How to avoid oscillations in a PROFIBUS-PA segment

Fieldbus systems with the 1158-2 Physical Layer have been used since 1997 in the process industry and are well accepted in the market place. The Medium Attachment Unit SIM 1 has proven its high performance and flexibility in multiple products.

With the experience of large applications including several hundreds of field devices the IEC 1158-2 Physical Layer has proved to be very stable even under extreme working conditions. However the standard 1158-2 allows device characteristics which can lead to oscillations on the bus in the range of 250 to 500 kHz. The oscillations have normally no influence on the data transmission because the transmission bandwidth is below 40 kHz. Nevertheless, in some limit conditions of the bus topology the oscillations may disturb the data transmission.

To prevent disturbing effects we recommend to optimise the behaviour of the field device above the transmission bandwidth within the circuitry of the SIM 1. Appendix 1 describes an easy solution recommended to implement in all devices under development and in production

Our analysis has shown that the oscillations can occur by using pairs of non-optimised field devices with a distance of ~30m in between the devices. The oscillations don't appear if the distance in between two field devices (non-optimised) is below 10m or above 70m.

Appendix 2 shows the steps to prevent or eliminate oscillations on an 1158-2 bus segment.

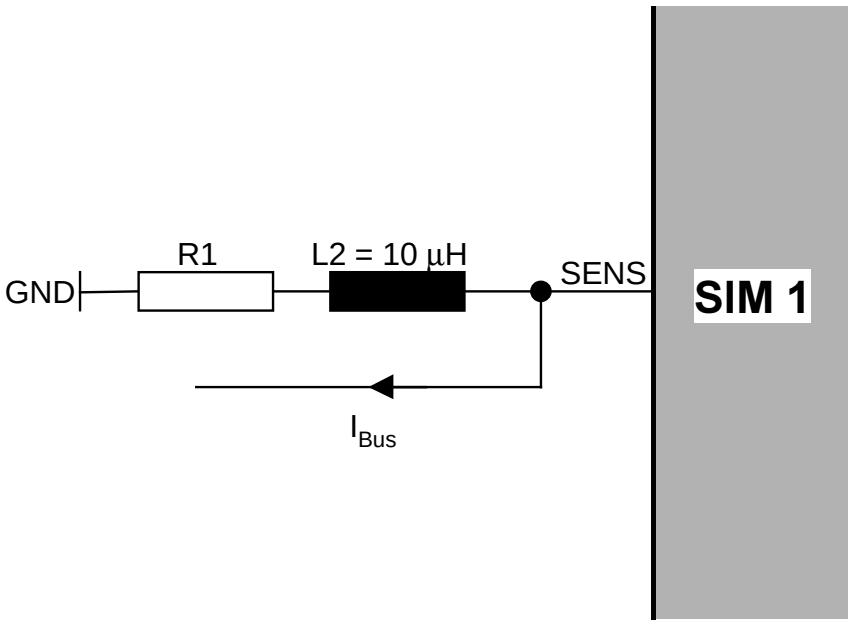
If there are distorted telegrams on an 1158-2 bus segment we recommend checking whether there is an oscillation on the bus and if so perform the described actions.

Appendix 1

Circuitry of the SIM 1 with prevention of potential oscillations

The circuits that are described in the User Description of the SIM 1 as Application Examples should be adjusted as follows:

- Add a coil L2 of 10 µH in series with the resistor R1



The following should be taken into consideration:

- Tolerance of the resistance of the coil: R(L2) <= 0.25 Ω
  Example of such components:
  muRata LQH3C100K04, L2 = 10 µH, R(L2) = 0,44 Ω ± 30 %
  MEC Citec Model 3613, L2 = 10 µH, R(L2) = 0,56 Ω ± 50 %
- R1 + R(L2) = 10 Ω
- The additional tolerance due to R(L2) can be compensated with lower tolerance components for R1, R2 and R_{ref}.

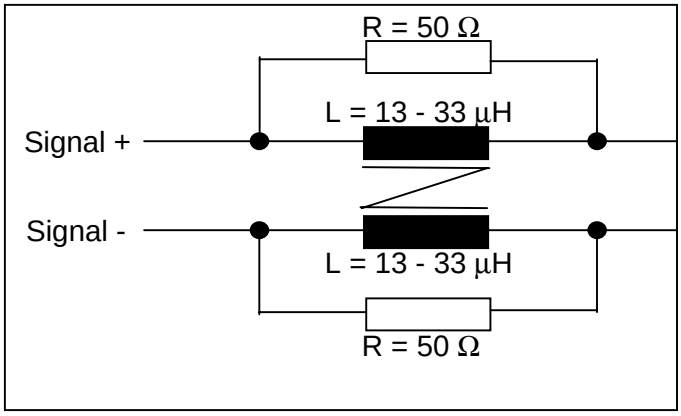
Appendix 2

Steps to avoid oscillations in the area of 250 - 500kHz on a 1158-2 bus segment

1. Avoid having pairs of non-optimised field devices on the bus with a distance in between 10 and 70 m.

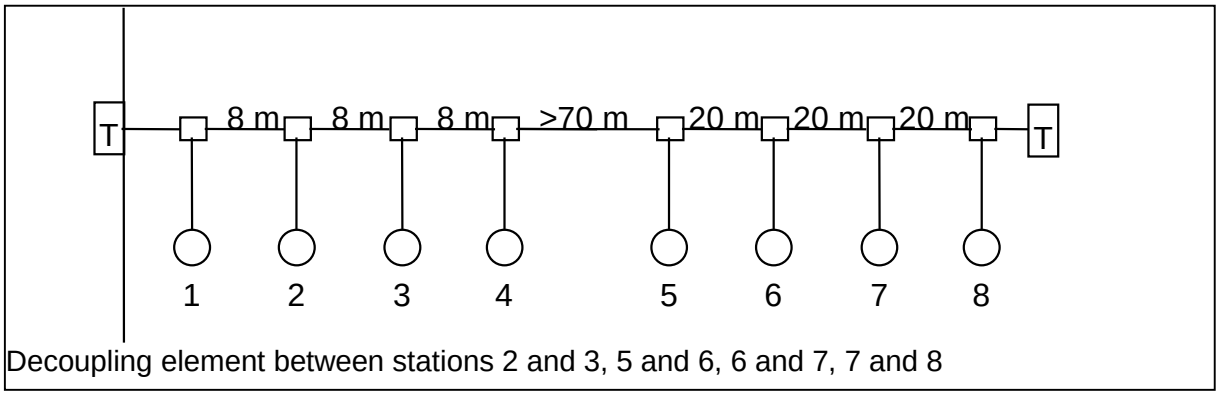
2. If 1. is not possible follow the rule below:

   Include at least one decoupling element between two pairs of not optimised field devices which have a distance between 10 and 70 m.
   The decoupling element is shown below :

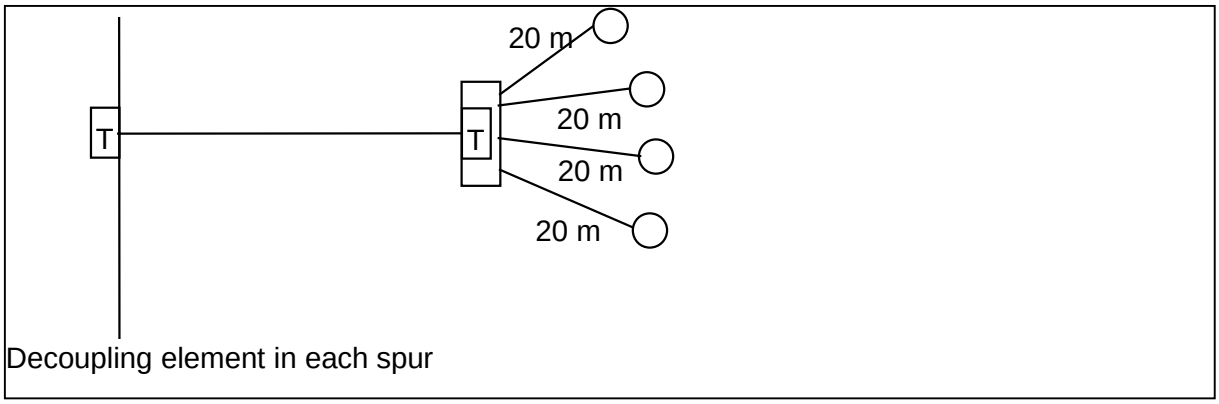


Examples of paired coils:
Siemens Torroidal-Core Inductor B62623-G1-A11
Schaffner Torroidal-Core Inductor RS 512-1/02, RS 612-1/02, RS 514-2/02, RS 614-2/02

Example of a decoupling element:



Decoupling element between stations 2 and 3, 5 and 6, 6 and 7, 7 and 8



Decoupling element in each spur