# RS485 LEVEL CONTROLLER AND REMOTE CONTROL UNIT

## OPERATING AND MAINTENANCE INSTRUCTIONS

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Only personnel who have read this notice in full and the safety instructions in document NH78380 are authorised to manipulate and use the devices described in this document.

Like all equipment, your device may suffer an electrical or electronic fault. The manufacturer cannot be held liable for stored products of any nature which might be lost as a result of this fault, even during the warranty period.

In accordance with Directive WEEE 2002/96/EC, this device can be made up of electronic components harmful to the environment. It is asked to all the owners of this device to contact the manufacturer or the distributor, in order to learn the procedure to be followed to recycle the device. The manufacturer shall in no case be held responsible for the recycling of a device for which the prescribed recycling procedure has not been followed.



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# 1 - PRESENTATION

This user guide is designed to describe the operation and explain the various settings of the RS485 UNIT. The RS485 UNIT is a peripheral option to the standard electronics supplied with cryogenic containers such as the level and temperature gauges in the form of two blue units, or even three if there is a second temperature indicator.

The blue units which can be connected to the RS485 UNIT are level gauges NH97027 or NH102885-N and temperature gauges NH97028 or NH102885-T.

The RS485 UNIT is used to regulate the nitrogen level within a container fitted with level and temperature gauges for storing in the liquid or gas phase. This product is also used to monitor via an RS485 modbus link, the interface can transmit temperature and level data and the status of the various alarms and controls.

Alarm and data hard contacts are available for local operation.

The interface receives a 24 V AC power supply via its supply cable fitted with a 3-pin DIN connector.

The RS485 UNIT consists of a pearlescent blue metal box containing a mother board to which are connected a level remote monitoring board and two temperature remote monitoring board.

The RS485 unit is positioned on the edge of the corresponding cryogenic container. It is held on the container using four retaining screws on a stainless steel plate. The unit can be fitted to all containers in the ESPACE and RCB ranges as well as the ARPEGE 40/70/110/140/170.

NOTE: The container can operate totally independently without an RS485 link.



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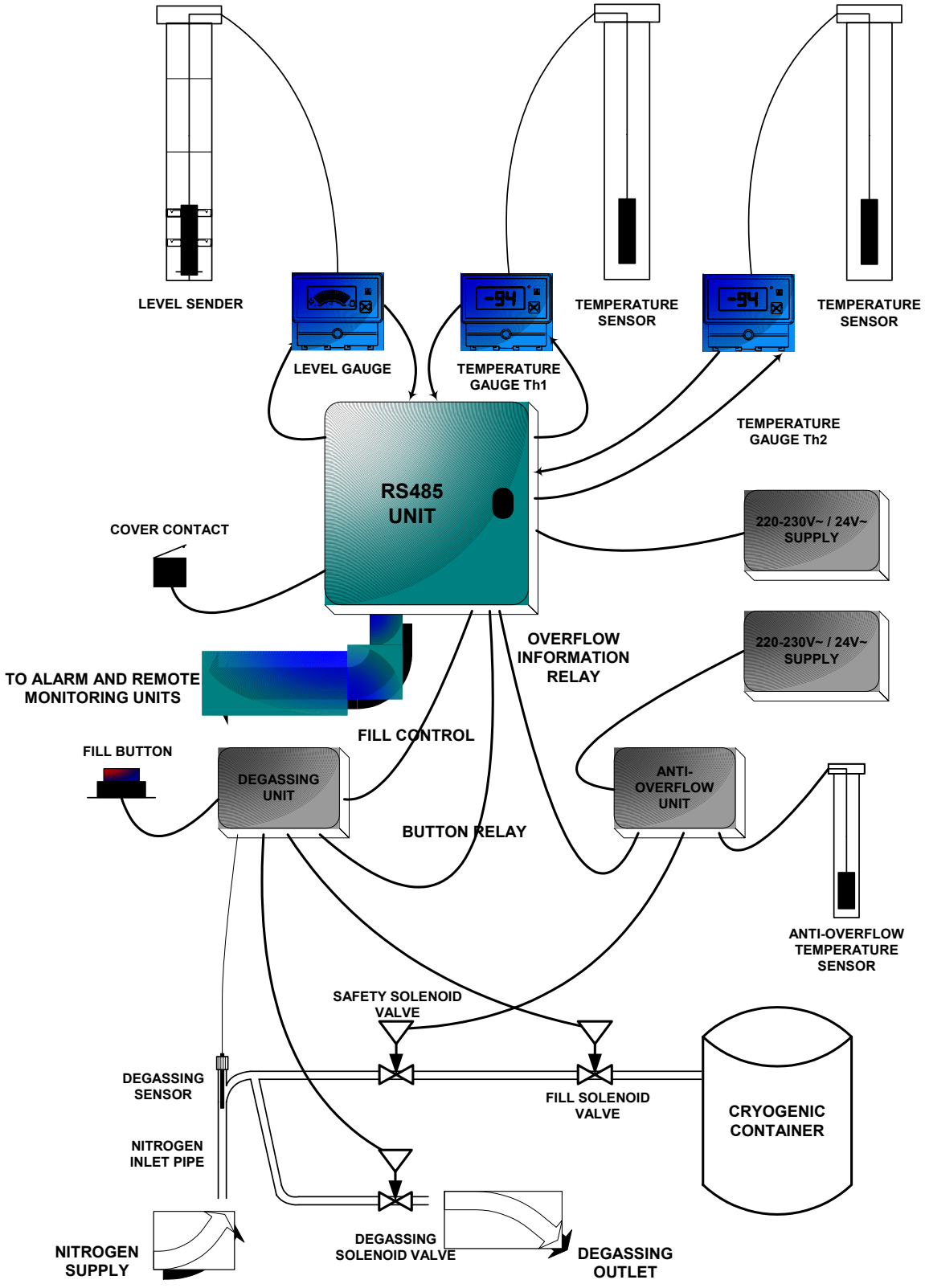


*General layout of a cryogenic container fitted with a RS485 UNIT*



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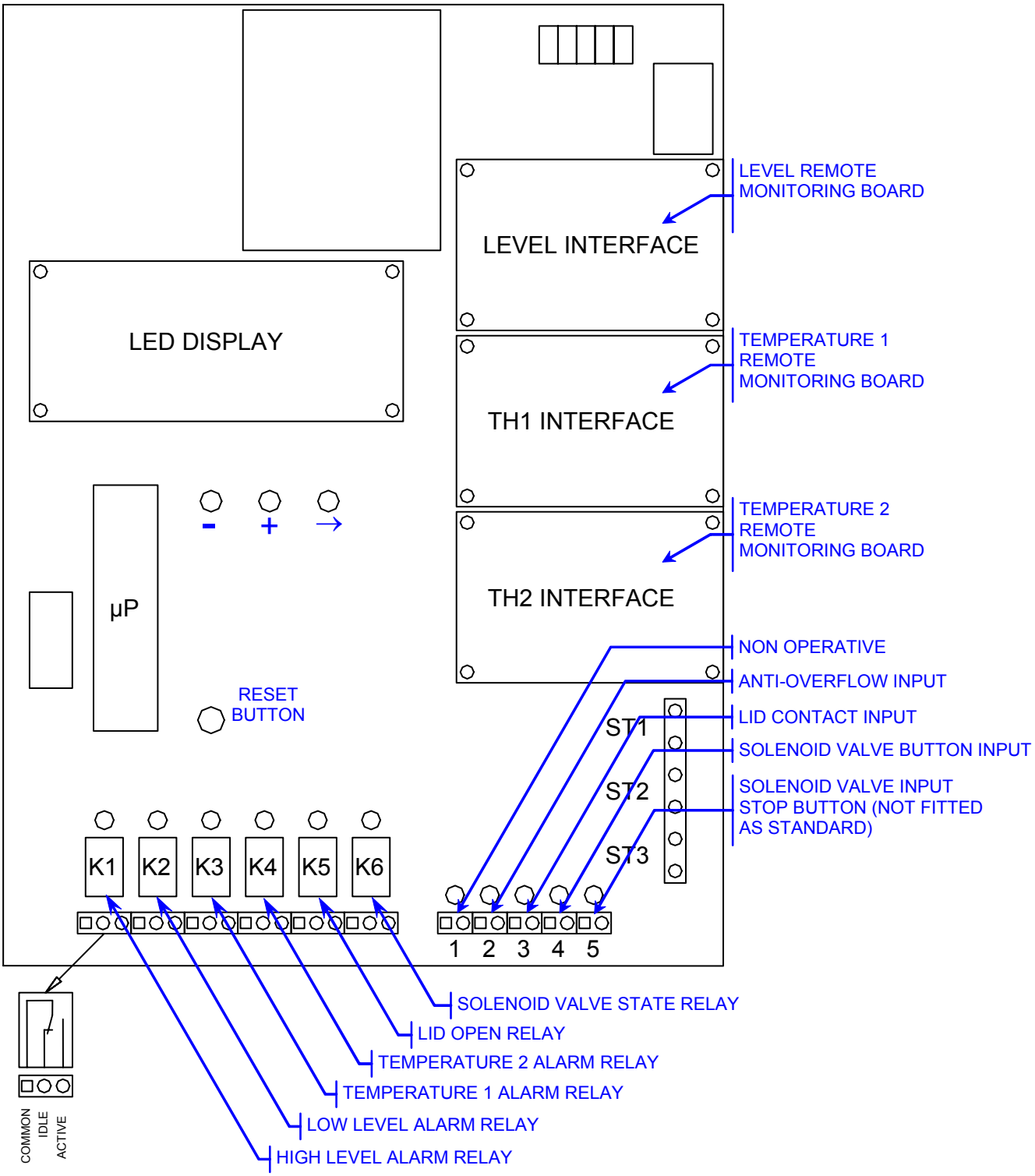
# 2 - DESCRIPTION & OPERATION

## 2.1 GENERAL DESCRIPTION OF THE RS485 UNIT



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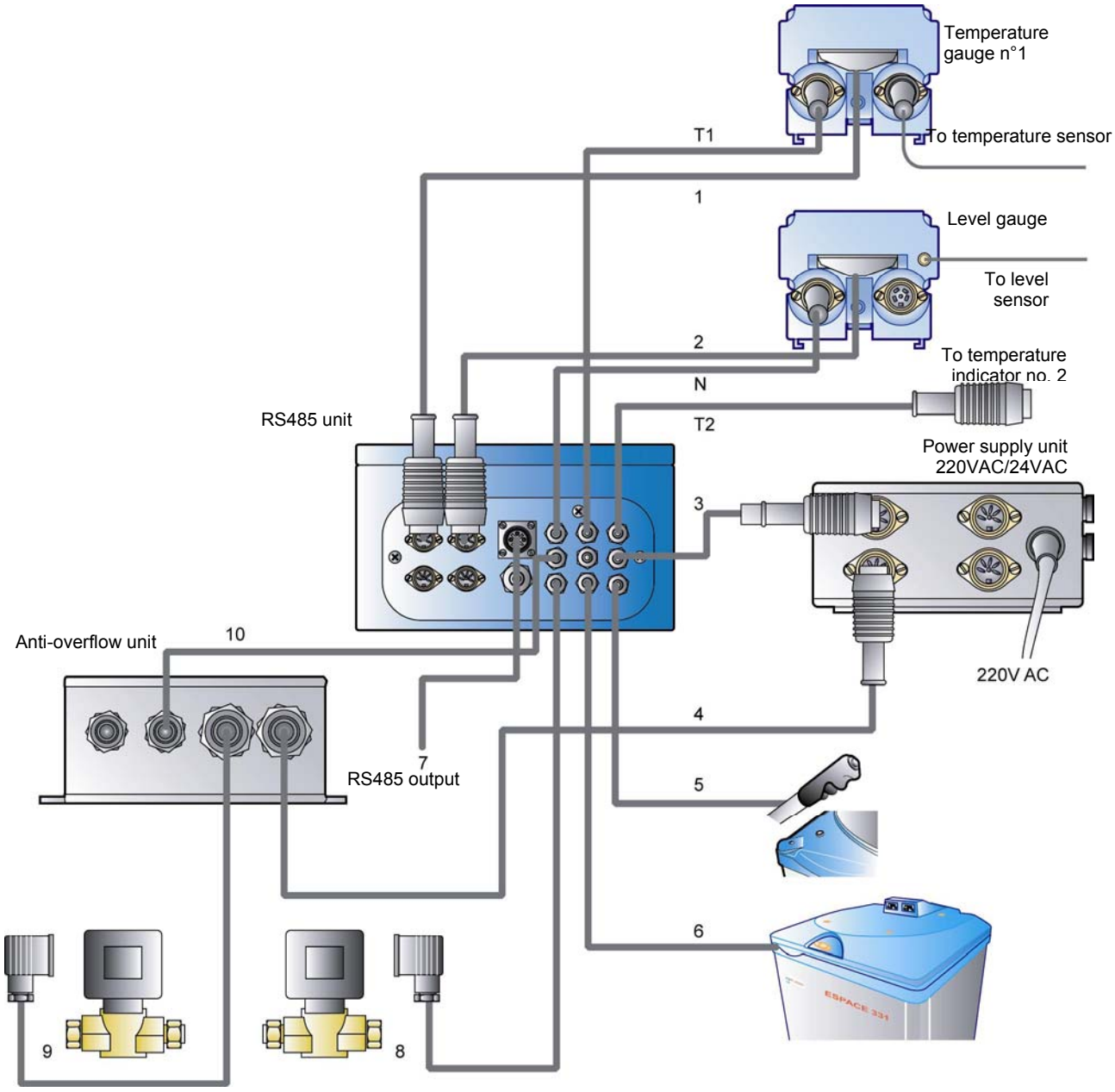
## 2.2 CONNECTIONS

### Overview of connections



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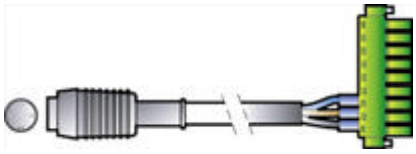
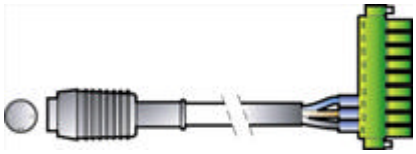
## Cables

| Rep. | Purpose | Appearance | Connects from | Connects to |
|---|---|---|---|---|
| T1 | Measurement output from temperature gauge T1 | | Temperature gauge | RS485 unit |
| T2 | Measurement output from temperature gauge T2 | | Temperature gauge | RS485 unit |
| N | Measurement output from level gauge | | Level gauge | RS485 unit |
| 1 | Power supply to temperature gauge T1 |  | Temperature gauge | RS485 unit |
| 2 | Power supply to level gauge |  | Level gauge | RS485 unit |
| 3 | Power supply to RS485 power pack | | Power pack | RS485 unit |
| 4 | Power supply to anti-overflow unit | | Anti-overflow unit | RS485 unit |
| 5* | Data from manual filling pushbutton | | Container | RS485 unit |
| 6* | Container lid open/closed status information | | Container | RS485 unit |
| 7 | RS485 output (data from temperature and level gauges) | | RS485 unit | User equipment |
| 8 | Filling solenoid valve control | | RS485 unit | Degassing solenoid valve |
| 9 | Relief solenoid valve control | | Anti-overflow unit | Degassing solenoid valve |
| 10* | Anti-overflow data | | Anti-overflow unit | RS485 unit |

*(*)Cable not supplied by Air Liquide.*



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## 2.3 COMMISSIONING

The interface must be parametered before the container is filled. This requires penetrating into the interface unit.

**Procedure:**

Once power has been connected and after the level and temperature indicator alarms have been cleared, switch the interface to parametering mode.

In normal operating conditions, the interface's LED display permanently shows temperature and level data.

To switch to parametering mode, press the "RESET" button: the display will indicate the software version (V 1.6 for example) and the interface modbus address (254 by default). Within the next 20 seconds (or press the "RESET" button again) press the "–" and "→" buttons together: the first parameter and its value will be displayed. The value of each parameter can be altered by pressing the "-" button to reduce it or the "+" button to increase it. Once the requisite value has been displayed, press the "→" button to validate the setting and then proceed to the next parameter.

Before the first parameter is displayed, a password may be requested (when this function was validated during the previous parametering operation). In this case, press the "+" or "-" button to alter the value of the two triplets of the password displayed. When the right value appears, press the "→" button and the first parameter will be displayed.

This method can be used to set the following parameters.

| PARAMETERS | VALUES | «by default» VALUES |
|---|---|---|
| Password (if activated) | XXX XXX | 000 000 |
| Low level alarm value (see*) | 0 to 100 | 45 |
| Level regulation low level threshold value (see*) | 0 to 100 | 50 |
| Level regulation high level threshold value (see*) | 0 to 100 | 80 |
| High level alarm value (see*) | 0 to 100 | 85 |
| Temperature 1 alarm value | -200 to -120 | -130 |
| Temperature 2 alarm value | -200 to -120 | -130 |
| Activation / Inhibition of solenoid valve control by Temp. indicator 1 | YES / NO | NO |
| Activation / Inhibition of solenoid valve. control by existing Temp. indicator 2 | YES / NO | NO |
| Temperature indicator 2 exists | YES/NO | NO |
| Password activated | 001 to 254 | 254 |
| Interface modbus address | 1200 to 19200 | 9600 |
| Data transfer rate | YES / NO | NO |
| Default parameters | YES / NO | NO |
| Parametering completed | | |
| ** These four values must be consistent with each other. Should this not be the case, new values will be requested when parametering has been completed.* | | |

The YES/NO transfer can be achieved using either "+" or "-" buttons.

When, in the case of "Default parameters ", the "YES" value is validated, all the parameters will adopt the value shown in the «default» column, irrespective of the value previously validated.



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When the "YES" value is validated upon completion of parametering, the values are stored, the interface exits the parametering mode and the display screen once again shows temperature and level values.

When the interface is connected to the Téléflo RS485 bus, it may be necessary (depending on the position on the bus and the system's configuration) to activate load resistors and/or bus polarisation:

Use the ST2 jumper to activate the 120 ohm load resistor.

To activate polarisation resistors: use both ST1 and ST3 jumpers. (See §2.1 for the location of these jumpers).

Polarisation resistors must be mounted in one single spot of the bus. In principle, this is done in the Téléflo housing.

**NOTE**: The load resistor must (only) be placed on the last bus terminal (the operative must be familiar with the routing of the bus' wiring).

Parametering may also be carried out remotely from the Téléflo via the RS485 modbus link (see §2.5 RS485 modbus link).

In this case, as each container is factory parametered to the 254 address, connect one container to the bus, change the address, and then connect the next container etc...

Once these setting operations have been completed, the container is ready and can be filled.

## 2.4 FILLING

(If applicable, refer to notice NH78360 "Venting device ")

The level indicator is fitted with a sensor failure safety mechanism. When the indicator measures a value < 0% or >100%, solenoid valve opening is inhibited.

In this case, it is then necessary to press the manual control button in order to open the solenoid valve until the liquid nitrogen has reached the capacity gauge.

Filling is then continued automatically and will stop when the upper threshold is reached.

**NB**: For an empty container, it is possible and logical that the indicator will measure a value slightly less than the empty value calibrated in the factory (this is caused by slight variations in physical parameters: temperature, humidity,…).


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## 2.5 ALARM CONNECTIONS

The interface has 6 alarm or data relays (cf §2.1). These relays (from left to right) have the following functions:

K1 .....LED off..... if "high level alarm" detected

K2 .....LED off .....if "low level alarm" detected

K1 and K2.....Both LEDs off .....if "sensor fault" detected

K3 ..... LED on ..... if "temperature 1 alarm" detected

K4 ..... LED on ..... if "temperature 2 alarm" detected

K5 ..... LED on ..... if "lid open" detected

K6 ..... LED on ..... if "Solenoid valve" activated

On each relay, the break and/or closing contact may be wired up to allow these alarms to be repeated in a remote location (see diagram §2.1).

Level alarms are "safe positive": in normal situations, the relay is activated.

The «Normally open» contact is a make contact.

In the event of an alarm or power failure, the relay falls and the «Normally open» contact is cut off.



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## 2.6 RS485 MODBUS LINK

The RS485 modbus link is used to provide two-way communication between Téléflo and the container(s).

Some values may be read off in the interface (level, alarm…) others may be written (alarm threshold, modbus address).

Each data has its own address in the values table.

| ADDRESSES | DATA | VALUES | | | | |
|---|---|---|---|---|---|---|
| 00 | Free | | | | | |
| Proportional values (interface output) | | | | | | |
| 01 | Nitrogen level value (%) | 0 to 100 | 255: ERROR | | | |
| 02 | Temperature 1 value | 0 to 100 | 255: ERROR | | | |
| 03 | Temperature 2 value | 0 to 100 | 255: ERROR | | | |
| Logic values (interface output) | | | | | | |
| 04 | Level detector link correct | 00: LINK OK | 255: DEFAULT | | | |
| 05 | Indicator low level | 00: NOT REACHED | 255: REACHED | | | |
| 06 | High level alarm | 00: NOT REACHED | 255: REACHED | | | |
| 07 | Low level alarm | 00: NOT REACHED | 255: REACHED | | | |
| 08 | Solenoid valve control status | 00: SV DEACTIVATED | 255: SV DEACTIVATED | | | |
| 09 | Cover position | 00: COVER CLOSED | 255: COVER OPEN | | | |
| 10 | Anti-overflow device status | 00: OK | 255: OVERFLOW DETECT | | | |
| 11 | Auto fill data through min threshold | 00: NO | 255: FILL. ACTIVATED | | | |
| 12 | Temperature sensor 1 link correct | 00: OK | 255: DEFAULT | | | |
| 13 | High temperature 1 alarm | 00: OK | 255: REACHED | | | |
| 14 | Temperature sensor 2 link correct | 00: OK | 255: DEFAULT | | | |
| 15 | High temperature 2 alarm | 00: OK | 255: REACHED | | | |
| Logic values (interface input) | | | | | | |
| 16 | Controlled fill initiated or stopped | 00: NO ACTION | 255: SOLENOID OPENS | | | |
| | | 1 to 254: SOLENOID CLOSES | | | | |
| NOTE: address 16 is the only address authorised for an 000 terminal number ("Broad cast") | | | | | | |
| Parametering | | | | | | |
| 17 | Upper level control threshold | 0 to 100 | | | | |
| 18 | Lower level control threshold | 0 to 100 | | | | |
| 19 | High level alarm | 0 to 100 | | | | |
| 20 | Low level alarm | 0 to 100 | | | | |
| 21 | Temperature 1 alarm | 0 to 100 | | | | |
| 22 | Temperature 2 alarm | 0 to 100 | | | | |
| 23 | Write word for Addresses 17-22 | 0/255 | | | | |
| 24 | Thermometer 2 present | 00: NO | 255: YES | | | |
| 25 | Thermometer 1, solenoid control active | 00: NO | 255: YES | | | |
| 26 | Thermometer 2, solenoid control active | 00: NO | 255: YES | | | |
| 27 | Modbus address | 1 to 254 | | | | |
| 28 | Data transfer rate | 00 = 1200 | 01 = 2400 | 02 = 4800 | 03 = 9600 | 04 = 19200 |
| 29 | Write word for Addresses 17 to 28 | 0/255 | | | | |
| 30 | Free | | | | | |
| 31 | Free | | | | | |



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## 2.7 CONNECTIONS BETWEEN THE INTERFACE AND THE CONTAINER (SEE §2.1)

The motherboard is fitted with 3 small interface cards used to decode the digital signal transmitted by the indicators. Connection is by a cable fitted with an 8-pin DIN connector.

The upper section of the card houses the 24 V~ input and the solenoid valve connection together with the 24 V~ distribution to the 4 DIN sockets.

These sockets, mounted on the base of the unit, are used to provide power to the indicators and to the venting device.

The bottom of the motherboard has a terminal block used to connect control inputs.

From left to right, these inputs are:

1 Non operational

2 Connection of anti-overflow mechanism .....LED off if "Overflow" detected

3 Cover contactor .....LED off if "Lid open"

4 Solenoid valve manual control knob.....LED on if "Button control" active

5 Solenoid valve shut off contact (optional mechanism, not standard issue).

The RS485 link is wired into a connector in the base of the case. A FCI type CLIPPER CL/M 1101 connector is used.

The + is wired to jack 1,– to jack 3.



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## 2.8 DETAILED OPERATION

### *2.8.1 Activating opening of the filler solenoid valve*

A signal is transmitted to the solenoid valve causing it to open at low threshold and to close at the upper threshold.

In parallel, data on the RS485 is transmitted confirming that automatic filling has been activated by the minimum threshold (address 11 on the table of values).

This information can be used to activate the filling of other containers using the "Broadcast" command (see NOTE 1).

The control is only activated when the detector signal is correct (see NOTE 2).

When the manual control button is operated, the solenoid valve opens as long as the button is activated. This function remains available during a level detector failure. It is inhibited above the high level alarm.

Pressing the manual control button four times in quick succession will initiate fill up to upper level.

When the level drops to the low level alarm threshold, the alarm is initiated after a time delay of about 30 seconds and remains active until the level rises to the lower control threshold. The same system applies to the high level and alarm functions.

When the temperature reaches 6°C below the alarm level, the solenoid valve will open when the four following conditions are met:

- the level is below that of the upper regulation threshold
- the level detector signal is correct
- the temperature detector signal is correct
- the solenoid valve control by the thermometer parameter is active.

The solenoid valve will close down when the temperature reaches 16°C below the alarm threshold.

When the filler command is transmitted by RS485 ("Broadcast"), the solenoid valve opening timing is set at the rate of 0.5 seconds multiplied by the address number in order to avoid the simultaneous appearance of solenoid valve activating current peaks.

(e.g.: for the reservoir having address n° 10, opening is timed to 5 seconds). The solenoid valve closes when the upper control threshold is reached.



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**NOTE 1**: Summary

The filler solenoid valve will be activated open by one of five different conditions:

1. manual control: open for as long as the control is depressed
2. manual control button depressed four times: remains open up to upper threshold.
3. temperature indicator controlled (when this function is activated):
4. open between–6°C and –16°C in relation to the temperature alarm threshold
5. RS485 "Broadcast" (address 16) controlled : timed opening up to upper threshold
6. controlled when lower threshold reached: remains open up to upper threshold.

The «auto fill due to min threshold» data is activated on the RS485 (address 11) solely under this last condition and is deactivated when the level reaches the upper regulation threshold.

**NOTE 2:** When the level indicator measures an error value (< 0% or > 100%) an alarm signal is transmitted on the indicator's digital output to the interface.

*2.8.2 Anti-overflow device*

When the overflow protection mechanism is activated (because of an excessively high nitrogen level). The information is transmitted by the RS485 bus to the Téléflo (address 10). Téléflo can activate the closure of the central liquid nitrogen valve (see also notice NH 78361).

*2.8.3 Cover switch*

When the cover is opened, the switch contact opens with three consequences:

- The input indicator light on the interface goes out.
- The information is transmitted by the RS485 bus to the Téléflo (address 9).
- The K5 output relay switches over and its indicator light goes out.

*2.8.4 Filler solenoid valve closure signal.*

When the solenoid valve has been controlled open (by the minimum threshold, temperature indicator, broadcast, ) early closure can be activated by closing a contact on the interface N° 5 input. This function is not wired up as a standard feature.

The solenoid valve can also be controlled closed via the RS485 (value 1 to 254 on address 16).

*2.8.5 Very low level alarm threshold*

In addition to the low level alarm parametered on the interface, a second threshold alarm can be programmed on the level indicator (see NH78363).

This data has no effect in local terms but is simply transmitted via RS485 modbus (address 5).


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## 2.9 SPARE PARTS

Some units which are particularly subject to stress or which may be accidentally damaged when the receptacle is used may deteriorate in the long term and require replacement.

The following lists provide manufacturer catalogue numbers for the parts offered, ensuring that your parts orders are correctly made out.

24V solenoid valve ..... ACC-GNL-1
Level indicator unit ..... ACC-GNL-10
Temperature display unit ..... ACC-GNL-11
Capacitor gauge ESPACE 150 for liquid storage ..... ACC-ESP-203
Capacitor gauge ESPACE 151 for liquid storage ..... ACC-CRYOBIO-2
Capacitor gauge ESPACE 330 for liquid storage ..... ACC-ESP-209
Capacitor gauge ESPACE 331 for liquid storage ..... ACC-CRYOBIO-3
Capacitor gauge ESPACE 660 for liquid storage ..... ACC-ESP-204
Capacitor gauge ESPACE 661 for liquid storage ..... ACC-ESP-205
Capacitor gauge RCB 500 for liquid storage ..... ACC-CRYOBIO-3
Capacitor gauge RCB 600 for liquid storage ..... ACC-RCB-102
Capacitor gauge RCB 1000 for liquid storage ..... ACC-RCB-103
Capacitor gauge RCB 1001 for liquid storage ..... ACC-CRYOBIO-2
Capacitor gauge ESPACE 151 gas storage ..... ACC-ESP-200
Capacitor gauge ESPACE 331 gas storage ..... ACC-ESP-201
Capacitor gauge ESPACE 661 gas storage ..... ACC-ESP-202
Capacitor gauge RCB 1001 gas storage ..... ACC-RCB-100
Capacitor gauge RCB 600 gas storage ..... ACC-RCB-101
220 / 4x24 V power pack ..... ACC-GNL-19
Anti-overflow device ..... ACC-ESP-106
Control and remote monitoring unit RS485 ..... ACC-GNL-13


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## 2.10 DEVELOPMENTS OF THE RS485 UNIT

### *2.10.1 Revision a*

This revision refers to the V1.4 version which incorporates the following developments:

- When a simultaneous fill signal is received, the solenoid valve opening is timed (chap.2.7.1).
- Introduction of a password for local access to the parametering mode (chap.2.2)
- Temperature alarm threshold value restricted to the range–200 à –120° (chap.2.2).
- Level parameter consistency control (chap. 2.2)
- Earth wired into jack 2 of the RS485 socket (chap.2.6).

### *2.10.2 Revision b*

This revision corresponds to version V1.5, with the changes relating to the following:

Section 2.2 modified V1.5

- 30 second alarm timer before activation.

  4 to 7

  10

  12 to 15

- Addition of two parameters at address 30 and 31 in read write only by ModBus (section 2.5)

### *2.10.3 Revision c*

This revision corresponds to version V1.6 which changes as follows:

Chapter 2.2 modified V1.6

- Solenoid valve K6 changes function and now indicates the state of the solenoid valve,
- Suppression of the recuperation of the earth of the unit on connector RS485.



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