Introduction

This Technical Note contains informative discussion and background for the corresponding S 9.x.1 Standard. This Technical Note is not normative in any way.

Intended Use

5   There is no intention that devices that connect more than on CAN segment (e.g. bridges) have to electrically interconnect those separate segments.

We don't discuss CAN terminators, because they're discussed in detail in the CAN documentation that the standard references. A simple resistor on a RJ45 plug can be used, or more complex devices can be created and sold that e.g. contain diagnostic readouts. So long 10   as it provides in-spec termination, they're all fine.

References and Context

NMRA conformance testing is simplified when it can be done by referring to vendor documentation, rather than requiring specific tests of parameters. The standard therefore refers to other to existing standards, where possible, instead of repeating the information here.

Physical Interconnection

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We're trying to enable two basic kinds of nodes: Board with 2 connectors and box with a pig-tail cable, e.g. a handheld throttle. But we don't want to rule out e.g. a board with two connectors and three pig-tails for attaching throttles, or anything else, hence the somewhat complex wording in this section.

20   The assignments to particular colors are for information only. These are the colors that users will encounter in the two popular ways of wiring commercial cables. If you're building a product using commercial cable, using one of these two color codes will reduce confusion, but most NMRAnet users will never need to refer to the colors in their cables.

The signal names refer back to the signal definitions in the CAN specifications. UTP is 25   unshielded cable, so the CAN_SHIELD conductor is being used as a second conductor for the CAN ground reference, CAN_GND.

The discussion of connecting in parallel is to make sure that all 8 wires go through a board, whether it's got connectors, pig-tail cables or a combination of the two, so long as it's got more than one connection to other nodes.

30   We want all 8 wires present so people can add power later, or we can define the reserved conductors later, and still use them. The 1A on interconnects is to make sure they're at least as robust as the connectors and cable.

For information on sizing circuit board traces to carry the required interconnection current, please see "IPC-2152 — Standard for Determining Current-carrying Capacity in Printed Board Design, 2009."

35   All 8 wires don't have to go through the board if there's only one connection, e.g. a throttle with a single jack or pig-tail cable with plug. In that case, only two pairs are required.

If your product is providing power and has e.g. two jacks, you can either connect them together and provide a max of 0.5A to both combined, or separately power them up to 0.5A each. This is the only case where a conductor doesn't have to pass through the board as a continuous electrical circuit. Note

40   that this means that your product has to provide power, however; if providing power is an option, not always present, you should connect conductor 8 across the board to ensure that downstream nodes aren't cut off from power when it's not provided by your board.

The 100V requirement on the reserved conductors is also there to make sure that when we later find a use for it, we don't blow up existing installations. The goal is to have all existing installations be able to

45   move to newly-defined uses without having to retrofit cables nor non-involved nodes.

If you want to use the reserved conductors for experimental purposes, we recommend using jumpers (fixed or movable) for making connections to the conductors and/or splitting the reserved conductors between connectors so that you can restore normal usage later, should some other use be defined for them.

50   The 27V requirement comes from the S9.1 limitation on track voltage.

Data Transport

A 4V/microsecond slew rate is preferred to reduce the effect of stubs on the network.

This standard is silent on the use of specific CAN frame formats or features.

Supply of Power

55   The power supply section is meant to define a 12V nominal system with wide margins on production and consumption of power over the UTP cable. We expect that nodes will use this power in a range of ways, including having local power regulation ranging from simple analog regulators through more advanced supplies that increase current and/or voltage. 12V was chosen to reduce heat loads when using the simplest regulators. The current limit was

60   required by use of 1 conductor in UTP wiring.

Power can be injected into the cable by simple "mid-span injector" devices, essentially just two RJ45 connectors and a 2.1mm jack for a wall-wart. It's not required that it comes from a NMRAnet node itself.

We expect that most power-supplying and power-consuming boards will connect PWR_NEG

65   and the 3/7 grounds. A good way to do this is a 10 ohm resistor and a 0.1uF capacitor in parallel, but a straight copper connection is within the letter of the requirement.

70 The power provisions are for low-power uses that can be conveniently handled over short lengths of cable. Boards are welcome to have other connectors for power. These other connectors can be anything not otherwise forbidden by some other standard, including terminal blocks, 2.1mm jacks, Anderson PowerPole connectors, or whatever else is considered useful for the specific market.

Note the effect of the "must withstand" requirement is that power supply boards must be able to be connected to each other, even if their output voltages are not exactly the same. One way to handle this is an isolating diode on the PWR_POS output.

75 ## Consumption of Power

For their thermal calculations, node designers must assume that power is supplied at 15V.

For their power calculations, node designers must assume that power is supplied at 7.5V.

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