saia-burgess

Smart solutions for comfort and safety

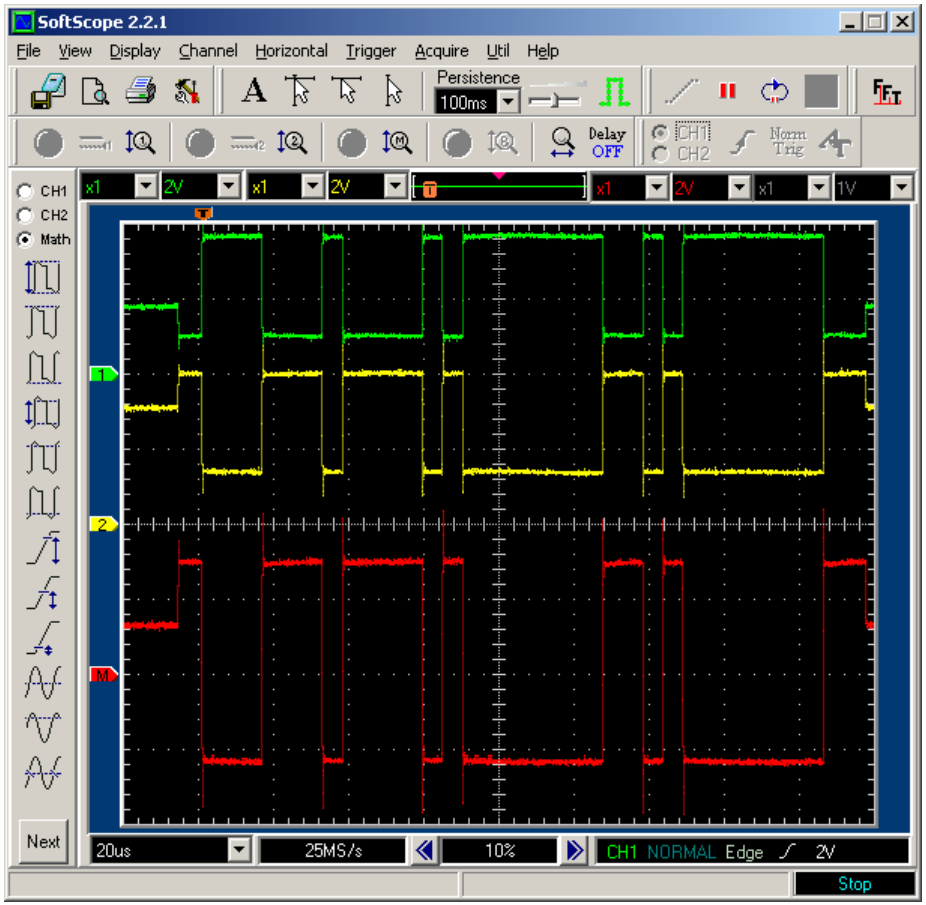
RS 485 oscilloscope screenshots

Technical Meeting 2004

Introduction

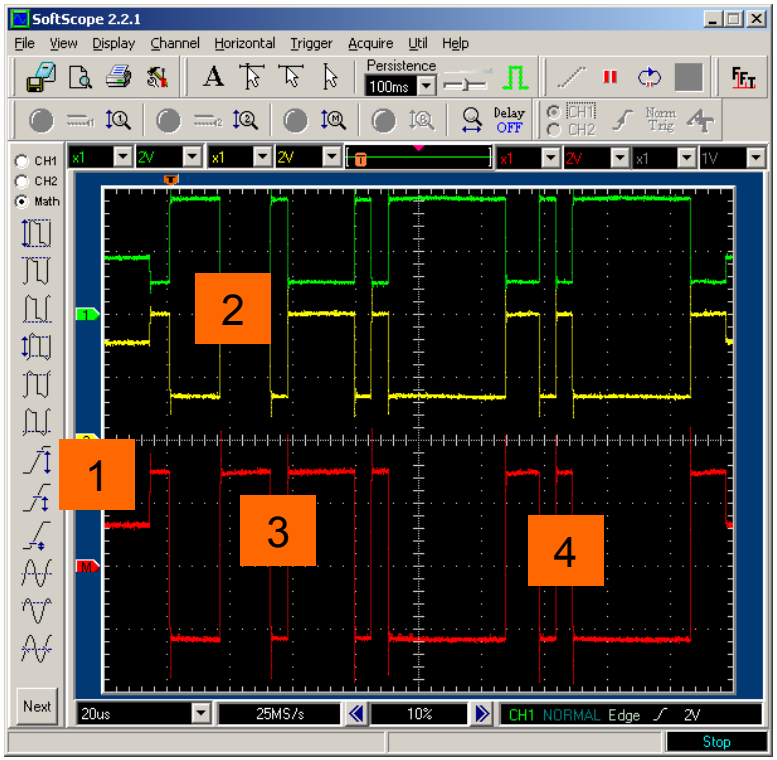
- an oscilloscope is a very useful tool to find hardware problems in RS 485 networks
- if you know what to look for, you can easily identify common errors like crossed lines, missing shield connections, missing terminations, reflections due to inadequate topology...
- with increasing baudrates, the conformity of networks to the specifications get more and more important

Settings of the oscilloscope



- single shot mode
- DC coupling
- 2 V / div
- CH1 = A resp. RX-TX resp. D (green line)
- CH2 = B resp. /RX-/TX resp. /D (yellow line)
- Math = CH2 – CH1 (red line)
- time division according to the baudrate, typical values:
  9600: 500 µs / division
  38.4 k: 100 µs / division
  187.5 k: 20 µs / division
  1.5 M: 2 µs / division

Everything is fine...

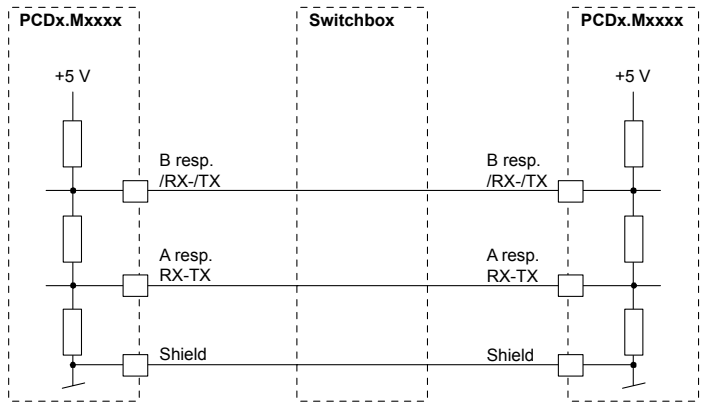


1) between telegrams constantly > 1 V (B is higher than A, /RX-/TX is higher than RX-TX).
Rising edge in the voltage difference at the beginning of the telegram

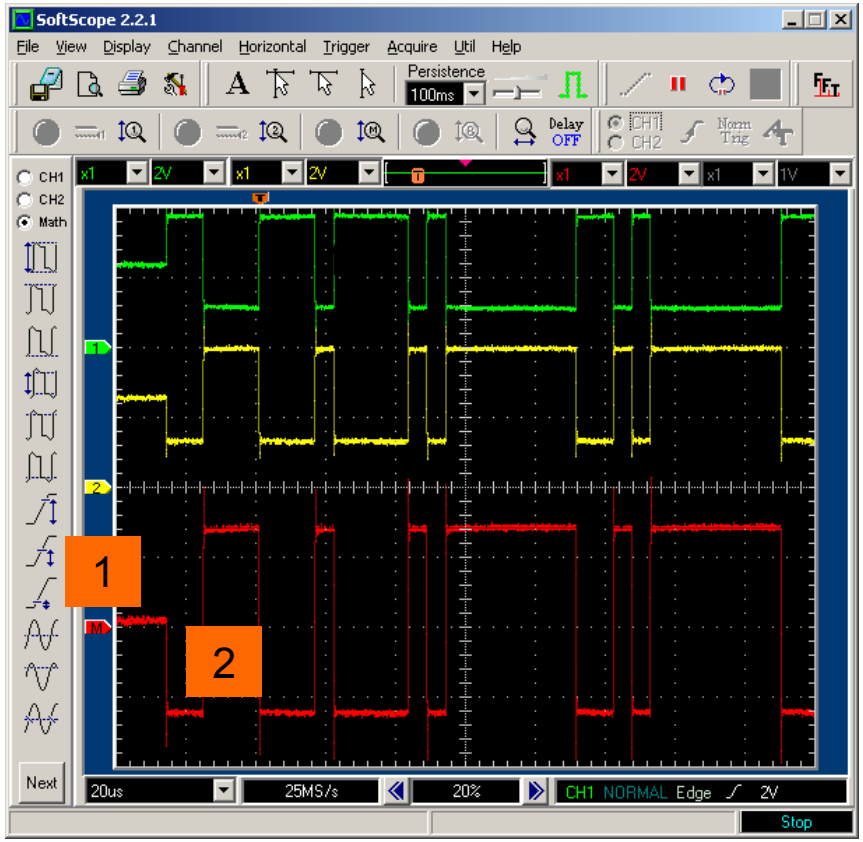
2) CH1 and CH2 move in opposite directions

3) significant oscillations only at the edges

4) amplitude of the voltage difference > 2 V peak peak

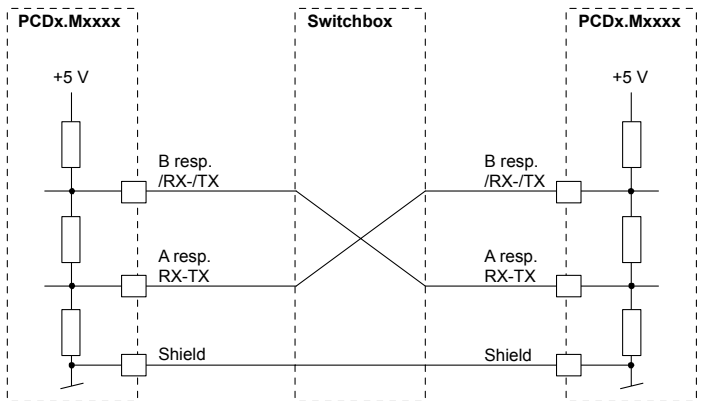


Signal lines crossed an odd number of times

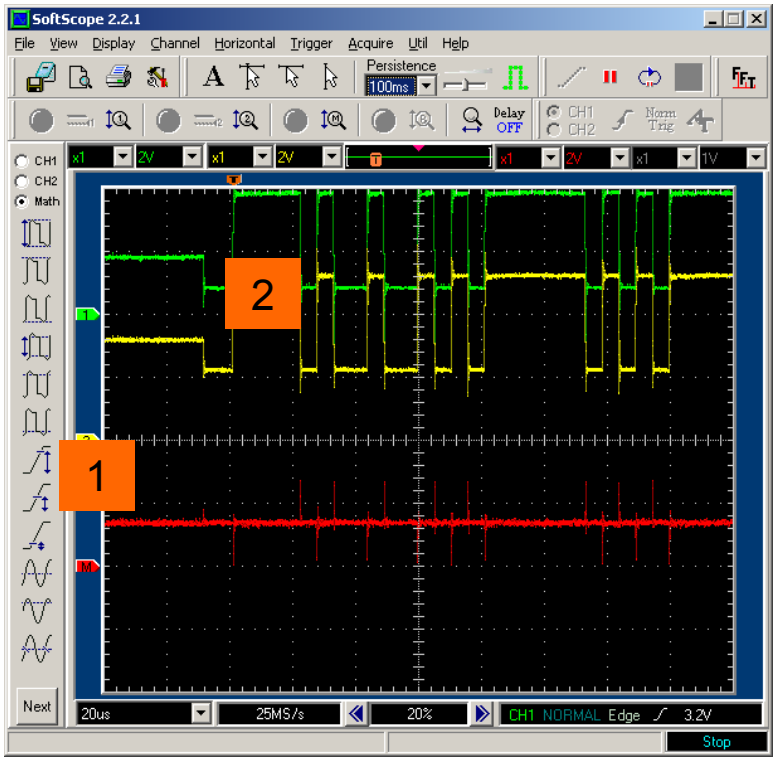


1) between telegrams constantly around 0 V (the termination resistances cannot create the usual > 1 V voltage difference)

2) rising or falling edge at the beginning of the telegramme according to the position of the station in the bus and the station of which a telegram has been captured

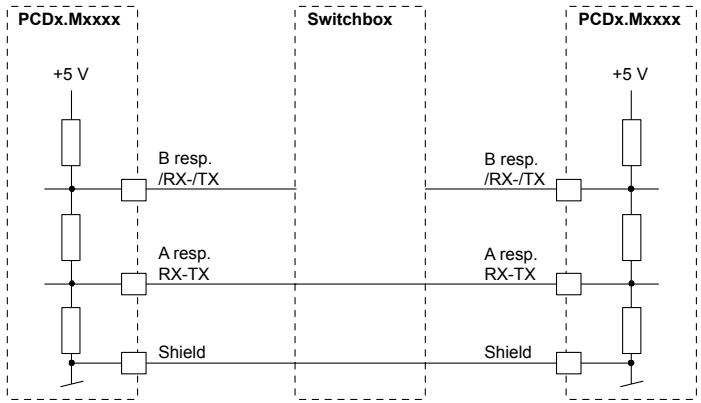


Signal B missing between the sender and the current station

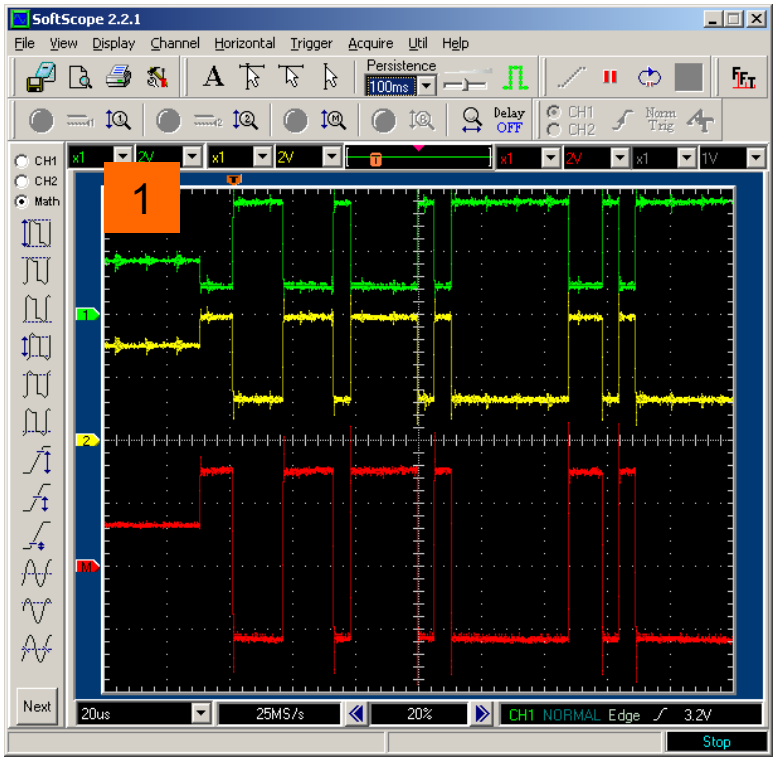


1) constant voltage difference, not moving during telegrams

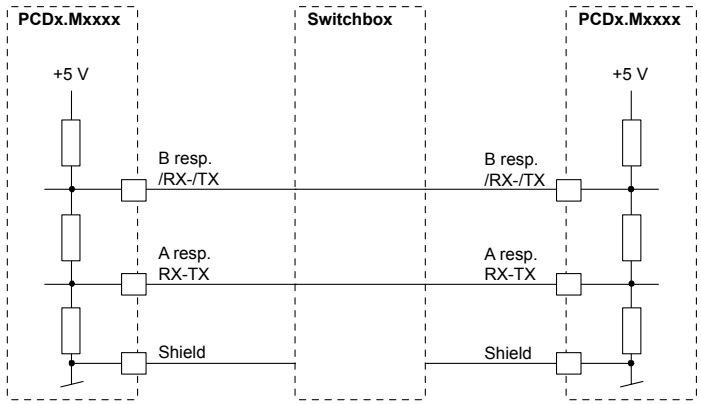
2) both channels move in the same direction during telegrams



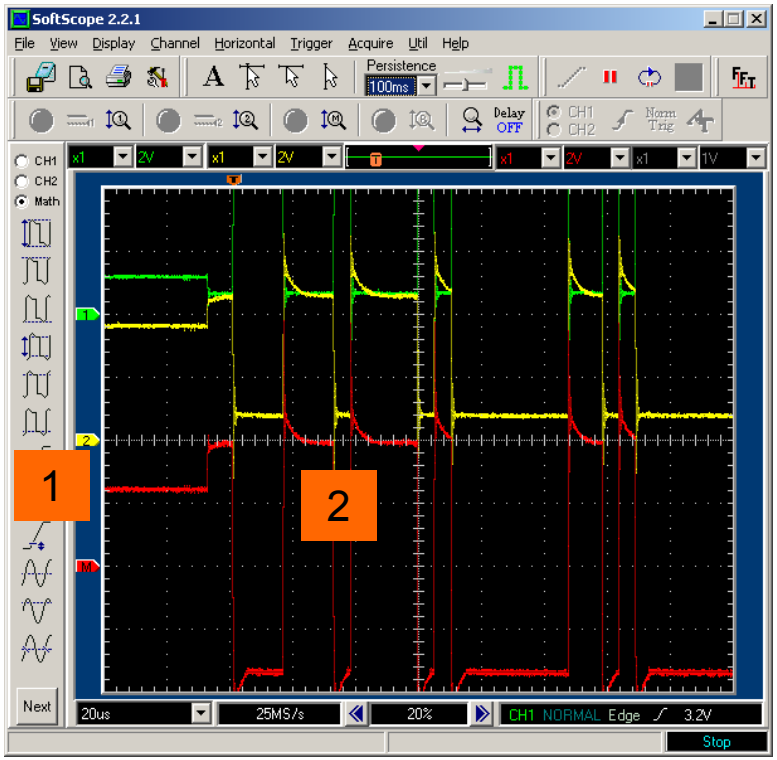
Shield missing between stations



1) significant oscillations besides the edges if there is no ground connection between the stations

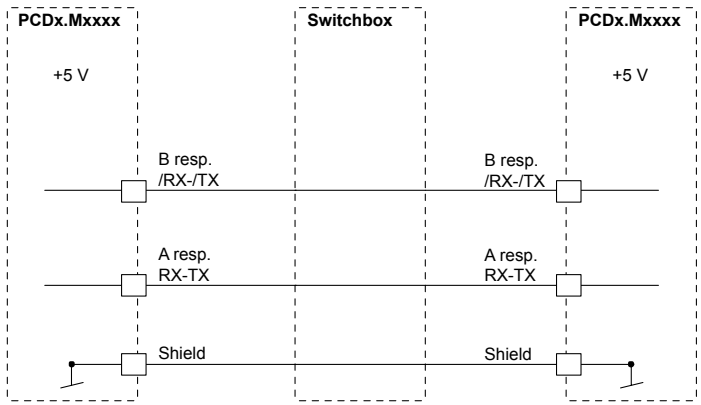


No terminations at all

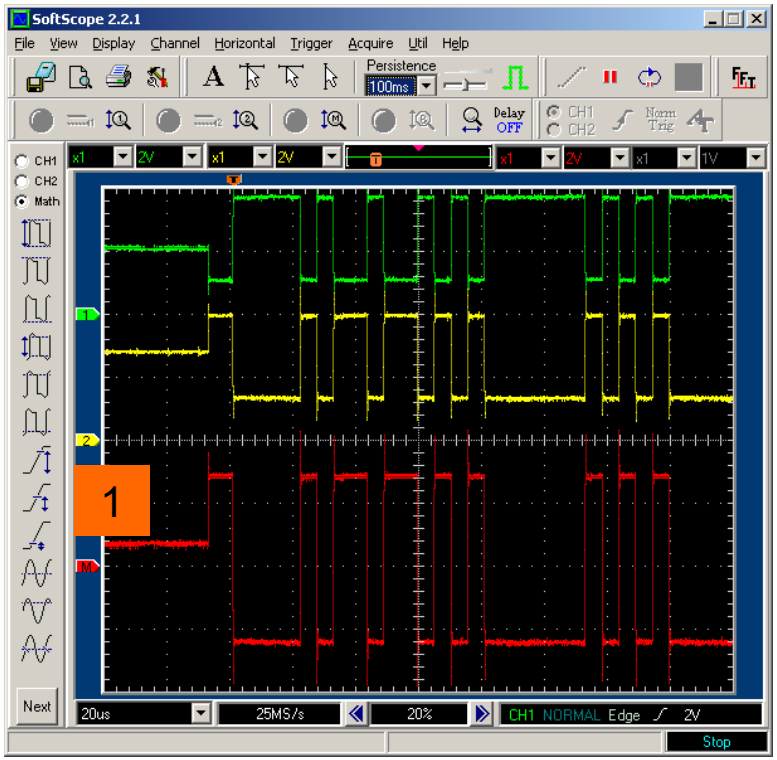


1) voltage difference between telegrams not at the usual level, not necessarily stable

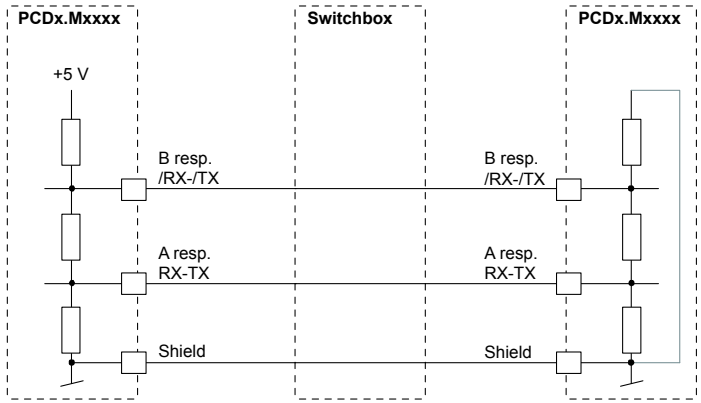
2) significant exponential charging curves at the transitions



Two terminations present, but only one of them supplied

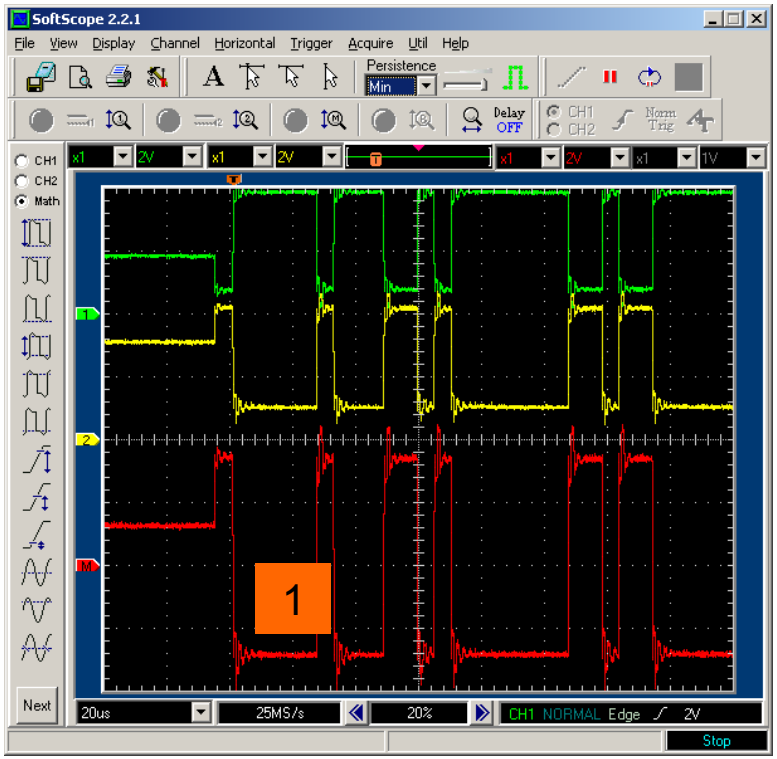


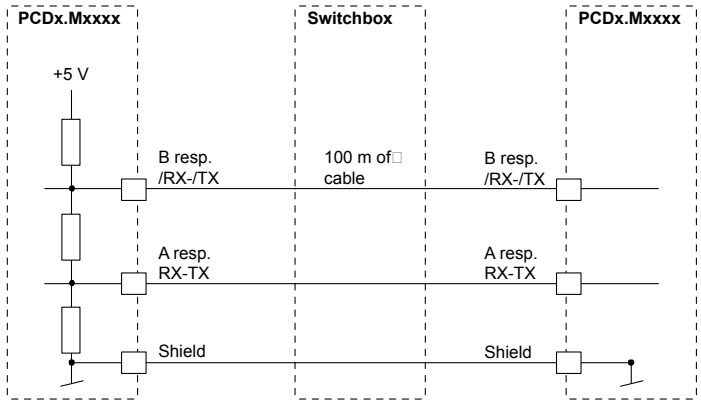
1) voltage difference between telegrams only half of the usual level (< 1 V, but amplitude of the voltage difference between telegrams OK)



Only one termination (100 m Profibus cable, 187.5 k) (similar effect when T's are present in the network)

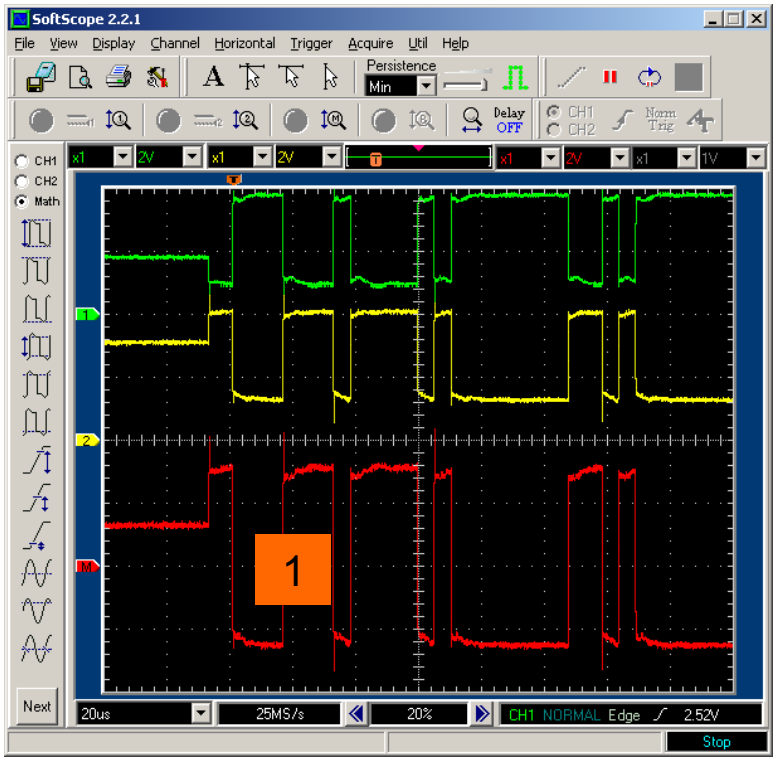
1) visible reflections on transistions

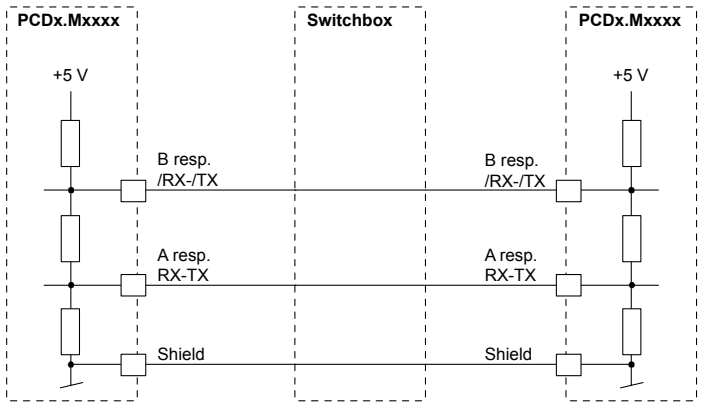




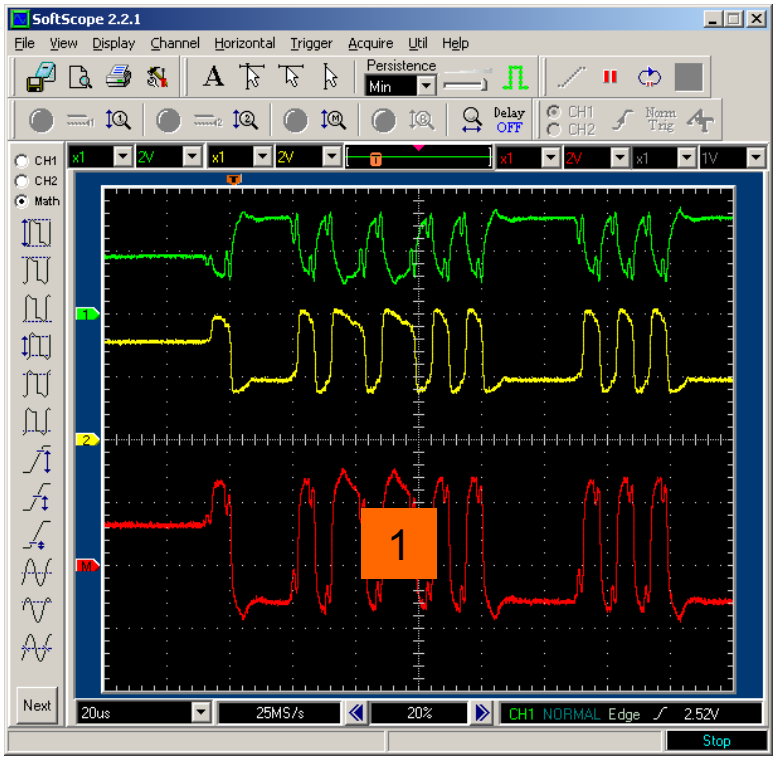
Long, non conform cable (54 Ω per line, shield 34 Ω) Signal of the station where the oscilloscope is connected

1) charging curves after the edges

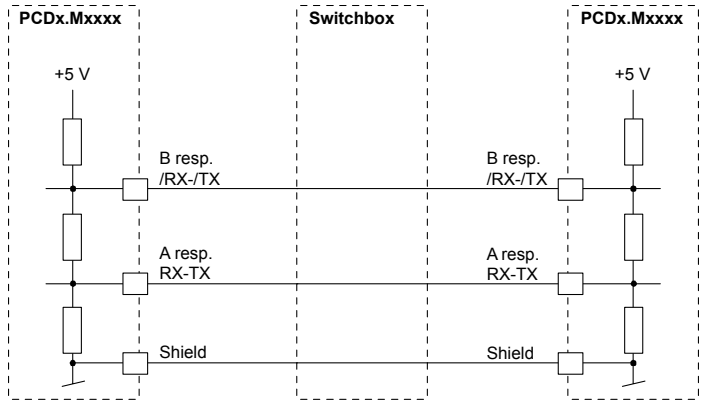




Long, non conform cable (54 Ω per line, shield 34 Ω)
Signal of the remote station



1) reduced amplitude, distorted signal (no bus errors were displayed)



Making your own experiences...

- to make it easy to simulate common network problems we created a switchbox
- you can connect three Profibus or Profi-S-Bus stations and introduce errors in the connections between the stations
- the networks created with the box are electrically not ideal, but good enough to observe common faults

Manipulate the data lines A and B

Switch position:

1) normal connection
2) A + B crossed
3) B missing
4) use the 4 mm banana connectors (green = A, red = B) to add an external cable

Hint to know what color have A and B in Profibus networks:

Bread (B is red)

Manipulate the shield connection

Switch position:

1) direct connection
2) 100 Ω in the connection
3) 10 kΩ in the connection
4) use the 4 mm banana connectors to add an external shield connection