

ETHERNET in Automation

The Ethernet standard is a permanent fixture in corporate IT departments due to ist simplicity. The reason for the acceptance and popularity not only lies in the integrated networking for a company, but rather in the fact that it forms the basic technology for the world’s largest network – the Internet. The Ethernet is the world’s most-used standard. The advantages of the Ethernet and the related networking are obvious:

- Simple, unliwithed expansion possibilities
- Fast commissioning due to simple connection technology with RJ45 or M12
- Dynamic bandwith adjustment with 10/100 Mbit/s, 1 Gbit up to a current 10 Gbit/s
- Networking of various applications areas (industrial, building, Automation, IT, ...)

Because of this reasons from time to time more companies are using the performance of Ethernet for their machine and plant control. In combination of using Ethernet protocols and components which are specified for industrial enviroment, there are more advantages over commercial fieldbussystems like PROFIBUS:

- Company-wide access to data and applications
- High data transmission rate for fast exange of information
- Improvement of efficiency and speed of work flow and furthermore an increase of energy efficiency and machine performance
- Continuously and coordinated monitoring and machine control for a optimized manufacturing process
- Wiring from office till machine is possible

The user can choose between copper cable (Twisted Pair-cable), fibre optics or wireless for physical connection of the devices. There are different maximum transmission lenght for the media.

	Medium	Cable	Installation length
ETHERNET	10 Base-T	Twisted Pair	100 m
	10 Base-FL	62.5 µm, 50 µm Multimode LWL	2.000 m
Fast ETHERNET	100 Base-TX	Twisted Pair	100 m
	100 Base-FX	62.5 µm, 50 µm Multimode LWL FDX	412 m
		62.5 µm, 50 µm Multimode LWL HDX	2.000 m
Gigabit ETHERNET	1000 Base-CX	Twinax STP (150 Ohm)	25 m
	1000 Base-T	Twisted Pair	100 m
	1000 Base-SX 850 nm	62.5 µm Multimode LWL	275 m
		50 µm Multimode LWL	550 m
	1000 Base-LX 1300 nm	62.5 µm Multimode LWL	550 m
		50 µm Multimode LWL	550 m
		Singlemode LWL	5.000 m
10 Gigabit ETHERNET	10G Base-T	Twisted Pair	100 m
	10G Base-LX4 WWD	Singlemode LWL	10.000 m
	10G Base-LX4 WWD	Multimode LWL	300 m
	10G Base-SR/SW 850 nm	62.5 µm Multimode LWL	26 m
		50 µm Multimode LWL	82 m
	10G Base-LR/LW 850 nm	Singlemode LWL	10.000 m
	10G Base-ER/EW 1550 nm	Singlemode LWL	40.000 m

Application classes (LAN copper cabling)			
Application class	Category	Frequency	Services and applications
Class A	-	Up to 100 kHz	
Class B	-	Up to 1 MHz	Telephone, ISDN
Class C	Cat.3	Up to 16 MHz	Tel, ISDN, TokenRing, Ethernet
Class D	Cat.5/5e	Up to 100 MHz	Fast Ethernet, Gigabit Ethernet
Class E	Cat.6	Up to 250 MHz	Fast Ethernet, Gigabit Ethernet
Class E _A	Cat.6 _A	Up to 500 MHz	10 Gigabit Ethernet
Class F	Cat.7	Up to 600 MHz	10 Gigabit Ethernet
Class F _A	Cat.7 _A	Up to 1 GHz	10 Gigabit Ethernet

In the field of Industrial Automation more than 20 different Industrial Ethernet protocols are defined by companies. All of them differ from their application field and technical functions to eachother

ProfiNet (PNO – ProfibusNutzerOrganisation)

The installation guide defines three different types of cables for their optimal use in different applications and enviroments:

- Type A stationary, no movement after installation, solid wire
- Type B flexible, occasional movement of vibration, 7-stranded wire
- Type C special applications (high flexible, draig chain, ...)

This guideline defines also the design of the cable types. Using a two pair cable with a min. category Cat.5, the design has to be:

- Type A 2x2xAWG22/1
- Type B 2x2xAWG22/7
- Type C 2x2xAWG22/...

Mostly the cables have a design of a quad star. Using a four pair cable with a min category Cat.5, the design has to be:

- Type A 4x2xAWG23/1
- Type B 4x2xAWG23/7
- Type C 4x2xAWG24/...

EtherNet/IPTM and EtherCAT are using Cat.5 standard cable, which are specified for industrial applications. Sercos III uses also standard components like Cat.5 cable with a double shielding.

ETHERNET in Automation

Quickfinder

Bus system	Transmission rate	Application/cabling Installation type		AWG	Outer sheath material	Approval	Characteristics	Article designation	Part number	Connectors						
PROFINET	2 pairs up to 100 Mbit/s Cat.5 and Cat.5e	static	Type A	2x2xAWG22/1	PVC	UL/CSA (CMX)	Quad pair	ETHERLINE® PN Cat.5e Y	2170891	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
						UL/CSA (PLTC), UL/CSA (CMG) UL AWM Style 21694	Quad pair, Fast Connect, UV- resistant	ETHERLINE® Y FC UL/CSA Cat.5	2170893	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
					PVC/PVC	UL/CSA (CMG)	Quad pair, Fast Connect, Direct burial, UV-resistant	ETHERLINE® PN FC Cat.5e YY	2170494	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
		flexible	Type B	2x2xAWG22/7	PVC	UL/CSA (PLTC),UL/CSA (CMG)	Quad pair, Fast Connect, Oil resistant, UV-resistant	ETHERLINE® PN Cat. 5 Y FLEX FC	2170886	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
						-	Quad pair, Black outer sheath, UV-resistant	ETHERLINE® Y CAT.5e BK	2170901	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
					FRNC	UL/CSA (PLTC), UL/CSA (CMG)	Fast Connect, UV-resistant, halogen free	ETHERLINE® PN Cat.5e FRNC FLEX	2170890	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
						Germanischder Lloyds, DNV Lloyds Register of Shipping ABS Europe Ltd, Bureau Veritas UL/CSA (PLTC), UL/CSA (CMG)	Fast Connect, halogen free, approved for marine and offshore applications	ETHERLINE® MARINE FRNC FC Cat 5	2170889	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
					TPE	-	Extended temperature range from -30°C to +105°C , temporary up to +120°C	ETHERLINE® 5e 105 plus	2170636	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
					high flexible special appl.	Type C	2x2xAWG22/7	PUR	UL/CSA (CMX)	Drag chain suitable, Fast Connect, UV-resistant, oil resistant, halogen free	ETHERLINE® PN CAT 5 FD	2170894	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14			
			FRNC	UL AWM Style 21282			UV-resistant, halogen free, hybrid + 4x1,5mm2	ETHERLINE® CAT 5 FRNC HYBRID	2170887	-						
		2x2xAWG22/19	PUR	UL AWM Style 21161			Suitable for torsional stress, Quad pair, halogen free	ETHERLINE® TORSION CAT 5	2170888	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
		2x2xAWG22/1	PE	-			Quad pair, UV-resistant, Rodent protection (galvanized steel tape)	ETHERLINE® CAT 5 ARM	2170496	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14						
	4 pairs up to 10 Gbit/s Cat.6A	static	Type A	4x2xAWG22/1	PVC	-	-	ETHERLINE® CAT 6A Y	2170464	2, 3, 6, 7, 10, 11, 12, 13, 14						
	PUR				-	Oil resistant, halogen free	ETHERLINE® CAT 6A P	2170465	2, 3, 6, 7, 10, 11, 12, 13, 14							
	FRNC				-	Halogen free	ETHERLINE® CAT 6A H	2170466	2, 3, 6, 7, 10, 11, 12, 13, 14							
	PVC				-	-	ETHERLINE® CAT 7 Y	2170474	2, 3, 6, 7, 10, 11, 12, 13, 14							
	PUR				-	Oil resistant, halogen free	ETHERLINE® CAT 7 P	2170475	2, 3, 6, 7, 10, 11, 12, 13, 14							
	4 pairs up to 10 Gbit/s Cat.7	static	Type A	4x2xAWG22/1	FRNC	-	Halogen free	ETHERLINE® CAT 7 H	2170476	2, 3, 6, 7, 10, 11, 12, 13, 14						
					4 pairs up to 10 Gbit/s Cat.6A	flexible	Type B	4x2xAWG23/7	PVC	UL/CSA (CMG)	UV-resistant	ETHERLINE® PN Cat 6a Y FLEX	2170930	2, 3, 6, 7, 10, 11, 12, 13, 14		
									FRNC	UL/CSA (CMG)	UV-resistant, halogen free	ETHERLINE® PN Cat 6a FRNC FLEX	2170931	2, 3, 6, 7, 10, 11, 12, 13, 14		
									high flexible special appl.	Type C	4x2xAWG24/7	PVC	UL/CSA (CMX)	Drag chain suitable, Oil resistant	ETHERLINE® FD Cat. 6A	2170485
PUR												UL/CSA (CMX)	Drag chain suitable, Oil resistant, halogen free	ETHERLINE® FD P Cat. 6A	2170484	2, 3, 6, 7, 10, 11, 12, 13, 14
PVC												UL/CSA (CMX)	Suitable for torsional stress, Oil resistant	ETHERLINE® TORSION Y Cat. 6A	2170482	2, 3, 6, 7, 10, 11, 12, 13, 14
PUR	UL/CSA (CMX)	Suitable for torsional stress, Oil resistant, halogen free	ETHERLINE® TORSION P Cat. 6A	2170483	2, 3, 6, 7, 10, 11, 12, 13, 14											
ETHERCAT	4 conductors up to 100 Mbit/s Cat. 5e	flexible	1 x 4 x AWG26/7	PVC	UL/CSA (CMX)	Oil resistant, UV - resistant	ETHERLINE® Y EC FLEX Cat 5e	2170430	1, 2, 3, 6, 7, 8, 9, 13, 14							
				PUR	UL/CSA (CMX)	Oil resistant, UV - resistant, halogen free	ETHERLINE® P EC FLEX Cat 5e	2170431	1, 2, 3, 6, 7, 8, 9, 13, 14							
		high flexible		PUR	UL/CSA (CMX)	Drag chain suitable, Oil resistant, UV - resistant, halogen free	ETHERLINE® EC FD Cat 5e	2170432	1, 2, 3, 6, 7, 8, 9, 13, 14							
ETHERNET IP ETHERCAT	2 pairs up to 100 Mbit/s Cat.5 and Cat.5e	static	2x2xAWG22/1	PVC	UL/CSA (CMX)	Quad pair	ETHERLINE® PN Cat.5e Y	2170891	1, 2, 3, 6, 7, 8, 9, 13, 14							
					UL/CSA (PLTC), UL/CSA (CMG) UL AWM Style 21694	Quad pair, Fast Connect, UV- resistant	ETHERLINE® Y FC UL/CSA Cat.5	2170893	1, 2, 3, 6, 7, 8, 9, 13, 14							
				PVC/PVC	UL/CSA (CMG)	Quad pair, Fast Connect, Direct burial, UV-resistant	ETHERLINE® PN FC Cat.5e YY	2170494	1, 2, 3, 6, 7, 8, 9, 13, 14							
				PUR	UL AWM Style 21576	UV-resistant, halogen free, water blue outer sheath	ETHERLINE® P CAT.5e	2170281	1, 2, 3, 6, 7, 8, 9, 13, 14							
				FRNC	-	Halogen free, water blue outer sheath	ETHERLINE® H CAT.5e	2170280	1, 2, 3, 6, 7, 8, 9, 13, 14							
		flexible	2x2xAWG22/7	PVC	UL/CSA (PLTC),UL/CSA (CMG)	Quad pair, Fast Connect, Oil resistant, UV-resistant	ETHERLINE® PN Cat. 5 Y FLEX FC	2170886	1, 2, 3, 6, 7, 8, 9, 13, 14							
				PVC	-	Quad pair, Black outer sheath, UV-resistant	ETHERLINE® Y CAT.5e BK	2170901	1, 2, 3, 6, 7, 8, 9, 13, 14							
				FRNC	UL/CSA (PLTC), UL/CSA (CMG)	Fast Connect, UV-resistant, halogen free	ETHERLINE® PN Cat.5e FRNC FLEX	2170890	1, 2, 3, 6, 7, 8, 9, 13, 14							
				FRNC	UL AWM Style 21282	UV-resistant, halogen free, hybrid + 4x1,5mm2	ETHERLINE® CAT 5 FRNC HYBRID	2170887	-							
				FRNC	Germanischder Lloyds, DNV Lloyds Register of Shipping ABS Europe Ltd, Bureau Veritas UL/CSA (PLTC), UL/CSA (CMG)	Fast Connect, halogen free, approved for marine and offshore applications	ETHERLINE® MARINE FRNC FC Cat 5	2170889	1, 2, 3, 6, 7, 8, 9, 13, 14							
				TPE	-	Extended temperature range from -30°C to +105°C , temporary up to +120°C	ETHERLINE® 5e 105 plus	2170636	1, 2, 3, 6, 7, 8, 9, 13, 14							
				high flexible special applications	2x2xAWG22/7	PUR	UL/CSA (CMX)	Drag chain suitable, Fast Connect, UV-resistant, oil resistant, halogen free	ETHERLINE® PN CAT 5 FD	2170894	1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 14					
	2x2xAWG26/19	PUR	UL AWM style 21576 and 11117			Drag chain suitable, Oil resistant, halogen free	ETHERLINE® FD P Cat. 5e	2170289	1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 14							
	2x2xAWG22/19	PUR	UL AWM Style 21161			Suitable for torsional stress, Quad pair, halogen free	ETHERLINE® TORSION CAT 5	2170888	1, 2, 3, 6, 7, 8, 9, 13, 14							
	4 pairs up to 10 Gbit/s Cat.5e and Cat.6A	static	4x2xAWG24/1			PUR	-	Oil resistant, halogen free, water blue outer sheath	ETHERLINE® P CAT. 5e	2170297	2, 3, 6, 7, 10, 11, 12, 13, 14					
						FRNC	-	Halogen free, water blue outer sheath	ETHERLINE® H CAT. 5e	2170296	2, 3, 6, 7, 10, 11, 12, 13, 14					
				FRNC/FRNC	-	Halogen free, double outer sheath, water blue outer sheath	ETHERLINE® H-H CAT 5e	2170298	2, 3, 6, 7, 10, 11, 12, 13, 14							
		flexible	4x2xAWG23/7	PVC	UL/CSA (CMG)	Resistente a rayos UV conforme a UL 1581	ETHERLINE® PN Cat.6A Y FLEX	2170930	2, 3, 6, 7, 10, 11, 12, 13, 14							
				FRNC	UL/CSA (CMG)	Resistente a rayos UV conforme a UL 1581	ETHERLINE® PN Cat.6A FRNC FLEX	2170931	2, 3, 6, 7, 10, 11, 12, 13, 14							
			4x2xAWG24/7	PVC	UL/CSA (CMX)	Drag chain suitable, Oil resistant, water blue outer sheath	ETHERLINE® FD Cat. 6A	2170485	2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14							
				PUR	UL/CSA (CMX)	Drag chain suitable, Oil resistant, halogen free, water blue outer sheath	ETHERLINE® FD P Cat. 6A	2170484	2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14							
				4x2xAWG26/19	PUR	UL AWM style 21576 and 11117	Drag chain suitable, Oil resistant, halogen free, water blue outer sheath	ETHERLINE® FD P Cat. 5e	2170489	2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14						
					PUR	-	Drag chain suitable, Oil resistant, UV-resistant, black outer sheath	ETHERLINE® FD P BK CAT.5	CE217489	2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14						
					PUR	UL/CSA (CMX)	Drag chain suitable, Oil resistant, UV-resistant, halogen free, water blue	ETHERLINE® FD P CAT.6	2170488	2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14						
	4x2xAWG24/7	PVC	UL/CSA (CMX)	Suitable for torsional stress, Oil resistant	ETHERLINE® TORSION Y Cat. 6A	2170482	2, 3, 6, 7, 10, 11, 12, 13, 14									
		PUR	UL/CSA (CMX)	Suitable for torsional stress, Oil resistant, halogen free	ETHERLINE® TORSION P Cat. 6A	2170483	2, 3, 6, 7, 10, 11, 12, 13, 14									

Legend

*see www.lappgroup.es/productos

**data sheet on www.lappgroup.es/productos

Please see detailed technical information on the data sheet (www.lappgroup.es/products).

FD: high flexible (german - “Flexible Dauerbiegung”)

FRNC: Flame Retardant Not Corrosive

H: halogen-free

P: PUR – Polyurethan – oil resistant

Y: PVC – Polyvinylchlorid

Connectors						
No.	Cable type	Max. Ø-cable	Category	Core dimension	Article designation	Part number
RJ45 connector						
1	solid + flexible	9 mm	Cat.5	solid: AWG24 – 22 flexible: AWG27 – 22	RJ45 connector Cat.5 field attachable connector PRO-FINET ED-IE-AX-5-PN-20-FC	21700605
2	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 22	RJ45 connector Cat.6 _A field attachable TIA568A	21700600
3	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 22	RJ45 connector Cat.6 _A field attachable TIA568B	21700601
4	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 flexible: AWG27/19 – 24/7	RJ45 connector Cat.6 _A field attachable TIA568A for FD cables	21700615
5	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 flexible: AWG27/19 – 24/7	RJ45 connector Cat.6 _A field attachable TIA568B for FD cables	21700616
6	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 22	circular connector IP68 (incl. 21700601) ED-IE-AX-RJ45-6A-B-68-FC	21700630
7	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 22	circular bulkhead housing IP68 (incl. 21700612) ED-IE-RJ45F-6A-B-68-FC	21700632



M12 connector							
8	flexible	8 mm	Cat.5e	flexible: AWG27 – 22	AB-C4-M12MSD-SH Male connector PROFINET	22260820	
9	flexible	8 mm	Cat.5e	flexible: AWG27 – 22	AB-C4-M12FSD-SH Female connector PROFINET	22261016	
10	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 24	ED-IE-AX-M12X-6A-67-FC Male connector 10G/X-coded	21700602	
11	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 24	ED-IE-AX-M12XF-6A-67-FC Female connector 10G/X-coded	21700621	
12	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 24	ED-IE-AX-M12XF-RM-6A-67-FC Female connector Wall mounting 10G/X-coded	21700622	
13	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 24	ED-IE-M12F-X-FM Flush type female connector Front mounting 10G/X-coded	21700617	
14	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 24	ED-IE-M12F-X-RM Flush type female connector Rear mounting 10G/X-coded	21700618	

Connector pin assignment RJ45			
PIN	TIA 568-A	TIA 568-B	PROFINET
1	White/Green	White/Orange	Yellow
2	Green	Orange	Orange
3	White/Orange	White/Green	White
4	Blue	Blue	–
5	White/Blue	White/Blue	–
6	Orange	Green	Blue
7	White/Brown	White/Brown	–
8	Brown	Brown	–

Legend

*see www.lappgroup.es/productos. Please see detailed technical information on the data sheet (www.lappgroup.es/productos).

Industrial Ethernet patchcords												
Industrial Ethernet protocol			2-pair cable						4-pair cable			
			Profinet			Industrial Ethernet EtherCat		EtherCat	Industrial Ethernet			
			Type A PVC	Type B PVC	Type C PUR	halogen-free	PUR	PVC	halo-genfree	PUR		
			length in m	Part number	Part number	Part number	Part number	Part number	Part number	Part number	Part number	
Connection type of cable	Connector to connector	M12-M12 (straight)	1	2171001	2171025	2171049	2171073	2171097				
			2	2171002	2171026	2171050	2171074	2171098				
			3	2171003	2171027	2171051	2171075	2171099				
			5	2171004	2171028	2171052	2171076	2171100				
			10	2171005	2171029	2171053	2171077	2171101				
			20	2171006	2171030	2171054	2171078	2171102				
		M12 (angled) – M12 (straight)	1	2171013	2171037	2171061						
			2	2171014	2171038	2171062						
			3	2171015	2171039	2171063						
			5	2171016	2171040	2171064						
			10	2171017	2171041	2171065						
			20	2171018	2171042	2171066						
		M12-RJ45 (straight)	1				2171085	2171109				
			2				2171086	2171110				
			3				2171087	2171111				
			5				2171088	2171112				
			10				2171089	2171113				
			20				2171090	2171114				
		RJ45-RJ45 (straight)	1				2171091	2171115		2171513	2171501	
			2				2171092	2171116		2171514	2171502	
			3				2171093	2171117		2171515	2171503	
			5				2171094	2171118		2171516	2171504	
			10				2171095	2171119		2171517	2171505	
			20				2171096	2171120		2171518	2171506	
	M8-M8 (straight)	0,5						2171300				
		1						2171301				
		2						2171302				
		3						2171303				
		5						2171304				
		7						2171305				
		10						2171306				
		15						2171307				
	M8 (angled) – M8 (straight)	0,5						2171350				
		1						2171351				
		2						2171352				
		3						2171353				
		5						2171354				
		7						2171355				
		10						2171356				
		15						2171357				
	M12 (straight) – OE	1	2171007	2171031	2171055	2171079	2171103					
		2	2171008	2171032	2171056	2171080	2171104					
		3	2171009	2171033	2171057	2171081	2171105					
		5	2171010	2171034	2171058	2171082	2171106					
		10	2171011	2171035	2171059	2171083	2171107					
		20	2171012	2171036	2171060	2171084	2171108					
	M12 (angled) – OE	1	2171019	2171043	2171067							
		2	2171020	2171044	2171068							
		3	2171021	2171045	2171069							
		5	2171022	2171046	2171070							
		10	2171023	2171047	2171071							
		20	2171024	2171048	2171072							
	RJ45 (straight) – OE	1							2171519	2171507		
		2							2171520	2171508		
		3							2171521	2171509		
		5							2171522	2171510		
		10							2171523	2171511		
		20							2171524	2171512		
	M8 (straight) – OE	0,5						2171320				
		1						2171321				
		2						2171322				
		3						2171323				
		5						2171324				
		7						2171325				
		10						2171326				
		15						2171327				
	M8 (angled) – OE	0,5						2171370				
		1						2171371				
		2						2171372				
		3						2171373				
		5						2171374				
		7						2171375				
		10						2171376				
		15						2171377				
	20						2171378					

Please see detailed technical information on the data sheet (www.lappgroup.com/products).

Quickfinder

Automation area	Inst. area	Category	Application/ cabling	halogen- free	Shielding (standard description)	AWG	Outer diameter [mm]	Characteristics	Approvals	Article designation	Part number	Connectors	Socket (SnapIn)	
Building 4-pairs	indoor	Cat.5e	static	x	U/UTP	4x2xAWG24/1	5,6			UNITRONIC® LAN 200 U/UTP Cat.5e LSZH	2170185	3,4,5,6	12,16,19,20	
					SF/UTP	4x2xAWG24/1	6,7			UNITRONIC® LAN 200 SF/UTP Cat.5e LSZH	2170138	3,4,5,6	12,16,19,20	
				flexible		U/UTP	4x2xAWG24/1	5,6			UNITRONIC® LAN 200 U/UTP Cat.5e Y	2170125	3,4,5,6	12,16,19,20
						F/UTP	4x2xAWG24/1	6,4			UNITRONIC® LAN 200 F/UTP Cat.5e Y	2170126	3,4,5,6	12,16,19,20
						SF/UTP	4x2xAWG24/1	6,7			UNITRONIC® LAN 200 SF/UTP Cat.5e Y	2170128	3,4,5,6	12,16,19,20
			x			F/UTP	4x2xAWG26/7	5,6			UNITRONIC® LAN 200 F/UTP Cat.5e Y Flex	2170127	1,2,3,4,5,6	13,15,19,20
					SF/UTP	4x2xAWG26/7	6			UNITRONIC® LAN 200 SF/UTP Cat.5e Y Flex	2170129	1,2,3,4,5,6	13,15,19,20	
					F/UTP	4x2xAWG26/7	5,6			UNITRONIC® LAN 200 F/UTP Cat.5e H Flex	2170137	1,2,3,4,5,6	13,15,19,20	
					SF/UTP	4x2xAWG26/7	6			UNITRONIC® LAN 200 SF/UTP Cat.5e H Flex	2170139	1,2,3,4,5,6	13,15,19,20	
			Cat.6		static	x	U/UTP	4x2xAWG24/1	6,5			UNITRONIC® LAN 250 U/UTP Cat.6 LSZH	2170193	5,6
		F/UTP		4x2xAWG24/1			7,5			UNITRONIC® LAN 250 F/UTP Cat.6 LSZH	2170194	5,6	14,16,17,18,19,20	
				U/UTP		4x2xAWG24/1	6,5			UNITRONIC® LAN 250 U/UTP Cat.6 Y	2170186	5,6	14,16,17,18,19,20	
		Cat.6 _A	static	x	U/FTP	4x2xAWG24/1	7,4			UNITRONIC® LAN 500 U/FTP Cat.6 _A LSZH	2170195	5,6	16,17,18,19,20	
					F/FTP	4x2xAWG24/1	7,6			UNITRONIC® LAN 500 F/FTP Cat.6 _A LSZH	2170196	5,6	16,17,18,19,20	
					S/FTP	4x2xAWG23/1	7,1			UNITRONIC® LAN 500 S/FTP Cat.6 _A Y	2170143	5,6	16,17,18,19,20	
		Cat.7	static	x	S/FTP	4x2xAWG23/1	7,7			UNITRONIC® LAN 1000 S/FTP Cat.7 LSZH	2170614	5,6	16,17,18,19,20,21	
					S/FTP	4x2xAWG23/1	2x7,7	DUPLEX		UNITRONIC® LAN 1000 S/FTP Cat.7 LSZH D	2170634	5,6	16,17,18,19,20,21	
			flexible		S/FTP	4x2xAWG26/7	6,5			UNITRONIC® LAN 600 S/FTP Cat.7 Y	2170144	3,4,5,6	15,17,18,19,20	
				x	S/FTP	4x2xAWG26/7	6,5			UNITRONIC® LAN 600 S/FTP Cat.7 LSZH	2170142	3,4,5,6	15,17,18,19,20	
		Cat.7 _A	static	x	S/FTP	4x2xAWG22/1	8,1			UNITRONIC® LAN 1200 S/FTP Cat.7 _A LSZH	2170615	5,6	16,17,18,19,20,21	
					S/FTP	4x2xAWG22/1	8,5			UNITRONIC® LAN 1500 S/FTP Cat.7 _A LSZH	2170199	5,6	16,17,18,19,20,21	
		outdoor ground	Cat.7	static			S/FTP	4x2xAWG23/1	10	PE-AL-outer sheath, direct burial		UNITRONIC® LAN 1000 S/FTP Cat.7 (L)PE	2170198	
						S/FTP	4x2xAWG23/1	9,6	PE-outer sheath		UNITRONIC® LAN 1000 S/FTP Cat.7 PE	2170197		

Automation area	Inst. area	Category	Application/ cabling	halogen- free	Sheath material	AWG	Outer diameter [mm]	Characteristics	Approvals	Article designation	Part number	Connectors	Socket (SnapIn)			
Industrial 2-pairs	indoor	Cat.5e	static	x	H	2x2xAWG24/1	5,8			ETHERLINE® H CAT.5e	2170280	4,5,6,7,9	8,12,14,17,18,20			
		Cat.5e	static		PVC	2x2xAWG22/1	6,4	QP	PN, UL/CSA(CMX)	ETHERLINE® PN Cat.5e Y	2170891	4,5,6,7,9	8,12,14,17,18,20			
		Cat.5e	flexible	x	H	2x2xAWG26/7	5,4			ETHERLINE® H Flex CAT.5e	2170283	1,2,4,5,6,7,9	8,13,15,17,18,20			
		Cat.5e	high flexible	x	PUR	2x2xAWG26/19	6,1	power chain		ETHERLINE® FD P CAT.5e	2170289	4,5,6,7,9	8,13,15,17,18,20			
		Cat.5	high flexible	x	PUR	2x2xAWG22/7	6,5	QP, power chain, Fast Connect	PN, UL/CSA(CMX)	ETHERLINE® FD P FC CAT.5	2170894	4,5,6,7,9,10	8,13,15,17,18,20			
		Cat.5	torsion	x	PUR	2x2xAWG22/19	6,5	QP, Torsion	PN, UL/CSA (AWM)	ETHERLINE® TORSION CAT.5	2170888	4,5,6,7,9,10	8,13,15,17,18,20			
	indoor and outdoor	Cat.5	static		PVC	2x2xAWG22/1	6,5	QP, UV resistant, Fast Connect	PN, UL/CSA (CMG)	ETHERLINE® Y FC CAT.5	2170893	4,5,6,7,9	8,12,14,17,18,20			
		Cat.5e	static	x	PUR	2x2xAWG24/1	5,8	limited UV resistance		ETHERLINE® P CAT.5e	2170281	4,5,6,7,9	8,12,14,17,18,20			
		Cat.5	flexible		PVC	2x2xAWG22/7	6,5	QP, UV resistant, Fast Connect	PN, UL/CSA (CMG)	ETHERLINE® PN Cat.5 Y FLEX FC	2170886	4,5,6,7,9,10	8,13,15,17,18,20			
		Cat.5e	flexible		PVC	2x2xAWG22/7	6,2	QP, black, UV resistant	PN	ETHERLINE® Y CAT.5e BK	2170901	4,5,6,7,9,10	8,13,15,17,18,20			
		Cat.5e	flexible	x	PUR	2x2xAWG26/7	5,8	limited UV resistance		ETHERLINE® P Flex CAT.5e	2170284	1,4,5,6,7,9	8,13,15,17,18,20			
		outdoor and ground	Cat.5	static		PVC/PE	2x2xAWG22/1	9,3	QP, steel armoured, black, UV resistant	PN	ETHERLINE® Cat.5 ARM	2170496	4,5,6,7,9	12,14,17,18,20		
	Cat.5e	static		PVC/PVC	2x2xAWG22/1	7,8	QP, double sheath, black, UV resistant	PN, UL/CSA (CMG)	ETHERLINE® PN Cat.5e YY	2170494	4,5,6,7,9	8,12,14,17,18,20				
Industrial 2-pairs combi	indoor	Cat.5	flexible	x	FRNC	2x2xAWG22/7 + 4x1.5	10,3	hybrid	PN, UL (AWM)	ETHERLINE® Cat.5 FRNC HYBRID	2170887					
Industrial 4-pairs	indoor	Cat.5e	static	x	H	4x2xAWG24/1	6,3			ETHERLINE® H CAT.5e	2170296	4,5,6,7,11	8,12,14,17,18,20			
					H/H	4x2xAWG24/1	7,5	double sheath		ETHERLINE® H-H CAT.5e	2170298	4,5,6,7,11	8,12,14,17,18,20			
			flexible		H	4x2xAWG26/7	6,1			ETHERLINE® H Flex CAT.5e	2170299	4,5,6,7,11	8,13,15,17,18,20			
	indoor and outdoor		static	x	PUR	4x2xAWG24/1	6,3	limited UV resistance		ETHERLINE® P CAT.5e	2170297	4,5,6,7,11	8,12,14,17,18,20			
			flexible		PUR	4x2xAWG26/7	6,1	limited UV resistance		ETHERLINE® P Flex CAT.5e	2170300	4,5,6,7,11	8,13,15,17,18,20			
		Cat.5	high flexible	x	PUR	4x2xAWG26/19	6,3	easy to wind, best for stage, power chain, black, UV resistant		ETHERLINE® FD BK CAT.5	CE217489	4,5,6,7,11	8,13,15,17,18,20			
					PUR	4x2xAWG26/19	6,1	power chain, limited UV resistance		ETHERLINE® FD P CAT.5e	2170489	4,5,6,7,11	8,15,17,18,20			
					PUR	4x2xAWG26/19	7,8	power chain, limited UV resistance	UL/CSA (CMX)	ETHERLINE® FD P CAT.6	2170488	4,5,6,7,11	8,15,17,18,20			
		indoor	Cat.6 _A	static	x		PVC	4x2xAWGG22/1	8,7			ETHERLINE® Cat.6 _A Y	2170464	4,5,6,7,11	8,14,17,18,20	
	x					PUR				ETHERLINE® Cat.6 _A P	2170465	4,5,6,7,11	8,14,17,18,20			
	x					H				ETHERLINE® Cat.6 _A H	2170466	4,5,6,7,11	8,14,17,18,20			
	Cat.7						PVC				ETHERLINE® Cat.7 Y	2170474	4,5,6,7,11	8,14,17,18,20		
						x	PUR				ETHERLINE® Cat.7 P	2170475	4,5,6,7,11	8,14,17,18,20		
						x	H				ETHERLINE® Cat.7 H	2170476	4,5,6,7,11	8,14,17,18,20		
	outdoor and ground						PE(L)	4x2xAWG23/1	10	PE-AL-outer sheath, direct burial		UNITRONIC® LAN 1000 S/FTP Cat.7 (L)PE	2170198			
							PE	4x2xAWG23/1	9,6	PE-outer sheath		UNITRONIC® LAN 1000 S/FTP Cat.7 PE	2170197			

ISO/IEC-11801 (2002)	LAPP-product-designations	Construction (outdoor/indoor)
U/UTP	UTP	Unshielded/Unshielded Twisted Pair
F/UTP	F/UTP	Foiled/Unshielded Twisted Pair
SF/UTP	S-FTP	Screened+Foiled/Unshielded Twisted Pair
S/FTP	STP/S PiMF	Screened/Foiled Twisted Pair

Legend
PN = PROFINET, cables acc. to PROFINET standard
QP = Quad Pair, star quad cable
**data sheet on www.lappgroup.com/products
Please see detailed technical information on the data sheet (www.lappgroup.com/products).

Connectors						
No.	Cable type	Max. Ø-cable	Category	Core dimension	Article designation	Part number
RJ45 connector						
1	flexible	5.8 mm	Cat.5	AWG26	RJ45 connector TM11 Hirose, beige	CE6321
2	flexible	5.72 mm	Cat.5	AWG26	RJ45 connector Stewart, grey	CE6323
3	solid + flexible	6.6 mm	Cat.6	AWG27 – 24	RJ45 connector TM21 Hirose, beige	CE6324
4	solid + flexible	8 mm	Cat.5e	AWG26 – 22	RJ45 connector FM45	21700540
5	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 22	RJ45 connector Cat.6 _A field attachable TIA568A	21700600
6	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 22	RJ45 connector Cat.6 _A field attachable TIA568B	21700601
7	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 22	circular connector IP68 (incl. 21700601) ED-IE-AX-RJ45-6A-B-68-FC	21700630
8	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 22	circular bulkhead housing IP68 (incl. 21700612) ED-IE-RJ45F-6A-B-68-FC	21700632
9	solid + flexible	9 mm	Cat.5	solid: AWG24 – 22 flexible: AWG27 – 22	RJ45 connector Cat.5 field attachable connector PROFINET ED-IE-AX-5-PN-20-FC	21700605



M12 connector							
10	flexible	8 mm	Cat.5e	flexible: AWG27 – 22	AB-C4-M12MSD-SH (PROFINET)	22260820	
11	solid + flexible	9 mm	Cat.6 _A	solid: AWG24 – 22 flexible: AWG27 – 24	ED-IE-AX-M12X-6A-67-FC 10G/X-coded	21700602	

LANmark SnapIn RJ45 socket							
12	solid	–	Cat.5e	AWG24/1 – 22/1	LANmark-5 EVO Snap-In connector	61103	
13	flexible	–	Cat.5e	AWG26/7	Lanmark-5 EVO Snap-In connector AWG26	61102	
14	solid	–	Cat.6	AWG24/1 – 22/1	LANmark-6 EVO 250 MHz Snap-In connector	62104	
15	flexible	–	Cat.6	AWG26/7	LANmark-6 EVO 250MHz Snap-In for AWG26	62105	
16	solid	–	Cat.6 _A	AWG24/1 – 22/1	LANmark-6 EVO 10 G Snap-In connector	62106	
17	solid + flexible	5 – 9 mm	Cat.6 _A	AWG27 – 22	ED-IE-AX-RJ45F-6A-A-FC	21700611	
18	solid + flexible	5 – 9 mm	Cat.6 _A	AWG27 – 22	ED-IE-AX-RJ45F-6A-B-FC	21700612	
19	solid + flexible	–	Cat.6	AWG24 – 22	SnapIn Rail mount adapter 1-single incl. Cat.6	60795	
20	solid + flexible	5 – 9 mm	Cat.6 _A	AWG27 – 22	easy connect rail mount adapter 1-single incl. Cat.6 _A	21700613 21700614	

LANmark SnapIn GG45 socket							
21	solid	–	Cat.7	AWG24/1 – 22/1	LANmark-7, 600 MHz Snap-In GG45 connector	63103	

Connector pin assignment RJ45			
PIN	TIA 568-A	TIA 568-B	PROFINET
1	White/Green	White/Orange	Yellow
2	Green	Orange	Orange
3	White/Orange	White/Green	White
4	Blue	Blue	–
5	White/Blue	White/Blue	–
6	Orange	Green	Blue
7	White/Brown	White/Brown	–
8	Brown	Brown	–

Legend
*see www.lappgroup.com/products. Please see detailed technical information on the data sheet (www.lappgroup.com/products).

Industrial Ethernet patchcords										
Industrial Ethernet protocol		2-pair cable						4-pair cable		
		Profinet			Industrial Ethernet		EtherCat	Industrial Ethernet		
		Type A	Type B	Type C	halogenfree	PUR	PVC	halogen-free	PUR	
		length in m	Part number	Part number	Part number	Part number	Part number	Part number	Part number	Part number
Connection type of cable	Connector to connector	M12-M12 (straight)	1	2171001	2171025	2171049	2171073	2171097		
			2	2171002	2171026	2171050	2171074	2171098		
			3	2171003	2171027	2171051	2171075	2171099		
			5	2171004	2171028	2171052	2171076	2171100		
			10	2171005	2171029	2171053	2171077	2171101		
			20	2171006	2171030	2171054	2171078	2171102		
		M12 (angled) – M12 (straight)	1	2171013	2171037	2171061				
			2	2171014	2171038	2171062				
			3	2171015	2171039	2171063				
			5	2171016	2171040	2171064				
			10	2171017	2171041	2171065				
			20	2171018	2171042	2171066				
		M12-RJ45 (straight)	1				2171085	2171109		
			2				2171086	2171110		
			3				2171087	2171111		
			5				2171088	2171112		
			10				2171089	2171113		
			20				2171090	2171114		
		RJ45-RJ45 (straight)	1				2171091	2171115		2171513
			2				2171092	2171116		2171502
			3				2171093	2171117		2171503
			5				2171094	2171118		2171504
			10				2171095	2171119		2171505
			20				2171096	2171120		2171506
		M8-M8 (straight)	0,5					2171300		
			1					2171301		
			2					2171302		
			3					2171303		
			5					2171304		
			7					2171305		
			10					2171306		
			15					2171307		
			20					2171308		
			0,5					2171350		
		M8 (angled) – M8 (straight)	1					2171351		
			2					2171352		
			3					2171353		
			5					2171354		
			7					2171355		
			10					2171356		
			15					2171357		
			20					2171358		
		M12 (straight) – OE	1	2171007	2171031	2171055	2171079	2171103		
			2	2171008	2171032	2171056	2171080	2171104		
			3	2171009	2171033	2171057	2171081	2171105		
			5	2171010	2171034	2171058	2171082	2171106		
			10	2171011	2171035	2171059	2171083	2171107		
			20	2171012	2171036	2171060	2171084	2171108		
		M12 (angled) – OE	1	2171019	2171043	2171067				
			2	2171020	2171044	2171068				
			3	2171021	2171045	2171069				
			5	2171022	2171046	2171070				
			10	2171023	2171047	2171071				
			20	2171024	2171048	2171072				
		RJ45 (straight) – OE	1							2171519
			2							2171507
			3							2171508
			5							2171509
			10							2171510
			20							2171511
			0,5							2171512
			1							
			2							
			3							
		M8 (straight) – OE	5							
			7							
			10							
			15							
			20							
		M8 (angled) – OE	0,5							
			1							
			2							
			3							
			5							
			7							
			10							
			15							
			20							
			0,5							
			1							
			2							
			3							
			5							
			7							
			10							
			15							
			20							

Type designation ETHERLINE®

Industrial Ethernet patchcords											
IE	PNB	5	M12D	A	3	Y	2	22	7	M12D	S
Industrial Ethernet	Ethernet-System	Categorie	Connection left	Cable outlet left	Cable length in m	Material of cable	Number of pairs	Conductor cross section (AWG)	Type of application	Connection right	Cable outlet right
	Profinet = PN	Cat.5 = 5	M8 = M8	straight (180°) = S	1 m = 1	halogenfree compound = H	2x2 = 2	AWG22 = 22	fixed installation (solid wire) = 1	M8 = M8	straight (180°) = S
	Profinet Type A = PNA	Cat.5e = 5e	M12 D-coded = M12D	angled (90°) = A	2 m = 2	PUR = P	4x2 = 4	AWG23 = 23	flexible use = 7	M12 D-coded = M12D	angled (90°) = A
	Profinet Type B = PNB	Cat.6 = 6	M12 X-coded = M12X		3 m = 3	PVC = Y		AWG24 = 24	high flexible = FD	M12 X-coded = M12X	
	Profinet Type C = PNC	Cat.6 _A = 6A	RJ45 = RJ45		...	flame redardant & halogenfree = FRNC		AWG26 = 26		RJ45 = RJ45	
	EtherCat = EC	Cat.7 = 7			20 m = 20	Polyethylen = PE		AWG27 = 27		open conductor end = OE	
		Cat.7 _A = 7A									

Connector and connection components											
ED	IE	AX	RJ45F		6A	A				FC	
EPIC® Data	Industrial Ethernet	Cable outlet	Interface	Coding	Categorie	Wiring connection standard	Interface characteristics	Special function	Protection class	Type of connection	Others
	Industrial Ethernet	90° = 90	RJ45 male = N/A. or RJ45	D-coded = N/A.	Cat.5 = 5	T568A = A	no special characteristics = N/A.	no special function = N/A.	IP20 as standard = N/A.	screw = N/A.	Accessories = AC
		45° = 45	RJ45 female = RJ45F	X- coded = X	Cat.5e = 5e	T568B = B	Reversed = R	Diagnose = DIAG	IP54 = 54	Fast Connect = FC	Accessorie Dust Cap = AC-DC
		35° = 35	SUB-D (BUS) = SD		Cat.6 = 6	ProfiNet = PN	Programming interface = PG	Repeater = REP	IP65 = 65		
		straight (0°) = AX	M12 = M12 M8 = M8 Hybrid = HY		Cat.6 _A = 6A Cat.7 = 7 Cat.7 _A = 7A				IP67 = 67 IP68 = 68 IP69 = 69		