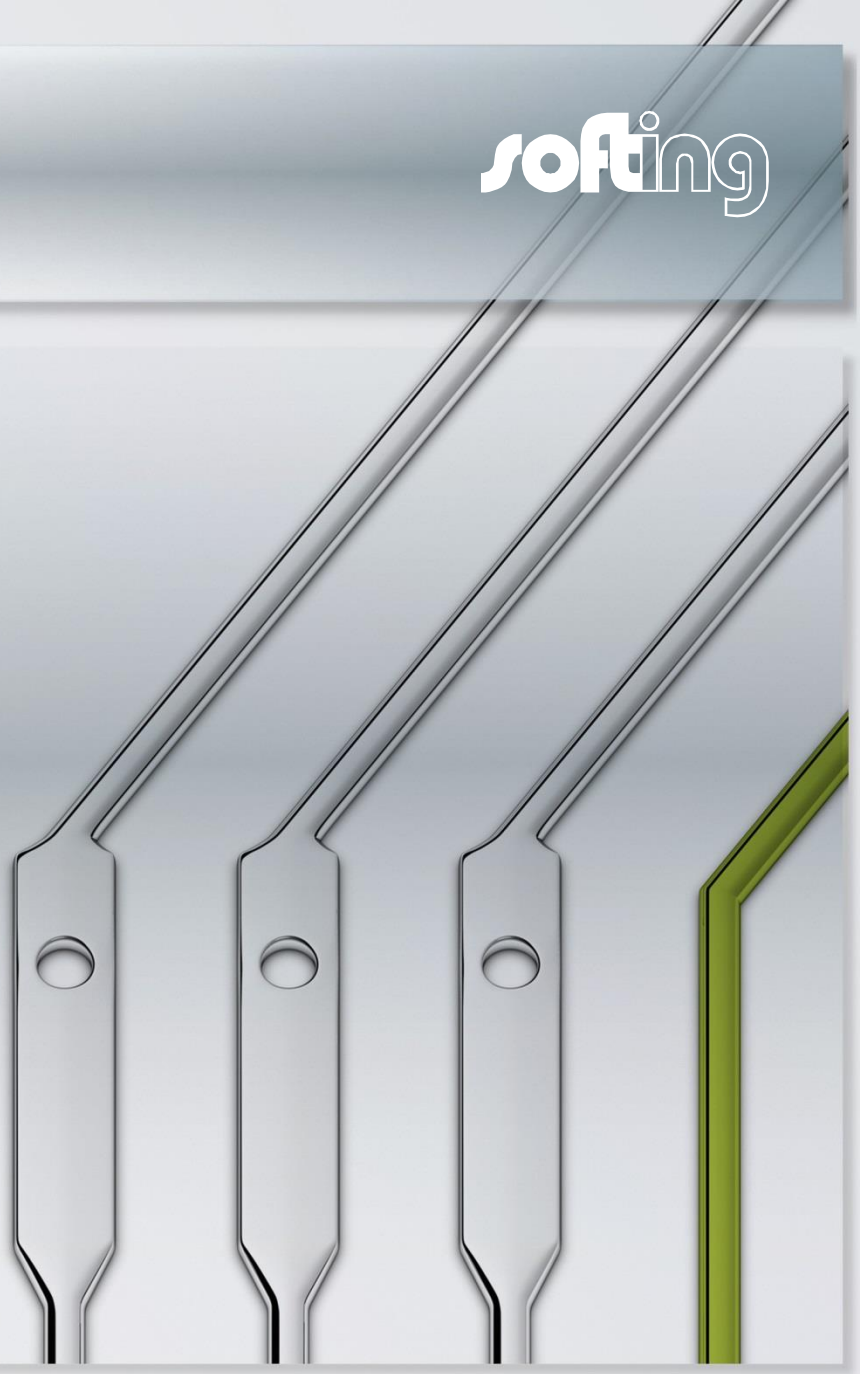
PROFIBUS DIAGNOSIS

How to Optimize your Network with PROFIBUS *Tester 5*

The easy Approach for Beginners and Professionals



0. Table of Contents

Here is a list of issues commonly found in PROFIBUS networks	
Missing, unpowered, or surplus bus-terminations	Bus cable too long
Dead-end branches	Wrong cable types
Damaged or defective bus drivers (RS 485 components)	Aging/corroding connectors and cables causing excessive transmission resistance
Cable-routing in environments subject to strong interference	EMC impacts
Network and node configuration errors, Data rate too high	Wrong GSD Files, and more…

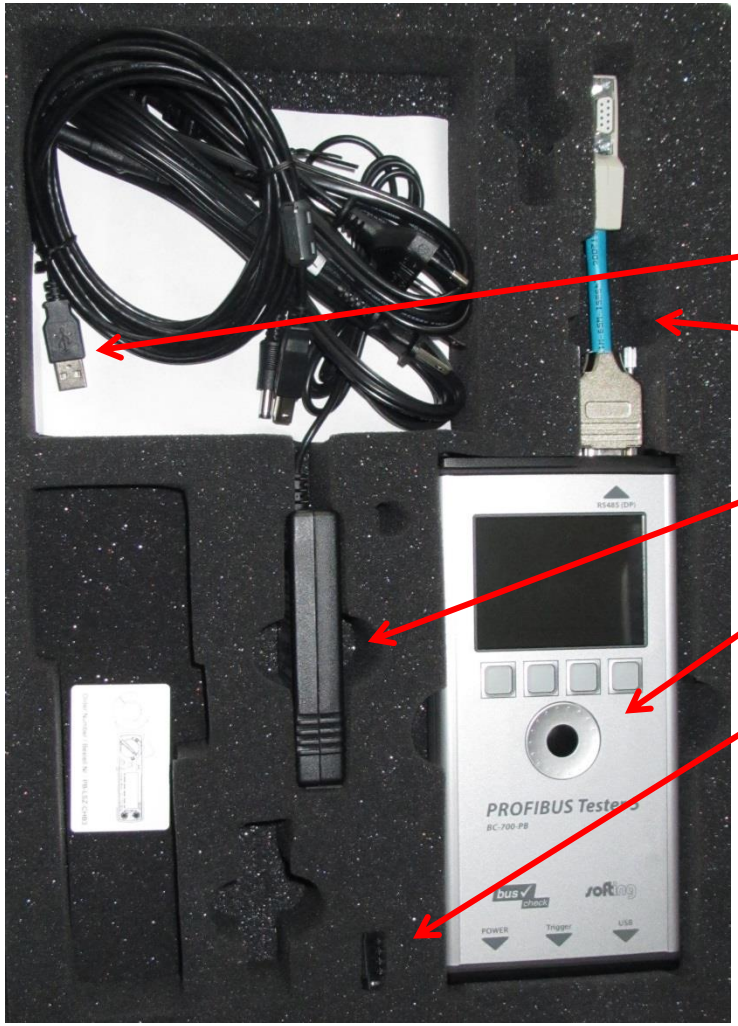
1. Introduction

- PROFIBUS Tester 5 is the new and "All-in-One"-tool to quickly and easily detect all of the problems mentioned before in your PROFIBUS networks.

- PROFIBUS Tester 5 supports you to
  - reduce network downtime
  - increase network reliability
  - reduce maintenance costs of your PROFIBUS networks

2. Scope of Delivery:

Standard

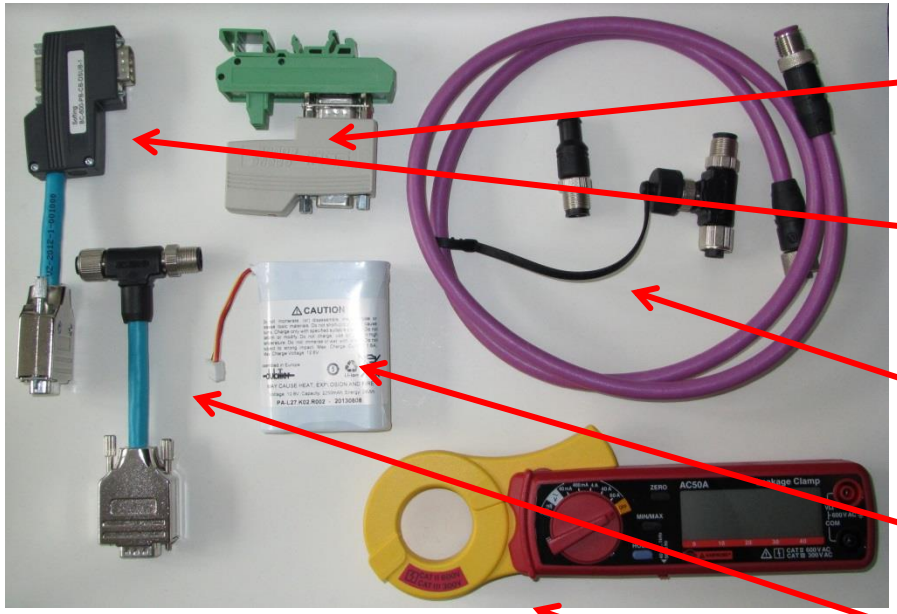


- ***PROFIBUS TESTER 5:***
  What is in the case:

- USB cable to connect PB-T5 with the PC
- D-SUB "Standard" adapter cable BC-600-PB-CB-DSUB2
- Power supply 240 V AC
- *PROFIBUS Tester 5*
- Terminal block for trigger input/output
- Not shown on the photo:
  - CD-ROM with PROFIBUS Diagnostics Suite software
  - Manuals
  - Replaceable and rechargeable battery (already included/installed in the device)

2. Scope of Delivery:

Optional



- ***Optional accessories:***
  - D-SUB service connector interface for connecting the tester to the network
  - Low impact connector cable for sensitive ans safety-critical networks
  - M12 service connector consisting of cable, T-junction and termination
  - Replacement battery
  - M12 connector cable
  - Current leakage-clamp meter LSZ-CHB3

3. Installation:

System requirements

- Supported operating systems:
  - Windows 7 (32 bit or 64 bit) or
  - Windows 8 / Windows 8.1 (32 bit or 64 bit).
- Your notebook or PC used shall fulfill the following minimum requirements:
  - RAM: ≥ 2 GB for Windows 7/8/8.1
  - Screen resolution ≥ 1024x768 Pixel (XGA)
  - USB interface 2.0
  - For recording with baud rates up to 1.5Mbit/s CPU rate >1GHz
  - For recording with baud rates higher than 1.5Mbit/s CPU rate >2GHz
- The above system requirements are only general guidelines. If more than the typical programs and services are loaded during Windows system startup or if they are very CPU intensive, the requirements given above might not be sufficient.

3. Installation:

How to install the Software

- **Installation of PB-Diag-Suite from the Supplied CD-ROM**

Install PB-DIAG Suite software prior to connecting PROFIBUS Tester 5 to PC!

Setup should normally start automatically when you insert the CD-ROM supplied with your test tool. If it doesn't, the “start.exe” file provided on the CD-ROM needs to be run manually. A dialog box appears where you can choose a language for the installation by selecting the corresponding national flag.

The CD-ROM also includes the “.NET-Framework” and the Microsoft Installer, which will be installed on Windows XP systems, if required, before installation of the PB-DIAG-Suite starts.
You can also install Acrobat Reader manually from the CD-ROM if you do not already have it. Acrobat Reader is required to display user manuals and test reports being exported to pdf-format.
(For further details please refer page 8 of manual)

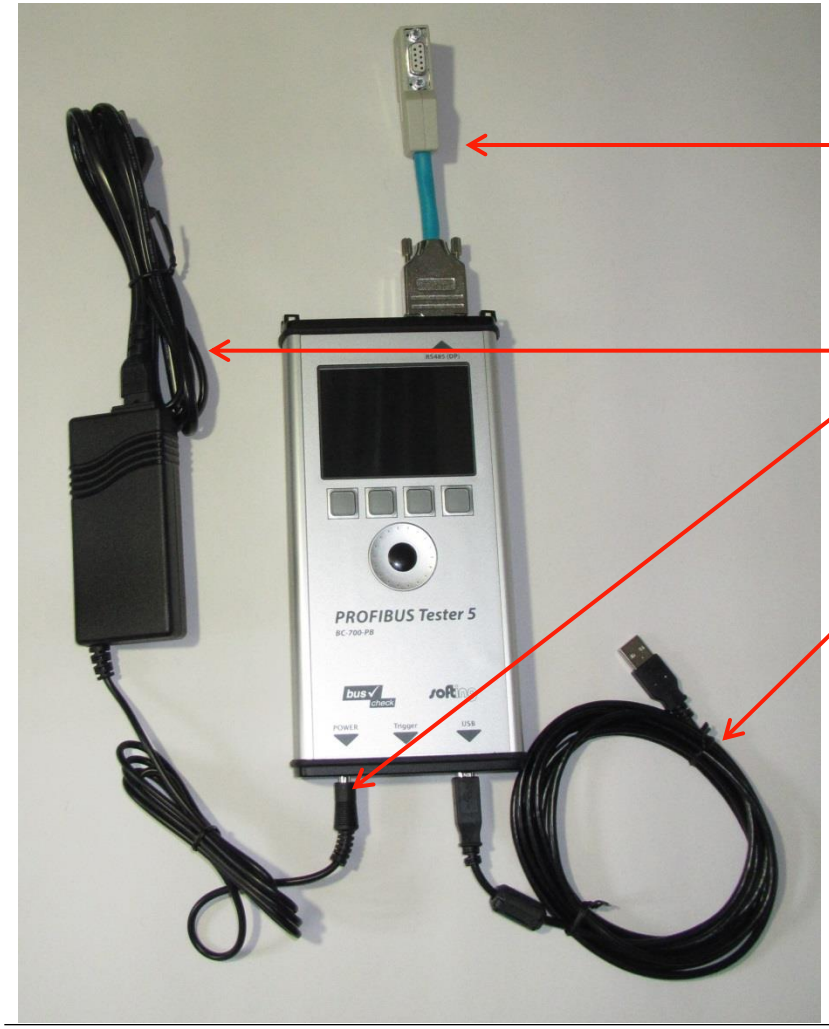
Installation of latest Update from Softing's Web Site

Please install the software from your CD-ROM first before downloading and installing any updates.

Download the update of latest version of PB-DIAG Suite Software from www.softing.com

3. Installation:

Connection to PROFIBUS DP



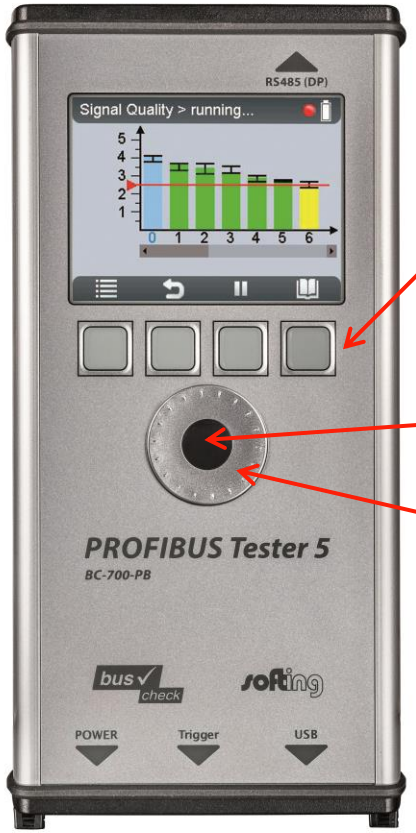
- D-SUB adapter cable to connect PB-T5 with the PROFIBUS network
- 240 V AC power supply (not required in stand-alone battery operation)
- USB cable for connecting to the PC (not required in stand-alone mode)

Please note:

Before connecting the PB-T5 for the first time to the PC you need to install the PB-DIAG-Suite software!

3. Installation:

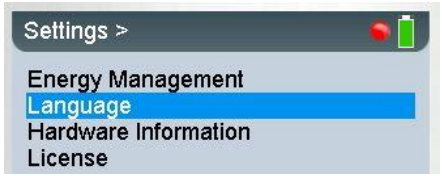
Basic operation of PROFIBUS Tester 5



- ***Controls***
  - Softkeys – keys depending on the current test context, e.g.
    - Confirm
    - Open context menu
    - Help
    - Back
  - Center key (confirm/select by pressing)
  - Scroll wheel (cursor/highlighting by turning the wheel)

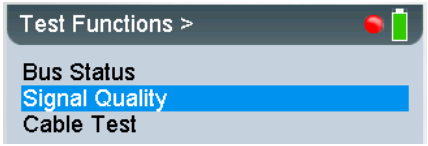
Switch language from German to English:

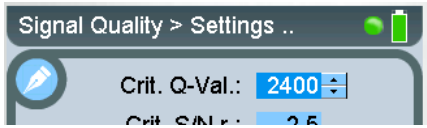
- Switch on PB-T5 ; do not establish a connection to the PC!
- Select Start > Settings > Language > English
- Confirm with softkey

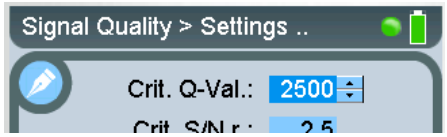


Modify quality index limit value:

- Switch on PB-T5 ; do not establish a connection to the PC!
- Start > Test Functions > Signal Quality > Settings Evaluation
- "Set Crit.. Q-Val." to 2500 using the scroll wheel







4. Strategy for analyzing networks with *PROFIBUS Tester 5*>

We recommend to proceed as follows:

Step 1:

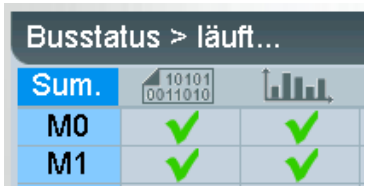
- Perform a "Bus Status"-test with PB-T5 in stand-alone mode (without PC; Start → Test Functions → Bus Status)
- Always (!) perform a "Bus Status" test on both network ends

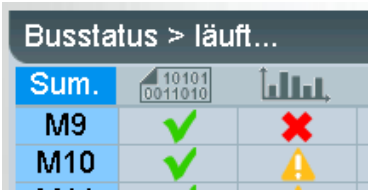
Step 1: The network is ok (no other activities required)

- if the quality index for both tests is ok
- if both tests do not contain error frames or frame repetitions

Step 2: The network needs maintenance when showing:

- poor signal levels or
- error frames or
- frame repetitions in one or both tests





Step 2:

- Create test locations (Start > Network Management > Network)
- Again connect PB-T5 with that end which showed errors
- Start a "Quick Test" (Recording Functions – Quick Test)
- Start another "Quick Test" from the other network end and if possible from the center part of the network as well

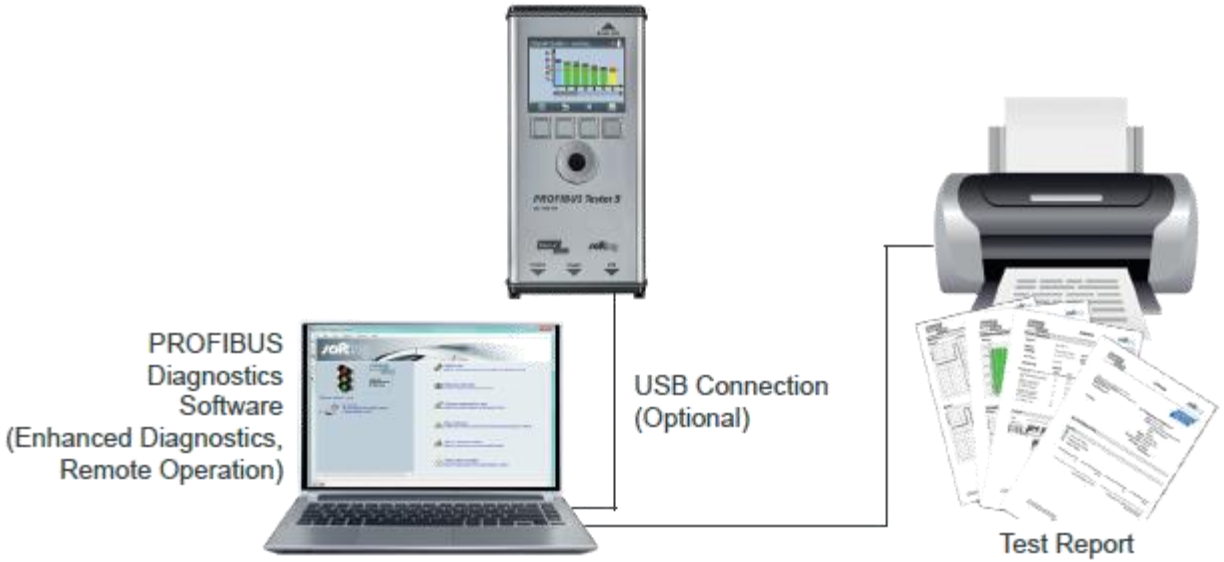
Thus you are able to save tests in PB-T5 without connecting to a PC and you can sort them directly in the device based on segments. Test locations which are already existing in the device will be directly imported to the PC.

4. Strategy for analyzing networks with *PROFIBUS Tester 5*

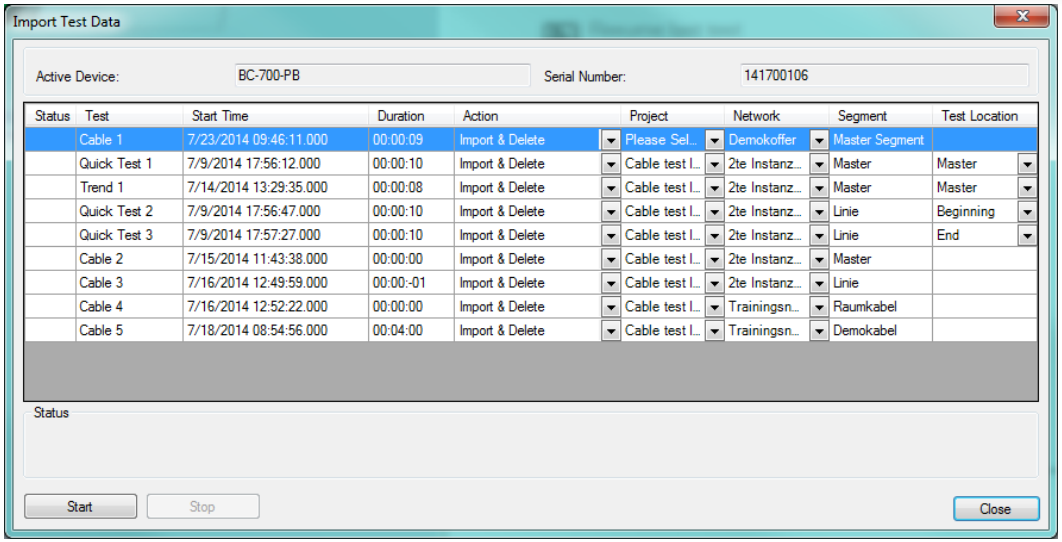
We recommend to proceed as follows:

Step 3 :
Now you can analyze your tests conveniently with the PC.
With the advantage of not needing to work directly in the plant (loud, dirty, inconvenient).
Search a convenient working place and proceed as follows:

- Connect PB-T5 to the USB port of your PC and start the PB-DIAG-SUITE software
- Load the tests recorded from the PB-T5 to your PC:



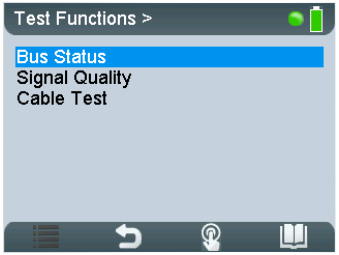
4. Strategy for analyzing networks with *PROFIBUS Tester 5*



- Start the import.
- The "network status overview" will help you to find out whether the error detected is an electrical problem (signal analysis) and/or a communication problem (protocol analysis).
- Select the "protocol" view and / or "Signal Quality" in order to receive more detailed information.

5. Stand-alone mode:

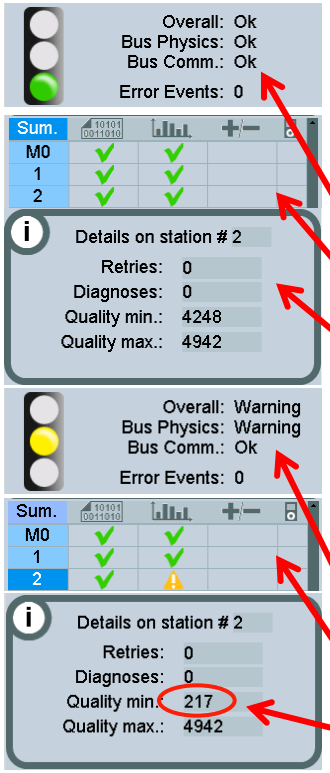
Quick test without PC



Use the bus status in ***the stand-alone mode*** for a first quick view on the current status of the

- communication (frame repetitions, erroneous frame diagnostics, …)
- signal quality (Qmin and Qmax of the complete network)

on **both** ends of a network:



Step 1:

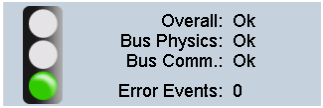
- connect PB-T5 with one end of the PROFIBUS network
- use the scroll wheel to sele "Test Functions"
- then start the function "Bus Status"
- Read result (in this example the network state is OK)
- pre and select "Detail View" for further details
- highlight the station and pres for station details
- The test at this bus end is ok.

Step 2:

- connect PB-T5 with the other end of the PROFIBUS network
- perform the "Bus Status"-test
- Read result (in this example the network state is erroneous)
- select "Detail View" for station details (pre)
- The test at this bus end has weak signal levels

5. Stand-alone mode:

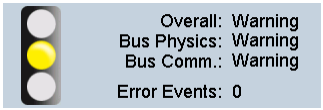
Quick test without PC

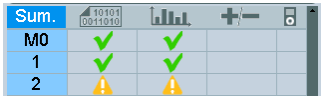


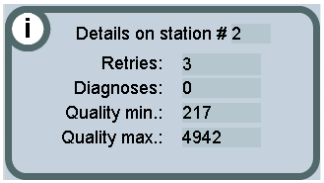
Conclusion:

If you get this result at **both** ends of your network, the segment tested is Ok. No erroneous frames or frame repetitions.

➔ No further tests required!



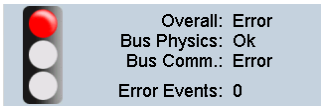


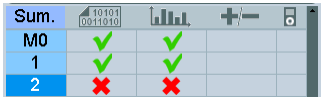


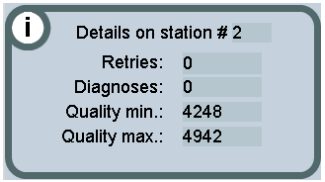
If the test result shows network errors at one or both ends, your network needs service or maintenance.

➔ Continue with the test at that location which displays the worst error indication.

➔ Connect the PB-T5 with your PC and start the PB-DIAG-SUITE for further tests. Alternatively you can save the "Quick Tests" on your PB-T5 and transmit them later to your PC for a convenient PC analysis in your office.







Special case:

- Communication test shows "ERROR"
- No frame repetitions and -errors, all signals are Ok

Interpretation: At least one PROFIBUS node is not working, but the remaining nodes are working faultlessly.

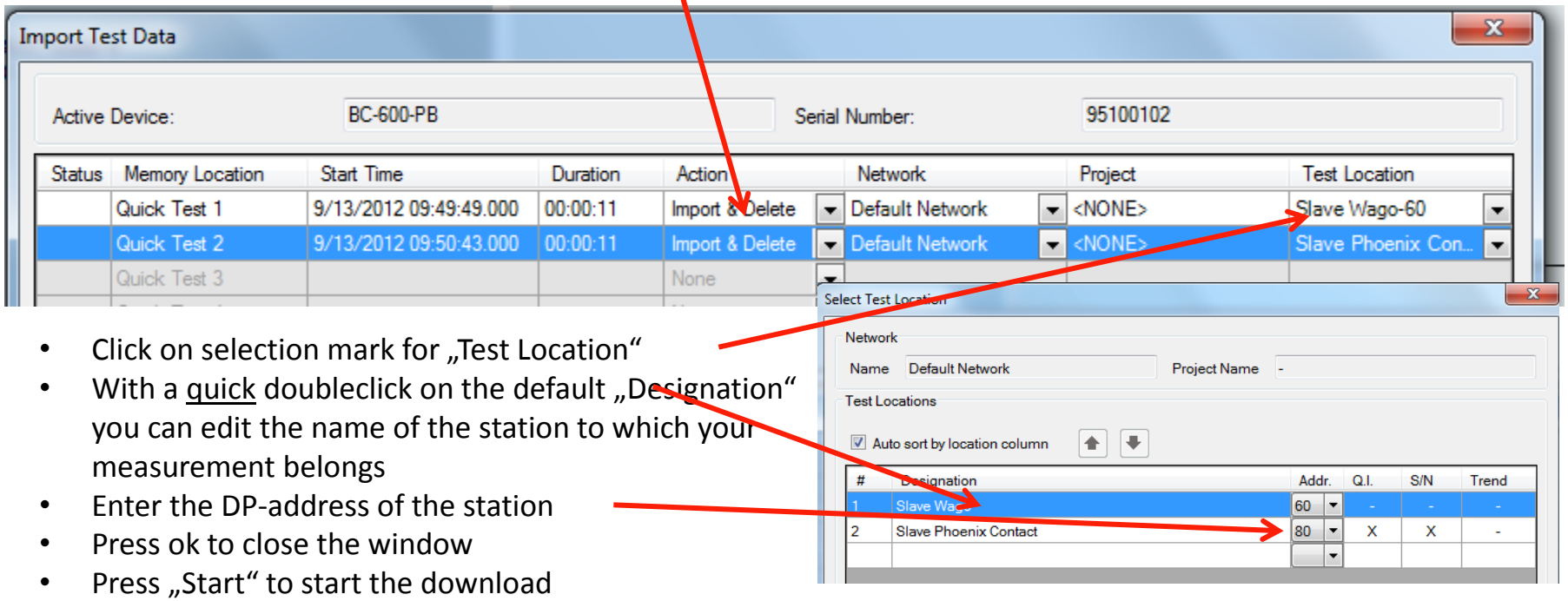
➔ Connect the PB-T5 to your PC and start the PB-DIAG-SUITE in order to identify the missing node(s). Alternatively you can save the "Quick Tests" on your PB-T5 and transmit them later to your PC for a convenient PC analysis in your office

5. Stand-Alone-Mode: “Quick-Test”

Download of measured Data from PB-T5 on your PC

Download of Data from PB-T5 on your PC:

- Connect PB-T5 with PC via USB cable
- Open PB-DIAG-Suite on your PC and wait until PB-T5 is recognized by PB-DIAG-Suite
- If you have got test data stored on PB-T5 the „Import Test Data“ window opens automatically
- Select your required action (e.g. „import“)
- Select the network name from the list or add a new network name



- Click on selection mark for „Test Location“
- With a quick doubleclick on the default „Designation“ you can edit the name of the station to which your measurement belongs
- Enter the DP-address of the station
- Press ok to close the window
- Press „Start“ to start the download

6. PB-DIAG-SUITE:

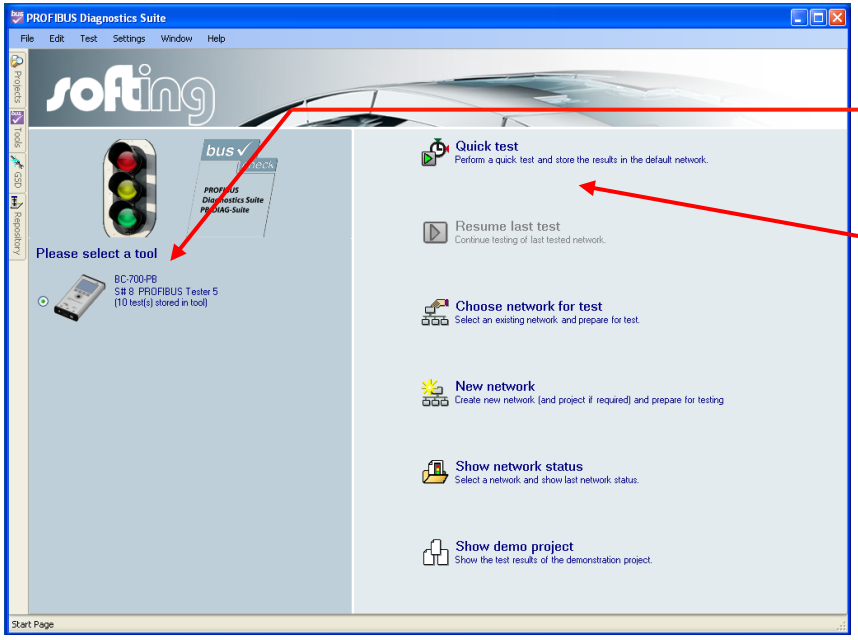
Step 1: Getting Started

- Connect PB-T5 to the PROFIBUS network at the location that indicated a network issue (as described in the previous 2 slides)

- Connect PB-T5 to your PC using the USB-cable

- Follow the installation wizard for the hardware istallation

  After a successful hardware installation click on  to start PB-DIAG-SUITE on your PC



- Check if your PB-T5 is recognized by PB-DIAG-SUITE

- Click on „Quick Test“ for starting a measurement.
  After this the „Overview Window“ will open automatically

6. PB-DIAG-SUITE:

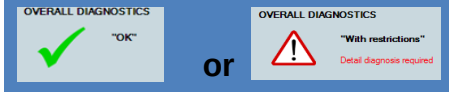
Step 2: Overview Window

The Overview Window indicates:

- Is the network OK from this side?
- if not, the problem is either related to communications or electrical problems

4 tabs for easy operation:
- **Overview**
- **Protocol,**
- **Signal Quality**
- **Topology**

First indication:

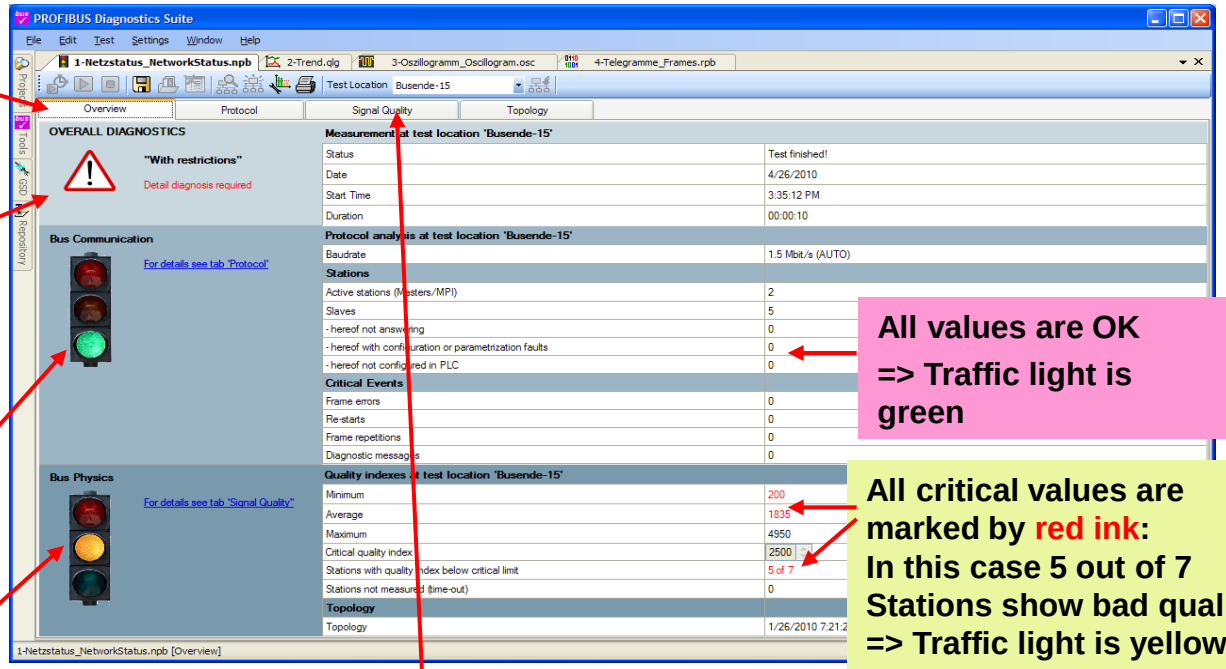


Green light indicates:

„Communication is okay“

yellow light indicates:

„Problems with the electrical signal quality“



All values are OK

=> Traffic light is green

All critical values are marked by red ink:
In this case 5 out of 7 Stations show bad quality
=> Traffic light is yellow

Result:

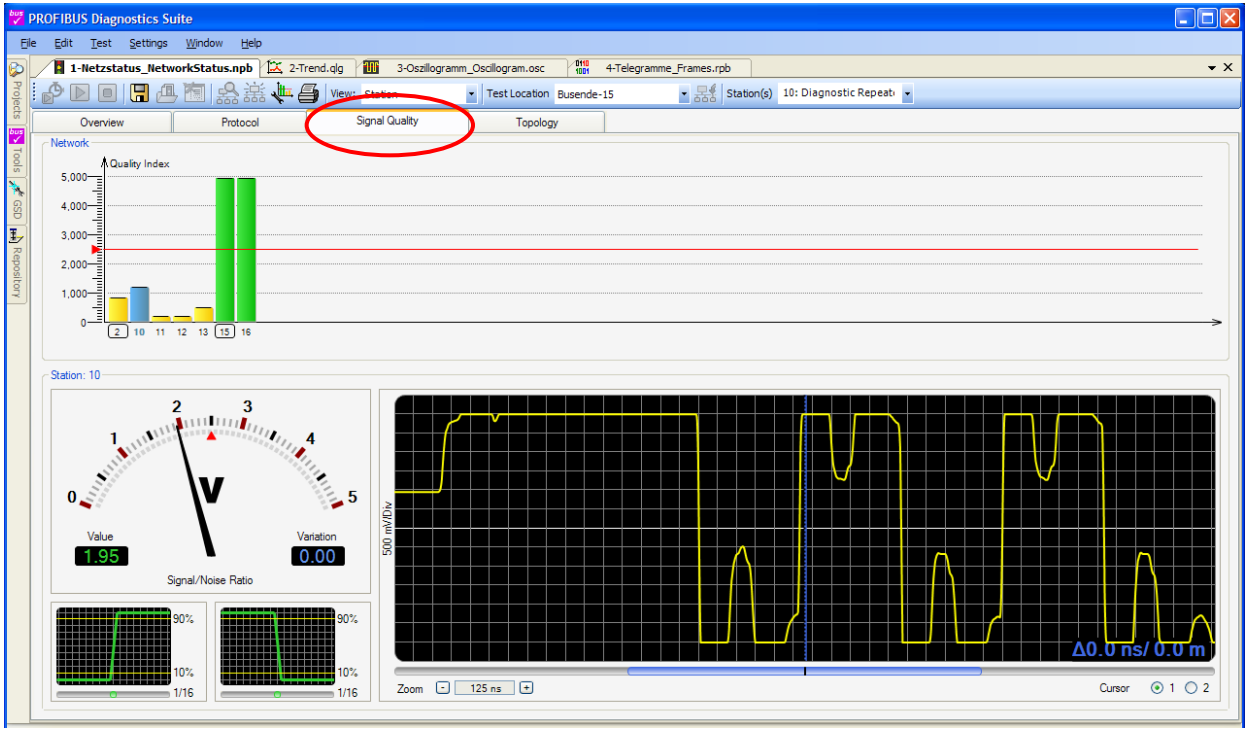
Measurement from this end indicates bad signal quality. Click on „Signal Quality“ (link or tab) for more details

6. PB-DIAG-SUITE:

Step 3: Signal Quality Window

- As indicated in the „Overview Window“ there are electrical issues in our demo network.
- For more details open the Signal Quality Window.

  This shows you the signal quality for all PROFIBUS stations as a bar graph and provides an oscilloscope view for a selected station.



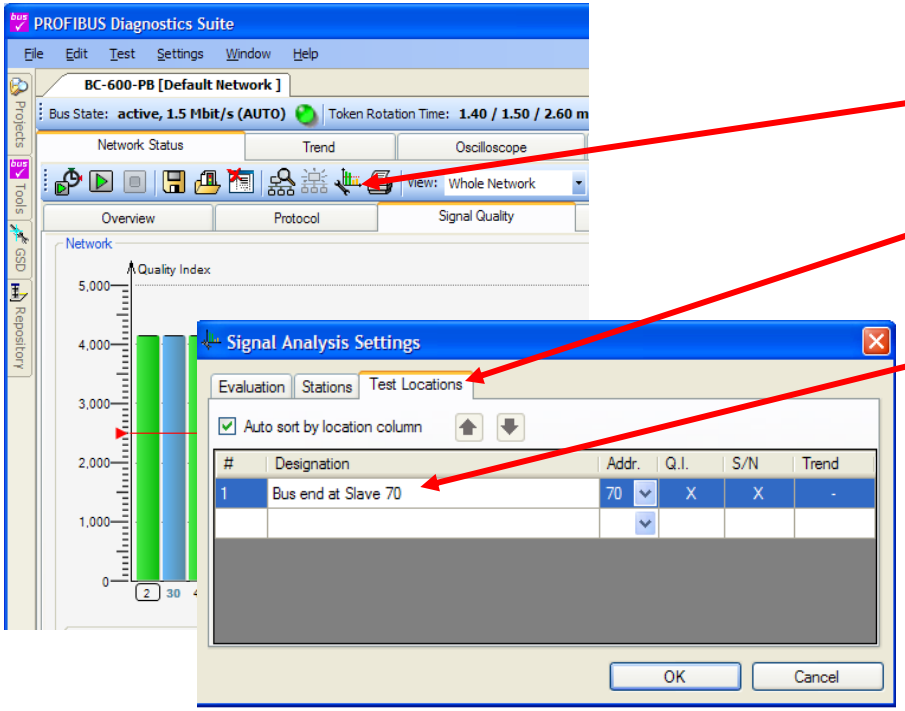
6. PB-DIAG-SUITE:

Step 4: Signal Quality Window: name test locations

Why should you name your test locations?

As already stated in the „Stand-Alone-Mode“ slides, test results may vary depending on the test location.

In order to easily compare the results later-on we recommend to associate a symbolic name with each test location.



Click on settings button to open menu for Signal Analysis Settings

Click on button „Test Locations“

Highlight „Default Test loc, then double click, then type in a name and the respective bus address

It is recommended to define at least two locations at the ends of each network or segment

6. PB-DIAG-SUITE:

Step 5: Signal Quality Window: sorting of bar graphs

By default the signal quality bars are sorted by node address. However, most of the time the physical location of a node with a specific address on the network does not follow this rule.

To make the interpretation easier it is highly recommended to sort the bars according the correct topology (their correct physical order).

You can achieve this
- manually as described below
- or automatically by a topology scan (see chapter 7)

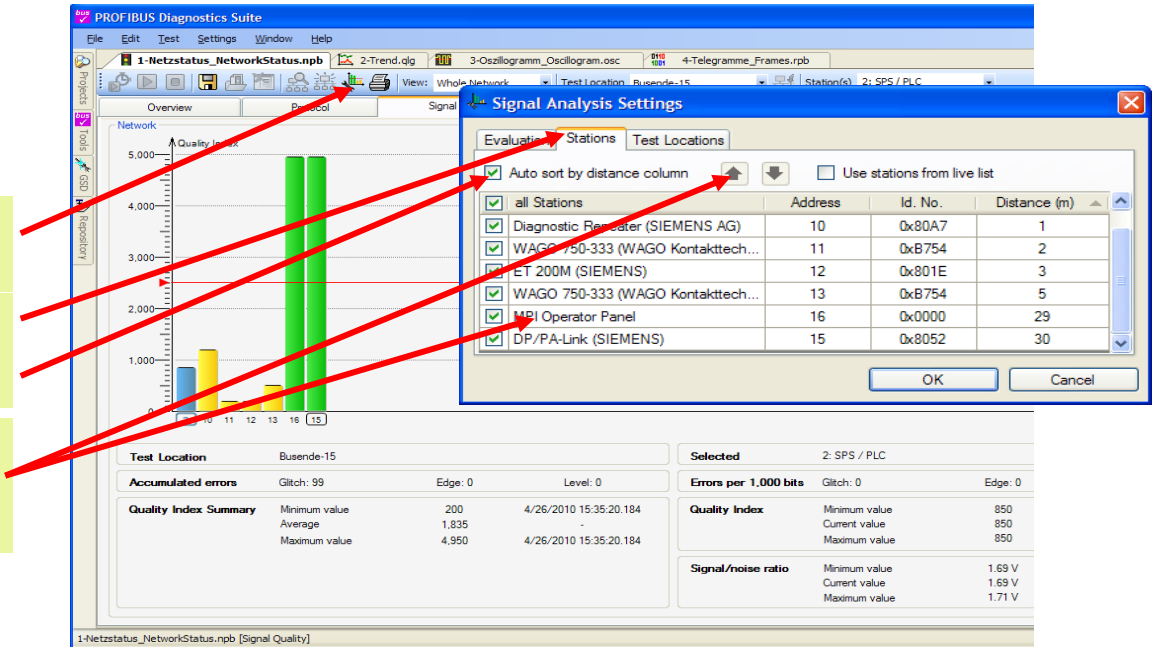
Manual sorting of bar graph:

Click on „Signal Analysis Settings“ for sorting bar graph

Click on „Stations“

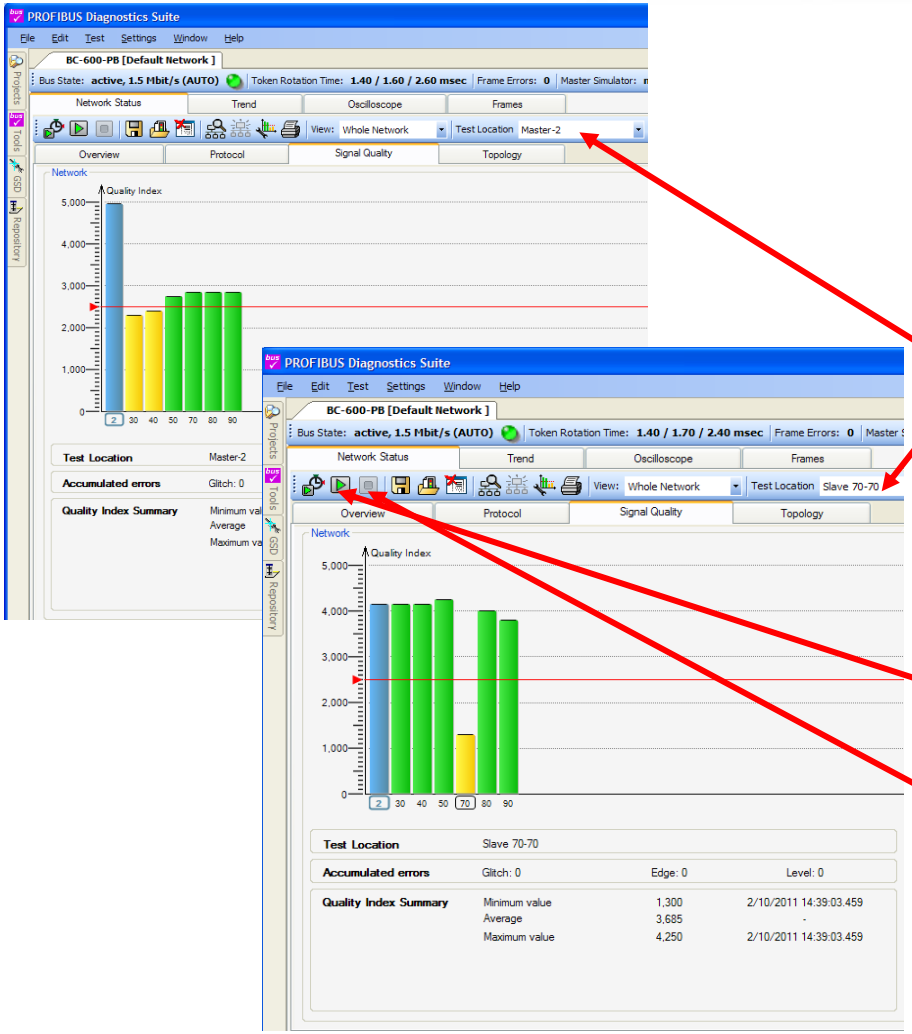
De-select (!) this check mark

Mark a station and change position in the list with these buttons



6. PB-DIAG-SUITE:

Step 6: Signal Quality Window: making further measurements



For a clearer picture of your network health you should run the same test at multiple test locations.

Select test location

Click on „Start Test“ for starting and wait until all stations have been scanned

Click on „Stop Test“ to stop the test

6. PB-DIAG-SUITE:

Step 7: Signal Quality Window: Oscilloscope

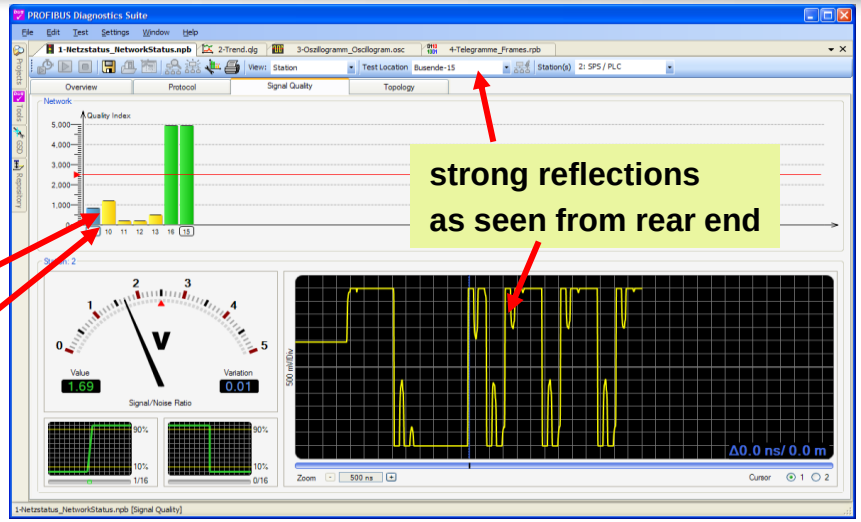
Poor signal quality is mainly caused by

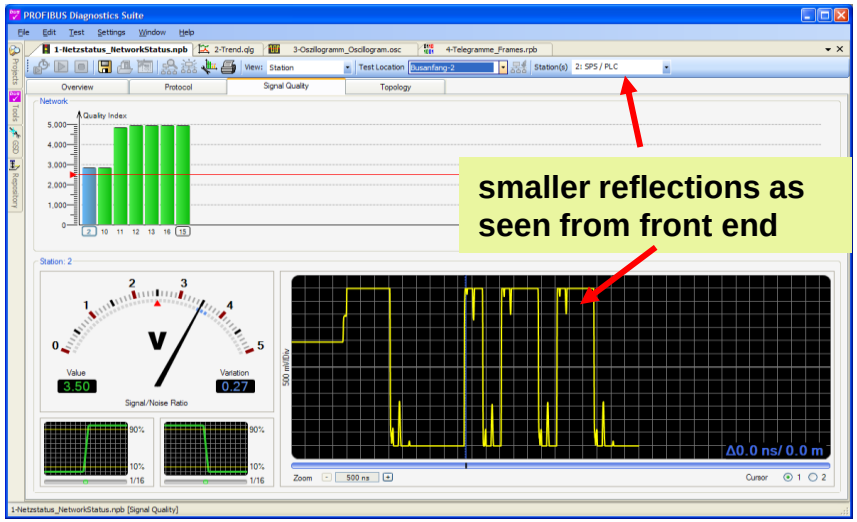
- Reflections (e.g missing termination, wrong cable type)
- High transmission resistance (e.g. defective cable, corrosion)
- EMC impacts

Visualize Reflections:

A double click on any bar opens the oscilloscope view

Once open, a single click on any bar displays the signal of the respective node





6. PB-DIAG-SUITE:

Step 7: Signal Quality Window: Oscilloscope

Localize the failure with the Oscilloscope:

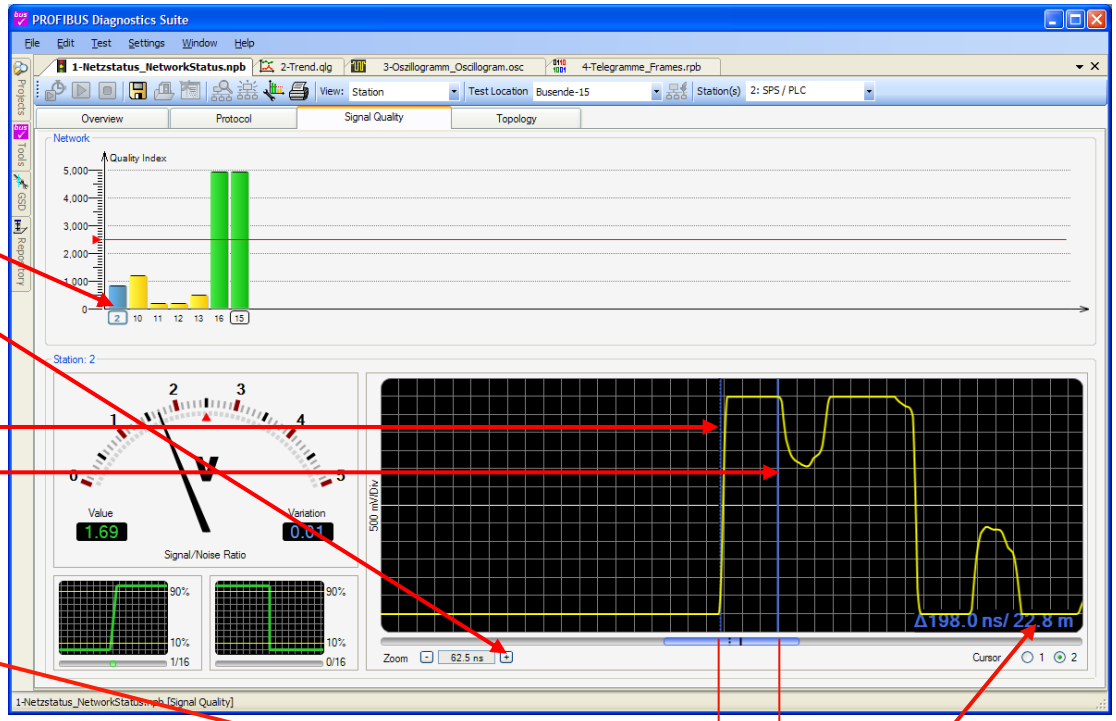
Click on bar #2

increase zoom to 62,5 ns

Place cursor 1 to rising edge

Place cursor 2 to distortion

=> Now you can read the distance from selected node (in this case No. 2) to the point where the reflection is caused: 22,8 m



Distance 22,8 m

6. PB-DIAG-SUITE:

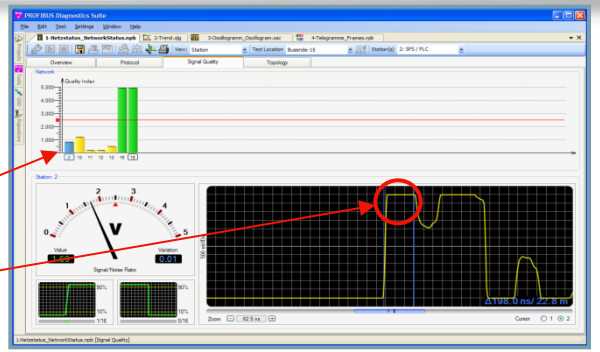
Step 7: Signal Quality Window: oscilloscope

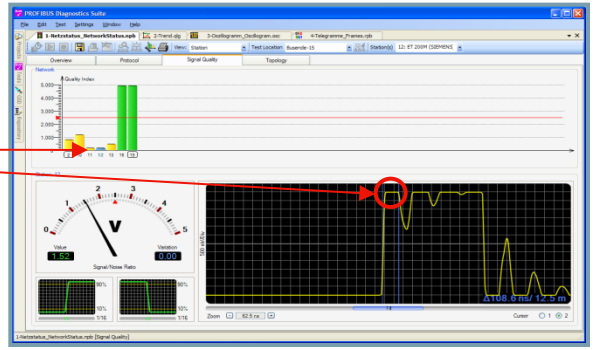
Now you can compare the distances between the failure and the different stations:

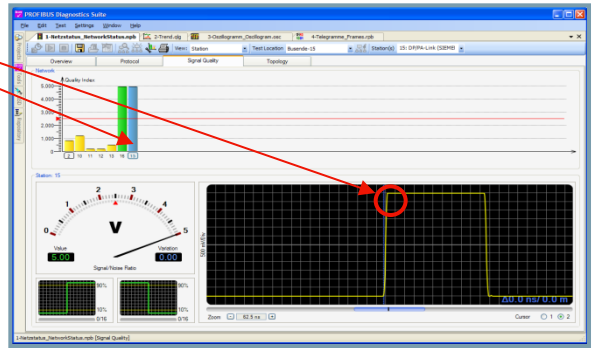
Click on bar #2
Place cursors
Now distance to problem is 22,8 m

Click on bar #12
Place cursors
Now distance to problem is only 12,5 m

Click on bar #15 (Busend)
Now distance to problem is 0 m and no distortion







Result: **the reflection is caused by (or is close to) node #15 (e.g. missing terminator). Consequently no reflections can be seen there.**

6. PB-DIAG-SUITE:

Step 8: Protocol Window

In case of communication problems open the „Protocol Window“

Typically, communication issues are caused by wrong PROFIBUS parameters settings in the master.

Click on “Protocol“

Click on Segment

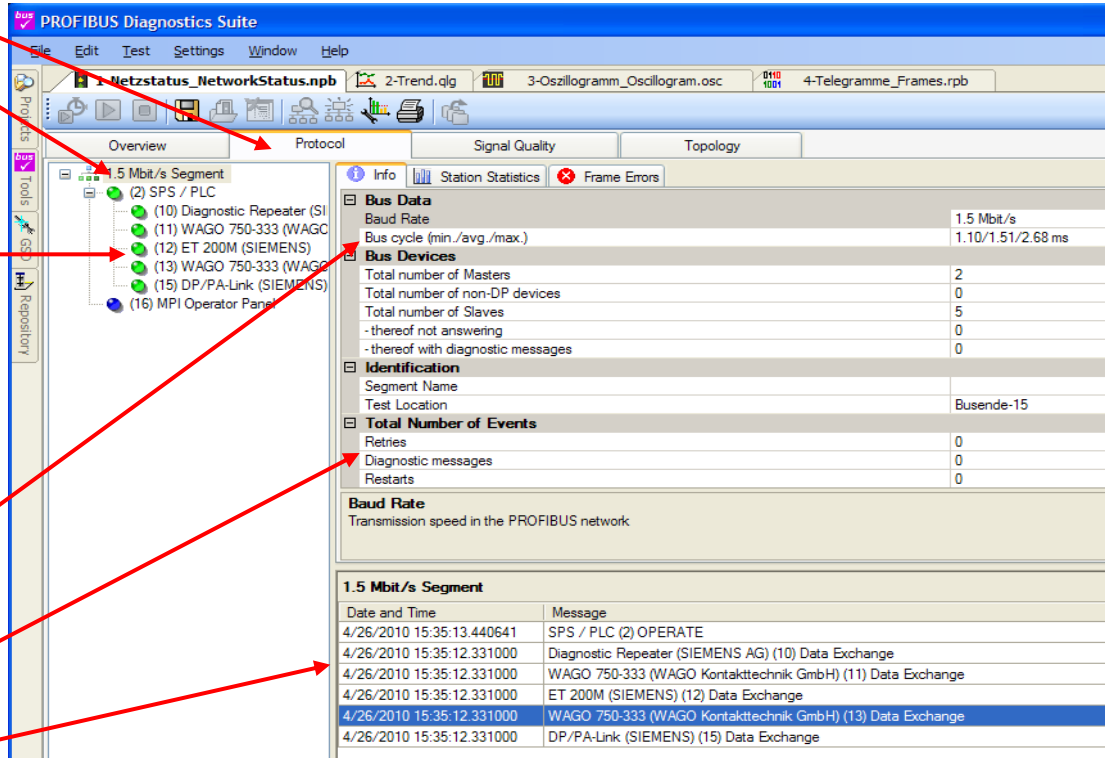
Live List

Green = data exchange okay
Yellow = slave reports diagnose
Orange = config or param failure
Red = no answer, station is dead
Blue = station not configured in Master

Bus cycle time

Number of Retries, Diagnostic Frames, Restarts are an indicator for developing problems in the network

Log for main communication events between master and slaves (e.g. communication start-up, etc.)



6. PB-DIAG-SUITE:

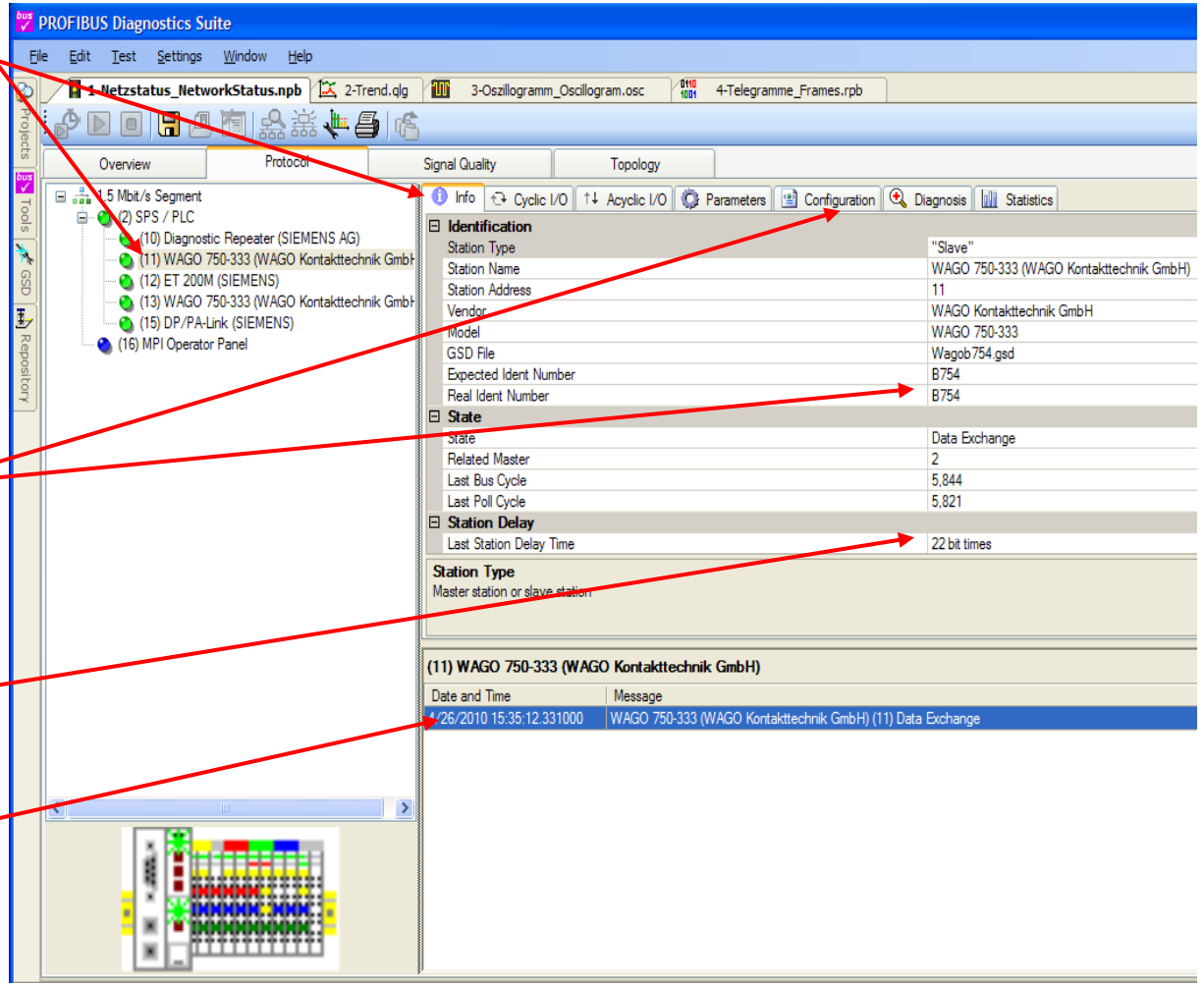
Step 8: Protocol Window

Clicking on a node (or station) will display its specific information.

Check GSD-file configuration:
Expected GSD = real GSD ?
If not => configuration failure
Configuration can be seen under configuration bookmark

Large variation of Station Delay Times indicates a problem of the station

Log file of the selected station



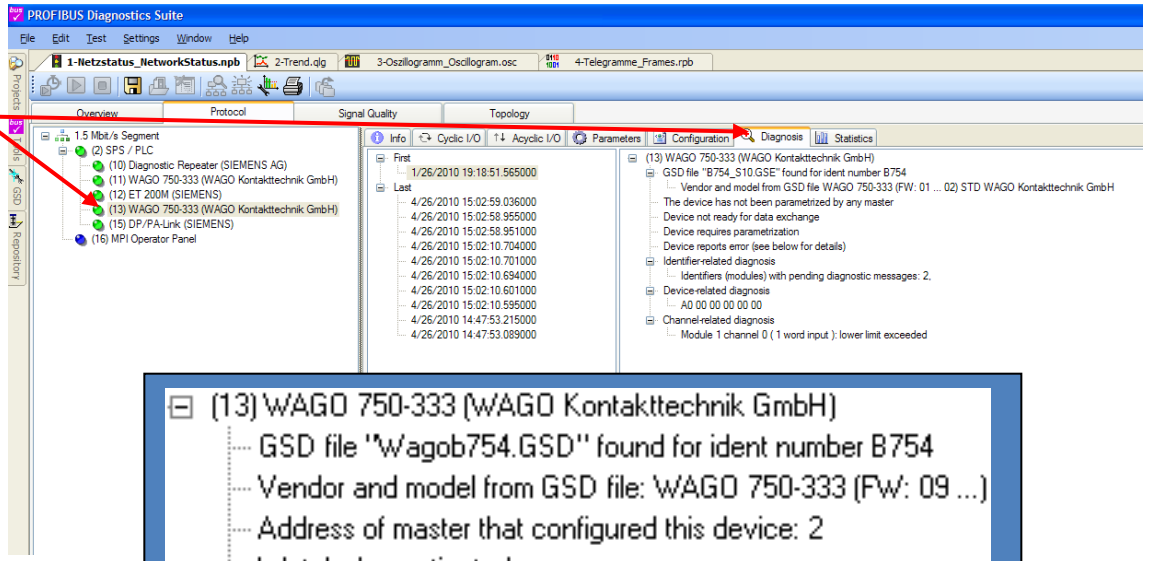
6. PB-DIAG-SUITE:

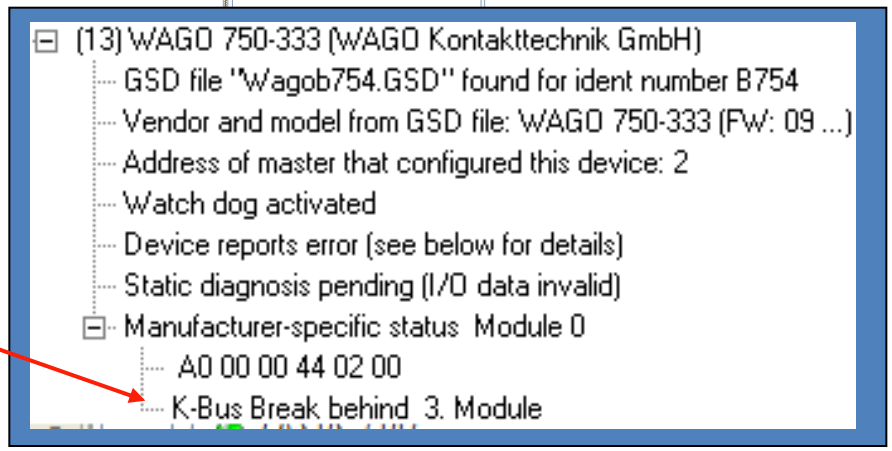
Step 8: Protocol Window

Diagnose Messages in Plain Text:

If a device reports problems you can read the respective diagnose telegrams in plain text.

Click on “Diagnosis“ to read diagnostic messages of selected slaves in plain text (not only hex strings)





Example of a diagnose message of a modular WAGO 750 slave:

One module was taken out and consequently the device reports „K-bus Break behind 3. module“

6. PB-DIAG-SUITE:

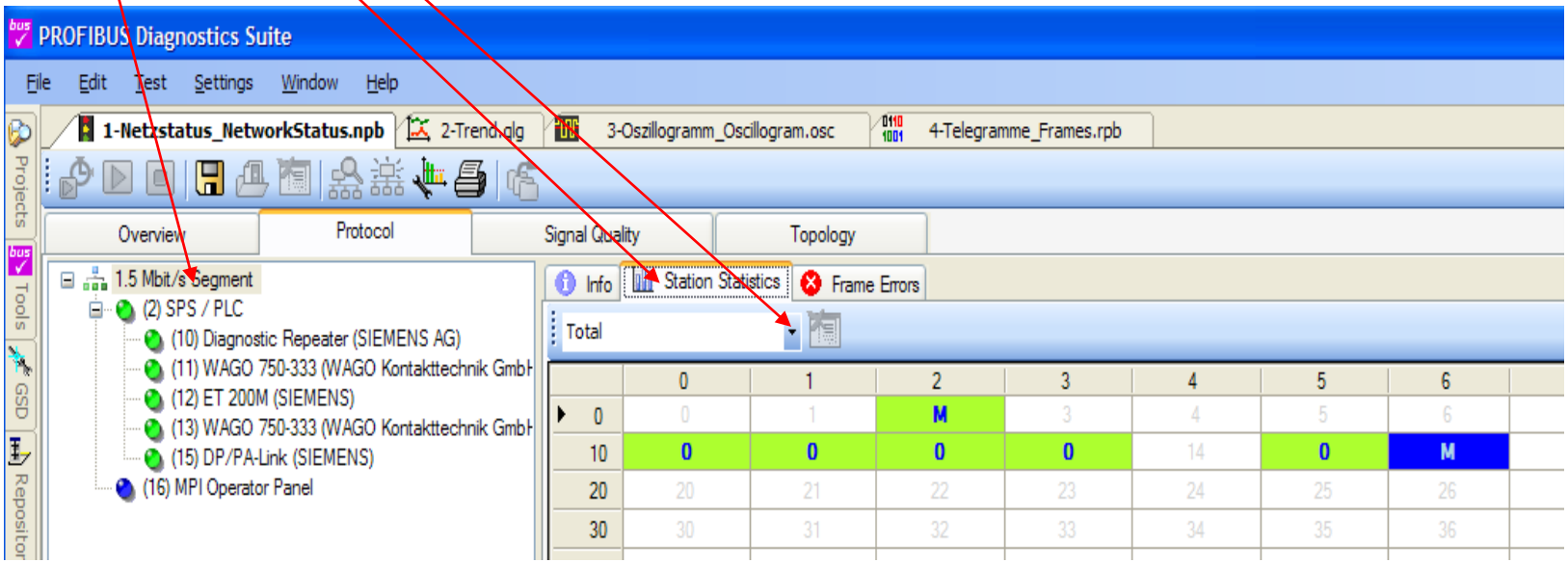
Step 8: Protocol Window

If you prefer the matrix overview, you may use this as well:

- Click on segment

- Select „Station Statistics“

- You can display all events or select „retries“, „diagnose“, „set parameters“ for each station



6. PB-DIAG-SUITE:

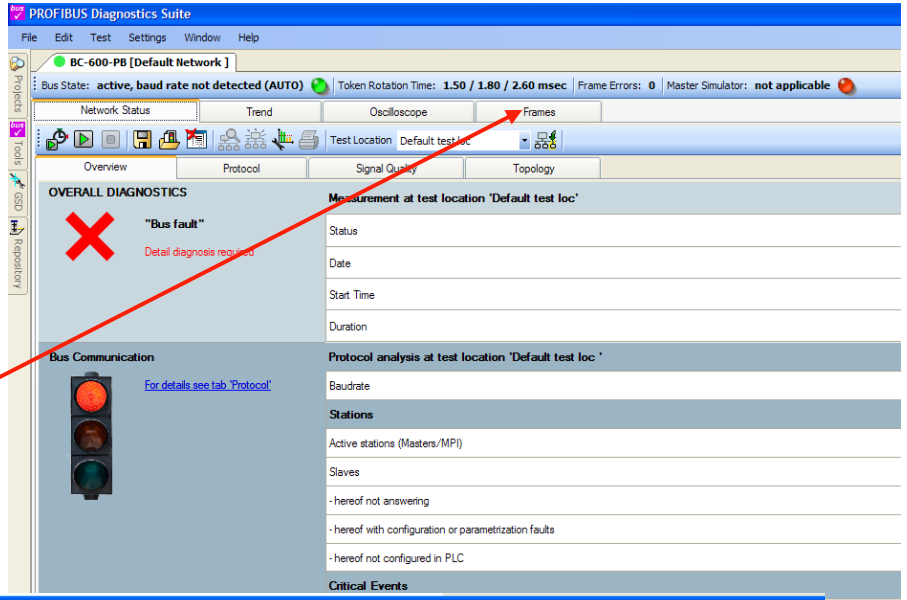
Step 9: Frame Window

Detailed Information for Professionals:

The Frames display allows you to record and analyze the entire communication down to a single bit:

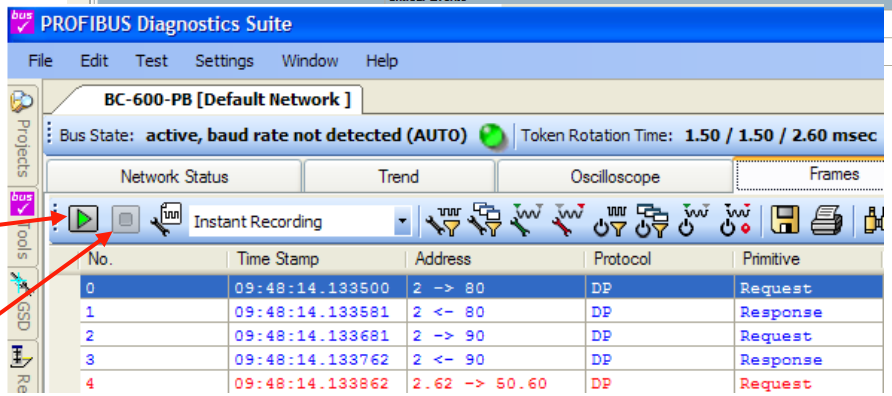
- Decode all frames
- Analyze timing by time stamps
- Trigger for frames or specific bits to catch sporadic events

click on „Frames“ tab to open the frame window



click on „Start Test“ button to start recording

click on „Stop Test“ button to stop recording

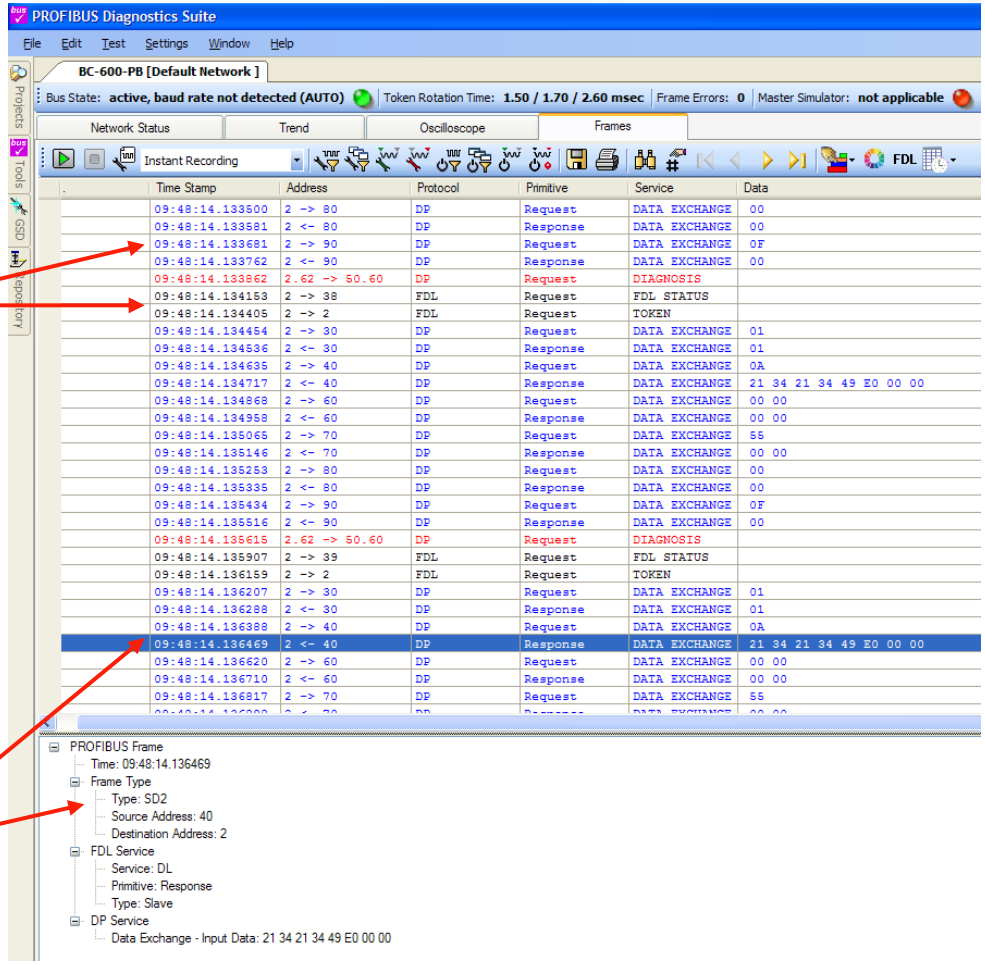


6. PB-DIAG-SUITE:

Step 9: Frame Window

You may define individual color coding for each type of frame

click on a single frame to get the decoded contents



6. PB-DIAG-SUITE:

Project Window

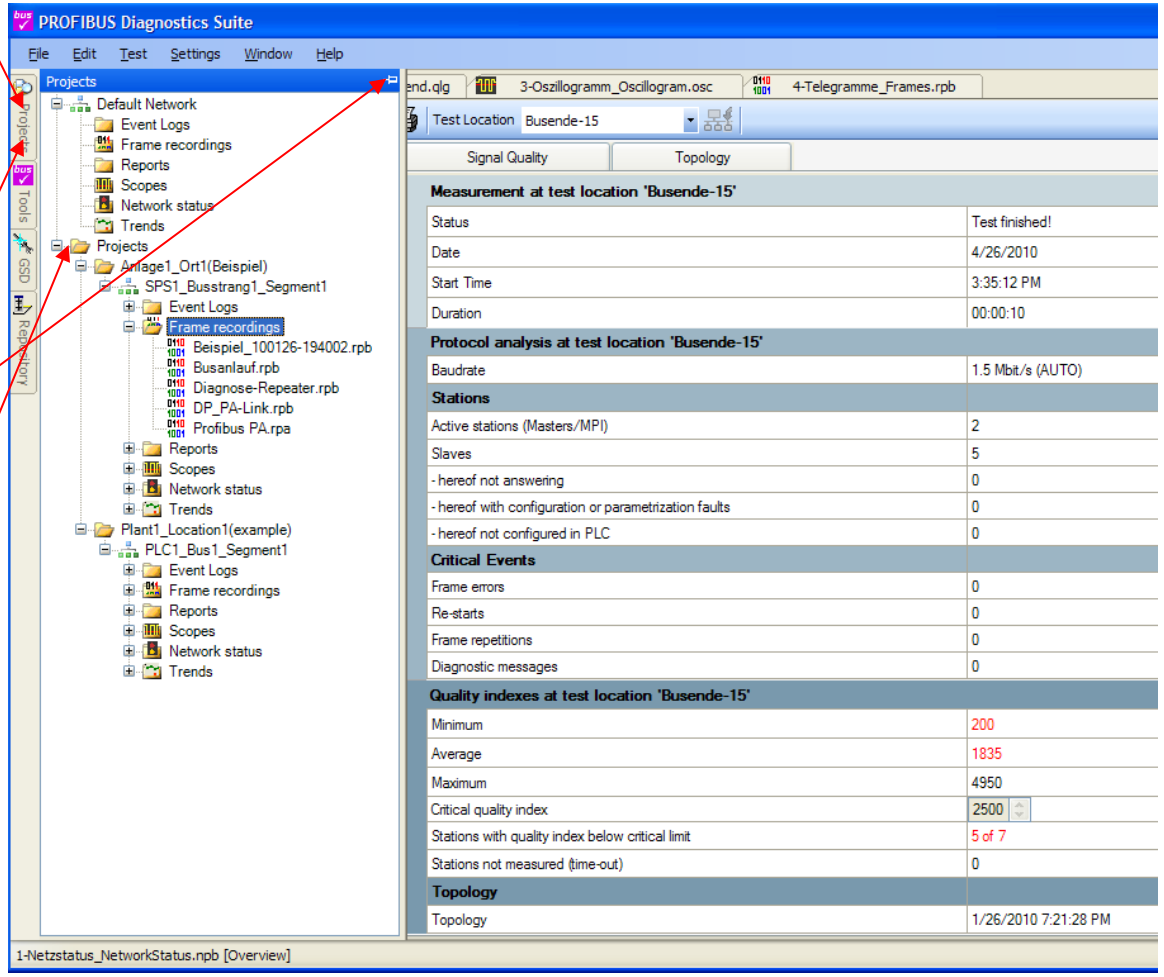
The „Project Window“ offers an easy filing of your records

You will find *<u>further record files</u>* for demonstration in the „Project View“

- **Place the cursor on „projects“ tag: =>The project view opens**
- **you may lock the window to avoid automatic closing**
- **open „Projects“-file to view saved records**

<u>Please note:</u>

You can send your records as file attachment by e-mail e.g. for remote interpretation by a specialist



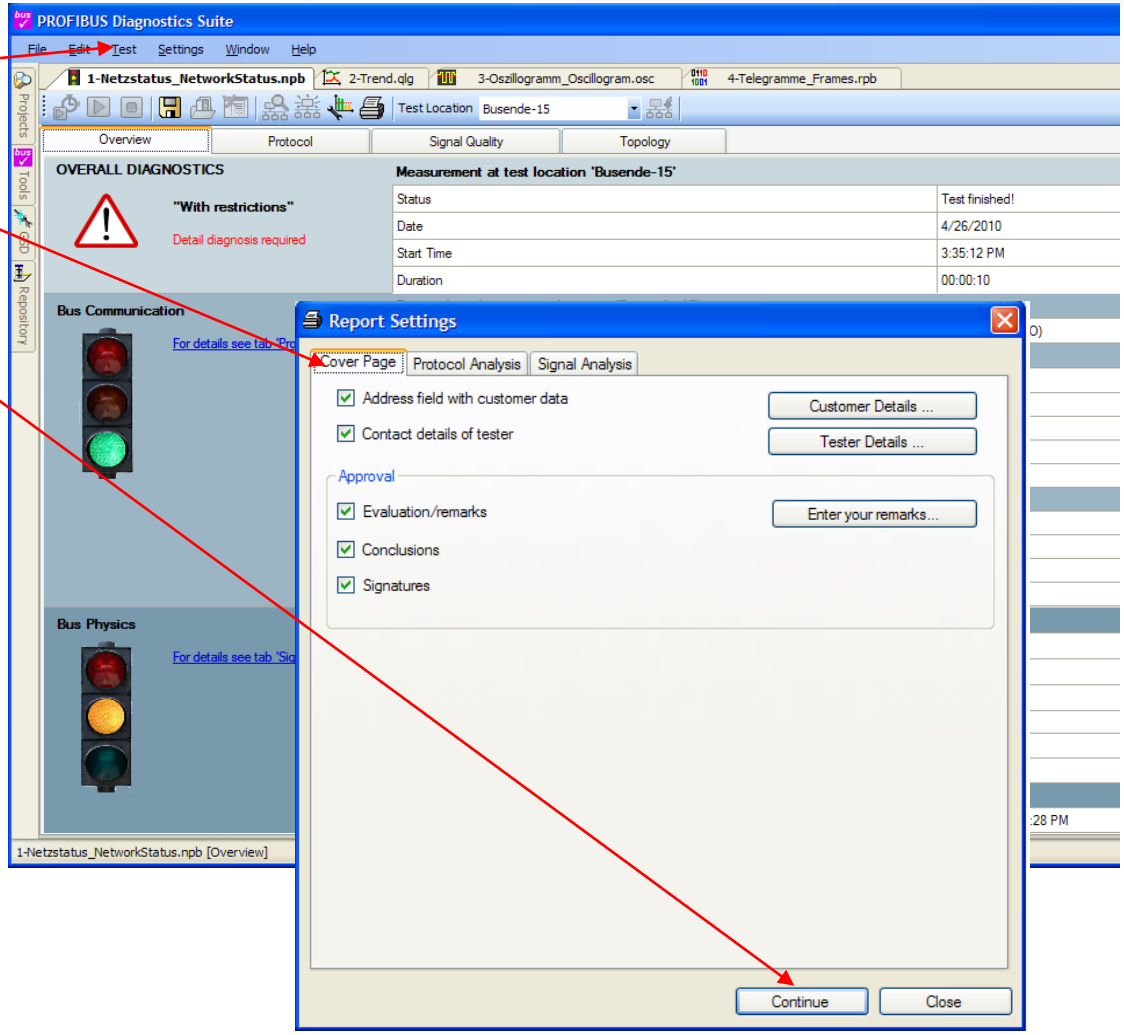
6. PB-DIAG-Suite:

Automatically generated Test Report

click on:
Test / Create Report

click on „Cover Page“ to type in your company data

click on „continue“ to create the report



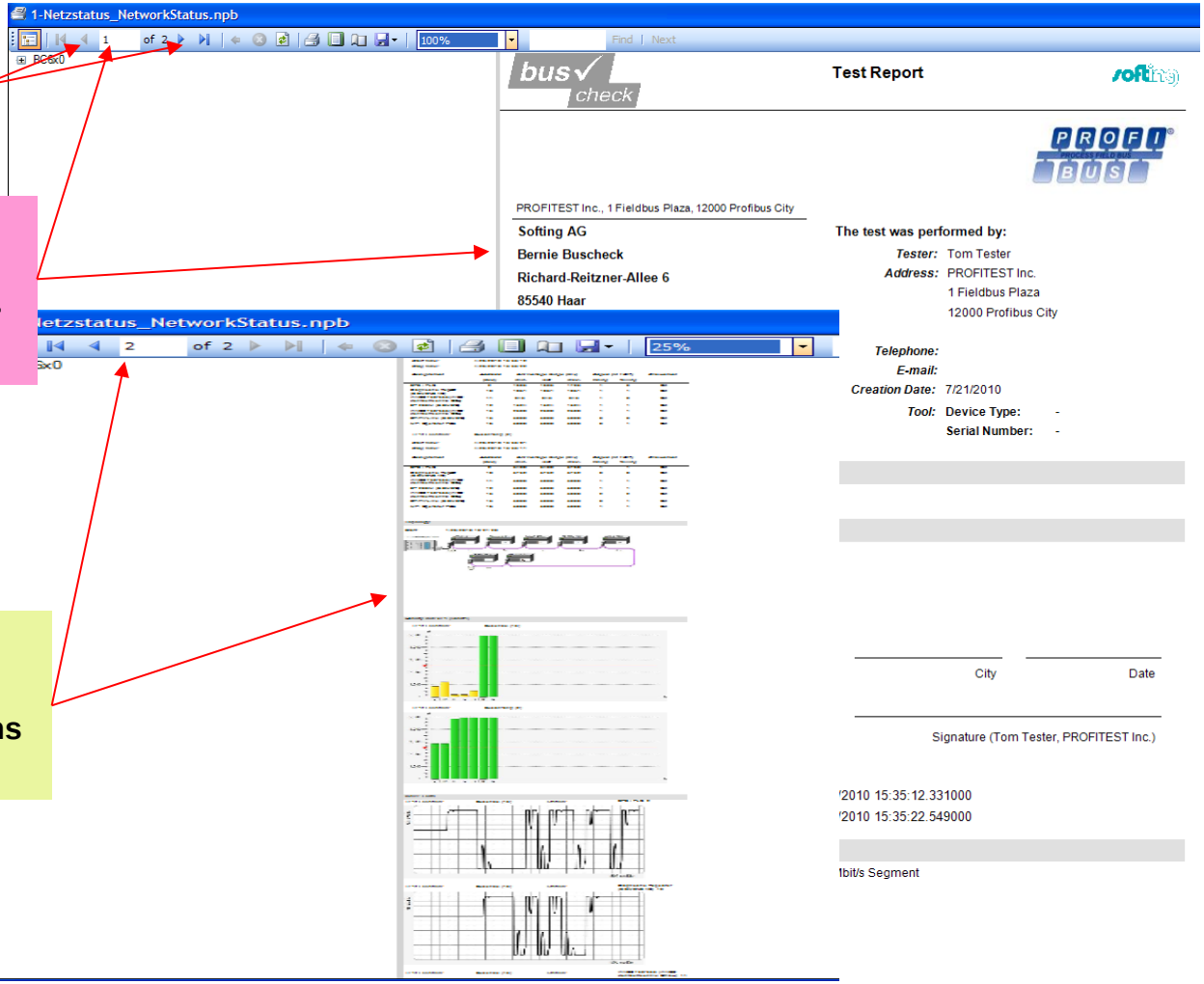
6. PB-DIAG-Suite:

Automatically generated Test Report

Toggle between protocol and signal quality report by selecting pages

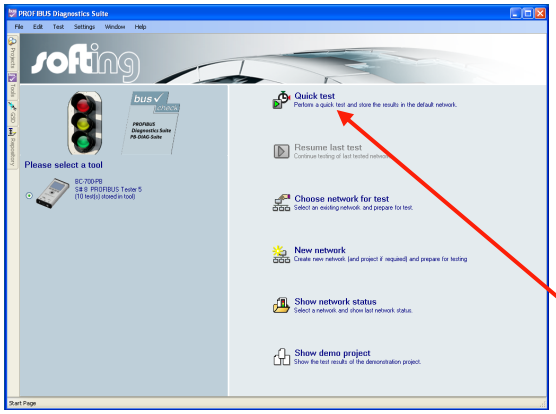
Protocol Report:
- **live list and status of stations**
- **retries, diagnose, set parameter for each station**

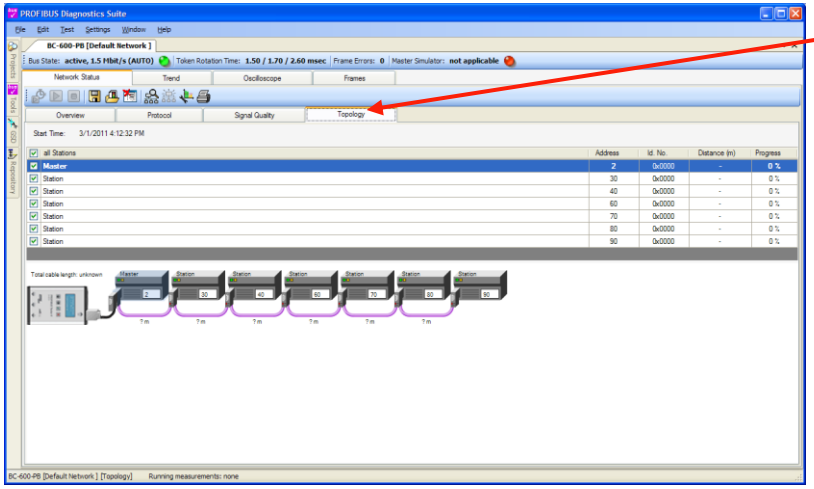
Signal Quality Report:
- **min, max, avg value per station**
- **bar graphs from all test locations**
- **oscilloscope charts**



7. Topology Scan

Step 1: Start with a Quick-Test of your network to scan all devices





For best-results, the network should be “healthy” before starting the topology scan. Please verify the health of your network by using the this suite as shown on the previous slides.

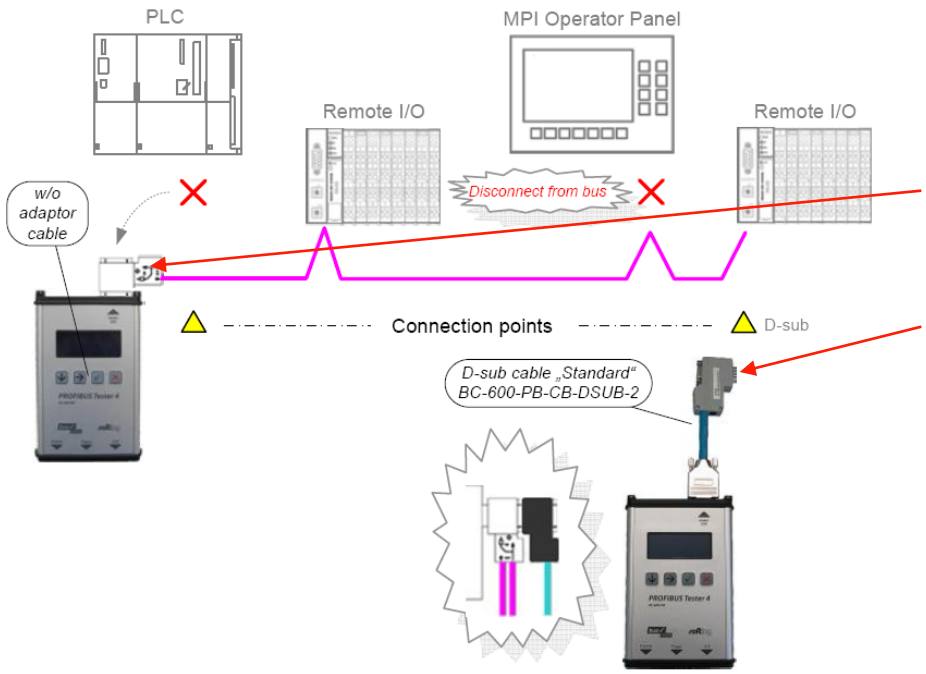
As a first step you need to scan for all slave devices in your network (if not already done).

- Connect your PB-T5 to a running network
- Start Quick Test with a click
- After completing the Quick Test open the window for topology scan

⇒ PB-T5 shows all detected devices in the numerical sequence of the PROFIBUS addresses (most of the time the physical sequence is different)

7. Topology Scan

Step 2: Disconnect masters and connect PROFIBUS Tester 5 instead



A true and correct Topology Scan can only be done with no active PROFIBUS master attached to the network.

Therefore you need to disconnect any masters in your network and then connect PB-T5 as shown.

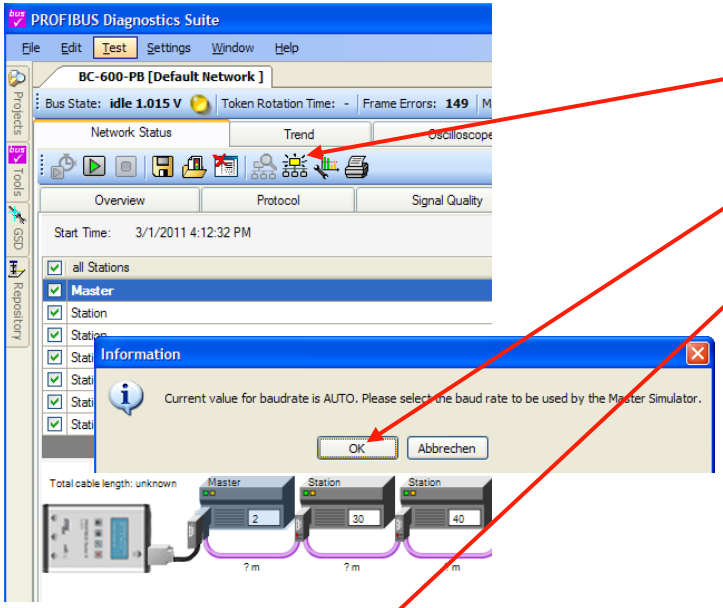
Please only use ***BC-600-PB-CB-DSUB-2*** cable that is included in the standard scope of supply.

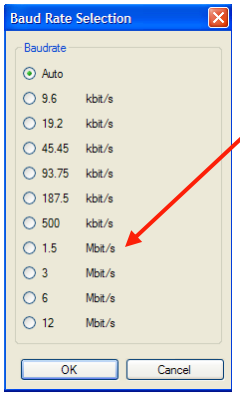
Disconnect every single active device (PLC, MPI and, if necessary, diagnostic repeaters) from the power supply or the bus.

Connect the PROFIBUS Tester 5 to one end of your network. Typically, you would remove the connector for your PLC and plug it directly into the Tester 5.
The PROFIBUS Tester 5 will provide the necessary power for the bus termination.

7. Topology Scan

Step 3: Activate Master Simulator in PB-DIAG-Suite on your PC

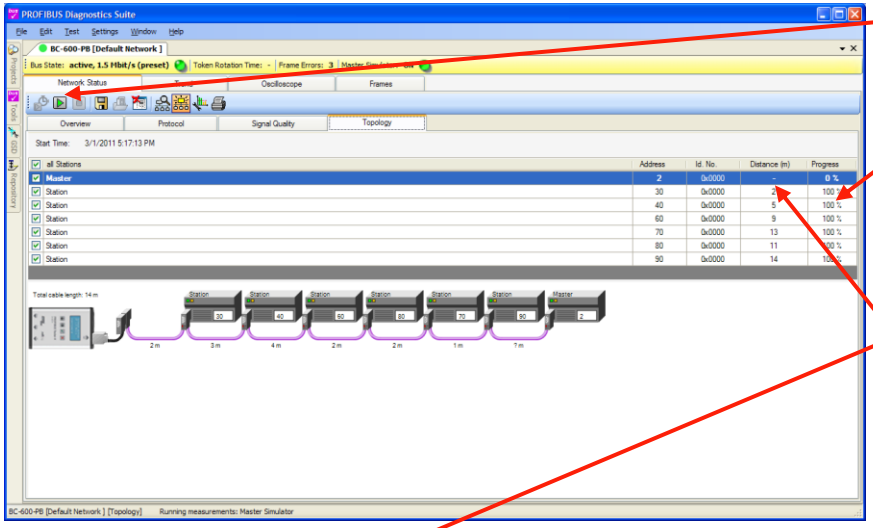




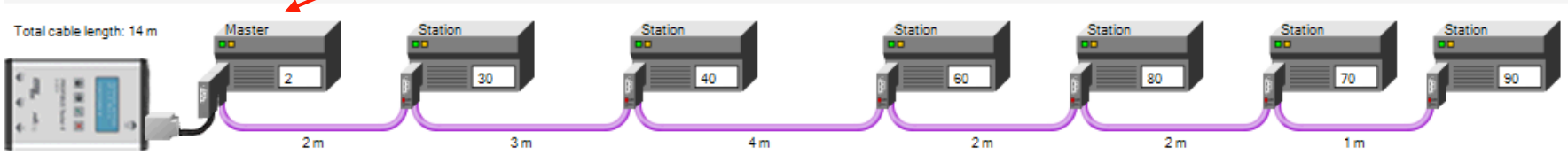
- Click on this button to activate the „Master Simulator“
- Accept manual setting of baudrate
- Select the correct baudrate of your system

7. Topology Scan

Step 4: Perform the topology scan



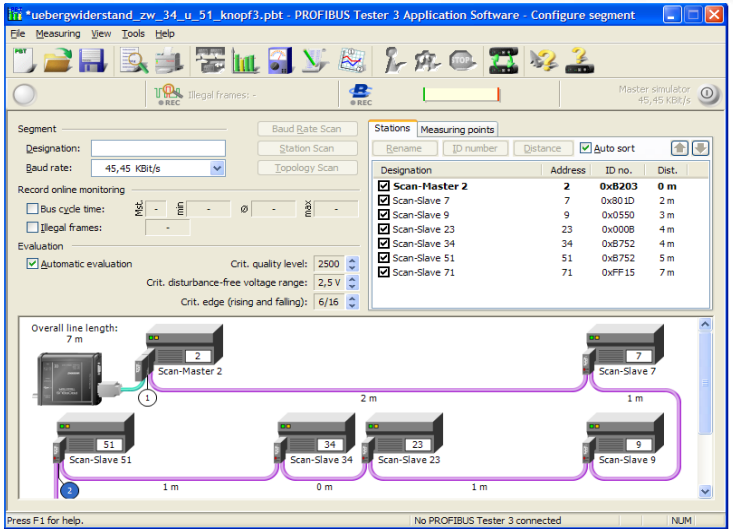
- Start topology scan by a click on the „Start-Test“ button
- Wait until progress of scan has reached 100% for all stations
- since the master is disconnected it cannot be located.
  Double click on master´s „Distance (m) and type in „0“ to locate the master correctly.

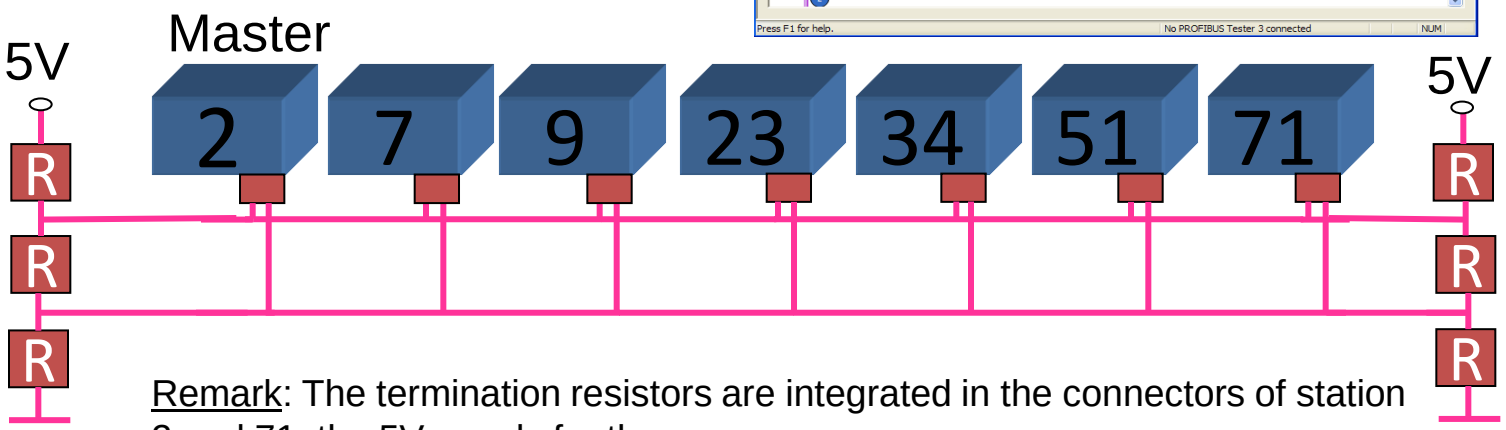


8. Typical Network Issues in a Profibus Network

Sample Network

The following network issues were recorded on a sample network as shown below:





Remark: The termination resistors are integrated in the connectors of station 2 and 71; the 5V supply for the termination is provided by the respective device.

8. Typical Network Issues in a Profibus Network

Case 1: Reversal of results from both ends of the system

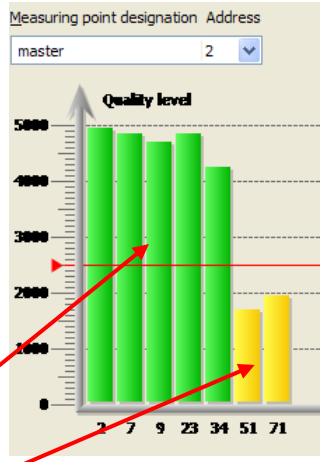
Case 1:

Step 1:

connect and test from ***left*** end side (Master 2)

Step 2:

connect and test from ***right*** end side (Slave 71)



measurement from left side (Master 2)

- ***Result:***

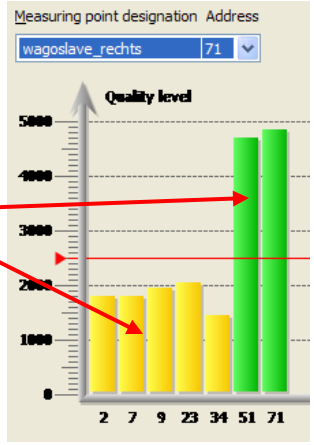
Test results on the **left** end:

- - good quality values for stations 2 - 34
- - bad quality values for stations 51 – 71

Test results on the **right** end:

- - bad quality values for stations 2 – 34
- - good quality values for stations 51 – 71

- ➔ ***Reversal of Q-Levels !***



measurement from right side (slave 71)

8. Typical Network Issues in a Profibus Network

Case 1: Reversal of results from both ends of the system

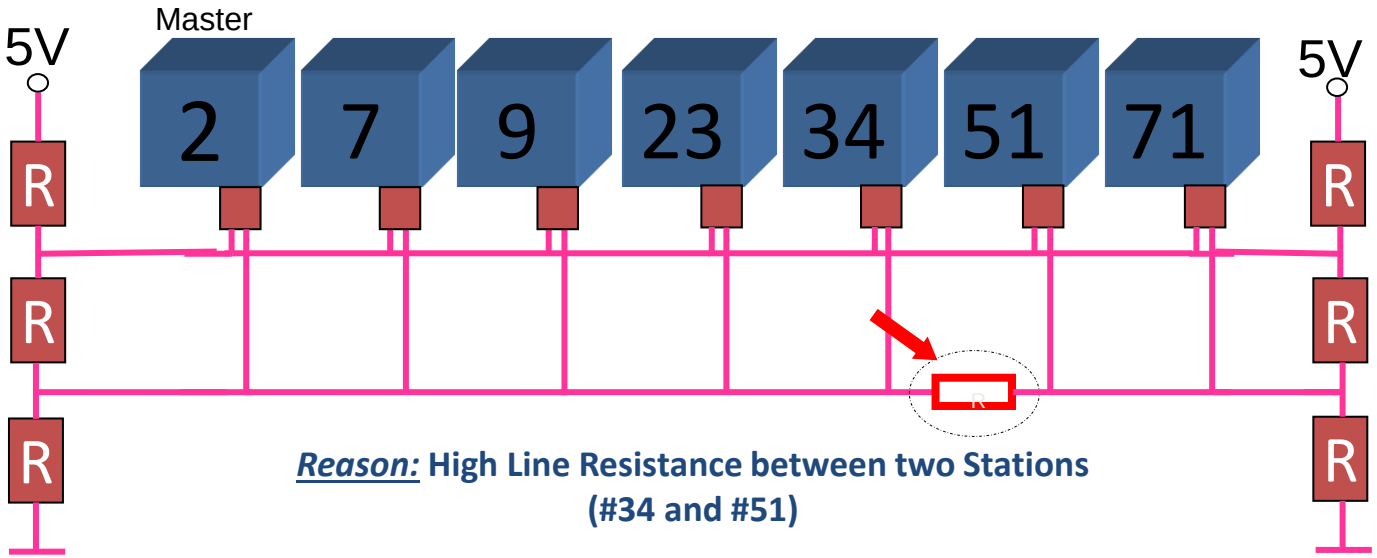
Interpretation:

The test result from the ***right*** side is the ***reversal (!)*** of the test results from the ***left*** side and vice versa.

This kind of reversal is a clear indication for a ***high resistance*** in the network.

In this case the problem is caused somewhere between slave 34 and slave 51

e.g. corrosion, sharply bent cable, etc.



8. Typical Network Issues in a Profibus Network

Case 2: Q-level becomes worse from one measuring point to the next

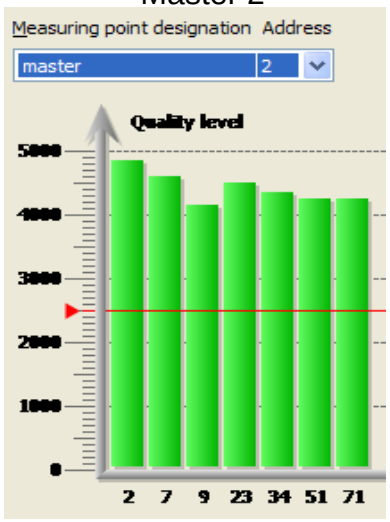
Case 2:

- Step 1: perform test at ***left*** end (Master 2)
- Step 2: perform test at ***right*** end (Slave 71)
- Step 3: perform tests at random stations located in the ***middle*** of the network

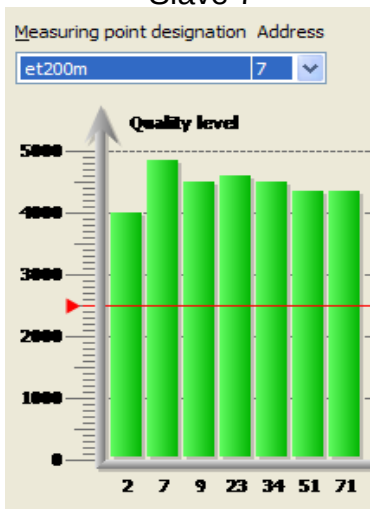
Result:

- No reversal of Q-level between left and right side
- Instead, the Q-level for all stations generally declines from one station to the other.

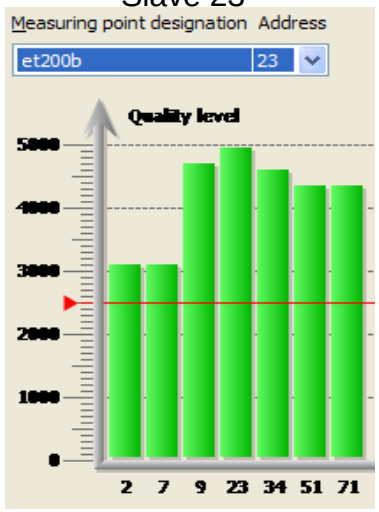
Master 2



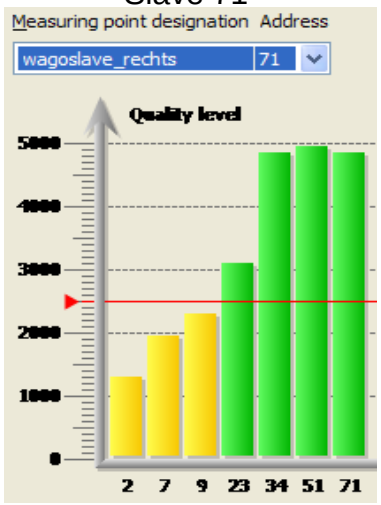
Slave 7



Slave 23



Slave 71



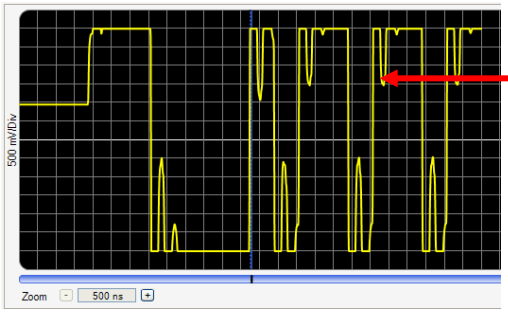
8. Typical Network Issues in a PROFIBUS Network

Case 2: Q-level becomes worse from one measuring point to the next

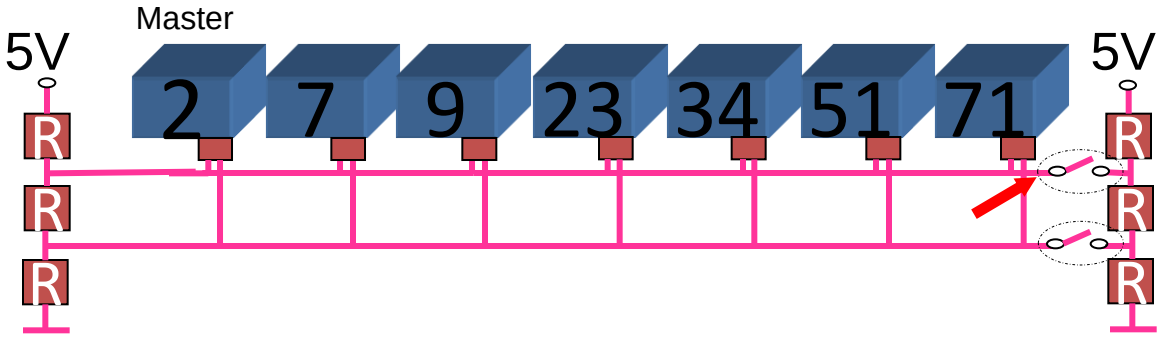
Interpretation:

- The problem is ***not*** caused by resistance problems (corrosion, cable too long, etc…
- The problem is caused by signal ***reflections*** in the network,
  in this case by a missing termination resistance at Slave 71.

Typically, the problem is located at the test point that shows most stations with a bad Q-level.



You can see the reflections in the oscilloscope display of master 2 while connected at test point Slave 71.

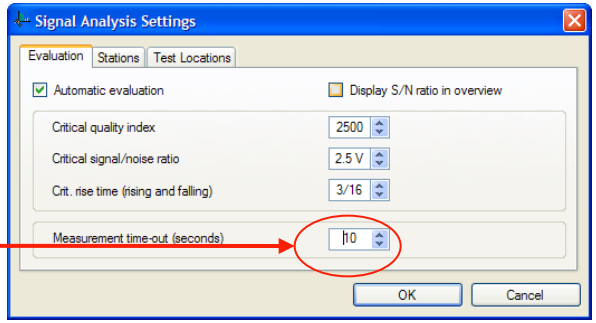


8. Typical Network Issues in a PROFIBUS Network

Case 3: Some stations are "missing" depending on the test location

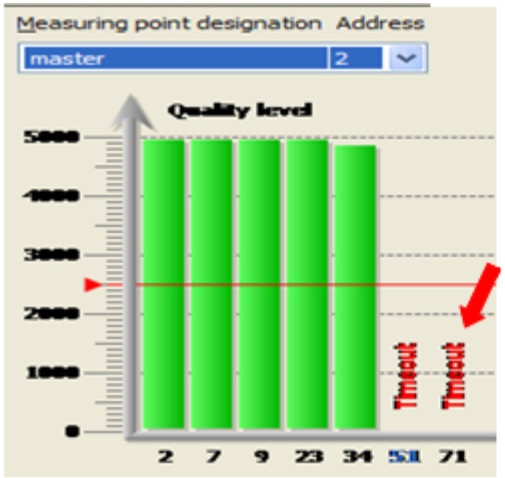
Case 3:

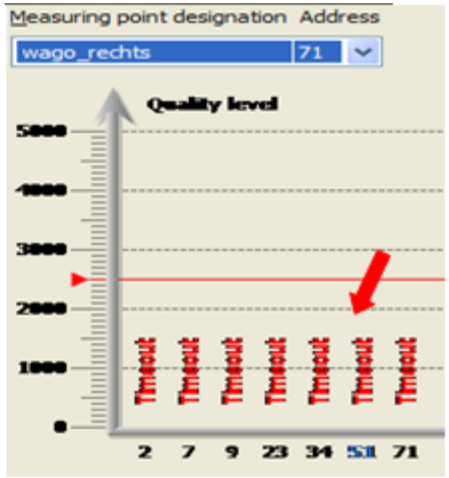
- Step 1: perform test at left side (Master 2)
- Step 2: perform test at right side (Slave 71)
  (Note: make sure that Timeout is not caused by the time-out setting in PB-T4: => Tools / settings)



Result:

- Test at left end: Slave 53 and 71 are missing
- Test at right end: all stations are missing





8. Typical Network Issues in a PROFIBUS Network

Case 3: Some stations are "missing" depending on the test location

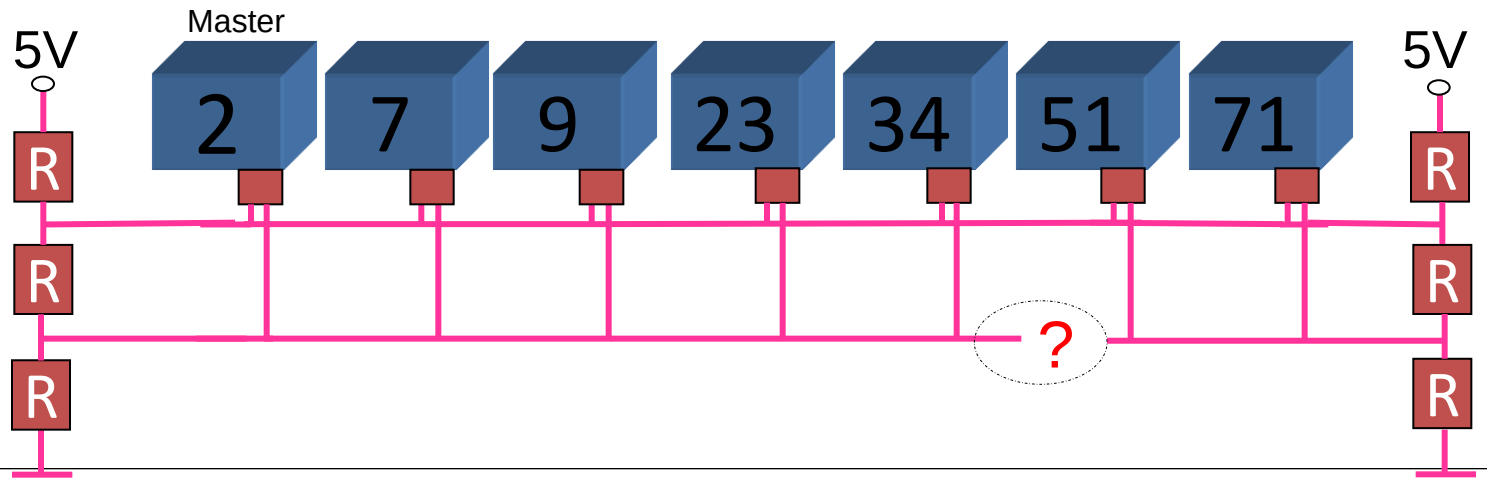
- **Interpretation:**

The fact that some devices can be seen from one end but not from the other indicates that the problem is not be caused by the devices themselves.

The test result at the left end shows that the Q-levels are good until slave 34. After slave 34 the Q-levels are not testable. This indicates that the problem must be in the line between slave 34 and 51.

- **Conclusion:**

The problem is caused by a break of one or both signal lines.

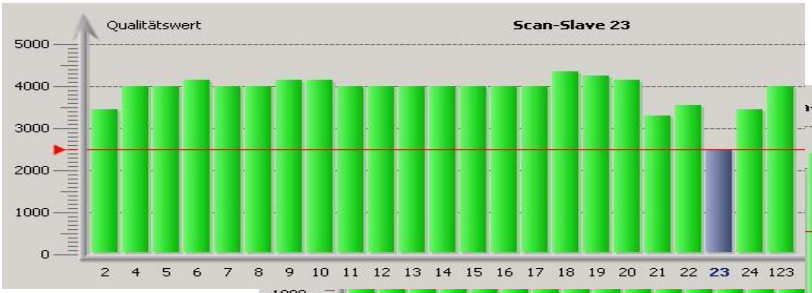


8. Typical Network Issues in a PROFIBUS Network

Case 4: Quality Level of one device is bad

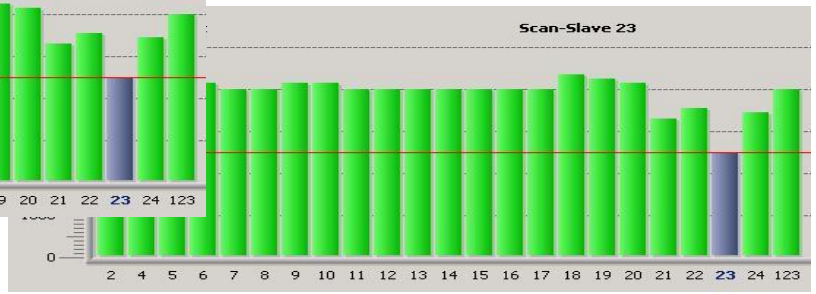
- **Case 4:**
  - Step 1: perform test at left side (Master 2)
  - Step 2: perform test at right side (Slave 123)
  - Step 3: perform test at Slave 23
- ***Result:***
- The Q-level of slave 23 is bad. All others are good. The result of ***all*** three measurements is basically ***identical***.
- ***Interpretation:***
- The voltage level of RS485 driver of station 23 (and only station 23) is too low.

measurement from left side (master 2)



measurement directly from slave 23

measurement from right side (slave 123)

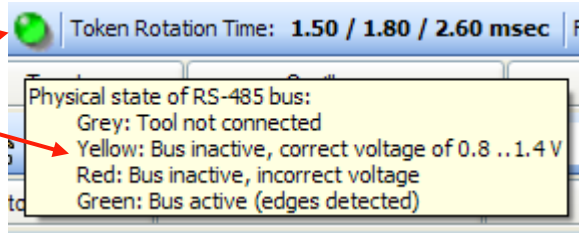


8. Typical Network Issues in a PROFIBUS Network

Case 5: Bus-termination is not powered correctly

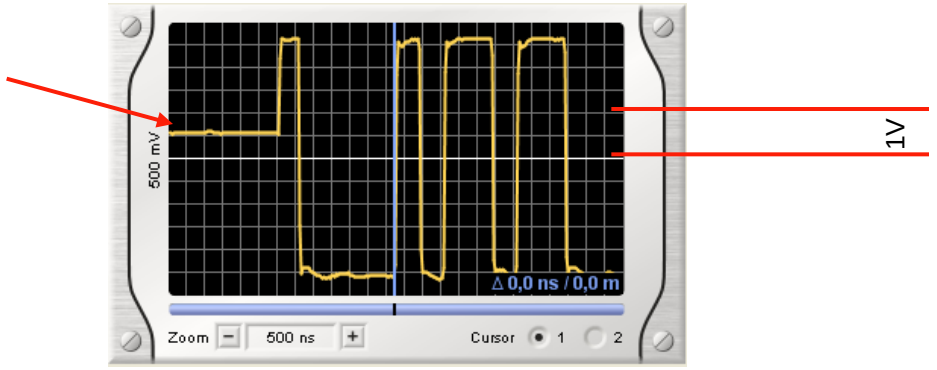
Indication of idle voltage:

The correct idle voltage is supposed to be between 0.8 and 1.4 V.
An idle voltage lower than that indicates that one or both bus-terminations are not powered correctly.



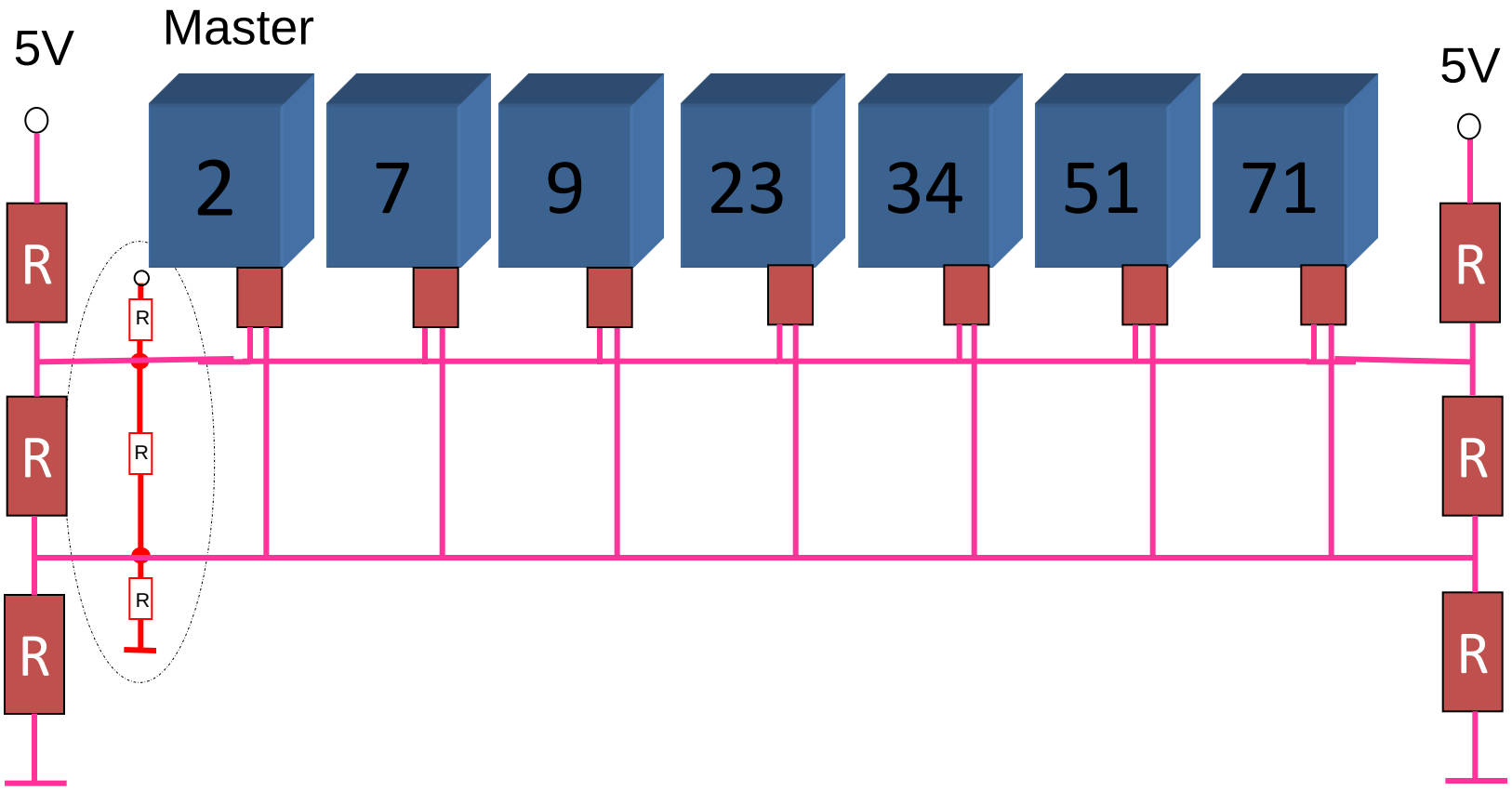
- An idle voltage of approx. 0.6 Volts indicates that only one bus-termination is powered correctly
  ⇒ communication may work, sporadic failures likely
- An idle voltage close to 0 Volts (both terminations not correctly powered or one termination missing/one not correctly powered ⇒ PROFIBUS will not start

In addtion, you can detect a low idle-voltage in the oscilloscope (in this case approx. 0.5 V)



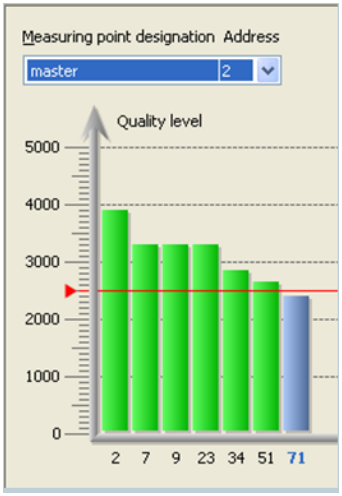
8. Typical Network Issues in a PROFIBUS Network

Case 6: Too many bus-terminations or additional electrical resistance



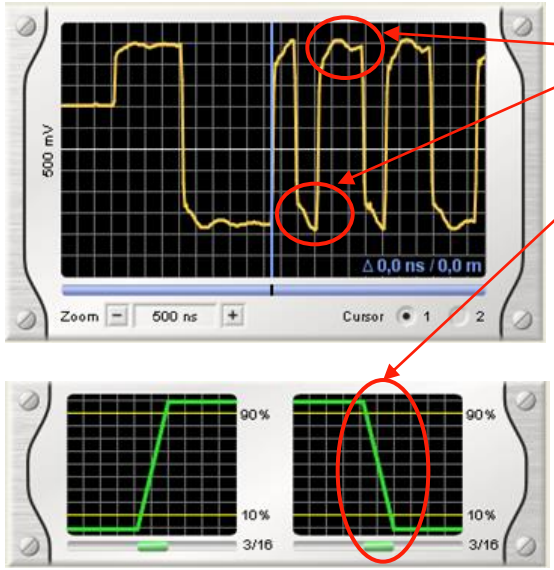
8.Typical Network Issues in a PROFIBUS Network

Case 6: Too many bus-terminations or additional electrical resistance



Note: The test results get worse the closer the PB-T5 is connected to the location of the problem (Master #2).

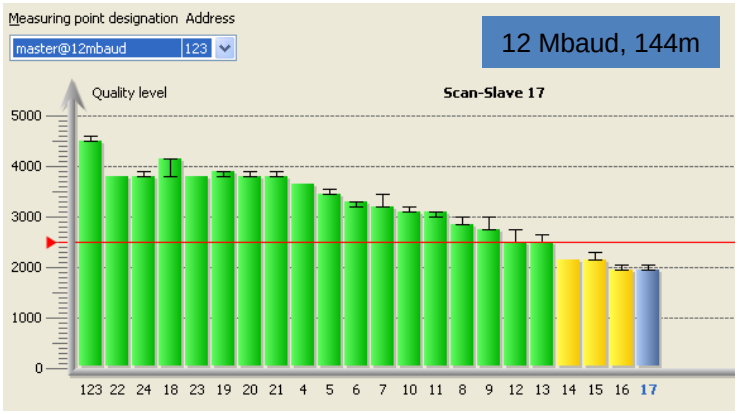
However, the signal quality level of the problematic station (Master #2) might be one of the best.
Unfortunately, the test results do not change as strikingly when dealing with tool many bus-terminations as they do with missing bus-terminations. Additional resistance usually affects all stations.



signal blurred
only some drops in signal due to reflections
bad signal edges

8.Typical Network Issues in a PROFIBUS Network

Case 7: Cable too long for selected baud rate (transmission speed)

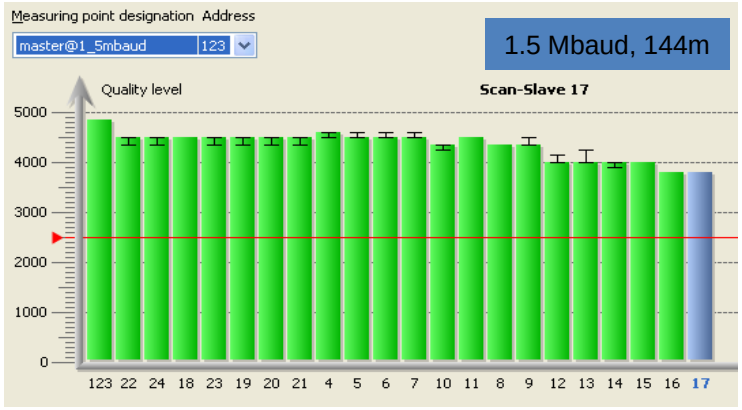


Note 1:

A cable length of 144m is too long for 12 Mbaud (100m permissible).
Therefore, the quality levels / signal level of the stations measured at the master drop with the distance to the referring slave.

Note 2:

A test performed at the opposite end of the network (station #17) will show a “mirrored image”. In contrast to high line resistance the signal quality degrades gradually.



Note:

Here the built-in Master functionality of the PB-T5 comes in very handy.
Without changing the PLC-program, the network can be tested at different baud rates (e.g. 1.5 Mbaud). As shown above, running the same network at a baud rate of 1.5 Mbaud is perfectly acceptable.

9. Best-Practice for a stable PROFIBUS Network

Cable type, number of stations, cable length

- **PROFIBUS RS-485**

Layout: terminated line, branch (or stub) lines < 0.3 m (1 foot) !!

Cable type: shielded twisted pair cable acc. to PROFIBUS specification

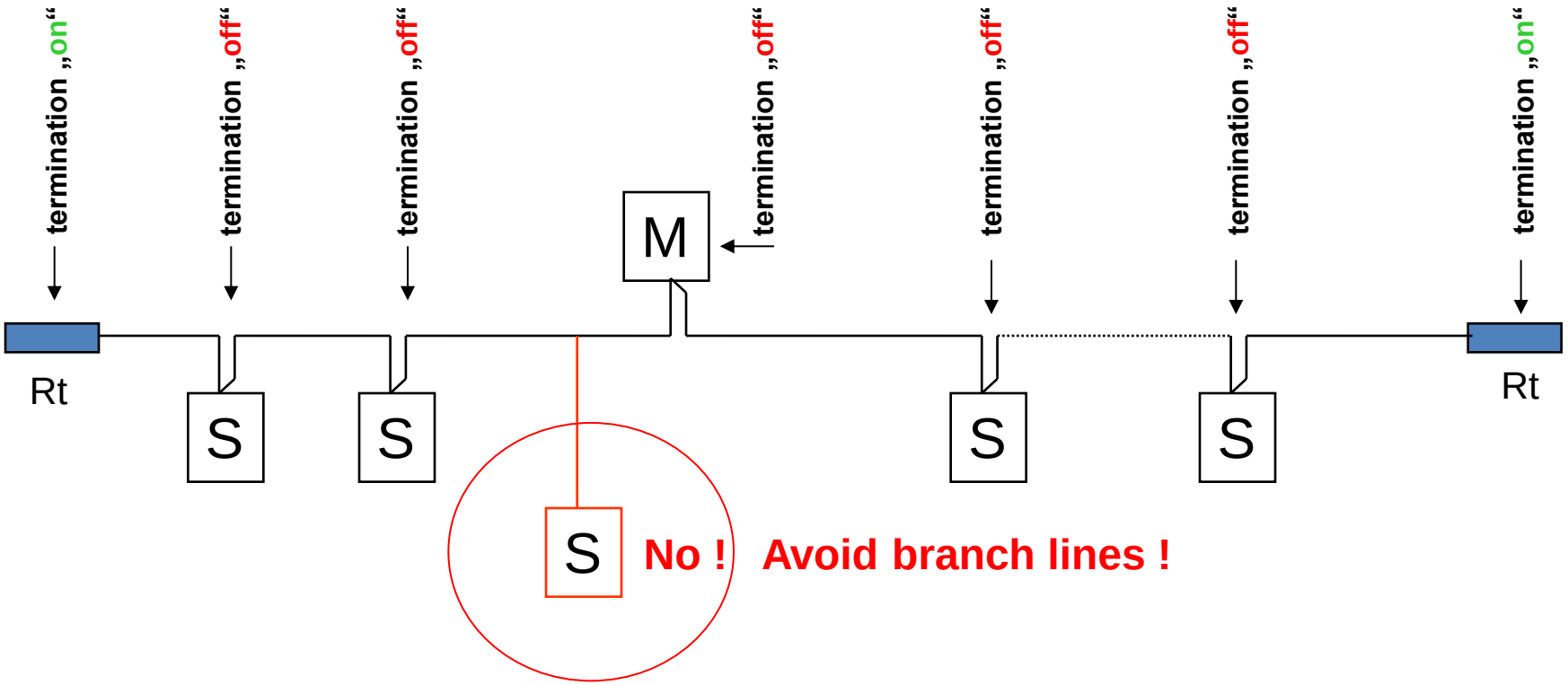
Number of stations: max. 32 w/o repeater, 127 using repeaters

Max. cable length (applies to cable type A only):

Baud Rate		Max. Cable Length	
9.6, 19.2, 31.25, and 45.45	Kbit/s	1200 m	(3940 ft)
93.75 and 187.5	Kbit/s	1000 m	(3280 ft)
500	Kbit/s	400 m	(1310 ft)
1500	Kbit/s	200 m	(656 ft)
3000, 6000, and 12000	Kbit/s	100 m	(328 ft)

9. Best-Practice for a stable PROFIBUS Network

Correct line topology, setting of bus termination

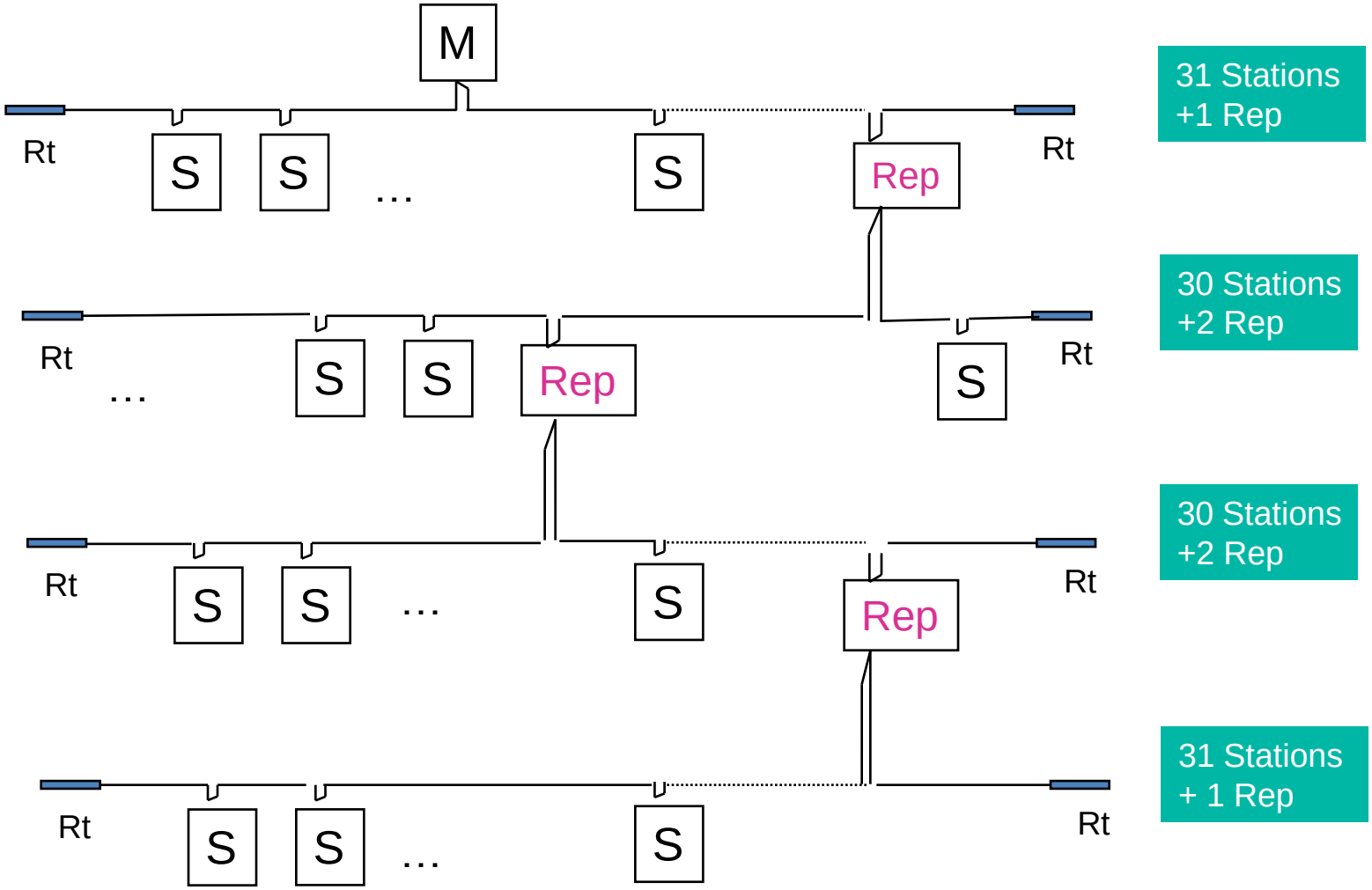


Copper cable 0.22 mm^2, twisted pair, shielded, AWG 24*

Max. 32 stations (Masters and Slaves) in one segment without repeater

9. Best-Practice for a stable PROFIBUS Network

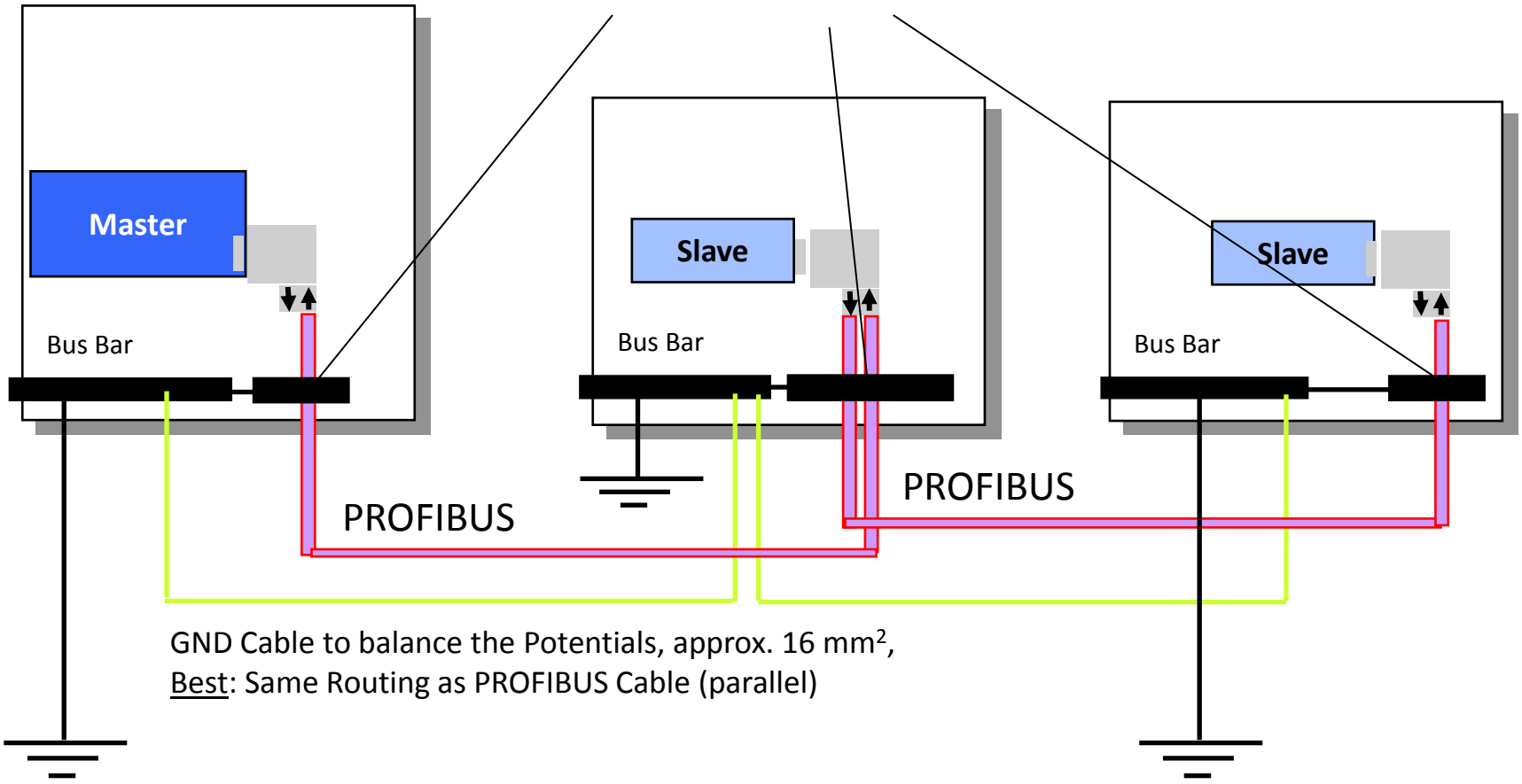
Correct line topology with repeaters



9. Best-Practice for a stable PROFIBUS Network

Grounding and mounting of PROFIBUS RS-485

Planar Connection of the PROFIBUS Cable Shielding to the Ground Potential, e.g. through special Clamps



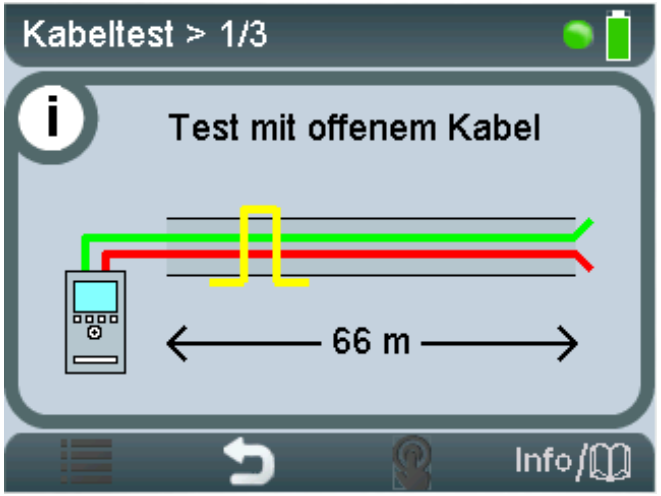
GND Cable to balance the Potentials, approx. 16 mm^2,
Best: Same Routing as PROFIBUS Cable (parallel)

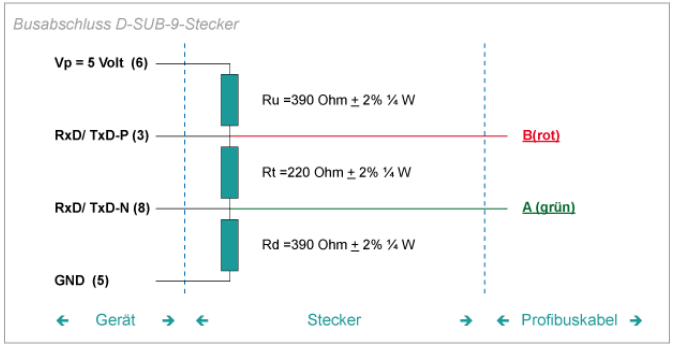
10. Cable test

- **Cable test functionality**

  The cable test functionality examines the cabling in PROFIBUS segments.

  The cable test functionality includes detection of cable segment length , scans for unwanted reflections on the line and verifies proper termination of the cable. Im Fehlerfall erhalten Sie eine Fehlerbeschreibung und eine Entfernungsabgabe (soweit möglich), um die Fehlerursache beheben zu können.





10. Cable test

- **Start**
  Start > Test Functions > Cable Test

- **if required edit configuration – otherwise start with** 

- **your test**
  Integrated 3-step menu guidance in the device:
  - Open Cable Test
  - Far-end Terminator Test
  - Near Terminator Test

10. Cable test

When does a cable test make sense:

-Self-check when assembling cables
-When performing an acceptance test of an installed cable
-If problems occur, e.g. in case of system downtime or repair of a badly damaged cable

How does the cable test work?

Step 1: Detect and eliminate unwanted reflections

Step 2: verify proper installation of terminating resistor

Follow the instructions which are shown on the device's display during cable test. You get hints concerning type and location of the cable error in order to eliminate it best possible.

Thank you for your attention!

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