plura®

TIMING SOLUTIONS

Rubidium Series

RUB IE-N
RUB PM-N

NTP Server
Network Synchronization

CONTENTS

A1 Revision History

No.	Date	Subject
0.n	January 05, 2005	Preliminary documents, changes without notice.
1.0	March 22, 2006	First released document.
2.0	June 22, 2012	Completely revised.
2.1	February 22, 2013	This option is available for PM modules as well.
2.2	August 26, 2019	Changed address of Plura Europe GmbH.
2.3	December 2, 2020	Re-formatted in new design.
2.4	September 23, 2021	Added NTP port.

A2 Copyright

Copyright © Plura Europe GmbH 2002-2021. All rights reserved. No part of this publication may be reproduced, translated into another language, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without the prior written consent of Plura Europe GmbH.

Printed in Germany.

Technical changes are reserved.

All brand and product names mentioned herein are used for identification purposes only and are trademarks or registered trademarks of their respective holders.

Information in this publication replaces all previously published information. Plura Europe GmbH assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained herein.

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 manual
    "Functional Description and Specifications of RUB Ethernet Modules".

It describes a special feature for module **IE** or **PM**, realized by an optional firmware.

1   NTP Server

1.1   Description

The NTP option for an RUB Ethernet module (**IE** or **PM**) makes the time signal, which is available at the internal bus (TC_link) of your Plura Rubidium system, retrievable via Ethernet.

This application requires that the Rubidium module acting as a time source (modules like **GT**, **GI**, **GNS 10 MHz**) gets the appropriate setup (see chapter "Configuration" for details).

The "Network Time Protocol" (NTP) is an open standard (Version 3 is defined in RFC 1305), therefore a lot of client-software packages for different operating systems exist. They make it possible to synchronize the computer's clock to an NTP Server. Some operating systems even have integrated NTP Clients by default.

To make use of the whole complexity of the protocol, it is recommended to use the reference implementation, which can be downloaded at „www.ntp.org".

In theory, NTP allows an accuracy of some 100 nanoseconds. In praxis, the accuracy normally will be some milliseconds. This is good enough to enable a frame-accurate synchronization of all network components. Please be aware that the accuracy depends on network architecture and load.

1.2   Specification

NTP version (server)	3
Supported NTP versions (as clients)	2, 3, 4
NTP mode	Normally mode = 4 (server). Any requests with mode = 1 (symmetric active) will be returned with mode = 2 (symmetric passive).
Queries per second	Max. est. 200
Measured sync precision (ntpd 4.2.0-nt)	< 10 ms
NTP port	UDP port 123

1.3   Configuration

1.3.1   Examples of Rubidium Systems with NTP Functionality

The NTP Server needs to receive a periodical sent reference time telegram via TC_link (= internal interface of the Plura Rubidium System). The following modules are able to transmit this time telegram: **GT**, **GI**, **GNS 10 MHz**.

These are typical systems with NTP Server functionality via any RUB Ethernet module:

RUB GT with GPS or DCF77 time & date reference

> Time telegram is sent from RUB GT.
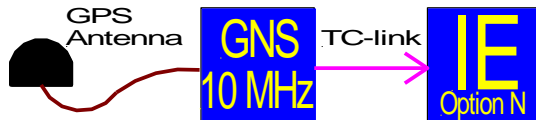

RUB GT with external LTC as a time & date reference

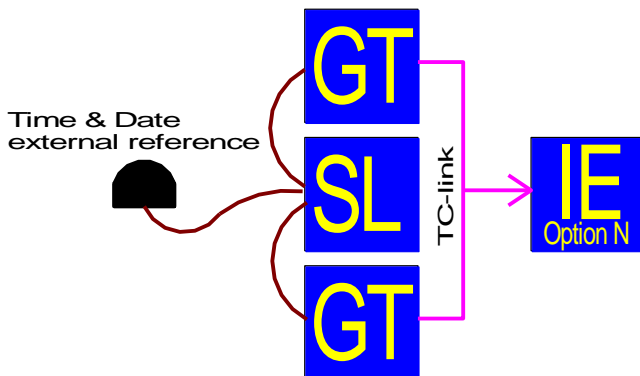> Time telegram is sent from RUB GT.

RUB GNS 10 MHz as a time & date reference

> Time telegram is sent from RUB GNS 10 MHz.

Redundant LTC system with 2 x RUB GT and GPS as a time & date reference

> Both RUB GT modules have the time telegram activated, but only the "Primary" module – controlled by RUB SL module – will transmit data.

1.3.2 Time Telegram

Any module of type **GT**, **GI**, **GNS 10 MHz** can send a "Reference" time telegram.

If you have a system of GT or GI modules in a non-redundant configuration, please take care that only one module is enabled to send this telegram.

In any redundant system (2 x GT + SL, 2 x GI + SI), both modules have the time telegram activated. It is important that both modules are connected to the changeover unit (SL or SI). The changeover unit allocates a "Primary"/"Back-Up" priority, and only a "Primary" module will transmit data. Again, only one module delivers the time telegram at a time.

If more than one module transmits a time telegram, the NTP server might not work properly.

Set-up is done at the **Link** page of one of the configuration tools:
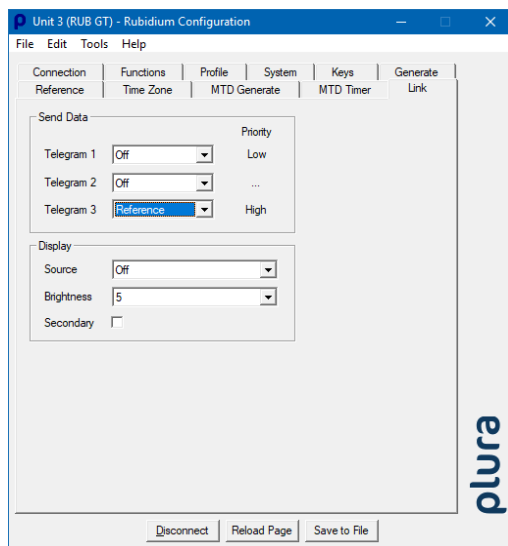
<u>Windows program</u>   <u>Browser</u>
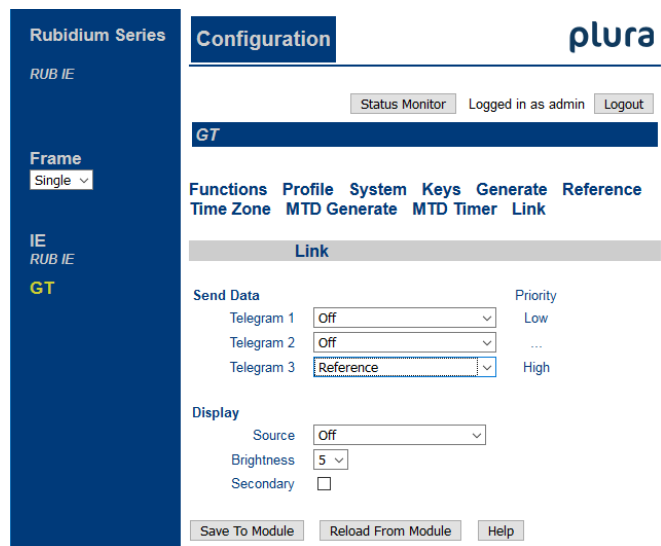
Within the "Link" submenu, set <u>one</u> of the three possible telegrams to "Reference". The NTP Server automatically detects the telegram and synchronizes its clock.

1.3.3   NTP Server

Basically, the NTP Server works automatically, provided that the time telegram as described in the previous chapter will be sent. No additional set-up is required.

You can access the Ethernet module to watch status information and to modify the stratum value. Please notice "Functional Description and Specifications of RUB Ethernet Modules" manual for details about how to access the Ethernet module.

Click on **NTP Server** to open the **NTP Server** page.
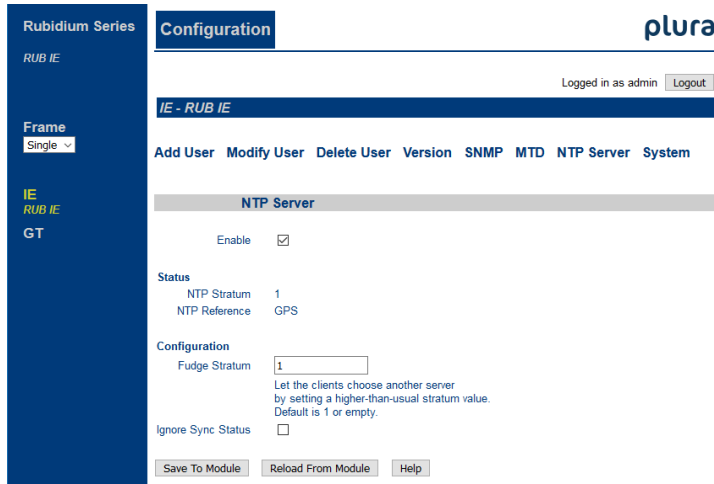
Status

NTP Stratum   Shows the current stratum value. A "1" should be indicated during normal operation. Please notice chapter "Troubleshooting".

NTP Reference   Shows the "reference clock identifier" of the NTP message string. This identifier depends on the stratum value:

NTP Stratum = 0:   NTP Reference = "INIT" or = "LOST".
NTP Stratum = 1:   NTP Reference = "GPS".
NTP Stratum > 1:   NTP Reference = "0.0.0.0".

Configuration

Fudge Stratum   This value is "1" for normal applications.

If a network includes several NTP server devices, it may be useful to allocate different priorities. The NTP standard does not provide a manual set-up of priorities, but the NTP option offers this set-up at this place.

"Fudge Stratum" determines the *NTP Stratum* value during normal operation:
                    "1" = highest priority → *NTP Stratum* = "1";
                    "2" = next lower priority → *NTP Stratum* = "2".

In some error cases (refer to chapter "Troubleshooting"), the *NTP Stratum* value receives an offset equal to "Fudge Stratum – 1".

1.4   NTP Server and Leap Second

The NTP Server basically works with **UTC**, so it is not affected by any DST switching of a local time zone, but it is affected by a time jump according to a leap second.

NTP itself does not provide any special leap second handling. You will find a lot of information on this issue in the Internet.

Please also refer to the document "Leap Second and Time Code".

RUB Ethernet module with "N" option operates as an NTP server, which normally receives time & date from a RUB GT module.
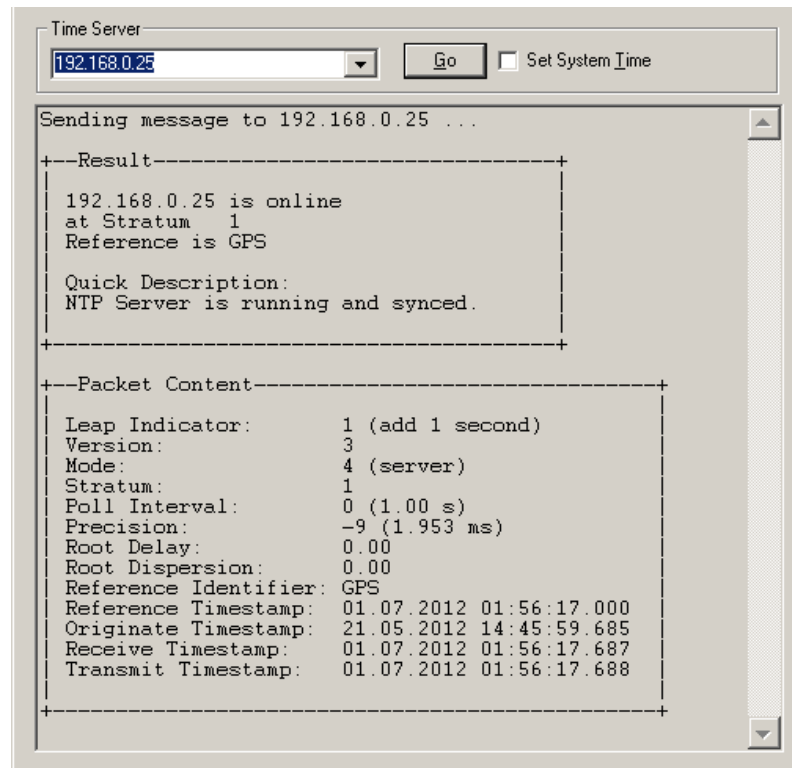
If RUB GT receives a leap second announcement from any external real-time reference, a leap second alarm will be transmitted to the Ethernet module via internal interface. Normally, this alarm will be raised 55 minutes before the event.

NTP messages include a leap indicator (**LI**). This way, a leap second alarm can be transported from NTP server via NTP clients to the operating system, which then can use this information for a leap second handling.

Note: Ethernet modules with firmware **2.12.7** or higher will handle this leap indicator. Please check whether a firmware update will be necessary. From version 2.12.7 on, the **LI** status will be set including the additional second.

You can check your NTP connection and the leap second announcement with **NTP Tool** by Plura.

Example: The "**Leap Indicator**" status announces a leap second:

```
┌ Time Server ─────────────────────────────────────────────────┐
│ │192.168.0.25│         ▼│   │ Go │  □ Set System Time         │
│                                                                │
│ Sending message to 192.168.0.25 ...                     ▲     │
│                                                                │
│  +--Result------------------------------+                     │
│  |                                       |                     │
│  | 192.168.0.25 is online                |                     │
│  | at Stratum    1                       |                     │
│  | Reference is GPS                      |                     │
│  |                                       |                     │
│  | Quick Description:                    |                     │
│  | NTP Server is running and synced.     |                     │
│  |                                       |                     │
│  +---------------------------------------+                     │
│                                                                │
│                                                                │
│  +--Packet Content------------------------------+             │
│  |                                               |             │
│  | Leap Indicator:      1 (add 1 second)         |             │
│  | Version:             3                        |             │
│  | Mode:                4 (server)               |             │
│  | Stratum:             1                        |             │
│  | Poll Interval:       0 (1.00 s)               |             │
│  | Precision:           -9 (1.953 ms)            |             │
│  | Root Delay:          0.00                     |             │
│  | Root Dispersion:     0.00                     |             │
│  | Reference Identifier: GPS                     |             │
│  | Reference Timestamp:  01.07.2012 01:56:17.000 |             │
│  | Originate Timestamp:  21.05.2012 14:45:59.685 |             │
│  | Receive Timestamp:    01.07.2012 01:56:17.687 |             │
│  | Transmit Timestamp:   01.07.2012 01:56:17.688 |             │
│  |                                               |             │
│  +-----------------------------------------------+      ▼     │
└────────────────────────────────────────────────────────────────┘
```

1.5 Troubleshooting

1.5.1 Checking the NTP Status

The NTP Server uses the NTP values "Stratum" and "Reference" to indicate its state of operation (refer to chapter "NTP Server").

Refer to the following table to interpret the given information:

Stratum: 0   **Reference: INIT**

The Ethernet module has not received any valid time telegram since power has turned on.

This state sets an alarm condition in the NTP message: **LI** = 3 = clock not synchronized.

Possible causes:

A   **TC_link** connection may be disconnected, for example the Ethernet module is plugged in a different chassis and the **RLC** connectors of the chassis are not connected.

B   "**Reference**" telegram may be not enabled for the relevant module (GT/GI or GNS 10 MHz). Check at **Link** function: any telegram (1, 2, or 3) set to "Reference"? Please refer to chapter "Time Telegram".

C   If one of the modules GT/GI is responsible for sending the time telegram: This module may be in a "**back-up**" operating mode. This is the case in a short of the **DRVSEL** signal to GND (pin 7 at DSUB9F or pin 5 at RJ45 – please refer to the operating manual of the module).

     Options for verifying:

     RUB1 modules offer lamps with programmable functions. Assign the "Primary Generator" function to a lamp. If this lamp does not light up, the module will stay in the "back-up" mode.

     GT/GI status monitor indicates the following status at the "Time and Date" page: "primary **yes**" or "primary **no**".

D   If one of the modules GT/GI is responsible for sending the time telegram: This module does not have a valid real-time or date, because …

     The external real-time reference is not connected or does not send valid data or sends an invalid protocol. Options for verifying:

         GT/GI status monitor indicates the status "external reference" at the "Time and Date" page: "connected before **no**" or "accepted before **no**".

         RUB1 modules: LED OPER normally has the "Reference Input" functionality. If it does not flash once per second, no valid data can be received.

     Help: Check and correct the set-up regarding the external reference. What has been selected at "Format" at the "Reference" page?

     And …

     Backup battery empty. Verify: GT/GI status monitor shows „real-time clock chip" status at the "Time and Date" page: "status **not ok**". In this case please insert a battery and set real-time and date manually afterwards.

Stratum: 0   Reference: LOST

Failure of the time telegram: telegram loss for more than one hour.

Possible causes: same as "Stratum: 0 Reference: INIT".

This state sets an alarm condition in the NTP message: **LI** = 3 = clock not synchronized.

Stratum: 1   Reference: GPS

Normal operating mode. The Ethernet module receives a time telegram via TC_link once per second.

[Stratum = 1 requires setting "Fudge Stratum" to 1]

   If the module GNS 10 MHz is responsible for sending the time telegram: This module receives signals from satellites.

   If one of the modules GT/GI is responsible for sending the time telegram: internal clock has been synchronized by an external synchronized reference within the last 24 hours **and** generator works in phase lock mode.

Stratum: > 1   Reference: 0.0.0.0

"Reference" will be set to "0.0.0.0" for any stratum values > 1. There are many possible causes for a stratum > 1:

A   **Fudge Stratum** set to > 1 (please refer to chapter "NTP Server"). In this case the stratum value receives an offset of "Fudge Stratum – 1" during normal operating.

B   **TC_link** connection interrupted. Check for possible causes as described at A, B, C at section "Stratum: 0 – Reference: INIT".
   After a loss for some seconds the stratum value will be set to 9. After a loss for a minute the stratum value will be set to 10, and it will increment by 1 each 10 minutes up to a maximum of stratum value = 15.
   In this case, "Fudge Stratum" has no influence on the stratum values.

C   If the module **GNS 10 MHz** is responsible for sending the time telegram: This module has **lost its synchronization**.
   Stratum: = 4 + possible offset by "Fudge Stratum".
   Options for verifying: This is a normal status for a short time (some minutes) after power has turned on. If this status does not change, watch the status monitor or – at RUB1 modules – look at the lamps of the keys.
   Help: Check position of antenna. Antenna should see as much sky as possible.

D   If one of the modules **GT/GI** is responsible for sending the time telegram:

   D_1 This module has lost its phase lock to an external sync signal (video, PPS, LTC/IRIG-B).
      Stratum: It gets a single increment by one after a loss for 256 seconds.
      Options for verifying: Status monitor indicates "pll lock current **no**" at the "System" page.

Help: Restore synchronization.
Verify that the correct sync signal is selected at the "Generate" page.

D_2 Internal clock of GT/GI has been set after power has turned on, either by an external real-time reference, or manually utilizing one of the configuration tools. But the time of the clock is (no longer) synchronized to the external reference, because ...

- it has been set "manually",
- the external real-time reference was in a free-running mode during the last update of the internal clock,
- the internal clock has not received an update since 24 hours by an external synchronized real-time reference.

Stratum: = 2 + possible offset by "Fudge Stratum".

Options for verifying: Status monitor indicates "locked no" at "local time zone" of the "Time and Date" page.

Help: Check external real-time reference.
Check and correct the set-up regarding the external reference. What has been selected at "Format" at the "Reference" page?

D_3 Internal clock of GT/GI has not received an update after power has turned on.

- Signals of a real-time reference can be received, but the receiver has not synchronized yet.
- No valid data of a real-time reference could be received. The module starts with the time of the real-time chip with battery backup .

Stratum: = 4 + possible offset by "Fudge Stratum".

Options for verifying: Status monitor indicates "sync after reset no" and "locked no" at "local time zone" of the "Time and Date" page.
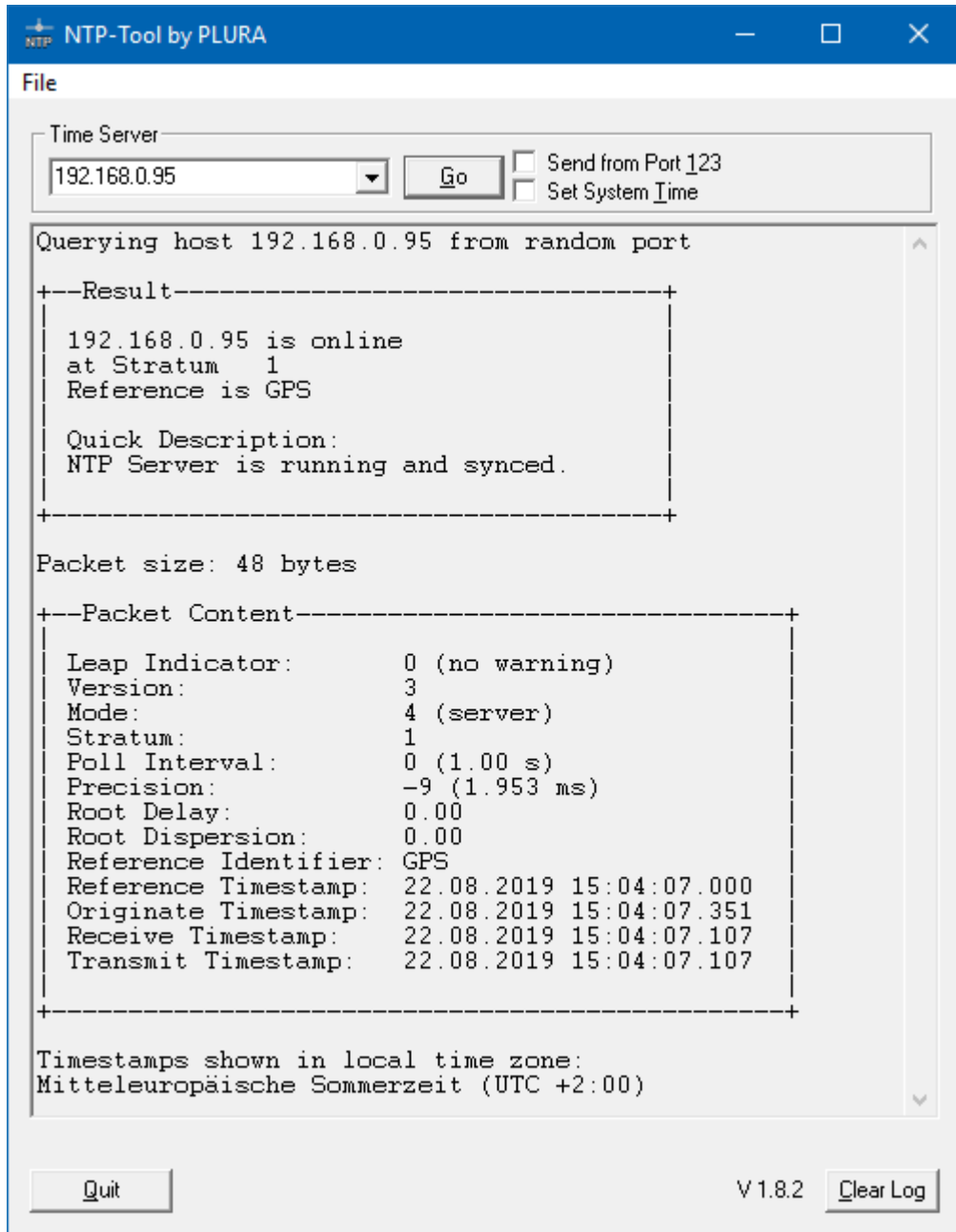
Help: Check external real-time reference.

1.5.2   Checking the NTP Connection

If you want to check the NTP connection, you can use the Plura **NTP Tool**. This tool enables a quick check that the NPT server is available and working.
This program runs on a windows operating system and queries the NTP server. Just enter the IP address of the NTP server and click the **Go** button.

```
NTP-Tool by PLURA                                    —    □    ×

File

 Time Server
 ┌─────────────────────────────┐          ☐ Send from Port 123
 │ 192.168.0.95          │ ▼ │    Go     ☐ Set System Time
 └─────────────────────────────┘

Querying host 192.168.0.95 from random port

+--Result----------------------------------+
|                                          |
| 192.168.0.95 is online                   |
| at Stratum    1                          |
| Reference is GPS                         |
|                                          |
| Quick Description:                       |
| NTP Server is running and synced.        |
|                                          |
+------------------------------------------+

Packet size: 48 bytes

+--Packet Content-----------------------------+
|                                             |
| Leap Indicator:       0 (no warning)        |
| Version:              3                      |
| Mode:                 4 (server)            |
| Stratum:              1                      |
| Poll Interval:        0 (1.00 s)            |
| Precision:            -9 (1.953 ms)         |
| Root Delay:           0.00                   |
| Root Dispersion:      0.00                   |
| Reference Identifier: GPS                    |
| Reference Timestamp:  22.08.2019 15:04:07.000|
| Originate Timestamp:  22.08.2019 15:04:07.351|
| Receive Timestamp:    22.08.2019 15:04:07.107|
| Transmit Timestamp:   22.08.2019 15:04:07.107|
|                                             |
+---------------------------------------------+

Timestamps shown in local time zone:
Mitteleuropäische Sommerzeit (UTC +2:00)


    Quit                              V 1.8.2   Clear Log
```

Contact Us

plura ®

Corporate Offices:
Plura Broadcast, Inc.
Ph: +1-602-944-1044
Sales@plurainc.com

U.S.A.

Plura Europe GmbH
Ph: +49-6725-918006-70
Sales@plurainc.com

GERMANY

Plura MEA
Ph: +971-50-715-9625
Sales@plurainc.com

U.A.E.

Plura Asia
Ph: +82-10-6688-8826
Sales@plurainc.com

S. KOREA