

10 COSTLY PROFIBUS MISTAKES YOU NEED TO STOP MAKING

eBOOK

DISCOVER THE BLUNDERS THAT LEAD TO UNHEALTHY INDUSTRIAL NETWORKS, ENGINEER CALL-OUTS AND UNNECESSARY PRODUCTION DOWNTIME

Introduction

PROFIBUS is still number one when it comes to Fieldbus communication.

True, it may gradually be losing market share to **Industrial Ethernet**, but there's plenty of evidence that industry is not turning its back on this successful technology just yet, even for new installations. More than 65 million devices have been installed to date. **PROFIBUS** is not going away anytime soon.

But just because **PROFIBUS** has been around for some time, it doesn't mean that you're always going to know what to do if a problem arises. 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, you don't always have the time to educate your team (or yourself) in ways to minimize downtime.

It's a common scenario.

So that is why Procentec has decided to produce this guide to 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 up front but will save you considerable money in the long run.

I really hope this guide gives you a greater understanding of **PROFIBUS**. More importantly, I hope it results in reduced downtime and more control of your network.

Elmer Vis
Manager Procentec Academy

Top 10 Blunders

- BLUNDER 1: Not Stocking Essential Spare Parts

- BLUNDER 2: Using Fast Connectors

- BLUNDER 3: Not Using the Proper Tools for Assembling Cables

- BLUNDER 4: Not Installing Piggyback Connectors on Every Segment of the Bus

- BLUNDER 5: Not Having Accurate Network Drawings

- BLUNDER 6: Lack of Training on PROFIBUS

- BLUNDER 7: Ignoring PI Installation Guidelines

- BLUNDER 8: Giving Each Segment More Than Two Terminations

- BLUNDER 9: Not Doing Measurements Frequently or Regularly

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- Are you a PROFIBUS Technician wanting to upskill?

BLUNDER 1: NOT STOCKING ESSENTIAL SPARE PARTS

BOWING TO 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 **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
- Class 2 Master Functionality

Being able to troubleshoot the moment there's a problem with your network is the best way to minimize or even prevent downtime.

Couple that with having a good store of spare parts, and the cost of these essential extras will far outweigh the cost of 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.

BLUNDER 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 rounded, 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.



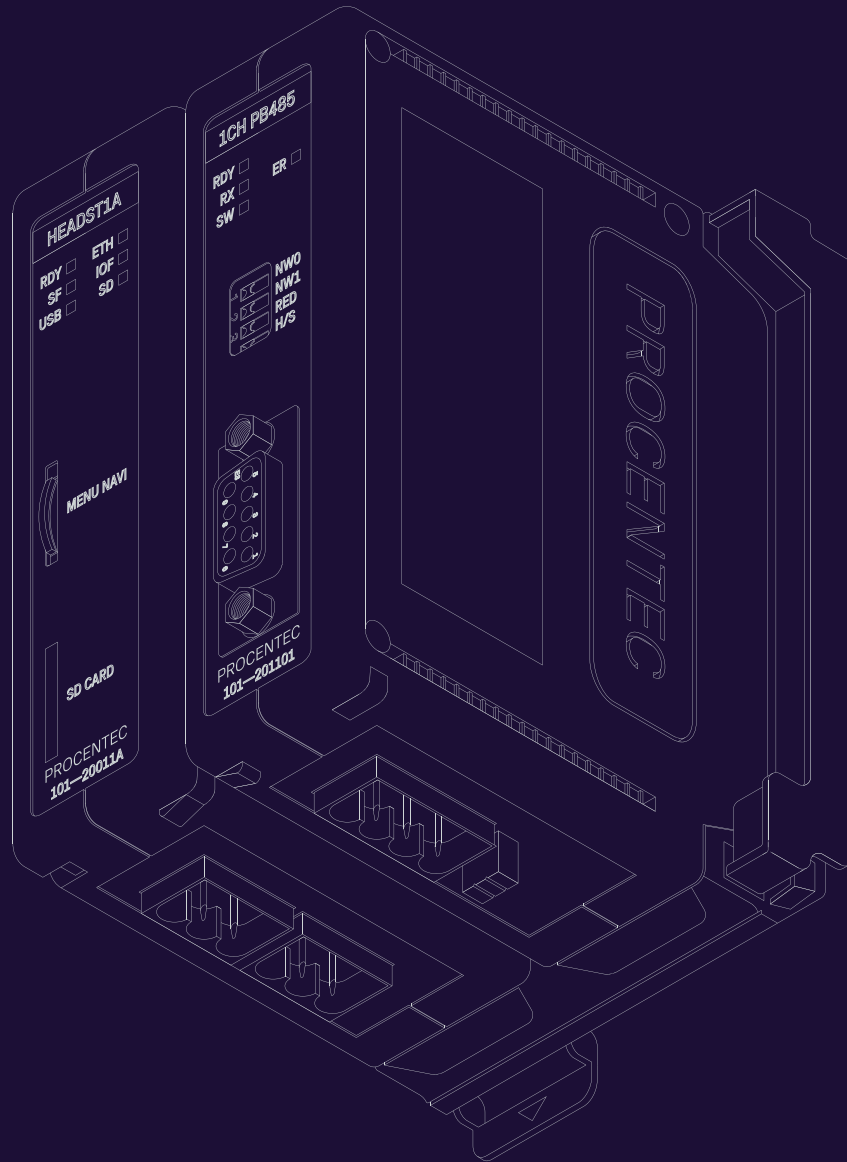
TRUE STORY.

A company in the food industry was experiencing continuous downtime, even though its network was well designed and had been installed correctly.

The engineer plugged in a mobile monitoring tool to do some on-the-spot troubleshooting, which identified the connectors as the likely cause of the problem.

It turned out that that company was using fast-connect connectors with flexible cable. After changing the connectors, the company hasn't experienced any downtime since.

ComBricks



BLUNDER 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 at the design and installation stage? And that bad connections top the list? That's a sobering thought.

What is it about connections that cause so many problems? One of the answers is not recognizing 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 tools for the job. That common-sense advice applies to a wide range of situations. Including assembling cables.

And the right tool for assembling 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!

BLUNDER 4: NOT INSTALLING PIGGYBACK CONNECTORS ON EVERY SEGMENT OF THE BUS

UNNECESSARY 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 enforce 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

Preventing this problem is pretty simple, however. All you need to do is create an extra measuring point on each segment of the bus. And you do that by installing a piggyback (PG) connector.

These female connectors allow you to plug in a measurement tool, such as ProfiTrace, without interrupting production or intruding on your 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.



DID YOU KNOW?

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, have 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.

ProfitTrace



BLUNDER 5: NOT HAVING ACCURATE NETWORK DRAWINGS

A ROADMAP FOR TROUBLESHOOTING

Some faults on a PROFIBUS network can be found very quickly. All you need is the assigned address of the faulty device and a measurement tool. And therein lies the problem.

Many companies do not know the addresses because they do not have a drawing that shows how the various nodes, devices and connections are arranged in relation to each other.

NOT KNOWING WHERE TO START

The trouble is, there are many ways to configure a PROFIBUS network. What's more, some configurations are quite complex, especially if the network has been expanding over a number of years.

All this means that, without a network drawing, it can be difficult to figure out which part of the network is having the issue. That lack of insight means you don't know where to plug in 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 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

You can do this scan yourself, of course, although you do need to have sufficient knowledge of the mapping tools.

If you're not confident, it's best to leave it to the experts. Many offer network mapping as part of their network certification service.

Once you have a drawing of your network's configuration, you or a support engineer can find network faults very quickly, saving your company considerable time and money.



DID YOU KNOW?

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. These can usually be found within a minute or two of plugging in a measurement tool if the specific address is known.

Yet, much too often, the engineer's time (and the company's time) is wasted looking for the address because no accurate drawings are available.

And time, as we all know, costs money.

BLUNDER 6:

LACK OF TRAINING ON PROFIBUS

THE CONSEQUENCES OF POOR TRAINING

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

The knowledge of those designing and installing a network has a direct impact on the health of the network 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

The other problem that lack of training causes is being unable to troubleshoot quickly when a problem does arise. And that can lead to unnecessary and/or unplanned downtime.

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

BECOME YOUR OWN PROFIBUS EXPERT

There comes a time when having the knowledge to solve the bulk of problems yourself is essential for a smooth-running 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.



DID YOU KNOW?

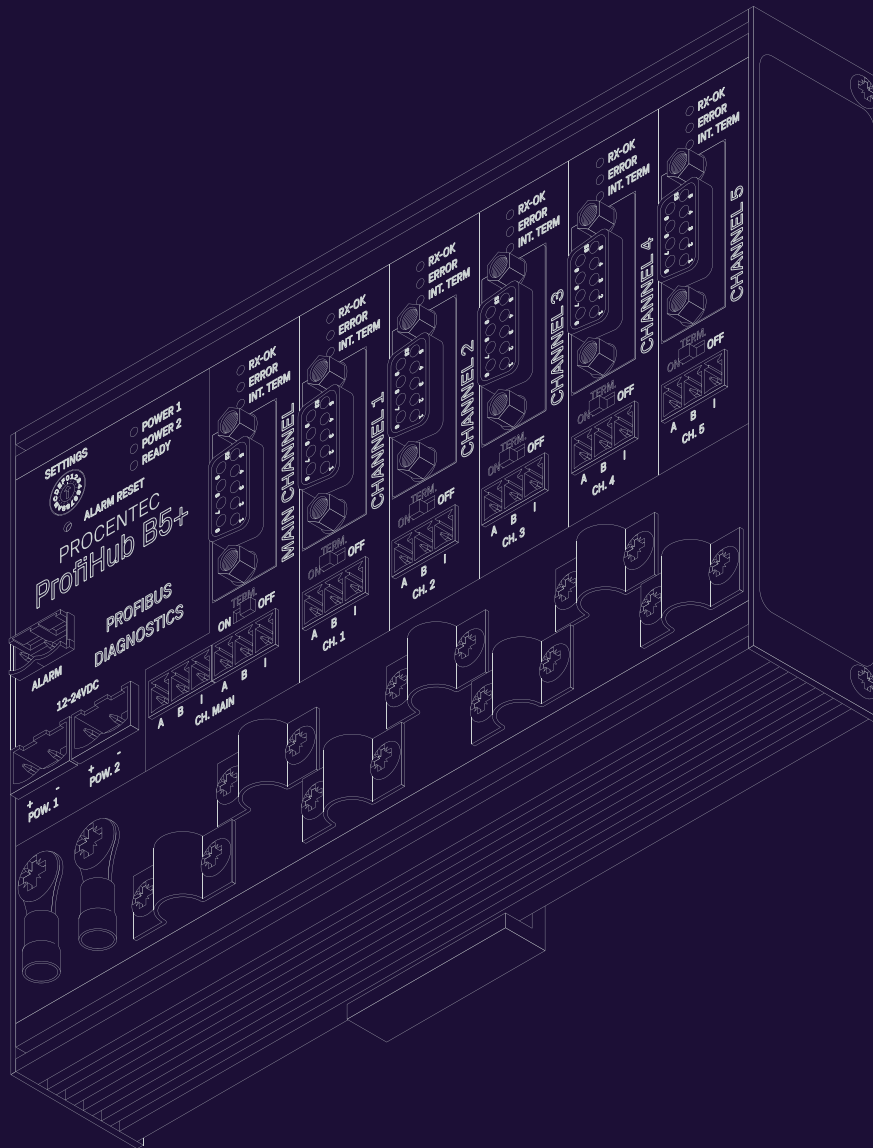
Across all businesses, the average cost per hour of downtime is \$260,000 (The Aberdeen 2016 Report: Maintaining Virtual System Uptime in Today's Transforming IT Infrastructure, 2016).

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



BLUNDER 7: IGNORING PI INSTALLATION GUIDELINES

DON'T DISREGARD BEST PRACTICE

Let's face it. Guidelines exist in all walks of life for good reason. To 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 practice. 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

The Installation Guidelines (produced by **PROFIBUS** International) provide information and practical guidance on how to plan, install and commission **PROFIBUS** wiring properly.

There is no doubt that following these guidelines will help to 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 cancelled because the network wouldn't work. The reason? The design was unacceptable, and the installation was third-rate.

The company had used untrained **PROFIBUS** electricians to install the network, which they treated as if they were installing normal electrical cabling.

It was the perfect storm.

BLUNDER 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, so simple. But you can run into trouble with terminations if you're not careful.

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

You may have heard the saying 'Too many cooks spoil the broth'. Well, 'too many terminations spoil the signal'.

Best practice is to use no more than two terminations per segment: one at the start and one at the end.

GO 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 wouldn't happen with active terminations.

BLUNDER 9:

NOT DOING MEASUREMENTS FREQUENTLY OR REGULARLY

GETTING INTO GOOD HABITS

Is performing a measurement on your PROFIBUS network something you think about only when you have an issue? If so, you may want to change your routine.

Regular monitoring and reporting help you to:

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

If you do a measurement before and after you make a change to your network, you will quickly spot any problems. You can then fix them before they become a real issue.

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.

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

If they do spot any changes, they can schedule that into their planned maintenance and fix the problem during their scheduled downtime.

BLUNDER 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. Just an 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 analyse 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 was able to change the connector. And to ensure that something similar would never happen again, they installed a permanent monitoring system.

About Procentec

Procentec is a global leader in diagnostic and monitoring solutions for the Industrial Automation Market. It develops and manufactures automation products for PROFIBUS, PROFINET, Industrial Ethernet, EtherNet/IP and EtherCAT . Some of its products are the most recognized solutions on the market today, including ProfiTrace, ProfiHub, ComBricks, Osiris, Mercury and EtherTAP.

It is also a certified PROFIBUS and PROFINET Competence and Training Centre. The Procentec Academy has certified over 4,000 engineers to implement and maintain their PROFINET and PROFIBUS networks to the highest standards available. In addition, experienced consultants assist on projects around the world, advising on architecture, engineering, training and commissioning.

Are you a PROFIBUS technician wanting to upskill?

The Procentec Academy makes it easy for you to develop your PROFIBUS skills and increase your confidence. It provides a range of training opportunities for all needs and budgets, from three-hour online tutoring to in-depth certification courses. You'll get:

- Access to experts with years of experience in the field
- Digestible online learning bites with clear instructions (Bytesize Training)
- Internationally recognized certificates of training (for certified courses)
- Technical theory combined with practical exercises
- High quality training customized for any industry

If you work every day with PROFIBUS, or if you supervise those that do, you'll find these professional courses an excellent investment. You'll know how to implement and make use of a widely used automation technology. More importantly, you can ensure your company won't have to face unexpected, costly downtime due to avoidable mistakes.

DISCOVER OUR COURSES

DISCLAIMER

The content provided in this guide has been created with the greatest of care. However, we cannot guarantee that it is free from errors or omission. Therefore, any action you take on the basis of this content is strictly at your own risk. You should always seek expert advice before making any changes to your network.

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