing timeout	
	1006	R/W	Damper2 - Open timeout	
	1007	R/W	Damper3 - Closing timeout	
	1008	R/W	Damper3 - Open timeout	
	1009	R/W	Damper4 - Closing timeout	
	1010	R/W	Damper4 - Open timeout	
	1011	R/W	Close fan delay (s)	
	1012	R/W	Close damper delay on test (s)	
	1013	R/W	Close damper delay on fire (s)	
Comment: Changing the device configuration can only be done after contact with support has taken place. Further instructions will be provided.				