

CABLES ACC. TO  
CROSS SECTION  
& ACC. TO DRIVE SYSTEMS



**HELUKABEL®**



 Drive Technology

## **SERVO & FEEDBACK CABLES**

Includes Hybrid Cables for **SICK HIPERFACE DSL**  
and **HEIDENHAIN HMC6**

**NEW! TOPSERV® PUR Single**

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# TOPSERV® Hybrid

Hybrid cable for SICK Hiperface DSL® motor feedback systems



Also see Catalogue  
„Cables, Wires &  
Accessories/Ed. 27“,  
page 474

**Technical data**

- **TOPSERV® PUR**
- Special PUR drag chain cable acc. to UL AWM Style 21223 CSA AWM
- **Temperature range** flexing -30°C to +80°C fixed installation -40°C to +90°C
- **Nominal voltage** VDE power supply cores U<sub>0</sub>/U 600/1000 V control cores U<sub>0</sub>/U 300/500 V UL/CSA 1000 V
- **A.C. test voltage**, 50 Hz power supply cores 4000 V control cores 1000 V
- **Insulation resistance** min. 20 MOhm x km
- **Coupling resistance** max. 250 Ohm/km
- **Minimum bending radius** flexing 7,5x cable Ø fixed installation 4x cable Ø min. 5 mio. cycles

**Cable structure**

- Bare copper-conductor, to DIN VDE 0295 cl.6, extra fine-wire, IEC 60228 cl.6
- Core insulation halogen-free PP
- Core identification
- **power supply cores** core 1: black with imprint U/L1/C/L+ core 2: black with imprint V/L2 core 3: black with imprint W/L3/D/L- control cores pair 1: black with number no. 5+6 pair 2: white and blue
- GN-YE conductor
- Screening of the control cores in pairs wrapped with tinned copper braid
- Power supply cores laid up with optimal lay length and stabilising filler
- Overall screening from tinned copper braid, optimal coverage approx. 85%
- Outer sheath of PVC or PUR
- Sheath colour orange (RAL 2003) acc. to DESINA®

**Properties**

- Low capacitance
  - PUR outer sheath: low adhesion, extremely abrasion resistant, halogen-free, resistant to UV-, oil-, hydrolysis and microbial attack
  - Optimum compliance with requirements for electromagnetic compatibility (EMC) by approx. 85% coverage from the braided screen
  - These cables are produced to high quality specifications and conform to the DESINA® standard.
  - The materials used in manufacture are cadmium-free and contain no silicone and free from substances harmful to the wetting properties of lacquers
- Tests**
- PUR outer sheath self-extinguishing and flame retardant to DIN VDE 0482-332-1-2, DIN EN 60332-1-2, IEC 60332-1 (equivalent DIN VDE 0472 part 804 test method B)

**Note**

- The technical data for **TOPSERV® Hybrid PVC** cables are available on request.
- The technical data for **TOPSERV® Hybrid PUR** cables according to **HEIDENHAIN HMC6** are available on request.
- **TOPSERV® Hybrid PUR** for **torsion application** available on demand.

## PVC

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>Hybrid acc. to SICK HIPERFACE DSL</b>							
TOPSERV® Hybrid PVC	709930	LI9YCY	8	4 G 0.5 + (2 x 0.34) C + (2 x 26 AWG) C	72	123	9.3
TOPSERV® Hybrid PVC	709931	LI9YCY	8	4 G 0.75 + (2 x 0.34) C + (2 x 26 AWG) C	85	138	11.0
TOPSERV® Hybrid PVC	709932	LI9YCY	8	4 G 1.0 + (2 x 0.75) C + (2 x 22 AWG) C	130	208	11.6
TOPSERV® Hybrid PVC	709933	LI9YCY	8	4 G 1.5 + (2 x 0.75) C + (2 x 22 AWG) C	152	248	12.2
TOPSERV® Hybrid PVC	709934	LI9YCY	8	4 G 2.5 + (2 x 1.0) C + (2 x 22 AWG) C	207	326	13.8
TOPSERV® Hybrid PVC	709935	LI9YCY	8	4 G 4 + (2 x 1.0) C + (2 x 22 AWG) C	273	415	15.3
TOPSERV® Hybrid PVC	709936	LI9YCY	8	4 G 6 + (2 x 1.0) C + (2 x 22 AWG) C	357	538	17.2
TOPSERV® Hybrid PVC	709937	LI9YCY	8	4 G 10 + (2 x 1.5) C + (2 x 22 AWG) C	530	752	20.3
TOPSERV® Hybrid PVC	709938	LI9YCY	8	4 G 16 + (2 x 1.5) C + (2 x 22 AWG) C	768	1005	22.6

suitable for itec

## PUR

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>Hybrid acc. to SICK HIPERFACE DSL</b>							
TOPSERV® Hybrid PUR	709703	LI9YC11Y	8	4 G 0.5 + (2 x 0.34) C + (2 x 26 AWG) C	76	127	9.3
TOPSERV® Hybrid PUR	709704	LI9YC11Y	8	4 G 0.75 + (2 x 0.34) C + (2 x 26 AWG) C	88	142	9.9
TOPSERV® Hybrid PUR	708543	LI9YC11Y	8	4 G 1.0 + (2 x 0.75) C + (2 x 22 AWG) C	133	212	11.6
TOPSERV® Hybrid PUR	710081	LI9YC11Y	8	4 G 1.5 + (2 x 0.75) C + (2 x 24 AWG) C	146	230	11.7
TOPSERV® Hybrid PUR	708544	LI9YC11Y	8	4 G 1.5 + (2 x 0.75) C + (2 x 22 AWG) C	155	269	12.7
TOPSERV® Hybrid PUR	708545	LI9YC11Y	8	4 G 2.5 + (2 x 1.0) C + (2 x 22 AWG) C	205	310	13.9
TOPSERV® Hybrid PUR	708546	LI9YC11Y	8	4 G 4.0 + (2 x 1.0) C + (2 x 22 AWG) C	280	420	15.9
TOPSERV® Hybrid PUR	708547	LI9YC11Y	8	4 G 6.0 + (2 x 1.0) C + (2 x 22 AWG) C	363	540	18.0
TOPSERV® Hybrid PUR	708548	LI9YC11Y	8	4 G 10 + (2 x 1.5) C + (2 x 22 AWG) C	538	760	21.0
TOPSERV® Hybrid PUR	709705	LI9YC11Y	8	4 G 16 + (2 x 1.5) C + (2 x 22 AWG) C	775	1020	23.4

suitable for itec

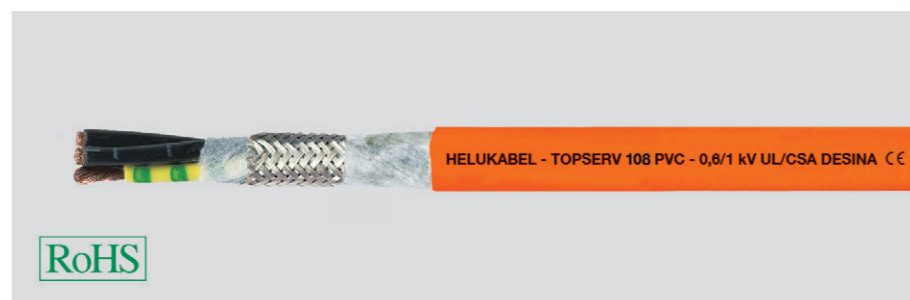
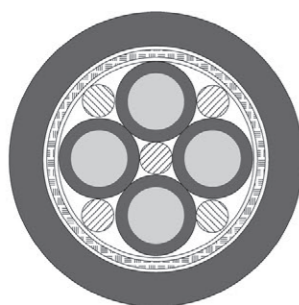
**Hybrid acc. to HEIDENHAIN HMC6**

TOPSERV® Hybrid PUR	709722	LI9YC11Y	12	4G1,5+(2x0,75)C+(2x0,24+2x2x0,09)C	159	265	12,8
TOPSERV® Hybrid PUR	709724	LI9YC11Y	12	4G4,0+(2x1,0)C+(2x0,24+2x2x0,09)C	261	453	16,2

**NEW**

## TOPSERV® PVC

Motor and servo cables for fixed or not constantly movements 0,6/1 kV, according to Siemens 6FX5008, Lenze, Bosch Rexroth



### Technical data

- Special PVC Motorcable acc. to UL AWM Style 2570 CSA AWM VDE-recognized
- **Temperature range**  
flexing -0°C to +60°C  
fixed installation -20°C to +80°C
- **Nominal voltage**  
VDE U<sub>0</sub>/U 600/1000 V  
UL/CSA 1000 V
- **A.C. test voltage**, 50 Hz  
4000 V
- **Minimum bending radius**  
flexing 15x cable Ø  
fixed installation 5x cable Ø min.  
100.000 cycles

### Cable structure

- Bare copper-conductor, acc. to DIN EN 60228 class 5: fine-wire class 6: extra fine-wire
- Core insulation to 6 mm<sup>2</sup> of halogen-free PP from 10 mm<sup>2</sup> of PVC
- Core identification  
**power supply cores**  
core 1: black with imprint U/L1/C/L+  
core 2: black with imprint V/L2  
core 3: black with imprint W/L3/D/L-  
**control cores**  
**TOPSERV® 108 PVC** without control cores  
**TOPSERV® 112 PVC** with 1 control cores acc. to Siemens  
core 1: black with imprint BR1  
core 2: white with imprint BR2 acc. to Lenze  
core 1: brown with imprint BR1  
core 2: white with imprint BR2  
**TOPSERV® 119 PVC** with 2 control cores  
pair 1: black with number no. 5+6  
pair 2: black with number no. 7+8
- GN-YE conductor
- Screening of the control cores in pairs wrapped with tinned copper braid
- Power supply cores laid up with optimal lay length and stabilising filler
- Fleece wrapping facilitates sliding
- Overall screening from tinned copper braid, optimal coverage approx. 85%
- Outer sheath of PVC
- Sheath colour orange (RAL 2003)

### Properties

- Low capacitance until 6mm<sup>2</sup> (included)
- Oil resistant PVC outer sheath
- Optimum compliance with requirements for electromagnetic compatibility (EMC) by approx. 85% coverage from the braided screen
- These cables are produced to high quality specifications and conform to the DESINA®-standard
- The materials used in manufacture are cadmium-free and contain no silicone and free from substances harmful to the wetting properties of lacquers

### Tests

- PVC sheath flame retardant acc. to DIN EN 60332-1-1 to -1-3 (VDE 0482-332-1-1 to -1-3)

Also see Catalogue  
Cables, Wires &  
Accessories/Ed. 27,  
page 465

### Note

- For a corresponding encoder cables please check chapter **TOPGEBER 511 PVC**
- For highly flexible, drag chain capable servo cables please check chapter **TOPSERV® PUR**
- Brackets ( ) indicate screen
- DESINA® explanation see introduction
- SIEMENS product designations 6FX 5008-plus are registered trademarks of Siemens AG and are to be used only for purposes of comparison
- Lenze product designations are registered trademarks of Lenze AG and are to be used only for purposes of comparison
- Bosch Rexroth product designations INK are registered trademarks of Bosch Rexroth AG and are to be used only for purposes of comparison

### Application

The combination of supply cores with the control cores for the braking function and the thermal protection in these cables is ideal. Precision servomotors, as used today in many areas of highly-automated manufacturing processes, call for high-quality, reliable and long-lasting cables. These requirements are met to a high degree by these cables. The cables have an additional overall screen to ensure EMC compatibility, i.e. for protection against electromagnetic interference. Production is based on the specifications of established manufacturers of servo-drives and controls, as well as on various VDE, UL and CSA standards.

Applications include machine, plant and robot construction, automation, drive, control and production engineering.

Attractive for export-oriented mechanical and system engineering.

**EMC** = Electromagnetic compatibility

To optimize the EMC features we recommend a large round contact of the copper braiding on both ends.

**CE** = The product is conformed with the EC Low-Voltage Directive 2006/95/EC.

## PVC Servo Cables

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>Without pair</b>							
TOPSERV® 108 PVC	707250	6FX5008-1BB11	4	4 G 1.5	78	119	8.0
TOPSERV® 108 PVC	707251	6FX5008-1BB21	4	4 G 2.5	130	174	9.6
TOPSERV® 108 PVC	707252	6FX5008-1BB31	4	4 G 4	198	252	11.0
TOPSERV® 108 PVC	707253	6FX5008-1BB41	4	4 G 6	288	365	13.3
TOPSERV® 108 PVC	707254	6FX5008-1BB51	4	4 G 10	463	705	19.3
TOPSERV® 108 PVC	707255	6FX5008-1BB61	4	4 G 16	701	1053	23.7
TOPSERV® 108 PVC	707256	6FX5008-1BB25	4	4 G 25	1068	1504	27.1
TOPSERV® 108 PVC	707257	6FX5008-1BB35	4	4 G 35	1449	1973	29.9
TOPSERV® 108 PVC	707258	6FX5008-1BB50	4	4 G 50	2096	2671	35.8
<b>With 1 pair</b>							
TOPSERV® 112 PVC	707221	LENZE	6	4 G 1.0 + (2 x 0.5) C	88	136	9.5
TOPSERV® 112 PVC	708560	LENZE	6	4 G 1.0 + (2 x 0.5) C	88	136	9.5
TOPSERV® 112 PVC	707222	LENZE	6	4 G 1.5 + (2 x 0.5) C	106	175	11.0
TOPSERV® 112 PVC	708561	LENZE	6	4 G 1.5 + (2 x 0.5) C	106	175	11.0
TOPSERV® 112 PVC	707280	6FX5008-1BA11	6	4 G 1.5 + (2 x 1.5) C	140	194	10.4
TOPSERV® 112 PVC	707223	LENZE	6	4 G 2.5 + (2 x 0.5) C	152	224	12.3
TOPSERV® 112 PVC	708562	LENZE	6	4 G 2.5 + (2 x 0.5) C	152	224	12.3
TOPSERV® 112 PVC	707281	6FX5008-1BA21	6	4 G 2.5 + (2 x 1.5) C	185	258	12.0
TOPSERV® 112 PVC	707224	LENZE	6	4 G 4 + (2 x 1.0) C	229	360	14.3
TOPSERV® 112 PVC	708563	LENZE	6	4 G 4 + (2 x 1.0) C	229	360	14.3
TOPSERV® 112 PVC	707282	6FX5008-1BA31	6	4 G 4 + (2 x 1.5) C	257	347	13.6
TOPSERV® 112 PVC	707225	LENZE	6	4 G 6 + (2 x 1.0) C	312	463	16.0
TOPSERV® 112 PVC	708564	LENZE	6	4 G 6 + (2 x 1.0) C	312	463	16.0
TOPSERV® 112 PVC	707283	6FX5008-1BA41	6	4 G 6 + (2 x 1.5) C	348	457	15.9
TOPSERV® 112 PVC	710054	LENZE	6	4 G 10 + (2 x 1.0) C	484	791	19.8
TOPSERV® 112 PVC	707284	6FX5008-1BA51	6	4 G 10 + (2 x 1.5) C	502	797	21.0
TOPSERV® 112 PVC	710055	LENZE	6	4 G 16 + (2 x 1.0) C	729	1199	23.3
TOPSERV® 112 PVC	707285	6FX5008-1BA61	6	4 G 16 + (2 x 1.5) C	741	1110	24.7
TOPSERV® 112 PVC	707286	6FX5008-1BA25	6	4 G 25 + (2 x 1.5) C	1100	1550	27.8
TOPSERV® 112 PVC	707287	6FX5008-1BA35	6	4 G 35 + (2 x 1.5) C	1498	2030	30.9
TOPSERV® 112 PVC	707288	6FX5008-1BA50	6	4 G 50 + (2 x 1.5) C	2450	2934	34.5
<b>With 2 pairs</b>							
TOPSERV® 119 PVC	707290	INK0653	8	4 G 1.0 + 2 x (2 x 0.75) C	130	196	11.2
TOPSERV® 119 PVC	707291	INK0650	8	4 G 1.5 + 2 x (2 x 0.75) C	155	218	11.5
TOPSERV® 119 PVC	707292	INK0602	8	4 G 2.5 + 2 x (2 x 1.0) C	216	304	13.5
TOPSERV® 119 PVC	707293	INK0603	8	4 G 4 + (2 x 1.0) C + (2 x 1.5) C	297	404	15.5
TOPSERV® 119 PVC	707294	INK0604	8	4 G 6 + (2 x 1.0) C + (2 x 1.5) C	374	527	17.3
TOPSERV® 119 PVC	707295	INK0605	8	4 G 10 + (2 x 1.0) C + (2 x 1.5) C	545	820	21.2
TOPSERV® 119 PVC	707296	INK0606	8	4 G 16 + 2 x (2 x 1.5) C	804	1168	25.0

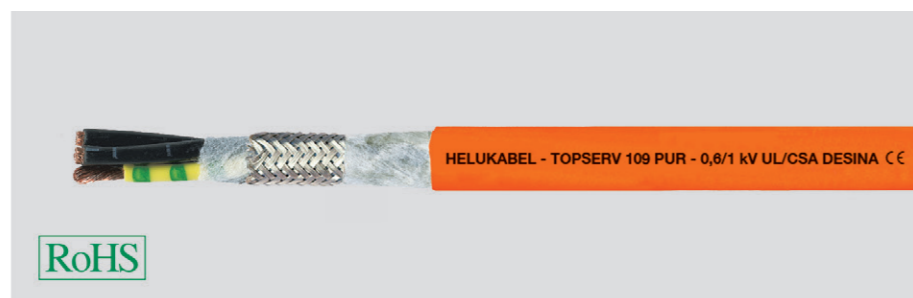
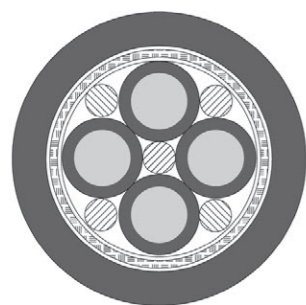
For additional information, please contact our Product Manager for Drive Technology:



Thomas Pikkemaat  
Comm. Plant Manager Windsbach / Productmanager Automation + Drives  
Ph.: +49 9871 6793-65  
Fax: +49 7150 9209-5241  
E-Mail: Thomas.Pikkemaat@helukabel.de

## TOPSERV® PUR

High flexible motor and servo cable for drag chain 0,6/1 kV, for example according to Siemens 6FX8008PLUS, Lenze, Bosch Rexroth



### Technical data

- Special PUR drag chain cable acc. to UL AWM Style 21223 or 20234 CSA AWM VDE-recognized
- **Temperature range** flexing -30°C to +80°C fixed installation -40°C to +90°C
- **Nominal voltage** VDE U<sub>0</sub>/U 600/1000 V UL/CSA 1000 V
- **A.C. test voltage**, 50 Hz 4000 V
- **Insulation resistance** min. 20 MOhm x km
- **Coupling resistance** max. 250 Ohm/km
- **Minimum bending radius** flexing 7,5x cable Ø fixed installation 4x cable Ø

Also see Catalogue „Cables, Wires & Accessories/Ed. 27“, page 468

### Cable structure

- Bare copper-conductor, to DIN VDE 0295 cl.6, extra fine-wire, IEC 60228 cl.6
- Core insulation halogen-free PP
- Core identification
- **power supply cores**  
core 1: black with imprint U/L1/C/L+  
core 2: black with imprint V/L2  
core 3: black with imprint W/L3/D/L-
- **control cores**  
**TOPSERV® 109 PUR** without control cores  
**TOPSERV® 113 PUR** with 1 control cores acc. to Siemens  
core 1: black with imprint BR1  
core 2: white with imprint BR2 acc. to Lenze  
core 1: brown with imprint BR1  
core 2: white with imprint BR2  
**TOPSERV® 121 PUR** with 2 control cores  
pair 1: black with number no. 5+6  
pair 2: black with number no. 7+8
- GN-YE conductor
- Screening of the control cores in pairs wrapped with tinned copper braid
- Power supply cores laid up with optimal lay length and stabilising filler
- Fleece wrapping facilitates sliding
- Overall screening from tinned copper braid, optimal coverage approx. 85%
- Outer sheath of PUR
- Sheath colour orange (RAL 2003)

### Properties

- Low adhesion, flame retardant, extremely abrasion resistant, halogen-free, resistant to UV, oil, hydrolysis and microbial attack PUR sheath
- Optimized insulation materials ensure resistance to oils (including mineral oils), greases, coolants, hydraulic fluids as well as many alkalis and solvents.
- Optimum compliance with requirements for electromagnetic compatibility (EMC) by approx. 85% coverage from the braided screen
- These cables are produced to high quality specifications and conform to the DESINA® standard.
- The materials used in manufacture are cadmium-free and contain no silicone and free from substances harmful to the wetting properties of lacquers
- Resistant to cleaning and disinfecting agents acc. to



### Tests

- PUR outer sheath self-extinguishing and flame retardant to DIN VDE 0482-332-1-2, DIN EN 60332-1-2, IEC 60332-1 (equivalent DIN VDE 0472 part 804 test method B)

### Note

- For a corresponding encoder cables please check chapter **TOPGEBER 512 PUR**
- For servo cables with non or only slight drag chain application please check chapter **TOPSERV® PVC**
- Brackets ( ) indicate screen
- DESINA® explanation see introduction
- SIEMENS product designations 6FX 5008-plus are registered trademarks of Siemens AG and are to be used only for purposes of comparison
- Lenze product designations are registered trademarks of Lenze AG and are to be used only for purposes of comparison
- Bosch Rexroth product designations INK are registered trademarks of Bosch Rexroth AG and are to be used only for purposes of comparison

### Application

The combination of supply cores with the control cores for the braking function and the thermal protection in these cables is ideal. Precision servomotors, as used today in many areas of highly-automated manufacturing processes, call for high-quality, reliable and long-lasting cables. These requirements are met to a high degree by these cables. The cables have an additional overall screen to ensure EMC compatibility, i. e. for protection against electromagnetic interference. Production is based on the specifications of established manufacturers of servo-drives and controls, as well as on various VDE, UL and CSA standards. Applications include machine, plant and robot construction, automation, drive, control and production engineering. Attractive for export-oriented mechanical and system engineering. Please observe applicable installation regulations for use in energy supply chains.

**EMC** = Electromagnetic compatibility

To optimize the EMC features we recommend a large round contact of the copper braiding on both ends.

**CE** = The product is conformed with the EC Low-Voltage Directive 2006/95/EC.

## PUR Servo Cables

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>PUR dynamic</b>							
<b>Single Cores unscreened</b>							
TOPSERV® PUR Single	712670	Li9Y11Y-HF	1	1 G 10	96	130	8,4
TOPSERV® PUR Single	712671	Li9Y11Y-HF	1	1 G 16	154	181	9,5
TOPSERV® PUR Single	712672	Li9Y11Y-HF	1	1 G 25	240	274	11,0
TOPSERV® PUR Single	712673	Li9Y11Y-HF	1	1 G 35	336	398	13,0
TOPSERV® PUR Single	712674	Li9Y11Y-HF	1	1 G 50	480	529	15,4
<b>Single Cores screened</b>							
TOPSERV® PUR Single	712675	Li9YC11Y-HF	1	1 x 10	122	168	9,7
TOPSERV® PUR Single	712676	Li9YC11Y-HF	1	1 x 16	180	217	11,7
TOPSERV® PUR Single	712677	Li9YC11Y-HF	1	1 x 25	282	342	13,2
TOPSERV® PUR Single	712678	Li9YC11Y-HF	1	1 x 35	386	468	15,2
TOPSERV® PUR Single	712679	Li9YC11Y-HF	1	1 x 50	535	584	18,7

<b>Without pair</b>							
TOPSERV® 109 PUR	75943	6FX8008-1BB11	4	4 G 1.5	80	136	8.9
TOPSERV® 109 PUR	75944	6FX8008-1BB21	4	4 G 2.5	120	195	10.7
TOPSERV® 109 PUR	75945	6FX8008-1BB31	4	4 G 4	195	273	12.2
TOPSERV® 109 PUR	75946	6FX8008-1BB41	4	4 G 6	296	401	14.5
TOPSERV® 109 PUR	75947	6FX8008-1BB51	4	4 G 10	445	616	17.5
TOPSERV® 109 PUR	75948	6FX8008-1BB61	4	4 G 16	730	948	21.6
TOPSERV® 109 PUR	75949	6FX8008-1BB25	4	4 G 25	1100	1495	25.2
TOPSERV® 109 PUR	75950	6FX8008-1BB35	4	4 G 35	1510	1936	28.6
TOPSERV® 109 PUR	75951	6FX8008-1BB50	4	4 G 50	2133	2774	33.4
TOPSERV® 109 PUR	700437	6FX8008-1BB70	4	4 G 70	3029	3803	39.9
TOPSERV® 109 PUR	700897	6FX8008-1BB95	4	4 G 95	4606	5102	47.6

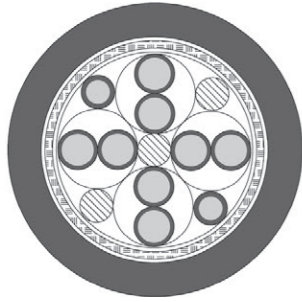
<b>With 1 pair</b>							
TOPSERV® 121 PUR	706003	INK0670	6	4 G 0.75 + (2 x 0.5) C	77	132	9.2
TOPSERV® 113 PUR	707228	Lenze	6	4 G 1.0 + (2 x 0.5) C	88	155	10.5
TOPSERV® 113 PUR	707229	Lenze	6	4 G 1.5 + (2 x 0.5) C	106	195	11.5
TOPSERV® 113 PUR	74506	Li9YC11Y	6	4 G 1.5 + (2 x 1.0) C	138	200	11.1
TOPSERV® 113 PUR	78948	6FX8008-1BA11	6	4 G 1.5 + (2 x 1.5) C	136	221	11.6
TOPSERV® 113 PUR	707230	Lenze	6	4 G 2.5 + (2 x 0.5) C	152	251	13.2
TOPSERV® 113 PUR	74507	Li9YC11Y	6	4 G 2.5 + (2 x 1.0) C	177	275	12.5
TOPSERV® 113 PUR	78949	6FX8008-1BA21	6	4 G 2.5 + (2 x 1.5) C	178	285	13.2
TOPSERV® 113 PUR	707231	Lenze	6	4 G 4 + (2 x 1.0) C	250	375	14.6
TOPSERV® 113 PUR	74508	Li9YC11Y	6	4 G 4 + (2 x 1.0) C	258	356	14.3
TOPSERV® 113 PUR	78950	6FX8008-1BA31	6	4 G 4 + (2 x 1.5) C	268	381	14.8
TOPSERV® 113 PUR	707232	Lenze	6	4 G 6 + (2 x 1.0) C	344	495	17.6
TOPSERV® 113 PUR	74514	Li9YC11Y	6	4 G 6 + (2 x 1.0) C	348	492	16.2
TOPSERV® 113 PUR	78951	6FX8008-1BA41	6	4 G 6 + (2 x 1.5) C	358	495	16.8
TOPSERV® 113 PUR	707746	Lenze	6	4 G 10 + (2 x 1.0) C	508	706	20.1
TOPSERV® 113 PUR	74509	Li9YC11Y	6	4 G 10 + (2 x 1.0) C	510	690	19.0
TOPSERV® 113 PUR	78952	6FX8008-1BA51	6	4 G 10 + (2 x 1.5) C	515	712	19.5
TOPSERV® 113 PUR	707747	Lenze	6	4 G 16 + (2 x 1.0) C	802	1008	23.8
TOPSERV® 113 PUR	74510	Li9YC11Y	6	4 G 16 + (2 x 1.0) C	798	981	22.2
TOPSERV® 113 PUR	75956	6FX8008-1BA61	6	4 G 16 + (2 x 1.5) C	802	1041	23.1
TOPSERV® 113 PUR	74511	Li9YC11Y	6	4 G 25 + (2 x 1.0) C	1130	1436	26.2
TOPSERV® 113 PUR	75957	6FX8008-1BA25	6	4 G 25 + (2 x 1.5) C	1144	1476	26.8
TOPSERV® 113 PUR	74512	Li9YC11Y	6	4 G 35 + (2 x 1.0) C	1490	1914	29.8
TOPSERV® 113 PUR	75958	6FX8008-1BA35	6	4 G 35 + (2 x 1.5) C	1509	1954	30.9
TOPSERV® 113 PUR	74513	Li9YC11Y	6	4 G 50 + (2 x 1.0) C	2110	2594	33.7
TOPSERV® 113 PUR	75959	6FX8008-1BA50	6	4 G 50 + (2 x 1.5) C	2140	2598	34.2

<b>With 2 pairs</b>							
TOPSERV® 121 PUR	708499	Li9YC11Y	8	4 G 0.75 + 2 x (2 x 0.34) C	103	177	10.4
TOPSERV® 121 PUR	73774	INK0653	8	4 G 1.0 + 2 x (2 x 0.75) C	148	208	11.2
TOPSERV® 121 PUR	76103	Li9YC11Y	8	4 G 1.5 + 2 x (2 x 0.5) C	145	250	11.6
TOPSERV® 121 PUR	700561	INK0650	8	4 G 1.5 + 2 x (2 x 0.75) C	170	276	12.2
TOPSERV® 121 PUR	707775	Schneider Electric	8	4 G 1.5 + 2 x (2 x 0.75) C	170	276	12.2
TOPSERV® 121 PUR	73579	Li9YC11Y	8	4 G 1.5 + 2 x (2 x 1.0) C	182	290	12.4
TOPSERV® 121 PUR	73580	INK0602	8	4 G 2.5 + 2 x (2 x 1.0) C	229	346	14.0
TOPSERV® 121 PUR	703103	Schneider Electric	8	4 G 2.5 + 2 x (2 x 1.0) C	229	346	14.0
TOPSERV® 121 PUR	78955	Li9YC11Y	8	4 G 2.5 + 2 x (2 x 1.5) C	241	350	15.4
TOPSERV® 121 PUR	74094	Li9YC11Y	8	4 G 4 + 2 x (2 x 1.0) C	312	475	15.5
TOPSERV® 121 PUR	700562	INK0603	8	4 G 4 + (2 x 1.0) C + (2 x 1.5) C	318	473	15.8
TOPSERV® 121 PUR	78956	Li9YC11Y	8	4 G 4 + 2 x (2 x 1.5) C	324	490	16.2
TOPSERV® 121 PUR	74095	Li9YC11Y	8	4 G 6 + 2 x (2 x 1.0) C	437	606	17.3
TOPSERV® 121 PUR	700563	INK0604	8	4 G 6 + (2 x 1.0) C + (2 x 1.5) C	445	609	17.6
TOPSERV® 121 PUR	78957	Li9YC11Y	8	4 G 6 + 2 x (2 x 1.5) C	450	621	18.0
TOPSERV® 121 PUR	700564	INK0605	8	4 G 10 + (2 x 1.0) C + (2 x 1.5) C	610	852	20.5
TOPSERV® 121 PUR	78958	Li9YC11Y	8	4 G 10 + 2 x (2 x 1.5) C	625	925	20.9
TOPSERV® 121 PUR	75978	INK0606	8	4 G 16 + 2 x (2 x 1.5) C	904	1290	23.6
TOPSERV® 121 PUR	75979	INK0607	8	4 G 25 + 2 x (2 x 1.5) C	1323	1700	27.0
TOPSERV® 121 PUR	75980	INK0667	8	4 G 35 + 2 x (2 x 1.5) C	1621	2155	30.5
TOPSERV® 121 PUR	700565	INK0668	8	4 G 50 + 2 x (2 x 2.5) C	2380	3100	35.5

# According to cross section

## TOPGEBER 511 PVC

Feedback cables according to Siemens-, Lenze- or Bosch Rexroth Standard with PVC-sheath for fixed or not constantly movements



### Technical data

- Special PVC feedback cable acc. to UL AWM style 20233 and CSA
- **Temperature range** flexing -0°C to +60°C fixed installation -20°C to +80°C
- **Nominal voltage** acc. to Siemens 30 V acc. to Bosch Rexroth and Lenze 300 V
- **A.C. test voltage**, 50 Hz core/core 1500 V core/screen 1000 V
- **Minimum bending radius** flexing 15x cable Ø fixed installation 6x cable Ø min. 100.000 cycles

### Cable structure

- Copper-conductor bare or tinned to DIN VDE 0295 cl.6, extra fine-wire, IEC 60228 cl.6
- Core insulation of special polypropylene
- Core colours on request
- Overall screening of tinned copper wire braid with tinned drain wire, coverage approx. 85%
- Polyester foil
- Outer sheath of PVC
- Sheath colour green (RAL 6018) acc. to DESINA® or orange

### Properties

- Outer sheath of PVC, oil resistant
- Optimum compliance with requirements for elect romagnetic compatibility (EMC) by approx. 85% coverage from the braided screen
- These cables are produced to high quality specifications and conform to the DESINA®-standard
- The materials used in manufacture are cadmium-free and contain no silicone and free from substances harmful to the wetting properties of lacquers
- Tests**
  - PVC sheath flame retardant acc. to DIN EN 60332-1-1 bis -1-3 (VDE 0482-332-1-1 bis -1-3)

### Note

- For a corresponding motor- and servocables please check chapter **TOPSERV® PVC**
- For drag chain capable encoder cables please check chapter **TOPGEBER 512 PUR**
- Brackets ( ) indicate screen.
- SIEMENS product designations 6FX 5008-... are registered trademarks of Siemens AG and are to be used only for purposes of comparison.
- INDRAMAT product designations INK- are registered trademarks of Bosch-Rexroth AG and are to be used only for purposes of comparison.
- LENZE product designations are registered trademarks of LENZE AG, and are to be used only for purposes of comparison.
- DESINA®: Explanation: see introduction.

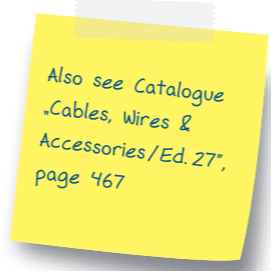
### Application

Low-cost alternative to motor cables with PUR sheath for fix instalation or occasional moving applications. These low-capacitance incremental encoder cables or position feedback cables transmit the control pulses for positioning and operating characteristics of servomotors. These cables are used as connecting cables for tachos, brakes and pulse generators in industrial equipment, machine tools, control and automation equipment.

**EMC** = Electromagnetic compatibillity

To optimize the EMC features we recommend a large round contact of the copper braiding on both ends.

**CE** = The product is conformed with the EC Low-Voltage Directive 2006/95/EC.



# According to cross section

## Feedback Cables

### PVC

#### TOPGEBER® 511 PVC

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>According to Siemens Standard</b>							
TOPGEBER 511 PVC	707417	6FX5008-1BD21	12	(4 x 2 x 0.34 + 4 x 0.5) C	70	116	8,9
TOPGEBER 511 PVC	707389	6FX5008-1BD41	12	(3 x (2 x 0.14) D + 4 x 0.14 + 2 x 0.5) C	66	114	8,9
TOPGEBER 511 PVC	707390	6FX5008-1BD51	16	(3 x (2 x 0.14) D + 4 x 0.14 + 4 x 0.25 + 2 x 0.5) C	75	129	9,4
TOPGEBER 511 PVC	803672	6FX5008-2DC00	6	(2 x 2 x 0.22 + 1 x 2 x 0.34)	38	61	6,9
TOPGEBER 511 PVC	802471	6FX5008-1DC00	4	(2 x 2 x 0.22)	35	71	6,9

#### According to Bosch Rexroth Standard

TOPGEBER 511 PVC	705461	INK 448	10	(4 x 2 x 0.25 + 2 x 0.5) C	61	95	8,4
TOPGEBER 511 PVC	707392	INK209	10	(4 x 2 x 0.25 + 2 x 1.0) C	64	119	8,8
TOPGEBER 511 PVC	707394	INK 532	16	(4 x 1 + 4 x 2 x 0.14 + (4 x 0.14) D) C	84	145	9,7

#### According to Lenze Standard

TOPGEBER 511 PVC	707077	Li9YY	8	3 x (2 x 0.14) C + (2 x 0.5) C	54	110	9,3
TOPGEBER 511 PVC	707397	Li9YY	10	4 x (2 x 0.14) C + (2 x 1.0) C	70	156	11,0
TOPGEBER 511 PVC	707398	Li9YY	9	3 x (2 x 0.14) C + (3 x 0.14) C	41	106	9,2

#### Various

TOPGEBER 511 PVC	705615	Li9YC11Y	16	(7 x 2 x 0,14 + 2 x 0,5) C	46	86	7,6
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NEW

#### COLOUR CODE - TOPGEBER® 511 PVC

Product	Part No. HELUKABEL	Colour Code
<b>According to Siemens Standard</b>		
TOPGEBER 511 PVC	707417	bn+bk; rd+og; bu+vt; gy+ye (0.34qmm pairs) ## bu/wh; bk/wh; rd/wh; ye/wh (0.5qmm)
TOPGEBER 511 PVC	707389	gn+ye; bk+bn; rd+og (0.14qmm pairs) ## bn/rd+bn/bu (0.5qmm) ## gy+bu+wh/ye+wh/sw (0.14qmm quad)
TOPGEBER 511 PVC	707390	gn+ye; bk+bn; rd+og (0.14qmm pairs) ## bn/rd+bn/bu (0.5qmm) ## gy+bu+wh/ye+wh/sw (0.14qmm quad) ## bn/ye+bn/gy+gn/bk+gn/rd (0.25qmm quad)
TOPGEBER 511 PVC	803672	gn+ye; pk+bu (0.22qmm) ## rd+bk (0.34qmm)
TOPGEBER 511 PVC	802471	gn+ye; pk+bu (0.22qmm)

#### According to Bosch Rexroth Standard

TOPGEBER 511 PVC	705461	gn+bn; bk+rd; gy+pk; bu+vt (0.25qmm pairs) ## wh+bn (0.5qmm)
TOPGEBER 511 PVC	707392	gn+bn; bk+rd; gy+pk; bu+vt (0.25qmm pairs) ## wh+bn (1.0qmm)
TOPGEBER 511 PVC	707394	ye/bk+bu/bk+gn/bk+rd/bk (0.14qmm quad) ## wh+bn/gn+wh/gn+bu (1.0qmm) ## rd+bk; bn+gn; ye+vt; gy+pk (0.14qmm pairs)

#### According to Lenze Standard

TOPGEBER 511 PVC	707077	bk+ye; bk+gn; bk+rd (0.14qmm pairs) ## bk+wh (0.5qmm)
TOPGEBER 511 PVC	707397	bk+ye; bk+gn; bk+rd; bk+bu (0.14qmm pairs) ## bk+wh (1.0qmm)
TOPGEBER 511 PVC	707398	bk+ye; bk+gn; bk+rd (0.14qmm pairs) ## bk+gy+pk (0.14qmm)

#### Various

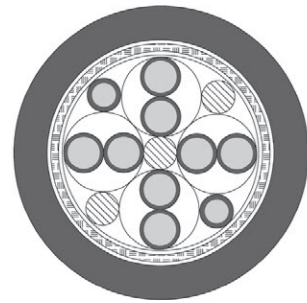
TOPGEBER 511 PVC	705615	wh, br (0,5qmm ); wh+br; gn+ye; gy+pink; bu+rd; bk+violet; gy-pink+rb-bu; wh-gn; bn-gn (0,14qmm pairs)
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NEW

# According to cross section

## TOPGEBER 512 PUR

High flexible Feedback cable for drag chain according to Siemens, Bosch Rexroth, Lenze and other Standards



### Technical data

- Special PUR drag chain feedback cable acc. to UL AWM style 20233 and 20236 and CSA
- Temperature range** flexing -30°C to +80°C fixed installation -40°C to +80°C
- Nominal voltage** acc. to Siemens 30 V acc. to Bosch Rexroth and Lenze 300 V further details on request
- A.C. test voltage**, 50 Hz core/core 2000 V core/screen 1000 V
- Mutual capacitance** at 800 Hz core/core approx. 70 nF/km core/screen approx. 110 nF/km
- Insulation resistance** min. 20 MOhm x km
- Coupling resistance** max. 250 Ohm
- Minimum bending radius** flexing 10x cable Ø fixed installation 6x cable Ø

### Cable structure

- tinned copper, to DIN VDE 0295 cl.6, extra fine-wire, BS 6360 cl.6, IEC 60228 cl.6
- Core insulation of special polypropylene
- Core colours on demand
- Fleece wrapping facilitates sliding
- Overall screening of tinned copper wire braid with tinned drain wire, coverage approx. 85%
- Polyester foil
- Outer sheath of PUR
- Sheath colour green (RAL 6018) acc. to DESINA® or orange

### Properties

- PUR outer sheath, low adhesion, extremely abrasion resistant, halogen-free, resistant to UV-, oil-, hydrolysis and microbial attack
- Special feature: These cables are produced to high quality specifications and conform to the DESINA®-standard
- Due to the high grade special core insulation, the PUR sheath and the highly flexible conductor, these cables are ideally suitable for use in drag chains and provide high functional reliability
- Optimum compliance with requirements for electromagnetic compatibility (EMC) by approx. 85% coverage from the braided screen
- Particularly attractive for export-oriented markets due to UL/CSA approval
- The materials used in manufacture are cadmium-free and contain no silicone and free from substances harmful to the wetting properties of lacquers
- Resistant to cleaning and disinfecting agents acc. to



### Note

- For a corresponding motor- and servocables please check chapter **TOPSERV® PUR**
- Encoder cables for static application please check chapter **TOPGEBER 511 PVC**
- Brackets ( ) indicate screen.
- SIEMENS product designations 6FX 8008-... are registered trademarks of Siemens AG and are to be used only for purposes of comparison.
- Bosch Rexroth product designations INK- are registered trademarks of Bosch-Rexroth AG and are to be used only for purposes of comparison.
- DESINA®: Explanation: see introduction.

### Application

These low-capacitance incremental encoder cables or position feedback cables transmit the control pulses for positioning and operating characteristics of servomotors. These cables are used as connecting cables for tachos, brakes and pulse generators in applications subjected to heavy mechanical stresses in industrial equipment, machine tools, control and automation equipment. Please observe applicable installation regulations for use in energy supply chains.

**EMC** = Electromagnetic compatibility

To optimize the EMC features we recommend a large round contact of the copper braiding on both ends.

**CE** = The product is conformed with the EC Low-Voltage Directive 2006/95/EC.

Also see Catalogue  
Cables, Wires &  
Accessories/Ed.27,  
page 470

# According to cross section

## Feedback Cables

### PUR

TOPGEBER® 512 PUR								
Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm	Colour Code
<b>According to Siemens Standard</b>								
TOPGEBER 512 PUR	700655	6FX8008-1BD11	16	(8 x 2 x 0.18) C	54	85	7.8	wh/ye+wh/gn; wh/rd+wh/og; wh/bk+wh/bn; gy+wh; bu+vt; ye+gn; rd+og; bk+bn
TOPGEBER 512 PUR	78081	6FX8008-1BD21	12	(4 x 2 x 0.34 + 4 x 0.5) C	74	115	8.9	bn+bk; rd+og; bu+vt; gy+ye (0.34qmm pairs) ## bu/wh; bk/wh; rd/wh; ye/wh (0.5qmm)
TOPGEBER 512 PUR	707400	6FX8008-1BD31	8	(3 x (2 x 0.14) D + 2 x (0.5) D) C	70	120	9.0	gn+ye; bk+bn; rd+og (0.14qmm pairs) ## bk+rd (0.5qmm)
TOPGEBER 512 PUR	700657	6FX8008-1BD41	12	(3 x (2 x 0.14) D + 4 x 0.14 + 2 x 0.5) C	66	120	8.9	gn+ye; bk+bn; rd+og (0.14qmm pairs) ## bn/rd+bn/bu (0.5qmm) ## gy+bu+wh/ye+wh/bk (0.14qmm quad)
TOPGEBER 512 PUR	700540	6FX8008-1BD51	16	(3 x (2 x 0.14) D + 4 x 0.14 + 4 x 0.25 + 2 x 0.5) C	75	135	9.6	gn+ye; bk+bn; rd+og (0.14qmm pairs) ## bn/rd+bn/bu (0.5qmm) ## gy+bu+wh/ye+wh/bk (0.14qmm quad) ## bn/ye+bn/gy+gn/bk+gn/rd (0.25qmm quad)
TOPGEBER 512 PUR	700654	6FX8008-1BD61	8	(4 x 2 x 0.18) C	35	61	6.4	bk+bn; rd+og; gn+ye; bu+vt
TOPGEBER 512 PUR	700653	6FX8008-1BD71	4	(2 x 2 x 0.18) C	24	39	5.0	rd+og; bk+bn
TOPGEBER 512 PUR	78079	6FX8008-1BD81	12	(12 x 0.22) C	49	77	6.9	bk; bn; rd; (first lay) ## og; ye; gn; bu; vt; gy; wh; wh/bk; wh/ bn (second lay)
TOPGEBER 512 PUR	804767	6FX8008-1DC00	6	(2 x 2 x 0.20 + 1 x 2 x 0.38)	41	72	7.0	bu+pk; gn+ye (0.2qmm) ## rd; bk (0.38qmm)

According to Schneider Electric Standard								
TOPGEBER 512 PUR	705413	Schneider Electric	8	(3 x 2 x 0.25 + 2 x 0.5) C	43	82	7.4	wh; bn; gn; ye; gy; pk (0.25qmm pairs) ## bu; rd (0.5qmm)
TOPGEBER 512 PUR	706333	Schneider Electric	12	(5 x 2 x 0.25 + 2 x 0.5) C	69	110	8.8	wh/bn; gn/ye; gy/pk; bk/vt; gypk/rdbu (0.25qmm pairs) ## bu; rd (0.5qmm)
TOPGEBER 512 PUR	708489	Schneider Electric	8	(3 x 2 x 0.14 + 2 x 0.34) C	29	65	6.8	wh+bn; gn+ye; gy+pk (0.14qmm pairs) ## bu+rd (0.34qmm)

According to B+R Standard								
TOPGEBER 512 PUR	707403	B+R	6	(3 x 2 x AWG24) C	31	57	6.5	wh+bn; gn+ye; gy+pk
TOPGEBER 512 PUR	707404	B+R	12	(5 x 2 x 0.14 + 2 x 0.5) C	48	79	7.8	gn+bn; gy+wh; wh+vt; bk+rd; pk+bu (0.14qmm pairs) ## wh/gn; wh/rd (0.5qmm)

According to Lenze Standard								
TOPGEBER 512 PUR	707405	Lenze	8	3 x (2 x 0.14) C + (2 x 0.5) C	54	114	9.9	bk+ye; bk+gn; bk+rd (0.14qmm pairs) ## bk+wh (0.5qmm)
TOPGEBER 512 PUR	707406	Lenze	10	4 x (2 x 0.14) C + (2 x 1.0) C	70	142	10.8	bk+ye; bk+gn; bk+rd; bl+bu (0.14qmm pairs) ## bk+ws (1.0qmm)
TOPGEBER 512 PUR	707407	Lenze	9	3 x (2 x 0.14) C + (3 x 0.14) C	41	98	9.2	bk+ye; bk+gn; bk+rd (0.14qmm pairs) ## bk+gy+pk (0.5qmm)

According to Bosch Rexroth Standard								
TOPGEBER 512 PUR	702050	INK209 green	10	(4 x 2 x 0.25 + 2 x 1.0) C	64	120	8.8	gn+bn; bk+rd; gy+pk; bu+vt (0.25qmm pairs) ## wh+bn (1.0qmm)
TOPGEBER 512 PUR	78080	INK448 green	10	(4 x 2 x 0.25 + 2 x 0.5) C	51	103	8.5	gn+bn; bk+rd; gy+pk; bu+vt (0.25qmm pairs) ## wh+bn (0.5qmm)
TOPGEBER 512 PUR	77741	INK208 green	9	(9 x 0.5) C	69	124	8.8	bu+wh+rd+pk+gn+ye+bn+bk+gy
TOPGEBER 512 PUR	707738	INK209	10	(4 x 2 x 0.25 + 2 x 1.0) C	64	112	8.8	gn+bn; bk+rd; gy+pk; bu+vt (0.25qmm pairs) ## wh+bn (1.0qmm)
TOPGEBER 512 PUR	707739	INK448	10	(4 x 2 x 0.25 + 2 x 0.5) C	51	104	8.5	gn+bn; bk+rd; gy+pk; bu+vt (0.25qmm pairs) ## wh+bn (0.5qmm)
TOPGEBER 512 PUR	707740	INK208	9	(9 x 0.5) C	69	124	8.8	bu+wh+rd+pk+gn+ye+bn+bk+gy
TOPGEBER 512 PUR	707408	INK532	16	(4 x 1 + 4 x 2 x 0.14 + (4 x 0.14) D) C	84	139	9.5	ye/bk+bu/bk+gn/bk+rd/bk (0.14qmm quad) ## wh+bn/gn+wh/gn+bu (1.0qmm) ## rd+bk; bn+gn; ye+vt; gy+pk (0.14qmm Pairs)
TOPGEBER 512 PUR	707418	INK280	11	(3 x (2 x 0.25) D + 3 x 0.25 + 2 x 1.0) C	74	130	9.0	gn+bn; gy+pk; bk+rd (0.25qmm pairs) ## ye+bu+vt (0.25qmm tripple) ## bn. wh (1.0qmm)
TOPGEBER 512 PUR	707409	INK750	6	(2 x 2 x 0.25 + 2 x 0.5) C	38	76	7.2	rd+bk; gy+pk (0.25qmm pairs) ## wh+bn (0.5qmm)

According to Heidenhain Standard								
TOPGEBER 512 PUR	710106	Heidenhain EnDat 2.0	8	(1 x 4 x 0.14 + 4 x 0.34) C	32	61	6.0	gy; ye; pink; violet (0.14qmm) ## bu; wh; bn-gn; ws-gn (0.34qmm)
TOPGEBER 512 PUR	77753	Heidenhain	12	(10 x 0.14 + 2 x 0.5) C	43	79	7.2	wh; bn; gn; ye; gy; pk; bu; rd; bk; vt (0.14qmm) ## gy/pk; rd/bu (0.5qmm)
TOPGEBER 512 PUR	77743	Heidenhain	8	(3 x (2 x 0.14) D + 2 x (1 x 0.5) D) C	81	103	8.4	gn+ye; gy+pk; bu+rd (0.14qmm pairs) ## wh+bn (0.5qmm)
TOPGEBER 512 PUR	709693	Heidenhain	8	(3 x (2 x 0.14) D + 2 x (1 x 0.5) D) C	81	103	8.4	gn+ye; gy+pk; bu+rd (0.14qmm pairs) ## wh+bn (0.5qmm)
TOPGEBER 512 PUR	79513	Heidenhain	12	(4 x 2 x 0.14 + 4 x 0.5) C	52	103	8.5	gn+bn; ye+vt; pk+gy; rd+bk (0.14qmm) ## wh; bu; wh/gn; bn/gn (0.5qmm)
TOPGEBER 512 PUR	709691	Heidenhain	12	(4 x 2 x 0.14 + 4 x 0.5) C	52	103	8.5	gn+bn; ye+vt; pk+gy; rd+bk (0.14qmm) ## wh; bu; wh/gn; bn/gn (0.5qmm)
TOPGEBER 512 PUR	707410	Heidenhain	8	(3 x (2 x 0.14) D + 2 x (1.0) D) C	72	132	9.1	gn+ye; gy+pk; bu+rd (0.14qmm) ## wh+bn (1.0qmm)
TOPGEBER 512 PUR	700560	Heidenhain	16	(4 x 2 x 0.14 + (4 x 0.14) C + 4 x 0.5) C	81	123	9.0	ge+vio; fr+rs; sw+rtbr+gn (0.14qmm) ## ge/sw; bl/sw; gn/sw; rt/sw (0.14qmm quad) ## ws; bl; ws/gn; br/gn (0.5qmm)
TOPGEBER 512 PUR	709692	Heidenhain	16	(4 x 2 x 0.14 + (4 x 0.14) C + 4 x 0.5) C	81	123	9.0	ge+vio; fr+rs; sw+rtbr+gn (0.14qmm) ## ge/sw; bl/sw; gn/sw; rt/sw (0.14qmm quad) ## ws; bl; ws/gn; br/gn (0.5qmm)

According to Baumüller Standard								
TOPGEBER 512 PUR	78963	Baumüller	12	(5 x 2 x 0.14 + 2 x 0.5) C	72	91	8.8	wh; bn (0.5qmm) ## gn+ye; gy+pk; bu+rd; bk+vt; gy/pk+rd/bu (0.14qmm pairs)

According to Fanuc Standard								
TOPGEBER 512 PUR	707761		16	(5 x 2 x 0.18 + 6 x 0.5) C	74	120	8.7	bk+og; bk+gy; wh+ye; wh+gy; wh+bn (0.18qmm) ## 3x rd num. 4-6; 3x bk num. 1-3 (0.5qmm)
TOPGEBER 512 PUR	707762		12	(3 x 2 x 0.18 + 6 x 1.0) C	93	130	8.7	rd+wh; rd+bk; bk+wh (0.18qmm) ## 3x rd num. 4-6; 3x bk num. 1-3 (1.0qmm)
TOPGEBER 512 PUR	707116		12	(3 x 2 x 0.18 + 6 x 0.5) C	66	108	8.7	rd+wh; rd+bk; bk+wh (0.18qmm) ## 3x rd num. 4-6; 3x bk num. 1-3 (0.5qmm)
TOPGEBER 512 PUR	707763		9	(2 x 2 x 0.18 + 5 x 0.5) C	55	90	7.8	bk+vt; wh+bn (0.18qmm) ## gn; ye; gy. pk. bu (0.5qmm)
TOPGEBER 512 PUR	707115		7	(1 x 2 x 0.18 + 5 x 0.5) C	49	86	7.4	bn+wh (0.18qmm) ## bu; pk; gy; ye; gn (0.5qmm)
TOPGEBER 512 PUR	707764		10	(4 x 2 x 0.22 + 2 x 0.5) C	54	87	7.8	bn/bk+bn/rd; ye/bk+ye/rd; gn/bk+gn/rd; gy/bk+gy/rd (0.22mm pairs) ## bn. ye (0.5qmm)

Various								
TOPGEBER 512 PUR	78828	LI9YC11Y	6	(3 x (2 x 0.25) D) C	55	79	7.2	wh+bn; gn+ye; gy+pk
TOPGEBER 512 PUR	79613	LI9YC11Y	12	(5 x 2 x 0.38 + 2 x 0.5) C	69	124	9.2	wh+bn; gn+ye; gy+pk; bu+rd; bk+vt (0.38qmm pairs) ## wh; bn (0.5qmm)
TOPGEBER 512 PUR	77744	LI9YC11Y	8	(3 x (2 x 0.14) D + 2 x 1.0) C	71	131	8.2	gn+ye; gy+pk; bu+rd (0.14qmm pairs) ## wh+bn (1.0qmm)
TOPGEBER 512 PUR	78372	LI9YC11Y	8	(3 x 2 x 0.14 + 2 x 0.5) C	35	73	7.2	gn+ye; gy+pk; bu+rd (0.14qmm pairs) ## wh+bn (0.5qmm)
TOPGEBER 512 PUR	705647	LI9YC11Y	16	(7 x 2 x 0.14 + 2 x 0.5) C	46	89	7.6	wh+br; gn+ye; gy+pink; bu+rd; bk+violet; gy-pk+rb-bu; wh-gn; bn-gn (0.14qmm pairs) ## wh; br (0.5qmm)
TOPGEBER 512 PUR	707748	LI9YC11Y	10	(4 x (2 x 0.14) C + (2 x 1.0) C)	90	185	11.4	wh+br; gn+gn; gn+pink; bu+rd (0.14qmm pairs) ## wh+br (1.0qmm pairs)
TOPGEBER 512 PUR	77750	LI9YC11Y	10	(4 x (2 x 0.25) C + 2 x 1.0) C	93	162	10.5	gn+bn; bk+rd; gy+pk; bu+vt (0.25qmm pairs) ## wh+bn (1.0qmm)
TOPGEBER 512 PUR	705221	LI9YC11Y	8	(4 x 2 x 0.25) C	39	82	7.5	wh+bn; gn+ye; gy+pk; bu+rd
TOPGEBER 512 PUR	74418	LI9YC11Y	6	(3 x 2 x 0.25) C	38.4	65	7.0	wh+bn; gn+ye; gy+pk
TOPGEBER 512 PUR	74419	LI9YC11Y	8	(4 x 2 x 0.25) C	43.2	72	7.1	wh+bn; gn+ye; gy+pk; bu+rd
TOPGEBER 512 PUR	74420	LI9YC11Y	10	(5 x 2 x 0.25) C	51.5	102	8.8	wh+br; gn+ye; gy+pk; bu+rd; bk+violet (0.25qmm pairs)

Tests

UL:  
TC-ER, WTTTC 1000 V, MTW, NFPA 79 2012, PLTC-ER (AWG 18 - AWG 12), ITC-ER (AWG 18 - AWG 12)  
OIL RES I & II, 90°C dry / 75°C wet, Cold Bend Test -40°C, Class 1 Div. 2 per NEC Art. 336, 392, 501

CSA:

c (UL) CIC-TC FT4, AWM I/II A/B FT4

More technical data available on request.

*Also see Catalogue  
Cables, Wires &  
Accessories/Ed. 27,  
pages 458-459 and  
pages 472-473*

FOR FIXED INSTALLATION

TOPFLEX® 600 VFD

EMC-preferred type, flexible motor power supply cable, oil-resistant, NFPA 79 Edition 2012

Part No.	No. Cores x AWG No.	Cross Section mm <sup>2</sup>	Outer Diameter app. mm	Cop. weight app. kg/km	Weight app. kg/km
63147	4 x 18	0,963	9.9	52.0	164.0
63148	4 x 16	1,31	11.4	72.0	183.0
63149	4 x 14	2,08	12.5	118.0	197.0
63150	4 x 12	3,31	14.0	182.0	267.0
63151	4 x 10	5,26	17.1	230.0	401.0
63152	4 x 8	8,37	22.3	384.0	669.0
63153	4 x 6	13,31	25.4	614.0	917.0
63154	4 x 4	21,21	30.1	960.0	1364.0
63155	4 x 2	33,6	35.3	1411.0	1994.0

TOPFLEX® 650 VFD

EMC-preferred type, flexible motor power supply cable with control cores, oil-resistant, NFPA 79 Edition 2012

Part No.	No. Cores x AWG No.	Cross Section mm <sup>2</sup>	Outer Diameter app. mm	Cop. weight app. kg/km	Weight app. kg/km
62876	4x AWG 16 +2x AWG 18	1,31/ 0,963	13.0	88.0	259.0
62877	4x AWG 14 +2x AWG 18	2,08/ 0,963	14.0	133.0	370.0
62878	4x AWG 14 +2x AWG 14	2,08/ 2,08	14.0	159.0	399.0
62879	4x AWG 12 +2x AWG 18	3,31/ 0,963	15.3	197.0	435.0
62880	4x AWG 12 +2x AWG 14	3,31/ 2,08	15.7	224.0	466.0
62881	4x AWG 10 +2x AWG 14	5,26/ 2,08	18.2	301.0	703.0
62882	4x AWG 8 +2x AWG 14	8,37/ 2,08	24.1	457.0	901.0
62883	4x AWG 6 +2x AWG 14	13,31/ 2,08	27.4	615.0	1275.0
62884	4x AWG 4 +2x AWG 14	21,21/ 2,08	33.4	1450.0	1861.0

FOR DRAG CHAIN APPLICATION

TOPSERV® 600 VFD

EMC-preferred type, high flexible motor power supply cable, oil-resistant, NFPA 79 Edition 2012

Part No.	No. Cores x AWG No.	Cross Section mm <sup>2</sup>	Outer Diameter app. mm	Cop. weight app. kg/km	Weight app. kg/km
62616	4 x 18	0,963	9.9	38.0	163.0
62617	4 x 16	1,31	11.4	51.0	184.0
62618	4 x 14	2,08	12.5	80.0	197.0
62619	4 x 12	3,31	14.0	127.0	266.0
62620	4 x 10	5,26	17.1	230.0	401.0
62621	4 x 8	8,37	22.3	384.0	669.0
62622	4 x 6	13,31	25.4	614.0	917.0
62623	4 x 4	21,21	30.1	960.0	1364.0
62624	4 x 2	33,6	35.3	1344.0	1990.0

TOPSERV® 650 VFD

EMC-preferred type, high flexible motor power supply cable, oil-resistant, NFPA 79 Edition 2012

Part No.	No. Cores x AWG No.	Cross Section mm <sup>2</sup>	Outer Diameter app. mm	Cop. weight app. kg/km	Weight app. kg/km
59846	4x AWG 16 +2x AWG 18	1,31/ 0,824	13.0	88.0	259.0
59847	4x AWG 14 +2x AWG 18	2,08/ 0,824	14.0	133.0	370.0
59848	4x AWG 14 +2x AWG 14	2,08/ 2,08	14.6	159.0	399.0
59849	4x AWG 12 +2x AWG 18	3,31/ 0,824	15.3	197.0	435.0
59850	4x AWG 12 +2x AWG 14	3,31/ 2,08	15.7	224.0	466.0
59851	4x AWG 10 +2x AWG 14	5,26/ 2,08	18.2	301.0	703.0
59852	4x AWG 8 +2x AWG 14	8,37/ 2,08	24.1	457.0	901.0
59853	4x AWG 6 +2x AWG 14	13,31/ 2,08	27.4	615.0	1275.0
59854	4x AWG 4 +2x AWG 14	21,21/ 2,08	33.4	1450.0	1861.0

According to SIEMENS MC 800Plus

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>PUR dynamic</b>							
TOPSERV® 109 PUR	75943	6FX8008-1BB11	4	4 G 1.5	80	136	8.9
TOPSERV® 109 PUR	75944	6FX8008-1BB21	4	4 G 2.5	120	195	10.7
TOPSERV® 109 PUR	75945	6FX8008-1BB31	4	4 G 4	195	273	12.2
TOPSERV® 109 PUR	75946	6FX8008-1BB41	4	4 G 6	296	401	14.5
TOPSERV® 109 PUR	75947	6FX8008-1BB51	4	4 G 10	445	616	17.5
TOPSERV® 109 PUR	75948	6FX8008-1BB61	4	4 G 16	730	948	21.6
TOPSERV® 109 PUR	75949	6FX8008-1BB25	4	4 G 25	1100	1495	25.2
TOPSERV® 109 PUR	75950	6FX8008-1BB35	4	4 G 35	1510	1936	28.6
TOPSERV® 109 PUR	75951	6FX8008-1BB50	4	4 G 50	2133	2774	33.4
TOPSERV® 109 PUR	700437	6FX8008-1BB70	4	4 G 70	3029	3803	39.9
TOPSERV® 109 PUR	700897	6FX8008-1BB95	4	4 G 95	4606	5102	47.6
<b>TOPSERV® 113 PUR</b>							
TOPSERV® 113 PUR	78948	6FX8008-1BA11	6	4 G 1.5 + (2 x 1.5) C	148	221	11.6
TOPSERV® 113 PUR	78949	6FX8008-1BA21	6	4 G 2.5 + (2 x 1.5) C	187	285	13.2
TOPSERV® 113 PUR	78950	6FX8008-1BA31	6	4 G 4 + (2 x 1.5) C	268	381	14.8
TOPSERV® 113 PUR	78951	6FX8008-1BA41	6	4 G 6 + (2 x 1.5) C	358	495	16.8
TOPSERV® 113 PUR	78952	6FX8008-1BA51	6	4 G 10 + (2 x 1.5) C	584	712	19.5
TOPSERV® 113 PUR	75956	6FX8008-1BA61	6	4 G 16 + (2 x 1.5) C	825	1041	23.1
TOPSERV® 113 PUR	75957	6FX8008-1BA25	6	4 G 25 + (2 x 1.5) C	1283	1476	26.8
TOPSERV® 113 PUR	75958	6FX8008-1BA35	6	4 G 35 + (2 x 1.5) C	1509	1954	30.9
TOPSERV® 113 PUR	75959	6FX8008-1BA50	6	4 G 50 + (2 x 1.5) C	2140	2598	34.0
<b>TOPGEBER 512 PUR</b>							
TOPGEBER 512 PUR	700655	6FX8008-1BD11	16	8 x 2 x 0.18) C	54	85	7.8
TOPGEBER 512 PUR	78081	6FX8008-1BD21	12	4 x 2 x 0.34 + 4 x 0.5) C	74	115	8.9
TOPGEBER 512 PUR	707400	6FX8008-1BD31	8	3 x (2 x 0.14) D + 2 x (0.5) D) C	70	120	9.0
TOPGEBER 512 PUR	700657	6FX8008-1BD41	12	3 x (2 x 0.14) D + 4 x 0.14 + 2 x 0.5) C	66	120	8.9
TOPGEBER 512 PUR	700540	6FX8008-1BD51	16	3 x (2 x 0.14) D + 4 x 0.14 + 4 x 0.25 + 2 x 0.5) C	75	135	9.6
TOPGEBER 512 PUR	700654	6FX8008-1BD61	8	4 x 2 x 0.18) C	35	61	6.4
TOPGEBER 512 PUR	700653	6FX8008-1BD71	4	2 x 2 x 0.18) C	24	39	5.0
TOPGEBER 512 PUR	78079	6FX8008-1BD81	12	12 x 0.22) C	49	77	6.9
TOPGEBER 512 PUR	804767	6FX8008-2DC00	6	2 x 2 x 0.20 + 1 x 2 x 0.38) C	41	72	7.0

According to SIEMENS MC 500

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>PVC static</b>							
TOPSERV® 108 PVC	707250	6FX5008-1BB11	4	4 G 1.5	78	119	8.0
TOPSERV® 108 PVC	707251	6FX5008-1BB21	4	4 G 2.5	130	174	9.6
TOPSERV® 108 PVC	707252	6FX5008-1BB31	4	4 G 4	198	252	11.0
TOPSERV® 108 PVC	707253	6FX5008-1BB41	4	4 G 6	288	368	13.3
TOPSERV® 108 PVC	707254	6FX5008-1BB51	4	4 G 10	463	705	19.3
TOPSERV® 108 PVC	707255	6FX5008-1BB61	4	4 G 16	701	1053	23.7
TOPSERV® 108 PVC	707256	6FX5008-1BB25	4	4 G 25	1068	1504	27.1
TOPSERV® 108 PVC	707257	6FX5008-1BB35	4	4 G 35	1449	1973	29.9
TOPSERV® 108 PVC	707258	6FX5008-1BB50	4	4 G 50	2096	2671	35.8
<b>TOPSERV® 112 PVC</b>							
TOPSERV® 112 PVC	707280	6FX5008-1BA11	6	4 G 1.5 + (2 x 1.5) C	140	194	10.4
TOPSERV® 112 PVC	707281	6FX5008-1BA21	6	4 G 2.5 + (2 x 1.5) C	185	258	12.0
TOPSERV® 112 PVC	707282	6FX5008-1BA31	6	4 G 4 + (2 x 1.5) C	257	347	13.6
TOPSERV® 112 PVC	707283	6FX5008-1BA41	6	4 G 6 + (2 x 1.5) C	348	457	15.9
TOPSERV® 112 PVC	707284	6FX5008-1BA51	6	4 G 10 + (2 x 1.5) C	502	797	21.0
TOPSERV® 112 PVC	707285	6FX5008-1BA61	6	4 G 16 + (2 x 1.5) C	741	1110	24.7
TOPSERV® 112 PVC	707286	6FX5008-1BA25	6	4 G 25 + (2 x 1.5) C	1100	1550	27.8
TOPSERV® 112 PVC	707287	6FX5008-1BA35	6	4 G 35 + (2 x 1.5) C	1498	2030	30.9
TOPSERV® 112 PVC	707288	6FX5008-1BA50	6	4 G 50 + (2 x 1.5) C	2149	2934	34.5
<b>TOPGEBER 511 PVC</b>							
TOPGEBER 511 PVC	707417	6FX5008-1BD21	12	4 x 2 x 0.34 + 4 x 0.5) C	70	116	8.9
TOPGEBER 511 PVC	707389	6FX5008-1BD41	12	3 x (2 x 0.14) D + 4 x 0.14 + 2 x 0.5) C	66	114	8.9
TOPGEBER 511 PVC	707390	6FX5008-1BD51	16	3 x (2 x 0.14) D + 4 x 0.14 + 4 x 0.25 + 2 x 0.5) C	75	129	9.4
TOPGEBER 511 PVC	803672	6FX5008-2DC00	6	2 x 2 x 0.22 + 1 x 2 x 0.34) C	38	61	6.9
TOPGEBER 511 PVC	802471	6FX2008-1DC00	4	2 x 2 x 0.22) C	35	71	6.9

According to Bosch Rexroth

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>PUR dynamic</b>							
TOPSERV® 121 PUR	706003	INK0670	6	4 G 0.75 + (2 x 0.5) C	77	132	9.2
TOPSERV® 121 PUR	73774	INK0653	8	4 G 1.0 + 2 x (2 x 0.75) C	148	208	11.2
TOPSERV® 121 PUR	700561	INK0650	8	4 G 1.5 + 2 x (2 x 0.75) C	170	276	12.2
TOPSERV® 121 PUR	73580	INK0602	8	4 G 2.5 + 2 x (2 x 1.0) C	229	346	14.0
TOPSERV® 121 PUR	700562	INK0603	8	4 G 4 + (2 x 1.0) C + (2 x 1.5) C	318	473	15.8
TOPSERV® 121 PUR	700563	INK0604	8	4 G 6 + (2 x 1.0) C + (2 x 1.5) C	445	609	17.6
TOPSERV® 121 PUR	700564	INK0605	8	4 G 10 + (2 x 1.0) C + (2 x 1.5) C	610	852	20.5
TOPSERV® 121 PUR	75978	INK0606	8	4 G 16 + 2 x (2 x 1.5) C	904	1290	23.6
TOPSERV® 121 PUR	75979	INK0607	8	4 G 25 + 2 x (2 x 1.5) C	1323	1700	27.0
TOPSERV® 121 PUR	75980	INK0667	8	4 G 35 + 2 x (2 x 1.5) C	1621	2155	30.5
TOPSERV® 121 PUR	700565	INK0668	8	4 G 50 + 2 x (2 x 2.5) C	2380	3100	35.5
<b>TOPGEBER 512 PUR</b>							
TOPGEBER 512 PUR	707738	INK0209	10	4 x 2 x 0.25 + 2 x 1.0) C	64	120	8.8
TOPGEBER 512 PUR	707739	INK0448	10	4 x 2 x 0.25 + 2 x 0.5) C	61	103	8.5
TOPGEBER 512 PUR	707740	INK0208	9	9 x 0.5) C	69	124	8.8
TOPGEBER 512 PUR	707408	INK0532	16	4 x 1 + 4 x 2 x 0.14 + (4 x 0.14) D) C	84	139	9.5
TOPGEBER 512 PUR	707418	INK0280	11	3 x (2 x 0.25) D + 3 x 0.25 + 2 x 1.0) C	74	130	9.0
TOPGEBER 512 PUR	707409	INK0750	6	2 x 2 x 0.25 + 2 x 0.5) C	38	76	7.2
<b>TOPGEBER 512 PUR</b>							
TOPGEBER 512 PUR	702050	INK209 green	10	4 x 2 x 0.25 + 2 x 1.0) C	64	120	8.8
TOPGEBER 512 PUR	78080	INK448 green	10	4 x 2 x 0.25 + 2 x 0.5) C	61	103	8.5
TOPGEBER 512 PUR	77741	INK208 green	9	9 x 0.5) C	69	124	8.8
<b>PVC static</b>							
TOPSERV® 119 PVC	707290	INK0653	8	4 G 1.0 + 2 x (2 x 0.75) C	130	196	11.2
TOPSERV® 119 PVC	707291	INK0650	8	4 G 1.5 + 2 x (2 x 0.75) C	155	218	11.5
TOPSERV® 119 PVC	707292	INK0602	8	4 G 2.5 + 2 x (2 x 1.0) C	216	304	13.5
TOPSERV® 119 PVC	707293	INK0603	8	4 G 4 + (2 x 1.0) C + (2 x 1.5) C	297	404	15.5
TOPSERV® 119 PVC	707294	INK0604	8	4 G 6 + (2 x 1.0) C + (2 x 1.5) C	374	527	17.3
TOPSERV® 119 PVC	707295	INK0605	8	4 G 10 + (2 x 1.0) C + (2 x 1.5) C	545		

## According to Fanuc

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
TOPSERV® 109 PUR	707752	LX66L-0003-0331	4	4 x 1.0	66	108	9.5
TOPSERV® 109 PUR	75944	LX66L-0003-0351	4	4 G 2.5	132	208	10.6
TOPSERV® 109 PUR	75945	LX66L-0003-0352	4	4 G 4	204	290	11.9
TOPSERV® 109 PUR	707753	LX66L-0003-0332	7	7 x 1.0	96	162	10.4
TOPSERV® 109 PUR	707756	LX66L-0003-0336	3	3 x 0.75	40	69	6.2
TOPSERV® 109 PUR	707249	LX66L-0003-0356	6	6 x 1.0	84	146	9.4
TOPSERV® 109 PUR	707760	LX66L-0003-0358	4	4 x 8.0	361	510	15.4
TOPGEBER 512 PUR	707750	LX66L-0003-0283	20	10 x 2 x AWG 28	35	55	7.0
TOPGEBER 511 PVC	707751	LX66L-0003-0284	20	10 x 2 x AWG 28	34	56	7.0
TOPGEBER 512 PUR	707761	LX66L-0003-0369	16	(5 x 2 x 0.18 + 6 x 0.5) C	74	120	8.7
TOPGEBER 512 PUR	707762	LX66L-0003-0401	12	(3 x 2 x 0.18 + 6 x 1.0) C	93	130	8.7
TOPGEBER 512 PUR	707116	LX66L-0003-0312	12	(3 x 2 x 0.18 + 6 x 0.5) C	66	108	8.7
TOPGEBER 512 PUR	707763	LX66L-0003-0461	9	(2 x 2 x 0.18 + 5 x 0.5) C	55	90	7.8
TOPGEBER 512 PUR	707115	LX66L-0003-0462	7	(1 x 2 x 0.18 + 5 x 0.5) C	49	86	7.4
TOPGEBER 512 PUR	707764	LX66L-0003-0482	10	(4 x 2 x 0.22 + 2 x 0.5) C	54	87	7.8

## According to Schneider Electric

Product	Part No. HELUKABEL	Part No. OEM	No. of Cores	Cable Structure / Sheath Colour	Cop. Weight app. kg/km	Weight app. kg/km	Outer Diameter app. mm
<b>PUR dynamic</b>							
TOPSERV® 121 PUR	707775	Schneider Electric	8	4 G 1.5 + 2 x (2 x 0.75) C	170	276	12.2
TOPSERV® 121 PUR	703103	Schneider Electric	8	4 G 2.5 + 2 x (2 x 1.0) C	229	346	14.0
TOPGEBER 512 PUR	705413	Schneider Electric	8	(3 x 2 x 0.25 + 2 x 0.5) C	43	82	7.4
TOPGEBER 512 PUR	706333	Schneider Electric	12	(5 x 2 x 0.25 + 2 x 0.5) C	69	110	8.8
TOPGEBER 512 PUR	708489	Schneider Electric	8	(3 x 2 x 0.14 + 2 x 0.34) C	29	65	6.8

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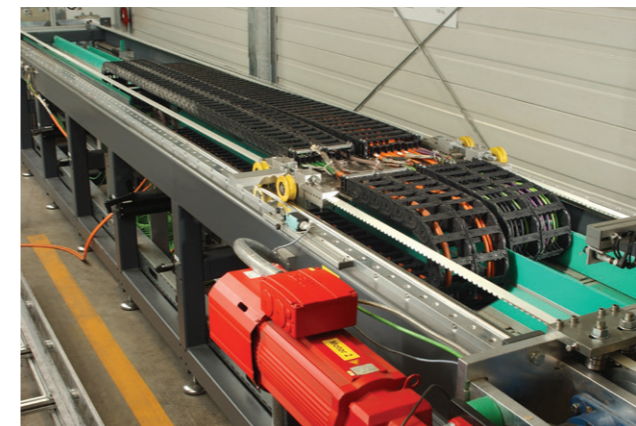
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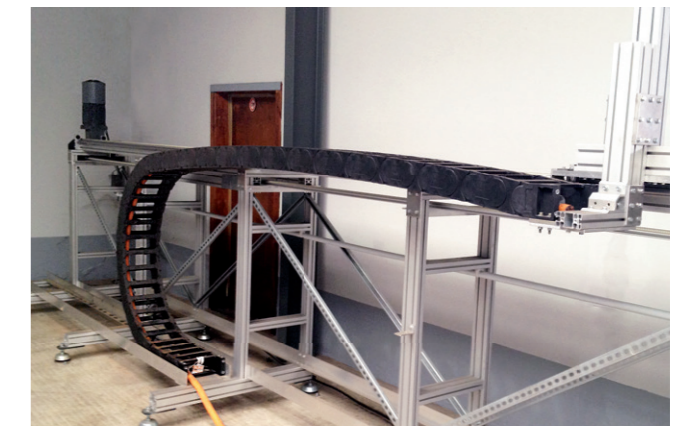
40 m drag chain test facility



18 m drag chain test facility



5 m drag chain test facility



6 m drag chain test facility for larger cross sections

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### NOTES

**Technical modifications**

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