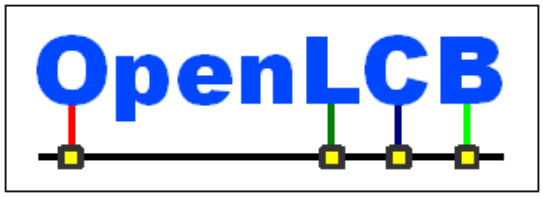

OpenLCB Standard	
CAN Physical Layer	
July 22, 2024	Adopted

1 Introduction (Informative)

This document defines the physical layer for carrying OpenLCB-CAN over a single Controller Area Network (CAN) bus. It it not otherwise normative.

2 Intended Use (Informative)

Conforming OpenLCB CAN nodes can be connected by cables to form a linear CAN bus with optional short stubs. OpenLCB CAN nodes generally have two RJ45 modular connectors and can be daisy-chained together with suitable computer-network ("Ethernet") cables. A CAN terminator is installed by the user at each end of the main bus.

A limited amount of power can be distributed via the cable, allowing a few nodes to draw their power from a nearby (less than 20 ft / 6m) source attached to the common bus.

3 References and Context (Normative)

In this document

- "RJ45" refers to the miniature 8 position unkeyed plug and jack defined in sections Section 6.1.1.3 and Section 6.1.1.4, respectively, of the TIA-968-A specification.
- "UTP" refers to CAT-3 or better cable as defined in TIA/EIA-568-B or the successor TIA/EIA- 568-C. This specifically includes CAT-5e cable.
- "CAN" refers to the electrical and protocol specifications as defined in ISO 11898-1:2003 and ISO 11898-2:2003 and their successors.
- NMRA S-9.1.2 Power Station Interface, which specifies options for interfacing DCC Command Stations with DCC Power Stations.

External certification of parts shall be accepted for conformance to these standards. Conformance with a later version of a standard shall be accepted as conformance with the referenced versions.

4 Physical Interconnection (Normative)

CAN connections between nodes shall be made using UTP cable. There shall be a RJ45 plug on the cable and RJ45 jack on the node unless the cable is permanently attached to the node.

The signal, conductor and pair assignments shall be:

Conductor	Signal Name	**TIA/EIA-568-A** (Informative)	**TIA/EIA-568-B** (Informative)
1	CAN_H	white/green	white/orange
2	CAN_L	green	orange
3	CAN_GND	white/orange	white/green
4	ALT_L	blue	blue
5	ALT_H	white/blue	white/blue
6	CAN_SHIELD	orange	green
7	PWR_NEG	white/brown	white/brown
8	PWR_POS	brown	brown

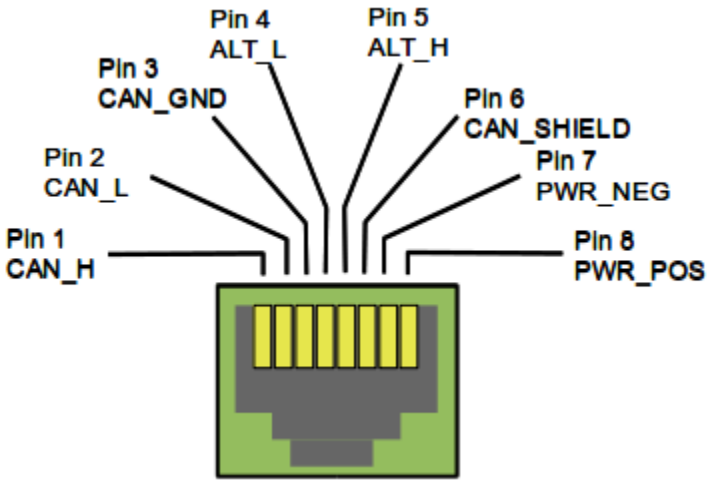

Figure 1: Jack viewed from plug side

Cables, including cables attached to nodes, shall carry conductors 1 & 2 as a pair, and conductors 3 & 6 as a pair.

Cables may, but are not required to, carry conductors 4 and 5. Conductors 4 and 5, if present, shall be carried as a pair.

Cables may, but are not required to, carry conductors 7 and 8. Conductors 7 and 8, if present, shall be carried as a pair.

If a node provides two or more connections to a single CAN segment, conductors 1 through 8 shall be provided on all connections. Conductors 1, 2, 3, 6, and 7 shall be connected in parallel on all connections to the single segment. If the node does not provide or amplify the ALT_L and ALT_H signals on pins 4 and 5, the pin 4 signal and the pin 5 signal on all connectors to the single segment shall each be separately connected in parallel. If the node does not provide power on pin 8 on all

connectors, pin 8 on all connectors to the single segment shall be connected in parallel. All wiring discussed in this paragraph shall be rated to carry at least 1A.

Nodes shall connect conductors 3 and 6 . This connection shall be rated to carry at least 1A.

A node may, but is not required to, connect conductor 7 with conductors 3 and 6. Nodes that require conductor 7 to be connected to conductors 3 and 6 for proper operation shall connect conductor 7 to conductors 3 and 6.

Voltages of up to 27 volts AC (peak) or either polarity DC on the ALT_L / ALT_H conductors 4 and 5 shall not damage the node nor prevent normal operation of the node.

Voltages of up to 27 volts AC (peak) or either polarity DC on the PWR_NEG / PWR_POS conductors shall not permanently damage the node.

5 Data Transport (Normative)

Data shall be transferred using a CAN signal at 125kbps and CAN frame protocol.

Any devices providing bus termination shall conform to CAN requirements for that termination.

A node may, but is not required to, provide a method for bus termination as part of the node. If so, there shall be a user-accessible method for enabling and disabling the termination, and the node shall be shipped from the original manufacturer with the termination disabled.

5.1 CAN Bit Timing

A node shall have its CAN bit timing configured[1] to support a maximum bus length of at least 300m and peer clock tolerance of 0.9% across the minimum ambient operating temperature range of 0°C to 50°C. Nodes shall have an oscillator tolerance of 0.9% or better.

6 ALT_L / ALT_H

The ALT_L / ALT_H pins 4 and 5 are available for alternate uses. This section describes the currently approved uses for the ALT_L / ALT_H conductors. Additional uses may be approved and added to this document in the future. All uses of ALT_L/ALT_H shall be visibly labeled on the node, and documented in the accompanying product literature.

6.1 DCC Signal

NMRA Standard S-9.1.2 defines the “Power Station Interface” for DCC power stations, more commonly known as DCC boosters. ALT_L / ALT_H may, but are not required to, be used to carry the “Power Station Interface” signals as described in NMRA Standard S-9.1.2.

The NMRA Standard S-9.1.2 only allows for bipolar signals. ALT_L shall be the “negative” voltage and ALT_H shall be the “positive” voltage during the first half of a DCC bit as described in the NMRA Standard S-9.1.2. The polarity shall be reversed during the second half of the DCC bit.

[1]There are specific recommended values in the OpenLCB CAN Physical Technical Note.

CAN_GND and CAN_SHIELD shall be used as the “reference” ground if NMRA S-9.1.2 Driver/Receiver Interface mode is used. CAN_GND, CAN_SHIELD, PWR_NEG, and the outside shielding of a potential STP cable shall not be utilized to satisfy any NMRA S-9.1.2 requirements for a Power Station Interface “common”.

A Full Scale Interface DCC signal consumer shall not assume that ALT_L and ALT_H signals are referenced to CAN_GND, but support arbitrary common mode voltages, including when these signals are floating (galvanically isolated) from CAN_GND.

A Full Scale Interface DCC signal source may, but is not required to produce the ALT_L and ALT_H signals as referenced to CAN_GND.

ALT_L and ALT_H shall not have a connection to CAN_GND, CAN_SHEILD, PWR_NEG, or any other signal in the physical interconnection described in section 4 that is less than 4K ohms impedance at DC in any DCC signal consumer node.

A node that either sources or consumes the DCC signal shall be permanently labeled as such in a location visible to the user. Nodes that do not supply or consume the DCC signal do not require labeling, even though all nodes are required to pass through the ALT_L / ALT_H signals, regardless as to whether they consume or source these signals.

An OpenLCB node that is a source or consumer of the DCC signal shall conform to the requirements in NMRA Standard S-9.1.2 in order to be considered in compliance with this Standard. Please refer to NMRA Standard S-9.1.2 for any additional requirements. The requirements in NMRA Standard S-9.1.2 are not applicable to OpenLCB nodes that do not source or consume a DCC signal.

7 Supply of Power (Normative)

A node may, but is not required to, provide power to the cable PWR_POS / PWR_NEG conductors.

If a node provides power, it shall provide at least 9VDC and no more than 15VDC from zero current draw up to its specified maximum current. Its specified maximum current shall not exceed 500 mA. The specified maximum current shall be permanently written on the node in a location visible to the user. This label is required whether or not the node provides power to the cable.

8 Consumption of Power (Normative)

Nodes may, but are not required to, draw power from the PWR_POS / PWR_NEG conductors in the cable. Nodes shall not draw more than 500 mA at any PWR_POS / PWR_NEG voltage from 7.5VDC to 15VDC. Nodes that draw power shall operate properly with a supply voltage of 7.5VDC to 15VDC on the PWR_POS / PWR_NEG conductors. The maximum current drawn by each node shall be permanently written on that node in a location visible to the user. This label is required whether or not the node draws power from the cable.

9 Injection Current (Normative)

In addition to the current and voltage requirements placed on the individual conductors of the Physical Interconnection signals elsewhere in this document, the current on all eight conductors going into and

out of a node shall sum to zero. In order to account for measurement tolerances, for testing purposes, zero current shall be defined as “zero +/-1mA”.

10 Electronic Labeling

Electronic labeling, or e-labeling, may be used in place of a physical label to meet the labeling requirements described in sections 6.1, 7, and 8 above. E-labeling shall be accepted in place of a physical label when the device, or a required accessory to the device, includes a display available to the user.

The e-label shall be accessible in no more than three steps from the product’s main or home menu.

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