

TBOX *LT2*



User's Guide
Cabling & Technical Specifications

Certifications

 CE	 FCC	 C US CSA for US and Canada	 C-Tick	 A-Tick	 RoHS	Hazardous Area Class I, Division 2
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Disclaimer

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Important Safety Instructions

Read and understand all instructions. Save these instructions.

- Read the instruction manual carefully before using the equipment and comply with the instructions that it contains to avoid mistakes and to prevent any personal injury or damage to property.
- **WARNING:** It is mandatory that this equipment is earthed by the rack. Connect the crimp terminal ring to the earth with a stranded wire between 1.5 and 2.5 mm² inclusively. The cable must be crimped consistent with rules of good practice.
- Installation must be carried out by suitable, competent personnel, according to the steps and stated specifications described in this manual.
- Use only the approved color-coded wires for connecting to mains. The green/yellow colored wire can be only used as earth wire.
- This equipment has been designed for use only by qualified and instructed personnel in an industrial environment. This equipment must be operated in a restricted access location according to IEC60950.
- It is Safety Class III equipment, according to IEC classification; this equipment must be powered by a Safety Extra Low Voltage (SELV).
- This equipment has been designed to meet IEC60950-1 requirements (safety of information technology equipment)
- This equipment has been designed for indoor use in a Pollution Degree 2 environment (dry non-conductive pollution).
- The module must be fastened to the rack using a screw driver, with a recommended minimum torque of 0.5 Nm.
- **CAUTION** – Never power the module when not fixed on the rack. Switch off and disconnect power before removing the module from the rack.
- Connection from the equipment to mains must be protected by a circuit breaker of 16 A on both line and neutral.
- **CAUTION** – To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.
- Do not use your TBox in a wet environment.
- Using this instrument in a way not specified by these instructions can impair the equipment safety. Do not operate the instrument outside its rated supply voltage and environmental ranges.
- Do not open power supply unit. There are no user serviceable parts inside.
- Do not connect or disconnect any connector when powered.
- Protect your TBox from environmental hazards such as dirt, dust, food, liquids, excessive temperature, and sunlight overexposure.
- Keep your TBox away from direct or excessive moisture or rain and extremely hot or cold temperatures to ensure that the TBox is used within the specified operating range.
- **CAUTION** – Risk of explosion if battery is replaced by an incorrect type or is incorrectly installed. Be careful to insert the battery with the right polarity. Dispose of used batteries according to the local regulations.
- This equipment is suitable for use in Class I, Division 2, Groups C-D
- **WARNING:** Do not open the box in explosive atmosphere

Canada

The TBox LT2 must be mounted in a suitable protective enclosure, which incorporates means to allow for field wiring connections in accordance with Section 18 of the Canadian Electrical Code (CEC), Part I, where the suitability of the final combination is to be determined by CSA or the Inspection Authority having jurisdiction.

Environmental Considerations

Battery Disposal

! CAUTION: There is a danger of a new battery exploding if it is incorrectly installed. Replace the battery only with the same or equivalent type recommended by the manufacturer. Do not dispose of the battery along with household waste. Contact your local waste disposal agency for the address of the nearest battery deposit site.



Your TBox uses a lithium coin cell battery. The lithium coin cell battery is a long-life battery, and it is very possible that you will never need to replace it. However, should you need to replace it, see chapter 19.2 for instructions.

General Precautions in Cabling

- To avoid **electrostatic discharge**, drain off electrostatic charges by touching a known earth immediately before handling TBox, touching front plate toggle switch, connectors or cables.
- Ethernet cabling must be with **Shielded SFTP** cable to guarantee **class B immunity**.
- Cabling of Inputs/Outputs, RS232 connections, GSM antennas cannot **exceed 30 m.**, neither leave the building without surge protection.
Cabling to DC power, PSTN modem and RS485 can exceed 30 m.
- In case of DC power to a distribution network, it is mandatory to use a **surge protection**.

Certifications

SAFETY	CSA CEBEC	CAN/CSA C22.2 No 60950-1-07 ANSI/UL 60950-1:2005 (2 nd edition) IEC 60950-1:2005 + corrigendum 2006 + A1:2009
EMC		EN 61000-4-2:1995 + A1:1998 + A2:2001 EN 61000-4-8:1993 + A1:2001 EN 61000-4-3:2002 + A1:2002 + A2:2005 EN 61000-4-11:2004 EN 61000-4-4:1995 + A1:2000 + A2:2001 EN 55011:1998 + A1:1999 + A2:2002 EN 61000-4-5:2006 EN 61326-1:2006 EN 61000-4-6:1996 + A1:2000 + A2:2005
FCC		CFR47: 2005 (Part 15 Sub Part B) EN55011: 1998 +A1, A2
CE		Low Voltage directive: 2006/95/EC Electromagnetic Compatibility Directive: 2004/108/EC
C-TICK		ACMA N3413
A-TICK		AS/ACIF S042.1:2006 AS/ACIF S042.3:2005
RoHS		
Class I, Division 2 Gr. A, B, C, D - T4		CSA Std C22.2 No 0-M1991 - General Requirements – Canadian Electrical Code Part II CSA Std C22.2 No 142-M1987 - Process Control Equipment CSA Std C22.2 No 213-M1987 – Non Incendive Electrical Eqpt for Use in CI, Div 2 Hazardous Loc. UL 916 (4th Edition) - Energy Management Equipment ANSI/ISA–12.12.01–2007 – Non incendive Electrical Eqpt. for Use in CI and II, Div 2 and CI III, Div 1 and 2 Hazardous (Classified) Locations CAN/CSA C22.2 No. 60950-1-07 - Information Technology Eqpt – Safety – Part 1: General Rqmts ANSI/UL 60950-1, 2nd Edition - Information Technology Equipment – Safety – Part 1: General Rqmts

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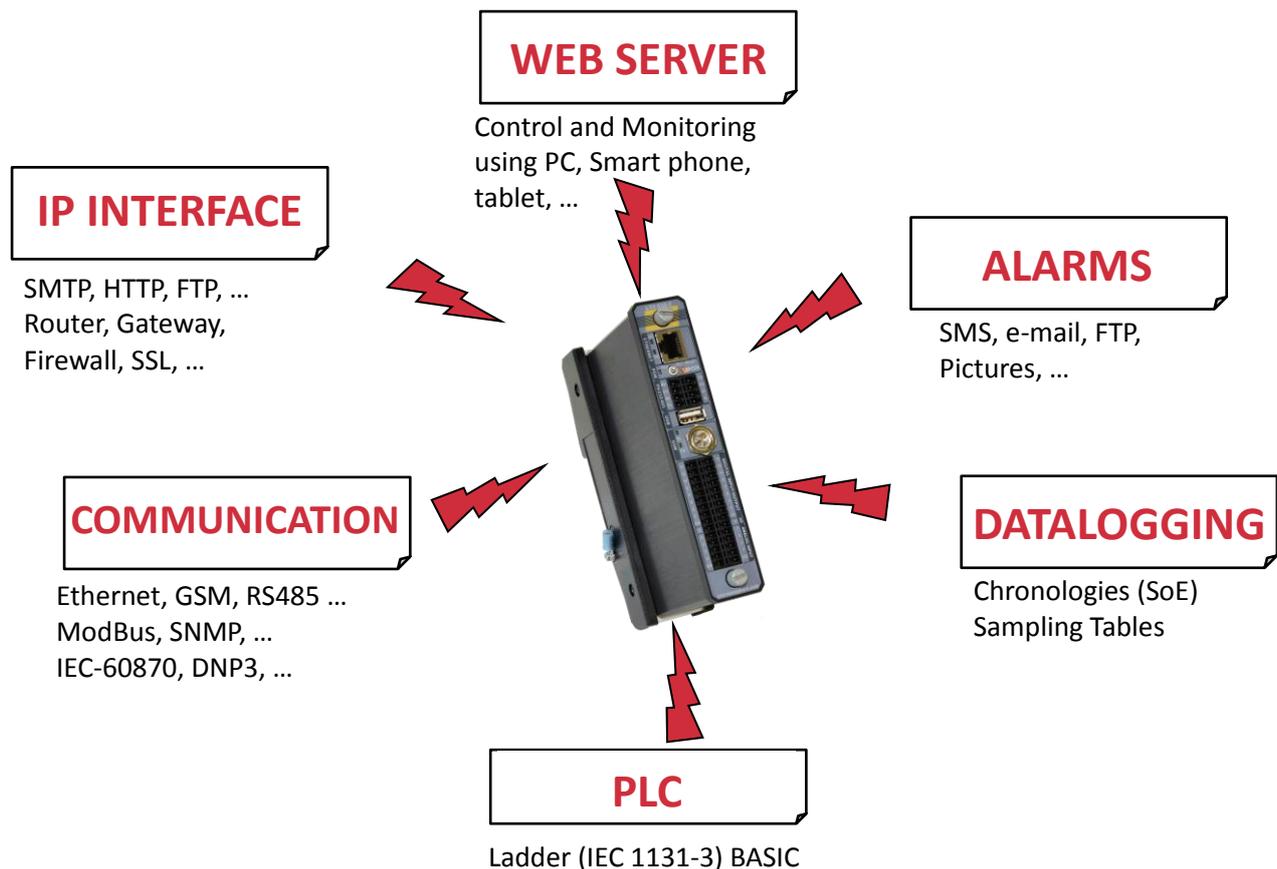
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PRESENTATION

Welcome to the World of TBOX LT2



The 'all-in-one' concept of **TBOX LT2**



1. How to use this manual?

1.1. What is in the manual?

This manual constitutes the **essential** of **TBox LT2** documentation.

It first introduces to the **hardware concept**

- Different models of **TBox LT2** chapter 2
- Quick overview on installing and powering chapter 3

Then it brings you to the programming of **TBox LT2** using **TWinSoft**. All features are explained using plenty of snapshots for an **easy understanding** ☺

- Starting TWinSoft chapter 5
- Properties of **TBox LT2** chapter 7
- Resources chapter 8
- Tags chapter 9
- IP Services Configuration chapter 10
- IP Security Services chapter 11
- Alarms chapter 12
- ReadSMS chapter 13
- Datalogging chapter 14
- ModBus Transactions chapter 15
- Periodic events chapter 16
- Security chapter 17

All **technical specifications** of the different models of **TBox LT2** and **cablings** are presented at the **end of this manual**.

Information related to **Licenses** is available in Appendix A.



All along this manual, I **warn** you:
"Read the manual!"



All along this manual, I inform you with **Notes** and **Remarks**:
"What a nice manual!"

1.2. What is not in the manual?

One major topic you will not find in this manual concerns the Logic Programming. **TBox LT2** supports BASIC and Ladder languages for developing any advanced process.

These languages are detailed in **another manual: BASIC and LADDER for TBOX**

Another important feature, which is not presented into this manual, concerns the development of **HTML pages**, to use **TBox LT2** as web server.

This matter is explained in details in **another manual: WEBFORM STUDIO 2.0 – Getting Started**

Another software part of the TWinSoft Suite is **Report Studio**, for creating e-mail report or files to send. It is explained in the 'On line' help of Report Studio.

2. The Hardware Models

TBox LT2 is a **All-in-one RTU**, including a **fix number of I/Os** and of **communication ports**.

It is not possible to add local I/O or communication ports but a connection to 'Remote device' is always possible.

TBox LT2 is available in **different models**, offering several combinations of I/O and different communication ports:

2.1. LT2-530-x

I/O	Communication ports
16 x DI/O Each channel can be used as input or output 3 first DI can be used as fast counter (>10 KHz) 8 x AI (0..10V and 4..20mA) Individual selection of signal per channel With validity bit working with 4..20mA signal	<u>On all models of LT2-530</u> RS232 RS485 Ethernet USB <u>-x Options</u> -3: GSM 3G

2.2. LT2-532-x

I/O	Communication ports
16 x DI/O Each channel can be used as input or output 3 first DI can be used as fast counter (>10 KHz) 8 x AI (0..10V and 4..20mA) Individual selection of signal per channel With validity bit working with 4..20mA signal 2 x AO (4..20mA)	<u>On all models of LT2-532</u> RS232 RS485 Ethernet USB <u>-x Options</u> -3: GSM 3G

2.3. LT2-540-x

I/O	Communication ports
16 x DI/O Each channel can be used as input or output 3 first DI can be used as fast counter (>10 KHz) 6 x AI (0..10V and 4..20mA) Individual selection of signal per channel With validity bit working with 4..20mA signal 2 x Pt1000	<u>On all models of LT2-532</u> RS232 RS485 Ethernet USB <u>-x Options</u> -3: GSM 3G

2.4. LT2-542-x

I/O	Communication ports
<p>16 x DI/O Each channel can be used as input or output 3 first DI can be used as fast counter (>10 KHz)</p> <p>6 x AI (0..10V and 4..20mA) Individual selection of signal per channel With validity bit working with 4..20mA signal</p> <p>2 x Pt1000</p> <p>2 x AO (4..20mA)</p>	<p>On all models of LT2-532</p> <p>RS232 RS485 Ethernet USB</p> <p><u>-x Options</u> -3: GSM 3G</p>

HARDWARE

3. Installation of the TBox-LT2

3.1. Installation of the Rack on a DIN rail

TBox LT2 is mounted on a mini rack equipped with **one spring** for DIN rail fixing.

To fix it on a DIN rail:

1. Make sure the **TBox LT2** is with its upper side on top
2. Place the spring of the Rack under the bottom side of the DIN rail and pull-up the **TBox LT2**
3. Push the **TBox LT2** against the DIN rail

3.2. Installation on a wall

The rack can be ordered with perpendicular brackets for wall fixing. The accessory ACC-WALLKIT can be ordered for an existing rack.

3.3. Earthconnection

Each Rack is equipped with a “Safety Earth Ground” PIDG ring tongue terminal. It is marked with the famous upside-down Christmas tree in a circle.



You have to crimp this ring tongue to a cable and screw this ring to the rack as indicated. On the other side, you must connect the cable to the ground.

The cable must be a **2.5mm²**, coloured **green/yellow** (ratio $\pm 70\%$ / 30%).

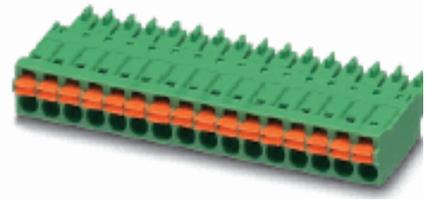
Be sure all connections and joints are reliably made and that Safety Earth Ground connections have no other function than connection to ground.



1. Be aware that **RS485 of TBox is not isolated**. If connecting several devices together, be sure they use **the same ground connection**; otherwise, you have to use **ACC-RS485** (contact your local TBox distributor)
2. If the environment is very **noisy**, like for instance with the presence of a **frequency variator**, make sure :
 - the connection to earth stake is **as short as possible**
 - to **separate the connection of TBox to ground** from other devices
 - **not to mix AC cabling** with low voltage DC cabling

3.4. Cabling

TBox LT2 is equipped with compact **spring-cage terminal blocks**. This connector allows a high density of connections. Press the orange plastic with a screwdriver for **inserting and removing**

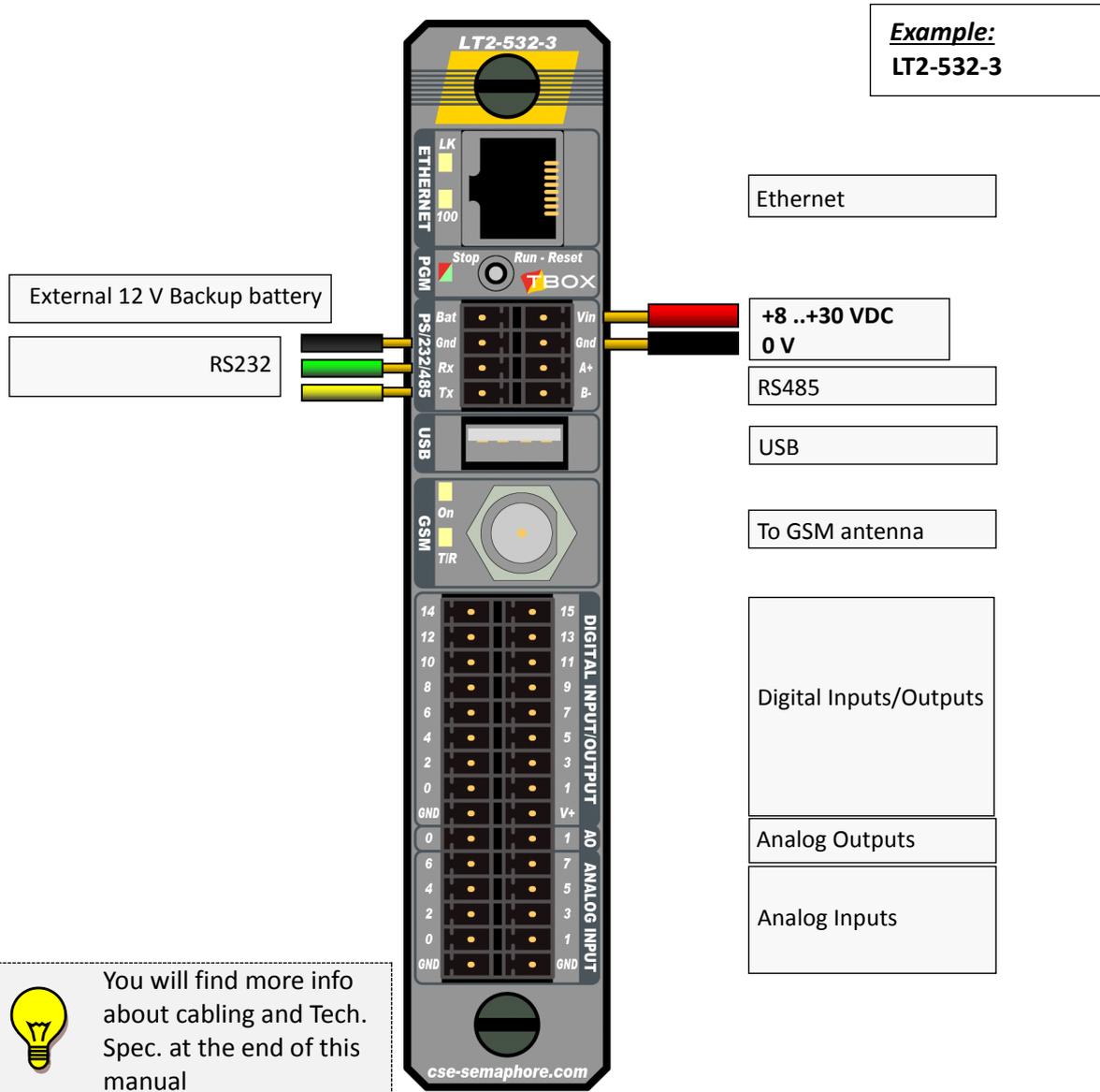


Connection capacity

Without ferrule	Solid cable: 0.2 .. 1.5 mm ² (24..16 AWG)
With ferrule without plastic sleeve	Solid or Stranded cable: 0.2 .. 1.5 mm ²
With ferrule with plastic sleeve	Solid or Stranded cable: 0.2 .. 0.75 mm ²

Ferrule specification for 0.75mm² cable

	B: minimum 10 mm C: 1.5 mm D: 3.5 mm	Reference: Weidmüller 9021050000
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TWINSOFT - GETTING STARTED

4. Installation of TWinSoft

4.1. System requirements

- **Hardware:** PC running Windows.
32bits or 64 bits
- **Memory:** 32 MB minimum.
- **Hard Disk:** 350 MB required plus the application files.
- **Display:** VGA, SVGA with a minimum resolution of 1024 x 768.
- **Mouse:** any Windows compatible mouse.
- **USB port:** required in case of license with dongle for 'USB' port and/or to communicate with **TBoxLT2** through USB.
- **Serial port:** required for a local connection to **TBoxLT2**. If no serial port available, you can use USB or Ethernet on PC.
- **Ethernet port:** 10/100 Mbps required for a connection to **TBoxLT2** through a LAN.
- **Modem:** to access TBox through dial-up connection from any modem properly configured in Windows.
- **Operating system:** Windows 2003, XP, VISTA, 2008, 7, 8, 10
32bits or 64 bits



To Browse **TBoxLT2**

Working with WebForm 2.0, any browser or smart phone supporting SVG and Ajax can be used. Note that a minimum version of browser and smart phone is required (see "help" in WebForm Studio 2.0).

4.2. Installation of the CD-ROM



From the USB stick of **TWinSoft Suite**, when running the Setup, the following software's are available



- **TWinSoft 11.xx**

TWinSoft is a Suite of software required for developing an application for any model of TBox RTU. The basis for configuring TBox RTU application is explained in this manual.

Installation of TWinSoft includes:

- WebForm Studio 2.0: HTML editor producing HTML pages based on SVG, JAVA and JSON.
- WebForm Studio 1.0: HTML editor for legacy HTML pages based on ActiveX.
- Report studio: Report editor dedicated to TBox.
- WebForm Viewer: ActiveX if working with legacy HTML page, supporting ActiveX only.
This has been replaced by WebForm 2.0 and AJAX technology

- **WebForm Viewer**

This setup contains the “ActiveX” used with legacy HTML page used to display dynamic objects dedicated to TBox. It must be installed on the PC used by operators using IE to display legacy HTML pages. In such case, TWinSoft Suite is not required; only the ActiveX needs to be installed.

With *TBox LT2* you will preferably use WebForms 2.0.

- **TBox Mail**

This software is used to display a **Chart** view from data logging attached to e-mail. To store data in a global database, you should use **TView** (call your local distributor).

(Administrator rights is required during installation)

- **RM Configurator**

RM’s consist in a family of Remote Modules, based on ***TBox-LITE*** architecture.

They are programmed through an interface running TWinSoft in background.

This entry installs this interface.

- **Acrobat Reader**

Software needed to read our documentation.

- **Explore this CD-ROM**

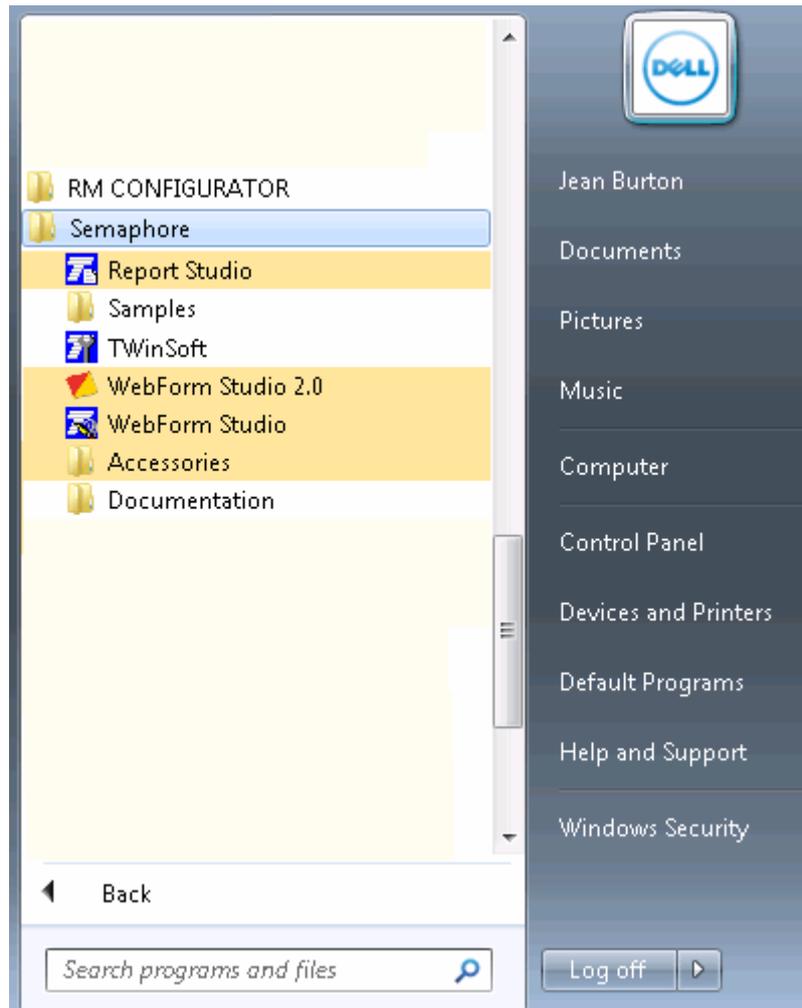
You will find on the USB stick many information related to ***TBox LT2*** and accessories: datasheets, manuals, ...



Administrator rights is required during installation

4.3. Programs of 'TWinSoft Suite'

During installation of TWinSoft, a group of programs is created where TWinSoft can be started from.



Other programs and menus (Found on Semaphore folder):

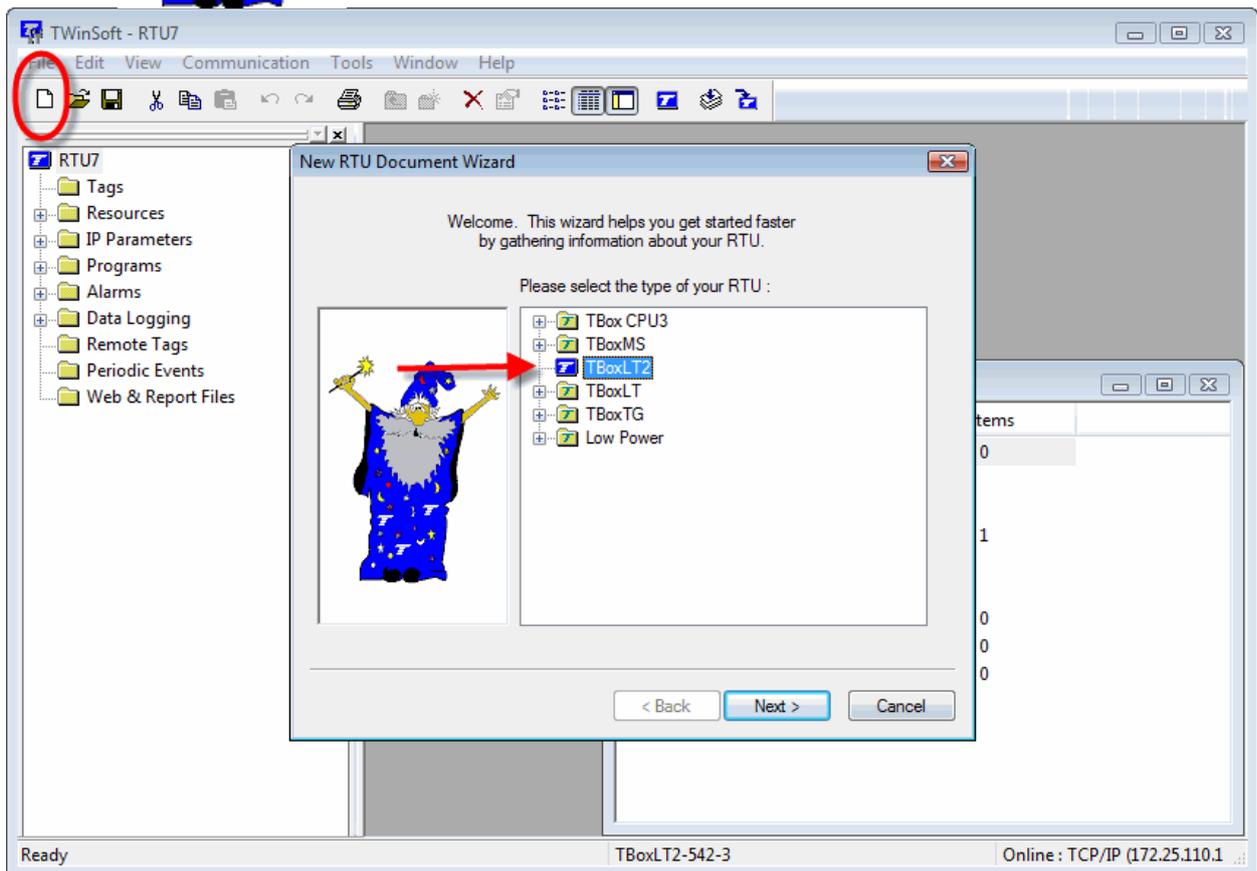
- **Accessories:** group containing the utility 'Password generator' and 'Reset User preferences': reset of registry information to restore the default configuration of TWinSoft.
- **Documentation:** group containing the various documents associated to TWinSoft and RTU.
- **Samples:** group with TWinSoft documents installed as example.
- **Report Studio:** to create reports dedicated to **TBox LT2**. It can also be started directly from TWinSoft and the list of "Web and Reports".
- **TWinSoft:** to start TWinSoft.
- **WebForm Studio:** to start the legacy HTML editor, based on ActiveX.
- **WebFormStudio 2.0:** HTML editor based on SVG, JAVA and XML. It is advised to start it directly from TWinSoft and the folder of "Web and Reports files".

5. Starting TWinSoft



I am the Wizard of TWinSoft!

When you start TWinSoft the first time, or when you create a new document, I help you with some basic configurations.



The use of TWinSoft is free, but sending of a program to **TBoxLT2** is protected. For more info about Licenses go to Appendix A. at the end of this manual.

5.1. Wizard

The “New Document Wizard” helps you getting started with a new application by gathering information about your **hardware** and some **basic configuration**.

Except for the “Type of RTU”, settings can be modified latter from the “RTU properties”.

New RTU Document Wizard

Station Name: MyTBox

Modbus Address: 1

SubAddress: 0

OS Version: 01.24

Required for off-line compilation of the program only.

RTU I/O - Board Selection

IO Module: TBoxLT2-530-x : 16DI, 16DO, 8AIVC, 3AI, 8DI

Main board: TBoxLT2-xxx-3 : RS232, RS485, Ethernet, Modem 3

< Back Next > Cancel

Free name of the RTU

Station address (1..254)

Sub address (0..255)

I/O combination

Optional com. port

I/O combination and optional com port, corresponds to the model of **TBoxLT2** you are configuring. Check the front sticker:



Example: LT2-542-3



New Document Wizard

RTU Ethernet card

IP Address: 172 . 25 . 110 . 187

Subnet mask: 255 . 255 . 255 . 0

Gateway: 172 . 25 . 110 . 1

Preferred DNS: 8 . 8 . 8 . 8

Alternate DNS: 0 . 0 . 0 . 0

< Back Finish Cancel

IP configuration of Ethernet

5.2. Communicating with TBox LT2

Once you have opened a document, either created a new one with the Wizard or opened an existing one, you can **establish the connection** with your **TBox LT2**.

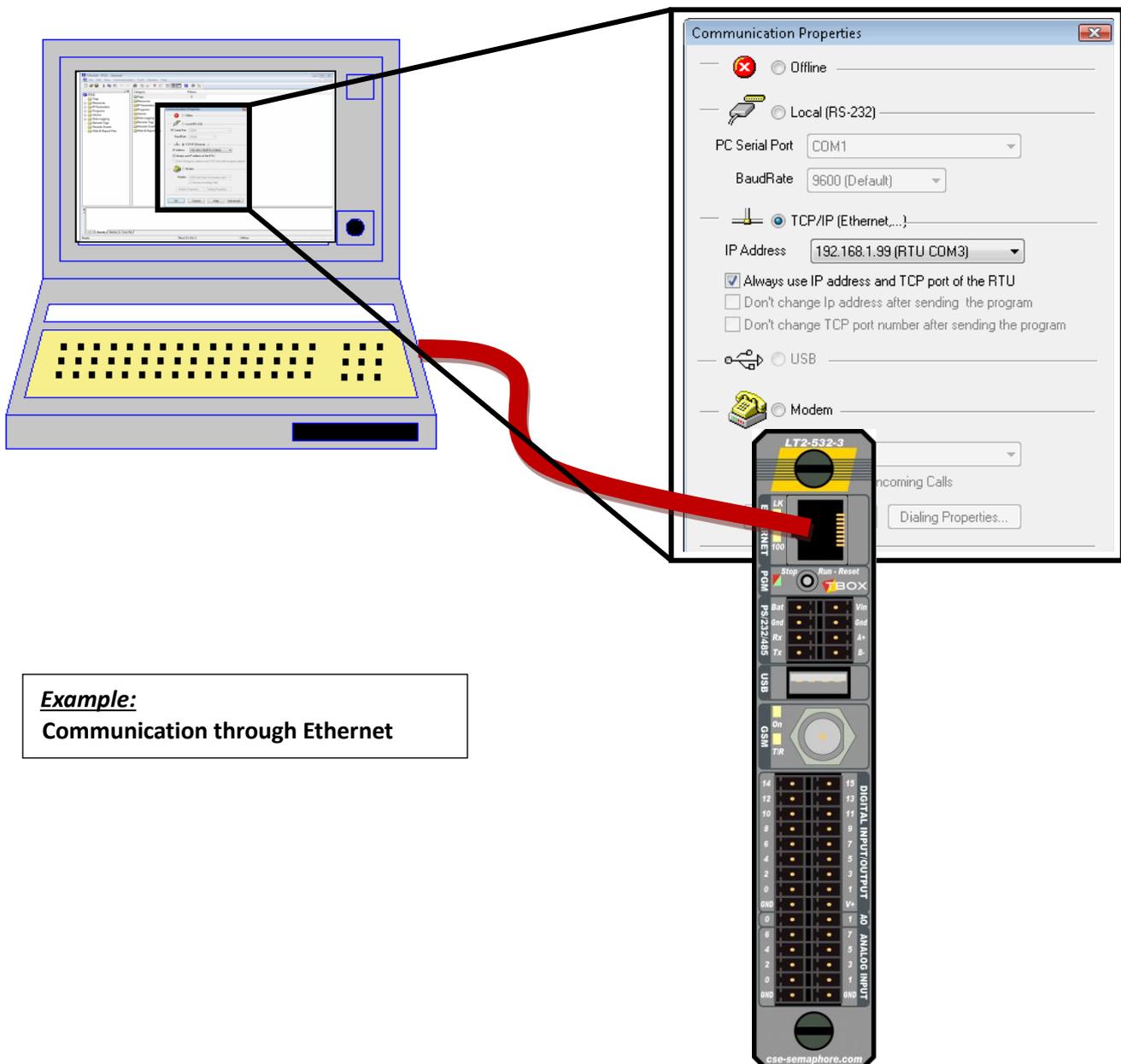
The possible communications are **serial**, **Ethernet**, **USB** or **modem**, according to the media used to connect to **TBox LT2**. See details in chapter 8.2. **RTU Communication Ports**.

- **Serial:** check the Baudrate you have given to the serial port in your application (by default 9600, N).
- **Ethernet:** check the IP address you have given to your **TBox LT2** and that it is in the same subnet of the PC or accessible to the PC.
- **USB:** Communication happens in TCP/IP. **TBox LT2** acts as a DHCP server and provides to the PC an IP in the range 10.8.10.xxx. **TBox LT2** itself uses the IP address 10.8.10.1.
- **Modem:** check the tel. Number of **TBox LT2**.

5.3. PC Communication Set up

To communicate with the **TBox LT2**, you need to select a communication media on the PC.

From the main menu of TWinSoft: → **Communication** → **PC Setup**:



5.3.1. Communication possibilities of TWinSoft

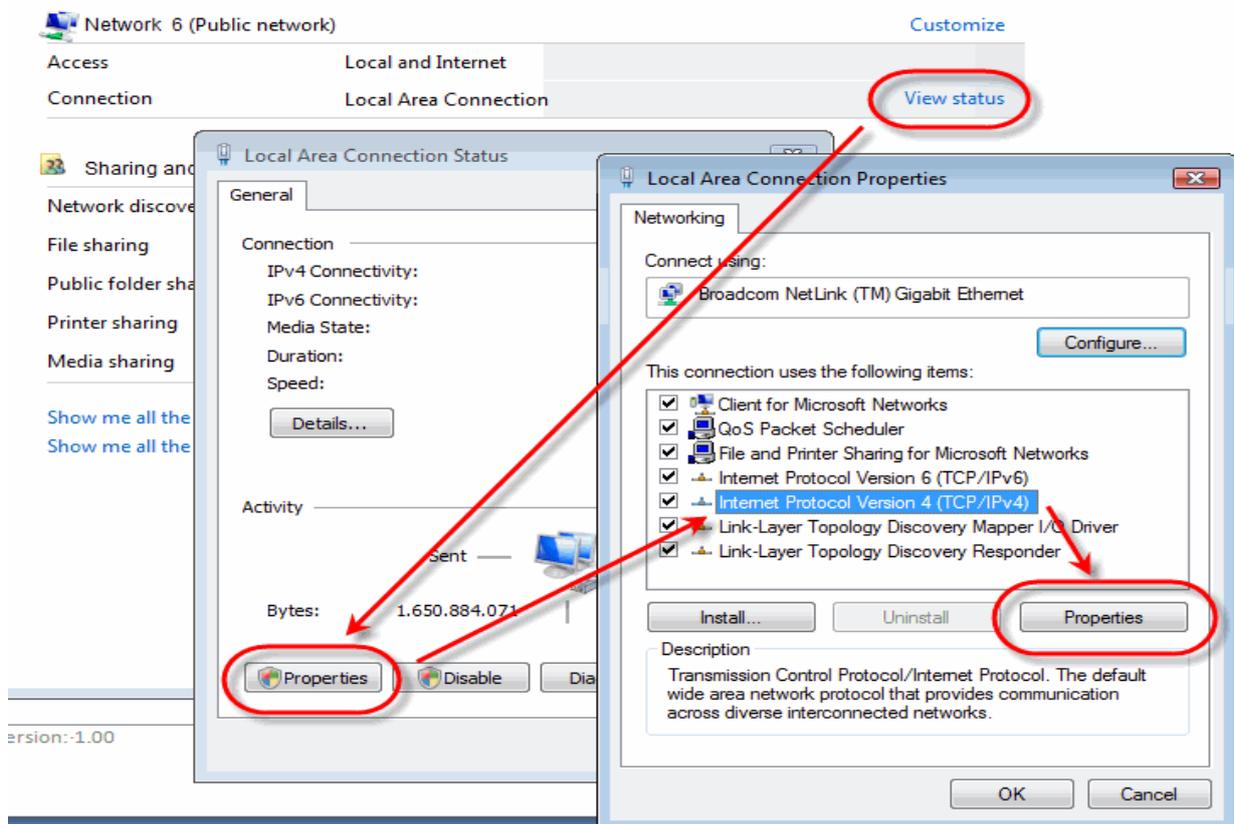
- **Offline:** this option avoid sampling **TBox LT2**
- **Local:** you select a serial port of the PC (typically RS232). The Baudrate must fit with the port of **TBox LT2** you are connected to.
- **TCP/IP:** to establish a communication in TCP/IP, typically through the Ethernet port of **TBox LT2**. TWinSoft will establish a connection with the IP address specified in the 'Ethernet' port settings (see chapter 8.1: '**CPU resources**'). It is also possible to specify another IP address, for instance if communicating to the **TBox LT2** through GPRS. (See details chapter 5.3.3 below)
- **USB:** You intend to access **TBox LT2** through a USB port of your PC. When you connect **TBox LT2** to the PC, the driver should be installed automatically by Windows. Would you find some problems, it can be installed manually. The driver is available in TWinSoft directory, name **TBoxUSBDriver.inf**. IP address of TBox is 10.8.10.1.
- **Modem:** to establish a remote connection to the **TBox LT2**. TWinSoft takes full advantage of Windows' built-in modem support: simply install your modem in the control panel's Modems applet of Windows and you are ready to call your **TBox LT2**.



You can develop your TWinSoft document **without connection** to the **TBox LT2**, but it will be mandatory to send it to have the RTU running!
The program can be sent through **RS232, RS485, Ethernet, USB or modem**

5.3.2. IP setting of PC

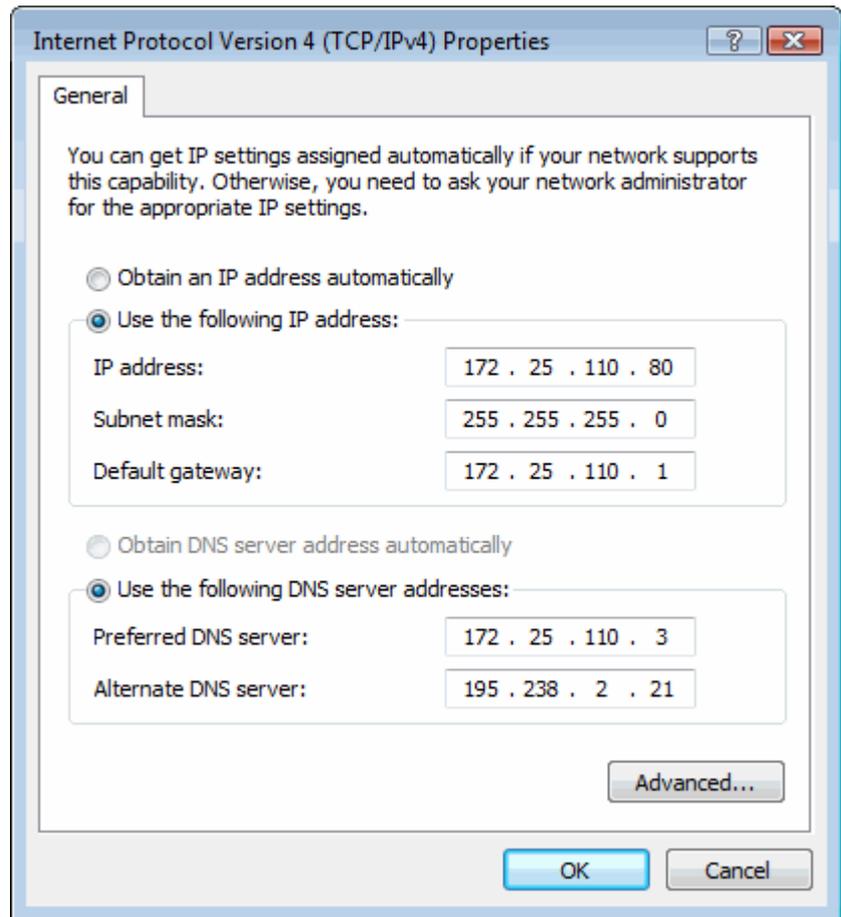
When communicating to **TBox LT2** through Ethernet, you have to make sure your PC is configured with fix IP. Go to "Network" -> "Local Area connection" -> "IPv4 properties":



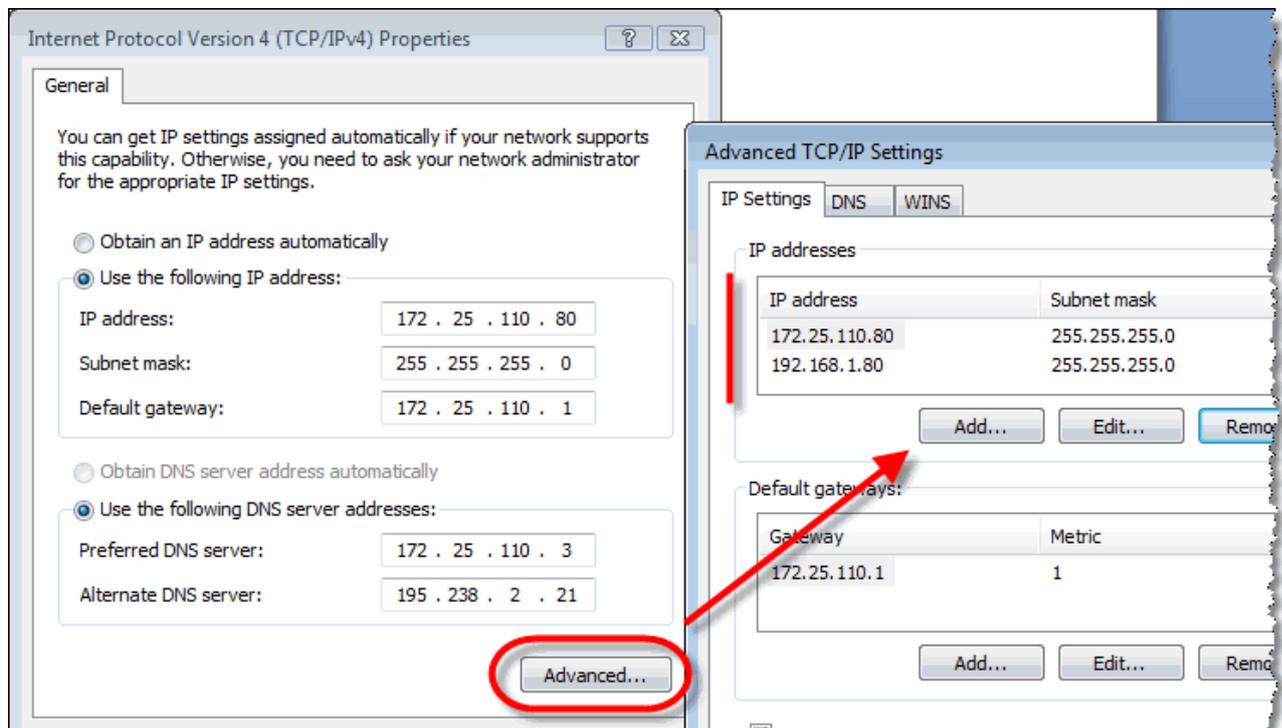
In IPv4 properties, type IP setting in the **same subnet as TBox**:

Example of subnet:

172.25.110.xxx
255.255.255.0



In case you intend to change IP address of **TBoxLT2**, you can define **several IP addresses in Windows**. In IPv4 properties, click "Advanced...", then "Add..." to add an IP address in the subnet corresponding to the current IP address of TBox, or to the one you want to change **TBoxLT2** to:

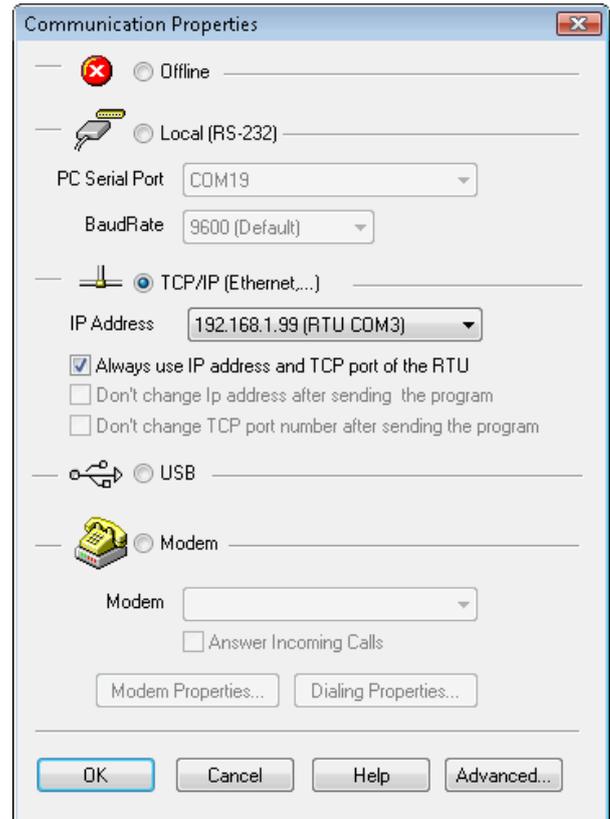


5.3.3. IP setting of TWinSoft

You may encounter three different situations requiring specific IP setting.

1. You program your **TBox LT2** through Ethernet and **you want to keep its IP address.**

You select in the drop list of IP addresses the one corresponding to the **TBox LT2** you are connected to.

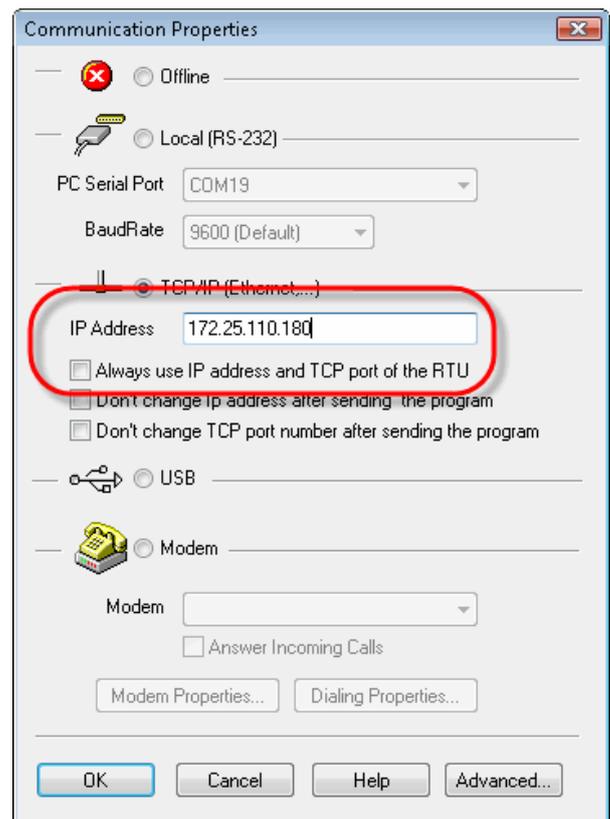


2. You program your **TBox LT2** through Ethernet and **you want to change its IP address.**

You check out the option “*Always use IP address of the RTU*” and you type the current IP address of the **TBox LT2** you are connected to.

When TWinSoft has finished sending the program, **it adapts itself automatically to communicate with the new IP address.**

 Make sure you have declared both subnets in Windows (see chapter 5.3.2. above)

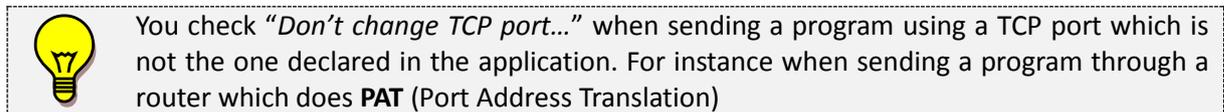
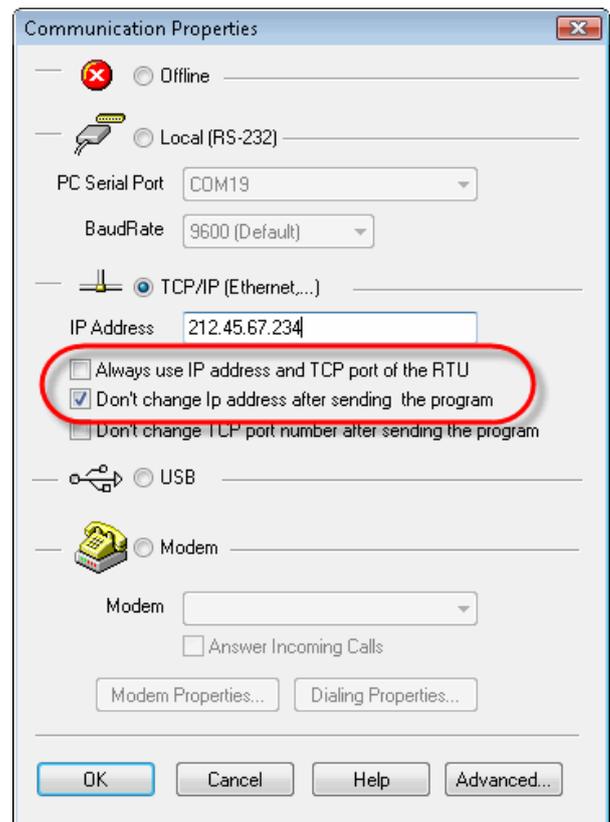
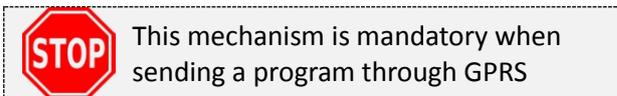


3. You **don't** program your **TBox LT2** through a **direct Ethernet connection** and you **don't** want TWinSoft to adapt to the Ethernet IP address

Example: you access your **TBox LT2** through ADSL or GPRS.

You check the option "*Don't change IP address after sending...*" and you type the current IP address of the port of RTU you are connected to, for instance the GPRS IP address.

When TWinSoft has finished sending the program, **it does not adapt itself to IP address of Ethernet of the RTU.**



5.4. Factory IP address - changing IP address

When you receive your **TBox LT2** from the factory, its IP setting is:

IP address: **192.168.1.99**

subnet MASK: **255.255.255.0**

To communicate using Ethernet, you have to make sure your PC is configured in the same subnet as **TBox LT2** (see chapter 5.3.2. above).

If you wish to **change the IP address** of **TBox LT2** to another subnet, you have to use the settings as described point 2. above.

In case you have not declared the 2 subnets in your PC (as described in 5.3.2. above), to restore the communication do the following:

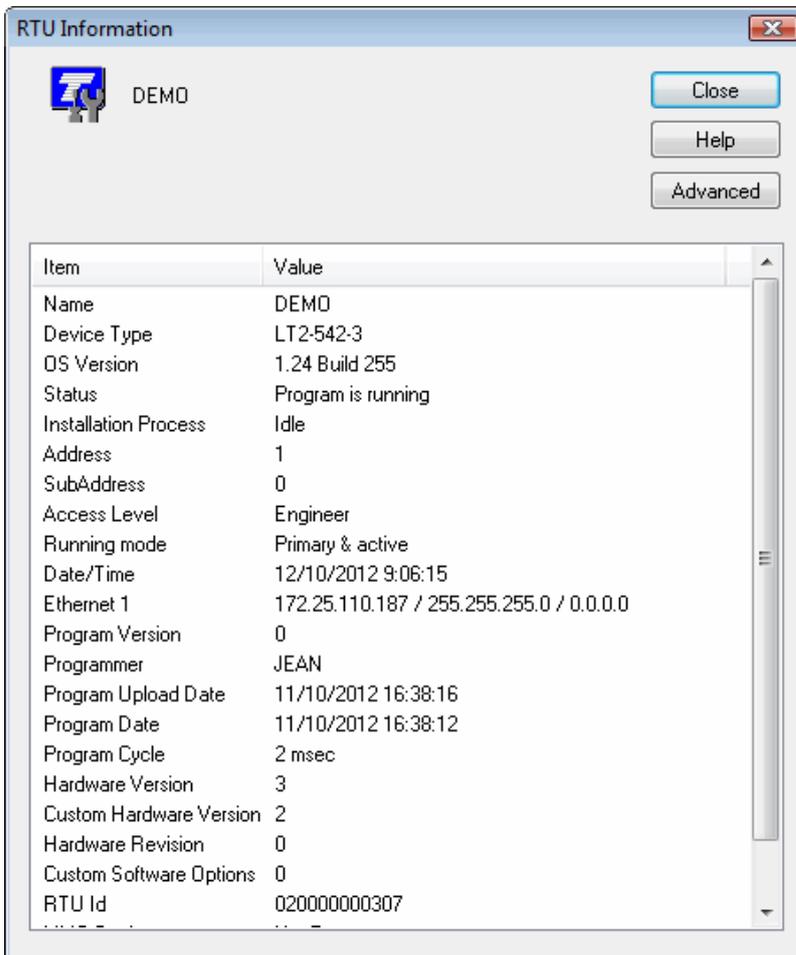
- Send program to **TBox LT2**. At the end of sending the RTU restarts with its new IP address. TWinSoft will lose communication and will not be able to start **TBox LT2**.
- Change the IP settings of your PC to the same subnet as **TBox LT2**.
- Go to TWinSoft "Communication" -> "PC Setup" and check the IP address selected is the new one.
- Click "OK" and check in the status bar you are connected.
- Go to TWinSoft "Communication" -> "Running mode" -> "Start/Stop Program".

When you don't know the IP address of **TBox LT2**, you can set its communication setting to the factory configuration (see chapter 5.6 below).

5.5. Testing communication

Once you have selected the media on the PC, you can **test the communication**.

From the main menu of TWinSoft: **Communication** → **RTU identification**:



Item	Value
Name	DEMO
Device Type	LT2-542-3
OS Version	1.24 Build 255
Status	Program is running
Installation Process	Idle
Address	1
SubAddress	0
Access Level	Engineer
Running mode	Primary & active
Date/Time	12/10/2012 9:06:15
Ethernet 1	172.25.110.187 / 255.255.255.0 / 0.0.0.0
Program Version	0
Programmer	JEAN
Program Upload Date	11/10/2012 16:38:16
Program Date	11/10/2012 16:38:12
Program Cycle	2 msec
Hardware Version	3
Custom Hardware Version	2
Hardware Revision	0
Custom Software Options	0
RTU Id	020000000307

Available information:

Name of the RTU
Type of Hardware
Version of Operating System
Status of the process

ModBus address of the Station
Sub-address of the Station
Access level of the current user

Date/Time in the RTU
IP configuration of the Ethernet

General information about the program

Process cycle time

Unique ID of the RTU

MMC (SD card) information

The **Status bar** of TWinSoft displays the status of the connection:

Online : TCP/IP (172.25.110.187) - Engineer

The communication media used by the PC is indicated as well as the access level of your connection (see chapter 17: **'Security'**).

If a connection cannot be established with **TBox LT2**, it might be because the configuration of its port does not fit with the PC setup you use (different Baudrate, different IP address, protocol other than ModBus, ...).

To set **TBox LT2** to a default configuration, you do a **global reset** (see next).

5.6. Reset of TBox LT2

Pushing toggle switch to “Reset” position restarts the program:

- stack of alarms and events are erased
- datalogging is maintained
- Tags with initial value are set to their initial value; others are maintained
- Local Tags and timers are reset (status and value=0)
- Counters are maintained

5.6.1. Global reset of TBox LT2

The Global Reset is used to set **TBox LT2** to a default, **well-known configuration**, in case it does not communicate anymore. The program running in the CPU is stopped and **TBox LT2** runs on the **Operating System**.

This is very useful when you take a CPU from the shell and you have no idea how the port you want to communicate with is configured.

The global reset is achieved using the **toggle switch on the front side of TBox LT2**.

Procedure:

- Push and maintain the toggle switch to “Reset” side
- The LED turns red for about ½ second
- Let the LED flash “green” 3 times
- Release the toggle switch



Global reset configuration:

The global reset mode is indicated by the LED **flashing green at 0.5 Hz** (instead of 2 Hz in RUN mode). In this mode, **TBox LT2** is configured like as following:

Port	Protocol	Station address	IP address
COM1 (RS232)	ModBus	1	-
COM2 (RS485)	ModBus	1	-
COM3 (Ethernet)	-	1	192.168.1.99
COM4 (modem)	ModBus	maintained	



The Global Reset **does not erase the current program**. Doing a single Reset will restart the program

5.6.2. Working Modes Available with Toggle Switch

Pressing and maintaining the toggle switch to “Reset” position, the LED Run will flash. According to the number of flashes, you can set **TBox LT2** to different working modes:

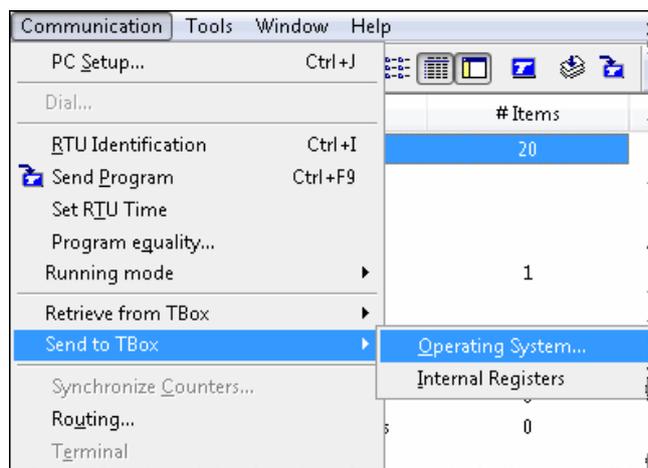
Flash #	Mode	Communication	Protocol	LED “Run”
1	Restart application	As in application	As in application	2 Hz
3	Program stopped	Serial: 9600, N, 8, 1 Ethernet: 192.168.1.99 Modem: available	ModBus-RTU ModBus/TCP Firewall stopped	½ Hz
9	OS stopped, LINUX running	Serial: 9600, N, 8, 1 Ethernet: 192.168.1.99 No Modem	SSH, PING, TFTP	ON - Green
11	U-BOOT	Serial: 9600, N, 8, 1 No Ethernet No Modem	Text, TFTP	ON - Red

5.7. Sending 'Operating System'

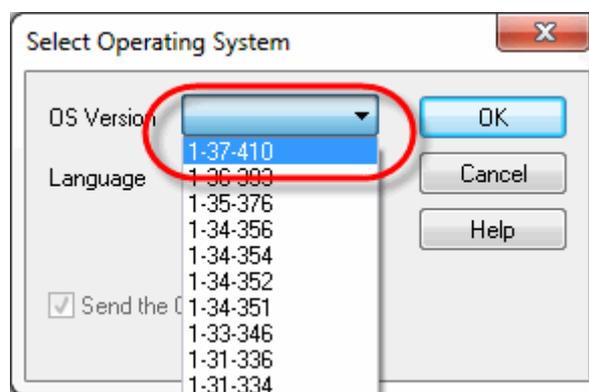
Operating System is the heart of your **TBox LT2**. It contains all features of **TBox LT2**.

In some cases you might have to change this operating system, when new features are available or a bug fix released.

From the main menu, "Communication", select "Send to TBox".



Select the highest version in the list to take advantage of latest features and corrections.



5.8. LED « RUN »

This LED, next to the "Reset" toggle switch indicates the status of the CPU.

LED sequence at **TBox LT2** startup:

Red one flash	Boot Strap starting
Red ON (1 sec.)	UBOOT starting
Orange ON (4 sec.)	KERNEL starting
Green ON (4 sec.)	OS starting
Red ON	Package installation after sending, Plug&Go on SD Card or USB stick (up to OS 1.31.336)
Red/Green flashing (1Hz)	Package installation after sending Plug&Go on SD Card or USB stick (as of OS 1.33.346)
Green flashing at 2 Hz	Application runs

Other status:

Green flashing (1/2 Hz)	Program Stopped
Green ON	OS Stopped
Red ON	LINUX stopped
Red flashing at 8 Hz	Alarm(s) active
Green flashing at 8 Hz	Running "Failsafe" program

5.9. Saving and Sending a Program

Like any Windows program, TWinSoft creates “Documents”.

A document corresponds to a **TBox LT2** application. Each of them must be saved using the Windows standard.

5.9.1. Saving a document – Backup document

Possibilities for saving a document:

- Use the icon  of the main tool bar
- From the main menu use: ‘File’ → ‘Save’
- Use the accelerator keys <CTRL + S>

Saving a document creates a file with the extension ‘.tws’ which is your TWinSoft application.

But each time a TWinSoft project ‘tws’ is opened successfully; it is saved in a back up file ‘.tbk’. If you encounter some problem retrieving your ‘.tws’ file, you can just replace the ‘.tbk’ extension by ‘.tws’ and use the back up.

During development of the application, it can be sent at any time to **TBox LT2**, for testing purpose. When sending an application to **TBox LT2**, it is first compiled and then sent, in the same sequence.

5.9.2. Compiling an application

Compilation converts the document into microprocessor code. To compile, you can:

- use the icon  of the main tool bar
- use the accelerator key <F9>

The result of the compilation is available in the **Results window**. This window automatically pops up when there is a compilation error but it can be opened manually:

- from the main menu: ‘View’ → ‘Results’
- using the accelerator keys <ALT + 2>

The Results window provides useful data:

Information: indicated in black
Warning: indicated in bold dark green
Error: indicated in bold red

```
Compiling '542-3.tws'...
RTU : Currently running Os Version : 1.24 (Build 255)
RTU : Os Version 1.24 (Build 255)
Warning : Port COM3 - gateway is empty.
Warning : No 'index.htm' file found in Web&Report Files.
Start programs compilation.
main
End of programs compilation.
Warning : Communication Port 'COM4' : The PIN Code 'AT+CPIN="n"' appears as not valid, it will not be used.
Error : Server "SMTP" uses DNS address, but associated port (COM3) does not have DNS server address.
Error : Server "SMTP" uses DNS address, but associated port (COM3) does not have a default gateway.
Memory information (bytes) :
- Programs : Available 262144, Used 1746, Free 260398
- SRAM : Available 1024000, Used 885951, Free 138049
- SRAM detail : Event(9484) ChronoDig(12018) ChronoAna(12024) EventLog(0) Sampling(786564) Backup(133) Addons(0)
Compilation failed : 2 errors (3 warnings).
```

Test of memory

Detail on memory “used” and “free” is also available during compilation.
See details chapter 20.1: **Technical Specifications**.

5.9.3. Sending an application

In order to have **TBox LT2** running with the program you have developed with TWinSoft, you have to send it. You can use any media to achieve it (RS232, modem, Ethernet, ...).

Possibilities for sending a program:

Use the icon  of the main tool bar
From the main menu use: ‘Communication’ → ‘Send program’
Use the accelerator keys <CTRL + F9>

The sequence for sending is **Compiling + Sending**.

If a problem occurs during compilation, the sequence is stopped and the “Results” window pops-up (see above)



TBox LT2 keeps running during sending. At the end of sending, there is a de-installation/re-installation controlled by TWinSoft. In case communication is lost during this period, **TBox LT2** will still be available with its IP address of the application.

DO NOT RESET TBOX DURING INSTALLATION AND START PROCEDURE

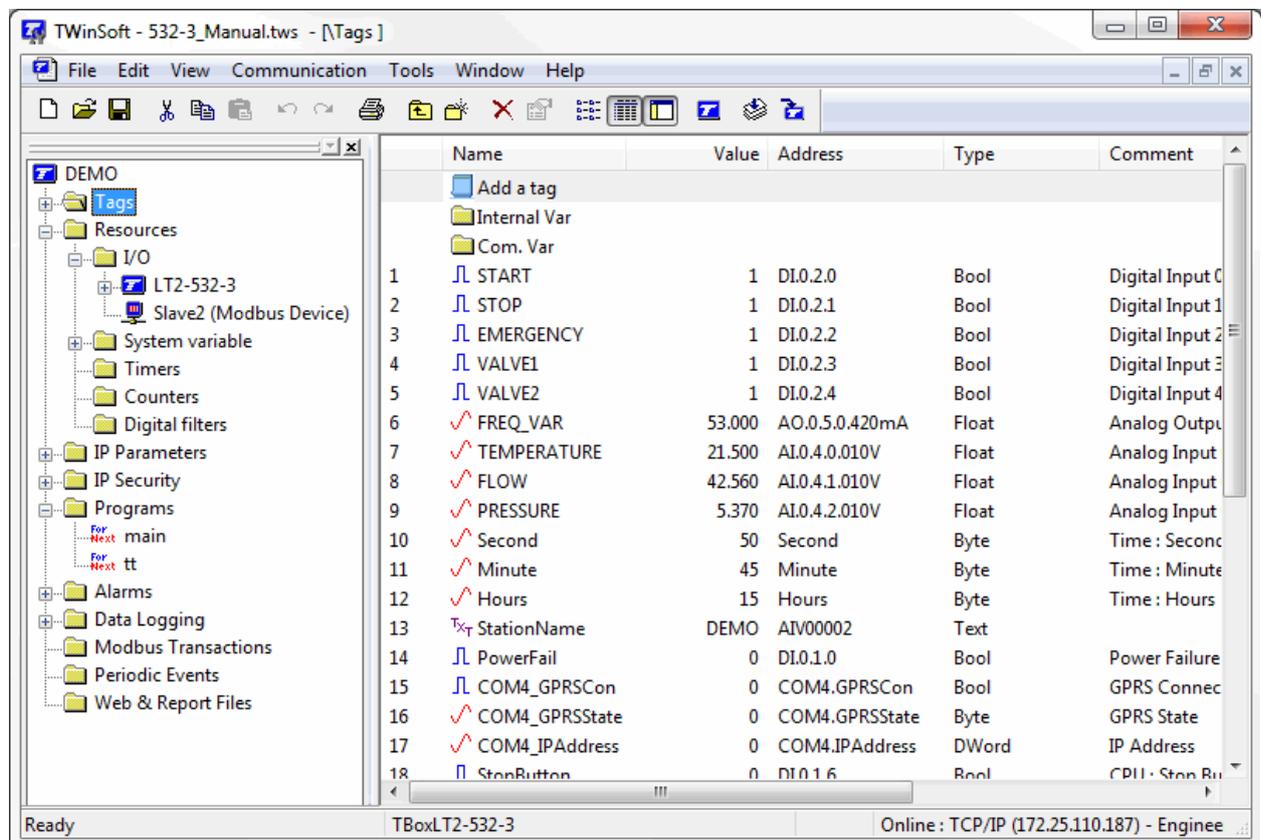
TWINSOFT - PROGRAMMING

6. Introduction

TWinSoft uses the standard look and feel of “Windows Explorer”, with at the left side a list of folders and at the right side the content of the folder selected.

Each Folder consists in a list of items.

For instance the **list of “Tags”**, or in the ‘Alarms’ folder the **list of “Recipients”** or in the ‘Datalogging’ folder the **list of “Sampling tables”**, ...



The programming of **TBox LT2** application will be done in different steps:

- Configuring the **RTU properties**
- Configuring the **communication ports** and **I/O's** (from the 'Resources')
- Creating **Tags**
- Creating **Programs** using automation language Ladder and/or BASIC
- Creating **Alarms**
- Creating **Datalogging**
- Creating **Remote Device** and associated **ModBus Transactions** to exchange data as Modbus “Master”.

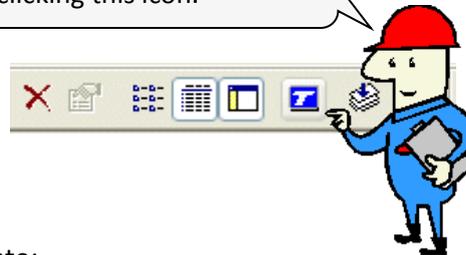
The sequence in which those tasks are executed is not fixed, but at least RTU properties, Resources and Tags should be configured first, as being required for all other programming.

All these configurations are explained in the following chapters.

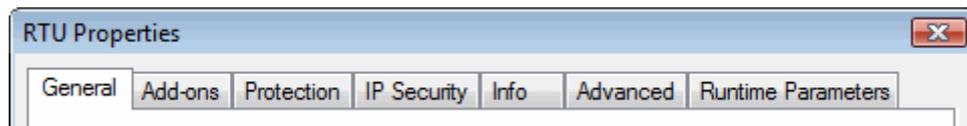
7. RTU properties

Setting the properties of **TBox LT2** has never been so easy thanks to a set of comprehensive dialog boxes, available from the main tool bar.

RTU properties can be accessed easily by clicking this icon.



The RTU properties are divided into:



- **General** the type of the RTU, station ModBus address, RTU location, size of the chronologies, ...
- **Add-ons** configuration of external software modules written in 'C', typically to communicate with advanced protocols like DNP.3 and IEC-60870, or to execute specific task like AGA calculations.
- **Protection** to activate protection on TWinSoft document, communication port, protocols, ...
- **IP Security** to activate Firewall, HTTPS and change SSH password.
- **Info** to type any info about your program, its different versions, ...
- **Advanced** for some features, advanced parameters are available: during start-up, when sending alarms, about sampling tables, TCP/IP, ...
- **Runtime Parameters** to declare some properties as Tag, to change them dynamically



Communication ports are configured from the 'Resources'.
Configuration of **TCP/IP** services is done from the 'Workspace' and folder IP parameters.

7.1. General properties

RTU Properties

General Add-ons Protection IP Security Info Advanced Runtime Parameters

Identification

RTU type: TBoxLT2-542-3

Name: DEMO Custom Code: 0

Modbus Address: 1 OS Version (Offline)

SubAddress: 0 Major: 1 Minor: 24

Telephone Number

Country: Belgium (32)

Area Code:

Telephone Number: Connect using an internal line

Sizes

Digital Chronology: 100 records

Analog Chronology: 100 records

Addon Event Log: 100 records

Time Zone

Time Zone: (GMT+01:00) Brussels, Copenhagen, Madrid, Paris

Summer / Winter Management

OK Cancel Help

RTU Type: The type of RTU you have selected with the Wizard.
It cannot be changed!

Name: type a free name for **TBox LT2**. It will be displayed when doing a 'RTU identification' and **used by the data aggregator software, TView**.
Maximum 11 characters.



Don't use space.
As far as **TView** is concerned, don't start the name with a number

ModBus address: with ModBus protocol, each device must have a **Station number**. It is its ModBus address.
Enter a number between 1 and 254 (default=1).

Sub address: if more than 254 x **TBox** must be installed in one project, you need to define a Sub address. As this is not ModBus standard, it is only supported by 'TComm.dll' based software (TWinSoft, **TView**,... please call your distributor for further information).
Enter a number between 0 and 255 (default=0).

OS version: when **working Offline**, it is the OS used to simulate the compilation.
By default it is the OS version associated to version of TWinSoft.

Telephone number: Configuration used by TWinSoft when it needs to dial **TBox LT2**.

Sizes: Number of records of **Digital and Analog chronologies**. Chronologies represent the "on event" method of recording data in **TBox LT2**, also known as "Sequence on Event" recording (see chapter 14: **Data logging**).
Digital Chronology: max. 32 000 (Default=100).
Analog Chronology: max. 32 000 (Default=100).



Check memory available. See chapter 5.10.2: **Compiling an application**

Time zone: The Time Zone **where TBox LT2 is installed**.
Timestamped data are recorded internally in **TBox LT2** with universal UTC time (Universal Coordinated Time). When data is generated from **TBox LT2** the latter uses this setting to convert UTC time into local time.
See Appendix B : **Time in the RTU** for more information.

Summer/Winter: Allows **automatic management of day light saving**. This selection has to be made according to the location where **TBox LT2** is installed.
See Appendix B : **Time in the RTU**

7.2. Add-ons

An add-on is a module written in 'C' that executes a dedicated task not embedded in Operating System. Typically, it is communication to SCADA, like DNP.3 or IEC protocols or communication to PLC like AB (DF1), OMRON, ...
It can be also specific tasks, like AGA calculation.
Check add-ons availability at <http://helpdesk.servelec-technologies.com>

7.3. Protection

Access security is discussed at chapter 17.

7.4. IP Security

7.4.1. Firewall

TBox LT2 embeds a Firewall.

Once activated it gives access to exception rules in folder "Resources" → "IP Security" → "Firewall" (see chapter 11.2).



Once Firewall has been activated, **make sure to define rules!** In case you activate Firewall without declaring any rules, **all IP access to **TBox LT2** will be blocked.**

- Doing a global reset, the rules are deactivated while TBox is in stop mode and access restored.
- Doing a stop from TWinSoft, the rules stay active, also when sending a program.

7.4.2. HTTPS

HTTPS, with "S" for "secured", is an alternative to HTTP but protected with the use of SSL and TLS protocols. It provides protection on data when accessing TBox as Web Server.



Certificate and key can be generated using OpenSSL.exe (see chapter 11.1. **OpenVPN**)

Certificate

When the browser connects to **TBox LT2** using HTTPS, it has to identify the server using a certificate. Either you don't have a certificate then you can generate one from TWinSoft. Click "**Generate**".

Or you have a certificate, public or private. A public certificate is authenticated by Certified Authorities like *Thawte, Verisign, DigiCert, ...*

Either you have authenticated a certificate to a Certified Authority and you connect directly to **TBox LT2** or you have created your own certificate and then during the first connection the browser will prompt you to trust the site. You indicate here the content of the "**Server**" certificate: **<server>.crt**

Key

The key is used to encrypt data. You indicate here the content of the "**Server**" key: **<server>.key**

Generate

In case you don't have your own certificate and key, type the button "Generate":

Generate a certificate

Common Name: Servelec-Semaphore

Country code: BE

Expiration: 365 days

OK Cancel

Fill the fields corresponding to your company.

Disable HTTP

To extend protection, HTTP can be disabled; meaning only secure connection will be allowed.

7.4.3. SSH

SSH stands for "Secure Shell". It is a secured protocol you can use to access TBox in Console mode. SSH requires a login.

As of OS 1.35, SSH login name can be changed in **TBox LT2**. You cannot use the name "root", which has highest privileges and a full system access. This is not allowed.

With older Operating System, the fixed name used previously is still used, even when it appears differently in TWinSoft.



Accessing TBox using console software, like PuTTY, make sure you start it "As Administrator". Depending on the Windows version, login might be rejected if not running as administrator.

7.5. Info properties

You can enter a version number, the name of the programmer and a description of your program. This information is not sent to **TBox LT2**.

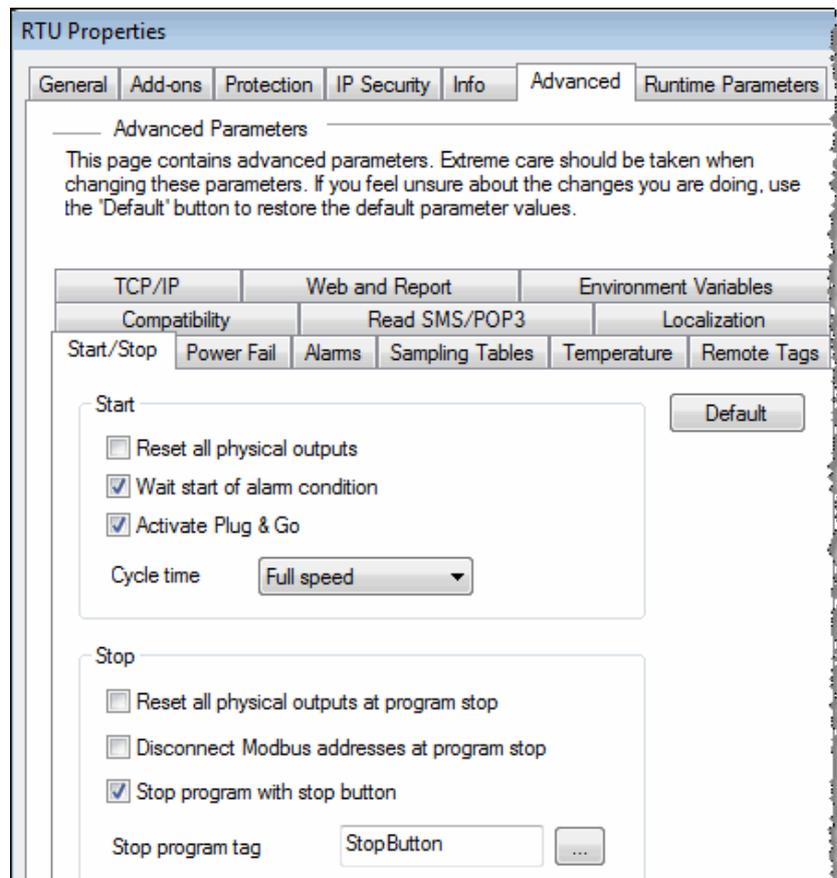
7.6. Advanced

7.6.1. Start/Stop

By Start-up we mean:

- Reset of RTU (HW or SW).
- Sending of Program

See also chapter 5.6 above



Under these conditions two mechanisms of the RTU can be customized:

START

Reset all physical outputs: when **active**, at start-up the **RTU reinitializes the outputs** to '0'. After that the outputs are monitored according to the process.

When **not active**, at start-up the **outputs are maintained to their last status**. After that, outputs are monitored according to the process (default).

Wait start of condition: this feature relates to **alarm condition**.

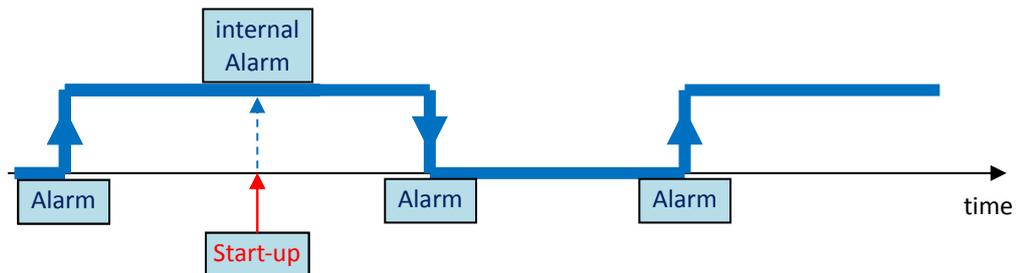
The mechanism of generating alarm is based on transition: the changing of a digital Tags or the overstepping of an analog threshold.

This option allows changing this rule at start-up:

With 'Wait start of condition' active:



With 'Wait start of condition' not active: if the alarm condition is true at startup, an internal 'start of alarm - auto-ack' is generated. When the alarm condition disappears, the alarm is generated.



Activate Plug & Go: *Plug & Go* feature allows storing the complete TWinSoft project into a SD card.

See chapter 19.3. **Micro SD card implementation.**

To use the feature, check this option.

Cycle Time: The frequency at which the process cycle is executed can be adjusted from here.

The choices are:

- Full Speed (default). By default it is executed as fast as possible, with no delay between the cycles.

- 20, 50, 100, 250, 500 ms.

The current time of one cycle can be checked in the RTU identification window.

STOP

Reset All physical outputs at program stop: when this option is active, the RTU reinitializes the outputs to '0' at **stop**. This is particularly useful if you want to reset the outputs when sending a new program, and **you want to be sure they stay at '0'** during the sending and restarting sequence.

After that, outputs are monitored according to the process.

Disconnect ModBus address at program stop: all variables will have their ModBus address disconnected, which means that external equipment accessing the RTU will receive communication error.

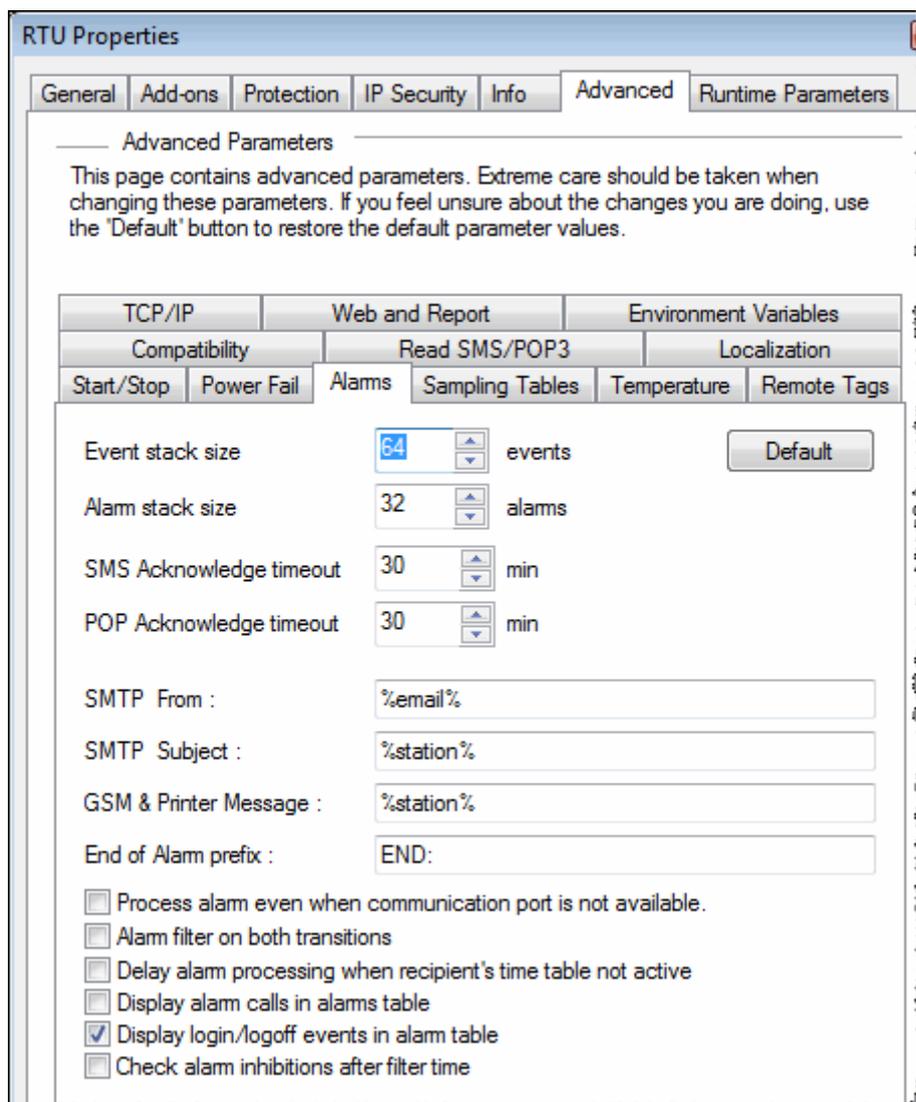
This feature has been implemented to allow a SCADA detecting immediately a TBox is stopped: as the ModBus addresses are not available, the RTU stays in communication but returns an 'Exception' error.

Stop program with toggle switch stop: when this feature is active, you have to select the Tag corresponding to the toggle switch 'Stop' in front of the CPU (See in the Resources → CPU → Group 1).

Pressing the toggle switch will stop the program (Process, Alarms, Datalogging, ModBus Transactions, ...)

NO other digital input than 'Stop' toggle switch can be used, but any internal digital register can.

7.6.2. Alarms



Event stack: is a public stack, accessible by users, where alarms are available with date, time, recipient, message, status,

The Event stack can be displayed from the main menu: 'Communication' → 'Retrieve from TBox' → 'Alarms'.

The **object 'Alarms' used in a WebForm** displays the Event stack. It corresponds also to the list of Alarms sent to **TView**.

Alarm stack: is an internal stack used to buffer alarms when there are several to handle at the same time or when the communication port is not available or when retries are required.

SMTP From: when receiving an e-mail from **TBox LT2**, the field 'From' indicates the origin of the e-mail.

It accepts any text and the following parameters:

%station% : replaced by the name of the station (see General properties)

%email% : replaced by the e-mail address of the RTU

Example: TBox_%station% <%email%>

SMTP subject: when receiving e-mail from **TBox LT2**, the field 'Subject' can be dynamized like following:

When sending a message, the field 'Subject' contains the message.

In addition, it accepts any fix text and the following dynamic data:

%station% : replaced by the name of the station (see General properties)

%email% : replaced by the e-mail address of the RTU

%time% : the time of the RTU when the e-mail was generated

Example: Report TBox %station% - %time% :

When sending a report, the subject field contains the Title of the report (see Report Studio); title that can contain the parameter %station% (see above)

GSM & Printer message: when **TBox LT2** sends SMS, you can add information to the message.

This information is sent in front of the message.

You can type any text and the following parameters:

%station% : replaced by the name of the station (see General properties)

%time% : the time of the RTU when SMS (or printing) was generated

%condition% : It will result in an exclamation mark (!) in the message if the condition of the alarm is still active when the alarm is sent.

End of Alarm prefix : allows specifying a text that will be sent in front of the message, **when the alarm condition ends**, to indicate it corresponds to the End of the alarm

Example:

END:

Message sent when the condition ends: .

END: Level too HIGH



Check the total length of SMS message according to the coding used (TEXT or UCS-2) as explained chapter 12.6.1. **SMS coding**.

Process alarm even when com. port not available:

An alarm corresponds always to a communication (at the exception of "Internal" alarms). When an alarm condition is activated, by default, it waits the availability of the com. port to be handled (Ethernet cable connected, GSM present, PSTN line detected, ...) This can lead to problems in handling escalation: if a media is not present, the alarm process will be stopped.

This option allows carrying on alarms, even when the port is not available.

Alarm filter on both transitions: this option allows computing the filter of alarm condition during **both transitions:** when the Tag value goes to alarm condition **AND** when it leaves alarm condition.
 This option will be applied to **all alarm conditions**.
 This is particularly useful to filter interferences on inputs.

Delay alarm processing when recipient's time table not available

This feature is associated to the "Scheduling" and time table attached to the recipient. If the time table is not active when the alarm is initiated, this feature provides 2 options:

- the alarm is auto-acknowledged (by default)
- the alarm is maintained in the alarms stack until the time table becomes active. The "Start" timestamp is the one at the moment the alarm condition was generated.

Example: the alarm condition happens at 2:35 AM, but it is not an urgent alarm. It is an SMS meant to inform the technician. The "recipient" is configured with a time table starting at 8:00 AM (corresponding to the technician work shift). Therefore, the technician will receive the message at 8:00 AM, but with a timestamp of 2:35, informing him when the event happened

Display alarm calls in alarm table: This feature is associated to the alarm condition sent to a group of recipients.
 When this feature is active, the alarms table displays the event having initiated the alarm and all the calls generated (see below).

Event stack displaying also alarm calls:

Working with group of recipients, it is also possible to display each call with its acknowledgment status:

Start timestamp	Message	Start	Recipient	End timestamp	End
9/06/2009 14:19:40	(*) It is time to wake up !	Ack'ed	George	-	-
9/06/2009 14:19:18	(*) It is time to wake up !	Ack'ed	John	9/06/2009 14:19:34	Ack'ed
9/06/2009 14:18:55	(*) It is time to wake up !	Ack'ed	Paul	9/06/2009 14:19:18	Auto ack.
9/06/2009 14:18:54	It is time to wake up !	Ack'ed	John	-	-
9/06/2009 14:17:50	New Program	Auto ack.		-	-

Message: message preceded by (*) means that it corresponds to a call

Start: always Ack'ed

Recipient: name of each recipient of the group

End timestamp: timestamp corresponding to the end of the call

End: acknowledgment status of the call: **Not Ack; Ack'ed** or **Auto ack.**

Display logon/logoff events in alarm table: Logon/Logoff are events logged when a user logs in on a communication port which is protected.
 These events can be removed from the list, to avoid events not being real alarms.

Check Alarm Inhibition after filter time: For each alarm condition, one can declare a filter before the alarm will be computed. For each condition, an option "handling" allows inhibiting the alarm according to external circumstances: flag *Disala* or *power failure*.
 This option allows checking the inhibition condition **after the filter has elapsed**. This is particularly useful working with "Power Failure" detection; the latter might be detected after the sensors have been in error which will then generate an alarm. In

such case, you declare a filter of some seconds on the alarm condition and check this option; the alarm on the sensor will be inhibited properly in case of *power failure*.

7.6.3. Sampling Tables

This menu gives access to the parameters for **long period recording in Sampling tables**. (See chapter 14.3: '*Sampling tables*')

These configurations concern all sampling tables.

The screenshot shows the 'RTU Properties' dialog box with the 'Advanced Parameters' tab selected. The 'Sampling Tables' sub-tab is active, showing configuration options for Daily, Weekly, and Monthly sampling. The 'Daily' section has a 'Time' field set to '00:00' and a 'Default' button. The 'Weekly' section has a 'Day' dropdown set to 'Monday' and a 'Time' field set to '00:00'. The 'Monthly' section has a 'Day' field set to '1' and a 'Time' field set to '00:00'. At the bottom, there is a checkbox labeled 'Sampling tables on SD/MMC' which is currently unchecked.

- **Daily:** When 'daily' is selected in sampling table, it is the time of the day the recording is executed.
- **Weekly:** When 'weekly' is selected in sampling table, it is the day of the week and the time the recording is executed.
- **Monthly:** When 'monthly' is selected in sampling table, it is the day of the month and the time the recording is executed.

Sampling tables on SD: In case a micro SD has been plugged into **TBox LT2** (see chapter 19.3. **Micro SD Implementation**) this option allows storing sampling tables on micro SD card and therefore increase the number of tables stored.

7.6.4. Temperature

For Temperature analog input (Pt1000), you can define a unit: **Celsius**, **Fahrenheit** or **Kelvin**.



The unit is the same for all inputs

7.6.5. ModBus Transactions

Reset the device Trigger only if success When communicating as 'Master' using 'ModBus Transactions', a Trigger is switching communication to the remote device (see chapter 15. *ModBus Transactions*).

This Trigger activates the communication according to a 'State' or 'Edge'. Working with 'Edge', the RTU restores automatically the Tag after the transaction(s).

- With this option active: the Trigger is restored **only when communication has been done successfully**.
- Without this option: the Trigger is restored when all ModBus Transactions associated to the device have been executed, with or without error.

Remote device inactivity delay: this option allows defining a quarantine delay when a Remote device is in communication error.

Keep socket open: **working with OS >= 1.35.374**

When carrying on Modbus Transactions in Modbus/TCP, *TBox LT2* will use one TCP context per remote device. Checkink this option, the socket for each device will be kept opened, preventing overhead communication.

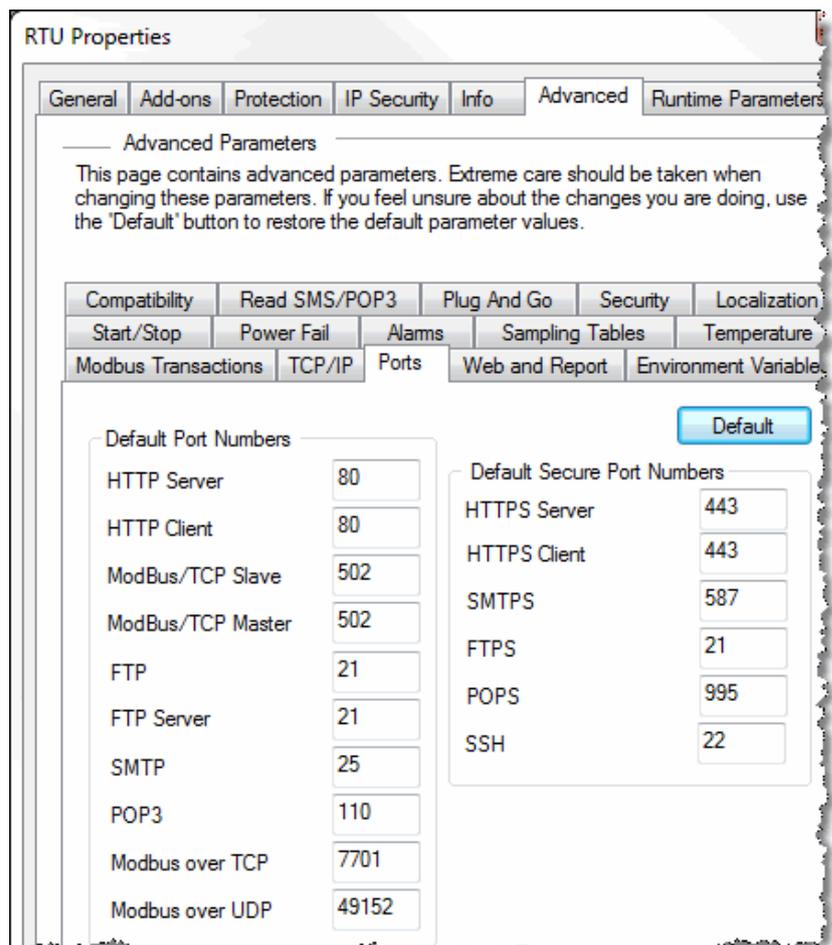
Working with OS < 1.35.374.

Only ONE is available socket available. Therefore, this socket is opened/closed at each execution of a list of Modbus Transactions. When there is only ONE remote device, this option allows keeping the socket opened and therefore improving the communication.

7.6.6. Ports

Each TCP/IP service has its own unique **TCP port**. It provides a logical location for the delivery of TCP data. TCP Port number complies with a standard defined by the IANA to be sure everyone using a TCP service uses the same TCP ports according to protocols used.

When working with *TBox LT2*, in some cases, you might want to change this port number.



HTTP(S): port used to access **TBox LT2** as WebServer. (by default= 80 & 443)

ModBus/TCP-Slave: port used by a 'Master' to access **TBox LT2** as 'Slave'. (by default=502)



Changing of TCP port is automatically applied to 'WebForms 1.0' as it uses ModBus for data communication.

ModBus/TCP-Master: port used when **TBox LT2** is 'Master' to access a remote device (by default=502)

ModBus over TCP: port used by ModBus RTU encapsulated into TCP (by default= 7701)

ModBus over UDP: port used by ModBus RTU encapsulated into UD (by default= 49152)

FTP(S): port used by **TBox LT2** to send Files (by default=21).

SMTP(S): port used by **TBox LT2** to send e-mails (by default=25 & 587).

POP3(S): port used by **TBox LT2** to collect subject of e-mail (by default=110 & 995).

Modbus over TCP: ModBus over TCP is a ModBus RTU frame encapsulated into a TCP frame.

Compared to ModBus/TCP, in which there is no station address neither CRC.

TCP port used by TBox MS to communicate in ModBus over TCP (default=7701)

Modbus over UDP: ModBus over UDP is a ModBus RTU frame encapsulated into a UDP frame.

Compared to TCP, it is faster than TCP because it does not require any acknowledgement.

With UDP, packets are just pushed without verification.

TCP port used by TBox MS to communicate in ModBus over UDP (default=49152)

SSH: used to carry on a secure connection, for instance to access LINUX in console mode. (default= 22)

7.6.7. TCP/IP

TCP/IP addresses for incoming calls

Range of addresses used during incoming calls. When **TBox LT2** is dialed in by a modem.

TBox LT2 uses the first address of the range and applies the following to the **remote equipment**.

Typically, this information is needed when **TBox LT2** is used as a Web Server, dialed from a browser.

RTU Properties

General Add-ons Protection IP Security Info Advanced Runtime Parameters

Advanced Parameters

This page contains advanced parameters. Extreme care should be taken when changing these parameters. If you feel unsure about the changes you are doing, use the 'Default' button to restore the default parameter values.

Compatibility	Read SMS/POP3	Plug And Go	Localization
Start/Stop	Power Fail	Alarms	Sampling Tables
Modbus Transactions	TCP/IP	Ports	Web and Report
			Environment Variables

Default

TCP/IP address for incoming Calls

From: 192 . 168 . 2 . 1

To: 192 . 168 . 2 . 99

TCP/IP miscellaneous

Enable IP forwarding

NAT

Address Translation

Virtual Server



Avoid using addresses in the **same range as the IP address defined for the LAN card of the PC used as Browser.**

TCP/IP miscellaneous



To access these features you have to **enable advanced IP configuration** (see chapter 17.1.7)
See also the sequence of configuration Appendix F.

Gives access to TCP/IP redirection:

- IP Forwarding
- NAT
- Virtual Server (configurable in IP Parameters as described chapter 12.8)

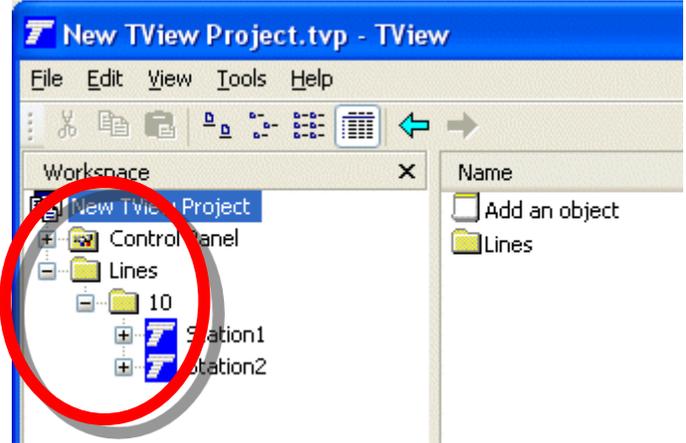
Once checking one of the above features, a login corresponding to the code typed when enabling advanced IP configuration is required.

It corresponds to the login as described chapter 17.3.

7.6.8. Environment variables

The environment variables are used when particular configuration might be needed in external software.

Available only when sending historical data through .tma file.

Variable	Value	Description
TViewPath	\path	<p>The path in which the station will be created when importing data in TView.</p> <p>The path is the relative path from the Project workspace of TView.</p> <p><i>Example:</i> with the Value: <code>\Lines\10</code></p> <p>Result in TView:</p> 
Longname	Type any long name	<p>The name typed here will be used in TView, instead of the one declared in the 'General' properties, which is limited to 8 characters</p>

7.6.9. Power Fail

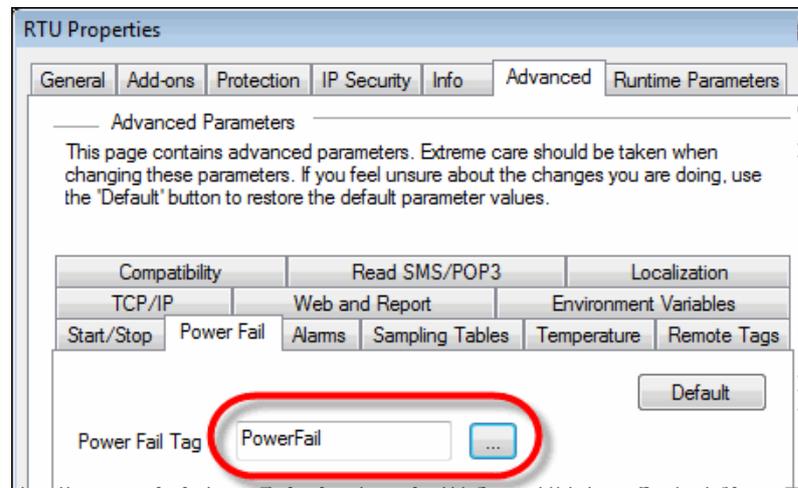
Working with an external 12 V backup battery, the RTU informs you when the main voltage is out of order and the RTU is powered from the 12 V backup battery. An internal DI variable informs that the main power broke down.

Example from the LT2-542-3:

Tag	Value	Channel	Comment
<u>PowerFail</u>	0	0	Power Failure (Power Failure)
• <AI.0.1.1>		1	Input Voltage (V)
• <AI.0.1.2>		2	Battery Voltage (V)
• <AI.0.1.3>		3	Internal Temperature
• <AO.0.1.4>		4	Charge Voltage (V)
• <DO.0.1.5>		5	Battery Stop
• <DI.0.1.6>		6	CPU : Stop Button

From the list of DI available with the card, you Tag the one indicating the **Power Failure** (DI.0.1.0)

From the RTU properties: → Advanced → tab “Power Fail” you select the Tag corresponding to the Power Failure (see above)



This power fail information will then condition the execution of alarm and chronology condition where you have specified a handling associated to “Power Failure”: in case of power failure, alarm and chronology conditions will not be executed (see chapters related to Alarm and Chronology conditions further in the manual).

In addition, the above Tag (in this example “PowerFail”) can be used to send an alarm and can be recorded into chronologies (datalogging).

7.6.10. Web and Report

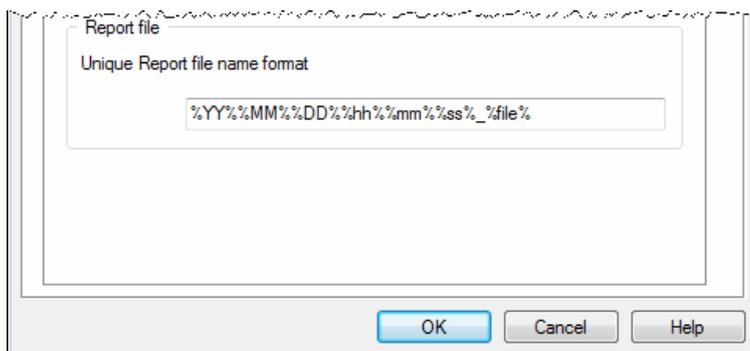
Check user's WebFormViewer version: This option concerns WebForm 1.0 only. **(this service is not supported anymore)**

Unique Report file name format: When sending a report by FTP, you have the choice of sending the report with ‘Unique file name’ (see Report Studio → report properties → Advanced). In this case, the RTU includes supplementary parameters in head of the name of the report.

Accepted parameters are:

%station%: name of the RTU %email%:
 e-mail of the RTU
%time%: complete date & time
%condition%: ! (if alarm active)

%YY%: year in 2 digits
%YYYY%: year in 4 digits
%M%: month in 1 digit (if possible)
%MM%: month in 2 digits
%MONTH%: month in letters
%D%: day in 1 digit (if possible)
%DD%: day in 2 digits
%h%: Eur. hour in 1 digit (if possib.)
%hh%: Eur. hour in 2 digits
%H%: US hour in 1 digit (if possible)
%HH%: US hour in 2 digits
%mm%: minute in 2 digits
%ss%: second in 2 digits
%file%: name of the report
%ampm%: US time am/pm
~mytag~: value of Tag



Any supplementary text can be added

7.6.11. Plug&Go

Activate Plug&Go: *Plug & Go* is associated to the SD card. When Plug & Go is activated, the complete project including webforms, reports, OS, ... is backed up on the SD card and loading upon CPU powering. Program is restored when the program on SD card is different from the one running in the CPU.

This allows easy deployment and maintenance when CPU must be changed on field.

Global Tags Backup: To backup on SD card "Global Tags" periodically (see below), or using digital system variable [55 - RuntimeBackup].

Tags are restored when the program on SD card is different from the one running in the CPU.

DB Backup: To backup on SD card "Sampling Tables and Chronologies" periodically (see below), or using digital system variable [55 - RuntimeBackup]

DB are restored when the program on SD card is different from the one running in the CPU.



Backup and restore of Tags and DB are not applicable when doing a stop/start of the TBox or when sending a new application. Only when putting SD card into a new CPU, it will restart with the image of data backed up.

Period: Period for automatic backup of Global Tags and DB (see above) on a hour base period.

8. Resources

The resources represent the list of the **hardware** that your **TBox LT2** has to its disposal.

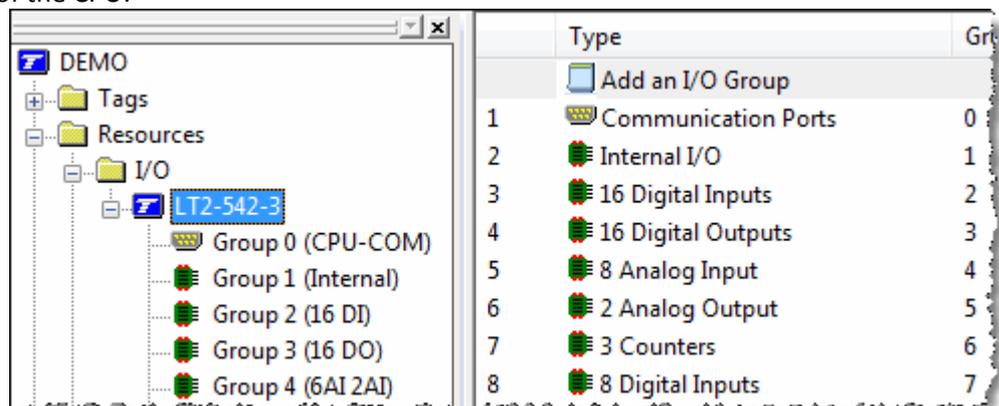
The **TBox LT2** being an **all-in-one RTU** has a fixed hardware all built within one module:

- A Power Supply
- A CPU
- Communication ports
- Groups of I/O
- If the CPU needs to communicate in 'ModBus Master' to another device (CPU, or an external ModBus device), the latter must be declared as a Remote I/O card (see chapter 15: '**ModBus Transactions**')
- The Resources also contain 2 lists with System variables. Systems variables have pre-defined function (see chapter 8.5 '**System variables**')

8.1. The CPU Card

When starting a new document, TWinSoft creates automatically the CPU card corresponding to the selection in the wizard (see chapter 5.).

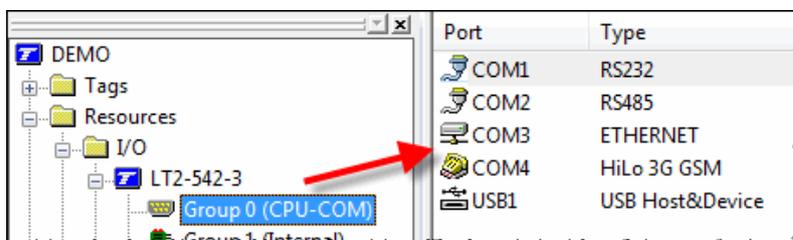
The communication ports of the CPU with their associated configuration and the I/O of the CPU are part from the resources of the CPU:



The CPU card is divided in several **groups**:

- **Group 0** : communication ports
- **Group 1, 2, 3, ...** : different groups of I/O corresponding to the model of **TBox LT2**. (See chapter 20.7. for more details about I/O).

8.2. Communication Ports



By selecting the **Group 0 Communication ports** in the workspace, you access each port separately.

8.2.1. Communication ports tabs

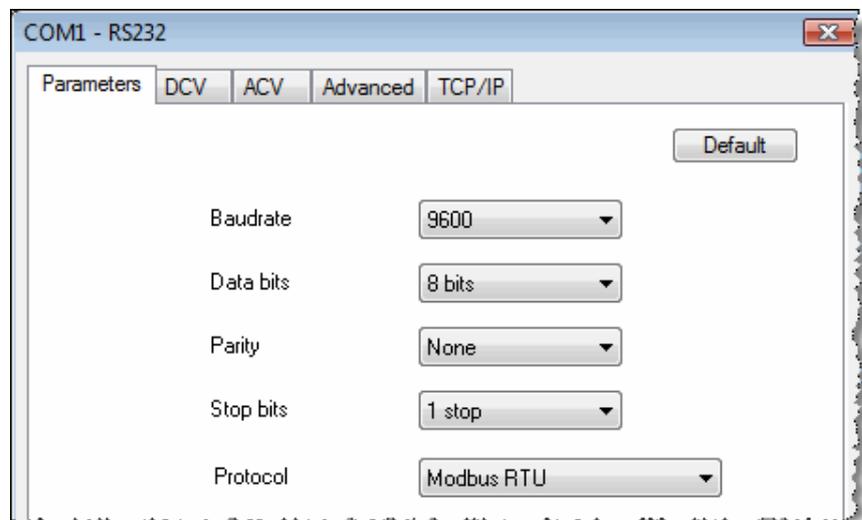
According to the type of communication port (RS232, RS485, modem or Ethernet), different tabs are available:

- Parameters:** general parameters (local or modem, Baudrate, Protocol).
- DCV:** **D**igital **C**ommunication **V**ariables. Special variables with a pre-defined function (communication error, modem online, ...). (see chapter 8.3)
- ACV:** **A**nalog **C**ommunication **V**ariables. Special variables with a pre-defined function (time-out, user ID, ...). (see chapter 8.3)
- Advanced:** mainly 'timing' parameters required when CPU is 'Master' or 'Slave' in a ModBus communication.
- TCP/IP:** TCP IP configuration dedicated to the communication port, when available. .

To enter the **configuration** of the communication port, double click the port in 'Group 0'.

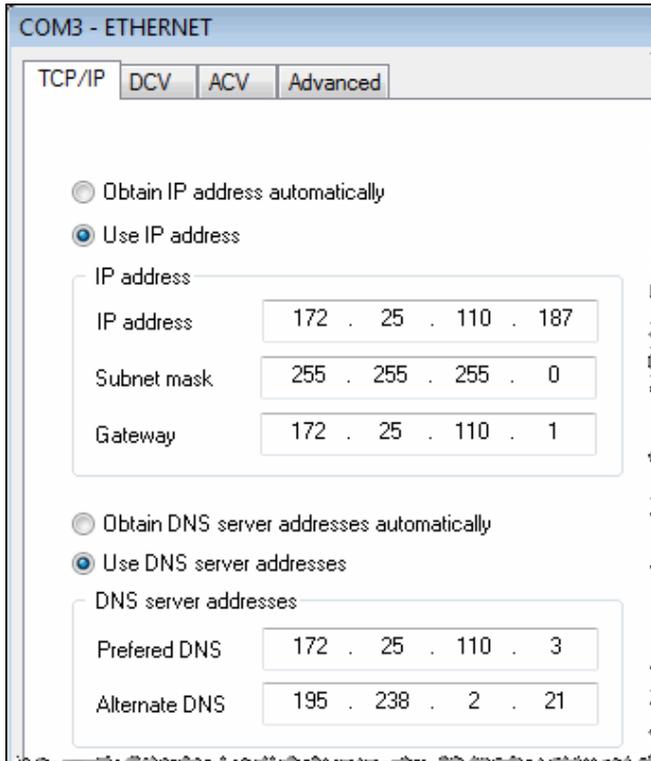
8.2.2. Serial ports

- Baudrate:** 200...115200 bps
- Data bits:** 7 or 8
- Parity:** None, Odd, Even, Space, Mark
- Stop bits:** 0, 1 or 2
- Protocol:**
ModBus (RTU/ASCII),
Printer, NMEA, PPP, SLIP



Example with COM1 – RS232

8.2.3. Ethernet



Obtain IP address:

TBox LT2 is connected to a DHCP server providing its IP settings.

Use IP address:

IP address the IP address of the Ethernet of **TBox LT2** (given by the network administrator).

Subnet mask the subnet mask defined by the subnet the **TBox LT2** will be included in (given by the network administrator).

Gateway the IP address of the equipment on the LAN that **TBox LT2** uses to access an IP address outside its subnet.

DNS DNS Server is used to resolve 'Names' in 'IP address' (given by the network administrator).

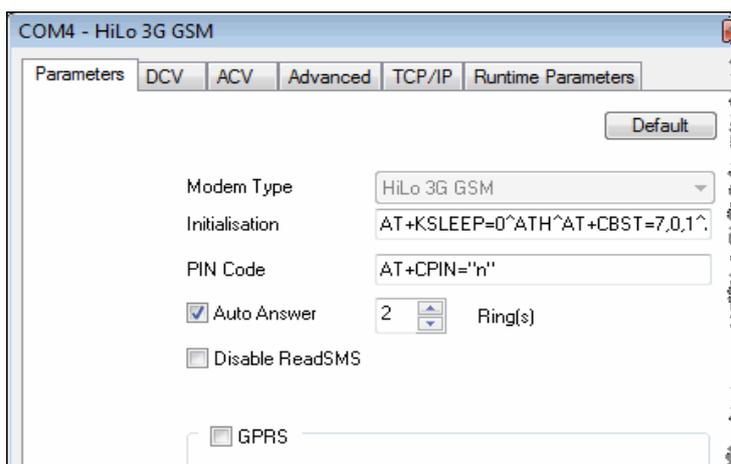
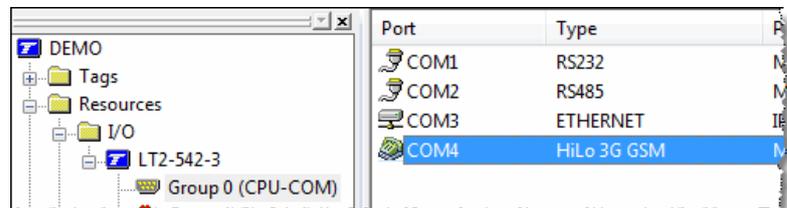
DNS can be set manually or acquired from a Server when available.

8.2.4. GSM 3G modem

When **TBox LT2** reference has the suffix **3**, it means it is equipped with a GSM-3G modem. Technical specifications are available at the end of the manual. The GSM 3G modem can be used in 2 modes:

- as a “dial-up” modem, also known as **GSM data (CSD)** modem
- in IP communication: **GPRS/EDGE/3G/HSDPA**, according to availability of the network

GSM 3G modem is available as **COM4**.



The main option 'GPRS' determine the working mode of the card:

GSM data (CSD)
OR
IP (GPRS, 3G...)

GSM-data (CSD) settings

Initialization: should not be changed

PIN Code: If the SIM card you have inserted uses a PIN code, type it at the place of the letter **n**.
Example: with the PIN code 4896, you should have in the field: AT+CPIN="4896"
including the quotes
If the SIM card you have does not require a PIN code, you can leave the field as it is or erase it completely.



If you type the wrong PIN code, or you type a PIN code when the SIM card does not require one, there is a risk of blocking the SIM card.
It must then be restored with the PUK code using a mobile.

Auto Answer: number of RINGS before the modem picks-up the line.

Dialing a GSM-data

The SIM card of a GSM has three telephone numbers: VOICE (the one you use to speak), DATA and FAX. To dial **TBox LT2**, you have to be sure that **data service has been activated** and you dial the **DATA number** (please call your GSM operator).



In some countries, like in US for instance, GSM operators do not provide DATA service. DATA communication is then only available in GPRS mode (see below)

About sending out e-mail or Files through a GSM-data connection

Some ISP requires **specific telephone number** for connecting through GSM (please check with your ISP).

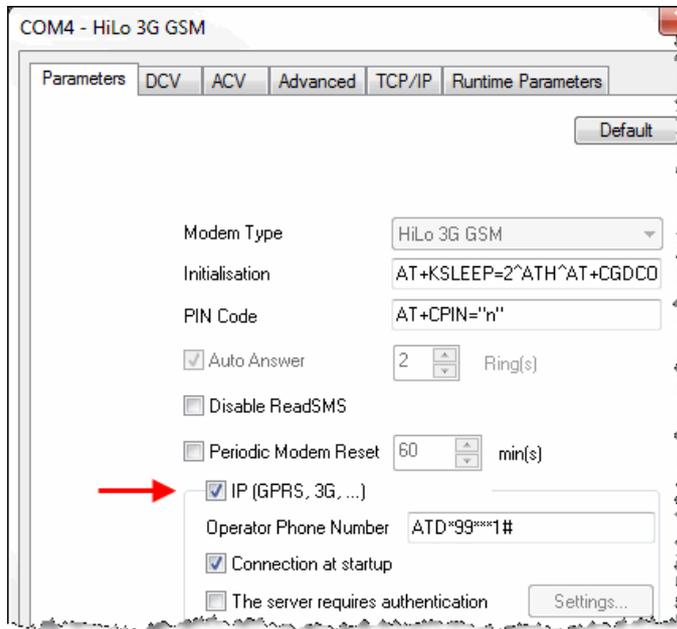
IP Communication (GPRS/EDGE/3G/HSDPA) settings

The GSM 3G supports third generation communication standard, including, from slowest to fastest: **GPRS (2G)**, **EDGE (2.5G)**, **UMTS (3G)** and **HSPDA (3.5G)**.

There is no configuration to select one or the other network; the GSM 3G will select the fastest available.



You have to choose either 'GSM-Data' mode **OR** 'GPRS' mode. It is not possible to use the modem in both modes at the same time, but it is possible to combine GPRS mode and sending of SMS (see below).



When selecting **IP (GPRS, 3G, ...)**, TWinSoft automatically adapts Initialization and Operator Phone number fields (see next).

If the connection requires a **login**, select the option 'The server requires authentication'.

You may receive a **fix, dynamic, public of private IP address**, it depends on your subscription; You don't have to declare the IP address anywhere.

Initialization: You have to update the initialization string with the APN (ask you GSM operator). Replace in the string the **apn** with the URL you receive from your GSM operator.

Example with Mobistar: AT+CGDCONT=1,"IP","WEB.PRO.BE".

PIN Code: If the SIM card you have inserted uses a PIN code, type it at the place of the letter **n**.

Example: with the PIN code 4896, you should have in the field: AT+CPIN="4896", **including the quotes**.

If the SIM card you have does not require a PIN code, you can leave the field as it is or erase it completely.

Operator Phone number: special number to establish the GPRS connection.

Typically, the number is ***99***1#**. Check with your operator and type it following the command ATD.

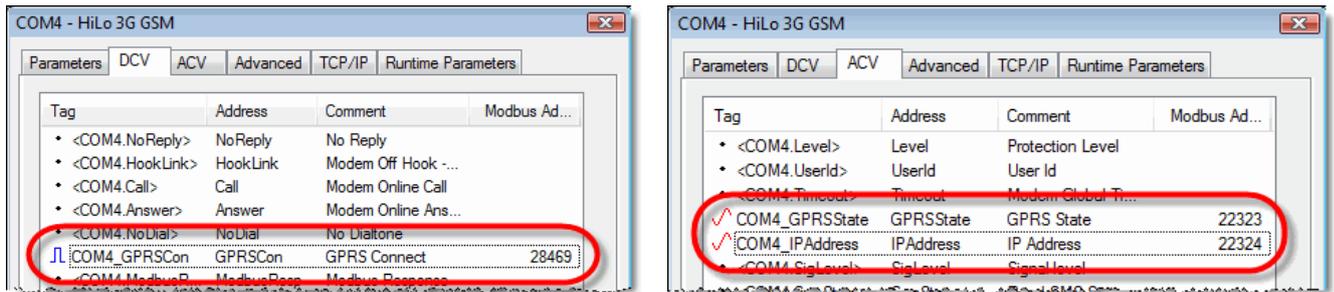
Example with Mobistar, Proximus, SFR, AllIP, ...: ATD*99***1#

Connection at start up: when this **option is selected** (by default) **TBox LT2** handles the modem to keep the connection permanently.

When this **option is removed**, **TBox LT2** handles the connection according to communication variables: GPRSCon (see below)

Communication Variables dedicated to GPRS, 3G,... IP Communication

Some communication variables allow manual handling of GPRS and give information on the status.



Digital Communication Variable

COMx.GPRSCon	<p>Handles the GPRS/3G connection. Working in <u>manual connection</u>, writing '1' forces a connection; writing '0' forces a disconnection.</p> <p>When working with <u>automatic connection</u>, if you reset this variable the connection will stop, but after maximum 5 minutes, it will be automatically restarted.</p> <div style="border: 1px dashed black; padding: 5px; text-align: center;"> USE A TRIGGER INPUT CONTACT TO ACTIVATE THE VARIABLE </div>
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Analog Communication Variable

COMx.GPRSState	<p>GPRS: indicates the status of the GPRS connection. Value=0 : disconnected Value=1 : currently connecting Value=2 : connected Value=3 : currently disconnecting</p>
COMx.IPAddress	<p>GPRS: this register gives the IP address used by TBox LT2 during its GPRS connection. The information is available in a DWORD, but in the list of Tags, you can display it as an <u>IP address</u>: from the list of Tags, right click the Tag → Display as → IP address. This information is very important when working with dynamic IP address. It can be sent for instance by e-mail (see Report Studio), or displayed in a webform, to inform on IP address changing.</p>

About sending alarms through GPRS/3G

With GPRS, you are able to send e-mail or files using FTP. You create recipient(s) associated to the SMTP or FTP server you have associated to the GSM/GPRS.

Working with a manual connection, first the RTU establishes the connection and sends the mail and/or files. Then it stops the connection.

If the connection was already established, the RTU maintains the connection.

Working with an automatic connection, the mail and/or files are sent immediately and the connection is maintained.



For sending e-mail, you need to use the SMTP server specific to the GPRS connection. Ask your GSM operator.

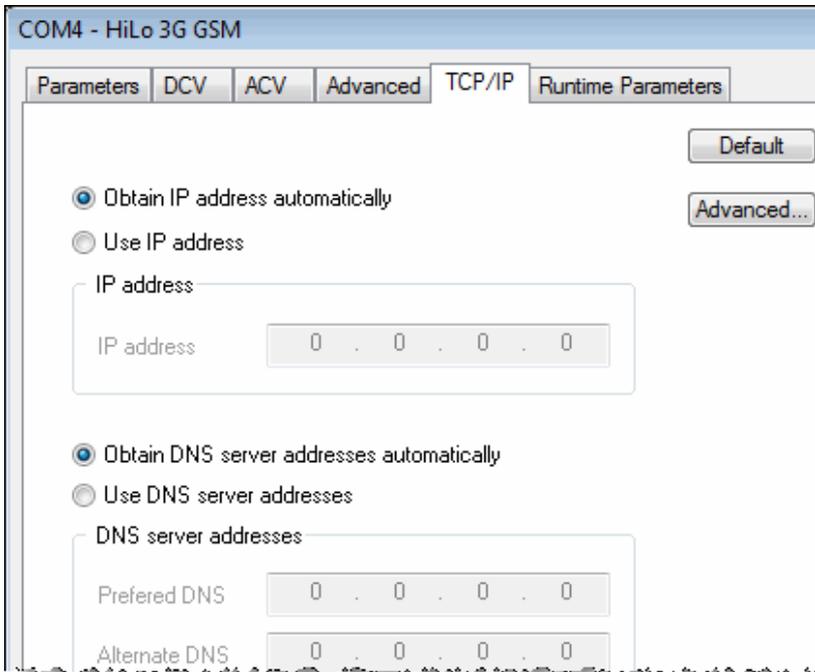
Example: gprsmail.myoperator.com

Sending of SMS with GSM configured in GPRS/3G

While connected in GPRS and a SMS has to be sent through the classical SMS-Center, **TBox LT2** will automatically disconnect, send the SMS and reconnect.

GPRS IP settings

GPRS represents a TCP/IP connection using GSM network. It then requires a TCP/IP configuration.



Obtain IP address automatically:

The IP address is provided by the Operator at the connection.

Use IP address:

Don't use it with GPRS connection.

Obtain DNS server addresses auto.:

The Operator provides you with DNS.

Use DNS Server addresses:

Don't use it with GPRS connection.

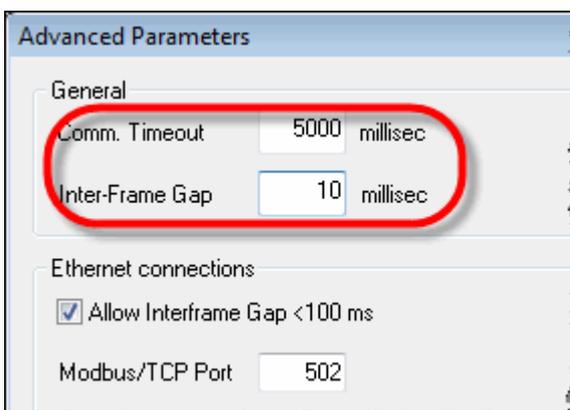


Even when working with **fix IP address**, it does need to be declared. IP address is always provided by the operator during connection.

Using TWinSoft to communicate to an RTU in GPRS/3G

Typically, TWinSoft will access **TBox LT2** from a LAN, using an Ethernet connection (in case your LAN has a Gateway connection to Internet).

In order to have a reliable communication, you have to increase some timing parameters in TWinSoft: menu 'Communication' → 'PC Setup'; select 'Ethernet' and click 'Advanced...'



Change 'Comm. Timeout' to 5000 ms. or higher

Change 'Inter-Frame Gap' to 10 ms.



Before **sending a program through GPRS**, check the PC setup settings of TCP/IP, like explains chapter 5.3.3. **IP address settings**, point 3.

8.2.5. USB

TBox LT2 is equipped with 1 x USB port. It can be used as "Device" as well as "Host".

Equipment supported:

- PC
- USB Memory Stick

USB as Device

When the USB port runs as "Device", it waits for a "Host", like a PC.

TBox LT2 can be connected to a PC to be programmed by TWinSoft.

Connection

You need a USB A/A male cable (host to host). The USB driver (**TBoxUSBDriver.inf**) is installed on PC during TWinSoft setup.

Communication

Communication is carried out in TCP/IP. **TBox LT2** acts as a DHCP server and provides to the PC an IP in the range 10.8.10.xxx. **TBox LT2** itself uses the IP address 10.8.10.1.

In PC Setup, you select "USB".

USB as Host

When the USB port runs as "Host", it expects to communicate with a "Device", like a USB memory stick. With a USB memory stick there are 2 features supported:

1. Programming TBox

This feature can be compared to Plug & Go. The procedure is:

- You create a "repository" directory on the USB stick, using Plug&Go.
- You insert the USB memory stick in **TBox LT2**.
- You press the button to the Reset position and let the LED flashing green 6 times (it must turn off after the sixth one)
- After the LED starting sequence, it flash at 1/2 Hz during copy and then starts with the new program

2. Alarm Recipient

The USB memory stick can be configured as an alarm recipient.

In the recipient, you chose "external memory" and select USB Mass Storage.

Demounting the USB Memory stick

When used for programming, the USB memory stick can be removed when **TBox LT2** has started with the new program.

When used as Alarm Recipient, you should check **TBox LT2** is not in alarm anymore (Ala_on=0) and then demount the USB Memory stick using the Digital System Variable 53 [USBStorage]

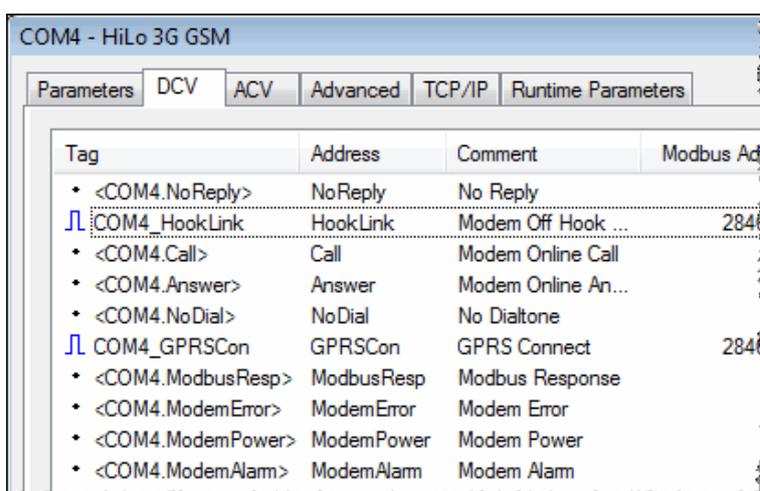
8.3. Communication Variables

Communication variables are dedicated registers providing different status of the communication. It is very useful for monitoring and controlling the connection.

Those variables are divided into 2 tabs, Digital Communication Variables (DCV) and Analog Communication Variable (ACV).

When you need one, double click it from the list and click <OK>! It becomes a Tag and then available in any feature of **TBox LT2**.

8.3.1. Digital Communication Variable



According to its function a Communication variable is Read/Write or Read only.

In the following table, the column **R/W** indicates:

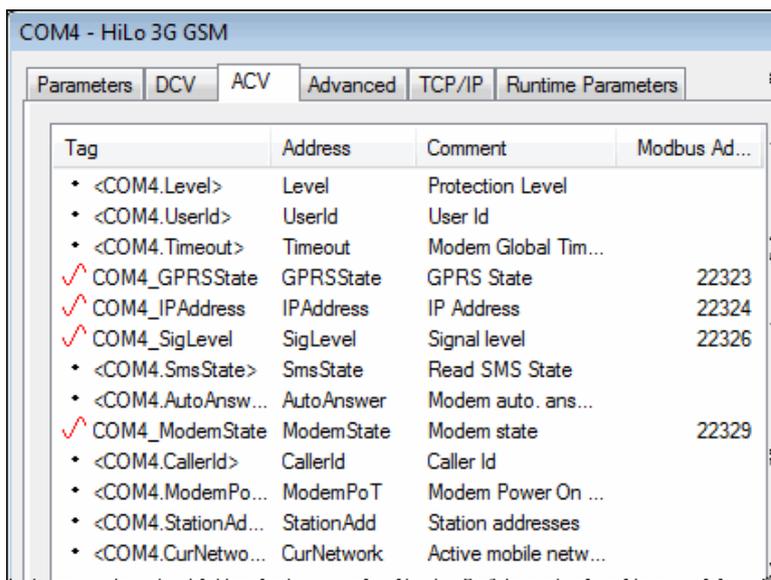
- : Read only.
- 0 : Write '0' only.
- 1 : Write '1' only.
- * : Write '0' or '1'.

Example with COM6 – GSM modem

Name	R/W	Description
COMx.NoReply	0	<p>Communication: SET by TBox LT2 in case of error during ModBus “Master” communication. Possible errors:</p> <ul style="list-style-type: none"> - Timeout. - ModBus: Unknown address, wrong quantity, CRC error. - TCP/IP: wrong closing of socket. <p>Must be RESET by the user.</p>
COMx.HookLink	*	<p>Modem: <u>Reading '1'</u>: indicates the modem is on-line - dial-up modem: connected to another mode - GPRS/3G: connected to the APN. <u>Writing '0'</u>: forces a hardware reset of the modem. <u>Writing '1'</u>: forces the modem to hang up and a GPRS/3G disconnection.</p> <p>Ethernet: <u>Reading '1'</u>: indicates the Ethernet is connected to a device (Switch, PC, ...) <u>Writing '0' or '1'</u>: forces a reset of the Ethernet chip. Ethernet communication is not interrupted.</p> <p>VPN: <u>Reading '1'</u>: indicates the VPN is connected</p> <div style="border: 1px dashed black; padding: 5px; text-align: center;"> USE A TRIGGER INPUT CONTACT TO ACCESS THE VARIABLE </div>
COMx.Call	-	<p>Modem: with GSM acting as “dial-up” modem, reading ‘1’ indicates the modems are synchronized with TBox LT2 ‘dialing out’</p>
COMx.Answer	-	<p>Modem: with GSM acting as “dial-up” modem, reading ‘1’ indicates the modems are synchronized with TBox LT2 ‘Answering’ incoming call</p>

Name	R/W	Description
COMx.NoDial	0	<u>Modem</u> : with PSTN modem, reading '1' indicates that no dial tone has been detected when the modem has picked-up the line. (not available with TBox LT2) Must be RESET by the user.
COMx.GPRSCon	*	<u>GPRS/3G</u> : Writing 1: demand of connection. (Automatic when selecting "Connection at start-up")  USE A TRIGGER INPUT CONTACT TO ACCESS THE VARIABLE
COMx.ModBusResp	0	<u>Communication</u> : indicates the port is transmitting answering. At each transmission, TBox LT2 SET this register. To check TBox LT2 is transmitting in "slave" mode. You RESET this register and test whether it is SET again (using Ladder or BASIC).
COMx.ModemError	0	<u>Communication</u> : modem initialization failed. Modem has answered with an ERROR to one of the parameters of the init. String (see modem properties). A reason could be, working with GSM, because it is not registered yet. When you RESET this register, OS executes a warm start of the modem (sending init. string)
COMx.ModemPower	*	<u>LowPower</u> : used only with Low Power RTU.
COMx.ModemAlarm	*	<u>LowPower</u> : used only with Low Power RTU.
COMx.VPNCon		<u>OpenVPN</u> : On VPN "Client" side: VPN.VPNcon=0 -> exit OpenVPN process VPN.VPNcon=1 -> restart OpenVPN process On VPN "Server" side, it has no function..

8.3.2. Analog Communication Variable



Tag	Address	Comment	Modbus Ad...
• <COM4.Level>	Level	Protection Level	
• <COM4.UserId>	UserId	User Id	
• <COM4.Timeout>	Timeout	Modem Global Tim...	
✓ COM4_GPRSState	GPRSState	GPRS State	22323
✓ COM4_IPAddress	IPAddress	IP Address	22324
✓ COM4_SigLevel	SigLevel	Signal level	22326
• <COM4.SmsState>	SmsState	Read SMS State	
• <COM4.AutoAnsw...	AutoAnswer	Modem auto. ans...	
✓ COM4_ModemState	ModemState	Modem state	22329
• <COM4.CallerId>	CallerId	Caller Id	
• <COM4.ModemPo...	ModemPoT	Modem Power On ...	
• <COM4.StationAd...	StationAdd	Station addresses	
• <COM4.CurNetwo...	CurNetwork	Active mobile netw...	

According to its function a Communication variable is Read/Write or Read only.

In the following table, the column **R/W** indicates:

- : Read only.
- 0 : Write '0' only.
- 1 : Write '1' only.
- * : Write '0' or '1'.

Example with COM2 – GSM modem

Name	R/W	Description
COMx.Level	*	<u>Access Control</u> : access level of the user currently logged (see chapter 17).
COMx.UserId	*	<u>Access Control</u> : user Id of the user currently logged (see chapter 17). The user Id and the authority level correspond to those you have defined with the utility ' PASSWORD '. The value returns to 0 when the user has disconnected. Values can be written to those registers.

		<p><u>Example:</u> when a user is connected you can modify its level access by writing a value in the register COMx.level (level available: 0, 1, 2 or 3).</p> <p>Those values can be stored in analog chronology for keeping a history on the access.</p> <p>When a user disconnects (Logout), the register returns to 0</p>
COMx.Timeout	*	<p><u>Modem:</u> global time-out for hanging-up the modem when there is no communication. Correspond to the 'Inactivity time-out' in the 'Advanced properties' of the modem.</p>
COMx.GPRSState	-	<p><u>GPRS/3G:</u> indicates the status of the GPRS connection.</p> <p>Value=0 : disconnected</p> <p>Value=1 : currently connecting</p> <p>Value=2 : connected</p> <p>Value=3 : currently disconnecting</p>
COMx.IPAddress	-	<p><u>GPRS/3G:</u> this register gives the IP address received by TBoxLT2 during its connection to the operator. The information is available in a DWORD. It can be displayed from the list of Tag as 'Ip Address'.</p>
COMx.SigLevel	-	<p><u>GSM:</u> when available, quality of the GSM signal. The range of the value is 1 to 31. A value of 18 is considered as a good signal level.</p> <p><u>PSTN:</u> when available, voltage on the line (+/- 20%)</p>
COMx.SmsState	-	<p><u>GSM:</u> associated to the GSM, can be used to check the status of ReadSMS.</p>
COMx.AutoAnswer	*	<p><u>MODEM:</u></p> <p><u>Read:</u> indicates the number of RING before the off hook</p> <p><u>Write "0":</u> no off hook</p> <p><u>Write "1":</u> force off hook at the next RING</p>
COMx.ModemState	-	<p><u>MODEM:</u> gives current status of the modem. Possible values are:</p> <ul style="list-style-type: none"> 1: PIN code sent (GSM only when PIN code activated) 4: Init string accepted 7: Idle mode (PSTN/CSD modem) 9: outgoing call. Waiting CONNECT 10: incoming call. RING arriving 12: Idle mode (GPRS/3G) ... more values in TWinSoft Help. <p>The last value is maintained, until the next status changing.</p>
COMx.CallerID	*	<p><u>MODEM:</u> variable which indicates the caller ID of the current incoming modem connection, 32 bits format, giving the 9 last digits of the calling number. It can be used in the program to trace and control who is calling</p> <p><u>Init string of GSM modem:</u> Caller ID identification must be activated. ^AT+CLIP=1</p>
COMx.ModemPoT	*	<p><u>LowPower:</u> used only with Low Power RTU.</p>
COMx.StationAdd	-	<p><u>General:</u> Station address of the RTU (see general RTU properties).</p> <p>LOW BYTE: ModBus station address.</p> <p>HIGH BYTE: Sub address.</p> <p>Doing ModBus Transactions through modem, useful to detect the calling "Slave" station, by doing a request to station "0" and read this variable. From there, the "Master" can activate the proper Trigger.</p>
COMx.CurNetwork	-	<p><u>GSM-3G:</u> Indicates the network the GSM is connected to</p> <ul style="list-style-type: none"> 0 : GPRS ou EDGE 1 : 3G
COMx.UsbState	-	<p><u>USB:</u> Gives current status of the USB port:</p> <ul style="list-style-type: none"> 0 = does not do anything (never visible) 10 = USB port in mode "device", waiting for a Host (PC) 11 = Something is connected in mode "device" 20 = USB port in mode "host" waiting for a device (USB stick) 21 = Something is connected to TBox LT2 <p>WARNING: this could be a device not recognized by TBox LT2 like a mouse, a keyboard, ...</p> <p>Without anything connected to the USB, the variable toggles 10, 20, 10, 20,</p>

Name	R/W	Description
COMx.ByteCount	-	<p><u>GSM/3G</u>: returns all bytes (sent and received) during a IP communication. It is reset at each start/stop of the program, then to sum the bytes up you should use the following BASIC code:</p> <pre> If TriggerPos (Prgrun!) Then ByteCount_old=COM4_ByteCount If ByteCount_old < COM4_ByteCount Then GPRS_Data=GPRS_Data + (COM4_ByteCount-ByteCount_old) ByteCount_old=COM4_ByteCount Endif </pre>

8.4. Groups of I/Os

The Hardware is represented in TWinSoft with a hierarchy of 3 levels:

- CARD : with **TBox LT2**, it is **all-in-one CPU** card
- GROUP : the communication ports form a group as well as each type of I/O:
group of DI, group of DO, group of AI, ...
- CHANNEL : each **physical connection**, within a Group, corresponds to a channel.

Tag	Value	Channel	Comment
START	1	0	Digital Input 0 (Digital Input 0)
STOP	1	1	Digital Input 1 (Digital Input 1)
EMERGENCY	1	2	Digital Input 2 (Digital Input 2)
VALVE1	1	3	Digital Input 3 (Digital Input 3)
VALVE2	1	4	Digital Input 4 (Digital Input 4)
• <DI.0.2.5>	5		Digital Input 5
• <DI.0.2.6>	6		Digital Input 6
• <DI.0.2.7>	7		Digital Input 7
• <DI.0.2.8>	8		Digital Input 8
• <DI.0.2.9>	9		Digital Input 9
• <DI.0.2.10>	10		Digital Input 10
• <DI.0.2.11>	11		Digital Input 11
• <DI.0.2.12>	12		Digital Input 12
• <DI.0.2.13>	13		Digital Input 13
• <DI.0.2.14>			Digital Input 14
• <DI.0.2.15>			Digital Input 15

When connected to **TBox LT2** the column 'Value' displays the current value, when the **channel has been declared as a Tag** and the program sent to the RTU.

8.5. System variables

The system variables have pre-defined functions.

They are very useful to check or to act on features of **TBox LT2**.

They are divided into 'Digital' and 'Analog'.

8.5.1. Digital System Variables

According to its function a register is Read/Write or Read only. In the following table, the column R/W indicates:

- : Read only.
- 0 : Write '0' only.
- 1 : Write '1' only.
- * : Write '0' or '1'.

When the action (**SET**) is specified, it means that **TBox LT2** maintains the variable at 1 to be sure it is detected. Such a variable **needs to be reset using Ladder/BASIC** logic.

Index	Name	R/W	Description
0	TikSec	0	<u>Tik Second</u> : Changes of state every second. Useful for counting time.
1	PrgRun	-	<u>Program run</u> : At each starting of TBox LT2 , this register changes to 1 and stays at 1 as long as the BASIC/Ladder program runs. This register is used in BASIC/Ladder to execute operations only at the start of the program, with the help of a positive edge trigger function.
2	NewPro	-	<u>New program</u> : Start of a program flag. Changes to 1 if TBox LT2 has started after having received a new program. Changes to 0 after a reset of the TBox LT2
3	Reboot	1	<u>Reboot</u> : complete restart of TBox LT2 . It is equivalent to hardware reset.
4	RstWat	1	<u>Reset Watchdog</u> : the watchdog checks the cycle time of BASIC/Ladder program. In case it is longer than 1 second, it resets TBox LT2 . This Watchdog can be reset to reinitialize the 1 second timer in case of cycle time longer.
5	Ala_On	0	<u>Alarm on</u> : this register indicates that alarm is active (not acknowledged). Writing 0 in this register causes a global acknowledgment of all alarms. It corresponds to a reset of the alarm stack.
6	Alaerr	0	<u>Alarm in error</u> : TBox LT2 SET this register 1 when an alarm failed to be sent. This means that after the number of tries, the alarm has been auto-acknowledged. Must be Reset by User.
7	RstAla	-	<u>Reset Alarm</u> : Not used. See 'Ala_On' here above.
8	EnaDCr	*	<u>Digital Chronology</u> : General enable of recording in digital chronology.
9	EnaACr	*	<u>Analog Chronology</u> : General enable of recording in analog chronology.
10	EnaSam	*	<u>Sampling Tables</u> : General enable of recording in sampling tables (not available).
11	EnaAla	*	<u>Enable Alarm</u> : General enable of generating alarms.
12	DisCrd	*	<u>Flag digital chronology</u> : can be associated to any digital chronology configuration to inhibit recording. When at value '1', inhibits recording in Database.
13	DisCra	*	<u>Flag analog chronology</u> : can be associated to any analog chronology configuration to inhibit recording. When at value '1', inhibits recording in Database.
14	DisSam	-	<u>Not used</u>
15	DisAla	-	<u>Alarm</u> : flag that can be associated to any Alarm condition. When at value '1', inhibits the sending of alarm.
16	DaySav	-	<u>Time</u> : 1 = summer time (the ASV "ZoneBia" increments or decrements with. 0 = wintertime. the number of seconds according to the time zone)

Index	Name	R/W	Description
17	PrgEnb	*	<u>Program Enable</u> : when reset to '0', allows stopping the execution of BASIC/Ladder program. It can be useful to execute the program manually (see next).
18	PrgOnc	1	<u>Program Once</u> : when set to '1', executes the cycle of BASIC/Ladder program once. Useful for debugging the program. TBox LT2 resets the variable automatically.
19	TcpIpLog	*	<u>TCP Logging</u> : Not needed with TBox LT2 . All logs available from TWinSoft main menu: 'Communication' → 'Retrieve from TBox' → 'Trace Log'.
20	ALAOvf	*	<u>Alarm Overflow</u> : overflow in the stack of alarms. The size of the stack of alarms can be adjusted from the 'Advanced' properties of the RTU
21	ComErr	0	<u>Communication error</u> : general communication error flag. It means that one of the communication ports (of the CPU or of a communication card) used as 'Master' has encountered a communication error. (SET)
22	Smtper	0	<u>Smtper Error</u> : an error occurred while sending an e-mail. (SET)
23	FtpErr	0	<u>Ftp Error</u> : an error occurred while sending files. (SET)
24	NTPErr	0	<u>NTP Error</u> : an error occurred while setting time of TBox LT2 . (SET)
25	GpsVF	-	<u>GPS</u> : GPS validity (connected on COM1). GPS returns a valid signal. Validity of the signal. When changes to '1', it indicates the GPS receives sufficient signals to calculate its position (from minimum 3 satellites). When changing from 0 to 1, the time of TBox LT2 is set to the time of GPS, with correction in regards to GMT according to the location of TBox. If you want to update the time manually, you reset the variable
26	GPRSErr	0	<u>GPRS Error</u> : an error occurred during GPRS connection. TBox LT2 does not succeed to connect (not supported yet) (SET)
27	ModemLog	*	<u>ModemLog</u> : Not needed with TBox LT2 . All logs available from TWinSoft main menu: 'Communication' → 'Retrieve from TBox' → 'Trace Log'.
28	SystemEr	0	<u>SystemErr</u> : the RTU detected an error during starting. Typically a problem with a card (not supported yet) or a discordance between cards detected in program and cards installed (SET)
29	MmcToRTU	-	<u>SD card</u> : indicates whether the program has been loaded from the micro SD. 1 = the program of the micro SD is different from the one of the RTU and has been loaded from the micro SD. 0 = there is no micro SD; the micro SD is empty; the program of the micro SD is identical to the one of the RTU (see also appendix C. Plug&Go)
30	DigChrOv	-	<u>Chronologies</u> : Indicates that the amount of records in the digital chronology has reached the maximum selected
30	DigChrOv	-	<u>Chronologies</u> : Indicates that the amount of records in the digital chronology has reached the maximum selected
31	AnaChrOv	-	<u>Chronologies</u> : Indicates that the amount of records in the analog chronology has reached the maximum selected
32	RsDigChr	-	<u>Chronologies</u> : Allows emptying the digital chronology using a SET. Automatically reset by OS
33	RsAnaChr	-	<u>Chronologies</u> : Allows emptying the analog chronology using a SET. Automatically reset by OS
34	BusError	-	<u>Not used</u>
35	MasterAnsw	*	<u>ModBus Transaction</u> : when set to 1, allows handling of ModBus Transactions on incoming call. It concerns then only ModBus Transactions through modem
36	DynDnsEr	0	<u>TCPIP</u> : error during a connection to DynDNS server. (SET)
37... 44	Tsl_Xa	-	<u>Alarm</u> : there are 8 time slices that can be used to build Time Tables. Those 8 variables indicate the activity of each of them
45	DisAla2	*	<u>Alarm</u> : flag #2 that can be associated to any Alarm condition. When at value '1', inhibits the sending of alarm

Index	Name	R/W	Description
46	DisAla3	*	<u>Alarm</u> : flag #3 that can be associated to any Alarm condition. When at value '1', inhibits the sending of alarm.
47	DisAla4	*	<u>Alarm</u> : flag #4 that can be associated to any Alarm condition. When at value '1', inhibits the sending of alarm.
48	Pop3Err	*	<u>Alarm</u> : an error occurred while accessing POP3 server. (SET)
49	PgmCnt	1	<u>Low Power</u> : used only with <i>Low Power RTU</i>
50	CntErr	0	<u>Low Power</u> : used only with <i>Low Power RTU</i>
51	SftpErr	0	<u>Ftp Error</u> : an error occurred while sending files through Secure FTP. (SET)
52	CycErr	0	<u>Cycle Error</u> : working with a periodical process cycle time, indicates the cycle – has been bigger than the period selected (see advanced RTU properties -> Start/Stop. (SET)
53	UsbStorage	0	<u>USB</u> Reading 1 = USB device has been detected. Writing 0 = demounting the USB device. Required after data transfer is done, before removing the dongle.
54	HttpErr	0	<u>HTTP Error</u> : an error occurred while sending HTTP Post to a server. (SET)
55	Runtime Backup	1	<u>Plug&Go</u> : to activate backup of global Tags and DB, as configured in Plug&Go configuration (see chapter 7.6.11).
56	SdPresent	-	<u>SD Card</u> : =1 means a SD card is detected in TBox LT2 .
57	SdFull	-	<u>SD Card</u> : =1 means the SD card is full at 90%.

8.5.2. Analog System Variables

According to its function a variable is Read/Write or Read only. In the following table, the column R/W indicates:

- : Read only.
- * : Writable.

Index	Name	R/W	Description
0	Second	*	<u>Time</u> : Second in TBox LT2 .
1	Minute	*	<u>Time</u> : Minute in TBox LT2 .
2	Hours	*	<u>Time</u> : Hour in TBox LT2 .
3	Day	*	<u>Time</u> : Day of the month in TBox LT2 .
4	Month	*	<u>Time</u> : Month in TBox LT2 .
5	Year	*	<u>Time</u> : Year in four digit in TBox LT2 .
6	DayOfw	*	<u>Time</u> : Day of the week in TBox LT2 . (Mo=1; Tu=2; We=3; ...)
7	AlaCnt	*	<u>Alarm quantity</u> : Amount of alarms in the alarms stack. It means the quantity of alarms that have not been generated yet. The size of the Alarm stack can be adjusted in the 'Advanced RTU properties'.
8	AlaID	*	<u>Alarm last index</u> : Absolute index of the last alarms generated (number between 0 and 65535). Can be used to acknowledge an alarm by writing its index.
9	ALACur	*	<u>Alarm current index</u> : Absolute index of the alarm being currently handled (number between 0 and 65535).
10	ALARec	*	<u>Alarm recipient</u> : gives the index of the recipient of the current alarm. Can be used to acknowledge all alarms of a Recipient by writing its index (see index in the list of Recipients).
11	SamQty	*	<u>Sampling Table</u> : Quantity of sampling tables defined.

Index	Name	R/W	Description
12	UtcTim	-	<u>Time</u> : Universal Coordinated Time (UTC). It is the number of seconds since 01/01/1970, GMT time. It is used as time-stamp reference for datalogging.
13	ZonBia	*	<u>Time</u> : Time difference in seconds with GMT.
14	ZonID	*	<u>Time</u> : ID of the zone where TBox LT2 has been installed. It uses by default Regional Settings of PC. It can be changed from RTU properties.
15	WeYear	*	<u>Time</u> : week of the year (*)
16	CycTim	*	<u>Time</u> : time for one cycle of the program (BASIC and Ladder). This register is refreshed after each cycle. Within the program, you could compute this register to memorize the highest value.
17	AAcond	-	<u>Alarms</u> : Quantity of alarm conditions, which are still active.
18	LevId	-	<u>Events</u> : absolute number of the last event (0...65535).
19	AppVer	-	<u>Application version</u> : according to the 'version' indicated in the 'Info' of the RTU properties. This register returns a version in a WORD format: 0...65535
20	OsVer	-	<u>Operating System</u> : version: running in TBox LT2 .
21	OsBuil	-	<u>Operating System</u> : build number of the OS running in TBox LT2 .
22	LoaVer	-	<u>Loader version</u> : Not available with TBox LT2 .
23	LoaBui	-	<u>Loader build</u> : Not available with TBox LT2 .
24	PortIdLog	*	<u>TCP Log</u> : Not needed with TBox LT2 . All logs available from TWinSoft main menu: 'Communication' → 'Retrieve from TBox' → 'Trace Log'.
25	EventLog	-	<u>TCP Log</u> : Not needed (see above)
26	Millis	-	<u>TIME</u> : With CPU-16: 10 milliseconds tik With CPU-32 and -LT2: 1 millisecond tik
27	GpsLat	-	<u>GPS</u> : current latitude given by the external GPS (ACC-GPS on COM1). Latitude in degrees multiplied by 1000000 (example: 50123456 means 50 degrees + 0.123456 degree). Resolution : 11 cm. Precision 15 meters
28	GpsLong	*	<u>GPS</u> : current longitude given by the external GPS (ACC-GPS on COM1). Longitude in degrees multiplied by 1000000 (example: 7123456 means 7 degrees + 0.123456 degree). Resolution : 11 cm. Precision 15 meters
29	GpsAlt	-	<u>GPS</u> : current altitude given by the external GPS (ACC-GPS on COM1). Altitude in meters. Resolution, 1 meter. Precision: depends on the quantity of satellites. Poor precision
30	GpsSats	-	<u>GPS</u> : quantity of satellites detected by the external GPS (ACC-GPS on COM1). Must be of minimum 3, or even 4 to expect a good precision.
31	Rerout	*	<u>Modbus</u> : variable 16 bits, each representing a COM Port from 1 to 16. The bits corresponding to the Ports in Rerouting are at 1, others at 0. Can be use to set the mask.
32	MasterErr	*	<u>Communication</u> : indicates the last station ID (ModBus station) in communication error. Once an error has been detected, the value is maintained until next error. Usually, communication errors can be solved by modifying the time-out available in the 'Advanced' tab of the communication used (End of Fame Detection, IFG, Rx Time-out). To trace an error, we advise you to reset the variable and check it when it is different from 0. When this happens, you can handle it in your process and reset the variable, that it is ready for the next error
33	CardErr	*	<u>System</u> : this variable indicates card(s) in error. For TBox-MS only
34	CPUusage	-	<u>Low Power</u> : Not available with TBox LT2 . Used with <i>Low Power RTU</i> only.
35	SerialNb	-	<u>Hardware</u> : indicates the S/N. of the CPU (see sticker on the side of the card).
36	CPUmode	-	<u>Redundancy</u> : for TBox MS32 only
37	OpenSoc	-	<u>TCP/IP</u> : number of sockets opened. Not available with TBox LT2

Index	Name	R/W	Description
38	GpsSpeed	-	<u>GPS</u> : with a GPS connected to TBox, current speed of TBox, expressed in km/h
39	GpsRoute	-	<u>GPS</u> : with a GPS connected to TBox, current direction of TBox, expressed in degree (0 .. 359.9 degree)
40	AlaPop3	-	<u>Alarm</u> : it indicates the number of alarm needing to be acknowledged by POP3 connection
41	EvenCur	*	<u>Alarm</u> : it indicates the current Event ID
42	HardRev	-	<u>HW</u> : it indicates the hardware revision of the CPU
43	Pop3State	*	<u>Alarm</u> : indicates the state of POP3 connection. Particularly useful when monitoring the RTU with POP3 connections. The last value is maintained: 1 Accepted message received 2 Acknowledgment received 10 Invalid message 11 Unknown command 20 Incorrect password 21 Incorrect password or not supplied for a com. Port protected 30 Message received does not match a pre-defined message
44	CntID	*	<u>Low Power</u> : used only with <i>Low Power RTU</i>
45	CntValue	*	<u>Low Power</u> : used only with <i>Low Power RTU</i>
46	CntTime	*	<u>Low Power</u> : used only with <i>Low Power RTU</i>
47	CrdrIndex	-	<u>Datalogging</u> : current position in the table of digital chrono. (circular counter)
48	CrdrSize	-	<u>Datalogging</u> : size of the table for digital chrono.(see RTU properties → General)
49	CraIndex	-	<u>Datalogging</u> : current position in the table of analog chrono.(circular counter)
50	CraSize	-	<u>Datalogging</u> : size of the table for analog chrono.(see RTU properties → General)
51	CreIndex	-	<u>Datalogging</u> : current position in the table of events (circular counter)
52	CreSize	-	<u>Datalogging</u> : size of the table of events (see Advanced RTU properties → Alarms)
53	InstState	-	<u>System</u> : during sending of a new application, current state of installation 1 Initializing installation 2 Uninstall package XXX 3 Create RTU Infos 4 Flushing I/O buffers 100 Operation is finished 101 ERROR during TEST 102 ERROR during UNINSTALL 103 ERROR during INSTALL 104 ERROR during PLUG & GO 105 ERROR during MD5 verification 106 ERROR application MISSING 107 ERROR BAD INSTALLATION 200 Check package <xx> 300 Install package <xx> 400 Copy to Plug&Go <xx> 500 Checking MD5 <xx>
54	BatUsage	-	<u>System</u> : number of seconds the TBox LT2 has been out of power and SRAM backed up with lithium battery The life time of the battery is estimated to 4 years (=126 144 000 seconds)
55	FreeMem	-	<u>System</u> : Displays the kBytes of SDRAM memory still available. The SDRAM is 64 MBytes memory. It shows the memory used by LINUX, like when establishing a 3G connection, or when opening a socket for instance. In no case it shows memory used by the application (datalogging, backup of Tag values, ...) or Operating System. One should check it never goes below 32 MBytes (=32 000 kBytes), reserved for ..\tmp directory. When sending a new application, it is first sent to ..\tmp directory before it is flashed

Index	Name	R/W	Description
56	XmlTag	*	<p>Backup allows backup/restore of Tags.</p> <p>Writing 1 in the variable forces the backup of value of Tags into the SD card. When the operation has succeeded, the Tag returns automatically to zero (see also return codes below).</p> <p>A file tags.xml is created in directory <i>../public/xml</i> of the SD card with the value of internal variables</p> <p>Writing 2 in the variable forces the restore of the value of Tags saved in file tags.xml (see above).</p> <p>Writing 2 in the variable, carries out a copy of the file into the directory <i>../public/dropbox</i> which then updates current value of Tags.</p> <p>On can also remotely update value of internal variables. You send a file <file>.xml to the directory <i>../public/dropbox</i> of the SD card. It can be of any file name; only the extension is important.</p> <p>TBox LT2 checks the presence of the file each 10 seconds. When a new file is detected, it is computed and value of Tags is updated</p> <p>Return codes :</p> <ul style="list-style-type: none"> 0 Idle (or operation succeeded) 10: importing from FTP directory <i>../dropbox</i> 11: import error from FTP directory <i>../dropbox</i> 100: exporting to FTP directory <i>../xml</i> 101: exporting error to FTP directory <i>../xml</i> (see logs details) 200: restoring tags.xml 201: restoring failed
57	LogLevel		<p>System: allows filtering recording of logs according to a level of log:</p> <ul style="list-style-type: none"> - 0 : Debug - 1 : Verbose (default) - 2 : Info - 3 : Warning - 4 : Error - 5 : Fatal error - 6 : None (log are disabled)
58	LogClass	*	<p>System: 32 bit Tag allowing filtering recording of logs according to a Class of log. Each bit corresponds to a class:</p> <ul style="list-style-type: none"> - SYSTEM: bit 0 - SERVICES: bit 1 - LOADXML: bit 2 - PROPERTIES: bit 3 - TAGS : bit 4 - SYSTEM TAGS: bit 5 - RESOURCES: bit 6 - COMMUNICATION: bit 7 - ALARMS: bit 8 - DATABASES: bit 9 - REMOTE TAGS (ModBus Transactions): bit 10 - HIGH SPEED TAGS: bit 11 - PERIODIC EVENTS: bit 12 - PROGRAMS: bit 13 - REPORTS: bit 14 - ADDONS: bit 15 - MODBUS: bit 16 - AT MODEM: bit 17 - PAGERS: bit 18 - NMEA: bit 19 - TCPIP: bit 20 - PPP: bit 21 - HTTP: bit 22 - SMTP: bit 23

		<ul style="list-style-type: none"> - FTP: bit 24 - NTP: bit 25 - PRINTER: bit 26 - PLUG AND GO: bit 27 - POP: bit 28 - SFTP: bit 29 - USB: bit 30 - VPN: bit 31 <p><u>Example:</u> there is a lot of Modbus transactions that fill the log and you wish to debug the GPRS or 3G connection. You need to log AT MODEM and PPP. You will set the system variable LogClass = 131 072 + 2 097 152 = 2 228 224 Check with the Tag displayed in "binary" format the correspond bits are set to 1.</p> <p>✓ LogClass B00000000000100010000000000000000</p> <div style="text-align: right; margin-right: 100px;">  </div> <p> The value of these two "Log" variables is maintained in case of all different start-ups of TBox LT2 (new program, reset, ...)</p>
59	Http Session	<p><u>HTTP:</u> Indicates the number of users that have logged in HTTP to TBox. This requires HTTP protection to be activated as well as HTTP session Authentication (See RTU properties → Protection and IP Security)</p>

(*) System variable 15. 'Week of the year' :

This system variable indicates the week of the year according to the date in the RTU.

The rules are the following:

- the changing of week happens on Monday, 00:00 AM
- the changing of week happens at January 1, whatever day it is
- if January 1 is a Friday, Saturday or Sunday, there will be two 'Week 1'

Examples:

Month	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Week
dec	21	22	23	24	25	26	27	51
dec / jan	28	29	30	31	1	2	3	52 / 1
jan	4	5	6	7	8	9	10	1
jan	11	12	..	..	..			2

Month	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Week
dec	22	23	24	25	26	27	28	51
dec / jan	29	30	31	1	2	3	4	52 / 1
jan	5	6	7	8	9	10	11	2
jan	12	13	..	..	..			3

8.6. Timers & Counters



Timers and Counters are described in the manual *BASIC & Ladder for TBox*

9. Tags & Variables

A Tag is essential for any programming

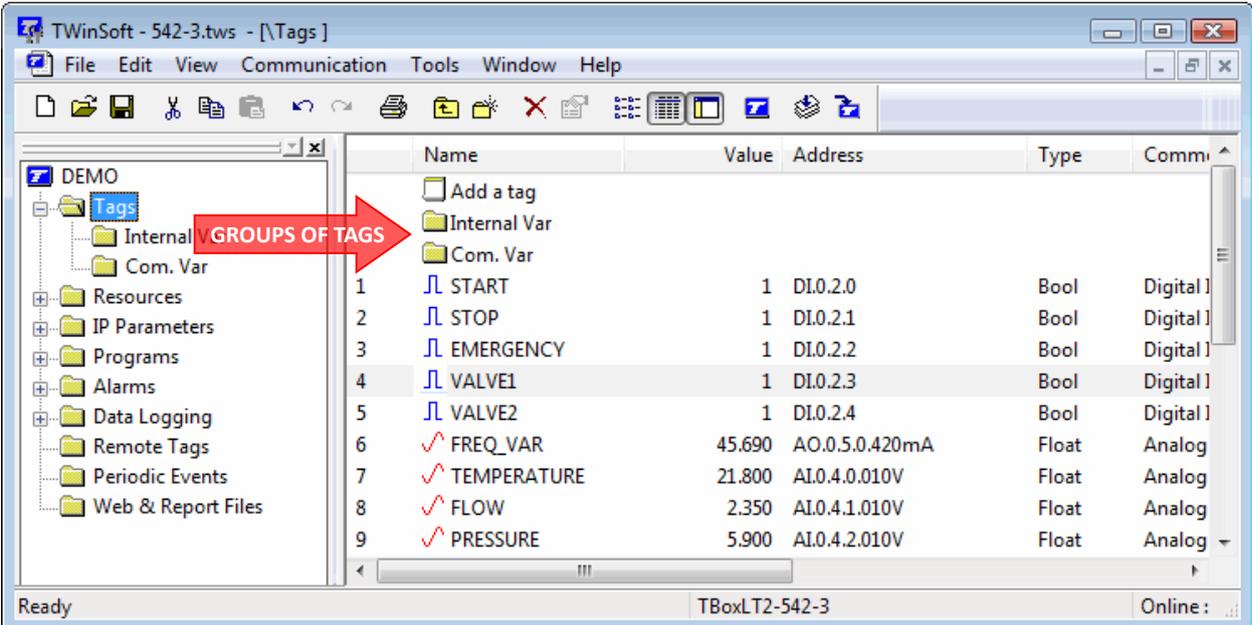
- An alarm is conditioned from a Tag.
- The Datalogging mechanism records values of Tags.
- BASIC/Ladder logic executes a process by handling Tags.
- ...

Any variable of the *TBoxLT2* that you want to use in any configuration *has to be available as a Tag.*

There are **4 types of variables**:

- The **Physical I/O** DI, DO, AI, AO (See chapter 9.1)
- The **Internal Variables** digital, analog and text (aka Registers) (See chapter 9.2)
- The **System Variables** predefined analog and digital functions (See chapter 8.5)
- The **Communication Variables** digital and analog (See chapter 8.3)

The Tags are gathered in the folder **Tags** of the Project Workspace:



The screenshot shows the TWinSoft software interface. On the left, the Project Workspace tree shows a folder named 'Tags' under 'DEMO'. A red arrow points to this folder with the text 'GROUPS OF TAGS'. The main window displays a table of tags:

	Name	Value	Address	Type	Comm
	Add a tag				
	Internal Var				
	Com. Var				
1	START	1	DI0.2.0	Bool	Digital I
2	STOP	1	DI0.2.1	Bool	Digital I
3	EMERGENCY	1	DI0.2.2	Bool	Digital I
4	VALVE1	1	DI0.2.3	Bool	Digital I
5	VALVE2	1	DI0.2.4	Bool	Digital I
6	FREQ_VAR	45.690	AO.0.5.0.420mA	Float	Analog
7	TEMPERATURE	21.800	AI0.4.0.010V	Float	Analog
8	FLOW	2.350	AI0.4.1.010V	Float	Analog
9	PRESSURE	5.900	AI0.4.2.010V	Float	Analog



The Tags can be sorted into **Groups of Tags**:

- From the list of Tags, right click.
- From the Context menu, select 'New' -> 'Group'.
- You can then move/create Tags into the Group.

9.1. Physical I/O

The physical I/O's are the signals available on I/O cards. They can be easily accessed from the 'Resources' (see chapter 8: '*The Resources*').

Details about the different I/O are available chapter 20.

To create a Tag of a variable from the Resources:

- select it into the list and double click it
- change its name and description
- click <OK>



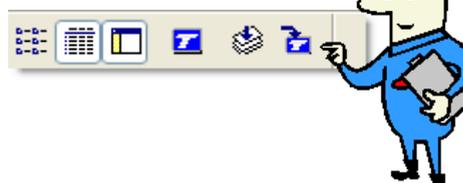
If you are connected to a **TBox LT2** when the Tag is created, you will see ***** appearing in the column 'Value'.

This is because the **ModBus address of the Tag** needs to be sent to **TBox LT2** (see chapter 9.3: '*ModBus addresses*')

Once the program has been sent, the **value appears**.

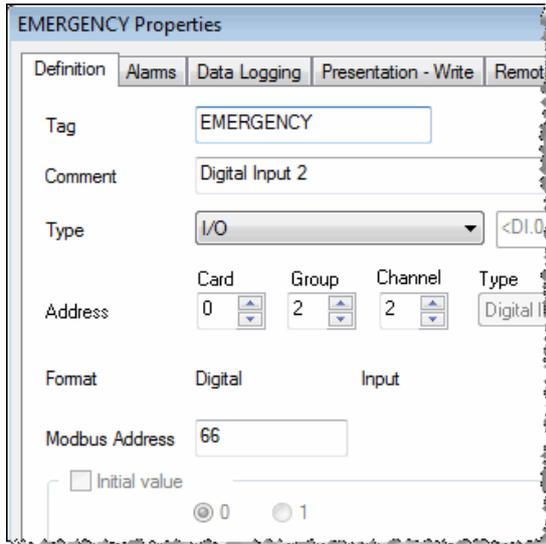
	Name	Value	Address
	Internal Var		
	Com. Var		
1	START	*****	DI.0.2.0
2	STOP	*****	DI.0.2.1
3	EMERGENCY	*****	DI.0.2.2
4	VALVE1	*****	DI.0.2.3
5	VALVE2	*****	DI.0.2.4
6	FREQ_VAR	*****	AO.0.5.0.420mA

You can send the program clicking this icon.

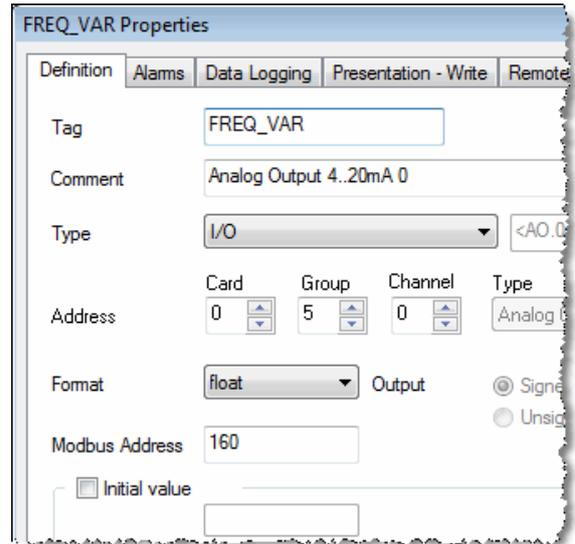


	Name	Value	Address
	Internal Var		
	Com. Var		
1	START	1	DI.0.2.0
2	STOP	0	DI.0.2.1
3	EMERGENCY	0	DI.0.2.2
4	VALVE1	0	DI.0.2.3
5	VALVE2	1	DI.0.2.4
6	FREQ_VAR	53.260	AO.0.5.0.420mA

Examples of Physical Inputs:



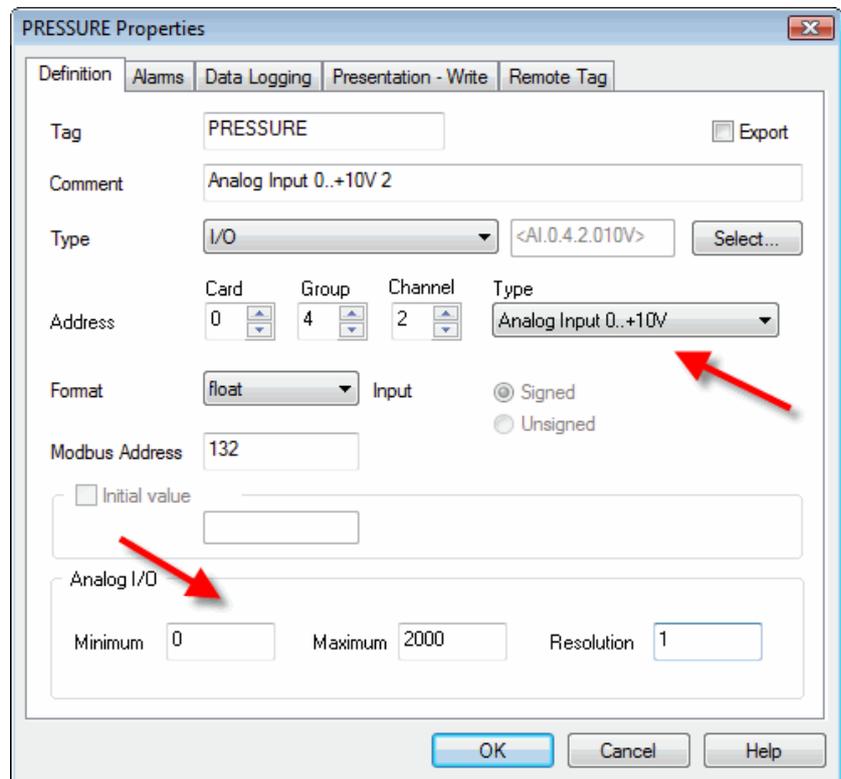
Digital Input



Analog Input

9.1.1. Analog I/O

Concerning Analog I/O, some settings are available:



Type: depending on the model of **TBoxLT2** there may have different types of signal available (1..5V; 4..20mA; 0..10V, ...)

 By default, Analog Inputs are configured as 0..10V inputs, to prevent damaging the hardware if it is cabled before it is programmed. 4..20mA input stage is not protected against over voltage.

Scaling: the I/O can be scaled to real value by defining a MIN (corresponding to the smallest signal) and a MAX (corresponding to the highest signal). The resolution defines the number of steps of the scale ($MAX - MIN / RESOLUTION$).

9.2. Internal Variables (Registers)

An internal variable (also known as Register) is an addressable location of the memory. It is used as flag, as temporary value, to make a calculation, ...

There are 3 types of internal variables:

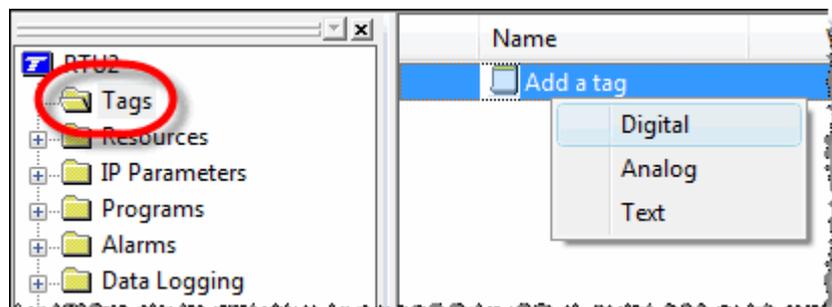
- **Digital (DIV)** Boolean register with possible values: 0 or 1.
- **Analog (AIV)** with several formats:
 - 8 bits, Signed or Unsigned
 - 16 bits, Signed or Unsigned
 - 32 bits, Signed or Unsigned
 - 32 bits Float, IEEE 754
- **TEXT (AIV)** analog register associated to a string of characters



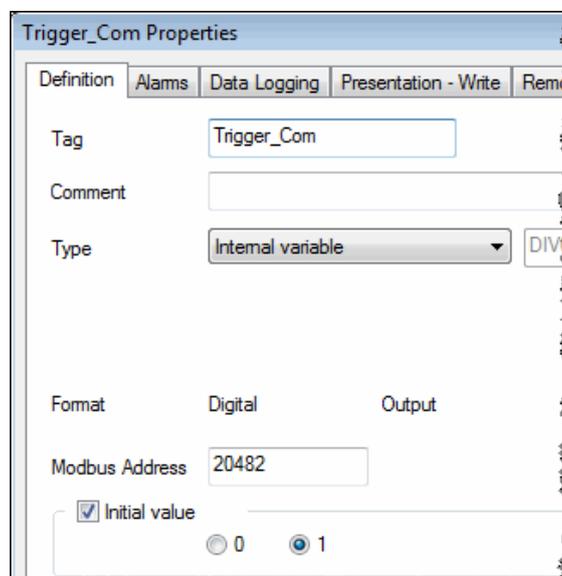
The internal variables can only be created from the list of Tags.

9.2.1. Digital Internal Variable

To create a Digital Internal Variable, from the list of Tags, click 'Add a Tag'.
Select 'Digital':



The Definition menu pops up:



You type a **Tag Name**, a **Comment** and select as **Type: 'Internal Variable'**

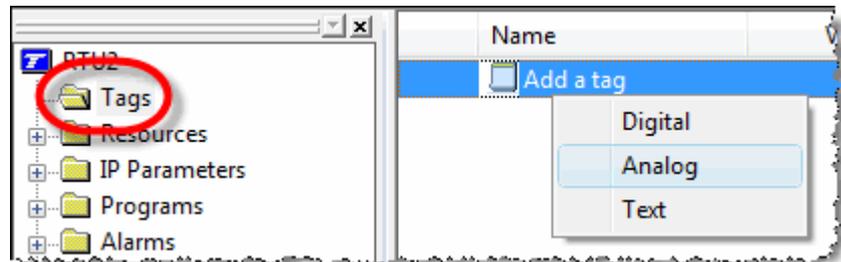
The **initial value** is the value the Tag will have at the start-up of **TBox LT2**.
If you select 'None' the value is maintained at start-up.



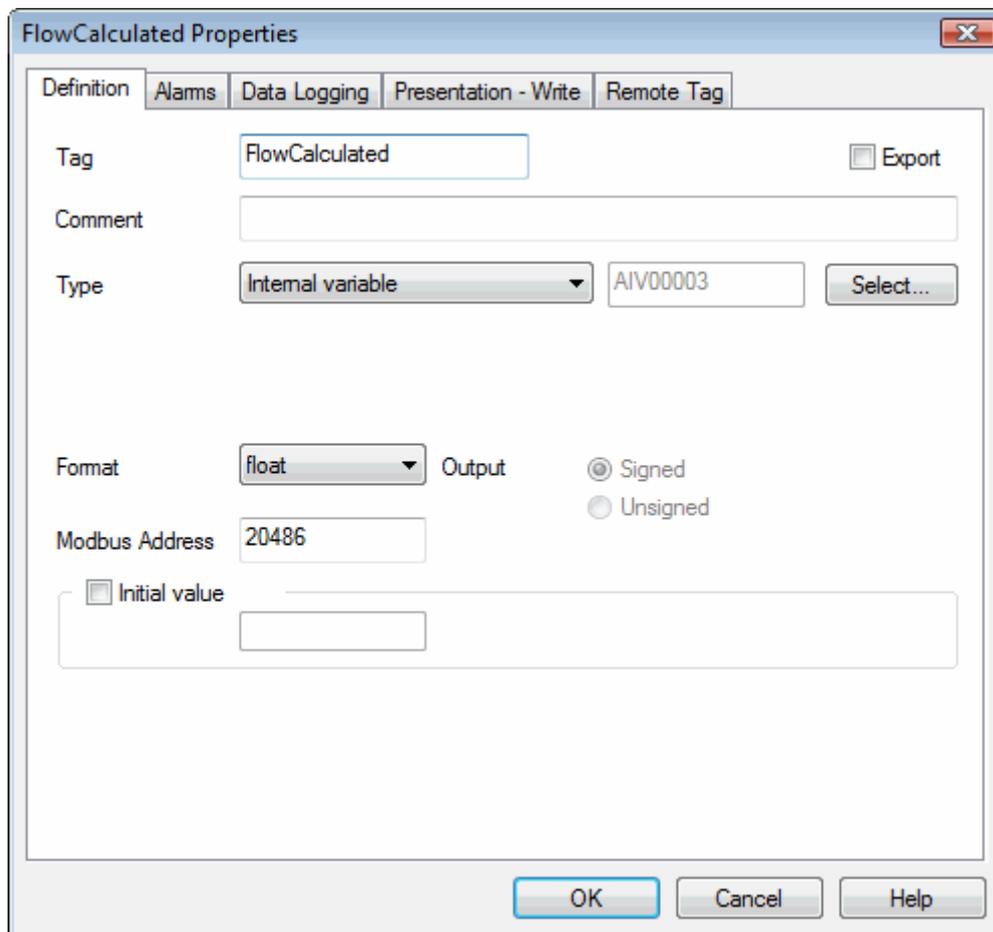
ModBus Address is discussed in chapter 9.3.

9.2.2. Analog Internal Variable

To create an Analog Internal Variable (also known as Register), from the list of Tags, click 'Add a Tag'.
Select 'Analog'



The Definition menu pops up:



Internal "Float" variable

You type a **Tag Name**, a **Comment** and select as Type: 'Internal Register'

For each Analog Register, the formats available are:

- 8 bits (Signed or Unsigned)
- 16 bits (Signed or Unsigned)
- 32 bits (Signed or Unsigned)
- Float (32 bits, IEEE 754)



By default, TWinSoft creates Analog Internal Variable in **format 'Float'**.
Check whether it fits with the use you intend to have of the variable.

The **initial value** is the value the Tag will have at the start-up of **TBox LT2**.
If you leave the field empty, **the value is maintained** at start-up.

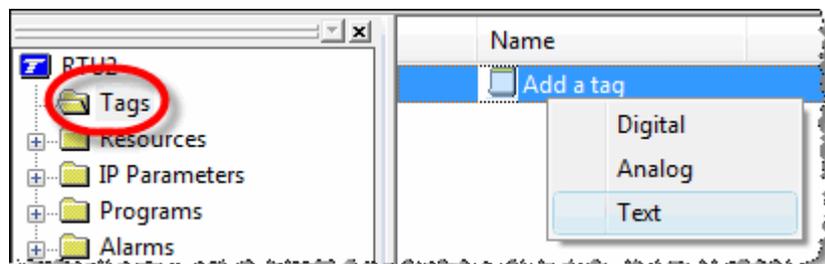


ModBus Address is discussed in chapter 9.3.

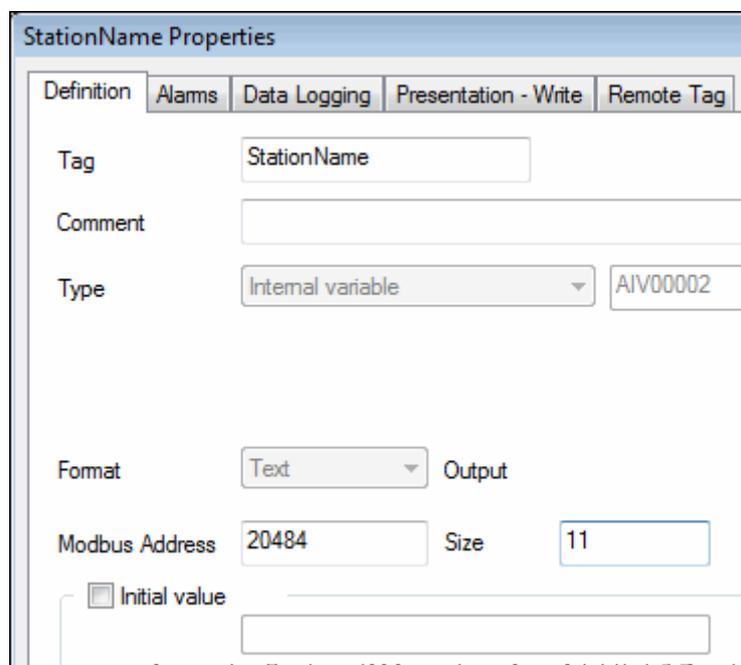
9.2.3. Text Internal Variable

The Tag TEXT uses ASCII character encoding ISO/CEI 8859-1 of the Latin alphabet.
To create a Tag TEXT (string of characters), from the list of Tags, click 'Add a Tag'.

Select 'Text'



The Definition menu pops up:



9.3. ModBus address

The ModBus address is the **link to the outside world**. When equipment must sample Tags in **TBox LT2**, it uses its ModBus addresses; like **TView**, SCADA or TWinSoft.

Each **Tag** has a **unique ModBus address**. By default TWinSoft proposes a ModBus address. You can change it if you want.



While being On-line, the value of the Tag can be displayed only when **TWinSoft has sent the program to TBox LT2**.

The Tag is then available for the outside world **at the ModBus address you have declared**

9.3.1. ModBus address of System Variables

With System Variables it is a little bit different; they have **two ModBus addresses**:

- One **internal and fixed** ModBus address. It explains why when you are connected to **TBox LT2**, even without sending a program, you still can see values from the Resources. The address of these variables is 65280 + ID of the variable.
Example: [AlaRec] = 65280+10=65290
- One **user definable** ModBus address that you modify as you want. When you create a Tag of system variable, you can change its default ModBus address. In case you wish to access the Tag, you declare this **user** ModBus address.



Other Tabs of the Tag configuration refer to menu where the Tag can be declared:

For **Alarms**, see chapter 12

For **Datalogging**, see chapter 14

For **ModBus Transactions**, see chapter 15

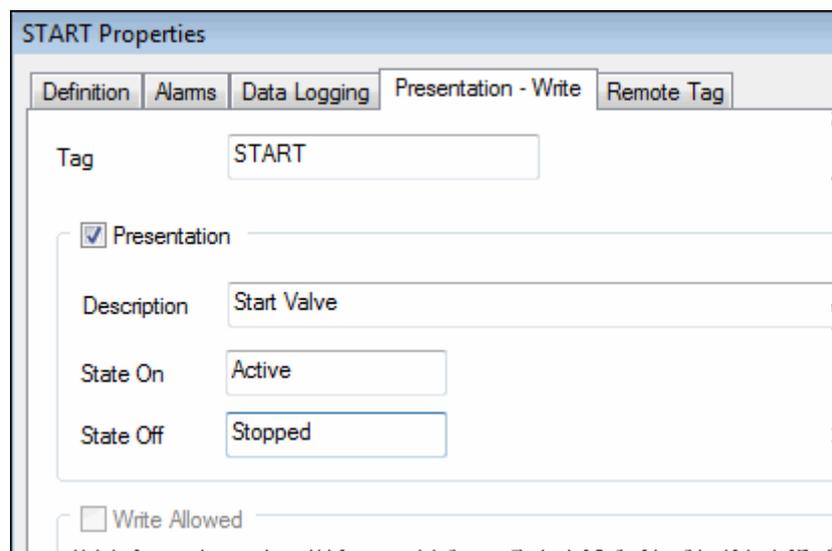
About **Presentation-write**, see next chapter

9.4. Tags - Presentation / Write

This tab contains configuration used when the Tag is declared in a **Report** or in a **WebForm**. The Description is also used in **TView**.

Presentation settings can also be used when the value of the Tag is included into message (SMS or e-mail).

- **Report:** file edited with 'Report Studio' and used for instance as text body when sending **e-mail**. To start **Report Studio** open the list of 'Web and Report files' from 'Project Workspace', double-click an existing report or "Add a new Report..."
- **WebForm:** file edited with 'WebForm studio'. Used to display values of Tags in a **HTML page**. (To start **WebForm Studio**, open the list of 'Web and Report files' from 'Project Workspace', double-click an existing webform or "Add a new WebForm..."
- **Message:** with Digital Tags, the 'states' defined in Presentation will be used and with Float Tags, the number of decimals.
(See also chapter 12.6.1. **Value of Tag in message**)



Presentation: makes the following information available to 'Report', 'WebForm', 'Message' and **TView** .

Description: in a Report, text displayed as 'Header' in sampling table or as Tag information in chronologies when the data is retrieved.

Units: (with analog Tags) text displayed as 'Unit' in datalogging when the data is retrieved. It can also be displayed when selecting as format 'Value + unit' in the report or WebForm.

dec.: (with analog Tags) the quantity of decimals of the value displayed

State On/Off (with digital Tags) Text appearing when value = 1 / 0

Write allowed: if the Tag is declared in a WebForm, allows defining a writing access to the Tag, within a specific range.

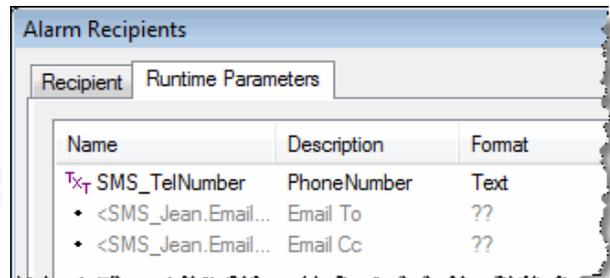
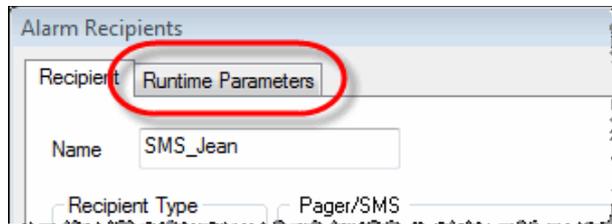
9.5. Run Time Parameters

Run time parameters feature allows accessing some **TBox LT2** configurations through Tags, in order to modify them "on line".

For instance, to change a **tel. number** of a SMS recipient, the **e-mail address** of a recipient, the address of **SMTP server**, the **handling** of alarm condition, ...

When a configuration provides access to run time parameters, a tab is attached to the configuration.

Example with Alarm Recipient:



You associate a Tag to the run time parameter you want to add

The Tag, and therefore its associated parameter, can then be modified from TWinSoft, a WebForm, a SCADA, ...

The format of the Tag depends on the parameter (Bool, Byte, Word, Float, Text)

Changing of parameters is maintained in case of **power cycle**, **reset**, **reboot** and **watchdog**. Original configuration is restored in case of **sending new program or OS** and doing **stop/start from TWinSoft**.

9.5.1. Modbus Device

Parameter	Tag Format
Station Address	Byte
URL	Text
Port TCP	Word

9.5.2. Alarm Parameters

Alarm Condition

Parameter	Choice	Tag Format
Handling	0 = enabled 1 = disabled 2 = power fail 3 = DisAla 4 = DisAla2 5 = DisAla3 6 = DisAla4	Byte
Threshold (analog)		Byte or Word or DWord or Float
Hysteresis (analog)		Byte or Word or DWord or Float

Alarm Recipient

Parameter	Recipient Type	Tag Format
Phone Number	ModBus, SMS, Printer, RAS, Custom	Text (20)
E-mail To	Email	Text (120)
E-mail Cc	Email	Text (120)

Alarm Time Slices

Parameter	Tag Format
From Hour	Byte
From Min	Byte
To Hour	Byte
To Min	Byte

Alarm Holidays

Parameter	Tag Format
Day	Byte
Month	Byte
Year	Word

9.5.3. Datalogging Parameters

Chronologies Condition

Parameter	Choice	Tag Format
Handling	0 = enabled 1 = disabled 2 = power fail 3 = DisCra/DisCrd	Byte
Variation (analog)		Byte or Word or DWord or Float

9.5.4. IP Parameters

ISP

Parameter	Tag Format
Phone Number	Text (20)
User Name	Text (30)
Password	Text (30)

FTP

Parameter	Tag Format
Host	Text (120)
TCP Port	Word
User Name	Text (30)
Password	Text (30)

SMTP

Parameter	Tag Format
Server	Text (120)
TCP Port	Word
E-mail From	Text (50)
Authentication	Bool
Login	Text (40)
Password	Text (40)

POP3

Parameter	Tag Format
Server	Text (120)
TCP Port	Word
Authentication	Bool
Login	Text (40)
Password	Text (40)

NTP

Parameter	Tag Format
Server	Text (120)

DynDNS

Parameter	Tag Format
URL	Text (120)
Authentication	Bool
User Name	Text (30)
Password	Text (30)

HTTP

Parameter	Tag Format (max.)
Server	Text(120)
TCP Port	Word
Authentication	Bool
Login	Text(30)
Password	Text(30)

9.5.5. GSM/GPRS Parameters

GPRS Authentication

Parameter	Tag Format (max. length)
(3G,GPRS) Authentication	Bool
(3G,GPRS) Login	Text (40)
(3G,GPRS) Password	Text (40)
(3G,GPRS) ModemInit String (see below)	Text (120)
(Ethernet) IP	DWord
(Ethernet) Subnet	DWord
(Ethernet) Gateway	DWord
(Ethernet) DNS1	DWord
(Ethernet) DNS2	DWord
(Serial) Baudrate	DWord
(Serial) Parity	Byte
(Serial) StopBits	Byte
(Serial) DataBits	Byte
(Serial) FlowControl	
MasterTimeOut	Word
PacketReceptionDelay	Word
SlaveIFG	Word

Declaring APN as Runtime Parameter

The APN is part of the modem init string. In case APN must be declared dynamically, for instance through a WebForm, the modem init string must be built manually. It must be composed from:
ModemInit = a prefix + APN + a suffix.

Example:

List of Tags:

31	T_{T} ModemInit	AT+KSLEEP=0^ATH^AT+CGDCONT=1,"IP","apn"^AT+COPS=0	AIV00007	Text
32	T_{T} Init_Prefix	AT+KSLEEP=0^ATH^AT+CGDCONT=1,"IP","	AIV00008	Text
33	T_{T} Init_Suffix	"^AT+COPS=0	AIV00009	Text
34	T_{T} Init_APN	apn	AIV00010	Text

BASIC:

```
Dim Init_Temp As Text(120)|  
  
Init_Temp=Cat(Init_Prefix,Init_APN)  
ModemInit=Cat(Init_Temp,Init_Suffix)
```

9.5.6. RTU Properties

Parameter	Tag Format (max. length)
StationName	Text (11)
POP3AckTimeout	Word
SMSTimeout	Word
HTTPServerPort	Word
FTPServerPort	Word
ModbusOverTCPPort	Word
ModbusOverUDPPort	Word
HTTPServerPort	Word
ModBusTCPSlavePort	Word
ModBusAddress	Byte

10. IP Parameters

IP parameters consist in the global configuration for TCP/IP services:

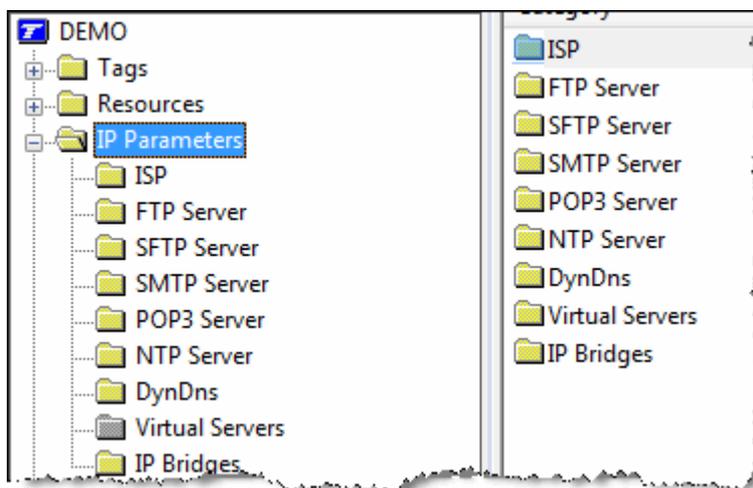
- connecting to an ISP (dial-up connection)
- sending files: FTP(S), SFTP
- sending e-mail: SMTP(S)
- reading e-mail subject: POP3
- time synchronization: NTP
- DynDNS: handling of public, dynamic IP addresses
- configuring Virtual Server rules
- Configuring IP Bridges



Concerning IP configuration of **Ethernet** port, refer to Group 0 from 'Resources' → 'I/O' → LT2-xxx-x.

Concerning IP configuration for incoming dial-up calls (Web Server), see advanced RTU properties → TCP/IP

All TCP/IP services are defined in a Folder, available from the 'Resources'.



The FTP Server, SMTP Server, POP3 Server and NTP configurations correspond to connections to the appropriate servers. **It is done for once**, and called when creating a recipient of alarms. This makes creating alarm recipients very easy!

Example with sending e-mail through a 3G connection:

The **Recipient** is of type 'e-mail' with the recipient's e-mail address and it refers to a **SMTP server**. This SMTP server uses the **3G modem connection**.

In other way round, when **TBox LT2** sends an e-mail, it sequences the tasks like following:

connection to a the 3G network (APN) → connection to a SMTP Server → sending to a recipient (e-mail address)

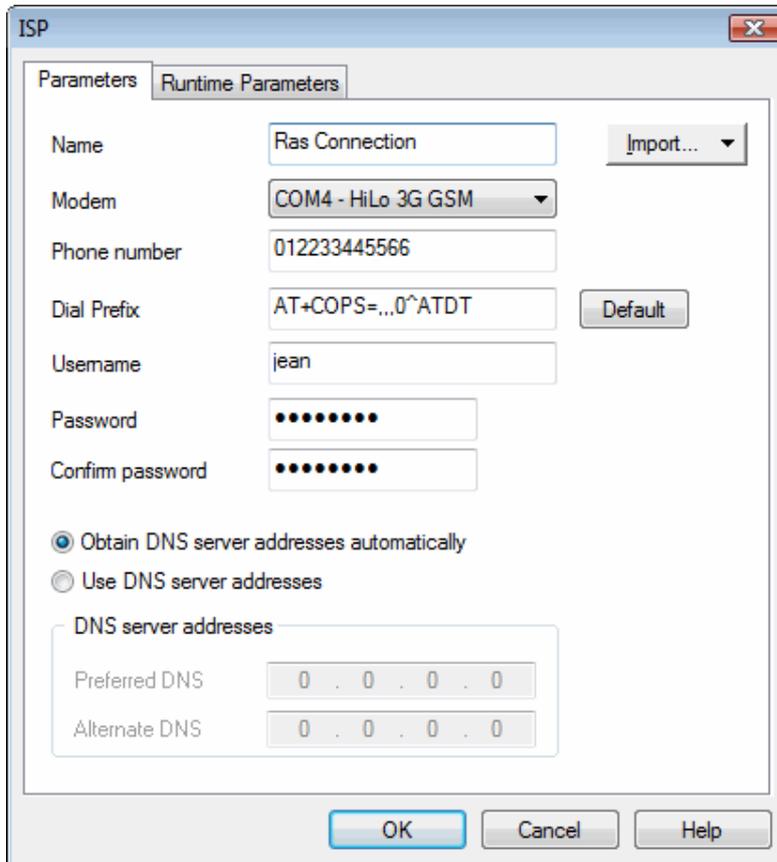
10.1. ISP configuration

ISP stands for **I**nternet **S**ervice **P**rovider. An ISP represents the entrance to Internet. It is required to access Internet with a **dial-up connection**: PSTN, GSM-DATA (CSD).

It represents the connection to the company you call to access an Internet service, like sending e-mail or files (FTP).

Some among the most well-known: AT&T, Scarlet, Tiscali, ...

When you want **TBox LT2** to send e-mail or send files to a FTP site through a dial-up connection, you subscribe an account to an ISP.



Using the button '**Import...**' you access an existing ISP configuration you have tested successfully on the PC.

Name: It is the name of the provider.

Modem: a connection to an ISP is always carried out through modem. Select the modem.

Phone number: It is the phone number of the provider **TBox LT2** must dial to send an e-mail or files.

Dial Prefix: The default dial prefix to connect to an ISP (ATDT). **It should not be changed** unless the modem needs a particular configuration.

If **TBox LT2** is placed behind a telephone switch, the 'outside line prefix' is defined in the modem properties (see chapter 8.2.2); **it should not be added to the dial prefix.**

User name: It is the name of your account needed to access Internet (usually it is given by the ISP).

Password: It is the password of your account needed to access Internet (usually it is given by the ISP).

DNS: A DNS converts names in IP address. It is needed in case the Server (SMTP, FTP, NTP, POP3) is indicated in 'text' and not with an IP address. Most ISPs support dynamic DNS, they provide the DNS addresses when connecting. If this is not the case, they provide you with a 'Preferred' and 'Alternate' DNS address.



You can declare several ISP entries!

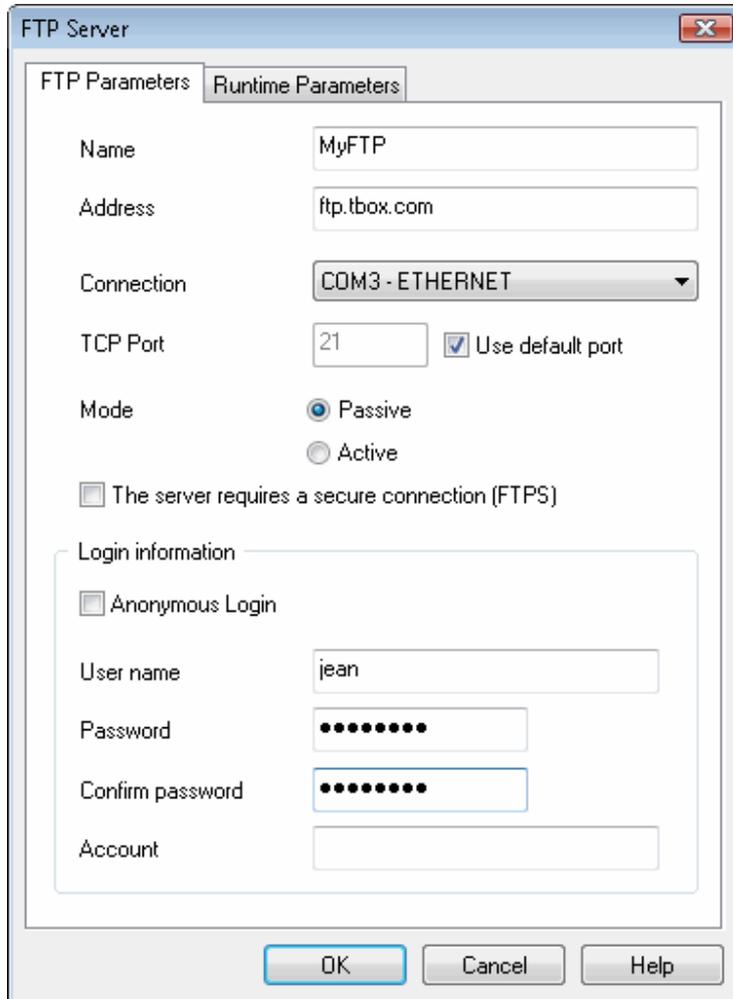
Then they can be used in redundancy to access internet services (FTP, e-mail, NTP). You are also allowed to define several SMTP Servers (see next), associated to different ISPs. Creating the alarm recipient, you can select the 'Redundancy' option.

10.2. FTP(S) Server

FTP stands for **File Transfer Protocol**. When subscribing an account to an ISP, usually you have some Mbytes to your disposal for sending files. It supports secure, encrypted communication.

The FTP server represents the target when sending files. The directory where the files are sent is defined in the Recipient (see chapter 12.4).

The sending is generated through an alarm recipient "FTP". **TBox LT2** connects to Internet (through a connection: ISP, Ethernet or GPRS/3G) and then connects to the FTP server.



Name: It is a free name, to recall when you create the alarm recipient

Address: text and IP address are accepted.

Connection: You select the way to connect to the Server (ISP, GPRS/3G, Ethernet).

TCP port: Each TCP/IP service has its own unique TCP port. It provides a logical location for the delivery of TCP data. TCP port used by **TBox LT2** to establish FTP connection (default=21).

Mode: A FTP connection uses 2 sockets: one CONTROL and one DATA connection. The mode determines which party takes the initiative of the DATA transfer

Passive:

- During the CONTROL connection, **TBox LT2** sends a request PASV. The server returns a TCP port to use during data connection
- TBox LT2 initiates the DATA connection to destination TCP port given by the Server during the CONTROL connection

Active:

- During the CONTROL connection, **TBox LT2** sends a request with IP address and the Active port (to access the IP address).
- The Server initiates the DATA connection to destination TCP port given by **TBox LT2** during the CONTROL connection.

FTPS: If required by the server, **TBox LT2** supports FTPS, for secure encrypted connection. It uses SSL as cryptographic protocol.

Login: Depending on the account you have subscribed, you have a login or work with 'Anonymous login'.

Account: Some Servers require an account name. If it is not the case, leave this field empty.



This is the basic configuration to connect to the 'FTP site'. You **do not declare a directory** in this configuration, but when declaring the 'Recipient' (see chapter 12.4. **The Recipients**).

This allows creating any combination:

- several 'FTP recipients' to one FTP site
- several 'FTP recipients' to different FTP sites.

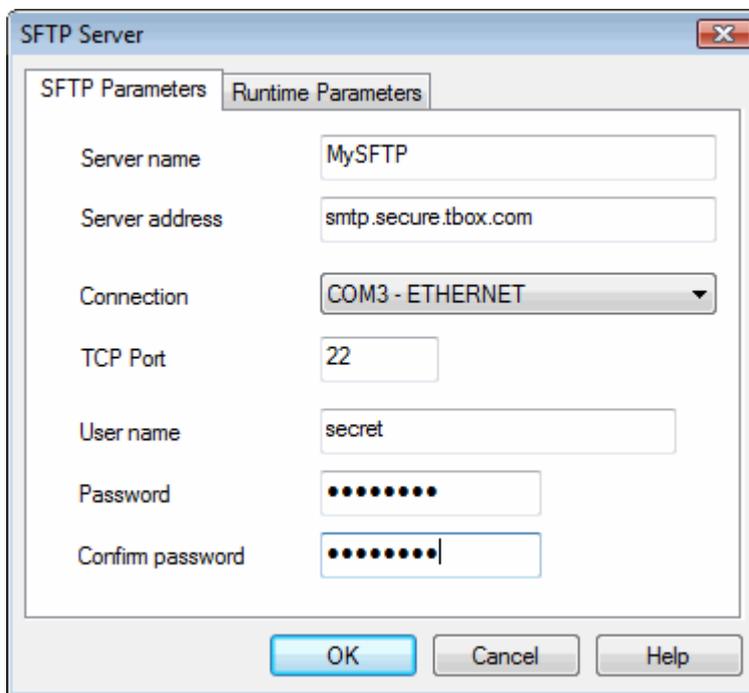
- ...

10.3. SFTP Server

SFTP provides secure in transferring files, using **SSH protocol**. It is also called **Secure File Transfer Protocol**.

The SFTP server represents the target when sending files. The directory where the files are sent is defined in the Recipient (see chapter 12.4).

The sending is generated through an alarm recipient "SFTP". **TBox LT2** connects to Internet (through a connection: ISP, Ethernet or GPRS/3G) and then connects to the SFTP server



Server name: It is a free name, to recall when you create the alarm recipient.

Server address: Address of the site. It can be in IP format or in 'text' format. In this last case, the DNS must be specified for the communication port used to send the file(s).

Connection: Connecting through dial-up modem, you select the ISP you have previously created. Connecting through Ethernet or GPRS/3G, select directly the corresponding COM port.

TCP port: Each TCP/IP service has its own unique TCP port. TCP port used by **TBox LT2** to establish SFTP connection (default=22).

Login: Depending on the account you have subscribed, type the name and password.

10.4. SMTP(S) Server

SMTP stands for **S**imple **M**ail **T**ransfer **P**rotocol. It is usually the main reason for subscribing an account to an ISP, for sending e-mail. It supports secure, encrypted communication



Concerning e-mail, **TBox LT2** is able to send e-mail (through SMTP server) and to read e-mail (through POP3 server)

The SMTP Server represents the mail server used for sending e-mail (typically the one of the ISP where we have subscribed and account).

The sending is generated through an alarm recipient "SMTP". **TBox LT2** connects to Internet (through a connection: ISP, Ethernet or GPRS/3G) and then connects to the SMTP server.

Name: It is a free name, to recall when you create the alarm recipient.

Mail Server (SMTP): It is the IP address (or the name) of the outgoing e-mail Server. It is the unique mail Server needed to send e-mails.

E-mail address: It is the e-mail address of the **TBox LT2**. You can usually choose it when you subscribe an account. This address will appear in the 'From:' when receiving the e-mail.

Connection: You select the way to connect to the Server (ISP, GPRS/3G, Ethernet).

SMTPS: If required by the server, **TBox LT2** supports SMTPS, for secure encrypted connection. It uses SSL as cryptographic protocol.



In order to **protect the mail sever** (and you) against spamming, the ISP risks to refuse sending e-mail if the address of the originator is not known. Therefore, be careful to indicate here **the e-mail address you have received from your ISP**.

TCP port: Each TCP/IP service has its own unique TCP port. It provides a logical location for the delivery of TCP data.
TCP port used by **TBox LT2** to establish SMTP connection (default=25).

The Server requires Authentication: Depending on your ISP and on the way you send e-mail, authentication might be needed to send e-mail.
Usually, when you have subscribed the e-mail account at your ISP it is not required. To be sure, if you have created this account to a PC, check its configuration otherwise contact your ISP.



TBox LT2 supports two SMTP authentication protocols: **PLAIN** and **LOGIN Authentication**. Check with your ISP.

10.4.1. About SMTP Redundancy

If you create more than one SMTP Server, they can be used in redundancy according to their order in the list.

You decide to work with redundancy when creating the e-mail recipient (see chapter 12.4).

10.5. POP3 Server

POP3 stands for **Post Office Protocol 3**. It is used to check and collect e-mails in a mail box.

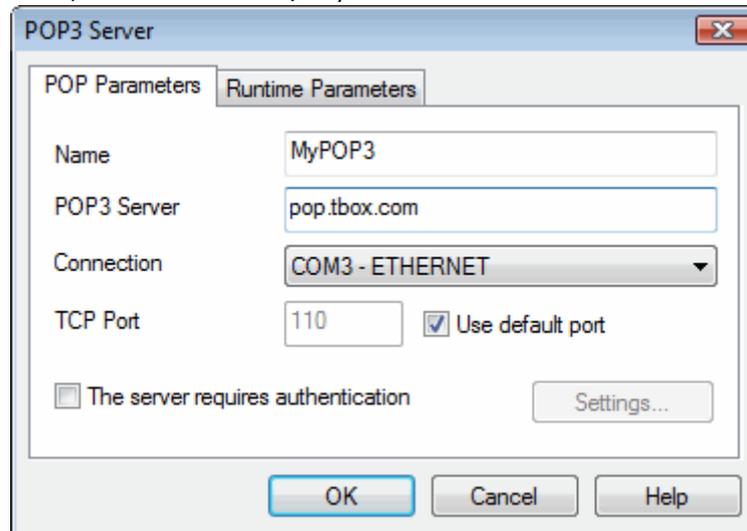
The POP3 Server represents the mail server used to read mails previously sent to the attention of **TBox LT2**.

The use of POP3 is not to retrieve e-mail, but to read the field "Subject" and take some actions. Two actions can be taken by sending e-mail to TBox:

Alarm acknowledgment sent through e-mail (see next page)

RTU monitoring with predefined message (see chapter 13. **ReadSMS/POP3**)

The checking of e-mail is generated through an alarm recipient "POP3". **TBox LT2** connects to Internet (through a connection: ISP, Ethernet or GPRS/3G) and then connects to the POP3 server.



Name: It is a free name, to recall when you create the alarm recipient.

POP3 Server: It is the IP address (or the name) of the POP3 Server to which **TBox LT2** connects to read e-mails.

Connection: You select the way to connect to the Server (ISP, GPRS/3G, Ethernet).

TCP port: Each TCP/IP service has its own unique TCP port. It provides a logical location for the delivery of TCP data.

TCP port used by **TBox LT2** to establish POP3 connection (default=110).

The Server requires Authentication: If authentication is required to collect e-mail: Login and Password. **TBox LT2** does not support SSL for POP3 connection.

10.5.1. Alarm Acknowledgment through POP3

Introduction

With **TBox LT2** sending a SMS through a GSM, it is possible to acknowledge the alarm by sending back a SMS to **TBox LT2**

In some countries, SMS can only be sent through email. A POP3 connection can then be used to acknowledge the alarm.

Sequence of connections

1. **TBox LT2** sends an e-mail. The alarm condition has been configured with the option "**POP3 Ack**". It is important you have a dedicated e-mail account for your RTU. The data sent by e-mail can be a report or a message.
2. The recipient retrieves its e-mail. The field "Subject" of the e-mail is preceded with internal data:
RTU Id (**I**)
Alarm index (**A**)
Example of message: #I460000020107,A00004# MyTBox: PUMP stopped
3. The user sends back the e-mail. Typically, he will make a "Reply" and sends back the e-mail to the address as specified in point 1. above, in the SMTP server
4. **TBox LT2** generates a POP3 connection (through alarm condition) and checks the presence of e-mail with specific data in field "Subject". With this data, **TBox LT2** knows which alarm for which RTU it can acknowledge.
The POP3 connections have to be handled into your process and can be checked from System Variables (see below)

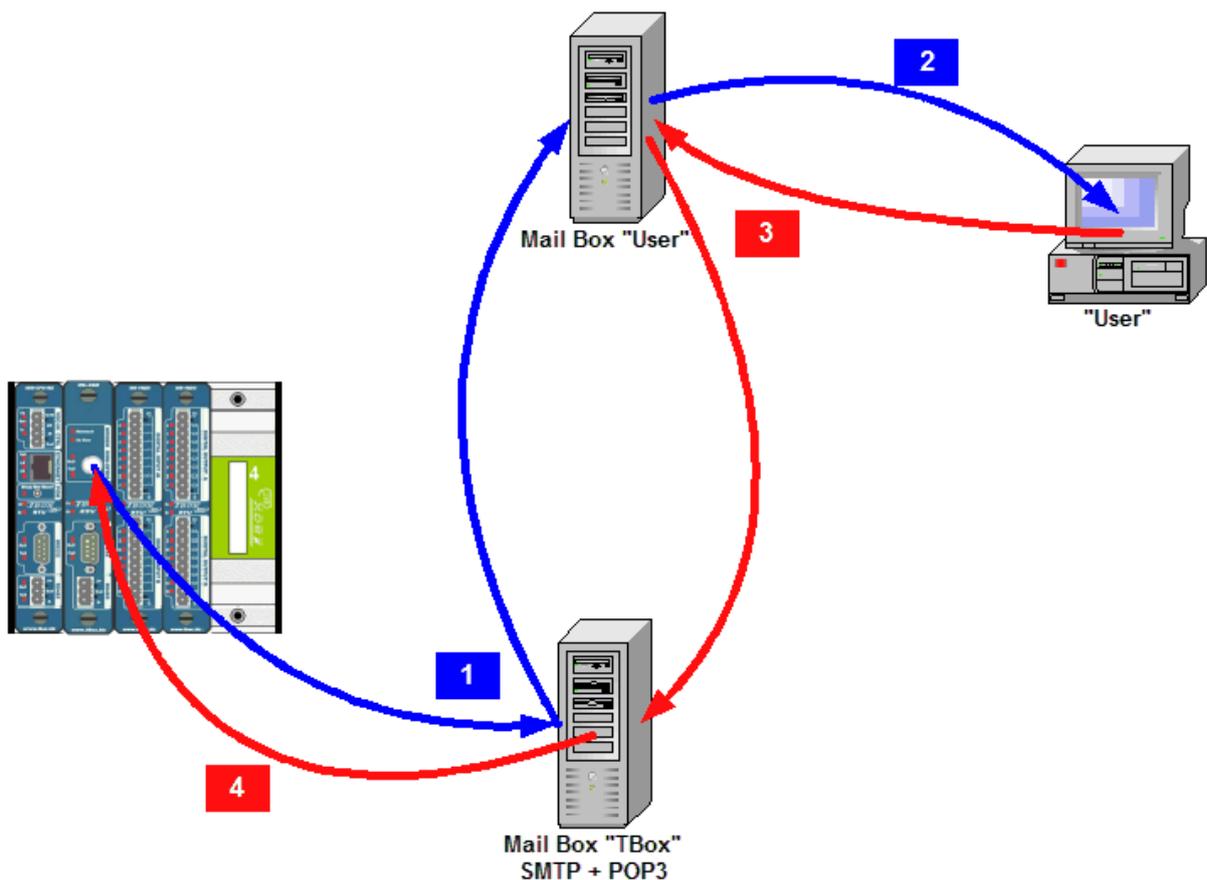


Illustration with a TBox MS

Supplementary information

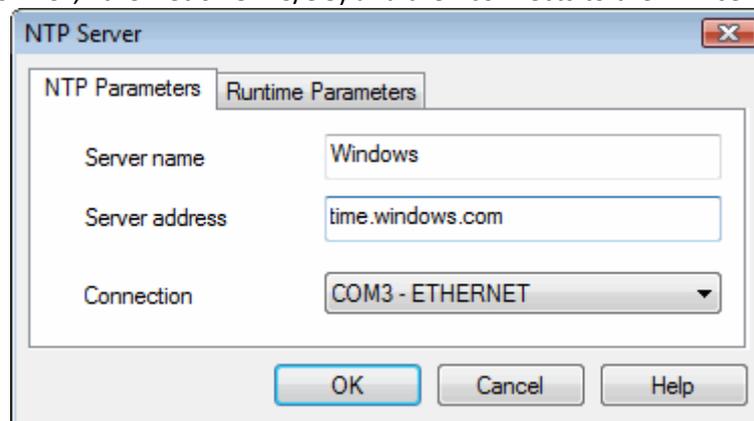
1. The time between phases 1 and 4 can be determined in RTU properties --> Advanced Alarms properties
2. System Analog Variable: **#40 [AlaPop3]** indicates the quantity of alarms needing to be acknowledged by POP3 connection and **#43 [Pop3State]** indicates the state of connection.
3. If escalation is required, Group of recipients can be associated to the alarm condition
4. Like other alarms, failure in sending SMTP alarms can be checked using System Digital Variable: **#06 [AlaErr]** and System Analog Variable: **#10 [AlaRec]**
5. Error in POP3 connection can be detected also using System Digital Variable: **#48 [POP3Err]**

10.6. NTP Server

NTP stands for **Network Time Protocol**, an Internet standard protocol (built on top of TCP/IP) that assures accurate synchronization of the clock of **TBox LT2**.

The NTP Server represents a server dedicated to time synchronization.

The time synchronization is generated through an alarm recipient "NTP". **TBox LT2** connects to Internet (through a connection: ISP, Ethernet or GPRS/3G) and then connects to the NTP server.



Example with a connection to Windows server through Ethernet

Examples of Servers:

time.windows.com
europe.pool.ntp.org

You will find valuable information, like lists of Servers with open access at:

www.ntp.org → public time server list

The organization pool.ntp.org proposes servers using DNS round robin, which make a **random selection from a pool** of open access time servers. This is good enough when working with **TBox LT2**.

Round Robin DNS technique is used when the number of access to a server is unpredictable, to balance the use of IP addresses (load balancing technique).

10.6.1. Time accuracy

When setting time, **TBox LT2** takes into account the propagation delay. This is particularly important when connecting to the server via modem.

The precision is of **1 second**.

10.7. DynDNS

DynDNS stands for **D**ynamic **D**omain **N**ame **S**ystem.

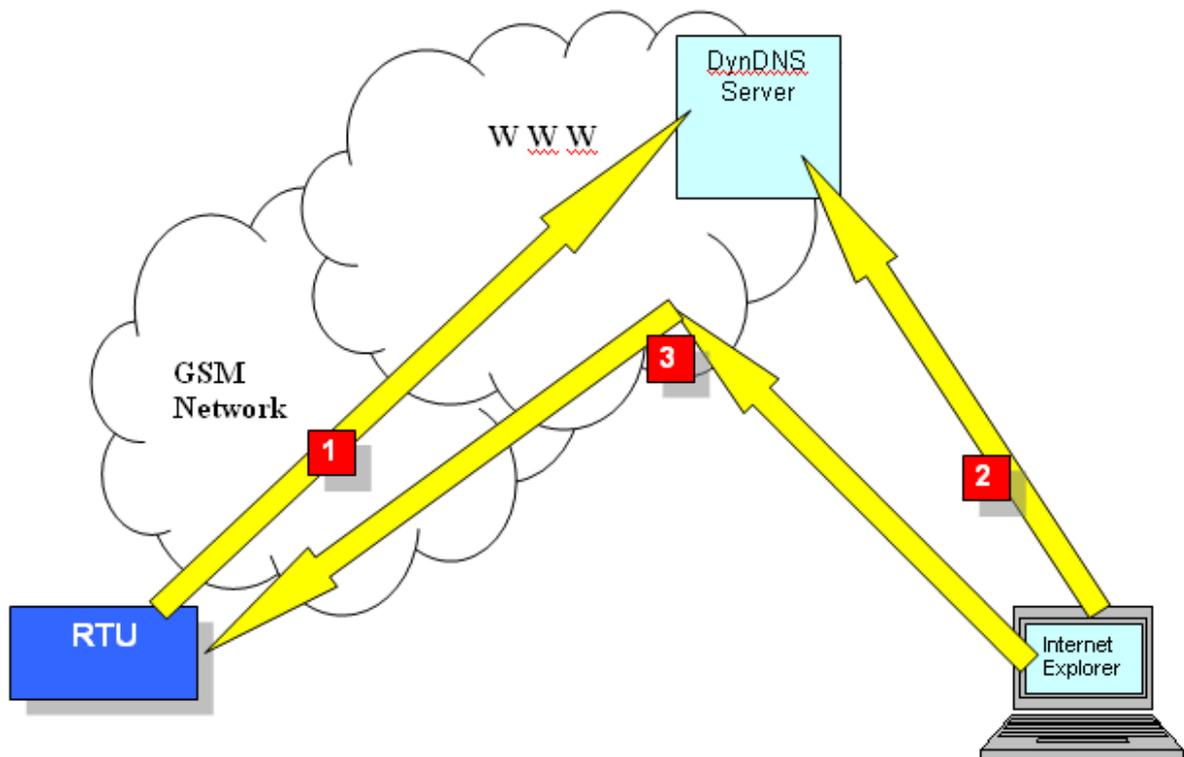
It is a service, provided by companies like www.DynDNS.org or www.noip.com, offering the handling of **dynamic IP addresses**.

When working with GPRS connection, using public dynamic IP addresses, it is not possible to access the RTU directly, as you don't know its IP address.

The DynDNS service solves this problem: each time the RTU **detects a changing of its IP address**, it informs the DynDNS server.

You then connect to the DynDNS Server that will redirect you to the RTU.

Example of topology: connecting with Internet Explorer to a RTU having a **GPRS dynamic IP address**.



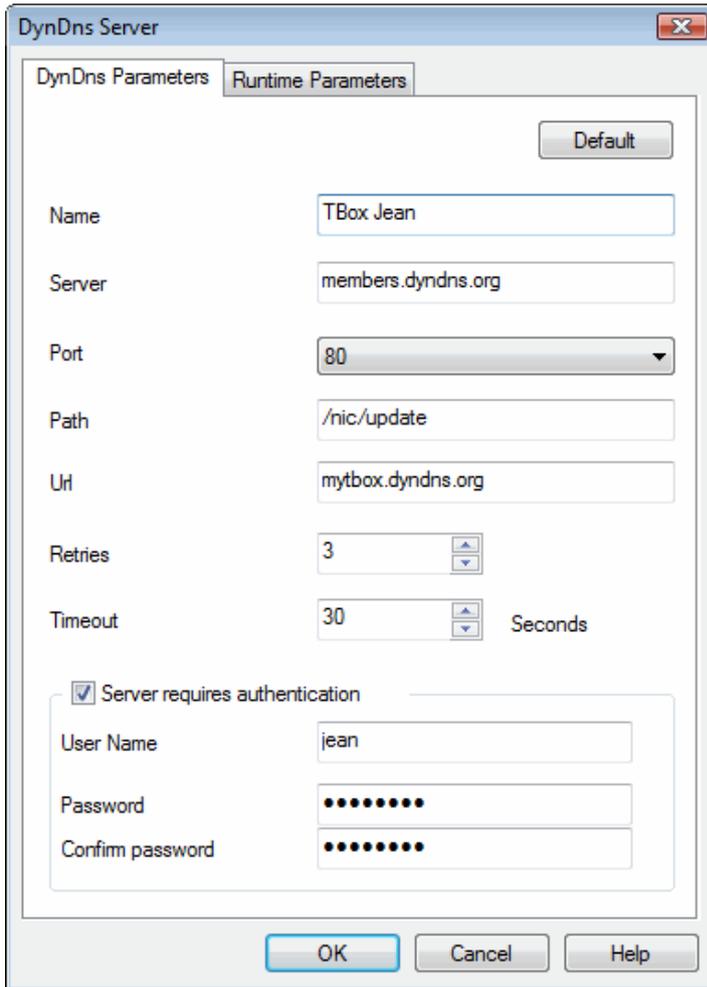
Sequence:

1. Detecting a changing in its IP address, the RTU informs the DynDNS Server.
2. Internet Explorer connects to the DynDNS Server (example: <http://waterloo.dyndns.org>). The DynDNS Server resolves the name and sends back the corresponding IP address.
3. Internet Explorer connects to the IP address it has received.

10.7.1. How to configure DynDNS in TBox

1. Subscribe a DynDNS account:
 - Go to www.dyndns.org or www.no-ip.com (examples of DynDNS services)
 - Create an Account
 - Create a Host

2. Create in TWinSoft IP Parameters the connection to DynDNS:



Name

Type any name

Server

DynDNS Server to which **TBox LT2** will connect when it detects a changing in its IP address. It should not be changed.

Path

Location in the server of the table of correspondences between IP address --> name. It should not be changed.

Url

You type the host address you have creating when subscribing the DynDNS account.

Example: waterloo.dyndns.org

Server requires authentication

Select the option to type the **login** corresponding to the account you have created at DynDNS organization.

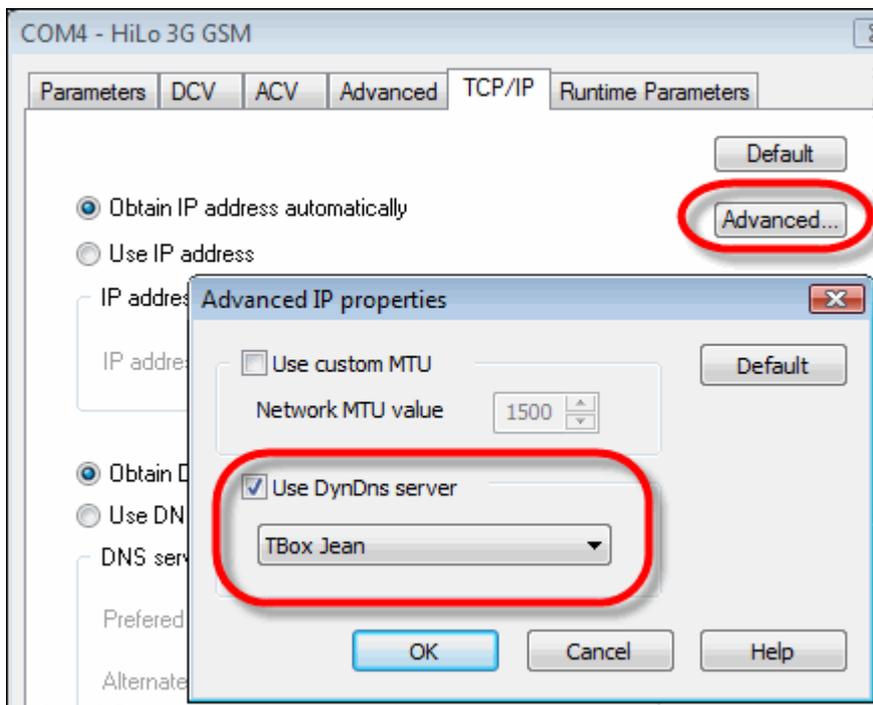
User name

Type the login name of your account.

Password

Type the login password of your account.

3. Associate the DynDNS connection to the modem (see communication port: TCP/IP Advanced...)



10.8. Virtual Server



To access Virtual Server configuration, you have to activate “RTU properties” -> “Protection” -> “Enable Advanced IP Configuration” (see chapter 17.1.5) and “RTU properties” -> “Advanced” -> “TCP/IP”, check **Virtual Server** (see chapter 7.6.6)

Virtual Server Parameters allow defining specific routes (in <--> out) based on IP protocol and TCP port

Virtual Server Parameters example:

The screenshot shows a dialog box titled "Virtual Server Parameters". It is divided into two main sections: "Incoming" and "Destination". In the "Incoming" section, the "Protocol" is set to "TCP" and the "Port" is "81". In the "Destination" section, the "IP Address" is "192 . 168 . 1 . 100" and the "Port" is "80". There is a "Comment" field with the text "Camera". At the bottom left, there is a checked checkbox labeled "Activate". On the right side of the dialog, there are three buttons: "OK", "Cancel", and "Help".

Accessing a Camera with IP address 192.168.1.100 connected to Ethernet, through a 3G connection using TCP port=81

Any request arriving with TCP port =81 will be redirected to IP address 192.168.1.100.

Example: <http://78.25.56.126:81/jpg/image.jpg>

Incoming Protocol: The incoming protocol that has to be routed.

Incoming Port: The incoming IP Port that has to be routed.

Destination IP address: The IP address to which data coming with above settings has to be routed.

Destination Port: The IP port used for data sent to the destination IP address.

Activate: Allows activating/deactivating a Virtual Server rule.

10.9. IP Bridge

10.9.1. Introduction

What is a Bridge ?

A Bridge is a device that connects two or more networks as a seamless single network. It supports any protocol as it operates on MAC-layer addresses, and then protocol independent. The bridge passes packets according to the destination and its internal table of addresses.

Why do we need a Bridge with TBox ?

This will be mostly required with MS-CPU32-X.

This allows carrying a seamless connection between SHDSL network and Ethernet; it connects through SHDSL network, two Ethernet LANs of 2 distant MS-CPU32-X.

How do we configure a Bridge with TBox ?

From the IP Parameters folder, go to "IP Bridges" you create a Bridge and define an IP address.

Then you attach this Bridge configuration to the communication ports you want to bridge (see TCP/IP configuration).

The IP address of the bridge has then priority on the one originally defined for the communication port.

10.9.2. Configuration

The screenshot shows the 'IP Bridge / Bonding' configuration window. The 'Bridge Parameters' tab is selected. The 'Name' field contains 'Bridge1'. Under 'IP address', the 'Use IP address' radio button is selected, with the IP address '172 . 50 . 110 . 99', Subnet mask '255 . 255 . 255 . 0', and Gateway '172 . 50 . 110 . 1'. Under 'DNS server addresses', the 'Use DNS server addresses' radio button is selected, with Preferred DNS '172 . 50 . 110 . 1' and Alternate DNS '8 . 8 . 8 . 8'. In the 'Advanced' section, the 'Type' dropdown is set to 'Bridge' and the 'Spanning Tree' checkbox is unchecked. The 'OK', 'Cancel', and 'Help' buttons are at the bottom.

You define the IP setting of the Bridge.

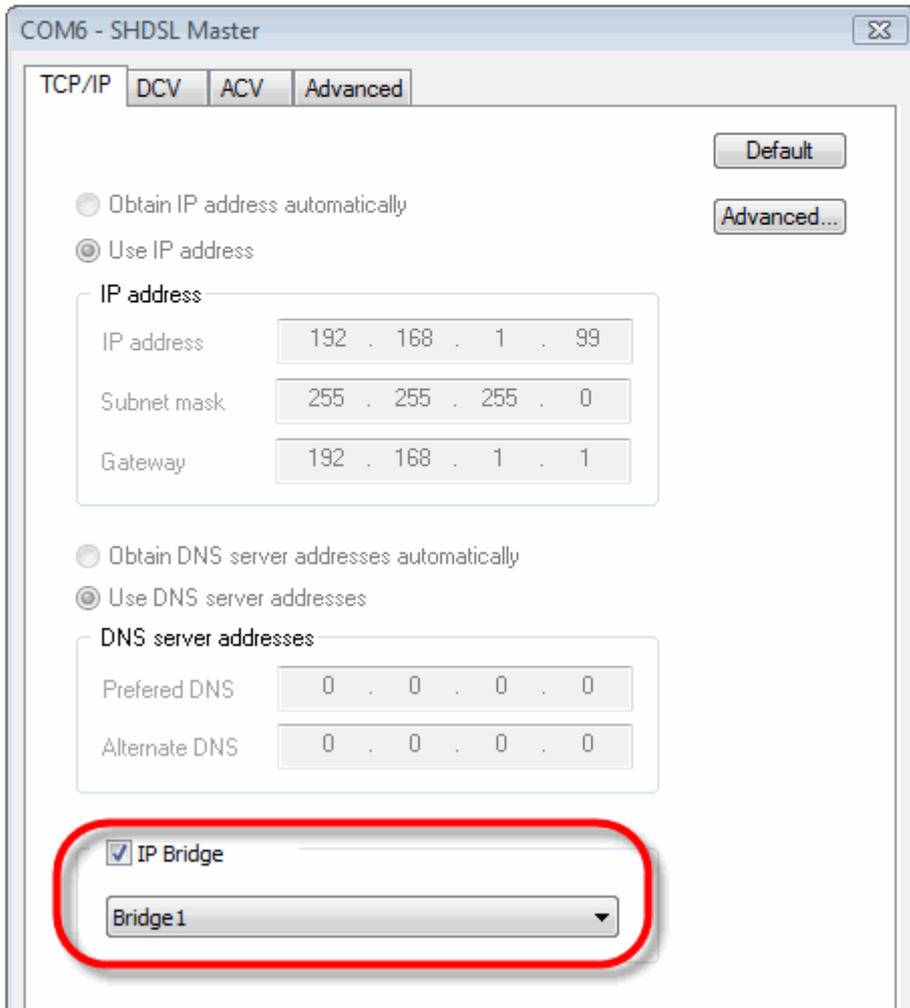
This IP will be attached to each port that needs to be bridged.

(See IP settings chapter 8.2.3)

In IP ports you want to bridge, select the bridge you have configured as above.
The IP of the bridge will be applied to each port.

Example with MS-CPU32X

Port	Type	Protocol	Informations
COM1	RS232	Modbus RTU	9600 - 8 bits - None - 1 stop
COM2	RS485	Modbus RTU	9600 - 8 bits - None - 1 stop
COM3	ETHERNET	IP	In IP Bridge "Bridge1"
COM4	ETHERNET	IP	0.0.0.0 / 0.0.0.0 / 0.0.0.0
COM5	SHDSL Slave	IP	192.168.1.99 / 255.255.255.0 / 192.168.1.1
COM6	SHDSL Master	IP	In IP Bridge "Bridge1"



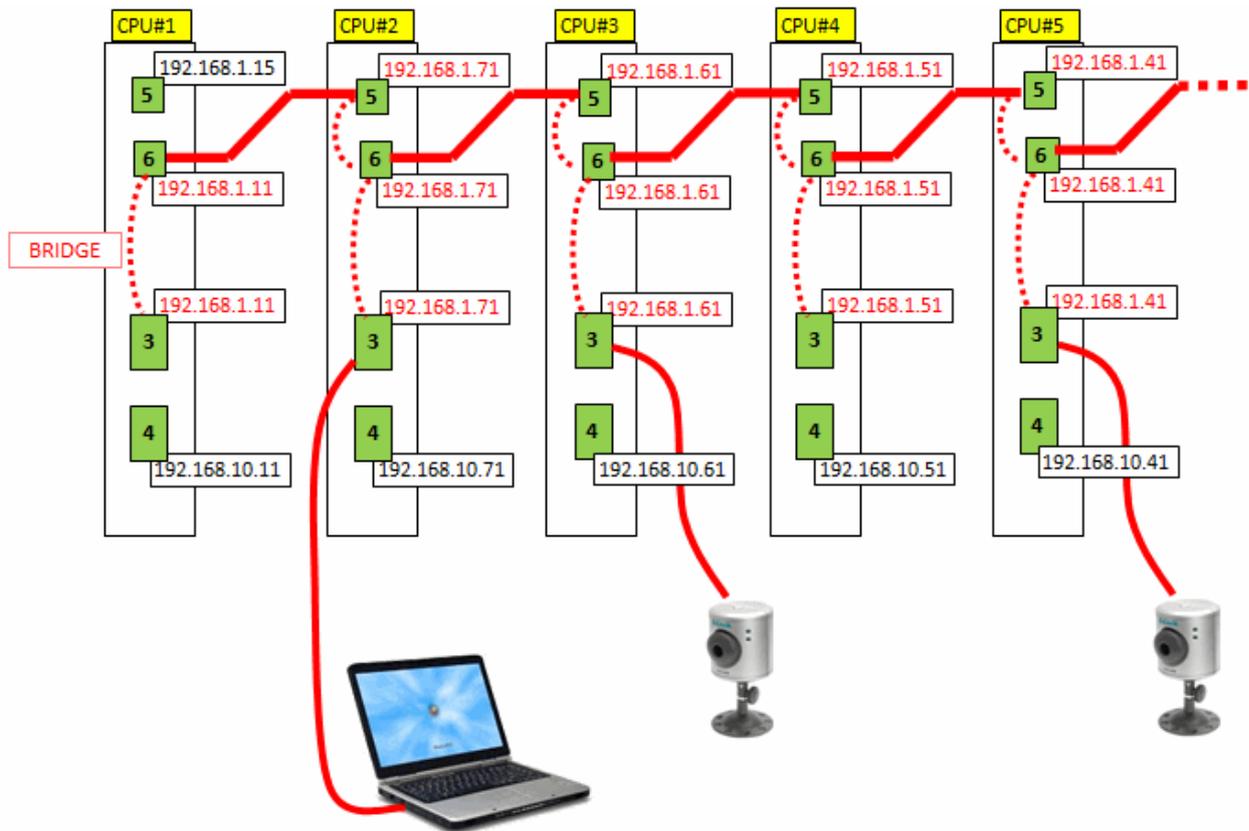
10.9.3. Example with MS-CPU32X.

In example below, one wants to access remote camera connected to TBox Ethernet.

By default in TBox, each IP port in TBox is separated from each other. The bridge represents a virtual connection between the ports.

When you need to access devices through different connections, you bridge the ports.
The bridges are represented with the dot lines.

The easiest is to draw the connections needed to access the devices and then you visualize which ports to bridge together.



10.9.4. Sending Configuration through a Bridge

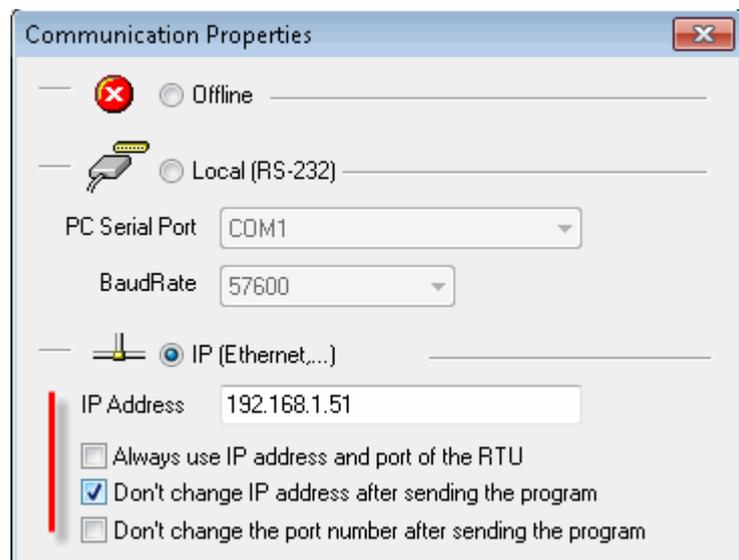
With example above, imagine TWinSoft is connected to COM3 of CPU#1 (192.168.1.11) and you wish to update the application of CPU#4.

In menu "PC setup":

Uncheck "Always use IP address of the RTU"

Type the IP address of destination TBox (192.168.1.51 in this case)

Check "Don't change IP address after sending program"



10.11. Trace Log

The Trace Log feature is a powerful tool to debug the **TBox LT2**, like modem connection or TCP/IP connection.

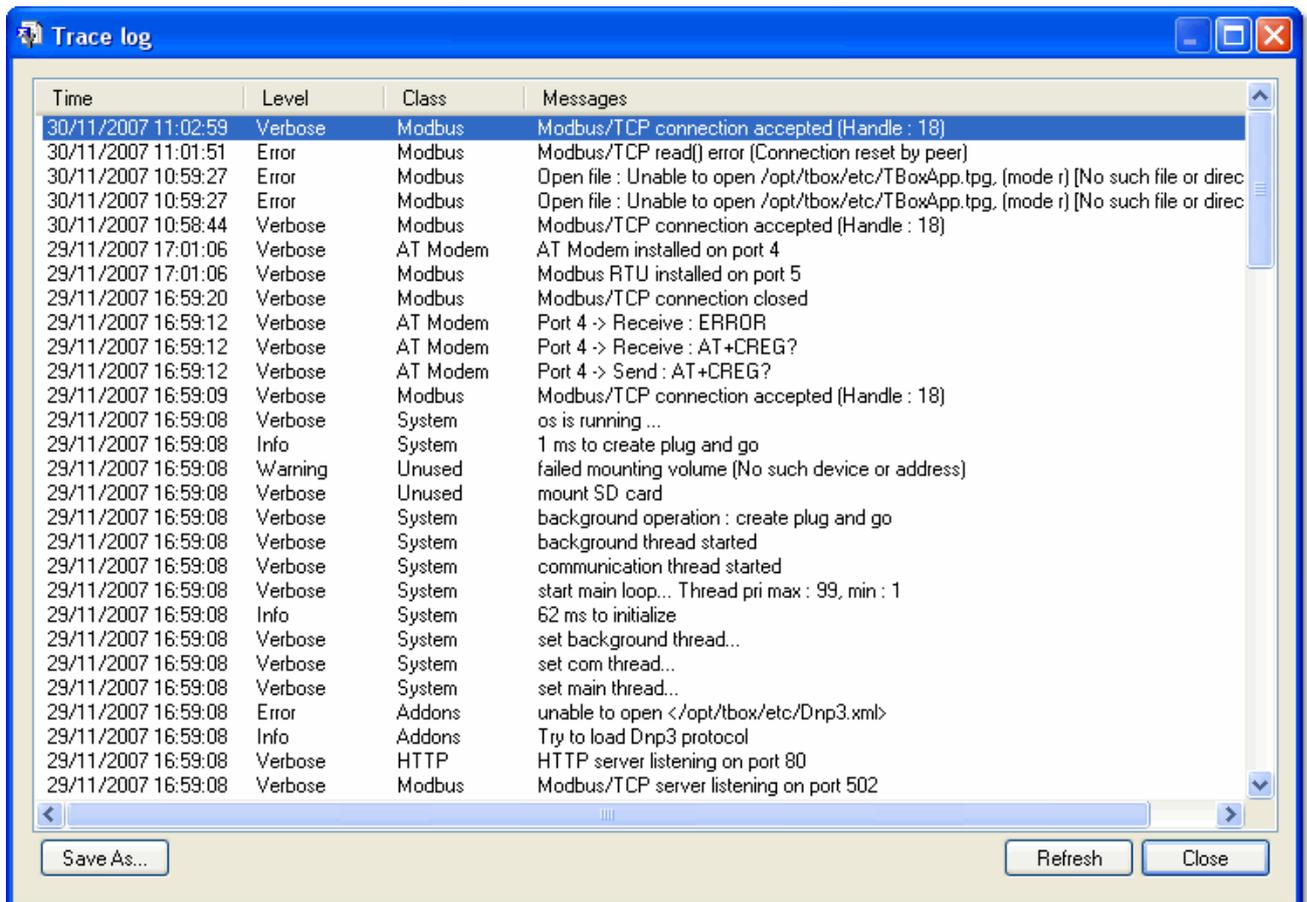
When you are online with your **TBox LT2**, it can be accessed from the menu 'Communication' → 'Retrieve from TBox' → 'Trace Log'.

Many events, related to many tasks are stored in the log. To adjust the analyses, TWinSoft provides 2 filters:

Level: The level allows you selecting the kind of messages (verbose, warning, info, ...). You can also select 'All' to display all levels of messages.

Class: The Class allows you selecting the feature for which you want to display message (modem connection, sending e-mail, ...).

Example with all levels and all classes:



You can also select 'All' to display all classes.

Time Range: You can select a "relative" or "absolute" time range.



TBox LT2 can store 64 kbytes of data for Trace Log. When this amount is reached, newer data replaces older data.

11. IP Security

IP security services are:

- VPN
- Firewall (must be activated from the RTU properties -> IP security)

11.1. VPN

11.1.1. Introduction

This feature provides secure connections using OpenVPN.

OpenVPN version used: **2.3.0-1**.

TBox LT2 can be configured as "Client" or "Server" in mode routing.

Any physical media can be used (Ethernet, 3G). The VPN connection represents a new communication port, including its communication variables.

As we have "COM3-Ethernet" or COM4-3G", we have new com. port(s) "VPN".

It supports site-to-site type of VPN.

11.1.2. How does OpenVPN work ?

Asymmetric authentication

Asymmetric authentication uses a pair of keys:

- the public key
- the private key, not known by anybody.

When "Client" connects to the server, they exchange their certificate, which are checked using the CA certificate.

Each party receives the other one certificate, it checks whether the certificate is signed by the master root certificate as specified in its CA certificate.

If the verification succeeds, the symmetric key (DH key) is exchanged between parties.

This asymmetric mechanism allows keeping this symmetric key secret.

Each partner is now able to encrypt data and the VPN tunnel is up.

Symmetric encryption

Once parties have authenticated each other, meaning the VPN is up and secured, each client uses the symmetric key (DH key) to encrypt and decrypt data.

Symmetric encryption highly improves time performance of communication.

Name: Type a name, without SPACE.
This name will be the reference to your VPN entry, like in the list of communication ports to protect, or as default prefix to the communication variables, ...

Type: Select what **TBox LT2** will be: "Server" or "Client".
Note that other parties need to support OpenVPN.
It can be a PC or a TBox.

Connection:
When **TBox LT2** is "Client": you indicate which communication port is used to connect to the server.
Select an IP port available.

Server Address :
When **TBox LT2** is "Client": you indicate the IP address of the server.
In case you access the Server through Internet, you indicate the **public IP address** (or name if accessing through dyndns for instance).



When **TBox LT2** is "Server": The Server acts as DHCP server, therefore, when VPN tunnel is built, it attributes an IP address to the "Client" in the range of VPN subnet (see below). This address is available in the ACV [OpenVPN.IPaddress].
Regarding DNS address, to access sites using names through the VPN connection, **TBox LT2** receives it from the server

Auto Connect: By default, TBox connects automatically.
If you uncheck this option, you have to use the digital communication variable <VPN.VPNcon> to connect/disconnect:

- VPN.VPNcon=0 -> exit OpenVPN process
- VPN.VPNcon=1 -> restart OpenVPN process



Digital Communication Variable [VPN.HookLink=1] indicates the VPN is up. Writing [VPN.HookLink=0] disconnects properly VPN connection.

VPN Subnet: When **TBox LT2** is "Server": you have to indicate the IP subnet of VPN tunnel.
TBox LT2 "Server" acts as DHCP server: the client(s) connecting to **TBox LT2** will receive an IP address in the range of the subnet.
TBox LT2 "Server" uses the first address of the subnet.

Protocol: Two transport protocols can be encrypted to build VPN tunnels: UDP or TCP.
Select the one used in the tunnel.

Port: Select the port used by OpenVPN.
Default: 1194



Certificates and keys can be created using OpenSSL.exe.

CA Certificate: The certificate signed from a Certification Authority. It is used to check the authenticity of the partner certificate.
Working in an internal network, you have to create your own self-signed CA.

After having generated certificates using OpenSSL, copy the content of **CA.crt here (file generated with *build-ca.bat*)**

Certificate: Partner certificate.
Working in an internal network, you have to create your own certificate.

Client: After having generated certificates using OpenSSL, copy the content of **<client>.crt** here (file generated with *build-key.bat*)

Server: After having generated certificates using OpenSSL, copy the content of **<server>.crt** here (file generated with *build-key-server.bat*)

Key: It is the private key required for Authentication, associate to the certificate.

Client: After having generated certificates using OpenSSL, copy the content of **<client>.key** here (file generated with *build-key.bat*)

Server: After having generated certificates using OpenSSL, copy the content of **<server>.key** here (file generated with *build-key-server.bat*)

DH Key: To declare on the Server only. It is used to encrypt and decrypt data transferred in the tunnel.

After having generated certificates using OpenSSL, copy the content of **dh1024.pem here (file generated with *build-dh.bat*)**

Advanced Parameters: the default parameters are:

```
persist-key
persist-tun
comp-lzo
keepalive 10 120
```

More information at: <http://openvpn.net/index.php/open-source/documentation/manuals.html>

11.2. Firewall



To access Firewall rules, make sure you have activated Firewall from the "RTU properties" -> "IP security" (see chapter 7.4)

Two kinds of rules can be applied:

- **Input:** to prevent incoming access
- **Forward:** to prevent access when TBox configured in IP forwarding

11.2.1. Firewall "Input"

When Firewall has been activated from the RTU properties, **all incoming accesses to TBox are blocked**. Outgoing connections, like sending mail or files are not affected.

By defining rules, you will control access for displaying HTM files, for access with TWinSoft, with SSH console,

A rule defines an exception: it gives access to **TBox MS** based on:

- Service
- Protocol
- TCP Port
- IP address(es)
- Communication Port
- Mac address

Input Exception Parameters

Packet Definition

Service: Modbus

Protocol: Tcp

Port: 502

IP Source: Subnet

IP: 172 . 25 . 110 . 0

Subnet: 255 . 255 . 255 . 0

Mac Source: Single Address

Mac: F8:B1:56:AB:56:F6

Concerned Ports

Port	Type
<input checked="" type="checkbox"/> COM3	ETHERNET
<input type="checkbox"/> COM4	HiLo 3G GSM

Activate

OK, Cancel, Help

Services: Any: all IP services have access to TBox. You filter access based on source IP only (see below).

Custom: you select the protocol and the TCP port yourself (see below).

ModBus, FTP, HTTP, HTTPS: server services available in TBox. Protocol is set by default to "TCP" and the port as defined in "RTU properties" -> "Advanced TCP /IP".

Protocol: If you have selected "Custom" as service (see above):
Any: all protocols (UDP, TCP, ICMP) have access to TBox. You can filter access based on TCP port and/or source IP (see below).
UDP, TCP, ICMP: you select the protocol yourself.



PING protocol is supported by **TBox LT2**. It works on ICMP protocol for which there is no TCP port

Port: When selecting a "Custom" service, you can type a TCP port.
 When selecting a specific service, the TCP port is automatically set as defined in "RTU properties" -> "Advanced TCP /IP".

Source: Any: Any source IP address can access TBox.
Single: you type a unique IP address.
Subnet: you type an IP address and a subnet mask, to filter on a group or IP addresses.

Examples:

IP: 172.25.110.0 Subnet: 255.255.255.0 ALL IP addr. in the range 172.25.110.xxx
 IP: 172.25.110.80 Subnet: 255.255.255.224 ALL IP addr. in the range 172.25.110.64...96

Connected Ports: Select in the IP ports available in the **TBox LT2** the port you want to

Activate: Uncheck the box in case you don't want the rule to be applied but don't want to delete the rule neither.

Example of Rules

Once created, the rules appear in the list.
 The order has no importance.

	Service	Source	Port	Enabled
	<input type="checkbox"/> Add Firewall Inpu...			
1	Modbus	172.25.110.80	COM3	Yes
2	Http	172.25.110.80 / 255.255.255.0	COM3	Yes
3	Port 22 (Tcp)	172.25.110.80	COM3	Yes
4	Ftp	Any IP	COM3	Yes
5	Port (Icmp)	Any IP	COM3	Yes
6	Https	Any IP	COM4	Yes

Access authorized:

1. ModBus-TCP on COM3 from IP 172.25.110.80 only
2. HTTP on COM3 from any IP in the range 172.25.110.xxx
3. SSH on COM3 from 172.25.110.80 only
4. FTP Server on COM3 from any IP
5. PING on COM3 from any IP
6. HTTPS only on COM4 (3G) from any IP

11.2.2. Firewall “Forward”

When Firewall has been activated from the RTU properties, IP forwarding, NAT and Virtual Servers rules are blocked.

By defining forward rules, you will control data communication between ports.

A rule defines an exception: the control of interconnection between ports is based on:

- 2 x IP communication ports (IN -> OUT)
- Protocol
- TCP Port
- Source IP address
- Destination IP address



The Forward entries provide automatically Firewall rules to the **outgoing port**. Concerning the **incoming port**, make sure you have defined input rules.

Forward Exception Parameters

Concerned Ports

From: COM3

To: COM4

Packet Definition

Service: Modbus

Protocol: Tcp

Port: 502

Source: Any

IP: 0 . 0 . 0 . 0

Subnet: 0 . 0 . 0 . 0

Destination: Any

IP: 0 . 0 . 0 . 0

Subnet: 0 . 0 . 0 . 0

Activate

OK

Cancel

Help

Communication Ports: Select both ports concerned by data forwarding (From .. To).

Services: Any: all IP services are forwarded. Protection can be based on IP only (see below).

Custom: you select the protocol and the TCP port yourself (see below).

ModBus, FTP, HTTP, HTTPS: server services available in TBox. Protocol is set by default to "TCP" and the port as defined in "RTU properties" -> "Advanced TCP /IP".

Protocol: If you have selected "Custom" as service (see above):

Any: all protocols (UDP, TCP, ICMP) are forwarded. Protection can be based on TCP port and/or IP (see below).

UDP, TCP, ICMP: you select the protocol yourself.



PING protocol is supported by **TBox LT2**. It works on ICMP protocol for which there is no TCP port

Port: When selecting a "Custom" service, you can type a TCP port.
When selecting a specific service, the TCP port is automatically set as defined in "RTU properties" -> "Advanced TCP /IP".

Source: Any: Any source IP address can access TBox.
Single: you type a unique source IP address.
Subnet: you type a source IP address and a subnet mask, to filter on a group or IP addresses.

Examples:

IP: 172.25.110.0 Subnet: 255.255.255.0 ALL IP addr. in the range 172.25.110.xxx
IP: 172.25.110.80 Subnet: 255.255.255.224 ALL IP addr. in the range 172.25.110.64...96

Destination: Any: Any destination IP address TBox is communicating with.
Single: you type a unique destination IP address TBox is communicating with.
Subnet: you type a destination IP address and a subnet mask, to filter on a group or IP addresses.

Activate: Uncheck the box in case you don't want the rule to be applied but don't want to delete the rule neither.

Example of Rules

Once created, the rules appear in the list.
The order has no importance.

	Port	Service	Source	Destination IP	Enabled
	<input type="checkbox"/> Add Firewall Forwar...				
1	COM4 to COM3	Modbus	Any IP	Any	Yes
2	COM4 to COM3	Http	Any IP	192.168.1.98	Yes

Forwarding authorized:

1. ModBus-TCP forwarded through COM4-COM3, from any IP address (on COM4) to any IP address (on COM3)
2. HTTP forwarded through COM4-COM3, from any IP address arriving on COM4 to 192.168.1.98 connected to COM3. For instance a camera with IP address 192.168.1.98 connected to COM3 of TBox

12. Alarms



12.1. Introduction

Alarm module of **TBox LT2** is the gate to the outside world.

An alarm consists in a **communication event**, not only for sending warning messages but to establish a connection, like we will see.

Via alarms, you are able to send **SMS** message to Mobile phone, send **e-mail**, send files to a **FTP** site, to **dial** another **TBox** or a **SCADA**, ...

Alarms can be used also to **send historical data (datalogging)** on regular base using e-mail or FTP. The historical data is sent as the attached file of a report, developed using **Report Studio**.

TView, the data aggregator software can then be used to collect data from a mail box or a FTP site.

The initiation of alarms in the **TBox LT2** relies on the variation of digital or analog Tags. For example, an intrusion contact or a flow level generates a call.

The three main items to create an alarm:

- **The condition:** a changing in a Tag.
- **The recipient:** to whom the data is sent.
- **The message** (or report): information to send to the recipient.

The Alarm stack

Each new alarm is immediately entered into a **32-alarms internal queue** (adjustable) and processed, according to the availability of communication ports required and its severity level. Alarms are generated one by one.

The alarm queue represents the **alarms stack**: if several alarms happen at the same time or if a communication port is not available when the alarm happens.

The Event stack (or Alarms table)

The **Events stack**, gives information about alarms status (Recipient - Started – Stopped – Acknowledged).



The **Events stack** (also called Alarms table) is discussed in chapter 12.8

To access the definition of Conditions, click the folder 'Alarms' in the Project workspace and select 'Conditions'.

According to the Tag you select, you define a **digital alarm condition** or an **analog alarm condition**.

12.2. Digital Alarm Condition

The screenshot shows the 'Alarm Conditions' dialog box with the following settings:

- Tagname: EMERGENCY
- Type: Positive Edge
- Recipient: SMS_Jean
- Call all recipients:
- Send Message: Send Report:
- Message: EMERGENCY BUTTON PRESSED
- Filter: 0 hour, 0 min, 0 sec
- Handling: Enabled
- Severity: Normal
- Notify End of Alarm:
- Attach message to subject:
- SMS Acknowledge:
- POP3 Acknowledge:

Tagname: The Tag selected to generate the alarm.

Type: The edge on which the alarm is going to be started (rising, falling or both).

Message or Report: text or file associated to the alarm.

Depending on the type of recipient associated, you can send a message or a report. It can be a message sent to a GSM, a message or report sent as e-mail, to a printer or the file sent by FTP ...

It always appears in the table of alarms, to distinguish them (see chapter 12.8).

If the alarm condition sends an **e-mail**, it can be of 2 kinds:

Message: a text message is sent and it appears in the 'object' field of the e-mail

Report: sending of a report created with **Report Studio**. The report must be created from the Project Workspace and the list of 'Web & Report files'.

Recipient: Select a **Recipient** or a **group of recipients**. The 'person' you wish to contact in case of alarm (see 'Recipients' below).

In case you select a **'group of Recipients'** see next.

Call all Recipients: can be used when selecting a Group of Recipients.

When the option is cleared: **TBox LT2** calls the first one in the group. In case the alarm cannot be acknowledged after the number of tries, **TBox LT2** automatically calls the next recipient in the group and so on until it succeeds. Then it stops. (Also known as 'Chain')

When the option is checked: **TBox LT2** sends the alarm to all recipients of the group. (Also known as 'Link')

Filter: The time in hour:minute:second during which the condition must stay TRUE, before the call is generated.



Filter can be tested either during both transitions or only during the transition selected (see chapter 7.5.2)

Handling: The handling option allows blocking each alarm condition, manually or automatically.

- Enabled: alarm condition always active.
- Disabled: alarm condition always de-activated.
- PowerF: alarm condition disabled when there is a main power failure.
- DisAla: alarm condition de-activated when the system variable 'DisAla' = 1.

Severity: Each alarm can be assigned a level of severity: Low, Normal or High. When several alarms are still present in the queue and then not processed yet, **TBox LT2** generates the calls according to the highest severity.

Notify End of Alarm: When the alarm condition is finished, the alarm is automatically re-sent to the same recipient with the same message **preceded with a prefix** (see chapter 7.5.2).

Example: for a 'positive edge' alarm, it is when the Tag returns to '0'.

It is also useful when the alarm condition is active when **TBox LT2** starts up. When 'end of alarm' is checked, an alarm is automatically generated when the alarm condition disappears (see illustration chapter 12.8: **Alarms table**)

SMS acknowledge: See chapter 13.2.

POP3 acknowledge: See chapter 10.5.1

12.3. Analog Alarm Condition



Tagname: The Tag selected to generate the alarm.

Type: Maximum or Minimum.
The threshold for which the alarm will be started. If the value of the analog Tag passes under (minimum) or over (maximum) this threshold, the alarm is started. If an alarm must be generated for both a maximum and a minimum threshold, 2 conditions must be declared with the same Tag.

Value: The threshold value, according to the format and scaling of the Tag (see chapter 9. *The Tags*).

Hysteresis: The amount that the level must fall or rise below or above the Max. or Min. value before an alarm can be re-started

Relation between Value and Hysteresis

With "MAXIMUM" threshold	Value > threshold = Alarm TRUE
	Value < (threshold – hysteresis) = Alarm FALSE
With "MINIMUM" threshold	Value < threshold = Alarm TRUE
	Value < (threshold + hysteresis) = Alarm FALSE

Recipient: Select a **Recipient** or a **group of recipients**. The 'person' you wish to contact in case of alarm (see 'Recipients' below).
In case you select a **'group of Recipients'** see next.

Call all Recipients: To be used when selecting a Group of Recipients.

When the option is cleared: **TBox LT2** calls the first one in the group. In case the alarm cannot be acknowledged after the number of tries, **TBox LT2** automatically calls the next recipient in the group and so on until it succeeds. Then it stops. (Also known as 'Chain')

When the option is checked: **TBox LT2** sends the alarm to all recipients of the group. (Also known as 'Link')

Message or Report: text or file associated to the alarm.

Depending on the recipient associated, it is the SMS sent to a GSM, or the message/report sent as e-mail or the text printed, or the file sent by FTP ...

It also appears in the table of alarms, to distinguish them (see chapter 12.9).

If the alarm condition sends an **e-mail**, it can be of 2 kinds:

Message: a text message is sent and it appears in the 'object' field of the e-mail

Report: sending of a report created with 'Report Studio'. The report must be created from the Project Workspace and the list of 'Web & Report files'.

Filter: The time in hour:minute:second during which the condition must stay TRUE, before the call is generated.



Filter can be tested either during both transitions or only during the transition selected (see chapter 7.6.2)

Handling: The handling option allows blocking each alarm condition, manually or automatically.

- Enabled: alarm condition always active.
- Disabled: alarm condition always de-activated.
- PowerF: alarm condition disabled when there is a main power failure.
- DisAla: alarm condition de-activated when the system variable 'DisAla' = 1.

Severity: Each alarm can be assigned a level of severity: Low, Normal or High. When several alarms are still present in the queue and not processed yet, **TBox LT2** generates the calls according to the highest severity.

Notify End of Alarm: When the alarm condition is finished, an alarm is automatically sent to the same recipient with the same message **preceded with a prefix** (see chapter 7.6.2).

Example: for a 'maximum' alarm, it is when the value returns below maximum - hysteresis.

It is also useful when the alarm condition is active when **TBox LT2** starts up. When 'end of alarm' is checked, an alarm is automatically generated when the condition of alarm disappears (see illustration chapter 12.8: **Alarms table**)

SMS acknowledge: See chapter 13.2.

POP3 acknowledge: See chapter 10.5.1

12.4. Recipients

To access the definition of Recipients, click the folder 'Alarms' in the Project workspace and select 'Recipients'.

The types of recipients supported are:

Internal: the alarm is saved in the stack of events and **no call is generated**.
It can be used to memorize a particular event without generating an alarm or to test an alarm condition.

ModBus: it can be Master or Slave.
It is used to establish a **dial-up ModBus connection** to another ModBus device or a SCADA accepting unsolicited ModBus communication (for instance **TView**).
The difference between Master and Slave concerns the handling of the modem connection and acknowledgement.

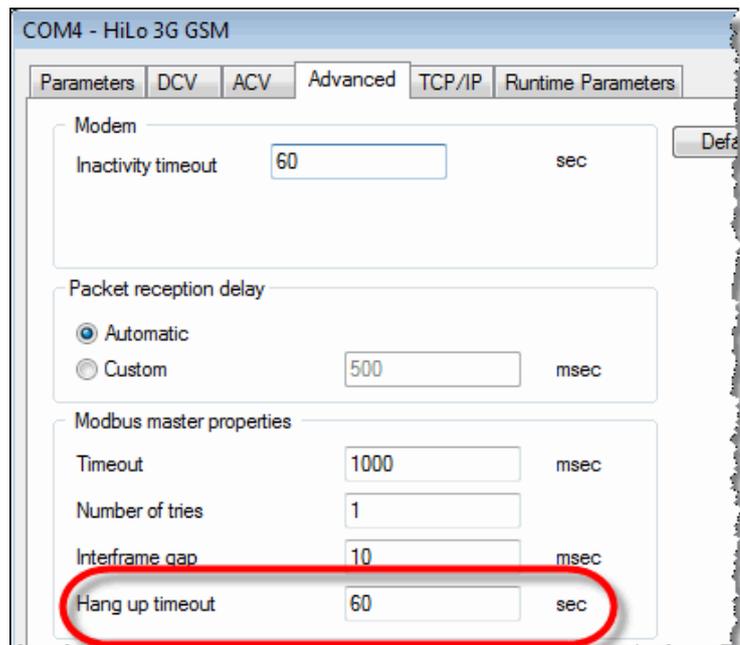
A 'Slave' connection means that **TBox LT2** dials equipment and doesn't do anything else. The dialed equipment will sample, acknowledge and hang-up. Typically used for instance when dialing **TView**.

A 'Master' connection means that **TBox LT2** dials ModBus equipment and will also sample this equipment (with Modbus Transactions).

TBox LT2 will then be also responsible for acknowledgement (see chapter 8.5.2 **System Variables** [8] AlaID or [10] AlaRec) and hanging-up (see 'Advanced' properties of the communication port used to send the alarm).

A modem parameter: "**Hang up timeout**" is used by 'ModBus-Master' alarm to define the maximum connection time. The maximum value is 600 seconds.

 Value=0 means it will **never hang up!**



Pager/SMS:to send **SMS** to a mobile or message to a **Pager**.

Select the **Service** corresponding to the **SIM card in TBox** and a **Modem**.

Type the **Phone Number** of the Pager or Mobile.

The default **Dial prefix** is **ATDT**. It **should not be changed** unless the modem needs a particular configuration.

The screenshot shows the 'Alarm Recipients' dialog box with the 'Runtime Parameters' tab selected. The 'Name' field contains 'SMS_Jean'. Under 'Recipient Type', 'Pager/SMS' is selected. The 'Pager/SMS' section includes a 'Service' dropdown set to 'Mobistar -> GSM', a 'Modem' dropdown set to 'COM4 - HiLo 3G GSM', a 'Phone number' text box with '012233445566', and a 'Dial Prefix' text box with 'AT+COPS=,,0^ATDT' and a 'Default' button. The 'Error Handling' section has 'Tries' set to 4 and 'Timeout' set to 1 minutes. The 'Scheduling' section has 'Time Table' set to 'Always active(Default)'. 'OK', 'Cancel', and 'Help' buttons are at the bottom.

Printer: sending of message(s) or report to a local printer.

E-mail: If you have subscribed an e-mail account (see chapter 10.4. **SMTP Server**), **TBoxLT2** is able to send an e-mail. You only have to specify the e-mail address of the recipient.

The screenshot shows the 'Alarm Recipients' dialog box with the 'Runtime Parameters' tab selected. The 'Name' field contains 'Mail_Jean'. Under 'Recipient Type', 'E-mail' is selected. The 'E-Mail' section includes a 'Redundancy' radio button, an 'SMTP Server' radio button which is selected and has a dropdown set to 'MySMTP', a 'To:' text box with 'jeanb@tbox.com', and an empty 'Cc:' text box. The 'Error Handling' section has 'Tries' set to 4 and 'Timeout' set to 1 minutes. The 'Scheduling' section has 'Time Table' set to 'Always active(Default)'. 'OK', 'Cancel', and 'Help' buttons are at the bottom.



Sending of e-mail supports **Redundancy**.

If you have created **several SMTP Servers** and you select 'Redundancy' instead of a Server, **TBox LT2** will use the first one in the list (see chapter 10.4. **SMTP Server**). In case it fails, it will try with the second one and so on...

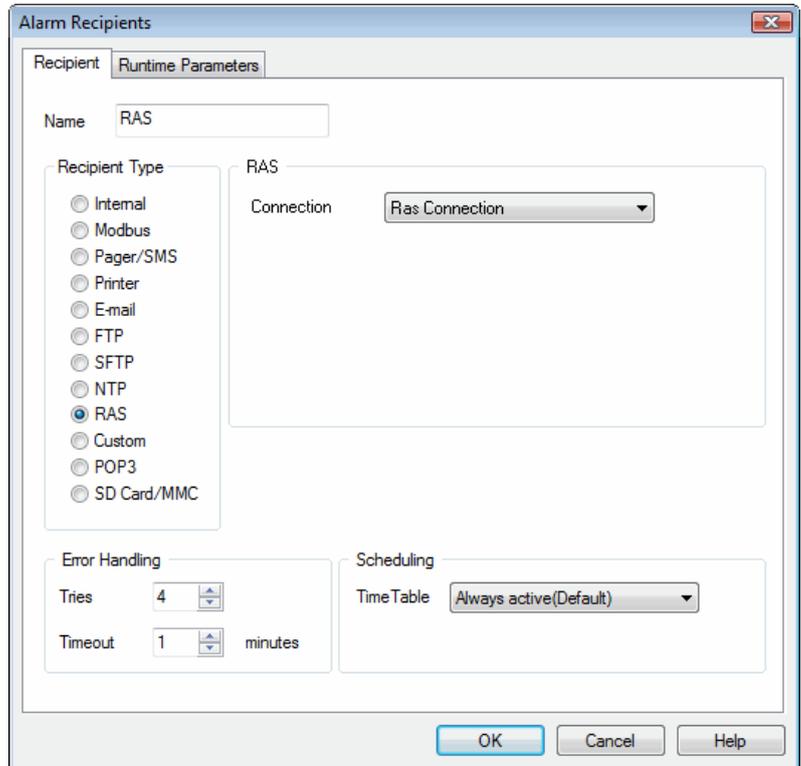
FTP: **TBox LT2** is able to send files to a FTP Host (see chapter 10.2. **FTP Server**).
In the recipient configuration you only need to indicate the directory where you want to send the files.

SFTP: **TBox LT2** is able to send files to a through Secure FTP (see chapter 10.3. **SFTP Server**).
In the recipient configuration you only need to indicate the directory where you want to send the files.

NTP: **TBox LT2** is able to synchronize its clock with an external NTP server.
In the recipient, you only select a server you have created in the list of NTP Servers (see chapter 10.5. **NTP Server**).

RAS: This type of recipient can be used to establish a 'Client' modem connection to a 'Server'. The Server is considered by **TBox LT2** as an ISP: it requires a telephone number and a login to establish the connection. You associate an ISP (previously created in the IP parameters of TWinSoft), and when connection is established, the 'Server' has to communicate in protocol **ModBus-TCP**

It can be assimilated to a 'Modbus-Slave' connection using ModBus/TCP protocol. The Server is responsible of acknowledgment and hanging-up.



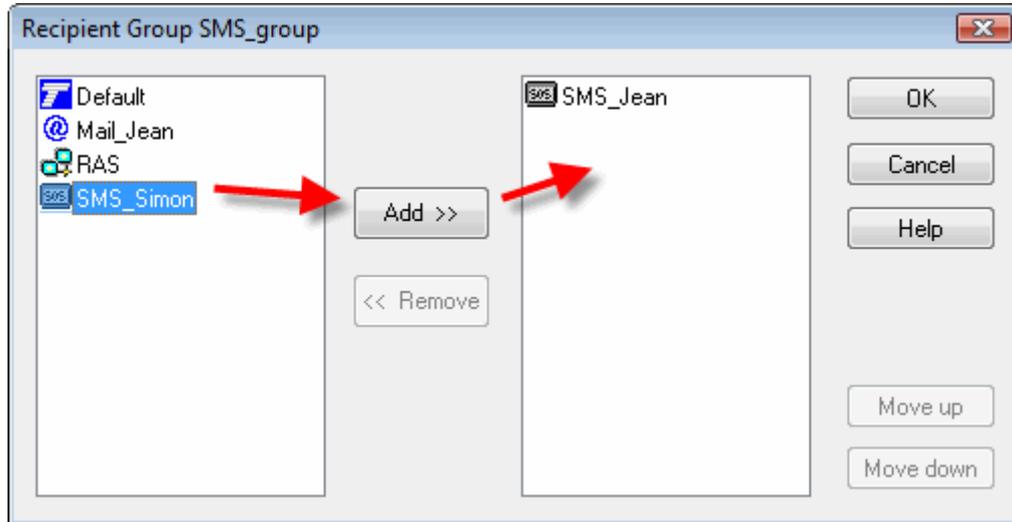
Custom: in case a 'C' driver allows sending alarms

POP3: allows reading e-mail to acknowledge e-mail or to operate TBox with a message (see details in chapter 10.5.1)

12.5. Group of Recipients

A group of recipients is composed of several recipients, which can be of different types (SMS, e-mail, ...). You can declare several groups.

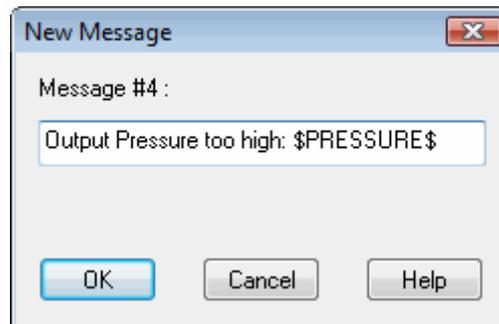
Then previous to creating groups of recipients, you have to create first the recipients (see above).



You can then associate an Alarm condition to a 'recipient' or a 'group of recipients'. See chapters 12.2. and 12.3. **Alarm Conditions**.

12.6. Messages

To access the definition of Alarm messages, click the folder 'Alarms' in the Project workspace and select 'Messages'.



Message number : ID of the message from the list of messages. Type a message of maximum 120 characters. This message is user specific:

- If it is for a Digital Pager, it will consist only of numbers.
- If it is meant to a mobile or e-mail, type a text.

12.6.1. SMS coding

By default, SMS message are coded according to GSM 03.38 table (7 bits character). It provides a total length of message of 160 characters:

Hex	0	10	20	30	40	50	60	70
0	@	Δ	space	0	i	P	ç	p
1	£	_	!	1	A	Q	a	q
2	\$	Φ	“	2	B	R	b	r
3	¥	Γ	#	3	C	S	c	s
4	è	Λ	¤	4	D	T	d	t
5	é	Ω	%	5	E	U	e	u
6	ù	Π	&	6	F	V	f	v
7	ì	Ψ	'	7	G	W	g	w
8	ò	Σ	(	8	H	X	h	x
9	Ç	Θ	)	9	I	Y	i	y
A	LF	Ξ	*	:	J	Z	j	z
B	Ø	ESC	+	;	K	Ä	k	ä
C	ø	Æ	,	<	L	Ö	l	ö
D	CR	æ	-	=	M	Ñ	m	ñ
E	Å	ß	.	>	N	Ü	n	ü
F	å	É	/	?	O	Ş	o	à

When characters in a message are not in the table, with an accent or from another alphabet than Latin, like Hebrew, Greek, Cyrillic, ... TWinSoft encodes the message in UCS-2 format. This format uses 2 bytes of 8 bits per character, which limits the total length of SMS message to 70 characters.

12.6.2. Value of Tag in a message

Two kinds of value are available:

The value at the moment the alarm is sent

The value will be the value of the Tag **at the moment the alarm is accessed**: the SMS is sent, the alarm list is displayed in a WebForm, the alarms retrieved from **TView**, ...

The syntax is: **~TAG~** (with TAG=the name of the Tag).

The value at the moment the alarm appeared

The value will be **frozen** to the one at the moment the alarm is stored in the stack of events.

The syntax is: **\$TAG\$** (with TAG=the name of the Tag).

Remarks:

1. With MS-CPU16 and TBox-LITE: ONE **\$Tag\$** can be inserted in a message. No limit with ~Tag~
2. With MS-CPU32 and TBox-LT2: TWO **\$Tag\$** (digital or analog) can be inserted in a message. No limit with ~Tag~
3. Tag TEXT with MS-CPU32 and TBox-LT2: ONE **\$Tag\$** of maximum 80 characters



With a **Digital Tag** for which you have defined 'States' in the 'Presentation' menu, those states will be used; otherwise, 0 and 1.
With a **Float Tag** for which you have defined a number of decimals in the 'Presentation' menu, this number will be used; otherwise, fixed to 3 decimals.

12.7. Alarm Timetables

Alarm timetables allow specifying an activity period associated to a recipient, in other words, periods of time during the day, the week, the year, when a recipient can receive an alarm.

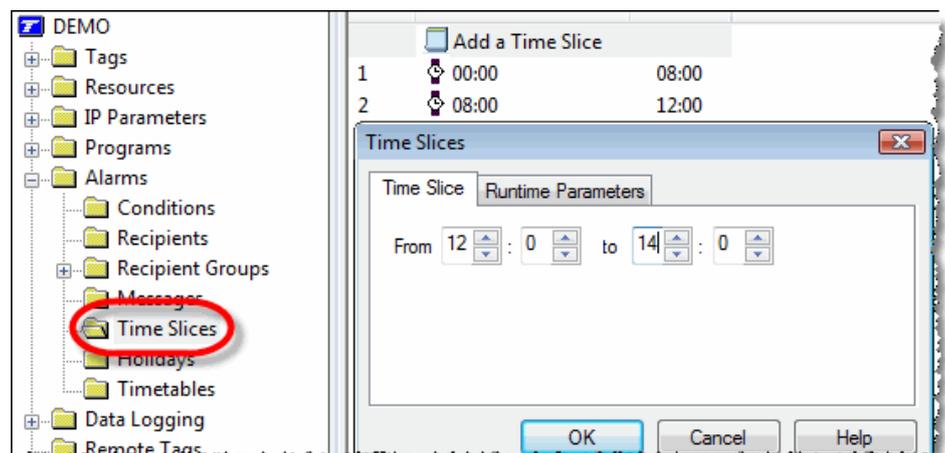
The time tables are based on the specification of 'Time Slices' (time periods of the day) and on 'Days' (days of the week and holidays).

12.7.1. Time Slices

The time slices are used to trunk the day in different slices. Further, you select these time slices when creating timetables.

To declare the time slice, just select the start time and the end time of the slice.

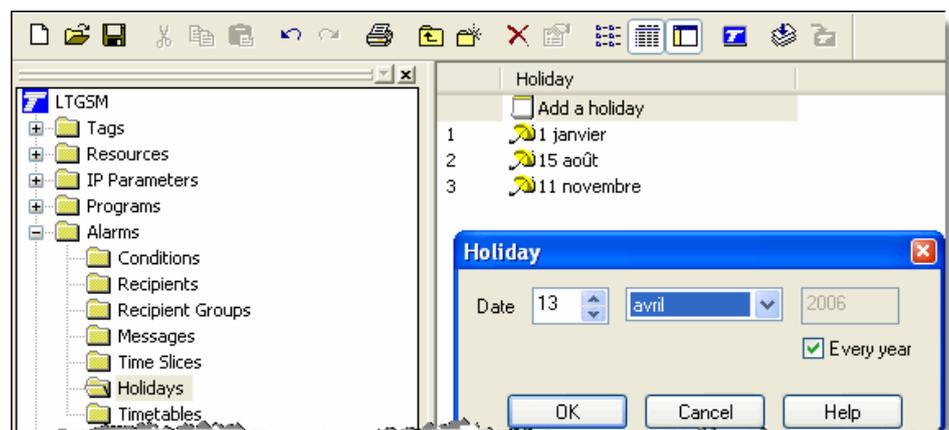
A time slice **can't be part of 2 different days**: no time slice can include midnight! (e.g. 18h30 to 08h30)



12.7.2. Holidays

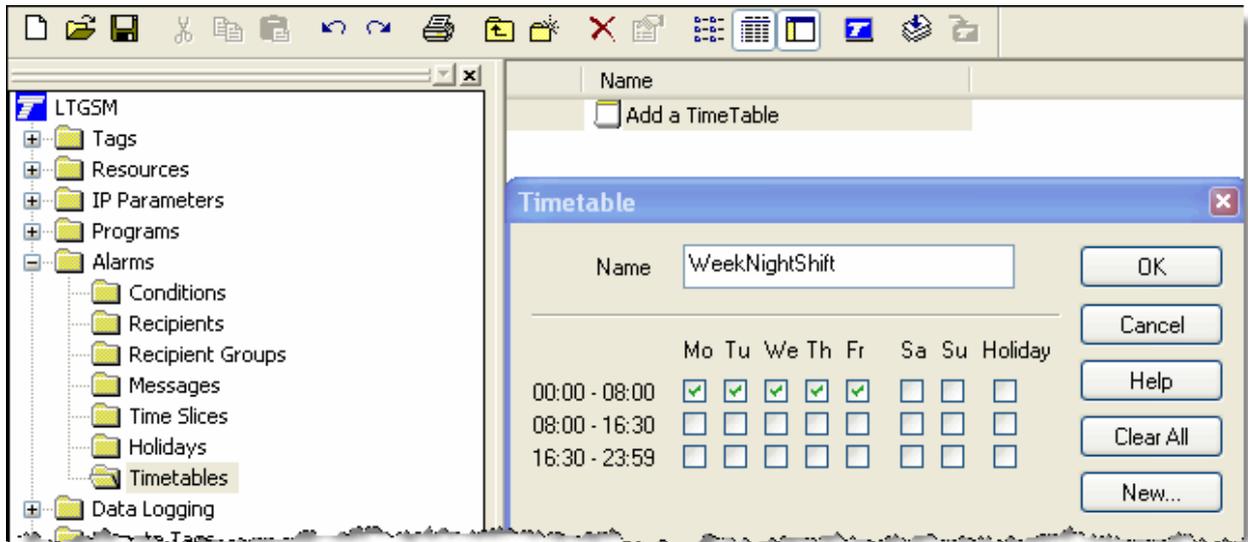
The holidays offer to flag specific days of the year; these days constitute a group that can be checked in the timetables (all at once, not days separately) like if it was a specific day of the week (see Time Tables next).

You can choose to keep each selected day as holiday for 'every year' (by default).

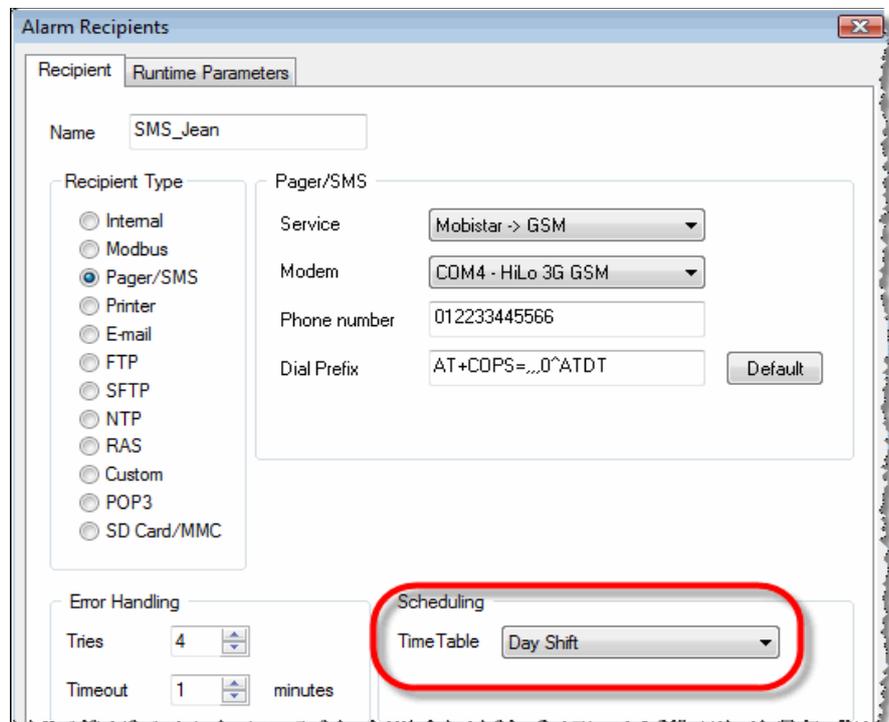


12.7.3. Timetables

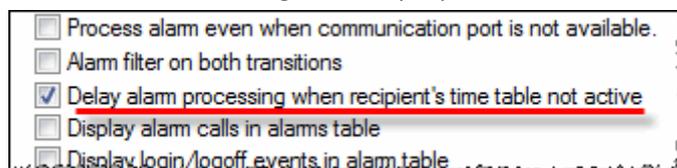
Based on the 'Time Slices', days of the week and 'Holidays' you create different 'Timetables' according to activity periods in your company (day shift, night shift, holidays, week-end, ...). A time table can then be associated to a recipient. You select for each day of the week which time slice will be part of the timetable (Holidays being treated like a unique 'day').



Following, in the recipients' setting, you can choose to have the recipient 'always active' which means that he will receive his alarms any time of the day, or you can also choose to have the recipient associated to a time table (e.g. Day shift without week-end and holidays)



If an alarm occurs when time table is active, the alarm will be sent. Otherwise, the alarm will be handled according to "RTU properties" → "Advanced alarms" settings:



If the option is checked, the alarm will be maintained in the queue and generated when the time table turns active, otherwise it is auto-ack.

12.8. Alarms Table

The Alarms table of TWinSoft displays the **Event stack** of **TBox LT2**. The Events stack is the visible part of the handling of some system events and alarms in **TBox LT2**. The internal queue of alarms is not accessible. You access the Alarms table from the main menu: Communication → Retrieve from TBox → Alarms:

Start timestamp	Message	Start	Recipient	End timestamp	End
24/02/2005 9:19:20	Level of Tank1 too HIGH	Auto ack.	SMS	24/02/2005 9:24:00	Ack'ed
24/02/2005 9:19:07	[Reset]	Auto ack.		-	-
24/02/2005 9:12:38	Level of Tank1 too HIGH	Ack'ed	SMS	24/02/2005 9:14:00	Ack'ed
24/02/2005 9:11:38	temperature water IN reached	Ack'ed	SMS	24/02/2005 9:11:38	Auto ack.
24/02/2005 9:09:25	[New Program]	Auto ack.		-	-

Labels below the table:

- Date/Time of the start of the condition
- Message Report Name
- Acknowledg. Status of the Start
- Recipient
- Date/Time of the start of the condition
- Acknowledg. Status of the End

Buttons: Refresh, Close

The Alarms table does not only display alarms generated in **TBox LT2**, but also **system events** like start-up of the program, Reset of the **TBox LT2**, ...

12.8.1. Columns description

Start Timestamp: Date and Time when the **alarm condition appears** ('Start' condition)

Message: Message (or name of the file) associated with the alarm.
System events appear between brackets.

Start: acknowledgment status of the 'Start' condition.
The possibilities are:

- Not ack.: the alarm is still in process.
- Ack'ed: the alarm has been processed successfully.
- Auto ack.: the alarm has not been processed successfully.

In case of 'system events', it is always the case as it is not an alarm but an event.

Recipient: The name of the Recipient (from the list of Recipients).
The name is listed only if the alarm was sent successfully. With chained alarms, this allows to show the one that was used. In case of 'system events', there is no name.

End Timestamp: Date and Time when the **alarm condition disappears** ('End' condition).

End: acknowledgment status of the 'End' condition.
When creating an alarm condition, there is an option '**Notify end of alarm**'. This option will automatically generate an alarm when the condition generating the alarm disappears.
The possibilities are:

- Not ack.: there is a 'Notify end of alarm' condition and the alarm is still in process.
- Ack'ed: the 'end of alarm' has been processed successfully.
- Auto ack.: the 'end of alarm' has not been processed successfully.
When there is **no 'end of alarm'**, it is immediately indicated as 'Auto ack.'

13. ReadSMS/POP3 embedded

13.1. Introduction

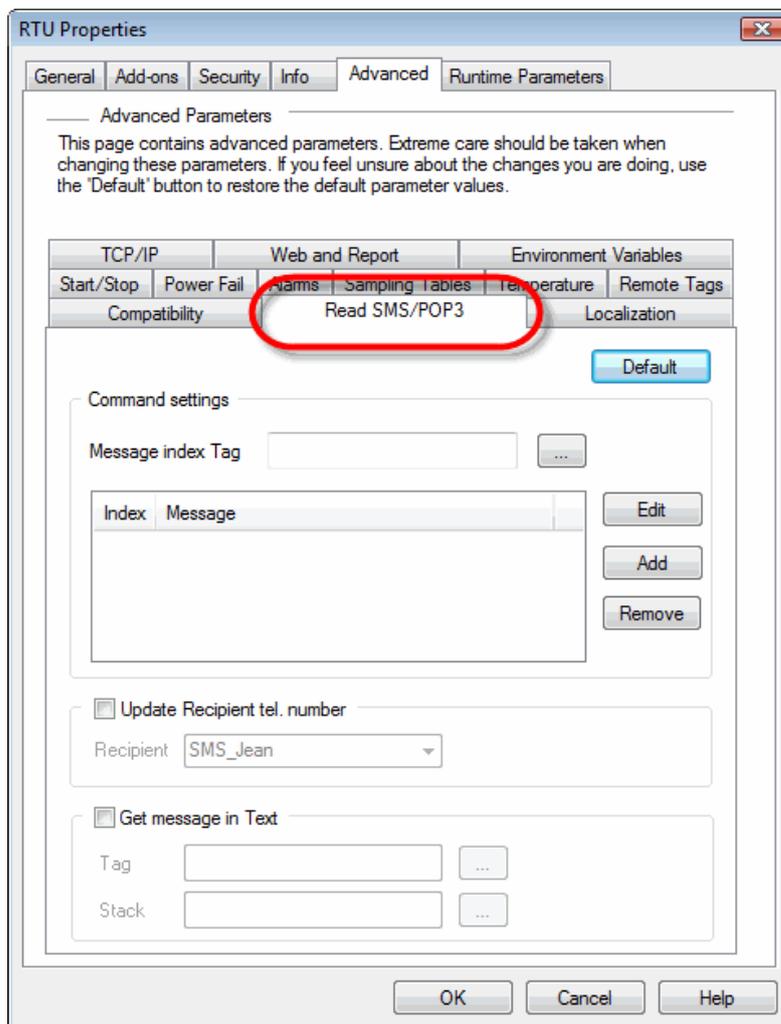
ReadSMS/POP3 is the ability to **TBox LT2** to receive and interpret incoming SMS messages, and to read “subject” field of e-mail in order to execute tasks.

Receiving an SMS requires a GSM on **TBox LT2**!

ReadSMS/POP3 features allow two uses:

1. **Acknowledgment** of an alarm by sending back a SMS to the RTU
2. **Controlling** the RTU by sending SMS message(s) or sending e-mail(s)

An advanced menu is available in the RTU properties:



For any incoming connection, either for acknowledgement or for controlling, the caller ID (phone number of the caller for the last call received) is available in the communication variable “ComX.Caller ID” (see chapter 8.3.2)

13.2. Acknowledgment of an alarm by sending data to the RTU

Two types of recipient may require an acknowledgment by SMS:

- Pager/SMS: sending a message through a SMS-C (standard way)
- E-mail: sending a message through a SMTP server, which can be forwarded as SMS through a dedicated service

Alarm Conditions dialog box showing configuration for an alarm condition. The 'Runtime Parameters' tab is selected. The 'Tagname' is 'EMERGENCY', 'Type' is 'Positive Edge', and 'Recipient' is 'SMS_Jean'. The 'Message' is 'EMERGENCY BUTTON PRESSED'. The 'Filter' is set to 0 hour, 0 min, and 0 sec. The 'Handling' is 'Enabled' and 'Severity' is 'Normal'. Two checkboxes, 'SMS Acknowledge' and 'POP3 Acknowledge', are circled in red.

Alarm conditions associated to a recipient of type “Pager/SMS” or “E-mail” provide the options: **SMS acknowledge** and **POP3 acknowledge** (with e-mail recipient only)

Acknowledgment is carried out in 2 steps. *Example with sending of a SMS:*

1. Sending of the message by **TBox LT2** (to the SMS-C or to the e-mail provider) will be first performed. Retries and time-out defined in the recipient will be used to determine the success or failure of sending.
2. Then a second time-out, defined in the advanced ‘Alarms’ properties, will check whether incoming SMS required to acknowledge the alarm, arrives on time.

RTU Properties dialog box, Advanced tab. The 'Advanced Parameters' section is visible. The 'SMS Acknowledge timeout' and 'POP Acknowledge timeout' are both set to 30 minutes, indicated by red arrows.

The incoming SMS must arrive within this time-out for the alarm to be acknowledged. If not, a retry will be executed according to the definition in the Recipient. After the end of retries, the alarm will be considered as in error: “*auto-ack*” and the system variable ‘AlaErr=1’.

Working with ‘Group of Recipients’:

- with option ‘Call all recipients’: all recipients have to acknowledge the alarm.
- without option ‘Call all recipients’: any recipient can acknowledge the alarm.

Don’t set a time-out too short; to give time to the SMS Center to send the SMS back to the CPU, in case the service is busy. Also, if the CPU is sending a SMS while an acknowledgment SMS is coming back, it may miss the warning received from the GSM. The SMS will be stored in the SIM card and will be treated at next auto-check from the CPU (max. 5 minutes).

13.2.1. Message sent by TBox

If the option “SMS acknowledge” or “POP3 acknowledge” has been selected, the RTU will send a **header** with the message including an identification number.

Example: **#A00056# Level too HIGH**

Header:

- #** prefix (fixed).
- A** precedes the absolute identification number of the alarm.
- 00056** absolute identification number of the alarm.
- #** suffix (fixed).

Message:

Level too High message associated to the alarm condition.

13.2.2. Acknowledgment by sending a SMS

By sending a SMS back including **the same header** to the RTU, you will acknowledge this specific alarm. Typically, this can be done using the option ‘Reply’ of the mobile. Verify that your mobile also sends the original message.

The text sent back to the RTU does not matter, as long as the syntax **#Axxxxx#** is sent.



Some Tags can be very useful to monitor the acknowledgment of the alarms by SMS: AlaErr, SmsState, CallerID (see chapters 8.3.2 and 8.5.1)

13.2.3. Acknowledgement by sending an e-mail

When SMS service is not supported, acknowledgement can be sent through e-mail. **TBox LT2** uses then POP3 to read the e-mail (see chapter 10.5.1)

13.3. Controlling the RTU using SMS message or POP3

ReadSMS/POP3 provides the possibility to **control the RTU** by sending a SMS to **TBox LT2** or by reading e-mail using POP3 service.

A message can combine several data: Password, acknowledgment ID, writing values directly to ModBus addresses,... It must always start and end with the character **#**

A specific character indicates the type of data sent to the RTU.

- Examples:
- : pre-defined message
 - W** : writing a value to a Modbus address
 - S** : setting of a Digital Tag

Details of the different types of data that can be included in a message sent to **TBox LT2** :

13.3.1. Using pre-defined messages (-)

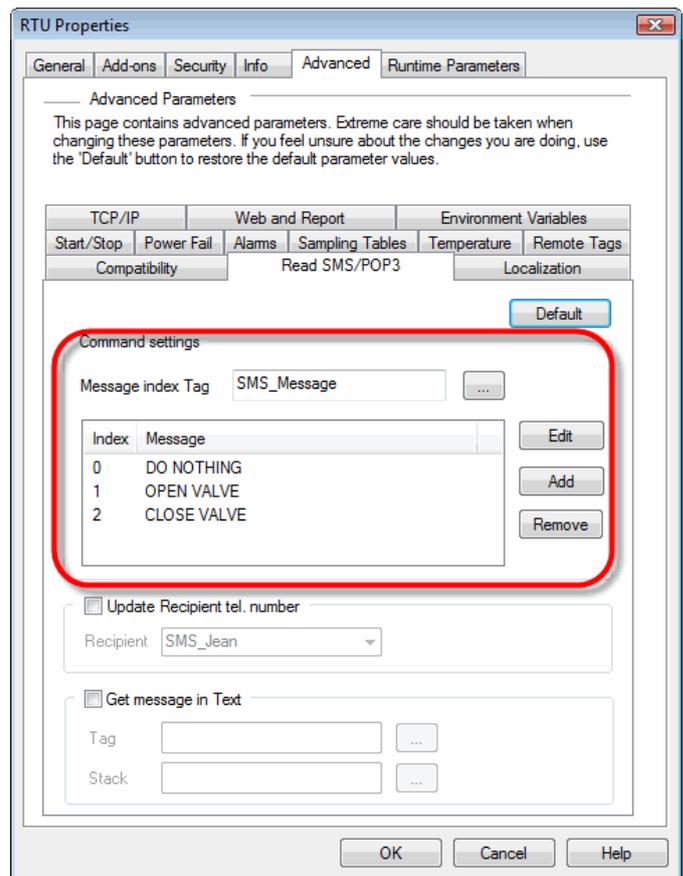
- From the ReadSMS properties menu, you select a **'Message index Tag'** (analog Tag - 16 bits format), that will contain a value associated to the message sent to the RTU
- You add the message(s) you intend to send to the RTU

When the RTU receives the message, it will put the corresponding value to the 'Message index Tag'

The maximum number of pre-defined messages supported is 20. In case you need to monitor more process, you can use the direct/indirect addressing (see next).

 - SMS/POP3 message is not case sensitive
- This method of monitoring using message, **is the only method supported by POP3.**

 Make sure the message sent is preceded by the character "-"



Message sent by a Mobile

Examples:

```
#-START PUMP#
#P1568,A00056,-START PUMP,W20480=123#
```

Message sent by e-mail

A message **must include the RTU Id** of **TBox LT2**, preceded by the letter **I** and a pre-defined message. It may also include an acknowledgment ID.

Examples:

```
#I460000020107,-START PUMP#
#I460000020107,A00002,-START PUMP#
```

13.3.2. Writing Tag with Direct addressing (W)

You write a value or a text directly to a ModBus address.

Syntax: `#Wmodbus address=value#`
`#Wmodbus address="text" #`

Examples:

```
#W20480=123#
```

This message sent to the RTU will write value 123 to the analog Tag with ModBus address 20480

```
#W1500="jean@tbox.be" #
```

This message sent to the RTU will the text "jean@tbox.be" to the Text Tag with ModBus address 1500. This can be useful for changing online runtime parameters (see chapter 9.5. "*Runtime Parameters*")

Notes:

1. You can combine several addresses, separated by a comma. For instance:

```
#W20480=123,W20481=456#
```

2. ReadSMS checks access protection level of the port before writing (see chapter 13.3.5. below)

13.3.3. Writing Tag with Indirect addressing – analog (N)

You write a value directly to a ModBus address representing a pointer.

Syntax: `#Nmodbus address=value#`

The value at 'modbus address' corresponds to the ModBus address to write in.

Example:

```
#N20480=123#
```

If ModBus address 20480 contains the value 1000, the value 123 will be written to the ModBus address 1000.



We make a distinction between Target address corresponding to an analog Tag and a digital Tag (see next).
With indirect addressing, ReadSMS **does no check the access protection** level of the GSM port

13.3.4. Writing Tag with Indirect addressing - digital (D)

You write a value directly to a ModBus address representing a pointer.

Syntax: `#Dmodbus address=value#`

The value at 'modbus address' corresponds to the ModBus address to write in.

Example:

```
#D20481=1#
```

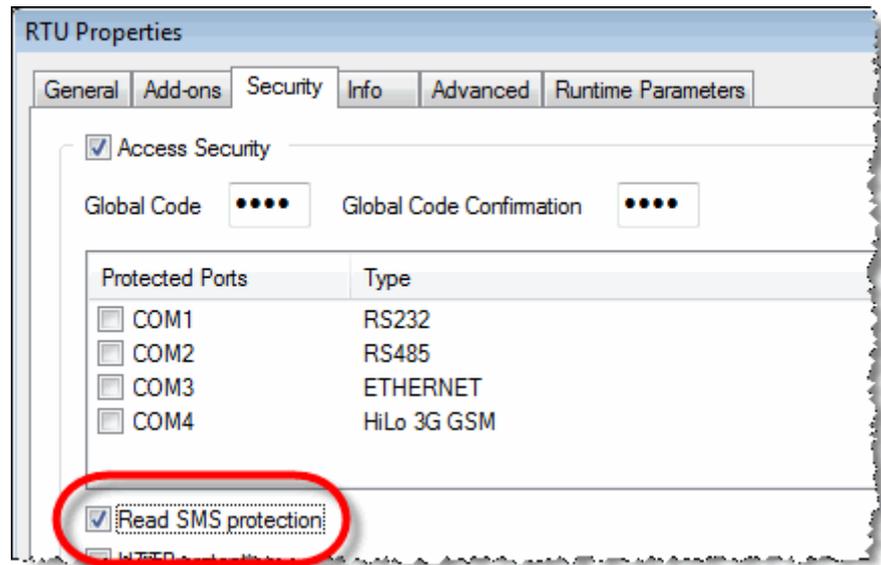
If ModBus address 20481 contains the value 512, the value 1 will be written to the ModBus address 512.

13.3.5. Access Protection (P)

ReadSMS/POP3 access protection is **independent from the GSM port it is associated to**. In other words, even if the communication port is protected, ReadSMS feature will not specially be protected.

ReadSMS/POP3 has its own independent access protection configuration, that can be activated from:

RTU properties
→ Security.



If ReadSMS protection is activated, a **login is required** in the incoming the SMS message or POP3 message. The login is composed of **the last 8 digits** of telephone number of the mobile used to send the SMS and a **password**.

To obtain the Password, the utility 'Password Generator' is needed (Start → Programs → Techno Trade → Accessories → Password generator).

From the Password utility, you define:

- the global code used in the RTU
- as NAME: the last 8 numbers of the telephone number of the mobile which will be used to send the SMS.
- as Access Level: Engineer (Level 3).

The resulting '**PASSWORD**' must be used to login.

Syntax: #Ppassword#

Example:

#P1568#



If needed, the Password **must be declared first**.
Acknowledgment (with code A) does not require password

13.3.6. Acknowledgment (A)

See chapter 13.2 above

13.3.7. SET a digital Tag (S)

You write 1 to a digital Tag using its ModBus address.

Syntax: #Smodbus address#

Example:

```
#S32#
```

The digital Tag at ModBus address 32 will be set to 1.

Note: ReadSMS checks access protection level of the port before writing (see chapter 13.3.5. above)

13.3.8. RESET a digital Tag (R)

You write 0 to a digital Tag using its ModBus address.

Syntax: #Rmodbus address#

Example:

```
#R32#
```

The digital Tag at ModBus address 32 will be reset to 0.

Note: ReadSMS checks access protection level of the port before writing (see chapter 13.3.5. above)

13.3.9. Writing minutes since midnight into a register (h)

To write in an analog register, the current number of minutes since midnight **at the moment the message is received**.

Syntax: #Wmodbus address=h#

Example:

```
#W20482=h#
```

If the message is received at 15:23, the value 923 will be written at ModBus address 20482

Note: ReadSMS checks the access protection level of the port before writing (see chapter 13.3.5. above) and also the 'Write' configuration of the 'Presentation' of the Tag (see chapter 9.4)

13.4. Automatic Update of a Recipient's tel. number

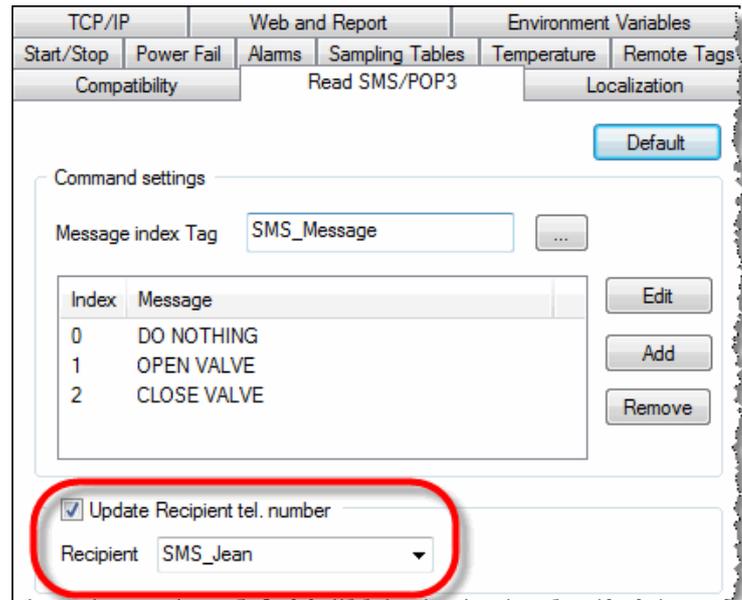
An **existing recipient** of type 'Pager/SMS' can be **updated** with the **mobile number of the originator**.

The idea is to check the incoming message, for instance using ReadSMS status (see next) and to send back a message to the originator.

ReadSMS uses the caller ID of the originator to update the recipient you select in this menu; it uses the **runtime parameter** associated to the recipient (see chapter 9.5.2)

From the Process, you can then decide to send back an SMS, to confirm the command, to indicate the incoming message was invalid, that password was incorrect, ...

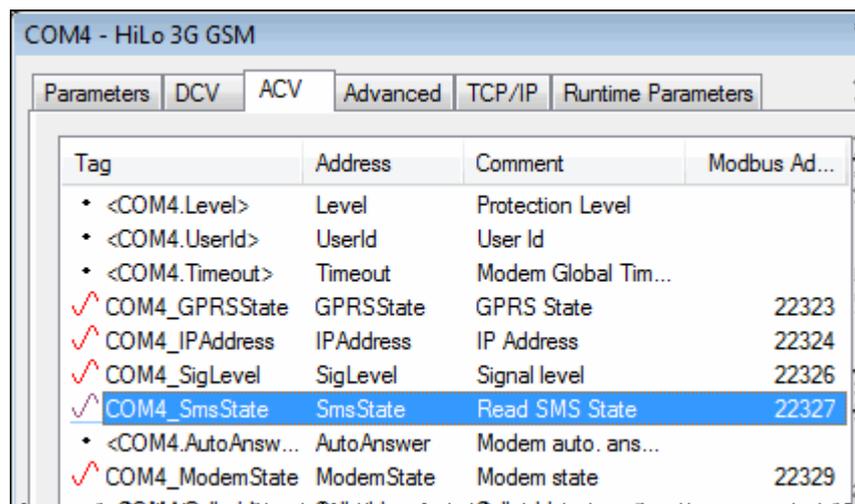
If this option is activated, the selected recipient will be automatically updated with the telephone number of **any incoming call** (if caller ID of originator has been activated!).



13.5. ReadSMS status

A communication variable, associated to the GSM can be used to check the status of ReadSMS.

From the GSM Com port, go to the tab 'ACV' and make a Tag of 'SmsState'



Value	Description
1	Accepted message received
2	acknowledgment received
10	Invalid message
11	Unknown command
12	Equality character (=) not found or incorrect
20	Incorrect password
21	Incorrect password or not supplied for a com. Port protected
30	Message received does not match a predefined message
31	Writing to an unknown address
32	Writing to an unknown address, using indirect addr. (address contained in the Tag not known)
33	Changing the telephone number of an unknown recipient

13.6. Get Message in Text Tag

This feature allows receiving the complete message (SMS or POP3) into a TEXT Tag. At the exception of the caller ID, which is available as a dedicated Communication Variable. The message will then be parsed using BASIC functions.



When this feature is active, ReadSMS/POP3 **pre-defined message feature** (see chapter 13.3.1) is not available anymore. OS is not parsing message anymore as it is done in the application.

The screenshot shows the 'Read SMS/POP3' configuration window. The 'Get message in Text' checkbox is checked and highlighted with a red box. The 'Tag' field is set to 'SMS_Text' and the 'Stack' field is set to 'SMS_Stack'. A table below shows message indices and actions:

Index	Message
0	DO NOTHING
1	OPEN VALVE
2	CLOSE VALVE

Tag Text: It will contain the date, time and the message. Make sure you define this text Tag with a minimum of 160 characters.

Example:

11/03/25,10:29:14+04 Hello to TBox!



- The date and time are the one given by the SMS-C (not from TBox, not from sender)
- The +04 indicates the differences to GMT in quarters of an hour.

Tag Stack: This is a digital Tag. When changing to 1, it indicates message(s) is(are) on the stack. By writing "0", you bring up a message from the stack to the Text Tag (see above). When it switches back to "1", it means there is at least one more message in the stack.

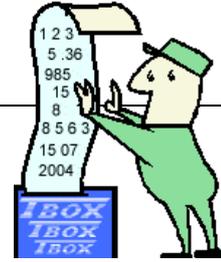
MS-CPU32, -LT2:

stack of 50 messages. Circular buffer.

MS-CPU16, -LITE, -WM, -LP:

no stack. Message with a maximum length of 89 characters.

14. Datalogging



14.1. Introduction

Datalogging allows **memorizing values of your process**, in order to visualize its history.

TBox LT2 contains memory for recording historical values of Tags and events (see technical specifications); the latter is what we call the **database** of **TBox LT2**.

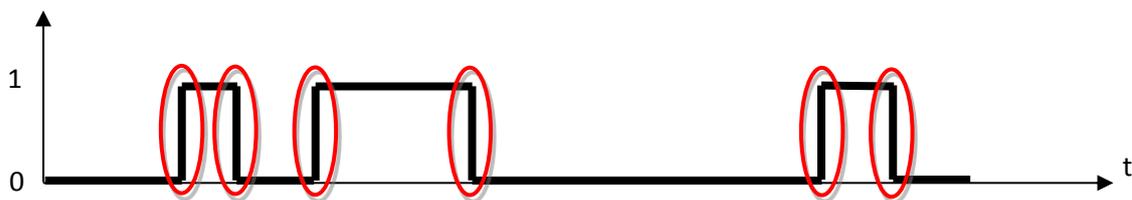
There are two categories of databases:

The Chronologies

Chronologies are '**On event**' recordings, by means of changes in Tags (also known as "Sequence of Events"). Each event is recorded with time, date, Tag and its status or value.

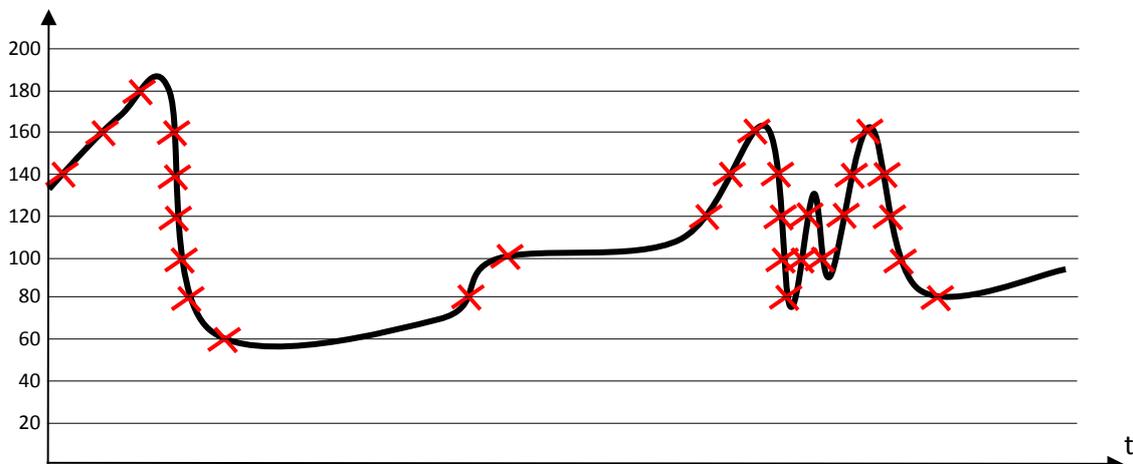
The minimum resolution is 1 ms.

Example of 'digital events':



The changes of status of the Tag represent the events.

Example of 'analog events':



The variations of the Tag represent the events.

TBox LT2 stores chronologies in 2 tables: one for digital data and one for analog data. The size of the tables is defined in the **General RTU properties**, as described chapter 7.1.

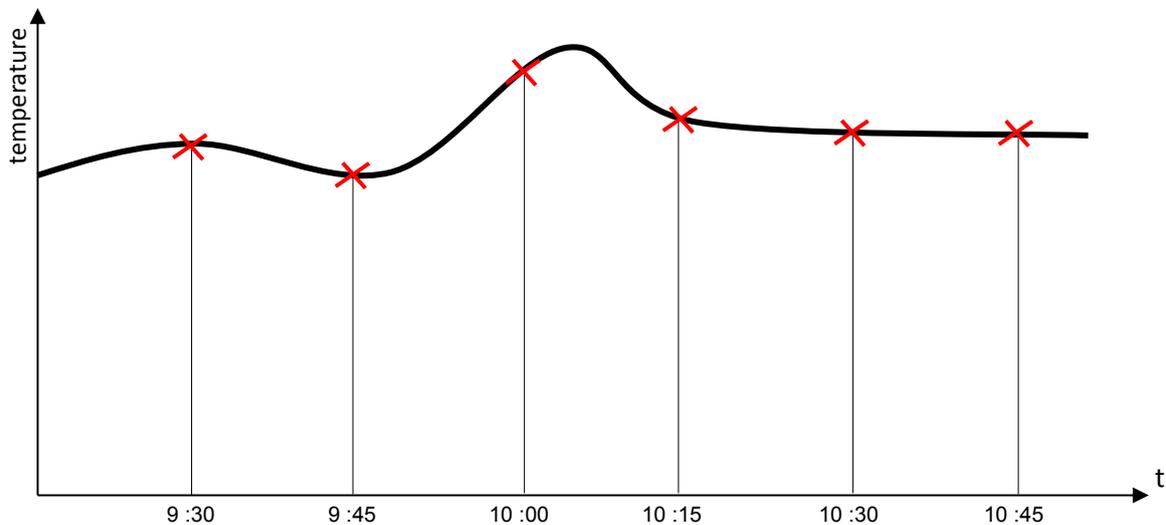
The Sampling Tables.

Sampling tables use '**Periodical**' recording, with a minimum period of 1 second.

Recording in sampling tables happens at fixed intervals and does not depend on signal variations; it uses the clock of the CPU to determine the recording.

Date and time of only the last record is stored. This mechanism requires less memory than chronology does. Timestamps are re-built when data is generated (by report or by polling)

Example of 'periodic recording':



Each Tag is recorded into a separate table. The maximum number of tables is 2000 and the size of each table is of maximum 65535 records. To increase quantity of data recorded, recording on micro SD card can be considered (see Chapter 7.6.3. **RTU properties** -> **Sampling Tables**)

The database information recorded in **TBox LT2** can be displayed directly on **WebForm** or retrieved with the use of SCADA software such as **TView** or other HMI package running 'TComm.dll' based driver (please call your distributor).

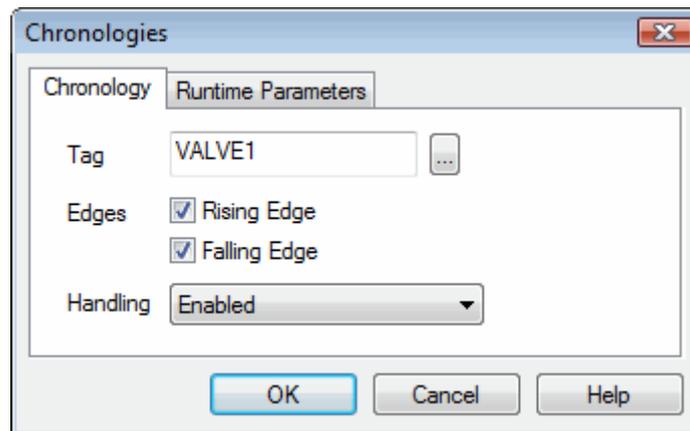


By doing a compilation you can check **the space of memory available** (see chapter 5.10.2).

14.2. The chronologies

14.2.1. Digital chronologies

Example of an entry in Digital chronology: Recording the starting and stopping of 'VALVE1'.



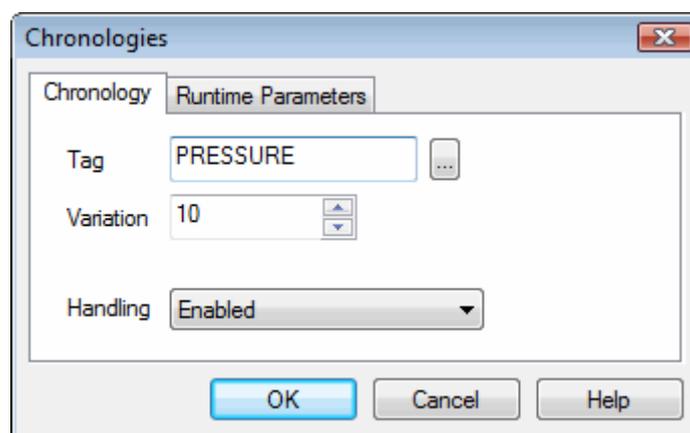
Edges: Recording on positive and (or) negative edge.

Handling:

- Enabled: always recorded.
- Disabled: never recorded.
- PowerF: recording disabled in case of 'mains' power failure.
- DisCRD: recording disabled when the system variable 'DisCRD' is at 1.

14.2.2. Analog chronologies

Example of an entry in Analog chronology: Recording of a variation of 10 mbar of 'PRESSURE'.

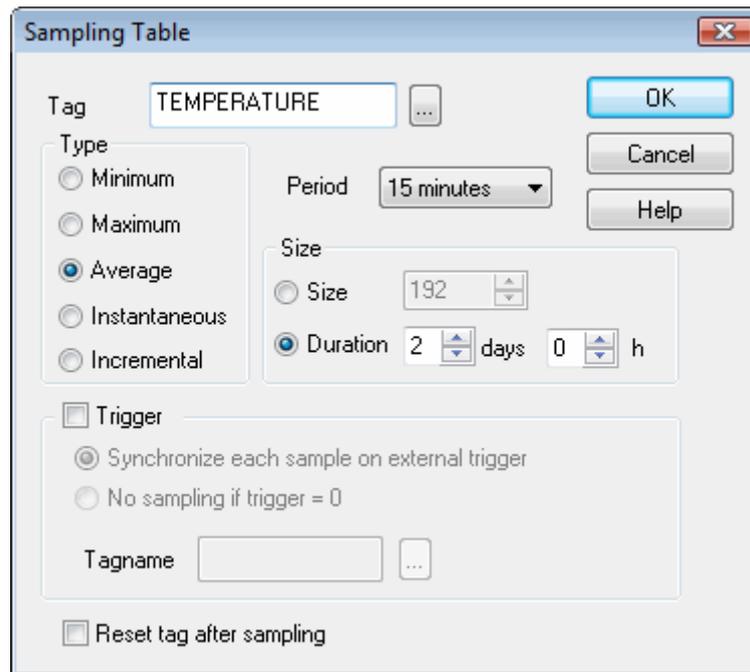


Variation: Recording in case of variation (higher or lower) in comparison with the previous recording. The weight of the value corresponds to the scaling defined in the Tag definition (see chapter 9.1.1: **Analog I/Os**).

Handling:

- Enabled: always recorded.
- Disabled: never recorded.
- PowerF: recording disabled in case of 'main' power failure.
- DisCRA: recording disabled when the system variable 'DisCRA' is at 1.

14.3. The sampling tables



Type: **TBox LT2** records data internally on a **minimum time-base of 1 second**. After the period selected (see next) the selected type of data (min., max., ..)is recorded.

This value can be:

- Minimum : minimum value during the period.
- Maximum : maximum value during the period.
- Average : arithmetic average value calculated during the period. For each period a new average is calculated.

Tag format	Limitation in recording
8 bits	All periods accepted
16 bits	Period limited to 12 hours
32 bits	Not available
Float	All periods accepted

- Instantaneous : value at the moment of the recording.
- Incremental : **TBox LT2** records the difference between the current value and previously recorded value.

Example of incremental recording:

Value of the Tag	865	878	902	905	965	985
Incremental value recorded	...	13	24	3	60	20

Period: Period between 2 recordings. You may choose between:
 1sec; 2sec; 4sec; 5sec; 10sec; 15sec; 30sec; 1min; 2min; 4min; 5min; 10min; 15min; 30min; 1h; 2h;
 4h; 6h; 12h; 24h; 48h; daily; weekly; monthly.

The recording happens at 'birthday' time of the period selected.

Example: if you select as period *5 minutes*, the recording will be done at:
 9:25:00; 9:30:00; 9:35:00; 9:40:00 ...

In case you wish to make recording every day, or even with a longer period, the options are:

- daily: recording once a day
- weekly: recording once a week
- monthly: recording once per month.

The hour of the day, the day of the week and/or the month are defined once for all sampling tables in the RTU Advanced properties (see chapter 7.6.3)

Size: The size can be expressed on two ways:

Size: the number of records of the table.

The recording works on the FIFO principle. According to the size, the duration is updated automatically (see next).

The size can be of maximum 65535 records, with a total of 1 Mbytes in SRAM and 8 Gbytes on micro SD card (optional).

Duration : you may prefer to enter a number of days and hours, in this case the size is automatically updated.



To adjust the sizes check the available memory with the compile option. See chapter 5.10.2: **Compiling a program.**

Trigger:

Synchronize each sample on external clock: recording of the value is executed on the positive edge of the Tag selected, and **not with the clock of the CPU.**



The period between 2 pulses of the Trigger must correspond to the period selected between 2 recordings (see above). The period selected with the timestamp of the last record to rebuild the table.

Example of use of external Trigger: quarter - hour management.

In some industries, every 15 minutes (may vary slightly), your electric company sends a pulse which is used to calculate the consumption, based on average consumption during 15 minutes.

You will be charged based on the **highest consumption.**

In order to analyze your consumption and prevent from peaks, you can use this pulse as Trigger.

Recording will be done each time the pulse arrives, but when **retrieving data**, the calculation of timestamp will be computed from the time stamp of the last recording and the period.

This means it can only be used if the period between pulses corresponds to a period between 2 recordings (see above).

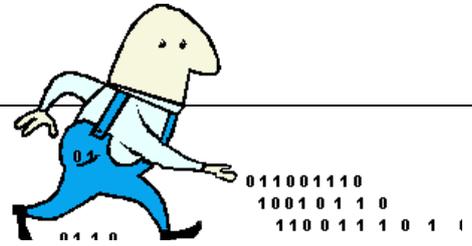
No sampling if trigger = 0: the CPU clock is used to record data (see period above), but recording is only possible when the Tag Trigger is in "high state". When it is negative, recording stops. **On the positive edge of the Tag, the table is erased and a new recording starts.**

Reset Tag after sampling: if this option is checked, the RTU automatically resets the register that has been recorded.



This option works only with registers, NOT I/O !

15. ModBus Transactions



Introduction

ModBus Transactions feature allow exchanging data between two or more ModBus stations via any communication ports.

One often speaks of 'Master Network' because it is a ModBus Master communication: the **Master (TBox LT2)** executes reading and writing in slave(s) through any media (RS485, Ethernet, modem...).

The protocol will be ModBus-RTU or ModBus/TCP according to the media used.

Each ModBus Transaction corresponds to **one transaction** (reading or writing) with 1 slave.

When there are several stations, **TBox LT2** executes the different transactions of one station at a time, then transactions of the following station, and so on ...

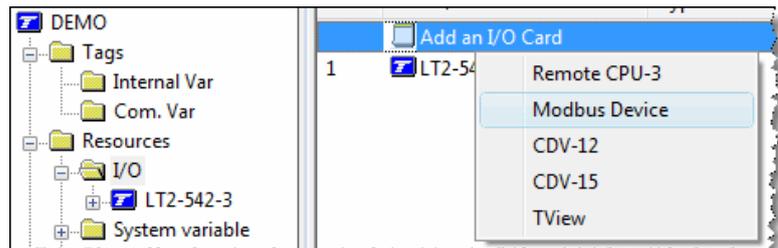
When a **dial-up modem** is used to execute ModBus Transactions, **TBox LT2** needs first to establish the connection using an **Alarm** of type 'ModBus' (see chapter 12.4. **Recipients**)

Before creating a ModBus Transaction you have to create the equipment you are going to communicate with.

15.1. Creating a Remote Device

From the Project Workspace, select 'Resources' → 'I/O'. Click 'I/O' and in the list of I/O, click 'Add an I/O Card'.

Select **ModBus Device**.



Name: You type any name. It will be available in a list of available equipment when creating 'ModBus Transactions' (see next).

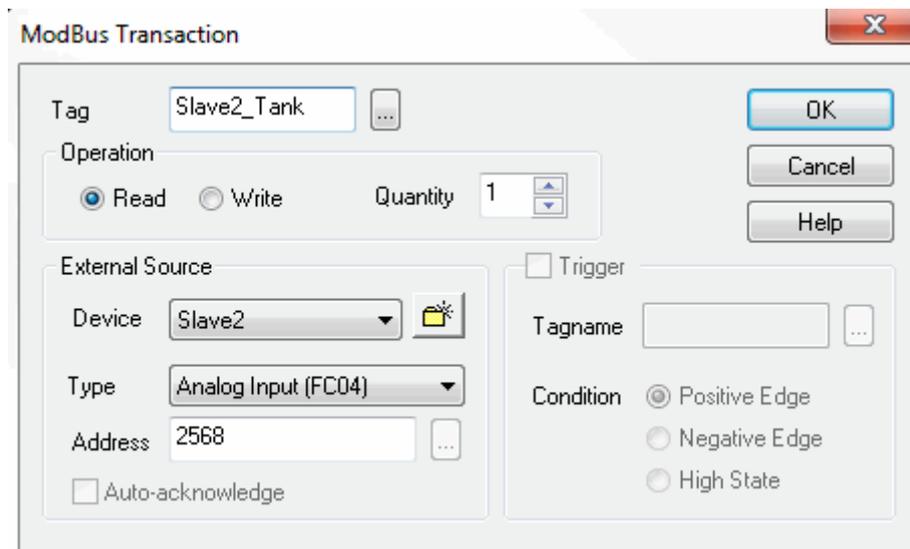
Address: It is the station address of the Remote equipment. **It must be different from the TBox LT2 and possible other equipment on the same network.** When communicating through TCP/IP port, you have to indicate the IP address of the remote device

RTU Port: The communication port used by **TBox LT2** to communicate with the remote equipment.

Trigger: Select a digital Tag that will trigger the communication, according to a 'Condition' (see next). Working with several equipment, you declare different Tags and then control differently the communication to each equipment.
The Trigger must be a digital variable (DIV).

Condition: Condition of Tag 'Trigger' to start communication. Typically, you will work with a **permanent connection** (Trigger in High or Low state). Or you can decide to execute one-shot communication, on edge changing of the Tag Trigger.
 The changing of state of the Tag can be controlled by BASIC, Ladder, or Periodic events.

15.2. Creating a ModBus Transaction



Example: reading of 8 'floating' variables in Slave22 starting at address 168

Tag: Select an existing Tag by clicking the  button. Be sure you select a Tag of the same type than the one you want to access in the 'Slave' (Byte, Word, DWord or Float).
 If the Tag does not exist, you can create it after having clicked the button. It is the Tag of the **Master**; it contains the value you want to write in a Slave or it is a register that contains the value that Master reads in a Slave.
 In case of block communication (with a quantity > 1), this Tag is the one of first ModBus address.

Operation :

Operations	MASTER (Tag)	SLAVE (Address)
READ		Data
WRITE	Data	

Read: the Master reads data from the Slave.

Write: the Master writes data to the Slave.

Quantity : Quantity of **variables** of successive addresses that are read (or written) in the Slave. It depends on the external source, the types of variable and the ModBus function used (see tables below).



ModBus protocol handles only words (16 bits). When working with 32 bits, TWinSoft adapts the quantity to double the number of words. 32 bits variables are handled with: <Hi word1><Lo word1><Hi word2><Lo word2>... It can be adapted from the "Advanced..." properties of the remote device.

External Source. All the following parameters concern the Slave station:

Device: select an existing external device from the 'Resources'. You can create one clicking the button 

Type: select the type of the external variable. The choices are:

With external source '**ModBus device**' (any [TBox MS](#), [TBox LT](#), any ModBus device)

Types	Connection in remote device	ModBus Function
Digital input	Only digital input(s)	2
Coil	Digital output(s) or register(s)	1, 5 or 15
Analog input	Only analog input(s)	4
Holding register	Analog output(s) or register(s)	3, 6 or 16

Operations	Types	ModBus Functions	Max. Quantity (*)
Read Digital	Digital Input	2	1600 (see Warning below)
Read Digital	Coil	1	1600 (see Warning below)
Read Analog	Analog Input	4	125 (16 bits) - 62 (32 bits)
Read Analog	Holding Register	3	125 (16 bits) - 62 (32 bits)
Write Single Digital	Coil	5	1
Write Single Analog	Holding Register	6	1 (word)
Write Multiple Digital	Coil	15	800 (see Warning below)
Write Multiple Analog	Holding Register	16	100 (16 bits) - 50 (32 bits)

(*): Maximum quantities for [TBox LT2](#), [TBox LITE](#), [TBox MS](#). You also have to check the maximum quantities of the 'Remote device'-they could be less.

With External source '**Remote TBox**' ([TBox CPU-3](#))

Description	Operations	Tag types	Max. Quantity
Digital I/O	Read/Write	IOD, T4m	16
Analog I/O	Read/Write	IOW, I4M	8
Digital registers	Read/Write	DIR, STD	1600 (see Warning below)
Analog registers (8 bits)	Read/Write	STB	8
Analog registers (16 bits)	Read/Write	AIR, STO	100
Analog registers (32 bits)	Read/Write	TOT	8
Analog registers (32 bits)	Read/Write	FLT	8
Timers	Read/Write	ATP, ATV, DTI	16
Counters	Read/Write	ACP, ACV, DCN	16
Special Registers	Read/Write	DSPE, ASPE	16
Register 'Sampling Table'	Read/Write	ECH	16

(*): with quantity > 16, ModBus addresses and quantities must be multiple of 8



When accessing **digital variables** (DIV, DIR, ...) into [TBox CPU-3](#), make sure you use **multiples of 8 for: quantity and address of Variable in External Source**

Address : The ModBus address must be typed according to the indication of the user's guide of the Remote device. Communicating to a [TBox](#), you have to refer to the TWinSoft application and its configuration of Tags.

15.3. ModBus Transactions through modem

With a remote device accessed by a dial-up modem, the connection must be first established **using an Alarm "ModBus"**.

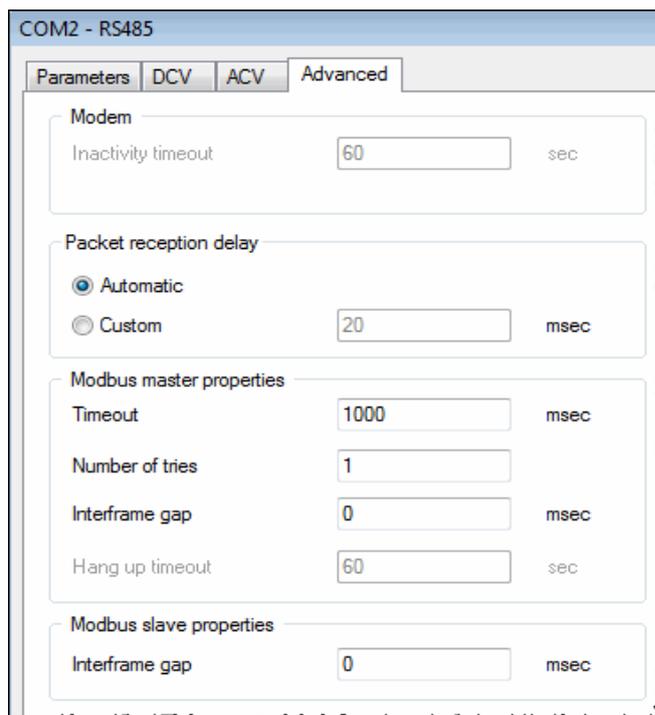
The sequence is the following:

- Create a *Remote Device*, associated to the communication port of the modem and to a Trigger – DIV (digital register) **always active**.
- Create the *ModBus Transactions* associated to this device.
- Create an *Alarm Recipient* of type 'ModBus - Master', with the telephone number of the remote device.
- Create an *Alarm Condition*, associated to the event requiring communication with the Remote TBox and to the Recipient created above.
- When TBox needs to communicate, generate the alarm condition.
- **When modems are connected (can be checked using the communication variable DCV – Comx.Call) and Trigger is active (see above)** ModBus Transactions associated to this station will be executed.
- Acknowledge the alarm, for instance using the special analog variable 'AlaRec'. You write into 'AlaRec' the ID of the "ModBus-Master" recipient.
- Stop connection by writing '0' to the Communication Variable 'COMx.HookLink', alternatively, communication will be automatically stopped after 1 minute (see hangup timeout below).

15.4. Timing configuration of ModBus Transactions

Several timings can be adjusted when communicating through ModBus Transactions. Their value mostly depends on the media and the baudrate (see on line help for more info).

They are available from the tab 'Advanced' of the properties of the communication port.



Example with RS485 of the CPU

Packet reception delay: maximum time for receiving a valid frame.

ModBus Master Properties

timeout: maximum time to receive an answer before sending the next query

Number of Tries: in case of error, number of times a query is sent

Interframe gap: after having received a valid answer, time before sending the next query.

Hang up timeout: doing a ModBus Master define the maximum connection time. The maximum value is 600 seconds.

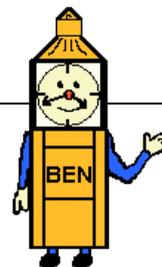


Value=0 means it will **never hang up!**

ModBus Slave Properties

Interframe gap: after having received a valid request, time before sending the answer.

16. Periodic Events



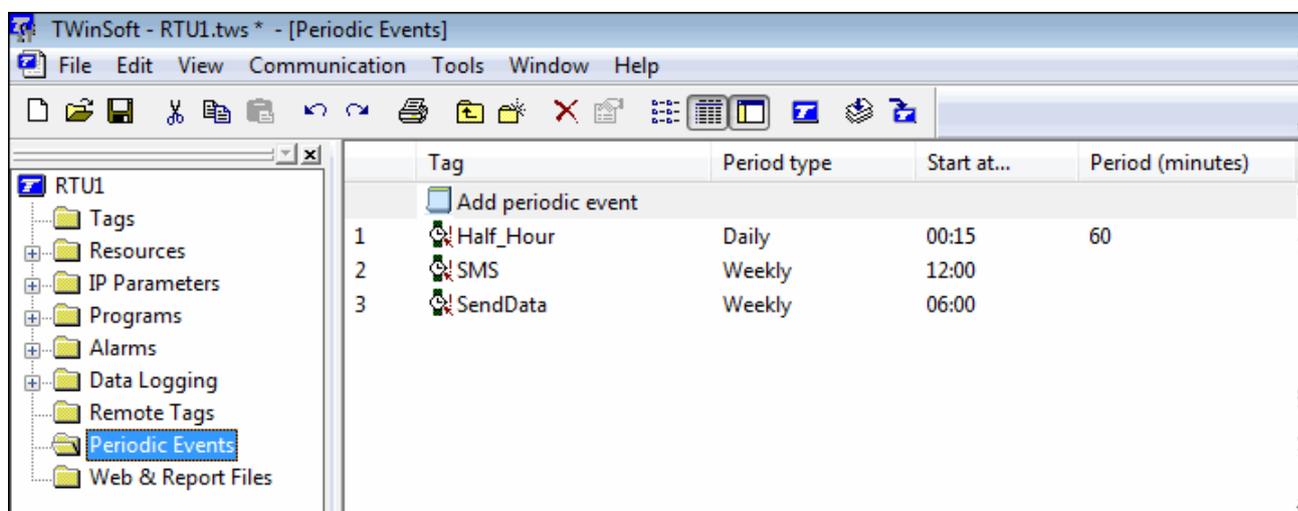
When **tasks** have to be executed **periodically**, periodical events constitute an easy way of **creating events** to launch the tasks, like ModBus Transactions, sending of test alarm, datalogging, a piece of Ladder/BASIC logic, etc..., and this, independently from any other condition.

A periodic event could be compared to an automatic timer.

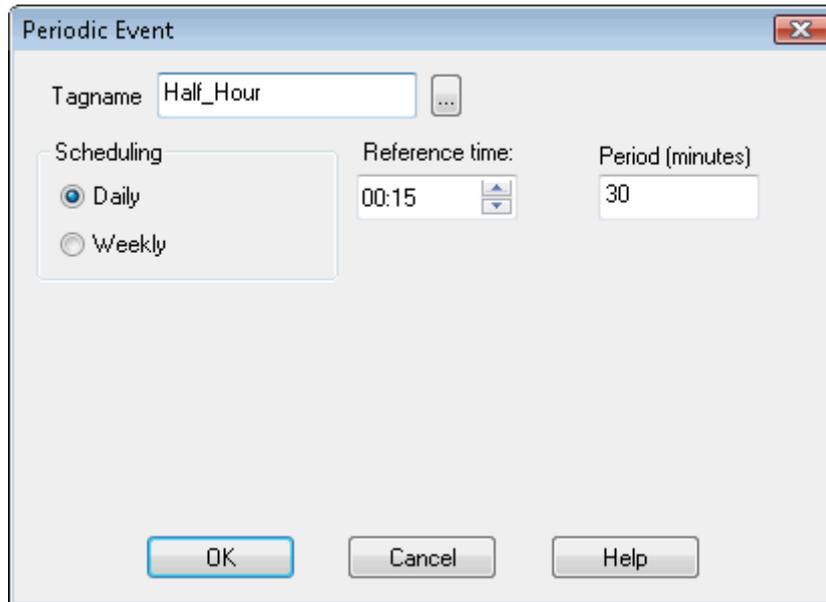
A digital Tag is Triggered periodically: it is automatically SET when the period has elapsed. All tasks associated to a positive edge on this Tag will be launched, then the Tag will be automatically RESET, ready for the next period.

Several tasks can be associated to the Tag triggered. This implies for the OS to RESET the Tag when all tasks have been launched.

In the project workspace of TWinSoft, a folder is available to declare the Periodic Events:

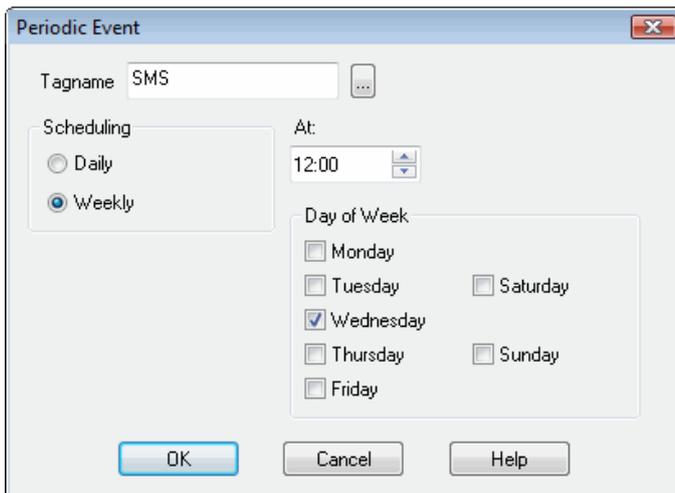


Example of a 'daily event':

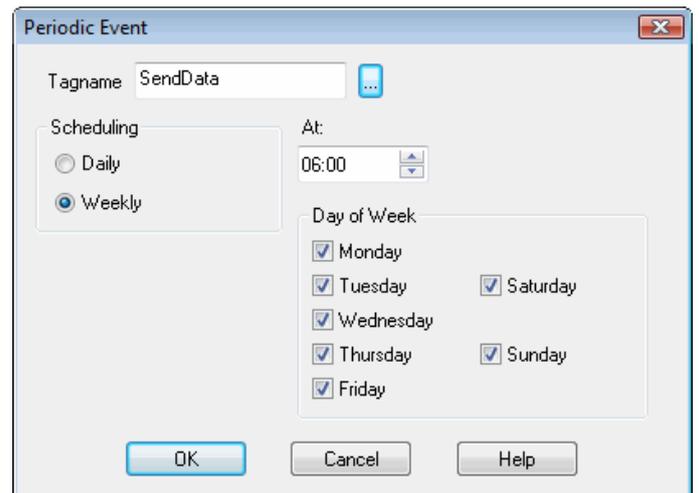


The Tag 'Half_Hour' (a DIV) will be automatically SET each 30 minutes, at each xx:15:00 and xx:45:00. The task(s) associated to Tag 'Half_Hour' will be executed each 30 minutes, for instance a communication to a Remote Device, the Tag would be the Trigger of the Remote Device.

Examples of a 'weekly event':



Sending a SMS each Wednesday at 12:00 AM



Sending a daily report at 6:00 AM

With the above examples, the digital Tags (DIV) "SMS" and "SendData" are associated to alarm condition.

17. Protection (Access security)



This (optional) access control on **TBox LT2** prevents non-authorized persons from accessing the RTU and from opening the TWinSoft document.

Several protocols can be protected: ModBus, HTTP, FTP (server), ReadSMS. More protection can be implemented, like Firewall (chapter 11.2), OpenVPN (chapter 11.1) or IEE802-1X though an add-on (see chapter 7.2. **Add-ons**).

Once you activate the “Access security” option, the TWinSoft document will also be protected, even if no port has been selected!

There are three methods of activating access security. You select one:

- **Global Code:** You define a 4 digits hexadecimal code.
- **Enhanced Global Code:** The same as above but with maximum 8 of any characters.
- **User list:** You define your own list of Users/Password.

17.1. Access Protection on Communication Ports

The configuration of access security of **TBox LT2** is available from the ‘RTU properties’:

- The protection must be activated by one of the three methods (see below).
- Then “ModBus” protection can be assigned individually to each port.
- Protection on other services (HTTP, ReadSMS, ...) can then be assigned too.

17.1.1. ModBus Protection

The ModBus protection provides a protection against writing values (from TWinSoft, from a WebForm) and sending a new application. Each port individually can be protected.

TWinSoft populates ports according to the model of **TBox LT2** you are configuring; you check the port(s) you want to protect.

Three access levels are available to access protected port(s):

- **Level 1:** Surveillance mode or **VISUALIZATION MODE**. The operator can view all **TBox LT2** values (local or remote), but cannot execute any command.
- **Level 2:** **COMMAND MODE**, the operator can view all the values and execute commands (locally or remotely). Also known as **READ/WRITE MODE**.
- **Level 3:** **ENGINEER MODE**, the operator can view all the values, execute commands and send new application (locally or remotely).



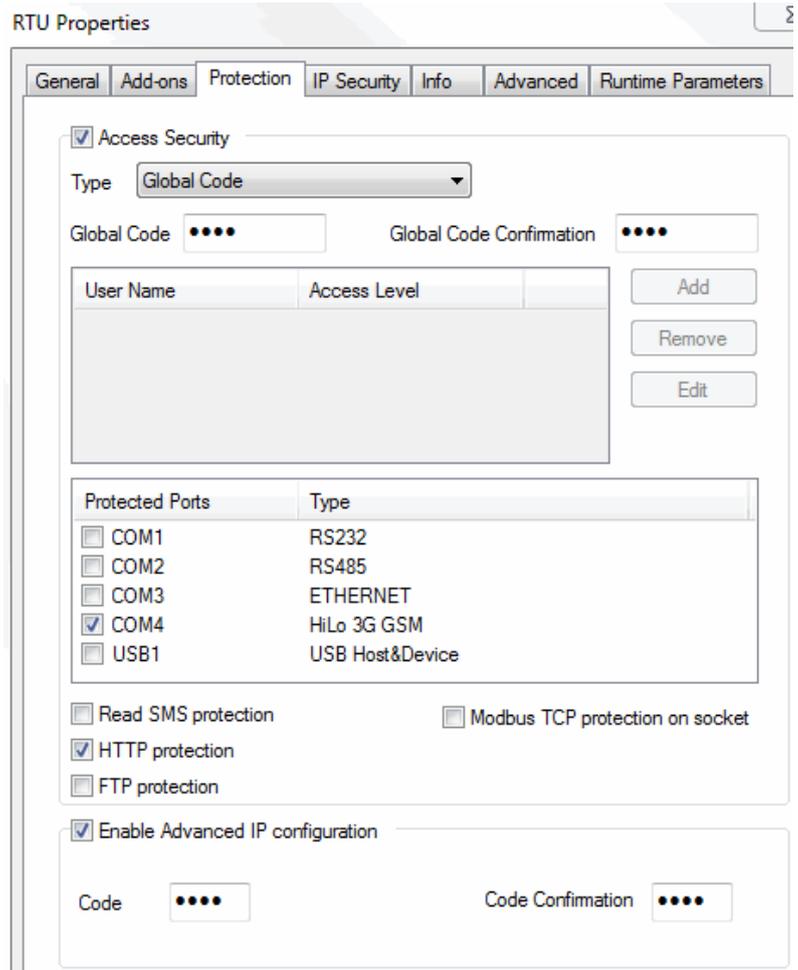
When a port is protected it cannot be written through ModBus Transactions.

TWinSoft presents all the communication ports according to your hardware configuration:

From the RTU properties → tab 'Protection', **you activate the general access security feature.**

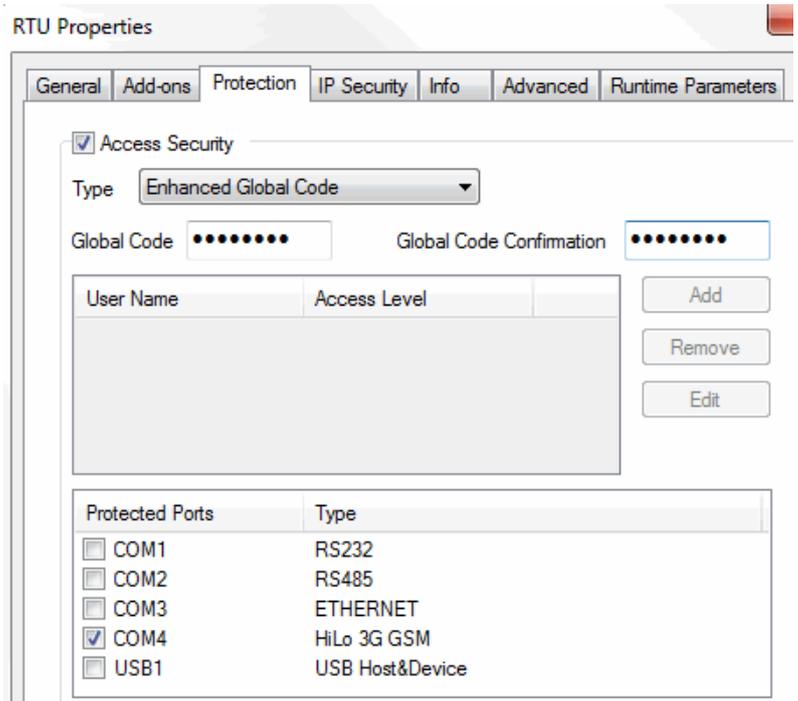
Global code: type in the **4 character hexadecimal code** that you have used to generate the Access Codes with the utility **Password Generator** (see chapter 17.3 following).

Type it a second time to confirm.

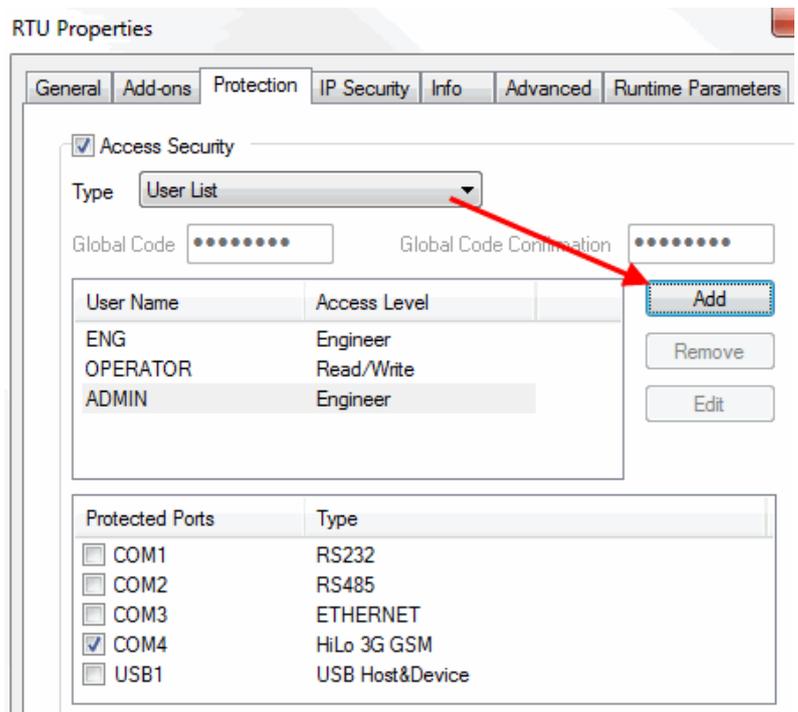


Enhanced Global code: type in a **code with maximum 8 of any characters** corresponding to the one you have used to generate the Access Codes with the utility **Password Generator** (see chapter 16.3 following).

Type it a second time to confirm.



User list: You add users with for each an access level.



17.1.2. Monitoring Access Level

Current access level on serial and modem ports can be checked using the Communication Variables (see chapter 8.3.2).

17.1.3. ReadSMS protection

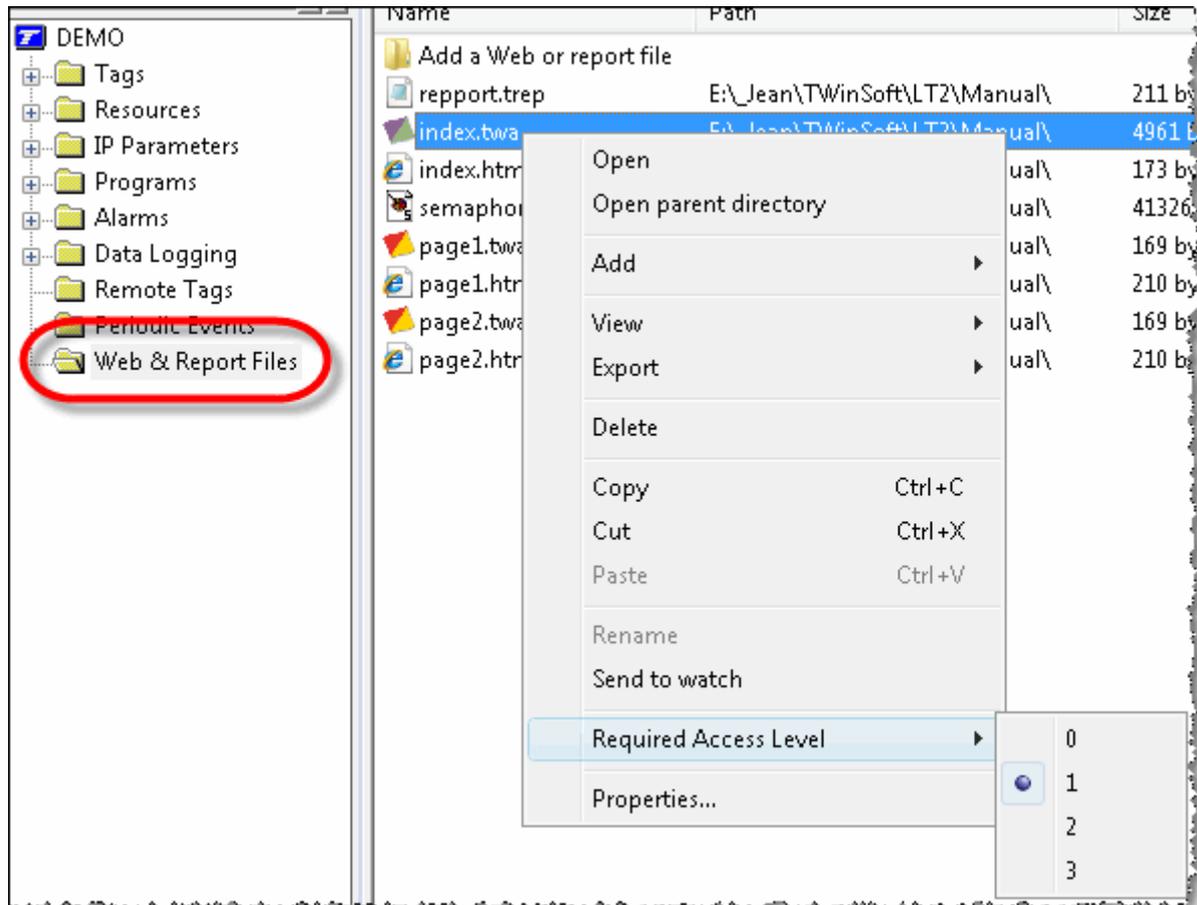
ReadSMS feature allows controlling TBox using SMS or e-mail. It can be protected as explained chapter 13.3.5.

17.1.4. HTTP Protection

HTTP protection assures protection at HTTP level, to prevent accessing files stored in **TBox LT2** using HTTP protocol. Typically when displaying HTM files with a browser.

Once HTTP security is activated, each file building the web site must be assigned an access level.

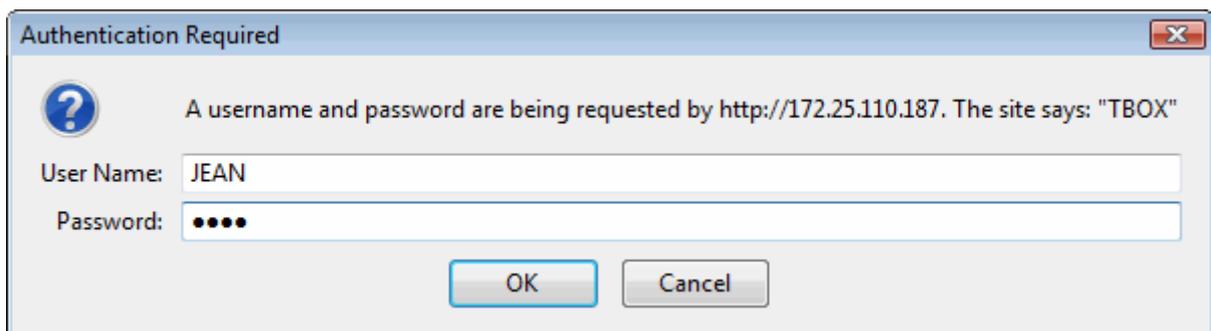
In folder "Web and Reports files", right click each file:



ALL files (.twa, .htm, .twf, .gif, ...) composing a view must be given an access level:

- Level 0: the file is always visible and does not require a login. Typically a home page.
- Level 1: the file is visible by user "Read only", "Read/Write" and "Engineer".
- Level 2: the file is visible by user "Read/Write" and "Engineer".
- Level 3: the file is visible by user "Engineer".

Once HTTP protection has been activated (and sent to the RTU), when connecting to **TBox LT2** using a browser you are prompted to login to open a file with access level 1, 2 or 3.



To create the Login, see chapter 17.3. below.

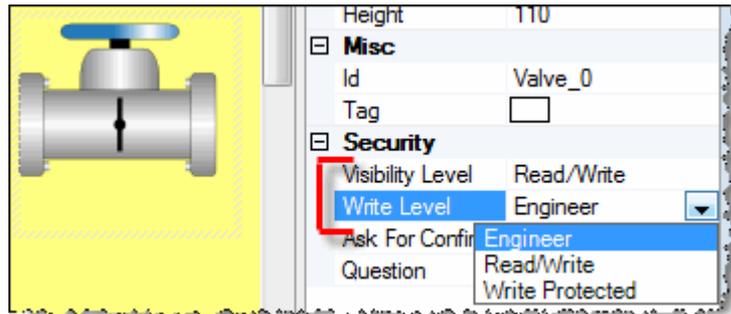
When several PC's connect to **TBox LT2**, a login is required for each PC.

Different sessions of the same browser on one PC use the same login.

Protection on Objects Inside Webform 2.0

Each object composing a webform can be assigned “visibility” and “write” levels of authorization

Example with WebForm 2.0



Ease of use recommendations

1. Common files

Files that everybody can see and files part of the template (icon, images, ...) should be assigned an access level= 0. It means they are displayed with any level of user. A home page with access level=0 will be displayed **without requiring a login**.

2. Protecting "IP" ports

Typically, Ethernet or GPRS communication port.

In case you need protection against writing to Tags or sending a program.

If the port is also protected, two login will be required: HTTP and ModBus/TCP.

3. Reminder about writing to Tags

If the communication port is protected and the presentation of the Tag is set "**write enable**" (see tab "Presentation" of the concerned Tags) user requires access level = 2 (Read/Write) to change value.

A user with access level = 3 can always change Tag value.



A login at ModBus level will be also required if the port has been protected (see above).

17.1.5. ModBus TCP protection on socket

A TCP communication is based on “Sockets”. They allow multiple, simultaneous communication:

ONE socket = ONE communication context

TBox LT2 supports 64 communication contexts.

Without the option checked: the protection is based on the com. port only:

When someone logs in to a communication port as “Engineer”, all users connecting after him will be automatically logged as “Engineer” too ...

With the option checked: the protection is based on sockets:

Each user connecting to a protected communication port has to log in, individually

17.1.6. FTP Protection

TBox LT2 can act as a “FTP Server”. It opens access to the micro SD and files sent using alarm recipient “micro SD”.

By default, FTP server is accessed in "anonymous" mode. To protect access by a login, check this option. The login is created as explained chapter 17.3 below.



Activating protection is mandatory to delete files on the SD, using a FTP Client.

17.1.7. Advanced IP Configuration

Activating this option gives access to different TCP/IP redirection features like **IP forwarding** and **Virtual Server** (see more info in Appendix F: **IP Forwarding, NAT, Virtual Server**).

Type a 4 digits hexadecimal code.

17.2. Document protection

It provides a protection against opening the, independent from the Global code mechanism.

Type a password of minimum 6 characters.

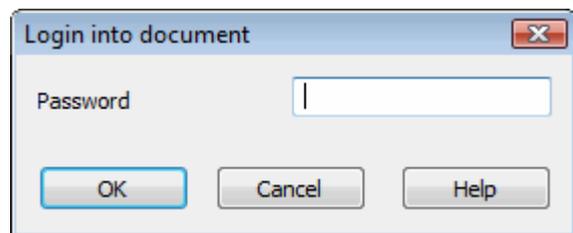


In case you have activated Access Security (see chapter 17.1. **Access Security**), this protection replaces TWinSoft document protection through access security login.

17.2.1. TWinSoft Document Protected

Once a document has been protected (see above), when opening it with TWinSoft, you are prompted to type the password:

Click OK



- There is no distinction between access levels when opening a document. Any acceptable login will be supported.
- By clicking ‘Cancel’, TWinSoft indicates the document is protected and opens a new one

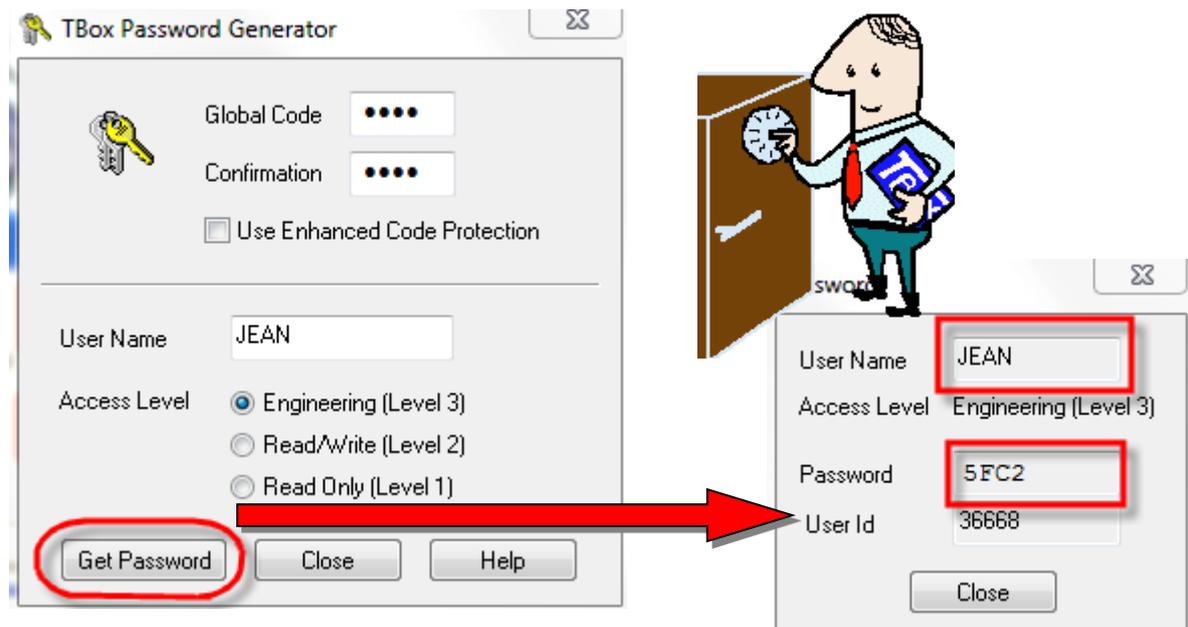
17.3. Password utility

The utility program **Password** generates **access codes** based on global codes

When installing *TWinSoft Suite* a password-creation program named **Password Generator** is installed in the same directory as TWinSoft. It can be started from the 'Start' button of Windows and is located in the group of programs "Techno Trade" → "Accessories" created while installing TWinSoft.

This program generates passwords needed to Login to **TBox LT2** when access security has been activated (see above).

A password is composed of 4 or 8 hexadecimal characters in response to information related to the user. It is based on a complex algorithm using the **global code (=key)**, the **user's name** and the **access level**. A 5-digit number (User Id) allows identifying the user accessing **TBox LT2**. This User Id can be used to trace users for example by inserting this number into datalogging (chronologies), with the help of Analog Communication Variables (see chapter 8.3.2.).



Global code This hexadecimal code of 4 or 8 characters is the basis for password generation. It is typed in the 'RTU Properties' (see above) of TWinSoft and sent to **TBox LT2**. When a user logs in, **TBox LT2** checks whether NAME and PASSWORD fit with the global code. This means that if different users with different access levels must communicate with **TBox LT2**, the **global code used to generate passwords must be the same**.

User name The **NAME** you use as login.

Access level Three access levels are available:

- **Level 1:** Surveillance mode or **VISUALIZATION MODE**. The operator can view all **TBox LT2** values (local or remote), but cannot execute any command.
- **Level 2:** **COMMAND MODE**, the operator can view all the values and execute commands (locally or remotely).
- **Level 3:** **ENGINEER MODE**, the operator can view all the values and execute commands and alter or send new TWinSoft documents (locally or remotely).

When this information has been entered, click on the button "Get password".

Two codes have been created:

- The PASSWORD: this **PASSWORD** must be used together with the **NAME** when logging in.
- The USER ID: this number is available in an Analog Communication Variable when a user is connected to a protected communication port of **TBox LT2**.

17.4. Login/Logout

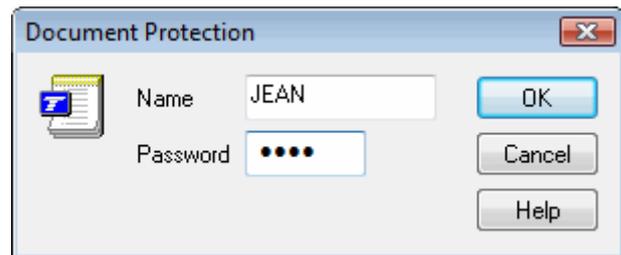
17.4.1. With TWinSoft

The Login feature of TWinSoft allows connecting to a protected communication port of the **TBox LT2** according to an access level. If a port is not protected, access level is automatically 3= Engineer.

The Login/Logout is executed from the main menu bar → 'Tools'.

Login

If connected to a port of **TBox LT2** that is protected, you need to Login to get an access level.



You type the Name you used in the 'Password' utility and the Password that was created (see previous). According to those, you access in:

- Read only
- Read/write
- Engineer

The access level is displayed in the Status bar.

- If 'Save password' is checked and TWinSoft is connected to a protected port: when TWinSoft starts, it uses the access level corresponding to the password saved (see the status line).
If it is not checked and TWinSoft is connected to a protected port: TWinSoft starts in 'Read only' mode. You need to do a Login to get your access level.

Logout

If the TWinSoft is connected to a protected port, the Logout sets TWinSoft in 'Read only' mode.

17.4.2. With Browser

If you have developed HTML pages based on webforms 2.0, you can access **TBoxLT2** using a browser. **TBoxLT2** acts as a **Web Server**. Any browser on multiple platforms can access webform 2.0 pages in **TBoxLT2**.

The utility software **TConnect** is the perfect candidate to establish this kind of connection (see <http://helpdesk.servelec-technologies.com>). In case of dial-up connection, you will have to indicate the **NAME** and **PASSWORD** to login.



Even if **TBoxLT2** is not protected, type a **NAME** and **PASSWORD**. Depending on Windows and IE versions, **they may not allow a connection without login**.

17.5. Deactivating protection

There are two methods of deactivating **TBoxLT2** access protection:

Global reset (see chapter 5.6.)

The first method is by performing a global reset, which must be carried out on site. When the program has been stopped, **the local port is no longer protected**.



If the 'modem' has been declared protected, it will still be protected even after a global reset. To deactivate the protection, an unprotected TWinSoft document must be sent to **TBoxLT2** (see below).

Sending an unprotected TWinSoft document

The second method involves modifying the TWinSoft document and deactivating the access Security option. The document is sent to **TBoxLT2** after having logged in as 'Engineer'.

17.6. Deactivating protection of TWinSoft document

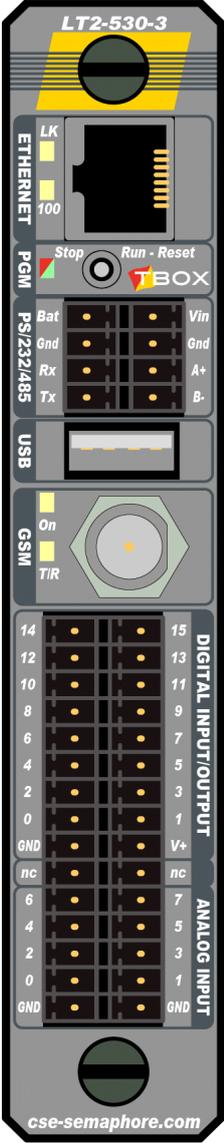
You have to open the document and de-activate 'Access security' and 'Document password' in tab 'Security' (RTU properties).

If you have forgotten your access security login, but still remember the Global Code, you can generate a new login (see chapter 17.3. above).

If you have forgotten your Global Code and or the document password, you have to contact your local distributor and send him the application, the <application>.tws file.

TECHNICAL SPECIFICATIONS - CABLING

18. Front panels

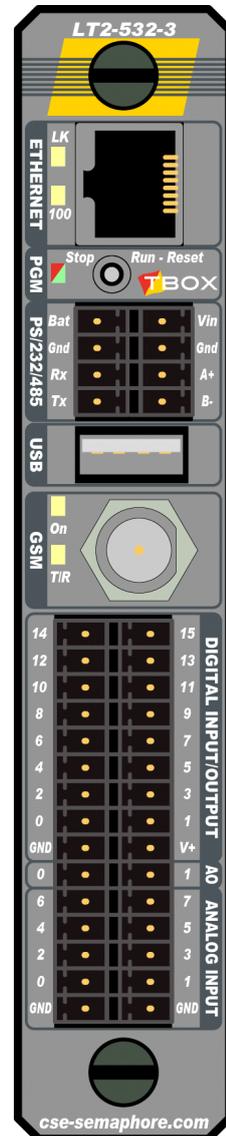
<p>18.1. LT2-530-xx</p>	<p>References: LT2-530 LT2-530-3 LT2-530-S</p>
<ul style="list-style-type: none">➤ Communication (standard)<ul style="list-style-type: none">• Ethernet• RS232• RS485• USB➤ Communication (optional)<ul style="list-style-type: none">• -3: GSM modem (3G)• -S: Full RS232 port➤ 16 x Digital Input/Output<ul style="list-style-type: none">• 3 x Fast Digital Inputs• 3 x Counter Inputs➤ 8 x Analog Input<ul style="list-style-type: none">• 4..20mA• 0..10V➤ Backup battery charger (for 12 V Lead Acid battery)	

18.2. LT2-532-xx

References:

LT2-532
LT2-532-3
LT2-532-S

- Communication (standard)
 - Ethernet
 - RS232
 - RS485
 - USB
- Communication (optional)
 - -3: GSM modem (3G)
 - -S: Full RS232 port
- 16 x Digital Input/Output
 - 3 x Fast Digital Inputs
 - 3 x Counter Inputs
- 8 x Analog Input
 - 4..20mA
 - 0..10V
- 2 x Analog Output
 - 4..20mA
- Backup battery charger (for 12 V Lead Acid battery)

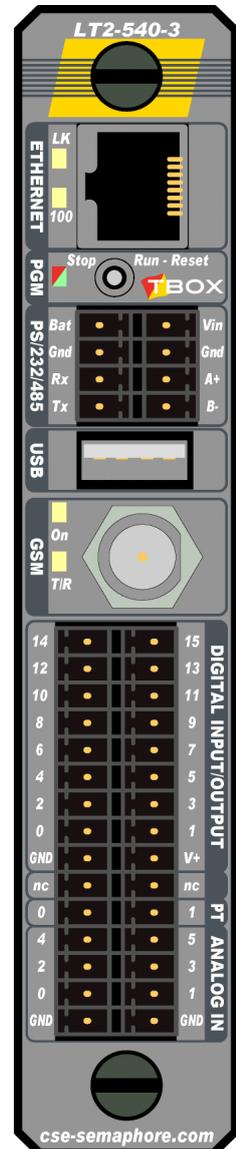


18.3. LT2-540-xx

References:

LT2-540
LT2-540-3
LT2-540-S

- Communication (standard)
 - Ethernet
 - RS232
 - RS485
 - USB
- Communication (optional)
 - -3: GSM modem (3G)
 - -S: Full RS232 port
- 16 x Digital Input/Output
 - 3 x Fast Digital Inputs
 - 3 x Counter Inputs
- 6 x Analog Input
 - 4..20mA
 - 0..10V
- 2 x Analog Input
 - Pt1000
- Backup battery charger (for 12 V Lead Acid battery)

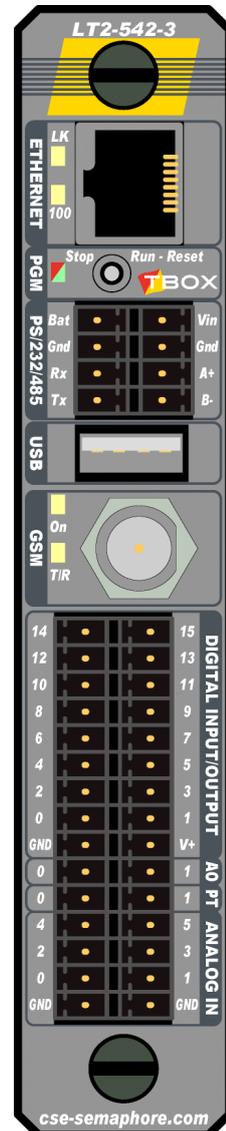


18.4. LT2-542-xx

References:

LT2-542
LT2-542-3
LT2-542-S

- Communication (standard)
 - Ethernet
 - RS232
 - RS485
 - USB
- Communication (optional)
 - -3: GSM modem (3G)
 - -S: Full RS232 port
- 16 x Digital Input/Output
 - 3 x Fast Digital Inputs
 - 3 x Counter Inputs
- 6 x Analog Input
 - 4..20mA
 - 0..10V
- 2 x Analog Input
 - Pt1000
- 2 x Analog Output
 - 4..20mA
- Backup battery charger (for 12 V Lead Acid battery)



19. Technical specifications

19.1. Common to all models

General		
Processor		32 bits, ARM based, 400 Mhz
Clock	Clock Drift	Realtime Clock Typical: 1.7 s / day @ 25°C
Watchdog		Watchdog circuitry included Maximum process cycle time = 1 sec.
Toggle Switch		STOP - RUN - RESET (see chapter 5.6)
LED	Green 2 Hz Green 0.5/Hz Green ON Red 8 Hz	Normal operation Application stopped OS stopped Presence of Alarm(s)

Power Supply - VOLTAGE	Different ranges according to functionalities:	
Functionalities	Voltage on Vin required	Voltage on Vbat
- CPU, Communications, Analog Inputs	8 → 30 VDC	10 → 16 VDC
- Analog Outputs	9 → 30 VDC	10 → 16 VDC
- Charger for backup battery (12 V Lead Acid)	20 → 30 VDC	-

Power Supply – CURRENT (Typical)		
All models of –LT2	Current with: Vin=24V	Current with: Vin/Vbat=12V
- Main board, I/O, Com (RS, Eth., USB), 3G (idle)	50 mA	90 mA
- 3G (in com)	+ 50 mA	+ 90 mA
- USB to power external device	+ 130 mA	+ 260 mA
- Analog output	+ 22 mA (per output)	+ 22 (per output)
- Charger	+ 210 (in charge)	-

12 V Battery charger	
- Power supply Vin required	20 -> 30 VDC
- Battery model	12 V Lead Acid. Typical 7 A/h
- Charge Mode	Constant current. Limited voltage
- Voltage	Temperature compensated: 13.8V @ 25°C – 18 mV / °C
- Current	Maximum: 250 mA fixed
- In Charge	Stops when temperature > 55 °C
- In Discharge	External 12 V backup battery automatically disconnected if voltage < 10 V Current max.: 2A
3 V Internal Battery	
Voltage	3 V
Model	Lithium CR-2450
Use	Backup of Clock and SRAM (datalogging) when TBox LT2 is out of power
Lifetime	Battery consuming only when TBox LT2 is out of power and plastic strip has been removed. Typical: 4 years @ 25 °C. Mechanical: 10 years
 We advise to consider replacing the 3V lithium battery when it has been used during 2 years. See procedure chapter 19.2.	

Protection	
Power Supply (Vin)	Reverse polarity protection
FUSE <i>external 12 V battery</i>	Soldered Fuse of 3 A. Not replaceable by user.
Memory	
Flash	32 MB (Uboot, LINUX, OS, Application, Web & Reports, Sources)
SDRAM	64 MB (Running part of LINUX, OS, Application)
SRAM	1 MB, backed up with Lithium battery (datalogging, log, backup value of Tags)
MicroSD (optional)	Max. 8 GB
RS 232	
Connector	Spring-cage terminal block
Cabling (see schema next)	2 Wires: TxD, RxD
Protocols	ModBus-RTU 'Slave', 'Master' (supplementary protocol with addons)
RS 485	
Connector	Spring-cage terminal block
Cabling (see schema next)	2 Wires: A, B
Number of slaves	256 (if RS485 technology of slaves allows it too)
Protocols	ModBus-RTU 'Master', 'Slave' (supplementary protocol with addons)
Isolation	No isolation between signals A - B and Power Supply
Termination	Terminations of 120Ω (between A-B at both ends) are in most cases not necessary, but they increase the quality of the signals for long distance connections. <i>Failsafe bias</i> resistors included: pullup and pulldown resistors which assures a logical level TRUE when A and B are opened or in short-circuit.
Ethernet	
Model	100 BASE-TX (4 wires) Full Duplex / Auto-negotiation
Connector	RJ-45
Cabling	Straight pinned CAT5 shielded cable or Crossover CAT5 shielded cable
Speed	10/100 Mbits
Protocols	ModBus/TCP 'Master' and 'Slave', SMTP, FTP, HTTP, Ping, ...
TCP/IP Connections	- "Client" for ModBus Transactions: 1 socket – 1 context - "Client" for Alarm: 2 sockets (required for FTP) – 1 context - "Server" ModBus: 64 sockets – 64 contexts - "Server" HTTP: 64 sockets – 64 contexts
LEDs	100 : ON when connected at 100 MHz – OFF when connected at 10 MHz Lk : ON when linked – FLASH when communicating
USB	
Model	USB 2.0
Connector	USB type A female (socket)
Cabling	USB A/A male cable (host to host)
Speed	High Speed (480Mbits / sec.)
Current	Max 500mA at ambient temperature
Temperature / Altitude	
Storage	-40°C...+85°C
Working	-40°C...+70°C
Hygrometry	0 to 95 % without condensation
Altitude	Maximum 4000 m

Dimensions	
Without connector	Height x Depth x Width: 150x83x29 mm (5.906x3.27x1.142 inches)
With rack, without connector	Height x Depth x Width: 152x115x40 mm (5.984x4.428x1.575 inches)
Weight	300 gr

19.2. Lithium Battery Implementation

TBox LT2 is equipped with a Lithium battery (3 V).

This battery is used to maintain the **clock and datalogging** when the RTU is out of power (neither Vin nor V bat).

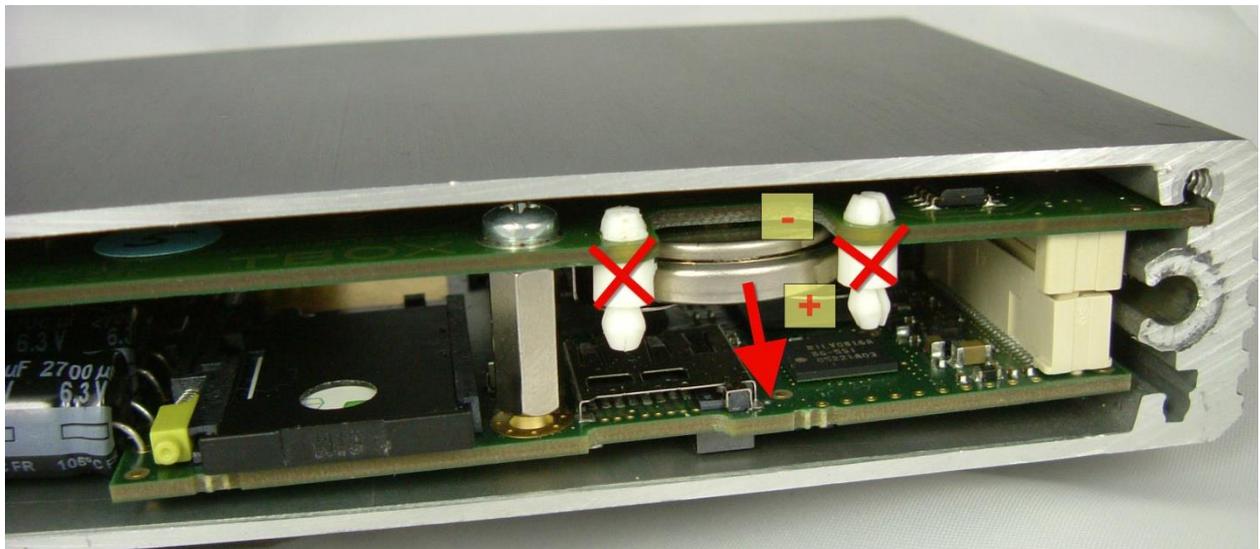
The time the battery has been used can be checked from the analog system variable "BatUsage". It returns the number of seconds the **TBox LT2** has been out of power and the Lithium battery has delivered current to the SRAM.



We advise to consider replacing the battery when the value reaches 63 072 000 seconds (=2 years)

In case the battery must be changed, unscrew **TBox LT2** from its rack to access the back of the PCB. To replace the battery:

1. Cut the 2 plastic spacers
2. Pull out the battery. Be careful not to short-circuit the battery
3. Push the new battery. **CHECK POLARITY** (see picture)



When you receive your **TBox LT2** the battery is placed but not connected.

Be sure to remove the plastic strip before installation.

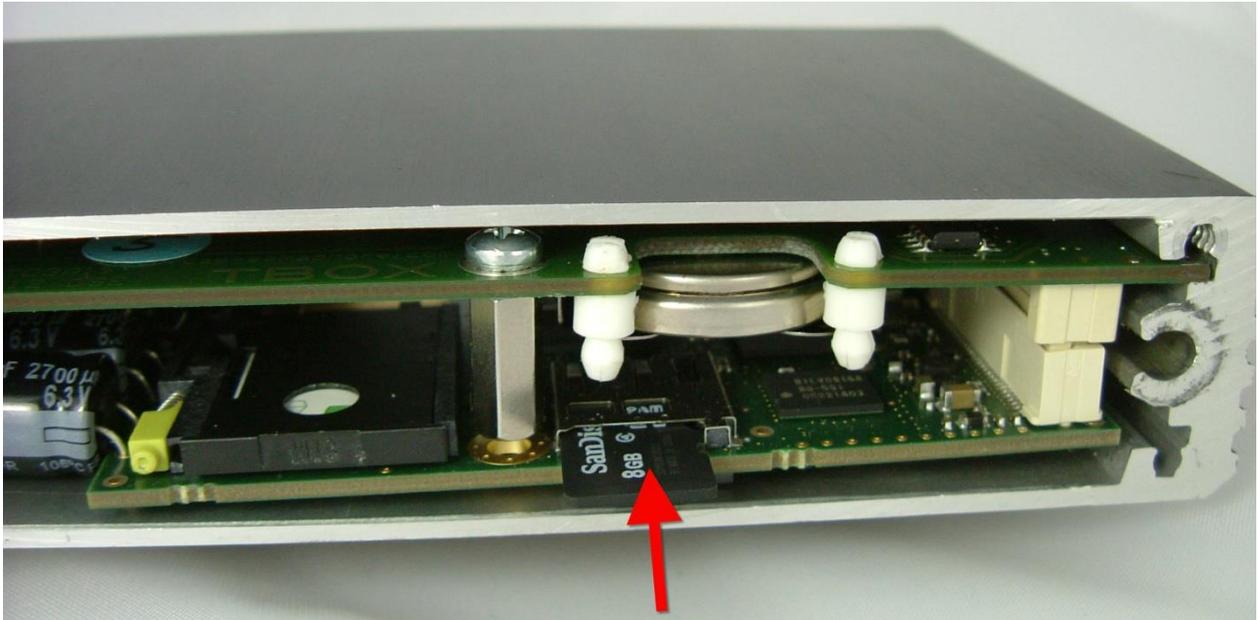
After battery replacement or after having removed the plastic strip, the system variable "BatUsage" should be automatically reset. Check the value = 0.

19.3. Micro SD Card Implementation

The micro SD card is an option of **TBox LT2** that provides several features:

1. To store all files running the **TBox LT2**, including LINUX kernel, Operating System, application, Web and reports, ... This feature is called "Plug&Go" (See Appendix C).
2. To store sampling tables in case large amount of data is required
3. As alarm recipient to store files (report, image, datalogging, ...)
4. To initialize IP settings of ethernet port using the file *system.xml* (see Appendix C).

To insert the micro SD card, unscrew **TBox LT2** from its rack. The micro SD card slot is accessible at the back of the PCB.



19.4. Toggle Switch (Working modes)

On the front side of **TBox LT2**, a toggle switch allows changing the working mode of the CPU: STOP - RUN - RESET



RUN	In middle position: all features of TBox LT2 run
RESET	Temporary switch: pressing Reset, restart the program, erase the alarms and the datalogging, reset the timers
STOP	On left side: Allows stopping the program (see TWinSoft User's guide, Advanced RTU properties, Start/Stop)

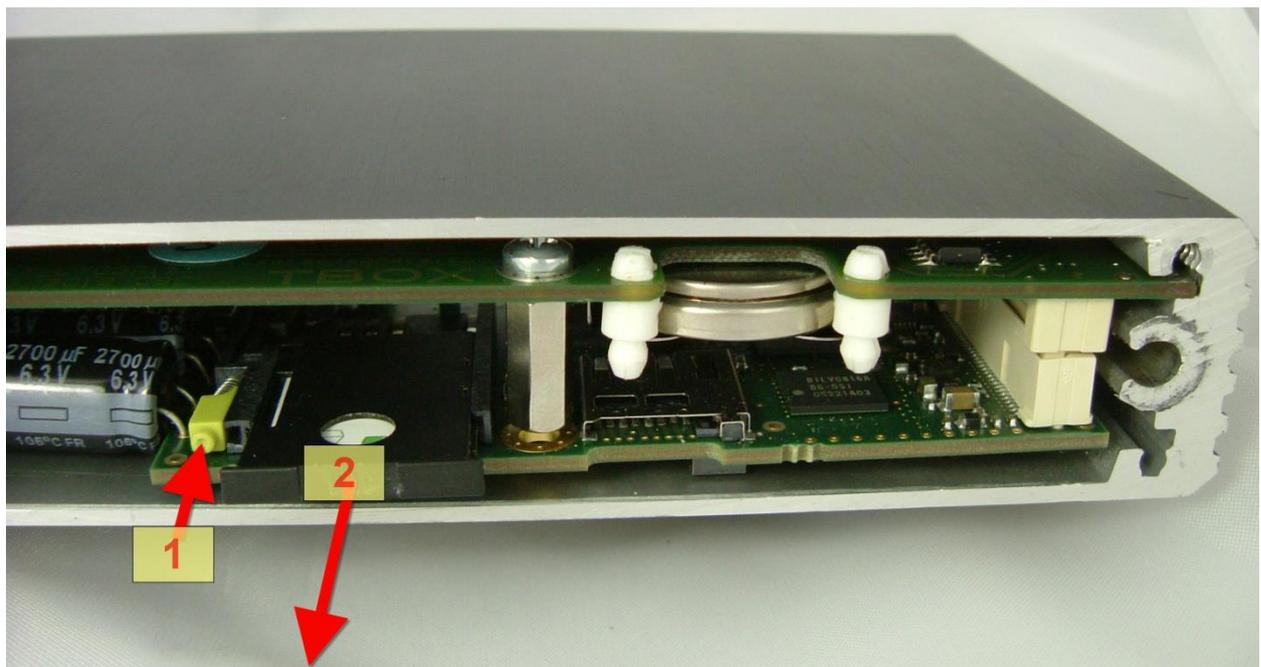
See also chapters 5.6 about **Reset**

19.5. GSM-3G (optional)

LED		
At the front side:		
	ON	Indicates the modem in 'On line' (= connected in DATA or GPRS)
	T/R	Transmit or Received = ON
Modem GSM-3G		
Frequencies	Model "Europe" Model "US"	WCDMA 900/1900/2100 & GSM850, EGSM900, DCS1800, PCS1900 WCDMA 850/1900/2100 & GSM850, EGSM900, DCS1800, PCS1900
GPRS		Multi slot Class 12, SMG 31bis, Class B Terminal, PBCCH support 3 PDP contexts, Coding Schemes CS1 to CS4
EDGE		Multi slot Class 12
UMTS/HSDPA		Class E2, 4 logical channel
HSDPA		Cat 5/6
Emitting power		CLASS 4 (2W) for GSM850 and EGSM900 CLASS 1 (1W) for DCS1800 and PCS1900 CLASS E2 EDGE 900 / 1800 CLASS 3 for UMTS 900/1900/2100
SIM card		1.8 V or 3 V SIM card accepted
Antenna connector		Screw connector, type FME Plug (male on TBoxLT2) See models of antenna below

19.5.1. SIM card insertion

To insert the SD card, unscrew **TBoxLT2** from its rack. The SIM card slot is accessible at the back of the PCB.



1. Press the extractor button
2. Pull the SIM tray

19.5.2. Antennas

There are five models of antenna, all 5 bands (850/900/1800/1900/2100 Mhz):

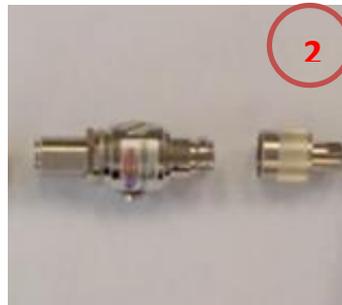
1. The magnetic car antenna - (ref: **ACC-GSM-CARANT**)
2. The right angle antenna - (ref: **ACC-GSM-ANTANGLE**). It should be used for demo purpose only because it may interfere with analog measurement.
3. The industrial antenna "+3 dB" - (ref: **ACC-GSM-ANT**) and the 5 meters cable (ref: **ACC-GSM-EXT5**). Optional arrestor is compatible with this antenna (see next).
4. The flat antenna - (ref: **ACC-GSM-ANT-FLAT**).
5. The "+6dB" antenna - (ref: **ACC-GSM-ANT6**).
Arrestor cannot be used with this antenna (see next).



19.5.3. Antenna Surge Arrestor

Connection to the arrestor:

- 1) Use the N-M>>N-M connector from the arrestor to connect it to the antenna (remove N-M>>FME-M from antenna if mounted).
- 2) Connect N-M>>FME-M adapter supplied with the antenna to the arrestor.
- 3) Connect the antenna cable.



19.6. RS232 (optional)

Communication	
Signals	TxD, RxD, RTS, CTS, GND, DTR, DCD, RI
Connector	RJ45 (see cabling next)
Protocols	ModBus-RTU Master / Slave
LED	
CD	Indicates the modem is 'On line' (after synchronization)
TxD	Data Transmit = ON . Data Receive = OFF

19.7. I/O

Group 1 – Internal I/O

DI:	Power Failure	Digital Input returning a failure of Power at Vin, when TBox LT2 is equipped with an external 12V Backup battery.
AI:	Power Supply Voltage	Voltage at Vin connection
AI:	External 12 V Backup Bat. V.	Voltage at Vbat connection
AI:	Internal Temperature	Temperature inside the TBox LT2
DI:	STOP Button	Input corresponding to the toggle switch in STOP position. To use STOP action, go to the TWinSoft application, RTU properties -> Advanced -> Start/Stop

Group 2 - Digital Inputs

Group 6 - Counter

V+	V+ MUST BE POWERED
External voltage to V+ accepted	With cabling only to DI: 8 → 30 VDC With cabling to DI and DO: 11 → 30 VDC
Voltage at input	
Typical	12 VDC
Maximum for a LOW level	2.0 VDC
Minimum for a HIGH level	7.4 VDC
Maximum	30 VDC
Resistance at input	
Resistance	> 39 kΩ
Sampling	
Minimum period LOW – HIGH	15 msec – 15 msec.
Frequency (software)	At each cycle of BASIC / Ladder
Protection	
RC filter	TBD
Voltage inversion	No protection
Protection EMC	RC
Isolation	
Between inputs	No isolation
To the power supply	No isolation

Counter inputs	
Input channels	DI 0, DI 1, DI 2
Maximum frequency	10 kHz with duty cycle 45 .. 55 %



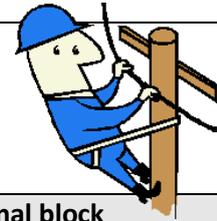
In all cases, V+ MUST be connected to prevent permanent damage; even when using the channels as input.

Group 3 - Digital Outputs	
V+	V+ MUST BE POWERED
External voltage to V+ accepted	11 → 30 VDC
Output	
Type	Current Sourcing
Voltage per output	Maximum: 30 VDC (depending on V+)
Current for 16 outputs at a time	Maximum: 3.2 A, protected by a fuse (SMD)
Current per output	Maximum: 625 mA up to 60°C (with a total for all output of 3.2 A) Maximum: 200 mA between 60°C .. 70°C
Short-Circuit current at 1 output	Typical: 1.4 A Maximum: 1.9 A
Protection	
Protection diode	Protection against inverted voltage when working with inductive load WARNING: when the output is connected to a DC relay driving an AC relay, the AC relay must be protected with a RC circuit
Over load	Maximum: 35 VDC
Short-Circuit + Overload	Thermal protection
Isolation	
Between outputs	No isolation
To the power supply	No isolation

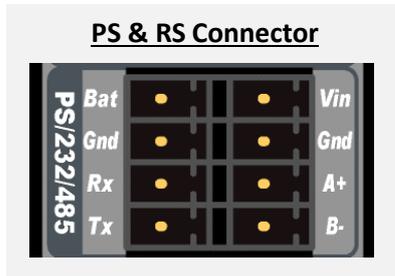
Group 4 - Analog Inputs Group 7 - Validity	
4..20mA	
Resolution	16 bits
Mode	Unipolar
Model	Passive input: sensor must be powered by an ext. power supply
Precision	0.1% full scale @ 25°C 0.2% full scale over the temperature range
Input Impedance	Typical: 249 Ω
DI: Validity input associated to each analog input 4..20mA	Returns '0' when signal < 2.4mA and > 21.6mA Returns '1' when the signal is valid.
0..10V	
Resolution	16 bits
Mode	Unipolar
Model	Passive input: sensor must be powered by an ext. power supply
Precision	0.1% full scale @ 25°C 0.2% full scale over the temperature range
Input Impedance	Typical: 60 kΩ
Pt1000	
Mode	2 wires
Resolution	16 bits
Range	Typical: -40°C .. +85°C
Precision	± 0.5 °C
Protection	
4..20mA	Max : 28 mA /7 V
0..10V	Max : 13.6V w/o influence on other AI. Absolute Max : 30 VDC
Pt1000	Max input voltage : 10 V
Isolation	
Between inputs	No isolation
To the power supply	No isolation

Group 5 - Analog Outputs	
4..20mA	
Resolution	16 bits
Mode	Unipolar
Model	Active output
Precision	0.1% full scale @ 25°C 0.2% full scale over the temperature range
Voltage at Output	Input power supply (Vin or Vbat) - 5 V
Current at Output	Maximum: 22mA
Outside Impedance limit	$\leq \frac{V_{in} - 5V}{22mA}$
Protection	
	Short-circuit protection
Isolation	
Between outputs	No isolation
To the power supply	No isolation

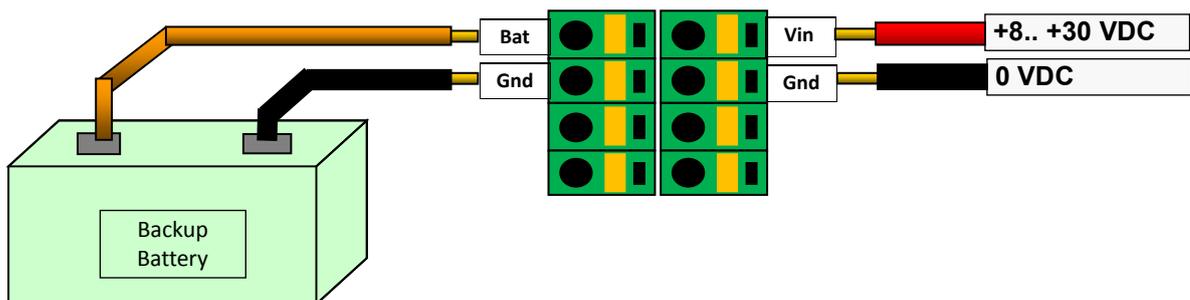
20. Cabling



20.1. Power Supply



Connector: **Spring Cage Terminal block**
(see chapter 3.4)



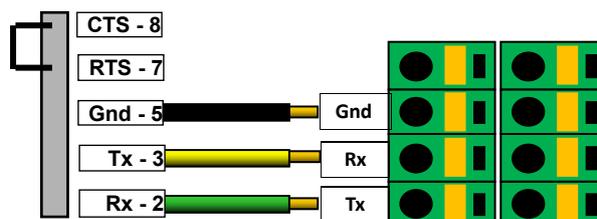
A power supply of **minimum 20 VDC** is required to charge the **external 12 V backup battery**.
When the voltage at Vin disappears, the 12 V backup battery powers *TBox LT2* down to 10 V.
Below 10 V, the external backup battery is automatically disconnected and *TBox LT2* will restart when applying voltage at Vin.

The Gnd connection should be used only for power supply. **DON'T USE IT TO CABLE Analog Inputs** (see Appendix H)

20.2. RS232 (standard)

Connector: **Spring Cage Terminal block**
(see chapter 3.4)

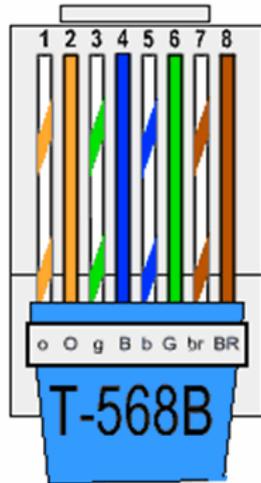
DB9 Female to PC



As an alternative, you can use a standard serial cable, cut one of the ends and cable directly to the *TBox LT2* connector.

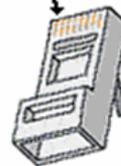
20.3. RS232 (optional)

Description: communication RS232	Connector: RJ 45	Pinout:
--	----------------------------	---------



RJ-45 Plug

Pin 1



Clip is pointed away from you.

1. RI white/orange
2. DCD orange
3. DTR white/green
4. Gnd blue
5. RxD (input) white/blue
6. TxD (output) green
7. CTS (input) white/brown
8. RTS (output) brown

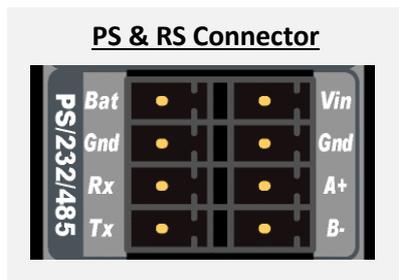
Exemple of CAT cabling

Cabling

RJ 45	DB-9 to the PC	Description
2	1	DCD (Data Carrier Detect)
6	2	RxD (Receive Data)
5	3	TxD (Transmit Data)
3	4	DTR (Data Terminal Ready)
4	5	GND (Ground)
	6	DSR (Data Set Ready)
8	7	RTS (Request To Send)
7	8	CTS (Clear To Send)
1	9	RI (Ring indicator)

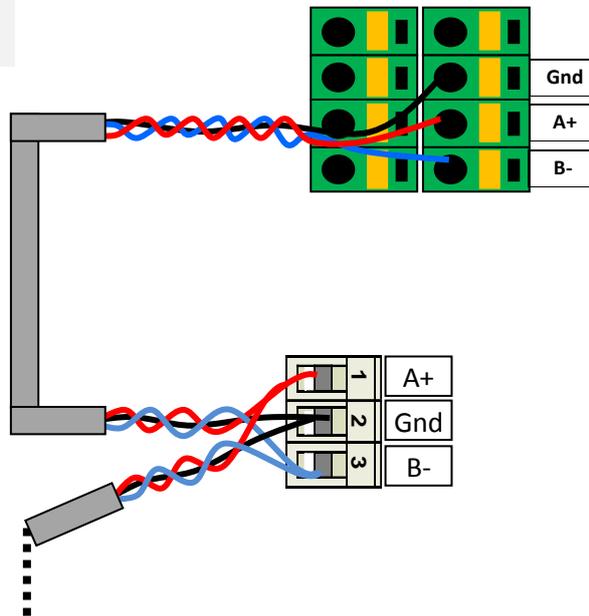
Reference of cable RJ45 to DB9 = ACC-CABL-PROG45

20.4. RS485



Connector: **Spring Cage Terminal block**
(see Appendix H)

Example:
Cabling **TBox LT2**
to **TBox MS16**



About RS485 cabling:

Use a **twisted pair** for signal A and B.

RS 485 is not isolated. If cabling equipment in different buildings (different Earth), you have to use ACC-RS485 (ask your local distributor)

Maximum length depends on quality of cable, speed and quantity of stations (max. 256 x **TBox** stations). In good condition, guaranteed to 1.2 km (max. 256 x **TBox** stations @ 9600 Bps) In practice, longer distance can be reached with lower Baudrate and fewer stations.

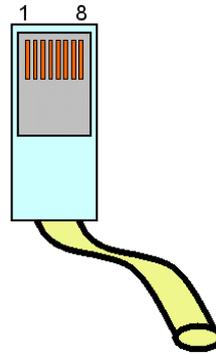


Cable:

- Twisted pair (2 pairs: one pair for A and B; one pair for Gnd)
- cross-section: minimum 0.5mm²
- screening: pair and global screening
- reference: Li2YCY-PiMF

20.5. Ethernet

Description: Ethernet communication	Connector: RJ 45	Pin out:
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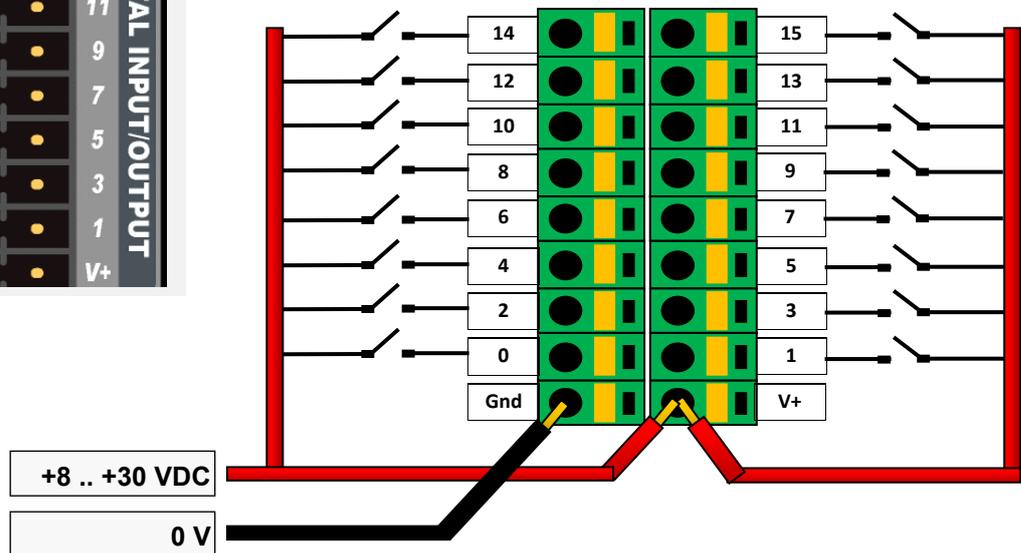
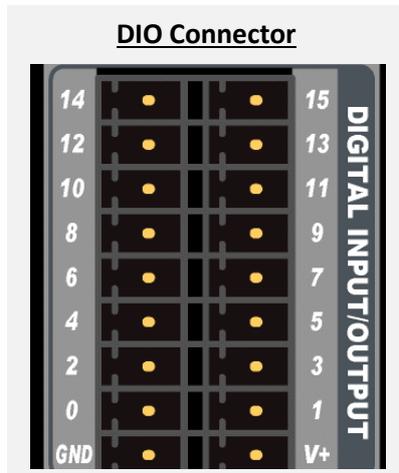
1. Tx+
2. Tx-
3. Rx+
4. not used
5. not used
6. Rx-
7. not used
8. not used

One can use **straight** or **cross-over cable**. It must be a **Shielded SFPT** cable.

It connects to a hub, a switch, a router or directly to a PC.

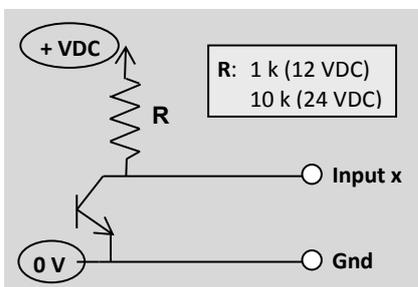
20.6. Digital Inputs - Counter inputs

Connector: **Spring Cage Terminal block**
(see Appendix H)



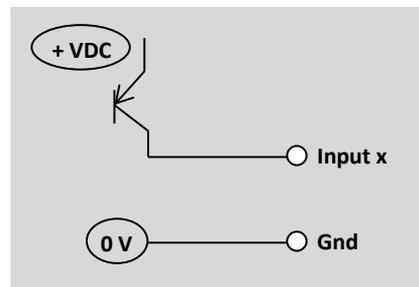
DO NOT MANIPULATE CONNECTORS UNDER VOLTAGE.
V+ **MUST** be connected to prevent permanent damage.

Cabling to NPN transistor



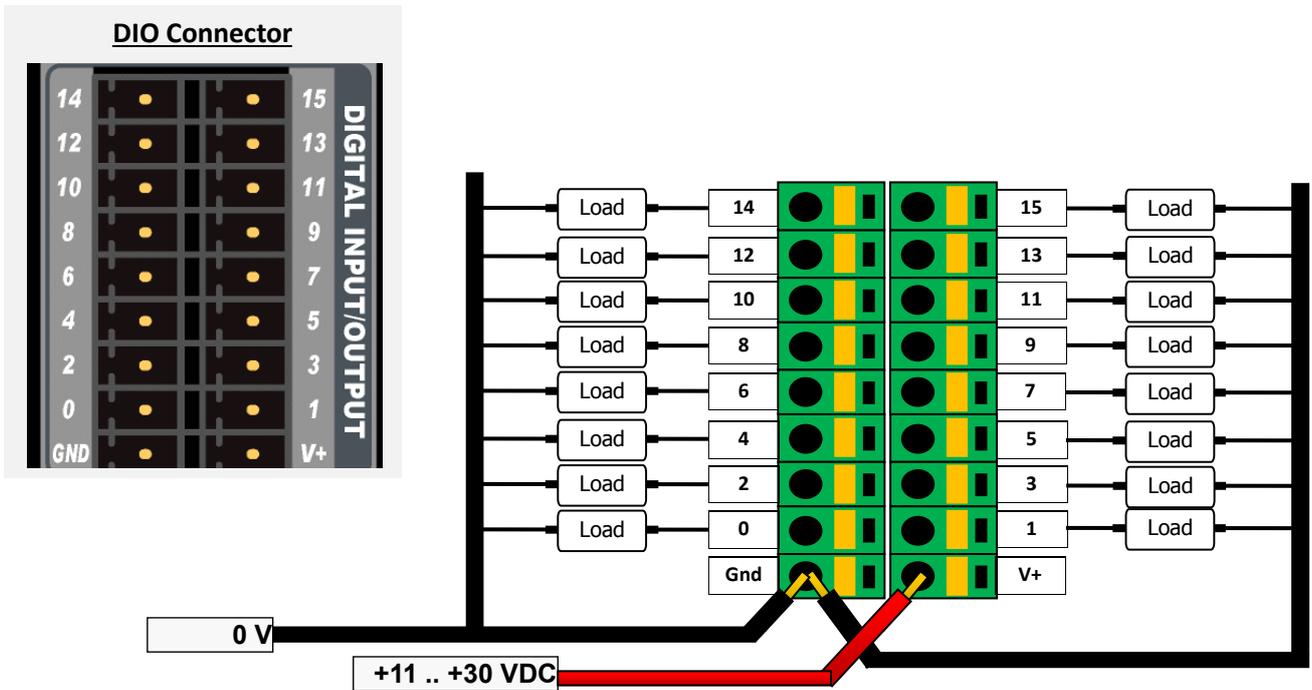
Inverted logic: output=1 → input=0

Cabling to PNP transistor (or OPTO)



20.7. Digital Outputs

Connector: **Spring Cage Terminal block**
(see Appendix H)



20.8. Analog Inputs – Current/Voltage

Connector: **Spring Cage Terminal block**
(see Appendix H)

Analog Input Connector



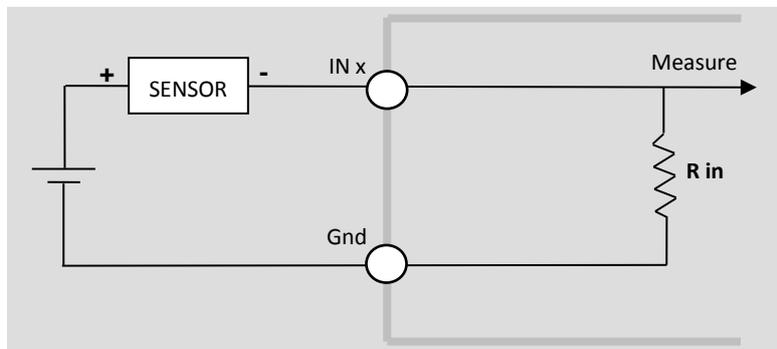
Analog Input Pinout

In 6 (+)	6			7	In 7 (+)
In 4 (+)	4			5	In 5 (+)
In 2 (+)	2			3	In 3 (+)
In 0 (+)	0			1	In 1 (+)
Inputs (-)	Gnd			Gnd	Inputs (-)

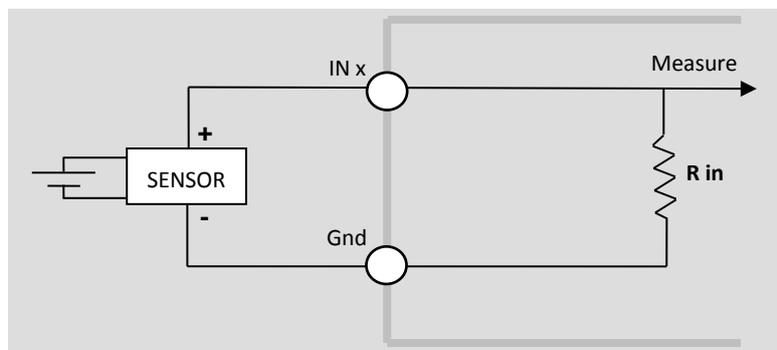


Read important information about **precautions in cabling** in Appendix H

Cabling to 2-wire sensor



Cabling to 4-wire sensor



Pin out - 'Current' inputs

Models	Quantity of AI	Input index (see front panel)
LT2-530-x	8 inputs: each input 4..20mA or 0..10V	Inputs 0, 1, 2, 3, 4, 5, 6, 7
LT2-532-x	8 inputs: each input 4..20mA or 0..10V	Inputs 0, 1, 2, 3, 4, 5, 6, 7
LT2-540-x	6 inputs: each input 4..20mA or 0..10V	Inputs 0, 1, 2, 3, 4, 5
LT2-542-x	6 inputs: each input 4..20mA or 0..10V	Inputs 0, 1, 2, 3, 4, 5

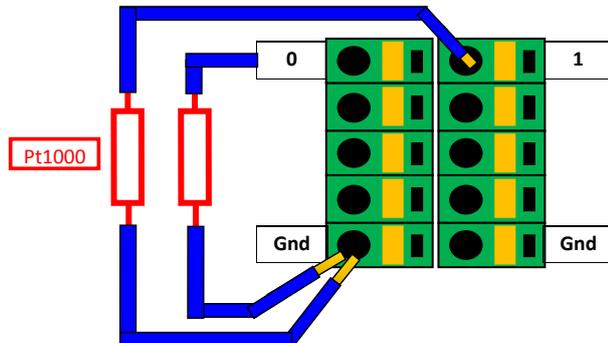
20.9. Analog Inputs – Temperature (Pt 1000)

Connector: **Spring Cage Terminal block**
(see Appendix H)

Analog Input Connector



Pt1000 Inputs Pinout



Read important information about **precautions in cabling** in Appendix H

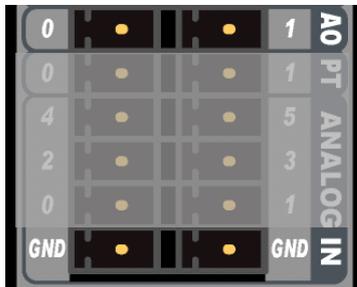
Pin out - 'Temperature' input

Models	Quantity of Pt1000 inputs	Input index (see front panel)
LT2-530-x	-	-
LT2-532-x	-	-
LT2-540-x	2 x Pt 1000	0, 1
LT2-542-x	2 x Pt 1000	0, 1

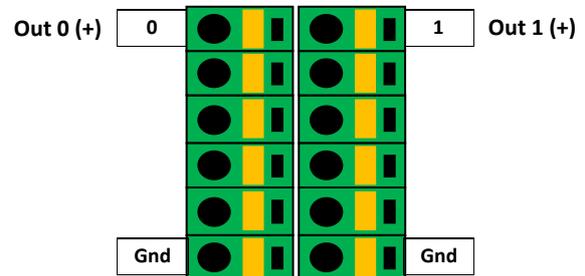
20.10. Analog outputs – Current

Connector: **Spring Cage Terminal block**
(see Appendix H)

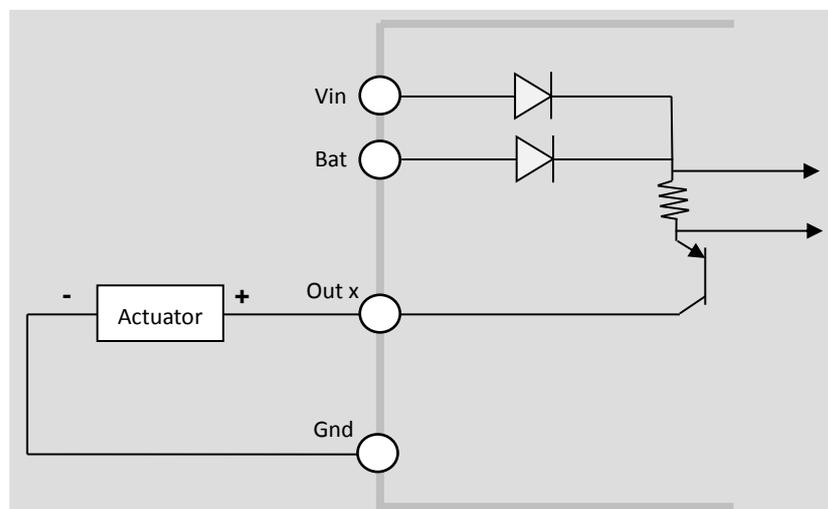
Analog Output Connector



Analog Outputs Pinout



Cabling to an actuator



APPENDIXES

Appendix A. Licenses



TWinSoft software itself is not protected and can be installed freely on any PC to develop TWinSoft document (online or offline) and to monitor **TBox LT2**.

The only operation protected is the sending of an application to **TBox LT2**.

In order to find the best way for you we offer different possibilities:

A.1. The Evaluation mode

You don't have any license. You are able to develop a complete **TBox LT2** project without any restriction, but when you send the application to **TBox LT2**, it will stop after 2 hours. This is a good solution for testing programs or creating a demo.

A.2. The Dongle

It is a hardware license. A dongle is placed **on your PC**. The dongle consists in a **USB key**. TWinSoft regularly checks the presence of the dongle. It allows you to send applications to as many **TBox LT2** as you want, with any PC.

You need to install a driver to run the dongle. It is available in our website:
<http://helpdesk.servelec-technologies.com> -> Download ->TBox -> Utilities

A.3. The Code (License)

Available from the menu 'Help' → 'License Register.'

Using information of the PC (the Company name, the User name, a Serial Number), you receive a code that you enter in the field "License". Once entered, you can send any application as if you had a dongle (see previous).

The only restriction is that it must **always be on the same PC**.

If you wish to use another PC, you have the possibility to remove registration on the first PC and register back on the second.

A.4. The TWinSoft LITE

Available from the menu 'Help' → 'TWinSoft Lite configuration.'

This protection mode is ideal for users having one or two **TBox LT2** units. The dongle or a license might be too expensive.

TWinSoft LITE code is linked to one and only one **TBox LT2**; it allows you sending an application to the **TBox LT2** for which you have the code.

This license can be introduced in as many PCs as you want.

Appendix B. Time in RTU

One of the biggest issues in Telemetry and data logging equipment is the handling of time. In order to have a universal solution wherever **TBox LT2** is used, TWinSoft, OS of the RTU and software's collecting data, share the same mechanism of time management.

Time in the RTU is based on UTC time.

B.1. Time in TBox LITE

The RTC (Real Time Clock)

TBox LT2 is equipped with a RTC chip (Real Time Clock). The RTC is used to manage timestamps internally.

Functions of the RTC:

- it is a calendar Y2000 compatible.
- it updates the UTC time (see next).
- it communicates with OS to handle the UTC time, used for data logging.

The RTC time is used at start-up of **TBox LT2** to update the UTC.

UTC Time

UTC time is based on the number of seconds since 1/1/1970 at Greenwich latitude. It is used as internal timestamp to each event (alarm, chronology, ...)

UTC time is converted into Analog System Variables to give access to time information: second, minute, hour, day, month, year, week.

Changing UTC time automatically updates the RTC.

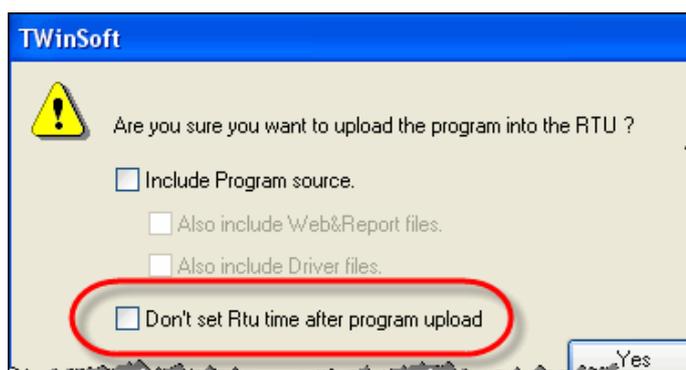
When time information needs to be sent (in a report, as header of an e-mail, in the Analog System Variable), it is always computed from UTC time to a local time according to TBox configuration Time Zone and Daylight Saving option as specified in the "General" RTU properties.

TBox LITE Time setting

In order to set **TBox LT2** to PC time, an option is available in the menu "Communication" from the main menu bar; option available when connected (locally or remotely) to the RTU.

When sending an application to **TBox LT2**, TWinSoft updates automatically the RTU time to the PC time.

This feature can be deactivated from the "Send application" menu.



RTU time can be checked anytime doing a RTU Identification, from the main menu -> "Communication"

Day Light Saving (Winter/Summer time)

When installed in regions using daylight saving, **TBox LT2** handles the changing automatically. It means that **RTC** and **Analog System Variable [hour]** are automatically updated when the time changes.

Standard changing date and time in Europe:

- last Sunday of October: 3:00 → 2:00
- last Sunday of March: 2:00 → 3:00

B.2. Data logging

Chronologies

In chronologies, timestamp is recorded for each log of data. The timestamp recorded is the UTC time. When generating data, **TBox LT2** converts UTC timestamps into local timestamps according to its Time Zone.

When retrieving data from a PC, the latter reads UTC timestamps and converts them according to the local time of the PC, depending on the time settings of the PC.

When a daylight saving change occurs, **TBox LT2** is informed and automatically adapts all coming timestamps to the new time.

Sampling tables

In sampling tables, **TBox LT2** records the timestamp of the last record only. The previous timestamps are built up when retrieving the data, based on the last timestamp and the period of recording. Conversion into local time is done as above with chronologies.

A choice had to be made concerning periods > 1 hour: either having always the same period of recording or having always the same "hour" of recording. The latter case has been chosen. When daylight saving change occurs, the target time is automatically updated for sampling tables having a period > 1 hour.

Example:

If recording a value once a day at 6.00 in the morning, the recording will always happen at 6.00, but when changing from winter to summer (in Europe), the sampling period will be 23 hours and when changing from summer to winter the period will be 25 hours.

Periodic events

When a periodic event is defined with a period > 1 hour, its target time is automatically adjusted when a changing winter/summer happens.

B.3. System variables associated

Some System Variables of **TBox LT2** are associated to the Time. They can be used in BASIC/Ladder programming to execute specific operations:

Type	Variable	Comment
Analog	Second, Minutes, ...	6 Registers giving the time in hour, minute, second, day, month and year .
Analog	UtcTim	Time in UTC format (number of seconds since 1/1/1970 at Greenwich latitude)
Analog	ZonBia	Time difference in seconds between local time and UTC time
Analog	ZonID	ID of the zone where RTU is installed. It uses regional settings of the PC

B.4. Summary

Summary of time handling in the different cases:

1. System variables in the RTU	They display the local time where the RTU is installed, according to the Regional settings declared in the "General" RTU properties
2. Identification from TWinSoft	The UTC time is computed according to Regional settings of the PC
3. List of alarms in a report	The time is computed according to RTU local time (see 1. above)
4. List of alarms in TWinSoft	See point 2. above
5. Object 'Time' in WebForm 1	See point 2. above
6. System variables in WebForm 1	Displays the value of the variables, as explained point 1. above

Appendix C. Plug & Go

Plug & Go allows storing the complete TWinSoft project into the micro SD card of **TBox LT2**.

When required, micro SD card must be inserted at the back **TBox LT2** (see chapter 19.3).

Micro SD of max. 8 GBytes, formatted in FAT32.

As TWinSoft project, we mean **all files**, including TWinSoft compiled document with Web and Report files, OS and even LINUX kernel; all ready to run in the RTU.

There are 4 ways *Plug & Go* can be used:

1. TWinSoft sends a project to TBox LT2.

When TWinSoft sends a program to the RTU, **all the files are sent and stored in the micro SD card**. This corresponds to a complete backup of the project on the SD card.

The advantage is that if you have **to replace a CPU**, you don't need to send the program; you insert the MMC in the new CPU and it will start with its program.

2. You insert an empty micro SD card in TBox LT2.

The running application of **TBox LT2 is not copied** to the micro SD card. Only when TWinSoft sends an application to **TBox LT2** it will be copied into the SD card (see above).

3. You insert a micro SD card including a project in a CPU.

In case of differences between the content of the micro SD card and memory of **TBox LT2, SD card has always priority**.

Both programs are compared (dates are compared). When dates of creation of the program are different, the project (including Webform, reports, OS, LINUX, ...) is copied from the SD card to the CPU. It may up to 1 minute. **DO NO RESET The CPU !**

During the loading the LED "Run" flash at ½ Hz, indicating the program is stopped.

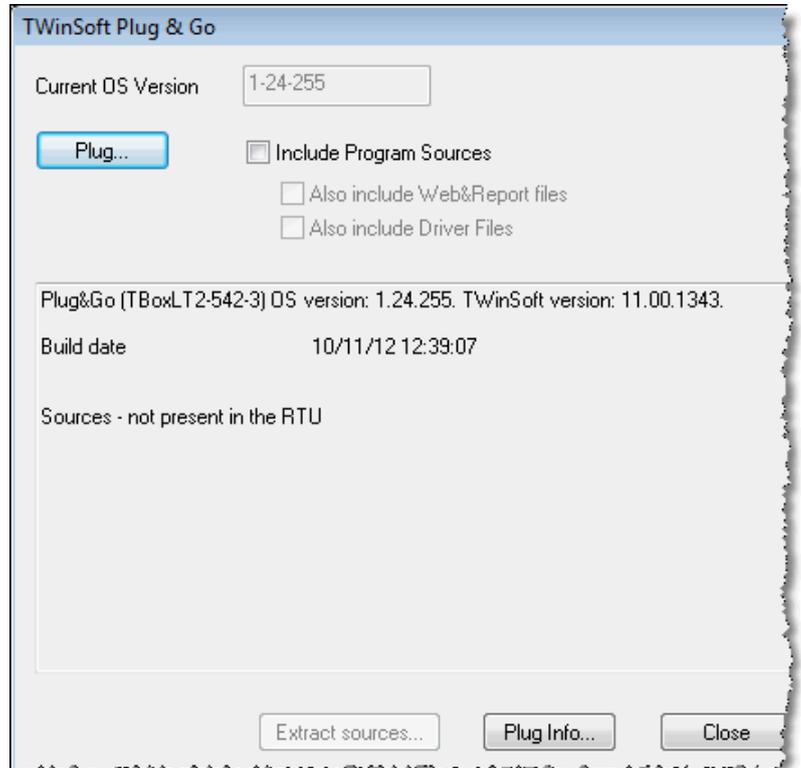
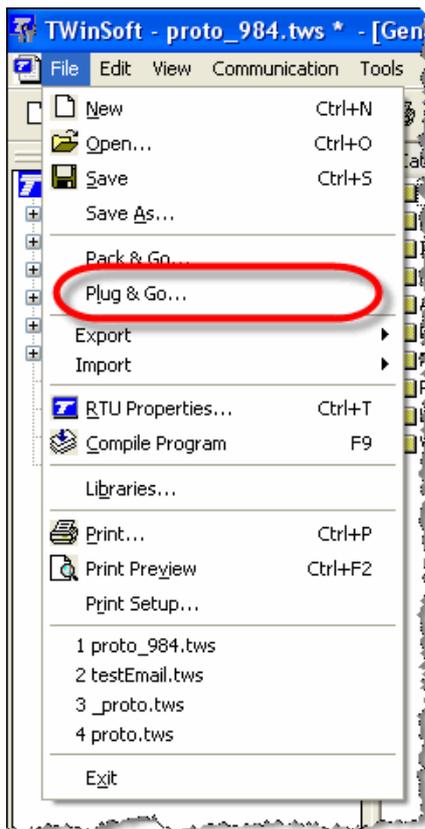
4. You program the micro SD card directly from TWinSoft.

A menu in TWinSoft allows storing the project to the SD card.

From the main menu "File" -> *Plug & Go* menu, TWinSoft compiles the complete project into a directory called **repository**. You then copy this directory to the SD card using a Card Reader on your PC.

The advantage is that you don't need TWinSoft to program the RTU. You can distribute the SD card to the field technicians.

Menu of TWinSoft:



Plug...: Click this button to create the Plug & Go directory **repository**. The name is unique. It means if you want to create Plug & Go files for several RTU's, you have to save each file in separate directories.

Once the Project is compressed, the window displays File Info (see example above)

Plug Info...: Click this button and select the parent directory of **repository** directory to display its Info

Extract sources...: once a repository has been selected (see Plug Info... above), allows extracting its content

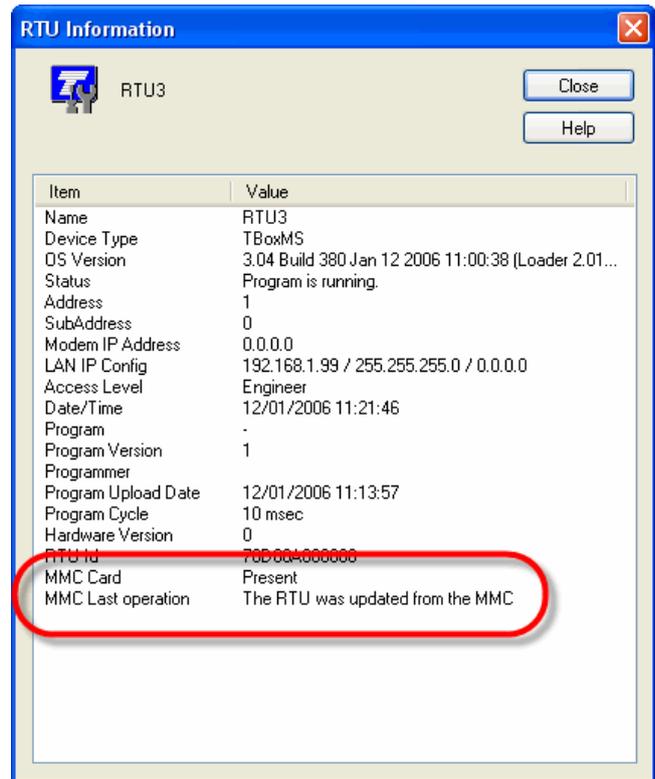
System variable

A digital system variable indicates the presence of micro SD card:

29	MmcToRTU	-	<p>MMC: indicates whether the program has been loaded from the SD card: 1 = the program of SD card is different from the one of the RTU and has been loaded from SD card 0 = there is no SD card; the SD card is empty; the program of the SD card is identical to the one of the RTU</p>
----	----------	---	--

RTU identification

Data relative to MMC is available in RTU identification window:



Item	Value
Name	RTU3
Device Type	TBoxMS
OS Version	3.04 Build 380 Jan 12 2006 11:00:38 (Loader 2.01...
Status	Program is running.
Address	1
SubAddress	0
Modem IP Address	0.0.0.0
LAN IP Config	192.168.1.99 / 255.255.255.0 / 0.0.0.0
Access Level	Engineer
Date/Time	12/01/2006 11:21:46
Program	-
Program Version	1
Programmer	
Program Upload Date	12/01/2006 11:13:57
Program Cycle	10 msec
Hardware Version	0
RTU ID	70B004000000
MMC Card	Present
MMC Last operation	The RTU was updated from the MMC

C1. File System.xml

IP address initialization is carried out using a file called 'System.xml', placed in the root of the SD Card.



When an IP configuration is defined in *System.xml*, **it has priority** on the one declared for the Ethernet ports of the CPU as well as in a possible 'Plug&Go' file.

Example of System.xml

```
<?xml version="1.0"?>
<System>
  <ComPort>
    <PortName>COM3</PortName>
    <IPconfig>
      <IP>192.168.1.75</IP>
      <Subnet>255.255.255.0</Subnet>
      <Gateway>192.168.1.1</Gateway>
      <PrimaryDNS>192.168.1.1</PrimaryDNS>
    </IPconfig>
  </ComPort>
</System>
```

<PortName>	Communication port of TBox LT2 (COM3 = Ethernet)
<IP>	IP address of the port selected
<Subnet>	IP address of the Subnet mask of the port selected
<Gateway>	IP address of the equipment used as Gateway on the Network
<PrimaryDNS>	IP address of the DNS Server (only primary DNS is handled)

Appendix D. Pack & Go

D.1. Presentation

Pack & Go is a tool that builds up one file with your complete project, including TWinSoft document, WebForms, Reports, OS,...

The goal is to **backup** or to **transfer** a complete project without missing files or to update an RTU with the complete project without requiring advanced knowledge of TWinSoft.

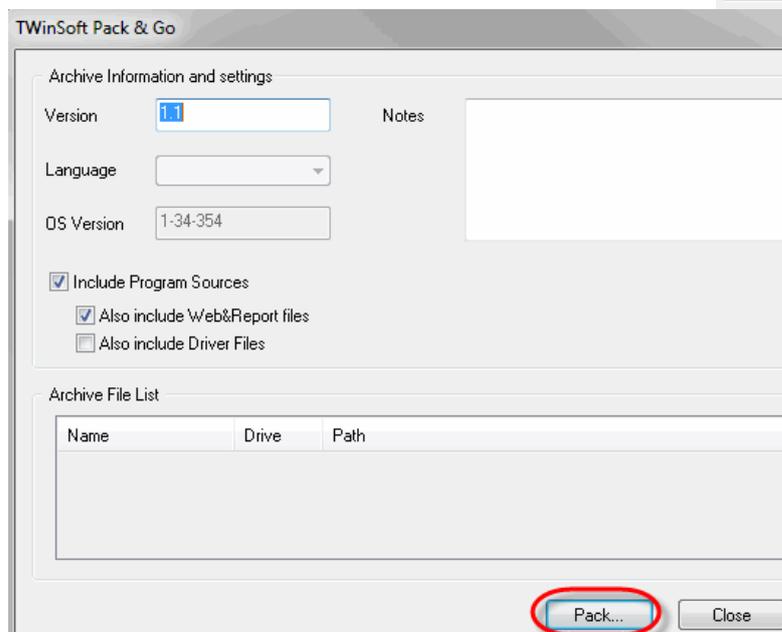
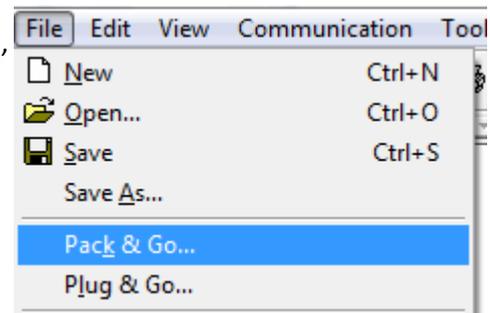
All files are compressed and packed into one file with the extension **.tpg** (TWinSoft Pack & Go). Once a project is packed, it can be unpacked and/or updated to the RTU from a double click on the **.tpg** file.

TWinSoft **needs to be installed** on the machine used to update the RTU with .tpg file, but the **TWinSoft license is not required**.

A license is required to pack (see appendix A.).

D.2. Pack

To access Pack & Go menu, select from the main menu 'File'
→ 'Pack & Go...'

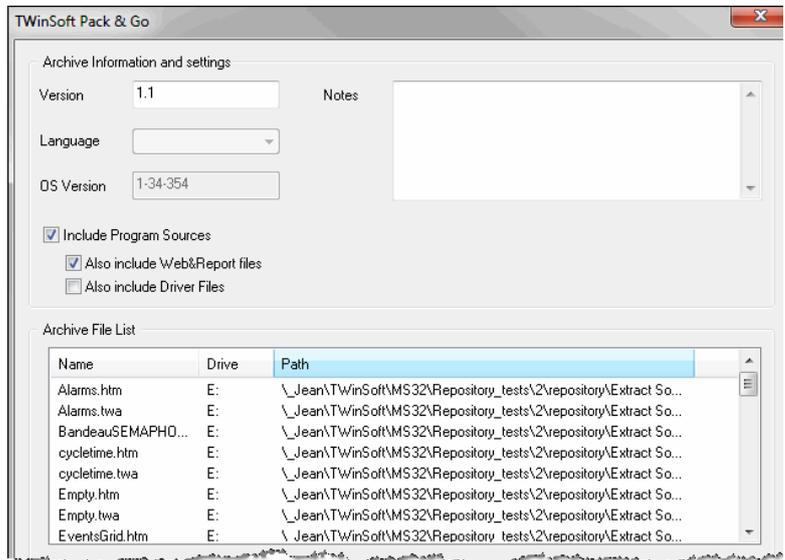


Select the button **Pack ...**



IF YOU ARE OFF LINE while compiling, TWinSoft uses the OS indicated as 'Off line OS' in the 'General RTU properties'. This OS, and only this OS, will be sent to the RTU.

All Files of the project, TwinSoft document, WebForm, html pages, OS, ... are packed in one file, with the extension **.tpg**



 Check the user running the .tpg file runs a version of TWinSoft equal or higher than the one used to pack the files.

D.3. Unpack

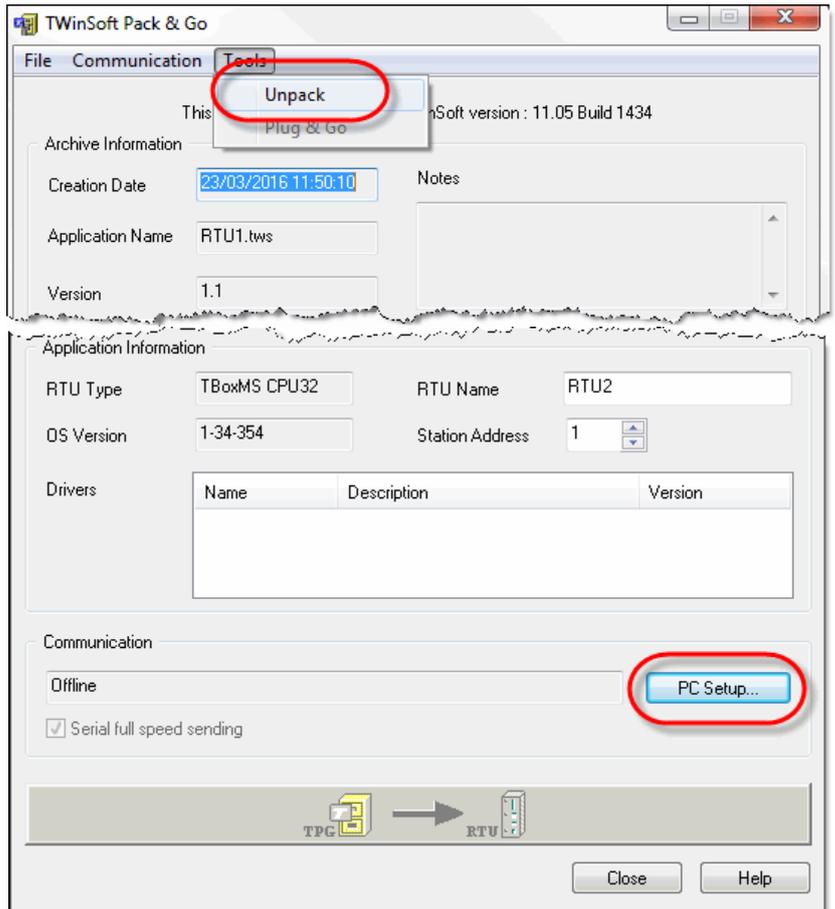
To open the Unpack window, double click a file with the extension **.tpg**.

Unpack menu offers 2 features:

1. Restore a project

Extract a project into a directory of your PC. This option is very convenient for backing up a project being sure you don't miss any file.

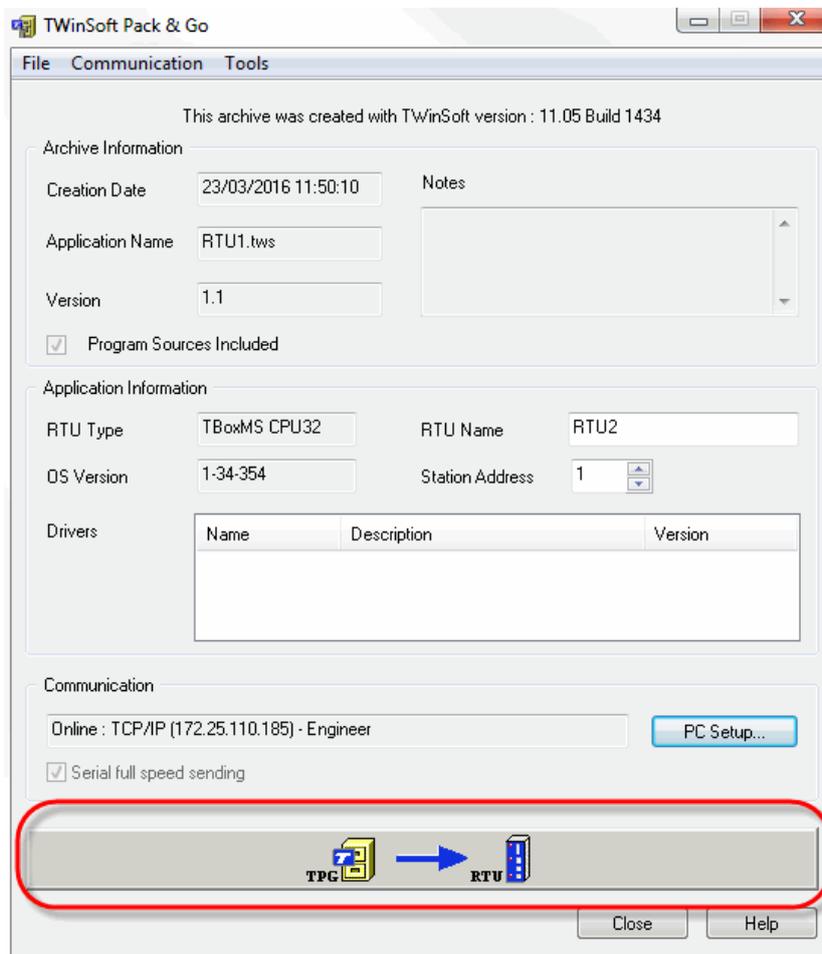
Option available from the main menu: 'Tools' → Unpack.



2. Update an RTU

Update an RTU with a complete project, including the application, OS, WebForms, report, ...from a unique file.

The button 'PC Setup...' gives you access to the configuration of the PC, to communicate with the RTU.



The button 'Update RTU' sends the project and OS to the RTU.



STOP If packed OS is different from OS in the RTU, Pack & Go updates the RTU with the OS.

Languages supported are English, French and German.

It can be selected from "Unpack" menu but changed from TWInSoft main menu: "Tools" → "Language".

Appendix E. ModBus Rerouting

E.1. Presentation

One of the nice communication features offered by **TBox LT2** is the ability to act as a **ModBus router**. That means that you can use a **TBox LT2** to make a connection between 2 x ModBus devices that are not on the same communication channel.

Routing can then be used to access a ModBus device through a **TBox LT2**.

ModBus Protocols

This feature creates a route between communication ports configured in ModBus protocol(s):

- ModBus-RTU <--> ModBus-RTU
- ModBus-RTU <--> ModBus/TCP



Concerning TCP/IP protocols, other redirections are possible using **IP forwarding**, **NAT** and **Virtual Server** (see Appendix F.).

Routing 2 communication ports in ModBus/TCP, is called **IP forwarding** (see next chapter).

Communication principle

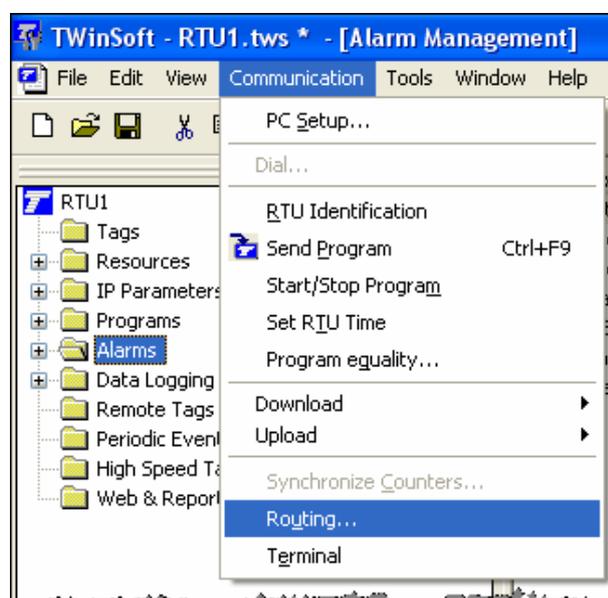
The idea is that **TBox LT2** receiving frames, analyzes the Station address: if it is for its own use, it keeps the frames; otherwise they are pushed to the “routed” communication port.

E.2. Routing using TWinSoft

ModBus rerouting allows associating two ‘ModBus-RTU’ communication ports, in order to access a remote RTU **with TWinSoft** from your computer by rerouting through a ‘Master’ RTU.

The typical application is dialing an RTU to access a remote RTU connected to the RS485 network.

You access routing from the main menu of TWinSoft : Communication → Routing

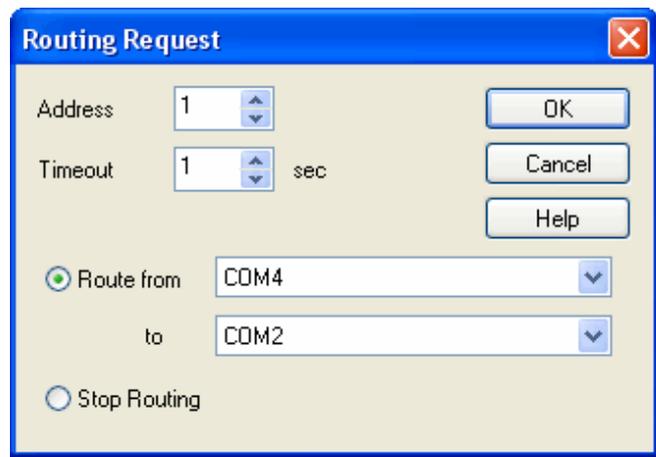


Address : Address of the RTU you are physically connected (the 'Master')

Timeout : Rx timeout used to communicate with the Remote device

Route from : incoming communication port (the port of the 'Master' TWinSoft is connected to)

to : outgoing communication port (the port of the 'Master' connected to the remote device)



The screenshot shows a 'Routing Request' dialog box with the following settings: Address: 1, Timeout: 1 sec, Route from: COM4, to: COM2. The 'Route from' radio button is selected, and the 'Stop Routing' radio button is unselected. Buttons for OK, Cancel, and Help are visible on the right side.

Sequence to access a Remote **TBox** in rerouting:

1. Open in TWinSoft the document corresponding to the "Master" (**TBox LT2**)
2. Fill in the Routing request menu as explained above.
3. Open in TWinSoft the document corresponding to the "Remote" RTU (if you were using modem communication, you will have to redial the "Master").

You are in communication with the Remote **TBox**.



This sequence is only possible when Master and Remote are of the **same model of RTU**. If not, you have to pre-configure the Analog system variable (see next chapter)

Analog System variable 'Rerout'

An **analog system variable 'Rerout'** can also be used in your Ladder/BASIC logic to force a rerouting. This 16 bits variable represents 16 communication ports, with the **lsb** corresponding to COM1.

Example: A rerouting between COM4(...001000) and COM2 (...000010) corresponds to the decimal value =10 (...001010)



Rerouting is only possible with local communication ports configured in ModBus

Sending a program using Rerouting

For instance, you can send a program by dialing a "Master", and accessing "Slaves" on RS485 network.



Doing a 'local' rerouting, for instance from a RS232 port to a RS485, we recommend to use the same Baudrate **all ports**.

If you have 'ModBus Transactions' running between 'Master' and 'Slave', we recommend stopping them during rerouting, to avoid communication errors.

E.3. Possibilities of Routing

The table below shows all possible connections between 2 ports:

IN: port in which requests are coming

OUT: ports to which requests have to be sent if it does not concern the "local" RTU (different ModBus address).

	OUT	RS232	RS485	GSM (CSD)	GPRS/3G	Ethernet
IN						
RS232		-	Routing	Routing (*)	Not avail.	Not avail.
RS485		Routing	-	Routing (*)	Not avail.	Not avail.
GSM (CSD)		Routing	Routing	-	Not avail.	Not avail.
GPRS/3G		Routing	Routing	Routing (*)	-	IP Forward (*)
Ethernet		Routing	Routing	Routing (*)	IP Forward (*)	-

(*) : increase Time out (see above) to at least 2 seconds, and with GPRS/3G at least 10 seconds.

Appendix F. IP forwarding, NAT, Virtual Server

IP forwarding, NAT and Virtual Server allows **redirecting IP requests**:

- IP modem connection (for instance incoming connection from **TConnect**)
- Ethernet ports

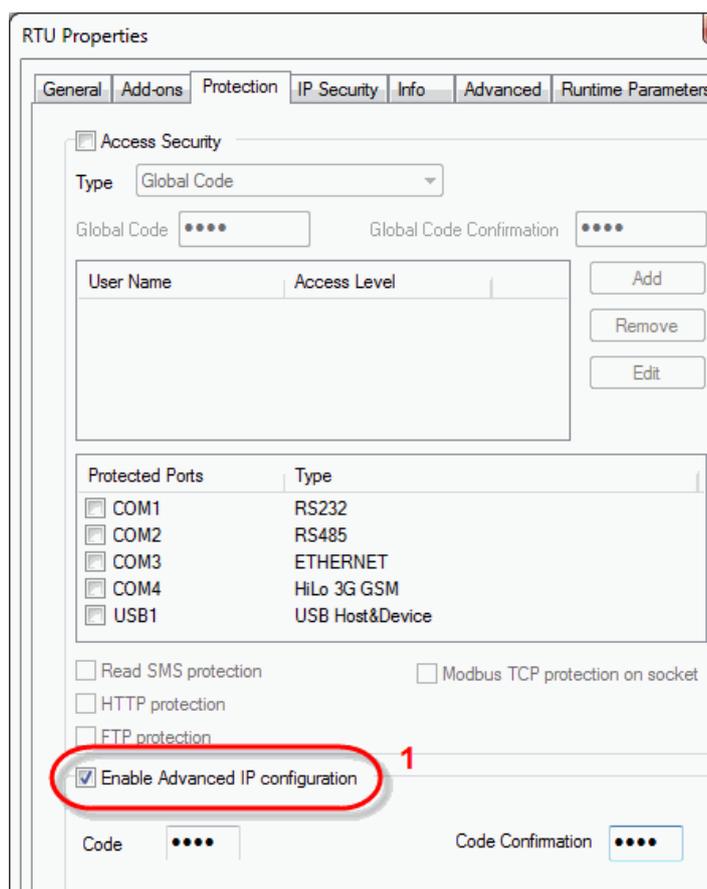
The typical use is a remote access to an **IP camera** connected to the Ethernet port of the RTU: you dial the RTU with **TConnect** and display a HTML page containing a link to the IP address of the camera.

This redirection feature requires **enabling Advanced IP Configuration**. As a matter of fact, if an Ethernet port of the RTU is connected to a LAN, and the IP forwarding is activated, anyone can access the LAN from a modem connection!

We provide several security levels, to enable these features:

1. From RTU properties, 'Protection' tab, the general access security of the document must be activated with a HEXADECIMAL code of 4 characters

To generate login and password corresponding to the code you have to use « Password generator » (see chapter 17.3).



To improve protection, we advise against using the same codes for Global code and Advanced IP configuration

2. From 'RTU properties' -> 'Advanced' -> 'TCP/IP' you can activate the required service.

Quand vous cliquez OK vous devez entrer le nom et mot de passe correspond au code choisi ci-dessus à l'étape 1.

The screenshot shows the 'RTU Properties' dialog box with the 'Advanced' tab selected. The 'Advanced Parameters' section contains a warning: 'This page contains advanced parameters. Extreme care should be taken when changing these parameters. If you feel unsure about the change the 'Default' button to restore the default parameter values.' Below this is a grid of sub-tabs: Compatibility, Read SMS/POP3, Plug And Go, Security, Start/Stop, Power Fail, Alarms, Sampling Table, Modbus Transactions, TCP/IP, Ports, and Web and Report. The 'TCP/IP' sub-tab is active, showing 'TCP/IP address for incoming Calls' with 'From' and 'To' fields set to '192 . 168 . 2 . 1' and '192 . 168 . 2 . 99' respectively. Below this is the 'TCP/IP miscellaneous' section, which is circled in red and has a red '2' next to it. It contains three checked options: 'Enable IP forwarding', 'NAT Address Translation', and 'Virtual Server'.



To deactivate these features, you are also prompted to type the Advanced IP activation code. **Virtual Server rules** can be configured as explained chapter 10.8.

Appendix G. Terminal mode

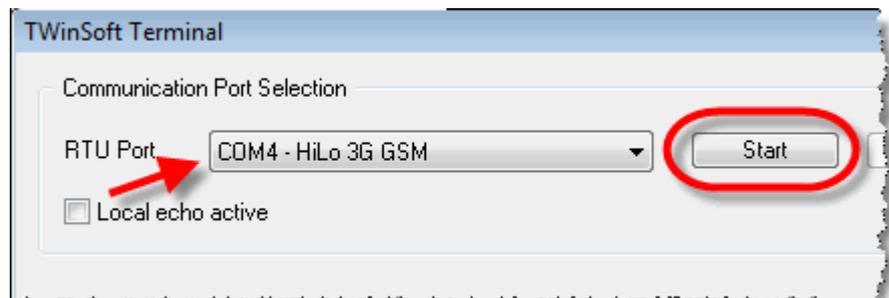
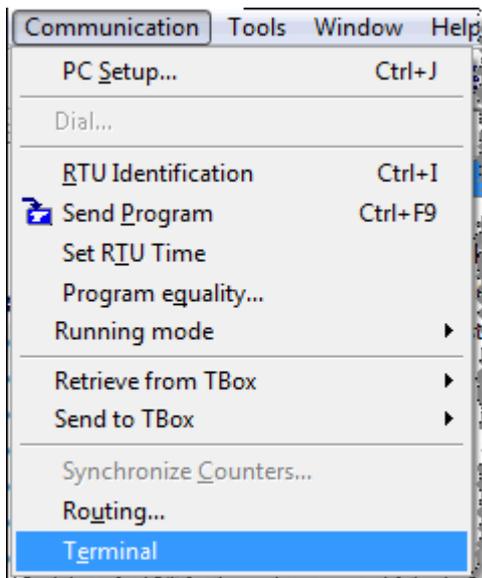
The 'Terminal' mode allows accessing a modem in 'AT command'.

Before starting:

TWinSoft must be connected to **TBox LT2** through RS232 at 57600 Bps (corresponding to the internal Baudrate of the modem).

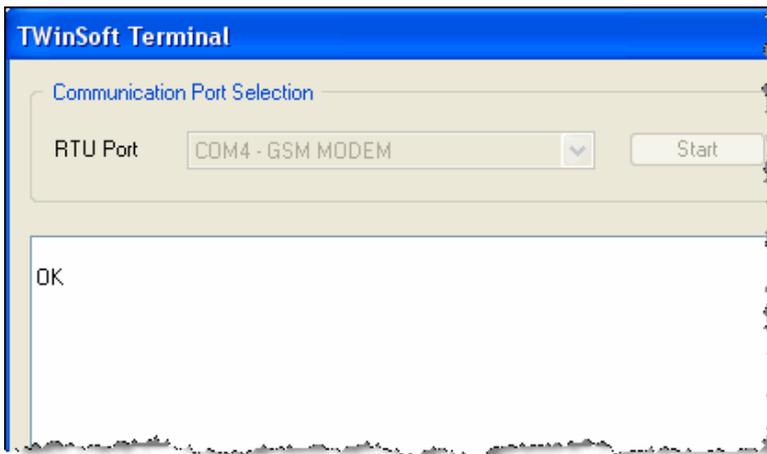
It is not possible to use Terminal mode through Ethernet connection.

It is available from the menu 'Communication' → 'Terminal':



Example with LT2-xxx-3

Examples of commands to check the availability of a GSM:



To activate the echo in the window, type

ATE1 <ENTER>

(you don't see what you type, it is normal)

The modem answers with **OK**

From now on you will see what you type



To check if the SIM card is ready, type

AT+CPIN? <ENTER>

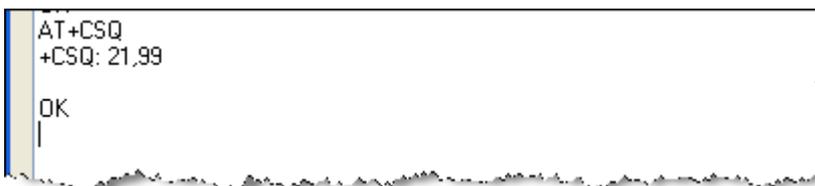
The modem answers **CPIN: READY**



To check the GSM operator has been found, type

AT+COPS? <ENTER>

The modem answers with a code or the name of the operator



To check the quality of the signal, type

AT+CSQ <ENTER>

The modem answers **+CSQ:xx,99**

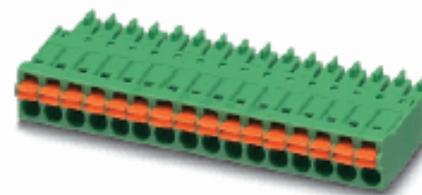
xx: must be between 20 and 31

To quit the Terminal mode, click button "Stop"

Appendix H. Precautions In Cabling

H.1. Cabling to Spring-Cage Terminal Blocks

TBox LT2 is equipped with compact **spring-cage terminal blocks**. This connector allows a high density of connections. Press the orange plastic with a screwdriver for **inserting and removing the cable**.



It is recommended to use either **solid cable** or **stranded cable with ferrule**.

Connection capacity

Without ferrule	Solid cable: 0.2 .. 1.5 mm ² (24..16 AWG)
With ferrule without plastic sleeve	Solid or Stranded cable: 0.2 .. 1.5 mm ²
With ferrule with plastic sleeve	Solid or Stranded cable: 0.2 .. 0.75 mm ²

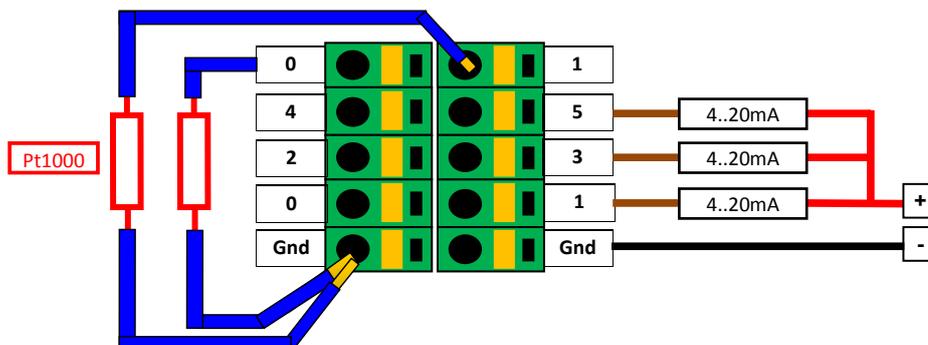
Ferrule specification for 0.75mm² cable

	B: minimum 10 mm C: 1.5 mm D: 3.5 mm
--	---

H.2. Cabling Analog Inputs

One must be **particularly careful when cabling temperature probes** (Pt1000) and more precisely when combining temperature probes and 4..20mA sensors.

- It is mandatory to cable temperature probes to **one of the GND from the AI stage**, and to reserve it **uniquely to the probes**.
- If you mix temperature probes and 4..20mA sensors, use a **separate GND** for each type of signal.



Example with LT2-542-x

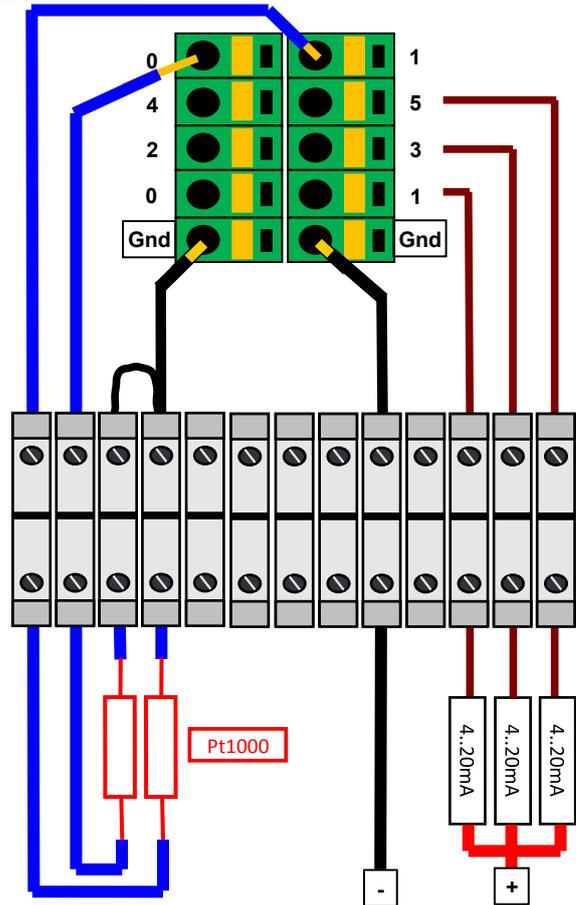
Example of cabling analog inputs of –LT2 through Terminal Blocks:

GOOD

Using separate GND cables.

To measure temperature with PT1000, a current of 0.1 mA is sent to the probe.

A variation of 1 °C corresponds to a variation of the resistor of **3.8 Ω**
 With a current of 0.1 mA it gives **0.38 mV per °C**

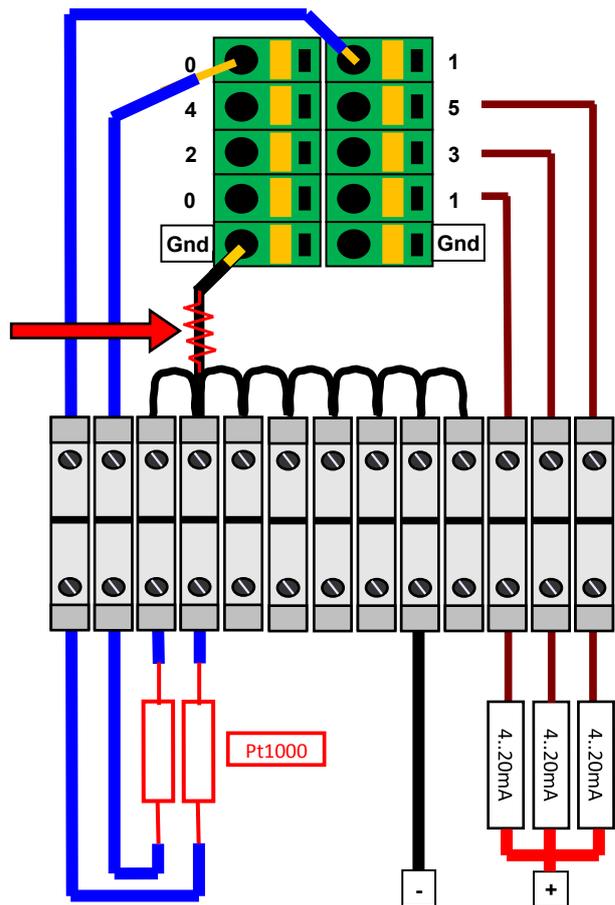


BAD

Using one GND cable.

The GND cable represents a **little resistor**, **common** to temperature probes and sensors.

One meter of 0.5 mm² represents a resistance of **0.034 Ω**
 Imagine a 4..20mA sensor returning 20mA.
20mA in a resistor of **0.034 Ω** gives a voltage of **0.68 mV**.
 With a voltage of **0.38 mV per °C** it constitutes an error of almost **2°C** on temperature inputs.



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