



NMRA Standard	
Decoder Interfaces	
Jan 8, 2021	S-9.1.1 Draft

# 1 General

## 1.1 Introduction and Intended Use (Informative)

This Standard is the parent Standard for interfaces between decoders, locomotives, rolling stock and other vehicles on model railroads. There are daughter Standards for each individual type of interface.

S-9.1.1.1	Six and eight pin Interface
S-9.1.1.2	JST 9 Interface
S-9.1.1.3	21MTC Interface
S-9.1.1.4	PluX Interface
S-9.1.1.5	Next18 Interface

The purpose of these Standards is to simplify the installation and exchange of electronic devices (hereafter called decoders) which are designed to control or modify the behavior of motors, lights, and other similar accessories installed in locomotives and other rolling stock.

This Standard applies to locomotives and cars of various sizes and scales, all kinds of controllers, (digital command control decoders in particular), and 2-rail, 3-rail, (central or trackside) and overhead wire power distribution systems.

The primary purpose of an interface is to make it easy to install a decoder between the power pick-up system and the motor(s), light(s), and/or other similar accessories within the locomotive, car, or vehicle. The interface should assure an easy, precise, and error-free installation or the exchange of a decoder. Installation or exchanges of decoders would need to use the same type of interface connector. Changing from one type of connector to another will require some rewiring. When an interface and/or decoder are installed in the locomotive or car by the manufacturer, this should be done in such a manner that it does not restrict the removal of the body from the chassis.

If no decoder is installed by the manufacturer; the decoder interface on the System Board shall be replaced by a "dummy plug" that will enable the locomotive or car to operate on DC as if no interface had been present. Enough room must be available around the installed interface to enable the replacement of the "dummy plug" with a decoder and any associated wiring.

Power rating values listed in the tables for each connector is for each pin of the interface. This does not account for the power requirement of the locomotive nor the power capacity of the decoder. Application of each interface must account for the electrical current requirements of the locomotive. It is recommended that locomotive manufacturers clearly document the required power for the motor and each light/function. Similarly, decoder manufacturers should clearly document the power rating capacity for the motor and light/function connections.

## 1.2 References

This standard should be interpreted in the context of the following NMRA Standards, Technical Notes, and Technical Information.

### 1.2.1 Normative

- S-9.1 Electrical Standards for Digital Command Control, which specifies signal voltages.

### 1.2.2 Informative

- TI-9.1.1 Sources for Connectors for DCC, which provides a list of manufacturer part numbers for DCC interface connectors. There are separate TI documents for each Standard e.g. TI-9.1.1.5.

## 1.3 Terminology

Term	Definition
Vehicle	Mobile model railroad device. This includes locomotives and other rolling stock.
Decoder	DCC receiver for controlling vehicle animation.
System Board	Electronic circuit board that is considered part of the vehicle into which a decoder is intended to be plugged. Also called a motherboard.
Dummy Plug	A device when inserted in the System Board in place of a decoder will allow the Vehicle to operate on DC.

## 1.4 Requirements

To meet this Standard all mechanical and electrical values mentioned must be met and conform, unless otherwise noted. It is not necessary to implement all connections of the interface. The connections belonging to unimplemented features must remain unconnected. This applies to vehicles as well as for other devices that use this interface.

## 2 Mechanical Properties

Please refer to individual Standards S-9.1.1.X for the specifics of each type of connector.

## 3 Electrical Properties

Please refer to individual Standards S-9.1.1.X for the specifics of each type of connector.

### 3.1 Color Code of Wiring

In some cases a decoder or interface (System Board) will be installed in the vehicle at the factory. The decoder or interface may be designed to install without wires and electrical connections made by means of contact points from the locomotive to the decoder or interface. In addition, the manufacturer may install a decoder or interface (System Board) by wiring at the factory and shall make all of the connections correctly. If multiple colors of wire are used it is recommended that the color code is followed to facilitate troubleshooting or service later if required.

If a decoder requires the end user to install the decoder by making wire connections supplied on the decoder, Table 3.1 provides the color code Recommended Practice for these wires. If a decoder is supplied where the end user supplies the wire for connections to the decoder or System Board (light board replacement) connection points must be clearly marked on the PCB as to their purpose and documented in the installation instructions. In all cases the manufacturer is required to provide

wiring diagrams or other documentation clearly showing all connections to the decoder. All other wiring connections beyond those listed have no recommended color. Also, the purpose of any other wiring connections must be documented.

- 65 Decoders that plug into a System Board such as 21 MTC, PluX, and Next18 have no wires or color codes. They must follow the pin assignment within each of those standards and shall provide documentation for installation or replacement of the decoder on the system board.

- 70 If a decoder has specific outputs and is wired with a connector to a device in a vehicle such as a smoke generator, remote un-coupler or other; any color wire may be used so long as the connector is keyed in such a way that it is only used for the intended purpose.

**Table 3.1 Interface Wire Color Codes**

COLOR	FUNCTION
RED	right-hand rail power pick-up (center rail, outside third rail, traction/overhead wire) to motor or interface
ORANGE	interface to motor (+) connected to right-hand rail (or center rail, outside third rail or traction wire)
BLACK	left-hand rail power pick-up to motor or interface
GRAY	interface to motor (-) connected to left-hand rail
WHITE	output 1 front headlight(s)
YELLOW	output 2 rear headlight(s)
BROWN or VIOLET <sup>1</sup>	speaker + and -
GREEN	output 3 (Aux 1)
BROWN or VIOLET <sup>1</sup>	output 4 (Aux 2)
<sup>2</sup>	output 5 (Aux 3)
<sup>2</sup>	output 6 (Aux 4)
<sup>2</sup>	output 7 (Aux 5)
<sup>2</sup>	output 8 (Aux 6)
BLUE	common (+) headlight(s)/output(s) power source
BLACK/WHITE STRIPE <sup>3</sup>	common (-) power sink or decoder ground

<sup>1</sup> Previously some manufacturers used brown, others violet prior to a defined Standard color. Manufacturer may use either color but must clearly document in their installation instructions.

<sup>2</sup> Manufacturer may use any colors or other means to identify each wire such as a tag but each wire must be identifiable and this must be documented in the installation instructions. Outputs may not use black, red, orange, gray or blue of the same shade as the power common.

<sup>3</sup> Black with white stripe wire preferred. Other colors may be used and must be documented in the instructions. All efforts must be taken so as not to confuse the decoder ground with any other input or output.

## 4 Document History

Date	Description
Dec 11, 2020	RP-9.1.1 became S-9.1.1. It was separated into individual Standards for each connector type. S-9.1.1 covers the overview. Errors in wire color code corrected. Added more information on wire color codes and where and how they apply.
Jan 10, 2021	Modified foot note 2 and added footnote 3 for Table 3.1

75

# Important Notices and Disclaimers Concerning NMRA Standards Documents

The Standards (S), Recommended Practices (RP), Technical Note (TN), and Technical Information (TI) documents of the National Model Railroad Association ("NMRA Standards documents") are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading "Important Notices and Disclaimers Concerning NMRA Standards Documents."

## Notice and Disclaimer of Liability Concerning the Use of NMRA Standards Documents

NMRA Standards documents are developed within the Standards and Conformance Department of the NMRA in association with certain Working Groups, members, and representatives of manufacturers and sellers. NMRA develops its standards through a consensus development process, which brings together volunteers representing varied viewpoints and interests to achieve the final product. NMRA Standards documents are developed by volunteers with modeling, railroading, engineering, and industry-based expertise. Volunteers are not necessarily members of NMRA, and participate without compensation from NMRA.

NMRA does not warrant or represent the accuracy or completeness of the material contained in NMRA Standards documents, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard or recommended practice, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, NMRA disclaims any and all conditions relating to results and workmanlike effort. In addition, NMRA does not warrant or represent that the use of the material contained in NMRA Standards documents is free from patent infringement. NMRA Standards documents are supplied "AS IS" and "WITH ALL FAULTS."

Use of NMRA Standards documents is wholly voluntary. The existence of an NMRA Standard or Recommended Practice does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the NMRA Standards documents. Furthermore, the viewpoint expressed at the time that NMRA approves or issues a Standard or Recommended Practice is subject to change brought about through developments in the state of the art and comments received from users of NMRA Standards documents.

In publishing and making its standards available, NMRA is not suggesting or rendering professional or other services for, or on behalf of, any person or entity, nor is NMRA undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any NMRA Standards document, should rely upon their own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given NMRA Standards documents.

IN NO EVENT SHALL NMRA BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: THE NEED TO PROCURE SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD OR RECOMMENDED PRACTICE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

## Translations

NMRA's development of NMRA Standards documents involves the review of documents in English only. In the event that an NMRA Standards document is translated, only the English version published by NMRA is the approved NMRA Standards document.

## Official Statements

A statement, written or oral, that is not processed in accordance with NMRA policies for distribution of NMRA communications, or approved by the Board of Directors, an officer or committee chairperson, shall not be considered or inferred to be the official position of NMRA or any of its committees and shall not be considered to be, nor be relied upon as, a formal position of NMRA.

## Comments on Standards

Comments for revision of NMRA Standards documents are welcome from any interested party, regardless of membership. However, **NMRA does not provide interpretations, consulting information, or advice pertaining to NMRA Standards documents.**

Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since NMRA standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, NMRA, its departments, Working Groups or committees cannot provide an instant response to comments, or questions except in those cases where the matter has previously been addressed. For the same reason, NMRA does not respond to interpretation requests. Any person who would like to participate in evaluating comments or in revisions to NMRA Standards documents may request participation in the relevant NMRA working group.

## Laws & Regulations

Users of NMRA Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any NMRA Standards document does not constitute compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. NMRA does not, by the publication of NMRA Standards documents, intend to urge action that is not in compliance with applicable laws, and NMRA Standards documents may not be construed as doing so.

## Copyrights

NMRA Standards documents are copyrighted by NMRA under US and international copyright laws. They are made available by NMRA and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of modeling, structural and engineering practices and methods. By making NMRA Standards documents available for use and adoption by public authorities and private users, NMRA does not waive any rights in copyright to the NMRA Standards documents.

## IMPORTANT NOTICE

NMRA Standards documents do not guarantee or ensure safety, security, health, or environmental protection, or ensure against interference with or from other systems, devices or networks. NMRA Standards documents development activities consider research and information presented to the standards development group in developing any safety recommendations. Other information about safety practices, changes in technology or technology implementation, or impact by peripheral systems also may be pertinent to safety considerations during implementation of the standard. Implementers and users of NMRA Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.