plura

TIMING SOLUTIONS

Rubidium Series

RUB SI

IRIG-B Time Code Monitoring and Changeover Module

Functional Description and Specifications
Supplement to the “Installation & Systems Manual RUBIDIUM SERIES”
Version: 4.3
December 2, 2020

CONTENTS

A1 Revision History

No.	Date	Subject
0.n	June 9, 2005	Preliminary documents, changes without notice.
1.0	November 10, 2005	First released document.
1.1	January 12, 2006	Revised.
2.0	December 12, 2006	Revised. Format of reference selectable.
2.1	August 1, 2007	Revised.
3.0	February 11, 2011	Completely revised.
3.1	August 1, 2011	IRIG formats IRIG-B 123, IRIG-B 127, AFNOR.
4.0	May 7, 2013	▪ Revised. ▪ Entries can be made to the log file of an Ethernet module. ▪ The TC_link telegram 'Reference' can be sent.
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

https://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

Printed in Germany.

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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 “SI”

1.1 General Description

This module can frame accurate and in real-time compare and contrast two incoming IRIG-B time code signals for indescribable differences. In the event of a failure, **SI** automatically switches to the other faultless source. The **SI** module is a must for all time code systems where failure proof IRIG-B is a requirement. This includes real-time applications. It monitors IRIG-B and real-time reference signals, time differences between the IRIG-B signals and time differences of IRIG-B against the real-time reference. Status information about all sources is available at a status monitor.

A **PC** or one of the RUB Ethernet modules (**RUB IE** or **RUB PM**) is required to configure this module.

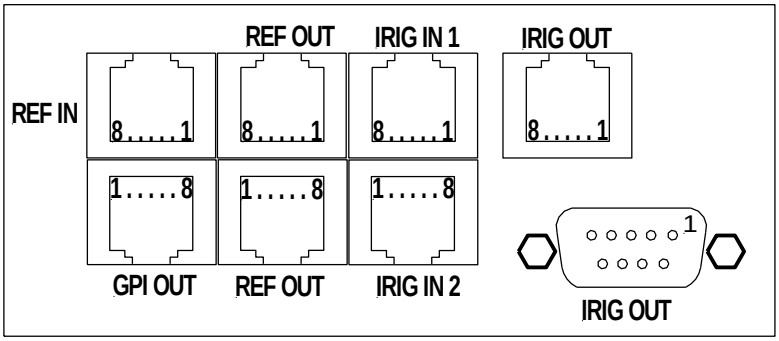
A front panel label **SI** visibly identifies RUB1 version modules. RUB3 version modules have this label at the rear plate. A serial number is located on the bottom side of the lower circuit board of each module.

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.
- Two IRIG-B time code inputs.
- Inputs for signals of a real-time reference (PPS, time & date data string), and 1 to 2 distribution of these signals.
- Changeover regarding the two IRIG-B signals and the SERIAL and TELEGRAM input signals, utilizing latching relays.
- Alarm outputs indicating failures and warnings: Lamps and LEDs (RUB1 version only), GPIs, SNMP traps, and entries in the log file of an Ethernet module.

1.2 Rear Panel and Connections



Pin assignments

IRIG IN (1/2) RJ45 jack	IRIG OUT RJ45 jack	IRIG OUT DSUB9F female
1: PIN 1 2: PIN 2 3: IRIG_IN_A 6: IRIG_IN_B 4: GND 5: DRVSEL 7: SERIAL IN 8: TELEGRAM IN	1: PIN 1 2: PIN 2 3: IRIG_OUT_A 6: IRIG_OUT_B 4: GND 5: n.c. 7: SERIAL OUT 8: TELEGRAM OUT	1: PIN 1 2: PIN 2 3: IRIG_OUT_A 4: IRIG_OUT_B 5: GND 6, 7: n.c. 8: SERIAL OUT 9: TELEGRAM OUT

REF IN RJ45 jack	REF OUT RJ45 jack
1: PPS IN 2: RXD IN 3, 6: n.c. 4: GND 5: VCC24G_OUT 7: GND IN 8: VCC5G_OUT	1: PPS OUT 2: TXD OUT 3, 6: n.c. 4: GND 5: VCC24G_IN 7: GND OUT 8: VCC5G_IN

GPI OUT RJ45 jack
1: GND 2: GPI_1 5: GPI_3 6: GPI_2 8: GPI_4 3: XCP 4: XCC 7: XCS

Signal descriptions

GND	Signal ground.
PIN 1 / PIN 2	Signals coming from the connected GI module, hard wired between input and output connectors.
IRIG_IN_A, IRIG_IN_B	Balanced IRIG-B inputs.
IRIG_OUT_A, IRIG_OUT_B	Balanced IRIG-B output, switched via relay 1 to one IRIG-B input.
DRVSEL	Output signal. In a redundant system, **SI** gives a feedback to the connected **GI** modules to define one module as "primary" and the other as "back-up".
SERIAL IN SERIAL OUT	Time & date serial; signal of a connected **GI** module. Output signal switched via relay 2 to one SERIAL IN input.
TELEGRAM IN TELEGRAM OUT	Impulse telegram; signal of a connected GI module. Output signal switched via relay 2 to one TELEGRAM IN input.
PPS IN PPS OUT	Pulse per second, input. Time mark of a real-time reference. Pulse per second, output. Hard wired to PPS IN.
RXD IN TXD OUT	Serial data string, input. Signal of a real-time reference. Serial data string, output. Hard wired to RXD IN.
VCC24G_OUT	24 VDC voltage output, 200 mA reversible fused. This output voltage will be delivered from the power supply module in use (please notice the power supply specifications), or from the VCC24G_IN pin.
⚠	Using VCC24G_OUT output please make sure not to exceed the total power rating of the power supply module.
VCC24G_IN	Hard wired with VCC24G_OUT signal.
GND_IN/GND_OUT	These signals are just hard wired.
VCC5G_IN/VCC5G_OUT	These signals are just hard wired.
GPI_1 … GPI_4	Output signals, indicating failures, warnings, or status.
XCP, XCC, XCS	Spare contacts at relay 2 for optional usage. Switching occurs in parallel to the IRIG-B relay 1. XCC: Common XCP: Primary XCS: Secondary/Back-up

1.3 Specifications

IRIG-B input

Format	IRIG-B: Amplitude modulated 1 kHz carrier signal, balanced. IRIG-B 123 or IRIG-B 127 according to IRIG STANDARD 200-04; AFNOR time code according to AFNOR NF S 87-500.
Input impedance	18 kΩ
Signal level	100 mV_{p-p} – 5 V_{p-p}, mark amplitude, auto-ranging
Accuracy of timing measurements	TC/TC difference and TC/Ref difference: ± 0.1 ms

PPS IN, RXD IN

Input specification	Input "Low": -15.0 to +1.0 V. Input "High": +3.0 to +15.0 V. Frequency: 0 – 1 MHz.

GPI_1, GPI_2, GPI_3, GPI_4

Output specification	Open Collector output of an NPN transistor. Max. power dissipation: 200 mW per output. "High" state: External pull-up needed to a positive power source of ≤ 24 VDC. Example: 2.2 kΩ @ 5 VDC or 4.7 kΩ @ 12 VDC or 12 kΩ @ 24 VDC. "Low" state: Output switched to GND. Max. collector current: 100 mA DC, fused (auto-recovery). Collector-emitter saturation voltage: @100 mA: Typ. 200 mV (≤ 600 mV). @10 mA: Typ. 90 mV (≤ 250 mV). Frequency: 0 – 150 kHz.

VCC24G_OUT

Output of the DC power supply of this module, normally = 23.8 VDC	Reversible fused. A continuous current of up to 120 mA may be applied over the whole specified operating temperature range. At an ambient temperature of e.g. 22 °C the output switches to a high-resistance state after a few seconds if a current of 400 mA is applied.

XCP, XCC, XCS

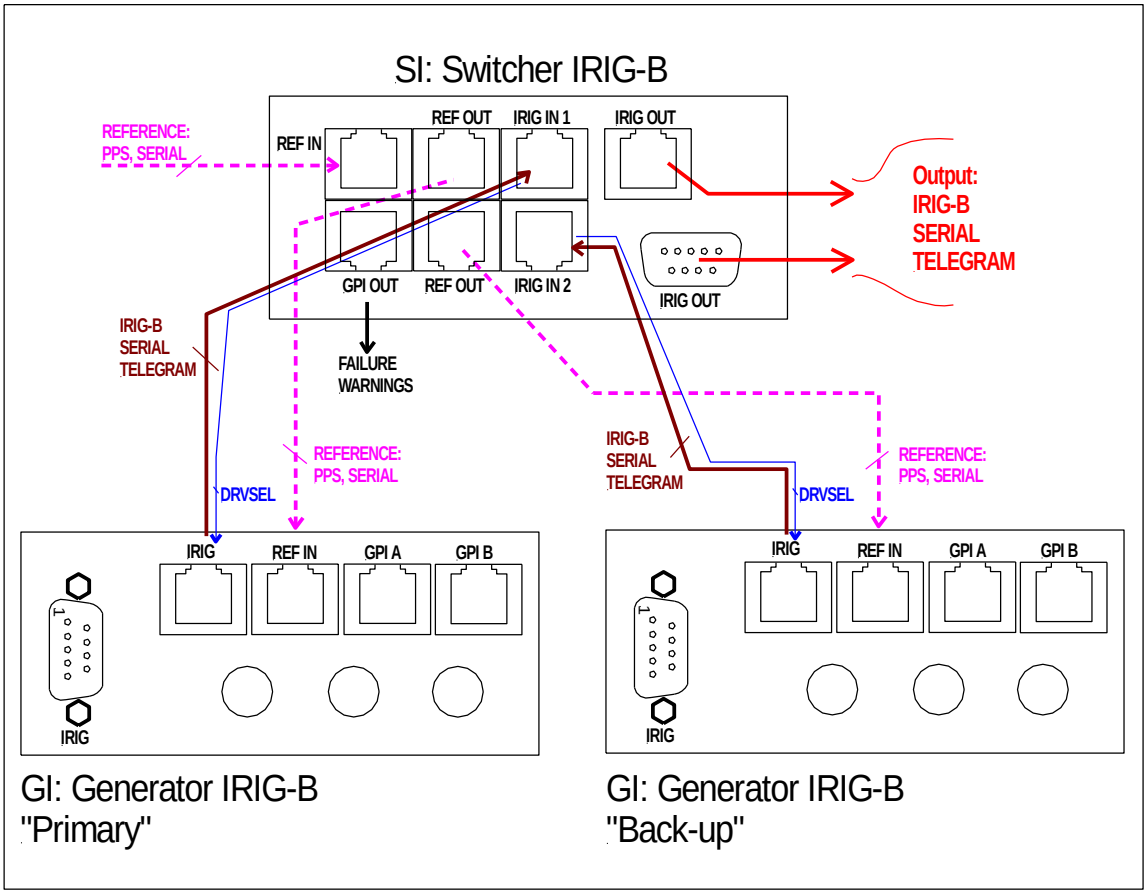
Spare contacts of the latching relay 2	Max. switching power: 24 W Max. switching voltage: 48 V	Max. switching current: 1 A Max. transportable current: 1 A

Others

Operating voltage	12 – 30 VDC
Power consumption	1.2 W at maximum
Weight	≈ 0.3 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

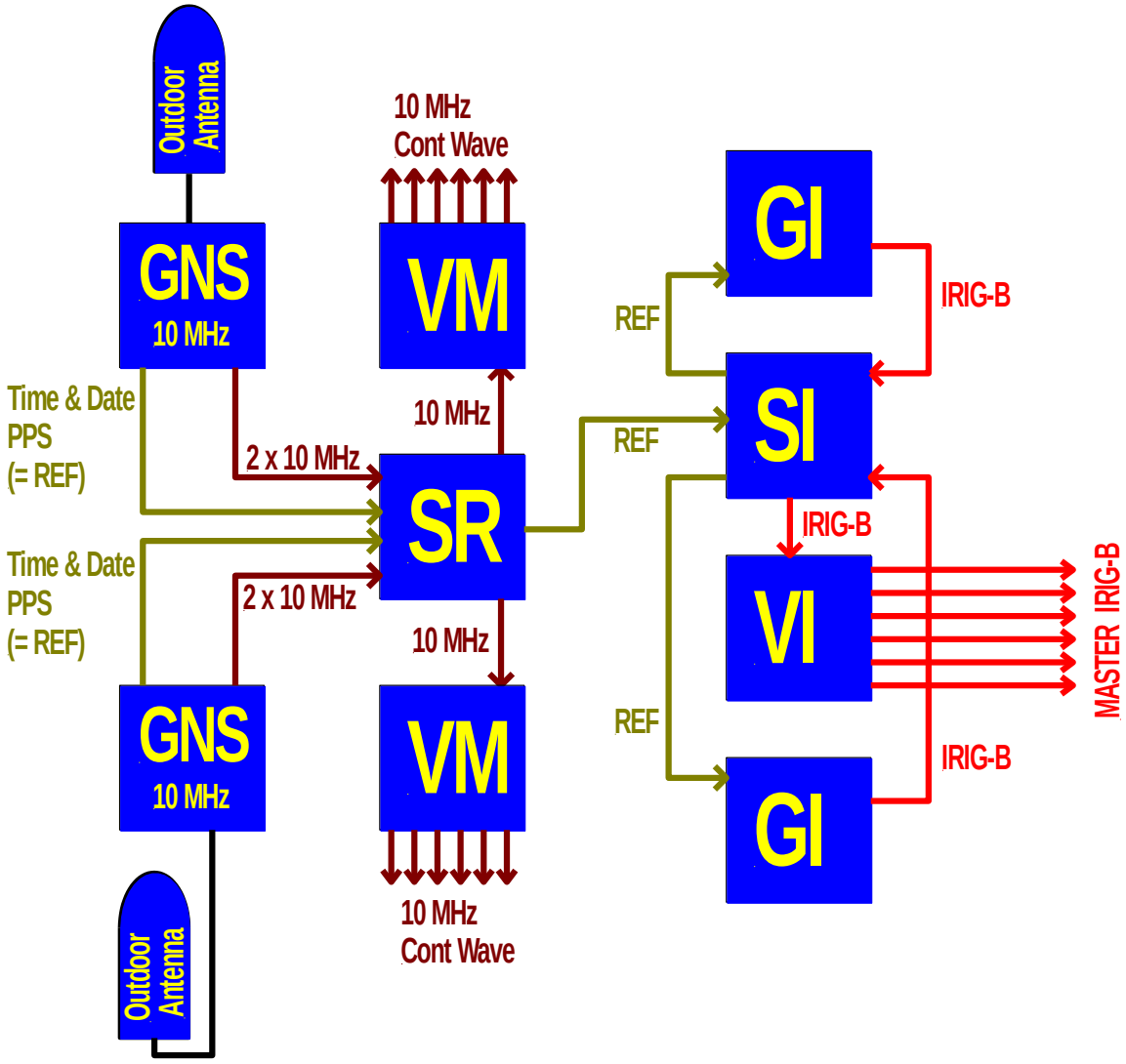
1.4 Typical Application Diagrams

1.4.1 Basic Signal Flow with the SI Module

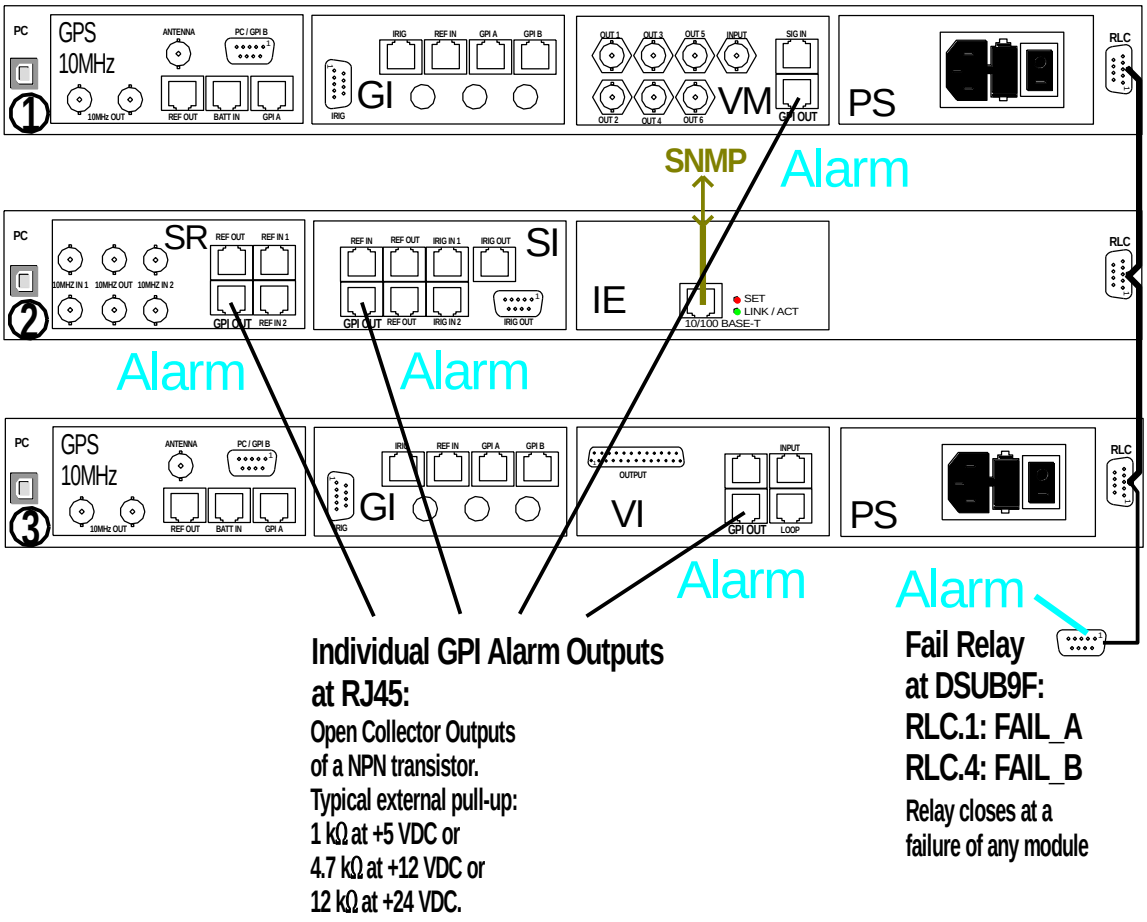


- IRIG-B: Monitoring and changeover.
- Signals of a real-time reference (PPS, serial data): Monitoring and 1 to 2 distribution.
- SERIAL and TELEGRAM will be switched simultaneously with the IRIG-B signals.
- The DRVSEL output signal gives a feedback to the connected GI modules to define one module as “primary” and the other as “back-up”. Only a “primary” module sends data on the internal TC_link interface, for example the reference time for an NTP time server.

1.4.2 Example of a Complete Redundant System



1.4.3 GPI Connection to an External Alarm System



GPI alarms, default configuration:

GPI	Switcher "SR"	Switcher "SI"
Signal 1 Failure	PPS/serial input 1 failure	IRIG-B input 1 failure
Signal 1 Warning	PPS/serial input 1 warning	IRIG-B input 1 warning
Signal 2 Failure	PPS/serial input 2 failure	IRIG-B input 2 failure
Signal 2 Warning	PPS/serial input 2 warning	IRIG-B input 2 warning

Please also notice the document *'Alarm GPO'*. You may open this document at https://www.plurainc.com

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 SI version.tcf".
   "version" stands for a revision no., e.g. 2.13.8.

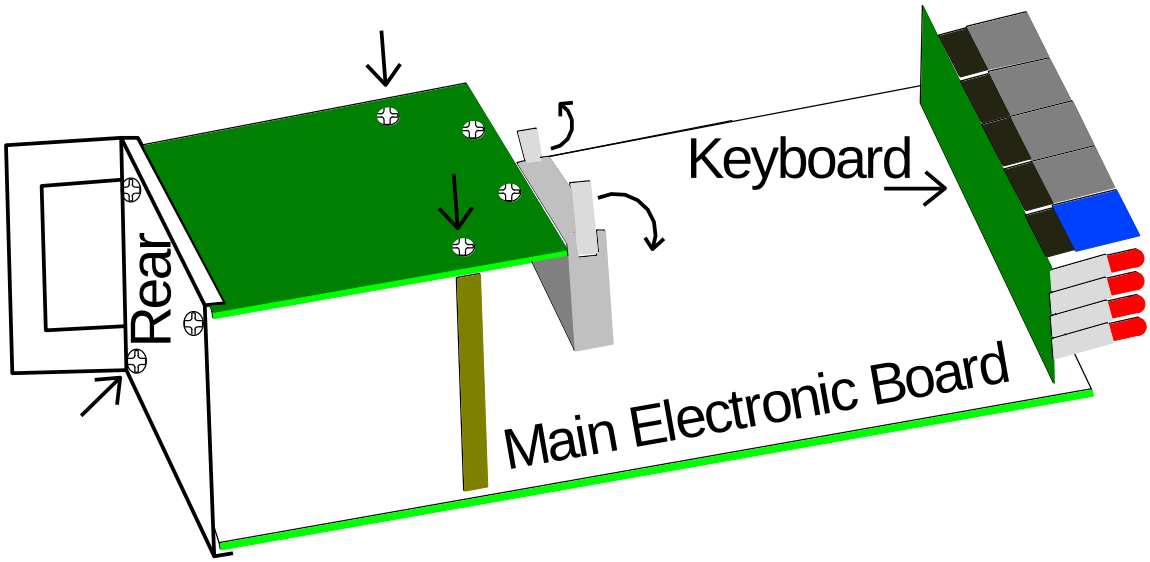
   Click the OK button, update starts. Click the OK button at the end.
6. Update is finished now. We recommend checking module's configuration utilizing the "RUBIDIUM CONFIGURATION" program.

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 relay 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.



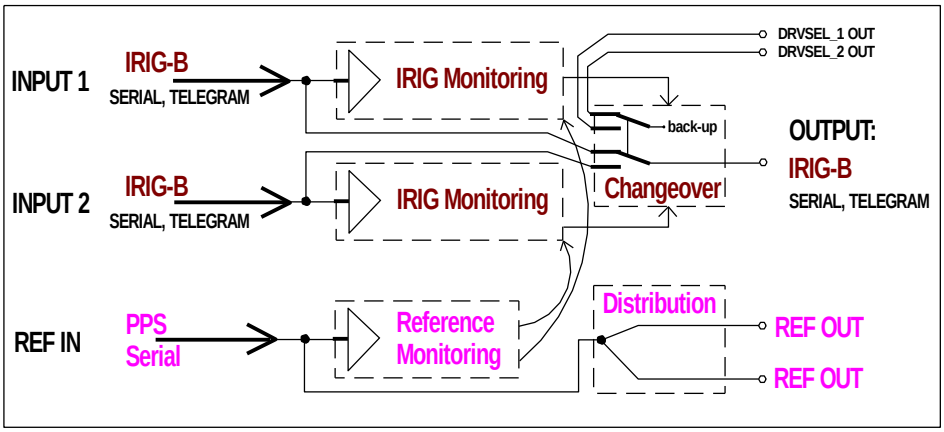
1. Arrangement:
   Contact your local dealer or Plura to order the main electronic board and the keyboard for a replacement. It is essential that you have as much information ready as possible: Serial number of the module, software version number, set-up and configuration. This will help to ensure that 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 the IDC connector and pull out the 20-way ribbon cable. Now the main electronic board and the keyboard can completely be removed.
5. Reassemble:
   In principle follow the procedure in the reverse order.

2 Operating Description

2.1 Functional Overview

2.1.1 Basic Functions

- Decoding of two IRIG-B signals. Checking the validity of the data (time, day of year, SBS).
- Monitoring and failure analysis of the IRIG-B inputs; changeover in an event of a failure.
- Measurement and monitoring the time difference and drift between the IRIG-B signals.
- Monitoring the signals of a real-time reference.
- Measurement and monitoring the time difference and drift of the IRIG-B signals against the real-time reference.



The Status Monitor indicates:

IRIG-B status information:

- IRIG-B time, date, SBS word and control bits information.
- Time difference between the IRIG-B signals.
- Time difference of the IRIG-B signals against the real-time reference.
- Error counters and error indications in case of failures.
- Error counters and error indications in case of warnings.

Status information regarding the real-time reference:

- Time, date and status.
- Error counters and error indications.

Additional system status information:

- Monitor for manual and automatic changeover events.
- Error counters/error indications: Check of set-up parameters, relay monitoring.
- And more …

PC programs are available for free: Configuration of the module = **RubidiumConfig.exe**, status monitor = **RubStatSE.exe**.

The RUBIDIUM SERIES HTTP server, located in the Ethernet module (**RUB IE** or **RUB PM**) enables the configuration of the module and offers a status monitor as well.

2.1.2 Overview of Error Indications and Alarms in General

This module detects errors on IRIG-B 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:

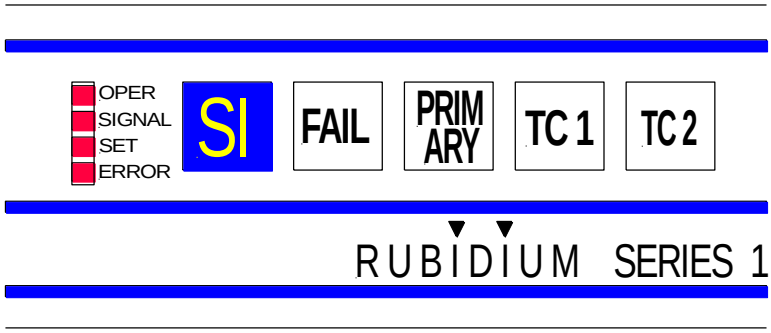
- The "overall errors" counter shows the sum of all individual errors. A count value of > 0 indicates that at least one error has been detected.
- The "overall failures" counter shows the sum of all individual failures, i.e. all those errors with the failure indication not disabled. A count value of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



GPI outputs can indicate failures and warnings:

→ Chapter '*Alarms by GPI 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

output	primary			
signals received	yes			
data received	yes			
overall failures	0			
overall errors	0			
tc/tc difference	+ 00 : 00 : 00	0,0 ms	valid	
max difference	00 : 00 : 00	0,0 ms		
changeover events:				
automatic	0	time tc1	11 : 11 : 34	
manual	1	time tc2	11 : 11 : 34	
last event	manual	reference	10.12.2010 10:11:33	
	status	counts	fail	disabled
power on	0		0	0
relay 1	0	0	0	0
relay 2	0	0	0	0
tc/tc difference	0	0	0	0

The **Input 1** page shows the individual errors with respect to the signals at IRIG IN 1.
The **Input 2** page shows the individual errors with respect to the signals at IRIG 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 '*IRIG-B 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. Maximum count = 65,535. 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 GPI outputs of functions **Signal 1 Failure**, **Signal 2 Failure**, **Signal 1 Warning**, **Signal 2 Warning**.

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

„overall errors“ > 0	„overall failures“ > 0
• LED (ERROR) in the **Switcher Error** function. • GPI output in the **System Error** function. • SNMP trap **System Error**.	• Lamp (FAIL) in the **Fail** function. • GPI output in the **System Failure** function. • SNMP trap **System Failure**.

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 IRIG-B Monitoring

2.2.1 Overview of Measurements and Error Detections

This module monitors two IRIG-B signals. After the power has turned on, the monitoring starts if once a valid signal has been received.

signals received	yes
data received	yes

signals received = yes, if once a complete IRIG-B frame has been received.
data received = yes, if once valid data has been decoded out of an IRIG-B frame.

The time difference between the IRIG-B signals will be measured. The result will be shown at the **System** page of the status monitor:

tc/tc difference	+ 00 : 00 : 00	0,0 ms	valid
max difference	00 : 00 : 00	0,0 ms	

tc/tc difference — Time difference, HH:MM:SS and milliseconds. This difference is calculated taking the time data and the phase of the reference bits into account.
A "+" sign means: *IRIG IN 1* time is equal or ahead of *IRIG IN 2* time.
A "valid"/"invalid" flag indicates whether the current difference is valid or not. If one IRIG-B input fails, the time difference is invalid.
Accuracy: ± 0.1 ms.
A "tc/tc difference" error will be indicated if the time difference equals or exceeds the limit "Limit TC/TC". This limit is programmable. Please refer to chapter '*The Individual Errors*' for more information.

max difference — Maximum value of "tc/tc difference", HH:MM:SS, no sign.

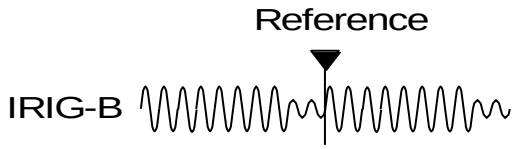
Further monitoring is done separately for signals at *IRIG IN 1* and *IRIG IN 2*. The status monitor shows the results at **Input 1** page or **Input 2** page resp.:

The decoded data of the IRIG-B signal:

time	11:12:30	**control**	000001000 010001000 000001000
days	344	**date**	10.12.10, dow:5
SBS	40350		

time — HH:MM:SS.
days — Day of the year (1 – 365/366).
SBS — (Straight Binary Seconds) Seconds of day, value <= 86,400.
control — 27 control function bits; bitwise representation starting with CNTRL1.
date — Depending on the time code format, data concerning a date may be included. IRIG-B 127 conveys units and tens of year; AFNOR NF S 87-500 time code conveys a complete date, which can be displayed in a day.month.year format together with the day-of-week (dow).

The time difference and drift of the IRIG-B signal against the real-time reference:



tc/ref difference	- 00 : 00 : 00	8,900 ms	valid
max difference	00 : 00 : 00	8,9 ms	
drift	0,4 ms	ready	

tc/ref difference — Time difference, HH:MM:SS and milliseconds. This difference is calculated taking the time data of IRIG-B and real-time reference as well as the phase of the reference bit against the PPS into account.
A "+" sign means: IRIG-B time is equal or ahead of the real-time reference. A "valid"/"invalid" flag indicates whether the current difference is valid or not. If IRIG-B or real-time reference input fails, the time difference is invalid.
Accuracy: ± 0.1 ms.
There are two programmable limits. An error will be indicated if the time difference equals or exceeds one of these limits. Please refer to chapter *'The Individual Errors'* for more information.

max difference — Maximum value of "tc/ref difference", HH:MM:SS and milliseconds, no sign.

drift — The drift (milliseconds) of the IRIG-B signal against the real-time reference = the variation of the difference with time. There are programmable limits, too. An error will be indicated if the drift equals or exceeds one of these limits. Please refer to chapter *'The Individual Errors'* for more information.

Errors and failures (see chapter *'The Individual Errors'* for details):

	status	counts	fail	disabled
change-over & monitoring				
sequence	0	0	0	0
data	0	0	0	0
timeout	0	0	0	0
tc/ref fail	0	0	0	0
monitoring				
tc/ref error	0	0	0	0
lock range	0	0	0	0
lock drift	0	0	0	0
current sequence	0	0		

2.2.2 The Individual Errors

The following error may occur comparing both signals at *IRIG IN 1* and *IRIG IN 2*. This error will be indicated at the **System** page of the status monitor:

Time difference between the IRIG-B signals: **TC/TC Difference**

The module decodes the time information and measures the phase of the reference bit of the IRIG-B signals. From that, the precise time difference can be calculated and displayed: "tc/tc difference" and "max difference". A "tc/tc difference" error will be indicated if the time difference equals or exceeds the limit "Limit TC/TC". This limit is programmable in the range from 0.1 s to 10.0 s.

This is the only error which is assigned together to both IRIG-B signals. A "System Error" or "System Failure" alarm can be raised, but no warning or failure indicating a problem of a specific IRIG-B input. Therefore, this error will not be considered for a changeover.

Further monitoring is done separately for signals at *IRIG IN 1* and *IRIG IN 2*. The status monitor indicates the errors at **Input 1** page or **Input 2** page resp.:

Signal loss: **Timeout**

No valid IRIG-B format detected since 1.0 s, or no valid IRIG-B time code word detected since 3.5 s. This leads to a "timeout" error.

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

Plausibility of data content: **Data**

The module decodes the data of the IRIG-B input. The data will be checked for plausibility: Time (HH:MM:SS),
day of year (1 – 365/366),
SBS (Straight Binary Seconds = seconds of the day, value <= 86 400).

Any implausibility leads to a "data" error.

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

Signal disturbances: **Sequence**

The IRIG-B input produces multiple dropouts or time discontinuities over a longer time interval. This leads to a "sequence" error.

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

Continuity of the time: **Current Sequence**

A time discontinuity has been detected while checking the IRIG-B time information (HH:MM:SS). This leads to a "current sequence" error - even at a valid time discontinuity in case of a leap second or a DST switching of a local time zone.

This error will be classified as a minor error, so this error will not be considered for a changeover. Different from all other errors, there is no 'fail' and 'disabled' bit provided, so this error cannot be a failure.

Time difference against the real-time reference: **TC/Ref Error** and **TC/Ref Fail**

If the PPS (pulse per second) and RXD (serial data string) signals of a real-time reference are connected, the module measures and displays the precise time difference of the IRIG-B signals against the real-time reference: "tc/ref difference" and "max difference".

It is common practice that the time zone of the real-time reference is different from the time zone of the IRIG-B time code, e.g. real-time reference = UTC and IRIG-B time code = local time zone. This often results in a time difference of some hours and should not be treated as an error. Accordingly, the "Ref. Compare" parameter (please refer to chapter *'"Switcher": Set-up the Monitoring and Changeover'*) should receive an appropriate set-up:

HH:MM:SS	= Time difference calculated without restrictions.
MM:SS	= Comparing only minutes and seconds.
M:SS	= Comparing only unit of minutes and seconds.
SS	= Comparing only seconds.

A "tc/ref error" error will be indicated if the time difference equals or exceeds the limit "Limit TC/Ref Error". This limit is programmable in the range from 1 s to 9 s. This error will be classified as a minor error; it is intended to give a warning.
A "tc/ref fail" error will be indicated if the time difference equals or exceeds the limit "Limit TC/Ref Fail". This limit is programmable in the range from 10 s to 59 s. This error will be classified as a major error, so this error will be considered for a changeover.

Drift against the real-time reference: **Lock Range** and **Lock Drift**

The module monitors the drift of the IRIG-B reference bit against the PPS of the real-time reference. This enables to verify a phase lock of the IRIG-B generator to a PPS sync signal. This monitoring starts 30 minutes after the power has turned on to ensure that all units have synchronized. If the time difference of the IRIG-B signal against the real-time reference equals or exceeds the limit "Limit Lock", the drift monitor stops and a "lock range" error will be indicated. This limit is programmable in the range from 0.1 s to 10.0 s.
While the time difference stays within the limit "Limit Lock", the drift will be measured. If the drift equals or exceeds the limit "Limit Drift", a "lock drift" error will be indicated. This limit is programmable in the range from 10 ms to 255 ms. The drift monitor stops for a short time, then the drift will be reset to zero and a new measurement starts. An error will be counted periodically as long as the drift has not been eliminated.

These errors will be classified as minor errors, so these errors will not be considered for a changeover.

2.2.3 Consequences of Errors

The "tc/tc difference" error will be indicated at the **System** page of the status monitor:

	status	counts	fail	disabled
power on	0		0	0
relay 1	0	0	0	0
relay 2	0	0	0	0
tc/tc difference	0	0	0	0

All other IRIG-B errors will be indicated at the **Input 1** and **Input 2** pages:

	status	counts	fail	disabled
change-over & monitoring				
sequence	0	0	0	0
data	0	0	0	0
timeout	0	0	0	0
tc/ref fail	0	0	0	0
monitoring				
tc/ref error	0	0	0	0
lock range	0	0	0	0
lock drift	0	0	0	0
current sequence	0	0		

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

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).
- GPI output programmed as 'System Error' becomes active.
- SNMP trap 'System Error' will be sent.

Each error except 'current sequence' 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).
- GPI 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 GPI Outputs*'.
→ Chapter '*Alarms by SNMP Traps*'.
→ Chapter '*Entries in the Log File of an Ethernet Module*'.

The individual errors separately detected for signals at *IRIG IN 1* and *IRIG IN 2* are divided into major and minor errors. Any major error can force a changeover. All these individual errors can raise special alarms if the corresponding '**disable**' checkbox has not been checked:

Major errors: "sequence", "data", "timeout", "tc/ref fail".

- GPI output, programmed as "Signal 1 Failure" or "Signal 2 Failure" resp.
- SNMP Trap "Signal 1 Failure" or "Signal 2 Failure" resp.

Minor errors: "tc/ref error", "lock range", "lock drift".

- GPI output, programmed as "Signal 1 Warning" or "Signal 2 Warning" resp.
- SNMP Trap "Signal 1 Warning" or "Signal 2 Warning" resp.

This table shows all the individual errors and their consequences:

		Individual Errors								
			Major Errors				Minor Errors			
		tc/tc difference	sequence	data	timeout	tc/ref fail	tc/ref error	lock range	lock drift	current sequence
Status Monitor	status Sets bit to 1	yes	yes	yes	yes	yes	yes	yes	yes	yes
	counts Counts + 1	yes	yes	yes	yes	yes	yes	yes	yes	yes
	overall errors Counts + 1	yes	yes	yes	yes	yes	yes	yes	yes	yes
	fail Sets bit to 1	yes*	yes*	yes*	yes*	yes*	yes*	yes*	yes*	no
	overall failures Counts + 1	yes*	yes*	yes*	yes*	yes*	yes*	yes*	yes*	no
LED and Lamp	LED function Switcher Error LED (ERROR) lights up	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Lamp function Fail Lamp (FAIL) lights up	yes*	yes*	yes*	yes*	yes*	yes*	yes*	yes*	no
GPI Functions	Signal 1 Failure (GPI_1) Signal 2 Failure (GPI_2)	no	yes*	yes*	yes*	yes*	no	no	no	no
	Signal 1 Warning (GPI_3) Signal 2 Warning (GPI_4)	no	no	no	no	no	yes*	yes*	yes*	no
	System Error (if "overall errors" > 0)	yes	yes	yes	yes	yes	yes	yes	yes	yes
	System Failure (if "overall failures" > 0)	yes*	yes*	yes*	yes*	yes*	yes*	yes*	yes*	no
SNMP Traps	System Error (if "overall errors" > 0)	yes	yes	yes	yes	yes	yes	yes	yes	yes
	System Failure (if "overall failures" > 0)	yes*	yes*	yes*	yes*	yes*	yes*	yes*	yes*	no
	Signal 1 Failure Signal 2 Failure	no	yes*	yes*	yes*	yes*	no	no	no	no
	Signal 1 Warning Signal 2 Warning	no	no	no	no	no	yes*	yes*	yes*	no
Log	Event SI	yes*	yes*	yes*	yes*	yes*	yes*	yes*	yes*	yes

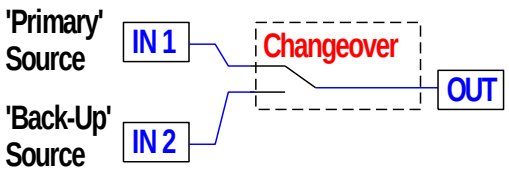
yes*: "yes" under the condition that the corresponding "**disable**" checkbox has not been checked, i.e. the status monitor shows "disabled" = 0.

2.3 IRIG-B Changeover

SI monitors IRIG-B signals of two 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 source 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 *IRIG IN 1*. This is the recommended function, because it avoids any unintentional changeover to the back-up source.
- 'Changeover Toggle': Changeover between sources *IRIG IN 1* ↔ *IRIG IN 2*.

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

	Automatic	**Manual**
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 regard-less of any errors or failures.

In the automatic mode, the module tries to output a "good" signal while avoiding any un-necessary 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

- has major errors and the back-up not,
- has a 'timeout' error and the back-up not.

Changeover from the back-up 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

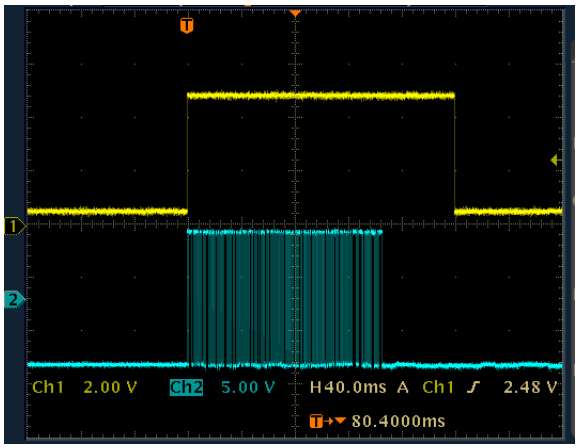
The inputs PPS IN and RXD IN at the REF IN connector are provided to connect signals of a real-time reference. These inputs are hard wired to both the REF OUT connectors (1 to 2 distribution).

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

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

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



These signals are used to calculate and monitor the time difference and drift of the IRIG-B signals against the real-time reference. This monitoring requires faultless real-time reference signals. For example, the serial data string has to be synchronized to the PPS.

In case of a changeover event, the time of this event will be derived from the time & date of the real-time reference.

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).
- GPI 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).
- GPI 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 GPI 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:

			power on	relay 1	relay 2
Status Monitor	status	sets bit to 1	yes	yes	yes
	counts	counts + 1	no	yes	yes
	overall errors	counts + 1	yes	yes	yes
	fail	sets bit to 1	yes*	yes*	yes*
	overall failures	counts + 1	yes*	yes*	yes*
LED Lamp	LED function	Switcher Error LED (ERROR) lights up	yes	yes	yes
	Lamp function	Fail Lamp (FAIL) lights up	yes*	yes*	yes*
GPI	System Error	(if "overall errors" > 0)	yes	yes	yes
	System Failure	(if "overall failures" > 0)	yes*	yes*	yes*
SNMP	System Error	(if "overall errors" > 0)	yes	yes	yes
	System Failure	(if "overall failures" > 0)	yes*	yes*	yes*
Log	Event SI		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 IRIG-B 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
relay 1	0	0	0	0
relay 2	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.

'relay 1' and 'relay 2': The latching relays can be monitored through internal sense signals. If any sense signal does not correspond to the intended switching position, a 'relay 1' resp. 'relay 2' error will be indicated.

Each error has the following consequences:

- Indication of an error at the status monitor (*'status'* = 1).
- In case of error 'relay1' or 'relay 2': Error counter counts one up.
- Counter 'overall errors' counts one up.
- LED programmed as 'Switcher Error' lights up (RUB1 version modules).
- GPI 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).
- GPI output 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 GPI 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:

			power on	relay 1	relay 2
Status Monitor	status	sets bit to 1	yes	yes	yes
	counts	counts + 1	no	yes	yes
	overall errors	counts + 1	yes	yes	yes
	fail	sets bit to 1	yes*	yes*	yes*
	overall failures	counts + 1	yes*	yes*	yes*
LED Lamp	LED function	Switcher Error LED (ERROR) lights up	yes	yes	yes
	Lamp function	Fail Lamp (FAIL) lights up	yes*	yes*	yes*
GPI	System Error	(if "overall errors" > 0)	yes	yes	yes
	System Failure	(if "overall failures" > 0)	yes*	yes*	yes*
SNMP	System Error	(if "overall errors" > 0)	yes	yes	yes
	System Failure	(if "overall failures" > 0)	yes*	yes*	yes*
Log	Event SI		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.

2.6 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 GPI and/or SNMP.

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

The usage of the **Signal 1/2 Failure** and **Signal 1/2 Warning** alarms offers the advantage that the problem directly can be related to source *IRIG IN 1* or *IRIG IN 2*. Additionally, it is possible to distinguish between failures (major errors) and warnings (minor errors). These alarms indicate real IRIG-B problems; none of these alarms should be raised in an IRIG-B system during normal 24 hours operation. A warning indicates a situation which may lead to a major problem if no interaction will take place.
In case of a GPI connection, these advantages are given only if the GPI outputs are connected separately to inputs of an alarm management system.
The „tc/tc difference" error as well as the errors with respect to the real-time reference and self test are missing if only these alarms are considered.

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 (IRIG-B or reference) time discontinuity in case of a leap second or a DST switching of a local time zone raises an alarm ("current sequence" or "serial sequence" error).

System Failure: Basically, this alarm combines all failures. The "current sequence" error will not be a failure. Only those errors which are enabled to indicate a failure can raise an alarm. So, your configuration determines which of the IRIG-B errors, errors with respect to the real-time reference, and errors with respect to the self test, are considered for sending an alarm. No alarm will be raised in case of a valid time jump. 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 **SI** module.

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

Using GPI outputs requires a proper configuration (→ chapter *'Alarms by GPI 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 GPI Outputs

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

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

Signal 1 Failure Recommended GPI: **GPI_1**
Signal 2 Failure Recommended GPI: **GPI_2**

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

sequence
data
timeout
tc/ref fail

Please refer to chapter '*IRIG-B Monitoring*' for a detailed error description.

Signal 1 Warning Recommended GPI: **GPI_3**
Signal 2 Warning Recommended GPI: **GPI_4**

Active, as long as there is a minor error at IRIG-B of *IRIG IN 1* or *IRIG IN 2* respectively. In detail, this GPI becomes active if one of the following errors has occurred and this error has been enabled to indicate a failure (checkbox "**disable**" not checked):

tc/ref error
lock range
lock drift

Please refer to chapter '*IRIG-B Monitoring*' for a detailed error description.

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 GPI becomes active in case of any error, i.e. IRIG-B 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.

Apart from the "current sequence" error, all other individual errors can raise this alarm provided this error has been enabled to indicate a failure (checkbox "**disable**" not checked). Depending on this configuration, IRIG-B errors, errors with respect to the real-time reference, and errors with respect to the self test, may activate this GPI output.

More GPI functions: → Chapter '*"Keys": Keys and Lamps, LEDs and GPIs*'.

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 a major error at IRIG-B of *IRIG IN 1* or *IRIG 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):

sequence
data
timeout
tc/ref fail

Please refer to chapter '*IRIG-B Monitoring*' for a detailed error description.

Signal 1 Warning / Signal 2 Warning Check the "Signal Warning" checkbox

Trap will be sent, as long as there is a minor error at IRIG-B of *IRIG IN 1* or *IRIG 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):

tc/ref error
lock range
lock drift

Please refer to chapter '*IRIG-B Monitoring*' for a detailed error description.

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. IRIG-B errors, errors with respect to the real-time reference, and errors with respect to the self test.

System Failure Check the "System Failure" checkbox

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

Apart from the "current sequence" error, all other individual errors can raise this alarm provided this error has been enabled to indicate a failure (checkbox "**disable**" not checked). Depending on this configuration, IRIG-B errors, errors with respect to the real-time reference, and errors with respect to the self test, 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:

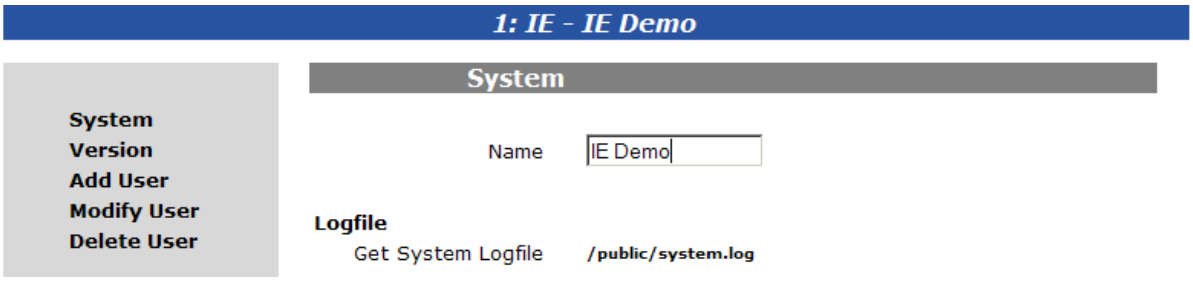
- *'IRIG-B Monitoring' – 'Consequences of Errors'*,
- *'Real-Time Reference Monitoring' – 'The Individual Errors and Consequences of Errors'*,
- *'Self Test'*,

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:

- IRIG-B 'current sequence' error,
- 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: (SI 2:1) identifies the module which sent this entry:
SI module located at frame address **2** at slot **1**.

[22/Apr/2013 14:18:55] (SI 2:1) Event: IRIG IN1 signal loss
[22/Apr/2013 14:18:55] (SI 2:1) Event: System automatic changeover
[22/Apr/2013 14:19:07] (SI 2:1) Event: System manual changeover
[22/Apr/2013 14:19:08] (SI 2:1) Event: System error reset

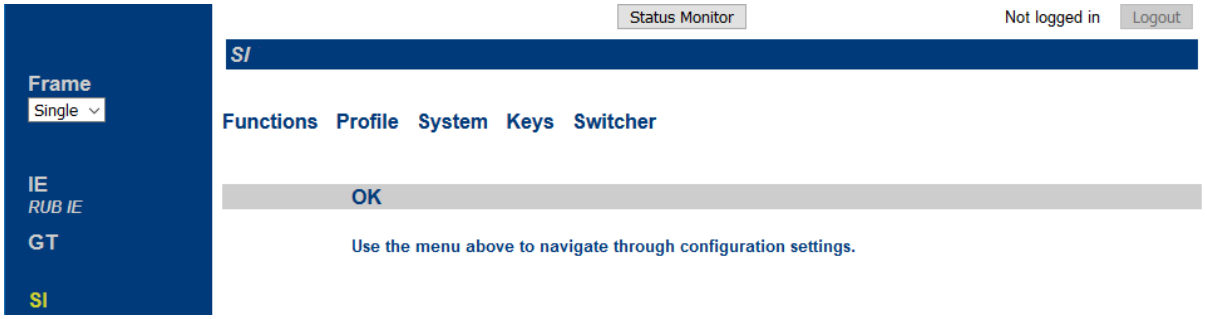
The Ethernet module adds a time stamp (time & date) = time of its internal clock when it receives the entry.

If **SI** receives real-time reference signals and no other module of the system sends the *'Reference'* telegram, this telegram should be sent from **SI** 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 **SI** On the left.
- Click on the button **Status Monitor** to open the **SI** status monitor.

Requirements:

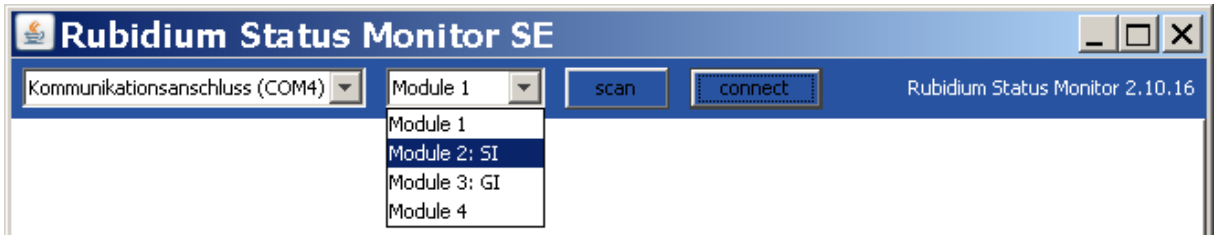
- Please have Java Runtime Environment 1.6.0 or higher installed (for example download at www.java.com).
- Java should be installed as a browser plug-in (a Windows installation will do this automatically if you download Java from the source mentioned above).
- The Status Monitor works with all operating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

System Set-Up

Reflects the set-up as selected by a configuration tool (see chapter '*"Switcher": Set-Up the Monitoring and Changeover*').

System Tally

Reflects the state of the relays, the GPIs, the lamps and the LEDs. The GPIs, 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	Sense of 1st relay (changeover IRIG/DRVSEL): 0 = primary, 1 = back-up
relay 2	Sense of 2nd relay (changeover SERIAL/TELEGRAM): 0 = primary, 1 = back-up
GPIs:	0 = output/function inactive, 1 = output/function active.
gpi 1	'Signal 1 Failure': Any failure of signal at *IRIG IN 1*.
gpi 2	'Signal 2 Failure': Any failure of signal at *IRIG IN 2*.
gpi 3	'Signal 1 Warning': Any error or warning of signal at *IRIG IN 1*.
gpi 4	'Signal 2 Warning': Any error or warning of signal at *IRIG IN 2*.
Lamps:	Lamps of the keys. 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 switched to *IRIG IN 1* (relays in primary position).
lamp 3	'Signal 1 present': = 1 if IRIG-B at *IRIG IN 1* is present.
lamp 4	'Signal 2 present': = 1 if IRIG-B at *IRIG IN 2* is present.
LEDs:	0 = off/function inactive, 1 = on/function active.
led 1	'Operation': = 1 during normal operating.
led 2	'Switcher signal': = 1 if IRIG-B signals at *IRIG IN 1* **and** *IRIG IN 2* are present.
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

output	*IRIG OUT* is currently switched to primary (*IRIG IN 1*) or back-up (*IRIG IN 2*) input.
signals received data received	Indicates that at least one IRIG-B of correct format has been detected. IRIG-B monitoring and changeover procedure starts if at least one IRIG-B signal with a valid time code word has been detected.
overall failures	Current value of the "overall failures" counter.
overall errors	Current value of the "overall errors" counter.
tc/tc difference	Current time difference between the IRIG-B signals, HH:MM:SS and milli-seconds. A "+" sign means: Signal at *IRIG IN 1* is equal or ahead of signal at *IRIG IN 2*. A valid/invalid flag indicates whether the current difference is valid or not.
max difference	Maximum value of "tc/tc difference", HH:MM:SS and milliseconds.

Changeover events: Number of automatic/manual changeover events. Kind and time (IRIG-B times and date & time of the real-time reference) of the last event.

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 for this error.
relay 1	Relay 1 (IRIG/DRVSEL changeover): Actual position not equal to intended position.
relay 2	Relay 2 (SERIAL/TELEGRAM/SPARE changeover): Actual position not equal to intended position.
tc/tc difference	The time difference between the IRIG-B signals equals or exceeds the limit "Limit TC/TC".

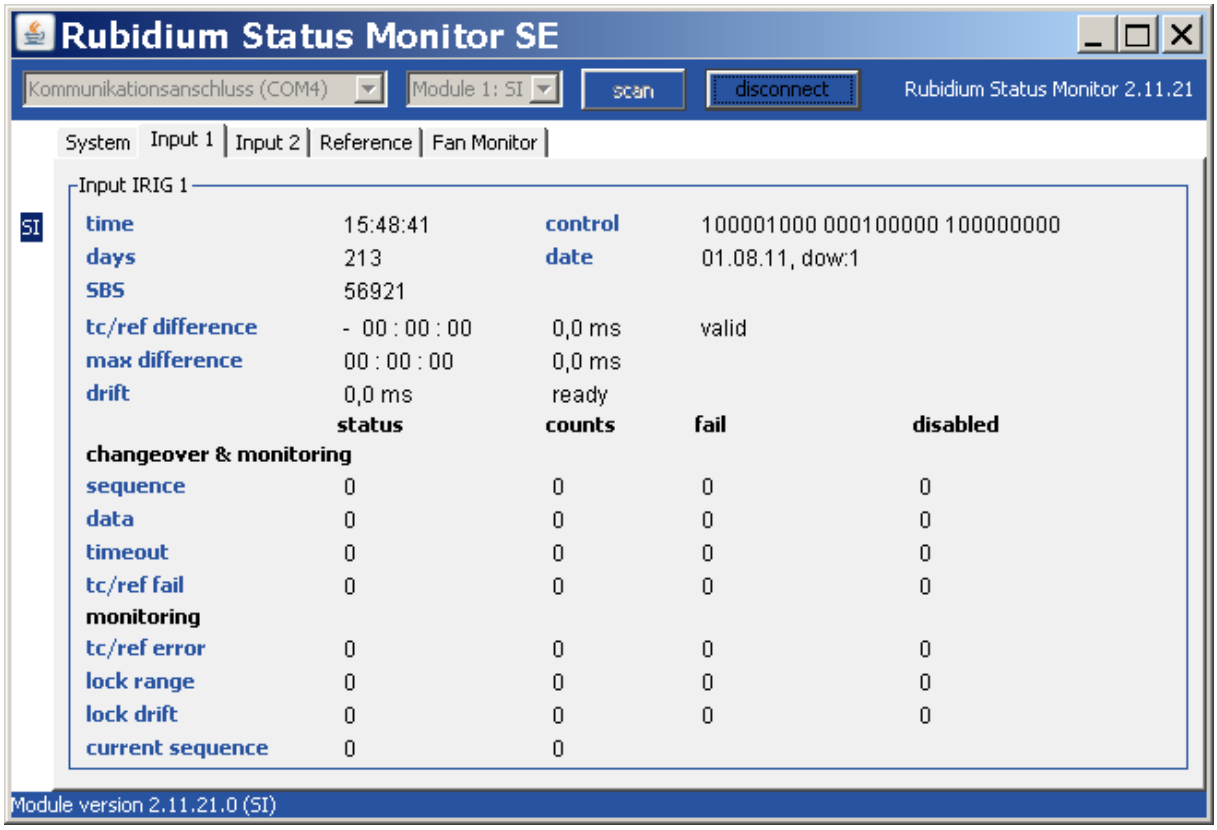
3.4 Signal Input Status

This module decodes and monitors IRIG-B signals at *IRIG IN 1* and *IRIG IN 2*.

The individual errors separately detected for signals at *IRIG IN 1* and *IRIG IN 2* are divided into major and minor errors:

- 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 the minor errors which are not considered for a changeover.
  These errors can raise an alarm of type "Signal 1 Warning" or "Signal 2 Warning" respectively.

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



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

time	IRIG-B time information: HH:MM:SS.
days	IRIG-B day of the year: 1 – 365 (leap year: 366).
SBS	Straight binary seconds: 0 – 86,399 (leap second: 86,400).
control	Indicates the control bits: CNTRL27 – CNTRL1.
date	If incorrect data has been detected, "na" will be displayed. If all data = 0 has been received, "00.00.00, dow:0" will be displayed. From a valid IRIG-B 127 time code, the year can be decoded: Example (year = 2011): 00.00.11, dow:0 From a valid AFNOR time code, the complete date can be decoded: Example (day.month.year): 01.08.11, dow:1 (dow = day-of-week).
tc/ref difference	Current time difference of IRIG-B against real-time reference, HH:MM:SS and milliseconds. A "+" sign means: IRIG-B is equal or ahead of real-time reference. A valid/invalid flag indicates whether the current difference is valid or not.
max difference	Maximum value of "tc/ref difference", HH:MM:SS and milliseconds.
drift	Current drift of the IRIG-B reference bit compared to the PPS of the real-time reference. This measurement starts with a 30 minutes delay after the power has turned on to give time for synchronization.

changeover & monitoring

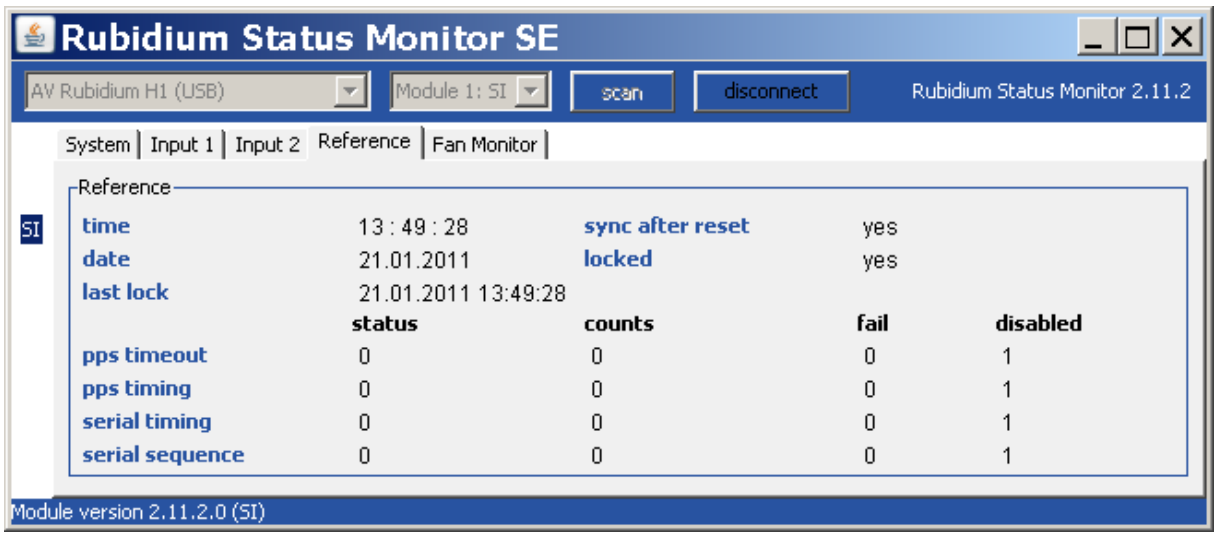
Error	Description
sequence	Multiple dropouts or time discontinuities detected.
data	Implausibility of time, day of year, or SBS data detected.
timeout	No valid IRIG-B format detected since 1.0 s, or no valid IRIG-B time code word detected since 3.5 s.
tc/ref fail	The time difference of IRIG-B against the real-time reference equals or exceeds the limit "Limit TC/Ref Fail".

monitoring

Error	Description
tc/ref error	The time difference of IRIG-B against the real-time reference equals or exceeds the limit "Limit TC/Ref Error"
lock range	The time difference of IRIG-B against the real-time reference equals or exceeds the limit "Limit Lock", the drift monitor stops.
lock drift	The drift of IRIG-B against the real-time reference equals or exceeds the limit "Limit Drift".
current sequence	A time discontinuity has been detected while checking the IRIG-B time information. This leads to an error even at a valid time discontinuity in case of a leap second or a DST switching of a local time zone. Different from all other errors, there is no 'fail' and 'disabled' bit provided.

3.5 Status of the Real-Time Reference

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.

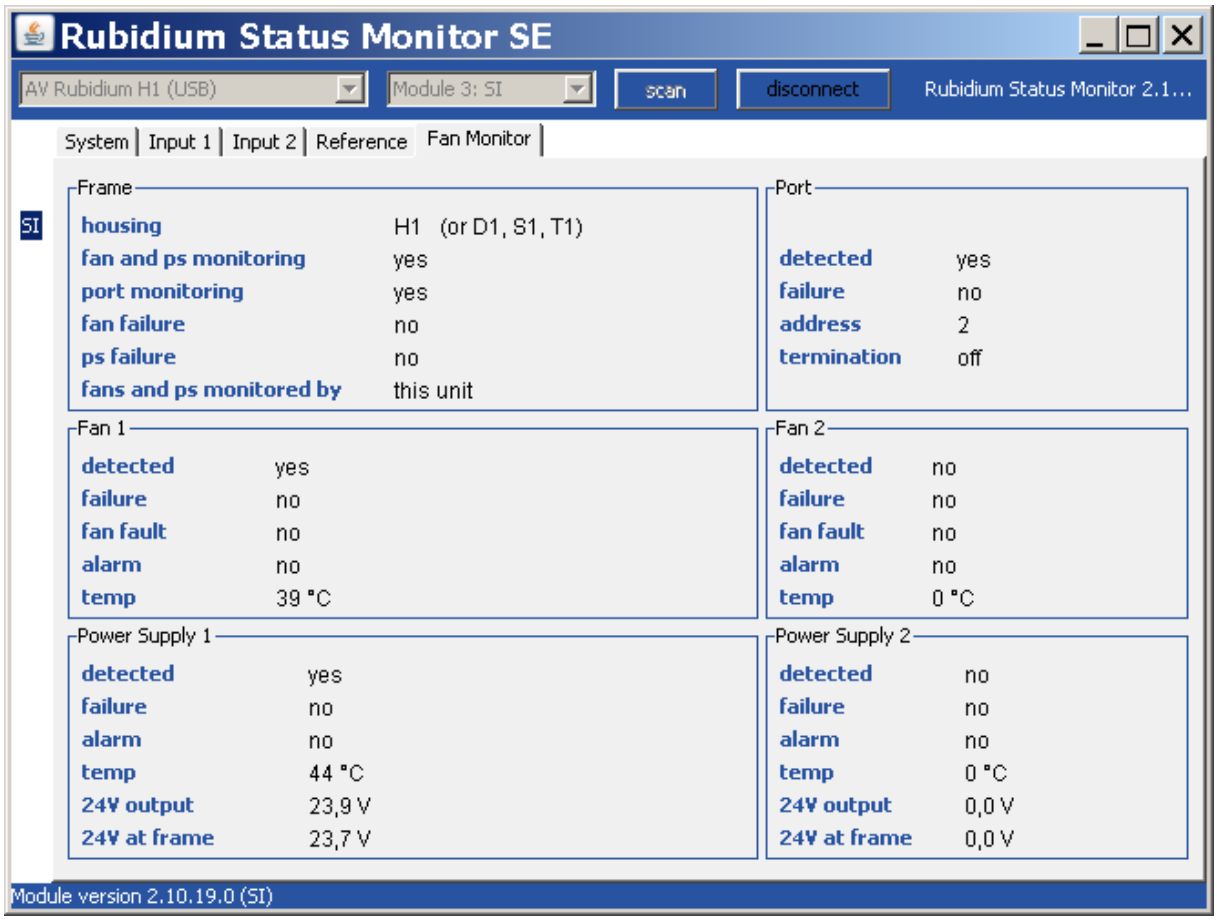
time	Current time, received via serial data string.
date	Current date, received via serial data string.
sync after reset	Status, received via serial data string. Indicates that the reference source could have been synchronized at least once after turning the power on.
locked	Status, received via serial data string. Indicates that the reference source currently is synchronized.
last lock	Time & date of the moment of last indication of a “locked” status.

Individual reference errors:

Error	Description
pps timeout	No valid PPS detected since 1.6 s.
pps timing	The interval between two consecutive PPS signals does not correspond to one second.
serial timing	The serial data string 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.

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 **SI**.



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 **SI** 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.

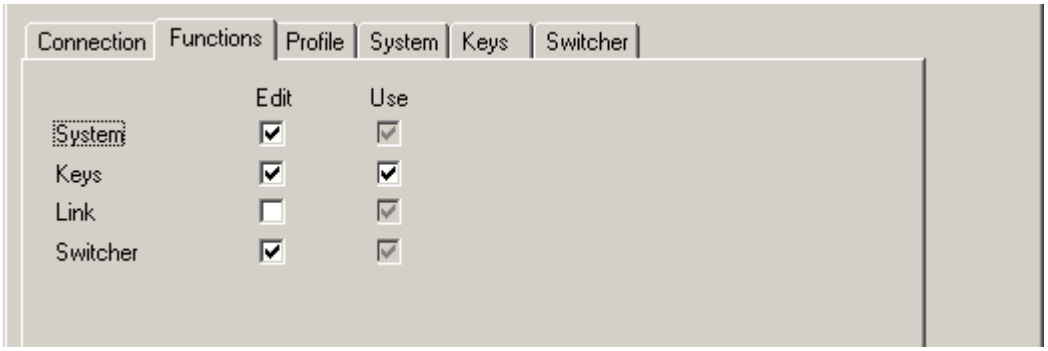
Button **Reload From Module**:

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

SI	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:

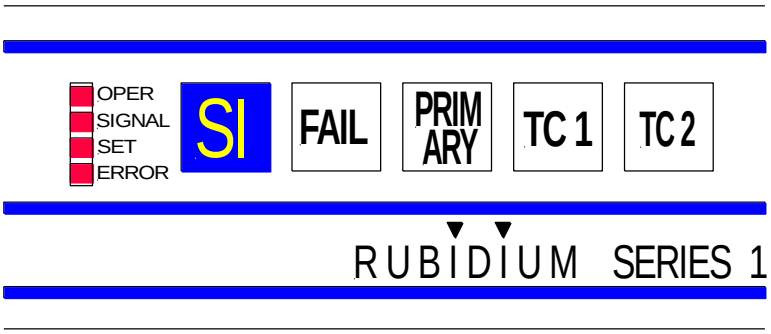
Profile	Store and Load Configurations on the Module (*)
System	Identification, Reset, SNMP, Fan Control
Keys	Keys and Lamps, LEDs and GPIs
Switcher	Set-Up the Monitoring and Changeover
Link	Communication between Modules

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

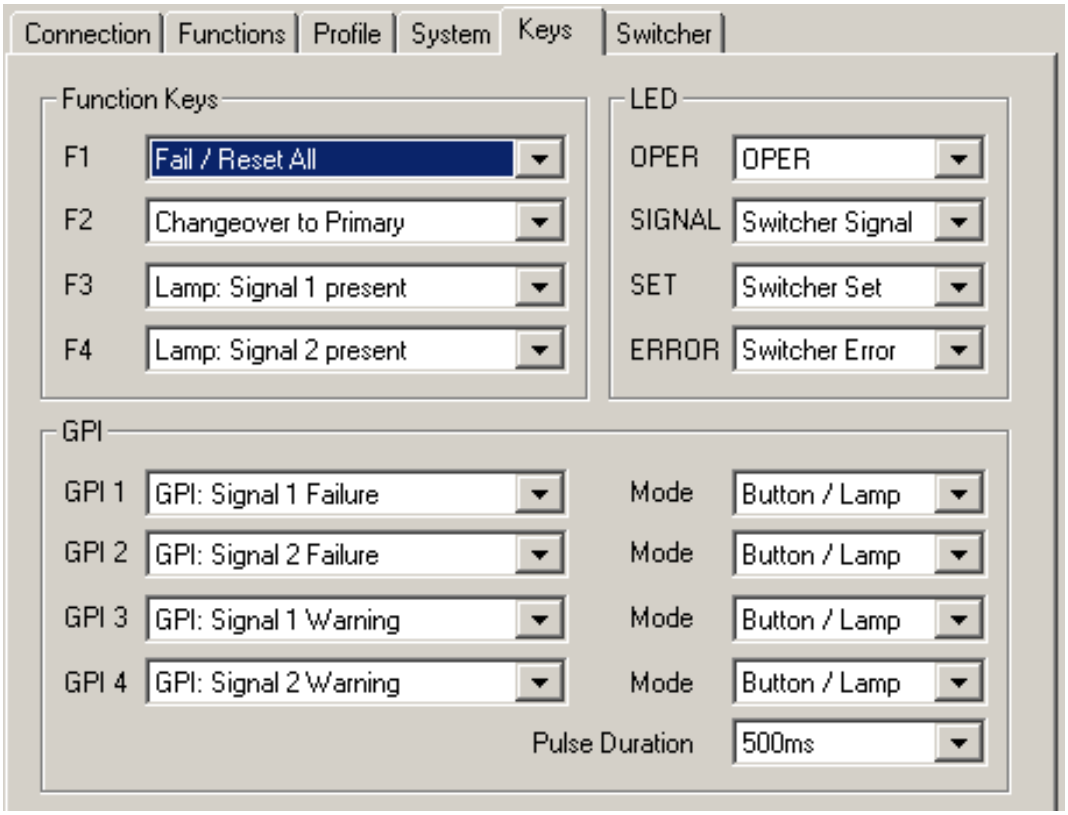
4.4 “Keys“: Keys and Lamps, LEDs and GPIs

The module has four GPIs (General Purpose Interface), 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 signal at *IRIG IN 1* (primary source): Automatic mode: Changeover occurs only if the signal at *IRIG IN 1* has not more failures than signal at *IRIG IN 2*. Manual mode: Changeover occurs without signal check.	F2: PRIMARY
Changeover Toggle	Manual changeover: Automatic mode: Changeover occurs only if the signal to which switching shall occur has not more failures than the current output signal. Manual 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 the output *IRIG OUT* is switched to *IRIG IN 1* (primary source).	F2: PRIMARY
Signal 1 present	Lights up, if IRIG-B at *IRIG IN 1* is present. Flashes to indicate an imminent timeout.	F3: TC 1
Signal 2 present	Lights up, if IRIG-B at *IRIG IN 2* is present. Flashes to indicate an imminent timeout.	F4: TC 2

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

Function	Description	Recommended LED
OPER	Lights up during normal operating.	OPER
Switcher Signal	Lights up, if there are IRIG-B signals present at both *IRIG IN 1* and *IRIG IN 2*.	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 **GPIs** are provided for this module:

Function	**Description**	**Recommended GPI**
Signal 1 Failure	Indicates, that the signal at *IRIG IN 1* has a failure.	GPI_1
Signal 2 Failure	Indicates, that the signal at *IRIG IN 2* has a failure.	GPI_2
Signal 1 Warning	Indicates, that the signal at *IRIG IN 1* has an error.	GPI_3
Signal 2 Warning	Indicates, that the signal at *IRIG IN 2* has an error.	GPI_4
System Error	Indicates, that the "overall errors" counter has a count value > 0.	
System Failure	Indicates, that the "overall failures" counter has a count value > 0.	
Switcher on Primary	Indicates, that the output *IRIG OUT* is switched to *IRIG IN 1* (primary source).	
Signal 1 present	Indicates, that IRIG-B at *IRIG IN 1* is present.	
Signal 2 present	Indicates, that IRIG-B at *IRIG IN 2* is present.	

Additionally, the output characteristic is selectable:

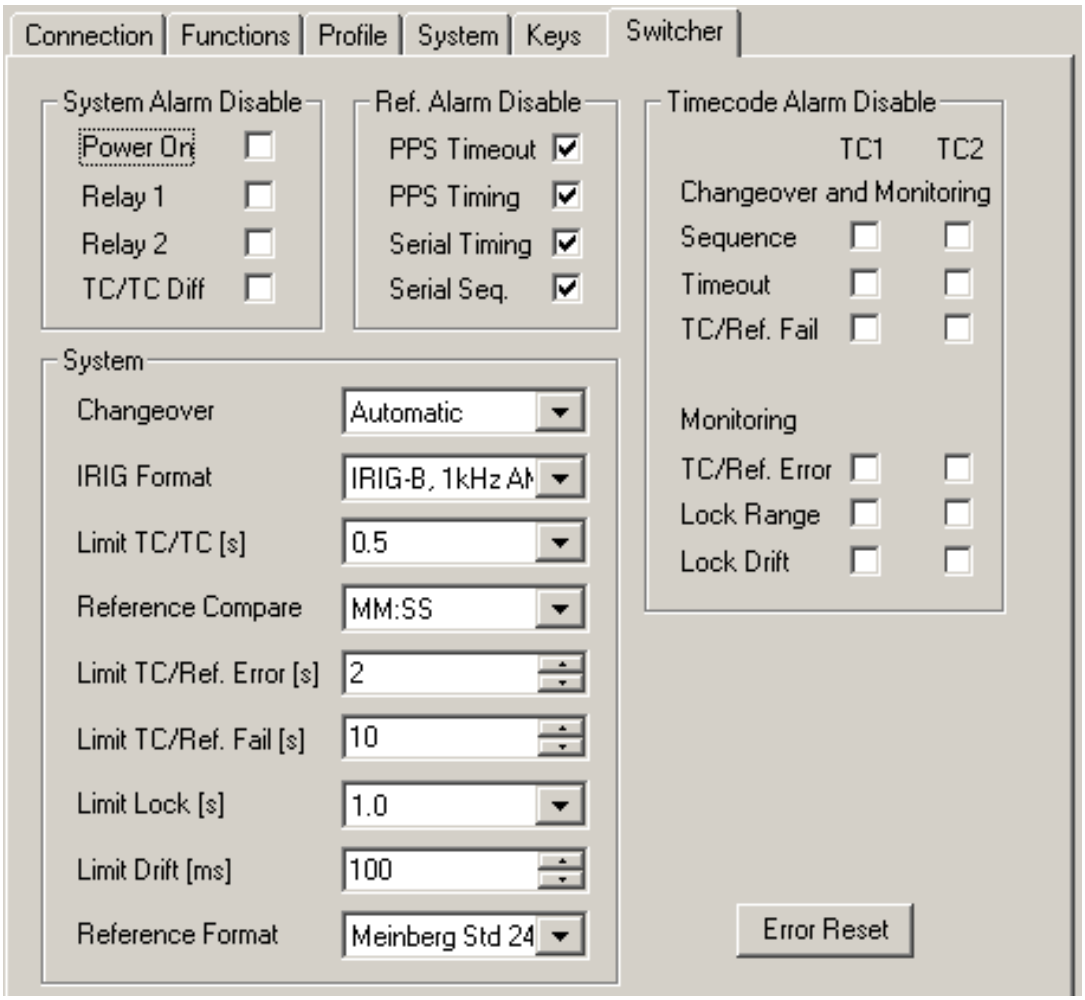
Dropdown list at **Mode**	Description
Button/Lamp	Statically, active "Low" [recommended]
Inv. Button/Lamp	Statically, active "High"
Switch/On Pulse	Pulse, active "Low"; pulse width selectable from 100 ms to 2 s. Pulse will be generated at event entry.
Inv. Switch/Off Pulse	Pulse, active "High"; pulse width selectable from 100 ms to 2 s. Pulse will be generated at the end of the event.

Pulse Duration The pulse width is selectable as 100 ms, 200 ms, 500 ms, 1 s, 2 s. This selection refers to all GPI outputs set to a pulse mode.

4.5 “Switcher“: Set-Up the Monitoring and Changeover

These set-ups are provided for the monitoring and changeover characteristics.

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



System Alarm Disable

SI monitors some system parameters. For a detailed description of each item please refer to chapter ‘*Self Test*’ and – for ‘TC/TC Diff’ – to chapter ‘*IRIG-B 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.

Ref. Alarm Disable

SI 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.

Timecode Alarm Disable

SI monitors the IRIG-B signals of input *IRIG IN 1* and *IRIG IN 2*. For a detailed description of each item please refer to chapter '*IRIG-B 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.

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.

System

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

Item	**Selection**	**Description**
Changeover	**Automatic** Manual	Automatic or manual changeover operating mode. → Chapter '*IRIG-B Changeover*'.
Format	**IRIG-B 1kHz am**	IRIG-B format. It should be a 1 kHz carrier, sine wave, amplitude modulated.
Limit TC/TC [s]	0.1 – 10.0 (**0.5**)	**SI** calculates and monitors the time difference between the IRIG-B signals. A "tc/tc difference" error will be indicated if the time difference equals or exceeds this limit. Allowed range: 0.1 – 10.0 seconds. → Chapter '*IRIG-B Monitoring*' → '*The Individual Errors*'.
Ref. Compare	HH:MM:SS **MM:SS** M:SS SS	**SI** compares the IRIG-B time with the real-time reference. If the time zone of the IRIG-B time is different from the time zone of the real-time reference, hours or even minutes should not be considered. Please select according to your application. → Chapter '*IRIG-B Monitoring*' → '*The Individual Errors*'.
Limit TC/Ref. Error [s]	1 – 9 (**2**)	**SI** calculates and monitors the time difference of IRIG-B time against the real-time reference. A "tc/ref error" error will be indicated if the time difference equals or exceeds this limit. The corresponding alarm indicates a warning. Allowed range: 1 – 9 seconds. → Chapter '*IRIG-B Monitoring*' → '*The Individual Errors*'.
Limit TC/Ref. Fail [s]	**10** – 59	**SI** calculates and monitors the time difference of IRIG-B time against the real-time reference. A "tc/ref fail" error will be indicated if the time difference equals or exceeds this limit. The corresponding alarm indicates a failure. Allowed range: 10 – 59 seconds. → Chapter '*IRIG-B Monitoring*' → '*The Individual Errors*'.

Limit Lock [s]	0.1 – 10.0 (**1.0**)	**SI** monitors the drift of the IRIG-B reference bit against the PPS of the real-time reference. This enables to verify a phase lock of the IRIG-B generator to a PPS sync signal. If the time difference of the IRIG-B signal against the real-time reference equals or exceeds this limit, the drift monitor stops and a "lock range" error will be indicated. Allowed range: 0.1 – 10.0 seconds. → Chapter '*IRIG-B Monitoring*' → '*The Individual Errors*'.
Limit Drift [ms]	10 – 255 (**100**)	**SI** monitors the drift of the IRIG-B reference bit against the PPS of the real-time reference. This enables to verify a phase lock of the IRIG-B generator to a PPS sync signal. If this drift equals or exceeds the limit, a "lock drift" error will be indicated. Allowed range: 10 – 255 ms. → Chapter '*IRIG-B Monitoring*' → '*The Individual Errors*'.
Reference Format	**Meinberg Std ...** NMEA $GPRMC... Meinberg Uni ... Wharton Status ...	**SI** 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 10 MHz, GLS 10 MHz] "*NMEA $GPRMC 4800/8n1 + PPS*" [GPS35, GPS16, GPS17] If "*Meinberg Std 2400/7e2 + PPS*" has been selected, **SI** automatically accepts the "*Meinberg GPS*" protocol as well. → Chapter '*Real-Time Reference Monitoring*'.

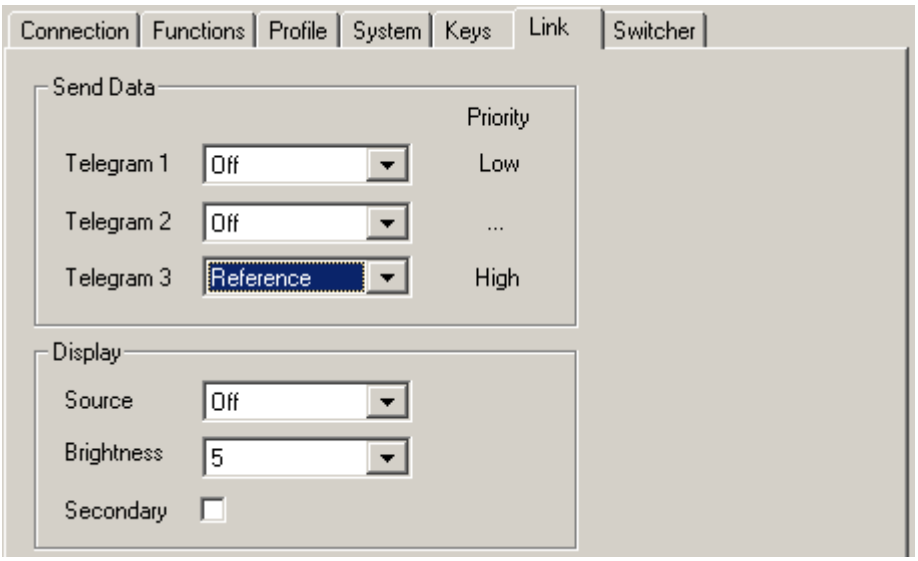
4.6 “Link”: Communication between Modules

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

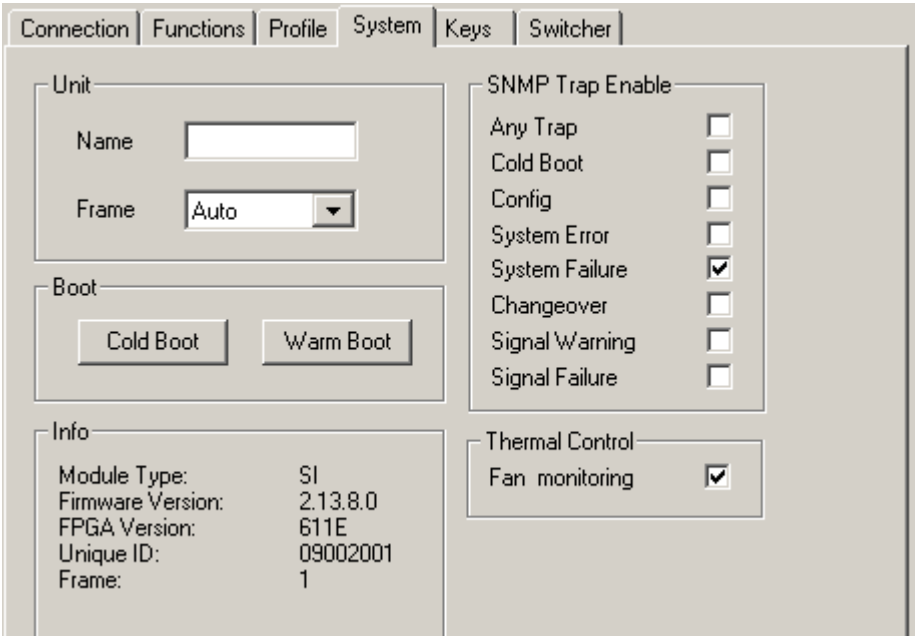
Three channels (**Telegram 1 - 3**) have been provided to transmit data. For each channel a function can be selected from the drop-down list:	
Off	This channel will not be used to transmit data, data can be received.
Reference	This channel transfers time and date (UTC) of the external reference once 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.		
Source	Select the kind of data to be sent and displayed:	
	Off	No data will be sent from this module.
	Reference Time	Time of the external reference (UTC) in a HH:MM:SS format.
	Reference Date	Date of the external reference (UTC) in a Day.Month.Year format.
Brightness	Adjust the brightness of the LEDs, steps 1 to 7.	
Secondary	Address the ‘secondary’ display instead of the ‘primary’ display.	

4.7 “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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