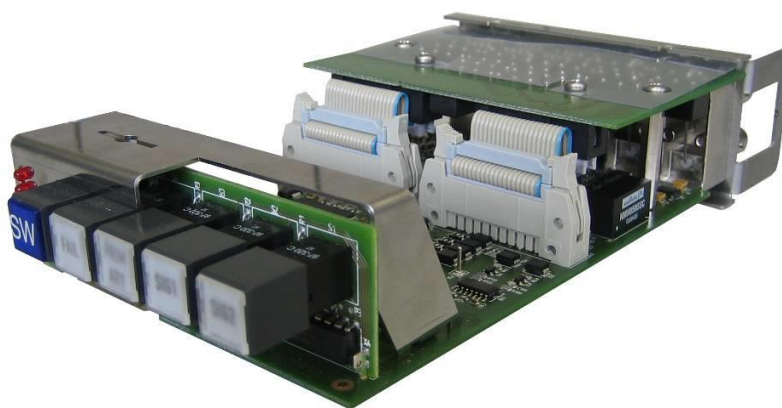




## RUB SW

# Word Clock Monitoring and Changeover Module DARS Monitoring and Changeover Module



Functional Description and Specifications  
Supplement to the "Installation & Systems Manual RUBIDIUM SERIES"  
Version: 4.2  
December 2, 2020





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# A1 Revision History

No.	Date	Subject
0.n		Preliminary documents, changes without notice.
1.0	August 6, 2010	First released document.
1.1		Revised.
2.0	February 21, 2011	Completely revised.
3.0	May 7, 2013	<ul style="list-style-type: none"> <li>▪ Revised.</li> <li>▪ Entries can be made to the log file of an Ethernet module.</li> <li>▪ The TC link telegram 'Reference' can be sent.</li> </ul>
4.0	March 1, 2014	DARS functionality.
4.1	September 3, 2019	Changed address of Plura Europe GmbH.
4.2	November 4, 2019	Fixed NMEA baud rate to 4800.
4.3	December 2, 2020	Re-formatted in new design.

Due to constant product development the features of this module are subject to change. The current functional description always refers to the current software and the current configuration tool.

You can download the latest version of the standard software from

<http://www.plurainc.com>.

Please be sure to use the latest configuration program after having done an update. You can download the latest version from the address above.



## A2 Copyright

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## A3 General Remarks

This manual is a supplement to the '*Installation & Systems Manual RUBIDIUM SERIES*'. Please read the below listed chapters of the '*Installation & Systems Manual RUBIDIUM SERIES*', as these chapters are necessary for the safe and proper use of RUB modules:

- *A3 Warranty,*
- *A4 Unpacking/Shipping/Repackaging Information,*
- *A5 Safety Instructions,*
- *A6 Certifications & Compliances,*
- *Plug-In a Module,*
- *Remove a Module.*



# 1 Module “SW”

## 1.1 General Description

This module can supervise and analyse incoming Word Clock and DARS signals of two sources. Each source can deliver up to four different Word Clock and two different DARS signals. In the event of a failure of one source, **SW** automatically switches to the other faultless source. The **SW** module is a must for all Word Clock/DARS systems where a failure proof and redundant Word Clock and DARS is a requirement. Additionally, it offers a status monitor indicating errors, failures, and status information of all incoming signals.

A **PC** or the **RUB IE** module is required for the configuration of this module.

The front panel label **SW** visibly identifies where each module is located. The serial number is located on the bottom side of the lower circuit board of each module.

The standard hardware of this module has all of the following key features:

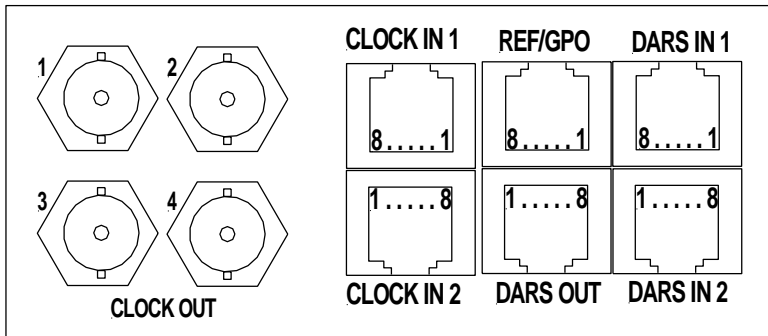
- “Hot Swapping”, i.e. it is possible to insert or remove a module without interrupting the operation of other modules in this frame.
- Failure relay, connected to the FAIL\_A and FAIL\_B pins of the **RLC** connector at the rear of the frame.
- RS232 and TC\_link (RLC connector) interfaces to have access to the internal bus of the chassis.
- Four programmable function keys, lamps and LEDs on the front panel (RUB1 version only).
- Flash memory containing the firmware, so configuration and updates are possible via a PC connection. You can download the latest version of the program from:

<https://www.plurainc.com>.

- 2 x 4 Word Clock inputs.
- 2 x 2 DARS inputs.
- Changeover regarding the Word Clock and DARS signals utilizing latching relays.
- Alarm outputs indicating failures and warnings: Lamps and LEDs (RUB1 version only), GPOs, SNMP traps, and entries in the log file of an Ethernet module.
- Inputs for signals of a real-time reference (PPS, time & date data string).



## 1.2 Rear Panel and Connections



CLOCK OUT 1 BNC	CLOCK OUT 2 BNC	CLOCK OUT 3 BNC	CLOCK OUT 4 BNC
--------------------	--------------------	--------------------	--------------------

<p>CLOCK IN 1 RJ45 jack</p> <p>4: GND 5: CLOCK IN 1_1 3: CLOCK IN 1_2 6: GND 1: CLOCK IN 1_3 2: GND 7: CLOCK IN 1_4 8: GND</p>	<p>CLOCK IN 2 RJ45 jack</p> <p>4: GND 5: CLOCK IN 2_1 3: CLOCK IN 2_2 6: GND 1: CLOCK IN 2_3 2: GND 7: CLOCK IN 2_4 8: GND</p>	<p>CLOCK IN 1/CLOCK IN 2 can be connected straight (1:1) to the CLOCK OUT (RJ45) at the RUB GW module.</p>
--	--	--

<p>DARS IN 1 RJ45 jack</p> <p>4: Signal 1_1 – 5: Signal 1_1 + 3: Signal 1_2 + 6: Signal 1_2 – 1, 2, 7, 8: GND</p>	<p>DARS IN 2 RJ45 jack</p> <p>4: Signal 2_1 – 5: Signal 2_1 + 3: Signal 2_2 + 6: Signal 2_2 – 1, 2, 7, 8: GND</p>	<p>DARS IN 1/ DARS IN 2 can be connected straight (1:1) to the DARS OUT (RJ45) at the RUB GW module.</p>
---	---	--

<p>REF/GPO RJ45 jack</p> <p>1: PPS IN 2: RXD IN 4: GND 5: not connected 3: GPO_1 6: GPO_2 7: GPO_3 8: GPO_4</p>
---





Signal descriptions

GND	Signal ground.
CLOCK IN	Word Clock signals, 8 inputs: 1_1 to 1_4 and 2_1 to 2_4.
CLOCK OUT	Word Clock signals, 4 outputs: Switched via relay to the corresponding Word Clock inputs of CLOCK IN 1 or CLOCK IN 2.
DARS IN	Digital Audio Reference Signal, 4 balanced signal inputs: 1_1 and 1_2 of DARS IN 1; 2_1 and 2_2 of DARS IN 2.
DARS OUT	Digital Audio Reference Signal, 2 balanced signal outputs: Switched via relay to the corresponding balanced inputs of DARS IN 1 or DARS IN 2.
PPS IN RXD IN	Pulse per second, input. Time mark of a real-time reference. Reference time & date input, serial data string.
GPO_1 ... GPO_4	Output signals, indicating failures and warnings.



# 1.3 Specifications

## Word Clock inputs CLOCK IN

Connector	RJ45 – suited for direct connection to CLOCK OUT of RUB GW
Input impedance	≈ 22 kΩ @ 48 kHz
Signal level	0.5Vpp to 6.0Vpp
Frequency	32 kHz to 256 x 48 kHz

## PPS IN

Connector	Pin 1 at RJ45 REF/GPO
Characteristic	Typical input signal: 5V impulse Input impedance: ≈ 100 kΩ Input “Low”: -2.0 to +1.7V Input “High”: +2.8 to +12.0V

## RXD IN

Connector	Pin 2 at RJ45 REF/GPO
Characteristic	Typical input signal: RS232 Input impedance: ≥ 30 kΩ Input “Low”: -15.0 to +1.0V Input “High”: +2.8 to +15.0V Frequency: 0 – 1 MHz

## GPO\_1, GPO\_2, GPO\_3, GPO\_4

Output specification	Open Collector output of an NPN Darlington transistor. Max. power dissipation: 125 mW each output. “High” state: External pull-up needed to a positive power source of ≤ 24VDC. Examples: 2.2 kΩ at +5VDC, 4.7 kΩ at +12VDC, 12 kΩ at +24VDC. “Low” state: Output switched to GND. Max. collector current: 100 mA DC, fused (auto-recovery) Collector-emitter saturation voltage: @ 20 mA: Typ. 0.72V (≤ 0.85V) @ 100 mA: Typ. 0.90V (≤ 1.10V) Frequency: 0 – 1 kHz.
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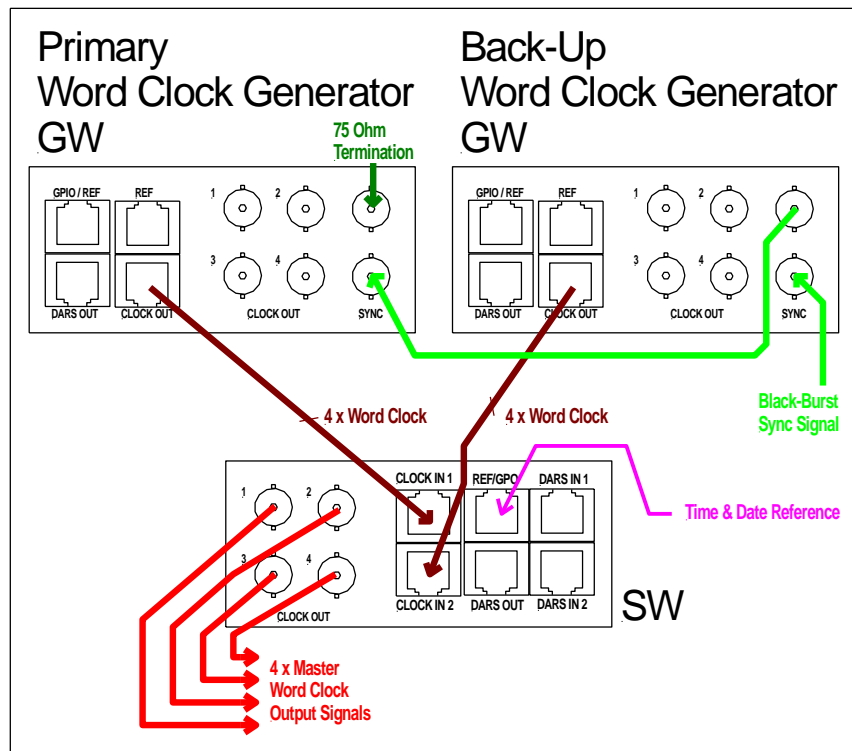
## Others

Operating voltage	12 – 30 VDC
Power consumption	2.1 W at maximum
Weight	≈ 0.4 kg
Dimensions	Standard circuit board (W x D): 100 x 160 mm/3.94 x 6.30 inch Rear panel: RUB1: 103 x 44 mm / 4.06 x 1.73 inch RUB3: 8HP, 3RU
Environmental characteristics, operating	Temperature: +5 °C to +40 °C Relative humidity: 30 % to 85 %, non-condensing
Environmental characteristics, non-operating	Temperature: -10 °C to +60 °C Relative humidity: 5 % to 95 %, non-condensing



# 1.4 Typical Application Diagrams

## Redundant Word Clock System



## 1.5 Software Update

Software updates require a (windows operating system) computer and the "RUBIDIUM CONFIGURATION" program. You can download the latest version of the program from:

<https://www.plurainc.com>.

Please check the **PC** connector at your RUBIDIUM housing: There is an USB or RS232 (with a DSUB9 connector) interface installed. You now need the same interface at your computer.

The new firmware should already be stored as a **.tcf** file at your computer.

Please now execute the following steps:

1. Connect your computer to the **PC** connector of that RUBIDIUM frame where the module has been plugged.

In case of an RS232 interface: Use a straight (1:1) connection between the **PC** connector at the RUBIDIUM frame and the RS232 of the computer.

In case of an USB interface: Use a USB A-B cable between your computer and the RUBIDIUM frame.

Switch on the power of all units.

2. Execute "Rubidium Config.exe" on your computer. Select the "Port" according to the interface (USB, RS232) you are using.
3. Select the module (unit 1, 2, 3 ...).
4. Select "Flash Update" in the *File* menu.
5. Open the **.tcf**-file. Standard name: "Rubidium SW version.tcf".  
"version" stands for a revision no., e.g. 2.13.8.  
Click the OK button, update starts. Click the OK button at the end.
6. Update is finished now. We recommend checking module's configuration utilizing the "RUBIDIUM CONFIGURATION" program.

*During the flash update the operation of the module stops!*

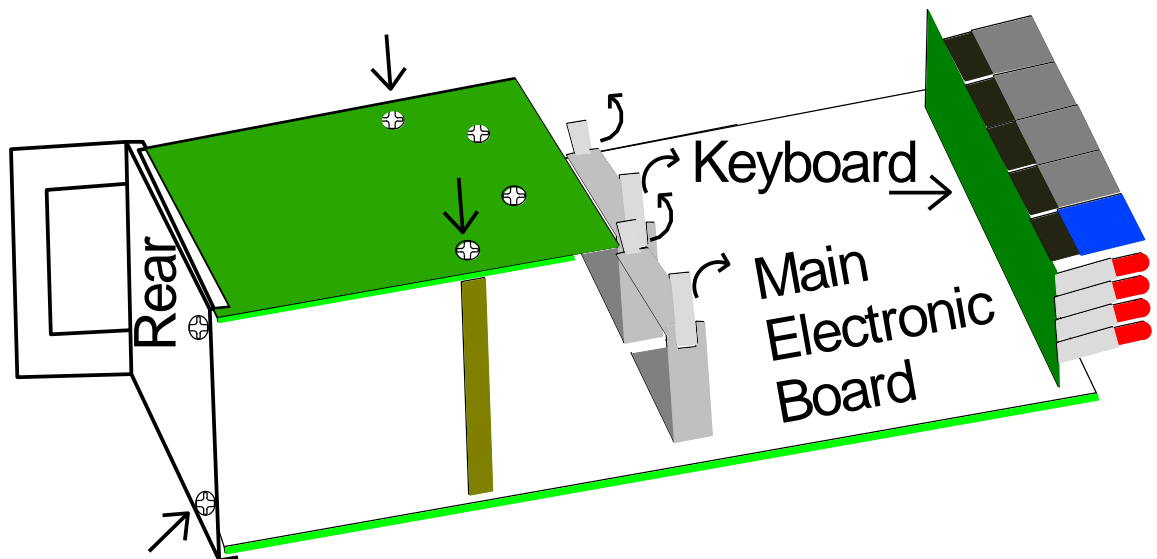
*The changeover relay remains in its last position, so the signal flow of the connected signals will not be affected.*



## 1.6 Electronic Part Exchange

The hardware of the module comprises three printed circuit boards: The main electronic board at the bottom layer, the keyboard which is fixed to the main electronic board by soldered pins, and the rear panel board which is attached to the main electronic board by screws.

The rear panel board with its connectors and the latching relays consists of “mechanical” parts, so there is a good chance that a damage of the module concerns the electronic part only. The following exchange procedure removes the main electronic board and the keyboard without interrupting the signal output. No cable should be disconnected.



1. Arrangement:
 

Contact your local dealer or Plura to order the main electronic board and the keyboard for a replacement. It is essential that you have as much information ready as possible: Serial number of the module, software version number, set-up and configuration. This will help to ensure that you are getting a direct replacement, even regarding the set-up values – which are stored in a non-volatile memory located at the main electronic board.
2. Preparation:
 

Have a screwdriver for recessed-head screws ready.
3. Removal:
 

Do not switch off the power. Do not disconnect cables. Follow the procedure described in the chapter 'Remove a Module' of the 'Installation & Systems Manual RUBIDIUM SERIES' to pull the module out of the slot. Observe precautions for handling electrostatic-sensitive devices.
4. Dismantle:
 

Unscrew only the three screws as shown in the figure above: One screw at the rear plate and two screws at the rear panel board. Release the levers of both the IDC connectors and pull out the 20-way ribbon cables. Now the main electronic board and the keyboard can completely be removed.
5. Reassemble:
 

In principle follow the procedure in the reverse order.





## 2.1.2 Overview of Error Indications and Alarms in General

This module detects errors on the word clock signals, on signals of the real-time reference, or on the module itself after a self-test.

Basically, each individual error will be represented by a status, an error counter, and an indication of a failure. The indication of a failure can be disabled. If not disabled, special alarms can be raised in case of an error. This gives the user the possibility to select individual errors for an alarm indication.

Furthermore, two overall counters are giving a quick overview:

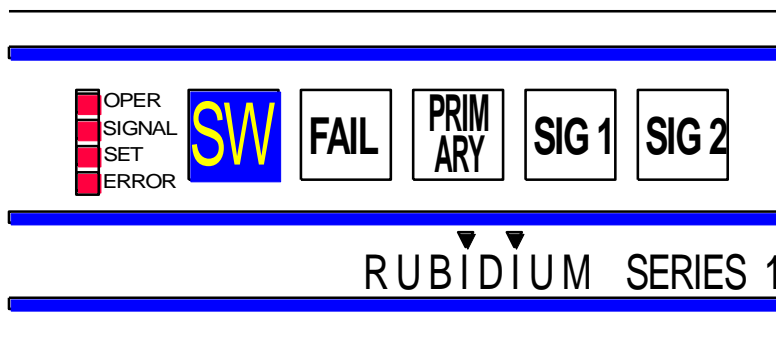
- The “**overall errors**” counter shows the sum of all individual errors. A count value of  $> 0$  indicates that at least one error has been detected.
- The “**overall failures**” counter shows the sum of all individual failures, i.e. all those errors with the failure indication not disabled. A count value of  $> 0$  indicates that at least one failure has been detected.

You can see all the individual errors and both overall counters at the [status monitor](#). Please open the status monitor to investigate the source of an error.

- Chapter ‘*Overview of Error Indications at the Status Monitor*’.
- Chapter ‘*Status Monitor*’.

RUB1 modules, i.e. modules plugged to a 1 RU chassis, indicate errors by the ERROR LED and failures by the FAIL lamp (in the default configuration):

- The LED in the “Switcher Error” function lights up as long as the “**overall errors**” counter has a count value  $> 0$ .
- The lamp/key in the “Fail” function lights up as long as the “**overall failures**” counter has a count value  $> 0$ .



GPO outputs can indicate failures and warnings:

- Chapter ‘*Alarms by GPO Outputs*’.

SNMP Traps can indicate failures and warnings.

- Chapter ‘*Alarms by SNMP Traps*’.

Entries in the log file of an Ethernet module can indicate failures and warnings.

- Chapter ‘*Entries in the Log File of an Ethernet Module*’.



### 2.1.3 Overview of Error Indications at the Status Monitor

The **System** page of the status monitor shows the “overall failures” counter, the “overall errors” counter, and the individual errors of the system:

System Status					
d/a converter check	ok				
output	primary				
word clock received	yes				
overall failures	0				
overall errors	0				
<b>changeover events:</b>					
automatic	0				
manual	1				
last event	manual	reference	26.01.2011 11:03:13		
	<b>status</b>	<b>counts</b>	<b>fail</b>	<b>disabled</b>	
power on	0		0	0	
relays	0	0	0	0	
<b>word clock frequency difference:</b>					
word clock 1	0	0	0	0	
word clock 2	0	0	0	0	
word clock 3	0	0	0	0	
word clock 4	0	0	0	0	
<b>word clock signal to signal drift:</b>					
word clock 1	0	0	0	0	0,0 ms (valid)
word clock 2	0	0	0	0	0,0 ms (valid)
word clock 3	0	0	0	0	0,0 ms (valid)
word clock 4	0	0	0	0	0,0 ms (valid)

The **Input 1** page shows the individual errors with respect to the signals at CLOCK IN 1. The **Input 2** page shows the individual errors with respect to the signals at CLOCK IN 2.

The **Reference** page shows the individual errors with respect to the real-time reference.

Please refer to the following chapters for a detailed description of the individual errors:

- Chapter ‘Word Clock Monitoring’.
- Chapter ‘Real-Time Reference Monitoring’.
- Chapter ‘Self-Test’.

Basically, the following happens in case of an error:

- status** Indicates the error status at this very moment: Error yes (1) or no (0). The status resets to 0 if this individual error has disappeared.
- counts** Counter counts up with every new error. Some counters count up to a maximum of 65,535, others to 255. A count value > 0 indicates that there has been an error even if the status currently indicates no error. Simultaneously, the “overall errors” counter counts up.
- fail** Indicates the individual failure status at this very moment: Failure yes (1) or no (0). The failure indication can be disabled. The failure indication corresponds to the error status if ‘fail’ has been enabled. A failure can raise special alarms. Simultaneously, the “overall failures” counter counts up.
- disabled** The failure indication of this individual error can be disabled. If disabled, no failure will be indicated, and no special alarm will be given in case of an error.





## 2.1.4 Error Reset

The following error indications are self resettable (reset, if no errors are present):

- The individual **status bits at the status monitor**.
- The GPO outputs of functions **Signal 1 Failure, Signal 2 Failure, Word Clock Warning**.

A reset of the **System Warning** error is done by one of the keys described below.

The following error indications remain as long as the overall counters have count values > 0:

„overall errors“ > 0	„overall failures“ > 0
<ul style="list-style-type: none"> <li>• LED (ERROR) in the <b>Switcher Error</b> function.</li> <li>• GPO in the <b>System Error</b> function.</li> <li>• SNMP trap <b>System Error</b>.</li> </ul>	<ul style="list-style-type: none"> <li>• Lamp (FAIL) in the <b>Fail</b> function.</li> <li>• GPO in the <b>System Failure</b> function.</li> <li>• SNMP trap <b>System Failure</b>.</li> </ul>

A reset of these counters and – at the same time – a reset of all individual error counters can be done by:

### Keystroke

RUB1 modules, i.e. modules plugged to a 1 RU chassis, offer four programmable keys. The following functions are provided for a reset:

Function	Description	Recommended Key
Clear	Resets all error counters to zero.	F1: FAIL
Reset All	Complete reset of error counters and status.	F1: FAIL

It is recommended to assign the „Reset All“ function to the FAIL key.

### Configuration

Utilizing one of the configuration tools, a complete reset of error counters and status can be done clicking the “Error Reset“ button at the **Switcher** page.



## 2.2 Word Clock Monitoring

### 2.2.1 Overview

SW monitors 2 x 4 word clock signals. After the power has turned on, the monitoring starts if once a valid signal has been received.

<b>word clock received</b>	yes
----------------------------	-----

At each of the 2 x 4 word clock signals, the following measurements will be taken:

- Signal level
- Signal frequency
- Drift compared to the PPS of a reference

monitoring:	1	2	3	4
<b>threshold [V]</b>	3,1	3,1	3,1	3,1
<b>level, measured [V]</b>	4,7	4,7	4,7	4,7
<b>frequency, measured</b>	word clock 32000 Hz x 1	word clock 32000 Hz x 1	word clock 48000 Hz x 1	word clock 48000 Hz x 1
<b>signal to pps drift [ms]</b>	0,0	0,0	0,0	0,0

Furthermore, the signals within a signal pair will be checked. There are four signal pairs:



The signals within a signal pair will be checked against:

- Equal frequency
- Signal to signal drift

word clock frequency difference:					
<b>word clock 1</b>	0	0	0	0	
<b>word clock 2</b>	0	0	0	0	
<b>word clock 3</b>	0	0	0	0	
<b>word clock 4</b>	0	0	0	0	
word clock signal to signal drift:					
<b>word clock 1</b>	0	0	0	0	0,0 ms (valid)
<b>word clock 2</b>	0	0	0	0	0,0 ms (valid)
<b>word clock 3</b>	0	0	0	0	0,0 ms (valid)
<b>word clock 4</b>	0	0	0	0	0,0 ms (valid)

Apart from measurement results, each individual check outputs a status, an error counter, and a fail indication. The fail indication can be disabled. Please refer to the next chapters for details.

	status	counts	fail	disabled
<b>1: signal loss</b>	0	0	0	0
<b>1: frequency</b>	0	0	0	0
<b>1: signal to pps drift</b>	0	43	0	1



## 2.2.2 Measurement of Signal Level

The level is important for the “signal loss” detector. Only the peak-to-peak value should be regarded, any DC offset will not be considered. **SW** sets the signal threshold to 62 % of the level, approximately.

Signals within a pair should have the same level. Utilising one of the configuration tools, the level of each signal pair can be selected. If “Auto” is selected, the threshold depends on the measured level.

Instead of “Auto”, a level can be selected in the range of 1.0 V to 6.0 V, with steps of 0.5 V. The threshold will be calculated from the selected level.

Example: Level = 5.0 V → threshold = 3.1 V.

In both cases, the measured level will be presented at the status monitor.

**SW** measures the level non-recurring; the measurement only takes place after the following events:

- First detection of a signal.
- “Error Reset” via front key at the module or via button at the configuration tool.
- Any change of level set-up at the configuration.

It is recommended to manually set the level, if the expected level is known and if **SW** operates in a redundant word clock system.

### Error **Signal Loss**

If the signal level falls below the threshold, a “[signal loss](#)” error will be indicated.

This error will be classified as a major error, so this error will be considered for a changeover.

The status monitor indicates these measurements and errors at **Input 1** page or **Input 2** page resp.

## 2.2.3 Measurement of Signal Frequency

**SW** permanently measures the frequency of all word clock signals. Signals within a pair should have the same frequency. Utilising one of the configuration tools, the frequency of each signal pair can be selected. If this is done, **SW** checks each signal of differences between measured and selected frequency. If “Auto” has been selected instead, each signal will be check for a valid word clock frequency only.

A valid word clock frequency should be a multiple of one of the basic sample frequencies: 32 kHz, 44.1 kHz or 48 kHz. The factor can be out of 1, 2, 4, 8, 16, 32, 64, 128 or 256.

Example: 96 kHz will be measured or selected as 48 kHz x 2.

The measurement is able to distinguish between all the Pull-Up and Pull-Down frequencies:

NTSC Pull-Down (NTSC_PD)	= x 1/1,001,
PAL Pull-Down (PAL_PD)	= x 24/25,
NTSC Pull-Up (NTSC_PU)	= x 1,001,
PAL Pull-Up (PAL_PU)	= x 25/24.



As a result of the frequency measurement, the status monitor thus shows one of the following frequencies [Hz]:

Basic frequency → Pull-Up/Pull-Down ↓	32 kHz	44,1 kHz	48 kHz
NTSC_PD + PAL_PD x 1/1.001 x 24/25	30 689	42 294	46 034
PAL_PD x 24/25	30 720	42 336	46 080
NTSC_PU + PAL_PD x 1.001 x 24/25	30 751	42 378	46 126
NTSC_PD x 1/1.001	31 968	44 056	47 952
x 1	32 000	44 100	48 000
NTSC_PU x 1.001	32 032	44 144	48 048
NTSC_PD + PAL_PU x 1/1.001 x 25/24	33 300	45 892	49 950
PAL_PU x 25/24	33 333	45 938	50 000
NTSC_PU + PAL_PU x 1.001 x 25/24	33 367	45 983	50 050

#### Error **Frequency**

A “**frequency**” error will be indicated, if a frequency has been selected (not “Auto”) and there is a difference of measured and selected frequency, or if “Auto” has been selected and the measured frequency does not comply with a valid word clock frequency. This check will be done permanently. Any Pull-Up or Pull-Down frequency will be converted to the basic frequency; the check thus compares the basic frequency and factor only. The cause of this error may be a faulty configuration of the signal source.

This error will be classified as a major error, so this error will be considered for a changeover.

The status monitor indicates these measurements and errors at **Input 1** page or **Input 2** page resp.

#### Error **Word Clock Frequency Difference**

Signals within a pair should have the same frequency. In this case, even the Pull-Up and Pull-Down frequencies are considered. **SW** permanently checks the signals for differences. In case of differences, a “**word clock frequency difference**” error will be indicated. The cause of this error may be a faulty configuration or synchronization of the signal source.

This error can be assigned to a signal pair only, so this error will not be considered for a changeover.

The status monitor indicates this error at the **System** page.



## 2.2.4 Signal to Signal Drift

Signals within a pair should have no drift against each other. **SW** permanently checks the signals for a drift.

### Error **Word Clock Signal to Signal Drift**

If the drift reaches or exceeds the “Limit Signal to Signal Drift”, a “[word clock signal to signal drift](#)” error will be indicated. The cause of this error may be a faulty synchronization of the signal source.

The error status will be maintained for about 10 seconds, and then a new check starts. If the drift still remains, an error will be indicated and counted again and again.

This error can be assigned to a signal pair only, so this error will not be considered for a changeover.

The status monitor indicates these measurements and errors at the **System** page.

## 2.2.5 Signal to PPS Drift

This measurement requires connecting a precise second pulse. **SW** permanently checks the eight word clock signals for a drift against this PPS.

### Error **Signal to PPS Drift**

If the drift reaches or exceeds the “Limit Signal to PPS Drift”, a “[signal to pps drift](#)” error will be indicated. The cause of this error may be a faulty synchronization of the signal source if a real-time synchronization is required.

The error status will be maintained for about 10 seconds, and then a new check starts. If the drift still remains, an error will be indicated and counted again and again.

This error will be classified as a major error, so this error will be considered for a changeover.

The status monitor indicates these measurements and errors at **Input 1** page or **Input 2** page resp.



### 2.2.6 Consequences of Errors

The “word clock frequency difference” and “word clock signal to signal drift” errors – referring to signal pairs only - will be indicated at the **System** page of the status monitor:

	status	counts	fail	disabled	
power on	0		0	0	
relays	0	0	0	0	
<b>word clock frequency difference:</b>					
word clock 1	0	0	0	0	
word clock 2	0	0	0	0	
word clock 3	0	0	0	0	
word clock 4	0	0	0	0	
<b>word clock signal to signal drift:</b>					
word clock 1	0	0	0	0	0,0 ms (valid)
word clock 2	0	0	0	0	0,0 ms (valid)
word clock 3	0	0	0	0	0,0 ms (valid)
word clock 4	0	0	0	0	0,0 ms (valid)

All the individual errors will be indicated at the **Input 1 / Input 2** page of the status monitor:

	status	counts	fail	disabled
1: signal loss	0	0	0	0
1: frequency	0	0	0	0
1: signal to pps drift	0	43	0	1
2: signal loss	0	0	0	0
2: frequency	0	0	0	0
2: signal to pps drift	0	45	0	1
3: signal loss	0	0	0	0
3: frequency	0	0	0	0
3: signal to pps drift	0	49	0	1
4: signal loss	0	0	0	0
4: frequency	0	0	0	0
4: signal to pps drift	0	49	0	1

Please refer to chapter ‘Overview of Error Indications at the Status Monitor’ as well.

Each individual error may be enabled to indicate a failure and to raise special alarms (GPO outputs, SNMP traps). This requires unchecking the “disable” checkbox. This way, the user chooses the errors which may raise alarms.

→ Chapter ‘Alarms by GPO Outputs’.

→ Chapter ‘Alarms by SNMP Traps’.

The individual errors separately detected for signals at **CLOCK IN 1** and **CLOCK IN 2** are major errors which can force a changeover. Signal pair errors cannot force a changeover. All these errors can have additional consequences if the corresponding ‘disable’ checkbox has not been checked:

Major errors: “signal loss”, “frequency”, “signal to pps drift”.

- “Signal 1 Failure” or “Signal 2 Failure” resp., as a GPO output and/or SNMP trap.

Signal pair errors: “word clock frequency difference”, “word clock signal to signal drift”.

- “Word Clock Warning”, as a GPO output and/or SNMP trap.



This table shows all the word clock errors and their consequences:

		Signal Pair		Major Errors		
		word clock frequency difference	word clock signal to signal drift	signal loss	frequency	signal to pps drift
Status Monitor	<b>status</b> sets bit to 1	yes	yes	yes	yes	yes
	<b>counts</b> counts + 1	yes	yes	yes	yes	yes
	<b>overall errors</b> counts + 1	yes	yes	yes	yes	yes
	<b>fail</b> sets bit to 1	yes*	yes*	yes*	yes*	yes*
	<b>overall failures</b> counts + 1	yes*	yes*	yes*	yes*	yes*
LED and Lamp	LED function <b>Switcher Error</b> LED (ERROR) lights up	yes	yes	yes	yes	yes
	Lamp function <b>Fail</b> Lamp (FAIL) lights up	yes*	yes*	yes*	yes*	yes*
GPO Functions	<b>Signal 1 Failure</b> (GPO_1) <b>Signal 2 Failure</b> (GPO_2)	no	no	yes*	yes*	yes*
	<b>Word Clock Warning</b> (GPO_3)	yes*	yes*	no	no	no
	<b>System Warning</b> (GPO_4)	no	no	no	no	no
	<b>System Error</b> (if "overall errors" > 0)	yes	yes	yes	yes	yes
	<b>System Failure</b> (if "overall failures" > 0)	yes*	yes*	yes*	yes*	yes*
SNMP Traps	<b>Signal 1 Failure</b> <b>Signal 2 Failure</b>	no	no	yes*	yes*	yes*
	<b>Word Clock Warning</b>	yes*	yes*	no	no	no
	<b>System Warning</b>	no	no	no	no	no
	<b>System Error</b> (if "overall errors" > 0)	yes	yes	yes	yes	yes
	<b>System Failure</b> (if "overall failures" > 0)	yes*	yes*	yes*	yes*	yes*
Log	<b>Event SW</b>	yes*	yes*	yes*	yes*	yes*

yes\*: "yes" under the condition that the corresponding "disable" checkbox has not been checked, i.e. the status monitor shows "disabled" = 0.

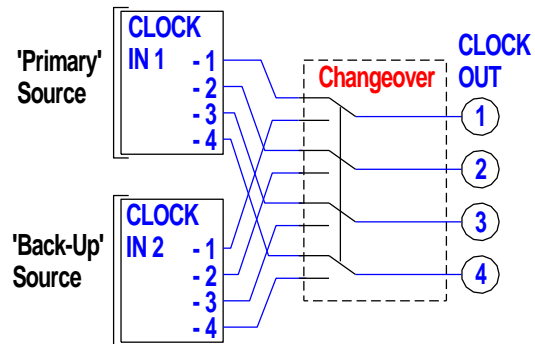


## 2.3 Word Clock Changeover

**SW** monitors signals received from two word clock sources.

With the default set-up ('Factory Settings'), the module operates in the **automatic mode**, i.e. in case of any major fault of the active source a changeover will occur to the other source.

**Latching relays** are used to switch the 2 x 4 word clock signals, so the signal path does not change if the module loses power.



Utilizing one of the configuration tools, you can choose an **automatic** or **manual** changeover operating mode: 'Changeover = Automatic' or 'Changeover = Manual' (please refer to chapter 'Switcher': Set-Up the Monitoring and Changeover).

RUB1 modules offer keys which enable to do a manual changeover at either operating mode. Two functions are provided (please refer to chapter 'Keys': Keys and Lamps, LEDs and GPI):

- 'Changeover to Primary': Changeover to the primary source **CLOCK IN 1**. This is the recommended function, because it avoids any unintentional changeover to the back-up source.
- 'Changeover Toggle': Changeover between sources **CLOCK IN 1** ↔ **CLOCK IN 2**.

Difference between *automatic* and *manual* operating mode:

	<b>Automatic</b>	<b>Manual</b>
Automatic changeover	Enabled	Disabled
Function of a key: 'Changeover Toggle' or 'Changeover to Primary'	Failure and error status checked before a manual changeover: Changeover only, if the currently inactive source has not more failures than the currently active source.	Changeover forced by a keystroke occurs regardless of any errors or failures.

In the automatic mode, the module tries to output "good" signals while avoiding any unnecessary changeover. This leads to a sophisticated changeover characteristic. All the major errors will be considered. In brief, a changeover to the back-up signal occurs if the primary input

- have more 'signal loss' errors than the back-up signals,
- have errors and the back-up signals have not.

Changeover from the back-up signal to the primary signal works in the same way.

The changeover characteristic can be modified by setting the 'disabled' bit for individual major errors. An error which is not enabled to become a failure will be ignored for the changeover. This allows you to adapt the changeover characteristic to your application.





## 2.4 Real-Time Reference Monitoring

### 2.4.1 Overview

The inputs PPS IN and RXD IN at the REF/GPO connector are provided to connect signals of a real-time reference.

PPS IN: "Pulse Per Second" input, electrical - for example - a TTL pulse (see chapter 'Specifications'). Positive edge = Time reference mark.

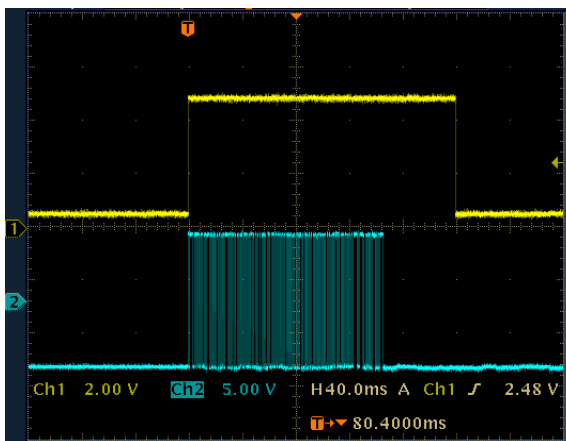
This signal is used to measure the drift of the word clock signals against the real-time reference.

RXD IN: Serial data string, electrical - for example - RS232 (see chapter 'Specifications'). The data protocol can be selected utilizing one of the configuration tools: At "Reference Format" on the "Switcher" page. For example, the following GPS units require the following protocols:

GPS 10 MHz	Meinberg Std 2400/7e2 + PPS
GPS16, GPS17, GPS35	NMEA \$GPRMC 4800/8n1 + PPS

This signal is used to display the time & date of the last changeover event.

Example: PPS IN (yellow) and RXD IN (blue):



Errors and status information will be indicated at the **Reference** page of the status monitor (chapter 'Status Monitor' → 'Status of the Real-Time Reference').

An LED (e.g. SET – RUB1 modules only) programmed as "Switcher Set" lights up if the module receives valid signals (PPS and RXD).



## 2.4.2 The Individual Errors and Consequences of Errors

The following errors will be indicated at the **Reference** page of the status monitor:

	status	counts	fail	disabled
pps timeout	0	0	0	1
pps timing	0	0	0	1
serial timing	0	0	0	1
serial sequence	0	0	0	1

Chapter 'Overview of Error Indications at the Status Monitor' describes the meaning of **status**, **counts**, **fail**, and **disabled**.

**pps timeout** Signal loss at the PPS input: no valid PPS detected since 1.6 s.

**pps timing** PPS signal disturbance: the interval between two consecutive PPS signals does not correspond to one second

**serial timing** Serial data string at RXD IN either is lost or is not synchronized with the PPS signal.

**serial sequence** A time discontinuity has been detected while checking the time & date information of the serial data string. This leads to an error even at a valid time discontinuity in case of a leap second or a DST switching if a local time zone has been selected as reference.

Each error has the following consequences:

- Indication of an error at the status monitor ('status' = 1).
- Error counter counts one up.
- Counter 'overall errors' counts one up.
- LED programmed as 'Switcher Error' lights up (RUB1 version modules).
- GPO output programmed as 'System Error' becomes active.
- SNMP trap 'System Error' will be sent.

Each error has additional the following consequences if the corresponding 'disable' checkbox has not been checked:

- Indication of a failure at the status monitor ('fail' = 1).
- Counter 'overall failures' counts one up.
- Lamp programmed as 'Fail' lights up (RUB1 version modules).
- GPO output programmed as 'System Failure' becomes active.
- SNMP trap 'System Failure' will be sent.
- The log file of an Ethernet module receives an entry.

Each 'current sequence' error produces an entry in the log file of an Ethernet module.

- Chapter 'Alarms by GPO Outputs'.
- Chapter 'Alarms by SNMP Traps'.
- Chapter 'Entries in the Log File of an Ethernet Module'.



This table shows all the individual errors and their consequences:

			pps timeout	pps timing	serial timing	serial sequence
Status Monitor	<b>status</b>	sets bit to 1	yes	yes	yes	yes
	<b>counts</b>	counts + 1	yes	yes	yes	yes
	<b>overall errors</b>	counts + 1	yes	yes	yes	yes
	<b>fail</b>	sets bit to 1	yes*	yes*	yes*	yes*
	<b>overall failures</b>	counts + 1	yes*	yes*	yes*	yes*
LED Lamp	LED function <b>Switcher Error</b>	LED (ERROR) lights up	yes	yes	yes	yes
	Lamp function <b>Fail</b>	Lamp (FAIL) lights up	yes*	yes*	yes*	yes*
GPO	<b>System Warning</b>		yes*	yes*	yes*	yes*
	<b>System Error</b>	(if "overall errors" > 0)	yes	yes	yes	yes
	<b>System Failure</b>	(if "overall failures" > 0)	yes*	yes*	yes*	yes*
SNMP	<b>System Warning</b>		yes*	yes*	yes*	yes*
	<b>System Error</b>	(if "overall errors" > 0)	yes	yes	yes	yes
	<b>System Failure</b>	(if "overall failures" > 0)	yes*	yes*	yes*	yes*
Log	<b>Event SW</b>		yes*	yes*	yes*	yes*

**yes\***: "yes" under the condition that the corresponding "**disable**" checkbox has not been checked, i.e. the status monitor shows "disabled" = 0.



## 2.5 Self Test

Apart from checking the word clock signals and the signals of the real-time reference, the module performs a self test.

The following errors will be indicated at the **System** page of the status monitor:

	status	counts	fail	disabled
power on	0		0	0
relays	0	0	0	0

Chapter 'Overview of Error Indications at the Status Monitor' describes the meaning of **status**, **counts**, **fail**, and **disabled**.

'power on': After the power has turned on, the non-volatile data will be checked for plausibility, for example regarding the set-up of the module. In case of any implausibility, a 'power on' error will be indicated.

'relays': The latching relays can be monitored through internal sense signals. If any sense signal does not correspond to the intended switching position, a 'relays' error will be indicated.

Each error has the following consequences:

- Indication of an error at the status monitor ('status' = 1).
- In case of error 'relays': Error counter counts one up.
- Counter 'overall errors' counts one up.
- LED programmed as 'Switcher Error' lights up (RUB1 version modules).
- GPO programmed as 'System Error' becomes active.
- SNMP trap 'System Error' will be sent.

Each error has additional the following consequences if the corresponding 'disable' checkbox has not been checked:

- Indication of a failure at the status monitor ('fail' = 1).
- Counter 'overall failures' counts one up.
- Lamp programmed as 'Fail' lights up (RUB1 version modules).
- GPO programmed as 'System Failure' becomes active.
- SNMP trap 'System Failure' will be sent.
- The log file of an Ethernet module receives an entry.

→ Chapter 'Alarms by GPO'.

→ Chapter 'Alarms by SNMP Traps'.

→ Chapter 'Entries in the Log File of an Ethernet Module'.



This table shows all the individual errors and their consequences:

		power on	relays
Status Monitor	<b>status</b> sets bit to 1	yes	yes
	<b>counts</b> counts + 1	no	yes
	<b>overall errors</b> counts + 1	yes	yes
	<b>fail</b> sets bit to 1	yes*	yes*
	<b>overall failures</b> counts + 1	yes*	yes*
LED Lamp	LED function <b>Switcher Error</b> LED (ERROR) lights up	yes	yes
	Lamp function <b>Fail</b> Lamp (FAIL) lights up	yes*	yes*
GPO	<b>System Warning</b>	yes*	yes*
	<b>System Error</b> (if "overall errors" > 0)	yes	yes
	<b>System Failure</b> (if "overall failures" > 0)	yes*	yes*
SNMP	<b>System Warning</b>	yes*	yes*
	<b>System Error</b> (if "overall errors" > 0)	yes	yes
	<b>System Failure</b> (if "overall failures" > 0)	yes*	yes*
Log	<b>Event SW</b>	yes*	yes*

**yes\*:** 'yes' under the condition that the corresponding '**disable**' checkbox has not been checked, i.e. the status monitor shows '*disabled*' = 0.



## 2.6 Alarms

### 2.6.1 Overview and Suggestions for Installation

In order to get aware of a problem, the module could periodically be checked (status monitor, LEDs, lamps, log file of the Ethernet module), or the module could be integrated into a management and control system via GPO and/or SNMP.

These are the suggestions for using the GPO and SNMP features.

The usage of the **Signal 1 Failure** and **Signal 2 Failure** alarms offers the advantage that the problem directly can be related to source *CLOCK IN 1* or *CLOCK IN 2*. These alarms indicate real word clock problems; none of these alarms should be raised in a word clock system during normal 24 hours operation.

Using the **Word Clock Warning** (errors related to signal pairs) and **System Warning** (errors related to real-time reference and self test) additionally, the monitoring will be complete, and the source of a problem can be found quickly.

In case of a GPO connection, these advantages are given only if the GPO outputs are connected separately to inputs of an alarm management system.

A complete monitoring can be realized using only one type of alarm: **System Error** or **System Failure**. Both alarms are available with firmware version 2.10.19 or higher. In case of an alarm, the cause of the alarm can be found quickly utilizing the status monitor.

**System Error:** This alarm offers monitoring with highest sensibility. Every error will raise this alarm. There is no way to disable any individual failure indication. Even a valid time discontinuity of the real-time reference in case of a leap second or a DST switching of a local time zone raises an alarm ("[serial sequence](#)" error).

**System Failure:** Basically, this alarm combines all errors which are enabled to indicate a failure. So, your configuration determines which of the word clock errors, errors with respect to the real-time reference, and errors with respect to the self test, are considered for sending an alarm. This way, an alarm in case of a valid time jump can be avoided. If an "SR" module is part of the system to monitor the real-time reference, all failure indications for the real-time reference can be disabled at the **SW** module.

The **Signal 1 Failure** and **Signal 2 Failure** and **System Warning** alarms will become inactive automatically as soon as the individual errors have disappeared. The **System Error** and **System Failure** and **System Warning** alarms remain active until a manual reset of the error counters.

Using GPO outputs requires a proper configuration (→ chapter '*Alarms by GPO Outputs*') and – of course – a proper cabling.

Using SNMP traps requires a proper configuration (→ chapter '*Alarms by SNMP Traps*') and an Ethernet module (**RUB IE** or **RUB PM**) as part of this RUBIDIUM system.



## 2.6.2 Alarms by GPO Outputs

The module has four GPOs (General Purpose Output). Basically, the functions of these outputs are programmable utilizing the **Keys** function of one of the configuration tools.  
(→ Chapter "'Keys": Keys and Lamps, LEDs and GPOs')

The following functions for the GPOs are provided to indicate errors and failures:

**Signal 1 Failure** Recommended GPO: **GPO\_1**  
**Signal 2 Failure** Recommended GPO: **GPO\_2**

Active, as long as there is any major word clock error at *CLOCK IN 1* or *CLOCK IN 2* respectively. In detail, this GPO becomes active if one of the following errors has occurred and this error has been enabled to indicate a failure (checkbox "**disable**" not checked):

- signal loss
- frequency
- signal to pps drift

Please refer to chapter 'Word Clock Monitoring' for a detailed error description.

**Word Clock Warning** Recommended GPO: **GPO\_3**

Active, as long as there is any error at a word clock signal pair. In detail, this GPO becomes active if one of the following errors has occurred and this error has been enabled to indicate a failure (checkbox "**disable**" not checked):

- word clock frequency difference
- word clock signal to signal drift

Please refer to chapter 'Word Clock Monitoring' for a detailed error description.

**System Warning** Recommended GPO: **GPO\_4**

In detail, this GPO becomes active if one of the following errors has occurred and this error has been enabled to indicate a failure (checkbox "**disable**" not checked):

- pps timeout (real-time reference) power on (self test)
- pps timing (real-time reference) relays (self test)
- serial timing (real-time reference)
- serial sequence (real-time reference)

Please refer to chapter 'Real Time Reference Monitoring' and chapter 'Self Test'.

**System Error** Available with firmware version 2.10.19 or higher

Active, as long as the "**overall errors**" counter has a count value > 0.

The error indication cannot be disabled, so this GPO becomes active in case of any error, i.e. word clock errors, errors with respect to the real-time reference, and errors with respect to the self test.

**System Failure** Available with firmware version 2.10.19 or higher

Active, as long as the "**overall failures**" counter has a count value > 0.

Each individual error can raise this alarm provided this error has been enabled to indicate a failure (checkbox "**disable**" not checked). Depending on this configuration, word clock errors, errors with respect to the real-time reference, and errors with respect to the self test, may activate this GPO output.

More GPO functions: → Chapter "'Keys": Keys and Lamps, LEDs and GPOs'.



### 2.6.3 Alarms by SNMP Traps

SNMP functionality for a RUBIDIUM system requires the installation of an Ethernet module (**RUB IE** or **RUB PM**) with option **S** (SNMP).

Utilizing one of the configuration tools, the SNMP traps can be enabled and disabled at the **System** page (please refer to chapter *“System”: Identification, Reset, SNMP, Fan Control*). The “Any Trap” checkbox in general controls the SNMP traps functionality. Furthermore, there are checkboxes corresponding to all the individual traps.

Recommended configuration: Check the “Any Trap” and “System Failure” checkboxes.

This chapter describes all the alarm functions for traps. The following feature is valid for all these traps: As long as the alarm condition is present, traps will be repeated in an 8 hours interval.

#### **Signal 1 Failure / Signal 2 Failure** Check the “Signal Failure” checkbox

Trap will be sent as long as there is any major word clock error at *CLOCK IN 1* or *CLOCK IN 2* respectively. In detail, this trap will be sent if one of the following errors has occurred and this error has been enabled to indicate a failure (checkbox “**disable**” not checked):

- signal loss
- frequency
- signal to pps drift

Please refer to chapter *‘Word Clock Monitoring’* for a detailed error description.

#### **Word Clock Warning** Check the “Signal Warning” checkbox

Trap will be sent in case of an error at a word clock signal pair. In detail, this trap will be sent if one of the following errors has occurred and this error has been enabled to indicate a failure (checkbox “**disable**” not checked):

- word clock frequency difference
- word clock signal to signal drift

Please refer to chapter *‘Word Clock Monitoring’* for a detailed error description.

#### **System Warning** Check the “Signal Warning” checkbox

In detail, this trap will be sent if one of the following errors has occurred and this error has been enabled to indicate a failure (checkbox “**disable**” not checked):

- pps timeout (real-time ref.)
- serial timing (real-time ref.)
- power on (self test)
- pps timing (real-time ref.)
- serial sequence (real-time ref.)
- relays (self test)

Please refer to chapter *‘Real Time Reference Monitoring’* and chapter *‘Self Test’*.

#### **System Error** Check the “System Error” checkbox

Active, as long as the “**overall errors**” counter has a count value > 0.

The error indication cannot be disabled, so this trap will be sent in case of any error, i.e. word clock/real-time reference/self test errors.

#### **System Failure** Check the “System Failure” checkbox

Active, as long as the “**overall failures**” counter has a count value > 0.

Any individual errors can raise this alarm provided this error has been enabled to indicate a failure (checkbox “**disable**” not checked). Depending on this configuration, word clock/real-time reference/self test errors may activate this trap.





## 2.6.4 Entries in the Log File of an Ethernet Module

The use of the log file requires the installation of an Ethernet module (**RUB IE** or **RUB PM**).

As it is shown in the tables of chapters:

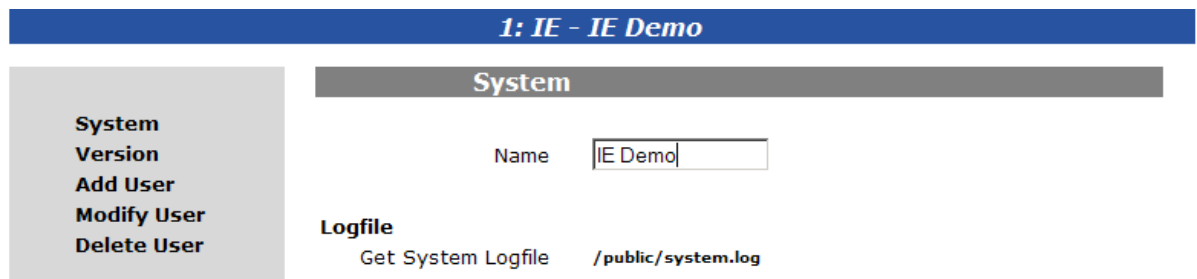
- 'Word Clock Monitoring' – 'Consequences of Errors',
- 'Real-Time Reference Monitoring' – 'The Individual Errors and Consequences of Errors',
- 'Self Test',

every error can produce an entry in the log file if the corresponding '**disable**' checkbox has not been checked.

Additional entries can be produced triggered by the following events:

- manual or automatic changeover,
- error reset – pressing key FAIL (or any key assigned with the '**Reset All**' function) or clicking the '**Error Reset**' button at the **Switcher** page of any configuration tool.

Open the log file clicking on **/public/system.log** at the **System** page of an Ethernet module.



Example: (SW 2:1) identifies the module which sent this entry:

**SW** module located at frame address **2** at slot **1**.

```
[22/Apr/2013 11:03:33] (SW 2:1) Event: CLOCK IN1 signal 3 loss
[22/Apr/2013 11:03:33] (SW 2:1) Event: System automatic changeover
[22/Apr/2013 11:03:33] (SW 2:1) Event: CLOCK IN1 signal 2 loss
[22/Apr/2013 11:03:33] (SW 2:1) Event: CLOCK IN1 signal 1 loss
[22/Apr/2013 11:03:33] (SW 2:1) Event: CLOCK IN1 signal 4 loss
[22/Apr/2013 11:03:37] (SW 2:1) Event: System manual changeover
[22/Apr/2013 11:03:41] (SW 2:1) Event: System error reset
```

The Ethernet module adds a time stamp (time & date) = time of its internal clock when it receives the entry.

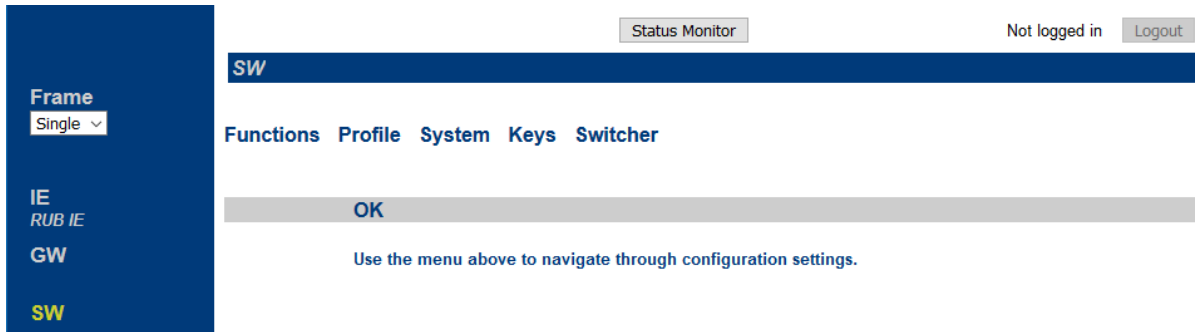
If **SW** receives real-time reference signals and no other module of the system sends the 'Reference' telegram, this telegram should be sent from **SW** module (see chapter "'Link": Communication between Modules'). This telegram sets and synchronizes the internal clock of the Ethernet module. The time stamps of each entry now correspond to the UTC time & date of the event.



### 3 Status Monitor

#### 3.1 Status Monitor by the Ethernet Module

The RUBIDIUM SERIES HTTP server, which is located in the Ethernet module (**RUB IE** or **RUB PM**), offers a status monitor. Please refer to the 'Functional Descriptions and Specifications RUB Ethernet' manual for a detailed description of how to access the RUBIDIUM SERIES system and how to open the RUBIDIUM homepage.



- Click on **SW** on the left.
- Click on the button **Status Monitor** to open the **SW** status monitor.

Requirements:

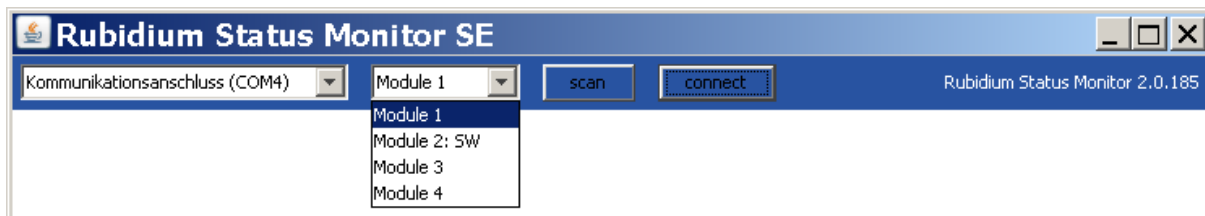
- Please have Java Runtime Environment 1.6.0 or higher installed (for example download at [www.java.com](http://www.java.com)).
- Java should be installed as a browser plug-in (a Windows installation will do this automatically if you download Java from the source mentioned above).
- The Status Monitor works with all operating systems which support Java.

#### 3.2 Status Monitor by a PC Program

The PC program **RubStatSE.exe** uses the **PC** interface (RS232 or USB) of the RUBIDIUM housing. This program is part of the "Rubidium Series, config software" packet you can download at:

<https://www.plurainc.com>.

Execute this program, select the COM port or USB connection and press the **scan** button to get a list of the modules plugged to this housing. Select the module and press the **connect** button.



Requirements:

- Please have Java Runtime Environment 1.6.0 or higher installed (for example download at [www.java.com](http://www.java.com)).
- For a Windows operating system: Please follow the description of **RubStatSE\_Readme.txt**.
- For a Linux operating system: Available on request.



### 3.3 System Status

The system status and individual system error sources are considered for monitoring only, they have no effects on the automatic changeover characteristics.

The screenshot displays the 'Rubidium Status Monitor SE' interface. At the top, there are dropdown menus for 'AV Rubidium H1 (USB)' and 'Module 1: SW', along with 'scan' and 'disconnect' buttons. The main area is divided into several sections:

- System Tally:** A table showing the status of relays, lamps, and LEDs.
 

relay 1	0	lamp 1	0
relay 2	0	lamp 2	1
relay 3	0	lamp 3	1
		lamp 4	1
gpo 1	0	led 1	1
gpo 2	0	led 2	0
gpo 3	0	led 3	1
gpo 4	0	led 4	0
- System Set-up:** Configuration parameters for changeover and word clocks.
 

changeover	automatic	
limit signal to signal drift	2 ms	
limit signal to pps drift	2 ms	
reference format	Meinberg Standard	
frequency	level	
word clock 1	auto	5 V
word clock 2	auto	5 V
word clock 3	auto	5 V
word clock 4	auto	5 V
- System Status:** Operational status and error counts.
 

d/a converter check	ok				
output	primary				
word clock received	yes				
overall failures	0				
overall errors	0				
changeover events:					
automatic	0				
manual	1				
last event	manual	reference	26.01.2011 11:03:13		
power on	0	status	counts	fail	disabled
relays	0		0	0	0
word clock frequency difference:					
word clock 1	0	0	0	0	
word clock 2	0	0	0	0	
word clock 3	0	0	0	0	
word clock 4	0	0	0	0	
word clock signal to signal drift:					
word clock 1	0	0	0	0	0,0 ms (valid)
word clock 2	0	0	0	0	0,0 ms (valid)
word clock 3	0	0	0	0	0,0 ms (valid)
word clock 4	0	0	0	0	0,0 ms (valid)

Module version 2.0.186.32 (SW)

#### System Setup

Reflects the set-up as selected by a configuration tool – please refer to chapters ‘“Switcher”’: Set-Up of General Parameters’ and ‘“Word Clock”’: Set-Up of Word Clock Monitoring’.



System Tally

Reflects the state of the relays, the GPOs, the lamps and the LEDs. The GPOs, lamps and LEDs have programmable functions. For service purpose, 'System Tally' reflects the state of the default function, independent of what has been really assigned to.

- relay 1 Reflects the sense of the 1<sup>st</sup> latching relay: 0 = primary position, 1 = back-up.
- relay 2 Reflects the sense of the 2<sup>nd</sup> latching relay: 0 = primary position, 1 = back-up.
- relay 3 Reflects the sense of the 3<sup>rd</sup> latching relay: 0 = primary position, 1 = back-up.

GPOs: 0 = output/function inactive, 1 = output/function active.

- gpo 1 'Signal 1 Failure': Any failure of signals at *CLOCK IN 1*.
- gpo 2 'Signal 2 Failure': Any failure of signals at *CLOCK IN 2*.
- gpo 3 'Word Clock Warning': Any signal pair error detected.
- gpo 4 'System Warning': Any error regarding the real-time reference or self test.

Lamps: 0 = off/function inactive, 1 = on/function active.

- lamp 1 'Fail': = 1 if any failure has happened ("*overall failures*" > 0).
- lamp 2 'Primary': = 1 if output *CLOCK OUT* is switched to *CLOCK IN 1*.
- lamp 3 'Signal 1 present': = 1 if at least one valid signal at *CLOCK IN 1* is present.
- lamp 4 'Signal 2 present': = 1 if at least one valid signal at *CLOCK IN 2* is present.

LEDs: 0 = off/function inactive, 1 = on/function active.

- led 1 'Operation': = 1 if the module is operating.
- led 2 'Switcher Signal': Reserved.
- led 3 'Switcher Set': = 1 if real-time reference signals (PPS IN, RXD IN) are present.
- led 4 'Switcher Error': = 1 as long as "*overall errors*" counter > 0.

System Status

- d/a converter check Result of checking all D/A converters after power-on.
- output *CLOCK OUT* is currently switched to the primary or the back-up source.
- word clock received Word clock monitoring and changeover procedure starts, if at least one word clock signal has been detected.
- overall failures Current value of the "*overall failures*" counter.
- overall errors Current value of the "*overall errors*" counter.

Changeover events: Number of all automatic and manual changeover events. Information about the last event: Automatic or manual, date & time at that moment.

Individual system errors:

Error	Description
power on	Check after power has turned on: Invalid set-up parameters found and/or latching relay error found. There is no individual counter provided for this error.
relays	The sense of one of the latching relays does not correspond to the intended switching position. An error will be indicated and counted.
word clock frequency difference word clock 1 ... 4	The frequencies of the signals within a pair should be equal. An error will be indicated and counted.
word clock signal to signal drift word clock 1 ... 4	No drift should be detectable between the signals of each pair. If a drift equals or exceeds the limit 'Limit Signal to Signal Drift', an error will be indicated and counted.



### 3.4 Signal Input Status

**SW** monitors 2 x 4 word clock signals at *CLOCK IN 1* and *CLOCK IN 2*.

The **changeover & monitoring** table shows the major errors which are considered for a changeover. These errors can raise an alarm of type “**Signal 1 Failure**” or “**Signal 2 Failure**” respectively.

The **monitoring** table shows measurement results which are for monitoring purposes only.

The status monitor shows at **Input 1** and **Input 2** page:

changeover & monitoring:				
	status	counts	fail	disabled
1: signal loss	0	0	0	0
1: frequency	0	0	0	0
1: signal to pps drift	0	0	0	0
2: signal loss	0	0	0	0
2: frequency	0	0	0	0
2: signal to pps drift	0	0	0	0
3: signal loss	0	0	0	0
3: frequency	0	0	0	0
3: signal to pps drift	0	0	0	0
4: signal loss	0	0	0	0
4: frequency	0	0	0	0
4: signal to pps drift	0	0	0	0
monitoring:				
	1	2	3	4
threshold [V]	3,1	3,1	3,1	3,1
level, measured [V]	4,7	4,7	4,7	4,7
frequency, measured	word clock 32000 Hz x 1	word clock 32000 Hz x 1	word clock 48000 Hz x 1	word clock 48000 Hz x 1
signal to pps drift [ms]	0,0	0,0	0,0	0,0

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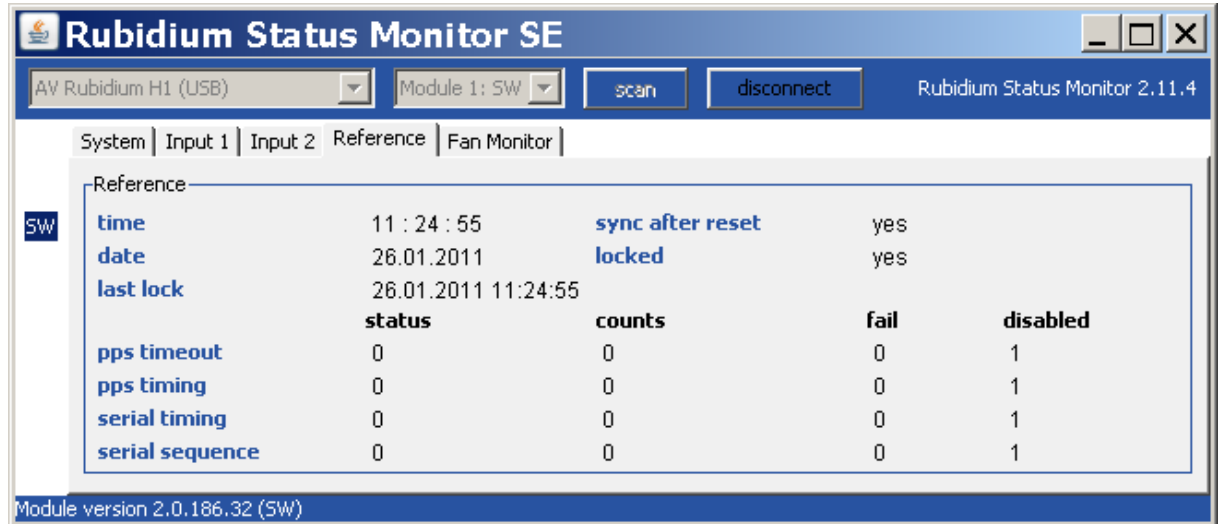
**Input 1** and **Input 2** show the same items.

changeover & monitoring:	
Error	Description
signal loss	A word clock signal, which has been present before, now has been lost.
frequency	In case the frequency has been selected manually (no "Auto" mode): The signal does not have the selected frequency. In case of "Auto" mode: The signal does not have a valid word clock frequency. Please refer to chapter "'Word Clock": Set-Up of Word Clock Monitoring'.
signal to pps drift	A drift, measured between the word clock signal and the PPS of the reference, equals or exceeds the limit 'Limit Signal to PPS Drift'. Please refer to chapter "'Switcher": Set-Up of General Parameters'.
monitoring:	
threshold [V]	<b>SW</b> sets the signal threshold to 62% of the level's peak-to-peak value. The level can be set manually or measured automatically.
level, measured [V]	Even if the level has been set manually, the result of the measurement will be shown.
frequency, measured	Even if the frequency has been set manually, the result of the measurement will be shown.
signal to pps drift [ms]	Drift, measured between the word clock signal and the PPS of the reference.



## 3.5 Time & Date Reference Status

This module monitors the pulse-per-second input signal (PPS), the serial data string with time & date and status information, and the correct timing of both signals with respect to a definite correspondence of the serial data to the PPS signal.



The status and individual errors are considered for monitoring only; they have no effects on the automatic changeover characteristics.

<b>time</b>	Current time, received via serial data string.
<b>date</b>	Current date, received via serial data string.
<b>sync after reset</b>	Status, received via serial data string. Indicates that the reference source could have been synchronized at least once after turning the power on.
<b>locked</b>	Status, received via serial data string. Indicates that the reference source currently is synchronized.
<b>last lock</b>	Time & date of the moment of last indication of a “locked” status.
Individual reference errors:	
Error	Description
<b>pps timeout</b>	No valid PPS detected since 1.6 s.
<b>pps timing</b>	The interval between two consecutive PPS signals does not correspond to one second.
<b>serial timing</b>	The serial data string is not synchronized with the PPS signal.
<b>serial sequence</b>	A time discontinuity has been detected while checking the time & date information of the serial data string. This leads to an error even at a valid time discontinuity in case of a leap second or a DST switching if a local time zone has been selected as reference.



## 3.6 Status of Fan and Power Supplies

This module – as all configurable RUBIDIUM modules – is able to monitor the fan and power supplies which are plugged to the same housing as **SW**.

**Rubidium Status Monitor SE**

AV Rubidium H1 (USB) | Module 1: SW | scan | disconnect | Rubidium Status Monitor 2.1...

System | Input 1 | Input 2 | Reference | Fan Monitor

Frame		Port	
housing	H1 (or D1, Q1, S1, T1)	detected	yes
fan and ps monitoring	yes	failure	no
port monitoring	yes	address	2
fan failure	no	termination	off
ps failure	no		
fans and ps monitored by	this unit		

Fan 1		Fan 2	
detected	yes	detected	no
failure	no	failure	no
fan fault	no	fan fault	no
alarm	no	alarm	no
temp	40 °C	temp	0 °C

Power Supply 1		Power Supply 2	
detected	yes	detected	no
failure	no	failure	no
alarm	no	alarm	no
temp	47 °C	temp	0 °C
24V output	23,9 V	24V output	0,0 V
24V at frame	23,7 V	24V at frame	0,0 V

Module version 2.11.2.32 (SW)

Please refer to the document 'Installation & Systems Manual RUBIDIUM SERIES' for a detailed description.





## 4 The Rubidium Configuration Tools

### 4.1 The Rubidium Configuration PC Program

Please refer to the

*'Installation & Systems Manual RUBIDIUM SERIES'*

for a general description of this program and how to install it. In this document please notice the following subchapters:

- *Overview*
- *Installation*
- *Connection to RUBIDIUM SERIES Chassis*
- *Starting the Program*
- *Store, Load and Update the Configuration on your PC*
- *The "Profile" Tab: Store and Load Configurations on the Module*

The program RUBIDIUM CONFIGURATION uses various tab cards. With one click on the button **Configure** all available and currently activated tabs of this specific module are displayed.

Any changes at a tab will immediately be stored at the module. If you enter a number or a text press the **tabulator key** at the PC's keyboard afterwards.



## 4.2 The Rubidium Series HTTP Server

The RUBIDIUM SERIES HTTP server is located in the Ethernet module (**RUB IE** or **RUB PM**). A 10/100Base-T Ethernet connection and a web browser allow access to the RUBIDIUM system.

Please refer to the '*Functional Descriptions and Specifications RUB Ethernet*' manual for a detailed description of how to access the RUBIDIUM SERIES system.

- Click on "Configuration" at the RUBIDIUM homepage to open the **Configuration** page.
- Click on the blue **SW** button to establish a communication to this module. It opens a page with a list of all the links which correspond to all the available functions.

Changes at a page will not be stored at the module automatically. At the bottom of each page there are two buttons which should be used to store or load the module's configuration:

Button **Save To Module**:

- Click on this button to transfer all settings on this page to the module.

Button **Reload From Module**:

- Click on this button to load the current configuration of the module.

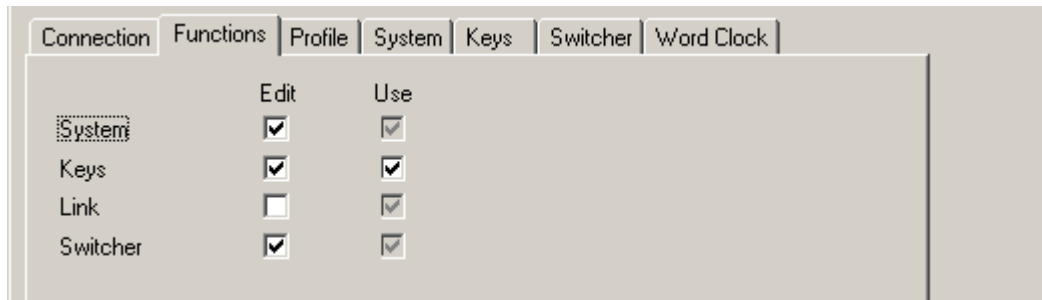


Every time you click on the blue button which indicates the module under configuration, a **Reload** will be done automatically.



## 4.3 “Functions“

Click on **Functions** to see all applicable tabs/pages listed, and to activate or deactivate tabs/pages. For example (screen shot of the PC program tab):



A tab/page reflects a function of the module. The columns **Edit** and **Use** determine whether the function in the module is activated/deactivated and whether user configuration of that specific function is allowed or not.

Click on the applicable **Edit** and/or **Use** check boxes to activate/deactivate a function:

Edit	Use	
		Function is deactivated, the tab/page is not visible.
√	√	Function is activated, the tab/page is visible and configurable.
	√	Function is activated but the tab/page not visible and therefore not configurable.

- We suggest that you deactivate the **Use** check boxes of all functions you are presently not using.
- We suggest that you deactivate the **Edit** check boxes of all functions you are presently not configuring. That avoids unintentional operating and malfunctions.

List of tabs/functions:

<b>Profile</b>	Store and Load Configurations on the Module (*)
<b>System</b>	Identification, Reset, SNMP, Fan Control
<b>Keys</b>	Keys and Lamps, LEDs and GPOs
<b>Switcher</b>	Set-Up of General Parameters
<b>Word Clock</b>	Set-Up of Word Clock Monitoring
<b>Link</b>	Communication between Modules

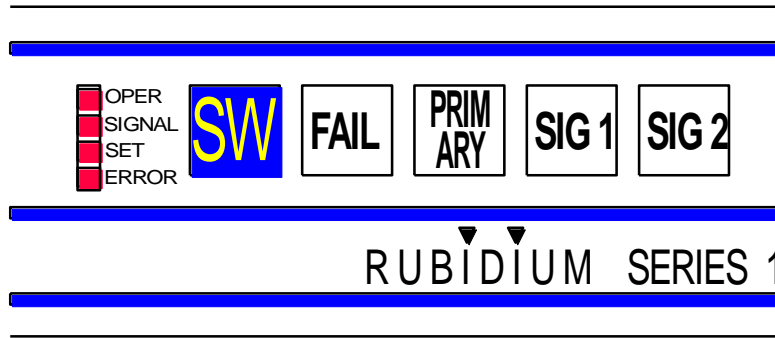
(\*) refer to “Installation & Systems Manual RUBIDIUM SERIES“



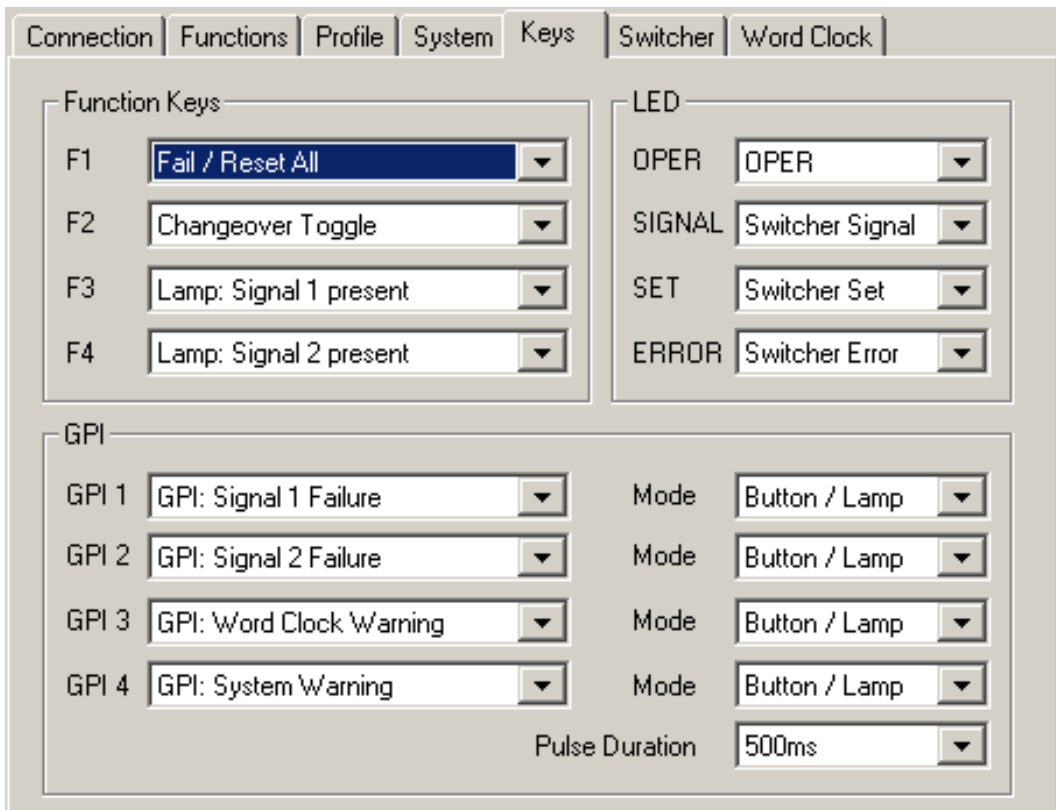
### 4.4 “Keys”: Keys and Lamps, LEDs and GPOs

The module has four GPOs (General Purpose Outputs), the RUB1 module additionally has four illuminated buttons (keys and lamps) and four LEDs (Light Emitting Diodes). Basically, the functions of these in- and outputs are programmable.

*Some functions presented by the configuration tool maybe assigned to special options, and therefore are not applicable with the standard firmware. For further information please contact Plura.*



Configuration (example shows a screen shot of the PC program tab):



The following functions for the **keys** are provided for this module:

Function	Description	Recommended Key
Clear	Resets all error counters.	F1: FAIL
Reset All	Resets all error counters and status.	F1: FAIL
Changeover to Primary	Manual changeover to "primary" source ( <i>CLOCK IN 1</i> ): <u>Automatic</u> mode: Changeover occurs only if the signals at <i>CLOCK IN 1</i> have not more failures than <i>CLOCK IN 2</i> . <u>Manual</u> mode: Changeover occurs without signal check.	F2: PRIMARY
Changeover Toggle	Manual changeover: <u>Automatic</u> mode: Changeover occurs only if the signals to which switching shall occur have not more failures than the current output signals. <u>Manual</u> mode: Changeover occurs without signal check.	F2: PRIMARY

The following functions for the **lamps** are provided for this module:

Function	Description	Recommended Lamp
Fail	Lights up, as long as the "overall failures" counter has a count value > 0.	F1: FAIL
Switcher on Primary Changeover Toggle Changeover to Primary	Lights up, if output <i>CLOCK OUT</i> is switched to <i>CLOCK IN 1</i> (primary source).	F2: PRIMARY
Signal 1 present	Lights up, if at least one word clock signal at <i>CLOCK IN 1</i> is present.	F3: SIG 1
Signal 2 present	Lights up, if at least one word clock signal at <i>CLOCK IN 2</i> is present.	F4: SIG 2

The following functions for the **LEDs** are provided for this module:

Function	Description	Recommended LED
OPER	Lights up, if the module is operating.	OPER
Switcher Signal	Reserved.	SIGNAL
Switcher Set	Lights up, if the real-time reference signals are present: PPS and a valid data string.	SET
Switcher Error	Lights up, as long as the "overall errors" counter has a count value > 0.	ERROR



The following functions for the **GPOs** are provided for this module:

Function	Description	Recommended GPO
Signal 1 Failure	Indicates a failure at <i>CLOCK IN 1</i> .	GPO_1
Signal 2 Failure	Indicates a failure at <i>CLOCK IN 2</i> .	GPO_2
Word Clock Warning	Indicates an error regarding the word clock signal pairs.	GPO_3
System Warning	Indicates an error regarding the signals of the real-time reference or after the self test.	GPO_4
System Error	Indicates, that the " <b>overall errors</b> " counter has a count value > 0.	
System Failure	Indicates, that the " <b>overall failures</b> " counter has a count value > 0.	
Switcher on Primary	Indicates that the output <i>CLOCK OUT</i> is switched to the primary source ( <i>CLOCK IN 1</i> ).	
Signal 1 present	Indicates, that at least one word clock signal at <i>CLOCK IN 1</i> is present.	
Signal 2 present	Indicates, that at least one word clock signal at <i>CLOCK IN 2</i> is present.	

Additionally, the output characteristic is selectable:

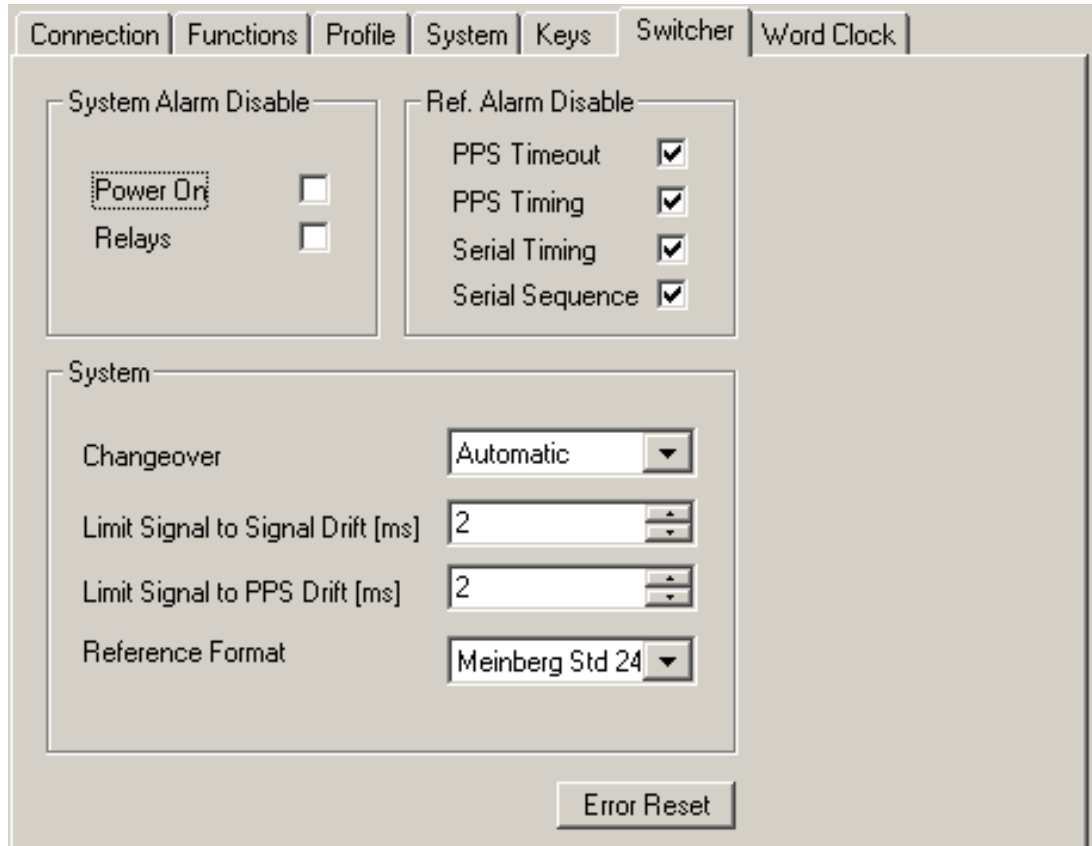
Dropdown list at <b>Mode</b>	Description
Button/Lamp	Statically, active "Low" [recommended]
Inv. Button/Lamp	Statically, active "High"
Switch/On Pulse	Pulse, active "Low"; pulse width selectable from 100 ms to 2 s. Pulse will be generated at event entry.
Inv. Switch/Off Pulse	Pulse, active "High"; pulse width selectable from 100 ms to 2 s. Pulse will be generated at the end of the event.
<b>Pulse Duration</b>	The pulse width is selectable as 100 ms, 200 ms, 500 ms, 1 s, 2 s. This selection refers to all GPO outputs set to a pulse mode.



## 4.5 “Switcher“: Set-Up of General Parameters

This function offers to select some general system parameters.

Configuration (example shows a screen shot of the PC program tab):



### System Alarm Disable

**SW** monitors some system characteristics. For a detailed description of each item please refer to chapter 'Self Test'.

The failure indication of each individual error can be disabled by checking the “disable” checkbox. If disabled, no failure alarm will be given in case of an error.

### Ref. Alarm Disable

**SW** monitors the signals of a real-time reference. For a detailed description of each item please refer to chapter 'Real-Time Reference Monitoring'.

The failure indication of each individual error can be disabled by checking the “disable” checkbox. If disabled, no failure alarm will be given in case of an error.



System

Select the operating mode and some parameters (default values in **bold** characters):

Item	Selection	Description
Changeover	<b>Automatic</b> Manual	Automatic or manual changeover operating mode. → Chapter 'Word Clock Changeover'.
Limit Signal to Signal Drift [ms]	1 – 100 <b>(2)</b>	<b>SW</b> monitors the drift between word clock signals. Signal 1 at <i>CLOCK IN 1</i> will be compared to signal 1 at <i>CLOCK IN 2</i> , signal 2 at <i>CLOCK IN 1</i> with signal 2 at <i>CLOCK IN 2</i> , etc. for all signal pairs. A "word clock signal to signal drift" error will be indicated if the drift equals or exceeds this limit. Allowed range: 1 – 100 ms. → Chapter 'Word Clock Monitoring' → 'Signal to Signal Drift'.
Limit Signal to PPS Drift [ms]	1 – 100 <b>(2)</b>	<b>SW</b> monitors the drift of each word clock signal compared to the PPS of the real-time reference. A "signal to pps drift" error will be indicated if the drift equals or exceeds this limit. Allowed range: 1 – 100 ms. → Chapter 'Word Clock Monitoring' → 'Signal to PPS Drift'.
Reference Format	<b>Meinberg Std ...</b> NMEA \$GPRMC... Meinberg Uni ... Wharton Status ...	<b>SW</b> expects a PPS and a serial data string from a real-time reference. The format and protocol of the serial data string should be selected in accordance with the connected device: "Meinberg Std 2400/7e2 + PPS" [GPS 10MHz, GLS 10MHz] "NMEA \$GPRMC 4800/8n1 + PPS" [GPS35, GPS16, GPS17] If "Meinberg Std 2400/7e2 + PPS" has been selected, <b>SW</b> automatically accepts the "Meinberg GPS" protocol as well. → Chapter 'Real-Time Reference Monitoring'.

Error Reset

Click this button to reset all error counters and status of the module – identical to pressing the FAIL key programmed with the "Reset All" function.





## 4.6 “Word Clock“: Set-Up of Word Clock Monitoring

This function offers to set up the word clock monitoring and changeover characteristic.

Configuration (example shows a screen shot of the PC program tab):

The screenshot shows the 'Word Clock' configuration window. It has tabs for 'Connection', 'Functions', 'Profile', 'System', 'Keys', 'Switcher', and 'Word Clock'. The 'Word Clock' tab is selected.

**Word Clock Monitoring Mode**

	Basis	Frequency	x	Factor	Level	Alarm Disable	Freq. Diff.	Drift
Signal 1	Auto		*	1	5.0V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Signal 2	Auto		*	1	5.0V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Signal 3	Auto		*	1	5.0V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Signal 4	Auto		*	1	5.0V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Word Clock Alarm Disable**

Changeover and Monitoring				Changeover and Monitoring			
IN1	Signal Loss	Frequency	Signal to PPS Drift	IN2	Signal Loss	Frequency	Signal to PPS Drift
Signal 1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Signal 1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Signal 2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Signal 2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Signal 3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Signal 3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Signal 4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Signal 4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Word Clock Monitoring Mode

The signals of a pair (signals 1 of *CLOCK IN 1* and *CLOCK IN 2*, etc.) should have same level and frequency. **SW** measures level (non-recurring) and frequency (permanently) of all word clock signals.

**Frequency:** A valid word clock frequency should be a multiple of one of the basic sample frequencies: 32 kHz, 44.1 kHz or 48 kHz. Any pull-up or pull-down frequency will not be regarded at this point. Example: 96 kHz = 48 kHz x 2. The factor can be out of 1, 2, 4, 8, 16, 32, 64, 128 or 256.

If you know the frequency of the signal, you can enter this frequency here. In this case, **SW** compares the measured frequency with the selected frequency, and raises an alarm in case of any differences.

The result of the frequency measurement will be presented at the status monitor.

→ Chapter 'Word Clock Monitoring' → 'Measurement of Signal Frequency'.



**Level:** The level is important for the “signal loss” detector. Only the peak-to-peak value should be regarded, any DC offset will not be taken into account. **SW** sets the signal threshold to 62 % of the level, approximately. Level measurement takes place only after the following events: First detection of a signal, “Error Reset” via key or button, any change of level set-up.  
Selecting “Auto”, the threshold will be calculated from the measured level.  
Instead of “Auto”, a level can be selected in the range of 1.0 V to 6.0 V, with steps of 0.5 V. The threshold will be calculated from the selected level. Example: Level = 5.0 V → threshold = 3.1 V.  
In both cases, the measured level will be presented at the status monitor.  
→ Chapter ‘Word Clock Monitoring’ → ‘Measurement of Signal Frequency’.

**Alarm Disable:** **SW** permanently monitors each signal pair: Between the signals of each pair the frequency should be equal, and no drift should be detectable. In case of a failure an alarm can be generated. Each individual alarm feature can be disabled by checking the corresponding box (“Freq. Diff.”, “Drift”).

#### Word Clock Alarm Disable

**SW** permanently checks 2 x 4 word clock signal for:

- “Signal Loss”. The level will be important for this check – see above.
- “Frequency”. In case the frequency has been selected manually (no “Auto” mode, see above), **SW** compares the measured frequency with the selected frequency.
- “Signal to PPS Drift”. In case that real-time reference signals have been connected, **SW** measures the drift of each signal compared to the PPS.

In case of a failure an alarm can be generated. Each individual alarm feature can be disabled by checking the corresponding box.

For more details please refer to chapter ‘Word Clock Monitoring’.



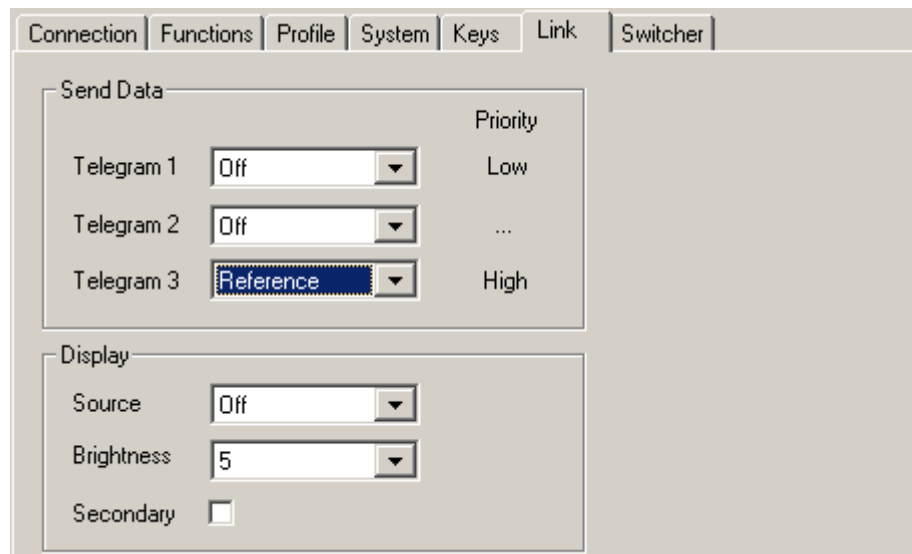
## 4.7 “Link”: Communication between Modules

**Link** uses the Rubidium internal TC\_link interface to transmit or receive data. This interface is shared by all the modules in one frame, and via the **RLC** connector it is possible to link further modules at different frames.

In case that the selected module should transmit data, **Link** selects the channel and the kind of data. The receiving module must select this channel as a reader input.

In case that the selected module should receive data, the **Link** function has to be activated (**Use**), and the selected channel (“Telegram” 1 or 2 or 3) has to be switched off.

Configuration (example shows a screen shot of the PC program tab):



### Send Data

Three channels (**Telegram 1 - 3**) have been provided to transmit data.

For each channel a function can be selected from the drop-down list:

<i>Off</i>	This channel will not be used to transmit data, data can be received.
<i>Reference</i>	This channel transfers time and date (UTC) of the external reference once per second, as long as there are valid signals (PPS IN, RXD IN) at REF IN connector.

### Display

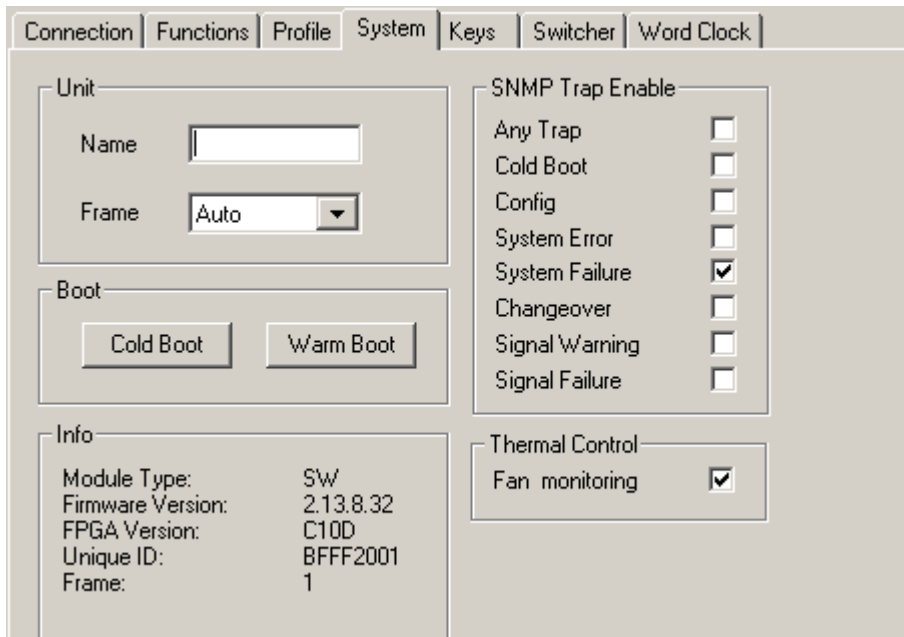
Adjust the parameters controlling the display of a RUBIDIUM **D1** or **Q1** chassis.

<b>Source</b>	Select the kind of data to be sent and displayed:
<i>Off</i>	No data will be sent from this module.
<i>Reference Time</i>	Time of the external reference (UTC) in a HH:MM:SS format.
<i>Reference Date</i>	Date of the external reference (UTC) in a Day.Month.Year format.
<b>Brightness</b>	Adjust the brightness of the LEDs, steps 1 to 7.
<b>Secondary</b>	Address the 'secondary' display instead of the 'primary' display.



## 4.8 “System“: Identification, Reset, SNMP, Fan Control

Configuration (example shows a screen shot of the PC program tab):



### Unit

**Name:** The connected module can get a name. You may enter, change, or verify this name at this window.

**Frame:** Modules in a network can be uniquely identified by a frame number and the module’s position within the frame. In a single frame system, you may select “Single” or “Auto” at this set-up. If a system is built-up of more than one frame, each frame has to receive a unique address (adjusted at the fan module). If you select “Auto”, the module will request this frame number automatically and will show it on the info box. Likewise, it is possible to select a frame number manually.

### Boot

**Cold Boot:** Do a cold boot of the module.

**Warm Boot:** Do a warm boot of the module.

### Info

Displays module’s status information.

### SNMP Trap Enable

Activate the “Any Trap” check box to enable the SNMP functionality in general. If not checked, this module will not send any SNMP traps.

The individual traps can be enabled/disabled by a click on the corresponding check box. Please notice the chapter ‘Alarms by SNMP Traps’ as well.

### Thermal Control

At least one module of each frame should have the fan monitoring activated. This enables the power supply monitoring – for power supplies within this frame - as well.





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