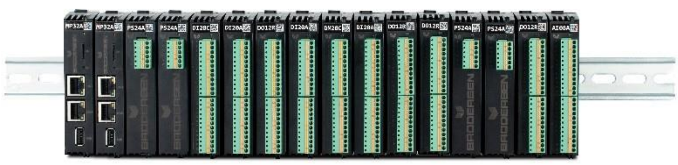
RTU32M Series

Modular RTU, PLC and Utility Controller

User Manual

Doc: 40431 ver. 117



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Customer Information

1.1 Copyright Notice

1.2 Trademark Acknowledgement

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1.3 Disclaimer

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As used herein:
1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into body, or (b) support or sustain life and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

1.5 Brodersen Customer Services

Your satisfaction is our primary concern. Here is a guide to Brodersen customer services. To ensure you get the full benefit of our services, please follow the instructions below carefully.

1.6 Technical Support

We want you to get the maximum performance from your products. If you run into technical difficulties, we are here to help. For the most frequently asked questions, you can easily find answers in the product documentation. These answers are normally a lot more in detail. Please consult this manual first.
To receive the latest version of the user manual, please visit our Web site at:

http://www.brodersen.com,
Choose the product in question under product search and under each product you will find accompanying data sheets, manuals, and user guides etc.
If you still cannot find the answer, gather all the information or questions that apply to your problem, and with the product close at hand, call your dealer. Our distributors are well trained and ready to give you the support you need to get the most from your Brodersen products.
In addition, technical support is available from Brodersen engineers every business day. We are always ready to give advice on application requirements or specific information on the installation and operation of any of our products. Please do not hesitate to call or e-mail us on support@brodersen.com

1.7 Product Warranty

Brodersen warrants you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Brodersen, or which have been subject to misuse, abuse, accident or improper installation. Brodersen assumes no liability under the terms of this warranty as a consequence of such events. Because of Brodersen's high quality control standards and rigorous testing, most of our customers never need to use our repair service. If a Brodersen product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time, and freight. Please consult your distributor for more details. If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, Product type and s/n, hardware and software version etc.) Note anything abnormal and describe the error in a product failure report.
2. Call your distributor and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, make arrangements with your distributor about this.
4. Carefully pack the defective product, a complete failure report and a photocopy of proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Ship it to your distributor.

2 Introduction

2.1 RTU32M – The modular Brodersen RTU, PLC and Industrial Controller

The Brodersen RTU32M series is based on a 32-bit i.Mx6 ARM Cortex-A7 for CPU Rev A,B,C and 64-bit NXP i.MX8Plus 1.8 GHz, for Rev D providing a small footprint modular RTU and PLC with leading edge functionality.

As well as being a versatile RTU and PLC with flexible I/O designed to perform embedded data processing, control, data logging and monitoring, it is also a networking communicator for collecting, managing and communicating data via protocols on different physical interfaces upwards and downwards in an industrial environment.

Typical applications for the RTU32M are:

- Control and monitoring of water and wastewater pump stations
- Substation automation applications
- Railway level crossing monitoring
- Communication Gateway applications between SCADA protocols – including Modbus, DNP3 and IEC60870.

The RTU32M hardware platform includes a 200-900MHz CPU with 128-256MB RAM and integrated 128MB NAND Flash. In addition, an optional removable microSD Flash card (default is 4GB, supports up to 64GB), provides an easy-to-use portable access/upgrade option. The integrated Flash stores the main RTU32 firmware including embedded Linux OS and your PLC runtime application. Standard drivers like the Modbus Protocol Suite, IEC60870 or DNP3 are stored in the integrated NAND Flash. The removable microSD card can be used for storing backup files and data logging files, or as the 'boot source'. When the SD card is used as the boot source, all firmware and applications are then stored on the SD card, allowing for easy 'swap and go' (simply move the SD card to another CPU module if required).

2.2 Webserver configuration and PLC programming in all IEC61131 languages

The RTU32M, like the other RTU32 Series of RTUs is configured via the integrated Webserver. Settings like LAN port addressing, time functions and 3g/4g modem credentials are handled in webpages. Online monitoring of connected physical I/O and display of graphical overviews is possible via webpages.

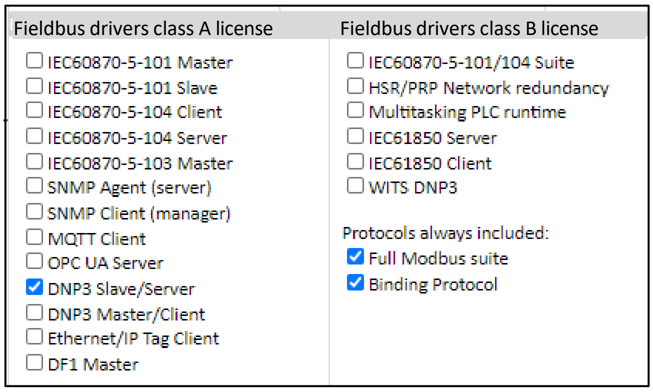
Programming of logic functions and configuration of communications drivers is managed using the Brodersen WorkSuite® software. WorkSuite® is a powerful tool that is used for configuration and programming of all RTU32 Series products. Applications developed and running in the RTU32M will easily run in other RTU32 Series products. The WorkSuite® software package will run in demo mode without any license (with some runtime restrictions).

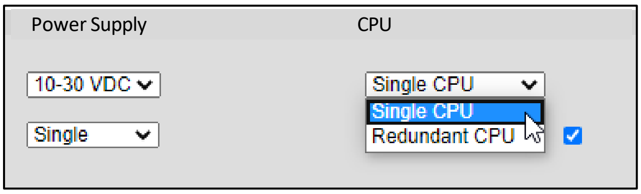
3 Online RTU Configurator Tool

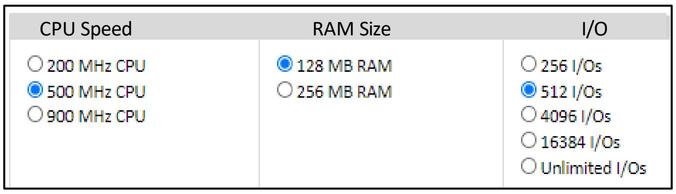
The Brodersen website includes an Online RTU Configurator tool that allows creation of RTU32N and RTU32M setups. It is recommended that you try using the configurator before attempting any RTU setup or logic programming as it provides a good overview of the RTU32M functionality. The configurator will step you through selection of power supply and CPU options and show how the various hardware items such as backplanes and I/O modules are used to create modular RTU solutions.

https://brodersen.com/RTUConfigurator/

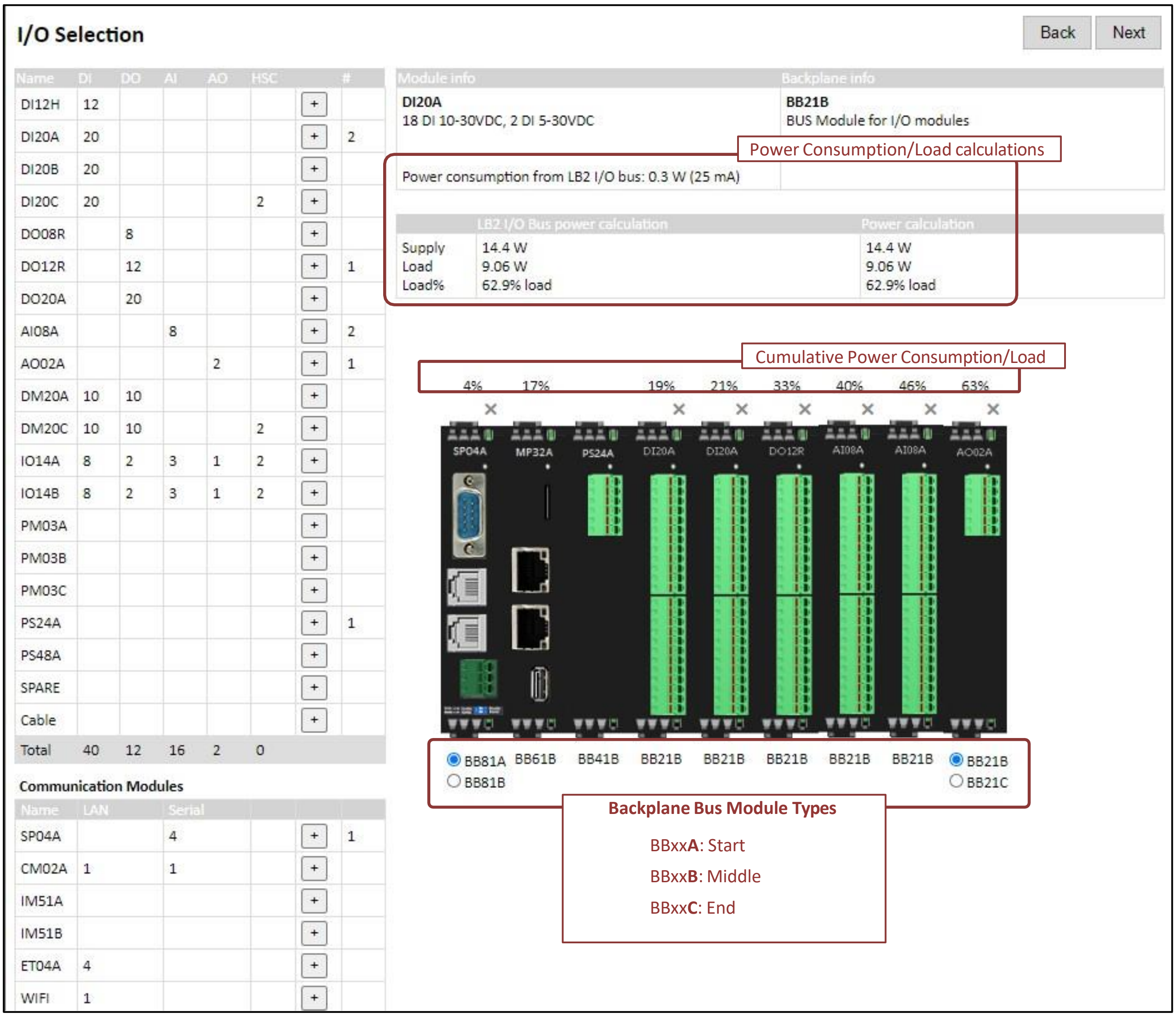
Select Power Supply, CPU and Protocol/Driver options.







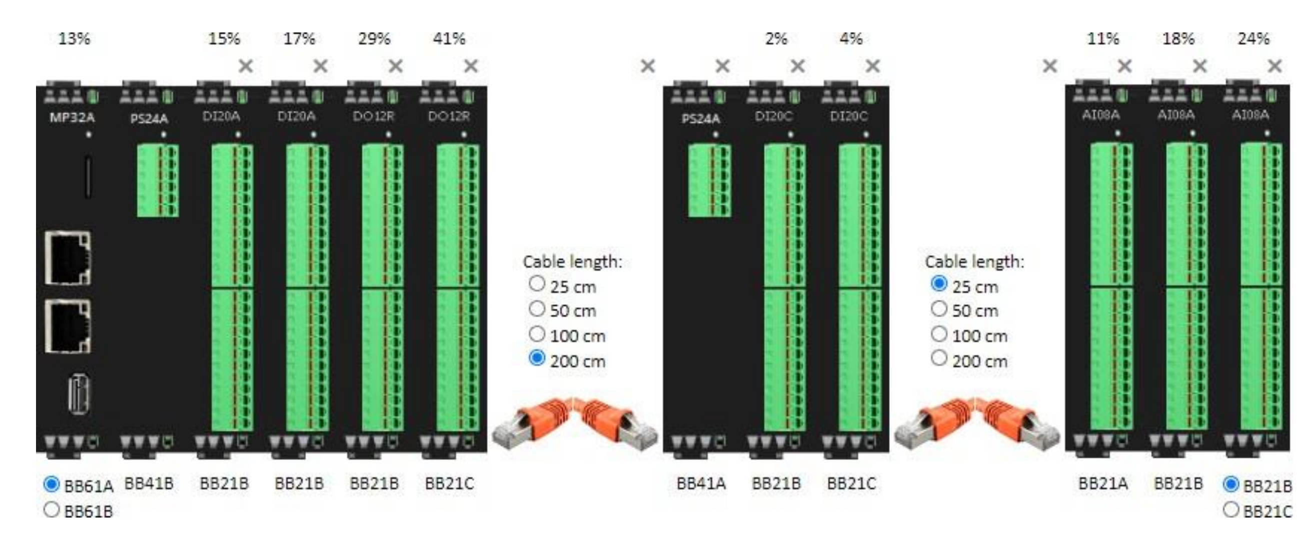
Select I/O modules, backplanes and additional power supply and communications modules as required.



Name	DI	DO	AI	AO	HSC		#
DI12H	12					+	
DI20A	20					+	2
DI20B	20					+	
DI20C	20				2	+	
DO08R		8				+	
DO12R		12				+	1
DO20A		20				+	
AI08A			8			+	2
AO02A				2		+	1
DM20A	10	10				+	
DM20C	10	10			2	+	
IO14A	8	2	3	1	2	+	
IO14B	8	2	3	1	2	+	
PM03A						+	
PM03B						+	
PM03C						+	
PS24A						+	1
PS48A						+	
SPARE						+	
Cable						+	
Total	40	12	16	2	0		

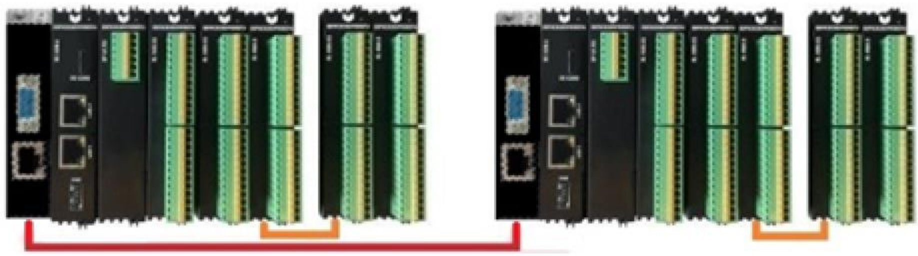
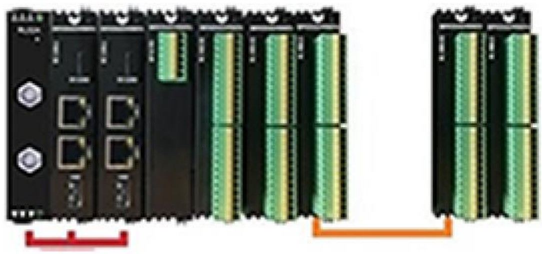
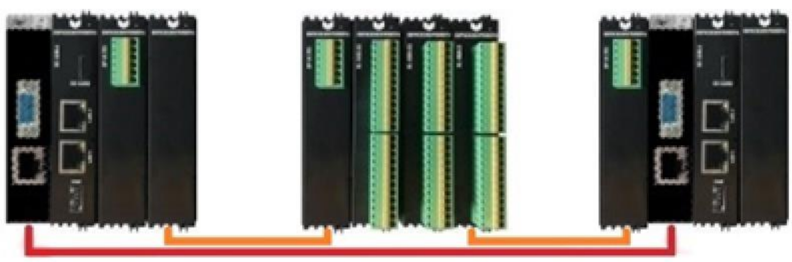
Name	LAN	Serial		#
SP04A		4	+	1
CM02A	1	1	+	
IM51A			+	
IM51B			+	
ET04A	4		+	
WIFI	1		+	

You are also able to split the backplane bus if required (a power supply is needed to start a new segment if the load is high).



The Configurator also allows selection of redundancy modes if required.

RTU32M Redundancy Variants

RTU32M Redundancy variant	Description
	Redundant CPUs and with identical redundant I/Os. CPUs are connected together with CM02A device and cables.
	Redundant CPUs with shared I/Os. CPUs are placed next to each other and to the left of I/Os. CPUs are connected together with REDLINK device.
	Redundant CPUs with shared I/Os. The shared I/Os are between the CPUs. CPUs are connected together with CM02A device and cables.

4 Getting Started

4.1 Configuration and default settings

The LAN interface on the RTU32M is set to its factory default settings at delivery:

LAN1: 192.168.0.1, Subnet: 255.255.255.0

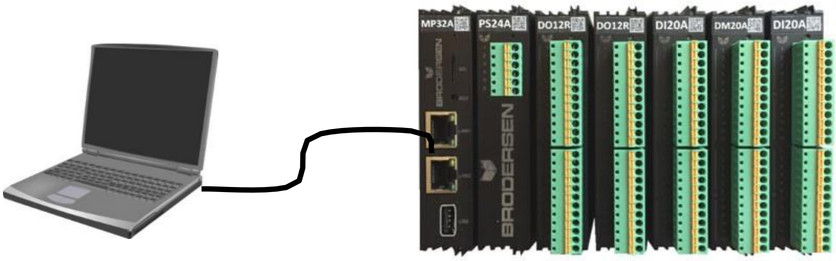
You can use the LAN1 interface to configure the basic settings in the RTU32M. The basic settings include setup of network parameters such as IP addresses, Subnet masks, default gateways, time settings, usernames and passwords for accessing the web server pages and file system with SFTP, SSH etc.

The configuration is done via web pages in the RTU32M Web Server. You must use your normal web browser to setup the basic settings for the RTU32M. The web pages are optimized for MS Internet Explorer/Edge, Firefox and Chrome. If you are experiencing problems with using the latest MS Internet Explorer/Edge version, please enable Compatibility settings in the browser.

5 How to connect and prepare your PC to configure the RTU32M

5.1 LAN Port Connection

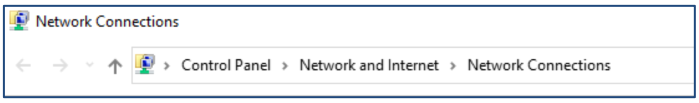
Use a cross-wired or standard patch cable to connect your PC Ethernet interface to the LAN1 Ethernet interface of the RTU.



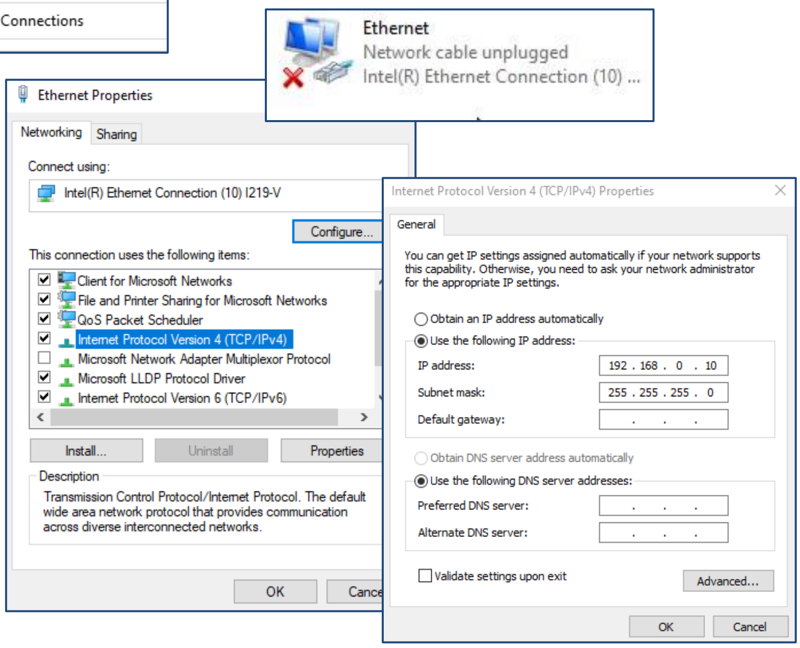
5.2 Setting up your PC Ethernet driver (Windows 10 example shown)

Your PC Ethernet driver must be setup to work in the same network segment as the LAN interface on the RTU32 if you want to connect with LAN1 which has a default IP address of 192.168.0.1. You must setup your PC Ethernet TCP/IP driver to work in the segment IP 192.168.0.x. Alternatively, you can connect with LAN 2 which is set to DHCP by default. To connect via LAN2 you must have an appropriate router/DHCP server (you can use the RTU32 Search Tool that installs with WorkSuite® to discover the RTU or connect to your router diagnostic interface to find the IP address allocated to LAN2).

To setup your PC Ethernet driver to connect via Lan1, select *start – Settings – Network & Internet* and select *Change adapter options*.



Select *Properties* of the appropriate adapter and then Click on *Internet Protocol Version 4 (TCP/IPv4)* and select *Properties*. A new window for setting the PC IP address will appear. Set an IP address in the same segment as the selected LAN IP address, for example 192.168.0.10 as shown here below.



NOTE: If you need to re-configure your Ethernet TCP/IP driver back to initial settings, it is recommended that you note the settings before you change them.

Click *OK* and *OK* again - now your PC Ethernet driver is setup for communicating with the RTU32M via LAN1.

5.3 Applying power to the RTU32M

Power is applied to the RTU32M power supply module via the 6 way power connector at the front of the module. Wait for the RTU32M to boot up – it takes approx. 20s. The amber Power LED on the power supply will indicate the status of the power supply.

5.4 Module status LEDs and flashing codes.

A two color (red/yellow) LED is provided on each module. This indicates the module status with different blinking patterns. The yellow color indicates the module mode (run, stop). The red color indicates module errors or warnings. Each pattern / color will operate in 2 second duty cycles. When the red LED is inactive (off), only the 2 second yellow duty cycle will operate (yellow is always active). When the red LED is active, a switch between 2 seconds of yellow, and 2 seconds of red patterns will occur.

5.4.1 Module LED pattern

LED	**Pattern**
Off	LED is constantly off
On	LED is constantly on
Blinking	LED is flashing, 200 ms on, 200 ms off
Flickering	LED is flashing, 50 ms on, 50 ms off
Single Flash	LED pattern is, 200 ms on, 1800 ms off
Double Flash	LED pattern is, 200 ms on, 200 ms off, 200 ms on, 1400 ms off
Triple Flash	LED pattern is, 200 ms on 200 ms off, 200 ms on 200 ms off, 200 ms on 1000 ms off
Quadruple Flash	LED pattern is, 200 ms on 200 ms off, 200 ms on 200 ms off, 200 ms on 200 ms off, 200 ms on 600 ms off

5.4.2 Yellow I/O module LED Codes

Yellow LED	**Pattern Description**
Off	**No module power**
On	Module is **Operational** mode.
Blinking	Module is in Operational Timeout, caused by missing RTU heartbeat “timeout from CPU to I/O module”. Outputs will be managed according to failsafe configuration (Last state, forced On, forced Off)
Flickering	**NA**
Single Flash	No valid node ID. Normal after power up.
Double Flash	Module is assigned a valid node ID, and is **Stopped**.
Triple Flash	**NA**
Quadruple Flash	Module is in firmware update mode.

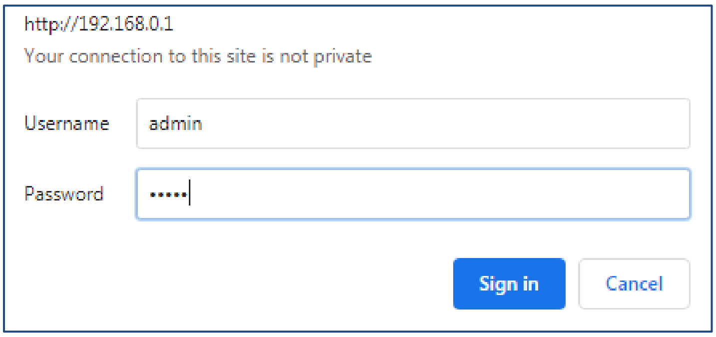
5.4.3 RED I/O module LED Codes

Red LED	**Pattern Description**
Off	No warnings or errors.
On	Module LB2 communication error. A number of LB2 communication errors has occurred, which has caused the LB2 error counters to reach the error level. The module will automatically stop any transmission on the bus, to prevent LB2 bus corruption for other modules (nodes). The module will still listen for NMT commands, and a communication reset command will reconfigure module, if the error was temporary.
Blinking	**NA**
Flickering	Corrupted module information / calibration data in EEPROM. Fatal error

Single Flash	Module communication error warning. A number of LB2 communication errors has occurred, which has caused the LB2 error counters to reach the warning level. Successful communications will reset this warning.
Double Flash	**NA**
Triple Flash	**NA**
Quadruple Flash	**NA**

5.5 First time configuration – example connecting via LAN1.

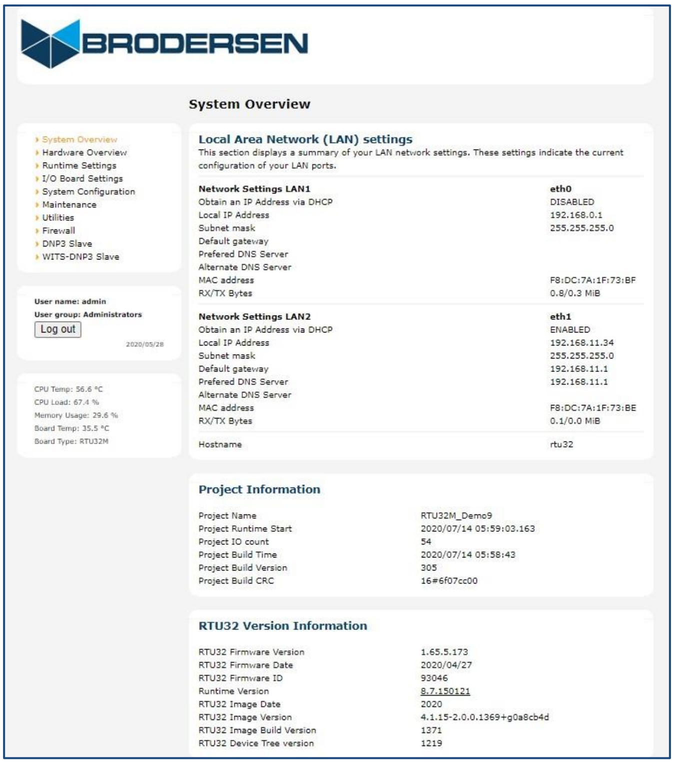
Start your Internet browser and enter the IP address of the RTU32M in the address field e.g., 192.168.0.1



Before the first RTU web page will appear in your browser you will be asked to enter a username and password. The username is admin. The RTU32M is shipped with the password set to admin.

Note: Additional users/access levels can be created.

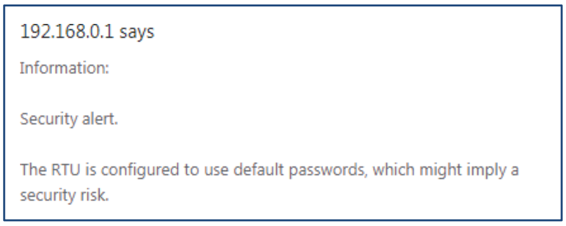
The RTU will then display the System Overview page. Information shown includes RTU status, network settings, project and version information. Menus allow access to additional RTU information including configuration parameters and status.



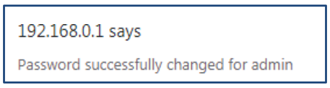
6 Managing Secure Access to the RTU32M

6.1 Changing the default admin user password

After logging in for the first time you are warned to change the default password. This is done from the Maintenance >Password menu item (the RTU will continue to prompt with a security alert if the password is not changed from the default, as shown here).



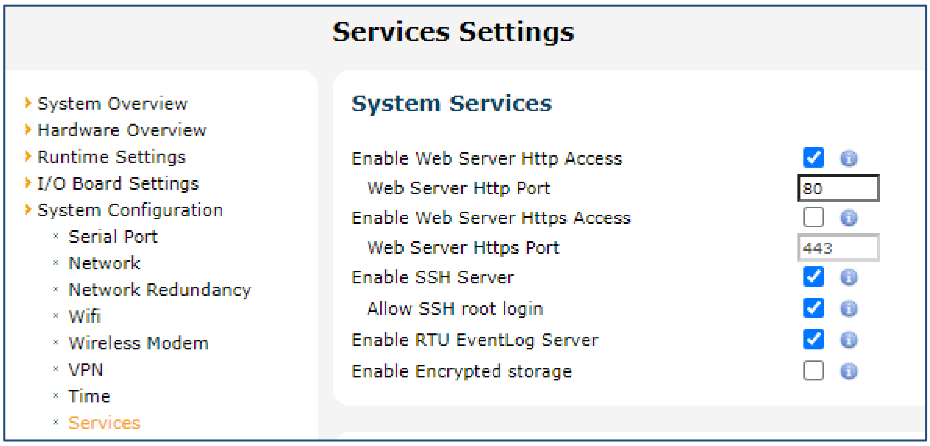
To change the admin user password from the default setting, you must first enter the existing password then enter and confirm the new password.



You will then be prompted to log in to the RTU again using the new password.

6.2 RTU System Services

The RTU System Services are managed from the System Configuration>Services menu.



6.2.1 Web Server

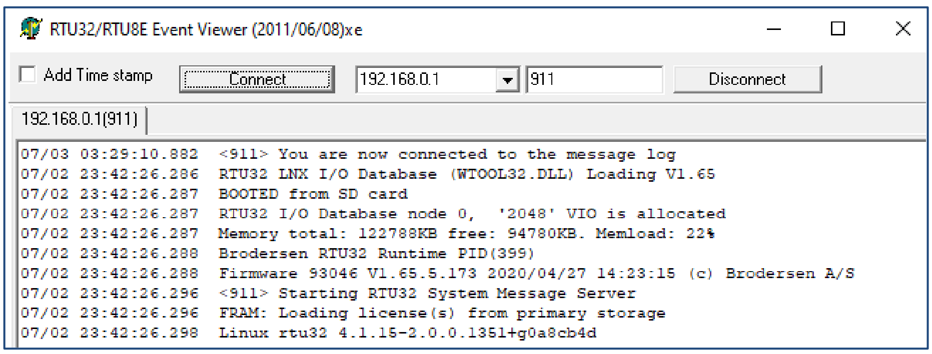
Enable/disable access and setting of port addresses for the web server (HTTP and HTTPS).

6.2.2 SSH Server

Enable the SSH Server to allow Secure Shell remote access to command line scripts from a SSH client application. Enable SSH root login if required.

6.2.3 RTU Event Log Server

If the RTU Event Log Server is enabled, then RTU events can be viewed from the RTU32 Event Viewer program (installs with WorkSuite®).



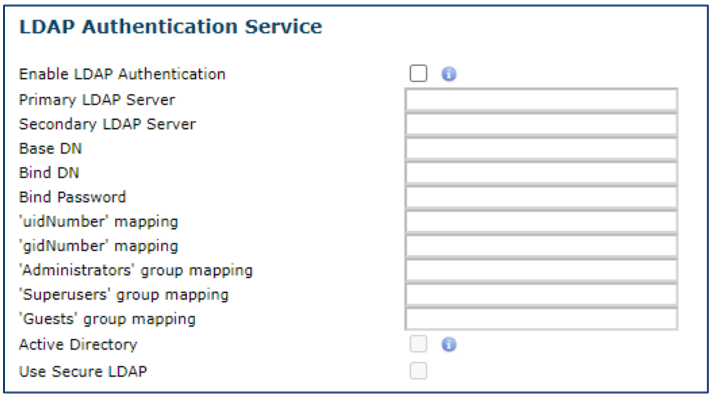
Note: Port 911 will need to be open in the RTU Firewall Settings for the Event Viewer to be able to connect.

6.2.4 Encrypted Storage

The RTU32M can be set to boot/load firmware and store logic applications on an optional SD card. If encrypted storage mode is enabled, the RTU will keep configuration information in an encrypted ‘container’ area of the SD card. Note: Once enabled, it is only disabled by a factory reset, which means that all configuration will be lost. The encrypted container can only be read by the RTU that created the container (this protects against the card being removed and sensitive configuration data being read by a third party).

6.2.5 LDAP – Lightweight Directory Access Protocol

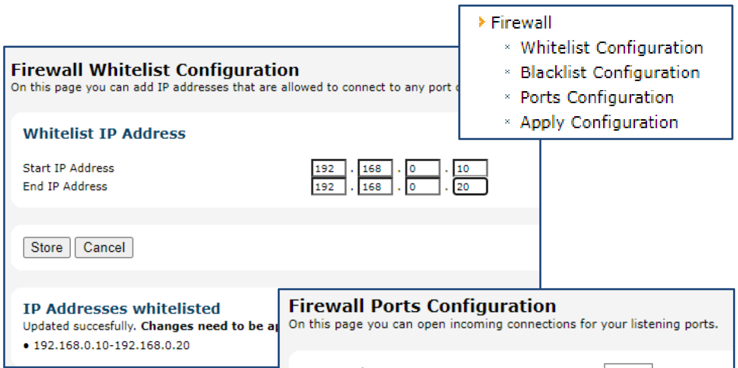
When LDAP Authentication is enabled:



- Root and Admin users are still able to login using SSH, but only authenticated LDAP users can login to the RTU webserver.
- If the Primary LDAP Server can't be contacted then the Secondary LDAP Server is used instead (if no LDAP server is available, web access will be denied).
- Base DN specifies the base distinguished name (DN) to use as search base.
- Bind DN is a user in the Active directory, which is allowed to query the LDAP Server.
- Bind Password is the password for the user in 'Bind DN'.
- 'uidNumber' mapping is used for mapping the user number from the AD. This information can be found on the Domain controller as described below.
- 'gidNumber' mapping is used for mapping the group number from the AD. This information can be found on the Domain controller as described below.
- Administrators mapping is used for mapping a group in the AD to the Webserver's Administrators group e.g., users in the AD 'Administrators' group mapping will have Administrator access to the RTU.
- Superusers mapping is used for mapping a group in the AD to the Webserver's Superusers group e.g., users in the AD 'Superusers' group mapping will have Superuser access to the RTU.
- Guests mapping is used for mapping a group in the AD to the Webserver's Guests group e.g., users in the AD 'Guests' group mapping will have Guest access to the RTU.

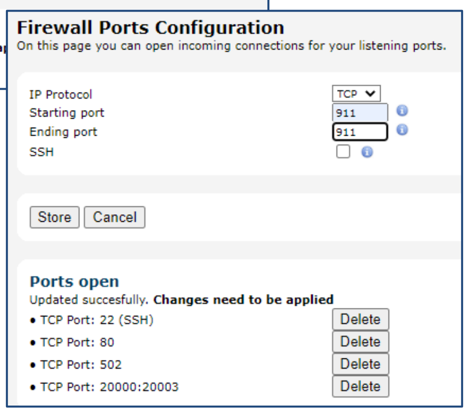
6.3 RTU Firewall Setup

The RTU firewall is a set of rules that determine if access is granted to incoming IP message packets.



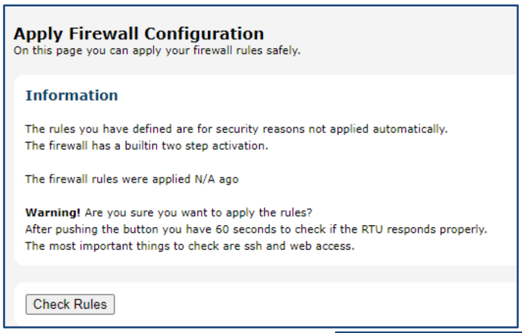
The **Firewall>Whitelist Configuration** page allows specific IP addresses to access all/any ports on the RTU.

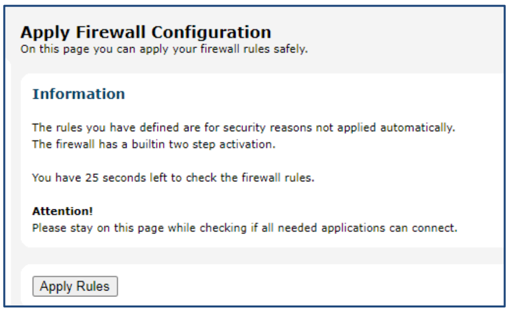
The **Firewall>Blacklist Configuration** page allows specific IP addresses to be blocked from access to all RTU ports.



The **Firewall>Ports Configuration** page allows management of the range of IP ports to be opened.

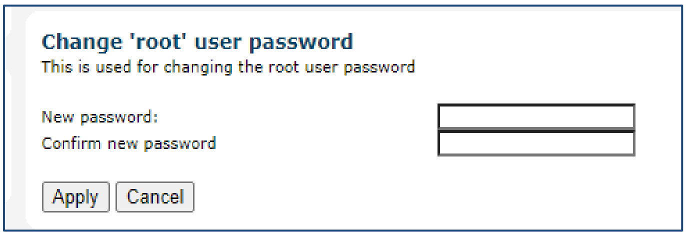
The **Firewall>Apply Configuration** page allows time to test the implications of changing the firewall rules. This is a two step process - first select 'Check Rules', you then have 60 seconds to check if the new rules are appropriate, before applying the new rules.





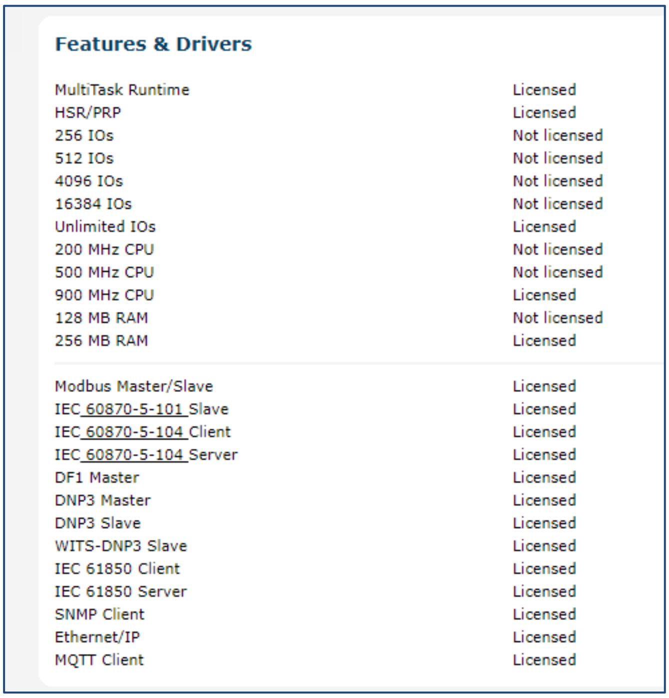
6.4 Root user access

The RTU32M allows access to the RTU operating system via a SSH client using the standard RTU passwords used for web access. Root level access is enabled in the System Configuration> Services menu and should only be enabled for advanced users that need to perform diagnostics. If root access is required a password must be created from the Maintenance >Password menu.



7 RTU32M – Licensing

The RTU32M includes license options that manage the RTU functionality and enable use of advanced drivers and options, hence some restrictions may be imposed, including limiting the number of project I/O variables, drivers and driver tags/data points. The System Overview page includes information about the licensing, as shown in the example below.

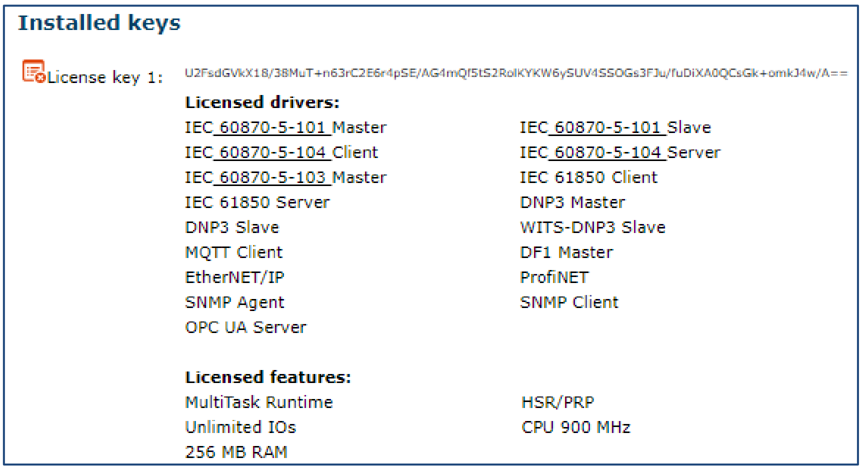


The license limitations are managed by the firmware of the RTU32M. If you try to start a logic application in the RTU32M that exceeds these limits, the project will NOT start and an info message in the Runtime info window in WorkSuite® will indicate the status of the limits in your project.

7.1 Adding Drivers and Runtime Options

The RTU32M Licensing interface allows loading and activation of runtime license options. The RTU ID is used by the Brodersen factory to generate a unique license code that enables the required functionality.

If you need additional drivers or other increased functionality that requires a license upgrade, please contact Brodersen or your authorized distributor and provide them with the RTU ID and details of the license requirements. You will then be sent a new license key that can be pasted into the License Key field and then select 'Apply' to activate the new license options.

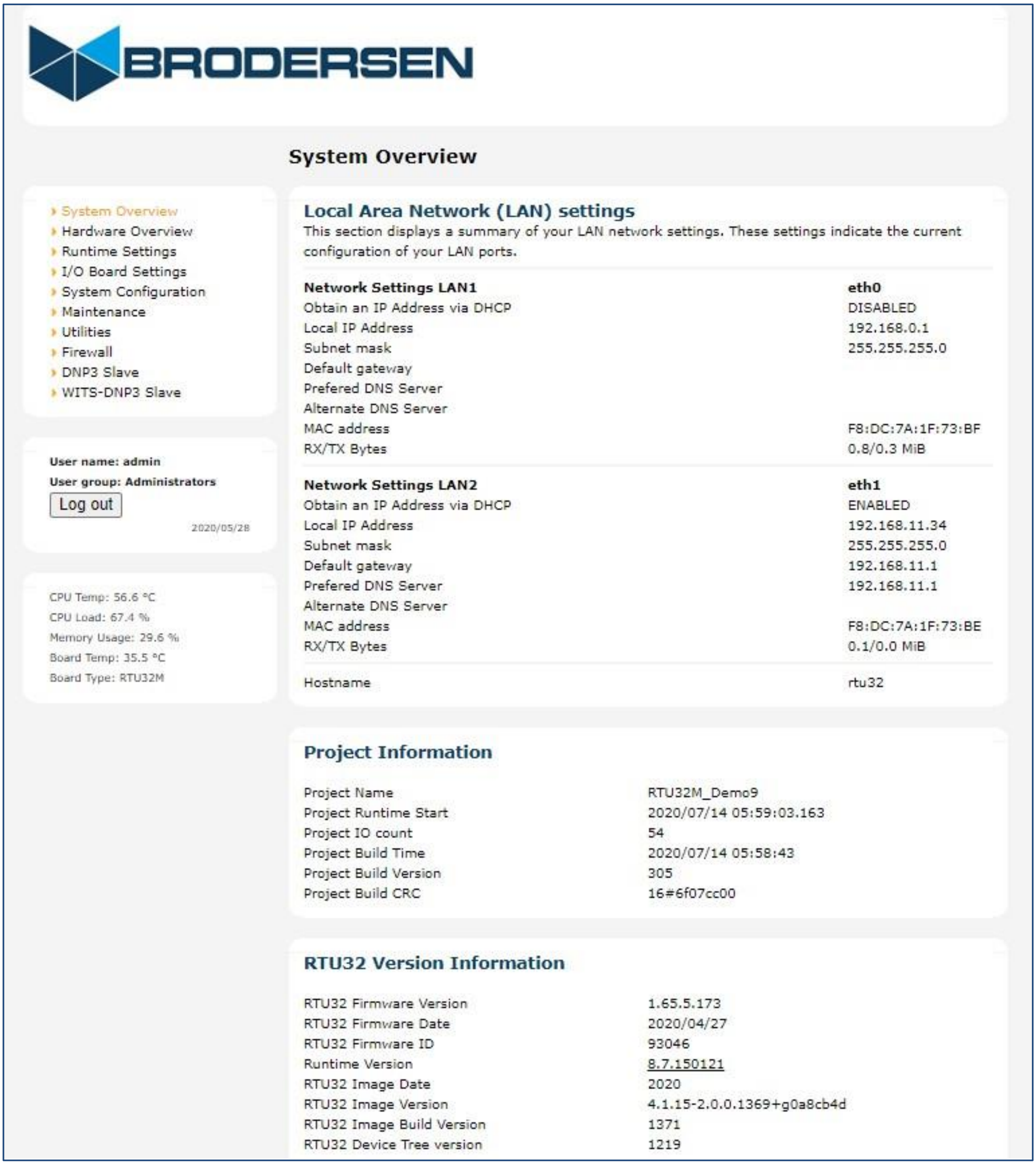


The example here shows a RTU licensed with many driver and functionality options.

8 Getting Online with your RTU32M

8.1 System Overview Web Page

The first page that you access when you enter the RTU32M Web pages is the System Overview page:

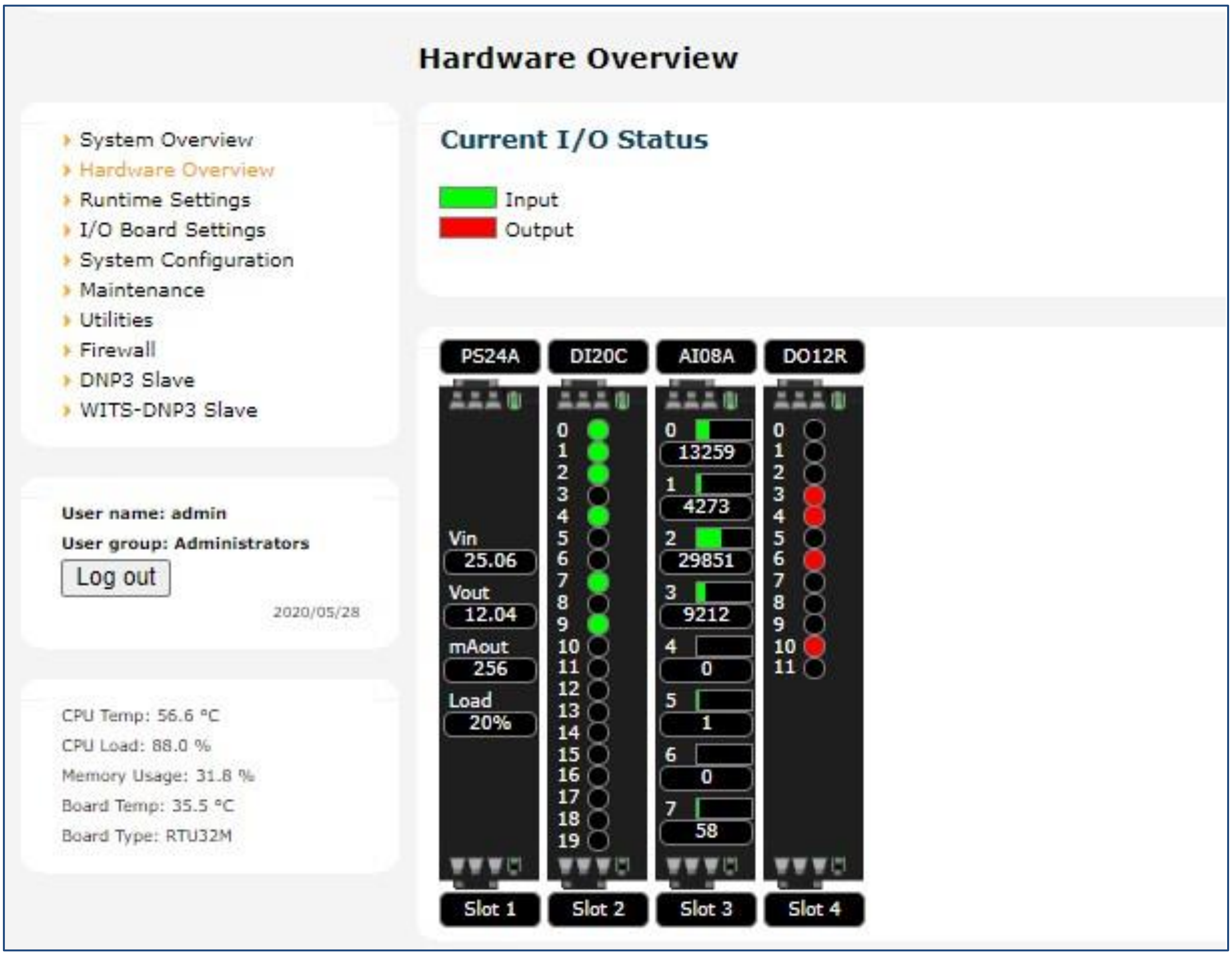


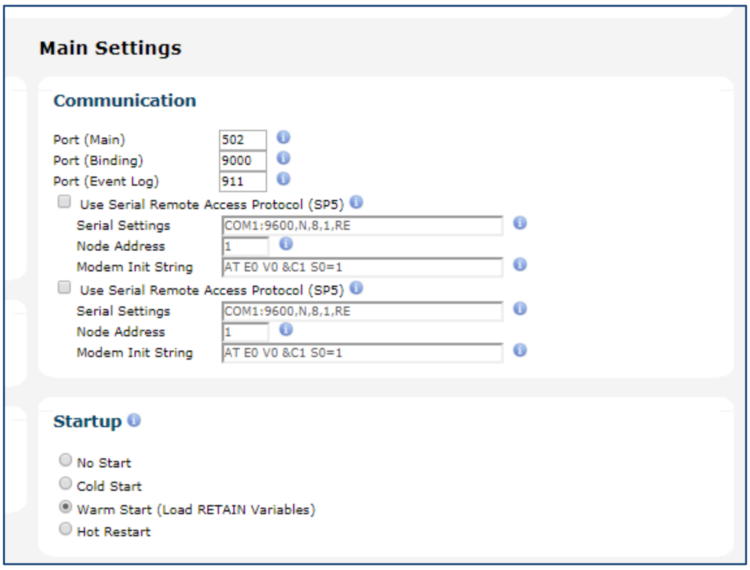
On this page you will get an overview of the network settings, project application that is running in the RTU, I/O count, the RTU status and version information. If you are contacting your support office or distributor, you will always be asked for the RTU32M Firmware Version Information e.g., 1.65.5.173 and the RTU Image Build Version e.g., 1363.

8.2 Hardware Overview Web Page

The hardware overview page shows the current I/O configuration status. It lists the physical internal I/O and any RTU32M style expansion I/O connected via the LB2 bus. You are able to read the status of each input or output. In the example shown here, the RTU32M is connected with 3x LB2 expansion I/O modules. The status of the various analog and digital values can be seen.

Note: an appropriate logic application must be loaded/running for the hardware overview to show status values.





8.3 Runtime Settings / Main Settings

The Runtime settings menu allows adjustment of the runtime (logic 'engine') setup.

8.3.1 Main Settings / Communication

Configuration of start-up settings, communication ports and enabling of Remote Access Protocols.

Port (Main) - is used for Brodersen WorkSuite® communications. Default is 502

- this port is also used for the ModbusTCP Server.

Port (Binding) - is used by the event based binding protocol, where two or more RTU32s can exchange data (redundancy mode). Default is 9000.

Port (Event log) - is for access to RTU System Logs, either by connecting using telnet or the Brodersen Event Viewer tool. Default is 911.

Enable Serial Remote Access Protocol (SP5)

This protocol allows remote serial communication from the Brodersen WorkSuite® and is well suited to communication using serial radios and modems. e.g. if you have the RTU32M placed on a remote site connected via serial communication using multi-drop radio or line connection – or even a dialup connection, you are able to remotely connect to the RTU32M with the Brodersen WorkSuite® and work online as if it was on your workshop table. The speed will however be slower depending on your actual serial communication speed. It is possible to attach this protocol to two communication ports.

Serial settings

The syntax is: [M]COM{n}:{b},{p},{d},{s}[,h][,LL] and the parameters in brackets [ ] are optional:
[M] Use modem connection
{n} Number of the COM port to be used (1 … 8)
{b} Allowed speeds: 300,600,1200,2400,4800,9600,19200,38400,57600,115200
{p} Parity: N,E,O (None,Even,Odd)
{d} Data bits: 7 or 8
{s} Stop bits: 1 or 2
[h] RTS/CTS handshaking where h is either RD,RE,RT:l:t or RC:l:t. In the COM port section you will find details of how to use these parameters.
[LL] Log all bytes received and transmitted into the system log (port 911)

The following example shows setting for communicating on COM1 port, at 19200 baud, with Even parity, 8 data bits and 1 stop bit: COM1:19200,E,8,1
Here a modem usage is enabled: MCOM2:9600,N,8,1
Here logging is enabled: COM1:9600,N,8,1,LL

Node address

Node Address (or Unit number) identifies the RTU32 on a multi drop network. The default number for RTU32M on a peer-to-peer network is 1. The address must be a value from 1 to 32767.

Modem Init String

Here you enter the initialization string (AT commands) when using a modem.
RTU32M default is: AT E0 V0 &C1 S0=1

8.3.2 Main Settings / Start-up

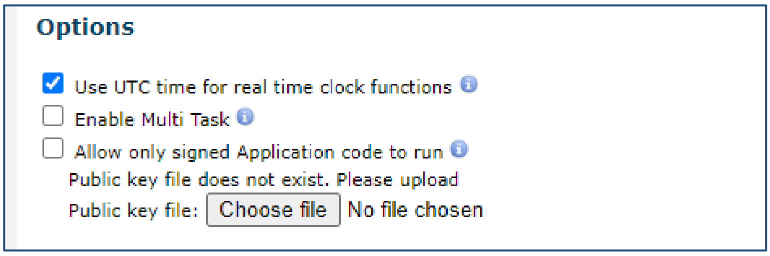
The start-up option specifies how the logic application is started when the RTU32M is powered up. The possible options are:

No Start – logic application is NOT started when booting the RTU32.
Cold Start – logic application is started without loading retained variables.

Warm Start – logic application is started and retained variables are loaded (default) **.
Hot Restart – Only supported with battery backed RAM option and in Redundancy configuration!

** Note: RTU32M has 4kB NV FRAM for retained variables (e.g., 1000x 32bit values). If a larger number of variables need to be retained, they can be managed using a SD card with the F_SAVERETAIN and F_LOADRETAIN function blocks.
Eg. Boot from SD card: 'etc/rtu32/retain.bin'. Boot from Internal flash using SD card: '/run/media/mmcblk0p1/retain.bin'.

8.3.3 Main Settings / Options



Use UTC time for real time clock functions.
If enabled, it instructs all logic real time functions (e.g., DTCurDate, DTCurTime and day_time) to return time in UTC. UTC time is not adjusted according to daylight savings.

If this parameter is disabled, then time is returned in local time.

Note: Drivers that are implemented via PLC Functions – like the IEC60870 Driver – will use the logic time stamp for events. Other drivers may take standard windows time or whatever time is defined in the applicable standards e.g. DNP3 always uses UTC time.

Enable Multitask
This is a licensed option allowing the RTU to run up to 4x independent logic tasks (global variables can be accessed from any/all tasks).

8.3.4 Signed Application Code

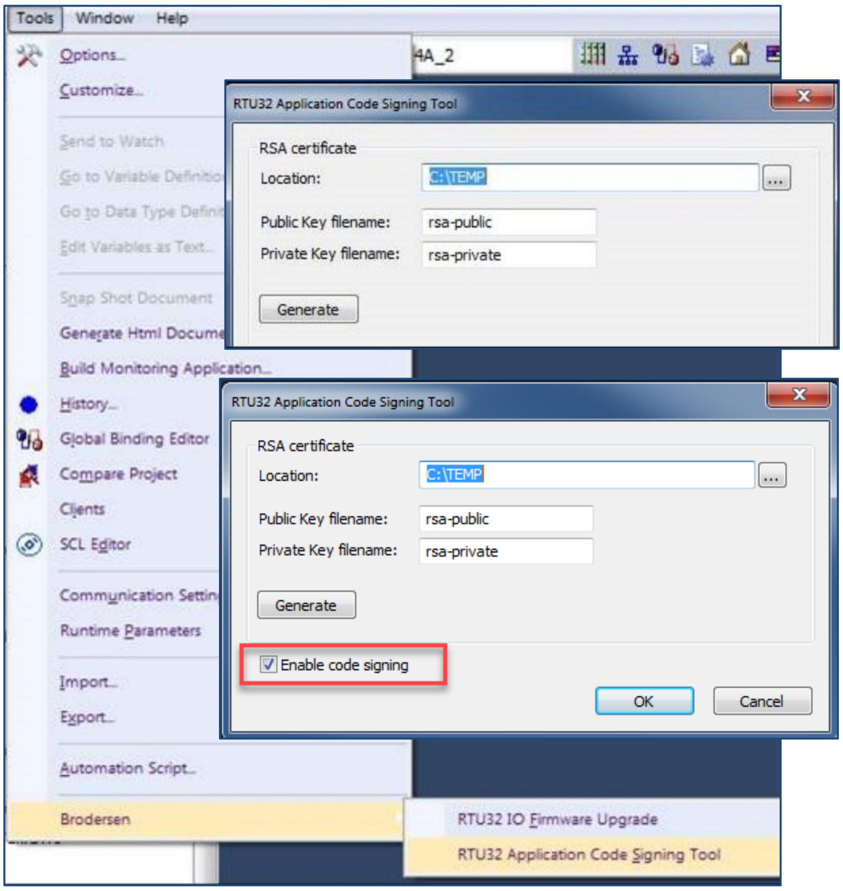
If 'Allow only signed Application code to run' is enabled, then an additional layer of security is added to logic applications and RTU firmware updates (SWU files) using RSA public-key cryptosystem techniques. WorkSuite® generates a public key (shared by WorkSuite® to encrypt authorisation and the RTU to decrypt authorisation) and a private key (used by WorkSuite® to encrypt authorisation).

Keys are generated from the WorkSuite® Tools menu. Select Brodersen>RTU32 Application Code Signing Tool, set the location where keys are to be stored and select Generate.

eg. if using C: \Temp then

- A public key **rsa-public.pem** will be generated and stored in C:\Temp
- A private key **rsa-private.pem** will be generated and stored in C:\Temp

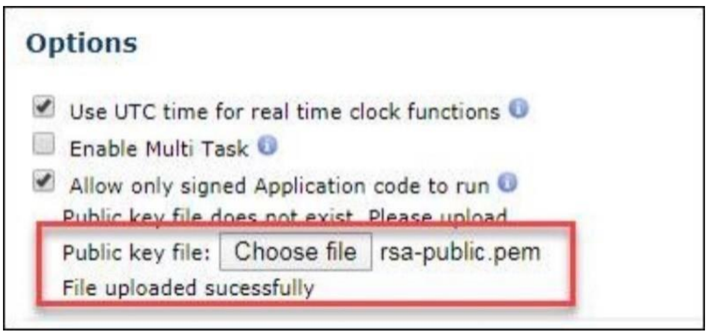
If the ' Enable code signing' check box is selected, then future compilations of RTU application logic will include an encrypted signature.



When compiling code in WorkSuite® with the code signing feature enabled, the last part of the compilation process shows the status of the signature generation and validation.

To enable the use of signed application code in the RTU, select 'Allow only signed Application code to run', from the web server page Runtime Settings>Main Settings>Options.

You must also then also upload the Public key file generated by WorkSuite® to the RTU, by selecting



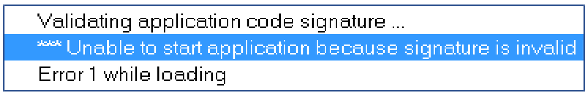
'Choose file' and then browsing to the location where the key file is stored e.g. C:\Temp as used earlier.

The public key file will then be sent to the RTU (as an encrypted packet sent securely using SSH) and stored as rtu32-app-public.pem in /etc./rtu32.

Note: important that the 'File uploaded successfully' statement appears. You may need to ensure that your browser is not catching old JavaScript files (use CTRL-F5 to force reload).

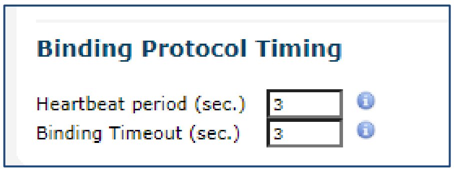
Ensure changes are applied by selecting Apply and then reboot the RTU. Download the code to the RTU from WorkSuite® and check the RTU is in the RUN state from the Debug status window.

If the RTU will not run, check the Runtime window. If the signature file is missing or invalid, the following error message will be shown.



8.3.5 Main Settings / Binding Protocol Timing

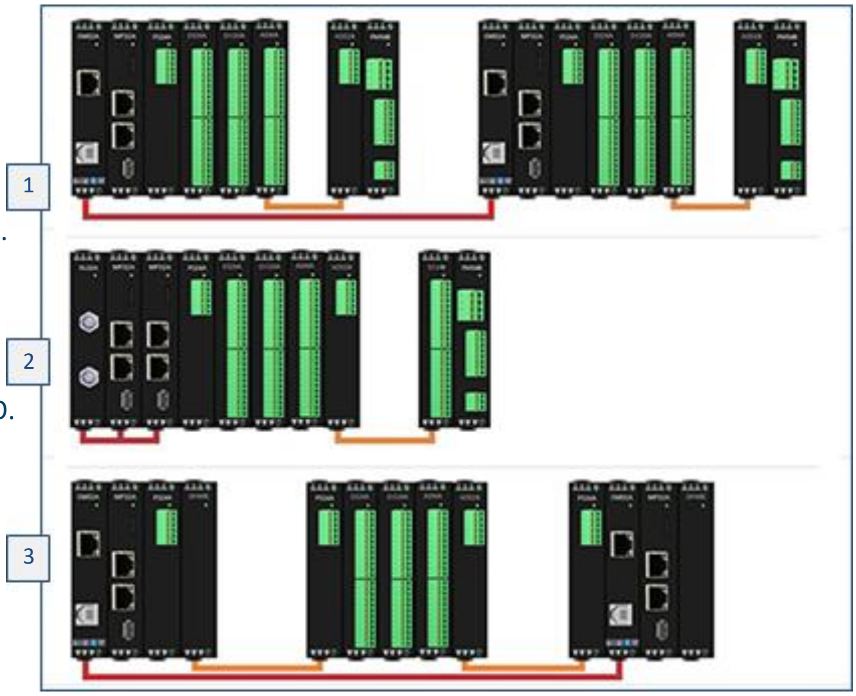
When using binding on slower network connections like some optical fiber modems or GPRS/3G wireless connections, you will need to adjust the timing for the Binding driver.



Heartbeat period – how often the binding link connection is checked.
Binding Time-out – time-out on link check and general binding events.

8.4 Runtime / Redundancy Settings

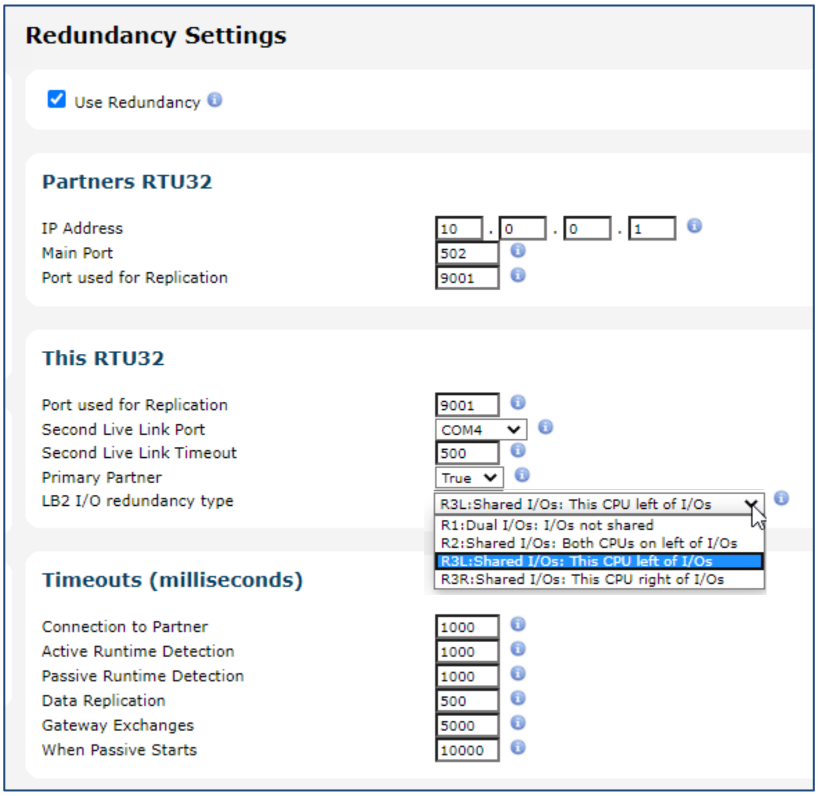
The RTU32M supports three different redundancy modes. The modes are managed from the RTU web server and include.



1. Dual I/Os - 2x RTUs with their own I/O. RTUs are connected together using CM02A modules (each module has 1x serial port and 1x Ethernet port).

2. Shared I/Os - 2x CPU on left side of I/O. CPUs are connected together using a RL02A module through:
M8-USB cable for MP32A-Rev A
M8-M8 cable for MP32A-Rev B
(This type of redundancy is not supported for MP32A-RevC).
M8-M8 cable for MP32A-Rev D

3. Shared I/Os - A CPU on each side of the I/O.
CPUs are connected together using CM02A modules (each module has 1x serial port and 1x Ethernet port)



Redundancy Operation Principles – the redundancy option allows two RTUs/CPUs to run as partners, where one is active and the other is passive. The active CPU keeps the passive updated (with both logic and real time data), so that if the active CPU fails, the passive CPU switches to active mode and 'hot restarts'.
Changeover typically occurs in less than
50 milli-seconds once failure is detected.

8.4.1 Redundancy / Partners RTU32

Each CPU needs to know the IP address and port settings of its 'partner' RTU32.

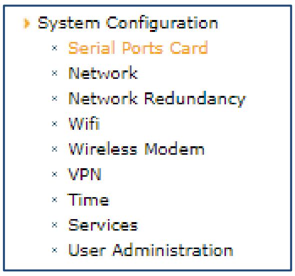
8.4.2 Redundancy / This RTU32

Each CPU needs to know if it is the Primary or Standby partner (left CPU is primary by default) and which redundancy mode it is using.

8.4.3 Redundancy Timeouts

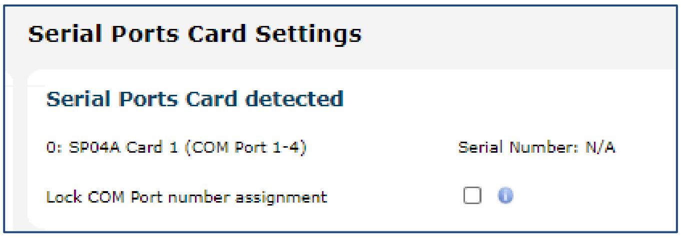
The timeout settings define various connection and heartbeat periods - default settings are recommended.

9 System Configuration



9.1 Serial Ports Card

This web pages shows if Serial; Port modules have been detected and includes an option to 'lock' the COM port assignment.

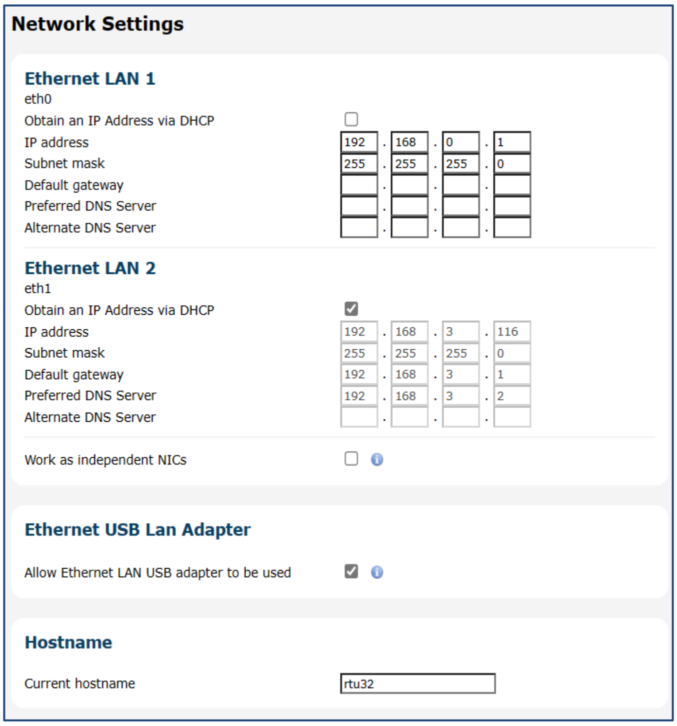


9.2 RTU Network Settings

On the System Configuration>Network Settings page you can change the LAN port settings to fit your local network. You can assign fixed IP addresses or select DHCP to have the address set by a router. You can then gain access to the RTU32M with your browser, SFTP client or Brodersen WorkSuite® in your LAN network. You can also change the RTU Host Name. The default host name of the RTU32M is **rtu32**.

If the RTU32M is connected with both LAN ports to the same network segment, you can enable the "Work as independent NICs"-option, and the network traffic will be routed correctly to the two LAN ports.

After entering new settings, click Apply to save. Note that the new settings are activated within a few seconds (you do not need to restart/reboot the RTU32M.

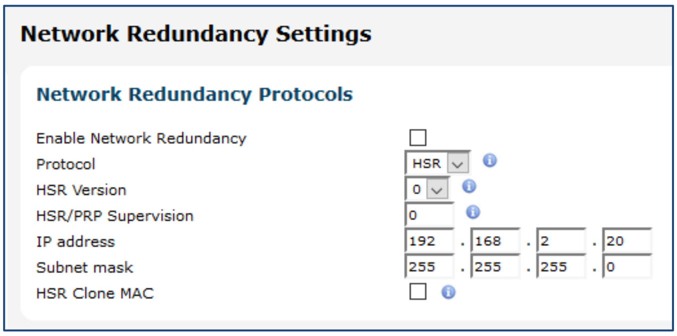


9.3 Adding a USB-Ethernet adapter

The RTU32M supports addition of a USB Ethernet Adapter (Important, use only the Brodersen USB Ethernet adapter). After inserting the USB Ethernet adapter, ETHERNET LAN 3 will be included on the Network Settings web page and it must be configured in the same way as LAN 1 andLAN2.

9.4 Network Redundancy Protocols

Modern substation automation systems use network redundancy to improve reliability and network changeover times. The RTU32M System Configuration>Network Redundancy page allows selection of network redundancy protocols HSR (High Availability Seamless Redundancy – where both LAN ports are used to ensure two network paths exist between adjacent nodes in a ring format), or PRP (Parallel Redundancy Protocol – where both LAN ports are used to communicate via independent/separated networks).



9.4.1 HSR – High Availability Seamless Redundancy

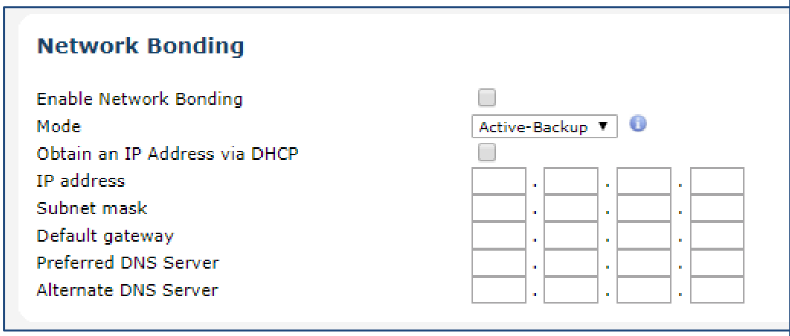
- Select HSR
- Select the correct HSR version.
- HSR/PRP supervision “Specifies the last byte of the multicast address used for HSR/PRP supervision.”
- Enter the IP Address that will be common for both LAN interfaces.
- Enter subnet mask or use default.
- HSR clone MAC address specifies whether the eth0 adapters MAC is used for both LAN adapters (supported by HSR only).

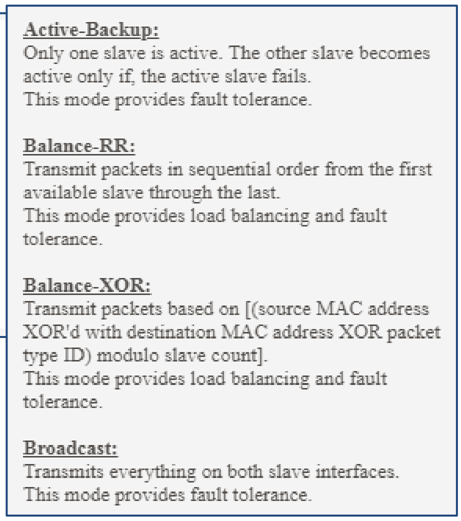
9.4.2 PRP – Parallel Redundancy Protocol

- Select PRP
- HSR/PRP supervision “Specifies the last byte of the multicast address used for HSR/PRP supervision.”
- Enter the IP Address that will be common for both LAN interfaces.
- Enter subnet mask or use default.
- HSR clone MAC is only supported by HSR.

9.5 Network Redundancy - Bonding

Network Bonding allows both RTU LAN ports to act as a single interface to allow primary/standby modes or load balancing in network redundancy applications.





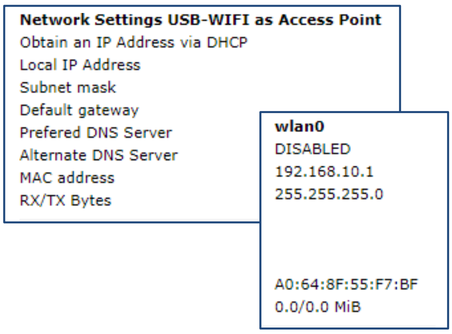
The four bonding modes include:

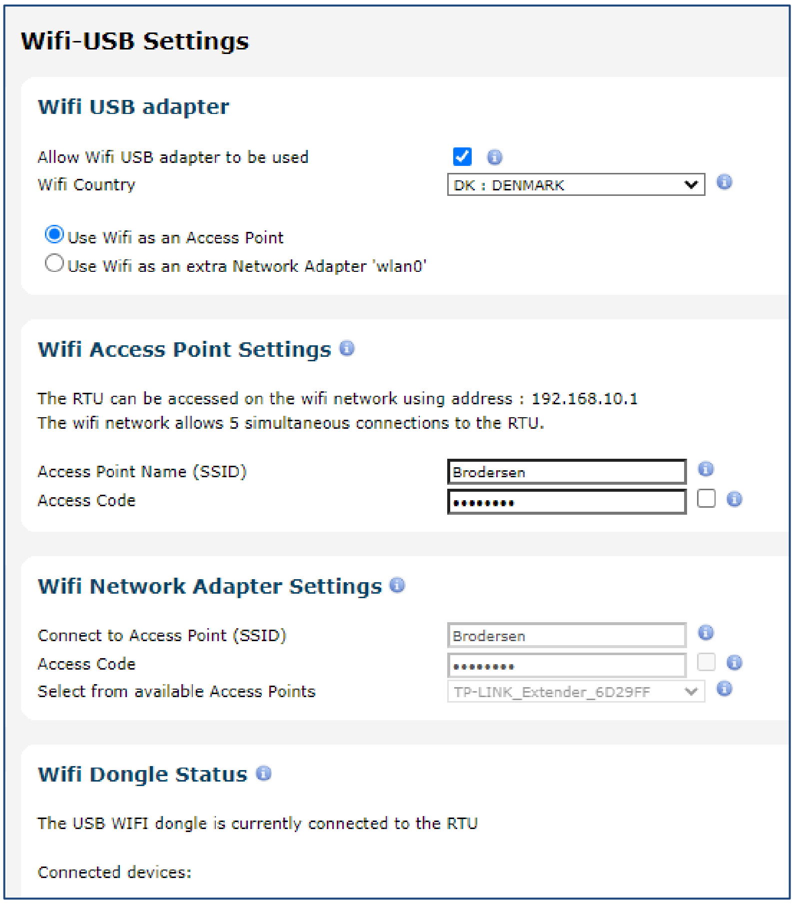
- Active- Backup
- Balance – RR
- Balance – XOR
- Broadcast

9.6 RTU Wifi Settings

The RTU32M supports addition of a USB WiFi Adapter to add an access point (default mode) or managed node (Important, use only Brodersen recommended USB adapters). The adapter can be disabled, configured and the mode changed from the Wifi-USB Settings page..

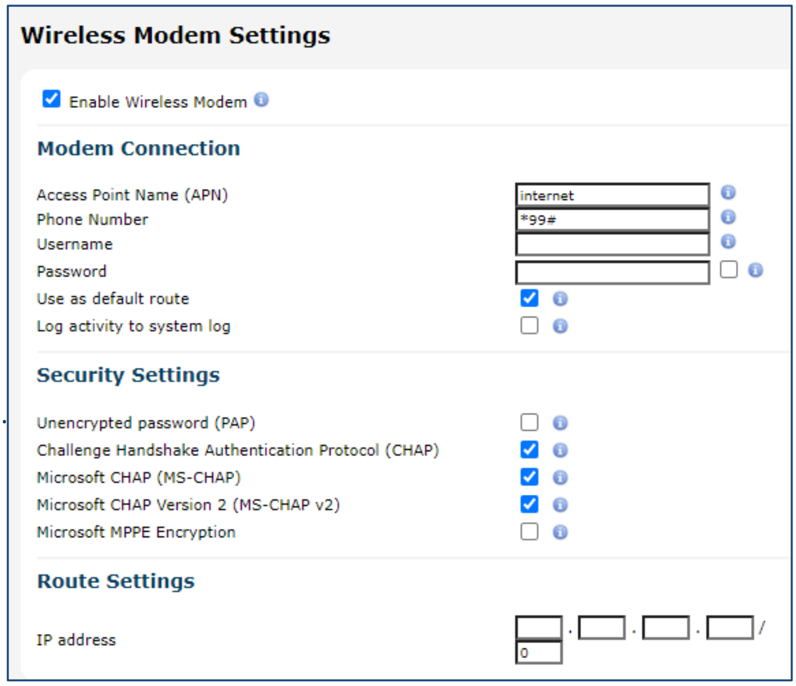
After inserting the USB Wifi adapter, an additional IP port will be added to the Network Settings web page.





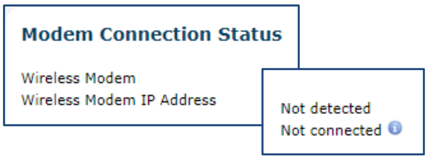
9.7 Wireless Modem Settings

The RTU32M supports Brodersen IM51A and IM51B 3g/4g modems via a USB port.



In order to ensure the modem operates you will need to enter all credentials correctly. The webpage includes small help icons - put the cursor on them and you will get details for each item.

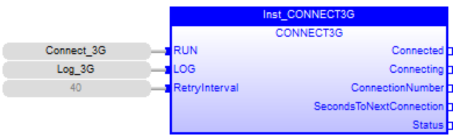
The modem connection status will be shown.

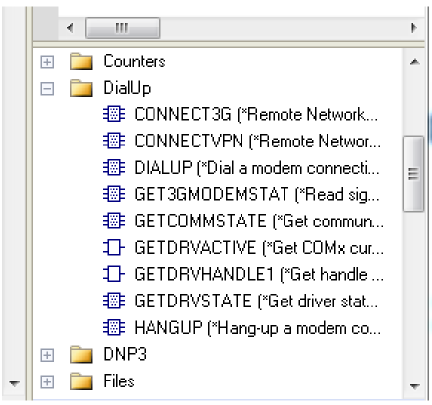


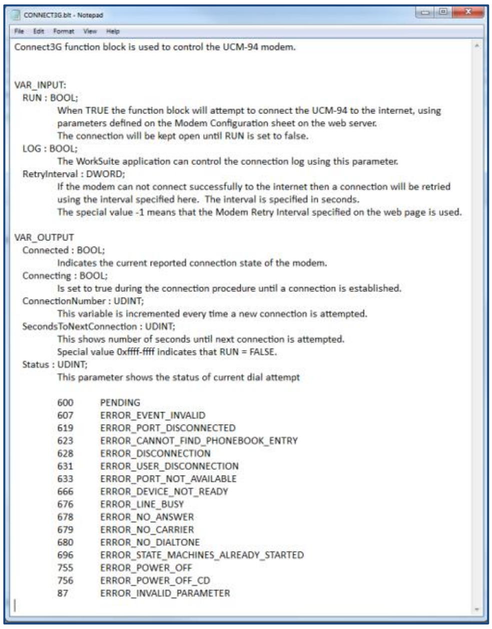
If a connection is established, an additional IP port will also be added to the Network Settings web page.

9.7.1 Wireless Modem Control from Logic

If you want to control the connection from the RTU logic application, you must select Connection Control from application. And then in your logic application use the Function Block 'Connect3G' (found in the Dial-up function group).



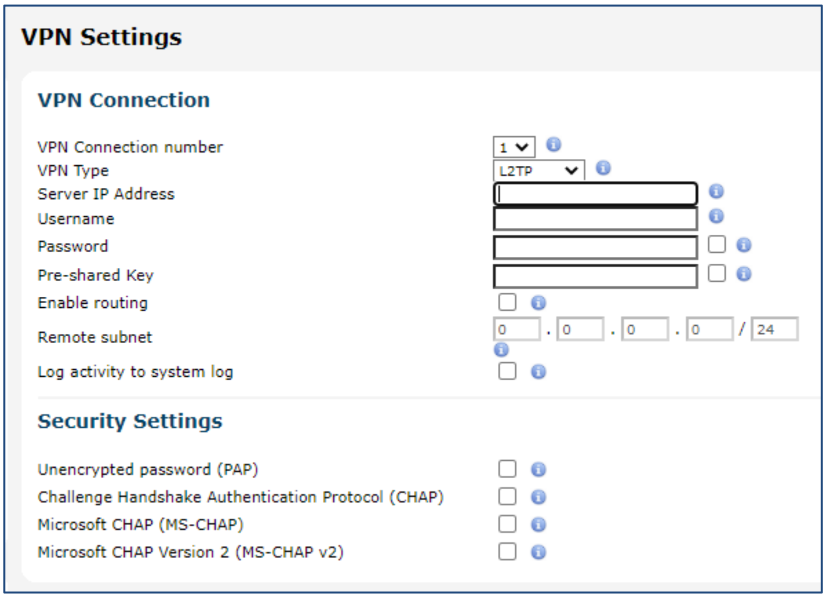



```
CONNECT3G.blt - Notepad
File  Edit  Format  View  Help
Connect3G function block is used to control the UCM-94 modem.

VAR_INPUT:
  RUN : BOOL;
        When TRUE the function block will attempt to connect the UCM-94 to the internet, using
        parameters defined on the Modem Configuration sheet on the web server.
        The connection will be kept open until RUN is set to false.
  LOG : BOOL;
        The WorkSuite application can control the connection log using this parameter.
  RetryInterval : DWORD;
        If the modem can not connect successfully to the internet then a connection will be retried
        using the interval specified here.  The interval is specified in seconds.
        The special value -1 means that the Modem Retry Interval specified on the web page is used.

VAR_OUTPUT
  Connected : BOOL;
        Indicates the current reported connection state of the modem.
  Connecting : BOOL;
        Is set to true during the connection procedure until a connection is established.
  ConnectionNumber : UDINT;
        This variable is incremented every time a new connection is attempted.
  SecondsToNextConnection : UDINT;
        This shows number of seconds until next connection is attempted.
        Special value 0xffff-ffff indicates that RUN = FALSE.
  Status : UDINT;
        This parameter shows the status of current dial attempt

        600     PENDING
        607     ERROR_EVENT_INVALID
        619     ERROR_PORT_DISCONNECTED
        623     ERROR_CANNOT_FIND_PHONEBOOK_ENTRY
        628     ERROR_DISCONNECTION
        631     ERROR_USER_DISCONNECTION
        633     ERROR_PORT_NOT_AVAILABLE
        666     ERROR_DEVICE_NOT_READY
        676     ERROR_LINE_BUSY
        678     ERROR_NO_ANSWER
        679     ERROR_NO_CARRIER
        680     ERROR_NO_DIALTONE
        696     ERROR_STATE_MACHINES_ALREADY_STARTED
        755     ERROR_POWER_OFF
        756     ERROR_POWER_OFF_CD
        87      ERROR_INVALID_PARAMETER
```

Note: The Settings Overview web page will include the modem connection status at the bottom of the web page if the modem is connected. It will also show you the IP address assigned on the cellular network.

9.8 VPN Settings

The RTU VPN Client supports PPTP and L2TP (IPsec) connections for up to two VPN Servers.

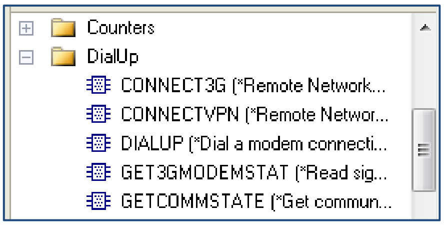


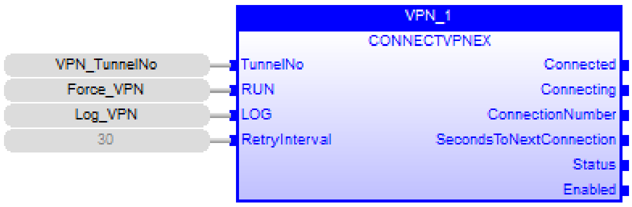
The settings for each VPN server interface can be adjusted from this webpage.

The VPN connection status will be shown and if a connection is established, an additional IP port will also be added to the Network Settings web page.

In order to ensure the VPN client connects you will need to enter all credentials correctly. The webpage includes small help icons - just put the cursor on them and you will get details for each item.

Controlling the connection of the VPN Client is managed from the RTU logic application. Use the Function Block ConnectVPN found in the Dial-up function block group to manage VPN connections.





9.9 RTU Time Settings

9.10 The time settings web page is used to configure and set the RTU32M real-time clock.

9.10.1 Time Settings

You can define if the RTU should be synchronized via a NTP Server, a PTP Server or you can use other synchronization options like manual time setting or synchronization via utility drivers that include this functionality, such as IEC60870 or DNP3.

NOTE: The time shown on the webpage is running in software and is only updated when the page is refreshed.

9.10.2 NTP Server

When set for synchronizing to a NTP Server you must define the NTP Server IP address or domain name. If you use a domain name, you must ensure that you have defined a DNS Server address in the network configuration. Update threshold can be set from 2 to 20160 minutes.

9.10.3 Time Zone

If you use local time you have to set the time zone correctly. By default, it is setup for Co-ordinated Universal Time (UTC).

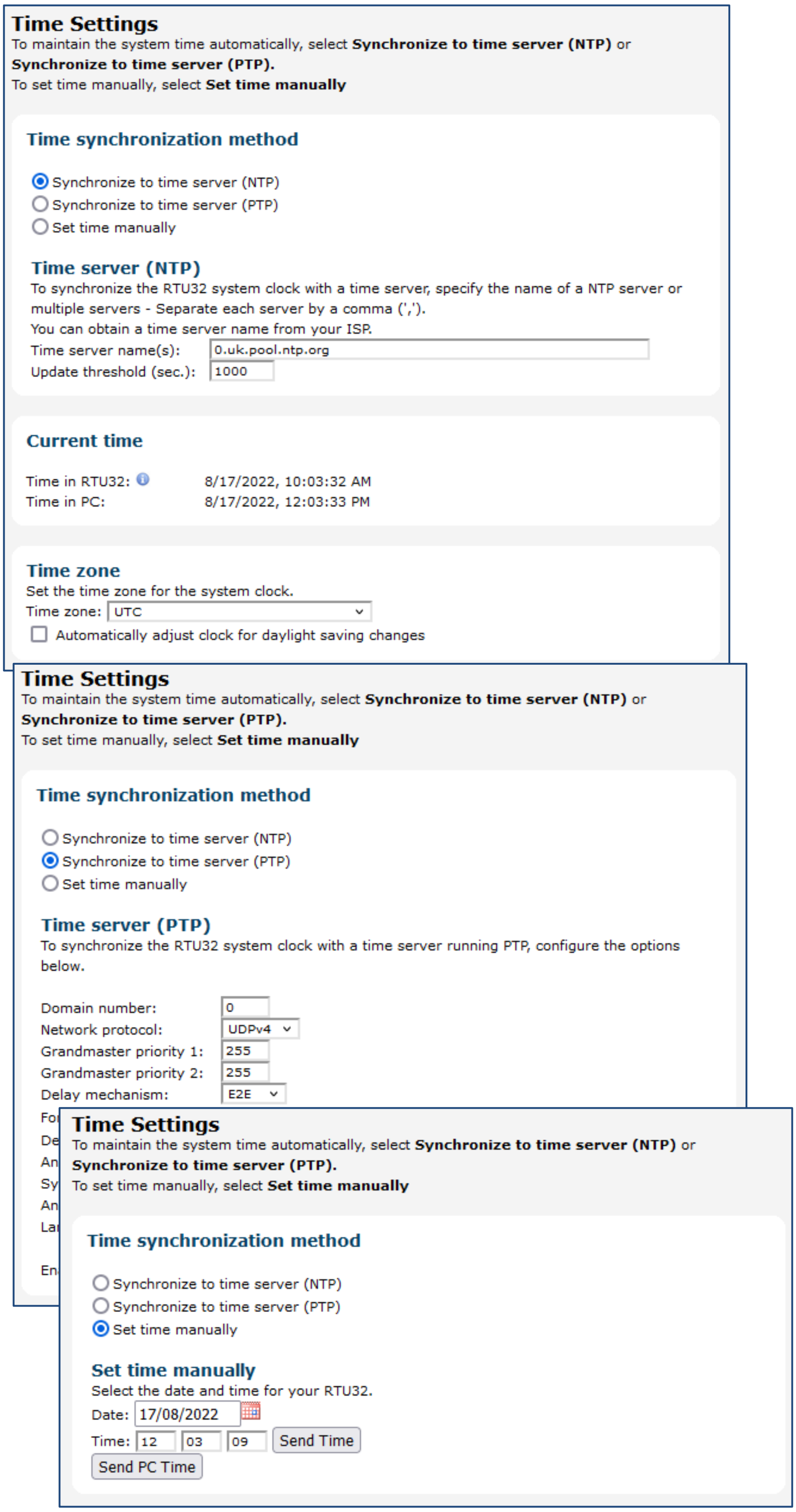
9.10.4 PTP Server

When set for synchronizing to a PTP Server you must set the configuration exactly as the PTP Server.

9.10.5 Manual time setup

When set for manually synchronization, the time in the RTU can be set manually from the webpage or automatically by a utility protocol, which supports time synchronization.

When clicking the button “Send PC Time”, the current time and date is taken from the PC and send to the RTU. When clicking the button “Send Time”,



the time and date entered in the textboxes are sent to the RTU.

9.11 Services

The Services Settings page allows for the enabling and disabling of the different services running in the RTU.

9.11.1 Syslog Reporting Service

You can define if the RTU should send syslog messages to a Syslog server.

The RTU can report the following events to the syslog server from web server:

- User logged successfully.
- User login failed.
- User logged out.
- User session timed out.
- Password changed.
- Time settings changed.
- User settings changed.
- RTU is rebooting.
- Saving a configuration file
- Network settings changed

The RTU can report the following events to the syslog server from the Runtime:

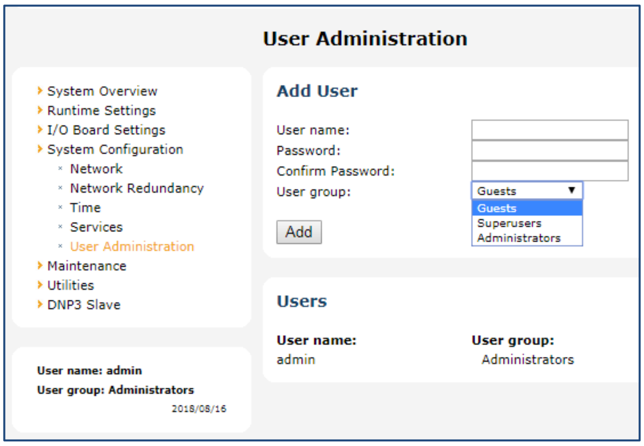
- Project started.
- Project stopped.

9.12 User Administration

The User Administration page allows setup of usernames and passwords. Each user is associated to a group of users – there can be up to 10 users in each group.

The three user groups have increasing levels of privileges and include:

Guests	Read only access.
Superusers	Full access and configuration, except for the Security pages (read only)
Administrators	Full access and configuration access



When adding new user to the RTU, remember to set a complex password, which is unique for every user. Furthermore use a secure method when handling over the user credentials to the intended person.

10 Maintenance

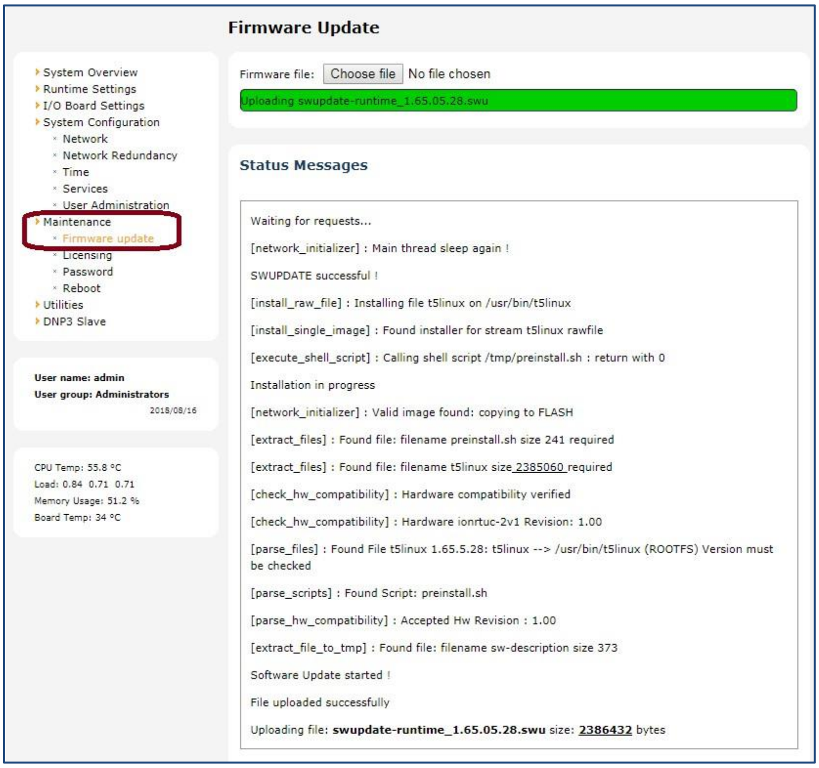
10.1 Firmware Update

The Firmware Update interface allows loading of updates to the RTU.

Update files with a. swu extension are selected using the “Choose File” button, then loaded to the RTU.

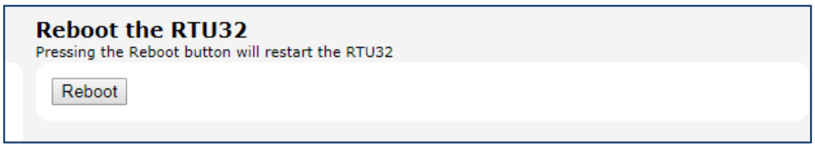
The update script provides feedback to the user as the update progresses, as shown in the example below.

Note: sometimes the firmware update may fail to report it has completed. If this occurs, reboot the RTU and check the System Overview page to see if the firmware version information has been updated.



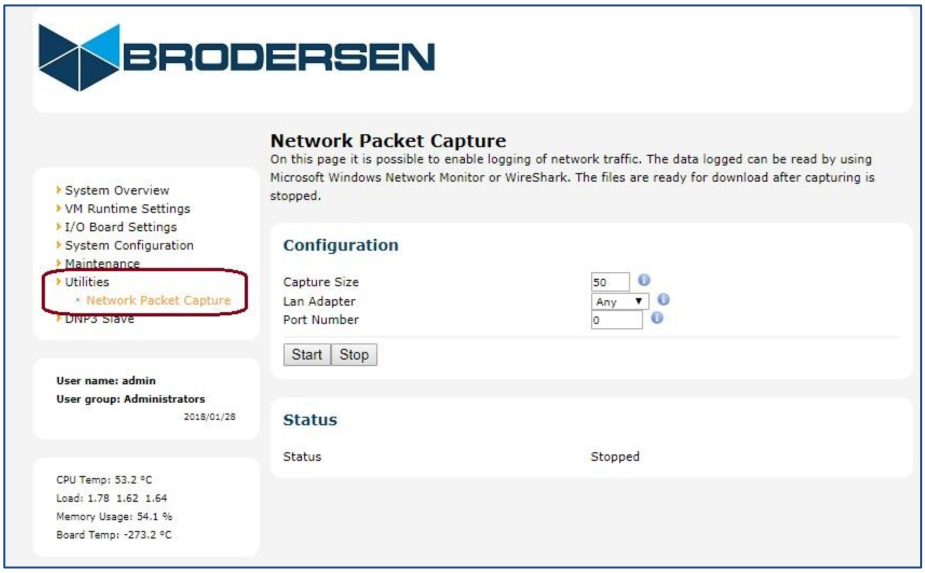
10.2 Reboot

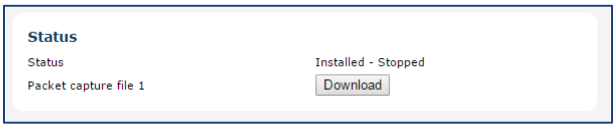
After changing parameters on the configuration pages, you must unless otherwise noted, run the reboot function to activate the changes. After booting the RTU32M you can start working with Brodersen WorkSuite® to create your application programs.



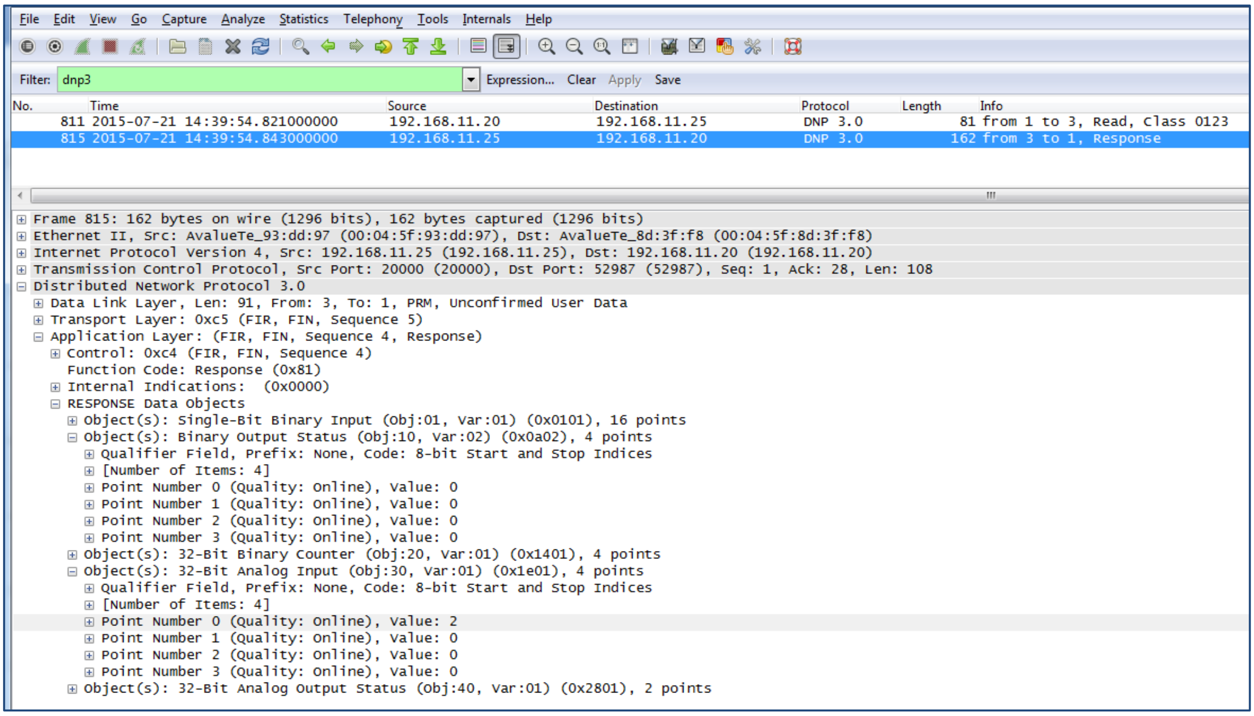
11 Utilities - Network Packet Capture

The Network Packet Capture utility allows IP traffic to be monitored and saved to a .pcap file. The file can then be uploaded to a PC and viewed by applications including Wireshark. Capture begins when the start button is selected. Files are ready for uploading when the capture is stopped.



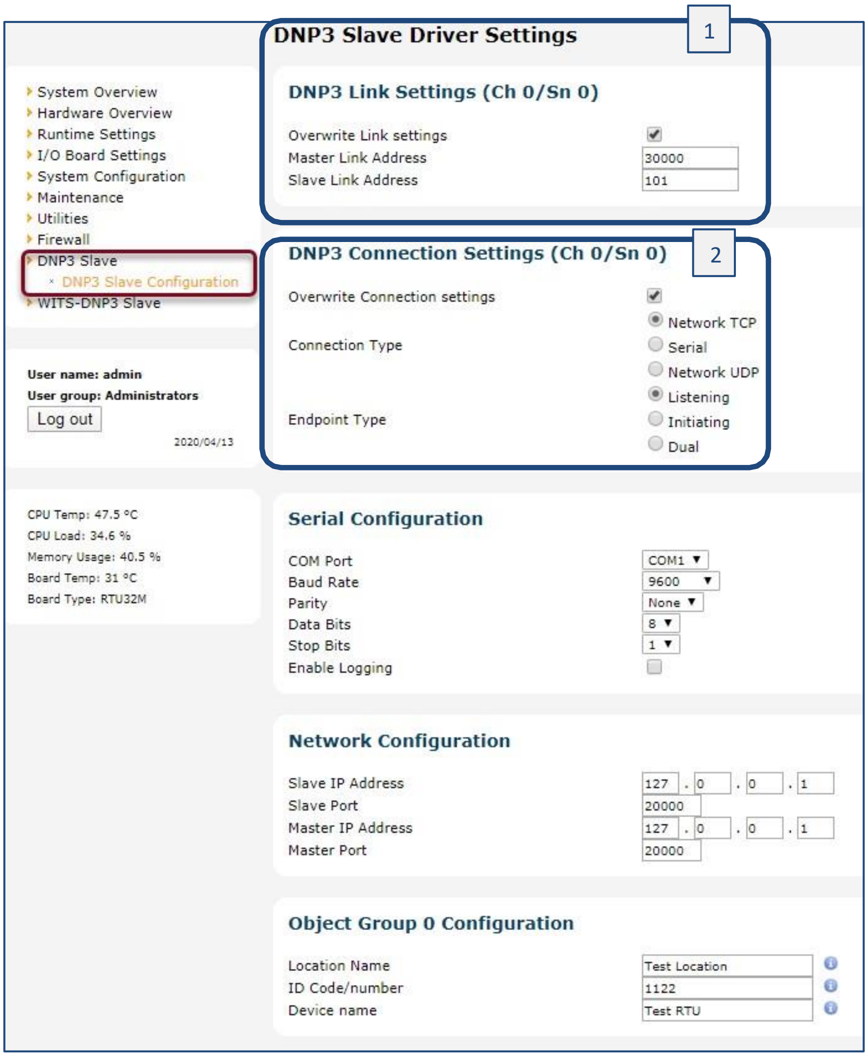


E.g., example below shows a captured DNP3 integrity poll and the response from the RTU32M can be viewed in Wireshark. A dnp3 filter has been applied to allow the message to be decoded.



12 DNP3 Slave – Configuration

The DNP3 Slave Configuration page allows slave setup parameters to be edited ‘outside’ of the RTU logic application.



Link Settings [1]

By default, the ‘Overwrite Link Settings’ parameter is disabled. If enabled, the RTU will read the DNP3 settings defined here, rather than the settings defined in the logic application.

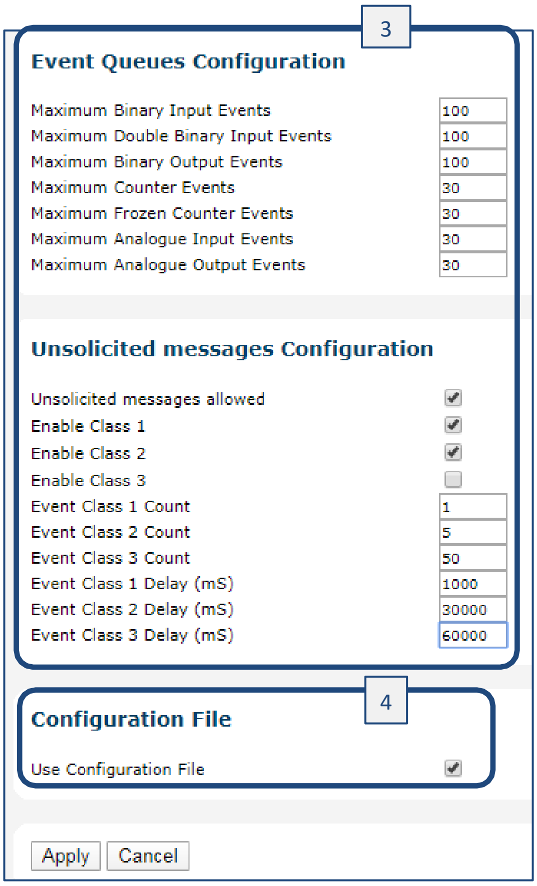
Connection Settings [2]

By default, the ‘Overwrite Connection Settings’ parameter is disabled. If enabled, the RTU will read the DNP3 settings defined here, rather than the settings defined in the logic application.

These parameters are stored in a file (etc./rtu32/config/dnp3s.ini) that can be manipulated by the logic application and/or overwritten by the SCADA host.

Note 1: the dnp3s.ini file is created by the RTU if settings are changed/applied.

Note 2: the parameters/values are only read after a RTU restart/boot.



DNP3 Application Layer Settings [3]:

The application layer settings allow setup of the size of DNP3 event queues and event reporting rules outside of the logic application. The application layer settings from the dnp3s.ini file are used instead of the values defined in the Fieldbus Editor application layer settings associated to the logic application, if the dnp3s.ini file exists.

DNP3 Points Configuration File [4]:

The parameter 'Use Configuration File' determines if the RTU reads the DNP point parameters (eg. Event class, threshold, debounce etc) from an external file (etc/rtu32/dnp3cfg.act), or from the DNP3 slave profile associated to the logic application.

Further details regarding 'Host Managed DNP3 Slave Setup' where the RTU32 DNP3 slave setup is managed outside of the logic application is available in a separate document.

13 Getting Started with the Brodersen WorkSuite® tools (3.9.2)

13.1 Introduction

The Brodersen WorkSuite® Package includes all software required to configure and program the Brodersen RTU32 Series.

The software components included in the package include:

- Brodersen WorkSuite® PLC configuration and programming tool.
- WIBUKey driver for the USB license key dongle for WorkSuite®.
- RTU32 Series tool package including:
    - Event Viewer – the telnet tool used for monitoring the System Log(s) in RTU32 Series products.
    - RTU32 Search tool for scanning and finding RTU32 products running on networks.

All software is installed in one installation process. The installation process will ask you what software to install and after making your selection, the installation process will run automatically and install and configure the all software, making it easy for you to begin working with configuration and programming of the Brodersen RTU32 Series products.

13.2 Installing the Brodersen WorkSuite® Package

Go to our website www.brodersen.com and find the WorkSuite® Installation Guide. It will guide you through all the installation details.

13.3 WorkSuite® License

The WorkSuite® tool requires a license to configure and program RTUs. Without a license the software package works in DEMO mode.

The license is locked to a USB hardware dongle that is included in the package. In the package you find also the WorkSuite® License Certificate with a License id number required to enter in the License utility after installing the software.
The standard license offers the possibility to create an unlimited number of I/O points in the RTU application program. All variables associated to communications drivers (except for Modbus Slave) are also counted as I/Os.

13.4 Compatibility with STRATON Workbench

The Brodersen WorkSuite® Package replaces all versions of STRATON Workbench. The WorkSuite® is backwards compatible with all STRATON versions and supports directly any older STRATON version 5.x, 6.x, 7.x and 8.x projects.

WorkSuite® is a Brodersen OEM version of STRATON, but includes a range of additional facilities:
1. One installation process for WorkSuite® - installs all software including license key drivers and all drivers, functions and Brodersen Tools supported by the RTU32 Series products.
2. Eliminates the need to install special hardware libraries, tools etc. After the installation of the WorkSuite® Package you are ready to go.
3. All drivers supported by the RTU32 Series of products are available in WorkSuite®, making for easier software version management.

Important Notes:
1. If you have existing licenses for STRATON Workbench version 8.x, they are 100% compatible with the WorkSuite®.
2. If you have an older Straton license, please contact Brodersen at sales@brodersen.com or your local representative for update prices. Please remember to include a copy of your current License Certificate.

13.5 User documentation and training/guideline videos

When installing the Brodersen WorkSuite® package, User Guides and Manuals are installed as well. You get access to these documents from the Help menu within WorkSuite®.

WorkSuite® has also implemented a help function that means that you can get help by pressing F1. If no valid help opens, please check the PDF manuals available under the general WorkSuite® Help menu or check our website www.brodersen.com for documentation.

We recommend that you use the Brodersen Training/Guideline Videos.

www.youtube.com/brodersensystems

Here you will find step-by-step guidelines with details of how to get started and how to setup drivers etc.

14 RTU32M I/O Setup in WorkSuite®

14.1 General

It is highly recommended to take a training course on the RTU32 product series and the WorkSuite® package. It will save you a lot of time and is a good investment because you will get familiar with the software and hardware and be able to quickly take advantage of all the RTU and WorkSuite® powerful features. Contact your local distributor, or Brodersen for RTU/WorkSuite® training exercises.

Besides the basic WorkSuite® standard PLC programming environment and EN/IEC61131-3 programming languages, there are some functions and features which are specific for the RTU32M Product Series.

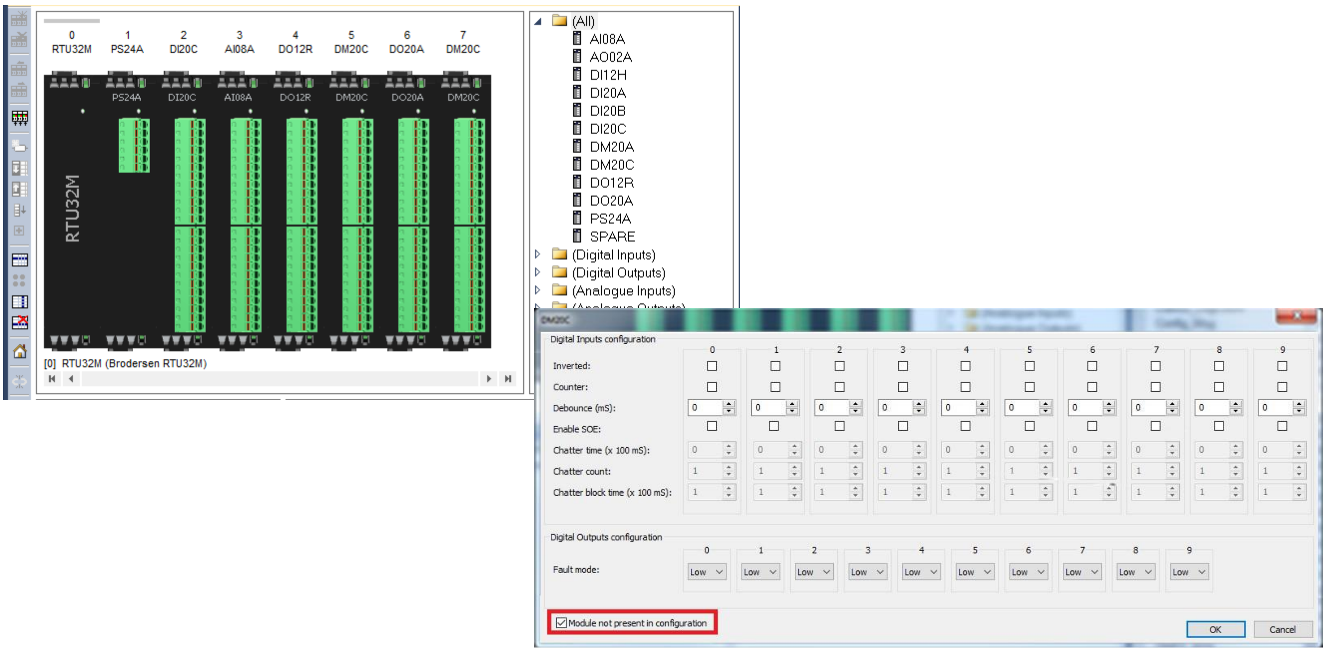
14.2 WorkSuite® I/O Drivers for RTU32M

The WorkSuite® I/O Drivers for the RTU32M are used to access the physical inputs and outputs. All RTU inputs are read online when the PLC runtime cycle is started, and all outputs are written online at the end of the runtime cycle.

The RTU32M supports the Brodersen LB2 Series expansion I/O modules via its modular backplane bus.

All I/Os (including status flags/words) are stored in an independent memory mapped database in the RTU32M. The database is a mirror of the physical I/O. The WorkSuite® I/O drivers handle the access to this database. You can program your logic application without any connected hardware.

You must be sure that you have the correct I/O configuration and modules when you try to run and debug your application program on the RTU32M – or ensure that missing/future modules in your I/O configuration are set to 'not present' as shown below.



14.3 INTRODUCTION to LB2 I/O series

The Brodersen LB2 Series I/O modules can be used with RTU32M & RTU32N Series products. The modules are in two parts - the bottom part contains the backplane bus and top part contains the I/O board and logic. All LB2 modules can be hot swapped.

Each I/O module has a 200 MHz CPU to process I/O, perform filtering, SOE, debounce, module clock and general module logic. Diagnostic variables are available for all modules - see the module datasheets for full info. Firmware updates are handled from Brodersen WorkSuite®.

Use only genuine Brodersen bus cables for connection to Brodersen RTUs and for extension of I/O module blocks. The LB2 bus connection cables are a special build, to handle the power requirements and shielding to run bus communications. The maximum overall length of a complete system is 5m. Each I/O module & Power supply module is calculated as 2cm. The cables are available in various lengths from 25cm to 200cm.

Each LB2 Bus supports up to 60 I/O modules.

LB2 Cables

Description	Part Number
100cm LB2 Cable	UCC-610/1
200cm LB2 Cable	UCC-610/2
25cm LB2 Cable	UCC-610/25
50cm LB2 Cable	UCC-610/50

IO MODULE BACKPLANE PARTS

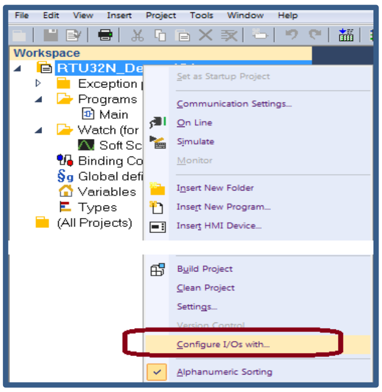
Description	Part Number
Bus I/O module Start	BB21A
BUS I/O module, Middle	BB21B
BUS I/O module, Expansion (End)	BB21C
BUS Power supply module, Start	BB41A
BUS Power supply module, Middle	BB41B
BUS P/S module, Extend (power to right side of P/S only)	BB41E

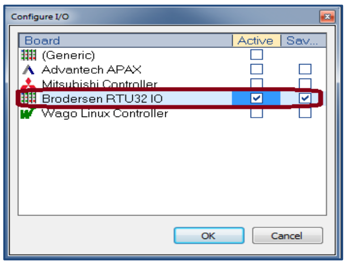
Description	Part Number
BUS CPU module, Start	BB61A
BUS CPU module, Middle	BB61B
BUS CPU module, Redundant (Second MP32A)	BB61R
BUS System module, Start	BB81A
BUS System module, Middle	BB81B

14.4 LB2 Series Module Configurator

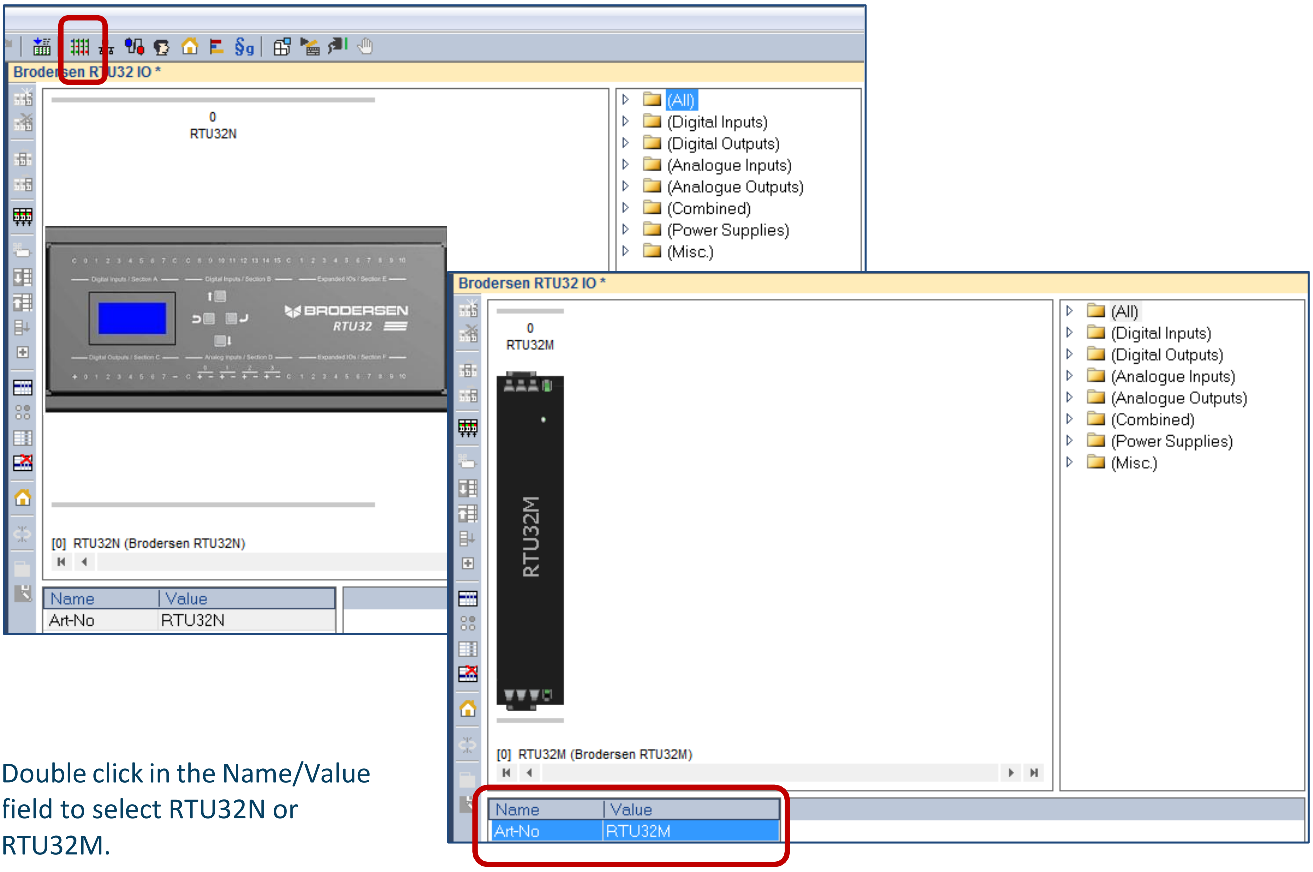
All LB2 Series modules are configured in WorkSuite®.

After creating a new project, right click the project heading and select ‘Configure I/Os with’ and select the Brodersen RTU32IO options.





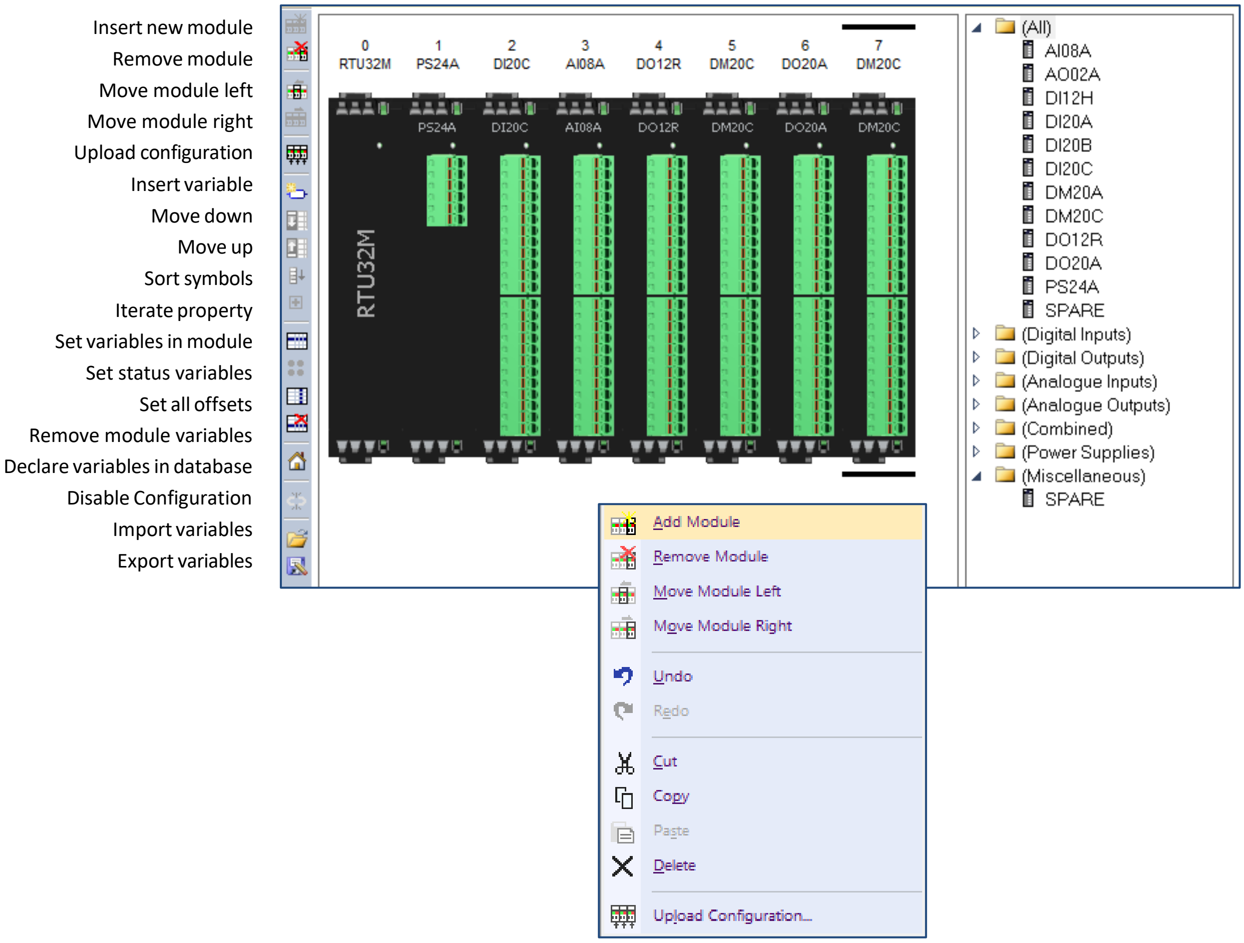
Then select the ‘Open I/Os’ icon in the top toolbar to access the Module Configurator.



Double click in the Name/Value field to select RTU32N or RTU32M.

14.4.1 Managing LB2 Series I/O Modules

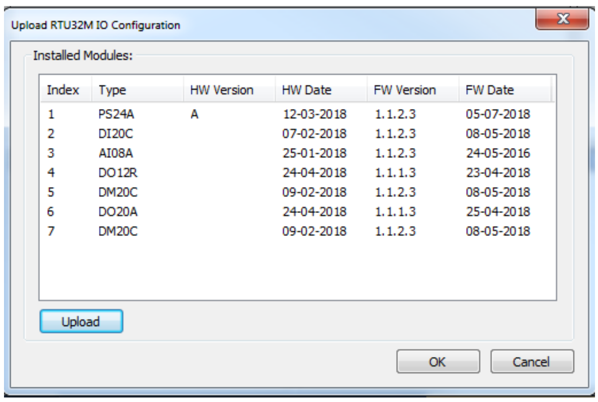
The Module Configurator allows creation and editing of the I/O module setup using a mix of toolbar icons and drag and drop menu items.



14.4.2 Inserting a module

Modules can be inserted in several ways.

- Drag and drop a module from the module list.
- Right click in the I/O module window and select ADD Module
- Copy existing I/O using Windows copy/paste commands.
- Right click in the I/O module window and select 'Upload Configuration' (uploads modules from the online RTU).



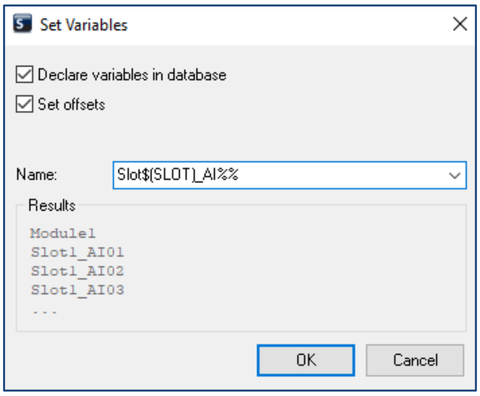
14.4.3 Moving a module

Modules can be moved left or right by placing the mouse cursor on the module – then press and hold the left mouse button to drag the module to the desired position, or press the right mouse button and select ‘Move Module Left’ or ‘Move Module Right’.

14.4.4 Remove a module in WorkSuite®

Modules can Removed/Deleted by placing the mouse cursor on the module - then press Delete on your keyboard, or press the right mouse button and select ‘Remove Module’.

14.4.5 Add variables to a module



In the left pane of the I/O module window, the Icon ‘Set Variables In Module’ opens the variables editor. Remember to check ‘Declare variables in database’ if the variables are to be used as Global Variables.

Use of syntaxes allows flexibility to engineer your own variable names.

Use the Drop Down list to select a suitable syntax, or make your own. For example, if the syntax $(SLOT)_$(OFFSET)_VAR is selected, the variables will be as shown below for an 8 channel analogue input module.

Symbol	Type	Channel
Slot3_AI_01	Analog value	0
Slot3_AI_02	Analog value	1
Slot3_AI_03	Analog value	2
Slot3_AI_04	Analog value	3
Slot3_AI_05	Analog value	4
Slot3_AI_06	Analog value	5
Slot3_AI_07	Analog value	6
Slot3_AI_08	Analog value	7

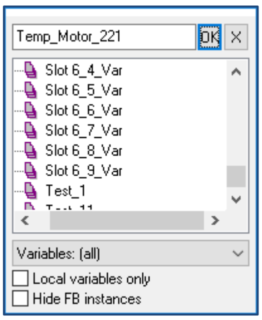
As another example, the syntax could be:
Module_Nr_$(SLOT)_Analogue_In_$(OFFSET)

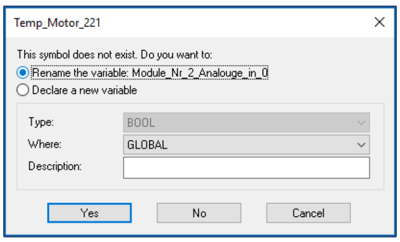
This would create eight variables as shown below;
‘Module_Nr_2_Analogue_In_1’
‘Module_Nr_2_Analogue_In_2’
‘Module_Nr_2_Analogue_In_3’
....
‘Module_Nr_2_Analogue_In_7’
‘Module_Nr_2_Analogue_In_8’

14.4.6 Rename auto generated variables

In cases where variable names can’t be easily generated through a syntax, they can be created/edited manually by placing the mouse cursor on the variable and using DoubleClick to access the variables editor.

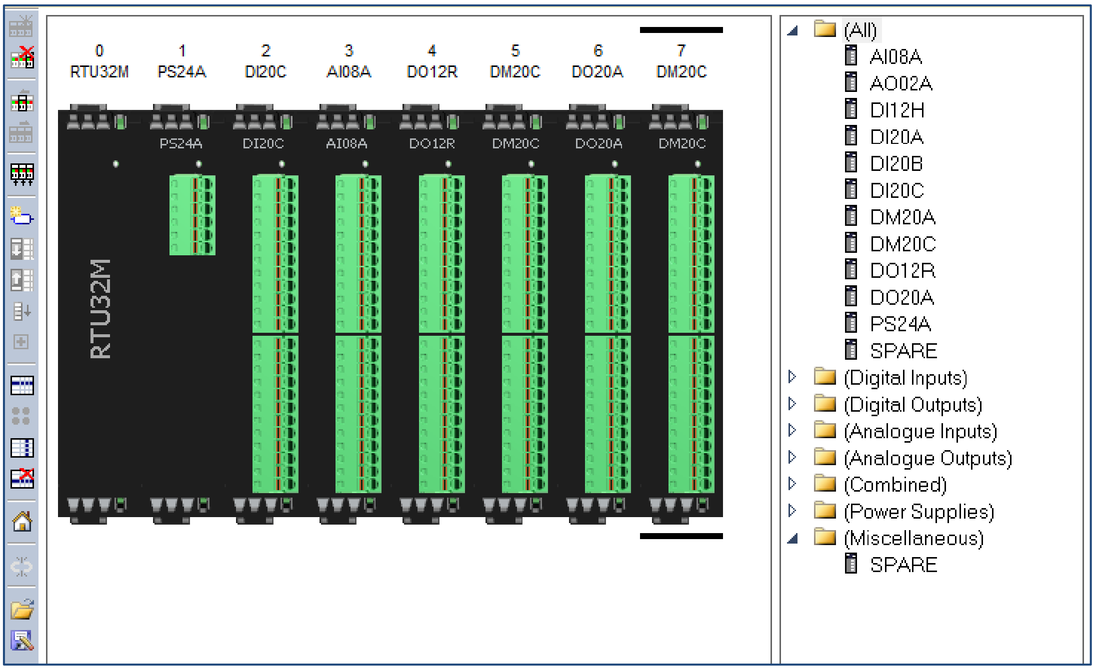
The user can then rename of the variable or create a new variable.





14.4.7 Configure Module Defaults

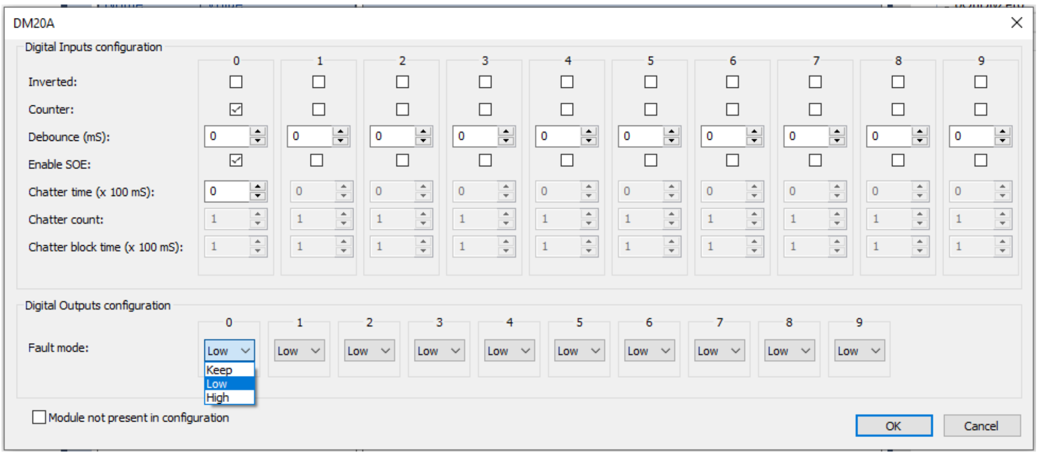
After creating or uploading a module array, module configurations can be modified from their default settings if required. Features and settings for each module can be found on their respective datasheets.



DoubleClick on a module in the I/ O configurator to access the module I/O editor.

14.4.8 Configure Combination DI/DO module example

In the example below a combination DI/DO module with 10 DI and 10 DO has been selected.



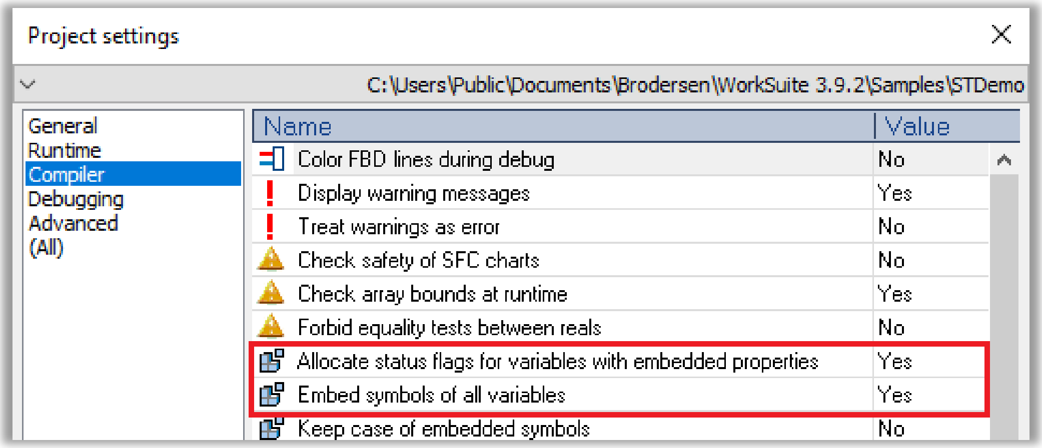
Configuration Fields - Inputs and Outputs:

- **Inverted:** Select if input is to be inverted.
- **Counter:** Select if input is a counter. Note: If an input is receiving a 5 Khz pulse/count, but not defined as a counter, the I/O bus will be spammed with 5000 pulses/sec!
- **Debounce:** Debounce in milliseconds, determines how long time the I/O must be high or low before it is detected as state change.

  Note: The default value for debounce filtering is '0'. To activate it, you need to ensure a stable source voltage. If you have a mechanical interface or unstable input voltage, it is advisable to increase this value.
- **SOE:** The SOE (Sequence Of Events) function is used for storing digital inputs events in a firmware FIFO with 1ms time stamp resolution and status information.

  Notes:

  1- The 'Allocated status flags' and 'Embedded symbols' must be activated in the project settings for the SOE function to work as expected.



  2- The RTU firmware version should be 1982 or newer.

  To get the SOE time stamp, you need to use VsiGetTime function and convert it to the time.

  Ex: Var_X_Time := any_to_time (vsiGetTime (Var_X)) ;

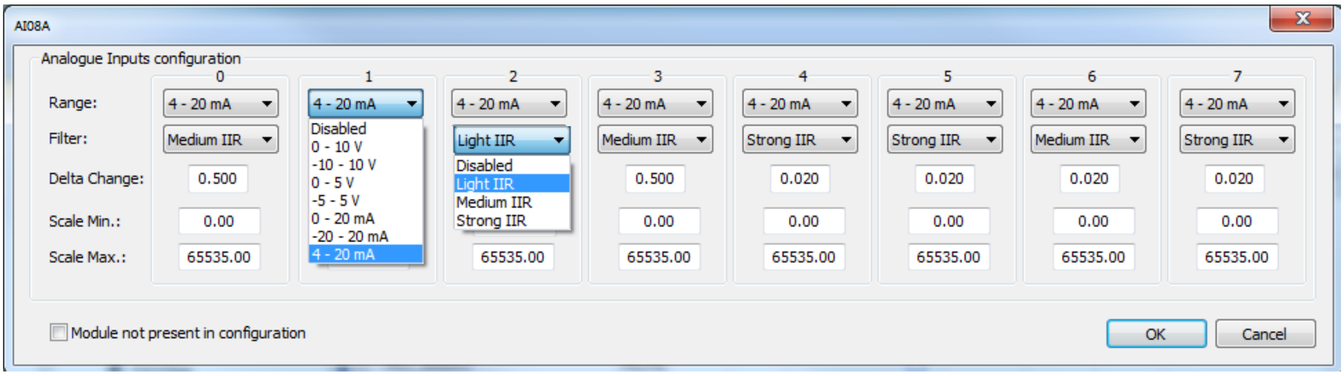
- **Chatter:** The chatter function helps filter out noise or unwanted fluctuations in a signal by employing debounce filtering with an adjustable threshold.

  It contains of three parameters (T(Chatter Time), C(Chatter Count), R(Chatter Block Time)).

  Note: more details are available on DI modules datasheet.
- **Fault Mode:** Fault mode is when the module loses contact with the CPU. Select for all channels.
  - Keep (I/O module will keep last state)
  - Low (Output will be forced Low)
  - High (Output will be forced High)

14.4.9 Configure AI module example

In the example below an AI08A eight channel AI module has been selected.



Configuration Fields - Inputs:

- **Range:** Select input type for each channel in the dropdown menu.
- **Filter:** select filter type for each channel in the dropdown menu.
- **Delta change:** See AI module datasheet.
- **Scale Min:** See AI module datasheet.
- **Scale Max:** See AI module datasheet.

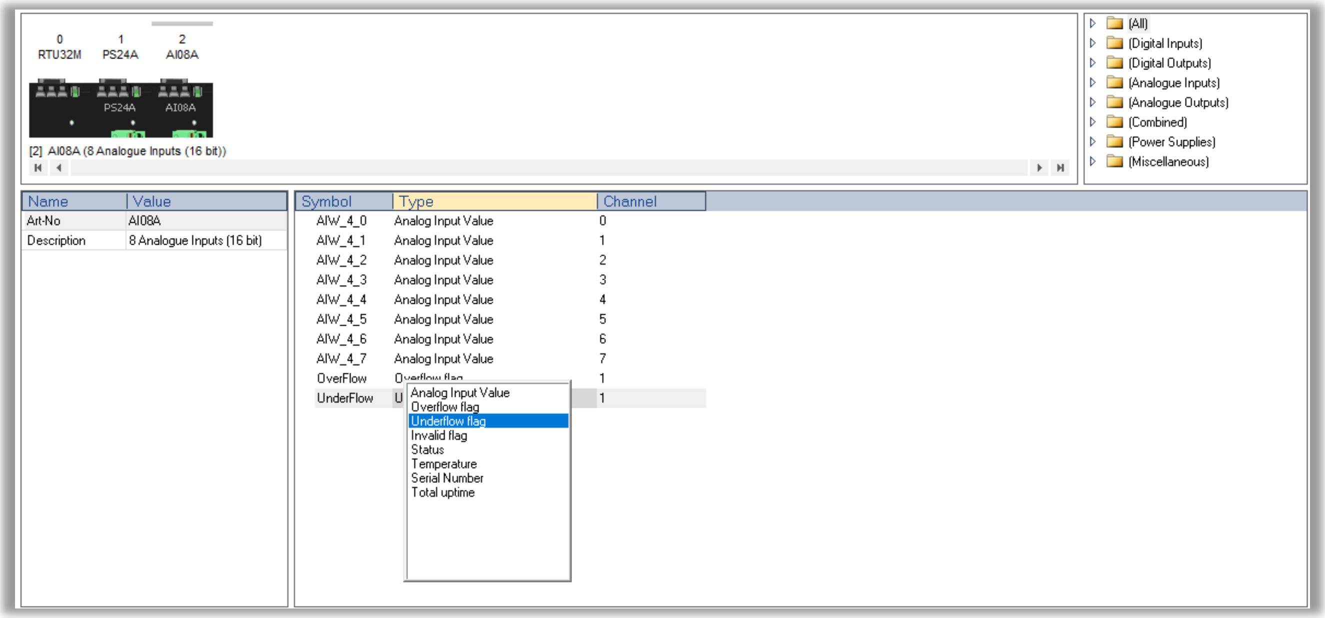
Overflow/ Underflow flags for identifying failure in 4~20ma mode:

Overflow/Underflow flags in the analog input modules operate in 4-20 mA mode to enhance system reliability by promptly identifying and alerting users to potential wiring or instrument failures.

For example: Wire cut or instrument failure triggers activation of the underflow flag, while overcurrent, surge, etc., activate the Overflow flag.

The definition of these flags is available through the I/Os configuration.

Note: Each channel has its own Over/Underflow flags and must be defined in the channel section.



Anticipated States of the Flags		
(t-1)	**(T)**	**(T+1)**
Underflow Off	Current < 2 mA	Underflow On
Underflow On	Current > 2.008 mA	Underflow Off
Overflow Off	Current > 22 mA	Overflow On
Overflow On	Current < 21.886 mA	Overflow Off

14.4.10 Export/Import Module variables.

WorkSuite® allows exporting and importing of variables for alternative methods of editing using document and spreadsheet software.

Export: Select the I/O module of interest and then select the Export Variables icon in the toolbar on the left to create a CSV export file.

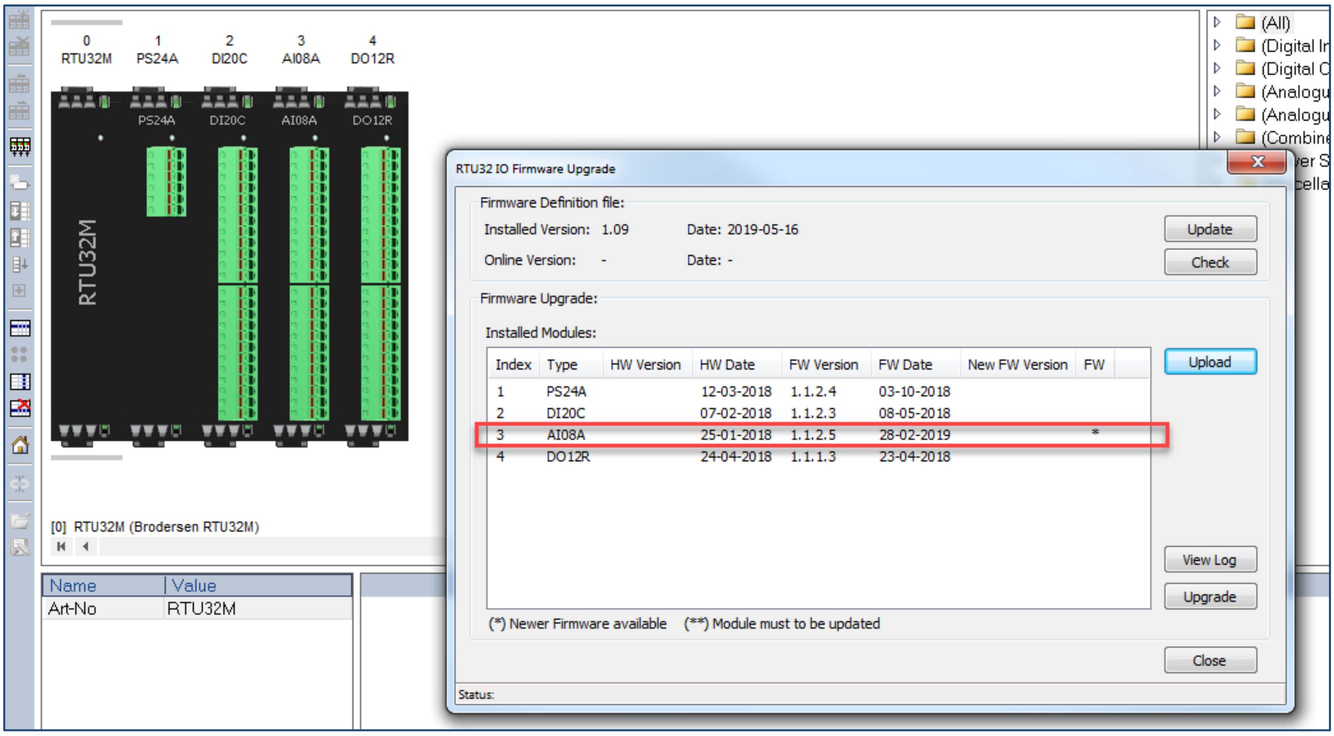
The file includes Scale min, Scale Max, Variable name etc.

	A	B	C	D	E	F	G	H
1	NAME	TYPE	OFFSET	SCALEMIN	SCALEMAX	HWMIN	HWMAX	#F
2	4_module1	IX	0	0.0	65535.0	0	65535	-1
3	4_module2	IX	1	0.0	65535.0	0	65535	-1
4	4_module3	IX	2	0.0	65535.0	0	65535	-1
5	4_module4	IX	3	0.0	65535.0	0	65535	-1
6	4_module5	IX	4	0.0	65535.0	0	65535	-1
7	4_module6	IX	5	0.0	65535.0	0	65535	-1
8	4_module7	IX	6	0.0	65535.0	0	65535	-1
9	4_module8	IX	7	0.0	65535.0	0	65535	-1
10	4_module9	IX	8	0.0	65535.0	0	65535	-1
11	4_module10	IX	9	0.0	65535.0	0	65535	-1
12	4_module11	QX	0	0.0	65535.0	0	65535	-1
13	4_module12	QX	1	0.0	65535.0	0	65535	-1
14	4_module13	QX	2	0.0	65535.0	0	65535	-1
15	4_module14	QX	3	0.0	65535.0	0	65535	-1
16	4_module15	QX	4	0.0	65535.0	0	65535	-1
17	4_module16	QX	5	0.0	65535.0	0	65535	-1

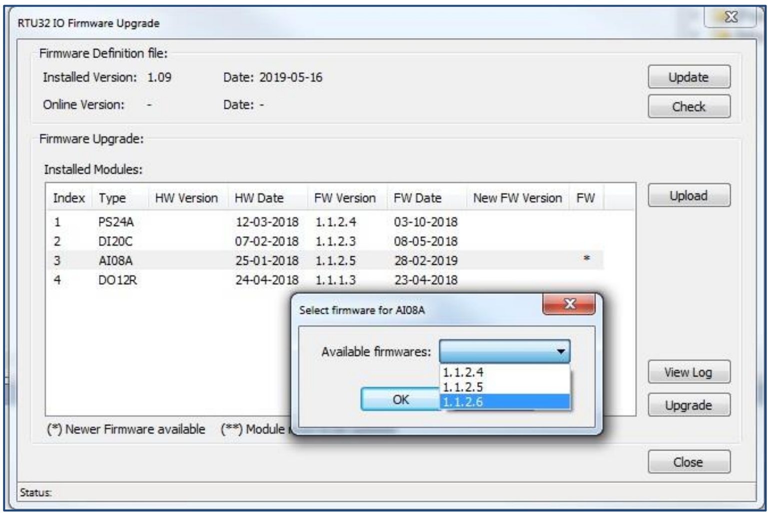
Import: Select the Import Variables icon in the toolbar on the left to read updates from a CSV file.

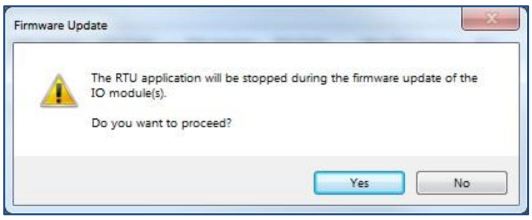
14.4.11 Firmware update I/O modules.

Firmware update of modules on the LB2 bus is done through the Firmware update utility in the Brodersen WorkSuite®. Select Tools>Brodersen>RTU32 IO Firmware Upgrade to access the upgrade tools. As shown below, the user interface allows uploading of the existing module firmware info and updating of individual modules. The Update and Check buttons allow updating of WorkSuite® with the latest IO firmware from the Brodersen FTP server (you will require an active Internet connection to perform an update of your WorkSuite® files). Any modules detected with older firmware will be marked with an asterisk to indicate there is newer firmware available (** indicating that the update is required).



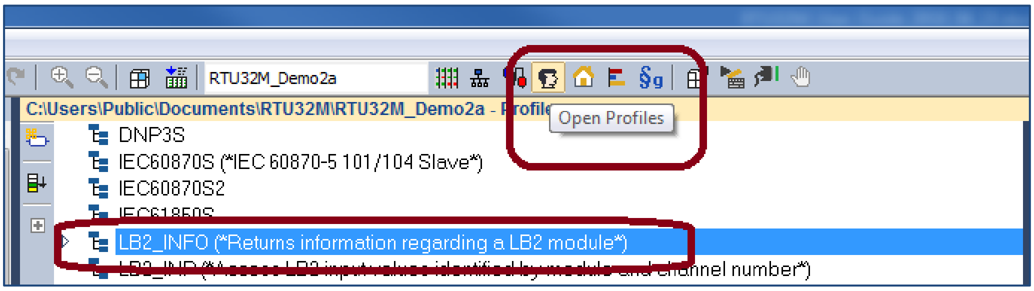
To update a module, double click on it then select the firmware and you will be prompted to continue.





14.4.12 LB2_INFO Profile – monitoring module status

Module status information is available via the Profile Editor, using the LB2_INFO Profile.

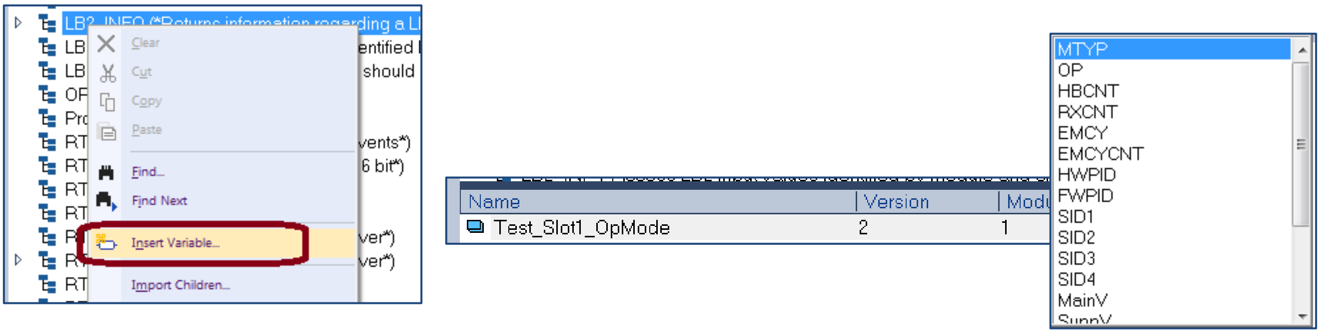


Profiles are a mechanism to add additional attributes to a point variable. The LB2_INFO profile allows access to module parameters and status information including:

Parameter Name	Variable Type	Module Type
OP:	BYTE	Current Operation Mode
		0 = No Module
		4 = Stopped
		5 = Operational
		6 = Operational with heartbeat timeout
		127 = Pre-operational
		150 = Missing
HBCNT:	DWORD	Number of heartbeat frames received
RXCNT:	DWORD	Number of frames received
EMCY:	LINT	Read last EMCY codes
HWPID:	DWORD	Module hardware ID
SWPID:	DWORD	Module firmware ID
SID1:	DWORD	Module serial ID1
SID2:	DWORD	Module serial ID2
SID3:	DWORD	Module serial ID3
SID4:	DWORD	Module serial ID4
MainV:	WORD	Main supply voltage (mV)
SuppV:	WORD	Internal supply voltage (mV)
IntC:	WORD	Internal temperature (C)
PwOn#:	WORD	Power on counter
WD#:	WORD	Watchdog restart counter
UpTim:	DWORD	Uptime in hours
TotUpTim: DWORD	Total uptime	

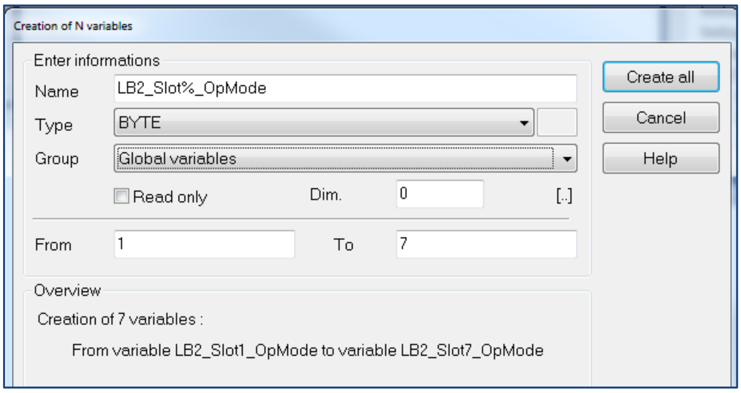
LB2_INFO Profile – Allows access to RTU32M Module Information

To use the Profile Editor – first create a variable by right clicking the LB2_INFO heading and selecting 'Insert Variable'. Eg. create a variable named 'Test_Slot1_OpMode', and give it a BYTE format, then select the 'OP' data type.



Load your application and check that the module returns the expected operating code (5 = operational).

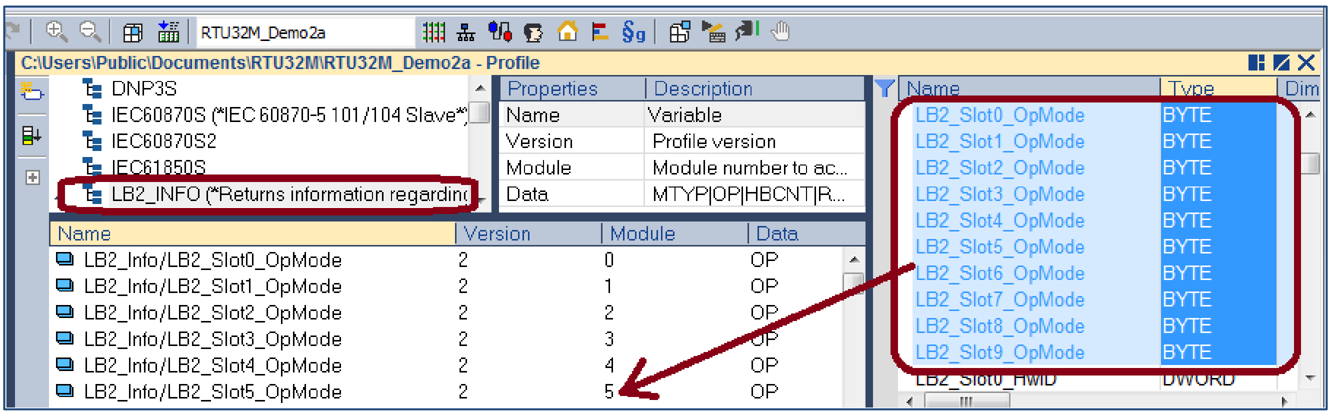
Note: you can create more local or global variables using the Wizard tool in the main variables editor eg. right click in the variables list and select 'Add Multi Variables'.



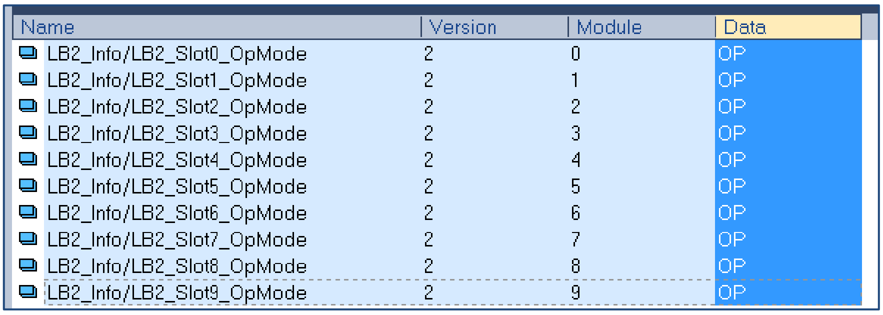
The example here creates 7x variables named LB2_Slot1_OpMode thru to LB2_Slot7_OpMode…

After creating each group of new variables, they can then be dragged in to the Profile editor and assigned their parameters and setting using column change and iterate functions…

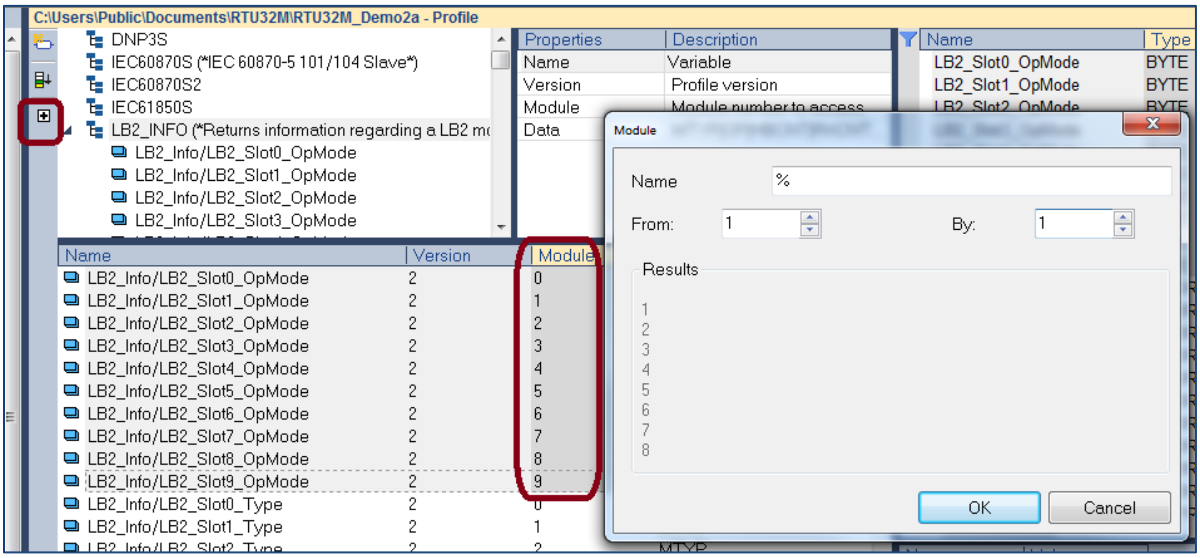
Then first ensure that the correct profile is highlighted, by selecting the header (LB2_INFO), then drag the new variables into the lower pane of the profile editor.



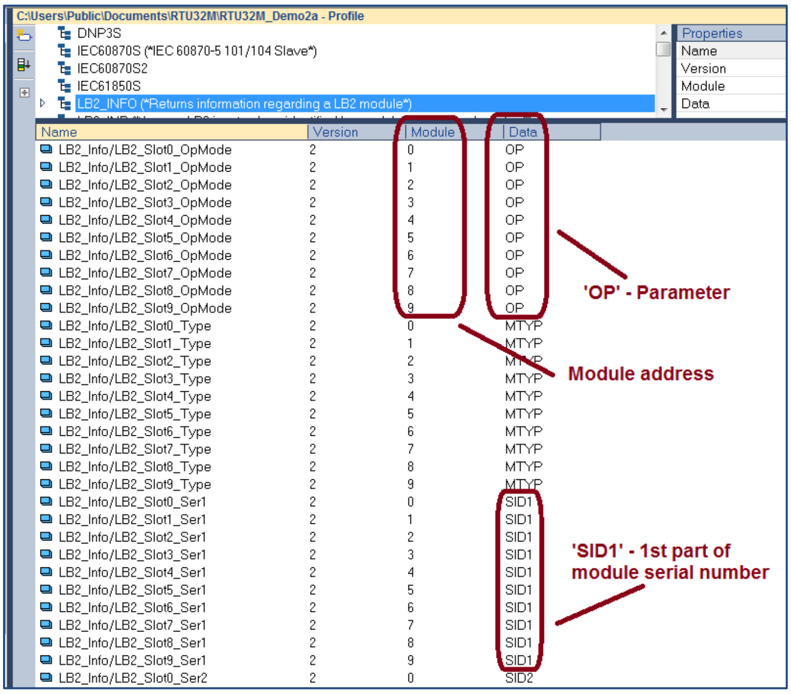
To make column contents change of the Data column, select the first value, then use SHIFT-Double Left Click to bring up the selection window. Select OP for Operating mode to change all of the selected values at once.



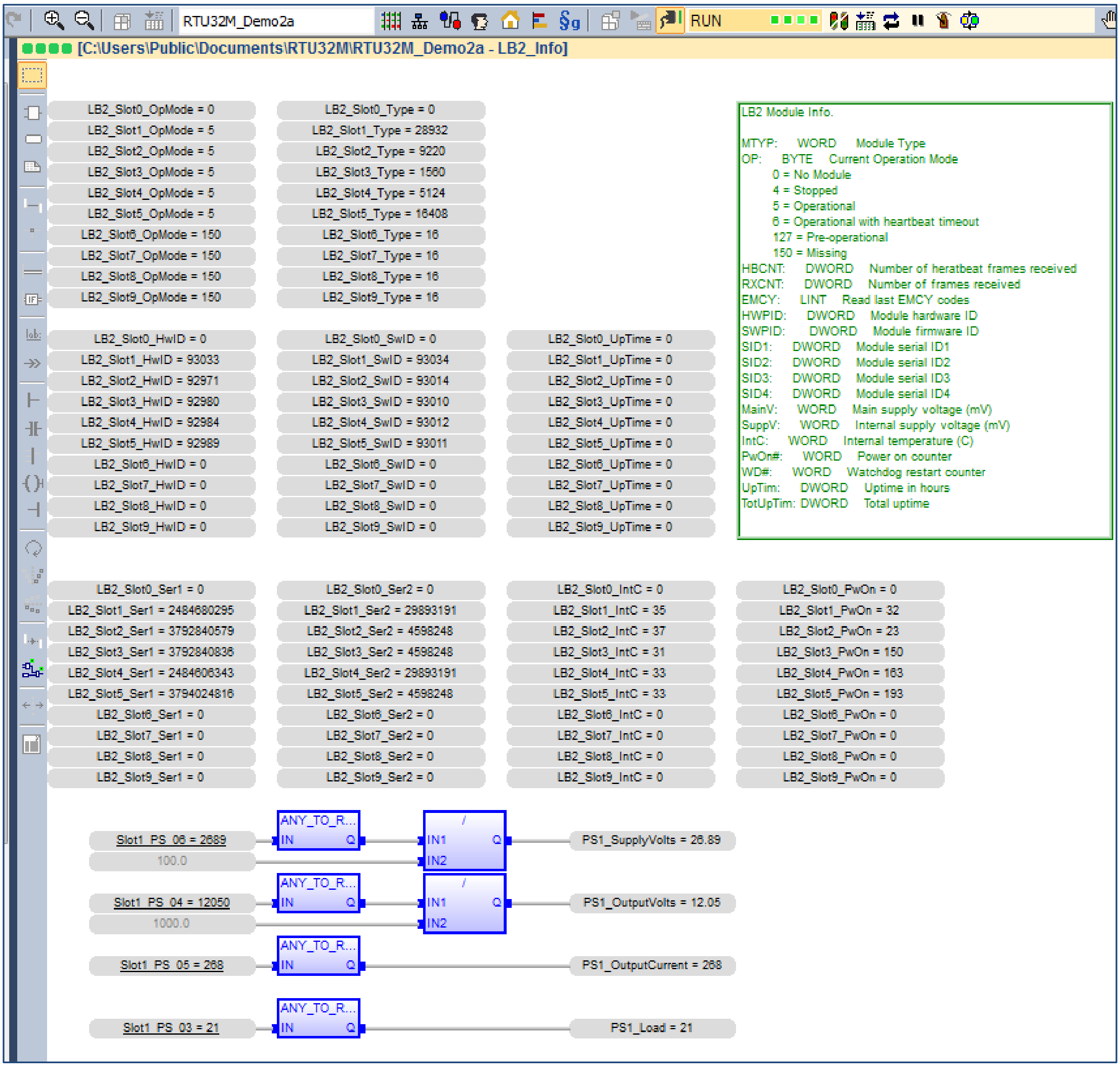
The iterate property button will allow you to rapidly increment the module address for each tag. First select the relevant tags in the module column by selecting the first value, then SHIFT-Left click the last value. Then select the 'Iterate Property' button and set the appropriate start/from value and increment/by value.



If you want to monitor additional module parameters and status information, repeat the above steps and create further variables, as per the example shown below.



Example Logic Application Page – showing various LB2_INFO parameters and status values.

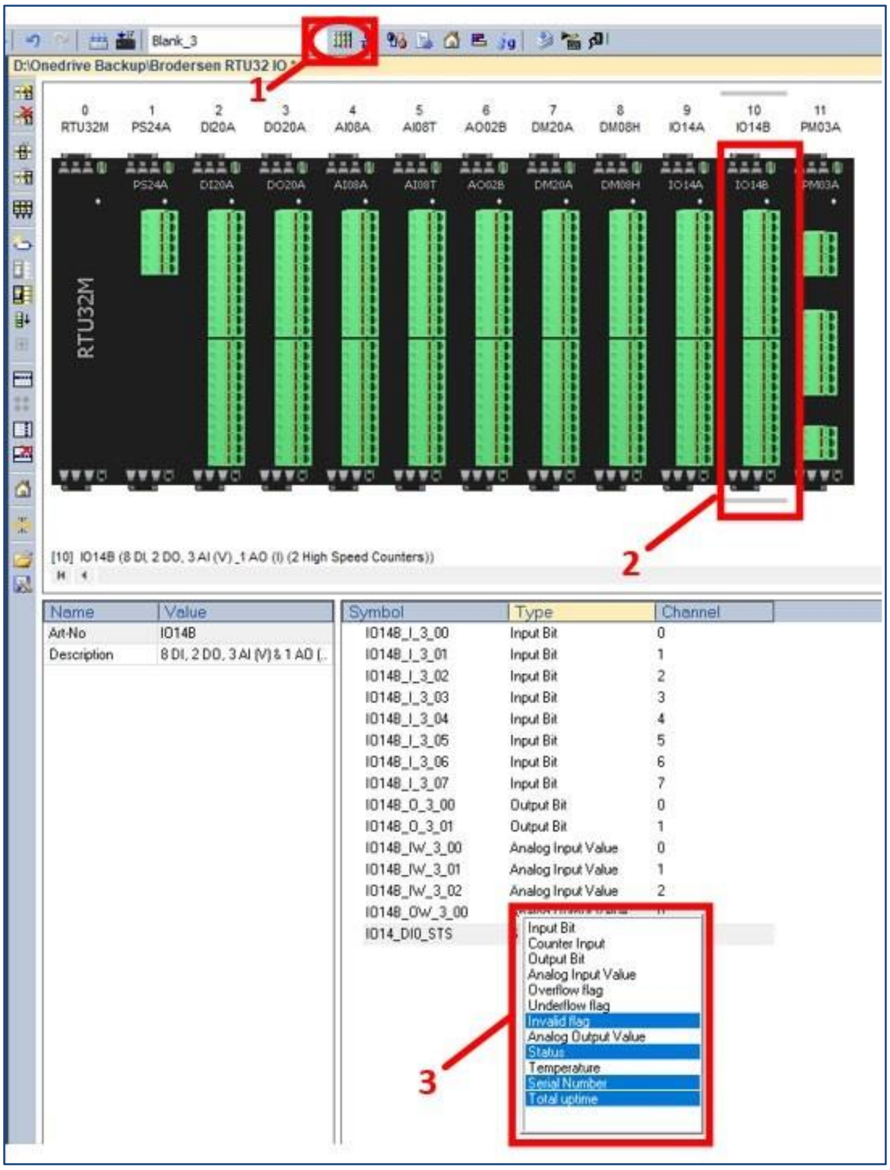


14.4.12.1 Monitoring module statuses through I/O configuration

There is one easier way to get the module status if the target is values validity, operation module, module temperature, serial number or module total uptime:

Follow below steps:

1- Go to the I/O configuration.
2- Select the target module.
3- Define the variable and choose the required status.
   - Invalid flag: Returns '1' when the module in not operational (DWORD)
     - It's useful to check the validity of the values on input modules due to the retention of the last values when the modules are non-operational or missing.
   - Status: Return the value the same as LB2_Inf.OP (DWORD)
   - Total uptime: Working time of the module (DWORD)
   - Serial Number: Returns the hardware's internal serial number. (String)
     - Note: (this is an internal serial number used to check the module's validity and for the module changes, so it's not related to the module box's serial number)



14.5 COM Port Settings

When using serial drivers the COM port parameters are defined as “COM1:9600,N,8,1”. In addition, some specific control and debug parameters can be added for the RTU32M.

The COM port setting strings follow the normal WorkSuite® conventions. COMa:b,c,d,e (e.g. COM1:9600,N,8,1).

a) COM port number:	1...3
b) Baud rate:	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
c) Byte size:	7, 8 (bit)
d) Parity	N, E, O (none, even, odd)
e) Stop bits	1, 2

A range of additional parameters on the COM port settings are supported to control:

- Setup the COM port for modem dial support – enable the Modem driver.
- Hardware handshake signal on null modem driver.
- Provide communication log in the general RTU32M System Log.

The extensions for these functions and features are:

- When using the modem driver a ‘M’ is added (e.g. MCOM1:9600,N,8,1)
- RTS / CTS hardware handshake control on the null modem serial driver is supported and enabled by the options as follows:

  ‘RD’ RTS is kept inactive (low) at all time.

  ‘RE’ RTS is kept active (high) at all time.

  ‘RT:Leading:Trailing’ RTS is inactive when receiving data, and becomes active when transmitting data. The RTS Leading setting defines the delay from activating the RTS to when the first character is transmitted. The RTS Trailing setting defines the delay from when the last character is transmitted to RTS is deactivated.

  Leading and trailing time is in units of msec. - e.g. COM1:9600,N,8,1,RT:50:10

  ‘RC:Leading:Trailing’ RTS is inactive when receiving data, and is activated when the RTU wants to transmit data. After activating RTS, the RTU will wait for CTS to become active, before start transmitting. The RTS Leading delay is still valid in this mode, and an adjustable delay from CTS activated to first character is then possible. However, by setting the Leading time to zero there is no unnecessary delay from CTS to first character (like a normal RTS / CTS function). After activating RTS the RTU waits up to 10 sec for the CTS signal. If timeout occurs, the transmission is discarded. The RTS Trailing setting defines the delay from when the last character is transmitted to RTS deactivated.
- Logging of serial data in the System Log.

  ‘LL’ Log Link data. All bytes transmitted and received on the COM port, are logged in the internal log message system, and are available using telnet at port 911. This is primarily for debug purpose.

  Examples: MCOM3:9600,N,8,1,LL
COM2:57600,E,8,1,RT:30:10,LL

Notes:

If you just connect a serial device, e.g. Modbus RTU communication via a Null Modem cable to the RS232 COM port, it is NOT required to add any special extensions.
Brodersen WorkSuite® has a limitation of max 31 chars in the settings string.

If you enable the SP5 (Secure Protocol for remote communication) on the RTU32 Webpage, you must set the COM parameters settings for the specific port on the webpage. If the SP5 setting is enabled, the COM settings overrule any later settings in WorkSuite®.

The serial port settings use the same syntax no matter where you configure it.

14.6 Modbus Drivers

The RTU32M PLC runtime supports function for several types of Modbus protocols:

- Modbus RTU Master and Slave
- Modbus ASCII Slave
- Modbus TCP Client and Server

The drivers are setup using the Fieldbus Configurator in WorkSuite®. Refer to WorkSuite® training and programming examples. You will find support for Modbus UDP, and Function Block managed Modbus drivers in the WorkSuite® help.

14.6.1 Modbus RTU Master

The RTU32M supports several Master/Client drivers. You can in fact setup as many Master drivers as you have COM ports available. The Modbus Master/Client is setup using the Fieldbus Configurator. See the WorkSuite® help for details.

14.6.2 Modbus RTU Slave

The RTU32M supports only one Slave/Server driver. You must add a MBSLAVERTU function block in the program logic for the Serial Modbus Slave driver (MBSLAVERTUEX function is used if more than one slave/server is required – it allows separation of the slave/server addresses using their ‘Server Id’). The MBSLAVERTU function defines the Modbus Slave address and port settings. You can find the function block in the “Advanced” function block folder. All variable assignments, addressing etc. are done in the Fieldbus Configurator. See WorkSuite® for details.

14.7 IEC60870-5-101/103/104 Drivers

The Utility protocols IEC60870-5-101, 103 and -104 are implemented as a basic link driver in the RTU32M. The application layer which includes all the specific handling of request and events communication is managed in the RTU application program. A range of WorkSuite® functions and example are provided for the different protocol functions and ASDU handling.

WorkSuite® include drivers for:

- IEC60870-5-101 Master
- IEC60870-5-101 Slave
- IEC60870-5-103 Master
- IEC60870-5-104 Server
- IEC60870-5-104 Client

The basic link drivers include handles for the link driver where you can define buffers, link address etc. The fact that the serial link is similar to the IEC60870-5-103, provides the option to implement application layer support for this protocol as well.

To use the IEC60870 driver, you must use the RTU32 Series Code Generator tool. This is used for simple configuration of any IEC60870 Driver.

14.8 Watchdog

The RTU32N has two built-in watchdog functions – all managed by a separate CPU on the interface board.

The system watchdog is monitoring all internal processes including the OS and communication processes between consoles and databases. In case of error, the watchdog will wait 30sec for the error to be either self-healed or the process to be restored. If this is not happening the watchdog will boot the RTU.

The application watchdog is monitoring the RTU/PLC runtime applications including all related tasks such as drivers. If any of the related tasks fail, stop or freeze for more than 10sec, the application watchdog will boot the RTU.

14.9 Real time Clock

The RTU32N has a hardware real time clock controlled by the operating system. It provides the RTU32N millisecond resolution in order to make accurate time stamps. From the RTU application program you have access to the real time clock via logic function blocks. You can both read and set the clock.

On the configuration webpages you can also define how to synchronise the clock. Options for manual setup and SNTP Server synchronisation are possible. If you use utility drivers (e.g. DNP3 and IEC61850) to synchronise the RTC you must disable SNTP on webpage by setting it to manual sync.

14.10 Modem Functions

WorkSuite® provides a range of modem control Functions. The Dialup library includes:

- Functions to control and monitor PSTN/GSM modem dial-in/out

14.10.1 Dial functions for GSM and PSTN Modems

Dial functions for communication with serial drivers over PSTN and GSM modems are provided.

The low level modem handling (send AT commands, connect detection etc.) is done by firmware. However, it is up to the application programmer to decide which protocol driver should be activated, when and where to dial, and respond to the modem connection state. A number of WorkSuite® functions are available for this:

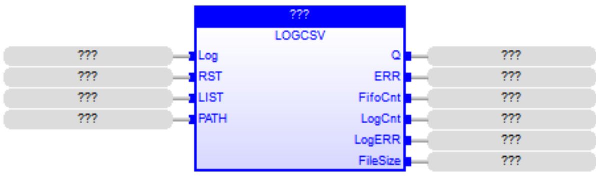
14.11 Data Logging

WorkSuite® provides functions for logging data into one or more file(s) in the RTU32. In general 2 functions are available:

1. LOGCSV Function - a dedicated RTU32 Series logging function. You can find an example of this being used in the WorkSuite® Demo examples installed together with your WorkSuite® Package. This data log function handles the read/write functions in a background scan and does not interfere with the general PLC cycle. You will find details of the LOGCSV file function below.
2. LogFileCSV – simple function for logging data into a CSV-file. It uses a standard file write function and it is not recommended to use for data logging as a standalone Function.

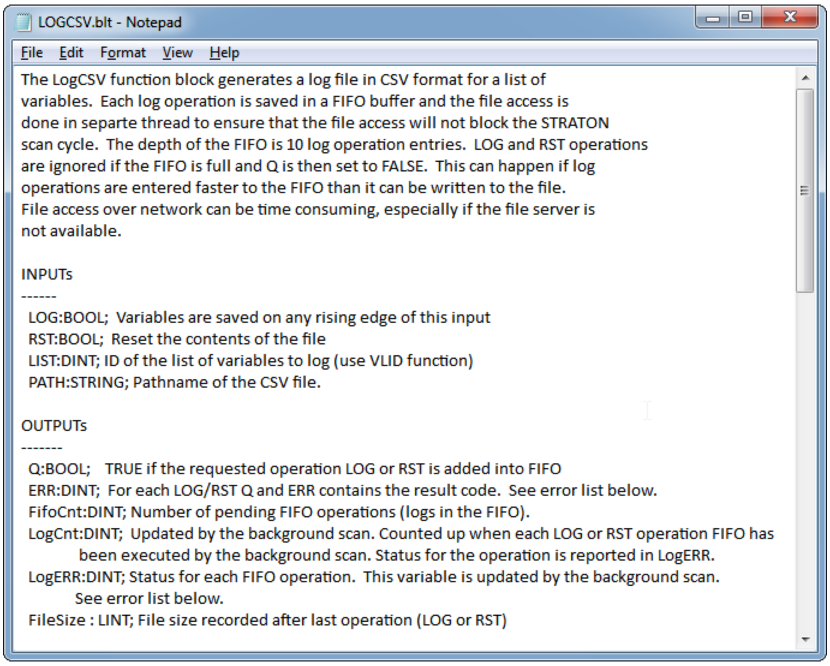
LOGCSV Function

The LOGCSV Function is found in the Brodersen Function library folder.



The LogCSV function block generates a log file in CSV format for a list of variables. Each log operation is saved in a FIFO buffer and the file access is done in a separate thread to ensure that the file access will not block the PLC runtime cycle. The depth of the FIFO is 10 log operation entries. LOG and RST operations are ignored if the FIFO is full and Q is then set to FALSE. This can happen if log operations are entered faster to the FIFO than it can be written to the file.

File access over network can be time consuming, especially if the file server is not available.



LOGCSV.blt - Notepad

File Edit Format View Help

```
The LogCSV function block generates a log file in CSV format for a list of
variables.  Each log operation is saved in a FIFO buffer and the file access is
done in separte thread to ensure that the file access will not block the STRATON
scan cycle.  The depth of the FIFO is 10 log operation entries.  LOG and RST operations
are ignored if the FIFO is full and Q is then set to FALSE.  This can happen if log
operations are entered faster to the FIFO than it can be written to the file.
File access over network can be time consuming, especially if the file server is
not available.

INPUTs
------
 LOG:BOOL;  Variables are saved on any rising edge of this input
 RST:BOOL;  Reset the contents of the file
 LIST:DINT; ID of the list of variables to log (use VLID function)
 PATH:STRING; Pathname of the CSV file.

OUTPUTs
-------
 Q:BOOL;    TRUE if the requested operation LOG or RST is added into FIFO
 ERR:DINT;  For each LOG/RST Q and ERR contains the result code.  See error list below.
 FifoCnt:DINT; Number of pending FIFO operations (logs in the FIFO).
 LogCnt:DINT;  Updated by the background scan. Counted up when each LOG or RST operation FIFO has
          been executed by the background scan. Status for the operation is reported in LogERR.
 LogERR:DINT; Status for each FIFO operation.  This variable is updated by the background scan.
          See error list below.
 FileSize : LINT; File size recorded after last operation (LOG or RST)
```

```
REMARKs
-------
The LogCSV function enables to log values of a list of variables into a CSV file.
On each rising edge of the LOG input, one more line of values is added to the file.
There is one column for each variable, as they are defined in the list.
The list of variables is prepared using the workbench or a text editor.
Use the VLID function to get the identifier of the list.

On a rising edge of the RST command, the file is emptied.

The "SetCsvOpt" function enables you to customize the format of the CSV file.
By default the sperator is (";") and the decimal point is ("."). (Available in VM8.0)

When a LOG or RST command is requested, the Q output is set to TRUE if the request can
be entered into the operation FIFO successfully.  If is set to Q=FALSE and ERR contains
a error code.

On each execution of the FIFO entries by the background scan the LogCnt is counted and
the result of the operation is reported in the LogERR output.

Possible ERR values are (when Q=FALSE):
Value Meaning
-------------
0  No error, (Q=TRUE)
3  Embedded lists are not supported by the runtime.
4  Invalid list ID.
5  Error while building log line.
6  FIFO full

Error reported in LogERR by the background scan thread
Value Meaning
-------------
0  No error
1  Cannot reset file on a RST command.
2  Cannot open file for data storing on a LOG command.
5  Cannot write to file

Hot restart / Redundancy switch over
------------------------------------
Pending logs in the FIFO are not restored during redundancy switch over
```

In the RTU32 Example projects in WorkSuite® you will find a WorkSuite® Demo project LOGCSV_Demo with a log UDFB (User Defined Function Block) block named TMultiFileLog. With this UDFB you will be able to control the number of files to log and limit file size. This allows management of log files in a ring buffer, ensuring that your log files will not fill up the available storage memory.

14.12 Status information functions

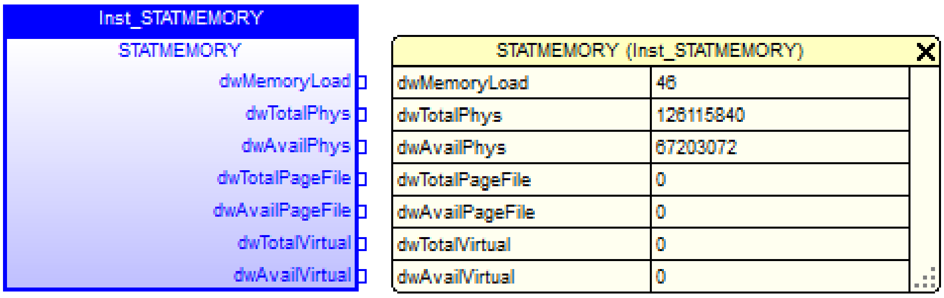
RTU32 Series products have hardware status information available.

```
RTU32Status
    STATBOARDINFO (*Main interface board info*)
    STATINTBATTERY (*Returns internal battery status*)
    STATINTTEMP (*Returns internal temperatur of the RTU*)
    STATLOCALBUS (*Returns localbus status, same as ST-0*)
    STATMEMORY (*Returns memory status of Windows CE*)
    STATSUPPLYVOLT (*Returns supply voltage to the RTU if supported.*)
```

Although most of these status functions are supported in the RTU32M/N firmware, only some of the status functions are available/relevant in the RTU32M/N (ie. many are available directly from the RTU32M modules). The following sections list the functions supported by the RTU32M/N.

14.12.1 RTU Memory Status (STATMEMORY)

The function StatMemory returns the RTU32M/N memory status.



Typical memory status in a running RTU32M/N

The commonly used monitoring functions are dwMemory Load, dwTotalPhys and dwAvailPhys.

The dwMemoryLoad tells you in percent the actual RAM program memory load. With a medium PLC runtime application you will see a load of approx. 50%. Only applications with multiple driver connections and a lot of logic will require larger amount of memory. The maximum load recommended on a RTU is 90%.

The dwTotalPhys tells you how much RAM program memory is available in the RTU. The rest of the RAM memory up to around 64MB is used for storage (file system etc.).

The dwAvailPhys tells you how much available program memory you have in your RTU. The rest is used by the Operating System and your PLC application.

14.13 Reading Text Files from WorkSuite®

To provide the functionality to read variables and strings from an external file in the RTU32M/N, a few simple read file functions are supported.

```
GETFILETIME (*Returns the time stamp of a file as LINT*)
GETINIFILEINT (*Read an integer value from an *.INI file*)
GETINIFILESTR (*Read a string value from an *.INI file*)
```

Note: You have to place the text file in the RTU32M/N file system manually – use sFTP to do this and use the Nand Flash location (or SD Flash). A SSH client SFTP interface (such as BitVise) can be used to explorer the RTU32M/N files. The file structure must be the same as other RTU .ini files (such as SNMP.txt and RTU32.ini). The structure is simple and looks like this:

```
[ABC]
def=123
ghi=456
```

ABC is called the section and def the item. NOTE: all are case sensitive.

The functions available are:

- **GetFileTime** - With this function you can check the time of the file so you only read the variables in case of changes.

```
GetFileTime (*Returns the time stamp of a file as LINT*)
IN
  FileName:STRING
OUT
  Q:LINT
```

- **GetIniFileInt** - Read an Integer value from a section and item

```
GetIniFileInt (*Read an integer value from an *.INI file*)
IN
  Section:STRING
  Item:STRING
  Default:DINT
  FileName:STRING
OUT
  Q:DINT
```

GetIniFileStr - Read a String variable from a section and item

```
GetIniFileStr (*Read a string value from an *.INI file*)
IN
  Section:STRING
  Item:STRING
  Default:STRING
  FileName:STRING
OUT
  Q:STRING
```

The primary use of these functions is to support ‘dynamic’ variables outside the RTU runtime application program. You can then use the same application program for several sites and manage the differences for each site in the file. You can edit the file from the web editor with your browser or directly send a new file to the RTU32M/N from your SCADA host using FTP.

14.14 Access to filesystem on the RTU

It is possible to access the root filesystem of the RTU by connecting using a SSH Client (such as Bitvise SSH Client). When connected it is possible to retrieve e.g., log files generated from application code or system generated event logs.

14.15 Access to filesystem on external microSD Card or USB memory stick

The RTU can access external storage depending on the boot source: when booted from internal flash, a microSD card or a USB memory stick can be accessed; when booted from an SD card, only a USB memory stick can be accessed. Supported filesystems include FAT, FAT32, EXT2, EXT3, and EXT4.

15 Distributed Event Binding Protocol / Redundancy Binding Communication

15.1 General

The Distributed Event Binding protocol is a proprietary protocol for fast time stamped event based data transfer directly from one Brodersen RTU runtime to another. The Binding protocol is communicating directly from one RTU32 to another RTU32 in a LAN/WAN network. It can run regardless of any other application. In a network with several Brodersen RTUs you can use the Global Binding Editor to bind any global declared variables together.

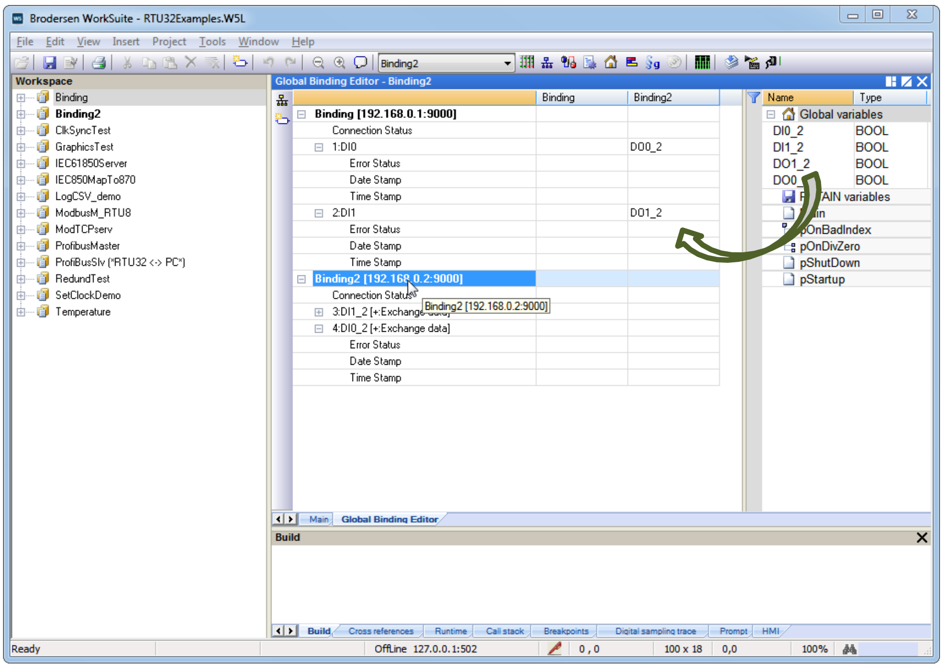
Redundancy Binding is used in a redundancy network connection using 2-6 separate network segments. Both the unit publishing variables (producer) and the unit subscribing variables (consumer) has to be equipped with 2-6 Ethernet network interfaces. Each network connection must be setup on the units as separate network segments using different TCP/IP subnet masks. The compiler also takes care of handling the sorting out of timing issues of any changes in values. This means that you on the subscriber side always will get the correct value. The first received event will be reported at the subscriber side and the same event with the same time stamp received on other network interfaces will be ignored.

15.2 Network settings in RTU32 (redundancy binding)

If you want to run redundancy Binding using the RTU32 you must configure all Ethernet interfaces. No additional settings are necessary as the networks is seen as direct accessible parallel networks. Routing to the networks is done as default. If you ping an address on any of the one of selected network segments, the ping request will find its way to the correct segment automatically.

15.3 Procedure for setting up binding/redundancy binding in WorkSuite®

You need to configure all the RTU32 runtimes before starting to bind (link) I/Os together. I/Os and variables to bind must be declared as Global variables. Use variable naming that makes sense for you. You could for example call all input variables published for binding *BindInput_DI0* and *BindInput_DI1*, and you could call outputs *BindOutput_DO0.* After defining the variables for use in both comms direction for all relevant projects (RTUs), you must start the Global Binding Editor (find it in WorkSuite® under the Tools menu). Note that in WorkSuite® you will need all Projects used for binding in the same project list.



You assign the IP addresses to each project. If using redundancy Binding, you add up to maximum 6 x "IP:TCP port" to the address of the RTU. If two network interfaces are used for binding (dual redundant binding), the two IP addresses are defined with a separator "|" – like 192.168.1.222:9000|192.168.2.21:9000"

As shown above, the OUTPUTS from Publishing RTU project are linked to the subscribing RTUs INPUTS.

After configuration you download ALL projects to the relevant RTUs. Use the "Download All Projects…" in the Project menu.

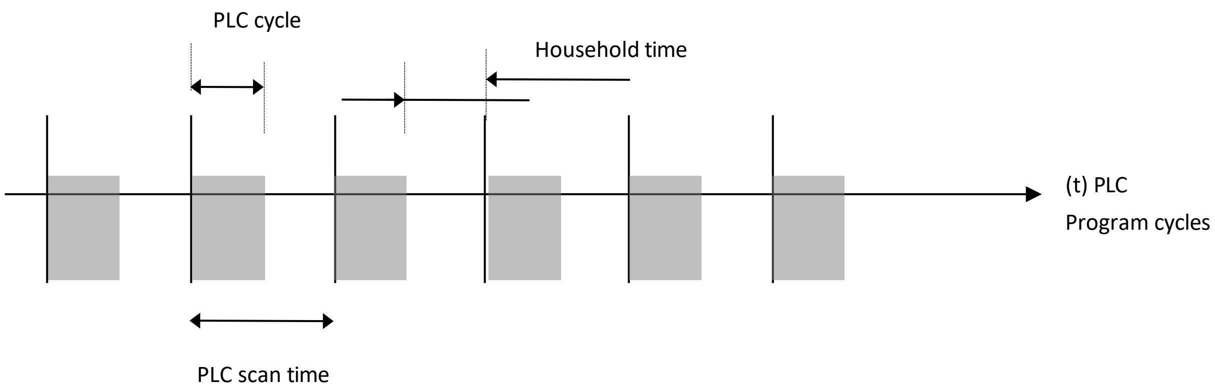
16 RTU32 cycle / scan time

All tasks run independent of each other. The RTU32 I/O database reflects the physical I/O. The PLC runtime program cycle time depends on the size of the application program, and can vary from less than 1 msec to >100 msec. At runtime application start, all inputs are read from the I/O database and at the end of each cycle the outputs are written to the I/O database.

16.1 RTU scan time

The RTU scan time can be set to 0 (zero) which automatically assigns some time for operating system household activities between each runtime program cycle. In this case the program runs as fast as possible. The automatic assignment of household execution time ensures all necessary operating system processes can be maintained with a good margin.

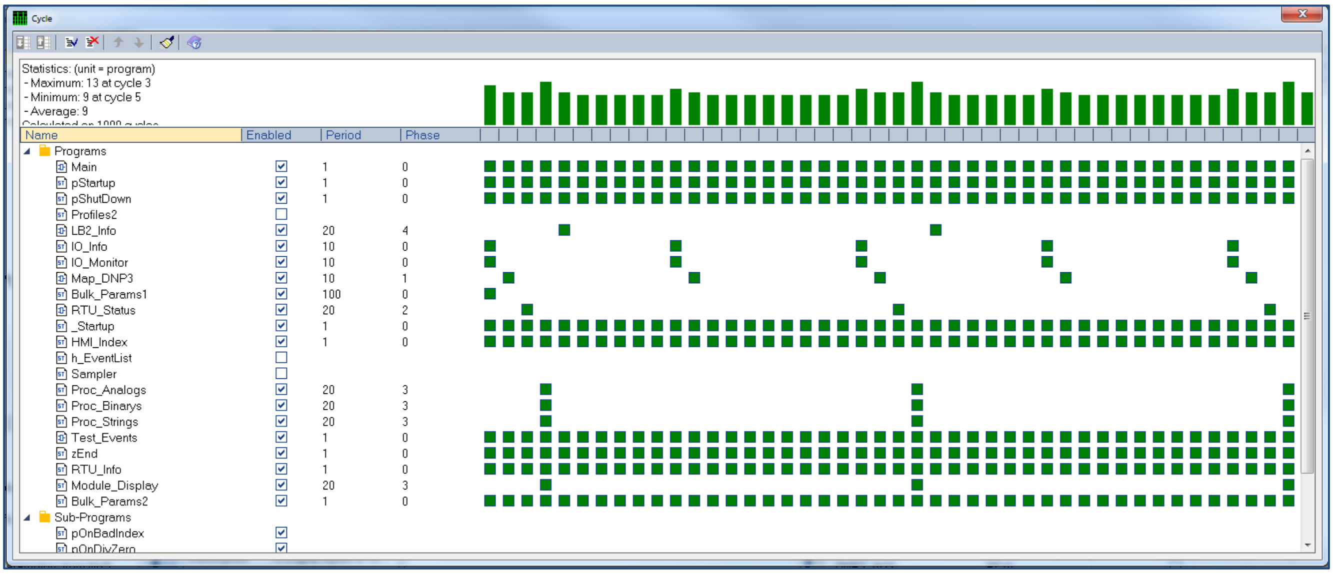
Note: RTU32M/N CPU with clock speeds of 200MHz have a forced delay of 40ms between cycles.



If you set the PLC scan time to a fixed value, you can in some cases obtain a better general scan time for your application program. But it is IMPORTANT to realize that you are then responsible to leave time for household operations.

IMPORTANT NOTICE: If you leave too short time for household operations, the firmware will automatically ensure that your PLC program does NOT compromise necessary household time. It also means that you will get a slower scan cycle time than adjusted. If your RTU/PLC application includes many TCTP/IP based connections over LAN connections, it is recommended to fix the scan time to a value leaving more time to the OS household than automatically assigned.

WorkSuite® 3.9 includes a scheduler that allows a visual setup for the period and phase of programs (right click the project heading).



16.2 LB2 Bus and Internal I/O Bus scan time

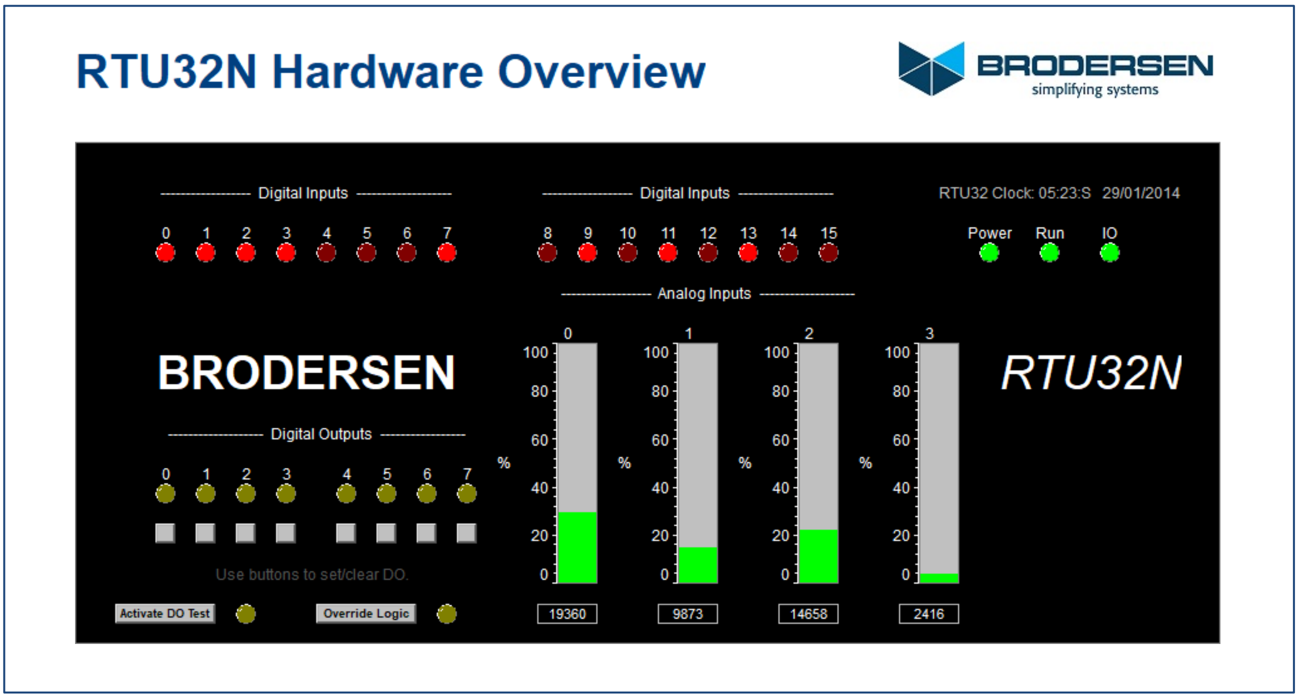
The scan time of the RTU32M internal I/O is running as fast as possible (in micro seconds).

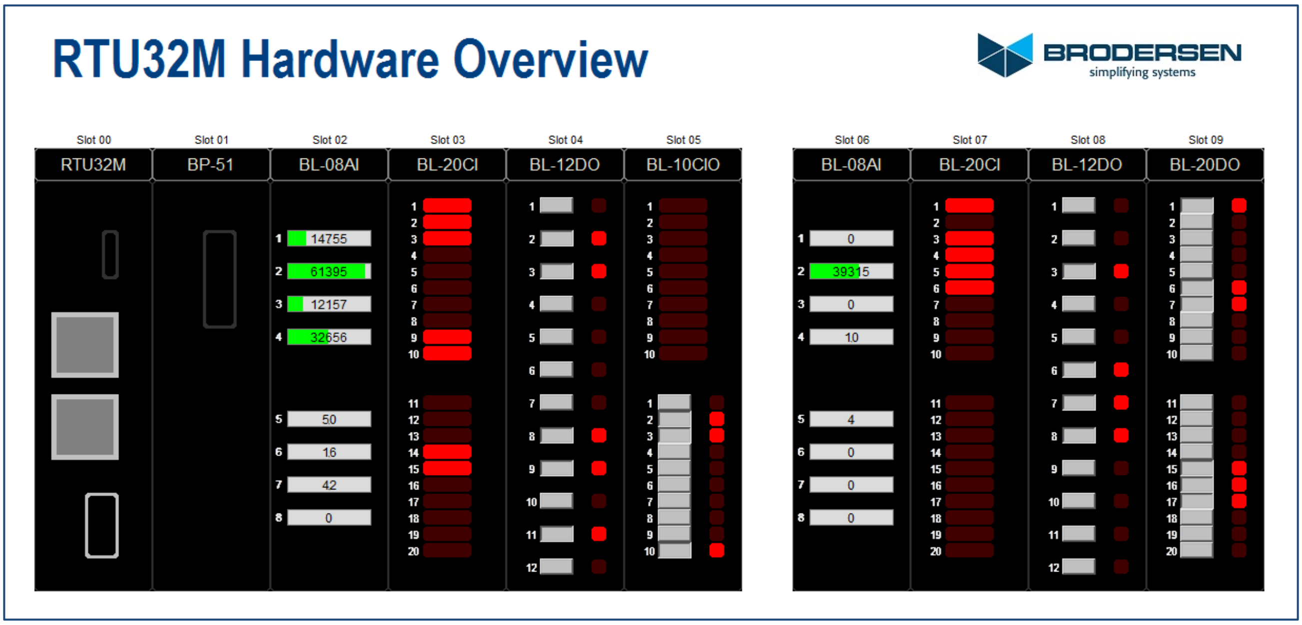
17 RTU HMI

17.1 Examples

The RTU32 Series supports simple HMI functions developed in WorkSuite®. You can easily add graphic displays to your application and monitor data online from your PC using the WorkSuite® HMI Viewer.

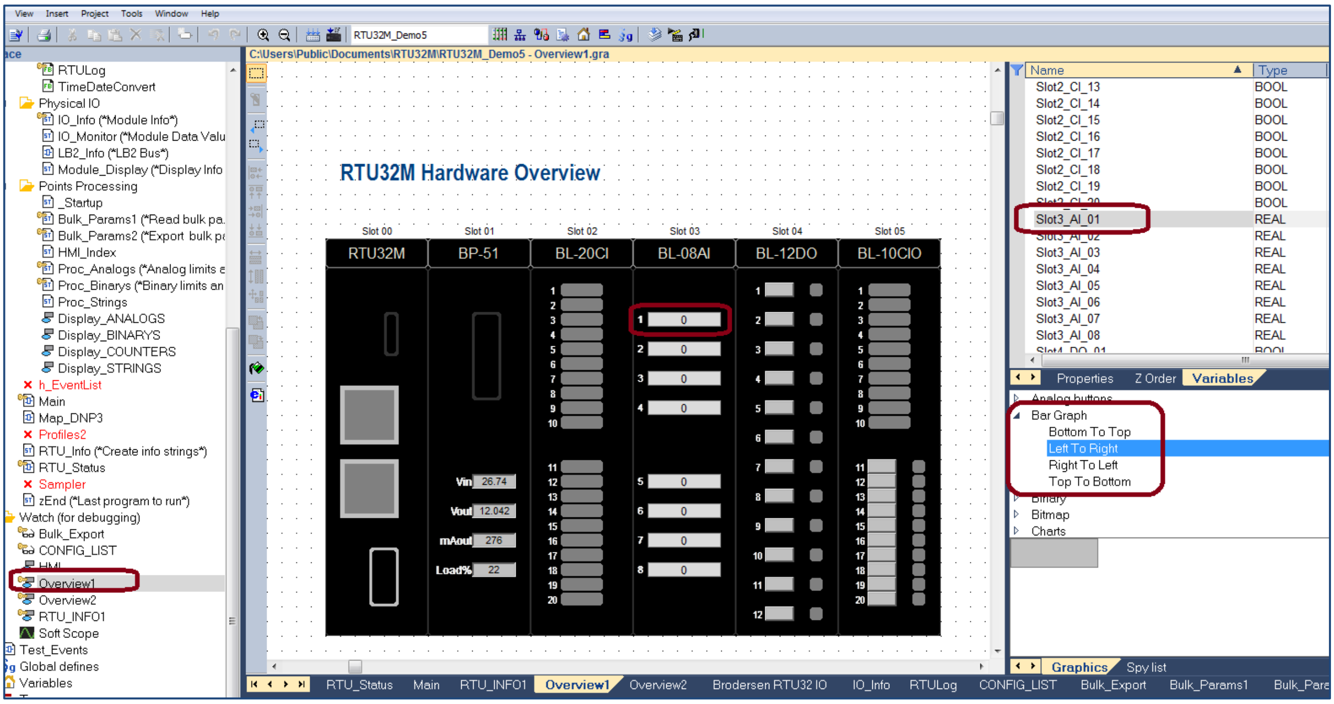
Examples:





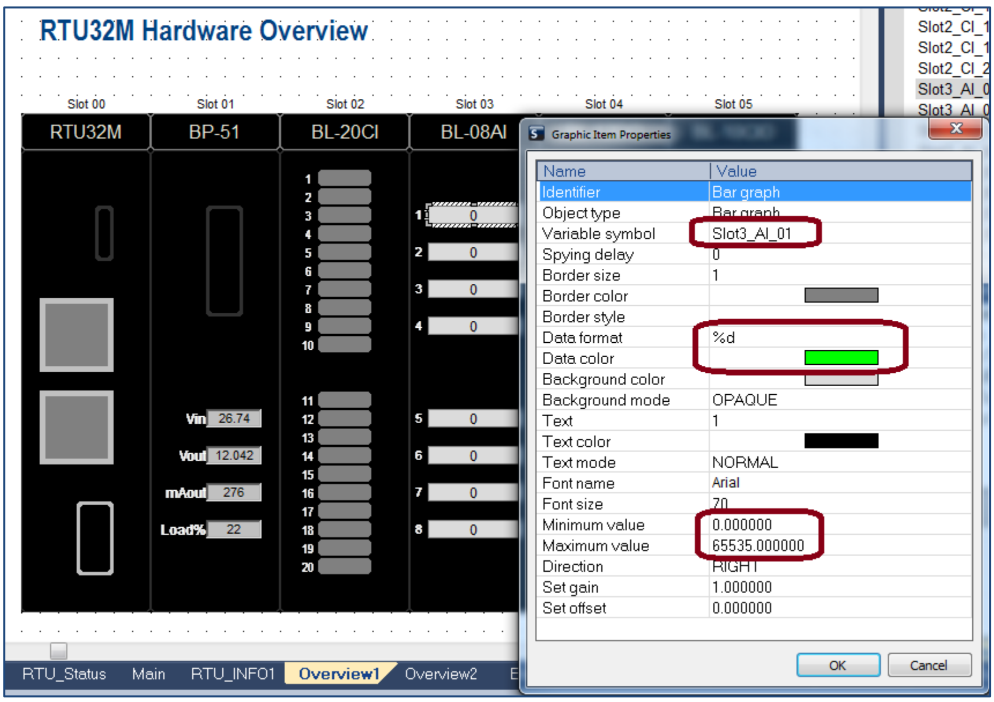
17.2 Creating and Viewing RTU Graphics

The example page below can be built using the standard WorkSuite® graphic tools.

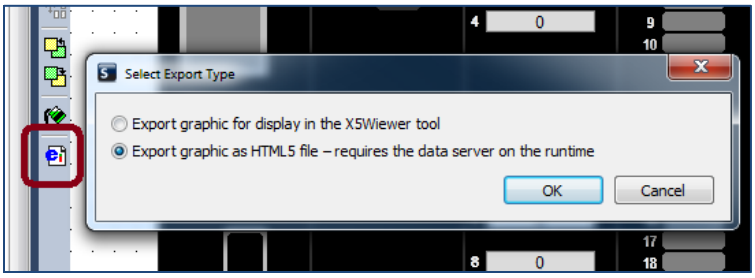


The page can include static text, shapes and a range of items that provide the animation.

The example here shows the setup of a horizontal bar graph that moves from left to right and uses the value from the variable named 'Slot3_AI_01' to show the value as both a text value and a scaled bar.

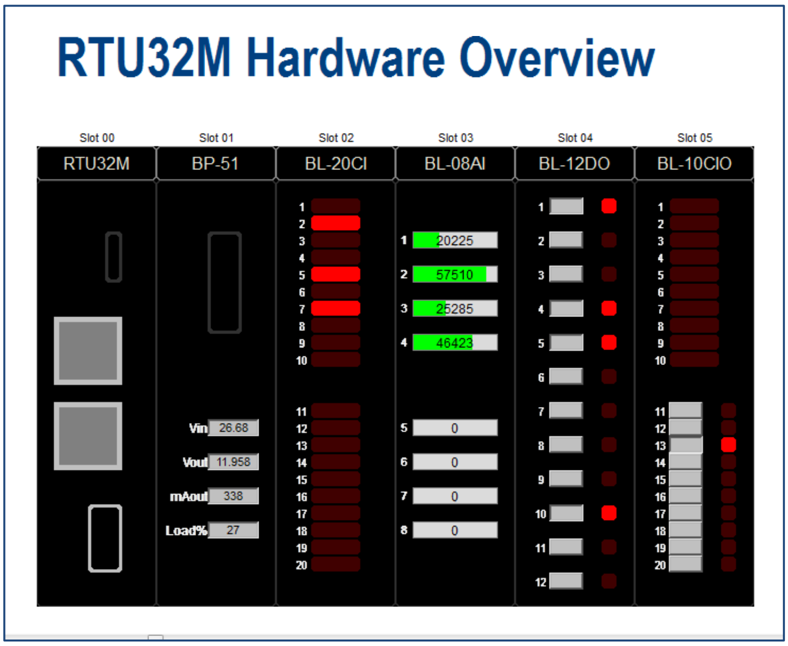


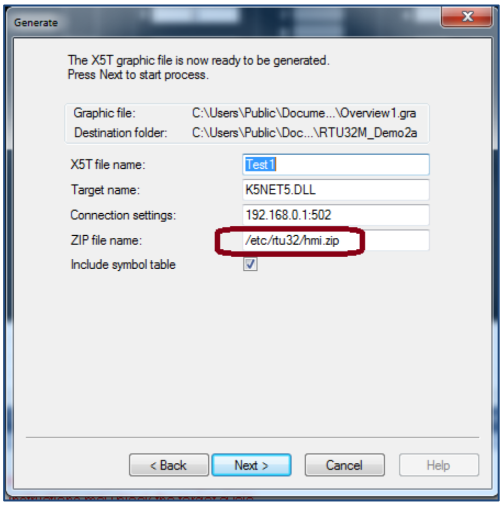
The pages can be viewed when simulating or debugging a logic application and can also be published for use by the X5 HMI Graphics Viewer (a free client application shipped with WorkSuite®), or published as a .htm file for use within web browser applications such as Internet Explorer and Chrome.

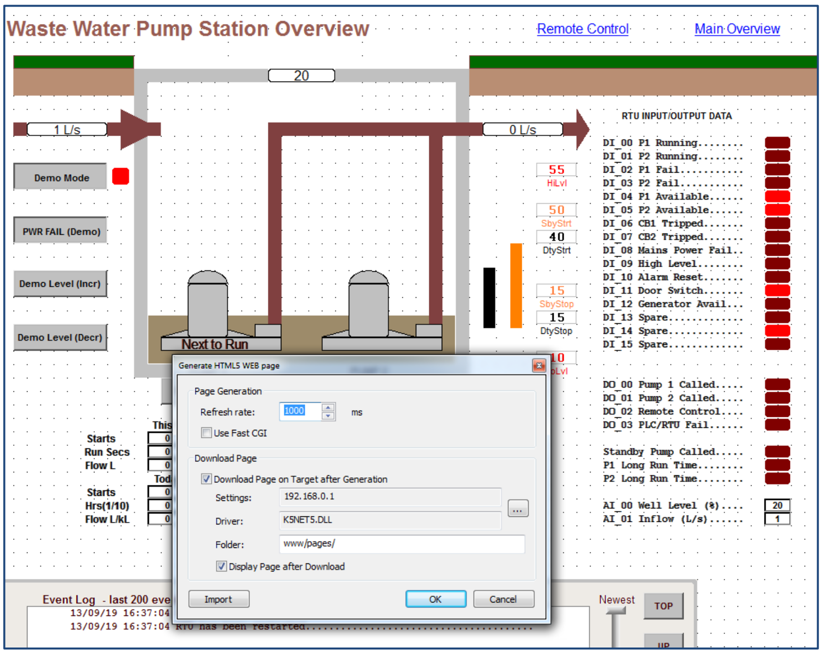


The X5 Viewer installs in the same location on your PC as WorkSuite® eg. Programs>Brodersen>WorkSuite®.

The WorkSuite® generate tools create a .zip file for use by the X5 Viewer and a .htm file, based on your Export selection .







The published files look the same when viewed in the X5 Viewer or a browser, as shown above.

Note: the destinations for X5 and html5 files are different.

X5 use:
/etc/rtu32/hmi.zip

Html use: www/pages

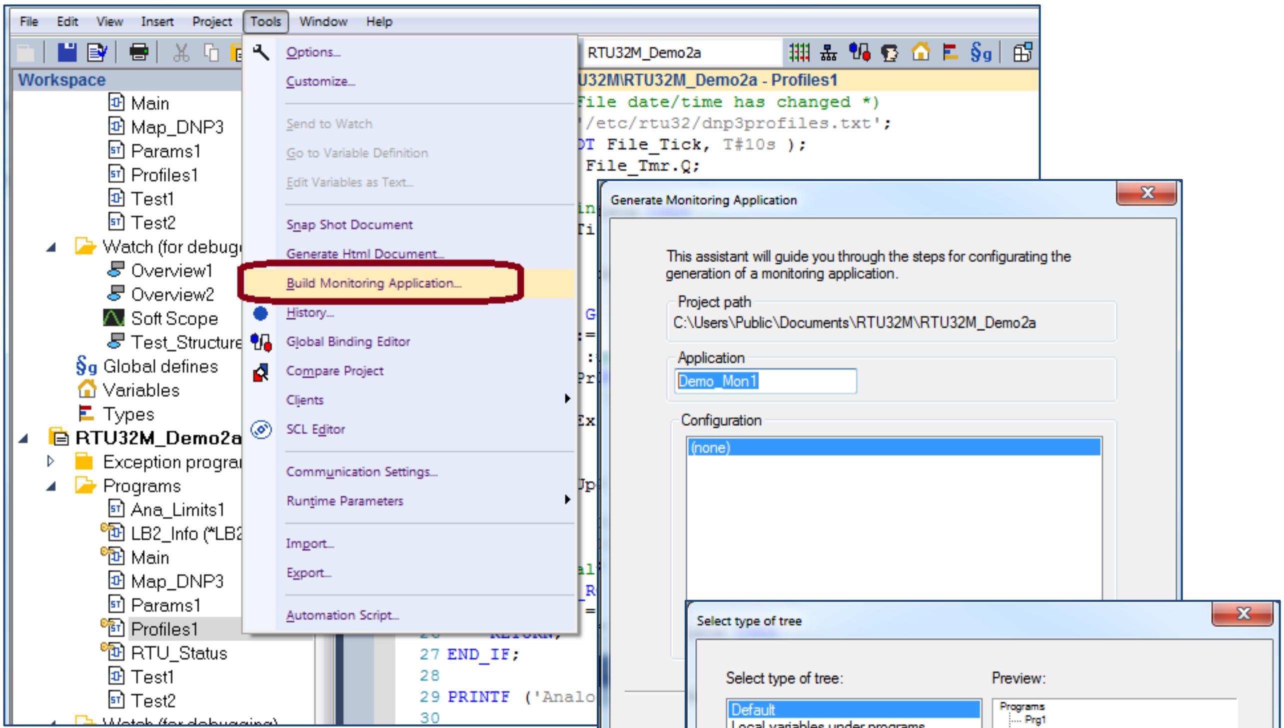
Note: FastCGI is presently not supported.

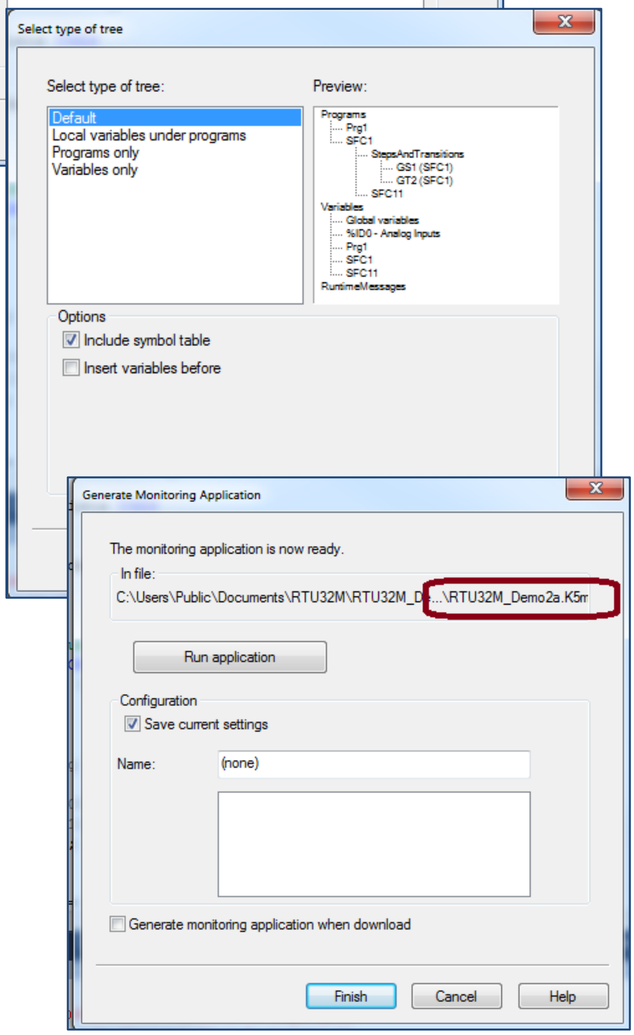
18 RTU Monitoring Applications

18.1 Creating and Viewing RTU Monitor Applications

WorkSuite® allows publishing of the RTU32 Series logic applications as pages that can be viewed online using the Monitoring tool.

From the Tools menu select ‘Build Monitoring Application’.





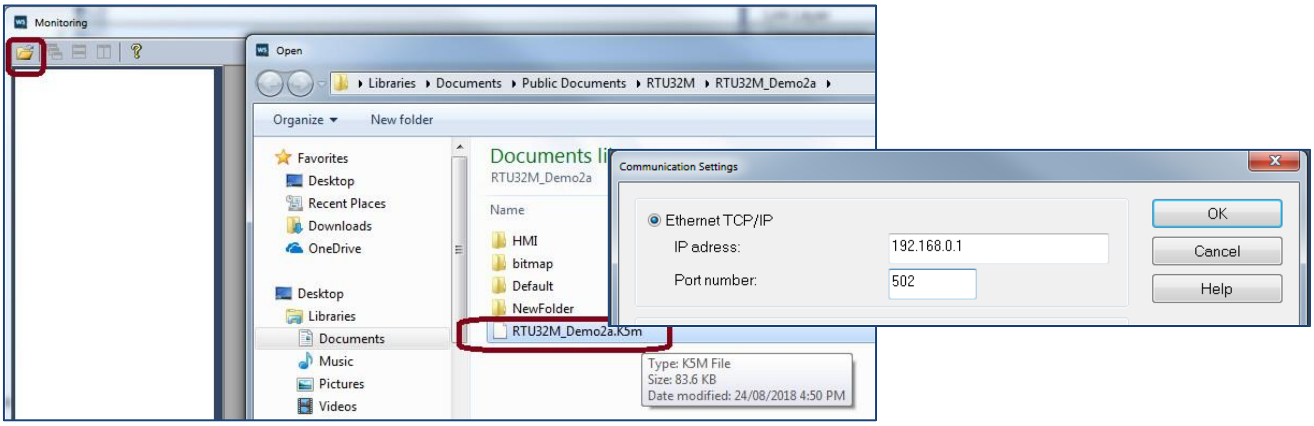
The Generation Tool will then prompt for a name to use eg. ‘Demo_Mon1’ is used here.

The next menu allows selection of the contents

eg. can include/exclude programs and variables, or simply accept the default settings.

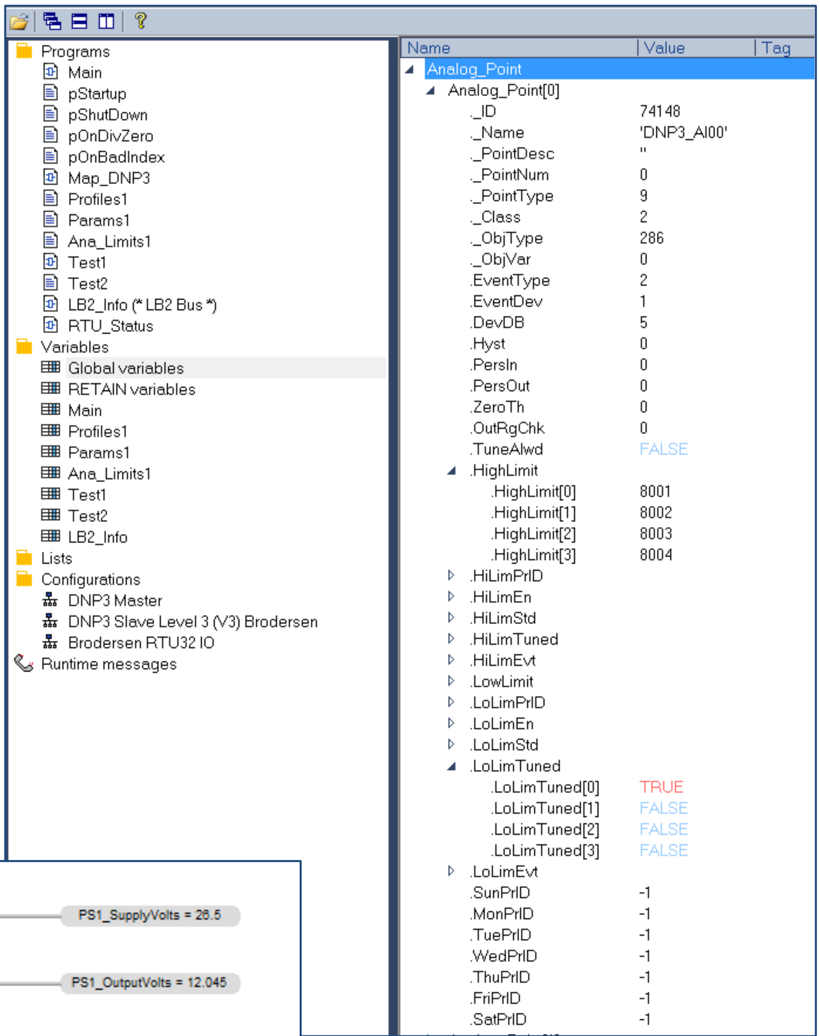
When complete a ‘project name’.k5m file will be generated and by default, this file is stored in the same folder as the other logic application files.

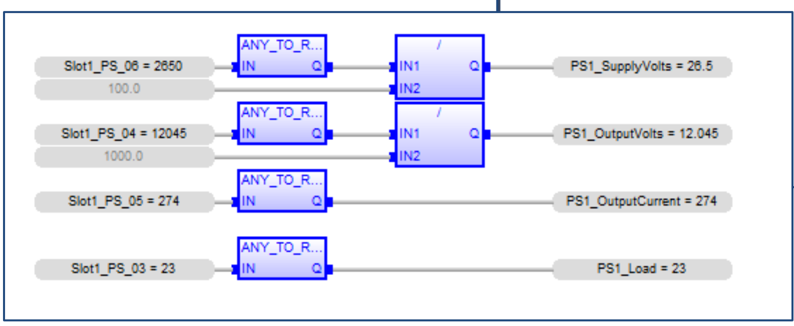
The monitoring application can be viewed using the ‘W5Monitoring.exe’ application that is located in the same folder as the WorkSuite® application eg. Program Files(x86)\Brodersen\WorkSuite®3.9.2. Use the folder icon to select the monitoring application.



You will then be prompted for the RTUs communications settings. The example above shows setup of the IP address and port number.

Once connected, you can view variables (local/global and complex/structured tags), programs and runtime information as shown below.





```
[1] 2018/08/24 07:57:44.324 - Analog Profiles - new update file received [ RTU32M_DEMO2A ]
[2] 2018/08/24 07:57:44.335 - Analog Profiles Updated (3 tags, including 156 parameters) [ RTU32M_DEMO2A ]
[3] 2018/08/24 07:57:44.336 - Point Parameters - new update file received [ RTU32M_DEMO2A ]
[4] 2018/08/24 07:57:44.358 - Point Parameters Updated (26 tags, including 572 parameters) [ RTU32M_DEMO2A ]
[5] 2018/08/24 07:57:44.358 - Analog Limits - new update file received [ RTU32M_DEMO2A ]
[6] 2018/08/24 07:57:44.381 - Analog Limits Updated (6 tags, including 288 parameters) [ RTU32M_DEMO2A ]
```

19 RTU32 Utilities and System Event Log

19.1 General

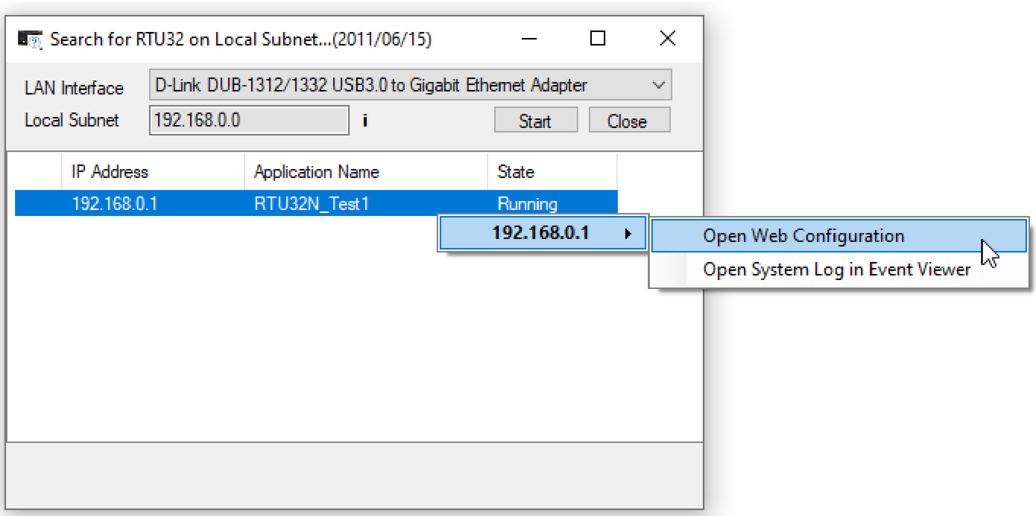
Brodersen provide some utility programs for the RTU32 Series on the RTU32 CD included in each package. The tools include:

- RTU32 Search Tool
- Event Viewer for RTU32 system log monitoring

19.2 RTU32 Search Tool

The RTU Search Tool is used to find RTUs on an Ethernet network. It will search using the network card/interface you define under the LAN Interface. Be careful that you select the right one before you start the search procedure.

The Local Subnet will automatically detect the network details and if you place your cursor on the "i" you will get network details.

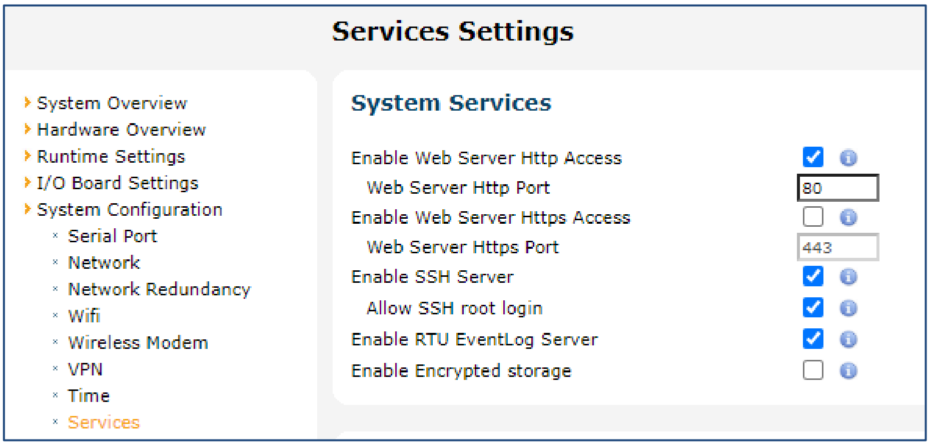


When you start the search process, the network will be scanned for Brodersen RTUs. Only RTUs with their RTU PLC runtime running will answer. If you select an RTU on the list of RTUs found on the network and right-click, you will be able to open either the Webpage or the Event Viewer (status Log info).

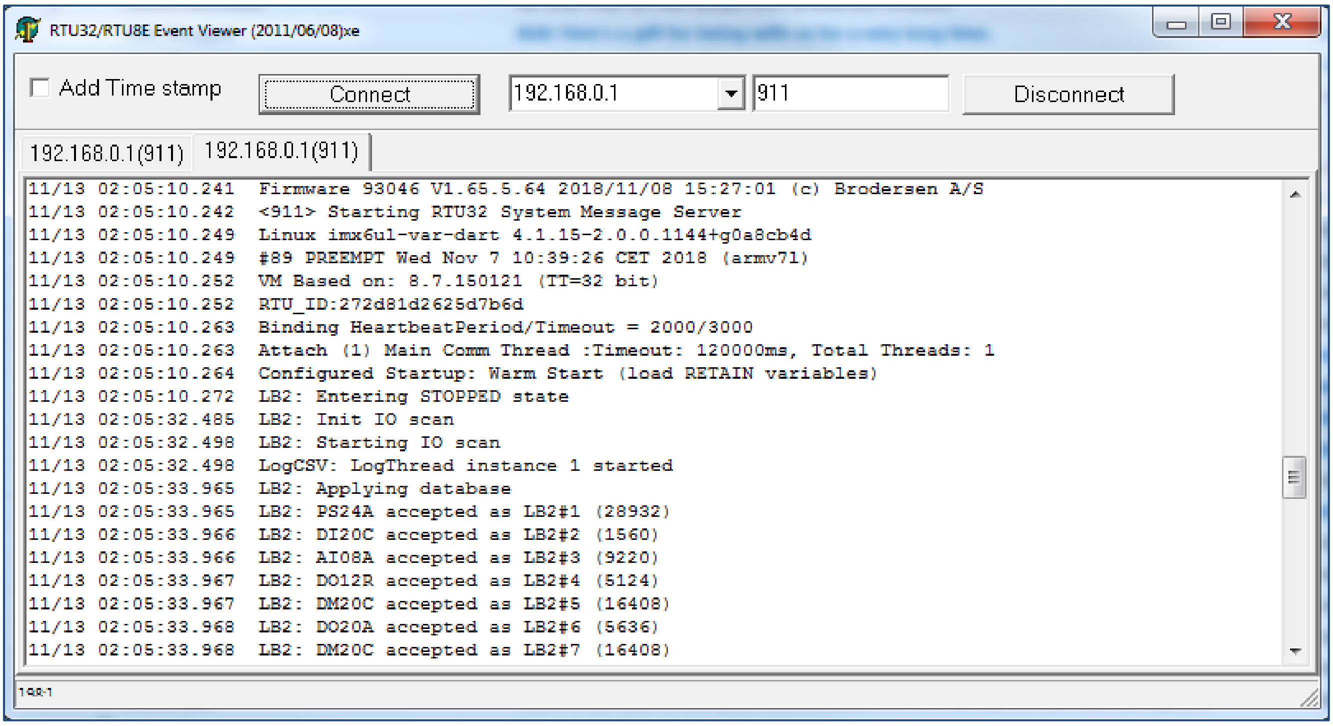
19.3 System Log/Event Viewer

The system log provides you with information about active processes in the RTU32M, errors and status information. You can also view debug or information text from your WorkSuite® application program which will be printed in the system log. COM port communications can be logged if you add the right parameters to the COM port setup (,LL extension) – see COM port settings for details.

The System Log can be viewed by using the Brodersen Event Viewer utility or a standard Telnet window. The RTU EventLog Server is enabled by default in the System Configuration>Services menu.



The event logs look like this in the Event Viewer:



The RTU32 allows a maximum of 20 continuous connections and the log FIFO includes a maximum of 100 messages.

20 RTU32M Technical Description

20.1 General

The RTU32M Compact RTU/PLC is based on a 32bit i.Mx6 CPU architecture running an Embedded Linux operating system. An industrial power supply is integrated to support industrial supply levels. The basic RTU32M includes a range of communication and other interfaces. The RTU32M provides interfaces like LocalBus and LB2 Bus for expansion I/O and integrated I/O.

The RTU32M software is stored on an internal Flash or micro SD card. During start-up, the operating system and applications are moved to RAM where it is executed. Retained variables are stored in NV RAM.

Using the Ethernet network for primary communication provides all the advantages of existing TCP/IP networking communication facilities. Fast, reliable and secure communication is the main features and all networking components (software, routers, switches, etc.) are available. In addition, serial ports for interfacing to application specific protocols (e.g. Modbus, Fieldbus, utility and traffic proprietary protocols etc.) are available.

Detailed technical information about the RTU32M hardware is provided in the RTU32M Data Sheet and in the RTU32M Wiring and Mounting Instruction manual.

20.2 PLC Runtime

The WorkSuite® programming tool fully supports EN/IEC61131 and is used for developing PLC programs in the RTU32M. The application program kernel is implemented and runs in the Windows Embedded CE real-time task. WorkSuite® offers complete PLC functionality as found in both normal PLC runtimes and in SoftPLCs, and supports all features needed in today's industrial environment. WorkSuite® supports programming languages including Structured Text, Function Block, Ladder, Instruction List and Sequential Function Chart. The VM PLC runtime supports cold restart, hot restart and on-line changes.

The Brodersen WorkSuite® is used for configuration protocols, programming and debugging. It supports several tools for multi-program handling and documentation. It is also a powerful tool for complete system design and programming, providing unique functions for event based communication. The Global Binding Editor makes it possible to publish and subscribe variables in a large network with minimum communication load. The events are time stamped and can also be used directly in ZenOn SCADA HMI applications.

Programming, debugging and upload and download of application programs can be done remotely via Ethernet or RS232.

The RTU32M application kernel is used in many products and applications worldwide. More details about WorkSuite® including training and help can be gained by contacting your local Brodersen distributor or Brodersen support.

20.3 Software Versions

The Settings overview page in the RTU32 includes the software version for the actual build.

RTU32 Version Information

RTU32 Firmware Version	1.65.5.173
RTU32 Firmware Date	2020/04/27
RTU32 Firmware ID	93046
Runtime Version	8.7.150121
RTU32 Image Date	2020
RTU32 Image Version	4.1.15-2.0.0.1351+g0a8cb4d
RTU32 Image Build Version	1363
RTU32 Device Tree version	1219

If you contact Brodersen or your local distributor / system integrator for support, it is important that you have the **RTU32M Version Information** ready together with the serial number of your device(s).

Please contact Brodersen or your local distributor if you need access to the latest firmware release.

Appendix 1

RTU32M runtime application measurement / benchmark

The RTU32M runtime cycle time is measured in a number of different applications below to provide examples of expected runtime periods.

The RTU32M cycle time is set to 0 by default in WorkSuite®. The cycle time is the period between the start of each logic cycle. When the cycle time is set to 0 there is no delay between successive logic cycles. Eg. If the logic cycle is set to 100ms and the time taken to complete a logic cycle is 3ms, then the logic process will be idle for 97ms. If the time taken to complete a logic cycle is >100mS, then the logic cycle will be completed, however the 'scan overrun' flag will bet set, indicating the logic cycle time was exceeded.

Note: CPUs with a clock speed of 200MHz are assigned a fixed delay between logic cycles of 40msec for 'household' activities to ensure sufficient time for communication drivers to run smoothly and avoid any overrun situations.

Example 1: RTU32M runtime application program without any communications

Test configuration:

1 x RTU32M with MP32A and PS24A modules

1 x DI20C I/O module (20x DI channels)

1 x AI08A I/O module (8x AI channels)

1 x DO12R I/O module (12x DO channels)

Logic:

- 8 analogue inputs are scaled, some simple calculations are executed, data is stored in internal registers.
- 20 digital inputs are controlling one timer each, connected to a digital output.
- 2 fast digital inputs are controlling 2 counters.

Number of scans completed in one second and average scan period.

CPU Clock Speed	Scans Per Second	Average Scan Period
200MHz	24	42ms
500MHz	550	<3ms
900MHz	565	<2ms

Example 2: RTU32M application program with ModbusTCP communications

Test configuration:

Same configuration as above, but Modbus TCP master protocol is used to read and write 50 holding registers from/to a Modbus slave (~15 read and write messages per second).

Number of scans completed in one second and average scan period.

CPU Clock Speed	Scans Per Second	Average Scan Period
200MHz	22	45ms
500MHz	477	<3ms
900MHz	512	<2ms

Appendix 2 – RTU32M Factory Reset

RTU32M complete Reset

You can make a complete reset of the RTU32M that will reset it back to factory default settings. Note that during reset process all settings in the RTU32M are lost.

To make a complete reset you will need a small screwdriver, pointed pen or paperclip for activating the reset button.

On the front panel of the RTU32M CPU module you will find a small 3mm hole located between the SD card and LAN 1. Behind this is a small push button that is used in the reset process.

Procedure:

Use a small pointed device to push/activate the reset button. Keep the reset button pressed for a minimum of 10 seconds before it is released (the CPU run LED will flash amber, then red). The RTU will then reset and then restart itself (run LED will then be off).

The RTU32M logic application will be erased and the RTU32M will then restart and start-up with factory default settings. LAN IP address = 192.168.0.1, LAN2 =DHCP and password at default setting.

Appendix 3 – Security recommendations

While connected to the RTU, i.e. through SSH, webpage or Brodersen Worksuite, please don't have an active connection to WhatsApp, Facebook or any other social media.

In order to detect unauthorized physical access to the RTU32M, it is recommended to install the unit in a locked cabinet with a switch, which detects if the cabinet is opened. The switch may then be connected to a digital input on the RTU, which can then generate an alarm to a supervisory control system.

Appendix 4 – Certificates used in RTU32M

The RTU32 supports certificates for TLS communication, i.e. OPC UA Server, https, SSH, and for signing the binary application code file
in WorkSuite. Please find below information about the algorithm and key strength.

OPC UA Server: SHA-256 with RSA (2048) encryption
WWW Server: SHA-256 with RSA (2048) encryption
SSH Server: RSA/sha2-512 (3072)
Brodersen WorkSuite code signing: RSA key strength (4096

Appendix 5 – Decommissioning the RTU32M

In order to prevent any data leakage from the RTU32M when it is taken out of service, we recommend you to do a firmware update of the RTU32M, as described in the document “107004 RTU32M Firmware installation”, as this will erase all old data from the internal storage.

Appendix 6 – ATEX Certifications of RTU32M

The **RTU32M system** has been certified for use in potentially explosive atmospheres under both **ATEX** and **IECEx** regulations. The detail of the certificates are as follows:

IECEx Certification

- **Certificate number:** IECEx CSAE 25.0004U
- **Certification code:** Ex ec nc IIC Gc

ATEX Certification

- **Certificate number:** CSANe 25ATEX1006U
- **Certification code:** Ex ec nc IIC Gc
- **Other marking:** II 3G

Model

- **Model number:** RTU32M System

Manufacturer Information

- **Manufacturer's name: Brodersen A/S**
- **Manufacturer's address: Byageren 7, 2850 Nærum, Denmark**

Safety Warnings

⚠ **WARNING:** DO NOT CONNECT OR DISCONNECT WHEN ENERGISED.

⚠ **AVERTISSEMENT** – NE PAS BRANCHER NI DÉBRANCHER SOUS TENSION

Explanation: Electrical connections to the RTU32M system must not be made or removed while the device is powered on. Doing so may cause a spark and ignite flammable gases or dust in hazardous environments, leading to potential safety hazards. Always ensure power is completely turned off before making or breaking any connections.

Certification Code Explantation :

- Ex ec nc IIC Gc:
  - **Ex**: Explosion-proof equipment.
  - **ec**: Enhanced safety protection.
  - **nc**: Non-conductive.
  - **IIC**: Equipment suitable for use with gases such as acetylene, hydrogen, or other highly flammable gases.
  - **Gc**: Equipment for use in explosive gas atmospheres, Group G, category C (Zone 2 environment).
- II 3G:
  - **II**: For use in explosive atmospheres other than mines (Group II).
  - **3G**: Category 3G (suitable for Zone 2, where explosive atmospheres are unlikely to occur during normal operation but may occur in rare conditions).

Traceability Information:

- Each RTU32M system is assigned a unique **serial number** for traceability. This number is marked on the nameplate and recorded in our manufacturing database.

Operational Guidelines:

- Please refer to the full RTU32M system manual for detailed installation, operation, and maintenance guidelines.

Maintenance and Inspection:

- Regular inspections should be conducted at intervals of **every 12 months** to ensure ongoing safe operation and compliance with all certification requirements. Any identified issues should be addressed promptly to maintain certification.

Installation Requirements:

- The RTU32M system must be installed in accordance with the installation guidelines provided in the manual. Only qualified personnel should perform the installation to ensure compliance with safety and certification standards.

Testing and Compliance:

- The RTU32M system undergoes comprehensive testing to ensure compliance with **ATEX** and **IECEx** regulations, including **[brief description of testing procedures such as electrical testing, explosion testing, etc.]**. This testing verifies the product's suitability for use in explosive atmospheres.

Environmental Conditions:

- The RTU32M system is designed for operation in environments with:
    - **Temperature range**: **-20°C to +65°C**
    - **Relative humidity**: **0% to 99.8%**
- Ensure the system is installed and operated within these conditions to maintain compliance with ATEX and IECEx certifications.