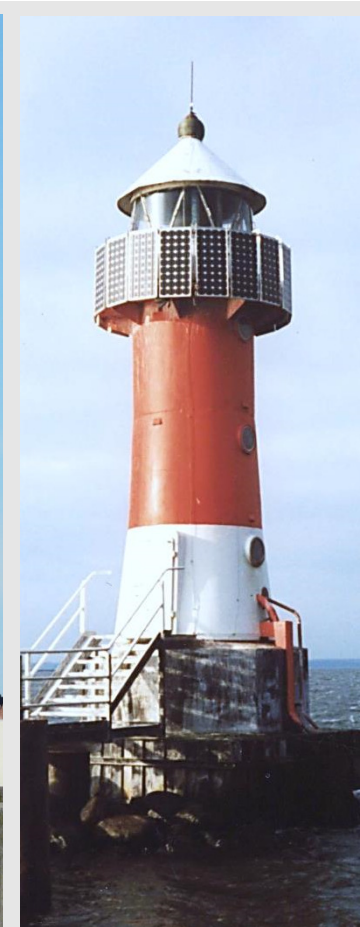
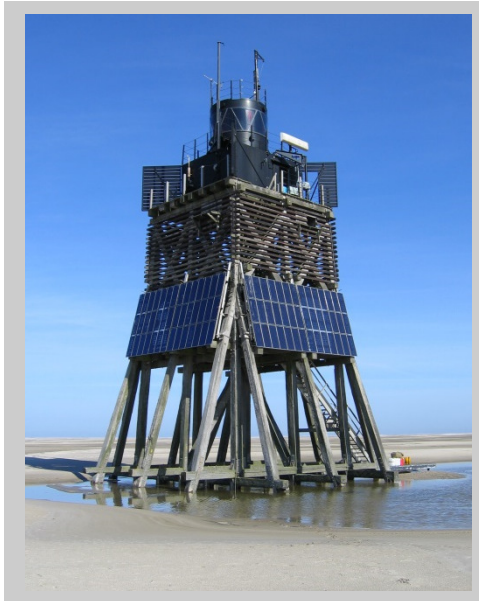


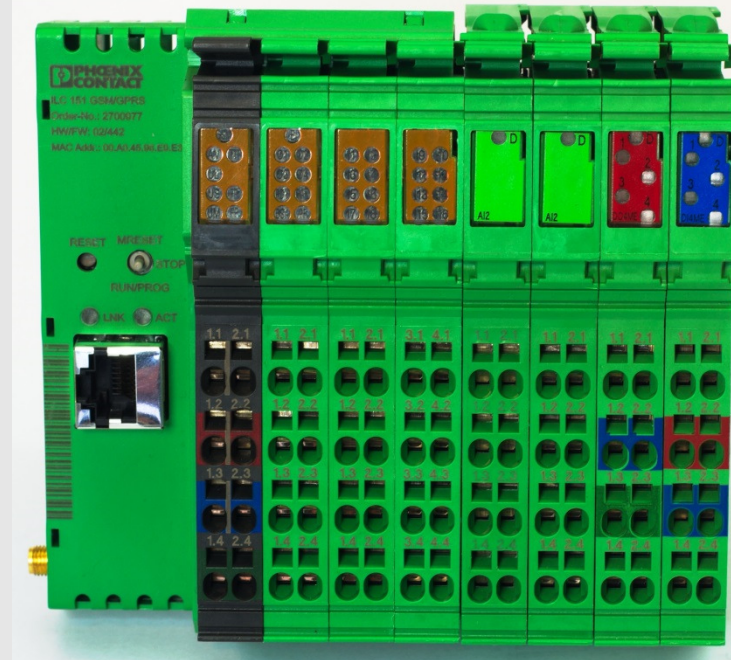
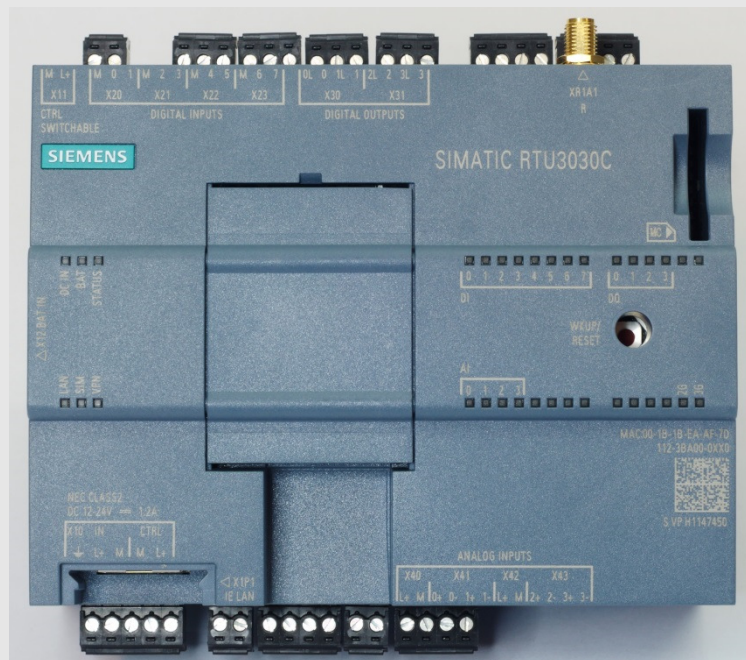
Comparison of energy - efficient RTUs/PLCs for remote control and monitoring of renewable powered lights



Comparison of energy - efficient RTUs/PLCs for remote control and monitoring of renewable powered lights

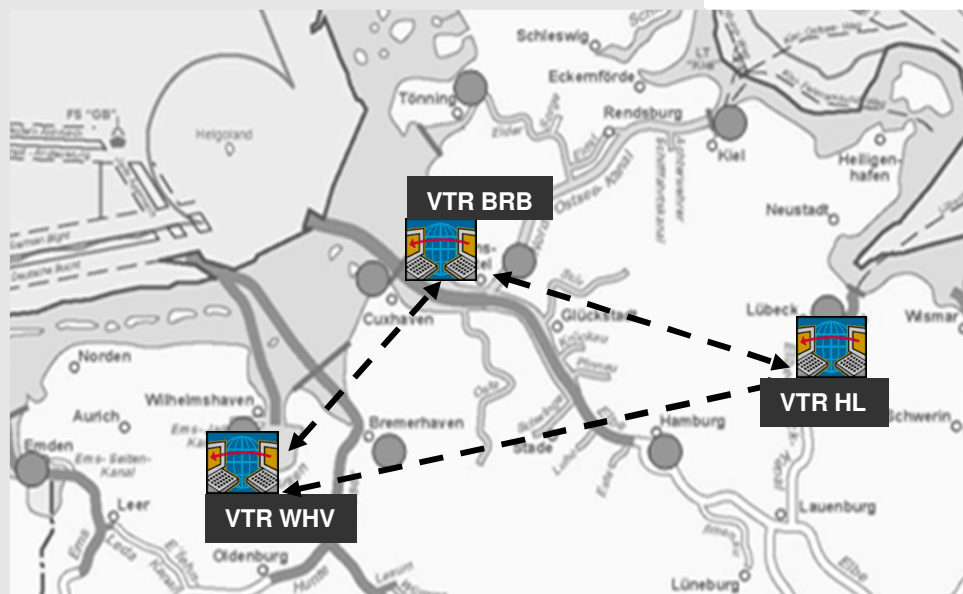
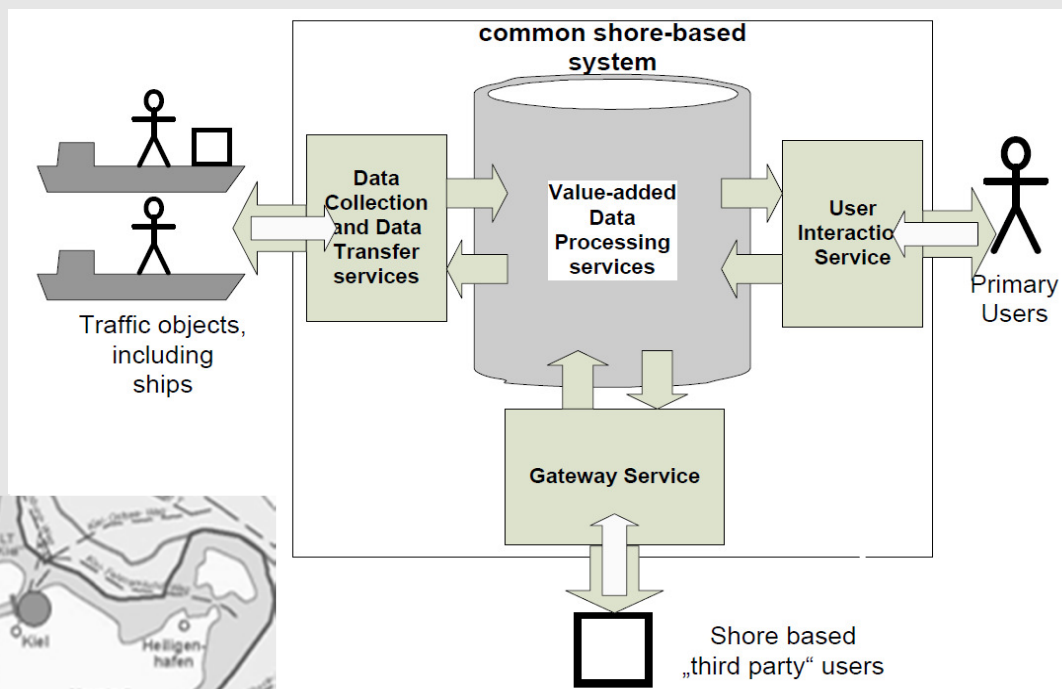
Content of the presentation

- Short overview „MTTS“ (marine traffic technology system)
- Remote control and monitoring of lights by the „VIF-service“ as part of the „MTTS“
- General requirements for an outstation control unit
- Implementation of a low power outstation control unit
- Comparison of different RTU's/PLC
- Conclusion



Remote control and monitoring of lights in the „MTTS“ by the „VIF-Service“ (FXA)

- The „MTTS“ (marine traffic technology system) on the German coast has been realized to a high level (in harmony with IALA Guidelines 1113 and 1114).
- Fixed visual aids to navigation become migrated into the „VIF-service“ (Fixed Visual Aids Service (FXA)).



The „VIF-service“ consists of:

- central components in 3 data centers (Wilhelmshaven, Brunsbüttel, Lübeck) and
- nearly 900 lights (outstations).

Wir machen Schifffahrt möglich.



Remote control and monitoring of lights by the “VIF-service” (FXA)

Dienstmanagement VIF Willkommen, vif_admin! [[Passwort ändern](#) - [Log Out](#)]

Übersichtskarte Leuchtfeuer konfigurieren Anzeigen Verwalten

ÜBERSICHTSKARTE

light overview

light name: Borkum, Großer Leuchtturm
light no.: 321300
flash character: FI (2) W 12 s

data center connection

last communication: 13.06.2016, 7:17
communication error: ☐
login light control:

monitoring

	BM	SM	AM
power supply	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
state VIF outstation control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
time error	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
light state	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
light intensity "high"	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
light intensity "day"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
light intensity to low	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
light availability	99,82 %		
structure illumination	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
structure illumination availability	99,82 %		
light on by astronomical clock	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
light on by twilight switch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
environmental brightness	250 lx		
light on by visibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
last switch-on time	12.06.2016, 20:17		
last switch-off time	13.06.2016, 7:17		
message acknowledge	<input type="button" value=""/>		
message reset	<input type="button" value=""/>		

remote control

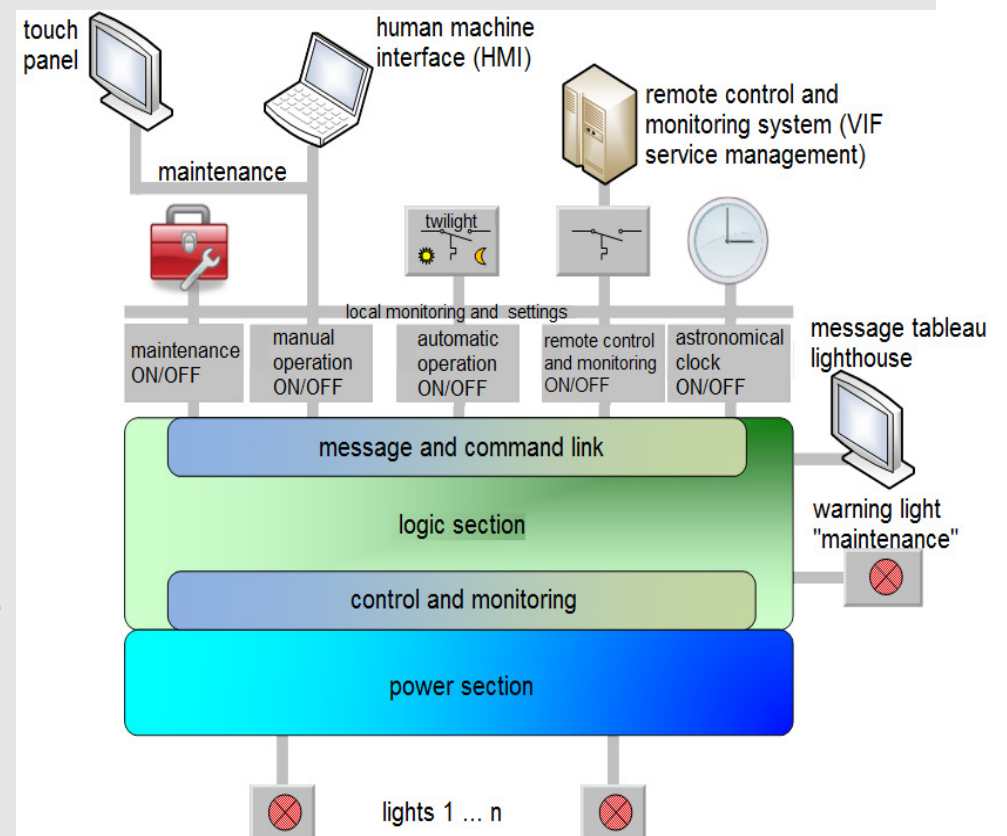
automatic operation:
manual operation:
message update:
restart outstation control:

- coast-wide overview of all lights
- remote control and monitoring functions
- management of technical data, approvals, etc.

Replacement of 900 lights: specification for the outstation control unit

- Definition of light source classes, different power sections, handling of the light sources
- Definition of coast-wide unified messages and commands for remote control/monitoring in dependance of the light source class
- Remote control/monitoring management: Data transfer between the outstation control unit and the central service components (data center).
- Human machine interface (HMI) for configuration and maintenance, locally and remotely access.
- Operation modes: automatic, manual, maintenance
- Astronomical clock, time synchronisation
- Twilight switch
- Flash character generator
- Measurements: voltages, currents, luminosity, temperature, humidity
- Monitoring of digital contacts, control of actors
- Handling of the renewable energy source
- Calculations, for example availability
- Mechanical requirements

-> **Normally a PLC is used to implement those functions.**



Remote control and monitoring of renewable powered lights

- Most lights on the German coast are powered by mains.
- But: small lights and lights on positions, where no main is available, are powered by renewable energy sources.
- At present some of them are not monitored or are monitored by systems with limited performance.

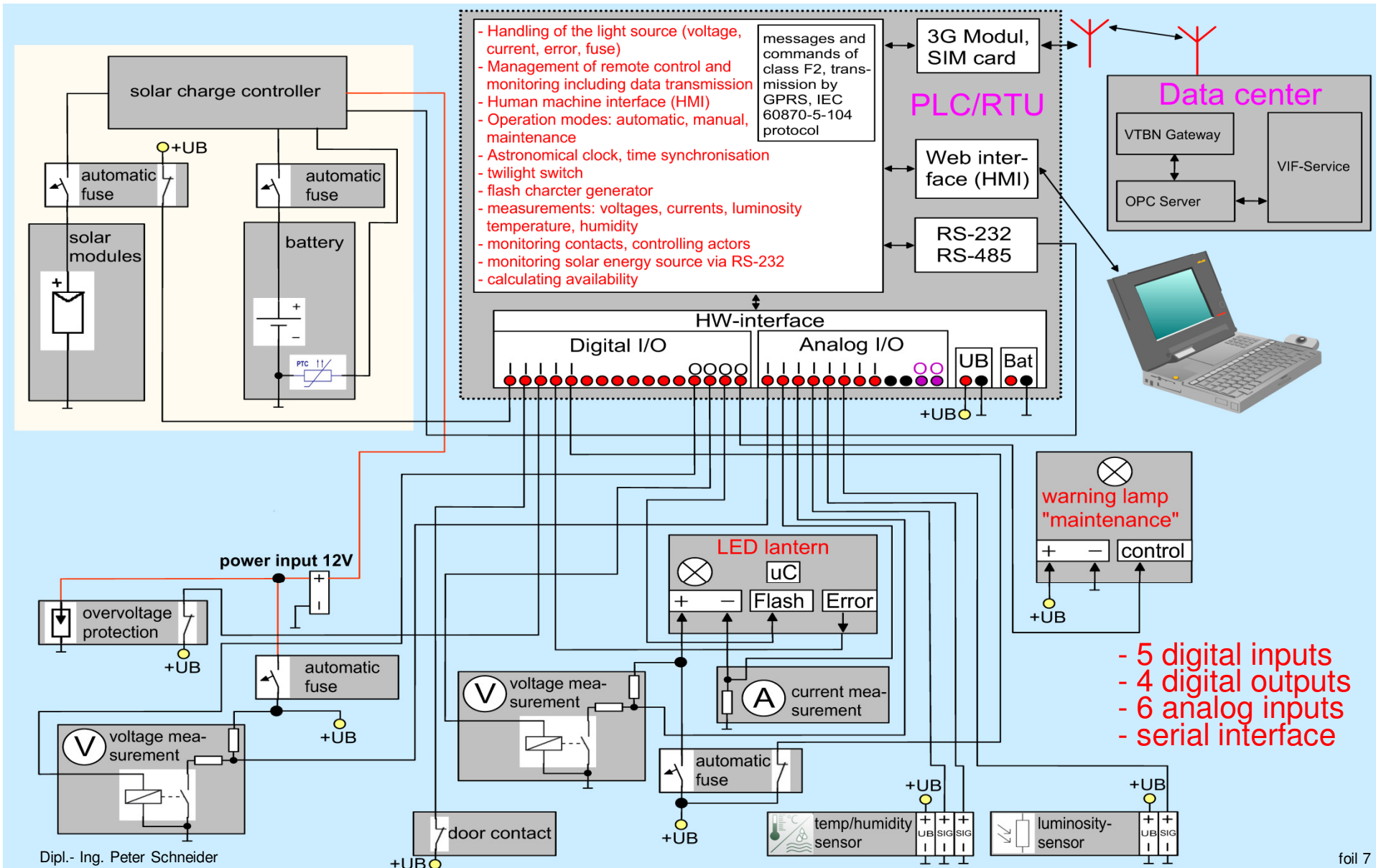
The goal is to integrate them into the MTTs by:

- implementation of all functions according to the coast-wide specification
- use of wireless communication for data transmission
- using the IEC 60870-5-104 protocol
- encryption of data transmission
- reliable hardware, PLC-based
- programming according to DIN EN 61131-3

Problem: the available power is less than 2W, a standard PLC needs 10W or more.



Hardware layout for a low power outstation control unit



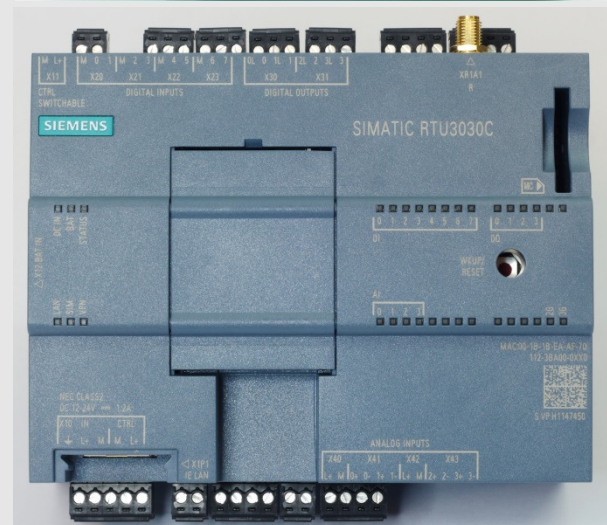
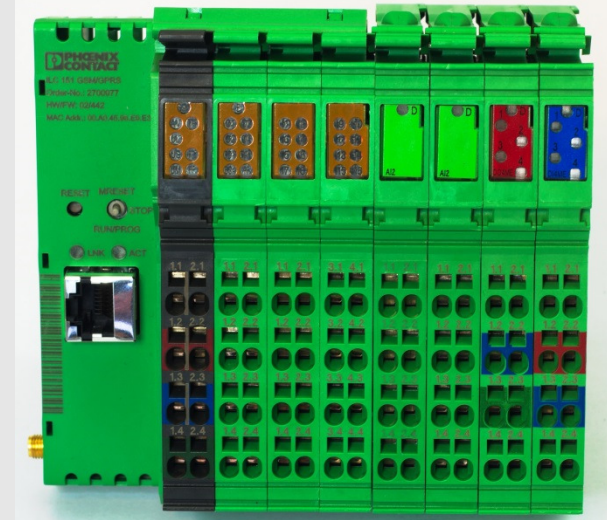
Testing different RTU's/PLC

In cooperation with the „University Of Applied Sciences Emden/Leer“ 2 RTU's and a PLC have been tested for suitability as an outstation control unit for renewable powered lights:

- “WebRtu” from “EES”
- “RTU3030C” from Siemens (new on the market)
- ILC 151 from Phoenix Contact (typical industry-PLC, not specially developed for energy saving application, but generally low energy consumption)

The tests have been done theoretical (data sheet comparison) and practical (measurements).

During the measurements the controllers operated under the same conditions: Each RTU/PLC was programmed to realize comparable functions.

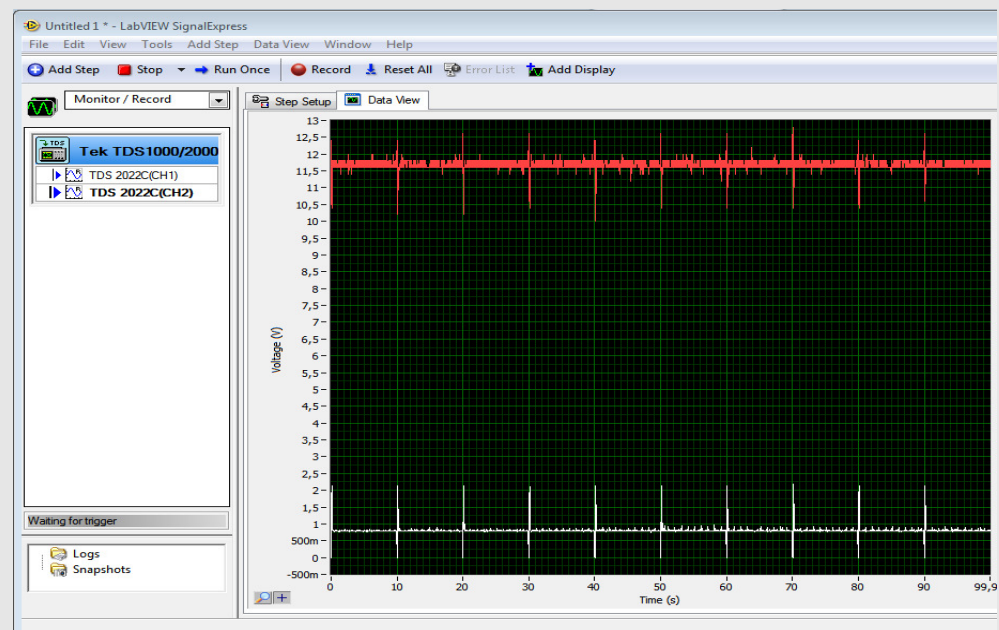
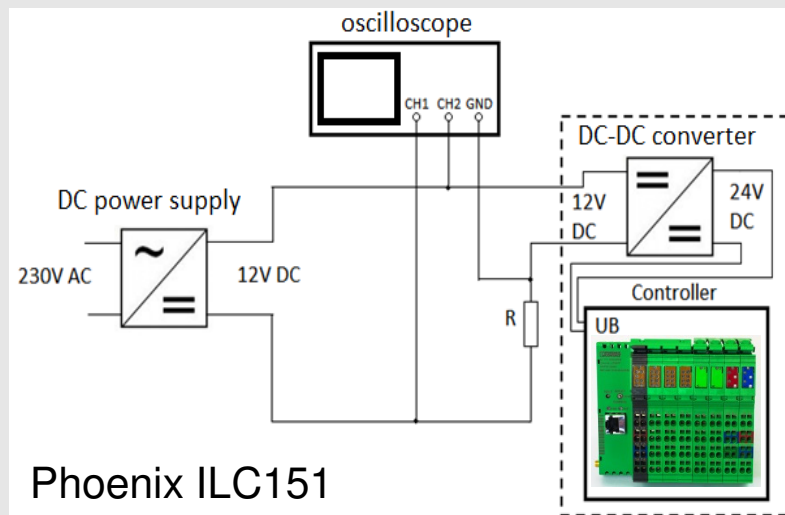
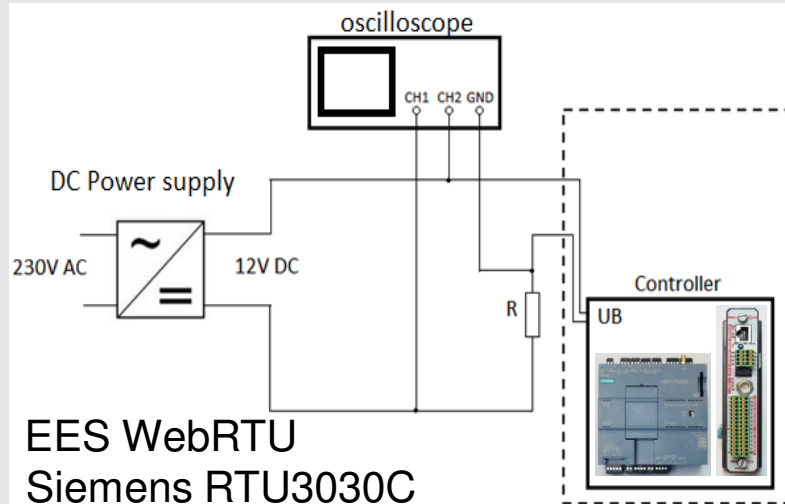


Testing different RTU's/PLC: data sheet comparison

characteristic	WebRTU	RTU3030C	ILC151
supply voltage	12 V / 24 V	12 V / 24 V	24 V
rated current	90 mA @ 12V (1,08 W) 50 mA @ 24V (1,2 W)	65 mA @ 7,2 V (0,468 W) 35 mA @ 24 V (0,84 W)	215 mA @ 24 V (5,16 W)
inputs, outputs	8 digital inputs 8 digital outputs 8 analogue inputs 2 analogue outputs	8 digital inputs 4 digital outputs 4 analogue inputs	16 digital inputs 4 digital outputs
programming language	LAD, BASIC	(FBS)	AWL,ST,AS,KOP,FUP
integrated modem	yes	yes	yes
external storage	up to 8GB	up to 32MB	up to 2GB
HMI for maintenance	yes (WebStudio)	no	no information available
internal sensors	temperature supply voltage	temperature supply voltage	no internal sensors
temperature range	-40 °C bis +70 °C	-40 °C bis 70 °C	-25 °C bis 55 °C
protection class	no information available	IP20	IP20
IEC 60870-5-104	yes	yes	no information available
real time clock	yes	yes	yes

Testing different RTU's/PLC: comparison by measurements

Different measurement setups:



Power measurements by use of:

- shunt resistor
- voltage measurements by an oscilloscope
- mathematic calculations (PC and "LabView").

Measurement results:

- WebRTU: 1.28 W
- RTU3030C: 1.18 W
- ILC151: 3.67 W

Conclusion

- The ILC151 is performant, but it has not been developed for low energy consumption (3,67 W).
- The RTU3030C is not able to execute complex algorithms. Measured values can be easily recorded and transmitted to a control system. It has a low power consumption (1,18 W). For the application in a VIF-service outstation it does not have enough inputs/outputs. But: An update is in preparation.
- The WebRtu is best suited for a low power outstation control unit. It is able to perform complex algorithms and has a relatively small energy consumption (1,28 W). It offers various possibilities for connection to control systems.

What are the next steps ?

- **At the moment 10 reference lights with the "WebRtu" are under construction.**
- **After successful tests probably a large part of the renewable powered lights on the German coast will be equipped with the WebRtu.**



Technical data

- Operating system: LINUX
- 16 digital inputs/outputs (programmable)
- 8 analogue inputs
- 2 analogue outputs
- Interfaces: Ethernet, RS232, RS485, USB 2.0
- Integrated 3G-Modem
- Supply voltage range : 8 – 30V
- Current consumption: 50mA @ 24 V
- Real time clock (RTC)
- programmable in LAD or Basic

Thanks for your attention!

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