Railway Products

Edition 2010/2011

HUBER+SUHNER

Excellence in Connectivity Solutions

Bridging our Technologies

Interdisciplinary knowledge

The HUBER+SUHNER Group is a leading international manufacturer of electrical and optical interconnectivity components and systems. Our main markets are communication, transport and industry. Under one roof, we combine technological capabilities in the three core fields of Radio Frequency, Fiber Optics and Low Frequency.

As one of Europe's leading suppliers, HUBER+SUHNER offers a wide range of products which provide the platform to build modern rail vehicles.

New and innovative products based on our proven technologies supports you to fulfil the demanding requirements of the railway industry.

HUBER+SUHNER

Excellence in Connectivity Solutions

Railway Products Overview

HUBER+SUHNER
Excellence in Connectivity Solutions

Engineering Services

Our years of experience in the field of Rail enable us to offer our customers individualised solution packages which – in addition to the selection of the most suitable products – also includes the related services.

We are proud of the smooth collaboration with our customers, with whose assistance we continuously further develop our products. Our services are designed to make it easier for our customers to apply our components.

Design support

- Creation of customised solutions by our applications engineers (by suitable combination of our components)
- Determination and definition of customer-specific products
- Exchange of CAD data for ensuring optimal design-in of our components in our customers' systems
- Investigation of special effects in the application of our products
- Environmental tests in our in-house test facilities

Project development

- Project management
- Materials planning, creation of component kits
- Assistance during installation

Training

- Local on-site product training courses by our specialists
- Individual workshops


SOB
526 041-9

Traction Cables

RADOX® 3 GKW

Halogen free, compact, single wall signal and power cable for general applications

RADOX 3 GKW are compact single core power and signal cables. Thanks to the medium-wall design weight and space requirements are minimised. They are halogen free, flame retardant, low smoke and have a low toxicity index. Demands for temperature, weathering and ozone resistance are fulfilled easily.

The cable is flexible and easy to install. The RADOX insulation makes it easy to strip and is soldering iron resistant.

RADOX 3 GKW cables are qualified for protected fixed cabling and installation inside and outside of rolling stock to connect fixed parts in AC and DC applications. Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connection.

Features

- Electron beam crosslinked RADOX insulation does not melt or flow at high temperatures
- Long service life
- Compact and weight optimised
- Tight bending radii
- Meeting the common railway fire performances

RADOX® 3 GKW

Single Core

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	1		900/1500 V DC
Cross section	0.5 - 400 mm^2	**Temperature range**	-40 °C to +120 °C

Composition of core

1.	Conductor	stranded tin plated copper	
2.	Insulation	RADOX GKW J	colour: grey

Characteristics and specialities

- Flame retardant
- Low smoke
- Halogon free
- Low toxicity
- Soldering resistant
- Easy to strip
- Flexible
- Weight optimized

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
BS 6853	Category	int. Ia, Ib, II / ext. Ia, Ib, II
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® 3 GKW

Single Core

Cross section	Conductor		Core	Conductor resistance	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	copper kg/100 m	cable kg/100 m	
0.5	19 x 0.18	0.90	2.00 ± 0.10	40.1	0.45	0.90	12548125
0.75	24 x 0.21	1.10	2.20 ± 0.10	26.7	0.70	1.20	12548126
1	37 x 0.18	1.22	2.45 ± 0.10	20.0	0.90.	1.40	12551402
1.5	30 x 0.26	1.50	2.70 ± 0.10	13.7	1.40	2.00	12545286
2.5	61 x 0.23	1.95	3.30 ± 0.10	8.21	2.20	3.10	12545288
4	61 x 0.29	2.45	3.95 ± 0.10	5.09	3.50	4.70	12545290
6	84 x 0.30	2.95	4.70 ± 0.15	3.39	5.20	6.90	12548127
10	80 x 0.40	3.90	5.85 ± 0.15	1.95	9.10	11.30	12545153
16	119 x 0.40	5.30	7.25 ± 0.15	1.24	13.50	16.60	12545292
25	182 x 0.40	6.60	8.90 ± 0.20	0.795	21	25	12543216
35	266 x 0.40	7.80	10.2 ± 0.20	0.565	30	35	12548128
50	378 x 0.40	9.30	11.9 ± 0.20	0.393	43	50	12545155
70	348 x 0.50	11.40	14.3 ± 0.25	0.277	61	69	12543214
95	444 x 0.50	12.90	15.9 ± 0.25	0.210	78	90	12548671
120	570 x 0.50	14.90	17.9 ± 0.30	0.164	100	118	12542936
150	722 x 0.50	16.80	20.3 ± 0.30	0.132	127	146	12548673
185	874 x 0.50	18.30	22.0 ± 0.30	0.108	150	178	12551404
240	1147 x 0.50	21.10	25.2 ± 0.30	0.0817	200	230	12551406
300	1443 x 0.50	23.70	28.0 ± 0.30	0.0654	250	300	12555741
400	2016 x 0.50	27.30	33.8 ± 0.30	0.0495	353	400	12557104

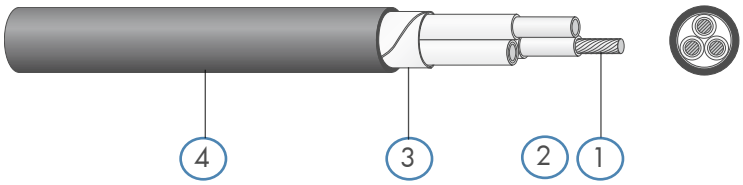
* Typical value x single wire diameter

Other colours on request.

RADOX® 3 GKW/S

Multi Core

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	2 - ...		900/1500 V DC
Cross section	0.5 - 35 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1. Cores	3 GKW	
		colours: grey, numbered or grey, numbered with yellowgreen
2. Fillers (optional)	RADOX	
3. Separator(s) (optional)	tape	
4. Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Resistance to oil, diesel oil, abrasion, ozone and weathering
- Soldering resistant
- Easy to strip
- Flexible
- Weight optimized

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® 3 GKW/S

Multi Core

Cross section	Conductor		Core	Cable	Conductor resistance	Capacitance ***	Fire load	Weight		Item no.
n x mm^2	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100 m	cable kg/100 m	
2 x 0.5	19 x 0.18	0.90	2.00	5.9 ± 0.3	40.1	110	551	0.91	4.80	12561172
4 x 0.5	19 x 0.18	0.90	2.00	7.0 ± 0.3	40.1	110	582	1.40	5.50	12561174
7 x 0.5	19 x 0.18	0.90	2.00	9.1 ± 0.3	40.1	110	706	1.80	7.20	12561177
18 x 0.5	19 x 0.18	0.90	2.00	12.7 ± 0.4	40.1	110	861	2.30	8.60	12567587
3 x 0.75	24 x 0.21	1.10	2.20	6.8 ± 0.3	26.7	110	690	2.00	7.00	12561181
5 x 0.75	24 x 0.21	1.10	2.20	8.4 ± 0.3	26.7	110	990	3.40	10.70	12561184
8 x 0.75	24 x 0.21	1.10	2.20	10.9 ± 0.4	26.7	110	1410	5.30	14.70	12561819
12 x 0.75	24 x 0.21	1.10	2.20	11.9 ± 0.4	26.7	110	1760	8.00	17.50	12561189
20 x 0.75	24 x 0.21	1.10	2.20	15.2 ± 0.5	26.7	110	2300	13.20	35.00	12561821
2 x 1	37 x 0.18	1.22	2.45	6.9 ± 0.3	20.0	120	560	1.80	7.20	12561190
6 x 1	37 x 0.18	1.22	2.45	10.0 ± 0.3	20.0	120	1240	5.40	16.00	12561194
9 x 1	37 x 0.18	1.22	2.45	12.5 ± 0.4	20.0	120	1830	8.10	21.00	12561196
25 x 1	37 x 0.18	1.22	2.45	18.7 ± 0.5	20.0	120	3880	22.50	51.90	12568300
2 x 1.5	30 x 0.26	1.50	2.70	7.5 ± 0.3	13.7	120	840	2.80	8.60	12561199
3 x 1.5	30 x 0.26	1.50	2.70	8.0 ± 0.3	13.7	120	770	4.20	9.00	12561200
5 x 1.5	30 x 0.26	1.50	2.70	10.2 ± 0.4	13.7	120	1430	7.00	16.90	12561202
**7G1.5	30 x 0.26	1.50	2.70	12.1 ± 0.4	13.7	120	1660	9.80	23.80	12564173
12 x 1.5	30 x 0.26	1.50	2.70	14.2 ± 0.4	13.7	120	2330	16.80	31.30	12561207
36 x 1.5	30 x 0.26	1.50	2.70	23.0 ± 0.5	13.7	120	6200	54.00	90.50	12567364

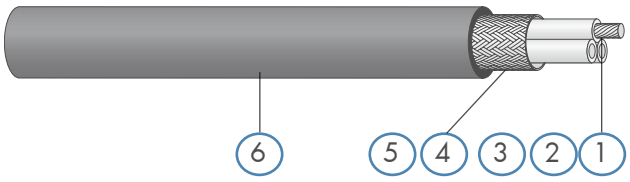
* Typical value x single wire diameter
** G (earth) = yellowgreen
*** Capacity in water typical value

S = GKW S sheath

RADOX® 3 GKW/S EMC

Multi Core screened

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	2 - 42		900/1500 V DC
Cross section	0.5 - 50 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1. Cores	3 GKW	colours: grey, numbered or grey, numbered with yellowgreen
2. Fillers (optional)	RADOX	
3. Separator(s) (optional)	tape	
4. EMC screen	tin plated copper braid	
5. Separator	tape	
6. Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Excellent screening properties
- Resistance to oil, diesel oil, abrasion, ozone and weathering
- Soldering resistant
- Easy to strip
- Flexible

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
BS 6853	Category	int. Ia, Ib, II / ext. Ia, Ib, II
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® 3 GKW/S EMC

Multi Core screened

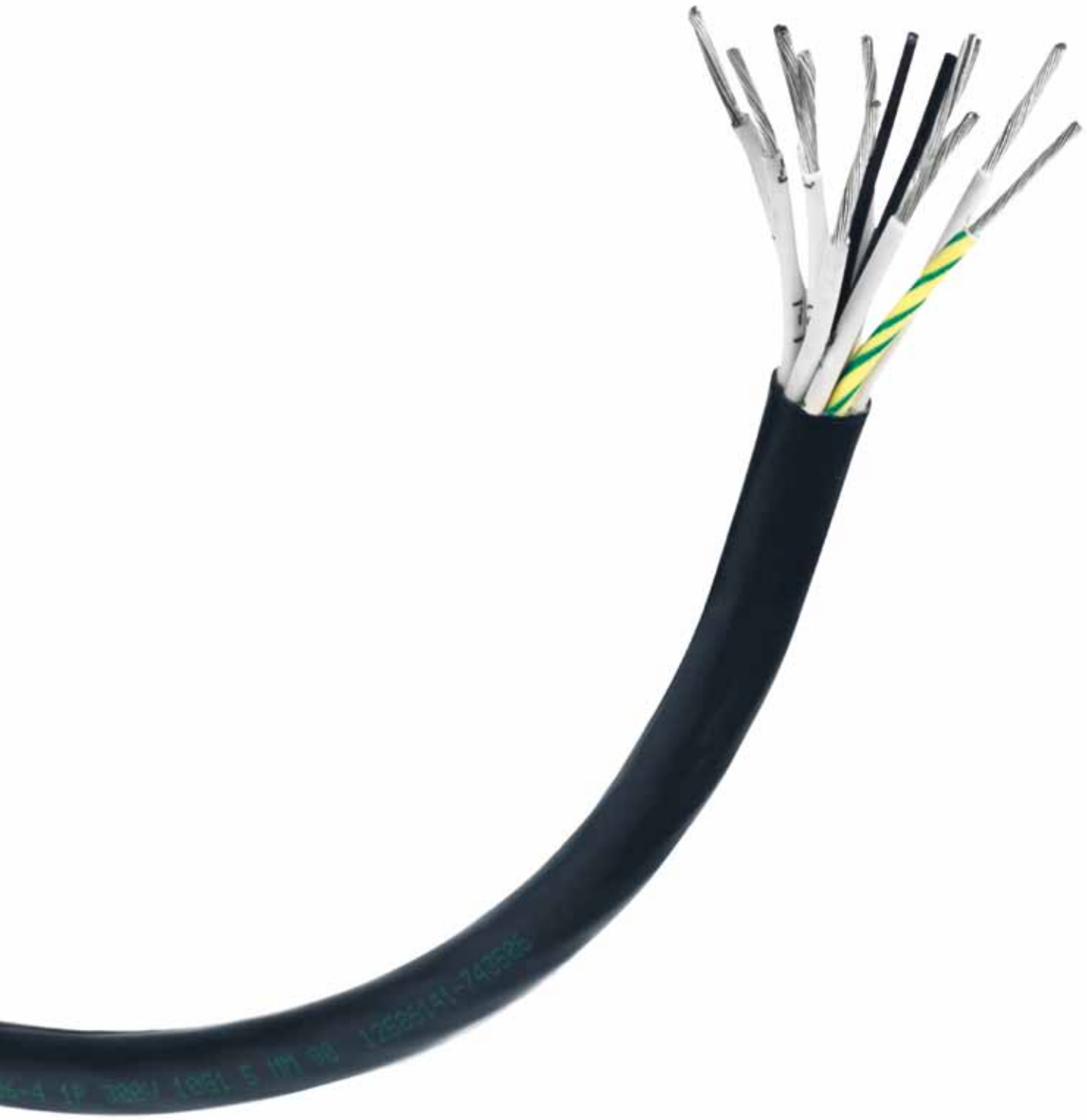
Cable type	Conductor		Core	Screen		Cable	Conductor resistance		I_K**	Z_T	Capacitance		Fire load	Weight		Item no.
n x mm²	constr.* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	$d_{max.}$ mm	size mm²	d mm	conductor R_{20} max. Ω/km	screen R_{20} max. Ω/km	screen A	max. Ω/m	core/core C pF/m	core/screen C pF/m	nom. kJ/m	copper kg/100 m	cable kg/100 m	
2 x 0.5	19 x 0.18	0.90	2.00	4.6	1.3	6.6 ± 0.3	40.1	16.1	510	170	170	300	510	2.3	6.84	12561219
4 x 0.5	19 x 0.18	0.90	2.00	5.8	1.7	7.5 ± 0.3	40.1	11.3	650	120	170	300	700	3.6	10.20	12561221
7 x 0.5	19 x 0.18	0.90	2.00	7.8	2.8	9.8 ± 0.3	40.1	7.33	1080	80	170	300	1090	6.3	14.50	12561224
15 x 0.5	19 x 0.18	0.90	2.00	10.6	5.1	13.4 ± 0.4	40.1	4.12	1970	60	170	300	2160	12.5	24.00	12567597
9 x 2 x 0.5	19 x 0.18	0.90	2.00	17.0	10.6	20.6 ± 0.5	40.1	2.0	4090	40	170	300	6300	19.2	54.10	12568527
3 x 0.75	24 x 0.21	1.10	2.20	5.4	1.7	7.5 ± 0.3	26.7	11.9	650	130	170	300	720	3.7	9.40	12561229
6 x 0.75	24 x 0.21	1.10	2.20	7.7	3.3	9.9 ± 0.3	26.7	6.15	1200	80	170	300	1080	7.2	16.50	12561232
9 x 0.75	24 x 0.21	1.10	2.20	10.0	5.1	12.3 ± 0.4	26.7	3.71	1950	70	170	300	1630	11.4	24.30	12561234
16 x 0.75	24 x 0.21	1.10	2.20	11.7	5.9	14.4 ± 0.4	26.7	3.47	2250	60	170	300	2200	16.9	34.80	12562206
5 x 2 x 0.75	24 x 0.21	1.10	2.20	12.8	8.0	16.0 ± 0.5	26.7	2.61	3000	55	170	300	2250	15.4	35.40	12566117
4 x 1	37 x 0.18	1.22	2.45	7.0	2.8	8.8 ± 0.3	20.0	6.81	1080	90	190	330	860	6.4	14.00	12559724
7 x 1	37 x 0.18	1.22	2.45	9.4	3.7	11.8 ± 0.4	20.0	4.98	1400	65	190	330	1430	10.0	22.60	12559727
3 x 1.5	30 x 0.26	1.50	2.70	6.8	2.5	8.6 ± 0.3	13.7	7.62	960	90	190	330	770	6.4	12.40	12559729
5 x 1.5	30 x 0.26	1.50	2.70	8.6	3.2	10.9 ± 0.4	13.7	6.14	1230	70	190	330	1240	9.9	20.80	12559731
9 x 1.5	30 x 0.26	1.50	2.70	12.5	7.9	14.9 ± 0.4	13.7	2.43	3000	50	190	330	2050	19.2	40.90	12559844
16 x 1.5	30 x 0.26	1.50	2.70	14.5	9.1	17.5 ± 0.5	13.7	2.09	3500	50	190	330	3030	30.3	56.00	12559846
6 x 2 x 1.5	30 x 0.26	1.50	2.70	15.9	9.1	18.9 ± 0.4	14.2	2.10	3500	55	190	330	3050	25.0	54.00	12559855
2 x 2.5	61 x 0.23	1.95	3.30	7.6	2.8	9.6 ± 0.3	8.21	7.23	1080	80	200	350	840	6.9	16.00	12559734
4 x 2.5	61 x 0.23	1.95	3.30	9.2	3.2	11.3 ± 0.4	8.21	5.74	1230	70	200	350	1230	12.1	22.20	12559736
7 x 2.5	61 x 0.23	1.95	3.30	12.1	5.9	14.8 ± 0.4	8.21	3.20	2250	50	200	350	2000	21.3	40.00	12559739
3 x 4	61 x 0.29	2.45	3.95	9.5	3.7	11.8 ± 0.4	5.09	5.12	1400	60	200	350	1400	14.4	26.00	12559743
5 x 4	61 x 0.29	2.45	3.95	12.3	5.5	14.7 ± 0.4	5.09	3.20	2100	60	200	350	1980	23.6	44.00	12561508
3 x 6	84 x 0.30	2.95	4.70	11.4	5.1	13.8 ± 0.4	3.39	3.74	1950	50	230	400	2240	21.8	37.00	12559744
5 x 6	84 x 0.30	2.95	4.70	14.1	9.1	17.4 ± 0.5	3.39	2.14	3500	50	230	400	2690	36.0	62.00	12559849
3 x 10	80 x 0.40	3.90	5.85	14.1	7.8	17.1 ± 0.5	1.95	2.40	3000	50	230	400	4050	36.3	58.00	12559746
4 x 10	80 x 0.40	3.90	5.85	16.1	10.2	19.2 ± 0.5	1.95	1.86	3900	50	230	400	5560	43.1	75.00	12559747
5 x 10	80 x 0.40	3.90	5.85	17.8	10.5	21.1 ± 0.5	1.95	1.87	4050	50	230	400	4670	56.8	85.00	12562116
3 x 16	119 x 0.40	5.30	7.30	17.3	10.2	20.5 ± 0.5	1.24	1.87	3900	50	230	400	4790	52.0	82.00	12559749
2 x 25	182 x 0.40	6.60	8.90	19.1	12.0	22.9 ± 0.5	0.795	1.72	4550	50	230	400	4900	53.6	99.00	12566322
3 x 35	266 x 0.40	7.80	10.2	23.6	15.1	27.9 ± 0.6	0.565	1.26	5800	50	230	400	8850	108	160.00	12559751
6 x 35	266 x 0.40	7.80	10.2	33.4	35.2	39.7 ± 0.7	0.565	0.59	13590	50	230	400	15600	162	339.00	12565410
2 x 50	378 x 0.40	9.30	11.9	25.0	15.2	29.8 ± 0.6	0.393	1.28	5850	50	230	400	21000	106	176.00	12560868

* Typical value x single wire diameter

** Short-circuit current rating of screen acc. to IEC 60949 (adiabatic), duration of short-circuit 0.1 s, initial temperature +90 °C, final temperature +200 °C

S = GKW S sheath

EMC = Electromagnetic Compatibility



RADOX® TENUIS-TW

With the railway cable family RADOX TENUIS-TW HUBER+SUHNER offers a new generation of control and signal cable. Its characteristic achieves new dimension of lightness and flexibility. RADOX TENUIS-TW is smaller, lighter and more flexible than previous products on the railway market. As a thin-wall cable is it particularly suitable for the wiring of cable looms, control panels and electrical cabinets and meets the requirements of the most important European Safety Standards for railways.
Unique characteristics of the cable improve its processability making it easier to strip without the need for special tooling. Therefore, greatly improving installation time and reducing costs.
RADOX TENUIS-TW cables are available in single core as well as in multi core screened and unscreened versions. The cable cores are manufactured using a dual-wall insulation system made from high-tech polymers and have excellent electrical and mechanical characteristics.
Especially developed for rolling stock the cables are recognised for their high resistance to all types of media, UV-rays, ozone and humidity as well as harsh environmental conditions. The cables are halogen free and do not release any corrosive gases in the event of fire. They are flame retardant and do not propagate fire, generate low smoke emissions and have low toxicity index.

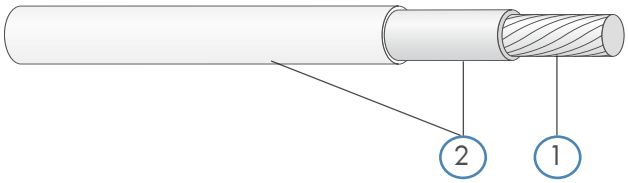
Features

- Dual wall insulation of high tech polymers
- High abrasion resistance
- Excellent flexibility
- Light weight
- Easy to strip and to install
- Meeting the common railway fire performances

RADOX® TENUIS-TW

Single Core

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	1		900/1500 V DC
Cross section	0.5 - 4.0 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of core

1. Conductor	stranded tin plated copper
2. Insulation	double coating RADOX GKW TP/GKW TS colours: white and yellowgreen

Characteristics and specialities

- Resistance to oil, ozone, weathering
- Broad product range

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® TENUIS-TW

Single Core

Cross section	Conductor		Core	Conductor resistance	Capacitance **	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100 m	cable kg/100 m	standard colour white
0.5	19 x 0.18	0.90	1.43 ± 0.02	40.1	360	33	0.45	0.58	12564379
0.75	19 x 0.23	1.10	1.63 ± 0.02	26.7	445	37	0.69	0.84	12566838
1	19 x 0.26	1.25	1.78 ± 0.02	20.0	478	43	0.88	1.00	12561500
1.5	19 x 0.31	1.50	2.17 ± 0.05	13.7	460	61	1.30	1.60	12564381
2.5	19 x 0.40	1.95	2.75 ± 0.05	8.21	513	95	2.20	2.60	12564382
4	56 x 0.31	2.50	3.35 ± 0.05	5.09	565	133	3.40	4.00	12581455

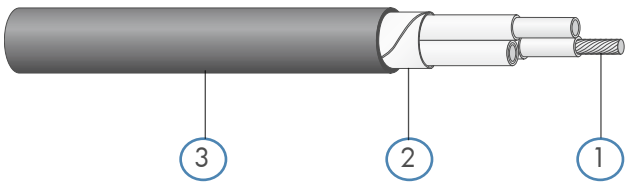
* Typical value X single wire diameter
** Capacity in water, typical value

TW = Thin Wall

RADOX® TENUIS-TW/S

Multi Core

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	2 - 6		900/1500 V DC
Cross section	0.5 - 4.0 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1. Cores	TENUIS-TW	
		colours: white, numbered and yellowgreen further colours on request
2. Separator	tape	
3. Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Resistance to oil, ozone, weathering
- Broad product range
- Space saving constructions

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

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UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® TENUIS-TW/S

Multi Core

Cable type	Conductor		Core	Cable	Conductor resistance	Fire load	Weight		Item no.
mm²	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	nom. kJ/m	copper kg/100 m	cable kg/100 m	
2 x 0.5	19 x 0.18	0.90	1.43	4.4 ± 0.2	40.1	290	0.90	3.1	12568036
3 x 0.5	19 x 0.18	0.90	1.43	4.6 ± 0.2	40.1	320	1.35	3.6	12568037
4 x 0.5	19 x 0.18	0.90	1.43	5.0 ± 0.2	40.1	362	1.80	4.3	12568038
5 x 0.5	19 x 0.18	0.90	1.43	5.5 ± 0.2	40.1	427	2.25	5.3	12566304
6 x 0.5	19 x 0.18	0.90	1.43	6.0 ± 0.2	40.1	544	2.70	6.2	12568039
2 x 2 x 0.5	19 x 0.18	0.90	1.43	6.5 ± 0.3	40.1	595	1.80	5.8	12568040
4 x 2 x 0.5	19 x 0.18	0.90	1.43	8.7 ± 0.3	40.1	900	3.60	9.9	12568041
2 x 0.75	19 x 0.23	1.10	1.63	4.75 ± 0.3	26.7	300	1.40	3.5	12568047
3 x 0.75	19 x 0.23	1.10	1.63	5.15 ± 0.3	26.7	372	2.10	4.7	12568048
4 x 0.75	19 x 0.23	1.10	1.63	5.6 ± 0.3	26.7	430	2.80	5.7	12568049
6 x 0.75	19 x 0.23	1.10	1.63	6.75 ± 0.3	26.7	659	4.20	8.3	12568050
2 x 2 x 0.75	19 x 0.23	1.10	1.63	7.75 ± 0.3	26.7	833	2.80	8.1	12568051
2 x 1	19 x 0.26	1.25	1.78	5.1 ± 0.3	20.0	377	1.65	4.5	12568052
3 x 1	19 x 0.26	1.25	1.78	5.4 ± 0.3	20.0	410	2.45	5.4	12568053
4 x 1	19 x 0.26	1.25	1.78	5.8 ± 0.3	20.0	460	3.30	6.4	12568054
6 x 1	19 x 0.26	1.25	1.78	7.3 ± 0.3	20.0	887	5.00	9.8	12568055
10 x 1	19 x 0.26	1.25	1.78	8.7 ± 0.3	20.0	950	8.50	14.3	12581348
25 x 1	19 x 0.26	1.25	1.78	12.8 ± 0.4	20.0	1890	21.20	32.4	12581349
2 x 1.5	19 x 0.31	1.50	2.17	6.0 ± 0.3	13.7	511	2.60	6.3	12568098
3 x 1.5	19 x 0.31	1.50	2.17	6.3 ± 0.3	13.7	540	3.90	7.6	12568099
3 G 1.5	19 x 0.31	1.50	2.17	6.3 ± 0.3	13.7	540	3.90	7.6	12582026
4 x 1.5	19 x 0.31	1.50	2.17	6.9 ± 0.3	13.7	631	5.10	9.4	12568100
5 x 1.5	19 x 0.31	1.50	2.17	7.8 ± 0.3	13.7	830	6.60	11.6	12581350
5 G 1.5	19 x 0.31	1.50	2.17	7.8 ± 0.3	13.7	830	6.60	11.6	12582027
6 x 1.5	19 x 0.31	1.50	2.17	8.45 ± 0.3	13.7	1020	7.90	14.1	12582028
7 G 1.5	19 x 0.31	1.50	2.17	9.1 ± 0.3	13.7	1220	9.20	16.5	12582029
8 x 1.5	19 x 0.31	1.50	2.17	10.3 ± 0.4	13.7	1590	10.50	20.1	12582030
10 x 1.5	19 x 0.31	1.50	2.17	10.6 ± 0.4	13.7	1370	13.10	21.6	12582031
18 x 1.5	19 x 0.31	1.50	2.17	13.4 ± 0.4	13.7	2360	23.70	37.4	12582032
25 G 1.5	19 x 0.31	1.50	2.17	15.5 ± 0.5	13.7	3010	33.10	49.4	12582033
2 x 2.5	19 x 0.40	1.95	2.75	7.3 ± 0.3	8.21	745	4.30	9.8	12568101
3 x 2.5	19 x 0.40	1.95	2.75	7.8 ± 0.3	8.21	840	6.60	12.2	12582034
3 G 2.5	19 x 0.40	1.95	2.75	7.8 ± 0.3	8.21	840	6.60	12.2	12582035
4 x 2.5	19 x 0.40	1.95	2.75	8.7 ± 0.3	8.21	1000	8.60	15.2	12566306
5 x 2.5	19 x 0.40	1.95	2.75	9.4 ± 0.3	8.21	1200	10.90	18.1	12581346
6 x 2.5	19 x 0.40	1.95	2.75	10.6 ± 0.4	8.21	1590	13.10	22.3	12581347

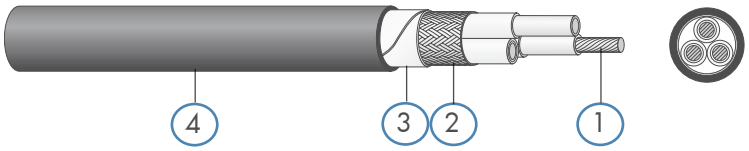
* Typical value x single wire diameter

S = RADOX GKW S sheath
G = (earth) = yellowgreen

RADOX® TENUIS-TW/S EMC

Multi Core screened

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	2 - ...		900/1500 V DC
Cross section	0.5 - 4.0 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1. Cores	TENUIS-TW	colour: white, numbered and yellowgreen further colours on request
2. EMC screen	tin plated copper braid	
3. Separator	tape	
4. Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Resistance to oil, ozone, weathering
- High screening effectiveness
- Broad product range
- Space saving constructions

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® TENUIS-TW/S EMC

Multi Core screened

Cable type	Conductor		Core	Cable	Conductor resistance	Fire load	Weight		Item no.
mm²	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	nom. kJ/m	copper kg/100 m	cable kg/100 m	
2 x 0.5	19 x 0.18	0.90	1.43	4.8 ± 0.3	40.1	323	1.8	4.2	12568117
6 x 0.5	19 x 0.18	0.90	1.43	6.5 ± 0.3	40.1	526	4.8	8.2	12568120
15 x 0.5	19 x 0.18	0.90	1.43	9.0 ± 0.3	40.1	1226	9.6	16.7	12582036
3 x 2 x 0.5	19 x 0.18	0.90	1.43	8.1 ± 0.3	40.1	765	4.8	9.8	12581451
12 x 2 x 0.5	19 x 0.18	0.90	1.43	13.0 ± 0.3	40.1	1594	20.6	27.6	12581358
2 x 0.75	19 x 0.23	1.10	1.63	5.0 ± 0.3	26.7	345	2.6	4.8	12568514
4 x 0.75	19 x 0.23	1.10	1.63	6.0 ± 0.3	26.7	441	4.8	7.2	12568516
6 x 0.75	19 x 0.23	1.10	1.63	7.2 ± 0.3	26.7	675	5.9	10.3	12568517
10 x 0.75	19 x 0.23	1.10	1.63	8.7 ± 0.3	26.7	896	9.6	15.2	12582046
18 x 0.75	19 x 0.23	1.10	1.63	11.0 ± 0.4	26.7	1397	16.2	24.4	12582048
3 x 2 x 0.75	19 x 0.23	1.10	1.63	9.0 ± 0.3	26.7	978	6.7	12.7	12581579
2 x 1	19 x 0.26	1.25	1.78	5.6 ± 0.3	20.0	430	2.7	6.0	12568162
4 x 1	19 x 0.26	1.25	1.78	6.5 ± 0.3	20.0	527	4.9	8.8	12568164
8 x 1	19 x 0.26	1.25	1.78	8.9 ± 0.3	20.0	1120	10.8	17.1	12581449
25 x 1	19 x 0.26	1.25	1.78	13.8 ± 0.4	20.0	2110	27.0	39.2	12582051
2 x 2 x 1	19 x 0.26	1.25	1.78	8.3 ± 0.3	20.0	877	5.5	11.7	12581357
3 x 1.5	19 x 0.31	1.50	2.17	6.8 ± 0.3	13.7	580	5.5	9.5	12568173
6 x 1.5	19 x 0.31	1.50	2.17	9.0 ± 0.3	13.7	1020	12.0	16.8	12581465
18 x 1.5	19 x 0.31	1.50	2.17	14.4 ± 0.4	13.7	3490	30.5	45.2	12582056
2 x 2.5	19 x 0.40	1.95	2.75	7.8 ± 0.3	8.21	806	6.3	12.2	12568175
6 x 2.5	19 x 0.40	1.95	2.75	11.4 ± 0.4	8.21	1650	16.5	26.8	12582059

* Typical value x single wire diameter

S = RADOX GKW S sheath
EMC = Electromagnetic Compatibility

RADOX® GKW-LW

Halogen free, compact, dual wall cable in a light weight design for demanding applications

RADOX GKW-LW single core cables have small diameters, low weight and a smooth and abrasion resistant surface. They are resistant to low and high temperatures, ozone and weathering and have excellent electrical characterisitcs, particularly in damp or humid conditions.

Due to their light weight construction,
RADOX GKW-LW cables are perfect for compact system wiring applications in modern rolling stock where space is at a premium and weight is restricted.

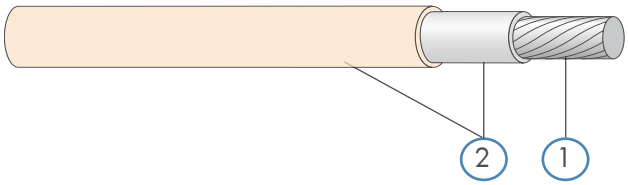
Features

- High abrasion resistance
- Flexible
- "Light weight" design saves space and weight
- Excellent in damp or humid conditions
- Meeting the common railway fire performances

RADOX® GKW-LW

Single Core

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	1		900/1500 V DC
Cross section	0.5 - 4.0 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of core

1. Conductor	stranded tin plated copper
2. Insulation	double coating RADOX GKW P / GKW HP colour: white

Characteristics and specialities

- Dual wall insulation of high tech polymers
- Resistance to oil, ozone and weathering
- Broad product range

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
BS 6853	Category	int. Ia, Ib, II / ext. Ia, Ib, II
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® GKW-LW

Single Core

Cross section		Conductor		Core	Conductor resistance	Capacitance **	Fire load	Weight		Item no.
mm^2	AWG	construction* n x mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
0.5		19 x 0.18	0.90	1.30 ± 0.05	40.1	385	25	0.45	0.55	12556113
0.6	20	19 x 0.20	1.00	1.39 ± 0.05	31.1	415	27	0.53	0.65	12556114
0.75		19 x 0.23	1.10	1.52 ± 0.05	26.7	470	30	0.67	0.80	12556115
1	18	19 x 0.26	1.25	1.67 ± 0.05	20.0	500	35	0.86	1.00	12556335
1.2	16	19 x 0.28	1.35	1.83 ± 0.05	15.5	520	40	1.05	1.20	12556117
1.5		19 x 0.31	1.50	2.04 ± 0.05	13.7	475	53	1.34	1.50	12554494
2	14	37 x 0.25	1.70	2.29 ± 0.10	10.5	500	65	1.65	1.90	12556119
2.5		19 x 0.40	1.95	2.54 ± 0.10	8.21	580	71	2.15	2.40	12554495
3	12	37 x 0.32	2.20	2.78 ± 0.10	6.56	620	82	2.65	2.90	12556121
4		56 x 0.30	2.50	3.21 ± 0.10	5.09	565	116	3.54	3.90	12566623

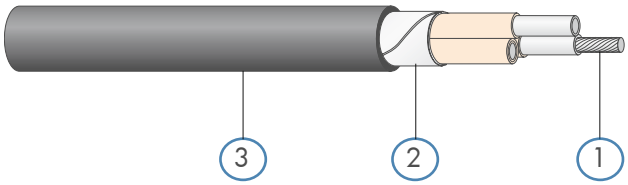
* Typical value x single wire diameter
** Capacity in water typical value

LW = Light Weight

RADOX® GKW-LW/S

Multi Core

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	2 - ...		900/1500 V DC
Cross section	0.25 - 4.0 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1. Cores	GKW-LW	
		colour standard: white numbered, others on request
2. Separator	tape	
3. Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Resistance to oil, ozone and weathering
- Broad product range
- Space saving constructions

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
BS 6853	Category	int. Ia, Ib, II / ext. Ia, Ib, II
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® GKW-LW/S

Multi Core

Cable type	Conductor		Core	Cable	Conductor resistance	Capacitance **	Fire load	Weight		Item no.
n x mm²	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	C_{H20} pF/m	kJ/m	copper kg/100 m	cable kg/100 m	
2 x 0.5	19 x 0.18	0.90	1.30	4.0 ± 0.2	40.1	105	248	0.95	2.4	12556756
5 x 0.5	19 x 0.18	0.90	1.30	5.0 ± 0.2	40.1	105	386	2.30	4.3	12556759
9 x 0.5	19 x 0.18	0.90	1.30	6.7 ± 0.3	40.1	105	612	4.20	6.6	12561299
12 x 0.5	19 x 0.18	0.90	1.30	6.9 ± 0.3	40.1	105	645	5.70	8.9	12556763
16 x 0.5	19 x 0.18	0.90	1.30	7.8 ± 0.3	40.1	105	876	7.40	11.5	12556764
25 x 0.5	19 x 0.18	0.90	1.30	9.5 ± 0.3	40.1	105	1186	11.60	17.0	12561301
30 x 0.5	19 x 0.18	0.90	1.30	10.1 ± 0.4	40.1	105	1372	14.00	20.5	12556810
2 x 2 x 0.5	19 x 0.18	0.90	1.30	5.8 ± 0.3	41.4	105	508	1.90	5.0	12561618
2 x 0.75	19 x 0.23	1.10	1.52	4.4 ± 0.2	26.7	110	294	1.40	3.2	12556767
4 x 0.75	19 x 0.23	1.10	1.52	5.0 ± 0.2	26.7	110	361	2.80	4.9	12556769
9 x 0.75	19 x 0.23	1.10	1.52	7.7 ± 0.3	26.7	110	755	6.30	10.6	12581701
14 x 0.75	19 x 0.23	1.10	1.52	8.4 ± 0.3	26.7	110	903	9.70	14.0	12561830
27 x 0.75	19 x 0.23	1.10	1.52	11.3 ± 0.4	26.7	110	1619	18.60	27.0	12556812
36 x 0.75	19 x 0.23	1.10	1.52	12.8 ± 0.4	26.70	110	2138	24.90	36.0	12556814
3 x 1	19 x 0.26	1.25	1.67	5.0 ± 0.2	20.0	115	360	2.7	4.7	12556778
6 x 1	19 x 0.26	1.25	1.67	6.6 ± 0.3	20.0	115	660	5.4	8.8	12556781
14 x 1	19 x 0.26	1.25	1.67	9.1 ± 0.3	20.0	115	1062	11.7	17.4	12582064
20 x 1	19 x 0.26	1.25	1.67	11.2 ± 0.4	20.0	115	1650	16.7	25.6	12556476
50 x 1	19 x 0.26	1.25	1.67	16.8 ± 0.5	20.0	115	3468	44.6	62.0	12565314
2 x 1.5	19 x 0.31	1.50	2.02	5.4 ± 0.3	13.7	120	433	2.80	5.5	12556786
5 x 1.5	19 x 0.31	1.50	2.02	7.1 ± 0.3	13.7	120	718	7.00	11.0	12555405
7 x 1.5	19 x 0.31	1.50	2.02	8.4 ± 0.3	13.7	120	1083	9.80	15.0	12556789
10 x 1.5	19 x 0.31	1.50	2.02	9.9 ± 0.3	13.7	120	1160	14.00	17.0	12556791
18 x 1.5	19 x 0.31	1.50	2.02	12.4 ± 0.4	13.7	120	2019	25.20	35.0	12556793
30 x 1.5	19 x 0.31	1.50	2.02	15.6 ± 0.5	13.7	120	2961	42.00	56.0	12556820
50 x 1.5	19 x 0.31	1.50	2.02	20.1 ± 0.5	13.7	120	4767	70.00	87.0	12565315
3 x 2.5	19 x 0.40	1.95	2.60	7.0 ± 0.3	8.21	125	692	6.70	10.5	12556415
6 x 2.5	19 x 0.40	1.95	2.60	9.6 ± 0.3	8.21	125	1343	13.50	20.0	12556797
12 x 2.5	19 x 0.40	1.95	2.60	12.6 ± 0.4	8.21	125	1969	27.00	36.0	12556416
18 x 2.5	19 x 0.40	1.95	2.60	15.3 ± 0.5	8.21	125	2962	40.50	54.5	12556802
24 x 2.5	19 x 0.40	1.95	2.60	17.8 ± 0.5	8.21	125	3653	54.00	69.5	12555975
30 x 2.5	19 x 0.40	1.95	2.60	19.3 ± 0.5	8.21	125	4401	67.50	87.0	12556417
36 x 2.5	19 x 0.40	1.95	2.60	21.0 ± 0.5	8.21	125	5236	81.00	105	12556822

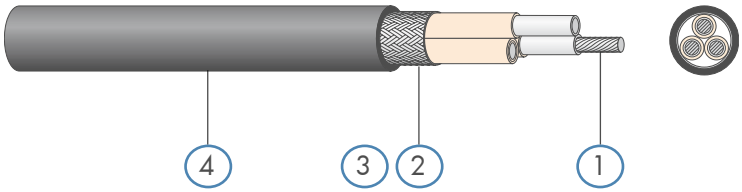
* Typical value x single wire diameter
** Capacity in water typical value

S = RADOX GKW S sheath

RADOX® GKW-LW/S EMC

Multi Core screened

Conductor	EN 60228, class 5	Voltage rating	600/1000 V AC
Number of conductors	2 - ...		900/1500 V DC
Cross section	0.25 - 3.0 mm2	Temperature range	-40 °C to +120 °C



Composition of cable

1. Cores	GKW-LW	
		colour standard: white, numbered, others on request
2. EMC screen	tin plated copper braid	
3. Separator	tape	
4. Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- High screening effectiveness
- Broad product range
- Space saving construction

Application

- Typical applications include carriage wiring, terminal boxes, power supply to various systems and ground connections inside railway rolling stock at fixed or sporadic moving installations.
- Guidelines for selection and the installation are described in the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
BS 6853	Category	int. Ia, Ib, II / ext. Ia, Ib, II
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

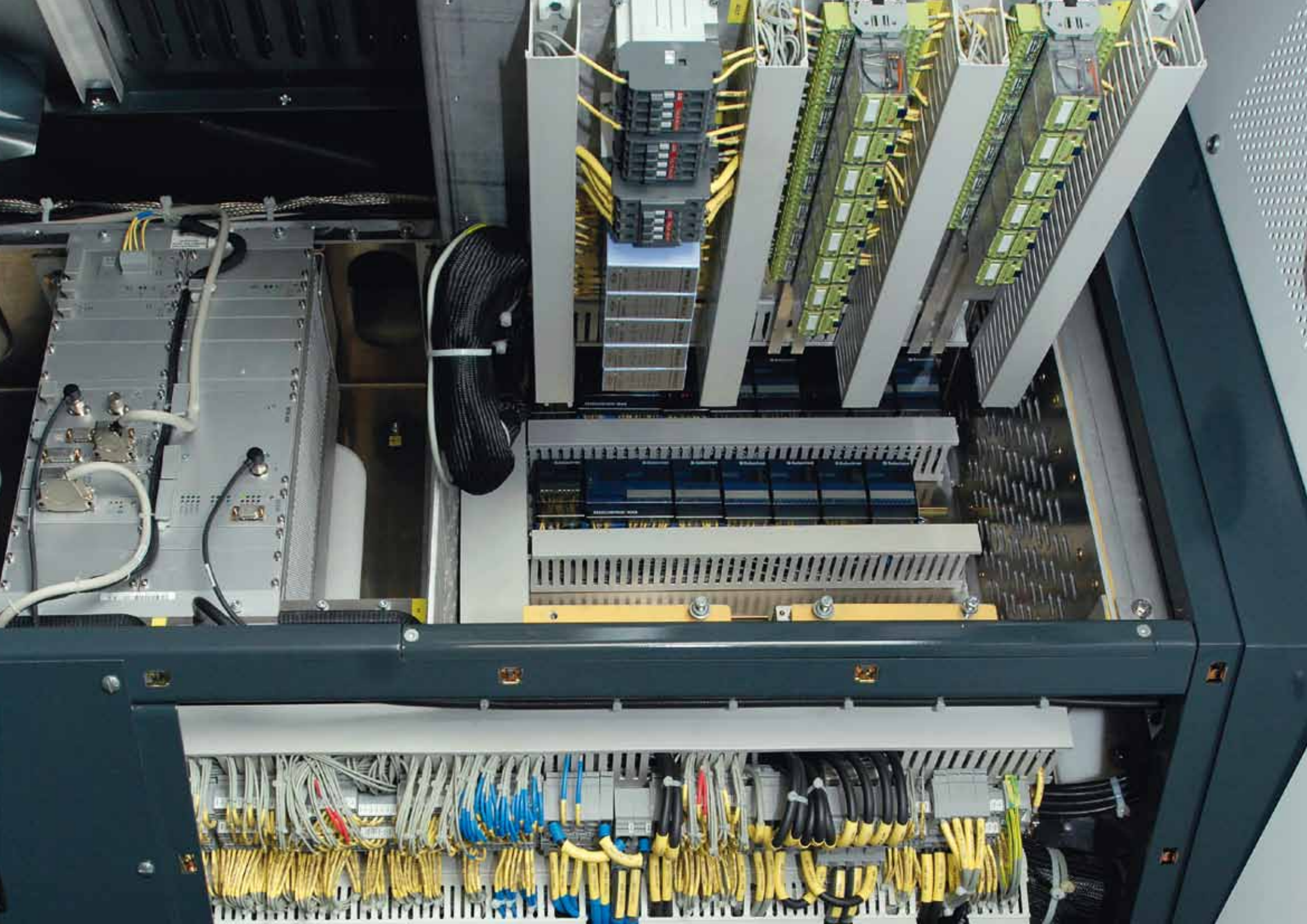
For further technical details please refer to our data sheet.

RADOX® GKW-LW/S EMC

Multi Core screened

Cable type	Conductor	Core	Screen		Cable diameter	Conductor resistance		I_K*	Z_T	Capacitance		Fire load	Weight		Item no.
mm^2	$d_{nom.}$ mm	$d_{nom.}$ mm	$d_{max.}$ mm	cross section mm^2	d mm	conductor R_{20} max. Ω/km	screen R_{20} max. Ω/km	screen A	max. mΩ/m	core/core C pF/m	core/screen C pF/m	kJ/m	copper kg/100m	cable kg/100m	
2 x 0.5	0.90	1.30	3.1	0.63	4.3 ± 0.3	40.1	31.1	200	200	110	190	265	1.6	3.4	12555592
7 x 0.5	0.90	1.30	5.0	1.50	6.3 ± 0.3	40.1	12.8	470	100	110	190	570	4.8	8.0	12555603
15 x 0.5	0.90	1.30	6.8	2.80	8.5 ± 0.3	40.1	6.92	880	40	110	190	880	9.9	13.5	12558110
22 x 0.5	0.90	1.30	8.3	3.30	9.9 ± 0.3	40.1	5.93	1000	25	110	190	1260	13.7	19.5	12558111
36 x 0.5	0.90	1.30	10.1	5.10	11.3 ± 0.4	40.1	3.78	1600	25	110	190	1790	22.1	30.1	12559009
50 x 0.5	0.90	1.30	12.2	7.90	14.2 ± 0.4	40.1	2.45	2500	25	110	190	2340	31.6	43.0	12559011
2 x 2 x 0.5	0.90	1.30	5.0	1.40	6.4 ± 0.3	41.4	13.7	440	200	110	190	650	3.3	6.9	12555604
6 x 2 x 0.5	0.90	1.30	7.7	3.00	9.2 ± 0.3	41.4	6.38	950	60	110	190	1040	8.7	14.8	12557170
15 x 2 x 0.5	0.90	1.30	11.1	5.90	13.0 ± 0.4	41.4	3.3	1850	25	110	190	1820	20.1	30.0	12555607
20 x 2 x 0.5	0.90	1.30	12.4	7.90	14.4 ± 0.4	41.4	2.47	2500	55	110	190	2390	26.9	36.0	12561619
3 x 0.75	1.10	1.52	3.9	1.00	5.0 ± 0.3	26.7	18.7	315	150	120	205	325	3.0	5.0	12556636
8 x 0.75	1.10	1.52	6.4	1.09	7.8 ± 0.3	26.7	9.8	600	50	120	205	900	7.3	11.3	12556631
16 x 0.75	1.10	1.52	8.1	3.20	9.7 ± 0.3	26.7	5.9	1000	25	120	205	1140	13.9	20.6	12556419
24 x 0.75	1.10	1.52	10.3	5.50	12.0 ± 0.4	26.7	3.5	1700	25	120	205	1580	21.4	29.4	12561836
3 x 2 x 0.75	1.10	1.52	6.2	2.36	9.9 ± 0.3	27.6	11.4	530	150	120	205	800	5.7	10.9	12558423
8 x 2 x 0.75	1.10	1.52	11.0	6.15	13.2 ± 0.4	27.6	3.29	1940	60	120	205	2170	17.2	29.1	12568613
5 x 4 x 0.75	1.10	1.52	10.8	5.10	12.8 ± 0.4	27.6	13.7	1600	100	120	205	1740	18.5	29.0	12564825
3 x 1	1.25	1.67	4.1	1.14	5.5 ± 0.3	20.0	18.6	345	150	125	215	400	3.8	6.0	12555688
6 x 1	1.25	1.67	5.9	1.8	7.3 ± 0.3	20.0	10.5	570	100	125	215	715	7.2	11.4	12555879
10 x 1	1.25	1.67	7.4	3.0	8.9 ± 0.3	20.0	6.4	950	40	125	215	855	12.0	16.8	12555881
18 x 1	1.25	1.67	9.4	3.8	11.2 ± 0.4	20.0	5.05	1200	20	125	215	1470	19.9	27.5	12555884
30 x 1	1.25	1.67	11.8	7.9	13.8 ± 0.4	20.0	2.45	2500	20	125	215	2120	34.8	45.0	12559013
50 x 1	1.25	1.67	15.3	9.4	17.8 ± 0.5	20.0	2.1	3000	15	125	215	3540	54.0	69.0	12559016
4 x 2 x 1	1.25	1.67	7.8	3.0	10.6 ± 0.3	20.7	6.4	950	40	125	215	9950	10.2	12.8	12555886
3 x 4 x 1	1.25	1.67	9.4	4.4	11.3 ± 0.4	20.7	4.4	1390	45	125	215	1460	15.2	24.5	12555887
2 x 1.5	1.50	2.04	4.5	0.95	5.8 ± 0.3	13.7	20.7	300	150	125	215	460	3.7	7.0	12555888
7 x 1.5	1.50	2.04	7.6	03.00	9.1 ± 0.3	13.7	6.3	950	60	125	215	1110	12.8	18.4	12555893
10 x 1.5	1.50	2.04	8.8	3.70	10.5 ± 0.4	13.7	5.2	1150	40	125	215	1170	17.7	24.0	12555894
18 x 1.5	1.50	2.04	11.7	5.90	13.2 ± 0.4	13.7	3.3	1860	20	125	215	2030	31.0	40.5	12555897
3 x 2 x 1.5	1.50	2.04	8.2	3.10	9.8 ± 0.3	14.2	6.2	980	70	125	215	1130	11.3	20.5	12561927
2 x 2.5	1.95	2.54	5.7	1.50	7.0 ± 0.3	8.21	12.8	470	76	125	215	665	6.2	10.5	12557233
6 x 2.5	1.95	2.54	8.6	3.70	10.4 ± 0.4	8.21	5.19	1170	40	125	215	1440	17.8	22.5	12557236
10 x 2.5	1.95	2.54	11.1	5.90	13.2 ± 0.4	8.21	3.3	1860	25	125	215	1890	29.0	37.0	12557238
18 x 2.5	1.95	2.54	14.1	9.10	16.6 ± 0.5	8.21	2.14	2850	20	125	215	3290	51.0	62.0	12557241
27 x 2.5	1.95	2.54	16.9	11.10	20.5 ± 0.5	8.21	1.75	3500	40	125	215	4570	74.0	87.0	12563351
48 x 2.5	1.95	2.54	22.2	17.80	25.7 ± 0.6	8.21	1.15	5620	25	125	215	7000	122.0	156.0	12565318

* Short-circuit current rating of screen acc. to IEC 60949 (adiabatic), duration of short-circuit 0.1 s, initial temperature +90 °C, final temperature +200 °C



RADOX® EN 50306 Family

Cables and cores for rolling stock

- With voltage rating 300 / 500 V AC
- With improved behaviour in case of fire
- With thin wall isolation

HUBER+SUHNER offers the new railway cables RADOX® EN 50306. Based on the recently developed insulation system RADOX TI® 306 and the sheath material RADOX® EM 104 and RADOX S2 they fulfil the standards of EN 50306. (hazard level: HL3; material level: M).

Product range overview

- EN 50306-2 single core

- EN 50306-3 single and multi core
  (pairs, three-way, four-way) screened with thin wall isolation

- EN 50306-4 P: multi core cablesl, protected installation,

  1P unscreened

  3P with overall sheath

  5P pairs, single screened, with sheatht

- EN 50306-4 E: multi core, exposed installation
  (same construction as EN 50306-4 P but with enhanced sheath)

  1E unscreened

  3E with overall sheath

  5E pairs, single screened, with sheath
  and overall sheath

All cores and cables have tin-plated stranded copper conductors and halogen-free insulation sheaths and jackets. The cores and cables are designed for unprotected installation (Class E) and for protected installation (Class P). They are intended for permanent installation in rail vehicles or for applications in which a limited alternating bending stress occurs during service.

Please find further technical details in our product catalogue RADOX® railway cables acc. EN 50264 and EN 50306, item no. 84109999.


RADOX EN 50264-3-1 600V 1-16 M

RADOX® EN 50264 Family

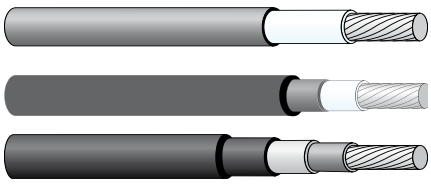
Cables and cores for rolling stock

- With voltage rating 600 / 1800 / 3600 V AC
- With improved behaviour in case of fire
- With thin wall isolation

RADOX high performance compounds ensure HUBER+SUHNER to fulfil the demanding requirements of the EN 50264 standards (material level: M).

Product range

EN 50264-3-1 single core		
600 / 1000 V AC	1.0 - 300 mm^2	
1800 / 3000 V AC	1.5 - 300 mm^2	
1800 / 3000 V AC	1.5 - 300 mm^2	with additional sheath
3600 / 6000 V AC	2.5 - 300 mm^2	with conductor screen and additional sheath



EN 50264-3-2 multi core		
600 / 1000 V AC	2 - 4 cores	unscreened
600 / 1000 V AC	2 - 4 cores	screened

All cables have tinned copper conductor according to EN 60288, class 5, halogen free insulation and halogen free sheath. They are for use in railway rolling stock as fixed wiring or wiring where limited flexing in operation is encountered.

Please find further technical details in our product catalogue RADOX® railway cables acc. EN 50264 and EN 50306, item no. 84109999.

RADOX® 4 GKW-AX 1800 V M

Halogen free, compact, dual wall power cable for demanding applications

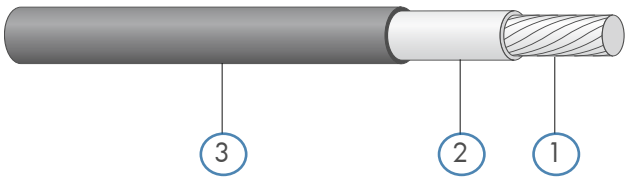
RADOX 4 GKW-AX are compact, flexible single core power and signal cables, designed for minimum cable weight and diameter. These cables meet the requirements of the modern railway industry. They are halogen free, flame retardant, low smoke and have a low toxicity index. Demands for temperature, abrasion, ozone and oil resistance are also easily fulfilled. RADOX 4 GKW-AX cables are qualified for permanently protected installations inside and outside of rolling stock to connect fixed and moving parts in AC and DC applications, especially inverter technology applications.

Features

- Electron beam crosslinked RADOX insulation does not melt or flow at high temperatures
- Resistant to mineral oils and detergents
- High flexibility and tight bending radii
- Easy to strip
- Meeting the common railway fire performances

RADOX® 4 GKW-AX 1800 V M Single Core

Conductor	EN 60228, class 5	Voltage rating	1800/3000 V AC
Number of conductors	1		2700/4500 V DC
Cross section	1.5 - 400 mm^2	Temperature range	-40 °C to +120 °C



Composition of core

1.	Conductor	stranded tin plated copper	
2.	Insulation	RADOX EI 110	colour: white
3.	Sheath	RADOX EI 109	colour: black

Characteristics and specialities

- Fully meet the requirements of material level M according to EN 50264-1
  - extra low termperature
  - extra oil resistant
  - extra fuel resistance
- Resistance to ozone and weathering
- Large product range

Application

- For protected connections of fixed and sporadic moving parts inside and outside of rolling stock.
- Guidelines for selections and the installation are described in the standards EN 50355 and EN50343.

Standards

Standard	Fire protection on railway vehicles	
BS 6853	Category	int. Ia, Ib, II / ext. Ia, Ib, II
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® 4 GKW-AX 1800 V M Single Core

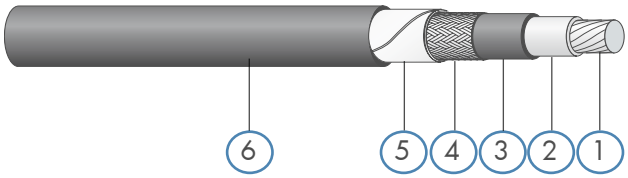
Cross section	Conductor		Core	Conductor resistance	Capacitance **	Fire load	Weight		Item no.
mm^2	construction* n x mm	d mm	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100 m	cable kg/100 m	
0.5	19 x 0.18	0.90	2.45 ± 0.05	38.5	236	91	0.40	1.10	12547128
0.75	24 x 0.21	1.10	2.65 ± 0.05	26.7	276	102	0.70	1.4	12548299
1	37 x 0.18	1.20	3.00 ± 0.05	20.0	266	132	0.90	1.8	12555986
1.5	37 x 0.23	1.50	3.55 ± 0.10	13.7	307	157	1.4	2.5	12536686
2.5	61 x 0.23	1.95	3.75 ± 0.10	8.21	343	205	2.2	3.6	12536692
4	61 x 0.29	2.45	4.50 ± 0.10	5.09	396	257	3.5	5.2	12536694
6	84 x 0.30	2.95	5.20 ± 0.15	3.39	419	334	5.2	7.4	12536696
10	80 x 0.40	3.90	6.40 ± 0.15	1.95	488	467	9.1	12	12545527
16	119 x 0.40	5.30	8.40 ± 0.20	1.24	535	801	13	19	12545528
25	182 x 0.40	6.60	10.2 ± 0.30	0.795	565	1125	21	28	12545529
35	266 x 0.40	7.80	11.7 ± 0.30	0.565	607	1457	30	40	12545530
50	378 x 0.40	9.30	13.5 ± 0.30	0.393	660	1737	43	54	12545531
70	348 x 0.50	11.4	15.8 ± 0.30	0.277	755	2178	61	75	12545532
95	444 x 0.50	12.8	17.5 ± 0.30	0.210	808	2549	78	95	12545533
120	570 x 0.50	14.9	19.8 ± 0.30	0.164	862	3118	100	120	12544522
150	722 x 0.50	16.8	22.1 ± 0.30	0.132	894	3474	127	150	12545534
185	874 x 0.50	18.3	24.0 ± 0.30	0.108	903	4432	153	182	12544523
240	1147 x 0.50	21.1	27.0 ± 0.30	0.0817	994	5225	201	235	12547684
300	1443 x 0.50	23.7	29.9 ± 0.30	0.0654	1060	6106	251	291	12552906
400	2016 x 0.50	29.1	34.1 ± 0.50	0.0495	1115	7639	342	392	12555997

* Typical value x single wire diameter
** Capacity in water, typical value

RADOX® 4 GKW-AX EMC-L

Single Core screened

Conductor	EN 60228, class 5	Voltage rating	1800/3000 V AC
Number of conductors	1		2700/4500 V DC
Cross section	1.5 - 300 mm^2	Temperature range	-40 °C to +120 °C



Composition of cable

1.	Conductor	stranded tin plated copper	
2.	Insulation	RADOX GKW K	colour: white
3.	Sheath	RADOX GKW S	colour: black
4.	EMC screen	tin plated copper braid, reduced coverage	
5.	Separator	tape	
6.	Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Resistance to oil, ozone and weathering

Application

- For protected connections of fixed and sporadic moving parts inside and outside of rolling stock.
- Guidelines for selections and the installation are described in the standards EN 50355 and EN50343.

Standards

Standard	Fire protection on railway vehicles	
BS 6853	Category	int. Ia, Ib, II / ext. Ia, Ib, II
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® 4 GKW-AX EMC-L

Single Core screened

Cross section	Conductor		Core	Screen		Cable	Conductor resistance		I_K **	I ***	Z_T	Capacitance	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	$d_{max.}$ mm	cross section mm^2	d mm	conductor R_{20} max. Ω/km	screen R_{20} max. Ω/km	screen A	screen A	max. mΩ/m	C pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
1.5	37 x 0.23	1.50	3.35	3.7	0.9	5.20 ± 0.15	13.7	21.33	355	18	100	254	363	2.1	4.8	12556535
2.5	61 x 0.23	1.95	3.90	4.8	1.0	5.80 ± 0.15	8.21	18.66	405	20	100	292	440	3.2	6.3	12556536
4	61 x 0.29	2.45	4.50	5.1	1.3	6.70 ± 0.15	5.09	14.14	529	24	100	322	584	4.6	8.9	12556537
6	84 x 0.30	2.93	5.20	5.7	1.5	7.40 ± 0.15	3.39	12.43	606	26	100	350	701	6.5	12	12556538
10	80 x 0.4	3.89	6.40	7.1	2.0	9.00 ± 0.2	1.95	9.48	795	30	100	392	1003	11	18	12556539
16	119 x 0.4	5.30	8.40	9.3	3.5	11.2 ± 0.2	1.24	5.70	1363	42	100	447	1489	17	28	12556540
25	182 x 0.4	6.60	10.20	11.2	4.2	13.4 ± 0.25	0.795	4.62	1637	48	100	451	2181	25	40	12556541
35	266 x 0.4	7.80	11.70	12.7	4.9	14.8 ± 0.25	0.565	3.98	1907	52	100	489	2557	35	51	12556542
50	378 x 0.4	9.30	13.50	14.7	5.6	16.8 ± 0.3	0.393	3.50	2182	57	100	512	3138	48	70	12556543
70	348 x 0.5	11.4	15.80	16.9	8.0	19.0 ± 0.3	0.277	2.67	3120	67	100	619	3867	69	92	12556544
95	444 x 0.5	12.8	17.50	18.6	9.2	20.7 ± 0.3	0.210	2.34	3564	73	100	640	4228	87	116	12556545
120	570 x 0.5	14.9	19.80	21.0	10.2	23.4 ± 0.3	0.164	2.10	3960	78	100	650	5471	104	145	12556546
150	722 x 0.5	16.8	22.10	23.6	15.7	25.9 ± 0.3	0.132	1.33	6066	103	100	719	6143	142	183	12556547
185	874 x 0.5	18.3	24.00	25.5	15.7	27.8 ± 0.3	0.108	1.37	6066	101	100	725	7034	168	213	12556548
240	1147 x 0.5	21.1	27.00	28.9	20.7	31.2 ± 0.3	0.0817	0.93	8023	129	100	791	8606	221	291	12556549
300	1443 x 0.5	23.7	29.90	31.8	22.1	34.2 ± 0.3	0.0654	0.95	8560	127	100	918	9618	276	337	12558471

* Typical value x single wire diameter

** Short-circuit current rating of screen acc. to IEC 60949 (adiabatic), duration of short-circuit 0.1 s, initial temperature +90 °C, final temperature +200 °C

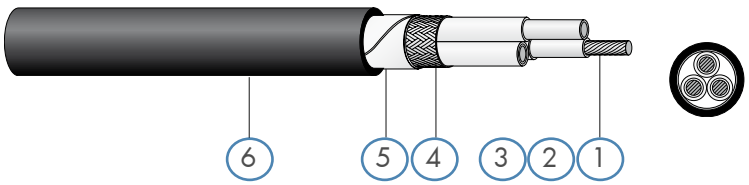
*** Permissible continuous current of screen under standard conditions of current rating acc. to table current rating 4/9GKW-AX single core cables 557 578

EMC = Electromagnetic Compatibility
L = Reduced Screen Coverage

RADOX® 4 GKW-AX/S EMC

Multi Core screened

Conductor	EN 60228, class 5	**Voltage rating**	1800/3000 V AC
Number of conductors	2 - ...		2700/4500 V DC
Cross section	1.5 - 95 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1.	Cores of type	4 GKW-AX	
			colour: black, numbered
2	Fillers (optional)	RADOX	
3	Separator(s) (optional)	tape	
4	EMC screen	tin plated copper braid	
5	Separator	tape	
6	Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Resistance to oil, ozone and weathering
- High screening effectiveness
- Wide product range

Application

- For protected connections of fixed and sporadic moving parts inside and outside of rolling stock.
- Guidelines for selections and the installation are described in the standards EN 50355 and EN50343.

Standards

Standard	Fire protection on railway vehicles	
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® 4 GKW-AX/S EMC

Multi Core screened

Cable type	Conductor		Core	Screen		Cable	Conductor resistance		Z_T	Weight		Item no.
n x mm^2	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	$d_{max.}$ mm	size mm^2	d mm	conductor R_{20} max. Ω/km	screen R_{20} max. Ω/km	max. m Ω/M	copper kg/100 m	cable kg/100 m	
2 x 1.5	37 x 0.23	1.50	3.35	7.0	2.0	9.2 ± 0.3	13.7	9.2	100	5.0	13.5	12552642
3 x 1.5	37 x 0.23	1.50	3.35	7.6	2.8	10.0 ± 0.3	13.7	7	50	6.7	16.4	12566644
6 x 1.5	37 x 0.23	1.50	3.35	10.9	5.9	13.8 ± 0.4	13.7	3.3	50	14.5	31.7	12564185
3 x 2.5	61 x 0.29	1.95	3.90	9.1	3.3	11.4 ± 0.4	8.21	5.9	70	10.3	22.5	12564186
4 x 4	61 x 0.29	2.45	4.50	12.2	6.2	15.4 ± 0.5	4.8	3.5	60	20.4	42.7	12568683
3 x 10	80 x 0.41	3.90	6.40	15.0	8.6	18.2 ± 0.5	1.95	2.2	25	37.5	65.0	12556070
3 x 16	119 x 0.40	5.30	8.40	19.2	12.0	23.1 ± 0.5	1.24	1.6	50	52.0	90.0	12564357
3 x 25	182 x 0.40	6.60	10.20	23.7	19.1	28.4 ± 0.6	0.795	1.10	50	81.7	152	12564358
3 x 25 +10	182 x 0.40 80 x 0.40	6.60 3.90	10.20 6.40	24.6	19.1	29.5 ± 0.6	0795 1.95	1.10	50	91.3	165	12563358
4 x 25	182 x 0.40	6.60	10.20	27.9	18.1	34.1 ± 0.6	0.795	1.26	50	104	187	12563356
2 x 35	266 x 0.40	7.80	11.70	24.9	19.4	29.8 ± 0.6	0.565	1.06	20	78.6	158	12583239
3 x 35	266 x 0.40	7.80	11.70	26.7	21.5	31.6 ± 0.7	0.565	0.89	50	112	197	12561687
3 x 35 +10	266 x 0.40 80 x 0.40	7.80 3.90	11.70 6.40	27.0	21.9	32.8 ± 0.6	0.565 1.95	1.03	50	125	214	12563359
4 x 35	266 x 0.40	7.80	11.70	30.9	35.2	37.1 ± 0.7	0.565	0.66	50	163	210	12563357

* Typical value x single wire diameter

Other colours on request.

S = GKW S sheath
EMC = Electromagnetic Compatibility

RADOX® 9 GKW-AX 3600 V M

Halogen free, compact, dual wall power cable for demanding applications

RADOX 9 GKW-AX are compact, flexible single core power and signal cables, designed for minimum cable weight and diameter. These cables meet the requirements of the modern railway industry. They are halogen free, flame retardant, low smoke and have a low toxicity index. Demands for temperature, abrasion, ozone and oil resistance are also fulfilled.

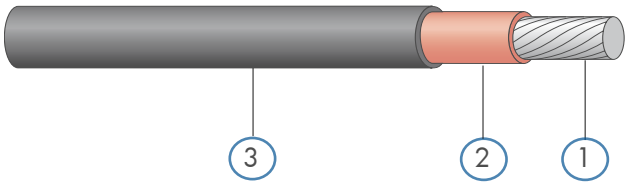
RADOX 9 GKW-AX cables are qualified for permanently protected installation inside and outside of rolling stock to connect fixed and moving parts in DC and AC applications, especially inverter technology applications.

Features

- Electron beam crosslinked RADOX insulation does not melt or flow at high temperatures
- Resistant to mineral oils and detergents
- Meeting the common railway fire performance

RADOX® 9 GKW-AX 3600 V M Single Core

Conductor	EN 60228, class 5	Voltage rating	3600/6000 V AC
Number of conductors	1		5400/9000 V DC
Cross section	1.5 - 300 mm^2	Temperature range	-40 °C to +120 °C



Composition of core

1.	Conductor	stranded tin plated copper	
2.	Insulation	RADOX EI 110	colour: red
3.	Sheath	RADOX EI 109	colour: black

Characteristics and specialities

- Fully meet the requirements of material level M according to EN 50264-1
  - extra low termperature
  - extra oil resistant
  - extra fuel resistance
- Resistance to ozone and weathering

Application

- For protected connections of fixed and sporadic moving parts inside and outside of rolling stock.
- Guidelines for selections and the installation are described in the standards EN 50355 and EN50343.

Standards

Standard	Fire protection on railway vehicles	
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® 9 GKW-AX 3600 V M Single Core

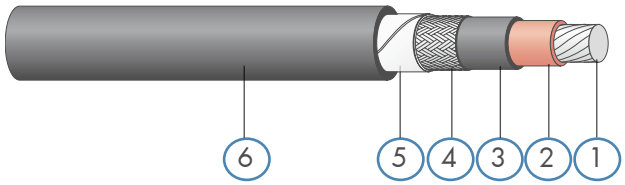
Cross section	Conductor		Core	Conductor resistance	Capacitance**	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
1.5	37 x 0.23	1.50	4.50 ± 0.10	13.7	215	317	1.4	3.6	12537829
2.5	61 x 0.23	1.95	5.10 ± 0.10	8.21	242	397	2.2	4.9	12537830
4	61 x 0.29	2.50	5.70 ± 0.10	5.09	280	474	3.5	6.7	12537831
6	84 x 0.30	2.95	6.30 ± 0.10	3.39	309	560	5.2	8.9	12537832
10	80 x 0.40	3.90	7.50 ± 0.15	1.95	363	742	9.1	14.1	12545520
16	119 x 0.40	5.30	9.40 ± 0.25	1.24	416	1138	13.5	21	12544525
25	182 x 0.40	6.60	11.0 ± 0.30	0.795	471	1444	21	30	12547257
35	266 x 0.40	7.80	12.6 ± 0.30	0.565	502	1868	30	42	12547260
50	378 x 0.40	9.30	14.6 ± 0.30	0.393	537	2355	43	58	12545521
70	348 x 0.50	11.40	16.7 ± 0.30	0.277	637	2720	61	80	12547262
95	444 x 0.50	12.90	18.7 ± 0.30	0.210	658	3404	78	101	12547264
120	570 x 0.50	14.90	21.0 ± 0.30	0.164	704	4441	100	128	12545522
150	722 x 0.50	16.80	23.2 ± 0.30	0.132	752	5208	127	160	12547268
185	874 x 0.50	18.30	25.0 ± 0.30	0.108	781	5539	153	189	12545523
240	1147 x 0.50	21.10	28.0 ± 0.30	0.0817	863	6462	201	243	12547678
300	1443 x 0.50	23.70	30.8 ± 0.30	0.0654	933	7379	253	301	12551573

* Typical value x single wire diameter
** Capacity in water, typical value

RADOX® 9 GKW-AX EMC-L

Single Core screened

Conductor	EN 60228, class 5	**Voltage rating**	3600/6000 V AC
Number of conductors	1		5400/9000 V DC
Cross section	1.5 - 300 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1.	Conductor	stranded tin plated copper	
2.	Insulation	RADOX GKW K	colour: red
3.	Sheath	RADOX GKW S	colour: black
4.	EMC screen	tin plated copper braid, reduced coverage	
5.	Separator	tape	
6.	Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Resistance to oil, ozone, weathering

Application

- For protected connections of fixed and sporadic moving parts inside and outside of rolling stock.
- Guidelines for selections and the installation are described in the standards EN 50355 and EN50343.

Standards

Standard	Fire protection on railway vehicles	
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® 9 GKW-AX EMC-L

Single Core screened

Cross section	Conductor		Core	Screen		Cable	Conductor resistance		I_K**	I***	Z_T	Capacitance ****	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	$d_{max.}$ mm	cross section mm^2	d mm	cond.* R_{20} max. Ω/km	screen R_{20} max. Ω/km	screen A	screen A	max. mΩ/m	C_{H20} pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
1.5	37 x 0.23	1.50	4.50	5.0	1.1	6.60 ± 0.15	13.7	16.9	456	21	100	171	632	2.6	7.2	12556520
2.5	61 x 0.23	1.95	5.10	5.5	1.5	7.20 ± 0.15	8.21	12.6	606	26	100	205	733	3.7	8.9	12556521
4	61 x 0.29	2.50	5.70	6.4	1.9	8.20 ± 0.15	5.09	10.2	738	29	100	223	937	5.2	12	12556522
6	84 x 0.31	2.95	6.30	7.2	2.0	9.10 ± 0.20	3.39	9.52	795	30	100	243	1083	7.2	15	12556523
10	80 x 0.41	3.90	7.50	8.4	3.2	10.4 ± 0.20	1.95	6.03	1270	40	100	293	1266	12	22	12556524
16	119 x 0.41	5.30	9.40	10.4	5.3	12.4 ± 0.25	1.24	4.73	2077	47	100	337	1967	18	33	12556525
25	182 x 0.41	6.60	11.0	11.8	4.2	14.3 ± 0.25	0.795	4.7	1637	47	100	373	2671	25	39	12556526
35	266 x 0.41	7.80	12.60	13.5	4.9	15.7 ± 0.30	0.565	4.01	1907	52	100	408	3168	35	55	12556527
50	378 x 0.41	9.30	14.60	15.5	5.6	17.7 ± 0.30	0.393	3.85	2182	53	100	431	3833	49	74	12556528
70	348 x 0.51	11.40	16.70	17.7	9.2	20.0 ± 0.30	0.277	2.21	3564	75	100	518	4610	70	97	12556529
95	444 x 0.51	12.90	18.70	19.9	14.1	22.0 ± 0.30	0.210	1.48	5460	97	100	519	5124	92	124	12556530
120	570 x 0.51	14.90	21.00	22.2	13.7	24.7 ± 0.30	0.164	1.46	5305	97	100	538	6646	107	151	12556531
150	722 x 0.51	16.80	23.20	24.5	15.7	27.1 ± 0.30	0.132	1.31	6066	104	100	596	7372	142	190	12556532
185	874 x 0.51	18.30	25.00	26.2	15.7	29.1 ± 0.30	0.108	1.31	6066	104	100	609	8388	169	222	12556533
240	1147 x 0.51	21.10	28.00	29.6	20.7	32.3 ± 0.30	0.0817	0.94	8024	128	100	673	9701	221	283	12556534
300	1443 x 0.51	23.70	30.80	32.7	22.1	35.6 ± 0.50	0.0654	1.04	8560	120	100	730	11206	278	352	12558472

* Typical value x single wire diameter

** Short-circuit current rating of screen acc. to IEC 60949 (adiabatic), duration of short-circuit 0.1 s, initial temperature +90 °C, final temperature +200 °C

*** Permissible continuous current of screen under standard conditions of current rating acc. to table current rating 4/9 GKW single core cables 557 578

**** Capacity in water, typical value

EMC = Electromagnetic compatibility

L = Reduced screen coverage

RADOX® JUMPER Cables

HUBER+SUHNER designs and produces a wide range of RADOX JUMPER cables for data and power transmission.

RADOX® JUMPER cables are specially designed for demanding applications, where permanent movements combined with enhanced fire performance is required.

Our sortiment includes:

- Standard single core and
- Customer specific multi core cables

Features

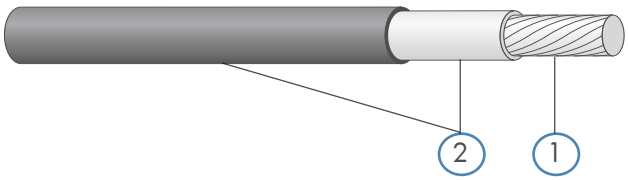
- Very flexible
- Mechanically robust
- High abrasion resistant
- Small dimensions
- Individually configurable
- High resistance to oil, fuel, acid, alcali- and weathering
- Meets the fire protection requirements DIN 5510-2, 2009

Customer benefit

- Long operating time
- Standard solutions
- Customer specific conduit solutions

RADOX® JUMPER 1800 V M Single Core

Conductor	IEC 60228, class 5	**Voltage rating**	1800/3000 V AC
Number of conductors	1		2700/4500 V DC
Cross section	16 - 185 mm^2	**Temperature range**	-30 °C to +90 °C



Composition of cable

1. Conductor	stranded tin plated copper, fine wire, acc. IEC 60228, class 5		
2. Insulation	RADOX EI 110	colour: nature	
	RADOX EM 104J	colour: black	

Min. bending radius *)

Permanent installation	bending angle ≤ 90°	all D	2 x D
	bending angle > 90°	D ≤ 10 mm	3 x D
	bending angle < 90°	D > 10 mm	4 x D
Flexible installation			8 x D

*) Provided that careful and competent handling is used in combination with proven fixture methods.

Application

- RADOX jumper cables for demanding applications where permanent movements with enhanced fire performance is required.

Standards

Standard	Fire protection on railway vehicles	
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
UNI CEI 11170		

For further technical details please refer to our data sheet.

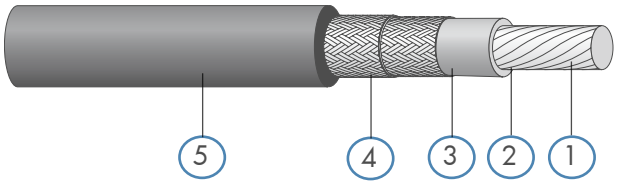
RADOX® JUMPER 1800 V M Single Core

Cross section	Conductor		Cable	Conductor resistance	Capacitance**	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	C_{H20} pF/m	kJ/m	copper kg/100m	cable kg/100m	
16	266 x 0.29	6.00	11.0 ± 0.30	1.22	390	1671	16	25	12585829
25	228 x 0.38	7.60	12.5 ± 0.30	0.795	475	1947	25	37	84101651
35	700 x 0.26	8.60	13.5 ± 0.30	0.554	523	2147	32	44	84097272
50	456 x 0.36	10.9	16.0 ± 0.30	0.385	635	2686	46	62	84095698
70	1008 x 0.31	12.3	17.5 ± 0.30	0.271	683	3063	64	83	84095709
95	1400 x 0.31	14.1	19.5 ± 0.30	0.206	756	3559	83	105	84098661
120	960 x 0.41	16.2	21.5 ± 0.30	0.164	867	3923	111	137	84101650
150	880 x 0.41 + 588 x 0.31	17.6	23.0 ± 0.30	0.132	906	4341	139	173	84094779
185	1520 x 0.41	19.7	25.0 ± 0.30	0.108	1010	2721	176	205	12585830

* Typical value x single wire diameter
** Capacity in water, typical value

RADOX® JUMPER 1800 V OM S T Single Core screened

Conductor	IEC 60228, class 5	**Voltage rating**	1800/3000 V AC
Number of conductors	1		2700/4500 V DC
Cross section	16 - 185 mm^2	**Temperature range**	-30 °C to +90 °C



Composition of cable

1.	Conductor	stranded tin plated copper, fine wire, acc. IEC 60228, class 5	
2.	Insulation	RADOX EI 110	colour: nature
3.	EMV screen	tin plated copper braid	
4.	Torsion protection	textil yarn	
5.	Sheat	RADOX EM 104J	colour: black

Min. bending radius *)

Permanent installation	bending angle ≤ 90°	all D	2 x D
	bending angle > 90°	D ≤ 10 mm	3 x D
	bending angle < 90°	D > 10 mm	4 x D
Flexible installation			10 x D

*) Provided that careful and competent handling is used in combination with proven fixture methods.

Verwendung

- RADOX jumper cables for demanding applications where permanent movements with enhanced fire performance is required.

Standards

Standard	Fire protection on railway vehicles	
CEN/TS 45545		
DIN 5510-2	Protection level	1, 2, 3, 4
UNI CEI 11170		

For further technical details please refer to our data sheet.

RADOX® JUMPER 1800 V OM S T Single Core screened

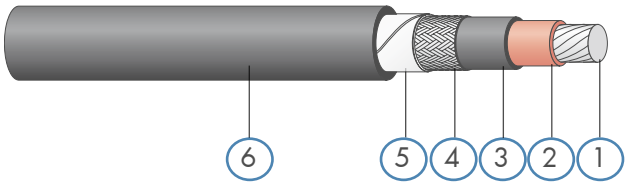
Cross section	Conductor		Core	Screen		Cable	Conductor resistance		Z_T	Capa-citance**	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	D mm	$D_{max.}$ mm	mm^2	d mm	cond.* R_{20} max. Ω/km	screen R_{20} max. Ω/km	max. mΩ/m	C pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
16	266 x 0.29	6.0	10.3	11.1	3.46	15.5 ± 0.30	1.22	8.5	250	448	3206	21	43	84119864
25	228 x 0.38	7.6	12.0	12.8	3.96	17.5 ± 0.30	0.795	7.5	250	530	3967	30	57	84128731
35	700 x 0.26	8.7	13.2	14.0	4.45	18.5 ± 0.30	0.554	6.7	250	579	4241	38	68	84095754
50	456 x 0.38	10.9	15.6	16.6	6.34	21.0 ± 0.30	0.385	4.7	250	694	4979	54	91	12585831
70	1008 x 0.31	12.2	17.0	18.0	7.13	22.5 ± 0.30	0.271	4.2	250	757	5585	73	114	12585837
95	1400 x 0.31	14.1	19.0	20.0	8.32	24.5 ± 0.30	0.206	3.6	250	837	6273	94	140	84101653
120	960 x 0.41	16.2	21.1	22.1	8.32	26.5 ± 0.30	0.164	3.7	250	950	6843	121	174	12585832
150	880 x 0.41 + 588 x 0.31	17.6	22.5	23.5	9.51	28.0 ± 0.40	0.132	3.1	250	1014	7370	150	207	84098250
185	1520 x 0.41	19.7	24.7	25.7	9.51	30.5 ± 0.40	0.108	3.3	250	1102	8555	186	251	84119900

* Typical value x single wire diameter, ohmic resistance acc. IEC 60228
** Capacity conductor/screen typical value

RADOX® 9 GKW-AX J EMC

JUMPER

Conductor	EN 60228, class 5	**Voltage rating**	3600/6000 V AC
Number of conductors	1		5400/9000 V DC
Cross section	16 - 240 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1.	Conductor	stranded tin plated copper, high flexible	
2.	Insulation	RADOX GKW K	colour: red
3.	Sheath	RADOX GKW S	colour: black
4.	EMC screen	tin plated copper braid	
5.	Separator	tape	
6.	Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- High screening effectiveness
- Resistance to oil, ozone, weathering
- Easy to strip
- Very flexible

Application

- RADOX jumper cables for demanding applications where movements with enhanced fire performance are required.

For further technical details please refer to our data sheet.

RADOX® 9 GKW-AX J EMC

JUMPER

Cross section	Conductor		Core	Screen		Cable	Conductor resistance		I_K**	I***	Z_T	Capacitance	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	$d_{max.}$ mm	cross section mm^2	d mm	cond.* R_{20} max. Ω/km	screen R_{20} max. Ω/km	screen A	screen A	max. mΩ/m	C pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
16	266 x 0.28	6.00	9.80	10.7	3.5	13.2 ± 0.3	1.24	8.24	1363	33	200	395	2170	20	35	12558412
25	228 x 0.36	7.60	11.50	12.4	4.2	14.9 ± 0.3	0.795	6.92	1637	37	160	461	2624	29	47	12558413
35	700 x 0.25	8.70	13.00	14.0	4.9	16.9 ± 0.3	0.565	5.81	1907	41	160	480	3375	38	61	12558414
50	456 x 0.36	10.9	16.10	17.3	7.5	20.6 ± 0.3	0.393	3.90	2896	53	140	499	4844	57	90	12558415
70	1008 x 0.30	12.3	17.20	18.4	8.0	21.9 ± 0.3	0.277	3.61	3120	55	140	581	5543	75	112	12558416
95	1400 x 0.30	14.1	19.70	21.1	12.3	24.8 ± 0.3	0.210	2.27	4776	74	120	577	6625	106	151	12558417
120	960 x 0.40	16.4	22.40	23.8	12.3	27.9 ± 0.3	0.164	2.28	4776	74	120	620	8187	129	185	12558418
150	880 x 0.40 + 588 x 0.30	17.6	23.70	25.1	14.1	29.4 ± 0.3	0.132	2.00	5460	80	120	646	8890	159	227	12558419
185	1520 x 0.40	19.7	26.20	27.9	15.7	32.5 ± 0.3	0.108	1.80	6066	86	100	675	10672	198	271	12558420
240	1920 x 0.40	23.6	30.30	32.0	22.1	37.0 ± 0.3	0.0817	1.29	8560	105	100	773	13049	256	344	12558421

* Typical value x single wire diameter

** Short-circuit current rating of screen acc. to IEC 60949 (adiabatic), duration of short-circuit 0.1 s, initial temperature +90 °C, final temperature +200 °C

*** Permissible continuous current of screen under standard conditions of current rating acc. to table current rating 4/9GKW single core cables 557 578.

RADOX® JUMPER

Based on the proven RADOX railway cables optimized solutions are designed according to customer specifications.

Recommended RADOX cores

•	600 V	up to 4 mm²	RADOX TENUIS-TW
		from 4 mm²	RADOX 3 GKW
•	1800 V	up to 10 mm²	RADOX 4 GKW AX - 1800 V M
		from 16 mm²	RADOX JUMPER 1800 V M

Types

- With or without EMC screen
- With or without torsion resistance braid
- With RADOX EM 104J sheath material

Application

- RADOX jumper cables for demanding applications where movements with enhanced fire performance are required.

Features

- Resistance to oil, fuel and weathering
- Very flexible
- Mechanically robust
- Individually configurable
- Meets the fire requirements DIN 5510-2, 2009

Benefits

- Long operation time
- Customized conduit solutions

RADOX® JUMPER

Multi Core Cable

HUBER+SUHNER's wide product range also enables us to combine the following transmission technologies in a single cable (hybrid solutions).

- Signal and power transmission
- Radio frequency transmission
- Fiberoptic transmission

These technologies have been part of our strategic core business. This enables us, together with our customers, to create complete solutions tailored to the needs of their specific applications. The dynamic rail sector is one of the main beneficiaries of these powerful technological skills.

In addition to standard and customised cables HUBER+SUHNER can also offer complete harnessed solutions.

Please find further information on page 83.

RADOX® JUMPER

In order to ensure a long service life in demanding environments, we test our cables extensively.

Fire tests

- CEN/TS 45545
- DIN 5510-2 (2009)
- NF F 16-101
- UNI CEI 11170

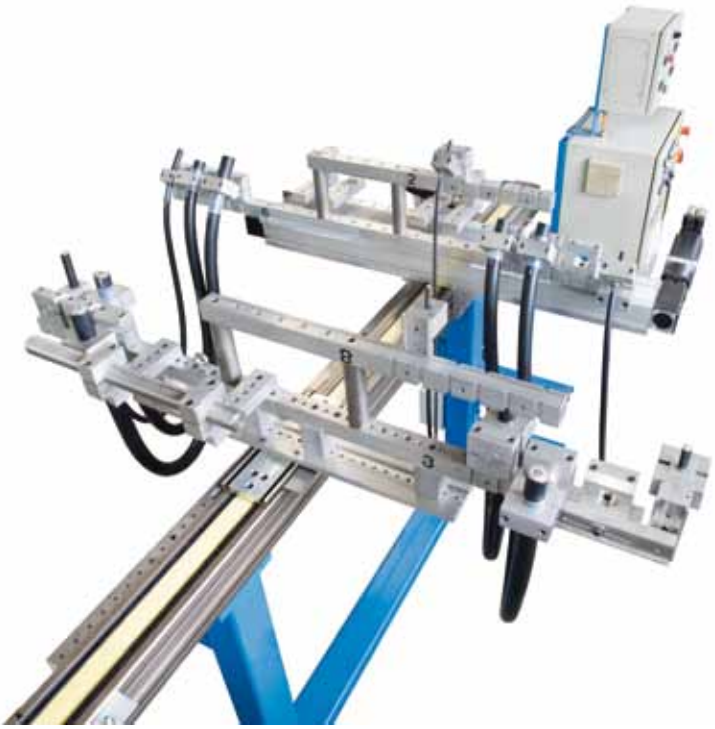
RADOX® JUMPER

Environmental testing, e.g.

- Ozone resistance
- Mineral oil resistance
- Acid resistance
- Alkali resistance
- Thermal aging
- Low-temperature bending and impact resistance

Mechanical testing of jumper cables, e.g.

- Bending test >3 million cycles according to ICE III test procedure
- Hammer impact test according to EN 60068-2-75 (1997)
- Falling rocks - ballast attack
- Jacket abrasion



RADOX® RAILCAT CAT5 Databus Cables

Halogen free, compact, 120 Ω data lines with excellent transmission qualities at high frequencies

Extract from our RADOX® databus cable families:

100 Ohm cables
- RADOX Databus
- RADOX RAILCAT CAT 5

110 Ohm cables
- Several constructions

120 Ohm cables
- MVB
- UIC
- WTB
- CAN-BUS

Characteristics RADOX® databus cables
- High resistance to heat, cold, ozone and weathering
- Very flexible
- Easy to strip
- Soldering resistant
- Electron beam RADOX insulation doesn't melt and flow at high temperatures
- Halogen free and flame retardant
- Excellent screening effectiveness

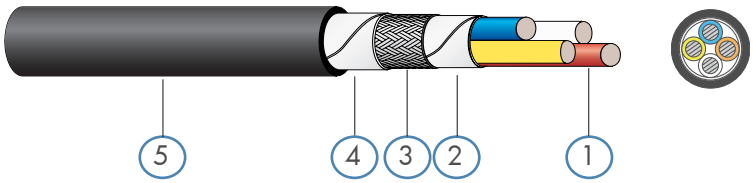
RADOX® RAILCAT CAT5 - the latest innovation of HUBER+SUHNER

The latest innovation from HUBER+SUHNER for the railway market is the CAT5 databus cable RADOX RAILCAT. Specifically developed for the railway market it meets the fire performance standards according to DIN 5510-2, BS 6853, NF F 16-101 and meets the requirement for data transmission according to EN 50288-2-2.

Features
- High speed data transmission, CAT5/CAT5E
- Designed and tested for railway use
- Proven RADOX insulation system
- Excellent mechanical performance
- Flame retardant, halogen free, low smoke
- Low toxicity

RADOX® RAILCAT CAT5 Databus

Conductor	EN 60228, class 5	Voltage rating	300 V AC
Number of conductors	4	Temperature range	-40 °C to +90 °C
Cross section	4 x 22 AWG		



Composition of cable

1. 4 cores 22 AWG	conductor:	stranded silver plated copper
	insulation	RADOX Com
	colours:	white, orange, blue, yellow
2. EMC screen	aluminium - tape, plastic laminated	
3. EMC screen	tin plated copper braid	
4. Separator(s)	tape	
5. Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- High speed data transmission, CAT5/CAT5E
- Designed and tested for railway use
- Excellent mechanical performance
- Proven RADOX insulation system
- Halogen free, low smoke, low toxicity
- Flame retardant

Application

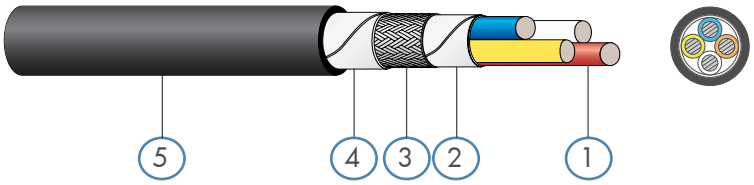
- For fixed installation inside and outside rolling stock. Decisive for the installation are the standards EN 50355 and EN 50343.
- Ethernet based networks as: infotainment, multimedia, passenger information system etc.

Standards

Standard	Fire protection on railway vehicles	
BS 6853	Category	int. Ia, Ib, II / ext. Ia, Ib, II
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
Multi-element metallic communication cables	EN 50288-2-2	

For further technical details please refer to our data sheet.

Characteristic impedance	100 ± 5 ohm	@ 100 MHz
Voltage rating	300 V AC	
Temperature range	-40 °C to +90 °C	



RADOX RAILCAT - CAT5 4 x 0.5 mm^2 XC S

Composition of cable

1. 4 cores 0.5 mm^2	conductor:	stranded tin plated copper
	insulation:	RADOX COM
	colours:	pair 1: white-blue, pair 2: yellow-orange
2. Screen	aluminium - tape, plastic laminated	
3. EMC screen	tin plated copper braid	
4. Separator	tape	
5. Sheath	RADOX GKW S	colour: black

RADOX RAILCAT - CAT5 4 x 22 AWG XC S

Composition of cable

1. 4 cores 22 AWG (0.34 mm^2)	conductor:	stranded silver plated copper
	insulation:	RADOX COM
	colours:	white, orange, blue, yellow
2. Screen	aluminium - tape, plastic laminated	
3. EMC screen	tin plated copper braid	
4. Separator	tape	
5. Sheath	RADOX GKW S	colour: black

RADOX RAILCAT - CAT5 4 x 22 AWG XC S RW

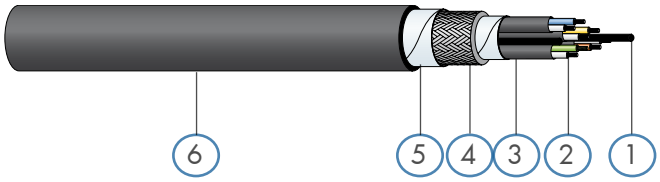
Composition of cable

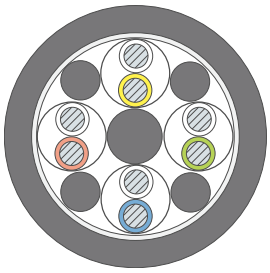
1. 4 cores 22 AWG (0.34 mm^2)	conductor:	stranded silver plated copper
	insulation:	RADOX FOAM SKIN
	colours:	pair 1: white-blue, pair 2: yellow-orange
2. Screen	aluminium - tape, plastic laminated	
3. EMC screen	tin plated copper braid	
4. Separator	tape	
5. Sheath	RADOX GKW S	colour: black

RADOX® RAILCAT

CAT5 Databus

Characteristic impedance	100 ± 5 ohm	@ 100 MHz
Voltage rating	300 V AC	
Temperature range	-40 °C to +90 °C	





RADOX RAILCAT - CAT5 4 x (2 x 22 AWG)

Composition of cable

1.	Center	PE filler	
2.	4 pairs 2x22 AWG (0.34 mm^2)	conductor:	stranded tin plated copper
		insulation:	RADOX COM
		separator:	plastic tape
		screen:	aluminium - tape, plastic laminated
		colours:	white-yellow, white-orange, white-blue, white-green
3.	4 x filler	PE	
4.	EMC screen	tin plated copper braid	
5.	Separator	tape	
6.	Sheath	RADOX GKW S	colour: black

Technical data

RAILCAT CAT5			4 x 0.5	4 x 22 AWG	4 x 22 AWG RW	4 x (2x22 AWG)
Item no.			12585489	12568935	12584038	12583107
Conductor restistance at 20 °C		Ω/km	≤ 40.1	54.4	54.4	54.7
Resistance unbalanced at 20 °C		Ω/km	≤ 1.1	≤ 1.1	≤ 1.1	≤ 1.1
Voltage rating		V	300	300	300	300
Test voltage		KV	2	2	2	2
Transfer impedance	f ≤ 30 MHz	mΩ/m	200	200	200	200
Characteristic impedance	f = 100 MHz	Ω	100 ± 5	100 ± 5	100 ± 5	100 ± 5
Signal propagation		%	66	66	75	66
Capacitance core/core		pF/m	≤ 65	≤ 65	≤ 65	≤ 60
core/screen		pF/m	≤ 100	≤ 100	≤ 100	≤ 100
Temperature range) fixed installation		°C	-40 to + 90	-40 to + 90	-40 to + 90	-40 to + 90
free installation/sporadic movement/ during installation		°C	-25 to + 90	-25 to + 90	-25 to + 90	-25 to + 90
Min. bending radius		fixed	6 x cable Ø	6 x cable Ø	6 x cable Ø	6 x cable Ø
Cable weight		approx.kg/100 m	10.2	8.1	7.0	17.4
Cable outer diameter		mm	8.30	7.25	6.60	12.6
Certified according to						
DIN 5510-2			X	X	X	X
BS 6853			X	X	X	-
NF F 16-101			X	X	X	-
Suitable connectors			M 12	M 12	RJ 45	special

RADOX® FR cables

Fire resistant

Effective and economical - simply use RADOX® FR safety cables wherever a high level of safety is a priority. RADOX® FR cables maintain circuit integrity in case of a fire situation ensuring that essential circuits maintain operational.

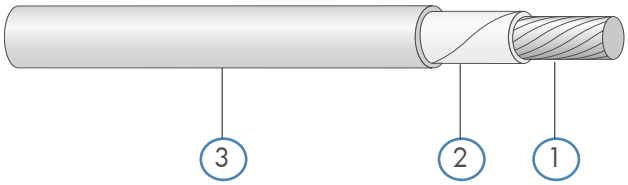
Features

- Fire resistant
- Resistance to high temperatures
- Flame retardance
- Low smoke density
- Low toxicity index

RADOX® 3 GKW FR RW

Single Core

Conductor	EN 60228, class 5	**Voltage rating**	300/500 V AC
Number of conductors	1		450/750 V DC
Cross section	0.5 - 2.5 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1.	Conductor	stranded tin plated copper	
2.	Flame barrier	MICA tape	
3.	Insulation	RADOX GKW J	colours: see table

Characteristics and specialities

- Meets requirement for circuit integrity in case of fire
- Excellent resistance to high and low temperature, ozone and weathering
- Soldering iron resistant
- Easy to strip
- Flexible

Application

- For applications where circuit integrity is required.
- Especially suitable as compact lead wires for systems inside railway rolling stock at fixed or sporadic moving installations.
- Recommended for the installation are the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
DIN 5510-2	Protection level	1, 2, 3, 4
EN 50200	Meets requirement for circuit integrity in case of fire	90 min.

For further technical details please refer to our data sheet.

RADOX® 3 GKW FR RW

Single Core

Cross section	Conductor		Insulation thickness	Core	Conductor resistance	Capacitance **	Fire load	Weight		Colour	Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	mm min.	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100m	cable kg/100m		
0.5	19 x 0.18	0.90	0.30	2.00 ± 0.10	40.1	300	45	0.45	0.8	grey	12564872
0.75	24 x 0.21	1.10	0.30	2.25 ± 0.10	26.7	350	50	0.64	1.1	grey	12564622
1	37 x 0.18	1.25	0.35	2.50 ± 0.10	20.0	360	65	0.86	1.4	grey	12564873
1.5	30 x 0.26	1.50	0.35	2.80 ± 0.10	13.7	430	75	1.34	1.9	grey	12564623
1.5	30 x 0.26	1.50	0.35	2.80 ± 0.10	13.7	430	75	1.34	1.9	yellow green	12564624
2.50	61 x 0.23	1.95	0.35	3.20 ± 0.10	8.21	455	85	2.25	2.9	grey	12564625
2.50	61 x 0.23	1.95	0.35	3.20 ± 0.10	8.21	455	85	2.25	2.9	yellow green	12564626

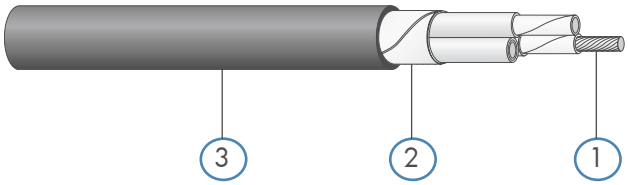
* Typical value x single wire diameter
** Capacity in water, typical value

FR = Fire Resistant
RW = Reduced Wall thickness

RADOX® 3 GKW/S FR RW

Multi Core

Conductor	EN 60228, class 5	**Voltage rating**	300/550 V AC
Number of conductors	2 - ...		450/750 V DC
Cross section	0.5 - 2.5 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1. Cores	3 GKW FR RW	
		colours: grey, numbered grey, numbered with yellowgreen core
2. Separator	tape	
3. Sheath	RADOX GKW S	colour: black

Characteristics and specialities

- Meets requirement for circuit integrity in case of fire
- Excellent resistance to high and low temperatures
- Resistance to oil, ozone and weathering
- Flexible
- Easy to strip

Application

- For applications where circuit integrity is required.
- Especially suitable as compact lead wires for systems inside railway rolling stock at fixed or sporadic moving installations.
- Recommended for the installation are the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
DIN 5510-2	Protection level	1, 2, 3, 4
EN 50200, EN 50362	Meets requirement for circuit integrity in case of fire	90 min.

For further technical details please refer to our data sheet.

RADOX® 3 GKW/S FR RW

Multi Core

Cable type	Conductor		Core	Cable	Conductor resistance	Capacitance **	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	$d_{nom.}$ mm	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
3 x 0.5	19 x 0.18	0.90	2.00	5.8 ± 0.3	40.1	130	350	1.3	4.1	12567511
26 x 0.5	19 x 0.18	0.90	2.00	14.7 ± 0.5	40.1	130	2040	11.9	29.7	12564979
5 x 2 x 0.5	19 x 0.18	0.90	2.00	12.9 ± 0.4	40.8	130	1855	4.6	17.8	12568623
2 x 0.75	24 x 0.21	1.10	2.25	5.9 ± 0.3	26.7	140	350	1.3	4.0	12565262
4 x 0.75	24 x 0.21	1.10	2.25	7.05 ± 0.3	26.7	140	490	2.6	7.5	12564977
8 x 0.75	24 x 0.21	1.10	2.25	9.3 ± 0.3	26.7	140	990	5.2	12.5	12565263
2 x 1	37 x 0.18	1.22	2.50	6.5 ± 0.3	20.0	150	390	1.7	6.1	12566547
2 x 1.5	30 x 0.26	1.50	2.80	7.1 ± 0.3	13.7	160	430	2.8	8.1	12564629
3 x 1.5	30 x 0.26	1.50	2.80	7.7 ± 0.3	13.7	160	526	4.1	9.9	12566342
5 x 1.5	30 x 0.26	1.50	2.80	9.5 ± 0.3	13.7	160	950	6.7	15.0	12566715
5 G 1.5	30 x 0.26	1.50	2.80	9.5 ± 0.3	13.7	160	950	6.7	15.0	12568269
6 x 1.5	30 x 0.26	1.50	2.80	10.7 ± 0.4	13.7	160	1150	8.2	18.8	12566341
7 G 1.5	30 x 0.26	1.50	2.80	10.3 ± 0.4	13.7	160	1010	9.7	19.0	12564630
12 G 1.5	30 x 0.26	1.50	2.80	13.8 ± 0.4	13.7	160	1980	16.2	31.9	12568270
20 x 1.5	30 x 0.26	1.50	2.80	17.8 ± 0.5	13.7	160	2950	27.2	53.3	12566343
25 G 1.5	30 x 0.26	1.50	2.80	19.6 ± 0.5	13.7	160	3300	35.0	63.0	12564631
37 x 1.5	30 x 0.26	1.50	2.80	22.6 ± 0.5	13.7	160	5710	49.5	88.9	12567870
3 G 2.5	61 x 0.23	1.95	3.20	8.5 ± 0.3	8.21	190	850	6.4	13.5	12568271
12 G 2.5	50 x 0.23	1.95	3.20	15.9 ± 0.5	8.21	190	2100	26.0	46.0	12568407
25 G 2.5	50 x 0.23	1.95	3.20	22.2 ± 0.5	8.21	190	3900	59.0	90.0	12564632

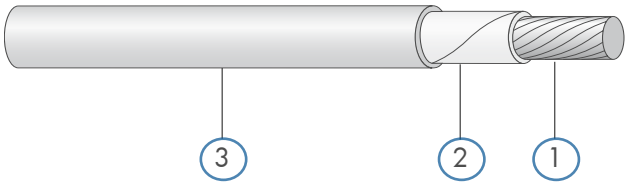
* Typical value x single wire diameter
** Capacity in water, typical value

S = GKW S sheath
FR = Fire Resistant
RW = Reduced wall thickness
G = (earth) = yellowgreen

RADOX® 3 GKW BS FR

Single Core

Conductor	EN 60228, class 5	**Voltage rating**	600/1000 V AC
Number of conductors	1		900/1500 V DC
Cross section	1.0 - 150 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1.	Conductor	stranded tin plated copper
2.	Flame barrier	MICA tape
2.	Insulation	RADOX GKW J, colours see table

Characteristics and specialities

- Meets requirement for circuit integrity in case of fire
- Excellent resistance to high and low temperature, ozone and weathering
- Soldering iron resistant
- Easy to strip
- Flexible

Application

- For applications where circuit integrity is required
- Especially suitable as compact lead wires for systems inside railway rolling stock at fixed or sporadic moving installations.
- Recommended for the installation are the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
DIN 5510-2	Protection level	1, 2, 3, 4
NF F 16-101	Class, category	C / F0, int. A1, A2, B / ext. A1, A2, B
EN 50200	Meets requirement for circuit integrity in case of fire	90 min.

For further technical details please refer to our data sheet.

RADOX® 3 GKW BS FR

Single Core

Cross section	Conductor		Insulation thickness	Core	Conductor resistance	Capacitance **	Fire load	Weight		Colour	Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	mm min.	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100m	cable kg/100m		
1	37 x 0.18	1.22	0.55	3.15	20.0	260	110	0.91	1.88	grau	12566936
1.5	30 x 0.26	1.50	0.55	3.40	13.7	300	125	1.33	2.40	grau	12566937
2.5	61 x 0.23	1.95	0.60	4.05	8.21	330	170	2.22	3.66	grau	12566914
4	61 x 0.29	2.45	0.65	4.60	5.09	380	210	3.54	5.25	grau	12560764
6	84 x 0.30	2.95	0.70	5.30	3.39	410	250	5.17	7.3	grau	12566938
10	80 x 0.40	3.90	0.80	6.35	1.95	490	345	9.21	12.1	grau	12566939
16	119 x 0.40	5.30	0.90	8.15	1.24	560	495	14.0	18.1	grau	12566940
25	182 x 0.40	6.60	1.00	9.65	0.795	630	685	20.6	26.1	grau	12566941
35	266 x 0.40	7.80	1.10	10.80	0.565	730	800	30.2	36.5	schwarz	12565134
50	378 x 0.40	9.30	1.20	12.80	0.393	750	1070	44.8	53	grau	12567265
70	348 x 0.50	11.40	1.30	15.10	0.271	810	1394	61.0	73	grau	12568268
95	444 x 0.50	12.90	1.40	17.00	0.210	890	1710	80.0	93.0	grau	12568409
150	722 x 0.50	16.80	1.60	21.30	0.132	1010	2450	127	145	grau	12567264

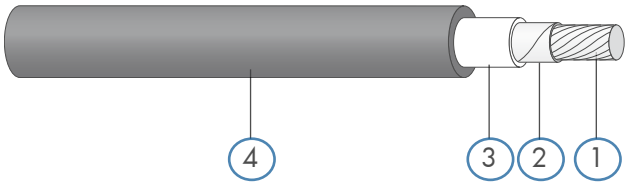
* Typical value x single wire diameter
** Capacity in water, typical value

FR = Fire Resistant
BS = British Standard

RADOX® 4 GKW-AX FR

Single Core

Conductor	EN 60228, class 5	**Voltage rating**	1800/3000 V AC
Number of conductors	1		2700/4500 V DC
Cross section	1.5 - 120 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1.	Conductor	stranded tin plated copper	
2.	Flame barrier	MICA tape	
3.	Insulation	RADOX GKW K	
4.	Sheath	RADOX GKW S	colour : black

Characteristics and specialities

- Meets requirement for circuit integrity in case of fire
- Resistance to oil, ozone and weathering
- Flexible
- Easy to strip

Application

- For applications where circuit integrity is required.
- Especially suitable as compact lead wires for systems inside railway rolling stock at fixed or sporadic moving installations.
- Recommended for the installation are the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
DIN 5510-2	Protection level	1, 2, 3, 4
EN 50200	Meets requirement for circuit integrity in case of fire	90 min. (1050 V)

For further technical details please refer to our data sheet.

RADOX® 4 GKW-AX FR

Single Core

Cable type	Conductor		Insulation thickness	Core	Conductor resistance	Capacitance **	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	mm min.	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
1.5	30 x 0.26	1.50	0.80	3.70 ± 0.10	13.7	221	205	1.3	2.6	12552226
2.5	61 x 0.23	1.95	0.75	3.95 ± 0.10	8.21	278	212	2.2	3.5	12559357
4	61 x 0.29	2.45	0.95	4.95 ± 0.10	5.09	273	330	3.4	5.5	12552871
6	84 x 0.30	2.95	0.90	5.35 ± 0.15	3.39	330	359	5.2	7.5	12559772
10	80 x 0.40	3.90	1.05	6.80 ± 0.15	1.95	337	572	9.1	13	12552228
16	119 x 0.40	5.30	1.20	8.60 ± 0.20	1.24	398	833	13	19	12555388
25	182 x 0.40	6.60	1.35	10.2 ± 0.30	0.795	456	1063	21	28	12559773
35	266 x 0.40	7.80	1.55	11.7 ± 0.30	0.565	502	1388	30	39	12560644
50	378 x 0.40	9.30	1.85	13.8 ± 0.30	0.393	511	1912	43	55	12560645
70	348 x 0.50	11.40	1.70	15.8 ± 0.30	0.277	597	2250	61	72	12552873
95	444 x 0.50	12.90	1.90	17.6 ± 0.30	0.210	620	2687	78	96	12560646
120	570 x 0.50	14.90	1.95	20.2 ± 0.30	0.164	598	3672	94	118	12552230

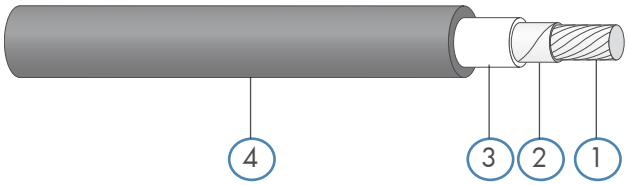
* Typical value x single wire diameter
** Capacity in water, typical value

FR = Fire Resistant

RADOX® 4 GKW-AX BS FR

Single Core

Conductor	EN 60228, class 5	**Voltage rating**	1800/3000 V AC
Number of conductors	1		2700/4500 V DC
Cross section	1.5 - 240 mm^2	**Temperature range**	-40 °C to +120 °C



Composition of cable

1.	Conductor	stranded tin plated copper	
2.	Flame barrier	MICA tape	
3.	Insulation	RADOX GKW K	
4.	Sheath	RADOX GKW S	colour : black

Characteristics and specialities

- Meets requirement for circuit integrity in case of fire
- Excellent resistance to high and low temperatures
- Resistance to oil, ozone and weathering
- Flexible
- Easy to strip

Application

- For applications where circuit integrity is required.
- Especially suitable as compact lead wires for systems inside railway rolling stock at fixed or sporadic moving installations.
- Recommended for the installation are the standards EN 50355 and EN 50343.

Standards

Standard	Fire protection on railway vehicles	
DIN 5510-2	Protection level	1, 2, 3, 4
EN 50200, EN 50362	Meets requirement for circuit integrity in case of fire	90 min. (1050 V)

For further technical details please refer to our data sheet.

RADOX® 4 GKW-AX BS FR

Single Core

Cross section	Conductor		Insulation thickness	Core	Conductor resistance	Capacitance **	Fire load	Weight		Item no.
mm^2	construction* n x mm	$d_{nom.}$ mm	mm min.	d mm	R_{20} max. Ω/km	C_{H20} pF/m	nom. kJ/m	copper kg/100m	cable kg/100m	
1.5	30 x 0.26	1.50	1.05	4.90 ± 0.15	13.7	175	371	1.3	3.8	12562986
2.50	61 x 0.23	1.95	1.15	5.35 ± 0.15	8.21	201	420	2.2	5.0	12562987
4	61 x 0.29	2.45	1.25	6.10 ± 0.15	5.09	222	538	3.4	8.8	12563012
6	84 x 0.30	2.95	1.30	7.00 ± 0.15	3.22	225	635	5.2	9.3	12565280
10	80 x 0.40	3.90	1.30	8.10 ± 0.20	1.91	267	780	9.1	14	12563738
16	119 x 0.40	5.30	1.15	9.30 ± 0.20	1.24	356	990	13	21	12563420
25	182 x 0.40	6.60	1.50	10.8 ± 0.20	0.795	412	1235	21	29	12565281
35	266 x 0.40	7.80	1.50	12.1 ± 0.25	0.565	466	1439	30	40	12562988
50	378 x 0.40	9.30	1.60	13.8 ± 0.25	0.393	510	1788	43	56	12563045
70	348 x 0.50	11.4	1.70	16.2 ± 0.30	0.277	576	2287	61	76	12563046
95	444 x 0.50	12.8	1.90	18.0 ± 0.30	0.210	591	2803	78	98	12562989
120	570 x 0.50	14.9	1.60	20.2 ± 0.30	0.164	618	3450	94	121	12565282
150	722 x 0.50	16.8	2.20	22.7 ± 0.30	0.132	654	4129	127	152	12562990
185	874 x 0.50	18.3	2.40	24.6 ± 0.30	0.108	665	4835	153	183	12562991
240	1147 x 0.50	21.1	2.50	27.6 ± 0.30	0.0817	741	5600	201	241	12562992

* Typical value x single wire diameter)
** Capacity in water, typical value)

FR = Fire Resistant
BS = British Standard


HUBER + SUHNER

Cable Systems

Powerful capabilities of a global contractor

The engineering teams of HUBER+SUHNER are made up of highly experienced specialists who have direct access to the comprehensive know-how of the Group.

The Railway Cable Systems unit develops solutions focused on specific customer needs which ensure a high level of safety and functionality. Its uncompromising claim to delivering integral solutions is confirmed time and again by its competence in project management, system engineering, prototyping and volume production. This holds true for national and international projects alike.

In the field of cables, we permanently refine existing products already excellently positioned in the marketplace such as RADOX® railway cables. At the same time, we forge ahead with the development of new successful product families.

Our extensive, worldwide group capabilities benefit all segments of the railway market: from underground and tramways to locomotives for urban and high-speed trains.

As our partner and customer, you will benefit from:

- Our unique global production and distribution network
- Our unique product capabilities in the areas of – Low Frequency – Radio Frequency – Fiber Optics
- Our global project management skills

Picture: HUBER+SUHNER railway cable harness solution

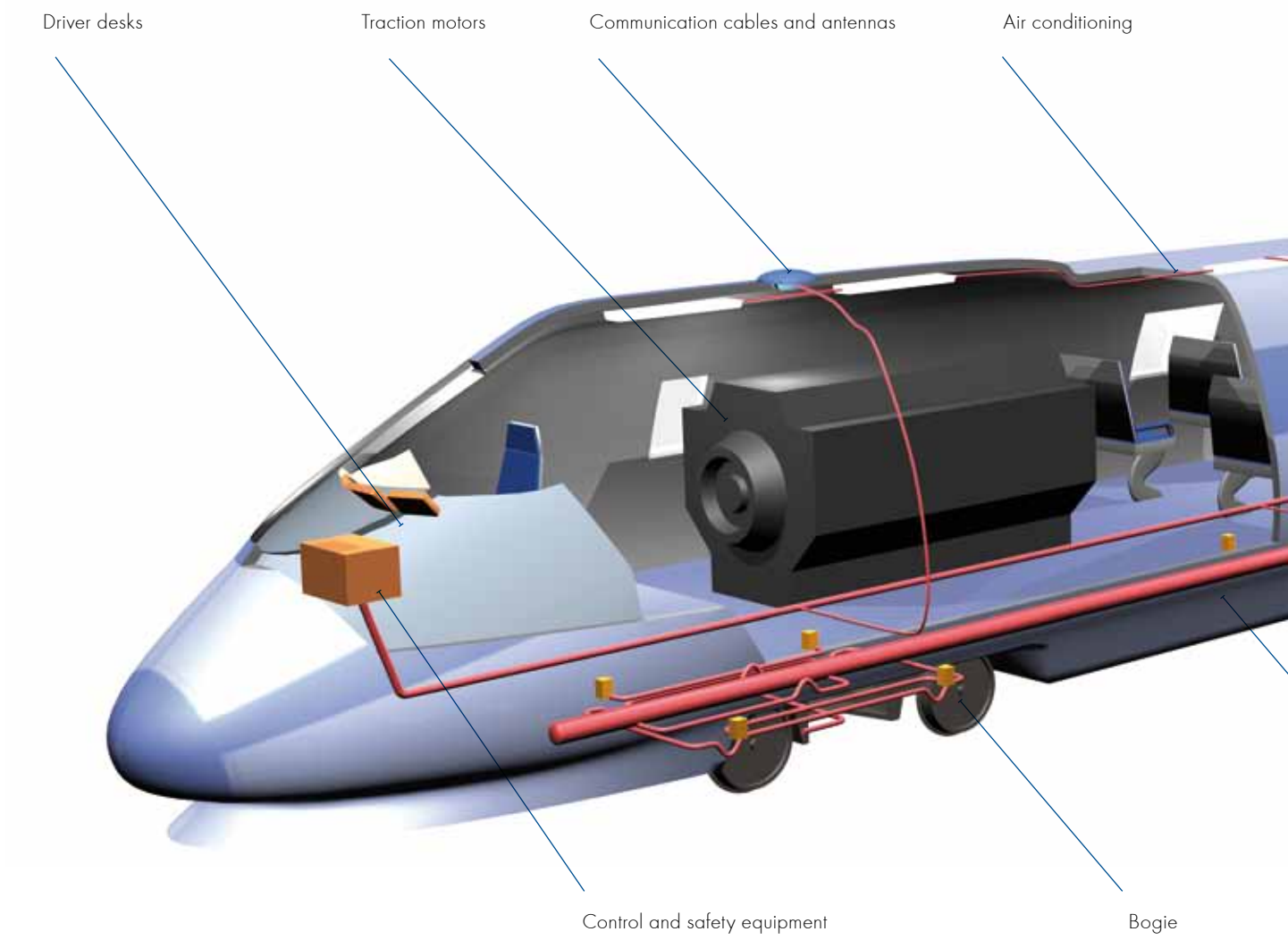
Tailored to your specific Needs

Inter-vehicle systems
HUBER+SUHNER supplies complete inter-vehicle systems including designs which combine Low Frequency, Fiber Optics or Radio Frequency technologies. Cables or hybrid cable solutions, pre-assembled units, EMC-optimised solutions and cable systems designed to withstand high dynamic stressing convince our demanding customers and prove their worth in heavy-duty applications.

Cable systems for bogies
Applications with increased requirements in the field of bogies have used our innovative cable and cable system solutions for years.

Coach harnesses
From cable assemblies to complex cable harnesses incorporating power, signal and communication lines, we supply everything from a single source. Optimised and certified processes ensure smooth project flows from development, sourcing and prototyping to volume production.

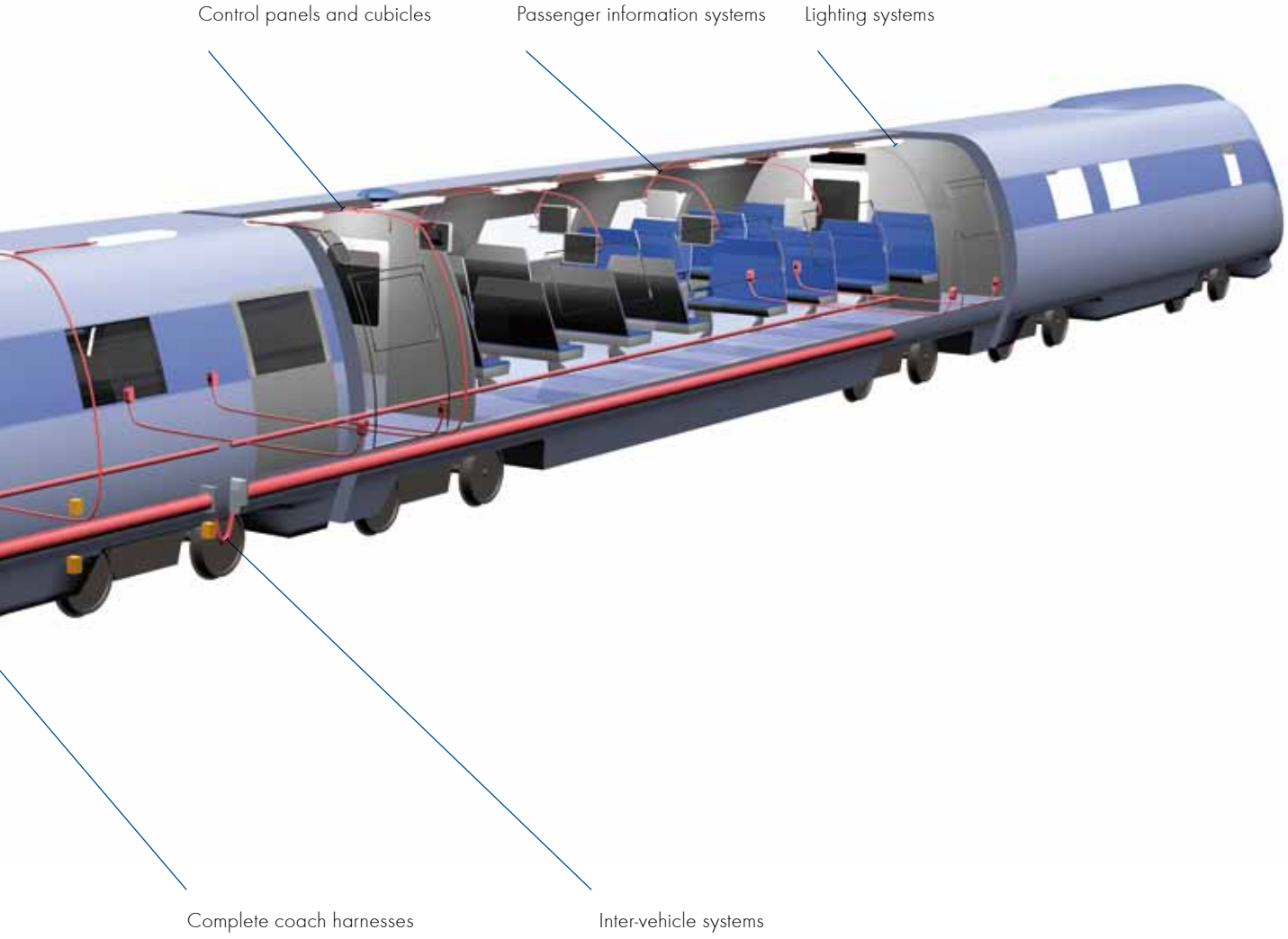
Cables and harnessing for the following applications:



Railcar and locomotive cabling
Solutions developed on the basis of "build to print" or together with our customers satisfy customer requirements the world over.

Cabling of control and safety systems
HUBER+SUHNER will take charge of complete implementation, from procurement to the ready-to-connect and tested assembled units.

Switchgear cabinets
Customised, rail-worthy switchgear and distribution cabinets complete our product portfolio.



Added Value thanks to extensive Services

On the train with HUBER+SUHNER

Public railway transport services are increasingly expected to offer networks with an ever-higher level of service and higher speeds, in the areas of both passenger and goods traffic. As a consequence, carriers and system integrators are permanently seeking new, more powerful solutions. Railway Cable Systems is one of these solutions – locally available, competent and just in time.

Mobility with an open future

Equipped with a unique set of technological capabilities from our product portfolio, Railway Cable Systems ensures that its customers around the world will maintain their edge in the marketplace. Innovative services ranging from cable assembly to the development of new products generate the added value that customers need to maintain their competitive edge in a highly competitive environment.

Our integral service package offers you added value

Our business model enables the Railway Cable Systems Unit to enhance the added value that it can offer customers thanks to HUBER+SUHNER railway cable harness. This enables the increasing flexibility and safety quality requirements to be satisfied in the international markets.

Development:	HUBER+SUHNER have the capability to take the responsibility of the design and development program according to the needs of the customers partners.
Project-Management:	Designated project responsibility is assured by the support of local HUBER+SUHNER group company.
Prototyping:	Ensures process stability guaranteen smooth transition into volume production.
Volume production:	Volume production according to ISO and soon also to the IRIS standard allows reliable and efficient cable assembly processes.

Qualified employees

Experienced engineers and project management specialists form the backbone of our organisation.
In order to maintain its leadership, the Group is committed to its employees.
Top performance has allowed the Group to rise to the illustrious circle of top employers in a number of countries.
Current examples include the distinction as "Top Employers 2008 – Shanghai Region" and the German "Top Job" seal of quality.

Market Leaders trust our Services

STADLER Rail AG

Services provided by HUBER+SUHNER
for STADLER Rail AG

- Project evaluation
- Development
- Production
- Logistics

Added value for STADLER Rail AG

- RADOX® railway cables developed to meet specific customer needs
- Tested and optimised solutions
- Quick responses to project changes
- Low project risks
- Just in time deliveries

ALSTOM Transport

Services provided by HUBER+SUHNER
for ALSTOM Transport

- Development
- Production
- Logistics

Added value for ALSTOM Transport

- RADOX® railway cables developed to meet specific customer needs
- Tested and optimised solutions
- Quick responses to project changes
- Low project risks
- Just in time deliveries

Market Leaders trust our Services

BOMBARDIER Transportation

Services provided by HUBER+SUHNER
for BOMBARDIER Transportation
- Development
- Production
- Logistics
- Installation support on site

Added value for BOMBARDIER Transportation
- RADOX® railway cables developed to meet specific customer needs
- Tested and optimised solutions
- Cost-effective pre-fabricated solutions
- Low project risks
- Just in time deliveries
- Global production and distribution network

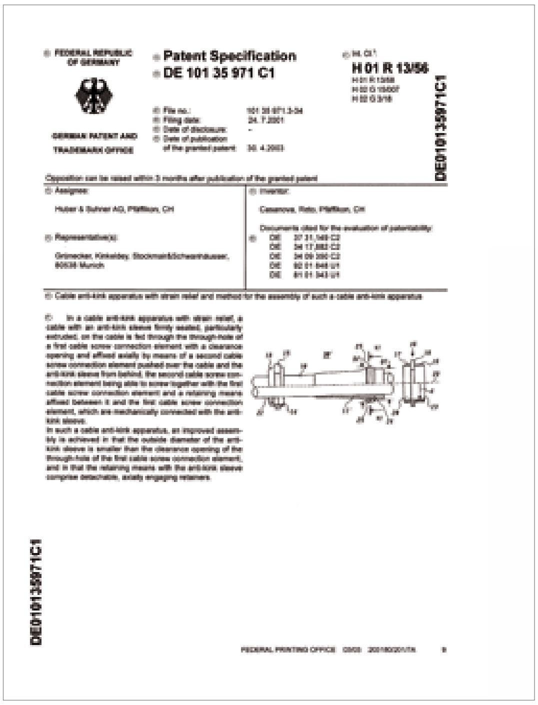
SIEMENS AG

Services provided by HUBER+SUHNER
for SIEMENS AG
- Development
- Production
- Logistics

Added value for SIEMENS AG
- Perfectly coordinated HUBER+SUHNER products
- Tested and optimised solutions
- System cable solutions for inter-vehicle systems
- Low project risks
- Just in time deliveries

Inter-vehicle Systems

Inter-vehicle systems must satisfy stringent demands, since the cables in motion are subjected to a wide range of different mechanical stresses. These are caused especially by vibration, bending and torsion in addition to occasionally extreme operating conditions and environmental influences. System cables are manufactured on the basis of specific customer needs, taking into account the proven HUBER+SUHNER design guidelines. Manufacturing is fairly time-consuming because the cables pass through several in-line process operations. The earlier HUBER+SUHNER is familiarised with concrete projects, the easier it will be to satisfy the relevant customer needs. As a system provider, HUBER+SUHNER offers professional consulting as early as during the development phase. In order to produce optimal cable design solutions, it makes sense in the project engineering phase to allow the widest possible latitude in terms of how the cores and elements are to be combined in the cables.


FEDERAL REPUBLIC OF GERMANY

GERMAN PATENT AND TRADEMARK OFFICE

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H 01 R 13/58
H 02 G 15/007
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Opposition can be raised within 3 months after publication of the granted patent

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Inventor:
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Documents cited for the evaluation of patentability:
DE 37 31 149 C2
DE 34 17 882 C2
DE 34 09 330 C2
DE 92 01 848 U1
DE 81 01 343 U1

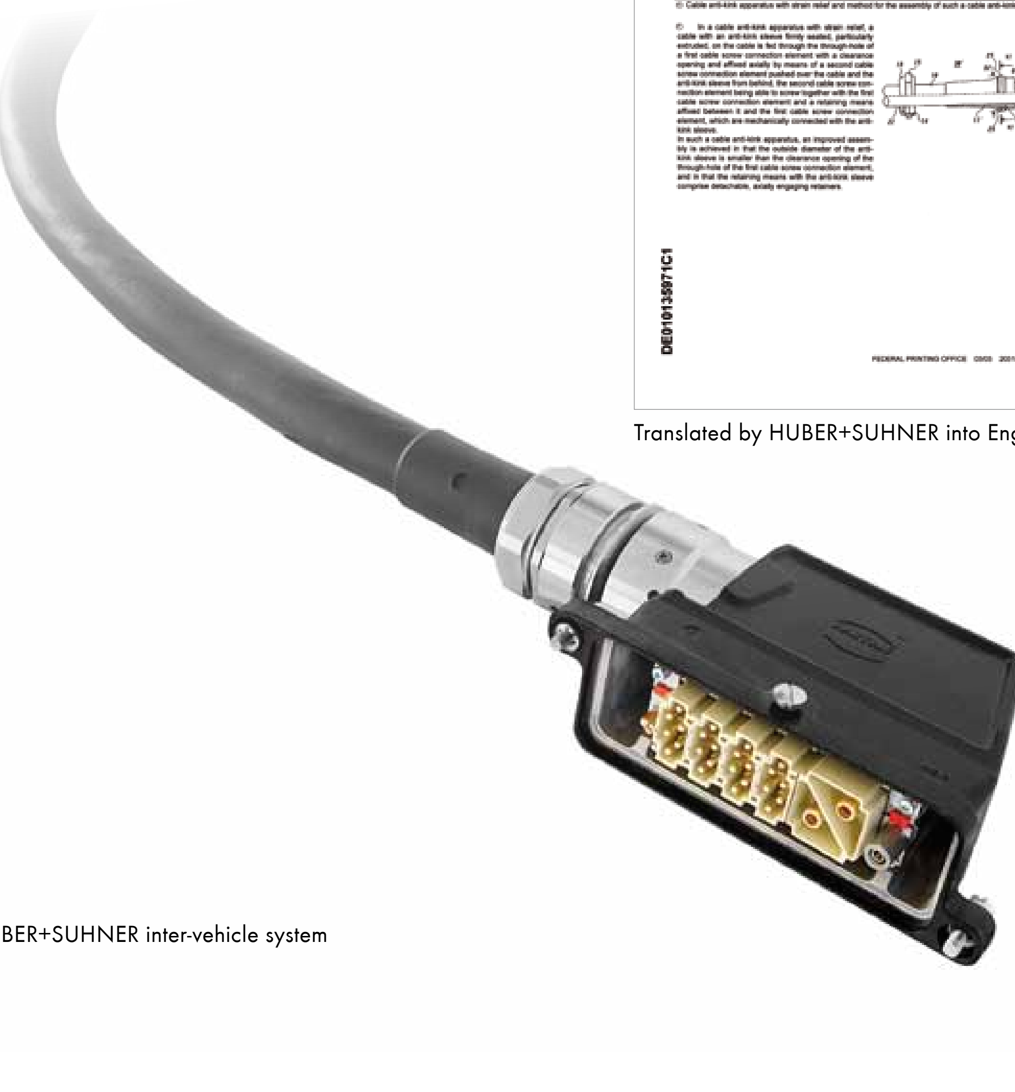
Cable anti-kink apparatus with strain relief and method for the assembly of such a cable anti-kink apparatus

In a cable anti-kink apparatus with strain relief, a cable with an anti-kink sleeve firmly seated, particularly extruded, on the cable is fed through the through-hole of a first cable screw connection element with a clearance opening and affixed axially by means of a second cable screw connection element pushed over the cable and the anti-kink sleeve from behind, the second cable screw connection element being able to screw together with the first cable screw connection element and a retaining means affixed between it and the first cable screw connection element, which are mechanically connected with the anti-kink sleeve.
In such a cable anti-kink apparatus, an improved assembly is achieved in that the outside diameter of the anti-kink sleeve is smaller than the clearance opening of the through-hole of the first cable screw connection element, and in that the retaining means with the anti-kink sleeve comprise detachable, axially engaging retainers.

DE10135971C1

FEDERAL PRINTING OFFICE 03/03 203 180/201/7A 8

Translated by HUBER+SUHNER into English.


HUBER+SUHNER inter-vehicle system

Wireless Communication

Wireless communication is an integral part of modern transportation systems: It covers train control and radio (GSM-R, CBTC or TETRA), satellite navigation (GPS), mobile communication (GSM, UMTS and LTE) and internet on train (WiFi).

HUBER+SUHNER offers antennas for the complete range of communication standards between 380 MHz and 6 GHz. As a solution provider, we deliver all necessary RF components (antennas, cable assemblies, filters) for antenna applications on trains, tramways and buses.

Roof-top railway/light rail antennas

Roof-top railway antennas must resist adverse environmental conditions. The railway industry has therefore defined several standards which these products must comply with:

- Protection by grounding all metal parts acc. to UIC 553
- High voltage protection (27.5 kV), high current protection (40 kA during 100 ms) acc. to Deutsche Bahn specifications
- Temperature and vibration requirements acc. to EN 50155
- EMC protection acc. to EN 50121-3-2
- Fire retardant, low toxicity, low smoke density materials acc. to NF F16-101/NF F16-102, DIN 5510-2, BS 6853 and CEN/TS 45545

In addition, our train antennas are protected against corrosion acc. to MIL-F-14072D.

We provide specific products for different applications:

- SENCITY®Rail
  Omni-directional antennas for railway applications
- SENCITY®Rail EXCEL
  Directional antennas for railway/light-rail* applications
- SENCITY®AVANT
  Omni-directional antennas for light rail* or bus applications

* Light rail is an urban rail public transportation system (e.g. tramway), with lower capacity and lower speed than railway systems (usual trains, high speed trains, metro). Light rail systems often operate at lower voltage and lower current.

SENCITY®Rail Antenna Family

The SENCITY®Rail antenna family provides an all-in-one wireless communication solution for all type of trains.

SENCITY®Rail antennas meet the special requirements of railway applications. They provide electrical protection against the impact of a contact with the overhead line (max. 27.5 kV and max. 40 kA/100 ms).

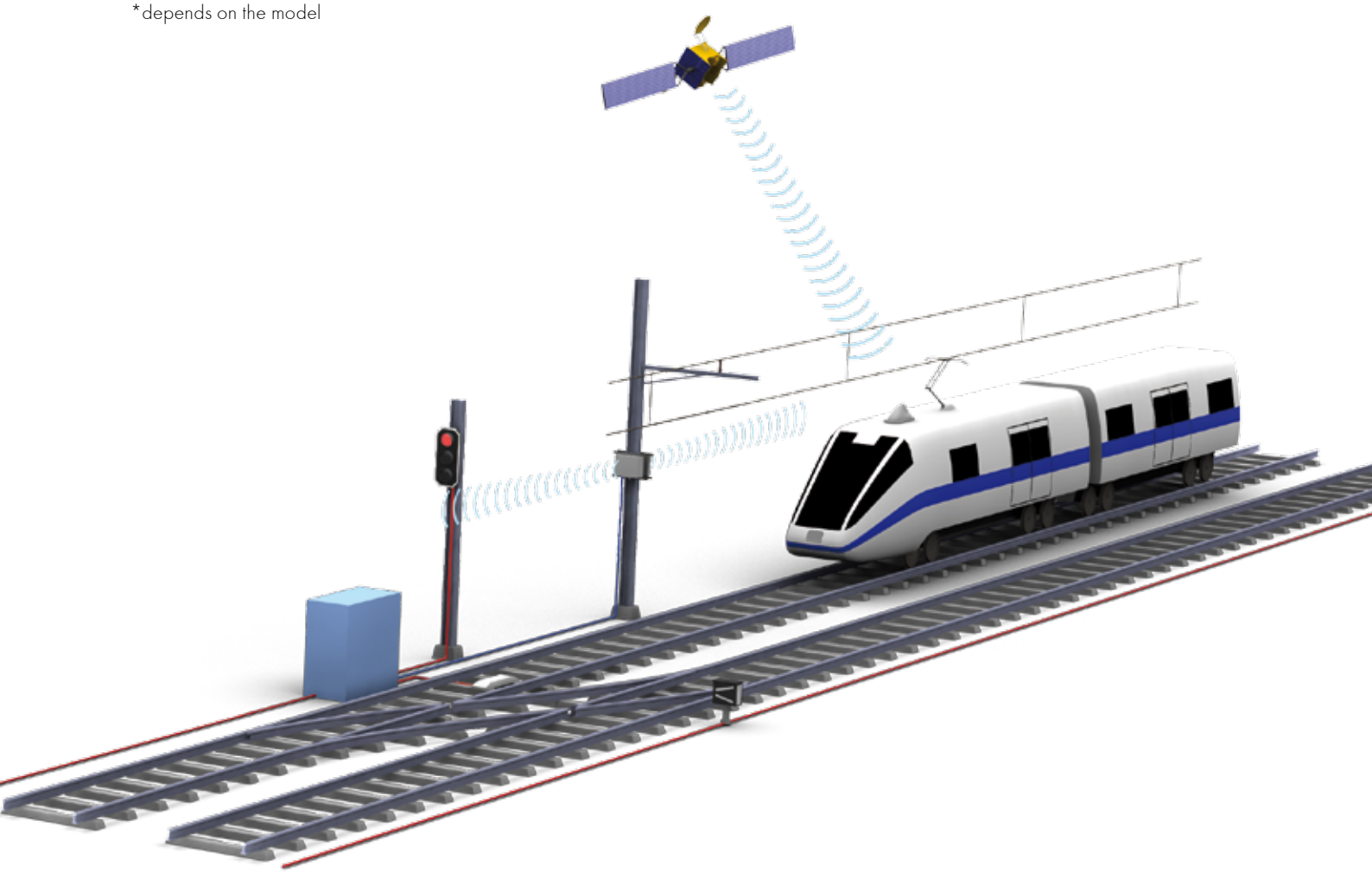
Key features:

- Omni-directional roof-top antenna with an extremely rugged mechanical design
- Multi-band support 380 MHz to 6 GHz*
- Embedded GPS/Galileo/Glonass antenna*
- Low profile version available

Target applications:

- Multi-band communication
  - TETRA, AMPS, GSM, UMTS, LTE
  - WiFi 2.4 and 5 GHz
  - WiMAX 2.6 and 3.5 GHz
- Vehicle localization with GPS/Galileo/Glonass
- Double-deck train

*depends on the model



Type designation		Antenna family	Remarks	Freq. min. [MHz]	Freq. max. [MHz]	Gain [dBi]	Pol.
1399.17.0094		SWA-0459/360/4/25/V	TETRA and LTE support Advanced mounting options	380 1710 2400 3400 4900	960 2170 2700 3700 5875	4.0 7.5 7.5 8.5 8.5	vertical
1399.99.0026		SWA-0459/360/4/25/DFRX30	TETRA and LTE support Embedded GPS antenna with integrated LNA Advanced mounting options	380 1710 2400 3400 4900 1574	960 2170 2700 3700 5875 1576	4.0 7.5 7.5 8.5 8.5	vertical
1309.17.0093		SOA 0900/360/6/0/V	GSM/GSM-R only version	870	960	6.0	vertical
1399.17.0039		SWA-0859/360/4/0/V		870 1710 2400 3400 5150	960 2170 2700 3700 5875	6.0 8.5 9.5 9.5 8.5	vertical
1399.17.0043		SWA-0859/360/4/0/DF	Embedded GPS antenna	870 1710 2400 3400 5150 1574	960 2170 2700 3700 5875 1576	6.0 8.5 9.5 9.5 8.5	vertical
1399.17.0044		SWA-0859/360/4/0/DFRX30	Embedded GPS antenna with integrated LNA	870 1710 2400 3400 5150 1574	960 2170 2700 3700 5875 1576	6.0 8.5 9.5 9.5 8.5	vertical
1399.17.0122		SWA-0859/360/4/0/V_3	LTE support Advanced mounting options	790 1710 2400 3400 4900	960 2170 2700 3700 5935	6.0 8.5 9.5 9.5 8.5	vertical
1399.99.0120		SWA-0859/360/4/0/DFRX30_2	LTE support Embedded GPS antenna with integrated LNA Advanced mounting options	790 1710 2400 3400 4900 1574	960 2170 2700 3700 5935 1576	6.0 8.5 9.5 9.5 8.5	vertical
1399.99.0121		SWA-0859/360/4/0/DFRX30_3	LTE support Embedded GPS/Glonass antenna with integrated LNA Advanced mounting options	790 1710 2400 3400 4900 1574	960 2170 2700 3700 5935 1610	6.0 8.5 9.5 9.5 8.5	vertical
1399.17.0125		SWA-0825/360/5/30/V	Low profile (40 mm)	790 1710 2400	960 2170 2700	5.0 6.5 7.0	vertical
1399.99.0037		SWA-0825/360/5/30/DFRX30	Low profile (40 mm) Embedded GPS antenna with integrated LNA	790 1710 2400 1574	960 2170 2700 1576	5.0 6.5 7.0	vertical

SENCITY®Rail EXCEL Antenna Family

The SENCITY®Rail EXCEL antenna family provides a high-gain solution for trackside wireless communications on all types of trains.

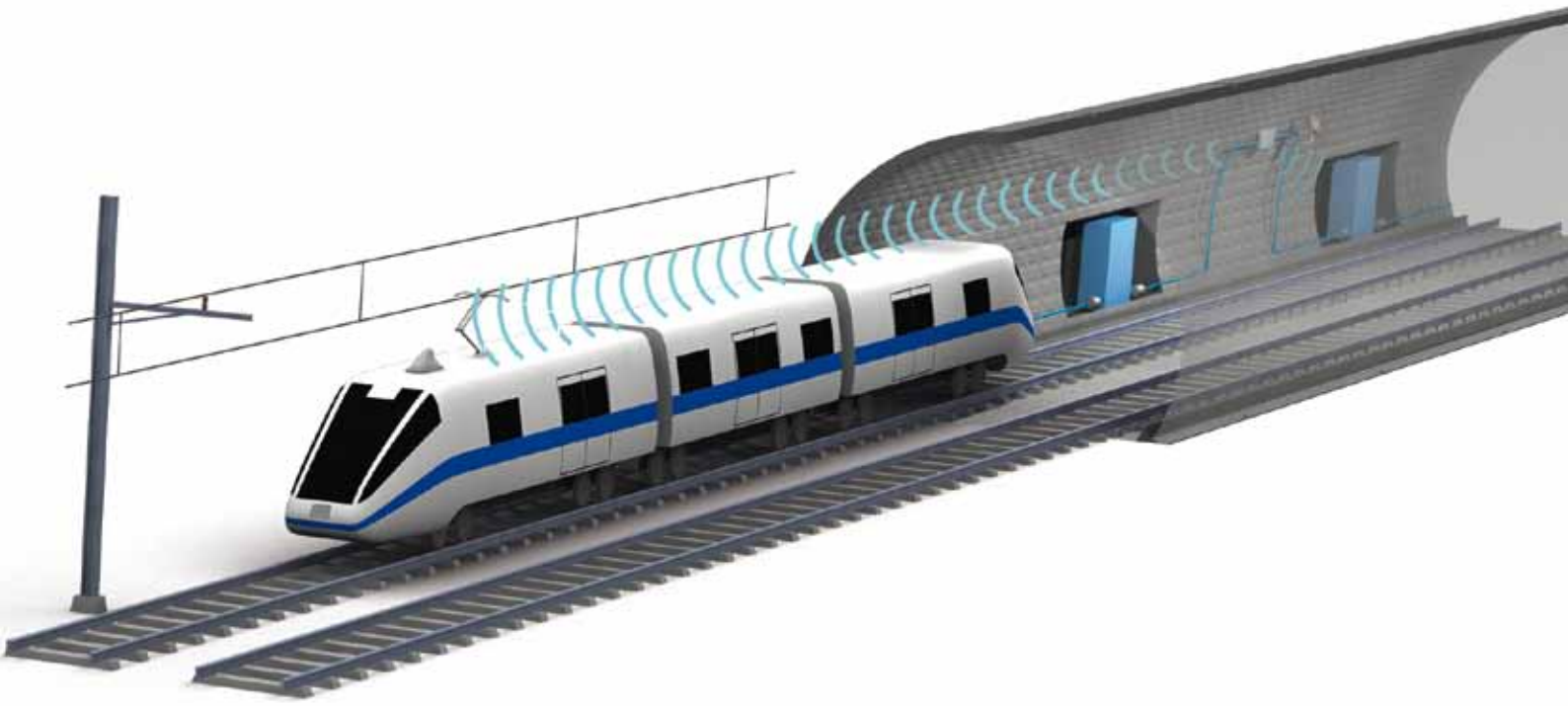
SENCITY®Rail EXCEL antennas meet the special requirements of railway applications. They provide electrical protection against the impact of a contact with the overhead line (max. 27.5 kV and max. 40 kA/100 ms).

Key features:

- High-gain directional roof-top antenna
- Directional and bidirectional types available
- Supports WiFi/WiMAX 2.4, 3.5 or 5 GHz bands

Target applications:

- Long distance and high data rate communication between train and trackside networks, e.g. for CBTC (Communication Based Train Control) and Internet in the train



Type designation		Antenna family	Remarks	Freq. min. [MHz]	Freq. max. [MHz]	Gain [dBi]	Pol.
1324.17.0089		SPA-2400/40/15/10/V_3	Directional	2400 2484 2550 2590 2630	2484 2550 2590 2630 2650	14.5 14.5 14.0 12.5 11.5	vertical
1324.17.0070		SPA-2400/50/12/10/V	Bi-Directional	2400 2484 2550 2600 2630	2484 2550 2600 2630 2650	13.5 13.0 12.0 11.0 10.0	vertical
1336.17.0030		SPA-3600/50/13/15/V	Bi-Directional	3400	3800	13.5	vertical
1356.17.0010		SPA-5600/45/12/10/V	Directional	4900 5150	5150 5935	12.5 12.5	vertical
1356.17.0042		SPA-5600/45/12/10/V_1	Bi-Directional	4900 5150 4900 5150 5470	5150 5470 5150 5470 5725	12.0 12.5 13.0 13.5 13.0	vertical

SENCITY®Avant Antenna Family

The SENCITY®AVANT antenna family provides an all-in-one wireless communication solution for light-rail vehicles.

Light rail is an urban public rail transportation system (e.g. tramway) with lower capacity and lower speed than railway systems (usual trains, high speed trains, metro).

SENCITY®AVANT antennas provide an electrical protection against the impact of a contact with the overhead line (max. 27.5 kV and max. 10 kA/100 ms).

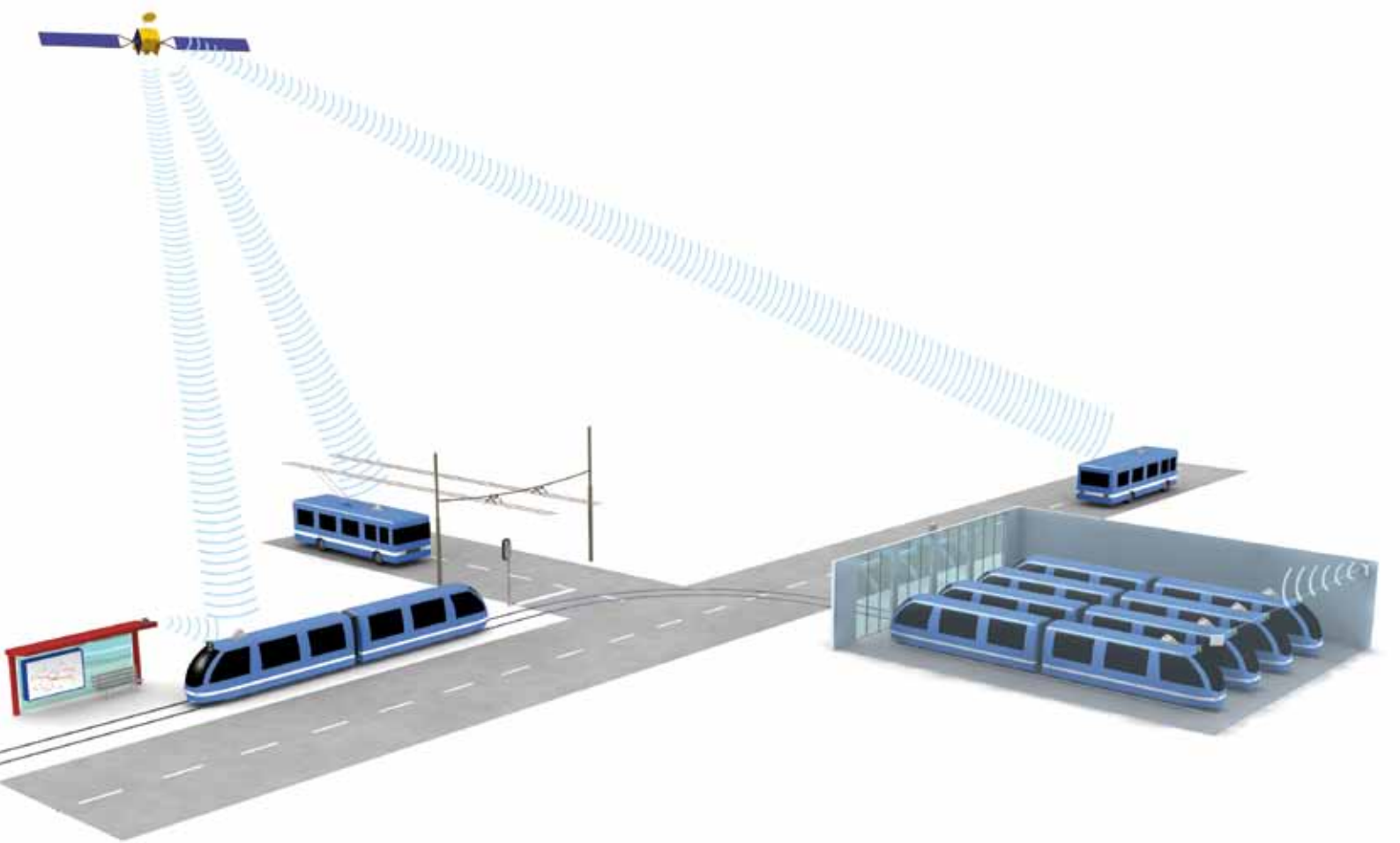
Key features:

- Omni-directional roof-top antenna with a rugged mechanical design
- Multi-band support 806 MHz to 6 GHz
- Embedded GPS/Galileo antenna*

Target applications:

- Multi-band communications on tramways or buses
  - AMPS, GSM, UMTS
  - WiFi 2.4 and 5 GHz
  - WiMAX 2.6 and 3.5 GHz
- Vehicle localization with GPS/Galileo

*depends on the model



Type designation	Antenna family	Remarks	Freq. min. [MHz]	Freq. max. [MHz]	Gain [dBi]	Pol.
1399.17.0099	SWA-0860/360/4/0/V_2		806 824 1710 2400 3400 4900	824 960 2170 2700 3700 5935	6.0 6.0 8.5 9.5 9.5 8.5	vertical
1399.17.0100	SWA-0860/360/4/0/DF_2	Embedded GPS antenna	806 824 1710 2400 3400 4900 1574	824 960 2170 2700 3700 5935 1576	6.0 6.0 8.5 9.5 9.5 8.5	vertical
1399.17.0101	SWA-0860/360/4/0/DFRX30_2	Embedded GPS antenna with integrated LNA	806 824 1710 2400 3400 4900 1574	824 960 2170 2700 3700 5935 1576	6.0 6.0 8.5 9.5 9.5 8.5	vertical

Additional Antenna Products

Vehicle outdoor

Antennas on the roof of a vehicle must allow multi-band operation. This approach eliminates the need to install more than one antenna and covers also future communication standards. Easy installation and maintenance-free products are the top priorities here.

In-carriage

For in-carriage applications, passenger safety is the main criterion. Besides offering high performance, our products are also fire retardant and use low toxicity materials (acc. to NF-F-16-101 and 102, DIN 5510-2, BS 6853 and CEN/TS 45545). Omni-directional as well as directional antennas are available in small form factors with different colors, connectors and mounting options.

Carriage bridging

Linking of train coaches using antennas instead of cables reduces the service requirement when disconnecting coaches. These antennas must resist adverse environmental conditions. Wireless bridging is usually based on WiFi communication standards.

Trackside (see page 118)

Trackside antennas are used for high data rate applications such as WiFi 2.4 GHz or WiMAX networks. Special accessories are available for different applications, e.g. brackets, lightning protectors, DC/DC blocks, power splitters and RF cable assemblies.

Type designation		Antenna family	Remarks	Freq. min. [MHz]	Freq. max. [MHz]	Gain [dBi]	Pol.
Vehicle outdoor							
1399.17.0111 1399.17.0108		SWA-2459/360/7/20/V_2	Omni-directional Connector mounting IP68	2400 2500 3400 4900 5470	2500 2700 3700 5470 5935	6.0 6.0 7.0 8.0 8.0	vertical
1349.99.0003		SOA 4900/360/7/10/V	Omni-directional NMO mount IP 65	4900	5935	7.0	vertical
In-carriage							
1324.17.0071		SOA-2400/360/4/20/V_2	Omni-directional	2400	2500	4.0	vertical
1324.26.0049		SPA-2400/75/9/0/V_1	Directional	2300	2500	8.5	vertical
1356.17.0043		SOA 5600/360/3/20/V_1	Omni-directional	4900	5935	7.0	vertical
1356.26.0013		SPA-5600/60/10/0/V_1	Directional	5150 5250	5250 5875	9.5 9.5	vertical
1399.17.0106		SWA-2459/360/7/20/V_1	Omni-directional	2400 2500 3400 4900 5470	2500 2700 3700 5470 5935	6.0 6.0 7.0 8.0 8.0	vertical
1399.35.0002		SWA-2456/360/6/0/ MIMO_2	Omni-directional	2400 5150	2700 5935	4.0 4.0	vertical
1399.17.0210		SPA-2456/75/9/0/DF_1	Directional dual band	2400 5150	2500 5875	9.0	vertikal
1356.17.0076		SPA-5600/70/9/0/DS	Directional MIMO 2x2	5150	5925	9.0	+/- 45°
1356.35.0003		SPA-5600/65/9/0/MIMO_1	Directional MIMO 3x3	5150	5875	8.0	vertical and +/- 45°
Carriage bridging							
1324.17.0077		SPA-2400/75/9/0/V_2	Directional Rugged design IP66	2400	2500	9.0	vertical
1356.17.0054		SPA-5600/55/8/0/V	Directional Rugged design IP66	5150 5250 5750 5825	5250 5750 5825 5875	8.5 8.5 8.5 7.5	vertical


HUBER+SUHNER SPUMA 400-FR 50 OHM AWM STYLE 1354 529123

Coaxial Cables, Connectors and RF Trackside Products

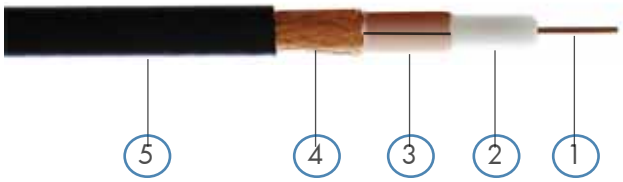
The mastery of comprehensive key technologies and the know-how of a worldwide leading manufacturer of coaxial cables, connectors and DC blocks are the foundation for innovative and high performance solutions.

The skilled engineering team as well as the network of HUBER+SUHNER product specialists who can draw on many years of experience provide RF solutions for every specific market requirement. Deep knowledge in coaxial cable and connector design, development and manufacturing technologies is the basis for successful projects.

Railway cable assemblies
Use our online configurator
http://rfwebpcf.hubersuhner.com
for fast and efficient configuration of your railway cable assemblies!

Coaxial Cable SPUMA_400-FR 50 Ω

Item no.	84040210
Impedance	50 Ω
Max. operating frequency	6 GHz
Signal delay	3.9 ns/m
Min. bending radius static	25 mm
Min. bending radius repeated	100 mm
Temperature range	-40 °C to +85 °C
Screening effectiveness	≥ 90 dB up to 6 GHz



Composition of cable

1.	Centre conductor	aluminium/copper, wire	Ø 2.74 mm
2.	Dielectric	SPE (foamed polyethylene)	Ø 7.24 mm
3.	Outer conductor	aluminium/PES, longitudinal foil, 100 %	Ø 7.4 mm
4.	Outer conductor	copper/tin plated, braid 78 %	Ø 8.15 mm
5.	Jacket	LSFH (modified polyethylene) black	Ø 10.25 mm +/- 0.1

Characteristics and specialities

- Very low loss
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- Flexible

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

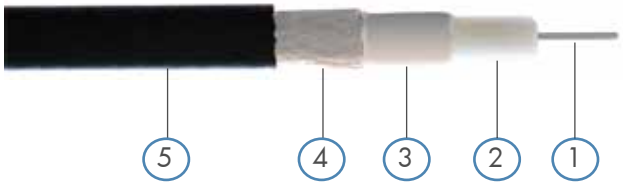
Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable SX_04172_B-60 50 Ω

Item no.	84026748
Impedance	50 Ω
Max. operating frequency	6 GHz
Signal delay	4.1 ns/m
Min. bending radius static	25 mm
Min. bending radius dynamic	90 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 90 dB up to 6 GHz



Composition of cable

1.	Centre conductor	copper wire, silver plated	Ø 1.4 mm
2.	Dielectric	SPEX (crosslinked foamed polyethylene)	Ø 3.8 mm
3.	Outer conductor	aluminium/PES, longitudinal foil	Ø 4 mm
4.	Outer conductor	copper/tin plated, braid 86 %	Ø 4.53 mm
5.	Jacket	RADOX®, black	Ø 5.5 mm +/- 0.1

Characteristics and specialities

- Low loss
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- Flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant
- GL approved

Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable GX_03272-04 50 Ω

Item no.	22512309
Impedance	50 Ω
Max. operating frequency	2 GHz
Signal delay	5.0 ns/m
Min. bending radius static	25 mm
Min. bending radius dynamic	100 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 40 dB up to 2 GHz

Composition of cable

1.	Centre conductor	copper/tin plated, strand, braid 96 %	Ø 0.94 mm
2.	Dielectric	PEX (crosslinked polyethylene)	Ø 2.95 mm
3.	Outer conductor	copper, tin plated, braid 96 %	Ø 3.6 mm
4.	Jacket	RADOX® (GKW-S), black	Ø 4.95 mm +/- 0.1

Characteristics and specialities

- Single screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- High flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable GX_07272 50 Ω

Item no.	22510708
Impedance	50 Ω
Max. operating frequency	2 GHz
Signal delay	5.0 ns/m
Min. bending radius static	50 mm
Min. bending radius dynamic	150 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 40 dB up to 2 GHz

Composition of cable

1.	Centre conductor	copper, strand	Ø 2.25 mm
2.	Dielectric	PEX (crosslinked polyethylene)	Ø 7.25 mm
3.	Outer conductor	copper, silver plated, braid 95 %	Ø 8.15 mm
4.	Jacket	RADOX®, black	Ø 10.3 mm +/- 0.1

Characteristics and specialities

- Single screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- High flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

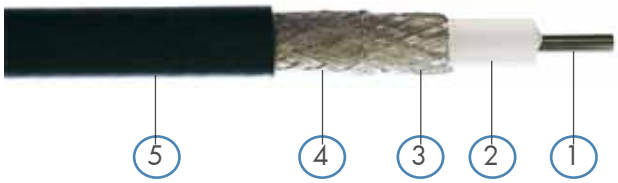
Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable GX_07272_D-04 50 Ω

Item no.	22511988
Impedance	50 Ω
Max. operating frequency	6 GHz
Signal delay	5.0 ns/m
Min. bending radius static	50 mm
Min. bending radius flexible	162 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 81 dB up to 6 GHz



Composition of cable

1.	Centre conductor	copper/silver plated, strand	Ø 2.25 mm
2.	Dielectric	PEX (crosslinked polyethylene)	Ø 7.25 mm
3.	Outer conductor	copper, silver plated, braid 93 %	Ø 8.00 mm
4.	Outer conductor	copper, silver plated, braid 95 %	Ø 8.70 mm
5.	Jacket	RADOX® (GKW-S), black	Ø 10.8 mm +/- 0.1

Characteristics and specialities

- Double screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- High flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

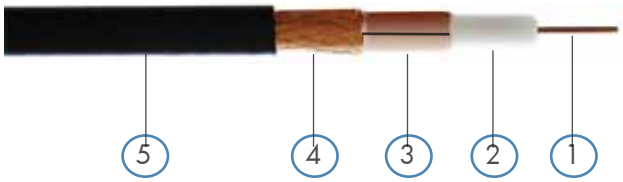
Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable S_10162_B-11 50 Ω

Item no.	23002145
Impedance	50 Ω
Max. operating frequency	7.5 GHz
Signal delay	3.85 ns/m
Min. bending radius static	129 mm
Min. bending radius repeated	258 mm
Temperature range	-40 °C to +85 °C
Screening effectiveness	≥ 90 dB up to 7.5 GHz



Composition of cable

1.	Centre conductor	copper/aluminum plated, wire	Ø 3.8 mm
2.	Dielectric	SPE (foamed polyethylene)	Ø 9.9 mm
3.	Outer conductor	copper longitudinal foil, 100 %	Ø 10 mm
4.	Outer conductor	copper braid, 80 %	Ø 10.8 mm
5.	Jacket	LSFH (modified PE)	Ø 12.9 mm +/- 0.2

Characteristics and specialities

- Low loss
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- Flexible
- Easy to strip

Application

- For fixed installations, inside and outside railway rolling stock
- For long distance RF signal transmission (antenna line)

Standards

- BS 6853 compliant
- DIN 5510-2 compliant

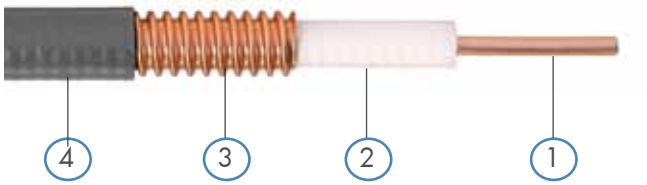
Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable SUCOFEED_1/2_HF_FR 50 Ω

Item no.	22512163
Impedance	50 Ω
Max. operating frequency	10 GHz
Signal delay	4 ns/m
Min. bending radius static	25 mm
Min. bending radius repeated	50 mm
Temperature range	-30 °C to +80 °C
Screening effectiveness	≥ 120 dB



Composition of cable

1.	Centre conductor	copper clad aluminium, wire	∅ 3.6 mm
2.	Dielectric	SPE (foamed polyethylene)	∅ 8.8 mm
3.	Outer conductor	corrugated copper tube, braid 100 %	∅ 12.2 mm
4.	Jacket	LSFH (modified PE), grey/black	∅ 13.4 mm +/- 0.2

Characteristics and specialities

- Low loss
- Mechanically robust
- Excellent screened
- Halogen free
- Low smoke
- Flame retardant
- Easy to strip
- No toxicity

Application

- For fixed installations, inside and outside railway rolling stock

Standards

- NF F 16-101 class C and D compliant
- DIN 5510-2 compliant
- DIN 5510-2 compliant

Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

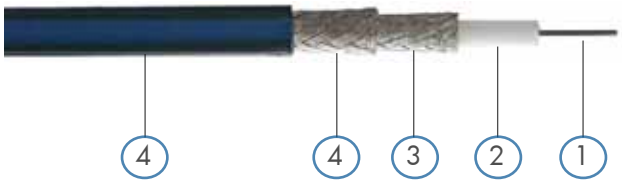
For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable ENVIROFLEX_142

50 Ω

Halogen free replacement for RG_142

Item no.	22512168
Impedance	50 Ω
Max. operating frequency	6 GHz
Signal delay	4.7 ns/m
Min. bending radius static	25 mm
Min. bending radius repeated	50 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 75 dB up to 5 GHz



Composition of cable

1.	Centre conductor	copper/silver plated, wire	Ø 0.95 mm
2.	Dielectric	SPEX (crosslinked foamed polyethylene)	Ø 2.98 mm
3.	Outer conductor	copper, silver plated, braid 97 %	Ø 3.58 mm
4.	Outer conductor	copper, silver plated, braid 95 %	Ø 4.18 mm
5.	Jacket	RADOX®, black with blue stripe	Ø 5 mm +/- 0.1

Characteristics and specialities

- Environmental friendly alternative to RG_142
- Double screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- Flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

Information about attenuation and power are shown on page 115.

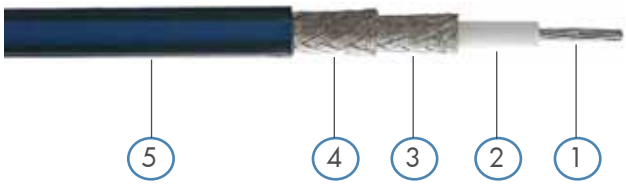
For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable ENVIROFLEX_316_D 50 Ω

Halogen free replacement for RG_316_D

Item no.	22512281
Impedance	50 Ω
Max. operating frequency	6 GHz
Signal delay	4.7 ns/m
Min. bending radius static	5 mm
Min. bending radius dynamic	30 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 70 dB up to 5 GHz



Composition of cable

1.	Centre conductor	steel, copper and silver plated, strand	Ø 1.54 mm
2.	Dielectric	SPEX (crosslinked foamed polyethylene)	Ø 1.54 mm
3.	Outer conductor	copper, silver plated, braid 96 %	Ø 2.03 mm
4.	Outer conductor	copper, silver plated, braid 90 %	Ø 2.5 mm
5.	Jacket	RADOX®, black with blue stripe	Ø 3.16 mm +/- 0.08

Characteristics and specialities

- Environmental friendly alternative to RG_316
- Double screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- High flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

Information about attenuation and power are shown on page 115.

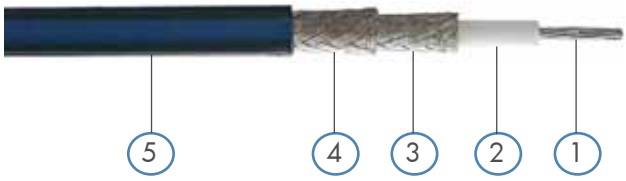
For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable ENVIROFLEX_400 50 Ω

Halogen free replacement for RG_400_U

Item no.	22512280
Impedance	50 Ω
Max. operating frequency	6 GHz
Signal delay	4.7 ns/m
Min. bending radius static	25 mm
Min. bending radius dynamic	75 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 70 dB up to 6 GHz



Composition of cable

1.	Centre conductor	copper/silver plated, strand	Ø 1.0 mm
2.	Dielectric	SPEX (crosslinked foamed polyethylene)	Ø 3.03 mm
3.	Outer conductor	copper, silver plated, braid 96 %	Ø 3.72 mm
4.	Outer conductor	copper, silver plated, braid 91 %	Ø 4.24 mm
5.	Jacket	RADOX®, black with blue stripe	Ø 5.00 mm +/- 0.1

Characteristics and specialities

- Environmental friendly alternative to RG_400
- Double screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- High flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

Information about attenuation and power are shown on page 115.

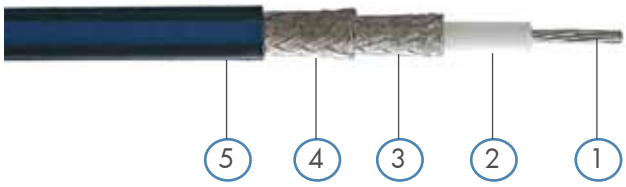
For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable ENVIROFLEX_393 50 Ω

Halogen free replacement for RG_393_U

Item no.	22512282
Impedance	50 Ω
Max. operating frequency	6 GHz
Signal delay	4.7 ns/m
Min. bending radius static	50 mm
Min. bending radius repeated	100 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 78 dB up to 3 GHz



Composition of cable

1.	Centre conductor	copper/silver plated, strand	Ø 2.45 mm
2.	Dielectric	SPEX (crosslinked foamed polyethylene)	Ø 7.30 mm
3.	Outer conductor	copper, silver plated, braid 92 %	Ø 8.00 mm
4.	Outer conductor	copper, silver plated, braid 99 %	Ø 8.75 mm
5.	Jacket	RADOX®, black with blue stripe	Ø 10.05 mm +/- 0.15

Characteristics and specialities

- Environmental friendly alternative to RG_393
- Double screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- High flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable ENVIROFLEX_179 75 Ω

Halogen free replacement for RG_179_B/U

Item no.	23019104
Impedance	75 Ω
Max. operating frequency	1 GHz
Signal delay	4.8 ns/m
Min. bending radius static	7 mm
Min. bending radius dynamisch	27 mm
Temperature range	-40 °C to +105 °C

Composition of cable

1.	Centre conductor	steel, copper/silver plated, strand	Ø 0.31 mm
2.	Dielectric	SPEX (crosslinked foamed polyethylene)	Ø 1.55 mm
3.	Outer conductor	copper, silver plated, braid 94 %	Ø 2.13 mm
4.	Jacket	RADOX®, black	Ø 2.54 mm +/- 0.07

Characteristics and specialities

- Environmental friendly alternative to RG_179
- Double screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- High flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- DIN 5510-2 compliant

Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

Coaxial Cable GX_04273-12 75 Ω

Item no.	23029791
Impedance	75 Ω
Max. operating frequency	1 GHz
Signal delay	5.0 ns/m
Min. bending radius static	30 mm
Min. bending radius dynamic	90 mm
Temperature range	-40 °C to +105 °C
Screening effectiveness	≥ 40 dB up to 1 GHz

Composition of cable

1.	Centre conductor	copper/tin plated, strand	Ø 0.65 mm
2.	Dielectric	PEX (crosslinked polyethylene)	Ø 3.83 mm
3.	Outer conductor	copper, tin plated, braid 95 %	Ø 4.45 mm
4.	Jacket	RADOX® (GKW-S), black	Ø 6.1 mm +/- 0.1

Characteristics and specialities

- Single screened
- Halogen free
- Low smoke
- Flame retardant
- No toxicity
- High flexible
- Easy to strip

Application

- For flexible installations, inside and outside railway rolling stock

Standards

- BS 6853 compliant
- DIN 5510-2 compliant

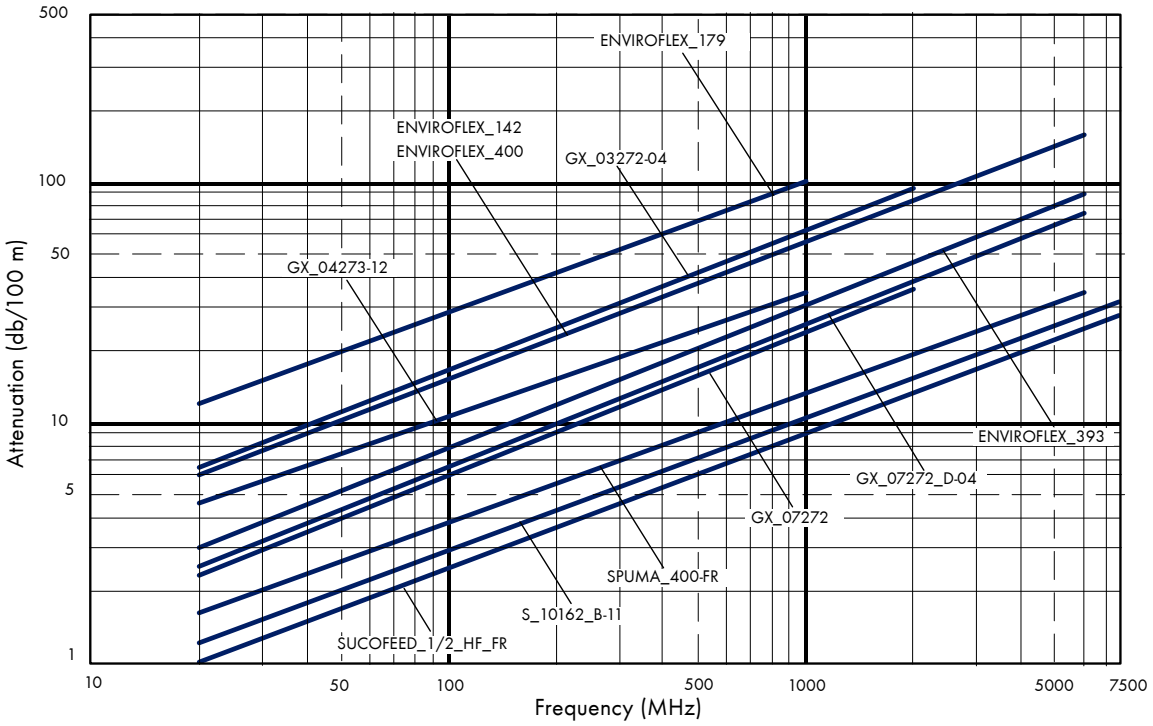
Information about attenuation and power are shown on page 115.

For further technical details please refer to our data sheet.

For suitable RF connector information please see our Coaxial Connectors General Catalogue, item no. 644802.

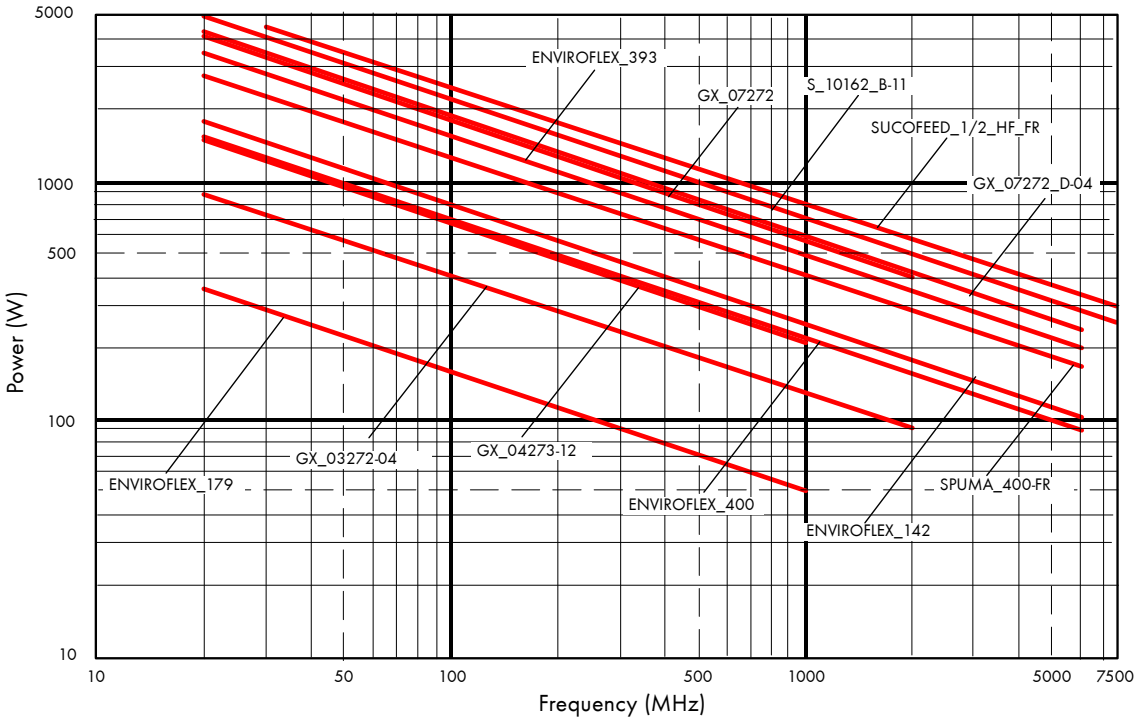
Attenuation

Coaxial cables for railway applications, 50 and 75 Ω
typical values at +20 °C ambient temperature



Power

Coaxial cables for railway applications, 50 and 75 Ω
typical values at +40 °C ambient temperature



RF Connectors

HUBER+SUHNER is one of the leading RF connector designer and manufacturer with a world wide sales and distribution network.

Series N connetors
- Available with 50 Ω and 75 Ω impedance
- Frequency range up to 18 GHz
- Screw-type coupling mechanism

Interface dimensions conformable to the standards:
- International: IEC 60169-16
- Europe: CECC 22 210
- USA: MIL-STD-348A/304

Series SMA connetors
- Pecision connectors up to 18 GHz
- High mechanical strength
- High durability
- High reliability
- Low VSWR

Interface dimensions conformable to the standards:
- International: IEC 60169-15
- Europe: CECC 22 210
- USA: MIL-C-39012, SMA interface MIL-STD-348a/310
- GB: BS 9210 N 0006
- F: NF-C-93563 (KMR)

Series BNC connetors
- Two stud bayonet coupling mechanism
- Frequencies up to 4 GHz
- 50 Ω and 75 BNC Ω connectors intermteable

Interface dimensions intermateable to the standards:
- International: IEC 60169-8
- Europe: CECC 22 210
- USA: MIL-C-39012, BNC interface MIL-STD-348A/301
- GB: BS 9210 N 004

RF Connectors

Series TNC connetors
- Frequency range up to 11 GHz
- Threaded coupling mechanism
- 50 Ω and 75 TNC Ω connectors intermateable

Interface dimensions conformable to the standards:
- International IEC 60169-17
- Europe: CECC 22 200
- USA: MIL-C-39012, TNC interface MIL-STD-348A/304

Series QMA connetors
- Frequency range up to 18 GHz
- 50 Ω impedance
- Snap-lock mechanism
- Cycle time improvement for making RF connections (10 times faster to mount than threaded connectors)
- No torque required
- Higher packaging density
- Free rotating connection when mated
- Eliminates loosening problems associated with threaded connectors
- Same electrical performance as equivalent threaded connectors
- QMA is not intermateable with SMA

Series QN connetors
- Frequency range up to 11 GHz
- 50 Ω impedance
- Snap-lock mechanism
- Cycle time improvement for making RF connections (10 times faster to mount than threaded connectors)
- No torque required
- Higher packaging density
- Free rotating connection when mated
- Eliminates loosening problems associated with threaded connectors

RF Trackside Products

HUBER+SUHNER supplies antennas, lightning protection components and DC blocks specially designed for installation along railway lines, in tunnels and at railway stations and depots. Special accessories are available for a variety of applications, e.g. mounting brackets, lightning protection components, DC blocks, RF power dividers and pre-assembled RF cables. HUBER+SUHNER products for railway applications are generally characterised by their robust design, reliability and excellent RF properties.

Trackside antennas

Trackside antennas are used for high data rate applications such as WiFi 2.4 GHz or WiMAX networks. Special accessories are available for different applications, e.g. brackets, lightning protectors, DC/DC blocks, power splitters and RF cable assemblies. The antennas are described in the catalogue "Antennas – Broadband wireless WiMAX and -WiFi".

Type designation		Antenna family	Remarks	Freq. min. [MHz]	Freq. max. [MHz]	Gain [dBi]	Pol.
Trackside							
1324.17.0098		SPA-2400/75/9/0/V_4	Directional NF-F-16-101 und 102 IP67	2400	2485	8.5	vertical
1351.30.0001		SPA-5100/40/14/0/V	Directional NF-F-16-101 und 102 IP67	4900	5350	13	vertical
1356.17.0077		SPA-5600/40/14/0/V_2	Directional NF-F-16-101 und 102 IP67	5150	5875	14	vertical

Please find further antennas and mounting accessories as well as full details in our catalogue „Antennas – Broadband wireless WiMAX and -WiFi" http://ipaper.ipapercms.dk/hubersuhner/Technologies/Radiofrequency/WIMAXWIFIEN/ and the individual data sheets.

Lightning protection components

The requirements during open-air installation on railway lines are similar to those for the installation of mobile communication base stations. Series 3407 components include DC decoupling of the protected connection. The WLAN broadband lightning protection is designed specially for WLAN 2.4 / 5.

Type	Description	Frequency range	IP Rating	Connector
3407.17.0085	Broadband Inline EMP Protector	2000 MHz up to 6000 MHz	68	N(m)/N(f)

Please find further lightning protection components as well as full details in our catalogue „Lightning Protection" <http://ipaper.ipapercms.dk/hubersuhner/Technologies/Radiofrequency/Lightningprotection> in EMP protectors and the individual data sheets.

High volage DC-Blocks

The HUBER+SUHNER DC Block product line include DC blocks (inner conductor disconnected) and DC/DC blocks (inner and outer conductor disconnected) for the galvanic isolation and large voltage disconnection for higher block voltages up to 15 kV. They block the large voltage rises and low-frequency surge voltages occurring during regular electric railway operation along railway lines.

Type	Description	Frequency range	Spannungsfestigkeit	Connector
9077.17.0016	Broadband high voltage DC-Block	140 MHz bis 2500 MHz	4kV	N(m)/N(f)
9077.17.0030	Broadband high voltage DC/DC-Block	160 MHz bis 2500 MHz	4kV	N(m)/N(f)
9077.17.0006	Broadband high voltage DC/DC-Block	180 MHz bis 2500 MHz	15kV	N(m)/N(f)
9077.17.0035	Broadband high voltage DC/DC-Block	160 MHz bis 6000 MHz	4kV	N(m)/N(f)

Please find further products as well as full details in our catalogue „Lightning Protection" <http://ipaper.ipapercms.dk/hubersuhner/Technologies/Radiofrequency/Lightningprotection> in DC-Block Series 9077 and the individual data sheets.

High frequency power splitter

The symmetrical RF power dividers are used for diversity transmission and for bidirectional track illumination. They feature low insertion loss and high adaptability.

Type	Description	Frequency range	IP Rating	Connector
5504.17.0005	Broadband power splitter	2000 MHz bis 6000 MHz	65	N(f)/N(f)

Please find further products as well as full details in our catalogue „RF and Microwave-Components" http://ipaper.ipapercms.dk/hubersuhner/Technologies/Radiofrequency/RFMWComponentsEN/ and the individual data sheets.

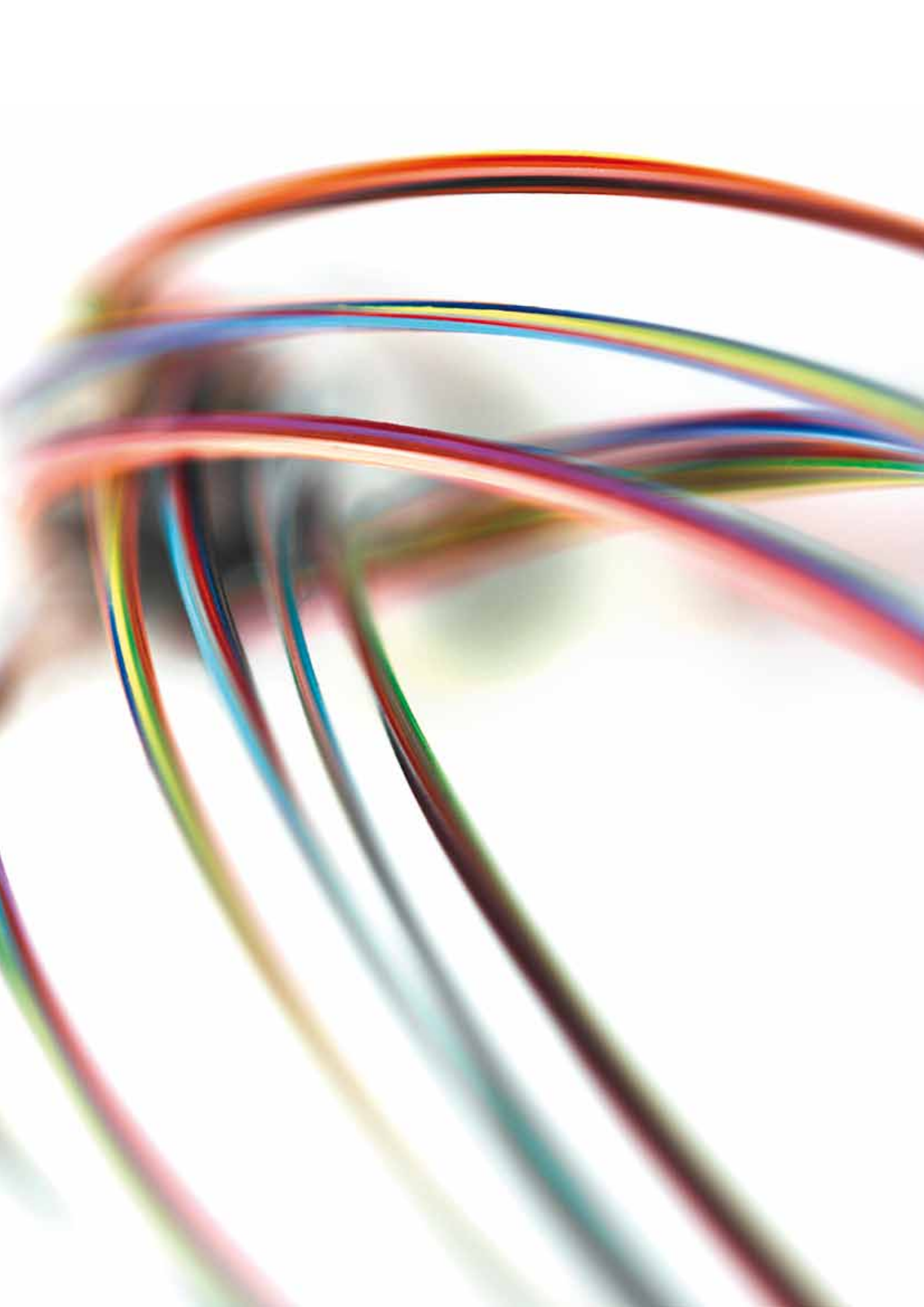
Cable assemblies

In addition to the special railway cable range, the broad range of industrial cables and connectors from HUBER+SUHNER is available, depending on the specific requirements placed on the installation.

Use our online configurator under
http://rfwebpcf.hubersuhner.com
to configure your cable assemblies quickly and efficiently!

RF components

Please find more RF components such as attenuators and terminations in our catalogue RF and Microwave Components" http://ipaper.ipapercms.dk/hubersuhner/Technologies/Radiofrequency/RFMWComponentsEN/.



Fiber Optic

HUBER+SUHNER provides optical connectivity technology, which is manufactured for the railway industry according to international and european standards. HUBER+SUHNER offers comprehensive solutions for complete fiber optic cabling through the whole train composition including fixed and moved installed cables in indoor and outdoor areas.

The fiber optic products for the railway industry are specially designed to resist high mechanical strains, big changes of temperature and critical influences like vibration, shock, humidity and UV radiation.

Fiber optic is resistant against electromagnetic interference and voltage peaks – a significant advantage for the transmission of high data rates on railway vehicles.

Further advantages compared to conventional copper connections and other available solutions are the low weight, the compact size and the high data rate.

Cabling Systems

Pre-terminated cabling systems for fixed installations in indoor or outdoor areas of railway vehicles guarantee a safe, installation friendly and time-saving mounting.

Features

- Fire retardant and halogen free components (LSFH™) for maximum safety in indoor areas
- Optimised divider in different designs for 2 to 144 fibers
- Conduit for additional cable protection
- Customer specific labeling
- Water proof and reusable pulling tube
- 100% tested, ready-to-install

Fiber optic cable systems that are mounted to the outside of trains require mechanical and thermal stability. These products are adapted and tailored to suit individual customer requirements.

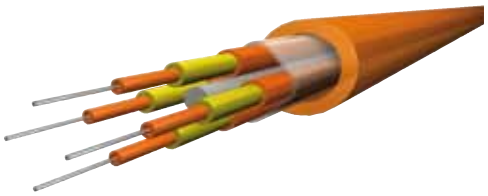
Features

- Long durability in moved applications
- Special designed with suitable cables
- Conduit for additional cable protection
- Customer specific marking and labeling
- Robust cable fixing
- Use of robust connectors
- 100% tested, ready-to-install

Fiber Optic Cables

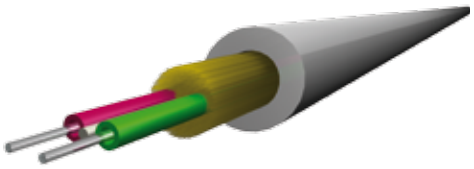
Cables for fix installations

The metal free cables fulfill high requirements concerning fire and personal security.



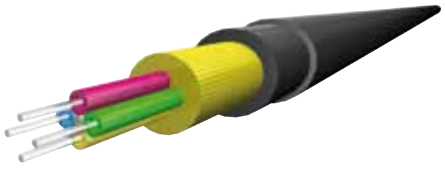
Breakout cable

- Up to max. 16 simplex cables
- Direct connector termination
- Fire retardant due to LSFH™ materials



RAILFO cable

- 2 fibers
- High mechanical and thermal stability
- Low smoke, halogen free und self-extinguishing
- According to the requirements of CEN/TS 45545
- For mounting on robust connectors

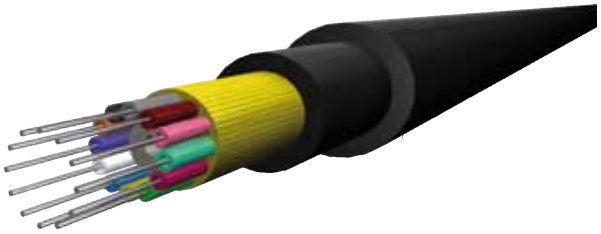


3 Star cable

- Up to max. 4 fibers
- High thermal and mechanical stability
- Low smoke, halogen free and self-extinguishing
- For mounting on robust connectors

Cables for dynamically moved installations

The metal free fiber optic cables are specifically designed for moved applications and offer a high mechanical and dynamic strength.



Jumper cable

- Up to max. 12 fibers
- Large temperature range
- High mechanical and dynamic resistance
- Highly flexible and although robust
- High abrasion resistance and compressive strength
- High chemical resistance against acids and bases
- For mounting on robust connectors

Fiber Optic Connectors

Connectors for protected environment

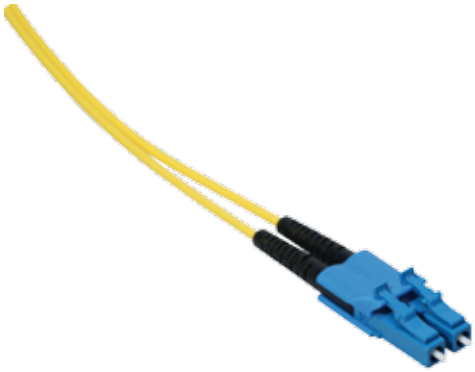
HUBER+SUHNER offers all common standard and „small-form-factor" connectors. Special types like the LSH (E-2000™) and LX.5 have a multifunctional, automatic metal shutter for dust protection and laser safety.

LSH (E-2000™)

- Latched push-pull connector
- Automatic metal shutter in connector and adapter for dust protection and laser safety
- Constant transmission due to long connector guiding
- Mechanical and colour coding of connector and adapter

ST-Security

- Internal suspension for uninterrupted connection
- Compatible to standard ST connectors
- Bayonet nut connector



LC-HQ

- Small form factor design for high packing density
- Easy coupling with push-pull
- Best handling with clip
- For connecting transceivers in switches
- Optional LX.5 with automatic dust cap

E-2000™ is manufactured under licence of DIAMOND SA, CH LOSONE

Connectors for harsh environment

The solutions of HUBER+SUHNER are specially designed and tested to resist against highest mechanical and thermic strains in harsh environment.

Q-ODC®

- 2 channels in singlemode or multimode
- Push-pull coupling mechanism
- Compact and robust design
- Secure coupling with two clearly defined mating states
- Protected fiber endfaces
- Water proof, dust proof and corrosion resistant
- EMI protected

ODC®

- 2 or 4 channels in singlemode or multimode
- Screwed locking mechanism
- Compact and robust design
- Easy and secure installation
- Protected fiber endfaces
- Water proof, dust proof and corrosion resistant
- EMI protected

Cable and Fiber Management

HUBER+SUHNER offers special components and solutions for fiber management systems on train vehicles. Special bend radius limiters, cable management elements and patch cord channels guarantee a technically professional and clearly arranged fiber management in the distribution rack.

LISA Fiber distribution systems

- Compact and robust construction
- For splicing and/or patching
- Optimized cable and fiber management
- Design according to customer requirements
- Compliance of minimal bend radii

Field Termination

With the HUBER+SUHNER Quick Assembly™ it's possible to terminate fiber optic connectors quickly and reliably on-site and with a maximum mobility and flexibility.

Quick Assembly™ – field termination system

- Quick termination process in 90 seconds, no set-up time
- Reliability and durability equal to factory termination
- Termination process adapted to all fiber types and performance levels
- All-in-one multifunctional tool
- Easy-to-carry on tool box for maximum mobility

Additional Information

Fire Protection Requirements for Traction Cables (Overview)

	Cable-Ø mm	Test method	Europe CEN/TS 45545-2: 2009 interior cables	Europe EN 50264: 2008
Vertical flame propagation		EN 60332-1-2	50 > L ≤ 540 mm	50 > L ≤ 540 mm
		NF C 032-070, 2.1	–	–
Vertical flame propagation, bunched	D ≥ 12	EN 50266-2-4	L ≤ 2.5 m	L ≤ 2.5 m
	6 < D < 12	EN 50266-2-5 EN 50305, 9.1.1	L ≤ 2.5 m	L ≤ 2.5 m
	D ≤ 6	EN 50305, 9.1.2	L ≤ 1.5 m	L ≤ 1.5 m
		NF C 032-070, 2.2		–
Smoke density		EN 61034-2	HL1: T ≥ 25 % HL2: T ≥ 50 % HL3: T ≥ 70 %	T ≥ 70 %
		X10-702-2	–	–
Toxicity		NF X70-100	–	–
		CEN/TS 45545-2, C.16.4	HL1: CITc ≤ 1.2 HL2: CITc ≤ 0.9 HL3: CITc ≤ 0.75	-
		EN 50305, 9.2	–	ITC ≤ 3
Corrosivity of combustion gases		EN 50267-2-2	–	pH ≥ 4.3 C ≤ 10 µS/mm
Amount of halogen		EN 50267-2-1	–	HCl + HBr ≤ 0.5 %
Content of fluorine		EN 60684-2, 45.2	–	HF ≤ 0.1 %

Europe EN 50306: 2002	Germany, Austria, Switzerland DIN 5510-2: 2009 interior cables	France, Belgium NF F 16-101: 1988 interior cables	Italy UNI CEI 11170-3: 2005
50 > L ≤ 540 mm	50 > L ≤ 540 mm	–	50 > L ≤ 540 mm
–	–	50 > L ≤ 540 mm	–
L ≤ 2.5 m	L ≤ 2.5 m	–	L ≤ 2.5 m
L ≤ 2.5 m	L ≤ 2.5 m	–	L ≤ 2.5 m
L ≤ 1.5 m	L ≤ 1.5 m	–	L ≤ 1.5 m
–	–	L ≤ 300 mm	–
HL1: no requirements HL2: T ≥ 60 % HL3: T ≥ 70 %	T ≥ 60 %	–	T ≥ 70 %
–	–	I.F. ≤ 20	–
–	–		–
–	–	–	–
HL1: no requirements HL2: ITC ≤ 10 for insulation HL2: ITC ≤ 5 for sheath HL3: ITC ≤ 6 for insulation HL3: ITC ≤ 3 for sheath	as EN 50264 respectively EN 50306		as EN 50264 respectively EN 50306
pH ≥ 4.3 C ≤ 10 µS/mm	pH ≥ 4.3 C ≤ 10 µS/mm		pH ≥ 4.3 C ≤ 10 µS/mm
HCl + HBr ≤ 0.5 %	HCl + HBr ≤ 0.5 %		HCl + HBr ≤ 0.5 %
HF ≤ 0.1 %	HF ≤ 0.1 %		–

Guide to Installation

Information regarding selection and installation of cables including current ratings can be found in EN 50355 and EN 50343.

Smallest acceptable bending radii

Installation method	For RADOX signal and power cables		For RADOX FR und databus cables	
	cable diameter		cable diametet	
	D <12 mm	D > 12 mm	D < 12 mm	D > 12 mm
- Fixed installation	3 x D	4 x D	5 x D	6 x D
- Flexible application [1]	4 x D	5 x D	–	
- Constantly moved	10 x D	10 x D	–	

[1] Correctly installed wires and cables which will be moved approx. 5 to 10 times per day (bending radius 90 °).

Conditions

The specified bending radii require a careful and proper handling using proven fastening technologies.

Cable lifetime reducing factors are:

- Number of bendings
- Tight bending radius
- High application temperature
- Bending at low temperatures
- Mechanical stress and improper installation

Allowable tensile stress

For installation cables by pulling on the conductor, or by drawing sleeve, the following max. pulling force (P) is allowed:

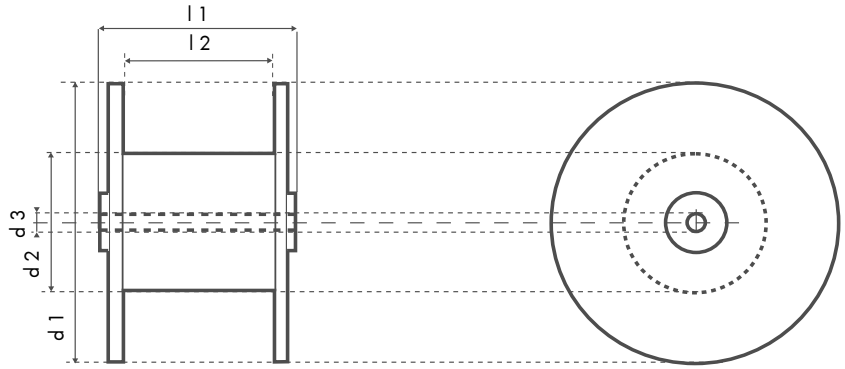
P = 50 x A (N)
A = Sum of conductor cross-section (mm^2)

Current carrying capacity

For the selection of the cable cross-section with regard to the current rating for continuous operation HUBER+SUHNER provides a produc specific documentation.

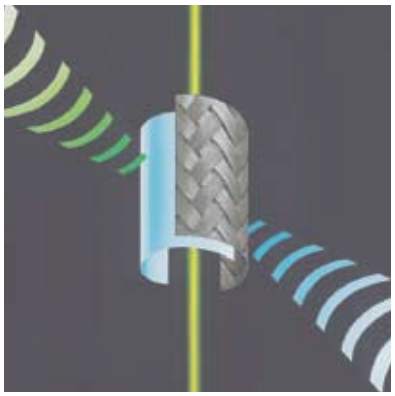
For further notes on installation, please see the relevant individual flyers/data sheets.

Delivery Spools



	Spool type													
	One-way spools													
	Nr. 5	Nr. 6	Nr. 7	DIN	L	L	L	L	LHL	LHL	LHL	LHL	LHL	LHL
				250	355	450/13	450/14	500	710	900	1050	1250	1400	1600
d 1	140	140	170	250	355	450	450	500	710	900	1050	1250	1400	1600
d 2	65	65	65	160	200	200	312	250	360	450	550	700	700	800
d 3	60	60	60	22	36	50	50	50	82	82	82	92	92	92
l 1	56	106	135	200	160	244	244	321	430	545	698	726	880	1025
l 2	50	100	130	160	150	228	228	305	400	450	600	630	760	900
Tara kg	0.08	0.10	0.15	0.71	1.54	2.48	3.02	3.16	10	36	53	74	120	174
Cable	Cable length per delivery spool m													
Ø mm														
1		970	2020	3710	8100									
2			500	930	2030	5820								
4					510	1450	940	2240	5880					
6					220	650	420	1000	2610	4770	8380			
8						360	230	560	1470	2680	4710			
10						230	150	360	940	1720	3010			
12								250	650	1190	2090			
14								180	480	880	1540			
16								140	370	670	1180			
18								110	290	530	930			
20									230	430	750	1060	1750	2710
22										350	620	880	1450	2240
24										300	520	740	1220	1880
26										250	450	630	1040	1610
28										220	380	540	890	1380
30										190	330	470	780	1210
32										170	290	410	680	1060
34										150	260	370	610	940
36										130	230	330	540	840
38										120	210	290	490	750
40											190	260	440	680
45											150	210	350	540
48											130	180	300	470

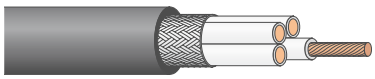
EMC screened Cables



The screening of cables can be described by the two coupling quantities of transfer impedance ZT and transfer admittance YT. Both coupling quantities are basically a function of the geometry and the environment; depending on the specific application and requirements, the coupling quantities can be optimized for a given cable.

EMI	electromagnetic interference
EMP	electromagnetic pulse
ESD	electrostatic discharge
LEMP	lightning electromagnetic pulse
NEMP	nuclear electromagnetic pulse
TEMPEST	tap-proofness (eaves-dropping protection)
NEXT	near-end crosstalk

With HUBER+SUHNER, your screening problems will end.
We can ensure this thanks to the vast experience accumulated in this field responding to every kind of customer need and collaborating continuously with research institutes.



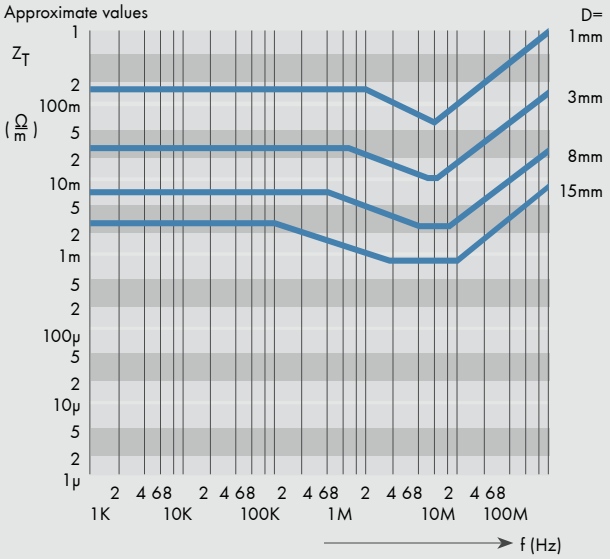
Measurement engineering at HUBER+SUHNER
Complies with the following standards:
IEC 96-1 and 46 A/DIN 47250/
VG 95373/CCITT/...

Screenings for all EMC requirements
HUBER+SUHNER designs, optimizes and produces products for a wide variety of performance classes. These products are implemented using different braids, foils, high-permeability intermediate layers, microwave-absorbing and semi-conducting layers, mixed screens, etc.

EMC screened Cables

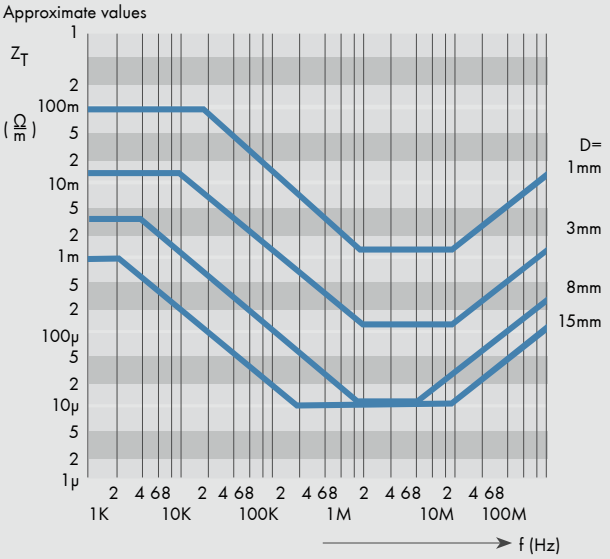
Screened cables from single braid to superscreen

Transfer impedance values of single braid screening



Transfer impedance values Z_T as a function of the frequency f and the cable diameter D as parameters

Transfer impedance values of superscreens



Transfer impedance values Z_T as a function of the frequency f and of the cable diameter D as parameters

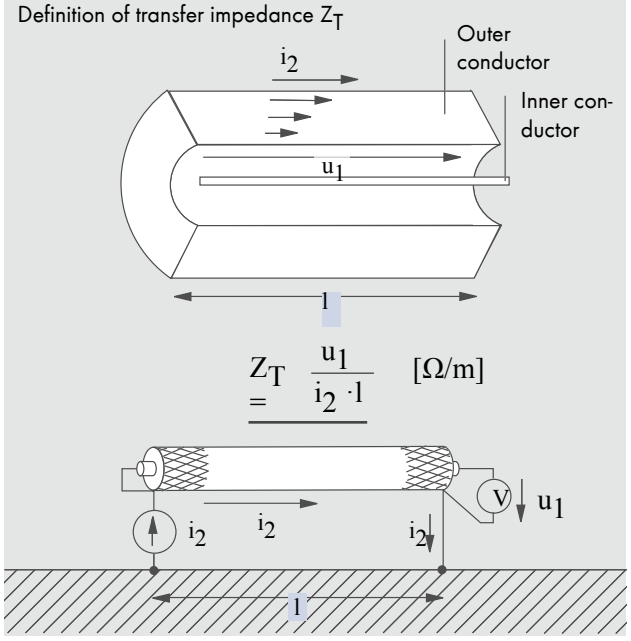
The transfer impedance Z_T

(also called "coupling resistance") refers to the relationship between the current in one wire and the longitudinal voltage it induces in the other wire (ohmic-inductive coupling).

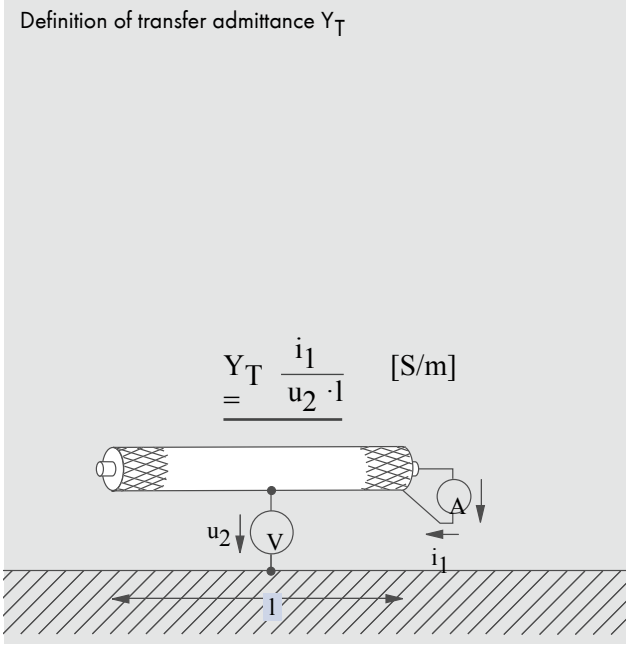
The transfer admittance Y_T

refers to the relationship between the voltage in one wire and the leak current it induces in the other line (capacitive coupling).

Definition of transfer impedance Z_T

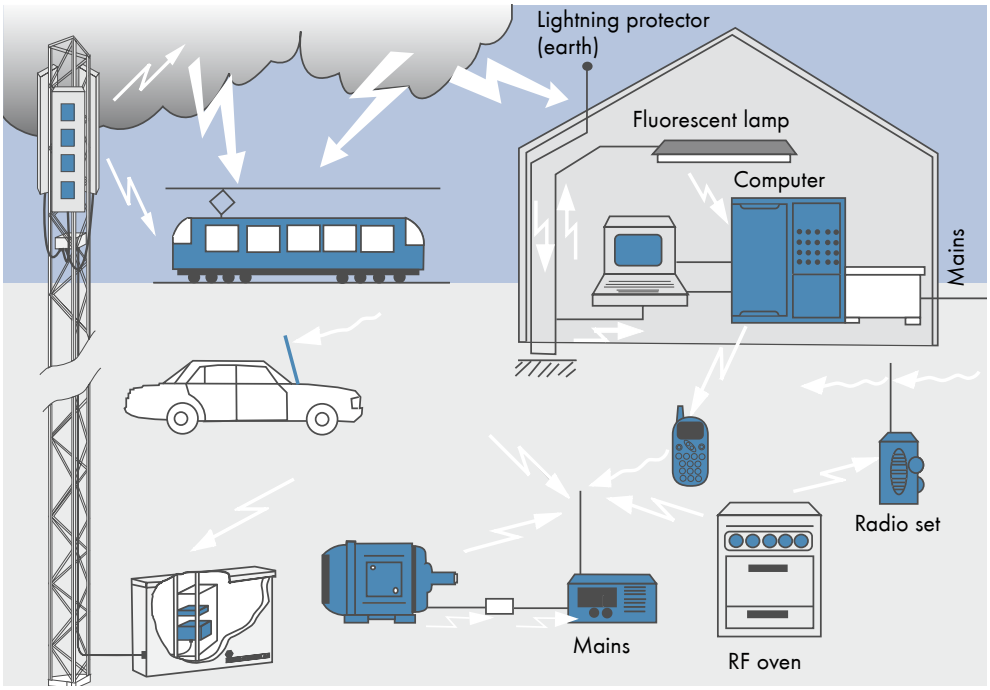


Definition of transfer admittance Y_T



The cable together with its surroundings form a three-conductor system. It consists of two coupled conductors with one common conductor (screen).
Transfer impedance Z_T and transfer admittance Y_T are cable quantities which are always defined in conjunction with the surroundings of the cable and the construction of the cable itself.

Protect your Equipment/Machinery against Interference and Failure

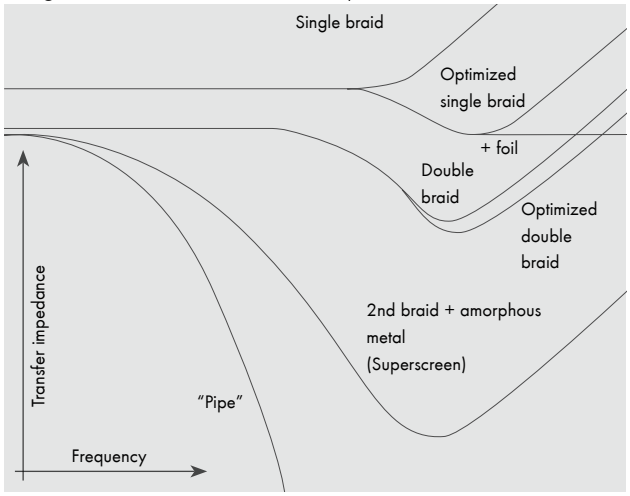


The situation

Environmental pollution is a modern buzzword. But do you ever think of it as "pollution" by electromagnetic radiation, by "electrosmog"?

Your problem

Only when machinery starts to fail and plant operation is disrupted do the people in charge start thinking. But things don't have to reach that point. Non-screened cables act in the same way as antennas, attracting interference from the outside or radiating it.



Our solution

Copper braids prevent dangerous interferences with cables. At the same time, the interference radiated by the cable is reduced. Our solution consists not only in the specification of a degree of coverage. HUBER+SUHNER also defines the effectiveness of a copper braid as a measurable quantity. This noise immunity is expressed by the transfer impedance (coupling resistance) at a given frequency (MHz) in Ω/m.

Optimized, high grade screening

Optimized screening braids enable even the most intractable screening problems to be solved. And in screening cables, we take care to ensure that performance of the screened cables will not be significantly affected in terms of flexibility, workability, weight and dimensions.

Further catalogues

RADOX® railway cables
acc. to EN 50264 and
EN 50306
Item no. 84072022

RailwayCableSystems

Item no. 84068664

Inter-vehicle systems

Item no. 84031286

Train-to-Shore Communication

Item Nr. 84112422

HUBER+SUHNER is certified according to
ISO 9001, ISO 14001, ISO/TS 16949 and IRIS.

WAIVER

It is exclusively in written agreements that we provide our customers with warrants and representations as to the technical specifications and/or the fitness for any particular purpose. The facts and figures contained herein are carefully compiled to the best of our knowledge, but they are intended for general informational purposes only.

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