



Protocol Server Bridge

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ReLab Protocol Server Bridge Manual

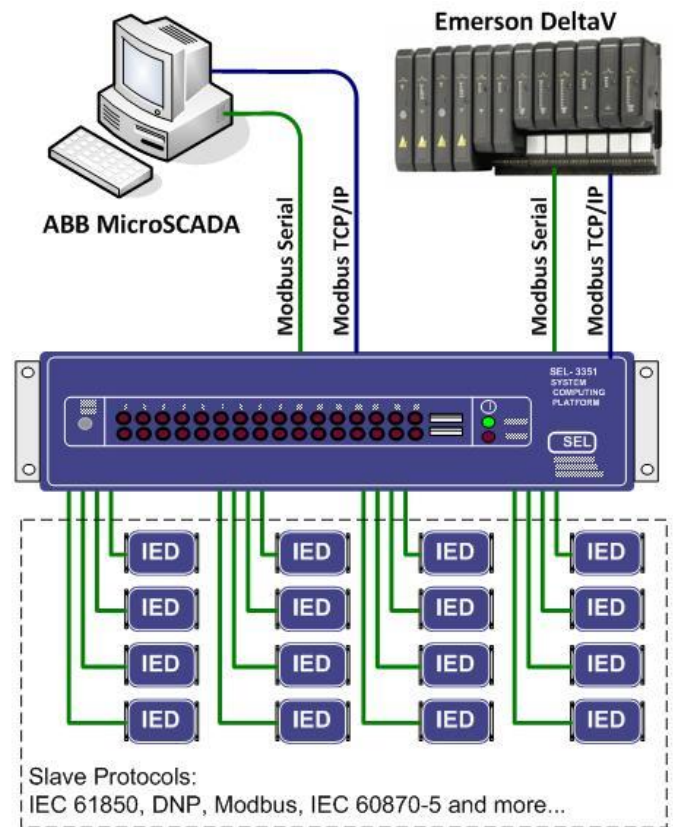
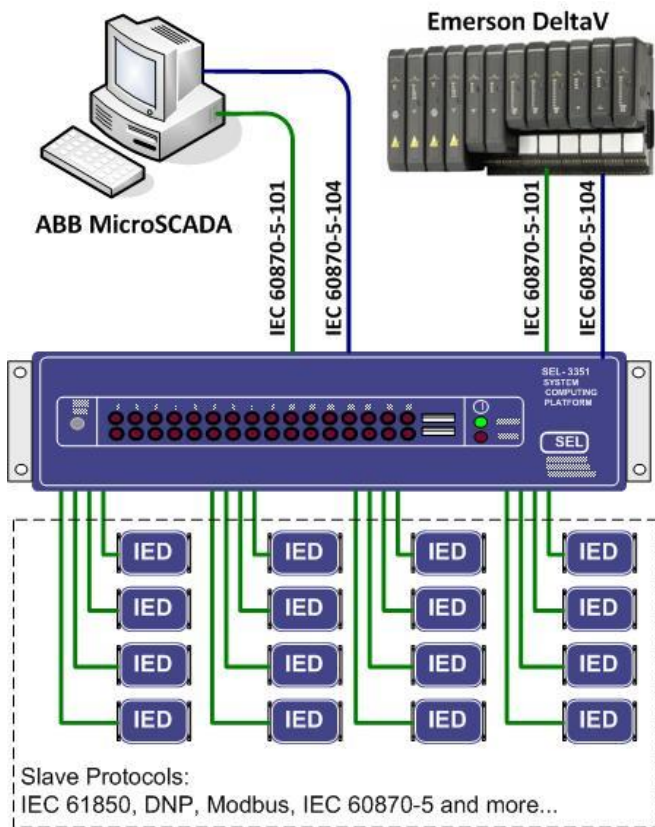
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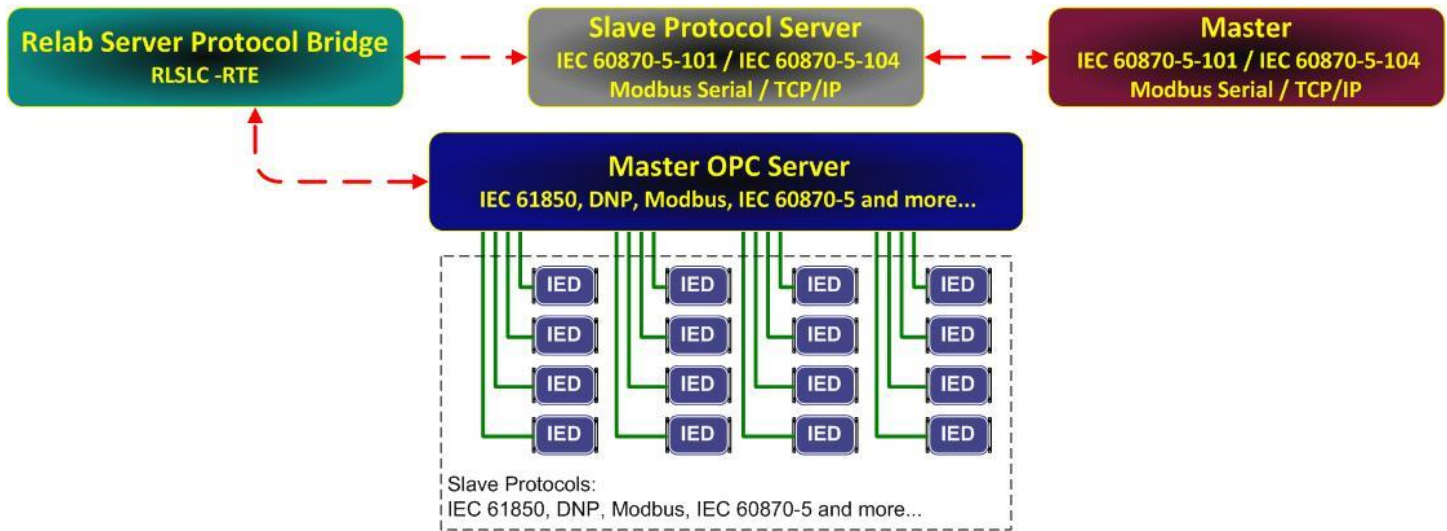
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Overview

ReLab Protocol Server Bridge implements “Slave” capability of IEC 60870-5-101, IEC 60870-5-104, Modbus Serial and Modbus TCP/IP protocols with ability to turn your computer into Slave Device. The application is developed for 32-bit industrial platforms and fully compatible with a TCP/IP stack and Serial interfaces. The application provides custom API with advanced features, which allow user to write into “read-only” registers. With the complements of ReLab Software Run-Time Engine (RTE) user can access OPC address space and perform protocol conversions. This manual explains required steps to configure these drivers.



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Hardware & Software Configuration Requirements

Operating System (OS)

Windows® 7

Windows® 8.1

Windows® Server 2003

Windows® Server 2008

Windows® Server 2010

Hardware

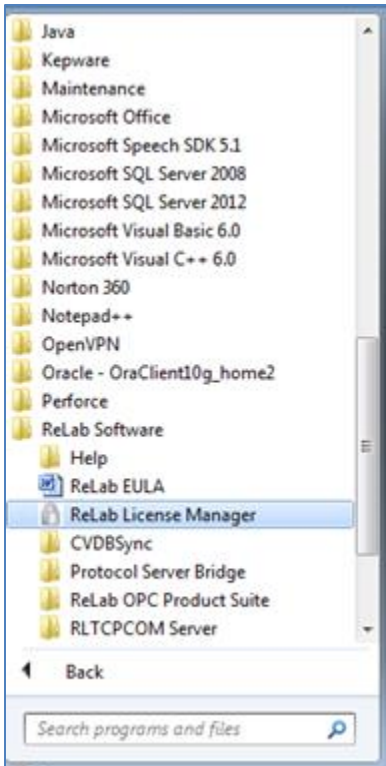
- ✓ CPU – 1GHz
- ✓ Memory – 500MB
- ✓ Storage – 500MB

Registering Slave Protocol Server

Note: make sure ReLab OPC Product Suite and ReLab Protocol Server Bridge are installed on your computer.

In order to license IEC 60870-5-101/104 Slave follow the steps below:

Step-1. Select ReLab License Manager



Step-2. Select which protocol you would like to use: ReLab IEC 60870-101, ReLab IEC 60870-104, ReLab Modbus Slave (Serial) or Modbus Slave (TCP/IP)

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ReLab License Manager

Create Application Key Register or Verify Registration

Select an application you want to register:

Component	License
ReLab IEC-60870-101 Slave	No
ReLab IEC-60870-104 Slave	No
ReLab MODBUS Slave (Serial)	No
ReLab MODBUS Slave (TCP/IP)	No

Enter customer information:

Company Name:

Purchase Order:

Register To:

E-Mail:

Email Request Print Request Show Request Key Close Help

Step-3. Click on “Show Request Key”. This key needs to be forwarded to ReLab Software

Product Key:

CVMBX.HMB.60870-101: J6LNS-9TXIA-LTLKC-SUYJ7

OK

Step-4. After the License key is received click “Register or verify Registration”

ReLab License Manager

Create Application Key Register or Verify Registration

Select an application you want to register:

Component	License
ReLab IEC-60870-101 Slave	No
ReLab IEC-60870-104 Slave	No
ReLab MODBUS Slave (Serial)	No
ReLab MODBUS Slave (TCP/IP)	No

Enter license key in the edit box below:

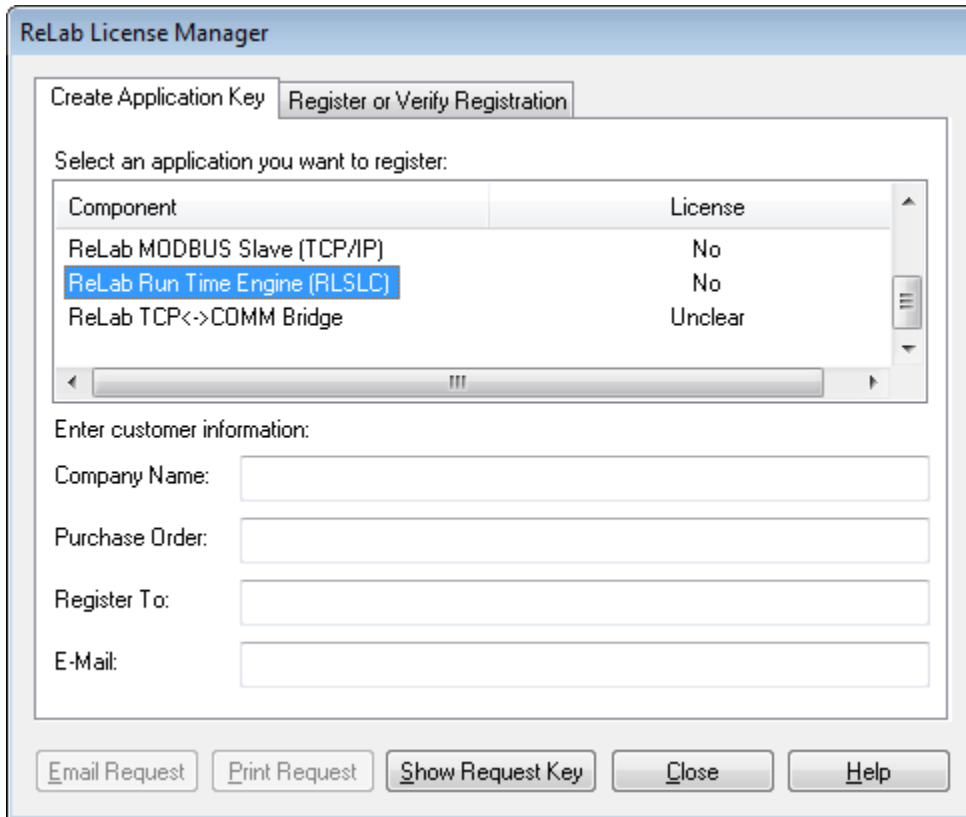
2222-22222-22222

Register Verify Close Help

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1. Select protocol which you would like to register
2. Enter the license key in edit box
3. Click "Register"

Note: For proper operation of ReLab Protocol Server Bridge it is required to register ReLab Run Time Engine (RLSLC)". Please follow the same Steps as above to register ReLab Run Time Engine (RLSLC).

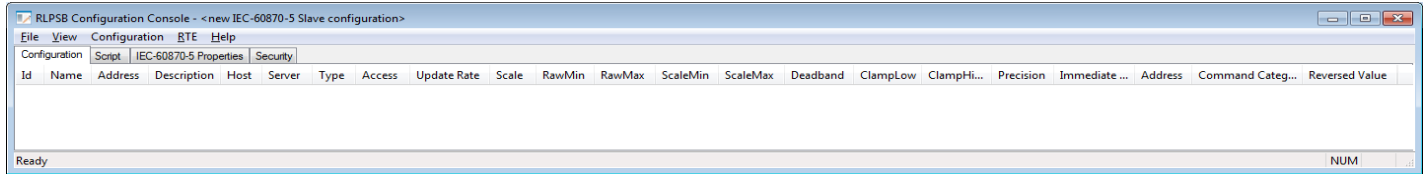


The image shows a screenshot of the 'ReLab License Manager' dialog box. It has two tabs: 'Create Application Key' and 'Register or Verify Registration'. The 'Register or Verify Registration' tab is active. Below the tabs, it says 'Select an application you want to register:'. There is a table with two columns: 'Component' and 'License'. The table has three rows: 'ReLab MODBUS Slave (TCP/IP)' with license 'No', 'ReLab Run Time Engine (RLSLC)' with license 'No' (this row is highlighted in blue), and 'ReLab TCP<->COMM Bridge' with license 'Unclear'. Below the table, it says 'Enter customer information:'. There are four text input fields: 'Company Name:', 'Purchase Order:', 'Register To:', and 'E-Mail:'. At the bottom, there are five buttons: 'Email Request', 'Print Request', 'Show Request Key', 'Close', and 'Help'.

Component	License
ReLab MODBUS Slave (TCP/IP)	No
ReLab Run Time Engine (RLSLC)	No
ReLab TCP<->COMM Bridge	Unclear

Project Configuration

1. Open RLPSB Configuration Console



2. From **File** menu select **New** menu item

3. Select one of the two options:

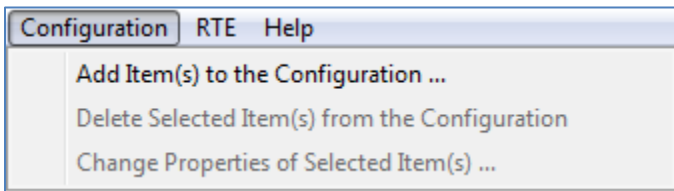
- Modbus Slave
- IEC 60870-5 Slave

4. Select Configuration Tab

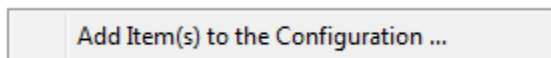
Adding OPC Items

There are two ways to add OPC Items to the configuration

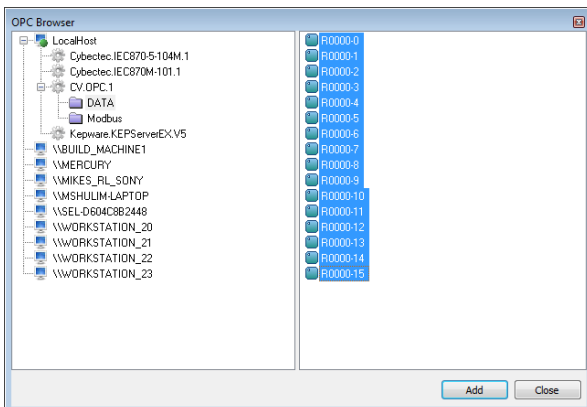
1. When **Configuration** tab is selected you can add items using menu item **Configuration**



2. Or you can right - click on the address space

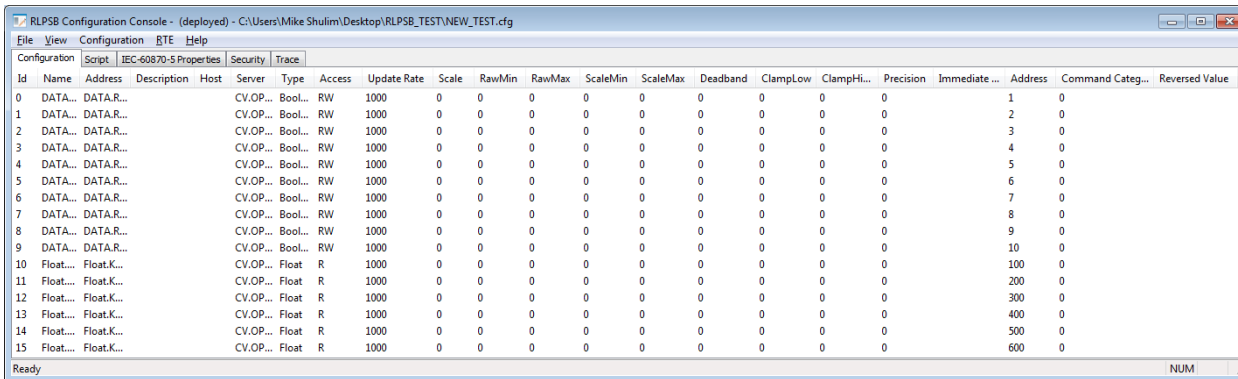


Clicking on Add Item(s) to the Configuration... will open OPC Browser interface



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You can select one or multiple items and click on **Add** button or right click on selected item(s) and click **Add** menu item. Clicking on **Close** button will unload OPC Browser interface.

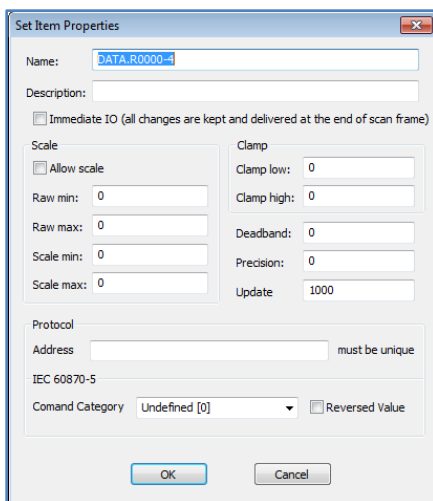


The screenshot shows the RLPSP Configuration Console window. The title bar indicates the file path: C:\Users\Mike Shulim\Desktop\RLPSB_TEST\NEW_TEST.cfg. The window has a menu bar (File, View, Configuration, RTE, Help) and a toolbar. Below the toolbar is a tabbed interface with 'Script', 'IEC-60870-5 Properties', 'Security', and 'Trace'. The 'Script' tab is active, displaying a table of OPC items. The table has columns: Id, Name, Address, Description, Host, Server, Type, Access, Update Rate, Scale, RawMin, RawMax, ScaleMin, ScaleMax, Deadband, ClampLow, ClampHi..., Precision, Immediate..., Address, Command Categ..., and Reversed Value. The table contains 15 rows of data, including various data points (DATA.R0000 to DATA.R0014) and float points (Float.K0000 to Float.K0014). The status bar at the bottom shows 'Ready' and 'NUM'.

Id	Name	Address	Description	Host	Server	Type	Access	Update Rate	Scale	RawMin	RawMax	ScaleMin	ScaleMax	Deadband	ClampLow	ClampHi...	Precision	Immediate...	Address	Command Categ...	Reversed Value
0	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		1	0	
1	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		2	0	
2	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		3	0	
3	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		4	0	
4	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		5	0	
5	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		6	0	
6	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		7	0	
7	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		8	0	
8	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		9	0	
9	DATA...	DATA.R...			CV.OP...	Bool...	RW	1000	0	0	0	0	0	0	0	0	0		10	0	
10	Float...	Float.K...			CV.OP...	Float	R	1000	0	0	0	0	0	0	0	0	0		100	0	
11	Float...	Float.K...			CV.OP...	Float	R	1000	0	0	0	0	0	0	0	0	0		200	0	
12	Float...	Float.K...			CV.OP...	Float	R	1000	0	0	0	0	0	0	0	0	0		300	0	
13	Float...	Float.K...			CV.OP...	Float	R	1000	0	0	0	0	0	0	0	0	0		400	0	
14	Float...	Float.K...			CV.OP...	Float	R	1000	0	0	0	0	0	0	0	0	0		500	0	
15	Float...	Float.K...			CV.OP...	Float	R	1000	0	0	0	0	0	0	0	0	0		600	0	

Modifying OPC Item Properties

You can modify the item property using menu or by right clicking on selected items and choosing “Change Properties of Selected Item(s)...”



The screenshot shows the 'Set Item Properties' dialog box. It has a title bar with a close button. The 'Name' field contains 'DATA.R0000'. The 'Description' field is empty. There is a checkbox for 'Immediate IO (all changes are kept and delivered at the end of scan frame)'. Below this are two sections: 'Scale' and 'Clamp'. The 'Scale' section has a checkbox for 'Allow scale' and fields for 'Raw min', 'Raw max', 'Scale min', and 'Scale max'. The 'Clamp' section has fields for 'Clamp low', 'Clamp high', 'Deadband', 'Precision', and 'Update'. At the bottom, there is a 'Protocol' section with an 'Address' field and a note 'must be unique'. Below that is the 'IEC 60870-5' section with a 'Command Category' dropdown set to 'Undefined [0]' and a checkbox for 'Reversed Value'. The dialog has 'OK' and 'Cancel' buttons at the bottom.

Item Properties

General

- Name - data input control (user configurable)
- Description - data input control (user configurable)
- Immediate IO - checkbox control (YES/NO)

Note: All changes are kept and delivered at the end of the scan frame – RLSLC event.

Scale

- Allow scale - checkbox control (enables/disables scaling)
- Raw min - data input control (specified raw minimum value of the input)

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- Raw max - data input control (specified raw maximum value of the input)
- Scale min - data input control (specified scaled minimum value of the input)
- Scale max - data input control (specified scaled maximum value of the input)

Clamp

- Clamp low - data input control (specified low value of input clamping)
- Clamp high - data input control (specified high value of input clamping)

Deadband

- Deadband - data input control (specifies deadband value of the input)

Precision

- Precision - data input control (specifies precision of the input)

Update Rate

- Update rate - data input control (specifies OPC Group update rate in milliseconds)

Protocol

- Address – data input control (see details on IEC 60870-5 and Modbus addressing)
 - The address specified must be unique with exception of LSB and MSB command category
 - If Empty value selected in **Address** data input this particular item will be ignored by the Slave protocol
- Command Category – dropdown control selector
 - <Multiple Values>
 - Undefined [0]
 - Double Point [1]
 - Step Position [2]
 - General Integrated Total [3]
 - Group1 Integrated Total [11]
 - Group2 Integrated Total [12]
 - Group3 Integrated Total [13]
 - Group4 Integrated Total [14]
 - Scaled Value [4]
 - Normalized Value [5]
 - LSB [6]
 - Lower Significant Bit for Double Points.
 - Applicable Only to Booleans
 - The same IEC-60870-5 address must be specified for LSB and MSB inputs

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- MSB [7]
 - Most Significant Bit for Double Points.
 - Applicable Only to Booleans
 - The same IEC-60870-5 address must be specified for LSB and MSB inputs
- Reversed Value – checkbox control (YES/NO) – Applicable only for Boolean data type

Modbus Item Properties

Set Item Properties

Name:

Description:

☐ Immediate IO (all changes are kept and delivered at the end of scan frame)

Scale

☐ Allow scale

Raw min:

Raw max:

Scale min:

Scale max:

Clamp

Clamp low:

Clamp high:

Deadband:

Precision:

Update:

Protocol

Address: must be unique

Modbus

Command Category: ☐ Reversed Value

OK Cancel

- Command Category – dropdown control selector
 - <Multiple Values>
 - Output Coils [0]
 - Input Coils [1]
 - Internal Registers [2]
 - Holding Registers [3]
 - Internal Registers Bits[4]
 - Holding Registers Bits [5]
- Reversed Value – checkbox control (YES/NO) – Applicable only for Boolean data type

Modbus Addressing

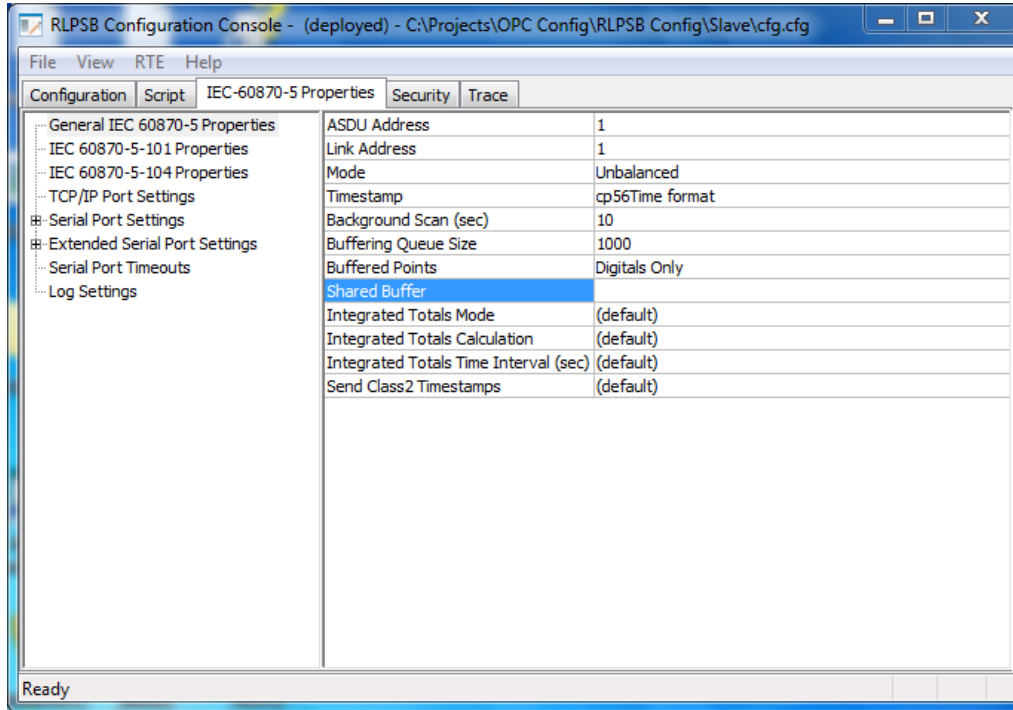
- Output Coils [1 to 65536]
- Input Coils [100001 to 165536]
- Internal Registers [300001 to 365536]
- Internal Registers Bits [300001:0 to 365536:15]
- Holding Registers [400001 to 465536]

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- Holding Registers Bits [400001:0 to 465536:15]

Configuring IEC 60870-5 Slave Protocol

IEC-60870-5 Properties Tab



General IEC 60870-5 Properties

Property	Description	Values
ASDU Address	The address of a particular sector of a physical device. The valid range is 0 to 254 or 0 to 65534, depending on whether the Common (ASDU) Address size setting is set to one or two octets.	Integer from 0 to 254 or from 0 to 65534
Link Address	This parameter identifies a session, which is a physical or logical device in the network. The valid range is 0 to 254 or 0 to 65534, depending on whether the Link Address Size setting is set to one or two octets.	Integer from 0 to 254 or from 0 to 65534
Mode	Specifies running mode of IEC 60870-5 Slave	Balanced = 0 Unbalanced = 1

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Timestamp	Timestamp format	Not supported = 0 cp16Time format = 1 cp24Time format = 2 cp56Time format = 3
Background Scan (sec)	The background scan is used to update process information from the controlled station to the controlling station as an additional safeguard to the station interrogation and spontaneous transmission procedures	Integer, time in milliseconds
Buffering Queue Size	Size of the buffering Queue, 0 means that buffering queue will not be used	Integer from 0 to 65534
Buffered Points	Specifies if buffering will be used for only digital values (signals) or for all values. This property is applicable only if Shared Buffer property is set.	Digitals Only = 0 All = 1
Shared Buffer	A comma separated pair of Master addresses that will share the buffering queue. The Master address could be either IP Address or a Serial Port. Examples of valid pairs: 192.168.1.22,Com1 or Com2,192.168.1.31 or Com1,Com2 or 192.168.1.22,192.168.1.31, for details, see Shared Buffer chapter below.	String
Integrated Totals Mode	Specifies Integrated Totals Mode	A = 0 B = 1 C = 2 D = 3
Integrated Totals Calculation	Specifies either Integrated Totals will be calculated on a Slave or on a Device	Slave = 0 Device = 1
Integrated Totals Time Interval (sec)	Specifies the time interval in second for Integrated Totals calculations	Integer, time in seconds
Send Class 2 Timestamps	Specifies if Slave will send Class 2 timestamps	Yes or No

IEC 60870-5-101 Properties

Property	Description	Values
Cause of Transmission	The Cause of Transmission data length, can be 1 or 2 octets (Bytes).	1 Byte = 0 2 Bytes = 1

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Length of ASDU address	ASDU Address Length, can be 1 or 2 octets (Bytes).	1 Byte = 1 2 Bytes = 2
Length of Information Object	Information Object Address Length, can be 1, 2 or 3 octets (Bytes).	1 Byte = 1 2 Bytes = 2 3 Bytes = 3
Length of link address	Length of link address, can be 1 or 2 octets (Bytes). "0" means link address is not used.	No Link = 0 1 Byte = 1 2 Bytes = 2
Master Inactivity Timeout	Time interval in milliseconds slave waits for any message from a Master. If no messages received Slave forces Master disconnect	Integer, time in milliseconds
Synchronization Timeout (default =1000) C_CS_NA_1	Time synchronization timeout in milliseconds.	Integer, time in milliseconds
Synchronization Time	Time (Local or UTC) used by the Slave when Time Synchronization command received from a Master	Local = 0 UTC = 1
Enable Synchronization	Enables or disables time synchronization	Disabled = 0 Enabled = 1
Send Class2 Timestamps	Specifies if Slave will send Class2 timestamps	No = 0 Yes = 1

IEC 60870-5-104 Properties

Property	Description	Values
Master Test Frame Timeout (multiplier)	Number of test frame intervals Slave waits for the test frames from a master before considering the Master disconnected. If "0" is specified Slave doesn't use Master's test frames for a disconnect detection.	Integer
Master Inactivity Timeout (msec)	Time interval in milliseconds slave waits for any message from a Master. If no messages received Slave forces Master disconnect	Integer, time in milliseconds
Cause of Transmission	The Cause of Transmission data length, can be 1 or 2 octets (Bytes).	0 = 1 Byte 1 = 2 Bytes

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Length of ASDU Address	ASDU Address Length, can be 1 or 2 octets (Bytes).	1 = 1 Byte 2 = 2 Bytes
Length of Information Object Address	Information Object Address length, can be 1, 2 or 3 octets (Bytes).	1 = 1 Byte 2 = 2 Bytes 3 = 3 Bytes
Slave Test Frame Frequency Interval (sec)	Time-out in seconds for sending test frames in case of a long idle state.	Integer, time in seconds

TCP/IP Port Settings

Settings	Values
TCP/IP Port	User Input

Serial Port Settings

Description	Values
Serial Port	1 to 255
Baud Rate	300 to 256000
Data Bits	5 6 7 8
Stop Bits	1 1,5 2
Parity	0 = No 1 = Odd 2 = Even 3 = Mark 4 = Space

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Extended Serial Port Settings

Description	Values
CTS (CLEAR-TO-SEND)	0 - NO 1 - YES
DSR (DATA-SET-READY)	0 - NO 1 - YES
DTR (DATA-TERMINAL-READY)	DISABLE = 0 ENABLE = 1 HANDSHAKE = 2
DSR SIGNAL SENSITIVE	0 - NO 1 - YES
CONTINUES ON XOFF	0 - NO 1 - YES
OUTX XON/XOFF FLOW CONTROL	0 - NO 1 - YES
INX XON/XOFF FLOW CONTROL	0 - NO 1 - YES
PARITY ERRORS	0 - NO 1 - YES
NULL BYTES ARE DISCARDED	0 - NO 1 - YES
RTS (REQUEST-TO-SEND)	DISABLE = 0 ENABLE = 1 HANDSHAKE = 2 TOGGLE = 3
XONLIM (MINIMUM NUMBER OF BYTES)	User Input
XOFFLIM (MINIMUM NUMBER OF FREE BYTES)	User Input
XONCHAR (VALUE OF THE XON CHARACTER)	User Input

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XOFFCHAR (VALUE OF THE XOFF CHARACTER)	User Input
ERRORCHAR (REPLACE BYTES RECEIVED WITH A PARITY ERROR)	User Input
EOFCHAR (CHARACTER USED TO SIGNAL THE END OF DATA)	User Input
EVTCHAR (VALUE OF THE CHARACTER USED TO SIGNAL AN EVENT)	User Input
RTSTIMEOUT (PREAMBLE)	User Input
DTRTIMEOUT (POSTAMBLE)	User Input

Note: Preamble and Postamble are usually required when the modem communication is used. Recommended settings are:

- DTR = Disabled
- RTS = Disabled
- PREAMBLE = 60
- POSTAMBLE = 30

Serial Port Timeouts

Description	Values
Read Interval Timeout	User Input (Default = 200)
Read Total Timeout	User Input (Default = 30)
Read Total Timeout Multiplier	User Input (Default = 5000)
Write Total Timeout	User Input (Default = 30)
Write Total Timeout Multiplier	User Input (Default = 1000)

Log Settings

Description	Values
Enable Logging	0 – NO 1 - YES
Path to Log File(s)	User Selectable
Log Verbosity	User Selectable from 1 to 9

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Max Number of Files	User Input
Log File Duration (Hour)	User Input

Shared Buffer

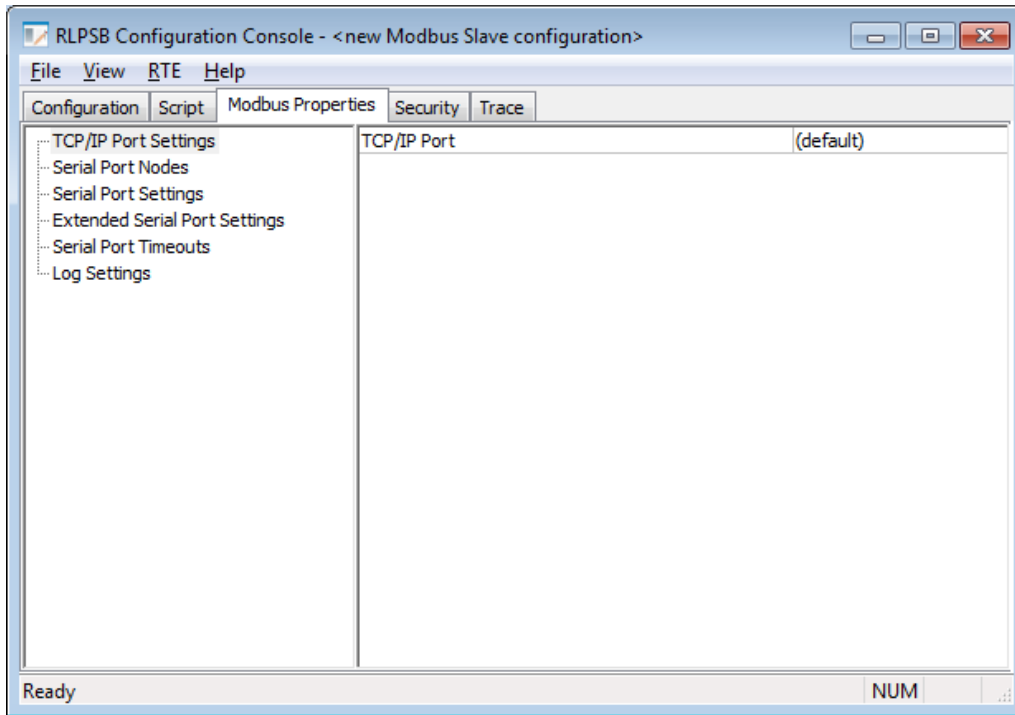
ReLab's IEC-60870 Slave provides Shared buffer capability. User can specify a pair of Masters' addresses and the Slave will send data from the buffered queue to a Master that is currently connected to the Slave.

This allows two Masters to work in interchangeable mode, meaning if one Master fails, another Master can connect to the Slave and receive the intended data.

Note the following:

- Only one Master out of the pair specified should be connected to the Slave at any given time
- Data from the buffer that was sent to one Master will not be sent to another one
- The Slave doesn't manage Masters' redundancy

Modbus Properties Tab



TCP/IP Port Settings

Settings	Values
TCP/IP Port	User Input

Serial Port Nodes

Description	Values
Node From	User Input
Node To	User Input

Serial Port Settings

Description	Values
Serial Port	1 to 255
Baud Rate	300 to 256000
Data Bits	5 6

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	7 8
Stop Bits	1 1,5 2
Parity	0 = No 1 = Odd 2 = Even 3 = Mark 4 = Space

Extended Serial Port Settings

Description	Values
CTS (CLEAR-TO-SEND)	0 - NO 1 - YES
DSR (DATA-SET-READY)	0 - NO 1 - YES
DTR (DATA-TERMINAL-READY)	DISABLE = 0 ENABLE = 1 HANDSHAKE = 2
DSR SIGNAL SENSITIVE	0 - NO 1 - YES
CONTINUES ON XOFF	0 - NO 1 - YES
OUTX XON/XOFF FLOW CONTROL	0 - NO 1 - YES
INX XON/XOFF FLOW CONTROL	0 - NO 1 - YES
PARITY ERRORS	0 - NO 1 - YES

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NULL BYTES ARE DISCARDED	0 – NO 1 - YES
RTS (REQUEST-TO-SEND)	DISABLE = 0 ENABLE = 1 HANDSHAKE = 2 TOGGLE = 3
XONLIM (MINIMUM NUMBER OF BYTES)	User Input
XOFFLIM (MINIMUM NUMBER OF FREE BYTES)	User Input
XONCHAR (VALUE OF THE XON CHARACTER)	User Input
XOFFCHAR (VALUE OF THE XOFF CHARACTER)	User Input
ERRORCHAR (REPLACE BYTES RECEIVED WITH A PARITY ERROR)	User Input
EOFCHAR (CHARACTER USED TO SIGNAL THE END OF DATA)	User Input
EVTCHAR (VALUE OF THE CHARACTER USED TO SIGNAL AN EVENT)	User Input
RTSTIMEOUT (PREAMBLE)	User Input
DTRTIMEOUT (POSTAMBLE)	User Input

Note: **Preamble** and **Postamble** are usually required when the modem communication is used.

- **DTR = Disabled**
- **RTS = Disabled**
- **PREAMBLE = 60**
- **POSTAMBLE = 30**

Serial Port Timeouts

Description	Values
Read Interval Timeout	User Input (Default = 200)
Read Total Timeout	User Input (Default = 30)
Read Total Timeout Multiplier	User Input (Default = 5000)

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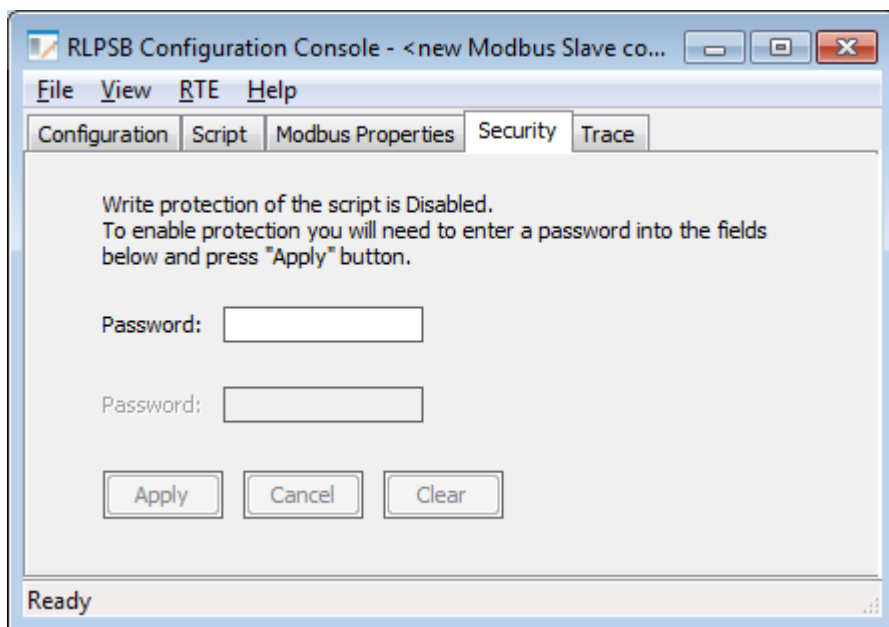
Write Total Timeout	User Input (Default = 30)
Write Total Timeout Multiplier	User Input (Default = 1000)

Log Settings

Description	Values
Enable Logging	0 – NO 1 - YES
Path to Log File(s)	User Selectable
Log Verbosity	User Selectable
Max Number of Files	User Input
Log File Duration (Hour)	User Input

Security Tab

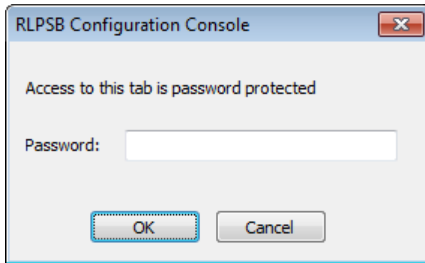
The security tab enables or disables custom scripting engine.



- In order to enable password protection Password and Confirm fields must be populated.
- Clicking on Apply button will set password protection
- Project Save is required

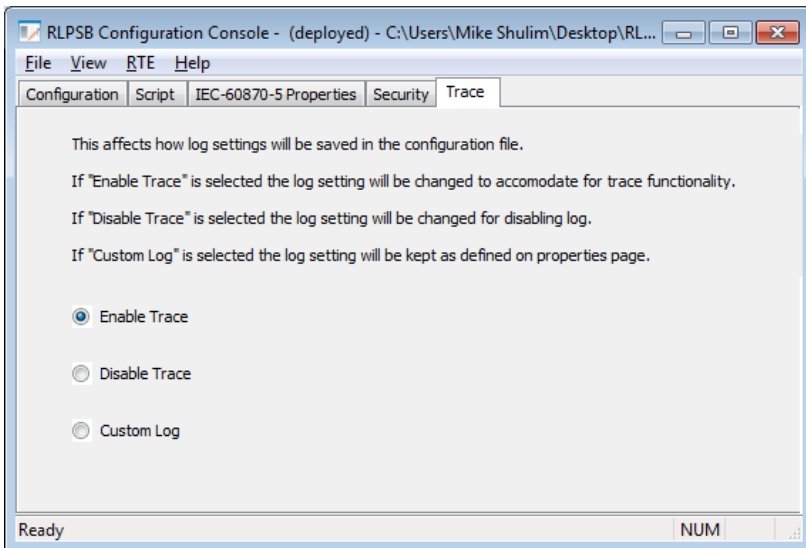
If protection is enabled the the user must enter a correct password to enter into scripting editor

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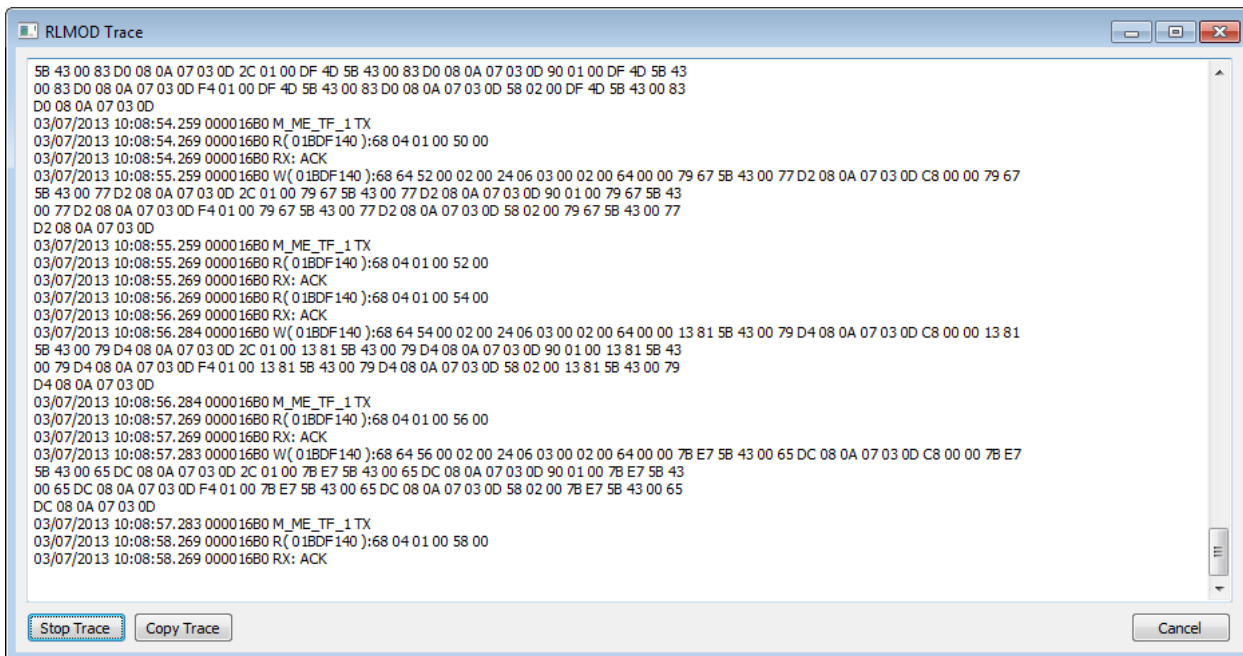


Trace Tab

The trace tab provides ability to control behavior of the trace



If the **Trace** is enabled the user can open the trace dialog window from the menu **RTE** and selecting **Show Trace** which provides tracing protocol messages.



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- **Start/Stop Trace** button – starts or stops the trace
- **Copy Trace** button – copies the current trace to the clipboard
- **Cancel** button – closes the interface

Menu

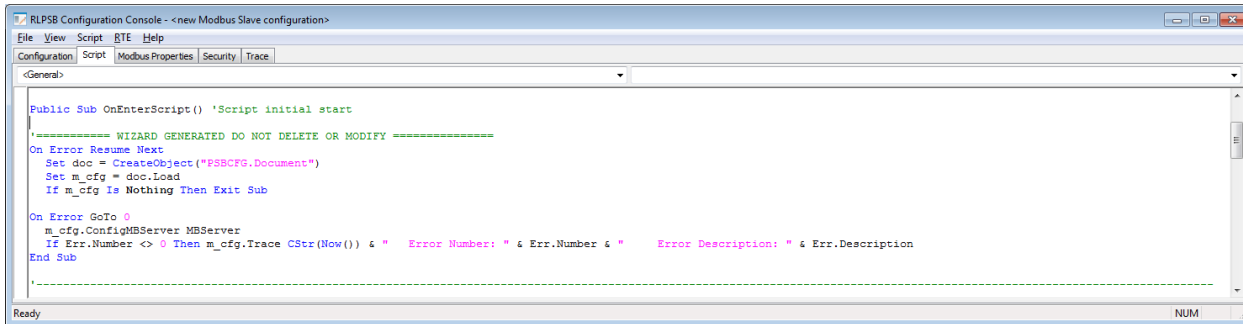
File New Load Open... Save Save As ... Deploy Exit		Creates new configurations (Modbus or IEC-60870-5) Loads previously saved and Deployed Project Opens existing project Saves current project Saves project under user specified name and location Deploys currently saved project Exits the application
View <input checked="" type="checkbox"/> Status Bar		Enables or disables the status bar
Configuration Add Item(s) to the Configuration ... Delete Selected Item(s) from the Configuration Change Properties of Selected Item(s) ...		Adds OPC Items to current configuration Deletes selected OPC item(s) Opens OPC properties interface
Script Replace Item Name(s) with Item ID(s) Replace Item ID(s) with Item Name(s) Verify Script Syntax		Replaces OPC Item Name(s) with ID(s) Replaces OPC Item ID(s) with Item Name(s) Verifies Script Syntax
RTE Suspend Resume Show Trace Options ...		Suspends project execution Resumes project execution Opens the protocol trace window Configuring run time options
Help Contents About RLPSB Configuration Console...		Help About

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Advanced Features

Scripting

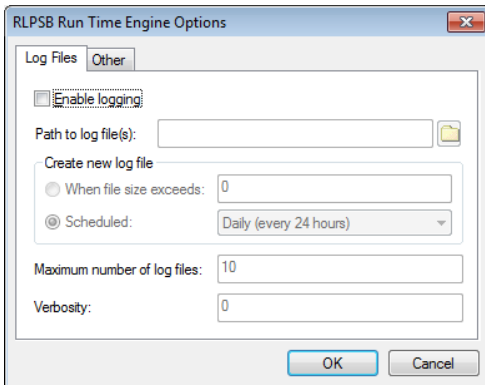
Application required scripts are Wizard generated and therefore it cannot be deleted or modified. The advanced users have ability to create custom scripts (VBScript).



RTE Options

“Log Files” Tab

The user can enable Run Time Engine logging for troubleshooting purposes.

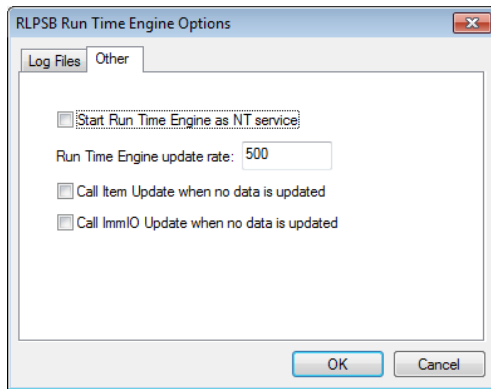


“Other” Tab

The user can run application as NT Service

The Run Time Engine update rate can be modified

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Appendix A – Extended Serial Port Properties

fOutxCtsFlow - If this member is TRUE, the CTS (clear-to-send) signal is monitored for output flow control. If this member is TRUE and CTS is turned off, output is suspended until CTS is sent again.

fOutxDsrFlow - If this member is TRUE, the DSR (data-set-ready) signal is monitored for output flow control. If this member is TRUE and DSR is turned off, output is suspended until DSR is sent again.

fDtrControl - The DTR (data-terminal-ready) flow control. This member can be one of the following values.

Value	Meaning
DTR_CONTROL_DISABLE 0x00	Disables the DTR line when the device is opened and leaves it disabled.
DTR_CONTROL_ENABLE 0x01	Enables the DTR line when the device is opened and leaves it on.
DTR_CONTROL_HANDSHAKE 0x02	Enables DTR handshaking. If handshaking is enabled, it is an error for the application to adjust the line by using the EscapeCommFunction function.

fDsrSensitivity - If this member is TRUE, the communications driver is sensitive to the state of the DSR signal. The driver ignores any bytes received, unless the DSR modem input line is high.

fTXContinueOnXoff - If this member is TRUE, transmission continues after the input buffer has come within **XoffLim** bytes of being full and the driver has transmitted the **XoffChar** character to stop receiving bytes. If this member is FALSE, transmission does not continue until the input buffer is within **XonLim** bytes of being empty and the driver has transmitted the **XonChar** character to resume reception.

fOutX - Indicates whether XON/XOFF flow control is used during transmission. If this member is TRUE, transmission stops when the **XoffChar** character is received and starts again when the **XonChar** character is received.

fInX - Indicates whether XON/XOFF flow control is used during transmission. If this member is TRUE, transmission stops when the **XoffChar** character is received and starts again when the **XonChar** character is received.

fErrorChar - Indicates whether bytes received with parity errors are replaced with the character specified by the **ErrorChar** member. If this member is TRUE and the **fParity** member is TRUE, replacement occurs.

fNull - If this member is TRUE, null bytes are discarded when received.

fRtsControl - The RTS (request-to-send) flow control. This member can be one of the following values.

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Value	Meaning
RTS_CONTROL_DISABLE 0x00	Disables the RTS line when the device is opened and leaves it disabled.
RTS_CONTROL_ENABLE 0x01	Enables the RTS line when the device is opened and leaves it on.
RTS_CONTROL_HANDSHAKE 0x02	Enables RTS handshaking. The driver raises the RTS line when the "type-ahead" (input) buffer is less than one-half full and lowers the RTS line when the buffer is more than three-quarters full. If handshaking is enabled, it is an error for the application to adjust the line by using the EscapeCommFunction function.
RTS_CONTROL_TOGGLE 0x03	Specifies that the RTS line will be high if bytes are available for transmission. After all buffered bytes have been sent, the RTS line will be low.

XonLim - The minimum number of bytes in use allowed in the input buffer before flow control is activated to allow transmission by the sender. This assumes that either XON/XOFF, RTS, or DTR input flow control is specified in the **fInX**, **fRtsControl**, or **fDtrControl** members.

XoffLim - The minimum number of free bytes allowed in the input buffer before flow control is activated to inhibit the sender. Note that the sender may transmit characters after the flow control signal has been activated, so this value should never be zero. This assumes that either XON/XOFF, RTS, or DTR input flow control is specified in the **fInX**, **fRtsControl**, or **fDtrControl** members. The maximum number of bytes in use allowed is calculated by subtracting this value from the size, in bytes, of the input buffer.

XonChar - The value of the XON character for both transmission and reception.

XoffChar - The value of the XOFF character for both transmission and reception.

ErrorChar - The value of the character used to replace bytes received with a parity error.

EofChar - The value of the character used to signal the end of data.

EvtChar - The value of the character used to signal an event

RTSTimeout - RTS timeout – Preamble

DTRTimeout - DTR timeout – Postamble

Appendix B – IEC 60870-5 Slave Interoperability

Transmission speed (control direction)					
Unbalanced interchange Circuit V.24/V.28 Standard		Unbalanced interchange Circuit V.24/V.28 Recommended if >1 200 bit/s		Balanced interchange Circuit X.24/X.27	
	100 bit/s	X	2400 bit/s	X	2400 bit/s
	200 bit/s	X	4800 bit/s	X	4800 bit/s
X	300 bit/s	X	9600 bit/s	X	9600 bit/s
X	600 bit/s			X	19200 bit/s
X	1200 bit/s			X	38400 bit/s
				X	56000 bit/s
				X	64000 bit/s

Transmission speed (monitor direction)					
Unbalanced interchange Circuit V.24/V.28 Standard		Unbalanced interchange Circuit V.24/V.28 Recommended if >1 200 bit/s		Balanced interchange Circuit X.24/X.27	
	100 bit/s	X	2400 bit/s	X	2400 bit/s
	200 bit/s	X	4800 bit/s	X	4800 bit/s
X	300 bit/s	X	9600 bit/s	X	9600 bit/s
X	600 bit/s			X	19200 bit/s
X	1200 bit/s			X	38400 bit/s
				X	56000 bit/s
				X	64000 bit/s

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Link layer					
Link transmission procedure		Address field of the link		Frame length	
X	Balanced transmission	X	Not present (balanced transmission only)	255	Maximum length L (control direction)
X	Unbalanced transmission	X	One octet	255	Maximum length L (monitor direction)
X	300 bit/s	X	Two octets		
X	600 bit/s		Structured		
X	1200 bit/s		Unstructured		

☒ The standard assignment of ASDUs to class 2 messages is used as follows:

Type identification	Cause of transmission
All	<2>
All	<20>
5,6,7,8,9,10,13,14,15,16,32,33,34,36,37	<3>

Application layer					
Common address of ASDU		Information object address		Cause of transmission	
X	One octet	X	One octet	X	One octet
X	Two octets	X	Two octets	X	Two octets (with originator address) Originator address is set to zero if not used
		X	Three octets		
			Structured		
			Unstructured		

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Process information in monitor direction			
No.	Description	Command	▼
1	Single-point information	M_SP_NA_1	X
2	Single-point information with time tag	M_SP_TA_1	X
3	Double-point information	M_DP_NA_1	X
4	Double-point information with time tag	M_DP_TA_1	X
5	Step position information	M_ST_NA_1	X
6	Step position information with time tag	M_ST_TA_1	X
7	Bitstring of 32 bit	M_BO_NA_1	X
8	Bitstring of 32 bit with time tag	M_BO_TA_1	X
9	Measured value, normalized value	M_ME_NA_1	X
10	Measured value, normalized value with time tag	M_ME_TA_1	X
11	Measured value, scaled value	M_ME_NB_1	X
12	Measured value, scaled value with time tag	M_ME_TB_1	X
13	Measured value, short floating point value	M_ME_NC_1	X
14	Measured value, short floating point value with time tag	M_ME_TC_1	X
15	Integrated totals	M_IT_NA_1	X
16	Integrated totals with time tag	M_IT_TA_1	X
17	Event of protection equipment with time tag	M_EP_TA_1	X
18	Packed start events of protection equipment with time tag	M_EP_TB_1	
19	Packed output circuit information of protection equipment with time tag	M_EP_TC_1	
20	Packed single-point information with status change detection	M_PS_NA_1	
21	Measured value, normalized value without quality descriptor	M_ME_ND_1	
30	Single-point information with time tag CP56Time2a	M_SP_TB_1	X
31	Double-point information with time tag CP56Time2a	M_DP_TB_1	X

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32	Step position information with time tag CP56Time2a	M_ST_TB_1	X
33	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1	X
34	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1	X
35	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1	X
36	Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1	X
37	Integrated totals with time tag CP56Time2a	M_IT_TB_1	X
38	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1	
39	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1	
40	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1	

Process information in control direction

No.	Description	Command	▼
45	Single command	C_SC_NA_1	X
46	Double command	C_DC_NA_1	X
47	Regulating step command	C_RC_NA_1	X
48	Set point command, normalized value	C_SE_NA_1	X
49	Set point command, scaled value	C_SE_NB_1	
50	Set point command, short floating point value	C_SE_NC_1	X
51	Bitstring of 32 bit	C_BO_NA_1	X

System information in control direction

No.	Description	Command	▼
100	Interrogation command	C_IC_NA_1	X
101	Counter interrogation command	C_DC_NA_1	
102	Read command	C_RD_NA_1	

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103	Clock synchronization command	C_CS_NA_1	X
104	Test command	C_TS_NA_1	
105	Reset process command	C_RP_NA_1	
106	Delay acquisition command	C_CD_NA_1	

Parameter in control direction

No.	Description	Command	▼
110	Parameter of measured value, normalized value	P_ME_NA_1	
111	Parameter of measured value, scaled value	P_ME_NB_1	
112	Parameter of measured value, short floating point value	P_ME_NC_1	
113	Parameter activation	P_AC_NA_1	

File transfer

No.	Description	Command	▼
120	File ready	F_FR_NA_1	
121	Section ready	F_SR_NA_1	
122	Call directory, select file, call file, call section	F_SC_NA_1	
123	Last section, last segment	F_LS_NA_1	
124	Ack file, ack section	F_AF_NA_1	
125	Segment	F_SG_NA_1	
126	Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1	

Basic application functions

Description	▼
Station initialization	

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Cyclic data transmission	X
Read procedure	
Spontaneous transmission	X
Station interrogation (Global)	X
Direct command transmission	X
Direct set point command transmission	X
Background scan	X

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Appendix C – Modbus Slave

Modbus Registers

Address Type	Decimal Range	Hex Range	Data Type	Client Access
Output Coils	000001 - 065536	H000001 - H0FFFF	Boolean	Read/Write
Input Coils	100001 - 165536	H100001 - H1FFFF	Boolean	Read Only
Internal Registers	300001 - 365536	H300001 - H310000	Word	Read Only
Holding Registers	400001 - 465536	H400001 - H410000	Word	Read/Write

Modbus Registers Data Type

Address Type	Data Type	Registers Num	Notes
Output Coils	Boolean	1	Single bit
Input Coils	Boolean	1	Single bit
Internal Registers	Byte	1	
Internal Registers	Char	1	
Internal Registers	Word	1	Unsigned 16 bit value bit 0 is the low bit and bit 15 is the high bit (default)
Internal Registers	Short	1	Signed 16 bit value bit 0 is the low bit bit 14 is the high bit and bit 15 is the sign bit
Internal Registers	DWord	2	Unsigned 32 bit value bit 0 is the low bit and bit 31 is the high bit
Internal Registers	Integer	2	
Internal Registers	Long	2	Signed 32 bit value bit 0 is the low bit and bit 30 is the high bit and bit 31 is the sign bit
Internal Registers	Float	2	32 bit floating point value
Internal Registers	Double	4	
Internal Registers	String	1	Two characters per register

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Internal Registers	Date	4	
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Modbus Register Types

Address Type	Data Type	Registers Num	Script Interface	Notes
Holding Registers	Byte	1	17	
Holding Registers	Char	1	16	
Holding Registers	Word	1	18	Unsigned 16 bit value bit 0 is the low bit and bit 15 is the high bit (default)
Holding Registers	Short	1	2	Signed 16 bit value bit 0 is the low bit bit 14 is the high bit and bit 15 is the sign bit
Holding Registers	DWord	2	19	Unsigned 32 bit value bit 0 is the low bit and bit 31 is the high bit
Holding Registers	Integer	2	3	
Holding Registers	Long	2	3	Signed 32 bit value bit 0 is the low bit and bit 30 is the high bit and bit 31 is the sign bit
Holding Registers	Float	2	4	32 bit floating point value
Holding Registers	Double	4	5	
Holding Registers	String	1	8	characters per register
Holding Registers	Date	4	7	

Modbus Internal Registers & Holding Registers Bit Access

First bit of Modbus register 4001C equals to $262172 * 16 + 15$ and the last bit of Modbus register 4001C equals to $262172 * 16 + 1$