



# Expansion of transmission distances for process signals

in hazardous areas using optical fibre cables

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Figure 1: The isolating repeater ISpac 9186 makes it possible to configure ring structures or point to point connection for signals

An undisputed trend in process automation is the usage of field devices that provide the user with ever increasing amounts of information. This growth is justified by increasing functionality, as well as, the users desire to monitor the state of the equipment (asset management). There are many examples of this, such as remote I/O systems, operator interfaces, scales, and so on. For years Profibus DP has played a key role in the integration of these field devices into the automation structure, as is clearly demonstrated by the large base installed worldwide. Along with classic transmission using special copper cable, another medium has become established: optical fibre. In

particular, the process automation sector has requirements such as large transmission distances and possible explosion hazards for which optical fibre transmission provides a particularly good solution. The industry has addressed this situation with appropriate developments. However, the user continues to face questions that will be addressed in more detail in the following article. What are the advantages of the transmission of Profibus signals using optical fibre?

The main argument for the use of transmission via glass fibre is the significantly greater transmission distance it has in comparison to copper. Using optical fibre cables, distances of more than 2 km can be covered without a problem, and without having to accept bandwidth limitations along the way. The fact that transmission of Profibus DP with a bandwidth of 1.5 Mbit/s using copper cables reaches its limit after approx. 150 m, demonstrates the superiority of glass fibre. A further advantage is immunity to interference as emitted by frequency converters, or other electrical devices with high electromagnetic emissions.

Transmission using optical fibre, which by its nature provides safe electrical isolation, is, however, also valued by anybody who has had to fight with transmission problems caused by unsatisfactory equipotential bonding related to the screen earthing on the copper cable.

These problems can mostly only be identified with extensive measurements and tests. Lasting rectification and high quality equipotential bonding then often involves extensive effort in terms of personnel and costs.

### What problems and restrictions does transmission using optical fibre involve?

Of course, this technology also has its disadvantages. The biggest concerns when weighing the pros and cons of optical fibre are based on the assumption that the costs are high and the installation complex. A few things must be taken into account when installing optical fibre cable. Along with the generally well known restrictions on the bending radii for optical fibre cables, it must also be noted during laying that limiting parameters for tensile and compressive strain defined by the manufacturer must be observed, otherwise there is a risk of increased attenuation and possible related claims.

Laying and connecting glass fibres requires special equipment and know-how. The usage of pre-assembled and tested cables relieves the user of a large portion of the work. The investment in trainings courses for in-house staff, and the procurement of equipment are only worthwhile for large businesses or projects. However, there are many qualified service providers who can undertake the installation efficiently.

### Costs and benefits

As far as the cost of optical fibre technology are concerned, these must be compared to its benefits. Take for example Profibus DP transmission: for a distance of only a few meters, in the majority of cases a copper cable is preferred over a glass fibre cable. However, the larger the factor distance and transmission bandwidth becomes, the more advantageous glass fibre can become. Modern optical fibre technology based on multi-mode transmission at 660 nm or 850 nm has a very good price-performance ratio.

### Optical fibre cables in hazardous areas

An important aspect of process automation is the usage of devices and data connections in hazardous areas. What this means for the installation and operation of electrical and electronic equipment has been familiar for decades, and is adequately regulated by national and international regulations and standards. The usage of optical fibre cables may initially appear non-critical. After all, how can sparks be produced here? What can heat up excessively during optical fibre transmission?

Investigations by, among others, the PTB (Physikalisch Technische Bundesanstalt) have however, shown that a light source can also become a source of ignition. The fact that there can be large amounts of energy in optical radiation is impressively demonstrated by laser cutting systems. Here, the amount of energy and focussing of the radiation play a crucial role. More information is given on this topic in the article 'Ignition risk due to optical radiation in hazardous areas', page 47 in this magazine.

For transmission using optical fibre conductors, there are three protection concepts of which inherently safe optical radiation (op is) is particularly suitable for optical fibre cable transmission based on its simple installation, and due to the high level of safety. By limiting the radiant intensity or radiant power transmitted, similar to electrical intrinsic safety, an explosive atmosphere cannot be ignited and it is possible to work on the system without shutdown.

Long before the standard IEC EN 60079-28 came into force, R.STAHL developed products for the transmission of Profibus DP signals in hazardous areas based on the principle of inherently safe optical radiation. →



Figure 2: Isolation repeater ISpac 9186 for Profibus or Modbus with optical transmission

To address the requirements of modern communication structures, a new generation of devices for optical fibre transmission has been launched. These include devices for Ethernet transmission, for remote I/Os and operator interfaces, as well as, isolating repeaters ISpac for Profibus DP.

**Profibus DP over optical fibre – the new product generation**

With the new optical fibre isolating repeater ISpac type 9186, R. STAHL is announcing a unique solution that makes it possible to transmit Profibus DP and Modbus signals between hazardous areas in zone 1 and the safe area. The special feature of this optical fibre isolating repeater is that it can be used to build ring structures. These ring structures have the advantage that they provide increased resilience to failure of the data connection in a very effective manner. If there is an open circuit between two apparatus in such a ring, it is possible to switch to the substitute path immediately. The availability of the data connection, and therefore the entire manufacturing plant, is significantly increased as a result.

Along with the ring structure, redundant point-to-point structures or line structures are also possible if required.

The optical fibre isolating repeater ISpac 9186 has a new, unique diagnostics function that continuously analyses the level of the optical signal received. This information is displayed to the user using an LED light bar on the front of the device.

As a result it is very easy to assess the quality of the reception signal without the usage of measuring instruments. If the level received reaches a critical area, the optical fibre isolating repeater signals this state via a floating contact.

This signal makes it possible for the maintenance personnel to detect impending failures in advance, and to rectify the malfunction without installation down time.

To keep the effort for installation and maintenance as low as possible, the interfaces for the data transmission are designed as type of protection intrinsically safe »i« or type of protection inherently safe optical radiation »op is«. This means that both the electrical RS-485 connector and the optical fibre connection can be disconnected and connected at any time under load, and therefore without switching off the laser diode. The usage of inherently safe optical radiation also makes it possible to use the usual optical fibre installation methods, as explosion protection is already provided by the limiting of the optical radiation energy.

The new optical fibre isolating repeater ISpac 9186 makes it possible to transmit Profibus DP, Modbus, HART RS-485 and the R. STAHL Servicebus. It is thus the ideal addition to the remote I/O system IS1 from R. STAHL and significantly expands the possible applications of the system.

The optical fibre isolating repeater ISpac 9186 product family offers a full range of versions for use in zone 1, 2, and the safe area. The optical fibre isolating repeater is a further module in the complete automation solution from R. STAHL.

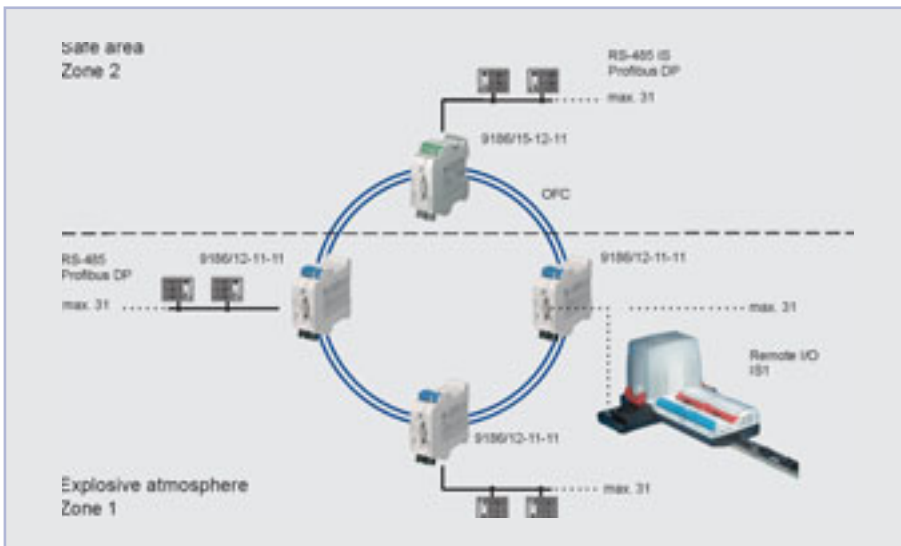


Figure 3: Optical transmission in a ring with structure for Profibus DP



Figure 4: Plug and unplug without risk - with Ex op is