Troubleshooting PROFIBUS networks

Elimination of transmission problems using Softing’s PROFIBUS Tester 3
Common problems on PROFIBUS cables

- Termination powered insufficiently
- Signal lines broken
- Signal line broken
- Termination missing at Master's end
- Termination missing at last Slave
- Extra termination/resistance at Master
- Extra termination/resistance at Slave
- High line resistance between two stations
- Baudrate too high for installed cable length
- PROFIBUS drivers output low voltage

- The perfect PROFIBUS network
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.
Remark: on the sample network the problem was provoked by removing the PROFIBUS connector from the Master. In industrial systems the idle voltage has to be checked using the PROFIBUS 'disconnector' supplied with the PBT-3. The disconnector interrupts the signal lines but keeps termination powered.
Termination powered insufficiently

Red: idle voltage too low, incl. numeric value
Yellow: idle voltage ok (ca. 1.1 volts)
Termination powered insufficiently

idle voltage ca. 0.6 Volts, e.g. if termination is not powered properly: communication may work, sporadic failures possible

idle voltage close to 0 Volts (both terminations unsupplied or one termination missing/one unsupplied: Profibus will not start
Termination powered insufficiently

online measurement of idle voltage on running system

idle voltage between frames too low
Both signal lines interrupted
Both signal lines interrupted

 Interruption close to Slave 51
One signal line interrupted
One signal line interrupted

Level changes occur, but no frame decodable
Remark: The termination resistors are integrated in the PROFIBUS connectors in stations 2 and 71. The termination network is powered by the respective device.
Termination missing at station 2 (master)
Termination missing at station 2 (master)

signal distortion due to reflections
Termination missing at station 71 (last slave)

Remark: The termination resistors are integrated in the PROFIBUS connectors in stations 2 and 71. The termination network is powered by the respective device.
Termination missing at station 71 (last slave)

Remark: The closer the PB-T3 is to the location of the problem (Slave 71), the worse the overall impression gets. The signal level of the station at the error location (slave 71) might be always excellent. In the detailed measurement of station 2 on location 51 distortions due to reflections would be visible.
Extra termination/resistance at Master 2
Remark: As in the previous slides: The closer the PBT-3 is to the location of the problem (Master 2), the worse the overall impression gets. Nevertheless, the signal level of the ‘problematic’ station (Master 2) might be one of the highest. In case of additional resistors the overall impression doesn’t change as strikingly as it does with missing termination.

Additional resistance usually affects all stations.
Extra termination/resistance at Master 2

- Signal blurred
- Only some drops in signal due to reflections
Extra termination/resistance at Slave 23
Remark: Location of worst overall impression is shows less clearly.
extra resistance may affect idle voltage
Extra termination/resistance at Slave 23

- Localization of problem by successive disconnection of stations from the bus. Done by activation of the termination resistors from the last slave to the master.

- Prerequisite: correct wiring of PB plugs, cable from master = 'IN'. Continuous measurement of master level and the level of the first (few) slave(s).

- When the faulty cable segment is switched off/on, signal levels of remaining stations (here: segment between 9 and 23) will show a sudden change in level (rise/fall).

- Switching of cable segments done using the termination switches on the PB connectors.
High line resistance between two stations (34 and 51)
High line resistance between two stations (34 and 51)

Remark: characteristic sign for the situation are the mirrored measurements. Stations looking no so good in the measurement on one end are ok in the other measurement. The greater the distance to the master is, the lower the quality levels become.

The location of the fault can be derived from the striking change in quality level. Here: fault located between 34 and 51.
Baudrate too high for installed cable length

Overall line length:
144 m
Baudrate too high for installed cable length

Remark 1: A buslength 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 slave.

Remark 2: A measurement carried out at the most distant slave (station 17) would show a 'mirror image'. In contrast to high line resistance the signal loss is gradual and not striking at a particular location.
Baudrate too high for installed cable length

Remark: Here the built in Master functionality of the PBT-3 proves very useful.
Without (re-)programming a PLC, the network can be checked at a different baudrate, e.g. 1.5MBaud

144 m are permissible at 1.5 MBaud and hence the quality levels of all stations are acceptable.
Remark: driver problems with PROFIBUS devices occur rather rarely compared to wiring problems. In the chart, driver problems can be identified as the signal level of a particular station has the same poor quality level across all measures locations.
The perfect PROFIBUS network