

Low Mass solutions

With long experience in space wiring and a mastery of many advanced cabling technologies, AXON' has designed two new solutions to lighten traditional high speed links: The Low Mass SpaceWire and the Ultra Low Mass Coax Link.



LOW MASS SPACEWIRE

Low Mass solutions

- > AXON's **Low Mass SpaceWire** has been submitted to an extensive evaluation under ESA supervision, and is currently pending ESA qualification. It is approximately half the mass of existing SpaceWire.
- > The **Ultra Low Mass Coax Link**, based on AXON's coaxial cable expertise, is almost 30% lighter still, and is significantly smaller and even more flexible. It is not ESA endorsed for the SpaceWire protocol, but may still be interesting for certain applications.

Main characteristics

| | SpaceWire ESCC 3902.003.01 | Low Mass SpaceWire ESCC 3902.004.01 | Ultra Low Mass Coax Link with overall shield | Ultra Low Mass Coax Link without overall shield |
|---------------------------------|----------------------------------|--|---|---|
| Mass (g/m) | 80 max. | 42 max. | 32.5 max. | 30 max. |
| Overall Ø (mm) | 7 max. | 6.5 max. | 4.5 max. | 4.2 max. |
| Static bend radius | 45 | 25 | 10 | 6 |
| Dynamic bend radius | 60 | 30 | 20 | 15 |
| Impedance (Ω) | 100 \pm 6 | 100 \pm 6 | 2x50 \pm 2 | 2x50 \pm 2 |
| Capacitance (pF) | | | | |
| - intra pair | < 50 | < 50 | < 48 | < 48 |
| - inter pair | < 90 | < 90 | < 97 | < 97 |
| Resistance DC (Ω /m) | 0.23 | 0.23 | 0.90 | 0.90 |
| Intra pair skew (ps/m) | < 80 | < 50 | < 20 | < 20 |
| Inter pair skew (ps/m) | < 130 | < 100 | < 20 | < 20 |
| α (dB/m) @1 GHz | -1.5 | -1.4 | -2.6 | -2.6 |
| Cable length (for -6 dB atten.) | 4.5 m max.* | 4.6 m max.* | 2.3 m max.* | 2.3 m max.* |
| Return Loss (dB) up to 2 GHz | -9 max. | -9 max. | -20 max. | -20 max. |

*= for a 400 Mb/s data rate (1 GHz)

E-10

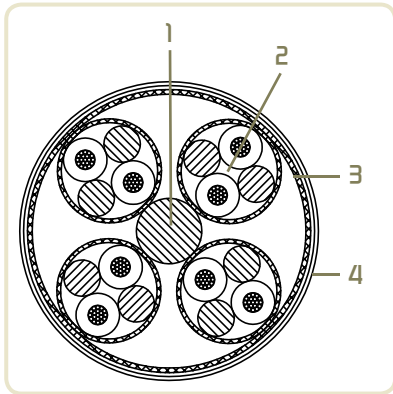
axon' cable & interconnect

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Low Mass 28AWG SpaceWire

Making use of AXON's CELLOFLON® expanded PTFE, alveolar a-PTFE dielectrics and AXON's patented AXALU® silver plated aluminium shields, the new **Low Mass SpaceWire** cable saves almost half the weight compared to conventional SpaceWire.



CONSTRUCTION

AXON's Low Mass 28AWG SpaceWire cable according to the **ESCC 3902/004.01** requirements (AXON' part number: P551259) consists of 4 shielded twisted pairs covered by an overall shield and outer jacket, as shown in the specification.

1 - CELLOFLON® expanded PTFE filler

- Diameter: 1.35 mm nom.

2 - 4 x 100 Ω 28AWG BUS Lines

CONDUCTOR AWG 2819

- Stranded silver plated copper alloy (2 µm minimum).
- 19 x 0.079 mm strands.
- Diameter: 0.395 mm nominal.
- Cross section: 0.093 mm² nominal.
- Resistance: 23 Ω/100 m nominal.

DIELECTRIC: Alveolar PTFE.

- Colour: blue / white.

INNER BRAIDED SHIELD

- Material: silver plated aluminium (2 µm minimum).
- Strand diameter: 0.079 mm.

3 - Braided shield (in electrical contact with the inner braided shields)

- Material: silver plated aluminium (2 µm minimum).
- Strand diameter: 0.100 mm.

4 - Outer jacket

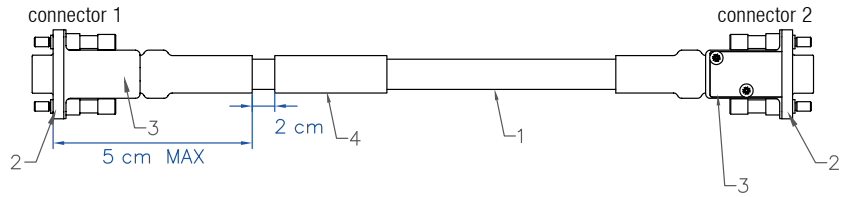
- Material: Expanded PTFE tape (CELLOFLON®) under a Polyimide tape.

MAIN CHARACTERISTICS

- Outer diameter: 6.5 mm maximum.
- Bend radius: 25 mm minimum for fully static applications.
- Weight: 42 g/m maximum.
- Operating temperature: -100 / +150°C.
- Impedance (between wires of a pair): 100 Ω (±6 Ω) at 400 MHz.
- All inner shields are in contact with overall shield.

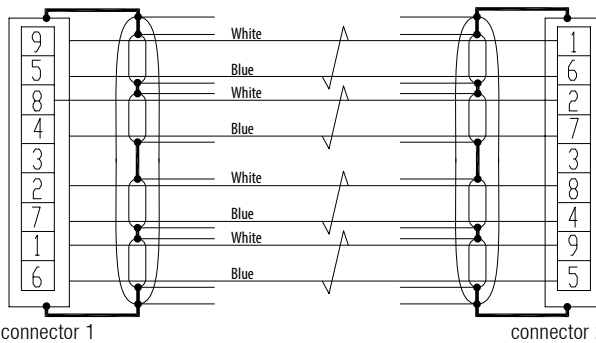
MAIN ADVANTAGES COMPARED TO THE ESCC3902/003 VARIANT 01

- Smaller bend radius (routing made easier)
- Approximately half the weight
- Reduced intra-pair and inter-pair skews
- Improved resistance to radiations (evaluation performed up to 300 Mrad)



Part list

- 1 - Low Mass SpaceWire cable (P551259)
- 2 - Micro-D plug connector (MDSA209P000B: 9 ways / high phosphorous nickel plated)
- 3 - High phosphorous nickel plated backshell and stainless steel 2-56 UNC-2A fastners
- 4 - Marking sleeve

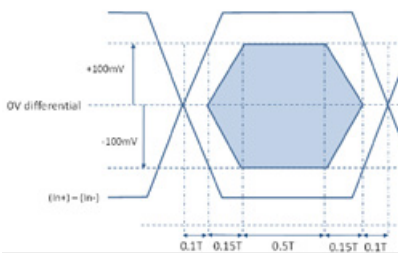


WIRING DIAGRAM (PINS ALLOCATION)

| ESCC | 3902.003/01 | 3902.004/01 |
|-------------|-------------|-------------|
| PART NUMBER | P532242 | P551259 |
| WEIGHT | 85 g/m | 42 g/m |
| DIAMETER | 7 mm max. | 6.5 mm max. |

Cable shield connection: All shields are terminated to the shell of the Micro-D connectors. Alternatively, the shields can also be connected to pin 3 at both ends on request.
Skew inter pair: 0.1 ns/m maximum. / **Skew intra pair:** 0.05 ns/m maximum.

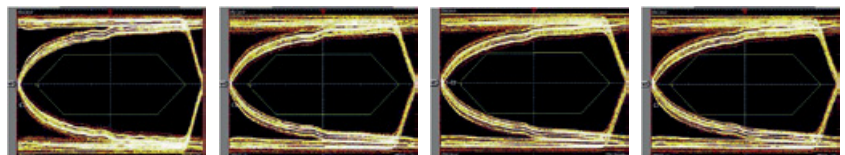
Depending on the required frequency and data rate, this assembly can be up to 10 meters long without exceeding the 6 dB attenuation limit. This limit is measured at the 5th harmonic of the fundamental equivalent frequency of the LVDS signal (250MHz for 100Mb/s; 500MHz for 200Mb/s or 1GHz for 400Mb/s). The real requirement is to be outside the mask (see above). Please contact us for more details.



SPACEWIRE PERFORMANCES MASK FOR EYE PATTERN MEASUREMENT. THE EYE PATTERN MODEL GIVEN FOR THE NEXT ISSUE OF THE ECSS-E-ST-50-12 STANDARD. THE SIGNALS FROM THE CABLE ASSEMBLY SHALL REMAIN OUTSIDE THE MASK AT RECEIVER END.

Test and measurements

- **Eye pattern measurements (up to 10 Gb/s):** Jitter measurements, Eye height and width, Q factor and Skew.
- **TDR (Time Domain Reflectometry) analysis:** Impedance analysis and Skew.
- **BER test (Bit Error Rate):** PRBS (Pseudo Random Binary Sequence) generation and analysis.
- **Crosstalk**



EYE PATTERN DIAGRAM MEASUREMENT AT 400 Mb/s FOR EACH PAIR OF A LIGHTWEIGHT SPACEWIRE ON A 4.5 m ASSEMBLY. WORST CASE OF AMPLITUDE (250 mV peak).

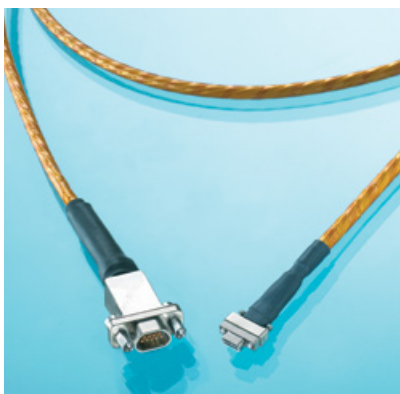
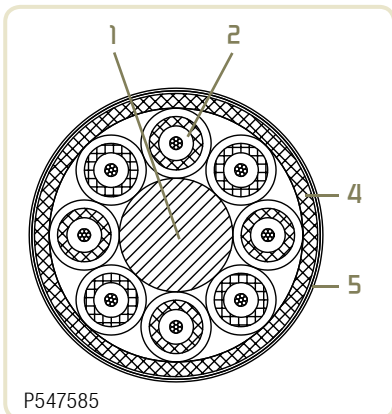
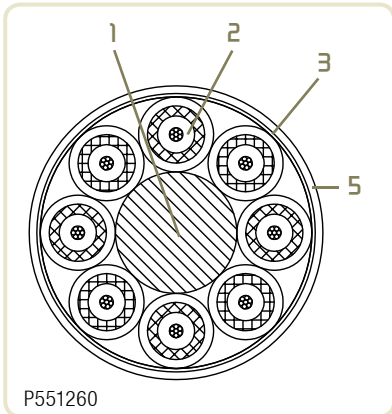
Ultra Low Mass Coax Link

The **Ultra Low Mass Coax Link** based on AXON' coaxial cable expertise, is almost 30% lighter than the already very light Low Mass SpaceWire. This radical solution is significantly smaller and more flexible than the conventional twisted pair approach and exceeds the performance requirements for high speed serial data links compared to twisted pair cables. The coaxial based cable is not recommended for ECSS-E-ST-50-12C SpaceWire links. It can therefore be an interesting alternative for applications where installation space and mass budgets are extremely limited, or particularly where an alternative protocol to SpaceWire is in use.

Important: Potential users of this solution must ensure for themselves that the cable is compatible with their application.

CONSTRUCTION

AXON's Ultra Low Mass Coax Link (AXON' part numbers: P551260 for the version without overall shield and P547585 for the version with) consists of 8 coaxial cables stranded around a filler and outer tape, as shown in the specification.



ULTRA LOW MASS COAX LINK

1 - CELLOFLON® expanded PTFE filler

- Diameter: 1.70 mm nominal.

2 - 8 x 50 Ω SM50 Coaxial cables

CONDUCTOR AWG 3407

- Stranded silver plated copper alloy (2 μm).
- 7 x 0.063 mm strands.
- Diameter: 0.187 mm nominal.
- Cross section: 0.020 mm² nominal.
- Resistance: 90.9 Ω/100 m nominal.

DIELECTRIC: PTFE

- Colour: white.

BRAIDED SHIELD

- Material: silver plated copper (2.5 μm).
- Strand diameter: 0.063 mm.

JACKET

- Material: extruded PFA.
- Colour: white.

3 - CELLOFLON® expanded PTFE tape (on P551260 only)

4 - Braided shield (on P547585 only)

5 - Polyimide tape (single layer on P551260, double layer on P547585)

MAIN CHARACTERISTICS

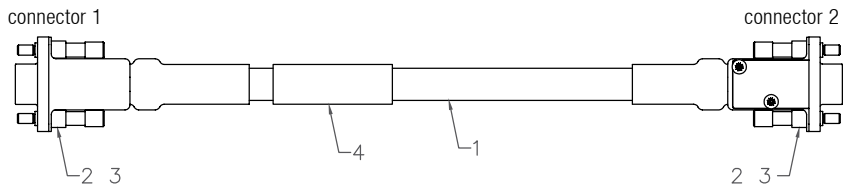
- Outer diameter: 4.20 mm maximum (4.50 mm with overshield).
- Bend radius: 6 mm minimum for fully static applications.
- Weight: 30 g/m maximum (32.5 g/m with overshield).
- Operating temperature: -100 / +150°C.
- Impedance (between wires of a pair): 8x50 Ω at 400 MHz.

MAIN ADVANTAGES COMPARED TO THE ECSS 3902/003 VARIANT 01

- Smaller bend radius (routing made easier)
- More than half weight saving
- Reduced intra-pair and inter-pair skews
- Improved resistance to radiations

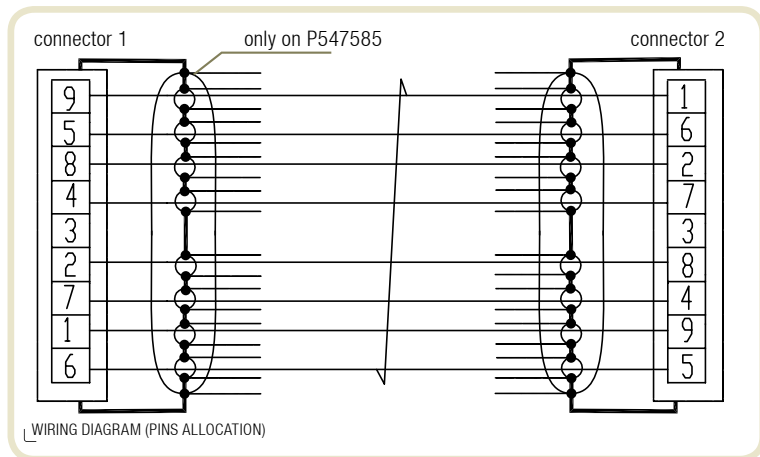
Note: One drawback is a shorter maximum length due to higher attenuation.

Ultra Low Mass Coax Links can be terminated with 9 way Micro-D connectors (such as are employed on SpaceWire and Low Mass SpaceWire links) or ultra miniature 15 way Nano-D connectors, suitable for applications where the connector interface area is extremely limited.



Part list

- 1 - Ultra Low Mass Coax cable (P551260 or P547585)
- 2 - Micro-D plug connector (MDSA209P000B: 9 ways / high phosphorous nickel plated)
- 3 - High phosphorous nickel plated backshell and stainless steel 2-56 UNC-2A fastners
- 4 - Marking sleeves



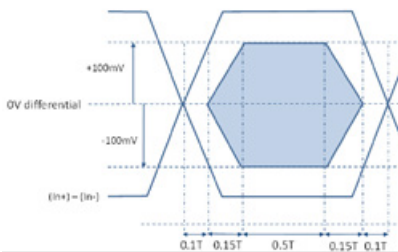
| ESCC | 3902.003/01 | Ultra Low Mass Coax cable with overall shield | Ultra Low Mass Coax cable without overall shield |
|-------------|-------------|---|--|
| PART NUMBER | P532242 | P547585 | P551260 |
| WEIGHT | 85 g/m | 32.5 g/m | 30 g/m |
| DIAMETER | 7 mm max. | 4.5 mm max. | 4.2 mm max. |

Cable shield connection: All coaxial shields are terminated to the shell of both connectors.
Skew inter pair: 0.1 ns/m maximum. / **Skew intra pair:** 0.02 ns/m maximum.

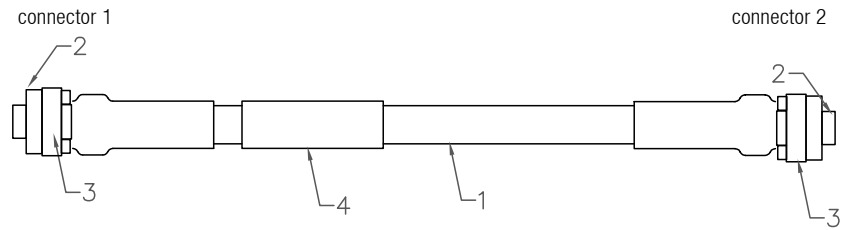
Depending on the required frequency and data rate, this assembly can be up to 4 meters long without exceeding the 6 dB attenuation limit. This limit is measured at the 5th harmonic of the fundamental equivalent frequency of the LVDS signal (250MHz for 100Mb/s; 500MHz for 200Mb/s or 1GHz for 400Mb/s). The real requirement is to be outside the mask (see above). Please contact us for more details.

Test and measurements

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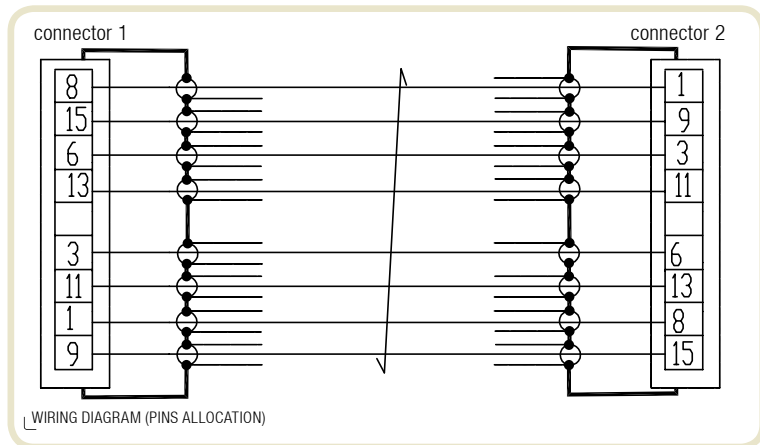


SPACEWIRE PERFORMANCES MASK FOR EYE PATTERN MEASUREMENT.
 EYE PATTERN MODEL GIVEN FOR THE NEXT ISSUE OF THE ECSS-E-ST-50-12 STANDARD. THE SIGNALS FROM THE CABLE ASSEMBLY SHALL REMAIN OUTSIDE THE MASK AT RECEIVER END.



Part list

- 1 - Ultra Low Mass Coax cable (P551260 or P547585)
- 2 - Nano-D plug connector (ND2A215P000B: 15 ways / nickel plated)
- 3 - Nickel plated backshell and stainless steel 0-80 UNF fasteners
- 4 - Marking sleeves



| ESCC | 3902.003/01 | Ultra Low Mass Coax cable with overall shield | Ultra Low Mass Coax cable without overall shield |
|-------------|-------------|---|--|
| PART NUMBER | P532242 | P547585 | P551260 |
| WEIGHT | 85 g/m | 32.5 g/m | 30 g/m |
| DIAMETER | 7 mm max. | 4.5 mm max. | 4.2 mm max. |

Cable shield connection: All coaxial shields are terminated to the shell of both connectors.
Skew inter pair: 0.1 ns/m maximum. / **Skew intra pair:** 0.02 ns/m maximum.

Depending on the required frequency and data rate, this assembly can be up to 4 meters long without exceeding the 6 dB attenuation limit. Please contact us for more details.

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