High Speed Data, Connector System 180°, 4 pos., shielded

High Speed Data, Steckverbinder System 180°, 4 pol., geschirmt

*Trademark
| Indicates change

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1. CONTENT
Inhalt

This specification covers the performance, tests and quality requirements for the High Speed Data connector system 180°, unsealed, 4 pos., shielded, as well as for the sealed version. The unsealed products are only permissible for car interior.
Diese Spezifikation beschreibt die Eigenschaften, Tests und Qualitätsanforderungen für High Speed Data, Stecker System 180° ohne Dichtung, 4 pol., geschirmt, sowie für die gedichtete Version. Die ungedichteten Produkte dürfen nur im Fahrzeuginnenraum eingesetzt werden.

1.1 Product Table
Produktübersicht

Different versions are available.
Es sind verschiedene Ausführungsvarianten verfügbar.

- **Order No. See drawing**
  Bestell-Nr. siehe Zeichnung

1.2 Qualification
Qualifikation

When tests are performed the following specified specifications and standards shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.
Bei der Prüfung der genannten Produkte sind die nachfolgend genannten Richtlinien und Normen zu verwenden. Alle Prüfungen müssen nach den zugehörigen Prüfplänen und Produktzeichnungen durchgeführt werden.

2. APPLICABLE DOCUMENTS
ANWENDBARE UNTERLAGEN

The following documents form a part of this specification to the extent specified herein. In the events of conflict between the requirements of this specification and the product drawing or of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.
Die nachfolgend genannten Unterlagen, sofern darauf verwiesen wird, sind Teil dieser Spezifikation. Im Falle des Widerspruches zwischen dieser Spezifikation und der Produktzeichnung oder des Widerspruches zwischen dieser Spezifikation und den aufgeführten Unterlagen hat diese Spezifikation Vorrang.

2.1 TE Documents
TE Unterlagen

A 109-1:
General Requirements for Test Specifications
Allgemeine Anforderungen für die Testabläufe

B Customer Drawings and Name
Kundenzeichnungen und Benennung

C Product Specifications
Produktspezifikationen

108-94106 **Product specification for the HSD Connnector System (system specification)**
Produktspezifikation für das HSD Steckverbindersystem (System-Spezifikation, elektrische und HF Eigenschaften)

D HSD-Test-Specification
HSD-Test-Spezifikation

109-18261 **Test-Specification for the HSD Connnector System**
Test-Spezifikation für das HSD Steckverbindersystem

E Application Specification
Verarbeitungsspezifikation

114-94058 **Application specification for the HSD Connector System 180°**
Verarbeitungsspezifikation für das HSD Steckverbinder System 180°

2.2 Other Documents
Allgemeine Unterlagen

A DIN IEC 512 **Electromechanical components for electronic equipment, basic testing procedures and measuring methods**
elektrisch-mechanische Bauelemente für elektronische Einrichtungen, Meß- und Prüfverfahren.
Edition May 1994 / *Ausgabe May 1994*

B DIN IEC 68 **Electrical engineering, basic environmental testing procedures**
Elektrotechnik, Grundlegende Umweltprüfverfahren
Edition August 1991 / *Ausgabe August 1991*

C IDB 1394 **1394 Copper Automotive Standard (Supplement to IDB 1394)**
1394 Automobil Standard (Anhang zu IDB 1394)
Edition June 2008 */ Ausgabe Juni 2008*

D SAE/USCar 2 Rev. 5 **Performance Specification for Automotive Electrical Connector Systems**
Durchführungsspezifikation für elektrische Steckverbinder Systeme im Fahrzeug
Edition November 2007 / *Ausgabe November 2007*
ONLY FOR SEALED CONNECTOR SYSTEMS!
NUR FÜR ABGEDICHTETE STECKVERBINDER SYSTEME!

3. REQUIREMENTS
ANFORDERUNGEN

3.1 Design and Construction
Entwurf und Konstruktion

Product shall be of the design, construction and physical dimensions specified on the applicable production drawing.
Das Produkt muss in seiner Ausführung und seinen physikalischen Abmessungen der Produktionszeichnung entsprechen.

3.2 Materials
Werkstoffe

Descriptions for material see in production drawing.
Angaben hierzu sind den Zeichnungsunterlagen zu entnehmen.

3.3 Performance and Test Description
Merkmale und Testbeschreibung

The product is designed to meet the electrical, mechanical and environmental performance requirements specified in paragraph 3.4. All tests are performed at ambient environmental conditions per IEC 512 unless otherwise specified.
Das Produkt erfüllt die in Abschnitt 3.4 aufgeführten elektrischen, mechanischen und klimatischen Anforderungen. Soweit nicht anders spezifiziert, sind alle Prüfungen unter den in der IEC 512 genannten Umweltbedingungen durchgeführt.

3.4 Test Requirements and Procedures Summary
Anforderungen und Prüfungen

- **acc. TE HSD-Test-Specification 109-18261**
  gemäß TE HSD-Test-Spezifikation 109-18261

Eigenschaft	Akzeptanzkriterien Acceptance Criteria	Characteristic
Mechanische Daten		**Mechanical Data**
Steckzyklen	min 25	Mating cycles
Steckkraft Steckerpaar	max. 30N	Mating Force Connector Pair
Trennkraft Steckerpaar	min. 5N max. 25N	Unmating Force Connector Pair
Haltekraft Steckerverriegelung	min. 110N	Retention Force Connector Lock
Kraft zur Betätigung der Steckerverriegelung	min. 3N max. 15N	Connector Lock
Lehren-Auszugskraft Außenleiter Steckkraft: Ziehkraft:	 max. 5N min. 0,28N	Gauge Retention Force Outer Contact Mating Force: Unmating Force:
Lehren-Auszugskraft Innenleiter Steckkraft: Ziehkraft:	 max. 20N min. 2N	Gauge Retention Force Inner Contact Mating Force: Unmating Force:
Haltekraft Primärverriegelung des Steckers im Gehäuse (bei Steckern ohne Sek.-Verriegelung)	min. 80N (min.110N)	Retention Force Primary Lock Connector to Housing (Connectors without secondary lock)
Haltekraft Sekundärverriegelung des Steckers im Gehäuse	min. 60N	Retention Force Secondary Lock Connector to Housing
Zulässige Einführkraft des Steckers in das Gehäuse	max. 50N	Acceptance for Insertion Force Connector into Housing
Kodierungseffizienz	min. 80N	Polarization Feature Effectiveness
Kabelhaltekraft	min. 110N	Cable Retention Force
Kabelverdrehung	min. 20Ncm	Cable Torsion
Elektrische Daten		**Electrical Data**
Kontaktwiderstand vor Belastung Außenleiter Signalkontakt	 max. 7.5 mOhm max. 10 mOhm (for 180°) max. 15 mOhm (for 90°)	Contact Resistance before exposure Outer Contact Signal Contact
Kontaktwiderstand nach Belastung Außenleiter Signalkontakt	 max. 40 mOhm max. 40 mOhm	Contact Resistance after exposure Outer Contact Signal Contact
Isolationswiderstand	min. 1.000 MOhm	Isolation Resistance
Strombelastbarkeit bei 80°C	min. 1.5 A (2.6 A)	Test Current Capability at 80°C
Betriebsspannung	100 Vrms	Operating Voltage
Prüfspannung	500 Vrms	Test Voltage

Daten der Signalübertragung		Signal Propagation Data
Impedanz Steckverbinder	100 +/- 15 Ohm	Impedance Connector only
Impedanz Kabelbaugruppe	=> Spec. 108-94106, Chap./ Kap.3.1, Tab. 2	Cable Assembly Impedance
Ausbreitungsgeschwindigkeit im Kabel	=> Spec. 108-94106, Chap./ Kap.3.1, Tab. 2	Propagation Delay within cable
Laufzeitdifferenz im Adernpaar Stecker gerade - gerade Stecker gerade - gewinkelt	 max. 5 ps max. 25ps	Propagation Delay Skew in a Wire pair Connectors straight - straight Connectors straight - angled
Laufzeitdifferenz im Kabel im Adernpaar	=> Spec. 108-94106, Chap./ Kap.3.1, Tab. 2	Cable Propagation Delay Skew within a wire pair
Laufzeitdifferenz zwischen Adernpaaren Stecker gerade - gerade Stecker gerade - gewinkelt	 max. 5 ps max. 5 ps	Propagation Delay Skew between Wire pairs Connectors straight - straight Connectors straight - angled
Laufzeitdifferenz im Kabel im Adernpaar zwischen Adernpaaren	=> Spec. 108-94106, Chap./ Kap.3.1, Tab. 2	Cable Propagation Delay Skew within a wire pair between wire pairs
Einfügedämpfung eines gesteckten Steckerpaares	max. 0.2 dB @ 1GHz	Insertion Loss of a mated pair of connectors
Einfügedämpfung Kabel f < 250Mhz f < 400Mhz f < 500Mhz f < 800Mhz f < 1000 Mhz	 < 0.60 dB/m < 0.75 dB/m < 0.85 dB/m < 1.15 dB/m < 1.30 dB/m	Cable Insertion Loss f < 250 MHz f < 400 MHz f < 500 MHz f < 800 MHz f < 1000 MHz
Variation Einfügedämpfung imTemperaturbereich -40℃ - +105℃ bis 1 GHz bis 2 GHz	 +/- 1.0 dB +/- 2.0 dB	Variation of Insertion Loss in the temp.-range -40℃ - +105℃ up to 1GHz up to 2 GHz
Rückflussdämpfung Steckerpaar 0 -1 GHz 0 - 2 GHz	 max. -20 dB max. -17 dB	Return Loss Mated Conn. - Pair 0 - 1 GHz 0 - 2 GHz
zulässige deterministische Unschärfe	max. 200 ps	maximum deterministic Jitter
Nahnebensprechen	max. 5% / < -30 dB to 1 GHz	Near End Cross Talk
Fernnebensprechen	max. 3% / < -35 dB to 1 GHz	Far End Cross Talk
Schirmungsdämpfung Kabelbaugruppe 0 - 1 GHz 0 - 2GHz	 min. 70 dB min. 60 dB	Shielding Attentuation Cable Assembly 0 - 1 GHz 0 - 2 GHz
Schirmungsdämpfung der Gehäusedurchführung 0 - 1 GHz 0 - 2 GHz	 min. 65 dB min. 60 dB	Shielding Attentuation Bulkhead Feedthrough 0 - 1 GHz 0 - 2 GHz

Depending on the used cable-type, deviations are possible.
In Anhängigkeit der verwendeten Leitung sind Abweichungen möglich.

Umwelt - Daten		Environmental Data
Mechanischer Schock	DIN IEC 60068-2-27	Mechanical Shock
Vibration	DIN IEC 60068-2-64 (Class 2)	Vibration
Aufschlag aus Höhe	1m	Drop from hight
Temperaturschock	DIN IEC 60068-2-14 -40℃ - +105℃	Thermal Shock
Temperatur-Feuchte Zyklus	USCar 2.4 -5.6.2. Test Temperature +105℃	Temperature Humidity Cycling
Hitzebeständigkeit	DIN IEC 60068 2-2 Temperature +105℃	Dry Heat

Materialien		Materials
Außenleiter	CuZn, CuSn	Outer Contacts
Innenleiter	CuZn, CuSn	Inner Contacts
Dielektrikum	PA, LCP	Dielectric
Dichtungen	Silicone, Rubber	Gaskets
Crimphülsen	CuSn	Crimp Ferrule
Gehäuse und Sicherungen	PA, PBT,POM	Housings and Locks

Oberflächen		Platings
Außenleiter	Ni, Au	Outer Contacts
Signalkontakte	Au	Signal Contacts

This table is part of the TE HSD-Test-Specification, all values apply to the test conditions specified there.
Die Tabelle ist Bestandteil der TE HSD-Test-Spezifikation, die Werte gelten unter den dort ausgeführten Prüfbedingungen.

- **acc. IDB 1394**
  gemäß IDB 1394

Performance Group A: Basic Construction, workmanship, dimensions, and plating thickness

Phase	Test to be performed			Measurements to be performed		Requirements
	Title	ID No.	Severity or conditions	Title	ID No.	Performance Level
A.1				Visual Inspection	USCAR-2, Rev. 5, 5.1.8	With aid of 10X magnification; No evidence of deterioration, cracks, deformities, etc., that could affect their functionality or distort their appearance. No deviation from dimensional tolerances of critical dimensions.
A.2				Plating Thickness Measurements		No deviation from plating materials and thickness specifications.

Performance Group B: Copper Socket DC Electrical Functionality when subjected to Mechanical Shock and Vibration

Phase	Test to be performed			Measurements to be performed		Requirements
	Title	ID No.	Severity or conditions	Title	ID No.	Performance Level
B.1	None		Mount socket rigidly. Insert plug by hand.	Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	50 milliohms maximum initial per mated contact
B.2	Connector Cycling	USCAR-2, Rev. 5 , 5.1.7	Cycle connector 25x.	Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	30 milliohms maximum change from initial per mated contact
B.3	Vibration	USCAR-2, Rev. 5, 5.4.6	Vibration per Figure 5.4.6.3, For components not coupled to engine. Grms=1.81.	Circuit Continuity Monitoring 7 ohms greater than 1micro-second	USCAR-2, Rev. 5, 5.1.9	No resistance change exceeding FFS ohms for more than 1 microsecond. (Each contact)
B.4	Mechanical Shock (Specified Pulse)	USCAR-2, Rev. 5, 5.4.6	10 half-sine wave impulses (10 milliseconds duration at 35 Gs force)	Circuit Continuity Monitoring 7 ohms greater than 1micro-second	USCAR-2, Rev. 5, 5.1.9	No resistance change exceeding FFS ohms for more than 1 microsecond. (Each contact)

B.5	None			Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	30 milliohms maximum change from initial per mated contact
				Visual Inspection	USCAR-2, Rev. 5, 5.1.8	With aid of 10X magnification; No evidence of deterioration, cracks, deformities, etc., that could affect their functionality or distort their appearance.

Performance Group C.1: Copper Socket DC Electrical Functionality when subjected to Humidity Stress

Phase	**Test to be performed**			**Measurements to be performed**		**Requirements**
	Title	**ID No.**	**Severity or conditions**	**Title**	**ID No.**	**Performance Level**
C.1.1	None		Mount socket rigidly. Insert plug by hand.	Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	50 milliohms maximum initial per mated contact
C.1.2	Connector Cycling	USCAR-2, Rev. 5 , 5.1.7	Cycle connector 25x.	Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	30 milliohms maximum change from initial per mated contact
C.1.3	Temperature/ Humidity Cycling	USCAR-2, Rev. 5, 5.6.2	-40 to 100C per class 2 environment. Maximum humidity per Figure 5.6.2.3. Total duration 320 hours (40 cycles).	Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	30 milliohms maximum change from initial per mated contact
				Visual Inspection	USCAR-2, Rev. 5, 5.1.8	With aid of 10X magnification; No evidence of deterioration, cracks, deformities, etc., that could affect their functionality or distort their appearance.

Performance Group C.2: Copper Socket Isolation Resistance Functionality when subjected to Humidity Stress

Phase	Test to be performed			Measurements to be performed		Requirements
	Title	ID No.	Severity or conditions	Title	ID No.	Performance Level
C.2.1	Connector Cycling	USCAR-2, Rev. 5 , 5.1.7	Cycle connector 25x.	Isolation Resistance	USCAR-2, Rev. 5, 5.5.1.4	Resistance between adjacent terminals must exceed 20 megohm at 500 VDC.
C.2.2	Temperature/Humidity Cycling	USCAR-2, Rev. 5, 5.6.2	-40 to 100C per class 2 environment. Maximum humidity per Figure 5.6.2.3. Total duration 320 hours (40 cycles).	Isolation Resistance	USCAR-2, Rev. 5, 5.5.1.4	Resistance between adjacent terminals must exceed 20 megohm at 500 VDC.

Performance Group C.3: Copper Socket Signal Integrity Functionality when subjected to Humidity Stress

Phase	Test to be performed			Measurements to be performed		Requirements
	Title	ID No.	Severity or conditions	Title	ID No.	Performance Level
C.3.1	Mated Connector and Termination Impedance		160 ps rise time at 50 ps, 100ps, and 150 ps beyond the connector launch plane	Impedance - Differential Mode (Connector Only)	IEEE Std 1394-2000 Annex K.3	System Impedance (ZTP) = 100 Ω: ZPTAConn =100Ω +/- 15Ω System Impedance (ZTP) =110 Ohms : ZPTAConn =110Ω +/- 15Ω
C.3.2	Cable Impedance			Impedance - Differential Mode (Cable Assembly)	IEEE Std 1394-2000 Annex K.3	System Impedance (ZTP) = 100 Ω: ZTPA=100Ω +/- 6Ω ZTPB=100Ω +/- 6 Ω System Impedance (ZTP) =110 Ohms : ZTPA=110Ω +/- 6Ω ZTPB=110 Ω +/- 6Ω
C.3.3	Propagation Velocity within a cable			Velocity of Propagation Differential Mode	IEEE Std 1394-2000 Annex K.5	min 66% Co

C.3.4	Propagation Delay Skew within a mated connector pair - straight			Propagation Skew - Differential Mode	IEEE Std 1394-2000 Annex K.6	max 10 ps
C.3.5	Propagation Delay Skew within a wire pair		Per meter	Propagation Skew - Differential Mode	IEEE Std 1394-2000 Annex K.6	max 10 ps/m
C.3.6	Maximum Propagation Delay Skew of entire cable assembly			Propagation Skew - Differential Mode	IEEE Std 1394-2000 Annex K.6	160 ps
C.3.7	Total Cable Insertion Loss (Attenuation)			Attenuation	IEEE Std 1394-2000 Annex K.6	f < 250 MHz < 4.8 dB f < 400 MHz < 6.0 dB f < 500 MHz < 6.8 dB f < 800 MHz < 9.2 dB f < 1000 MHz < 10.4 dB
C.3.8	Return Loss (Mated Connector Pair)			Return Loss	ANSI/EIA 364-108	max -20 dB (0 - 1 GHz)
C.3.9	Near End Cross Talk (Mated Connector Pair)			Cross Talk	IEEE Std 1394-2000 Annex K.8	max. 5 % (differential TDT at 160 ps, 10-90% rise time) max. -30 dB (0 – 1 GHz)
C.3.10	Far End Cross Talk (Mated Connector Pair)			Cross Talk	IEEE Std 1394-2000 Annex K.8	max. 5 % (differential TDT at 160 ps, 10-90% rise time) max. -30 dB (0 – 1 GHz)
C.3.11	Connector Cycling	USCAR-2, Rev. 5, 5.1.7	Cycle connector 25x.			
C.3.12	Temperature/ Humidity Cycling	USCAR-2, Rev. 5, 5.6.2	-40 to 100C per class 2 environment . Maximum humidity per Figure 5.6.2.3. Total duration 320 hours (40 cycles).			
C.3.13 - C.3.22	Repeat C.3.1 through C.3.10					

NOTE – Phase C.1, C.2 and/or C.3 can be combined if the sample configuration is suitable for the laboratory.

Performance Group D: Copper Socket DC Electrical Funcitonality when subjected to Thermal Shock

Phase	Test to be performed			Measurements to be performed		Requirements
	Title	ID No.	Severity or conditions	Title	ID No.	Performance Level
D.1	None		Mount socket rigidly. Insert plug by hand.	Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	50 milliohm maximum initial per mated contact
D.2	Connector Cycling	USCAR-2, Rev. 5, 5.1.7	Cycle connector 25x.	Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	30 milliohm maximum change from initial per mated contact
D.3	Thermal Shock	USCAR-2, Rev. 5, 5.6.1	-40 to 100C per class 2 environment. Total duration 100 cycles, 30 minute dwell.	Dry Circuit Resistance	USCAR-2, Rev. 5, 5.3.1	30 milliohm maximum change from initial per mated contact
				Visual Inspection	USCAR-2, Rev. 5, 5.1.8	With aid of 10X magnification; No evidence of deterioration, cracks, deformities, etc., that could affect their functionality or distort their appearance.

Performance Group E: Copper Socket Mechanical Funtionality when subjected to Temperature Life Stress

Phase	Test to be performed			Measurements to be performed		Requirements
	Title	ID No.	Severity or conditions	Title	ID No.	Performance Level
E.1	None		Mate Force Only	Connector-Connector Mating/Un-mating Force	USCAR-2, Rev. 5, 5.4.2	55N Max Mate Force
E.2	Connector Cycling	USCAR-2, Rev. 5, 5.1.7	Cycle connector 25x.			
E.3	High temperature exposure	USCAR-2, Rev. 5, 5.6.3	100 C for 1008 hours mated			
E.4			Un-mate Force w/ & w/o Lock & Lock Actuation Force	Connector-Connector Unmating Force Only	USCAR-2, Rev. 5, 5.4.2	Connectors with locks: Un-mating force w/ Locke engaged; 100N Min, Connector Lock Manipulation Force; 3N min to 60N max Connectors without locks:. Un-mating force w/o Lock; 5N min 55N max

Note: Phase E.1 and E.2 can be combined if the sample configuration is suitable for the laboratory.

Performance Group F: General Tests

Phase	Test to be performed			Measurements to be performed		Requirements
	Title	ID No.	Severity or conditions	Title	ID No.	Performance Level
F.1	Connector/ Cable Axial Pull test (5 cable assemblies with connector at one end 1m long, 5 mating connectors.)		Fix connector housing and apply a 100N load to the cable for one minute on cable axis.	Continuity	ANSI/EIA 364-46B	No discontinuity 1 microsecond or longer. (Each contact).
				Visual Inspection	USCAR-2, Rev. 5, 5.1.8	No jacket tears or visual exposure of shield. No jacket movement greater than 1.5 mm at point of exit from the connector or over mold.
F.2	Cable Flexing (5 cable assemblies with plug at one end 1m long, 5 mating connectors.)	ANSI/EIA 364-41C	Test Condition 1, Dimension X= 25 mm, 25 Cycles	Continuity	ANSI/EIA 364-46B	No discontinuity > 1 microsecond (Each contact).
				Isolation Resistance	USCAR-2, Rev. 5, 5.1.4	Resistance between adjacent terminals must exceed 20 megohm at 500 VDC.
				Visual Inspection	USCAR-2, Rev. 5, 5.1.8	With aid of 10X magnification; No jacket tears or visual exposure of shield, evidence of deterioration, cracks, deformities, etc., that could affect their functionality or distort their appearance. No jacket movement greater than 1.5 mm at point of exit.
F.3	Audible Click (5 mating connector pairs w/o humidity aging, 5 mating connector pairs w/ humidity aging.)	USCAR-2, Rev. 5, 5.4.7	95% - 98% RH @ 40C, 6 hours Minimum	Audible Click	USCAR-2, Rev. 5, 5.4.7	Report Data - Desired Goal:7 dB above Ambient unconditioned , 5 dB above Ambient conditioned

F.4	Polarization Feature Effectiveness (1 mating connector pair per mis-mating orientation)	USCAR-2, Rev. 5, 5.4.7	80N	Continuity	USCAR-2, Rev. 5, 5.4.7	No contact with mating contacts during mis-mating.
				Visual Inspection	USCAR-2, Rev. 5, 5.1.8	With aid of 10X magnification; No evidence of deterioration, cracks, deformities, etc., that could affect their functionality or distort their appearance. No deviation from dimensional tolerances of critical dimensions.
F.5	Cavity Damage (5 plug terminals, 5 plug housings, 5 socket terminals, 5 socket housings)	USCAR-2, Rev. 5, 5.4.9		Visual Inspection	USCAR-2, Rev. 5, 5.1.8	Confirm that the secondary lock (TPA) does not fully seat when the terminal partially inserted.
			Remove force, fully seat terminal and fully seat secondary lock (TPA),	Terminal/ Connector Extraction Force	USCAR-2, Rev. 5, 5.4.1	USCAR-2, Rev. 5, 5.4.1.4
F.6	Connector Drop (10 Plug & Socket Connector Cable Assemblies)	USCAR-2, Rev. 5, 5.4.8	3 Drops of each unmated connector @ 1m	Visual Inspection	USCAR-2, Rev. 5, 5.1.8	With aid of 10X magnification; No evidence of deterioration, cracks, deformities, etc., that could affect their functionality or distort their appearance.

Notes:
1) Test Group F is not sequential. Each phase above is an independent test with separate sets of samples for each phase.
2) Cable length for Test Phase F.1 may be changed to facilitate laboratory and test equipment requirements.
3) Phase F.5 is applicable to connector systems with secondary locks (TPA's).

3.5 Qualification and Requalification Test Sequence
Qualifikations- und Requalifikationsprüfungen

- **acc. TE HSD-Test-Specification 109-18261**
  gemäß TE HSD-Test-Spezifikation 109-18261

Prüfgruppe **Test group**		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Prüfvorschrift Abschnitt **Test Specification Section**		Steck- und Ziehkraft **Mating- / Unmating Force**	Lehren-Auszugskraft **Gauge Retention Force**	Wirksamkeit der Kodierung **Polarization Effecitveness**	Zugprüfung **Pull Test**	Kabelausreißkraft **Cable Retention Force**	Kabelverdrehungskraft **Cable Torsion**	Aufschlagprüfung **Drop Test**	Mechan. Schock, Vibration **Mechanical Shock, Vibration**	Gehäuse-Einführ- / Auszugskraft **Terminal Insertion/Retention Force**	Betätigung Sekundärverriegelung **Secondary Lock Manipulation**	Kabel- und Stecker-Impedanz **Cable- and Connector Impedance**	Signalübertragung **Transmission Parameters**	Dämpfung, Unschärfe, Übersprechen **Attenuation, Jitter and Cross-Talk**	Schirmungseffizienz **Shielding Efficiency**	Strombelastbarkeit **Maximum Test Current**	Temperaturschock **Thermal Shock**	Temperatur- und Feuchtezyklus **Temperature / Humidity Cycling**	Hitzebeständigkeit **High Temperature Exposure**
	Anzahl Prüfmuster **Sample size**	10	10	12	10	5	5	3	5	10	5	5	5	5	5	5	10	10	10
	Prüfreihenfolge/**Test sequence** [1)]																		
5.1.	Allgemeines **General**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5.1.5.	Stecken und Ziehen **Connector Cycling**				4			4	4			4	4	4		4	4	4	4
5.1.6.	Sichtprüfung **Visual Inspection**	2 5	2 4	2 5	2 23	2 5	2 6	2 7	2 23	2 4 7	2 4	2 6	2 8	2 9	2 5	2 6	2 23	2 23	2 24
5.1.7.	Kritische Abmessungen **Critical Dimensions**	3		3	3 14	3	3 5	3 6	3 14			3	3	3	3	3	3 14	3 14	3 15
5.1.8.	Stromkreis-Überwachung **Circuit Continuity Monitoring**				13				13										

5.2.1.	Steck- und Ziehkraft Stecker **Mating/Unmating Force Connectors**	4																	
5.2.2.	Lehren-Auszugskraft **Gauge Retention Force**		3																
5.2.3.	Wirksamkeit der Kodiervorrichtung **Polarization Effectiveness**			4															
5.2.4.	Mechanische Zugprüfung **Pull Test**				13														
5.2.5.	Kabelausreißkraft **Cable Retention Force**					4													
5.2.6.	Kabelverdrehung **Cable Torsion**						4												
5.2.7.	Aufschlagprüfung **Drop Test**							5											
5.2.8.	Mechanischer Schock, Vibration **Mechanical Shock, Vibration**								13										
5.2.9.	Gehäuse Einführ-/Auszugskraft **Terminal Insertion/Retention Force**									3 6									
5.2.10.	Betätigung d. Sekundärverriegelung **Manipulation of Secondary Lock**										3								
5.3.1.	Kontaktwiderstand **Contact Resistance**				11 21				11 21								11 21	11 21	11 22
5.3.2.	Isolationswiderstand **Isolation Resistance**				12 22				12 22								12 22	12 22	12 23
5.3.3.	Strombelastbarkeit **Maximum Test Current (Derating)**															5			
5.4.1.	Impedanz der Kabelbaugruppe **Cable Assembly Impedance**				5 15				5 15			5					5 15	5 15	5 16

5.4.2.	Ausbreitungsgeschwindigkeit **Propagation delay**												5						
5.4.3.	Laufzeitdifferenz im Adernpaar **Propagation Delay Skew**				6 16				6 16				6				6 16	6 16	6 17
5.4.4.	Einfügungsdämpfung **Attenutation**				7 17				7 17					7			7 17	7 17	7 18
5.4.5.	Temperaturgang der E.-Dämpfung **Attenuation Temperature-Variation**													8					
5.4.6.	Rückflußdämpfung **Return Loss**				8 18				8 18				7				8 18	8 18	8 19
5.4.7.	Zulässige Unschärfe **Maximum Jitter**				9 19				9 19					5			9 19	9 19	9 20
5.4.8.	Übersprechen **Cross Talk**				10 20				10 20					6			10 20	10 20	10 21
5.4.9. 5.4.10.	Schirmungseffizienz **Shielding Effectiveness**														4				
5.5.1.	Temperaturschock **Thermal Shock**																13		
5.5.2.	Temperatur-Feuchte-Zyklus **Temperature Humidity Cycling**																	13	
5.5.3.	Hitzebeständigkeit **High Temperature Exposure**																		13

[1)] **Numbers indicate sequence in which test are performed.**
Die Zahlen geben die Reihenfolge an, in der die Prüfungen erfolgen.

Additional Test Matrix for Qualification of waterproof HSD-Connector Systems
Zusatzprüfungs-Matrix zur Qualifikation von wasserdichten HSD-Steckverbinder-Systemen

Prüfgruppe **Test group**		W01	W02	W03	W04	W05	W06	W07	W08	W09	W10
Prüfvorschrift Abschnitt **Test Specification Section**		Steck- und Ziehkraft **Mating- / Unmating Force**	Wirksamkeit der Kodierung **Polarization Effecitveness**	Zugprüfung **Pull Test**	Mechan. Schock, Vibration **Mechanical Shock, Vibration**	Gehäuse-Einführ- / Auszugskraft **Terminal Insertion/Retention Force**	Temperaturschock **Thermal Shock**	Temperatur- und Feuchtezyklus **Temperature / Humidity Cycling**	Hitzebeständigkeit **High Temperature Exposure**	Wasserdichtigkeit **Waterproof**	Chemikalienbeständigkeit **Chemical Solvent Resistance**
	Anzahl Prüfmuster **Sample size**	10	12	10	10	10	10	10	10	10	51
	Prüfreihenfolge **Test sequence** [1)]										
5.1.	Allgemeines **General**	1	1	1	1	1	1	1	1	1	1
5.1.5.	Stecken und Ziehen **Connector Cycling**			4	4		4	4	4	4 20	3 5
5.1.6.	Sichtprüfung **Visual Inspection**	2 5	2 5	2 7	2 8	2 4	2 8	2 8	2 8	2 21	2 6
5.1.7.	Kritische Abmessungen **Critical Dimensions**	3	3	3 6	3 7		3 7	3 7	3 7	3	
5.1.8.	Stromkreis-Überwachung **Circuit Continuity Monitoring**			5	5		5				
5.2.1.	Steck- und Ziehkraft Stecker **Mating/Unmating Force Connectors**	4									
5.2.2.	Lehren-Auszugskraft **Gauge Retention Force**										
5.2.3.	Wirksamkeit der Kodiervorrichtung **Polarization Effectiveness**		4								
5.2.4.	Mechanische Zugprüfung **Pull Test**			5							
5.2.5.	Kabelausreißkraft **Cable Retention Force**										
5.2.6.	Kabelverdrehung **Cable Torsion**										
5.2.7.	Aufschlagprüfung **Drop Test**										

5.2.8.	Mechanischer Schock, Vibration **Mechanical Shock, Vibration**				5						
5.2.9.	Gehäuse Einführ-/Auszugskraft **Terminal Insertion/Retention Force**					3					
5.2.10.	Betätigung d. Sekundärverriegelung **Manipulation of Secondary Lock**										
5.3.1.	Kontaktwiderstand **Contact Resistance**										
5.3.2.	Isolationswiderstand **Isolation Resistance**				6		6	6	6	7 9 11 13 15 17 19	
5.3.3.	Strombelastbarkeit **Maximum Test Current (Derating)**										
5.4.1.	Impedanz der Kabelbaugruppe **Cable Assembly Impedance**										
5.4.2.	Ausbreitungsgeschwindigkeit **Propagation delay**										
5.4.3.	Laufzeitdifferenz im Adernpaar **Propagation Delay Skew**										
5.4.4.	Einfügungsdämpfung **Attenutation**										
5.4.5.	Temperaturgang der E.-Dämpfung **Attenuation Temperature-Variation**										
5.4.6.	Rückflußdämpfung **Return Loss**										
5.4.7.	Zulässige Unschärfe **Maximum Jitter**										
5.4.8.	Übersprechen **Cross Talk**										
5.4.9. 5.4.10.	Schirmungseffizienz **Shielding Effectiveness**										
5.5.1.	Temperaturschock **Thermal Shock**						5			5	
5.5.2.	Temperatur-Feuchte-Zyklus **Temperature Humidity Cycling**							5			

5.5.3.	Hitzebeständigkeit **High Temperature Exposure**										
5.5.4.	Wasserdichtigkeit **Water Proof**										
5.6.1.	Dampfstrahlprüfung **Steam Jet Test**									6	
5.6.2.	Wasserbadprüfung **Submersion Test**									8	
5.6.3.	Wasserbadprüfung m Zugbelastung **Submersion Test under pull force**									10	
5.6.4.	Tauchen bei Unterdruck **Vacuum Submersion Test**									12	
5.6.5.	Tauchen mit Temperaturschock **Submersion with thermal shock**									14	
5.6.6.	Wasserstrahl m. Vibration **Water jet stream and vibration**									16	
5.6.7.	Salznebeltest **Salt Spray Test**									18	
5.6.8.	Tauchen bei Überdruck **Submersion under Pressure**				6		6	6	6		
5.6.9.	Chemikalienbeständigkeit **Chemical Solvent Resistance**										4

[1)] **Numbers indicate sequence in which test are performed.**
Die Zahlen geben die Reihenfolge an, in der die Prüfungen erfolgen.

- **acc. IDB 1394**
  gemäß IDB 1394

Cable to Cable Configurations

Cable to Cable Configurations	Performance Group														
	A	B	C.1	C.2	C.3	D	E.1	E.2(5)	F.1	F.2	F.3	F.4 (4)	F.5	F.6	Total
Sockets, not assembled to a cable	3														3
Socket Terminals Terminated to Wires													5		5
Socket Housings with TPA's w/o Terminals Installed											16		5		21
Cable assemblies with a Socket assembled to one end, ~ 75 mm long												3			3
Cable assemblies with a Socket assembled to one end, > 75 mm long (1)	3		10	3		10	10	10							46
Cable assemblies with a Socket assembled to one end, > 100 mm long (2).		10													10
Cable assemblies with a Socket assembled to one end, >= 1m long.									5	5				10	20
Plugs, not assembled to cable	3														3
Plug Terminals Terminated to Wires													5		5
Plug Housings with TPA's w/o Terminals Installed												16	5		21
Cable assemblies with a Plug assembled to one end, ~ 75 mm long												3			3
Cable assemblies with a Plug assembled to one end, > 75 mm long (1)	3		10	3		10	10	10							46
Cable assemblies with a Plug assembled to one end, > 100 mm long (2)		10													10
Cable assemblies with a Plug assembled to one end, >= 1m long.									5	5				10	20
Socket and Plug assemblies configured for signal integrity measurements (3)					3										3

Number of samples required by each performance group regardless of circuit size

Notes:

(1) Samples are to be prepared to facilitate resistance measurements made at points on the wire 75 mm back from the contact/wire termination.

(2) Samples are to be prepared to facilitate clamping the cable 100mm back from the connector housing in a vibration fixture and resistance measurements made at points on the wire 75 mm back from the contact/wire termination.

(3) Samples are to be prepared to facilitate high speed signal integrity measurements. Configurations are to include any necessary SI fixtures.

(4) One connector pair mis-mate orientation. See Test Group F.4

(5) The same samples are used for phases E.2, E.3, and E.4.

- **acc. SAE/USCar 2 Rev.5**
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Sealed Connector System Environmental Test Sequences

Test group		Q	R	S	T	U
Test Specification Section		Fluid Resistance	Temperature/Humidity Submersion	Temperature/Humidity PV-Leak	High Temperature Exposure-PV Leak	Pressure/Vacuum Stand Alone
	Sample size	8	10	10	10	10
5.1.	**General**	1	1	1	1	1
5.1.8.	**Visual Inspection**	2,4	2,10	2,11	2,9	2,10
5.1.7.	**Connector Cycling**		3	3	3	3
5.1.9.	**Circuit Continuity Monitoring**					
5.3.1.	**Dry Circuit Resistance**					
5.3.2.	**Voltage Drop**					
5.4.1.	**Terminal-Connector Extraction Force**		9	10		
5.4.6.	**Vibration/Mechanical Shock**					
5.5.1.	**Isolation Resistance**		4,6,8	5,7,9	4,6,8	5,7,9
5.6.1.	**Thermal Shock**					
5.6.2.	**Temperature/Humidity Cycling**		$5^{(8,7)}$	$6^{(8,7)}$		
5.6.3.	**High Temperature Exposure**				$5^{(8,7)}$	$6^{(8,7)}$
5.6.4.	**Fluid Resistance**	3				
5.6.5.	**Submersion**		$7^{(6,8,9)}$		$7^{(6,8,9)}$	
5.6.6.	**Pressure/Vacuum Leak**			$4,8^{(5,8,9)}$		$4,8^{(5,8,9)}$

Numbers indicate sequence in which test are performed.

Notes:

(1) For connectors with shorting bars, complete Dry Circuit Test on shorted contacts prior to connector mating and after final connector un-mating.

(5) Use 48KPa prior to High Temp. Exposure test (5.6.3) and Temp./Humidity Cycling test (5.6.2). Use reduced pressure/vacuum of 28KPa (4psig) following High Temp. Exposure test (5.6.3) and Temp./Humidity Cycling test (5.6.2)

(6) Submersion test (5.6.5) reduced to one (1) cycle following High Temperature Exposure Test (5.6.3) and Temperature/Humidity Cycling Test (5.6.2).

(7) When Temperature/Humidity Cycling or High Temperature Exposure are done as Part of this table, complete the conditioning procedure only. Dry Circuit/voltage drop readings and monitoring are not required.

(8) In order to reduce sample size, the Pressure/Vacuum Leak (5.6.6) and Submersion (5.6.5) may be run in series. This allows Sequences R and S to be combined and T and U to be combined. When tests are done in series, do not open the connectors as directed in section 5.6.5.4 and 5.6.6.4. Isolation resistance must be run between the PV Leak and Submersion tests.

(9) Mat seal terminal insertion per section 5.6.5.3-2, 5.6.6.3-4 may be done prior to beginning the table sequence, or may be done prior to Submersion or PV Leak.

4. QUALITY ASSURANCE PROVISIONS
QUALITÄTSSICHERUNGSMASSNAHMEN

4.1 Qualification Testing
Qualifikationsprüfung

A Sample Selection
Auswahl der Prüflinge

The samples shall be prepared in accordance with product drawings. They shall be selected at random from current production.
Die Prüflinge müssen den Zeichnungsunterlagen entsprechen. Sie sind der laufenden Produktion zufällig zu entnehmen.

B Test Sequence
Prüfgruppen

Qualification inspection shall be verified by testing samples as specified in Paragraph 3.5.
Die Prüfungen müssen gemäß der unter Abschnitt 3.5 aufgeführten Prüfgruppen durchgeführt werden.

4.2 Requalification Testing
Requalifikationsprüfung

If changes significantly affecting form, fit or function are made to product or to the manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by the product/development , quality and reliability engineering department.
Falls signifikante, die vereinbarten Eigenschaften berührende Änderungen der Form, Ausstattung oder Funktion des Produktes oder dessen Herstellungsverfahrens vorgenommen wurden, wird die zuständige Entwicklungsabteilung einen Requalifikationstest koordinieren. Dieser besteht aus einem Teil oder den gesamten ursprünglichen Prüfgruppen, je nach Festlegung durch die Entwicklungs- und Qualitätssicherungsabteilung.

4.3 Acceptance
Abnahme

Acceptance is based on verification that the product meets the requirements of Paragraph 3.4. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. When product failure occurs, corrective action shall be taken and samples resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.
Die Abnahme basiert auf dem Nachweis, daß das Produkt den Anforderungen nach Abschnitt 3.4 genügt. Abweichungen, die auf Meßgeräte, Meßanordnungen oder Bedienungsmängel zurückzuführen sind, dürfen nicht zum Entzug der Qualifikation führen. Tritt eine Abweichung auf, müssen korrigierende Maßnahmen ergriffen werden und die Qualifikation ist erneut nachzuweisen. Vor dieser Requalifikation ist durch entsprechende Prüfungen der Erfolg der Korrekturmaßnahme zu bestätigen.

4.4 Prüfung Conformance Inspection
Prüfung und Konformität

The applicable TE quality inspection plan will specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.
Die Konformitätsprüfung erfolgt nach dem zugehörigen Qualitätsinspektionsplan, der die annehmbare Qualitätsgrenzlage nach dem Stichprobenumfang festlegt. Maßliche und funktionelle Anforderungen müssen mit den Produktzeichnungen und dieser Spezifikation übereinstimmen.