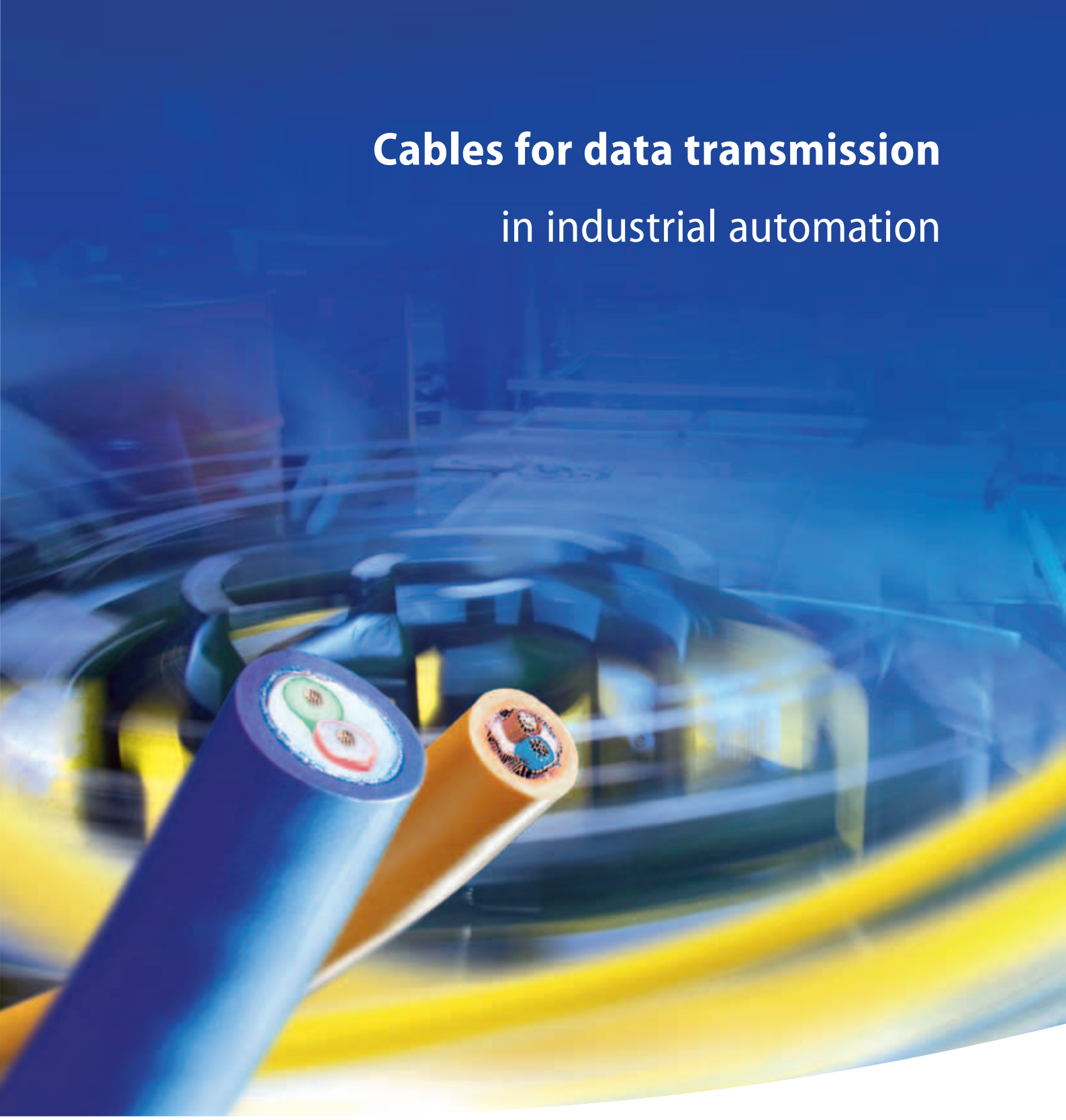
Cables for data transmission

in industrial automation



The Quality Connection

LEONI

The LEONI Group

Cable expertise for the most various industrial markets.

LEONI is a leading supplier of cable systems and related services for the automotive industry and various other industrial sectors.

Our group of companies employs more than 55,000 people in 37 countries. Corporate vision, highest quality and innovative power have made us one of the leading cable manufacturers in Europe. LEONI develops and produces technically sophisticated products ranging from wire and optical fibers to cables through to complete cable systems and also offers the related services. Moreover, the product portfolio comprises strands, standardised cables, hybrid cables, glass fiber as well as special cables, cable harnesses, wiring systems components and fully assembled systems for applications in various industrial markets.

Your markets – our strength.
As diverse as our product and service range are the markets and sectors LEONI is supplying. We focus our activities on customers in the fields of Automotive, Industry & Healthcare, Communication & Infrastructure, Electrical Appliances and Conductors & Copper Solutions.

We are among the leading European suppliers in the Communication & Infrastructure market to which at LEONI, as a cable manufacturer, also belong activities in the fields of infrastructure & data communications, industrial plant projects, solar- and wind power, energy & telecommunications, irradiation cross-linking and traffic engineering. Our customers benefit from innovative as well as reliable and long-lasting products of high quality worldwide. LEONI – we create the best connection for your future.

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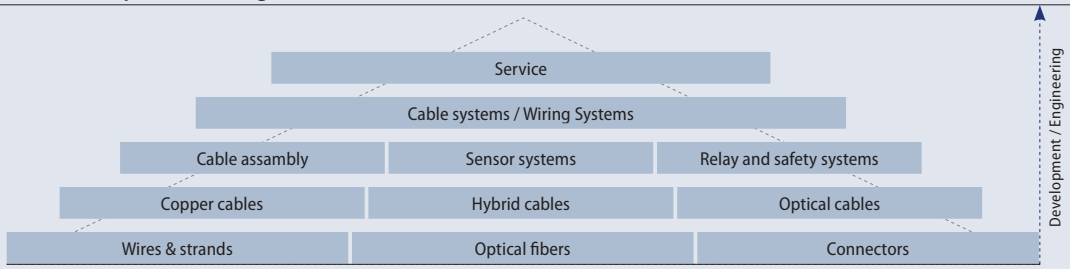
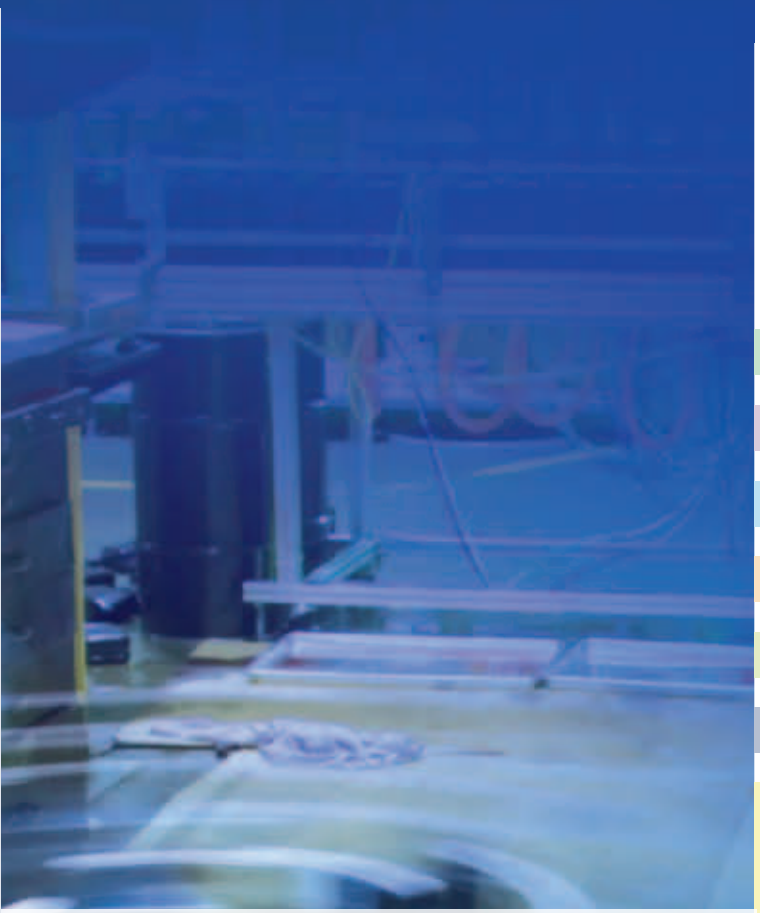
Products and services portfolio at a glance



LEONI's core markets



Application

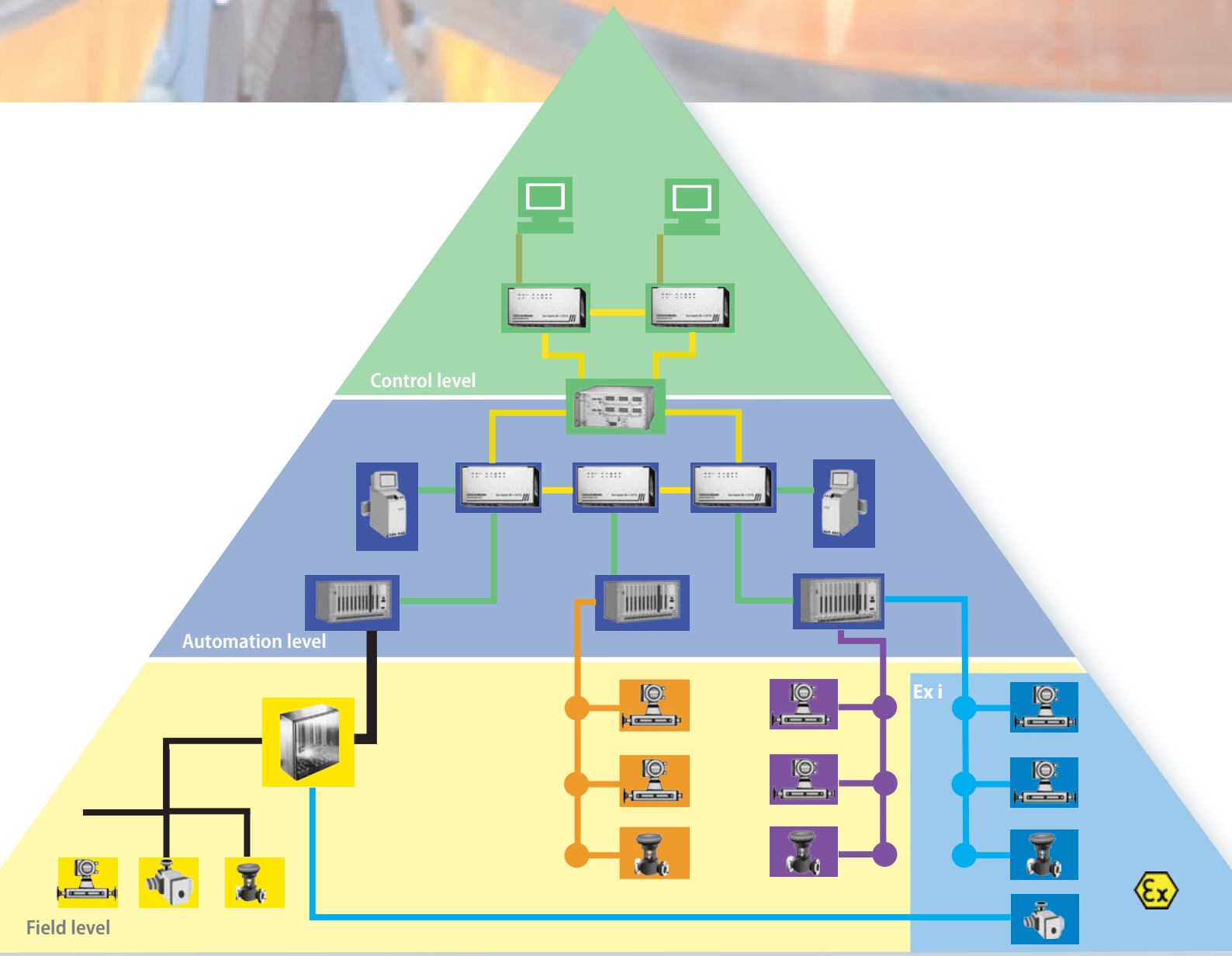
Fieldbus systems are used in digital networks which control machines and devices within a production plant with the help of actuators and sensors.

The IEC standard 61158-2 defines the profile of so-called H1 buses. The bus systems Profibus and FOUNDATION™ Fieldbus now predominant in process automation, follow this communication protocol.

Fieldbuses shall meet the following requirements:

- **Use in hazardous and no-hazardous areas**
- **High transmission speeds**
- **Large amounts of data**
- **Real-time capabilities**
- **Deterministic**
- **Energy supply via bus**

Contents



Hierarchical Model with Industrial data transmission cable types

Fieldbus technology

Levels of the hierarchy

Digital communication and data transfer within a production structure takes place horizontally, i.e. between devices on one level, and vertically, to the systems on the other levels of the hierarchy.

The following levels are usually distinguished in automation systems:

Control level

This level controls and monitors higher functions with bus cycle times of <1000 ms.

Cables:
- Ethernet TCP/IP copper cable
- Fiber optic cable

Automation level

This level controls the actual processes and control loops with bus cycle times of <100 ms.

Cables:
- HSE-Industrial Ethernet cable
- Profibus FMS/DP cable

Field level

This level transfers data of the actuators and sensors; this requires a bus cycle time of <10 ms.

Cables:
- 4 … 20 mA/Hart Instrumentation cable
- FOUNDATION™ Fieldbus cable
- Profibus PA cable
- Ex i

Demands made on Fieldbuses and Fieldbus systems

In the automation engineering, a wide range of factors determine which Fieldbus system to use, i.e. the technical characteristics of each bus system make it suitable for the sector and the application for which it is intended.

Process Automation

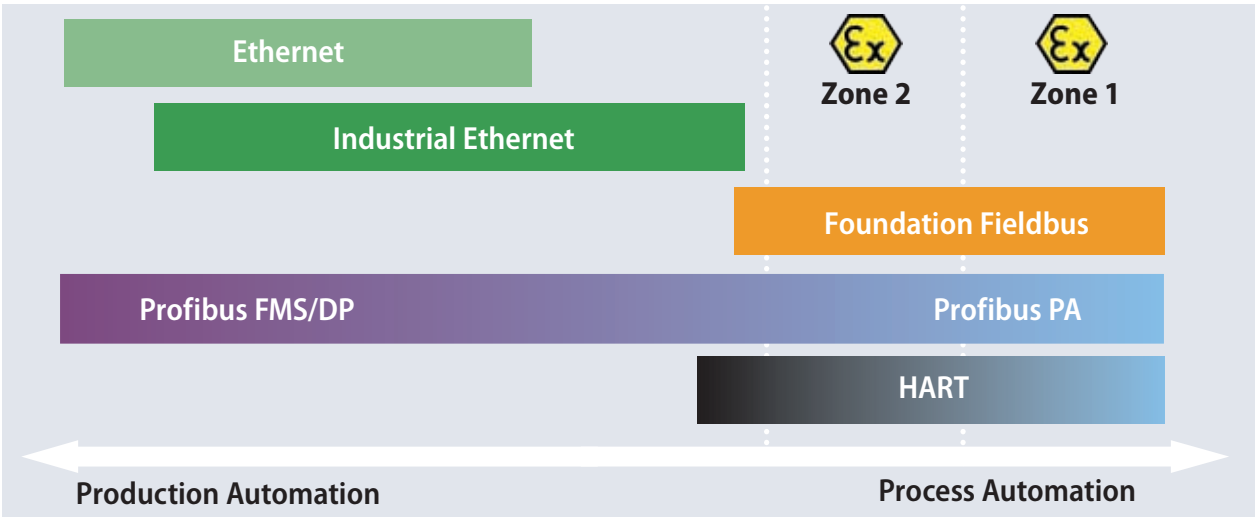
In process automation, we speak of the continuous or batch processing of goods in plants of the chemical, food or steel industries, power stations etc. Typically, the systems used for the process industry are strongly decentralized, complex plants which can be very extensive. The demands made on response times are usually less critical: these can be in the range of several seconds.

However, 'always up' systems are important for process automation as plants cannot be switched off due to the continuous processes running there.

Production Automation

Production automation mainly deals with the processing of goods in phases which are often independent of one another, e.g. in the automobile or electronic industry.

In these fields, high demands are made on the reaction times, i.e. hard real-time requirements in the millisecond range.



FISCO-Model

Especially in the use of bus systems in explosion-hazard areas, the so-called FISCO (Fieldbus Intrinsically Safe COncept) facilitates the planning, installation and extension of networks.

The FISCO model was developed in Germany by the Physikalisch Technische Bundesanstalt (PTB) and has now been standardised according to the international standard IEC 60079-27.

The requirements for use of the FISCO model are as follows:

- All participants in the bus (devices) must be FISCO-approved
- Every field device takes up a constant basic current of at least 10 mA
- Only one supply source per Fieldbus segment
- With ignition protection type ia (Zone 0), the cable must not be longer than 1000 m and with ignition protection ib (Zone 1 and Zone 2) 1900 m
- Maximum length of each spur cable: 60 m for device group IIC and IIB
- Maximum length of each trunk cable, including all spur cables: **1000 m** for device group **IIC** and **5000 m** for device group **IIB**

According to IEC 60079-27, the parameters for the bus cables are as follows:

Loop resistance	R = 15…150 Ω/km
Loop inductance	L = 0.4…1 mH/km
Mutual capacitance	C = 45…200 nF/km

When lines and cables matching the above requirements are used, it is no longer necessary to take other cable parameters into account.

F	**Fieldbus**
I	**Intrinsically**
S	**Safe**
CO	**Concept**

The Fieldbus Standard IEC 61158-2

Bus-types for 31.25 kbit/s – 100 Ω (e.g. PROFIBUS PA, FOUNDATIONTM Fieldbus).

IEC 61158-2 defines following categories for cable types for the data transfer range of 31.25 kbit/s.

Parameter	Type A	Type B	Type C	Type D
Impedance at f = 31.25 kHz	100 ± 20 Ω	100 ± 30 Ω	not specified	not specified
Max. conductor resistance	24 Ω/km	56 Ω/km	132 Ω/km	20 Ω/km
Max. attenuation at f = 39 kHz	3.0 dB/km	5.0 dB/km	8.0 dB/km	8.0 dB/km
Max. capacitance unbalance to shield	2 nF/km	not specified	not specified	not specified
Max. capacitance unbalance	not specified	6 nF/km length ≥ 30 m	not specified	not specified
Nom. conductor cross-section	0.8 mm²	0.32 mm²	0.13 mm²	1.25 mm²
Max. propagation delay change	1.7 µs/km	not specified	not specified	not specified
Min. shield coverage	90 %	not specified	not specified	not specified
Max. usable length including all spur cables	1,900 m	1,200 m	400 m	200 m

Type A is the preferred bus type nowadays.

Type A is a single pair cable with an overall shield and is tailor-made to meet the high demand of automation engineering.

LEONI also offers multipair individually screened cables wherein each pair fulfils type A requiremensts acc. to IEC 61158-2.

Type B is an alternative type also used.

Type B is a version consisting of several pairs and an overall shield. Please note the restricted characteristics which can have a detrimental effect in case of future extensions of the plant.

Types C and D are of little importance and have been included here for the sake of completeness only.

Bus-types for the characteristic impendance range – 100 Ω up to 220 Ω (e.g. PROFIBUS DP).

For bus use in the characteristic impedance range between 100 Ω and 220 Ω, IEC 61158-2 defines cable types A and B with the following characteristics:

Parameter	Type A	Type B
Characteristic impedance	135 – 165 Ω at f = 3 up to 20 MHz	100 – 130 Ω at f >100 kHz
Conductor resistance (loop)	110 Ω/km	not specified
Minimum conductor cross-section	0.34 mm²	0.22 mm²

The cable consists of one pair and an overall shield and the preferred type is type A.

Fiber optic cables

In addition to copper cables, fiber optic cables consisting of the following fiber types defined according to IEC 61158-2 are used:

Multi mode fiber	62.5/125 µm
Single mode fiber	9…10/125 µm as well as
Plastic fiber	980/1000 µm

Transmission systems

Profibus (Process Fieldbus)

PROFIBUS DP (Decentralized Periphery)
PROFIBUS DP was specially designed for rapid cyclical data transmission. PROFIBUS DP uses RS-485 as a transmission technology for high data rates.

Depending on the data rate, the maximum segment lengths for cable type A are as follows:

Data rate kbit/s								
9.6	19.2	93.75	187.5	500	1500	3000	6000	12000
Segment length (m)								
1200	1200	1200	1000	400	200	100	100	100

PROFIBUS PA (Process Automation)
The PROFIBUS PA is used in the field of process automation and its special characteristics are power supply over bus and intrinsic safety.

The transmission technology used MBP (Manchester Coded Bus Powered). MBP is synchronous transmission with a fixed transmission rate of 31.25 kbit/s and Manchester-II coding. The intrinsically safe PROFIBUS PA is connected to the PROFIBUS DP via segments couplers or links.

Synopsis of Transmission Media PROFIBUS

	MBP	RS485	RS485-IS	Optical fiber
Data transmission	digital, Manchester Coding	digital, NRZ✖ coding, RS485	digital, NRZ✖ coding, RS485	optical, NRZ✖ coding
Transmission rate	31.25 kbit/s	9.6 – 12000 kbit/s	9.6 – 1500 kbit/s	9.6 – 12000 kbit/s
Cable	1-pair cable, twisted and shielded Type A	1-pair cable, twisted and shielded Type A	1-pair cable, twisted and shielded Type A	multi- and singlemode-fiber with glass, plastic fiber (POF)
Power supply	via bus line	optionally via additional cores	optionally via additional cores	optionally via additional cores
Ignition protection type	EEx ia/ib	no	EEx ia/ib	no
Network topology	Line and tree structure	Line structure	Line structure	Line-, star- and ring structure
Number of participants	max. 32 per segment, max. 126 per network	max. 32 per segment, max. 126 per network	max. 32 per segment, max. 126 per network	max. 126 per network
Repeater	max. 32 per segment, max. 126 per network	max. 9 with signal refresh	max. 9 with signal refresh	unlimited with signal refresh (depending on the time delay of signal)

✖ *Non-Return-to-Zero*

Transmission systems

FOUNDATION™ Fieldbus

Like the PROFIBUS PA, the FOUNDATION™ Fieldbus is standardised via IEC 61158-2 and works with the same transmission media (see page 9).

The difference to PROFIBUS PA is that the FOUNDATION™ Fieldbus does not require Fieldbus masters and the field devices can correspond with each other.

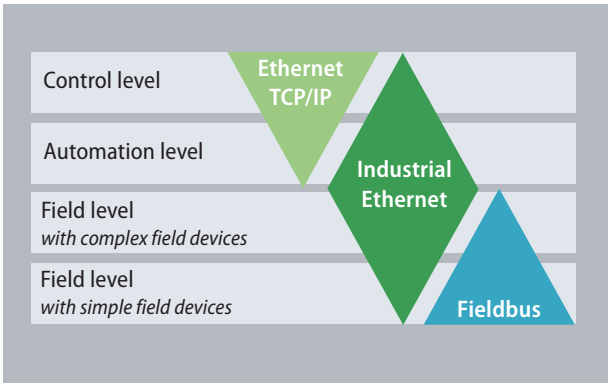
With the FOUNDATION™ Fieldbus, the "host device" only monitors the procedures. Within process automation, the FF forms a so-called LAN (Local Area Network) and the FF devices are connected to H1 links. Several H1 links are connected to the high-performance network HSE High-Speed-Ethernet via linking devices. Individual devices can also be directly connected to the HSE network.

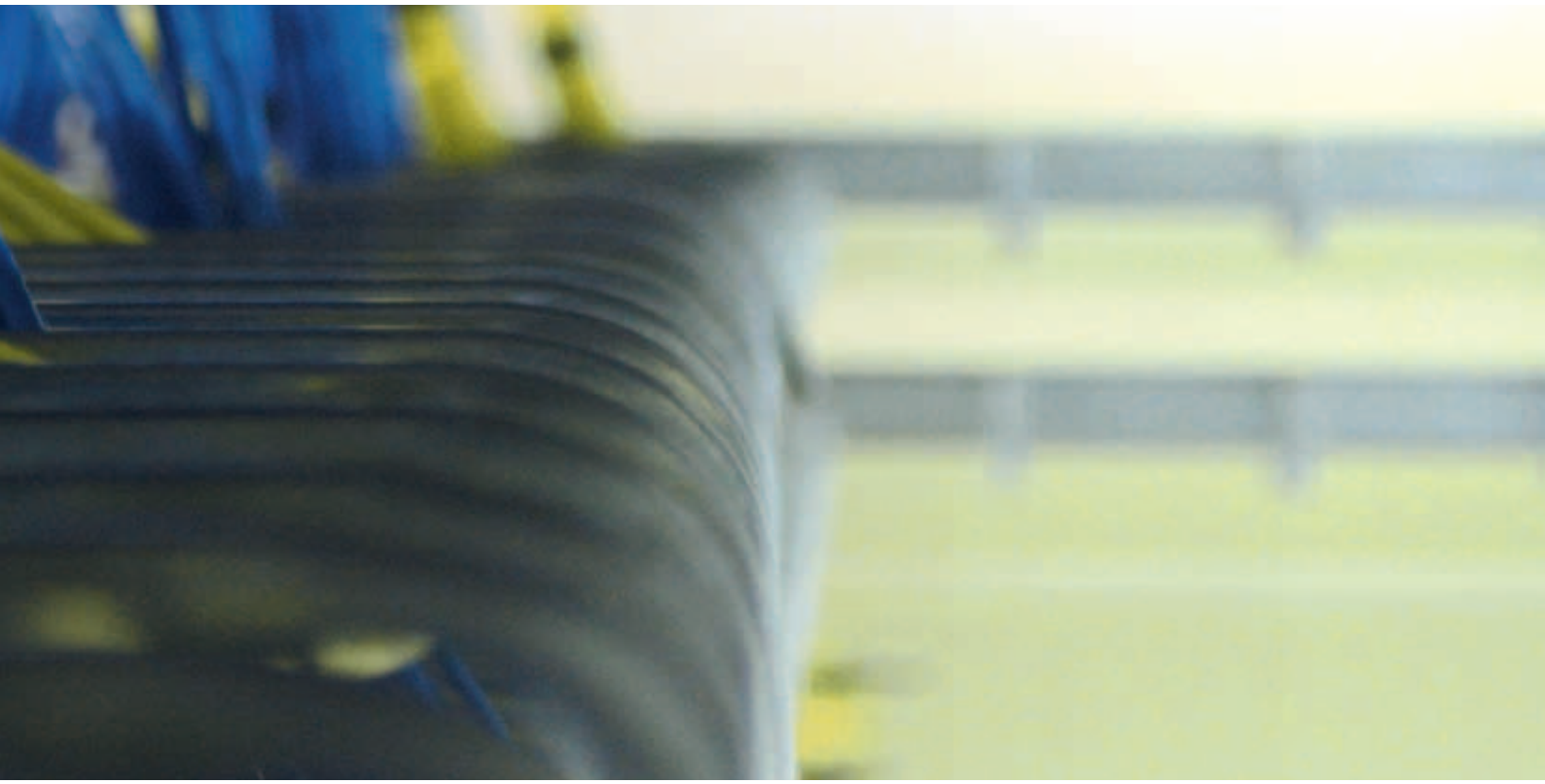
As with the PROFIBUS PA, the FISCO model applies for the FOUNDATION™ Fieldbus, thus allowing intrinsically safe use of the FF in explosion-hazard areas of the plant.

Industrial Ethernet

As a result of the increased demands made on transmission speeds and data rates, the Ethernet Protocol is also found besides bus technology in the world of automation, including field device controls.
New technologies (such as switching etc.) also make Ethernet suitable for real-time applications, allowing it to be used in the field of automation parallel to the Fieldbus.

The level structure is then as follows:





The M I C E concept

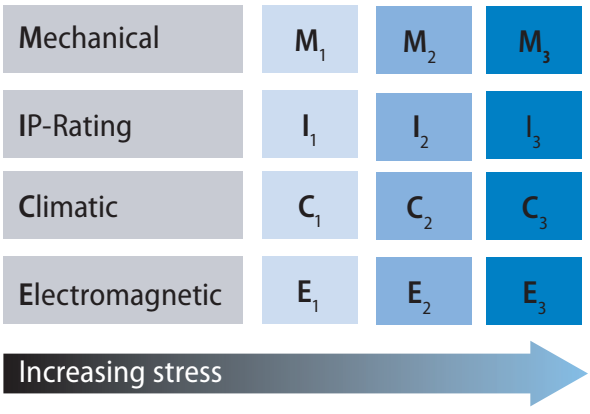
The wide range of environmental conditions prevailing with industrial applications mean that the demands made on lines and systems can vary. The draft standard ISO/IEC 24702 / EN 50173-3 classifies environmental conditions via the so-called MICE matrix.

This distinguishes between the following

M	**…mechanical environmental influences** This category defines shock, impact and vibratory stress
I	**…housing protection** This category defines the particle size and quantity of liquid, etc.
C	**…climatic and chemical environmental influence** This category defines environmental temperature, humidity and concentration of various gases, etc.
E	**…electromagnetic stress** This category defines electrostatic discharges and magnetic field strengths, etc.

A wide range of environmental profiles can be defined according to the MICE table. Examples:

$M_1I_1C_1E_1$	Office area (worst case)
$M_2I_2C_2E_2$	Factory buildings (worst case, light duty)
$M_3I_3C_3E_3$	Field area (worst case, heavy duty)
$M_3I_1C_2E_2$	Combination



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The standard in office communication

Cable programme

Industrial Ethernet

In contrast to the office environment, the industrial environment is quite different and often presents harsh conditions, such as:

- High dust load
- High humidity
- Mechnical stress due to vibrations or impact
- High temperatures and temperature fluctuations

Corrosive or contaminating media such as acids, alkalis and oils

Characteristics

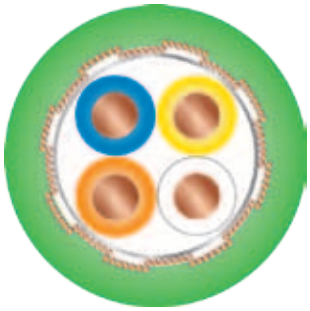
- **Flame retardant**
- **Zero halogen**
- **Oil resistant**
- **Radiation-proof**
- **Perspiration-proof**
- **Abrasion-proof**
- **Suitable for drag chains**
- **Heat resistant**

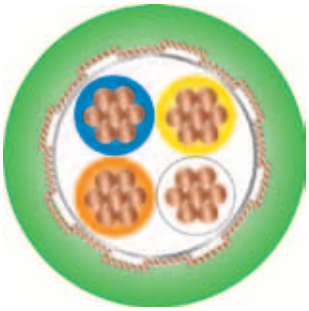
For cables in "harsh environments", IEC 62012 offers design elements and materials adapted to industrial environmental conditions.

For example:

- 2-pair designs support Ethernet (10 Mbit/s) and Fast Ethernet (100 Mbit/s).
- 4-pair designs support all current and future protocols, i.e.: Ethernet (10 Mbit/s), Fast Ethernet (100 Mbit/s) and GigaBit Ethernet (1000 Mbit/s)
- S/FTP cables have one dual screen consisting of an individual and an overall screen. They have excellent EMC characteristics and superior electrical performance and are designed for industrial use.

They also support the transmission of several services under one sheath (cable sharing).

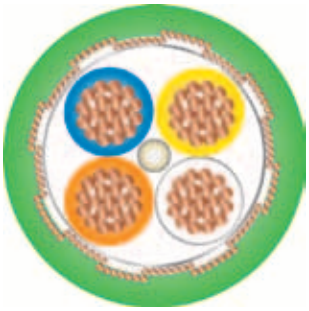




MegaLine®

PROFINET Type A CAT 5	PROFINET Type B CAT 5	Industrial Ethernet
Industrial secondary and tertiary cabling acc. to EN 50173–3 and ISO/IEC 24702 for indoor application. (fixed installation)	Industrial secondary and tertiary cabling acc. to EN 50173–3 and ISO/IEC 24702 for indoor application. (flexible installation)	Application
		Design Design
2 x 2 x AWG 22/1 (quad)	2 x 2 x AWG 22/7 (quad)	Dimension
KS-2YY(St+C)Y	KS-2YY(St+C)Y	Type
green	green	Outer sheath colour
7KS01674	7KS01675	Part No.
		Construction
plain annealed copper, AWG 22/1	plain annealed copper, max. AWG 22/7	Conductor
polyethylene PE	polyethylene PE	Insulation
pair 1: blue/white – pair 2: orange/yellow	pair 1: blue/white – pair 2: orange/yellow	Colour code
cores twisted to quad	cores twisted to quad	Laying up
extruded thermoplastic material	extruded thermoplastic material	Inner sheath
plastic coated aluminium tape in contact with tinned copper wire braid, optical coverage approx. 85 %	plastic coated aluminium tape in contact with tinned copper wire braid, optical coverage approx. 85 %	Screen
polyvinyl cloride PVC diameter 6.6 mm	polyvinyl cloride PVC diameter 6.7 mm	Outer sheath approx.
60 kg/km	60 kg/km	Weight approx.
8 x cable diameter	8 x cable diameter	Minimum bending radius
		Temperature range
–20 °C up to + 70 °C	–20 °C up to + 70 °C	-during operation
–5 °C up to + 50 °C	0 °C up to + 50 °C	-during installation
		Electrical properties
max. 57.1 Ω/km	max. 57.6 Ω/km	Conductor resistance
100 Ω ± 5 Ω	100 Ω ± 5 Ω	Impedance (f = 100 MHz)
200 MHz	200 MHz	Bandwidth
nominal 33 dB	nominal 33 dB	Next at Bandwidth frequency
nominal 24 dB/100 m	nominal 24 dB/100 m	Attenuation at Bandwidth frequency
nominal 90 dB	nominal 90 dB	Interference power suppression up to f = 1 GHz
		Other Properties
acc. to IEC 60332–3-24 (cat. C)	acc. to IEC 60332–3-24 (cat. C)	Flame retardant
please see our catalogue datacom-cable and cabling systems or visit our homepage www.leoni-datacom.com		Connectors/Glands

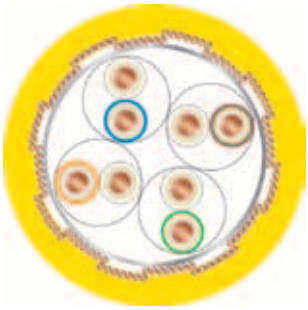
Further cable variations and part numbers on page 19.

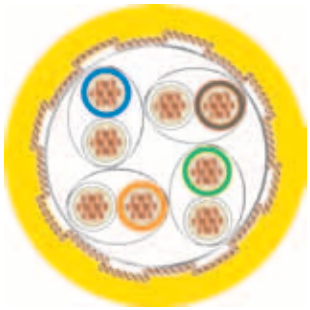


MegaLine®

Industrial Ethernet	PROFINET TYPE C CAT 5	
Application	Industrial secondary and tertiary cabling acc. to EN 50173–3 and ISO/IEC 24702 for indoor application. (for drag chains)	
Design		
Dimension	2 x 2 x AWG 22/19 (Quad)	
Type	KS-2YH(St+C)11Y	
Outer sheath colour	green	
Part No.	7KS01676	
Construction		
Conductor	plain annealed copper, AWG 22/19	
Insulation	polyethylene PE	
Colour code	pair 1: blue/white – pair 2: orange/yellow	
Laying up	cores twisted to quad	
Inner sheath	extruded thermoplastic material	
Screen	plastic coated aluminium tape in contact with tinned copper wire braid, optical coverage approx. 85 %	
Outer sheath	polyurethane PUR,	
approx.	diameter 6.8 mm	
Weight approx.	60 kg/km	
Minimum bending radius	8 x cable diameter	
Temperature range		
-during operation	–20 °C up to + 70 °C	
-during installation	–5 °C up to + 50 °C	
Electrical properties		
Conductor resistance	max. 57.8 Ω/km	
Impedance (f = 100 MHz)	100 Ω ± 5 Ω	
Bandwidth	200 MHz	
NEXT at Bandwidth frequency	nominal 33 dB	
Attenuation at Bandwidth frequency	nominal 24 dB/100 m	
Interference power suppression up to f = 1 GHz	nominal 90 dB	
Other Properties		
Flame retardant	acc. to IEC 60332-1-2	
Connectors/Glands	please see our catalogue datacom-cable and cabling systems or visit our homepage www.leoni-datacom.com	

Further cable variations and part numbers on page 19.

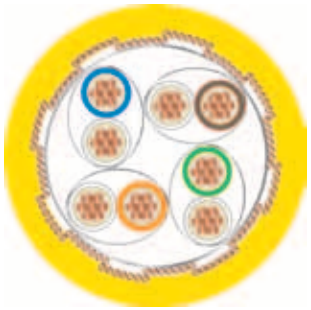


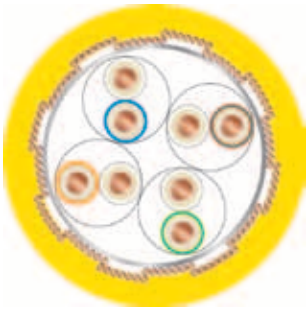


MegaLine®

MegaLine® D1-20 SF/U HV CAT 5, heavy duty	MegaLine® F6-70 S/F HV flex CAT 7, heavy duty	Industrial Ethernet
Industrial secondary and tertiary cabling acc. to EN 50173–3 and ISO/IEC 24702 for indoor application. (fixed installation)	Industrial secondary and tertiary cabling acc. to EN 50173–3 and ISO/IEC 24702 for indoor application. (fixed installation)	Application
		Design
4 x 2 x AWG 24/1	4 x 2 x AWG 24/7 PiMF	Dimension
KS-02YS(St+C)HV	KS-02YSC11Y	Type
yellow	yellow	Outer sheath colour
7KS50053	7KS70139	Part No.
		Construction
plain annealed copper, AWG 24/1	plain annealed copper, AWG 24/7	Conductor
foamed polyethylene with skin layer	foamed polyethylene with skin layer	Insulation
white/blue, white/orange, white/green, white/brown	white/blue, white/orange, white/green, white/brown	Colour code
	plastic coated aluminium tape	Individual screen
cores to pairs, pairs to cable core	cores to pairs, pairs to cable core	Laying up
plastic coated aluminium tape in contact with tinned copper wire braid, optical coverage approx. 40 %	plastic coated aluminium tape in contact with tinned copper wire braid, optical coverage approx. 65 %	Screen
low smoke zero halogen compound LSZH	polyurethane PUR	Outer sheath
diameter 6.6 mm	diameter 8.8 mm	approx.
51 kg/km	78 kg/km	Weight approx.
8 x cable diameter	5 x cable diameter	Minimum bending radius
		Temperature range
–20 °C up to + 60 °C	–20 °C up to + 60 °C	-during operation
0 °C up to + 50 °C	–5 °C up to + 50 °C	-during installation
		Electrical properties
max. 95 Ω/km	max. 84 Ω/km	Conductor resistance
100 Ω ± 5 Ω	100 Ω ± 5 Ω	Impedance (f = 100 MHz)
200 MHz	700 MHz	Bandwidth
nominal 40 dB	nominal 68 dB	NEXT at Bandwidth frequency
nominal 26.5 dB/100 m	nominal 5.23 dB/100 m	Attenuation at Bandwidth frequency
nominal 90 dB	nominal 90 dB	Interference power suppression up to f = 1 GHz
		Other Properties
acc. to IEC 60332–3-24 (cat. C)	acc. to IEC 60332-1-2	Flame retardant
please see our catalogue datacom-cable and cabling systems or visit our homepage www.leoni-datacom.com		Connectors/Glands

Further cable variations and part numbers on page 19.

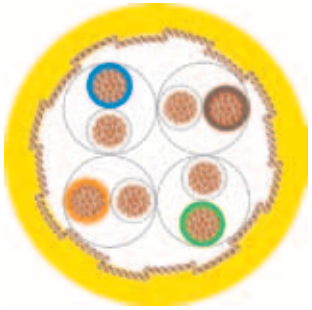




MegaLine®

Industrial Ethernet	MegaLine® E5-70 S/F 11Y flex CAT 6A, heavy duty	MegaLine® D1-20 SF/U 11Y flex CAT 5, heavy duty
Application	Industrial secondary and tertiary cabling acc. to EN 50173–3 and ISO/IEC 24702 for indoor application. (fixed installation)	Industrial workplace, work area and patch panel acc. to EN 50173-3 and ISO/IEC 24702 for indoor application (flexible installation)
Design		
Dimension	4 x 2 x AWG 27/7 PiMF	4 x 2 x AWG 26/7
Type	KS-02YSC11Y	KS-02YS(St+C)11Y
Outer sheath colour	yellow	yellow
Part no.	7KS60048	7KS50046
Construction		
Conductor	plain annealed copper, AWG 27/7	plain annealed copper, AWG 26/7
Insulation	foamed polyethylene with skin layer	foamed polyethylene with skin layer
Colour code	white/blue, white/orange, white/green, white/brown	white/blue, white/orange, white/green, white/brown
Individual screen	plastic coated aluminium tape	
Laying up	cores to pairs, pairs to cable core	cores to pairs, pairs to cable core
Screen	plastic coated aluminium tape in contact with tinned copper wire braid, optical coverage approx. 65 %	plastic coated aluminium tape in contact with tinned copper wire braid, optical coverage, approx. 40 %
Outer sheath	polyurethane PUR diameter approx. 5.9 mm	polyurethane PUR diameter approx. 6 mm
Weight	approx. 34 kg/km	approx. 37 kg/km
Minimum bending radius	5 x cable diameter	8 x cable diameter
Temperature range		
-during operation	–40 °C up to + 70 °C	–40 °C up to +70 °C
-during installation	0 °C up to + 50 °C	–10 °C up to +50 °C
Electrical properties		
Conductor resistance	max. 170 Ω/km	max. 145 Ω/km
Impedance (f = 100 MHz)	100 Ω ± 5 Ω	100 Ω ± 5 Ω
Bandwidth	700 MHz	200 MHz
NEXT at bandwidth frequency	nominal 65 dB	nominal 42 dB
Attenuation at bandwidth frequency	nominal 8.15 dB/100 m	nominal 3.86 dB/10 m
Interference power suppression up to f = 1 GHz	nominal 90 dB	nominal 55 dB
Other properties		
Flame retardant	acc. to IEC 60332–2-2	acc. to IEC 60332-1-2
Connectors/Glands	please see our catalogue datacom-cable and cabling systems or visit our homepage www.leoni-datacom.com	

Further cable variations and part numbers on page 19.



MegaLine®

MegaLine® D1-20 S/U 11Y superflex CAT 5, heavy duty	MegaLine® F10-130 S/F (L)2Y CAT 7A, heavy duty	Industrial Ethernet
Industrial cabling acc. to EN 50173-3 and ISO/IEC 24702 for indoor application (for drag chains)	Industrial cabling acc. to EN 50173-3 and ISO/IEC 24702 for outdoor application. (fixed installation)	Application
		Design
4 x 2 x AWG 26/19	4 x 2 x AWG 22/1 PiMF	Dimension
KS-6Y3GC11Y	KS-02YSCH(L)2Y	Type
yellow	black	Outer sheath colour
7KS50051	7KS7002U	Part no.
		Construction
plain annealed copper, AWG 26/19 plain annealed copper, AWG 24/19	plain annealed copper, AWG 22/1	Conductor
FEP	foamed polyethylene with skin layer	Insulation
white/blue, white/orange, white/green, white/brown	white/blue, white/orange, white/green, white/brown	Colour code
	plastic coated aluminium tape	Individual screen
cores to pairs, pairs to cable core	cores to pairs, pairs to cable core	Laying up
	zero halogen compound	Inner sheath
tinned copper wire braid, optical coverage, approx. 85 %	plastic coated aluminium tape in contact with tinned copper wire braid, optical coverage approx. 65 %	Screen
polyurethane PUR diameter approx. 6.8 mm – AWG 26/19 diameter approx. 8.3 mm – AWG 24/19	aluminium tape laminated to polyethylene PE diameter approx. 12 mm	Outer sheath
approx. 58 kg/km (AWG 26/19) approx. 84 kg/km (AWG 24/19)	approx. 150 kg/km	Weight
5 x cable diameter	8 x cable diameter	Minimum bending radius
		Temperature Range
–40 °C up to +85 °C	–25 °C up to +70 °C	-during operation
–0 °C up to +50 °C	–10 °C up to +50 °C	-during installation
		Electrical Properties
max. 130 Ω/km (AWG 26) max. 95 Ω/km (AWG 24)	max. 57.1 Ω/km	**Conductor resistance**
100 Ω ± 5 Ω	100 Ω ± 5 Ω	Impedance (f = 100 MHz)
100 MHz	1300 MHz	Bandwidth
nominal 45 dB	nominal 80 dB	NEXT at bandwidth frequency
nominal 3.95 dB/10 m (AWG 26) nominal 3.15 dB/10 m (AWG 24)	61.4 dB/100 m	Attenuation at bandwidth frequency
nominal 55 dB	nominal 70 dB	Interference power suppression up to f = 1 GHz
		Other properties
acc. to IEC 60332-1-2	acc. to IEC 60332-2-2	Flame retardant
please see our catalogue datacom-cable and cabling systems or visit our homepage www.leoni-datacom.com		Connectors/Glands

Further cable variations and part numbers on page 19.

Notes:

MegaLine®

Overview of part numbers and cable variations

Industrial Ethernet

Cable		Type description	Size	Colour	Part number
ML 522MSC	with PVC PROFINET Type A, better than CAT 5	KS-2YY(St+C)Y	2 x 2 x AWG 22/1 (Quad)	green	**7KS01674**
ML 522MSC	with PVC PROFINET Type B, better than CAT 5	KS-2YY(St+C)Y	2 x 2 x AWG 22/7 (Quad)	green	**7KS01675**
ML 522MSC	with PUR PROFINET Type C, better than CAT 5	KS-2YH(St+C)11Y	2 x 2 x AWG 22/19 (Quad)	green	**7KS01676**
ML D1-20 SF/U HV	in LSZH zero halogen, flame retardant; better than CAT 5	KS-02YS(St+C)HV	4 x 2 x AWG 24/1	yellow	**7KS50053**
ML D1-20 SF/U 11V	with PUR flexible; better than CAT 5	KS-02YS(St+C)11Y	4 x 2 x AWG 24/1	yellow	**7KS50046**
ML F6-70 S/F HV	flex in LSZH zero halogen, flame retardant; better than CAT 7	KS-02YSCHV	4 x 2 x AWG 24/7 PiMF	yellow	**7KS70139**
ML F6-70 S/F flex	with PUR flexible; better than CAT 7	KS-02YSC11Y	4 x 2 x AWG 24/7 PiMF	yellow	**7KS70139**
ML E5-70 S/F flex	with PUR flexible; better than CAT 6A	KS-02YSC11Y	4 x 2 x AWG 27/7 PiMF	yellow	**7KS60048**
ML D1-20 S/U superflex	with PUR for drag chains; better than cat 5	KS-6Y3GC11Y	4 x 2 x AWG 26/19	yellow	**7KS50051**
ML D1-20 S/U superflex	with PUR for drag chains; better than cat 5	KS-6Y3GC11Y	4 x 2 x AWG 24/19	yellow	**7KS50052**
ML F10-130 S/F	with PE outer sheath for outdoor applications; better than Cat. 7	KS-02YSCH(L)2Y	4 x 2 x AWG 22/1 PiMF	black	**7KS7002U**

PROFIBUS DP was specially designed for rapid cyclic data transmission.

PROFIBUS DP uses RS-485 as a transmission technology for high data rates.

DP – Decentralized Periphery

Cable programme

PROFIBUS DP 150 Ω

The Business Unit Industrial Projects offers products for PROFIBUS DP which are optimised for the miscellaneous applications in automation technology.

The LEONI cable versions fulfil type A according to IEC 61158-2, i.e. the laying-up of cables are pairs with screen. Following cable versions are available:

Characteristics

- **Flame retardant**
- **Permanent installation**
- **Zero halogen**
- **Silicon free**
- **Oil resistant**
- **RoHS compliant**

Following cable versions are available:

Basic

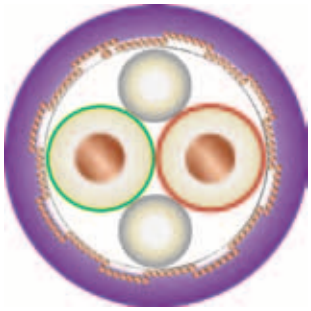
- Standard version for fixed installation.

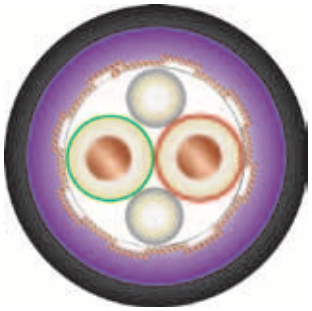
Fast Assembly FA

- Such as standard version Basic, but suitable for fast assembly with special tool (see chapter “assembly” on page 52).

Flex

- Such as standard version Basic, but with 19-strands conductor for flexible installation.

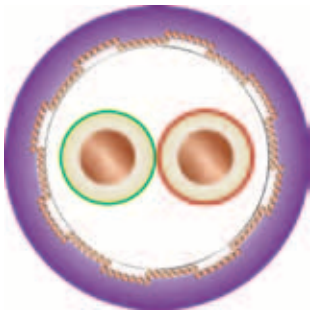


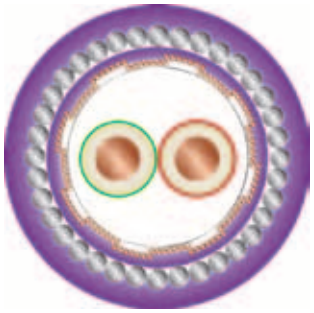


ICON® Bus

Basic 70 °C	Basic with PE sheath 70 °C	Profibus FMS/DP 150 Ω
Spur and trunk cable for fixed installation indoor and outdoor, on racks, in conduits.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial.	Application
		Design
76770501	7677501V	Part. No.
FB-02YS(St+Ce)Y-fl	FB-02YS(St+Ce)Y2Y	**Type description**
1 x 2 x AWG 22/1	1 x 2 x AWG 22/1	Product size
violet	violet	Colour
		Construction
plain annealed copper wire, solid, size: AWG 22	plain annealed copper wire, solid, size: AWG 22	Conductor
foamed polyethylene with skin layer	foamed polyethylene with skin layer	Insulation
(+)-core: green, (-)-core: red	(+)-core: green, (-)-core: red	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	Collective screen
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath
	polyethylene PE	Outer cover
7.5 x cable diameter	7.5 x cable diameter	Min. bending radius
75 kg/km	100 kg/km	Cable weight
		Temperature Range
-30°C up to +70°C	-30°C up to +70°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
110 Ω/km	110 Ω/km	Conductor resistance (loop) max.
12 Ω/km	12 Ω/km	Screen resistance nom.
0.9 mH/km	0.9 mH/km	Inductance nom.
1.5 nF/km	1.5 nF/km	Capacit. unbalance to earth max.
150 Ω ± 15 Ω	150 Ω ± 15 Ω	Impedance at f ≥ 3 MHz
nom. 6 / 9 / 12 / 18 / 40 dB/km	nom. 6 / 9 / 12 / 18 / 40 dB/km	Attenuation at f = 0.25 / 0.625 / 1.25 / 3.125 / 16 MHz
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray) **(without additional PE sheath)**	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c) **(without PE)**	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance
M 16	M 16 / M 12; 9-pin D-sub	Connectors/Glands

Further cable variations, part numbers and UL listed types on page 25.

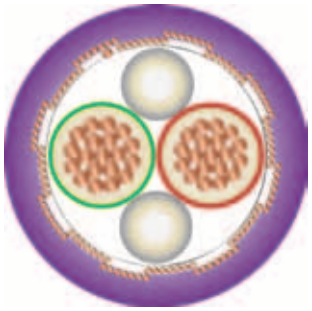


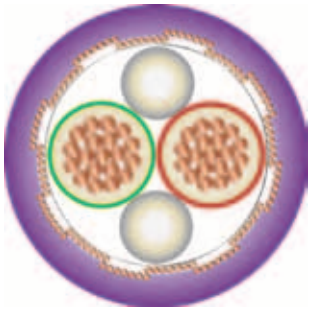


ICON® Bus

ProUIIfibus FMS/DP 150 Ω	Fast Assembly 70 °C	Fast Assembly with steel wire armour 70 °C
Application	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for fast assembly tool.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Recommended for increased mechanical stresses. Suitable for fast assembly tool.
Design		
Part. No.	74220501	7422501U
Type description	FB-02YS(St+C)Y-fl	FB-02YS(St+C)YSWAY-fl
Product size	1 x 2 x AWG 22/1	1 x 2 x AWG 22/1
Colour	violet	violet
Construction		
Conductor	plain annealed copper wire, solid, size: AWG 22	plain annealed copper wire, size: AWG 22
Insulation	foamed polyethylene with skin layer	foamed polyethylene with skin layer
Colour code	(+)-core: green, (-)-core: red	(+)-core: green, (-)-core: red
Collective screen	plastic coated aluminium tape in contact with tinned copper wire braid	plastic coated aluminium tape in contact with tinned copper wire braid
Filling material	extruded copolymer	extruded copolymer
Inner sheath 1 material		polyvinyl chloride PVC
Armour		galvanised round steel wires
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius	7.5 x cable diameter	10 x cable diameter
Outer dia approx.	8.0 ± 0.4 mm	11.7 mm
Cable weight	78 kg/km	275 kg/km
Temperature Range		
- during operation	-30°C up to +70°C	-30°C up to +70°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	110 Ω/km	110 Ω/km
Screen resistance nom.	12 Ω/km	12 Ω/km
nom. Inductance	0.9 mH/km	0.9 mH/km
Capacit. unbalance to earth max.	1.5 nF/km	1.5 nF/km
Impedance at f ≥ 3 MHz	150 Ω ± 15 Ω	150 Ω ± 15 Ω
Attenuation at f = 0.25 / 0.625 / 1.25 / 3.125 / 16 MHz	nom. 6 / 9 / 12 / 18 / 40 dB/km	nom. 6 / 9 / 12 / 18 / 40 dB/km
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200
Connectors/Glands	M 16 / M 12; 9-pin D-sub	M 16 / M 12; 9-pin D-sub

Further cable variations, part numbers and UL listed types on page 25.





ICON® Bus

Flex 70 °C	Flex 70 °C	Profibus FMS/DP 150 Ω
Spur and trunk cable for flexible installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for flexible installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Application
		Design
76770503	82050000	Part. No.
FB-02YS(St+Ce)Y-fl	FB-02YS(St+C)11Y	Type description
1 x 2 x AWG 22/19	1 x 2 x AWG 22/19	Product size
violet	violet	Colour
		Construction
plain annealed copper wire, multi stranded, size: AWG 22	plain annealed copper wire, multi stranded, size: AWG 22	Conductor
foamed polyethylene with skin layer	foamed polyethylene with skin layer	Insulation
(+)-core: green, (-)-core: red	(+)-core: green, (-)-core: red	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape in contact with tinned copper wire braid	Collective screen
polyvinyl chloride PVC	polyurethane PUR	Outer sheath material
10 x cable diameter	10 x cable diameter	Min. bending radius - repeated bending
7.5 x cable diameter	7.5 x cable diameter	- single bending
8.9 mm	7.8 mm	Outer dia approx.
80 kg/km	60 kg/km	Cable weight
		Temperature Range
-30°C up to +70°C	-30°C up to +70°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
110 Ω/km	110 Ω/km	Conductor resistance (loop) max.
12 Ω/km	12 Ω/km	Screen resistance nom.
0.9 mH/km	0.9 mH/km	Inductance nom.
1.5 nF/km	1.5 nF/km	Capacit. unbalance to earth max.
150 Ω ± 15 Ω	150 Ω ± 15 Ω	Impedance at f ≥ 3 MHz
nom. 6 / 9 / 12 / 18 / 40 dB/km	nom. 6 / 9 / 12 / 18 / 40 dB/km	Attenuation at f = 0.25 / 0.625 / 1.25 / 3.125 / 16 MHz
		Other properties
		Flame retardant
UL 13 (vertical tray)		- Test on single cable
IEC 60332-3-24 (Cat. c)		- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200		Sunlight resistance
M 16	M 16 / M 12; 9-pin D-sub	Connectors/Glands

Further cable variations, part num-bers and UL listed types on page 25.

Notes:

ICON® Bus

Overview of part numbers and cable variations

Profibus FMS/DP 150 Ω

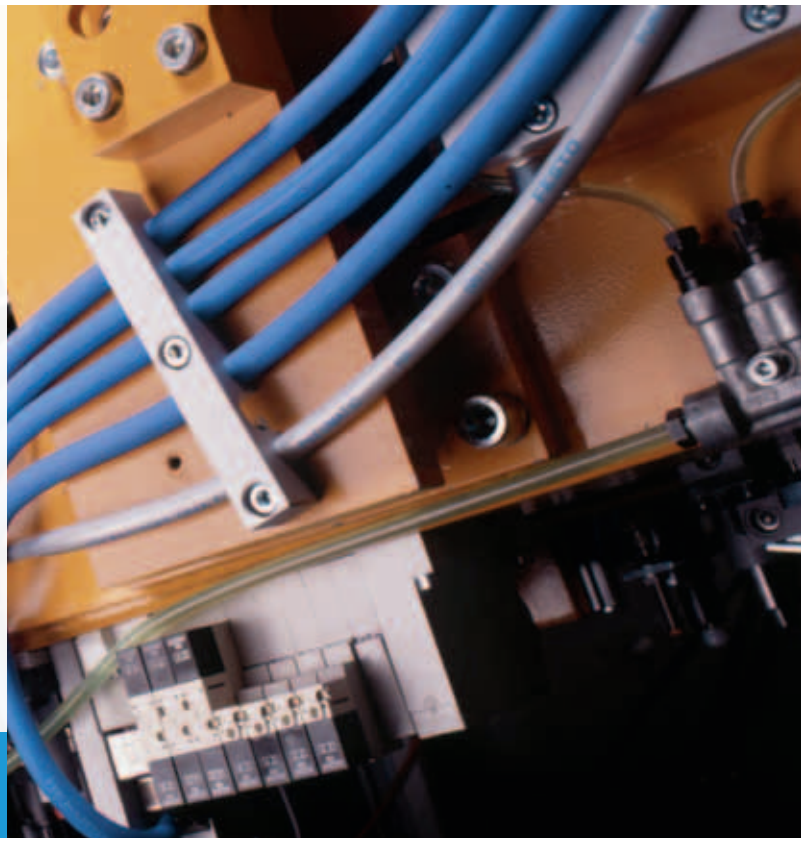
Cable	Type description	Size	Part number			
			UL approval (75 °C)*		EN 50288-7 (70 °C)	
			blue	violet	blue	violet
70 °C / 75 °C						
Basic	FB-02YS(St+Ce)Y-fl	1 x 2 x AWG 22/1	**76770302**	**76770301**	**76770502**	**76770501**
Basic with Padditional PE sheath	FB-02YS(St+Ce)Y2Y	1 x 2 x AWG 22/1	---	---	**7677502V**	**7677501V**
Basic, zero halogen	FB-02YS(St+Ce)H	1 x 2 x AWG 22/1	**79260302**	**79260301**	**79260502**	**79260501**
Basic with steel wire armour	FB-02YS(St+Ce)YSWAY-fl	1 x 2 x AWG 22/1	**7677302U**	**7677301U**	**7677502U**	**7677501U**
Basic with steel wire armour, zero halogen	FB-02YS(St+Ce)HSWAH	1 x 2 x AWG 22/1	**7926302U**	**7926301U**	**7926502U**	**7926501U**
Flex	FB-02YS(St+Ce)Y-fl	1 x 2 x AWG 22/19	**76770304**	**76770303**	**76770504**	**76770503**
Flex with PUR	FB-02YS(St+C)11Y	1 x 2 x AWG 22/19	---	---	**82050001**	**82050000**
Flex, zero halogen	FB-02YS(St+Ce)H	1 x 2 x AWG 22/19	**79260304**	**79260303**	**79260504**	**79260503**
Fast Assembly	FB-02YS(St+C)Y-fl	1 x 2 x AWG 22/1	**74220301**	**74220302**	**74220502**	**74220501**
Fast Assembly with additional PE sheath	FB-02YS(St+C)Y2Y	1 x 2 x AWG 22/1	---	---	**7422502V**	**7422501V**
Fast Assembly, zero halogen	FB-02YS(St+C)H	1 x 2 x AWG 22/1	**74360301**	**74360302**	**74360502**	**74360501**
Fast Assembly, steel wire armour	FB-02YS(St+C)YSWAY-fl	1 x 2 x AWG 22/1	**7422301U**	**7422302U**	**7422502U**	**7422501U**
Fast Assembly, steel wire armour, zero halogen	FB-02YS(St+C)HSWAH	1 x 2 x AWG 22/1	**7436301U**	**7436302W**	---	---
Fast Assembly, steel wire braid, zero halogen	FB-02YS(St+C)HQH	1 x 2 x AWG 22/1	---	---	**7436301V**	**7436302X**

* UL file E107687

The PROFIBUS PA is used in the field of process automation and its special characteristics are power supply over bus and intrinsic safety.

The transmission technology used MBP (Manchester Coded Bus Powered). MBP is synchronous transmission with a fixed transmission rate of 31.25 kbit/s and Manchester-II coding.

The intrinsically safe PROFIBUS PA is connected to the PROFIBUS DP via segments couplers or links.



PA – Process Automation

Cable programme

PROFIBUS PA 100 Ω

The Business Unit Industrial Projects offers products for PROFIBUS PA which are optimised for the miscellaneous applications in automation technology.

The LEONI cable versions fulfil type A according to IEC 61158-2, i.e. the laying-up of cables are pairs with screen.

Characteristics

- **Flame retardant**
- **Permanent installation**
- **Zero halogen**
- **Silicon free**
- **Oil resistant**
- **RoHS compliant**

Following cable versions are available:

Basic

- Standard version for fixed installation.

Fast Assembly FA

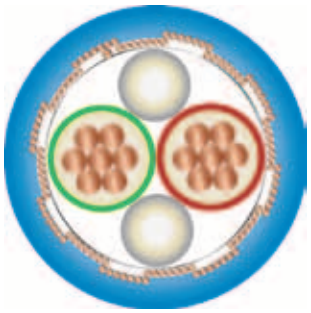
- Such as standard version Basic, but suitable for fast assembly with special tool (see chapter “assembly” on page 66).

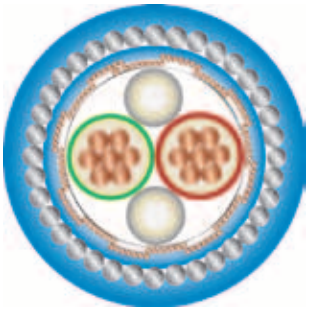
Flex

- Such as standard version Basic, but with 19-strands conductor for flexible installation.

Long Distance

- Version with PE-insulation and sizes AWG 16/7 or AWG 14/7 as trunk cable with reduced voltage drop.

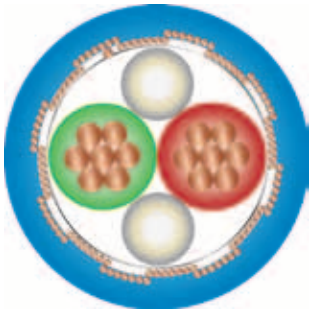


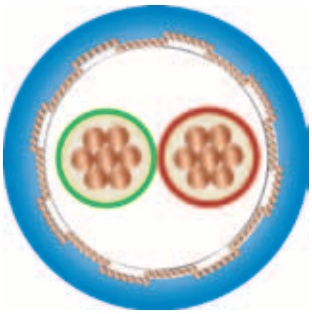


ICON® Bus

Basic 70 °C	Basic with steel wire armour 70 °C	Profibus PA 100 Ω
Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.	Application
		Design
76770601	7677601U	Part. No.
FB-02YS(St+Ce)Y-fl	FB-02YS(St+Ce)YSWAY-fl	Type description
1 x 2 x AWG 18/7	1 x 2 x AWG 18/7	Product size
blue	blue	Colour
		Construction
plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18	Conductor
foamed polyethylene with skin layer	foamed polyethylene with skin layer	Insulation
(+)-core: green, (-)-core: red	(+)-core: green, (-)-core: red	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	Collective screen
--	polyvinyl chloride PVC	Inner sheath
--	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
7.5 x cable diameter	10 x cable diameter	Min. bending radius - repeated bending
7.9 mm	12.0 mm	Outer dia approx.
75 kg/km	275 kg/km	Cable weight
		Temperature Range
-30°C up to +70°C	-30°C up to +70°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
43.6 Ω/km	43.6 Ω/km	Conductor resistance (loop) max.
12 Ω/km	12 Ω/km	Screen resistance nom..
60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom.
2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz max.
1.7 µs/km	1.7 µs/km	Propagation delay change max. (f = 7.9 kHz - 39 kHz)
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cabl
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance
M 16 / M 12	M 16 / M 12	Connectors/Glands

Further cable variations, part numbers and UL listed types on page 31.

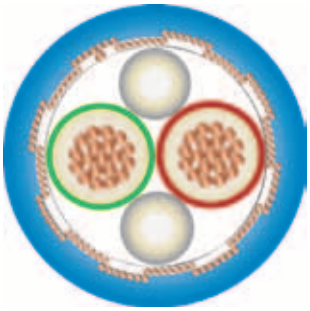


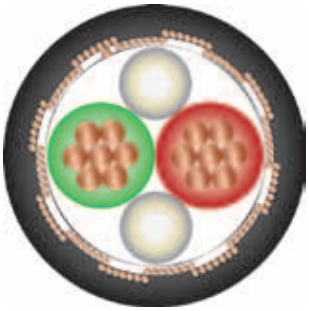


ICON® Bus

Profibus PA 100 Ω	Basic 90 °C	Fast Assembly 70 °C
Application	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for fast assembly tool.
Design		
Part. No.	76990601	74220601
Type description	FB-2X(St+Ce)Y-fl	FB-02YS(St+C)Y-fl
Product size	1 x 2 x AWG 18/7	1 x 2 x AWG 18/7
Colour	blue	blue
Construction		
Conductor	plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18
Insulation	cross-linked polyethylene XLPE	foamed polyethylene with skin layer
Colour code	(+)-core: green, (-)-core: red	(+)-core: green, (-)-core: red
Collective screen	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape in contact with tinned copper wire braid
Filling material		extruded copolymer
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius - repeated bending	7.5 x cable diameter	7.5 x cable diameter
Outer dia approx.	8.1 mm	8.1 mm
Cable weight	85 kg/km	90 kg/km
Temperature Range		
- during operation	-30°C up to +90°C	-30°C up to +70°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	43.6 Ω/km	43.6 Ω/km
Screen resistance nom.	12 Ω/km	12 Ω/km
Mutual capacitance nom.	60 nF/km	60 nF/km
nom. Inductance	0.7 mH/km	0.7 mH/km
Capacit. unbalance to earth max.	2 nF/km	2 nF/km
Impedance at f = 31.25 kHz	100 Ω ± 20 Ω	100 Ω ± 20 Ω
Attenuation at f = 39 kHz max.	3.0 dB/km	3.0 dB/km
Propagation delay change max. (f = 7.9 kHz - 39 kHz)	1.7 µs/km	1.7 µs/km
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200
Connectors/Glands	M 16 / M12	M 16 / M12

Further cable variations, part numbers and UL listed types on page 31.





ICON® Bus

Flex 70 °C	Long Distance 70 °C	Profibus PA 100 Ω
Spur and trunk cable for flexible installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Between Segment-Coupler and "Field-Barrier-Device".	Application
		Design
76770603	79290604	Part. No.
FB-02YS(St+Ce)Y-fl	FB-2Y(St+Ce)Y-fl	Type description
1 x 2 x AWG 18/19	1 x 2 x AWG 14/7	Product size
blue	black	Colour
		Construction
plain annealed copper wire, multi stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 14	Conductor
foamed polyethylene with skin layer	polyethylene PE	Insulation
(+)-core: green, (-)-core: red	(+)-core: green, (-)-core: red	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	Collective screen
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
10 x cable diameter	10 x cable diameter	Min. bending radius - repeated bending
7.5 x cable diameter	7.5 x cable diameter	- single bending
90 kg/km	160 kg/km	Cable weight
		Temperature Range
-30°C up to +70°C	-30°C up to +70°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
43.6 Ω/km	17.9 Ω/km	Conductor resistance (loop) max.
12 Ω/km	12 Ω/km	Screen resistance nom.
60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom.
2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz max.
1.7 µs/km	1.7 µs/km	Propagation delay change max. (f = 7.9 kHz - 39 kHz)
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance
M 16 / M 12	M 16 / M 12	Connectors/Glands

Further cable variations, part numbers and UL listed types on page 31.

Notes:

ICON® Bus

Overview of part numbers and cable variations

Profibus PA 100 Ω

Cable	Type description	Size	Part number			
			UL-approved (75 °C)		EN 50288-7 (70 °C)	
			black	blue	black	blue
70 °C / 75 °C						
Basic	FB-02YS(St+Ce)Y-fl	1 x 2 x AWG 18/7	**76770101**	**76770100**	**76770602**	**76770601**
Basic, zero halogen	FB-02YS(St+Ce)H	1 x 2 x AWG 18/7	**79260101**	**79260100**	**79260602**	**79260601**
Basic with steel wire armour	FB-02YS(St+Ce)YSWAY-fl	1 x 2 x AWG 18/7	**7677101V**	**7677100V**	**7677602U**	**7677601U**
Basic with steel wire armour, zero halogen	FB-02YS(St+Ce)HSWAH	1 x 2 x AWG 18/7	**7926101U**	**7926100U**	**7926602U**	**7926601U**
Fast Assembly	FB-02YS(St+C)Y-fl	1 x 2 x AWG 18/7	**74220101**	**74220100**	**74220602**	**74220601**
Fast Assembly, zero halogen	FB-02YS(St+C)H	1 x 2 x AWG 18/7	**74360101**	**74360100**	**74360602**	**74360601**
Flex	FB-02YS(St+Ce)Y-fl	1 x 2 x AWG 18/19	**76770201**	**76770200**	**76770604**	**76770603**
Flex, zero halogen	FB-02YS(St+Ce)H	1 x 2 x AWG 18/19	**79260201**	**79260202**	**79260604**	**79260603**
Long Distance	FB-2Y(St+Ce)Y-fl	1 x 2 x AWG 14/7	**79290103**	**79290102**	**79290604**	**79290603**
Long Distance, zero halogen	FB-2Y(St+Ce)H	1 x 2 x AWG 14/7	**79300103**	**79300102**	**79300604**	**79300603**
			UL-approved (90 °C)		EN 50288-7 (90 °C)	
			black	blue	black	blue
90 °C						
Basic with XLPE Insulation	FB-2X(St+Ce)Y-fl	1 x 2 x AWG 18/7	**76990101**	**76990100**	**76990602**	**76990601**

* UL file E107687

With the FOUNDATION™ Fieldbus, the "host device" only monitors the procedures. Within process automation, the FF forms a so-called LAN (Local Area Network) and the FF devices are connected to H1 links. Several H1 links are connected to the high-performance network HSE High-Speed-Ethernet via linking devices. Individual devices can also be directly connected to the HSE network.

Bus system for process automation

Cable programme

FOUNDATION™ Fieldbus 100 Ω

The Business Unit Industrial Projects offers products for the FOUNDATION™ Fieldbus which are optimised for the miscellaneous applications in automation technology.

The LEONI cable versions fulfil type A according to IEC 61158-2, i.e. the laying-up of cables are pairs with screen.

Characteristics

- **Flame retardant**
- **Permanent installation**
- **Zero halogen**
- **Silicon free**
- **Oil resistant**
- **RoHS compliant**

Following cable versions are available:

Basic

- Standard version for fixed installation.

Fast Assembly FA

- Such as standard version Basic, but suitable for fast assembly with special tool (see chapter "assembly" on page 66).

Flex

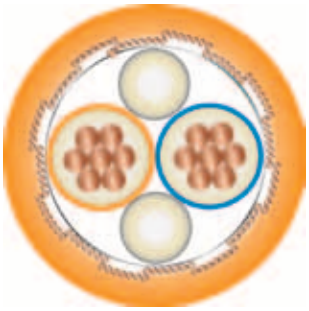
- Such as standard version Basic, but with 19-strands conductor for flexible installation.

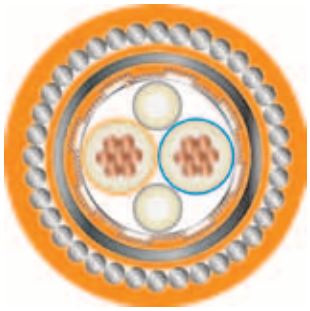
Eco

- Such as standard Basic, but without braided screen.

Long Distance

- Version with PE-Insulation and sizes AWG 16/7 or AWG 14/7 as trunk cable with reduced voltage drop.

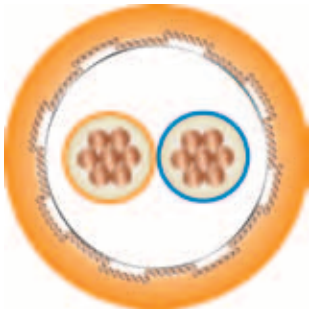


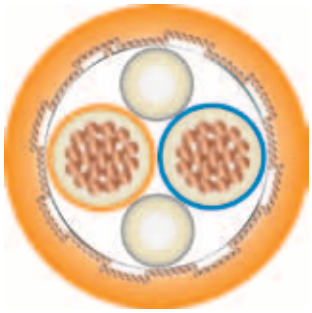


ICON® Bus

Basic 70 °C	Basic 70 °C, lead sheath with steel wire armour	FOUNDATION Fieldbus H1 100 Ω
Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Recommended for direct burial, especially in presence of oil and aggressive chemical substances.	Application
		Design
76770605	82380002	Part. No.
FB-02YS(St+Ce)Y-fl	FB-02YS(St+Ce)YMYSWAY-fl	Type description
1 x 2 x AWG 18/7	1 x 2 x AWG 18/7	Product size
orange	orange	Colour
		Construction
plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18	Conductor
foamed polyethylene with skin layer	foamed polyethylene with skin layer	Insulation
(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	Collective screen
	polyvinyl chloride PVC, orange	Inner sheath 1
	lead sheath	Metallic sheath
	polyvinyl chloride PVC, orange	Inner sheath 2
	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
7.5 x cable diameter	15 x cable diameter	Min. bending radius
7.9 mm	16.3 mm	Outer dia approx.
75 kg/km	710 kg/km	Cable weight
		Temperature Range
-30°C up to +70°C	-30°C up to +70°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
43.6 Ω/km	43.6 Ω/km	Conductor resistance (loop) max.
12 Ω/km	12 Ω/km	Screen resistance nom.
60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom.
2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz max.
1.7 µs/km	1.7 µs/km	Propagation delay change max. (f = 7.9 kHz - 39 kHz)
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
EC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance
M 16 / M 12	M 16 / M 12	Connectors/Glands

Further cable variations, part numbers and UL listed types on page 46.





ICON® Bus

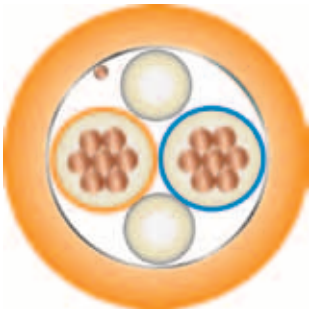
FOUNDATION™ Fieldbus H1 100 Ω	Fast Assembly 70 °C	Flex 70 °C
Application	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for fast assembly tool.	Spur and trunk cable for flexible installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.
Design		
Part. No.	74220603	76770607
Type description	FB-02YS(St+C)Y-fl	FB-02YS(St+Ce)Y-fl
Product size	1 x 2 x AWG 18/7	1 x 2 x AWG 18/19
Colour	orange	orange
Construction		
Conductor	plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, multi stranded, size: AWG 18
Insulation	foamed polyethylene with skin layer	foamed polyethylene with skin layer
Colour code	(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue
Collective screen	plastic coated aluminium tape in contact with tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid
Filling material	extruded copolymer	
Inner sheath 1 material		
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius	7.5 x cable diameter	7.5 x cable diameter
Cable weight	95 kg/km	90 kg/km
Temperature Range		
- during operation	-30°C up to +70°C	-30°C up to +70°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	43.6 Ω/km	43.6 Ω/km
Screen resistance nom.	12 Ω/km	12 Ω/km
Mutual capacitance nom.	60 nF/km	60 nF/km
Inductance nom	0.7 mH/km	0.7 mH/km
Capacit. unbalance to earth max.	2 nF/km	2 nF/km
Impedance at f = 31.25 kHz	100 Ω ± 20 Ω	100 Ω ± 20 Ω
Attenuation at f = 39 kHz max.	3.0 dB/km	3.0 dB/km
Propagation delay change max. (f = 7.9 kHz - 39 kHz)	1.7 µs/km	1.7 µs/km
Other properties		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200
Connectors/glands	M 16 / M12	M 16 / M12

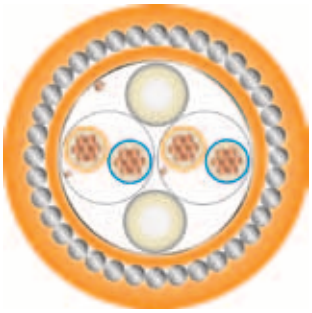
Further cable variations, part numbers and UL listed types on page 46.

ICON® Bus

Long Distance 70 °C AWG 16	Long Distance 70 °C AWG 14	FOUNDATION Fieldbus H1 100 Ω
Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Between Segment-Coupler and "Field-Barrier-Device". Recommended for use as fire protection measure for people and important material assets.	Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Between Segment-Coupler and "Field-Barrier-Device". Recommended for use as fire protection measure for people and important material assets.	Application
		Design
79300605	79300607	Part. No.
FB-2Y(St+Ce)H	FB-2Y(St+Ce)H	Type description
1 x 2 x AWG 16/7	1 x 2 x AWG 14/7	Product size
orange	orange	Colour
		Construction
plain annealed copper wire, stranded, size: AWG 16	plain annealed copper wire, stranded, size: AWG 14	Conductor
polyethylene PE	polyethylene PE	Insulation
(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	Collective screen
low smoke zero halogen flame retardant compound LSZH	low smoke zero halogen flame retardant compound LSZH	Outer sheath material
7.5 x cable diameter	7.5 x cable diameter	Min. bending radius - repeated bending
115 kg/km	160 kg/km	Cable weight
		Temperature Range
-30°C up to +70°C	-30°C up to +70°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
28.5 Ω/km	17.9 Ω/km	Conductor resistance (loop) max.
12 Ω/km	12 Ω/km	Screen resistance nom.
60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom
2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz max.
1.7 µs/km	1.7 µs/km	Propagation delay change max. (f = 7.9 kHz - 39 kHz)
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532 (*)	ICEA S-73-532 (*)	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance
M 16	M 16	Connectors / glands

Further cable variations, part numbers and UL listed types on page 46.

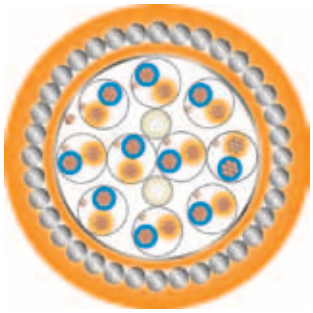




ICON® Bus

FOUNDATION™ Fieldbus H1 100 Ω	Eco 70 °C	Eco 70 °C with steel wire armour
Application	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.
Design		
Part. No.	74250601	7425601U
Type description	FB-02YS(St)Y-fl	FB-02YS(St)YSWAY-fl
Product size	1 x 2 x AWG 18/7	1 x 2 x AWG 18/7
Colour	orange	orange
Construction		
Conductor	plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18
Insulation	foamed polyethylene with skin layer	foamed polyethylene with skin layer
Colour code	(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue
Collective screen	plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire
Inner sheath 1 material		polyvinyl chloride PVC, orange
Armour		galvanised round steel wires
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius - repeated bending	7.5 x cable diameter	10 x cable diameter
Outer dia.	8.2 mm	11.8 mm
Cable weight	85 kg/km	260 kg/km
Temperature Range		
- during operation	-30°C up to +70°C	-30°C up to +70°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	43.6 Ω/km	43.6 Ω/km
Screen resistance nom.	30 Ω/km	30 Ω/km
Mutual capacitance nom.	60 nF/km	60 nF/km
Inductance nom	0.7 mH/km	0.7 mH/km
Capacit. unbalance to earth max.	2 nF/km	2 nF/km
Impedance at f = 31.25 kHz	100 Ω ± 20 Ω	100 Ω ± 20 Ω
Attenuation at f = 39 kHz max.	3.0 dB/km	3.0 dB/km
Propagation delay change max. (f = 7.9 kHz - 39 kHz)	1.7 µs/km	1.7 µs/km
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200
Connectors/glands	M 16 / M 12	M 16 / M 12

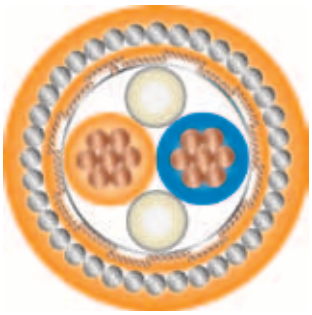
Further cable variations, part numbers and UL listed types on page 46.



ICON® Bus

Multipair 70 °C with steel wire armour	Multipair 70 °C with steel wire armour	FOUNDATION Fieldbus H1 100 Ω
Trunk cable for fixed installation indoor and outdoor, on racks, in conduits. Suitable for direct burial and increased mechanical stresses.	Trunk cable for fixed installation indoor and outdoor, on racks, in conduits. Suitable for direct burial and increased mechanical stresses.	Application
		Design
74790009	74790010	Part. No.
FB-02YS(St)YSWAY-fl PiMF	FB-02YS(St)YSWAY-fl PiMF	Type description
5 x 2 x AWG 18/7 PiMF	10 x 2 x AWG 18/7 PiMF	Product size
orange	orange	Colour
		Construction
plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18	Conductor
foamed polyethylene with skin layer	foamed polyethylene with skin layer	Insulation
(+)-core: orange, (-)-core: blue, element identification with numbered tapes	(+)-core: orange, (-)-core: blue, element identification with numbered tapes	Colour code
plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire	Induvidual and collective screen
polyvinyl chloride PVC, orange	polyvinyl chloride PVC, orange	Inner sheath 1 material
galvanised round steel wires	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
10 x cable diameter	10 x cable diameter	Min. bending radius - repeated bending
19.9 mm	25.9 mm	Outer dia. nom
770 kg/km	1140 kg/km	Cable weight
		Temperature Range
-30°C up to +70°C	-30°C up to +70°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
43.6 Ω/km	43.6 Ω/km	Conductor resistance (loop) max.
30 Ω/km	30 Ω/km	Screen resistance nom.
60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom
2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz
1.7 µs/km	1.7 µs/km	Propagation delay change max. (f = 7.9 kHz - 39 kHz)
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance

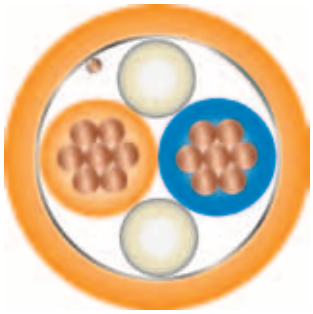
Further cable variations, part numbers and UL listed types on page 46.

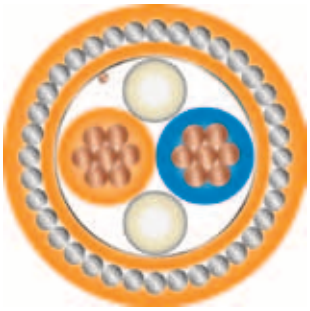


ICON® Bus

FOUNDATION™ Fieldbus H1 100 Ω	Basic 90 °C	Basic 90 °C with steel wire armour
Application	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.
Design		
Part. No.	76990000	77580003
Type description	FB-2X(St+Ce)Y-fl	FB-2X(St+Ce)YSWAY-fl
Product size	1 x 2 x AWG 18/7	1 x 2 x AWG 18/7
Colour	orange	orange
Construction		
Conductor	plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18
Insulation	cross-linked polyethylene XLPE	cross-linked polyethylene XLPE
Colour code	(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue
Collective screen	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid
Inner sheath 1 material		polyvinyl chloride PVC, orange
Armour		galvanised round steel wires
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius	7.5 x cable diameter	10 x cable diameter
Outer dia approx.	8.1 mm	12.7 mm
Cable weight	90 kg/km	300 kg/km
Temperature Range		
- during operation	-30°C up to +90°C	-30°C up to +90°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	43.6 Ω/km	43.6 Ω/km
Screen resistance nom.	12 Ω/km	12 Ω/km
Mutual capacitance nom.	60 nF/km	60 nF/km
Inductance nom.	0.7 mH/km	0.7 mH/km
Capacit. unbalance to earth max.	2 nF/km	2 nF/km
Impedance at f = 31.25 kHz	100 Ω ± 20 Ω	100 Ω ± 20 Ω
Attenuation at f = 39 kHz max.	3.0 dB/km	3.0 dB/km
Propagation delay change max. (f = 7.9 kHz - 39 kHz)	1.7 µs/km	1.7 µs/km
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200
Connectors/glands	M 16 / M 12	M 16 / M 12

Further cable variations, part numbers and UL listed types on page 46.

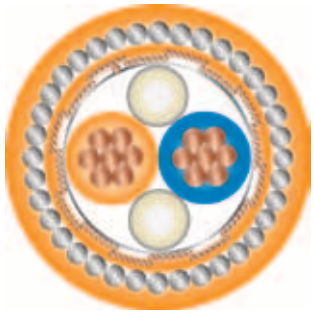




ICON® Bus

Eco 90 °C	Eco 90 °C with steel wire armour	Eco 90 °C with corrugated steel tape	FOUNDATION™ Fieldbus H1 100 Ω
Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.	Application
			Design
80830005	80830006	82560001	Part. No.
FB-2X(St)Y-fl	FB-2X(St)YSWAY-fl	FB-2X(St)Y(SR)Y-fl	Type description
1 x 2 x AWG 18/7	1 x 2 x AWG 18/7	1 x 2 x AWG 18/7	Product size
orange	orange	orange	Colour
			Construction
plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18	Conductor
cross-linked polyethylene XLPE	cross-linked polyethylene XLPE	cross-linked polyethylene XLPE	Insulation
(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue	Colour code
plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire	Collective screen
	polyvinyl chloride PVC, orange	polyvinyl chloride PVC, orange	Inner sheath 1 material
	galvanised round steel wires	corrugated steel tape	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
7.5 x cable diameter	10 x cable diameter	10 x cable diameter	Min. bending radius
			Temperature Range
-30°C up to +90°C	-30°C up to +90°C	-30°C up to +90°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	-5°C up to +50°C	- during installation
			Electrical Properties at 20 °C
43.6 Ω/km	43.6 Ω/km	43.6 Ω/km	Conductor resistance (loop) max.
30 Ω/km	30 Ω/km	30 Ω/km	Screen resistance nom.
60 nF/km	60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	0.7 mH/km	Inductance nom.
2 nF/km	2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz max.
1.7 µs/km	1.7 µs/km	1.7 µs/km	Propagation delay change max. (f = 7.9 kHz - 39 kHz)
			Other properties
			Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance
M 16 / M 12	M 16 / M 12	M 16 / M 12	Connectors/Glands

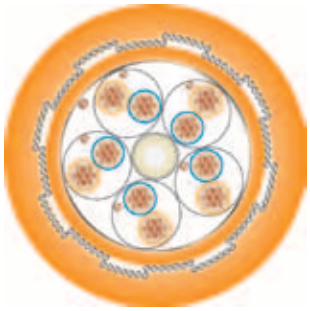
Further cable variations, part numbers and UL listed types on page 46.

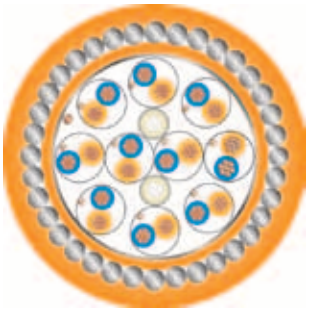


ICON® Bus

FOUNDATION™ Fieldbus H1 100 Ω	Long Distance 90 °C	Long Distance 90 °C with steel wire armour
Application	Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Between Segment-Coupler and "Field-Barrier-Device".	Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Between Segment-Coupler and "Field-Barrier-Device". Suitable for direct burial and increased mechanical stresses.
Design		
Part. No.	76990001	77580022
Type description	FB-2X(St+Ce)Y-fl	FB-2X(St+Ce)YSWAY-fl
Product size	1 x 2 x AWG 16/7	1 x 2 x AWG 14/7
Colour	orange	orange
Construction		
Conductor	plain annealed copper wire, stranded, size: AWG 16	plain annealed copper wire, stranded, size: AWG 14
Insulation	cross-linked polyethylene XLPE	cross-linked polyethylene XLPE
Colour code	(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue
Collective screen	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid
Inner sheath 1 material		polyvinyl chloride PVC, orange
Armour		galvanised round steel wires
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius	7.5 x cable diameter	10 x cable diameter
Outer dia.	9.4 mm	16 mm
Cable weight	115 kg/km	450 kg/km
Temperature Range		
- during operation	-30°C up to +90°C	-30°C up to +90°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	28.5 Ω/km	17.9 Ω/km
Screen resistance nom.	12 Ω/km	12 Ω/km
Mutual capacitance nom.	60 nF/km	60 nF/km
Inductance nom	0.7 mH/km	0.7 mH/km
Capacit. unbalance to earth max.	2 nF/km	2 nF/km
Impedance at f = 31.25 kHz	100 Ω ± 20 Ω	100 Ω ± 20 Ω
Attenuation at f = 39 kHz max.	3.0 dB/km	3.0 dB/km
Propagation delay change max (f = 7.9 kHz - 39 kHz)	1.7 µs/km	1.7 µs/km
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200
Connectors/glands	M 16 / M 12	M 16 / M 12

Further cable variations, part numbers and UL listed types on page 46.

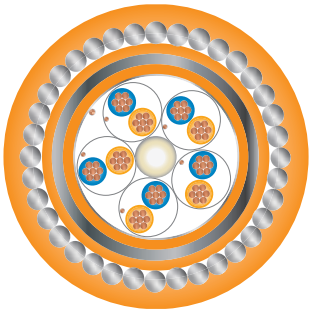


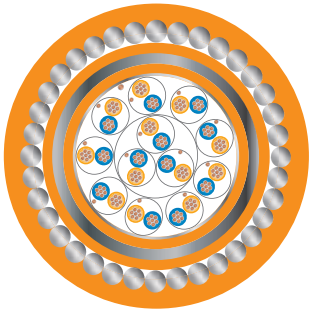


ICON® Bus

Multipair 90 °C with steel wire armour	Multipair 90 °C with steel wire armour	FOUNDATION™ Fieldbus H1 100 Ω
Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.	Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.	Application
		Design
75370025	75370026	Part. No.
FB-2X(St)YSWAY-fl PiMF	FB-2X(St)YSWAY-fl PiMF	Type description
5 x 2 x AWG 18/7 PiMF	10 x 2 x AWG 18/7 PiMF	Product size
orange	orange	Colour
		Construction
plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18	Conductor
cross-linked polyethylene XLPE	cross-linked polyethylene XLPE	Insulation
(+)-core: orange, (-)-core: blue, element identification with numbered tapes	(+)-core: orange, (-)-core: blue, element identification with numbered tapes	Colour code
plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire	Individual and collecitve screen
polyvinyl chloride PVC, orange	polyvinyl chloride PVC, orange	Inner sheath 1 material
galvanised round steel wires	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
10 x cable diameter	10 x cable diameter	Min. bending radius
19.9 mm	25.9 mm	Outer dia approx.
770 kg/km	1140 kg/km	Cable weight
		Temperature Range
-30°C up to +90°C	-30°C up to +90°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
43.6 Ω/km	43.6 Ω/km	Conductor resistance (loop) max.
30 Ω/km	30 Ω/km	Screen resistance nom.
60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom.
2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz max
1.7 µs/km	1.7 µs/km	Propagation delay change max (f = 7.9 kHz - 39 kHz)
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance
M 16 / M 12	M 16 / M 12	Connectors/Glands

Further cable variations, part numbers and UL listed types on page 46.

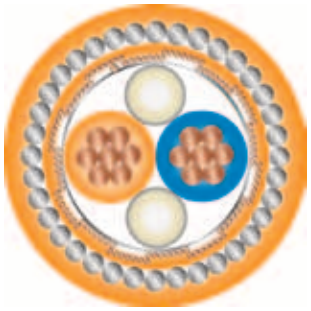




ICON® Bus

FOUNDATION™ Fieldbus H1 100 Ω	Multipair 90 °C, lead sheath with steel wire armour	Multipair 90 °C with steel wire armour, lead sheath
Application	Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Recommended for direct burial, especially in presence of oil and aggressive chemical substances.	Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Recommended for direct burial, especially in presence of oil and aggressive chemical substances.
Design		
Part. No.	82310004	82310005
Type description	FB-2X(St)YMYSWAY-fl PiMF	FB-2X(St)YMYSWAY-fl PiMF
Product size	5 x 2 x AWG 18/7 PiMF	10 x 2 x AWG 18/7 PiMF
Colour	orange	orange
Construction		
Conductor	plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18
Insulation	cross-linked polyethylene XLPE	cross-linked polyethylene XLPE
Colour code	(+)-core: orange, (-)-core: blue, element identification with numbered tapes	(+)-core: orange, (-)-core: blue, element identification with numbered tapes
Individual screen	plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire
Inner sheath 1 material	polyvinyl chloride PVC, orange	polyvinyl chloride PVC, orange
Metallic sheath	lead sheath	lead sheath
Inner sheath 2	polyvinyl chloride PVC	polyvinyl chloride PVC
Armour	galvanised round steel wires	galvanised round steel wires
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius	15 x cable diameter	15 x cable diameter
Outer dia approx.	26.9 mm	33.0 mm
Cable weight	1820 kg/km	2700 kg/km
Temperature Range		
- during operation	-30°C up to +90°C	-30°C up to +90°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	43.6 Ω/km	43.6 Ω/km
Screen resistance nom.	30 Ω/km	30 Ω/km
Mutual capacitance nom.	60 nF/km	60 nF/km
Inductance nom.	0.7 mH/km	0.7 mH/km
Capacit. unbalance to earth max.	2 nF/km	2 nF/km
Impedance at f = 31.25 kHz	100 Ω ± 20 Ω	100 Ω ± 20 Ω
Attenuation at f = 39 kHz max.	3.0 dB/km	3.0 dB/km
Propagation delay change max. (f = 7.9 kHz - 39 kHz)	1.7 µs/km	1.7 µs/km
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200

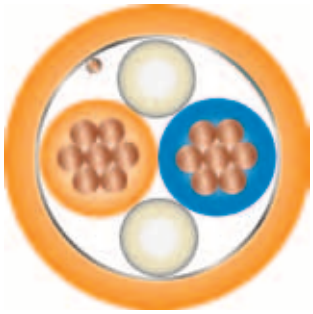
Further cable variations, part numbers and UL listed types on page 46.

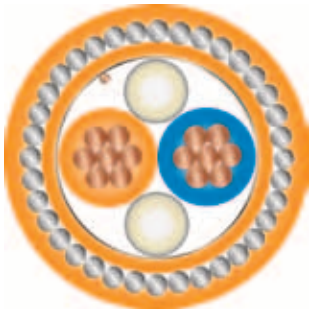


ICON® Bus

Basic 105 °C	Basic 105 °C with steel wire armour	FOUNDATION™ Fieldbus H1 100 Ω
Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.	Application
		Design
82460002	81370000	Part. No.
FB-9Y(St+Ce)Yw-fl	FB-9Y(St+Ce)YwSWAYw-fl	Type description
1 x 2 x AWG 18/7	1 x 2 x AWG 18/7	Product size
orange	orange	Colour
		Construction
plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18	Conductor
thermoplastic polyolefin compound	thermoplastic polyolefin compound	Insulation
(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid	Collective screen
	polyvinyl chloride PVC, orange	Inner sheath 1 material
	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
7.5 x cable diameter	10 x cable diameter	Min. bending radius
7.7 mm	12.9 mm	Outer dia approx.
80 kg/km	315 kg/km	Cable weight
		Temperature Range
-30°C up to +105°C	-30°C up to +105°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
43.6 Ω/km	43.6 Ω/km	Conductor resistance (loop) max.
12 Ω/km	12 Ω/km	Screen resistance nom.
60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom.
2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz max.
1.7 µs/km	1.7 µs/km	Propagation delay change max (f = 7.9 kHz - 39 kHz)
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance
M 16 / M 12	M 16 / M 12	Connectors/Glands

Further cable variations, part numbers and UL listed types on page 46.

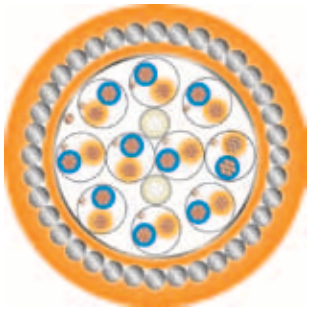




ICON® Bus

FOUNDATION™ Fieldbus H1 100 Ω	Eco 105 °C	Multipair 105 °C with steel wire armour
Application	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations.	Spur and trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.
Design		
Part. No.	83170000	89880000
Type description	FB-9Y(St)Yw-fl	FB-9Y(St)YwSWAYw-fl
Product size	1 x 2 x AWG 18/7	1 x 2 x AWG 18/7
Colour	orange	orange
Construction		
Conductor	plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18
Insulation	thermoplastic polyolefin compound	thermoplastic polyolefin compound
Colour code	(+)-core: orange, (-)-core: blue	(+)-core: orange, (-)-core: blue
Collective screen	plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire
Inner sheath 1 material		polyvinyl chloride PVC, orange
Armour		galvanised round steel wires
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius	7.5 x cable diameter	10 x cable diameter
Outer dia approx.	8.1 mm	12.7 mm
Cable weight	75 kg/km	290 kg/km
Temperature Range		
- during operation	-30°C up to +105°C	-30°C up to +105°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	43.6 Ω/km	43.6 Ω/km
Screen resistance nom.	30 Ω/km	30 Ω/km
Mutual capacitance nom.	60 nF/km	60 nF/km
Inductance nom.	0.7 mH/km	0.7 mH/km
Capacit. unbalance to earth max.	2 nF/km	2 nF/km
Impedance at f = 31.25 kHz	100 Ω ± 20 Ω	100 Ω ± 20 Ω
Attenuation at f = 39 kHz max.	3.0 dB/km	3.0 dB/km
Propagation delay change max. (f = 7.9 kHz - 39 kHz)	1.7 µs/km	1.7 µs/km
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200

Further cable variations, part numbers and UL listed types on page 46.



ICON® Bus

Multipair 105 °C with steel wire armour	Multipair 105 °C with steel wire armour	FOUNDATION™ Fieldbus H1 100 Ω
Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.	Trunk cable for fixed installation indoor and outdoor, on racks, trays, in conduits, in dry and wet locations. Suitable for direct burial and increased mechanical stresses.	Application
		Design
89880002	89880003	Part. No.
FB-9Y(St)YwSWAYw-fl PiMF	FB-9Y(St)YwSWAYw-fl PiMF	Type description
5 x 2 x AWG 18/7 PiMF	10 x 2 x AWG 18/7 PiMF	Product size
orange	orange	Colour
		Construction
plain annealed copper wire, stranded, size: AWG 18	plain annealed copper wire, stranded, size: AWG 18	Conductor
thermoplastic polyolefin compound	thermoplastic polyolefin compound	Insulation
(+)-core: orange, (-)-core: blue, element identification with numbered tapes	(+)-core: orange, (-)-core: blue, element identification with numbered tapes	Colour code
plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire	Individual and collective screen
polyvinyl chloride PVC, orange	polyvinyl chloride PVC, orange	Inner sheath 1 material
galvanised round steel wires	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
10 x cable diameter	10 x cable diameter	Min. bending radius
19.9 mm	25.9 mm	Outer dia approx.
770 kg/km	1140 kg/km	Cable weight
		Temperature Range
-30°C up to +105°C	-30°C up to +105°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
43.6 Ω/km	43.6 Ω/km	Conductor resistance (loop) max.
30 Ω/km	30 Ω/km	Screen resistance nom.
60 nF/km	60 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom.
2 nF/km	2 nF/km	Capacit. unbalance to earth max.
100 Ω ± 20 Ω	100 Ω ± 20 Ω	Impedance at f = 31.25 kHz
3.0 dB/km	3.0 dB/km	Attenuation at f = 39 kHz max.
1.7 µs/km	1.7 µs/km	Propagation delay change max. (f = 7.9 kHz - 39 kHz)
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance

Further cable variations, part numbers and UL listed types on page 46.

ICON® Bus

FOUNDATION™ Fieldbus H1 100 Ω

Overview of part numbers and cable variations

Cable	Type description	Size	Part number			
			UL-approval (75 °C)*		EN 50288-7 (70 °C)	
			orange	blue	orange	blue
70 °C / 75 °C						
Basic	FB-02YS(St+Ce)Y-fl	1 x 2 x AWG 18/7	**76770102**	**76770103**	**76770605**	**76770606**
Basic, zero halogen	FB-02YS(St+Ce)H	1 x 2 x AWG 18/7	**79260102**	**79260103**	**79260605**	**79260606**
Basic with steel wire armour	FB-02YS(St+Ce)YSWAY-fl	1 x 2 x AWG 18/7	**7677102U**	**7677103U**	**7677605U**	**7677606U**
Basic with steel wire armour, zero halogen	FB-02YS(St+Ce)HSWAH	1 x 2 x AWG 18/7	**7926102U**	**7422302W**	---	---
Basic with steel wire armour, lead sheath	FB-02YS(St+Ce)YMYSWAY-fl	1 x 2 x AWG 18/7	---	---	**82380002**	**82380003**
Fast Assembly	FB-02YS(St+C)Y-fl	1 x 2 x AWG 18/7	**74220103**	**74220102**	**74220603**	**74220604**
Fast Assembly, zero halogen	FB-02YS(St+C)H	1 x 2 x AWG 18/7	**74360103**	**74360102**	**74360603**	**74360604**
Flex	FB-02YS(St+Ce)Y-fl	1 x 2 x AWG 18/19	**76770203**	**76770202**	**76770607**	**76770608**
Flex,zero halogen	FB-02YS(St+Ce)H	1 x 2 x AWG 18/19	**79260203**	**79260202**	**79260607**	**79260608**
Long Distance	FB-2Y(St+Ce)Y-fl	1 x 2 x AWG 14/7	**79290107**	**79290106**	**79290607**	**79290608**
Long Distance	FB-2Y(St+Ce)Y-fl	1 x 2 x AWG 16/7	**76290105**	**76290104**	**76290605**	**76290606**
Long Distance, zero halogen	FB-2Y(St+Ce)H	1 x 2 x AWG 14/7	**79300107**	**79300106**	**79300607**	**79300608**
Long Distance, zero halogen	FB-2Y(St+Ce)H	1 x 2 x AWG 16/7	**79300105**	**79300104**	**79300606**	**79300605**
Long Distance with steel wire armour	FB-2Y(St+Ce)YSWAY-fl	1 x 2 x AWG 16/7	**82030000**	**82030001**	---	---
Eco	FB-02YS(St)Y-fl	1 x 2 x AWG 18/7	**74250100**	**74250101**	**74250601**	**74250602**
Eco, zero halogen	FB-02YS(St)H	1 x 2 x AWG 18/7	**79270100**	**79270101**	**79270601**	**79270602**
Eco with steel wire armour	FB-02YS(St)YSWAY-fl	1 x 2 x AWG 18/7	**74150022**	**74150021**	**7425601U**	**7425602U**
Eco with steel wire armour, zero halogen	FB-02YS(St)HSWAH	1 x 2 x AWG 18/7	**82430003**	**82430002**	---	---
Multipair	FB-02YS(St)Y-fl PiMF	2 x 2 x AWG 18/7PiMF	---	---	**74250008**	**74250009**
Multipair with steel wire armour	FB-02YS(St)YSWAY-fl PiMF	2 x 2 x AWG 18/7PiMF	---	---	**74790008**	**74790038**
Multipair with steel wire armour	FB-02YS(St)YSWAY-fl PiMF	5 x 2 x AWG 18/7PiMF	---	---	**74790009**	**74790030**
Multipair with steel wire armour	FB-02YS(St)YSWAY-fl PiMF	10 x 2 x AWG 18/7PiMF	---	---	**74790010**	**74790040**

* UL file E107687

ICON® Bus

FOUNDATION™ Fieldbus H1 100 Ω

Overview of part numbers and cable variations

Cable	Type description	Size	Part number			
			UL-approval		EN 50288-7	
			orange	blue	orange	blue
90 °C						
Basic	FB-2X(St+Ce)Y-fl	1 x 2 x AWG 18/7	**76990007**	**76990008**	**76990000**	**76990003**
Basic, zero halogen	FB-2X(St+Ce)H	1 x 2 x AWG 18/7	---	---	**82330000**	**82330003**
Basic with steel wire armour	FB-2X(St+Ce)YSWAY-fl	1 x 2 x AWG 18/7	**77580023**	**77580024**	**77580003**	**77580018**
Basic with steel wire armour, zero halogen	FB-2X(St+Ce)HSWAH	1 x 2 x AWG 18/7	---	---	**82340000**	---
Long Distance	FB-2X(St+Ce)Y-fl	1 x 2 x AWG 14/7	**76990012**	**76990010**	**76990006**	**76990005**
Long Distance	FB-2X(St+Ce)Y-fl	1 x 2 x AWG 16/7	**76990011**	**76990009**	**76990001**	**76990004**
Long Distance, zero halogen	FB-2X(St+Ce)H	1 x 2 x AWG 16/7	---	---	**82330001**	**82330002**
Long Distance with steel wire armour	FB-2X(St+Ce)YSWAY-fl	1 x 2 x AWG 14/7	**77580028**	**77580026**	**77580022**	**77580021**
Long Distance with steel wire armour	FB-2X(St+Ce)YSWAY-fl	1 x 2 x AWG 16/7	**77580027**	**77580025**	**77580020**	**77580019**
Long Distance w. steel wire armour, zero halogen	FB-2X(St+Ce)HSWAH	1 x 2 x AWG 16/7	---	---	**82340001**	**82340002**
Multipair with steel wire armour	FB-2X(St)YSWAY-fl PiMF	2 x 2 x AWG 16/7 PiMF	---	---	**72410003**	---
Multipair with steel wire armour	FB-2X(St)YSWAY-fl PiMF	5 x 2 x AWG 18/7 PiMF	---	---	**75370025**	**75370023**
Multipair with steel wire armour, lead sheath	FB-2X(St)YMYSWAY-fl PiMF	5 x 2 x AWG 18/7 PiMF	---	---	**82310004**	**82310002**
Eco	FB-2X(St)Y-fl	1 x 2 x AWG 18/7	---	---	**80830005**	**80830006**
Eco, zero halogen	FB-2X(St)H	1 x 2 x AWG 18/7	---	---	**80340001**	**80340002**
Eco with steel wire armour	FB-2X(St)YSWAY-fl	1 x 2 x AWG 18/7	---	---	**75370006**	**75370032**
Eco with steel wire armour, zero halogen	FB-2X(St)HSWAH	1 x 2 x AWG 18/7	---	---	**80350002**	**80350000**
Eco with currugated steel tape	FB-2X(St)Y(SR)Y-fl	1 x 2 x AWG 18/7	---	---	**82560001**	**82560002**
105 °C						
Basic	FB-9Y(St+Ce)Yw-fl	1 x 2 x AWG 18/7	---	---	**82460002**	**82460000**
Basic with steel wire armour	FB-9Y(St+Ce)YwSWAYw-fl	1 x 2 x AWG 18/7	---	---	**81370000**	**81370001**
Multipair with steel wire armour	FB-9Y(St)YwSWAYw-fl PiMF	5 x 2 x AWG 18/7 PiMF	---	---	**89880002**	**89880004**
Eco	FB-9Y(St)Yw-fl	1 x 2 x AWG 18/7	---	---	**83170000**	**83170001**
Eco with steel wire armour	FB-9Y(St)YwSWAYw-fl	1 x 2 x AWG 18/7	-----	---	**89880000**	**89880001**

* UL file E107687

Modbus allows for communication between many devices connected to the same network, for example a system that measures temperature and humidity and communicates the results to a computer. Modbus is often used to connect a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems.

LEONI Modbus cables are available as one pair or multipair cable. The cable is used for connecting Modbus components and is suitable for indoor installations.

Serial communication protocol

Cable programme

Modbus 105 Ω

The Business Unit Industrial Projects offers products for Modbus which are optimised for the miscellaneous applications in automation technology.

The laying-up of cables are pairs with screen.

Characteristics

- **Flame retardant**
- **Permanent installation**
- **Halogen free**
- **Silicon free**
- **Oil resistant**
- **RoHS compliant**

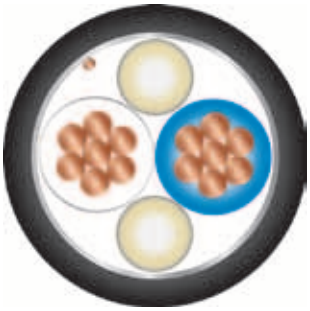
Following cable versions are available:

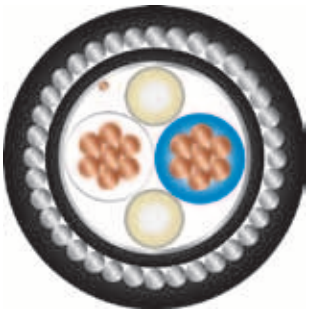
Single pair

- Standard version for fixed installation.

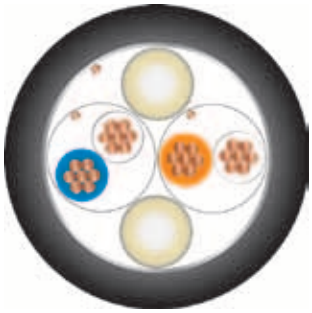
Multi pair

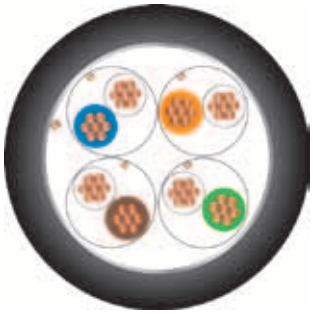
- Standard version for fixed installation.



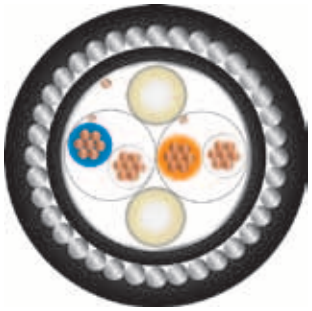


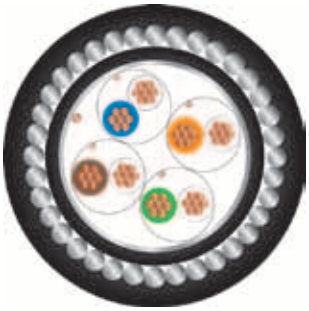
Single pair 70 °C	Single pair 70 °C with steel wire armour	MOD Bus 105 Ω
For transmission of digital signals in instrument and control systems.	For transmission of digital signals in instrument and control systems. Suitable for direct burial and increased mechanical stresses.	Application
		Design
82090004	72410004	Part No.
FB-2Y(St)Y-fl	FB-2Y(St)YSWAY-fl	Type description
1 x 2 x 0,75mm²	1 x 2 x 0,75mm²	Size
black	black	Outer sheath colour
		Construction
plain annealed copper wire, stranded, size 0.75mm²	plain annealed copper wire, stranded, size 0.75mm²	Conductor
polyethylene PE	polyethylene PE	Insulation
blue, white	blue, white	Colour code
plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire	Collective screen
	polyvinyl chloride PVC, black	Inner sheath 1 material
	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath
7.5 x cable diameter	10 x cable diameter	Min. bending radius (single bending)
7.5 mm	12.1 mm	Outer dia.
70 kg/km	263 kg/km	Cable weight
		Temperature range
–5 °C up to +50 °C	–5 °C up to +50 °C	-during installation
–30 °C up to +70 °C	–30 °C up to +70 °C	-during operation
		Electrical properties
50 Ω/km	50 Ω/km	Conductor resistance (loop) max.
105 Ω	105 Ω	Impedance at 1 MHz
54 nF/km	54 nF/km	Mutual capacitance nom.
		Other properties
		Flame retartdant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance





MOD Bus 105 Ω	Multipair 70 °C	Multipair 70 °C
Application	For transmission of digital signals in instrument and control systems.	For transmission of digital signals in instrument and control systems.
Design		
Part. No.	82090005	82090006
Type description	FB-2Y(St)Y-fl PiMF	FB-2Y(St)Y-fl PiMF
Product size	2 x 2 x 0.75 mm^2/7 PiMF	4 x 2 x 0.75 mm^2/7 PiMF
Colour	black	black
Construction		
Conductor	plain annealed copper wire, stranded, size: 0.75 mm^2	plain annealed copper wire, stranded, size: 0.75 mm^2
Insulation	polyethylene PE	polyethylene PE
Colour code	white/blue, white/orange	white/blue, white/orange, white/green, white/brown
Individual screen	plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire
Collective screen	plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire
Armour		
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Min. bending radius - repeated bending	7.5 x cable diameter	7.5 x cable diameter
Outer dia.	12.5 mm	14.4 mm
Cable weight	160 kg/km	230 kg/km
Temperature Range		
- during operation	-30°C up to +70°C	-30°C up to +70°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop)	50 Ω/km	50 Ω/km
nom. Mutual capacitance	54 nF/km	54 nF/km
Impedance at f = 1 MHz	105 Ω	105 Ω
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200





Multipair 70 °C with steel wire armour	Multipair 70 °C with steel wire armour	MOD Bus 105 Ω
For transmission of digital signals in instrument and control systems. Suitable for direct burial and increased mechanical stresses.	For transmission of digital signals in instrument and control systems. Suitable for direct burial and increased mechanical stresses.	Application
		Design
72410002	72410005	Part. No.
FB-2Y(St)YSWAY-fl PiMF	FB-2Y(St)YSWAY-fl PiMF	Type description
2 x 2 x 0.75 mm²/7 PiMF	4 x 2 x 0.75 mm²/7 PiMF	Product size
black	black	Colour
		Construction
plain annealed copper wire, stranded, size: 0.75 mm²	plain annealed copper wire, stranded, size: 0.75 mm²	Conductor
polyethylene PE	polyethylene PE	Insulation
white/blue, white/orange	white/blue, white/orange, white/green, white/brown	Colour code
plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire	Individual screen
plastic coated aluminium tape in contact with tinned copper drain wire	plastic coated aluminium tape in contact with tinned copper drain wire	Collective screen
polyvinyl chloride PVC, black	polyvinyl chloride PVC, black	Inner sheath 1 material
galvanised round steel wires	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
10 x cable diameter	10 x cable diameter	Min. bending radius - repeated bending
17.3 mm	19.8 mm	Outer dia.
475 kg/km	610 kg/km	Cable weight
		Temperature Range
-30°C up to +70°C	-30°C up to +70°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
50 Ω/km	50 Ω/km	Conductor resistance (loop)
54 nF/km	54 nF/km	Mutual capacitance nom.
105 Ω	105 Ω	Impedance at f = 1 MHz
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance

Control Area Network (CAN) was originally made for the automotive market, but in the meantime it is being used more and more as a bus standard for industrial applications. FieldLink bus cables for CAN systems are applied for the exchange of digital information, control apparatus net for faster data transmission.

LEONI Business Unit Industrial Projects offers shielded industrial bus cables for CAN standard, which are available as one pair or multipair cable. The cable is used for connecting CAN bus components and is suitable for indoor installations.

Control Area Network

Cable programme

CAN Bus 120 Ω

The Business Unit Industrial Projects offers products for CAN Bus, which are optimised for the miscellaneous applications in automation technology.

The laying-up of cables are pairs with screen.

Characteristics

- **Flame retardant**
- **Permanent installation**
- **Zero halogen**
- **Silicon free**
- **Oil resistant**
- **RoHS compliant**

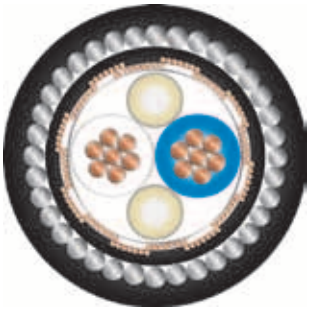
Following cable versions are available:

Single pair

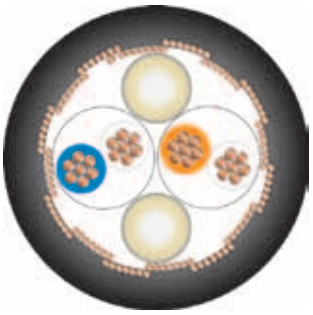
- Standard version for fixed installation.

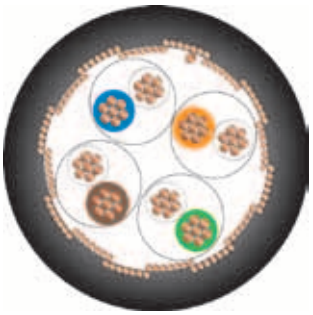
Multi pair

- Standard version for fixed installation.

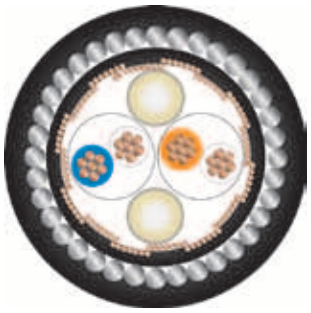


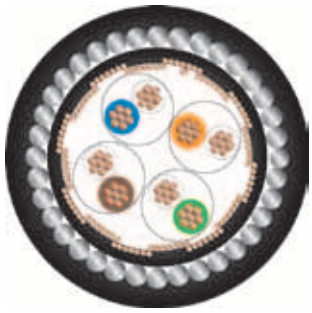
Single pair 90 °C	Single pair 90 °C with steel wire armour	CAN Bus 120 Ω
For transmission of CAN (Control Area Network) bus signals or computer signals with RS 485 or RS 422 interface.	For transmission of CAN (Control Area Network) bus signals or computer signals with RS 485 or RS 422 interface. Suitable for direct burial and increased mechanical stresses.	Application
		Design
82620000	78510004	Part. No.
FB-v2X(St+Ce)Y-fl	FB-v2X(St+Ce)YSWAY-fl	Type description
1 x 2 x AWG 24/7	1 x 2 x AWG 24/7	Product size
black	black	Outer sheath colour
		Construction
tinned annealed copper wire, stranded, size: AWG 24	tinned annealed copper wire, stranded, size: AWG 24	Conductor
cross-linked polyethylene XLPE	cross-linked polyethylene XLPE	Insulation
white/blue	white/blue	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid, opt. coverage approx. 80 %	plastic coated aluminium tape, metallic surface outside, in contact with tinned copper drain wire and tinned copper wire braid, opt. coverage approx. 80 %	Collective screen
	polyvinyl chloride PVC	Inner sheath 1 material
	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
7.5 x cable diameter	10 x cable diameter	Min. bending radius - repeated bending
10.0 mm	14.6 mm	Outer dia.
105 kg/km	360 kg/km	Cable weight
		Temperature Range
-30°C up to +90°C	-30°C up to +90°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
184.8 Ω/km	184.8 Ω/km	Conductor resistance (loop) max.
42 nF/km	42 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom.
120 Ω ± 10 Ω	120 Ω ± 10 Ω	Impedance at f = 1 MHz
24 dB/km	24 dB/km	Attenuation at f = 1 MHz nom.
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance





CAN Bus 120 Ω	Multipair 90 °C	Multipair 90 °C
Application	For transmission of CAN (Control Area Network) bus signals or computer signals with RS 485 or RS 422 interface.	For transmission of CAN (Control Area Network) bus signals or computer signals with RS 485 or RS 422 interface.
Design		
Part. No.	79240000	79240002
Type description	FB-v2XCeY-fl PiMF	FB-v2XCeY-fl PiMF
Product size	2 x 2 x AWG 24/7 PiMF	4 x 2 x AWG 24/7 PiMF
Outer sheath colour	black	black
Construction		
Conductor	tinned annealed copper wire, stranded, size: AWG 24	tinned annealed copper wire, stranded, size: AWG 24
Insulation	cross-linked polyethylene XLPE	cross-linked polyethylene XLPE
Colour code	white/blue, white/orange	white/blue, white/orange, white/green, white/brown
Individual screen	plastic coated aluminium tape, metallic surface outside, in contact with collective screen	plastic coated aluminium tape, metallic surface outside, in contact with collective screen
Collective screen	tinned copper wire braid, opt. coverage approx. 80 %, in contact with stranded tinned copper drain wire	tinned copper wire braid, opt. coverage approx. 80 %, in contact with stranded tinned copper drain wire
Outer sheath material	polyvinyl chloride PVC	polyvinyl chloride PVC
Armour		
Min. bending radius - repeated bending	7.5 x cable diameter	7.5 x cable diameter
Outer dia.	10.0 mm	11.5 mm
Cable weight	105 kg/km	130 kg/km
Temperature Range		
- during operation	-30°C up to +90°C	-30°C up to +90°C
- during installation	-5°C up to +50°C	-5°C up to +50°C
Electrical Properties at 20 °C		
Conductor resistance (loop) max.	184.8 Ω/km	184.8 Ω/km
Mutual capacitance nom.	42 nF/km	42 nF/km
Inductance nom.	0.7 mH/km	0.7 mH/km
Impedance at f = 1 MHz	120 Ω ± 10 Ω	120 Ω ± 10 Ω
Attenuation at f = 1 MHz nom.	24 dB/km	24 dB/km
Other properties		
Flame retardant		
- Test on single cable	UL 13 (vertical tray)	UL 13 (vertical tray)
- Test on bunched cables	IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)
Oil resistance	ICEA S-73-532	ICEA S-73-532
Sunlight resistance	UL 1581 section 1200	UL 1581 section 1200





Multipair 90 °C with steel wire armour	Multipair 90 °C with steel wire armour	CAN Bus 120 Ω
For transmission of CAN (Control Area Network) bus signals or computer signals with RS 485 or RS 422 interface. Suitable for direct burial and increased mechanical stresses.	For transmission of CAN (Control Area Network) bus signals or computer signals with RS 485 or RS 422 interface. Suitable for direct burial and increased mechanical stresses.	Application
		Design
7924000U	7924002U	Part. No.
FB-v2XCeYSWAY-fl PiMF	FB-v2XCeYSWAY-fl PiMF	Type description
2 x 2 x AWG 24/7 PiMF	4 x 2 x AWG 24/7 PiMF	Product size
black	black	Outer sheath colour
		Construction
tinned annealed copper wire, stranded, size: AWG 24	tinned annealed copper wire, stranded, size: AWG 24	Conductor
cross-linked polyethylene XLPE	cross-linked polyethylene XLPE	Insulation
white/blue, white/orange	white/blue, white/orange, white/green, white/brown	Colour code
plastic coated aluminium tape, metallic surface outside, in contact with collective screen	plastic coated aluminium tape, metallic surface outside, in contact with collective screen	Individual screen
tinned copper wire braid, opt. coverage approx. 80 %, in contact with stranded tinned copper drain wire	tinned copper wire braid, opt. coverage approx. 80 %, in contact with stranded tinned copper drain wire	Collective screen
polyvinyl chloride PVC, black	polyvinyl chloride PVC, black	Inner sheath 1 material
galvanised round steel wires	galvanised round steel wires	Armour
polyvinyl chloride PVC	polyvinyl chloride PVC	Outer sheath material
10 x cable diameter	10 x cable diameter	Min. bending radius - repeated bending
14.6 mm	16.3 mm	Outer dia.
360 kg/km	420 kg/km	Cable weight
		Temperature Range
-30°C up to +90°C	-30°C up to +90°C	- during operation
-5°C up to +50°C	-5°C up to +50°C	- during installation
		Electrical Properties at 20 °C
184.8 Ω/km	184.8 Ω/km	Conductor resistance (loop) max.
42 nF/km	42 nF/km	Mutual capacitance nom.
0.7 mH/km	0.7 mH/km	Inductance nom.
120 Ω ± 10 Ω	120 Ω ± 10 Ω	Impedance at f = 1 MHz
24 dB/km	24 dB/km	Attenuation at f = 1 MHz nom.
		Other properties
		Flame retardant
UL 13 (vertical tray)	UL 13 (vertical tray)	- Test on single cable
IEC 60332-3-24 (Cat. c)	IEC 60332-3-24 (Cat. c)	- Test on bunched cables
ICEA S-73-532	ICEA S-73-532	Oil resistance
UL 1581 section 1200	UL 1581 section 1200	Sunlight resistance

Conventional links based on copper cables are now often reaching the limits of their capacity.

The use of GigaLine® fiber optic cables offers for the most diverse bus applications (e.g. High Speed Ethernet – HSE) advantages in the following cases:

When…
- electromagnetic effects can occur
- reliable potential separation is required
- broad transmission ranges are required
- low attenuation and thus long channels are necessary
- when crosstalk must not occur
- sparks must not emerge (for explosive environments)
- low weight and small dimensions are an advantage
- increased security against tapping is required.

GigaLine®

Cable programme

Fiber optic cables

LEONI offers the comprehensive GigaLine® product range for virtually all applications.

Besides easy-to-assemble indoor cables with compact wire technology for the patch and floor area, universal cables for the backbones indoors and outdoors and the classical outdoor cables, the Business Unit Industrial Projects offers manufacturing options for a large number of additional designs such as GigaLine® outdoor cables:

Characteristics
- **with corrugated steel sheath**
- **with steel tape**
- **with SWA armour**
- **with additional lead covering as protection against chemicals**
- **zero halogen**
- **flame retardant.**

Following cable versions are available:

Indoor and outdoor cables
- Breakout cables
- Universal (LSZH) cables

GigaLine®

Fiber Optic Cables

GigaLine® DXO Indoor breakout cable	GigaLine® AT Indoor breakout cable	
Floor cabling, suitable for direct plug mounting and splicing	Floor cabling, suitable for direct plug mounting and splicing.	**Application**
2 G/E ... (Figure O)	2 G/E ... (round in shape)	Dimension
KL-J-V(ZN)HH	KL-AT-V(ZN)HY-fl	Type
yellow or orange	yellow or orange	Outer sheath colour
		Part no.
		Construction
multi mode 50/125 µm or 62.5/125 µm and single mode 9..10/125 µm fiber qualities as well as colour code see page 65	multi mode 50/125 µm or 62.5/125 µm and single mode 9..10/125 µm fiber qualities as well as colour code see page 65	Fiber
compact wires Ø approx. 0.9 mm	compact wires Ø approx. 0.9 mm	Core
aramid yarn over the core	aramid yarn over the core	Strain relief
zero halogen compound, Ø approx. 2.1 mm, yellow, continuously numbered	zero halogen compound, Ø approx. 2.1 mm, yellow, continuously numbered	Inner sheath
	swellable tape	Wrapping
low smoke zero halogen compound LSZH approx. 3.1 x 5.2 mm	polyvinyl chloride PVC Ø 8.5 mm	Outer sheath
approx. 18 kg/km	approx. 18 kg/km	Weight
min. 150 mm	min. 150 mm	Minimum bending radius
min. 35 mm min. 65 mm	min. 35 mm min. 65 mm	during Installation during operation
		Temperature range
–5 °C up to +50 °C –10 °C up to +60 °C	–5 °C up to +50 °C –25 °C up to +70 °C	during Installation during operation
		during operation
max. 600 (2 x 300) N	max. 1200 N	Tensile stress
permanent: max. 500 N/dm short-term: max. 750 N/dm	permanent: max. 1000 N/dm short-term: max. 1500 N/dm	Transverse compression strength
		Other properties
acc. to IEC 60332-1		Flame retardant
please see our catalogue datacom-cable and cabling systems or visit our homepage www.leoni-datacom.com		Connectors/glands

GigaLine®

Fiber Optic Cables	**GigaLine® DQ** **Universal cable, longitudinally watertight**	**GigaLine® DQ** **Outdoor cable, longitudinally watertight**
Application	Campus-/backbone cabling, suitable for splicing, indoor installation in the case of increased mechanical requirements, outdoor installation in dry tubes.	Campus-/backbone cabling, suitable for splicing, outdoor installation (direct burial) or in tubes.
Dimension	1 x m G/E	1 x m G/E…
Type	KL-U-DQ(ZN)BH	KL-A-DQ(ZN)B2Y
Outer sheath colour	yellow	black
Part no.		
Construction		
Fiber	multi mode 50/125 µm or 62.5/125 µm and single mode 9..10/125 µm fiber qualities as well as colour code see page 65	multi mode 50/125 µm or 62.5/125 µm and single mode 9..10/125 µm fiber qualities as well as colour code see pages 65
Core	filled loose tube, central	filled loose tube, central
Strain relief	glass rovings as rodent protection under outer sheath	glass rovings as rodent protection under outer sheath
Inner sheath		
Wrapping	swellable tape	swellable tape
Outer sheath	low smoke zero halogen compound LSZH ≤ 12 fiber: Ø approx. 7.0 mm ≤ 24 fiber: Ø approx. 7. 5mm	polyethylene PE ≤ 12 fiber: Ø approx. 7.0 mm ≤ 24 fiber: Ø approx. 7.5 mm
Weight	≤ 12 fiber: approx. 48 kg/km ≤ 24 fiber: approx. 55 kg/km	≤ 12 fiber: approx. 38 kg/km ≤ 24 fiber: approx. 43 kg/km
Minimum bending radius		
during Installation during operation	min. 15 x outer-Ø min. 20 x outer-Ø	min. 15 x outer-Ø min. 20 x outer-Ø
Temperature range		
during Installation during operation	–5 °C up to +50 °C –10 °C up to +60 °C	–5 °C up to +50 °C –25 °C up to +70 °C
Mechanical properties		
Tensile stress	max. 1750 N	max. 1750 N
Transverse compression strength	permanent: max. 1500 N/dm short-term: max. 2500 N/dm	permanent: max. 1500 N/dm short-term: max. 2500 N/dm
Other properties		
Flame retardant	acc. to IEC 60332-3-24 (CAT C)	
Connectors/glands	please see our catalogue datacom-cable and cabling systems or visit our homepage www.leoni-datacom.com	

GigaLine®

GigaLine® DQ **Outdoor cable, longitudinally watertight**	**GigaLine® DQ** **Outdoor cable, longitudinally watertight**	**Fiber Optic Cables**
Campus-/backbone cabling, suitable for splicing, outdoor installation (direct burial) or in tubes	Campus-/backbone cabling, suitable for splicing, outdoor installation (direct burial) or in tubes, and increased mechanical stresses.	**Application**
1 x m G/E…	1 x m G/E…	Dimension
KL-A-DQ(ZN)2YW2Y	KL-A-DQ(ZN)B2YSWAYfl	Type
black	black	Outer sheath colour
		Part Number
		Construction
multi mode 50/125 µm or 62.5/125 µm and single mode 9..10/125 µm fiber qualities as well as colour code see pages 65	multi mode 50/125 µm or 62.5/125 µm and single mode 9..10/125 µm fiber qualities as well as colour code see pages 65	Fiber
filled loose tube, central	filled loose tube, central	Core
aramid yarn over the core	aramid yarn over the core	Strain relief
polyethylene PE, black	polyethylene PE, black	Inner sheath
swellable tape	swellable tape	Wrapping
corrugated steel sheath	galvanised round steel wires SWA-Ø: 0.9 mm	Armour
polyethylene PE ≤ 12 fiber: Ø approx. 12.5 mm ≤ 24 fiber: Ø approx. 13.0 mm	polyvinyl chloride PVC ≤ 12 fiber: Ø approx. 12.5 mm ≤ 24 fiber: Ø approx. 13.0 mm	Outer sheath
≤ 12 fiber: approx. 160 kg/km ≤ 24 fiber: approx. 170 kg/km	≤ 12 fiber: approx. 250 kg/km ≤ 24 fiber: approx. 265 kg/km	Weight
		Minimum bending radius
min. 15 x outer-Ø min. 20 x outer-Ø	min. 15 x outer-Ø min. 20 x outer-Ø	During installation During operation
		Temperature Range
–5 °C up to +50 °C –25 °C up to +70 °C	–5 °C up to +50 °C –25 °C up to +70 °C	during Installation during operation
		Mechanical Properties
max. 2500 N	max. 1750 N	Tensile stress
permanent: max. 2500 N/dm short-term: max. 3500 N/dm	permanent: max. 1000 N/cm short-term: max. 3000 N/cm	Transverse compression strength
		Other Properties
	acc. to IEC 60332-1	Flame retardant
please see our catalogue datacom-cable and cabling systems or visit our homepage www.leoni-datacom.com		Connectors/Glands

GigaLine®

Fiber Optic Cables

Overview of part numbers and cable variations

Cable	Description	Type	Size	Part number			
				Fiber type			
				G 50/125	G50/125 OM3	G 62.5/125	E 9/...10/125
GigaLine® DXO	Indoor breakout cable, zero halogen, oval	KL-AT-V(ZN)HH	2 G/E	8DA20011 orange	8DA50011 orange	8DB70011 orange	8DC70010 yellow
GigaLine® DX	Indor breakout cable, round	KL-AT-V(ZN)HY-fl	2 G/E	8BA22004 orange	8BA52004 orange	8BB77004 orange	8BC72004 orange
GigaLine® DQ	Universal cable, zero halogen, longitudinally watertight	KL-U-DQ(ZN)BH	1 x 2 G/E	8UA200A1	8UA500A1	8UB700A1	8UC700A1
			1 x 4 G/E	8UA200A2	8UA500A2	8UB700A2	8UC700A2
			1 x 6 G/E	8UA200A3	8UA500A3	8UB700A3	8UC700A3
			1 x 8 G/E	8UA200A4	8UA500A4	8UB700A4	8UC700A4
			1 x 10 G/E	8UA200A5	8UA500A5	8UB700A5	8UC700A5
			1 x 12 G/E	8UA200A6	8UA500A6	8UB700A6	8UC700A6
			1 x 16 G/E	8UA200A7	8UA500A7	8UB700A7	8UC700A7
			1 x 20 G/E	8UA200A8	8UA500A8	8UB700A8	8UC700A8
			1 x 24 G/E	8UA200A9	8UA500A9	8UB700A9	8UC700A9
GigaLine® DQ	Universal cable, longitudinally watertight	KL-A-DQ(ZN)B2Y	1 x 2 G/E	8AA200A1	8AA500A1	8AB700A1	8AC700A1
			1 x 4 G/E	8AA200A2	8AA500A2	8AB700A2	8AC700A2
			1 x 6 G/E	8AA200A3	8AA500A3	8AB700A3	8AC700A3
			1 x 8 G/E	8AA200A4	8AA500A4	8AB700A4	8AC700A4
			1 x 10 G/E	8AA200A5	8AA500A5	8AB700A5	8AC700A5
			1 x 12 G/E	8AA200A6	8AA500A6	8AB700A6	8AC700A6
			1 x 16 G/E	8AA200A7	8AA500A7	8AB700A7	8AC700A7
			1 x 20 G/E	8AA200A8	8AA500A8	8AB700A8	8AC700A8
			1 x 24 G/E	8AA200A9	8AA500A9	8AB700A9	8AC700A9

GigaLine®

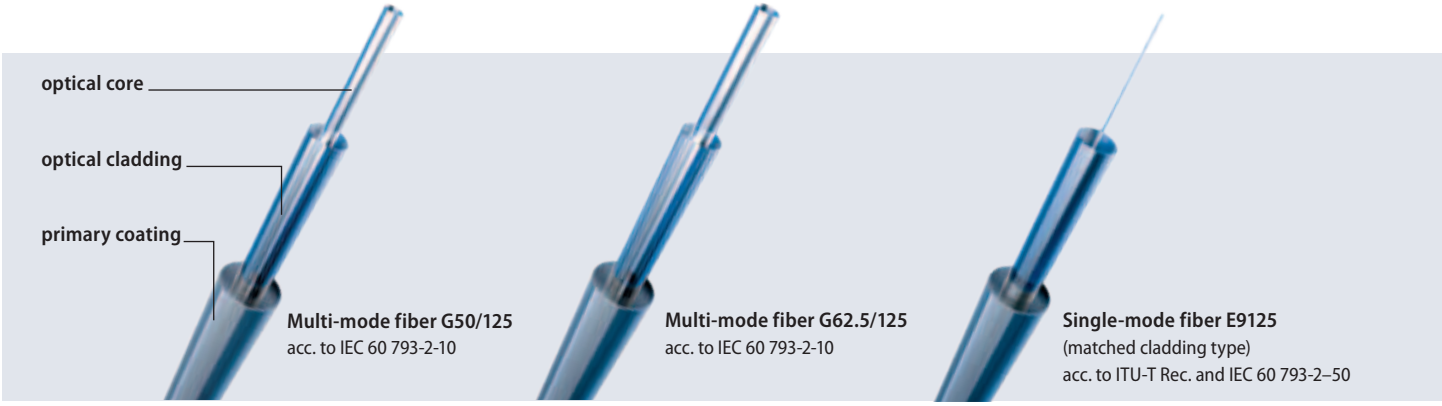
Overview of part numbers and cable variations

Fiber Optic Cables

Cable	Description	Type	Size	Part number			
				Fiber type			
				G 50/125	G50/125 OM3	G 62.5/125	E 9/...10/125
GigaLine® DQ	Outdoor cable, longitudinally watertight, with corrugated steel sheath armoured	KL-A-DQ(ZN) 2YW2Y	1 x 2 G/E	8AA20041	8AA50041	8AB70041	8AC70041
			1 x 4 G/E	8AA20042	8AA50042	8AB70042	8AC70042
			1 x 6 G/E	8AA20043	8AA50043	8AB70043	8AC70043
			1 x 8 G/E	8AA20044	8AA50044	8AB70044	8AC70044
			1 x 10 G/E	8AA20045	8AA50045	8AB70045	8AC70045
			1 x 12 G/E	8AA20046	8AA50046	8AB70046	8AC70046
			1 x 16 G/E	8AA20047	8AA50047	8AB70047	8AC70047
			1 x 20 G/E	8AA20048	8AA50048	8AB70048	8AC70048
			1 x 24 G/E	8AA20049	8AA50049	8AB70049	8AC70049
GigaLine® DQ	Outdoor fiber optic cable, longitudinally watertight with SWA-armour	KL-A-DQ(ZN) B2YSWAYfl	1 x 2 G/E	8AA2W0A1	8AA5W0A1	8AB7W0A1	8AC7W0A1
			1 x 4 G/E	8AA2W0A2	8AA5W0A2	8AB7W0A2	8AC7W0A2
			1 x 6 G/E	8AA2W0A3	8AA5W0A3	8AB7W0A3	8AC7W0A3
			1 x 8 G/E	8AA2W0A4	8AA5W0A4	8AB7W0A4	8AC7W0A4
			1 x 10 G/E	8AA2W0A5	8AA5W0A5	8AB7W0A5	8AC7W0A5
			1 x 12 G/E	8AA2W0A6	8AA5W0A6	8AB7W0A6	8AC7W0A6
			1 x 16 G/E	8AA2W0A7	8AA5W0A7	8AB7W0A7	8AC7W0A7
			1 x 20 G/E	8AA2W0A8	8AA5W0A8	8AB7W0A8	8AC7W0A8
			1 x 24 G/E	8AA2W0A9	8AA5W0A9	8AB7W0A9	8AC7W0A9

Notes:

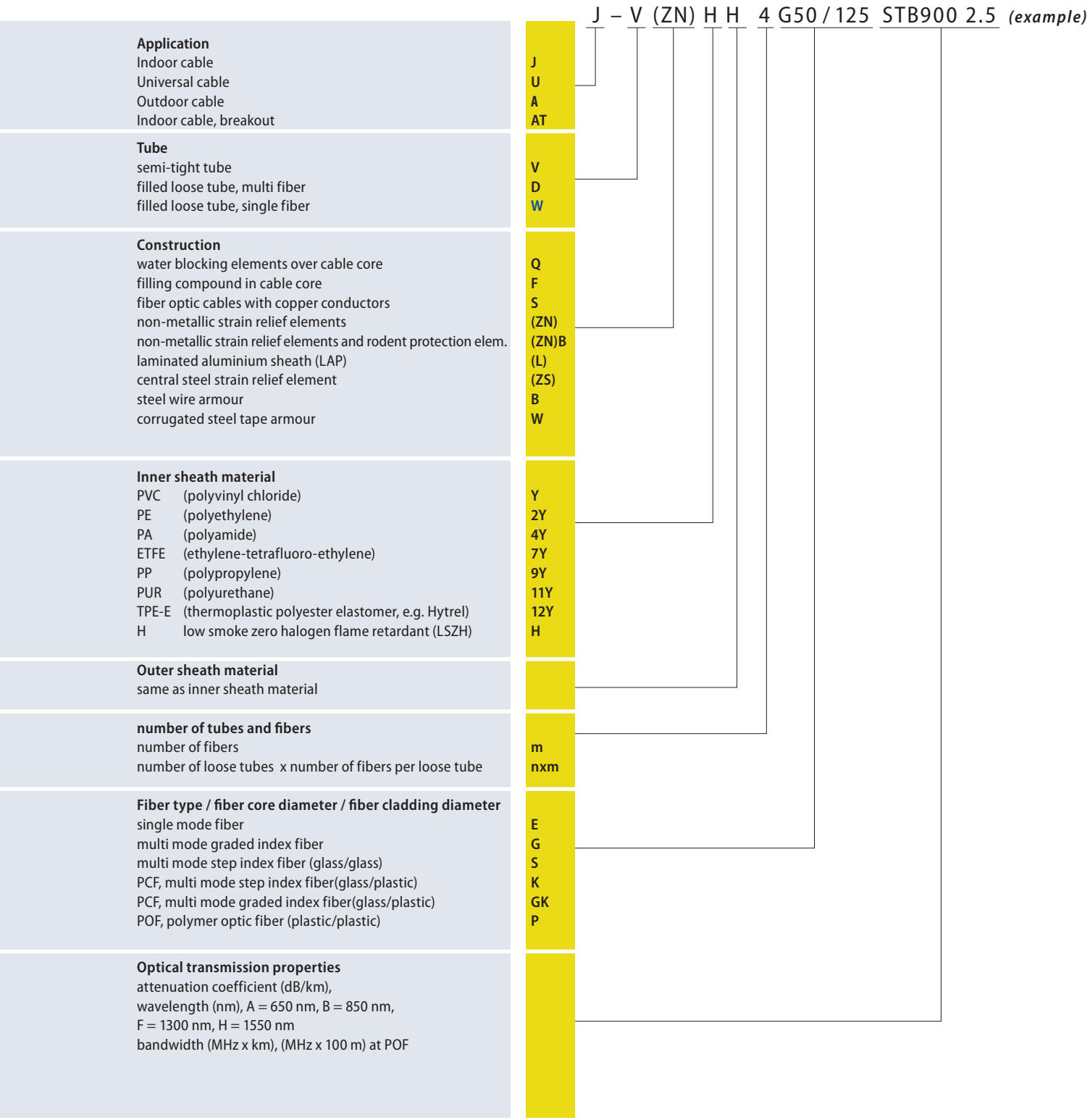
GigaLine® fiber qualities



Fiber specifications	G50/125 OM2e	G50/125 OM3	G50/125 OM3e	G62.5/125 OM1e	E9…10/125 OS1e
Attenuations coefficient					
at 850 nm	max. 2.5 dB/km	max. 2.5 dB/km	max. 2.5 dB/km	max. 3.0 dB/km	
at 1300 nm	max. 0.7 dB/km	max. 0.7 dB/km	max. 0.7 dB/km	max. 0.7 dB/km	
at 1310 nm					max. 0.36 dB/km
at 1383 nm					max. 0.40 dB/km
at 1550 nm					max. 0.22 dB/km
Bandwidth					
at 850 nm	min. 600 MHz x km	min. 1500 MHz x km	min. 3500 MHz x km	min. 250 MHz x km	
at 1300 nm	min. 1200 MHz x km	min. 500 MHz x km	min. 500 MHz x km	min. 800 MHz x km	
Laser bandwidth					
at 850 nm		min. 2000 MHz x km	min. 4700 MHz x km		
Dispersion					
at 1310 nm					max. 3.5 ps/nm x km
at 1550 nm					max. 18 ps/nm x km
Segment length 1 Gigabit-Ethernet					
at 850 nm (1000 BASE SX)	min. 750 m	min. 900 m	min. 1000 m	min. 500 m	
at 1300 nm (1000 BASE LX)	min. 2000 m	min. 550 m	min. 550 m	min. 1000 m	
Segment length 10 Gigabit-Ethernet					
at 850 nm (10G BASE-SR)	min. 150 m	min. 300 m	min. 550 m	min. 65 m	
at 1300 nm 10G BASE-LX4)	min. 900 m	min. 300 m	min. 300 m	min. 450 m	
Numerical aperture					
nominal value	0.20	0.20	0.20	0.275	0.12
Refraction index (nominal value)					
at 850 nm	1.483	1.483	1.483	1.497	
at 1300 nm	1.478	1.478	1.478	1.493	
at 1310 nm					1.467
at 1550 nm					1.467
Test load					
	100 kpsi	100 kpsi	100 kpsi	100 kpsi	100 kpsi

GigaLine® abbreviations

Identification of the structural elements in fiber optic cables



GigaLine® colour codes

Colour code for tubes

(in case of stranded loose tubes)

Tube	colour code
counting tube	red
counting direction tube	white
other tubes	green for G50/125 blue for G62.5/125 yellow for E9…10/125
dummy elements	uncoloured

Colour code for multi-fiber loose tubes

No of fiber	colour code
1	red
2	green
3	blue
4	yellow
5	white
6	grey
7	brown
8	violet
9	turquoise
10	black
11	orange
12	rose

No of fiber	colour code with black ring marking
13	red
14	green
15	blue
16	yellow
17	white
18	grey
19	brown
20	violet
21	turquoise
22	transparent
23	orange
24	rose

Stripping tools for fast assembly

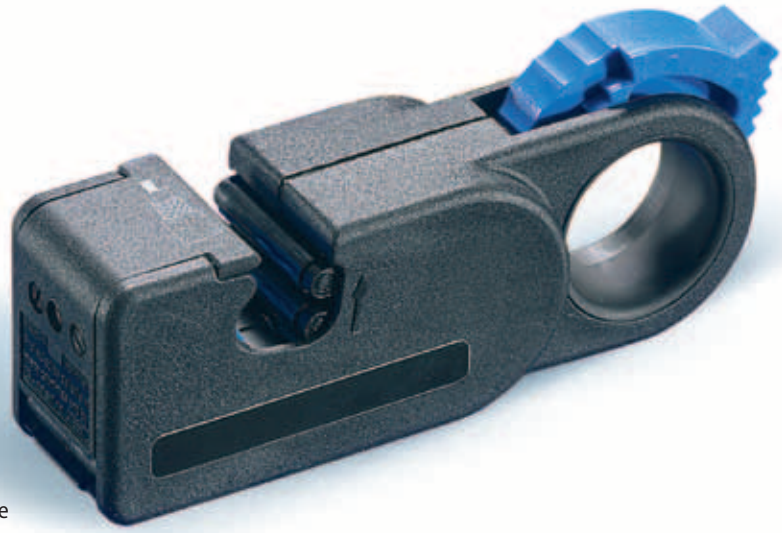
Stripping Tool for PROFIBUS, FOUNDATION™ Fieldbus and PROFINET (Industrial Ethernet)
For assembly work with stripping tools LEONI created FA Fast Assembly bus cables, marked with FA.

Area of Application:
This stripping tool is solely intended for use as described in these instructions. Other uses may result in accidents, severe personal injury, or damage to the tool and/or cable. For your own safety, use only the Connectors/Glands or additional devices recommended in these instructions or by the manufacturer.

The adjusting screws have already been adjusted for the bus system specified on the stripping tool. Protect yourself from live parts do not work on live parts. Keep live parts away from the area in which you are working or cover them appropriately.

To avoid personal injury or damage to the tool or cable, ensure that repairs are carried out by authorised personnel only.

Data of the stripping tool:
- Length: 100 mm
- Weight: 65 g
- Preset cutting depth for ES-Bus Cables
- Exchangeable cassette with require blade intervals
- Blade cassette can be used from two sides



Preadjusted stripping tool
Do not change the setting of the adjusting screws. The adjusting screws have already been adjusted for the bus system specified on the stripping tool.

Exchanging the blade cassette
We recommend using a small slotted screwdriver to open the blade cassette compartment, especially if the tool is new. Warning: risk of injury.

Both sides of the PROFIBUS blade cassette can be used. Remove the cartridge, rotate it vertically by 180° and then put it back into place. When working with PVC sheaths, the cartridge should be replaced after it has been used approx. 3,000 times (2 x 1,500). In the case of PUR sheaths, the cassette must be replaced after it has been used 300 times (2 x 150). Replacement cassettes can be purchased from your LEONI distributor.

To do the assembly work in a professional manner, please follow the introduction step by step:

1. Determining the stripping length
The centimetre scale on the tool will help you to measure the length. For stripping length, please consult the connector manufacturer's operating instructions. Add 7 mm to the stripping length specified in manufacturer's instructions and use the tip of your thumbnail to mark the length.

2. Inserting the cable into the stripping tool
Insert the length of cable you have measured into the stripping tool using your thumb as a guide. Close the clamp by turning the dial, for best results first click the dial by two notches.

3. Stripping the cable by rotating the tool
Rotate the stripping tool twice around the cable in the direction of the arrow. Close the clamp completely and rotate the stripping tool twice more around the cable.

4. Removing the stripping tool from the cable
Pull the stripping tool lengthways away from the cable. Avoid tilting the tool as this could damage the wires inside.

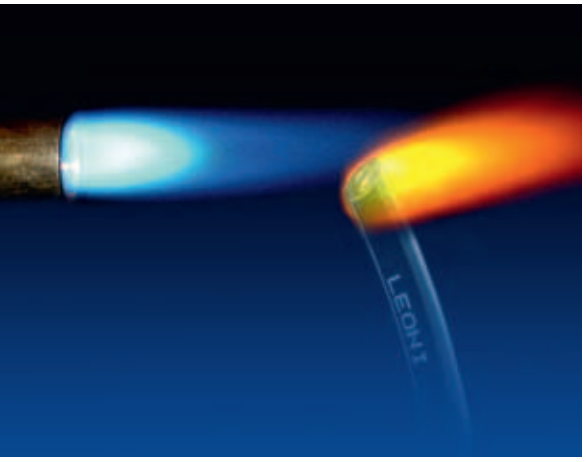
If the results are not satisfactory, it is possible that the blade cassette needs to be rotated or replaced.

5. Removing scrap insulation sheath
After you have opened the clamp you can remove the scrap.

6. Slitting the plastic foil
To remove the remaining plastic foil from the cable, slit the foil with a small slotted screwdriver.

7. Removing the plastic foil
The protective foil you have cut can now be removed easily. You can then attach the section of cable you have stripped to the connector.

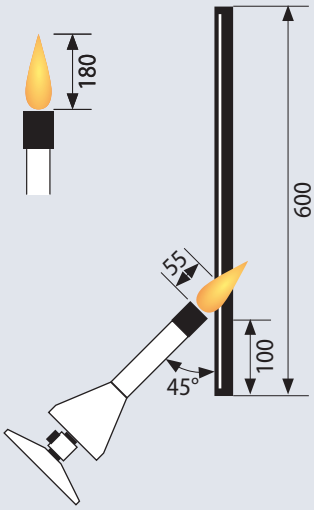
In case of fire

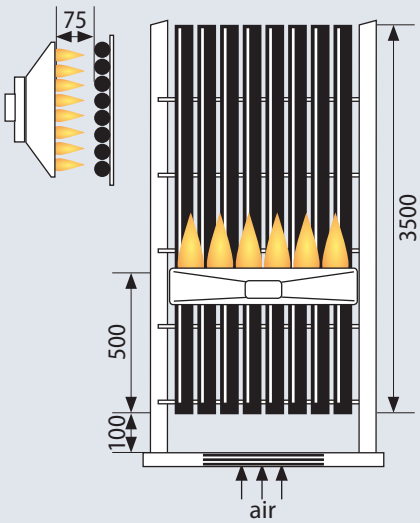


Halogen content and smoke density

In areas where lifes and material assets are endangered in case of a fire by toxic gases or smoke, so-called zero halogen, flame retardant cables are used (LSZH = Low-Smoke-Zero-Halogen or FRNC = Flame-Retardant-Non-Corrosive)
The defined properties:

- low smoke characteristic according to IEC 61034
- light transmittance (L.T.) ≥ 60 %
- amount of halogen acid according to IEC 60754-1, 0 %
- degree of acidity of gases according to IEC 60754-2, pH-value ≥ 4.3 and conductivity c < 10 µS/mm
- oxygen index of sheaths in accordance with ASTM-D 2863 (annex B), ≥ 35 %





Improved fire behaviour

Cables with increased requirements with regard to the fire behaviour have to fulfil the following tests:

IEC 60332-1

Test set-up:	The single cable to be tested is fixed vertically and exposed to a Bunsen burner flame at a 45° angle to the vertical.
Flame temperature:	Determined by the specified setting of the Bunsen burner flame.
Test duration:	Cable with a diameter of ≤ 25 mm: 60 sec Cable with a diameter of 25 < D < 50 mm: 120 sec Cable with a diameter of 50 < D < 75 mm: 240 sec Cable with a diameter of D > 75 mm: 480 sec
Compliance criterion:	The fire damage must end at least 50 mm below the upper fixing clamp. The cable must be self-extinguishing.

IEC 60332–3-24 (cat. C)

Test set-up:	Cable pieces mounted on a ladder in a test chamber
Total volume of Non-metal material:	1.5 litre/m
Test duration:	20 minutes flame application time
Compliance criterion:	max. 2.5 burnt length

Mechanical and chemical protection

Mechanical protection

The primary purpose of armour is to protect the cable against mechanical damage during installation and operation.

The most common armour designs with their most important features are the following:

A suitable protection can be achieved by corresponding measures:

Armour of galvanised round steel wires (SWA)

Very good mechanical protection; reasonably good flexibility; suitable for tensile loads; coverage of over 90 %

Armour of galvanised steel wire braid (Q)

Lightweight armour to withstand tensile loads; permits the smallest bending radii of all armour designs; used mainly for small cable diameters; a coverage of at least 80 % and a wire diameter of 0.3 mm are recommended to achieve sufficient mechanical protection

Armour of corrugated steel tape (SR)

100 % covering of the cable assembly; good protection against rodents.

Chemical protection

If the risk of oil and chemicals affecting the installed cable cannot be excluded this may affect the operation of the cables in long term.

The extent of the risk is determined by type, agressive nature, condition and quantity of the medium, the duration of immersion and the temperature.

Lead sheath (M)

The safest, though most expensive protection against aromatic hydrocarbons and active chemicals.

Multilayer sheath ((L)2Y4Y)

Same as lead protection against aromatic hydrocarbons and active chemicals. This design combining aluminium tape and high density polyethylene HDPE sheath with a covering of polyamide PA (Nylon), represents an excellent barrier against penetrating chemicals and can be used as an alternative to lead sheath. Advantage: lighter, smaller diameter.

Oil resistant PVC sheath (Yö)

In contrast to standard PVC (Y) this compound is more resistant to oils and aliphatic hydrocarbons. It passes the oil resistance test
according to IEC 60811-2-1.

Type designations for copper and **Giga**Line® fiber optic cables

The abbreviations used by LEONI for cables and construction elements refer as far as possible to DIN VDE standards.

0	Fiber optic communication cable	KL
1	Indoor cable Outdoor cable, breakout	I AT
2	Semi-loose tube Filled loose tube	V D
3	Non-metallic strain relief elements	(ZN)
4	Halogen-free flame-retardant sheath of basic element (AT only)	H
5	Halogen-free flame-retardant sheath	H
6	Number of fibers/ number of loose tubes x number of fibers per loose tube	n nxm
7	Multimode fiber Singlemode fiber	G E
8	Core diameter in µm (multimode fiber) Field diameter in µm (singlemode fiber)	
9	Cladding diameter in µm	
10	Attenuation coefficient in dB/km	
11	Wavelength B = 850 nm F = 1,300/1,310 nm H = 1,550 nm	 B F H
12	Bandwidth in MHz for 1 km in the case of multimode fibers, dispersion parameter in ps/nm for 1 km in the case of singlemode fibers	

0	Fiber optic communication cable	KL
1	Outdoor cable Universal cable	A U
2	Filled loose tube	D
3	Filling compound in cable core Water blocking material in cable core	F Q
4	Non-metallic strain relief elements Non-metallic strain relief elements and rodent protection elements	(ZN) (ZN)B
5	Corrugated steel sheath Armour Outer sheath made of PE Layered sheath Halogen-free flame-retardant outer sheath suitable for direct burial Halogen-free flame-retardant outer sheath	W B 2Y (L)2Y Hc H
6	Number of fibers/number of loose tubes x number of fibers per loose tuber	n nxm
7	Multimode fiber Singlemode fiber	G E
8	Core diameter in µm (multimode fiber) Field diameter in µm (singlemode fiber)	
9	Cladding diameter in µm	
10	Attenuation coefficient in dB/km	
11	Wavelength B = 850 nm F = 1,300/1,310 nm H = 1,550 nm	 B F H
12	Bandwidth in MHz for 1 km in the case of multimode fibers, dispersion parameter in ps/nm for 1 km in the case of single-mode fibers	

Fieldbus cables	**FB-**
Communication cable copper	**KS-**
Insulation of foamed polyethylene PE with skin layer	**O2YS**
Insulation or sheath of polyvinyl chloride (PVC)	**Y**
Sheath of oil-resistant polyvinyl chloride (PVC)	**Yö**
Sheath of polyvinyl chloride (PVC), reinforced	**Yv**
Sheath of flame-retardant polyvinyl chloride (PVC)	**Yfl**
Cable flame-retardant in compliance with IEC 60332–3-24	**-fl**
Insulation or sheath of cross linked polyethylene (XLPE)	**2X**
Insulation or sheath of polyethylene (PE)	**2Y**
Sheath of polyamide (PA)	**4Y**
Insulation or sheath of fluorinated ethylene-propylene (FEP)	**6Y**
Sheath of polyurethane (PUR)	**11Y**
Inner sheath of elastomer	**3G**
Laminated sheath with additional PA sheath	**(L)2Y4Y**
Sheath of zero halogen, flame retardant compounds (FRNC/LSZH)	**H**
Screen of aluminium bonded plastic tape	**(St)**
Screen of copper wire braid	**C**
Collective screen of aluminium bonded plastic tape and copper wire braid with drain wire	**(St+Ce)**
Collective screen of aluminium bonded plastic tape and copper wire braid	**(St+C)**
Pair in metal foil	**PiMF**
Lead sheath	**M**
Armour of galvanized steel wire braid	**Q**
Armour of 2 layers of galvanized steel tape	**B**
Armour of galvanized round steel wires	**SWA**
Armour of corrugated steel tape	**(SR)**

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