Functional Description and Specifications

Version: 1.6

June 19, 2020

RUB C3

IEEE1588 / PTP Module
Time & Date Reference
Reference Frequency Output for Synchronisation Tasks

Supplement to the “Installation & Systems Manual RUBIDIUM SERIES”

plura

CONTENTS

A1 Revision History

No.	Date	Subject
0.n		Preliminary documents, changes without notice.
1.0	November 25, 2016	First released document.
1.1	September 12, 2017	Added PTP grandmaster modes.
1.2	June 21, 2018	Corrected OCXO specifications.
1.3	August 2, 2018	More detailed operating mode descriptions.
1.4	November 13, 2018	Added "Sync Interval" setting and PTP reference protocols.
1.5	May 31, 2019	Added leap second configuration and metadata functions.
1.6	September 4, 2019	Changed address of Plura Europe GmbH.

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.

For further information please contact your local dealer or:

Plura Europe GmbH
Binger Weg 12
D- 55437 Ockenheim
Phone: +49 6725 918 006-70
Fax: +49 6725 918 006-77
E-Mail: info@plurainc.com
Internet: http://www.plurainc.com

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 Introducing C3

1.1 Overview

The C3 module is a highly reliable and accurate PTP grandmaster or slave. Different slave or grandmaster operating modes can be selected by module's configuration. Grandmaster or slave functionality depends on purchasing options, they can also be enabled later by purchasing an activation key.

In slave mode C3 accepts signals from IEEE1588-2008 (PTP version 2) grandmaster clocks. Accurate time is provided by a precise PPS (pulse per second) output and serial time & date protocols. A 10 MHz sine wave PTP disciplined frequency output is available.

In Grandmaster mode C3 accepts real-time form external sources like a GPS receiver. It needs a precise PPS (pulse per second) input and serial time & date protocol. Then it acts as an IEEE1588-2008 (PTP version 2) grandmaster clock.

The C3 module's versatility makes it ideally suited for time and frequency synchronisation tasks, such as time and frequency reference in broadcast facilities, e.g. to slave video sync and time code generators.

A **PC** or one of the RUB Ethernet modules (**RUB IE** or **RUB PM**) is required for set-up.

C3 is provided for the RUB1 system (19", 1 RU). A button on the front panel visibly identifies this module. The serial number is located on the bottom side of the printed circuit board.

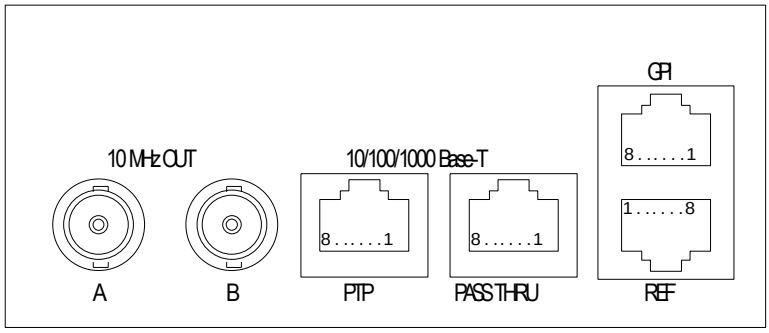
Overview of the most important module-specific functions:

- Precision timekeeping via TCXO or high stability OCXO (option).
- PTP disciplined frequency outputs: 10 MHz sine waves, PPS (pulse per second).
- RS232 communication ports for time & date and status output.
- PPS and time & date inputs in grandmaster mode.
- Four programmable function keys, lamps and LEDs on the front panel.

Overview of the most important functions within a RUBIDIUM system:

- "Hot Swapping", i.e. it is possible to insert or remove a module without interrupting the operation of other modules in this frame.
- Alarm feature via failure relay: contacts of the relay connected to the FAIL_A and FAIL_B pins of the **RLC** connector at the rear of the frame.
- RS232 and TC_link interfaces to have access to the internal bus of the chassis:
  - RS232 enables access to the module via USB using the RS232/USB converter of the chassis. The PC programs "Rubidium Config" (configuration) and "RubStatSE" (status monitor) are provided for this interface.
  - TC_link will be connected to the RLC DSUB of the chassis. This interface enables, on the one hand, communication to modules located in different chassis and, on the other hand, access to the module via internet browser – provided any RUB Ethernet module (**RUB IE** or **RUB PM**) is part of the system. Via internet browser it is possible to open the configuration pages as well as the status monitor.
- Flash memory containing the firmware, so updates are possible via USB. You can download the latest version of the program from: https://www.plurainc.com.
- SNMP functionality if any RUB Ethernet module (**RUB IE** or **RUB PM**) with SNMP option is part of the system.

1.2 Rear Panel and Connections

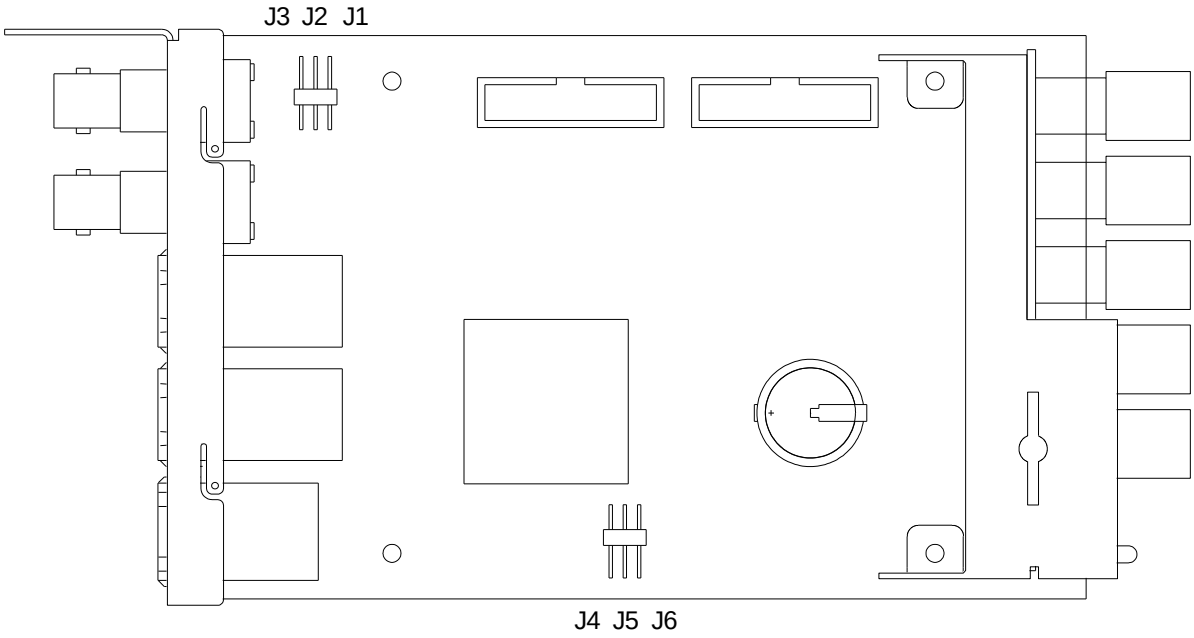


	GPI		REF
	RJ45		RJ45
1	PPS_3 IN	1	PPS_1 OUT
2	RXD_1 (RS232 IN)	2	TXD_1 (RS232 OUT)
3	GPI_1	3	n. c. (optional: PPS_2 OUT)
4	GND	4	GND
5	+24V / 200mA	5	n. c.
6	GPI_2	6	n. c. (optional: 10 MHz sine wave output)
7	GPI_3	7	n.c. (optional: PPS_RS422_A)
8	GPI_4	8	n. c. (optional: PPS_RS422_B)

10 MHz OUT	2 x BNC 75 Ω (optional 50 Ω). 10 MHz sine wave outputs, 1 V_{PP}.
PTP	10/100/1000 Base-T, accepting IEEE 1588-2008 (PTP version 2) timestamps.
PASS THRU	Reserved, do not connect.

1.3 Jumpers

Optional signals on RJ45 REF connector can be enabled by jumpers, as well as output impedance of both BNC 10MHz OUT signals can be changed:



Jumper	
J1	Enables signal on RJ45 REF pin 6 (10 MHz sine wave output).
J2	Switches 10 MHz OUT “A” to 50 Ω impedance.
J3	Switches 10 MHz OUT “B” to 50 Ω impedance.
J4	Enables signal on RJ45 REF pin 7 (PPS_RS422_A).
J5	Enables signal on RJ45 REF pin 8 (PPS_RS422_B).
J6	Enables signal on RJ45 REF pin 3 (PPS_2 OUT).

1.4 Specifications

PTP Slave

Standards	IEEE 1588-2008 (PTP version 2) SMPTE ST 2059-2:2015
Frequency alignment	Better than $\pm 10 \cdot 10^{-9}$ on a managed 10-switch GbE network under G.8261 test conditions
Time Alignment	Better than ±1µs accuracy on a managed 10-switch GbE network under G.8261 testing conditions
Delay mechanism	One-step or two-step
Input sync rate	Up to 128 sync packets per second

PTP Grandmaster

Standards	IEEE 1588-2008 (PTP version 2) SMPTE ST 2059-2:2015
Delay mechanism	One-step or two-step
Output sync rate	Up to 8 sync packets per second
Capacity	Up to 8 slaves @16 packets per second
Reference time & date protocol	NMEA or Meinberg Std/GPS/Uni protocols, 2400 or 4800 bps, data bits and parity selectable

Accuracy of the frequency outputs

Oscillator		TCXO (standard)	OCXO (option)
Warm-up time		n/a	1 – 2 minutes
Short term stability (τ = 1s)			$\pm 1 \cdot 10^{-9}$
Stability vs. temperature (over specified range of environmental temperature)		$\pm 1 \cdot 10^{-6}$	$\pm 1 \cdot 10^{-7}$
Oscillator aging	per day per year	 $\pm 1 \cdot 10^{-6}$	$\pm 1 \cdot 10^{-8}$ $\pm 3 \cdot 10^{-7}$

10 MHz Continuous Wave (sine wave output)

Oscillator		TCXO (standard)	OCXO (option)
Phase noise	1 Hz 10 Hz 100 Hz 1 kHz 10 kHz		< -67 dBc/Hz < -100 dBc/Hz < -130 dBc/Hz < -148 dBc/Hz < -154 dBc/Hz
Level at BNC 75 Ω		1 V_{PP} @ 75 Ω (±10 %)	[optional by jumper: 50 Ω]
Level at RJ45 REF		1 V_{PP} @ 75 Ω (±10 %)	[optional by jumper: pin 6]

PPS (output)

Connector	RJ45 REF, pin 1 Optional: RJ45 REF, pin 3
Pulse width (active high)	Adjustable: 0.25 / 1.0 / 10 / 100 / 250 ms
Output characteristics	Output impedance: 50 Ω Signal level: 5.0 V ±2 % (no load) 4.5 V ±2 % @ 600 Ω 2.1 V ±2 % @ 50 Ω Slew rate (rising edge): > 0.2 V/ns
Accuracy	Refer to "Accuracy of the frequency outputs"

GPI

Connector	RJ45 OPT, Pins 3, 6, 7 or 8
Input specification	Input "Low": -8.0 to +0.5 V Input "High": +1.9 to +15.0 V Impedance: ≥ 10 kΩ
Output specification	Open Collector output of an NPN transistor at 10 kΩ pull-up resistor. Maximum power dissipation: 200 mW. "High" state: 3.8 V (no load). "Low" state: output switched to GND. Max. collector current: 100 mA DC, fused by a 100 mA auto-recovery fuse. Collector-emitter saturation voltage: @100 mA: typ. 300 mV (≤ 1 V) @10 mA: typ. 100 mV (≤ 250 mV)

Serial Interface: TXD_1

Electrical format	RS232
Parameters	Baud rate: 2400/4800/9600/19200/38400 Data bits: 7, 8 Parity: none, even, odd Stop bits: 1, 2
TXD_1 features	UTC time & date output once per second.

RTC: Buffered Real-Time Clock

Kind of buffering and buffering time	Capacitor; ≥ 7 days typical
Accuracy of clock	±2.0 ppm over +5 °C to +40 °C [173 ms per day] ±3.5 ppm over -10 °C to +60 °C
RTC features	Sets time & date of the internal clock after warm-up if no other time & date source is available.

Electrical, Mechanical, and Environmental Characteristics

Power consumption	2.0 W typical during normal operation 5.1 W maximum during warm-up [with option OCXO] 3.5 W typical during normal operation [with option OCXO]		
Weight	≈ 0.25 kg		
Dimensions	Circuit board: 100 (W) x 160 (D) mm RUB1 rear panel: 103 x 44 mm / 4.06 x 1.73 inch		
Environmental		Operating	Non-operating
	Temperature:	+5 °C to +40 °C	-10 °C to +60 °C
	Relative humidity: (non-condensing)	30 % to 85 %	5 % to 95 %

1.5 Features

1.5.1 Slave Mode: PTP used as Timing Reference

The "Precision time Protocol" (PTP) is standardized in IEEE 1588-2008. Its use in broadcast applications is specified in SMPTE 2059-2:2015 "Profile for Use of IEEE-1588 Precision Time Protocol in Professional Broadcast Applications".

The C3 module in slave mode uses PTP as a timing reference by synchronizing to a PTP grandmaster in the local network. The PTP slave converts these signals to UTC (Universal Time Coordinated). This UTC sets and synchronizes the internal clock of the C3 module. A high-precision oscillator, a temperature compensated oscillator (TCXO) or optionally an oven-controlled oscillator (OCXO) is the fundamental part of the internal clock. Its frequency will be disciplined continuously by the PTP grandmaster, thus compensating the aging of the oscillator.

1.5.2 Grandmaster Mode: External Time & Date used as Timing Reference

The C3 module in grandmaster uses external time & date as a timing reference. The PTP grandmaster interprets these signals as UTC (Universal Time Coordinated). This UTC sets and synchronizes the internal clock of the C3 module and is used to provide PTP grandmaster functionality.

1.5.3 Time & Date Output

The C3 module outputs a precise pulse per second (PPS) and a RS232 data string once per second. Both these signals are commonly used as the time & date reference for various applications.

PPS

The **leading edge** of the PPS OUT pulse always is defined to be the timing reference.
This pulse is available: at pin 1 of connector RJ45 **REF** (= PPS_1 OUT),
optionally at pin 3 of connector RJ45 **REF** (= PPS_2 OUT),

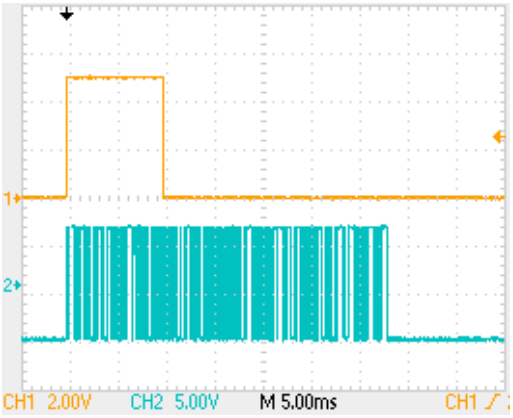
The pulse width is adjustable to 0.25 / 1.0 / 10 / 100 / 250 ms.

Time, Date, and Status Information

There is a RS232 data string available containing time, date, and status information. Time & date corresponds to the **UTC** time zone. The data refers to the leading edge of the preceding PPS.
This data string is available at pin 2 of connector RJ45 **REF** (= TXD_1).

The TXD output can be configured with respect to data protocol and serial interface parameters. For more information please refer to chapter "Serial Interfaces: Programming the Serial Interfaces".

Example: PPS (yellow, active high, pulse width 10 ms) and TXD_1 (blue, 9600 baud)



1.5.4 Reference Frequency Output

The C3 module outputs precise reference frequencies for various applications. These frequencies are derived from the internal 10 MHz oscillator, optionally a high stability OCXO (Oven Controlled Crystal Oscillator).

10 MHz Sine Wave

Available at 2 x BNC 75 Ω (optional 50 Ω). Level adjustable to 6/8/10/12 dBm.
Optional available at connector RJ45 **REF**, pin 6. Level will be fixed to 1 V_{PP} @ 75 Ω (±10 %).

1.5.5 Time & Date Input

In grandmaster mode the C3 module needs an external time & date reference. It consists of a precise pulse per second (PPS) and a RS232 data string once per second. Both these signals are commonly used as the time & date reference for various applications.

PPS

The **leading edge** of the PPS IN pulse is defined to be the timing reference. The pulse needs to be connected to at pin 1 of connector RJ45 **GPI** (= PPS_3 IN).

Time, Date, and Status Information

This is a RS232 data string containing time, date, and status information. Time & date protocol, baud rate and format are selectable. NMEA protocol should be used at 4800 baud, 8 data bits, no parity and 1 stop bit. It shall correspond to the **UTC** time zone. The data refers to the leading edge of the preceding PPS. The data string needs to be connected to pin 2 of connector RJ45 **GPI** (= RXD_1).

1.6 PTP Operating Modes

1.6.1 PTP Slave

In this mode the RUB C3 acts as a PTP slave only. If there is no PTP grandmaster on the network the clock will stay in the listening state waiting for the grandmaster to appear.

When RUB C3 is switched to this mode the engine changes the clock class to SLAVEONLY (255) and the clock accuracy to UNKNOWN (0xFE).

1.6.2 PTP Grandmaster

The RUB C3 is a grandmaster and the GPS is the only source of synchronization. It can never become a slave to another clock regardless of its clock class.

In this mode the clock class is automatically controlled by the engine. The clock is initialized with class DEFAULT (248) and as soon as the engine detects the presence of a stable GPS signal it raises the class to PRC_SYNC (6). If both PPS and TOD input signals are available, then the timescale is automatically switched to PTP and the clock class is PRC_SYNC (6).

If later the GPS-signal is lost the clock is switched to the holdover mode and lowers its class to PRC_HOLDOVER (7). If after the holdover period, the GPS-signal is still not available the clock downgrades its class PRC_DEGRADATION_A (52) and stays as the PTP grandmaster in the free-running mode. If a better clock exists on the network the clock will switch to the PTP passive state.

1.6.3 PTP Grandmaster with PTP fallback

This mode is almost the same as PTP grandmaster Mode above, but after the holdover interval the clock degrades its class to PRC_DEGRADATION_B (187), so it can potentially become a PTP slave if a better clock appears on the network.

It means that the clock has the GPS-signal as its primary source of synchronization and the PTP as a backup source, i.e. when no GPS-signal present.

1.6.4 PTP Boundary Clock

This is an ordinary PTP master-slave mode. The GPS interface is disabled. In this mode the RUB C3 acts as a PTP slave but may also become a PTP grandmaster if no better clock exists on the network.

The clock class is initialized to DEFAULT (248) and is not changed by the engine while operating.

1.6.5 PTP Boundary Clock with GPS

This mode is designed for unstable GPS-reception environments, where the node having a better signal reception becomes a PTP grandmaster and all others become PTP slaves, even if they have their own GPS-signal.

The clock is initialized with class DEFAULT (248) and the class is not changed by the engine while operating. Instead after detecting the stable GPS-signal the engine increases the priority2 member of the Default Dataset (lowers its value) by some small margin, which might depend on the reception quality. That clock which has a higher priority2 (better GPS signal reception) becomes the PTP grandmaster on the network and all others synchronize with it.

1.7 Software Update

Software updates require a computer with the **Rubidium Config** program, and an Ethernet interface (**C3** module and computer connected to the same network). When using a firewall, ensure that the computer can connect to the module on TCP ports 20, 21 and 23 and on UDP port 8001 for both incoming and outgoing traffic.

Current C3 module firmware – with all combinations of standard options – is available at:
https://www.plurainc.com.

Store your update file on your computer.

Now execute the following steps:

1. Be sure that **C3** module and computer are connected to the same network and that they can reach each other at the ports listed above. Disable any firewall that might block the **Rubidium Config** program.
2. Start the **Rubidium Config** program.
3. Choose "Ethernet Module Configuration…" from the "Tools" menu.
4. Press "Scan network" and choose the module from the list. The "Status" box now shows the current firmware version and installed options.
5. Click the Browse ("…") button to search for the update file.
6. Press "Start Update".
7. The module reboots after flash update. A "Reboot complete" message appears. Press the "OK" button.
8. An "Update complete" message appears. Press the "OK" button. Update is finished now.

During the flash update the operation of the module stops!

1.8 License Change

Changing the license by entering an activation key allows enabling new functionality after purchasing. This requires a computer with the **Rubidium Config** program, and an Ethernet interface (**C3** module and computer connected to the same network). When using a firewall, ensure that the computer can connect to the module on TCP ports 20, 21 and 23 and on UDP port 8001 for both incoming and outgoing traffic.

Now execute the following steps:

1. Be sure that **C3** module and computer are connected to the same network and that they can reach each other at the ports listed above. Disable any firewall that might block the **Rubidium Config** program.
2. Start the **Rubidium Config** program.
3. Choose "Ethernet Module Configuration…" from the "Tools" menu.
4. Press "Scan network" and choose the module from the list. The "Status" box now shows the current firmware version and installed options.
5. Click the "Change License…" button. Copy the "Serial Number" to the clipboard and paste it to an e-mail to sales@plurainc.com to purchase an activation key.

6. After purchasing you'll get an e-mail with the activation key. Copy it to the clipboard, paste it to the "Activation Code" field and click OK.
7. You'll get a response that the module options were successfully changed.
8. Now you can use the new functionality by changing C3's operating mode.

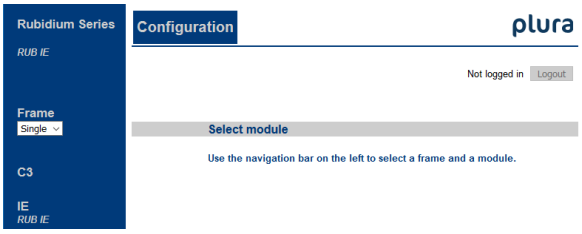
1.9 Status Monitor by the Ethernet Module

The RUBIDIUM SERIES HTTP server, which is located in the Ethernet module (**RUB IE** or **RUB PM**), offers a status monitor. There is no HTTP server running on the C3 module itself.

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

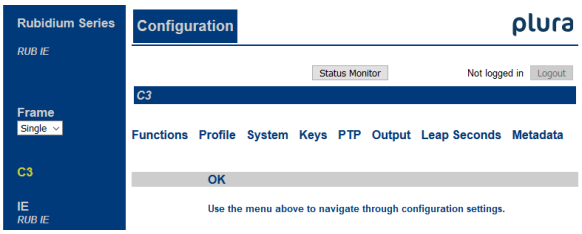
Start an Internet Browser and type in the IP address of the Ethernet Module.

If C3 does not appear in the bar on the left, you have to enter the correct address of the chassis at the **Frame** entry.



Click **C3** to access the C3 module.

Click the Status Monitor button to open the status monitor. It is not necessary to perform a **LOGIN**.



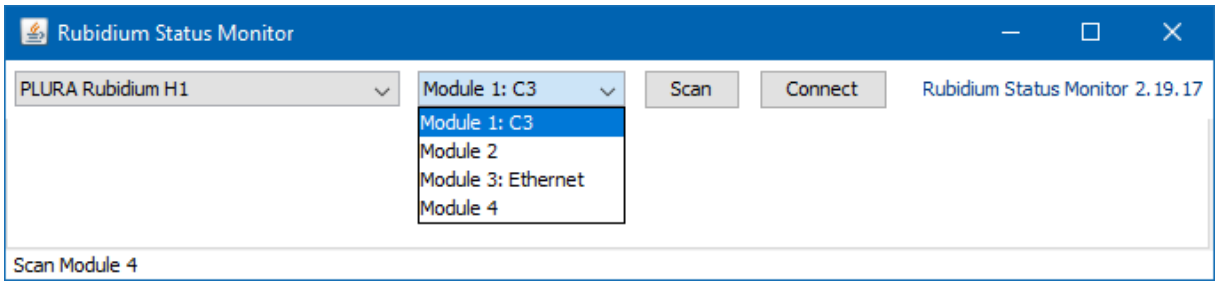
Requirements:

- Please have Java Runtime Environment 1.6.0 ("Java 6") 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.

1.10 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 Configuration and Status Monitor PC Programs*" packet you can download at https://www.plurainc.com.

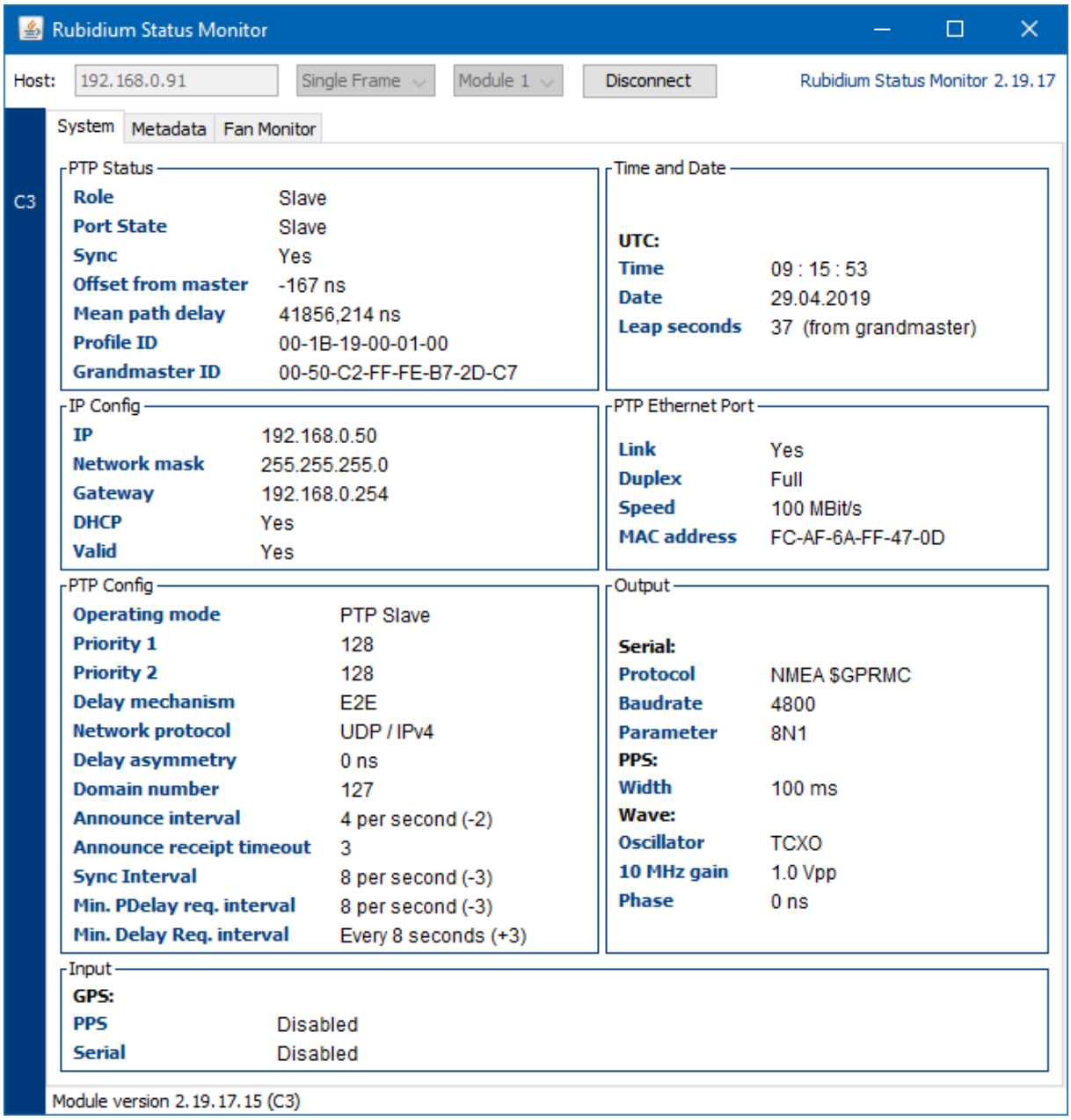
Execute this program, select the COM port or USB connection and press the **scan** button to get a list of the modules plugged to this housing. Select the module and press the **connect** button.



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.

1.11 Status: System



PTP Status		Time and Date	
Role	Slave or Grandmaster (or error)		
Port State	State of the PTP port	UTC:	
Sync	Yes/No	Time	Current UTC time
Offset from master	Measured offset	Date	Current UTC date
Mean path delay	Compensated network delay	Leap seconds	Current difference between PTP time and UTC in seconds
Profile ID	ID of the current PTP profile		
Grandmaster ID	ID of the PTP Grandmaster		

IP Config	PTP Ethernet Port

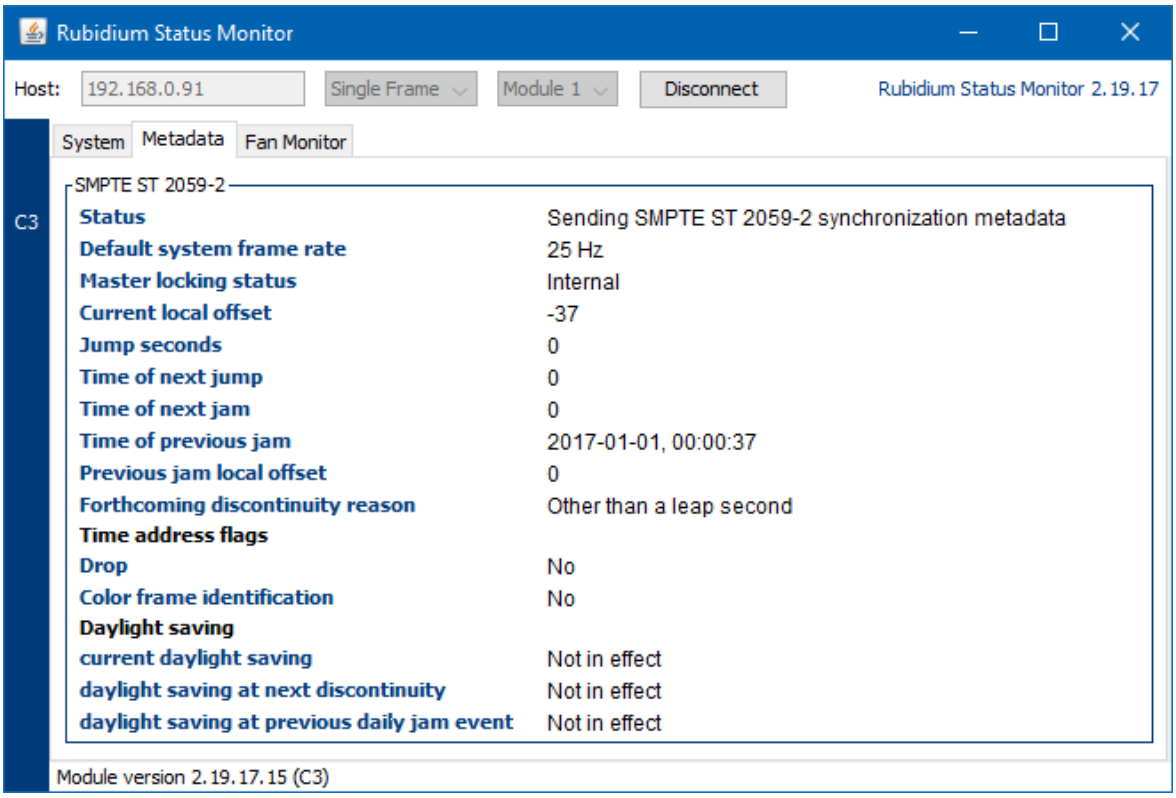
IP	Current IP address		
Network mask	Current network mask	Link	Yes/No
Gateway	Current gateway	Duplex	Full/Half
DHCP	DHCP enabled Yes/No	Speed	10/100/1000 MBit/s
Valid	IP configuration valid Yes/No	MAC address	MAC address of PTP Ethernet interface

PTP Config {Feedback on current set-up}		**Output** {Feedback on current set-up}	
Operating Mode	Grandmaster or Slave	Serial:	
Priority 1	0-255	Protocol	Serial time+date string
Priority 2	0-255	Baudrate	2400-38400 bps
Delay mechanism	E2E/P2P	Parameter	Data bits, parity, stop bits
Network protocol	IEEE802.3 or UDP/IPv4	PPS:	
Delay asymmetry	Nanoseconds	Width	0.25-250 ms
Domain number	0-127	Wave:	
Announce interval	Packets per second	Oscillator	TCXO or OCXO
Announce receipt timeout	2-10 seconds	10 MHz gain	0.5-1.5 V_{PP}
Sync interval	Packets per second	Phase	Measured 10 MHz phase
Min. PDelay req. interval	Packets per second		
Min. Delay req. interval	Packets per second		

Input	
GPS:	
PPS	Status of PPS input in grandmaster mode
Serial	Status of serial time+date input in grandmaster mode

1.12 Status: Metadata

This page shows the SMPTE synchronization metadata as defined in ST 2059-2.

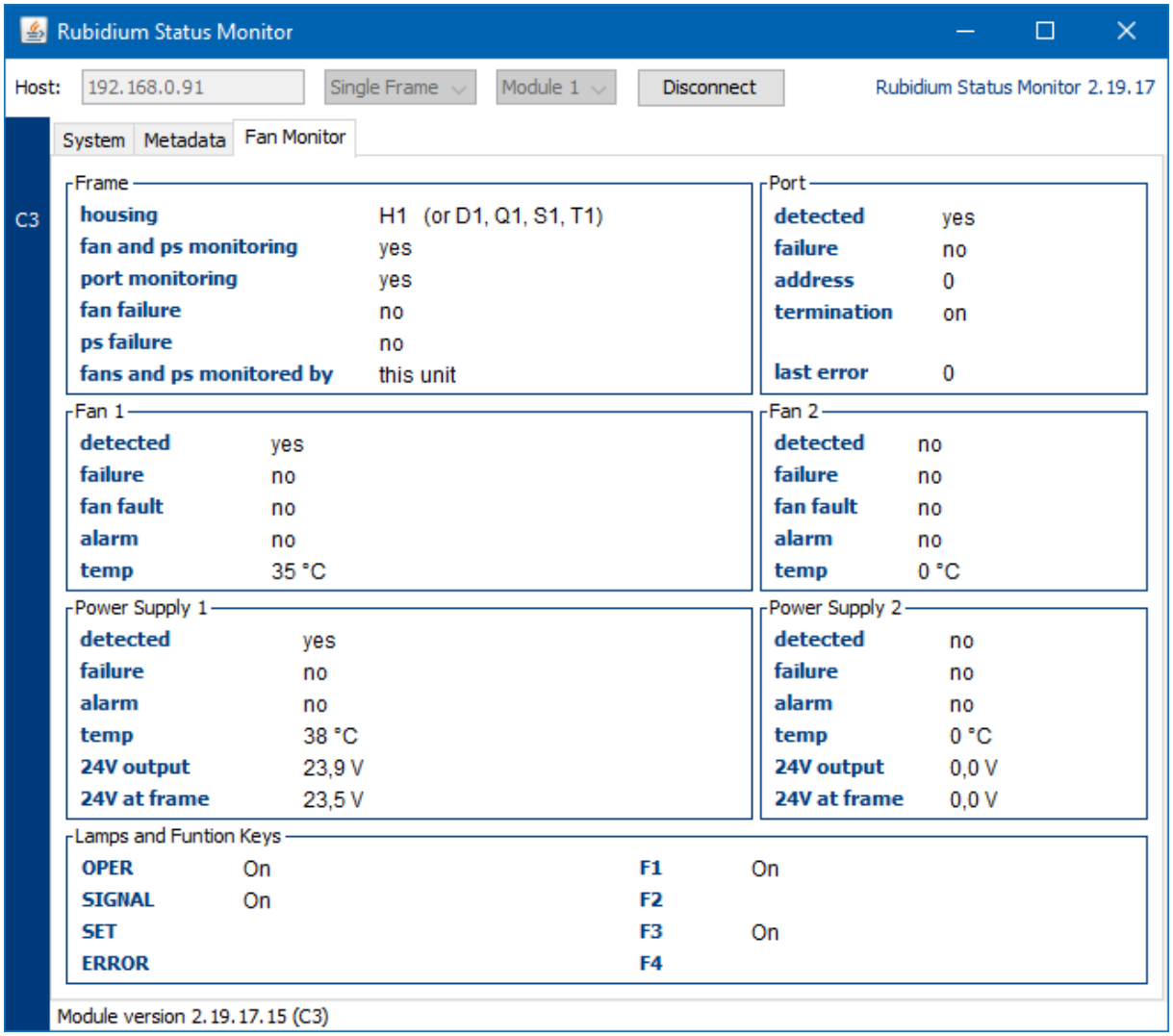


SMPTE ST 2059-2

Status	Shows if metadata are sent or received
Master locking status	Complementary information to clockClass
Current local offset	Offset in seconds of Local Time from grandmaster PTP time.
Jump seconds	The size of the next discontinuity, in seconds, of local time.
Time of next jump	The value of the seconds portion of the grandmaster PTP time at the time that the next discontinuity of the current local offset will occur.
Time of next jam	The value of the seconds portion of the PTP time corresponding to the next scheduled occurrence of the daily jam.
Time of previous jam	The value of the seconds portion of the PTP time corresponding to the previous occurrence of the daily jam
Previous jam local offset	The value of current local offset at the time of the previous Daily Jam event.
Forthcoming discontinuity reason	Leap second or not.
Time address flags	
Drop	SMPTE ST 12-1 drop flag.
Color Frame Identification	SMPTE ST 12-1 color framing flag.
Daylight saving	
Current daylight saving	Yes or no.
Daylight saving at next discontinuity	Yes or no.
Daylight saving at previous daily jam event	Yes or no.

1.13 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 **C3**.



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

2 The Rubidium Configuration Tools

2.1 The Rubidium Configuration PC Program

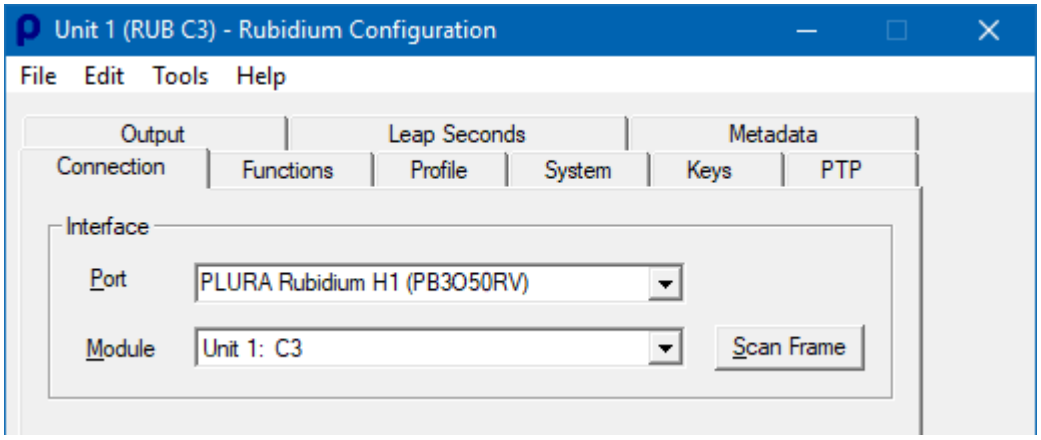
Please refer to the

'Installation & Systems Manual RUBIDIUM SERIES'

for a general description of this program and how to install it. In this document please notice the chapter *'The Rubidium Configuration PC Program'* and its 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 computer's keyboard afterwards.

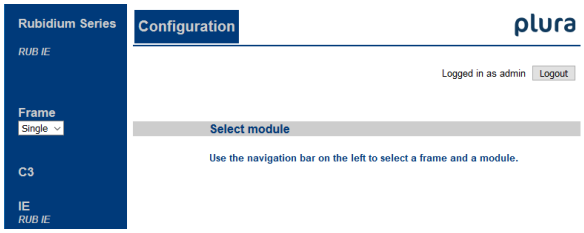
2.2 The Rubidium Series HTTP Server

The RUBIDIUM SERIES HTTP server, which is located in the Ethernet module (**RUB IE** or **RUB PM**), offers a status monitor. There is no HTTP server running on the C3 module itself.

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

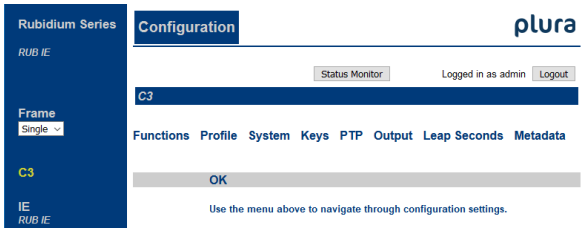
Start an Internet Browser and type in the IP address of the Ethernet Module.

If C3 does not appear in the bar on the left, you have to enter the correct address of the chassis at the **Frame** entry.



Click **C3** to access the C3 module.

A horizontal menu appears which shows a list of all configuration pages which are currently available. With a click on one of these entries of the menu a configuration page will be opened where you can see and change parameters. If it is the first time that you try to open a configuration page, you have to pass the **LOGIN**.



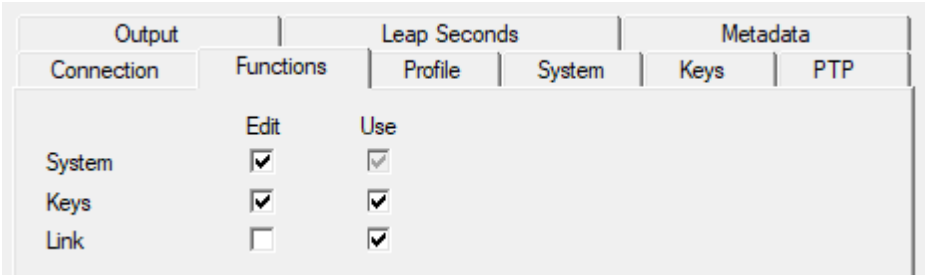
Changes on a parameter will <u>not</u> be stored automatically. At the bottom of each page there are two buttons which should be used to transfer the parameters:

Save To Module: Click this button to store the changes on the module.
Reload From Module: Click this button to refresh the configuration page.

2.3 “Functions“: Functions of the Module

The configuration page **Functions** indicates the complete range of functions. It is possible to individually switch on or off functions.

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



The **Edit** and **Use** checkboxes define the state of a function:

Edit	**Use**	State of a function
		Function disabled; corresponding configuration page not available.
√	√	Function enabled; corresponding configuration page available.
	√	Function enabled; corresponding configuration page not available. This avoids any unintentional operating.

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

Functions **Profile**, **PTP** and **Output** cannot be switched off.

Function **System** cannot be switched off completely, i.e. the corresponding **Use** checkbox is inoperable.

Attention using the Browser:

Changes on any parameter will not be transferred to the module automatically. Click “**Save To Module**” to store the changes at this configuration page to the module.

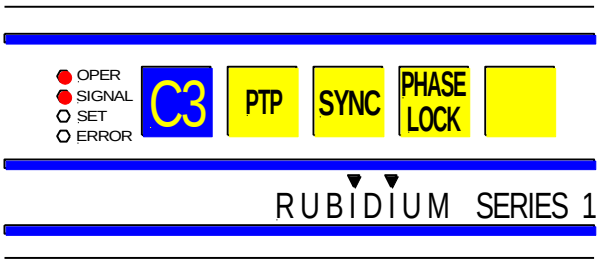
List of functions:

Profile	Store and load Set-Ups (*)
System	Name, Boot, Info, Fan, SNMP
Keys	Keys and Lamps, LEDs and GPI
Link	Communication between modules
PTP	PTP parameters of synchronization
Output	Serial interface, PPS and 10 MHz outputs

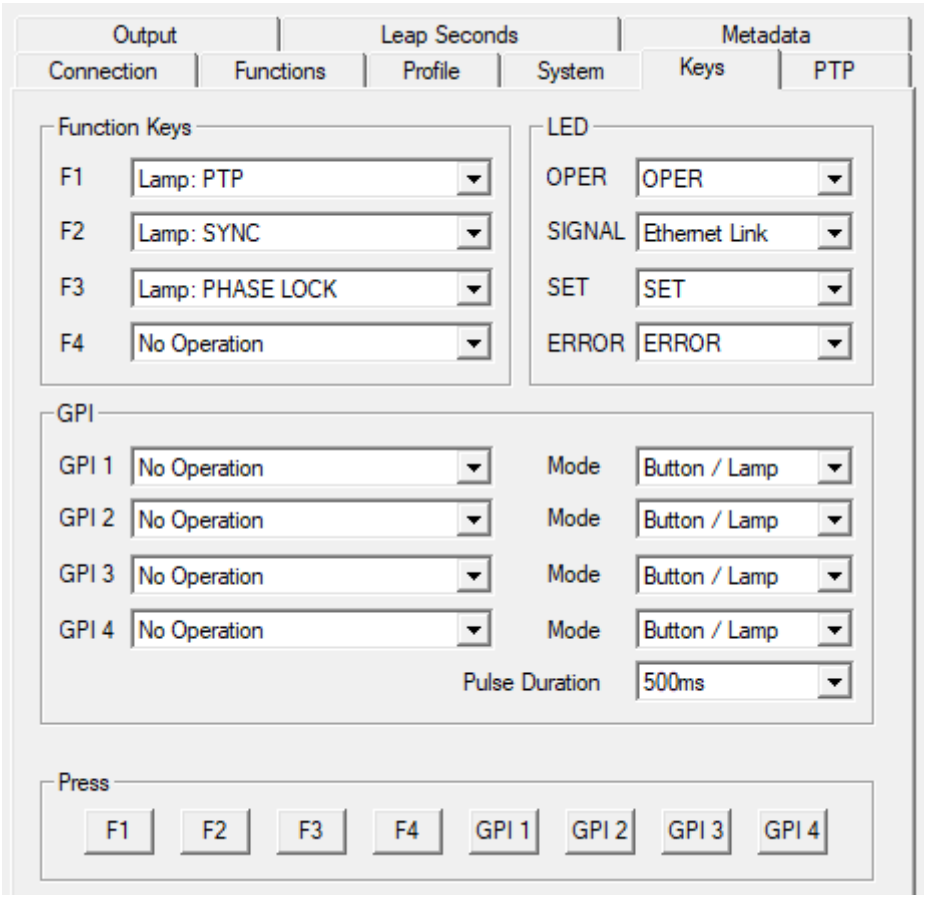
(*) refer to *‘Installation & Systems Manual RUBIDIUM SERIES’*

2.4 “Keys“: Keys and Lamps, LEDs and GPI

RUB1 version modules have four illuminated buttons (keys and lamps) and four LEDs (Light Emitting Diodes). Additionally, four GPI (input or output) are available. Basically, the functions of these in- and outputs are programmable.



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



Function Keys (keys and lamps)

RUB1 version modules offer four keys F1, F2, F3, and F4. They can get a function independently from each other. Select a function from the drop-down list. This selects the function of the lamps as well. The following functions are especially provided for this module:

Lamp: PTP	Feedback: Slave operating mode: The PTP grandmaster has been found. Grandmaster operating mode: Serial reference is valid, and device is in PTP grandmaster mode.
Lamp: SYNC	Feedback: Time & date has been set from PTP grandmaster.
Lamp: PHASE LOCK	Feedback: 10 MHz outputs are synchronized to PPS.
Lamp: Ethernet Link	Feedback: An Ethernet link on the PTP port has been established.

LED

RUB1 version modules offer four LEDs (named OPER, SIGNAL, SET, and ERROR) which can get a function independently from each other. Select a function from the drop-down list. The following functions are especially provided for this module:

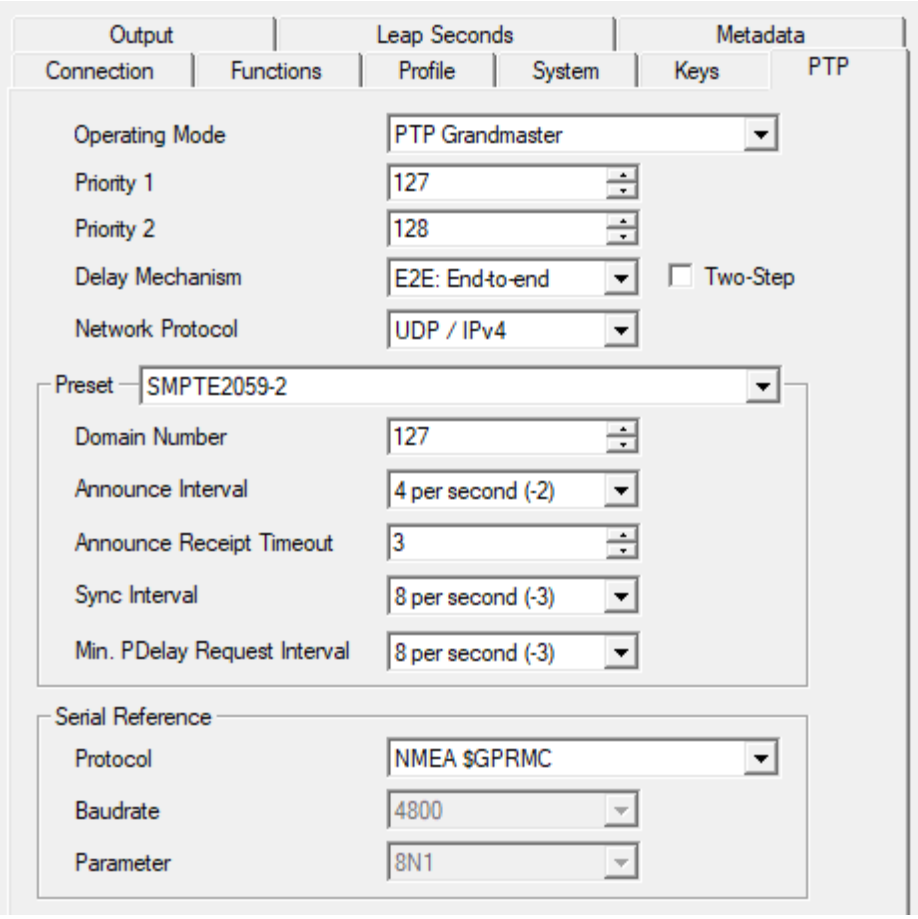
OPER	Lights up, if the module is operating.
Ethernet Link	An Ethernet link on the PTP port has been established.

GPI

GPI can be used as input or output. All function key programming is available (see above).

2.5 “PTP“: Operating Parameters of Synchronization

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



Operating Mode The operating mode specifies role of the PTP engine.

Possible values: PTP Slave,
PTP Grandmaster,
PTP Grandmaster with PTP fallback,
PTP Boundary clock, or
PTP Boundary clock with GPS.

Default: PTP Slave.

Priority 1 Priority 1 specifies the priority to be used in the execution of the BMCA.

Possible values: 0 to 255.
SMPTE 2059-2 recommendation: 128.

Priority 2 Priority 2 specifies the secondary priority to be used in the execution of the BMCA.

Possible values: 0 to 255.
SMPTE 2059-2 recommendation: 128.

Delay Mechanism The delay mechanism specifies the delay measuring option used by PTP.

Possible values:	E2E (end-to-end) or P2P (per-to-peer).
Default:	E2E.

Network Protocol Specifies the transport protocol of PTP packages over the network.

Possible values:	IEEE 802.3, UDP / IPv4 or UDP / IPv6.
SMPTE 2059-2 recommendation:	UDP / IPv4 or UDP / IPv6.

Preset

Domain Number A domain consists of one or more PTP devices communicating with each other as defined by the protocol.

Possible values:	0 to 127.
SMPTE 2059-2 recommendation:	127.

Announce Interval Specifies the mean time interval between successive Announce messages. This interval in concert with Announce Receipt Timeout (see below) governs how quickly the BMCA re-configures the system in the event of a master failure.

Possible values:	8 per second (2^{-3} s) to every 2 seconds (2^{1} s).
SMPTE 2059-2 recommendation:	4 per second (2^{-2} s).

Announce Receipt Timeout Specifies the number of Announce Intervals (see above) that have to pass without receipt of an Announce message before the occurrence of the event.

Possible values:	2 to 10.
SMPTE 2059-2 recommendation:	3.

Sync Interval Specifies the mean time interval between successive Sync messages.

Possible values:	128 per second (2^{-7} s) to 2 per second (2^{-1} s).
Default:	8 per second (2^{-3} s).

Min. PDelay Request Interval Specifies the minimum permitted mean time interval between successive Pdelay_Req messages sent over a link.

Possible values:	128 per second (2^{-7} s) to every 16 seconds (2^{4} s).
Default:	8 per second (2^{-3} s).

Serial Reference

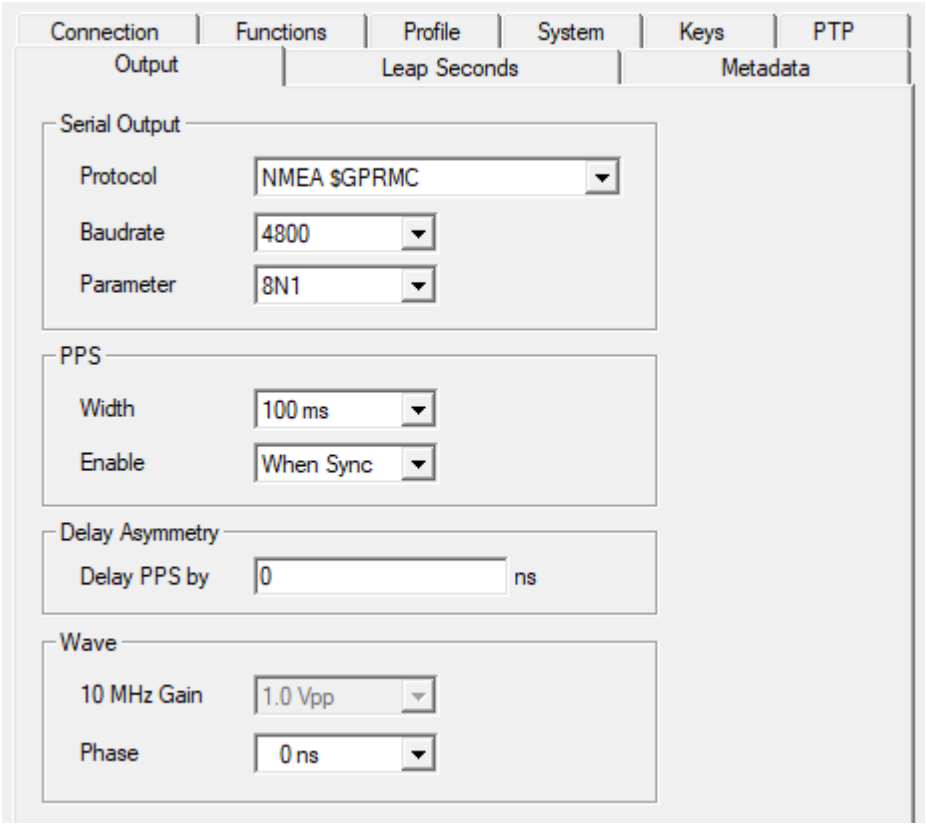
Protocol	Data protocol used for serial reference used on RXD_1 line in PTP grandmaster operating modes.
Baudrate	Baud rate.
Parameter	Data bits, parity, stop bits.

For compatibility with other Plura timecode equipment this settings are recommended:

Protocol	Baudrate	Parameter
NMEA $GPRMC	4800	8N1
Meinberg (Std or GPS)	2400	7E2
Meinberg Uni	2400	7E2

2.6 “Output“: Serial interface, PPS and 10 MHz outputs

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



Serial Output

Protocol	Data protocol used on TXD_1 line.
Baudrate	Baud rate.
Parameter	Data bits, parity, stop bits.

For compatibility with other Plura timecode equipment this settings are recommended:

Protocol	Baudrate	Parameter	Remark
UTC Time+Date	2400	7E2	“Meinberg Std.”
GPS Time+Date + Leap Seconds	2400	7E2	“Meinberg GPS”
NMEA $GPRMC	4800	8N1	

PPS

Width	Width of positive PPS pulse.
Enable	Specifies when the PPC pulses will be enabled, at start-up or at first sync.

Wave

10 MHz Gain	Fixed to 1 V_{PP}
Phase	Phase relationship of 10 MHz to PPS outputs. Adjustable in steps of 10 ns.

The "UTC Time + Date " data protocol

32 characters of ASCII format: <STX>D:01.01.16;T:4;U:14.15.41;*uvxy*<ETX>

STX	start of text	$02		
D:	followed by the date	day.month.year		
;		$3B		
T:	followed by the day of week	1-7, 1 = Monday		
;		$3B		
U:	followed by the time	hours.minutes.seconds A leap second is transferred as second = 60		
;		$3B		
u	status of time & date	#	($23)	time of internal clock is not yet precise
		' '	($20)	time of internal clock is precise
v	SYNC and LOCK	*	($2A)	SYNC or LOCK not yet reached
		' '	($20)	SYNC and LOCK
x	time zone indicator	U = UTC		
y	announcement of a leap second event	A = announcement of a leap second event during the hour preceding the event ' ' = no announcement		
ETX	end of text	$03		

The "UTC Time + Date + Leap Seonds" data protocol

36 characters of ASCII format: <STX>D:01.01.16;T:4;U:14.15.41;*uvxy;lll*<ETX>

32 characters of this data protocol are conforming to "UTC Time + Date". There are four additional characters:

;		$3B
lll	UTC leap seconds	Number of UTC leap seconds, for example 035 at 17.02.2015

The "GPS Time + Date + Leap Seonds" data protocol

36 characters of ASCII format: <STX>D:01.01.16;T:4;U:14.15.41;*uvGy;lll*<ETX>

lll	GPS leap seconds	Number of GPS leap seconds, for example 016 at 17.02.2015

This data protocol is identical to "UTC Time + Date + Leap Seconds" with the exception that time+date is in GPS timescale. That is indicated by a "G" (instead of "U") time zone indicator.

2.7 “Leap Seconds“: Setting the Leap Seconds

Leap seconds

UTC is the worldwide real-time reference. Occasionally, UTC will be corrected introducing a leap second. It is not possible to predict a leap second; the leap second is determined by the IERS (International Earth Rotation and Reference Systems Service) and will be announced at the Bulletin C (services.iers@obspm.fr). Up to now, all leap seconds have been inserted as last second before either 1st of January or 1st of July, regarding UTC time scale.

G3 receiving signals of a real-time reference

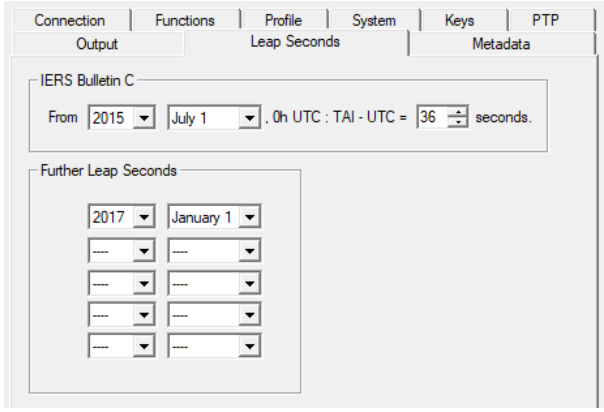
G3 needs to know the amount of leap seconds. In PTP slave mode leap seconds information is provided by PTP grandmaster. If C3 is in PTP grandmaster mode, if the serial protocol sent from the external real-time reference includes this information, C3 will take it for internal calculations. Otherwise, the amount of leap seconds has to be set manually at this tab.

> Please verify the protocol sent from the external real-time reference. The *UTC Time+Date + Leap Seconds* and the *GPS Time+Date + Leap Seconds (aka Meinberg GPS)* protocols contain the amount of leap seconds.

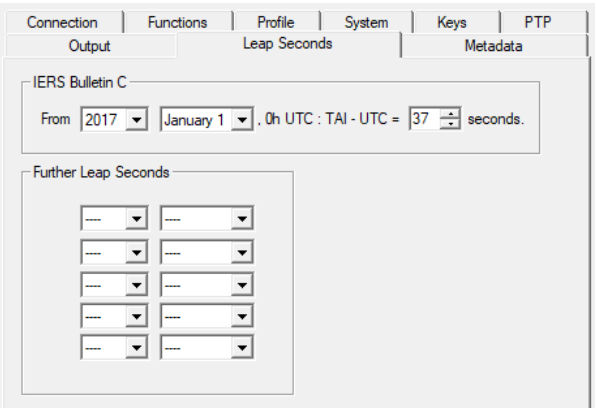
You can verify the correct leap second information at the status monitor: *Time and Date – Leap seconds* at the *System* tab indicates the amount of leap seconds taken for internal calculations.

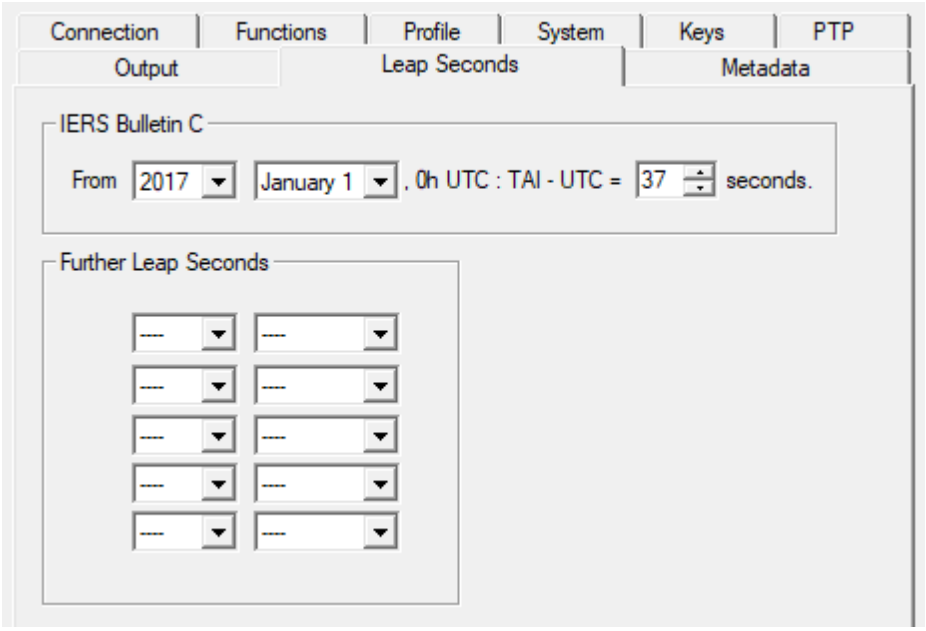
It is recommended to keep the parameters at this tab updated. As soon as a leap second event is announced, update the *Further Leap Seconds* entry. After a leap second event, you can correct the *IERS Bulletin C* entries. Example (before UTC 0h 0m 0s @ January 1, 2017, a leap second has been inserted):

Parameter before January 2017



Parameter after January 2017





IERS Bulletin C

The leap second is determined by the IERS (International Earth Rotation and Reference Systems Service). The "Bulletin C", published by the IERS twice a year, contains the information about the current number of leap seconds and about an upcoming leap second event. Example:

```
from 2017 January 1, 0h UTC, until further notice : UTC-TAI = -37 s
```

This information can be entered here.

Further Leap Seconds

If upcoming leap second events are known, you can enter the date of this event. Up to now, all leap seconds have been inserted as last second before either 1st of January or 1st of July, regarding UTC time scale.

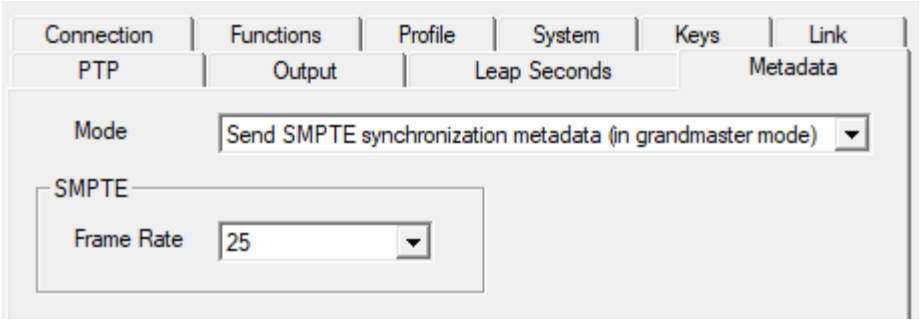
This entry allows either 1st of January, or 1st of April, or 1st of June, or 1st of October.

Changes in this tab are processed with a delay of about 30 seconds to allow entering consistent values.

2.8 “Metadata“: SMPTE Synchronization Metadata

Synchronization Metadata

SMPTE ST 2059-2:2015 defines synchronization metadata as an organization extension TLV (Type Length Value), processed as PTP management packets. C3 can send those metadata in PTP grandmaster mode or receive it in PTP slave mode.



Mode Specifies if SMPTE synchronization metadata are received (useful in PTP slave mode) or sent (only possible in PTP grandmaster mode).

SMPTE

Frame Rate	Specifies the system frame rate.
Possible values:	23.98 to 60.
Default:	25.

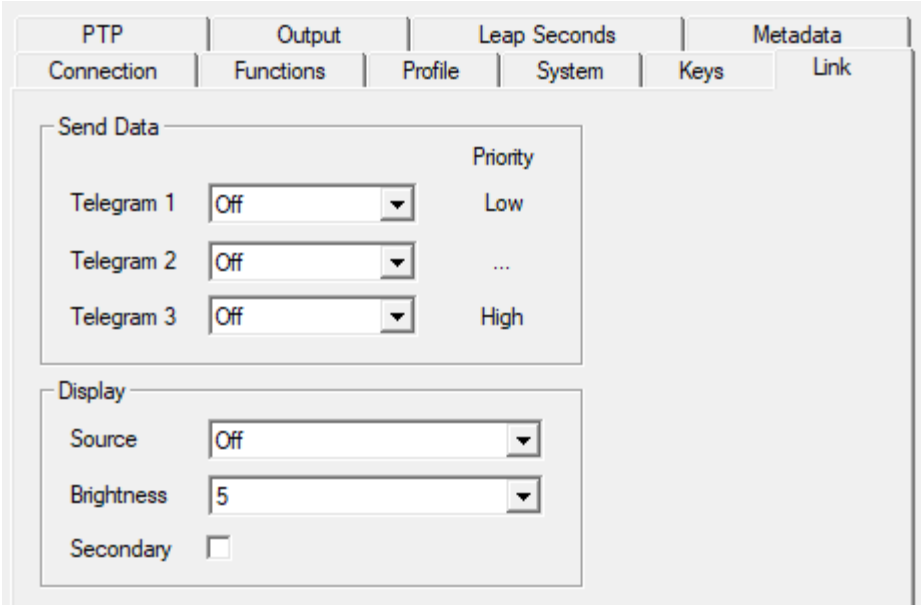
2.9 “Link”: Communication between Modules

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

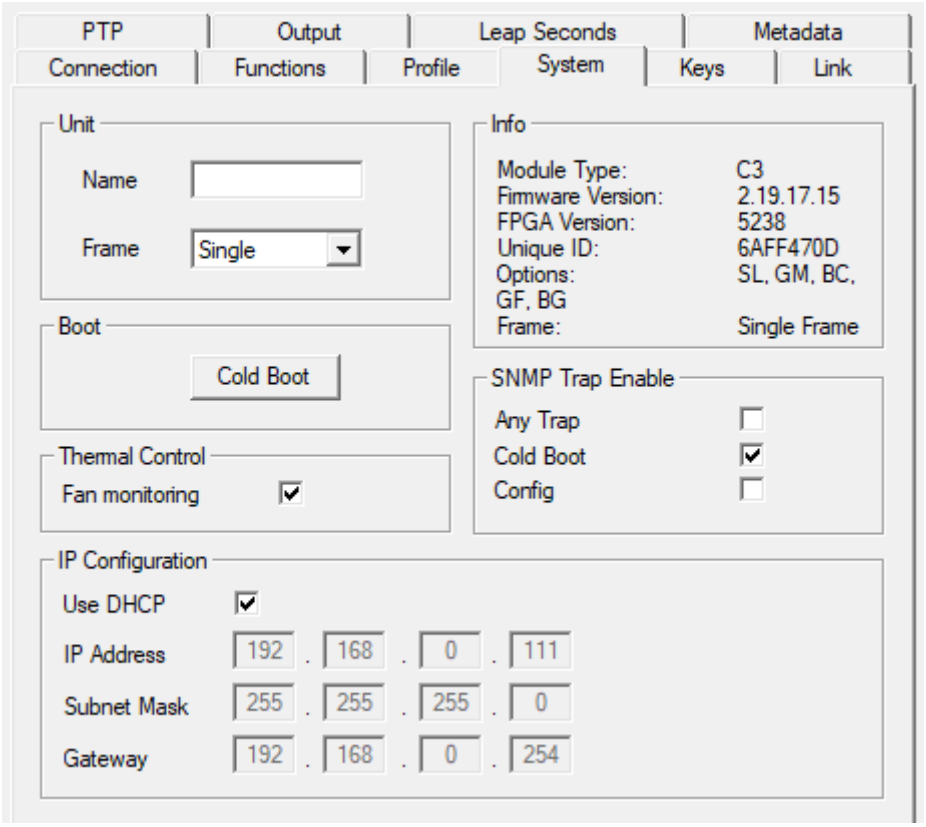
Three channels (**Telegram 1 - 3**) have been provided to transmit data in a time code format. For each channel a function can be selected from the drop-down list:	
Off	This channel will not be used to transmit data, data can be received.
Reference	This channel transfers time and date (UTC).

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.
	Real-Time	Time of the reference (UTC) in a HH:MM:SS format.
	Date	Date of the 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.	

2.10 “System“: Name, Boot, Info, Fan, IP, SNMP

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	Clicking this button enables a restart of the module. At first a window appears with the message that the operation of the module will stop during restart. Click **ok** to do the restart.

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.

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.

IP Configuration

Use DHCP	If checked, the device will automatically request its IP parameters (IP address, subnet mask, and gateway) from a DHCP server. In this case the “IP Address”, “Subnet Mask”, and “Gateway” boxes have no relevance.
IP Address	IP address, manually set.
Subnet Mask	Subnet mask, manually set.
Gateway	Gateway, manually set.

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