Scalibur – Modular Controllers
SCA-340 / SCA-340-L

Manual

SysMik® GmbH Dresden

Rev.20

This manual is intended to provide support for installation and usage of the device. The information is believed to be accurate and reliable. However, SysMik GmbH Dresden assumes no responsibility for possible mistakes and deviations in the technical specifications. SysMik GmbH Dresden reserves the right to make modifications in the interest of technical progress to improve our modules and software or to correct mistakes.

We are grateful to you for criticism and suggestions. Further information (device description, available software) can be found on our homepage www.sysmik.de. Please ask for latest information.

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Contents

1. Introduction

Scalibur is a powerful modular controller for Niagara and Sedona. Scalibur stands for scalability, a major characteristic of this controller. Scalability comprises several aspects:

1) Scalable IO
   A Scalibur station consists of the Scalibur controller and up to 63 terminals of the modular Inline system. The terminals are available in a wide variety of types: digital and analog inputs and outputs with different numbers of channels as well as functional terminals for DALI light control, pulse metering, MBUS or serial interfaces.
2) Scalable software
   Scalibur has been developed primarily for the Niagara framework. Niagara applications are built with the software tool Niagara Workbench. While Niagara is very powerful, it is not very well suited for specific real-time applications. In order to realize such applications with Scalibur too, the controller has the Sedona framework in parallel to Niagara. Sedona applications run with fixed cycle times in the millisecond range and are created with the Niagara AX Workbench. Beside the separate exclusive use of either framework, the parallel use of Niagara and Sedona is supported. The Niagara and Sedona application can communicate to each other with a Sedona driver for Niagara.
3) Scalable licensing
   The license model for Scalibur is very flexible: a license comprises a certain number of data points which can be integrated with Scalibur. These license packs are available as first-time license (250/500/1250/5000/10000 data points) or as upgrade license (500/1250/2500 data points). Sedona, as open source project, doesn't have any license fees.
4) Scalable IP network
   Scalibur contains two logically separated IP interfaces and an integrated Ethernet switch with four external ports. The configurable assignment of the Ethernet ports to the separate IP interfaces and the usage of the spanning-tree-protocol allow flexible topologies like daisy-chain and redundant ring-structures for both the backbone and the local control network.

2. Device and System Overview

2.1 Hardware

2.1.1 Functional Overview

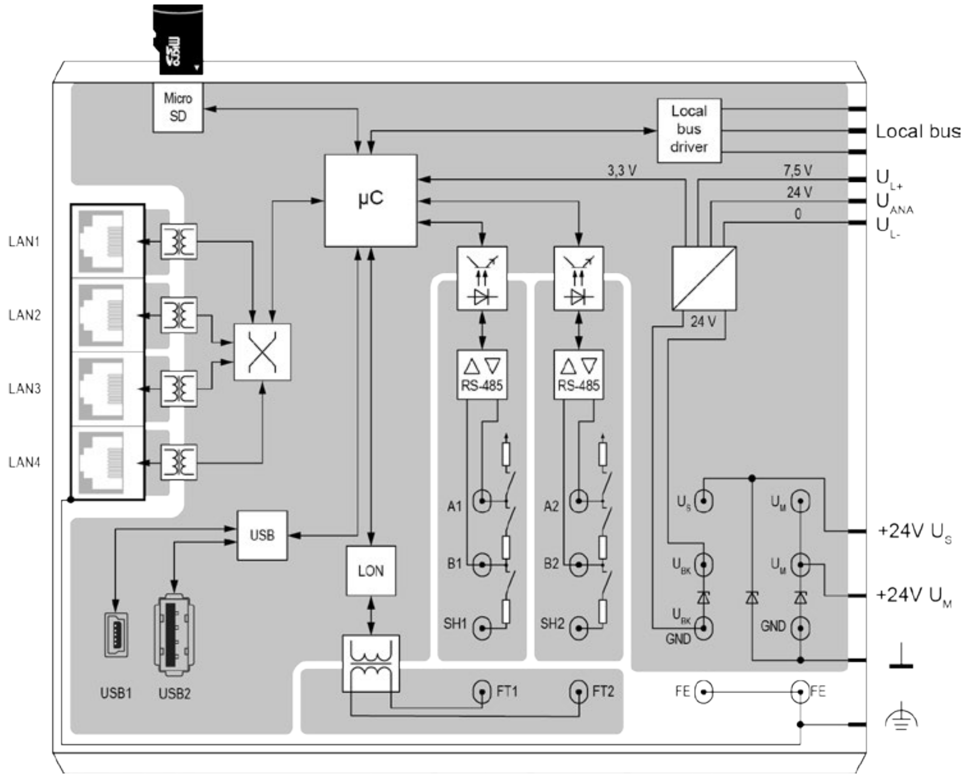


Fig. 2.1.1.1: SCA-340-L basic circuit diagram

2.1.2 Processor Core

The processor core is made up of a 1 GHz ARM Cortex A8 CPU, 512 MiB RAM, 1,8 GB Flash, 512 KiB SRAM and an RTC. SRAM and RTC are buffered for a power failure of 5 days.

The internal Flash memory can be extended with a microSD card.

2.1.3 Ethernet

The integrated Ethernet switch has 4 external ports, which can be assigned independently to one of the two separate IP interfaces. If at least two ports belong to an IP interface, then redundant communication paths can be established, for example by connecting several devices in a ring. The Ethernet switch supports the Rapid Spanning Tree Protocol (RSTP), as well as a ring monitoring function to automatically switch off redundant paths, and a broadcast storm protection function.

Factory default: eth0 is assigned to LAN3/LAN4, eth1 is assigned to LAN1/LAN2, and RSTP and ring monitoring are deactivated.

2.1.4 Serial Ports

Both RS-485 ports have switches for bias and terminating resistors, and are galvanically isolated from each other and the rest of the circuit.

Further serial interfaces may be added using modular IO terminals (M-Bus, RS-232, RS-485, RS-422).

2.1.5 USB

USB 1 is a USB-OTG port with Mini-USB socket, and is used for installation and maintenance. Connected to a PC, it allows to control the device via console and to access the internal installation web site for device configuration and data point test.

The second USB port (USB 2) allows to connect USB end-devices.

2.1.6 LON

The SCA-340-L has a LON interface according to the CEA-709 standard, to connect directly to LonMark TP/FT-10 networks.

2.1.7 Inline Local Bus Interface / Modular IO Terminals

The local bus interface allows to connect up to 63 modular IO terminals. This interface comprises the communication channel to the IO terminals as well as the power supply of these terminals and their connected sensors and actuators.

Scalibur is a controller for the Inline IO system and unlocks the rich pool of Inline IO terminals for building automation.

Inline is a modular IO system by Phoenix Contact, to flexibly and quickly build up space-saving automation stations. An Inline station consists of a bus controller and a set of IO terminals, chosen freely in terms of numbers, type, and sequential arrangement. The bus controller runs the Inline station and has interfaces to the higher level controller. Up to 63 IO terminals can be connected to a bus controller. There are IO terminals for almost any purpose:

- digital inputs and outputs with 1, 2, 4, 8, 16, or 32 channels per terminal
- Triac and relay outputs for switching signals or for higher loads
- analog inputs for measuring voltage, current, resistance, or temperature with 2, 4, or 8 channels per terminal
- analog outputs for voltage or current with 2, 4, or 8 channels per terminal
- function terminals for complex IO operations or gateway functions (DALI, M-Bus, S0 pulse metering, serial interface)
- supply and support terminals , e.g. to realize separated voltage domains within an Inline station

The overall width of the Inline extension terminals is 1, 2 or 4 DU (1 DU, division unit = 12.2 mm or approx. 0.48 in.).

Inline terminals are provided with a pluggable wiring level enabling pre-wiring and easy module exchange.

The mechanics of the system also allows exchanging terminals without complete dismantling of the station.

Scalibur determines type and function of all supported terminals automatically, thus certain in- and output functions can also be created without a previous configuration of the station, which is especially helpful for commissioning tests.

2.2 Software Overview

Scalibur is using a Linux operating system, which runs several applications in parallel.

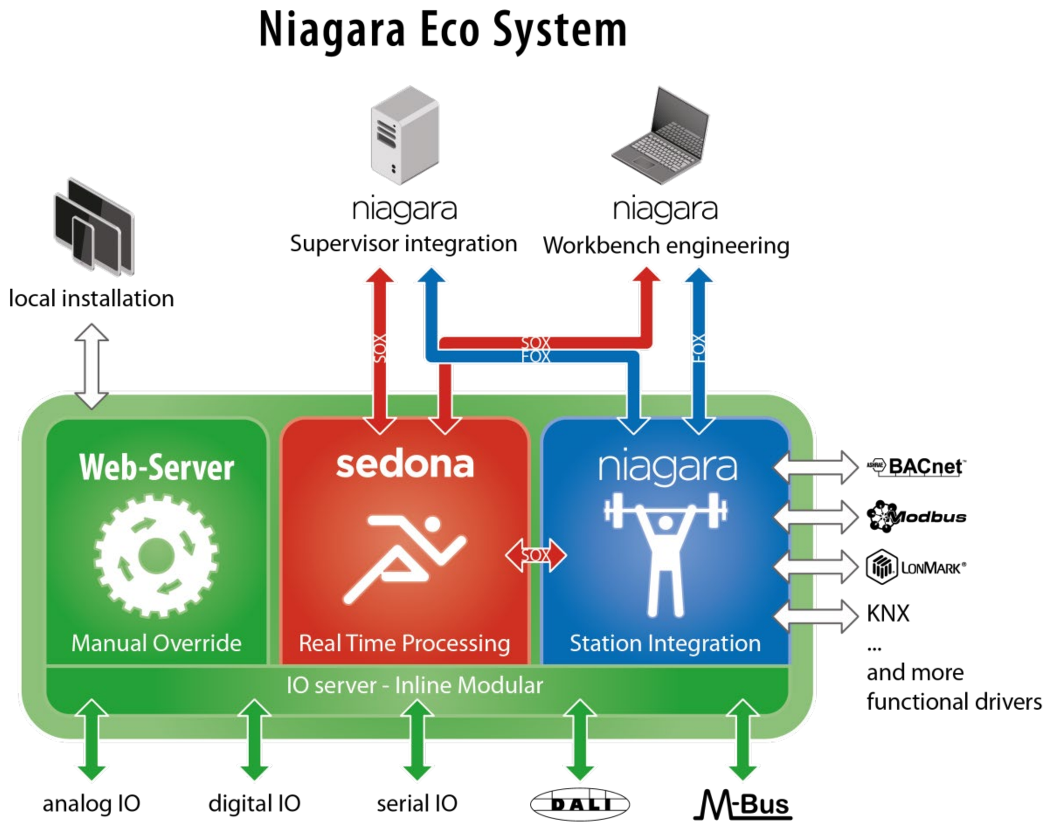


Fig. 2.1.7.1: Scalibur software structure

2.2.1 Scalibur System Shell

The Scalibur System Shell is accessible only via the local USB-OTG port, and is used during commissioning to configure basic settings like IP address, or as maintenance access if IP address or passwords have been lost.

2.2.2 IO Server

The IO server controls the modular Inline terminals of the Scalibur station and manages concurrent accesses to the hardware data points. Niagara and the IO server communicate via an TCP connection. This allows to control IOs remotely from another Niagara station. The remote access can be limited or disabled by the setting of the IP address of the controlling station.

2.2.3 Commissioning Web Server

The commissioning web server is exclusively accessible via the local USB-OTG port. It presents web pages to commission the device: setting IP addresses and time zone, reading state of inputs and setting output states of the data points of the local IO terminals for test purposes.

2.2.4 Sedona Virtual Machine

The Sedona virtual machine (SVM) runs the Sedona application in real-time with configurable cycle time. The Niagara AX Workbench connects to the SVM to modify the application, load updates, or create backups of the application. Platform specific kits provide access to the IO terminals, and also to system settings like IP addresses and Modbus settings. A Modbus TCP server and a Modbus TCP client/Modbus RTU master are integrated and are used to exchange data with other Sedona controllers. Also, Niagara can be deactivated here.

2.2.5 Niagara Framework

Scalibur can be parameterized with Niagara Workbench and a platform connection to the Niagara daemon. This includes loading of software updates and of a station (Niagara application), which can be run automatically by the Niagara daemon.

A Workbench connection to a station is used to modify the station. All features of the Niagara framework are available:

- data point integration over a plethora of open automation protocols (LON, BACnet, KNX, M-Bus, Modbus, and others) with data normalization
- system functions (scheduler, alarming, trend log)
- web visualization
- enterprise interfaces (oBIX, data bases) and many more

3. Installation and Commissioning

3.1 Assembly

3.1.1 Dimensions

Width x Height x Depth:

80 mm x 119,8 mm x 71,5 mm (3.15 inch x 4.72 inch x 2.81 inch)

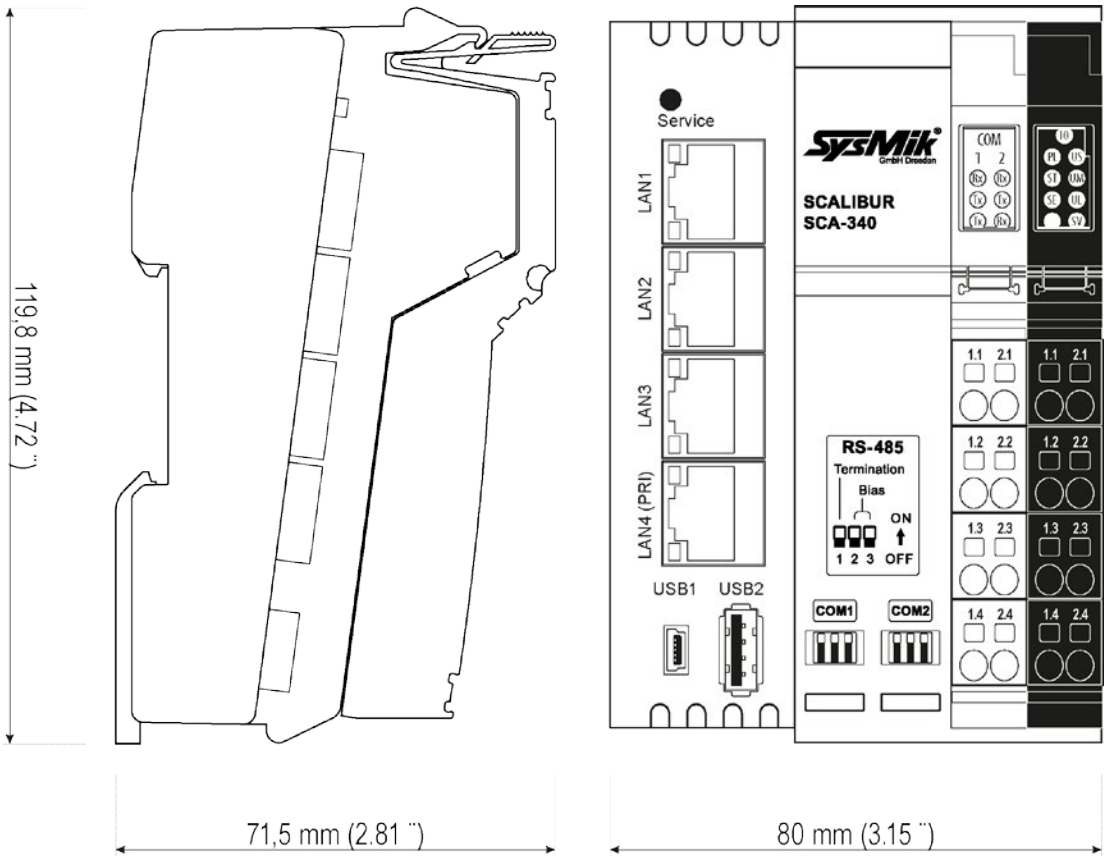


Fig. 3.1.1.1: Scalibur dimensions

3.1.2 Mounting

Preferred mounting position is horizontal (i.e. on a horizontal DIN rail which is attached to a vertical wall). For all other mounting positions, a derating has to be observed (see chapter 6).

Note: The air vents have to be kept free with a sufficient spacing to other components, to ensure optimal air ventilation.

The device is designed for easy snap in mounting on 35 mm x 7.5 mm DIN EN 60715 rails (formerly DIN EN 50022).

Note: The DIN rail should be attached to a mounting plate or an even back plane for best stability.

Suitable fixtures, like end clamps or grounding terminals have to be used at both ends of the station, to prevent sliding off the rail.

Note: To ensure easy unlocking of the Ethernet connectors, use only clamps at the bus controller side of the station that do not protrude more than 30 mm from the rail.

Note: Only use clean and corrosion free mounting rails in order to ensure a safe contact between the FE terminals.

3.1.3 Adding Inline Terminals

An Inline station is assembled by plugging the individual components to each other, thus establishing the potential and bus signal connection between the individual components of the station. Figure 3.1.3.1 shows the procedure of mounting a terminal.

- Disconnect power to the entire station.
- Mount the electronics base onto the rail (A). Adjacent terminals are interlocked by their feather keys / keyways (B).
- First insert the feather keys of the local bus into the keyways of the preceding terminal (B1).
- Guide the feather keys along the keyways until they lock appropriately (B2).
- Ensure that the feather keys are properly connected (C2). C1 shows the common mistake that the feather keys are not inside their keyways.
- After mounting all electronics bases install the connectors onto their respective bases. First insert the front detent (D1). Then push the connector onto the electronics base until the rear detent locks properly (D2).

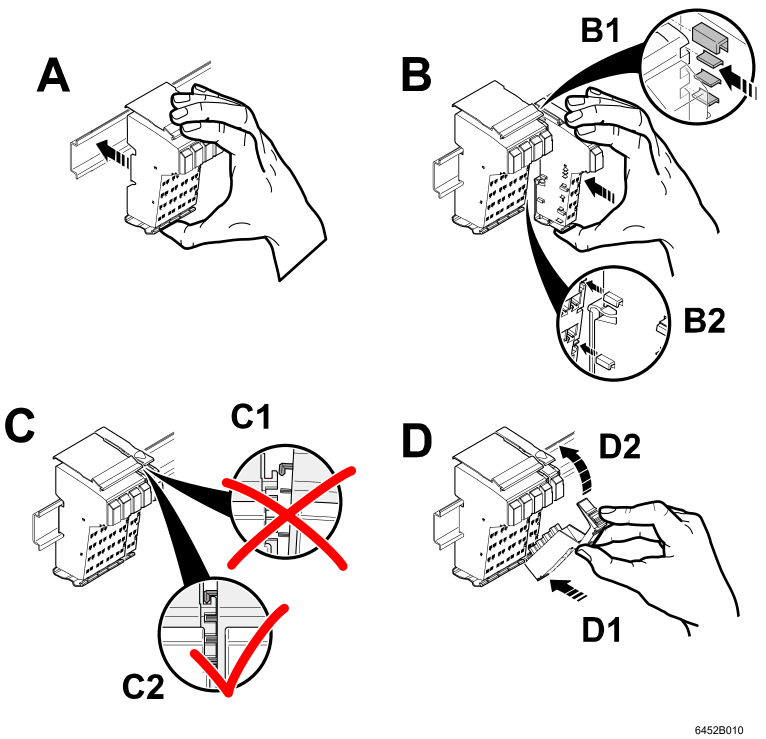


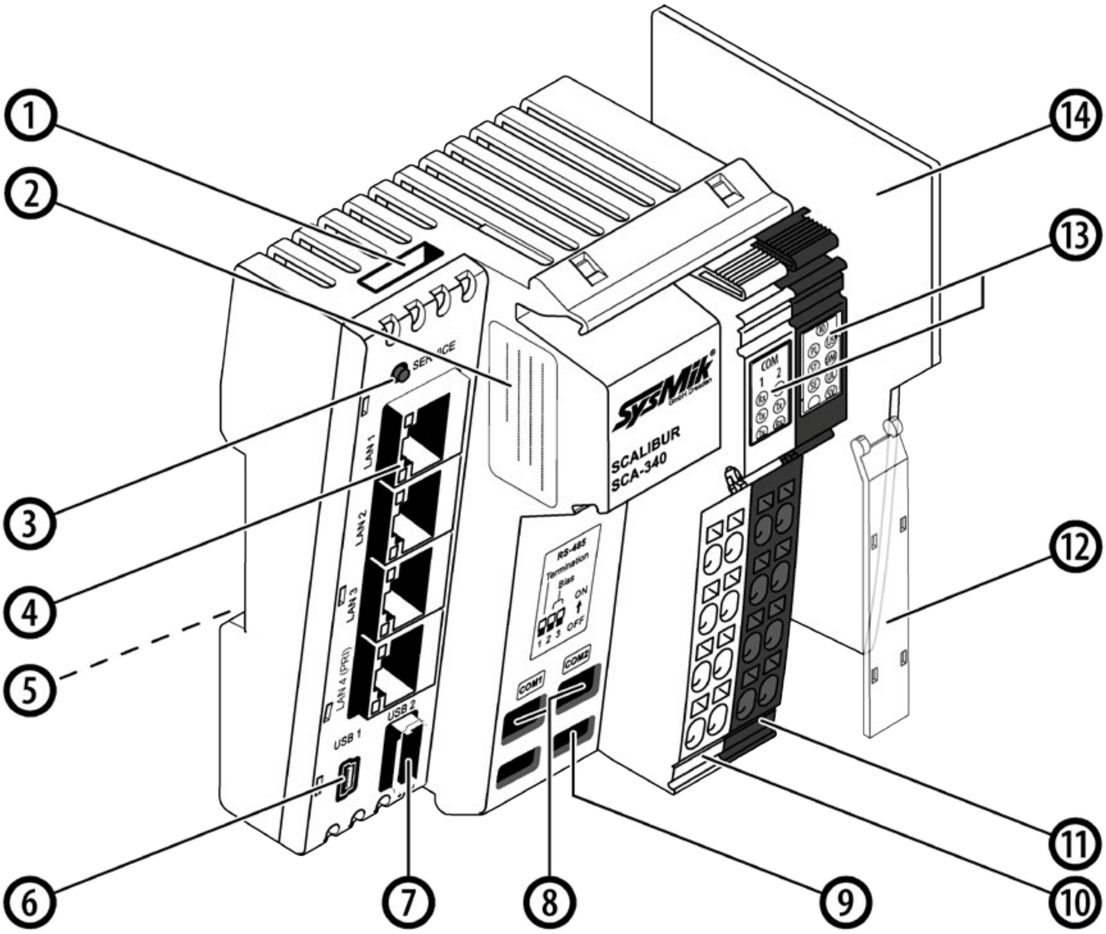
Figure 3.1.3.1: Installation on the mounting rail (A), connection of Inline components to each other (B), connection check (C), plugging of the wiring level (D)

Note: While connecting the components to each other and to the mounting rail later, please make sure that all feather keys and latches are properly snapped in!

Note: Please consult the User Manual with regard to configuration and installation of the Inline product family (see [1]).

3.2 Connections

3.2.1 Connectors



1	Micro-SD card slot	8	Switches for RS-485 termination / bias
2	Type label with device-specific information	9	Service interface
3	Service button	10	Bus interface connector
4	Ethernet (4x 10/100BaseT)	11	Supply connector
5	FE connector *)	12	Labeling field (2x)
6	USB 1 (mini USB, USB-OTG)	13	Diagnostic indicators
7	USB 2	14	End plate

*) … The FE connector is placed at the rear side of the controller – it is not visible in the sketch.

Fig. 3.2.1.1: Overview device connections

3.2.2 Power Supply

3.2.2.1 How to Connect Power

The bus controller is operated with 24 V DC. The bus controller is powered from this source and it generates the logic voltage for the logic circuit and the analog voltage for the analog circuit. The logic circuit supplies the internal bus including the communication chips of all connected automation I/O terminals. The analog circuit provides an auxiliary supply for analog signals.

Note: While connecting the automation terminals please observe the derating of the logic voltage, the supply of the analog terminals, and the maximum ampacity of the terminals.

Furthermore the bus controller includes connections for the supply of the mains and segment voltage of the Inline station.

Fig. 2.1.1.1 shows the basic circuit for the connections of the power supply.

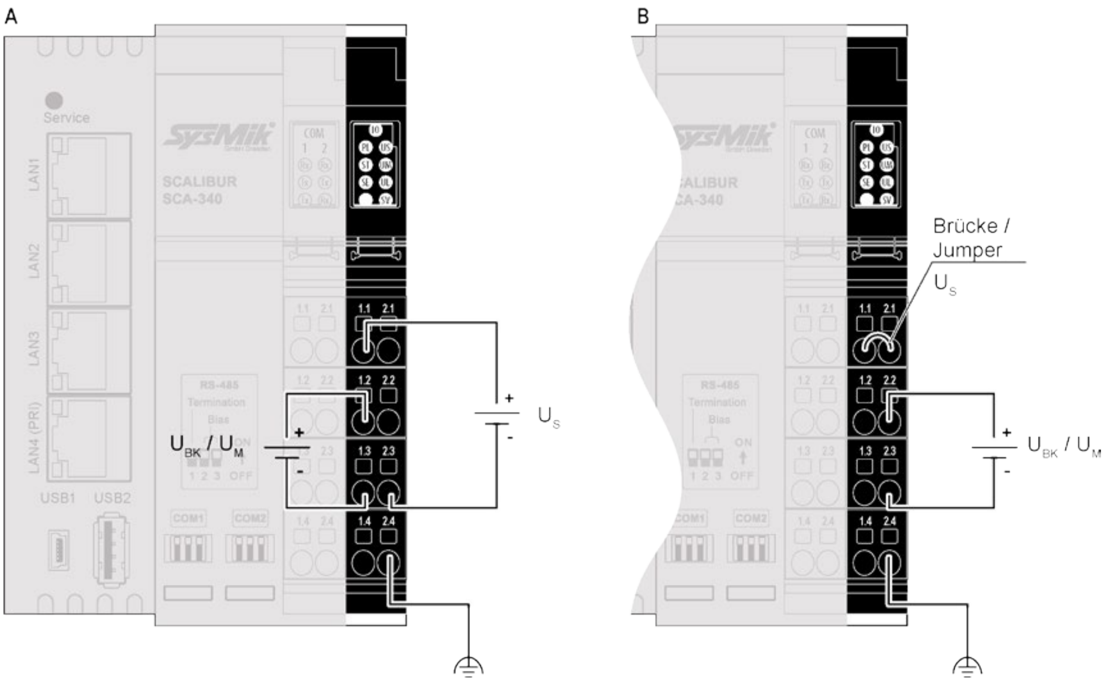


Fig. 3.2.2.1: Supply of U_M / U_{BK} and U_S from different sources (A) and from a common source (B)

Note: If U_{BK}/U_M and U_S are to be supplied from a common source, the fuse protection of the individual sections with regard to their supply requirements has to be observed.

Note: The current passing through terminals and potential routing contacts must not exceed 8 A.

The Functional Earth ground FE is connected to the potential routing contacts and is automatically grounded if the bus controller is snapped on a grounded mounting rail. The function of FE is to discharge interferences.

Note: Functional earth ground (1.4 and. 2.4) has to be connected additionally via 1.5 mm² wire (AWG 15) and grounding terminal to the mounting rail (see Fig. 3.2.2.2).

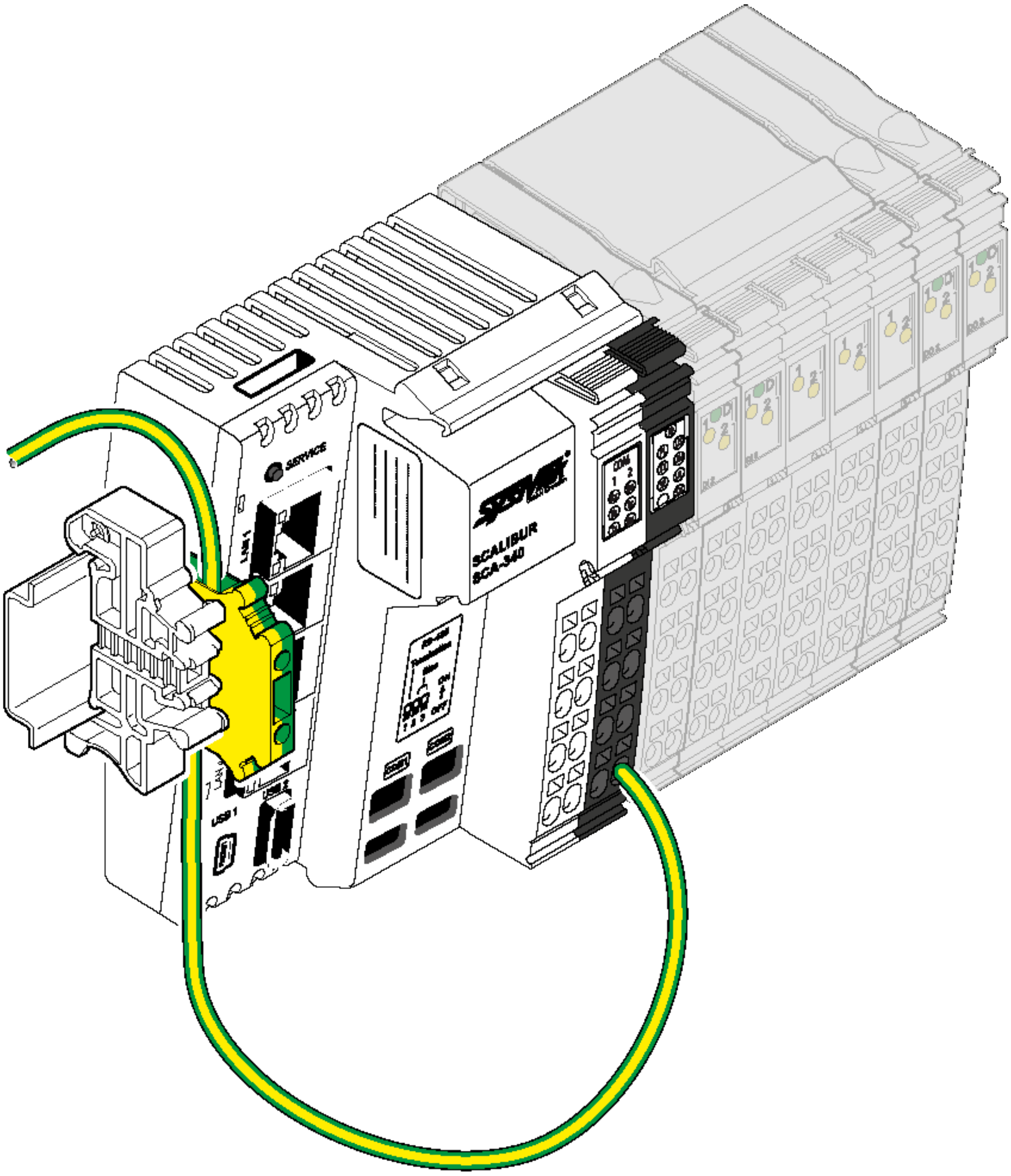


Fig. 3.2.2.2: Connecting functional earth ground (FE) of Scalibur

Terminal point	Name	Function
1.1	U_S	24 V DC segment supply (segment circuit); The supplied voltage is lead to the automation terminals via the potential routing contacts.
2.1 1.2, 2.2	U_{BK} / U_M	U_{BK}: 24 V DC bus controller supply, logic supply (U_L) and analog supply (U_{ANA}) U_M: 24 V DC main voltage (main circuit); The supplied voltage is lead to the automation terminals via the potential routing contacts
1.3, 2.3	GND	Reference ground for the internal bus and automation terminals (logic and analog circuit) and for the main and segment supply (main and segment circuit).
1.4, 2.4	FE	Functional ground; Connecting the functional ground to this terminal point is mandatory (see above). The terminal point is internally connected to the potential routing contacts and the FE contact at the back side of the enclosure.

Table 3.2.2.1.1: Terminal assignment of supply connector

3.2.2.2 Power Dissipation Calculations for a Scalibur Controller

The power dissipation of the bus controller equals the sum of the power requirements of the bus controller itself and the power loss of the internal power supply for the whole Inline station:

$$P_{SCA} = P_O + P_{USB} + P_{PERI}$$

P_{SCA} power dissipation of the bus controller

P_O power requirements for operating the bus controller without terminals and any external load (4.1 W)

P_{USB} power dissipation of the bus controller caused by the load on USB1 and USB2 (max. 500 mA each)

$$P_{USB} = 0.7\ V \times (\ I_{USB1} + I_{USB2})$$

P_{PERI} power dissipation of the bus controller caused by the Inline IO terminals

$$P_{PERI} = 1.0\ V \times I_L$$

I_L current consumption of U_L

Note: The factors 1.1 V und 0.7 V result from the electrical efficiency of the internal power supply unit.

Sample calculation: Power dissipation of a Scalibur in case of the maximum possible current drawn from U_L and a USB memory stick with 0.1 A current consumption.

$$P_{SCA} = 4.1\ W + 0.7\ V \times 0.1\ A + 1.0\ V \times 2.0\ A$$

$$P_{SCA} = 4.1\ W + 0.07\ W + 2.0\ W$$

$$P_{SCA} = 6.17\ W$$

3.2.2.3 Current Consumption Calculation for a Scalibur Station (with Terminals)

To find a suitable external power supply, the current consumption of the entire Scalibur station has to be considered:

$I_{IS} = I_{SCA} + I_{USB} + I_K + I_{AS}$

I_{IS}	current consumption of the entire Scalibur Inline station
I_{SCA}	current consumption of the Scalibur
I_{USB}	current consumption of connected USB devices
I_K	current consumption of connected terminals
I_{AS}	current consumption of sensors and actuators, fed by the Inline station

- The current consumption of a Scalibur (without terminals) is maximum 170 mA.

I_{SCA} = 0.17 A

Please consult the manual of the connected USB device to find out the actual current draw from USB.

- The respective USB currents I_{USB1} and I_{USB2} are weighted by a factor of 0.24, resulting in the equation:

$I_{USB} = (I_{USB1} + I_{USB2}) \times 0.24$

The current consumption of the connected terminals can be found in their manuals. The following rules of thumb apply:

- The current provided by U_{ANA} influences the total current directly.
- The current provided by U_L applies to the total current with a factor of 0.36.

The following formula applies:

$I_K = I_A + I_L \times 0.36$

I_A	current from U_{ANA} (max. 500 mA)
I_L	current from U_L (max. 2.0 A)

See the according datasheets in order to determine the current consumption of the connected actuators and sensors.

For an estimation it is often sufficient to check, whether the supply can be provided completely by the Scalibur, that is without power or boost terminals.

Without power and boost terminals and regardless of the circuits U_M und U_S, the maximum current consumption of the Scalibur with connected terminals is 1.7 A.

In addition there are the current requirements of the sensors and actuators, whereas the current through feather keys and keyways is limited to a maximum of 8 A.

Note: When selecting an external power supply, plan sufficient reserves. also into account that it could come to a current increase to a multiple of the rated current in the moment of turn-on caused by input capacities. Power supplies with over current shut-down must have a sufficient response delay to avoid start-up problems.

3.2.2.4 Derating of Terminal and USB Supply

Because USB and the Inline terminals are supplied by Scalibur's internal power supply unit, an increased load there increases Scalibur's internal power dissipation., Therefore, a derating has to be observed, which is depending on the mounting position (see Fig. 3.2.2.3). The recommended mounting position (with least derating) is horizontally (that is, clipped to a horizontal DIN rail on the wall).

The internal power dissipation caused by USB loads (P_{USB}) and the connected Inline terminals (P_{PERI}) is calculated according to chapter 0.

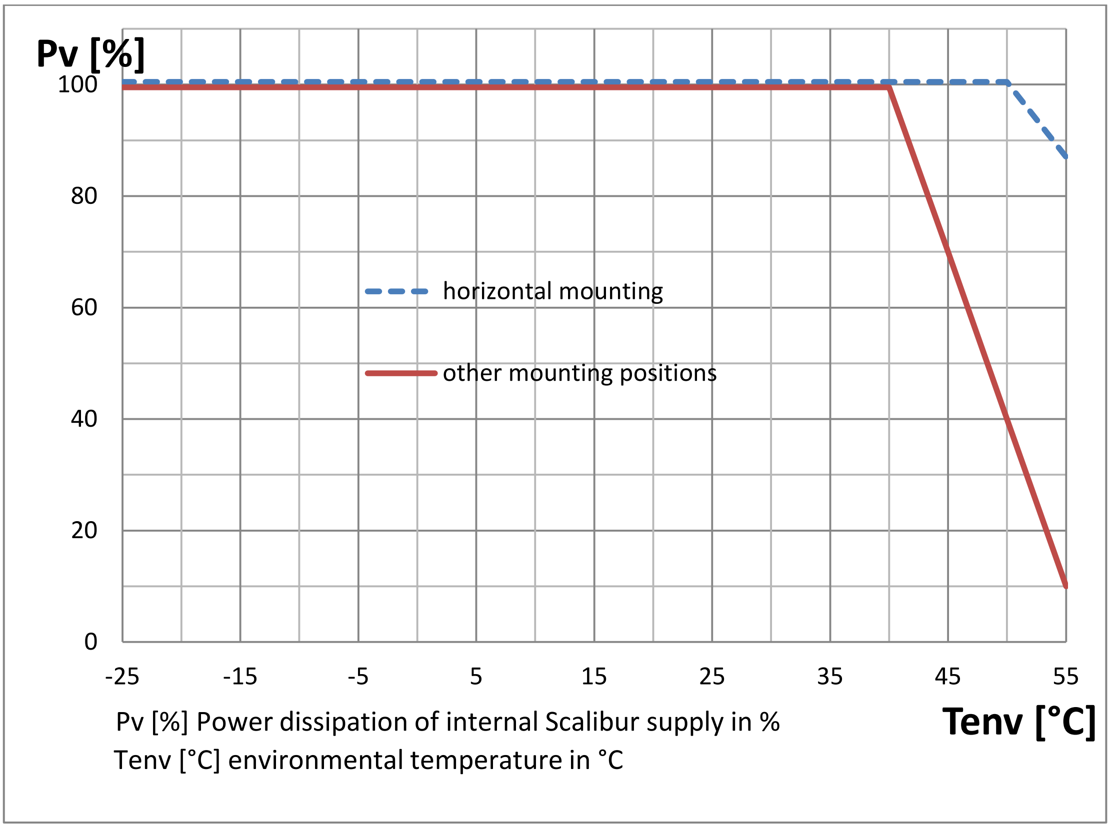


Fig. 3.2.2.3: Derating diagram of maximum internal power dissipation

Please refer to the manuals of the Inline terminals to find out the load of the logic supply.

Maximum load on the logic supply (2 A) and on USB (2 x 500 mA) leads to a 100% power dissipation of 2.7 W:

$$P_V = 1.0\ V \times I_L + 0.7\ V \times I_{USB}$$

$$P_V = 1.0\ V \times 2.0\ A + 0.7\ V \times 1.0\ A = 2.7\ W$$

This power dissipation can be maintained up to a maximum environmental temperature of 40 °C (104 °F). For higher temperatures, the load (P_{PERI} and P_{USB}) must be reduced according to Fig. 3.2.2.3.

Example 1: Horizontal mounting position

For an environmental temperature of 55 °C (131 °F) and horizontal mounting, the power dissipation is limited to 87 %, which means 2.35 W. Supposed I_L is fully loaded with the max. allowed 2 A, then the USB ports can support a maximum of 0,5 A:

$$I_{USB} = \frac{0.87\ P_V - 1\ V \times I_L}{0.7\ V}$$

$$I_{USB} = \frac{2.35\ W - 2\ W}{0.7\ V} = 0.5\ A$$

Example 2: Other mounting positions

For an environmental temperature of 45 °C (113 °F) and non-horizontal mounting, using additionally a USB device with 200 mA, the power dissipation is limited to 70 %, i.e. 1.89 W. Therefore, the max. current from U_L is:

$$I_L = \frac{0.7\,P_V - 0.7\,V \times I_{USB}}{1\,V}$$

$$I_L = \frac{1.89\,W - 0.14\,W}{1\,V} = 1.75\,A$$

3.2.2.5 Protective Devices of 24 V Main and Segment Supply U_M and U_S

Surge / overvoltage: Input protective diodes (can be destroyed by permanent overload).

Polarity reversal: Parallel diodes. In case of wrong polarity a high current is flowing which is blowing the external fuses.

Segment supply and main supply are related to the same ground potential.

Note: Each 24 V voltage supply must be fused externally. The power supply unit must be capable of supplying a current four times the nominal value of the external fuse to reliably blow the fuses in case of an error.

3.2.3 RS-485 and LON

The interface connector provides terminals for both RS-485 interfaces and (for SCA-340-L only) the LON TP/FT-10 interface.

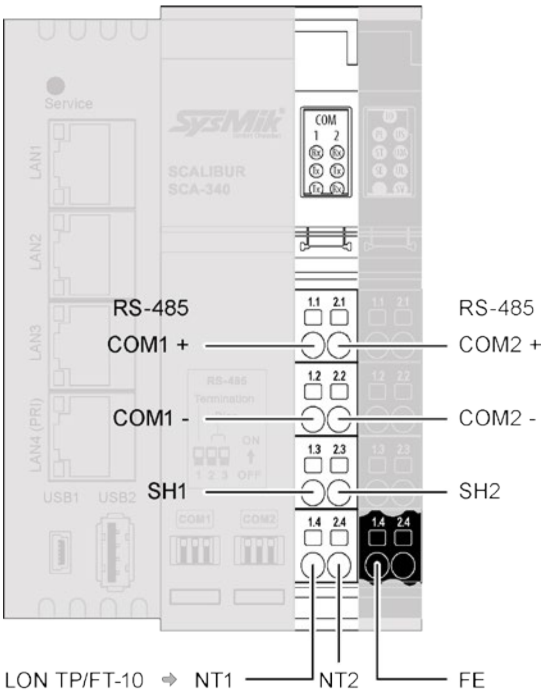


Fig. 3.2.3.1: RS-485/LON Interface terminal connections

Terminal-point	Name	Function
1.1	COM1 +	COM1 RS-485 data signal + positive
1.2	COM1 -	COM1 RS-485 data signal - negative
1.3	SH1	COM1 shield
2.1	COM2 +	COM2 RS-485 data signal + positive
2.2	COM2 -	COM2 RS-485 data signal - negative
2.3	SH2	COM2 shield
1.4	NT1	LON TP/FT-10 (SCA-340-L only), polarity independent
2.4	NT2	

Fig. 3.2.3.2: Terminal assignment of interface connector

For RS-485 the proper polarity has to be observed, and bias and termination resistors have to be chosen properly. Scalibur has fitting built-in-resistors, which can be used via DIP switches. The shield connections are internally capacitive connected to FE (functional earth).

The connection is pluggable and includes two terminal points connected inside the plug for each bus line. Thus the TP/FT-10 bus can be wired in one line without additional terminals and the ICS can be removed without bus interruption.

While connecting LONWORKS technology based devices to the bus, the LONMARK wiring guidelines [3] must be observed. According to the network topology one or two network terminators such as SysMik ACC-BT have to be attached. If shielded cables are used, the shield can be connected to the SH connector in order to avoid electrostatic charging. The data bus is polarity independent. More detailed information can be found in the manual of the used transceiver [2].

3.2.4 Ethernet

The Scalibur provides four Ethernet ports with built-in switch and the following properties:

- shielded RJ45 connectors
- 10/100BaseT, automatic detection
- automatic MDI/MDI-X crossover detection

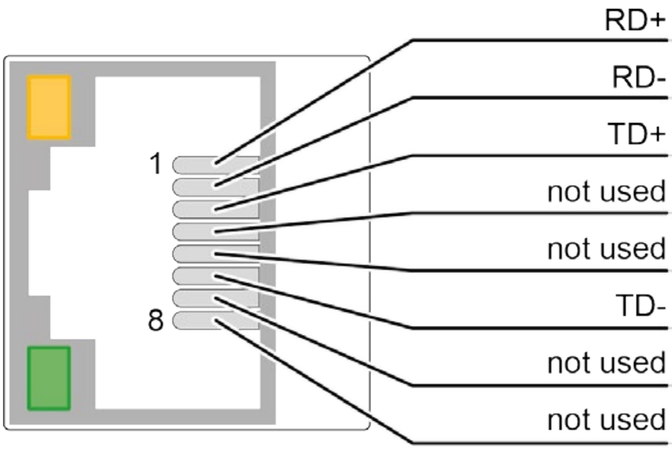


Figure 3.2.4.1: Terminal assignment of Ethernet port

The 10/100BaseT-Ports are able to recognize and to correct an interchanged receive path pair (RD+/RD-). Thus either crossover or patch cable can be used, no matter if the remote station is another end device, a switch or a hub.

Note: The maximum distance of 100 m between Ethernet devices can only be achieved using cables from category 5 on.

3.2.5 USB-OTG for local Access

The local access is a connection between Scalibur and a PC, which works regardless of the device settings (especially IP address). Simply connect a Windows PC to the Scalibur with a standard Mini USB cable.

Installation of PC driver

With Scalibur Operating System 1.01.0 or newer, the PC driver software is automatically installed (Windows 8.1, Windows 10).

For older Scalibur Operating Systems or when using Windows 7, the proper driver has to be selected manually as follows:

If you connect the Scalibur to your PC for the first time, Windows detects a new device and shows this in the Device Manager as “RNDIS/Ethernet Gadget” below “Other devices”.[1]

- select “Update driver software…” in the local menu of the device entry
- chose “Browse my computer for driver software”
- chose “Let me pick from a list of device drivers on my computer”
- select “Network adapters” as device type
- select “Microsoft Corporation” as manufacturer and “Remote NDIS Compatible Device” as network adapter and click “Next”
- pass warning “Update driver warning” with “Yes”
- close the notification window after successful device driver installation

[1] If the device is detected as a serial COM device instead, we recommend a firmware upgrade of the Scalibur. If that is not feasible, please contact SysMik for an alternative solution of the driver installation.

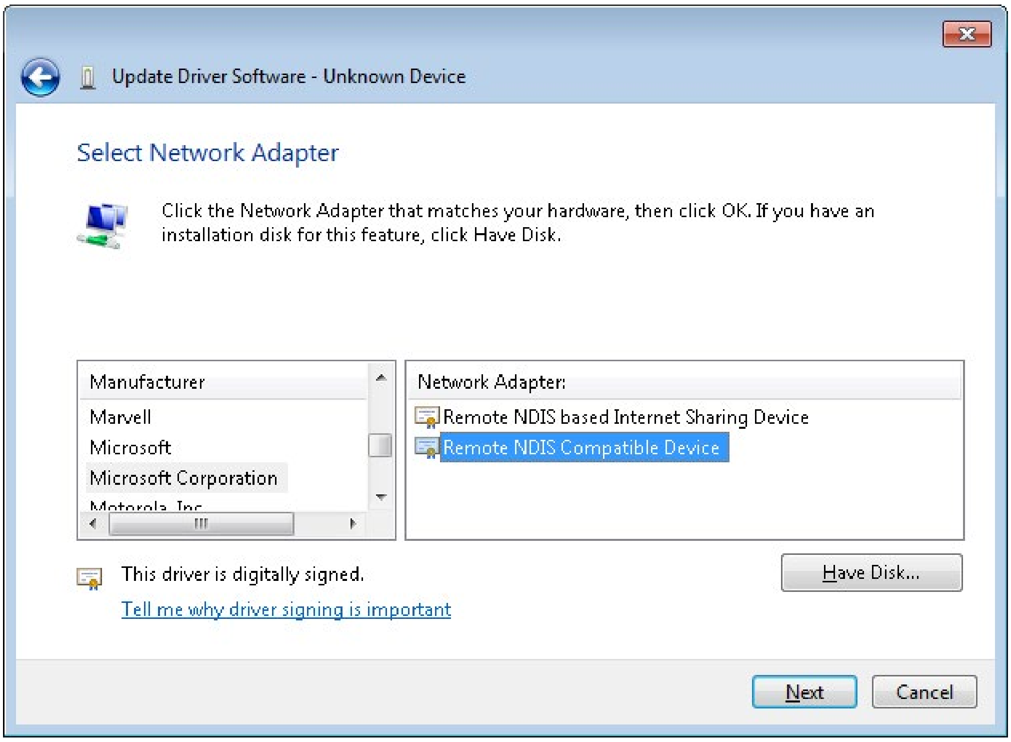


Fig. 3.2.5.1: Selecting device driver

The Scalibur is now located under „Network adapter“ as „RNDIS/Ethernet Gadget“. This acts as additional network interface, which provides a local network access to the Scalibur.

3.2.6 USB

The USB type A socket accepts USB end devices according to the standard USB 1.0 and USB 2.0. Beside this, the device must also be supported by software (esp. driver).

3.3 Operating Elements

3.3.1 Overview

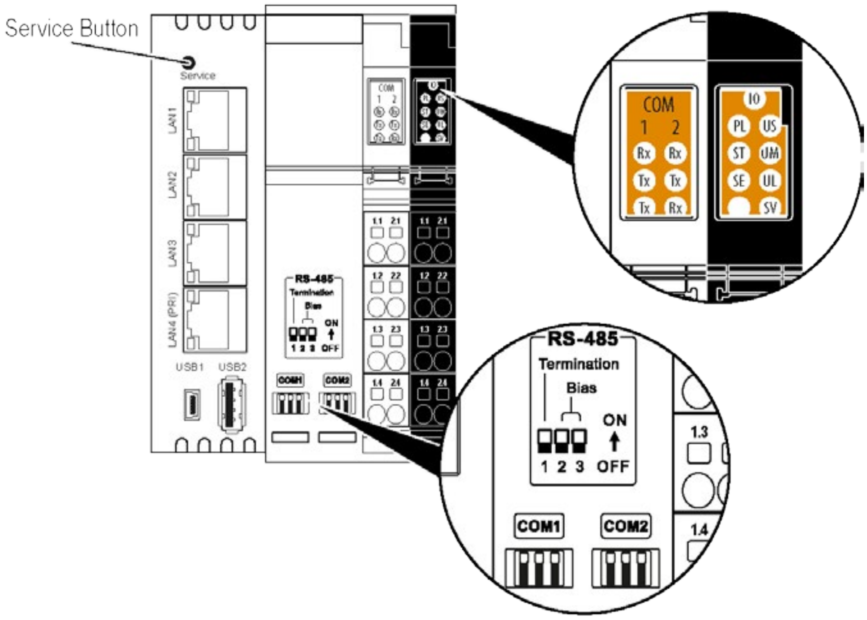


Fig. 3.3.1.1: Front view with display and operating element s

3.3.2 Inline Supply LEDs “US”, “UM”, “UL”

LED	State	Description
US	green	voltage at segment circuit (+24 V DC)
	off	no voltage at segment circuit
UM	green	voltage at main circuit (+24 V DC)
	off	no voltage at main circuit
UL	green	U_{BK} (24 V supply), U_L (logic supply) OK
	off	U_{BK}, U_L not OK

Table 3.3.2.1: Inline supply LEDs

3.3.3 Process Status LEDs “PL”, “ST”, “SE”

LED	Description
PL	status of Niagara Platform
ST	status of Niagara station
SE	status of Sedona Virtual Machine, incl. IO-server

Table 3.3.3.1: Process status LEDs

In normal operation, all three LEDs are using the same signalizing method.

LED status		Description
off		The process has not been started.
blinking yellow (2 s period)	10 % on time	The process is running and needs less than 10 % of processor time.
	50 % on time	The process is running and needs between 10 % and 50 % processor time.
	90 % on time	The process is running and needs more than 50 % processor time.

Table 3.3.3.2: Process status LED behavior

During a software update, the process status LEDs signalize the programming process as a running light.

3.3.4 IO Status LED “IO”

The communication state of the IO terminals is signalized by a dual colored “IO” LED, located at the supply connector.

State	Description
off	The IO server is not running.
green	Communication with Inline terminals is OK.
red	Communication with the Inline Terminals is not working. Possibly, there are no terminals attached or the terminals are not snapped-in properly.

Table 3.3.4.1: IO status LED

3.3.5 Communication LEDs “COM1”, “COM2”, “LON”

Located at the interface connector, the Scalibur has LEDs which signalize the data transmission of their respective interface. The layout of the LEDs resembles the layout of the terminals: COM1 upper left, COM2 upper right, and LON below (only SCA-340-L).

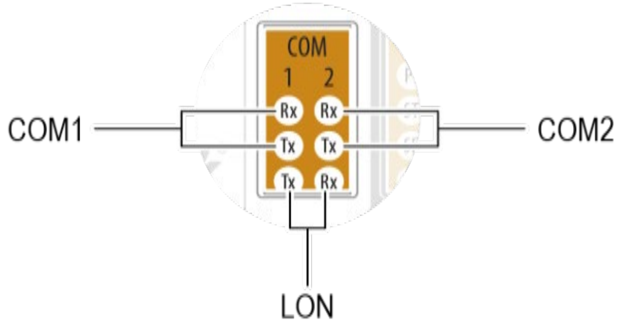


Fig. 3.3.5.1: COM LEDs

LED	State	Description
COM1 Rx	green	Data are being received via COM1.
COM1 Tx	yellow	Data are being sent via COM1.
COM2 Rx	green	Data are being received via COM2.
COM2 Tx	yellow	Data are being sent via COM2.
LON Rx	green	Data are being received via LON (only SCA-340-L).
LON Tx	yellow	Data are being sent via LON (only SCA-340-L).

Table 3.3.5.1: Inline supply LEDs

3.3.6 Service Button and LED “SV”

LED state	Description
off	normal operation and for about 7 s after power-on
red	booting, approx. 7 s
blinking red 5 Hz	Time slice of about 2 s after booting; allows manual reset of IP address and Niagara Platform access credentials to state of delivery.
blinking green 5 Hz	Time slice of about 2 s after red blinking; allows manual reset of Sedona application and kits to state of delivery.

Table 3.3.6.1: Service LED

How to reset IP address, access credentials, and Sedona

The Service button can be used in interaction with the Service LED to manually reset IP address, Niagara Platform access credentials, *Daemon HTTP Port*, *Daemon HTTPS Port*, and Sedona to the state of delivery.

If the Service button is pressed when the Service LED is blinking red, and is held pressed for at least 3 s, the IP address of *eth0* and the Niagara Platform credentials are reset to the state of delivery.

If the Service button is pressed when the Service LED is blinking green, and is held pressed for at least 3 s, the Sedona app and Sedona kits are reset to the state of delivery.

3.3.7 Ethernet Status LEDs

Each Ethernet port has two LEDs to signalize its link and communication state.

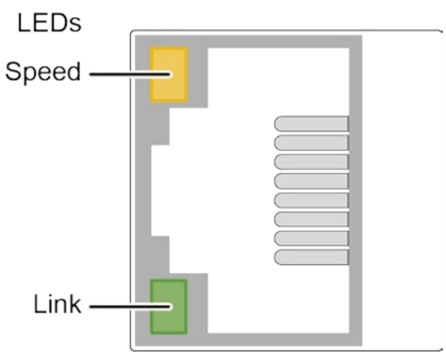


Fig. 3.3.7.1: Ethernet status LEDs

LED	State	Description
Speed	yellow	100 Mbps
	off	10 Mbps (if link is active)
Link	green	electrical connection to network
	short off	packet transmission
	permanent off	no electrical connection to network

Table 3.3.7.1: Ethernet port LEDs

3.3.8 RS-485 Termination

RS-485 networks are using bus topology and are terminated at both ends with a termination resistor. Additionally, the data lines are pulled once with bias resistors to a defined idle state. The Scalibur has built-in resistors for termination (120 Ω) and biasing (510 Ω) of COM1 and COM2, according to the BACnet MS/TP specification. Each resistor can be separately activated via DIP switches.

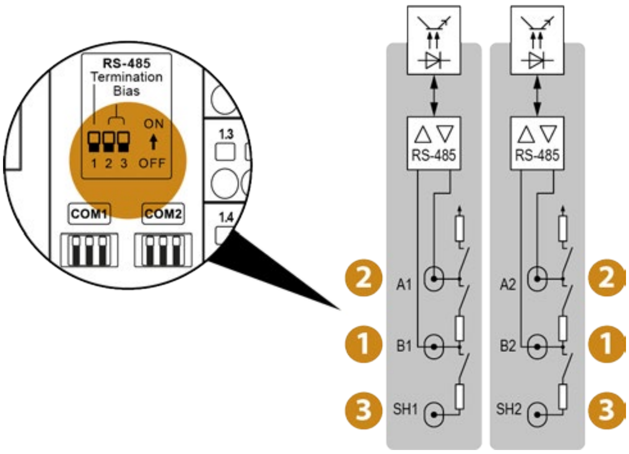


Fig. 3.3.8.1: Assignment of DIP switches to RS-485 termination

4. Software

Note: Scalibur factory defaults

Ethernet	eth0 – LAN3 / LAN4:	192.168.1.1 / subnet mask 255.255.255.0
	eth1 – LAN1 / LAN2:	disabled
Platform-Credentials:		sysmik / intesa
Sedona-Credentials:		admin / no password (after Sedona activation)

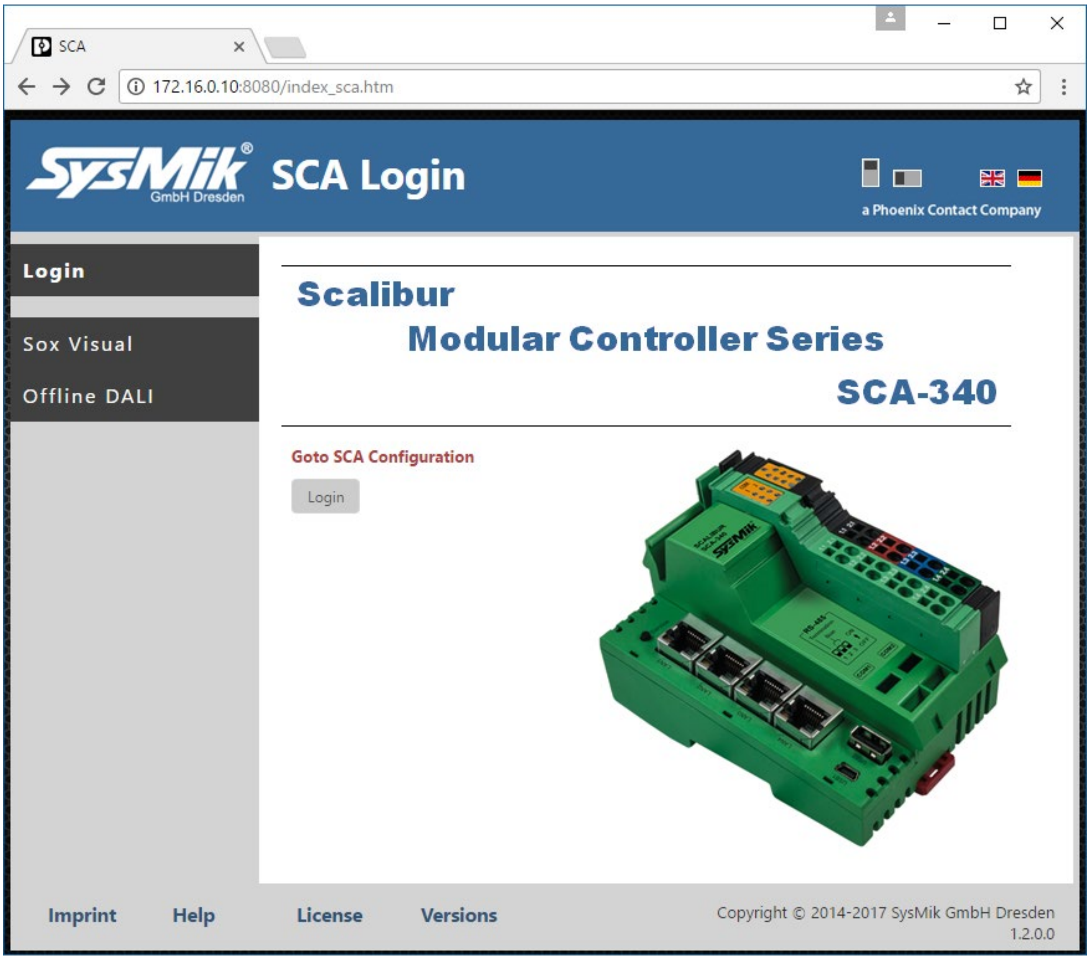


Fig. 10.1: Login

4.1 Configuration Tools

Fundamental device settings are vital to the device operation and should be protected carefully. To prevent unwanted accesses from the network while offering a stable configuration access, which is independent of the current IP settings, the Scalibur offers a local access via USB-OTG (see chapter 3.2.5).

The connected PC is getting another virtual network adapter, which is connected to the Scalibur and is automatically receiving IP settings from the Scalibur DHCP server. The IP address of the Scalibur is `172.16.0.10` in this virtual network.

The local access offers several services and protocols to the PC for configuration and diagnosis.

Protocol	Port	PC-Software	Application
Telnet	23	Telnet client	SCA system shell
HTTP	8080	Web browser	commissioning website

Table 4.1.1: Protocols of local access

4.1.1 SCA System Shell

The SCA System Shell allows to configure fundamental settings of the Scalibur. To this end, the PC is connected via USB-OTG to the Scalibur and then a Telnet client is used on the PC to establish a Telnet session with the Scalibur (address `172.16.0.10` / port `23`).

The SCA System Shell shows host ID, version information of several software components, the current time, and the IP addresses of the Scalibur. A number-based menu allows to perform different actions:

`1. Update System Time`	configure current system time
`2. Update IPv4 Settings`	configure IP addresses
`3. Update IPv6 Settings`	configure IPv6 addresses
`4. Switch Configuration`	configure the Ethernet switch (Ethernet port assignment to IP interface, RSTP, ring monitoring, broadcast storm protection)
`5. Ping IPv4 Host`	ping an IP address from the Scalibur
`6. SSH/SFTP usage`	start/stop SSH/SFTP server
`7. Sedona/Niagara Enable`	activate/deactivate Niagara and Sedona
`8. IO Server`	configure IO server (port number, remote address)
`9. Sedona Factory Default`	reset Sedona app and Sedona kits to state of delivery
`10. Reset Platform Credentials`	reset Platform credentials to default (user *sysmik* / password *intesa* / *Daemon HTTP Port 3011 / Daemon HTTPS Port 5011*)
`11. Reboot`	reboot Scalibur
`x. Exit`	exit Telnet session

4.1.2 Commissioning Website

The commissioning website allows to configure the Scalibur and to access data points of connected IO terminals.

To this end, a PC is connected via USB-OTG to the Scalibur and the following URL is entered in the address field of the web browser:

`172.16.0.10:8080`

The page *Overview* shows host ID and version information of several software components.

Page *Settings* allows to configure several settings:

- *Network* to configure IP addresses

- *Webserver* to configure the port at which the restricted webserver (without device settings) is accessible
- *Date/Time* to configure current time and time zone
- *IO Server* to configure the IO server (port number, remote access)
- *Run* to activate/deactivate Niagara and Sedona
- *Switch* to configure the Ethernet switch (Ethernet port assignment, RSTP, ring monitoring, broadcast storm protection)

On the page *Terminals*, the data points of the connected IO terminals can be observed and manually overridden (see 4.2.3).

The webserver hosts further web pages, which are alternatively also available via Ethernet:

- DALI configurator to assign addresses to DALI ballasts (connected via DALI terminals) and configure them
- User defined visualization pages, which are created using Sedona programming [4].

4.1.3 File Access via FTP

The Scalibur has an SFTP server to access the file system. This can be used to load software updates from the PC to the Scalibur. The SFTP server can only be activated and deactivated from the SCA System Shell (see chapter 4.1.1). A password for the user “sftpuser” can be defined.

In parallel to SFTP an SSH server can be activated. It can be used for command line based diagnosis of the controller by the manufacturer only.

4.2 Commissioning Scalibur

Scalibur comes with a default configuration and settings like IP addresses, time, time zone, and others have to be specifically configured.

The following Scalibur functions are active:

- The SCA System Shell expects input.
- The IO server detects the connected IO terminals and opens its interface for commissioning website, Sedona, and Niagara.
- The commissioning webserver hosts the commissioning website.
- The Niagara daemon is ready for a Platform connection with Workbench (user sysmik / password intesa). Though there is no station running – these can be loaded later during the Niagara commissioning.

Changing IP addresses or time zone becomes effective only after reboot.

4.2.1 IP Addressing

Scalibur's default IP address of the primary IP interface (*eth0*) is `192.168.1.1`, the subnet mask `255.255.255.0`. The secondary IP interface (*eth1*) is deactivated by default. There are several ways to configure the IP settings:

- SCA System Shell (see 4.1.1)
- Commissioning website via *Settings/Network* (see 4.1.2)
- Workbench via Platform connection with the Niagara daemon under *TCP/IP Configuration*

4.2.2 Time and Time Zone

The internal time is derived from a buffered RTC. At delivery the buffer capacitor is usually discharged and the time at the first start of the Scalibur is set to midnight 2000-01-01. Time and time zone (default Central European Time CET or Central European Summer Time CEST) can be configured in several ways:

- SCA System Shell (see 4.1.1)
- Commissioning website via *Settings→Date/Time* (see 4.1.2)
- Workbench via Platform connection with the Niagara daemon under *Platform Administration→Change Date/Time*

4.2.3 Hardware Data Point Test

Usually, the electrical connection and the software integration of control stations are done by different persons and at different times. Ideally, the electrical installation (mounting and cabling) should be finished with a data point test and its according documentation. This is supported by the commissioning webserver, which clearly visualizes all input and output signals of the IO terminals. If required, output channels and also their configuration, like measuring ranges, can be manually overridden. Thus, a data point test doesn't need any application software. By leaving the commissioning page (either manually or by timeout), all overrides are reverted.

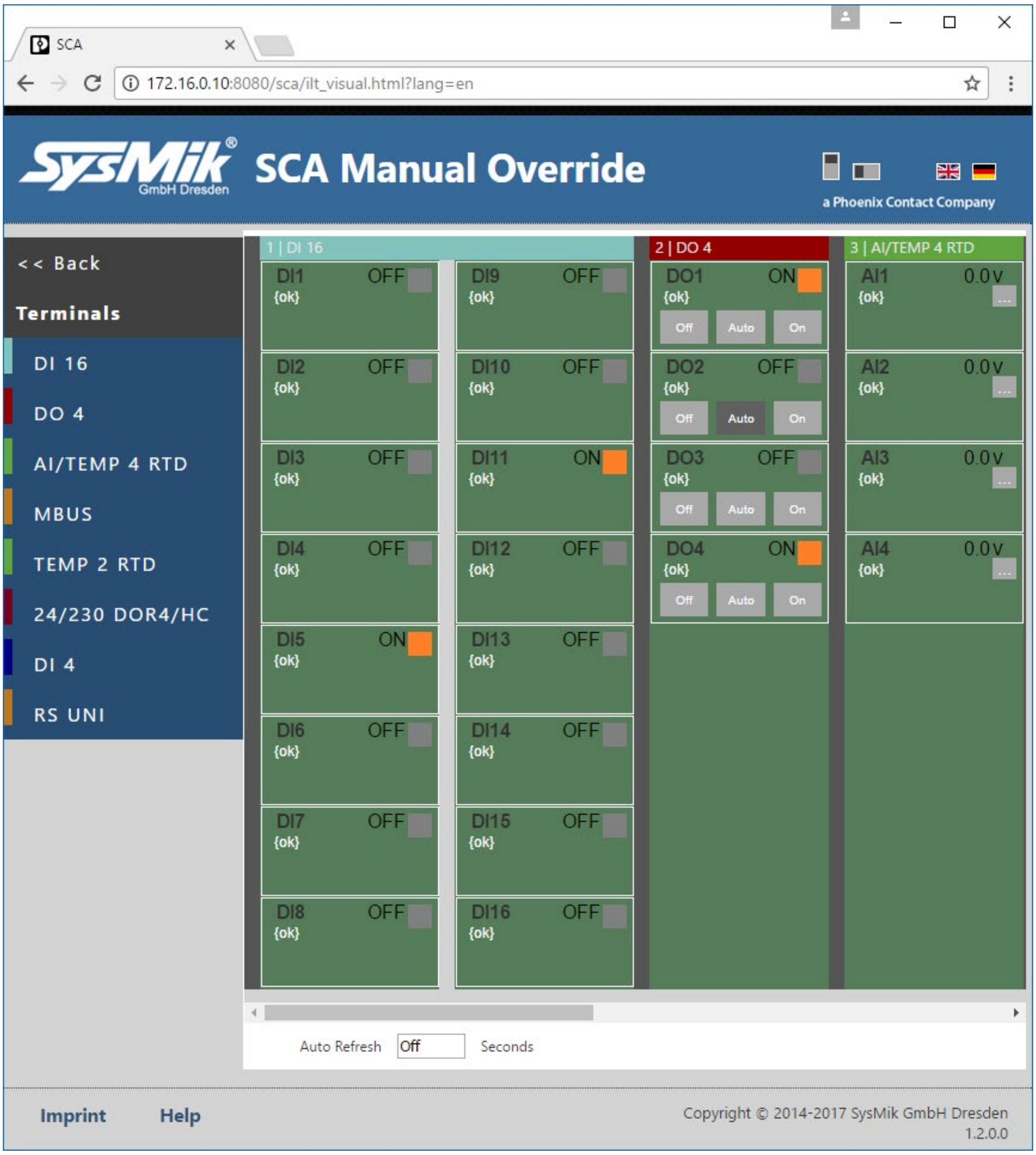


Table 4.2.1: Testing data points via commissioning webpage

4.3 Ethernet Switch for Flexible Network Topologies

The integrated Ethernet switch with four external and two internal ports, allows Ethernet cabling without additional switches. It supports:

- free assignment of IP interfaces to external Ethernet ports
- ring monitoring with automatic port deactivation
- Rapid Spanning Tree Protocol (RSTP) to manage redundant Ethernet topologies
- throtteling of Ethernet traffic to prevent multicast and broadcast storms

The Ethernet switch can be configured here:

- SCA System Shell (see 4.1.1)
- Commissioning Website (see 4.1.2)
- WorkPlace via Fox connection with Niagara Station under *Config→Drivers→SysmikScaIoNetwork→LocalPlatform→EthSwitch (SysmikScaSwitchCfgView)*

When using ring monitoring or RSTP, the status of the respective ports (activated, deactivated) is changed automatically. The port status information shows the state of the redundant topology. The state of the external ethernet ports is provided in the Niagara Station, in the Sedona Application, and on the Commissioning Website.

Factory default:

- RSTP deactivated
- ring monitoring deactivated
- Broadcast/Multicast throtteling: 1Mbps
- eth1on ports LAN1, LAN2
- eth0 on ports LAN3, LAN4

4.3.1 Assignment of IP Interfaces to External Ethernet Ports

The Ethernet Switch connects the two internal IP interfaces eth0 and eth1 with the external Ethernet ports. Fig. 4.3.1.1 to Fig. 4.3.1.4 show the possible combinations.

<table>
<tr><td>LAN1</td><td rowspan="4">eth0</td></tr>
<tr><td>LAN2</td></tr>
<tr><td>LAN3</td></tr>
<tr><td>LAN4</td></tr>
</table>

Fig. 4.3.1.1: LAN1-4 on *eth0*, *eth1* deactivated

<table>
<tr><td>LAN1</td><td>eth1</td></tr>
<tr><td>LAN2</td><td rowspan="3">eth0</td></tr>
<tr><td>LAN3</td></tr>
<tr><td>LAN4</td></tr>
</table>

Fig. 4.3.1.2: LAN2/3/4 on *eth0*, LAN1 on *eth1*

LAN1	eth1
LAN2	
LAN3	eth0
LAN4	

Fig. 4.3.1.3: LAN3/4 on *eth0*, LAN1/2 on *eth1* (factory default)

LAN1	eth1
LAN2	
LAN3	
LAN4	eth0

Fig. 4.3.1.4: LAN4 on *eth0*, LAN1/2/3 on *eth1*

If an IP interface has more than one Ethernet port assigned to it, the IP interface is accessible on each of these ports. Also, Ethernet traffic is forwarded between these ports, so that several devices can be linked in a line-topology (see Fig. 4.3.1.5).

Between Ethernet ports that do belong to different IP interfaces there is no Ethernet traffic (i.e. these ports are completely separated at Ethernet level).

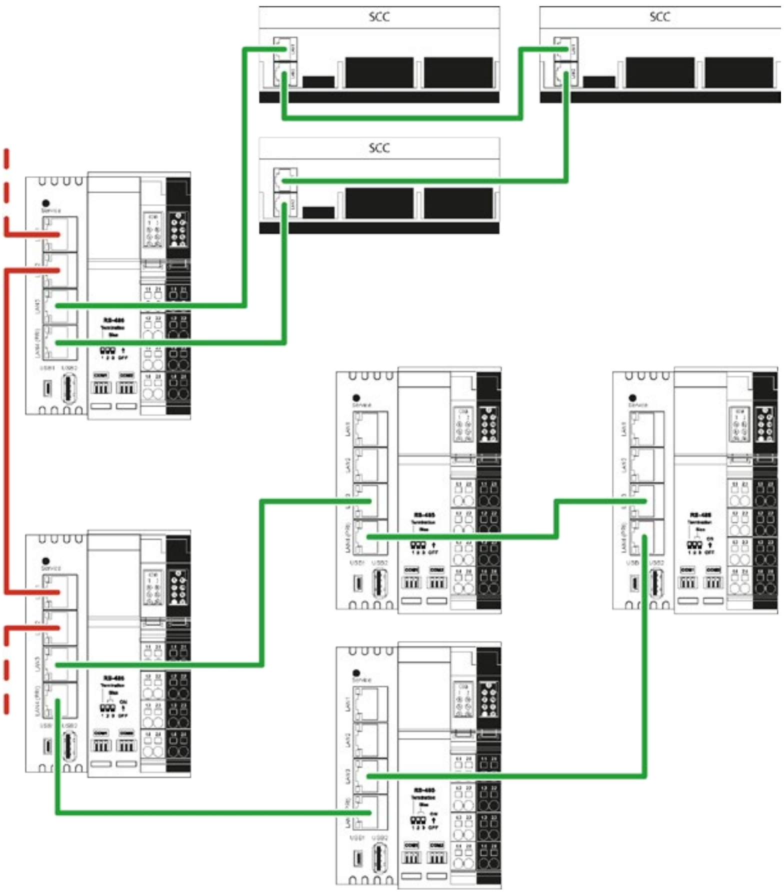


Fig. 4.3.1.5: Example of Ethernet wiring

4.3.2 Ethernet Ring Monitoring

Ethernet ports LAN3 and LAN4 allow to build an Ethernet ring, provided both ports belong to *eth0*. The Ethernet ring connects Ethernet field devices with integrated unmanaged switch (with at least two Ethernet ports, like SysMik's SCC devices) and ensures Ethernet communication even when one connection in the ring is broken (see Fig. 4.3.1.5).

If the ring is completely closed and the involved switches are unmanaged ones, a so called broadcast storm is likely to occur: because broadcast and multicast messages are always forwarded, they circulate in the ring and create high traffic load. The Ethernet ring monitoring observes always the state of the ring and deactivates LAN4 when the ring is faultless. If the ring connection is broken at one point, LAN4 is activated.

Note: The time for complete recovery of the communication in the ring is defined by the aging-time of the switches in the ring.

4.3.3 Rapid-Spanning-Tree-Protocol (RSTP)

The Rapid-Spanning-Tree-Protocol allows to build arbitrary redundant Ethernet structures, also beyond simple ring structures, by detecting redundant paths in the system and disabling them as long as they are not needed. As soon as a connection is broken it will be replaced by a redundant path (provided there is one). RSTP needs just a few seconds to re-establish a broken connection.

Note: Inside an RSTP structure, all involved Ethernet switches must support RSTP and must be adequately configured.

Tables Table **4.3.3.1** to Table **4.3.3.4** show the possible combinations regarding RSTP. A LAN port can be configured for RSTP if there is at least one further LAN port assigned to the same IP interface.

eth	LAN	RSTP configurations						
0	1				✓	✓	✓	✓[A)]
	2			✓	✓	✓	✓	✓[A)]
	3		✓	✓	✓		✓	✓[B)]
	4		✓	✓	✓			✓[B)]

[A), B)] RSTP topologies independent of each other

Table 4.3.3.1: LAN1-4 at *eth0*, *eth1* deactivated

eth	LAN	RSTP configurations		
1	1			
0	2			✓
	3		✓	✓
	4		✓	✓

Table 4.3.3.2: LAN2/3/4 at *eth0*, LAN1 at *eth1*

eth	LAN	RSTP configurations			
1	1			✓	✓
	2			✓	✓
0	3		✓		✓
	4		✓		✓

Table 4.3.3.3: LAN3/4 at *eth0*, LAN1/2 at *eth1* (factory default)

eth	LAN	RSTP configurations		
1	1		✓	✓
	2		✓	✓
	3			✓
0	4			

Table 4.3.3.4: LAN4 at *eth0*, LAN1/2/3 at *eth1*

4.3.4 Port Status Informations

If ring monitoring or RSTP is active, then the state of the external Ethernet ports is available in the Niagra station, the Sedona application, and the Commissioning Website. This allows to check whether the redundancy of a topology is still intact. When a path gets disconnected, formerly inactive ports will be activated, which can be signalized.

Sedona PlatformService *Lan1State…Lan4State: Boolean*

- *true = FORWARDING*
- *false = BLOCKING*
- *null* = no current information available (RSTP or loop not active)

Niagara Station *Config→Drivers→SysmikScaIoNetwork→LocalPlatform→EthSwitch Lan1State…Lan4State: Status Boolean*

- *true {ok} = FORWARDING*
- *false {ok} = BLOCKING*
- *xxx {stale}*: no current information available (RSTP or loop not active)
- *xxx {disabled}*: status check disabled (configurable via *Config→Drivers→SysmikScaIoNetwork→LocalPlatform→EthSwitch.Enabled*)

4.3.5 Broadcast Storm Protection

Broadcast storm protection limits the traffic rate for multicast and broadcast packets. Configurable values are 0.032 / 0.05 / 0.1 / 0.5 / 1 (factory default) / 2 / 5 / 10 / 20 Mbps. This setting applies to all four ports.

Even with ring monitoring and RSTP, redundant paths can't be completely avoided. From detecting a topology change it takes several seconds until the reorganisation is completed. In this period a broadcast storm can develop, which might interfere with the management messages for the reorganisation, thus effectively preventing a proper reorganisation. The broadcast storm protection function limits the traffic load of broadcast and multicast messages and terminates broadcast storms.

4.4 Real-Time Control with Scalibur and Sedona

Sedona allows to program control applications, which run with configurable cycle times. Sedona must first be activated from the SCA system shell (s. 4.1.1) or the commissioning website (s. 4.1.2). Niagara Workbench is used as engineering tool. The programming follows a component-based approach: The application consists of components, which are parameterized and connected with each other. With the textual programming language Sedona (similar to C++ and Java), it is even possible to create own Sedona components. An introduction to Sedona offers [4], while further, more detailed information can be found in [6].

4.4.1 IO Access

Hardware data points can be accessed via the terminal components of the *SysMikScalo* kit. There is a component for each terminal type with its specific slots, that allow to access inputs and outputs and to parameterize the terminal.

The component *Scalo* works as folder, into which the hardware related components are added. Furthermore, it provides an Action *Restart IO* to restart the IO server.

Each terminal component has a property *Terminal*, which defines the terminal position. The first terminal directly at the Scalibur has position 1, and so on. Some terminal components contain further parameters (e.g. measuring ranges for analog input terminals) or actions (e.g. counter initialization of pulse metering terminals).

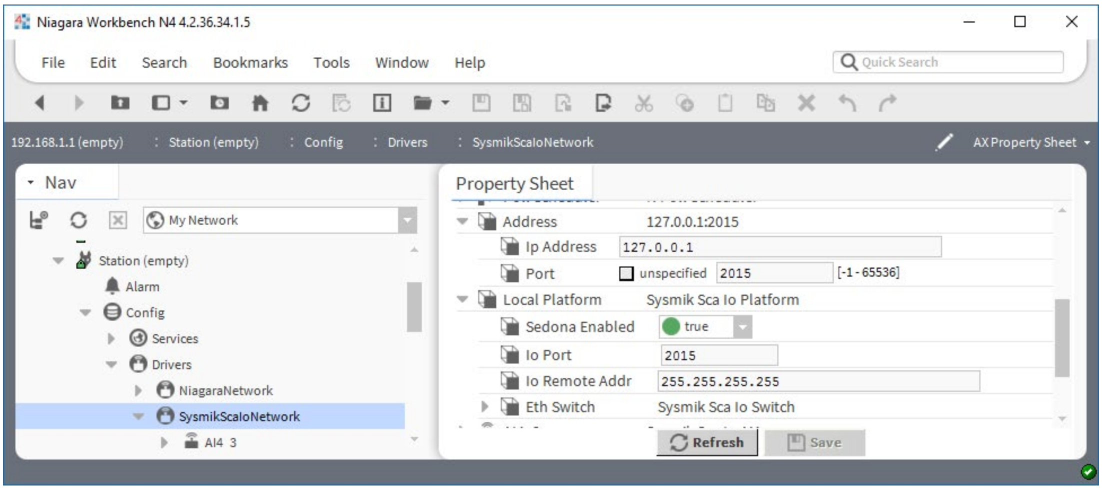


Table 4.4.1: PropertySheet view of a terminal component

4.4.2 Modbus

Via *Platform Service*, a Modbus TCP server can be started for the Sedona Virtual Machine, which hosts the following data points:

- 10,000 coils (digital outputs)
- 10,000 discrete inputs (digital inputs)
- 10,000 holding registers (analog outputs)
- 10,000 input registers (analog inputs)

The Sedona application has access to these data points via components of the kit *SysMikModbusServer*.

Additionally, with components of the kit *SysMikModbusClient*, the Sedona application can act as Modbus TCP client or Modbus RTU master to read and write data points of remote Modbus devices.

4.4.3 Platform Service

The platform service (*Sedona→App→service→plat*) is a mandatory element of any Sedona application and allows device specific configurations:

- *Timezone* – time zone, e.g. Europe/Berlin
- IP-Addressing
  - *Ip Addressing* – static or DHCP
  - *Ip Address*
  - *Ip Net Mask* – subnet mask
  - *Ip Gateway* – gateway address
  - *Ip Dns1*, *Ip Dns2*, *Ip Dns3* – Domain Name Server
- *Sntp Address* – SNTP server address
- Modbus TCP server
  - *Modbus Port* (0 to deactivate Modbus server)
  - *Unit-ID*
- Modbus RTU
  - *Modbus Rtu Enabled*
  - *Modbus Rtu Baud*
  - *Modbus Rtu Parity*
  - *Modbus Rtu Stop Bits*
- *Niagara enabled* – in case the parallel operation of Niagara and Sedona is not wanted, Niagara can be deactivated or again be enabled
- *IoPort* – TCP port number of the IO server
- *IoRemoteAddr* – to prevent an unwanted remote control of Scalibur IOs by other Niagara stations, a remote control address can be configured. Default is empty which blocks remote control completely. It is possible to allow remote control only for a specific IP address by setting the entry to this specific IP address. `255.255.255.255` allows remote control from any IP address..

All configurations require a restart of the Scalibur to become effective.

4.5 Integration with Scalibur and Niagara Framework

The Niagara framework contains many communication protocols, which are automatically available in the Scalibur, too:

BACnet IP, BACnet MS/TP (only at COM1 and COM2), LonWorks IP852, LonMark TP/FT-10 (only SCA-340-L), Modbus TCP, Modbus RTU, M-Bus, KNX/IP, SNMP, oBIX, Sedona and many more. Data points from different sources can be integrated and connected using these communication protocols. Niagara offers a rich set of processing and system functions, like trend log, alarming, scheduling, web visualization, report generators, and interfaces to e-mail, SMS, data bases and other. All the engineering is done with a single tool – Workbench.

4.5.1 Local IO Access

The components of the module *sysmikScaIo* allow to access the IO terminals. This follows consequently the approach of the Niagara Driver Framework (*Network – Device – Point*): SysMikScaNetwork – Terminals – Data points (IO channel).

From the Driver Manager, the default view of *Station→Config→Drivers*, a *SysmikScaIoNetwork* is created via *New.*

In the *N Device Manager*, the default view of the *SysmikScaIoNetwork*, the connected terminals can be detected via *Discover*. The detected terminals can be inserted to the station via *Add*.

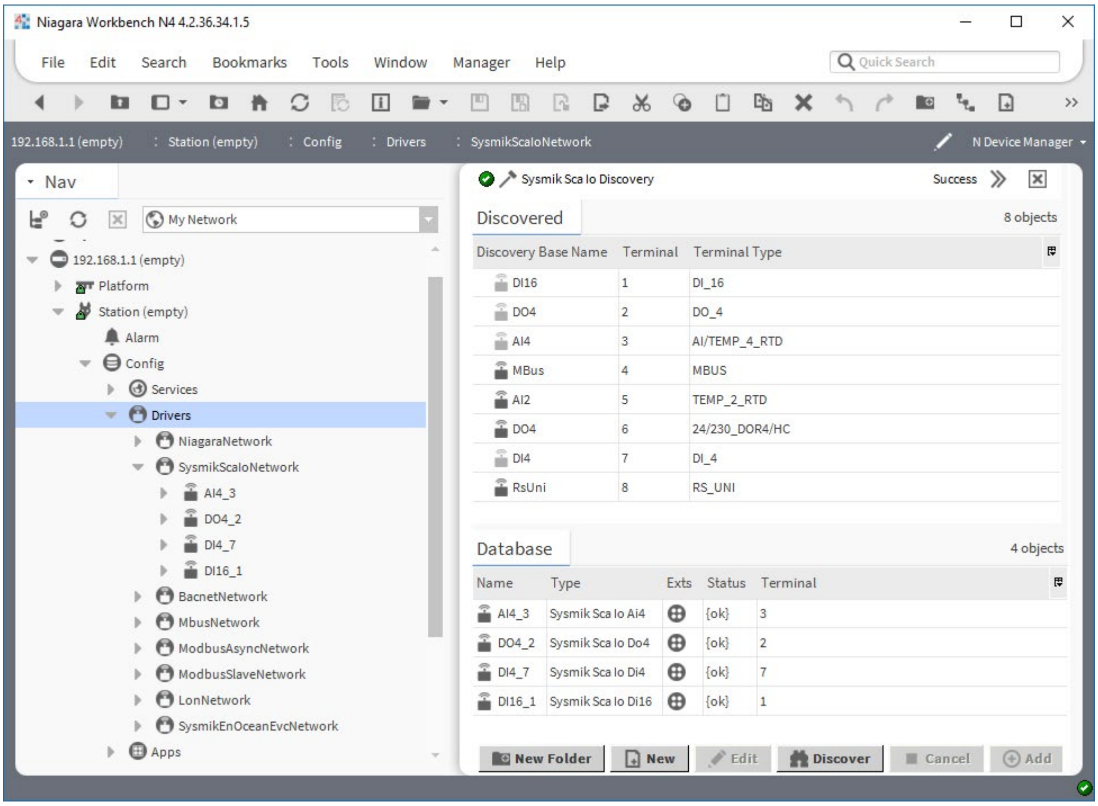


Fig. 4.5.1.1: N Device Manager of the SysmikScaIoNetwork

In the *N Point Manager*, the default view of the points folder, the available IO channels can be displayed via *Discover*. These can be inserted as proxy points to the station via *Add*. Some data points have specific functions:

- Measurement ranges of the analog input terminals can be configured with the additional property *Ai Type* of the proxy extension.
- Counter values of the pulse metering terminal can be initialized with the action *Init Counter* of the proxy extensions.

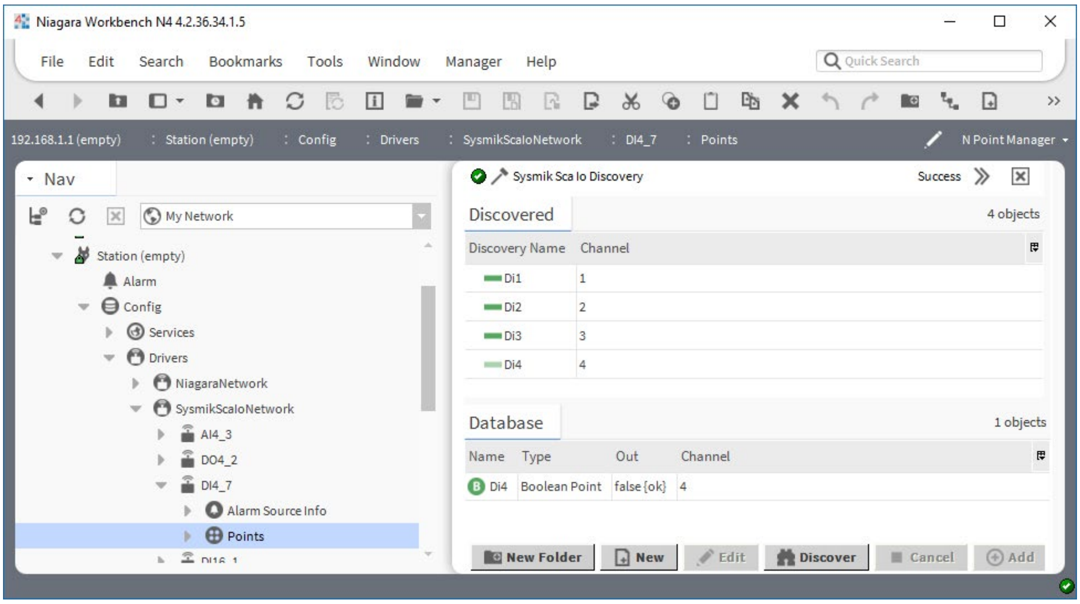


Fig. 4.5.1.2: N Point Manager of a terminal component

4.5.2 Serial Interfaces

The Scalibur has two serial RS-485 interfaces, that are available as *COM1* and *COM2* for any serial protocols. All relevant baud rates equal or above 200 baud are supported.

Further serial interfaces can be added via IO terminals. Universal serial terminals of type IB IL RS UNI support the interface types RS-232, RS-485, and RS-422, which can be configured with Workbench via their associated terminal component in SysmikScaNetwork. IB IL RS 232-ECO and IB IL RS 485-ECO support serial interfaces types regarding their names. The serial interfaces of the IO terminals can be used as master for serial protocols except BACnet MS/TP. The supported baud rates are documented in the data sheets of the terminals.

Terminals of type IB IL MBUS extend the Scalibur by serial interfaces according to the M-Bus standard for connection of up to 30 M-Bus slaves and are controlled with the Niagara M-Bus driver.

The interface names of the serial terminals are assigned according to their position, starting with *COM3*.

A summary of all serial interfaces, including their current use (owner) is available at *Station/Config/Services/PlatformServices/SerialPortPlatformServiceNpsdk*.

Example:

The screenshot shows an overview for a Scalibur controller with 4 serial ports total – two from the controller itself and two added via serial terminals:

- COM1: The first built-in RS-485 interface is used by the MS/TP port of the *BacnetNetwork*.
- COM2: The second built-in RS-485 interface is assigned to the *ModbusSlaveNetwork*.
- COM3: The IB IL MBUS terminal at Inline position 7 is used as interface for the *MbusNetwork*.
- COM4: The IB IL RS UNI terminal at Inline position is used by the *ModbusAsyncNetwork*. To this end the property *RsType* of the terminals PropertySheet in *SysmikScaNetwork* is set to RS-485.

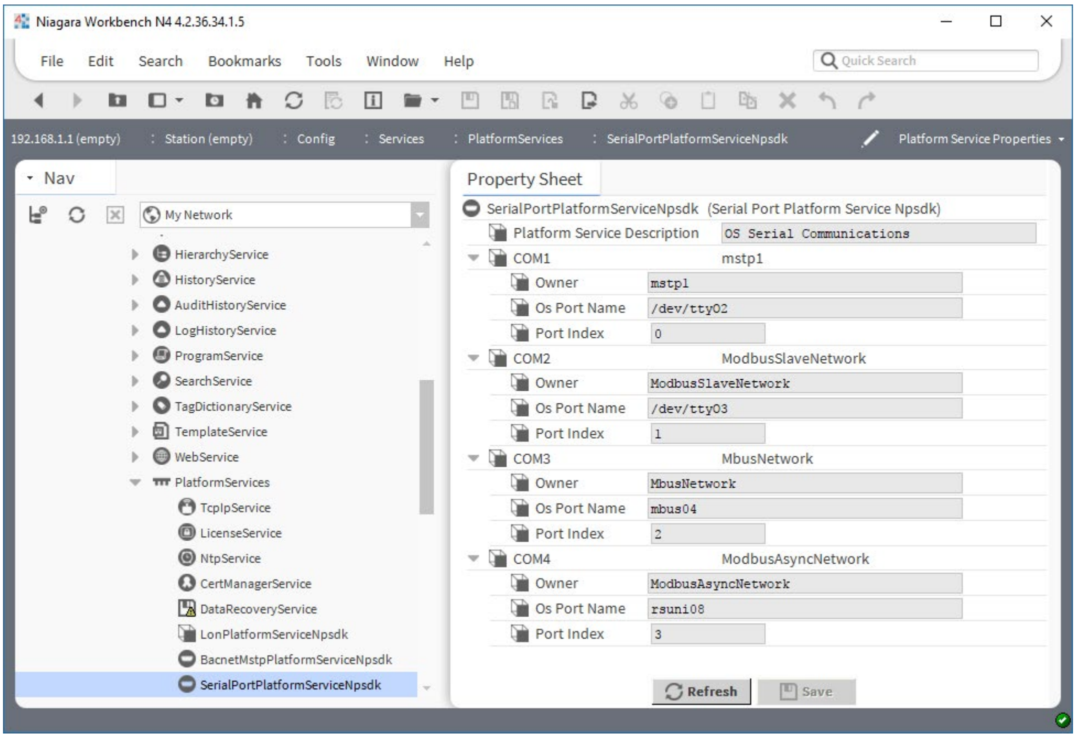


Fig. 4.5.2.1: SerialPortPlatformServiceNpsdk

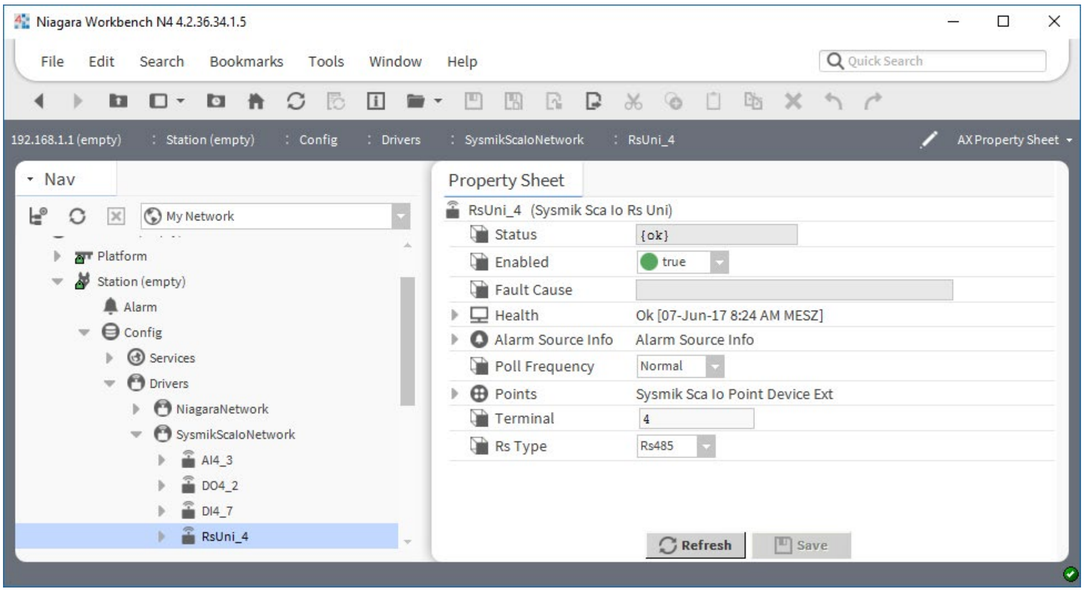


Fig. 4.5.2.2: Interface configuration of IB IL RS UNI

4.5.3 IO Remote Control

The SysmikScaNetwork sets up a TCP connection to an IO server, to access the IO terminals. The property Address defines address and port of this server. Default is the local address `127.0.0.1:2015`, which establishes contact to the local IO server. But it is also possible to connect to an IO server of a different device by configuring its address here.

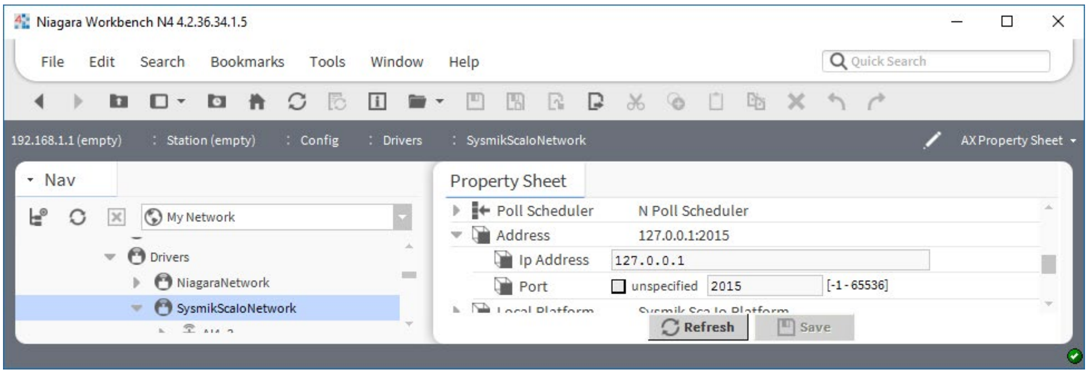


Fig. 4.5.3.1: Configuration of the IO server to be contacted

To do so the remote access must be activated first. In Workbench an allowed remote control address can be configured via

Station→Config→Drivers→SysmikScaIoNetwork→localPlatform→IoRemoteAddr

Address setting	Description
invalid address (empty string)	remote control deactivated (default)
valid IP address	IO server accepts only accesses from this IP address
255.255.255.255	any IP address can access the IO server

Table 4.5.3.1: Address settings for IO server access

Furthermore, the port number of the IO server can be defined via

Station→Config→Drivers→SysmikScaIoNetwork→localPlatform→Io Port

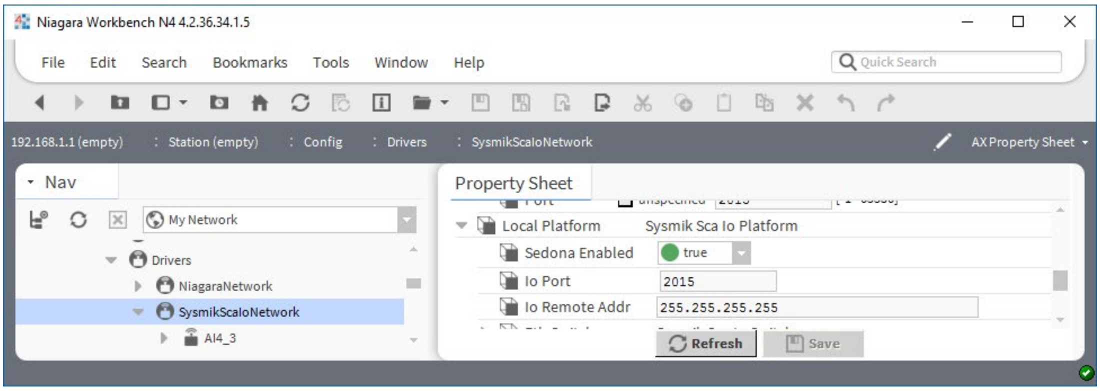


Fig. 4.5.3.2: Configuration of IO server

4.5.4 Sedona Integration

Data points of the local Sedona application can be added to Niagara via the Sedona driver. If a parallel operation of Niagara and Sedona is not desired, Sedona can be deactivated via

Station→Config→Drivers→SysmikScaIoNetwork→localPlatform→SedonaEnabled

4.6 Concurrent Access to the IO Terminals

Several software components can access the IO terminals of the Inline system. For reading input data, this poses no problems. For outputs and configuration however, the different program parts could work against each other. In order to achieve a predictable behavior of the IOs, there is a channel-wise priority control.

Each source can set a value with its source-specific priority, or release its access. This release is using technology specific values:

Type	Commissioning website	Sedona	Niagara
Digital output, bool	auto	null	null
Analog output, DALI-control, float	auto	nan (not a number)	null
Measuring range, enum	auto	auto	auto

Table 4.6.1: Release values of priority control

If several sources try to access the same IO channel, the following ranking applies:

Rank	Component
1	Commissioning website (i.e. manual override in test mode)
2	Sedona
3	Niagara local access
4	Niagara remote access

Table 4.6.2: Ranking of priority sources

The commissioning website has highest priority. Manual override is always possible regardless of the other program components. By leaving the commissioning page, all overrides are automatically released.

Sedona and Niagara components do by default release their priority. Only if they are configured or connected to other components, the priority is actually used.

Note: Deleting or re-addressing components does not automatically release the priority of this channel. Of course, a priority could be manually released by setting explicitly to the release value. Restarting the Scalibur re-initializes (releases) the complete internal priority array.

Depending on the data point type, the following default values apply if all priorities are released (that is, no software component accesses this channel):

Type of data point	Default value
Digital output – output signal	off
Analog output – output signal	0.0 V
DALI control - ballast	0.0 %
Analog input – measurement range	0..10 V, if applicable

Table 4.6.3: Default values of priority control

Some actions have command character. These do not change the priority level, but are processed in their order of occurrence (or suppressed completely in case of insufficient priority). Such commands are:

- Initialization of counter values of the pulse metering terminal
- DALI lighting control commands
- Initialization, read and write operations of serial terminals

For these cases it is up to the application programmer to prevent unwanted concurrent accesses from different sources.

5. Best Practices and Troubleshooting

5.1 Performance and Resource Management

All software processes share the common resources (processor time, memory). Besides the complexity of the application itself, the interface definitions, especially the connected I/O terminals have an important impact on ressource usage. While each data point needs ressources just by its existence, it is usually also processed within the application, thus enlarging the application.

Note: All quantitative information given in this chapter are not guaranteed. They may help you to estimate the load caused by I/O terminals.

I/O terminals

Scalibur can handle up to 63 I/O and function terminals. This is a rather theoretical limit, which gets relativated by the geometrical size of the station. In general, stations with more terminals need more time to transfer data between controller and terminals. Digital input and putput terminals have the least performance impact.

If you connect 63 digital I/O terminals with 32 channels each, the station has 2016 I/O datapoints, while being more than 9 ft. wide. Supply and segment terminals might enlarge the stations width even further.

IB IL DALI/PWR, IB IL DALI, IB IL DALI/MM

A DALI terminal can adress up to 81 data points (64 short addresses, 16 group addresses, one broadcast). The ressource demand depends on the number of DALI ballasts and how they are controlled:

addressing via broadcast (one data point, no status), maybe using scenes

group addressing (some data points, which are written on change only, no status)

individual addressing (many data points, which are written on change only)

individual addressing with evaluation of ballast status (many data points, which are polled periodically)

individual or group addressing with additional use of DALI sensors

While e.g. broadcast addressing needs little ressources and would allow the maximum number of 63 DALI terminals, for a higher load on the DALI terminals no more than 8 DALI terminals should be used. Especially when using DALI sensors, the desired reaction time is an important criterion.

IB IL RS UNI, IB IL MBUS, IB IL RS 232-ECO, IB IL RS 485-ECO

These terminals are serial interfaces which can have 30 (MBus) or more slave devices. The limiting factor is here the required poll rate or reaction time. The hard limit is 16 serial terminals, but then no other terminals could be added. We recommend to use 8 terminals at the most.

With Modbus RTU, the max. number of about 4-5 messages per second can be achieved with one connected terminal IL IL RS UNI. When 8 such terminals are connected, the poll rate drops to about 2 messages per second (for each terminal).

Diagnosis

The available resources can be shown in Workbench using all accesses:

- Platform: *Platform Administration*
- Station: *Views→Resource Manager*
- Sedona: *App→service→plat (see [4])*

Note: The system load should be below 100 %, because otherwise the relevant timing (cycle times) can't be ensured. Optimize in this case your application, i.e. by increasing Sedona task cycle time or intervals of the Niagara station (e.g. poll intervals). Please be aware that every kind of communication creates processor load, too – so leave a margin for that.

5.2 Reliability of Nonvolatile Memory

Scalibur contains a highly integrated Flash memory for use in the industrial temperature range. Physically caused, the reliability is depending on the number of writes and the environmental temperature: frequent writing of large data blocks wears out the memory and a high environmental temperature reduces the guaranteed data retention time.

The stress on the memory depends heavily on the application. Occasional write accesses due to programming and software upgrades cause writing of large data blocks to the Flash. However, these are almost negligible in comparison to the amount of data which is written in regular intervals, like logging of history data or *StationSave*.

The write load caused by history data can be shown via *Station→Config→Services→PlatformServices→DataRecoveryService*.

Size and write frequency of history data should be configured in such a way, that writing of a data recovery block happens less than once a minute.

StationSave should be performed much less than once per hour.

Regarding the environmental temperature, the defined maximum values in chapter 6 must not be exceeded and the mounting position has to be observed (see chapter 3.1.2).

5.3 Diagnosis and Troubleshooting

Scalibur is a very complex device with many functions and interfaces. This complexity leads to many possible misconfigurations in practical use. Most mistakes arise from connections with other devices or components. Therefore the controller should not be diagnosed isolated, but in context with the complete system.

Several tools allow to locate possible reasons for failures:

- power LEDs (see 3.3.2)
- software status LEDs (see 3.3.3)
- IO status LED (see 3.3.4)
- communication LEDs (see 3.3.5)
- diagnosis LEDs of the connected IO terminals
- Service LED (see 3.3.6)
- Ethernet status LEDs (see 3.3.7)

Additionally, Niagara provides powerful tools to analyze the communication in connected automation networks.

Before starting a detailed analysis, make sure that the device is properly wired, supplied and has finished booting. Check especially

- if all IO terminals are properly interlocked and connected by their feather keys/keyways
- if the mounting rail is properly grounded
- if the functional earth connector of the device is connected using a 1.5 mm² (AWG) wire with the mounting rail via a earthing clamp
- if the LEDs UM, US, UL are permanently on
- if the power supply voltage is within the allowed tolerance range
- A good indicator are the tree software status LEDs (see 3.3.3). Only if they are regularly blinking, the boot process has finished.

5.3.1 SCA System Shell / Commissioning Website is not accessible

Both of these need an USB cable from the PC USB port to the Mini USB port of the Scalibur.

Please verify that the cable is not damaged and is properly plugged into both sockets.

Check if the Device Manager shows the device *Remote NDIS Compatible Device* is shown as *Network adapter*. If not, re-install the device driver (see 3.2.5).

5.3.2 IP Address unknown

The IP addresses of the Scalibur can be shown and modified via the SCA System Shell or the commissioning website. Both accesses work independent of the current IP settings via a local USB connection (see 0).

5.3.3 No IP Communication

The command ping allows to test the Ethernet connection between two devices. The SCA System Shell provides a ping function.

Please check first the proper connection of the Scalibur to the Ethernet using the Ethernet status LEDs.

Then, the IP addresses and subnet masks of all devices that shall communicate with each other. Especially ensure unique IP addresses and proper subnet settings.

5.3.4 Unknown Niagara Platform Access Credentials

If the access credentials are lost, they can be reset to their default value (user *sysmik* / password *intesa*) with the Service button (see 3.3.6). The Scalibur has to be restarted and the Service button must be pressed at the right moment.

5.3.5 No Platform Connection to Device - Platform Daemon is not starting

If the Platform daemon doesn't start, it's not possible to connect to the Niagara Platform of the device. This can be identified by looking at the PL LED (see Table 3.3.3.1): it doesn't blink or ceases to blink about one minute after the start. Possible reasons and measures:

Daemon HTTP Port is doubly used

The Daemon HTTP Port must not be used by any other system component (e.g. by the IO server).

Check with the SCA System Shell (see 4.1.1) or the Commissioning Website (see 4.1.2), that there is no other software component (webserver, IO server) is using the Daemon HTTP Port (default: standard 3011 / secure 5011).

The Daemon HTTP Port can be reset to its default value using the Service button (see 3.3.6) or the SCA System Shell.

RTC date in invalid range

If the device has no power supply for several days, eg. when in storage, the RTC can loose its date, which is then set to a random value at start. A date outside the range of June, 6^{th} 2015 to December, 29^{th} 2020 prevents starting the Niagara Platform daemon.

Set the date with the SCA System Shell to a value inside the above mentioned range. Check the Operating System version with the SCA System Shell or the Commisioning Website. If the version is ≤ 1.0.1.2, then the device software needs to be upgraded. Versions from 1.0.1.3 on will automatically fix a date outside of this range.

5.3.6 Sedona Virtual Machine is not Starting

Sedona must be activated from the SCA system shell (s. 4.1.1) or the commissioning website (s. 4.1.2). If the Scalibur Sedona files (app.sab and kits.scode) are corrupted or inconsistent, the SVM cannot start. In this case, a device connection from Niagara AX Workbench to the Sedona controller is not possible. Consequently, Sedona tools cannot be used to fix this situation.

Instead, the Service button offers a way to overwrite these files with default files (see 3.3.6). The Scalibur has to be restarted and the Service button must be pressed at the right moment.

5.3.7 IO Errors

Important indicators for the state of the IO terminals are Scalibur's IO LED and the diagnosis LEDs of the Inline terminals (labelled "D").

State	Description
off	no logic voltage
on	logic voltage ok, local bus active
blinking 0.5 Hz	logic voltage ok, local bus not running
blinking 2 Hz	logic voltage ok, peripheral error (see manual of specific terminal)
blinking 4 Hz	logic voltage ok, error at interface between blinking and previous terminal (e.g. loose contact, defective terminal, hot-plugging of terminal)

Table 5.3.6.1: Behavior of diagnosis LED D

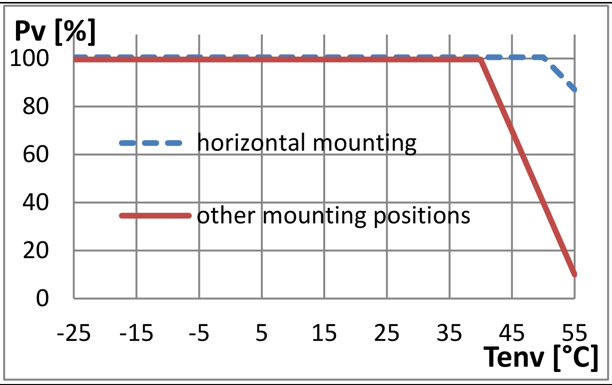
6. Technical Data

Processing unit	
Processor / clock	ARM® Cortex® A8 32 bit RISC processor 1 GHz
DDR3 SDRAM	512 MiB
eMMC	1.8 GB
NVRAM	512 KiB buffered for 5 days
RTC	buffered for 5 days

Ethernet switch	
Connections	4 x 10/100BaseT
MDI/MDI-X crossover	automatic
Aging time	default 330 s
Isolation	
LAN1/2/3/4 vs. module	test voltage 1500 V AC, 1 min 1)
LAN vs LAN	test voltage 1500 V AC, 1 min 1)

RS-485 (COM1, COM2)	
Max. number of bus devices	256 (1/8 unit load)
Max. data rate	200 kbps
Isolation	
RS-485 vs. module	test voltage 500 V AC, 50 Hz, 1 min 1)
RS-485 Port 1 vs. RS-485 Port 2	test voltage 500 V AC, 50 Hz, 1 min 1)

LON TP/FT-10 (twisted pair bus connection for free topology)	
Transceiver	TP/FT-10
Isolation	
LON vs. module	test voltage 250 V AC, 50 Hz, 1 min 2)

Connecting Inline automation terminals	
Max. number of I/O terminals per Inline station	63
Max. load of logic supply (U_L)	2 A
Max. load of analog supply (U_{ANA})	0.5 A
Max. ampacity of potential routing contacts U_M, U_S, and GND	8 A
Derating of logic supply and USB supply, depending on mounting position	
Isolation	none

General electrical data	
Supply voltage U_{BK}	24 V DC
Absolute limits	19.2 V to 30 V DC
Current drain at nominal voltage without local bus terminals	
I_{BK}	≤ 170 mA
Current drain at nominal voltage with local bus terminals (without U_M and U_S)	
I_{BK} [2)]	≤ 1.5 A (7.5 V logic supply loaded with 2 A and 24 V analog supply with 0.5 A, no USB devices)

Connections	
Supply, RS-485, TP/FT-10	
Type	Spring-cage terminals
Rated cross section	0.08 mm^2 to 1.5 mm^2, 24 - 16 AWG
Ampacity	8 A
Ethernet	
Type	RJ45, shielded

Enclosure	
Width x height x depth	80 mm x 119,8 mm x 71,5 mm
Weight	approx. 230 g / 8 oz

Environmental conditions		
Operating temperature		-25 °C to 55 °C (32 °F to 122 °F)
Storage temperature	max.	-25 °C to 85 °C (-4 °F to 158 °F)
	recommended	-25 °C to 35 °C (-4 °F to 95 °F)
Rel. humidity		0 % to 75 %, non condensing
Protection standard		IP20

EMC conformity	
IEC 61000-4-2 (ESD) 6 kV contact discharge / 8 kV air discharge	criterion A
IEC 61000-4-3 (immunity field) 10 V/m	criterion A
IEC 61000-4-4 (burst) 1 kV / 2.2 kV	criterion A , criterion B
IEC 61000-4-5 (surge) 0.5 kV asymmetric	criterion A
IEC 61000-4-6 (conducted immunity) 10 V/m	criterion A
EN 55011 (emission of ISE devices) EN 55022 (emission of ITE devices)	class A2)

1) Functional isolation! The isolation is bridged by an RC filter for EMC reasons. Safety agency hazardous voltage barrier requirements are not supported!

2) Functional isolation! The isolation is bridged by a 300 V varistor for protection of the device. Safety agency hazardous voltage barrier requirements are not supported!

3) The data retention time of the Flash memory depends on the temperature. Longer storage periods (weeks) at higher temperatures should be avoided.

Table 6.1: Technical data

7. Order Information

7.1 Scalibur and Accessories

Variant	Configuration	Part no.
SCA-340	no Niagara license	1226-100550-04-0
SCA-340-005	Niagara license for 5 devices / 250 data points	1226-100550-10-1
SCA-340-010	Niagara license for 10 devices / 500 data points	1226-100550-11-8
SCA-340-025	Niagara license for 25 devices / 1250 data points	1226-100550-12-5
SCA-340-100	Niagara license for 100 devices / 5000 data points	1226-100550-13-2
SCA-340-200	Niagara license for 200 devices / 10000 data points	1226-100550-14-9
SCA-340-L	LON TP/FT-10, no Niagara license	1226-100550-06-4
SCA-340-L-005	LON TP/FT-10, Niagara license for 5 devices / 250 data points	1226-100550-15-6
SCA-340-L-010	LON TP/FT-10, Niagara license for 10 devices / 500 data points	1226-100550-16-3
SCA-340-L-025	LON TP/FT-10, Niagara license for 25 devices / 1250 data points	1226-100550-17-0
SCA-340-L-100	LON TP/FT-10, Niagara license for 100 devices / 5000 data points	1226-100550-18-7
SCA-340-L-200	LON TP/FT-10, Niagara license for 200 devices / 10000 data points	1226-100550-19-4

Table 7.1.1: Order information for Scalibur

7.2 Supported Inline Automation Terminals

Device	Function	Part no. [1]
Digital input terminals		
IB IL 24 DI4-ME	4 inputs 24 V	2863928
IB IL 24 DI8/HD	8 inputs 24 V, 1 DU	2700173
IB IL 24 DI16-ME	16 inputs 24 V	2897156
IB IL 24 DI32/HD	32 inputs 24 V	2862835
IB IL 120 DI 1	1 input 120 V	2861917
IB IL 230 DI 1	1 input 230 V	2861548
IB IL 24 DI 8/HD-ECO [1]	8 inputs 24 V	2702792
Relay terminals		
IB IL 24/230 DOR 1/W-PAC	1 change over contact 230 V / 3 A	2861881
IB IL 24/48 DOR 2/W-PAC	2 change over contact 48 V / 2 A	2863119
IB IL 24/230 DOR 4/W-PAC	4 change over contact 230 V / 3 A	2861878
IB IL 24/230 DOR 4/HC-PAC	4 bistable contacts 230 V / 16 A, high inrush current	2897716
Digital output terminals		
IB IL 24 DO 4-ME	4 transistor outputs 24 V / 0.5 A	2863931
IB IL 24 DO 8/HD	8 transistor outputs 24 V DC/ 0.5 A, 1 DU	2700172
IB IL 24 DO 16-ME	16 transistor outputs 24 V DC/ 0.5 A	2897253
IB IL 24 DO 32/HD	32 transistor outputs 24 V DC/ 0.5 A	2862822
IB IL 24 DO 8/HD-ECO [1]	8 transistor outputs 24 V DC	2702793
TRIAC terminals		
IB IL DO 1 AC	1 x TRIAC 12-253 V AC/ 0.5 A	2861920
IB IL DO 4 AC-1A	4 x TRIAC 12-253 V AC/ 1 A	2861658
Analog input terminals		
IB IL AI 2/SF-ME	2 x voltage, current	2863944
IB IL AI 8/SF	8 x voltage, current	2861412
IB IL TEMP 2 RTD	2 x resistance, temperature	2861328
IB IL AI/TEMP 4 RTD	4 x voltage, resistance, temperature	2897952
IB IL AI 4/I/4-20-ECO [2]	4 x current (4..20 mA)	2702495
IB IL AI 4/U/0-10-ECO [2]	4 x voltage (0..10 V)	2702496
IB IL RTD 4/PT100-ECO [2]	4 x temperature (Pt 100)	2702499
IB IL RTD 4/PT1000-ECO [2]	4 x temperature (Pt 1000)	2702501
IB IL UTH 4/J-ECO [2]	4 x temperature (thermal element type J)	2702502
IB IL UTH 4/K-ECO [2]	4 x temperature (thermal element type K)	2702503
IB IL UTH 4/L-ECO [2]	4 x temperature (thermal element type L)	2702504

Analog output terminals		
IB IL AO 2/U/BP-ME	2 x voltage	2863957
IB IL AO 4/U/SF	4 x voltage	2692050
IB IL AO 4/8/U/BP	8 x voltage	2878036
IB IL AO 4/I/4-20-ECO [2)]	4 x current (4..20 mA)	2702497
IB IL AO 4/U/0-10-ECO [2)]	4 x voltage (0..10 V)	2702498
Function terminals		
IB IL DALI/PWR	DALI master with DALI supply	2897813
IB IL DALI	DALI master, extension terminal	2897910
IB IL DALI/MM	DALI-Master with DALI supply, multi-master capable	2700605
IB IL DI 8/S0	8 S0 counter inputs / digital inputs	2897020
IB IL MBUS	M-Bus master for up to 30 meters	2701927
IB IL RS UNI	serial interface (RS-232, RS-422, RS-485)	2700893
IB IL RS 232-ECO [2)]	RS-232, up to 38400 Baud	2702795
IB IL RS 485-ECO [2)]	RS-485, up to 38400 Baud	2702141
IB IL MP-BUS-PAC	MP-Bus.Master	2702921
Power and segment terminals		
IB IL 24 PWR IN/R	supply of bus electronics (U_L, U_{ANA})	2861674
IB IL 120 PWR IN	120 V feed in	2861454
IB IL 230 PWR IN	230 V feed in	2861535
IB IL DOR LV-SET	spacer terminal to separate 120 V (or 230 V) and 24 V	2861645

1) Part numbers of Phoenix Contact apply

2) requires Niagara version 4.3 or higher

Table 7.2.1: Inline automation terminals supported by Scalibur

8. Glossary

Term	Explanation
HTTP	State less protocol for data transfer from a webserver to a web browser.
Localbus	Channel for the communication of the Inline bus controller with the automation terminals within an Inline station
Niagara	Software framework (Tridium Inc.) for web-based automation and management systems
Sedona Framework	System platform to develop, use, integrate, and manage embedded devices. Seamlessly integrated into Niagara framework.
Sedona Virtual Machine (VM)	The Sedona Virtual Machine (VM) is an interpreted which is designed for portability. It executes code created by the Sedona programming language.
SFTP	Secure File Transfer Protocol, to transfer files over IP network
SSH	Secure Shell for command line based access to devices in IP networks
Switch	Device to connect several network segments. Each port can receive data and forward it selectively to other ports, based on source and target address.
DU	Division unit, 12.2 mm in the Inline system
Telnet	Network protocol for character-based data exchange in IP networks.
TP/FT-10	Channel type specified by LonMark; twisted-pair technology with free topology based on CEA-709, most common channel type, 78 kBit/s
Webserver	Server service making the protocols of the Internet technologies available (e.g. HTTP)
Webservices	Services based on Internet technologies, which use XML documents for data exchange, e.g. XMP/SOAP
Workbench	Graphic configuration system for Niagara

Table 8.1: Glossary

9. Third-Party Software

This product contains open source software and other third party software. A document with a list of embedded software components according to the documentation obligations of the respective license conditions is on the web server of the device.

The document can be accessed from the device with a Web browser by using the URL: <device IP address>: <HTTP Port>/licenses.htm.

On delivery those reads URL 192.168.1.1: 81/licenses.htm.

10. Bibliography

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[2] LONWORKS FTT-10A Free Topology Transceiver User's Guide, Echelon Corporation.

[3] LONWORKS Wiring Guidelines, SysMik GmbH Dresden.

[4] First Steps with Sedona 1.2, SysMik GmbH Dresden

[5] www.tridium.com

[6] www.sedonadev.org

[7] www.phoenixcontact.com

[8] www.sysmik.de