

Fast and Flexible

MTP could revolutionize the biotech and pharma industry – the machine description standard enables plant modules and controllers to recognize each other, thus shortening the commissioning times and time to market for the plants

Not only since the Corona pandemic have companies in the pharmaceutical and biopharmaceutical industry been faced with the challenge of developing, approving and producing active ingredients on a large scale as quickly as possible. Speed is required because patent protection for drugs expires after 20 years. However, only some of the time remaining after patenting is available to generate income from patented products, since it usually takes many years from the granting of the patent to the marketable product. Products therefore must be available on the market as soon as possible after a drug is approved. The entire process from development to the saleable product in the pharmacy usually takes around twelve years. Companies must begin building production capacity before final approval for a drug has been granted. If approval is not granted, the company is left with the production facilities and must retrofit them again at a cost of many millions of euros.

QUICK READ

In many industries, modularization and standardization are considered target-oriented strategies to reduce costs, production, delivery and development times. This particularly applies to the biotech and pharmaceutical sectors due to the time pressure arising from the process of approvals and patent protection. Turck is supporting this approach with its first MTP-capable I/O and control components. Thanks to multiprotocol Ethernet, with their three Ethernet protocols Profinet, Ethernet/IP and Modbus TCP, the devices are also suitable for most of the control systems used in the market and thus help to establish standards in-house and still meet the preferences of global pharmaceutical manufacturers.



Modularization is a big issue in the biotech and pharma industries; standardized signal transmission and control of the plant modules can significantly shorten the duration of engineering, manufacturing and commissioning

Much more common, however, is the situation in which approval has already been granted but the plant is unable to start production immediately due to delays in setting up the production line. The drug then goes into what is called overtime. A situation that is very costly. Integrators and plant manufacturers hope for a way out of this dilemma – or at least a less difficult process – by building up production capacities more quickly. Since each plant is usually designed individually, engineering times as well as commissioning and testing often take too long.

Modular plant concepts could considerably expedite the setup of production plants. This is because many plant components or machines in the biopharmaceutical industry can in principle be standardized – from upstream with bioreactors and filtration units, to midstream with centrifuges, microfiltration and ultrafilter units, right through to downstream. If all these units are joined together like building blocks



TURCK'S MTP SYSTEMS IN DETAIL

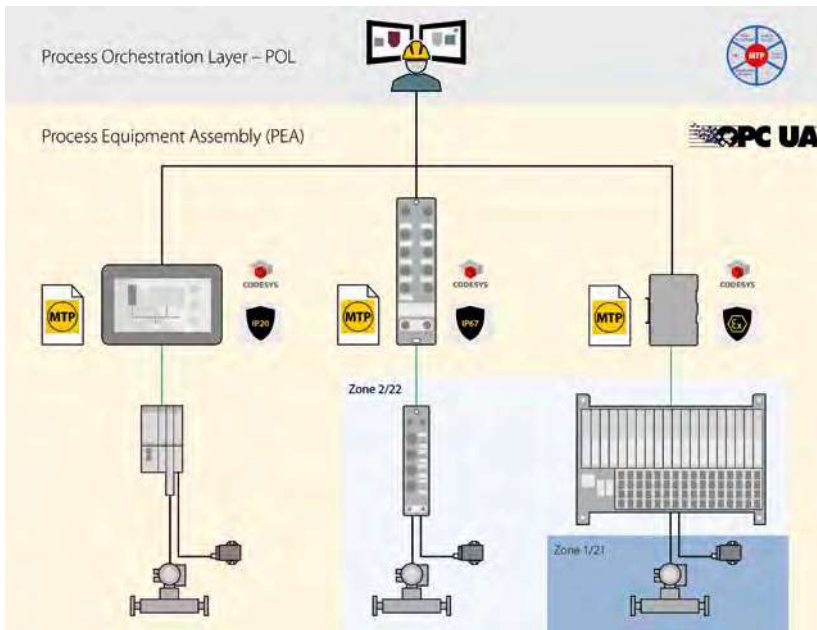


Turck supports modular machine and plant building with its I/O and control components with multiprotocol Ethernet and MTP

Turck's I/O and controller portfolio already offers different MTP solutions with IP67 and IP20 protection. Turck's compact edge controllers can be used for the fully autonomous control of machine modules or skids, such as fermenters or stirrers. The control tasks of the edge controllers are not only programmed in Codesys but also the pre-processing and filtering of the data. This effectively reduces the data flow to the cloud, which not only benefits the bandwidth but also offers a certain security benefit. The Codesys vendor-neutral system platform enables the use of different fieldbus/Ethernet protocols in an automation system. The edge controller generates the MTP file based on Codesys. It is then stored and installed in the Process Orchestration Layer (POL). The instructions are transferred via the OPC UA industrial communication standard, which is supported by a large number of devices from different manufacturers. MTP enables PEAs (Process Equipment Assembly) to be integrated quickly in modular plants.



Turck's excom I/O series is available for use in Ex areas. It promises maximum availability and configuration options during operation, and with the latest Ethernet gateways also supports Multiprotocol Ethernet



The infrastructure graphic shows different scenarios for MTP communication – also for Ex areas

with standardized interfaces to form a complete system, both the time required for engineering, the actual production and the commissioning can be significantly shortened.

MTP: semantics for machines

Control systems, however, have so far not been able to detect machine modules automatically. The semantics were not available by which the control level can understand the functions, capabilities and tasks of machine modules. Anyone who used a PC in the

nineties could understand this situation. Although the peripheral components like printers, mice, keyboards all provided the same standard functions, they had to be set up manually with drivers in the operating system. Today a new printer is normally detected correctly and can be used straightaway when you connect it.

Process orchestration layer POL: conducting instead of controlling processes

The Module Type Package, or MTP for short, is designed to build this bridge between machines and the control level and become the driver for machine modules. The MTP files describe their functions as well as their most important parameters and characteristic values. The task of the control system is handled in the MTP world by a so-called Process Orchestration Layer, or POL for short. Processes are thus no longer controlled but only conducted. The POL sets the beat and piece of music like a conductor and keeps an eye on the overall work – without telling any individual musician when and which note to play.

The POL and other machines can read and understand MTP files and accordingly interact with them. The function of the module is detected, and its process control is based on the description in the MTP file. In this way, plant modules from different manufacturers can be used flexibly and combined to form complex overall plants. MTP thus considerably reduces the programming effort required when commissioning new plants. Genuine “plug and produce plants” are coming within reach.



RFID is a simple and reliable solution for the identification and verification of modules, containers or hoses, as shown here

Different network protocols prevent standardization

The different controllers of the end customers represent another obstacle for modular plant concepts for conventional controllers and control systems. They usually require the use of different I/O components, actuators and sensors, which in turn requires increased effort in engineering, in e-planning and ultimately also in warehousing.

Turck offers efficient solutions with its multiprotocol Ethernet I/O and control modules that can be used in Profinet, Ethernet/IP or Modbus TCP without any intervention by the user. The devices themselves detect which protocol is being used in the network and adapt themselves to it automatically. This therefore enables the machine builder to install multiprotocol devices independently of the end customer's network.

Offline tests shorten commissioning

Machine builders can expedite the process even more by testing the machine modules or skids already in their own production facilities. The so-called factory acceptance tests (FAT) can also be performed offline, i.e. without a connection to the subsequent plant

control system, by using the integrated control functions of the TBEN I/O modules. Turck's I/O components enable the simulation of live operation with their integrated ARGEE logic software, which simulates the inputs of connected machines. If the possibilities of the I/O modules are not sufficient with ARGEE, Turck offers its IP67 TBEN-PLC controller, a fully-fledged Codesys 3 programmable controller, which also supports the three protocols of the multiprotocol standard.

IP67 components and quick connectors reduce wiring effort

The high degree of protection of the TBEN series also contributes to the faster commissioning of the plant. Thanks to IP67, the assembly and wiring of large control cabinets can be kept to a minimum. The use of quick connectors means that in principle only the process connections, power supply and network cables need to be connected on site. In real applications it is rare for all components to be available in IP67, but the assembly of the control cabinet is nevertheless considerably shortened or can be largely pre-assembled. Turck's new IP67 PSU67 power supply units also eliminate the need for cabinets for the power supply.



In this application, Turck's IO-Link master module with Profinet S2 system redundancy controls actuators in a bioreactor

Multiprotocol I/O systems for all zones, protection types, availability requirements

The Turck multiprotocol device series has continued to expand over the years. Customers wanting the flexibility of a modular system will find the BL20 and BL67 system solutions suitable for installation in the control cabinet or directly in the field. If, however, I/O blocks are required, Turck offers the devices of the TBEN series for cabinet-free installation directly at the machine, or the FEN20 series I/O block for installation in protective housings.

If an application in hazardous areas requires maximum availability and configuration options during operation, users choose a system from the excom series, which also supports the three multiprotocol networks with the latest Ethernet gateways – both as a system for mounting in zone 2 or as an N series for mounting in the safe area.

Modbus TCP as parallel channel for diagnostic data

The multiprotocol capabilities of the devices offer other benefits besides variant reduction and simple standardization and modularization: The devices can thus also be used via Modbus TCP in parallel to Ethernet communication via Profinet or Ethernet/IP as a channel for data access. User data and analysis data can be easily branched off via this channel to external IT systems and evaluated for diagnosis and monitoring tasks independently of plant operation.

IO-Link and RFID for automatic skid identification

The documentation of where and when mobile units are used, particularly those used at different points in the plant, is advisable – and this is usually also required by certification guidelines or laws. The use of machine modules can be identified and documented with IO-Link or RFID easily, reliably and without the risk of

manipulation. If the modules use IO-Link components anyway, the entire machine can be identified via the Application Specific Tag of these components. Diagnostic data for predictive maintenance can also be communicated via IO-Link. Many components already offer this option as a standard feature, without the need for complex programming. Increased internal device temperature or reduced signal strength provide early warning of wear, contamination, or other problems. If no IO-Link components are used, RFID tags can be used to identify the modules via their UID. The UID is a unique one-time identification number of the tags, which cannot be changed after production. Turck is the only manufacturer on the market to offer RFID read/write devices with the Ex-e protection type for identification in explosion-protected areas, which can be used directly in Ex zone 1/21 without a protective housing.

MTP in practice

One of the first projects today using MTP in a real environment is in the laboratory of a major pharmaceutical manufacturer. This system can combine different laboratory devices such as stirrers, reagent containers with sensors and the filtration unit as modules. The benefits of modular systems cannot be fully leveraged until the module is provided with a decentralized controller – either with IP67 protection directly in the field or with compact PLCs in decentralized control cabinets.

In this project the customer chose Turck's decentralized I/O blocks and the TBEN-L-PLC decentralized controller with IP67 protection. This saves the user the time required to install additional housings and offers flexibility in the handling of the overall system. Laboratory staff can refit the TBEN-S modules without any tools in order to set up different measuring tasks. Another benefit: The integrated WebVisu visualization software enables the information on the HMI to be displayed in the field – even if the POL running on a central Windows computer is unreachable.

Conclusion

The path to a modular biopharma plant is not an easy one. The established routines must be broken down first and investments must be made in the modified production and development strategy. Cost benefits and synergy effects only materialize after a certain lead time. Once modularization is ultimately established, benefits can be achieved in all stages of the product life cycle. Manufacturers then also consistently decentralize the control capacity and logic of their machine modules. The three Profinet, Ethernet/IP and Modbus TCP protocols cover a large part of the market.

Author | André Ammann is Key Account Manager Pharma Europe
Webcode | more22205e