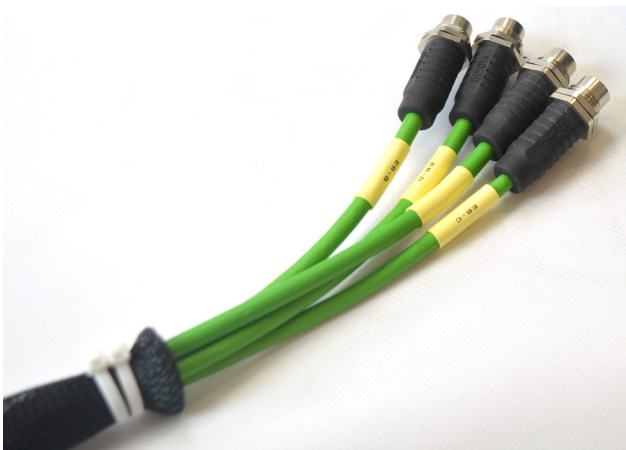
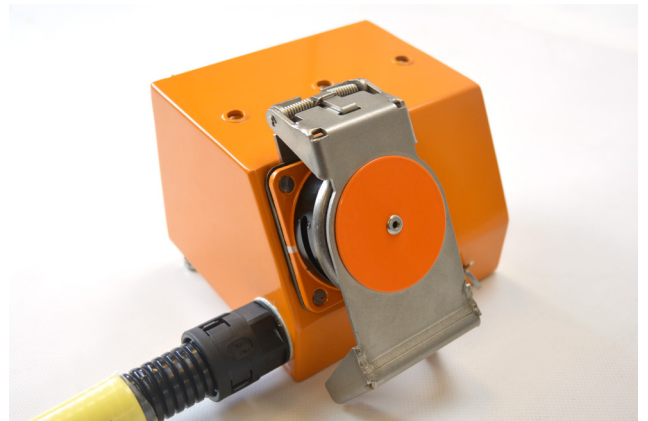


Jumper Assemblies



Ten 47 Limited

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Tel: +44 (0)1592 655725

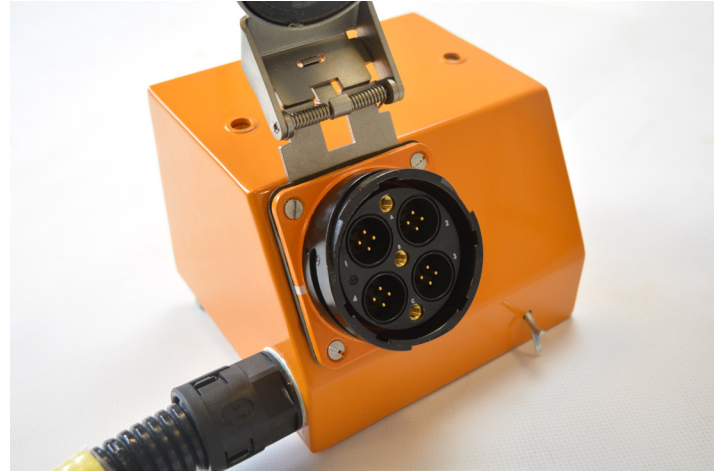
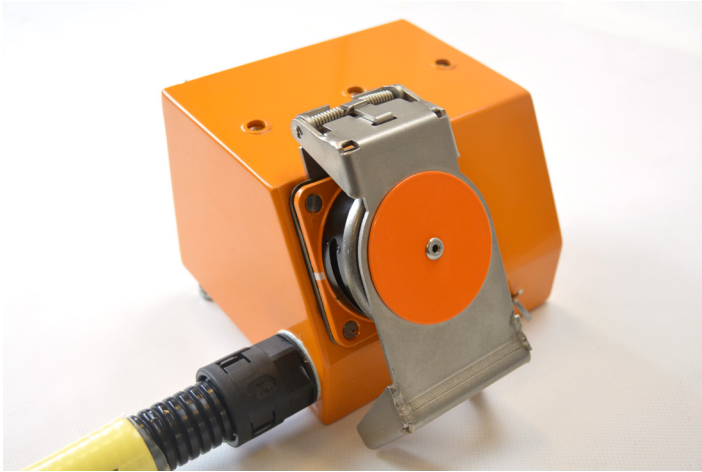
Fax: +44 (0)1592 651049

Email: sales@ten47.com

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Ten 47 Data Products comprises of our modular circular quarter turn reverse bayonet connectors developed with Van-System, the M12 connectors designed specifically for railway applications by Gimota and a range of railway approved cables to go with them. With this range of products we are able to offer very flexible solutions which are almost off the shelf. Ten 47 has supplied numerous projects where we take these products and adapt them to the customer's individual requirements.

GM Modular Jumper Series – Ethernet Implementation

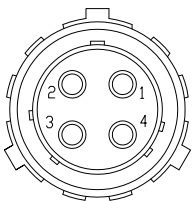
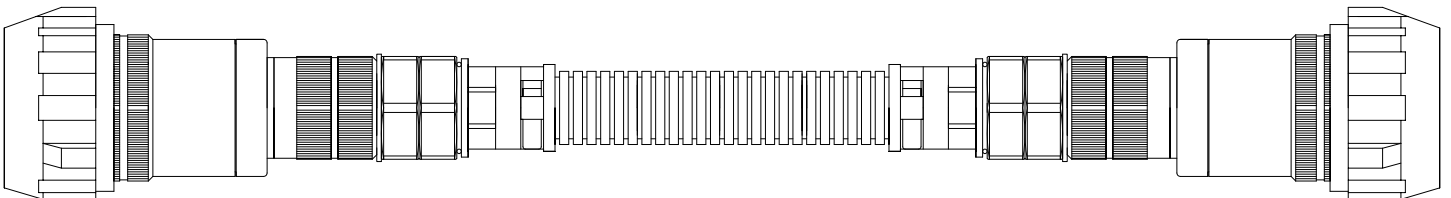


Receptacle assembly with integrated dust cover

Based on standard GM modular connector series with additional feature:

- Increased environmental protection
- Increased sealing in the interface between plug and conduit
- Reduced stress over the contacts due to internal cable support and mechanical sealing
- Protection against improper mating of the connector
- Visible identification of connector mated condition

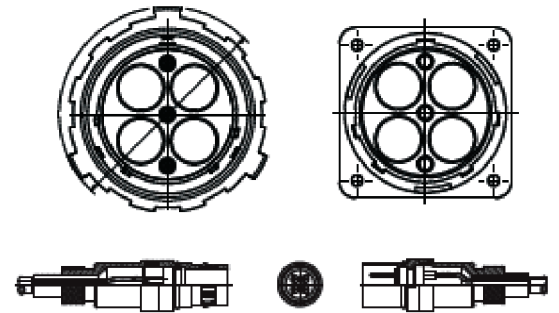
Jumper Assemblies



Connector front view

Standard GM 4 Pole Modular Connector Characteristics

- 5 keyways giving positive alignment
- 4 module cavity-each module can be individually configured, choosing between 7 different arrangements
- Each module is individually sealed by itself and relation to the insert
- Each module can be individually shielded
- Connector can be mechanically key coded
- IP67 sealing
- Module can be individually mounted and tested before being inserted into the connector



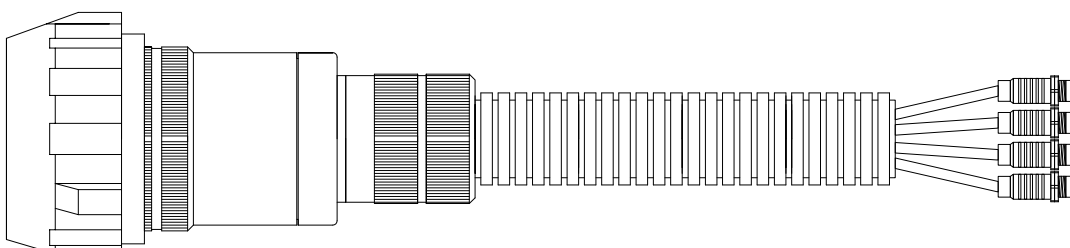
Application Specific Characteristics

- Four Ethernet Cat 5 modules – tested up to 1 gigabit
Also available with Cat 6A, Cat 7 and Cat 7A modules
- EMI shielded backshell specific for H&S RailCat ethernet cable
- Double plating system improved environmental resistance
- Special spring loaded cap designed to retain the plug in case of incorrect mating
- Individual clamp system to avoid mechanical stress being transmitted to the mating area
- Sealing cable grommet to protect against water ingress from conduit to connector
- Special marking on the coupling nut and on the receptacle in order to identify the correct mating condition
- Plug backshell with PMA interface
- Rubber coated stainless steel coupling nut



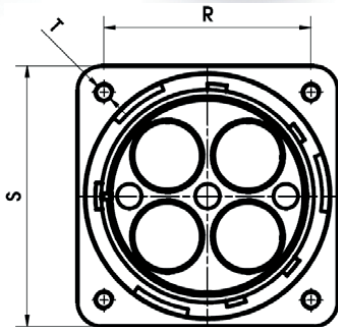
Receptacle connector in exploded view

Jumper to M12



M12 connectors

GM Series



- Directly derived from the reliable CVBS series
- 5 keyed guiding system
- Mechanical coding – variable combined polarization system (available for 4 and 7 modules only)
- Audible, visible and tactile mating
- One quarter turn lock for coupling
- Optical, coax, combined data and power modules available
- Comply all requirements of transit applications
- IP67 rating according EN 60529
- RoHS complying material and finish
- Rubber coated coupling nut offers damping protection against mechanical shock
- Available with back-shells expressly designed for single or double headed interconnection between vehicles

14S2 Module



- 2x4 contact termination 0.5 sqmm. – available 26÷20 AWG
- High grade efficiency shielding for each module's EMI/RFI protection

12Z10 Module



- 4 contact terminations 0.5 sqmm. – available 26÷20 AWG and 1÷1.5 sqmm
- High grade efficiency shielding for each module's EMI/RFI protection

C7 Module



- Match CAT 7A requirements
- Tested according to Trenitalia 376575
- Over-moulded contacts pairs at controlled impedance
- Each pair is fully shielded from the adjacent to reduce the crosstalk
- 2 × 4 contact termination 23 AWG – available 24 and 26 AWG
- Reduced components quantity makes easier and more reliable assembly

Other modular connectors available on request including:

- Fibre Optic
- Coax
- Power

Tecnikabel

Code : 522E0040	Description : SPECIAL ETHERNET CABLE 4 PAIRS 23 AWG CAT.7 FOR ROLLING STOCK APPLICATION
-----------------	-----------------------------------------------------------------------------------------

Conductor

	u/m	
Material	Stranded Bare Copper	
Nominal Diameter of conductor	0.66	mm

Insulation

	u/m		
Material	Cellular Polyolefin		
Colour of the pairs	1. White – Blue 2. White – Orange	3. White – Green 4. White – Brown	
Nominal Diameter	1.55		mm

Individual Pairs screen with Aluminium/Polyester or Aluminium/Polyester/Aluminium Tape and four pairs twisted together

Overall Shield

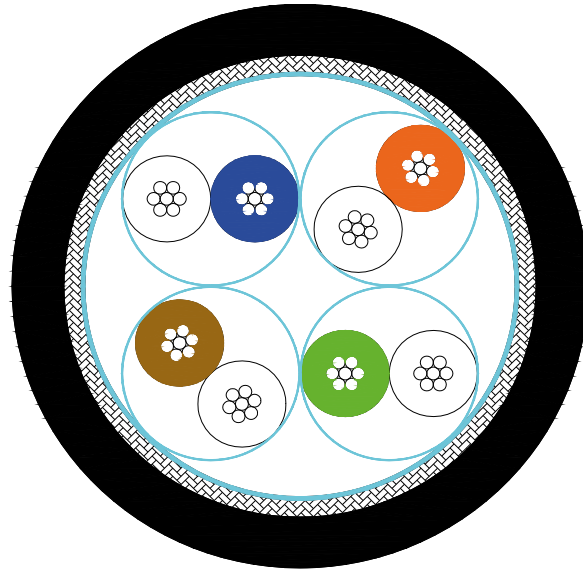
	u/m	
Material	Tinned Copper	
Diameter of strands	≥ 0.10	mm
Type of shield	Braid	
Coverage	≥ 85	%

Outer Sheath

	u/m	
Material	Cross-linked ethylene copolymer, flame retardant, zero halogen, type EM 104 according to EN 50264-1	
Colour	Black	
Overall Diameter	8.8 ± 0.20	mm
Marking	TECNIKABEL (TO) – ITALY – (month/year) 4 PAIRS ETHERNET CABLE CAT.7M + metric	

Code : 522E0040

Description : SPECIAL ETHERNET CABLE 4 PAIRS 23 AWG CAT.7 FOR ROLLING STOCK APPLICATION



Electrical Characteristics according to EN 50288-4-2

Test Voltage		1 kVd.c. or 0.7 kVa.c. for 1 minute
Operating Voltage		125 V
Resistance of the conductor at 20°C		69.5 Ω /km
Insulation Resistance at 20°C		$\geq 5000 \text{ M}\Omega \times \text{km}$
Nominal Capacitance at 800 ÷ 1000 Hz		43 pF/m
Average Characteristic Impedance		100 \pm 10 Ω at 100MHz
Velocity of propagation		78%
Transfer Impedance at	1 MHz	$\leq 10 \text{ m}\Omega/\text{m}$
	10 MHz	$\leq 10 \text{ m}\Omega/\text{m}$
	30 MHz	$\leq 15 \text{ m}\Omega/\text{m}$

Code : 522E0040	Description : SPECIAL ETHERNET CABLE 4 PAIRS 23 AWG CAT.7 FOR ROLLING STOCK APPLICATION
-----------------	-----------------------------------------------------------------------------------------

Attenuation $a \leq 1.5 (1.75\sqrt{f} + 0.01f + 0.2/\sqrt{f})$, $1\text{MHz} \leq f \leq 600\text{MHz}$													
Frequenzy	MHz	1	4	10	16	20	31.25	62.5	100	155	200	300	600
Required	dB/100m	2.9	5.5	8.5	10.8	12.1	15.2	21.7	27.8	35	40.1	50	73.3
Typical	dB/100m	2.2	3.8	5.9	7.4	8.4	10.5	15.3	18.1	23.2	26.6	33.3	50.1
Near-End Crosstalk (NEXT) ≥ 80 $1\text{MHz} \leq f \leq 31,25\text{MHz}$; $80 - 15\log(f/31,25)$ $31,25\text{MHz} \leq f \leq 600\text{MHz}$													
Frequenzy	MHz	1	4	10	16	20	31.25	62.5	100	155	200	300	600
Required	dB	80	80	80	80	80	80	75.1	72.4	69.6	67.9	65.3	60.8
Typical	dB	100	100	95	90	90	90	85	82	80	77	71	67
Power-Sum Near-End Crosstalk (PSNEXT) ≥ 77 $1\text{MHz} \leq f \leq 31.25\text{MHz}$; $77 - 15\log(f/31,25)$ $31,25\text{MHz} \leq f \leq 600\text{MHz}$													
Frequenzy	MHz	1	4	10	16	20	31.25	62.5	100	155	200	300	600
Required	dB	77	77	77	77	77	77	72.5	69.4	66.6	64.9	62.3	57.8
Typical	dB	95	95	90	86	80	80	80	75	70	68	66	62

Equal Level Far-End Crosstalk (ELFEXT) $\geq 94 - 20\log(f)$ $1\text{MHz} \leq f \leq 600\text{MHz}$ (Maximum 80dB) (Values referenced to 100m)													
Frequenzy	MHz	1	4	10	16	20	31.25	62.5	100	155	200	300	600
Required	dB	80	80	74	69.9	68	64.1	58.1	54	50.2	48	44.5	38.4
Typical	dB	96	93	90	100	100	100	100	100	100	100	100	100
Power-Sum Equal Level Far-End Crosstalk (PSELFEXT) $\geq 91 - 20\log(f)$ $1\text{MHz} \leq f \leq 600\text{MHz}$ (Maximum 77dB) (Values referenced to 100m)													
Frequenzy	MHz	1	4	10	16	20	31.25	62.5	100	155	200	300	600
Required	dB	77	77	71	66.9	68	64.1	58.1	54	50.2	48	44.5	38.4
Typical	dB	98	90	98	105	90	90	90	90	90	90	90	90
Return Loss $\geq 20 + 5 \log(f)$ $4\text{MHz} \leq f \leq 10\text{MHz}$ $\geq 25 \text{ dB}$ $10\text{MHz} \leq f \leq 20\text{MHz}$ $\geq 25 + 7 \log(f/20)$ $20\text{MHz} \leq f \leq 250\text{MHz}$													
Frequenzy	MHz	4	8	10	16	20	31.25	62.5	100	155	200	300	600
Required	dB	23.1	24.5	25	25	25	23.6	21.5	20.1	18.8	17.3	17.3	17.3
Typical	dB	35	31	38	32	32	31	27	34	28	25	23	21

Code : 522E0040	Description : SPECIAL ETHERNET CABLE 4 PAIRS 23 AWG CAT.7 FOR ROLLING STOCK APPLICATION
-----------------	-----------------------------------------------------------------------------------------

Other Characteristics	
Temperature Range	-40°C + 90°C
Bending Radius	8 x D
Net weight	91 Kg/km
Flame propagation (one vertical cable)	EN 60332-1-2
Flame propagation (bunched cable)	EN 50305 par.9.1 (EN 50266-2-5)
Low Smoke density	EN 61034-2 Transmittance ≥ 70%
Degree of acidity of gases evolved during of the combustion	50267-2-2 pH ≥ 4,3 Conductivity ≤ 10µS/mm
Halogen acid gas emission	EN 50267-2-1 HCL ≤ 0.5 %
Fluorine content	EN 60684-2 ≤ 0.10%
No Toxic Gases	EN 50305 par.9.2 ≤ 3
European Directives 2002/95/CE (RoHS - Reduction of Hazardous Substances) and 2002/96/CE (WEEE – Waste from Electrical and Electronic Equipment)	

Railway Cable for Rolling Stock Application

Description : FE(4XAWG22)M/SN/ST/M Green	Code : 524V0028
------------------------------------------	-----------------

Conductor

		u/m
Material	Tinned Copper	
Construction	19 x 0.66	mm
Nominal Section	0.38 (AWG22)	mm ²

Insulation

		u/m
Material	Special Thermoplastic Polymer according to Attached A	
Colours	White – Yellow – Blue – Orange	

Star quad with any fillers and any synthetic tape overlapped (see drawing)

Sheath

		u/m
Material	Thermoplastic Material LSZH Elastene TK 45	
Colour	Black	
Diametro nominale	3.90	mm

Shield

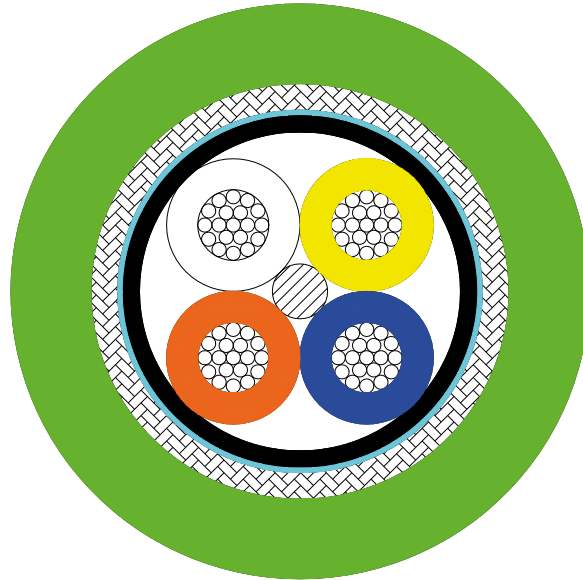
	I°	II°	u/m
Material	Aluminium/Polyester or Aluminium/Polyester/Aluminium	Tinned Copper	
Type of shield	Tape	Braid	mm
∅ strands	–	≥ 0.10	mm
Coverage	≥ 100	≥ 85	%

Sheath

		u/m
Material	Cross-linked Material Elastene TK 38 type EM 104, Flame Retardant, Halogen Free.	
Colour	Green Ral 6018	
Minimum Thickness	0.90	mm
Diameter	6.50 ± 0.20	mm
Marking	TECNIKABEL (TO) – ITALY – (Year) – 4x22 AWG – CAT.5E – 100 ohm	

Description : FE(4XAWG22)M/SN/ST/M Green

Code : 524V0028



Electrical Characteristics

Electrical Resistance of Conductor at 20°C	≤ 60 Ω/km
Electrical Resistance of Shield at 20°C	≤ 120 Ω/km
Insulation Resistance at 20°C	≤ 500 MΩxkm
Nominal Velocity of Propagation	78%
Operating voltage	300 Vrms
Test Voltage for 1 minute	700 Vrms (Conductor/Conductor) 700 Vrms (Conductor/Shield)
Mutual Capacitance	≤ 46 pF/m (Conductor/Conductor)
Unbalance Capacitance (Single conductor/Shield)	≤ 3.3 pF/m
Characteristic Impedance Zo da 1 a 100 MHz	100 ± 15 Ω
Transfer Impedance Zt up to 10 MHz	10 mΩ/m
Attenuation at	
0,256 MHz	≤ 1,3 dB/100m
0,512 MHz	≤ 1,8 dB/100m
0,772 MHz	≤ 2,2 dB/100m
1 MHz	≤ 2,4 dB/100m
4 MHz	≤ 4,9 dB/100m
10 MHz	≤ 7,8 dB/100m
16 MHz	≤ 9,8 dB/100m
20 MHz	≤ 11,1 dB/100m
31,25 MHz	≤ 14 dB/100m
62,5 MHz	≤ 20,4 dB/100m
100 MHz	≤ 26,4 dB/100m

Description : FE(4XAWG22)M/SN/ST/M Green

Code : 524V0028

Electrical Characteristics

Near-End Crosstalk	α 0,772 MHz	67 dB
	α 1 MHz	65,3 dB
	α 4 MHz	56,3 dB
	α 10 MHz	50,3 dB
	α 16 MHz	47,3 dB
	α 20 MHz	45,8 dB
	α 31,25 MHz	42,9 dB
	α 62,5 MHz	38,4 dB
	α 100 MHz	35 dB
Far-End Crosstalk	α 0,772 MHz	66 dB
	α 1 MHz	63,8 dB
	α 4 MHz	51,7 dB
	α 10 MHz	43,8 dB
	α 16 MHz	39,7 dB
	α 20 MHz	37,7 dB
	α 31,25 MHz	33,9 dB
	α 62,5 MHz	27,8 dB
	α 100 MHz	23,8 dB

Other Characteristics

Nominal Cable Weight	65kg/km
Minimum Bending Radius	70mm
Temperature Range	-40°C ÷ +80°C
Fire Propagation Resistance	EN 50265-2-1 (CEI 20-35/1-1) IEC 60332-1
Flame Propagation Resistance	EN 50266-2-4 (CEI 20-22/3-4) IEC 60332-3-24
Low Smoke density (EN 61034-2-1)	Transmittance ≥ 70%
Halogen acid gas emission (EN 50267-2-1)	HCL ≤ 0.5 %
Degree of acidity of gases evolved during of the combustion (EN 50267-2-2)	pH ≥ 4.3 Conductivity ≤ 10 μS/mm
No Toxic Gases (EN 50305 par.9.2)	≤ 3

Description : FE(4xAWG22)M/SN/ST/M Green

Code : 524V0028

Attached A Special Thermoplastic Polymer					
Mechanical Requirements		Limits	Measuring Unit	Value	Related Test
1.1	Cold Bending Test				EN 50306 Part 2 par. 4.18 EN 60811-1-4
	Temperature		°C	-40	
	Time		Hours	16	
	Mandrel Diameter		mm	25.4	
	Time		minute	1	
	Result				
1.2	Hot Set Test				EN 50306 Part 2 par. 4.18
	Temperature		°C	150	
	Time		Hours	15	
	Weight		N/cm ²	10	
	Elongation under load	Max	%	100	
	Elongation unloading after 5 minutes	Max	%	20	
1.3	Short Thermal Stability				MIL-W-22759 Life cycle
	Temperature		°C	175	
	Time		Hours	2	
	Weight		g	125	
	Mandrel		mm	20	
	Test Voltage		kV	1	
1.4	Shrinkage				EN 50306 Part 2 par. 4.16
	Temperature		°C	150	
	Shrink	Max	mm	1.5	
1.5	Hot Blocking of Cores				CENELEC/T20 (sec) 1128 Par. 5.29.2
	Temperature		°C	150	
	Time		Hours	6	
	Mandrel	∅	(9 ÷ 10) ∅ cable		

Description : FE(4xAWG22)M/SN/ST/M Green

Code : 524V0028

Attached A Special Thermoplastic Polymer					
Mechanical Requirements		Limits	Measuring Unit	Value	Related Test
1.6	Dynamic Cut Through				EN 50306 Part 2 par. 4.14
	Temperature		°C	20	
	Weight	Min	N	20	
	Speed		N/s	1	
1.7	Ozone Resistance (Method A)				EN 50306 Part 2 par. 4.21
	Concentration		p.p.m.	250 ÷ 300	
	Temperature		°C	25 ± 2	
	Time		Hours	24	
	Result				No Cracks
1.8	Pressare Test at High Temperature				MIL-W-22759 Life cycle No breakdown
	Temperature		°C	125	
	Weight		N	*	
	Time		Hours	4	
	Test Voltage after tratment		kV	1.5	
	Time		Minute	1	
	Result				No breakdown
1.9	Blocking of Cores				EN 50306 Part 2 par. 4.17
	Force	Min	N	12	
		Max	N	70	
1.10	Abrasion Test				EN 50306 Part 2 par. 4.19
	Load		N	4	
	Cycles		n°	100	

Description : FE(4x2xAWG24)ccSN/M Violet Category 5E

Code : 518E0095

Conductor

		u/m
Material	Stranded Bare Copper	
Nominal Diameter	0.20	mm
Number of pairs	7	

Insulation

		u/m
Material	Polyolefin	
Colour of the pairs	1. White/Blue – Blue; 2. White/Orange – Orange 3. White/Green – Green; 4. White/Brown – Brown	

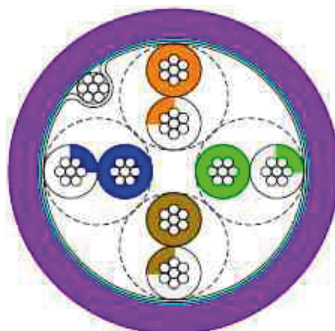
Assembly: Four pairs assembled with plastic tape

Overall Shield

		u/m
Drain Wire	Tinned Copper AWG24	mm
Material	Aluminium/Plastic	
Type of shield	Tape	
Coverage	≥ 100	%

Outer Sheath

		u/m
Material	Cross-linked ethylene copolymer, flame retardant, zero halogen, type EM 104 according to EN 50264-1	
Colour	Violet Ral 4005	
Nominal Diameter	6.2	mm
Marking	TECNIKABEL (TO) – ITALY – (Week/Year) – CATEGORY 5 E FTP 4 PA IRS AWG 24/7 IEC 60332-1 – (Meter Marking)	



Description : FE(4x2xAWG24)ccSN/M Violet Category 5E

Code : 518E0095

Electrical Characteristics

Resistance of the inner conductor at 20°C	$\leq 95 \Omega/\text{km}$
Insulation Resistance at 20°C	$\leq 500 \text{ M}\Omega \times \text{Km}$
Test Voltage	1000 Volt DC x 1 minutes
Temperature range	$-40^\circ\text{C} \div +80^\circ\text{C}$
Nominal Capacitance at 800 ÷ 1000 Hz	50 pF/m
Characteristic Impedance at 1 ÷ 100 Hz	$100 \pm 10 \Omega$
Nominal Velocity of propagation	65%
NEXT (TIA/EIA – 568B.2)	At 772 KHz 67dB $0.772 \leq f_{\text{MHz}} \leq 100.0$: NEXT _r ≥ 67–15 log ₁₀ (f/0.772)
ELFEXT (TIA/EIA – 568B.2)	At 772 KHz 66dB $1.0 \leq f_{\text{MHz}} \leq 100.0$: ELFEXT _r ≥ 66–20 log ₁₀ (f/0.772)
Return loss (TIA/EIA – 568B.2)	$1.0 \leq f_{\text{MHz}} \leq 10.0$: RL ≥ 20+5 log ₁₀ (f) $10.0 \leq f_{\text{MHz}} \leq 20.0$: RL ≥ 25 $20.0 \leq f_{\text{MHz}} \leq 100.0$: RL ≥ 20–8, 6 log ₁₀ (f/20)

Electrical Characteristics

Halogen acid gas emission $\leq 0.3\%$ when tested to IEC 60754–1. (EN 50267–2–1)

Degree of acidity of gases evolved of the combustion (pH value 4.3 and Conductivity $\leq 10\mu\text{S}/\text{mm}$ when tested accordance to IEC 60754–1. (EN 50267–2–2)

Smoke emission (Transmittance) 60% when tested accordance to IEC 61034–1 – IEC 61034–2. (EN 50305)

Toxicity of evolved gas ≤ 2 when tested accordance to NES 713 (EN 50305)

Oxygen Index $\geq 40\%$ when tested accordance to EN ISO 4589

Flame propagation complying with IEC 60332–1–2 (EN 50265–2–1)

Reference Standards IEC 60811 – EN 50305 – EIA T IA 568 – EIA TIA 569 – EN 50173 – EN 50288–2–1

European Directives 2002/95/CE (RoHS – Reduction of Hazardous Substance)
 and 2002/96/CE (WEEE – Waste from Electrical and Electronic Equipment)

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