White Paper WP73

Decentralization made easy.

Selective current distribution and protection directly in the field.

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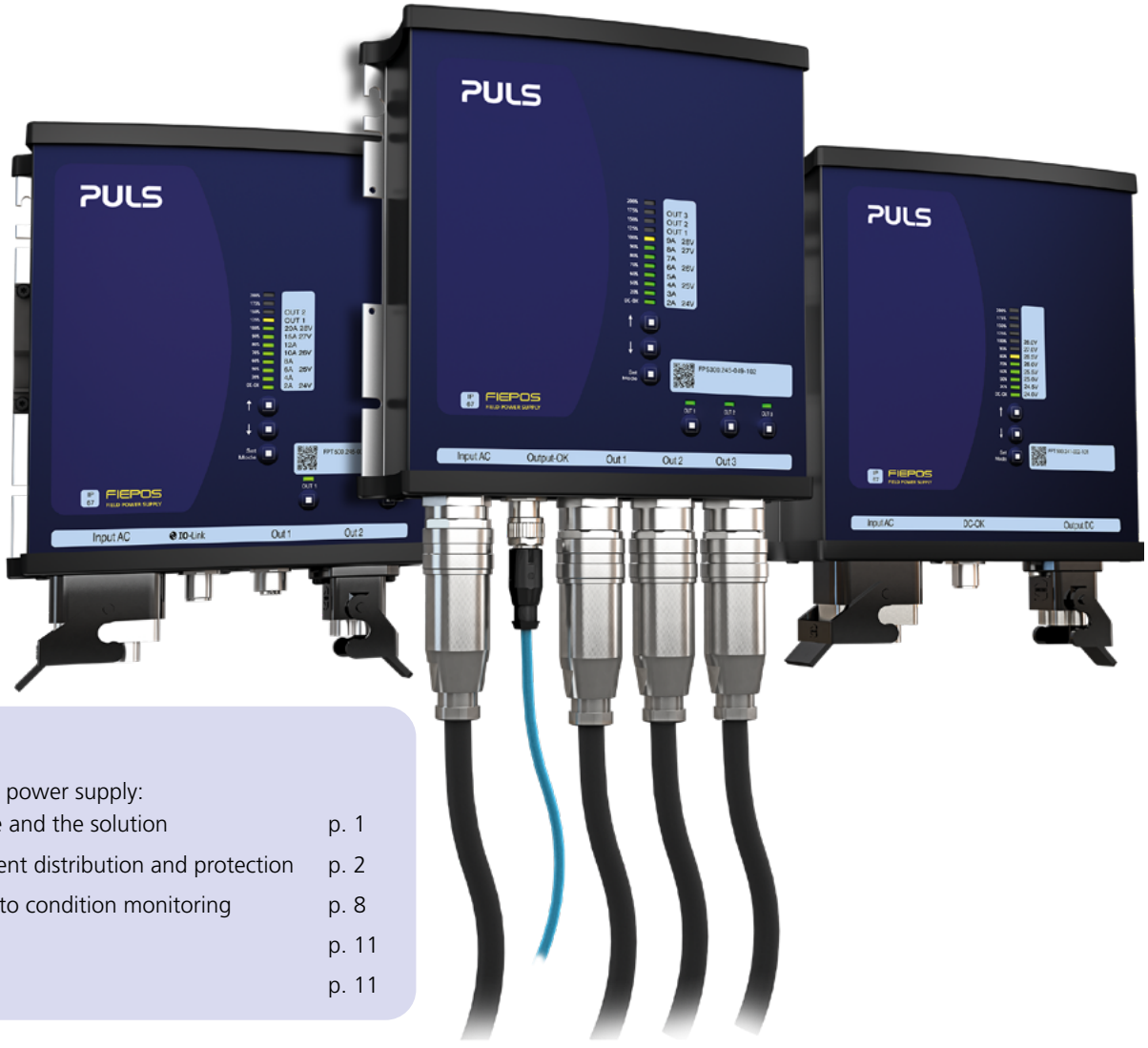
The demand for flexible, modular systems is shaping the world of systems and mechanical engineering. Decentralization of the system components has proven to be an important factor in this growing trend. It speeds up the system planning process, simplifies maintenance and facilitates straightforward expansion. For many companies, however, the power supply has been an obstacle on the path to consistent decentralization. In particular, where functions such as selective current distribution, protection and condition monitoring needs to be implemented, all while providing maximum reliability and uptime. This White Paper will explain how you can achieve these requirements with an all-in-one power supply.



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1. Decentralized power supply: The challenge and the solution

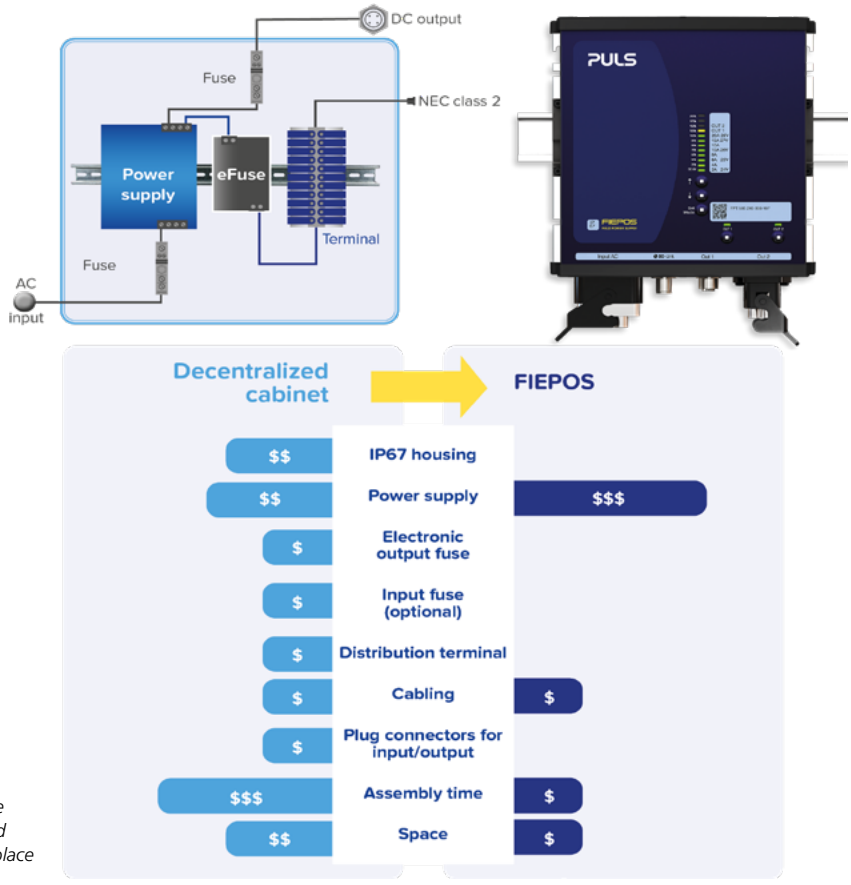
The challenge:
One conventional solution is to design a system which can be mounted directly on the machine or the system. The power supply and other standard components such as electronic fuses, communication terminals, distributor blocks or switches are relocated from the central control cabinet to smaller enclosures directly in the field. In addition, a higher IP rating offering protection against dust and moisture is required for installation outside the central cabinet. Housing with protection class IP54, IP65 or IP67 is needed, depending on the application.

The result is a small, decentralized on-site cabinet for which the individual components have to be selected, ordered, stored, assembled and installed, which is very time consuming. Usually there is very little space available for control systems, so finding a location for this cabinet can create problems. Engineers often need to be creative, positioning the cabinets above or below the system making access sometimes difficult for service technicians.

The PULS all-in-one solution:
PULS now offers a compact all-in-one solution for decentralized applications. The new FIEPOS Field power supply family is based on a modular platform developed for use outside the cabinet. All units are based on either 1-phase or 3-phase with either a 300W or 500W rating. All devices in the FIEPOS family provide 120% power continuously (up to +45°C) and 200% for 5s. This makes them suitable for starting demanding loads.

With a housing size of only 182 x 183 x 57mm (WxHxD), they can be installed even in applications where space is at a premium. The units can be mounted via DIN-rail or mounted in place using a variety of mounting holes.

The FIEPOS product family has two versions; the Basic series with one DC output and the eFused series with up to four current-limited DC outputs to ensure easy, selective current distribution, protection and monitoring directly in the field, with no need for any further accessories, or costly enclosures.



Graphic 1: FIEPOS switch-mode power supplies can be attached directly to the machine and replace complex, decentralized control cabinets.

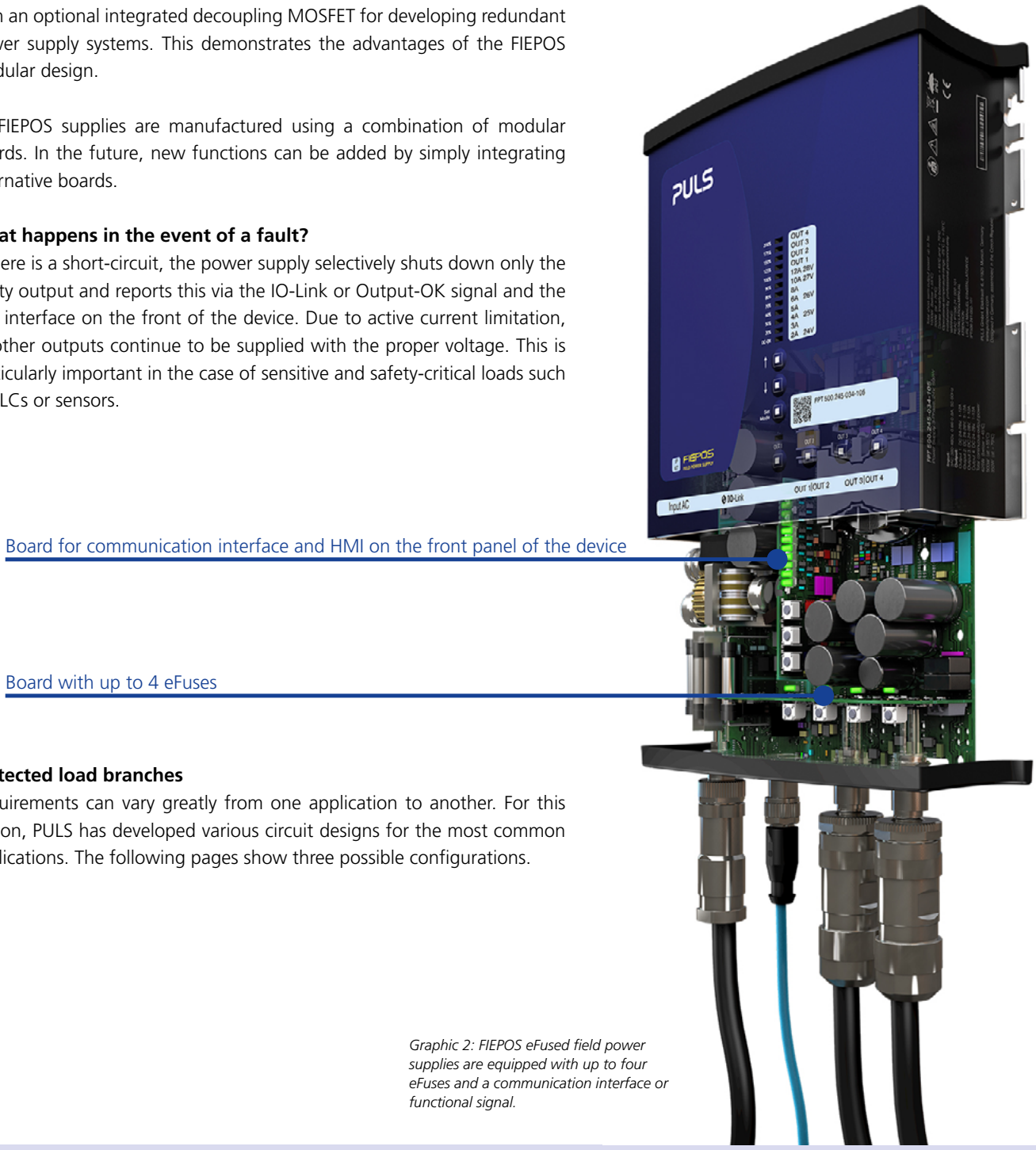
2. Selective current distribution and protection

The FIEPOS power supplies in the eFused series offer an alternative to power supplies which are protected either by means of an external electronic four-channel protection module, four external fuses or circuit breakers. Due to selective current distribution, the eFused versions are well suited for simultaneously supplying electromechanical loads (e.g. motors) and sensitive loads such as controls or sensors via a decentralized, fused power supply.

This is achieved by up to four electronic fuses integrated into the eFused versions. In the place of the eFused module, the Basic versions are equipped with an optional integrated decoupling MOSFET for developing redundant power supply systems. This demonstrates the advantages of the FIEPOS modular design.

All FIEPOS supplies are manufactured using a combination of modular boards. In the future, new functions can be added by simply integrating alternative boards.

What happens in the event of a fault?
If there is a short-circuit, the power supply selectively shuts down only the faulty output and reports this via the IO-Link or Output-OK signal and the LED interface on the front of the device. Due to active current limitation, all other outputs continue to be supplied with the proper voltage. This is particularly important in the case of sensitive and safety-critical loads such as PLCs or sensors.



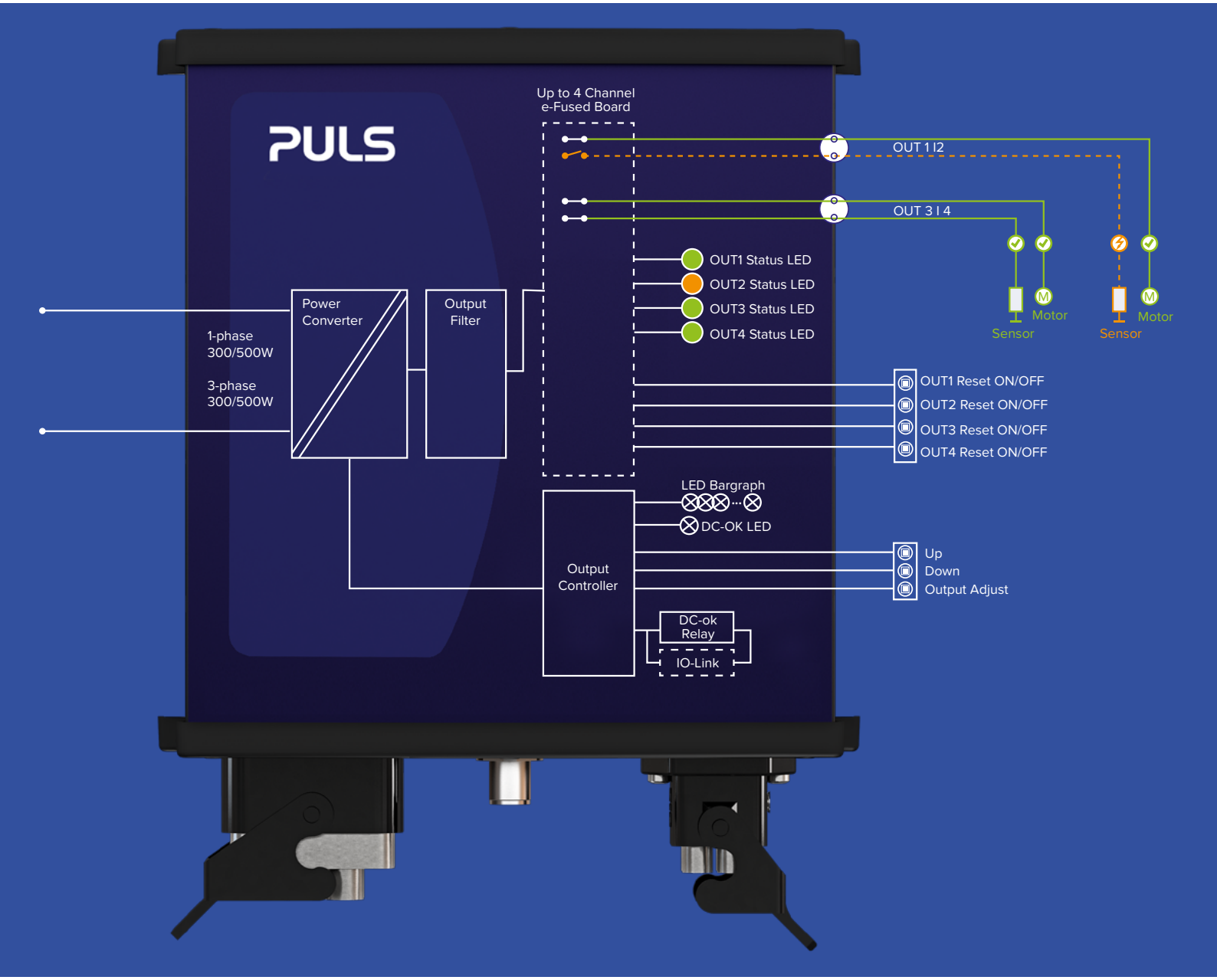
Graphic 2: FIEPOS eFused field power supplies are equipped with up to four eFuses and a communication interface or functional signal.

Protected load branches
Requirements can vary greatly from one application to another. For this reason, PULS has developed various circuit designs for the most common applications. The following pages show three possible configurations.

Option 1: Two outputs - Four load branches

This configuration allows up to four separate load branches with two outputs. For this solution, PULS offers three eFused models with an output power of 300W or 500W.

With these models, two separate electric circuits per output can be achieved. This allows sensors and actuators to be independent of each other. If one sensor load branch fails due to a fault, the other three load branches continue to be supplied with power. The fault is indicated via IO-Link and the status LED on the front of the device. The communications and LED status allows maintenance to be performed quickly and efficiently. The tripped channel is reset using the pushbutton on the front of the device or alternatively, via IO-Link.

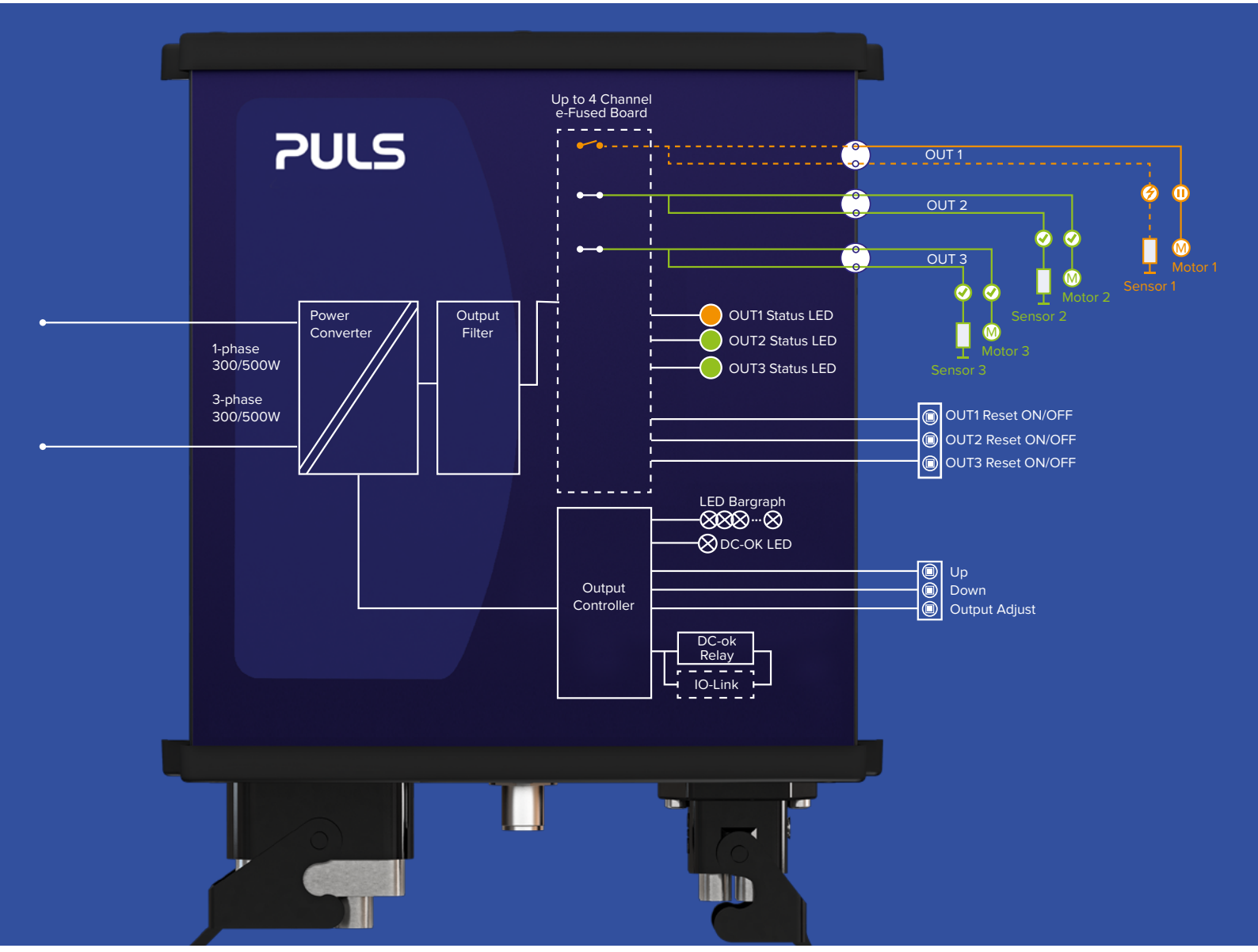


FIEPOS models optimized for this solution:	Power	Input Connector	Communication	Current limited load branches	Output 1 Connector	Output 2 Connector	Output 3 Connector	Output 4 Connector	IP class	Details
FPT500.245-034-105	500W	M12-S	IO-Link	4	M12-L	M12-L	-	-	IP67	Each output with 2 current-limited load branches.
FPT500.245-018-103	500W	M12-S	IO-Link	4	7/8"	7/8"	-	-	IP67	Each output with 2 current-limited load branches.
FPS300.245-047-103	300W	7/8"	IO-Link	4	7/8"	7/8"	-	-	IP67	Each output with 2 current-limited load branches.

Option 2: Three outputs - Three load branches.

These options allow up to three separate and individually protected load branches with one power supply for several sensors and actuators with power via each load branch.

If a sensor connected to output 1 fails, the electric circuit is open. All sensors and actuators connected to the faulty output are no longer supplied with power. The fault is indicated via IO-Link and the status LED on the front of the device. Outputs 2 and 3 remain unaffected by this fault, and the power to these outputs is maintained.

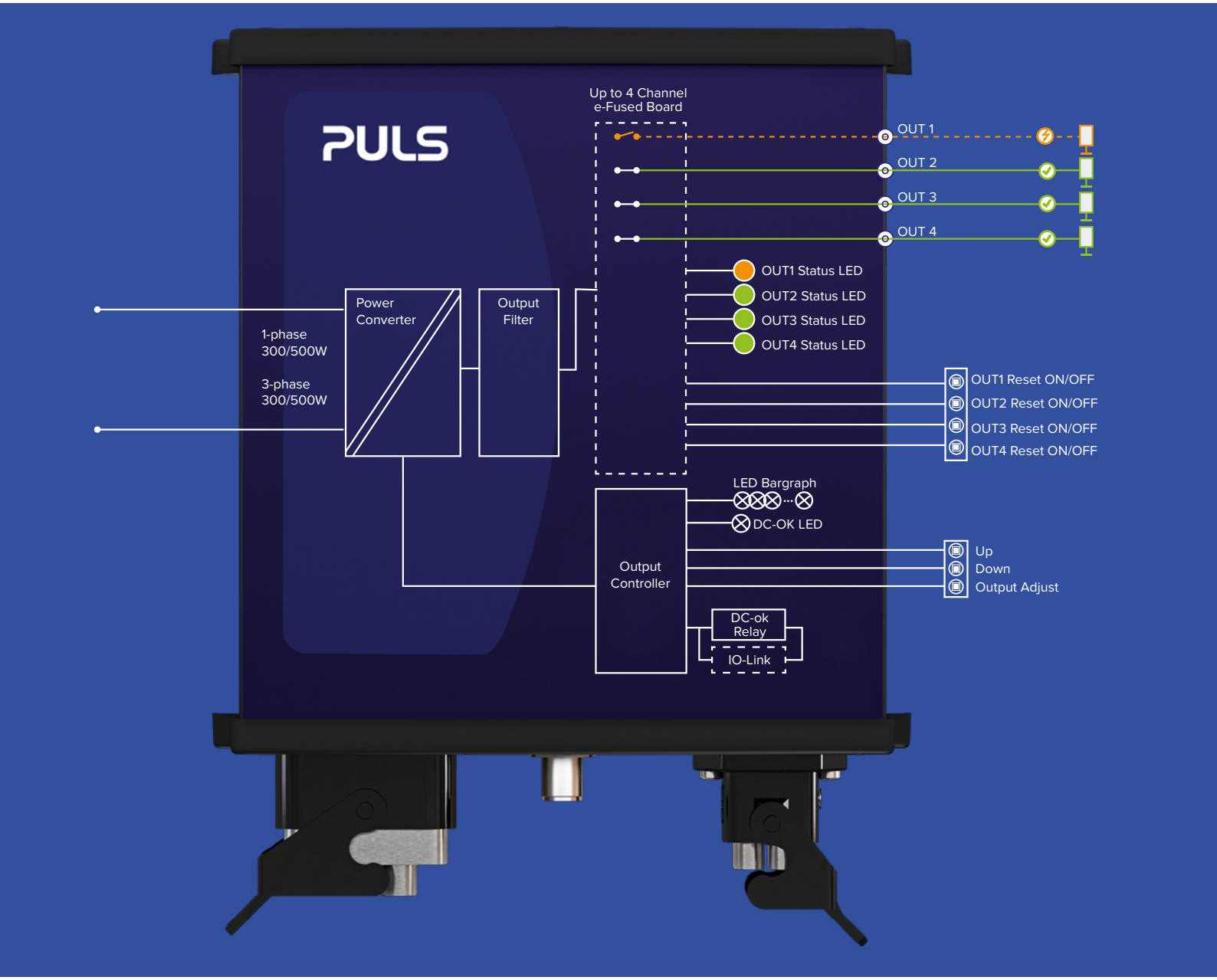


FIEPOS models optimized for this solution:	Power	Input Connector	Communication	Current-limited load branches	Output 1 Connector	Output 2 Connector	Output 3 Connector	Output 4 Connector	IP class
FPT500.245-020-101	500W	M12-S	IO-Link	3	7/8“	7/8“	7/8“	-	IP67
FPT500.245-020-102	500W	M12-S	Output-OK	3	7/8“	7/8“	7/8“	-	IP67
FPT500.245-024-104	500W	7/8“	IO-Link	3	M12-L	M12-L	M12-L	-	IP67
FPH500.245-049-102	500W	7/8“	Output-OK	3	7/8“	7/8“	7/8“	-	IP67
FPH500.245-024-103	500W	7/8“	IO-Link	3	7/8“	7/8“	-	-	IP67
FPH500.245-047-104	500W	7/8“	Output-OK	4	7/8“	7/8“	7/8“	-	IP67
FPS300.245-049-102	300W	7/8“	Output-OK	3	7/8“	7/8“	7/8“	-	IP67

Option 3: Four outputs - Four NEC Class 2 load branches

A power source with limited power may be necessary for applications operated in North America. For this reason, the maximum wattage of FIEPOS model FPT300.246-042-101 meets the NEC Class 2 requirements. Up to four load branches can be set directly on the front of the device or on the versions with integrated IO-Link interface, they can also be set remotely.

In the case of an overload, the current is limited to ensure that the maximum power of 100W defined for NEC Class 2 is not exceeded. The other NEC Class 2 load branches remain unaffected by the fault on the first output.

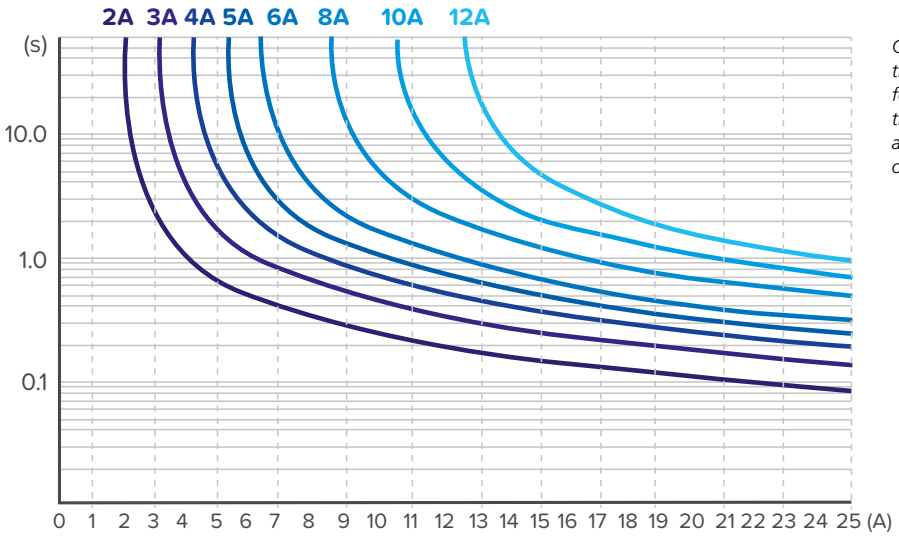


FIEPOS models optimized for this solution:	Power	Input Connector	Communication	Current-limited load branches	Output 1 Connector	Output 2 Connector	Output 3 Connector	Output 4 Connector	IP class	Details
FPT300.246-042-103	300W	HAN Q5/0	Output-OK	4	M12-A	M12-A	M12-A	M12-A	IP67	NEC CLASS 2

Further information on the eFused series

Tripping characteristic

The tripping current for each individual output can be set via the buttons on the front panel of the device. A different characteristic curve applies in each case, depending on the set tripping current. If the tripping current is set to 4A, the output allows 1.25 times the nominal current (5A) for a 2 second duration and then switches off. See the diagram below for further details.



Graphic 5: The diagram shows the characteristic curves that form the basis for shutting down the outputs. A different curve applies in each case, depending on the set tripping current.

Prioritized protection through selectivity function

The eFused power supplies have an integrated selectivity function which allows prioritized protection of sensitive loads. Output 1 of the four-channel eFused device FPT300.246-042-101 has the highest priority, output 4 the lowest. Therefore, a sensitive, safety or system critical load such as a PLC, is best supplied via output 1. If the overall current is exceeded, the supply switches off the outputs with the lowest priority first.

Activation of the outputs is also staggered and are switched on in 100ms increments and according to their priority.

3. Condition monitoring

Monitor your application any time, anywhere.
Digitalization has led to a high priority being placed on a constant central condition monitoring system. Seamless networking and communication between the various system components allows comprehensive analysis of their status and early detection of anomalies in the system. In this manner, preventative and cost-effective maintenance can be carried out, reducing system downtime to a minimum.
But this data can also be used to see the utilization on the current application or a strategic decision such as to expand the system?

In both cases, the information provided by the power supply plays a key role. The power supply is at the heart of the system and allows conclusions to be drawn about its overall conditions. FIEPOS eFused power supplies can be easily integrated into an existing condition monitoring system, providing status data in various ways.

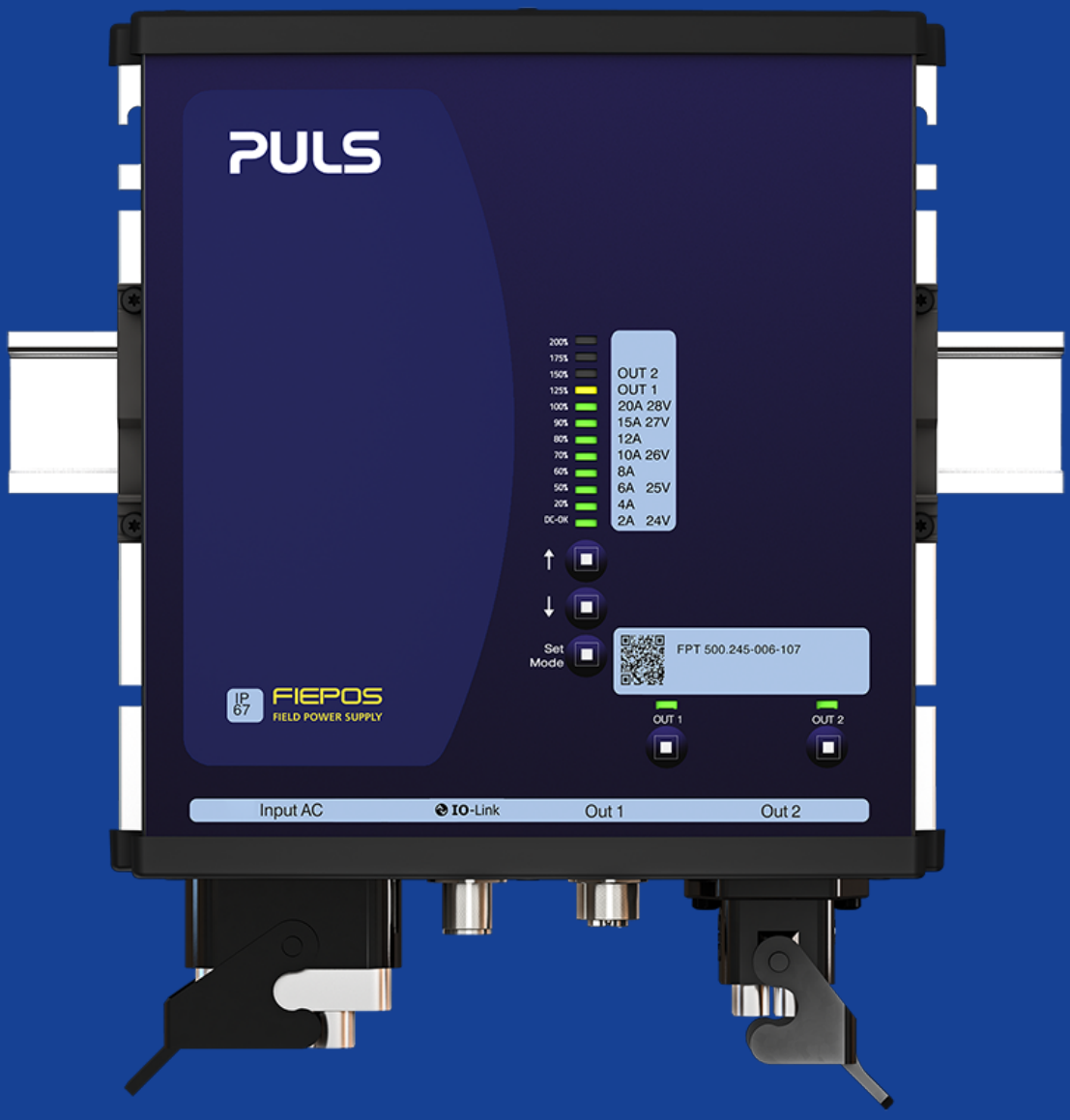
LED interface and pushbuttons on the front panel of the device
The LEDs allow immediate diagnostics directly in the field. At a glance, the technician can see how great the load is on the power supply. The device also signals if one or more of the protected channels has tripped and can be reset via the pushbuttons on the front of the device. The tripping currents can also be configured directly at the device (see page 9).

Condition monitoring via IO-Link
In large-scale applications, there are often hundreds of power supplies distributed over a wide area. In these applications, efficient preventive maintenance via a central condition monitoring system is particularly important in order to prevent costly downtimes. With the help of this information, a technician can quickly be deployed to the correct location, possibly preventing a fault from occurring.

For implementation of the digital system integration of power supplies, PULS places great value on a user-friendly and flexible solution. However, the communication interface should not affect the core functions and high reliability of the power supply. Based on these criteria, PULS uses IO-Link technology (IEC 61131-9).

IO-Link is a global, standardized communication interface suitable for industrial use with serial bidirectional, point-to-point communication between an IO-Link device and the IO-Link Master. Simple, unshielded cables are all that is required for the wiring between an IO-Link device and the IO-Link Master. The IO-Link Master allows integration into any commonly used field bus or IIoT protocol such as PROFINET, EthernetIP, EtherCAT or OPC-UA. In this manner, the power supply can communicate directly with a PLC or an IIoT gateway via the IO-Link Master.

Human-Machine Interface in the eFused series



To set the tripping current on the front panel of the device:

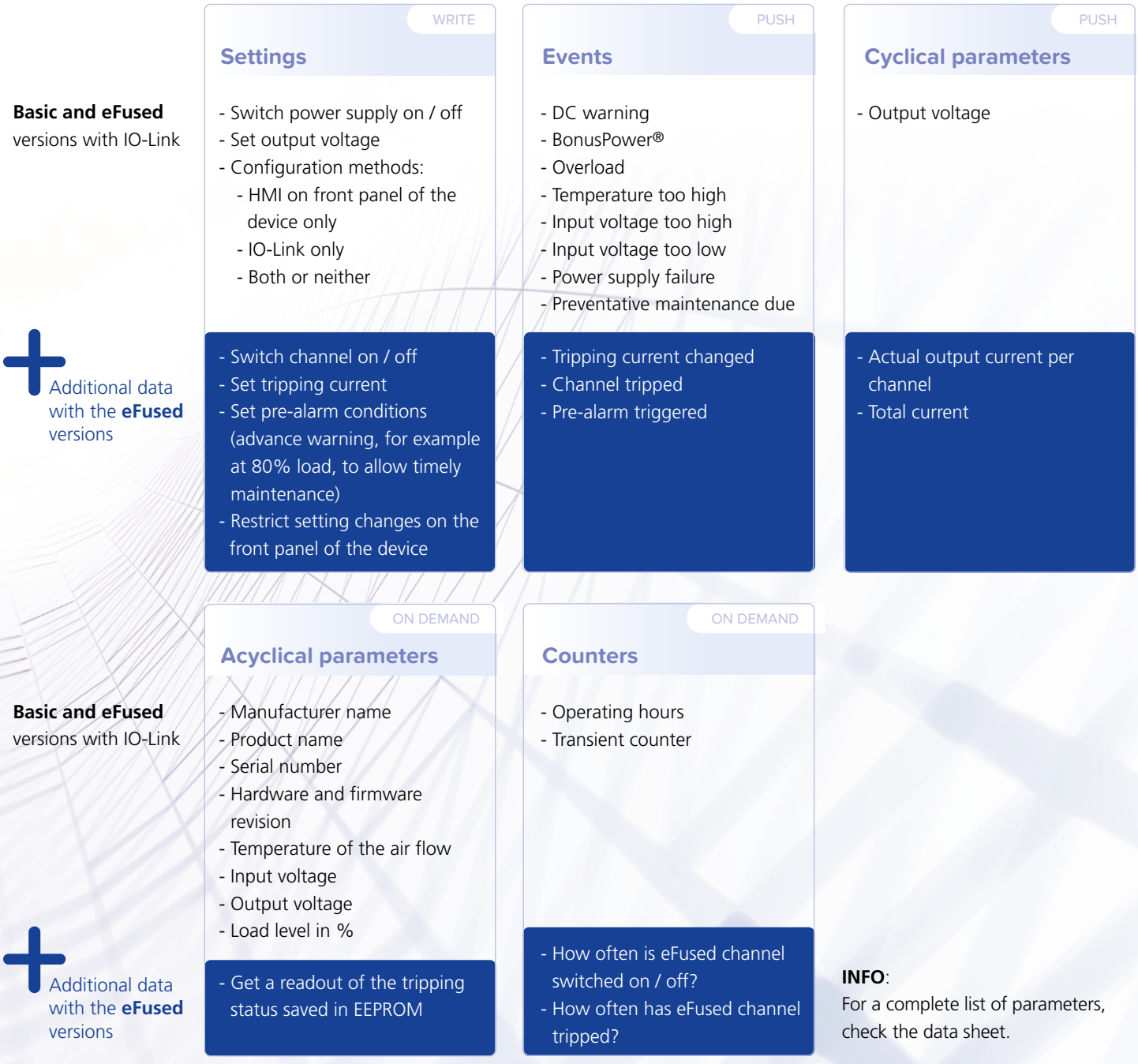
1. Press **SET / MODE** ■ for 3 seconds.
   All LEDs light up for one second.
2. The LED display is now in Voltage Set Mode. A green LED signals the currently set voltage. The LED next to 20% represents a value of 24.5V.
3. To continue configuration of the tripping currents, press **SET / MODE** ■ .
4. An orange LED indicates the selected channel, always beginning at channel 1.
5. The possible tripping currents are shown to the right of the LED display.
6. The tripping current can be increased or decreased using the **UP** ↑ **and DOWN** ↓ buttons.
7. The newly selected tripping current is immediately saved.
8. To set the next channel, press the **SET / MODE** ■ button and repeat step 6. When the last channel has been set, press the **SET / MODE** ■ button to return to Voltage Set Mode.
9. The configuration menu will exit automatically after 15 seconds.

IO Device Description (IODD)

A key advantage of the IO-Link interface is the low number of additional components required in the power supply. The MTBF (Mean Time Between Failures), a significant key figure for the evaluation of system reliability, remains virtually unchanged.

FIEPOS power supplies give users access to the following information via the IO-Link:
How much output current, quality of the mains voltage, temperature, and if the load on the supply is static or dynamic? This information allows you to detect abnormally high transient surges in the mains supply, which can not only damage the power supply, but also adversely affect all other connected components. With the eFused models, you can also detect via the IO-Link which current-limited output has tripped, and also the channels can be reset remotely.

All this information can by analysed in a central condition monitoring system, allowing the proper preventative maintenance and increasing the system reliability while cutting maintenance and operating costs.



INFO:
For a complete list of parameters, check the data sheet.

Output-OK signaling contact

As an alternative to the IO-Link, the eFused power supplies in the FIEPOS product family are also available with an Output-OK interface. The Output-OK interface can be selected as a simplified alternative to the IO-Link. It functions is similar to the established DC-ok signal of an industrial power supply. If the DC voltage fails, the device reports a fault via a common signalling contact in addition to the LED display on the front panel of the device. However, the cause of the fault can only be diagnosed by a technician on-site. The channels can also only be reset on the front panel of the device. An M12 connection is provided on the underside of the power supply for the Output-OK signal, as well as for the IO-Link.

4.Summary

A power supply solution based on the flexible FIEPOS product family is a decisive step on the road to comprehensive decentralization and allows the highest degree of flexibility in system planning.

These solutions offer many advantages, especially in large-scale applications with long cable, as now, shorter cables and smaller cable cross-sections can be used. This saves on the cost of wiring and installation. Eliminating multiple cabinets frees up more space in the overall system, so fewer components need to be ordered and installed.

PULS is currently expanding the FIEPOS product family in order to offer all customers a suitable, decentralized standard solution which can be supplied from stock. PULS is working with numerous companies from various industries, including intra logistics, factory automation, automotive and process control to ensure to meet all the requirements of a cabinet free power supply.

Please contact PULS at any time if you have questions on the use of FIEPOS for your specific application.

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