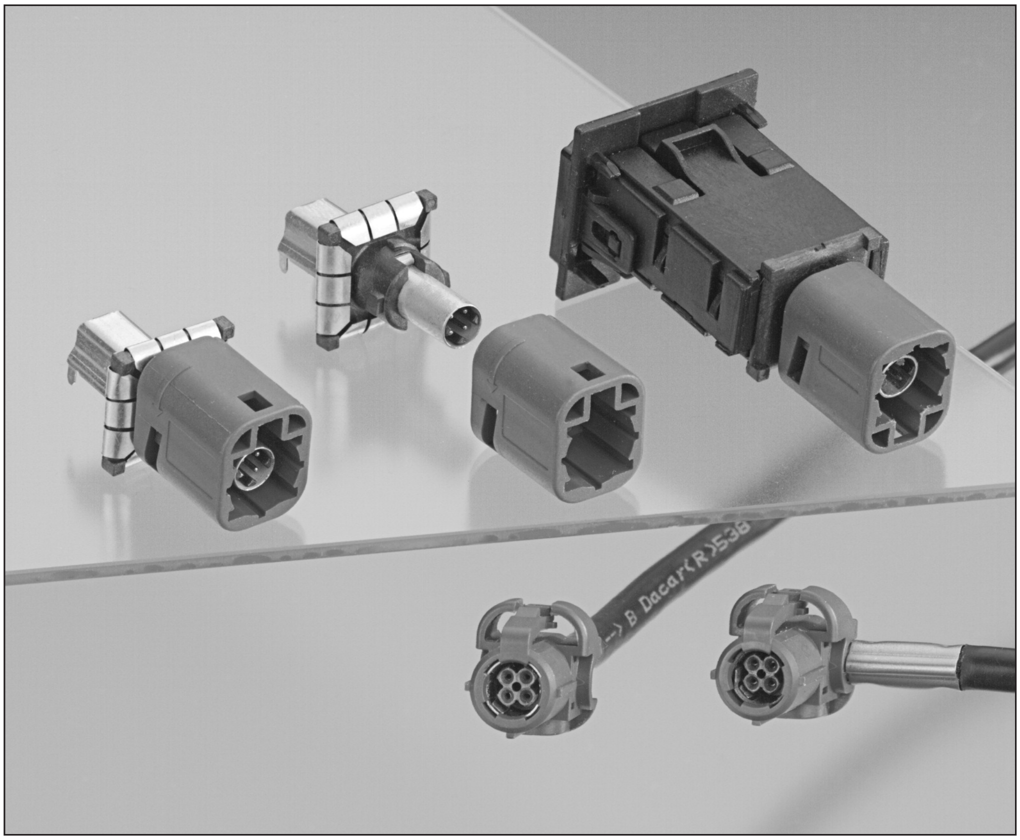
Automotive Compatible High Speed Data Connection Portfolio



The requirements for High Speed Data connection systems based on Shielded Twisted Pair (STP) or Shielded Star Quad (SSQ) cable is increasing greatly. These requirements are been driven by the growth and complexity of Telematic and Information applications being introduced in the automobile. TE Connectivity's commitment to support this technology segment has been strengthened with the introduction of the HSD (High Speed Data) product portfolio.

The HSD (High Speed Data) product portfolio is focused on various application areas in the automobile, such as the inside compartment for connections to displays, head units, cluster displays and rear seat infotainment modules. Additionally the portfolio covers harsh environment conditions for camera applications such as bumper zones or side mirrors.

The product portfolio can be used in combination with a variety of protocols such as LVDS (Low Voltage Differential Signaling), GVIF (Gigabit Video Interface), USB, IEEE 1394 as well as Ethernet protocols.

TE Connectivity has incorporated its broad spectrum of knowledge and experience in the development of this product portfolio. This knowledge and experience is not just restricted to over 40 years automotive experience, supporting every global OEM in their connection requirements, but also supporting the Infotainment requirements of OEM's and Tier 1's for over 12 years with coaxial, optical as well as connection systems based on STP.

Once more, TE Connectivity offers a world class product portfolio exceeding the market requirements, offering a full product spectrum covering connectors and if required cable assemblies.

Product Features

- Full product range of header connections based on the planned AK (German OEM Working Group) Interface
- Full product range of connectors based on the planned AK (German OEM Working Group) Interface
- Sealed applications ideal for camera connections
- All connections available through cable assemblies if required
- Products compatible to AK (German OEM Working Group) as well as USCAR requirements

USCAR is a trademark

Standardized Data Transmission Systems are Using the Serial Data Processing

Today standard data transmission systems are using the serial data processing. Due to the serial data processing the number of conductors and single contacts in a connector can be drastically reduced. This is necessary due to proceeding miniaturization of connecting devices. On the other hand the whole data processing will be transmitted by one (or only a few) cable therefore a higher bandwidth is mandatory. In the following the fundamentals of serial data processing and influences will be described.

Fig. 1

Differential Data Transmission

The differential data transmission offers an advantage over the noise immunity combined with a low emitted interference compared to the asymmetrical signal transmission. The reason for that is, that the differential data signal is lead through twisted pair wires and an external interference affects both wires with the same intensity. This results in a constant differential signal under ideal conditions.

➔$\Delta U = (U_+ + U_{interfer}) - (U_- + U_{interfer})$ = const. Emissions are minimized due to the erasement of the electromagnetic fields beyond the twisted cable affiliation.

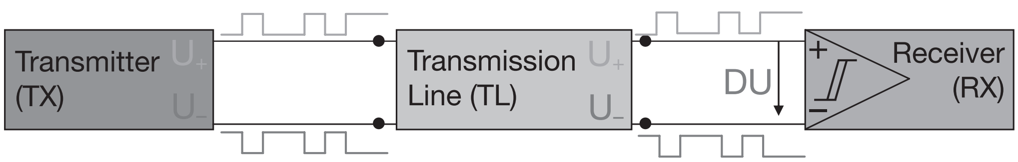


Fig. 2

Parameters of Data Transmission Cables in the Time Domain

Impedance

The impedance in the Time Domain describes the current/voltage ratio along the signal propagation direction on a data transmission channel. The impedance is not the same as the ohmic resistance. The absolute value needs to be constant in common with the system impedance along the whole data transmission line in order to avoid signal reflections. Due to connector-mechanic reasons this target is not achievable at all times. Target is to minimize the impedance aberration and the spatial width in the connector. The impedance is largely defined by the connector geometry, the distance between the conductors and the dielectric constant. Therefore the impedance will be influenced by an appropriate insulation material (ε_r) (see Formula 1).

$$Z \sim \sqrt{\frac{1}{\varepsilon_r}}$$

Formula 1

Time Delay

Time Delay describes the time it takes for an electrical signal to pass through a specific distance. With s = distance and v = velocity –> time delay t = v * s. The typical velocity of the HSD system is about 2/3 of the speed of light in vacuum (c_0 = 300000 km/s). This is caused by the mechanical additive length of the wire conditioned by the twist on one hand and by the material properties of the transmission line on the other hand. The velocity (v) is mainly influenced by the dielectric constant (see Formula 2).

$$v \approx c_0 \cdot \frac{1}{\sqrt{\varepsilon_r}}$$

Formula 2

Intra Pair Skew

Intra Pair Skew describes the difference of the propagation delay between electrical signals within a signal wire pair. This will be influenced by the mechanical length differences of conductors within a signal pair or by different dielectric constants. This mainly appears in 90° variants of connectors. HSD 90° headers have a basic grid of 2 mm which results in a length difference of 4 mm between 2 conductors of a pair. This implicates approximately 20 ps difference in time delay. Intra Pair Skew causes signal distortions and a decrease of the transmission bandwidth. Furthermore higher electromagnetic emissions and lower noise immunity takes place.

Inter Pair Skew

Inter Pair Skew describes the difference of the propagation delay between two or more signal wire pairs in one cable. The reasons for Inter Pair Skew are comparable with Intra Pair Skew. Inter Pair Skew leads into a reduction of bandwidth due to the fact that with most of the multi-channel data bus systems all datas must be valid simultaneously. Otherwise the time frames for a secure acceptance of valid information must be set unnecessary high.

Eye Diagram

The graph of the eye diagram (Fig. 3) of digital signals provides a first quantification of the signal quality. Therefore an array of curves will be superposed. The time trigger can be chosen as fixed or regained out of the signal. This depends on the parameter chosen to be measured. An ideal signal quality is indicated by an eye of rectangular form that means with high signal rise time and a constant amplitude. For the appraisal of the eye diagram it is of importance that a high signal rise time or a flat amplitude response with a visible noise may cause a high bit error rate. Therefore the probable bit error rate will be calculated via the eye diagram using statistical methods.

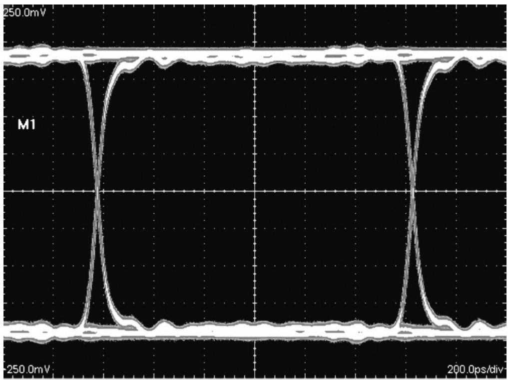


Fig. 3

From Time Domain to Frequency Domain

In order to get a sufficient description of the data transmission line in the frequency range it is useful to have a look at the frequency spectrum which has to be transmitted. A continuing rectangular pulse pattern consists of (referring to Fourier) a sum of sinus and cosinus functions (Fourier composition). Every signal in the time domain can be degraded in its several spectral frequency shares. The decay of the amplitudes of each spectral frequency will be determined by the signal rise time. The fundamental frequency will be determined by the signal period time.

Regarding the outcome of Fouriers decompensation with a finite number of harmonics (5. harmonic = 11 * f_0). So the superposition of the several harmonics will lead into a continuing rectangular pulse pattern again (see Fig. 4, Fig. 5). As a result a data transmission line must not transmit only the fundamental wave but also even higher frequencies to avoid signal distortion.

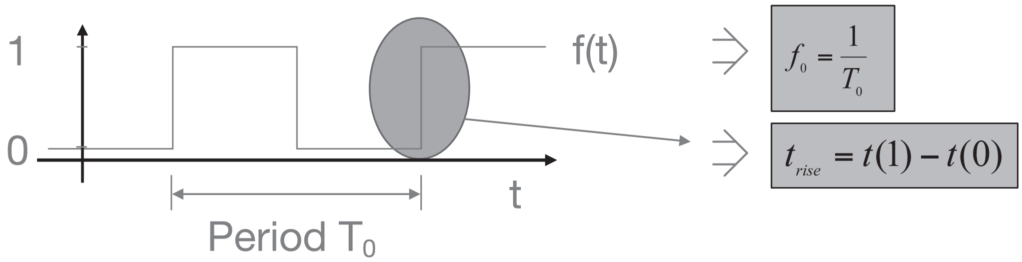


Fig. 4

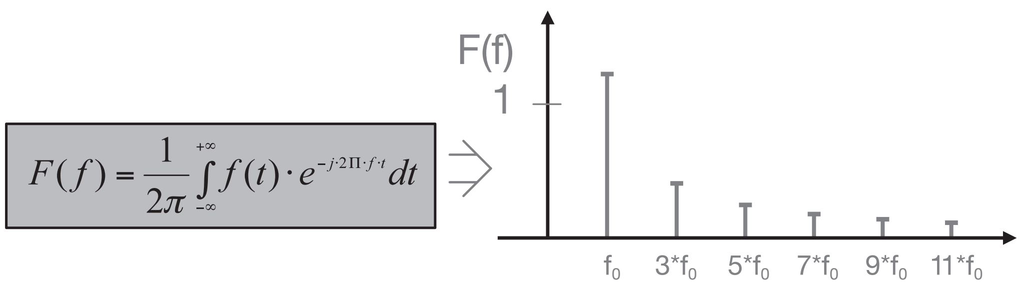


Fig. 5

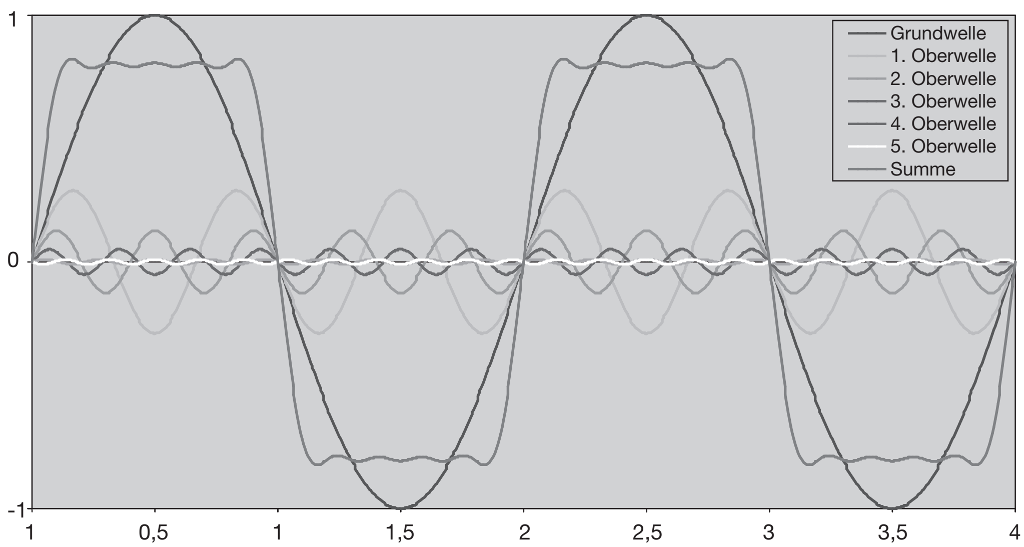


Fig. 6

Important Parameters of the Frequency Range

The description of a time discrete signal with the aid of the Fourier composition shows the importance of analysing parameters in the frequency range.

Attenuation:

Attenuation is the ratio of output voltage to input voltage of a transmission network $D = U_1/U_0$ (see Fig. 1). Normally the logarithmic voltage ratio is declared (see Formula. 3). In the lower frequency range attenuation is mainly caused by ohmic loss (conductance, conductor cross-section). With increasing frequency the dielectric losses and current displacement (Skin Effect) will be added.

$$D[dB] = 20 * \log\left[\frac{U_1}{U_0}\right]$$

Formula 3

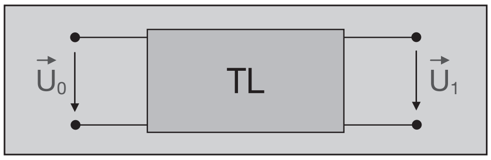


Fig. 7

Reflection Loss

Reflection loss is the ratio between the reflecting signal amplitude $U_{refl.}$ and the transmitted signal amplitude U_0 (see Formula 4, Fig. 8). Reasons for bad reflection loss ratio are inhomogeneities of the impedance on the transmission network. These are mainly caused by inhomogeneous geometries, inhomogeneous dielectrica and frequency depend dielectric constants of the insulating material.

Good Reflection loss values, even at higher frequencies, imply short lateral dimensions of possible impedance fluctuations.

$$A_{refl.}[dB] = 20 \cdot \log\left[\frac{U_{refl.}}{U_0}\right]$$

Formula 4

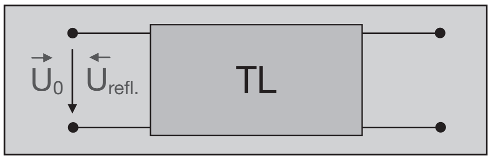


Fig. 8

Crosstalk

Crosstalk is an undesirable transmission of electrical signals between two or more transmission media due to inductive or capacitive coupling. More reasons are inhomogeneities of the transmission media and Skew effects in the signal transmission pair. Crosstalk causes on the one hand additional attenuation on the transmitted signal and on the other hand undesirable signal distortion on the adjoining signal channels. There are two different kinds of Crosstalk:

- Near End Crosstalk (NEXT, see Fig. 9)
- Far End Crosstalk (FEXT, see Fig. 10).

$$NEXT[dB] = 20 \cdot \log\left[\frac{U_{NEXT}}{U_0}\right]$$

Formula 5

$$FEXT[dB] = 20 \cdot \log\left[\frac{U_{FEXT}}{U_0}\right]$$

Formula 6

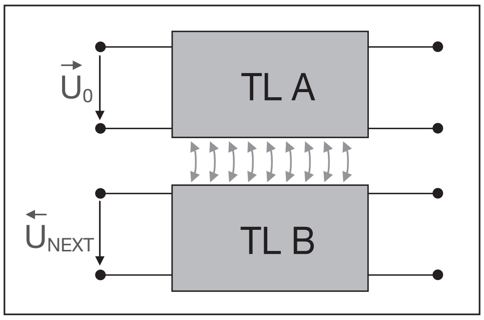


Fig. 9

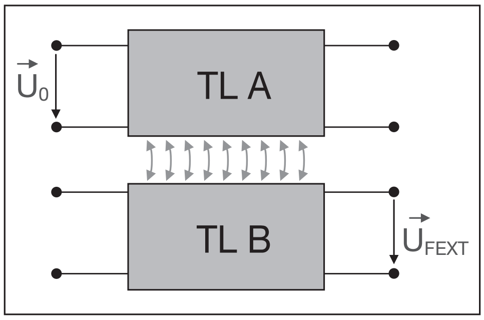


Fig. 10

EMC

EMC is the generic term of radiation and immunity of electrical systems. Radiation may cause a negative influence on adjoining systems. A high immunity is a fundamental assumption to avoid erroneous data transmission. Missing or insufficient shielding causes also a bad EMC performance, this will be improved by using twisted pair cables. Aside from optimal requirements a bad connection of the component shields, connectors, housings and wires also causes a bad EMC performance. Furthermore Skew effects will influence the EMC performance negative. For passive components as connectors and wires it is necessary to mention the shielding effectiveness. Their must be diefferentiatied between shielding effectiveness and coupling attenuation. Shielding effectiveness describes the behaviour of the shielding of the “coaxial” cable shield only. Coupling attenuation is the combination of the shielding effectiveness and the common mode rejection of the signal pair. The performance of the shielding connectivity of PCB Connectors (Pin Header) relating to a metallic device housing is very important for the shielding performance. The quality of such a connection can be described with the parameter Bulkhead Feed-Through.

Cable

The applied interconnection cable is designed as a star quad. Detailed information concerning the cable are listed in several data sheets of the cable manufacturers. The construction shown in Fig. 10 shows the principle construction of the star quad cable.

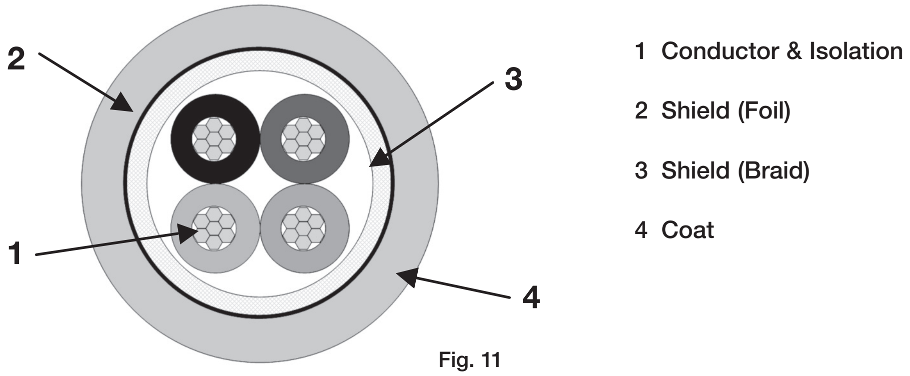


Fig. 11

Engineering Notes

Pin Header 90°

Interface

According to
HSD Interface Drawing:
114-18950

Documents

Application Specification
114-18867: HSD Pin Header

Product Specification
108-94105: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawing:
1823071: HSD Pin Header 90°

Material and Plating

Center Contact:
CuZn35Pb2, gold plated (Au)

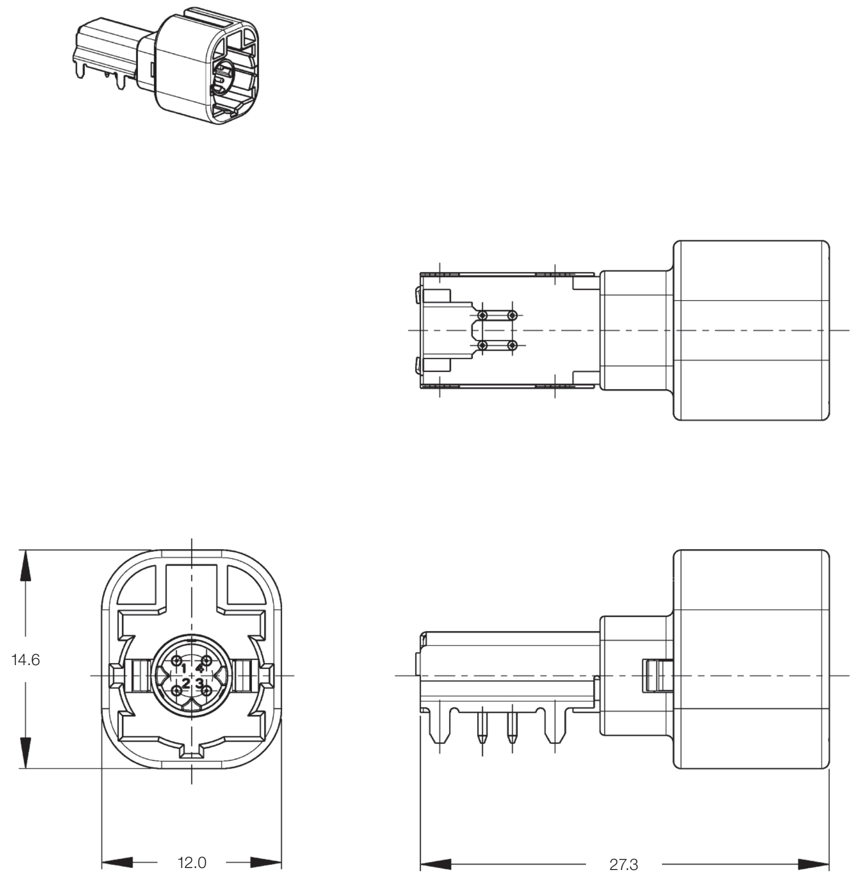
Outer Contact:
CuZn30, tin plated (Sn)

Dielectric:
LCP-GF30, black

Housing:
PPA-GF25, see drawing

Assembly

Part No. **1823071**



Pin Header 90° (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

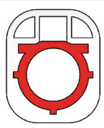
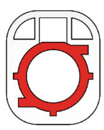
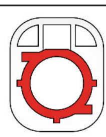
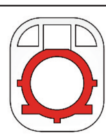
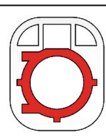
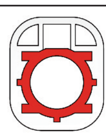
Soldering Profile:
Lead-free wave and reflow soldering according Specification 114-18867

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit
Impedance	–	100 Ω ±15 %
Propagation Delay	–	≤ 100 ps
Intra-Pair Skew	–	≤ 25 ps
Inter-Pair Skew	–	≤ 5 ps
Attenuation	≤ 1 GHz	≤ 0,1 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB
Cross Talk	≤ 1 GHz	≤ –40 dB
Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB

Coding

Coding	Plug	Color	RAL	Part Number
A		Black	9011	8-1823071-1
B		Natural	–	8-1823071-2
C		Blue	5012	8-1823071-3
D		Claret Violet	4004	8-1823071-4
E		Green	6001	8-1823071-5
Z		Water Blue	5021	8-1823071-9

Pin Header 90° + 2 MQS

Interface

According to
HSD Interface Drawing:
114-18969

Documents

Application Specification
114-18867: HSD Pin Header

Product Specification
108-94105: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawing
1823326: HSD Pin Header 90° + 2 MQS

Material and Plating

Center Contact:
CuZn35Pb2, gold plated (Au)

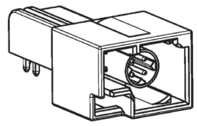
Outer Contact:
CuZn30, tin plated (Sn)

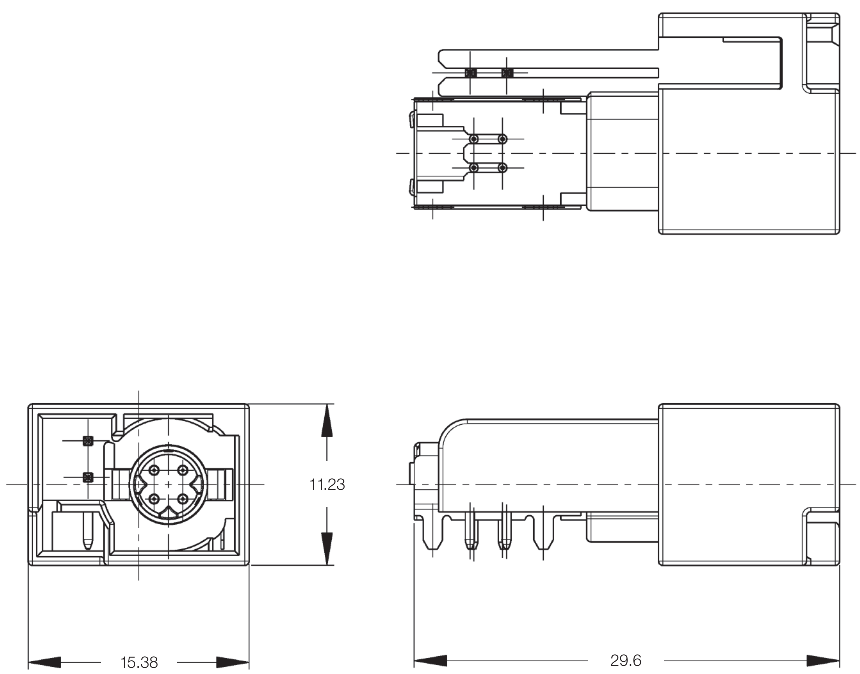
Dielectric:
LCP-GF30, black

Housing:
PPA-GF25, see drawing

Assembly

Part No. **1823326**





Pin Header 90° + 2 MQS (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

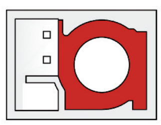
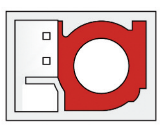
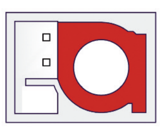
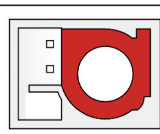
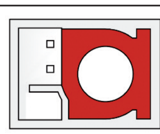
Soldering Profile:
Lead-free wave and reflow soldering according Specification 114-18867

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit
Impedance	–	100 Ω ±15 %
Propagation Delay	–	≤ 100 ps
Intra-Pair Skew	–	≤ 25 ps
Inter-Pair Skew	–	≤ 5 ps
Attenuation	≤ 1 GHz	≤ 0,1 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB
Cross Talk	≤ 1 GHz	≤ –40 dB
Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB

Coding

Coding	Plug	Color	RAL	Part Number
A		Black	9011	8-1823326-1
B		Natural	–	8-1823326-2
C		Blue	5012	8-1823326-3
D		Claret Violet	4004	8-1823326-4
Z		Water Blue	5021	8-1823326-9

Pin Header 90° with Shielding Device

Interface

According to
HSD Interface Drawing:
114-18950

Documents

Application Specification
114-18867: HSD Pin Header

Product Specification
108-94105: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawings
1563414: Header
1563416: Coding Cap

Material and Plating

Center Contact:
CuZn35Pb2, gold plated (Au)

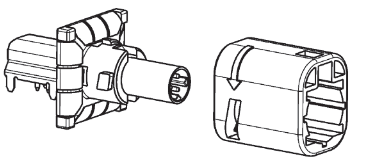
Outer Contact:
CuZn30, tin plated (Sn)

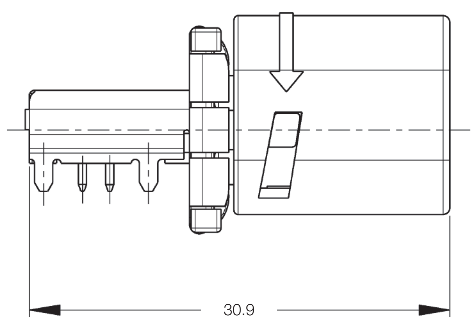
Dielectric:
LCP-GF30, black

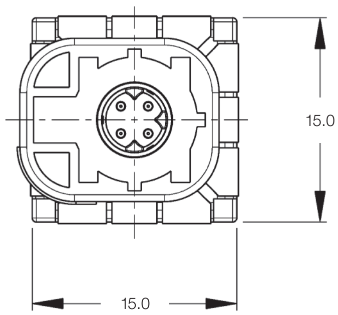
Housing:
PBT-GF10, see drawing

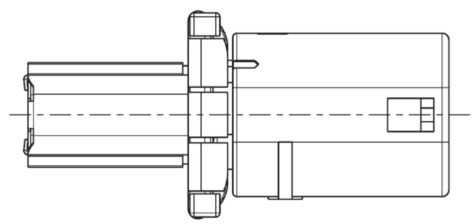
Assembly

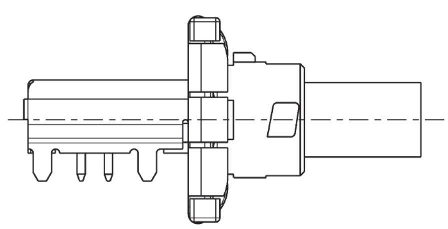
Part No. **1563414** and **1563416**











Pin Header 90° with Shielding Device (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

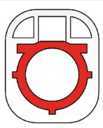
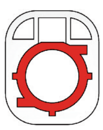
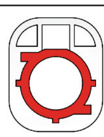
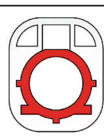
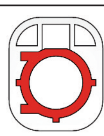
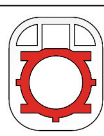
Soldering Profile:
Lead-free wave and reflow soldering according Specification 114-18867

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit
Impedance	–	100 Ω ±15 %
Propagation Delay	–	≤125 ps
Intra-Pair Skew	–	≤25 ps
Inter-Pair Skew	–	≤5 ps
Attenuation	≤1 GHz	≤0,1 dB
Reflection Loss	≤1 GHz ≤2 GHz	≥20 dB ≥17 dB
Cross Talk	≤1 GHz	≤–40 dB
Differential Shielding Effectiveness	≤1 GHz ≤2 GHz	≥75 dB ≥65 dB
Bulkhead Feed-Through	≤1 GHz ≤2 GHz	≥75 dB ≥65 dB

Coding

Coding	Plug	Color	RAL		Part Number
A		Black	9011		8-1563414-1 8-1563416-1
B		Natural	–		8-1563414-1 8-1563416-2
C		Blue	5012		8-1563414-1 8-1563416-3
D		Claret Violet	4004		8-1563414-1 8-1563416-4
E		Green	6001		8-1563414-1 8-1563416-5
Z		Water Blue	5021		8-1563414-1 8-1563416-9

Pin Header 90° with Shielding Device

Interface

According to
HSD Interface Drawing:
114-18950

Documents

Drawing:
1823354: HSD Pin Header 90°

Material and Plating

Center Contacts:
CuSn4, gold plated (Au)

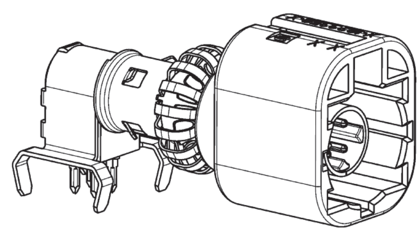
Outer Contact:
CuSn4, tin over nickel plated (Sn over Ni)

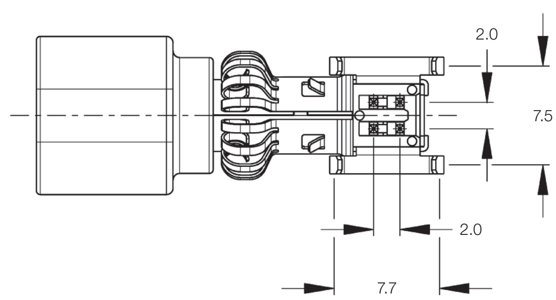
Dielectric:
LCP-GF30, black

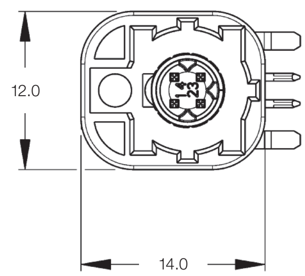
Housing/Cover:
PA46, see drawing

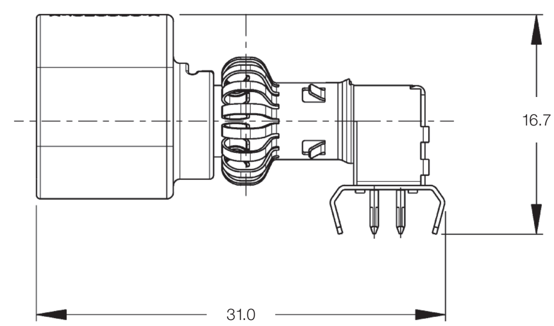
Pin Connector

Part No. **1823354**









Pin Header 90° with Shielding Device (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 20 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

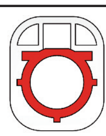
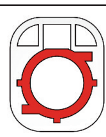
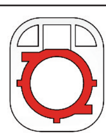
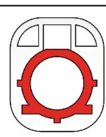
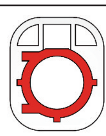
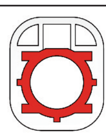
Soldering Profile:
Lead-free wave and reflow soldering according Specification 114-18867
3x 260 °C, 10 s

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit
Impedance	–	100 Ω ±15 %
Propagation Delay	–	≤ 125 ps
Intra-Pair Skew	–	≤ 20 ps
Inter-Pair Skew	–	≤ 5 ps
Attenuation	≤ 1 GHz	≤ 0,1 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB
Cross Talk	≤ 1 GHz	≤ –35 dB
Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB
Bulkhead Feed-Through	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB

Coding

Coding	Plug	Color	RAL	Part Number
A		Black	9011	1823354-2
B		Natural	–	1823354-3
C		Blue	5012	1823354-4
D		Claret Violet	4004	1823354-5
E		Green	6001	1823354-6
Z		Water Blue	5021	1823354-1

Pin Header 180°

Interface

According to
HSD Interface Drawing:
114-18950

Documents

Application Specification
114-18867: HSD Pin Header

Product Specification
108-94105: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawing:
1823271: HSD Pin Header 180°

Material and Plating

Center Contact:
CuZn35Pb2, gold plated (Au)

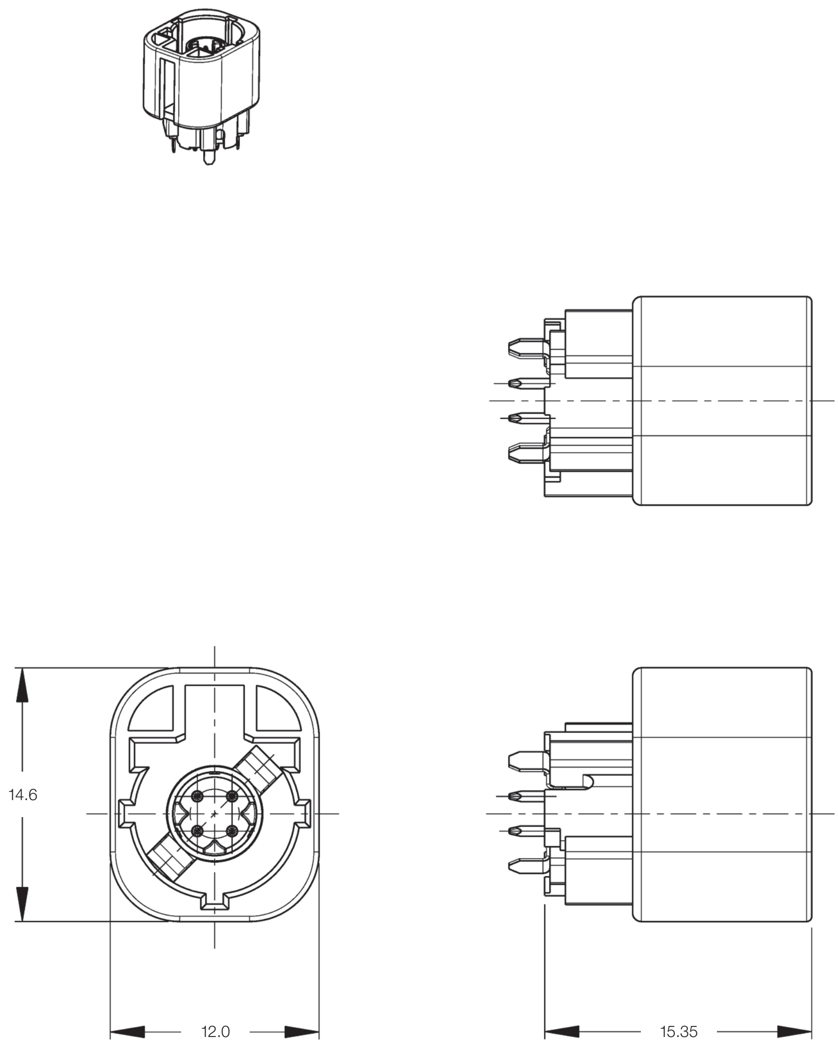
Outer Contact:
CuZn30, tin plated (Sn)

Dielectric:
LCP-GF30, black

Housing:
PPA-GF25, see drawing

Assembly

Part No. **1823271**



Pin Header 180° (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

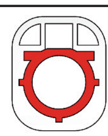
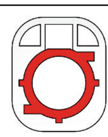
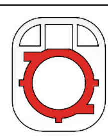
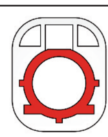
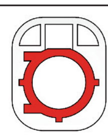
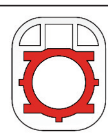
Soldering Profile:
Lead-free wave and reflow soldering according Specification 114-18867

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit
Impedance	–	100 Ω ±15 %
Propagation Delay	–	≤ 50 ps
Intra-Pair Skew	–	≤ 5 ps
Inter-Pair Skew	–	≤ 5 ps
Attenuation	≤ 1 GHz	≤ 0,1 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB
Cross Talk	≤ 1 GHz	≤ –40 dB
Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB

Coding

Coding	Plug	Color	RAL	Part Number
A		Black	9011	8-1823271-1
B		Natural	–	8-1823271-2
C		Blue	5012	8-1823271-3
D		Claret Violet	4004	8-1823271-4
E		Green	6001	8-1823271-5
Z		Water Blue	5021	8-1823271-9

Pin Header 180°, Sealed

Interface

According to
HSD Interface Drawing:
114-18950

Documents

Drawing:
1823361: HSD Pin Header 180°

Material and Plating

Center Contacts:
CuSn4, gold plated (Au)

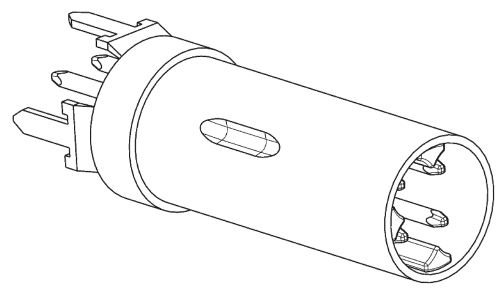
Outer Contact:
CuZn37 optional CuSn8,
tin over nickel plated (Sn over Ni)

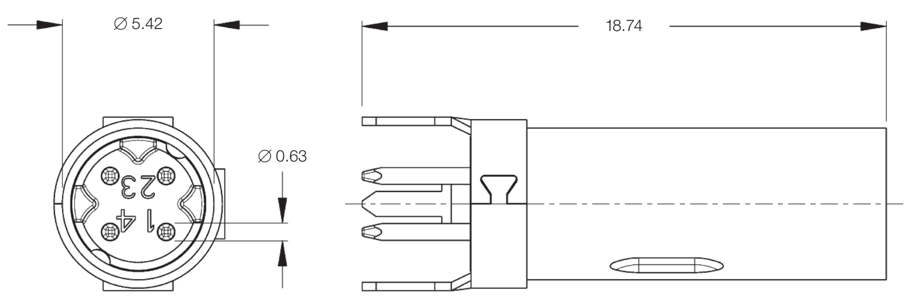
Dielectric:
LCP-GF30, black

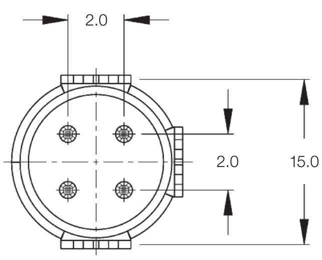
Sealing:
PUR

Pin Connector

Part No. **1823361-1**







Pin Header 180°, Sealed (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Pin Retention Force:
min. 20 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

Soldering Profile:
Lead-free wave and reflow soldering according Specification 114-18867
3x 260 °C, 10 s

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit
Impedance	–	100 Ω ±15 %
Propagation Delay	–	≤ 50 ps
Intra-Pair Skew	–	≤ 5 ps
Inter-Pair Skew	–	≤ 5 ps
Attenuation	≤ 1 GHz	≤ 0,1 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB
Cross Talk	≤ 1 GHz	≤ –40 dB
Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB

USB-HSD Adapter, HSD Plug (Male) / USB Receptacle

Interface

HSD according to
HSD Interface Drawing:
114-18950

USB according to
USB Series "A" Receptacle:
USB Specification Rev. 2.0

Documents

Application Specification
114-18951: USB-HSD Adapter

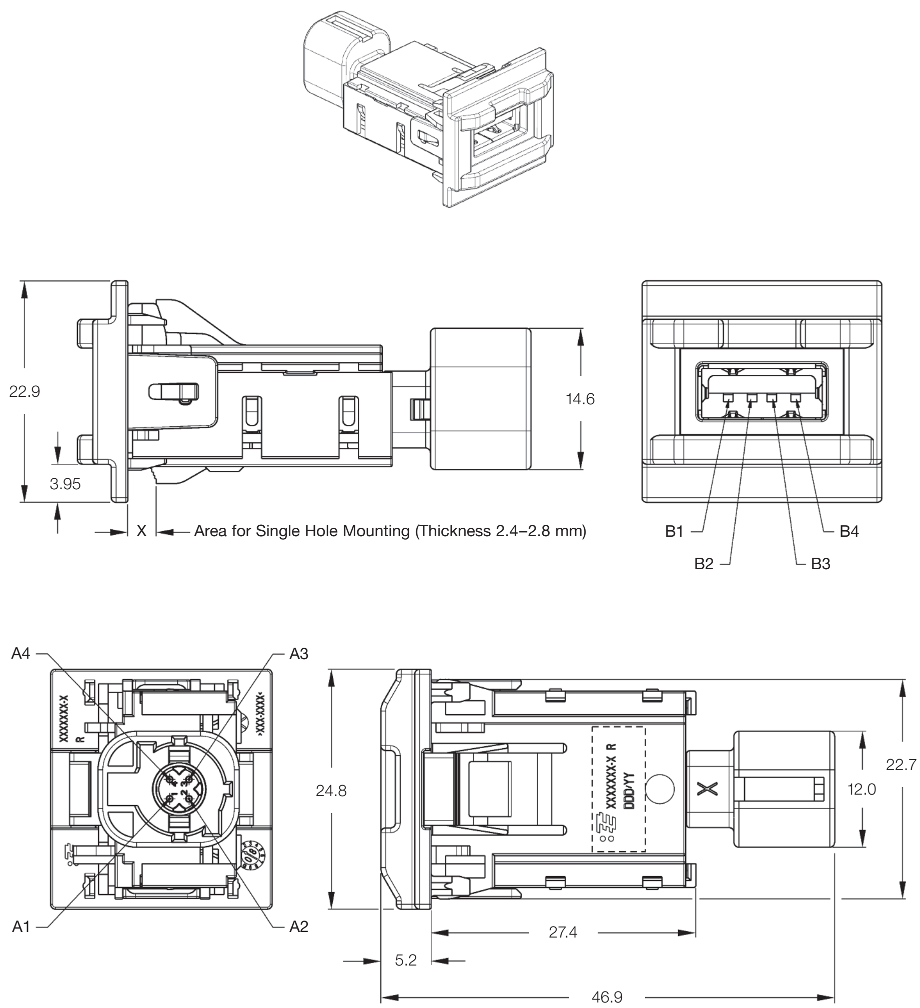
Product Specification
108-94158: USB-HSD Adapter

Drawing
1564925: USB-HSD Adapter

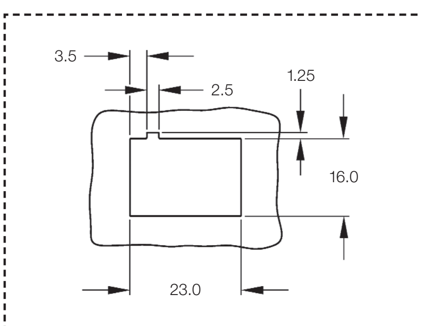
Other Specifications:
- USB Specification Rev. 2.0 April 27, 2000
- SAE/USCAR-30 November, 2006

Assembly

Part No. **1564925**



Mounting Opening



Name	Pin	Assignment
HSD	A1	D+
	A2	VBUS
	A3	D–
	A4	GND
USB Type A	B1	VBUS
	B2	D–
	B3	D+
	B4	GND

USB-HSD Adapter, HSD Plug (Male) / USB Receptacle (continued)

Electrical Data

According to
USB Specification Rev. 2.0

Mechanical Data

Mating Cycles HSD:
min. 25 (Contact Surface: Gold)

Mating Cycles USB (Durability):
20,000 (SAE/USCAR-30, Chapter 5.1.7)

Mating/Unmating Force HSD:
max. 25 N

Insertion/Extraction Force USB:
max. 35 N/min. 10 N (EIA 364-13)

Coding Efficiency HSD:
min. 80 N

Pin Retention Force HSD:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +85 °C

Thermal Shock:
EIA 364-32 (Test Condition I)

Temperature and Humidity:
EIA 364-31 (Test Condition A, Method III)

Physical Shock:
EIA 364-27 (Test Condition H)

Random Vibration:
EIA 364-28 (Test Condition V, Test Letter A)

2002/95/EC (RoHS):
compliant

Material and Plating

Connector Parts HSD

Center Contacts:
CuZn35Pb2, gold (Au)

Outer Contact:
CuZn30, tin (Sn)

Dielectric:
LCP-GF30, black

Housing:
PPA-GF25, see drawing

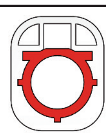
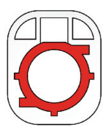
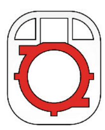
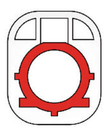
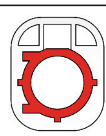
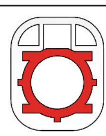
Connector Parts USB

Contacts:
CuSn4, gold (Au)

Housing:
PBT-GF15, black

EMI Shielding:
CuSn4, tin (Sn)

Coding

Coding	Plug	Color	RAL		Part Number
A		Black	9011		1564925-1
B		Natural	–		1564925-2
C		Blue	5012		1564925-3
D		Claret Violet	4004		1564925-4
E		Green	6001		1564925-5
Z		Water Blue	5021		1564925-9

USB-HSD Cable Assembly, USB (Plug-In) / HSD AK 180° Jack (Female)

Interface

HSD according to
HSD Interface Drawing:
114-18950

USB according to
USB Series "A" Receptacle:
USB Specification Rev. 2.0

Documents

Application Specification
114-94023: USB-HSD Cable Assembly

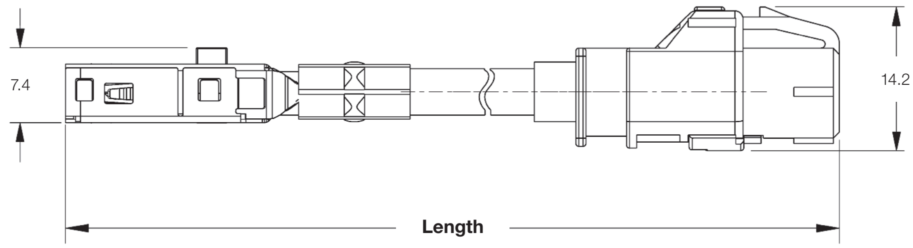
Product Specification
108-94222: USB-HSD Cable Assembly

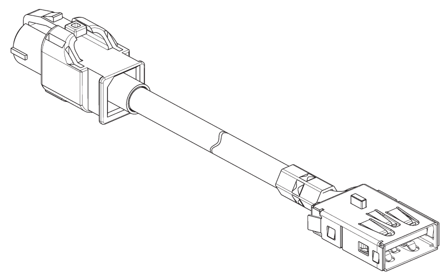
Drawing:
2112252: USB with HSD Pigtail

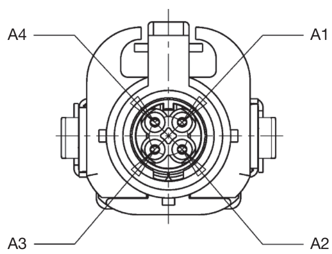
Other Specifications:
- USB Specification Rev. 2.0 April 27, 2000
- SAE/USCAR-30 November, 2006

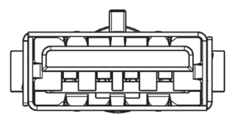
Assembly

Part No. **2112252**

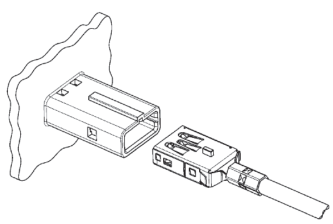






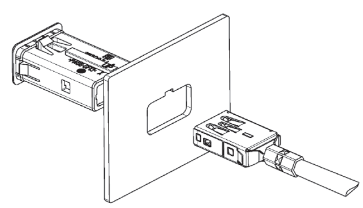


USB Housing Interface



Housing Interface: see 114-94009-001

USB Housing Insert



Housing Insert: Part No. **2112307-1**

Pinning of Assembly

Name	Pin	Assignment
HSD	A1	D+
	A2	D–
	A3	VBUS
	A4	D+

USB-HSD Cable Assembly, USB (Plug-In) / HSD AK 180° Jack (Female) (continued)

Electrical Data

According to
USB Specification Rev. 2.0

Material and Plating

Connector Parts HSD

Center Contacts:
CuZn35Pb2, gold (Au)

Outer Contact:
CuZn30, tin (Sn)

Dielectric:
LCP-GF30, black

Housing:
PPA-GF25, see drawing

Connector Parts USB

Contacts:
CuNiSi, gold (Au)

Housing:
PA66-GF13, black

EMI Shielding:
CuSn4, tin (Sn)

Mechanical Data

Mating Cycles HSD:
min. 25 (Contact Surface: Gold)

Mating Cycles USB:
20,000 (SAE/USCAR-30, Chapter 5.1.7)

Mating and Unmating Force:
max. 35 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
SAE/USCAR-30, Chapter 5.5.1)

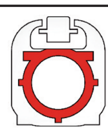
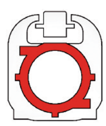
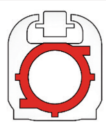
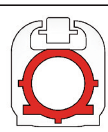
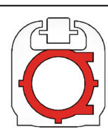
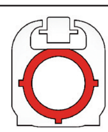
Temperature and Humidity:
SAE/USCAR-30, Chapter 5.5.2)

High Temperature Exposure:
SAE/USCAR-30, Chapter 5.5.3)

Vibration (Random) and Mechanical Shock:
SAE/USCAR-30, Chapter 5.2.3)

2002/95/EC (RoHS):
compliant

Coding

Coding	Plug	Color	RAL	Part Number*
A		Black	9011	2112252-1
B		Natural	–	2112252-2
C		Blue	5012	2112252-3
D		Claret Violet	4004	2112252-4
E		Green	6001	2112252-5
Z		Water Blue	5021	2112252-9

*) Drawing, configuration, etc. will be realized according to customer request.

Cable Assembly 90° Jack (Female) / 90° Jack (Female)

Cable Assembly Configuration

Cable Assembly Length "L":
0.3 m up to 10.0 m

Sender:
90° Plug, Cable Outlet Left

Receiver:
90° Plug, Cable Outlet Left

Interface

Mating Interface
114-18950: HSD Interface Drawing

Documents

Product Specification
108-94105: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawing
1564654: HSD 4 Pos. 90, 90 Cable Assembly

Material and Plating

Contacts:
CuZn36Pb3, gold plated (Au)

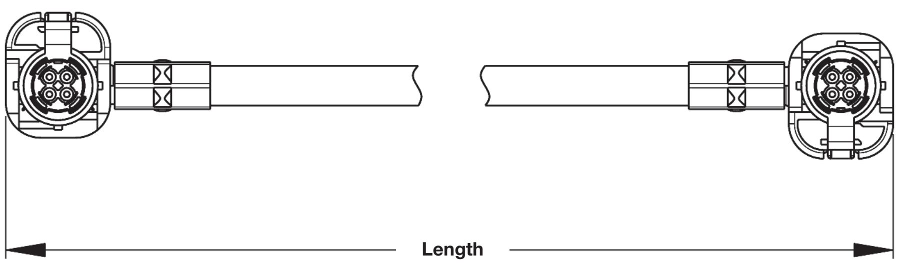
Shield Contact:
CuSn4, tin plated (Sn)

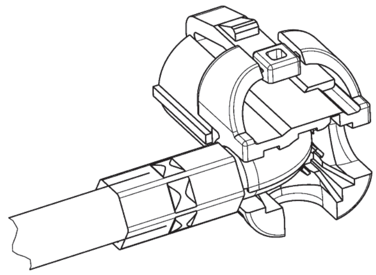
Dielectric:
PA12, black

Housing:
PBT-GF10, color see drawing

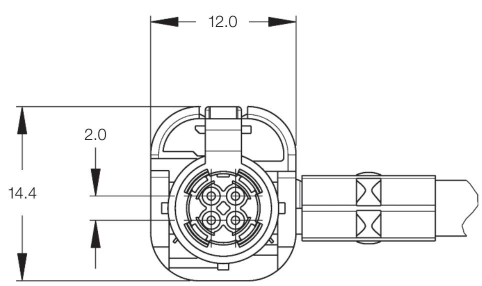
Assembly

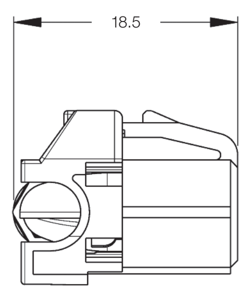
Part No. **1564654**

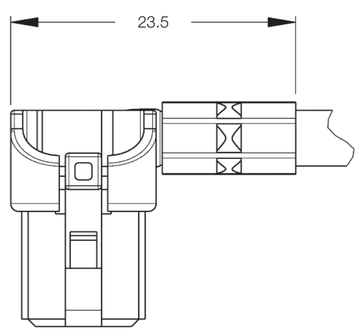




Cable Outlet Left







Cable Assembly 90° Jack (Female) / 90° Jack (Female) (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

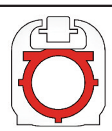
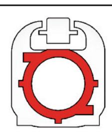
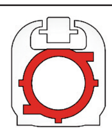
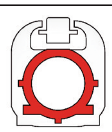
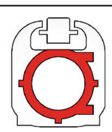
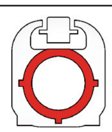
Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit	
Impedance	–	100 Ω ±15 %	
Propagation Delay	–	≤ 5.05 ns/m	
Intra-Pair Skew Connector	–	≤ 10 ps	
Intra-Pair Skew Cable	–	≤ 25 ps/m	
Inter-Pair Skew Connector	–	≤ 10 ps	
Inter-Pair Skew Cable	–	≤ 25 ps/m	
Attenuation mated Cable Assembly	f [MHz]	D @ 5.0 m	D @ 10.0 m
	250 MHz 400 MHz 500 MHz 800 MHz 1000 MHz	≤ 3.10 dB ≤ 3.80 dB ≤ 4.40 dB ≤ 5.90 dB ≤ 6.80 dB	≤ 6.10 dB ≤ 7.60 dB ≤ 8.60 dB ≤ 11.60 dB ≤ 13.20 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB	
Near End Cross Talk	≤ 1 GHz	≤ –30 dB	
Far End Cross Talk	≤ 1 GHz	≤ –35 dB	
Cable Assembly Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB	

Coding

Coding	Plug	Color	RAL	Part Number*
A		Black	9011	*
B		Natural	–	*
C		Blue	5012	*
D		Claret Violet	4004	*
E		Green	6001	*
Z		Water Blue	5021	1564654-1

*) Drawing, configuration, etc. will be realized according to customer request.

Cable Assembly 90° Jack (Female) / AK 180° Plug (Male)

Cable Assembly Configuration

Cable Assembly Length "L":
0.3 m up to 10.0 m

Sender:
90° Jack, Cable Outlet Down

Receiver:
180° Plug

Interface

Mating Interface
114-18950: HSD Interface Drawing

Documents

Product Specification
108-94105: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawing
1564656: HSD 4 Pos. 90, In-Line Cable Assy

Material and Plating

Contacts:
CuZn36Pb3, gold plated (Au)

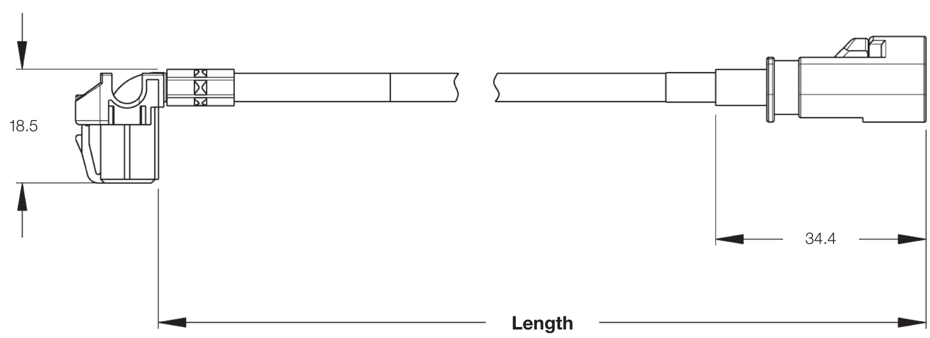
Shield Contact:
CuSn4, tin plated (Sn)

Dielectric:
PA12, black

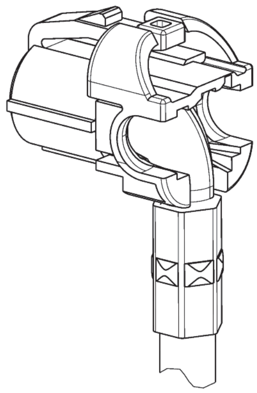
Housing:
PBT-GF10, see coding

Assembly

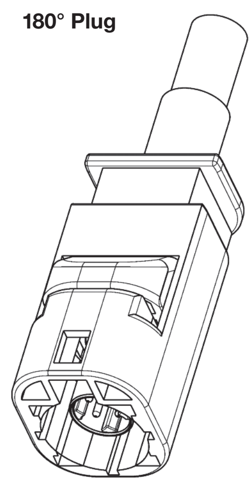
Part No. **1564656**

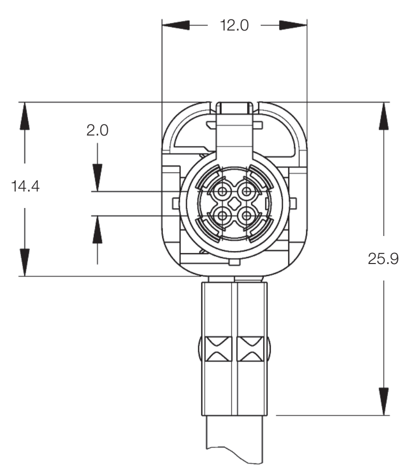


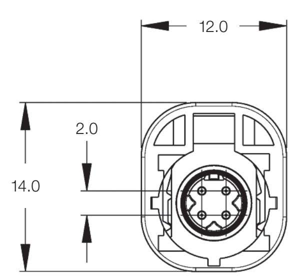
90° Jack, Cable Outlet Down



180° Plug







Cable Assembly 90° Jack (Female) / AK 180° Plug (Male) (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

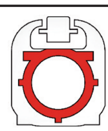
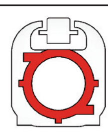
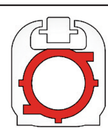
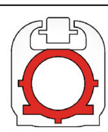
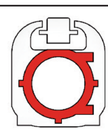
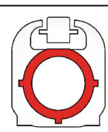
Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit	
Impedance	–	100 Ω ±15 %	
Propagation Delay	–	≤ 5.05 ns/m	
Intra-Pair Skew Connector	–	≤ 10 ps	
Intra-Pair Skew Cable	–	≤ 25 ps/m	
Inter-Pair Skew Connector	–	≤ 10 ps	
Inter-Pair Skew Cable	–	≤ 25 ps/m	
Attenuation mated Cable Assembly	f [MHz]	D @ 5.0 m	D @ 10.0 m
	250 MHz 400 MHz 500 MHz 800 MHz 1000 MHz	≤ 3.10 dB ≤ 3.80 dB ≤ 4.40 dB ≤ 5.90 dB ≤ 6.80 dB	≤ 6.10 dB ≤ 7.60 dB ≤ 8.60 dB ≤ 11.60 dB ≤ 13.20 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB	
Near End Cross Talk	≤ 1 GHz	≤ –30 dB	
Far End Cross Talk	≤ 1 GHz	≤ –35 dB	
Cable Assembly Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB	

Coding

Coding	Plug	Color	RAL	Part Number*
A		Black	9011	*
B		Natural	–	*
C		Blue	5012	*
D		Claret Violet	4004	*
E		Green	6001	*
Z		Water Blue	5021	1564656-1

*) Drawing, configuration, etc. will be realized according to customer request.

Cable Assembly AK 180° Jack (Female) / AK 180° Jack (Female)

Cable Assembly Configuration

Cable Assembly Length "L":
0.3 m up to 10.0 m

Sender:
180° Jack

Receiver:
180° Jack

Interface

Mating Interface
114-18950: HSD Interface Drawing

Documents

Product Specification
108-94223: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawing
1823193: HSD 4 Pos. 180, 180, Cable Assembly

Material and Plating

Contacts:
CuSn6, gold plated (Au)

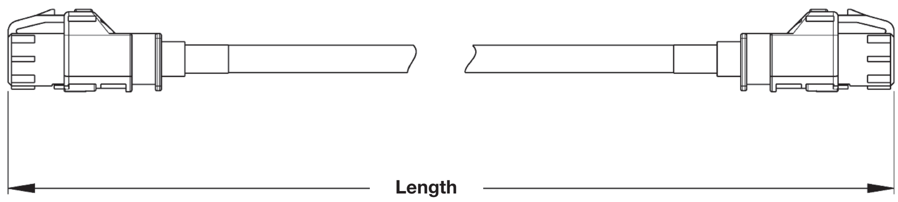
Shield Contact:
CuZn39Pb3, nickel plated (Ni)

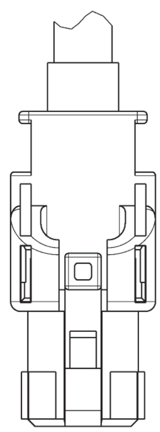
Dielectric:
LCP-GF15, nature

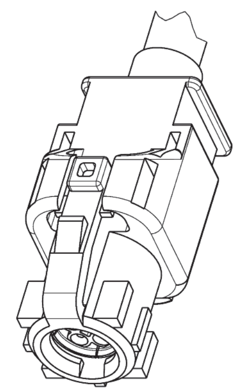
Housing:
PBT-GF10, color see drawing

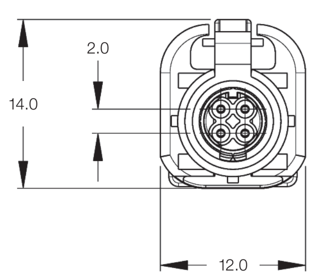
Assembly

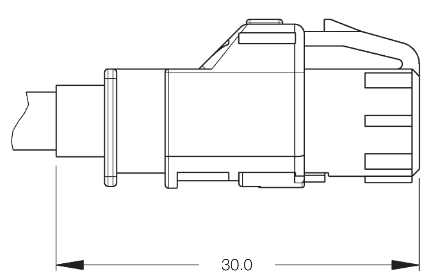
Part No. **1823193**











Cable Assembly AK 180° Jack (Female) / AK 180° Jack (Female) (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
−40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

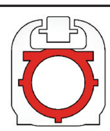
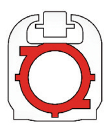
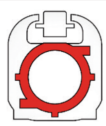
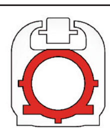
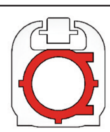
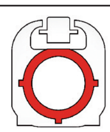
Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit	
Impedance	–	100 Ω ±15 %	
Propagation Delay	–	≤ 5.05 ns/m	
Intra-Pair Skew Connector	–	≤ 10 ps	
Intra-Pair Skew Cable	–	≤ 25 ps/m	
Inter-Pair Skew Connector	–	≤ 10 ps	
Inter-Pair Skew Cable	–	≤ 25 ps/m	
	f [MHz]	D @ 5.0 m	D @ 10.0 m
Attenuation mated Cable Assembly	250 MHz 400 MHz 500 MHz 800 MHz 1000 MHz	≤ 3.10 dB ≤ 3.80 dB ≤ 4.40 dB ≤ 5.90 dB ≤ 6.80 dB	≤ 6.10 dB ≤ 7.60 dB ≤ 8.60 dB ≤ 11.60 dB ≤ 13.20 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB	
Near End Cross Talk	≤ 1 GHz	≤ −30 dB	
Far End Cross Talk	≤ 1 GHz	≤ −35 dB	
Cable Assembly Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB	

Coding

Coding	Plug	Color	RAL	Part Number*
A		Black	9011	*
B		Natural	–	*
C		Blue	5012	*
D		Claret Violet	4004	*
E		Green	6001	*
Z		Water Blue	5021	1823193-1

*) Drawing, configuration, etc. will be realized according to customer request.

Cable Assembly AK 180° Jack (Female) / AK 180° Plug (Male)

Cable Assembly Configuration

Cable Assembly Length "L":
0.3 m up to 10.0 m

Sender:
180° Jack

Receiver:
180° Plug

Interface

Mating Interface
114-18950: HSD Interface Drawing

Documents

Product Specification
108-94223: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawing
1823194: HSD 4 Pos. 180, In-Line, Cable Assy

Material and Plating

Contacts:
CuSn6, gold plated (Au)

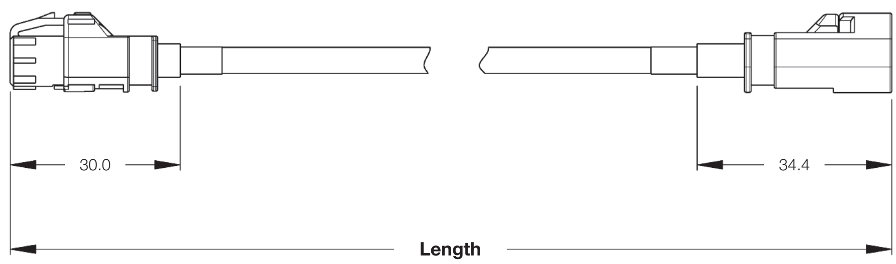
Shield Contact:
CuZn39Pb3, nickel plated (Ni)

Dielectric:
LCP-GF15, nature

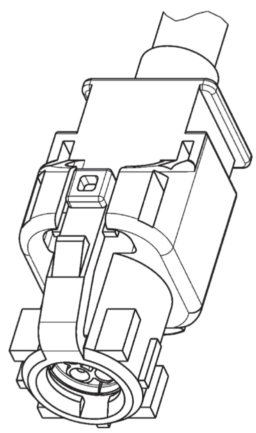
Housing:
PBT-GF10, color see drawing

Assembly

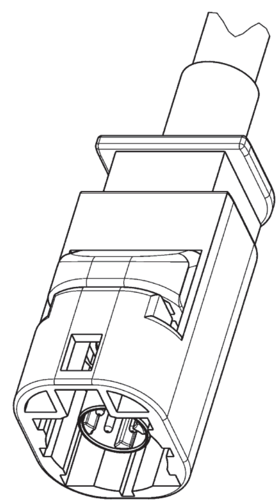
Part No. **1823194**

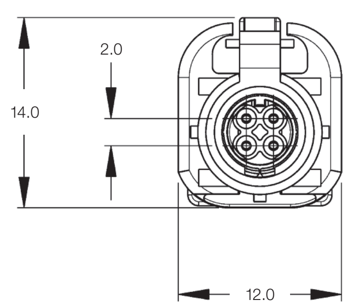


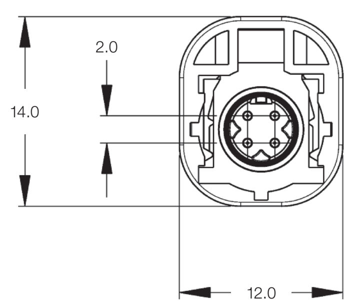
180° Jack



180° Plug







All specifications subject to change. Consult TE Connectivity for latest specifications.

Cable Assembly AK 180° Jack (Female) / AK 180° Plug (Male) (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

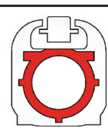
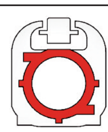
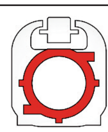
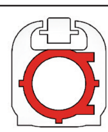
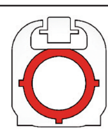
Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit	
Impedance	–	100 Ω ±15 %	
Propagation Delay	–	≤ 5.05 ns/m	
Intra-Pair Skew Connector	–	≤ 10 ps	
Intra-Pair Skew Cable	–	≤ 25 ps/m	
Inter-Pair Skew Connector	–	≤ 10 ps	
Inter-Pair Skew Cable	–	≤ 25 ps/m	
Attenuation mated Cable Assembly	f [MHz]	D @ 5.0 m	D @ 10.0 m
	250 MHz 400 MHz 500 MHz 800 MHz 1000 MHz	≤ 3.10 dB ≤ 3.80 dB ≤ 4.40 dB ≤ 5.90 dB ≤ 6.80 dB	≤ 6.10 dB ≤ 7.60 dB ≤ 8.60 dB ≤ 11.60 dB ≤ 13.20 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB	
Near End Cross Talk	≤ 1 GHz	≤ –30 dB	
Far End Cross Talk	≤ 1 GHz	≤ –35 dB	
Cable Assembly Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB	

Coding

Coding	Plug	Color	RAL	Part Number*
A		Black	9011	*
B		Natural	–	*
C		Blue	5012	*
D		Claret Violet	4004	*
E		Green	6001	*
Z		Water Blue	5021	1823194-1

*) Drawing, configuration, etc. will be realized according to customer request.

Cable Assembly AK 180° Jack (Female) / 90° Jack (Female)

Cable Assembly Configuration

Cable Assembly Length "L":
0.3 m up to 10.0 m

Sender:
180° Jack

Receiver:
90° Jack

Interface

Mating Interface
114-18950: HSD Interface Drawing

Documents

Product Specification
108-94223: HSD Connector System

Test Specification
108-94106: HSD Connector System

Drawing
1823858: HSD 4 Pos. 180, 90, Cable Assy

Material and Plating

Contacts:
CuSn6, gold plated (Au)

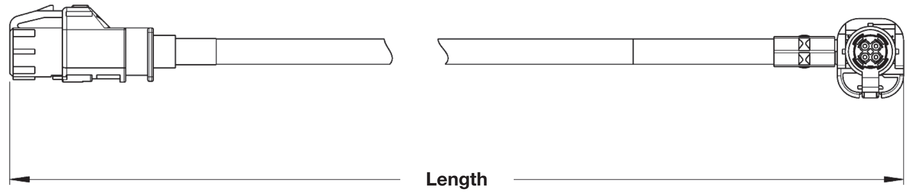
Shield Contact:
CuZn39Pb3, nickel plated (Ni)

Dielectric:
LCP-GF15, nature

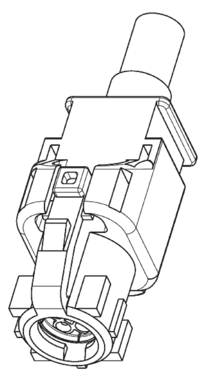
Housing:
PBT-GF10, color see drawing

Assembly

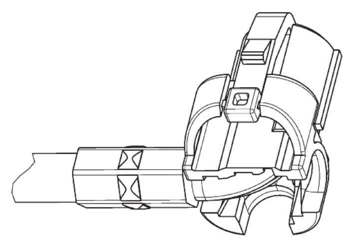
Part No. **1823858**

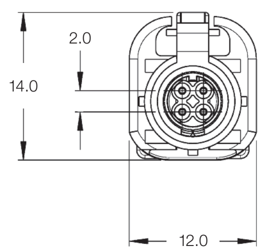


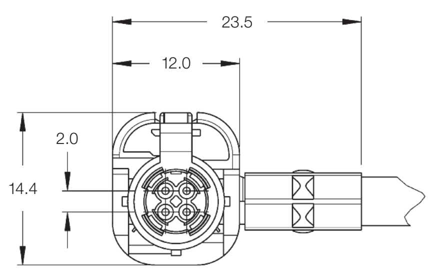
180° Jack

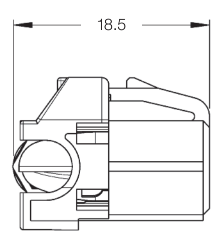


Cable Outlet Left
90° Jack









Cable Assembly AK 180° Jack (Female) / 90° Jack (Female) (continued)

Mechanical Data

Mating Cycles:
min. 25 (Contact Surface: Gold)

Mating and Unmating Force:
max. 30 N

Coding Efficiency:
min. 80 N

Pin Retention Force:
min. 25 N

Environmental Data

Temperature Range:
–40 °C to +105 °C

Thermal Shock:
DIN IEC 60068-2-14

Temperature and Humidity:
DIN IEC 60068-2-30

High Temperature Exposure:
DIN IEC 60068-2-2

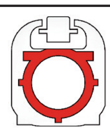
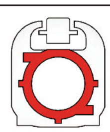
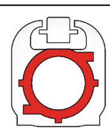
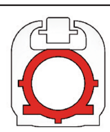
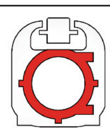
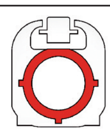
Vibration (Random) and Mechanical Shock:
DIN IEC 60068-2-64

2002/95/EC (RoHS):
compliant

Electrical Data

Test Case	Condition	Limit	
Impedance	–	100 Ω ±15 %	
Propagation Delay	–	≤ 5.05 ns/m	
Intra-Pair Skew Connector	–	≤ 10 ps	
Intra-Pair Skew Cable	–	≤ 25 ps/m	
Inter-Pair Skew Connector	–	≤ 10 ps	
Inter-Pair Skew Cable	–	≤ 25 ps/m	
Attenuation mated Cable Assembly	f [MHz]	D @ 5.0 m	D @ 10.0 m
	250 MHz 400 MHz 500 MHz 800 MHz 1000 MHz	≤ 3.10 dB ≤ 3.80 dB ≤ 4.40 dB ≤ 5.90 dB ≤ 6.80 dB	≤ 6.10 dB ≤ 7.60 dB ≤ 8.60 dB ≤ 11.60 dB ≤ 13.20 dB
Reflection Loss	≤ 1 GHz ≤ 2 GHz	≥ 20 dB ≥ 17 dB	
Near End Cross Talk	≤ 1 GHz	≤ –30 dB	
Far End Cross Talk	≤ 1 GHz	≤ –35 dB	
Cable Assembly Differential Shielding Effectiveness	≤ 1 GHz ≤ 2 GHz	≥ 75 dB ≥ 65 dB	

Coding

Coding	Plug	Color	RAL	Part Number*
A		Black	9011	*
B		Natural	–	*
C		Blue	5012	*
D		Claret Violet	4004	*
E		Green	6001	*
Z		Water Blue	5021	1823858-1

*) Drawing, configuration, etc. will be realized according to customer request.

Engineering Notes