NEK KABEL AS

Handling and Installation Guide for Profibus Cables Marine & Offshore Division

High Performance Cables Since 1913

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The cable installer is also recommended to take cognizance of all environmental issues and comply with laws, by-laws, rules and regulations related to the environment. This shall include but not be limited to avoiding unnecessary felling or damaging of trees, emission of noise & fumes, dust control, proper discharge of effluents, and proper handling of waste and toxic substances in the course of transporting, handling and installing fiber cables.

Purpose & Scope

Profibus comes in four variants, each with a different purpose:

- PROFIBUS DP (Decentralized Peripherals) used to drive sensors and actuators via a central controller. Dataspeed up to 12 Mbit/s with twisted pair cables and fiber optic cables are an option.

- PROFIBUS PA (Process Automation) is used to monitor measuring equipment via a process control system. This Profibus variant is ideal for use in explosive areas (Ex-zone 0 and 1). In the cables flows namely a weak current through the bus lines in an intrinsically safe circuit so that sparks do not occur, even at fault. The con. about this variant is the slow dataspeed at 31,25 kbit/s.

The standards for the Profibus networking are IEC 61158 (Field Busses) and IEC 61784-1 and -2 (previously EN 50170).

This guide is focused on Profibus DP network, which is one of the fastest and most commonly used widespread industrial network.

The Cable

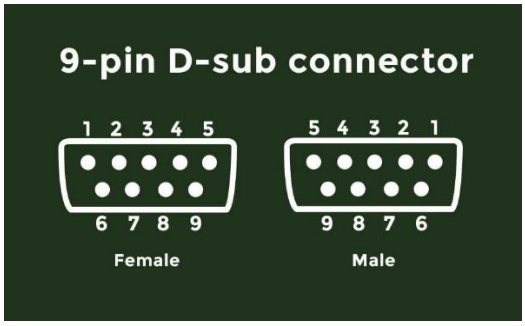
For Profibus networks a shielded AWG 22 or 0.34 mm² twisted pair cable is used. The standard isolation color of a Profibus DP cable is purple, and the two wires in the twisted pair are usually green and red, and below is a typical standard Profibus cable specification:

- Twisted pair with shielding braid.
- Wire gauge: 0.34 mm² or AWG 22.
- Resistance at max 110 Ω/km.
- Capacity at least 30 pF per meter.

Impedance from 35 to 165 Ω at frequencies from 3 to 20 Mhz.

The Connectors

Usually, 9-pin D-sub connectors are used in the end of the cables to connect to the devices (recommended in EN 50170). The 9-pin D-sub connectors are the default Profibus connectors on most components. Here is an overview of the 9 pins in a 9-pin D-sub connector:



1. Remove The Isolation With A Profibus Stripping Tool

The first thing to do is to remove the isolation of the Profibus cable. Use a special Profibus stripping tool, a knife or a wire cutter. It can be difficult to strip the cables correctly with a knife, so that both the shield and the two wires inside are visible.

2. Connecting The Profibus Cable And Connectors

The next thing to do is to lay the Profibus cable in the Profibus connector so that the shield and the wires are connected correct. The connectors have 9 pins, but you will only be using some of them.

Pin #	Function	Description
1	Shield	Shield and functional earth
2	NC	Not in use
3	RxD/TxD-P	Data recieve and transmit (positive)
4	CNTR-P	Control signal to repeater (positive)
5	DGND	Reference potential for +5 volt and data
6	VP	+5 volt for terminating resistors (active termination)
7	NC	Not in use
8	RxD/TxD-N	Data recieve and transmit (negative)
9	CNTR-N	Control signal to repeater (negative)

Although there are altogether 9 pins, for most purposes only pin 3, 5, 6 and 8 will be used.

2 Pins For Data Transmisstion

Pin 3 and pin 8 are used for the data transmission. This is where you will connect the green and the red wire. The green wire is usually the positive or channel A. When you are connecting the Profibus cable you should be connecting the green wire to pin 3. The red wire is considered the negative or channel B. Pin 8 is for the green wire.

Connect the two wires the opposite way or use your own wire colors. As long as you use the same colors in each end of the cables and are consistent. Most Profibus connectors though has a green indicator for where channel A goes and a red indicator for where channel B goes. Using different colors or switching the green and red can cause a lot of confusion.

2 Pins For Active Termination

Pin 5 and pin 6 are used for termination. Please refer to termination of the cables in next section.

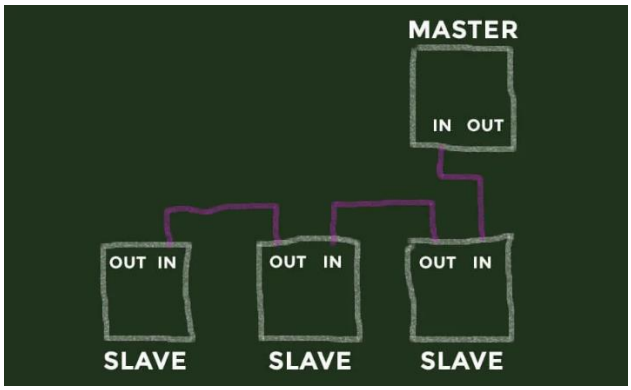
Examples of the standard Profibus connectors:

In And Out Of Profibus Connectors

Most of them have two connections for IN and two connections for OUT.

The OUT is where the network will start. When building network topology, always begin the network from the OUT or output of the first connector. The OUT is also where the network continues. If you have a station connected to the master in a network and you want the network connected to a new slave, you should use OUT.

The IN or the input of the connector is where the “network line” ends. So except from the master, all cables should be connected to IN. When extending the “network line” you should use OUT. Here is how it should look:



Connecting the Profibus cable to the connector should be done with extra caution. Remember, that it is very important not only to connect the wires correct, but also to connect the shield correct and even to strip the wire correct.

Termination Of Profibus Cables

To minimize signal reflections the Profibus cable has to be terminated in the end. Signal reflection occurs when in a signal transmitted by a transmission media, such as copper cable or an optical fiber, some of the signal energy may be reflected back, instead of being passed all the way along the cable to the second end. Just like grounding this is such an issue that wrong termination of the Profibus cables will prevent the bus from working.

A Profibus termination is done by inserting a 220 Ω resistor in each end of the Profibus line. So, insert a 220 Ω resistor in the first and one in the last station. The reason for using a 220 Ω resistor is that the two 220 Ω resistors are connected parallel to each other. The parallel connection of the two resistors make a total resistance of 110 Ω. The loop resistance of the standard Profibus DP cable is 110 Ω/km. Be aware that a standard Profibus PA cable has a loop resistance of 44 Ω/km.

Most Profibus connectors has a termination option. This means it is not required to connect your own resistor manually. The termination in the connector can be activated or deactivated by flipping the switch, usually placed at the top of the connector. This is useful in two ways. First of all it makes termination very easy, since you can make all your connections and then flip the switches where you need to terminate the Profibus cable. The second reason is that troubleshooting becomes easier. Without disconnecting anything it is possible to check if the termination is done correctly.

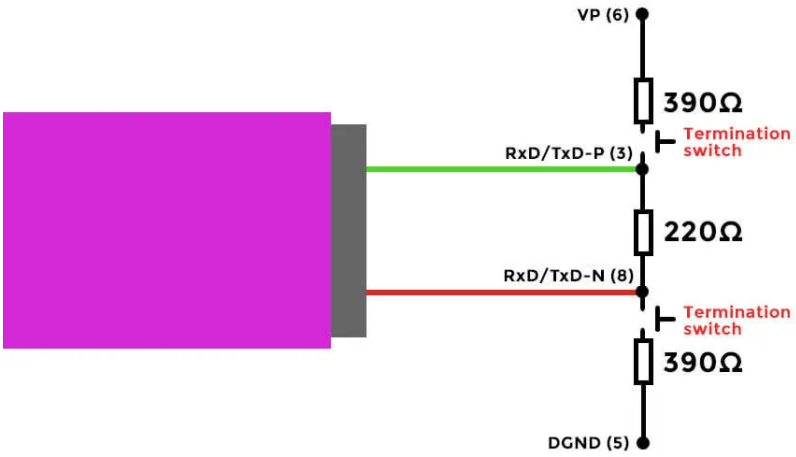
Active Termination In Bus Networks

Profibus uses an extended way of terminating called active termination. This is needed when using very long communication cables. Active termination can be used to increase the line voltage of the bus.

The only difference between normal termination and active termination is that besides the 220 Ω resistor, you also have to connect 5V to the termination (between VP(6) and DGND(5)). This will create a defined ground signal when none of the stations are active. You can make active terminations in three ways:

- In the connector
- In the station
- With a seperate terminator

The reason why this an active termination is that +5 volt is used in the termination. Usually active termination happens when the termination switch on the connector is flipped.



When the microswitch for termination is switched on, the connection to pin 5 and 6 will be made. An active termination will be achieved. Active termination is a voltage regulator that makes sure that there is a constant voltage over the terminating resistor.

Profibus And Grounding

The connection of the shield is crucial to avoid noise. Profibus will not even work if the shields are connected incorrectly. In addition to the shield, it is also important to connect all stations to ground. In machinery sold in the European Union the grounding wire has to be at least a 16 mm² wire. The simple reason for grounding is to make sure all the stations in out installations works (IEC 60204-1). Another reason is to avoid potential differences between stations in the installation. Normally different power supplies are used in each station, and this alone can create a potential difference. If the shield is connected to two stations with a difference in their potential, a current will flow in the shield and that will make some noises.

Profibus Addressing

Before powering on the Profibus network, assign an address to each of the stations. The addresses go from 0 til 125. The address of a station can be set in several ways depending on the specifications of the station:

- Via a DIP-switch or digit wheel
- Via. the display
- In the software by using master class 2.
- 1 or 3 (micro switch)
- 1 or 2 (microswitch)

Structure of the Profibus addresses (unwritten rules of addressing)

Low addresses are reserved for Master Class 1 & 2 (addresses: 0,1,2) often default addresses.

Do not use the addresses 124 & 125, since some slaves uses these as default addresses.

The address 126 is reserved for service.

New addresses are only in use after a reboot of the system (OFF/ON). This does not apply to addressing via. Master Class 2)!

What Is The Transmission Speed Or Baudrate In Profibus?

The baudrate or the transmission speed is the speed of the whole network. All the stations in a Profibus network has to run at the same transmission speed to be able to communicate. The default baudrate for your Profibus network is set in Master Class 1 and can be between 9.6kbit/s and 12Mbit/s. The speed of your Profibus will influence how long your cables can be. Some stations may even run a a maximum baudrate of 9.6kbit/s. This means that the used baudrate in your Profibus network can only be at maximum 9.6kbit/s.

The baudrate can be set in the following ways:

- DIP-switch on the station
- In a display
- Autoselect

Faster transmission speed also shortens the length of cables or segments. A segment is defined as the stations or devices between two Profibus repeaters. Profibus repeaters works by strengthening the signal, so the network can be extended. Up to 32 (31 and a repeater) stations can be in one segment. After 32 stations you would need another repeater to continue the bus line. One Profibus network can have a maximum of 126 stations.

When using repeater ,you have to terminate two times. You have to terminate the Profibus cable going into (IN) the repeater. But you also have to terminate at the beginning of the continuing Profibus cable going out of the repeater (OUT).