Data connections for the factory of the future
Single Pair Ethernet Solutions
Industrial Internet of Things

Weidmüller 3€

Single Pair Ethernet
The network infrastructure for Industrial IIOT

In the factory of the future, machines and systems will be connected to each other consistently via a data infrastructure. These cyber-physical systems can act independently in the Industrial Internet of Things (IIoT), communicate in real time, and control production processes. In order to enable this, a continuous network with high-performance data connections from the sensor to the cloud is required. This pushes conventional Ethernet systems to their limits.

Single Pair Ethernet (SPE) facilitates the extension of the Ethernet to the sensor. It is compact, flexible, and enables high ranges. This means that data connections are achievable in situations where conventional Ethernet systems have reached their limits. SPE provides for the extension of existing installations and supports consistent communication based on the Ethernet protocol. Indeed, SPE is considered by Weidmuller as the missing component needed to close the current gap in the supply of standard Ethernet at field level.

SPE runs at the same transmission speeds as conventional Ethernet but with simplified 2-wire cabling technology and data lines up to 1,000 m in length. Together with other new technologies such as TSN, OPC-UA, or 5G, SPE enables both continuous IP communication between the server and the cloud, as well as supplying up to 60 Watts of power in complex IIoT solutions through PoDL (Power over Data Line).

Versatile use in different applications
SPE applications in practice

SPE solutions are particularly suitable for infrastructures in mechanical and plant engineering, process technology, and building infrastructure – in other words, wherever data must be transmitted continuously and over long distances. With SPE, field devices, sensors and actuators can be integrated directly into an existing Ethernet environment without additional gateways and interfaces.

Factory Automation

Process Automation

Building Infrastructure

Examples of the use of SPE in buildings:
Building automation systems, lighting systems, control systems for lifts and escalators, surveillance systems, access control systems, security and fire alarm systems

Examples for industrial applications:
Industrial automation, process automation, robotics, mechanical engineering, conveyor technology, quality control, agricultural machinery

The new standard for high demands
Continuous communication from the sensor to the cloud

Single Pair Ethernet can transfer data and power using only one twin wire. This enables both end-to-end IP communication between server and cloud, as well as power supply in complex IIoT solutions. SPE connectors and devices therefore are particularly efficient and future-oriented and at the same time extremely compact..

In addition to the existing connectors, switches are also available on request:

Unmanaged Switches 10Base-T1L (and 100Base-T1)

The unmanaged switch offers the solution for reliable and efficient networking. It enables the bridging of large distances of up to 1,000 m through the SPE standard 10Base-T1L (10 MBit/s). Using this switch eliminates the need for subsystems or gateways, simplifying the network infrastructure and reducing complexity.

- Simple and space-saving installation, as both data transmission and power supply are provided via only one pair of wires (PoDL classes 10 - 14, up to 30 W, SCCP support).

- Weidmüller's unmanaged switch is compatible with all Ethernet and IP-based protocols and can be used universally.

- Provides a reliable and efficient way to optimise network connectivity and increase system efficiency.

Preview
Prototypes
available

SPE connectors for the industry
Advantages of SPE connectors at a glance

The market requirements for data connectors in the field level are:

- Smallest, most compact design
- Easy to connect / safe, fast installation
- High robustness for use in industrial environments
- Future-proof through international standards

Miniaturisation

Industrial suitability

Simplicity

Future-proof

Miniaturisation

Particularly compact
Miniaturisation of SPE connectors according to IEC 63171-2

Weidmuller has been developing user-friendly connectors for industrial use, according to IEC63171-2. With a pitch of 7.62mm the compact connector system saves up to 50% space in comparison to RJ45 interfaces. The vertical arrangement of the two contacts allows a very high packing density. This enables device manufacturers to save valuable space on the PCB and to build smaller devices. This reduces port costs in device construction and effectively saves space in the control cabinet.

Small mating face
• Currently the smallest mating face according to IEC 63171 on the market

High packing density
• Double the packing density compared to RJ45 connectors
• Doubling of the interfaces with the same housing contour
• Only 20% of the volume of an RJ45 jack
• Minimum space requirement in the device

Easy IP67-integration
• Can be integrated into standard M8 housings and connectors as with I/O-Link or PROFINET
• M8 connectors with male and female contacts available
• Front and rear panel mounting with male and female contacts supported
• Simple integration in M8 sensors
• Inverse M8 system possible

Industrial suitability

Made for highest demands
The industrial suitability of SPE connectors

Originally developed for automotive applications, the aim of single pair ethernet technology was to realise the most efficient infrastructure capable of delivering high performance with as little cabling as possible. There are similar expectations within industry applications and building automation where the number of intelligent end devices in the plant is increasing but the amount of available space is not. Weidmuller SPE connector solutions deliver long cable lengths, a compact design that is simple, robust and vibration-proof, as well as being insensitive to electromagnetic influences.

Mechanical robustness
• Robust metal housing with metal snap-in hooks
• Safe industrial double contacting compared to single-sided contacting RJ45
• Shock resistant and vibration resistant according to IEC 60068
• Stable latching with lateral forces

EMC Compatibility
• Coupling attenuation at 600 MHz according to IEEE 802.3
• Additional burst test according to IEC 61000-6-2
• Optimum shield connection on the PCB due to four symmetrical legs

Industrial suitability
• PCB connectors for environments up to pollution degree 2
• Impulse voltage strength of 2.25 kV according to IEEE 802.3
• Optimum contact distance for 100 Ohm systems

Simplicity

Easy to use
The simplicity of SPE connectors

Ethernet technology is too complex for many industrial applications. SPE components are clearly superior due to their simplicity. Compared to four-pair Ethernet, installation is less difficult and allows a significant reduction in space and weight. SPE connectors also enable robust cabling in a short time. At the same time, they offer extended cable lengths in an extremely compact design.

Proven locking mechanism
- Industry standard plugs and sockets with metal Snap-in hooks locking
- Known locking and unlocking mechanism as for RJ45 connectors
- High holding force (> 50 N)

Tool-free installation
- Well proven IDC connection technology
- Simple assembly due to a two-part connector
- Clear colour coding to prevent miswiring
- Suitable for all commercially available SPE cables

Easy integration
- Trouble-fee integration into M8 housings and connectors
- Compatibility of IP20 and IP67 variants
- Optional use of the IP20 connector as service connector for devices with M8 IP67 interfaces

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Future-proof

Ready for the challenges of tomorrow
Future-proof SPE connectors

SPE is the next milestone in network technology, as it enables continuous intelligent networking across all levels. SPE is scalable, deterministic, and fully compatible, allowing all components to communicate with each other. As a comprehensive key technology for applications in the field of Industry 4.0 and IIoT, it will form the core of a wide range of industrial applications in the future.
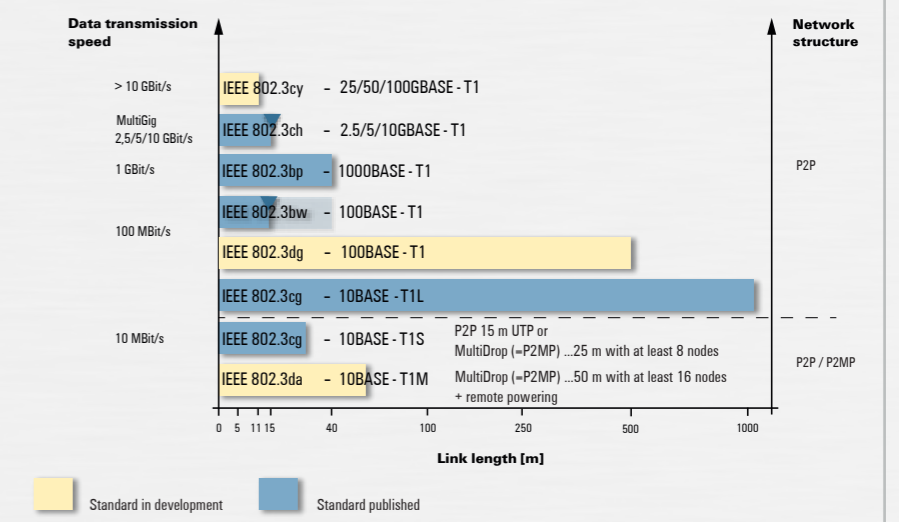
Extensive support
The SPE product family is already supported by several well-known connector manufacturers, which have joined together to form the Single Pair Ethernet System Alliance. This collaboration, with leading technology companies from a wide range of markets and application areas, means that the level of combined technological competence will result in unprecedented and lasting benefits for all users.

Suitable for low to high transmission rates
The compact SPE interface is suitable for various Ethernet applications with transfer rates from 10 MBit/s to 1 GBit/s. Simulations confirm a bandwidth of up to 2.5 GHz – this corresponds to the new Ethernet transmission standard IEEE 802.3ch. which is currently under development for up to 10 GBit/s.

Overview IEEE802.3 SPE protocols

Further SPE standards in progress – Outlook until 2024/25

Data transmission speed	IEEE standard	Protocol		Network structure
> 10 GBit/s	IEEE 802.3cy	– 25/50/100GBASE-T1		
MultiGig 2,5/5/10 GBit/s	IEEE 802.3ch	– 2.5/5/10GBASE-T1		
1 GBit/s	IEEE 802.3bp	– 1000BASE-T1		P2P
	IEEE 802.3bw	– 100BASE-T1		
100 MBit/s	IEEE 802.3dg	– 100BASE-T1		
	IEEE 802.3cg	– 10BASE-T1L		
10 MBit/s	IEEE 802.3cg	– 10BASE-T1S	P2P 15 m UTP or MultiDrop (=P2MP) ...25 m with at least 8 nodes	P2P / P2MP
	IEEE 802.3da	– 10BASE-T1M	MultiDrop (=P2MP) ...50 m with at least 16 nodes + remote powering	

Link length [m]: 0 5 11 15 40 100 250 500 1000

Standard in development   Standard published

Single Pair Ethernet
System Alliance

On the path to a uniform market standard
The SPE System Alliance and its objectives

The SPE System Alliance is an association of leading technology companies from different industries and fields of application who bundle and exchange their expertise regarding Single Pair Ethernet. All partners pursue the common goal of promoting the SPE technology for the IIoT and every other field of application.

The mission of the SPE System Alliance
- Promote exchange between experts from different technology fields
- Removing technological barriers to the implementation of SPE in IIoT applications
- Build a competent and respected knowledge base for the fast and reliable implementation of SPE

Main targets of the SPE System Alliance
In the SPE System Alliance, manufacturers of sensors, cables, connectors, measuring devices, chips, switches, and end devices, as well as companies in online education work together. The aim of the co-operation is to establish Single Pair Ethernet solutions and applications across many markets and to create a common market standard.

Further information about the
SPE System Alliance
can be found at
www.singlepairethernet.com

Sensors · Chips · Cable · Connection Technology · Control Technology · Single Pair Ethernet · User Communities · Devices · End User · Measurement Technology · Switches

Single Pair Ethernet Solutions
Ordering data

IP20 SPE cabling

Type	Versions	Qty.	Order No.
IE-S1DS2VE0010T01T01-E	Patch cable overmoulded, IP 20, Female-Female, 1m	1	2725850010
IE-S1DS2VE0020T01T01-E	Patch cable overmoulded, IP 20, Female-Female, 2m	1	2725850020
IE-S1DS2VE0030T01T01-E	Patch cable overmoulded, IP 20, Female-Female, 3m	1	2725850030
IE-S1DS2VE0050T01T01-E	Patch cable overmoulded, IP 20, Female-Female, 5m	1	2725850050
IE-S1DS2VE0100T01T01-E	Patch cable overmoulded, IP 20, Female-Female, 10m	1	2725850100
IE-S1DS2VE0150T01T01-E	Patch cable overmoulded, IP 20, Female-Female, 15m	1	2725850150
IE-S1DS2VE0400T01T01-E	Patch cable overmoulded, IP 20, Female-Female, 40m	1	2725850400

Other lengths on request

IP67 SPE cabling

Type	Versions	Qty.	Order No.
IE-S1DS2VE0020TM1TM1-E	Patch cable overmoulded, M8 IP 67, Female-Female, 2m	1	2726050020
IE-S1DS2VE0050TM1TM1-E	Patch cable overmoulded, M8 IP 67, Female-Female, 5m	1	2726050050
IE-S1DS2VE0100TM1TM1-E	Patch cable overmoulded, M8 IP 67, Female-Female, 10m	1	2726050100
IE-S1DS2VE0150TM1TM1-E	Patch cable overmoulded, M8 IP 67, Female-Female, 15m	1	2726050150
IE-S1DS2VE0200TM1TM1-E	Patch cable overmoulded, M8 IP 67, Female-Female, 20m	1	2726050200
IE-S1DS2VE0400TM1TM1-E	Patch cable overmoulded, M8 IP 67, Female-Female, 40m	1	2726050400
IE-S1DS2VE0020TM1TM2-E	Patch cable overmoulded, M8 IP67, Female-Male, 2m	1	2726060020
IE-S1DS2VE0020TM2TM2-E	Patch cable overmoulded, M8 IP67, Male-Male, 2m	1	2726070020

Other lengths on request

Connecting components

	Type	Versions	Qty.	Order No.
	IE-PS-SP0-S-FH-180	Field attachable plug IP20, Female	1	2726040000
	IE-AD-SP0-P-SPM-P-90	SPE IP20 to SPE M8 adapter, Male	1	2814400000
	IE-BI-SP0-C	SPE IP20 coupling, Male, for installation in service interface FrontCom® Vario	10	2861260000
	IE-FCM-SP0-C	FrontCom® Micro Service interface IP65 with SPE coupling, Male	1	2870820000
	IE-TO-SP0-C-LP	DIN rail outlets IP20 with SPE coupling, Male	1	2870790000

PCB components

	Type	Versions	Qty.	Order No.
	IE-PCB-SP0-P-90V-THR	PCB connector, IP20, 90°, THR Male	100	2726010000
	IE-PCB-SP0-P-90V-THR-YG/YG	PCB connector, IP20, 90°, LED, THR, Male	100	2795120000
	IE-PCB-SP0-P-180V-THR	PCB connector, IP 20, 180°, THR, Male	100	2795170000
	IE-BHD-SPE-M8-OT-FP	M8 Device housing, front panel mounting	10	2726020000
	IE-BHD-SPE-M8-OT-BP	M8 Device housing, back panel mounting	20	2726030000
	IE-BHD-SPE-BP-CN-M10X0.75	Locknut for M8 socket housing	10	2739640000
	IE-PCB-SPM-P-180-THR	M8 SPE insert, 180°, THR, Male	100	2735920000
	IE-PCB-SPM-P-180-SMD	M8 SPE insert, 180°, SMD, Male	100	2795110000
	IE-PCB-SPM-P-90-THR	M8 SPE insert, 90°, THR, Male	100	2795100000

Weidmüller – Your partner in Smart Industrial Connectivity

As experienced experts we support our customers and partners around the world with products, solutions and services in the industrial environment of power, signal and data. We are at home in their industries and markets and know the technological challenges of tomorrow. We are therefore continuously developing innovative, sustainable and useful solutions for their individual needs. Together we set standards in Smart Industrial Connectivity.

Made in Germany