

Data Concentrator TELEM-GW6

User Manual

Martem AS
2010

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1. Main Tasks

The tasks of the Data Concentrator Telem-GW6 (GW6) include the following:

- To control and monitor the system from the control center using data communication protocols IEC 60870-5-101 and IEC 60870-5-104
- To concentrate data collection from lower level peripheral devices and control them by using different data exchange protocols

2. Possible Applications

- Data acquisition and control of regional and national electricity utilities in SCADA systems for remote control and substation automation
- Comprehensive integration of different devices
- As a communication gateway

3. Features

- Telem-GW6 base model includes basic card with built-in communication ports
- Expansion card 1 and 2 are optional extras (see 5. Technical Data)
- Data concentrator with an associated event annunciator performing substation level master unit functions in the substation secondary equipment system
- Duplex data communications between the feeder and the equipment level versus the station control level in substations using different communication protocols and cross-referencing between the protocols
- Full scale data exchange between the levels of the substation control system including setting values, measurement values, registered fault parameter values, changes of state with associated time markings etc
- Data concentrator provided with serial interfaces to facilitate the connection between local output devices and external host systems
- All the settings can be changed using software configuration tool
- Output channel to the remote control system can be connected to a leased or a dial-up line using a copper line-, radio- or GSM modem
- Data concentrator GW6 is provided with control input for clock synchronizing purposes using GPS
- Logical operations between digital and analog signals can be described
- Hierarchical connection is possible
- TELEM RTU devices can be remotely configured across Telem-GW6
- Microsoft Excel direct import and export facilities are in use
- A user-friendly user interface similar to MS

4. View



Figure 4 Telem-GW6 view

5. Technical Data

Data communication protocols

- To higher or lower level systems IEC 60870-5-101 or IEC 60870-5-104
- To lower level devices IEC 61850, IEC 60870-5-103, IEC 60870-5-101 Unbalanced, SPA-bus, IEC 62056-21 (IEC 1107), Modbus-RTU

Communication ports

Communication ports may be freely configured for upper or lower level communication

Built-in

- 1x Ethernet connection with RJ45 connector
- 1x RS232 full modem serial connection with RJ45 connector
- 1x RS485/422 serial connection with RJ45 connector
- 1x USB connection with Type B connector

Expansion card 1

- 1x Fiber-optic connection with ST or Versalink connectors
- 1x RS232 with RTS, CTS handshake signal serial connection with RJ45 opticallyisolated connector
- 1x RS485/422 serial connection with RJ45 optically isolated connector
- 1x GPS Fiber-optic connection with Versalink connector

Expansion card 2

- 8x RS232 with RTS, CTS handshake signals serial connections with RJ45 connectors

Data communication parameters

- 1 start bit
- Odd, even or no parity
- Communication rates from 300 to 115200 bit/sec
- Configurable RTS/CTS handshake for all RS232 ports.

Electrical characteristics of isolated input

- Dielectric withstand IEC 60255-5
- Withstand to static discharge IEC 61000-4-2
- Withstand to surges, bursts IEC 61000-4-4, 61000-4-5

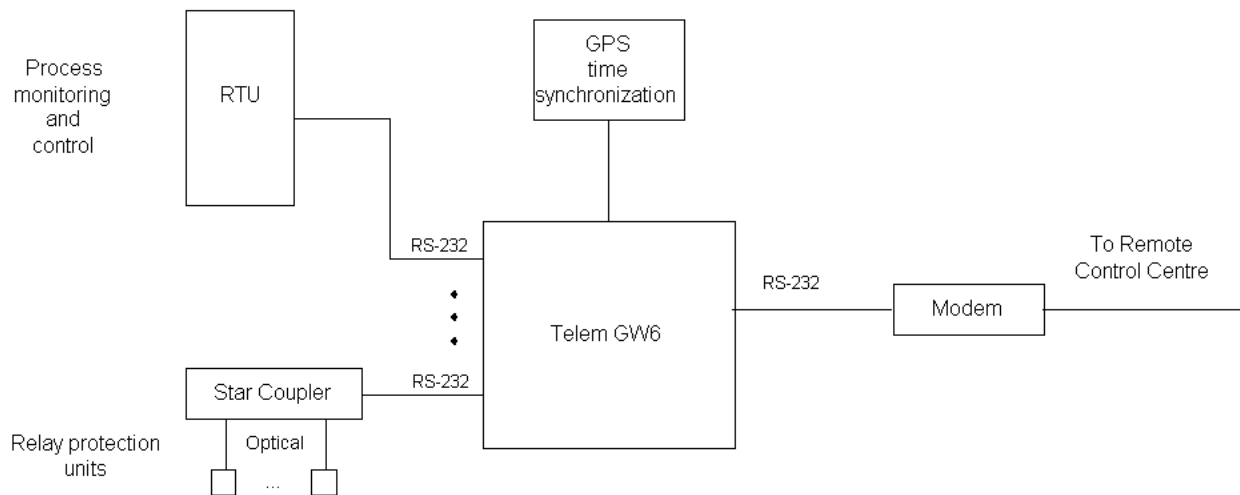
Mechanical parameters

- Degree of protection IP 32
- Dimensions (W x H x D) ~ 84 x 107 x 164
- Ambient temperature in operation -20...+50°C
- Weight ~ 1kg
- Mounting DIN rail

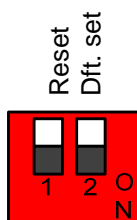
Power supply

- Supply voltage range 10 to 24 V DC
- Power consumption < 8 VA

6. Typical Application for Electric Power Station



7. Switches



1 – Reset: Switch RESET to ON state and then back to OFF state for Reset operation

2 – Dft. Set: To apply default setup:

1. Switch DFT. SET to ON state
 - *Alert indication LED starts blinking with 5 second interval
2. Switch DFT. SET back to OFF state when the alert indication LED is **blinking** to apply default setup
 - *If DFT. SET is switched back to OFF state at a moment when the alert indication LED is not blinking, default setup will NOT be applied

8. Indication

For operation

Green LED – Blinking green indicates that the program is running

Red LED – Failure

For communication

Yellow LED – RX

Green LED – TX

Green LED at GPS port – blinking indicates the existence of GPS time synchronization.

9. Firmware Update

Loading GW6 firmware is done through Secure Digital (SD) Memory Card port.

Updating firmware:

1. Connect Secure Digital (SD) Memory Card to your computer
2. Extract the compressed firmware update file (provided by Martem AS) to your SD Memory Card
3. Disconnect the card from your computer
4. Insert the card to Telem-GW6 SD Memory Card port
 - * SD Memory Card port is located at the back of the device
5. Perform reset operation to Telem-GW6 device
6. Wait until the device resumes to it's normal operation state
7. Firmware update is complete. Remove the SD Memory Card and check if firmfare update was successful

Checking results of the firmware update operation:

1. Connect the SD Memory Card to your computer
2. Open the folder you extracted earlier
3. Check if the file "res.txt" is present and open it
4. Check the state of installed files at the last part of the file
 - *If the state of update files is OK - firmware update was successful

10. GW6 Configuration Tool

10.1 Getting Started

When starting the GW6 configuration program, user interface window with the main menu is opened:



Figure 10. 1.1 User interface window

The following parameters are shown for information:

- **Port** – PC port which is used to communicate with GW6
- **Link address** – Link address of GW6
- **ASDU address** – ASDU address of GW6
- **Status** – Status of the connection. RED – no connection, GREEN – connection OK

Main menu

- **Device** – For selecting the device type
- **Communication Setup** - For changing communication parameters.

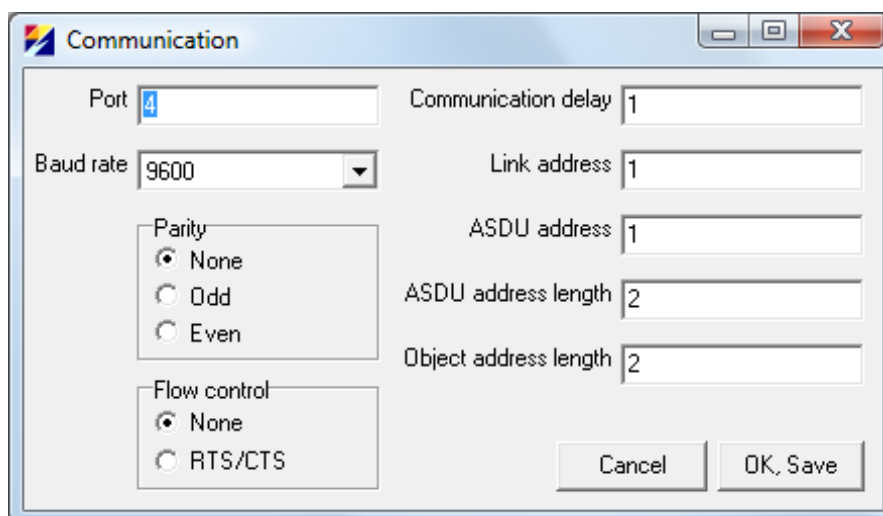


Figure 10.1.2. Communication parameters window




Fields in the communication parameters window

- **Port** – PC communication port which is used to communicate with GW6
- **Baud rate** – Data communication rate
- **Parity** – Use of parity control bit
- **Flow control** – Determines whether the RTS/CTS handshaking is used
- **Communication delay** – Delay between reception of data and the next query in milliseconds
- **Link address** – Link address of GW6
- **ASDU address** – ASDUI address of GW6
- **ASDU address length** – The length of the ASDU address in bytes: typically 2, possible values are 1 or 2.
- **Object address length** – Length in bytes. Typically 2, possible values are 1, 2 or 3.

10.2 GW5 Configuration Window

To open the GW6 configuration window, select **Device > GW6 / RTA-A** from the user interface main menu.

Shortcut icons below the menu bar:

	Open a new configuration
	Open a configuration file
	Save the configuration to a file
R	Read the configuration from GW6
W	Write the configuration to GW6
RS	*Reset GW6

* Possible Reset codes:

- 1 – Simple Reset
- 2 – Reset that also clears memory buffers
- 3 – Reset that also restores the default setup

Saving, editing and opening configuration data

Configuration data is saved to the hard disk in the form of comma separated files*.CSV files when the **Save** or **Save As** command is chosen from the File menu. Correspondingly, the **Open** command from the File menu opens this type of file. **Open** and **Save** can also be accessed via shortcut icons.

*.CSV files can be conveniently edited with Excel software or even with the Note Pad program. When editing the configuration with Excel, the file has to be saved as a comma separated CSV file.

Table of configuration window menu items

Main menu	File	Common	View	Help
Submenu (Shortcut key)	New (Ctrl+N)	Read Configuration	Basic	Help (F1)
	Open(Ctrl+O)	Write Configuration	Advanced	About
	Save (Ctrl+S)	Cancel Active Transfer		
	Save As	Send Reset		
	Exit	Interval Groups		
		Tcp/Ip Settings		
		Timing Settings		
		Modem Settings		
		Port Mirroring		
		Options		

10.3 Tab Cards in the Configuration Window

Configuration and setting parameters can be utilized by using topic tab cards:

Ports, Devices, Objects, Formulas, RTA IO, Status.

A click on a tab card button switches between tab cards.

Using the grid area

Parameters can be selected or changed in the grid area cells. Values of some cells can be changed directly and those of others via a list box or a popup window.

Values of the same column can be copied to clipboard. Use a left mouse click together with the Shift key to copy and a left mouse click together with the Ctrl key for paste operation.

Status message in the bottom left corner of the window shows the result of the last data modification action (OK, Error, etc).

10.3.1 Ports Tab Card

Ports/configuration tab card (Figure 10.3.1) is active when the GW6 configuration window is opened.

From the **View** menu a **Basic** or an **Advanced** view of the **Port configuration tab card** can be selected. The Advanced view shows the additional query and echo suppression parameters.

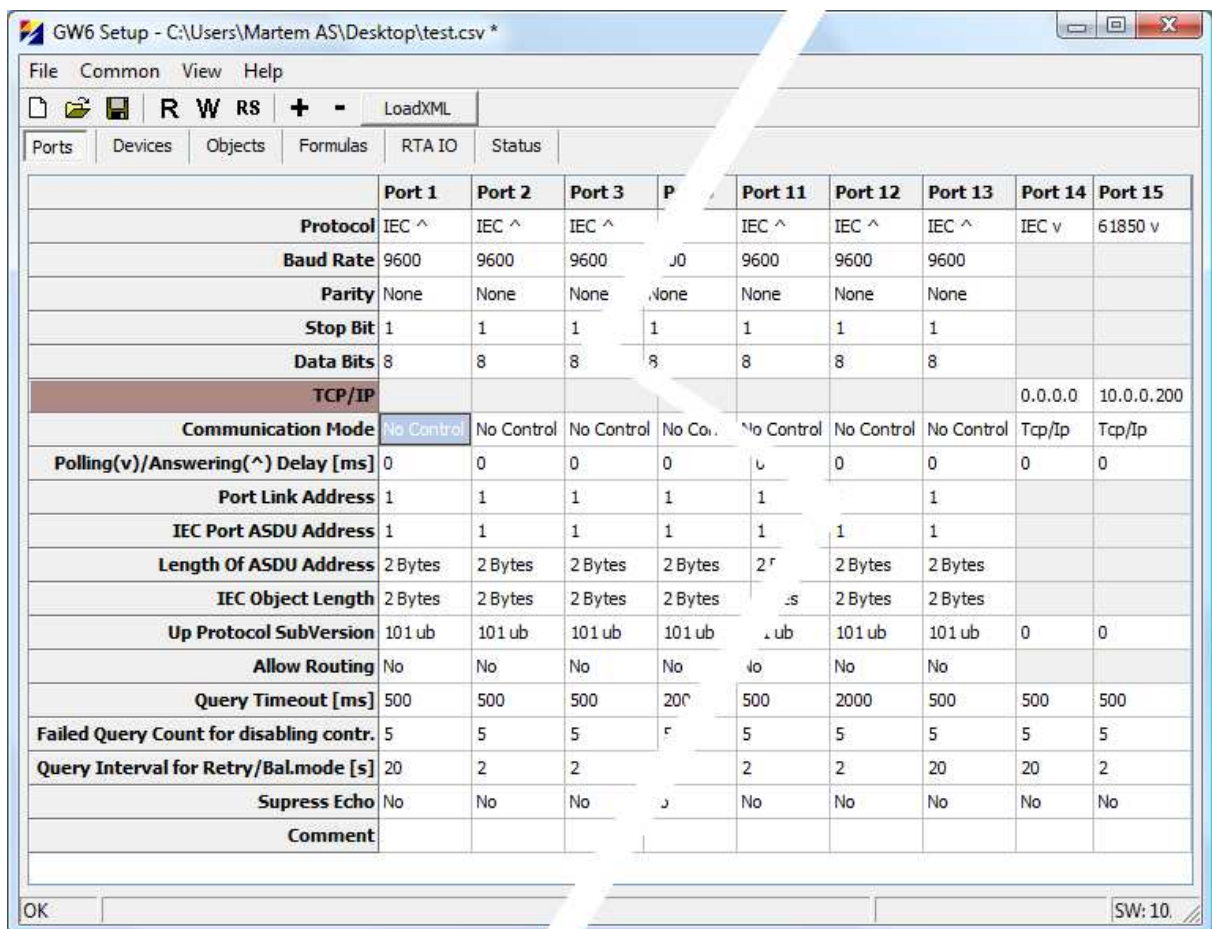


Figure 10.3 .1 Configuration window with an advanced Port configuration tab card

Configuration parameters of a port:

- **Protocol** – Communication protocol used by all the devices of this port. Each protocol name is accompanied with a symbol "u" or "d" which indicates whether the port is used for an uplink or a downlink channel. For example, "Modbus d" means that this port is used for downlink with Modbus protocol.
- **Baud rate** – Data communication rate
- **Parity** – Use of parity bit for all the devices on this channel
- **Stop Bit** – possible values are 1, 2
- **Data Bits** – possible values are 7, 8
- **TCP/IP** – communication IP address (used if Communication Mode is set to TCP/IP)
- **Communication Mode** – Makes it possible to choose between the following handshaking options:
 - No control
 - RTS/CTS Control
 - Tcp/Ip
- **Polling(d)/Answering(u) Delay** – Delay between reception and the next query
- **Port Link Address** – Link address of the device on uplink channels
- **IEC ASDU Address** – ASDU address on uplink channels
- **Length of the ASDU Address** – Length of the ASDU address in bytes on uplink channels. Typically 2, possible values are 1 or 2
- **IEC Object Length** – Length of the IEC object address in bytes on uplink channels. Typically 2, possible values are 1, 2
- **Up Protocol Subversion** – Number of protocol subversion on uplink channels

More on the advance view:

- **Allow Routing** – Allows routing of IEC 60870-5-101 protocol messages between the upper and lower level channels
- **Query Timeout [ms]** – Query timeout for devices on downlink channels
- **Failed Query Count for disabling contr.** – Count of timeouts after which the error flag is raised and the query of this device temporarily suspended
- **Query Interval for Retry/Bal.mode [s]** – Time period after which the suspended device is queried again
- **Suppress Echo** – If the sent messages are echoed back by the connected devices then they need to be suppressed

If some parameters in the grid area have a grey background then these are not used for the chosen protocol type but you are still allowed to modify them.

10.3.2 Devices Tab Card

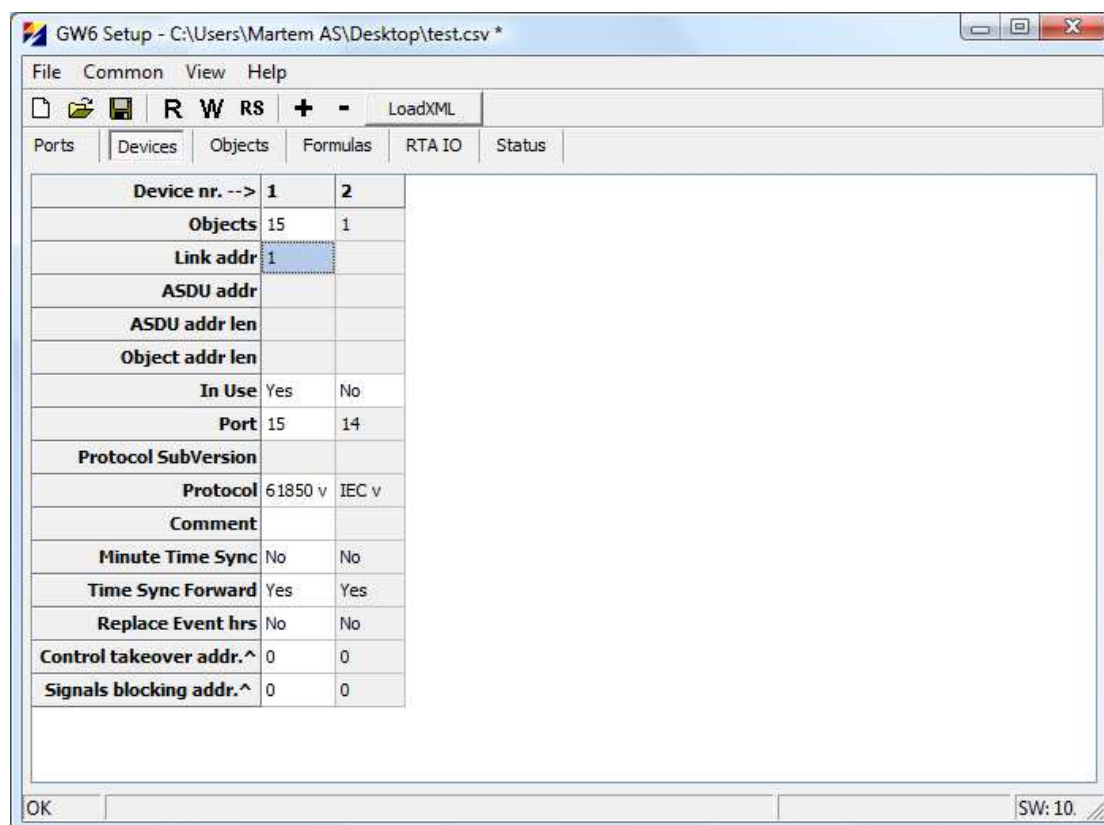



Figure 10.3.2. Devices tab card

Parameters:

- **Device nr** – Sequence number of the device
- **Objects** – Number of objects in the device
- **Link address** – Link address of the connected device
- **ASDU address** – ASDU address of the connected device
- **ASDU address length** – Length in bytes, possible values are 1 or 2
- **Object address length** – Length in bytes, possible values are 1, 2 or 3
- **In use** – Indicates whether the device is in use or not. If the device is not in use, the whole row has a grey background
- **Port** – Port no. of GW6 to which the device is connected
- **Protocol Subversion** – Number of protocol subversion
- **Protocol** – For information only. It is filled automatically according to the number of the used port.
- **Minute Time Sync** – Yes/No. If Yes, the device is synchronized with 10 second period
- **Time Sync Forward** – Yes/No. If Yes, the time synchronization which is received from upper channel, it is forwarded to the device
- **Replace Event hrs** – Yes/No. If Yes, events are sent to control centre with UCT time (the time correction value is set in Common Menu, Timing Settings)

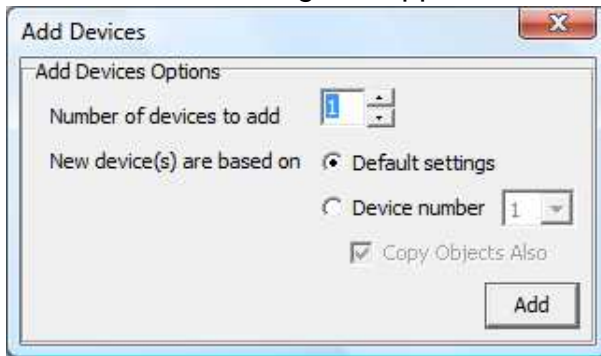
- **Control takeover addr.^** – The address of an object which determines control takeover of that device
- **Signals blocking addr.^** – The address of an object which determines blocking of all signals from that device. No signals are sent to control centre from that device

Adding devices

By clicking on the  shortcut icon, a new device with default settings is added. It is also possible to add new devices with a right mouse click which makes the extended control menu to appear.



Add Devices dialog box appears.



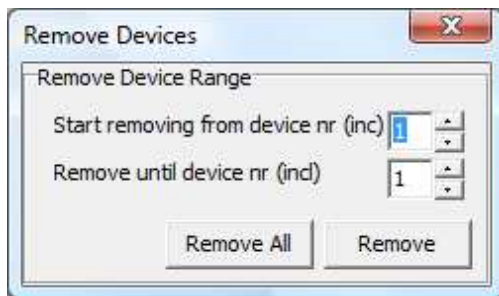
Set the Add Devices options:


- Number of devices to add
- Default settings or the device number from where the settings are derived
- Copy Object Also

Click the Add button.

Removing Devices

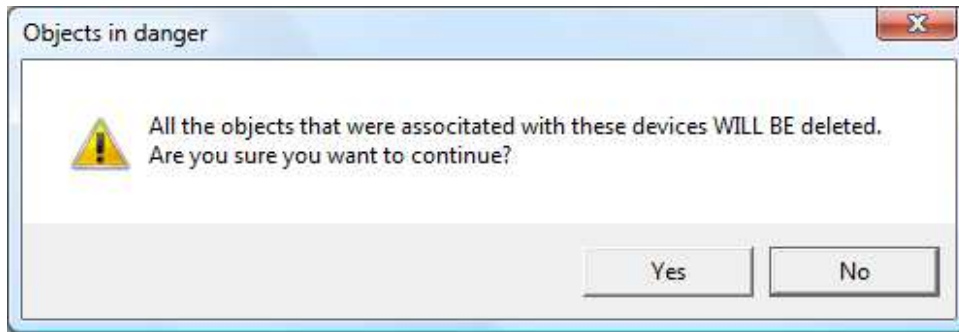
To remove a device, select **Remove Devices** from the extended control menu or click on the shortcut icon.



Select the range of the removed devices and click the **Remove** or **Remove All** button. The selected device is also removed after the warning dialog when  is clicked.

Clearing Devices

To clear the Device Tab Card, select Clear from the extended control menu. A warning window always appears before removing operations are concluded:



Select **Yes** to accept or **No** to cancel the removal operation of the devices.

10.3.3 Objects Tab Card

Dev. nr.	Obj. nr.	Type	Analog Group	SubType ^	SubType v	Invert	Fn. Code	Info nr.	Index	Obj. Addr. v	Obj.
1	1	DI		SN NTime/LTime	0	No				61850 v	16
1	2	DI		SN NTime/LTime	0	No				VampRelay/AR5RREC1\$ST\$BlkRec	16
1	3	DI		SN NTime/LTime	0	No				VampRelay/AR5RREC1\$ST\$Op	16
1	4	DI		SN NTime/LTime	0	No				VampRelay/AR5RREC1\$ST\$AutoRecSt	16
1	5	DI		SN NTime/LTime	0	No				VampRelay/VI1GGIO137\$ST\$SPCSO	16
1	6	DI		SN NTime/LTime	0	No				VampRelay/DI01GGIO45\$ST\$Ind	16
1	7	DI		SN NTime/LTime	0	No				VampRelay/DI02GGIO46\$ST\$Ind	16
1	8	DI		SN NTime/LTime	0	No				VampRelay/DI03GGIO47\$ST\$Ind	16
1	9	DI		SN NTime/LTime	0	No				VampRelay/DI04GGIO48\$ST\$Ind	16
1	10	DO			0	No				VampRelay/AR5RREC1\$CO\$BlkRec	16
1	11	DO			0	No				VampRelay/Obj1CSWI1\$CO\$Pos	16
1	12	DO			0	No				VampRelay/VI1GGIO137\$CO\$SPCSO	16
1	13	AI	none	FP NTime/LTime	0					VampRelay/U3pMMXU4\$MX\$PhV\$phsA	16
1	14	AI	none	FP NTime/LTime	0					VampRelay/U3pMMXU4\$MX\$PhV\$phsB	16
1	15	AI	none	FP NTime/LTime	0					VampRelay/U3pMMXU4\$MX\$PhV\$phsC	16
2	1	DI		DB NTime/LTime	Normal	No					0

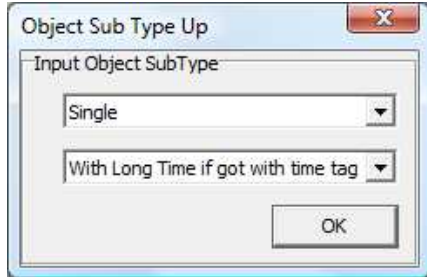
Figure 10.3.3 Objects tab card

The first object of every device is used as the communication status signal of the device. If its value is “1” then communication with this device is broken. The object (first object) of communication status signal is not counted in the **Objects** row of the **Devices Tab Card**.

Columns:

Type – Object's type: digital input (DI), digital output (DO), analog input (AI), counter (CN)

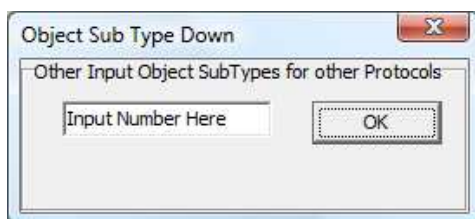
Sub Type[^] – Object's subtype for uplink. The following dialog box opens on clicking:



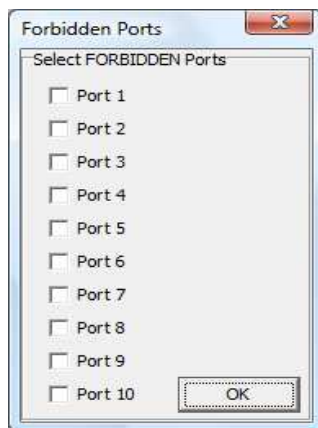
Subtypes of object and time marking mode can be selected.

Object type	Format	Time marking
DI – Digital input	Single Double	Without time With Short Time With Long Time With Short Time if got with time tag With Long Time if got with time tag
DO – Digital output	Single Double Direct Execute Select Execute	
AI – Analog input	Normalized Floating point Step position	Without time With Short Time With Long Time With Short Time if got with time tag With Long Time if got with time tag
CN – Counter		

Sub Type^v – Object's subtype for downlink. The following dialog box opens on clicking:




- **Invert** – Object's value will be inverted
- **Fn.code** – Function code on the IEC 60870-5-103 protocol
- **Info no.** – Information number on the IEC 60870-5-103 protocol
- **Index** – Object index on the IEC 60870-5-103 protocol. It indicates the order number of the object in message types 3 and 9 of analog measurements.
- **Object.Addr v** – Object's downlink address
- **61850 v** – 61850 address (selected from drop-down menu)
- **Object.Addr ^** – Object's uplink address
- **DB1 %Fs** – Deadband (% of full scale). If the value has changed less than the deadband then it is not spontaneously transferred.
- **DB2 %Fs** – This is used instead of DB if the **Crit.Min** and **Crit.Max** fields are used and the value falls within these limits. **In case of offline (GSM) channel**, if the change in value is bigger than deadband 2 (% of full scale) then a call to SCADA system is initiated.
- **Raw Min, Raw Max** – Minimum and maximum raw values of analog measurement (before scaling).
- **Scale Min, Scale Max** – Minimum and maximum scale values of analog measurement.
- **Forb. Ports** – Uplink port to which the object's value transfer is blocked. To select uplink ports, which should not be used for transferring these object values, double-click on the cell of the **Forb. Ports** column and select the corresponding ports from the window that has appeared.



- **Crit.Min %Fs / On Ev. Nr; Crit.Max %Fs / Off Ev. Nr**
Crit.Min %Fs; Crit.Max %Fs – Minimum and maximum values in % from the full scale of analog measurements on which GW6 initializes communication (Fig. 10.5.1). If Crit. Max and Crit. Min do not have values, DB1 and DB2 are in use. If Crit. Max and Crit. Min have the value 'zero', only DeadB1 is in use. If the analog measurement value is between Crit. Min and Crit. Max, DB2 is in use. If the analog measurement value is out of limits, DB1 is in use.
On Ev. Nr; Off Ev. Nr – Corresponding event number used in SPA-bus
- **Forb. Calling** – Block object's value transfer.

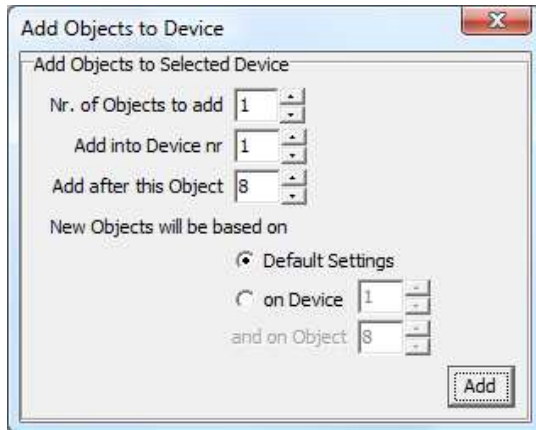
- **Ch. Nr.** – Channel nr. for SPA-bus communication protocol
- **noFlags** – If set to Yes, removes Invalid and Not Topical flags from object status. Used for digital objects, which statuses are not received with General Interval time.

Adding Objects


By clicking on the  button, a new device with default settings is added. Objects can also be added with a right click on the device tab card. After that the following extended control menu appears:

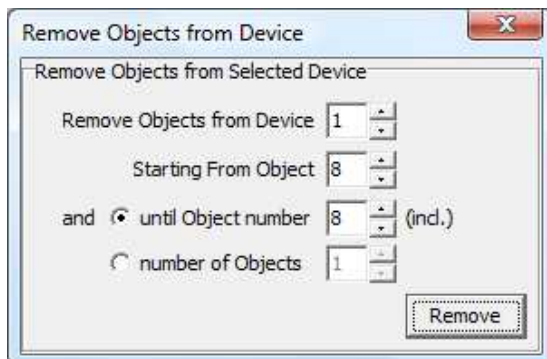


When selecting Add Objects, the following dialog box appears:



Removing Objects

To remove a device, click the  button or select Remove Devices from the extended control menu. The following dialog box appears:



Hints

- Repeated object addresses are shown on yellow background.
- When leaving the Object Tab Card, all the objects are hidden. To see the objects on returning to Object Tab Card, use **Expand All** from the extended control menu that appears after a right click.

10.3.4 Formulas Tab Card

No.	Type	SubType ^	Invert	Obj. Addr. ^	DB1, %Fs	DB2, %Fs	Scale Min	Scale Max	Forb. Ports	Module	LED no.	Formula	Comment	Crit Min, %
1	DI	SN NTime/Time	No	701					0000000000		0			
2	DI	SN NTime/Time	No	702					0000000000		0			
3	AI	FP NTime/Time		619	2	2	0	0	0000000000		0			0
4	DI	SN NTime/Time	No	20					0000000000		0			
5	DI	SN NTime/Time	No	21					0000000000		0			
6	DI	DB NTime/Time	No	22					0000000000		0			

Figure 10.3.4 Formulas tab card

Columns:

- **Type, Sub Type , Invert, Object Adr ^, DB1 %Fs, DB2 %Fs, Crit. Min %Fs, Crit. Max %Fs, Raw Min, Raw Max, Scale Min, Scale Max, Forb.Ports** - as in **Objects Tab Card**
- **LED no** – The alarm (LED) number (1...16) on the LED Alarm panel which corresponds with the result of this formula
- **DO addr.** – Number of the digital output (1...16) in the TLM GW-IO device controlled by the result of this formula
- **Execution count** – The number of control operations executed, if no feedback is received from control relay. Feedback must be determined in the formula
- **Delay** – Delay for execution in seconds
- **Forb. DO** – The number of DO, which control is forbidden with the result of this formula
- **LED Blinking** – Determines if the LED that indicates the result of this formula, remains blinking when corresponding signal disappears. The LED remains blinking until the acknowledge button is pressed
- **Formula** – Formula string

Editing formulas

Formulas can be created between the values of analog and/or digital objects.

Referencing to object values

To use the measurement object in the formula, insert an @ sign together with the **object address up**.

Example: @101 points to the value of the object with an address to uplink 101.

Constants

Constants can be used in formulas.

Example: 1.1+2.2+3 consists of 3 floating point constants

Brackets

Brackets can be used in formulas to change the priority of the operation.


Example: $\sqrt{(@101/2+@102)}$; $(@201+@202+@203)/3$


Operators

Oper.	Obj. type	Description	Sample	*Priority
+	DI/AI	Addition	@101+3,2	3
-	DI/AI	Subtraction	@101-0,49	3
*	DI/AI	Multiplication	@101*2	2
/	DI/AI	Division	@101/2	2
^	DI/AI	Exponentiation	@101^2	1
<	DI	Greater than	@101<0,499	4
>	DI	Less than	@101>0,5	4
sqr	DI/AI	Square	sqr(@101*10)	0
sqrt	DI/AI	Square route	sqrt(@101*10)	0
and	DI	Logical conjunction	@201and@202	5
or	DI	Logical disjunction	@201or@202	6
xor	DI	Exclusive disjunction	@201xor@202	6
not	DI	Logical negation	not@201	0
dbl	DI	Converts 2 single digital inputs into a double signal	@201dbl@202	7
sin	DI/AI		sin@301	0
cos	DI/AI		cos@301	0
tan	DI/AI		tan@301	0
arcsin	DI/AI		arcsin@301	0
arccos	DI/AI		arccos@301	0
arctan	DI/AI		arctan@301	0

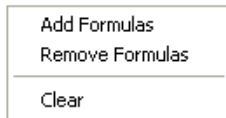
* priority determines the order of operations in the formula (the highest priority is 0)

Notes

- All analog values should be scaled before making calculations; therefore, it is very important to fill the **Raw Min, Raw Max, Scale Min, Scale Max** fields with Normalized values that are used in calculations.
- After editing the formula, the program automatically validates this formula and shows the result in the status area. If the formula is incorrect, the background of the edited formula is changed to pink and an error message is displayed in the status area.
- By clicking on the  button, a new formula row with default settings is added.

By clicking on the  button, the selected formula row is removed.

- Formula rows can also be added, removed or cleared by using the extended control menu like in the Object Tab Card. It appears with a right mouse click on the Formula Tab Card.



To add a Formula, select **Add Formulas**, to remove a Formula, select **Remove Formula** and to clear all formulas, select **Clear**.

- The formulas of DI type of objects can contain AI values and floating point constants. If the result of the formula is greater than 0, the value of the DI object is "1"; if the result of the formula is less than or equal to 0, the value of the DI object is "0".

< or > statement: if the statement is true, the value of the DI object is 1; if the statement is false, the value of the DI object is 0.

10.3.5 RTA IO Tab Card

Tab Card for configuring the **RTA-A** device's built-in IO objects.

10.3.6 Status Tab Card

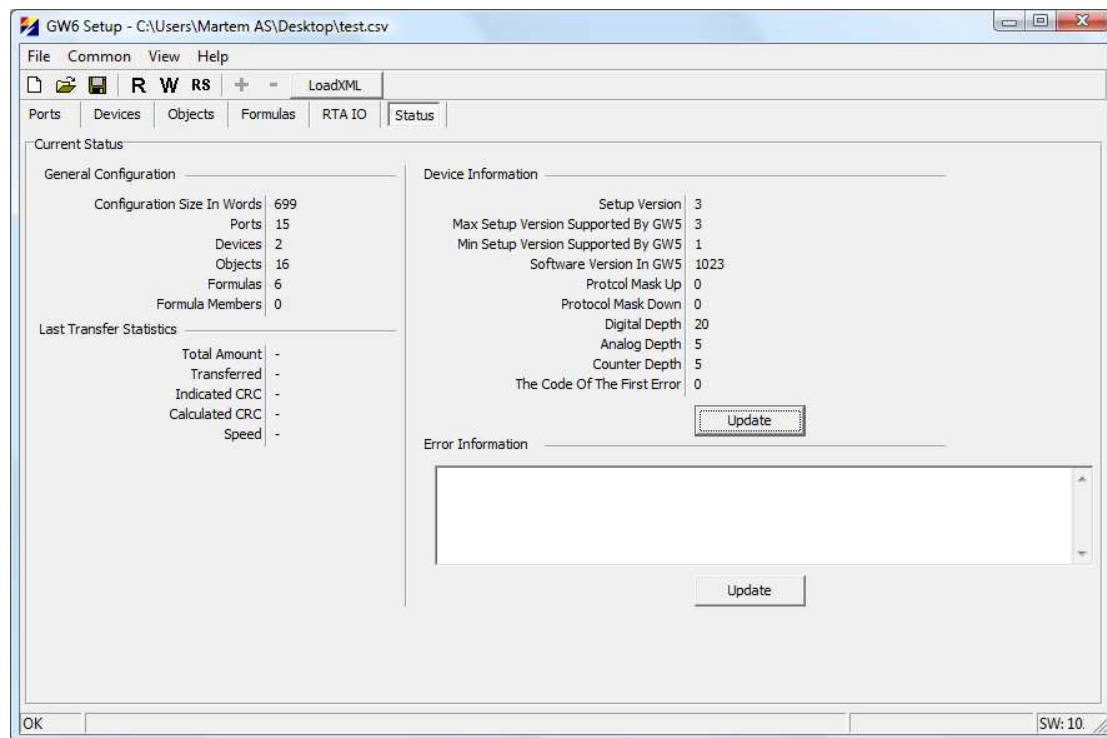


Figure 10.3.5 Status tab card

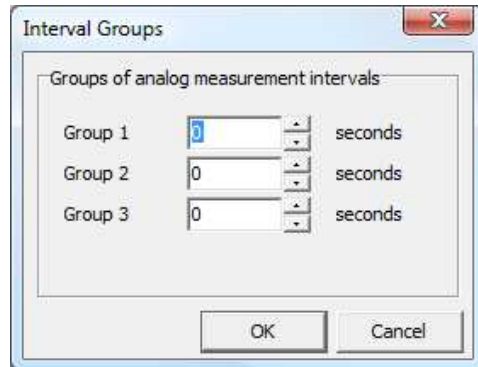
Status tab card presents the status of GW6 general configuration parameters and transfer statistics.

Update button is used to get information from the connected GW5 and it is displayed under Device Information.

11. Common Main Menu

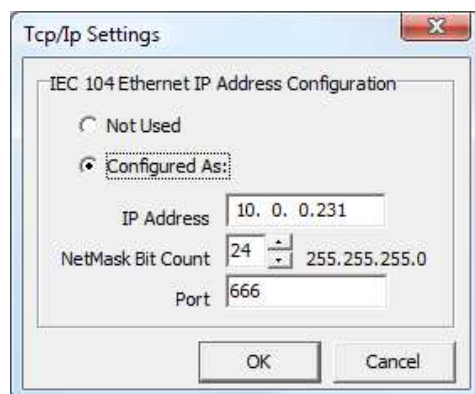
11.1 Interval Groups

Interval groups are used to specify the time interval of sending analog input value to the remote control center when the value has changed less than the deadband. Interval groups can be added to analog input objects in the Configuration tool in the Objects tab (Analog groups).



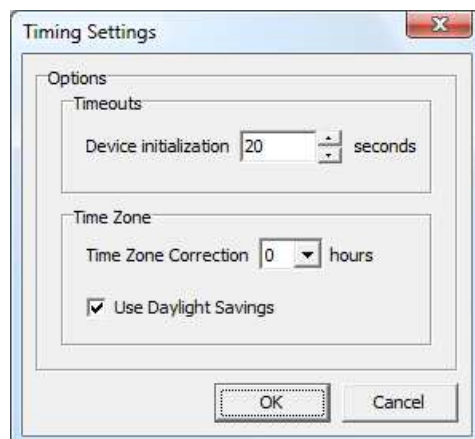
11.1 TCP/IP Settings

Used for GW6 to determine IP parameters.



11.2 Timing Settings

To determine device initialization timeouts and time zone correction.



12. Communication Cables

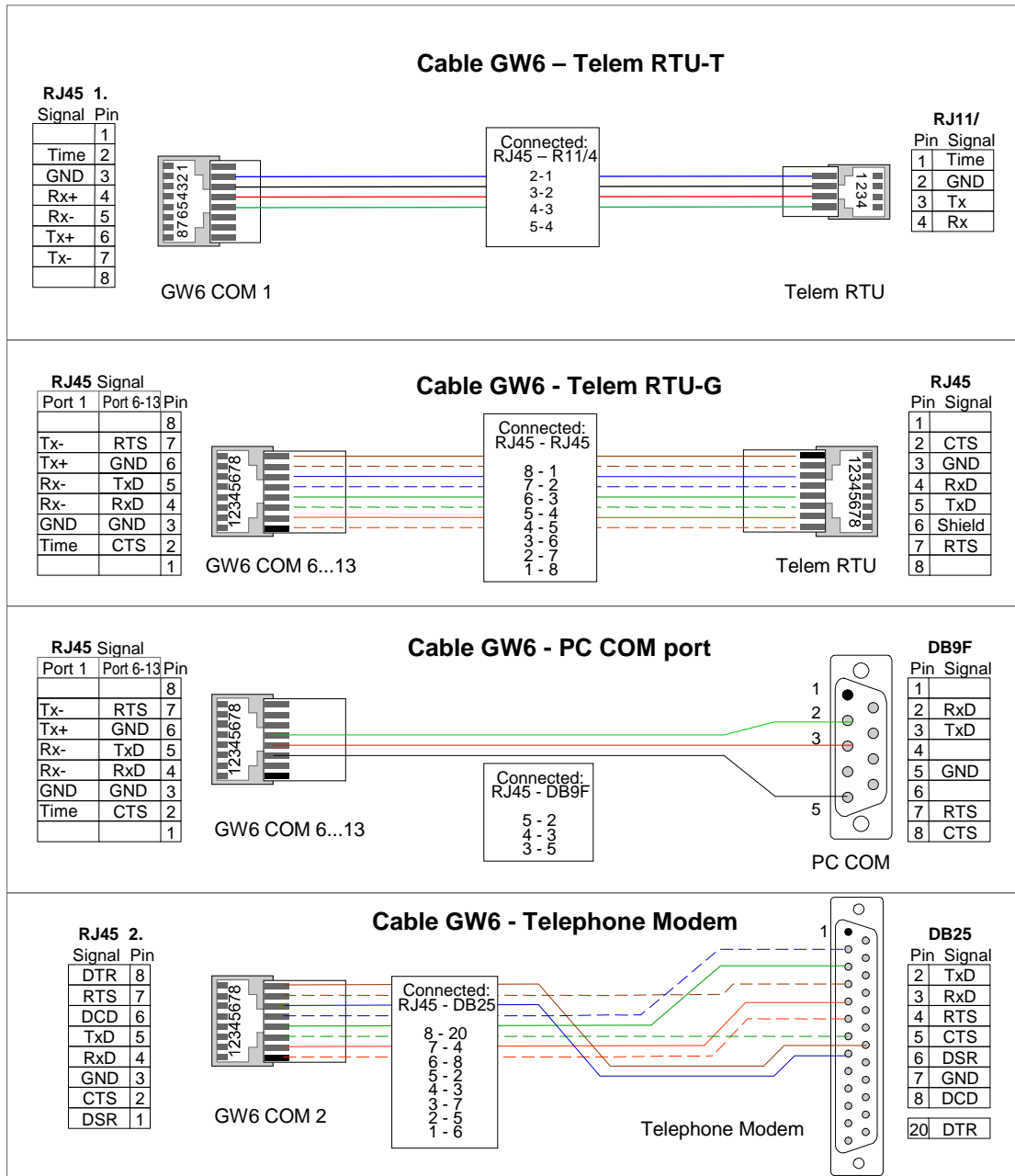


Figure 11.1 GW6 communication cables

Port RJ-45 pin layout.

PIN	Ethernet port	Port 1 RS-422	Port 2-3 RS-232	Port 5 Isolated RS-422/485	Port 6-13 RS-232
1	TX+		DSR	RX -	
2	TX-	Time sync.	Cts	RX +	CTS
3	RX+	GND	GND	TX -	GND
4		RX+	RXD	TX +	RXD
5		RX-	TXD	S GND	TXD
6	RX-	TX+	DCD		GND
7		TX-	RTS		RTS
8			DTR		RD - *

* GPS Time

13. Notes

- If not stated otherwise on the individual pages of this document, AS Martem reserves the right to make modifications.
- Although the contents of this publication have been checked for conformity with the hardware and software described, we cannot guarantee complete conformity since errors cannot be excluded.
- The information provided in this manual is checked at regular intervals and any corrections that might become necessary are included in the next releases.
- Any suggestions for improvement are welcome.
- The contents of this manual are subject to change without prior notice.