



cavi
cables



**Cavi per Strumentazione,
Automazione Industriale,
Trasmissione Dati e Controllo**

**Instrumentation, Industrial
Automation, Data and Control
Transmission Cables**

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General Information

With the evolution of technology intelligent electronic devices such as sensors, inverters, measuring instruments, control and adjustment instruments have developed, which need to communicate with each other for achieving their goal. The idea of network has then become realistic not only for computers but also for all devices which have to interact with each other. In order that communication can take place between different devices, it is necessary to refer to a set of rules, defined as communication protocol. Today a variety of communication protocols are used (IEEE 488.2, RS 232, RS 422, RS 485, PROFIBUS,); but the main element for each connection is the cable, which must be designed and produced according to the specifications of the communication protocol and the national, European and international norms.

The main function of the cable is that of transmitting the signal sent by the emitting device to the receiving one as faithfully as possible, then signal losses while it is carried must be reduced to a minimum loss. The main disturbances altering the value of the transmitted signal are the electrostatic and electromagnetic interferences which can be found in any environment. These interferences can be stopped (attenuated) by a suitable shielding of the cable.

The shielding of the cable can be of a tape kind, in order to reduce electrostatic interferences and of a copper braid, in order to reduce electromagnetic interferences.

In both cases shielding not only reduces interferences that the external environment can cause, but it also protects the external environment from possible disturbance caused by the signal propagating inside the cable.

The cable choice should be, therefore, carefully evaluated, considering some fundamental aspects such as type of laying (for indoors or for moving condition); the characteristics of the installation environment (dry, humid, wet,...); the ambient temperature; the protection from external factors (oil resistance, ultraviolet ray resistance,...); and obviously the electric characteristics linked to the communication protocol.

The cable can be designed and produced for obtaining all of or only some of the following characteristics:

- Optimum mechanical flexibility
- Good resistance to mechanic stress
- Good resistance to hydrocarbons
- Contained dimensions
- Optimum protection of the transmitted signal from external interferences
- Low capacitance
- The necessary insulation degree
- High insulation resistance

The main components of a multicore cable are:

- Conductors
- Insulation
- Separator tape
- Possible shielding
- Possible fillers
- Sheath

The inner conductors consist of copper wires assembled in bunches or in a single bunch of the same diameter (from 0,10 mm to 0,40 mm), the number of wires of the conductor and their diameter distinguish the size which is measured in mm². They enable the transmission in a low voltage environment.

Core is named the conductor covered with an insulating layer of a suitable thickness. Both the thickness and the material used for insulating depend on the reference norm for the construction of the cable. The single cores can be identified either by their colour or by a progressive number given to each of them, in both cases the reference norms are to be observed (DIN 47100, CEI –UNEL 00722, ...).



Screened and Unscreened Multicore Cables

The number of wires, the diameter of the single elementary wire and the pitch characterize the copper braid shielding. The efficiency of shielding is proportional to the coverage percentage of the same, which is the parameter taken under control. It is obvious that a higher coverage implies a lesser flexibility of the cable. This kind of shielding is used to reduce electromagnetic interferences.

The tape shielding is made by wrapping it spiral wise on the cores, thus obtaining an overlap approx. 20% to achieve a total coverage of 100%. This kind of shielding is used to reduce electrostatic interferences.

The sheath is made of a layer of insulating material. It is the protection barrier against certain external factors such as:

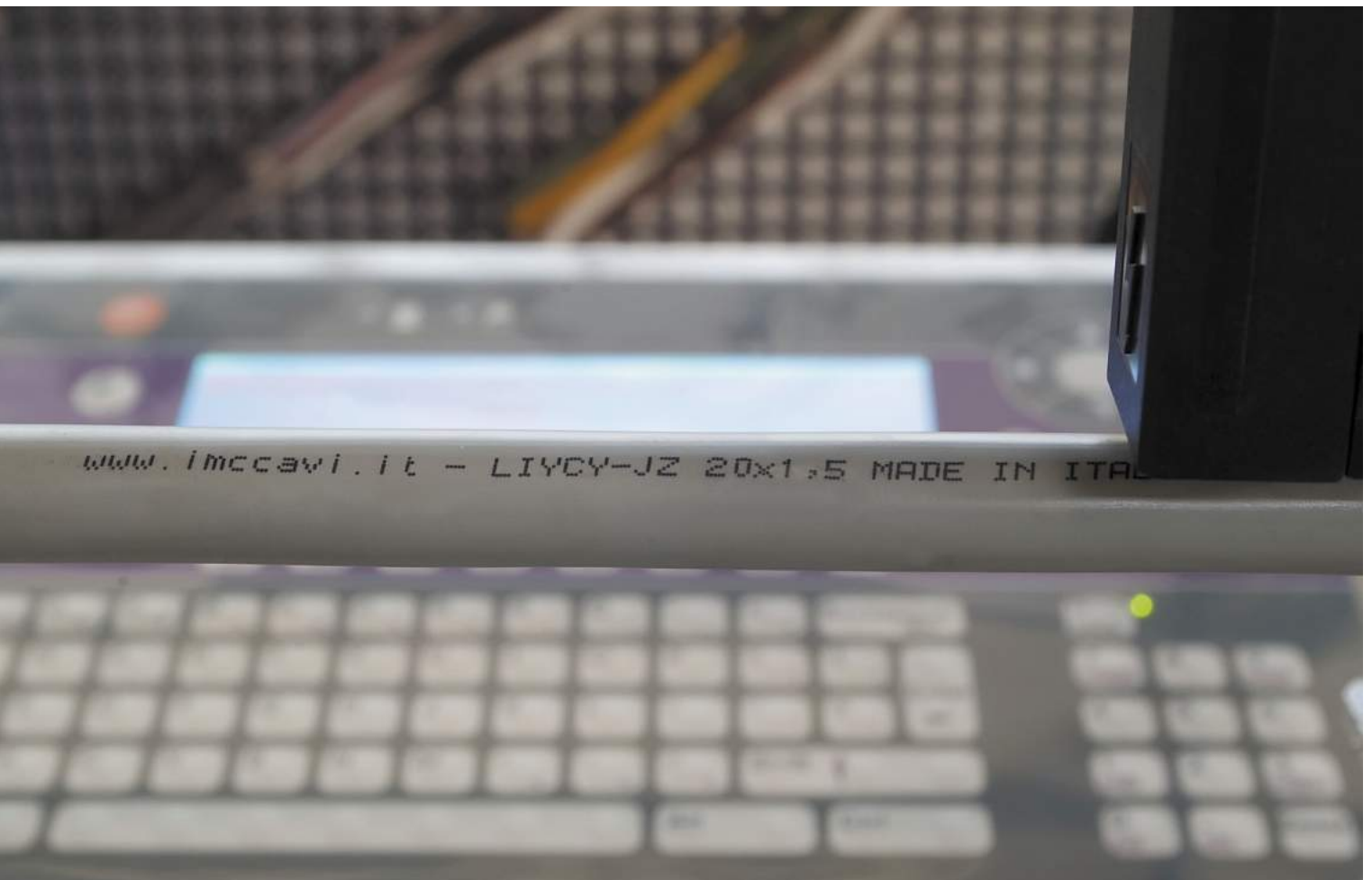
- humidity
- resistance to ultraviolet rays
- oils
- fats
- rats

In order to meet such demands, IMC produces a range of single, paired, triple and multicore cables.

Some cables are produced in pairs, in order to notably reduce the effects of reciprocal influence which are obtained during the signal propagation, the measuring of this characteristic is called "cross talk".

In this category of shielded cables the cables LiYCY, 2LiYCY, LiYCY-CY, LiYY-CY, Li2YCY-PiMF, Li2YCYv, LiHCH, FR2OH2R (TOP-FLEX), FR2OHH2R, FG7OH2M1 are included.

NOTE IMC CAN SUPPLY ON REQUEST LiYY WITH THE SAME SIZE AND NUMBER OF CONDUCTORS OF LiYCY CABLES, AND ARE USED WHERE THE ELECTROMAGNETIC INTERFERENCE IS VERY SMALL.





Screened and Unscreened Multicore Cables

Shielded cables galvanized steel (LiYY-SY / FRORAR)

In this type of cables the shielding with a steel wires braid is a mechanical protection; while the transparent sheath allows to check if the cable has been damaged.

The use of these cables is recommended in the industrial environment, where the cable can be accidentally knocked, or where we can find rats.

Screened Cable (LI2YCY-PIMF)

Cable with polyethylen insulation, in pairs wrapped with tape (Al/Pet) with 100% coverage, tinned copper wire braid on the lay-up pairs. This kind of cable has got a low capacitance and is characterized by an optimum protection from electrostatic and electromagnetic phenomena, therefore it is used in environments where these characteristics are fundamental.

BUS cables

BUS technology is required in a variety of industrial applications. This technology can be used in any industrial field, where a technique of the process control is adopted. The data derived from the process control by using suitable components and the BUS network, can be used, once they have been processed, to improved the process, and used as feedbacks for carrying out changes in real time along the production line, for adjusting the line parameters.

The existence of a lot of communication protocols has caused the necessity of unifying some basic parameters of communication of the field BUS, in order to allow the interconnection of devices having different protocols and then to exchange all the necessary information for a right process control at a higher level along a common connection network.

IMC produces different BUS cables which meet these demands and are conforming with different communication protocols.

Special cables

IMC produces special cables according to customer's requirements, such as:

- FR2XHE
- FR2OHR
- FR2XHOHR
- FR2XHOH2R
- FR2ORAR
- FR2XHOHRAR
- FR2OH2RAR
- FEXHOH2M1
- FM1OH2M1

Denomination initials are conforming with the CEI 20-27 or with the TABLE CEI - UNEL 36011; from these initials it is possible to track the cable structure and then its application field.

Besides cables conforming with CEI norms, IMC produces cables conforming both with international norms and the norms of different Countries, such as for example the DIN VDE for Germany. Some examples of cables produced in conformity with these norms are:

- RE - 2Y(St)Y PiMF
- RE - 2Y(St)Yv
- RS - 2YCY PiMF
- JE - LiYCY

Technical Data

Electrical Resistance (R)

It's the passive circuit parameter, conductors characteristic of transmission lines, given by the result of the resistivity, (constant depending by the material used), and the ratio between its length in metres and its size in mm²

$$R = \rho * \frac{l}{S} \quad [\Omega]$$

Therefore in conductors of a lower size the Resistances increases; the value of resistivity can be obtained in special tables. From an electric point of view, the Resistance represents the constant of proportionality between the applied voltage and the current circulating within the conductor; the measure unit is the Ohm [Ω]. This value is measured in the laboratories of IMC and is then reported in Ω /km (in an ambient temperature of 20 °C). IMC guarantees values not higher than the specifications of the cable.

Capacitance / Mutual capacitance

The capacitance of a cable is the parameter which shows the property of insulating material placed between conductors of storing electric charges, when different charges are applied between conductors.

The mutual capacitance is the capacitance between two conductors when all the others are connected together and to the earth core.

It is measured in Farad/length unit and at the frequency of 1 kHz.

This value is directly proportional to the dielectric constant of the material, then with the increase of the latter the capacitances itself increases; furthermore, it also depends on the conductor size.

Also for this parameter, the values are not higher to the specifications of the cable reported in pF/m or nF/m.

Insulation rigidity

It is also known as voltage test of insulation, it consists of testing the capacitance of the insulation of supporting the specified voltage. This test is carried out in the laboratories of IMC by a voltage generator in c.c. and with voltage values which depend on the construction characteristics of the cable, as it is provided by the international norms.

Voltage is applied for a period of time established by the norms, in the case of standard cables, or for a period of time fixed by the customer for cables produced according to the customer's requirements. This test is carried out between the cable cores, and between the cores and the screen/shield.

Insulation resistance

It shows the insulation resistance in c.c. among the conductors of a cable; it is measured with a megaohmmeter having a capacitance over 10⁵ M Ω .

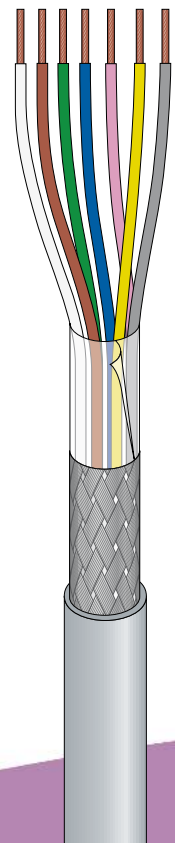
The measured value is reported in M Ω x km.



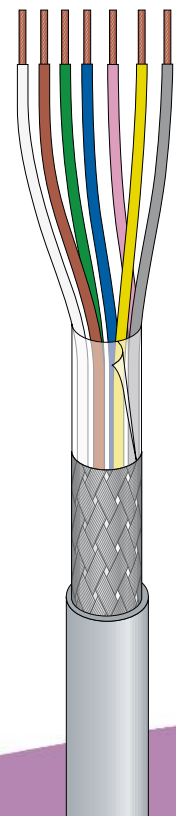
Cavi schermati isolamento PVC/guaina PVC LiYCY

Shielded cables PVC Insulated/PVC Sheath LiYCY

Caratteristiche costruttive		LiYCY nx0,14	LiYCY nx0,25	LiYCY nx0,34	Legenda
Constructive characteristics					Legend
Conduttore interno Inner conductor	Tipo/Type n x ø (mm)	Cu 18 x 0,10	Cu 14 x 0,15	Cu 7 x 0,25	Cu Rame Bare Copper
Isolamento Insulation	Tipo/Type	PVC	PVC	PVC	CuSn Rame stagnato Tinned Copper
Sezione conduttore Section conductor	mm ²	0,14	0,25	0,34	CuAg Rame argentato Silver Plated Copper
Nastro separatore Separator Tape		Pet	Pet	Pet	FeCu Acciaio ramato Copper Clad Steel
Schermo Treccia Screen Braid	Tipo/Type % coverage	CuSn 85 (approx.)	CuSn 85 (approx.)	CuSn 85 (approx.)	Al Alluminio Aluminium
Guaina Sheath	Tipo/Type	PVC	PVC	PVC	Pet Poliestere Polyester
	Colore/Colour	grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015	grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015	grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015	Al / Pet / Al Alluminio/Poliestere/Alluminio Aluminium/Polyester/Aluminium
Caratteristiche elettriche					
Electric characteristics					
Resistenza conduttore (max) Conductor resistance (max)	/ km 20 °C	148	79,9	57,5	Al / Pet Alluminio/Poliestere Aluminium/Polyester
Impedenza (approx.) Impedance (approx.)		80	80	80	Al / Pet / Sy Alluminio/Poliestere/Copolimero Aluminium/Polyester/Copolymer
Capacità mutua Mutual capacitance	pF / m	120	150	150	Cu / Pet Rame/Poliestere Copper/Polyester
Tensione di esercizio Operating voltage	V	250	350	350	TNT Tessuto non tessuto Polyester Woven non Woven
Tensione di prova anima/anima Test voltage core/core	V	1200	1200	2000	G7 Gomma sintetica del tipo HEPR Hard Ethylene-Propylene-Rubber
Tensione di prova anima/schermo Test voltage core/screen	V	800	800	1200	PE Polietilene solido Solid Polyethylene
Resistenza di isolamento (min.) Insulation resistance (min.)	M x km	200	200	200	PEE Polietilene espanso Cellular Polyethylene
Temperatura di esercizio Operating temperature	°C	- 30 / + 70	- 30 / + 70	- 30 / + 70	PEE GAS Polietilene con espansione a gas Gas-injected foam Polyethylene
Norme e campi di applicazione					
Standards and applications					
<p>VDE 0295 cl. 5 • IEC 60228 cl. 5 VDE 0812 • CEI 20 - 22 II • IEC 60332 - 1</p> <p>Per impieghi in elettronica, per apparecchiature di controllo e regolazione, strumenti di misura etc.</p> <p>For employment in electronic field, control and regulation equipments and apparatus connections, tools of measurement etc.</p> <p>EMC = Electromagnetic compatibility</p>					
<p>Colori Anime: DIN 47100 Coloured Cores: DIN 47100 Vedi tabelle allegate / See attached charts</p> <p>Raggio di curvatura minimo Posa Fissa: 5 x Ø Cavo Posa Mobile: 10 x Ø Cavo Minimum Bending radius Fixed Installation: 5 x Cable Ø Flexing: 10 x Cable Ø</p>					



Caratteristiche costruttive		LiYCY nx0,50	LiYCY nx0,75	Legenda
Constructive characteristics				Legend
Conduttore interno Inner conductor	Tipo/Type n x ø (mm)	Cu IEC 60228 CL 5	Cu IEC 60228 CL 5	Cu Rame Bare Copper
Isolamento Insulation	Tipo/Type	PVC	PVC	CuSn Rame stagnato Tinned Copper
Sezione conduttore Section conductor	mm ²	0,50	0,75	CuAg Rame argentato Silver Plated Copper
Nastro separatore Separator Tape		Pet	Pet	FeCu Acciaio ramato Copper Clad Steel
Schermo Treccia Screen Braid	Tipo/Type % coverage	CuSn 85 (approx.)	CuSn 85 (approx.)	Al Alluminio Aluminium
Guaina Sheath	Tipo/Type	PVC	PVC	Pet Polyestere Polyester
	Colore/Colour	grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015	grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015	Al / Pet / Al Alluminio/Poliestere/Alluminio Aluminium/Polyester/Aluminium
Caratteristiche elettriche				Al / Pet Alluminio/Poliestere Aluminium/Polyester
Electric characteristics				Al / Pet / Sy Alluminio/Poliestere/Copolimero Aluminium/Polyester/Copolymer
Resistenza conduttore (max) Conductor resistance (max)	/ km 20 °C	39	26	Cu / Pet Rame/Poliestere Copper/Polyester
Impedenza (approx.) Impedance (approx.)		80	80	TNT Tessuto non tessuto Polyester Woven non Woven
Capacità mutua Mutual capacitance	pF / m	150	150	G7 Gomma sintetica del tipo HEPR Hard Ethylene-Propylene-Rubber
Tensione di esercizio Operating voltage	V	300 / 500	300 / 500	PE Polietilene solido Solid Polyethylene
Tensione di prova anima/anima Test voltage core/core	V	2000	2000	PEE Polietilene espanso Cellular Polyethylene
Tensione di prova anima/schermo Test voltage core/screen	V	1200	1200	PEE GAS Polietilene con espansione a gas Gas-injected foam Polyethylene
Resistenza di isolamento (min.) Insulation resistance (min.)	M x km	200	200	PE/A Polietilene + aria Air + Polyethylene
Temperatura di esercizio Operating temperature	°C	- 30 / + 70	- 30 / + 70	PP Polipropilene solido Solid Polypropylene
				PPE Polipropilene espanso Cellular Polypropylene
				PVC Polivinilcloruro ritardante la fiamma esente da piombo Polyvinil Chloride Flame Retardant Lead Free
				PVC O.R. Polivinilcloruro resistente agli oli Polyvinil Chloride Oil Resistant
				LSZH Compound privo di alogeni ritardante la fiamma Zero Halogen Compound Flame Retardant
				PUR Poliuretano Polyurethane
				Colori Anime: DIN 47100 Coloured Cores: DIN 47100 Vedi tabelle allegate / See attached charts
				Raggio di curvatura minimo Posa Fissa: 5 x Ø Cavo Posa Mobile: 10 x Ø Cavo Minimum Bending radius Fixed Installation: 5 x Cable Ø Flexing: 10 x Cable Ø



Norme e campi di applicazione

Standards and applications

VDE 0295 cl. 5 • IEC 60228 cl. 5
VDE 0812 • CEI 20 - 22 II • IEC 60332 - 1

Per impieghi in elettronica, per apparecchiature di controllo e regolazione, strumenti di misura etc.

For employment in electronic field, control and regulation equipments and apparatus connections, tools of measurement etc.

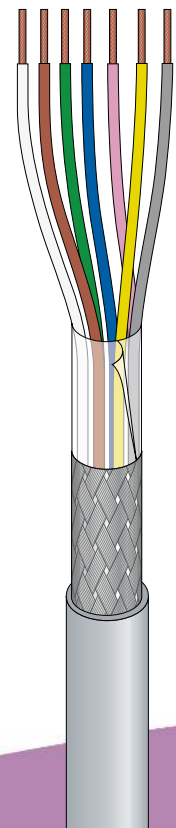
EMC = Electromagnetic compatibility



Cavi schermati isolamento PVC/guaina PVC LiYCY

Shielded cables PVC Insulated/PVC Sheath LiYCY

Caratteristiche costruttive		Legenda			
Constructive characteristics		LiYCY nx1,00	LiYCY nx1,50	LiYCY nx2,50	Legend
Conduttore interno Inner conductor	Tipo/Type n x Ø (mm)	Cu IEC 60228 CL 5	Cu IEC 60228 CL 5	Cu IEC 60228 CL 5	Cu Rame Bare Copper
Isolamento Insulation	Tipo/Type	PVC	PVC	PVC	CuSn Rame stagnato Tinned Copper
Sezione conduttore Section conductor	mm ²	1,00	1,50	2,50	CuAg Rame argentato Silver Plated Copper
Nastro separatore Separator Tape		Pet	Pet	Pet	FeCu Acciaio ramato Copper Clad Steel
Schermo Treccia Screen Braid	Tipo/Type % coverage	CuSn 85 (approx.)	CuSn 85 (approx.)	CuSn 85 (approx.)	Al Alluminio Aluminium
Guaina Sheath	Tipo/Type Colore/Colour	PVC grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015	PVC grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015	PVC grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015	Pet Poliestere Polyester
Caratteristiche elettriche					Al / Pet / Al Alluminio/Poliestere/Alluminio Aluminium/Polyester/Aluminium
Electric characteristics					Al / Pet Alluminio/Poliestere Aluminium/Polyester
Resistenza conduttore (max) Conductor resistance (max)	/ km 20 °C	19,5	13,3	8	Al / Pet / Sy Alluminio/Poliestere/Copolimero Aluminium/Polyester/Copolymer
Impedenza (approx.) Impedance (approx.)		80	80	80	Cu / Pet Rame/Poliestere Copper/Polyester
Capacità mutua Mutual capacitance	pF / m	150	150	150	TNT Tessuto non tessuto Polyester Woven non Woven
Tensione di esercizio Operating voltage	V	300 / 500	450 / 750	450 / 750	G7 Gomma sintetica del tipo HEPR Hard Ethylene-Propylene-Rubber
Tensione di prova anima/anima Test voltage core/core	V	2000	2000	2000	PE Polietilene solido Solid Polyethylene
Tensione di prova anima/schermo Test voltage core/screen	V	1200	1200	1200	PEE Polietilene espanso Cellular Polyethylene
Resistenza di isolamento (min.) Insulation resistance (min.)	M x km	200	200	200	PEE GAS Polietilene con espansione a gas Gas-injected foam Polyethylene
Temperatura di esercizio Operating temperature	°C	- 30 / + 70	- 30 / + 70	- 30 / + 70	PE/A Polietilene + aria Air + Polyethylene
Norme e campi di applicazione					PP Polipropilene solido Solid Polypropylene
Standards and applications					PPE Polipropilene espanso Cellular Polypropylene
VDE 0295 cl. 5 • IEC 60228 cl. 5 VDE 0812 • CEI 20 - 22 II • IEC 60332 - 1					PVC Polivinilcloruro ritardante la fiamma esente da piombo Polyvinil Chloride Flame Retardant Lead Free
Per impieghi in elettronica, per apparecchiature di controllo e regolazione, strumenti di misura etc.					PVC O.R. Polivinilcloruro resistente agli oli Polyvinil Chloride Oil Resistant
For employment in electronic field, control and regulation equipments and apparatus connections, tools of measurement etc.					LSZH Compound privo di alogeni ritardante la fiamma Zero Halogen Compound Flame Retardant
EMC = Electromagnetic compatibility					PUR Poliuretano Polyurethane
					Colori Anime: DIN 47100 Coloured Cores: DIN 47100 Vedi tabelle allegate / See attached charts
					Raggio di curvatura minimo Posa Fissa: 5 x Ø Cavo Posa Mobile: 10 x Ø Cavo Minimum Bending radius Fixed Installation: 5 x Cable Ø Flexing: 10 x Cable Ø



Caratteristiche costruttive		LiICY nx4,00		LiICY nx6,00		Legenda	
Constructive characteristics						Legend	
Conduttore interno Inner conductor	Tipo/Type n x ø (mm)	Cu IEC 60228 CL 5		Cu IEC 60228 CL 5		Cu	Rame Bare Copper
Isolamento Insulation	Tipo/Type	PVC		PVC		CuSn	Rame stagnato Tinned Copper
Sezione conduttore Section conductor	mm ²	4,00		6,00		CuAg	Rame argentato Silver Plated Copper
Nastro separatore Separator Tape		Pet		Pet		FeCu	Acciaio ramato Copper Clad Steel
Schermo Treccia Screen Braid	Tipo/Type % coverage	CuSn 85 (approx.)		CuSn 85 (approx.)		Al	Alluminio Aluminium
Guaina Sheath	Tipo/Type Colore/Colour	PVC grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015		PVC grigio RAL 7001 / blu RAL 5015 grey RAL 7001 / blue RAL 5015		Pet	Poliestere Polyester
Caratteristiche elettriche						Al / Pet / Al	Alluminio/Poliestere/Alluminio Aluminium/Polyester/Aluminium
Electric characteristics						Al / Pet	Alluminio/Poliestere Aluminium/Polyester
Resistenza conduttore (max) Conductor resistance (max)	/ km 20 °C	5		3,3		Al / Pet / Sy	Alluminio/Poliestere/Copolimero Aluminium/Polyester/Copolymer
Impedenza (approx.) Impedance (approx.)		80		80		Cu / Pet	Rame/Poliestere Copper/Polyester
Capacità mutua Mutual capacitance	pF / m	150		150		TNT	Tessuto non tessuto Polyester Woven non Woven
Tensione di esercizio Operating voltage	V	450 / 750		450 / 750		G7	Gomma sintetica del tipo HEPR Hard Ethylene-Propylene-Rubber
Tensione di prova anima/anima Test voltage core/core	V	2000		2000		PE	Polietilene solido Solid Polyethylene
Tensione di prova anima/schermo Test voltage core/screen	V	1200		1200		PEE	Polietilene espanso Cellular Polyethylene
Resistenza di isolamento (min.) Insulation resistance (min.)	M x km	200		200		PEE GAS	Polietilene con espansione a gas Gas-injected foam Polyethylene
Temperatura di esercizio Operating temperature	°C	- 30 / + 70		- 30 / + 70		PE/A	Polietilene + aria Air + Polyethylene
Norme e campi di applicazione						PP	Polipropilene solido Solid Polypropylene
Standards and applications						PPE	Polipropilene espanso Cellular Polypropylene
VDE 0295 cl. 5 • IEC 60228 cl. 5 VDE 0812 • CEI 20 - 22 II • IEC 60332 - 1						PVC	Polivinilcloruro ritardante la fiamma esente da piombo Polyvinil Chloride Flame Retardant Lead Free
Per impieghi in elettronica, per apparecchiature di controllo e regolazione, strumenti di misura etc. For employment in electronic field, control and regulation equipments and apparatus connections, tools of measurement etc.						PVC O.R.	Polivinilcloruro resistente agli oli Polyvinil Chloride Oil Resistant
EMC = Electromagnetic compatibility						LSZH	Compound privo di alogeni ritardante la fiamma Zero Halogen Compound Flame Retardant
						PUR	Poliuretano Polyurethane
						Colori Anime: DIN 47100 Coloured Cores: DIN 47100 Vedi tabelle allegate / See attached charts	
						Il raggio di curvatura minimo: Posa Fissa: 5 x ø Cavo Posa Mobile: 10 x ø Cavo Minimum Bending radius: Fixed Insallation: 5 x Cable ø Flexing: 10 x Cable ø	

