DIN rail power supply with integrated IO-Link port

The power supply as a data source in IIoT

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The power supply is placed at a central nodal point in the system. There is more than just current flowing. A power supply records a significant amount of real-time information that is of particular interest to the operating company as well as the system manufacturer. What are the output current and output voltage levels? How long is the remaining lifetime of the device? What is the temperature development like in the application? How high is the load on the power supply? What is the quality of the mains voltage like?

The QT40.241-B2, in addition to a reliable power supply, also delivers valuable data via IO-Link.

This data can help increase system availability and reduce maintenance and operating costs. Users also benefit permanently from lower maintenance and operating costs. And last but not least, reliable data are the key to success in the Industrial Internet of Things (IIoT). This means the power supply has the potential – in parallel with its function as a converter – to also act as a sensor and therefore make a significant contribution to the Industrial Internet of Things (IIoT).

The DIMENSION QT40.241-B2 is the first 3-phase DIN rail power supply (24V / 40A) that makes this system data available to users via an I/O port.

The implementation by PULS relies on the combination of the trusted 960W QT40 power supply and internationally standardised I/O technology (IEC 61131-9) IO-Link. IO-Link was developed to retrieve the signals from the sensors and actuators (IO-Link devices) from the field level. Via an IO-Link Master, these signals are imported onto the corresponding field bus system and transmitted to the automation system. The combination of field bus and IO-Link facilitates continuous communication across all levels that is indispensable for smart factories.

The QT40.241-B2 has a permanently integrated 4-pole M12 socket on the front that is used for the connection to the IO-Link Master. This means that the device can be quickly and efficiently integrated into existing IO-Link systems.

Availability of the overall system in focus

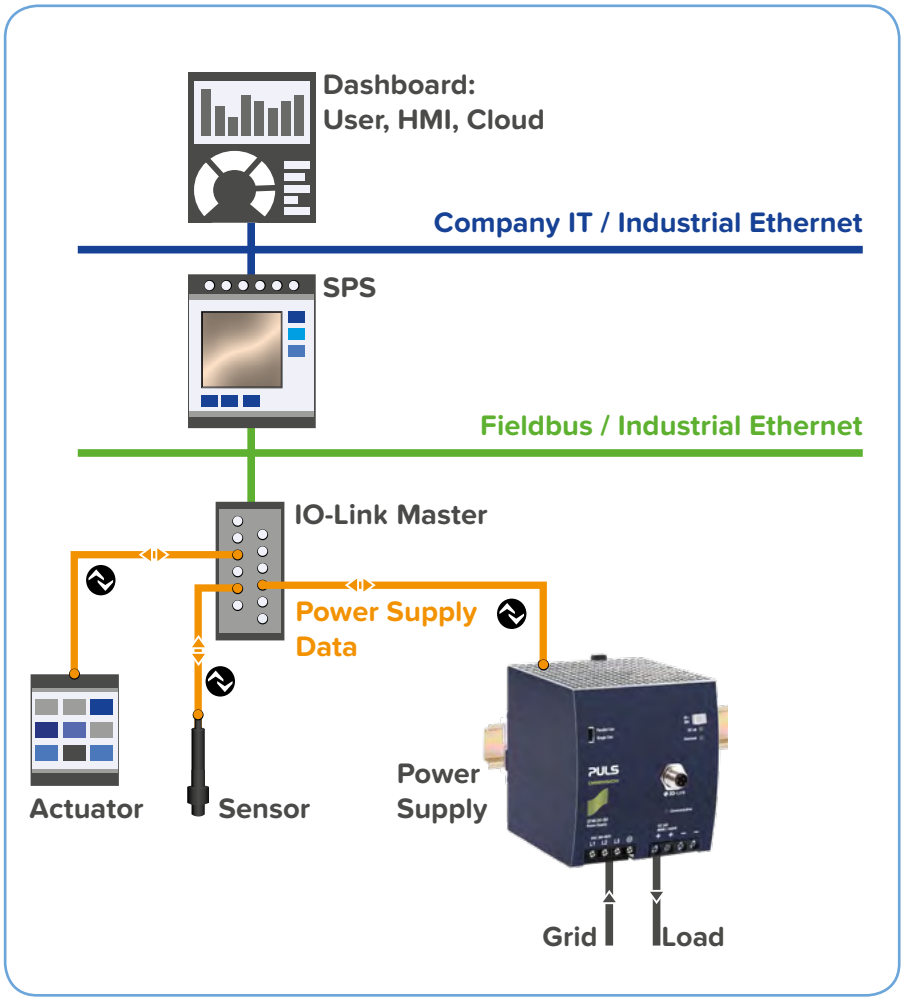
Power supplies adopt a rather more passive role in terms of communication output. Following installation, they need to function reliably in the background and remain as maintenance-free as possible – ideally for many years. With the new IO-Link port, the power supply – in addition to its basic functionality – makes an active contribution to improved understanding of the application and thus also to process optimisation. It ensures transparency of the performance data and operating costs, protects users against oversizing and provides prompt warnings in the event of a fault. The Manufacturing Leadership Council of consulting company Frost & Sullivan looks for innovations that contribute to digitalisation in the production industry.

With that in mind, PULS submitted the QT40.241-B2 to the panel in the first quarter of 2018. The panel members conducted intensive tests to examine the added value that the power supply offers production companies. With its user-oriented strategy, PULS has been able to maintain its position alongside large firms such as IBM, Bosch, Cisco and Roche. The result was the QT40.241-B2 being awarded the respected Manufacturing Leadership Award even before its official market launch.

Remote diagnostics and automated parameterisation

The connection via IO-Link also facilitates remote diagnostics and parameterisation via the user software being used in the automation system. The user can set the output voltage of the QT40.241-B2 via the configuration software and the device can be switched on and off remotely assuming remote access is enabled in the user software.

The settings made by the user, as well as critical process values, are saved on the automation system with full resistance to voltage failures and simultaneously on the built-in non-volatile memory in the power supply. If a device exchange becomes necessary, rapid, automated parameterisation of the new device is carried out in ongoing operation – in accordance with the parameters stored on the automation system. Downtime due to maintenance work is therefore avoided in the long term. The data sent by the power supply also provide information on the cause of the fault and simplify problem-solving.



The QT40 is integrated seamlessly into the infrastructure via IO-Link – independently of the higher level field bus.

No compromises in terms of reliability

The component cost for an IO-Link port in the power supply is relatively low in comparison to more complex communication protocols. That provides a number of advantages for the user: due to the low number of additional components, the MTBF value (Mean Time Between Failures) of the QT40.241-B2 remains constantly high. The MTBF is 678,000 hours and reflects the reliability and thus the fault tolerance of the device. Despite the additional IO-Link features, the QT40.241-B2 matches the robust original QT40 when it comes to reliability. The same also applies to the long lifetime of 66,000 hours – under extreme conditions of 3AC 480V, continuous full load and +40°C ambient temperature. This makes the IO-Link-compatible QT40 particularly well suited to failure-critical applications, such as in the car industry, factory automation and process industries.

In the development process, particular attention has been paid to reliability when selecting the components and the layout. The internal integration of the communication interface into existing power supply electronics has also been optimised in terms of reliability aspects, however. For example, the integrated PULS IO-Link module works autonomously from the actual AC/DC conversion in the device. This means any failure in the IO-Link communication module would not have any effect on the functionality and availability of the converter function in the power supply.

However, if an external influence (such as an overvoltage due to a lightning strike) were to result in a fault in the power supply, the internal IO-Link module can immediately output an error message to the higher level control. The protocol can then be queried from the outside to analyse the situation that caused the failure and to find a solution. The power supply data obtained are permanently stored in the integrated memory in this process, and this data can be queried via a standard IO-LINK/USB-Master, for example.

Overall the IO-Link port adds a smart communication function to the field-tested QT40 power supply. This makes the high reliability, lifetime and efficiency of the device transparent (efficiency: 95.3%) and also fits into the compact original QT40 housing (W x H x D: 110 x 124 x 127mm). All the tried and trusted features of the original QT40 are naturally also still present. Full power is available across a temperature range of -25°C to +60°C – with derating up to +70°C. The power supply also has a power reserve of 50%. To start heavy loads, the QT40.241-B2 therefore generates 1440W for 5 seconds. For fuses to be tripped reliably, the power supply generates a peak current of up to 110A for 25ms.

Advantages of the IO-Link communication protocol

IO-Link is based on serial, bidirectional point-to-point communication. The system is very robust overall and also has a high level of safety – two factors that PULS pays particular attention to in the development of its industrial power supplies. The devices are often exposed to the harsh environments of the lower automation level and at the same time need to be protected against sabotage from outside. Data transmission via IO-Link is tried and tested for this usage.

In addition, IO-Link has been designed from the ground up as a user-friendly plug and play solution. Installation and operation are simple and can be realised cost-effectively. Standard shielded IO cables are all that are required for the cabling. Compatibility with all standard field bus and automation systems is ensured, offering flexible usage options.

The QT40.241-B2 has IO-Link specification V1.1, providing a rapid data transfer speed at COM 3 (230.4 kBaud). PULS provides for the QT40 an electronic device description, the IODD file (IO Device Description). The file contains all information required for the system integration process.

In communication in IO-Link systems, a general distinction is drawn between cyclical and acyclical data. The output current is included in the process data, for example, and is communicated to the master

INFO

ON DEMAND

Acyclical parameters

Device information (static)
Manufacturer name
Product name
Serial number
Hardware and firmware inspection status

Device information (dynamic)
Device runtime
Remaining lifetime in years
Temperature of the air flow

Input parameters
Transient counter
Input voltage

Output parameters
Output voltage
Load level in %

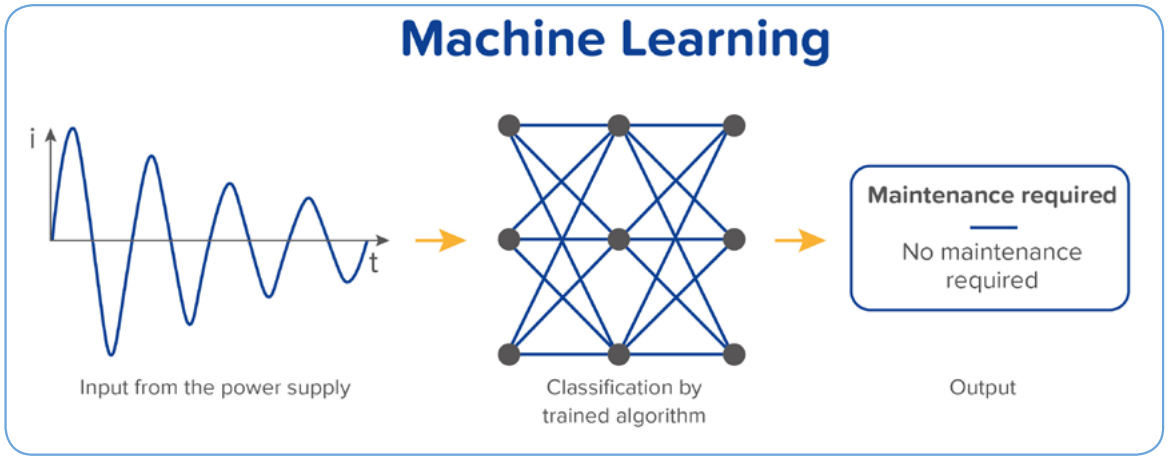
PUSH

Cyclical process data
Output current (every 2ms)

Events PUSH
DC warning
Bonus Power
Overload
Temperature too high
Input voltage too high
Input voltage too low
Power supply failure
Maintenance required

Remote functions WRITE
Switch on power supply
Switch off power supply
Setting the output voltage

The information that the QT40.241-B2 communicates to the automation system is defined in the IODD.



Simplified depiction of a machine learning process based on power supply data.

by the QT40 every 2ms in a cyclical data telegram. The acyclical signals include device information such as input and output parameters that can be queried at all times via the master. Special events are also reported by the power supply.

In the QT40, these events could be warnings or error messages, such as too low or too high input voltages, an overload or too high temperatures. If an abnormal condition arises, the power supply sends a message to the master and displays to the user the need for action, even before a failure actually occurs. Maintenance is therefore preventative and needs-oriented. This means that rigid cycles of regular servicing work are no longer required. In turn, this saves costs on new purchases and maintenance.

Machine learning based on digital load profiles

The data recorded by the QT40.241-B2 forms the basis for the technical innovations of the coming years. Above all, PULS is thinking here of the importance of machine learning in combination with the IIoT. The power supply is already supplying precise measurements of the output current, in other words, the load current. On the basis of these very carefully measured values, it is possible to detect and describe digital load profiles.

Based on information on the output current, for example, it is possible to determine whether or not a load changes across an extended period. This change can be an indication of signs of wear in the machine or plant. As an example, in the case of knocked out profiles, a sinus curve would be detectable in the load profile. As part of computer-aided data analysis based on artificial neural networks, this anomaly would be detected and reported. The next step would then be a similarly automated decision-making process on the subsequent procedure using artificial intelligence. This approach means that the power supply as a data source opens up entirely new options in the use of data in the factory environment.

The use of current as a standardized data source in the production process plays an important role here. As a physical value, current supplies precise, interpretable and reliable data. This means that common big data problems in established company structures, such as incompatibility and inconsistency of data, or difficulties in networking and scaling, can be avoided.

Summary

The QT40.241-B2 sees PULS extending one of its most reliable and most efficient 3-phase power supplies with a smart sensor function, making the device ready for simple integration into existing communication networks. Customers profit from a future-proof solution that alongside a stable energy supply, also provides completely new insights into the performance requirements and physical processes of their plants or machines. This valuable information can be used to optimise the availability and capacity utilisation of the plant. In addition, it helps to reduce energy costs and permits needs-oriented, preventative maintenance.