



SURFACE VEHICLE STANDARD	J3117/3™	SEP2024
	Issued	2024-09

2.5/5/10GBASE-T1 Shielded Balanced Single Pair Ethernet Cable

RATIONALE

This is a new standard for single shielded balanced pair (twisted or parallel) jacketed data cable intended for use in surface vehicle cables for 2.5/5/10GBASE-T1 (2.5/5/10Gb/s) Ethernet PHY applications.

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1. SCOPE

This standard covers a single shielded balanced pair (twisted or parallel) jacketed data cable intended for use in surface vehicle cables for 2.5, 5, and 10 Gb/s Ethernet applications. The tests in this standard are intended to qualify cables for normal operation in an automotive environment while maintaining the necessary electrical properties for reliable data transmission.

1.1 Application

The 2.5 Gb/s cable is used for 2.5GBASE-T1, 5 Gb/s is used for 5GBASE-T1, and 10 Gb/s is used for 10GBASE-T1 Ethernet PHY applications.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1678	Low Voltage Ultra-Thin Wall Primary Cable
SAE J3117/1	100BASE-T1 Un-Shielded Balanced Single Twisted Pair Ethernet Cable
SAE J3117/2	1000BASE-T1 Un-Shielded and Shielded Balanced Single Twisted Pair Ethernet Cable
SAE EA-1128	Wire Color Charts

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B5374	Standard Test Methods for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation
ASTM B5423	Standard Specification for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation

2.1.3 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC 61156-1	Multicore and symmetrical pair/quad cables for digital communications - Part 1 - Generic specification IEC TR 61156-1-2:2009+AMD1:2014 CSV Consolidated version, Multicore and symmetrical pair/quad cables for digital communications - Part 1-2: Electrical transmission characteristics and test methods of symmetrical pair/quad cables
IEC 62153 4-4	Metallic communication cable test methods - Part 4-4: Electromagnetic compatibility (EMC) - Test method for measuring of the screening attenuation up to and above 3 GHz - Triaxial method
IEC 62153 4-5	Metallic communication cables test methods - Part 4-5: Electromagnetic compatibility (EMC) - Coupling or screening attenuation - Absorbing clamp method
IEC 62153 4-9	Metallic communication cables test methods - Part 4-9: Electromagnetic compatibility (EMC) - Screening attenuation of screened balanced cables, triaxial method

2.1.4 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE 802.3 (2022) Physical Layer Specifications and Management Parameters for 2.5 Gb/s, 5 Gb/s, and 10 Gb/s Automotive Electrical Ethernet, Clause 149, Amendment 8.

2.1.5 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 19642-1 Road Vehicles - Automotive Cables - Part 1: Vocabulary and Design Guidelines

ISO 19642-2 Road Vehicles - Automotive Cables - Part 2: Test Methods

ISO 19642-3 Road Vehicles - Automotive Cables - Part 3: Dimensions and Requirements for 30 Vac or 60 Vdc Single Core Copper Conductor Cables

ISO 19642-7 Road Vehicles - Automotive Cables - Part 7: Dimensions and Requirements for 30 Vac or 60 Vdc, Round, Sheathed, Screened or Unscreened Multi or Single Core Copper Conductor Cables

2.1.6 OPEN Alliance Publications

Available from OPEN ALLIANCE online at www.opensig.org.

Channel and Component Requirements for Fully Shielded 1000BASE-T1 and 2.5G/5G/10GBASE-T1 Link Segments, Version 1.0

3. DEFINITIONS

For the purposes of this document, the following terms and definitions apply.

3.1 CROSSTALK

A measurement of the unwanted signal transmitted from one aggressor circuit or channel of a transmission system to the victim circuit or channel (for two or more channels in the same bundle).

3.2 EMC CLASSIFICATION (CLASS 2)

The amount of additional EMC margin, i.e., the degree of shielding and coupling attenuation, may depend on the specific implementation in the vehicle. Two electromagnetic environment classes are defined to provide the most flexibility for choosing suitable components. Class 1 relies on lower mode conversion, allowing simpler shielding, while Class 2 requires full shielding. The coupling and screening attenuation limits for Class 1 are more relaxed compared to Class 2.

3.3 IMPEDANCE (Z)

The total opposition to alternating current by an electric circuit, equal to the square root of the sum of the squares of the resistance and reactance of the circuit and usually expressed in ohms; denoted as Z.

3.4 INSERTION LOSS (ATTENUATION)

The ratio of transmitted power to received power measured at the end of the cable expressed in decibels (dB). This is the s-parameter defined as S_{dd21} or S_{dd12} .

3.5 LONGITUDINAL CONVERSION LOSS (LCL)

A ratio, expressed in decibels (dB), of the differential mode (DM) signal applied between the wires in a pair and the resulting common mode (CM) noise signal reflected at the same end. This is the s-parameter defined as S_{dc11} and S_{dc22} .

3.6 LONGITUDINAL CONVERSION TRANSMISSION LOSS (LCTL)

A ratio, expressed in decibels (dB), of the differential mode (DM) signal applied between the wires in a pair and the resulting common mode (CM) noise signal transmitted from one end to the other end.

This is the s-parameter defined as S_{dc21} and S_{dc12} .

3.7 LOW VOLTAGE (LOW TENSION)

Usually considered to be ≤ 60 VDC (25 VAC).

3.8 MINIMUM WALL (THICKNESS)

The lowest allowable insulation thickness at any point.

3.9 NOMINAL

A suitable approximate value used to designate or identify a component.

3.10 PHY

Abbreviation for the physical layer device. A PHY connects a link layer device to a physical medium such as a copper cable or optical fiber. A PHY chip (PHYceiver) is commonly found on Ethernet devices. Its purpose is to provide analog signal physical access to the link.

3.11 RETURN LOSS

A ratio, expressed in decibels (dB), of the power of the outgoing signal to the power of the reflected or returned signal.

This is the s-parameter defined as S_{dd11} and S_{dd22} .

3.12 S-PARAMETER

Table 1 - S-Parameter

Single Channel Characteristics (Port 1, 2)		
RL	S_{dd11} , S_{dd22}	Return loss (differential mode)
IL	S_{dd21}	Insertion loss (differential mode)
LCL	S_{dc11} , S_{dc22}	Longitudinal conversion loss
LCTL	S_{dc12} , S_{dc21}	Longitudinal conversion transmission loss

3.13 SDP

Shielded differential pair (e.g., STP, SPP, shielded twin-axial, etc.).

3.14 SPP

Shielded parallel pair.

3.15 STP

Shielded twisted pair.

3.16 TEMPERATURE CLASS RATING (TCR)

A temperature class designation based on the long-term heat aging (3000 hours) test.

3.17 VNA

Vector Network Analyzer.

3.18 WCC

Whole communication channel is the complete electrical wire connection between two ECUs.

4. GENERAL

4.1 Classification

4.1.1 Temperature Classes

Four cable classes have been defined in Table 2 to respond to the various temperatures encountered on vehicles.

Table 2 - Temperature class

Class	Operating Temperature	Equivalent to Temperature Class	Typical Usage
A	-40 °C to 85 °C	T1	Interior wiring harness (IP, body, headliner, doors, liftgate)
B	-40 °C to 100 °C	T2	Engine bay, forward lamp
C	-40 °C to 125 °C	T3	Engine
D	-40 °C to 150 °C	T4	On engine, behind engine

4.2 General Test Conditions

Test samples shall be preconditioned for at least 16 hours at a room temperature of $23\text{ °C} \pm 3\text{ °C}$. Unless otherwise specified, all tests shall be conducted at this same temperature. All samples shall pass. In the case where the test result is based on an average, the average shall meet the requirement.

4.3 Ovens

Unless otherwise specified, when an oven is required, it shall be a hot air oven in accordance with ASTM D5374 and ASTM D5423. The air contained in the oven shall be completely changed at least eight times, but not more than 20 times per hour at the specified temperature.

4.4 Tolerances

Unless otherwise specified, all values are considered to be approximate.

4.5 Representative Conductor Sizes for Testing

When a test is required, all combinations of conductor size, wall thickness, and insulation formulation shall meet the appropriate requirements.