

# LEONI Dacar® Automotive Cables



**The Quality Connection**

**LEONI**

## About us

**Our Automotive Cables business unit is the leading manufacturer of single-core automotive cables globally. In the ABS/sensor cable segment we are number 1 in Europe and North America as we are Europe-wide with LEONI Dacar data transmission and coaxial cable products.**

**Globally we are extending our position as a world market leader in data cables for vehicles.**

Being strategically located near our customers is at the core of all our Automotive Cables activities. This close proximity allows to identify requirements and market demand at an early stage and to develop innovative solutions together with our direct and indirect customers. The basis for our successful growth lies in our service as well as in the stability and ongoing optimisation of our production processes – the proverbial LEONI quality.

International outlook of our Automotive Cables activities and its worldwide production network is reinforced by the proximity to customers.

**Issue: July 2009**

*Subject to technical changes.*



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# Materials LEONI Dacar®

## Insulation materials

Symbol	Name e.g. DIN ISO 1629 and 7728	Code	Hardness Shore A/D DIN 53504 ± 5.0	Tensile strength DIN 53504 MPa	Elongation at break DIN 53504 %	Service temperatures ISO 2578/6722, DIN 0472 °C	Dielectric strength DIN 53481 kV/mm	Dielectric constant DIN 53483
Thermoplastics								
PVC-P	Polyvinyl chloride (plasticized)	Y	acc. to sample (75 A–95 A)*	>12,5	>150	–40 up to +90	>10	4–6
PVC-P	(heat resistant) lead free	YW	acc. to sample (90 A–97 A)*	>15	>150	–40 up to +105	>10	4–6
PE-LD-E	Cellular polyethylene	02Y	40D	>10	>100	–40 up to +85	>10	1.25–1.7
PE	Polyethylene	2Y	50D	>10	>300	–40 up to +85	>30	2.3
PP	Cellular polypropylene	09Y	50D	>15	>100	–40 up to +105	>10	1.5–1.7
PP	Polypropylene	9Y	70D	>25	>300	–40 up to +125	>30	2.3
FEP	Tetrafluoroethylene/hexafluoropropylene	6Y	55D	>15	>200	–65 up to +210	>30	21
ETFE	Ethylene/tetrafluoroethylene	7Y	75D	>30	>200	–65 up to +180	>30	2.6
Thermoplastic elastomers								
TPE-U	Thermoplastic polyether polyurethane	11Y	85 A–95 A	>30	>400	–40 up to +125	>10	7
TPE-O	Thermoplastic polyolefin elastomer	91Y	60 A–50 D	>10	>300	–40 up to +125	>20	3
Cross-linked plastics								
PE-X	Polyethylene, crosslinked	2X	95 A	>10	>200	–40 up to +125	>20	3–4

\* depends on recipe





## Conductor materials

	Symbol	Material Number	Conductivity at 20 °C	Density	Tensile strength	Elongation at break	Melting point
<b>Copper acc. to DIN 40500 Part 4</b>	E-Cu 58 F 21	2.0065	>58.0 m/mm <sup>2</sup>	8.9 g/cm <sup>3</sup>	>210 MPa	> 21 %	1083 °C
<b>Copper acc. to DIN EN 13602</b>	Cu-ETP1		>58.58 m/mm <sup>2</sup>				
<b>Copper clad steel wire</b>	Staku 40: Class 40 HS		23.2 m/mm <sup>2</sup> , >40 % IACS	8.2 g/cm <sup>3</sup>	>770 MPa	< 5 %	

## Galvanic coatings

Tin	
Designation	Tin 99.90
Density	7.29 g/cm <sup>3</sup>
Melting point	232 °C
Symbol	Sn

Silver	
Designation	Fine silver 99.97
Density	10.5 g/cm <sup>3</sup>
Melting point	960 °C
Symbol	Ag

# Coding key

The type designation provides information on the type of wire, the insulation and sheath materials used and the principle design features in abbreviated and simplified form.

A type designation is made up of several groups. The type of wire is specified first and then its construction from inside to outside.

## 1. Type of wire (German abbreviations)

<b>FL</b>	= Automotive wire
<b>FZL</b>	= Automotive ignition wire
<b>EFL</b>	= Automotive wires for electric vehicles

## 2. Special conductor materials (excl. electrolytic copper)

<b>M</b>	Materials other than E-Cu or resistance conductors (e. g. aluminium, steel, steel copper, etc.)
<b>W</b>	Resistance conductors (usually copper alloys with Ni, Cr, Mn, etc.)

## 3. Geometric construction of insulation

Normal thickness of insulation (equivalent to ISO 6722 "Thick wall") is not coded.

<b>U</b>	Greatly reduced thickness of insulation equivalent to ISO 6722
<b>R</b>	Reduced thickness of insulation equivalent to ISO 6722*
<b>S</b>	Reinforced insulation (thickness bigger than specified in ISO 6722)

\* The code can also be used for other thicknesses.  
The relevant standard or thickness is then also named.

## 4. Codes for the dielectrics

Code for the dielectrics used for the insulation and sheath.

<b>Y</b>	Soft-PVC (polyvinyl chloride)
<b>YW</b>	Soft-PVC, heat-resistant, hot-pressure resistant
<b>YK</b>	Soft-PVC, cold-resistant
<b>2Y</b>	PE (polyethylene)
<b>4Y</b>	PA (polyamide)
<b>6Y</b>	FEP (tetrafluoroethylene/hexafluoropropylene)
<b>7Y</b>	E/TFE (ethylene/tetrafluoroethylene)
<b>9Y</b>	PP (polypropylene)
<b>11Y</b>	TPE-U (thermoplastic elastomer on polyurethane basis)
<b>12Y</b>	TPE-E (thermopl. polyester elastomer on polyether ester basis)
<b>13Y</b>	TPE-E (thermopl. polyester elastomer on polyester ester basis)
<b>31Y</b>	TPE-S (thermopl. polyester elastomer on polystyrene basis)
<b>41Y</b>	TPE-A (thermopl. polyester elastomer on polyamide basis)
<b>51Y</b>	PFA (perfluoroalkoxy copolymer)

<b>91Y</b>	TPE-O (thermopl. polyester elastomer on polyolefin basis)
<b>X</b>	PVC-X (polyvinyl chloride crosslinked)
<b>2X</b>	XLPE (polyethylene crosslinked)
<b>4G</b>	EVA (ethylene/vinyl acetate)
<b>10Y</b>	PVDF (polyvinylidene fluoride)

In foamed materials the code is preceded by a "zero":  
e. g. **02Y** = foamed or cellular PE.

## 5. Codes for constructional elements

Codes for further constructional elements and non-extruded coverings (where applicable).

<b>B</b>	Foil shield
<b>C</b>	Copper wire braiding
<b>D</b>	Copper wire spiral shield
<b>G</b>	Glass fiber braiding
<b>P</b>	Insulation foil
<b>T</b>	Textile braiding

## 6. Special design features

<b>F</b>	Flat wire
<b>Z</b>	Multi-core wire with separable cores

## 7. Finally...

... the number of cores (except in the case of single core wires) and the nominal cross section in mm<sup>2</sup> are specified. Especially flexible or highly flexible stranded conductors are identified by additional specification of the nominal cross-section of the single wire.

In some cases the type of metal plating is specified for metal-plated copper wires as follows:

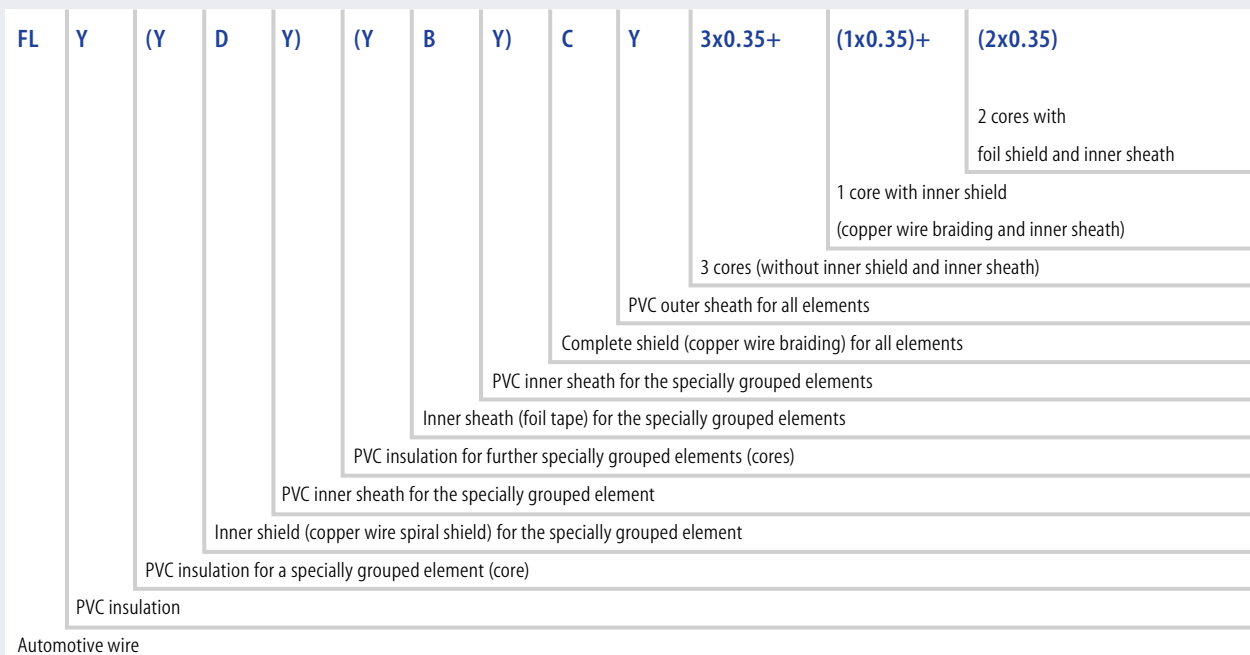
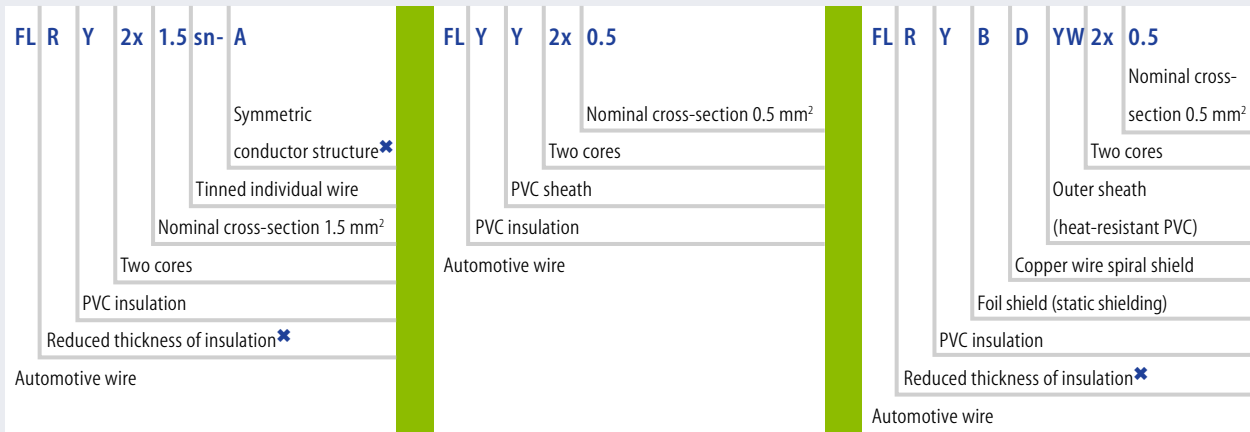
<b>SN</b>	tin-plated
<b>NI</b>	nickel-plated
<b>AG</b>	silver-plated

Bare copper has no special code.

Various components joined by specific structural elements (e. g. inner sheaths or inner shields) are grouped in parentheses in the type code (see examples of coding).

# Examples

## Multi-core cables



\* according to ISO 6722

# LEONI Dacar® Data Transmission Cables

Symmetrical data transmission cables  
for a wide variety of telematic systems.

## BENEFITS/PROPERTIES

- flexible
- heat resistant
- very good transmission properties
- outstanding coupling resistance and shield attenuation properties
- stable impedance
- lowest Alien Next
- superior environmental properties/recyclability
- flame resistant

## APPLICATIONS

CD changer, multimedia / MP3 player, TFT, rear view camera system, bus systems (Flexray/FireWire/CAN/USB), LVDS, mobile phone interface and iPod.

## PROPERTIES

- solid/foam dielectrics
- standard temperature range  $-40^{\circ}\text{C}$  up to  $+105^{\circ}\text{C}$
- high mechanical strength







# Probe Cables *Data transmission cables*



Code	Part Number	Cable structure	Conductor diameter	Core diameter	Shield type	Outer diameter
			[mm]	[mm]		
<b>LEONI Dacar 540</b>	76841012A	2x2x0.35+(0.35)	0.80	1.30	PETP-AL	6.20
<b>LEONI Dacar 541</b>	76881015A	2x2x0.35+(0.35)+(0.35)	0.80	1.30	PETP-AL	6.20
<b>LEONI Dacar 550</b>	76780000A	1x0.35+(0.35)	0.80	1.25	PVC-AL	4.10
<b>LEONI Dacar 551</b>	76780002A	2x0.35+(0.35)	0.80	1.30	PVC-AL	4.30

*Focused on communication.*



Insulation material	Jacket material	Service temperature	Capacity	Conductor resistance	Weight
		[°C]	[max. pF/m]	[ $\Omega$ /km]	[kg/km]
PVC	PVC	-40 up to +105	200	52	52
PVC	PVC	-40 up to +105	200	52	52
PVC	TPE-U	-40 up to +105	380	52	22
PVC	TPE-U	-40 up to +105	360	52	25

# LVDS + Bus Systems *Data Transmission Cables*



Code	Part number	Cable structure	Conductor material / shield type	Diameter over shield nom.
				[mm]
<b>LVDS</b>				
LEONI Dacar 501	76981008A	4x2x0.22+0.22	Cu bare / PETP-AL / C-shield	5.80
LEONI Dacar 502	76981009A	4x2x0.22+0.22	Cu bare / PETP-AL / C-shield	5.80
LEONI Dacar 503	76981003A	4x2x0.22	Cu bare / PETP-AL / C-shield	5.60
LEONI Dacar 505	76981000A	4x2x0.22+(0.22)	Cu bare / AL coated foil / C-shield	5.50
LEONI Dacar 506	76981020A	4x2x0.22+(0.22)	Cu tinned / AL coated foil / C-shield	5.50
LEONI Dacar 508	76981006A	5x2x0.22	Cu bare / PETP-AL / C-shield	6.50
LEONI Dacar 509	76981007A	5x2x0.22	Cu bare / PETP-AL / C-shield	6.00
LEONI Dacar 511	76981060A	5x2x0.22	Cu bare / PETP-AL / C-shield	6.00
LEONI Dacar 522	76981035A	2x0.14	Cu tinned / PVC-AL / C-shield	3.10
LEONI Dacar 538	76981056A	4x0.14	Cu tinned / PVC-AL / C-shield	3.40
<b>CAN</b>				
LEONI Dacar 520	79116800A	2x0.35	Cu bare / PETP	–
LEONI Dacar 560	76731000A	2x0.35	Cu bare	–
LEONI Dacar 562	76731010A	2x0.5	Cu bare / PETP	–
LEONI Dacar 565	76981030A	2x0.75+(0.75)	Cu bare / PETP-AL	–
<b>Flexray</b>				
LEONI Dacar 533	76981025A	2x0.35+(0.35)	Cu bare / PETP-AL	–
<b>Fire Wire</b>				
LEONI Dacar 536	76981040A	4x0.14	Cu tinned / PVC-AL / C-shield	3.40
<b>USB</b>				
LEONI Dacar 516	76981063A	(2x0.089)+2x0.24+(0.089)	Cu tinned / PETP-AL / C-shield	3.20
LEONI Dacar 518	76981065A	(2x0.35)+2x0.35+(0.35)	Cu bare / PETP-AL / C-shield	4.10

The table only shows an excerpt of our portfolio – please contact us for further cable designs.



*Your way to be connected.*



Outer cable diameter nom. [mm]	Insulation material		Jacket material	Service temperature [°C]	Impedance [Ω]	Weight [kg/km]
	1	2				
6.80	PE	–	PVC	–40 up to +90	100	56.0
6.80	PP	–	PVC	–40 up to +105	100	55.0
6.80	cellular PP	–	PVC	–40 up to +105	100	56.0
6.30	PE	–	TPE-U	–40 up to +90	100	51.0
6.30	FEP	–	TPE-U	–40 up to +110	100	61.0
7.40	PE	–	PVC	–40 up to +90	100	63.5
7.40	PP	–	PVC	–40 up to +105	100	71.0
7.00	cellular PP	–	PVC	–40 up to +105	100	69.0
4.60	PP	–	PVC	–40 up to +105	100	27.0
4.60	PP	–	PVC	–40 up to +105	100	34.0
4.90	cellular PP	–	TPE-U	–40 up to +105	120	22.0
5.00	TPE-O-X	–	TPE-U	–40 up to +125	120	28.5
5.40	TPE-O-X	–	TPE-U	–40 up to +120	120	31.0
8.00	cellular PP	–	PVC	–40 up to +105	120	62.0
4.80	cellular PP	–	PVC	–40 up to +105	100	28.0
4.60	cellular PP	–	PVC	–40 up to +105	110	32.0
4.30	PP	PVC	PVC	–40 up to +105	90	29.0
5.80	cellular PP	PVC	PVC	–30 up to +105	90	54.0

# Multimedia *Data Transmission Cables*



Code	Part number	Cable structure	Conductor material / shield type
<b>Multimedia</b>			
LEONI Dacar 594	76981103A	$(3 \times 0.14) + 4 \times 0.14 + 2 \times 0.5 + Z50 + (0.14)$	Cu bare / Copper clad steel conductor bare / PETP / C-shield
LEONI Dacar 805	76981108A	$(2 \times 0.055) + ((2 \times 0.14) + (0.14)) + 4 \times Z53$	Cu bare / PETP-AL / D-shield
<b>Car phone</b>			
LEONI Dacar 590	76981090A	$8 \times 0.22 + 2 \times 0.35 + Z50$	Cu tinned / Cu bare / PETP-AL / C-shield
LEONI Dacar 514	76981080A	$5 \times 2 \times 0.14 + 2 \times 0.5$	Cu tinned / Cu bare / AL-PETP-AL / C-shield
<b>iPod</b>			
LEONI Dacar 533	76981025A	$2 \times 0.35 + (0.35)$	Cu bare / PETP-AL
LEONI Dacar 592	76981025A	$((2 \times 0.089) + 2 \times 0.22 + (0.22)) + 2 \times (3 \times 0.089)$	Cu tinned / AL-PETP-AL / C-shield

*Pioneering digital entertainment.*



Diameter over shield nom. [mm]	Outer cable diameter nom. [mm]	Insulation material				Jacket material	Service temperature [°C]	Impedance [Ω]	Weight [kg/km]
		1	2	3	4				
5.50	6.70	PVC	PVC	PP	–	PVC	–40 up to +105	50	70
5.50	5.80	PP	PP	PP	–	PVC	–25 up to +90	53	54
5.60	6.70	ETFE	ETFE	PE	–	TPE-U	–40 up to +85	50	104
4.60	5.80	TPE-E	TPE-E	–	–	PVC	–40 up to +105	–	60
–	4.80	cellular PP	–	–	–	PVC	–40 up to +105	100	28.0
5.40	7.10	PP	PVC	PVC	PVC	PVC	–40 up to +105	90	75

# LEONI Dacar® Coaxial Cables

Coaxial cables for antennas made for special and standard applications.

## BENEFITS/PROPERTIES

- fits all standard components
- excellent properties for processing
- approvals from all major OEMs
- outstanding coupling resistance and shield attenuation properties
- stable impedance
- low signal attenuation
- best environmental properties/recyclability
- solid / foam dielectrics
- standard temperature range  
–40 up to +85 °C / –65 up to +205 °C
- standard diameter ranging from 1.6 to 6.7 mm
- standard impedances of 50/75/120/125/130 Ω available

## APPLICATIONS

GSM, GPS/Galileo, DVB, Radio, WCDMA, HSPDA, WLAN, WUSB, WiMAX, mobile broadcast, Car to Car Communication

## CUSTOMISED OPTIMISATIONS OF

- high frequency properties such as
  - EMC properties
  - Impedance
  - Reflection and transmission parameters
- mechanical properties
- chemical and thermal parameters based on inhouse material design and radio frequency laboratories







# Coaxial Cables *with foam dielectric*



Code	Part number	Cross section	Diameter of conductor	Conductor material	Diameter of core
		nom. [mm <sup>2</sup> ]	nom. [mm]		nom. [mm]
<b>50 Ohm</b>					
LEONI Dacar 031	85120003A	0.40	0.81	Cu bare	2.10
LEONI Dacar 037	85120030D	0.75	1.11	Cu bare	2.95
LEONI Dacar 302	85120380D	0.40	0.81	Cu bare	2.10
LEONI Dacar 380	85120385A	0.22	0.60	Cu bare	1.53
<b>75 Ohm</b>					
LEONI Dacar 360	85120370A	0.089	0.385	Cu bare	1.68
LEONI Dacar 362	85120381D	0.141	0.48	Cu tinned	2.10
<b>120 Ohm</b>					
LEONI Dacar 077	85120035D	0.055	0.32	Copper clad steel conductor bare	3.10

Code	Impedance	Capacity at 1kHz	Conductor resistance at 20 °C	Velocity of propagation	Weight					
	[Ω]	[pF/m]	[Ω/km]	[%]	[kg/km]	0.1	0.2	0.5	0.8	
<b>50 Ohm</b>										
LEONI Dacar 031	50.00	85.00	48.50	77	23.00	20.5	25.9	–	48.3	
LEONI Dacar 037	50.00	88.50	25.50	78	39.00	11.2	16.1	26	33.5	
LEONI Dacar 302	50.00	85.00	48.50	78	23.00	–	21.1	30.3	43.7	
LEONI Dacar 380	50.00	90.00	85.00	78	12.00	22.7	33.7	54.4	69.7	
<b>75 Ohm</b>										
LEONI Dacar 360	75.00	61.00	208.00	–	11.00	22.8	–	–	–	
LEONI Dacar 362	75.00	58.00	126.00	–	13.50	15.6	22.2	35.9	46.2	
<b>120 Ohm</b>										
LEONI Dacar 077	120.00	37.00	850.00	–	23.00	14.2	20.3	32.7	42.1	

Connecting the world.



Foil shield	Shield optical coverage nom.	Diameter over shield nom.	Shield material	Outer diameter	Material jacket	Material dielectric	Service temperature
	[%]			[mm]			[mm]
AL-PP-AL	92.00	2.65	Cu tinned	3.20	PVC	cellular PE	-40 up to +85
PETP-AL	95.00	3.58	Cu tinned	4.95	PVC	cellular PP	-40 up to +105
AL-PETP-AL	90.00	2.50	Cu tinned	3.20	PVC	cellular PP	-40 up to +105
AL-PETP-AL	80.00	2.03	Cu tinned	2.60	PVC	cellular PP	-40 up to +105
-	90.00	2.08	Cu tinned	2.70	PVC	cellular PP	-40 up to +105
-	89.00	2.50	Cu tinned	3.10	PVC	cellular PP	-40 up to +105
-	75.00	3.50	Cu bare	4.80	PVC	cellular PE	-40 up to +85

Attenuation [dB/100 m]															
Frequency [GHz]															
1	1.2	1.5	1.8	2	2.2	2.8	3	3.5	4	4.5	5	5.5	5.60	6	
53.5	58.6	65.3	72.4	76.7	81.7	95	99.1	110.0	120.0	131.0	141.3	151.2	153.5	161.1	
38	41.8	47.8	53.3	56.6	60	69.3	72.4	80.1	87.9	95.3	103.1	110.7	112.6	119.6	
48.9	53.6	60.5	66.3	70.5	74	84.4	88.1	96.6	104.2	112.3	120.4	127.8	129.3	134.9	
78.7	86.2	97.8	107.9	113.9	118.4	134.4	138.7	150.0	160.4	171.2	182.0	192.9	-	203.0	
74.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
52.1	57.5	65.1	-	-	-	-	-	-	-	-	-	-	-	-	
47.5	52.5	59.4	65.7	69.7	73.6	84.4	87.8	-	-	-	-	-	-	-	

# Coaxial cables *with solid dielectric*



Code	Part number	Cross section	Diameter of conductor	Conductor material	Diameter of core
		nom. [mm <sup>2</sup> ]	nom. [mm]		nom. [mm]
<b>50 Ohm</b>					
LEONI Dacar 100	85020350D	0.14	0.48	copper clad steel conductor	1.50
LEONI Dacar 110	85020610D	0.50	0.9	Cu tinned	2.95
LEONI Dacar 300	85120355D	0.14	0.5	copper clad steel conductor	1.52
LEONI Dacar 310	85122990D	0.50	0.9	Cu tinned	2.95
LEONI Dacar 400	85022050A	0.14	0.51	Copper clad steel conductor silver plated	1.48
LEONI Dacar 403	85022055A	0.15	0.51	Cu tinned	1.48
LEONI Dacar 410	85021080A	0.057	0.31	Copper clad steel conductor silver plated	0.81

<b>75 Ohm</b>					
LEONI Dacar 200	85023015D	0.182	0.55	Cu tinned	3.10
LEONI Dacar 450	85020360A	0.055	0.31	Copper clad steel conductor silver plated	1.60
LEONI Dacar 210	85040320D	0.22	0.58	Copper clad steel conductor bare	3.70

Code	Impedance	Capacity at 1kHz	Conductor resistance at 20 °C	Velocity of propagation	Weight
	[Ω]	[pF/m]	[Ω/km]	[%]	[kg/km]
<b>50 Ohm</b>					
LEONI Dacar 100	50.00	106.00	317.00	66	13.00
LEONI Dacar 110	50.00	105.00	41.00	66	39.00
LEONI Dacar 300	50.00	106.00	317.00	66	13.00
LEONI Dacar 310	50.00	105.00	41.00	66	39.00
LEONI Dacar 400	50.00	106.00	317.00	70	17.00
LEONI Dacar 403	50.00	98.00	125.00	67	14.00
LEONI Dacar 410	50.00	105.00	800.00	70	9.00

<b>75 Ohm</b>					
LEONI Dacar 200	75.00	70.00	97.00	–	36.00
LEONI Dacar 450	75.00	75.00	802.00	–	17.00
LEONI Dacar 210	75.00	73.00	157.00	–	56.00



Your link to mobile communication.



Shield optical coverage nom.	Diameter over shield nom.	Shield material	Outer diameter nom.	Material jacket	Material dielectric	Service temperature
[%]	[mm]		[mm]			[°C]
86.00	1.90	Cu tinned	2.80	PVC	PE	-40 up to +85
94.00	3.50	Cu tinned	4.95	PVC	PE	-40 up to +85
85.00	1.92	Cu tinned	2.80	PVC	PP	-40 up to +85
95.00	3.45	Cu tinned	4.95	PVC	PP	-40 up to +85
96.00	1.90	Cu silver plated	2.50	FEP	FEP	-65 up to +205
96.00	1.90	Cu tinned	2.50	TPE-E	FEP	-40 up to +125
96.00	1.25	Cu silver plated	1.80	FEP	FEP	-65 up to +205

95.00	3.70	Cu tinned	4.60	PVC	PE	-40 up to +85
92.00	2.00	Cu silver plated	2.60	FEP	FEP	-65 up to +205
94.00	4.35	Cu tinned	6.15	PVC	PE	-40 up to +85

Attenuation [dB/100 m]												
frequency [GHz]												
0.1	0.2	0.5	0.8	1	1.2	1.5	1.8	2	2.2	2.5	2.8	3
31.3	43.8	69.3	85.9	96.7	105.9	121.1	134.5	141.8	152.5	162.6	172.1	180.9
20.3	27.2	43.0	53.5	60.4	66.2	77.8	87.9	92.7	103.8	110.6	122.1	126.3
29.7	41.8	66.2	81.9	91.9	100.8	115.5	128.5	135.5	145.5	155.1	165.9	171.7
20.3	27.2	43.0	53.5	60.4	66.2	77.8	87.9	92.7	103.8	110.6	122.1	126.3
29.5	42.0	67.7	86.6	97.5	108.0	121.0	134.0	142.0	149.0	160.0	170.0	177.0
29.4	-	61.7	92.8	106.4	-	137.7	-	163.9	-	189.2	-	-
50.4	71.3	112.8	152.6	173.5	198.7	222.1	247.0	260.4	285.7	304.5	328.6	340.1

16	22.5	37.0	48.0	55.0	62.0	72.0	81.0	88.0	94.0	103.0	112.0	117.0
27.6	38.1	59.3	75.0	84.1	92.3	103.7	114.2	120.7	127.0	136.0	144.6	150.1
12.4	17.9	29.3	37.9	42.9	-	-	-	-	-	-	-	-

# LEONI Dacar® FP Automotive Cables

For Data communication between audio devices and airbag management in vehicles.

## BENEFITS / PROPERTIES

- easy and cost-efficient assembly
- very good processing properties
- insusceptibility to interference from electromagnetic radiation
- low weight
- large bandwidths
- direct assembly of sockets
- length 5,000 m
- where subject to heavy mechanical strain and in highly flexible applications with small bending radii

The core jacket always consists of two polyamide layers: a black inner jacket to rule out possible interference from outside light and a coloured outer sheath (blue, green, yellow or orange).

The fibre consists of a PMMA core and optimised double cladding.

The design significantly reduces the attenuation that occurs when the fibre optic cable is bent compared with standard polymer optical fibre.

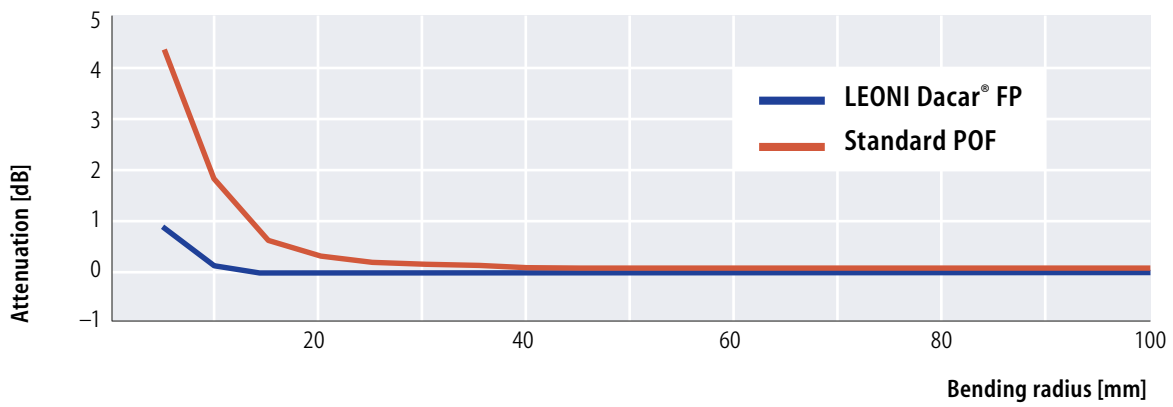
## Coding LEONI Dacar® FP:

Colour	Code Number	Part Number
orange	17	84A00500S262
green	C7	84A00500S666
blue	C8	84A00500S519
yellow	C9	84A00500S201

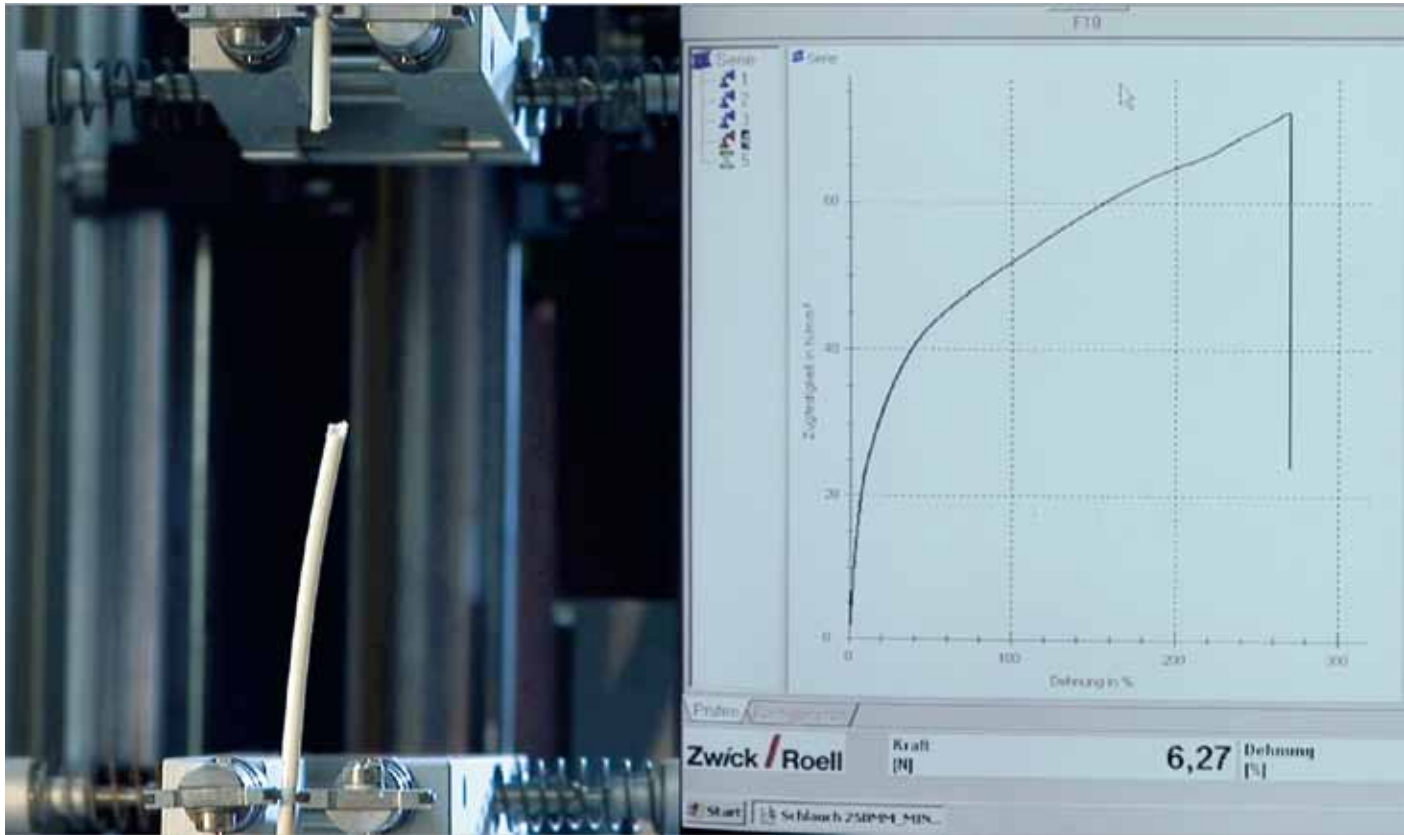


**Diagram:**

Dependance attenuation to bending radius (standard POF compared to LEONI Dacar® FP)



## LEONI Roth radio frequency lab



LEONI cables are used in various sectors and applications. They are therefore subject to differing mechanical, electrical and climatic requirements, which are specified and published in our data sheets. Radio frequency properties are significant especially when it comes to the coaxial and data cables of the LEONI Dacar® line. To meet these different requirements, we integrated a laboratory within the test lab at our facility in Roth fitted with state-of-the-art equipment for measuring and ascertaining the radio frequency properties of our cables. To guarantee a high level of production quality at all plants that are producing LEONI data cables the necessary measuring devices were installed and specialised staff in laboratories and quality management has been trained.

### Scope of the RF lab's activity

The tasks of the lab for radio frequency measurements are wide ranging. In addition to development and production-related measurements and analysis, the lab measures, evaluates and assures the cables' radio frequency properties pursuant to the pertinent national and international test standards as well as customer specifications in the context of qualification and re-qualification tests. The properties of cables under different ambient conditions such as cold, heat

(constant or cyclical changes) or humidity as well as various kinds of mechanical strain such as flex cycles and torsion are of increasing importance. This enables making predictions about the long-term behaviour and useful life of the cables in the various areas of use.

The characteristic impedance (wave impedance) of a cable can be ascertained by various measurement methods. Time domain reflectometry (TDR) determines and shows the pattern of a cable's wave resistance over time. The impedance pattern is scrutinised for irregularities, i.e. for reflections in the cable's make-up. This makes it possible to identify and correct for example discontinuities or damage caused in the manufacturing process or during fitting. A network analyser makes it possible to ascertain all the key parameters of a cable. The wave impedance is determined indirectly by means of two reflection measurements set off against each other. This complex process makes sure that the measured impedance of the cable is only marginally affected by the properties of the measuring instrument and the measuring set-up. Due to the modern equipment that, besides different standard network analysers also comprises a symmetric network analyser, measurements become



possible that go far beyond the limitations of usual baluns (symmetric transmitters).

Rather like four-terminal attenuation, the parameter of wave attenuation describes the transmission property of a cable depending on its length and is usually quoted in the unit [dB/100m] on data sheets and in specifications. Either wave or four-terminal attenuation enables determining the maximum length of a cable along which reliable and faultless data transmission is possible.

In the case of cables with either a foil or braided shield, or a combination of the two, the quality of the shield is determined by measuring the electromagnetic radiation of the cable by means of line injection or triaxial measuring methods. Both measuring methods can be performed in the radio frequency lab at LEONI. Measurements of shield attenuation values beyond –100dB can be carried out using the shield attenuation chamber set up for the line injection method.

Besides the desired effect, the transmission of signals, all methods of transmitting data involve unwanted noise transmission. These effects are defined by several different terms like NEXT, FEXT, PSNEXT, ELFEXT, ALIENNEXT, etc. When an electrical signal, such as a data signal, is transmitted via a core pair that is fed through a cable with several other core pairs (for instance star quad cables), this signal is coupled to other core pairs. The intensity of coupling the signal to another core pair is described, depending on the end at which the interfering signal is received, by the parameters of either near-end crosstalk (NEXT) or far-end crosstalk (FEXT).

### Overview of the RF lab's equipment

- Digital Sampling Oscilloscope 20GHz/tr=17.5 ps
- Symmetric Network Analyser 300 kHz up to 8 GHz
- Network analyser 300 kHz to 8.5 GHz
- Precision LCR meter 10 Hz to 1 MHz
- Shield attenuation chamber with measuring space for the line injection method
- Network analyser 30 kHz to 4 GHz
- Triaxial measurement tube 1–3 m, climate chamber for measurements under climatic conditions with temperatures ranging from –40 °C to +180 °C

### Radio frequency properties of cables

Transfer parameters:

- Impedance
- Structured return loss
- Attenuation
- Shield attenuation
- Transfer impedance
- Cross-talk (NEXT, FEXT, PSNEXT, Alien NEXT)

Primary cable parameters:

- $R' / G'$
- $C'$
- $L'$

LEONI has invested repeatedly over the past few years to bring the RF laboratory within the LEONI group to such a high level it is currently at. With their automated measuring systems, the production plants are able to record all RF parameters that are relevant to the production. This guarantees a stable and high level of quality of the transmission parameters. The facility of Roth, as development and competence centre, has been equipped with additional high-precision measurement devices. This equipment allows us to respond to the highest quality and performance requirements from the development phase to serial production.

Neither the ongoing expansion nor further development of measurement methods in the area of high frequency measuring is just for internal purposes, but rather also important to serve the interests of our customers.



# Quality management

Automotive Cables

## LEONI quality management

We are able to satisfy the exceptionally high standards of our customers from the automobile industry. The quality management at all the LEONI Wire and Cable locations throughout the world is certified as complying with ISO 9001:2002; locations producing automotive cables are also certified according to ISO/TS 16949:2002. Our efforts are concentrated on preventive quality assurance involving fault-inhibiting instruments such as FMEA or machine and process capability analysis.

We use state-of-the-art systems to continuously measure, monitor and control the diameter and dielectric strength of our cables and wires during the production process. Regular testing of random samples guarantees product compliance with the required limit values. With these tests conducted directly alongside the production line it is possible to respond quickly to any faults.

Product properties are tested in accordance with our customers' own specifications and/or German and international standards. They include:

- **cable and wire behaviour under extreme temperature conditions**
- **functionality after artificial ageing**
- **resistance to fuels, lubricants and environmental influences**
- **resistance of the insulated covering to stretching, abrasion and tearing**
- **mechanical and electrical properties of the conductor**
- **alternate bending strength and resistance to torsion**

Through the combined efforts of these quality assurance activities we are able to continuously optimize our ambitious quality goals.



## LEONI environmental management

For us, business success with ecological responsibility is not a contradiction in terms. As a globally active producer we acknowledge our co-responsibility in protecting the world's natural resources and basis of life. It is our objective to strike a harmony between nature's needs and our company's interests. As such, environmental protection is an intrinsic element of our corporate activities. We motivate our contractual partners to follow environmental guidelines that are equivalent to our own and advise our customers on how to use and dispose our products in an environmentally responsible manner.

Our environmental management system is certified as complying with DIN EN ISO 14001, confirming that our environmental policy is effectively implemented.

## LEONI worldwide

Cable facilities of the LEONI group

<b>Germany</b>	→ LEONI Kabel GmbH, LEONI HighTemp Solutions GmbH
<b>China</b>	→ LEONI Cable (Changzhou) Co. Ltd.
<b>Hungary</b>	→ LEONI Kábelgyár Hungaria Kft.
<b>Poland</b>	→ LEONI Kabel Polska S.p.z.o.o.
<b>Mexico</b>	→ LEONI Cable Mexico S.A. de C.V.
<b>Turkey</b>	→ LEONI Kablo ve Teknolojileri San. ve Tic. Ltd. Sti.
<b>Slovakia</b>	→ LEONI Slovakia spol. s.r.o.

### ● Sales offices of the Automotive Cables business unit

### ● Production facilities of the Automotive Cables business unit



## LEONI news

Our regularly updated information services such as the customer publication "LEONI inTeam" keep you abreast of recent developments at LEONI and on the market, either by mail or by e-mail. So that we can tailor our choice of topics even more closely to your requirements and interests, we would be delighted to receive your suggestions and comments.

Proximity to our customers is a core element of our corporate policy. LEONI is a dependable partner to its customers – all over the world. We also regard maintaining, as well as raising quality and service at the same high level everywhere in the world as a sign of proximity.

We support efficient operating as well as our customers' power of innovation and market position on the basis of our own international positioning, standardised methods and clearly defined processes. No matter where we apply and realise our know-how, commitment and ideas: we want confident customers around the world.

**Visit our website**  
**[www.leoni-automotive-cables.com](http://www.leoni-automotive-cables.com)**



**LEONI Kabel GmbH**

Automotive Cables

Stieberstrasse 5

91154 Roth

Germany

Phone +49 (0)9171-804-2218

Fax +49 (0)9171-804-2232

E-mail [cable-info@leoni.com](mailto:cable-info@leoni.com)

[www.leoni-automotive-cables.com](http://www.leoni-automotive-cables.com)