Proposed RP

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NMRA RECOMMENDED PRACTICES

Asymmetrical Signal

For Digital Command Control,

All Scales

Draft September 2004 V1.1	RP 9.x.1

A: Introduction

Digital Command Control is intended to operate a loco independent of electrical blocks along the track. However there are operation modes and features, which require a control linked to a certain space, e.g. to stop a train automatically at a certain place. Therefore the mobile decoder must get localized information. This may be done by adding an offset between the voltages of the two phases of each DCC bit defined in S 9.1, i.e. generating an asymmetrical signal.
The prime function is direct speed influence, but other functions may use this method of providing local information to the decoder as well.
This offers a for the modeler very easy way to influence trains without caring about rolling stock crossing the gaps as with the broadcast stop command. It works independent of the command station thus not depending on any bus system and is also faster.

B: Power Stations

The absolute value of the voltage of the two output signal polarities may not differ by more than 0.2 Volts.
This limit shall be met at zero load and full load with a quarter of the load being asymmetrically.

Note: S 9.1 calls for "two equal voltage levels that have opposite polarity" but there is no clear measurement given to consider the voltage levels as equal.
Note: Any lights or other function loads connected to the locomotive frame instead of a decoder common raw plus act as a load on one polarity only.

C: Voltage Offset Device

Devices to make the DCC signal asymmetric shall modify the DCC signal by increasing the difference between the voltages of the two polarities by at least 1.2 Volts.
To conform to this RP this specification must be met at a minimum load of 20 mA.

Note: The offset may be induced by placing antiparallel diodes in the signal path with a different number of diodes for the two directions. Depending on diode type three diodes in one and a single diode in the other direction may be sufficient. But care must be taken to produce a large enough offset even at small loads. I may be necessary to add some permanent load to meet the requirement.

D: Mobile Decoders

A decoder shall detect a voltage offset of
0.8 Volts or more
as an asymmetrical signal. Any offset of
0.6 Volts or less
shall not be regarded as an asymmetrical signal.

Reaction on detection of a voltage offset

A decoder conforming to this RP is required to support the following operational modes, selected via CV settings. Further modes may be supported but are not part of this RP.

Mode 1: No reaction on detection of an asymmetrical signal

Note: This mode allows decoders with this feature to run without problems on layouts not conforming to this RP.

Mode 2: Stop the locomotive with the set momentum on detection of an asymmetrical signal [during the preamble of a DCC packet [1])].

Note: This mode is intended for third rail layouts where no detection of the physical direction of travel is possible. It also allows to block a track section independent of the direction of entry.

Mode 3: Stop the locomotive with the set momentum on detection of an asymmetrical signal [during the preamble of a DCC packet [1])] only if the lower voltage is during the right rail positive phase. Right is relative to the current direction of travel. This conforms to stopping with detection of a DC voltage in the opposite direction as described in the third paragraph of RP-9.2.4 section B.

Note: This is the intended mode of this RP on two rail layouts.

Note: The text in angled brackets "during the preamble of a DCC packet" has been added on request of a manufacturer. The intention is to use the Asymmetrical Signal within a DCC packet on a by bit base for further localized information. While this opens up the possibility for several further developments it may make the basic function too complex.

F: Recommendations

On layouts where the Asymmetrical Signal is used asymmetrical loads should be avoided where possible. This addresses mainly but not only functions not connected the decoder raw plus but via the locomotive frame to one rail.

Note: The proposed RP-9.1.1 Appendix A: Improved Wiring of the Small Connector shows the recommended wiring of the small connector inside the locomotive to avoid asymmetrical loads.

[1]) The decoder is not required to check during the full preamble but may check at any time within the preamble. The voltage offset device has to insure the offset throughout the full preamble.

Appendix A: Explanation of Voltage Levels

The voltage levels specified above are selected to allow for as reliable operation as possible without requiring an excessive high voltage difference. The following figure shows the interaction of the specified voltages. The wiring tolerance allows for different voltage drop along the layout and locomotive wiring due to asymmetrical loads. "Inside" corresponds to the section with intended asymmetrical signal, i.e. inside the stopping section. "Outside" corresponds to sections without intended asymmetrical signal, i.e. outside the stopping section. As the inside areas are usually smaller the wiring may be improved more easily. Furthermore less rolling stock will be in such an area at any time reducing the asymmetrical load in those sections. Therefore a smaller tolerance may be specified for the inside sections.

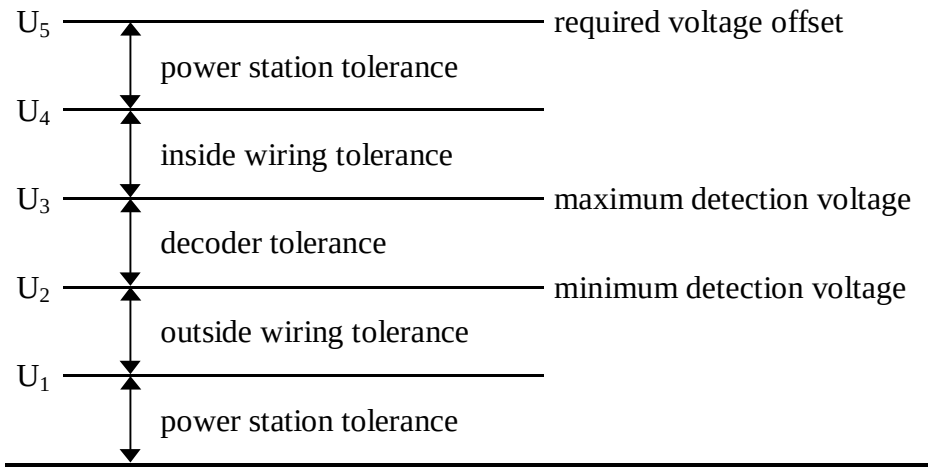

Figure 1: Addition of the different tolerance levels.

In the following table two sets of possible voltage specifications are given based on four and five diode voltage offset devices producing an offset of 2 and 3 diode voltage drops respectively. There is space for a third and forth set of voltages open for discussion.

Parameter	**Section**	**Symbol**	**Value**	**Value**	**Value**	**Value**
power station tolerance	B	U_1 & $U_5 - U_4$	0.2 V	0.3 V		
required voltage offset	C	U_5	1.2 V	1.8 V		
maximum detection voltage	D	U_3	0.8 V	1.2 V		
minimum detection voltage	D	U_2	0.6 V	0.9 V		
outside wiring tolerance	–	$U_2 - U_1$	0.4 V	0.6 V		
inside wiring tolerance	–	$U_4 - U_3$	0.2 V	0.3 V		

Table 1: Different sets of possible voltage definitions. Only one will be in the final RP!