

# High speed links



SPACEWIRE LINKS

## SpaceWire links

### "LVDS spacecraft communication network" to ESCC-E-50-12C

AXON' has developed cables and connectors for SpaceWire links, allowing transfer speeds up to 400 Mb/s.

AXON' SpaceWire has been approved to ESCC-E-50-12C (SpaceWire cabling) by the French National Space Engineering Centre (CNES).

### Signal integrity

AXON' digital data transmission bus assemblies which meet the MIL-STD-1553 standard are used for military and aeronautic applications, and have also been integrated within the space environment for over 10 years.

In addition to bus harnesses which ensure the connection between on-board devices, SpaceWire links make possible the transfer of up to 400Mb/s while maintaining a wide working margin, thanks to the use of CELLOFLON®, expanded PTFE developed by AXON'.

The ESCC 3902/003 qualified cable and ESCC 3401/029 EPPL2 connectors and accessories manufactured by AXON' protect the integrity of LVDS signals (Low Voltage Differential Signalling) provided by the devices. The cabling has been optimised in order to reduce the mismatching and crosstalk between lines at the maximum.

A test report validates every SpaceWire link. The electrical performance, which depends on the transmission speed, can be shown with an eye pattern which includes characteristics such as signal jitter. AXON' can analyse high speed signals up to 10 Gb/s.

### Engineering Model or Flight Model designs

AXON' can offer several designs for Engineering Models (EM) or Flight Models (FM) on request. For custom Lab test harness, AXON' can offer lightweight design configurations for a more cost effective solution (EMI backshell replaced by conductive potting).

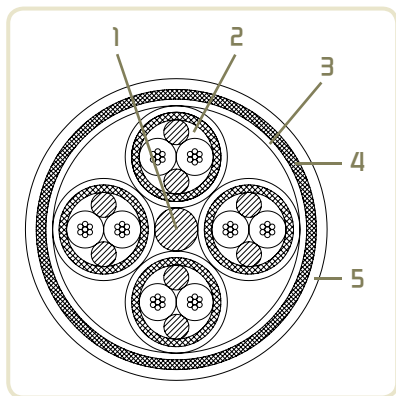
### Electrical & environmental characteristics

RADIATION	20 Mrad (for static use)
Jitter (@ 400 Mb/s)	< 0.35 nS
Skew (data and strobe lines at 400 Mb/s, length 5 m max.)	< 0.5 nS

# 28AWG SpaceWire cable

## CONSTRUCTION

AXON' 28AWG SpaceWire cable qualified to **ESCC 3902/003 variant 01** (AXON' part number: P532242) 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: 1.00 mm nom.

### 2 - 4 x 100 $\Omega$ 28AWG BUS Lines

CONDUCTOR AWG 2807

- Stranded silver plated copper alloy 2  $\mu\text{m}$ .
- 7 x 0.127 mm strands.
- Diameter: 0.38 mm nominal.
- Cross section: 0.089 mm<sup>2</sup> nominal.
- Resistance: 23  $\Omega$ /100 m nominal.

DIELECTRIC: CELLOFLON® expanded PTFE.

- Colour: blue / white.

BRAIDED SHIELD

- Material: silver plated copper 2.5  $\mu\text{m}$ .
- Strand diameter: 0.079 mm.

JACKET

- Material: extruded PFA.
- Diameter: 2.37 mm nominal.
- Colour: white.

### 3 - CELLOFLON® expanded PTFE tape

### 4 - Braided shield

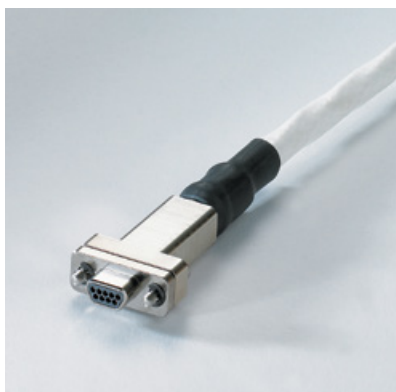
- Material: silver plated copper 2.5  $\mu\text{m}$ .
- Strand diameter: 0.102 mm.

### 5 - Outer jacket

- Material: PFA.
- Colour: white.

## MAIN CHARACTERISTICS

- Outer diameter: 7.5 mm maximum.
- Weight: 85 g/m maximum.
- Operating temperature: -200 / +180°C.
- Impedance (between wires): 100  $\Omega$  ( $\pm 6 \Omega$ ) at 400 MHz.

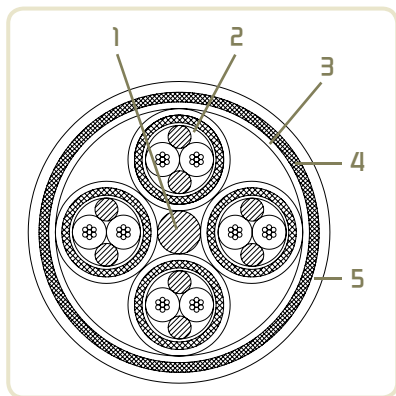


SPACEWIRE LINK WITH EMI BACKSHELL

# 26AWG SpaceWire cable

## CONSTRUCTION

AXON' 26AWG SpaceWire cable qualified to **ESCC 3902/003 variant 02** (AXON' part number: P544806) 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: 1.40 mm nominal.

### 2 - 4 x 100 Ω 26AWG BUS Lines

CONDUCTOR AWG 2607

- Stranded silver plated copper alloy 2 µm.
- 7 x 0.160 mm strands.
- Diameter: 0.48 mm nominal.
- Cross section: 0.141 mm<sup>2</sup> nominal.
- Resistance: 14 Ω/100 m nominal.

DIELECTRIC: CELLOFLON® expanded PTFE.

- Colour: blue / white.

BINDER

BRAIDED SHIELD

- Material: silver plated copper 2.5 µm.
- Strand diameter: 0.079 mm.

JACKET

- Material: extruded PFA.
- Diameter: 3.05 mm nominal.
- Colour: white.

### 3 - CELLOFLON® expanded PTFE tape

### 4 - Braided shield

- Material: silver plated copper 2.5 µm.
- Strand diameter: 0.102 mm.

### 5 - Outer jacket

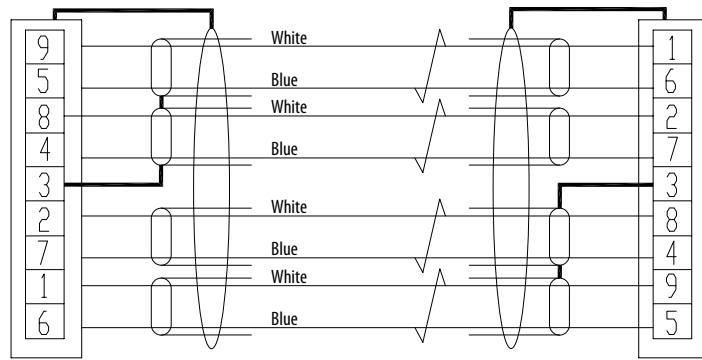
- Material: PFA.
- Colour: blue

## MAIN CHARACTERISTICS

- Outer diameter: 9.00 mm maximum.
- Weight: 115 g/m maximum.
- Operating temperature: -200 / +180°C.
- Impedance (between wires): 100 Ω (±6 Ω) at 400 MHz.



SPACEWIRE CABLE



WIRING DIAGRAM (ACCORDING TO ECSS-E-50-12C)

## Test and measurements

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

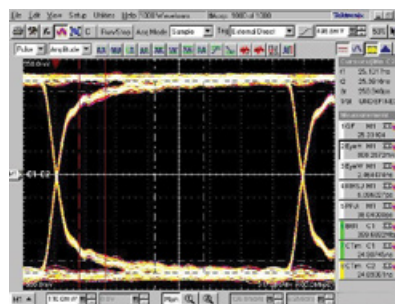
## Connection

For either cable size (AWG26 or AWG28), there are two possibilities to connect the link to the PCB:

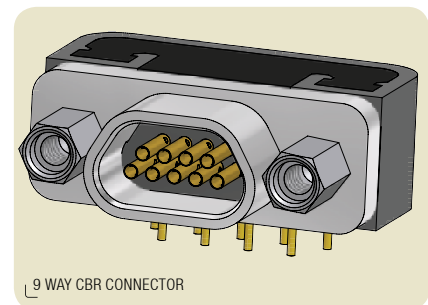
- Pigtail whose wires are soldered to the PCB.
- Special 9 way CBR connector (each line has the same electrical length to reduce the skew between one another).



SPACEWIRE LINKS



EYE PATTERN - 400 MBPS



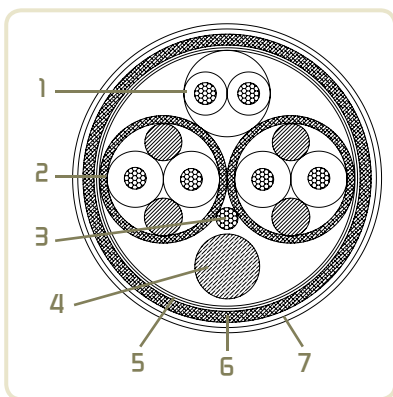
9 WAY CBR CONNECTOR

# IEEE 1394 links

IEEE 1394 A used as spacecraft communication network.

## CONSTRUCTION

AXON' IEEE 1394 cable (AXON' part number: P838566) consists of two screened twisted pairs and one unscreened twisted pair as shown in the specification. The cable has an overall shield and jacket.



IEEE 1394 LINK



IEEE 1394 CABLE

### 1 - One 26AWG unscreened pair

CONDUCTOR AWG 2619

- Stranded silver plated copper alloy 2  $\mu\text{m}$ .
- 19 x 0.102 mm strands.
- Diameter: 0.504 mm nominal.
- Cross section: 0.15 mm<sup>2</sup> nominal.
- Resistance: 13.65  $\Omega$ /100 m nominal.

DIELECTRIC: Extruded PTFE.

- Colour: black / white.
- Diameter: 1.00 mm nominal.

### 2 - Two screened pairs CRP 26AWG - 110 $\Omega$

CONDUCTOR AWG 2619

- Stranded silver plated copper alloy 2  $\mu\text{m}$ .
- 19 x 0.102 mm strands.
- Diameter: 0.504 mm nominal.
- Cross section: 0.15 mm<sup>2</sup> nominal.
- Resistance: 13.65  $\Omega$ /100 m nominal.

DIELECTRIC: CELLOFLON® (expanded PTFE).

- Colour: red-green & orange-blue.

BRAIDED SHIELD

- Material: silver plated copper 2  $\mu\text{m}$  minimum.
- Strand diameter: 0.079 mm.
- Diameter: 2.95 mm nominal.

### 3 - Drain wire: AWG2619

CONDUCTOR: same as above.

### 4 - CELLOFLON® expanded PTFE filler

### 5 - Two bonded polyimide separating tapes

### 6 - Braided shield

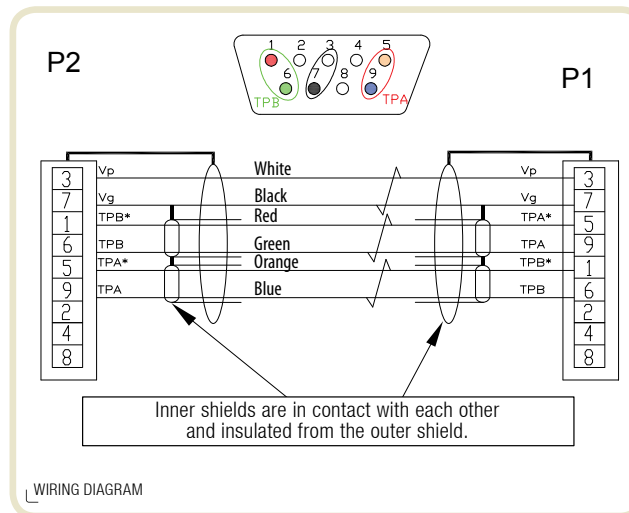
- Material: silver plated copper 2.5  $\mu\text{m}$ .
- Strand diameter: 0.127 mm.

### 7 - Outer jacket

- Material: wrapped PTFE.
- Colour: white

## MAIN CHARACTERISTICS

- Outer Diameter: 7.15 mm maximum.
- Weight: 84 g/m maximum.
- Operating temperature: -90°C / +200°C.
- Impedance (pair CRP2619 S2): 110  $\Omega$  ( $\pm 6 \Omega$ ).
- Voltage rating (E2619): 600 Vac.



## Test and measurements

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

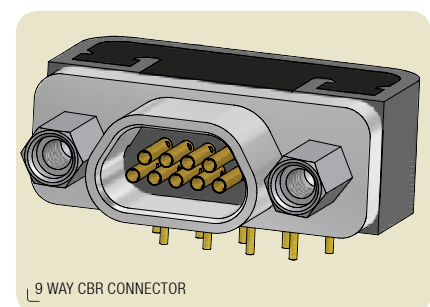
## Connection

There are two possibilities to connect the link to the PCB:

- Pigtail whose wires are soldered to the PCB.
- Special 9 way CBR connector (each line has the same electrical length to reduce the skew between one another).



IEEE 1394 LINK



9 WAY CBR CONNECTOR