Air conditioner Controller MODBUS Reference

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B&R offer

B&R do not offer any MODBUS support or software to access the MODBUS interface to our TX-NOX range of air-conditioner. It is expected that customer have the skills to integrate or have access to skilled persons that can setup and integrate the air-conditioning range of products into their monitoring system. The document below describes that important information needed for a skilled person to integrate these air-conditioners. It is recommended to visit the MODBUS organisation website https://modbus.org/ for detailed explanation of all the intricacies of MODBUS.

Introduction

The MODBUS protocol is a widely adopted industrial communication protocol that allows for seamless data exchange between electronic devices. Developed for its simplicity and reliability, MODBUS has become a standard communication method in various industrial applications, including automation, energy management, and monitoring systems.

This information sheet provides essential details on configuring and using the MODBUS device. It covers the default settings, communication parameters, and specific register mappings that ensure effective communication with the device.

Key Features:

- **Easy Integration**: Compatible with a wide range of MODBUS master devices.
- **Flexibility**: Supports multiple communication modes, including RTU (Remote Terminal Unit) and ASCII.
- **Reliability**: Ensures robust and error-free data transmission.

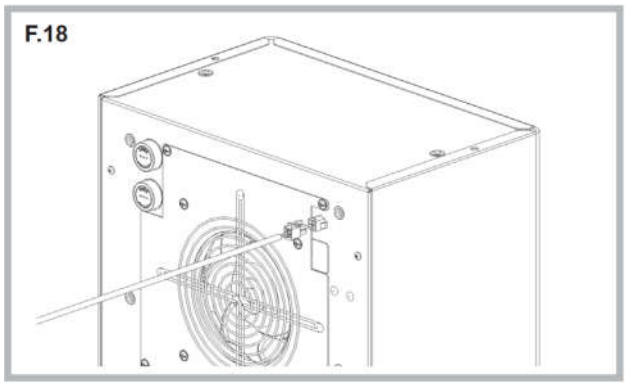
Contents:

1. **Default MODBUS Parameters**: Pre-configured settings for quick setup.
2. **Communication Settings**: Baud rate, parity, and stop bit configurations.
3. **Register Map**: Detailed mapping of available registers for data access.
4. **Operational Modes**: Instructions for unicast and broadcast communication.
5. **Parameter Configuration**: Guidelines for modifying device parameters via the interface.

This guide aims to facilitate the integration and operation of your MODBUS device, ensuring optimal performance and compatibility with your existing systems.

Physical layer

The Modbus interface is shown in the air conditioners installation instructions as:



The connection cable is not supplied. The interface is a RS485 interface and the air conditioner will always be a slave.

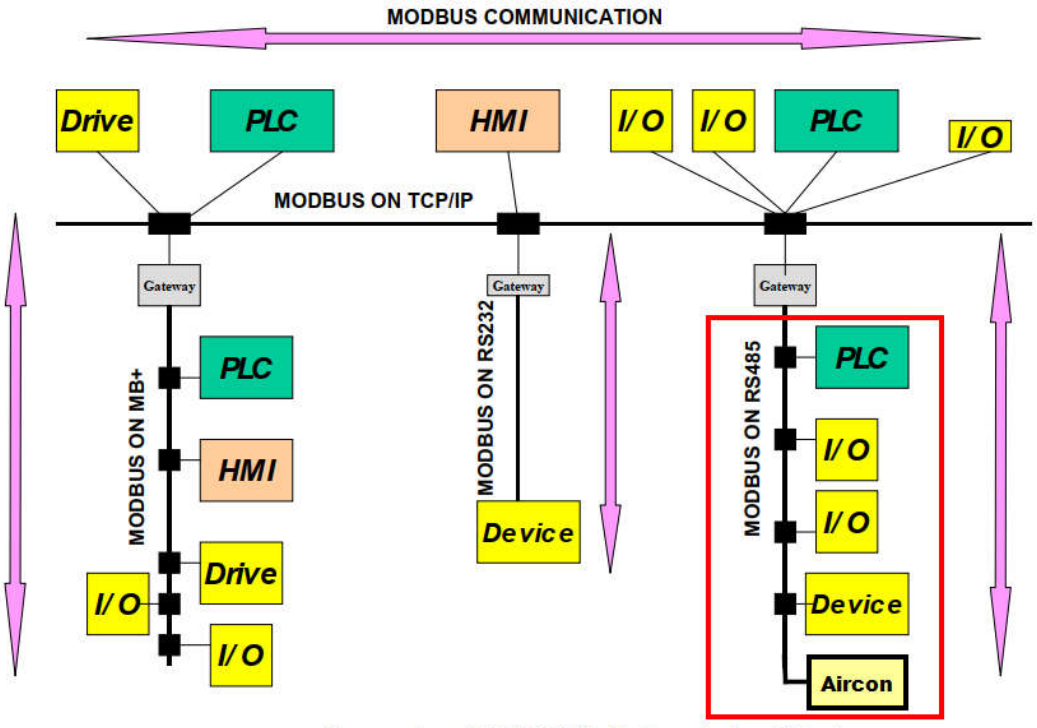
Pin	***Description***	***Function***
1	RS-485 MODBUS port: reference (GND) [G]	Modbus protocol slave, configurable, for supervision and device programming use
2	RS-485 MODBUS port: - [B-]	
3	RS-485 MODBUS port: + [A+]	

Protocol overview (RS485)

MODBUS follows the ISO/OSI model but only includes

ISO Layer	ISO model	
7	Application	MODBUS Application Protocol
6	Presentation	Empty
5	Session	Empty
4	Transport	Empty
3	Network	Empty
2	Data Link	MODBUS Serial Line Protocol
1	Physical	EIA/TIA-485 (or EIA/TIA-232)

At the physical level, MODBUS over Serial Line systems may use different physical interfaces (RS485, RS232) however in this case RS485. MODBUS application layer messaging protocol, positioned at level 7 of the OSI model, provides client/server communication between devices connected on buses or networks. On MODBUS serial line the client role is provided by the Master of the serial bus and the Slaves nodes act as servers. For air-conditioner communication the MODBUS on RS485 is applicable, other networks are shown for clarity.



Example of MODBUS Network Architecture

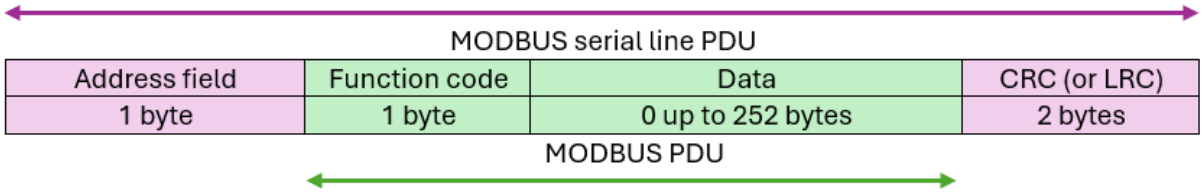
MODBUS Master/Slaves Protocol

MODBUS is a Master-Slaves communication protocol. Only one master can be connected to the bus at any time, along with up to 247 slave nodes. Communication is always initiated by the master, and slave nodes will only respond to requests from the master. Slave nodes do not communicate with each other.

- **Unicast Mode**: The master addresses an individual slave (address range 1 to 247). The slave processes the request and sends a reply.
- **Broadcast Mode**: The master sends a request to all slaves (address 0). No response is sent back. Broadcast requests are always write commands, which all devices must accept.

MODBUS frame description

The mapping of MODBUS protocol on a specific bus or network introduces some additional fields on the Protocol Data Unit (PDU). The client that initiates a MODBUS transaction builds the MODBUS PDU, and then adds fields to build the appropriate communication PDU.



Address field

The Address field only contains the slave address or the 0 broadcast address. The Address 0 is reserved as the broadcast address. All slave nodes must recognise the broadcast address. The MODBUS Master node has no specific address, only the slave nodes must have an address. This address must be unique.

Function code

The function code indicates to the slave what kind of action to perform.

Data

The function code can be followed by a data field that contains request and response parameters.

CRC

Error checking field is the result of a "Redundancy Checking" calculation that is performed on the message contents.

RTU Transmission Mode

When devices communicate on a MODBUS serial line using the RTU (Remote Terminal Unit) mode, each 8–bit byte in a message contains two 4–bit hexadecimal characters. The main advantage of this mode is that its greater character density allows better data throughput than ASCII mode for the same baud rate. Each message must be transmitted in a continuous stream of characters

11 bit byte format for RTU mode:

- **Coding System**: 8-bit binary
- **Bits per Byte**:
    - 1 start bit
    - 8 data bits (least significant bit sent first)
    - 1 bit for parity
    - 1 stop bit
- **Parity**: Even parity is the default. Odd parity and no parity are also supported. If no parity is used, 2 stop bits are required.

With Parity Checking

Start	1	2	3	4	5	6	7	8	Par	Stop

Setting MODBUS Parameters from TX-i40 Display

1. Long press the SET key to enter USER level.
2. Use the UP or DOWN keys to scroll to the "Par" menu and press SET.
3. Scroll to "PG parameters" and press SET.
4. Scroll to the desired parameter, press SET to modify, use UP or DOWN to select the required value, and press SET to confirm.

Parameter	**Description**	**Assignable values**	**Factory Setting**	**Default MODBUS Communication Settings**
G03	Device address	0 From 1 to 247	0	247
G04	Baud rate	0 = 2400 1 = 4800 2 = 9600 3 = 19200	Disabled	19200
G05	Parity bit	0 = none 1 = odd 2 = even	Disabled	Even
G06	Stop bits	0 = 1 stop bit 1 = 2 stop bits	Disabled	1

STATUS							
Item	Label	MODBUS Addr (Base 0)	MODBUS Addr (Base 1)	MODBUS Access	Measure unit	Inf	Sup
Status							
Unit Status	S02	0501h	HR:1282	RW		0=ON	2=Stand-by by Digital Input
					0	ON	
					1	Stand-by	
					2	Stand-by by Digital Input	
On Alarm	S03	0502h	HR:1283	RW		0=Off	1=On
Working Hours							
Compressor Working Hours	S15	050Eh	HR:1295	RW	h x10		
Evaporator Fan Working Hours	S21	0514h	HR:1301	RW	h x10		
Condenser Fan Working Hours	S23	0516h	HR:1303	RW	h x10		
Filter Working Hours	S99	058Fh	HR:1424	RW	h x10		
I/O							
Analog Inputs							
Condenser NTC Probe Temperature*	IN1	0201h	HR:514	R	°C-°F (0.1 resolution)		
Evaporator inlet air NTC Probe Temperature	IN2	0202h	HR:515	R	°C-°F (0.1 resolution)		
Ambient air NTC Probe Temperature*	IN3	0203h	HR:516	R	°C-°F (0.1 resolution)		
Digital Inputs							
Condenser NTC Probe Status*	DI1	0101h.Bit0	HR:258.Bit0	R		0=Off	1=On
Evaporator inlet air NTC Probe Status	DI2	0101h.Bit1	HR:258.Bit1	R		0=Off	1=On
Ambient air NTC Probe Status*	DI3	0101h.Bit2	HR:258.Bit2	R		0=Off	1=On
Digital input External Alarm Status	DI4	0101h.Bit3	HR:258.Bit3	R		0=Off	1=On
Phase sequence relay Status*	DI5	0101h.Bit4	HR:258.Bit4	R		0=Off	1=On
Compressor overload protection Status*	DI6	0101h.Bit5	HR:258.Bit5	R		0=Off	1=On
High pressure switch Status*	DI7	0101h.Bit6	HR:258.Bit6	R		0=Off	1=On
Digital Outputs							
General alarm relay Status	DO1	0181h.Bit0	HR:386.Bit0	R		0=Off	1=On
Evaporator fan relay Status	DO2	0181h.Bit1	HR:386.Bit1	R		0=Off	1=On
Condenser fan relay Status	DO3	0181h.Bit2	HR:386.Bit2	R		0=Off	1=On
Compressor relay Status	DO4	0181h.Bit3	HR:386.Bit3	R		0=Off	1=On
PARAMETERS							
Setpoint							
Cooling mode setpoint	Coo	0600h	HR:1537	RW	°C-°F	20	45
General							
Measurement Unit	G07	060Ah	HR:1547	RW	0=Celsius/Bar	1=Fahrenheit/Psi	

Enable Sequencing	G20	0617h	HR:1560	RW	0=Off	1=On	
Alarm							
High/Low Control Temperature Alarm Differential	A16	062Ch	HR:1581	RW	K-R (0.1 resolution)	0.0	59.9
High/Low Control Temperature Alarm Mode	A86	06E2h	HR:1763	RW	0=Relative	1=Absolute	
Absolute High Control Temperature Alarm Setpoint Cooling Mode	A87	06E3h	HR:1764	RW	°C-°F	-58	199
Absolute Low Control Temperature Alarm Setpoint Cooling Mode	A88	06E4h	HR:1765	RW	°C-°F	-58	199
Maximum Filter Working Hours	A91	06F5h	HR:1782	RW	h*10	0=Disabled	9999
Regulation							
Cooling mode control band	r01	0687h	HR:1672	RW	K-R (0.1 resolution)	0.0	99.9

ALARMS							
Item	Label	MODBUS Addr (Base 0)	MODBUS Addr (Base 1)	MODBUS Access	Measure unit	Inf	Sup
High regulation temperature Alarm	Hrt	0303h	HR:772	R			
Phase sequence Alarm*	PH	0305h	HR:774	R			
Generic Alarm	ALL	0309h	HR:778	R			
Expansion communication Alarm	CoM	030Dh	HR:782	R			
Working hours Alarm	Hou	030Eh	HR:783	R			
Low Control Temperature Alarm	Lrt	030Fh	HR:784	R			
High pressure Alarm*	HP1	0311h	HR:786	R			
Compressor thermal overload Alarm*	t1	0317h	HR:792	R			
Condenser NTC Probe Error*	A01	0331h	HR:818	R			
Evaporator inlet air NTC Probe Error	A02	0332h	HR:819	R			
Ambient air NTC Probe Error*	A03	0333h	HR:820	R			