

Slim for industry 4.0

Harting drives standardization of single-pair ethernet

Slim for Industry 4.0

International standardization bodies have decided in favour of a SPE connector face by the Harting Technology Group in a multi-stage selection process. This also enables secure planning for developers of new appliances or sensor/actuator technologies, who can now begin to actively implement SPE in their device technologies. That is the final step towards IP-based network connectivity from the sensor right through to the cloud.

Matthias Fritsche, Product Manager Device Connectivity at Harting in Espelkamp

The single-pair ethernet connector face by the Harting Technology Group supports the trends towards IIoT and industry 4.0

SPE opens up new application areas and meaningfully supplements the existing four-pair cabling systems. Single-pair ethernet therewith especially supports trends like IIoT and industry 4.0. Particularly in the expansion of cloud computing, single-pair ethernet can provide an important technological basis for further developments.

Single-pair ethernet is a technology that makes do with a single wire pair for data and power transfer. Driven by the automotive industry, this technology is increasingly also gaining in importance in automation engineering, where it is developed further in a targeted manner. Given the reduced weight, space requirements and installation effort, this technology appears earmarked for a great future in industry, automation technology

and the rail sector. SPE now also enables the digitalization and/or continuous IP-based communication to be carried to the field level. The equipment of simple sensors, cameras and reading devices with ethernet interfaces supports the implementation of I 4.0 and the IIoT.

Full compatibility

The large-scale deployment and successful marketing of SPE depends on full compatibility between all devices, cables and connectors. Two connector faces have managed to win through in the international standardization selection:

- The connector face as per IEC 63171-1 for wiring premises: This is based on a suggestion by CommScope and known under the synonym variant 1 (LC style) for M11C1E1 environments.
- The connector face as per IEC 61076-3-125 is recommended for industry and industry-related applications: This is

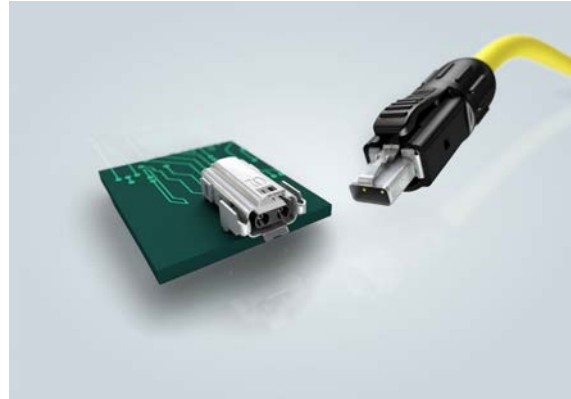
based on a suggestion by Harting, specifically designed for use in environmental conditions up to M3I3C3E3, and known as variant 2 (industrial style).

MICE describes environmental conditions for installations and provides planners and users with valuable advice for the specification of technical equipment and cabling systems. This involves a description of requirements for their mechanical robustness (M), IPxx degree (I), chemical and climatic resistance (C), and electromagnetic safety (E). In the broadest sense, M1I1C1E1 describes the kind of environment found in an office building, for example, and M3I3C3E3 a rather extreme environment that can potentially occur in industry or outdoors.

The SPE ethernet technologies developed so far as per IEEE 802.3bp 1000Base-T1 delivers a transmission rate of 1 Gbit/s by means of just one double-wire copper cable. At the same time, devices can be remotely supplied with electricity by IEEE 802.3bu power over ethernet – here referred to as PoDL = power over data line. The requirements of I 4.0 or IIoT go even further, however. Development of the simple, safe and efficient industrial communication of the future also calls for the consistent integration of all the users of a comprehensive network, from the cloud to the sensor, by IP-based ethernet services. This is where SPE delivers the decisive difference from bus systems or power interfaces.

Based on the connector face defined in the standard, Harting is preparing a comprehensive product portfolio for industry. Prototypes of this connector face

were first introduced around two years ago at the SPS 2016, along with the two further connectors ix Industrial and M8 d-coded. Following the standardization of the Harting ix Industrial, this is now the second connector to become an industry standard.



Generic cabling solutions based on symmetric twisted-pair wires and glass fibres have been in use since the 1990s. The twisted-pair cabling systems originally used two-pair cables, where one wire pair served as the outgoing line and the other as the incoming line (100Base-TX). This principle gets by with a transmission rate of 100 Mbit/s, is still the predominant transmission principle in industry and automation engineering today, and often realized by means of star quad cable constructions. The transmission method selected for realizing higher transmission speeds of 1 Gbit/s and 10 Gbit/s requires four symmetrical pairs in combination with eight-pin connectors. The ethernet transmission with just a single wire pair thus evidently runs against the technical development with the ethernet and attendant cabling.

Megatrends in the industry

The development of new communication technologies and attendant wiring philosophies are decisively driven by current ICT megatrends such as IIoT, I 4.0

and cloud computing. This leads to new requirements for the communication technology and network infrastructure behind it, including high availability, short access times also for distributed data, and the fast transmission of these data. Another requirement is the safe transmission of large data volumes in various application environments through to determinism, ergo real-time transmission, meaning guaranteed data transmission in a defined time window.

Another trend in network technology and cabling is the spread of the ethernet protocol into new application areas. This embraces many automation protocols, and increasingly also sensor/actuator applications. In addition to this, many transport and transportation means such as railways, trams, buses, ships and airplanes are equipping their fleet with ethernet. And in industry, where automation profiles are still largely based on 100-Mbit ethernet today (100BASE-TX), the interest in single-pair ethernet is also growing, for example in process engineering.

Normative activities

Standardization activities in the IEEE802.3 specify the ethernet transmission protocol and define the minimum requirements. ISO/IEC JTC1 SC25 WG3 defines the cabling required for this, and in turn relies on component standards for cables and connectors created in IEC standardization groups. Several standards have already been published as part of the introduction of SPE. IEEE 802.3bp 1000 BASE-T1 "Physical Layer Specifications and Management Parameters for 1 Gb/s

Operation over a Single Twisted-Pair Copper Cable" defines single-pair transmission by way of a 15 m UTP channel (type A, unshielded) and a 40 m STP channel (type B, shielded). Both channels are specified for a bandwidth of 600 MHz, may include up to four connectors, and guarantee a transmission capacity of 1 Gbit/s. Also published is IEEE 802.3bu: "Physical Layer and Management Parameters for Power over Data Lines (PoDL) of Single Balanced Twisted-Pair Ethernet". This standard specifies parallel energy provision up to 50W by way of single-pair ethernet channels in analogy to PoE (power over ethernet).

Various current ISO/IEC JTC1 SC25 WG3 activities and/or projects concern the realization and implementation of IEEE 802.3's technical results in structured building cabling. A technical report describing single-pair shielded transmission channels is also being elaborated under the title: "TR ISO/IEC 11801-9906 'One Pair Channels up to 600MHz'". Target applications are the so-called non-automotive segments and/or I 4.0, IIoT and smart lighting modelled on IEEE 802.3bp. These transmission channels allow bidirectional transmission of 1 Gbit/s using a symmetrical pair of up to 40 m with simultaneous power supply for devices.

The transmission channels typically consist of a 36 m permanent link using up to four connectors, and two 2 m patch cords. The restructuring and updating of the ISO/IEC 11801 will additionally also decide on the application-specific parts where supplementation with single-pair, shielded, symmetrical cabling could be technically and economically meaningful.

At first glance, this appears to be the case in ISO/IEC 11801-3 (industrial applications) and ISO/IEC 11801-6 (building automation). The requirements for the cable and connector components are derivable from the specification of the cabling link in parallel. This is seen to in the IEC SC46C standardization body for cables and the IEC SC48B standardization body for connectors.

2-wire cables and connectors for 1 GB

Described under this international standard title are cables enabling the transmission of 1 Gbit/s by a symmetrical pair. Based on the application areas and capacity of single-pair cables, the two-pin connectors are also standardized up to 600 MHz as a minimum. The connector face for the connectors is normatively enshrined. The definition of the connector face ensures mating compatibility, enabling products from various manufacturers to be used. Corresponding designs of single-pair connectors in protection class IP 20 to IP65/67 will be available then.