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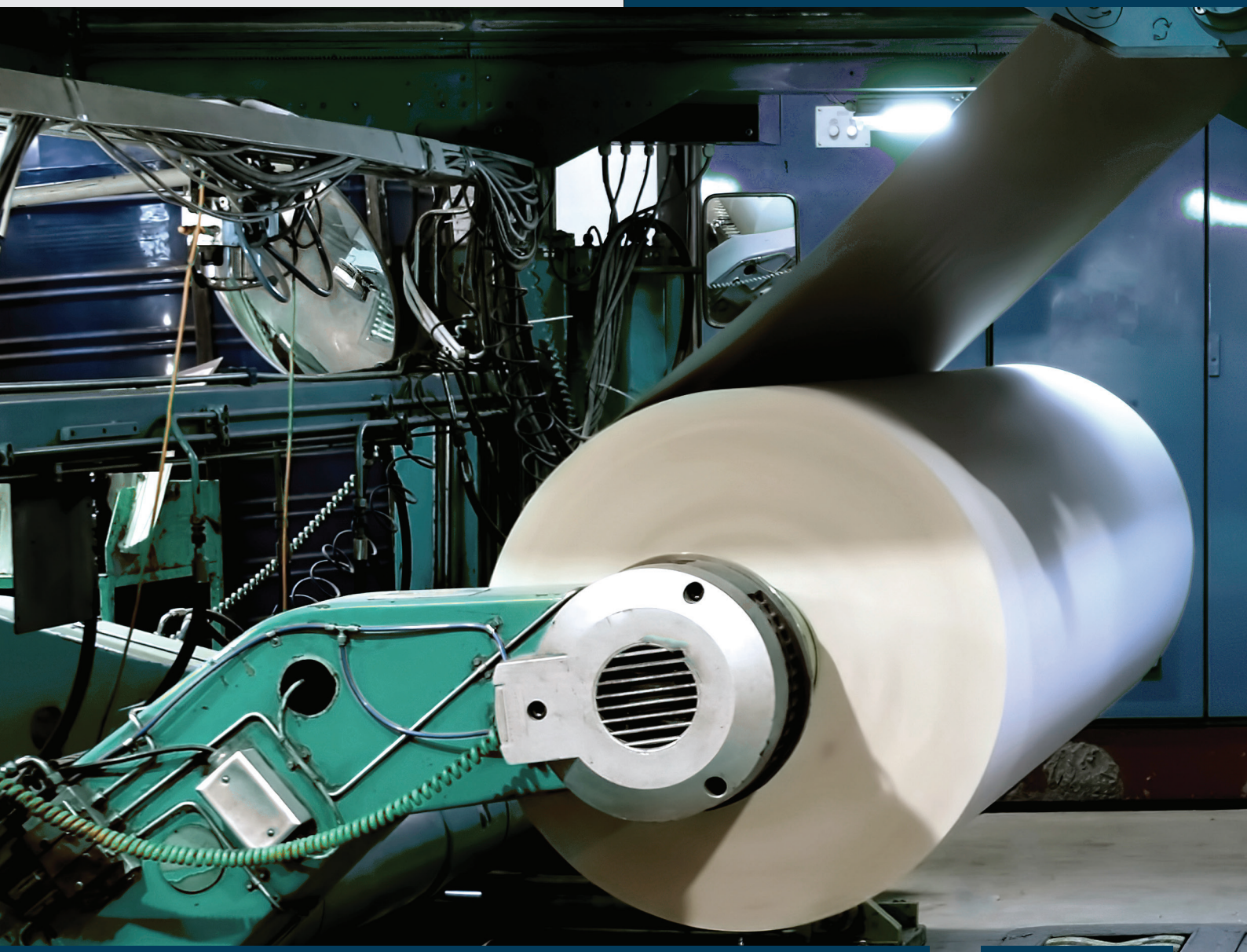
Diagnostics



PROFIBUS DP

PROFIBUS PA

10 costly PROFIBUS mistakes you need to stop making

Discover the mistakes that lead to unhealthy industrial networks, engineer call-outs and production downtime

Introduction

PROFIBUS continues to be the leading choice for Fieldbus communication. Despite the rising popularity of Industrial Ethernet, the industry's reliance on PROFIBUS remains evident, even for new installations. With over 65 million devices installed to date, PROFIBUS is not going away anytime soon.

But just because PROFIBUS has been around for some time, it doesn't guarantee that you'll always know how to address problems that arise. Maybe you're more familiar with another industrial network. Or maybe your site is now running multiple protocols, and with so many tasks on the table, leaving little time to educate your team on how to minimize PROFIBUS downtime. This is a common challenge faced by many.

To simplify the process and empower you with practical solutions, Anybus Diagnostics has developed this comprehensive guide highlighting the most common mistakes made by PROFIBUS field technicians. It's full of practical knowledge based on our years of experience in the field. Many solutions are relatively quick to adopt. Others may require some investment upfront but will save you considerable money in the long run.

This guide will give you a greater understanding of PROFIBUS, enabling you to reduce downtime and gain greater control of your network.

Happy reading!

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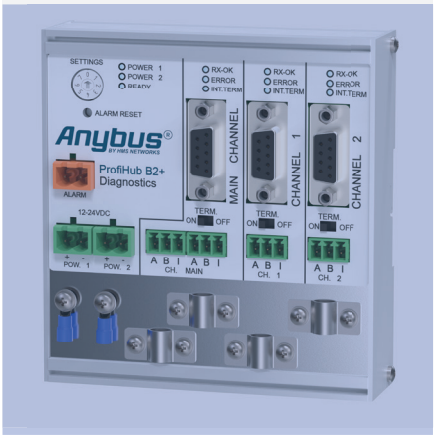
MISTAKE 1:
Not stocking essential spare parts



Prepare for the inevitable

PROFIBUS can and will suffer from hardware problems from time to time. In fact, hardware problems are the single biggest cause of network communication faults. Therefore, be prepared for the inevitable by making sure you have - at all times - a good stock of essential spare parts such as:

- **Connectors**
- **Cables**
- **Terminators**
- **Hubs**
- **Repeaters**
- **Devices**

Never bank on getting your spare parts quickly, even from your most reliable supplier. Lead times can suddenly lengthen, especially during exceptional circumstances like a natural disaster or an economic downturn.

Protecting the entire daisy chain

Having spare parts to hand is particularly important if you have a linear, daisy chain topology. This configuration, which is most common with PROFIBUS DP but also found in PROFIBUS PA networks, is basically a fault sensitive network. In other words, when one part of it is down, all of it is down.

Troubleshooting at a moment's notice

You should also have one or more troubleshooting tools in stock to diagnose any connection problems. Having a device that is dedicated to assessing the health of your industrial network and discovering any faults is a must-have tool for network technicians.

Essential troubleshooting tools

There are various troubleshooting tools that are handy to have nearby, but you should have these at least:

- **PROFIBUS diagnostic tool**
- **Oscilloscope**
- **Network mapping tool**
- **Device with Class 2 Master Functionality**

By promptly troubleshooting network issues, you can minimize or even prevent downtime. Combining troubleshooting tools with a well-stocked inventory of spare parts will prove to be much more cost-effective than downtime.

TRUE STORY

A warehouse was having problems with its PROFIBUS network. The entire system kept dropping out. The engineer eventually traced it to a broken repeater.

Fortunately, this particular engineer always carried spare parts in his car (maybe he was a former boy scout). He dashed off to the car, fetched a replacement repeater and swapped it for the broken one.

Just as well because waiting for the replacement part to arrive from their usual supplier would have taken around 12 hours.

The cost of downtime for this warehouse is €3,500/hour, so his foresight saved the company around €42,000.

MISTAKE 2:
Using fast connectors with flexible cables

The popularity of flexible cables

Flexible cables are becoming increasingly popular in manufacturing and process settings, where automation is being introduced at a pace, thanks to Industry 4.0.

The constant movement of automated applications such as robotics or conveyors puts a severe strain on non-flexible cables since they can't withstand repetitive motion or constant bending. So, if flex cabling is the answer for transferring the main source of power to automated applications, what about the connectors?

Flexible cables and fast connectors don't mix

One of the most common fast connectors still widely used by PROFIBUS networks, especially in IP20 environments, is the DB9 connector. This fast connector, which has the smallest footprint of all D-Subminiature connectors, is great for creating high transmission speeds. However, never use this or other fast connectors with flexible cables.

Cutting to the chase

The problem with fast connectors is that their housing contains insulation displacement blades, and these can pierce or cut right through the copper strands of a flexible cable.

As you know, damaged strands will lead to overheating, wire pull-out and eventually network failure, which is not something you want to experience.

Therefore, if you're using flexible cables in your network, make sure you select compression-type connectors rather than fast connectors.

Match the connector to the cable

The advantage of compression connectors is that they won't break or cut the fine strands of copper that run through flex cables. There are several types of connectors to choose from (including DB9 connectors with cage clamps and screw terminals). Which one you choose depends largely on whether your cables are flat or round, so first check the specifications.

When flex isn't mandatory

Would you rather replace the cable than the connector? Maybe flexible cable isn't necessary for your application. In that case, replace the cabling with one that is compatible with fast connectors.

TRUE STORY

A food industry company faced persistent downtime issues despite having a well-designed and correctly installed network.

During on-the-spot troubleshooting using a mobile monitoring tool, an engineer identified the connectors as the likely cause of the problem. It turned out that that company was using fast-connect connectors with flexible cables.

After changing the fast connectors to compression connectors, the company hasn't experienced any downtime.

ComBricks


Head Station
RDY ETH
SF IOF
USB SD
MENU NAV
SD CARD
1CH-PA-NEX
RDY
RX ER
POW HWE
AMP NWER
SCOPE
PROFI BUS
PA
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MISTAKE 3:
Not using the proper tools for assembling cables

Saving money now to spend more later

Did you know that 90% of all PROFIBUS problems occur during the design and installation stage, with poor connections being the primary culprit? That's a sobering thought.

What is it about connections that causes so many issues? One of the answers is failing to recognize a false economy when you see it.

A PROFIBUS stripping tool is the right tool

There's a saying that you should always use the right tool for the job. That common-sense advice applies to a wide range of situations. Including assembling PROFIBUS cables.

And the right tool for assembling PROFIBUS cables is a PROFIBUS cable stripping tool. This relatively inexpensive tool is perfect for stripping your PROFIBUS cables when preparing them for connectors.

Improving your speed and precision

Unlike generic cable strippers, PROFIBUS stripping tools do a much neater job because they're designed especially for PROFIBUS cables.

That's why many manufacturers include one with their cabling solutions.

It will let you determine the exact stripping length, then cut through the outer layer cleanly and sharply, leaving the shield, foil and wires visible and intact.

A small outlay reaps many rewards

Of course, some field technicians choose to ignore sound advice from time to time (well, we're all human).

But if you want to speed up your work, produce precise stripping results each and every time, and avoid the problems associated with bad connections, you'll make this small investment.

TRUE STORY

A visiting engineer went to a new PROFIBUS installation that wasn't working correctly.

After some initial troubleshooting, he discovered that the installer hadn't used a stripping tool to cut five cables and attach them to their connectors.

The reason? He didn't want to splash out €150 on a tool that he didn't think was necessary.

Unfortunately, that decision turned out to be a false economy. The bill for the engineer's call-out was €1,500. Ouch!

MISTAKE 4:
Not installing piggyback connectors on every segment of the bus

Avoidable downtime

If you want a healthy and robust PROFIBUS network, analyzing the physical layer is crucial. But what if there's no measuring point available for the measurement tool?

This is a problem that support engineers come across time and time again. When they come on site, they have to either force an unplanned stoppage or wait for a scheduled break in production.

Either way, the lack of measuring points costs the company time and money.

A simple solution

Fortunately, preventing this problem is relatively simple. All you need to do is create an extra measuring point on each bus segment by installing a piggyback (PG) connector. These connectors allow you to plug in a measurement tool, such as Profi Trace, without interrupting production or interfering with the network.

Measuring without interference

Measurement tools are invaluable to field technicians. Without any interference to your network, they identify typical PROFIBUS failures such as:

- **noise**
- **reflections**
- **voltage drops**
- **termination problems**
- **wire breaks**
- **configuration faults**

The results can then be exported to detailed reports for further analysis.

TRUE STORY

PROFIBUS Installation Guidelines recommend three measuring points on a network: at the beginning, middle, and end.

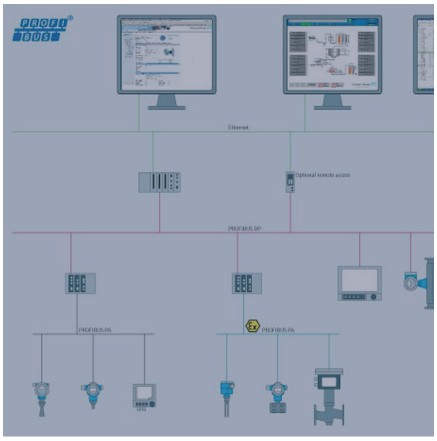
However, for a much more detailed and accurate level of diagnostics, install a measuring point on every segment or behind each repeater.

For the cost of a few extra PG connectors and a troubleshooting tool, you'll be able to prevent unplanned downtime and reduce the time you spend troubleshooting.

ProfiTrace


BY HMS NETWORKS
User Manual
ProfiTrace
PROFIBUS Combi-Analyzer on USB
PROFIBUS
NET
PROFIBUS
ULTRA

MISTAKE 5:
Not having accurate network drawings



A roadmap for troubleshooting

Some faults on a PROFIBUS network can be quickly identified with just the assigned address of the faulty device and a measurement tool.

However, many companies lack this crucial information due to the absence of accurate network drawings that depict the arrangement of nodes, devices, and connections in relation to each other. This oversight complicates a simple task.

Not knowing where to start

PROFUBUS networks can be configured in many different ways, and as the network expands, the configurations tend to become more complex.

Without an accurate network drawing, pinpointing the problematic section of the network is difficult.

This lack of insight means you don't know where to connect your measurement tool and start troubleshooting.

Carrying out a topology scan

The best (and easiest) way to map out your network is to get an expert PROFIBUS engineer to do it on your behalf.

They can use tools like ProfiTrace to do a topology scan and build up an accurate picture of the network using the oscilloscope function. This identifies all your nodes, devices and connections, plus their types and addresses.

Putting your network on the map

Performing a topology scan yourself is possible, but it requires a good understanding of mapping tools.

If you lack confidence in this area, it's best to seek assistance from experts who usually offer network mapping as part of their network certification service.

By obtaining a detailed network topology that accurately depicts your network's configuration, you or a support engineer can quickly identify network faults, resulting in significant time and cost savings for your company.

TRUE STORY

It's not uncommon for support engineers to spend a whole day at a customer's site physically mapping networks and looking for measuring points before their work can even begin—work that sometimes only takes a few minutes.

Termination issues are a good example, as they can usually be found within a minute or two of connecting a measurement tool if the specific address is known.

Yet, all too often, the engineer's and company's time is wasted looking for IP addresses due to the unavailability of accurate network drawings.

MISTAKE 6:
Lack of training on PROFIBUS

The consequences of insufficient training

Design and installation are key failure points for the majority of PROFIBUS networks. The reason these two stages produce so many failures is exactly the same: lack of training.

The knowledge and expertise of those involved in network design and installation directly impacts the network's performance once it's up and running. In fact, poor design and installation can prevent a PROFIBUS network from even being commissioned.

Don't overlook the basics

Here's a simple example of a problem that is caused by poor design: placing power cables in close proximity to network cables without shielding. This simple (and common) mistake can lead to electrical disturbances. That, in turn, can lead to voltage overloads, voltage spikes, sags, and transients.

Yet too many of those tasked with designing and installing a PROFIBUS network do not understand basic aspects such as electromagnetic interference, messages, voltages, and wave signals.

Virtual help will get you only so far

Another challenge posed by inadequate training is the inability to troubleshoot efficiently when problems arise, leading to unnecessary and unplanned downtime.

While virtual engineers like Delphi can point you in the right direction, they won't be able to solve all your network problems. Certainly not the more complex (and costly) ones.

Become your own PROFIBUS expert

There comes a point where possessing the knowledge to address most problems internally becomes essential for maintaining a reliable network.

If you receive targeted training by PROFIBUS experts, you'll be able to:

- **prevent common design and installation mistakes that can lead to downtime**
- **drastically reduce the time it takes to find network faults**
- **gain control over your own installation**
- **make the most of this advanced technology**

It's pretty clear. The benefits of proper training far outweigh its cost.

TRUE STORY

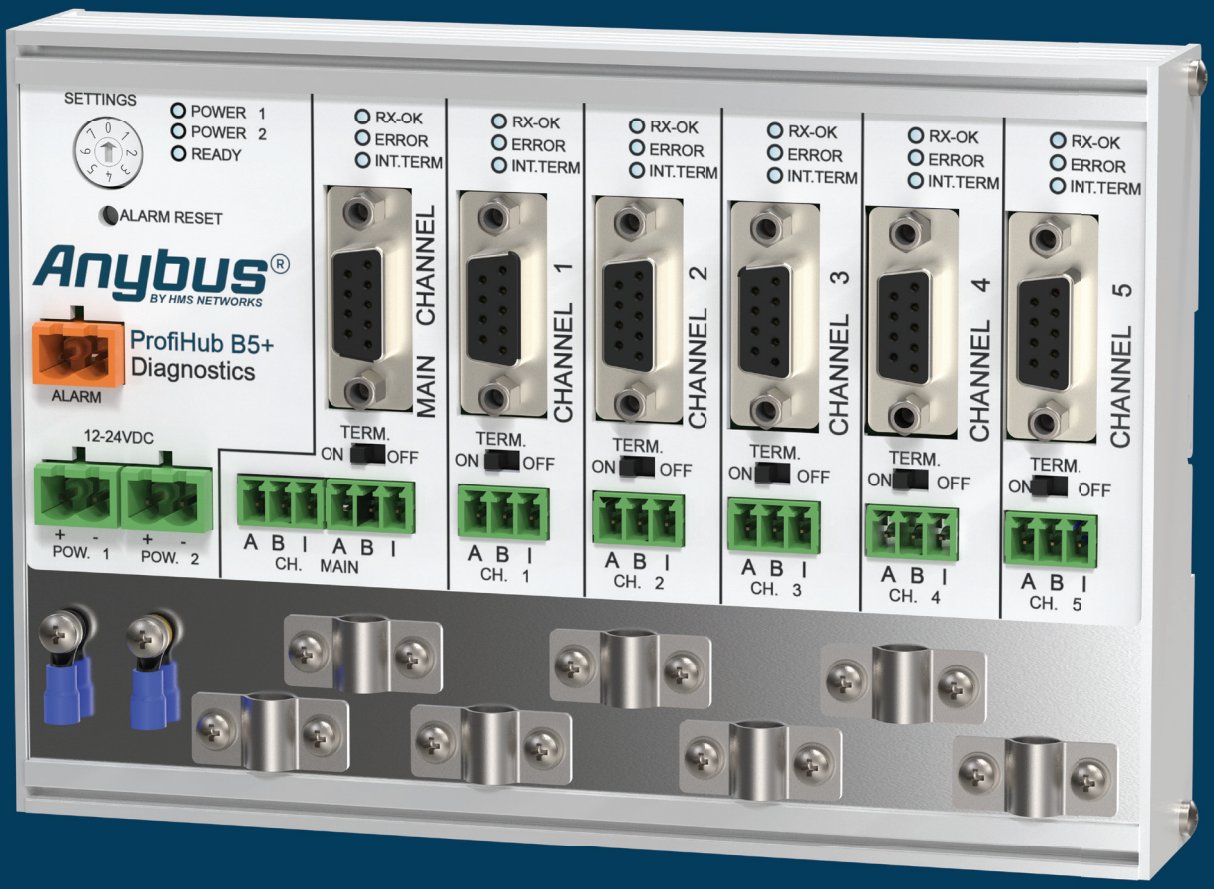
Across all businesses, the average cost per hour of downtime is $260,000 (The Aberdeen 2016 Report: Maintaining Virtual System Uptime in Today's Transforming IT Infrastructure, 2016).

Yet having a technician or engineer on site who is trained on PROFIBUS could save companies hours or even days of downtime every year.

Not to mention the cost of calling out a support engineer whenever there's an issue that needs fixing.

Just think how happy your budget manager would be.

ProfiHub


SETTINGS
POWER 1
POWER 2
READY
ALARM RESET
Anybus®
BY HMS NETWORKS
ProfiHub B5+
Diagnostics
ALARM
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MISTAKE 7:
Ignoring PI installation guidelines

Don't disregard best practice

Guidelines exist in all walks of life for good reason. They streamline a particular process, ensure compliance with regulations, or achieve a certain level of quality.

One thing they all have in common is that they set out best practices. And that is exactly what the PI Installation Guidelines do. So why do so many technicians ignore them?

After all, PROFIBUS is an advanced piece of technology. It can't be compared to installing a bathroom cabinet or an app on your phone.

Thinking you know it all

Let's say that you're running your network at 6 Mbps. You set your cable length per segment at 200 m, thinking it's the standard length. Bad move. This would result in signal loss.

If you had checked the Installation Guidelines, you would have known that 100 m is the maximum cable length per segment for high speed transmission rates.

Accept invaluable, expert advice

PI's Installation Guidelines provide crucial information and practical guidance on how to plan, install and commission PROFIBUS wiring properly.

Following these guidelines will undoubtedly make your network more robust. They give you:

- **best advice on designing the network**
- **instructions for grounding and shielding**
- **insight into the maximum cable lengths for each transmission speed**
- **standards and guidance on the commissioning stage**

Basically, they tell you everything you need to know about installing a PROFIBUS network successfully. So, grab yourself a copy.

TRUE STORY

A multi-million-euro project at a power plant was canceled because the PROFIBUS network didn't work. The reason? The design was inadequate, and the installation was subpar. The company had employed untrained PROFIBUS electricians who didn't follow the advice outlined in the PI installation guideline and instead treated the installation like standard electrical cabling. This disregard for the guidelines created a perfect storm of problems, ultimately leading to the project's cancellation.

Long story short - read the manual.

MISTAKE 8:
Giving each segment more than two terminations

Getting a good signal

All PROFIBUS networks use bus terminations in order to get a good signal transmission. The type of bus termination you use depends on your network's application:

- **PROFIBUS RS485: a bus termination is made up of three resistors**
- **PROFIBUS MBP (PA): a bus termination has a resistor and a capacitor**

So far, it seems straightforward. However, terminations can become problematic if not handled carefully.

Too much of a good thing

Bus terminations are often switched on and off as devices are added to or removed from the various segments of a network.

This can result in too many bus terminations in one segment. And that can corrupt signals throughout your entire network and cause it to malfunction.

Just two terminations per segment

Remember the saying, "Too many cooks spoil the broth"? Well, in this case, "too many terminations spoil the signal."

It is best practice to limit the number of terminations to a maximum of two per segment: one at the beginning and one at the end.

Opt for active terminations

Here's another good tip: use active rather than normal terminations, especially if the last device in the chain gets powered off or disconnected frequently.

Active terminations have their own 24VDC power supply. So, even if a device before the active termination is powered off, the termination remains active.

These simple measures prevent almost all termination issues.

TRUE STORY

Support engineers will tell you that too many terminations on a PROFIBUS network is a common cause of signal loss.

They see evidence of companies turning on the termination of the latest device that's been added to the network, forgetting to turn off the termination of the previous device installed.

This issue can be avoided by utilizing active terminations.

MISTAKE 9:
Not taking measurements frequently or regularly

Getting into good habits

Do you only think about measuring your PROFIBUS network when issues arise? If so, it's time to change your approach. Regular measurements and monitoring are essential for the following reasons:

- **spot degradation on your network**
- **detect faulty devices or connections**
- **check the overall signal quality**
- **reduce engineer call-outs**
- **prevent unforeseen downtime**

By conducting measurements before and after making changes to your network, you can quickly identify and address any problems before they escalate.

The benefits of permanent monitoring

While regular monitoring is highly recommended, the most effective method is undoubtedly permanent monitoring.

Permanent monitoring will alert you if any faults arise or are likely to arise. This feature is essential if you have one or more critical networks.

There are a variety of permanent monitoring tools on the market. The very best include:

- **Simultaneous monitoring**
- **Several repeater modules**
- **Bus monitor and oscilloscope**
- **Ethernet connection**

Note, however, that permanent monitoring is not permitted on some industrial networks for security reasons since it involves connecting to an IT network.

If that's the case with your network, the best way for you to prevent any degradation is to carry out regular measurements.

TRUE STORY

An automotive company runs measurement reports every month. They print the report on transparent paper and lay it on top of the previous month's report, so they can easily spot any changes.

If they spot any differences, they investigate the issue during their next scheduled downtime. Simple, yet highly effective.

MISTAKE 10:
Not having permanent monitoring tools on site

Being told that something is wrong

If you have a car, you know how important the warning lights on your dashboard are. If the brake pad monitoring light turns orange, you know your brake pads are wearing out. This is your handy reminder to schedule a service and have them replaced.

Likewise, if you see the red temperature warning light come on, you know you have to stop driving immediately and switch off the engine to allow it to cool. And then get your car to the nearest garage.

Preventing unforeseen downtime

Permanent monitoring tools work on the same principle as a car's dashboard. They keep an eye on your network's performance, and they warn you if something is either wrong or about to go wrong.

A tool like ComBricks will do all the monitoring for you. There is nothing else for you to do after installation unless you get an orange or red light.

A handy warning light system

An orange light tells you that something is about to go wrong in your network but it's still running for now, so plan a maintenance check.

A red light tells you that your network is (about to go) down and that you have to take immediate action.

Permanent monitoring tools are ideal for preventative maintenance, but they're also great at spotting intermittent faults, especially if they occur in the middle of the night or happen for just fractions of a second. Their return on investment is significant.

TRUE STORY

A paper and pulp company was experiencing intermittent faults on its network. These faults were happening for just a fraction of a second. Nevertheless, they were sufficient to bring down the entire network.

And each time the network crashed, it would take an hour to get it up and running again. It was not only puzzling but also expensive, as one hour of downtime costs this company €100,000.

After two weeks, the company turned to a support engineer, who advised installing a demo of ComBricks to analyze events. Sure enough, the tool captured the intermittent faults. It turned out that a connector was coming loose every time a train went past the factory.

This was enough to briefly drop the network. Armed with that information, the company promptly changed the connector. And to ensure that something similar would never happen again, they installed a permanent monitoring system.

Introducing Anybus Diagnostics

Anybus Diagnostics is a leading provider of diagnostic and monitoring solutions for the industrial automation market. They specialize in developing and manufacturing high-quality automation products for PROFIBUS, PROFINET, Industrial Ethernet, EtherNet/IP, and EtherCAT networks. Their products, including ProfiTrace, ProfiHub, ComBricks, Osiris, Mercury, and EtherTAP, are highly recognized and used by customers worldwide.

To ensure engineers are equipped with the skills needed to design, install, maintain, and troubleshoot industrial networks effectively, Anybus Diagnostics offers a certified PROFIBUS and PROFINET Competence and Training Centre. The Anybus Diagnostics Academy has already certified over 4,000 engineers to implement and maintain their PROFINET and PROFIBUS networks to the highest standards available.

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