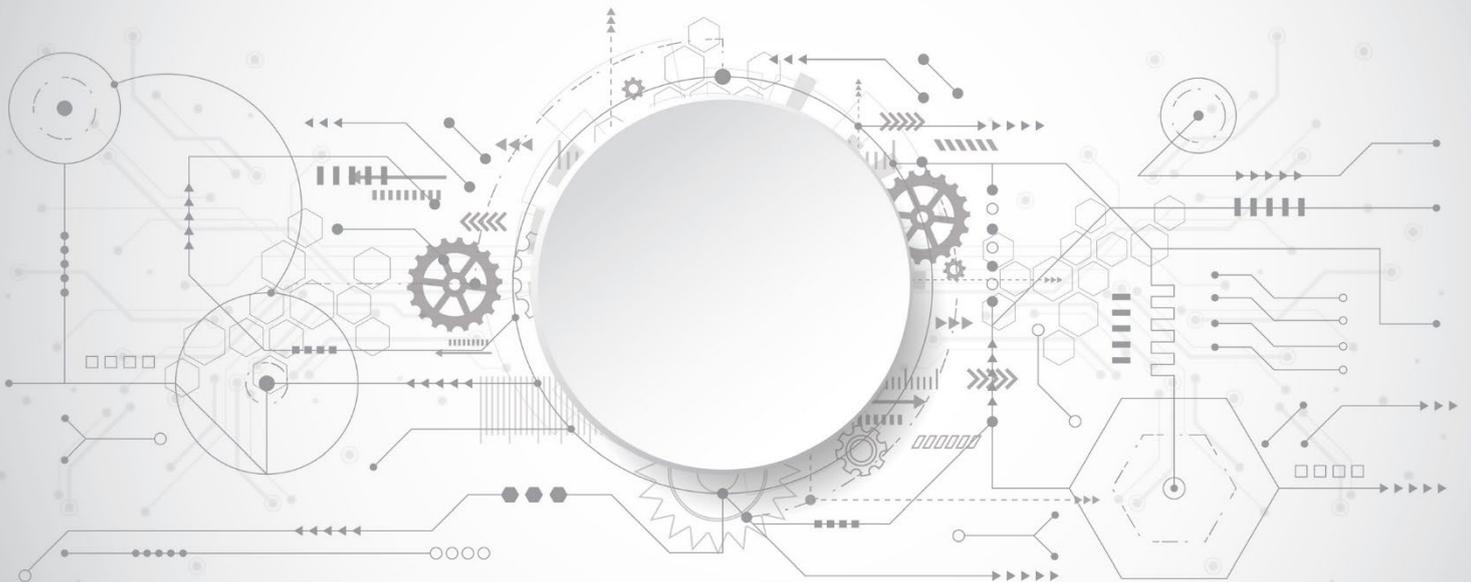




ELEKTRONIK
BEYOND CONNECTIONS



MD GROUP HANDLING INSTRUCTION

For assembled coaxial cables for the
data transmission in the automotive sector

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1. Abbreviations and Definitions

Coax	Coaxial
FAKRA	Fachkreis Automobil (Automobile Expert Group)
Assembled cables	Cables consisting of goods on reels and connector(s)
Coding	Unambiguous distinction of the coding housings in terms of geometry and color
Interface specification	Definition of an electrical supply terminal on the basis of the geometry and the mechanical and electrical properties
OEM	Original Equipment Manufacturer
DMU/PMU	Digital Mock Up/Physical Mock Up
Customer	Requester or ordering party of the assembled cables (OEM, Tier1, other customers)

2. Range of Application

This instruction describes the intended installation/the intended handling of assembled coaxial cables of MD ELEKTRONIK GmbH. The data and values indicated in this handling instruction refer to the technical specifications of the individual components and to the experiences in the automotive field of application. The (mechanical, electrical, thermal and environmental) requirements are binding for the intended use and for the handling of the products.

3. General Requirements

When handling assembled cables and their components, all mechanical influences that are not caused by the mating process itself have to be avoided. It has to be always considered that strong deformations (e.g. by the load of heavy objects or by stepping on the cable and its add-on parts) are not allowed and have to be avoided during handling. In general, tensile loads are not allowed. It is not allowed to throw assembled cables (e.g. into the vehicle body). The placement of the assembled cables in the vehicle has to be adapted by the customer in the KSK design according to the installation situation in the vehicle (e.g. static/dynamic, engine compartment/passenger compartment, tensile loads, ...). Continuous loads (e.g. tensile loads) during operation are not covered by the manufacturer specifications (see respective data sheets) and have to be coordinated with the component manufacturer if necessary (see chapter 4). Only substances/media (e.g. lubricants) that are approved according to the manufacturer's standard and OEM specification and that are qualified in combination with the assembled cables are allowed to be used in order to facilitate the processing. In order to minimize the loads on the assembled cables, an optimum design and installation of the cable harness (DMU/PMU) is to be strived for. In order to ensure this requirement, the wide variety of connectors (e.g. cable exit directions) is to be used and low loads are explicitly to be considered. Additionally, the MD document "Application Instruction" (C30301) has to be considered.

This handling instruction makes no claim to be complete. Subject to errors and changes. Solely such handling and/or applications being defined as allowed in this document are approved. Any other handling and/or application is/are explicitly deemed to be not approved and is/are the sole responsibility of the customer.

3.1 Interface

Only components that are qualified and approved according to the respective OEM interface specification are allowed to be used. The mating compatibility has to be ensured by the individual manufacturers.

3.2 Order and cleanliness

When handling assembled cables, any type of dirt has to be avoided and order and cleanliness are required at any time.

3.3 Delivery and storage

The delivery, receipt and storage of assembled cables, see also the Storage Advice MD ELEKTRONIK – finished products (C11569), must not take place outdoors without any protection. Under such conditions, the protection of the mating areas against dirt or humidity is not ensured. Additionally, UV irradiation and increased temperature can result in an unintentional aging.

3.4 Simplified installation by heating

The cables must not be preconditioned above 60 °C (140 °F) for the purpose of simplified cable harness installation because this can result in an unintentional aging/damage of the cables. In consequence, this can adversely affect their function and lifetime.

3.5 Handling

In order to avoid injuries during mating, disconnecting and installing cables, it is recommended to wear protective gloves.

4. Mechanical and Thermal Loads

4.1 Tensile load

Regarding the mechanical load, coaxial cables are subject to special criteria. During processing and operation, tensile forces on the cable or the connector are not allowed.

Tensile forces between the cable and connector that will result in the malfunction of the assembly can be caused by:

- a cable length that is too short
- a cable fixation that is under tension
- an insufficient fixation and therefore damage due to self-weight, vibration or strokes

The manufacturer specifications refer to the pure qualification tests according to the required specifications for the components. These tests are only a snapshot of the moment of qualification. In case of a deviation from these requirements, a qualification according to these conditions is recommended.

4.2 Bending load

During the installation of assembled cables, it has to be ensured that the bending radii on all assembled cables are complied with. This applies to all variants.

4.2.1 Static installation in the vehicle

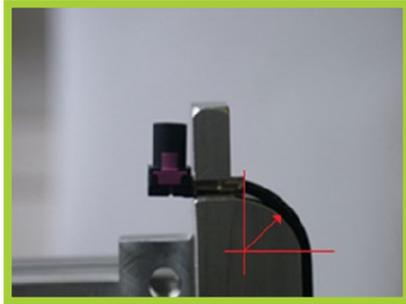
For a static installation of the cables, i.e. installation without movement, the values can be found in the manufacturer specifications under the item "Bending radius" (e.g. under "Single" or at "Single bending").

4.2.2 Dynamic installation in the vehicle

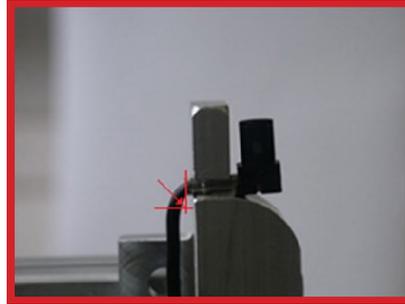
For the installation with dynamically recurring bending (flexible application) of the cable (e.g. in doors, exterior mirrors or tailgates), the values can be found in the manufacturer specifications under the item "Bending radius" (e.g. under "Multiple" or at "Repeated bending").

Loads that exceed the specifications of the individual components (connectors) have to be validated on a case-by-case basis or they must be independently tested and approved by the OEM or the cable harness supplier.

4.2.3 Definition of the bending radius



Correct bending



Incorrect bending

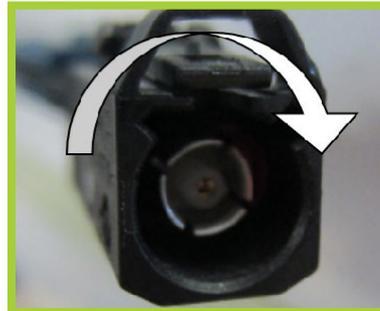
4.2.4 Use of MQS stranded wires

Currently, there are no coding housings with additional stranded wires (MQS) for coaxial cables.

4.3 Load due to torsion

In case of assembled coaxial cables, torsion is limited to an angle of $\pm 45^\circ$ with a minimum free cable length of ≥ 150 mm. This only applies to housings of not freely rotatable connectors and when mated.

In general, it is recommended to verify this on a case-by-case basis because this significantly depends on the cable and contact (see data sheet). Regarding the taping, it has to be considered that a minimum free cable length must be complied with (see point 5.2).



4.4 Combined load (bending-torsional load)

Combined loads that occur due to special applications (e.g. retracting the mirror, panorama display, retractable display, tailgate) have to be minimized by the cable harness design. Since combined loads exceed the specified loads, it is necessary to prove the fulfillment of the application-related requirements of the customer.

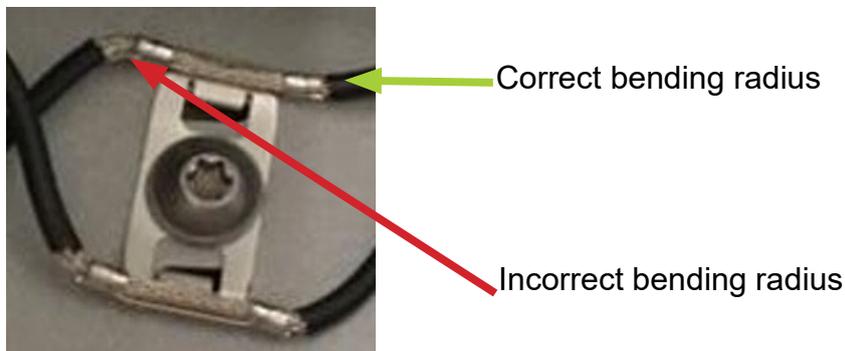
4.5 Thermal load

The individual components of an assembled cable have different thermal specifications. The total load limit depends on the weakest part of the assembled cable, thus specifying the area of application. The temperature ranges can be found in the component data sheets.

5. Add-on Parts and Taping

5.1 Add-on parts (e.g. ground clamps)

The improper assembling of add-on parts can result in changed properties, damage and/or additional loads. MD ELEKTRONIK GmbH does not assume warranty for subsequently assembled add-on parts and affixed tapings. Additionally, the bending radii (see chapter 4.2.3) for the continuing cables (e.g. after the ground clamp) have to be complied with.



5.2 Taping of coaxial cables

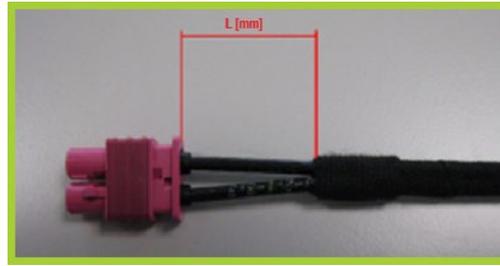
When taping an assembled cable, it has to be ensured that no mechanical loads influence the cables.

The minimally non-taped length between the end of the connector and the end of the taping, that is specified below, must be complied with in any case. (Separate manufacturer specifications have to be considered.)

System	Case	Distance between component and taping
FAKRA II and FAKRA SF	Single Coax cable	L ≥ 30 mm
	Two Coax cables within one taping	L ≥ 50 mm
	Three and more cables within one taping	L ≥ 100 mm
FAKRA LC	Single Coax cable	L ≥ 30 mm
	Two Coax cables within one taping	L ≥ 50 mm
	Three and more cables within one taping	L ≥ 100 mm
Mini Coax	Single Coax cable	L ≥ 50 mm
	Several cables within one taping	L ≥ 100 mm



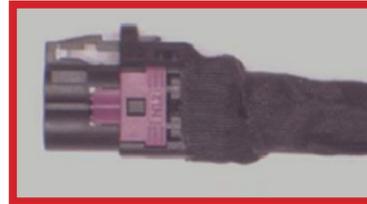
Example: 1-pin



Example: 2-pin



Example: 4-pin and multipin



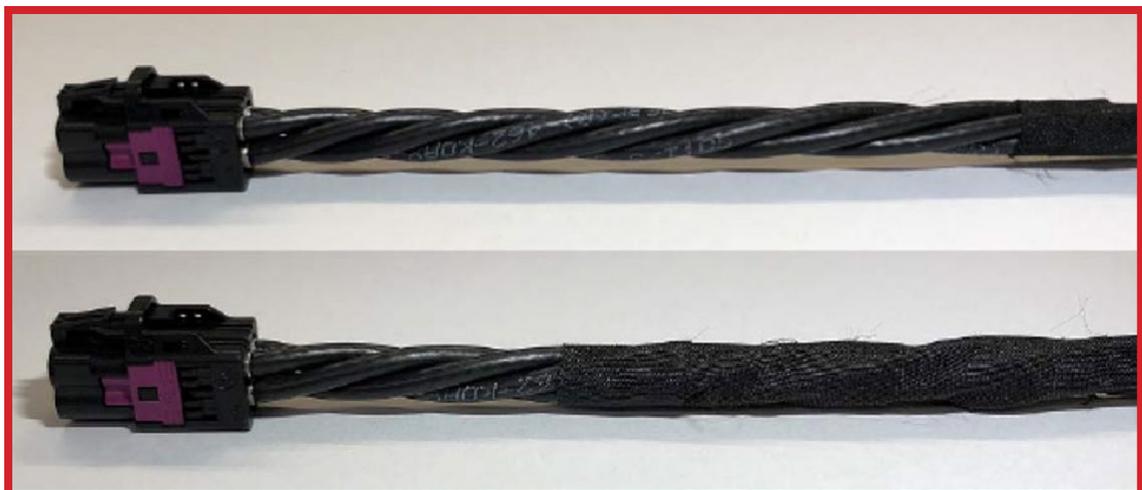
Example: incorrectly taped

5.3 Torsion-free processing in the case of multiple systems

The manner of taping and the location where the cable is fixed have a direct influence on the torsion of every single cable within the multiple system. No rotational load is allowed to occur during taping. The minimum clamping length (distance between the mated housing on the cable side and the cable fixation) ensures that a twist (torsion) of the cables towards each other is avoided. In case of all cables, the minimum distance (see table 5.2) without taping/fixation has to be complied with.



Example: 4-pin connector system OK



Example: 4-pin connector system NOK

5.4 Attaching fixing elements (e.g. cable ties, holders)

The cable fixation must be designed in such a way that it does not require additional physical effort when mating. Squeezing/damaging the cable by the fixing elements is not allowed. Fixing with cable ties is only allowed on taped surfaces.

For fixing inline connections only fixing elements of MD ELEKTRONIK GmbH are allowed.

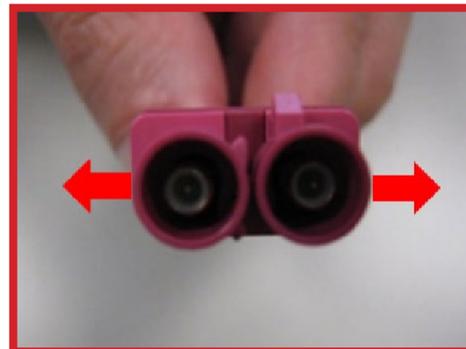
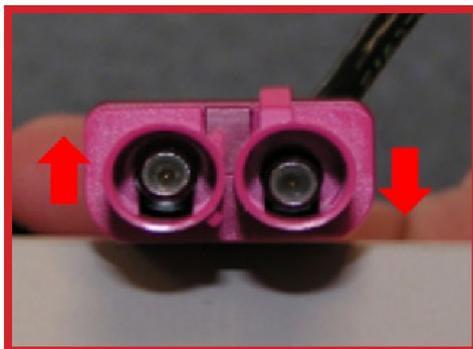
5.5 Splice connections

Splice connections must not be exposed to mechanical loads neither during further assembling nor during the installation in the vehicle.

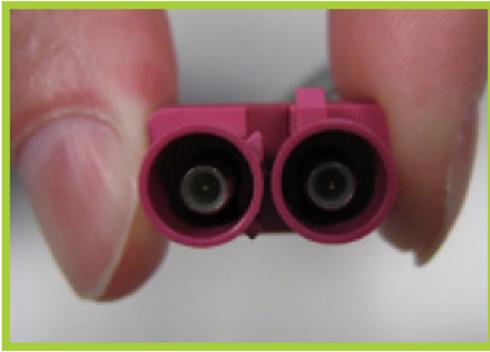
6. Mating of Assembled Cables

6.1 Mating process of the assembled cable

As a basic principle, it has to be ensured that the assembled cable is held during mating on the connector housing or contact (if partially assembled), but not on the cable itself. The connector has to be inserted in the correct direction into the correct slot (coding) until it locks clearly audibly.



Incorrect handling

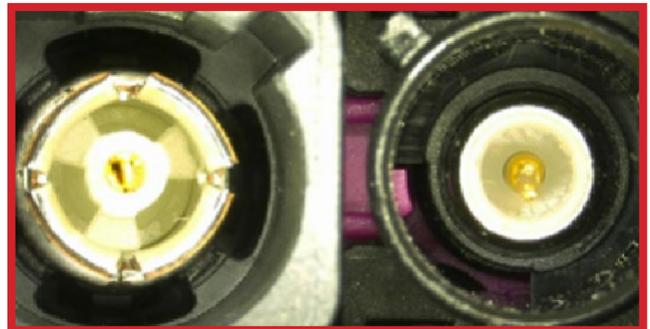


Correct handling

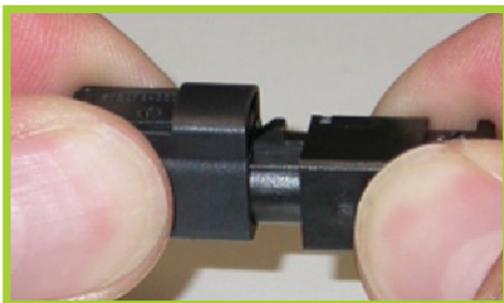
During the mating process, the housings must not tilt. The male and female housing must be connected without any large physical effort. The component manufacturer's requirements have to be complied with (mandatory).



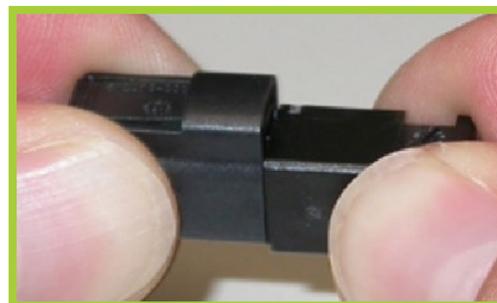
Incorrect mating



Bent inner contacts



Correct mating



Correctly mated

6.2 Disconnecting the connectors/cable

In order to disconnect the connectors, it is necessary to follow these steps: First push the housings together to make the connection free of forces (without load). Then push the locking latch with the finger so that the locking element opens. Finally, the two connectors can be pulled off in axial direction. The two connectors are only allowed to be held at the housings.

Tools, such as screwdrivers, knives or similar, must not be used for pushing the locking latch. The component manufacturer's requirements have to be complied with (mandatory).



6.3 Mating cycles

The quantity of the maximum permissible mating cycles is defined by the component manufacturer and must not be exceeded.

7. Positioning of the Cable Exit

The portfolio of Coax connectors offers various exit directions. The adjustment of the correct exit direction has to be indicated when ordering the assembled cable at MD ELEKTRONIK GmbH. Here, it has to be made sure that the cable exit is adjusted according to the positioning in the vehicle in order to ensure the correct installation in the vehicle. The change of the cable exit results in a reduction of the self-retaining forces of the connector. The compliance with the component manufacturer's requirements is mandatory and the OEM requirements have to be revalidated.

A positioning of the cable exit to the correct exit direction by the customer is only allowed in exceptional cases. In this case, the order has to be modified as soon as possible. Before mating, the positioning has to be adapted as follows:

Step 1: Fix the coding housing between the forefinger and thumb.

Step 2: Hold the metallic outer contact and move the outer conductor to the correct exit direction/end position.

Step 3: Insert the connector into the intended position (see 6.1).



Correct turning



Correct turning



Incorrect turning



Incorrect turning

8. Tests

It is not allowed to contact the cables delivered and tested by MD ELEKTRONIK GmbH prior to the installation in the vehicle (according to various OEM specifications).

8.1 Error test

In some instances, the automotive manufacturers have specifications for tests in the event of errors. If a test is necessary, solely test devices and test adapters being suitable for the connector, both approved by MD ELEKTRONIK GmbH, are allowed to be used. Only instructed persons are allowed to perform the error analysis. Furthermore, the test devices are solely allowed to be used for their intended purpose.

These test devices can be purchased from MD ELEKTRONIK GmbH upon request. The following test devices are available:

- MD short-circuit tester for HSD/HSDe/antenna (coaxial cables)



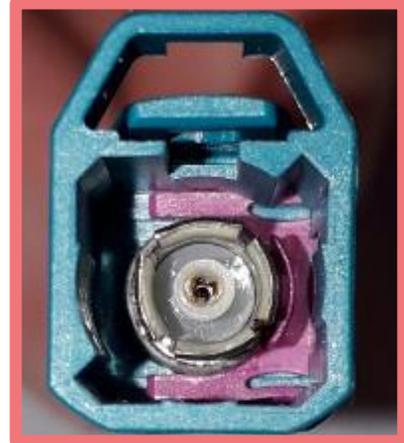
Correct testing equipment

8.2 Not allowed electrical tests

8.2.1 Use of not allowed testing equipment

It is not allowed in any case to use contacts for the electrical test of assembled cables. Reason: using contacts can damage the connector.

The following pictures show examples for tests of Coax/Mini Coax connectors that are not allowed:



Example: Damaged coaxial connector



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