Altivar 21

User's manual

Modbus

Telemecanique

Contents

1. Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personnal if the instruction are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death, serious injury, or equipment damage.

⚠ WARNING

Warning indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

PLEASE NOTE

Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.
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2. Before you begin

Read and understand these instructions before performing any procedure with this inverter, in order to completely and correctly utilize excellent performance of this unit.

Besides this user manual, you will find in the chapter "Documentation structure" which manuals we advice you to read to develop software communicating with Altivar 21.

If you need support, please contact our sales offices.

After reading this instruction manual, please keep it handy for future reference

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⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand the Installation Manual before installing or operating the Altivar 21 inverter. Installation, adjustment, repair, and maintenance must be performed by qualified personnel.

- The user is responsible for compliance with all international and national electrical standards in force concerning protective grounding of all equipment.

- Many parts of this variable speed drive, including the printed circuit cards, operate at the line voltage. DO NOT TOUCH. Use only electrically insulated tools.

- DO NOT touch unshielded components or terminal strip screw connections with voltage present.

- DO NOT short across terminals PA and PC or across the DC bus capacitors.

- Install and close all the covers before applying power or starting and stopping the inverter.

- Before servicing the variable speed drive
  - Disconnect all power.
  - Place a "DO NOT TURN ON" label on the variable speed drive disconnect.
  - Lock the disconnect in the open position.

- Disconnect all power including external control power that may be present before servicing the inverter. WAIT 15 MINUTES to allow the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure given in the Installation Manual to verify that the DC voltage is less than 45 VDC. The inverter LEDs are not accurate indicators of the absence of DC bus voltage.

Electric shock will result in death or serious injury.

⚠ CAUTION

DAMAGED EQUIPMENT

Do not install or operate any inverter that appears damaged.

Failure to follow this instruction can result in injury or equipment damage.

3. Introduction

Thank you for purchasing the Altivar 21 inverter equipped with an embedded Modbus port.

The present guide contains information about the installation of the Altivar 21 inverter on a Modbus network and describes the Modbus services available.

By using the Modbus port of the Altivar 21, data communication can be made with a PLC, a host computer or other devices via a Modbus network.

Data exchanges give access to all Altivar 21 functions:
• Control (start, stop, reset, setpoint),
• Monitoring (status, current, voltage, thermal state...),
• Diagnostics (alarms),
• Settings,
• Configuration.

The communication port has an RJ45 connector for the connection to the network. At the physical layer, it supports 2-wire RS485 and transmission speed at 9600 or 19200 bps.

4 Modbus functions are available:
• 3 (16#03) Read Holding Registers
• 6 (16#06) Write Single Register
• 16 (16#10) Write Multiple Registers
• 43/14 (16#2B/0E) Read Device Identification

Function 3 has a restricted implementation:
• with length 1 ("Read one word"), it permits to read any parameter of the inverter, one by one.
• with lengths 2 to 5 ("Read indirect block"), it permits to read a particular block of 2 to 5 indirect parameters. These 5 parameters can be configured through the operation panel to relevant monitoring parameters.

Function 16 has a restricted implementation:
• with length 1 ("Write one word"), it permits to write any writable parameter of the inverter, one by one.
• with length 2 ("Write indirect block"), it permits to write a particular block of 2 indirect parameters. These 2 parameters can be configured through the operation panel to relevant control parameters.

4. Documentation structure

■ Modbus ATV21 manual

This manual describes:
• Connection to the network,
• Configuration of the communication-related parameters,
• Modbus services supported,
• Parameter list (additional to the ATV21 user manual).

You will also find important information in other Altivar 21 technical documents. They are available on the Web site www.telemecanique.com and on the CDROM delivered with each inverter:

■ ATV21 user manual

This manual describes:
• How to assemble the inverter,
• How to connect the inverter,
• The functions and the parameters of the inverter,
• How to use the operation panel.

You will find in this manual the address and possible values of the parameters of the inverter.

Note: In both manuals, the address of the parameters is named "Communication number" and coded in hexadecimal (16 #).

5. Connection to the network

5. 1. Connection to the inverter

Connection accessories should be ordered separately (please consult our catalogues).

Connect the RJ45 cable connector to the Modbus connector.
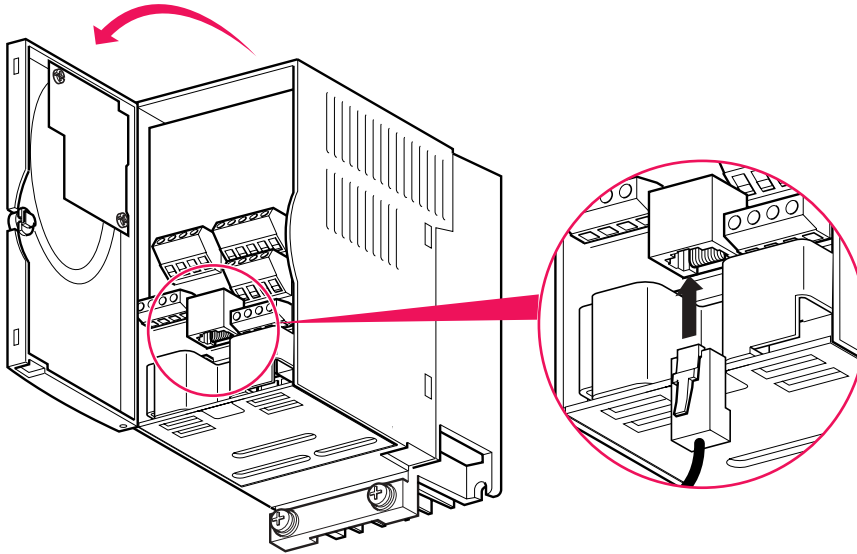
Pin out of the Modbus connector
View from underneath

8.........................1

Pin	Signal
1	Reserved
2	Common (common of the signal and power supply)
3	Reserved
4	D1 (Modbus name) or B (EIA / TIA485 name)
5	D0 (Modbus name) or A (EIA / TIA485 name)
6	Reserved
7	24 V supply (for RS232 / RS485 converter or remote terminal)
8	Common (common of the signal and power supply)

⚠ WARNING

DAMAGED EQUIPMENT
Use wiring cables or taps that connect only signals D0, D1 and common. Refer to Telemecanique catalogue or to "5.2 Connection via RJ45 wiring system". Failure to follow this instruction can result in injury or equipment damage.

⚠ WARNING

DAMAGED DEVICE
If a converter or a terminal is connected to the RJ45 connector using the power supply on pin 7 and 8, check that the voltage (24V) of this power supply is compatible with the converter or the terminal. Failure to follow this instruction can result in injury or device damage.

5. Connection to the network

5. 2. Connection via RJ45 wiring system
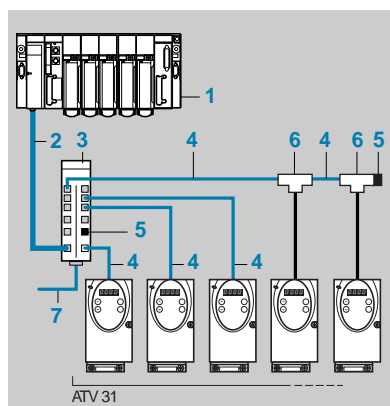
1 Master (PLC, PC or gateway)

2 Modbus cable depending on the type of master (see table)

3 Modbus splitter block **LU9 GC3**

4 Modbus drop cables **VW3 A8 306 R●●**

5 Line terminators **VW3 A8 306 RC**

6 Modbus T-junction boxes **VW3 A8 306 TF●●** (with cable)

7 Modbus cable (to another splitter block) **TSX CSA●00**

■ Connection accessories

Description		Reference
Modbus splitter block	10 RJ45 connectors and 1 screw terminal	LU9 GC3
Modbus T-junction boxes	With integrated cable (0.3 m)	VW3 A8 306 TF03
	With integrated cable (1 m)	VW3 A8 306 TF10
Line terminators	For RJ45 connector	R = 120 Ω, C = 1 nF	VW3 A8 306 RC
	R = 150 Ω (specific to "2-wire Jbus schematic", page 45)	VW3 A8 306 R

■ Connecting cables

Description	Length m	Connectors	Reference
Cables for Modbus bus	3	1 RJ45 connector and 1 stripped end	VW3 A8 306 D30
	0.3	2 RJ45 connectors	VW3 A8 306 R03
	1	2 RJ45 connectors	VW3 A8 306 R10
	3	2 RJ45 connectors	VW3 A8 306 R30
RS 485 double shielded twisted pair cables	100	Supplied without connector	TSX CSA 100
	200	Supplied without connector	TSX CSA 200
	500	Supplied without connector	TSX CSA 500

| Type of master	Master interface	Modbus connection accessories for RJ45 wiring system	
		Description	Reference
Twido PLC	Adaptor or mini-DIN RS485 interface module	3 m cable fitted with a mini-DIN connector and an RJ45 connector	TWD XCA RJ030
	Adaptor or screw terminal RS485 interface module	3 m cable fitted with an RJ45 connector and stripped at the other end	VW3 A8 306 D30
TSX Micro PLC	Mini-DIN RS485 connector port	3 m cable fitted with a mini-DIN connector and an RJ45 connector	TWD XCA RJ030
	PCMCIA card (TSX SCP114)	Stripped cable	TSX SCP CM 4030
TSX Premium PLC	TSX SCY 11601 or TSX SCY 21601 module (SUB-D 25 socket)	Cable fitted with a SUB-D 25 connector and stripped at the other end (for connection to the screw terminals of the LU9GC3 splitter block)	TSX SCY CM 6030
	PCMCIA card (TSX SCP114)	Stripped cable	TSX SCP CM 4030
Ethernet bridge (TSX ETG 100)	Screw terminal RS485	3 m cable fitted with an RJ45 connector and stripped at the other end	VW3 A8 306 D30
Profibus DP gateway (LA9P307)	RJ45 RS485	1 m cable fitted with 2 RJ45 connectors	VW3 P07 306 R10
Fipio (LUFP1) or Profibus DP (LUFP7) or DeviceNet (LUFP9) gateway	RJ45 RS485	0.3 m cable fitted with 2 RJ45 connectors or 1 m cable fitted with 2 RJ45 connectors or 3 m cable fitted with 2 RJ45 connectors	VW3 A8 306 R03 or VW3 A8 306 R10 or VW3 A8 306 R30
Serial port PC	Male SUB-D 9 RS232 serial port PC	RS232/RS485 converter and 3 m cable fitted with an RJ45 connector and stripped at the other end (for connection to the screw terminals of the LU9GC3 splitter block)	TSX SCA 72 and VW3 A8 306 D30

5. Connection to the network

5. 3. Connection via junction boxes
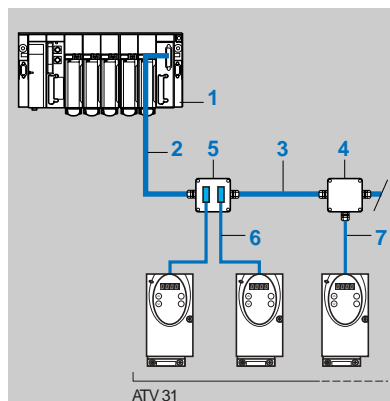
1 Master (PLC, PC or communication module)

2 Modbus cable depending on the type of master

3 Modbus cable **TSX CSA●00**

4 Junction box **TSX SCA 50**

5 Subscriber sockets **TSX SCA 62**

6 Modbus drop cables **VW3 A8 306**

7 Modbus drop cable **VW3 A8 306 D30**

ATV 31

■ Connection accessories

Description	Reference
Junction box 3 screw terminals and an RC line terminator, to be connected using cable VW3 A8 306 D30	TSX SCA 50
Subscriber socket 2 female 15-way SUB-D connectors, 2 screw terminals, and RC line terminator, to be connected using cable VW3 A8 306 or VW3 A8 306 D30	TSX SCA 62

■ Connecting cables

Description	Length m	Connectors	Reference
Cables for Modbus bus	3	1 RJ45 connector and one stripped end	VW3 A8 306 D30
	5	1 RJ45 connector and 1 male 15-way SUB-D connector for TSX SCA 62	VW3 A8 306
RS 485 double shielded twisted pair cables	100	Supplied without connector	TSX CSA 100
	200	Supplied without connector	TSX CSA 200
	500	Supplied without connector	TSX CSA 500

Type of master	Master interface	Modbus connection accessories for junction boxes using screw terminals	
		Description	Reference
Twido PLC	Adaptor or screw terminal RS485 interface module	Modbus cable	TSX CSA100 or TSX CSA200 or TSX CSA500
TSX Micro PLC	Mini-DIN RS485 connector port	Junction box	TSX P ACC 01
	PCMCIA card (TSX SCP114)	Cable fitted with a special connector and stripped at the other end	TSX SCP CU 4030
TSX Premium PLC	TSX SCY 11601 or TSX SCY 21601 module (SUB-D 25 socket)	Cable fitted with a SUB-D 25 connector and stripped at the other end	TSX SCY CM 6030
	PCMCIA card (TSX SCP114)	Cable fitted with a special connector and stripped at the other end	TSX SCP CU 4030
Ethernet bridge (TSX ETG 100)	Screw terminal RS485	Modbus cable	TSX CSA100 or TSX CSA200 or TSX CSA500
Profibus DP gateway (LA9P307)	RJ45 RS485	3 m cable fitted with an RJ45 connector and stripped at the other end	VW3 A8 306 D30
Fipio (LUFP1) or Profibus DP (LUFP7) or DeviceNet (LUFP9) gateway	RJ45 RS485	3 m cable fitted with an RJ45 connector and stripped at the other end	VW3 A8 306 D30
Serial port PC	Male 9-way SUB-D RS232 serial port PC	RS232/RS485 converter and Modbus cable	TSX SCA 72 and TSX CSA100 or TSX CSA200 or TSX CSA500

5. Connection to the network

5. 4. Wiring recommendations

• Use Telemecanique-approved cables and wiring accessories to ensure good transmission quality (matched impedance, immunity, shielding connection, etc.).

• Keep the Modbus cable away from the power cables (30 cm minimum).

• Be sure to cross the Modbus cable and the power cables at right angles.

• Whenever possible, connect the bus cable shielding to the protective ground, e.g., to the ground of each device if this ground is connected to the protective ground.

• Install a line terminator at both ends of the line.

• Ensure the correct line polarization.

For more information, please refer to the technical publication "Electromagnetic compatibility EMC - Practical installation guidelines" (deg999gb.pdf). You can download this manual from Telemecanique web site www.telemecanique.com.

5. 5. RS485 wiring diagrams

The characteristics and accessories mentioned in this section comply with the Modbus standard : "Modbus over serial line - Specification and implementation guide". Other non-Modbus-standard RS485 wiring diagrams are possible.
Please see the Appendix for further information.
The latest generation of Telemecanique devices conform to Modbus (2-wire RS485).

Main characteristics:

Maximum length of bus	1000 m at 19 200 bit/s
Maximum number of stations	32 stations, i.e. 31 slaves (without repeater)

6. Configuration

The settings of communication-related parameters can be changed from the operation panel or from Modbus (PLC, computer or controller).

Note that there are two types of parameters: parameters whose settings take effect immediately after the setting and parameters whose settings do not take effect until the inverter is turned back on or reset. In the table below, these 2 types are mentioned in the column "valid" by "After setting" and "After reset".

6. 1. Configuration of the communication parameters

Title	Communication Number	Function	Adjustment range	Unit	Default setting	Valid
F829	0829	Selection of communication protocol	0 ... 4 1: Modbus-RTU protocol	-	1	After reset
F800	0800	Baud rate	0: 9600 bps 1: 19200 bps	-	1	After reset
F801	0801	Parity	0: NON (No parity) 1: EVEN (Even parity) 2: ODD (Odd parity)	-	1	After reset
F802	0802	Modbus address	0 ... 247	-	1	After setting

Notes:
• Baud rate and parity bit should be uniform inside the same network.
• Modbus address should not be duplicate inside the same network.

6. Configuration

6. 2. Configuration of the control source

The inverter can receive commands and setpoint from the Modbus network or from the terminals (F, R, RES, VIA, VIB).

In the default configuration, both commands and setpoint come from the terminals.

The LOC/REM key of the operation panel is always available to switch the control to the operation panel.

The inputs F, R or RES can be configured to switch the control from the Modbus network to the terminals.

Different usual possibilities are described in the chapters below:
• Control from the Modbus network,
• Control from the terminals, monitoring from the Modbus network,
• Control from the Modbus network or the terminals, switched via Modbus,
• Command from the Modbus network, setpoint from the Modbus network or the terminals switched to by a logic input.
Refer to these examples.

■ Control by the Modbus network

The commands and the setpoint come from the Modbus network.
The signals wired on the terminals are ignored.

The LOC/REM key is always valid.

List of parameters that must be configured:

Parameter title	Function number	Function description
C∏00	2	Serial communication
F∏00	4	Serial communication
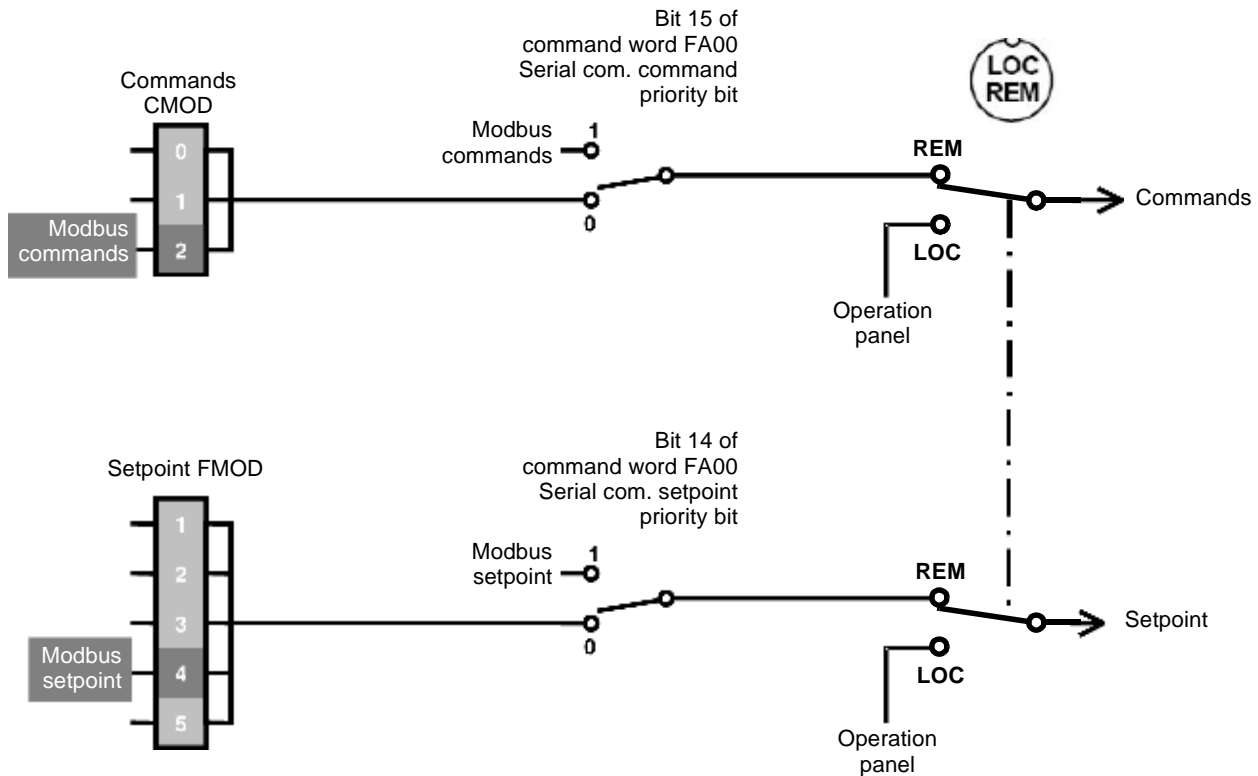
6. Configuration

■ Control by the terminals, monitoring by the Modbus network

The commands and the setpoint come from the terminals.
The inverter is monitored via the Modbus network.

The LOC/REM key is always valid.

List of parameters that must be configured:

Parameter title	Function number	Function description
С ∏ О О	0 (default setting)	Terminal board
F ∏ О О	1 (default setting)	VIA
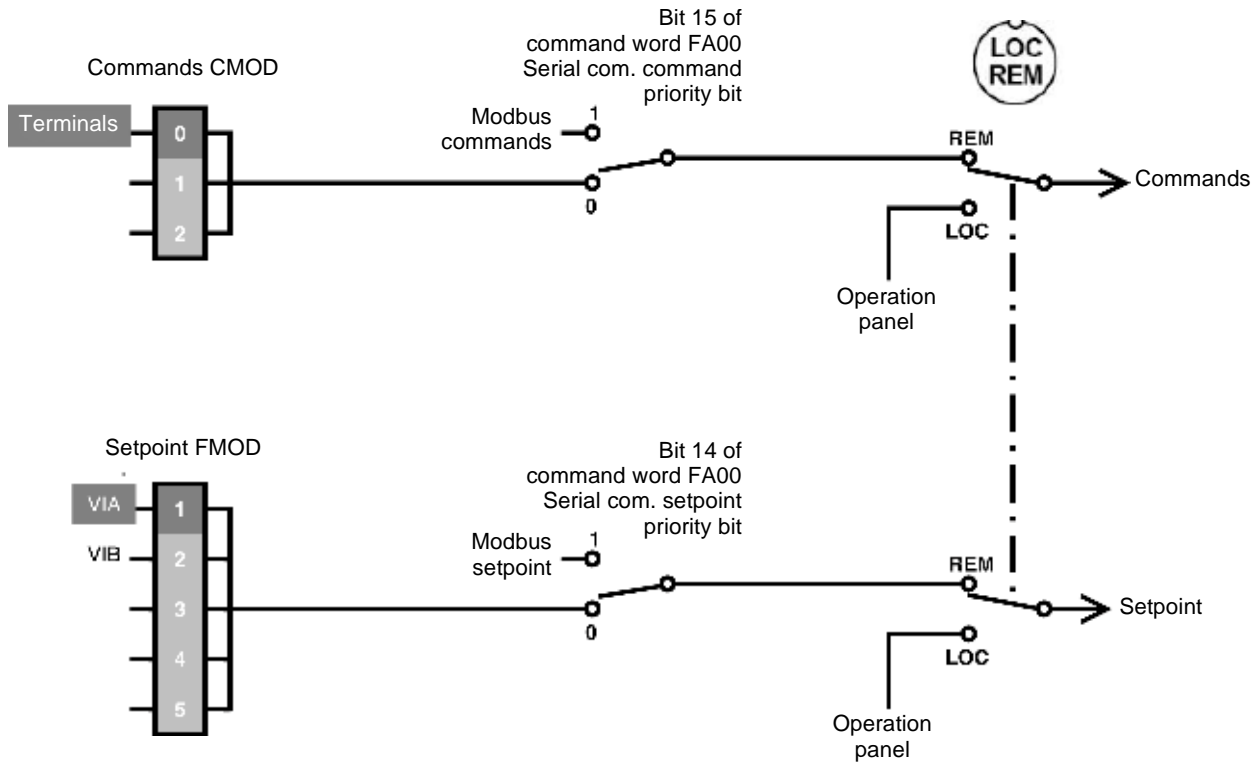
6. Configuration

■ Control by the Modbus network or the terminals, switched via Modbus

The commands come from the terminals if bit 15 of the command word (FA00) is "OFF" (value 0).
The commands come from the Modbus network if bit 15 of the command word (FA00) is "enabled" (value 1).

The setpoint comes from the terminals if bit 14 of the command word (FA00) is "OFF" (value 0).
The setpoint comes from the Modbus network if bit 14 of the command word (FA00) is "enabled" (value 1).

The LOC/REM key is always valid.

List of parameters that must be configured:

Parameter title	Function number	Function description
C N O O	0 (default setting)	Terminal board
F N O O	1 (default setting)	VIA
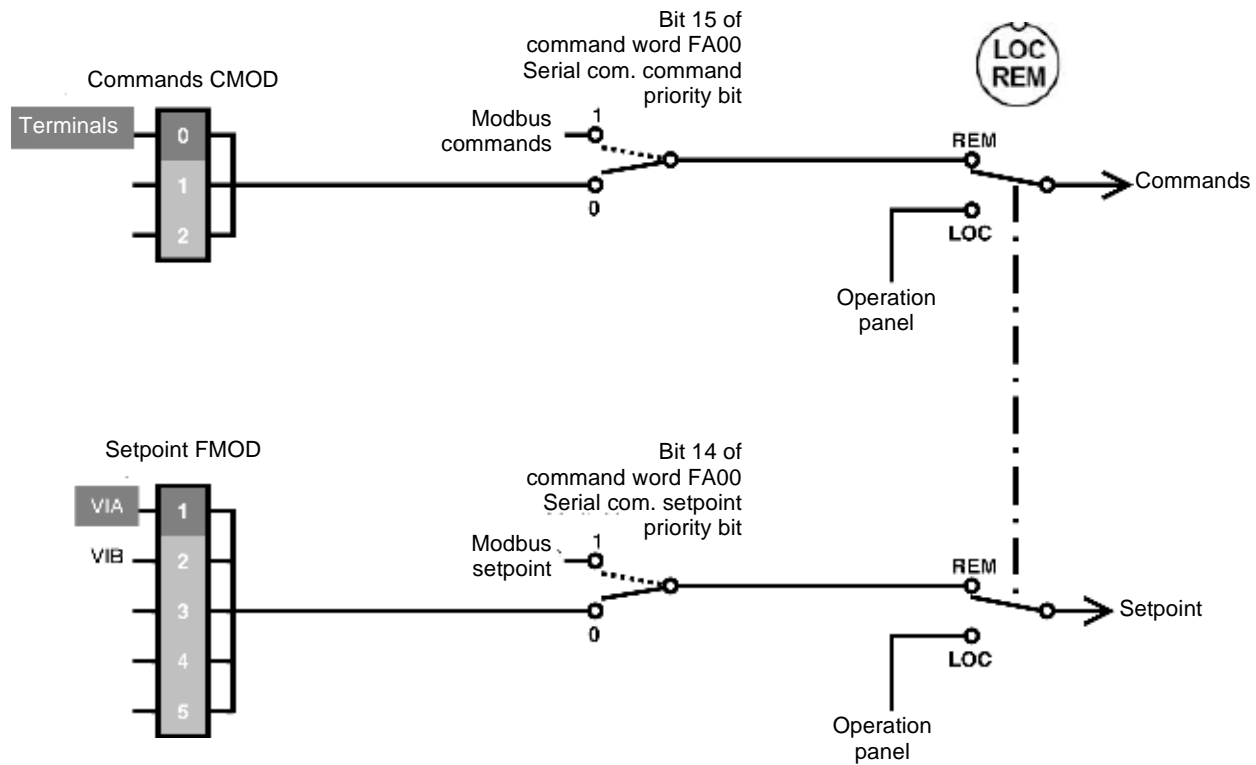
6. Configuration

■ Control by the Modbus network or the terminals switched to by a logic input

The commands and the setpoint come from the Modbus network if logic input R is OFF.
Th commands and the setpoint come from the terminals if logic input R is ON.
The function SC/LC (or CPCA) is assigned to the logic input R.

The LOC/REM key is always valid.

List of parameters that must be configured:

Parameter title	Function number	Function description
$CMOO$	0 (default setting)	Terminal board
$FMOO$	1 (default setting)	VIA
$F112$	48	Logic input R configured to "Forced switching from remote to local control" (SC/LC or CPCA)
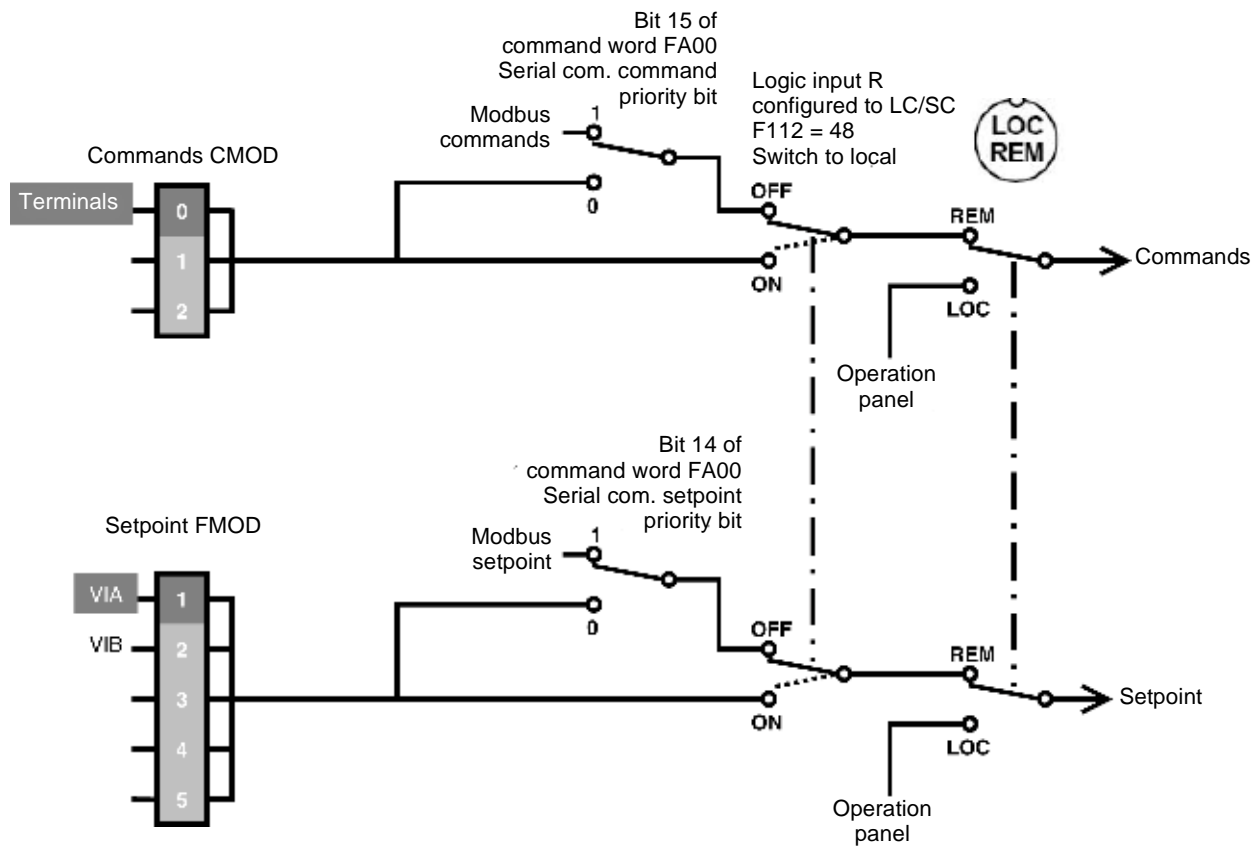
6. Configuration

■ Command by the Modbus network, setpoint by the Modbus network or the terminals switched to by a logic input

The commands always come from the Modbus network.

The setpoint comes from the Modbus network if logic input R is OFF.
The setpoint comes from the terminals if logic input R is ON.
The function FCHG is assigned to the logic input R.

The LOC/REM key is always valid.

List of parameters that must be configured:

Parameter title	Function number	Function description
CMOO	2	Serial communication
FMOO	4	Serial communication
F207	1	VIA
F112	38	Logic input R configured to " Frequency command forced switching" (FCHG)
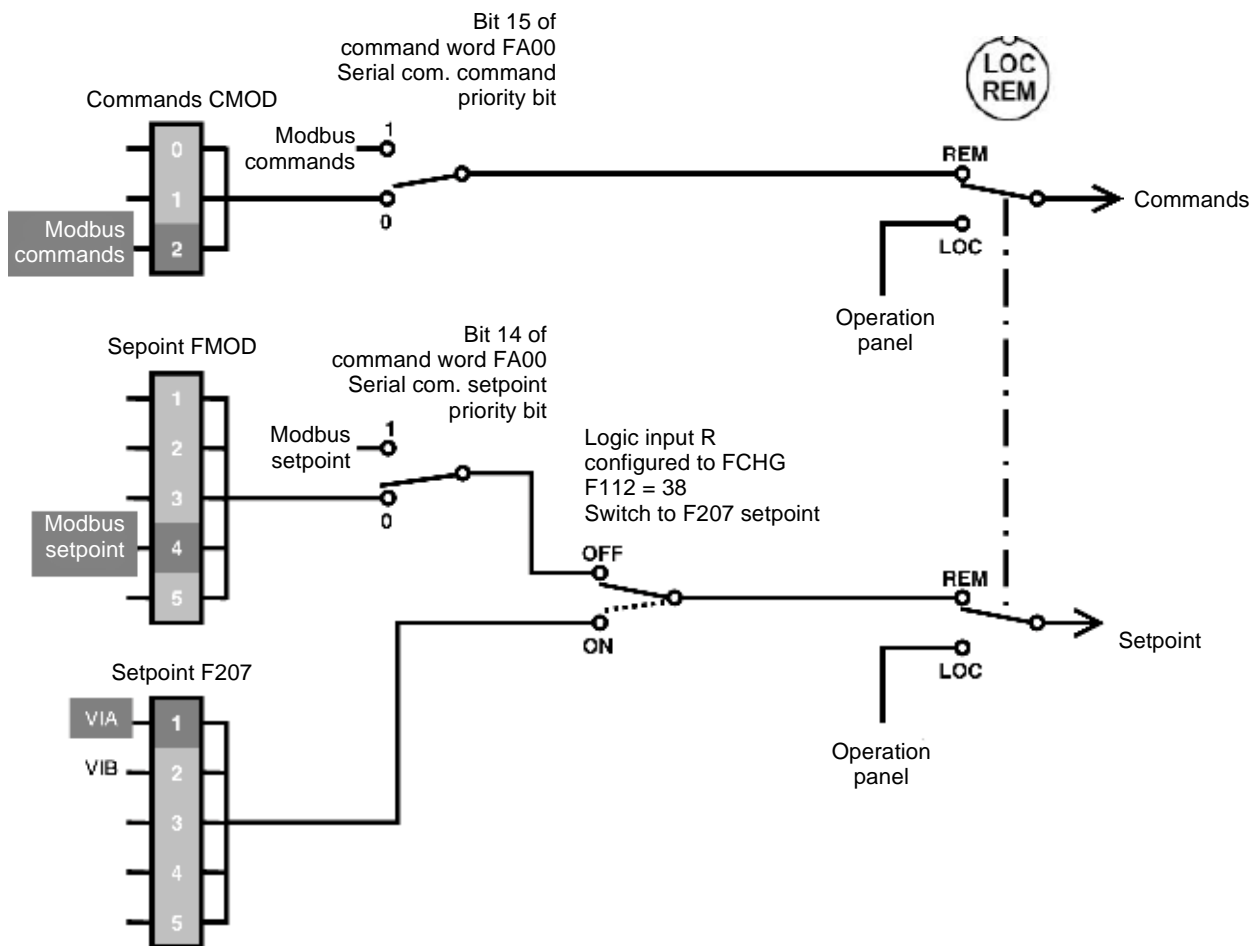
6. Configuration

■ Complete control diagram
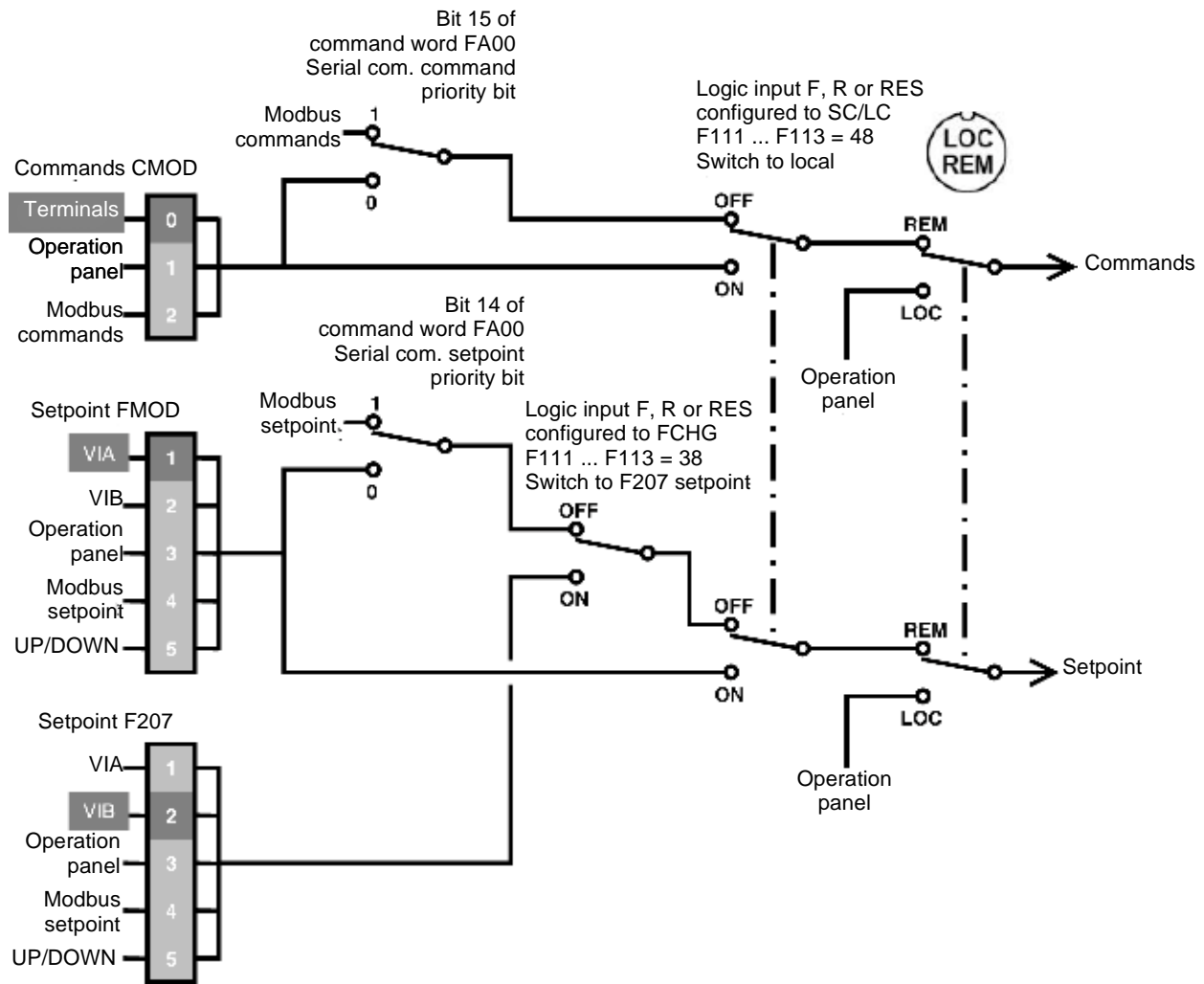
6. Configuration

6. 3. Configuration of the indirect blocks

These parameters configure the Modbus functions and

Title	Communication Number	Function	Adjustment range	Unit	Default setting	Valid
F870	0870	Block write data 1	0: No selection 1: Command word (FA00) 2: Command word 2 (FA20) 3: Frequency setpoint (FA01) 4: Digital outputs command (FA50) 5: Analog outputs command (FA51) 6: Speed setpoint (FA13)	-	0	After reset
F871	0871	Block write data 2			0	
F875	0875	Block read data 1	0: No selection 1: Status word (FD01) 2: Output frequency (FD00) 3: Output current (FE03) 4: Output voltage (FE05) 5: Alarm code (FC91) 6: PID feedback value (FE22) 7: Digital inputs status (FD06) 8: Digital outputs status (FD07) 9: Analog input VIA value (FE35) 10: Analog input VIB value (FE36) 11: Output speed (FE90)	-	0	After reset
F876	0876	Block read data 2			0	
F877	0877	Block read data 3			0	
F878	0878	Block read data 4			0	
F879	0879	Block read data 5			0	

6. Configuration

6. 4. Configuration of the communication fault

■ Configure the Modbus time out

A Modbus fault (error 5) is triggered if the inverter does not receive any valid Modbus requests at its address within a predefined time period (time out).

The timer starts when the communication has been established for the first time (valid frame, inverter address matches). All Modbus request functions are taken into account to reactivated the timer (read, write and identification).

Title	Communication Number	Function	Adjustment range	Unit	Default setting	Valid
F803	0803	Modbus time out	0: disabled 1 ... 100: enabled, value of time out	- 1 s	3	After setting

⚠ WARNING
If this function is not properly set up, it may cause an accident. If you configure the parameter 0829 to the value 0, the inverter will not trip in case of loss of communication.

■ Configure the inverter behaviour

The response of the inverter in the event of a Modbus communication fault can be configured.

Title	Communication Number	Function	Adjustment range	Unit	Default setting	Valid
F603	0603	Behaviour on Modbus fault	0: Coast stop (error 5) 1: Deceleration stop (error 5) 2: DC injection stop (error 5)	-	4	

7. Modbus services

7. 1. Principle of the Modbus protocol

The Modbus protocol is a master-slave protocol.

Only one device can transmit on the line at any one time.

The master manages the exchanges and only it can take the initiative.

It interrogates each of the slaves in succession.
No slave can send a message unless it is invited to do so.

In the event of an error during data exchange, the master repeats the question and declares the interrogated slave absent if no response is received within a given time period.

If a slave does not understand a message, it sends an error response to the master.
The master may or may not repeat the request.

Master

Slave i   Slave j   Slave k
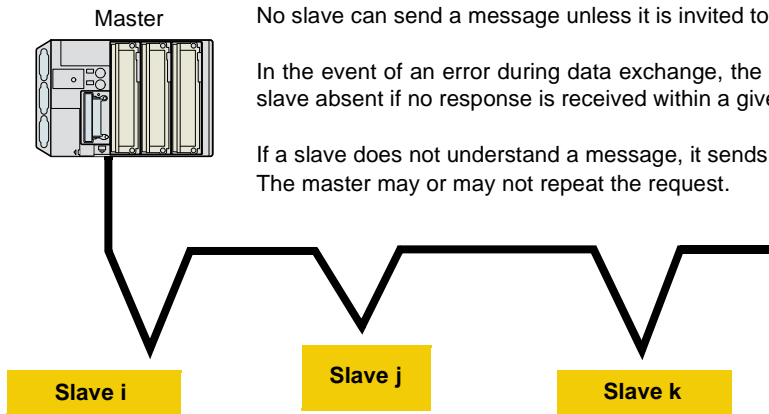
Two types of dialog are possible between master and slaves:
- The master sends a request to a slave and waits for it to respond. The request contains the slave address (1 ... 247).
- Broadcast: the master sends a request to all slaves. Slaves do not answer. The value of the slave address is 0.

Direct slave-to-slave communications are not possible.

For slave-to-slave communication, the master's application software must therefore be designed to interrogate one slave and send back data received to the other slave.

7. 2. RTU mode

ATV21 supports RTU mode.
The Modbus RTU frame contains no message header byte, nor end of message bytes.
It is defined as follows:

Slave address	Function code	Data	CRC16

The data is transmitted in binary code.
CRC16: Cyclic redundancy check parameter.
The end of the frame is detected on a silence greater than or equal to 3 characters.
The master must not introduce a space of more than 3.5 characters in a frame; otherwise the inverter may recognize it as a start of new frame.

7. Modbus services

7. 3. Modbus functions available

The following table indicates which Modbus functions are managed by the Altivar 21 and specifies their limits.
The "read" and "write" functions are defined from the point of view of the master.

Code	Function name	Size of data	Altivar 21 function name	Broadcast
3 = 16#03	Read Holding Registers	1 object	Read one word	No
		2 ... 5 objects	Read indirect block	No
6 = 16#06	Write Single Register	1 objects		Yes
16 = 16#10	Write Multiple Registers	1 object	Write one word	Yes
		2 objects	Write indirect block	Yes
43/14 = 16#2B/0E	Read Device Identification	3 objects		No

7. 4. Read one word (3)

Function 3, quantity = 1
The Read one word function permits to read one parameter value. All parameter of the inverter can be read.

Request:

Slave no.	Function code	Starting address		Quantity of registers (fixed)		CRC16	
	03	Hi	Lo	00	01	Lo	Hi
1 byte	1 byte	2 bytes		2 bytes		2 bytes	

Response:

Slave no.	Function code	Byte count	Register value		CRC16	
	03		Hi	Lo	Lo	Hi
1 byte	1 byte	1 byte	2 bytes		2 bytes	

Error response:

Slave no.	Function code	Exception code	CRC16	
	83		Lo	Hi
1 byte	1 byte	1 byte	1 byte	1 byte

Example: Read output frequency (FD00) on inverter at slave address 1

Request:

01	03	FD 00	00 01	B5 A6

Response:

01	03	02	17 70	B6 50

Example: Invalid read of 2 words

Request:

01	03	FD 00	00 02	F5 A7

Error response:

01	83	03	01 31

7. Modbus services

7. 5. Read indirect block (3)

Function 3, quantity = 2 ... 5
The Read indirect block function permits to read 2 to 5 parameters. These parameters can be chosen by parameters F875 ... F879 (refer to "Configuration of the indirect blocks", page 18)

Title	Communication Number	Function	Adjustment range	Unit	Default setting	Valid
F875	0875	Block read data 1	0: No selection	-	0	After reset
F876	0876	Block read data 2	1: Status (FD01) 2: Output frequency (FD00)		0	
F877	0877	Block read data 3	3: Output current (FE03) 4: Output voltage (FE05)		0	
F878	0878	Block read data 4	5: Alarm code (FC91) 6: PID feedback value (FE22)		0	
F879	0879	Block read data 5	7: Digital inputs status (FD06) 8: Digital outputs status (FD07) 9: Analog input VIA value (FE35) 10: Analog input VIB value (FE36) 11: Output speed (FE90)		0	

Request:

Slave no.	Function code	Starting address		Quantity of registers		CRC16	
	03	Hi 18 (fixed)	Lo 75 (fixed)	Hi 00	Lo 02 to 05	Lo	Hi
1 byte	1 byte	2 bytes		2 bytes		2 bytes	

Response:

Slave no.	Function code	Byte count	First register value		-------	Last register value		CRC16	
	03		Hi	Lo		Hi	Lo	Lo	Hi
1 byte	1 byte	1 byte	2 bytes			2 bytes		2 bytes	

Error response:

Slave no.	Function code	Exception code	CRC16	
	83		Lo	Hi
1 byte	1 byte	1 byte	1 byte	1 byte

Example: Read indirect block in an inverter with slave address 1.

Configuration parameters:
F875 (Block read data 1) = 1: Status (FD01)
F876 (Block read data 2) = 2: Output frequency (FD00)
F877 (Block read data 3) = 3: Output current (FE03)
F878 (Block read data 4) = 4: Output voltage (FE05)
F879 (Block read data 5) = 5: Alarm code (FC91)

• Read indirect block of 5 parameters:

Request:	01	03	18 75	00 05	92 B3				

Response:	01	03	0A	64 04	17 70	00 00	26 FB	00 80	1E 29

• Read indirect block of 2 parameters:

Request:	01	03	18 75	00 02	D3 71

Response:	01	03	04	64 04	17 70	AA D6

• Error response on invalid starting address:

Request:	01	03	18 76	00 02	23 71

Response:	01	83	03	01 31

• Error response on invalid quantity of registers:

Request:	01	03	18 75	00 06	D2 B2

Response:	01	83	03	01 31

7. Modbus services

7. 6. Write Single Register (6)

The Write Single Register function permits to write value of one parameter. Not all inverter parameters can be written.

Request and response:

Slave no.	Function code 06	Register address		Register value		CRC16	
		Hi	Lo	Hi	Lo	Lo	Hi
1 byte	1 byte	2 bytes		2 bytes		2 bytes	

Error response:

Slave no.	86	Exception code	CRC16	
			Lo	Hi
1 byte	1 byte	1 byte	1 byte	1 byte

Example: Write value 60 Hz to the parameter Frequency Setpoint (FA01) in inverter slave 1.

Request and response:

01	06	FA01	1770	E6C6

Example: Error response due to invalid register address.

Request:

01	06	FFFF	0000	89EE

Error response:

01	86	02	C3A1

7. 7. Write one word (16)

Function 16 = 16#10, quantity =1
The Write Single Register function permits to write value of one parameter. Not all inverter parameters can be written.

Request:

Slave no.	Function code 10	Starting address	Quantity of register		Byte count 02 (fixed)	First register value	-------	CRC16
			00 (fixed)	01 (fixed)				
1 byte	1 byte	2 bytes	2 bytes		1 byte	2 bytes		2 bytes

Response:

Slave no.	Function code 10	Starting address	Quantity of register		CRC16
			00 (fixed)	01 (fixed)	
1 byte	1 byte	2 bytes	2 bytes		2 bytes

Error response:

Slave no.	Function code 90	Exception code	CRC16
1 byte	1 byte	1 byte	2 bytes

Example: Write value 60Hz in the parameter Frequency Setpoint (FA01) in inverter slave 1.

Request:

01	10	FA 01	00 01	02	17 70	F3 9A

Response:

01	10	FA 01	00 01	60 D1

7. 8. Write indirect block (16)

Function 16 = 16#10, quantity = 2
The Write indirect block function permits to write 2 parameters. These parameters can be chosen by parameters F870 and F871 (refer to "Configuration of the indirect blocks", page 18).

Title	Communication Number	Function	Adjustment range	Unit	Default setting	Valid
F870	0870	Block write data 1	0: No selection 1: Command word 1 (FA00) 2: Command word 2 (FA20) 3: Frequency Setpoint (FA01) 4: Digital output command (FA50) 5: Analog output command (FA51) 6: Speed Setpoint (FA13)	-	0	After reset
F871	0871	Block write data 2			0	

Request:

Slave no.	Function code 10	Starting address 18 (fixed)	70 (fixed)	Quantity of register 00 (fixed)	02 (fixed)	Byte count 04 (fixed)	First register value	-------	CRC16
1 byte	1 byte	2 bytes		2 bytes		1 byte	2 bytes		2 bytes

Response:

Slave no.	Function code 10	Starting address 18 (fixed)	70 (fixed)	Quantity of register 00 (fixed)	02 (fixed)	CRC16
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Error response:

Slave no.	Function code 90	Exception code	CRC16
1 byte	1 byte	1 byte	2 bytes

Refer to "Error response", page 26.

Example: Write value 60Hz in the parameter Frequency Setpoint (FA01) and run forward command in inverter slave 1.
Configuration:
F870 (Block write data 1) = 1: Command word 1 (FA00)
F871 (Block write data 2) = 3: Frequency Setpoint (FA01)

- · The inverter accepts the request:

Request:	01	10	18 70	00 02	04	C4 00	17 70	6D AF

Response:	01	10	18 70	00 02	43 B3

.
- The inverter rejects the request because it is busy or F870 is 0:

Request:	01	10	18 70	00 02	04	C4 00	17 70	6D AF

Response:	01	90	**04**	4D C3

- The inverter rejects the request because of an invalid starting address:

Request:	01	10	**18 71**	00 02	04	C4 00	17 70	AC 63

Response:	01	90	**03**	0C 01

- The inverter rejects the request because of an invalid quantity of registers:

Request:	01	10	18 70	**00 03**	04	C4 00	17 70	6C 7E

Response:	01	90	**03**	0C 01

- · The inverter rejects the request because of an invalid byte count:

Request:	01	10	18 70	00 02	**03**	C4 00	17 70	D8 6F

Response:	01	90	**03**	0C 01

7. Modbus services

7. 9. Read Device Identification (43/14)

Function 43/14 = 16#2B/0E
Request:

Slave no.	Function code 2B	MEI type 0E	Read Device Id code 01 ... 03	Object Id 00	CRC16 Lo	Hi
1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes	

Response:

Slave no.	Function code 2B	MEI type 0E	Read Device Id code 01 ... 03	Conformity level 01	-------
1 byte	1 byte	1 byte	1 byte	1 byte	

-------	More follows 00	Next object Id 00	Number of objects 03	-------
	1 byte	1 byte	1 byte	

-------	Id of object no. 1 00	Length of object no. 1 0D	Value of object no. 1 "Telemecanique"	-------
	1 byte	1 byte	13 bytes	

-------	Id of object no. 2 01	Length of object no. 2 0C	Value of object no. 2 "ATV21H075M3X"	-------
	1 byte	1 byte	12 bytes	

-------	Id of object no. 3 02	Length of object no. 3 04	Value of object no. 3 "0201"	-------
	1 byte	1 byte	4 bytes	

-------	CRC16 Lo	Hi
	1 byte	1 byte

The total response size given in this example equals 45 bytes.

The response contains the following four objects:

- Object no. 1: Manufacturer name (always "Telemecanique", i.e., 13 bytes).
- Object no. 2: Device catalog number (ASCII string; for example: "ATV21H075M3X", i.e., 11 bytes).
  The length of this object varies according to inverter type. Use the "Length of object no. 2" field to determine the length.
- Object no. 3: Device version, in "MMmm" format where "MM" represents the major revision and "mm" the minor revision (4-byte ASCII string; *for example:* "0201" for version 2.1).

Error response:

Slave no.	Function code AB	Exception code	CRC16 Lo	Hi
1 byte	1 byte	1 byte	1 byte	1 byte

7. Modbus services

7. 10. Error response

An error response is returned by the inverter when it is unable to perform the request.

Format of an error response:

Slave no.	Function code	Exception code	CRC16	
			Lo	Hi
1 byte	1 byte	1 byte	2 bytes	

Function code: request code + H'80.

Exception code:

Exception Code	Description
01	Unknown function: The function code received in the query is not an allowable action for the inverter. - The function is not supported by the inverter error. - Function code 43 but MEI Type not equal: to 14.
02	Illegal data address:The data address received in the query is not an allowable address for the inverter. - Communication number is not supported. - Request to write a read only parameter.
03	Illegal data value: A value contained in the query data field is not an allowable value for the inverter. - Data range error. - Fixed data error. - Function code 43 and MEI Type 14 but invalid Read Device ID Code (Read Dev ID code > 3).
04	Unable to execute: The request commands an operation that the inverter is not able to execute due to another task or condition. - Request to write in a parameter that cannot be changed during running. - Request to write during executing "tyP" (return to factory setting ...). - Error occurs during writing data. - The request infringes a safety rule.

8. Parameter list

8. 1. Referring to the Altivar 21 user manual

Parameters are decribed in the Altivar 21 user manual.
For communication purposes, the section "Table of parameter and data" references communication number, unit, range... The table below is an abstract, just for example.
Additionnal parameter, not listed in the altivar 21 user manual, are described in the present section.

Title	Communication No.	Function	unit	Minimum setting unit Panel/ Communication	Range	Default setting	User setting	Reference
AUH	-	History function	-	-	operation panels parameters in groups of five in the reverse order to that in which their settings were changed.* (Possible to edit)	-		4.1.4
AUF	-	Wizard function	-	-	0: no wizard 1: Basic setting wizard	-		0 4.1.5
AU1	0000	Automatic acceleration/ deceleration	-	-	0: Disabled (manual)1: Automatic2:Automatic (only at acceleration)	0		5.1.1
ACC	0009	Acceleration time1	s	0.1/0.1	0.0-3200	10.0		5.1.2

- "Title" means the operation panel on the inverter panel.

- "Communication number" identifies the parameter for communication.
  In Modbus protocol, it is also called "register address" or "Parameter address".

- "Adjusment range" or "Range" means the data cannot be written outside the range.
  The data is expressed in the decimal notation. For writing the data through the communication function, take the minimum setting unit into consideration, and use hexadecimal notation.

- "Minimum setting unit" is the unit of a single data.
  When the minimum unit is "-", 1 is equal to 1.
  For example, the "Minimum setting unit" of acceleration time (acc) is 0.01. 1 corresponds to 0.01s. For setting the acceleration time (acc) to 10 seconds, transmit 16#03E8 by communication [10÷0.01=1000=16#03E8].

8. Parameter list

8. 2. List of control parameters

These parameters are only in the RAM and not in the EEPROM, they return to initial values when the power is turned off, in failure resetting, or when standard shipment settings are set.

■ Commands from serial communication

Title	Communication No.	Function	Range	Min. setting unit	Initial value	Write during operation	EEPROM
FA00	FA00	Command word	0 to 65535	-	0	Yes	None
FA20	FA20	Command word 2	0 to 65535	-	0	Yes	None

■ Setpoints from serial communication

Title	Communication No.	Function	Range	Min. setting unit	Initial value	Write during operation	EEPROM
FA01	FA01	Frequency setpoint	0 to Max. frequency (FH)	0.01 Hz	0	Yes	None
FA13	FA13	Speed setpoint	0 to 24000	1 min^{-1} (1 rpm)	0	Yes	None

■ Outputs control from serial communication

Title	Communication No.	Function	Range	Min. setting unit	Initial value	Write during operation	EEPROM
FA50	FA50	Digital outputs command	0 to 255	1	0	Yes	None
FA51	FA51	Analog outputs command	0 to 1023 (10-bit resolution)	1	0	Yes	None

8. Parameter list

8. 3. List of monitoring parameters

Monitoring parameters are read only.

■ Status

Title	Com No.	Function	Unit	Remark
F001	FD01	Status word	-	Current value
F042	FD42	Status word 2	-	Current value
F049	FD49	Status word 3	-	Current value
FE01	FE01	Status word at last trip	-	Value before trip
FE42	FE42	Status word 2 at last trip	-	Value before trip
FE49	FE49	Status word 3 at last trip	-	Value before trip
FE45	FE45	Command mode status	-	
FE46	FE46	Setpoint mode status	-	

■ Frequency and speed

Title	Com No.	Function	Unit	Remark
F000	FD00	Output frequency	0.01Hz	Current value
FE00	FE00	Output frequency at last trip	0.01Hz	Value before trip
FE90	FE90	Output speed	1min-1 (1 rpm)	calculated by FD00 and F856 : min-1 = (Fx12+5xPole)/(Polex10)
FE16	FE16	Estimated speed	0.01Hz	Value before trip
FE02	FE02	Frequency reference before ramp	0.01Hz	Value before trip (before PI and speed ramp)
FE15	FE15	Frequency reference after ramp	0.01Hz	Value before trip (after PI and speed ramp)
FE22	FE22	PID feedback value	0.01Hz	Value before trip

■ Current and torque

Title	Com No.	Function	Unit	Remark
FE03	FE03	Output current	0.01%	
FE18	FE18	Torque	0.01%	
FE20	FE20	Torque current	0.01%	Value before trip
FE21	FE21	Exciting current	0.01%	Value before trip

■ Voltage

Title	Com No.	Function	Unit	Remark
FE05	FE05	Output voltage	0.01%	Value before trip
FE04	FE04	Voltage at DC bus	0.01%	

■ Power and energy

Title	Com No.	Function	Unit	Remark
FE29	FE29	Input power	0.01KW	Value before trip
FE30	FE30	Output power	0.01KW	Value before trip
FE76	FE76	Input energy	-	
FE77	FE77	Output energy	-	

■ Maintenance

Title	Com No.	Function	Unit	Remark
FE26	FE26	Motor load	1%	Value before trip
FE27	FE27	Inverter load	1%	Value before trip
FE14	FE14	Cumulative run time	1h	
FE80	FE80	Cumulative power-on time	1h	

8. Parameter list

■ I/O values

Title	Com No.	Function	Unit	Remark
F006	FD06	Digital inputs status	-	Current value
F007	FD07	Digital outputs status	-	Current value
FE06	FE06	Digital inputs status at last trip	-	Value before trip
FE07	FE07	Digital outputs status at last trip	-	Value before trip
FE35	FE35	Analog input VIA value	-	
FE36	FE36	Analog input VIB value	-	

■ Faults and alarms

Title	Com No.	Function	Unit	Remark
FC90	FC90	Trip code	-	
FC91	FC91	Alarm code	-	
FE79	FE79	Alarm of run time	-	
FE10	FE10	Latest trip code	-	
FE11	FE11	2nd previous trip code	-	
FE12	FE12	3rd previous trip code	-	
FE13	FE13	4th previous trip code	-	

8. Parameter list

8. 4. Commands

■ Command word (𝐹𝐴𝟶𝟶)

Bit	Specifications	0	1	Remarks
0	Preset speed operation 1	000:preset speed operation disabled 001:preset speed 1 010:preset speed 2 011:preset speed 3 100:preset speed 4 101:preset speed 5 110:preset speed 6 111:preset speed 7		
1	Preset speed operation 2			
2	Preset speed operation 3			
3	-	Reserved		Do not set to "1".
4	Motor selection (1 or 2) (THR 2 selection)	Motor 1 (THR 1)	Motor 2 (THR2)	THR1 : PT=set value, vL, vb, tHr THR2 : PT=0, F170, F172, F173
5	PI control	Normal operation	PI OFF	
6	Acceleration/deceleration pattern selection (1 or 2) (AD2 selection)	Acceleration/deceleration pattern 1 (AD1)	Acceleration/deceleration pattern 2 (AD2)	AD1 : ACC, DEC AD2 : F500, F501
7	DC braking	No braking	Forced DC braking	
8	-	-	-	
9	Forward/reverse run selection	Forward selection	Reverse selection	
10	Run/stop	Stop	Run	
11	Coast stop command	No stop	Coast stop	
12	Emergency stop	No stop	Emergency stop	"E" trip
13	Fault reset	No reset	Reset	
14	Setpoint priority selection	Disabled	Enabled	Enabled regardless of the setting of FMOD
15	Command priority selection	Disabled	Enabled	Enabled regardless of the setting of CMOD

Commands and setpoint can be enabled through communication irrespective of settings of the command mode (𝐶𝑀𝑂𝑑) and setpoint mode (𝐹𝑀𝑂𝑑).
If "48: Forced change from communication to local", "52: Forced operation", or "53: Fire speed" is set by input terminal function selection (𝐹𝟷𝟷𝟶 to 𝐹𝟷𝟷𝟹, 𝐹𝟷𝟷𝟾), a change to commands or setpoint is feasible through the terminals.
Refer to "Configuration of the control source", page 12
Once the command word (𝐹𝐴𝟶𝟶) is set to enable communication command priority and frequency priority, both priorities will be enabled unless OFF is set, power is turned off or is reset, or standard shipment setting (tYP) is selected.
Emergency stop, RY terminal output hold and OUT terminal output hold are always enabled even though communication command priority is not set.

If the command word (𝐹𝐴𝟶𝟶) is enabled and the "Preset speed operation is used (bits 0, 1 or 2 set to "1"), the analog setpoint is disabled, the velocity is controlled by preset speeds through the communication, irrespective of the setpoint selection.

Examples:
Run forward (𝐶𝑀𝑂𝑑 and 𝐹𝑀𝑂𝑑 configured to serial communication)
FA00 = 16# 0400

Run reverse (𝐶𝑀𝑂𝑑 and 𝐹𝑀𝑂𝑑 configured to serial communication)
FA00 = 16# 0600

Run forward, commands and setpoint from Modbus (irrespective of 𝐶𝑀𝑂𝑑 and 𝐹𝑀𝑂𝑑)
FA00 = 16# C400

Run reverse, commands and setpoint from Modbus (irrespective of 𝐶𝑀𝑂𝑑 and 𝐹𝑀𝑂𝑑)
FA00 = 16# C600

8. Parameter list

■ Command word 2 (*FA2O*)

Bit	Function	0	1	Remarks
0	Reserved	-	-	-
1	Energy reset	No reset	Reset	Input energy (FE76) Output energy (FE77)
2 to 11	Reserved	-	-	Do not set to "1"
12	Over-current stall level change	OC stall 1	OC stall 2	OC1 (F601), OC2 (F185)
13 to 15	Reserved	-	-	Do not set to "1"

Energy reset (bit 1):
This command is enabled regardless of the command priority selection (bit 15 of common word (*FAOO*)).
It is necessary to reset it after the command is performed.

Over-current stall level change (bit 12):
This command word is enabled only when the communication command is enabled. Set Bit 15 of the Command word (*FAOO*) to "1" (enabled).
This command word will be disabled is set (value 0), power is turned off or is reset, or standard shipment setting (tYP) is selected.

8. Parameter list

8. 5. Setpoints

■ Frequency setpoint (*F A 0 1*)

Frequency setpoint from Modbus
Unit: 0.01 Hz
Range: 0 to Maximum frequency (FH)

This setpoint is enabled by setting "4: serial communication" to the setpoint selection parameter (*F П 0 d*) or setting to "1" (enabled) setpoint priority selection (Bit 14 of Command word (*F A 0 0*)).
If "48: Forced change from communication to local", "52: Forced operation", or "53: Fire speed" is set by input terminal function selection (*F 1 1 0* to *F 1 1 3*, *F 1 1 8*), a change to a command or setpoint is feasible through the terminals.

Once enabled, this setpoint selection is enabled till disabled ("0") is set in the setpoint priority selection (bit 14 of the command word (*F A 0 0*)), power is turned off or is reset, or standard shipment setting (*t Y P*) is selected.

Example: Frequency setpoint 80Hz
80Hz = 80 ÷ 0.01 = 8000 = 16# 1F40

Request:	01	06	FA 01	1F 40	B5 A6

Response:	01	06	FA 01	1F 40	B5 A6

■ Speed setpoint (*F A 1 3*)

Speed setpoint from Modbus
Unit: min^{-1} (rpm)
Range: 0 ... 24 000 min^{-1}
With this setpoint, it is possible to control the inverter with rpm instead of Hz.
This reference is converted into Frequency Setpoint using "Number of motor poles" (*F 8 5 6*).

8. 6. Status

■ Status word (*F E 0 1   F d 0 1*)

Status immediately before the occurrence of a trip: Communication Number FE01
Current status: Communication Number FD01

Bit	Specifications	0	1	Remarks
0	Failure FL	No output	Output in progress	
1	Failure	Not tripped	Tripped	Trip statuses include rtry and trip retention status.
2	Alarm	No alarm	Alarm issued	
3	MOFF	Normal	MOFF	Main circuit undervoltage alarm.
4	Motor section (1 or 2) (THR 2 selection)	Motor 1 (THR 1)	Motor 2 (THR 2)	THR1: PT=set value, vL, vb, Thr THR2: PT=0, F170, F172, F173
5	PI control OFF	PI control permitted	PI control prohibited	
6	Acceleration/deceleration pattern selection (1 or 2)	Acceleration/deceleration pattern 1 (AD 1)	Acceleration/deceleration pattern 2 (AD 2)	AD1: ACC, DEC, AD2: F500, F501
7	DC braking	OFF	Forced DC braking	
8	Reserved	-	-	
9	Forward/reverse run	Forward run	Reverse run	
10	Run/stop	Stop	Run	
11	Coast stop (ST=OFF)	ST=ON	ST=OFF	
12	Emergency stop	Not emergency stop status	Emergency stop status	
13	Standby ST=ON	Start-up process	Standby	Standby: Initialization completed, not failure stop status, not alarm stop status (MOFF, LL forced stop or forced stop due to a momentary power failure), ST=ON, and RUN=ON
14	Standby	Start-up process	Standby	Standby: Initialization completed, not failure stop status, and not alarm stop status (MOFF, LL forced stop or forced stop due to a momentary power failure)
15	Local/Remote status	Remote	Local	Command is "FA08"

■ Status word 2 (*F E 4 2   F d 4 2*)

Status 2 immediately before the occurrence of a trip: Communication Number FE42
Current status 2: Communication Number FD42

Bit	Function	0	1	Remarks
0	Reserved	-	-	
1	Electric Power Counting (FE76,FE77) status	Counting	Resetting	
2 to 7	Reserved	-	-	
8	Acceleration/deceleration pattern selection1	Acc/Dec 1	Acc/Dec 2	
9 to 11	Reserved	-	-	
12	Over-current stall level change	OC stall 1	OC stall 2	OC1: F601, OC2: F185
13 to 15	Reserved	-	-	

■ Status word 3 (*F E 4 9   F d 4 9*)

Status 3 immediately before the occurrence of a trip: Communication Number FE49
Current status 3: Communication Number FD49

Bit	Function	0	1	Remarks
0	RY terminal output hold	OFF	Holding	
1 to 11	Reserved	-	-	
12	RCH	OFF	ON	F102
13	RCHF	OFF	ON	F101, F102
14 and 15	Reserved	-	-	

8. Parameter list

■ Command mode status (*FE45*)

This parameter monitors the source of the commands.

Data	Function
0	Terminal board
1	Operation panel
2	Serial communication

■ Setpoint mode status (*FE46*)

This parameter monitors the source of the setpoint.

Data	Function
0	-
1	VIA
2	VIB
3	Operation panel
4	Serial communications
5	TB up down frequency
6	-
255	Preset speed operation

8. Parameter list

8. 7. Faults and alarms

■ Alarm code (*FC91*)

Bit	Specifications	0	1	Remarks (Code operation paneled on the panel)
0	Overcurrent alarm	Normal	Alarming	"C" flickering
1	Inverter overload alarm	Normal	Alarming	"L " flickering
2	Motor overload alarm	Normal	Alarming	"L" flickering
3	Overheat alarm	Normal	Alarming	"H" flickering
4	Overvoltage alarm	Normal	Alarming	"P" flickering
5	Main circuit undervoltage alarm	Normal	Alarming	
6	Reserved	-	-	-
7	Undercurrent alarm	Normal	Alarming	-
8	Over-torque alarm	Normal	Alarming	-
9	Reserved	-	-	-
10	Cumulative operation hours alarm	Normal	Alarming	-
11	Reserved	-	-	-
12	Reserved	-	-	-
13	Main circuit undervoltage alarm same as MS-relay status	Normal	Alarming	"MOFF" flickering
14	At the time of the instant blackout, Forced deceleration/stop	-	Decelerating, stopping	Related: F256 setting
15	An automatic stop during the lower limit frequency continuance	-	Decelerating, stopping	Related: F302 setting

■ Alarm of run time (*FE79*)

Bit	Specifications	0	1	Remarks
0	Fan life alarm	Normal	Alarm issued	-
1	Circuit board life alarm	Normal	Alarm issued	-
2	Main-circuit capacitor life alarm	Normal	Alarm issued	-
3	User set alarm	Normal	Alarm issued	-
4-15	Reserved	-	-	-

8. Parameter list

■ **Trip code (current status: $FC\,90$, historic records: $FE\,10$ to $FE\,13$)**

Code	Value (hexadecimal number)	Value (decimal number)	Description
NErr	0	0	No error
OC1	1	1	Over-current during acceleration
OC2	2	2	Over-current during deceleration
OC3	3	3	Over-current during constant speed operation
OCL	4	4	Over-current in load at startup
OCA	5	5	Short circuit in arm
EPHI	8	8	Input phase failure
EPHO	9	9	Output phase failure
OP1	A	10	Overvoltage during acceleration
OP2	B	11	Overvoltage during deceleration
OP3	C	12	Overvoltage during constant speed operation
OL1	D	13	Over-LOAD in inverter
OL2	E	14	Over-LOAD in motor
OH	10	16	Overheat trip
E	11	17	Emergency stop
EEP1	12	18	EEPROM fault 1 (writing error)
EEP2	13	19	EEPROM fault 2 (reading error)
EEP3	14	20	EEPROM fault 3 (internal fault)
Err2	15	21	RAM fault
Err3	16	22	ROM fault
Err4	17	23	CPU fault
Err5	18	24	Communication error trip
Err7	1A	26	Current detector fault
Err8	1B	27	Optional circuit board type error
UC	1D	29	Small-current trip
UP1	1E	30	Trip due to undervoltage in main circuit
Ot	20	32	Over-torque trip
EF2	22	34	Ground fault trip (hardware detection)
OC1P	25	37	Overcurrent flowing in element during acceleration
OC2P	26	38	Overcurrent flowing in element during deceleration
OC3P	27	39	Overcurrent flowing in element during operation
EtYP	29	41	Inverter type error
OH2	2E	46	External thermal input
SOUt	2F	47	VIA cable break
E-18	32	50	Break in an analog signal cable
E-19	33	51	CPU fault
E-20	34	52	Excess torque boost
E-21	35	53	CPU fault
Etn1	54	84	Auto-tuning error

8. Parameter list

8. 8. Monitoring and control of I/O from communication

The digital inputs, digital outputs, analog input and output signals of the inverters can be controlled by communication.

■ Digital inputs status (*F d 0 6*, *F E 0 6*)

Digital inputs status immediately before the occurrence of a trip: Communication Number FE06
Current digital inputs status: Communication Number FD06

In case "0: No assignment function" is selected in function selection, inverter operations will not be affected even when terminals are turned on and off. Therefore, the terminals can be used as input terminals for customer's own use.

The input terminal function selection parameter is used to select a function for each input terminal.

Bit	Terminal name	Function (parameter title)	0	1
0	F	Input terminal selection 1 (*F 1 1 1*)	OFF	ON
1	R	Input terminal selection 2 (*F 1 1 2*)	OFF	ON
2	RES	Input terminal selection 3 (*F 1 1 3*)	OFF	ON
3 to 6	Reserved	-	-	-
7	VIA (1)	Input terminal selection 8 (*F 1 1 8*)	OFF	ON
8 to 15	Reserved	-		

(1): It is valid only when it is selected as contact input by F109.

Example: When both F and RES terminals are ON: FE06 = 16#0005

	BIT 15															BIT 0
FE06:	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
	0				0				0				5			

■ Digital outputs status (*F d 0 7*, *F E 0 7*)

Digital outputs status immediately before the occurrence of a trip: Communication Number FE07
Current digital outputs status current status: Communication Number FD07

The output terminal function selection parameter is used to select a function for each output terminal.

Bit	Terminal name (extended)	Function (parameter title)	0	1
0	RY	Output terminal selection1 (*F 1 3 0*)	OFF	ON
1	Reserved	-	-	-
2	FL	Output terminal selection3 (*F 1 3 2*)	OFF	ON
3 to 15	Reserved	-	-	-

Example: When both the RY and FL terminals are ON: FE07 = 16#0005

	BIT 15															BIT 0
FE07:	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
	0				0				0				5			

■ Analog inputs values (*F E 3 5*, *F E 3 6*)

Analog input VIA value: Communication Number FE35
Analog input VIB value: Communication Number FE36
Data: 10bit resolution (Data range 0 to 1023)

These parameters can also be used as an A/D converter independent of inverter control (Frequency setting mode selection (FMOD) not assigned to VIA nor VIB).

8. Parameter list

■ Digital outputs command (*FA50*)

The digital outputs (relays) of the inverter can be controlled directly by communication.
Before controlling them, select Function Number 38 or 39 in Output terminal function selection (F130 , F132 , F137).

Bit	Output Terminal Function	0	1
0	Relay RY (F130 and F137)	OFF	ON
1 to 15	Reserved	-	-

Example: Controlling only relay RY by communication

Set "38" (specified data output 1 [positive logic]) in Output terminal selection 1 (F130) in advance.
Set "0001H" in FA50 to turn relay RY on.

■ Analog outputs command (*FA51*)

The analog output FM on the inverter can be controlled directly by communication.
Select "18" (Communication analog output) in Analog terminal connection selection parameters (example: FM terminal connection meter selection [FMSL]) before controlling them.
The data adjustment range is 0 to 1023 (10bit resolution). Refer to "Meter Setting and adjustment" in the ATV 21 user manual for complete information.

8. Parameter list

8. 9. Identification

■ Inverter model code (*F B 0 5*)

Model	Voltage Power Rating	Code (FB05)	Class (FB72:bit7)
-------	3ph 200V 0.37/0.4kw	2	0
ATV21H075M3X	3ph 200V 0.75kW	4	0
ATV21HU15M3X	3ph 200V 1.5kW	6	0
ATV21HU22M3X	3ph 200V 2.2kW	7	0
ATV21HU30M3X	3ph 200V 3kW	8	0
ATV21HU40M3X	3ph 200V 3.7kW / 4kW	9	0
ATV21HU55M3X	3ph 200V 5.5kW	10	0
ATV21HU75M3X	3ph 200V 7.5kW	11	0
ATV21HD11M3X	3ph 200V 11kW	108	0
ATV21HD15M3X	3ph 200V 15kW	109	0
ATV21HD18M3X	3ph 200V 18.5kW	110	0
ATV21HD22M3X	3ph 200V 22kW	111	0
ATV21HD30M3X	3ph 200V 30kW	112	0
-----	3ph 400/460V 0.4kW	34	0
ATV21H075N4	3ph 400/460V 0.75kW	36	0
ATV21HU15N4	3ph 400/460V 1.5kW	38	0
ATV21HU22N4	3ph 400/460V 2.2kW	39	0
ATV21HU30N4	3ph 400/460V 3.0kW	40	0
ATV21HU40N4	3ph 400/460V 3.7/4 kW	41	0
ATV21HU55N4	3ph 400/460V 5.5kW	42	0
ATV21HU75N4	3ph 400/460V 7.5kW	43	0
ATV21HD11N4	3ph 400/460V 11kW	44	0
ATV21HD15N4	3ph 400/460V 15kW	45	0
ATV21HD18N4	3ph 400/460V 18.5kW	46	0
ATV21HD22N4	3ph 400/460V 22kW	47	0
ATV21HD30N4	3ph 400/460V 30kW	48	0
ATV21HD37N4	3ph 400/460V 37kW	49	0
ATV21HD45N4	3ph 400/460V 45kW	50	0
ATV21HD55N4	3ph 400/460V 55kW	51	0
ATV21HD75N4	3ph 400/460V 75kW	52	0
-----	3ph 400/460V 0.4kw IP54	134	0
ATV21W075N4	3ph 400/460V 0.75kW IP54	0136	0
ATV21WU15N4	3ph 400/460V 1.5kW IP54	0138	0
ATV21WU22N4	3ph 400/460V 2.2kW IP54	0139	0
ATV21WU30N4	3ph 400/460V 3.0kW IP54	0140	0
ATV21WU40N4	3ph 400/460V 3.7/4 kW IP54	0141	0
ATV21WU55N4	3ph 400/460V 5.5kW IP54	0142	0
ATV21WU75N4	3ph 400/460V 7.5kW IP54	0143	0
ATV21WD11N4	3ph 400/460V 11kW IP54	0144	0
ATV21WD15N4	3ph 400/460V 15kW IP54	0145	0
ATV21WD18N4	3ph 400/460V 18.5kW IP54	0146	0
ATV21WD22N4	3ph 400/460V 22kW IP54	0147	0
ATV21WD30N4	3ph 400/460V 30kW IP54	0148	0
ATV21WD37N4	3ph 400/460V 37kW IP54	0149	0
ATV21WD45N4	3ph 400/460V 45kW IP54	0150	0
ATV21WD55N4	3ph 400/460V 55kW IP54	0151	0
ATV21WD75N4	3ph 400/460V 75kW IP54	0152	0

8. Parameter list

Model	Voltage Power Rating	Code (FB05)	Class (FB72:bit7)
-----	3ph 400/460V 0.4kW IP54+ClassB	134	1
ATV21W075N4C	3ph 400/460V 0.75kW IP54+ClassB	136	1
ATV21WU15N4C	3ph 400/460V 1.5kW IP54+ClassB	138	1
ATV21WU22N4C	3ph 400/460V 2.2kW IP54+ClassB	139	1
ATV21WU30N4C	3ph 400/460V 3.0kW IP54+ClassB	140	1
ATV21WU40N4C	3ph 400/460V 3.7/4 kW IP54+ClassB	141	1
ATV21WU55N4C	3ph 400/460V 5.5kW IP54+ClassB	142	1
ATV21WU75N4C	3ph 400/460V 7.5kW IP54+ClassB	143	1
ATV21WD11N4C	3ph 400/460V 11kW IP54+ClassB	144	1
ATV21WD15N4C	3ph 400/460V 15kW IP54+ClassB	145	1
ATV21WD18N4C	3ph 400/460V 18.5kW IP54+ClassB	146	1
ATV21WD22N4C	3ph 400/460V 22kW IP54+ClassB	147	1
ATV21WD30N4C	3ph 400/460V 30kW IP54+ClassB	148	1
ATV21WD37N4C	3ph 400/460V 37kW IP54	149	1
ATV21WD45N4C	3ph 400/460V 45kW IP54	150	1
ATV21WD55N4C	3ph 400/460V 55kW IP54	151	1
ATV21WD75N4C	3ph 400/460V 75kW IP54	152	1

9. Appendix

9. 1. RS485 standard

The RS485 standard (ANSI/TIA/EIA-485-A-1998) allows variants of certain characteristics:
• Polarization
• Line termination
• Distribution of a reference potential
• Number of slaves
• Length of bus

It does not specify the connector type or pinout.

The Modbus specification published on www.modbus.org in 2002 contains precise details of all these characteristics. They are also summarized in the next sections (Modbus 2-wire and 4-wire standard schematics). The latest generation Telemecanique devices (Altivar 31, Altivar 71, Altivar 21, Altivar 61, etc.) conform to this specification.

Older devices comply with earlier specifications. The two most widespread are described in the following sections:

Requirements enabling different types of protocol to coexist are given in the following section in this appendix:

9. Appendix

9. 2. Modbus 2-wire standard schematic

The standard schematic corresponds to the Modbus specification published in 2002 on www.modbus.org (Modbus_over_serial_line_V1.pdf, Nov 2002) and, in particular, to the 2-wire multipoint serial bus schematic.

The Modbus card (VW3 A3 303) conforms to this specification.

Schematic diagram:

Type of trunk cable	Shielded cable with 1 twisted pair and at least a 3rd conductor
Maximum length of bus	1000 m at 19200 bps with the Telemecanique TSX CSA●00 cable
Maximum number of stations (without repeater)	32 stations, i.e., 31 slaves
Maximum length of tap links	• 20 m for one tap link • 40 m divided by the number of tap links on a multiple junction box
Bus polarization	• One 450 to 650 Ω pull-up resistor to the 5 V (650 Ω or thereabouts recommended) • One 450 to 650 Ω pull-down resistor to the Common (650 Ω or thereabouts recommended) This polarization is recommended for the master.
Line termination	One 120 Ω 0.25 W resistor in series with a 1nF 10 V capacitor
Common polarity	Yes (Common)

9. Appendix

9. 3. Uni-Telway schematic

The Uni-Telway bus schematic was used by Telemecanique for older-generation inverters and soft starters (ATV58, ATV28, ATS48, etc.) marketed before the Modbus specifications were published on www.modbus.org.
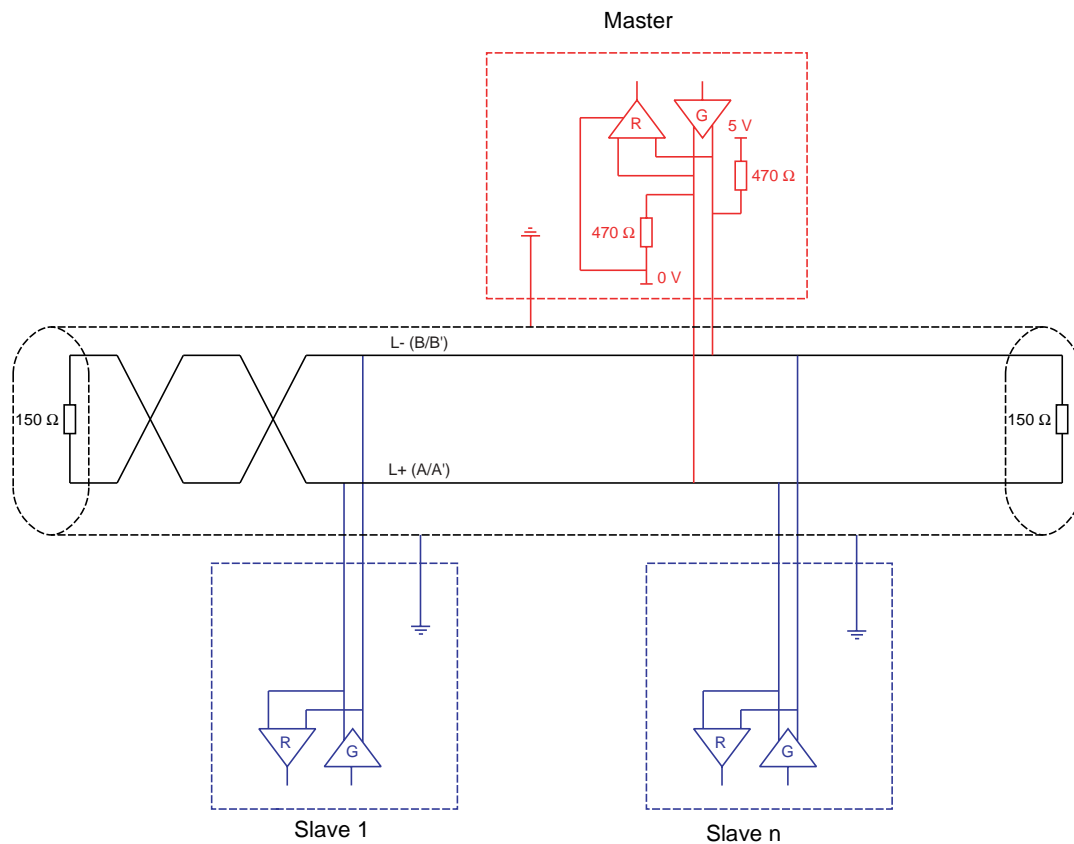
Schematic diagram:
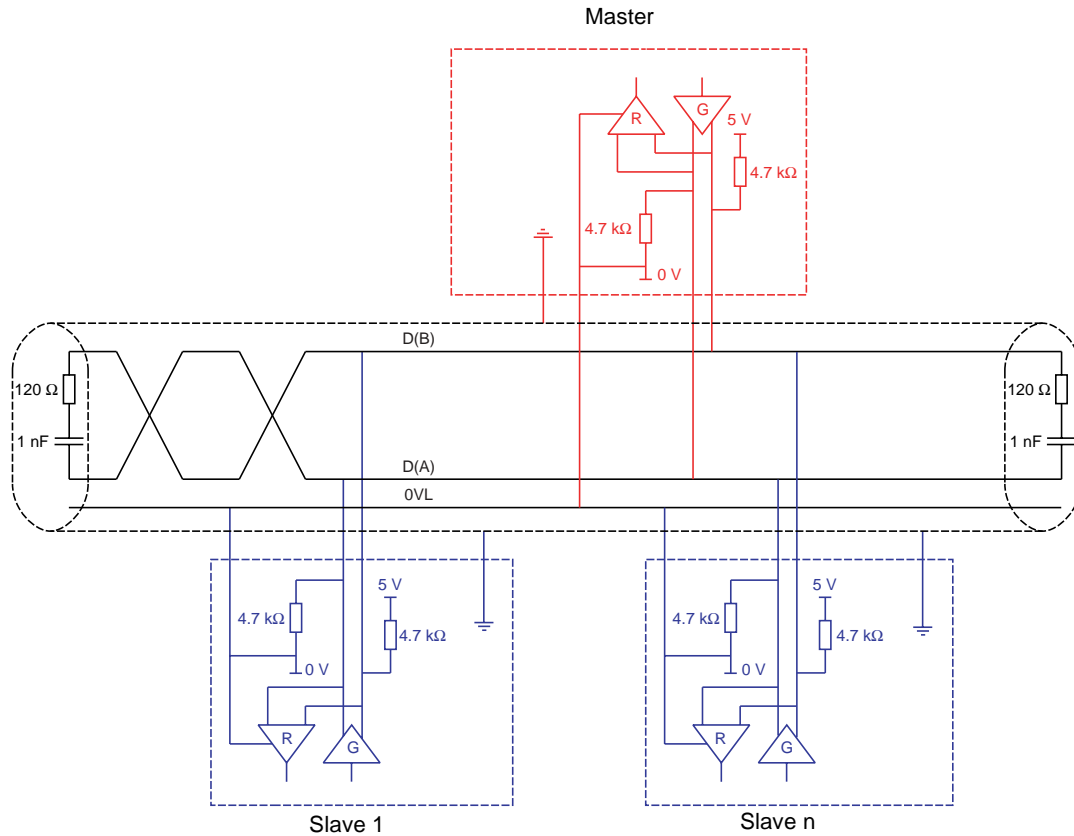
Type of trunk cable	Cable with 2 twisted pairs shielded in pairs
Maximum length of bus	1000 m at 19200 bps
Maximum number of stations (without repeater)	29 stations, i.e., 28 slaves
Maximum length of tap links	• 20 m • 40 m divided by the number of tap links on a multiple junction box
Bus polarization	For the master and each slave: • One 4.7 kΩ pull-up resistor to the 5 V • One 4.7 kΩ pull-down resistor to the 0 VL
Line termination	One 120 Ω 0.25 W resistor in series with a 1 nF 10 V capacitor
Common polarity	Yes (0 VL) and high impedance placed between 0 VL and the ground in each station

9. Appendix

9. 4. 2-wire Jbus schematic

Schematic diagram:

Type of trunk cable	Cable with 1 shielded twisted pair
Maximum length of bus	1,300 m at 19200 bps
Maximum number of stations (without repeater)	32 stations, i.e., 31 slaves
Maximum length of tap links	3 m
Bus polarization	One 470 Ω pull-up resistor to the 5 V One 470 Ω pull-down resistor to the 0 V This polarization is often provided in the master.
Line termination	One 150 Ω resistor
Common polarity	No

9. Appendix

9. 5. Creating a Modbus bus using non-standard equipment

■ Different scenarios

❏ If the Modbus bus is created using the latest-generation Telemecanique devices and Telemecanique Modbus wiring accessories, installation is simple and no calculation is required (see the section entitled "Connecting to the bus").

❏ If a new Modbus bus has to be created using devices of different brands or older-generation devices, which do not comply with the Modbus standard, several checks are required (see "Recommendations" below).

❏ If, on an existing Modbus bus, a device with 4.7 kΩ polarization is to be replaced by a new-generation device, set the 2 polarization switches to the lower position to activate the card's 4.7 kΩ polarization.

Polarization switches:

4.7 kΩ RS485 line polarization at inverter level

■ Recommendations

1. **Identify the polarities D0 and D1.**
They are labeled in different ways depending on the standard:

	Standard			
	Modbus	**EIA/TIA-485 (RS 485)**	**Uni-Telway**	**Jbus**
Signals	D0	A/A'	D (A)	RD +/TD + or L +
	D1	B/B'	D (B)	RD -/TD - or L -
	Common	C/C'	0VL	
Generator	B	G		
Receiver	R	R		

However, certain RS485 electronic components are labeled in the opposite way to the EIA/TIA-485 standard.
It may be necessary to perform a test by connecting a master to a slave, then reversing the connection in the event of failure.

2. **Check polarizations**
Check the documentation supplied with the devices to determine their polarization.
If there is a polarization, check that the equivalent polarization value is correct (see "Calculating the polarization").

It is not always possible to implement correct polarization (for example, if the 5 V is not available on the master).
In this case, it may be necessary to limit the number of slaves.
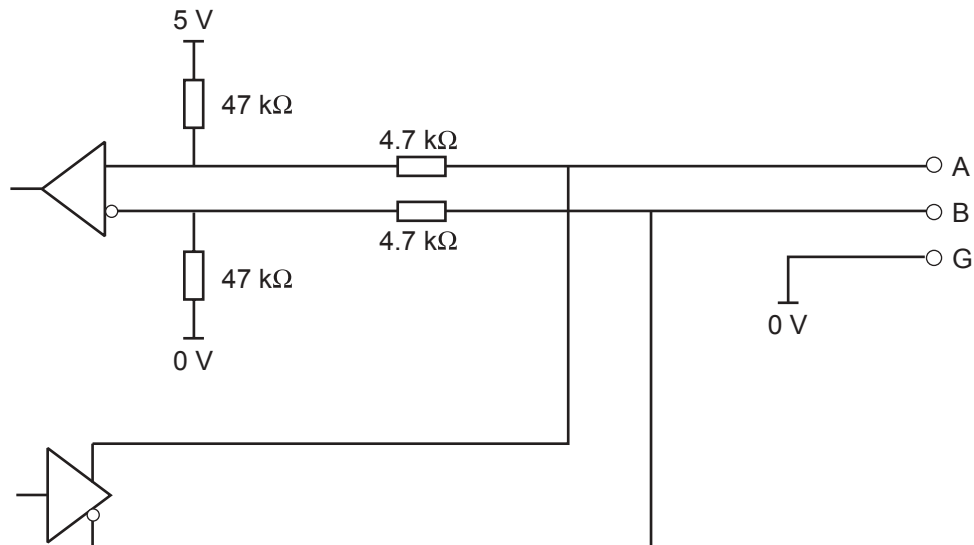
3. **Choose a line terminator**
If there is a polarization, select an RC line terminator (R = 120 Ω, C = 1 nF)
If it is not possible to install a polarization, select an R line terminator (R = 150 Ω).

9. Appendix

9. 6. RS485 schematic for the modbus port

The RS485 interface on the Modbus card is electrically isolated from the inverter.

Schematic diagram:

The polarization switches are used to connect or disconnect the pull-up and pull-down resistors, which implement either Modbus (no slave polarization) or Uni-Telway (4.7 kΩ polarization for each station) type polarization.

9. 7. Connector pinout

Pin	Signal
1	Reserved
2	Common (common of the signal and power supply)
3	Reserved
4	D1 (Modbus name) or B (EIA / TIA485 name)
5	D0 (Modbus name) or A (EIA / TIA485 name)
6	Reserved
7	24 V supply (for RS232 / RS485 converter or remote terminal)
8	Common (common of the signal and power supply)