



**HIGH DATA RATE CABLE ASSEMBLIES
WITH MICROMINIATURE, RECTANGULAR, CONNECTORS**

BASED ON TYPE MICROMACH

ESCC Detail Specification No. 3409/002

Issue 1	February 2020
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1 GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics and test and inspection data for the range of components specified below. It supplements the requirements of, and shall be read in conjunction with, the ESCC Generic Specification listed under Applicable Documents.

1.2 APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:

- (a) ESCC Generic Specification No. [3409](#), High Data Rate Cable Assemblies.
- (b) ESCC Detail Specification No. [3902/003](#), Cable, "Spacewire", Round, Quad using Symmetric Cables, Flexible, -200 to +180°C.
- (c) ESCC Detail Specification No. [3902/004](#), Cable, Low Mass, "Spacewire", Round, Quad using Symmetric Cables, Flexible, -100 to +150°C.

1.3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. [21300](#) shall apply.

1.4 THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS

1.4.1 The ESCC Component Number

The ESCC Component Number shall be constituted as follows:

Example: 34090020101D032000

- Detail Specification Reference: 3409002
- Component Type Variant Number: 01 (as required)
- Characteristic Code: Connector Type Side A (MicroMach HDR, SpaceWire Adapted, Male, In-line Plug): 01 (as required)
- Characteristic Code: Wiring Type (Direct): D (as required)
- Characteristic Code: Connector Type Side B (MicroMach HDR, SpaceWire Adapted, Female, Panel Mount Jack): 03 (as required)
- Characteristic Code: Total Length (L = 2000mm): 2000 (as required)

1.4.1.1 *Characteristics Codes*

Characteristics to be codified as part of the ESCC Component Number shall be as follows:

(a) Connector Types

The connector type(s) at side A and side B of the HDR cable assembly (see Para. 1.6.2) shall be expressed by means of the following codes:

Connector Type	Connector Code	Remarks
MicroMach HDR, SpaceWire Adapted, Male, In-line Plug	01	Used for side A and/or B. Only applicable for Variant 01 and 02. See Note 1 for available combinations.
MicroMach HDR, Low Mass SpaceWire Adapted, Male, In-line Plug	02	Used for A and/or B. Only applicable for Variant 03. See Note 1 for available combinations.
MicroMach HDR, SpaceWire Adapted, Female, Panel Mount Jack	03	Used for side A and/or B. Only applicable for Variant 01 and 02. See Note 1 for available combinations.
MicroMach HDR, Low Mass SpaceWire Adapted, Female, Panel Mount Jack	04	Used for A and/or B. Only applicable for Variant 03. See Note 1 for available combinations.
No Connector	00	Pigtail Used only for side B. See Note 1 for available combinations.

NOTES:

- Available combinations of the above listed connector types within a single cable assembly are indicated by the cable assembly Variant Number in the table below:

		Connector Code Side B				
		01	02	03	04	00
Connector Code Side A	01	01, 02		01, 02		01, 02
	02		03		03	03
	03			01, 02		01, 02
	04				03	03

(b) Wiring Type

The type of wiring employed between the contacts of the two sides of the HDR cable assembly shall be expressed by means of the following codes.

Wiring Type (Note 1)	Code	Remarks
Direct	D	Note 2
Indirect	I	

NOTES:

- For Direct wiring of the cable assembly, each contact in the connector on side A shall be connected to its matching contact in the connector on side B as defined below. For contact number, see Para. 1.6.4 Pin-out Arrangement.

Connector Side A Contact number	Connector Side B Contact number
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8

For Indirect wiring of the cable assembly, each contact in the connector on side A shall be connected to the contact in the connector on side B as defined below. For contact number, see Para. 1.6.4 Pin-out Arrangement.

Connector Side A Contact number	Connector Side B Contact number
1	3
2	4
3	1
4	2
5	7
6	8
7	5
8	6

- For cable assemblies with Connector Code 00 (pigtailed), the wiring type code shall be D by default.

(c) Cable Assembly Length

The total nominal length of the cable assembly, L, expressed by means of the following codes. The unit quantity shall be millimetre (mm).

Nominal Length L (mm) (Note 1)	Code
250 to 999	0XXX
1000 to 9999	XXXX

NOTES:

- See Para. 1.6.1 for details and limitations.

1.4.2 Component Type Variants and Range of Components

The Component Type Variants and range of components applicable to this specification are as follows:

Variant Number	Description (See Note 1)	Applicable Cable (ESCC Component Number)	Physical Dimensions	Weight Max (g)
01	MicroMach HDR Cable Assembly, with AWG26 SpaceWire Cable	390200302B (Note 2)	See Para. 1.6	See Note 4
02	MicroMach HDR Cable Assembly, with AWG28 SpaceWire Cable	390200301B (Note 2)	See Para. 1.6	See Note 4
03	MicroMach HDR Cable Assembly, with AWG28 Low Mass SpaceWire Cable	390200401B (Note 3)	See Para. 1.6	See Note 4

NOTES:

- The available configurations for cable assemblies, including details of the connector types, wiring types and the cable assembly length, shall be as indicated in Para. 1.4.1.1.
- In accordance with ESCC Detail Specification No. [3902/003](#).
- In accordance with ESCC Detail Specification No. [3902/004](#).
- The cable assembly total maximum weight is calculated from the individual maximum weights of the various piece parts, as applicable, as follows:

- Each connector:

Connector Code	Connector Type	Weight Max (g)
01	MicroMach HDR, SpaceWire Adapted, Male, In-line Plug	9.5
02	MicroMach HDR, Low Mass SpaceWire Adapted, Male, In-line Plug	9.5
03	MicroMach HDR, SpaceWire Adapted, Female, Panel Mount Jack	9
04	MicroMach HDR, Low Mass SpaceWire Adapted, Female, Panel Mount Jack	9

- Cable:

Variant Number	Cable Description	ESCC Component Number	Weight Max (kg/km)
01	AWG26 SpaceWire	390200302B	100
02	AWG28 SpaceWire	390200301B	85
03	AWG28 Low Mass SpaceWire	390200401B	42

1.5 MAXIMUM RATINGS

The maximum ratings shall not be exceeded at any time during use or storage.

Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

Characteristics	Symbols	Maximum Ratings	Units	Remarks
Maximum Operating Data Rate (Base band)	DR_{max}	3	Gb/s	
Operating Frequency Range	f_R	≤ 4.5	GHz	Note 1
Working Voltage	U_R	150	V _{rms}	At sea level. Note 2
Rated Current	I_R	1	A	Each contact
Minimum Dynamic Bending Radius	R_{min}	Note 3	mm	
Operating Temperature Range	T_{op}	-55 to +125	°C	T_{amb}
Storage Temperature Range	T_{stg}	-55 to +125	°C	

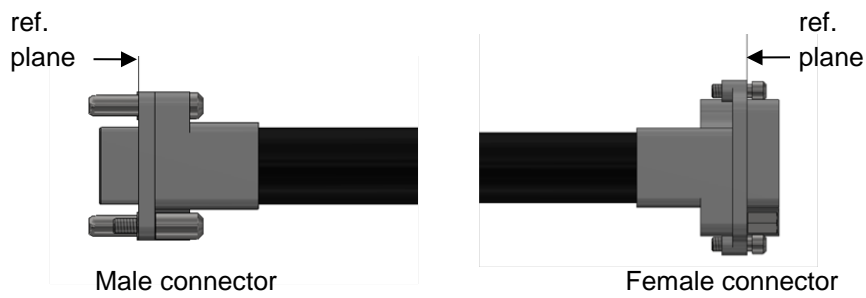
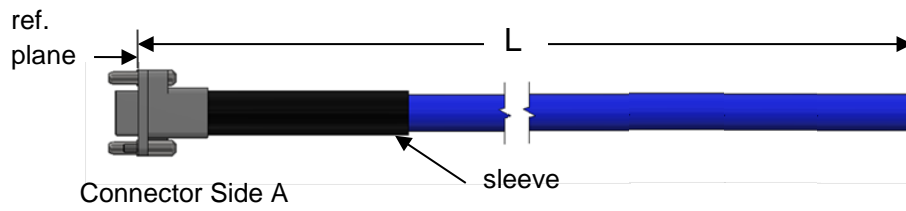
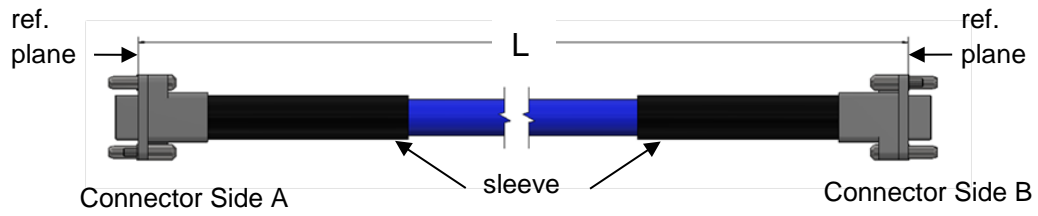
NOTES:

1. Bandwidth used for electrical measurement (insertion loss, crosstalk...); based on $f_R = 3 \cdot f_0$ (with $f_0 = DR_{max} / 2$).
2. Between contacts, and contacts and shell.
3. As specified for bend radius in the applicable cable ESCC Detail Specification (see Para. 1.4.2 and 1.7.2).

1.6 PHYSICAL DIMENSIONS

1.6.1 Cable Assembly Dimensions

Examples:



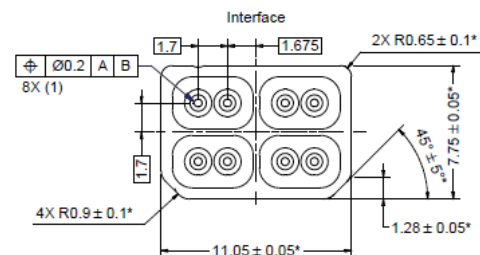
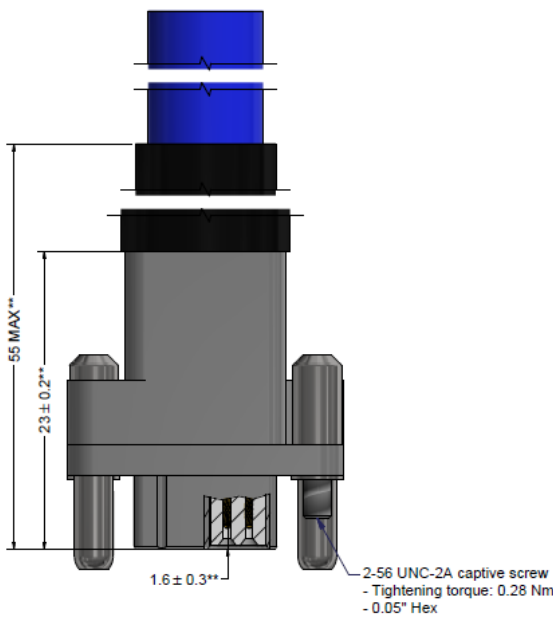
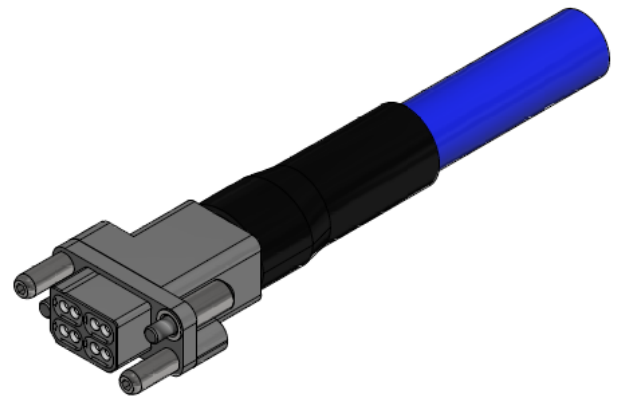
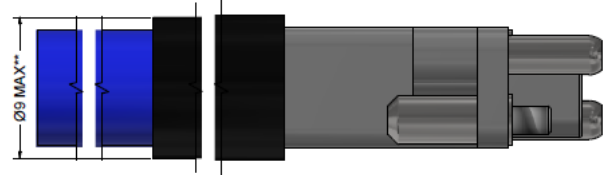
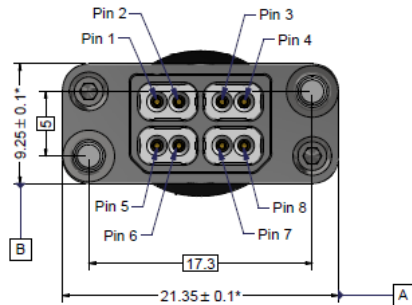
Symbols	Dimensions (mm)		Tolerance (mm)
	Min	Max	
L (Note 2)	250	499	±25
	500	4999	±50
	5000	9999	±100

NOTES:

1. For connector dimensions, see Para. 1.6.2 (as applicable) and Para. 1.6.3.
2. L = nominal length.

1.6.2 Connectors

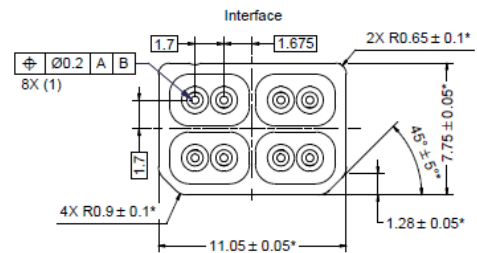
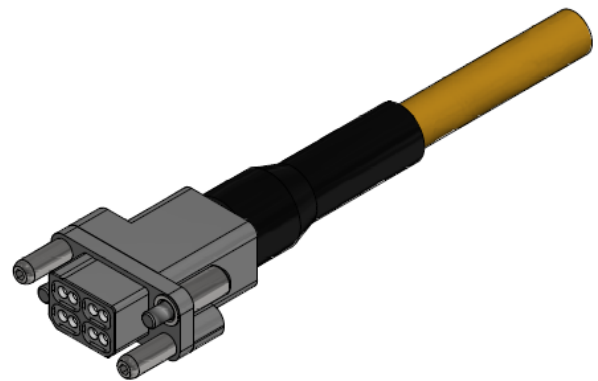
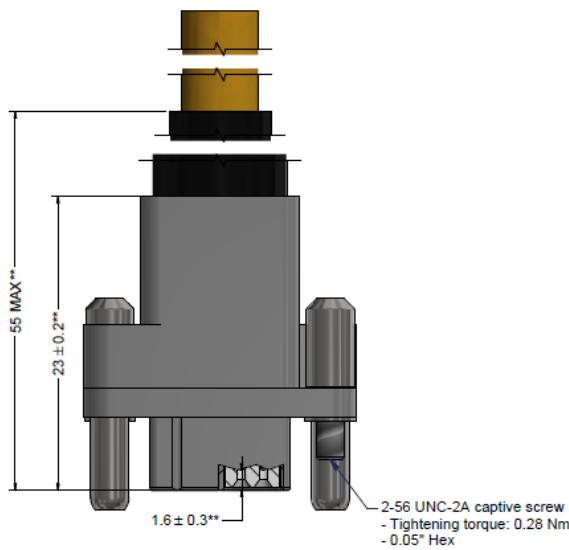
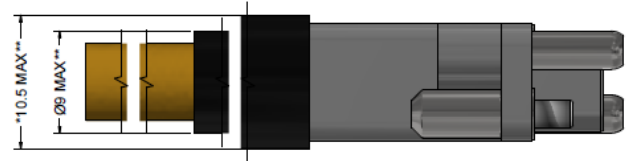
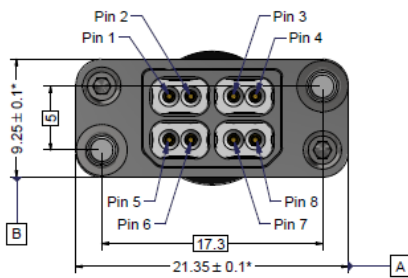
1.6.2.1 *Connector Code 1 – MicroMach HDR, SpaceWire Adapted, Male, In-line Plug*



NOTES:

1. All dimensions are in mm.
2. Dimensions with a single asterisk (*) may be checked during the Manufacturer's internal processing. Dimensions with a double asterisk (**) shall be checked after assembly of the cable assembly.
3. For connector interface dimensions, see also Para. 1.6.3.
4. Mating torque: 0.28N.m ±5%.
5. Contact identification: Contact No. 1 is indicated by the physical configuration. In addition, contact No. 1 is indicated by an index mark on the shell above pin 1 (as shown above).
6. Cable diameter: as specified in ESCC No. [3902/003](#) for the applicable cable type: [390200302B](#) or [390200301B](#) (see Para. 1.4.2).
7. For pin-out arrangement, see Para. 1.6.4.

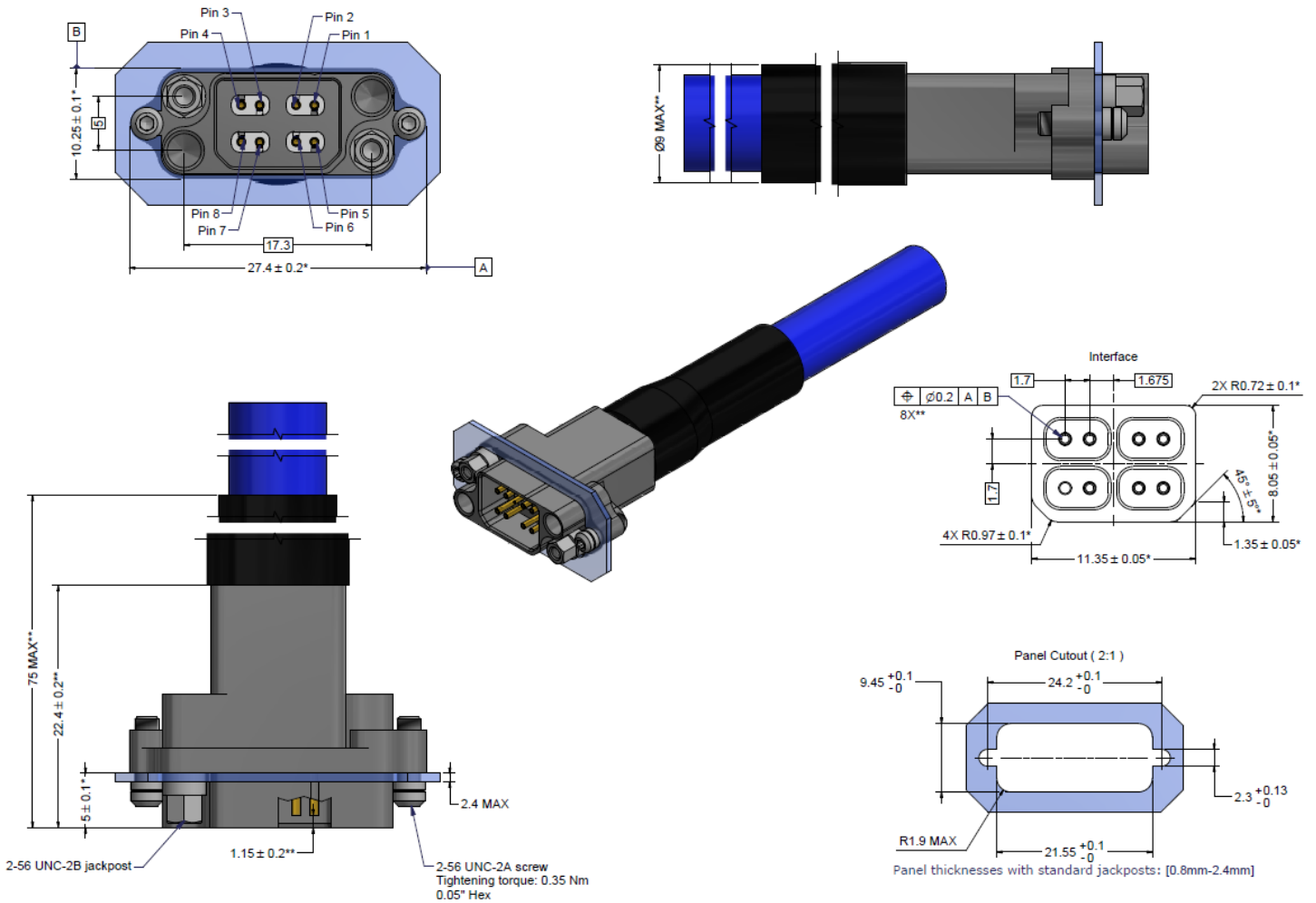
1.6.2.2 Connector Code 2 – MicroMach HDR, Low Mass SpaceWire Adapted, Male, In-line Plug



NOTES:

1. All dimensions are in mm.
2. Dimensions with a single asterisk (*) may be checked during the Manufacturer's internal processing. Dimensions with a double asterisk (**) shall be checked after assembly of the cable assembly.
3. For connector interface dimensions, see also Para. 1.6.3.
4. Mating torque: 0.28N.m ±5%.
5. Contact identification: Contact No. 1 is indicated by the physical configuration. In addition, contact No. 1 is indicated by an index mark on the shell above pin 1 (as shown above).
6. Cable diameter: as specified in ESCC No. [3902/004](#) for cable type [390200401B](#).
7. For pin-out arrangement, see Para. 1.6.4.

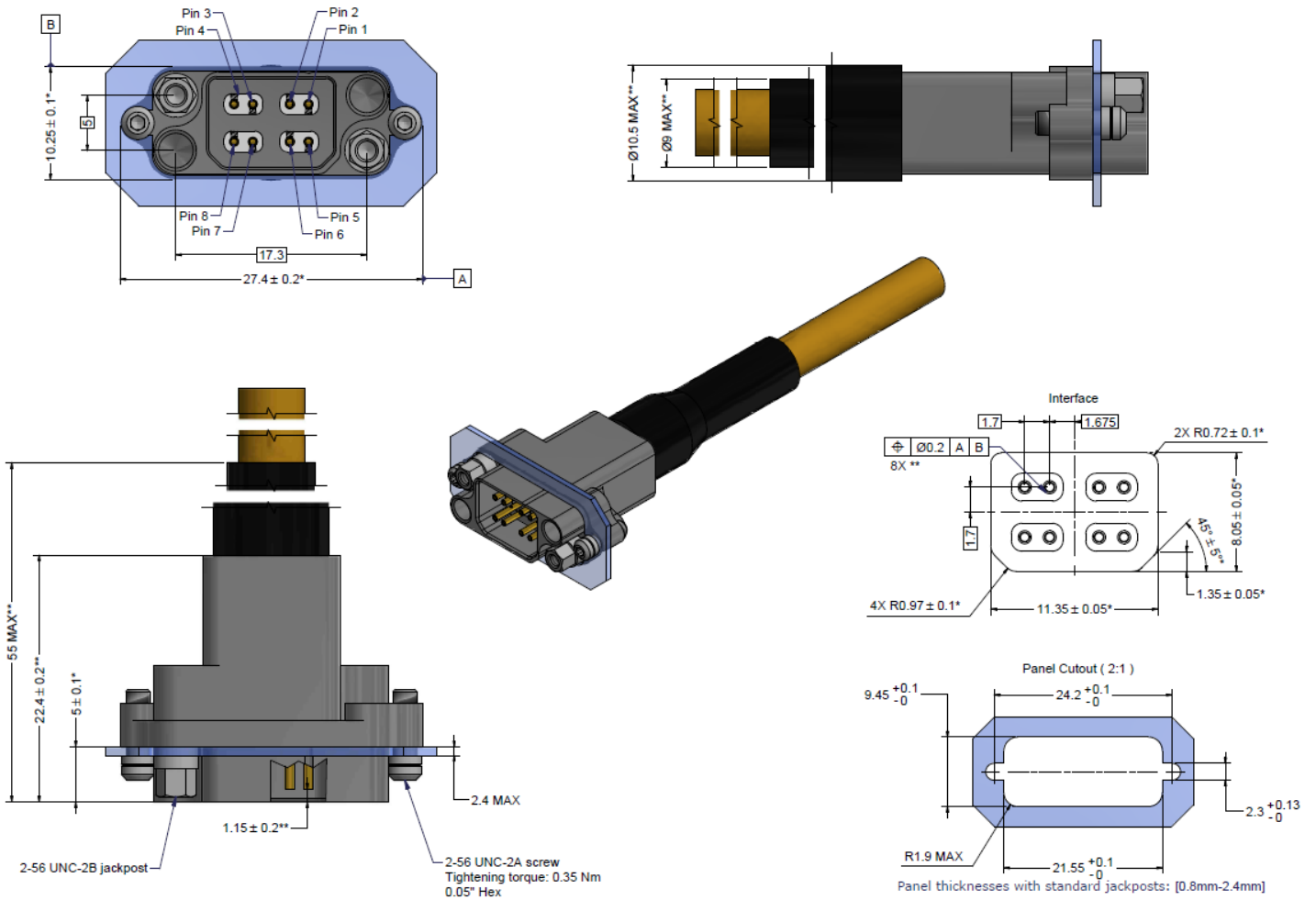
1.6.2.3 Connector Code 3 – MicroMach HDR, SpaceWire Adapted, Female, Panel Mount Jack



NOTES:

1. All dimensions are in mm.
2. Dimensions with a single asterisk (*) may be checked during the Manufacturer's internal processing. Dimensions with a double asterisk (**) shall be checked after assembly of the cable assembly.
3. For connector interface dimensions, see also Para. 1.6.3.
4. Mating torque: 0.35N.m ±5%.
5. Contact identification: Contact No. 1 is indicated by the physical configuration. In addition, contact No. 1 is indicated by an index mark on the shell above pin 1 (as shown above).
6. Cable diameter: as specified in ESCC No. [3902/003](#) for the applicable cable type: [390200302B](#) or [390200301B](#) (see Para. 1.4.2).
7. For pin-out arrangement, see Para. 1.6.4.

1.6.2.4 Connector Code 4 – MicroMach HDR, Low Mass SpaceWire Adapted, Female, Panel Mount Jack

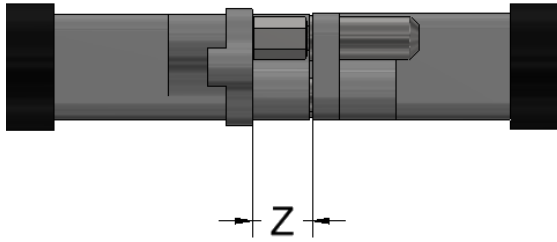


NOTES:

1. All dimensions are in mm.
2. Dimensions with a single asterisk (*) may be checked during the Manufacturer's internal processing. Dimensions with a double asterisk (**) shall be checked after assembly of the cable assembly.
3. For connector interface dimensions, see also Para. 1.6.3.
4. Mating torque: $0.35\text{N.m} \pm 5\%$.
5. Contact identification: Contact No. 1 is indicated by the physical configuration. In addition, contact No. 1 is indicated by an index mark on the shell above pin 1 (as shown above).
6. Cable diameter: as specified in ESCC No. [3902/004](#) for cable type [390200401B](#).
7. For pin-out arrangement, see Para. 1.6.4.

1.6.2.5 Mated Connector Dimensions

Example:

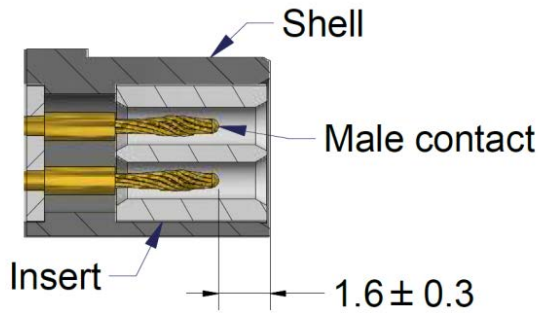


Symbols	Dimensions mm	
	Min	Max
Z	5.1	5.4

1.6.3 Connector Interface Dimensions (Contact Height)

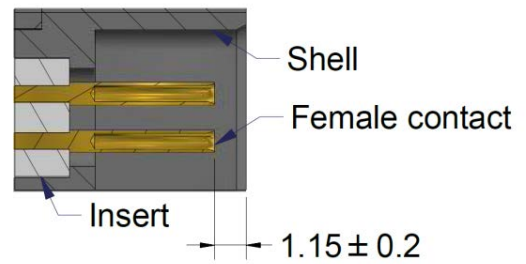
Plug Side, Male Contact

Applicable for Connector Codes 01, 02 (Male)



Jack Side, Female Contact

Applicable for Connector Codes 03, 04 (Female)

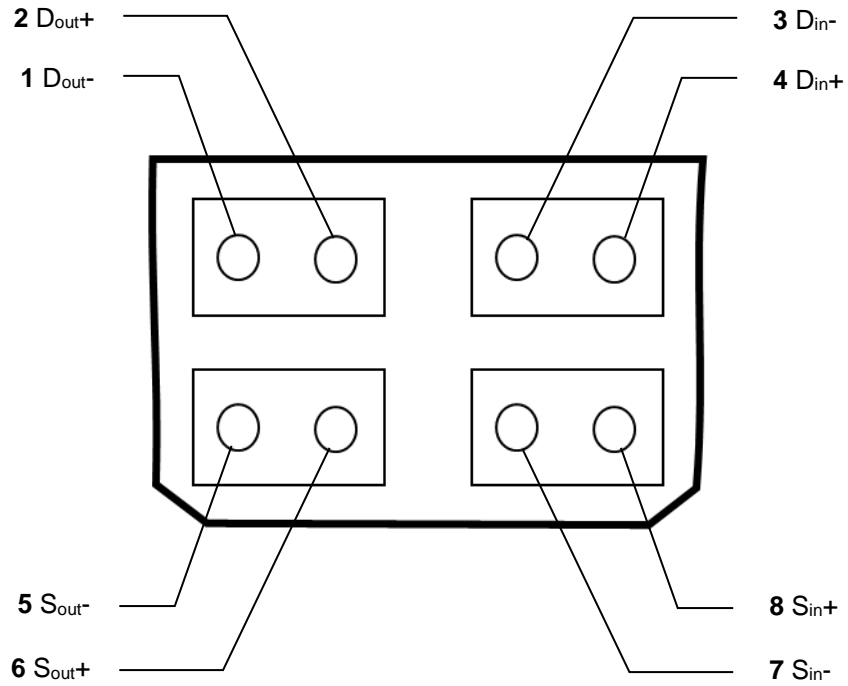


NOTES:

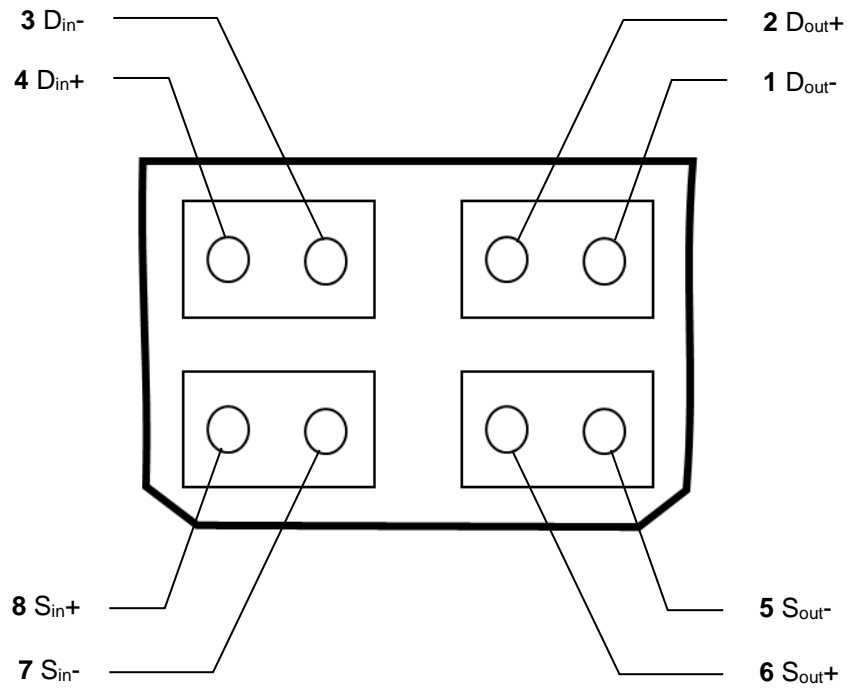
1. All dimensions are in mm.

1.6.4 Pin-Out Arrangement

1.6.4.1 *Connector Codes 01, 02 (Male)*



1.6.4.2 *Connector Codes 03, 04 (Female)*



1.7 ADD-ON COMPONENTS

1.7.1 Connectors

The connectors to be used in the components specified herein shall meet the requirements of this specification and the ESCC Generic Specification.

1.7.2 Cable

The cables to be used in the components specified herein shall be as follows. They shall meet the requirements of this specification and the ESCC Generic Specification.

- For Variants 01 & 02: as specified in Para. 1.4.2, in accordance with ESCC Detail Specification No. [3902/003](#).
- For Variant 03: as specified in Para. 1.4.2, in accordance with ESCC Detail Specification No. [3902/004](#).

1.8 MATERIALS AND FINISHES

Materials and finishes shall be as follows.

1.8.1 Connectors

The materials and finishes applicable to the various connectors shall be as follows:

- (a) Body Shell and Shield Cross: Aluminium alloy, high phosphorus (10 to 13%) nickel plated, thickness 25.4µm minimum.
- (b) Centre Contact: Copper alloy, gold plated 1.27µm minimum over nickel underplate 1.27µm minimum.
Note: measurements of plating thickness shall be made at 1.5mm from the engagement end.
- (c) Male plug connector front face, and connector to backshell interface EMI seals: Conductive silicone-base rubber.
- (d) Insert (insulator): PEEK.
- (e) Locking devices: Passivated stainless steel
- (f) Sleeve: fluoropolymer; colour: black.

1.8.2 Cable

As specified in the applicable cable ESCC Detail Specification (see Para. 1.4.2 and 1.7.2).

2 REQUIREMENTS

2.1 GENERAL

The complete requirements for procurement of the components specified herein are as stated in this specification and the ESCC Generic Specification. Permitted deviations from the Generic Specification, applicable to this specification only, are listed below.

Permitted deviations from the Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirement and do not affect the component's reliability, are listed in the appendices attached to this specification.

2.1.1 Deviations from the Generic Specification

2.1.1.1 *Deviations from Qualification Testing – Chart F4A*

- (a) Para. 8.33, Destructive Physical Analysis: For Connector Code 00 (pigtailed), a solderability test shall be added to DPA in accordance with ESCC Generic Specification No. 3902, performed on the centre conductor and shields of the cables.
- (b) Para. 8.29.2, Insert Retention in Shell: For Connector Codes 01, 02, the Insert Retention test is not applicable.

2.1.1.2 *Deviations from Periodic Testing – Chart F4B*

- (a) Para. 8.33, Destructive Physical Analysis: For Connector Code 00 (pigtailed), a solderability test shall be added to DPA in accordance with ESCC Generic Specification No. 3902, performed on the centre conductor and shields of the cables.

2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and as follows.

The information to be marked on the component or its primary package shall be:

- (a) The ESCC qualified components symbol (for ESCC qualified components only).
- (b) The ESCC Component Number (see Para. 1.4.1).
- (c) Traceability information.

2.3 ENVIRONMENTAL AND MECHANICAL TESTS

The following requirements apply to tests performed on the connector (and contact) lot, the cable lot and the cable assembly lot, as specified in the ESCC Generic Specification:

- (a) Para. 8.2, Contact Capability: The following test requirements shall apply, for male connectors only (Connector Codes 01, 02):

	Pick-up Test	Drop Test
Weight (g)	14 ±10%	170 ±10%
Test Sleeve Inner Diameter (mm)	0.582 to 0.587	0.559 to 0.564
Insertion Depth (mm)	1.5 ±0.05	1.5 ±0.05

- (b) Para. 8.3, Engagement and Separation Forces: The following test requirements shall apply, for male connectors only (Connector Codes 01, 02):

	Minimum Diameter Test Sleeve Test	Maximum Diameter Test Sleeve Test
Engagement Force (N)	1.667 maximum	-
Separation Force (N)	-	0.14 minimum
Test Sleeve Inner Diameter (mm)	0.559 to 0.564	0.582 to 0.587
Insertion Depth (mm)	1.4 ±0.05	1.4 ±0.05

- (c) Para. 8.5, Plating Thickness: See Para. 1.8.1.
- (d) Para. 8.6, Magnetism Level: Not applicable.

- (e) Para. 8.8, Insulation Flaws (Spark Test):
 - Applied voltage:
 - For Variants 01, 02: 1.4kV
 - For Variant 03: 1.0kV
 - Frequency:
 - For Variants 01, 02: 3kHz
 - For Variant 03: 3.0kHz
- (f) Para. 8.12, Adhesion of Inner Conductor: 1N minimum.
- (g) Para. 8.13, Dielectric Strength of Jacket: Applicable to all cable assemblies.
 - Test voltage: 2kVAc
 - Frequency: 50Hz
- (h) Para. 8.14, Conductor Resistance:
 - For Variant 01: 159Ω/km maximum at $T_{amb} = +20^{\circ}C$.
 - For Variants 02, 03: 256Ω/km maximum at $T_{amb} = +20^{\circ}C$.
- (i) Para. 8.15, Capacitance:
 - For Variant 01, 03: 90pf/m maximum.
 - For Variant 02: 79pf/m maximum.
- (j) Para. 8.16, Characteristic Impedance: 100 ±6Ω.
- (k) Para. 8.19, Coupling Proof Torque: Not applicable.
- (l) Para. 8.23, Contact Height: See Para. 1.6.3.
- (m) Para. 8.26, Cable Retention Force:

Variant	Cable Retention Force
01	90N
02, 03	80N
- (n) Para. 8.29.1, Contact Retention (in Insert): 14.8N.
- (o) Para. 8.29.2, Insert Retention (in Shell): 30N
- (p) Para. 8.34, Radiation: Applicable to all cable assemblies.
 - For Variant 01, 02: Radiation dosage: 20Mrad.
 - For Variant 03: Radiation dosage: 300Mrad.
- (q) Para. 8.35, Permanence of Marking: Applicable to all components with marking.
- (r) Para. 8.36, Mating and Unmating Forces:

Connector Code	Mating Force	Unmating Force	
	Max	Min	Max
01, 02, 03, 04	25N	3N	25N
- (s) Para. 8.37, Crimp Contact Tensile Strength: Applicable to all Connector Codes.

2.4 ROOM TEMPERATURE ELECTRICAL MEASUREMENTS

The measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

Characteristics	Symbols	Test Method and Conditions	Limits		Units
			Min	Max	
Dielectric Withstanding Voltage	DWV	ESCC No. 3409, Note 1	600	-	Vrms
Voltage Proof Leakage Current	I _{VPL}	Note 2	-	1	mA
Insulation Resistance	R _I	ESCC No. 3409, V = 500Vdc	1	-	GΩ
Conductor Resistance	R _C	ESCC No. 3409 For Variant 01: For Variants 02, 03:	- - -	159 256	mΩ/m
Shield Resistance	R _S	ESCC No. 3409 For all cables: Per couple of connectors:	- - -	11 10	mΩ/m mΩ
Mated Shell Conductivity	R _M	ESCC No. 3409 For Connector Code 01 mated with Connector Code 03, Connector Code 02 mated with Connector Code 04:	-	5	mΩ
Uniformity of Characteristic Impedance	Z _C	ESCC No. 3409 Each pair of cables. tr ≤ 260ps Note 3	90	110	Ω
Intra-pair Skew	SK ₁	ESCC No. 3409 Test each pair of cables Note 4 For Variants 01, 02: For Variant 03:	- - -	80 50	ps/m
Inter-pair Skew	SK ₂	ESCC No. 3409 Test each pair of cables Note 4 For Variants 01, 02: For Variant 03:	- - -	130 100	ps/m
Mask test	MT	ESCC No. 3409	Note 5		
Jitter pp	Jpp	ESCC No. 3409, Note 4, Note 6 For Variant 01: For L ≤ 2.5m; For L ≤ 4m; For L ≤ 10m: For Variants 02, 03: For L ≤ 2.5m; For L ≤ 4m; For L ≤ 10m:	- - - - - - -	75 100 400 100 125 450	ps

Characteristics	Symbols	Test Method and Conditions	Limits		Units
			Min	Max	
Jitter rms	Jrms	ESCC No. 3409 Note 4, Note 6 For Variant 01: For L ≤ 2.5m; - 15 For L ≤ 4m; - 20 For L ≤ 10m; - 100 For Variants 02, 03: For L ≤ 2.5m; - 20 For L ≤ 4m - 40 For L ≤ 10m - 150			ps
Near-end Crosstalk	N _{ext}	ESCC No. 3409 Frequency ≤ 1 GHz: - -50			dB
Far-end Crosstalk	F _{ext}	ESCC No. 3409 Frequency ≤ 1 GHz: - -50			dB
Insertion Loss	IL _{CA}	ESCC No. 3409 , f ≤ 1GHz	-	Note 7	dB

NOTES:

1. Test voltage shall be applied between centre contacts, and between each centre contact and both respective connector bodies in the cable assembly.
2. Measured during Dielectric Withstanding Voltage.
3. Read and record measurements shall be performed on a sample of 3 components from each lot with 0 failures allowed. Alternatively a 100% inspection may be performed.
4. Tested using a PRBS-7 pattern with 1Vpp differential amplitude.
5. Mask test shall be selected according to the protocol used.
6. Not applicable to cable assemblies with Connector Code 00 on side B (pigtail).
7. Insertion Loss limit shall be calculated as follows:

$$IL_{CA} = IL_{CONNECTOR-A} + IL_{CONNECTOR-B} + (IL_{CABLE} \times L)$$

where:

- IL_{CA} = total cable assembly insertion loss
- IL_{CONNECTOR-A}, IL_{CONNECTOR-B} = insertion loss for the connector types on side A and B
- IL_{CABLE} = cable insertion loss
- L = cable assembly length (in m)

IL_{CONNECTOR} and IL_{CABLE} shall be calculated as follows, where f = frequency (in GHz):

- For each connector: $IL_{CONNECTOR} = 0.2 \times f$
- For the cable:
 - Variant 01 : $IL_{CABLE} = (3.5E^{-2} \times \sqrt{f}) + (1.8E^{-4} \times f) + \frac{5E^{-4}}{\sqrt{f}}$
 - Variants 02, 03 : $IL_{CABLE} = (4.5E^{-2} \times \sqrt{f}) + (4E^{-4} \times f) + \frac{5E^{-4}}{\sqrt{f}}$

2.5 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}C$

Unless otherwise specified, test methods and test conditions shall be as per the corresponding test defined in Para. 2.4 Room Temperature Electrical Measurements.

Test Reference per ESCC No. 3409	Characteristics	Symbols	Limits		Units
			Min	Max	
Shielding Effectiveness	Shielding Effectiveness Frequency ≤ 1 GHz	SE	-80	-	dB
Cable Retention Force	Dielectric Withstanding Voltage	DWV	See Para. 2.4		
	Voltage Proof Leakage Current	I_{VPL}	See Para. 2.4		
	Insulation Resistance	R_i	See Para. 2.4		
	Conductor Resistance	R_c	See Para. 2.4		
	Shield Resistance	R_s	See Para. 2.4		
	Mated Shell Conductivity	R_m	See Para. 2.4		
Ageing	Dielectric Withstanding Voltage	DWV	See Para. 2.4		% (1)
	Voltage Proof Leakage Current	I_{VPL}	See Para. 2.4		
	Insulation Resistance	R_i	See Para. 2.4		
	Conductor Resistance	R_c	See Para. 2.4		
	Shield Resistance	R_s	See Para. 2.4		
	Mated Shell Conductivity	R_m	See Para. 2.4		
	Mated Shell Conductivity Drift	ΔR_m	-	+25	
	Uniformity of Characteristic Impedance	Z_c	See Para. 2.4		
	Intra-pair Skew	SK_1	See Para. 2.4		
	Inter-pair Skew	SK_2	See Para. 2.4		
	Mask Test	MT	See Para. 2.4		
	Jitter rms	J_{rms}	See Para. 2.4		
	Jitter pp	J_{pp}	See Para. 2.4		
	Near-end Crosstalk	N_{ext}	See Para. 2.4		
	Far-end Crosstalk	F_{ext}	See Para. 2.4		
	Insertion Loss	IL_{CA}	See Para. 2.4		

Test Reference per ESCC No. 3409	Characteristics	Symbols	Limits		Units
			Min	Max	
Mating Endurance					
Initial Measurement	Conductor Resistance	R _C	See Para. 2.4		
	Shield Resistance	R _S	See Para. 2.4		
	Mated Shell Conductivity	R _M	See Para. 2.4		
Final Measurement	Dielectric Withstanding Voltage	DWV	See Para. 2.4		
	Voltage Proof Leakage Current	I _{VPL}	See Para. 2.4		
	Insulation Resistance	R _I	See Para. 2.4		
	Conductor Resistance	R _C	See Para. 2.4		
	Shield Resistance	R _S	See Para. 2.4		
	Mated Shell Conductivity	R _M	See Para. 2.4		
	Uniformity of Characteristic Impedance	Z _C	See Para. 2.4		
	Intra-pair Skew	SK ₁	See Para. 2.4		
	Inter-pair Skew	SK ₂	See Para. 2.4		
	Mask Test	MT	See Para. 2.4		
	Jitter rms	J _{rms}	See Para. 2.4		
	Jitter pp	J _{pp}	See Para. 2.4		
	Near-end Crosstalk	N _{ext}	See Para. 2.4		
	Far-end Crosstalk	F _{ext}	See Para. 2.4		
	Insertion Loss	IL _{CA}	See Para. 2.4		
Bending	Dielectric Withstanding Voltage	DWV	See Para. 2.4		
	Voltage Proof Leakage Current	I _{VPL}	See Para. 2.4		
	Insulation Resistance	R _I	See Para. 2.4		
	Conductor Resistance	R _C	See Para. 2.4		
	Shield Resistance	R _S	See Para. 2.4		
	Mated Shell Conductivity	R _M	See Para. 2.4		
	Uniformity of Characteristic Impedance	Z _C	See Para. 2.4		
	Intra-pair Skew	SK ₁	See Para. 2.4		
	Inter-pair Skew	SK ₂	See Para. 2.4		
	Mask Test	MT	See Para. 2.4		
	Jitter rms	J _{rms}	See Para. 2.4		
	Jitter pp	J _{pp}	See Para. 2.4		
	Insertion Loss	IL _{CA}	See Para. 2.4		
	Shielding Effectiveness Frequency ≤ 1 GHz (ref. Para. 2.5)	SE	-80	-	dB

Test Reference per ESCC No. 3409	Characteristics	Symbols	Limits		Units
			Min	Max	
Random Vibration During Testing Final Measurement	Electrical Continuity Dielectric Withstanding Voltage Voltage Proof Leakage Current Insulation Resistance Conductor Resistance Shield Resistance Mated Shell Conductivity Mated Shell Conductivity Drift	- DWV I _{VPL} R _I R _C R _S R _M ΔR _M	No discontinuities > 1μs See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 - +25	% (1)	
Sine Vibration	Dielectric Withstanding Voltage Voltage Proof Leakage Current Insulation Resistance Conductor Resistance Shield Resistance Mated Shell Conductivity Mated Shell Conductivity Drift	DWV I _{VPL} R _I R _C R _S R _M ΔR _M	See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 - +25	% (1)	
Temperature Cycling	Dielectric Withstanding Voltage Voltage Proof Leakage Current Insulation Resistance Conductor Resistance Shield Resistance Mated Shell Conductivity Mated Shell Conductivity Drift Uniformity of Characteristic Impedance Intra-pair Skew Inter-pair Skew Mask Test Jitter rms Jitter pp Near-end Crosstalk Far-end Crosstalk Insertion Loss	DWV I _{VPL} R _I R _C R _S R _M ΔR _M Z _C SK ₁ SK ₂ MT J _{rms} J _{pp} N _{ext} F _{ext} IL _{CA}	See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 - +25 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4 See Para. 2.4	% (1)	
Thermal Stability and Skew During Testing (at each temperature step)	Intra-pair Skew Inter-pair Skew	SK ₁ SK ₂	- Note 2 - Note 2		

Test Reference per ESCC No. 3409	Characteristics	Symbols	Limits		Units
			Min	Max	
Electrical Measurements at Room, High and Low Temperatures	At room temperature: $T_{amb} = +22 \pm 3^{\circ}\text{C}$				
	Dielectric Withstanding Voltage	DWV	See Para. 2.4		
	Voltage Proof Leakage Current	I_{VPL}	See Para. 2.4		
	Mask Test	MT	See Para. 2.4		
	Jitter rms	Jrms	See Para. 2.4		
	Jitter pp	Jpp	See Para. 2.4		
	Insertion Loss	IL_{CA}	See Para. 2.4		
	At high temperature: $T_{amb} = +125 (+0 -5)^{\circ}\text{C}$				
	Dielectric Withstanding Voltage	DWV	See Para. 2.4		
	Voltage Proof Leakage Current	I_{VPL}	See Para. 2.4		
	Mask Test	MT	See Para. 2.4		
	Jitter rms	Jrms	-	Note 3	
	Jitter pp	Jpp	-	Note 3	
	Insertion Loss	IL_{CA}	-	Note 4	
	At low temperature: $T_{amb} = -55 (+5 -0)^{\circ}\text{C}$				
	Dielectric Withstanding Voltage	DWV	See Para. 2.4		
	Voltage Proof Leakage Current	I_{VPL}	See Para. 2.4		
	Mask Test	MT	See Para. 2.4		
	Jitter rms	Jrms	See Para. 2.4		
	Jitter pp	Jpp	See Para. 2.4		
	Insertion Loss	IL_{CA}	-	Note 4	

Test Reference per ESCC No. 3409	Characteristics	Symbols	Limits		Units
			Min	Max	
Radiation Initial Measurement	Dielectric Withstanding Voltage	DWV	See Para. 2.4		
	Voltage Proof Leakage Current	I _{VPL}	See Para. 2.4		
	Insulation Resistance	R _I	See Para. 2.4		
	Uniformity of Characteristic Impedance	Z _C	See Para. 2.4		
	Insertion Loss	IL _{CA}	See Para. 2.4		
Final Measurement	Dielectric Withstanding Voltage	DWV	See Para. 2.4		
	Voltage Proof Leakage Current	I _{VPL}	See Para. 2.4		
	Insulation Resistance	R _I	See Para. 2.4		
	Uniformity of Characteristic Impedance	Z _C	See Para. 2.4		
	Insertion Loss	IL _{CA}	See Para. 2.4		

NOTES:

1. Parameter Drift referred to the initial measurement prior to the test in question.
2. 125% of the limit given in Para. 2.4, at all test temperatures.
3. 133% of the limit given in Para. 2.4.
4. Insertion Loss maximum limits at high and low temperatures shall be calculated using the Insertion Loss measured at room temperature and the applicable test temperature (T) in °C, as follows:

$$IL(at T) = 1.2 \times IL(at 22^{\circ}C) \times (1 + (T - 22) \times 0.002)$$

APPENDIX A
AGREED DEVIATIONS FOR AXON CABLE (F)

Items Affected	Description of Deviations
Para. 2.1.1 Deviations from the Generic Specification – Production Control – Chart F2	Para. 8.10 Anthony and Brown Test: is performed on the conductor prior to cable manufacturing (i.e. it is not performed on the finished cable).
Para. 2.1.1.1 Deviations from Qualification Testing – Chart F4A	Para. 8.37, Crimp Contact Tensile Strength: is not required to be repeated if it has already been performed as part of the Manufacturer's internal processing of the same lot, with equivalent sampling.