ID 985 LX M
Serial Communication Protocol Modbus

1 CONTENTS

2 HOW TO USE THIS MANUAL

This manual is designed to permit quick, easy reference with the following features:

References

***References* column:**
A column to the left of the text contains *references* to subjects discussed in the text to help you locate the information you need quickly and easily.

Cross references

***Cross references*:**
All words written in *italics* are referenced in the subject index to help you find the page containing details on this subject; supposing you read the following text:
"when the alarm is triggered, the compressors will be shut down"
The italics mean that you will find a reference to the page on the topic of compressors listed under the item compressors in the index.
If you are consulting the manual "on-line" (using a computer), words which appear in italics are hyperlinks: just click on a word in italics with the mouse to go directly to the part of the manual that discusses this topic.

Instrument Version

Instrument Version

This manual refers to the instruments ID 985 LX M as indicated below

Field Code	*Field Description*
0	Constructor ID **(= "INVENSYS")**
1	Instrument Model ID **(= "0010_0401")**
2	Instrument Version ID **(= "00A3_0016")**

It is possible to verify these informations using the serial command "Reading the Instrument ID" described in the chapter ***Functions and Resources Modbus***

3 ID 985 LX MODBUS

3.1 ID 985 LX M Introduction

electronic controller for refrigerating units with programmable outputs, specifically designed for supermarkets

The ID 985 LX controllers are devices suitable for applications on normal or low temperature ventilated refrigerating units. They are provided with three outputs for NTC (PTC can be set by parameter) thermostatic probes for cell and defrost management and for viewing an additional temperature value.
The four relay outputs are suitable for compressor, defrost, evaporator fans and alarm management; the alarm relay can also be configured for managing an auxiliary load, such as the lights. The buzzer is optional.
Two programmable digital inputs are also supplied that can be used as microports, to enable remotely the defrost cycle, the reduced set, an auxiliary load or an alarm signal.
The defrosting cycle may be stopped at a specified time or, by using the appropriate probe placed on the evaporator, when the end cycle temperature has been reached. The value of the probe's reading is viewed on a display by three digits and a minus sign; the decimal point reading can be set by parameter. All versions are provided by TTL connections for using *Copy Card*, the quick programming accessory, and for connection to the Televis system.
The timers are available in the 32x74 standard *format* and the power supply voltage is at 12 V ~ / ⎓ .

3.2 USER INTERFACE

The user has a display and four keys for controlling status and programming of the instrument.

3.3 KEYS AND MENUS

Tasto UP

UP Key
- Scrolls menu entries
- Increases values
- Activates manual def. function

Tasto DOWN

DOWN Key
- Scrolls menu entries
- Decreases values
- Can be set by parameter

Tasto fnc

fnc key
- ESC function (exit)
- Can be set by parameter

Tasto set

set key
- Accesses the setpoint
- Accesses the menus
- Confirms the commands
- Displays the alarms (if active)
- Stores hours/minutes

At start-up the instrument performs a Lamp Test; for few seconds the display and the leds blink, in order to verify their integrity and correct operation. The instrument has two main menus: the "Machine Status" and "Programming" menu.

3.3.1 LED

ECO

ECO
Set/Reduced set
ON for Set-Point changing; blinking when the reduced set is on

Compressor or Relay 1

Compressor or Relay 1

ON for compressor on; blinking for delay, locked protection or activation

Defrosting

Defrosting

ON when defrosting;
blinking in case of manual or digital input activation

Alarm

Alarm

ON when the alarm is enabled;
blinking when the alarm is silenced

Fans

Fans

ON when fan is on

aux

aux

ON when the auxiliary output is on

decimal point

decimal point
ON when the instrument is in stand-by mode

3.4 ACCESSING AND USING MENUS

Resources are arranged in a menu, which can be accessed by pressing and quickly releasing the “set” key (“Machine Status” menu), or by holding down the “set” key for more than 5 seconds (“Programming” menu). To access the *contents* of each folder, indicated by the relevant label, just press the “set” key once. You can now scroll through the *contents* of each folder, modify it or use its *functions*. If you do not use the keyboard for over 15 seconds (time-out) or if you press the “fnc” key once, the last value shown on the display is confirmed and you return to the previous screen mask.

3.5 MACHINE STATUS MENU

To access the "Machine Status" menu, press and quickly release the "set" key. If alarms are not present, the label "SEt" appears. By using the "UP" and "DOWN" keys you can scroll through the other folders in the menu:

- AL: alarm folder (if alarms present);
- SEt: Setpoint setting folder.
- rtc : *real time clock* folder.
- Pb1: probe 1 value folder;
- Pb2: probe 2 value folder;
- Pb3: probe 3 value folder (if present);

3.5.1 Set setting

Access the "Machine Status" menu by pressing and quickly releasing the "set" key. The label of the "Set" folder appears. To display the Setpoint value press the "set" key again. The value appears on the display. To change the Setpoint value, use the "UP" and "DOWN" keys within 15 seconds. If the parameter is LOC = y the Setpoint cannot be changed.

3.5.2 Real Time Clock

By pressing the "set" key when the related "rtc" label appears, the label d00 (days) is displayed. Use the "UP" and "DOWN" keys to set days. If you do not use the keys for over 2 seconds, or if you press "ENTER" you switch to hours (h00) and minutes ('00) folders: use the "UP" and "DOWN" keys to set hours and minutes respectively. If you do not use the keyboard for over 15 seconds (time-out) or if you press the "fnc" key once, the last value shown on the display is confirmed and you return to the previous screen mask.
PLEASE NOTE: Always confirm with the "set" key to store the hours/minutes/days setting

3.5.3 Alarm on

If an alarm condition exists, when accessing the "Machine Status" menu the "AL" folder label appears (see the "*Diagnostics*" section).

3.5.4 Displaying probes

By pressing the "set" key when the appropriate label appears, the value of the probe associated to it is displayed.

3.6 PROGRAMMING MENU

(See *Programming Menu Diagram*)

3.6.1 1) Level 1 Parameters

To access the "Programming" menu, press the "set" key for more than 5 seconds. If specified, the level 1 access *PASSWORD* will be requested (see parameter "PA1") and (if the *password* is correct) the label of the first folder will follow. If the *password* is wrong, the display will show the PA1 label again.

To scroll other folders, use the "UP" and "DOWN" keys; the folders contain only the level 1 *parameters*.
NOTE: At this point level 2 *parameters* are NOT visible, even if they aren't protected by *password*.

3.6.2 2) Level 2 Parameters

In the *Programming Menu* go into the "CnF" folder, scroll all the parameter until you reach the PA2 label. By pressing and releasing the "set" button you will enter to level 2 *parameters* and the label of the first folder in the *programming menu* will follow.
The level 2 *parameters* may be protected by a second *password* (see "PA2" parameter inside "diS" folder, not to be confused with PA2 label inside "CnF" folder.
If specified, level 2 *parameters* are hidden to user; accessing the "CnF" folder the level 2 access *PASSWORD* will be requested and (if the correct *password* is entered) the label of the first folder in the *programming menu* will follow.
NOTE: At this point you will see only level 2 *parameters*.
Level 1 *parameters* will NOT be visible;
to reach them you shall exit the *Programming Menu* and re-entry the *Programming Menu* section (see step 1).
To enter the folder, press "set". The label of the first visible parameter appears. To scroll through the other *parameters*, use the "UP" and "DOWN" keys; to change the parameter, press and release "set", then set the desired value using the "UP" and "DOWN" keys, and confirm with the "set" key. Move to the next parameter.
PLEASE NOTE: It is suggested to switch-off and switch-on again the instrument everytime it is changed the configuration of the *parameters*: this prevents malfunctioning on regulation and delay time occuring.

3.6.3 PASSWORD

The passwords "PA1" and "PA2" allow access respectively to level 1 and level 2 *parameters*. In the standard configuration passwords are not present. To enable them and assign them the desired value, access the "Programming" menu, within the folder with the "diS" label. If passwords are enabled, they will be requested:

- PA1 at the entrance of the "Programming" menu (see the "*Programming Menu*" section);
- PA2 within the folder with the "Cnf" label containing level 1 *parameters*.

3.6.4 Enabling defrost cycle manually

To manually activate the defrosting cycle, press the "UP" key (if configured) for 5 seconds. If the conditions for defrosting are not present, (for example, the evaporator probe temperature is higher than the defrost end temperature), or if parameter OdO≠0, the display will blink three (3) times, to indicate that the operation will not be performed.

3.7 COPY CARD

The *Copy Card* is an accessory connected to the TTL serial port which allows programming quickly the instrument *parameters* (*upload* and *download* parameter's map). The operation is performed as follows:

3.7.1 Format

This command allows *copy card* formatting, an operation necessary in case of first use or to copy maps with different models.
Warning: if the *copy card* has been programmed, using the "Fr" the data entered are erased. This operation cannot be cancelled.

3.7.2 Upload

This operation loads the programming *parameters* from the instrument.

3.7.3 Download

This operation downloads to the instrument the programming *parameters*.
NOTE:
- ***UPLOAD*: instrument --> *Copy Card***
- ***DOWNLOAD*: *Copy Card* --> instrument**

The operations are performed accessing the folder identified by the "FPr" label and selecting, according to the case, "UL", "dL" or "Fr" commands; the operation is confirmed by pressing the "set" key. If the operation is successful an "y" is displayed, on the contrary, if it fails a "n" will be displayed.

3.7.4 Download "from reset (instrumennt OFF"

Connect the coy card with the instrument OFF (not under voltage).
When the instrument is switched on the programming *parameters* will be downloaded into the instrument; after the lamp-test the diplay will show for about 5 seconds:
- label dLY if copy operation successful
- label DLn if not

PLEASE NOTE:
- after the *download* operation the instrument will immediately work with the new *parameters* map setting.

3.8 TELEVIS DISTANCE-MANAGED SYSTEMS

The *Televis distance-managed systems* can be connected through TTL serial port (the TTL- RS 485 *BUS* ADAPTER 100 interface module must be used). To configure the instrument for this purpose you need to access to the folder identified by the "Add" label and to use the "dEA" and "FAA" *parameters*.

3.9 Keyboard locking

The instrument includes a facility for disabling the keyboard, by programming the "Loc" parameter (see folder with "diS" label). In case of *keyboard locking* you can access to the "Programming" Menu by pressing the "set" key. The Setpoint can also be viewed.

3.10 ADVANCED FUNCTIONS

3.10.1 LINK

The *Link* function allows to connect up to 8 instruments (1 *Master* device and 7 *slave* and echo devices) to a network. The distance between devices must be 7 mt. at least.
NOTE: the serial connection between devices is power supplied.

Master ***Master***
An instrument that manages the network by sending commands to Slaves. The *Master* is selected through the L00 parameter (the 0 value defines the *Master*)

Slave ***Slave***
Instrument(s) supplied with its (their) own controls which also performs commands issued by the *Master*.

Echo **Echo**
Instrument(s) provided with a function to view just the values of the instrument which is associated to (thus it is not provided with its own I/O resources, but only acts as a repeater).
NOTE: several Echo devices can be connected to the same instrument (*Master* or *Slave*; in case it is connected to a *Slave* module set L04=n).

3.10.2 Defrostings

The *Link* network allows to manage *defrostings*; the *Master* sends the command for defrosting, which can be performed synchronously (at the same time) or sequentially (defrost after defrost), without affecting the standard protections or delays of the instruments (see parameter L03). The *Master* can also activate the following *functions*: lights coming on and going off, alarm silencing, auxiliary Setpoint, aux relay, stand-by (on/off), and *Night & Day control* (see parameter L05). The *Master* can then synchronize *Slave* and Echo displays according to the *Master* or to a *Slave* display (for Echoes) (see parameter L04). NOTE: synchronous defrost is considered as regards the actual defrost, dripping and subsequent *functions*. The defrost *LED* of the Slaves blinks at the end of defrosting , when Slaves wait for the thermostat to be enabled by the *Master*. The *functions* of the instrument are associated by setting appropriately the correct *parameters* (see the parameter table of the folder with "Lin" label)

3.10.3 Night & Day control

The *Night & Day control* algorithm allows to set events and cycles at predefined times of the week. You can set an event start time and duration, as well as the *functions* and *defrostings* (daily or festive) to be enabled.
By pressing the "set" key when the related "nad" label appears, the label d0 is displayed in the "Programming" menu. Use the "UP" and "DOWN" keys to set other days (d1...d6) and Everyday). By pressing "ENTER" the first parameter E00 is displayed; use the "UP" and "DOWN" keys to scroll through other *parameters* E01...03. If you do not use the keyboard for over 15 seconds (time-out), or if you press the "fnc" key once, the last value shown on the display is confirmed and you return to the previous screen mask.
The different *functions* are set through the appropriate *parameters* (see the parameter table of the folder with the "nad" label)

3.11 DIAGNOSTICS

The alarm condition is always signaled by the buzzer (if present) and by the *led* of the alarm icon The alarm signals from the faulty thermostat probe (probe 1), the faulty evaporator probe (probe 2), and the faulty display probe (probe 3) is viewed on the instrument display by E1, E2, and E3 respectively.

DISPLAY	FAULT
E1	Faulty probe 1 (thermostat)
E2	Faulty probe 2 (evaporator)
E3	Faulty probe 3 (display)
Se contemporanei verranno visualizzati a display, in alternanza, con cadenza 2 secondi	

The error condition of the probe 1 (thermostat) causes the following:

- viewing E1 code on the display
- activating compressor as indicated by "Ont" and "Oft" *parameters*, if these are programmed for duty cycle.

Ont	Oft	Compressor Output
0	0	OFF
0	>0	OFF
>0	0	ON
>0	>0	dc

The error condition of the probe 2 (evaporator) causes the following:
• viewing E2 code on the display
• end of defrost because of time-out.
The error condition of the probe 3 (display) causes the following:
• viewing E3 code on the display.
The other alarm signals do not show directly on the display, but can be viewed from the "Machine Status" menu within the "AL" folder.
The regulation of the *maximum and minimum temperature alarm* refers to the thermostat probe (probe 1) and/or dipaly probe (probe 3) . The temperature limits are defined by "HAL" (maximum alarm), "LAL" (minimum alarm) and PbA (alarm configuration on probe 1,3 or both) *parameters*.

Maximum and minimum temperature alarm

3.11.1 Maximum and minimum temperature alarm

In case of alarm condition, if alarm exclusion times are not in progress (see, alarm exclusion *parameters*), the fixed alarm icon is turned on and the relay configured as an alarm is activated. This kind of alarm does not affect the regulation in progress. Alarms are considered as absolute (default) values or as values related to the Setpoint (the distance from the Setpoint itself) and based on the Att parameter. In this case (Att=1), the HAL parameter must be set to positive values and the LAL parameter to negative values.
This alarm condition can be viewed in the folder "AL" with the labels "AH1-AL1".

Alarm with threshold (probe 3)

3.11.2 Alarm with threshold (probe 3)

By setting the PbA=3 parameter an alarm is associated to probe 3. It refers to a specific threshold (definded by the SA3 parameter). Furthermore, an over-temperature or an under-temperature alarm is generated and the icon is turned on. This alarm condition can be viewed in the "AL" folder with the labels "AH3-AL3". The alarm is managed as a temperature alarm referred to probe 3: refer to standard delays and back swings

Defrost alarm

3.11.3 Defrost alarm

If defrost ends because of a time-out (instead that because of a defrost end temperature detected by the defrosting probe), an alarm is generated an the icon is turned on consequently. This condition can be viewed in the "AL" folder with the label "Ad2". Automatic back swing occurs when the next defrost starts. By pressing any key during the alarm condition, the signal light disappears. In order to really erase the alarm you must wait the next defrost.

External alarm

3.11.4 External alarm

The device includes the possibility to control an *external alarm*, from a digital input. If the digital input is active, the alarm control is activated, if programmed, and stays until the next time the digital input is deactivated. The alarm is signaled by turning on the fixed alarm icon, by activating the relay configured as alarm, and by deactivating compressor, defrost and

fan controls (if specified by the “EAL” parameter). This alarm condition can be viewed in the “AL” folder with the label “EA”. The relay can be silenced; even if alarm icon starts blinking, controls stay locked until the next time the digital input is deactivated.

Open door alarm

3.11.5 Open door alarm

In case of an open door, in *response* to delay defined by tdO parameter the *Open Door alarm* is signaled. The alarm is signaled by turning on the blinking alarm icon. This alarm condition can be viewed in the “AL” folder with the label “Opd”.

DISPLAY	ALARM
AH1	High temperature alarm (referred to the thermostat probe or probe 1)
Al1	Low temperature alarm (referred to thermostat probe or probe 1)
AH3	High temperature alarm (referred to probe 3)
AL3	Low temperature alarm (referred to probe 3)
Ad2	Defrost end due to time-out
EAL	*External alarm*
Opd	*Open door alarm*
E7	*Master-Slave* communication failed
E10	Clock battery alarm

3.12 MECHANICAL ASSEMBLY

The instrument is designed for panel mounting. Make a hole of 29x71 mm, insert the instrument and fix it using the brackets provided. Do not mount the instrument in humid and/or dirty places; it is suitable for use in ordinary polluted places. Ventilate the place in proximity to the instrument cooling slits.

3.13 ELECTRICAL CONNECTIONS

Warning! Never work on *electrical connections* when the machine is switched on.
The instrument is equipped with screw terminal boards for connection of electrical cables with a diameter of 2,5 mm2 (one conductor only per terminal for power connections): for the capacity of the terminals, see the label on the instrument. The relay contacts are voltage free. Do not exceed the maximum current allowed; in case of higher loads, use an appropriate contactor. Make sure that power supply voltage meets the instrument voltage.
Probes have no connection polarity and can be extended using a regular bipolar cable (note that the extension of the probes affects the EMC electromagnetic compatibility of the instrument: pay extreme attention to *wiring*). Probe cables, power supply cables and the TTL serial cables should be distant from power cables.

3.14 CONDITIONS OF USE

3.14.1 Permitted use

For safety reasons the instrument must be installed and used according to the instruction provided and in particular, under normal conditions, parts bearing dangerous voltage levels must not be accessible. The device must be adequately protected from water and dust as per the application and must also only be accessible via the use of tools (with the exception of the frontlet). The device is ideally suited for use on household appliances and/or similar refrigeration equipment and has been tested with regard to the aspects concerning European reference standards on safety. It is classified as follows:
• according to its manufacture: as an automatic electronic control device to be incorporated by independent mounting;
• according to its automatic operating features: as a 1B-type operated control type;
• as a Class A device in relation to the category and structure of the software.

3.14.2 Unpermitted use

Any other use other than that permitted is de facto prohibited. It should be noted that the relay contacts provided are of a practical type and therefore subject to fault. Any protection devices required by product standards or dictated by common sense due to obvious safety reasons should be applied externally.

3.15 RESPONSIBILITY AND RESIDUAL RISKS

Invensys Controls Italy S.r.L. shall not be liable for any damages deriving from:
- installation/use other than that prescribed and, in particular, that which does not comply with safety standards anticipated by regulations and/or those given herein;
- use on boards which do not guarantee adequate protection against electric shock, water or dust under the conditions of assembly applied;
- use on boards which allow access to dangerous parts without the use of tools;
- tampering with and/or alteration of the product;
- installation/use on boards that do not comply with the standards and regulations in force.

3.16 TECHNICAL DATA

Front panel protection: IP65.
Container: plastic in PC+ABS UL94 V-0 resin casing, polycarbonate glass, thermoplastic resin keys.
Size: front panel 74x32 mm, depth 60 mm. Mounting: panel, with 71x29 mm (+0.2/0.1 mm) drilling template.
Usage temperature: 5...55 °C.
Storage temperature: 30...85 °C.
Usage environment humidity: 10...90 % RH (non-condensing).
Storage environment humidity: 10...90% RH (non-condensing).
View *range*: -50...110 (NTC); -50...140 (PTC) °C without decimal point (set by parameter), on a 3 and a half digits display and a plus sign.
Analogue inputs: three PTC or NTC inputs (set by parameter).
Digital inputs: 2 voltage-free digital inputs that can be set by parameter.
Serial: TTL for connecting a Televis system or a *Copy Card*.
Digital outputs: 4 outputs on relay:
first output (A) SPDT 8(3)A 250Va, second and third output (B-C) SPST 8(3)A 250Va, fourth output (D) SPST 5(2)A 250Va.
Link: Output for *Link* network
Measurement *range*: from 50 to 140 °C. Accuracy: better of 0,5% than the end of scale +1 digit.
Resolution: 1 or 0.1 °C.
Consumption: 3 VA.
Power supply: 12 Va/c ±10% 50/60 Hz

Warning: check the power supply indicated on the label of the instrument; for any information about the relay current carrying capacity and the power supply, contact the trade office.

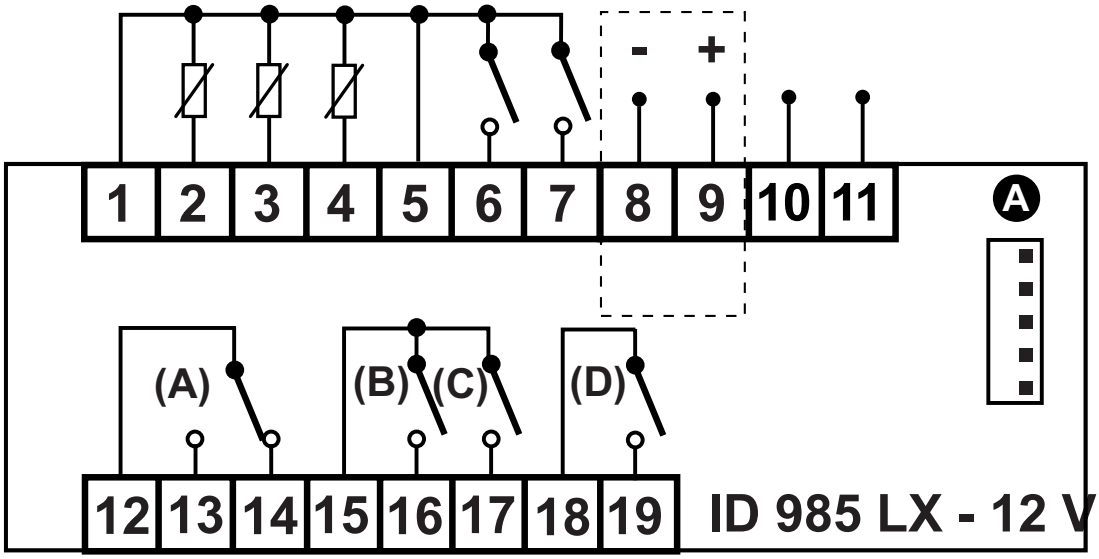
PLEASE NOTE: The *technical data* included in this document, related to measurement (*range*, accuracy, resolution, etc.) refer to the instrument itself, and not to its equipment such as, for example, sensors.
This means, for example, that sensor(s) error(s) shall be added to the instrument's one.

3.17 Parameters

See

- next chapter **Funzioni e Risorse Modbus**
- paragraph **Funzioni disponibili ed aree dati**
- table **Parametri impostazione dispositivo**

(!) ATTENZIONE!
Spegnere e riaccendere lo strumento ogniqualvolta si modifichi la configurazione dei parametri per prevenire malfunzionamenti sulla configurazione e/o temporizzazioni in corso.

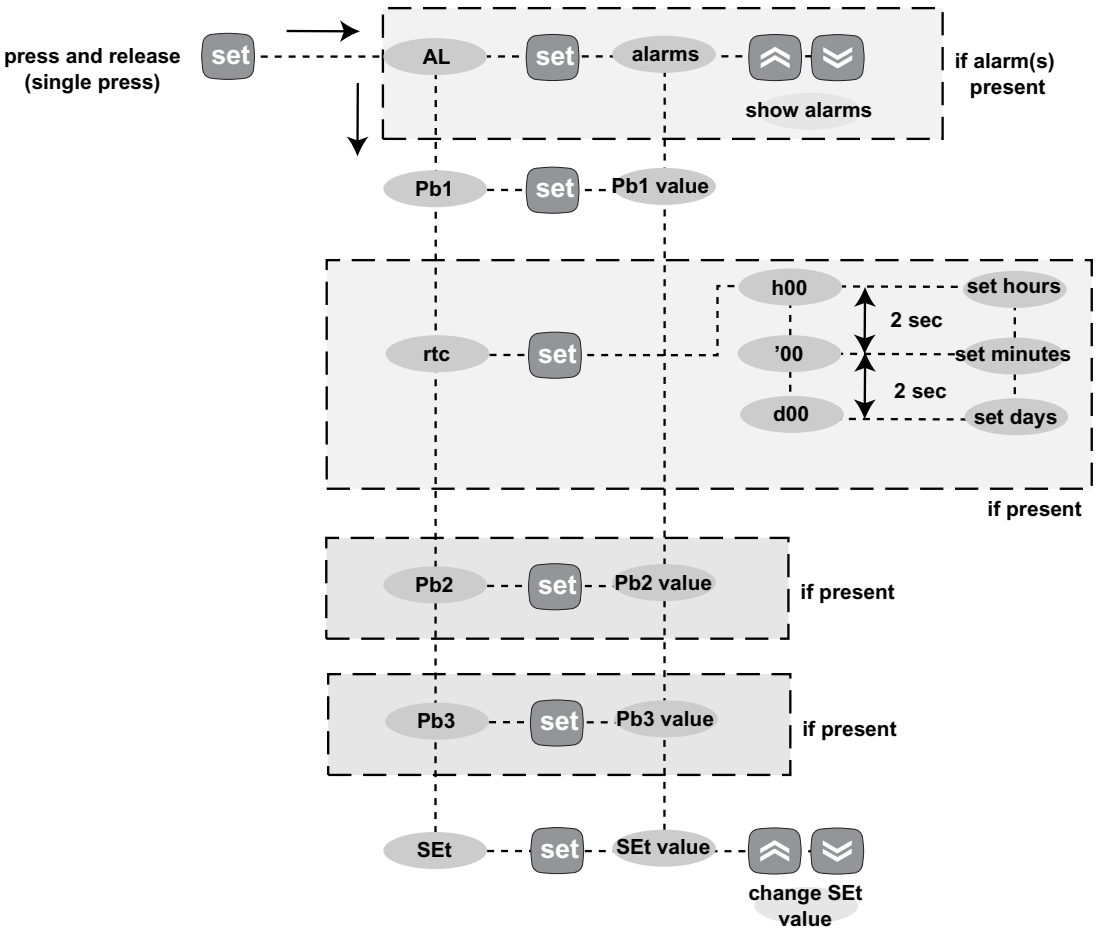


3.18 WIRING

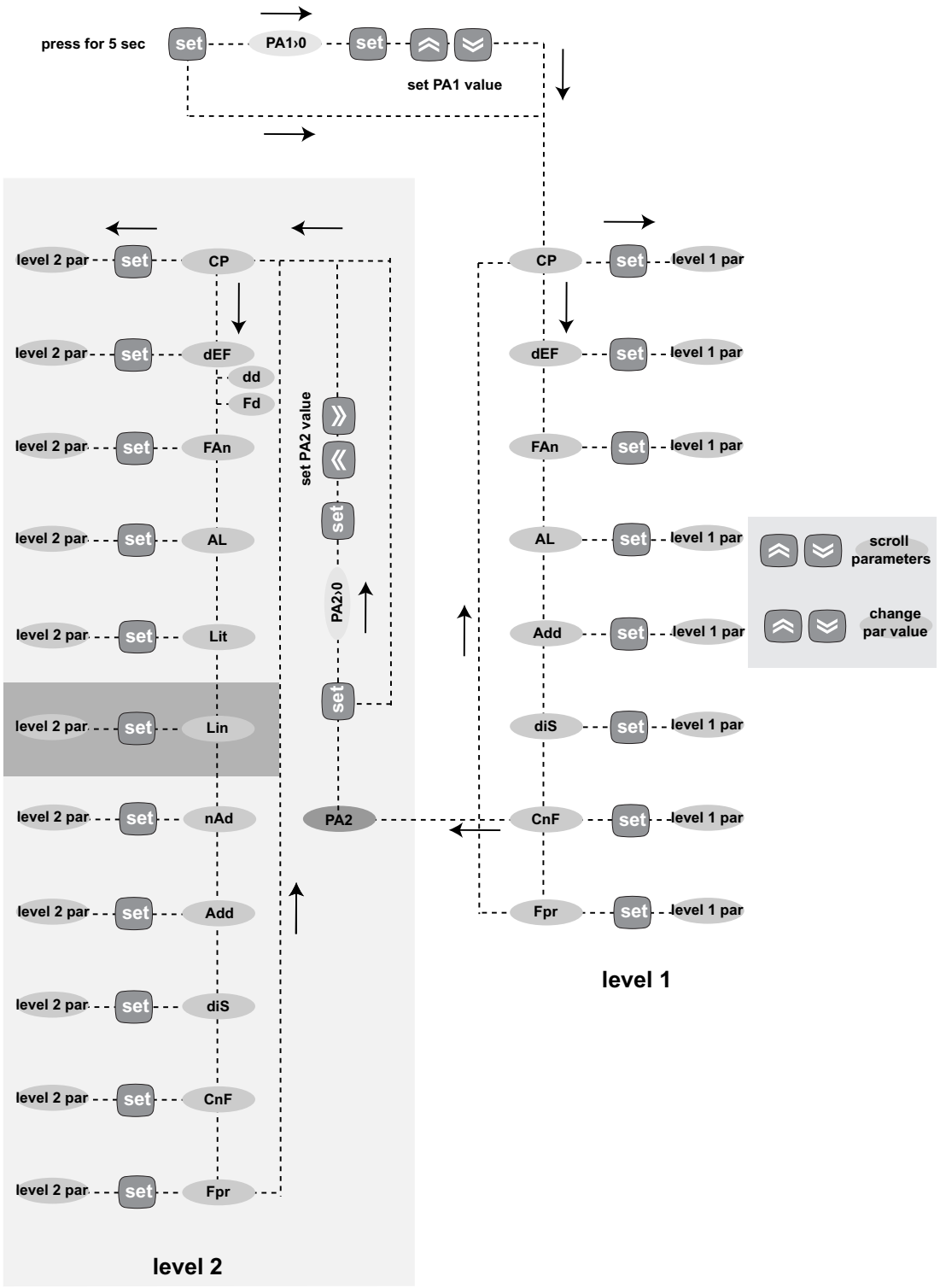
1 - 2 Probe 1 (thermostat) input
1 - 3 Probe 2 (evaporator) input
1 - 4 Probe 3 (display) input
5 - 6 Digital input 2
5 - 7 Digital input 1
8 - 9 *Link* (powered; 8= -, 9= +)
10 - 11 Power supply
12 - 13 N.O. Defrost relay (A)
12 - 14 N.C. Defrost relay (A)
15 - 16 N.O. Compressor relay. (B)
15 - 17 N.O. Fan relay (C)
18 - 19 N.O. Alarm relay (D)
A TTL input for *Copy Card* and connection to Televis system

NOTE: User Default settings

3.19 Machine Status Menu Diagram

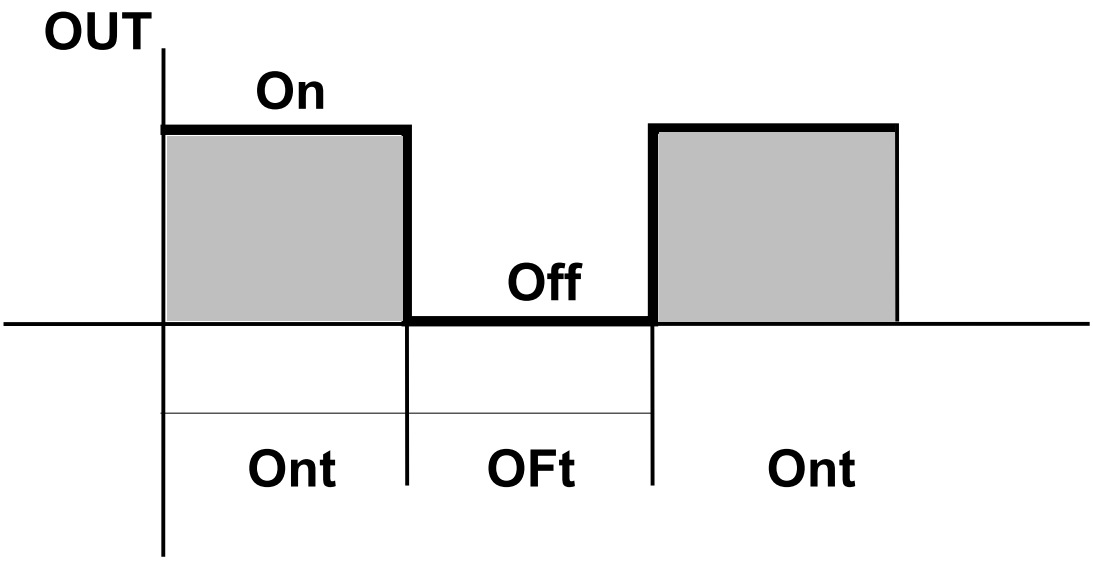


3.20 Programming Menu diagram



Duty Cycle Diagram

Duty Cycle Diagram



Ont	Oft	Compressor Output
0	0	OFF
0	>0	OFF
>0	0	ON
>0	>0	dc

Maximum alarm

The maximum alarm will become when the probe temperature will be:
(1) higher o equal to HAL if Att=Abs(olute)
(2) higher o equal set + HAL if Att=rEL(ative)

• if Att=Abs(olute) HAL should be with sign;
• if Att=rEL(ative) HAL should be only positive

Minimum alarm

The minimum alarm will become when the probe temperature will be::
(1) lower or equal to LAL if Att=Ab(solute)
(2) lower or equal to set + LAL if Att=rEl(ative)
• if Att=Ab(solute) LAL should be with sign;
• if Att=rEl(ative) LAL should be only positive

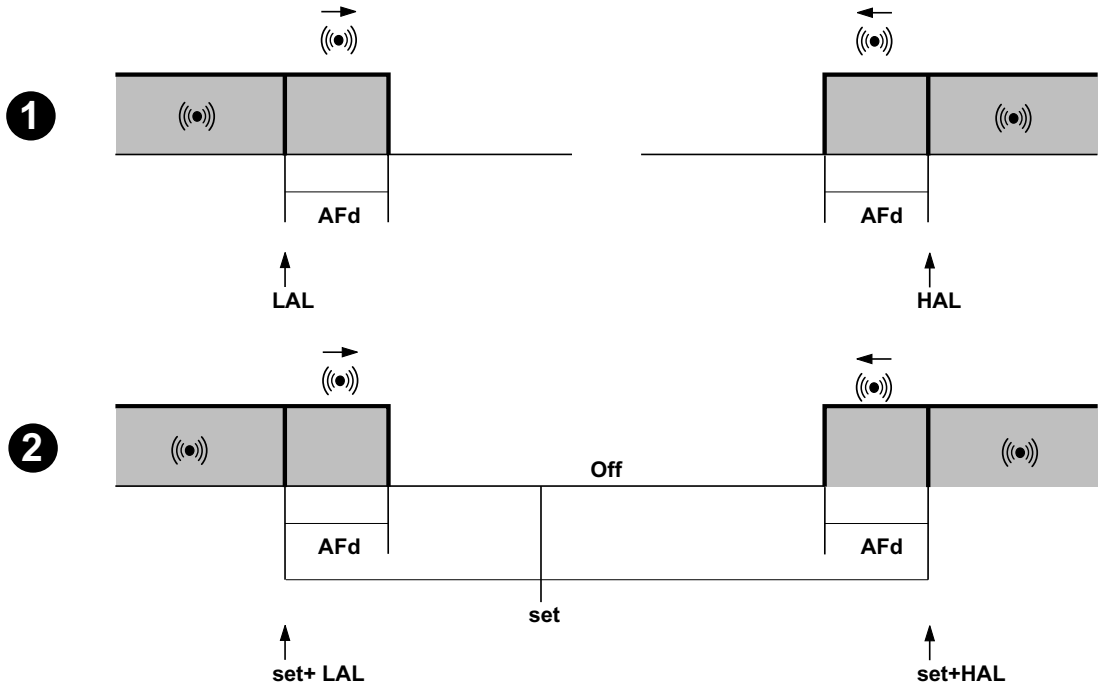
End Alarm

The maximum alarm will ends when the probe temperature will be:
(1) lower or equal to HAL - AFd if Att=Abs(olute)
(2) lower or equal to set + HAL - AFd if Att=rEL(ative)

The minimum alarm will ends when the probe temperature will be:
(1) higher o equal a LAL + AFd if Att=Abs(olute)
(2) higher o equal a set + LAL + AFd if Att=rEL(ative)

Max-Min Alarms

Max/Min. Alarms Diagram (*Maximum and Minimum Temperature Alarms*)



4 FUNCTIONS AND RESOURCES MODBUS

This section describes the ID 985 LX M (Modbus) communication and interface modes, using Modbus protocol.
Knowledge of specific protocol principles is required in order to be able to read and understand this section, therefhours the reader is advised to refer to the "Modbus Protocol" general protocol.

4.1 Transmission Format

Configuration of the serial port

The protocol uses the binary method (RTU) with byte composed as follows:
8 data bit, 1 parity bit configurable (see parameter **PtY**, default value=odd), 1 stop bit.

Please Note: The communication speed must be set to 9600 baud
The Parameter's setting allows the whole configurability of ID 985 LX M.
They can be modified by:

- instrument's keyboard
- *Copy Card*
- sending data, through Modbus Protocol, to each instrument, using the address 0 (broadcast mode)

4.2 Configuration parameters

ID 985 LX M communication and interface modes, using Modbus protocol *parameters* are listed in the table below.
To operate on prameters listed below. Please look at ID 985 LX M *technical data* sheet and/or table *Configuration parameters* to see complete list of *parameters*.

Configuration parameters table

*CONFIGURATION PARAMETERS**				
Par.	**Description**	**Value**	**Limits**	**Unit of measurement**
FAA	Family serial address		0 ÷ 14	Num
dEA	device serial address		0 ÷ 14	Num.
PtY	Parity bit Setting (None, Even, Odd) **Please Note:** the controller must be turned off after the modification and turned on again to guarantee correct functioning	o	N, E, o	Flag

Parameters described above permit to select the serial address:

- **dEA: low *nibble***
- **FAA: high *nibble***

For example: adress 01 00 (dEA= 00; FAA= 01)

WARNING!

- Almost one of the *parameters* should be <>0 (address 00 00 is reseved to The Modbus Protocol for Broadcast messages)

4.3 Available Functions and implemented Areas

The Available Functions an implemented Areas are the following:

function code	***Command Description***
3	Multiple-read registers. It is possible to read at least 125 *parameters* It is not possible to read with an unique command *parameters* of different blocks.
16	Multiple-write registers. It is possible to writeat least 4 *parameters*
43	Instrument ID. It is possible to read the following fields

Field Code	***Field Description***
0	Constructor ID **(= "INVENSYS")**
1	Instrument Model ID **(= "0010_0401")**
2	Instrument Version ID **(= "00A3_0016")**

The ID 985 LX M makes available 1 single area MODBUS accessible by read/write *functions* records (registers) *format* to 16 bit (codes function 3 and 16 for operations in area 4 – "Holding Registers? -). Inside the area blocks are subdivided in homogenous blocks based on data type and type access. The following tables describe the content of every block, the data type and the related *format*. All the addresses and the values in the tables are expressed in decimal base.

Analogue Inputs

4.3.1 Analogue Inputs

Phisycal Position:
RAM
Acess Type: read only
Data Dimension: 16 bit

Label /	Address	MODBUS	Description	*Range*	U.M.
ValSondeVis[0]	8302	48303	Value shown probe 1	(-32768...32767)	°C x 10
ValSondeVis[1]	8304	48305	Value shown probe 2	(-32768...32767	°C x 10
ValSondeVis[2]	8306	48307	Value shown probe 3	(-32768...32767	°C x 10
ValSondeReg[0]	8308	48309	Value regulation probe 1	(-32768...32767	°C x 10
ValSondeReg[1]	8310	48311	Value regulation probe 2	(-32768...32767	°C x 10
ValSondeReg[2]	8312	48313	Value regulation probe 3	(-32768...32767	°C x 10

Serial Communication Functions

4.3.2 Serial Communication Functions

Phisycal Position: RAM
Acess Type: read / write
Data Dimension: 16 bit

Note
The value after the comma indicated in theMODBUS address represent the single bit positioningi (position 0 for Less Significative Byte *LSB*)

Label /	Address	MODBUS	Description	*Range*	U.M.
ACCENSIONE	8316,6	48317,6	Set the bit to 1 to turn On the instrument	(0 ... 1)	number
SPEGNIMENTO	8316,7	48317,7	Set the bit to 1 to turn Off the instrument	(0 ... 1)	number
RICHIESTA SBRINAMENTO	8316,9	48317,9	Set the bit to 1 to enable manual defrosting	(0 ... 1)	number

Digital inputs, Machine Status and Alarms

4.3.3 Digital inputs, Machine Status and Alarms

Phisycal Position: RAM
Acess Type: read only
Data Dimension: 8 bit

Note
The value after the comma indicated in theMODBUS address represent the single bit positioningi (position 0 for Less Significative Byte *LSB*)
(*) active defrost is indicated by the following : (DEF_1 > 0) OR (DEF_2 > 0)

Label /	Address	MODBUS	Description	*Range*	U.M.
DI1	8845,4	48846,4	Status Digital Input n° 2	(0 ... 1)	number
DI2	8845,5	48846,5	Status Digital Input n° 1	(0 ... 1)	number
Alarm AH3	8846,0	48847,0	Status High Alarm Probe 3	(0 ... 1)	number
Alarm AL3	8846,3	48847,3	Status Low Alarm Probe 3	(0 ... 1)	number
Alarm EA	8846,4	48847,4	Status *External Alarm* from Digital Input	(0 ... 1)	number
Alarm AH1	8846,5	48847,5	Status High Alarm Probe 1	(0 ... 1)	number
Alarm AL1	8846,6	48847,6	Status Low Alarm Probe 1	(0 ... 1)	number
Alarm OPd	8846,7	48847,7	Status Alarm Door Open	(0 ... 1)	number
Alarm E10	8847,4	48848,4	Status Alarm RTC	(0 ... 1)	number
Alarm E7	8847,1	48848,1	Status Alarm communication network *LINK* failed	(0 ... 1)	number
Alarm Ad2	8847,2	48848,2	Status Alarm defrost end for time-out	(0 ... 1)	number
LIGHT	8850,2	48851,2	Status output light regulator	(0 ... 1)	number
AUX	8850,4	48851,4	Status output aux regulator	(0 ... 1)	number
Alarm E1	8853,3	48854,3	Status Probe 1 in error	(0 ... 1)	number
CPR	8854,3	48855,3	Status output regulator compressor	(0 ... 1)	number
DEF_1	8854,4	48855,4	Status output defrost [1] regulator (*)	(0 ... 1)	number
DEF_2	8854,5	48855,5	Status output defrost [2] regulator (*)	(0 ... 1)	number
ON	8854,6	48855,6	Status On/Off instrument	(0 ... 1)	number
FAN	8856,7	48857,7	Status output fans regulator	(0 ... 1)	number
Alarm E2	8857,7	48858,7	Status Probe 2 in error	(0 ... 1)	number
Alarm E3	8860,6	48861,6	Statu sProbe 3 in error	(0 ... 1)	number

Current Settings Clock and Keyboard

4.3.4 Current Settings Clock and Keyboard

Phisycal Position: RAM
Acess Type: read only
Data Dimension: 8 bit

Note
Il valhours indicato dopo la virgola nell'Address MODBUS rappresenta la posizione di un singolo bit (posizione 0 per il bit meno significativo)

Label /	Address	MODBUS	Description	*Range*	U.M.
RealTimeData.second	8866	48867	Clock: seconds	(0 ... 59)	sec
RealTimeData.minutes	8867	48868	Clock: minutes	(0 ... 59)	min
RealTimeData.hour	8868	48869	Clock: hours	(0 ... 23)	hours
RealTimeData.dayweek	8869	48870	Clock: day week	(0 ... 6)	days

Device Settings Parameters

4.3.5 Device Settings Parameters

Phisycal Position: EEPROM
Acess Type: read / write
Data Dimension: 16 bit

Label /	Address	MODBUS	Description	*Range*	U.M.
diF	6146	46147	diFferential. The compressor stops on reaching the Setpoint value (as indicated by the adjustment probe), and restarts at temperature value equal to the Setpoint plus the value of the differential. Note: the value 0 cannot be assumed.	(1 ... 300)	°C x 10
OSP	6148	46149	Offset SetPoint. Temperature value to be added algebraically to the setpoint in the case of reduced set enabled (Economy function). The reduced set can be enabled by a key configured on purpose.	(-300 ... 300)	°C x 10
dSt	6150	46151	defrost Stop temperature. Defrosting end temperature (determined by the evaporator probe).	(-500 ... 500)	°C x 10
tcd	6152	46153	time compressor for defrost. Minimum time for compressor On or OFF before defrost. If >0 (positive value) the compressor will be ON for tcd minutes; If<0 (negative value) the compressor will be OFF for tcd minutes. If =0 parameter is disregarded If =0 is ignored	(-31 ... 31)	min
FSt	6154	46155	Fan Stop temperature. Fan lock temperature; a value, read by the evaporator probe higher than the set value causes the fans stop. The value is positive or negative and depending on FPt parameter could represent the temperature in absolute value or relative to Setpoint.	(-500 ... 1500)	°C x 10
Fot	6156	46157	Fan on-start temperature. Fan start temperature; if the temperature read by the evaporator is lower than the value set for this parameter, the fans stay still. The value is positive or negative and depending on FPt parameter could represent the temperature in absolute value or relative to Setpoint.	(-500 ... 1500)	°C x 10
FAd	6158	46159	FAn differential. Fan activation intervention differential (see par. "FSt" and "Fot").	(10 ... 500)	°C x 10
AFd	6160	46161	Alarm Fan differential. Alarm differential.	(10 ... 500)	°C x 10
dAO	6162	46163	*defrost Alarm* Override. Alarm exclusion time after defrost.	(0 ... 999)	min
CA1	6164	46165	CAlibration 1. Calibration 1. Positive or negative temperature value added to the value read by probe 1, based on "CA"parameter settings.	(-120 ... 120)	°C x 10
CA2	6166	46167	CAlibration 2. Calibration 2. Positive or negative temperature value added to the value read by probe 2, based on "CA"parameter settings.	(-120 ... 120)	°C x 10
CA3	6168	46169	CAlibration 3. Calibration 2. Positive or negative temperature value added to the value read by probe 3, based on "CA"parameter settings.	(-120 ... 120)	°C x 10
LdL	6170	46171	Low display Label. Minimum value the instrument is able to display.	(-550 ... HdL)	°C x 10
HdL	6172	46173	High display Label. Maximum value the instrument is able to display.	(LdL ... 3020)	°C x 10
H11	6174	46175	Configuring digital inputs/polarity. 0= disabled; 1 = defrosting; 2 = reduced set; 3 = auxiliary; 4 = door switch; 5 = *external alarm*.	(-8 ... 8)	number

			*6 = disable store HACCP alarms (*only in HACCP models) 7 = stand-by (ON-OFF) 8 = maintenance requested WARNING! positive or negative values change polarity		
Setpoint	6178	46179	Setpoint	(LSE ... HSE)	°C x 10
HSE	6180	46181	Higer SEt. Maximum possible setpoint value.	(LSE ... 3020)	°C x 10
LSE	6182	46183	Lower SEt. Minimum possible setpoint value.	(-580 ... HSE)	°C x 10
HAL	6184	46185	Higher ALarm. Maximum temperature alarm. Temperature value (with regard to Setpoint, or as an absolute value based on Att) which if exceeded in an upward direction triggers the activation of the alarm signal.	(LAL ... 1500)	°C x 10
LAL	6186	46187	Lower ALarm. Minimum temperature alarm. Temperature value (with regard to Setpoint, or as an absolute value based on Att) which if exceeded in a downward direction triggers the activation of the alarm signal.	(-500 ... HAL)	°C x 10
SA3	6196	46197	Probe 3 alarm Set-Point (display)	(-500 ... 1500)	°C x 10
dA3	6198	46199	Probe 3 alarm differential (display)	(-300 ... 300)	°C x 10
H12	6200	46201	Configuring digital inputs/polarity. The same as H11. 0 = disabled;	(-8... 8)	number

Phisycal Position: EEPROM
Acess Type: read / write
Data Dimension: 8 bit

Note
(*) the controller must be turned off after the modification and turned on again to guarantee correct functioning

Label /	Address	MODBUS	Description	*Range*	U.M.
Cit	6715	46716	Compressor min on time. Minimum compressor activation time before any possible disabling. If set at 0 it is not active	(0 ... 250)	min
CAt	6716	46717	Compressor mAx on time. Maximum compressor activation time before any possible disabling. If set at 0 it is not active.	(0 ... 250)	min
dOd	6717	46718	digital input switches off loads . On digital input command, programmed as door-switch, allows to stop all the loads when opening the door and re-starting then when the door will be closed.	(0=n ... 1=Y)	min
dAd	6718	46719	loads digital input enabling delay.	(0 ... 255)	min
Ont	6719	46720	On time (compressor). Compressor activation time in the event of faulty probe. If set to “1” with Oft at “0” the compressor is always on, while at Oft >0 it *functions* always in duty cycle mode.	(0 ... 250)	min
OFt	6720	46721	OFF time (compressor). Compressor in disabled state time in the event of a faulty probe. If set to “1” with Ont at “0” the compressor is always off, while at Ont >0 it *functions* always in duty cycle mode.	(0 ... 250)	min
dOn	6721	46722	delay (at) On compressor. Delay time in activating the compressor relay after switch-on of instrument.	(0 ... 250)	sec
dOF	6722	46723	delay (after power) OFF. Delay after switch off; the indicated time must elapse between switch-off of the compressor relay and the successive switch-on.	(0 ... 250)	min
dbi	6723	46724	delay between power-on. Delay between switch-ons; the indicated time must elapse between two successive switch-ons of the compressor.	(0 ... 250)	min
OdO	6724	46725	delay Output (from power) On. Delay time in activating the outputs after switch-on of the instrument or after a power failure. 0= not active.	(0 ... 250)	min
dtY	6725	46726	defrost type. Type of defrost. 0 = electrical defrost; 1 = cycle reversing defrost (hot gas); 2 = Free mode defrost (compressor disabling).	(0 ... 2)	number
dt1	6726	46727	defrost time 1. Measure unit for time intervals between defrosting (“dit” parameter). 0 = “dit” parameter in hours; 1 = “dit” parameter in minutes; 2= “dit” parameter in seconds.	(0 ... 2)	number
dt2	6727	46728	defrost time 2. Measure unit for defrosting duration (“dEt” parameter). 0 = “dEt” parameter in hours; 1 = “dEt” parameter in minutes; 2 = “dEt” parameter in seconds.	(0 ... 2)	number
dCt	6728	46729	defrost Counting type. Selection of count mode for the defrosting interval. 0 = compressor hour of operation (DIGIFROST® method); Defrosting active ONLY with the compressor on.	(0 ... 3)	number

			NOTE: compressor time of operation is counted regardless the evaporator probe (counting is active if evaporator probe is absent or faulty). The value is ignored if RTC is enabled. 1 = Real Time - equipment hours of operation; defrost counting is always active when the machine is on and starts at each power-on. 2 = compressor stop. Every time the compressor stops a defrost cycle is performed according to the dtY 3= parameter with RTC. *Defrostings* at times set by d1...d8 *parameters*, F1...F8		
dOH	6729	46730	defrost Offset Hour. Start-of-defrosting delay time from start up of instrument.	(0 ... 59)	min
dEt	6730	46731	defrost Endurance time. Defrosting time-out; determines duration of defrosting. U.M. minutes (default) /hours/sec depending on dt2 parameter	(1 ... 250)	hours/min /sec in base a dt2
dPO	6731	46732	defrost (at) Power On. Determines if at start-up the instrument must enter defrosting (if the temperature measured by the evaporator allows this operation). y = yes, starts defrost at start-up; n = no, doesn't start defrost.	(0=n ... 1=Y)	number
Cod	6732	46733	Compressor off (before) defrost. Time for compressor OFF in proximity of the defrost cycle. If a defrost cycle is set within the programmed time for this parameter, the compressor is not started up. If =0 function is stopped.	(0 ... 60)	min
FPt	6733	46734	Fan Parameter type. "FSt" parameter mode. It can be expressed as temperature absolute value or as a value related to the Setpoint. 0 = absolute; 1 = relative.	(0 ... 1)	number
Fdt	6734	46735	Fan delay time. Delay time at fan activation after a defrosting cycle.	(0 ... 250)	min
dt	6735	46736	drainage time. Dripping time.	(0 ... 250)	min
dFd	6736	46737	defrost Fan disable. It allows to select or to not select the exclusion of the evaporator fans during defrosting. y = yes; n = no.	(0=n ... 1=Y)	number
FCO	6737	46738	Fan Compressor OFF. It allows to select or to not select fan lock when compressor OFF (switched off). y = fans active (with thermostat; in *response* to the value read by the defrost probe, see "FSt" parameter); n = fans off; dc = duty cycle (through "Fon" and "FoF" *parameters*).	(0=n ... 1=Y ... 2=dc)	number
Fod	6738	46739	Fan open door open. Fans active when the door is open Allows to select the fans stop when door is open, and the fan re-start when door will be closed (if they we active). n=fans stop; y=fans unchanged	(0=n ... 1=Y)	number
FdC	6739	46740	Fan delay Compressor off. Fan switch off delay dime after compressor stop. In minutes. =0 function excluded	(0 ... 99)	min
Fon	6740	46741	Fan on (in duty cycle). Time the fans are ON in a duty cycle. Use of fans in duty cycle mode; valid for FCO = dc and H42=1 (evaporator probe present)	(0 ... 99)	min
FoF	6741	46742	Fan oFF (in duty cycle). Time the fans are OFF in a duty cycle. Use of fans in duty cycle mode; valid for FCO = dc and H42=1 (evaporator probe present)	(0 ... 99)	min
dEA	6742	46743	*dEvice Address*. *Device address*: indicates the appliance address to the management protocol. *dEvice Address*. .	(0 ... 14)	number
FAA	6743	46744	Family Address: indicates the appliance family to the management protocol.	(0 ... 14)	number
Att	6744	46745	Alarm type. Parameter "HAL" and "LAL" modes, as temperature absolute values or as differential compared to the Setpoint. 0 = absolute value; 1 = relative value.	(0 ... 1)	number
PAO	6745	46746	Power-on Alarm Override. Alarm exclusion time after instrument switch on, after a power failure.	(0 ... 10)	hours
OAO	6746	46747	Alarm signaling delay after digital input disabling (door open). Alarm is only for high-low temperature alarms.	(0 ... 10)	hours
tdO	6747	46748	time out door Open. Time out after alarm signal following digital input disabling (door open) temperature Alarm Override. Temperature alarm signal delay time.	(0 ... 250)	min
tAO	6748	46749	temperature Alarm Override. Temperature alarm signal delay time.	(0 ... 250)	min
dAt	6749	46750	*defrost Alarm* time. Alarm signal for defrost end due to time-out. n = activates alarm; y = does not activate alarm.	(0=n ... 1=Y)	number
EAL	6750	46751	*External Alarm* Lock. *External alarm* to lock loads.	(0=n ... 1=Y)	number
AOP	6751	46752	Alarm Output Polarity. Polarity of alarm output.	(0 ... 1)	number

			0 = alarm active and output disabled; 1 = alarm active and output enabled.		
LOC	6753	46754	(keyboard) LOCk. *Keyboard locking*. It is still possible to enter parameter programming and modify them, including the status of this parameter, in order to allow keyboard unlocking. y = yes; n = no.	(0=n ... 1=Y)	number
ndt	6754	46755	number display type. View with decimal point. y = yes; n = no.	(0=n ... 1=Y)	number
CA	6755	46756	CAlibration Intervention. Intervention on view offset, thermostat offset or both. 0 = modifies the temperature displayed only; 1 = adds to the temperature used by regulators, not to the temperature displayed, which stays unchanged; 2 = adds to the temperature displayed that is also used by regulators.	(0 ... 2)	number
ddL	6756	46757	defrost display Lock. Viewing mode during defrosting. 0 = shows the temperature read by the thermostat probe; 1 = locks the reading on the temperature value read by thermostat probe when defrosting starts, and until the next time the Setpoint value is reached; 2 = displays the label “deF” during defrosting, and until the next time the Setpoint value is reached.	(0 ... 2)	number
ddd	6757	46758	Selection of the value type to be shown on the display. 0 = Setpoint; 1 = probe 1(thermostat); 2 = probe 2(evaporator); 3 = probe 3 (display).	(0 ... 3)	number
H02	6758	46759	Time to enable keys, if these are configured for a specific function. For ESC, UP and DOWN keys configured for specific function (defrost, aux, etc) it set the elapsed time for the manual activation of the related function. aux function has a fixed time of 1 second	(0 ... 15)	sec
H21	6759	46760	Digital output 2 configurability. (B) 0 = disabled; 1 = compressor; (default) 2 = defrosting; 3 = fans; 4 = alarm; 5 = auxiliary. 6 = stand-by 7 = light 8 = maintenance requested	(0 ... 8)	number
H22	6760	46761	Digital output 1 configurability. (A)	(0 ... 8)	number
H23	6761	46762	The same as H21. (2= defrosting; default)	(0 ... 8)	number
H24	6762	46763	Digital output 3 configurability. (C)	(0 ... 8)	number
H25	6763	46764	PARAMETER VISIBLE IN MODELS WITH BUZZER. Configurability buzzer. (if present) 0 = disabled; 8= enabled (default); 1-7= not used	(0 ... 8)	number
H31	6764	46765	Configurability UP key. 0 = disabled; 1 = defrosting; 2 = auxiliary; 3 = reduced set (economy). *4 = *reset* HACCP alarms (*only in HACCP models) *5 = disable HACCP alarms (*only in HACCP models) 6 = light 7 = stand-by 8 = maintenance requested	(0 ... 8)	number
H32	6765	46766	Configurability DOWN key.	(0 ... 8)	number
H33	6766	46767	Same as H31. (0= disabled; default)	(0 ... 8)	number
H41	6768	46769	Control probe presence. n= not present; y= present.	(0=n ... 1=Y)	number
H42	6769	46770	Evaporator probe presence. n= not present; y= present.	(0=n ... 1=Y)	number
H43	6770	46771	Display probe presence. n= not present; y= present.	(0=n ... 1=Y)	number
dit	6771	46772	defrost interval time. Interval between the start of two successive defrosting operations. 0= the function is disabled (defrost is NEVER performed) U.M. Hours (default) /min/sec depending on dt1 parameter	(0 ... 250)	hours/min /sec dependin g on dt1
PbA	6776	46777	Configuring temperature *alarm on* probe 1 and/or 3. 0 = *alarm on* probe 1 (thermostation); 1 = *alarm on* probe 3 (display) ; 2 = *alarm on* probes 1 and 3 (both thermostation and display); 3 = *alarm on* probes 1 and 3 (both thermostation and display) on external thresold;	(0 ... 3)	number

Ldd	6777	46778	Lock defrost disable. Time-out value for delock display (DEF label) if reaching the setpoint is too long during defrosting, or if the *Link* (*Master-Slave*) communication fails (E7 error)	(0 ... 255)	min
H06	6778	46779	key/input aux/door switch light active when instrument is off (but under tension)	(0=n ... 1=Y)	number
H08	6779	46780	Stand-by operating mode. 0=display switch off; 1= diplay on and loads stopped; 21= display off and loads stopped;	(0 ... 2)	number
dSd	6780	46781	Enabling light relay by door switch. n = door open, the light does not turn on; y = door open, the light turns on (if it was off).	(0=n ... 1=Y)	number
dLt	6781	46782	Light relay disabling (switch off) delay (cell light). The cell light will remain on for dLt minutes after closing the door if dSd parameter is set for this.	(0 ... 31)	min
OFL	6782	46783	Light switch always disables light relay; enable the switching off through light switch even if it is enable the delay after closing the door (set by dLt)	(0=n ... 1=Y)	number
PA1	6783	46784	*PAssword* 1. When enabled (value different from 0) it represent the access key for level 1 *parameters*.	(0 ... 250)	number
PA2	6784	46785	*PAssword* 2. When enabled (value different from 0) it represents the access key for level 2 *parameters*.	(0 ... 250)	number
H00 (*)	6785	46786	Probe type selection, PTC or NTC. 0 = PTC; 1 = NTC.	(0=PTC ... 1=NTC)	number
dro	6786	46787	display read-out. Select °C or °F for displaying the temperature read by the probe. 0 = °C, 1 = °F. PLEASE NOTE: the switch between °C and °F DO NOT modify setpoint, differential, etc. (for example set=10°C become 10°F).	(0=°C ... 1=°F)	number
			Nella cartella deF sono presenti due cartelle “dd” (daily defrost) e “Fd” (Festive Defrost); all’ interno della prima cartella sono presenti i parametri d1...d8 (start sbrinamenti feriali), all’ interno della seconda cartella sono presenti i parametri F1...F8 (start sbrinamenti festivi). Le due cartelle saranno visbili solo se dit =3 e l’RTC é dichiarato presente.		
dd: d1(h)	6788	46789	Start time 1° daily defrost	(0 ... 23 ... 24=Off)	hours
dd: d2 (h)	6789	46790	Start time 2° daily defrost	(0 ... 23 ... 24=Off)	hours
dd: d3 (h)	6790	46791	Start time 3° daily defrost	(0 ... 23 ... 24=Off)	hours
dd: d4 (h)	6791	46792	Start time 4° daily defrost	(0 ... 23 ... 24=Off)	hours
dd: d5 (h)	6792	46793	Start time 5° daily defrost	(0 ... 23 ... 24=Off)	hours
dd: d6 (h)	6793	46794	Start time 6° daily defrost	(0 ... 23 ... 24=Off)	hours
dd: d7 (h)	6794	46795	Start time 7° daily defrost	(0 ... 23 ... 24=Off)	hours
dd: d8 (h)	6795	46796	Start time 8° daily defrost	(0 ... 23 ... 24=Off)	hours
dd: d1(m)	6796	46797	Start time 1° festive defrost	(0 ... 59)	min
dd: d2 (m)	6797	46798	Start time 2° festive defrost	(0 ... 59)	min
dd: d3 (m)	6798	46799	Start time 3° festive defrost	(0 ... 59)	min
dd: d4 (m)	6799	46800	Start time 4° festive defrost	(0 ... 59)	min
dd: d5 (m)	6800	46801	Start time 5° festive defrost	(0 ... 59)	min
dd: d6 (m)	6801	46802	Start time 6° festive defrost	(0 ... 59)	min
dd: d7 (m)	6802	46803	Start time 7° festive defrost	(0 ... 59)	min
dd: d8 (m)	6803	46804	Start time 8° festive defrost	(0 ... 59)	min
Fd: F1(h)	6804	46805	Start time 1° defrost festivo	(0 ... 23 ... 24=Off)	hours
Fd: F2 (h)	6805	46806	Start time 2° festive defrost	(0 ... 23 ... 24=Off)	hours
Fd: F3 (h)	6806	46807	Start time 3° festive defrost	(0 ... 23 ... 24=Off)	hours
Fd: F4 (h)	6807	46808	Start time 4° festive defrost	(0 ... 23 ... 24=Off)	hours
Fd: F5 (h)	6808	46809	Start time 5° festive defrost	(0 ... 23 ... 24=Off)	hours
Fd: F6 (h)	6809	46810	Start time 6° festive defrost	(0 ... 23 ... 24=Off)	hours
Fd: F7 (h)	6810	46811	Start time 7° festive defrost	(0 ... 23 ... 24=Off)	hours
Fd: F8 (h)	6811	46812	Start time 8° festive defrost	(0 ... 23 ... 24=Off)	hours
Fd: F1(m)	6812	46813	Start time 1° festive defrost	(0 ... 59)	min

Fd: F2 (m)	6813	46814	Start time 2° festive defrost	(0 ... 59)	min
Fd: F3 (m)	6814	46815	Start time 3° festive defrost	(0 ... 59)	min
Fd: F4 (m)	6815	46816	Start time 4° festive defrost	(0 ... 59)	min
Fd: f5 (m)	6816	46817	Start time 5° festive defrost	(0 ... 59)	min
Fd: F6 (m)	6817	46818	Start time 6° festive defrost	(0 ... 59)	min
Fd: F7 (m)	6818	46819	Start time 7° festive defrost	(0 ... 59)	min
Fd: F8 (m)	6819	46820	Start time 8° festive defrost	(0 ... 59)	min
E00 [1]	6820	46821	*Functions* enabled during the 1° event	(0 ... 4)	number
E00 [2]	6821	46822	*Functions* enabled during the 2° event	(0 ... 4)	number
E00 [3]	6822	46823	*Functions* enabled during the 3° event	(0 ... 4)	number
E00 [4]	6823	46824	*Functions* enabled during the 4° event	(0 ... 4)	number
E00 [5]	6824	46825	*Functions* enabled during the 5° event	(0 ... 4)	number
E00 [6]	6825	46826	*Functions* enabled during the 6° event	(0 ... 4)	number
E00 [7]	6826	46827	*Functions* enabled during the 7° event	(0 ... 4)	number
E00 [OG]	6827	46828	*Functions* enabled during daily event	(0 ... 4)	number
E02 [1]	6828	46829	Duration of 1° event	(0 ... 72)	hours
E02 [2]	6829	46830	Duration of 2° event	(0 ... 72)	hours
E02 [3]	6830	46831	Duration of 3° event	(0 ... 72)	hours
E02 [4]	6831	46832	Duration of 4° event	(0 ... 72)	hours
E02 [5]	6832	46833	Duration of 5° event	(0 ... 72)	hours
E02 [6]	6833	46834	Duration of 6° event	(0 ... 72)	hours
E02 [7]	6834	46835	Duration of 7° event	(0 ... 72)	hours
E02 [OG]	6835	46836	Duration of daily event	(0 ... 72)	hours
E03 [1]	6836	46837	Enabling daily or festive defrost during 1° event	(0 ... 1)	number
E03 [2]	6837	46838	Enabling daily or festive defrost during 2° event	(0 ... 1)	number
E03 [3]	6838	46839	Enabling daily or festive defrost during 3° event	(0 ... 1)	number
E03 [4]	6839	46840	Enabling daily or festive defrost during 4° event	(0 ... 1)	number
E03 [5]	6840	46841	Enabling daily or festive defrost during 5° event	(0 ... 1)	number
E03 [6]	6841	46842	Enabling daily or festive defrost during 6° event	(0 ... 1)	number
E03 [7]	6842	46843	Enabling daily or festive defrost during 7° event	(0 ... 1)	number
E03 [OG]	6843	46844	Enabling daily or festive defrost during event giornaliero	(0 ... 1)	number
E01 (h) [1]	6844	46845	Hours start 1° event	(0 ... 23)	hours
E01 (h) [2]	6845	46846	Hours start 2° event	(0 ... 23)	hours
E01 (h) [3]	6846	46847	Hours start 3° event	(0 ... 23)	hours
E01 (h) [4]	6847	46848	Hours start 4° event	(0 ... 23)	hours
E01 (h) [5]	6848	46849	Hours start 5° event	(0 ... 23)	hours
E01 (h) [6]	6849	46850	Hours start 6° event	(0 ... 23)	hours
E01 (h) [7]	6850	46851	Hours start 7° event	(0 ... 23)	hours
E01 (h) [OG]	6851	46852	Hours start daily event	(0 ... 23)	hours
E01 (m) [1]	6852	46853	Start time 1° event	(0 ... 59)	min
E01 (m) [2]	6853	46854	Start time 2° event	(0 ... 59)	min
E01 (m) [3]	6854	46855	Start time 3° event	(0 ... 59)	min
E01 (m) [4]	6855	46856	Start time 4° event	(0 ... 59)	min
E01 (m) [5]	6856	46857	Start time 5° event	(0 ... 59)	min
E01 (m) [6]	6857	46858	Start time 6° event	(0 ... 59)	min
E01 (m) [7]	6858	46859	Start time 7° event	(0 ... 59)	min
E01 (m) [OG]	6859	46860	Start time daily event	(0 ... 59)	min
L00	6860	46861	It allows to select the instrument as *Master* (0), *Slave* (from 1 to 7), Echo(0, in this case the Echo is a repetitor of the *Master* also if connected to a *Slave*)	(0 ... 7)	number
L01	6861	46862	Referred to the *Master* only. Number of Slaves in the network (from 0 to 7). For Slaves/Echoes leave the value =0	(0 ... 7)	number
L02	6862	46863	Presence of local Echoes referred to the single *Slave*. 0 = local Echo not present;	(0 ... 2)	number
L03	6863	46864	1 = local Echo present sharing the *Slave* view at fixed intervals; if *Master* or *Slave* identifies that the device is active, and shares in the network, at fixed intervals it's local view.	(0=n ... 1=Y)	number
L04	6864	46865	2 = Echo shows the display of the *Slave* associated (*Slave* and associated Echo should have the same L00 address)	(0=n ... 1=Y)	number
L05	6865	46866	Referred both to *Master* and *Slave*. Simultaneous/sequential defrosting.	(0=n ... 1=Y)	number
L06	6866	46867	*Master*: n = simultaneous; y = sequential. *Slave*: n = ignore; y = accept.	(0=n ... 1=Y)	number

Phisycal Position: EEPROM
Acess Type: read / write
Data Dimension: 8 bit

Note
(*) per rendere effettiva la modifica dei parametri indicati con l'asterisco è necessario spegnere e riaccendere lo strumento dopo le modifiche

Label /	Address	MODBUS	Description	*Range*	U.M.

PtY (*)	6876	46877	Setting serial communication RS 485 parity bit	(0=n ... 1=E ... 2=o)	number

4.4 Error codes

If an error occurs, the ID 985 LX M device provides one of the following *error codes* in the *data field*:

error code	description
1	function not recognized
2	Address not valid, or you tried to read a group of resources over the block dimension.
3	invalid requested register number/sent/ in address header
4	device error

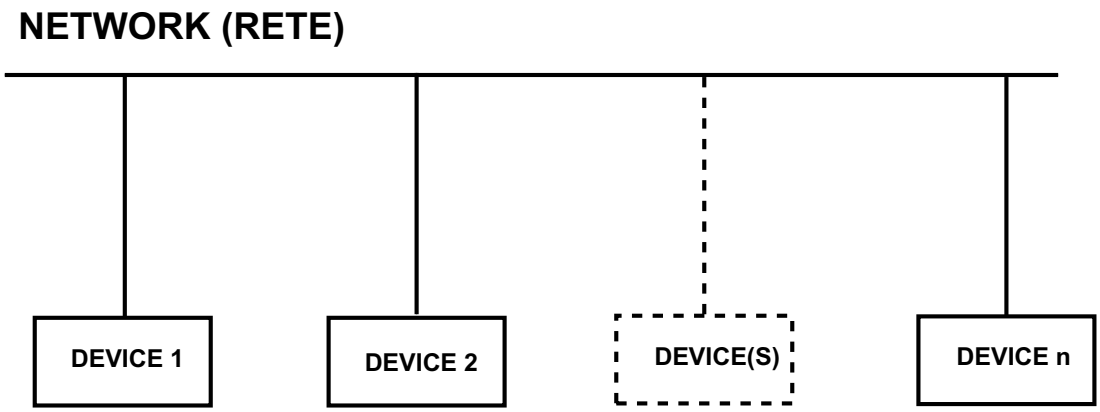
5 THE MODBUS STANDARD PROTOCOL

5.1 Introduction

The Modbus protocol is for communications between devices connected together over a network.

Network Diagram

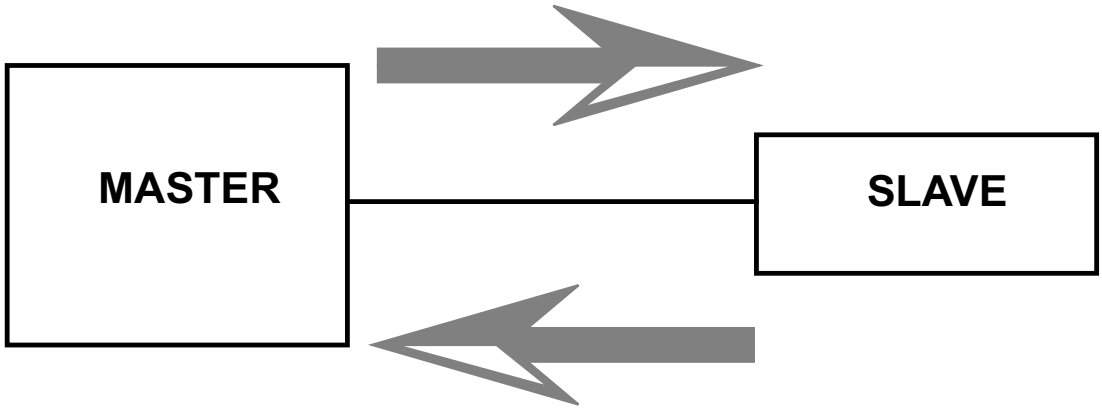
Network Diagram



The system is based on the *master* - *slave* mechanism where only the *master* device can initiate communications. The other devices (slaves) respond either by supplying data or performing the operations requested by the *master*.

Master-Slave Diagram

Master-Slave **Diagram**

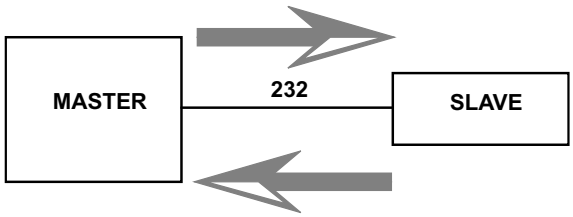


Generally speaking, the protocol describes the routines a device has to use to: request access to another device, respond to queries from other controllers or devices, detect and signal errors and, lastly, establish a common *format* for both content and layout in the various fields of the message.

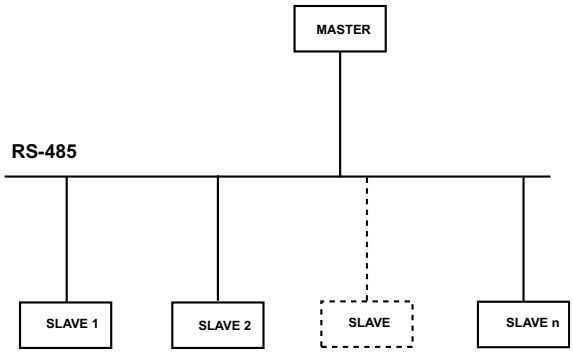
5.2 Modbus Network

As regards the physical connection, the devices normally use RS232 compatible interfaces for point-to-point communications or RS485 for multidrop connections.

Multi-drop Diagram



Multi-drop Diagram



The type of connection, *wiring*, signal levels and communications *parameters* such as parity and *baud rate* are defined.
Controllers can be connected directly over a network or via modem.
Each device must be assigned a unique address for the entire network.

During communications over a *Modbus network* the protocol establishes how each device recognises a message addressed to it, determines the type of action to take, extracts the data and any other information contained in the message.
If a *response* is envisaged, the *slave* device, using the Modbus protocol, will in its turn create and send the message.

Broadcast

Broadcast
The protocol makes it possible to send messages either to a single *slave*, specifying the address in the *query* packet, or to all the slaves on the network via a broadcast message. The *slave* responds to the *master*'s queries only if individually called upon (addressed).

Slaves do not respond to broadcast messages (broadcast/no *response* system).

In particular, the queries of the *master* device will comprise:
- *Device address* (or broadcast address)
- *Function code* that defines the required action
- A set of data
- An error check field.

Similarly, the responses of a *slave* device will contain the fields that confirm the actions performed, the data that need to be returned and an error check field.
If an error occurs in communicating the message, or if the *slave* cannot perform the requested action, the *slave* will create an error message and send it in *response*.

5.3 Other types of network

On *other types of network*, the messages containing the Modbus protocol are enclosed in the *frames* of the network used.
The controllers of the *Modbus network*, via the relevant software applications and drivers, will make the conversion between the Modbus protocol and the specific protocol used by the network.

5.4 Frames

Communication between two devices via the modbus protocol takes place with an exchange of *frames* (structure).
In a frame, composed of a set of bits, there is a start, an end and an internal structure that can be exemplified by the following outline:

Frames

Device
Function
8 bits Data Byte
Error Check

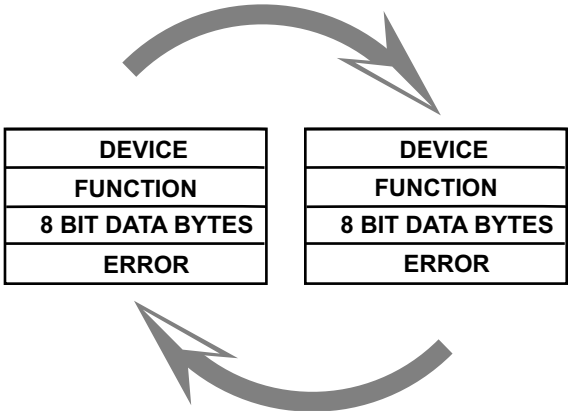
The maximum length of a packet is closely tied to the transmission/reception buffer of the interface used. It is therefore a function of the resources. In any case, a message can be at most 256 bytes long.

5.5 The query-response cycle

A communications cycle between a *master* and a *slave* device takes place by an exchange of *frames*:

Query-Response Diagram

Query-Response **Diagram**



Query

The *query* will contain the following fields:

- *Device address*: address of the *slave* in the network. This address necessarily needs to be the same in both the *query* and the *response*.
- *Function code*: The *function code* in the *query* tells the *slave* device concerned (addressed) the type of action to perform.
- *Data bytes*: contain any additional information that the *slave* needs to perform the function.
- Error check: The check error field provides a method to check the integrity of the message content

For example, the function with code 03 (decimal) requests the *slave* to read the registers (holding register) and to respond with their values. The *data field*, in this example, will contain the data informing the *slave* from which register (variable) to begin and for how many registers to continue reading

Response

If the *slave* creates a normal *response*, the *function code* in the *response* is an echo of the *query function code*. The *data bytes* field contains the data collected by the *slave*, such as the value of a register.
If an error occurs, the *function code* is modified to indicate that the *response* is an error-*response* and the *data bytes* field contains a code describing the error.
The error check field enables the *master* to understand whether the message content is valid.

5.6 Serial transmission mode

The instruments can be configured to communicate with the *Modbus network* standard using two transmission codes: ASCII and RTU.
They establish how the bits form the fields of the frame.

The type of coding used is pre-set by the firm or can be selected together with the communications *parameters* (parity, *baud rate*, etc.).

The type of coding (ASCII/RTU), and relevant *parameters* (parity, *baud rate*) must be the same for all the devices on the network.

The coding used by the Eliwell/Invensys devices is RTU; in the remainder of this manual we will therefore always either explicitly or implicitly refer to this type of coding.

5.6.1 Character serial transmission

When messages are transmitted over a Modbus standard serial network, each character or byte is sent in this order (from left to right):
Least Significant Bit (*LSb*) ... ... Most Significant Bit (*MSb*).

With the RTU characters the sequence is as follows:

With parity check byte

Start	*LSb*							*MSb*	Parity	Stop

Without parity check byte

Start	*LSb*							*MSb*	Stop	Stop

5.7 Creating frames with RTU coding

A frame created with *RTU coding* has the following structure:

RTU framing

Start	***Device Address***	***Function Code***	***Data Bytes***	**ErrorCheck-CRC**	**End**
T1-T2-T3-T4	8 bit	8 bit	n x 8 bit	16 bit	T1-T2-T3-T4

In *RTU coding*, messages start with a silence lasting at least equal to the time for transmitting 3.5 characters.

Character-time

Character-time

It is more common practice to use a multiple of the transmission time of a character (shown as T1-T2-T3-T4 in the figure. Where T-nth = transmission time of 1 character).

If the transmission speed is set to 9600 *baud rate* the transmission time of one character will be equal to (1/9600) * 8 (number of bits to make one character in RTU code) = 0.00083

5.7.1 Device Address

The address field of a message contains eight bits (RTU).
Valid addresses for *slave* devices lie in the *range* between 0 ... and 255 (decimal values).
A *master device address*es the message to a designated *slave* by putting the *slave*'s address in the *device address* field of the message. When a *slave* responds, it puts its own address in the address field so the *master* can identify it.
The address 0 is used for the Broadcast address, which identifies all the slaves. Slaves do not respond to a broadcast *query*.
In some Invensys/Eliwell instruments the address field is interpreted as two nibbles respectively specifying the family and the device (address within the family);
example:
The address 11010011 is interpreted as

- 1101 → Family 11
- 0011 → Device 3

When the Modbus protocol is used on a higher level network (*other types of network* (e.g. on TCP-IP), the broadcast service might not be permitted or it could be replaced by other methods.

The devices connected to the network constantly analyse the network *bus*, also during periods of silence.
When a device receives the first field (address field), it decodes it to find out whether the address it contains is its own, in which case it goes on to read the rest of the message.
In sequence, straight after the last character transmitted, an interval of at least 3.5 character-time marks the end of the message, after which a new message can commence.
The entire frame of the message has to be transmitted in a continuous stream.
If there is an interval longer than 1.5 character-time before completing the frame, the receiving device will delete the incomplete message and consider the next byte received as the start of the address field of a fresh message. Likewise, if a new message starts sooner than the interval of 3.5 character-time following a previous message, the receiving device will consider it as a continuation of the former one. This would cause an error in the final value of the CRC, which would establish that joining the two messages is not legitimate.

5.7.2 Function code

Function code

The *function code* field of a message contains eight bits (RTU). Valid codes lie in the *range* from 1 to 255 (decimal values).

Only a few *functions* of the modbus protocol are implemented in the Eliwell/Invensys controller.

When a message is sent from a *master* to a *slave* device, the *function code* field specifies the kind of action to take.
For example, read the ON/OFF status of a set of digital variables, read the data of a set of registers, write to a specific register.....
When the *slave* responds to the *master*, it uses the function field to indicate either a normal *response*, if there are no errors, or some kind of error that has occurred (exception *response*).
For a normal *response*, the *slave* simply repeats (echo) the original code. In the case of an exception *response*, the *slave* returns a code that is equivalent to the original *function code* with the most significant bit (*MSb*) set to one (logic 1).

For example, a message from the *master* to the *slave* to read a set of registers would have the following *function code*:
0000 0011 (hexadecimal 03)
If the *slave* receives the *query* and performs the envisaged action without error then it will return the same code in its *response*.
If there is an exception the *slave* will return:
1000 0011 (hexadecimal 83)

The *slave* will put a single code in the *data field* describing the type of error that occurred or the reason for the exception.

The application program of the *master* device is responsible for handling the exception responses. Typical actions are successive attempts at resending the message, sending a message to the *slave* or notifying the operators.

5.7.3 Data bytes

Data field

The *data field* is created using blocks of two hexadecimal figures (1 byte), in the *range* between 00 and FF.
These form a single RTU character of eight bits.
The *data field* of the message sent by the *master* to the *slave* device contains the additional information to use to perform the action defined in the *function code*.

5.7.4 Logic Areas

Logic areas

area no.	description	Reading function (*function code*)	Writing function (*function code*)
1	*parameters*	3	16
2	*analogue inputs*	4	--
3	timer	3	16
4	digital inputs	2	--
5	digital outputs	1	15
6	EEPROM	3	16
7	analogue outputs	3	16
8	RAM	3	16

That is

functions

function	function description	action
1-2	reading digital variable	obtains the value of one or more digital variables
3-4	reading analogue variable	obtains the value of one or more analogue variables
15	writing digital variables	forces the value of one or more digital variables
16	writing analogue variables	forces the value of one or more analogue variables

Areas 6 and 8 are used when the limited availability of device resources does not permit using *logic areas*.
Then the specified address is the real (physical) address of the resource in RAM or in EEPROM.

5.7.5 CRC field

When using RTU transmission coding to form message *frames*, the error check field contains a 16 bit value composed of two bytes (of eight bits each).
The error check characters are the result of the calculation of the CRC function (Cyclical Redundancy Check) that is performed on the entire message.
The *CRC field* is added to the message as the last field.

When the *CRC field* is formed the low-order byte is set first, followed by the high-order byte. The high-order byte of the CRC is the last byte in the message to be sent.

6 DISCLAIMER

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7 APPENDIX-GLOSSARY

7.1 ASCII coding

ASCII

When the controllers are set up for working in a *Modbus network* that uses *ASCII coding* (American Standard Code for Information Interchange), each byte (eight bits) (2 hexadecimal characters) represents an alphanumeric character.

The greatest advantage of this coding is that it allows a time interval between two characters of up to one second (1 s) without an error being signalled.

Each character is sent with 10 bits used as described here:

- start bit
- 7 data bits, *LSb* (least significant bit) sent first
- bit for odd/even parity – no bit for no parity
- stop bit if parity is used or 2 stop bits for no parity

For example: coding the decimal figure 63 requires 2 characters (6 and 3) and therefore 2 transmissions:

start bit	7 data bits	2 stop bits (if no parity)
1	0110110 (the ASCII code for 6)	11
1	0110011 (the ASCII code for 3)	11

7.2 RTU coding

RTU

When the controllers are set up for communicating over a *Modbus network* that uses *RTU coding* (Remote Terminal Unit), each byte (eight bits) represents two hexadecimal characters (4 bits each).
The greatest advantage in using this coding consists of the higher density of characters; it permits more efficient (faster) transmissions than ASCII for the same *baud rate*.

Each character is sent with 10 bits used as described here:

- start bit
- 8 data bits, *LSB* (least significant bit) sent first
- bit for odd/even parity – no bit for no parity
- 1 stop bit if parity is used – 2 stop bits for no parity

For example: coding the decimal figure 63 requires 2 hexadecimal characters (6 and 3) that converted into binary *format* are 0110 (6) and 0011 (3).
They are joined together to form a single byte so there is just one transmission:

start bit	8 data bits	2 stop bits (if no parity)
1	011000011 (the ASCII code for 6)	11

7.3 ASCII framing

ACII

If you use *ASCII coding*, the *frames* (messages) start with a colon (:) (ASCII 3A hex) and end with “carriage return” + “line feed” or CRLF (ASCII 0D hex and 0A hex).
In transmitting all the other fields of the message the hexadecimal characters are used: 0 ... 9, A ... F.
The devices connected together in the network are constantly analysing the network *bus*, waiting for the colon (:). When they receive this character, each device decodes the next field (address field) to find out whether its address is the one specified.
There can be time intervals of up to one second between the characters in the message. If there is a longer time interval between characters, the receiving device assumes that some kind of error has occurred during the transmission.

7.4 Glossary

Logical OR

Multiple inputs with an OR relationship to one another are equivalent to a single input with the following status:
Active if at least one input is active
Inactive if no input is active

input 1	input 2	output (*Logical OR*)
0	0	0
0	1	**1**
1	0	**1**
1	1	**1**

Exclusive OR

Two inputs related to one another are equivalent to a single input with the following status:
Inactive if both inputs are active or both are inactive
Active if only one of the two is active

input 1	input 2	output (*Exclusive OR*)
0	0	0
0	1	**1**
1	0	**1**

Stand by

Indicates that the instrument is waiting, in stand-by mode; all *functions* are suspended

Reset

Means set to zero.

Range

Values falling within a given interval; *Range* 1...100 indicates all values between 1 and 100

Master

In communications between two devices, the term *Master* specifies the device that starts, governs and ends the communication

Slave

In communications between two devices, the term *Slave* specifies the device that responds to and obeys the requests of the *Master*

Baud rate

The *baud rate* (Baud) measures the transmission speed of a channel: 1*Baud rate* = 1 bit/1s

LSb

Least significant bit.

MSb

Most significant bit.

BUS

Type of physical connection between devices. All the devices are connected to the same physical line.

Timeout interval

Timeout is the time limit on waiting to receive a message, after which an error is considered to have occurred

Nibble

A *nibble* is a set of 4 bits (e.g. 1001)

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8 ANALITIC INDEX

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